User Manual

Models 8571A/8572A

Single / Dual Channel Pulse/Waveform Generators

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Tabor Electronics Ltd.

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Products sold by Tabor Electronics Ltd. are warranted to be free from defects in workmanship or materials. Tabor Electronics Ltd. will, at its option, either repair or replace any hardware products which prove to be defective during the warranty period. You are a valued customer. Our mission is to make any necessary repairs in a reliable and timely manner.

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The warranty period for this Tabor Electronics Ltd. hardware is three years, except software and firmware products designed for use with Tabor Electronics Ltd. Hardware is warranted not to fail to execute its programming instructions due to defect in materials or workmanship for a period of ninety (90) days from the date of delivery to the initial end user.

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Authorization is required from Tabor Electronics before you send us your product for service or calibration. Call your nearest Tabor Electronics support facility. A list is located on the last page of this manual. If you are unsure where to call, contact Tabor Electronics Ltd. Tel Hanan, Israel at 972-4-821-3393 or via fax at 972-4-821-3388. We can be reached at: support@tabor.co.il

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PROPRIETARY NOTICE

FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuits points.

Before operation this instrument:

1. Ensure the instrument is configured to operate on the voltage at the power source. See Installation Section.

2. Ensure the proper fuse is in place for the power source to operate.

3. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

DECLARATION OF CONFORMITY

We: Tabor Electronics Ltd.
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ISRAEL 36888

declare, that the 350MHz Arbitrary Funtion Generators

Models 8571A and 8572A

complies with the requirements of the Electro Magnetic Compatibility 2004/108/EC, class A and the Low Voltage Directive 73/23/EEC amended by 93/68/EEC, according to testing performed at HERMON LABRATORIES (#EN21356, Jan. 2012). Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities:

Safety:
IEC/EN 61010-1 2nd Edition: 2001+ C1, C2

EMC:

IEC 61326-1:2006	Class A Radiated and Conducted Emission
EN 61000-4-2	ESD
EN 61000-4-3	Radiated Immunity
EN 61000-4-4	Burst/fast transients
EN 61000-4-5	Surge
EN 61000-4-6	Conducted Immunity
EN 61000-4-8	Power frequency magnetic field
EN 61000-4-11	Voltage dips and fluctuations
EN 55011	Radiated and conducted Emissions

Models 8571A and 8572A are built on the same platform and share specifications and features except the 8571A is a single channel version and while the 8572A has two channels. The tests were performed on a typical configuration.

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Getting Started

What's in This Chapter

This chapter contains a general description of the Model PM8572A Pulse Waveform Source and an overall functional description of the instrument. It also describes the front and rear panel connectors and indicators.

NOTE

This manual is common to both Model PM8571A and Model PM8572A. If you purchased the Model PM8571A, please ignore all references to the second channel in this manual.

Conventions Used in this Manual

The following conventions may appear in this manual:

NOTE

A Note contains information relating to the use of this product

CAUTION

A Caution contains information that should be followed to avoid personal damage to the instrument or the equipment connected to it.

WARNING

A Warning alerts you to a potential hazard. Failure to adhere to the statement in a WARNING message could result in personal injury.

The following symbol may appear on the product:

CAUTION:
Refer to Accompanying Documents

This refers you to additional information contained in this manual. The corresponding information in the manual is similarly denoted.

PM8572A Feature Highlights

- Dual output configuration with Independent waveform control (model PM8572A only)
- Tight phase offset control between channels (1 point resolution)
- Can operate in one of the following modes:

  50 MHz pulse generator
  25 MHz serial pattern generator
  100 MHz function generator
  300 MS/s waveform generator
  300 MS/s wireless waveform generator
  300 MS/s sequence generator
  100 MHz modulation generator
  25 MB/s 16-bit LVDS level digital pattern generator
  100 MHz half cycle waveform generator
  100 MHz counter/timer

- 16 Bit vertical resolution
- 1 ppm clock stability
- Extremely low phase noise carrier
- 1M waveform memory, optional 2M and 4M waveform memory
- 16 Vp-p into 50Ω, double into open circuit
- Interrupted run modes such as, re-triggered and delayed trigger
- 10 separate sequences link and loop segments in user-definable order
- 3.8” high resolution color LCD display
- Ethernet, USB and GPIB interfaces
- Multi-Instrument synchronization
- Free ArbConnection software to easily create and download complex waveforms
- Emulates remote commands of old instruments such as from the Agilent 811xx family, Fluke 80/1, HP8116, HP8112, HP8160, HP8165, HP8013B, LeCroy LW410/420, Tabor 8500 and 8550/1, Tek PG5110 and more
- Multiple instrument synchronization, jitter-free and phase control
- Remote calibration without removing case covers
- Direct waveforms transfer and storage though USB / CD / DVD

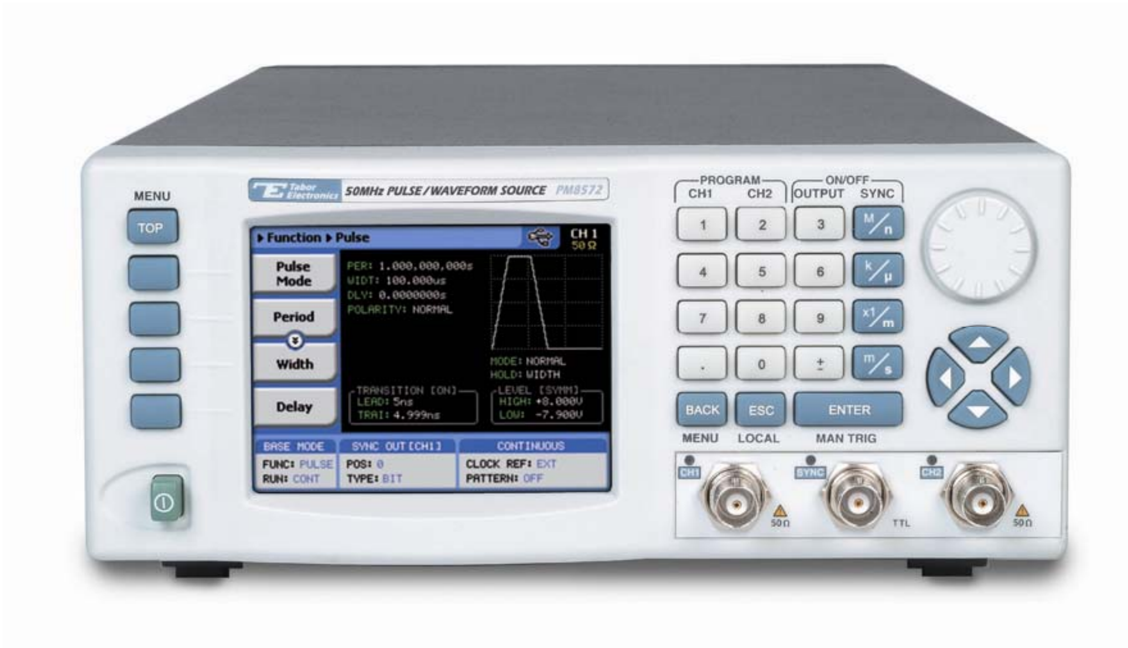

Figure 1-1, Model PM8572A

ArbConnection Feature Highlights

ArbConnection is a graphical tool that provides a source of unlimited waveforms. With the ArbConnection software you can control instrument functions, modes and features. You can quickly and easily breadboard a multitude of test waveforms including arbitrary waveforms, sequences, pulses and modulation. Freehand sketch mode allows you to draw your own custom waveform for quick analysis of analog signals or you can use the built-in equation editor to create your own exotic functions. Add or subtract components of a Fourier series to characterize digital or analog filters or inject random noise into a signal to test immunity to auxiliary noise.

- Multiple and powerful tools in one software package: Complete instrument control, pulse, arbitrary waveform, pulse patterns, 3D and FM composers
- Detailed virtual front panels control all PM8572A functions and modes
- Wave composer generates, edits and downloads complex waveforms
- Pulse composer generates extremely complex pulse patterns and levels
- FM wave composer generates and downloads complex modulating signals
- Easy, on-screen generation of complex pulses using the pulse composer

- Equation editor generates waveforms from equations
- SCPI command and response editor simulates ATE operation
- Translates waveform coordinates from ASCII and other formats
- Simplifies generation of complex sequences

Various screens of the ArbConnection program are shown in Figures 1-2 through 1-5.

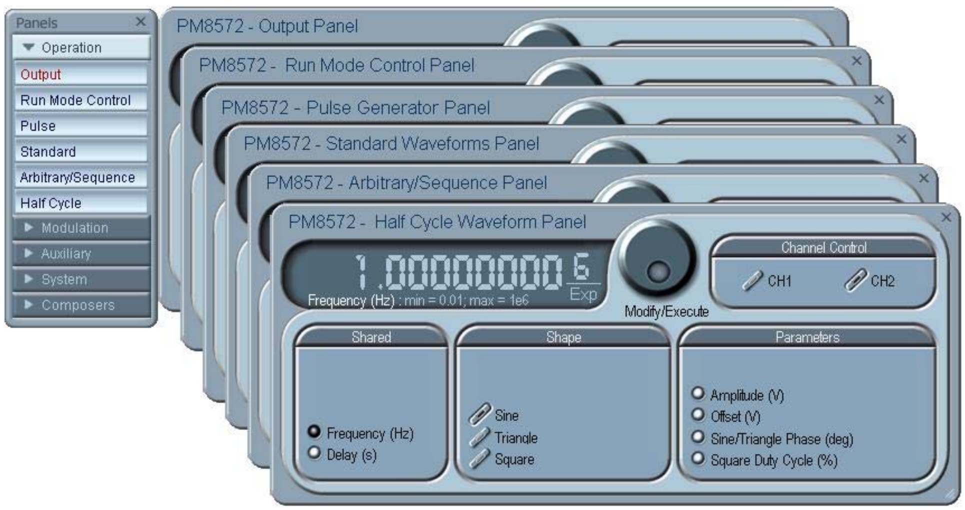

Figure 1-2, ArbConnection – The Control Panels

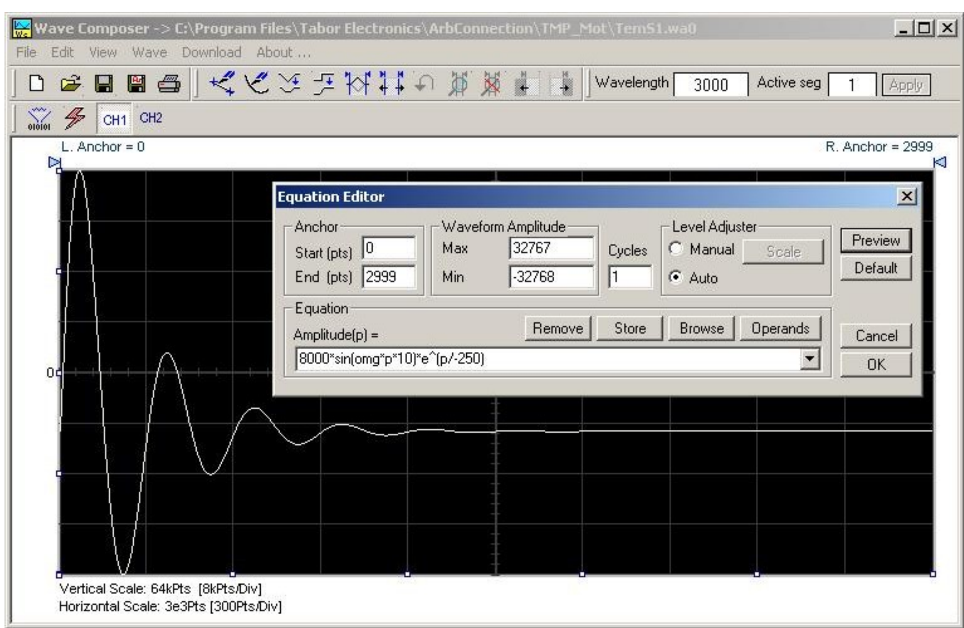

Figure 1-3, ArbConnection – The Wave Composer

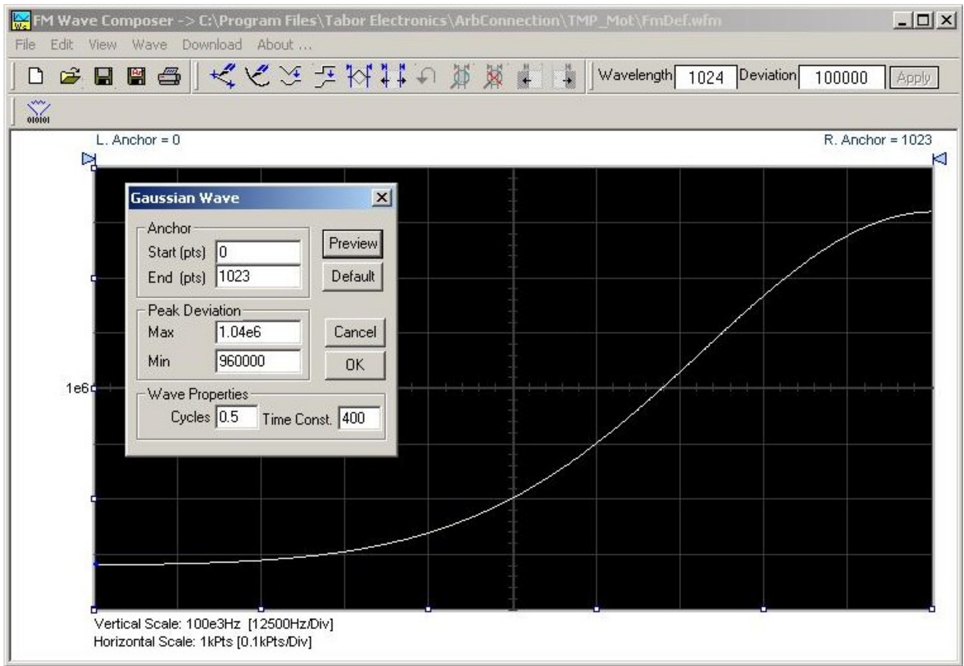

Figure 1-4, ArbConnection – The FM Wave Composer

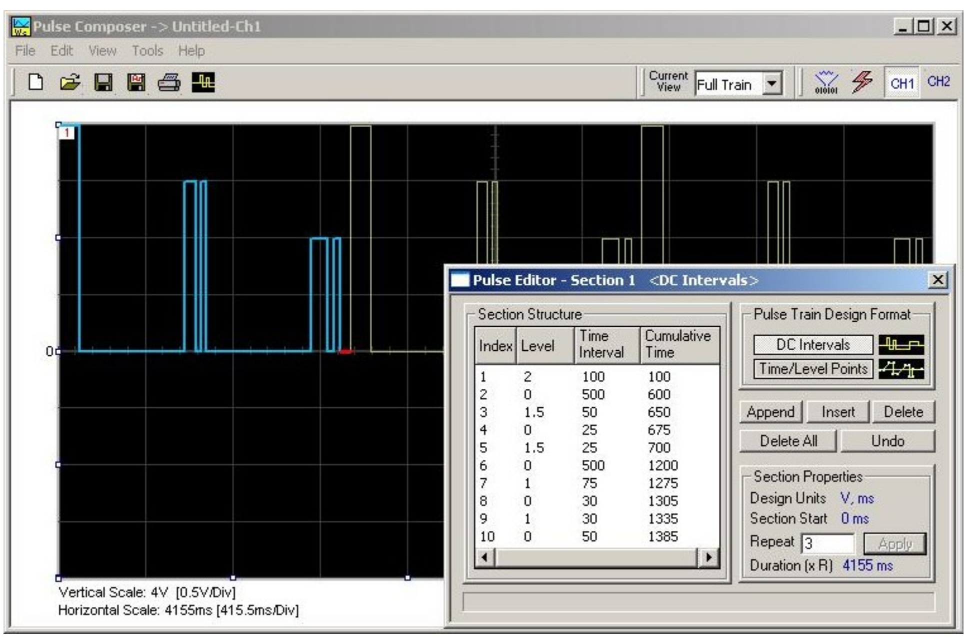

Figure 1-5, ArbConnection – The Pulse Composer

Introduction

Detailed functional description is given following the general description of the features and functions available with the Model PM8572A.

General

The Model PM8572A is a dual-channel universal waveform source. Aside from its standard ability to generate arbitrary shapes, functions or modulation, it can also be used as a full-featured pulse generator and as a wireless signal source. The PM8572A offers unmatched performance even compared to instruments designed to generate fewer types of signals. Its small footprint saves space and cost without compromising bandwidth and signal integrity. Cutting-edge technology is utilized to assure you that this will be the only source you'll ever need for many years to come.

Two Synchronized Channels

The PM8572A has two output channels, both of which are synchronized to the same reference clock and share the same sample clock. This is not a limitation because the output frequency is a function of the number of points which are used for creating the waveform shape. On the other hand, the advantage of having two synchronized channels is huge in applications that require accurate and controlled phase between channels. Many applications require X-Y mode which the Model PM8572A is well-suited for.

Stable and Accurate Output Signals

As standard, the instrument is equipped with a frequency reference that has 1ppm accuracy and stability over a period of 1 year. An external frequency reference input is provided on the rear panel for applications requiring greater accuracy and stability.

Signal Integrity

As technology evolves and new devices are developed each day, faster and more complex signals are needed to simulate and stimulate these new devices. The PM8572A has the highest bandwidth in its class enabling it to accurately duplicate and simulate high frequency test signals. With its wide sample clock generator range (up to 300 MS/s), 16-bit vertical resolution, 32Vp-p (into high impedance loads and over 100 MHz output bandwidth, one can create mathematical profiles, download the coordinates to the instrument and re-generate waveforms without compromising signal fidelity and system integrity.

Pulse Waveforms

Need to generate accurate and jitter-free pulses? Just set the main operating mode to pulse generator and the instrument will be transformed into a full-featured pulse generator. Need to control pulse transitions and placement? Just program each channel to output pulses with linear or fast transitions and control edge placement with 10 ps resolution. Further, if your application requires more than just a fixed duty cycle or programmable pulse width, then modulate and control your leading edge with any standard or arbitrary waveform shape. Combine all of these features with external pulse width control and you have an extremely versatile pulse generation tool.

Arbitrary Waveforms and Memory Segmentation

Waveform memory is the internal scratchpad where the waveforms reside. Larger memory banks provide for longer waveforms. One can use the entire memory for a single waveform or split the length to smaller segments. In this case, many waveforms can be stored in the same memory and replayed, one at a time, when recalled to the output. The memory segmentation feature may be combined with a sequence generator that can take different memory segments and link (and loop) them in any order as required for the test. The ability to loop waveform segments in a sequence can save a lot of memory to extend the capability of the generator to produce longer, more complex waveforms. The PM8572A has four sequence generators that can be loaded with unique sequences for each of its output channels.

Built-in Waveform Gallery

Care to use the instrument as a function generator? No need to calculate complex waveforms because the PM8572A does the work for you. Select the standard waveforms tab and start generating any of ten waveforms that are pre-computed and available for immediate use. Included are: sine, triangle, square, pulse, ramp, sinc and others. Remember that waveforms are created from sampled waveform points and therefore some of the waveforms cannot be generated above certain frequencies where the number of points are insufficient to draw a perfect shape. Nevertheless, by using advanced techniques, the PM8572A generates standard sine and square waveforms at frequencies up to 100 MHz.

Local Operation

Operating the Model 8572A from the front panel is intuitive and extremely easy. A large and user-friendly 3.8” back-lit color LCD display facilitates browsing though menus, updating parameters and displaying detailed waveform information. Combined with a numeric keypad, cursor position control and a knob, the front panel controls simplify the operation of this universal waveform source.

Remote Operation

Access speed is an increasingly important requirement for test systems. Ethernet, USB and GPIB interfaces are available so that the most suitable interface for the application may be selected. Remote control of instrument functions, parameters and waveform downloads is easily tailored to specific system environments regardless of whether control is via a laptop computer or full-featured ATE system. IVI drivers and factory support will speed up system integration and minimize test development time and costs.

Remote Calibration

Normal calibration cycles in the industry range from one to three years where instruments are sent to a service center, opened to allow access to trimmers, calibrated and certified for repeated usage. Leading-edge technology was employed on the PM8572A to allow calibration from any PM8572A remote interface such as USB, GPIB or LAN. Calibration factors are stored in a flash memory thus eliminating the need to open instrument covers.

Replacement of Old Products

While other pulse generator products are aging in the market, Tabor took upon itself to include command converters, for the most popular instruments in the market, that will emulate remote commands and thus allow easy transitions and replacement of old equipment without the hassle of re-writing TPS's code. A good example of the usefulness of this feature is the code emulation of the HP8116A that was built in the Models 8550 and 8551; Till today, almost 25 years later, these two products successfully replace old HP equipment and keep project managers out of trouble when in urgent need to replace products that are now beyond repair.

Options

Several options are available for the PM8572A. These are listed below. Note that all options are factory installed and therefore, they must be ordered with the product.

1. **Option 1**, 2M Waveform Memory – increases the memory capacity from 1M to 2M.
2. **Option 2**, 4M Waveform Memory – increases the memory capacity from 1M to 4M.
3. **Option 3**, 20Vp-p into 50Ω - increases the output voltage window from 16Vp-p to 20Vp-p into 50Ω. Open circuit spec remain the same.
4. **Option 4**, ±5V DC, 50Ω protection (10Vp-p) – improves the output protection, which limiting the voltage window to 10Vp-p.

Identifying Installed Options

Options must be specified at the time of your purchase. If you place an order for an option, you may interrogate the instrument if the option is indeed installed on your unit. The Installed Options field in the System display shows which of the options is installed in your instrument. Information how to operate the menus and how to access the System menu is given in Chapter 3.

Manual Changes

Technical corrections to this manual (if any) are listed in the back of this manual on an enclosed MANUAL CHANGES sheet.

Safety Considerations

The Model PM8572A has been manufactured according to international safety standards. The instrument meets EN61010-1 and UL1244 standards for safety of commercial electronic measuring and test equipment for instruments with an exposed metal chassis that is directly connected to earth via the chassis power supply cable.

WARNING

Do not remove instrument covers when operating the instrument or when the power cord is connected to the mains.

Any adjustment, maintenance and repair of an opened, powered-on instrument should be avoided as much as possible, but when necessary, should be carried out only by a skilled person who is aware of the hazard involved.

Supplied Accessories

The instrument is supplied with a power cord and a CD which contains ArbConnection, manual, IVI driver and supporting files. USB, LAN and synchronization cables and a service manual are available upon request.

Specifications

Instrument specifications are listed in Appendix A. These specifications are the performance standards or limits against which the instrument is tested. Specifications apply under the following conditions: output terminated into 50 Ω after 30 minutes of warm up time, and within a temperature range of 20^{o}C to 30^{o}C. Specifications outside this range are degraded by 0.1% per ^{o}C.

Functional Description

A detailed functional description is given in the following paragraphs. The description is divided into logical groups: Front panel input and output connectors, rear panel input and output connectors, operating modes, output type, output state, synchronization, and front panel indicators.

Front Panel Connectors and Indicators

The Model PM8572A has 3 BNC connectors on its front panel: two main outputs and one SYNC output. Each connector on the front panel has an LED associated with it, indicating when the output is active (LED on), or when inactive (LED off). The function of each of the front panel connectors is described in the following paragraphs.

Main Output - Channels 1 and 2

The main output connectors generate pulses to 50 MHz; built-in standard waveforms to 100MHz, user (arbitrary), sequenced and modulated waveforms that are sampled with sampling clock rate to 300 MS/ and the carrier waveform from the modulated function is programmable to 100 MHz. Output source impedance is 50Ω, hence the cable connected to this output should be terminated with 50Ω load resistance. For different load resistance, determine the actual amplitude from the following equation:

$$V_{out} = 2V_{prog}\left(\frac{50\Omega}{50\Omega + R_L} \right)$$

The output amplitude is doubled when the output impedance is above roughly 10 kΩ. Also, the output can be turned on and off by means of a mechanical relay and thus providing a high impedance path for connecting to an analog bus.

SYNC Output

The SYNC output generates a single or multiple TTL pulses for synchronizing other instruments (i.e., an oscilloscope) to the output waveform. The SYNC signal always appears at a fixed point relative to the waveform. The location of the pulse sync along the waveform is programmable. The source of the sync is programmed to source from channel 1 or from channel 2.

Note that the SYNC output is also used as a marker output when the PM8572A is set to generate one of the modulation functions.

Front Panel Controls

Front panel controls and keys are grouped in logical order to provide efficient and quick access to instrument functions and parameters. Refer to Figure 1-6 throughout the following description to learn the purpose and effect of each front panel control.

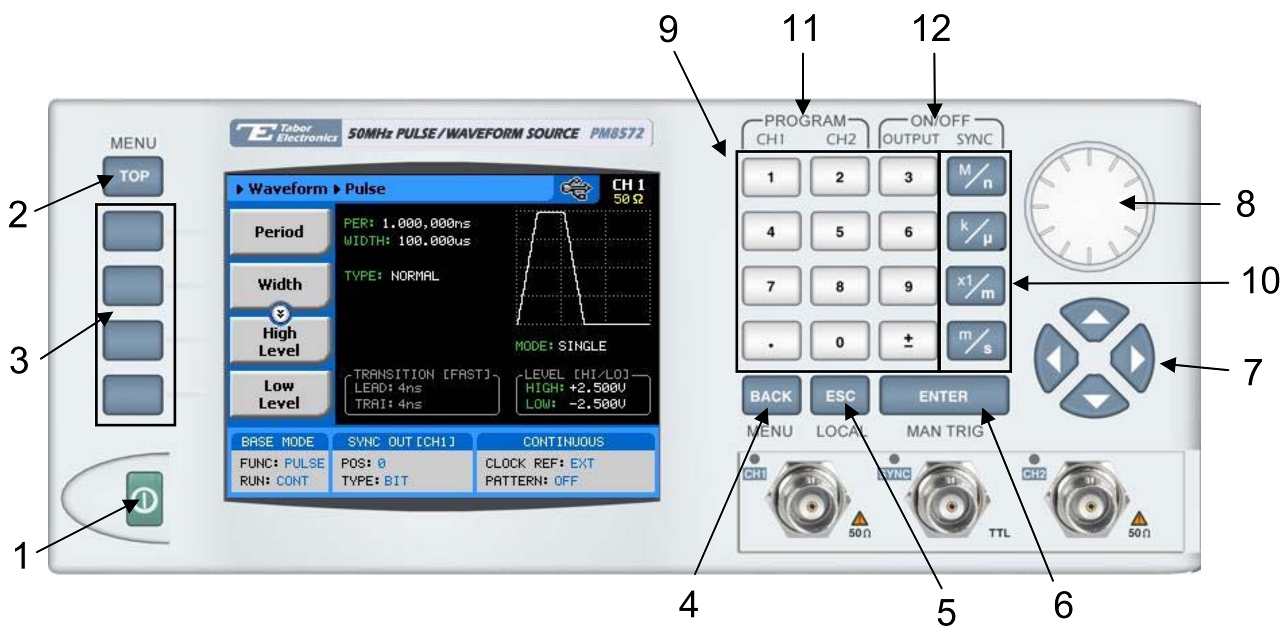

Figure 1-6, PM8572A Front Panel Controls

Note

The index in the following paragraphs point to the numbered arrows in Figure 1-6.

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1. *Power Switch* – Toggles PM8572A power ON and OFF
2. *Menu Top* – Selects the root menu. This button is disabled during parameter editing
3. *Menu Soft Keys* – Soft keys have two functions:

1) Selects output function shape or operating mode,
2) Selects parameter to be audited

These buttons are disabled during parameter editing

4. *Menu Back* – Backs up one menu position. This button is disabled during parameter editing
5. *Cancel (Local)* – Has two functions:
   1) When in edit mode, cancels edit operation and restore last value
   2) When operating the PM8572A from a remote interface, none of the front panel buttons are active. The Local button moves control back from remote to front panel buttons
6. *Enter (Man Trig)* – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the parameters. Pressing Enter selects the parameter for edit. After the parameter has been modified, the Enter button locks in the new variable and releases the buttons for other operations
   2) When the PM8572A is placed in “Triggered” run mode, the Man Trig button can be used to manually trigger the PM8572A
7. *Cursor UP, Down, Left and Right* – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the parameters
   2) When parameter is selected for editing, cursor buttons right or left move the cursor accordingly. Cursor buttons up or down modify parameter value accordingly
8. *Dial* – Has similar functionality as the cursor UP and Down keys
9. *Numeral keypad* – These keys are used for modifying an edited parameter value
10. *Parameter Suffixes (M, k, x1 and m)* – These keys are used to place suffix at the end of the parameter. They are also used for terminating an edit operation
11. *Program* CH1, CH2 – Use Program CH1 to modify the screen to display channel 1 parameters. Use Program CH2 to modify the screen to display channel 2 parameters. These keys can be used only when the PM8572A is not in edit mode
12. *ON/OFF Output, Sync* – These keys can be used only when the PM8572A is not in edit mode. The Output ON/OFF toggles output waveform, at the output connector, ON and OFF. The Sync ON/OFF toggles the sync waveform, at the SYNC output connector, ON and OFF

Rear Panel Input & Output Connectors

The PM8572A has a number of connectors on its rear panel. These connectors are described below. Figure 1-7 shows rear panel plugs, indicators, connectors and other parts.

TRIG IN

In general, the trigger input is used for stimulating output waveforms at the main output connector(s). The trigger input is inactive when the generator is in continuous operating mode. When placed in trigger, gated or burst mode, the trigger input is made active and waits for the right condition to trigger the instrument. The trigger input is edge sensitive, i.e., it senses transitions from high to low or from low to high.

Trigger level and edge sensitivity are programmable for the trigger input. For example, if your trigger signal rides on a dc level, you can offset the trigger level to the same level as your trigger signal, thus assuring correct threshold for the trigger signal. The trigger level is adjustable from -5V to +5V.

The trigger input is common to both channels. Therefore, if the PM8572A is placed in trigger mode, both channels share the same mode and the trigger input causes both channels to start generating waveforms at the same time. Phase relationship between channels is tightly controlled in trigger mode and therefore, you should expect both channels to start generating waves with exactly the same start phase. Further control of leading edge offset between channels is also provided.

The same input is also used in FSK, ASK and PSK modes, where the output shifts between two frequencies – carrier and shifted frequencies. The output generates carrier frequency when the input signal is false (below trigger level) and shifted frequency when the input is true (above trigger level).

Figure 1-7, PM8572A Rear Panel

REF IN

This SMB connector accepts 10MHz, TTL level reference signal. The external reference input is available for those applications requiring better accuracy and stability than what is provided by the PM8572A. The reference input is active only after selecting the external reference source mode.

16-bit Digital Out

This 68 pin, high density SCSI-2 connector outputs 16 bits, LVDS (Low Voltage Differential Signal) logic level. The output to this connector is routed from channel 1 only and can be turned on and off from the front panel and from an interface bus. The digital patterns are derived from lines that are connected to the DAC and therefore, when the digital pattern output is enabled, the 16 bits that drive the DAC are routed to this connector in parallel. The digital patterns can be designed in two ways: 1) Downloaded to the PM8572A from an external utility as an arbitrary waveform and 2) ArbConnection lets you write the patterns to a simple table (hex words) and then this table can be loaded to the instrument through a remote interface.

LAN

This RG45 connector accepts standard Ethernet cable. Correct setting of the IP address is required to avoid conflicts with other instruments or equipment on the network. Information how to change IP address and load instrument drivers to the computer is provided in the Installation chapter of this manual.

USB Device

This connector accepts standard USB cable. The connection to the host computer is automatic and does not require any address setting from within the PM8572A. The first time the PM8572A is connected to the computer, it will request the driver file. This file is located on the CD which is supplied with the instrument. Information how to install the driver is provided in the Installation chapter of this manual.

USB Host

This connector accepts standard USB devices, such as disk-on-key and external CD/DVD-ROM. The connection to the devices is automatic and does not require any address setting from within the PM8572A. Once the external device is connected, it’s ready to be used.

GPIB

This 24-pin connector accepts standard GPIB cable. The GPIB address is configured using the front panel utility menu. The PM8572A conforms to the IEEE-488.2 standard. Programming protocol is SCPI version 1993.0. GPIB cables are available separately from your Tabor dealer.

AC LINE

This 3-prong AC LINE connector accepts ac line voltage. The PM8572A senses the line voltage and sets the appropriate range automatically. Therefore, the traditional line voltage selector is not available on the rear panel. To avoid potentially hazardous situations, always connect the center pin to mains ground using the line cord that is supplied with the instrument.

AC FUSE

The AC fuse protects the PM8572A from excessive current. Always replace the fuse with the exact type and rating as printed on the rear panel. If the fuse blows again after replacement, we recommend that you refer your instrument immediately to the nearest Tabor service center.

X-INST SYNC

The X_INST SYNC (Multi-Instrument Synchronization) group of is comprised of four SMB connectors, designated as SCLK OUT/IN, and COUPLE OUT/IN. Theses connectors are installed in your instrument only if you ordered the multi-instrument synchronization option. Besides the rear panel connectors, you should receive a few other cables. Information how to connect and synchronize between two or more instrument is given later in this manual.

SCLK OUT

This SMB connector outputs the programmed sample clock frequency. Output level is 400mVp-p, terminated into 50Ω. Note that correct termination is necessary for this output otherwise you will not see this signal at all. This output generates sample clock waveforms continuously, regardless if the PM8572A is operating in continuous, trigger, or gated modes.

The sample clock output is used for multiple-instruments synchronization. In master mode, connect this output with an SMB to SMB cable to the SCLK IN on the adjacent slave instrument. You may also use this output to synchronize other components in your system to one master clock.

SCLK IN

This SMB connector accepts 300mVp-p to 1Vp-p into 50Ω level signal. Normally, this input is disabled. When enabled, the clock at this input replaces the internal clock generator and the PM8572A generates waveforms having the external sample clock rate.

When synchronizing you PM8572A as a slave unit, an SMB to SMB cable is connected from the Master SCLK OUT connector to this SCLK IN connector.

COUPLE OUT

This SMB connector outputs the coupling signals to the slave unit. Output level is LVPECL, terminated into 50Ω to 1.3V. For multi-instrument synchronization, connect this output to the COUPLE IN connector on the slave unit.

COUPLE IN

This SMB connector accepts coupling signals from the master unit. Input level is LVPECL, terminated into 50Ω to 1.3V. For multi-instrument synchronization, connect this input to the COUPLE OUT connector on the master unit.

Run Modes

The PM8572A can be programmed to operate in one of four run modes: Continuous, Triggered, Gated and counted burst. There are two other modes that can operate in conjunction with the basic four run modes, these are: Delayed Trigger and Re-Trigger. The run modes are common to all of the PM8572A waveform output however, they may behave differently for arbitrary and for modulated waveforms. For example, the waveform baseline (where the output idles) for arbitrary waveforms in triggered mode is always a dc level but for modulated waveforms you can select from dc level or continuous carrier waveforms. The differences are explained in the relevant sections however, you do have to remember, that after you select the run mode, it affects every waveform output regardless from where you programmed the mode.

Summary of run modes and optional trigger sources are listed in Table 1-1. Information in this table also identifies legal run modes and lists possible setting conflicts.

Continuous

In normal continuous mode, the selected waveform is generated continuously at the selected frequency, amplitude and offset. Only when operated from a remote interface, the output can be toggled on and off using a trigger command.

Triggered

In triggered mode, the Model PM8572A circuits are armed to generate one output waveform. The trigger circuit is sensitive to transitions at the trigger input. Select between positive or negative transitions to trigger the instrument. You may also program the trigger level to the desired threshold level. When triggered, the generator outputs one waveform cycle and remains idle at the last point of the waveform.

The Model PM8572A can be triggered from a number of sources:

1) Rear panel connector, designated as TRIG IN,
2) Front panel button marked as MAN TRIG (second function to the Enter button), and
3) Bus commands that are applied to the instrument from any interface, LAN, USB or GPIB.

Description of the various trigger source options is given in the following paragraphs.

The trigger signal, whether it comes from an external source or from an interface command, is routed through some electrical circuits. These circuits cause some small delay known as system delay. System delay cannot be eliminated completely. The system delay is a factor that must be considered when applying a trigger signal. It defines the time that will lapse from a valid trigger edge or software command to the instant that the output reacts.

Note that there is different behavior of the output in triggered mode for standard, arbitrary and sequenced to that of the modulated waveform. While the modulated waveform baseline can be programmed to idle on either dc level or continuous carrier waveform frequency, the other waveforms idle on dc level only.

Burst

The burst mode is an extension of the triggered mode where the Model PM8572A can be programmed to output a pre-determined number of waveforms. Note that the burst run mode cannot be applied to sequenced waveform because the two functions share the same circuit and therefore, whenever counted burst is selected for sequenced waveforms, the generator will issue a setting conflict error.

Note that there is different behavior of the output in burst mode for standard, arbitrary and sequenced to that of the modulated waveform. While the modulated waveform baseline can be programmed to idle on either dc level or continuous carrier waveform frequency, the other waveforms idle on dc level only.

Gated

In gated mode, the PM8572A generates output waveforms between two gating signal. Only hardware triggers can be used to open and close the gate. The gate opens on the first trigger transition and closes on the second transition. Trigger level and trigger slope are programmable. Trigger delay and re-trigger do not apply to the gated run mode.

Note that there is different behavior of the output in gated mode for standard, arbitrary and sequenced to that of the modulated waveform. While the modulated waveform baseline can be programmed to idle on either dc level or continuous carrier waveform frequency, the other waveforms idle on dc level only.

Delayed Trigger

The delayed trigger function is exactly the same as the trigger mode except a programmable delay inhibits signal output for a pre-determined period after a valid trigger. The delay time defines the time that will lapse from a valid trigger (hardware or software) to output. The delay is programmable in steps of 20ns from 200ns to 21 seconds. The trigger delay can be applied to all run modes: continuous, trigger and burst.

Re-Trigger

The Re-trigger run mode requires only one trigger command to start a sequence of triggered or counted burst of signals. The re-trigger delay defines the time that will lapse from the end of a signal to the start of the next signal. Re-trigger delay is programmable in steps of 20ns from 200ns to 21 seconds.

Trigger Source

The Model PM8572A can be triggered from a number of sources:

1) Rear panel connector, designated as TRIG IN;
2) Front panel button marked as MAN TRIG (second function to the Enter button); and
3) Bus commands that are applied to the instrument from any interface, LAN, USB or GPIB.

Description of the various trigger source options is given in the following paragraphs. Summary of trigger options and optional trigger sources are listed in Table 1-2, identifying legal operating modes and listing possible setting conflicts.

External

When selecting the External trigger source, the rear panel TRIG IN connector becomes active and every legal signal that is applied to this input is causing the PM8572A to trigger. Alternately, if an external signal is not available, the front panel MAN TRIG button may also be used to trigger the instrument. When EXT is selected, triggers commands from a remote interface are ignored. EXT is the default trigger source.

Bus

When selecting the Bus as a trigger source, the rear panel TRIG IN connector and the front panel MAN TRIG button are disabled and only trigger commands from a remote interface are accepted by the instrument. Make sure that the appropriate trigger source is selected if you mix remote and local operation.

Table 1-1, Run Modes and Trigger Source Options Summary

Run Mode	**Trigger Option**	**Status**
Continuous	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger* *(*) Output signal is toggled on and off using interface triggers*	*Disabled* *Active(*)* *Disabled* *Active* *Disabled*
Triggered	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Active* *Active* *Active*
Counted Burst	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger* *(*) Not in conjunction with Re-Trigger* *(**) Not in conjunction with Mixed*	*Active* *Active* *Active(*)* *Active* *Active(**)*
Gated	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Disabled* *Active* *Disabled*

Table 1-2, Trigger Source Options Summary

Trigger Option	**Source/ Description**	**Status**
External	*Interface trigger commands* *Rear panel TRIG IN connector* *Front panel MAN TRIG button*	*Disabled* *Active* *Active*
Bus	*Interface trigger commands* *Rear panel TRIG IN connector* *Front panel MAN TRIG button*	*Active* *Disabled* *Disabled*
Mixed	*Interface trigger commands* *Rear panel TRIG IN connector* *Front panel MAN TRIG button* *(*) First trigger from BUS only, subsequent triggers from EXT only*	*Active(*)* *Active(*)* *Active(*)*

Mixed

Mixed trigger advance source defines special trigger behavior where the PM8572A expects to first receive remote bus trigger and only then accept hardware triggers. The first time that the PM8572A is placed in this mode, all EXT (rear and front panel hardware) triggers are ignored until a remote *TRG is issued. Following the first software trigger, subsequent triggers from the remote interface (software) are ignored and only rear and front panel triggers are accepted by the instrument.

Output Type

The Model PM8572A can output various types of waveforms, such as, Pulse, Standard, Arbitrary, Sequenced and Modulated. Using a rear-panel, high-density connector, The instrument can also generate Digital Patterns, separately, or in conjunction with the basic output types. The various output types are described in the following paragraphs.

Pulse Generator

The pulse generator function transforms the PM8572A into a pulse generator with the capability to generate pulses exactly as they would be generated by a stand-alone pulse generator instrument. When using this function one could program all pulse parameters in units of time (seconds). All pulse parameters are programmable including period, pulse width, rise and fall times, delay, polarity and more. As a dual channel instrument, you may program different pulse settings for each channel as long as the period remains the same. Operating instructions for the pulse generator are given in Chapter 3. The PM8572A front panel and ArbConnection control panel examples for the pulse generator function are shown in figures 1-8 and 1-9, respectively.

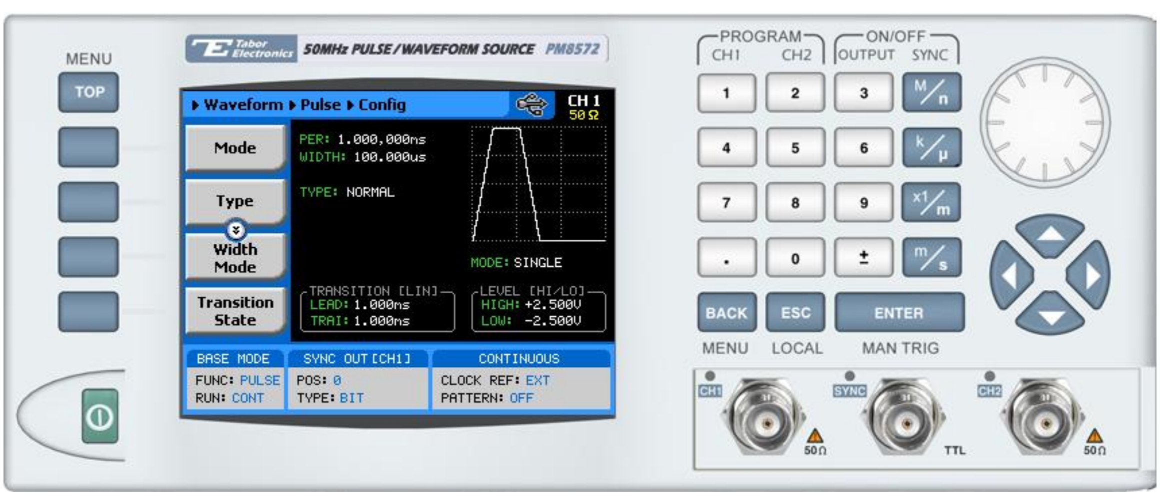

Figure 1-8, PM8572A Pulse Generator Menu Example

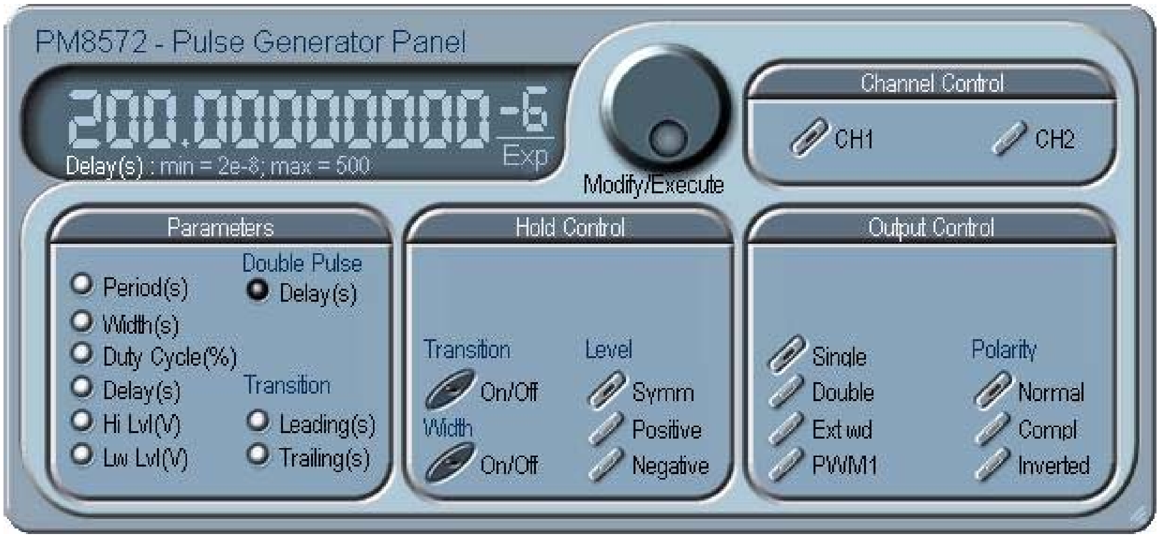

Figure 1-9, ArbConnection Pulse Generator Panel Example

Standard Waveforms

An array of built-in standard waveforms is available when the PM8572A is placed in its standard waveforms mode. The waveforms are generated mathematically from standard equations and converted to waveform coordinates that are downloaded to the working memory. Unlike analog function generators that use electrical circuits to produce the wave shapes, the PM8572A must compute the waveform coordinates every time a new function is selected or every time the parameters of the function change.

The PM8572A can produce 11 standard waveforms: sine, triangle, square, ramp and pulse, sinc, gaussian and exponential pulses, dc and Pseudo-random noise. Some of the waveforms parameters can be modified such as start phase for sine and triangle, duty cycle for square, rise and fall times for pulses etc. The standard waveforms are the most commonly used wave shapes and therefore were collected to a library of standard waveforms that can be used without the need to compute and download waveform coordinates.

The repetition rate of the standard waveforms is given in units of Hz. Both channels share the same clock source and therefore, when a standard function shape is selected for re-play, the frequency of the waveforms is the same at the output connectors of both channels. Also, when standard waveforms are used, both channels share the same run mode, as well as delayed trigger and re-trigger settings. On the other hand, each channel can have a unique set of waveform, amplitude, offset and waveform parameters without interference between the channels and with minimal skew of the waveform starting edges. Refer to Appendix A for the skew between channels specification.

Figure 1-10 shows typical front panel for the standard waveform display and Figure 1-11 shows typical standard waveform panel as displayed when ArbConnection is used for remote programming.

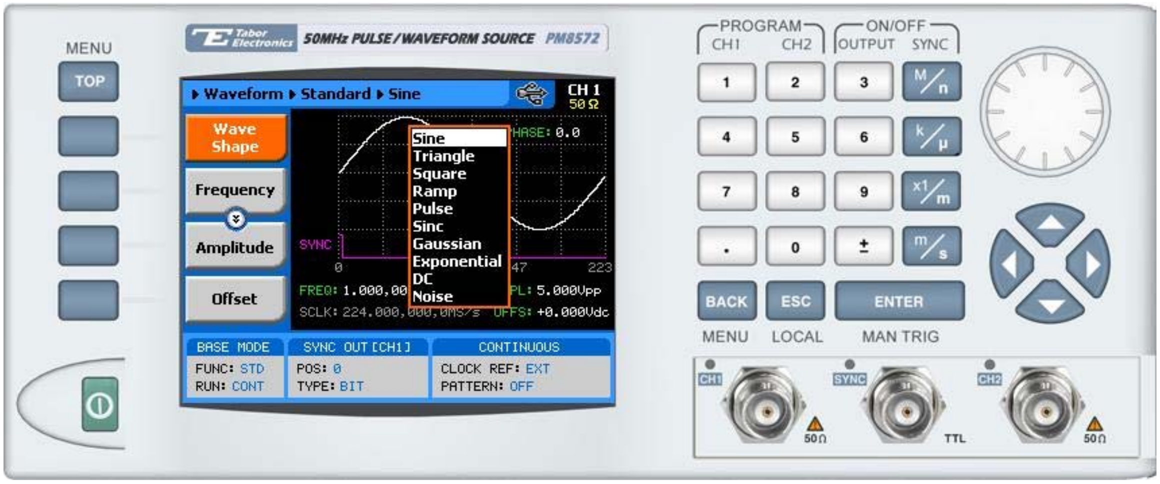

Figure 1-10, Typical PM8572A Standard Waveforms Display

Figure 1-11, ArbConnection Example - Typical Standard Waveforms Panel

Arbitrary Waveforms

One of the main functions of the Tabor model PM8572A is generating real-life waveforms. These are normally not sinewaves and squares but user specific waveforms. Generating such waveforms require external utilities such as MatLAB or even spreadsheets but having the program alone is not enough for the PM8572A; Once the waveform is computed and defined, it must be converted to a format which the instrument can accept and coordinates downloaded to the generator memory for re-play.

Arbitrary waveforms are stored as digital XY coordinates in a special memory, normally referred to as working memory. Each coordinate is referred to as waveform point, or waveform sample. The waveform is better defined if it has many waveform points. For example, with only 8 point, sine waveform will hardly resemble the shape of a sinewave and will look more like an up-down staircase, but with 100 points, the same sine waveform will look almost perfect.

The final shape of the waveform is produced by a DAC (Digital to Analog Converter) The waveform samples are clocked to the DAC at a rate defined by the sample clock frequency. The output of the DAC converts the digital data to analog levels and passes on the signal to the output amplifier. The shape of the function is more or less the same as it comes out of the DAC except it could be amplified or attenuated, depending on the require amplitude level.

The size of the working memory is limited to the way the hardware was designed. The PM8572A has 1M points available as standard (2M/4M point optional) to build one or more waveforms. There is no need to use the entire memory for only one waveform; The memory can be divided into smaller segments loaded with different waveforms while the instrument can be programmed to output one segment at a time.

The Model PM8572A has separate arbitrary waveform memories for each channel and each channel can be loaded with different waveforms. Channels are not limited by the number of segments and by the shape of the waveforms.

Figure 1-12 shows typical front panel for the arbitrary waveform display and Figure 1-13 shows typical ArbConnection panel as displayed when ArbConnection is used for remote programming.

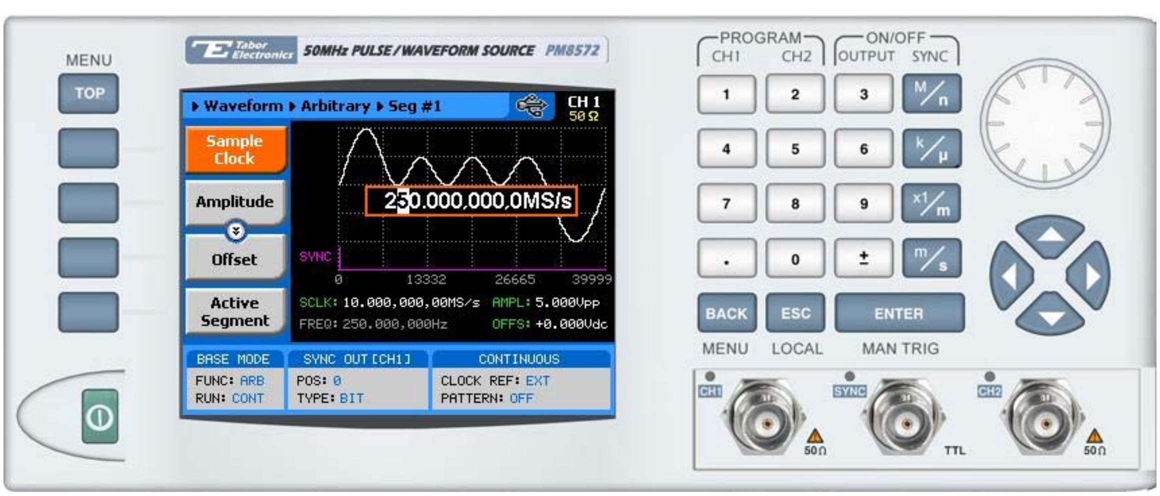

Figure 1-12, Typical PM8572A Arbitrary Waveforms Display

Figure 1-13, ArbConnection Example – Typical Arbitrary & Sequenced Waveforms Panel

Sequenced Waveforms

The sequence generator is a very powerful tool that lets you link and loop segments in any way you desire. The Model PM8572A has two separate sequence generators – one for each channel. Each sequence generator is dedicated to its own channel.

The sequence circuit is useful for generating long waveforms with repeated sections. The repeated waveform has to be programmed once and the repeater will loop on this segment as many times as selected. When in sequenced mode, there is no time gap between linked or looped segments. Sequence tables must be loaded to the generator before sequenced waveforms can be generated. The data for the sequence table is first prepared on an external platform, then downloaded to the generator.

As a simple example of a sequenced waveform, look at Figures 1-14 through 1-16. The waveforms shown in these figures were placed in memory segments 1, 2 and 3, respectively. The sequence generator takes these three waveforms links and loops them in a predefined order to generate the waveform shown in Figure 1-17.

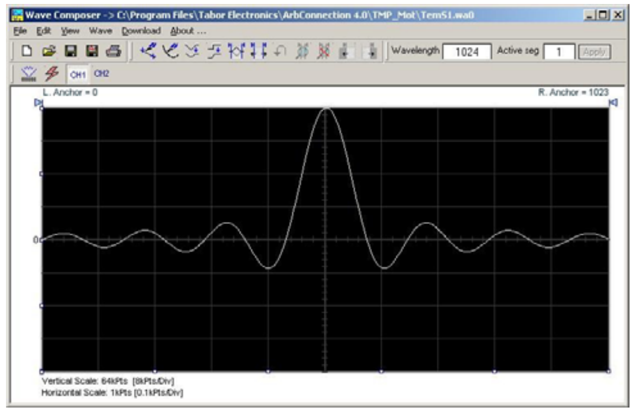

Figure 1-14, Segment 1 Waveform – Sinc

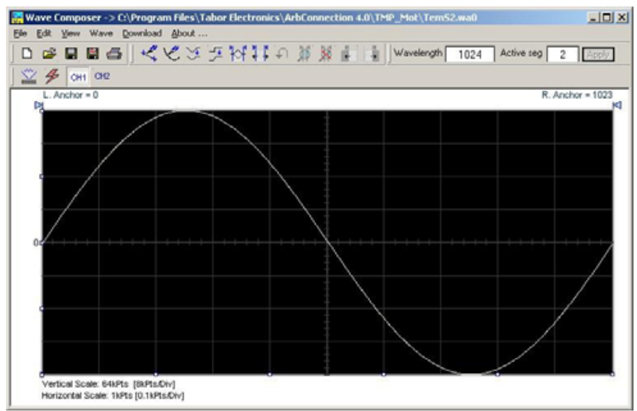

Figure 1-15, Segment 2 Waveform - Sine

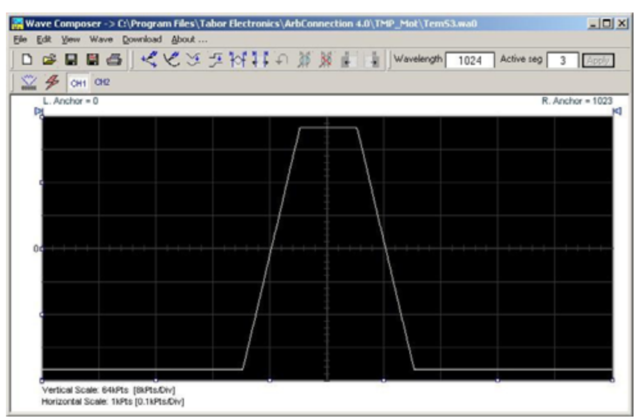

Figure 1-16, Segment 3 Waveform - Pulse

The following sequence was made of segment 2 repeated twice, segment 1 repeated four times, and segment 3 repeated two times.

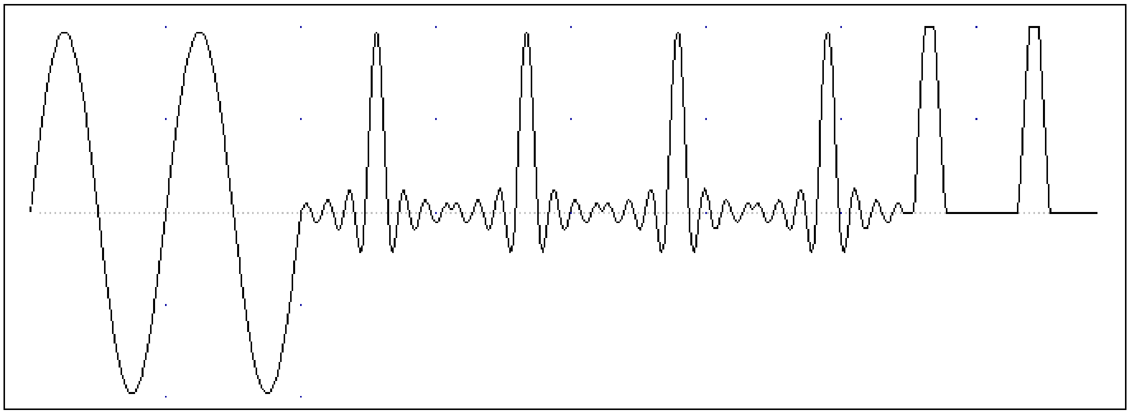

Figure 1-17, Sequenced Waveform

Figure 1-18 shows typical front panel entry for the above sequence and Figure 1-19 shows the waveform studio as is typically being used for building and generating the sequence table from remote.

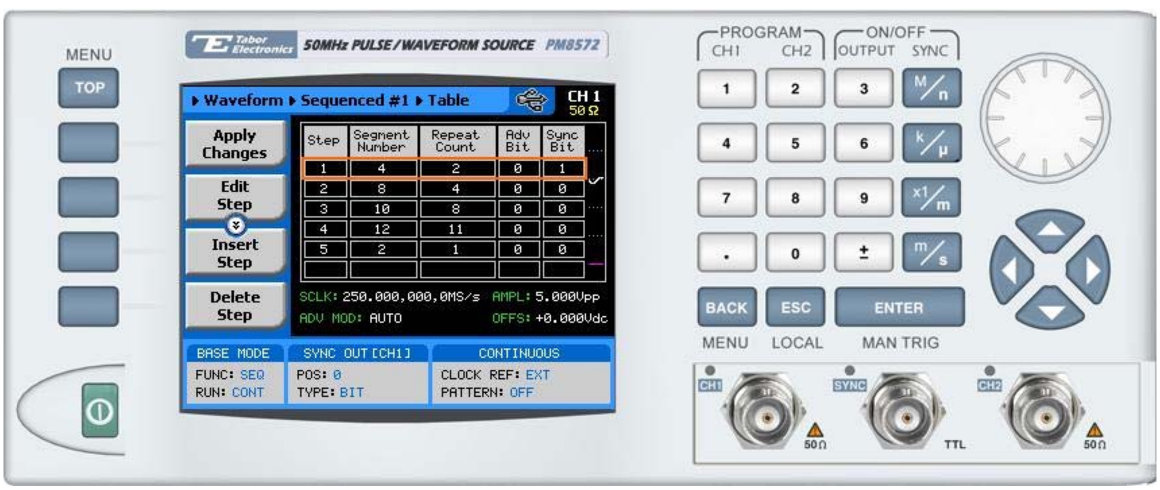

Figure 1-18, Typical Front Panel Programming of a Sequence Table

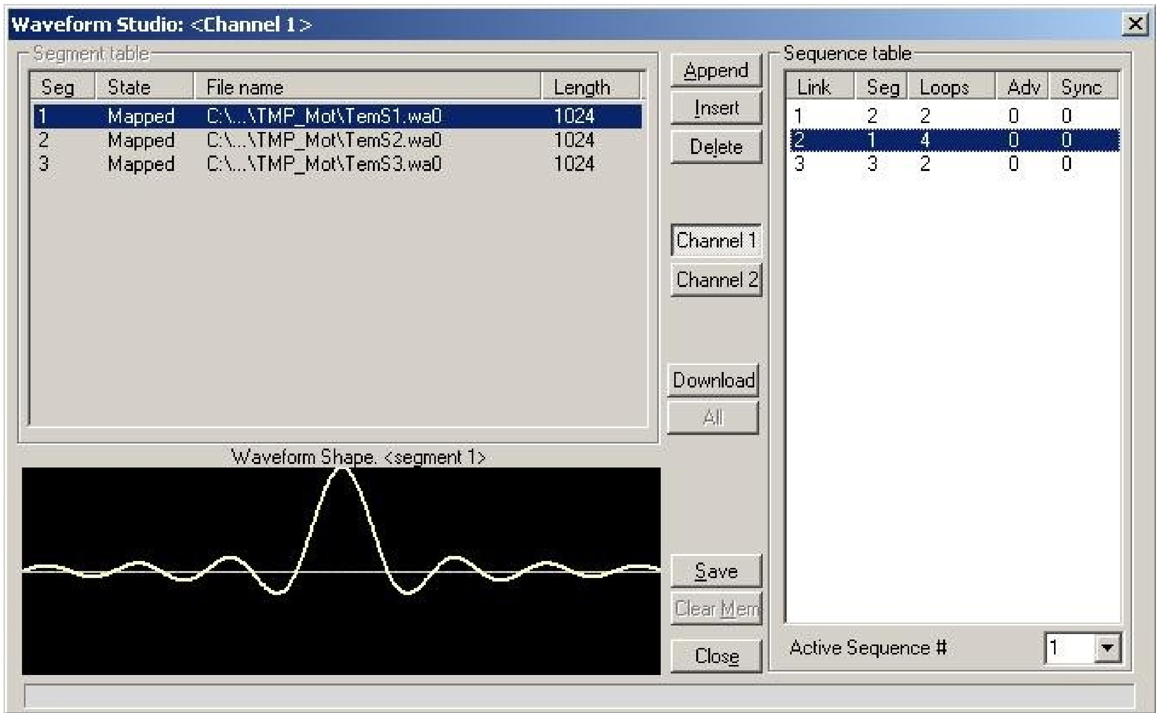

Figure 1-19, ArbConnection Sequence Table Studio

Sequence Advance Modes

As shown above, sequences are built as simple table of which define link, segment, loops and advance bits. When placed in sequenced mode, the output is changing from link to link in an ascending order. The term Sequence Advance Modes defines what is causing the instrument to step from link to link. There are four basic advance modes that can be selected for the sequence mode: Auto, Stepped, ingle and Mixed. These modes are explained in the following paragraphs. Also note that there are some limitations that should be observed while using the various sequenced advance modes. These limitations are summarized in Table 1-3.

Auto

Auto advance sequence is the mode that you want to use when the sequence is expected to run continuously from the first step in the table to the last, and then resume from the first step. There are no interrupts between steps and between the last and the first step of the sequence. When auto mode is selected, the PM8572A can also be placed in triggered and gated run modes. The various run mode options that are available for the auto advance mode are summarized in Table 1-3.

Stepped

Stepped advance sequence is the mode that you want to use when the sequence is expected to advance on triggers only. The trigger source is selectable from either external or bus commands. The step will run continuously until a trigger advances the sequence to the next step. When the last step is reached, the next trigger will advance to the first step in the sequence and this sequence will repeat itself as long as triggers are applied to the generator. Note that the generator operates in continuous run mode; Trying to place it in trigger or gated run mode will issue a settings conflict error message. The various run mode options that are available for the step advance mode are summarized in Table 1-3.

Table 1-3, Sequence Advance and Trigger Options Summary

Run Mode	***Run Mode***	***Status***	***Trigger Option***	***Status***
Auto	*Continuous Triggered Gated Burst*	*Active Active Active Disabled*	*External Bus Mixed Delayed Trigger Re-Trigger*	*Active Active Disabled Active Disabled*
Step	*Continuous Triggered Gated Burst*	*Active Disabled Disabled Disabled*	*External Bus Mixed Delayed Trigger Re-Trigger*	*Active Active Disabled Active Disabled*
Single	*Continuous Triggered Gated Burst*	*Disabled Active Disabled Disabled*	*External Bus Mixed Delayed Trigger Re-Trigger*	*Active Active Disabled Active Disabled*
Mixed	*Continuous Triggered Gated Burst*	*Active Disabled Disabled Disabled*	*External Bus Mixed Delayed Trigger Re-Trigger*	*Active Active Disabled Active Disabled*

Single

Single sequence advance is the mode that you want to use when the sequence is expected to advance on triggers only. The trigger source is selectable from either external or bus commands. The step will run once until a trigger advances the sequence to the next step. When the last step is reached, the next trigger will advance to the first step in the sequence and this sequence will repeat itself as long as triggers are applied to the generator. Note that the generator operates in triggered run mode; Trying to place it in continuous or gated run mode will issue a settings conflict error message. The various run mode options that are available for the single advance mode are summarized in Table 1-3.

Mixed

Mixed advance sequence is the mode that you want to use when some steps of the sequence are expected to run as if in Auto advance mode while some steps that are flagged should wait and operate as if in Stepped sequence mode. The base run mode of the instrument is continuous. The sequence will step through segments of the table that are marked as continuous and will stop and wait for a trigger on sequence steps that are marked with a special flag. Note that the generator operates in continuous run mode; Trying to place it in trigger or gated run mode will issue a settings conflict error message. The various run mode options that are available for the step advance mode are summarized in Table 1-3.

Modulated Waveforms

Using the latest DDS technology, the PM8572A is capable of producing an array of modulation, which places this generator in-line with stand-alone, high performance modulation generators. The PM8572A can produce: Sweep, FSK, PSK, ASK, Frequency and amplitude Hops, AM, FM and the most advanced modulation function - Arbitrary FM. It can also generate 3D modulation where amplitude, frequency and phase are swept as a function of time. When modulation is used from one channel, the other channel is 90° phase shifted, specifically convenient for applications such as I & Q modulation and for this purpose, the PM8572A can also generate many types of (n)PSK and (n)QAM schemes.

Figure 1-20 shows a typical front panel entry for modulated waveform and Figure 1-21 shows an ArbConnection example of a modulation panel.

General description of all modulation functions is given in the following.

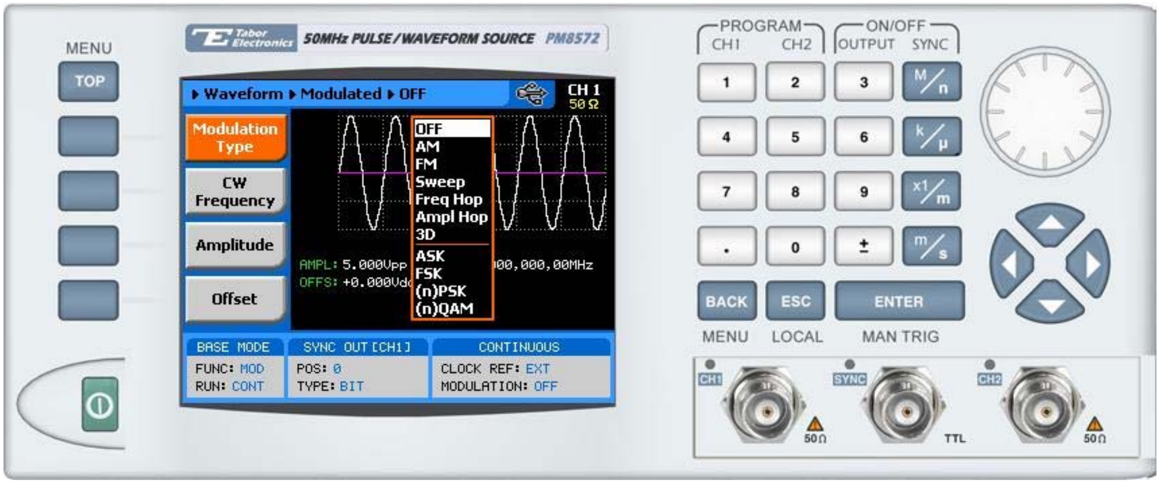

Figure 1-20, Typical Modulated waveform Display

Figure 1-21, ArbConnection Example – FM Modulation Panel

Modulation Off

In modulation OFF, the output generates continuous Carrier Waveform frequency. The carrier waveform is sinewave and its frequency can be programmed using the CW Frequency menu. The value programmed for the CW Frequency parameter, is used for all other modulation functions.

AM

The AM function enables amplitude modulation of a carrier waveform (CW). The carrier waveform is sinewave and it is being modulated by an internal waveform, normally referred to as envelop waveform. The envelop waveform can be selected from sine, triangle square or ramp shapes.

FM

The FM function allows frequency modulation of a carrier waveform (CW). The carrier waveform is sinewave and it is being modulated by an internal waveform, normally referred to as modulating waveform. The modulating waveform can be selected from sine, triangle or square waveforms.

Arbitrary FM

The Arbitrary FM function is very similar to the standard FM function except the modulating waveform is user programmable. The arbitrary waveform to modulate the carrier is generated using the FM composer panel from ArbConnection. It also can be generated by the user using other utilities.

FSK

FSK (Frequency Shift keying) modulation allows frequency hops between two pre-programmed frequencies: Carrier Waveform Frequency and Shifted Frequency. Note that CW is sinewave only and that the switch between two frequencies is always coherent.

ASK

ASK (Amplitude Shift keying) modulation allows amplitude hops between two pre-programmed amplitude levels. Note that sinewave CW only is hopped. The signal level can hop between two amplitude levels throughout the entire amplitude range without crossing range or relay ranges. Amplitude is programmed from 0 V to 16 V.

PSK

In Phase Shift Keying (PSK), the output of the PM8572A hops between two phase settings: start and shifted phase while the frequency of the carrier waveform remain the same. Note that CW is sinewave only.

Sweep

Sweep modulation allows carrier waveform (CW) to sweep from one frequency, defined by the sweep start parameter to another frequency, defined by the sweep stop parameter. Note that CW is sinewave only. The start and stop frequencies can be programmed throughout the entire frequency range of the instrument.

Frequency Hop

In frequency hop mode, the output waveform (sinewave) hops from frequency to frequency in a sequence defined by the hop table. There are two hop types:

1. Frequency hops with fixed dwell time and
2. Frequency hops with variable dwell time

Amplitude Hop

In amplitude hop mode, the output waveform (sinewave) hops from amplitude to amplitude in a sequence defined by the hop table. There are two hop types:

1. Amplitude hops with fixed dwell time and
2. Amplitude hops with variable dwell time

3D

The 3D modulation allows profiling over time of the carrier waveform over three domains: frequency, amplitude and phase. 3D waveforms must be generated in external utilities such as ArbConnection's 3D composer. The 3D composing software converts the curves to waveform coordinates which are stored in a dedicated 3D memory.

(n)PSK

The (n)PSK function is very similar to the standard PSK function except the output can shift to multiple phase and amplitude positions to form phase shift constellations. There are 6 different types of phase shift keying that the PM8572A can generate: BPSK, QPSK, OQPSK, pi/4DQPSK, 8PSK and 16PSK.

(n)QAM

The (n)QAM function is similar to the standard ASK function except the output can shift to multiple amplitudes and phase positions to form an amplitude/phase shift constellations. There are 4 different types of Quadrature Amplitude Modulation that the PM8572A can generate: 16QAM, 64QAM and 256QAM. If another constellation scheme is required, one can use the User QAM to design his/her own symbol list and constellation.

Modulation Run Modes

Run modes are shared by all waveforms that are generated by the PM8572A, including modulation. However, when in modulation function, where run mode options take different meaning. When in triggered, burst or gated run modes, the PM8572A outputs sine carrier waveform (CW) until a valid trigger is received and then reacts to the trigger. If triggers cease to stimulate the input, the output resumes generating CW frequency only. Carrier frequency is common to all modulation functions and can be programmed from the modulation menus. If the above behavior is not desired, the PM8572A can be programmed to output dc level when idle, generate the modulated signal when triggered and then, resume dc level position when the modulation cycle has ended. The baseline option is programmable from either the front panel or from remote.

Half Cycle Waveforms

As a subset of the standard waveforms, the PM8572A can generate some of the waveforms, split into two half cycle. When generated continuously, the second half cycle is delayed by a programmed interval. In triggered mode, each trigger stimulates half cycle of the selected function.

Three half cycle waveform shapes are available for generation: Sine, triangle and square. Note when the half cycle function is selected, both channels are placed in this mode automatically.

The repetition rate of the half cycle waveforms is given in units of Hz. Both channels share the same clock source and therefore, when a standard function shape is selected for re-play, the frequency of the half cycle waveforms is the same at the output connectors of both channels. Also, when half cycle waveforms are selected, both channels share the same run mode, as well as delayed trigger and re-trigger settings.

Figure 1-22 shows typical front panel for the half cycle waveform display.

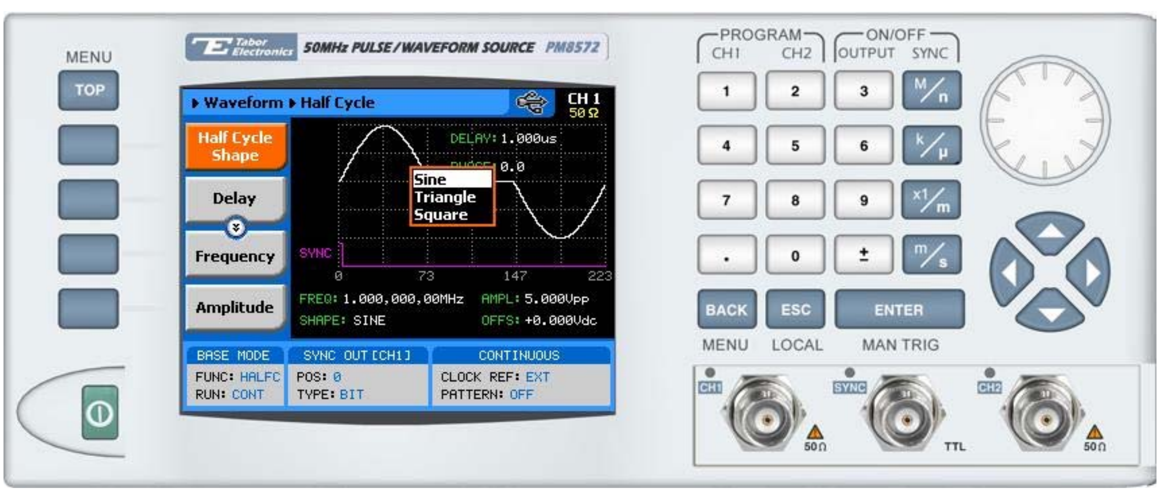

Figure 1-22, Typical Half Cycle Display

Auxiliary Functions

The PM8572A, besides its standard waveform generation functions, has two additional auxiliary functions that can transform the instrument full-featured Counter/Timer, or enable the instrument to output digital patterns. From the auxiliary menu, you can also set up the PM8572A to synchronize to one or more PM8572A instruments to create a multi channel system. Operating instructions for the auxiliary functions are given in Chapter 3. The following describes the auxiliary functions in general.

Counter/Timer

The counter/timer auxiliary function transforms the PM8572A into a counter/timer instrument with the capability to measure parameters exactly as they would be measured by a stand-alone counter/timer instrument. When using this function one could select the measurement function, gate time trigger level and hold the measurement till condition requires a reading. The readings are taken and displayed on the LCD display, or passed on the remote interface to the host computer for further processing. Operating instructions for the counter/timer are given in Chapter 3. PM8572A front panel and ArbConnection control panel examples for the counter/timer are shown in figures 1-23 and 1-24, respectively.

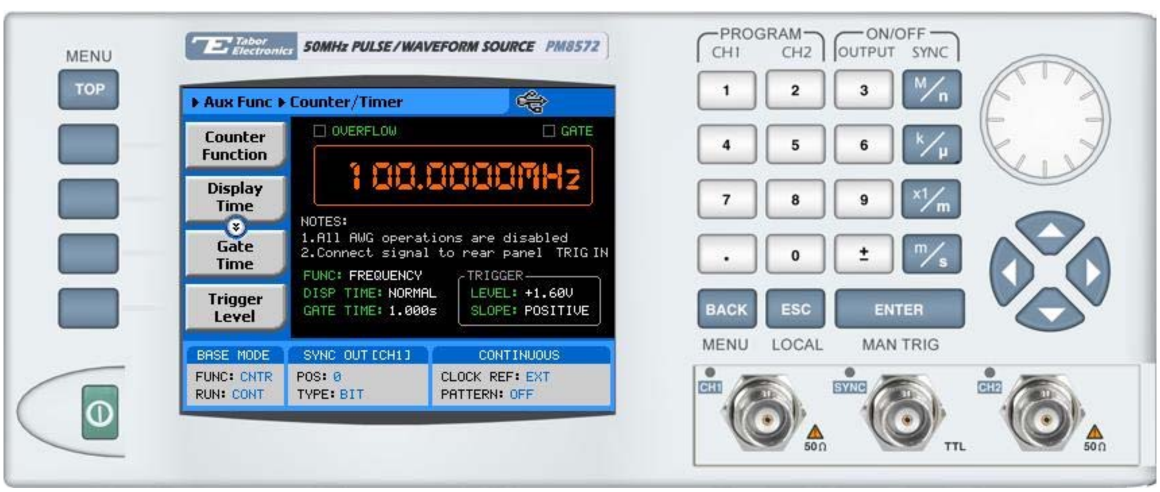

Figure 1-23, PM8572A Counter/Timer Menu Example

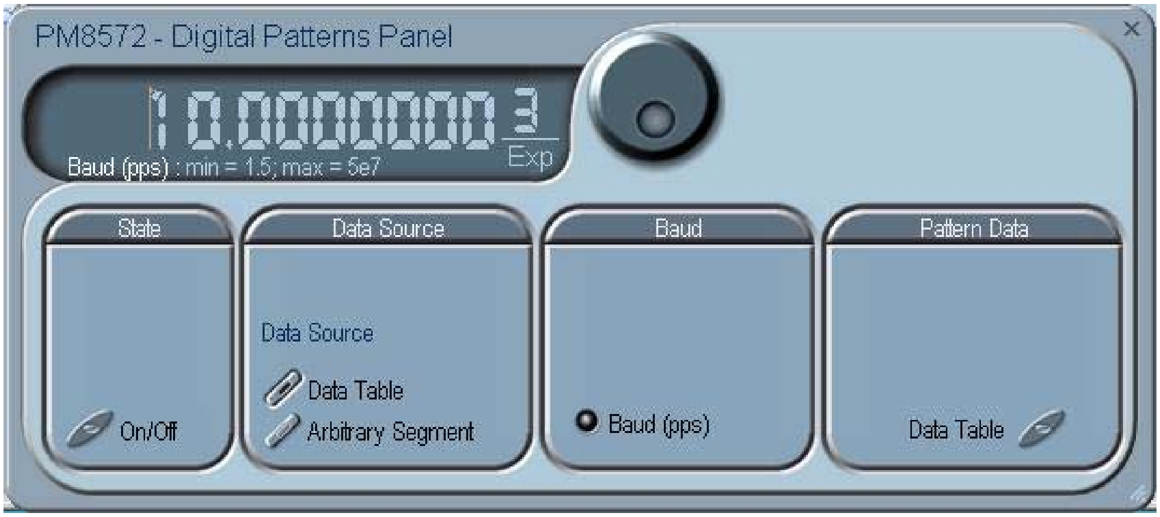

Figure 1-24, ArbConnection Counter/Timer Panel Example

Digital Patterns

Digital patterns are generated through a special rear-panel connector. The output is generated from channel 1 only. Patterns are user programmable using 16-bit hex words and are stored in pattern tables, as shown in figure 1-8. The digital pattern output is activated from the front panel, or using remote programming commands. PM8572A front panel and ArbConnection control panel examples for the digital pattern is shown in figures 1-25.

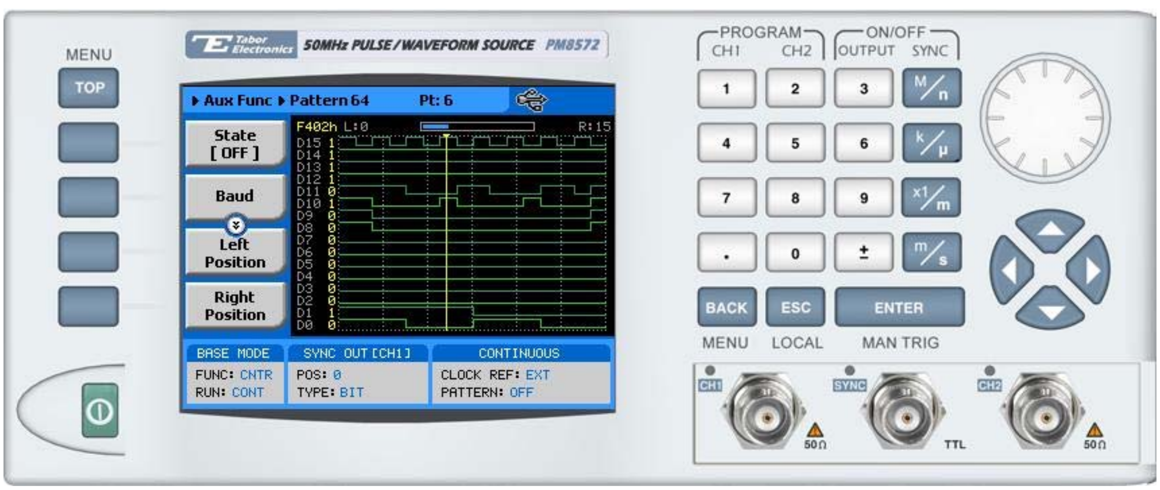

Figure 1-25, Digital Pattern Panel Example

Multi-Instrument Synchronization

Applications that require more than two channels present a problem because most of the instruments that are available on the market normally have maximum two output channels. With the built-in synchronization feature and with simple cables and LAN connections, you can synchronize as many PM8572A units as desired to create a fully synchronized system, without the slightest degradation of performance. Information on how to synchronize PM8572A instruments is given in Chapter 3. Sample synchronization panel is shown in Figure 1-26.

Figure 1-26, Multi-Instruments Synchronization Panel Example

Output State

The main outputs can be turned on or off. The internal circuit is disconnected from the output connector by a mechanical switch (relay). This feature is useful for connecting the main outputs to an analog bus. For safety reasons, when power is first applied to the chassis, the main output is always off.

Output Protection

Normal operation of the output amplifiers allows 16 Vp-p amplitudes to be generated on 50 Ω load impedance, drawing roughly 320 mA from the output amplifier. This should not be a problem since the output stage is rated to deliver this power continuously and without time limitation. On the other hand, if the load impedance is not perfectly resistive, the actual load could increase the stress by drawing more current than the output is rated for. This is the case with inductive or capacitive load impedance.

While resistive load is recommended for prolonged and safe operation, it is understood that certain degree of resistive and capacitive components are always present in the load impedance and the PM8572A is built to overcome these obstacles. However, there are limitations that can cause damage to the output stage and these are specified in Appendix A of this manual.

For the standard PM8572A, the output can be shorted to ground for a limited interval only. Option 4 is available for test environments that are having hard time to control what is connected to the output cable. With option 4, overload conditions are detected by special sensors and disconnect the output automatically. Also note that with option 4, the maximum output amplitude is reduced to 10 Vp-p and the protection is limited to external signals limited to ±5 V only.

Customizing the Output Units

There are some parameters that could be customized for easier fit of the output; These are: horizontal time units, load impedance, 10 MHz reference source and sample clock source. Information on the customization options is given in chapter 3.

Storing and Recalling Setups

The store and recall functions allow you to save important front panel settings and recall them later, when they are needed for a specific application. If you are using external utilities and control the instrument remotely, then it will be best to store all instrument settings and waveforms on the computer's media. However, if local operation is desired, you may still store settings. Settings are stored on a disk-on-key that is connected to a rear-panel host USB connector (type 1). You may also build setup files on an external computer, burn the setting on a CD disk and read the file from the 8572A using a portable CD drive.

The front-panel store/recall function allows access to 10 memory cells. The store/recall function is described in greater details in Chapter 3 of this manual.

Programming the Model PM8572A

The Model PM8572A has no controls on its front panel. Instrument functions, parameters, and modes can only be accessed through bus commands. There are a number of ways to “talk” to the instrument. They all require that an appropriate software driver be installed. The rest is a matter of practice and knowledge of the language in use. There are other system considerations like address selection that have to be settled before programming the instrument. These topics are discussed in later chapters.

Low level programming of the Model PM8572A is done using SCPI commands. Programming aspects are covered in Chapters 4. High level drivers like IVI drivers are beyond the scope of this manual. Contact your Tabor representative for more information about high level drivers for the Model PM8572A.

Chapter 2
Configuring the Instrument

Title **Page**

Installation Overview

This chapter contains information and instructions necessary to prepare the Model PM8572A for operation. Details are provided for initial inspection, grounding safety requirements, repackaging instructions for storage or shipment, installation information and Ethernet address configuration.

Unpacking and Initial Inspection

Unpacking and handling of the generator requires normal precautions and procedures applicable to handling of sensitive electronic equipment. The contents of all shipping containers should be checked for included accessories and certified against the packing slip to determine that the shipment is complete.

Safety Precautions

The following safety precautions should be observed before using this product. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

CAUTION

This product is intended for use by qualified persons who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on power cables, connector jacks, or test fixtures. The American National Standard Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak or 60 VDC are present.

WARNING

For maximum safety, do not touch the product, test cables, or any other instrument parts while power is applied to the circuit under test. ALWAYS remove power from the entire test system before connecting cables or jumpers, installing or removing cards from the computer, or making internal changes such as changing the module address.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always keep your hands dry while handling the instrument.

When using test fixtures, keep the lid closed while power is applied to the device under test. Carefully read the Safety Precautions instructions that are supplied with your test fixtures.

Before performing any maintenance, disconnect the line cord and all test cables. Only qualified service personnel should perform maintenance.

Performance Checks

The instrument has been inspected for mechanical and electrical performance before shipment from the factory. It is free of physical defects and in perfect electrical order. Check the instrument for damage in transit and perform the electrical procedures outlined in the section entitled **Unpacking and Initial Inspection.**

Power Requirements

The function generator may be operated from a wide range of mains voltage 85 to 265 Vac. Voltage selection is automatic and does not require switch setting. The instrument operates over the power mains frequency range of 48 to 63Hz. Always verify that the operating power mains voltage is the same as that specified on the rear panel.

The PM8572A should be operated from a power source with its neutral at or near ground (earth potential). The instrument is not intended for operation from two phases of a multi-phase ac system or across the legs of a single-phase, three-wire ac power system. Crest factor (ratio of peak voltage to rms.) should be typically within the range of 1.3 to 1.6 at 10% of the nominal rms. mains voltage.

Grounding Requirements

To ensure the safety of operating personnel, the U.S. O.S.H.A. (Occupational Safety and Health) requirement and good engineering practice mandate that the instrument panel and enclosure be “earth” grounded. Although BNC housings are isolated from the front panel, the metal part is connected to earth ground.

WARNING

Do not attempt to float the output from ground as it may damage the Model PM8572A and your equipment.

Long Term Storage or Repackaging for Shipment

If the instrument is to be stored for a long period of time or shipped to a service center, proceed as directed below. If repacking procedures are not clear to you or, if you have questions, contact your nearest Tabor Electronics Representative, or the Tabor Electronics Customer Service Department.

1. Repack the instrument using the wrappings, packing material and accessories originally shipped with the unit. If the original container is not available, purchase replacement materials.
2. Be sure the carton is well sealed with strong tape or metal straps.
3. Mark the carton with the model and serial number. If it is to be shipped, show sending and return address on two sides of the box.

NOTE

If the instrument is to be shipped to Tabor Electronics for calibration or repair, attach a tag to the instrument identifying the owner. Note the problem, symptoms, and service or repair desired. Record the model and serial number of the instrument. Show the RMA (Returned Materials Authorization) order as well as the date and method of shipment. ALWAYS OBTAIN AN RMA NUMBER FROM THE FACTORY BEFORE SHIPPING THE PM8572A TO TABOR ELECTRONICS.

Preparation for Use

Preparation for use includes removing the instrument from the container box, installing the software and connecting the cables to its input and output connectors.

Installation

If this instrument is intended to be installed in a rack, it must be installed in a way that clears air passage to its cooling fans. For inspection and normal bench operation, place the instrument on the bench in such a way that will clear any obstructions to its rear fan to ensure proper airflow.

CAUTION

Using the PM8572A without proper airflow will result in damage to the instrument.

Installing Software Utilities

The PM8572A is supplied with a CD that contains the following programs: IVI Driver, ArbConnection, USB driver and some other utilities to aid you with the operation of the instrument. For bench operation, all that you need from the CD is this manual however, it is recommended that you stow away the CD in a safe place in case you'll want to use the PM8572A from a host computer or in a system.

The *IVI driver* is a useful utility that provides standard communication and commands structure to control the PM8572A from remote. Programming examples are also available to expedite your software development. The IVI driver comes free with the PM8572A however, you'll need the IVI engine and visa32.dll run time utilities to be able to use the IVI driver. The additional utilities can be downloaded for free from NI's (National instrument) web site – www.ni.com.

ArbConnection is a user friendly program that lets you control instruments functions and features from a remote computer. It also lets you generate and edit arbitrary waveforms on the screen, build sequence tables, modulating signals and much more and then download the signals to your PM8572A without the hustle of writing complex programs and utilities. This is also a great tool for you to experiment simple, or complex command string to gain experience before you write your own code. ArbConnection has a command editor feature that allows direct low-level programming of the PM8572A using SCPI commands, just as you will be using them in your program. Installation of ArbConnection is simple and intuitive and only requires that visa32.dll runtime file be added to your Windows system folder. Download the file from NI's (National instrument) web site – www.ni.com. Installation and operating instruction for ArbConnection are given in Chapter 4.

The *USB* driver is required if you intend to connect the PM8572A to a host computer on a USB bus. Information how to connect the USB cable and how to load the software is given in this chapter.

Controlling the Instrument from Remote

In general, the PM8572A can be controlled from remote using one of the following interfaces: USB, Ethernet and GPIB. Remote interface cables are not supplied with the instrument so if you plan on using one of the remote programming option, make sure you have a suitable cable to connect to your host computer. The following paragraphs describe how to connect and configure the PM8572A to operate from remote. The description is given for computers fitted with Windows XP but little changes will show while installing software on different Windows versions.

Connecting to a Remote interface

You can connect your Tabor PM8572A to GPIB, USB, or LAN adapters, depending on your application and requirements from your system. Installing interface adapters in your computer will not be described in this manual since the installation procedures for these adapters change frequently. You must follow the instructions supplied with your particular adapter. Before proceed with the remote interface installation, install an adapter card and follow the instructions in the following paragraphs.

GPIB Connection

Direct connection between a host computer and a single device with GPIB is not recommended since GPIB adapter is usually expensive and is not really required for direct connection. Use GPIB connection in cases where download speed is critical to the system or when you already have GPIB system in place and you are adding the PM8572A as a GPIB device. The GPIB port is connected with a special 24-wire cable. Refer interconnection issues to your GPIB supplier. After you connect the PM8572A to the GPIB port, proceed to the GPIB Configuration section in this chapter for instructions how to select a GPIB address.

USB Connection

Direct connection between a single host computer and a single device with USB is most recommended as this does not require any specific considerations and device configuration. Just connect your Tabor PM8572A to your PC using a standard USB cable and the interface will self configure. After you connect the PM8572A to the USB port, proceed to the USB Configuration section in this chapter for instructions how to install the USB driver.

LAN Connection

Direct connection between a single host computer and a single device with 10/100 BaseT is possible, but you must use a special cable that has its transmit and receive lines crossed. If your site is already wired connect the PM8572A via twisted pair Ethernet cable. Take care that you use twisted pair wires designed for 10/100 BaseT network use (phone cables will not work). Refer interconnection issues to your network administrator. After you connect the PM8572A to the LAN port, proceed to the LAN Configuration section in this chapter for instructions how to set up LAN parameters.

Selecting a Remote interface

The PM8572A is supplied by the factory with the active remote interface set to USB. If you intend to use USB connection, then all you need to do is connect your USB cable and proceed with the USB Configuration instructions as given in this chapter to install the USB driver and to configure the USB port (first connection only). If you already used your instrument in various platforms and want to re-select your interface

To select an active Interface, you need to access the Select

Interface screen as shown in Figure 2-1. To access this screen press the TOP menu button, then select the Utility soft key and scroll down with the dial to the Remote Setup option and press the Enter key. The Select Interface soft key will update the display with the interface parameters.

Use the curser keys left and right to point to the required interface option then press Enter. The new interface will Initialize and the icon at the top will be updated and will flag the active interface option.

The interface icon is always displayed at the top of the screen so if you are not sure which of the interfaces is selected, compare the following icons to what you have on the screen:

Designates GPIB interface is selected and active. GPIB configuration is required to communicate with your PC.

Designates USB interface is selected and active. First connection requires USB configuration and software driver installation to communicate with your PC.

Designates LAN interface is selected and active. LAN configuration is required to communicate with your PC.

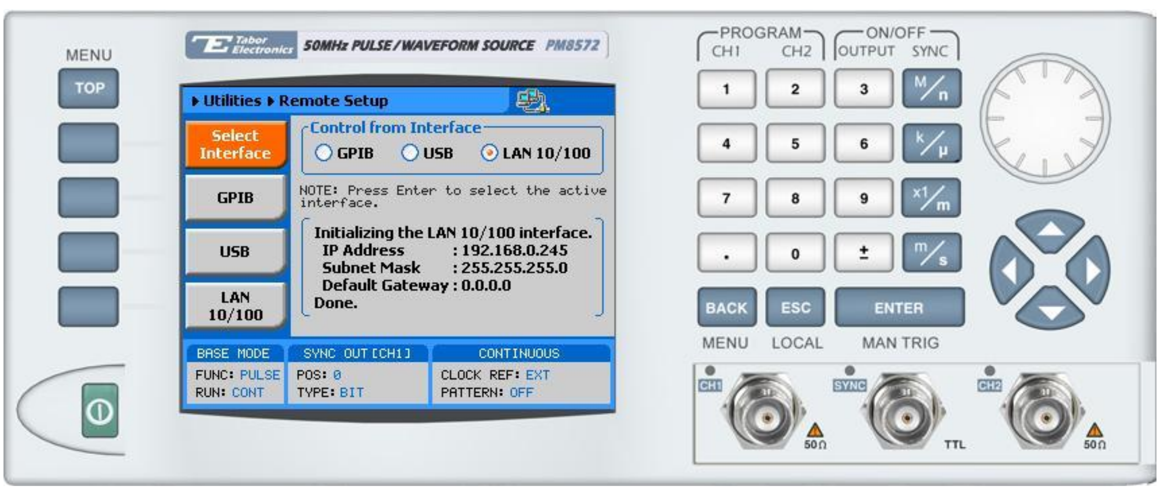

Figure 2-1, Selecting a Remote interface

GPIB Configuration

GPIB configuration requires an address setting only. If you intend to use more than one instrument on the bus, you have to make sure each device has a unique address setting. GPIB address is programmed from the front panel Utility menu as shown in Figure 2-2. To access this screen press the TOP menu button, then select the Utility soft key and scroll down with the dial to the Remote Setup option and press the Enter key. The GPIB soft key will update the display with the GPIB address parameter. The default address is 4. To modify the address, press the Enter key and use the dial or keypad to select the new address. Press Enter for the PM8572A to accept the new address setting.

Note

Configuring your GPIB address setting does not automatically select the GPIB as your active remote interface. Setting a remote interface is done from the Select interface menu. Information how to select and Interface is given hereinbefore.

Figure 2-2, GPIB Configuration Screen

USB Configuration

The USB requires no front panel configuration parameters. Following simple installation steps as shown later, just connect your Tabor PM8572A to your PC using a standard USB cable and the interface will self configure. The first time you connect the generator to your PC, the new hardware will be detected and the message as shown in Figure 2-3 will appear:

Figure 2-3, USB Device Detected

Figure 2-4, Found New Hardware Wizard

Immediately thereafter, the Found New Hardware Wizard will open, as shown in Figure 2-4. Select the Install from a list or specific Location option and click on next. At this time insert the installation CD into your CD driver. If you know the logical letter for your CD drive, type in the information in the path field. If you are not sure where this driver is, click on the Browse button and look for the path. Check the appropriate controls as shown in Figure 2-5 and then click on Next. With Service Pack 2 only, you'll be prompted with a Windows Logo Warning message, as shown in figure 2-6, advising you that the software has not been verified for its compatibility with Windows XP. Click on Continue Anyway. To complete the process press on Finish, as shown in Figure 2-7.

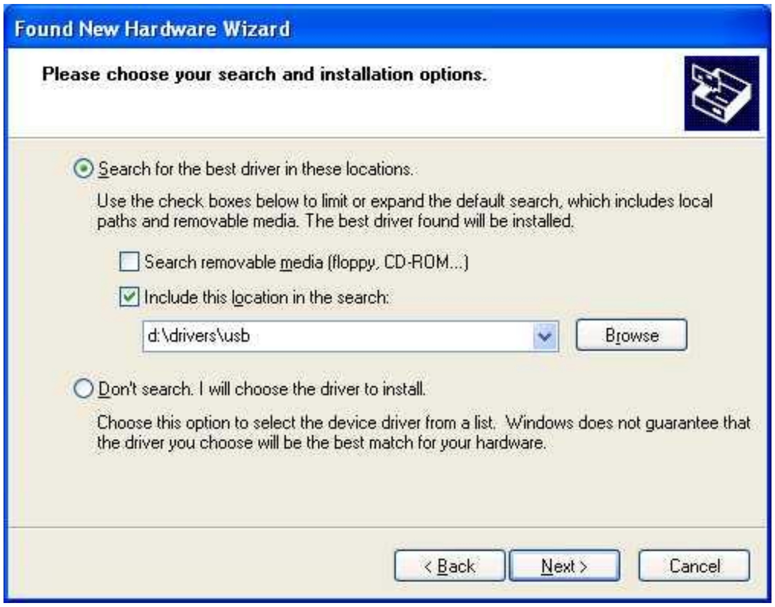

Figure 2-5, Choose Your Search and installation Options

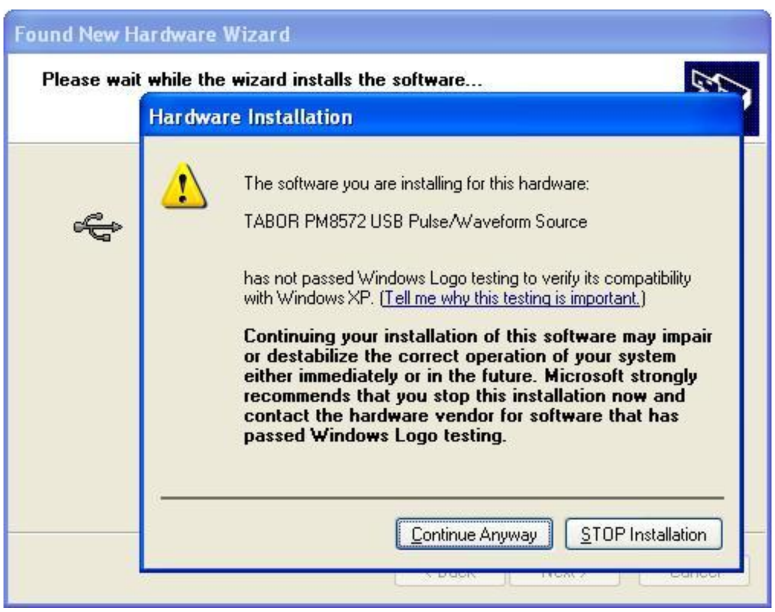

Figure 2-6, Windows Logo Warning Message

Figure 2-7, New Hardware Found and Software installed

Figure 2-7 shows that the Tabor PM8572A USB Waveform Generator has been found and software driver installed. However, the process does not end at this point but continues to assign a logical port address to the USB driver. After you click on Finish, the Found New Hardware message appears however, this time it has found a USB serial port, as shown in Figure 2-8.

Figure 2-8, Found New Hardware - USB Serial Port

Proceed with the installation till a logical drive is assigned to the USB port. The process is very similar to what you have done before, just select the path and options in the next dialog box and click on Next as shown in Figure 2-9. With Service Pack 2 only, you'll be prompted with a Windows Logo Warning message, as shown in figure 2-10, advising you that the software has not been verified for its compatibility with Windows XP. Click on Continue Anyway. To complete the process click on Finish, as shown in Figure 2-11.

Figure 2-9, Choose Your Search and installation Options

Figure 2-10, Windows Logo Warning Message

Figure 2-11, New Hardware Found and Software installed

The process above detected a USB device and installed the software for it, then it has assigned a Serial Port address to the USB post. In fact, this ends the process unless you want to verify that the drivers and the port are correctly assigned on your PC.

To make sure your USB port and the Tabor PM8572A configured correctly, compare your Device Manager to the example in Figure 2-12.

Note

Configuring your USB setting does not automatically select the USB as your active remote interface. Setting a remote interface is done from the Select interface menu. Information how to select and Interface is given hereinbefore.

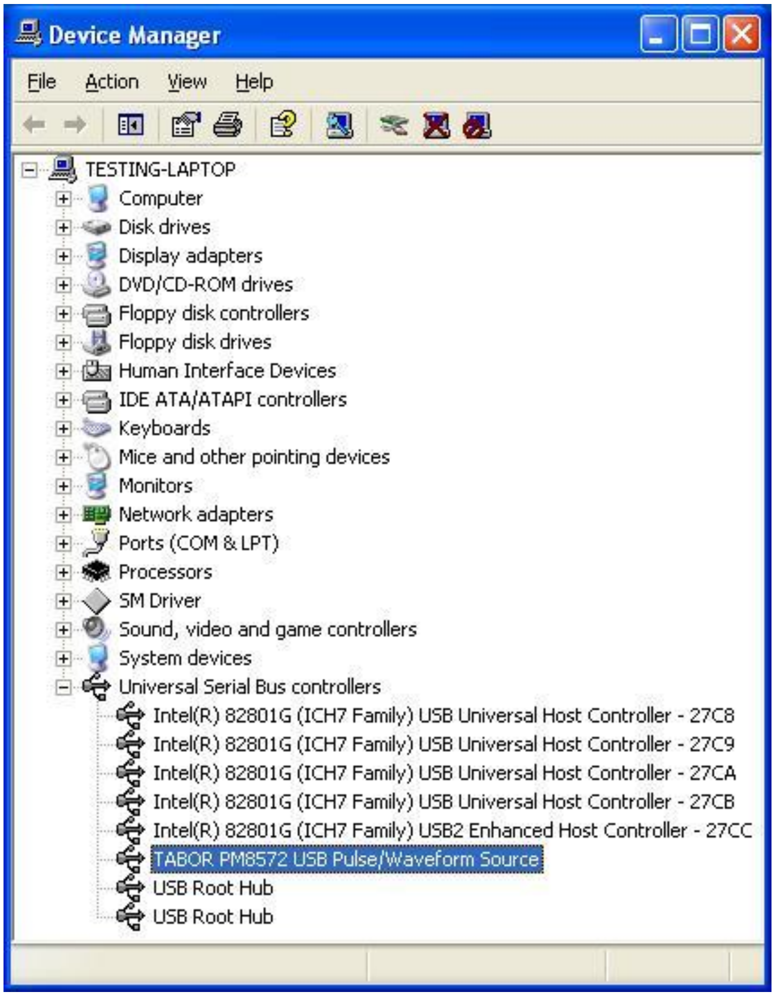

Figure 2-12, Model PM8572A Configured for USB Operation

LAN Configuration

There are several parameters that you may have to set to establish network communications using the LAN interface. Primarily you'll need to establish an IP address. You may need to contact your network administrator for help in establishing communications with the LAN interface. To change LAN configuration, you need to access the LAN 10/100 screen as shown in Figure 2-13. To access this screen press the TOP menu button, then select the Utility soft key and scroll down with the dial to the Remote Setup option and press the Enter key. The LAN 10/100 soft key will update the display with the LAN parameters.

Note there are some parameters that are shown on the display that cannot be accessed or modified; These are: Physical Address and Host Name. These parameters are set in the factory and are unique for product. The only parameters that can be modified are the IP Address, the Subnet mask and the Default gateway. Correct setting of these parameters is essential for correct interfacing with the LAN network. Description of the LAN settings and information how to change them is given in the following.

Note

Configuring your LAN setting does not automatically select the LAN as your active remote interface. Setting a remote interface is done from the Select interface menu. Information how to select and Interface is given herinbefore.

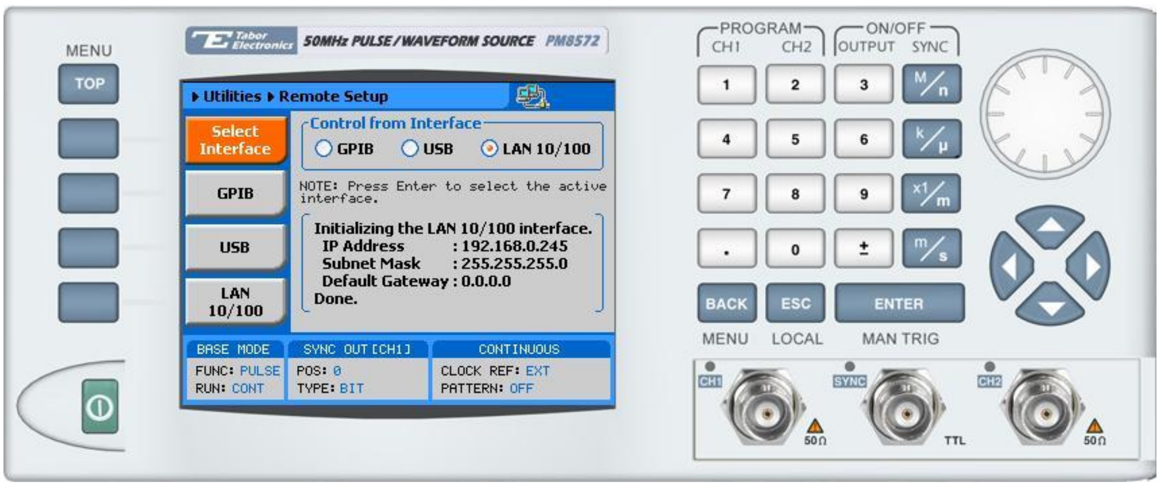

Figure 2-13, LAN Configuration Screen

There are three LAN parameters in this screen that can be modified and adjusted specifically to match your network setting; These are described below. Consult your network administrator for the setting that will best suit your application.

- **IP address** - The unique, computer-readable address of a device on your network. An IP address typically is represented as four decimal numbers separated by periods (for example, 192.160.0.233). Refer to the next section - Choosing a Static IP Address.
- **Subnet mask** - A code that helps the network device determine whether another device is on the same network or a different network.
- **Gateway IP** - The IP address of a device that acts as a gateway, which is a connection between two networks. If your network does not have a gateway, set this parameter to 0.0.0.0.

Choosing a Static IP Address

For a Network Administered by a Network Administrator

If you are adding the Ethernet device to an existing Ethernet network, you must choose IP addresses carefully. Contact your network administrator to obtain an appropriate static IP address for your Ethernet device. Also have the network administrator assign the proper subnet mask and gateway IP.

For a Network without a Network Administrator

If you are assembling your own small Ethernet network, you can choose your own IP addresses. The format of the IP addresses is determined by the subnet mask. You should use the same subnet mask as the computer you are using with your Ethernet device. If your subnet mask is 255.255.255.0, the first three numbers in every IP address on the network must be the same. If your subnet mask is 255.255.0.0, only the first two numbers in the IP addresses on the network must match.

For either subnet mask, numbers between 1 and 254 are valid choices for the last number of the IP address. Numbers between 0 and 255 are valid for the third number of the IP address, but this number must be the same as other devices on your network if your subnet mask is 255.255.255.0.

Table 2-1 shows examples of valid and invalid IP addresses for a network using subnet mask 255.255.255.0. All valid IP addresses contain the same first three numbers. The IP addresses in this table are for example purposes only. If you are setting up your own network, you probably do not have a gateway, so you should set these values to 0.0.0.0.

Table 2-1, Valid and Invalid IP Addresses for Subnet Mask 255.255.255.0

IP Address	Comment
123.234.45.211	Valid.
123.234.45.213	Valid. The first three numbers match the previous IP address. The fourth number must be a unique number in the range of 1 to 254.
123.202.45.214	Invalid. Second number does not match the previous IP addresses. The first three numbers must match on all IP addresses with subnet mask 255.255.255.0.
123.234.45.0	Invalid. The first three numbers are valid but the fourth number cannot be 0.
123.234.45.255	Invalid. The first three numbers are valid but the fourth number cannot be 255.

TIP

To find out the network settings for your computer, perform the following steps:

- **For Windows 98/Me/2000/XP**

    1. **Open a DOS prompt.**
    2. **Type IPCONFIG.**
    3. **Press <Enter>.**

If you need more information, you can run ipconfig with the /all option by typing IPCONFIG /all at the DOS prompt. This shows you all of the settings for the computer. Make sure you use the settings for the LAN adapter you are using to communicate with the LAN device.

- **For Windows 95**

    1. **Open a DOS prompt.**
    2. **Type WINIPCFG.**
    3. **Press <Enter>.**

Select the Ethernet adapters you are using to communicate with the *Ethernet device* from the drop-down list.

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Chapter 3
Using the Instrument

Title **Page**

Overview

This chapter contains information about how to operate the Tabor PM8572A. Operation is divided into two general categories: basic bench operation, and remote operation (GPIB, USB and ENET). Basic bench operation, which is covered in this section, describes how to operate the arbitrary waveform generator using front panel sequences. The PM8572A is supplied with ArbConncetion, a PC based software package with a graphical user interface to allow users to program all of the functions directly. LabView drivers and a set of SCPI commands are available for more experienced programmers.

The following paragraphs describe the various modes of operation and give examples of how to program the Model PM8572A. The manual is organized by instrument function and instructions are given in each paragraph on how to use the function from both the front panel and ArbConncetion.

Inter-Channel Dependency

The PM8572A has two output channels. Although this is a two-channel instrument, many of the commands that set parameters and functions are common for both channels. For example, sample clock and run modes can not be set separately for each channel. On the other hand, you may program each channel to have different function shape, amplitude and offset. Table 3-1 lists the function and parameters and their related Inter-channel dependency.

Inter-Channel Phase Dependency

The PM8572A has only one sample clock source, which means that waveform samples are clocked simultaneously on both channels. Therefore, if you are looking to have to completely separated channels, with no correlation between the two signals, this is not the right instrument for you. However, most applications for two channel generator require phase correlation between the channels and this is the way the PM8572A is constructed. Shared sample clock source assures that both channels start generating signals exactly on the same phase and, in addition, there is an assurance that there is no jitter between the two channels. Inter-channel phase control is described later in this chapter, in the Using the Auxiliary Functions section.

Output Termination

During use, output connectors must be properly terminated to minimize signal reflection or power loss due to impedance mismatch. Proper termination is also required for accurate amplitude levels at the output connectors. Use 50Ω cables and terminate the main and SYNC cables with terminating resistors. Always place the 50 Ω termination at the far end of the cables.

Note that the display reading of the amplitude level is calibrated to show the actual level on the load when the load impedance is exactly 50 Ω. There are cases however, where the load has different impedance so, in that case, the display reading will indicate a different reading than the actual amplitude level on the load. The PM8572A provides a customization menu where the load impedance can be changed from 50 Ω to other values. Information how to customize the PM8572A is given later in this chapter.

Input / Output Protection

The Model PM8572A provides protection for internal circuitry connected to input and output connectors. Refer to the specifications in Appendix A to determine the level of protection associated with each input or output connector.

Normal operation of the output amplifiers allows 16 Vp-p amplitudes to be generated on 50 Ω load impedance, drawing roughly 320 mA from the output amplifier. This should not be a problem since the output stage is rated to deliver this power continuously and without time limitation. On the other hand, if the load impedance is not perfectly resistive, the actual load could increase the stress by drawing more current than the output is rated for. This is the case with inductive or capacitive load impedance.

While resistive load is recommended for prolonged and safe operation, it is understood that certain degree of resistive and capacitive components are always present in the load impedance and the PM8572A is built to overcome these obstacles. However, there are limitations that can cause damage to the output stage and these are specified in Appendix A of this manual.

For the standard PM8572A, the output can be shorted to ground for a limited interval only. Option 4 is available for test environments that are having hard time to control what is connected to the output cable. With option 4, overload conditions are detected by special sensors and disconnect the output automatically. Also note that with option 4, the maximum output amplitude is reduced to 10 Vp-p and the protection is limited to external signals limited to ±5 V only.

WARNING

The outputs can only be connected to resistive loads. Connecting the PM8572A to inductive or capacitive load may damage the output and void the warranty on the instrument.

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WARNING

The outputs can only be connected to resistive loads. Connecting the PM8572A to inductive or capacitive load may damage the output and void the warranty on the instrument.

As was discussed above, PM8572A-4 has special sensors that detect overload conditions. When such conditions occur, the outputs are turned off automatically to avoid possible damage to the output amplifiers. Immediately thereafter, the instrument attempts to recover from this error. The auto recovery process takes about 30 seconds, which is required to allow the output amplifier and relays to cool down. At the end of the auto recovery process, the outputs are turned on automatically and the instrument resumes generating its waveforms. If overload conditions were not removed, the outputs are disconnected again and the auto recovery process starts over. The PM8572A cycles through the auto recovery process three times and if overload conditions persist, the outputs will be turned off permanently and only manual recovery will be possible.

Figure 3-1 shows the auto recovery display. The auto recovery process can be terminated pre-maturely by pressing the Enter button however, it is recommended to allow the full recovery cycle to allow the circuits to cool down.

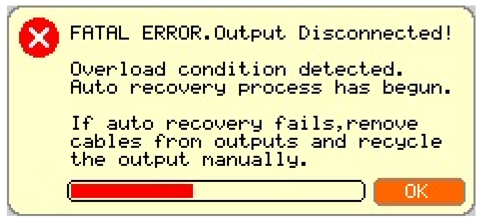

Figure 3-1, Auto Recovery from Overload conditions

Power On/Reset Defaults

The PM8572A utilizes non-volatile memory backup that automatically stores the last setup before the generator has been turned off. Every time you turn on the instrument, the non-volatile memory updates the front panel setting with modes, parameters and waveforms from its last setting with only one exception, for safety reasons, the outputs remain off even if they were turned on before powering down the PM8572A.

After power on, the instrument displays information messages and updates the display with the last setup information. The PM8572A can always be reset to its default values; Information on how to restore default parameters is given below.

If you are not yet fully familiar with front panel operation of the PM8572A, you may find yourself locked into a "dead-end" situation where nothing operates the way it should. The fastest way to restore the generator to a known state is by resetting the instrument to factory defaults.

Observe Figure 3-2 and reset parameters to factory defaults as follows:

1. Press the Utilities soft key
2. Scroll down to the, or
3. Press button 3 to restore factory defaults

Table 3-2 summarizes factory defaults for the most common parameters. A complete list of all parameters, their defaults, as well as their maximum and minimum values is given in Chapter 4.

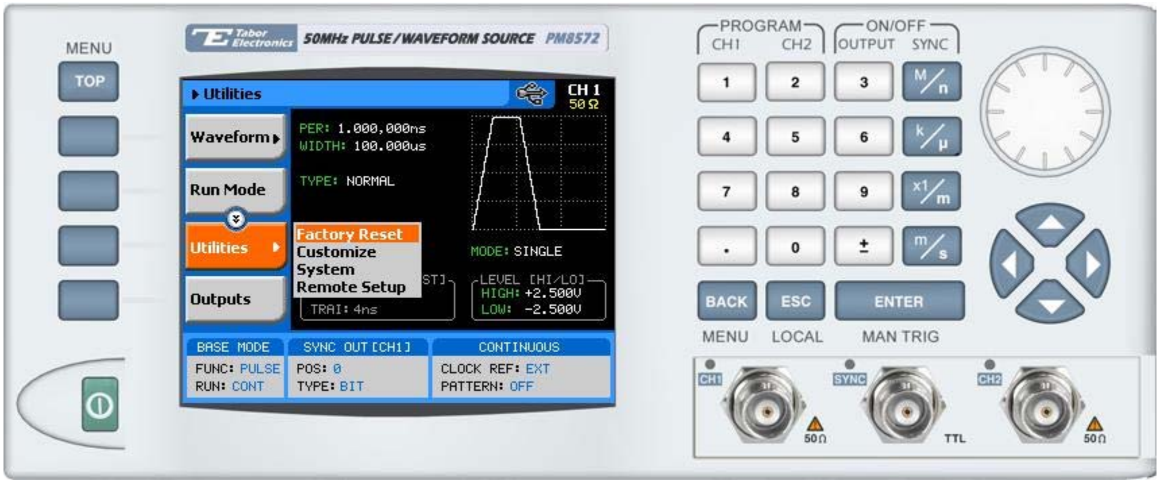

Figure 3-2, Reset PM8572A to Factory Defaults

Table 3-1, Default Conditions After Reset

Function / Parameter	Default	Inter-Channel Dependency
Outputs State:	Off	Separate
SYNC State:	Off	Common
Operating Mode:	Continuous	Common
Active Channel:	1	Separate
Digital Pattern State:	Off	Separate
Output Function:	Pulse	Separate
Output Function Shape:	Single	Separate
Standard Wave Frequency:	1 MHz	Common
User Wave Sample Clock:	10 MS/s	Common
Sample Clock Source & Reference:	Internal	Common
Amplitude:	5 V	Separate
High Level:	+2.5 V	Separate
Low Level:	-2.5 V	

Table 3-1, Default Conditions after Reset (continued)

Function / Parameter	Default	Inter-Channel Dependency
Filter State:	Off	Separate
Filter Type:	Auto	Separate
Trigger Slope:	Positive	Common
Trigger Level:	1.6 V	Common
Trigger Source:	External	Common
Trigger Delay:	Off	Common
Re-Trigger:	Off	Common
Modulation State:	Off	Common

Controlling the PM8572A

Controlling PM8572A function, modes and parameters is simply a matter of pressing once or twice the appropriate button as described in the following paragraphs. Refer to Figure 3-3 throughout this description.

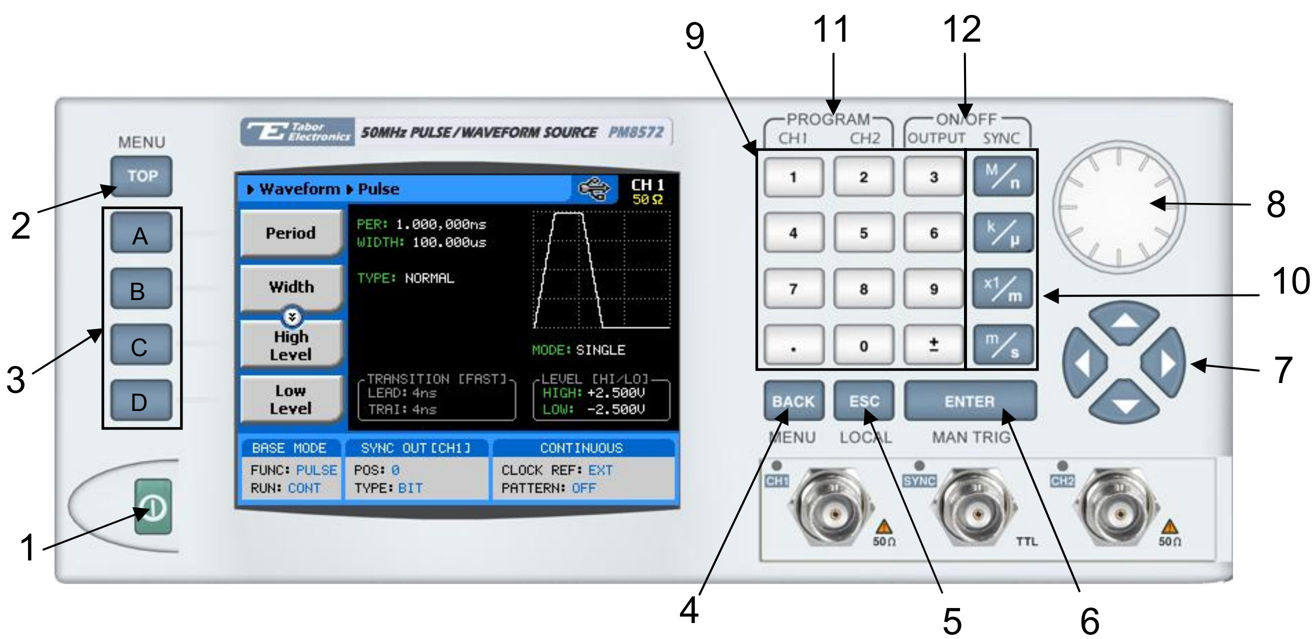

Figure 3-3, PM8572A Front Panel Operation

1. ***Power Switch*** – Toggles PM8572A power ON and OFF
2. ***Menu Top*** – Selects the root menu. This button is disabled during parameter editing
3. ***Menu Soft Keys*** – Soft keys have two functions:
   1) Selects output function shape or operating mode,

2) Selects parameter to be audited

These buttons are disabled during parameter editing

4. ***Menu Back*** – Backs up one menu position. This button is disabled during parameter editing
5. ***Cancel (Local)*** – Has two functions:
   1) When in edit mode, cancels edit operation and restore last value
6. When operating the PM8572A from a remote interface, none of the front panel buttons are active. The Local button moves control back from remote to front panel buttons ***Enter (MAN TRIG)*** – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the parameters. Pressing Enter selects the parameter for edit. After the parameter has been modified, the Enter button locks in the new variable and releases the buttons for other operations
   2) When the PM8572A is placed in "Triggered" run mode, the Man Trig button can be used to manually trigger the PM8572A
7. **Cursor** ***UP, Down, Left and Right*** – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the parameters
   2) When parameter is selected for editing, cursor buttons right or left move the cursor accordingly. Cursor buttons up or down modify parameter value accordingly
8. ***Dial*** – Has similar functionality as the cursor UP and Down keys
9. **Numeral** ***keypad*** – These keys are used for modifying an edited parameter value
10. ***Parameter Suffixes (M, k, x1 and m)*** – These keys are used to place suffix at the end of the parameter. They are also used for terminating an edit operation
11. ***Program CH1, CH2*** – Use Program CH1 to modify the screen to display channel 1 parameters. Use Program CH2 to modify the screen to display channel 2 parameters. These keys can be used only when the PM8572A is not in edit mode
12. ***ON/OFF Output, Sync*** – These keys can be used only when the PM8572A is not in edit mode. The Output ON/OFF toggles output waveform, at the output connector, ON and OFF. The Sync ON/OFF toggles the sync waveform, at the SYNC output connector, ON and OFF

PM8572A Front Panel Menus

The PM8572A has over 300 parameters that control functions, modes, waveforms and auxiliary functions. Due to the complexity of the product, the functions were divided to logical groups and sub-groups and access to these groups is provided using the soft key menus. There are five main menus, of which can be accessed after pressing the TOP soft key; These are shown in Figure 3-2 and are mark as item 3 (A, B, C and D). The main menus are Waveform, Run Mode, Utility, Outputs and Auxiliary. Each main menu provides access to sub-menus as summarized in Tables 3-2 to 3-5. Note that the description in these tables is given for general understanding of what is available in terms of operating the instrument. For detailed instructions, check the appropriate section of the manual.

Table 3-2, Front Panel Waveform Menus

Soft Key	TOP Menu	2nd Level Menu	3rd Level Menu	4th Level Menu	Notes
A	Waveform				Provides access to initial selection of waveform types: Pulse, Std., Arb., Seq., Mod and half cycle
A		Pulse			
A			Period		Programs the period of the pulse
B			Width		Programs the pulse width parameter.
(B)			Duty Cycle		Programs the pulse duty cycle parameter. This parameter is available when Width Mode is toggled to Duty Cycle
(C)			Amplitude		Programs the pulse amplitude parameter. This parameter is available when Level Mode is toggled to Symmetrical
(D)			Offset		Programs the pulse offset parameter. This parameter is available when Level Mode is toggled to Symmetrical
C			High Level		Programs the pulse high level parameter
D			Low Level		Programs the pulse low level parameter
(C)			Pulse Delay		Programs the inter-pulse delay. This parameter is available when double pulse mode is selected
(C) (*)			Delay		Programs the pulse delay. This parameter is available when delayed pulse mode is selected
(↓D) (**)			Leading Edge		Programs the leading edge transition time. This parameter is available when the Transition State is set to Linear
(↓D)			Trailing Edge		Programs the trailing edge transition time. This parameter is available when the Transition State is set to Linear
↓D			Configure		Provides access to pulse configuration menus
A				Mode	Selects between Single, Double, Delayed, Fixed Duty, External Width and PWM
B				Polarity	Selects between Normal, Complement and Inverted
C				Hold Mode	Selects between Width and Duty Cycle control
D				Transition	Selects between Fast and Linear control
↓D				Level Mode	Selects between High/Low, Symmetrical, Positive and Negative control

(*) (C) Denotes conditional menu, not always shown. Available in conjunction with a specific mode only

(**) ↓D Denotes you have to scroll down to access the menu. Scroll using the arrows up or down or the dial.

Table 33-2, Front Panel Waveform Menus (continued)

Soft Key	TOP Menu	2nd Level Menu	3rd Level Menu	Notes
A		Standard		
A			Wave Shape	Select from a wave shapes list
B			Frequency	Programs standard waveform frequency
C			Amplitude	Programs output amplitude
D			Offset	Programs output amplitude offset
↓D (*)			Phase	Parameters depend on selected shape
↓D			Reset Parameters	Resets parameters for this waveform only
B		Arbitrary		
A			Sample Clock	Programs sample clock frequency
B			Amplitude	Programs output amplitude
C			Offset	Programs output amplitude offset
D			Active Segment	Selects the active arbitrary waveform segment
↓D			Wave Composer	Provides access to the waveform composer
↓D			Delete Segments	
C		Sequenced		
A			View Table	Allows view and modification of sequence table
B			Advance Mode	Selects between auto, stepped, single and mixed
C			Advance Source	Selects the advance source
D			Sample Clock	Programs the sequence sample clock
↓D			Amplitude	Programs the waveform amplitude
↓D			Offset	Programs the waveform offset
↓D			Active Segment	Applies the SYNC to the selected segment
	Modulation Type			
D		Modulated		
A	Off		Modulation Type	Selects from Off, AM, FM, FSK, PSK, Hop and Sweep
B	Off		CW Frequency	Programs the carrier waveform frequency
C	Off		Amplitude	Programs the CW Amplitude
D	AM		Offset	Programs the CW amplitude offset
B	AM		Modulation Shape	Programs the modulating waveform shape
C	AM		Modulation Depth	Parameter modulation depth
D	AM		Modulation Freq	Parameter envelop frequency
↓D	AM		CW Frequency	Programs the carrier waveform frequency
↓D	AM		Trigger Baseline	Programs the baseline wave in triggered mode
↓D	AM		Amplitude	Programs the CW Amplitude
↓D	FM		Offset	Programs the CW amplitude offset
B	FM		Modulation Shape	Programs the modulating waveform shape
C	FM		CW Frequency	Programs the carrier waveform frequency
D	FM		Frequency Deviation	Programs FM deviation frequency
↓D	FM		Modulation Freq	Parameter modulation frequency
↓D	FM		Marker	Programs the marker frequency
↓D	FM		Trigger Baseline	Programs the baseline wave in triggered mode
↓D	FM		Amplitude	Programs the CW Amplitude

(*) ↓D denotes you have to scroll down to access the menu. Scroll using the arrows up or down or the dial.

Table 33-2, Front Panel Waveform Menus (continued)

Soft Key	TOP Menu	2nd Level Menu	3rd Level Menu	Notes
↓D	Sweep		Offset	Programs the CW amplitude offset
B	Sweep		Sweep Type	Selects from linear or logarithmic
C	Sweep		Direction	Selects from up or down
D	Sweep		Start Frequency	Programs the start frequency
↓D	Sweep		Stop Frequency	Programs the stop frequency
↓D	Sweep		Sweep Time	Programs the sweep time
↓D	Sweep		Marker	Programs the marker frequency
↓D	Sweep		Trigger Baseline	Programs the baseline wave in triggered mode
↓D	Sweep		Amplitude	Programs the CW Amplitude
↓D	Sweep		Offset	Programs the CW amplitude offset
B	Freq HOP		Hop Data	Programs the frequency hops table
C	Freq HOP		Dwell Type	Selects between fixed and variable
D	Freq HOP		Dwell Time	Programs hop dwell time (fixed mode)
↓D	Freq HOP		Marker	Programs the marker position
↓D	Freq HOP		Trigger Baseline	Programs the baseline wave in triggered mode
↓D	Freq HOP		Amplitude	Programs the CW Amplitude
↓D	Freq HOP		Offset	Programs the CW amplitude offset
B	Ampl HOP		Hop Data	Programs the frequency hops table
C	Ampl HOP		CW Frequency	Programs the carrier waveform frequency
D	Ampl HOP		Dwell Type	Selects between fixed and variable
↓D	Ampl HOP		Dwell Time	Programs hop dwell time (fixed mode)
↓D	Ampl HOP		Marker	Programs the marker position
↓D	Ampl HOP		Amplitude	Programs the CW Amplitude
↓D	Ampl HOP		Offset	Programs the CW amplitude offset
B	3D		Load Demo Table	Loads a sample 3D table for demo purpose
↓D	3D		Trigger Baseline	Programs the baseline wave in triggered mode
C	3D		Offset	Programs the CW Offset
B	ASK		ASK Data	Displays and edits ASK data table
C	ASK		CW Frequency	Programs the carrier waveform frequency
D	ASK		Start Amplitude	Programs the start amplitude level
↓D	ASK		Shifted Amplitude	Programs the shifted amplitude level
↓D	ASK		Baud	Programs the baud frequency
↓D	ASK		Marker	Programs the marker position
↓D	ASK		Offset	Programs the CW amplitude offset
B	FSK		FSK Data	Displays and edits FSK data table
C	FSK		CW Frequency	Programs the carrier waveform frequency
D	FSK		Shifted Frequency	Programs the shifted frequency
↓D	FSK		Baud	Programs the baud frequency
↓D	FSK		Marker	Programs the marker position
↓D	FSK		Trigger Baseline	Programs the baseline wave in triggered mode
↓D	FSK		Amplitude	Programs the CW Amplitude
↓D	FSK		Offset	Programs the CW amplitude offset

(*) ↓D denotes you have to scroll down to access the menu. Scroll using the arrows up or down or the dial.

Table 3-2, Front Panel Waveform Menus (continued)

Soft Key	Modulation Option	2nd Level Menu	3rd Level Menu	Notes
B	PSK		PSK Type	Programs the PSK type: PSK, BPSK, QPSK, OQPSK, pi/4DQPSK, 8PSK and 16PSK
C	PSK		PSK Data	Displays and edits PSK data table
D	PSK		CW Frequency	Programs the carrier waveform frequency
↓D	PSK		Start Phase	Programs the start phase
↓D	PSK		Shifted Phase	Programs the shifted phase
↓D	PSK		Baud	Programs the baud frequency
↓D	PSK		Marker	Programs the marker position
↓D	PSK		Trigger Baseline	Programs the baseline wave in triggered mode
↓D	PSK		Amplitude	Programs the CW Amplitude
↓D	PSK		Offset	Programs the CW amplitude offset
B	(n)PSK		PSK Type	Programs the PSK type: PSK, BPSK, QPSK, OQPSK, pi/4DQPSK, 8PSK and 16PSK
C	(n)PSK		PSK Data	Displays and edits (n)PSK data table. Also, provides access to demonstration data symbols
D	(n)PSK		CW Control	Turns CW on and off
↓D	(n)PSK		CW Frequency	Programs the carrier waveform frequency
↓D	(n)PSK		Symbol Rate	Programs the symbol transition rate
↓D	(n)PSK		Marker	Programs the marker position
↓D	(n)PSK		Amplitude	Programs the CW Amplitude
↓D	(n)PSK		Offset	Programs the CW amplitude offset
B	(n)QAM		QAM Type	Programs the QAM type: 16QAM, 64QAM, 256QAM and User QAM
C	(n)QAM		QAM Data	Displays and edits (n)QAM data table. Also, provides access to demonstration data symbols
D	(n)QAM		CW Control	Turns CW on and off
↓D	(n)QAM		CW Frequency	Programs the carrier waveform frequency
↓D	(n)QAM		Symbol Rate	Programs the symbol transition rate
↓D	(n)QAM		Marker	Programs the marker position
↓D	(n)QAM		Amplitude	Programs the CW Amplitude
↓D	(n)QAM		Offset	Programs the CW amplitude offset
A		Half Cycle	Half Cycle Shape	Selects the half cycle waveform shape. Select between sine, triangle or square waveforms
B			Delay	Programs the delay between the half cycles
C			Frequency	Programs the delay from the start of the pulse
D			Amplitude	Programs the half cycle Amplitude
↓D			Offset	Programs the half cycle amplitude offset
↓D				Programs the start phase of the sine and triangular waveforms
↓D			Phase	Programs the half cycle start phase angle

(*) ↓D denotes you have to scroll down to access the menu. Scroll using the arrows up or down or the dial.

Table 3-3, Front Panel Run Mode Menus

Soft Key	TOP Menu	2^{nd} Level Menu	3^{rd} Level Menu	Notes
B	Run Mode			Provides access to PM8572A Run Mode options: Continuous, Triggered, Gated and Counted Burst
A		Continuous		Selects the continuous run mode
B		Triggered		Selects the triggered run mode. Provides access to trigger parameters, re-trigger on/off and re-trigger parameters
C		Gated		Selects the gated run mode. Provides access to gating parameters
D		Burst		Selects the triggered run mode. Provides access to counted burst parameters, re-trigger on/off and re-trigger parameters

Table 3-4, Front Panel Utility and Output Menus

Soft Key	TOP Menu	2nd Level Menu	3rd Level Menu	Notes
C	Utility			Provides access to factory reset, display customization, remote setup and system parameters
		Factory Reset		Allows reset of all PM8572A parameters to factory default values
		Customize		Provides access to display customization: horizontal units, clock sources, load impedance, dial direction and display brightness
		System		Displays all PM8572A system parameters, including serial number, installed option, last calibration date. Also monitors internal temperature rise.
		Remote Setup		Provides access to selecting the remote interface. Available interfaces are LAN, USB and GPIB
		Store/Recall		Provides access to storing and recalling instrument setups.
A			Select interface	Selects between GPIB, USB and LAN
B			GPIB	Programs GPIB address
C			USB	Display information on the USB ID
D			LAN	Programs LAN IP address
D	Outputs			Provides access to output on/off control, filter on/off and type, SYNC output on/off control and properties, and start phase offset between channels.

Table 3-5, Front Panel Auxiliary Menus

Soft Key	TOP Menu	Auxiliary Function	2^{nd} Level Menu	Notes
↓D	Auxiliary			Provides access to the following auxiliary functions: Digital Pulse Generator, Counter/Timer, Half Cycle waveforms, Multi-instrument synchronization and Digital Patterns.
A		Counter/Timer	Function	Selects the counter/timer measurement function
B			Gate Time	Programs the counter gate time
C			Display Time	Selects between continuous and single measurement cycles
D			Trigger Level	Programs the trigger level for the counter input
↓D			Trigger Slope	Programs the trigger slope for the counter input

(*) ↓D denotes you have to scroll down to access the menu. Scroll using the arrows up or down or the dial.

Table 3-5, Front Panel Auxiliary Menus (continued)

Soft Key	TOP Menu	Auxiliary Function	2nd Level Menu	Notes
A		X-Inst Sync,	Couple State	Toggles master/slave mode on and off
B			Properties	Provide access to selection of the master and delay between adjacent instruments
C			Slaves IP Address	Allows addition of slave units. Every added IP address is automatically added as slave
A		Digital Pattern	State	Toggles digital pattern output on and off
B			Baud	Programs the baud for the digital pattern
C			Left Position	Sets the left boundary for the pattern display
D			Right Position	Sets the right boundary for the pattern display
↓D			Go to Pattern	Moves the cursor to the selected pattern number

(*) ↓D denotes you have to scroll down to access the menu. Scroll using the arrows up or down or the dial.

Enabling the Outputs

For safety reasons, main outputs default setting is OFF. The outputs can be turned on and off using either the hot keys, or the Output Menu. Observe Figure 3-4 and disable or enable the main outputs using the procedure below. The same procedure can be used for enabling and disabling the SYNC output. The numbers on Figure 3-4 correspond to the procedure steps in the following description.

1. While not editing any parameter, select the channel you want to turn on using the PROGRAM CH1 or CH2 keys
2. Press ON/OFF OUTPUT or SYNC to toggle main and sync output on and off

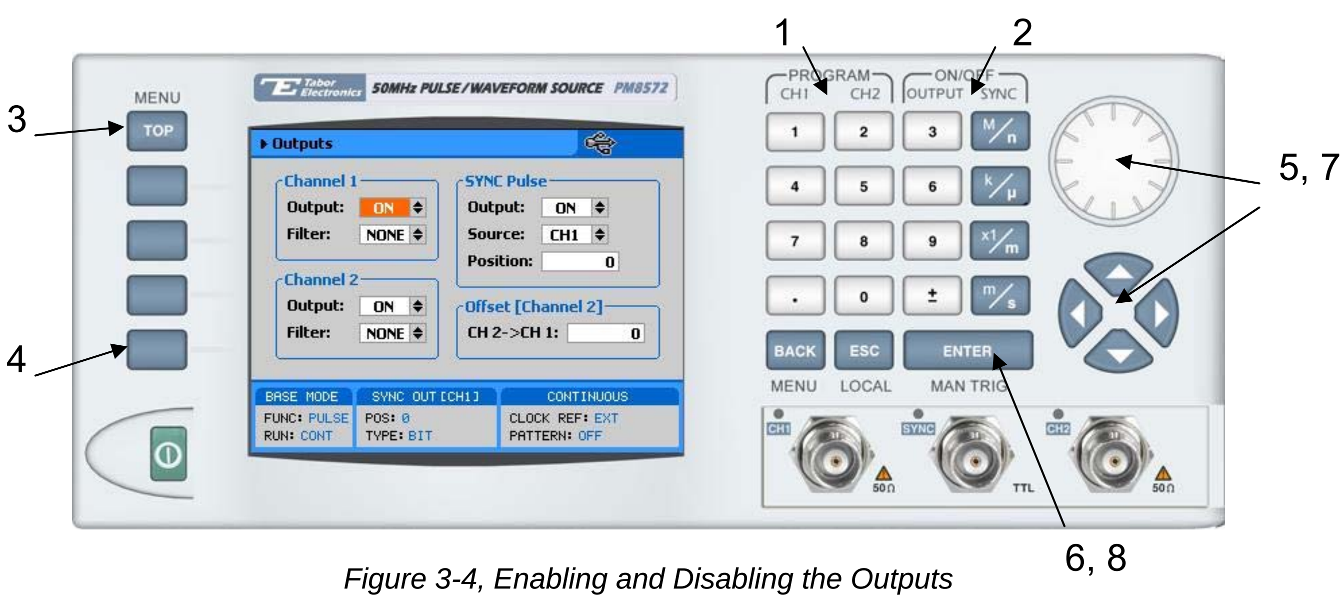

Figure 3-4, Enabling and Disabling the Outputs

Alternately, the outputs can be turned on and off from the Outputs sub menu. Use the following procedure to open the Outputs dialog box press to toggle output state:

3. Press TOP to display the root menu
4. Press Outputs to open the Outputs dialog box as shown in Figure 3-4
5. Use the dial or arrow keys to access the required field. Focus is on a field that is painted orange.
6. To edit the field press Enter. The edited field will turn white with orange borders
7. Use the dial or arrow keys to change the field
8. Press Enter again to lock in the setting

Selecting a Waveform Type

There are four main types of waveforms that the PM8572A can produce: Standard, Arbitrary, Sequenced and Modulated waveforms. Standard and modulated waveforms are computed from equations and tables that are built into the program. The instrument can output arbitrary and sequenced waveforms however, only after waveform data has been downloaded into its memory.

Digital patterns can also be generated from a rear-panel connector in conjunction with the arbitrary waveform output. The digital patterns, however, will be described and discussed separately in this chapter.

Refer to Figure 3-5 and use the following procedure to select an output type.

Note that there are sub-menus associated with each output type menu. Accessing and using these sub-menus is described later in this chapter. The numbers on Figure 3-5 correspond to the procedure steps in the following description.

1. Press TOP to display the root menu
2. Press Waveforms, the display as shown in Figure 3-5 will open.
3. Press one of the soft keys to select the required waveform.

Note the waveform screen shows a pulse waveform. Pulse is the default waveform. After you select a different waveform type, the screen will be updated with a new picture, which is associated with the new type.

Note

The picture in the PM8572A LCD display is an icon only. The actual output waveform may look entirely different.

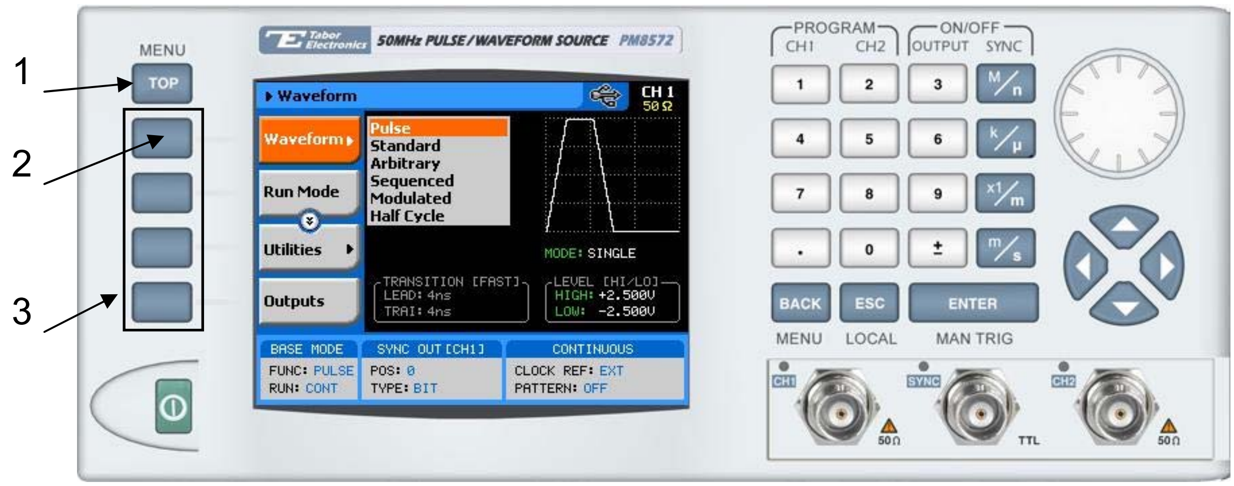

Figure 3-5, Selecting an Output Waveform Type

Changing the Output Frequency

You should be careful not to confuse waveform period, frequency and sample clock frequency. Period is programmed for the pulse waveform only, frequency applies to standard waveforms only and controls waveform frequency at the output connector; The sample clock frequency parameter is valid for arbitrary and sequenced waveforms only and defines the frequency of which the generator clocks data points.

Pulse waveform period is measured in units of seconds; Standard waveform frequency is measured in units of Hz and Arbitrary waveform sample clock frequency is measured in units of S/s (samples per second). The frequency of a given arbitrary waveform at the output connector is dependant on sample clock frequency, the number of data points, and other specific waveform definitions.

The frequency of the output waveform will change only if a standard waveform is generated. First select a standard waveform as described earlier and then proceed with frequency modification.

Observe Figure 3-6 and modify frequency using the following procedure. The index numbers in Figure 3-6 correspond to the procedure steps in the following description.

1. Press the Frequency soft key to select the frequency parameter
2. Use the numeric keypad to program the new frequency value
3. Press M/n, k/µ, x1/m or m/s to terminate the modification process

Alternately, you can modify the frequency value with the dial and arrow keys but then the termination of the process is by pressing Enter only.

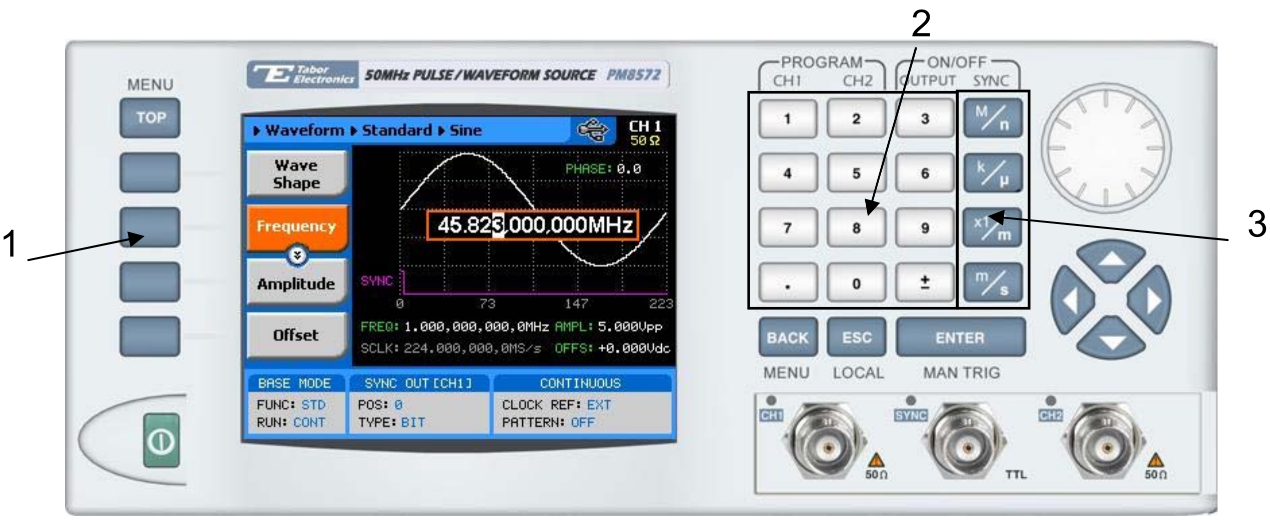

Figure 3-6, Modifying Output Frequency

Note

If you use the dial or arrow keys to modify the frequency parameter, the output is updated immediately as soon as you modify the parameter. The final value will be locked in as soon as you press Enter. If you choose to leave the old value, press Cancel to terminate the process and to discard of any change made to this parameter

Changing the Sample Clock Frequency

The frequency of the sample clock will affect the output waveform only if arbitrary or sequenced waveforms are generated. First select an arbitrary waveform as described earlier and then proceed with sample clock frequency modification.

Observe Figure 3-7 and modify the sample clock using the following procedure. The index numbers in Figure 3-7 correspond to the procedure steps in the following description.

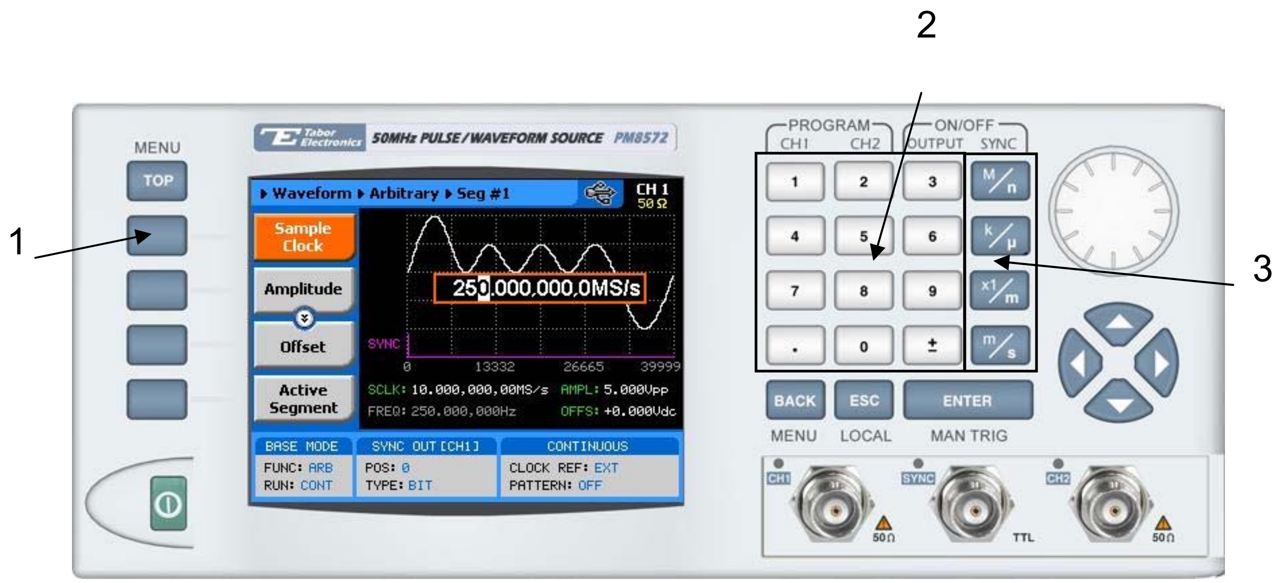

Figure 3-7, Modifying Sample Clock Frequency

1. Press the Frequency soft key to select the Sample Clock parameter
2. Use the numeric keypad to dial the new sample clock frequency value
3. Press “M/n”, “k/μ”, “x1/m” or “m/s” to terminate the modification process

Alternately, you can modify the sample clock frequency value with the dial and arrow keys but then the termination of the process is by pressing Enter only.

Note

If you use the dial or arrow keys to modify the sample clock frequency parameter, the output is updated immediately as soon as you modify the parameter. The final value will be locked in as soon as you press Enter. If you choose to leave the old value, press Cancel to terminate the process and to discard of any change made to this parameter

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Programming the Amplitude and Offset

Output amplitude and offset can be programmed independently and separately for each channel. Amplitude and offset are set within windows, so before you select values for these parameters, make sure you do not exceed the limits.

Amplitude and offset can be programmed independently as long as the following relationship between the two values is not exceeded:

$$Window \geq \frac{Amplitude}{2} + |Offset|$$

The first thing you do before you program amplitude and offset setting is define which of the channels is being programmed. The active channel is displayed at the upper right corner of the LCD display.

When the display shows CH 1 at the upper right corner, you are currently programming channel 1 parameters. Keypads “1” and “2” are used as hot keys for channel selection. While not editing any parameter, press key “2” to program channel 2 parameters.

When the display shows CH 2 at the upper right corner, you can proceed with channel 2 programming.

The amplitude and offset parameters are duplicated in multiple screens however, when changed for a specific function shape, the new value is updated on all screens for all other function shapes. Refer to Figure 3-8 and modify amplitude and offset using the procedure as described below. The index numbers in Figure 3-8 correspond to the procedure steps in the following description.

1. Press the Amplitude soft key button
2. Press Enter to edit the Amplitude value
3. Use the numeric keypad to program the new value
4. Press “m” for mV, or “x1” for volts to select the suffix letter.
5. Press Enter to lock in the value

Alternately, you can modify the amplitude value with the dial and arrow keys but then the termination of the process is by pressing Enter.

Offset is programmed the same way as amplitude except select Offset from the soft key menus to access the offset parameter.

Note

If you use the dial or arrow keys to modify the amplitude or offset parameters, the output is updated immediately as soon as you modify the parameter. The final value will be locked in as soon as you press Enter. If you choose to leave the old value, press Cancel to terminate the process and to discard of any change made to this parameter

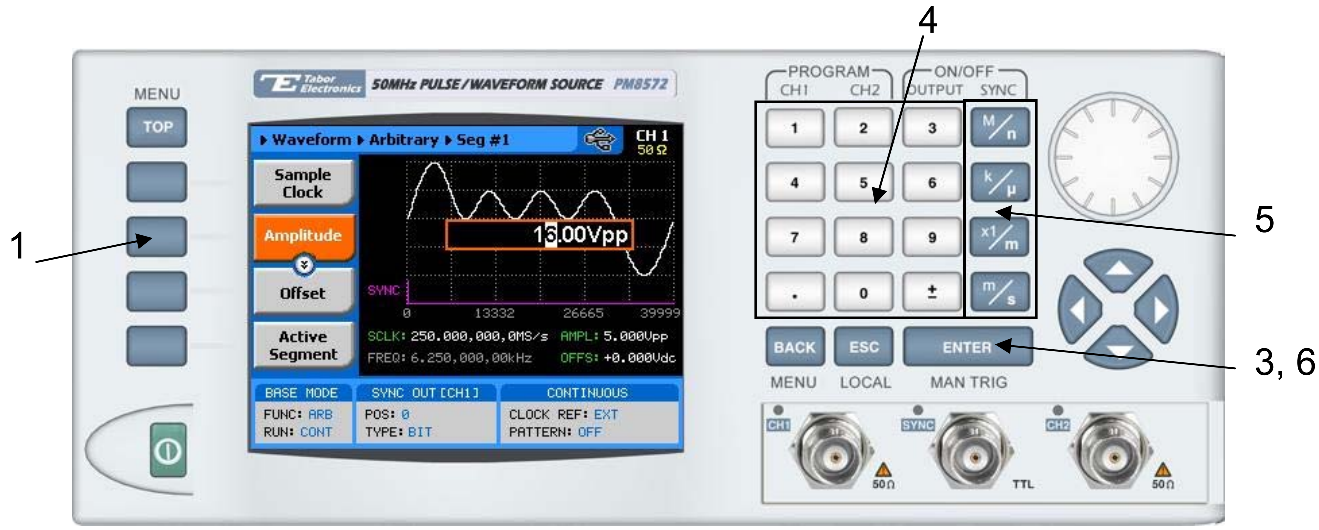


Figure 3-8, Programming Amplitude and Offset

Selecting a Run Mode

The Model PM8572A offers four run modes: Continuous, Triggered, Gated and Burst.

The selected waveform is repeated continuously when the instrument is set to operate in Continuous mode. The continuous output can be turned on and off from a remote interface, and thus controlling the start and stop of the waveform from an external source. The operating mode defaults to continuous after reset.

Triggered, Gated, and Burst modes require an external signal to initiate output cycles. In some case, an internal trigger generator is available to generate the required trigger stimuli without the need to connect to external devices. Figure 3-9 show the run mode options. Press one of the soft keys in the left to select the required run mode.

Descriptions of the various run modes and the parameters that are associated with each run mode are given in the following paragraphs.

Note

Burst run mode is shown in Figure 3-9 as an example however, the following description applies to all Run Mode menus.

In general, a specific run mode is selected from the Run Mode soft key menu. The screen as shown in Figure 3-8 is displayed. Proceed to select the run mode and to program parameters as follows:

1. Press one of the soft keys to select from: Continuous, Triggered, Gated or burst. The output will immediately be updated with the selected run mode

2. Use the arrow keys or the dial to scroll down to the parameter field you want to modify
3. Press Enter to edit the Divider value
4. Use the arrow keys or the dial to modify the edited parameter

Press Enter to lock in the value

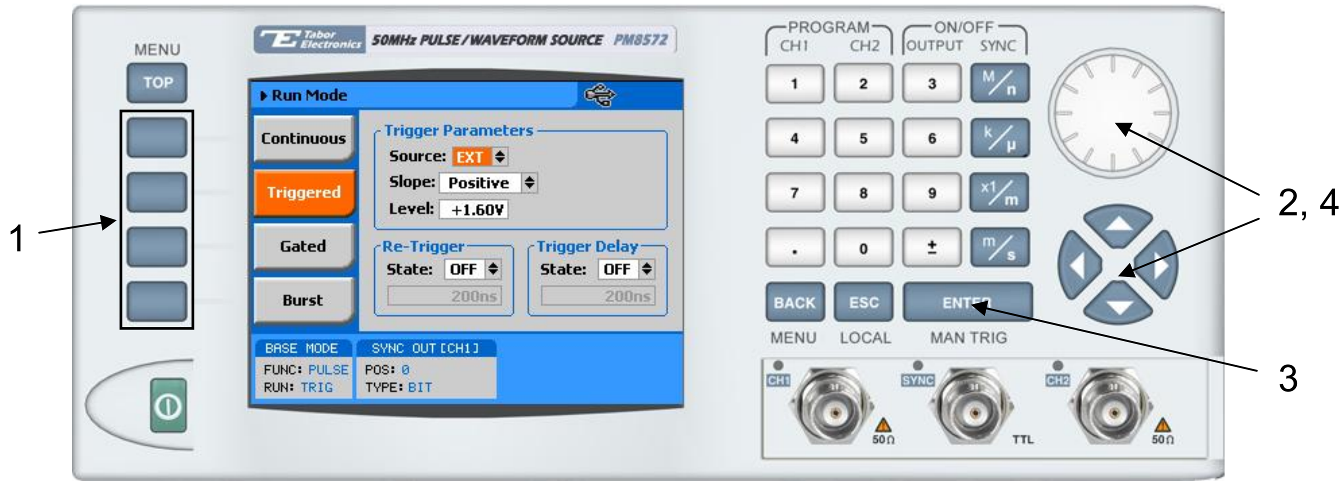


Figure 3-9, Run Mode Options

Selecting the Modulation Run Modes

The PM8572A run modes are shared by all waveform type: Pulse, Standard, Arbitrary, Sequenced, including Modulated. However, when in modulation function, run mode options take different meaning. When in triggered, burst or gated run modes, the PM8572A outputs sine carrier waveform (CW) until a valid trigger is received and then reacts to the trigger. If triggers cease to stimulate the input, the output resumes generating CW frequency only. Carrier frequency is common to all modulation functions and can be programmed from the modulation menus. If the above behavior is not desired, the PM8572A can be programmed to output dc level when idle, generate the modulated signal when triggered and then, resume dc level position when the modulation cycle has ended. The baseline option is programmable from either the front panel (Modulated Waveforms) or from remote.

Triggered Mode

In Triggered mode, the output remains at a DC level as long as a valid trigger signal has not occurred. Each time a trigger occurs, the PM8572A generates one complete output waveform. At the end of the output cycle, the output resumes position at a DC level that is equal to the amplitude of the last point of the waveform.

The instrument may be triggered from one of the following sources: A rear panel input, designated as TRIG IN, front panel button, marked MAN TRIG and a remote command such as *TRG. When placed in EXT (external) trigger source, remote commands are ignored and the instrument monitors the TRIG IN connector or the MAN TRIG control. When in BUS, the hardware inputs are ignored and only remote commands can trigger the instrument. The MIX is a special trigger advance mode that senses the first remote trigger and only then enables the hardware sources.

There are four parameters you can adjust for this mode:

Source – defines the trigger source. EXT enables the rear panel trigger input, BUS enables remote commands and MIX enables remote command and after the first trigger enables the EXT source. Another option is enabled when pulse waveforms are selected, this is INT. The internal source is a free running timer that can be programmed for the desired trigger intervals without using an external stimulus.

Slope – defines edge sensitivity for the trigger input

Level – sets the trigger level crossing point for the rear panel TRIG IN connector. Signal transition to above the trigger level will trigger the instrument. When the slope is set to negative, transitions to below the trigger level will trigger the instrument. Trigger level sensitivity and maximum level should be observed to avoid damaging the input

Trigger Delay – defines the state of the delayed trigger function.

Re-Trigger – defines the state of the re-trigger function

You may use the triggered mode to trigger standard, arbitrary sequenced and modulated waveforms. However, note that in modulation mode, the output generate CW frequency before and after the trigger event. The Trigger run mode parameters are shown in Figure 3-10.

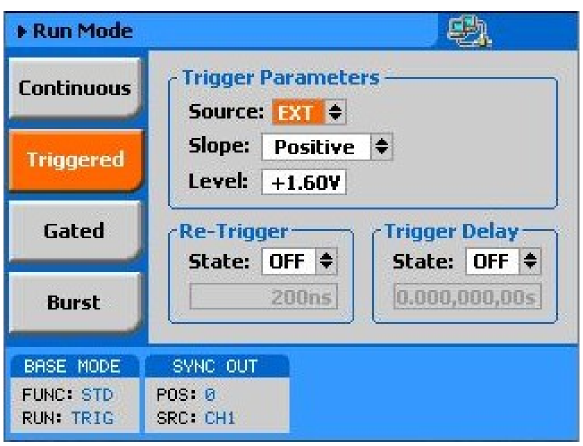


Figure 3-10, Trigger Run Mode Parameters

Delayed Trigger

The delayed trigger function operates in conjunction with the triggered and counted burst modes. When enabled, it inhibits the output signal for a pre-determined period after a valid trigger. The delay time defines the time that will lapse from a valid trigger (hardware or software) to output. To enable the delayed trigger feature, scroll down to the Trigger Delay State field and press Enter. Use the down key to change the sate to ON and press enter again to lock in the state position. The delay field then becomes active. Scroll down to the delay field and press enter. Modify the delay to match your delay requirement and press Enter again.

Note that the minimum delay is 200ns and can be increased to over 20 seconds with 20ns resolution.

Re-Trigger

The re-trigger function operates in conjunction with the triggered and counted burst modes. When enabled, it does not modify the output except when a valid trigger is received. It then starts an automatic sequence of internal triggers that generate repeated output cycles or bursts. The time in the re-trigger group defines the time that will lapse from the end of the signal to the start of the next signal.

To enable the re-trigger feature, scroll down to the Re-Trigger State field and press Enter. Use the down key to change the sate to ON and press enter again to lock in the state position. The re-trigger time field then becomes active. Scroll down to the re-trigger time field and press enter. Modify the time to match your requirement and press Enter again.

Note that the minimum re-trigger interval is 200ns and can be increased to over 20 seconds with 20ns resolution.

Gated Mode

When set to gated mode, the PM8572A output remains at a DC level as long as the rear-panel TRIG IN signal remains inactive. The output gates on and off between two transitions, either positive or negative, depending on the slope setting. Only the rear panel TRIG IN connector can be used for operating the gated mode.

When placed in gated mode, the generator idles on a DC level until the first gate on transition. The signal will complete after the gate off transition and the generator will once again resume DC level equal to the last point of the waveform.

There are two parameters you can adjust for the gated mode:

> ***Source*** – defines the gating signal source. Since the gated run mode relies on hardware transitions, only EXT is a valid source for the gated mode.
>
> ***Slope*** – defines if the generator is gating on and off on positive or negative transitions.

Level – sets the trigger level crossing point for the rear panel TRIG IN connector. Signal transition to above the trigger level will gate the instrument. When the slope is set to negative, transitions to below the trigger level will gate the instrument. Trigger level sensitivity and maximum level should be observed to avoid damaging the input

You may use the gated mode to gate standard, arbitrary, sequenced and modulated waveforms. The gated run mode parameters are shown in Figure 3-11.

Figure 3-11, Gated Mode Parameters

Burst Mode

Burst mode is similar to Triggered mode with the exception that only one trigger signal is needed to generate a counted number of output waveforms. In Burst mode, the output remains at a DC level as long as a valid trigger signal has not occurred. Each time a trigger occurs, the PM8572A generates a counted number of burst of waveforms. At the end of the output burst, the output resumes position at a DC level that is equal to the amplitude of the last point of the waveform.

The instrument may be triggered from one of the following sources: A rear panel input, designated as TRIG IN, front panel button, marked MAN TRIG and a remote command such as *TRG. When placed in EXT (external) trigger source, remote commands are ignored and the instrument monitors the TRIG IN connector or the MAN TRIG control. When in BUS, the hardware inputs are ignored and only remote commands can trigger the instrument. The MIX is a special trigger advance mode that senses the first remote trigger and only then enables the hardware sources.

There are four parameters you can adjust for this mode:

Source – defines the trigger source. EXT enables the rear panel trigger input, BUS enables remote commands and MIX enables remote command and after the first trigger enables the EXT source.

Slope – defines edge sensitivity for the trigger input

Level – sets the trigger level crossing point for the rear panel TRIG IN connector. Signal transition to above the trigger level will trigger the instrument. When the slope is set to negative, transitions to below the trigger level will trigger the instrument. Trigger level sensitivity and maximum level should be observed to avoid damaging the input

Burst – Defines the number of cycles the generator will output after a trigger signal. Each channel can be programmed to have a unique burst counter.

Trigger Delay – defines the state of the delayed trigger function.

Re-Trigger – defines the state of the re-trigger function

You may use the counted burst mode in conjunction with standard, arbitrary and modulated waveforms only. Sequenced waveforms can not be used in burst mode. The Burst run mode parameters are shown in Figure 3-12.

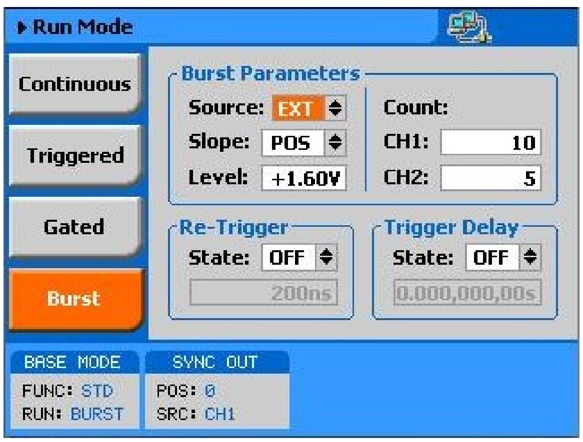


Figure 3-12, Burst Run Mode Parameters

Using the Manual Trigger

The manual trigger allows you to trigger or gate the PM8572A directly from the front panel. This button is active only when the generator is placed in external trigger only. The MAN TRIG button is a second function to the Enter button and can be used only when the display is not in editing mode.

Using the SYNC Output

For safety reasons, every time you turn the PM8572A OFF and ON, the SYNC output defaults to OFF. If you want to use the SYNC output you must turn it on immediately after you power up the generator. You can turn the SYNC on using the ON/OFF SYNC hot key as was explained earlier in this chapter or you can do it from the Outputs menus shown in Figure 3-13.

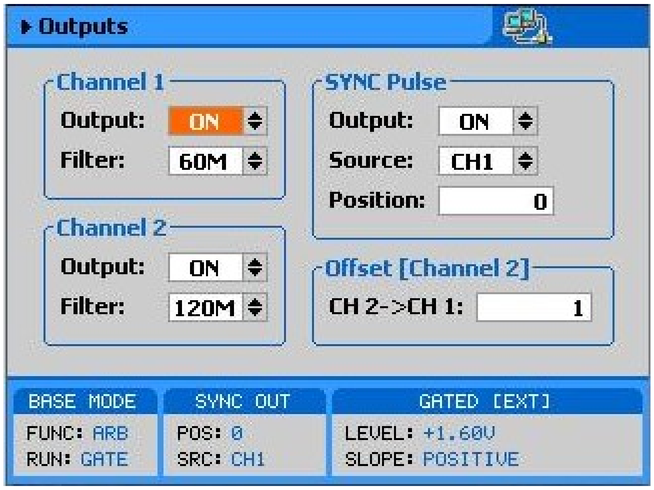


Figure 3-13, SYNC and Filter Parameters

There are four parameters you can adjust for the SYNC output:

Output – Turns the SYNC output on and off. Note that the termination of the output state shifts the dc level to 0V but leaves a low impedance path to the connector and therefore, if your UUT (unit under test) is sensitive to level transitions, make sure you remove the cable from this connector before turning the output state off.

Source – Selects if the output is synchronized to channel 1 or 2. In fact, the two channels are always synchronized between themselves however, one may select either channel because the waveforms may be different for each channel and thus the selection options.

Position – Lets you place the sync start at any point along the length of the waveform. Placement resolution is 4 points. As default, the sync signal is positioned at the beginning of the waveform.

The SYNC parameters are shown in Figure 3-13. The Menu is accessible by selecting the Outputs soft key as shown in Figure 3-4.

Applying Filters

Four filters are available for each channel. These filters have fixed cutoff frequencies of which their properties are specified in Appendix A. The built-in filters are switched in after the DAC circuit and are used for reducing the noise, harmonics and spurious signals above the cutoff frequency.

The built-in filters are available for the user in pulse, standard, arbitrary, sequenced and modulated modes. The only function where the Model PM8572A does not allow external control is when standard sinusoidal waveform is selected.

Note

The instrument is using filters to reconstruct the sine waveform and therefore, the state of the filters can not be changed until another output function is selected. A setting conflict error will occur if one attempts to turn filters on and off before changing to another output function.

If you do not plan on using the filters, make sure that you leave the selection OFF. This will eliminate confusing setting conflicts.

Modification of the filter state and range is done from the Outputs menu. To access this menu select the Outputs screen as shown in Figure 3-4 and modify the parameters as shown in Figure 3-13.

Selecting the SCLK Source and Reference

In cases where synchronization to other instruments in a system is required, you have two options: Use an external clock source for the 10MHz reference clock or replace the internal sample clock generator entirely with an external clock source. Either way, this is a major twist in the PM8572A basic operation because if, for any reason, you leave one or both source options on external and do not apply the necessary signal to the input, the operation of the generator will be impeded without visual references that something is wrong.

The SCLK and the 10MHz reference source menu were placed in the Customize menu, as shown in Figure 3-14. Change these settings only if you are absolutely sure that another reference source is available at the appropriate inputs.

The SCLK input is located on the rear panel. Use this input to replace the internal sample clock generator. The external sample clock input accepts ECL level signals, terminated to –2V into 50Ω.

The 10MHz reference input is also located on the rear panel. It accepts TTL level signals only. Note that the PM8572A internal reference is accurate to 1ppm.

To display and modify the SCLK or the 10MHz clock source, press TOP, then Utility and scroll down to the Customize option.

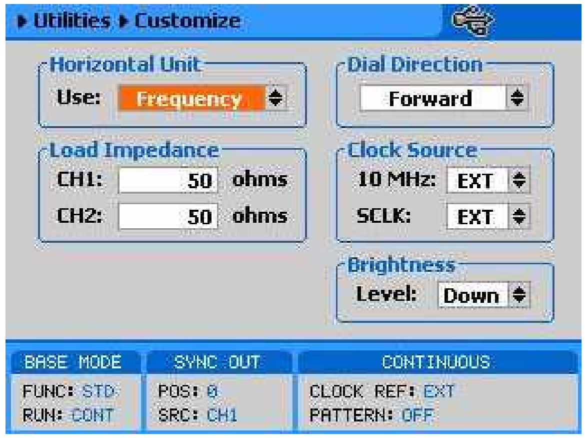


Figure 3-14, Modifying the SCLK and 10MHz Clock Source

Generating Pulse Waveforms

Upon reset, the default waveform type is set to pulse. The pulse waveforms and its parameters are generated in an analog fashion but are digitally controlled to achieve maximum resolution, accuracy and stability.

The pulse generator function provides means of designing pulses and their associated parameters in units of time, exactly as would be done on a stand-alone, bench-type, analog pulse generator. Use the instructions below to access and program the pulse menus.

1. Press TOP to display the root menu.
2. Press the Waveform soft key. Observe the list of waveforms that appears in the menu.
3. Scroll up or down to highlight the pulse option as shown in Figure 3-15.
4. Press the Enter button to select the pulse generator function Figure 3-16 shows the Pulse Generator panel and menus.

Note

The pulse shape on the PM8572A LCD display is an icon only. The actual output waveform may look entirely different.

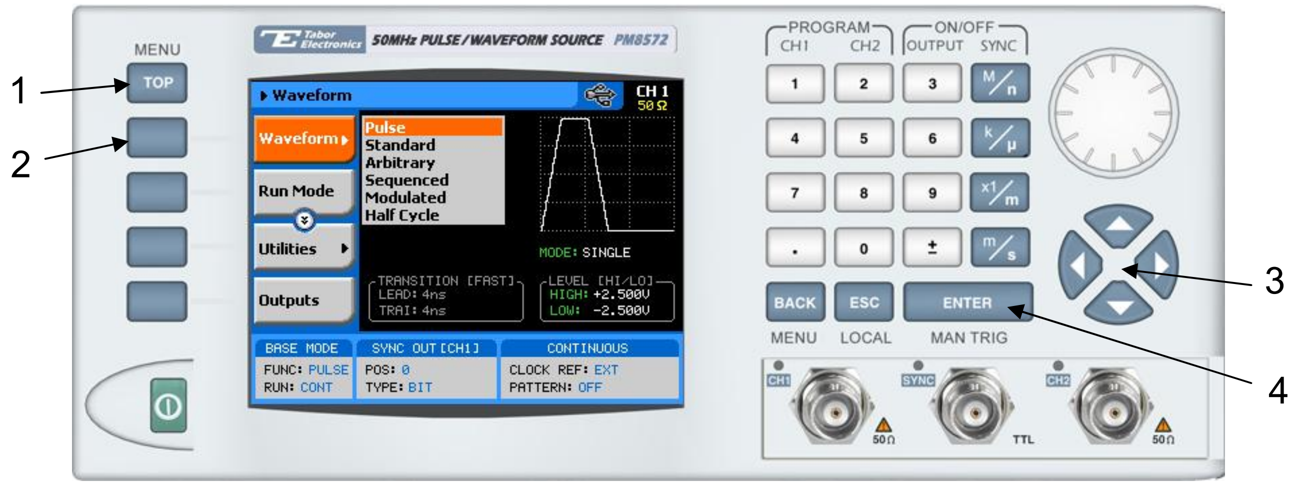


Figure 3-15, Accessing the Pulse Generator Menus

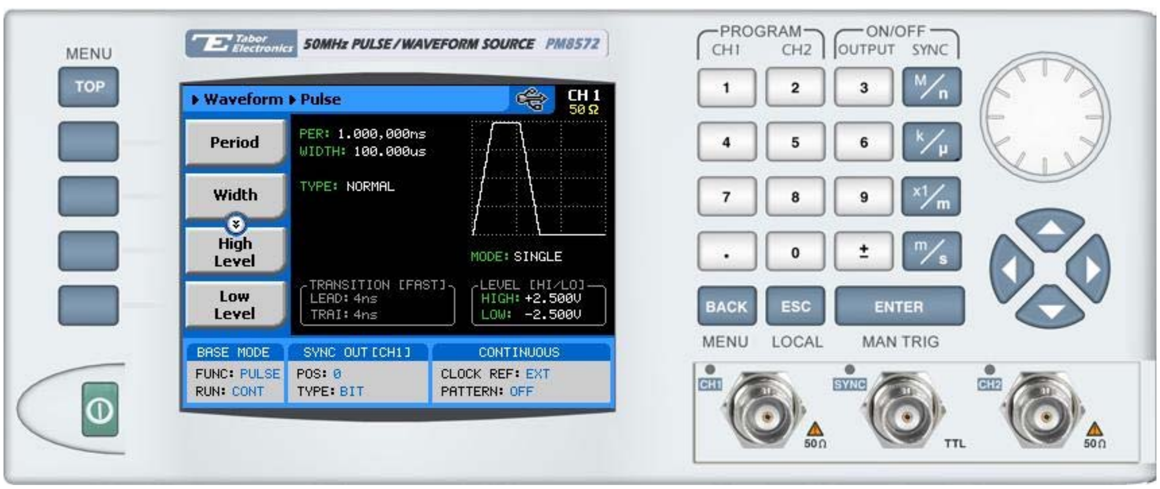


Figure 3-16, the Pulse Generator Menus

The pulse generator menus provide access to all pulse parameters just as they would be programmed on an analog pulse generator.

To access the pulse parameters, use one of the soft keys. If you do not see a required parameter on the screen, press the key up or down to scroll through the menus.

There are many pulse parameters that can be displayed on the screen however, most applications do not require that all pulse parameters be displayed and therefore, the menus were built in a way that show all of the parameters that are absolutely necessary to program the selected pulse mode. For example, if single pulse mode with fast transitions is required, the delay, rise and fall time parameters will not be shown on the screen. Information on how to program simple and complex pulse modes is given in the following paragraphs.

The technique of changing parameter values is exactly the same as you are using to modify standard waveform parameters. Simply press the soft key that is associated with the parameter, then punch in the numbers using the numeric keyboard and complete the modification by assigning a suffix and pressing the Enter button. Figure 3-17 shows the screen after the Period soft key has been depressed.

Figure 3-17, Programming the Pulse Period Parameter

Adjusting the pulse shape with the required characteristics can only be done if all of its parameters can be adjusted both in the time and amplitude domain. The Model PM8572A provides all the necessary controls to do just that. However, always bear in mind that some parameters may collide during the programming sequence and cause setting conflicts. These setting conflicts will be discussed later in this chapter. Below you will find a list of all pulse parameters that you'll be able to access though the soft key menus.

Pulse Modes

The pulse mode menu provides access to modifying the basic shape of the pulse waveform; These are: Single Pulse, Double Pulse and Delayed Pulse, Hold and External Pulse Width and Pulse Width Modulation. These modes and their associated parameters are discussed below. Information how to access the various pulse modes is given in the following.

1. Within the Pulse menus, scroll down until the Config tab is visible, as shown in Figure 3-18.
2. Press the Config soft key. Observe the list of menus change.
3. Press the Mode soft key, as shown in Figure 3-19.
4. Scroll up or down to highlight the required pulse mode option,
5. Press the Enter button to complete the selection process.

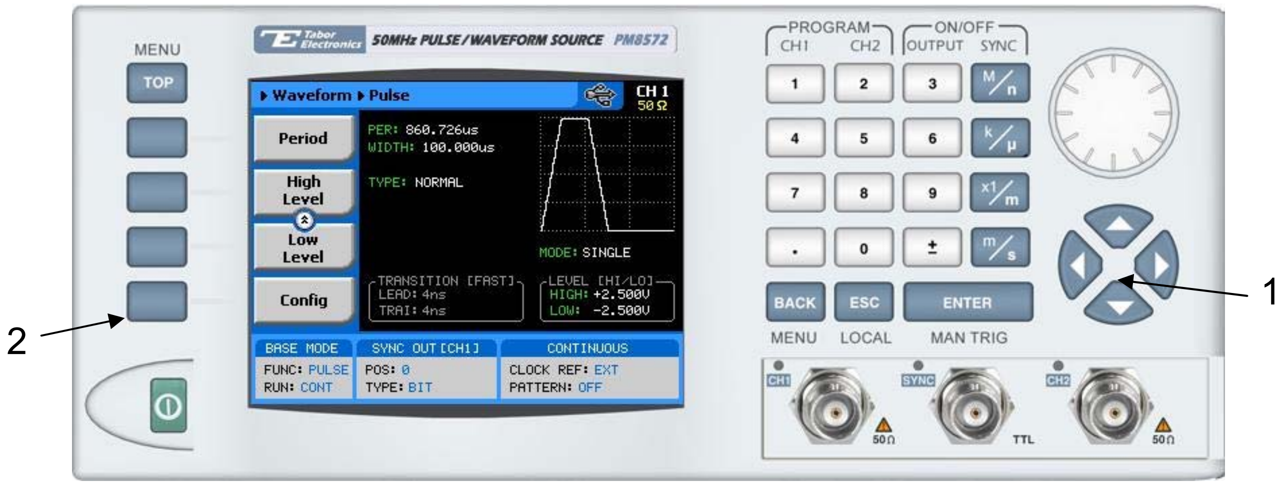


Figure 3-18, Accessing the Pulse Configuration Menus

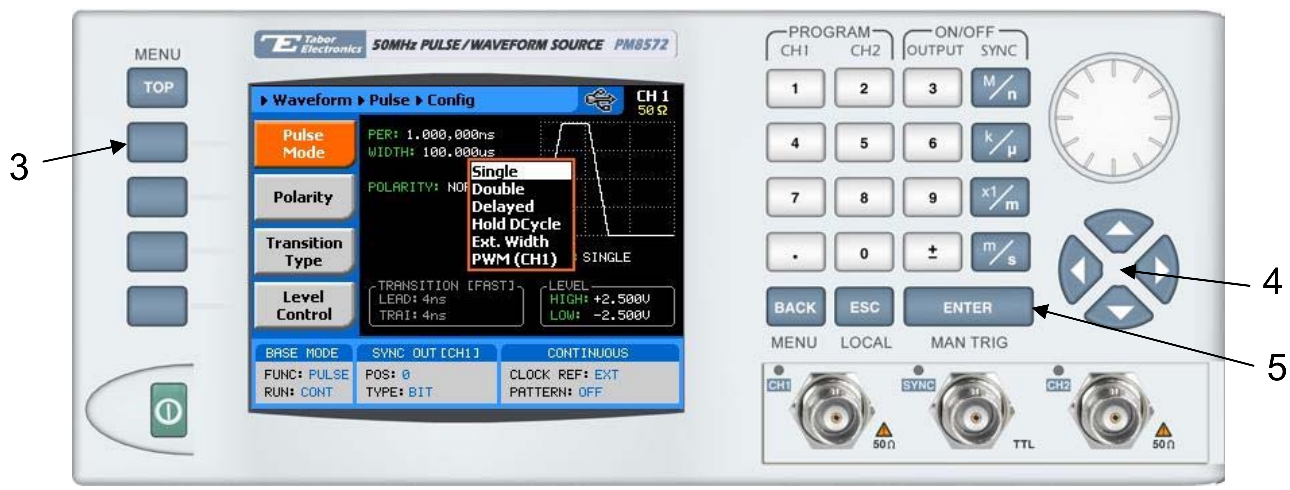


Figure 3-19, Pulse Mode Options

Single Pulse Mode

The basic pulse mode is the Single Pulse. Single pulse defines the shape of a single pulse only. In continuous operating mode it may appear as a string of pulses that have constant period, width and amplitude however, the meaning of this mode is that is you place the instrument in triggered run mode, only one pulse is initialed with every trigger. The menus that are associated with the simplest configuration of the single pulse mode are: Period, Width, High and low Levels. These parameters are discussed below. With more complex configuration, you can select linear transitions and width and amplitude modes however, these will be discussed separately.

Figure 3-20 shows a typical real-life single pulse shape and highlights all of its relevant parameters. While most of the parameters that are shown in Figure 3-20 can be programmed and adjusted for a specific application, some characteristics of the pulse are derived from the quality of the generator and its output stage; These are specified and can be found in Appendix A.

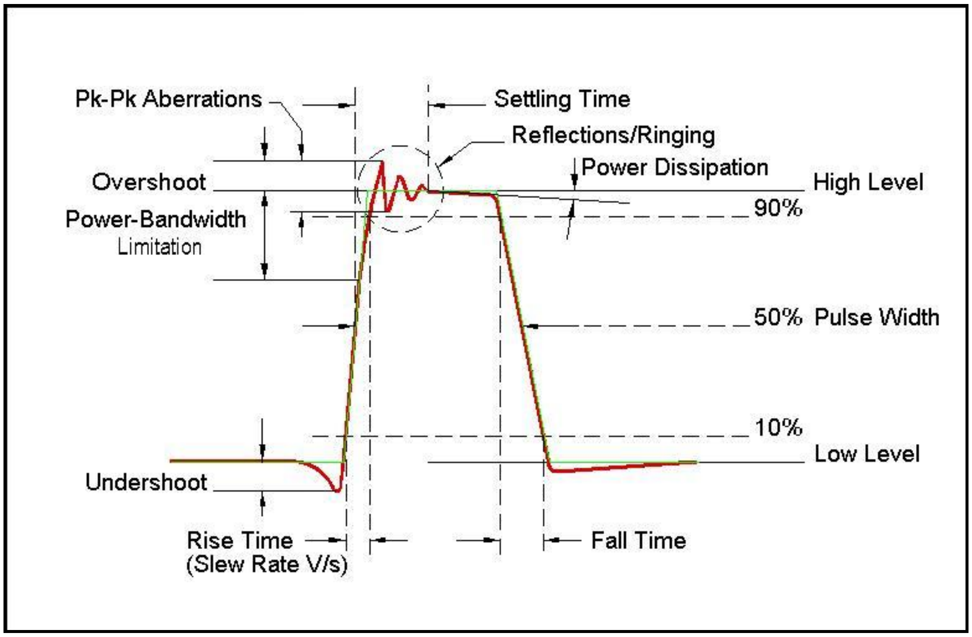


Figure 3-20, Single Pulse Parameters Summary

Note

Before you start programming pulse parameters, bear in mind that incorrect planning of your entries may cause setting conflicts that may, in turn, cause the instrument to ignore some parameters. For example, if you try to program pulse width that is wider than the period. Therefore, always program the period first and enter other pulse parameters in a descending order. A list of setting conflicts is given later in this chapter.

Period

The period defines the repetition rate of the pulse in continuous run mode. The period parameter has no meaning if the PM8572A is set up to operate in triggered or counted burst run modes. The period is programmable from 20 ns to 10 seconds.

Width

The Width defines the width of the pulse exactly at the 50% point between its high and low level settings. The pulse width interval is not affected by settings of other parameters such as rise and fall times. The pulse width parameter can be programmed from 8 ns to 10 s with an incredible resolution of 10 ps up to 11 digits.

High Level

The high level parameter defines the top amplitude level of the pulse. Any value is acceptable as long as it is larger than the low level setting and does not exceed +16 V and does not fall short of the 16 mV minimum high to low level setting.

Low Level

The low level parameter defines the lower amplitude level of the pulse. Any value is acceptable as long as it is smaller than the high level setting and does not exceed -16 V and does not fall short of the 16 mV minimum high to low level setting.

Double Pulse Mode

The Double Pulse mode is a special mode that doubles pulse output into a pair of two pulses at a time. In continuous run mode the output will appear as a string of pulse pairs separated by an interval set by the period parameter. If you place the instrument in triggered run mode, a pair of pulses is initialed with every trigger. To modify the pulse mode to double pulse, use the procedure as given above under the Pulse Modes heading.

The menus that are associated with the simplest double pulse configuration are: Period, Width, High and low Levels and Pulse Delay, which sets the delay between the pairs of pulses. The double pulse is measured at the 50% amplitude of the leading edges, as shown in Figure 3-21.

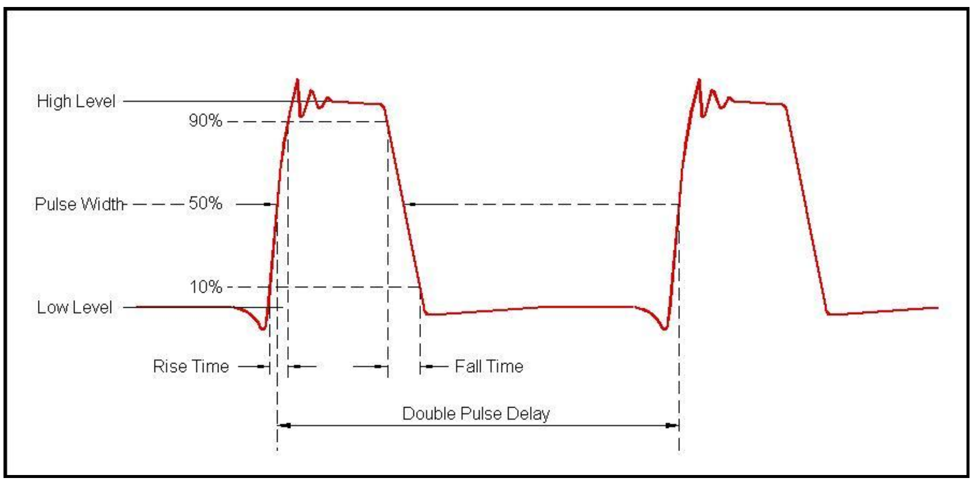


Figure 3-21, Double Pulse Mode

The double pulse delay parameter becomes available in the main pulse parameters screen, as shown in Figure 3-22, only after you select the double pulse mode. The delay can be modified from 0 to 10 seconds with a resolution of 10 ps, limited by 11 digits.

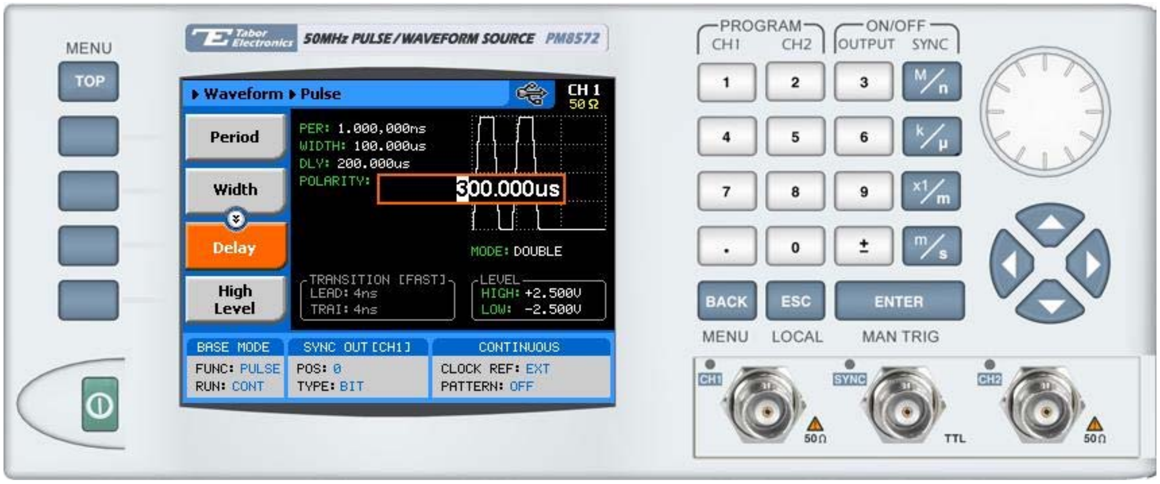
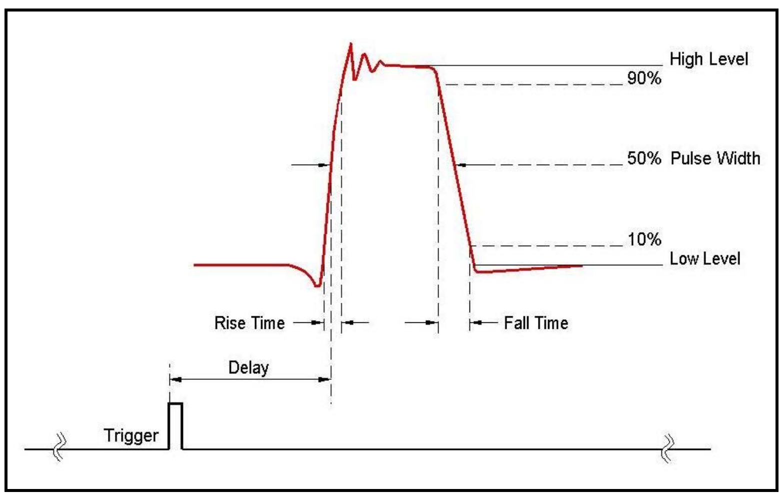


Figure 3-22, Programming the Double Pulse Delay

Delayed Pulse Mode

The Delayed Pulse mode is a special mode that delays the pulse output after a trigger is issued. To modify the pulse mode to delayed pulse, use the procedure as given above under the Pulse Modes heading.



3-23, Delayed Pulse Mode

The menus that are associated with the simplest delayed pulse configuration are: Period, Width, High and low Levels and Pulse Delay. The pulse delay is measured from the trigger edge to the 50% amplitude of the pulse leading edge, as shown in Figure 3-23.

The pulse delay parameter becomes available in the main pulse parameters screen, as shown in Figure 3-24, only after you select the delayed pulse mode. The delay can be modified from 0 to 10 seconds with a resolution of 10 ps, limited by 11 digits.

Figure 3-24, Programming the Delay Parameter

Hold DCycle Mode

When single, double, or delayed pulse modes are selected, the programmed pulse width does not change when you change the period of the pulse. On the other hand, some applications require that the ratio between the period and the pulse width remain constant regardless of the period setting. In this case, select the fixed duty cycle mode.

The Hold Duty Cycle mode is programmed in units of percent (%) that defines the ratio between the pulse width to the period x 100. An example is shown in Figure 3-25. If you program the duty cycle parameter to be 10% and the period to be 50 ms, after you modify the period to 25 ms, the width is adjusted automatically to 2.5 ms so that the duty cycle remains 10%.

To modify the pulse mode to hold duty cycle mode, use the procedure as given above under the Pulse Modes heading.

The duty cycle parameter becomes available in the main pulse parameters screen, as shown in Figure 3-26, only after you select the Fixed Duty Cycle pulse mode. The duty cycle can be modified from 1% to 95% with a resolution of 0.001%.

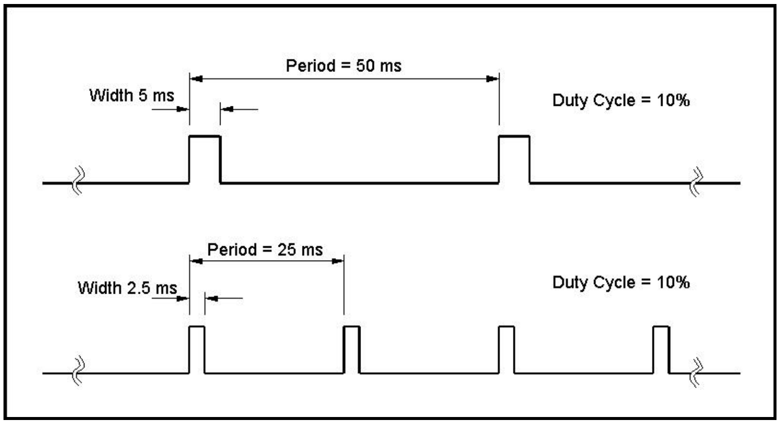


Figure 3-25, Hold Duty Cycle Mode Example

Figure 3-26, Programming the Duty Cycle Parameter

External Pulse Width Mode

The external pulse width mode is using the trigger input to shape and define the width of the pulses that are applied to the trigger input. As shown in Figure 3-27, as long as the signal remains below the trigger level threshold, the pulse idles on its low level setting. When the signal is crossing the trigger level threshold, the output generates the high level and the width is determined from the time that the signal remains above the trigger level threshold level.

To modify the pulse mode to external width mode, use the procedure as given above under the Pulse Modes heading along with Figures 3-18 and 3-19. Note that period and width settings become irrelevant because both are being extracted from the external signal. These parameters are being replaced by the trigger level and trigger slope parameters, as shown in Figure 3-29.

The relevance of the trigger slope is to determine if the levels above or below the threshold generate the pulse width. When the trigger slope is set to positive (default), the output will behave as shown in

Figure 3-27. Using the same input signal but negative trigger slope, will result an inverted pulse sequence where all low levels become high and high levels become low, as shown in Figure 3-28.

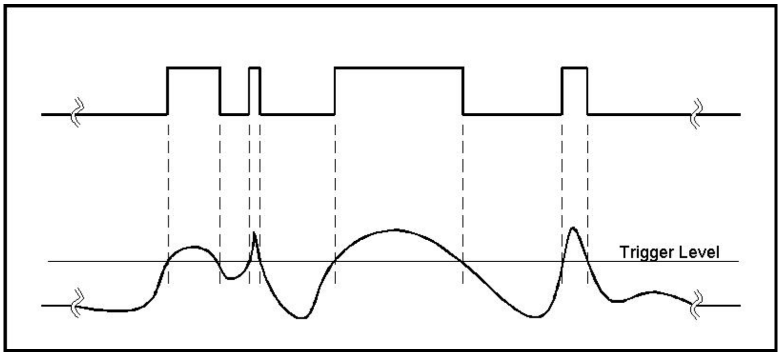


Figure 3-27, External Pulse Width Mode, Positive Slope Example

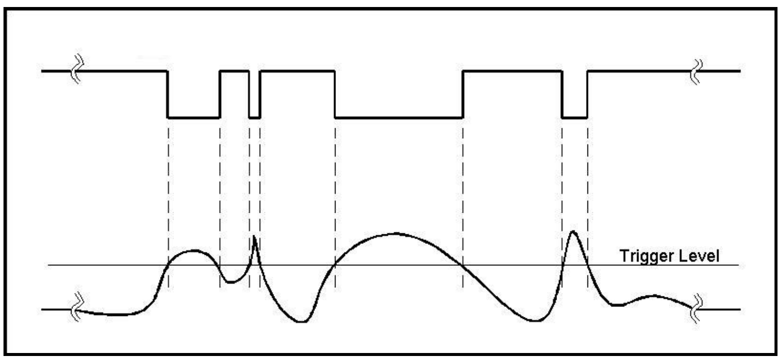


Figure 3-28, External Pulse Width Mode, Negative Slope Example

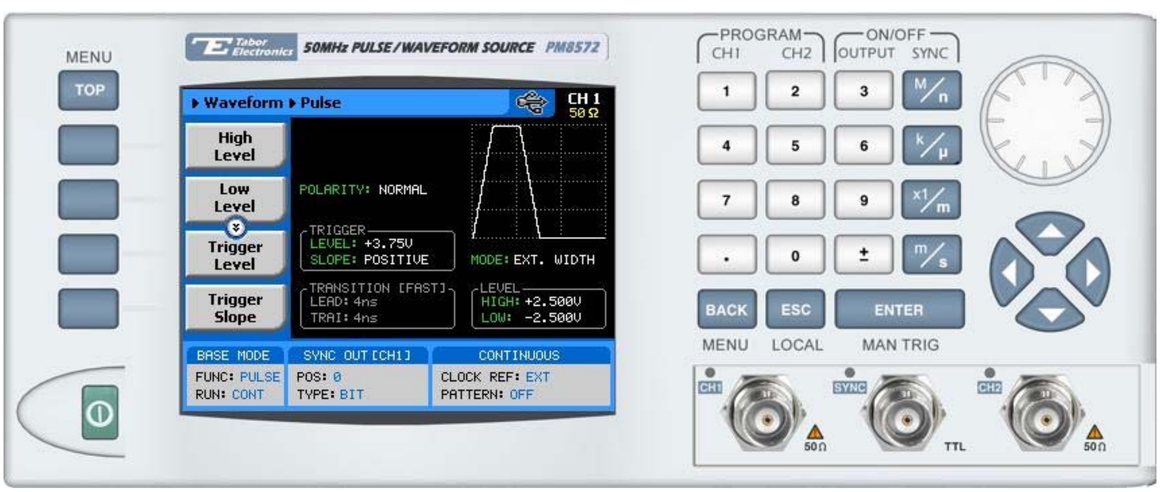


Figure 3-29, External Pulse Width Menus

TIPS

1. **While using the external pulse width mode, bear in mind that the period and the width are controlled by a signal that is applied to the trigger input and therefore, you'll have to watch out for the limitations of the trigger input. For example, the maximum frequency of a signal that will be legal at the trigger input is 2.5 MHz and its minimum pulse width is 10 ns, which implies that the signal that you will apply to the trigger input must not exceed these limitations and hence, your output period for this mode will not exceed 2.5 MHz, nor will its pulse width decrease below 10 ns.**
2. **The external pulse width mode does not impose any limitations to use linear transitions, change the high and low level settings, or modify the polarity of the output.**

The external pulse width parameter becomes available in the main pulse parameters screen, as shown in Figure 3-30, only after you select the external pulse width mode. The trigger level can be modified from -5.0 V to +5.0 V and the slope can be toggled between positive and negative.

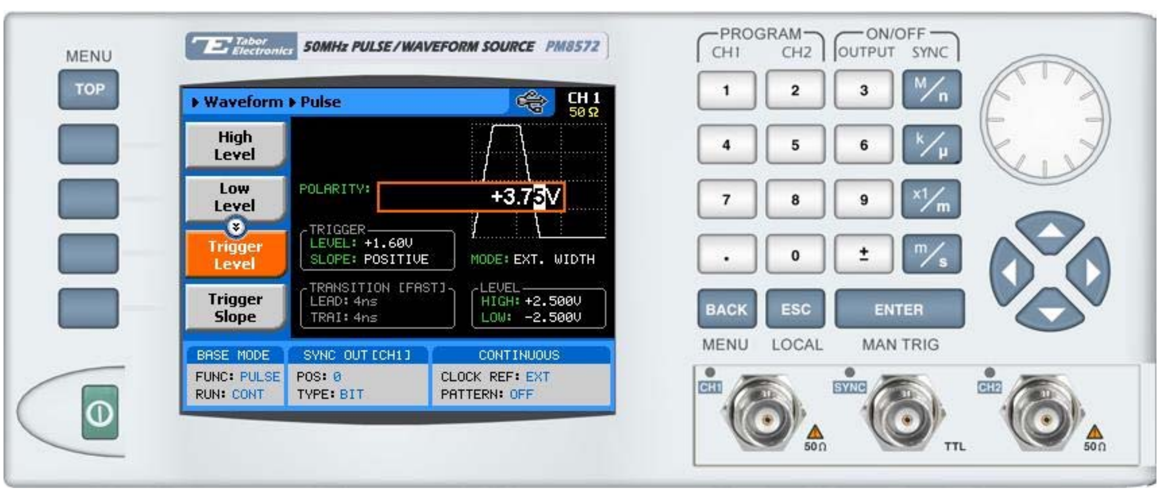


Figure 3-30, External Pulse Width Parameters

Pulse Width Modulation (PWM)

In PWM mode, a modulating signal modulates the trailing edge of a known pulse shape. Modulation is internal only, meaning that the modulating signal resides in the PM8572A memory. The source of the modulating waveforms is stored in a built-in library of standard waveforms, such as, sine, triangle, square as well as ramp up and ramp down waveforms. The modulating waveform is then converted to machine code and transferred to the PWM memory.

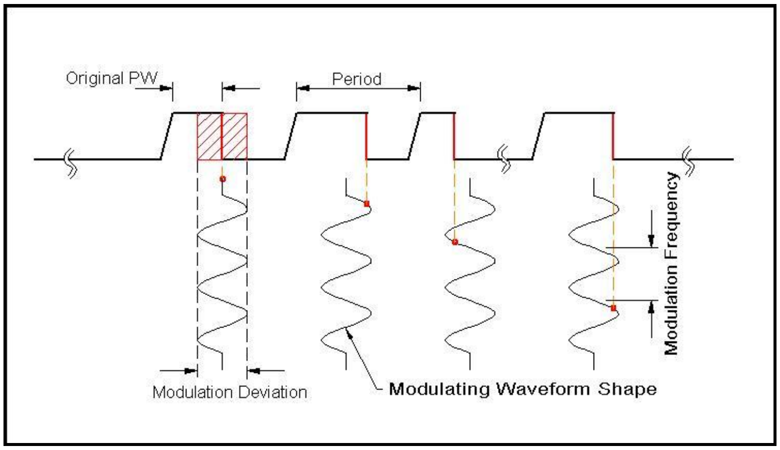


Figure 3-31, Pulse Width Modulation Example

Pulse width modulation example using standard sine waveform is shown in Figure 3-31. As you can see the trailing edge of the pulse follows a sine wave pattern. Similarly, you can select to modulate the waveform with either a triangular or square shapes.

Since PWM is internal, the parameters that control the modulation must be programmed correctly to get the appropriate result. The modulation parameters are accessible from the front panel only after you select the PWM mode; These are shown in Figure 3-32.

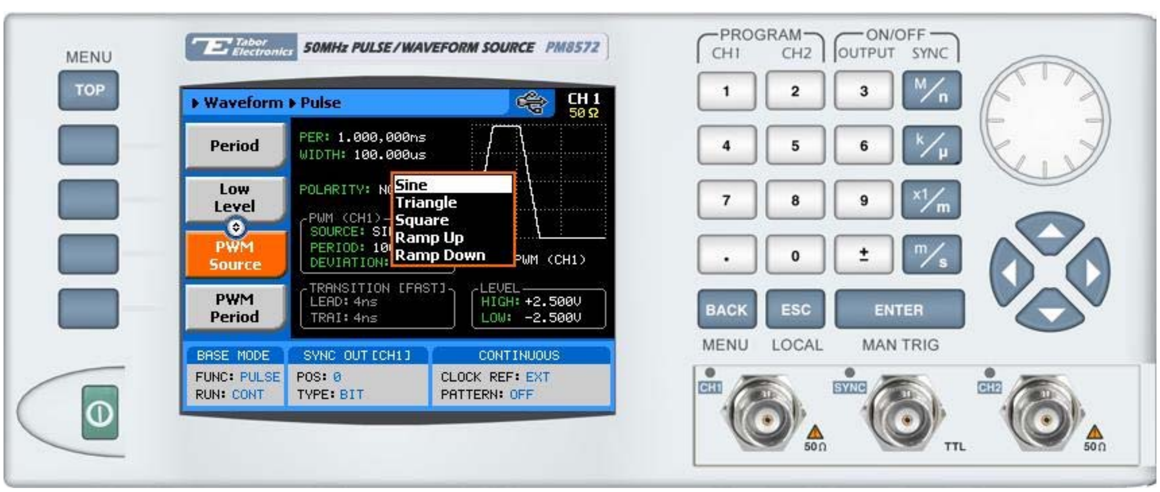


Figure 3-32, the PWM Parameters

As shown in Figure 3-32, there are three parameters that control the pulse width modulation: PWM Source, PWM Period and PWM Deviation. These parameters are described below.

PWM Source

The PWM source provides access to a list of waveforms that will be used for modulating the pulse width. The list contains five waveforms: Sine, Triangle, Square and Ramp Up and Ramp Down waveforms. The trailing edge will follow a pattern which is defined by the shape of the modulating waveforms. The example in Figure 3-30 depicts a sine wave shape as the modulating waveform shape.

PWM Period

The PWM period parameter defines the period of the modulating waveform. Note that the period of the modulating waveform must be significantly smaller than the period of the pulse for every pulse cycle to be effected by the modulating waveform. The PWM period is programmable from 100 ns to 1 s.

PWM Deviation

The PWM deviation parameter defines the modulation depth. The depth is defined as percentage of the width. The depth is programmable from 0 to 99%. At 0% there is no deviation from the original width and at 99%, the width rotates from 1% to 98% of the original width. The PWM deviation is symmetrical around the trailing edge axis, as shown in Figure 3-31.

Programming Pulse Polarity

The pulse polarity parameter determines if the pulse is generated In Normal, Complemented, or Inverted shape. Pulse polarity can be selected in conjunction with any of the pulse modes except with external pulse width mode. The various polarity options are shown in Figure 3-33.

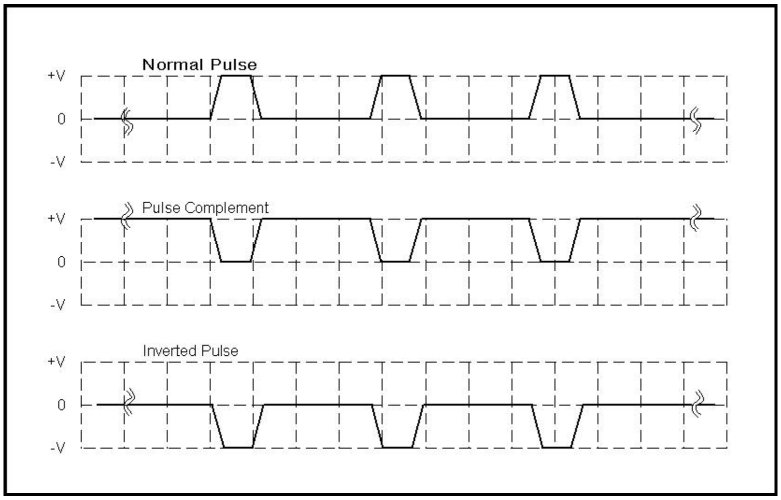


Figure 3-33, Pulse Polarity Options

As shown in this figure, the complemented shape is mirrored around the horizontal axis in a way that the high level becomes low and likewise, the low level becomes high. In complemented mode, the inversion process is symmetrical about the 50% value of the pulse amplitude.

In Inverted mode, the normal pulse is mirrored about the 0 V horizontal axis, positive values are converted to negative and negative values are converted to positive.

The normal pulse and the pulse complement are specifically valuable for applications requiring differential signals and hence a dual channel like the PM8572A that has this feature can easily be programmed to generate these signals. Simply set one channel to Normal and the second channel to Complemented and both signals will be generated differentially, perfectly synchronized, no phase offset and without the slightest jitter.

Use Figure 3-34 to access and modify the pulse polarity parameter. Note that the pulse polarity can be programmed separately for each channel and therefore, before you modify this parameter, make sure that you program the correct channel.

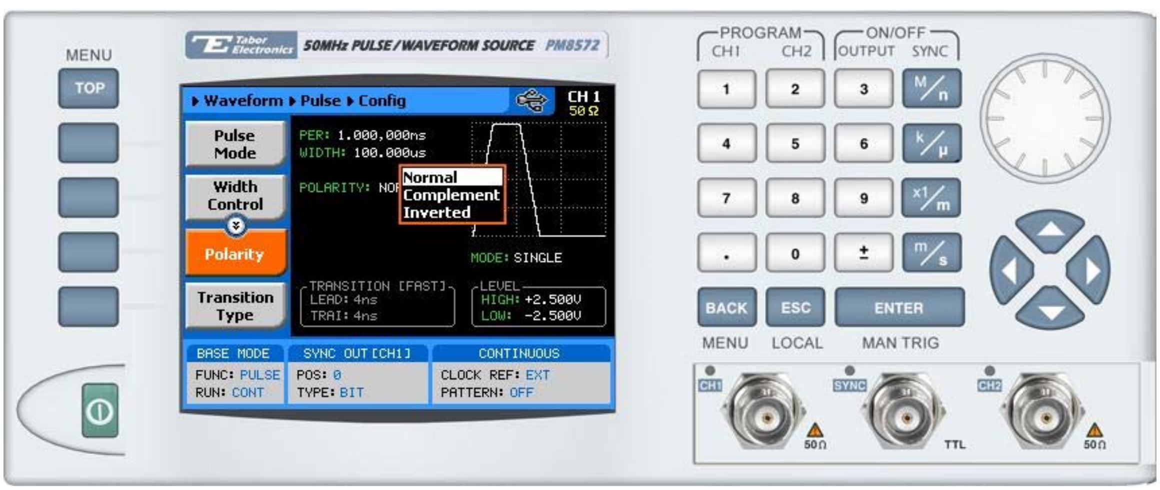


Figure 3-34, Programming the Pulse Polarity

Applying Linear Transitions

Most of the applications that use pulse generation require that the transitions from low to high and from high to low be done in the fastest possible speed. Such transitions are normally are created as a by-product of the output amplifier. General purpose amplifiers that can drive 50 Ω loads with high amplitudes are rare and the products that you can usually buy of the shelf either have poor drive capabilities or uncontrolled aberration capability.

For a pulse generator that generates pulses with just fast transitions only, the problem is simpler because the designer can use a switching amplifier at the output amplifier stage. It takes a very different approach to design an output stage that slows the transitions of the leading and trailing edges. To this extent, the Model 8572A has a unique output amplifier stage that allows full control over pulse transitions over a very high dynamic range of amplitudes and offsets without the slightest degradation of the integrity of the signal. A comparison between pulses with fast and linear transitions is shown in Figure 3-35. As you can see, the top train has fast transitions; These are normally in the range of 4 ns and are expected to be very fast and without aberrations. The bottom pulse has linear transitions that are expected to have good linearity and slew-rate accuracy. Observe that the pulse width on the pulses that have linear transitions is measured at the 50% amplitude level. Also note that the leading and the trailing edges can be programmed to have different transitions times.

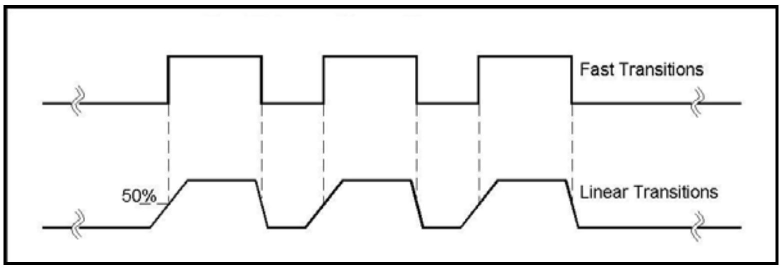


Figure 3-35, Fast and Linear Transitions, Compared

To menus to select between fast and linear transitions are shown in Figure 3-36. The application of linear transitions affects all pulse modes, including external pulse width and pulse modulation.

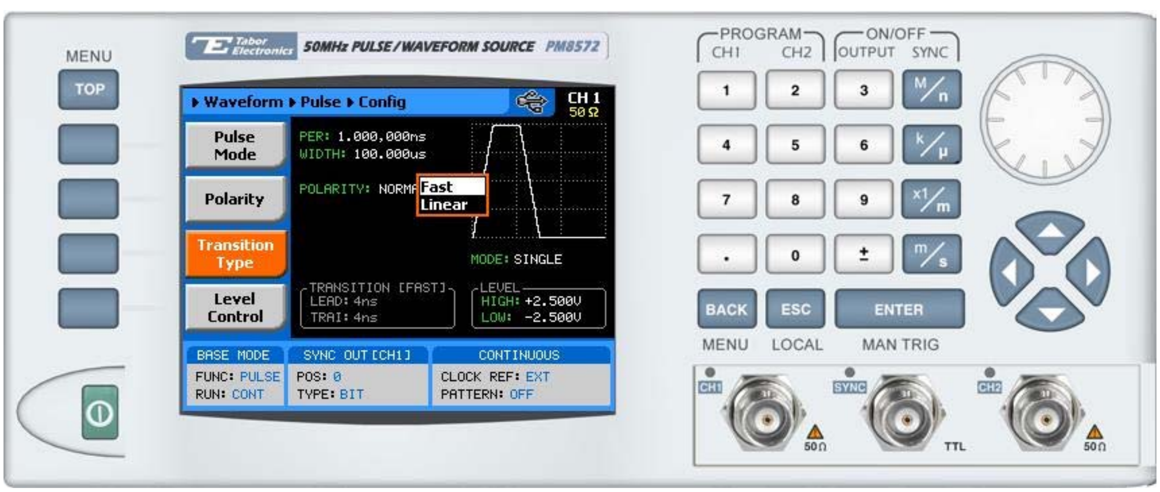


Figure 3-36, Programming the Transition Type

After you select the linear transition option, you'll probably want to program the transition times for the leading and trailing edges. There are some considerations to observe before you program the transitions. First, note the limits, as specified in Appendix A. These tell you that you can set transition times within the range of 5 ns to 5 ms. Then you have to make sure that the transition settings do not conflict with the pulse width settings. For example, if you set the pulse width to 100 ns and the leading edge transition time to 120 ns, the instrument will not allow you to do the change. A list of setting conflicts is given later in this chapter.

Finally, you have to bear in mind that the transition times are programmed in six ranges and further, both the leading and the trailing edges must be programmed within the same range.

TIP

Setting conflict may occur if the leading and trailing edges are not programmed within the same range. To avoid such an error, the leading edge value ALWAYS sets the range for the trailing edge and therefore, always programs the leading edge first and then program the trailing edge.

Transition time rages are shown in Figure 3-37. Note that there are six overlapping ranges that you may use. In-range ratio between minimum to maximum values is 20:1, except the first range that has a 10:1 ratio only. Both values for the leading and trailing edges must be placed inside one range only. For example, you may program 37 ns for the leading edge and 480 ns for the trailing edge because both are values within range 2 but if you program 37 ns for the leading edge and 501 ns for the trailing edge, the instrument will issue a setting conflict message and will ignore the setting of the trailing edge.

The trailing and leading edges parameters become available in the main pulse parameters screen, only after you select the linear transitions mode. The linear transitions can be programmed from 5 ns to 5 ms. A sample front panel menu is shown in Figure 3-38.

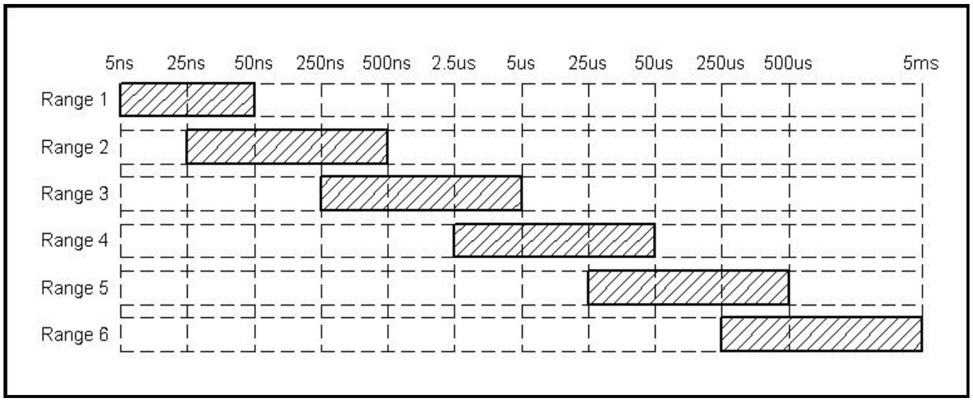


Figure 3-37, Linear Transition Ranges

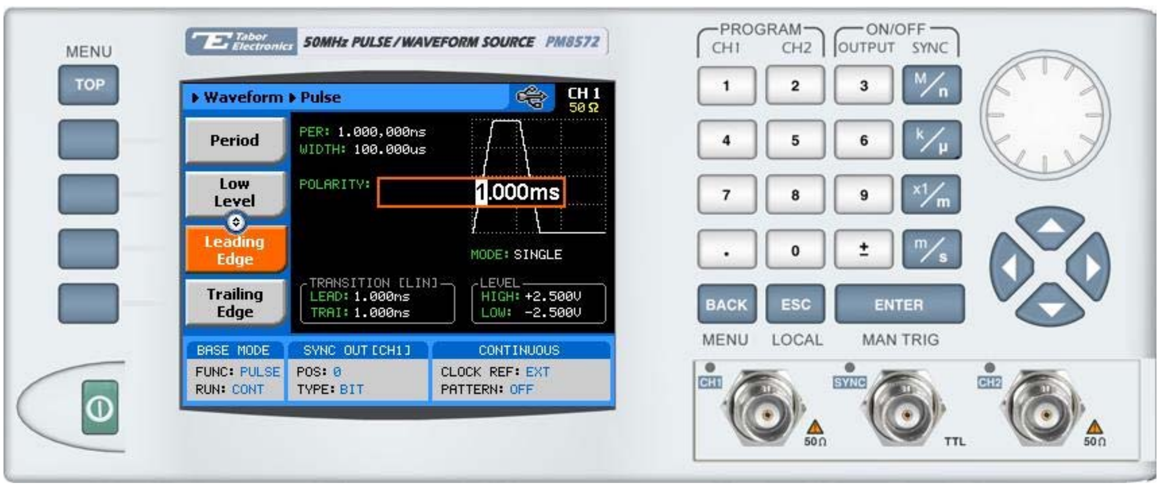


Figure 3-38, Leading Edge Programming Example

Programming the Amplitude Level Mode

Common waveform generators allow adjustment of the peak-to-peak amplitude plus offset, in cases where the required level is none symmetrical about the 0 V level. While this is normally acceptable for generating standard waveforms, pulsed waveforms application require additional flexibility in the way that the levels are set. For example, one may want the base line to stay on 0V regardless of the top or the low peaks settings. Other applications could require separate adjustments of each level and so on.

Using the PM8572A as your pulse source, you have four options to set up the pulse levels, these are shown in Figure 3-39 and explained below:

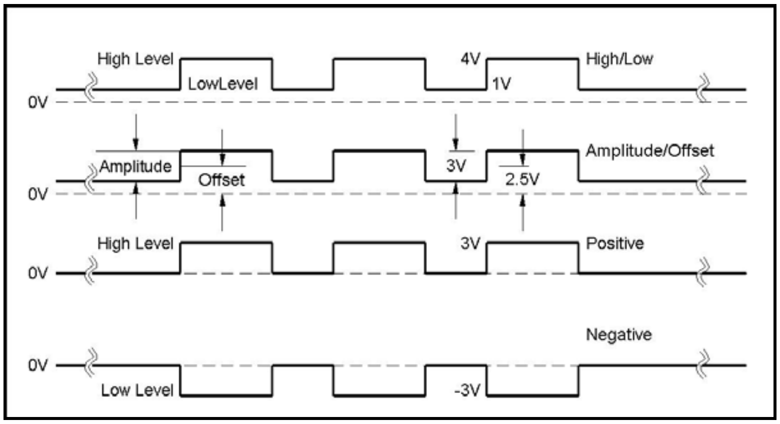


Figure 3-39, Amplitude Level Modes Options

1. ***High/Low Levels.*** This is the default option. Using this mode, you program the high and the low levels directly and let the instrument set the internal amplitude and offset according to your selection. The maximum amplitude that can be programmed is 16 V peak to peak. The achieve this level, program the low level to -8 V and the high level to +8 V. Note that although the specified maximum peak to peak amplitude is 16 V, the high and low level can not exceed the ±8 V rail limits. Also note that the amplitude level is specified when the pulse is applied on a 50Ω load impedance. The only way to exceed the peak to peak rail limitation is by increasing the load impedance but then expect degradation of the pulse shape. The example in Figure 3-39 shows the high level set at 4 V and the low level set at 1 V and hence the resulting peak-to-peak level is 3 V.
2. ***Amplitude/Offset.*** This option allows separate modification of the amplitude and the offset. This option is very useful when you want to vary the vertical position of the pulse but hold the peak to peak amplitude level fixed. Obviously, when the amplitude is set to 16 Vp-p, offsetting the signal is not possible because of the ±8 V rail limits. The example in Figure 3-39 shows the amplitude set at 3 V and the low level set at 2.5 V and hence the resulting waveform is exactly as was programmed in the high/low level programming example.
3. ***Positive.*** This option is very useful when you want to vary the positive position of the pulse but hold the low level fixed at the 0 V level. The example in Figure 3-39 shows the high level set at 3 V and the low level fixed at 0 V. Modification of the high level will not alter the low level position. Note that in this case the peak to peak amplitude is limited to 8 Vp-p because the high level setting can not exceed the +8 V rail limit.

4. ***Negative.*** This option is very useful when you want to vary the negative position of the pulse but hold the high level fixed at the 0 V level. The example in Figure 3-39 shows the low level set at -3 V and the high level fixed at 0 V. Modification of the low level will not alter the high level position. Note that in this case the peak to peak amplitude is limited to 8 Vp-p because the low level setting can not exceed the -8 V rail limit.

The amplitude level options are selected in the configuration menus, after you select the Level Control tab, as shown in Figure 3-40.

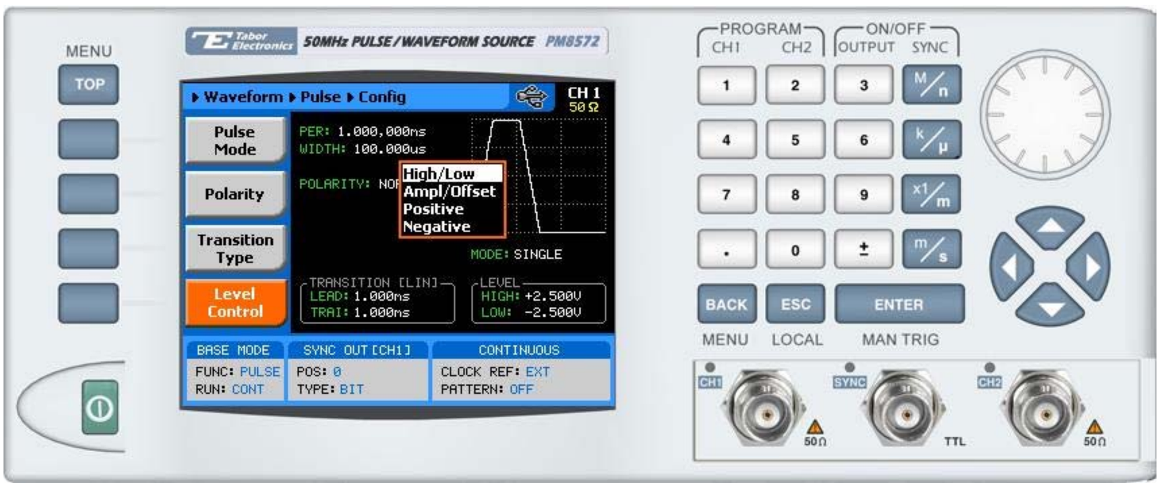


Figure 3-40, the Amplitude Level Control Options

Pulse Design Limitations

There are a number of limitations that must be observed before you program pulse parameters. These limitations are grouped into two groups: Timing limitations and amplitude limitations. The limitations arise from fact that the instrument has a finite frequency range and a finite amplitude span. These limitations are summarized in Appendix A of this manual. For example, the maximum peak to peak amplitude span for a given pulse design is 16 V and further limitation is that the positive and negative settings can not exceed the output amplifier rails of +8 V and -8 V. Another example is the leading and trailing edge transition times. This is limited, by design, to 5 ns minimum and therefore, faster transitions can not be programmed into the instrument.

Besides design limitations, one may enter into a conflicting situation where one parameter exceeds its limits when programmed in conjunction with another parameter. For example, programming a period of 10 ms and pulse width of 100 ms is not possible because, by definition, the pulse width must be smaller than the period. The paragraphs below summarize possible settings conflicts and devises options to undo the lockup. In case you try to program a parameter that will cause a setting conflict, the instrument will automatically detect the problem and issue an error message. In this case, the output may appear distorted and generate uncontrolled signals. Under no circumstances you may use the output when an error is displayed, even if the signal appears to look somewhat as expected because there is not control over accuracy and signal integrity when an error message is displayed.

Settings Conflict Errors

Settings conflict errors may involve one or more parameters and there is also a chance that more than one error is embedded in the settings. For simplicity, the PM8572A displays the first error it detects. In this case the output does not change but displays an error message. Each error is indicated by a number and short description. The same numbers are used as error codes for remote programming and the short description come to give clues which of the parameters conflict. Detailed description for each of the conflicting settings is given below.

Settings conflict errors may occur when you program one channel but fail to notice that parameters are affected on the other channel. For this purpose, the error codes have three digits, 1xx and 2xx where 1xx describe setting conflicts on channel 1 and 2xx describe setting conflicts on channel 2.

Note

The following abbreviations were used throughout the following settings conflicts descriptions:

PER – Period setting
HIL – High level setting
LOL – Low level setting
WID – Pulse width setting
DEL – Delay setting
LEE – Leading edge setting
TRE – Trailing edge setting
BUR – Burst count setting
ITRG – Period of internal trigger setting

Error 101 (CH1), Error 201 (CH2)

Error 101 (201) occurs when attempting to program an amplitude which is smaller than the specified limits. This error will occur in all run mode options. When such an error is detected, the following message will display:

HIL – LOL ≤ 16 mV

This error will be detected on all of the pulse modes and options. The minimum level is an absolute value that the PM8572A can accept. The same will occur if you reverse the high and low levels because the instrument will sense it as a negative voltage, which is obviously less than the minimum 16 mV limit.

Note that when you try to exceed the amplitude level, this error will xsbe detected by a separate mechanism that is common to all of the operating modes of the instrument and is not just unique to the operation of the pulse. In this case, the instrument will simply not let you exceed the limits.

Corrective Actions

1. Increase the high level value
2. Decrease the low level value

Error 102 (CH1), Error 202 (CH2)

Error 102 (202) occurs when attempting to program a pulse width value that is larger than the programmed pulse period. This error may occur in single pulse mode only and in continuous run mode. When this error is detected, the following error will display:

WID + 0.625(LEE + TRE) ≥ PER

When such an error occurs, the output would have looked distorted, as illustrated in Figure 3-41 (red line). To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the pulse width value
2. Increase the pulse period value, or
3. Decrease the leading edge value
4. Decrease the trailing edge value

Error 103 (CH1), Error 203 (CH2)

Error 103 (203) occurs when attempting to program a pulse width value that is larger than the programmed period of the internal trigger generator. This error may occur when the instrument is set to trigger on its internal trigger generator. When this error is detected, the following message will display:

WID + 0.625(LEE + TRE) ≥ ITRG

When such an error occurs, the output would have looked distorted, as illustrated in Figure 3-40 (red line). To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the pulse width value
2. Increase the period of the internal trigger generator
3. Decrease the leading edge value
4. Decrease the trailing edge value

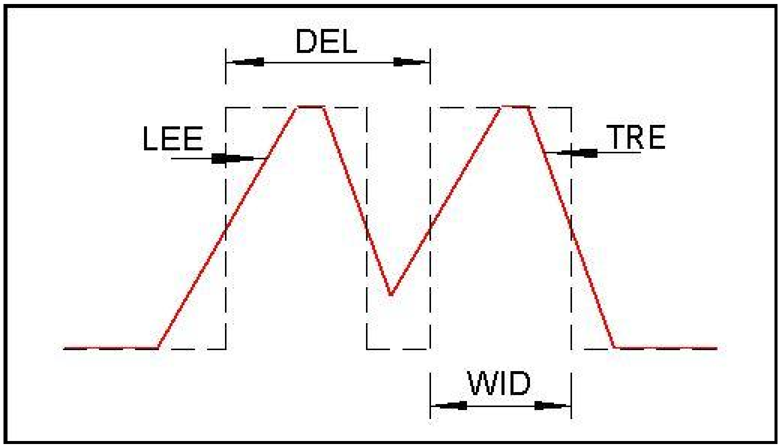


Figure 3-41, Output Waveform with Error 102 (202) Example

Error 104 (CH1), Error 204 (CH2)

Error 104 (204) occurs when attempting to program a delay to the pulse width value that is larger than the programmed pulse period. This error may occur in delayed and double pulse modes and in continuous run mode. When this error is detected, the following error will display:

DEL + WID + 0.625(LEE + TRE) + 4 ns ≥ PER

When such an error occurs, the output would have looked distorted, as illustrated in Figure 3-41 (red line). To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the delay value
2. Decrease the pulse width value
3. Increase the pulse period value, or
4. Decrease the leading edge value
5. Decrease the trailing edge value

Error 105 (CH1), Error 205 (CH2)

Error 105 (205) occurs when attempting to program a delay to the pulse width value that is larger than the programmed period of the internal trigger generator. This error may occur in delayed and double pulse modes when the instrument is set to trigger on its internal trigger generator. When this error is detected, the following error will display:

DEL + WID + 0.625(LEE + TRE) + 4 ns ≥ ITRG

When such an error occurs, the output would have looked distorted, as illustrated in Figure 3-42 (red line). To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the delay value
2. Decrease the pulse width value
3. Increase the period of the internal trigger generator
4. Decrease the leading edge value
5. Decrease the trailing edge value

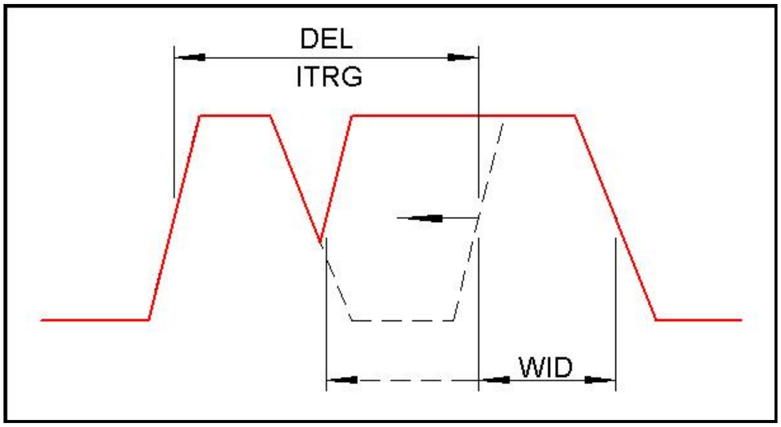


Figure 3-42, Output Waveform with Error 104 (204) Example

Error 106 (CH1), Error 206 (CH2)

Error 106 (206) occurs when attempting to program leading or trailing edge values that are smaller than the programmed pulse width. This error may occur in all pulse and run modes except in external pulse width pulse mode.

When this error is detected, the following message will display:

0.625(LEE + TRE) ≥ WID

When such an error occurs, the output would have looked distorted, as illustrated in Figure 3-43 (red line). To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Increase the pulse width value
2. Decrease the leading edge value
3. Decrease the trailing edge value

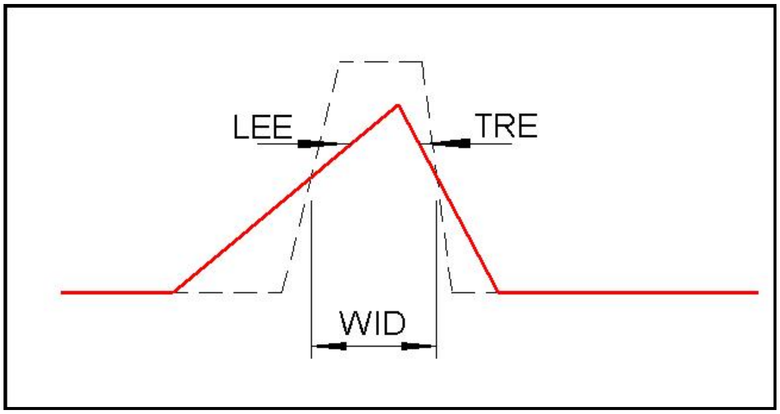


Figure 3-43, Output Waveform with Error 106 (206) Example

Error 107 (CH1), Error 207 (CH2)

Error 107 (207) occurs when attempting to program leading or trailing edge values that are larger than the programmed delay. This error may occur in delayed or double pulse modes only and in conjunction of all run modes. When this error is detected, the following message will display:

WID + 0.625(LEE + TRE) ≥ DEL

When such an error occurs, the output would have looked distorted, as illustrated in Figure 3-44 (red line). To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the pulse width value
2. Increase the delay value
3. Decrease the leading edge value
4. Decrease the trailing edge value

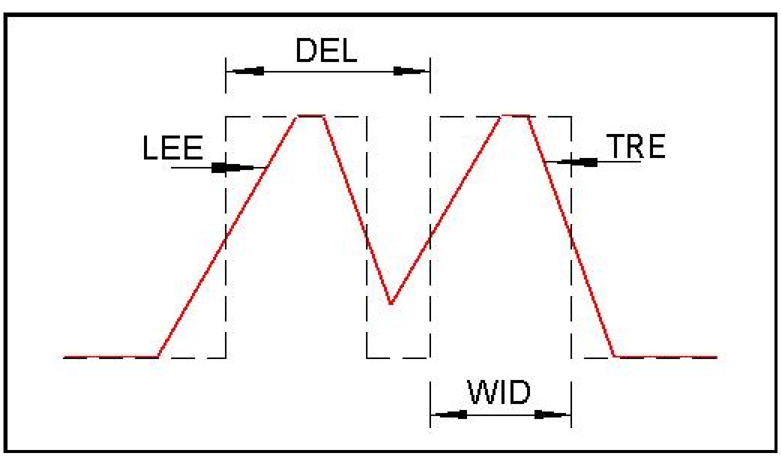


Figure 3-44, Output Waveform with Error 107 (207) Example

Error 108 (CH1), Error 208 (CH2)

Error 108 (208) occurs when attempting to program a counted burst value that is larger than the programmed period of the internal trigger generator. This error may occur in single delayed and double pulse modes and in counted burst run mode when the instrument is set to trigger on its internal trigger generator. When this error is detected, the following message will display:

(BUR x PER) +4 ns ≥ ITRG

When such an error occurs the output would have looked distorted, as illustrated in Figure 3-45 (red line). To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the period value
2. Decrease the counted burst value
3. Increase the period of the internal trigger generator

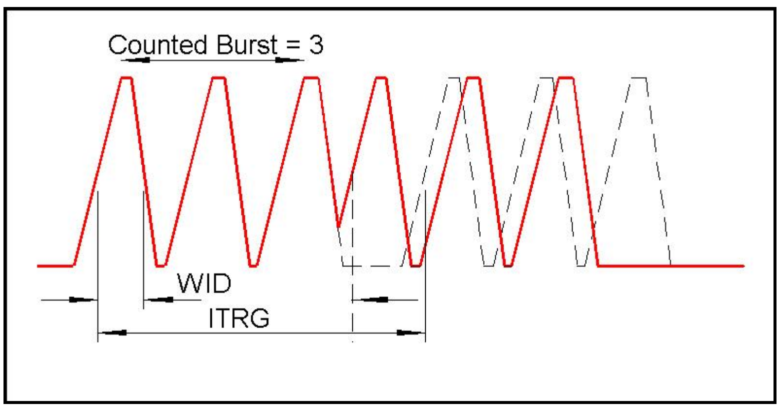


Figure 3-45, Output Waveform with Error 108 (208) Example

Error 110 (CH1), Error 210 (CH2)

Error 110 (210) occurs when attempting to program the trailing edge value outside of the leading edge range. This error may occur in all pulse modes except external pulse width and in all run modes. When this error is detected, the following message will display:

LEE & TRE ≠ In Range

To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Re-program the leading and trailing edge values to be within the same range as shown in Figure 3-37.

Error 111 (CH1), Error 211 (CH2)

Error 111 (211) occurs when attempting to program the trailing edge value outside of the leading edge range. This error may occur in positive and negative pulse level modes and in all run modes. When this error is detected, the following message will display:

2 * LEE and 2 * TRE ≠ In Range

To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Re-program the leading and trailing edge values (x2) to be within the same range as shown in Figure 3-37.

Error 112 (CH1), Error 212 (CH2)

Error 112 (212) occurs when attempting to program either the leading edge or the trailing edge value but the x2 factor causes either one to go outside of the edge range. This error may occur in positive and negative pulse level modes and in all run modes. When this error is detected, the following message will display:

2 * LEE or 2 * TRE ≠ In Range

To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

2. Re-program the leading and trailing edge values (x2) to be within the same range as shown in Figure 3-36.

Error 113 (CH1), Error 213 (CH2)

Error 113 (213) occurs when attempting to program the high level below 8 mV. This error may occur in positive normal or positive complemented pulse level modes and in all run modes. When this error is detected, the following message will display:

HIL ≤ 8 mV

To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Increase the high level value above 8 mV.

Error 114 (CH1), Error 214 (CH2)

Error 114 (214) occurs when attempting to program the low level above -8 mV. This error may occur in negative normal or negative complemented pulse level modes and in all run modes. When this error is detected, the following message will display:

LOL ≥ -8 mV

To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the low level value below -8 mV.

Error 115 (CH1), Error 215 (CH2)

Error 115 (215) occurs when attempting to program the low level above -8 mV. This error may occur in positive inverted pulse level modes and in all run modes. When this error is detected, the following message will display:

LOL ≥ -8 mV

To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

2. Increase the high level value above 8 mV.

Error 116 (CH1), Error 216 (CH2)

Error 116 (216) occurs when attempting to program the high level below 8 mV. This error may occur in negative inverted pulse level modes and in all run modes. When this error is detected, the following message will display:

HIL ≤ 8 mV

To correct the problem and to restore the pulse generator to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Increase the high level value above 8 mV.

PWM Setting Conflict Errors

PWM settings conflict errors are unique for this mode only. Such errors may involve one or more parameters and there is also a chance that more than one error is embedded in the settings. Since PWM mode is available on channel 1 only, there is no need to worry about settings on the channel 2.

For simplicity, the PM8572A displays the first error it detects. In this case the output does not change but displays an error message.

Each error is indicated by a number and short description. The same numbers are used as error codes for remote programming and the short description come to give clues which of the parameters conflict. Detailed description for each of the conflicting settings is given below.

Note

The following abbreviations were used throughout the following settings conflicts descriptions:

PER – Pulse period setting

WID – Pulse width setting

DEV – Modulation deviation setting

LEE – Leading edge setting

TRE – Trailing edge setting

ITRG – Period of internal trigger setting

MPER – Period of the modulating waveform

Where MPER = PER x number of waveform points that are used for building the modulating waveform.

Error 117

Error 117 occurs when attempting to program a deviation value that will cause the pulse width to exceed the period setting. This error may occur in all run modes. When this error is detected, the following message will display:

PER – 0.625(LEE-TRE) – WID(1+DEV/100) ≤ 40 ns

To correct the problem and to restore the PWM function to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Reduce the deviation value
2. Increase the period value
3. Reduce the pulse width value

Error 118

Error 118 occurs when attempting to program a deviation value that will cause the pulse width to exceed the minimum value. This error may occur in all run modes. When this error is detected, the following message will display:

WID(1-DEV/100) ≤ 10 ns

To correct the problem and to restore the PWM function to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Reduce the deviation value
2. Increase the pulse width value

Error 119

Error 119 occurs when attempting to program a deviation value that will cause the pulse width to exceed the maximum value. This error may occur in all run modes. When this error is detected, the following message will display:

WID(1-DEV/100) ≥ 670 ms

To correct the problem and to restore the PWM function to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Reduce the deviation value
2. Decrease the pulse width value

Error 120

Error 120 occurs when the number of points to create the modulating waveform is too less for the resulting pulse PWM period. This error may occur in all run modes. When this error is detected, the following message will display:

MPER < 4 points

To correct the problem and to restore the PWM function to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Increase the period of the modulating waveform

Error 121

Error 121 occurs when the number of points to create the modulating waveform is too high for the resulting pulse PWM period. This error may occur in all run modes. When this error is detected, the following message will display:

MPER > 2048 points

To correct the problem and to restore the PWM function to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the period of the modulating waveform

Error 122

Error 122 occurs when the period of the modulating waveform is larger than the period of the internal trigger generator. This error may occur in all triggered run mode only and when the selected trigger source internal. When this error is detected, the following message will display:

MPER > ITRG

To correct the problem and to restore the PWM function to normal operation, proceed with one or more of the following corrective action options.

Corrective Actions

1. Decrease the period of the modulating waveform
2. Increase the period of the internal timer

Inter-Channel Dependencies

Bear in mind that while most of the pulse parameters may be programmable independently for each channel, some modes and parameters are shared across the channels. For example, period and run modes are common for both channels but different amplitudes and different pulse widths can be programmed for each channel.

In general, and for the simplicity of the settings, it is recommended that both channels are programmed to operate in the same pulse mode however, this is not mandatory, the PM8572A was designed in a way that allows complete freedom to program each channel the way you desire. For example, you may program channel 1 to operate in double pulse mode and channel 2 to operate in hold duty cycle pulse mode, which is a special case of single pulse mode. However, when you program each channel to have a unique pulse mode, you have to be extra careful not to breach settings of one channel with the settings of the other channel. Setting conflicts were summarized and discussed above so if you get into a setting conflict situation, you will be able to bail out only if you adjust the parameters as suggested in the setting conflicts section.

The following parameters may be programmed separately for each channel: Pulse width, Duty Cycle, Delay, Double Pulse Delay, High and Low Levels, Amplitude and Offset, Leading and Trailing edges Transition time and Pulse Polarity.

Finally, there are two pulse modes that behave differently. These are: External Pulse Width and PWM.

In External Pulse Width mode, the period and the width of the pulses are being derived from an external signal. The parameters that control the shape of the signal are trigger level and trigger slope; These can be programmed separately for each channel. When you place one channel in external pulse width mode and the other in any other pulse mode, the controlling input (TRIG IN connector) is automatically associated with the channel that is set to operate in external pulse width mode. When both channels are programmed for the external pulse width mode, the controlling input is automatically routed to both channels in parallel and hence you may source this mode from one input but the resulting outputs can be different for separate trigger levels and trigger slopes.

The PWM (pulse width modulation) mode is the only mode that is associated with a single channel only – channel 1. Therefore, if you need to modulate your signal, channel 1 is the selected channel; The other can be programmed to generate any other mode that you desire.

Generating Standard Waveforms

The majority of applications require the use of common waveforms such as sinusoidal, triangular and square. In fact, these are the only waveforms that function generators can produce and therefore, one should expect that these waveforms be available even in a complex generator such as this. The PM8572A, being a completely digital instrument, has a library of built-in waveforms that allow generation of these basic waveforms plus many more.

By default, the PM8572A is programmed to generate pulse waveform however, modifying the output to generate standard waveforms is done in a second. Just use the procedure as given in the Selecting a Waveform Type section of this chapter to access the top menu and from there the way is clear to access the standard waveforms menus. One of the readily used waveform in the market is sine waveform but there are many other waveforms that can be selected.

Figure 3-46 shows a list of waveforms that the instrument can generate however, one must not forget that the waveforms are generated digitally from either lookup tables or formulated from standard equations and therefore, each time a new waveform is selected, one should expect to have a slight delay between the time the waveform was selected to when it is being generated at the output connector.

The waveforms that reside in the built- in library are referred to as Standard Waveforms. The meaning of this term is that these waveforms have standard characteristics that are commonly associated with these waveforms. For example, sine waveform has known spectral and power distribution that could be compared to published mathematical equations. The quality of the generator determines the proximity of the waveform generation to its pure mathematical expression.

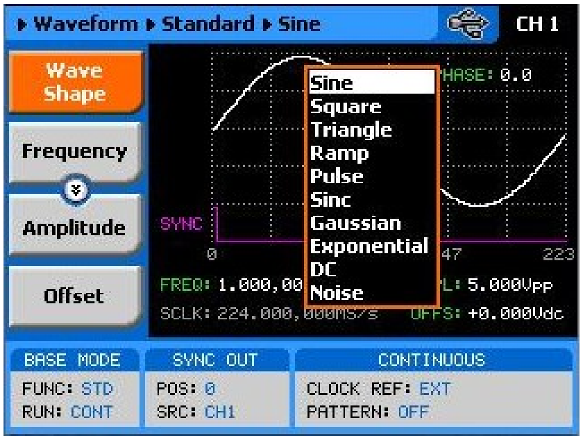


Figure 3-46, Built-in Standard Waveforms Menu

The PM8572A has a library of 9 standard waveforms: Sine, Triangle, Square, Ramp, pulse, sinc, Gaussian, Exponential, DC and Noise. Some of the parameters for these waveforms can be modified to fine tune the waveforms for specific applications. For example, changing the sine start phase of the 2nd channel can create a 2-phase sine system. The standard waveforms and their parameters that can be modified are summarized in the following paragraphs.

Sine Wave

The sine waveform is the most commonly used waveform. The waveform is generated from a lookup table that has 1000 points and therefore, the sine waveform is generated with 1000-points accuracy up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically up to a point where filters are being switched in to reconstruct the waveform. The technique of generating sine waves above certain frequency is not within the scope of this manual however, one should remember that above certain frequency the waveform is loosing purity and quality because the number of points that are available to construct the waveform are inversely proportional to the output frequency. This statement is true for all standard waveforms and this is the reason for limiting the upper frequency of certain waveforms.

There are certain menus that provide access to sine waveform parameters; These are:

Frequency – programs the frequency of the sine waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Phase – sets the start phase of the output waveform. You will not be able to see any change in the waveform if you generate a continuous sine waveform however, if you place the generator in triggered run mode, the output will start the sine wave generation from a point defined by the Phase parameter. The start phase is programmed in units of degree.

Reset Parameters – Resets the sine wave parameters to their original factory defaults.

Square Wave

The square waveform is a commonly used waveform. The waveform is generated from a lookup table that has 1000 points and therefore, the square waveform is generated with 1000-points accuracy up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically.

There are certain menus that provide access to square waveform parameters; These are:

Frequency – programs the frequency of the square waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Duty Cycle – programs the square wave duty cycle (pulse width to period ratio). The duty cycle is programmed as percent of the period. The default value is 50%.

Reset Parameters – Resets the square wave parameters to their original factory defaults.

Triangle Wave

The triangle waveform is a commonly used waveform. The waveform is generated from a lookup table that has 1000 points and therefore, the triangle waveform is generated with 1000-points accuracy up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The triangular waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape becomes distorted to a point where it is not usable anymore.

There are certain menus that provide access to triangle waveform parameters; These are:

Frequency – programs the frequency of the triangle waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Phase – sets the start phase of the output waveform. You will not be able to see any change in the waveform if you generate a continuous triangular waveform however, if you place the generator in triggered run mode, the output will start the triangle wave generation from a point defined by the Phase parameter. The start phase is programmed in units of degree.

Reset Parameters – Resets the triangular wave parameters to their original factory defaults.

Ramp Wave

The ramp waveform is a special case of the triangular waveform with a slight difference, the ramp can be adjusted for its rise and fall times. The ramp waveform is a very common waveform and is required for numerous applications however, not being a true ramp generator, the ramp parameters are computed and programmed as percent of the ramp period. The waveform is computed every time a parameter is modified. 1000 points are allocated for the ramp shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The ramp waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the resolution of the parameters is lost to a point where it is not usable anymore.

There are certain menus that provide access to ramp waveform parameters; These are:

Frequency – programs the frequency of the ramp waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Delay – sets the delay time for the ramp start. The delay is programmed as percent of the ramp period.

Rise – programs the ramp rise time. The rise time is programmed as percent of the ramp period.

Fall – programs the ramp fall time. The fall time is programmed as percent of the ramp period.

Note that the sum of the delay, rise and fall times cannot exceed 100%. If the sum is less than 100%, the end of the ramp will remain at a dc level to the completion of the period.

Reset Parameters – Resets the ramp wave parameters to their original factory defaults.

Pulse Wave

The pulse waveform is a very common waveform and is need for the majority of the applications however, bear in mind that this function is different than the pulse generation function that was described earlier in the manual. The pulse generator that appears in the standard waveforms menu is created digitally in the arbitrary waveform memory and has limited control over pulse parameters.

Note

The pulse waveform in the standard waveforms list has limited control over pulse parameters and modes. This waveform is recommended for simple applications only. Real pulse control is offered with the Pulse Generator waveforms that can be selected from the Waveforms menu. Information how to access and operate the analog pulse generator function is given in the Pulse Waveform Generation section, earlier in this chapter.

As was mentioned before, the pulse waveform that is selected from the standard waveforms menu is created digitally and its parameters can only be computed and programmed as percent of the pulse period. Further, the waveform is computed every time a parameter is modified. 1000 points are allocated for the pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the resolution of the parameters is lost to a point where it is not usable anymore.

There are certain menus that provide access to pulse waveform parameters; These are:

Frequency – programs the frequency of the pulse waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Delay – sets the delay time for the ramp start. The delay is programmed as percent of the ramp period.

Rise – programs the ramp rise time. The rise time is programmed as percent of the ramp period.

Fall – programs the ramp fall time. The fall time is programmed as percent of the ramp period.

Note that the sum of the delay, rise, high and fall times cannot exceed 100%. If the sum is less than 100%, the end of the pulse will remain at a dc level to the completion of the period.

Reset Parameters – Resets the pulse wave parameters to their original factory defaults.

Sinc Wave

The sinc pulse (sine x/x) waveform is a very common waveform and is required in many applications however, not being a true pulse generator, the sinc pulse parameters are re-computed every time a parameter is changed. 1000 points are allocated for the sinc pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The sinc pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape of the pulse is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to sinc pulse waveform parameters; These are:

Frequency – programs the frequency of the sinc waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

#Cycles – sets the number of “0” crossing cycles for the sinc function. Note that the default value is 4. Changing the value to a different number requires re-calculation of the waveform and may take a few seconds until the waveform is computed and generated at the output connector.

Reset Parameters – Resets the sinc pulse wave parameters to their original factory defaults.

Gaussian Wave

The gaussian pulse waveform is useful in many applications. The gaussian pulse parameters are re-computed every time a parameter is changed. 1000 points are allocated for the gaussian pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The gaussian pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape of the pulse is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to gaussian pulse waveform parameters; These are:

Frequency – programs the frequency of the sinc waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Exponent – sets the exponent factor for the gaussian function. Changing the default exponent value to a different number requires re-calculation of the waveform and may take a few seconds until the waveform is computed and generated at the output connector.

Reset Parameters – Resets the gaussian pulse wave parameters to their original factory defaults.

Exponential Wave

The exponential pulse waveform is useful in applications simulating capacitor charge or discharge. Not being a true pulse generator, the exponential pulse parameters are re-computed every time a parameter is changed. 1000 points are allocated for the exponential pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The exponential pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape of the pulse is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to sinc pulse waveform parameters; These are:

Frequency – programs the frequency of the sinc waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Exponent – sets the exponent factor for the exponential function. Setting the exponent to a negative value inverts the exponential function. Changing the default exponent value to a different number requires re-calculation of the waveform and may take a few seconds until the waveform is computed and generated at the output connector.

Reset Parameters – Resets the exponential pulse wave parameters to their original factory defaults.

DC Wave

The DC waveform is useful applications requiring simply an accurate DC level.

There are certain menus that provide access to the DC waveform parameters; These are:

DC Level – programs the level of the DC output function. The amplitude is programmed in units of volts and generated continuously at the output connector in a similar way as a power supply generates its output. Note however, that the amplitude is calibrated when the output is terminated into 50Ω load impedance.

Reset Parameters – Resets the DC amplitude parameter to its original factory default.

Noise Wave

The noise waveform is useful in applications requiring generation of simple noise. The spectral spread of the noise is pseudo-random and is limited in its bandwidth by the bandwidth parameter. The noise parameters are re-computed every time a parameter is changed. 1000 points are allocated for the noise shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The noise waveform is reasonable up to about 2.5MHz where 100 points are available to generate its shape. As the number of points decrease further, the shape of the noise is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to noise waveform parameters; These are:

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Bandwidth – sets the sample clock rate which generates the noise. It also serves as a simple tool to limit the bandwidth of the noise to a know value.

Note that while generating noise, bear in mind that the noise is generated in a certain memory size and it is being repeated over and over until the function is disabled. Therefore, the noise is not really random as is the pure translation of the word.

Reset Parameters – Resets the gaussian pulse wave parameters to their original factory defaults.

Generating Arbitrary Waveforms

In general, the Model PM8572A cannot by itself create arbitrary waveforms. If you want to use arbitrary waveforms, you must first load them into the instrument. The PM8572A is supplied with waveform creation and editing, called – ArbConnection. Besides waveform generation, ArbConnection has instrument control features, sequence table generator, FM and pulse composers and many other features that will be described separately. Figure 3-47 shows an example of a waveform that was created with the ArbConnection. Once the waveform is created on the screen, downloading it to the PM8572A is just a click of a mouse away.

Detailed information on the structure of the arbitrary waveform and the commands that are needed to download arbitrary waveforms to the PM8572A is given in Chapter 5. Information in this Chapter will give you some general idea what arbitrary waveforms are all about.

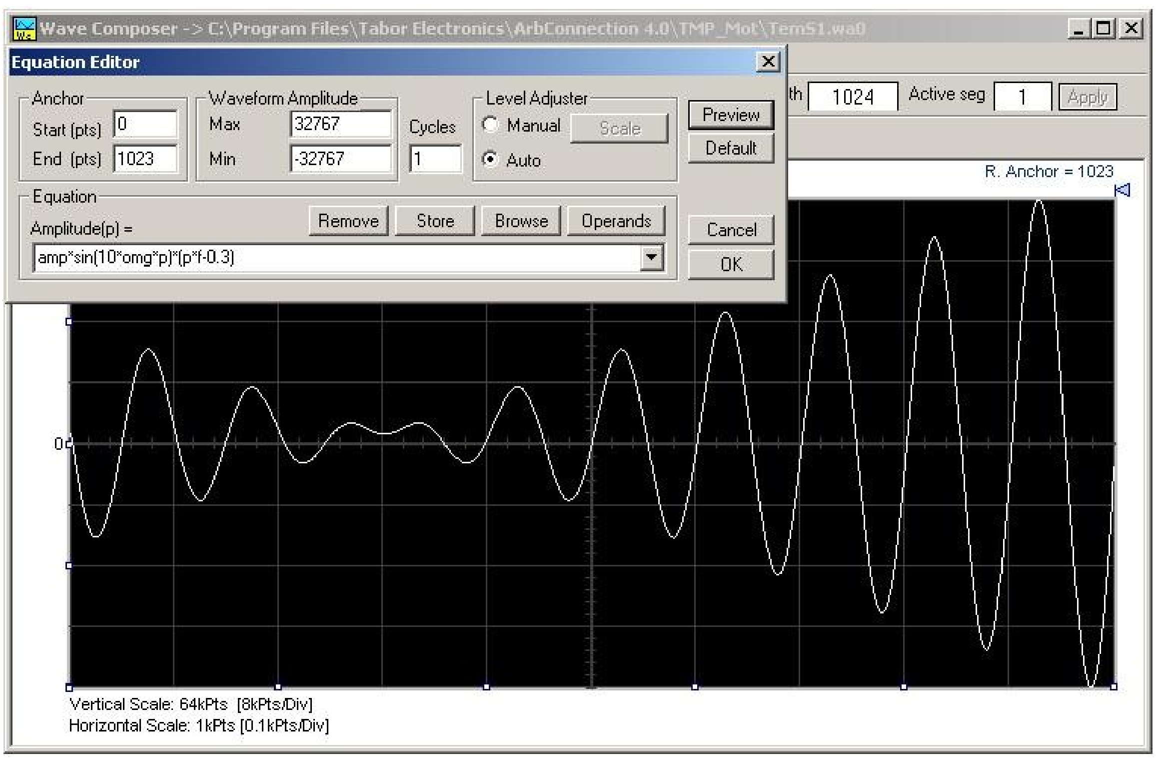


Figure 3-47, the Wave Composer Tool for Generating Arbitrary Waveforms

What Are Arbitrary Waveforms?

Arbitrary waveforms are generated from digital data points, which are stored in a working memory. The working memory is connected to a digital to analog converter (DAC) and a sample clock generator is clocking the data points, one at a time, to the output circuit. In slow motion, the output generates a waveform that resembles the look of a staircase. In reality, the DAC is generating amplitude hops that depend on bit arrangement and sample clock speed.

The working memory has two major properties: vertical resolution and memory depth.

Vertical Resolution – This term defines the precision along the vertical axis of which data points can be placed and generated by the DAC. The PM8572A is using 16-bit DAC's to generate arbitrary waveforms. Converting 16 bits to precision shows that each data point can be placed along the vertical axis with a precision of 1/65,536.

Memory Depth – Defines how many data points can be stored for a single waveform cycle. The PM8572A has 1M basic waveform memory capacity and 2M and 4M waveform memory as an option.

Having such large memory capacity is an advantage. Modern applications in the telecommunications industry require simulation of long waveforms without repeatable segments. The only way to create such waveforms is having sufficient memory depth. On the other hand, if you do not need to use very long waveforms but must have many other waveforms stored in your working memory, the PM8572A lets you divide the memory bank to smaller segments and load different waveforms into each segment.

Generating Arbitrary Waveforms

Downloading waveforms to the PM8572A and managing arbitrary memory are explained in the programming section of this manual. This section assumes that you have already downloaded waveforms and want the instrument to output these waveforms.

Refer to Figure 3-48 and use the following description to learn how to output arbitrary waveforms and how to program arbitrary waveform parameters. To select Arbitrary waveforms as the output waveform type press Waveforms, then Arbitrary. The screen as shown in Figure 3-48 will display and the output will already generate arbitrary waveforms. Note the channel you are currently program and make sure the icon at the upper right corner agrees with your required programming sequence. Use the following procedure to modify the parameters that are associated with the arbitrary waveform function:

1. Press the soft key next to the required parameter to display the edit field
2. Punch in the value using the numeric keypad. Be careful not to exceed parameter limits while you key the numbers
3. Select and press a suffix
4. Press Enter to lock in the new value

Alternately, after you display the edit field, you may use the dial and/or the arrow keys to modify the field then, press Enter to lock in the new value. If you did not make programming errors and did not make any mistake while downloading your waveform segment(s), then the output should generate your desired waveform.

There are four parameters that are available for programming in this window:

Sample Clock – Defines the sample clock frequency for the arbitrary waveform. Information how to modify the sample clock is given in this chapter.

Amplitude – Defines the amplitude of the arbitrary waveform. Note that regardless of the amplitude setting, the vertical resolution of which the waveform is generated is always 14 bits.

Offset – Defines the offset value of the arbitrary waveform. The offset and the amplitude can be freely programmed within a 10V window (+5V to -5V rails).

Segment Number – Defines which of the segments in the working memory is currently active at the output connector. As was discussed earlier, the working memory can be divided to 2k segments and different waveforms loaded in each segment. Any segment is available at the output connector only if it has been selected to be the active segment. The segment selection field lets you select any segment from 1 to n regardless if it contains waveform data or not so be careful when you select a segment number as it may be empty and no output will be generated.

Delete Segments – Allows distractive removal of all segments from the memory. In fact, this command does not erase the memory but only removes the table that defines start and stop for each segment location. If you have recorded your segment sizes you can always re-define the segment table, which will restore the original waveforms in each segment. There is however, no way back if you perform a download action after you delete the segment table.

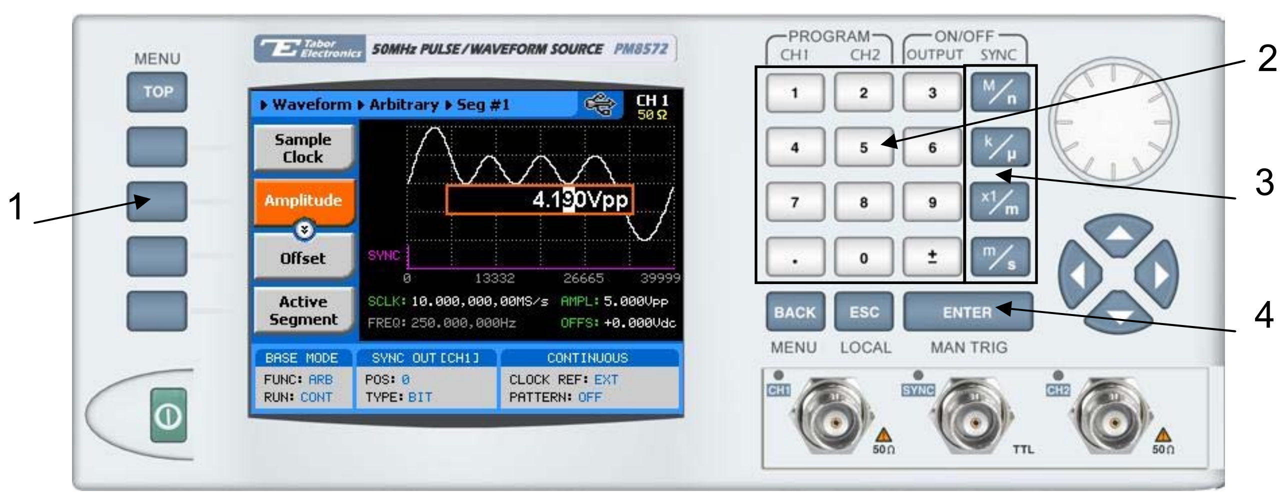


Figure 3-48, Programming Arbitrary Waveform Parameters

Generating Sequenced Waveforms

In general, the Model PM8572A cannot by itself create sequenced waveforms. If you want to use sequenced waveforms, you must first load them into the instrument. The PM8572A is supplied with waveform creation and editing, called – ArbConnection. Besides waveform creation, ArbConnection has instrument control features, sequence table generator, FM composer and many other features that will be described separately. To generate a sequence you must first download waveforms to the instrument, generate a sequence table and download the sequence table to the instrument. Sequences are generated easily using the waveform Studio as demonstrated in Figure 3-49. Note that different sequences can be generated for each channel.

Detailed information on the structure of the arbitrary waveform and the commands that are needed to download arbitrary waveforms to the PM8572A is given in Chapter 4. There, you can also find information how to create and download sequence tables using SCPI programming commands. Information in this chapter will give you some general idea what sequenced waveforms are all about.

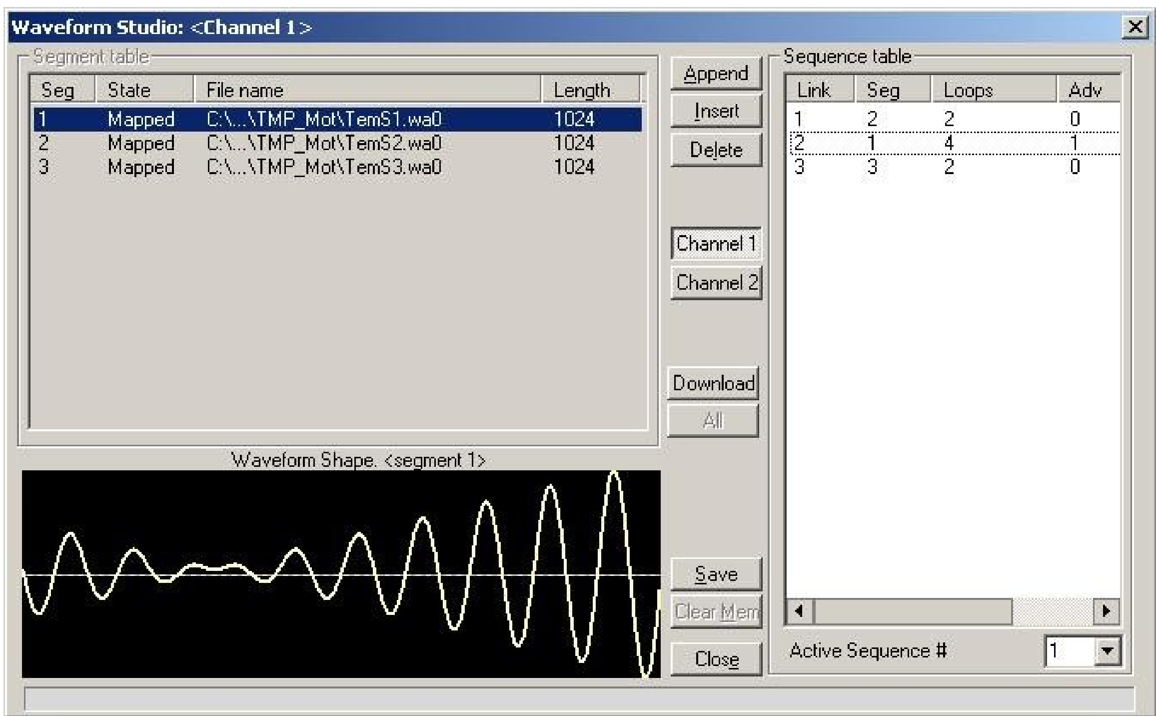


Figure 3-49, Using ArbConnection to Generate Sequences

What Are Sequenced Waveforms?

Sequenced waveforms are constructed from two or more arbitrary waveforms, which are linked and looped in any way you can imagine, as long as you observe the limitations set forth in the specification section of this manual.

The first thing to do before you can generate sequenced waveforms is download waveforms to the PM8572A. You may use ArbConnection or any other application to create waveform segments. Then, you can build your sequence table. An example of how sequenced waveforms work with three different waveforms is demonstrated in Chapter 1, Figures 1-8 through 1-11.

The sequence table, as shown in Figure 3-50, specifies: Link, Seg, Loops and Adv. Description of the various elements within the sequence table is given below.

Link - This parameter defines an index array for the sequence generator. When generating sequences, the instrument steps though the link # in descending order therefore, make sure that you enter your waveform segments in exactly the order you would like them at the output.

Seg - This parameter associates waveform segments with links. You can use different segments for different links or you can use the same segment for a number of links. There are no limitations how you associate links to segments, except you can not program in the sequence table segments that were not defined earlier.

Loops – This parameter define how many times the segment will loop for the selected link. For example, if you program 2, the waveform will cycle twice through the same segment before transitioning to the next link.

Adv – This field is a special code that is used in conjunction with the mixed advance mode. This bit flags the PM8572A if the selected link is continuous or stepped. Information on the Mixed sequence advance mode is given later. “0” flags continuous, “1” flags stepped.

Assuming that you already downloaded waveforms, created and downloaded sequence table, you can proceed with the following description to set the PM8572A to output sequenced waveforms.

Refer to Figure 3-50 and use the following description to learn how to output sequenced waveforms and how to program sequence parameters. To select Sequenced waveforms as the output waveform type press Waveforms, then Sequenced. The screen as shown in Figure 3-50 will display and the output will already generate arbitrary waveforms. Note the channel you are currently program and make sure the icon at the upper right corner agrees with your required programming sequence.

Use the following procedure to modify the parameters that are associated with the Sequenced waveforms function:

1. Press the soft key next to the required parameter to display the edit field
2. Punch in the value using the numeric keypad. Be careful not to exceed parameter limits while you key the numbers
3. Select and press a suffix
4. Press Enter to lock in the new value

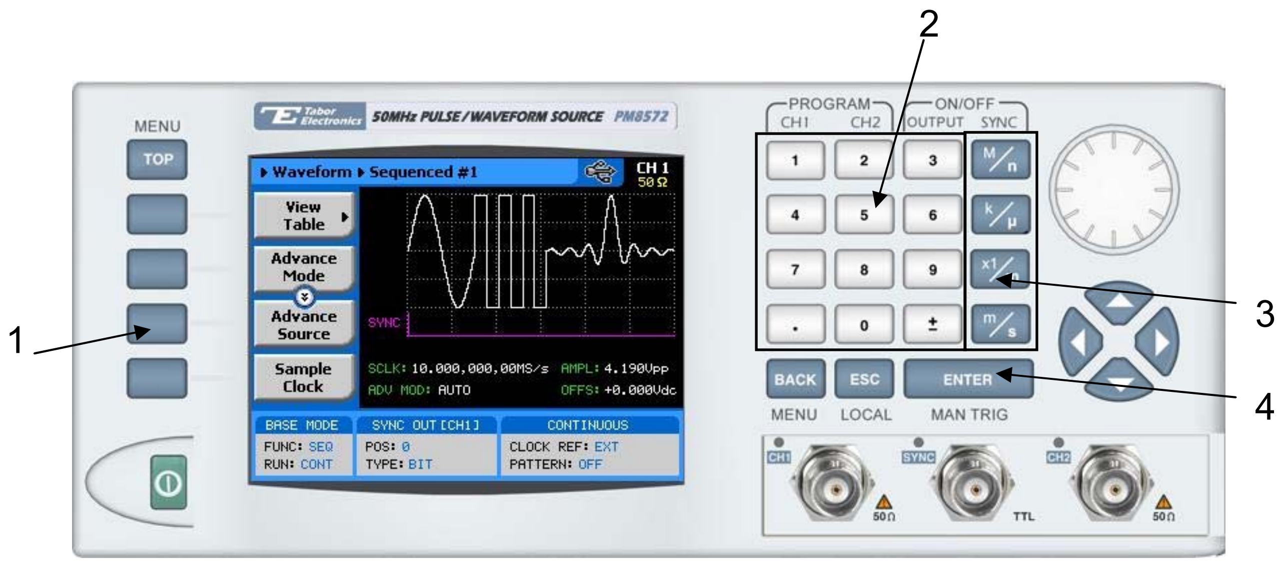


Figure 3-50, Sequence Parameters

Alternately, after you display the edit field, you may use the dial and/or the arrow keys to modify the field then, press Enter to lock in the new value. If you did not make programming errors and did not make any mistake while downloading your waveform segment(s), then the output should generate your desired waveform. There are seven parameters that are available for programming in this window:

View Table – Provides access to a sequence table. If no table was yet defined, you can define the sequence table from this menu. You can also edit an existing sequence table from this command. Information on editing the sequence table is given later.

Advance Mode – Defines the advance mode for the sequence. There are four advance mode options you can select from: Automatic, Stepped, Single and Mixed. A description of the various advance modes is given later. Note that advance mode depends on run mode and therefore, if you selected continuous run mode for the PM8572A, you will not see the Single advance mode in the advance mode options list. Similarly, if you selected triggered run mode, Stepped and Mixed will be omitted from the list.

Advance Source – Defines which of the triggers inputs will advance the sequence. The advance source has no effect on Automatic advance source.

Sample Clock – Programs the sample clock frequency for the sequenced waveform. The final period of the complete sequence can be extracted from the following relationship:

$$\text{Sequence Duration} = 1 / (\text{SCLK} / n)$$

n = the number of waveform points in the sequence, including looped waveforms.

Amplitude – Defines the amplitude of the sequenced waveform.

Offset – Defines the offset of the sequenced waveform.

Active segment – Programs the active segment in a sequence. The SYNC will start at the active segment. There is no other purpose for this parameter in the sequence.

Tip

Use the arrow keys or the dial to scroll through the sequence parameters. The View Table will remain at the top while the others may be accessed selectively.

Editing the Sequence Table

If you select the View option as was described above, the sequence table will display as shown in Figure 3-51. If you already have a sequence table in place, you can edit the steps and modify the table per your new requirements. If you do not have a sequence table, you can construct the table from this screen however, you must make sure first that the segments you intend to use are loaded with waveforms.

Observe Figure 3-51 and note the commands that are available for editing and creating a sequence table.

Apply Changes – After you make modifications to the sequence table, you must use this command to update the internal registers with the new table settings and output updated immediately with the new settings. Changes, if made, in the table will be updated automatically when you exit the Edit Table screen however, the output will change to the new settings only after you re-enter the sequence function.

Edit Step – Provides entry point to the table. You may scroll between the fields using the arrow keys. If you want to edit a specific step, place the cursor on the step and press Enter. Edit the field as required and press Enter again to lock in the new value.

Insert Step – Allows adding another step to the sequence table. You have a choice of adding the step above or below the cursor line or at the end of the sequence table.

Go to Step – Provides entry point to the sequence table at a specific step number. Continue editing the step as described above.

Delete Step – Use this command to delete a specific step from the sequence. You'll be asked to confirm if you really want to delete the step before the final execution.

Delete Table – Use this command to delete the entire sequence table. You'll be asked to confirm if you really want to delete the step before the final execution.

Tip

Use the arrow keys or the dial to scroll through the edit parameters. The Apply Changes will remain at the top while the others may be accessed selectively.

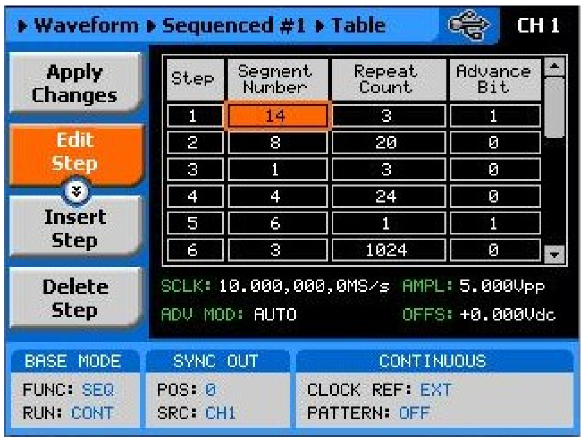


Figure 3-51, Editing the Sequence Table

Selecting Sequence Advance Modes

As was explained above, the PM8572A steps through an index of links; It may loop a few times on a designated link and eventually, after the last link, the process repeats itself. Stepping from link to link through the sequence table is done automatically by the instrument. However, there are applications requiring control when and how the link is stepped. The PM8572A has a number of sequence advance options: Auto, Stepped, Single and Mixed. These advance modes are described in the following.

Automatic – specifies continuous advance where the generator steps continuously and automatically through the links to the end of the sequence table and then repeats the sequence from the start. For example, if a sequence is made of three segments – 1, 2, and 3, and AUTO mode is used, the sequence will generate an infinite number of 1, 2, 3, 1, 2, 3, 1, 2, 3…waveforms. Of course, each link (segment) can be programmed with its associated loop (repeat) number. AUTO is the default sequence advance mode. Note, to use this mode, the PM8572A must be in *continuous* operating mode.

Stepped – Using this advance mode, the sequence is advanced to the next link only when a valid trigger is received. The output of the PM8572A generates the first segment continuously until a trigger signal advances the sequence to the next link. If repeats were selected for a segment, the loop counter is executed automatically. Note, although the trigger input controls advanced steps, to use this mode, the PM8572A must be in *continuous* operating mode.

Single – Using this advance mode, the PM8572A idles between steps until a valid trigger signal is sensed. The single advance mode requires that the PM8572A be in trigger operating mode only. An attempt to select the Single advance mode when the instrument is in continuous operating mode can not be done. When triggered, the generator outputs one waveform cycle. Then, the output level idles at a DC level equal to the last point of the last generated waveform. If loops were programmed, the output will repeat this segment for n times automatically. Only after executing all of the programmed loops will the sequence step to the next assigned link.

Note

To use the single advance mode, the PM8572A must be in programmed first to *triggered* run mode.

Mixed – This sequence advance mode allows combination of automatic and stepped links in one sequence table. To use this mode, in the sequence table, mark the Adv field "1" to flag stepped link or "0" for continuous link. Then, download the sequence table to the PM8572A. Note, to use this mode, the PM8572A must be in *continuous* operating mode. Step with a "0" bit assigned to a step it will advance automatically to the next step. If "1" is assigned to a step, the instrument will generate this step and its associated number of repeats then, will wait for the next trigger to advance to the next step.

1. Refer to Figure 3-52 and select the Advance Mode with the appropriate soft key. The advance mode options, as shown in Figure 3-52 will display. Use the dial or arrow keys to scroll down to the required mode and press Enter to lock in the selected mode.

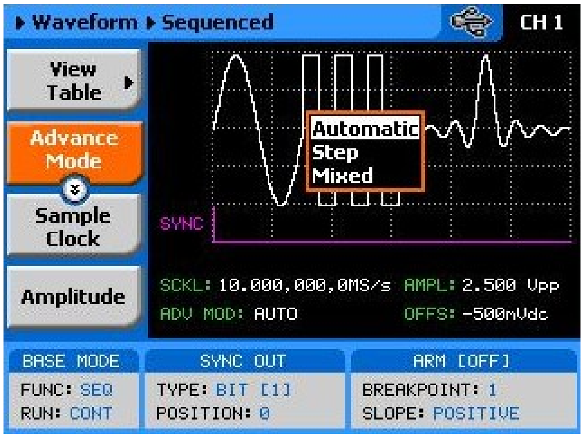


Figure 3-52, Sequence Advance Options

Note

The operating mode of the instrument, as selected from the Run Modes menu, affects the way that the PM8572A lets you access the sequence advance mode parameter. If you are in continuous mode, as shown in Figure 3-51, you can select one of: AUTO, STEP, or MIXED. If you already selected the triggered run mode, you'll be able to select from AUTO, or SINGLE only as advance modes.

Generating Modulated Waveforms

Utilizing DDS (direct digital synthesis) technology, the Model PM8572A is extremely frequency-agile. Changing the sample clock frequency is as easy as changing bits at the DDS control. The DDS has an extremely wide dynamic range with excellent linearity throughout the complete range. The properties of the DDS are passed on directly to the output therefore, the frequency is modulated within an extremely wide band, without loosing linearity. For example, the PM8572A can sweep linearly from minimum to its maximum frequency whereas similar instruments that use the standard VCO design can sweep through 3 decades only.

The PM8572A can produce: Sweep, FSK, PSK, ASK, Frequency and amplitude Hops, AM, FM and the most advanced modulation function - Arbitrary FM. It can also generate 3D modulation where amplitude, frequency and phase are swept as a function of time. When modulation is used from one channel, the other channel is 90° phase shifted, specifically convenient for applications such as I & Q modulation and for this purpose, the PM8572A can also generate many types of (n)PSK and (n)QAM schemes.

Modulated waveforms are split in two parts:

1) The single channel version, Model 8571A does not have (n)PSK, (n)QAM and user QAM because the operation of these modulation schemes require two channels.
2) The dual channel version has complete modulation capabilities.

Modulated waveforms are selected from the waveforms menu. Figure 3-52 shows how to select the FM. To access this menu, press TOP, then waveforms and select the Modulated waveforms option.

Modulation type is selected from the Modulation Type menu. Refer to Figure 3-53 and use the following procedure to select the modulation type.

1. Press on the Modulation Type soft key. The following options will display: Off, AM, FM, Sweep Frequency Hop, Amplitude Hop, 3D, ASK, FSK, (n)PSK and (n)QAM
2. Using the dial or the up and down arrow keypad, scroll down to the desired option

3. Press Enter to lock in the selected modulation type. The output will be updated immediately after you press the Enter button.

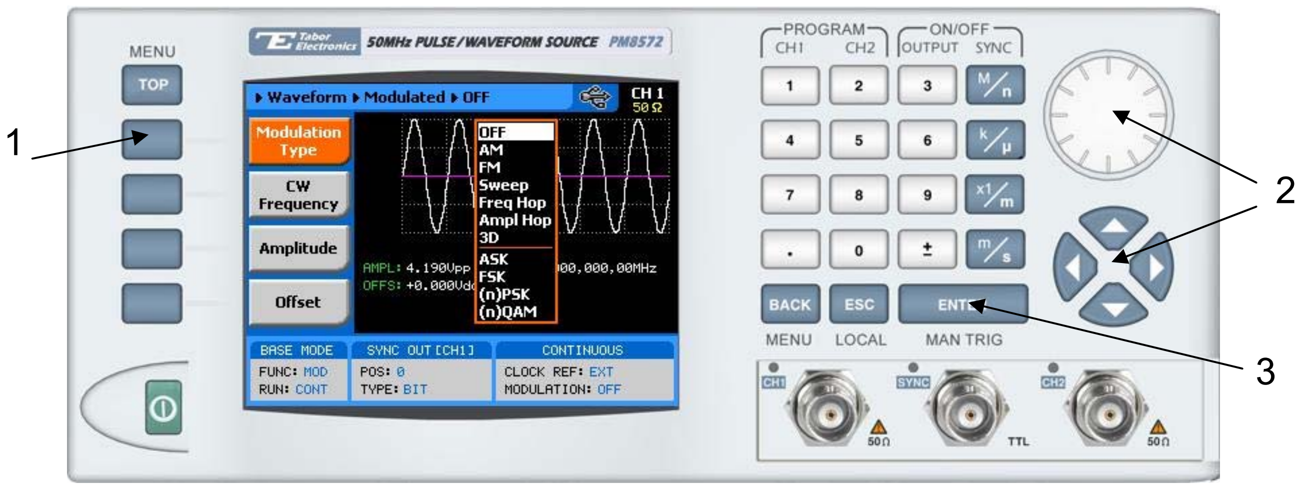


Figure 3-53, Selecting a modulated Waveform

Off

The Modulation Off is a special case of the modulation function where the output is not modulated but generates carrier waveform (CW) frequency only. CW is the sine waveform that is being modulated. When placed in Modulation Off, the sine waveform is generated from the main outputs continuously. The advantage of this mode is that sine waveforms can be generated from 100 μHz to 100 MHz. Modulation off operates in continuous mode only. The CW parameter does not change when you switch from one modulation function to another. Figure 3-54 shows the Modulation Off menus.

While in the Off option, there are some parameters that can be programmed for the carrier waveform:

CW Frequency – defines the frequency of the carrier waveform. Using this standard AM function, the shape of the carrier waveform is always sine. The CW parameter, as programmed in this menu is shared by all other modulation options.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another. The Amplitude parameter, as programmed in this menu is shared by all other waveform options.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another. The Offset parameter, as programmed in this menu is shared by all other waveform options.

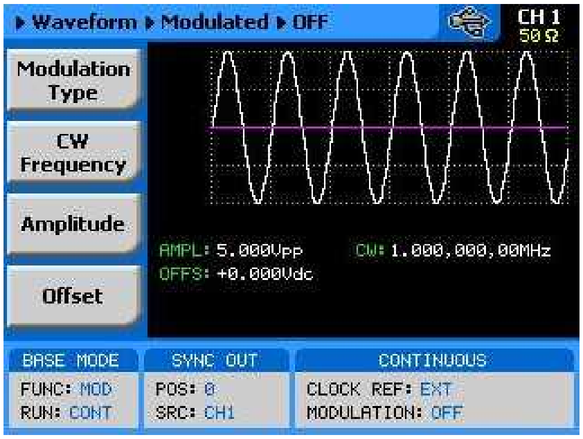


Figure 3-54, Modulation OFF Parameters

AM

The AM function enables amplitude modulation of a carrier waveform (CW). The carrier waveform is sinewave and it is being modulated by an internal waveform, normally referred to as envelop waveform. The envelop waveform can be selected from sine, triangle square or ramp shapes. When AM is selected, the menus that are associated with AM will be accessible. These are shown in Figure 3-55.

There are other parameters that control how the CW is amplitude modulated, these are:

Modulation Shape – defines the envelop function. There are four shapes that can be used: Sine, Triangle, Square and Ramp. The Modulation Shape menu that provides access to the selection of the envelop waveform is shown in Figure 3-56.

Modulation depth – programmed in units of % and defines the depth of the modulating envelop. Modulation depth is programmed from 0% to 100%.

Modulation Frequency – defines the frequency of the modulating waveform. The modulating waveform is programmed from 10mHz to 100kHz.

CW Frequency – defines the frequency of the carrier waveform. Using this standard AM function, the shape of the carrier waveform is always sine.

Trigger Baseline – defines the idle state of the AM output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the AM waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the AM waveform and resumes outputting continuous dc waveform.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

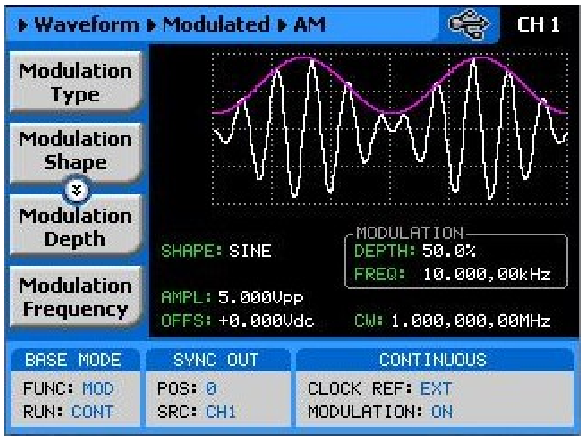


Figure 3-55, AM Menus

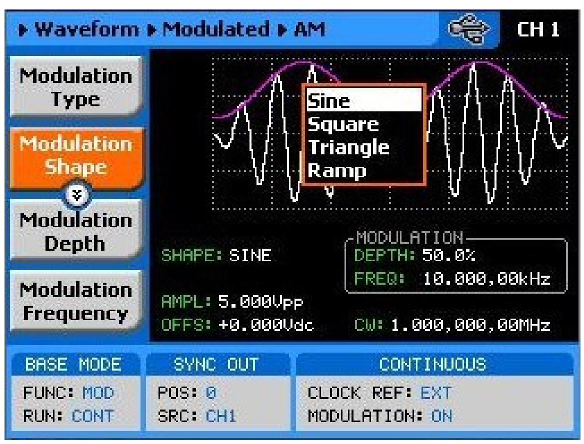


Figure 3-56, Modulating Waveform Shapes

FM – Standard Waveforms

The FM function allows frequency modulation of a carrier waveform (CW). The carrier waveform is sinewave and it is being modulated by an internal waveform, normally referred to as modulating waveform. The shape of the modulating waveform can be selected from sine, triangle, square or arbitrary waveforms. Carrier waveforms are programmed with 10 digits resolution from 10 mHz to 100 MHz.

The FM function has a number of menus that control the modulation parameters. These are shown in Figure 3-57 and described in the following paragraphs:

Modulation Shape – Defines the shape and type of the modulating waveform. Although there are 5 options shown in the menu, there is a significant difference between the first four: Sine Triangle, Square and Ramp, and the last option – Arbitrary. The first four modulating waveforms are described in this section whereas, the description of the arbitrary FM, is given separately below.

The Modulation Shape menu that provides access to the selection of the envelop waveform is shown in Figure 3-58.

CW Frequency – defines the frequency of the carrier waveform. Using this standard FM function, the shape of the carrier waveform is always sine.

Frequency Deviation – defines the range of frequencies of which the modulation will go through. The peak value is symmetrical around the value of the carrier waveform frequency.

Modulation Frequency – defines the frequency of the modulating waveform. The modulating waveform is programmed from 10mHz to 100kHz.

Marker– programs a unique frequency where the SYNC output generates a pulse to mark this frequency.

Trigger Baseline – defines the idle state of the FM output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the FM waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the FM waveform and resumes outputting continuous dc waveform.

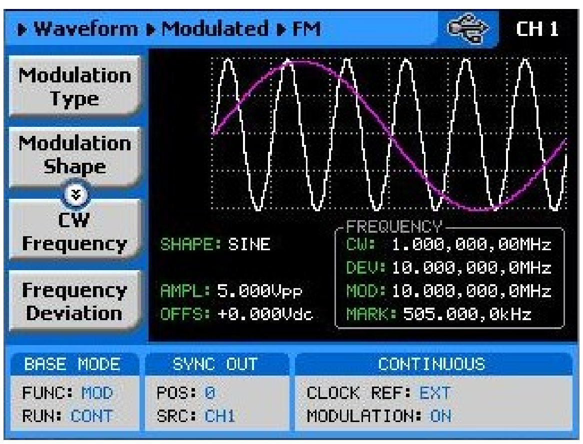


Figure 3-57, FM Modulation Parameters

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

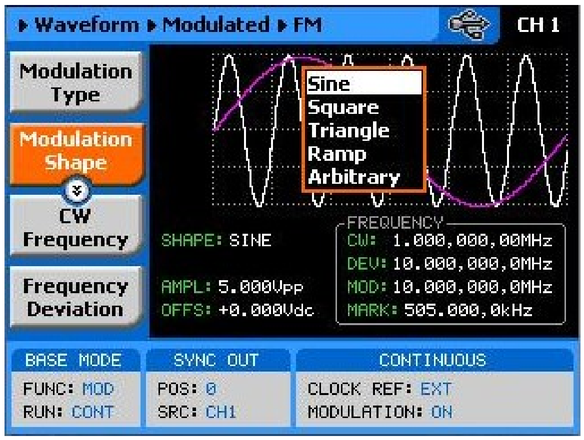


Figure 3-58, Modulation Waveform Shapes

FM – Arbitrary Waveforms

There are two separate FM functions within the PM8572A of which differ in the way that the carrier is being modulated. Looking at Figure 3-56, the first four modulating waveforms are created internally by the instrument and their parameters can be characterized by the user from the front panel or from a remote interface.

The arbitrary modulating waveform option opens an avenue for the user to create proprietary and application specific waveforms that will be used for modulating the carrier waveform. The arbitrary modulating waveform must be created and downloaded to the instrument; It is being downloaded to a special memory, separate to the main arbitrary working memory and thus, one can create arbitrary waveforms and modulate them with an arbitrary modulating waveform where the only limitations are memory size and creativity. The PM8572A is supplied with an FM composer that lets you create, edit, store and download arbitrary modulating waveforms.

The arbitrary modulating waveform you will create and download to the PM8572A resides in a separate and dedicated memory; It can be programmed to have variable length and has a separate and independent sample clock control.

The arbitrary FM waveform has an array size of 10000 frequency points. If you look at the following FM composer example, you'll see that the vertical scale is made of frequency points, The change in frequency will follow the curve shown in the FM composer panel.

The frequency of the arbitrary FM wave is computed in the same way as a standard arbitrary waveform.

Frequency = Sample Clock / Number of waveform points

In the example shown in Figure 3-59 below, the frequency of the waveform will change from 960kHz to 1.04MHz. The sample clock for the modulating waveform can be programmed from 1S/s to 2.5MS/s while the carrier waveform frequency can be selected from 10mHz to 100MHz.

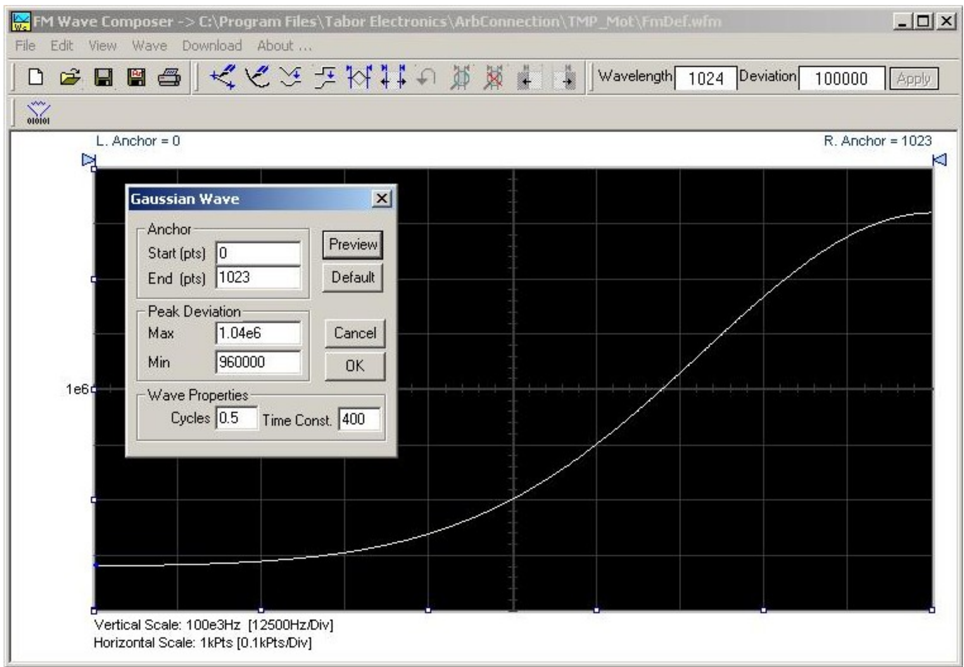


Figure 3-59, ArbConncetion Example - Arbitrary FM Composer Panel

The equivalent minimum and maximum modulating frequencies you can generate with the arbitrary FM are 50µHz to 1.6MHz. Note that the CW wave is always sine waveform however, the modulating waveform can take any shape defined by the FM composer panel. While the low frequency is very useful in applications like wander and slow drifting oscillators, the higher frequencies are as much needed for testing fast modems, PLL circuits and for wide-band digital modulation technology.

The arbitrary FM function has a number of menus that control the modulation parameters. These are shown in Figure 3-60 and described in the following paragraphs:

There are other parameters that control the Arbitrary FM function, these are:

FM Sample Clock – defines the rate of which the sample of the modulating waveform is clocked. Observe the waveform as shown in Figure 3-40. Unlike an ordinary arbitrary waveform that defines amplitude over time, this curve defines frequency over time where each point on the waveform defines a specific frequency.

CW Frequency – defines the frequency of the carrier waveform. Using this arbitrary FM function, the shape of the carrier waveform is always sine.

Trigger Baseline – defines the idle state of the arbitrary FM output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the Arbitrary FM waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the arbitrary FM waveform and resumes outputting continuous dc waveform.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

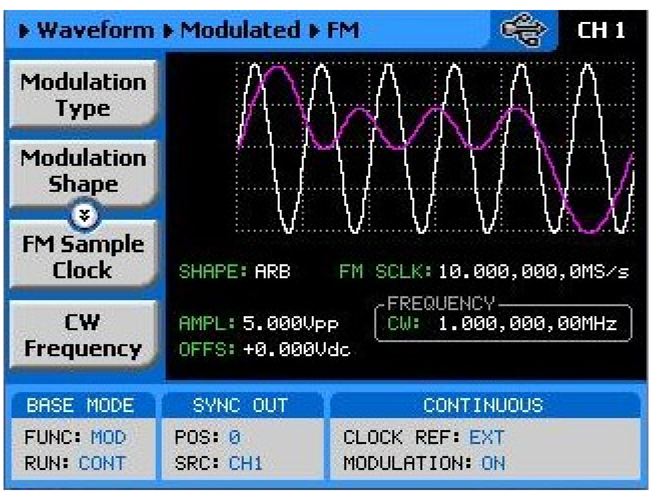


Figure 3-60, Arbitrary Frequency Modulation menus

Sweep

Sweep modulation allows carrier waveform (CW) to sweep from one frequency, defined by the sweep start parameter to another frequency, defined by the sweep stop parameter. Note that CW is sinewave only. The start and stop frequencies can be programmed with 11 digits throughout the entire frequency range of the instrument, from 10 mHz to 100 MHz.

When you select sweep modulation, the menus, as shown in Figure 3-61 and described in the following paragraphs, will be available for modification:

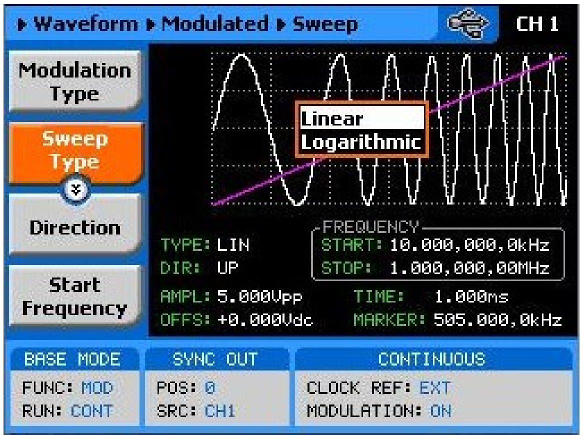


Figure 3-61, Sweep Menus

Sweep Type – defines the steps of which the frequency increments or decrements from start to stop frequencies. A choice is provided between linear and logarithmic steps. If you select linear sweep the carrier waveform frequency steps through the frequencies within a time interval which is set by the sweep time parameter. Likewise, using the logarithmic sweep type, the frequency span between the start and stop frequencies is stepped through using logarithmic steps.

Sweep Direction – defines the sweep direction. UP sets sweep direction from start frequency to stop frequency; DOWN reverses the sweep direction so the output sweeps from stop frequency to start frequency.

Start Frequency – defines the frequency value of which the generator will start its sweep. Note that the sweep start can be at a higher frequency value, depending on the sweep direction setting.

Stop Frequency – defines the frequency value of which the generator will stop its sweep. Note that the sweep stop can be at a lower frequency value, depending on the sweep direction setting.

Sweep Time – defines the time that will lapse from sweep start to sweep stop frequencies. Sweep time is programmable from 1.4 μs to 40 s.

Marker – defines a frequency of which, when transitioned through, will output a marker pulse at the SYNC output connector. The default position of the marker is the sweep start frequency.

Trigger Baseline – defines the idle state of the sweep output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the sweep waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the sweep waveform and resumes outputting continuous dc waveform.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

Frequency Hop

In frequency hop mode, the output waveform (sinewave) hops from frequency to frequency in a sequence defined by the hop table. Frequencies can be programmed with 11 digits resolution from 10 Hz to 100 MHz. There are two frequency hop types:

1. Frequency hops with fixed dwell time and
2. Frequency hops with variable dwell time

Dwell time defines the time that the frequency will remain stable and of which the frequency will change at the end of this interval. With the fixed dwell time, the waveform hops from frequency to frequency at constant intervals, defined by the fixed dwell time parameter. When the variable dwell time is selected, each hop can be programmed to have a unique dwell interval.

When you select frequency hop modulation, the menus, as shown in Figure 3-62 and described in the following paragraphs, will be available for modification:

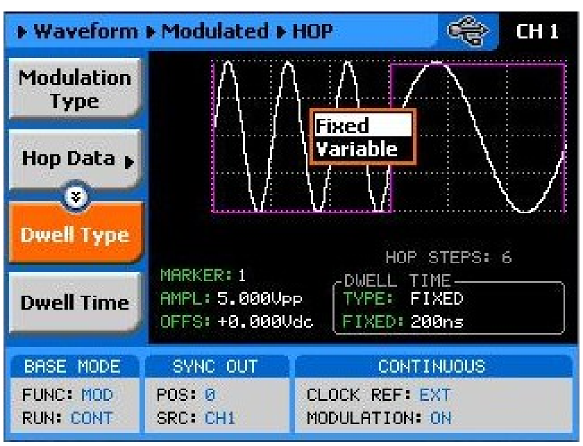


Figure 3-62, Frequency Hop Menus

Hop Data – allows programming and editing of the frequency hop table. The hop data table contains a list of frequencies and the generator will hop through these frequencies in the same order and at a rate defined by the dwell time setting. The hop table size is from 2 to 1000 and the generator can hop from 10 Hz to 100 MHz.

The frequency hop table depends on the Dwell Type selection and will display the dwell time parameter only if the variable dwell time option has been selected. The hop table as shown in Figure 3-63 is an example how such table are programmed from ArbConncetion.

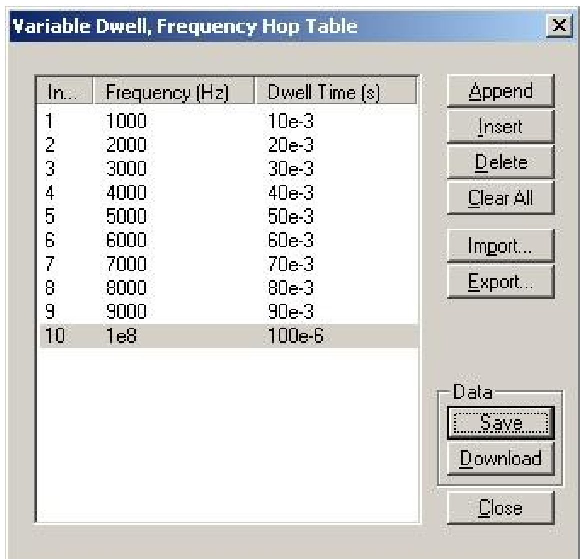


Figure 3-63, Variable Dwell Time Frequency Hop Table Example

Dwell Type – defines if each hop step will have constant or variable dwell times. Using the variable time option, each step can be programmed to have a unique dwell time value.

Dwell Time – defines the lapse of time for a hop step, when the variable dwell time option has been selected. Dwell time is programmable in steps of 20 ns from 200 ns to 21 seconds.

Marker– programs a unique index point where the SYNC output generates a pulse to mark a specific hop step.

Trigger Baseline – defines the idle state of the frequency hop output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the frequency hop waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the frequency hop waveform and resumes outputting continuous dc waveform.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

Amplitude Hop

In Amplitude hop mode, the output waveform (sinewave) hops from amplitude to amplitude in a sequence defined by the hop table. Amplitude hop modulation allows amplitude hops throughout the entire range of the instrument. The base signal is always CW (sine waveform). Amplitudes are programmed with 4 digits resolution from 0 V to 16 V.

There are two amplitude hop types:

1. Amplitude hops with fixed dwell time and
2. Amplitude hops with variable dwell time

Dwell time defines the time that the amplitude will remain stable and of which the amplitude will change at the end of this interval. With the fixed dwell time, the waveform hops from amplitude to amplitude at constant intervals, defined by the fixed dwell time parameter. When the variable dwell time is selected, each hop can be programmed to have a unique dwell interval.

When you select the amplitude hop modulation, the menus, as shown in Figure 3-64 and described in the following paragraphs, will be available for modification.

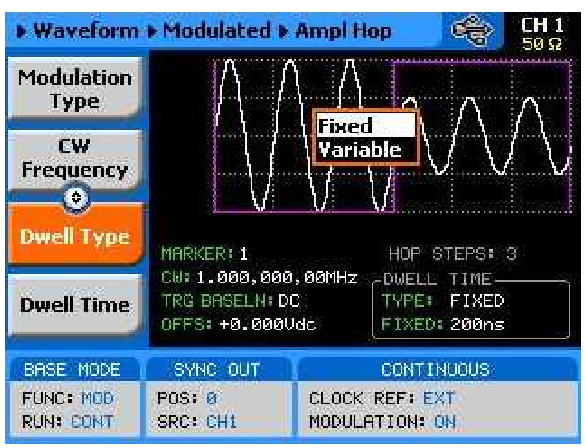


Figure 3-64, Amplitude Hop Menus

Hop Data – allows programming and editing of the amplitude hop table. The hop data table contains a list of amplitudes and the generator will hop through these amplitudes in the same order and at a rate defined by the dwell time setting. The hop table size is from 2 to 1000 and the generator can hop from 0 V to 16 V.

The amplitude hop table depends on the Dwell Type selection and will display the dwell time parameter only if the variable dwell time option has been selected. The hop table as shown in Figure 3-65 is an example how such table are programmed from ArbConncetion.

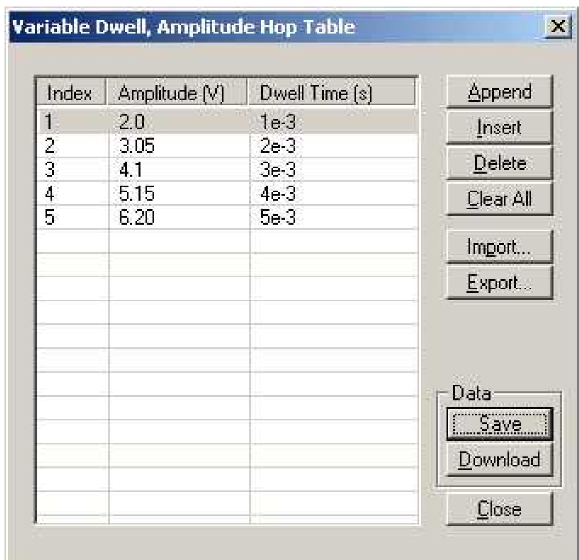


Figure 3-65, Variable Dwell Time Amplitude Hop Table Example

CW Frequency – defines the frequency of the carrier waveform. The shape of the carrier waveform is always sine.

Dwell Type – defines if each hop step will have constant or variable dwell times. Using the variable time option, each step can be programmed to have a unique dwell time value.

Dwell Time – defines the lapse of time for a hop step, when the variable dwell time option has been selected. Dwell time is programmable in steps of 20 ns from 200 ns to 21 seconds.

Marker– programs a unique index point where the SYNC output generates a pulse to mark a specific hop step.

Trigger Baseline – defines the idle state of the Amplitude hop output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the amplitude hop waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the amplitude hop waveform and resumes outputting continuous dc waveform.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

3D

The 3D modulation allows profiling over time of the carrier waveform over three domains: frequency, amplitude and phase. Figure 3-66 shows an example of the 3D profiling utility. Notice how the amplitude changes independently for channels 1 and 2, simultaneously while frequency and phase change as well. In this example, a complete cycle changes in 100 ms however, there is a great deal of flexibility and programmability to allow changes exactly as required by your application.

The 3D composer is part of ArbConncetion and is available from version 4.1 and above. The 3D software converts the curves to waveform coordinates which are stored in a dedicated 3D memory. Notice however, that the 3D shares its memory with some other modulation functions and therefore, if you plan on using the 3D function intermittently with other modulation functions (such as arbitrary FM), make sure that the coordinates are readily available for replacement because operating one function may be destructive to the other. Instructions how to use the 3D composer are given in Chapter 4.

When you select the 3D modulation option, the menus, as shown in Figure 3-65 and described in the following paragraphs, will be available for modification.

Load Demo Table – loads pre-determined set of coordinates to the 3D memory. The demo waveforms can be used for either demonstration purpose or for building your confidence that the 3D function really works. The 3D memory will be overwritten as soon as you download waveforms from the 3D composer however, the demo can always be recalled from the front panel.

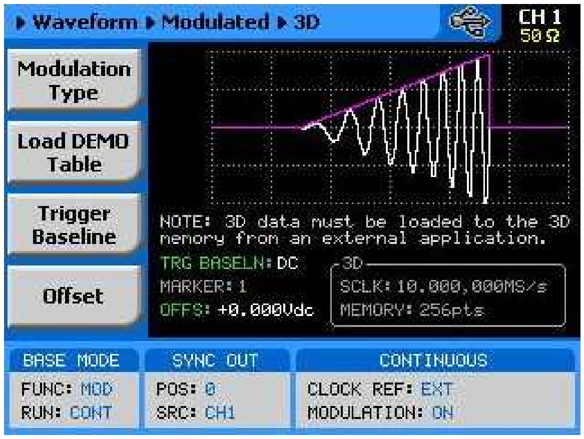


Figure 3-66, 3D Modulation Menus

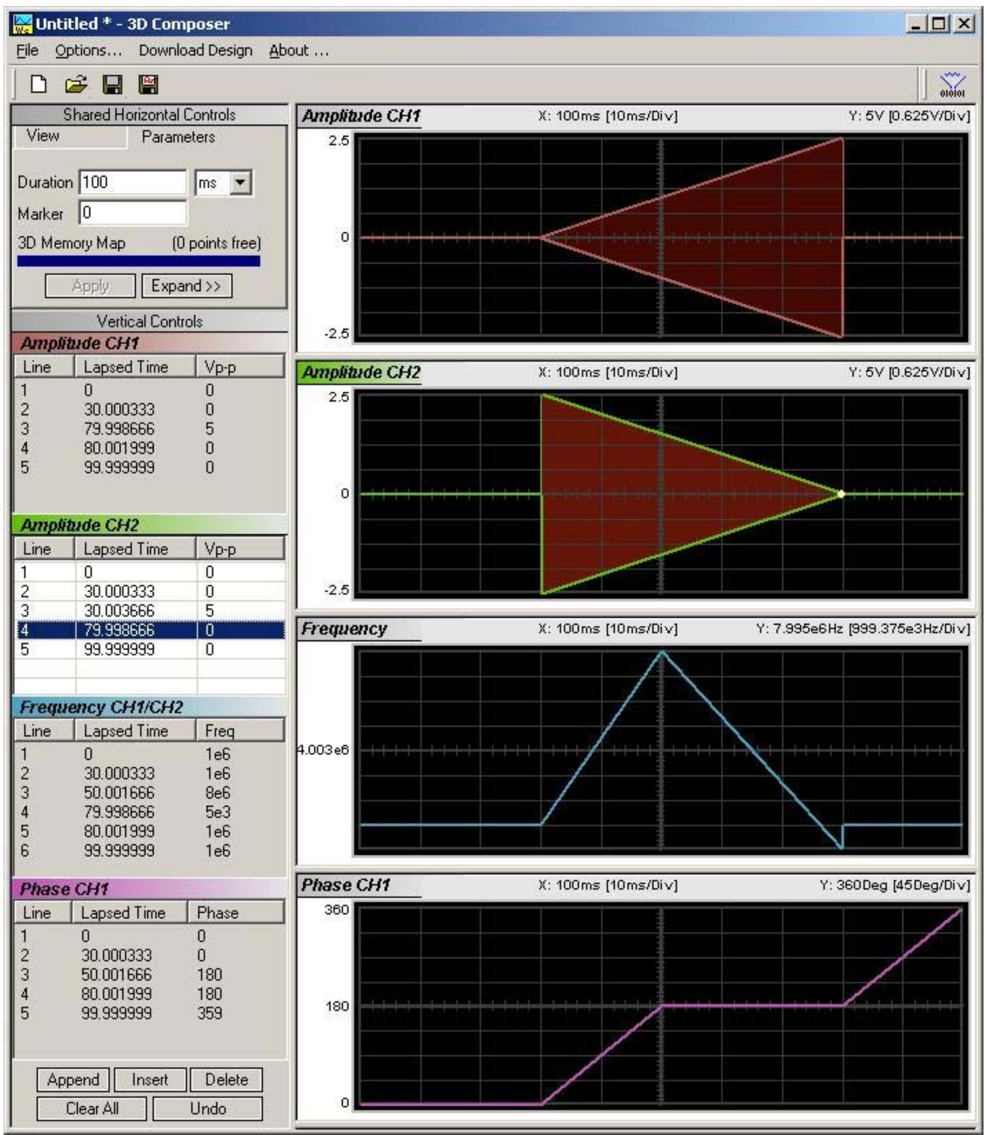


Figure 3-67, 3D Composer Example

Trigger Baseline – defines the idle state of the 3D output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the 3D waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the 3D waveform and resumes outputting continuous dc waveform.

Offset – defines the baseline offset level for the 3D waveform. The same level is used throughout the instrument when you move from waveform shape to another.

ASK

ASK (Amplitude Shift keying) modulation allows amplitude hops between two pre-programmed amplitude levels. Note that sinewave CW only is hopped. The signal level can hop between two amplitude levels throughout the entire amplitude range without crossing range or relay ranges. Amplitude is programmed with 4 digits of resolution. The start and shifted amplitudes can be programmed with 4 digits from 0 V to 16 V.

The ASK sequence is designed in an ASK table that can either be loaded from the front panel or downloaded from a remote interface from a utility such as ArbConncetion. An example of the ASK table, as created in ArbConncetion, is shown in Figure 3-69.

When you select ASK modulation, the parameters, as shown in Figure 3-68 and described in the following paragraphs, will be available for modification:

ASK Data – defines the sequence of which the amplitudes will toggle. ASK data is stored in an external table. The length of the table is limited from 1 to 4096 toggle sequences. The ASK Data table contains a list of “0”s and “1”s which determine the sequence. “0” defines the initial amplitude and “1” the shifted amplitude.

CW Frequency – defines the frequency of the carrier waveform. In this case, the CW frequency will also be used as the idle frequency. Using this standard ASK function, the shape of the carrier waveform is always sine.

Start Amplitude – defines the initial amplitude level. Note that the start amplitude does not necessarily define lower value than the stop amplitude.

Shifted Amplitude – defines the amplitude level of which the generator will shift when logic level “1” is sensed at the trigger input. Note that the stop amplitude does not necessarily define higher value than the start amplitude.

Baud – defines the rate of which the amplitude is toggled. The rate can be programmed within the range of 1 bits/s to 10 Mbits/s.

Marker – defines an index point in the ASK sequence where the SYNC output will generate a marker pulse.

Trigger Baseline – defines the idle state of the ASK output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the ASK waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the ASK waveform and resumes outputting continuous dc waveform.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

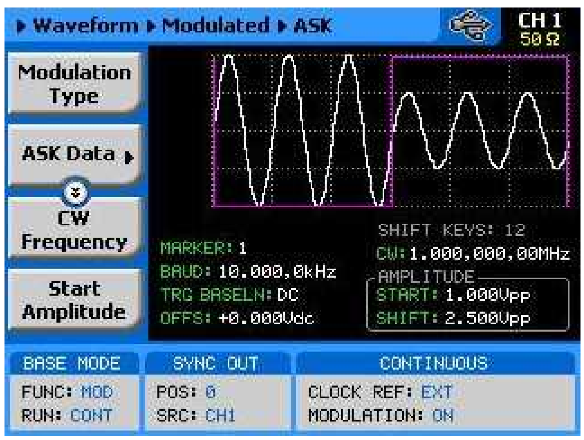


Figure 3-68, ASK Menus

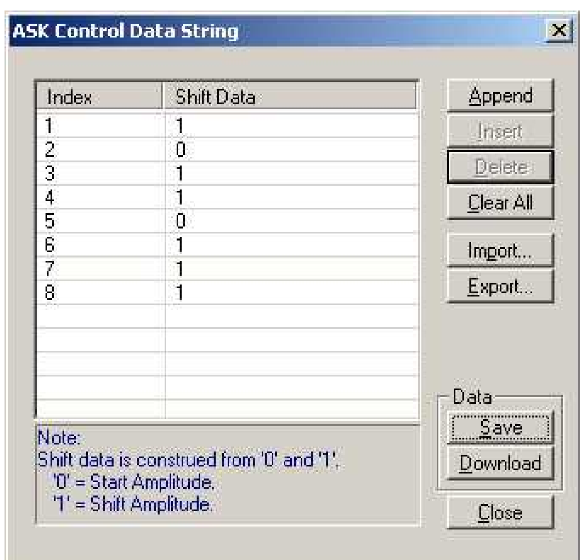


Figure 3-69, ASK Control Data String Example

FSK

FSK (Frequency Shift keying) modulation allows frequency hops between two pre-programmed frequencies: Carrier Waveform Frequency and Shifted Frequency. Note that CW is sinewave only and that the switch between two frequencies is always coherent.

The CW and shifted frequencies can be programmed with 10 digits throughout the entire frequency range of the instrument, from 100 μHz to 100 MHz. The FSK sequence is designed in an FSK table that can either be loaded from the front panel or downloaded from a remote interface from a utility such as ArbConncetion. An example of the FSK table, as created in ArbConncetion, is shown in Figure 3-70.

When you select FSK modulation, the parameters, as shown in Figure 3-71 and described in the following paragraphs, will be available for modification:

FSK Data – defines the sequence of which the frequencies will toggle. FSK data is stored in an external table. The length of the table is limited from 1 to 4096 toggle sequences. The FSK Data table contains a list of “0”s and “1”s which determine the sequence. “0” defines CW and “1” defines shifted frequency.

CW Frequency – defines the frequency of the carrier waveform. In this case, the CW frequency will also be used as the idle frequency. Using this standard FSK function, the shape of the carrier waveform is always sine.

Shifted Frequency – defines the frequency of which the generator will shift when logic level “1” is sensed at the trigger input.

Baud – defines the rate of which the frequencies are toggled. The rate can be programmed within the range of 1 bits/s to 10 Mbits/s.

Marker – defines an index point in the FSK sequence where the SYNC output will generate a marker pulse.

Trigger Baseline – defines the idle state of the FSK output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the FSK waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the FSK waveform and resumes outputting continuous dc waveform.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

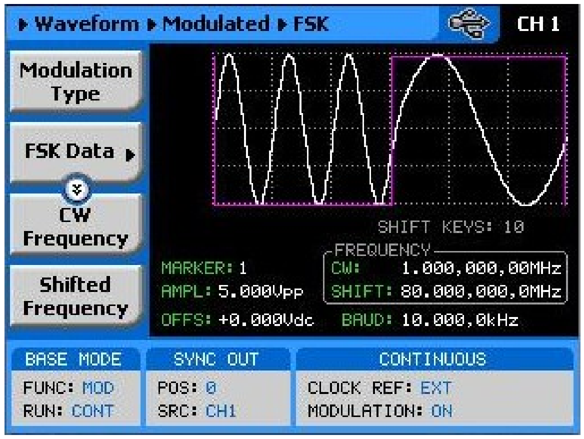


Figure 3-70, FSK Menus

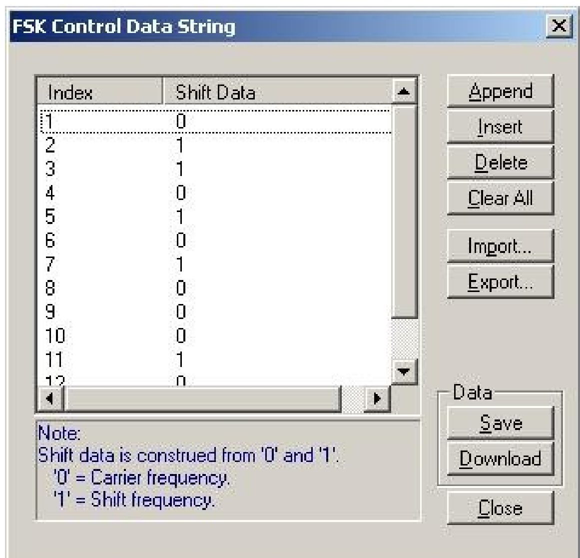


Figure 3-71, FSK Control Data String Example

PSK

PSK (Phase Shift keying) modulation allows phase hops between two pre-programmed phases: The initial phase can be programmed from 0 to 360°, the shifted phase can also be programmed through the same range. The PSK sequence is designed in a PSK table that can either be loaded from the front panel or downloaded from a remote interface from a utility such as ArbConncetion. An example of the PSK table, as created in ArbConncetion, is shown in Figure 3-73.

When you select PSK modulation, the parameters, as shown in Figure 3-72 and described in the following paragraphs, will be available for modification:

PSK Data – defines the sequence of which the phase will toggle. FSK data is stored in an external table. The length of the table is limited from 1 to 4096 toggle sequences. The PSK Data table contains a list of "0"s and "1"s which determine the sequence. "0" defines start phase and "1" defines the shifted phase.

CW Frequency – defines the frequency of the carrier waveform. In this case, the CW frequency will also be used as the idle frequency. Using this standard PSK function, the shape of the carrier waveform is always sine.

Start Phase – defines the initial start phase. Note that the start and stop phase only define the phase difference between these values and not fixed values of which the generator will adhere to.

Shifted Phase – defines the phase of which the generator will shift when logic level “1” is sensed at the trigger input. Note that the start and stop phase only define the phase difference between these values and not fixed values of which the generator will adhere to.

Baud – defines the rate of which the phase is toggled. The rate can be programmed within the range of 1 bits/s to 10 Mbits/s.

Marker – defines an index point in the PSK sequence where the SYNC output will generate a marker pulse.

Trigger Baseline – defines the idle state of the PSK output when placed in trigger mode. There are two options: continuous carrier or dc level. The continuous carrier option generates CW waveforms until triggered, generates the PSK waveform and resumes outputting continuous CW waveform. Selecting dc, the output generates dc level until triggered. Generates the PSK waveform and resumes outputting continuous dc waveform.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

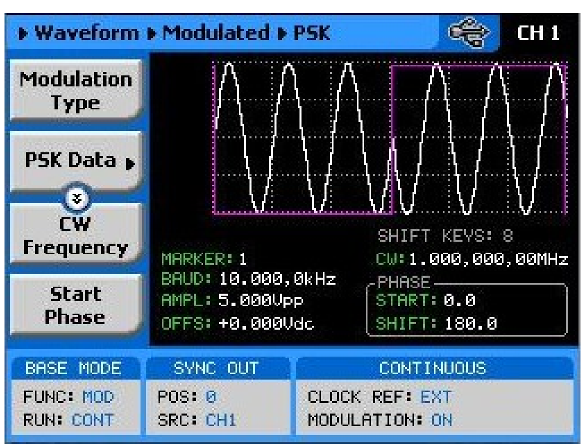


Figure 3-72, PSK Menus

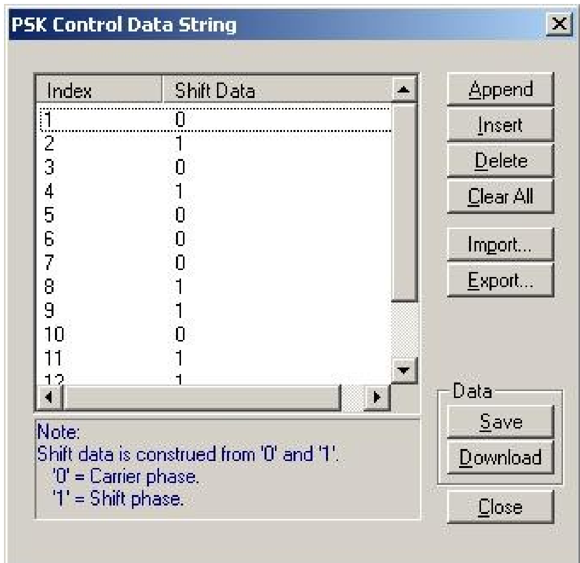


Figure 3-73, PSK Control Data String Example

(n)PSK

The (n)PSK function is similar to the standard PSK function except the output can shift to multiple phase and amplitude positions to form phase shift constellations. There are 6 different types of phase shift keying that the PM8572A can generate: BPSK, QPSK, OQPSK, pi/4DQPSK, 8PSK and 16PSK. If another constellation scheme is required, one can use the User PSK to design his/her own symbol list and constellation. An example of a QPSK display is shown in Figure 3-74.

There are other parameters that control the (n)PSK function, these are:

PSK Type – selects from one of BPSK, QPSK, OQPSK, pi/4DQPSK, 8PSK and 16PSK. Once a type is selected the associated parameters are automatically available on the display for adjustments.

PSK Data – provides access to the PSK data symbols. By default the table is empty so the symbols must be loaded into the table before the (n)PSK function can be used. For testing and/or demonstration purpose, a default table is available to download from the front panel however, this table must be converted for different applications. An example of the QPSK data entry table is given in figure 3-75.

CW Control – can turn the carrier waveform on and off. Use the carrier off position when directly driving vector generators.

CW Frequency – defines the frequency of the carrier waveform. Using this PSK function, the shape of the carrier waveform is always sine. CW frequency is programmable from 10 Hz to 62.5 MHz.

Symbol rate – programs the rate of which symbols step through. The rates can be programmed from 1 symbol/s to 1e6 symbols/s.

Marker – defines an index point where the SYNC output generates a synchronization pulse. The marker can be programmed within the range of the symbol list.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

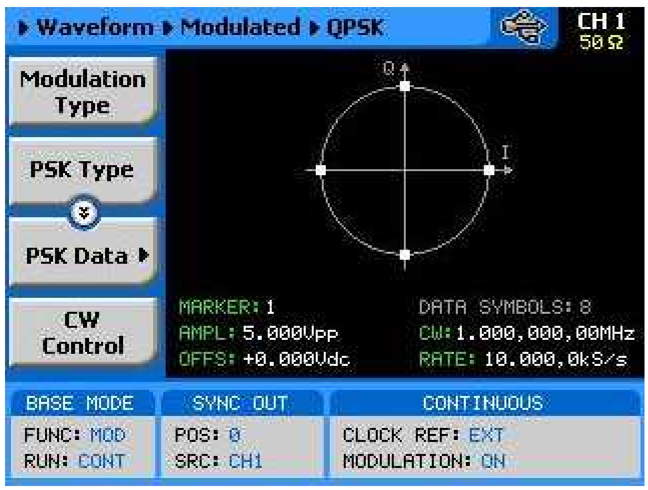


Figure 3-74, PSK Modulation Display Example

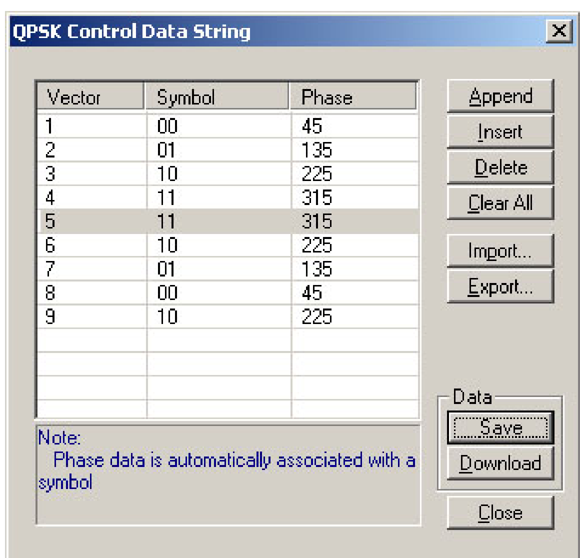


Figure 3-75, QPSK Data Entry Table Example

User PSK

The User PSK function is similar to the (n)PSK function except the symbols and their associated vector positions can be freely designed at locations that are non-standard. The user PSK display is shown in figure 3-76. The symbols can be designed on the PM8572A display, or on the User PSK Control Data String dialog box as shown in figure 3-77.

After you design the symbols and generate the control data string, the definition and the modification of the other parameters are done exactly as you would do for the other PSK functions.

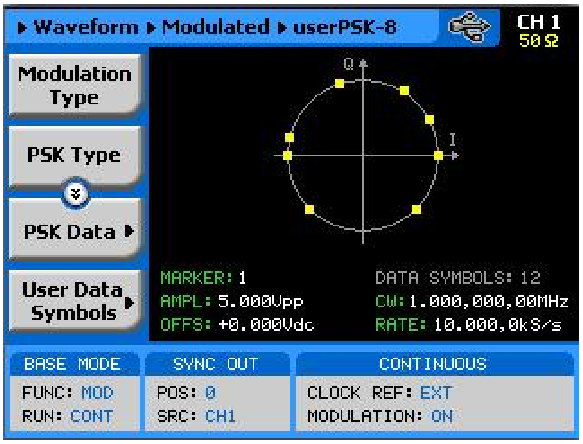


Figure 3-76, User PSK Display

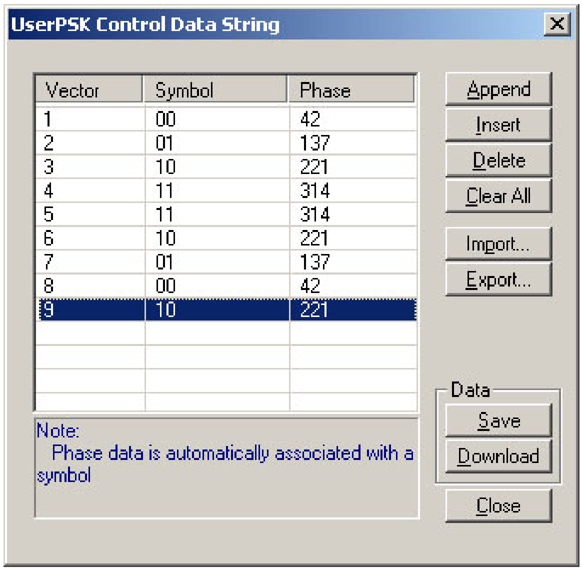


Figure 3-77, User PSK Data Entry Table Example

(n)QAM

The (n)QAM function is similar to the standard ASK function except the output can shift to multiple amplitudes and phase positions to form an amplitude/phase shift constellations. There are 4 different types of Quadrature Amplitude Modulation that the PM8572A can generate: 16QAM, 64QAM and 256QAM. If another constellation scheme is required, one can use the User QAM to design his/her own symbol list and constellation. An example of a 64QAM display is shown in Figure 3-78.

There are other parameters that control the (n)QAM function, these are:

QAM Type – selects from one of 16QAM, 64QAM, 256QAM and User QAM. Once a type is selected the associated parameters are automatically available on the display for adjustments.

QAM Data – provides access to the QAM data symbols. By default the table is empty so the symbols must be loaded into the table before the (n)QAM function can be used. For testing and/or demonstration purpose, a default table is available to download from the front panel however, this table must be converted for different applications. An example of the 64QAM data entry table is shown in figure 3-79.

CW Control – can turn the carrier waveform on and off. Use the carrier off position when directly driving vector generators.

CW Frequency – defines the frequency of the carrier waveform. Using this QAM function, the shape of the carrier waveform is always sine. CW frequency is programmable from 10 Hz to 62.5 MHz.

Symbol rate – programs the rate of which symbols step through. The rates can be programmed from 1 symbol/s to 1e6 symbols/s.

Marker – defines an index point where the SYNC output generates a synchronization pulse. The marker can be programmed within the range of the symbol list.

Amplitude – defines the carrier amplitude level. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level for the carrier waveforms. The same level is used throughout the instrument when you move from waveform shape to another.

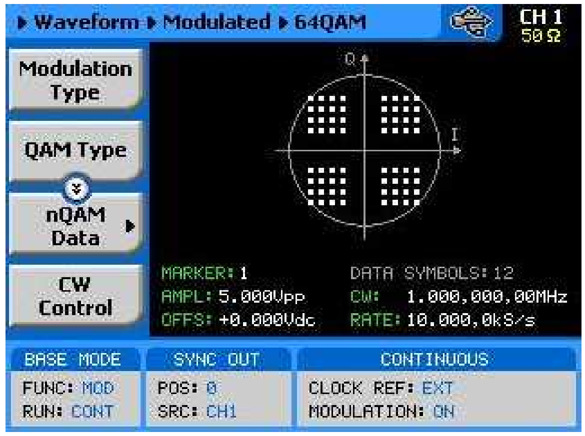


Figure 3-78, 64QAM Display Example

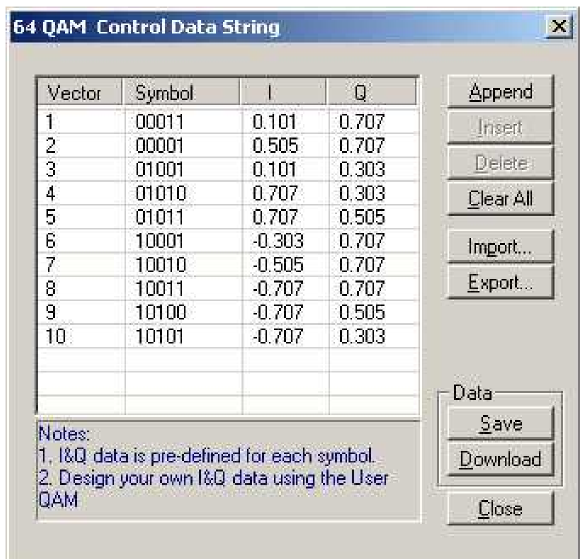


Figure 3-79, 64QAM Data Entry Table Example

User QAM

The User QAM function is similar to the (n)QAM function except the symbols and their associated vector positions can be freely designed at locations that are non-standard. The user QAM display is shown in figure 3-80. The symbols can be designed on the PM8572A display, or on the User QAM Control Data String dialog box as shown in figure 3-81.

After you design the symbols and generate the control data string, the definition and the modification of the other parameters are done exactly as you would do for the other QAM functions.

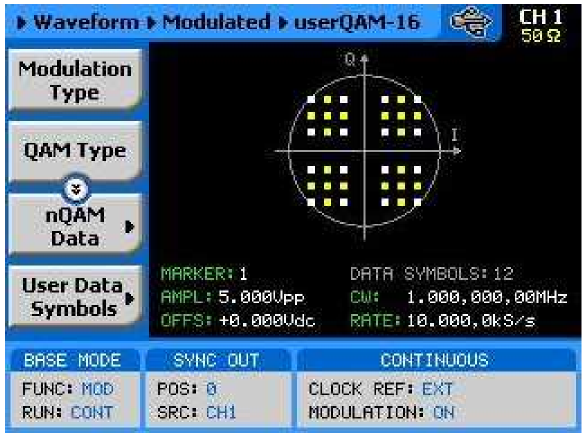


Figure 3-80, User Display

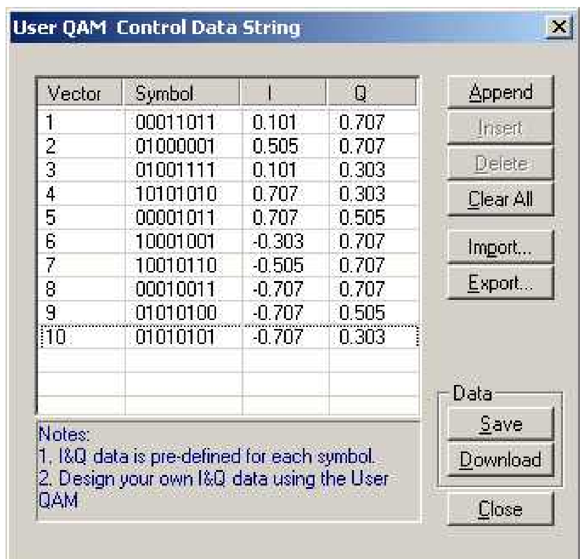


Figure 3-81, User QAM Data Entry Table Example

Generating Half Cycle Waveforms

Half Cycles is a special case of the standard waveforms except the waveforms are generated half cycle at a time, displaced by a delay time that is user programmable. In continuous mode, the half cycles are generated continuously. In triggered mode, each half cycle is generated only after a valid trigger signal is sensed at the trigger input connector. The half cycle waveforms can also be triggered from remote.

Accessing the half Cycle Menus

There are three half cycle waveforms that can be generated: Sine, Triangle and Square. Use the instructions below to access and select the digital patter mode and its associated data source.

1. Press TOP to display the root menu.
2. Press the arrow down key once and observe that the Auxiliary Functions menu appears.
3. Press the Auxiliary Functions soft key and scroll down to highlight the Half Cycle option, as shown in Figure 3-82.
4. Press the Enter button to select the half cycle function Figure 3-83 shows the half cycle panel and menus.

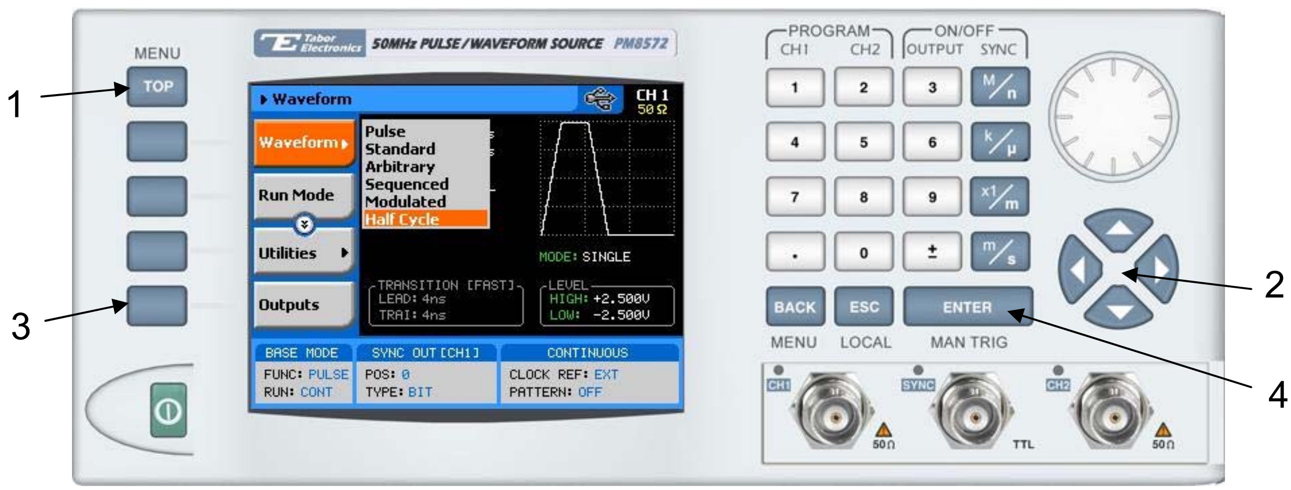


Figure 3-82, Accessing the Digital Pattern Menus

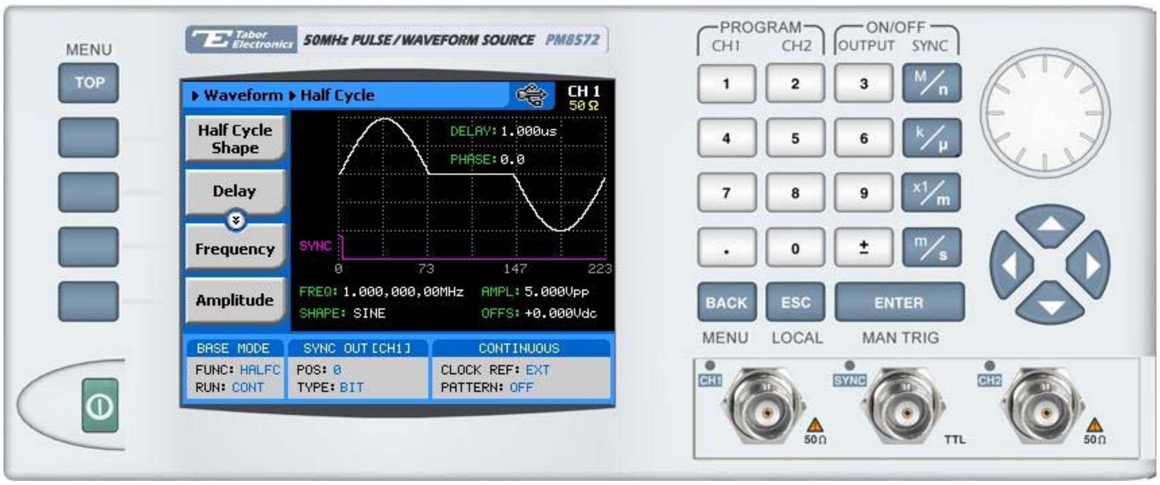


Figure 3-83, the Digital Pattern Menus

Half Cycle Menus

There are various settings that define how the instrument will generate half cycles. For example, spacing between the halves can be programmed to any length between 200 ns to 20 s. Figure 3-82 shows the various half cycle menus. The half cycle menus are described below.

Half Cycle Shape – defines the shape of the half cycle waveform. There are three types of waveforms that can be halved: sine triangle and square.

Delay – defines the delay between the halves. The delay can be programmed from 200 ns to 20 s with increments of 20 ns.

Frequency – defines the frequency of the half cycle waveforms as if they were combined to a single cycle waveform. Actually, if you want to calculate the period of the half cycle use the following relationship:

Half Cycle Period = 2 / frequency

Amplitude – defines the amplitude level of the half cycle waveform. The same level is used throughout the instrument when you move from waveform shape to another.

Offset – defines the offset level of the half cycle waveform. The same level is used throughout the instrument when you move from waveform shape to another.

Phase – defines the start phase of the half cycle waveform. The first cycle starts with this phase offset setting and the second half starts 180° later.

The PM8572A Auxiliary Functions

The PM8572A, besides its standard waveform generation functions, has additional auxiliary functions that add flexibility to the operation of the instrument, these are: Counter/Timer, Digital Patterns and Multi-Instrument Synchronization. The Digital Patterns output can be used for generating 16-bit LVDS level patterns and the rear panel multi-instrument synchronization connector can transform multiple the PM8572A units to multi-channel system with full synchronization, jitter and phase control between channels. Detailed operating instructions for the auxiliary functions are given in the following paragraphs.

Using the Counter/Timer

The first auxiliary function transforms the PM8572A into a counter/timer instrument with the capability of measuring parameters exactly as they would be measured by a stand-alone counter/timer instrument. When using this function one could select the measurement function, gate time trigger level and hold the measurement till condition requires a reading. The readings are taken and displayed on the LCD display, or passed on the remote interface to the host computer for further processing. PM8572A front panel example for the counter/timer is shown in figures 3-84.

Because the PM8572A cannot measure and generate waveforms at the same time, when placed in the counter/timer mode, all waveform generation are purged and the PM8572A can be used for measurements only.

Figure 3-84, the Digital Counter/Timer Menus

Accessing the Counter/Timer Menus

The digital counter/timer function provides means of measuring timing characteristics of external signals, exactly as would be done on a stand-alone, bench-type, counter/timer. Use the instructions below to access and select the counter/timer mode and any of its measurement functions.

1. Press TOP to display the root menu.
2. Press the arrow down key once and observe that the Auxiliary Functions menu appears.
3. Press Auxiliary Functions soft key and notice that the Counter/Timer option is highlighted, as shown in Figure 3-85.
4. Press the Enter button to select the counter/timer function Figure 3-86 shows the counter/timer panel and menus.

Note

After you select the counter/timer function, the front-panel Counter On LED illuminates, designating the counter/timer function is enabled and all other PM8572A waveform generation functions are disabled.

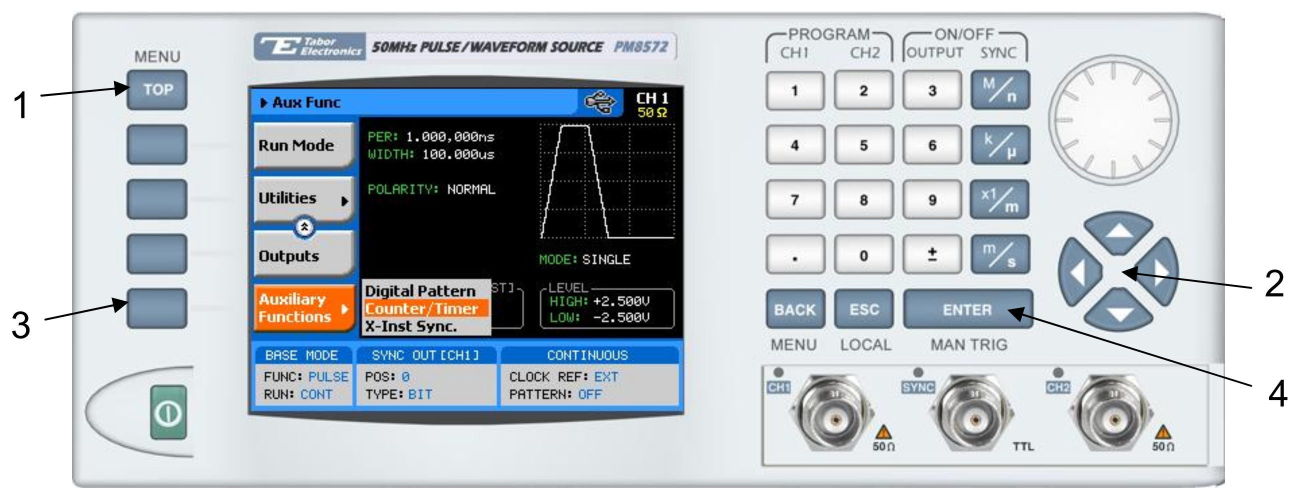


Figure 3-85, Accessing the Counter/Timer Menus

Selecting a Counter/Timer Function

The digital counter/timer can measure one of the following functions: Frequency, Period, Period Averaged, Pulse Width and Totalize, either within a specified gate time or infinitely. Use Figure 3-85 and the instructions below to access and select one of the counter/timer measurement functions.

1. Press the Counter Function soft key button to display the measurements list.
2. Use the dial or the up and down keys to scroll through the list. Select the required function.

3. Press Enter to execute the selected function.

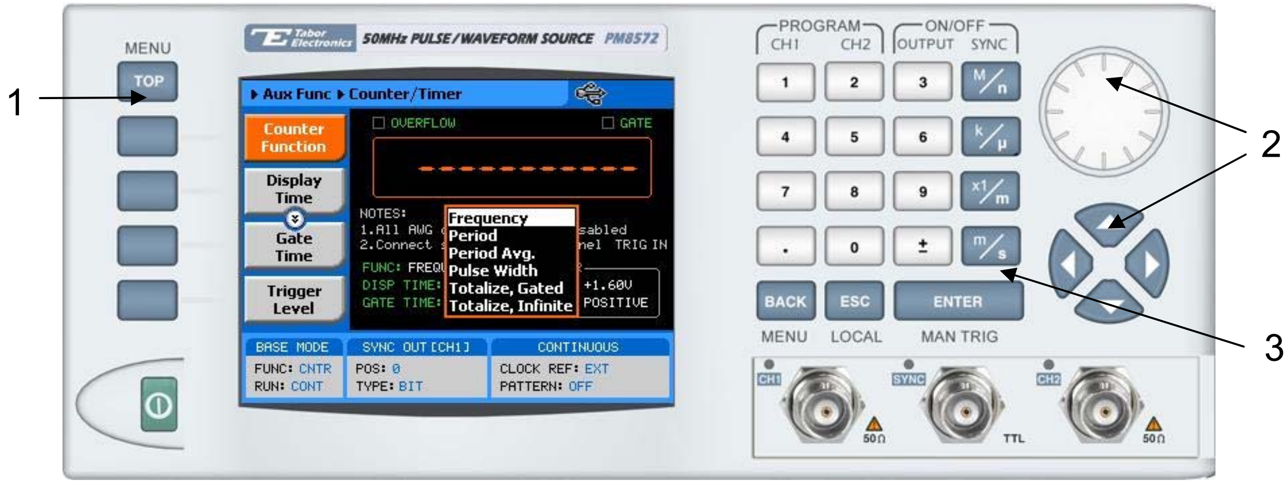


Figure 3-86, Selecting a Counter/Timer Measurement Function

Counter/Timer Menus

There are various counter/timer settings that define how the instrument will perform the measurement. For example, the period of the gate time must always be larger than the period of the measured signal. The counter/timer menus are described below.

Display Time

There are two display times available with the PM8572A: Normal and Hold.

Normal – defines continuous measurement taken at an interval equal to about gate time period plus 300 ms. This mode of operation assures that reading are taken and displayed long enough for the eye to see the result.

Hold – defines single reading taken and held on the display until cleared and armed for the next measurement. This mode is especially useful for systems applications where reading must be prepared only once and taken at a specific time.

Gate Time

The gate time defines how long the gate will open and allow signal to enter the measurement bin. The gate time value is important because it must be larger than the period of the signal. It also, indirectly, controls the number of digits that can be displayed. At a gate time of 1 second, the counter can display eight digits. As the gate time is reduced, the number of displayable digits is reduced proportionally. Also note that the gate opens only after a valid signal is available at the counter input (TRIG IN connector) and therefore, make sure you arm the counter for measurement only when you expect the signal to appear at the input otherwise, you may lock out the remote interface until a signal triggers the input and the measurement has been completed.

Trigger Level

The trigger level parameter defines the vertical cross point where the signal will trigger a measurement. Trigger level range is from -5 V to +5 V and the default threshold level is set to 1.6 V, which is very convenient for TTL level signals. To change the default level, select the Trigger Level menu and modify the level using direct keyboard entry. Press Enter to lock in the new value.

Trigger Slope

The Trigger Slope defines on which transition the counter input will trigger. There are two options: Positive and Negative. The default option is positive, which means that the counter will trigger on positive transitions at the counter input. The trigger slope parameter is also used for defining the measured portion of a pulse. When in pulse width measurements, the counter will measure the width when transitioning from low level to high level and when the negative slope is selected, the counter will measure the high to low level transitions.

Reset/Arm

The Rest/Arm button has two functions: Reset removes the last reading from the display and zeroes the reading. At the same time, the counter is armed for the next measurement. Use this button to clear the display reading when the display time is set to hold.

Counter/Timer Limitations

Keeping in mind that the counter/timer is a by-product of the AWG, one should understand there are limitations to what this product can do. Summary of the counter/timer limitations is given below.

1. *Measurement speed*

What is expected from a full-featured counter/timer is measurement speed. The rate of which the counter performs its measurements depends on the display mode setting. The Normal setting is normally used for bench reading, where the user expects to see the result after each measurement. The display time is roughly 300 ms allowing enough time to see the result after each gate time cycle. In this case, the maximum rate is 3 measurements in one second when using low period gate times. The Hold display mode allows one reading at a time. The reading starts when the input senses a valid trigger signal and ends after the gate has closed. Processing time for the reading and the display is roughly 100 ms and therefore, in this mode, the counter can take 10 readings maximum in one second. Regardless of the display mode, the readings are also available for collection from a remote interface.

2. *Gate time period must be higher than the signal period*

In Fact, this limitation is true for every counter. The gate must open for an interval that allows enough transitions to pass through the counter gate. If the gate time is too short to measure a signal, the gate will open but no results can be obtained and displayed.

3. Auxiliary functions disables waveform generation
When the auxiliary counter/timer function is selected, all operations of the waveform generator are purged. Do not expect from the PM8572A to make counter measurements and at the same time have signals at output connectors.

Using the Digital Patterns

Patterns are generated through a 68 pin high density, SCSI-2 connector that is located on the rear panel. The output level is LVDS (Low Voltage Differential Signal) logic level. The digital patterns are derived from lines that are connected to the DAC and therefore, when the digital pattern output is enabled, the 16 bits that drive the DAC are routed to this connector.

There are two memory sources for the digital patterns: 1) A pattern-dedicated memory can store up to 128k of patterns, and 2) Individual arbitrary memory segments can be used as the data source and then the size of the table can be extended to 1M, or 2M with option 1 installed.

The digital patterns are designed in an external software utility such as ArbConncetion and then downloaded to the instrument using a remote interface. The patterns are written in a simple table (hex words) as shown in Figure 3-89.

Patterns can be used with or without the main output turned on. The recommended way to use the patterns is of course generating arbitrary waveforms from channel 2 and patterns from channel 1 however, one can use the channel 1 output and in parallel generate the digital patterns from the rear panel to synchronize to other devices.

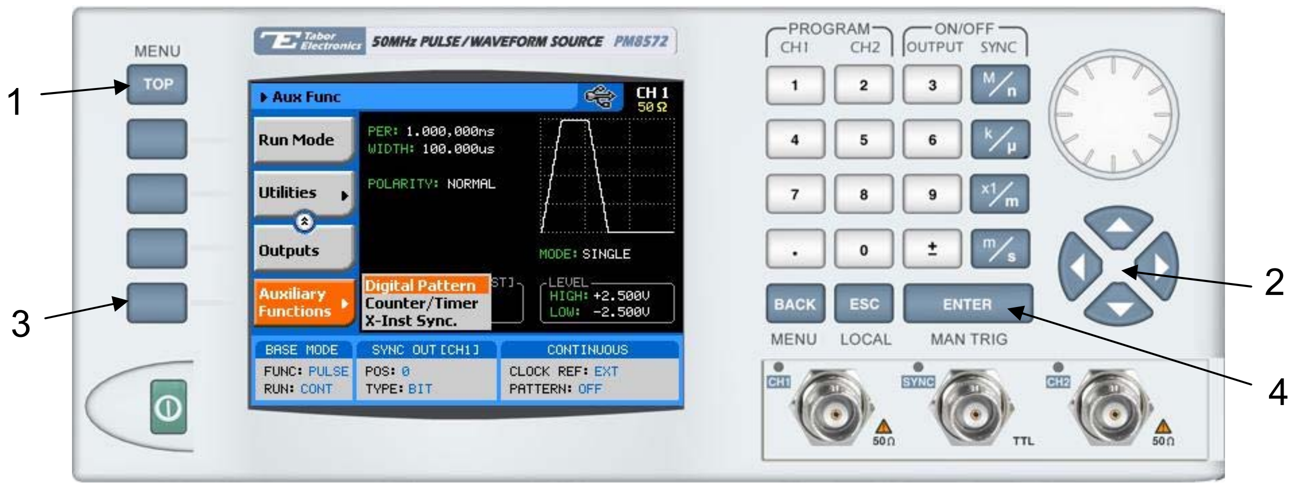


Figure 3-87, Accessing the Digital Pattern Menus

Accessing the Digital Pattern Menus

The digital pattern function provides means of generating digital data, exactly as would be done on a stand-alone, bench-type, pattern generator. Use the instructions below to access and select the digital patter mode and its associated data source.

1. Press TOP to display the root menu.
2. Press the arrow down key once and observe that the Auxiliary Functions menu appears.
3. Press the Auxiliary Functions soft key and scroll down to highlight the Digital Pattern option, as shown in Figure 3-88.
4. Press the Enter button to select the digital pattern function. Figure 3-88 shows the digital pattern panel and its menus.

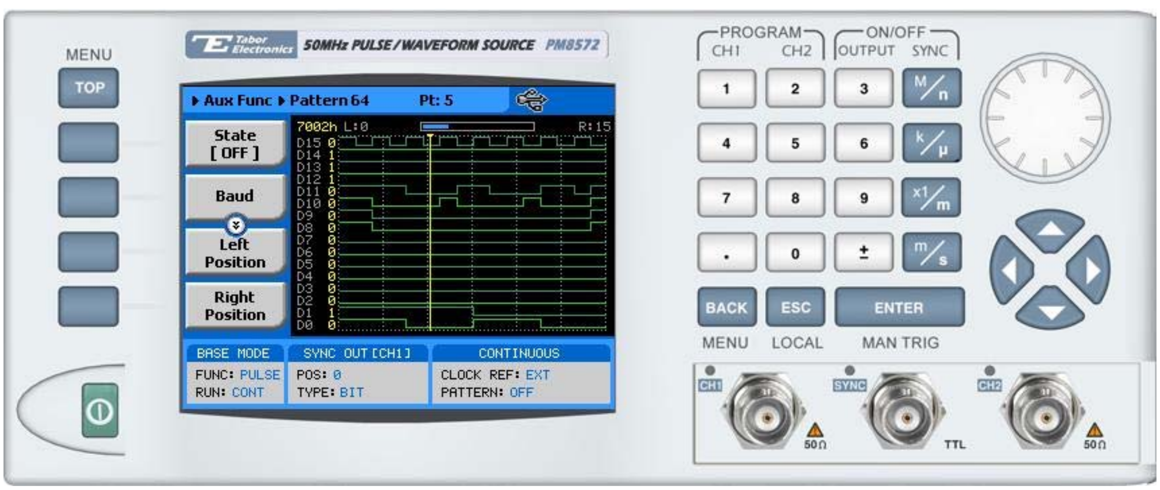


Figure 3-88, the Digital Pattern Menus

Digital Pattern Menus

There are various settings that define how the instrument will perform generate patterns. For example, the source can be defined as any of the arbitrary waveform segments or a special, dedicated pattern memory. The digital pattern menus are described below.

State On/Off – turned the digital pattern output on and off. This switch affects the rear panel connector only. In the On state, the digital pattern outputs are active and generate parallel LVDS data into a terminated load source. The channel 1 front panel output can be turned off if signal is not required through this connector. In the Off state, the rear panel connector is inactive.

Baud – defines the sample clock rate for the digital output. Note that the same parameter is used for the arbitrary and sequenced waveforms and therefore, it can be accessed from other menus as well.

Left Position – defines the left position of the data block that you want to display on the front panel.

Right position – defines the right position of the data block that you want to display on the front panel.

Data Source – selects from where you generate the patterns. There are two options:

1) Pattern Memory provides dedicated digital pattern source that is separate from the arbitrary memory data. The data from the pattern memory can be displayed and edited on the front panel. The dedicated pattern memory is limited to 128k pattern steps
2) Arbitrary Memory provides access to the entire arbitrary memory however, the data cannot be displayed on the front panel. If you select the arbitrary memory option, any waveform that is downloaded to the arbitrary memory can be generated simultaneously, from the front panel as an arbitrary memory and from the rear panel as digital pattern. When you select the arbitrary memory option, the message as shown in figure 3-89 will display.

Go to Line – provides access to a specific line in the pattern sequence. Line cannot be added from the front panel as patterns can be downloaded from a remote controller only however, when a line is accessed from the front panel, it can be modified using the field modification procedure as described in many instances in this chapter.

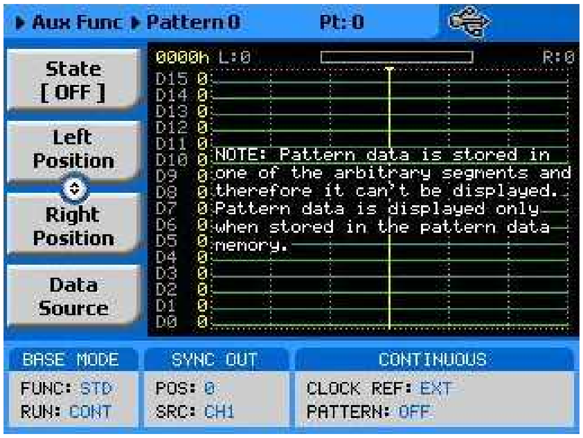


Figure 3-89, Digital Pattern Display while Using the Arbitrary Memory

Go to Pattern – provides access to a specific line in the pattern sequence. Notice that pattern sequences cannot be added from the front panel because patterns can only be downloaded from a remote controller. Figure 3-90 shows the Go to Pattern display.

Notice the display elements as shown in this figure. On the left you can see the pattern designator from D0 to D15 and the data value at the cursor position is shown on the left top position of the display. In the figure below, the cursor is placed at pattern step number 10 and the hex value of this position is F001h. You can also observe on the top of the display the left and right boundaries of the pattern (L:0, R:15) so if you are interested to see larger portions of the sequence, you can change the boundaries using the left and right position controls.

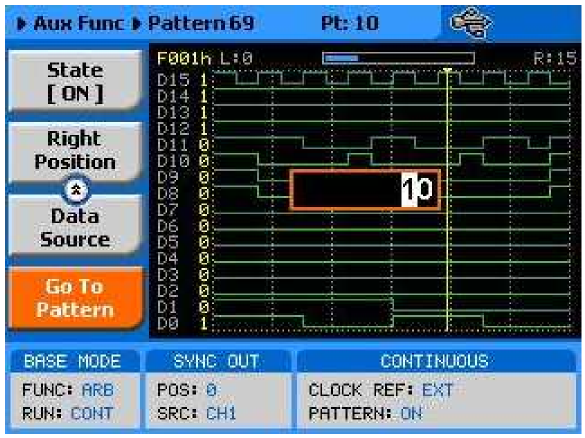


Figure 3-90, Go to Pattern Display

Creating Digital Patterns

As was mentioned above, digital patterns can be loaded to the PM8572A from a remote interface only. Information how to generate and download patterns is provided in Chapter 4. An example of a digital pattern data table is shown in figure 3-91. The patterns are written in hex words and the PM8572A will output the data in the same order as written in the table and at a rate defined by the Baud parameter.

Note that patterns are generated from channel 1 only and therefore, this option is available on the PM8571A as well except, the PM8572A has an advantage in a way that channel 1 can generate digital pattern data while the second channel can simultaneously generate arbitrary waveforms.

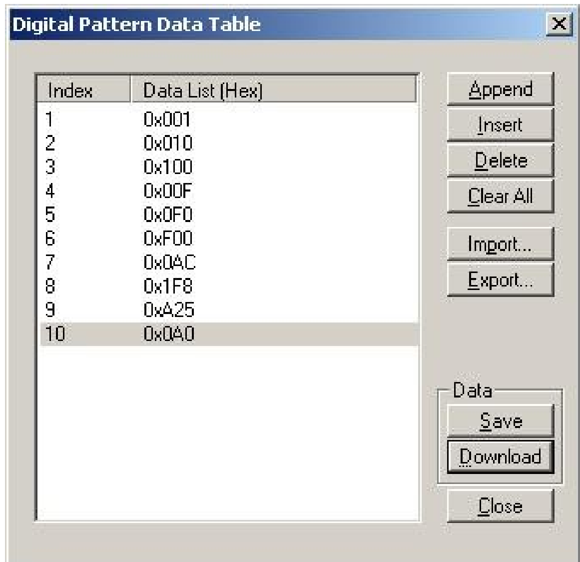


Figure 3-91, Digital Pattern Data Table Example

Synchronizing Multiple Instruments

The PM8572A waveform generator has two output channels. These outputs are just about everything you'll ever need for generating your signals however, some applications require multiple of synchronized channels, which can only be available if you purchase a much more expensive waveform generator or, by combining two separate instruments into one.

As you probably know, having two separate instruments will no do the job because each has its own clock source. Also, driving one generator from the clock of the other will not work because of the nature of memory-driven digital waveform generators that must have definite and clear signals when to start clocking the samples of the waveform.

The two instrument synchronization technique that is utilized by the PM8572A provides complete control over waveform run mode, start point, phase offset between adjacent units while maintaining jitter-free and skew-free synchronized outputs. Before or after multiple instruments are synchronized, each instrument can be programmed to have different waveform shape and amplitude however, in this mode, both units share the same run mode, i.e., continuous, triggered, etc.

To achieve synchronization, you must have special inter-connection cables and, in addition, LAN cables that either connect to a LAN network or, in case you do not use a network, two adjacent instruments can be connected together by a cross-wired LAN cable, with no connection to a LAN network. In any case, before you commence with your connections, make sure you get the synchronization cables from your Tabor dealer and get yourself familiar with the information below.

The interconnection cables are proprietary and must be bought from Tabor Electronics Ltd. In case you require such cables, contact your nearest dealer or the Tabor customer service department for price and delivery information. The purpose of these cables is to link the necessary signals from instrument to instrument. These signals will assure that the clock is the same, the reference is the same and that both units share start and stop signals for careful and complete control over waveform start phase.

Hardware synchronization is only part of the deal. The two PM8572A's must be set up so that one becomes master and the other(s) slave. Information how to connect the two instruments with the synchronization cable, how to select the master unit and how to proceed with synchronized operation is given in the following paragraphs.

Connecting the instruments

There is a difference if you wish to synchronize two or more instruments because, for two instruments you do not need to have a LAN network however, if you need more than 4 channels, the only way to do it is by connecting each instrument, separately, to the LAN network. For two instruments only, you can either connect to the LAN network or connect between the two instrument using a cross-wired LAN cable. In addition to the LAN cable(s) you need to connect the sample clock and the trigger signals between instruments. If you look at figure 3-91 below, you'll notice the X-INST SYNC group of connectors. These are SMB type connectors. They are connected as follows: The SCLK OUT and the COUPLE OUT connectors on the master module are connected to the SCLK IN and the COUPLE IN on adjacent slave unit. Additional units are connected in a daisy chain manner.

As a general note, if you do not intend to use PM8572A's in Master/Slave mode, it is highly recommended to remove the cable from one of the instrument because signals that are routed from one instrument to the other may interfere during normal operation.

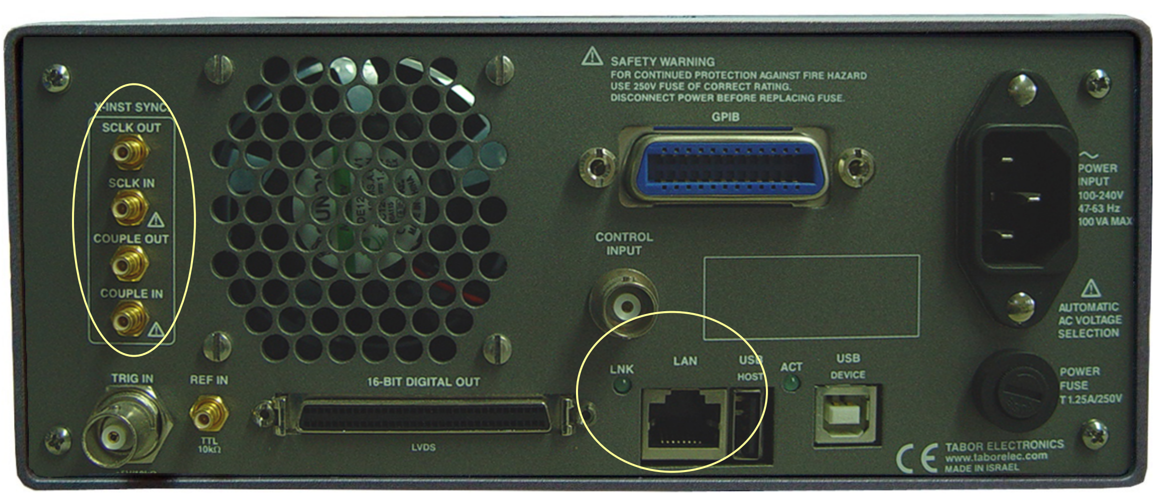


Figure 3-92, Connecting the PM8572A Synchronization Cables

Selecting a Master

Connecting the cables between the instruments is just the first step. The next is to select one instrument as master and the others as slave. Use the following procedure:

1. On the master unit, press the TOP Menu button to select the root menus
2. Press the down key button
3. Press the Auxiliary Functions soft key button
4. Use the dial or the up/down keys to scroll down to the X-Inst Sync option, as shown in figure 3-93
5. Press Enter. The display will change to show the multi-instruments synchronization menus
6. Press the Properties soft key button and select the role of the instrument as mater, as shown in figure 3-94. You may select from this menu if the instrument will be master or slave. If you select as slave, you will be able to program the start phase offset for the slave instrument as well.

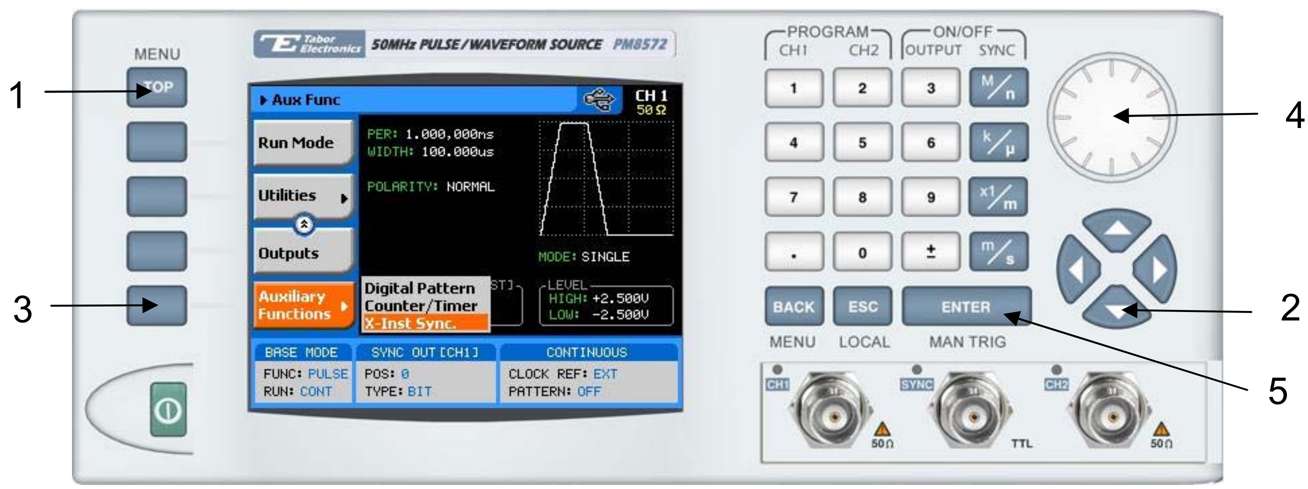


Figure 3-93, Selecting the Multi-Instruments Synchronization Menus

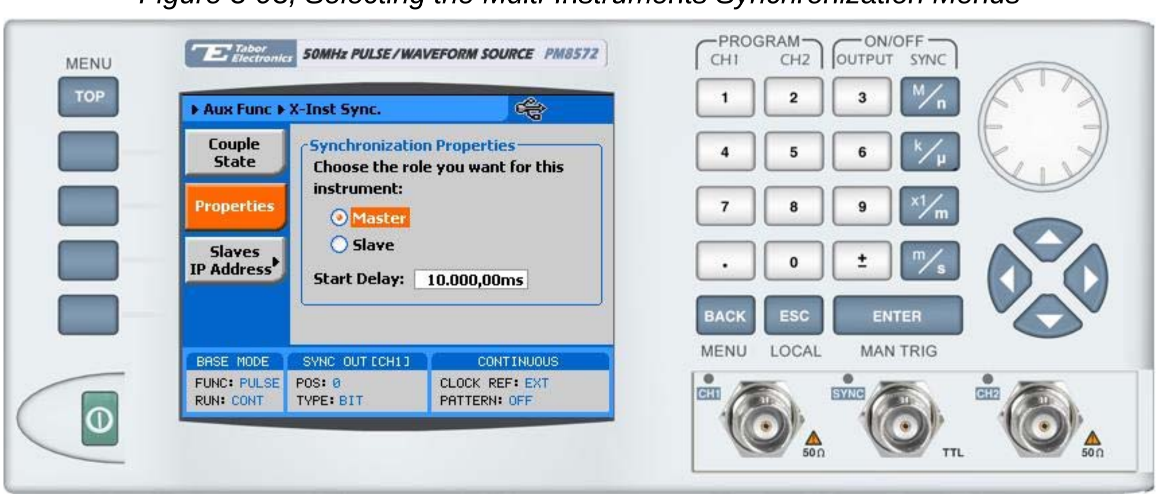


Figure 3-94, Selecting the Couple State

The next step is to tell the master instrument that will become slave instrument. Remember that the PM8572A can synchronize more than two instruments and that each one must be connected to a LAN network for communications and synchronization signals and therefore, all instruments must be set up to operate from a LAN interface and each instrument must have a unique LAN address for identification.

Slave units are identified by their LAN address. Press the Slaves IP Address soft key button to access the identification menu as shown in Figure 3-95.

There are two additional soft key commands added as you enter the Slaves IP Address menu: Insert Slave and Delete Slave. Use these buttons to add or remove salve identifications from your synchronization list. Every IP address that will be added to this table will automatically become part of the synchronization scheme.

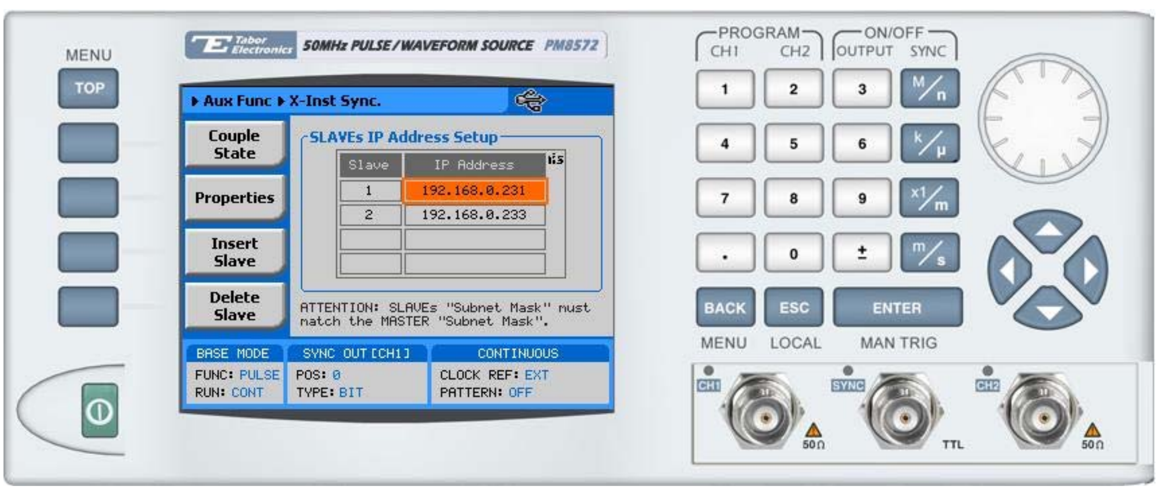


Figure 3-95, Programming Slaves IP Address

The final step to synchronize all instruments is the Couple State button as shown in figure 3-96. Select the Active state and press Enter to synchronize the instruments.

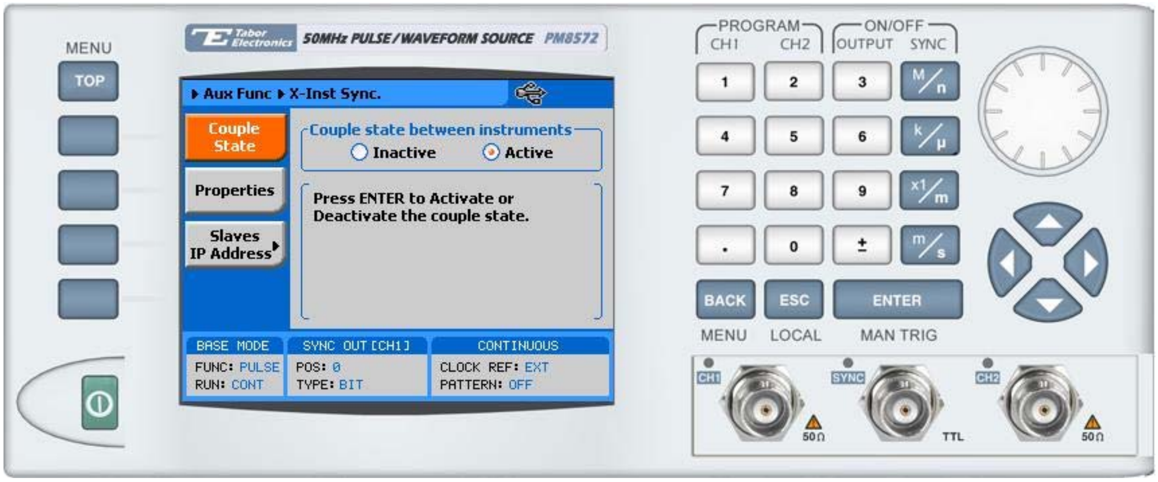


Figure 3-96, Activating the Synchronization Process

Operating Synchronized Instruments

Operating synchronized instruments is best achieved if some ground-rules are learned and adhered to.

1. Connecting the synchronization cables is pre-requisite however, additional steps must be performed to set one unit in master mode the others as slave.
2. Make sure you activate the synchronization sequence from the Master unit only
3. Sample clock and output frequency can only be controlled from the master unit
4. Both master and slave units must be placed in the same run mode to operate synchronously. For example, units in burst mode will synchronize however, one set to continuous and the another to burst will not synchronize
5. Both master and slave units must be placed in the same waveform mode to operate synchronously. For example, both units in sequence mode will synchronize however, one set to Arbitrary and the other to sequence will not synchronize
6. Two instrument synchronization does not operate in modulated waveform mode
7. Trigger signal is applied to the master input and is common to both master and slave units
8. Each instrument can have a unique set of waveforms, active segment, sequence, amplitude and offset parameters
9. Slave channels can be delayed in reference to the master channels by a pre-defined number of sample clocks. Observe Figure 3-95 and access the Start Phase field in the Synchronization Properties group. The start phase defines the delay time that the instrument will hold off before it will start

generating the output waveform. Setting resolution is 20 ns and the delay can be programmed from 200 ns to 20 s.

10. There is always some skew between adjacent instruments, which is due to circuit delays and cable length. Always consider the initial skew in your inter-instrument delay calculations. The initial waveform skew on the slave unit is roughly 15 ns.

Understanding the Basics of Phase Offset between Channels

The PM8572A has two output channels that can generate various and numerous waveforms. Although the control over waveform parameters is separate for each channel, the sample clock is derived from a single source. Having a single source for both channels is of great advantage because of two main reasons: 1) There is no jitter between the two channels and 2) If we ignore the initial skew, both waveforms start at exactly the same phase.

Understanding the initial skew term is very important. If you set both channels to output square waveforms and then connect these signals to an oscilloscope; If you then set the oscilloscope to its fastest time base setting, you'll see the two rising edges of the PM8572A signals. They do not overlap exactly because the instrument has a skew spec of 1ns ± 1 SCLK.

Skew is caused as a result of many factors. Although the two channels were designed exactly the same, small variations in printed circuit board layout or component values are enough to cause skew. These factors were known during the design phase and were minimized as practical. On the other hand, skew can also be generated from external factors that are controlled by the user alone. Examples for these factors are variation in cable length and quality, as well as, non-symmetrical end termination. Therefore, if you want to eliminate skew between channels, you have to use exactly the same cable type, the same cable length and the same termination on both channels.

There are times, however, that you do need to offset phase between channels. In that case, the PM8572A lets you adjust phase-offset variations with resolution of one point. When you do, just keep in mind that the initial skew will escort your programmed phase offset throughout the entire phase offset range.

Adjusting Phase Offset for Standard Waveforms

The PM8572A can generate an array of standard waveforms however, one should bear in mind that the PM8572A is a digital instrument and that standard waveforms are created from lookup tables or computed from equations; The lookup tables or equations are converted to waveform coordinates, placed in the arbitrary waveform memory and then clocked to the DAC with the sample clock generator. The frequency of the output waveform is computed from the relationship of two parameters: sample clock frequency and number of points.

Output Frequency = SCLK / number of waveform points

As you probably already realize, the sample clock has a finite frequency, 250 MS/s in the case of the PM8572A. And therefore, to reach high frequencies, the number of points is reduced proportionally. For example, consider output frequency of 25 MHz, there are only 10 points available to create the shape of the waveform.

With the above information on hand, we can deduct that if we want to phase offset one channel in reference to another, the number of waveform points determine the resolution of the phase steps. For example, for a 250 kHz sine wave, the number of points that are required to generate the waveform is 1000. So, phase offset can be programmed with resolution of 360°/1000=0.36°. On the other hand, at 25 MHz, the number of points that are required to generate the waveform is 10. So, phase offset can be programmed with resolution of 360°/10=36°.

So how do you figure out how many waveform points are used and what is the best resolution you may get? Simply look at the display of the standard waveform. You may not control the sample clock frequency when you use standard waveforms however, the display provides information on the internal SCLK setting and you may find out how many waveform points are used by looking at the SYNC line below the waveform icon. With this information, you can now compute your phase offset resolution.

Now, navigate to the Outputs menu, as shown in figure 3-97, you can see the Offset [Channel 2] field. CH2->CH1 delay is programmed in units of waveform points. Use the examples above to compute how many degrees are represented by each waveform point and enter the phase offset you wish to program. If you program any value besides 0, the start of channel 2 output will be delayed for an interval set by the following relationship:

Offset [Channel 2] = n x 1/sclk

Or, if you prefer to use phase offset in degrees, compute your phase offset resolution from the following relationship:

Phase Offset Resolution = 360° / n (where n = wave points)

And then multiply n by the value you program in the CH2->CH1 field.

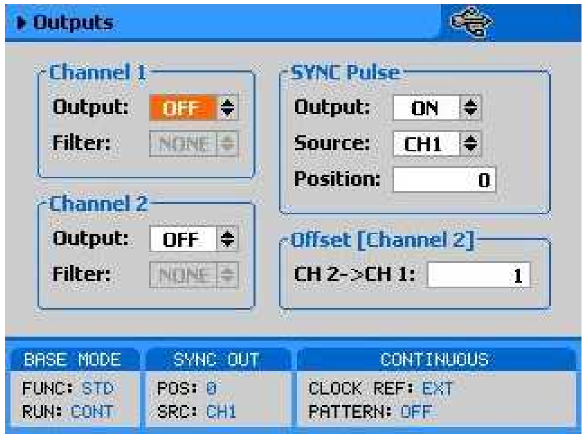


Figure 3-97, Programming Phase Offset between Channels

Contrary to what was discussed in the above, there are two waveforms that behave differently; these are sine and triangular waveforms. You can still use the phase offset method as was described in the above however, the two functions are different in a way that you can change the start phase on each waveform in increments of 0.2° regardless of how many waveform points are being used for generating the shape. This is true even if the number of waveform points do not allow such resolution however, it is also limited to 50MHz maximum. The phase offset for sine and triangle are changed from the Standard Sine and Standard Triangle menus and not from the Outputs menu. When you change start phase on one channel, you automatically generate a phase offset between the two channels, provided that both channels generate the same waveform shape. The phase adjustment for the sine and triangle waveforms is accessed from the Waveform->Standard->Phase menu, as shown in figure 3-98.

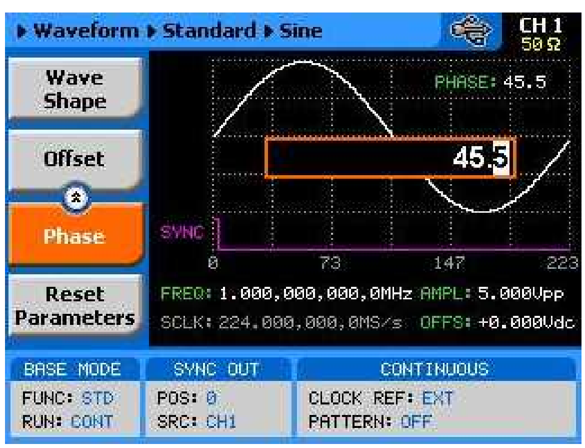


Figure 3-98, Changing the Start Phase on the Sine Waveform

Adjusting Phase Offset for Arbitrary Waveforms

The method of setting phase offset between channels when the PM8572A is programmed to generate arbitrary or sequenced waveforms is simpler because you already know how many waveform points you used for generating your waveform and what is the programmed sample clock and therefore, as discussed before, the delay is computed from the following relationship:

Offset [Channel 2] = n x 1/sclk

Or, if you prefer to use phase offset in degrees, compute your phase offset resolution from the following relationship:

Phase Offset Resolution = 360° / n   (where n = wave points)

And then multiply n by the value you program in the CH2->CH1 field. Navigate to the Outputs menu, as shown in figure 3-69, and modify the Offset [Channel 2] field as required.

Adjusting Phase Offset for Modulated Waveforms

Modulated waveforms are generated by the DDS circuit and therefore the phase offset between channels cannot be modified because the DDS generates sine waveform only and does not depend on waveform memory for the shape of the waveform. Using the modulated waveforms, there is a constant phase offset between the channels; this phase offset is always 90°. The constant phase offset for the modulated waveform is especially valuable for generating I & Q vectors.

Customizing the PM8572A

The PM8572A has customization features that modify its appearance and performance in such a way to simulate an entirely different product. For example, if you want to replace an HP8160 that failed in your test system, you can select the HP8160 from the customization list and from then on the PM8572A will accept and emulate HP8160 remote commands and will behave and perform exactly as if you have an HP product in your test system.

You can also customize other parameters, such as, the Horizontal Units, the Load Impedance, the Dial Direction, the Clock Source and the Display Brightness. Figure 3-99 shows the customization panel. Navigate to the customization display from the Utility menu. Adjust the brightness and the dial direction for your preferences and select the clock source as required by your system management. Information on the how to adjust the horizontal units and how to adjust the display for your load impedance is given in the following paragraphs, followed by description how to modify the commands set to emulate and simulate instruments from other vendors.

Selecting the Horizontal Units

Normally, frequency units – Hertz are used when specifying waveform frequency however, at times and as part of global system considerations, it makes it more convenient to work with time units – seconds. The horizontal scale of the PM8572A can be modified to operate either in the frequency domain or time domain. The default setting for the generator is frequency units.

Figure 3-99, Customizing the Output Parameters

Adjusting the Load Impedance

As specified in Appendix A, the display of the output amplitude is valid when the load impedance is exactly 50Ω. Such impedance is absolutely necessary when operating at high frequencies where unmatched output impedance can cause reflections and standing waves. It is therefore recommended to terminate the output with 50Ω loads only.

In certain applications where the load impedance is of no consequence, it may range from 50Ω to open circuit however, since the source impedance is 50Ω, the displayed amplitude will be different than the actual level on the load. If you know your load impedance, you can adjust the display to show the exact level on your load. The adjustment, as you can see in Figure 3-99 can be made separately for each channel. The default load impedance setting is 50Ω.

Emulating Foreign Remote Commands

While future applications were used as guidance for the design of the PM8572A, at the same time, Tabor Electronics made sure that existing and mature systems could easily transition to the new pulse master product line using the built-in cross compilers that automatically convert native commands to PM8572A code. This feature permits replacement of old and obsolete products without the need to write new code. Just imagine that you have an old HP8160 or an old Wavetek pulse generator in your system but no service and parts can be found to repair these instruments. Do not worry too much, simply remove the product from your old system, install the Tabor PM8572A, select the appropriate commands set and continue with your tests without the hassle of writing new test programs.

At the time that this manual was written, the cross compiler included a list of twelve emulation tables. This list will be updated regularly, as cross compilers will be added to the code. If you intend to replace an old instrument but your equipment is not listed in this page, make sure you call your dealer or a Tabor representative that will be able to tell you if your instrument is already supported, or if there are future plans to add such a support.

Currently, the following instruments are supported by the PM8572A:

Manufacturer	Model	Description
HP	8112A	50 MHz pulse generator
HP	8116A	50 MHz function/pulse generator
HP	81101A	50 MHz pulse generator
HP	8160A	50 MHz pulse generator
HP	8165A	50 MHz function/pulse generator
LeCroy	LW400	400 MS/s waveform generator
Fluke	80	50 MHz function generator
Fluke	81	50 MHz function/pulse generator
Tabor	8500	2-channel 50 MHz pulse generator
Tabor	8550	50 MHz function generator
Tabor	8551	50 MHz function/pulse generator

To modify the remote commands set to a specific instrument, as listed in the table above, access the Customization dialog box from the Utility tab, scroll down to the Command Emulator field, press Enter and use the keys up and down to scroll through the emulators list, then press Enter to accept your selection.

Note

The PM8572A is a modern and extremely high performance instrument. Very unlikely that any of the instruments that the PM8572A emulates exceeds its performance. Regardless, there is a possibility that functions and features that are available on other instruments are either not available or operate slightly different with the PM8572A. Therefore, 100% compatibility is not assured when used as a replacement emulator. When such an incompatibility is detected, Tabor takes the necessary steps to correct the irregularity however, functionality that does not exist on the PM8572A will not be supported with the commands emulator.

Always check the Tabor Electronics web site for firmware updates and for additional emulators. Also note that custom emulators are available upon request.

Using the Store/Recall Function

The store and recall functions allow you to save important front panel settings and recall them later, when they are needed for a specific application. If you are using external utilities and control the instrument remotely, then it will be best to store all instrument settings and waveforms on the computer's media. However, if local operation is desired, you have two options: 1) Store instrument settings and waveforms on a disk-on-key media, or 2) Generate a settings file on an external computer, save the file and the waveforms on a cd and use a cd drive to download the settings to the instrument.

The PM8572A utilizes two USB inputs of which, one is a Device and the other is a Host. The Device input has a standard type 2 connector and is used for programming the PM8572A from remote. The Host input has a standard type 1 connector and is used for the store and recall media.

The instrument employs 10 memory cells of which can be used to store ten different instrument setups. The store operation saves all current settings including waveforms, sequence tables and run mode. Note however that the instrument can store and recall setting on a disk-on-key media but can only read settings from a cd and therefore, the front panels display different dialog boxes when one or the other is detected.

For simplicity, the image of the stored file is done in a text format that anyone can read and write. The format of the file, as well as, the commands to read and write from and to the memory media is given in the programming chapter of this manual.

To access the Store/Recall panels, press the Utility soft-key and then select the Store/Recall option. If you have a disk-on-key plugged in, you'll be prompted with the display as shown in Figure 3-100 but if you had a cd driver plugged in, the display will be different, as shown in Figure 3-102.

There are two or three soft-key buttons in these displays: Store (disk-on-key only), Catalog, and Update. Information on how to use the keys to store and recall setups on different media options is given below.

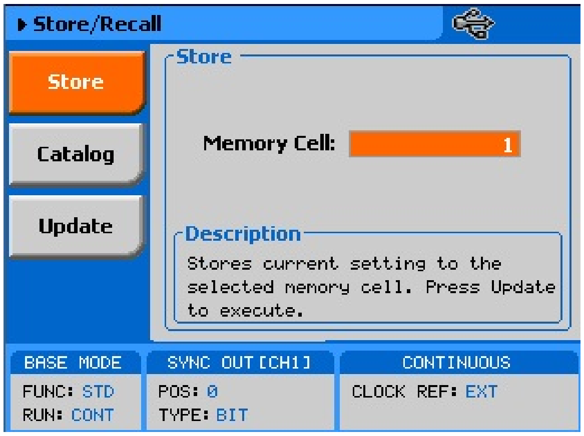


Figure 3-100, Disk-On-Key Store Menus

Storing Instrument Setups

As was mentioned above, setups can be stored on a disk-on-key media only and therefore, if you have such a storage media plugged into the USB host input, the display will automatically allow you to store setups.

The Store display is shown in Figure 3-100. This is the first display you enter after pressing the Store/Recall option in the utility menu. The Store display has only one field that you can program: Memory Cell. And two other soft-key buttons that you may use. Description of the store operation is given below.

Memory Cell – use this field to select the active memory cell. There are 9 memory cells that you may access and each of these cells can be used to store different setups and different waveforms, but you may not store more than one waveform in a specific memory cell location.

Use the Update button to execute the store operation and wait for the operation to complete. Upon completion of the store operation, the instrument will display an end of operation message.

Note that storing waveforms near or around 1M points is rather slow and therefore, expect long delays while doing a store action. It is highly recommended that waveforms near 1M points be stowed away on a faster media such as a computer hard drive and downloaded to the instrument as required for the test.

Recalling Instrument Setups

While setups can be stored on a disk-on-key media only the PM8572A can recall setups from either a disk-on-key or from a cd driver and the display will automatically revert to displaying menus that allow recalling settings from the detected media.

For a disk-on-key media, press the Catalog soft-key button, as shown in Figure 3-100. From the Catalog display, as shown in Figure 3-101 you will be able to recall setups, as listed in the Catalog cells.

To recall a specific setup, use the up or down keys to scroll through the Cell fields, highlight the required cell number and press Update to complete the recall operation. Wait for the operation to complete and for the instrument to display a message that the operation has been successful.

Use the clear soft-key to clear old setups from a specific cell number. Cells that were loaded with setups show “Setup” in the Contents filed. Cells that do not contain any settings show “Empty” in the Contents field.

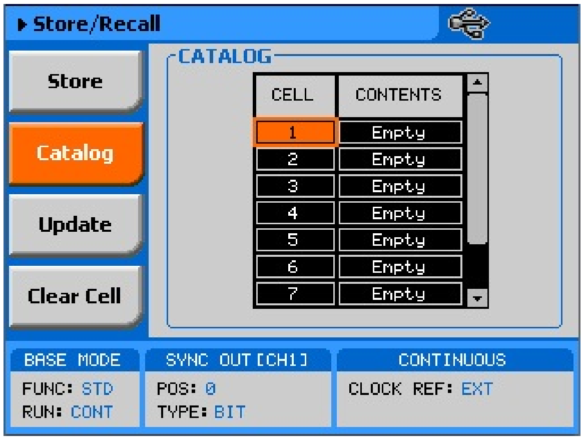


Figure 3-101, Disk-On-Key Recall Display

For a CD drive media, the recall display is shown in Figure 3-102. Use the up or down buttons to scroll between the cells and press the Update soft-key to recall setting. Wait for the operation to complete and for the instrument to display a message that the operation has been successful.

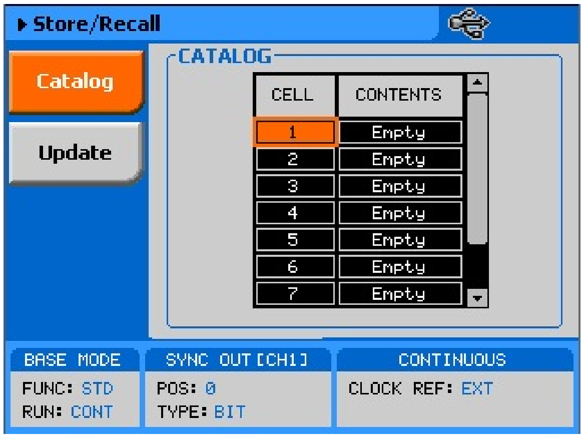


Figure 3-102, CD Drive Recall Display

Store/Recall Considerations

Built on an ARM9 infrastructure, the PM8572A is using Linux as its operating system. Although the displays and menus have the feeling of Windows operating system, some of the privileges that are associated with Windows OS are not available in the PM8572A. For example, do not expect the same behavior as plugging a stick to a Windows based operating system; There are no messages and no confirmation when a USB has been mounted or removed.

The following are some considerations that you should bear in mind when using the USB stick to store waveforms and setups out of the PM8572A.

- When plugging a USB stick to the PM8572A, allow between 5 to 10 seconds for the operating system to mount the device. An attempt to access the stick before it has been mounted generates an error.
- Waveform data is stored in a working memory that is extremely fast because it feeds the DAC however, in contrary, the flash memory that is used for storing waveforms is much slower and therefore, moving large chunks of waveforms from the working memory to the USB stick memory is a slow process because the data is transferred one word at a time. For this reason, keeping your large waveforms on a hard drive is a much faster method to recall waveforms to the working memory.

It is possible to copy files that were stored on a USB stick to a host computer however, before copying files from a computer to another USB stick make sure that the files have names like setup1 and wave1 with no added characters or extensions. Sometimes, Linux adds strange characters to file names but these can be renamed in Windows environment to remove the extra characters.

Monitoring the Internal Temperature

The PM8572A has an internal temperature sensor that allows monitoring of the internal temperature. In cases where you suspect that the instrument is getting too warm, or malfunction occurs, you can monitor the internal temperature to see if the cause is excessive heat inside the unit. The temperature information is also available to read from a remote interface, so constant control over system temperature can be maintained.

Temperature reading is automatically read and displayed every time you select the System display from the Utility menus. Figure 3-103 is an example of the System menu, showing the temperature inside the unit as 35°C. To update the reading press the numeric “0” button.

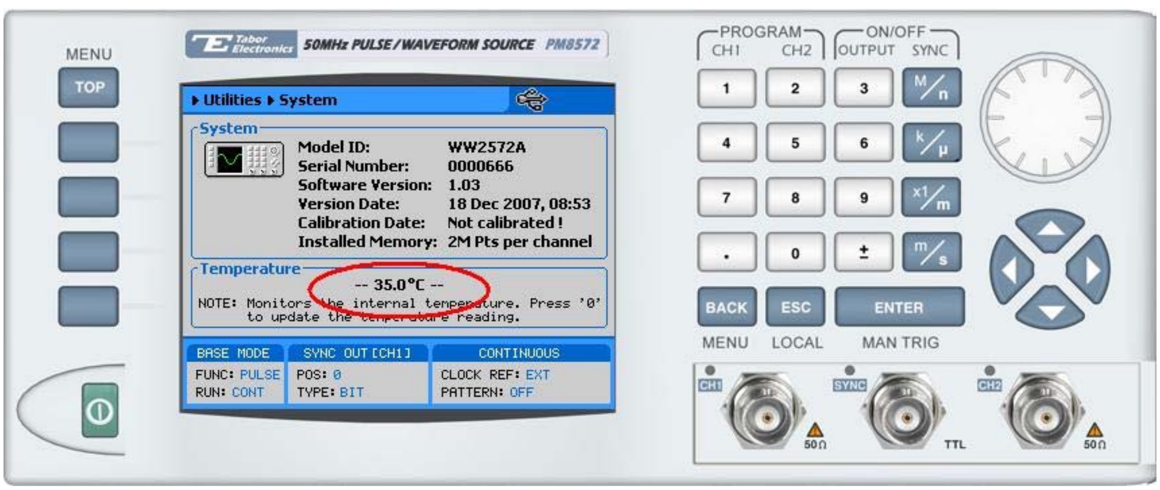


Figure 3-103, Reading the PM8572A Internal Temperature

Chapter 4
ArbConncetion

Title	Page

What's in This Chapter?

This Chapter contains information how to install, invoke and use ArbConnection. Introduction to ArbConnection and examples how to program instrument controls and parameters and how to generate waveforms and download them to the PM8572A are also given in the following sections.

Introduction to ArbConnection

In general, ArbConnection is a utility program that serves as an aid for programming the Model PM8572A. ArbConnection has many functions and features of which all of them share a common purpose – controlling PM8572A functions from remote. As minimum, to use ArbConnection, you'll need the following tools:

1. Computer, Pentium III or better
2. Windows 2000/XP/Vista, or higher
3. High resolution screen, at least, 1024 x 768 pixels
4. Pointing device, mouse or ball
5. Visa 2.6, or higher installation
6. Last, but not least, some basic knowledge how to operate computers and Windows-based programs.

ArbConnection operation is divided into three main functions: 1) Front panel control, 2) Waveform generation and editing and 3) FM waveform generation and editing. These operating options are described in this chapter however, you must install ArbConnection before you can use it. The next paragraphs describe installation and first steps before going into in-depth operation.

Installing ArbConnection

The installation program installs ArbConnection on a logical drive of your choice. The default is drive C. It automatically creates a new directory and copies the files that are required to run the program. Before you install ArbConnection, make sure that there is at least 10 megabytes of available memory on your hard disk drive.

To install ArbConnection, insert the distribution disk in the A: drive.

Invoke Run and type:

```
A:\Setup
```

The install program does the complete job far you and creates a workgroup and icons to start ArbConnection.

Quitting ArbConnection

Before you start roaming through menus and editing commands, we strongly recommend that you make yourself familiar with ArbConnection basics and concept. For now quit the program and spend some more time with this section of the manual. Point the mouse cursor to the File menu and press the left mouse button. Move the mouse cursor to the Exit command and press the left mouse button.

For the New and Advanced Users

For the New User
Learning to use ArbConnection is easy, intuitive and quick, even if you have never used such programs before. After you have installed ArbConnection on your computer read the following paragraphs to learn how to find your way around ArbConnection's menus.

Once you are familiar with the basics, you'll continue to learn about features, programming, and editing commands. If you can't find the answer to a question in this guide, call your distributor or the LeCroy customer support service near you and we'll gladly assist you with your problems.

For the Advanced User
If you are already familiar with computer conventions and have basic knowledge of Windows programming, you may want to skip some of the following paragraphs.

Conventions Used in This Manual

This manual uses certain typographical conventions to make it easier for you to follow instructions. These conventions are described in the following:

[Enter, or ↵] Press the Enter or Return key.

[Esc] Press the Escape key.

[Alt-F] Press the Alt key and the key that follows, simultaneously. In this example the key that follows is F.

[Ctrl-S] Press the Control key and the letter that follows, simultaneously. In this example, the letter is S. The control key also appears in the menus as a target sign.

[↑] [↓] [→] [←] Press the Arrow key with the symbol pointing in the direction specified (i.e., up, down, left, or right).

<+> Press the key for the character or word enclosed in angle brackets. In this case, the Plus sign key.

The Opening Screen

Invoke ArbConnection by double clicking on the icon. If you cannot find the icon on your desktop, click on Start, Programs and ArbConnection. The opening screen will show. If you installed the program correctly, your screen should look as shown in Figure 4-1.

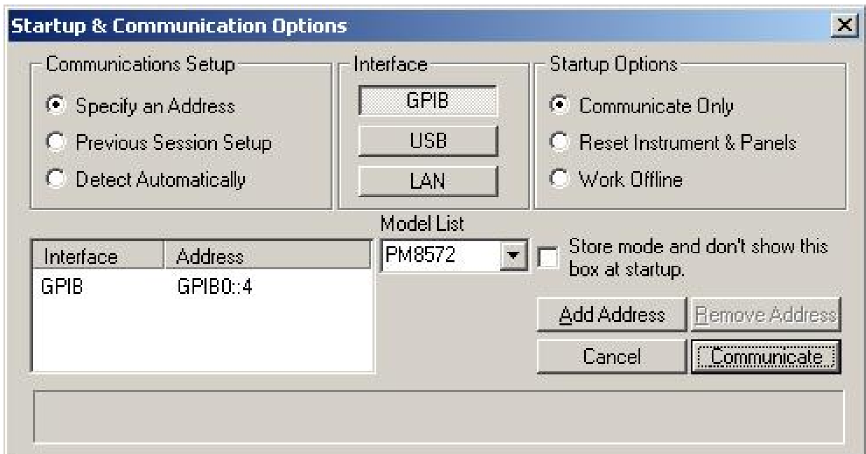


Figure 4-1, Startup & Communication Options

The Startup & Communication Options dialog box is displayed. You can check the “Store and don’t show…” so next time you invoke ArbConnection, this dialog box will not be displayed. The purpose of this dialog box is to update the program in the way you intend to use it. For example, if you are using a GPIB device that has address 4, you can click on the Specify an Address option and type in the required address so the next time you use ArbConnection, the program will automatically resume communication with the same address as was originally detected.

If you chose to hide this dialog box, you can still access and change the options from the System command, at the top of the screen.

Make your selection and click OK. The Startup & Communication Updater dialog box will be removed from the screen. And the Main panel will now be accessible. But before we go into panel operation, let’s look at the toolbars at the left top of the screen as shown in Figures 4-2 and 4.2A.

Figure 4-2, ArbConnection's Toolbars

Figure 4-2a, the Panels Toolbar

The standard Windows **Menu Bar** is the top bar. It provides access to main system controls like saving files, and viewing or removal of screen images.

The second bar is called **Link** bar. It provides direct access to different instruments that are active on the active interface bus. ArbConnection can control a number of PM8572A units simultaneously. If the instruments were connected to the interface while invoking ArbConnection, they will automatically be detected by the program and will be placed in the Link pull-down window. The active instrument is displayed with its associated address. If you run ArbConnection in offline mode, the Link bar will show PM8572A, Offline.

The **Panels** toolbar, as shown in Figure 4-2A, provides direct access to instrument control panels. The individual control panels are explained later in this chapter. The Main, Standard, Arbitrary, Trigger and the other buttons will bring up to the screen panels that are associated with these names. The Composers button provides access to the Waveform, Pulse, FM and 3D composers. The first time you launch ArbConnection, the opening screen will have the Main panel open. Click on other buttons and interactively get the feel how ArbConnection opens and closes control panels.

ArbConnection Features

ArbConnection's main purpose is controlling PM8572A functions and parameters. The PM8572A can generate standard waveforms from a built-in library, arbitrary waveforms from user-downloaded coordinates, modulated waveforms, digital patterns and much more. The only way to access all of these features is through software utilities such as Plug & Play drivers, and soft front panels. ArbConnection is built to provide complete control over the PM8572A.

ArbConncetion has four main screens: control panels, waveform composers and various utility control panels. The various screen images along with instructions how to access and use them are described below in detail.

The Control Panels

The control panels look and feel just as if you would operate an instrument from its front panel. They even look like instrument front panels, so operating function and changing parameters is easy and intuitive. Let's look at the first panel that shows at the opening screen. This panel, as shown in Figure 4-3, is called the Main Panel.

To begin with, let's explore the panel controls to see how they feel, react and what they do. All other panels share almost the same feel, so the description of how to operate the Main Panel can serve as general guide for controlling the rest of the panels.

Looking at the panel you can identify the following controls: Push buttons, LED's, radio buttons, Dial and Digital display. The function of each control is described below.

Push Buttons – These are used for toggling a function on and off. For example, the Output Enable button in the Output group toggles the output on and off. The first mouse click will push the button inwards and will turn on a red bar at the center of the button, indicating that the function is on. The second mouse click will turn the function off.

Radio Buttons – Are used for changing operating modes, or selecting between mode options. One of the radio buttons is always on with a red dot in its center, indicating its state condition.

LED's – The LED's indicate which of the parameters are displayed on the Digital Display. Red LED indicates that the parameter name next to this LED is selected. Only one LED can be ON at a time.

HINT

LED's are turned on by clicking on the LED or the text next to it. The selected parameter is flagged by a darker LED shade.

Dial – Use the dial to modify displayed reading. To use the dial, press and hold the mouse cursor on the dial and move the mouse in a clockwise circle to increase the number, or counterclockwise circle to decrease the displayed number. The dial modifies digits at the cursor position and will allow modification within the legal range of the displayed parameter. If you reach the end of the range, the dial will have no further effect on the display. If you do not want to use the dial, you can still change the display reading by using the [↑], or [↓] keys, or simply type the required number using the standard keyboard features.

NOTE

After you change the displayed readout, the PM8572A will be updated with the new parameter only after you press the Execute button.

Digital Display – The display is used for displaying and reading various PM8572A parameters, just as you would use it on your instrument.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the PM8572A has not been

updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

The Operation Panels

Figure 4-3a -, the Operation Panels

The Operation tab provides access to a group of panels that control the basic operation of the generator. From this group you can set the output function, run mode, turn the outputs on and off and adjust the parameters for the various functions. There are six panels in this group: Output, Run Mode, Pulse, Standard, Arbitrary/Sequence and Half Cycle. The Output panel is always visible because this is the panel that controls operating functions, run modes and sets the outputs on and off. The other panels can be made visible by clicking on the appropriate tab in the Operation group. The operation set of panels are described below.

Output

The Main Panel, as shown in Figure 4-3, is the first panel you see after invoking ArbConnection. Notice how buttons and LED's are grouped; this is done specifically so that common parameters are placed in functional groups. The Main Panel groups allow (from left to right) adjustment of amplitude and offset, selection of waveform mode, selection of run mode and control over SYNC and Main output parameters. Controls, where applicable, are provided for each channel separately.

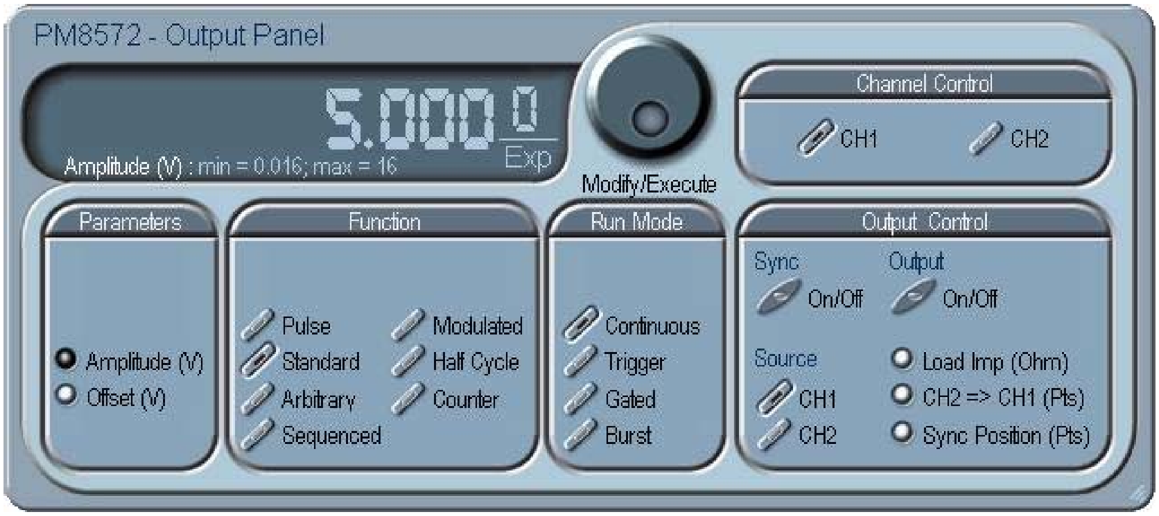


Figure 4-3, the Main Panel

If you are connected properly to a PC and ArbConnection has detected your instrument, then every time you press a button, you are getting an immediate action on the PM8572A. It is different if you are changing parameters on the display; Doing this, you'll have to press the Execute button for the command to update the instrument. The functional groups in the Main Panel are explained below.

Channel Control

The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the Output panel while the other channel remains passive. Note however, that Function and Run Mode parameters are common for both channels and therefore, every time you change one of the functions or run modes, expect that the other channel will be updated accordingly.

Parameters

The Parameters group contains two parameters: Amplitude and Offset. The values that are exhibited in this group might be duplicated on other panels, so every time you change amplitude and offset in the Parameters group, the other panels are updated automatically. When you program a specific parameter, make sure that the appropriate channel is selected in the channel control group.

To access the required parameter, click on the parameter name. The LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new reading.

Function
The Function group is used for selecting between function types. The PM8572A provides seven types of waveforms: Pulse, Standard, Arbitrary, Sequenced, Modulated Half Cycle and Counter/Timer. By pressing one of these buttons output waveform will change to the selected option. The default function type is Pulse. If you want to change the pulse waveform parameters, you can select Pulse from the Panels bar.

Run Mode
The Run Mode group is used for selecting the active run mode for the instrument. You can select between continuous, triggered, gated and burst modes. There is no additional panel associated with the continuous mode, but if you press one of the other run mode options, you'll be able to adjust the trigger parameters from the Trigger Panel.

Output Control
The Output Control group controls the state of the main outputs and the state of the SYNC output. Click on the State buttons to toggle the outputs on and off.

From this group you also control the position of the SYNC pulse and the source of the sync. If you select the SYNC source to come from channel 1, the waveform that is generated at the CH1 output connector will be synchronized with the rising edge of the SYNC output pulse. Selecting the SYNC source as CH2, transfers the synchronization to the second channel. Note that you'll notice the difference only if you have different waveforms and waveform length in channels 1 and 2.

The load impedance buttons allow you to adjust the display amplitude reading to your actual load impedance value. The default value is 50 Ω and the output range is calculated in reference to this value. If your actual load impedance is higher than 50 Ω and you increase the load impedance value in this group, the output of the PM8572A will display the correct value as is measured on your load impedance.

Run Mode Control

The Run Mode Control panel, as shown in Figure 4-4, is invoked by pressing the Run Mode button on the Panels bar. Note that if you invoke the Run Mode from the Panels menu, the PM8572A will not change its trigger mode. To modify the instrument's run mode, use the Output Panel. The trigger parameters and setting in the Run Mode Control Panel will have an effect on the PM8572A only if an appropriate run mode setting has been selected. The Run Mode Control Panel groups allow (from left to right) adjustment of Trigger Modifier and their associated Trigger Parameters. The functional groups in the Run Mode Control panel are described below.

Channel Control
The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the Output panel while the other channel remains passive. Note however, that some parameters and modes are common for both channels and therefore, every time you change one of these functions, expect that the other channel will be updated accordingly.

Trigger Modifier
The Trigger modifier group provides access to delayed trigger state and its delay parameter and to the Re-trigger state and its parameter. The Manual button operates in conjunction with the BUS mode only. Use this button when an external generator is not available. Pressing the Manual button is stimulating the instrument as if an external trigger has been applied.

To change the trigger delay or the re-trigger interval, point and click on one of these parameters. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new reading.

Figure 4-4, the Run Mode Control Panel

Trigger Parameters
Slope - The Slope group lets you select edge sensitivity for the trigger input connector. If you click on Positive, the instrument will trigger on the rising edge of the trigger signal. Likewise, if you click on Negative, the instrument will trigger on the falling edge of the trigger signal.

Source - The PM8572A can accept triggers from a number of sources: BUS, External, Internal or Mixed. When the Bus option is selected, only bus c3ommands trigger the instrument. The External position is the default trigger option which enables the rear panel trigger input and the front panel manual trigger button. The Internal position is available only in Pulse mode and operates in conjunction with the Timer parameter. The Internal trigger mode, when selected, disables the external trigger input and enables an internal, none synchronized, trigger generator. This is especially useful when you do not have an external source to trigger the generator. The Mixed position disables the rear-panel trigger input until a software command is executed; the trigger source then reverts to the rear-panel trigger input.

Burst - Programs the burst count for burst mode. Note that in all functions, except pulse, the burst count is separate for each channel. However, for the pulse output, the burst count is the same for channel 1 and channel 2.

Timer – The timer field programs the trigger period of the free-running internal trigger generator. The internal trigger timer is programmed in units of seconds. Note that the internal trigger generator function is available in pulse mode only. Other output functions use the re-trigger generator that has a different interpretation than the internal trigger period. Information on the re-trigger mode is given in Chapter 3.

Trigger Level – Programs the trigger level parameter. Depending on the slope setting, the PM8572A will be stimulated to output waveforms when the trigger level threshold has been crossed.

Pulse

The Pulse Panel, as shown in Figure 4-5, is accessible after you click on the Pulse button in the Panels bar. The Pulse Generator Panel groups allow (from left to right) adjustment of Parameters, Hold Control, Output Control and Channel Control. The functional groups in the Pulse Generator panel are described hereinafter.

The pulse generator panel, as shown in Figure 4-5, demonstrates default condition where the output pulse mode is Single, the amplitude level hold control is high and low and the pulse transitions are fast. Notice that only four parameters are visible in the Parameters group while there are many other parameters that can program the pulse shape. This was done to simplify the operation and the parameters that are not visible show up on the panel only with the relevant output mode. For example, if you select the linear transition mode, the leading and trailing edge parameters will become visible on the panel. Also, if you use the hold duty cycle mode, the width parameter will be replaced by the duty cycle parameter because the width has no meaning when the hold duty cycle mode is selected. Figure 4-6 shows the same pulse generator panel with the linear transitions mode turned on and the hold duty cycle pulse selected for the pulse output mode.

Figure 4-5, the Default Pulse Generator Panel

Figure 4-6, the Pulse Generator Panel with Linear Transitions and Hold DCycle Output

As explained above, not all pulse parameters are visible at default. Regardless, all of the parameters that are available in the parameters group will be explained in the following paragraphs along with explanations when they become active and when they apply for pulse shape programming.

Channel Control

The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the pulse panel while the other channel remains passive. Note however, that some parameters and modes are common for both channels and therefore, every time you change one of these functions, expect that the other channel will be updated accordingly.

Parameters
Period - The period parameter defines the period of the pulse, regardless of the pulse mode. The period parameter is not visible in external pulse width mode because the period and the width are generated from an external signal.

Width - The width parameter defines the width of the pulse, regardless of the pulse mode. The width parameter is not visible in external pulse width mode because the period and the width are generated from an external signal. The width is replaced by the duty cycle parameter when the hold duty cycle pulse mode is selected.

Duty Cycle - The duty cycle parameter defines the width of the pulse in reference to its period. The duty cycle parameter is visible only when the hold duty cycle pulse mode is selected.

High Level - The high level parameter defines the high level of the pulse. It is visible in the following level hold modes: High/Low and Positive.

Low Level - The low level parameter defines the low level of the pulse. It is visible in the following level hold modes: High/Low and Negative.

Amplitude - The amplitude parameter defines the amplitude of the pulse. It is visible only when the Ampl/Offset hold level is selected

Offset - The offset parameter defines the offset of the pulse. It is visible only when the Ampl/Offset hold level is selected

Delay - The delay parameter defines the delay from the SYNC leading edge to the leading edge of the pulse. This parameter is visible only in delayed pulse mode.

Double Delay - The double delay parameter defines the delay between the leading edges of the pulse pairs. This parameter is visible only in double pulse mode.

There are two special pulse modes that need separate sets of parameters; These are: External Width and Pulse Width Modulation (PWM). The parameters of these two functions are described separately in this chapter.

Hold Control
The hold control group has dual functionality; It determines how you program the level of your signal and defines if the signal has fast transitions or controllable linear transitions.

The level control provides flexibility in the way that you place your pulse along the vertical axis. There are four options, as described below:

High/Low – when this option is selected you enter your pulse amplitude using two parameters: High Level and Low Level. In this case, the instrument determines automatically from your inputs the required amplitude and offset to place the pulse exactly where you intended to. This level hold mode is especially useful for applications that require precise settings of both the high and low levels.

Amplitude/Offset – this option is useful for applications that require an absolute magnitude and precise placement of the pulse offset. This setting option is common for waveform generators where signals are normally generated symmetrically around the 0V level but is not as frequently used for pulse applications. Nevertheless, this option is available and sets the amplitude and offset separately.

Positive – this option fixes the low level at the 0V level and every change in the positive level setting moves the positive level only. This level setting is extremely useful for applications that require control over the high level only while keeping the low level fixed.

Negative – this option fixes the high level at the 0V level and every change in the negative level setting moves the negative level only. This level setting is extremely useful for applications that require control over the low level only while keeping the high level fixed.

Output Control

The output control group defines the shape and the polarity of the pulse. The menu provides a selection from six pulse shape options: Single, Delayed, Double, Hold Duty Cycle, External Width and PWM1. These pulse modes are described below.

Single – this pulse mode defines single pulse with properties that can be programmable to suite even the most complex application. The single pulse mode may be generated in continuous, triggered, gated and counted burst run modes, while retaining all of its pulse characteristics. The SYNC output is synchronous with the start of the pulse and appears every time a cycle is initiated. The parameters that control the single pulse output are: period, width, high and low levels, leading and trailing edge transitions and polarity.

Delayed – this pulse mode defines single pulse with properties that can be programmable to suite even the most complex application. The delayed pulse mode may be generated in continuous, triggered, gated and counted burst run modes, while retaining all of its pulse characteristics. The SYNC output is synchronous with the start of the pulse except, the pulse is always delayed from the SYNC position by a programmable interval. The delay parameter is extremely stable and may be programmed with resolution as small as 10 ps. The parameters that control the delayed pulse output are: period, width, high and low levels, delay, leading and trailing edge transitions and polarity.

Double – this pulse mode defines double pulse with properties that can be programmable to suite even the most complex application. The double pulse mode may be generated in continuous, triggered, gated and counted burst run modes, while retaining all of its pulse pair characteristics. The SYNC output is synchronous with the start of the first pulse and appears every time a cycle is initiated. The double pulse delay parameter is extremely stable and may be programmed with resolution as small as 10 ps. The parameters that control the double pulse output are: period, width, high and low levels, double delay, leading and trailing edge transitions and polarity.

Hold Duty Cycle – this pulse mode defines a special case of the single pulse mode except, instead of programming the pulse width, the duty cycle is held fixed at a value set by the duty cycle parameter. The fixed duty cycle pulse mode may be generated in continuous, triggered, gated and counted burst run modes, while retaining all of its pulse characteristics. The SYNC output is synchronous with the start of the pulse and appears every time a cycle is initiated. The parameters that control the single pulse output are: period, duty cycle, high and low levels, leading and trailing edge transitions and polarity.

Figure 4-7, External Width Control Parameters

External Width – unlike any of the other pulse modes, the pulse is regenerated from an external input and by setting the trigger level and the trigger slope at the trigger input connector. Every time the external signal is crossing the trigger level threshold, the output generates pulse high level, or pulse low level, depending on the trigger slope selection. When you select the external width mode, the panel, as shown in Figure 4-7 appears, allowing modification of the trigger level and the trigger slope. Notice that the period and width parameters have no meaning in this case because they are being reconstructed from the external shape.

The parameters that control the external pulse width output are: trigger level, trigger slope, high and low levels and leading and trailing edge transitions.

PWM CH1 – the pulse width modulation function is another special case of the pulse generator output. In this mode, the pulse width is modulated by a built in signal that has known properties and timing characteristics. When you select the pulse width modulation mode, the panel, as shown in Figure 4-8 appears, allowing modification of the PWM parameters. Notice that the width parameter has a primary meaning only as it varies with the modulating signal.

The parameters that control the primary pulse output are: period, width, high and low levels, leading and trailing edge transitions and polarity. The modulating waveforms have additional parameters: Source, which defines the shape of the modulating signal, Period, which define the period of the modulating signal and Deviation, which define the depth of the modulation.

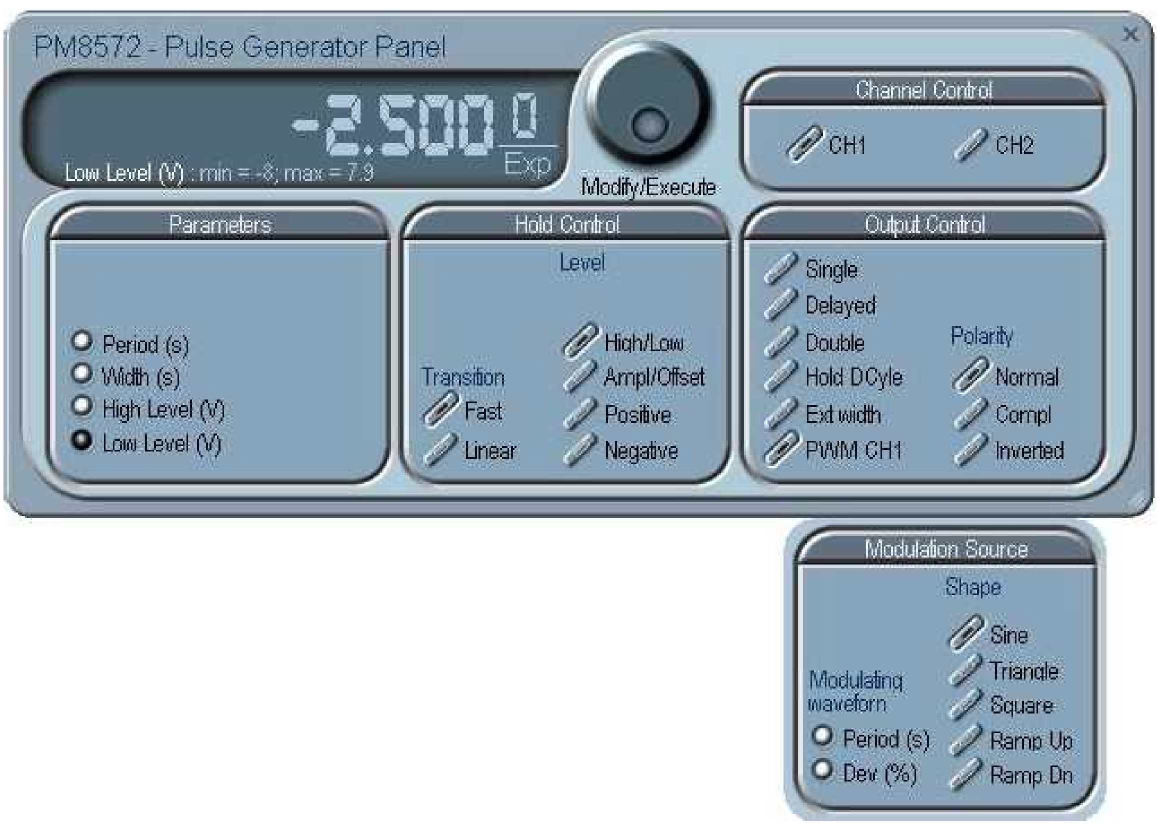


Figure 4-8, PWM Control Parameters

Standard

The Standard Panel, as shown in Figure 4-9, is accessible after you click on the Standard button in the Panels bar. The Standard Waveform Panel groups allow adjustment of channel control, parameters, 10 MHz reference and waveforms. The functional groups in the Standard Waveforms panel are described below.

Figure 4-9, the Standard Waveforms Panel

Channel Control

The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the standard waveforms panel while the other channel remains passive. Note however, that some parameters and modes are common for both channels and therefore, every time you change one of these functions, expect that the other channel will be updated accordingly.

Parameters

The parameters group contains buttons that control the setting of the amplitude, offset and output frequency for the standard waveforms function. Note that by selecting amplitude and offset values, other functions are automatically updated with these values and the same numbers will be displayed when you migrate from panel to panel, except when you select the pulse panel that has a different set of amplitude and offset values.

The Frequency control lets you program the output frequency of the selected waveform shape. The parameters may be modified when the LED illuminates. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new reading.

10 MHz Ref
The 10 MHz group contains buttons that control the source of the 10MHz reference for the standard waveforms function.

The 10MHz Ref controls toggle between internal and external references. The default setting is internal, which provides frequency accuracy of 1ppm. If such accuracy is not sufficient for your application, click on the external option but make sure that a reference source is applied to the rear panel connector; otherwise, the accuracy of the output will deteriorate completely.

Waveforms
The Waveforms group provides access to a library of built-in standard waveforms. The library includes: Sine, Triangle, Square, Pulse Ramp, Sinc, Exponential, Gaussian and DC waveforms. Each waveform has one or more parameters that can be adjusted for the required characteristics of the output. For example, phase start can be adjusted for the sine and triangle waveforms and duty-cycle can be adjusted for the square waveform. The pulse waveform can be adjusted for rise and fall time as well as width and delay. Parameters that are associated with each waveform are automatically displayed when the waveform is selected.

Note that by clicking a button in this group, you are immediately updating the PM8572A output with this waveform shape.

Arbitrary/Sequence

The Arbitrary & Sequence panel, as shown in Figure 4-10, is invoked by pressing the Arbitrary/Sequence button on the Panels bar. Note that if you invoke the Arbitrary & Sequence Panel from the Panels menu, the PM8572A will not change its output type. On the other hand, if you select the arbitrary, or the sequenced options from the Main Panel, the PM8572A will immediately change its output to the selected waveform type. The functional groups in the Arbitrary Waveforms Panel are described below.

Channel Control
The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the standard waveforms panel while the other channel remains passive. Note however, that some parameters and modes are common for both channels and therefore, every time you change one of these functions, expect that the other channel will be updated accordingly.

Parameters
The Parameters group contains three parameters: Amplitude, Offset and Segment. Actually, the amplitude and offset values exhibited in this group are exactly the same as in the Main Panel, so every time you change amplitude and offset in the Parameters group, the other panels are updated automatically. The segment parameter provides access to the active segment for each channel.

To access the required parameter, click on the parameter name. The LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new reading.

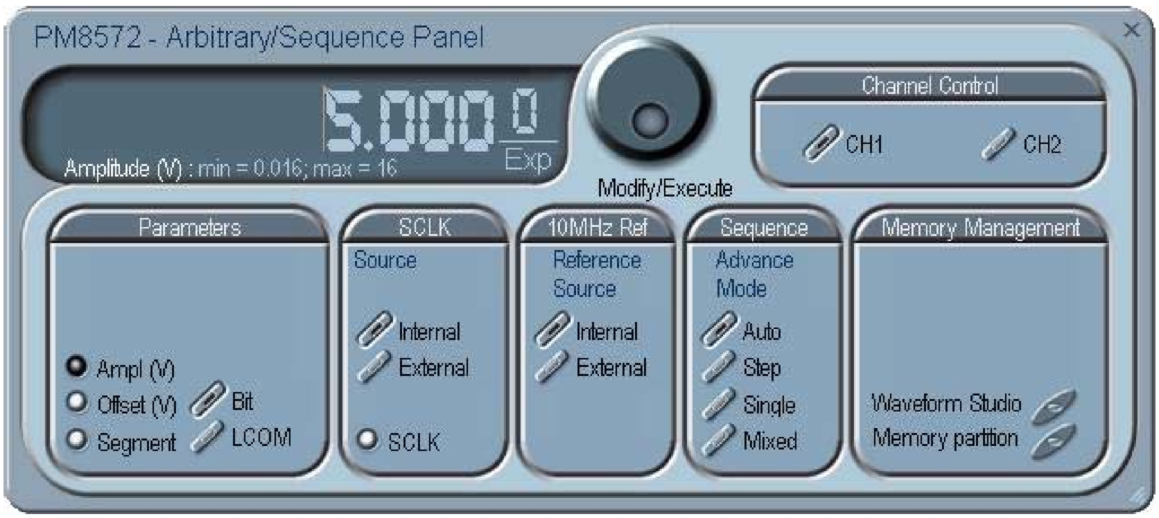


Figure 4-10, the Arbitrary & Sequence Panel

SCLK

The SCLK (Sample Clock) group provides access to programming the source of the sample clock and the value of the sample clock frequency. The sample clock setting affects the PM8572A in arbitrary mode only; It is programmed in units of S/s (samples per second) and will affect the instrument only when it is programmed to output arbitrary or sequenced waveforms. The SCLK parameter has no effect on the frequency of the standard waveforms.

The two switches in the SCLK group select between internal and external sample clock inputs. The internal is the default setting. When you select the external sample clock option, make sure an appropriate signal is connected to the external sample clock connector on the rear panel.

To access the required parameter, click on the button until the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new reading.

10MHz Ref
The 10MHz Ref controls toggle between an internal and external references. The default setting is internal, which provides frequency accuracy of 1ppm. If such accuracy is not sufficient for your application, click on the external option but make sure that a reference source is applied to the rear panel connector; otherwise, the accuracy of the output will deteriorate completely.

Sequence
The Sequence Advance Mode group provides control over advance modes for the sequence generator. Advance options are: Auto, Stepped, Single and Mixed. Refer to the PM8572A manual to find out more when and how to use these advance modes. You should be careful while selecting modes because it is possible to cause settings conflict, for example, if you select the Single option before you modified the run mode to Triggered.

Memory Management
The memory management group provides access to the memory partition and waveform studio screens. The Waveform Partition button opens a screen as shown in Figure 4-11 and the Waveform Studio button opens a screen as shown in Figure 4-12. Information how to use these screens is given in the following paragraphs.

Using the Memory Partition Table

If you want to learn more about waveform memory and segment control, you should refer to section 3 of this manual. In general, the PM8572A can generate arbitrary waveforms but, before it can generate waveforms, they must be downloaded to the instrument from a host computer. Waveforms are downloaded to the instrument as coordinates and are stored in the PM8572A in a place designated as “waveform memory”. The waveform memory has a finite size of 1M and optional extension to 2M and 4M.

Having such long memory does not necessarily mean that you have to use the entire memory every time you download a waveform. On the contrary, the PM8572A allows segmentation of the memory so that up to 4096 smaller waveforms could be stored in this memory. There are two ways to divide the waveform memory to segments: 1) Define a segment and load it with waveform data, define the next and load with data, then the third etc. or 2) Use what ArbConncetion has to offer and that is to make up one long waveform that contains many smaller segments, download it to the instrument in one shot and then download a memory partition table that splits the entire waveform memory into the required segment sizes. Want to use it? Here is how it is done. Point and click on the Memory Partition. A dialog box as shown in Figure 4-11 will pop up.

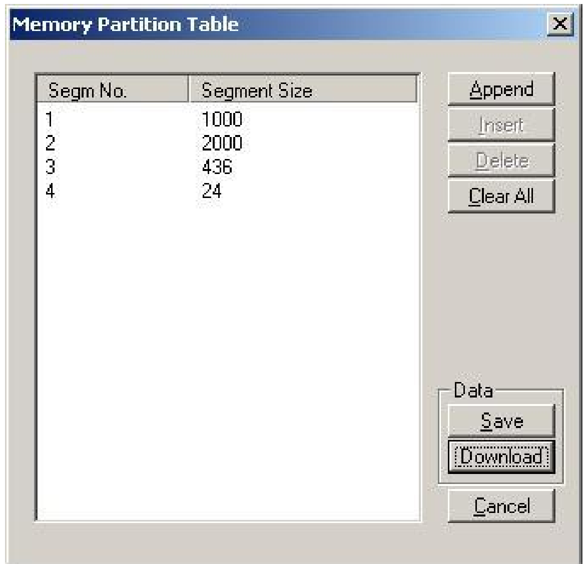


Figure 4-11, the Memory Partition Table

The two main fields in the segment table are Segment number and segment size. The **Seg No** (segment number) is an index field that can has values only, from 1 to 2048. The **Segment Size** is always associated with the segment number. You can program any segment size from 16 to 4M (1M is the standard memory size, 2M and 4M are optional).

Use the **Append** key to add a segment at the end of the segment list. If you highlighted a segment, the Append key turns automatically to insert Use the **Insert** key to insert a segment at the cursor location. The **Delete** key is used for deleting a segment at the cursor position.

The **Clear All** key will remove all segments from the table and will let you start designing your segment table from fresh.

Click on the **Close** to discard of the contents of the dialog box without saving your last actions and to remove the Segment Table from the screen.

The **Save** key saves the current session so you can start the Memory Partition table from the same point after you close this session. The **Download** key updates the PM8572A with the present segment table settings.

TIP

The Memory Partition table does not download waveforms. Use the memory partition table only if you merged a few waveforms to one. The partition table then divides the memory to the individual and original size of each waveform. If you download waveforms using the

waveform studio, they already contain segment size and there is no need for further use of the memory partition table.

Using the Waveform Studio

The Waveform Studio, as shown in Figure 4-12 has two parts: 1) Segment Table and 2) Sequence Table. The purpose of the waveform studio is to provide access to waveform files that are already resident in the system. These files can be delegated to various segments and later be used as individual waveforms or combined into complex sequences.

The Segment Table

Using the Segment Table you may list and download waveform files that were previously stored on the computer. The table shows the segment number and its associated file name, length and its download status. There are other means to download waveforms to memory segments such as the Wave Composer and individual function calls; The waveform studio makes it easier by combining multiple and complex commands into one simple dialog box.

To access the Segment table, click anywhere on the Segment Table area. If it was not yet, it will turn white as opposed to the Sequence Table area that turns gray. The Segment Table area is divided into three parts: the table area, the waveform shape area and control buttons. When you point and click on one of the waveforms, its shape is shown in the Waveform Shape window.

The Segment Table has four fields:

The **Seg** field contains numbers from 1 through 2048, designating the programmed memory segment. Note that memory segments are numbered from 1 to 2048.

The **State** field shows the current status of the memory segment. It can be *Free*, if no file has yet been assigned to this segment number, or *Mapped*, if file name has been assigned to the segment but the Download button has not been used yet to move the file to the PM8572A memory, or *Loaded*, if the process has been completed by pressing either the Download button or the All (download all) button.

The **File** field is an edit field that lets you browse and select file names to be applied to a specific memory segment. To change or add file name, point and click on the File name field and either type your path or browse to the file location and let Windows find the right path.

The **Length** field displays the length of the selected memory segment. Memory segments size may be programmed from 16 to 4M. Note that the length field is not accessible and shown for reference purpose only.

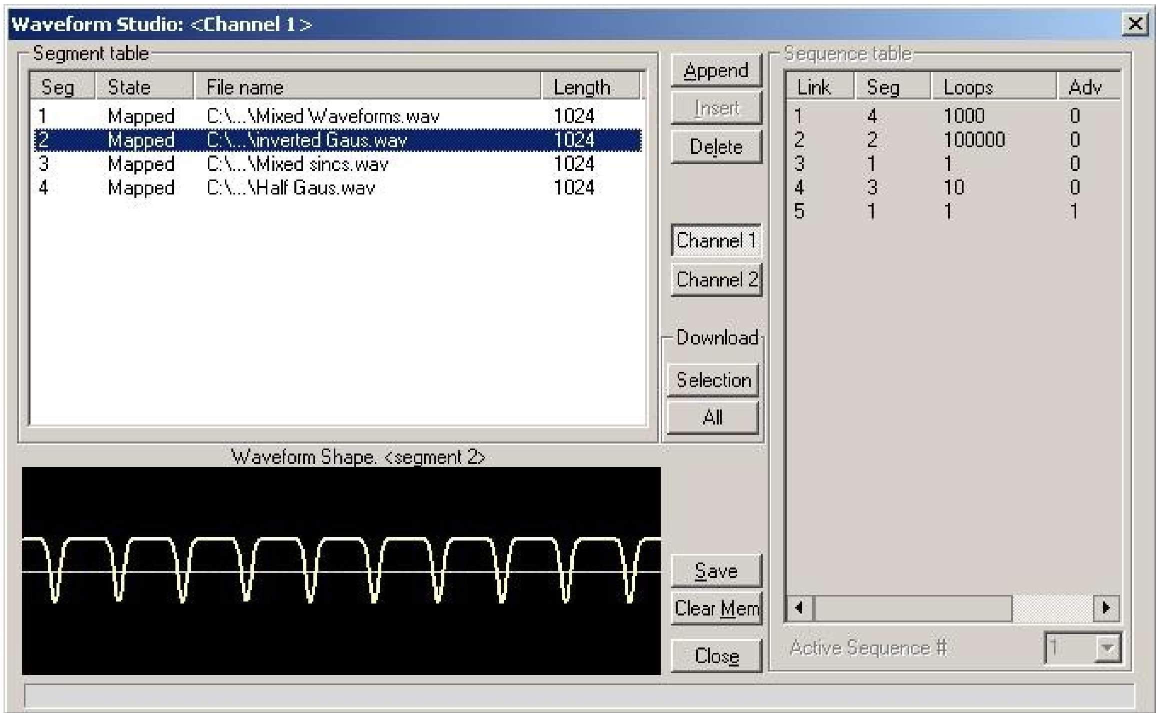


Figure 4-12, the Waveform Studio

TIP

Point and click on one of the segments to show its shape in the Waveform Shape window.

Description of the various buttons in the Segment Table is given below.

Append – adds segment number at the end of the table

Insert – adds a segment above a highlighted segment line

Delete – removes a highlighted segment

Channel 1 – shows segment table for channel 1 only

Channel 2 – shows segment table for channel 2 only

Save – saves current table settings

(Download) Selection – downloads a highlighted segment only to the PM8572A memory

(Download) All – downloads the complete table to the PM8572A memory

Clear Mem – wipes out the entire memory and clears the table for fresh settings

Close – removes the Waveform Studio from the screen. If you have not saved your work, the table setting will be lost.

The Sequence Table

As was explained in the above, the waveform memory can be divided into smaller segments and up to 2048 segments can be defined and used as individual arbitrary waveforms. Having a limited size of waveform memory can, for some applications, pose a limitation however, if sections of the waveform are repetitive, one may use the sequence generator to take these segments and replay them as part of the complete waveform without loosing valuable memory space and without scarifying waveform coherences, or integrity. The tool for using repetitive and multiple segments in one long waveform is called Sequence Generator. The PM8572A has two separate sequence generators, one for each channel and ArbConncetion has a special dialog box where sequences are designed. This tool is called – Sequence Table.

Using the Sequence table you can use waveforms that you already downloaded to the PM8572A from the Segment table, link and loop in random order to create one long and complex waveform that combines the individual memory segments.

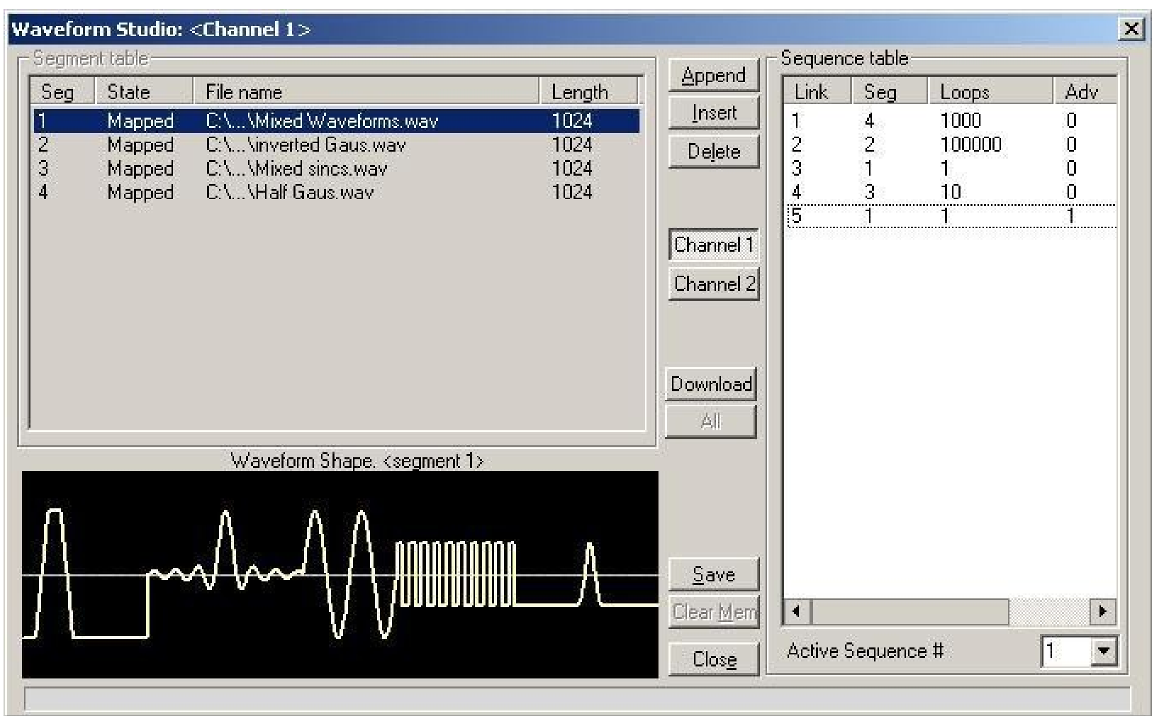


Figure 4-13, the Sequence Table

The Sequence Table is demonstrated in Figure 4-13. To access the Sequence table, click anywhere on the Sequence Table area. If it was not yet, it will turn white as opposed to the Segment Table area that turns gray.

There are four major elements that you should consider while programming a sequence table. They are: Link, Seg, Loops and Adv. These terms are explained below.

Link - This parameter defines an index array for the sequence generator. When generating sequences, the instrument steps though the links in descending order therefore, make sure that you enter your waveform segments in exactly the order you would like them at the output.

Seg - This parameter associates waveform segments with links. You can use different segments for different links or you can use the same segment for a number of links. There are no limitations how you associate links to segments, except you cannot program in the sequence table segments that were not defined earlier.

Loops – This parameter define how many times the segment will loop for the selected link. For example, if you program 2, the waveform will cycle twice through the same segment before transitioning to the next link.

Adv – This parameter flags the advance mode for the specific segment. This flag is active when the advance mode is Stepped. When set to 0, the sequence will advance through the list automatically until a segment that is flagged 1 is encountered. When 1 is encountered, the generator will idle on this segment until an external trigger is applied. Learn more about the sequence advance modes in Chapter 3.

Figure 4-8 shows an example of a 5-step sequence of which the first waveform is made of segment 2, which will loop 15 times; segment 4, looping 2 times; segment 1, looping 7 times; segment 2, once and segment 3, looping 4 times. The Adv bits on links 2 and 5 are set to 1 and therefore, external triggers are required for the sequencer to step through these links.

HINT

The PM8572A has two separate sequence generators, one for each channel. If the PM8572A is programmed to continuous run mode, make sure both channels have the same sequence length for inter-channel synchronization. For triggered run mode, each channel can be programmed for a unique sequence length.

The control buttons on the left of the Sequence Table have the same functionality as for the Segment Table.

Use the **Append** key to add a step at the end of the sequence list. Use the **Insert** key to insert a step at the cursor location. The **Delete** key is used for deleting a step at the cursor position.

Click on the **Close** to discard of the contents of the dialog box without saving your last actions and to remove the sequence Table from the screen but click on the **Save** key if you want just to save your work before you close the dialog box.

The **Download** key has double action, it will download the sequence table to the instrument and will save the contents of your table so the next time you open this table, it will have the same contents as you saved in your previous session.

Active Sequence
The active sequence field let you select between 10 different sequences. You may program each sequence separately and replay them individually as required. The output is updated with the selected sequence number as soon as the active sequence is selected.

Half Cycle

The Half Cycle panel contains controls that select the half cycle functions and adjust the half cycle parameters. The half cycle functions are generated with variable and controllable delay between the halves. If triggered mode, one half at a time is generated as a result of a trigger signal regardless of the programmed delay value. The half cycle functions have different limitations compared to the standard functions; These are listed in Appendix A. The half cycle panel and the various parameters that control these functions are described below.

Figure 4-14, the Half Cycle Panel

Channel Control

The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the standard waveforms panel while the other channel remains passive. Note however, that some parameters and modes are common for both channels and therefore, every time you change one of these functions, expect that the other channel will be updated accordingly.

Shared

The shared group has parameters that are shared by the two channels. The shared parameters are: Frequency and Delay. Note that the frequency value is a bit different than the standard frequency parameter because it describes the frequency as if the two halves were combined (which is never the case). Since two halves are always separated by certain delay, the frequency value has a meaning as if the two halves were combined.

Shape

The Shape group has controls that select the shape of the half cycle function. Each channel can have an independent half cycle shape.

Parameters

The Parameters group has controls for programming the amplitude, offset, start phase and duty cycle. Each channel can have an independent set of these parameters.

The Modulation Panels

The Modulation functions were designed over seven separate panels, as shown in Figures 4-15 through 4-22. The panels are invoked by pressing the Modulation header and then one of the modulation panels that appear below it (Figure 4-15a). These panels provide access to all modulation functions and their respective run modes and parameters. The modulation functions that are available on these panels are: FM (frequency modulation), AM (amplitude modulation), Sweep, FSK (frequency shift keying), PSK (phase shift keying) and ASK (amplitude shift keying) and Amplitude and Frequency hops. There are also two other panels for controlling the I&Q modulation modes – (n)PSK and (n)QAM. All modulation functions are programmed simultaneously for both channels except AM where each channel can be programmed separately with a different set of parameters.

When modulation run other than continuous is selected, there are two options that control the idle state between triggers: 1) Carrier baseline and 2) DC baseline. When the first option is selected, the instrument generates non-modulated carrier frequency (CW) until a valid stimuli signal is applied and when the second option is selected, the instrument generates a dc level signal until a stimulated to generate a modulation cycle. The modulation options,

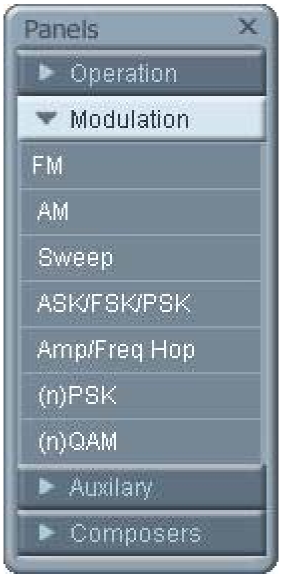


Figure 4-15a, the Modulation Panels

their associated parameters and the various run mode options are described separately for each of the panels.

FM

The FM panel contains parameters for controlling the amplitude modulation function. To turn the FM function on and off, click on the FM button in the State group. The various groups in the FM panel are described below.

FM Parameters - This group contains parameters that allow complete control over the FM function. These are:

CW Frequency
The CW Frequency is the frequency of the pre-modulation carrier waveform. In case the modulating waveform is one of the built-in standard waveforms, the modulation will be symmetrical about the CW frequency setting.

Baseline
The Baseline parameter affects the output characteristics in one of the interrupted run modes (i.e., triggered, burst). In this case this parameter defines where the signal idles between triggers. There are two options: CW and DC. The DC option will set the idle state to a dc level, meaning that in between triggers, the output resides on a dc level and generates modulation when a trigger is accepted. The CW is similar except the signal idles on the pre-trigger CW frequency setting, executes the modulation upon receipt of a legal trigger signal and returns to continuous CW frequency output.

Standard FM Parameters
These parameters are active only when one of the built-in waveforms is selected as the modulating signal. These are: Sine, Triangle, Square, or Ramp. The modulation frequency, deviation and marker frequency control the standard FM modulation scheme.

Modulating Wave

Defines the shape of the modulating waveform. There are two basic options: Standard (built-in) waveforms and Arbitrary waveforms. If you do not need exotic waveforms, you can use one of the built-in standard wave shapes: Sine, Triangle, Square, or Ramp. These waveforms can be adjusted for their frequency and deviation range. On the other hand, you can select the arbitrary modulating wave option where you can use any shape however, you must load the modulating waveform from an external application, such as the FM composer in ArbConncetion. Information on the standard and arbitrary FM functions is given in Chapter 3. Click on the button next to the required modulating waveform shape to select it.

Arbitrary FM Parameters

Allow adjustment of the sample clock of the modulating waveform. These parameters are active only when arbitrary modulating waveform option is selected. The modulating waveform must be downloaded from an external utility such as ArbConncetion and the sample clock is programmed from this location.

To access the required parameter, click on the parameters name and observe that the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new setting.

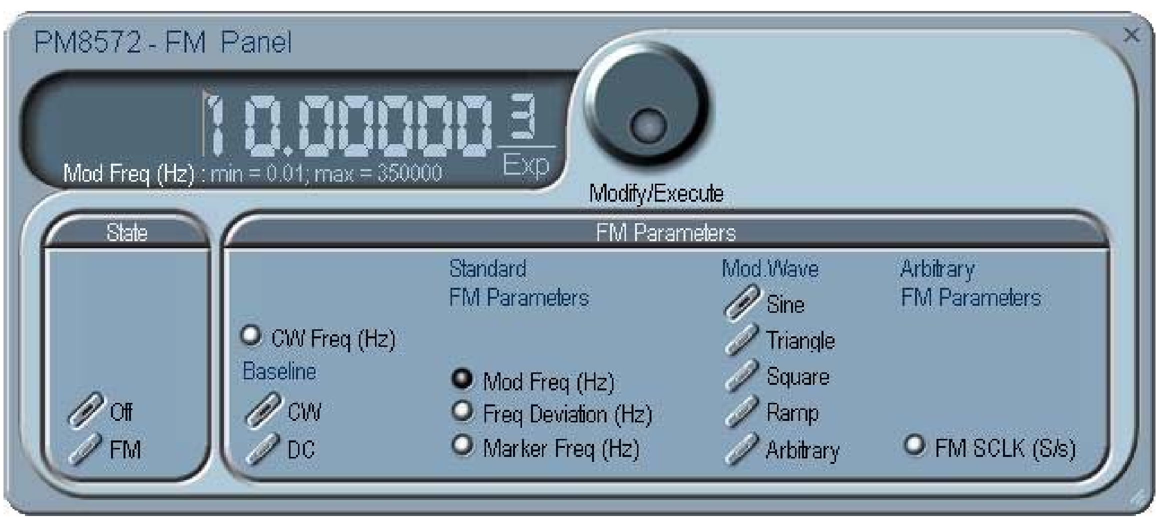


Figure 4-15, the FM Panel

AM

The AM panel contains parameters for controlling the amplitude modulation function. To turn the AM function on and off, click on the AM button in the State group. The various groups in the AM panel are described below.

Although both channels are set to output amplitude modulations simultaneously, each channel can be programmed to be modulated using a unique envelop waveform. Select the appropriate parameters for each channel using the channel control description below.

Channel Control
The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the standard waveforms panel while the other channel remains passive. Note however, that some parameters and modes are common for both channels and therefore, every time you change one of these functions, expect that the other channel will be updated accordingly.

AM Parameters - This group contains parameters that allow complete control over the AM function. These are:

CW Frequency
The CW Frequency is the frequency of the carrier waveform.

Baseline
The Baseline parameter affects the output characteristics in one of the interrupted run modes (i.e., triggered, burst). In this case this parameter defines where the signal idles between triggers. There are two options: CW and DC. The DC option will set the idle state to a dc level, meaning that in between triggers, the output resides on a dc level and generates modulation when a trigger is accepted. The CW is similar except the signal idles on the pre-trigger CW frequency setting, executes the modulation upon receipt of a legal trigger signal and returns to continuous CW frequency output.

Modulating Wave
Defines the shape of the modulating waveform. There are four built-in standard wave shapes: Sine, Triangle, Square, or Ramp. These waveforms can be adjusted for their frequency and deviation range. Click on the button next to the required modulating waveform shape to select it. The modulating waveform can be selected independently for each channel

Freq
Programs the frequency of the modulating waveform. Note that the frequency setting must be smaller than the CW frequency for the AM function to operate correctly. Note that the modulating frequency setting is common to both channels.

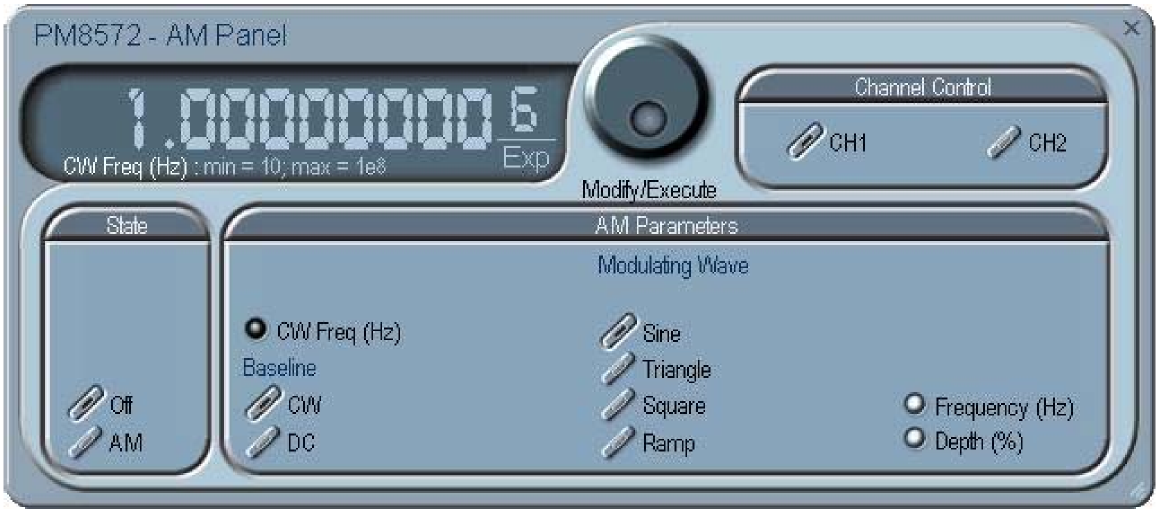


Figure 4-16, the AM Panel

Depth
The Depth parameter programs the modulation depth, or index in percent of the un-modulated CW amplitude. The depth is symmetrical about the center of the CW amplitude. Each channel can have a unique setting of the modulation depth.

To access the required parameter, click on the parameters name and observe that the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new setting.

Sweep

The Sweep panel contains parameters for controlling the sweep function. To turn the sweep function on and off, click on the Sweep button in the State group. The various groups in the sweep panel are described below.

Sweep Parameters - This group contains parameters that allow complete control over the sweep function. These are:

Baseline
The Baseline parameter affects the output characteristics in one of the interrupted run modes (i.e., triggered, burst). In this case this parameter defines where the signal idles between triggers. There are two options: CW and DC. The DC option will set the idle state to a dc level, meaning that in between triggers, the output resides on a dc level and generates modulation when a trigger is accepted. The CW is similar except the signal idles on the pre-trigger CW

frequency setting, executes the modulation upon receipt of a legal trigger signal and returns to continuous CW frequency output. Note that is sweep modulation, the Start parameter replaces the CW value.

Step
Use these keys to select sweep step from two increment options: linear, or logarithmic.

Figure 4-17, the Sweep Modulation Panel

Direction
Use these keys to program sweep direction. Up select sweep from Start to Stop sample clock setting and Down selects sweep from the Stop to Start sample clock setting. Refer to Chapter 3 of this manual to learn more about sweep operation.

Parameters
Allow adjustment of Sweep Start (CW), Stop and Sweep Time. You can also place a marker at a position programmed by the Mark parameter. To access the required parameter, click on the parameters name and observe that the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new setting.

FSK/PSK/ASK

The FSK/PSK/ASK panel, as shown in Figure 4-18, contains parameters for controlling the shift keying modulation function. To turn one of the functions on and off, click on the appropriate button in the State group. The various groups in this panel are described below.

General

CW Frequency
The CW Frequency is the frequency of the pre-modulation carrier waveform.

Baseline
The Baseline parameter affects the output characteristics in one of the interrupted run modes (i.e., triggered, burst). In this case this parameter defines where the signal idles between triggers. There are two options: CW and DC. The DC option will set the idle state to a dc level, meaning that in between triggers, the output resides on a dc level and generates modulation when a trigger is accepted. The CW is similar except the signal idles on the pre-trigger CW frequency setting, executes the modulation upon receipt of a legal trigger signal and returns to continuous CW frequency output.

FSK

Control Data
The Control Data button in the FSK group provides access to the data string that controls the sequence of base frequency and shifted frequency. It contains a list of “0” and “1” and the output will repeatedly follow the frequency shift keying sequence in the same order as programmed.

“0/1” Frequency
In FSK, the carrier waveform (CW) has two frequencies: an initial frequency level which is set by the “0” Frequency parameter and shifted frequency which is set by the “1” Frequency. The control data table has a list of “0” and “1” values that flag when the frequency shifts from base to shifted frequency.

Baud
The baud parameter sets the rate of which the generator steps through the sequence of the FSK Control Data bits.

Marker Index
The marker setting programs a specific step (index) in the control data string to output a pulse at the SYNC output connector. The SYNC State button must be turned on to generate the FSK marker output.

Figure 4-18, the FSK/PSK/ASK Modulation Panel

PSK

Control Data

The Control Data button in the PSK group provides access to the data string that controls the sequence of base phase and shifted phase. It contains a list of “0” and “1” and the output will repeatedly follow the phase shift keying sequence in the same order as programmed.

“0/1” Phase

In PSK, the carrier waveform (CW) has two phase settings: an initial phase which is set by the “0” Phase parameter and shifted phase which is set by the “1” Phase. The control data table has a list of “0” and “1” values that flag when the phase shifts from base to shifted phase.

Baud

The baud parameter sets the rate of which the generator steps through the sequence of the PSK Control Data bits.

Marker Index

The marker setting programs a specific step (index) in the control data string to output a pulse at the SYNC output connector. The SYNC State button must be turned on to generate the PSK marker output.

To access the required parameter, click on the button below parameters sub-group until the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new reading.

ASK

Control Data
The Control Data button in the ASK group provides access to the data string that controls the sequence of base amplitude and shifted amplitude. It contains a list of “0” and “1” and the output will repeatedly follow the amplitude shift keying sequence in the same order as programmed.

“0/1” Amplitude
In ASK, the carrier waveform (CW) has two amplitudes: an initial amplitude level which is set by the “0” Amplitude parameter and shifted amplitude which is set by the “1” Amplitude. The control data table has a list of “0” and “1” values that flag when the amplitude shifts from base to shifted amplitudes.

Baud
The baud parameter sets the rate of which the generator steps through the sequence of the ASK Control Data bits.

Marker Index
The marker setting programs a specific step (index) in the control data string to output a pulse at the SYNC output connector. The SYNC State button must be turned on to generate the ASK marker output.

Ampl/Freq Hop

The Ampl/Freq panel, as shown in Figure 4-19, contains parameters for controlling the hop modulation function. To turn one of the functions on and off, click on the appropriate button in the State group. The output has two hop options: Fixed and Variable. In the Fixed mode, the output steps through the pre-assigned hop values at a constant rate, as programmed using the dwell time parameter. In the variable mode, the output dwells on each step for a period of time that is programmed in the Dwell Time field in the hop data table that is programmed for the Variable Hold option.

The various groups in this panel are described below.

General

CW Frequency
The CW Frequency is the frequency of the pre-modulation carrier waveform.

Baseline
The Baseline parameter affects the output characteristics in one of the interrupted run modes (i.e., triggered, burst). In this case this parameter defines where the signal idles between triggers. There are two options: CW and DC. The DC option will set the idle state to a dc level, meaning that in between triggers, the output resides on a dc level and generates modulation when a trigger is accepted. The CW is similar except the signal idles on the pre-trigger CW frequency setting, executes the modulation upon receipt of a legal trigger signal and returns to continuous CW frequency output.

Amplitude Hop

Hop Data

The Hop Data button in the Ampl Hop group provides access to the data string that controls the sequence of amplitude hops. The hop data table contains a list of amplitude levels and the output will step from one amplitude level to another in the same order as programmed in the hop data table.

Fixed Hold

The hold parameter determines how long will certain step of amplitude dwells on this specific setting before it will step to the next amplitude setting. By selecting the Fixed Hold, the hold time remains constant throughout the entire hop table.

Figure 4-19, the Ampl/Freq Hop Panel

Variable Hold

The hold parameter determines how long will certain step of amplitude dwells on this specific setting before it will step to the next amplitude setting. By selecting the Variable Hold, the hold time changes automatically from one step to the next, depending on the hold time value that is affixed to the hop step. The values can be programmed in the HOP Data table.

Dwell Time

The Dwell Time parameter programs the period of time that will lapse before the amplitudes hops to the next amplitude setting. The Dwell time is associated with the Fixed Dwell option only.

Marker Index

The marker setting programs a specific step (index) in the hop data string to output a pulse at the SYNC output connector. The SYNC State button must be turned on to generate the hop marker output.

Freq Hop

Hop Data
The Hop Data button in the Freq Hop group provides access to the data string that controls the sequence of frequency hops. The hop data table contains a list of frequencies and the output will step from one frequency to another in the same order as programmed in the hop data table.

Fixed Hold
The hold parameter determines how long will certain step of frequency dwells on this specific setting before it will step to the next frequency setting. By selecting the Fixed Hold, the hold time remains constant throughout the entire hop table.

Variable Hold
The hold parameter determines how long will certain step of frequency dwells on this specific setting before it will step to the next frequency setting. By selecting the Variable Hold, the hold time changes automatically from one step to the next, depending on the hold time value that is affixed to the hop step. The values can be programmed in the HOP Data table.

Dwell Time
The Dwell Time parameter programs the period of time that will lapse before the frequency hops to the next frequency setting. The Dwell time is associated with the Fixed Dwell option only.

Marker Index
The marker setting programs a specific step (index) in the hop data string to output a pulse at the SYNC output connector. The SYNC State button must be turned on to generate the hop marker output.

To access the required parameter, click on the button below parameters sub-group until the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the PM8572A with the new setting.

(n)PSK

The (n)PSK panel, as shown in Figure 4-20, contains parameters for controlling multiple PSK modulation functions. To turn the (n)PSK function on and off, click on the appropriate button in the State group. The various groups in this panel are described below.

Type

The Type group allows selection of one of the PSK types. The list has seven PSK options. To select one of the (n)PSK functions, click on BPSK, QPSK, DPSK, OPSK, 8PSK, 16PSK, or User PSK.

(n)PSK Parameters

CW Frequency
The CW Frequency is the frequency of the pre-modulation carrier waveform.

Figure 4-20, the (n)PSK Modulation Panel

Baseline
The Baseline parameter affects the output characteristics in one of the interrupted run modes (i.e., triggered, burst). In this case this parameter defines where the signal idles between triggers. There are two options: CW and DC. The DC option will set the idle state to a dc level, meaning that in between triggers, the output resides on a dc level and generates modulation when a trigger is accepted. The CW is similar except the signal idles on the pre-trigger CW frequency setting, executes the modulation upon receipt of a legal trigger signal and returns to continuous CW frequency output.

Marker Index
The marker setting programs a specific step (index) in the control data string to output a pulse at the SYNC output connector. The SYNC State button must be turned on to generate the PSK marker output.

Baud
The baud parameter sets the rate of which the generator steps through the phase symbols.

Carrier On/Off
This button toggles between PSK modulation with or without the carrier. Having or not having a carrier depends on the application.

Data Table

The Data Table provides means of programming the phase steps sequence. An example of a 16PSK data table sequence is shown in Figure 4-21. Note that the value of each symbol is pre-defined and hence, every time you enter a vector, the associated symbol is automatically fetched from the list and displayed in the Phase field. The sequence of which the symbols are generated at the output has the same order as was entered in the Vector list. For applications requiring non-standard phase values, use the Symbol Design option to design your custom symbols.

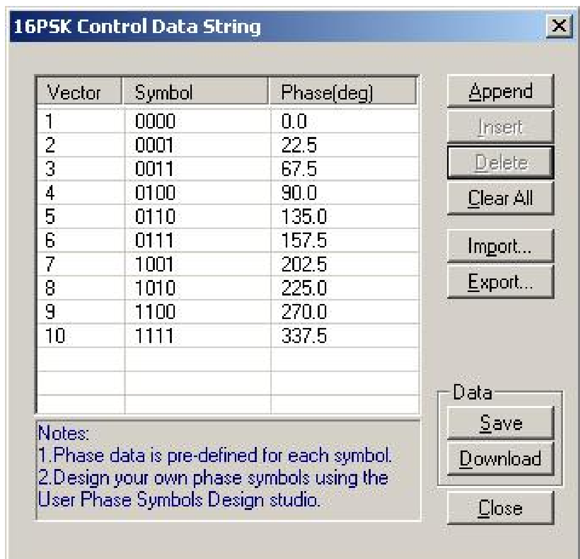


Figure 4-21, 16PSK Data Table Sample

Symbol Design

The Symbol Design table, as shown in Figure 4-22, is used for generating custom symbols. While the standard (n)PSK modulation functions use pre-defined phase values, using the Symbol Design table, you can design and associate any symbol with any vector as you desire.

Demo

The demo button loads demo data to the generator. The list s pre-defines and is created just for demonstration purpose. There is no specific application that this demo file is built for.

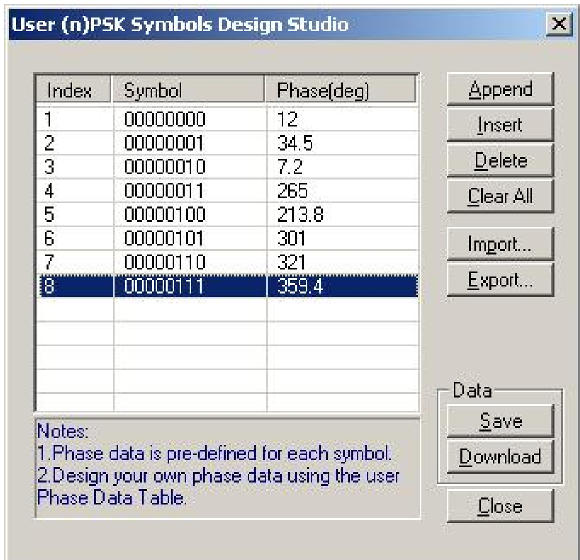


Figure 4-22, Symbol Design Table Sample

(n)QAM

The (n)QAM panel, as shown in Figure 4-23, contains parameters for controlling multiple QAM modulation functions. To turn the (n)QAM function on and off, click on the appropriate button in the State group. The various groups in this panel are described below.

<u>Type</u>

The Type group allows selection of one of the QAM types. The list has four QAM options. To select one of the (n)QAM functions, click on 16QAM, 64QAM, 256QAM, or User QAM.

<u>(n)QAM Parameters</u>

CW Frequency
The CW Frequency is the frequency of the pre-modulation carrier waveform.

Baseline
The Baseline parameter affects the output characteristics in one of the interrupted run modes (i.e., triggered, burst). In this case this parameter defines where the signal idles between triggers. There are two options: CW and DC. The DC option will set the idle state to a dc level, meaning that in between triggers, the output resides on a dc level and generates modulation when a trigger is accepted. The CW is similar except the signal idles on the pre-trigger CW frequency setting, executes the modulation upon receipt of a legal trigger signal and returns to continuous CW frequency output.

Marker Index
The marker setting programs a specific step (index) in the control data string to output a pulse at the SYNC output connector. The SYNC State button must be turned on to generate the QAM marker output.

Figure 4-23, the (n)QAM Modulation Panel

Baud
The baud parameter sets the rate of which the generator steps through the amplitude-phase symbols.

Carrier On/Off
This button toggles between QAM modulation with or without the carrier. Having or not having a carrier depends on the application.

Data Table
The Data Table provides means of programming the amplitude-phase steps sequence. An example of a 64QAM data table sequence is shown in Figure 4-24.

Note that the value of each symbol is pre-defined and hence, every time you enter a vector, the associated symbol is automatically fetched from the list and displayed in the "I" and "Q" fields. The sequence of which the symbols are generated at the output has the same order as was entered in the Vector list. For applications requiring non-standard amplitude-phase values, use the Symbol Design option to design your custom symbols.

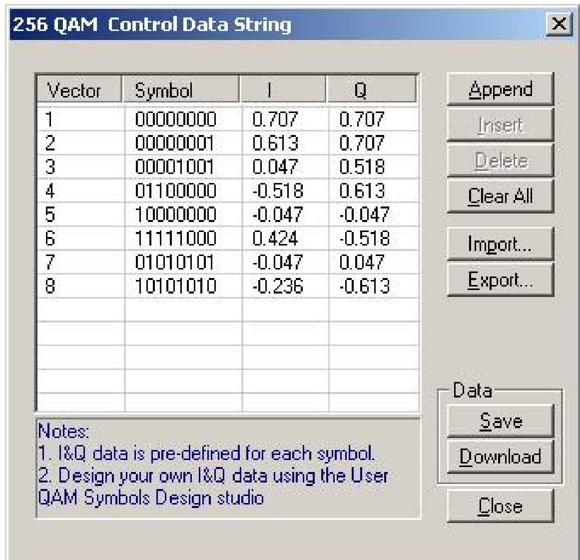


Figure 4-24, 64QAM Data Table Sample

Symbol Design

The Symbol Design table, as shown in Figure 4-25, is used for generating custom symbols. While the standard (n)QAM modulation functions use pre-defined amplitude-phase values, using the Symbol Design table, you can design and associate any symbol with any vector as you desire.

Demo

The demo button loads demo data to the generator. The list s pre-defines and is created just for demonstration purpose. There is no specific application that this demo file is built for.

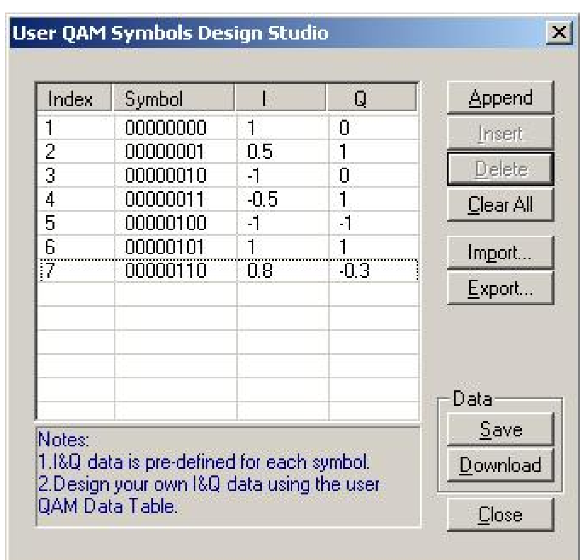


Figure 4-25, Symbol Design Table Sample

The Auxiliary Panels

Figure 4-26a, the Auxiliary Panels

The Auxiliary tab provides access to a group of panels that control some auxiliary and Utility functions.

There are three panels in this group: Counter/Timer, which provides access to the auxiliary Counter/Timer function; Digital Patterns, which provides access to the auxiliary digital pattern generator function; and X-Instrument Sync for multi instrument synchronization control.

The Auxiliary set of panels are shown in Figure 4-25a. Each of the panels is described below.

Counter/Timer

The Counter/Timer panel, as shown in Figure 4-26, contains controls that select the measurement function and adjusts the counter/timer parameters for measuring external signals. The counter/timer measures signals that are connected to the TRIG IN input. The various parameters that control the counter/timer features are described below.

State
The State Group has controls to turn the counter on and off. And to reset the counter and arm it for the next measurement cycle. Note that when the counter function is turned on, all other waveform generation features of the PM8572A are purged.

Measurement Function
The measurement function group has control to select the measurement function for the counter/timer operation. The PM8572A can measure the following function: Frequency, Period, Period Averaged, Pulse Width, and Totalize. The totalize function has two options. If Totalize Infinite function is selected the input will count every legal pulse at the counter input, for an indefinite period of time, and will display the total number of pulses until the counter has been reset. If Totalize Gated function is selected, the input will count every legal pulse at the trigger input for a period of time that is defined with the Gate Time parameter.

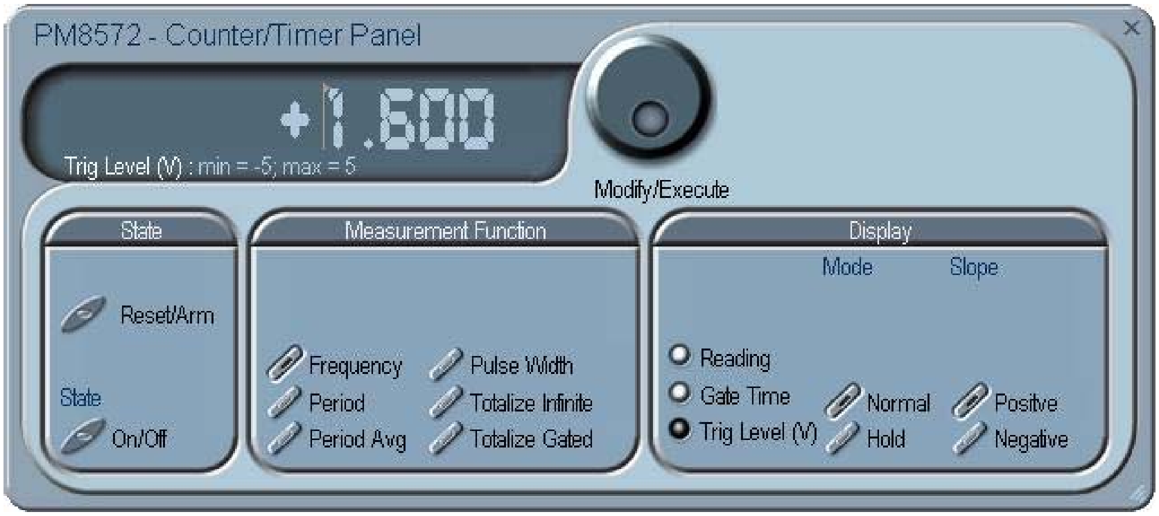


Figure 4-26, the Counter/Timer Panel

Display

The Display Group has controls to select the display mode and to select if the display shows measurement or gate time readings.

In normal mode, the counter is armed to receive signal at the trigger input. When signal is sensed, the gate to the counter opens for duration as programmed with the Gate Time parameter, processes the result, displays the reading and continues with the same process as long as the signal is available at the input.

In hold mode, the counter is armed to receive signal at the trigger input. When signal is sensed, the gate to the counter opens for duration as programmed with the Gate Time parameter processes the result, displays and holds the reading until the next Reset/Arm command.

To display and modify the gate time parameter, click on the Gate Time LED and modify the gate time per your requirements. Gate time rage is from 100 μs to 1 s. Normal counter/timer readings are displayed when the Reading LED is selected.

Digital Pattern

The Digital Pattern panel (Figure 4-27), contains controls that control the functionality of the pattern output and provides access to the pattern source. The Digital Pattern panel and the various parameters that control this function are described below.

State

The state button toggles the pattern output on and off. When the state is on, patterns are routed to the rear panel connector. Note that the channel 1 output connector can also be made active and then both the rear and front outputs generate waveforms and patterns.

Figure 4-27, the Digital Pattern Panel

Data Source

This Data Source has two buttons which select between the Data Table and an Arbitrary Segment as the source for the digital pattern output. If you select the Data Table option, you must generate pattern data as shown in Figure 4-28. Pattern data for the Data Table option can be generated from the Pattern Data group.

If you select the Arbitrary Segment as your data source, data is stored as a normal waveform and can be generated simultaneously from the front-panel output connector, as an arbitrary waveform and from the rear-panel Digital Pattern output, as a pattern sequence.

The question if to use one data source option or the other is relevant only if your pattern data is longer than 128k sequences. Below 128k, you can use the Data table entry and further, you can look at the data from the display. Larger blocks of data can be stored in the same memory as arbitrary waveforms are bring stored however, such data cannot be displayed on the front panel but on the other hand, multiple blocks of data can be stored in the arbitrary waveform data, as long as the total length of patterns do not exceed the arbitrary waveform memory capacity of the PM8572A.

Baud

The baud parameter programs the rate of which the output step through the pattern sequence, which was programmed in the Pattern Design table.

Pattern Data

This opens a table that allows programming of the digital patterns. Patterns are 16 bits and are programmed in hex format. An example of the Data table entry format is shown in Figure 4-25.

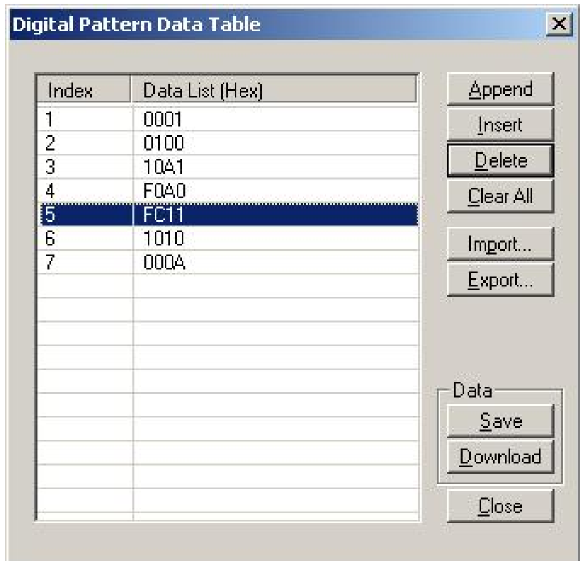


Figure 4-28, Digital Pattern Data Table Example

X-Instrument Sync

The X-Instrument Sync serves the multi-instrument synchronization purpose. It is a bit different than the other panels as it has only one function of providing an environment for setting up the various instruments for the setting and therefore, a dialog box is invoked when you hit the X-Instrument Sync button.

There are some preliminary actions you must take before you can synchronize instruments of which the first is to connect the cables and set up LAN addresses. Follow the procedure as described hereinafter:

Tip

Multiple Instrument synchronization requires that all instruments are connected to a Local Area Network (LAN) system. If just two instruments are to be synchronized, connection between the two instruments can be made with a crossed wire LAN cable however, activation and operation is possible from the front panel only.

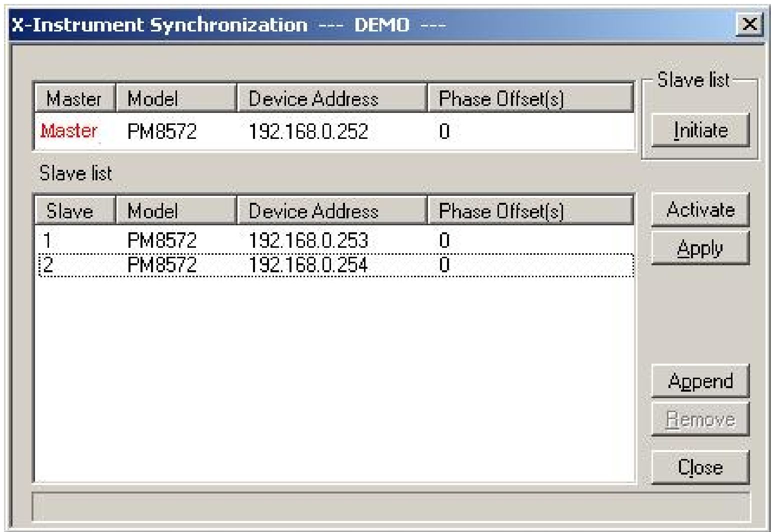


Figure 4-29, Multi-Instruments Synchronization Dialog Box Example

1. First, and most important step, designate which of the instruments will be set up as master and which will serve as slaves.
2. Locate the multi-instrument cluster of connectors on the back of the PM8572A. They are grouped under the X-Inst Sync title. There are four SMB connectors. These should be connected as follows: The SCLK OUT from the master should be connected to the SCLK IN on the first slave unit and the TRIG OUT from the master connected to the TRIG IN on the first slave.
3. Connect LAN cables from your LAN system to both the master and slave units. If more than two units are connected to the system, proceed with connecting wires as described in step 2 above, in a daisy-chain manner, OUT to the next IN connector. Connect all instruments in the chain.

4. Turn on the instruments and set all of them up to operate from a LAN interface. Information how to set up the PM8572A to operate from a LAN interface is given in Chapter 2. An example of mater and slave IP address setting is shown in Figure 4-30. The master was assigned the highest IP address …252 and the two slaves were assigned …246 and …245, respectively.

Tip

The IP address determines if instruments are to be set up as master or slave. The highest IP address setting designates the master instrument. Lower IP addresses designate slave instruments.

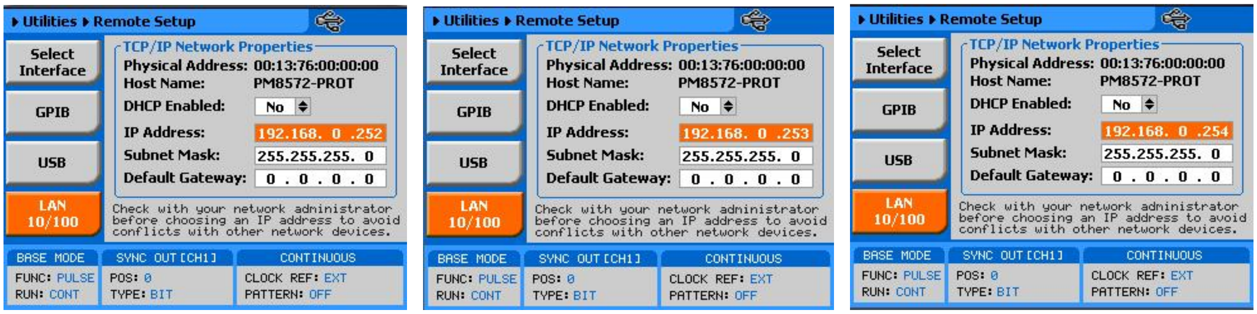


Figure 4-30, IP Address Setup Example (from left to right) Master and two Slaves

5. Invoke the System->Setup and Communication Options. Select the Communicate Only in the Startup Options group and select the Specify an Address Option in the Communications Setup group.
6. Select the LAN Interface and add the master and slave addresses as shown in Figure 4-31.
7. ArbConncetion can communicate with one instrument at a time and therefore, highlight the master IP address and then click on Communicate. Regardless, each of the assigned addresses will be tested for LAN accessibility and made available in the Link field for future programming.

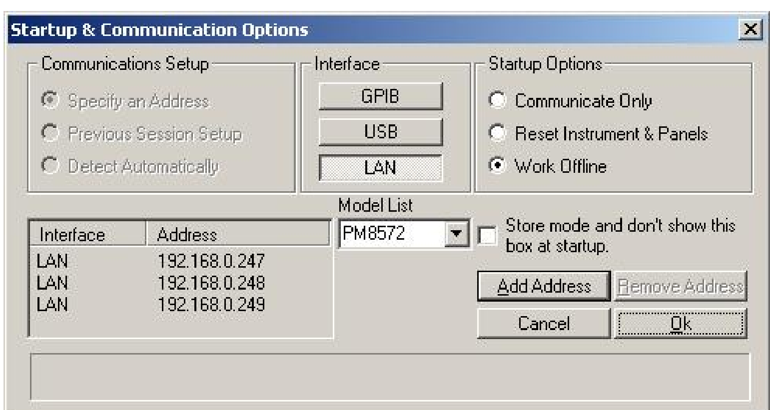


Figure 4-31, Assigning Master and Slave Addresses

8. The last step is to activate the synchronization. This is done from the X-Instruments Synchronization dialog box, as shown in Figure 4-26. Click on Activate to start the synchronization, click on the same button to toggle synchronization off.
9. Adjust the parameters and the functions on the master and slave units however, bear in mind that some functions are

shared by all modules and therefore can only be modified on the master instrument. Chapter 3 describes the synchronization aspects and Appendix A lists the multi-instruments specifications and limitations.

The System Panels

Figure 4-32a, the System Panels

The System tab provides access to a group of panels that control some general system parameters and provides access to the calibration. There are two panels in this group: General/System, which provides access to some system commands, utilities and filters; and Calibration, which provides access to the calibration remote calibration utility. Note however, that access to the calibration panel is permitted to qualified service persons and requires special user name and password. Information how to access the calibration panel is given in Chapter 7.

The System set of panels are shown in Figure 4-32a. Each of the panels is described below.

General/Filters

The General/Filters panel provides access to some general system common commands, allows read back of information that is stored in the flash and provides means of adding filters to the output path. The General/Filters panel and the various parameters that control these functions are described below.

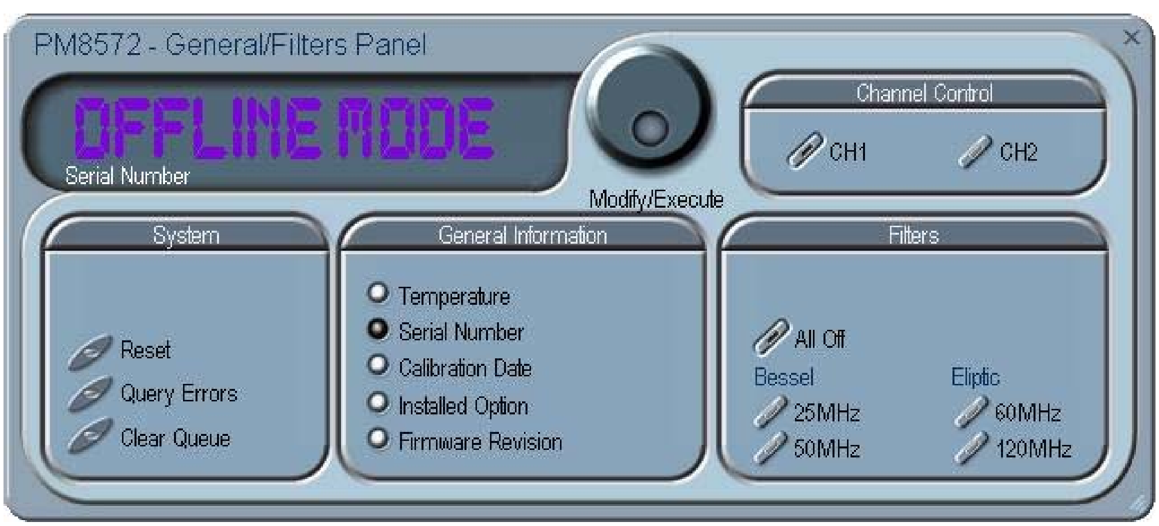


Figure 4-32, the General/Filters Panel

Channel Control

The Channel Control group has two buttons: CH1 and CH2. These buttons determine which of the channels is currently active. The active channel will be sensitive to changes that are made on the Filter group while the other channel remains passive. Other parameters on the General Panel are not specifically associated with a single channel and therefore, the channel control has no meaning when one of these parameters is accessed.

System

The System group has three buttons that are normally associated with system control. These are:

Reset – generates soft reset to the instrument controls and dialog boxes and modifies all parameters to factory default. A list of factory defaults is given in Chapter 5.

Query Error – queries the PM8572A for programming errors. This command is normally no necessary because ArbConnection makes sure that programming errors cannot be made from the panels however, while executing commands from the Command Editor, errors can be generated and the only way to monitor the errors is by using this command.

Clear Queue – clears the error queue. The error queue can buffer up to 35 errors and then generates an error queue overflow message while ignoring new errors. This command clears the error queue and allows fresh errors to be captured.

General Information

This general information group buttons are used for displaying or monitoring of certain parameters that are stored in the flash memory. These are: Instrument serial number, Last calibration data, PM8572A installed options and the installed firmware version.

Filters

The Filters group has a set of selectors that select a particular filter low pass and properties. Filters can be turned on and off freely as long as you are not generating the standard sine waveform. The following filter options are available:

All Off – no filter is applied to the output path

25MHz – a Bessel type filter that has 25 MHz cutoff frequency.

50MHz – a Bessel type filter that has 50 MHz cutoff frequency.

60MHz – an Elliptic type filter that has 60 MHz cutoff frequency.

120MHz – an Elliptic type filter that has 120 MHz cutoff frequency.

Calibration

The Calibration panel provides access to remote calibration procedures. To access the remote calibration panel, you will need to have a valid User Name and Password and to quality to perform such calibration, you'll need to be trained and certified by Tabor Electronics. Information how to access the calibration panel and how to perform the calibration is given in Chapter 7. The picture below is just for reference how the calibration panel will look after you gain access to this panel.

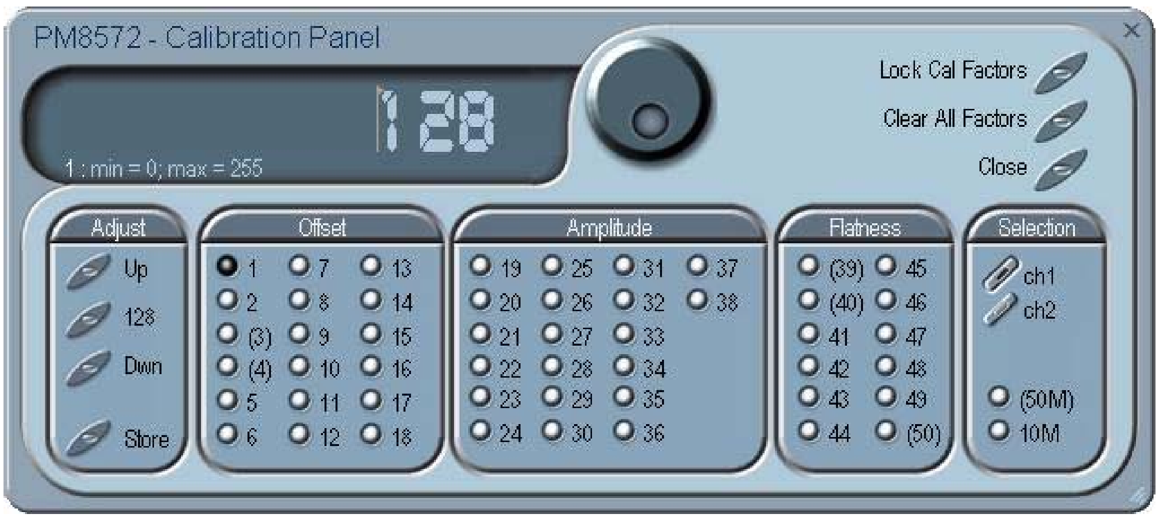


Figure 4-33, the Utility Panel

The Composers Panels

Figure 4-34a, the Composers Panels

The Composers tab provides access to a group of composers that allow generation and editing of arbitrary waveforms, pulse shapes, arbitrary frequency modulation and 3D profiling. Without utilities such as the above, the operation of an arbitrary waveform generator is extremely limiting.

There are four waveform composers built into ArbConnection:

Wave – for generating arbitrary waveforms. Arbitrary waveforms can be generated from standard libraries, from an equation editor, or imported to the composer from external utilities such as MatLAB. The waveforms can be edited and stored on hard or soft disks.

Pulse – for generating complex pulse trains. Unlike a standard pulse generator, you can design and edit multiple pulse trains with linear transitions and variable amplitudes.

FM – for generating arbitrary frequency modulation profiles without being limited by the standard sine, triangle and square modulating shapes, and

3D – for generating chirps and simultaneous variations of amplitude, frequency and phase on each channel, separately.

The Composers set of panels are shown in Figure 4-34. Each of the composers is described below.

The Wave Composer

Being an arbitrary waveform generator, the PM8572A has to be loaded with waveform data before it can start generating waveforms. The waveform generation and editing utility is part of ArbConncetion and is called – The Waveform Composer. This program gives you tools to create definitions for arbitrary waveforms. It can also convert coordinates from other products, such as, oscilloscopes and use them directly as waveform data. The program is loaded with many features and options so use the following paragraphs to learn how to create, edit and download waveforms to the PM8572A using the Waveform Composer.

To launch the wave composer point and click on the Wave tab in the Panels bar. Figure 4-34 shows an example of the wave composer. The Wave Composer has main sections: Commands bar, Toolbar and Waveform screen. Refer to Figure 4-34 throughout the description of these sections.

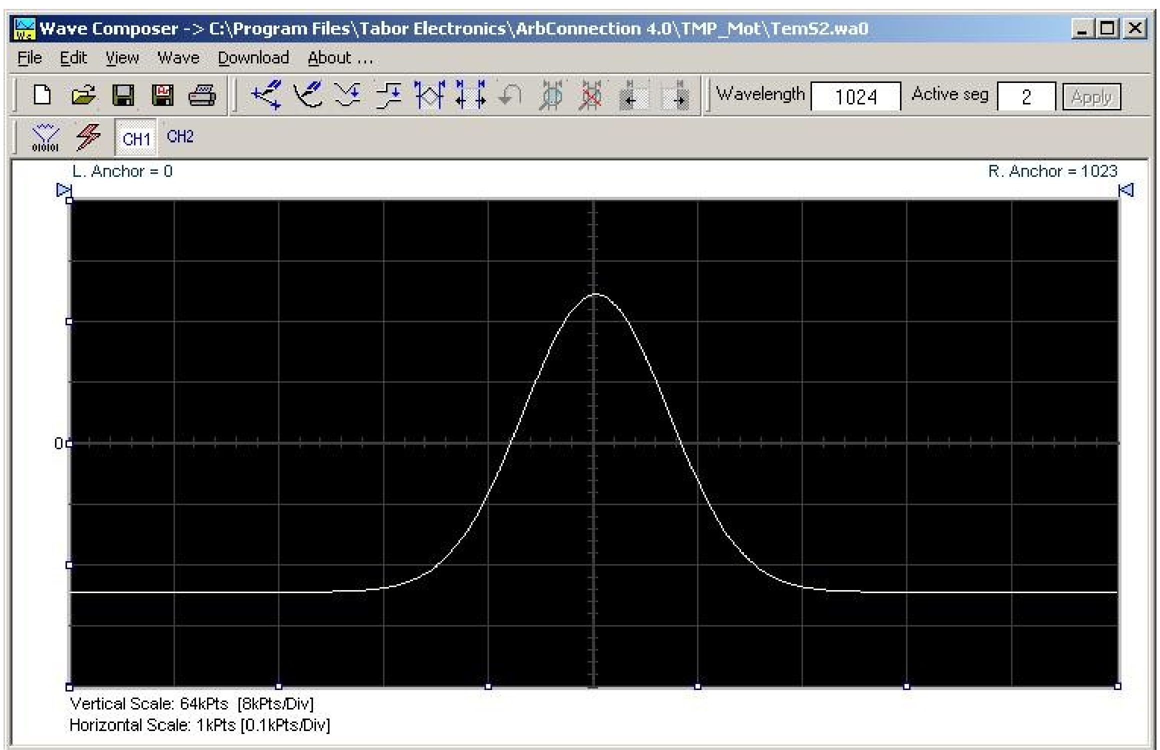


Figure 4-4434, the Wave Composer Opening Screen

The Commands bar

The commands bar provides access to standard Windows commands such as File and View. In addition, there are ArbConncetion-specific commands such as Edit, Wave and System.

In general, clicking on one of the commands opens a dialog box with an additional list of commands. Then, clicking on an additional command, may open a dialog box, or generate an immediate action. For example, Clicking on File and then Exit will cause an immediate termination of the Wave Composer. On the other hand, clicking on Wave and then on Sine, will open a Sine Wave dialog box that lets you program and edit sine wave parameters. The various commands in the Commands bar are listed and described below.

File Commands

The File command has 4 command lines that control waveform files. Also use this command to print the active waveform, or exit the wave composer program. Description of the various commands under File is given below.

New Waveform
The New Waveform (Ctrl+N) command will remove the waveform from the screen. If you made changes to the waveform area and use the New Waveform command, you should save your work before clearing the screen. The New Waveform command is destructive to the displayed waveform.

Open Waveform…
The Open Waveform… (Ctrl+O) command will let you browse your disk for previously saved waveform files and load these waveforms to the waveform area. This command is also very useful for converting waveform files to format that is acceptable by the Wave Composer. The Open Waveform command can convert ASCII. *CSV (comma delimited text), *PRN (space delimited text) and *.0* (LeCroy binary format). The Open dialog box in Figure 4-35 shows the various file extensions that can be opened into the Wave Composer environment. The file that is opened is automatically converted to *.wav format and can later be saved as a standard ArbConncetion file.

Save Waveform
The Save Waveform (Ctrl+S) command will store your active waveform in your PM8572A directory, as a binary file with an *.wav extension. If this is the first time you save your waveform, the Save Waveform As… command will be invoked automatically, letting you select name, location and format for your waveform file.

Save Waveform As…
Use the Save Waveform As… command the first time you save your waveform. It will let you select name, location and format for your waveform file.

Print
With this command you may print the active Waveform Window. The standard printer dialog box will appear and will let you select printer setup, or print the waveform page.

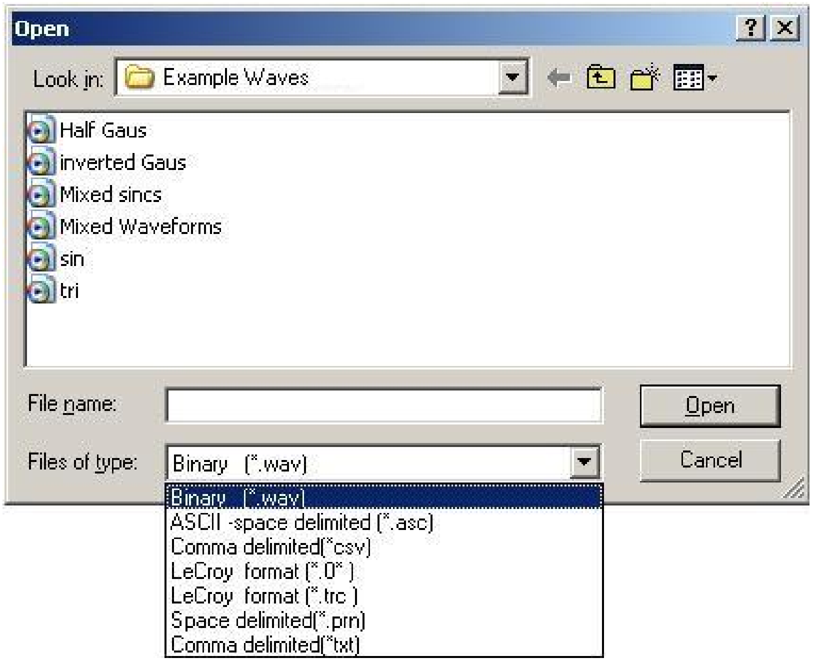


Figure 4-35, the Open Waveform Dialog Box

Exit
The Exit command ends the current Wave Composer session and takes you back to the Panels screen. If you made changes to your waveform since it was last saved, the Wave Composer will prompt you to Save or Abandon changes these changes.

Edit Commands

The Edit commands are used for manipulating the waveform that is drawn on the screen. The editing commands are explained in the following paragraphs.

Autoline
The Autoline command lets you draw straight-line segments. To draw a line the left mouse button at the start point. Click again at the next point and then click on the right mouse button to terminate this operation.

Sketch
The Sketch command lets you draw free-hand segments. To draw a line using this command click and hold the left mouse button at the start point. Release the mouse button when you want to stop and then click on the right mouse button to terminate this operation.

Smooth
The Smooth command lets you smooth out rough transitions on your waveform. This is done mathematically by multiplying waveform coordinates by the non-linear portion of a cubic parabola.

The Smooth operation is done on segments of the waveform that are bound by anchors. Anchor operation is described later in this chapter. Place the anchors on the left and right of your waveform segment and select the Smooth command. The waveform will change its shape immediately to follow the mathematical pattern of a parabolic curve.

Note that small segments with fast transitions, when combined with parabolic expressions have tendencies to generate even larger transitions. Therefore, make sure you omit such sections of the waveform when you use this operation.

Filter
The Filter used with this command is moving average. This is done by recalculating each point as an average of symmetrical number of adjacent points. When you select the Filter command, a dialog box pops up, letting you program the filter spacing in number of adjacent points. You can filter the entire waveform, or you may chose to filter a segment of the waveform by placing the anchors as boundaries on the left and right of the segment.

Invert
The Invert command lets you invert the entire waveforms, or marked segments of waveforms. The waveform is inverted about the 0-point axis.

Trim Left
The trim left command lets you trim waveforms to the left of the anchor point. This command is grayed out if the left anchor was not moved from its original left position. The waveform is trimmed and the point at the left anchor point becomes the first point of the waveform.

Trim Right
The trim right command lets you trim waveforms to the right of the anchor point. This command is grayed out if the right anchor was not moved from its original right position. The waveform is trimmed and the point at the right anchor point becomes the last point of the waveform.

Unmark
The unmark command removes the anchors from the waveform screen and resets anchor positions to point 0 and the last waveform point.

Undo
The Undo command undoes the last editing operation.

View Commands

The View commands have commands that let you view various sections of the waveform area. The View commands include: Zoom In, Zoom Out, Hide/Show Toolbars and Channel ½ waveforms. Description of the view commands is given in the following.

Zoom In

The zoom in command operates between anchors. Anchors are marked as left and right hand triangles. The default position of the anchors is the start and the end of the waveform. To move an anchor to a new location, click and hold on the triangle and drag the anchor to left or right as required. If you move the left anchor to the right and the right anchor to the left, the area between the anchors will zoom in as you select this command.

Looking at the Waveform Map, as shown in Figure 4-36, you'll see that the white portion is the zoomed area. Click and hold on the white area and move your cursor around and the waveform screen will be updated accordingly.

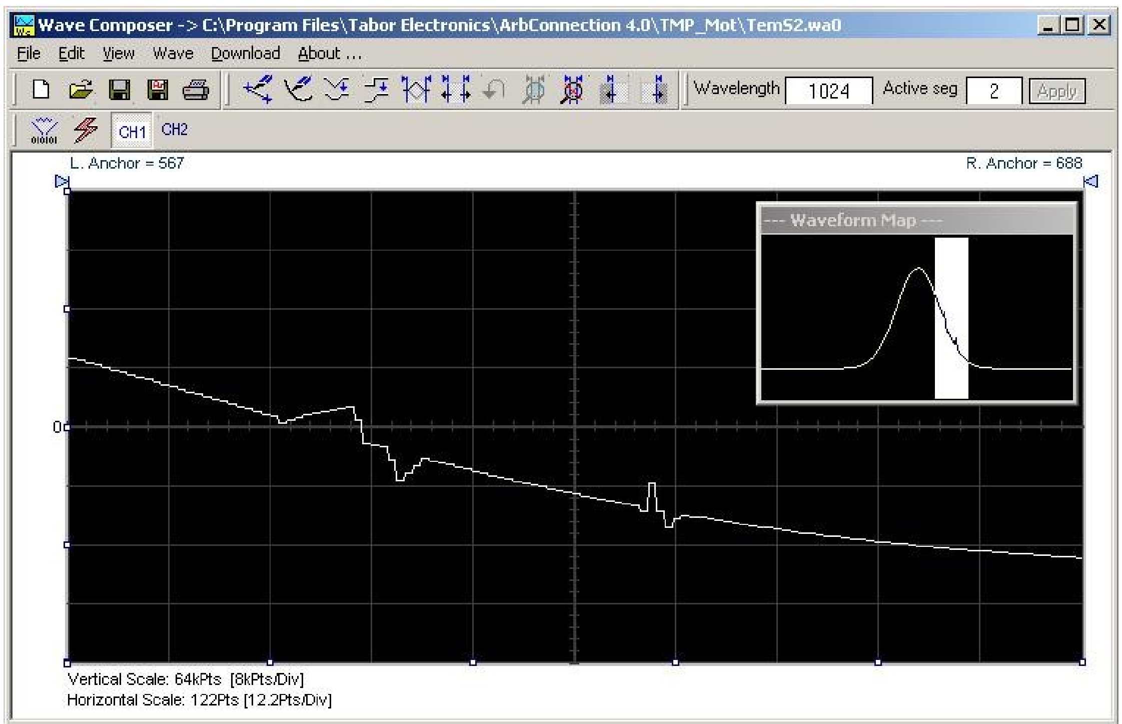


Figure 4-36, Zooming In on Waveform Segments

While zoomed in you can perform Autoline and sketch editing, or zoom-in further by clicking and holding the mouse at one corner and releasing the mouse button at the other corner.

Zoom Out

The zoom out restores the screen to display the complete waveform.

Channel 1

The Channel 1 Waveform command updates the waveform screen with the Channel 1 waveform. If you have not yet generated a waveform for channel 1, the waveform screen will show a dc level at vertical point 0.

Channel 2

The Channel 2 command updates the waveform screen with the Channel 2 waveform. If you have not yet generated a waveform for Channel 2, the waveform screen will show a dc level at vertical point 0.

Wave Commands

The Wave commands let you create waveforms on the screen. The Wave command has a library of 8 waveforms: Sine, Sawtooth, Square, Sinc, Gaussian, Exponent, Pulse, and Noise. It also lets you create waveforms using the Equation Editor. Information how to create waveforms using the Wave commands is given below.

Creating Waveforms From the Built-in Library

You can create any waveform from the built-in library using the Wave command. Clicking on one of the Wave options will open a dialog box. An example of the Sine waveform dialog box is shown in Figure 4-37. This dialog box is representative of the rest of the waveforms, so other waveforms will not be described.

Creating Sine Waveforms

Use the following procedure to create sine waveforms from the built-in library. Click on Wave, then sine… the dialog box as shown in Figure 4-37 will appear. You can now start programming parameters that are available in this box.

Start Point – Defines the first point where the created wave will start. Note that if you change the start point the left anchor will automatically adjust itself to the selected start point. The example shows start point set at point 0.

End Point – Defines where the created waveform will end. Note that as you change the end point the right anchor will automatically adjust itself to the selected end point. The example shows end point set at point 499.

Cycles – The Cycles parameter defines how many sine cycles will be created within the specified start and end points. The example below shows five sine cycles.

Amplitude – 14-bit of vertical define 16,384 incremental steps. The Amplitude parameter defines how many of these steps are used for generating the sine. The example is showing sine waveform with maximum peak-to-peak amplitude. Any number below the maximum will generate an attenuated sine.

Start Phase – The start phase parameter defines the angle of which the sine will start. The example shows start phase of 90°.

Power – The example shows sine cubed. Sine to the power of 1 will generate a perfect sine. Power range is from 1 through 9.

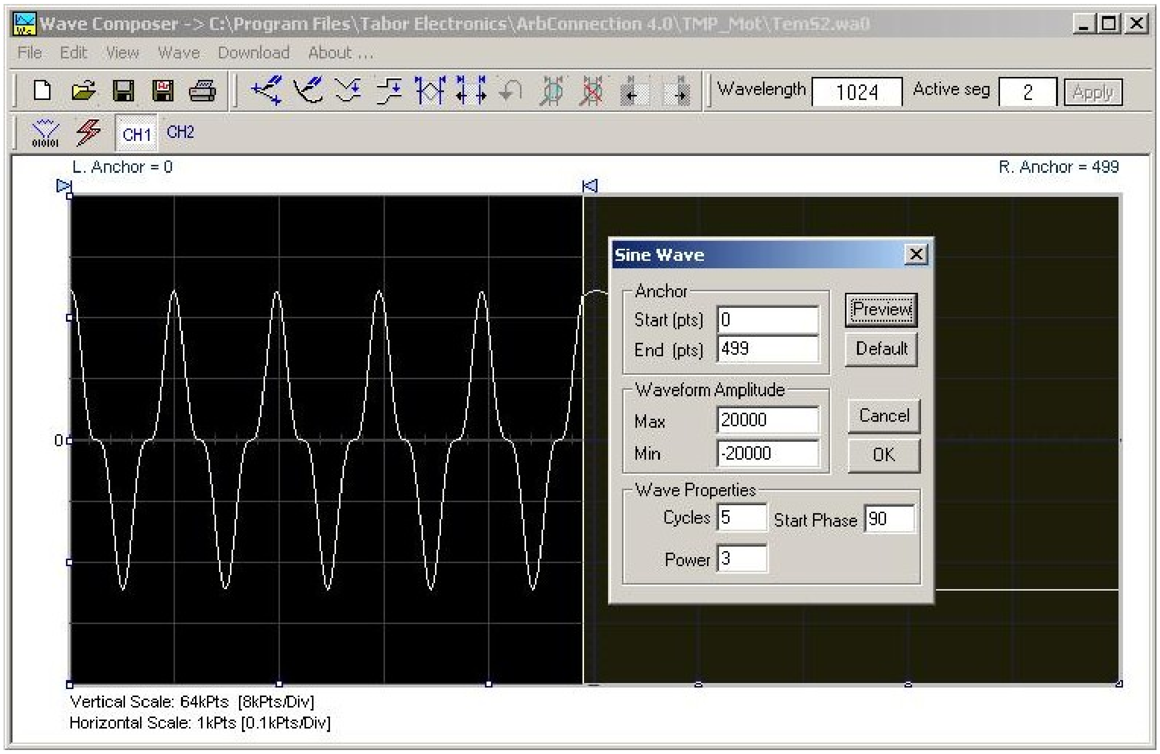


Figure 4-37, Generating Distorted Sine waves from the built-in Library

The Toolbar

The toolbar contains icons for editing the waveform screen, icons for saving and loading waveforms, fields for selecting an active channel and for adjusting segment length and more. The Toolbar is shown in Figure 4-38. For the individual icons, refer to the descriptions above of the Wave Composer Menus.

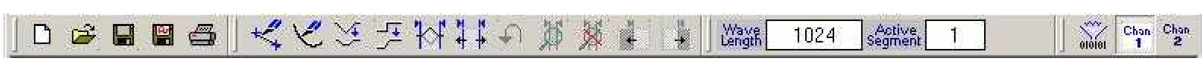


Figure 4-38, the Toolbar Icons

The Waveform Screen

Waveforms are created and edited on the waveform screen. Figure 4-39 shows an example of a waveform created using the equation editor and the anchors to limit generation of the waveform between points 100 and 900. The various elements of the waveform screen are described below.

The waveform screen has two axes – vertical and horizontal. Both axes are divided into points.

The vertical axis is labeled from –8191 through 8192 for a total of 16,384 point. This number represents 14 bits of vertical resolution and cannot be changed because it is critical to the range of which the PM8572A operates.

The horizontal axis, by default has 1000 points (from point 0 to 999). This number can be changed using the Wave Length field in the Toolbar. The maximum length depends on the option installed in your instrument. The wave composer will let you define the horizontal axis to a maximum of 2M words).

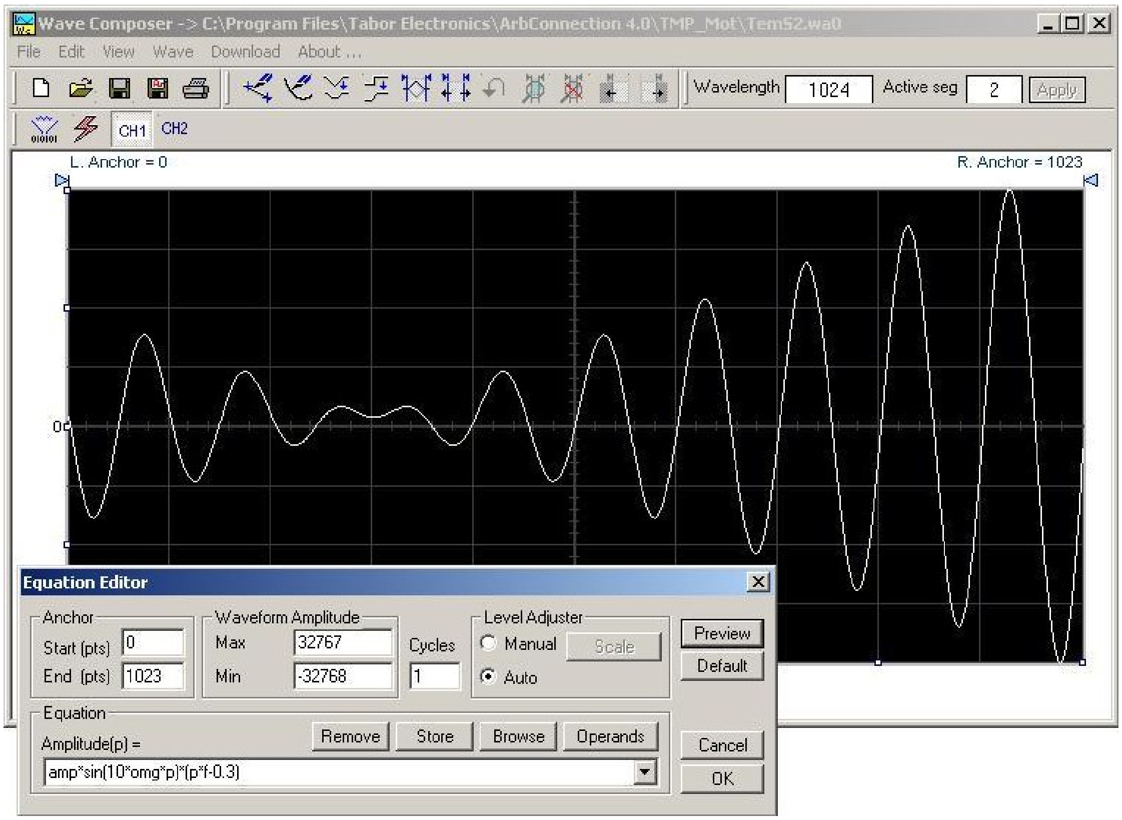


Figure 4-39, the Waveform Screen

Notice on the left top and on the right top there are two triangles pointing to the center of the screen. These are the anchors. The anchors are used as the start and end pointers where your waveform will be created. For example, if you want to create a sine waveform between point 100 and point 500, you place the left anchor at point 100 and the right at point 500 and then generate the sine from the built-in library.

There are two ways to control anchor placements.

1) Click and hold your mouse cursor on the left anchor triangle and then drag the curtain to the left position. Do the same for the right anchor. Notice the X and Y coordinates at the top of the waveform screen and how they change to correspond to your anchor placement.

2) You can also place your anchors in a more precise manner from the waveform library by programming the start and end points

for the waveform. An example of anchor placement using the sine dialog box is shown in Figure 4-37.

Finally, when you are done creating and editing your waveform, you can save your work to a directory of your choice. The name at the title will show you the name you selected for storing your waveform and its path.

Generating Waveforms Using the Equation Editor

One of the most powerful feature within ArbConncetion and probably the feature that will be used most is the Equation Editor. The Equation Editor let you write equations the same way as you would do on a blank piece of paper. The equations are then translated to sequential points that form waveforms and are displayed on the waveform screen. The Equation Editor will detect and inform you on syntax errors and, with its self adjusting feature, will automatically adjust your parameters so that none of the points on your waveform will exceed the maximum scale limits.

When you invoke the Equation Editor, the dialog box, as shown in Figure 4-40 will display. Use the following paragraphs to learn how to use this dialog box and how to write your equations.

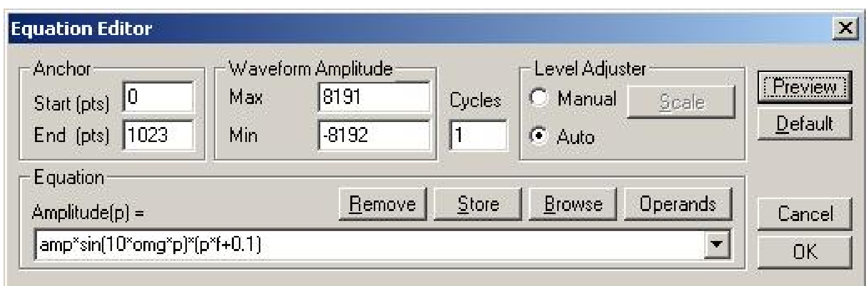


Figure 4-40, the Equation Editor Dialog Box

There are four sub-group parameters in the equation editor plus control buttons and equation field. These parts are described below.

Anchor
The anchors define start and end point of which the equation will be generated. By default the anchors are placed at the start and the end of the horizontal (time) scale however, the equation can be limited to a specific time scale by moving the anchor points from their default locations.

Start – defines the first point where the created wave will start. Note that if you change the start point the left anchor will automatically adjust itself to the selected start point.

End – defines where the created waveform will end. Note that as you change the end point the right anchor will automatically adjust itself to the selected end point.

Waveform Amplitude

The vertical axis of the Wave Composer represents 14-bits of vertical resolution. That means that the equation is computed, resolved and generated with 1/32,768 increments and accuracy. The Waveform Amplitude fields in the Equation Editor are used in two cases: 1) when the “amp” parameter is used in the equation or 2 if the Level Adjuster is set to Auto. Information on these two operations is given later.

Max – defines the positive peak of the vertical axis

Min – defines the negative peak of the vertical axis

Cycles

The Cycles parameter defines how many waveform cycles will be created within the specified start and end anchor points.

Level Adjuster

The Level Adjuster is a convenient tool that helps you adjust the amplitude and offset without modifying your equation. The Level Adjuster mode does not interfere with your calculations and displays the waveform as computed from your equation. The only difference is that your final calculations are stretched or shrunk or offset on the vertical scale to fit the new amplitude and offset boundaries.

If you change the Max and Min setting in the Waveform Amplitude fields and press the Adjust key, your waveform will offset immediately without changing the equation. The same way, you can also change amplitude only or both amplitude and offset. If you check the Manual option, you’ll have to click on the Adjust button for the Waveform Amplitude parameters to take effect. The Adjust button name will change to Restore and back to Adjust if you click on it again. If you check the Auto option, your waveform will be created automatically with the new Amplitude setting.

Equation

The Equation group has four buttons and the equation field. You will be using the Equation field for writing your equations. Equation syntax and conventions are discussed in the following paragraphs. The *Remove* button clears the equation field so you can start typing a new equation. Click on the *Store* button to store your equation if you intend to use it again. The Browse button provides access to waveform pre-stored files in your computer for combining them in new equations. The *Operands* button expands the bottom of the dialog box to show the operands you can use with your equation.

While you type and store equations, they are collected in a history file and can be used again by expanding the history log from the equation field.

Control Buttons

There are four control buttons at the right corner of the dialog box. Use the *Preview* button to preview an image of your equation, or use the *OK* button to place your waveform on the waveform screen and to leave the dialog box on the screen. The *Default* button restores the parameters in the equation editor to their original factory default values. The *Cancel* button will remove the dialog box from the screen and will discard of any waveforms that you previewed with your Equation Editor.

Writing Equations

The Equation Editor lets you process mathematical expressions and convert them into waveform coordinates. As you probably already know, waveforms are made of vertical samples. The number of samples on your waveform is determined by the wavelength parameter. For example, if you have 1024 horizontal points, your equation will be computed along 1024 points as a function of the vertical scale. Each vertical sample is computed separately and placed along the horizontal axis. The points are graphically connected to form a uniform and continuous waveform shape however, if you zoom in on a waveform line, you'll see that the points are connected like a staircase. In reality, the PM8572A generates its waveforms exactly as shown on the screen but, if the waveform has many horizontal points, the steps get smaller and harder to see without magnification.

Equations are always computed as a function of the vertical (Amplitude) axis therefore the left side of your equation will always look as Amplitude(p)=, where "p" is the equation variables in units of waveform points. You can write equations with up to 256 characters. If the equation is too long to fit in the visible field, parts to the left or right will scroll off the ends.

Equation Convention

The following paragraphs describe the conventions that are used for writing an equation. To avoid errors, it is extremely important that you make yourself familiar with these conventions before you plan your waveforms.

Equations are written in conventional mathematical notation. You may only enter the right part of the equation. The only limitation is that the equation must be of a single variable that is directly related to the current horizontal axis setting. Case is not important and spaces are ignored. Numbers are entered in scientific notation. All calculations are done with double-digit precision. For the trigonometric functions, all angles are expressed in radians.

A number of constants are provided: e, which is the base of the natural logarithm; pi, which is the circumference of a unit-diameter circle; per, which equals the programmed horizontal range; f, which equals 1 /per; omg, which equals 2 * pi / per, and numerals in the range of -1E^20 to 1E^20.

There are three classes of precedence: ^ (raise to power) has the highest precedence; (multiply) and / (divide) come second; + and -

have the lowest precedence. Parentheses may be used to change the order of precedence. The following table summarize the mathematical expressions and their respective abbreviated commands that can be used with the Equation Editor.

Equation Editor Operands

^	Raise to the power
*	Multiply
/	Divide
+	Add
Ä	Subtract
( )	Parentheses
e	Base of natural Logarithm
pi (π)	Circumference of unit-diameter circle
per	Horizontal wavelength in points
f	I/per
omg (Ω)	2*π / per
amp	Amplitude in units of points or seconds
sin(x)	The sine of x(*)
cos(x)	The cosine of x
tan(x)	The tangent of x
ctn(x)	The cotangent of x
log(x)	The base IO logarithm of x
In(x)	The natural (base e) logarithm of x
abs(x)	The absolute value of x
-1E^20<>1E^20	Numerals, equation constants

(*)x = argument mathematical expression

After you get familiar with the operands and conventions, you can commence with a few simple equations and see what they do to your waveform screen. Once you'll get the feel, you'll be able to explore your own creativity to generate much more complicated and complex waveforms.

Typing Equations

If you remember from your old high school studies, the simplest curve of Y as a function of X is defined by the equation Y=aX+b. You can use the same “technique” to generate straight lines with the Equation Editor. Assuming first that p=0, try this:

Amplitude(p)=1000

Press [Preview] and see what you get. Of course, you get an uninteresting line that runs parallel to the X-axis. Now, lets give the line some angle by typing:

Amplitude(p)=-2*p+2000

Press [Preview] and see that the line slopes down. It may still be not very interesting however, pay close attention to the convention that is used in this equation. You cannot type: Amplitude(p)=-2p+1000, like you would normally do in your notebook; You must use the * (multiply) sign, otherwise you'll get a syntax error. Now we'll try to generate a simple sine waveform. Try this:

Amplitude(p)=sin(10)

Press [Preview] and… sorry, you still get nothing on the screen. The Wave Composer did not make a mistake! The sine of 10 in radians is exactly what it shows. You are unable to see the result because the line on your screen running across the 0 vertical point.

REMEMBER

The equation must be a function of a single variable and that variable must be directly related to the Horizontal axis Scale setting.

Now try this:

Amplitude(p)=sin(omg*p)

Still no good, but now press the [Adjust] button and here is your sinewave. So what's wrong? Well, if you'll give it a little amplitude it might help so, do it now exactly as follows:

Amplitude(p)=8000*sin(omg*p)

There you go. You should now see a perfect sine waveform with a period of 1000 points. This is because you have asked the Equation Editor to compute the sine along p points (“p” is the equation variable, remember?). If you want to create 10 sine waveforms, you should multiply p by 10. Try this:

Amplitude(p)=8000*sin(omg*p*10)

Equation Samples

So far, you have learned how to create two simple waveforms: straight lines and trigonometric functions. Let’s see if we can combine these waveforms to something more interesting. Take the straight line equation and add it to the sinewave equation:

Amplitude(p)=12000*sin(omg*p*l0)-8*p+4000

Press [Preview]. Your screen should look like Figure 4-41.

Now let’s try to modulate two sine waves with different periods and different start phase. Type this:

Amplitude(p)= 12000*sin(omg*p)*cos(omg*p*30)

Press [Preview]. Your screen should look like Figure 4-42.

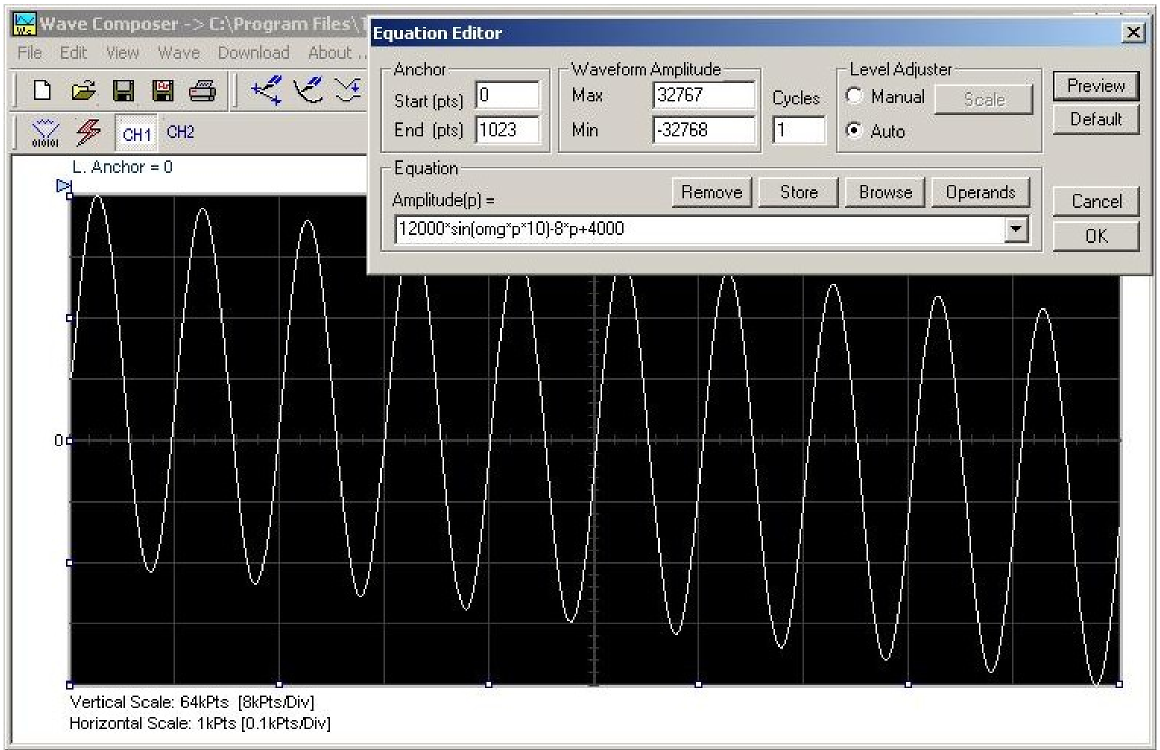


Figure 4-41, an Equation Editor Example

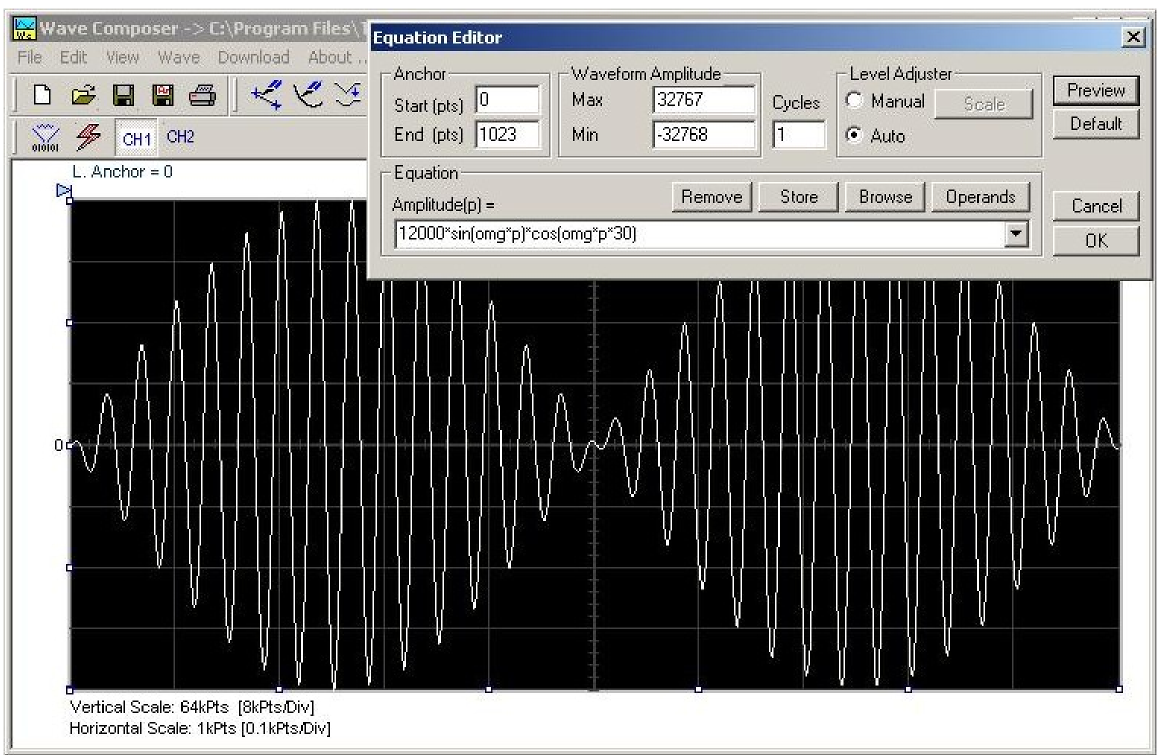


Figure 4-42, Using the Equation Editor to Modulate Sine Waveforms.

In the following example, 20% second harmonic distortion has been added to a standard sinewave. The original waveform had a peak-to-peak value of 24000 points so 19% second harmonic is equivalent to 4500 points. The frequency of the second harmonic is obviously double that of the fundamental, so term +4500*sin(2*omg*p) is added to the original sine wave equation. Use the following equation:

Amplitude(p)=24000*sin(omg*p)+4500*sine(2*omg*p)

Press [Preview]. Your screen should look like Figure 4-43.

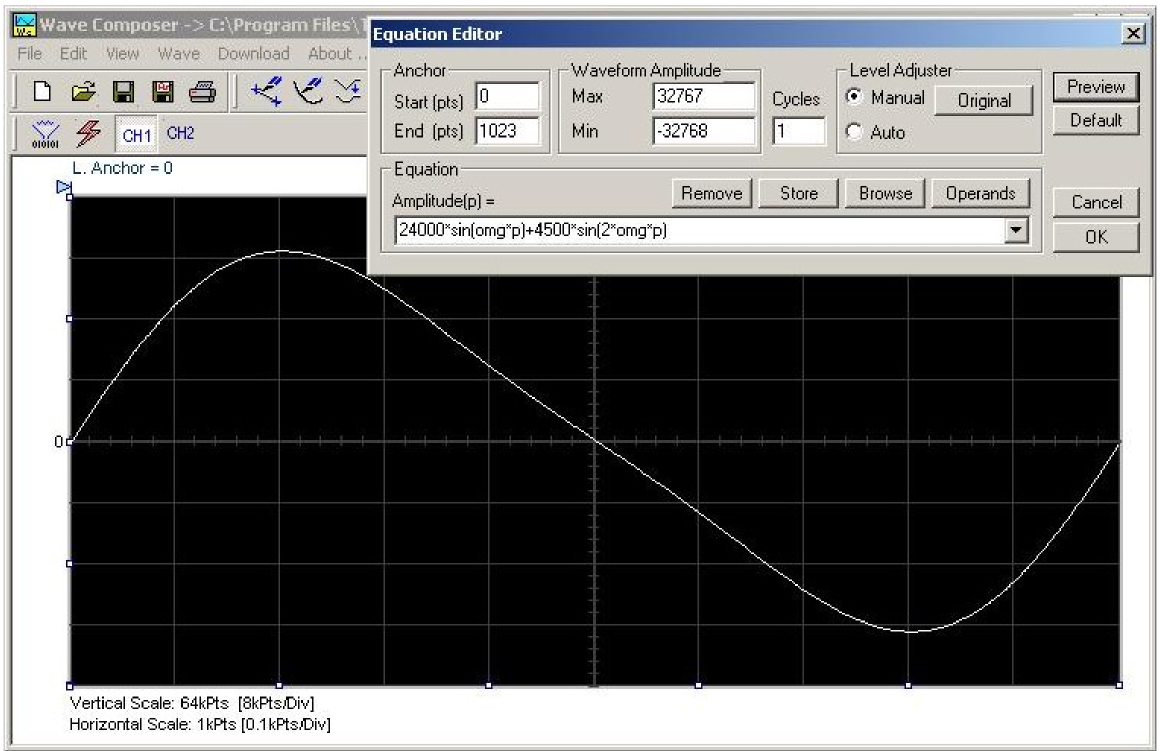


Figure 4-43, Using the Equation Editor to Add Second Harmonic Distortion.

In Figure 4-41 we created 10 cycles of sinewave made to decay exponentially. The original expression for a standard sinewave is multiplied by the term e^(p/-250). Increasing the value of the divisor (200 in this case) will slow down the rate of decay.

Use the following equation:

Amplitude(p)=12000*sin(omg*p*10)*e^(p/-250)

Press [Preview]. Your screen should look like Figure 4-44.

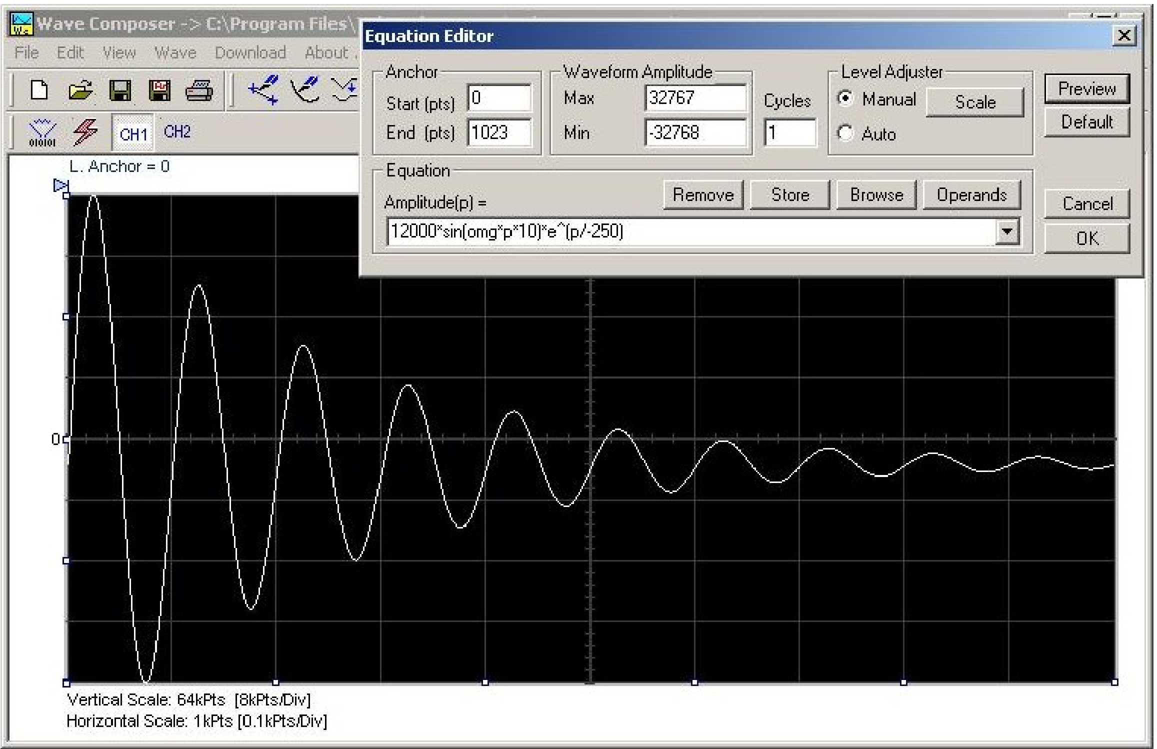


Figure 4-44, Using the Equation Editor to Generate Exponentially Decaying Sinewave

The last example as shown in Figure 4-45 is the most complex to be discussed here. Here, 100 cycles of sinewave are amplitude modulated with 10 cycles of sine wave with a modulation depth of 20%. To achieve this, the upper and lower sidebands are defined separately and added to the fundamental or carrier. The upper sideband is produced by the expression 100*cos(110*omg*p) and the lower sideband by the term 100*cos(90*omg*p).

Use the following equation:

Ampl(p)=6000*sin(100*omg*p)+1200*cos(110*omg*p)-1200*cos(90*omg*p)

Press [Preview]. Your screen should look like Figure 4-45.

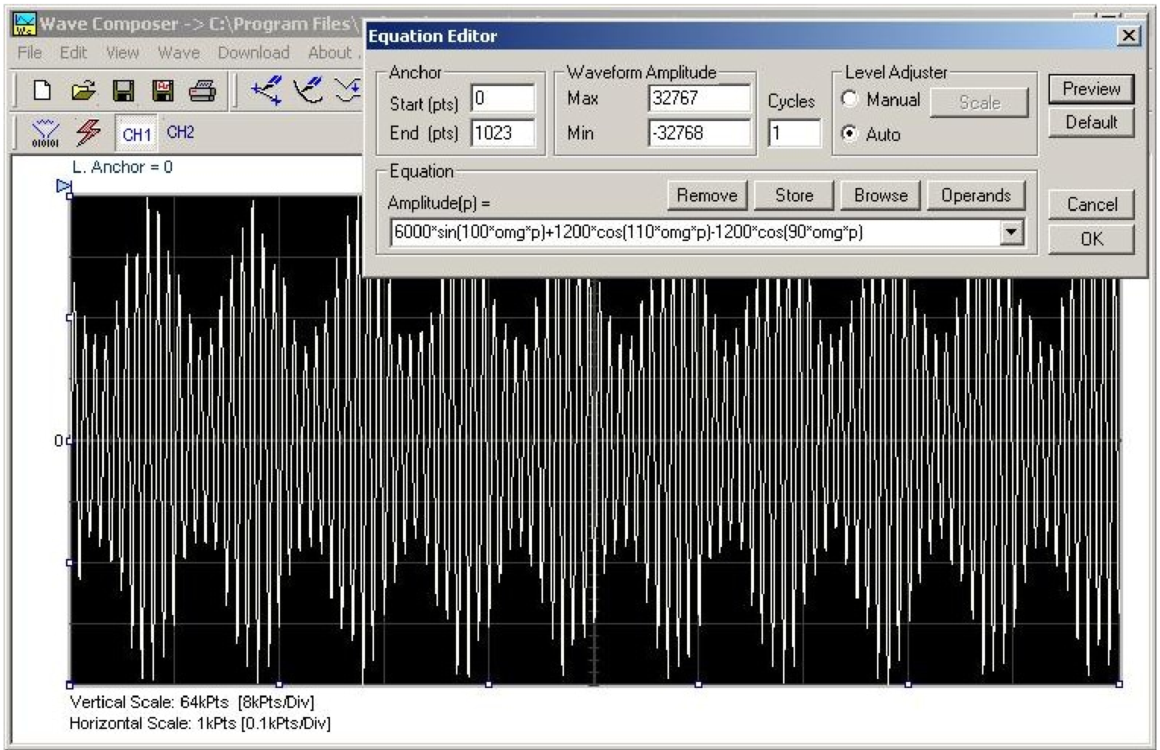


Figure 4-45, Using the Editor to Build Amplitude Modulated Signal with Upper and Lower Sidebands

Combining Waveforms

The last but not least powerful feature allows you to combine waveforms which you previously stored on your hard disc. You can write mathematical expressions that contain waveforms, simple operands and trigonometric functions similar to the example given below. If you want to use waveforms in your equations, you must first generate these waves and store them on your hard disk. You identify waveforms by adding the *.wav extension as shown in the example below.

Amplitude(p)= Sine.wav*sin(omg*p*10)*Noise.wav/1000

The above equation will generate amplitude-modulated waveform with added noise. The following steps demonstrate how to create, store and combine waveforms using this equation.

Step 1 – Create and store sine.wav. Invoke the Wave command and generate a sine waveform. Press OK and then select the Save Waveform As… from the File command. Save this file using the name Sine.wav. Note where you store this waveform as you would have to know the path for the next step.

Step 2 – Create and store Noise.wav. From the Wave command select Noise. Click OK and watch your waveform screen draw noisy signal. From the File menu select Save Waveform As… and save this waveform using the name Noise.wav.

Step 3 – Write and compute the original equation:

Amplitude(p)= c:/Sine.wav*sin(omg*p*5)*c:/Noise.wav/10

If you did not make any mistakes, your waveform screen should look as shown in Figure 4-46

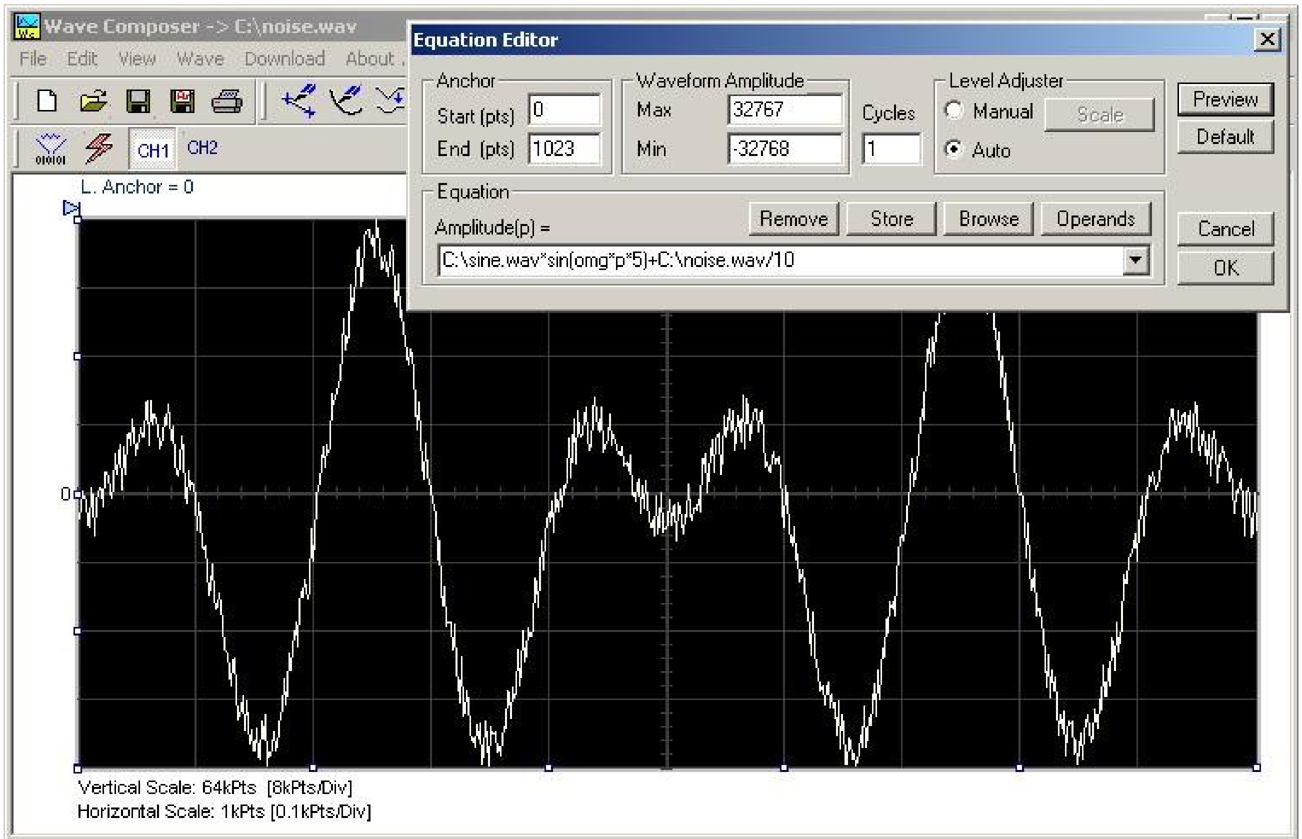


Figure 4-46, Combining Waveforms into Equations

The Pulse Composer

The Pulse Composer is a great tool for creating and editing pulses without the need to think about sample clock, number of points and complex equations. Pulses are created on the screen, simply and efficiently in a special dialog box by typing in the width and level, or by using the “rubber band” method to place straight line segments with the exact amplitude and time duration. The pulse composer can also multiply pulse sections to create pulse duplication along lengthy time intervals.

When you finally have your pulse design on the screen the program determines if the pulse design will fit in one memory segment or use multiple segments and employ the sequence generator for repeatable segments. In either case, bear in mind that if you already have some waveforms stored in memory segments, these will be erased to make room for the new pulse design. If you insist on keeping arbitrary waveforms and still download complex pulses, you can check the “Force pulse to one segment” option and the PM8572A will do some extra “muscle flexing” to fit the pulse as required.

To launch the pulse composer point and click on the Pulse tab in the Panels bar. Figure 4-47 shows an example of the pulse composer. The Pulse Composer has three main sections: Commands bar, Toolbar and Waveform screen. Refer to Figure 4-47 throughout the description of these sections.

The Pulse Composer Commands bar

The commands bar provides access to standard Windows commands such as File and View. In addition, there are ArbExplorer-specific commands such as Edit, Wave and System.

In general, clicking on one of the commands opens a dialog box with an additional list of commands. Then, clicking on an additional command, may open a dialog box, or generate an immediate action. For example, Clicking on File and then Exit will cause an immediate termination of the Pulse Composer. The various commands in the Commands bar are listed and described below.

File Commands

The File command has 4 command lines that control pulse waveform files. Also use this command to print the active waveform, or exit the pulse composer program. Description of the various commands under File is given below.

New
The New (Ctrl+N) command will remove the waveform from the screen. If you made changes to the waveform area and use the New command, you should save your work before clearing the screen. The New command is destructive to the displayed waveform.

Open…
The Open… (Ctrl+O) command will let you browse through your disk space for previously saved pulse waveform files and load them to the pulse screen area. File extension that can be read to the pulse composer is *.pls.

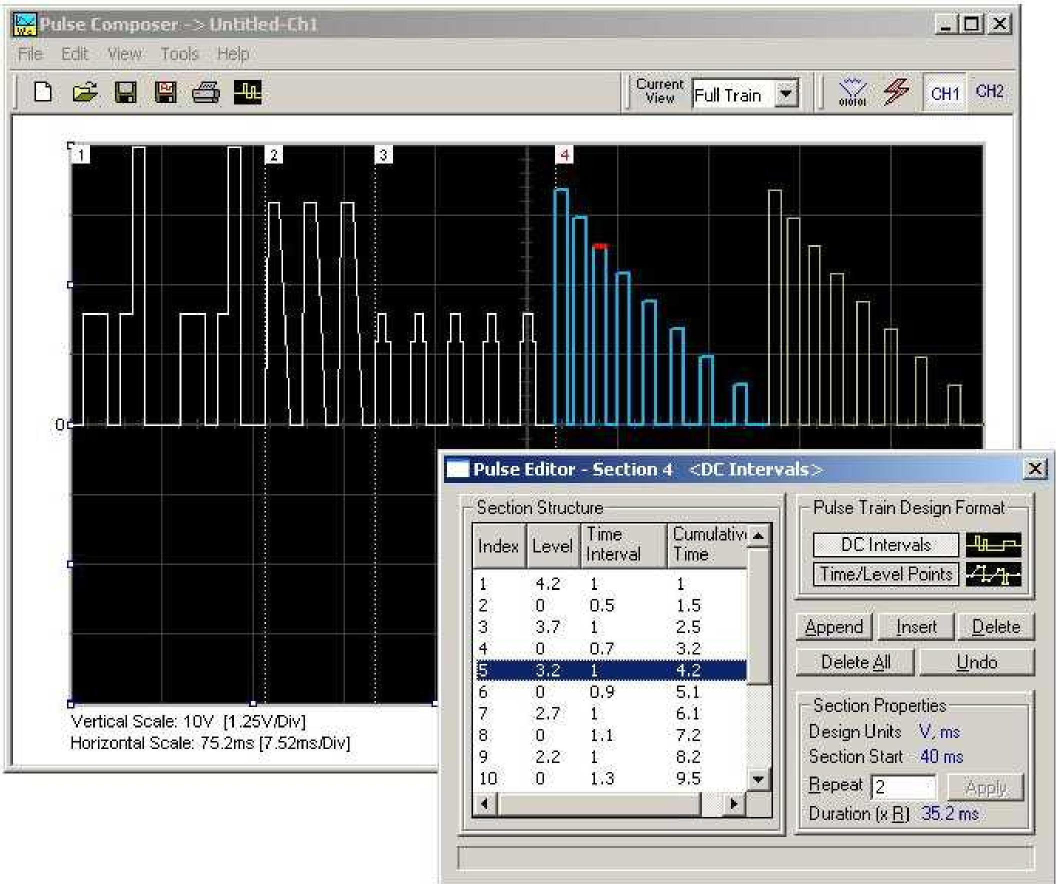


Figure 4-47, the Pulse Composer Screen

Save
The Save (Ctrl+S) command will store the active waveform in your PM8572A directory with a *.pls extension. If this is the first time you save your waveform, the Save As… command will be invoked automatically, letting you select name, location and format for your waveform file.

Save As…
Use the Save As… command the first time you save your waveform. It will let you select name, location and format for your waveform file.

Print
With this command you may print the active Pulse Window. The standard printer dialog box will appear and will let you select printer setup, or print the waveform page.

Exit

The Exit command ends the current Pulse Composer session and takes you back to the Panels screen. If you made changes to your waveform since it was last saved, the Wave Composer will prompt you to Save or Abandon changes these changes.

Edit Commands

The Edit commands are used for adding or removing pulse train sections. Use these commands to Append, Delete, Insert, or Undo last operation. The editing commands are explained in the following paragraphs.

Append Section

The Append Section command lets you append a new section at the end of the pulse train. Only one new section can be appended at the end of the train. If an empty section already exists, the append command will alert for an error. New sections are always appended at the end of the pulse train.

Insert Section

The insert Section command lets you insert a new section in between sections that were already designed. Only one new section can be inserted at the middle of the train. If an empty section already exists, the insert command will alert for an error.

Delete Section

The Delete Section command lets you remove sections from the pulse train without affecting the rest of the train. If you use this command from the Edit menu, make sure that the section you want to remove is currently the active section.

Remove all Sections

The Remove all Sections command lets you remove the entire pulse design from the pulse screen and start from a fresh page.

Undo

The Undo command undoes the last editing operation. This command is extremely useful in cases where you unintentionally delete a section from the pulse train and want to restore it to the screen.

View Commands

The View commands have commands that let you view various sections of the pulse area. The View commands include: Pulse Editor, Full Train or individual Sections, Channel 1 and 2 screens and Options. Description of the view commands is given in the following.

Pulse Editor

The view Pulse Editor command invokes a dialog box as shown in Figure 4-48. In general, the pulse editor is used for placing straight line segments on the screen in intervals that define pulse width, rise/fall times and amplitude. Information how to use the pulse editor to create pulse trains is given later in this chapter.

Full Train

The view Full Train shows on the pulse screen all sections of the pulse train. Eventually, when all pulse sections have been designed, the entire pulse train as shown when the Full Train option has been selected will be downloaded to the instrument as a single waveform.

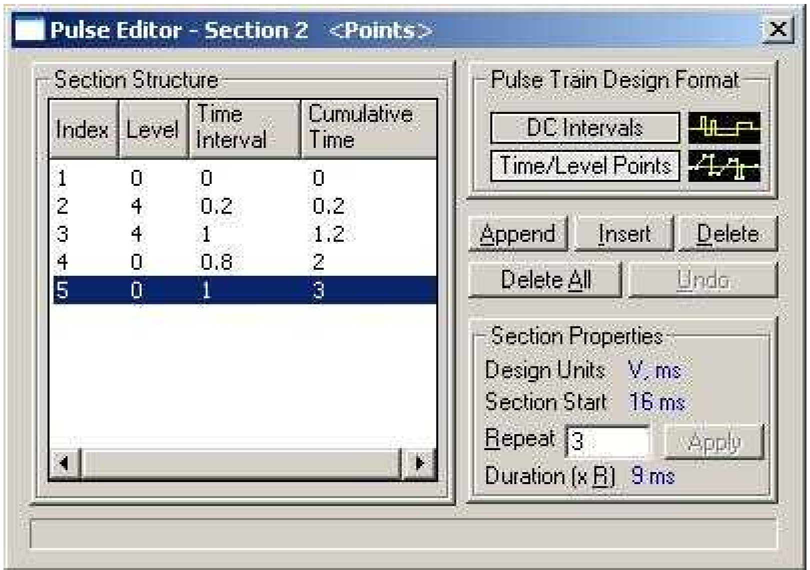


Figure 4-48, the Pulse Editor

Single Section

The view Single Section shows on the pulse screen one section at a time. Eventually, when all pulse sections have been designed, the entire pulse train as shown when the Full Train option has been selected will be downloaded to the instrument as a single waveform.

Channel 1

The view Channel 1 command updates the waveform screen with the Channel 1 pulse train. If you have not yet generated a waveform for channel 1, the waveform screen will show a clear display.

Channel 2

The view Channel 2 command updates the waveform screen with the Channel 2 pulse train. If you have not yet generated a waveform for channel 2, the waveform screen will show a clear display.

Options

The view options command opens the dialog box as shown in Figure 3-49. Use this dialog box to fine-tune the pulse composer to the way it should deal with operational modes and the waveform memory. Information on options is given later in this chapter.

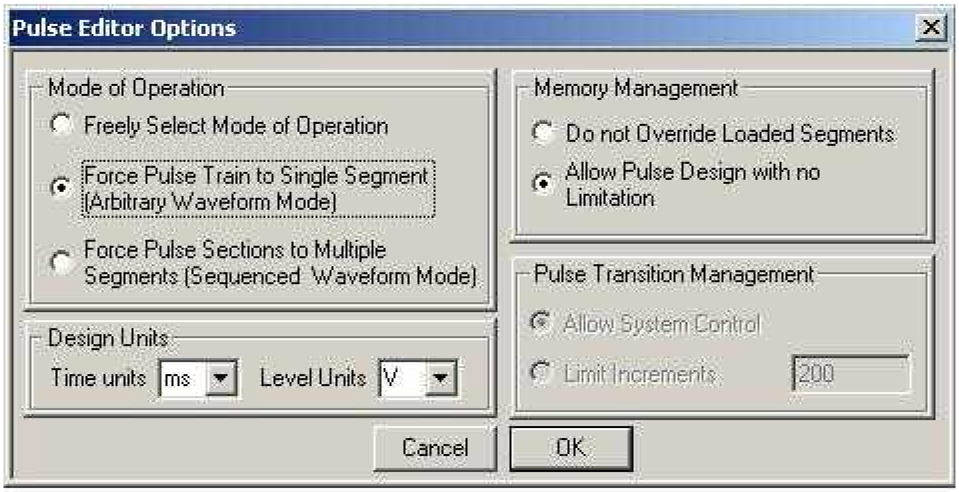


Figure 4-49, the Pulse Editor Options

Tools Commands

The Tools commands let you download pulse trains to either channel 1 or channel 2. You can also clear the entire waveform memory using the Clear memory command.

Note

The Clear Memory command affects the entire waveform memory of the PM8572A and therefore, be careful not to erase memory segments that you'll need to use with the arbitrary function.

The Pulse Composer Toolbar

The toolbar contains icons for editing the waveform screen, icons for saving and loading waveforms, fields for selecting an active channel and more. The Toolbar is shown in Figure 4-50. The icons, from left to right operate the following functions: New waveform, Open an existing waveform file, Save pulse train, Save pulse train As, Print the screen and open the pulse editor dialog box. Other icons select the current view on the screen, shows channel 1 and channel 2 waveforms, clear the memory and download the displayed pulse train to the active channel.

Figure 4-50, the Pulse Composer Toolbar Icons

Creating Pulses

As was mentioned above, creating pulses with the pulse editor is simple and intuitive, just as you would draw the pulse on a piece of paper. The pulse editor then processes the information, determines the appropriate mode and converts to waveform coordinates for downloading to the instrument for it to generate the required pulse shape.

There are a number of terms that will be used throughout the following description; Make yourself familiar with these terms before you proceed with actual design of your pulse.

Pulse Editor
The Pulse Editor is the prime tool for creating pulses. To invoke the pulse editor, point and click on the pulse editor icon on the pulse composer toolbar. You can also invoke the editor by clicking on the Section Number icon as will be shown later in this description. The pulse editor dialog box is shown in Figure 4-48.

Pulse Train
The Pulse Train identifies the entire pulse design. When downloading the waveform to the instrument, the entire pulse train will be downloaded, regardless if part of the pulse train is displayed on the pulse composer screen.

Pulse Section
Pulse train is constructed from 1 or more sections. If the pulse is simple, it can be created using one section only. For more complex pulse train, the train can be divided to smaller sections and each section designed separately for simplicity. Figure 4-48 shows a complex pulse train which was made from five simpler sections and Figure 4-49 shows the design of the fifth section only of the pulse train.

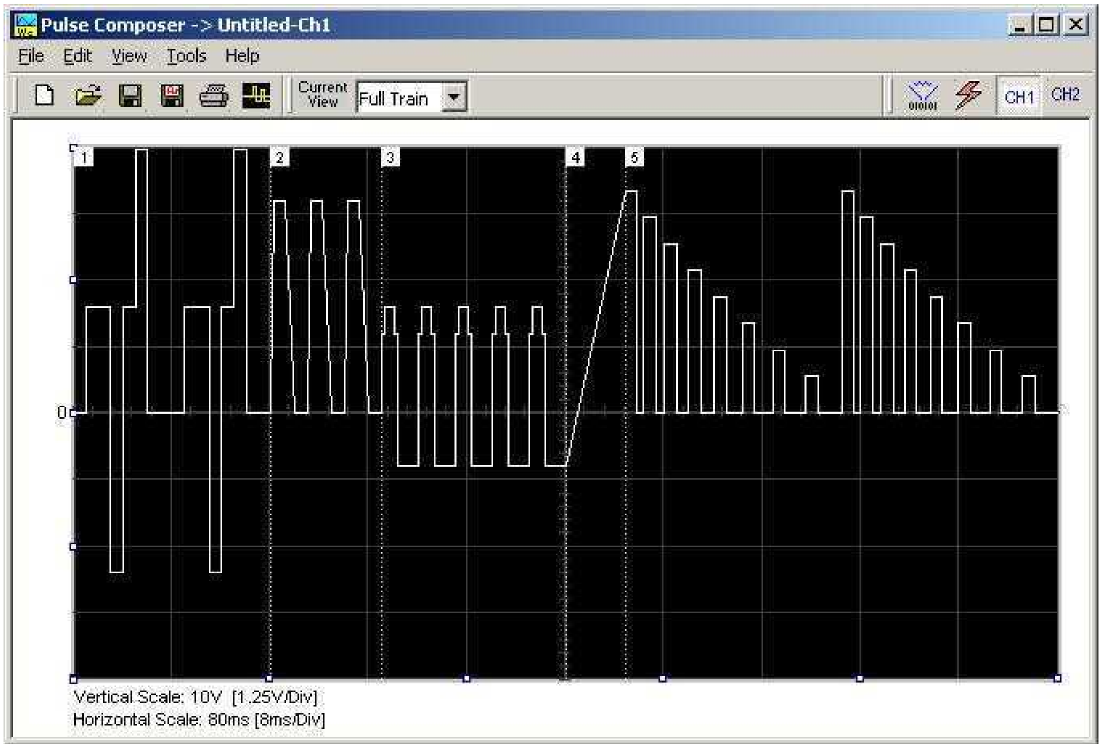


Figure 4-51, Complete Pulse Train Design

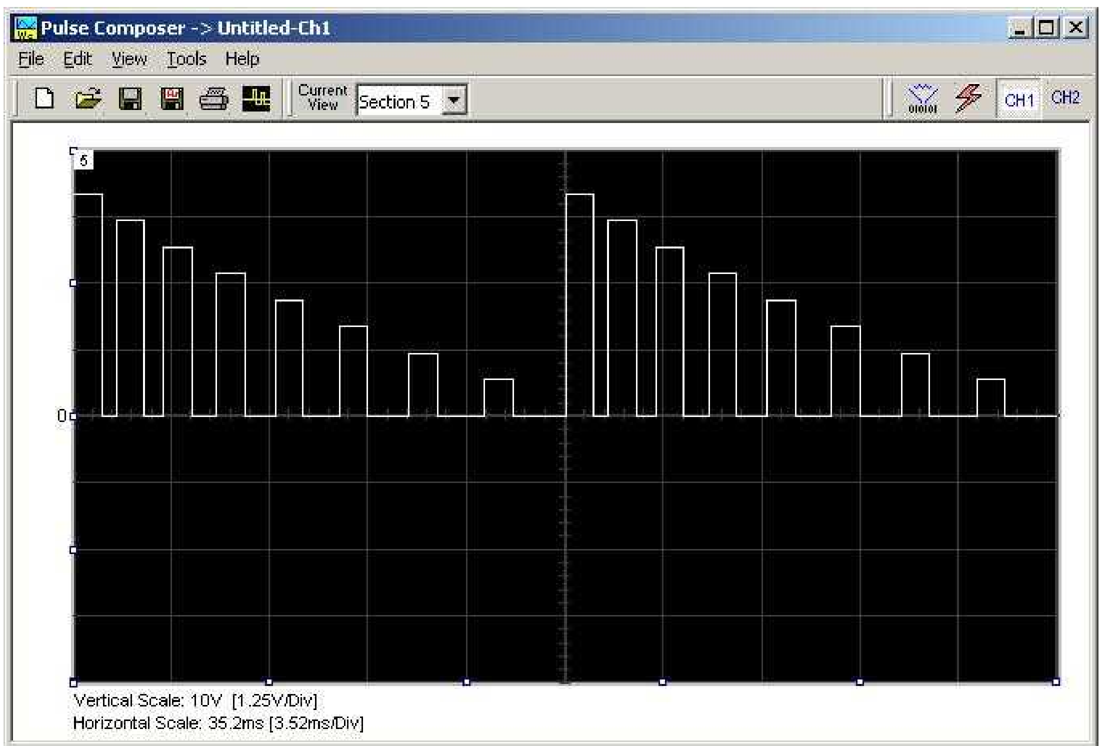


Figure 4-52, Section 5 of the Pulse Train Design

Now that we somewhat understand the terms we use for the pulse design, we start with an example how to design the pulse train as shown in Figure 4-52. If you already have some pulses shown on your pulse composer screen, click on New to start from a fresh page. Another step before you design your pulse train is to set the design parameters in the options menu that will determine the way that the pulse will be distributed in your waveform memory. Click on View→Options and refer to Figure 4-53 throughout the following description.

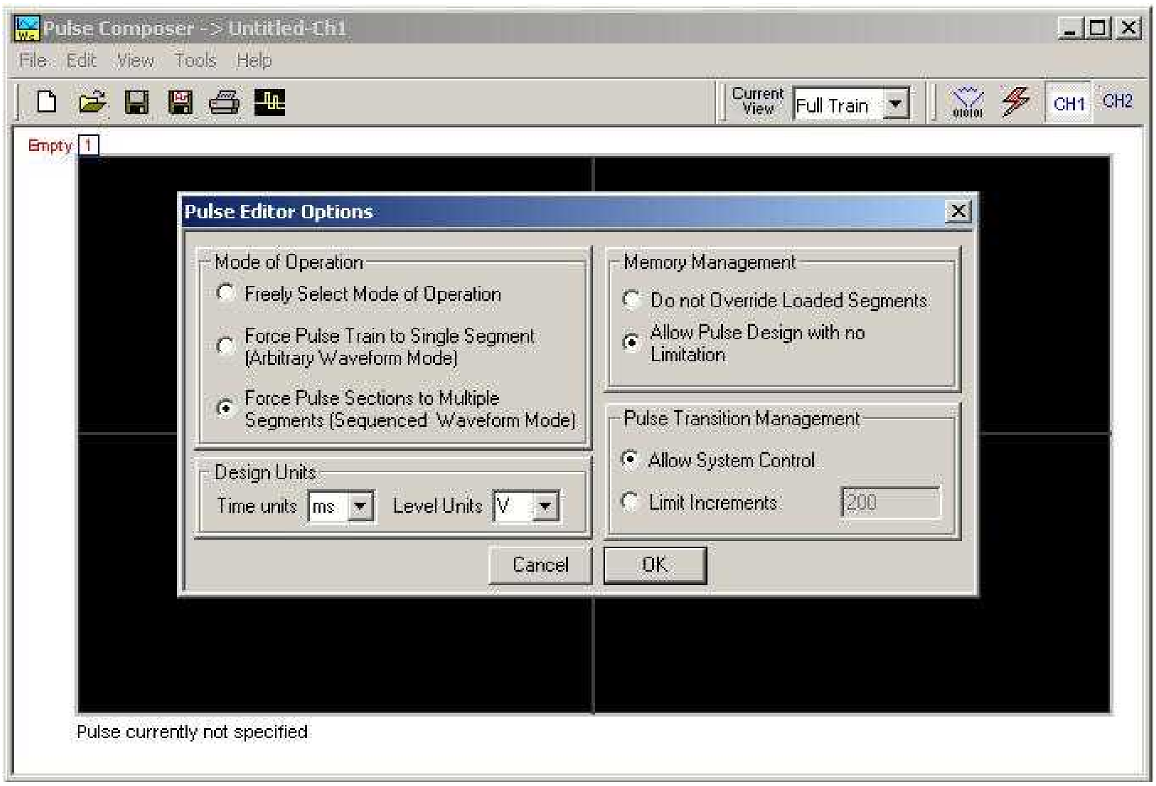


Figure 4-53, Selecting Pulse Editor Options

Setting the Pulse Editor Options

As shown in Figure 4-53, the pulse editor option dialog box is divided to functional groups: Mode of operation, Design Units, Memory Management and Pulse Transition Management. These groups are described below.

Mode of Operation
There are three options in the mode of operation group.

The force pulse train to single segment option is recommended if you are using one pulse section only. In this case, the pulse waveform will occupy one segment only and the generator will automatically be set to operate in arbitrary mode.

The force pulse sections to multiple segments option will place each section of the pulse train into a different memory segment and the generator will automatically be set to operate in sequenced mode. Select this option for the example we are going to build later.

If you are not sure what to do, select the freely select mode of operation and the generator will do the work for you.

Design Units

As you design your pulse pattern, it will be easier if you design it using the exact units as you would want to output to your load. Select between μs, ms and s for the pulse intervals and mV or V for the amplitude level. Select ms and V for the example we are going to build later.

Memory management

There are two options in the memory management group.

The do not override loaded segments option will make sure that whatever waveforms you already stored for the arbitrary function will stay intact after you save your pulse waveform.

The allow pulse design with no limitations option may overwrite memory segments that you already used previously for the arbitrary function however, this is the recommended option for the program and for the example we are going to build later.

Pulse Transition management

The pulse transition management parameter defines for the program how many waveform points will be used to step from one amplitude level to another amplitude level. The longer the transition time, the program will need more steps to smooth the transition. If you select the limit increments and set a pre-defined number of increments, you manually control how many waveform points will be dedicated for transitions however, if you are not sure what is the optimum number of increments, select the allow system control option for the program to make the transitions efficient in terms of memory usage and slope smoothness.

After you complete setting the pulse editor options, point and click on OK.

Using the Pulse Editor

The prime tool for building pulse patterns on the pulse composer screen is the pulse editor. To invoke the pulse editor, point and click on the pulse editor icon on the tools bar. The editor as shown in Figure 4-54 will show. Refer to this figure for the following descriptions.

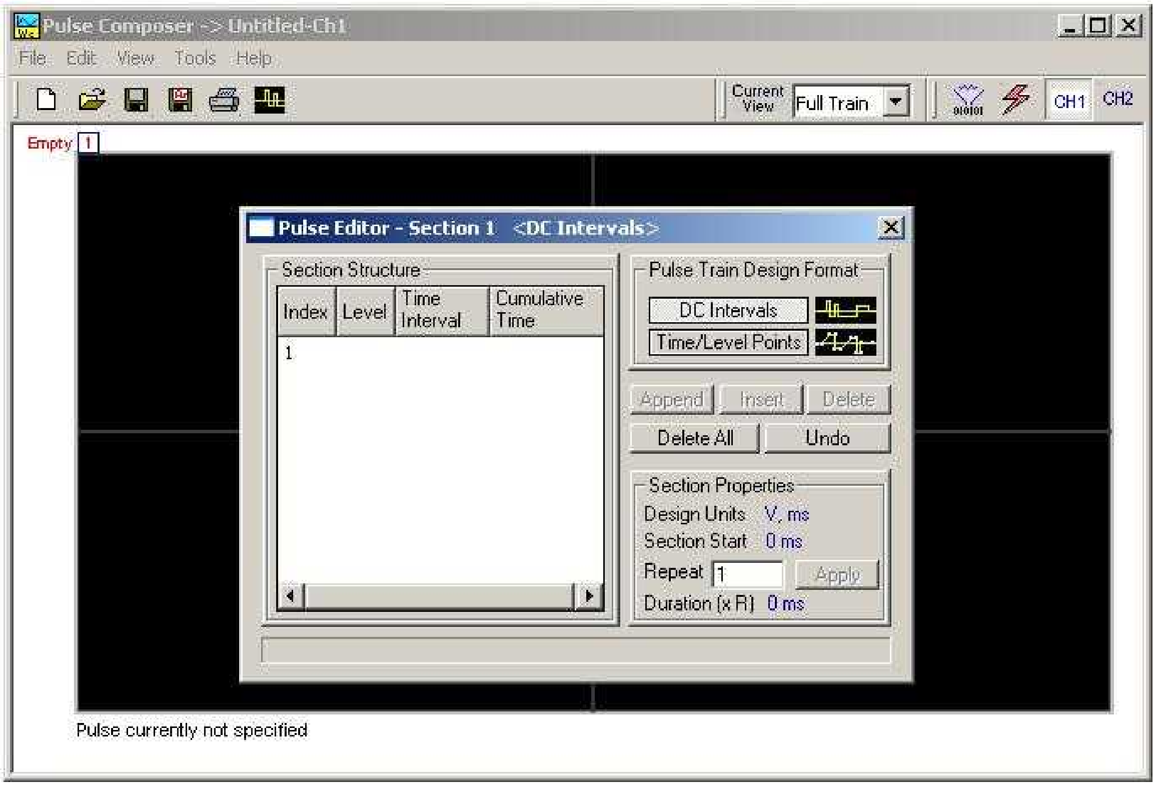


Figure 4-54, Using the Pulse Editor

The Pulse Editor as shown in Figure 4-54 has four groups: Section Structure, Pulse Train Design Format, Section Properties and control buttons. These groups are described below.

Pulse Train Design Format
There are two methods (or formats) that can be use for designing the pulse shape: DC Intervals and Time/Level Points. The design format is unique for the current section and cannot be switched during the section design.

DC Intervals – programs pulse duration using DC levels only. Transition times for this format are at the maximum rate that the generator can produce. For example, if you want to draw a simple square waveform that has 0V to 3.3V amplitude, 50% duty cycle and 1ms period, you enter the following parameters:

Index = 1, Level = 3.3, Time interval = 0.5 (Cumulative Time = 0.5)
Index = 2, Level = 0, Time Interval = 0.5 (Cumulative Time = 1.0)

Note as you build the segments that the pulse is being drawn on the screen as you type in the parameters. Also note that the Cumulative Time column is updated automatically with the cumulative time lapse from the start of the pulse.

Time/Level Points – programs pulse turning points using level and time markers. This format is a bit more complex to use however, it allows pulse design that require linear transition times. For example, if you want to draw a simple square waveform that has 0V to 3.3V amplitude, 50% duty cycle, 1ms period and 100ns transition times, you enter the following parameters:

Index = 1, Level = 0, Time interval = 0, (Cumulative Time = 0)
Index = 2, Level = 3.3, Time Interval = 0.1, (Cumulative Time = 0.1)
Index = 3, Level = 3.3, Time interval = 0.4, (Cumulative Time = 0.5)
Index = 4, Level = 0, Time interval = 0.1, (Cumulative Time = 0.6)
Index = 5, Level = 0, Time interval = 0.4, (Cumulative Time = 1.0)

Note as you build the segments that the pulse is being drawn on the screen as you type in the parameters and the specified point is marked with a red dot. Also note that the Cumulative Time column is updated automatically with the cumulative time lapse from the start of the pulse.

Section Structure

The term Section Structure is used to define part of the pulse train that share common properties. There are four parameters that can be programmed in this group: Index, Level, Time Interval and Cumulative Time.

Index – Is added automatically as you program pulse segments. The index line is highlighted as you point and click on pulse segments on the pulse editor screen.

Level – Specifies that peak level of the programmed segment. As you build the pulse, the level window is expended automatically to fit the required amplitude range. Note however, there is a limit to the level, which is being determined by the generator's peak to peak specification.

Time Interval – Specifies the time that will lapse for the current index level. You can program the time interval and the cumulative time will be adjusted accordingly.

Cumulative Time – Specifies the time that will lapse from the start of the current pulse section. You can program the cumulative time and the time interval will be adjusted accordingly.

Section Properties

The Section Properties contains a summary of properties that are unique for the current section.

Design Units – Provide information on the units that are used when you draw the pulse segments. These units can be changed in the pulse editor options.

Section Start – Provides timing information for the start of the current section. If this is the first pulse section the value will always be 0. Subsequent sections will show the start mark equal to the end mark of the previous section.

Repeat – Allows multiplication of pulse segments without the need to re-design repetitive parts. After you enter a repeat value, press the Apply button to lock in the repeat multiplier.

Duration – Displays the time that will lapse from the start of the pulse section to the end. The duration shows the total time lapse, including the repeated sections.

Control Buttons

The control buttons allow appending, inserting, and deleting one or all index lines. The Undo button is useful in cases where an error was made and restoration of the last operation is critical.

Pulse Example, Section 1

Now that we are better familiar with the pulse editor and its options, we are ready to start building the first section of the pulse as shown in Figure 4-51. Point and click on the New icon and open the pulse editor. Type in the level and time intervals as shown in Figure 4-55. Note that the pulse segments are being created on the screen as you type the values.

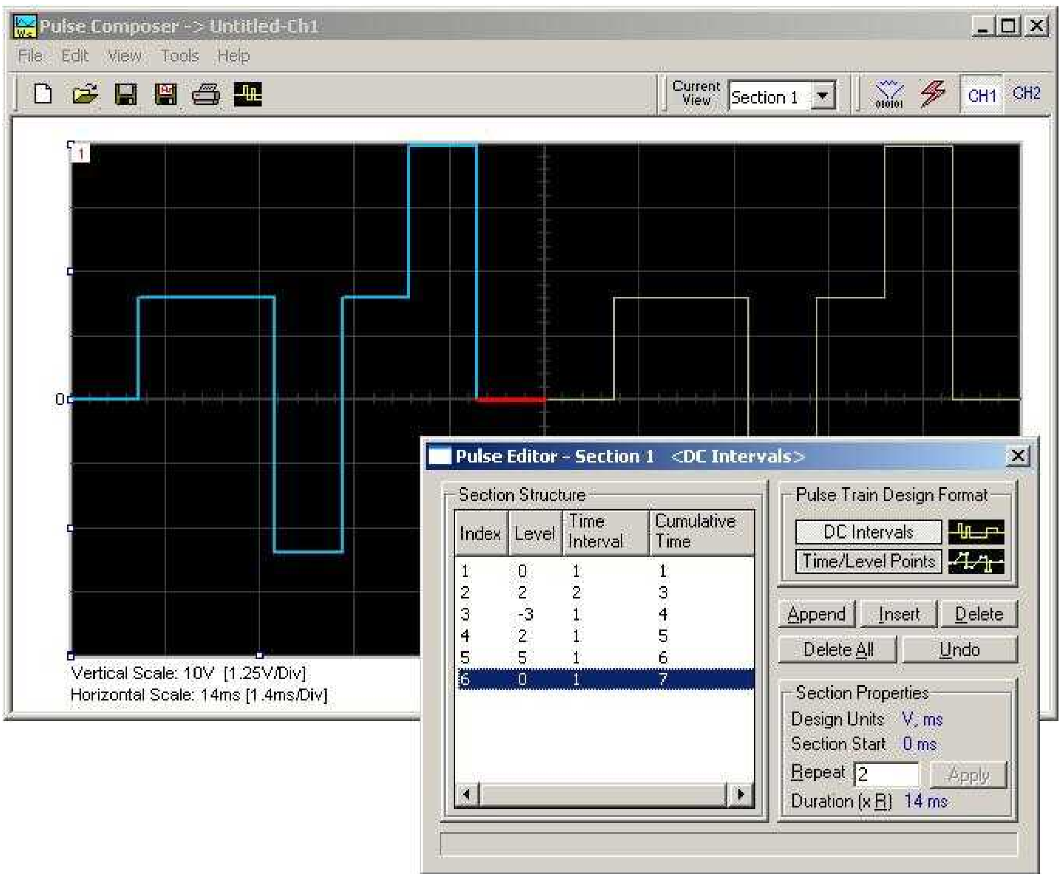


Figure 4-55, Building Section 1 of the Pulse Example

Tips

1. Use the tab button to edit the Section Structure fields.
2. Use Append to add an index line at the end of the list.
3. Use insert to add a segment above a focused line.

Before we proceed with the design of the next section, pay attention to some values that are now available on the composer screen. On the left bottom corner of the composer, Vertical Scale is showing 10 V (1.25 V/Div) and Horizontal Scale is showing 14 ms (1.4 ms/Div). These two values are critical for the integrity of the design because they are later being interpreted by the program and converted to waveform coordinates that the generator can process and output as a pulse shape. These values, may change as you add more sections to the pulse train.

Pulse Example, Section 2

The first pulse section is complete. We are ready now to start building the second section of the pulse as shown in Figure 4-51. Point and click on the Edit command and select the Append Section option. A new section number will appear but it will show empty next to the section identifier.

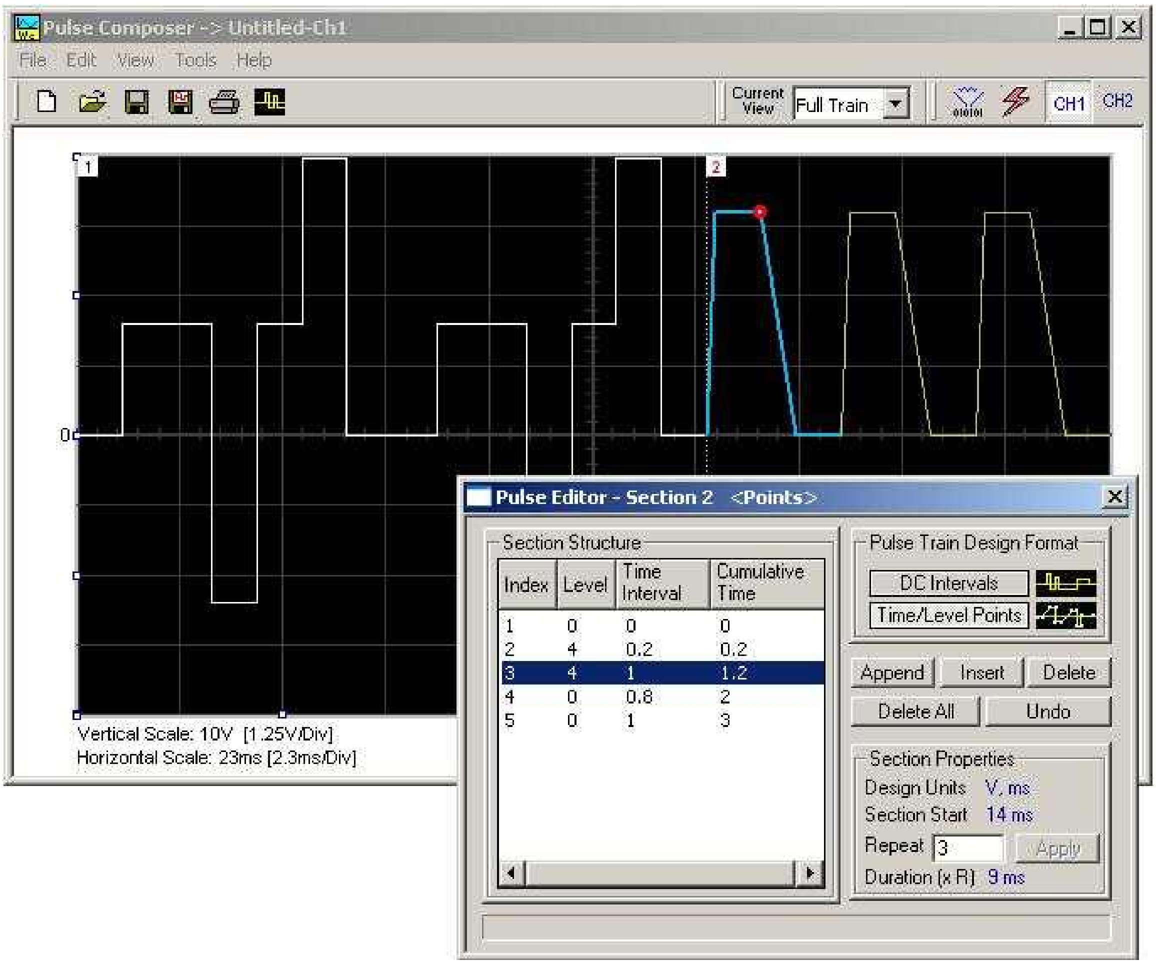


Figure 4-56, Building Section 2 of the Pulse Example

Before you start entering values to this section, note that there are linear transitions required for this section. Therefore, select the Time/Level Points option in the Pulse Train Design Format. You are now ready to start programming values. In case you made a mistake and want to switch design formats after you have already typed in some values, the Pulse Editor will show an error alerting you that design format can only be changed for empty section. In this case, the only way to recover is to delete all entries and start from an empty index list. Type the section entries as shown in Figure 4-56.

Pulse Example, Section 3

The second pulse section is complete. We are ready now to start building the third section of the pulse as shown in Figure 4-51. Point and click on the Edit command and select the Append Section option. A new section number will appear but it will show empty next to the section identifier.

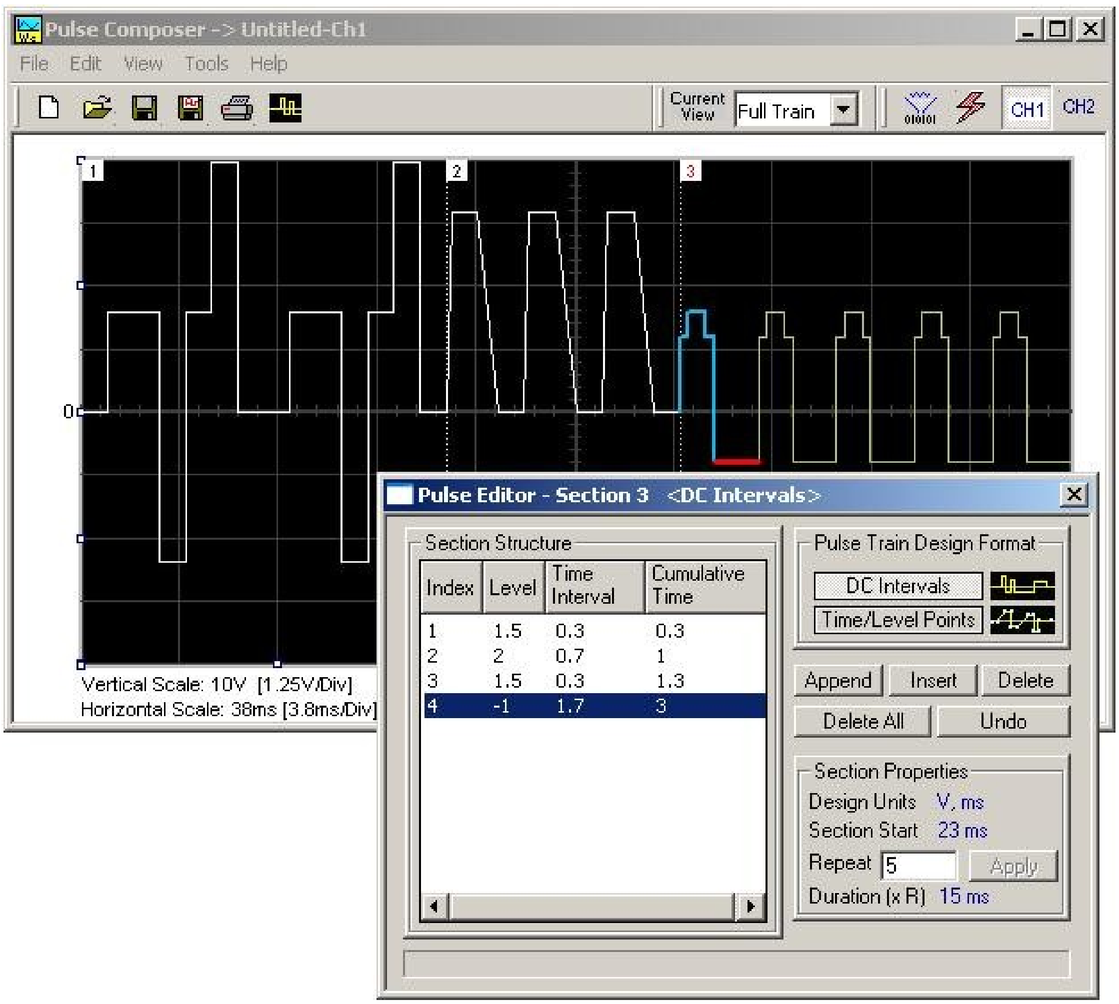


Figure 4-57, Building Section 3 of the Pulse Example

Before you start entering values to this section, note that there are fast transitions required for this section. Therefore, select the DC Intervals option in the Pulse Train Design Format. You are now ready to start programming values. In case you made a mistake and want to switch design formats after you have already typed in some values, the Pulse Editor will show an error alerting you that design format can only be changed for empty section. In this case, the only way to recover is to delete all entries and start from an empty index list. Type the section entries as shown in Figure 4-57.

Pulse Example, Section 4

The third pulse section is complete. We are ready now to start building the forth section of the pulse as shown in Figure 4-51. Point and click on the Edit command and select the Append Section option. A new section number will appear and will show empty next to the section identifier.

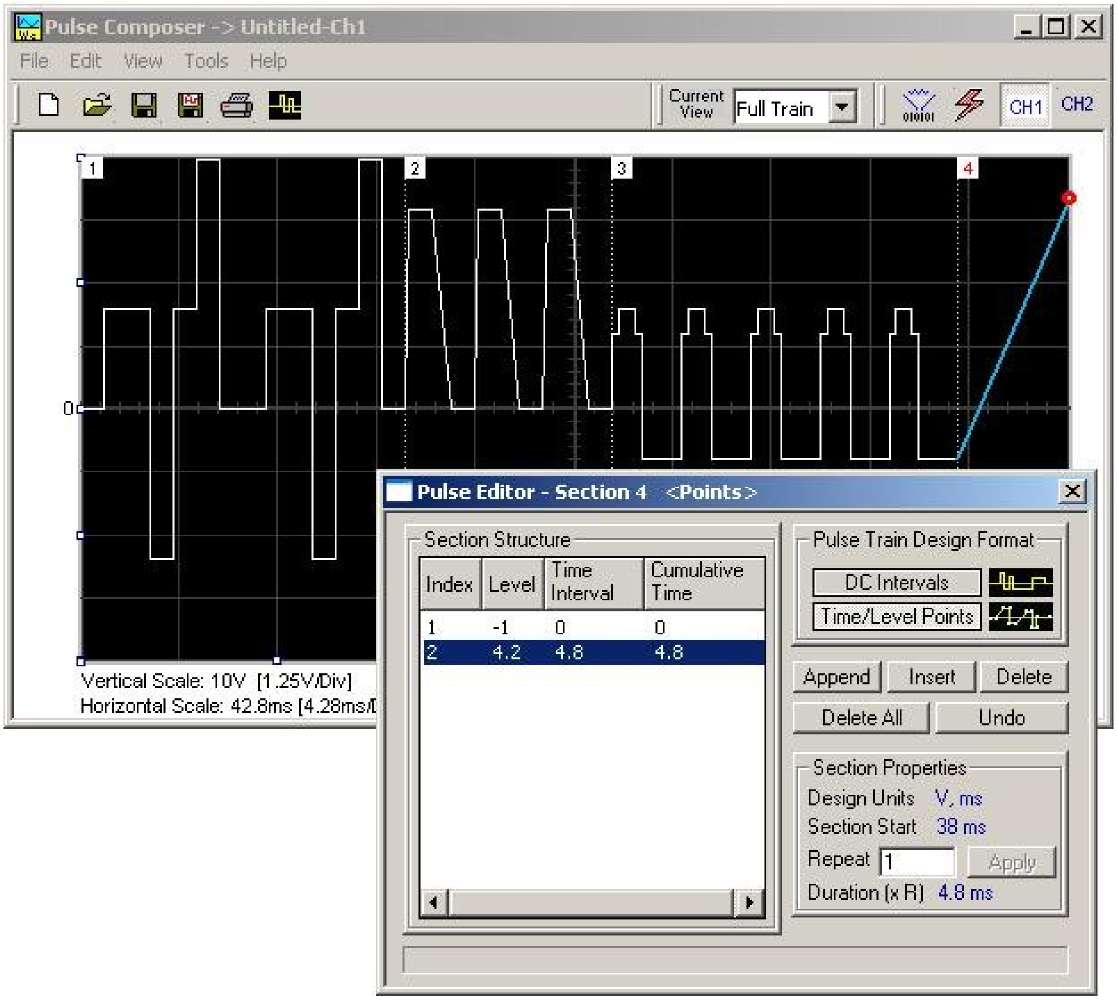


Figure 4-58, Building Section 4 of the Pulse Example

Before you start entering values to this section, note that there is only one linear transition required for this section that will start from the last point of the previous section and will connect to the start point of the next section. Therefore, select the Time/Level Points option in the Pulse Train Design Format. You are now ready to start programming values. Type the section entries as shown in Figure 4-58.

Pulse Example, Section 5

The fourth pulse section is complete. We are ready now to start building the fifth and final section of the pulse as shown in Figure 4-51. Point and click on the Edit command and select the Append Section option. A new section number will appear and will show empty next to the section identifier.

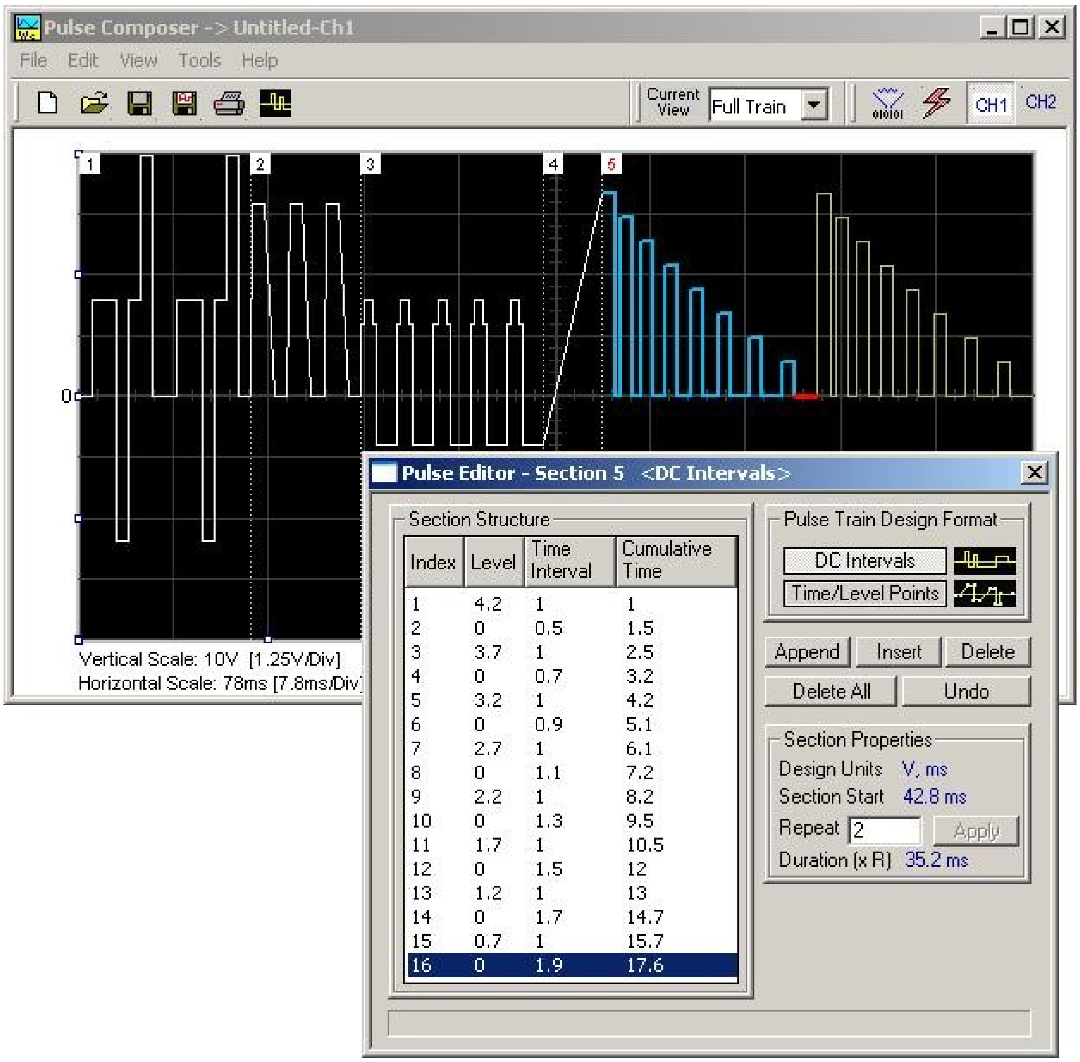


Figure 4-59, Building Section 5 of the Pulse Example

Note that there are fast transitions required for this section that will start from the last point of the previous section and will connect to the start point of the next section. Therefore, select the Time/Level Points option in the Pulse Train Design Format. You are now ready to start programming values. Type the section entries as shown in Figure 4-59.

Downloading the Pulse Train

Congratulations for coming that far. If you followed the above description how to build this pulse example, the screen should look exactly as shown in Figures 4-51. If you are happy with the results, the next step is to download what you see on the pulse composer screen to the generator.

One more step before you download the waveform to the instrument is to check the Pulse Train Download Summary as appears after you press the Download icon. You can also view the same information if you select it from the View menu. Refer to Figure 4-60 for information how to interpret your download summary.

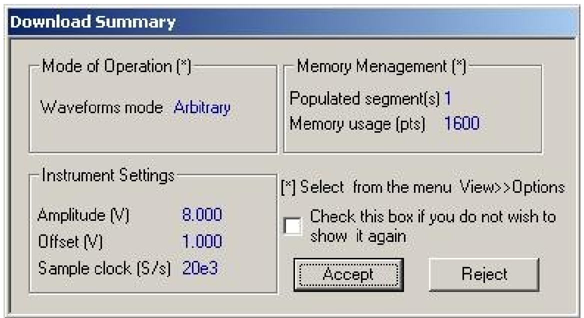


Figure 4-60, the Pulse Editor Download Summary

Interpreting the Download Summary

It is very important for you to understand that when you download a pulse waveform from the pulse composer, parameters and mode of operation may change settings on your generator. The download summary shows what will change and will let you reject the new settings if you do not agree to the changes. Once you press the Accept button, the waveform will be downloaded to the generator and the modes and parameters updated as shown in the dialog box. If you are already familiar with the changes and do not care to see the download summary every time you download a pulse waveform, you can check the box and it will not be shown on your next download. You can restore this summary from the View>>Download Summary command.

Mode of Operation – This describes the new setting of the operating mode. This field could display one of two options: Arbitrary or sequenced. Pay attention to the note (*) that says “Select from the menu View>>Options” Since we checked the Force Pulse Train to Single Segment (see Figure 4-53), the generator determines that the waveform mode be arbitrary and only one segment can be loaded with the pulse train.

Memory management – By selecting the arbitrary mode of operation, the pulse train is forced to a single segment. This summary shows which segment has been populated and how much memory was used to build the required pulse train.

Instrument Settings – Show the amplitude, offset and sample clock settings that will be changed on the generator. The settings in this summary cannot be affected from the pulse editor options settings. These are being computed and modified specifically for the current pulse train pattern and will change from pattern to pattern.

Accept/Reject – These buttons are the final step before you download the pulse train to the instrument. If you are unhappy with the instrument setting and want to change some of the options, there is still time Point and click on the Reject button and go do your changes. Point and click on the Accept button to complete the download process.

The FM Composer

The FM Composer looks and feels almost like the waveform composer except there is a major difference in what it does. If you look at the opening screen as shown in Figure 4-61, you'll see that the vertical axis is marked with frequencies. You'll see later that as you draw waveforms on the FM composer screen, these waveforms represent frequency changes and not amplitude changes as are generated by the waveform composer.

The FM composer is a great tool for controlling frequency agility by generating the agility curve as an arbitrary waveform. For example, if you create a sine waveform, the PM8572A will generate frequency-modulated signal that will follow the sine pattern. The resolution and accuracy of the modulated waveform is unsurpassed and can only be duplicated by mathematical simulation. The FM composer is loaded with many features and options so use the following paragraphs to learn how to create and download modulating waveforms to the PM8572A using the FM Composer.

Invoke the FM Composer from Panels bar. The Wave Composer has three sections: Commands bar, Toolbar and Waveform screen. Refer to Figure 4-61 throughout the description of these parts.

The Commands bar

The commands bar is exact duplication of the commands bar in the Wave composer. It provides access to standard Windows commands such as File and View.

In general, clicking on one of the commands opens a dialog box with an additional list of commands. Then, clicking on an additional command, may open a dialog box, or generate an immediate action. For example, Clicking on File and then Exit will cause an immediate termination of the FM Composer. On the other hand, clicking on Wave and then on Square, will open a Square Wave dialog box that lets you program and edit square wave parameters. The various commands in the Commands bar are listed and described below.

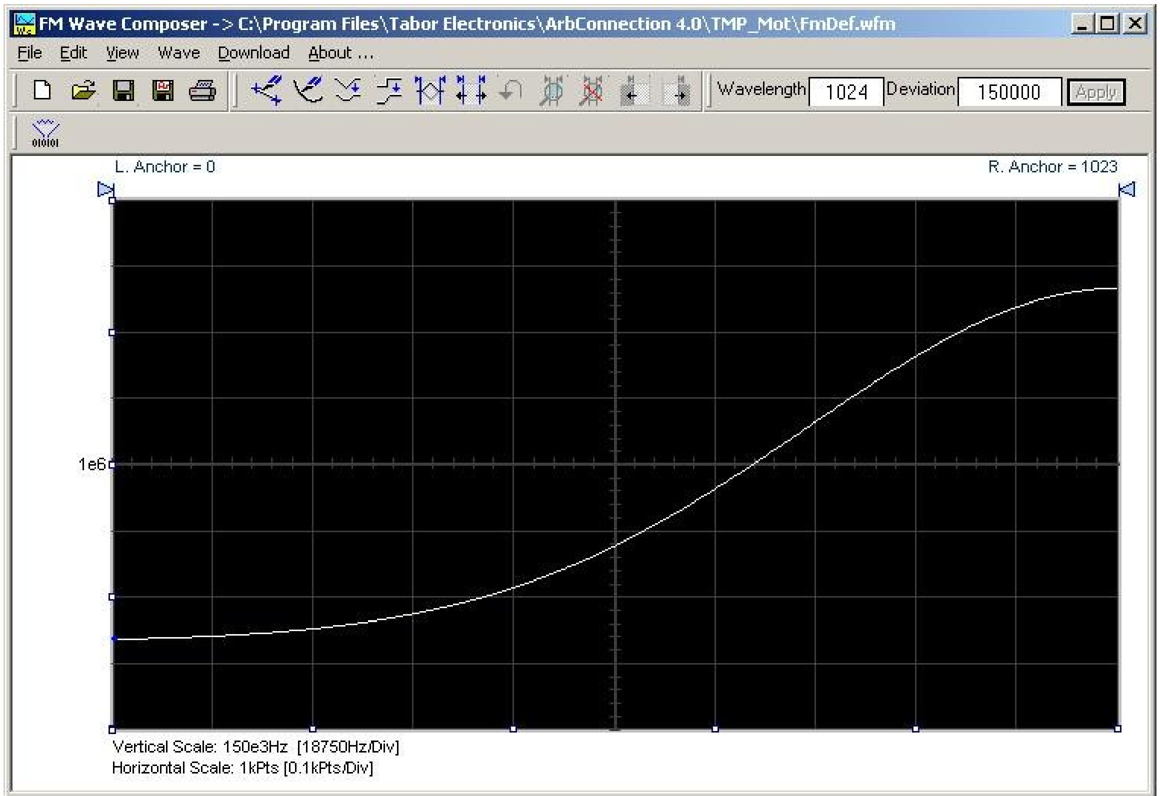


Figure 4-61, The FM Composer opening Screen

File Commands

The File command has 4 command lines that control waveform files. Also use this command to exit the FM composer program. Description of the various commands under File is given below.

New Waveform

The New Waveform command will remove the waveform from the screen. If you made changes to the waveform area and use this command, you should save your work before clearing the screen. The New Waveform command is destructive to the displayed waveform.

Open Waveform…

The Open Waveform… command will let you browse your disk for previously saved waveform files and load these waveforms to the waveform area. This command is also very useful for converting waveform files to format that is acceptable by the Wave Composer.

Save Waveform

The Save Waveform command will store your active waveform in your PM8572A directory, as a binary file with a *.wvf extension. If this is the first time you save your waveform, the Save Waveform As… command will be invoked automatically, letting you select name, location and format for your waveform file.

Save Waveform As…

Use the Save Waveform As… command the first time you save your waveform. It will let you select name, location and format for your waveform file.

Print

With this command you may print the active Waveform Window. The standard printer dialog box will appear and will let you select printer setup, or print the waveform page.

Exit

The Exit command ends the current FM Composer session and takes you back to the Panels screen. If you made changes to your waveform since it was last saved, make sure to Save your work before you use this command.

Wave Commands

The Wave commands let you create waveforms on the screen. The Wave command has a library of 6 waveforms: Sine, Triangle, Square, Exponent, Pulse, and Noise. It also lets you create waveforms using an Equation editor. Information how to create waveforms using the Wave commands is given below.

Creating Waveforms From the Built-in Library

You can create any waveform from the built-in library using the Wave command. Clicking on one of the Wave options will open a dialog box. An example of the Sine waveform dialog box is shown in Figure 4-62. This dialog box is representative of the rest of the waveforms, so other waveforms will not be described.

Creating Sine Waveforms

Use the following procedure to create sine waveforms from the built-in library. Click on Wave, then sine… the dialog box as shown in Figure 4-62 will appear. You can now start programming parameters that are available in this box.

Start Point Anchor – Defines the first point where the created wave will start. Note that if you change the start point the left anchor will automatically adjust itself to the selected start point. The example shows start point set at point 200.

End Point Anchor – Defines where the created waveform will end. Note that as you change the end point the right anchor will automatically adjust itself to the selected end point. The example shows end point set at point 499.

Max. Peak Deviation – This parameter defines the forward peak deviation. Note that the forward peak deviation cannot exceed the pre-defined Deviation parameter as shown on the Toolbar. In case you need to exceed the pre-defined peak value you must quit this box and modify the Deviation parameter to provide sufficient range for the forward peak deviation range.

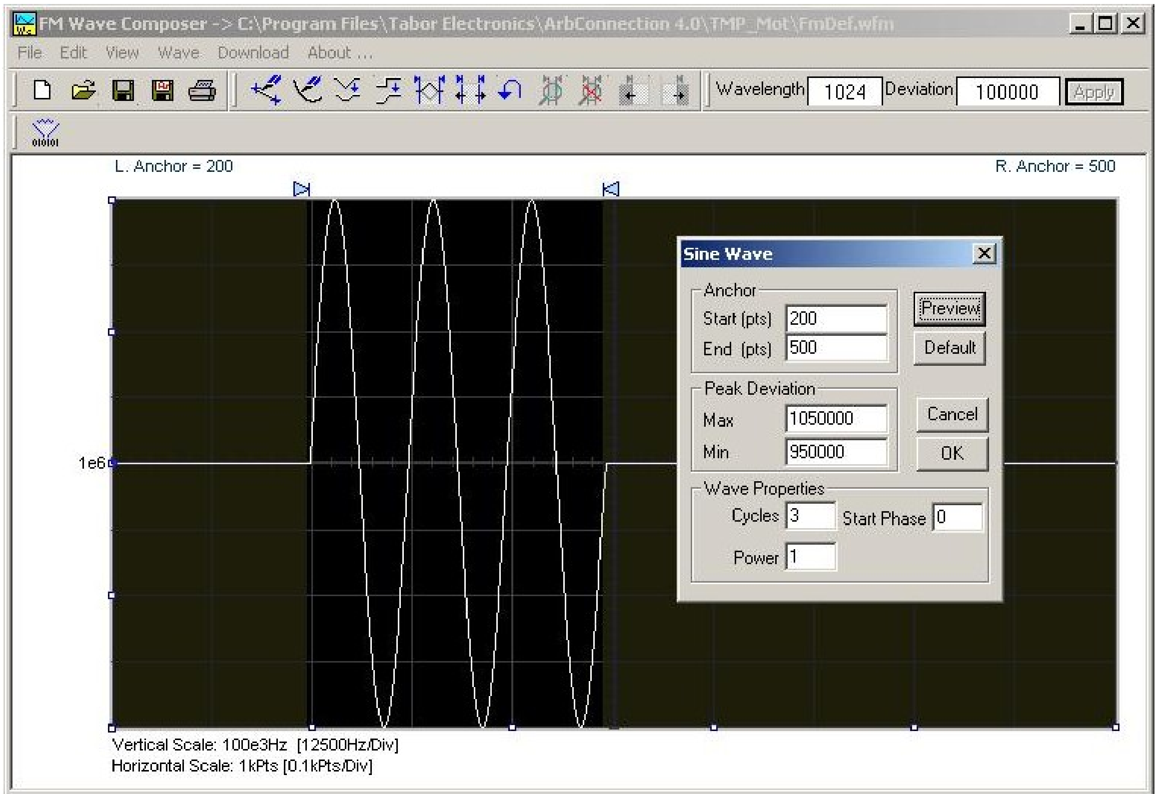


Figure 4-62, Generating Sine Modulation Using the FM Composer

Min. Peak Deviation – This parameter defines the backwards peak deviation. Note that the backwards peak deviation cannot exceed the pre-defined Deviation parameter as shown on the Toolbar. In case you need to exceed the pre-defined peak value you must quit this box and modify the Deviation parameter to provide sufficient range for the backwards peak deviation range.

Cycles – The Cycles parameter defines how many sine cycles will be created within the specified start and end anchor points. The example below shows three sine cycles.

Start Phase – The start phase parameter defines the angle of which the sine will start. The example shows 0° start phase.

Power – Sine to the power of 1 will generate a perfect sine. Power range is from 1 through 9.

Tip

The functionality of the FM composer is similar to the Wave composer. If you need more information on the FM composer functions, features and it equation editor, refer to the Wave composer section in this manual information.

The 3D Composer

The 3D Composer was specifically designed for simultaneous profiling of amplitude, frequency and phase. Amplitude profiles can be designed separately for channels 1 and 2, but frequency and phase profiles are shared by both channels. The following paragraphs will describe the various sections of the 3D composer and will guide you through some 3D programming examples.

The opening screen of the 3D composer is shown in Figure 4-63. As you can see it does not at all look like any of the other composers that were described previously discussed however, generating waveforms and programming profiles is very similar to other composer so you will be up and running in no time.

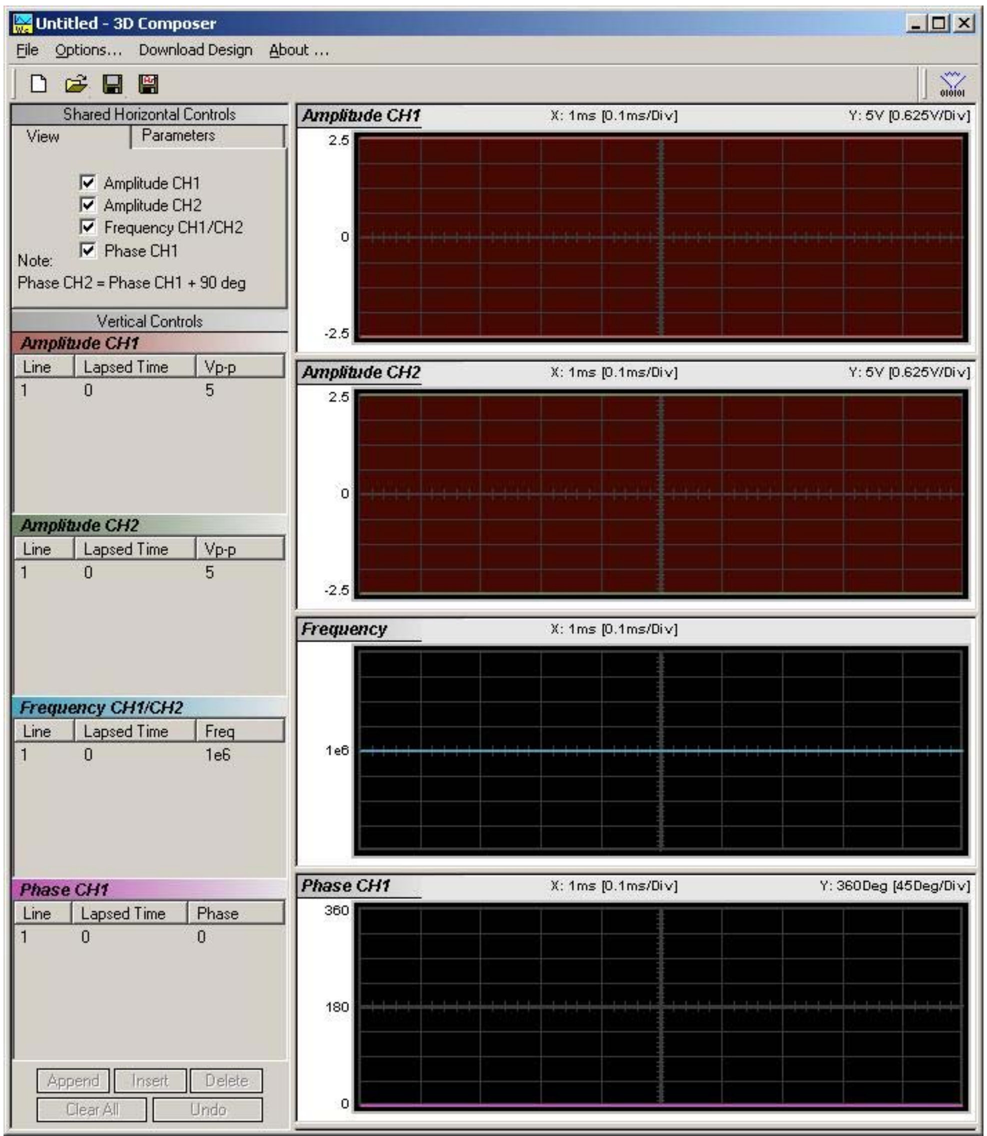


Figure 4-63, the 3D Composer Screen

The 3D composer has three main sections: Shared horizontal Controls, Vertical Controls and Graphical Screens. The panels on the left are used for designing the waveform parameters and the screens on the right side depict the shape of the profile. Below find a detailed description of all of these sections. Refer to Figure 4-63 throughout the description.

Shared Vertical Parameters

The *Shared Horizontal Control* has two tabs: *View* and *Parameters*.

View
The *View* tab is useful if you are interested in programming 1 or two profiles only and do not care to see other screens. Check the boxes for the profiles you wish to program only and these will be shown on the screen. For example, if you check the Amplitude CH1 and the Frequency CH1/CH2 options, the Amplitude CH2 and Phase CH1 screens will not be visible.

Parameters
The *Parameters* tab is used for setting up the duration of the signal, the position of the marker (if required) and the amount of memory that is allocated for this purpose. Setting up correctly the parameters in this group is the basic and the most important task before you start designing 3D waveforms. The duration can be set in units of ns, us, ms and seconds and can be programmed within the range of 800 ns to 30,000 s.

The 3D profiler behaves just like an arbitrary waveform. The shape of the profiler is generated using waveform points and a dedicated 3D sample clock. So, just as the basics for an arbitrary waveform design, the duration is derived from the following relationship:

Duration = SCLK / # of waveform points

where SCLK is the 3D sample clock and the # of waveform points can be programmed from 2 to 30,000.

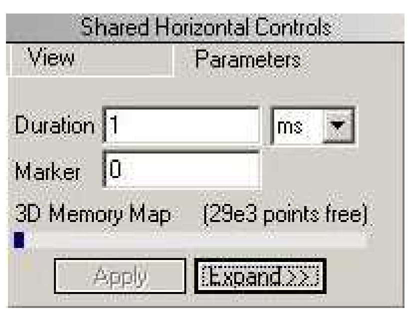


Figure 4-64, the Parameters Tab

The best idea is to let the 3D composer set up the sample clock and the numbers of points automatically for you however, in some cases you may fine tune your requirement by pressing the Expand button. Figure 4-65 shows the Expanded Parameters options dialog box.

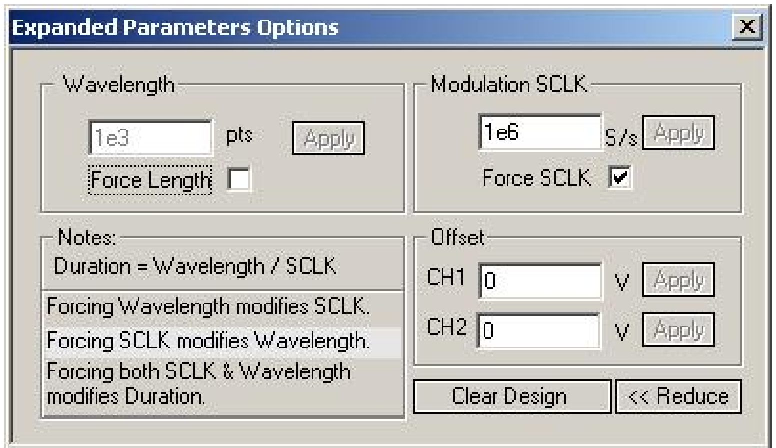


Figure 4-65, the Expanded Parameters Options Dialog Box

The Expanded Parameters options dialog box has three sections: Wavelength, Modulation SCLK and Offset. The wavelength and the modulation SCLK control the duration of the entire wave through the following relationship:

Duration = Modulation SCLK / Wavelength

Each of the parameters has a finite length and therefore, the duration has maximum and minimum intervals. The modulation SCLK has a range of 1 Hz to 2.5 MHz and the Wavelength is limited from 2 points to 30,000 points. As a result, the duration can be programmed from 800 ns to 30,000 s.

If you do not care to control the wavelength and the SCLK, then you can leave the task for the 3D composer. In that case you must leave the Force Length and Force SCLK check boxes – unmarked. If you check the Force SCLK box, the wavelength will be modified automatically to match the selected duration, as shown in Figure 4-62. If you check the Force Length box, the modulation SCLK will be modified automatically to match the selected duration. Finally, if you check both the Force Length and the Force Modulation SCLK boxes, the duration of the 3D profile will be affected.

To modify wavelength or modulation SCLK, check the appropriate box, modify the value and click on the Apply button to force the selected value. Any successive changes that you make to the edit fields require that you click on the Apply button to accept the new value.

The Offset group controls DC offsets of the modulated waveform. Changing offset does not affect other parameters except the location of the waveform along the vertical axis.

The Clear Design button resets the 3D composer and the Reduce button closes the dialog box.

Vertical Controls

The *Vertical Controls* are used for profiling amplitude, frequency and phase. When you modify the fields in any of the controls, the associated graphical screen are automatically updated with the assigned values and display the profile as designed in the vertical control fields. The Vertical Controls are shown in Figure 4-66. You can start designing profiles only when one of the control fields is active. Control fields become active when you click on a control field. Note in the figure below that the Amplitude CH2 control was removed from the group. This was done by un-checking the Amplitude CH2 check box in the View group.

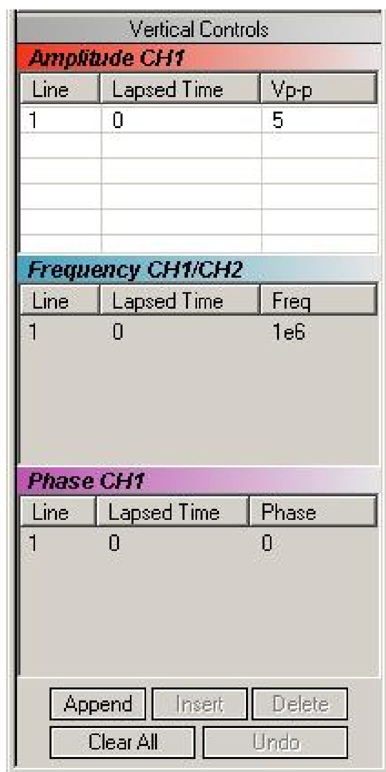


Figure 4-66, the 3D Vertical Controls

Graphical Screens

The *Graphical Screens* are shown in Figure 4-67. You can not change anything on the screens however, anything that you design in the Vertical Controls fields will automatically be updated and displayed on the graphical screens.

Note in the figure below that the Amplitude CH2 graphical screen was removed from the group. This was done by un-checking the Amplitude CH2 check box in the View group.

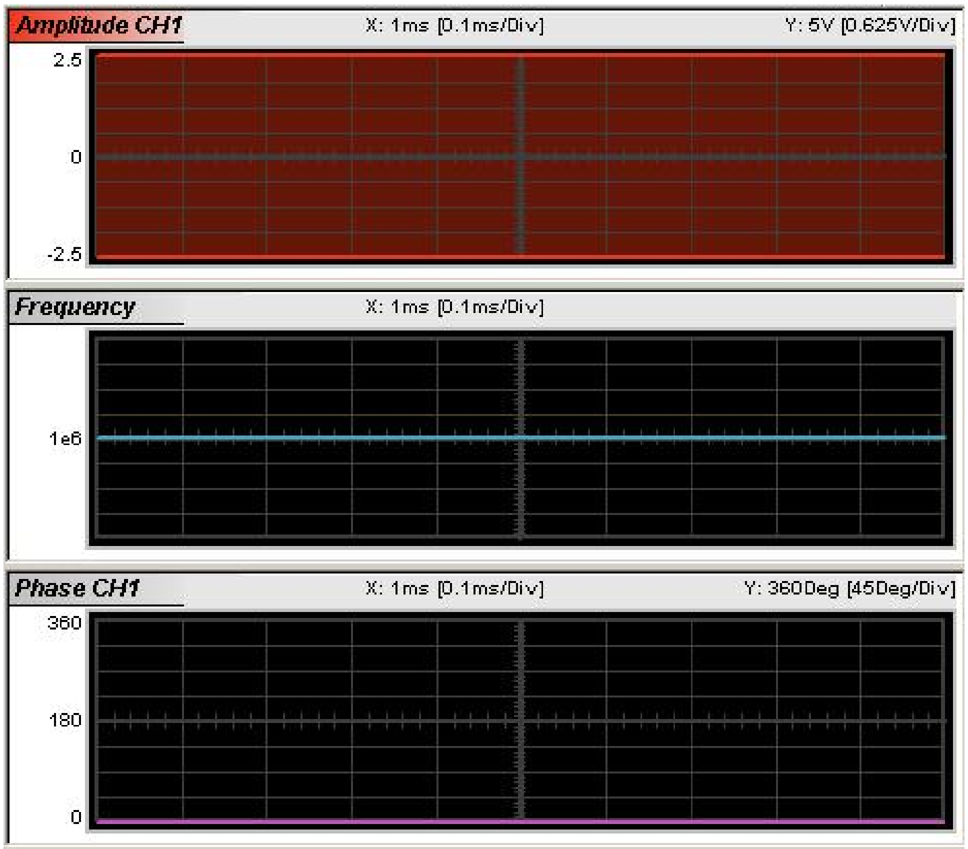


Figure 4-67, the 3D Graphical Screens

Designing 3D profiles

3D profiles are designed in the Vertical Controls fields. Notice that there are four separate control fields: Amplitude CH1, Amplitude CH2, Frequency CH2/CH2 and Phase CH1. Amplitude control is separate for channels 1 and 2 however, frequency is common to both channels. The phase parameter is designed for channel 1 only but is automatically converted to phase + 90° for channel 2.

Always start the design from the Shared Horizontal Controls group. In the View group, remove profiles that you do not care to change. Click on the Parameters tab and set up the duration of the waveform. An example of a 3D profile (chirp, in this example) is shown in Figure 4-68. Profiles were designed for channel 1, frequency and phase. As you can see the duration of the waveform was selected to be 100 ms.

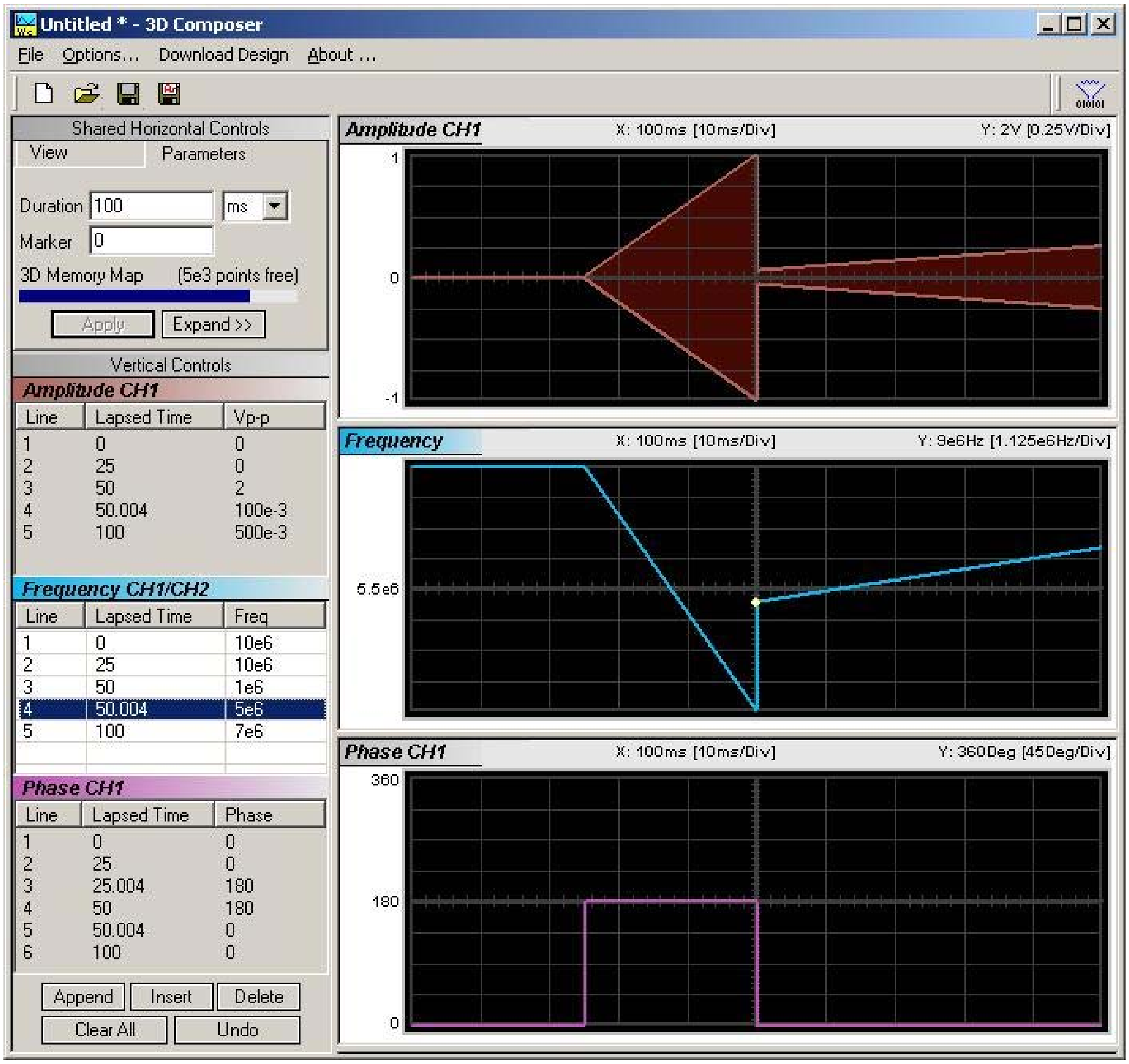


Figure 4-68, 3D Chirp Design Example

The Command Editor

The Command Editor is an excellent tool for learning low level programming of the PM8572A. Invoke the Command Editor from the System menu at the top of the screen. Dialog box, as shown in Figure 4-69 will pop up. If you press the Download button, the function call in the Command field will be sent to the instrument.

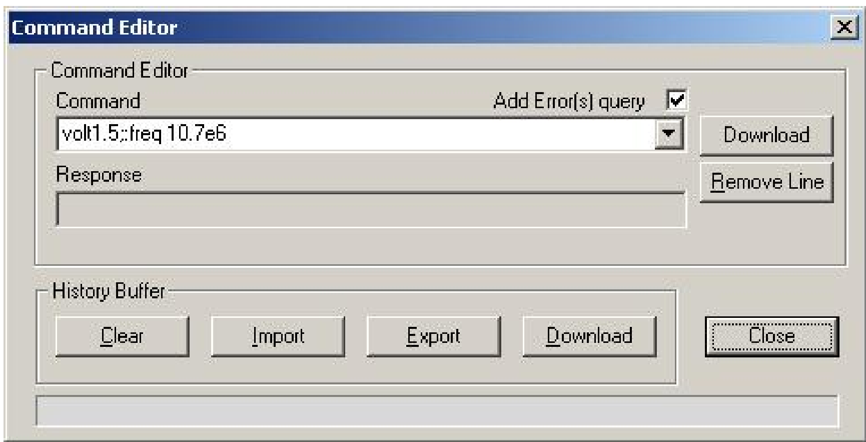


Figure 4-69, the Command Editor

Low-level SCPI commands and queries can be directly sent to the PM8572A from the **Command** field and the instrument will respond to queries in the **Response** field. The command editor is very useful while developing your own application. Build your confidence or test various commands using the command editor. This way you can assure that commands or syntax that you use in your application will behave exactly the same way as it responds to the editor commands. A complete list of SCPI commands is available in Chapter 5.

Logging SCPI Commands

The Log File is very useful for programmers that do not wish to spend a lot of time on manuals. When you use ArbConncetion, every time you click on a button or change parameter, the command is logged in the same format as should be used in external applications. Figure 4-70 shows an example of a log file and a set of SCPI commands as resulted from some changes made on ArbConncetion panels. You can set up the PM8572A from ArbConncetion to the desired configuration, log the commands in the log file and then copy and paste to your application without any modifications. Of course, this is true for simple commands that do not involve file download but, on the other hand, this is a great tool to get you started with SCPI programming.

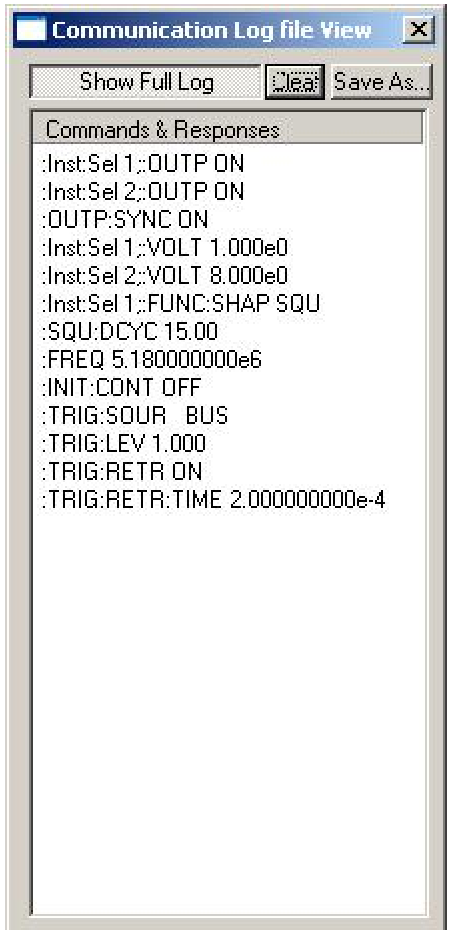


Figure 4-70, Log File Example

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Chapter 5
Remote Programming Reference

What's in This Chapter

This Chapter lists and describes the set of SCPI-compatible (Standard Commands for Programmable Instruments) remote commands used to operate the PM8572A. To provide familiar formatting for users who have previously used the SCPI reference documentation, the command descriptions are dealt with in a similar manner. In particular, each sub-system's documentation starts with a short description, followed by a table showing the complete set of commands in the sub-system; finally the effects of individual keywords and parameters are described. Complete listing of all commands used for programming the PM8572A is given in Table 5-1.

Introduction to SCPI

Commands to program the instrument over the GPIB are defined by the SCPI 1993.0 standard. The SCPI standard defines a common language protocol. It goes one step further than IEEE-STD-488.2 and defines a standard set of commands to control every programmable aspect of the instrument. It also defines the format of command parameters and the format of values returned by the instrument.

SCPI is an ASCII-based instrument command language designed for test and measurement instruments. SCPI commands are based on a hierarchical structure known as a tree system. In this system, associated commands are grouped together under a common node or root, thus forming subsystems.

Part of the OUTPut subsystem is shown below to illustrate the tree system:

```
:OUTPut
  :FILTer
     [:LPASs] {NONE|25M|50M|ALL}
        [:STATe] OFF | ON
```

OUTPut is the root keyword of the command; FILTer and STATe are second level keywords. LPASs is third level keyword. A colon (:) separates a command keyword from a lower level keyword.

Command Format

The format used to show commands in this manual is shown below:

```
FREQuency {<frequency>|MINimum|MAXimum}
```

The command syntax shows most commands (and some parameters) as a mixture of upper and lowercase letters. The uppercase letters indicate the abbreviated spelling for the command. For shorter program lines, send the abbreviated form. For better program readability, use the long form.

For example, in the above syntax statement, FREQ and FREQUENCY are both acceptable forms. Use upper or lowercase letters. Therefore, FREQ, FREQUENCY, freq, and Freq are all acceptable. Other forms such as FRE and FREQUEN will generate an error.

The above syntax statement shows the frequency parameter enclosed in triangular brackets. The brackets are not sent with the command string. A value for the frequency parameter (such as "FREQ 50e+6") must be specified.

Some parameters are enclosed in square brackets ([]). The brackets indicate that the parameter is optional and can be omitted. The brackets are not sent with the command string.

Command Separator

A colon (:) is used to separate a command keyword from a lower level keyword as shown below:

```
SOUR:FUNC:SHAP SIN
```

A semicolon (;) is used to separate commands within the same subsystem, and can also minimize typing. For example, sending the following command string:

```
TRIG:SLOP NEG;COUN 10;TIM 5e-3
```

is the same as sending the following three commands:

```
:TRIG:SLOP NEG
:TRIG:COUN 10
:TRIG:TIM 5e-3
```

Use the colon and semicolon to link commands from different subsystems. For example, in the following command string, an error is generated if both the colon and the semicolon are not used.

```
OUTP:STATE ON;:TRIG:BURS ON
```

The MIN and MAX Parameters

Substitute MINimum or MAXimum in place of a parameter for some commands. For example, consider the following command:

```
FREQuency {<frequency>|MINimum|MAXimum}
```

Instead of selecting a specific frequency, substitute MIN to set the frequency to its minimum value or MAX to set the frequency to its maximum value.

Querying Parameter Setting

Query the current value of most parameters by adding a question mark (?) to the command. For example, the following command sets the output function to square:

```
SOUR:FUNC:SHAP SQR
```

Query the output function by executing:

```
SOUR:FUNC:SHAP?
```

Query Response Format

The response to a query depends on the format of the command. In general, a response to a query contains current values or settings of the generator. Commands that set values can be queried for their current value. Commands that set modes of operation can be queried for their current mode. IEEE-STD-488.2 common queries generate responses, which are common to all IEEE-STD-488.2 compatible instruments.

SCPI Command Terminator

A command string sent to the function generator must terminate with a <new line> character. The IEEE-STD-488 EOI message is a <new line> character. Command string termination always resets the current SCPI command path to the root level.

IEEE-STD-488.2 Common Commands

The IEEE-STD-488.2 standard defines a set of common commands that perform functions like reset, trigger and status operations. Common commands begin with an asterisk (*), are four to five characters in length, and may include one or more parameters. The command keyword is separated from the first parameter by a blank space. Use a semicolon (;) to separate multiple commands as shown below:

```
*RST; *STB?; *IDN?
```

SCPI Parameter Type

The SCPI language defines four different data formats to be used in program messages and response messages: numeric, discrete, boolean, and arbitrary block.

Numeric Parameters

Commands that require numeric parameters will accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation. Special values for numeric parameters like MINimum and MAXimum are also accepted.

Engineering unit suffices with numeric parameters (e.g., MHz or kHz) can also be sent. If only specific numeric values are accepted, the function generator will ignore values, which are not allowed and will generate an error message. The following command is an example of a command that uses a numeric parameter:

```
VOLT:AMPL <amplitude>
```

Discrete Parameters

Discrete parameters are used to program settings that have a limited number of values (i.e., FIXed, USER and SEQuence). They have short and long form command keywords. Upper and lowercase letters can be mixed. Query responses always return the short form in all uppercase letters. The following command uses discrete parameters:

```
SOUR:FUNC:MODE {FIXed | USER | SEQuence}
```

Boolean Parameters

Boolean parameters represent a single binary condition that is either true or false. The generator accepts "OFF" or "0" for a false condition. The generator accepts "ON" or "1" for a true condition. The instrument always returns "0" or "1" when a boolean setting is queried. The following command uses a boolean parameter:

```
OUTP:FILT { OFF | ON }
```

The same command can also be written as follows:

```
OUTP:FILT {0 | 1 }
```

Arbitrary Block Parameters

Arbitrary block parameters are used for loading waveforms into the generator's memory. Depending on which option is installed, the Model PM8572A can accept binary blocks up to 1M bytes. The following command uses an arbitrary block parameter that is loaded as binary data:

```
TRAC:DATA#564000<binary_block>
```

Binary Block Parameters

Binary block parameters are used for loading segment and sequence tables into the generator's memory. Information on the binary block parameters is given later in this manual.

SCPI Syntax and Styles

Where possible the syntax and styles used in this section follow those defined by the SCPI consortium. The commands on the following pages are broken into three columns; the KEYWORD, the PARAMETER FORM, and any NOTES.

The KEYWORD column provides the name of the command. The actual command consists of one or more keywords since SCPI commands are based on a hierarchical structure, also known as the tree system. Square brackets ([ ]) are used to enclose a **keyword** that is optional when programming the command; that is, the PM8572A will process the command to have the same effect whether the optional node is omitted by the programmer or not. Letter case in tables is used to differentiate between the accepted short form (upper case) and the long form (upper and lower case).

The PARAMETER FORM column indicates the number and order of parameter in a command and their legal value. Parameter types are distinguished by enclosing the type in angle brackets (< >). If **parameter** form is enclosed by square brackets ([ ]) these are then optional (care must be taken to ensure that optional parameters are consistent with the intention of the associated keywords). The vertical bar (|) can be read as "or" and is used to separate alternative parameter options.

Table 5-1, Model PM8572A SCPI Commands List Summary

Keyword	**Parameter Form**	**Default**
	Instrument Control Commands	
:INSTrument		
[:SELect]	1 | 2	1
:COUPle		
:MODE	MASTer | SLAVe	MAST
:DELay	0 to 20	0
:SLAVe		
:DELete	<LAN_IP_address>	
:INSert	<PM8572A>,<LAN_IP_address>	
:STATe	OFF | ON | 0 | 1	0
:OUTPut		
:LOAD	50 to 1e6	50
[:STATe]	OFF | ON | 0 | 1	0
:SYNC		
[:STATe]	OFF | ON | 0 | 1	0
:POSition	0 to 1e6-1 (0 to 2e6-1 with option 1, 0 to 4e6-1 with option 2)	0
:SOURce	1 | 2	1
:FILTer		
[:LPASs]	NONE | 25M | 50M | 60M | 120M	NONE
[:SOURce]		
:ROSCillator		
:SOURce	INTernal | EXTernal	INT
:FREQuency		
[:CW]	10e-3 to 100e6 | MINimum | MAXimum	1e6
:RASTer	5 to 300e6 | MINimum | MAXimum	1e7
:SOURce	INTernal | EXTernal	INT
:VOLTage		
[:LEVel]		
[:AMPLitude]	16e-3 to 16 (16e-3 to 10 with option 4)	5
:OFFSet	-7.992 to 7.992 (-4.992 to 4.992 with option 4)	0
:PHASe		
[:OFFSet]	0 to 1e6-1 (0 to 2e6-1 with option 1, 0 to 4e6-1 with option 2)	0
:FUNCtion		
:MODE	PULSe | FIXed | USER | SEQuence | MODulation | HALFcycle | COUNter	PULS

Table 5-1, Model PM8572A SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
Run Mode Commands		
:INITiate		
[:IMMediately]		
:CONTinuous	OFF | ON | 0 | 1	1
:TRIGger		
[:IMMediate]		
:BURSt		
[:STATe]	OFF | ON | 0 | 1	0
:COUNt	1 to 1000000	1
:DELay		
[:STATe]	OFF | ON | 0 | 1	0
:TIMe	200e-9 to 20	200e-9
:GATE		
[:STATe]	OFF | ON | 0 | 1	0
:LEVel	-5 to 5	1.6
:SOURce		
[:ADVance]	BUS | EXTernal | MIXed | INTernal	EXT
:RETRigger		
[:STATe]	OFF | ON | 0 | 1	0
:TIMe	200e-9 to 20	200e-9
:TIMer	100e-9 to 200e-3	1e-3
:SLOPe	POSitive | NEGative	POS
Pulse Waveforms Commands		
[:SOURce]		
:PULSe		
:MODe	SINGle | DELayed | DOUBle | HOLDdcycle | EWIDth | PWM1	SING
:PERiod	20e-9 to 10	1e-3
:WIDTh	8e-9 to 10	100e-6
:DCYCle	1 to 99	50
:DELay	0 to 10	0
:DOUBle		
:DELay	0 to 10	200e-6
:LEVel		
[:MODe]	HLOW | AOFFset | POSitive | NEGative	HLOW
:HIGH	-7.983 to 8 (-4.983 to 5 with option 4)	+2.5
:LOW	-8 V to +7.983 V (-5 to 4.983 with option 4)	-2.5

Table 5-1, Model PM8572A SCPI Commands List Summary (continued)

Keyword	**Parameter Form**	**Default**
Pulse Waveforms Commands		
:AMPLitude	16e-3 to 16 (16e-3 to 10 with option 4)	5
:OFFSet	-7.992 to 7.992 (-4.992 to 4.992 with option 4)	0
:MODulation		
:SOURce	SINusoidal | TRIangular | SQUare | PRAMp | NRAMp	SIN
:PERiod	100e-9 to 1	100e-3
:DEViation	0 to 99	50
:POLarity	NORMal | COMPlement | INVerted	NORM
:TRANsition		
:STATe	FAST | LINear | SYMMetrical	FAST
[:LEADing]	5e-9 to 5e-3	10e-6
:TRAiling	5e-9 to 5e-3	10e-6
:BURSt	1 to 65535	2
Standard Waveforms Commands		
:SHAPe	SINusoid | TRIangle | SQUare | SPULse | RAMP | SINC | GAUSsian | EXPonential | NOISe | DC	SIN
:SINusoid		
:PHASe	0 to 360	0
:TRIangle		
:PHASe	0 to 360	0
:SQUare		
:DCYCle	0 to 99.99	50
:SPULse		
:DELay	0 to 99.999	10
:WIDth	0 to 99.999	10
:TRANsition		
[:LEADing]	0 to 99.999	10
:TRAiling	0 to 99.999	10
:RAMP		
:DELay	0 to 99.99	0
:TRANsition		
[:LEADing]	0 to 99.99	60
:TRAiling	0 to 99.99	30
:SINC		
:NCYCle	4 to 100	10
:GAUSsian		
:EXPonent	10 to 200	20

Table 5-1, Model PM8572A SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
Standard Waveforms Commands (continued)		
:EXPonential		
:EXPonent	-100 to 100	1
:DC		
[:AMPLitude]	-8 to 8	5
Arbitrary Waveforms Commands		
:TRACe		
[:DATA]	<data_array>	
:DEFine	<1 to 10k>,<16 to 1(2 or 4)e6> (<segment_#>,<size>)	1
:DELete		
[:NAME]	1 to 10k	
:ALL		
:SELect	1 to 10k	1
:SEGMent		
[:DATA]	<data_array>	
Sequenced Waveforms Commands		
[:SOURce]		
:SEQuence		
[:DATA]	<data_array>	
:ADVance	AUTOmatic | STEP | SINGle | MIX	AUTO
:SELect	1 to 10	1
:DEFine	<step>,<seg_number>,<repeat>,<adv_mode>,<sync_bit>	
:DELete		
:NAME	1 to 4096	
:ALL		
:SYNC		
[:TYPe]	BIT | LCOMplete	LCOM
Modulated Waveforms Commands		
[:SOURce]		
:MODulation		
:TYPE	OFF | FM | AM | SWE | FSK | ASK | FHOPping | AHOPping | 3D | PSK | QAM	OFF
:CARRier		
[:FREQuency]	10 to 100e6	1e6
:BASeline	CARRier | DC	CARR
:LOAD		
:DEMO		

Table 5-1, Model PM8572A SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
Modulated Waveforms Commands (continued)		
:FM		
:DEViation	10.0e-3 to 100e6	100e3
:FUNCtion		
:SHAPe	SINusoid | TRIangle | SQUare | RAMP | ARB	SIN
:FREQuency	10e-3 to 350e3	10e3
:RASTer	1 to 2.5e6	1e6
:MARKer		
[:FREQuency]	10e-3 to 100e6	1e6
:DATA	<data_array>	
:AM		
:FUNCtion		
:SHAPe	SINusoid | TRIangle | SQUare | RAMP	SIN
:MODulation		
:FREQuency	10e-3 to 1e6	10e3
:DEPTh	0 to 100	50
:SWEep		
[:FREQuency]		
:STARt	10 to 100.0e6	10e3
:STOP	10 to 100e6	1e6
:TIME	1.4e-6 to 40.0	1e-3
:DIRection	UP | DOWN	UP
:SPACing	LINear | LOGarithmic	LIN
:MARKer		
[:FREQuency]	10 to 100e6	505e3
:FSK		
:FREQuency		
:SHIFted	10 to 100e6	100e3
:BAUD	1 to 10e6	10e3
:MARKer	1 to 4000	1
:DATA	<data_array>	
:ASK		
[:AMPLitude]		
[:STARt]	0 to 16	5
:SHIFted	0 to 16	1
:BAUD	1 to 2.5e6	10e3
:MARKer	1 to 1000	1
:DATA	<data_array>	

Table 5-1, Model PM8572A SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
Modulated Waveforms Commands (continued)		
:FHOPping		
:DWELl		
:MODe	FIXed | VARiable	FIX
[:TIMe]	200e-9 to 20	200e-9
:FIXed		
:DATA	<data_array>	
:VARiable		
:DATA	<data_array>	
:MARKer	1 to 1000	1
:AHOPping		
:DWELl		
:MODe	FIXed | VARiable	FIX
[:TIMe]	200e-9 to 20	200e-9
:FIXed		
:DATA	<data_array>	
:VARiable		
:DATA	<data_array>	
:MARKer	1 to 5000	1
:3D		
:DATA	<data_array>	
:MARKer	1 to 30000	
:RASTer	1.5 to 2.5e6	1e6
:PSK		
:TYPE	PSK | BPSK | QPSK | OQPSK | DQPSK | 8PSK | 16PSK | USER	PSK
:PHASe		
[:STARt]	0 to 360	0
:SHIFted	0 to 360	180
:RATE	1 to 10e6	10e3
:DATA	<data_array>	
:MARKer	1 to 4000	1
:BAUD	1 to 10e6	10e3
:CARRier		
:STATe	OFF | ON | 0 | 1	1
:USER		
:DATA	<data_array>	

Table 5-1, Model PM8572A SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
Modulated Waveforms Commands (continued)		
:QAM		
:TYPE	16QAM | 64QAM | 256QAM | USER	QAM
:CARRier		
:STATe	OFF | ON | 0 | 1	1
:BAUD	1 to 10e6	10e3
:DATA	<data_array>	
:MARKer	1 to 4000	1
:USER		
:DATA	<data_array>	
Half Cycles Waveform Commands		
:HALFcycle		
:DELay	200e-9 to 20	1e-6
:DCYCle	0 to 99.99	50
:FREQuency	10e-3 to 1e6	1e6
:PHASe	0 to 360	0
:SHAPe	SINusoid | TRIangle | SQUare	SIN
Counter Commands		
:COUNter		
:FUNCtion	FREQuency | PERiod | APERiod | PULSe | GTOTalize | ITOTalize	FREQ
:DISPlay		
:MODE	NORMal | HOLD	NORM
:GATE		
:TIME	100e-6 to 1	1
:RESet		
:READ		
Digital Pattern Commands		
[:SOURce]		
:DIGital		
:DATA	<data_array>	
:SOURce	FIXed | USER	FIX
:RATE	5 to 25e6	10e3
[:STATe]	OFF | ON | 0 | 1	0
System Commands		
:RESet		

Table 5-1, Model PM8572A SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
System Commands		
:SYSTem		
:ERRor?		
:LOCal		
:VERSion?		
:INFOrmation		
:CALibration?		
:MODel?		
:SERial?		
:IP		
[:ADDRess]	<IP_address>	
:MASK	<mask>	
:GATeway	<gate_way>	
:BOOTp	OFF | ON | 0 | 1	0
HOSTname:	<host_name>	
:KEEPalive		
:STATe	OFF | ON | 0 | 1	1
:TIMEout	2 to 300	45
:PROBes	2 to 10	2
:TEMPerature?		
Mass Memory Store/Recall Commands		
:MMEMory		
:CLEar		
[:CELL]	1 to 99	1
:STORe		
[:CELL]	1 to 99	1
:RECall		
[:CELL]	1 to 99	1
Common Commands		
*CLS		
*ESE	1 to 255	1
*OPC		
*RST		
*SRE	1 to 255	1
*TRG		
*ESR?		
*IDN?		
*OPT?		
*STB?		

Instrument Control Commands

This group is used to control output channels and their respective state, amplitude and offset settings, as well as the waveform mode. You can also set the phase offset between channels and select filters to re-structure the shape of your waveform. Multiple instruments can be synchronized with these commands, as well. The output frequency and the reference source are also selected using commands from this group. Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-2, Instrument Control Commands Summary

Keyword	Parameter Range	Default
:INSTrument		
[:SELect]	1 | 2 | 3 | 4 | n …	1
:COUPle		
:MODE	MASTer | SLAVe	MAST
:DELay	0 to 20	0
:SLAVe		
:DELete	<LAN_IP_address>	
:INSert	<PM8572A>,<LAN_IP_address>	
:STATe	OFF | ON | 0 | 1	0
:OUTPut		
:LOAD	50 to 1e6	50
[:STATe]	OFF | ON | 0 | 1	0
:SYNC		
[:STATe]	OFF | ON | 0 | 1	0
:POSition	0 to 1e6-1 (0 to 2e6-1 with option 1, 0 to 4e6-1 with option 2)	0
:SOURce	1 | 2	1
:FILTer		
[:LPASs]	NONE | 25M | 50M | 60M | 120M	NONE
[:SOURce]		
:ROSCillator		
:SOURce	INTernal | EXTernal	INT
:FREQuency		
[:CW]	10e-3 to 100e6 | MINimum | MAXimum	1e6
:RASTer	5 to 300e6 | MINimum | MAXimum	1e7
:SOURce	INTernal | EXTernal	INT
:VOLTage		
[:LEVel]		
[:AMPLitude]	16e-3 to 16 (16e-3 to 10 with option 4)	5
:OFFSet	-7.992 to 7.992 (-4.992 to 4.992 with option 4)	0
:PHASe		
[:OFFSet]	0 to 1e6-1 (0 to 2e6-1 with option 1, 0 to 4e6-1 with option 2)	0
:FUNCtion		
:MODE	PULSe | FIXed | USER | SEQuence | MODulation | HALFcycle | COUNter	PULS

INSTrument{1|2|.3.|.4.|..n}(?)

Description

This command will set the active channel for future programming sequences. Subsequent commands affect the selected channel only.

Parameters

Range	Type	Default	Description
1-2 (3 - n)	Discrete	1	Sets the active channel for programming from remote. Channels 1 and 2 are associated with the PM8572A. Channels 3 and subsequent channels are available only when the PM8572A operate in master/slave mode and was coupled to other instruments. The channel designator is automatically adjusted to the number of channels that are joined to form the multi-channel system, regardless if PM8572A or PM8571A units are used in this system

Response

The PM8572A will return 1, 2 or n depending on the present active channel setting

INSTrument:COUPle:MODE{MASTer|SLAVe}(?)

Description

This command will assign master or slave properties to the instrument. If the assignment is slave, most of the instrument operational functions will be controlled from the master instrument however, waveforms, amplitudes and offsets can be controlled individually for each slave unit.

Parameters

Name	Type	Default	Description
MASTer	Discrete	MAST	Programs a specific PM8572A, in a multi-instruments system, as master instrument. Note that only one instrument can be designated as master while all other instruments must be programmed as slaves.
SLAVe	Discrete		Programs PM8572A's, in a multi-instruments system, as slave instrument. Note that multiple instruments can be designated as slaves but only one instrument can be designated as master.

Response

The PM8572A will return MAST or SLAV depending on current instrument couple mode assignment.

INSTrument:COUPle:DELay<delay>(?)

Description
This command will assign master or slave properties to the instrument. If the assignment is slave, most of the instrument operational functions will be controlled from the master instrument however, waveforms, amplitudes and offsets can be controlled individually for each slave unit.

Parameters

Name	Range	Type	Default	Description
<delay>	0 to 20	Numeric	0	Will set the waveform start delay between channels in units of seconds. Channel 1 is always the reference channel. Channels 2 to “n” are delayed in reference to channel 1. Note that this parameter is operating in conjunction with the continuous run mode and only when multiple instruments are synchronized.

Response
The PM8572A will return the present delay value in units of seconds.

INSTrument:COUPle:SLAVe:DELete<LAN_address>

Description
This command will delete a designated slave unit from a synchronized multi-instruments system list.

Parameters

Name	Type	Default	Description
<LAN_address>	String		Will remove a designated instrument, which is specified through its IP address, from a synchronized multi-instruments system list. Contact your computer administrator, if you are not sure how to specify LAN address.

INSTrument:COUPle:SLAVe:INSert<857xA>,<LAN_address>

Description
This command will add a designated slave unit to a synchronized multi-instruments system list.

Parameters

Name	Type	Default	Description
<857xA>, <LAN_address>	String		857xA specifies if the instrument has one channel (PM8571A), or 2 channels (PM8572A). Specifying the correct model number is crucial for correct assignment of the channel designators, for selecting the correct channel number for the INST:SEL command.

INSTrument:COUPle:STATe{OFF|ON|0|1}(?)

Description
This command will turn the PM8572A couple state on and off.

Parameters

Range	Type	Default	Description
0-1	Discrete	0	Sets the couple mode on and off. Note that this command must be applied to the master instrument only otherwise, the couple state will not be affected. To select the master instrument use the INST:SEL 1 command.

Response
The PM8572A will return 1 if the couple state is on, or 0 if the couple state is off.

OUTPut:LOAD<load>

Description
This command will specify the load impedance that will be applied to the PM8572A output.

Parameters

Name	Type	Default	Description
<load>	Numeric (integer only)	50	Will specify the load impedance that will be applied to the PM8572A outputs in units of Ω. The default setting is 50 Ω. The range of load impedance is 50 Ω to 1 MΩ..Accurate setting of the load impedance is crucial for correct display readout of the amplitude level on the load.

OUTPut{OFF|ON|0|1}(?)

Description
This command will turn the PM8572A output on and off. Note that for safety, the outputs always default to off, even if the last instrument setting before power down was on

Parameters

Range	Type	Default	Description
0-1	Discrete	0	Sets the output on and off

Response
The PM8572A will return 1 if the output is on, or 0 if the output is off.

OUTPut:SYNC{OFF|ON|0|1}(?)

Description

This command will turn the PM8572A SYNC output on and off. Note that for safety, the SYNC output always defaults to off, even if the last instrument setting before power down was on

Parameters

Range	Type	Default	Description
0-1	Discrete	0	Will set the SYNC output on and off

Response

The PM8572A will return 1 if the SYNC output is on, or 0 if the SYNC output is off.

OUTPut:SYNC:POSition<position>(?)

Description

This command will program the PM8572A SYNC position. This command is active in arbitrary (USER) mode only.

Parameters

Name	Range	Type	Default	Description
<position>	0 to 1e6-1	Numeric (Integer only)	0	Will set the SYNC position in waveform points. The sync position can be programmed in increments of 4 points minimum. The range is extended to 2e6-1 when option 2 is installed. 1M memory size is standard.

Response

The PM8572A will return the present SYNC position value

OUTPut:SYNC:SOURce{1|2}(?)

Description

This command will program the PM8572A source of the SYNC output.

Parameters

Range	Type	Default	Description
1-2	Discrete	1	Will set the source for the SYNC output. 1 selects channel 1 as the source; 2 selects channel 2 as the source.

Response

The PM8572A will return the present SYNC source value

OUTPut:FILTer{NONE|25M|50MH|60M|120M}(?)

Description
This command will select which filter is connected to the PM8572A output. Observe the following restrictions when you try to use this command:

1) Filter selection is not available when the instrument is set to output the standard sine waveform. In fact, the default waveform shape is sine. Therefore, filter selection will be available for use only after you select a different waveform, or change the output mode to use.
2) Filters are placed before the output amplifier. Therefore, do not expect the filters to remove in-band amplifier harmonics and spurious.

Parameters

Name	Type	Default	Description
None	Discrete	None	Disables all filters at the output path. This option cannot be selected when standard waveform is generated
25M	Discrete		Connects a 25MHz, Bessel type filter, to the output path
50M	Discrete		Connects a 50MHz, Bessel type filter, to the output path
65M	Discrete		Connects a 25MHz, Elliptic type filter, to the output path
120M	Discrete		Connects a 120MHz, Elliptic type filter, to the output path

Response
The PM8572A will return NONE, 25M, 50M, 60M, or 120M depending on the type of filter presently connected to the output.

ROSCillator:SOURce{INTernal|EXTernal}(?)

Description
This command will select the reference source for the sample clock generator.

Parameters

Name	Type	Default	Description
INTernal	Discrete	INT	Selects an internal source. The internal source is 1ppm TCXO
EXTernal	Discrete		Activates the external reference input. An external reference must be connected to the PM8572A for it to continue normal operation

Response
The PM8572A will return INT, or EXT depending on the present PM8572A setting.

FREQuency{<freq>|MINimum|MAXimum}(?)

Description

This command modifies the frequency of the standard waveforms in units of hertz (Hz). It has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<freq>	10e-3 to 100e6	Numeric	1e6	Will set the frequency of the standard waveform in units of Hz. Although the display resolution for the frequency setting is 9 digits only, the frequency command can be used with resolutions up to 14 digits. The accuracy of the instrument however, can only be tested to this accuracy using an external reference that provides the necessary accuracy and stability
<MINimum>		Discrete		Will set the frequency of the standard waveform to the lowest possible frequency (10e-3).
<MAXimum>		Discrete		Will set the frequency of the standard waveform to the highest possible frequency (100e6).

Response

The PM8572A will return the present frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FREQuency:RASTer{<sclk>|MINimum|MAXimum}(?)

Description

This command modifies the sample clock frequency of the arbitrary waveform in units of samples per second (S/s). It has no affect on standard waveforms.

Parameters

Name	Range	Type	Default	Description
<sclk>	5 to 300e6	Numeric	1e7	Will set the sample clock frequency of the arbitrary and sequenced waveform in units of S/s. Although the display resolution for the frequency setting is 9 digits only, the frequency command can be used with resolutions up to 14 digits. The accuracy of the instrument however, can only be tested to this accuracy using an external reference that provides the necessary accuracy and stability
<MINimum>		Discrete		Will set the sample clock frequency to the lowest possible frequency (5).
<MAXimum>		Discrete		Will set the frequency of the standard waveform to the highest possible frequency (300e6).

Response

The PM8572A will return the present sample clock frequency value. The returned value will be in standard scientific format (for example: 100MHz would be returned as 100e6 – positive numbers are unsigned).

FREQuency:RASTer:SOURce{EXTernal|INTernal}(?)

Description
This command selects the source of the sample clock generator. This command affects both the standard and the arbitrary waveforms.

Parameters

Name	Type	Default	Description
INTernal	Discrete	INT	Selects an internal source.
EXTernal	Discrete		Activates the external sample clock reference input. An external reference must be connected to the PM8572A, in the range of the internal source, for it to continue normal operation. Observe the input level and limitations before connecting an external signal.

Response
The PM8572A will return EXT if an external source is selected, or INT if the internal source is selected.

VOLTage{<ampl>|MINimum|MAXimum}(?)

Description
This command programs the peak to peak amplitude of the output waveform. The amplitude is calibrated when the source impedance is 50Ω.

Parameters

Name	Range	Type	Default	Description
<ampl>	16e-3 to 16e0	Numeric	5	Will set the amplitude of the output waveform in units of volts. Amplitude setting is always peak to peak. Offset and amplitude settings are independent providing that the offset + amplitude does not exceed the specified window.
<MINimum>		Discrete		Will set the amplitude to the lowest possible level (16mV).
MAXimum>		Discrete		Will set the amplitude to the highest possible level (Normally 16V, 10V with option 4).

Response
The PM8572A will return the present amplitude value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

VOLTage:OFFSet<offs>(?)

Description
This command programs the amplitude offset of the output waveform. The offset is calibrated when the source impedance is 50Ω.

Parameters

Name	Range	Type	Default	Description
<offs>	-7.992 to 7.992	Numeric	0	Will set the offset of the output waveform in units of volts. Offset and amplitude settings are independent providing that the offset + amplitude do not exceed the specified window. (Range is reduced to -4.992 to 4.992 with option 4).

Response
The PM8572A will return the present offset value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

PHASe:OFFSet<phase_offs>(?)

Description
This command programs the start phase offset between channels 1 and 2 in units of waveform points. Phase offset resolution when using this command is 1 point.

Parameters

Name	Range	Type	Default	Description
<phase_offs>	0 to 1e6-1	Numeric (Integer only)	0	Will set the phase offset between the two channels. Channel 1 trails channel 2 edge. The range is extended to 2e6-1 when option 1 is installed or 4e6-1 when option 2 is installed. 1M is standard.

Response
The PM8572A will return the present phase offset value.

FUNCTion:MODE{PULSe|FIXed|USER|SEQuence|MODulated|HALFcycle|COUNter}(?)

Description
This command defines the type of waveform that will be available at the output connector. It also selects one fo the auxiliary functions from: counter/timer, digital pulse generator and half cycle waveforms

Parameters

Name	Type	Default	Description
PULSe	Discrete		Selects the digital generator function. Note that when you select this function, all waveform generation of

			the PM8572A are purged and the PM8572A is transformed to behave as if it was a stand-alone pulse generator. Pulse generator functions and parameters are programmable.
FIXed	Discrete	FIX	Selects the standard waveform shapes. There is an array of waveforms that is built into the program. You can find these waveform shapes in the standard waveforms section.
USER	Discrete		Selects the arbitrary waveform shapes. Arbitrary waveforms must be loaded to the PM8572A memory before they can be replayed. You can find information on arbitrary waveforms in the appropriate sections in this manual.
SEQuenced	Discrete		Selects the sequenced waveform output. To generate a sequence, you must first download waveform coordinates to different segments and then build a sequence table to generate a complex waveform that is using these segments.
MODulated	Discrete		Selects the modulated waveforms. There is an array of built-in modulation schemes. However, you can also build custom modulation using the arbitrary function.
HALFcycle	Discrete		Selects the half cycle function. Note that when you select this function, all waveform generation of the PM8572A are purged and the PM8572A is transformed to behave as if it was a stand-alone half cycle generator.
COUNter	Discrete		Selects the counter/timer auxiliary function. Note that when you select this function, all waveform generation of the PM8572A are purged and the PM8572A is transformed to behave as if it was a stand-alone counter/timer. The counter/timer functions and parameters can be programmed using the auxiliary commands.

Response

The PM8572A will return PULS, FIX, USER, SEQ, MOD, HALF, or COUN depending on the present PM8572A setting.

Run Mode Commands

The Run Mode Commands group is used to synchronize device actions with external events. These commands control the trigger modes of the Model PM8572A. The generator can be placed in Triggered, Gated or Burst mode. Trigger source is selectable from an external source, an internal re-trigger generator or a software trigger. Optional nodes were omitted from these commands. The Run Mode settings affect all waveform shapes equally except when using the modulated waveforms. In the case of modulated waveform, the output idles on either the carrier waveform or on a dc level, until stimulated to output a modulation cycle or burst of cycles. Additional information on the run mode options and how the PM8572A behaves in the various run mode options is given in Chapter 3. Factory defaults after *RST are shown in the default column. Parameter low and high limits are given where applicable.

Table 5-3, Run Mode Commands

Keyword	**Parameter Form**	**Default**
:INITiate		
[:IMMediately]		
:CONTinuous	OFF | ON | 0 | 1	1
:TRIGger		
[:IMMediate]		
:BURSt		
[:STATe]	OFF | ON | 0 | 1	0
:COUNt	1 to 1000000	1
:DELay		
[:STATe]	OFF | ON | 0 | 1	0
:TIMe	200e-9 to 20	200e-9
:GATE		
[:STATe]	OFF | ON | 0 | 1	0
:LEVel	-5 to 5	1.6
:SOURce		
[:ADVance]	BUS | EXTernal | MIXed | INTernal	EXT
:SLOPe	POSitive | NEGative	POS
:RETRigger		
[:STATe]	OFF | ON | 0 | 1	0
:TIMe	200e-9 to 20	200e-9
:TIMer	100e-9 to 200e-3	1e-3

INITiate:CONTinuous{OFF|ON|0|1}(?)

Description
This command will set the output in continuous operation and interrupted operation. The run mode commands will affect the PM8572A only after it will be set to interrupted operation.

Parameters

Name	Type	Default	Description
ON	Discrete	ON	Disables all interrupted modes and forces the continuous run mode
OFF	Discrete		Select the interrupted run mode. While in this switch option, you can program the PM8572A to operate in triggered, gated, or counted burst run modes.

Response
The PM8572A will return OFF, or ON depending on the selected option.

TRIGger:BURSt{OFF|ON|0|1}(?)

Description
This command will toggle the counted burst run mode on and off. This command will affect the PM8572A only after it will be set to INIT:CONT OFF.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the burst run mode off.
ON	Discrete		Enables the counted burst run mode. Burst count is programmable using the TRIG:BURS:COUN command.

Response
The PM8572A will return OFF, or ON depending on the selected option.

TRIGger:BURSt:COUNt<burst>(?)

Description
This function sets the number of cycles when the Burst Mode is on. Use the init:cont off;:trig:burs on commands to select the Burst Mode.

Parameters

Name	Range	Type	Default	Description
<burst>	1 to 1M	Numeric (integer only)	1	Programs the burst count.

Response
The PM8572A will return the present burst count value.

TRIGger:DELay{OFF|ON|0|1}(?)

Description
This command will toggle the delayed trigger mode on and off. This command will affect the PM8572A only after it will be set to INIT:CONT OFF.

Note: System delay must always be considered when using an external trigger. System delay is measured from a valid trigger input to the transition of the first waveform point. It has a fixed period that adds to the programmed trigger delay value. Consult Appendix A for the system delay specification.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the delayed trigger mode off.
ON	Discrete		Enables the delayed trigger mode.

Response
The PM8572A will return OFF, or ON depending on the selected option.

TRIGger:DELayTime<time>(?)

Description
The trigger delay time parameter defines the time that will elapse from a valid trigger signal to the initiation of the first output waveform. Trigger delay can be turned ON and OFF using the trig:del command. The trigger delay time command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the PM8572A to interrupted run mode using the init:cont off command.

Parameters

Name	Range	Type	Default	Description
<time>	200e-9 to 20	Numeric	200e-9	Programs the trigger delay time.

Response
The PM8572A will return the present trigger delay time value.

TRIGger:GATE{OFF|ON|0|1}(?)

Description
This command will toggle the gate run mode on and off. This command will affect the PM8572A only after it will be set to INIT:CONT OFF.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the gate run mode off.
ON	Discrete		Enables the gated run mode.

Response
The PM8572A will return OFF, or ON depending on the selected option.

TRIGger:LEVel<level>(?)

Description

The trigger level command sets the threshold level at the trigger input connector. The trigger level command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the PM8572A to interrupted run mode using the init:cont off command.

Parameters

Name	Range	Type	Default	Description
<level>	-5 to +5	Numeric	1.6	Programs the trigger level. The value affects the rear panel input only.

Response

The PM8572A will return the present burst count value.

TRIGger:SOURce:ADVance{EXTernal|INTernal|BUS|MIXed}(?)

Description

This selects the source from where the PM8572A will be stimulated to generate waveforms. The source advance command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the PM8572A to interrupted run mode using the init:cont off command.

Parameters

Name	Type	Default	Description
EXTernal	Discrete	EXT	Activates the rear panel TRIG IN input and the front panel MAN TRIG button. Either a front panel button push or a legal signal which will be applied to the rear panel input will stimulate the PM8572A to generate waveforms. BUS commands are ignored.
INTernal	Discrete		Activates the built in internal trigger generator. This mode is available for pulse waveforms only (func:mod:puls). In this mode, BUS and external trigger are ignored. The period of the internal trigger is programmable and can be used to replace an external trigger source.
BUS	Discrete		Selects the remote controller as the trigger source. Only software commands are accepted while rear and front panel signals are ignored
MIXed	Discrete		Hardware triggers are ignored until. First output cycle is initiated using a software command. Subsequent output cycles are initiated using one of the following: rear panel TRIG IN, or front panel MAN TRIG button.

Response

The PM8572A will return EXT, INT, BUS, or MIX depending on the selected trigger source advance setting.

RETRigger{OFF|ON|0|1}(?)

Description
This command will toggle the re-trigger mode on and off. This command will affect the PM8572A only after it will be set to INIT:CONT OFF.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the re-trigger mode off.
ON	Discrete		Enables the re-trigger mode.

Response
The PM8572A will return OFF, or ON depending on the selected option.

RETRigger:TIMe<time>(?)

Description
This parameter specifies the amount of time that will elapse between the end of the delivery of the waveform cycle and the beginning of the next waveform cycle. Re-trigger can be initiated from any of the selected advance options. The re-trigger command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the PM8572A to interrupted run mode using the init:cont off command.

Parameters

Name	Range	Type	Default	Description
<time>	200e-9 to 20	Numeric	200e-9	Programs the re-trigger period.

Response
The PM8572A will return the present re-trigger period value.

TRIGger:TIMer<timer>(?)

Description
This parameter specifies the period of the internal trigger generator. This value is associated with the internal trigger run mode only and has no affect on other trigger modes. The internal trigger generator is a free-running oscillator, asynchronous with the frequency of the output waveform.

Parameters

Name	Range	Type	Default	Description
<time>	100e-9 to 200e-3	Numeric	1e-3	Programs the re-trigger period.

Response
The PM8572A will return the present re-trigger period value.

TRIGger:SLOPe{POSitive|NEGative}(?)

Description

The trigger slope command selects the sensitive edge of the trigger signal that is applied to the TRIG IN connector. The Model PM8572A can be made sensitive to either the positive or negative transitions. Positive going transitions will trigger the generator when the POS option is selected. Negative transitions will trigger the generator when the NEG option is selected. In Gated mode, two transitions in the same direction are required to gate on and off the output. The trigger slope command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the PM8572A to interrupted run mode using the init:cont off command.

Parameters

Name	**Type**	**Default**	**Description**
POSitive	Discrete	POS	Selects the positive going edge.
NEGative	Discrete		Selects the negative going edge.

Response

The PM8572A will return POS, or NEG depending on the selected trigger slope setting.

Pulse Waveforms Control Commands

This group is used to control the pulse waveforms and their respective parameters. A variety of pulse modes is available, such as single double and delayed pulses. The commands that are listed below provide access to programming all of the pulse parameters, including, pulse width, transition times and amplitude.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-4, Pulse Waveform Commands

Keyword	Parameter Form	Default
[:SOURce]		
:PULSe		
:MODe	SINGle | DELayed | DOUBle | HOLDdcycle | EWIDth | PWM1	SING
:PERiod	20e-9 to 10	1e-3
:WIDTh	8e-9 to 10	100e-6
:DCYCle	1 to 99	50
:DELay	0 to 10	0
:DOUBle		
:DELay	0 to 10	200e-6
:LEVel		
[:MODe]	HLOW | AOFFset | POSitive | NEGative	HLOW
:HIGH	-7.983 to 8 (-4.983 to 5 with option 4)	+2.5
:LOW	-8 to 7.983 (-5 to 4.983 with option 4)	-2.5
:AMPLitude	16e-3 to 16 (16e-3 to 10 with option 4)	5
:OFFSet	-7.992 to 7.992 (-4.992 to 4.992 with option 4)	0
:MODulation		
:SOURce	SINusoidal | TRIangular | SQUare | PRAMp | NRAMp	SIN
:PERiod	100e-9 to 1	100e-3
:DEViation	0 to 99	50
:POLarity	NORMal | COMPlement | INVerted	NORM
:TRANsition		
:STATe	FAST | LINear | SYMMetrical	FAST
[:LEADing]	5e-9 to 5e-3	10e-6
:TRAiling	5e-9 to 5e-3	10e-6
:BURSt	1 to 65535	2

PULSe:MODe{SINGle|DELayed|DOUBle|HOLDdcycle|EWIDth|PWM1} (?)

Description
This command will program the mode of the pulse. Pulse mode options are: Single pulse, Delayed pulse, Double pulse, Hold duty cycle pulse, External width pulse and PWM1.

Parameters

Name	Type	Default	Description
SINGle	Discrete	SING	Programs single pulse output, which generates normal pulses
DELayed	Discrete		Programs a delayed pulse mode, which generates normal pulses that are delayed from the SYNC output
DOUBle	Discrete		Programs a double pulse mode, which generates a pair of single pulses that are displaced by a double delay period
HOLDdcycle	Discrete		Programs a pulse mode, which generates a normal pulse that has a fixed duty cycle regardless of the period setting
EWIDth	Discrete		Programs a pulse mode that reconstructs the pulse shape from an external input (TRIG IN)
PWM1	Discrete		Programs the pulse width modulation mode (for channel 1 only), which allows modulation of the pulse width using the built-in standard waveforms

Response
The PM8572A will return SING, DEL, DOUB, HOLD, EWID or PWM1 depending on the present pulse mode setting.

PULSe:PERiod<period>(?)

Description
This command will program the pulse repetition rate (period). Note that the sum of all parameters, including the pulse width, rise and fall times can not exceed the programmed pulse period and therefore, it is recommended that the pulse period be programmed first before all other pulse parameters. Note that by selecting the double pulse mode, the pulse period remains unchanged.

Parameters

Name	Range	Type	Default	Description
<period>	20e-9 to 10	Numeric	1e-3	Will program the period of the pulse waveform in units of seconds.

Response
The PM8572A will return the present pulse period value in units of seconds.

PULSe:WIDth<width>(?)

Description
This command will program the pulse width value. Note that the only case where the pulse width can exceed the value of the period setting is in triggered mode, where the trigger determines the period of the pulse.

Parameters

Name	Range	Type	Default	Description
<width>	8e-9 to 10	Numeric	100e-6	Will set the width of pulse in units of seconds. Note that the sum of all parameters, including the pulse width must not exceed the programmed pulse period and therefore, it is recommended that the pulse period be programmed before all other pulse parameters.

Response
The PM8572A will return the present pulse width value in units of seconds

PULSe:DCYCle<duty_cycle>(?)

Description
This command affects the output only when the PM8572A is placed in Hold Duty Cycle pulse mode. The programmed duty cycle parameter holds maintains constant duty cycle scenario regardless of the period setting.

Parameters

Name	Range	Type	Default	Description
<duty_cycle>	1 to 99	Numeric	50	Will set the pulse duty cycle in units of percent. Note that this parameter will affect the pulse output only in the Hold Duty Cycle pulse mode.

Response
The PM8572A will return the present duty cycle value in units of percent

PULSe:DELay<delay>(?)

Description
This command will program the delayed interval of which the output idles on the low level amplitude until the first transition to high level amplitude. The delay is measured from the SYNC position to the first pulse transition. Note that this delay does not include the system delay error that is specified in Appendix A. Also note that the only case where the delay can exceed the value of the period setting is in triggered mode, where the trigger determines the period of the pulse.

Parameters

Name	Range	Type	Default	Description
<delay>	0 to 10	Numeric	0	Will set the delay time interval in units of seconds. Delay is measured from the SYNC to the first pulse transition. System delay error is not included in the delay value and must be taken into consideration.

Response
The PM8572A will return the pulse delay value in units of seconds.

PULSe:DOUBle:DELay<d_delay>(?)

Description
This command will program the delay between two adjacent pulses when the double mode is selected. Otherwise, the double pulse delay has no effect on the pulse structure. Note that the only case where the delay can exceed the value of the period setting is in triggered mode, where the trigger determines the period of the pulse.

Parameters

Name	Range	Type	Default	Description
<d_delay>	0 to 10	Numeric	200e-6	Will set the delay between two adjacent pulses for the double pulse mode in units of seconds. Note that the sum of all parameters, including the pulse delay time must not exceed the programmed pulse period and therefore, it is recommended that the pulse period be programmed before all other pulse parameters.

Response
The PM8572A will return the present double pulse delay value in units of seconds.

PULSe:LEVel{HLOW|AOFFset|POSitive|NEGative} (?)

Description
This command will program the level mode of the pulse. Pulse level mode options are: High/Low, Amplitude/Offset, Positive and Negative.

Parameters

Name	Type	Default	Description
HLOW	Discrete	HLOW	Programs pulse level using high level and low level parameters.
AOFFset	Discrete		Programs pulse level using the amplitude and offset parameters. When the offset is left at 0 V settings (default), amplitude changes modifies the pulse level symmetrically about the 0 V level.
POSitive	Discrete		Programs pulse level using the high level parameters. The low level remains at 0 V at all times.

NEGative	Discrete	Programs pulse level using the low level parameters. The high level remains at 0 V at all times.

Response
The PM8572A will return HOLW, AOFF, POS or NEG depending on the present pulse level mode setting.

PULSe:LEVel:HIGH<high_level>(?)

Description
This command programs the high level amplitude of the pulse waveform. The high level is calibrated when the load impedance is 50 Ω.

Parameters

Name	Range	Type	Default	Description
<high_level>	-7.983 to 8	Numeric	2.5	Will set the high level of the pulse waveform in units of volts. High level is limited from -4.983 to 5 with option 4.

Response
The PM8572A will return the present high level value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

PULSe:LEVel:LOW<low_level>(?)

Description
This command programs the low level amplitude of the pulse waveform. The low level is calibrated when the load impedance is 50 Ω.

Parameters

Name	Range	Type	Default	Description
<low_level>	-8 to 7.983	Numeric	-2.5	Will set the low level of the pulse waveform in units of volts. Low level is limited from -5 to 4.983 with option 4.

Response
The PM8572A will return the present low level value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

PULSe:LEVel:AMPLitude<ampl>(?)

Description
This command programs the peak to peak amplitude of the pulse waveform. The amplitude is calibrated when the source impedance is 50Ω. Note that this value is a duplication of the volt:ampl parameter and therefore, modifying this parameter in the pulse menu will automatically modify the amplitude setting for the other instrument functions.

Parameters

Name	Range	Type	Default	Description
<ampl>	16e-3 to 16e0	Numeric	5	Will set the amplitude of the pulse waveform in units of volts. Amplitude setting is always peak to peak. Offset and amplitude settings are independent providing that the offset + amplitude do not exceed the amplitude window, as specified in Appendix A. Amplitude level is limited from 16e-3 to 10 with option 4.

Response
The PM8572A will return the present pulse amplitude value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

PULSe:LEVel:OFFset<offs>(?)

Description
This command programs the offset amplitude of the pulse waveform. The offset is calibrated when the source impedance is 50Ω. Note that this value is a duplication of the volt:offs parameter and therefore, modifying this parameter in the pulse menu will automatically modify the amplitude setting for the other instrument functions.

Parameters

Name	Range	Type	Default	Description
<offs>	-7.992 to 7.992	Numeric	0	Will set the offset of the pulse waveform in units of volts. Offset and amplitude settings are independent providing that the offset + amplitude do not exceed the specified window. Offset is limited from -4.992 to 4.992 with option 4.

Response
The PM8572A will return the present pulse offset value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

PULSe:MODulation:SOURce{SINusoidal|TRIangular|SQUare|PRAMp|NRAMp} (?)

Description
This command will program the source for the pulse modulation. The modulating waveform options are: sine, triangle, square, ramp up and ramp down. The period and the deviation factor of the modulating waveforms can be adjusted separately.

Parameters

Name	Type	Default	Description

SINusoidal	Discrete	SIN	Selects the sine as the modulating waveform for the pulse modulation
TRIangular	Discrete		Selects the triangle as the modulating waveform for the pulse modulation
SQUare	Discrete		Selects the square as the modulating waveform for the pulse modulation
PRAMp	Discrete		Selects the ramp up as the modulating waveform for the pulse modulation
NRAMp	Discrete		Selects the ramp down as the modulating waveform for the pulse modulation

Response
The PM8572A will return SIN, TRI, SQU, PRAM or NRAM depending on the present modulation source setting

PULSe:MODulation:PERiod<mod_per>(?)

Description
This command will program the period of the modulating waveform. This command will affect the generator only when the PM8572A is programmed to operate in PWM mode.

Parameters

Name	Range	Type	Default	Description
<mod_per>	100e-9 to 1	Numeric	100e-3	Will program the period of the modulating waveform in units of seconds.

Response
The PM8572A will return the present period setting of the pulse modulation waveform value in units of seconds.

PULSe:DEViation<deviation>(?)

Description
This command will program the deviation, or the modulation index of the modulating waveform. This command will affect the generator only when the PM8572A is programmed to operate in PWM mode.

Parameters

Name	Range	Type	Default	Description
<deviation>	0 to 99	Numeric	1e-3	Will program the deviation of the modulating waveform in units of percent.

Response
The PM8572A will return the present setting of the modulation deviation value in units of percent.

PULSe:POLarity{NORMal|COMPlemented|INVerted} (?)

Description
This command will program the polarity of the pulse in reference to the base line level. The polarity options are: Normal, where the pulse is generated exactly as programmed; Inverted, where the pulse is inverted about the 0 level base line; and Complemented, where the pulse is inverted about its mid amplitude axis.

Parameters

Name	Type	Default	Description
NORMal	Discrete	NORM	Programs normal pulse output
COMPlemeted	Discrete		Programs complemented pulse output
INVerted	Discrete		Programs an inverted pulse output

Response
The PM8572A will return NORM, COMP or INV depending on the present polarity setting.

PULSe:TRANsition:STATe{FAST|LINear|SYMMetrical} (?)

Description
This command will program select of the leading edges will transition linearly or in the fastest way. The transition options are: Fast and Linear.

Parameters

Name	Type	Default	Description
FAST	Discrete	FAST	Programs the fast transitions mode. In this mode the leading and trailing edges will transition as fast as the instrument allows and as specified in Appendix A.
LINear	Discrete		Programs the linear transitions. The transitions are allowed within 6 ranges, where the leading edge setting sets the operational range and the leading transition must be programmed within the same range. Additional information on the range settings is provided in Chapter 3 of this manual
SYMMertical	Discrete		Programs a special mode where the transitions are symmetrical for both the leading and trailing edges, regardless if you program the leading or the trailing edge parameter, the other parameter will automaticall be adjusted to have the same value

Response
The PM8572A will return FAST, LIN or SYMM depending on the present transition setting.

PULSe:TRANsition<leading_edge>(?)

Description

This command will program the interval it will take the leading edge of the pulse to transition from its low to high level settings. The parameter is programmed in units of seconds. Transition times are programmed within 6 ranges of which both leading and trailing edges must reside in the same range. The leading edge setting determines the range. More information on this function is available in Chapter 3. Note that this parameter will affect the instrument only when the pulse transition mode is set to linear.

Parameters

Name	Range	Type	Default	Description
<leading _edge>	5e-9 to 5e-3	Numeric	10e-6	Will set the leading edge transition time parameter in units of seconds. Note that the sum of all parameters, including transition times must not exceed the programmed pulse period and therefore, it is recommended that the pulse period be programmed before all other pulse parameters.

Response

The PM8572A will return the present leading edge transition time value in units of seconds.

PULSe:TRANsition:TRAiling<fall>(?)

Description

This command will program the interval it will take the trailing edge of the pulse to transition from its high to low level settings. The parameter is programmed in units of seconds. Transition times are programmed within 6 ranges of which both leading and trailing edges must reside in the same range. The leading edge setting determines the range. More information on this function is available in Chapter 3.Note that this parameter will affect the instrument only when the pulse transition mode is set to linear.

Parameters

Name	Range	Type	Default	Description
<trailing_ edge>	5e-9 to 5e-3	Numeric	10e-6	Will set the fall time parameter. Note that the sum of all parameters, including the fall time must not exceed the programmed pulse period and therefore, it is recommended that the pulse period be programmed before all other pulse parameters.

Response

The PM8572A will return the present trailing edge transition time value in units of seconds.

PULSe:BURSt<burst>(?)

Description

This command will program the burst count when the instrument is programmed to burst mode. Note that this parameter is unique for the pulse output. There is another parameter that controls burst count for the other waveforms but these two parameters are separate and have no affect on each other.

Parameters

Name	Range	Type	Default	Description
<burst>	1 to 65535	Integer	2	Will set the counted burst parameter.

Response
The PM8572A will return the present burst number.

Standard Waveforms Control Commands

This group is used to control the standard waveforms and their respective parameters. There is an array of standard waveforms that could be used without the need to download waveform coordinates to the instrument. You can also modify the parameters for each waveform to a shape suitable for your application.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-5, Instrument Control Commands Summary

Keyword	Parameter Range	Default
:FUNCtion		
:SHAPe	**SINusoid** | TRIangle | SQUare | SPULse | RAMP | SINC | GAUSsian | EXPonential | NOISe | DC	SIN
:SINusoid		
:PHASe	0 to 360	0
:TRIangle		
:PHASe	0 to 360	0
:SQUare		
:DCYCle	0 to 99.99	50
:SPULse		
:DELay	0 to 99.999	10
:WIDth	0 to 99.999	10
:TRANsition		
[:LEADing]	0 to 99.999	10
:TRAiling	0 to 99.999	10
:RAMP		
:DELay	0 to 99.99	0
:TRANsition		
[:LEADing]	0 to 99.99	60
:TRAiling	0 to 99.99	30
:SINC		
:NCYCle	4 to 100	10
:GAUSsian		
:EXPonent	10 to 200	20
:EXPonential		
:EXPonent	-100 to 100	1
:DC		
[:AMPLitude]	-8 to 8	5

FUNCtion:SHAPe{SINusoid|TRIangle|SQUare|PULSe|RAMP|SINC|EXPonential| GAUSsian|NOISe|DC}(?)

Description
This command defines the type of waveform that will be available at the output connector.

Parameters

Name	Type	Default	Description
SINusoid	Discrete	SIN	Selects the sine waveform from the built in library.
TRIangle	Discrete		Selects the triangular waveform from the built in library.
SQUare	Discrete		Selects the square waveform from the built in library.
SPULse	Discrete		Selects the pulse waveform from the built in library.
RAMP	Discrete		Selects the ramp waveform from the built in library.
SINC	Discrete		Selects the sinc waveform from the built in library.
EXPonential	Discrete		Selects the exponential waveform from the built in library.
GAUSsian	Discrete		Selects the gaussian waveform from the built in library.
DC	Discrete		Selects the DC waveform from the built in library.
NOISe	Discrete		Selects the noise waveform from the built in library.

Response
The PM8572A will return SIN, TRI, SQU, SPUL, RAMP, SINC, EXP, GAUS, NOIS, or DC depending on the present PM8572A setting

SINusoid:PHASe<phase>(?)

Description
This command programs start phase of the standard sine waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<phase>	0 to 360	Numeric	0	Programs the start phase parameter in units of degrees. Sine phase can be programmable with resolution of 0.1° throughout the entire frequency range of the sine waveform.

Response
The PM8572A will return the present start phase value.

TRIangle:PHASe<phase>(?)

Description
This command programs start phase of the standard triangular waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<phase>	0 to 360	Numeric	0	Programs the start phase parameter in units of degrees. Triangle phase can be programmable with resolution of 0.1° throughout the entire frequency range of the triangular waveform.

Response
The PM8572A will return the present start phase value.

SQUare:DCYCle<duty_cycle>(?)

Description
This command programs duty cycle of the standard square waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<duty_cycle>	0 to 99.99	Numeric	50	Programs the square wave duty cycle parameter in units of percent

Response
The PM8572A will return the present duty cycle value.

SPULSe:DELay<delay>(?)

Description
This command programs delay of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<delay>	0 to 99.999	Numeric	10	Programs the pulse delay parameter in units of percent

Response
The PM8572A will return the present pulse delay value.

SPULSe:WIDth<pulse_width>(?)

Description
This command programs pulse high portion of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<pulse_width>	0 to 99.999	Numeric	10	Programs the pulse width parameter in units of percent

Response
The PM8572A will return the present width value.

SPULSe:TRANsition<rise>(?)

Description
This command programs pulse transition from low to high of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<rise>	0 to 99.999	Numeric	10	Programs the pulse rise time parameter in units of percent

Response
The PM8572A will return the present rise time value

SPULSe:TRANsition:TRAiling<fall>(?)

Description
This command programs pulse transition from high to low of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<fall>	0 to 99.999	Numeric	10	Programs the pulse fall time parameter in units of percent

Response
The PM8572A will return the present fall time value.

RAMP:DELay<delay>(?)

Description
This command programs delay of the standard ramp waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<delay>	0 to 99.99	Numeric	10	Programs the ramp delay parameter in units of percent

Response
The PM8572A will return the present ramp delay value.

Ramp:TRANsition<rise>(?)

Description
This command programs ramp transition from low to high of the standard ramp waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<rise>	0 to 99.99	Numeric	60	Programs the pulse rise time parameter in units of percent

Response
The PM8572A will return the present rise time value

RAMP:TRANsition:TRAiling<fall>(?)

Description
This command programs ramp transition from high to low of the standard ramp waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<fall>	0 to 99.99	Numeric	30	Programs the ramp fall time parameter in units of percent

Response
The PM8572A will return the present fall time value.

SINC:NCYCleN_cycles>(?)

Description
This command programs the number of “0-crossings” of the standard SINC pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<N_cycle>	4 to 100	Numeric (Integer only)	10	Programs the number of zero-crossings parameter

Response
The PM8572A will return the present number of zero-crossing value.

GAUSsian:EXPonent<exp>(?)

Description
This command programs the exponent for the standard gaussian pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<exp>	4 to 100	Numeric	20	Programs the exponent parameter

Response
The PM8572A will return the present exponent value.

EXPonential:EXPonent<exp>(?)

Description
This command programs the exponent for the standard exponential waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<exp>	-100 to 100	Numeric	1	Programs the exponent parameter

Response
The PM8572A will return the present exponent value.

DC<amplitude>(?)

Description
This command programs the exponent for the standard exponential waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	**Range**	**Type**	**Default**	**Description**
<amplitude>	-8 to 8	Numeric	5	Programs the DC amplitude parameter

Response
The PM8572A will return the present DC amplitude value.

Arbitrary Waveforms Control Commands

This group is used to control the arbitrary waveforms and their respective parameters. This will allow you to create segments and download waveforms. Using these commands you can also define segment size and delete some or all unwanted waveforms from your memory. Use the commands in this group to turn the digital output on and off and to download data to the digital pattern buffer.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Generating Arbitrary Waveforms

Arbitrary waveforms are generated from digital data points, which are stored in a dedicated waveform memory. Each data point has a vertical resolution of 16 bits (65536 points), i.e., each sample is placed on the vertical axis with a precision of 1/65536. The Model PM8572A has the following waveform memory capacity:

1M – standard memory configuration
2M/4M – optional memory expansion

Each horizontal point has a unique address - the first being 00000 and the last depends on the memory option. In cases where smaller waveform lengths are required, the waveform memory can be divided into smaller segments.

When the instrument is programmed to output arbitrary waveforms, the clock samples the data points (one at a time) from address 0 to the last address. The rate at which each sample is replayed is defined by the sample clock rate parameter.

Unlike the built-in standard waveforms, arbitrary waveforms must first be loaded into the instrument's memory. Correct memory management is required for best utilization of the arbitrary memory. An explanation of how to manage the arbitrary waveform memory is given in the following paragraphs.

Arbitrary memory Management

The arbitrary memory in comprised of a finite length of words. The maximum size arbitrary waveform that can be loaded into memory depends on the option that is installed in your instrument. The various options are listed in Chapter 1 of this manual. If you purchased the PM8572A with in its basic configuration, you should expect to have 1M words to load waveforms.

Waveforms are created using small sections of the arbitrary memory. The memory can be partitioned into smaller segments (up to 16k) and different waveforms can be loaded into each segment, each having a unique length. Minimum segment size is 16 points. Information on how to partition the memory, define segment length and download waveform data to the PM8572A is given in the following paragraphs.

Table 5-6, Arbitrary Waveforms Commands Summary

Keyword	Parameter Range	Default
:TRACe		
[:DATA]	<data_array>	
:DEFine	<1 to 10k>,<16 to 1(2/4)e6> (<segment_#>,<size>)	1
:DELete		
[:NAME]	1 to 10k	
:ALL		
:SELect	1 to 10k	1
:SEGMent		
[:DATA]	<data_array>	

TRACe#<header><binary_block>

Description

This command will download waveform data to the PM8572A memory. Waveform data is loaded to the PM8572A using high-speed binary transfer. A special command is defined by IEEE-STD-488.2 for this purpose. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. This command is particularly useful for sending large quantities of data. As an example, the next command will download to the generator an arbitrary block of data of 1024 points

```
TRACe#42048<binary_block>
```

This command causes the transfer of 2048 bytes of data (1024 waveform points) into the active memory segment. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "4" designates the number of digits that follow.
- "2048" is the even number of bytes to follow.

The generator accepts binary data as 16-bit integers, which are sent in two-byte words. Therefore, the total number of bytes is always twice the number of data points in the waveform. For example, 20000 bytes are required to download a waveform with 10000 points. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1.

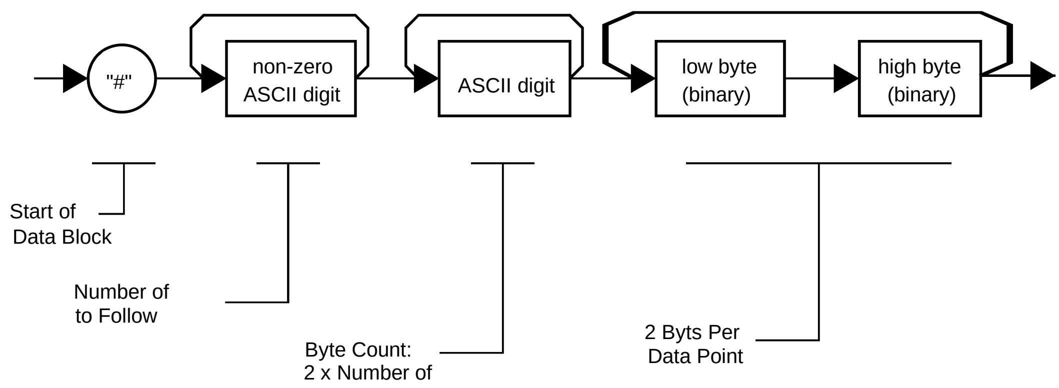

Figure 5-1, Definite Length Arbitrary Block Data Format

Transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as waveform data points and will not cause unexpected termination of the arbitrary block data.

- <binary_block> Represents waveform data.

The waveform data is made of 16-bit words however, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 16-bit words and rearranged as two 8-bit words before it can be used by the PM8572A as waveform data points. The following description shows you how to prepare the data for downloading to the PM8572A. There are a number of points you should be aware of before you start preparing the data:

1. Each channel has its own waveform memory. Therefore, make sure you selected the correct active channel before you download data to the generator
2. Waveform data points have 16-bit values
3. Data point range is 0 to 65,535 decimal
4. Data point 0 to data point 65,535 corresponds to full-scale amplitude setting.

Figure 5-2 shows how to initially prepare the 16-bit word for a waveform data point. Data has to be further manipulated to a final format that the instrument can accept and process as waveform point.

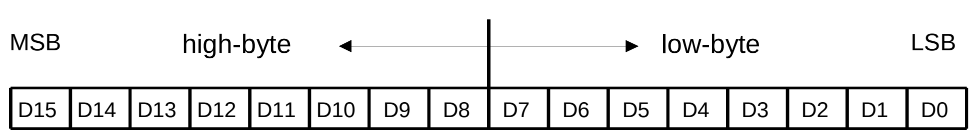

Figure 5-2, 16-bit Initial Waveform Data Point Representation

Figure 5-3 shows the same 16-bit word as in Figure 5-2, except the high and low bytes are swapped. This is the correct format that the PM8572A expects as waveform point data. The first byte to be sent to the generator is the low-byte and then high-byte.

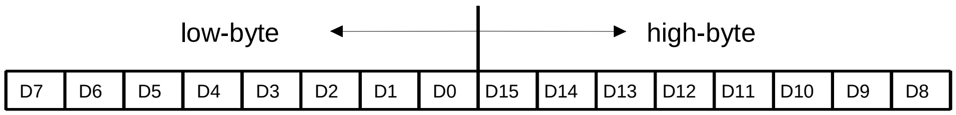

Figure 5-3, 16-bit Waveform Data Point Representation

Parameters

Name	**Type**	**Description**
<header>	Discrete	Contains information on the size of the binary block that contains waveform coordinates.
<binary_block>	Binary	Block of binary data that contains information on the waveform coordinates.

TRACe:DEFine<segment_number>,<length>

Description

Use this command to attach size to a specific memory segment. The final size of the arbitrary memory is 1M points (2M/4M optional). The memory can be partitioned to smaller segments, up to 10k segments. This function allows definition of segment size. Total length of memory segments cannot exceed the size of the waveform memory.

NOTE

The PM8572A operates in interlaced mode where four memory cells generate one byte of data. Therefore, segment size can be programmed in numbers evenly divisible by four only. For example, 2096 bytes is an acceptable length for a binary block. 2002 is not a multiple of 4, therefore the generator will generate an error message if this segment length is used.

Parameters

Name	**Range**	**Type**	**Default**	**Description**
<segment_ number>	1 to 10k	Numeric (integer only)	1	Selects the segment number of which will be programmed using this command
<length>	16 to 1(2/4)M	Numeric (integer only)		Programs the size of the selected segment. Minimum segment length is 16 points, the maximum is limited by the memory option that is installed in your instrument either 1M, 2M, or 4M

TRACe:DELete<segment_number>

Description

This command will delete a segment. The memory space that is being freed will be available for new waveforms as long as the new waveform will be equal or smaller in size to the deleted segment. If the deleted segment is the last segment, then the size of another waveform written to the same segment is not limited. For example, let consider two segments, the first being a 1000-point waveform and the second with 100 points. If you delete segment 1, you can reprogram another waveform to segment 1 with size to 1000 points. If you reprogram segment 1 with 1004 points, the instrument will generate an error and will not accept this waveform. On the other hand, if you delete segment 2, which was the last segment you programmed, then you can reprogram this segment with waveforms having length limited only by the size of the entire memory space.

Parameters

Name	Range	Type	Default	Description
<segment_ number>	1 to 10k	Numeric (integer only)	1	Selects the segment number of which will be deleted

TRACe:DELete:ALL

Description

This command will delete all segments and will clear the entire waveform memory. This command is particularly important in case you want to de-fragment the entire waveform memory and start building your waveform segments from scratch.

TIP

The TRAC:DEL:ALL command does not re-write the memory so, whatever waveforms were downloaded to the memory are still there for recovery. The TRAC:DEL:ALL command removes all stop bits and clears the segment table. You can recover memory segments by using the TRAC:DEF command. You can also use this technique to resize, or combine waveform segments.

TRACe:SELect<segment_number>

Description

This command will select the active waveform segment for the output. By selecting the active segment you are performing two function:

1. Successive :TRAC commands will affect the selected segment
2. The SYNC output will be assigned to the selected segment. This behavior is especially important for sequence operation, where multiple segments form a large sequence. In this case, you can synchronize external devices exactly to the segment of interest

Parameters

Name	**Range**	**Type**	**Default**	**Description**
<segment_ number>	1 to 10k	Numeric (integer only)	1	Selects the active segment number

Response

The PM8572A will return the active segment number.

SEGment#<header><binary_block>

Description

This command will partition the waveform memory to smaller segments and will speed up memory segmentation. The idea is that waveform segments can be built as one long waveform and then just use this command to split the waveform to the appropriate memory segments. In this way, there is no need to define and download waveforms to individual segments.

Using this command, segment table data is loaded to the PM8572A using high-speed binary transfer in a similar way to downloading waveform data with the trace command. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. This command is particularly useful for large number of segment. As an example, the next command will generate three segments with 12 bytes of data that contains segment size information.

```
SEGment#212<binary_block>
```

This command causes the transfer of 12 bytes of data (3 segments) into the segment table buffer. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "2" designates the number of digits that follow.
- "12" is the number of bytes to follow. This number must divide by 4.

The generator accepts binary data as 32-bit integers, which are sent in two-byte words. Therefore, the total number of bytes is always 4 times the number of segments. For example, 36 bytes are required to download 9 segments to the segment table. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1. The transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as segment table data points and will not cause unexpected termination of the arbitrary block data.

The segment table data is made of 32-bit words however, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 32-bit words and rearranged as six 8-bit words before it can be used by the PM8572A as segment table data. Figure 5-4 shows how to prepare the 32-bit work for the segment start address and size. There are a number of points you should be aware of before you start preparing the data:

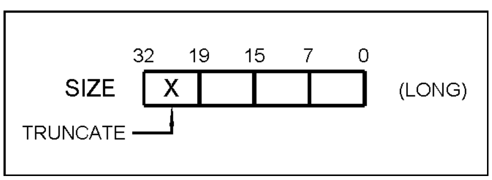

Figure 5-4, Segment Address and Size Example

1. Each channel has its own segment table buffer. Therefore, make sure you selected the correct active channel (with the INST:SEL command) before you download segment table data to the generator
2. Minimum number of segments is 1; maximum number of segments is 16k
3. Maximum segment size depends on your installed option. With the basic PM8572A you can program maximum 1M in one segment. With the 2M/4M option, you can use the full size of 2M/4M
4. Segment table data has 32-bit values of which are used for segment size. Therefore, Data for each segment must have 4 bytes
5. The number of bytes in a complete segment table must divide by 6. The Model PM8572A has no control over data sent to its segment table during data transfer. Therefore, wrong data and/or incorrect number of bytes will cause erroneous memory partition

Parameters

Name	Type	Description
<binary_block>	Binary	Block of binary data that contains information on the segment table.

Sequenced Waveforms Control Commands

This group is used to control the sequenced waveforms and their respective parameters. This will allow you to create multiple sequence table and modify segment loops and links. Also use these commands to add or delete sequences from your instrument.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Generating Sequenced Waveforms

Sequenced waveforms are made of a number of arbitrary waveforms, which can be linked and looped in user-programmable order. Sequenced waveforms are generated from waveforms stored in the PM8572A as memory segments. Therefore, before a sequence can be used, download waveform segments to the arbitrary memory using TRAC# or DMA methods. Information on how to partition the memory and how to download waveforms is given in the section entitled **Generating Arbitrary Waveforms**.

An example of how sequenced waveforms work is demonstrated in figure 1-13 through 1-15. The sequence generator lets you link and loop segments in user-defined order. Figure 1-16 shows a sequence of waveforms that were stored in three different memory segments.

There are a number of tools that you can use to build a sequence table. The easiest way is of course to use the ArbConnection program. Information how to use the ArbConnection program is given in a later chapter. In other cases, SCPI programming allows low-level programming of sequence tables.

In general, sequences can be build one step at a time using the SEQ:DEF command. The one step method is slow and tedious however, it allows better control for one who just begins his first sequence programming. Advanced users can download a complete sequence table using the binary sequence download option. The later being much faster for applications requiring large sequence tables. Use the information below to understand sequence commands and how to implement them in your application.

Table 5-7, Sequence Control Commands

Keyword	Parameter Form (Default in Bold)	Notes
[:SOURce]		
:SEQuence		
[:DATA]	<data_array>	
:ADVance	AUTOmatic | STEP | SINGle | MIX	AUTO
:SELect	1 to 10	1
:DEFine	<step>,<seg_number>,<repeat>,<adv_mode>,<sync_bit>	
:DELete		
:NAME	1 to 4096	
:ALL		
:SYNC		
[:TYPe]	BIT | LCOMplete	LCOM

SEQuence#<header><binary_block>

Description

This command will build a complete sequence table in one binary download. In this way, there is no need to define and download individual sequencer steps. Using this command, sequence table data is loaded to the PM8572A using high-speed binary transfer in a similar way to downloading waveform data with the trace command. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. This command is particularly useful for long sequences that use a large number of segment and sequence steps. As an example, the next command will generate three-step sequence with 16 bytes of data that contains segment number, repeats (loops) and mixed mode flag option.

```
SEQuence#216<binary_block>
```

This command causes the transfer of 16 bytes of data (2-step sequence) to the sequence table buffer. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "2" designates the number of digits that follow.
- "16" is the number of bytes to follow. This number must divide by 8.

The generator accepts binary data as 64-bit integers, which are sent in two-byte words. Therefore, the total number of bytes is always eight times the number of sequence steps. For example, 16 bytes are required to download 2 sequence steps to the sequence table. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1. The transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as sequence data and will not cause unexpected termination of the arbitrary block data. Figure 5-5 shows how to prepare the 64-bit word for the sequence step, repeat, mixed mode and sync bit.

The sequence table data is made of 64-bit words however, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 64-bit words and rearranged as six 8-bit words before it can be used by the PM8572A as sequence table data. Figure 5-6 shows how to prepare the 64-bit word for the sequence step, repeat and mixed mode flag.

There are a number of points you should be aware of before you start preparing the data:

1. Each channel has its own sequence table buffer. Therefore, make sure you selected the correct active channel (with the INST:SEL command) before you download sequence table data to the generator
2. Minimum number of sequencer steps is 1; maximum number is 4096
3. The number of bytes in a complete sequence table must divide by 8. The Model PM8572A has no control over data sent to its sequence table during data transfer. Therefore, wrong data and/or incorrect number of bytes will cause erroneous sequence partition
4. The LSB bit is the only bit used in the mode byte. This bit has an affect on the operation of the sequence only when Mixed Step Advance mode is active. With the LSB bit set to “0”, the sequence generator will advance to the next step automatically. With the LSB bit set to “1”, the sequence generator will advance to the next step only when a valid trigger signal will be sensed at the trigger input.
5. SYNC state bit is valid only when the sequence sync type is BIT

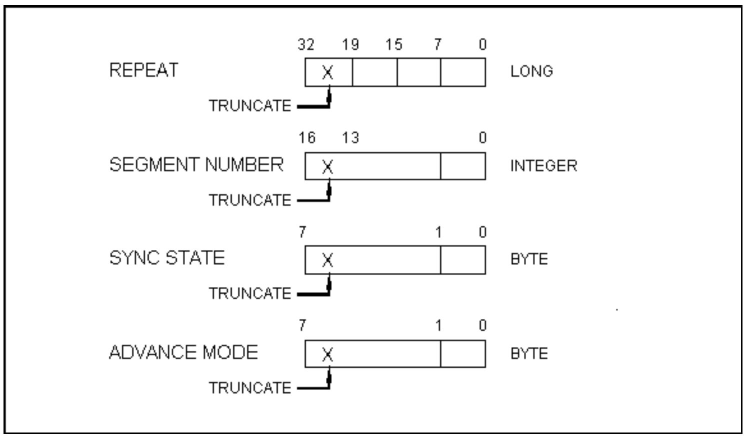

Figure 5-5, 64-bit Sequence Table Download Format

Parameters

Name	Type	Description
<binary_block>	Binary	Block of binary data that contains information on the sequence table.

SEQuence:ADVance{AUTOmatic|STEP|SINGle|MIXed}(?)

Description

This command will select the sequence advance mode. The way the instrument advances through the sequence links can be specified by the user.

Parameters

Name	Type	Default	Description
AUTOmatic	Discrete	AUTO	Specifies continuous advance where the generator steps continuously to the end of the sequence table and repeats the sequence from the start. For example, if a sequence is made of three segments 1,

		2 and 3, the sequence will generate an infinite number of 1,2,3,1,2,3,1,2,3…waveforms. Of course, each link (segment) can be programmed with its associated loop (repeat) number.
STEP	Discrete	In step advance mode, the sequence is advanced to the next waveform only when a valid trigger is received. The output of the PM8572A generates the first segment continuously until a trigger signal advances the sequence to the next segment. If repeats were selected for a segment, the loop counter is executed automatically.
SINGle	Discrete	In single advance mode, the generator idles between steps until a valid trigger signal is sensed. This mode operates with trigger mode only. An attempt to select the SING advance mode when the PM8572A is in continuous operating mode will generate an error. After trigger, the generator outputs one waveform cycle. Then, the output level idles at a DC level equal to the last point of the last generated waveform. If loops (repeats) were programmed, the output will repeat this segment every time a trigger is received. Only after executing all of the programmed loops will the sequence step to the next assigned segment.
MIXed	Discrete	Mixed mode is a special mode that combines continuous step advance with single step advance in a sequence. There are three conditions for the sequence generator to operate in this mode: 1) The PM8572A must be set to operate in continuous mode 2) Select the MIX sequence advance mode 3) Assign the mixed mode bits for each sequence step in your SEQ:DEF command. “0” programs normal advance, “1” programs trigger advance. Step with a “0” bit assigned to it will advance automatically to the next step. If “1” is assigned to a step, the instrument will generate this step and its associated number of repeats continuously and only a valid trigger signal will advance this step to the next step.

Response

The PM8572A will return the AUTO, STEP, SING, or MIX depending on the present sequence advance mode setting.

SEQuence:SELect<sequence_number>(?)

Description

This command will select an active sequence to be generated at the output connector. By selecting the active sequence, successive :SEQ commands will affect the selected sequence only

Parameters

Name	Range	Type	Default	Description
<sequence_ number>	1 to 10	Numeric (integer only)	1	Selects the active sequence number

Response

The PM8572A will return the active sequence number.

SEQuence:DEFine<step>,<seg_number>,<repeat>,<adv_mode>,<sync_ bit>(?)

Description

This command builds a step in a sequence table. It defines all of the parameters that are associated with the sequence step such as segment number, link, loop, advance mode and sync mode.

Parameters

Name	Range	Type	Description
<step>	1 to 4096	Numeric (integer only)	Programs the step in the sequence table. Steps are indexed from 1 to 4096 and must be programmed in an ascending order; Empty step locations in a sequence table are not permitted.
<seg_number>	1 to 10k	Numeric (integer only)	Assigns a segment to a specific step number. When encountered in the sequence table, the segment number that is associated with the step will be generated.
<repeat>	1 to 1M	Numeric integer only)	Programs the repeat number of loops that a specific step will play before advancing to the next step in the sequence.
<adv_mode>	0-1	Boolean	"0" programs normal advance, "1" programs trigger advance. Step with a "0" bit assigned to it will advance automatically to the next step. If "1" is assigned to a step, the instrument will generate this step continuously and only a valid trigger signal will cause the sequence to advance to the next step. Note that the <adv_mode> parameter has no affect when the sequence advance mode is set to SING
<sync_bit>	0-1	Boolean	"1" programs bit present at a specific sequence step. This feature is required in applications where multiple sync bits are required in a single sequence. Note that normal sync output during sequence mode is LCOM.

NOTE

Although trigger signals are used to advance mixed mode, the mixed mode operates in continuous mode only. The <mode> parameter will be ignored if you will use SING as advance mode for the sequence table.

TIP

Every time you use the SEQ:DEF command while your PM8572A is in sequenced operating mode, the instrument attempts to rebuild the sequence table and restart the sequence. Therefore, sending this command in sequenced mode will slow the programming process and the operation of the generator. Using the SEQ:DEF command in FIX or USER mode will greatly speed up programming time.

SEQuence:DELete<sequence_number>

Description

This command will delete a step in a specific sequence table. Before you use this step make sure your sequence number is setup correctly for this operation.

Parameters

Name	Range	Type	Default	Description
<sequence_ number>	1 to 4096	Numeric (integer only)	1	Selects the step number of which will be deleted

SEQuence:DELete:ALL

Description

This command will delete the enire sequence table. Before you use this step make sure your sequence number is setup correctly for this operation.

OUTPut:SYNC:TYPE{BIT|LCOMplete}(?)

Description

This command will program the PM8572A SYNC mode.

Parameters

Name	Type	Default	Description
BIT	Discrete		The sync output will generate a pulse at the beginning of a specific segment regardless how many times the segment appears in a sequence. The width of the sync pulse is 16 waveform points.
LCOMplete	Discrete	LCOM	The sync output will transition high at the beginning of the sequence and will transition low at the end of the sequence, less 16 waveform points.

Response

The PM8572A will return BIT or LCOM depending on the present SYNC mode

Modulated Waveforms Control Commands

This group is used to control the modulated waveforms and their respective parameters. Note that the modulation can be turned off to create continuous carrier waveform (CW). The following modulation schemes can be selected and controlled: FM, AM, FSK, ASK, Sweep, Amplitude and Frequency hops, 3D, (n)PSK and (n)QAM. The modulation commands are summarized in Table 5-8. Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-8, Modulated Waveforms Commands

Keyword	Parameter Form	Default
[:SOURce]		
:MODulation		
:TYPE	OFF |FM | AM | SWEep | FSK | ASK | FHOPping | AHOPping | 3D | PSK | QAM	OFF
:CARRier		
[:FREQuency]	10 to 100e6	1e6
:BASeline	CARRier | DC	CARR
:LOAD		
:DEMO		
	Frequency Modulation Commands	
:FM		
:DEViation	10.0e-3 to 99.95e6	100e3
:FUNCtion		
:SHAPe	SINusoid | TRIangle | SQUare | RAMP | ARB	SIN
:FREQuency	10e-3 to 350e3)	10e3
:RASTer	1 to 2.5e6)	1e6
:MARKer		
[:FREQuency]	10e-3 to 100e6)	1e6
:DATA	<data_array>	
	Amplitude Modulation Commands	
:AM		
:FUNCtion		
:SHAPe	SINusoid | TRIangle | SQUare | RAMP	SIN
:MODulation		
:FREQuency	10e-3 to 1e6	10e3
:DEPTh	0 to 100	50
	Sweep Modulation Commands	
:SWEep		
[:FREQuency]		
:STARt	10 to 100.0e6	10e3
:STOP	10 to 100e6	1e6
:TIME	1.4e-6 to 40.0	1e-3
:DIRection	UP | DOWN	UP
:SPACing	LINear | LOGarithmic	LIN
:MARKer		
[:FREQuency]	10 to 100e6	505e3

Table 5-8, Model PM8572A SCPI Commands List Summary (continued)

Keyword	**Parameter Form**	**Default**
[:SOURce]		
	Frequency Shift Keying Modulation Commands	
:FSK		
:FREQuency		
:SHIFted	10 to 100e6	100e3
:BAUD	1 to 10e6	10e3
:MARKer	1 to 4000	1
:DATA	<data_array>	
	Amplitude Shift Keying Modulation Commands	
:ASK		
[:AMPLitude]		
[:STARt]	0 to 16	5
:SHIFted	0 to 16	1
:BAUD	1 to 2.5e6	10e3
:MARKer	1 to 1000	1
:DATA	<data_array>	
	Frequency Hopping Modulation Commands	
:FHOPping		
:DWELl		
:MODe	FIXed | VARiable	FIX
[:TIMe]	200e-9 to 20	200e-9
:FIXed		
:DATA	<data_array>	
:VARiable		
:DATA	<data_array>	
:MARKer	1 to 1000	1
	Amplitude Hopping Modulation Commands	
:AHOPping		
:DWELl		
:MODe	FIXed | VARiable	FIX
[:TIMe]	200e-9 to 20	200e-9
:FIXed		
:DATA	<data_array>	
:VARiable		
:DATA	<data_array>	
:MARKer	1 to 5000	1
	3D Modulation Commands	
:3D		
:DATA	<data_array>	
:MARKer	1 to 30000	
:RASTer	1.5 to 2.5e6	1e6

Table 55-8, Model PM8572A SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
[:SOURce]		
:PSK		
:TYPE	PSK | BPSK | QPSK | OQPSK | DQPSK | 8PSK | 16PSK | USER	PSK
:PHASe		
[:STARt]	0 to 360	0
:SHIFted	0 to 360	180
:RATE	1 to 10e6	10e3
:DATA	<data_array>	
:MARKer	1 to 4000	1
:BAUD	1 to 10e6	10e3
:CARRier		
:STATe	OFF | ON | 0 | 1	1
:USER		
:DATA	<data_array>	
:QAM		
:TYPE	16QAM | 64QAM | 256QAM | USER	QAM
:CARRier		
:STATe	OFF | ON | 0 | 1	1
:BAUD	1 to 10e6	10e3
:DATA	<data_array>	
:MARKer	1 to 4000	1
:USER		
:DATA	<data_array>	

MODulation:TYPE{OFF|FM|AM|SWEeep|FSK|ASK|FHOPping|AHOPping |3D|PSK|QAM}(?)

Description

This command will select the modulation type. All modulation types are internal, thus external signals are not required for producing modulation.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Modulation off is a special mode where the output generates continuous, non-modulated sinusoidal carrier waveform (CW).
FM	Discrete		This turns on the FM function. Program the FM parameters to fine tune the function for your application.
AM	Discrete		This turns on the AM function. Program the AM parameters to fine tune the function for your application.
SWEep	Discrete		This turns on the sweep function. Program the sweep parameters to fine tune the function for your application.
FSK	Discrete		This turns on the FSK function. Program the FSK parameters to fine tune the function for your application.
ASK	Discrete		This turns on the ASK function. Program the ASK parameters to fine tune the function for your application.
FHOPping	Discrete		This turns on the frequency hopping function. Program the hop parameters to fine tune the function for your application.
AHOPping	Discrete		This turns on the amplitude hopping function. Program the amplitude hopping parameters to fine tune the function for your application.
3D	Discrete		This turns on the 3D function. Program the 3D parameters to fine tune the function for your application.
PSK	Discrete		This turns on the PSK function. Program the PSK parameters to fine tune the function for your application.
QAM	Discrete		This turns on the QAM function. Program the QAM parameters to fine tune the function for your application.

Response

The PM8572A will return OFF, FM, AM, SWE, FSK, ASK, HOP, AHOP, 3D, PSK, or QAM depending on the present modulation type setting.

MODulation:CARRier<frequency>(?)

Description

This command programs the CW frequency. Note that the CW waveform is sine only and its frequency setting is separate to the standard sine waveform. The CW frequency setting is valid for all modulation types.

Parameters

Name	Range	Type	Default	Description
<frequency>	10e-3 to 100e6	Numeric	1e6	Programs the frequency of the carrier waveform in units of Hz. Note that the CW waveform is sine only and its frequency setting is separate to the standard sine waveform.

Response

The PM8572A will return the current carrier frequency value.

MODulation:CARRier:BASeline{CARRier|DC}(?)

Description

This command will program the carrier baseline when the modulation is used in triggered mode.

Parameters

Name	Type	Default	Description
CARRier	Discrete	CARR	This selects the carrier as the baseline for the modulation function, when operating in one of the interrupted run modes. The output will generate continuous, none modulated sinusoidal waveform (CW) until triggered, upon trigger will generate the modulated waveform and then resume generating continuous CW.
DC	Discrete		This selects DC level as the baseline for the modulation function, when operating in one of the interrupted run modes. The output will generate continuous DC until triggered, upon trigger will generate the modulated waveform and then resume generating continuous DC level.

Response

The PM8572A will return CARR, or DC depending on the present carrier baseline setting.

MODulation:LOAD:DEMO

Description

This command will load demo table to the memory. The table type depends on the selected modulation function. Table will be loaded for the following functions: (n)PSK, User PSK, (n)QAM and User QAM.

FM Modulation Programming

Use the following command for programming the FM parameters. FM control is internal. There are two types of waveforms that can be used as the modulating waveforms: Standard and Arbitrary. The standard waveforms are built in a library of waveforms and could be used anytime without external control. The arbitrary waveforms must be loaded into a special FM arbitrary waveform memory and only then can be used as a modulating waveform.

FM:DEViation<deviation>(?)

Description
This programs the deviation range around the carrier frequency. The deviation range is always symmetrical about the carrier frequency. If you need non-symmetrical deviation range, you can use the arbitrary FM composer screen or an external utility to design such waveforms.

Parameters

Name	Range	Type	Default	Description
<deviation>	10e-3 to 100e6	Numeric	100e3	Programs the deviation range around the carrier frequency in units of Hz.

Response
The PM8572A will return the present deviation frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:FUNCtion:SHAPe(SINusoid|TRIangle|SQUare|RAMP|ARB}(?)

Description
This command will select one of the waveform shapes as the active modulating waveform.

Parameters

Name	Type	Default	Description
SINusoid	Discrete	SIN	Selects the sine shape as the modulating waveform
TRIangle	Discrete		Select the triangular shape as the modulating waveform
SQUare	Discrete		Select the square shape as the modulating waveform
RAMP	Discrete		Selects the ramp shape as the modulating waveform
ARB	Discrete		Selects an arbitrary waveform as the modulating shape. The waveform must be designed and downloaded to the FM arbitrary modulating waveform memory before one can use this option. Information on how to create and download FM arbitrary waveforms is given later in this chapter.

Response
The PM8572A will return SIN, TRI, SQU, RAMP, or ARB depending on the selected function shape setting.

FM:FREQuency<fm_freq>(?)

Description
This command will set the modulating wave frequency for the built-in standard modulating waveform library.

Parameters

Name	Range	Type	Default	Description
<fm_freq>	10e-3 to 350e3	Numeric	10e3	Programs the frequency of the modulating waveform in units of Hz. The frequency of the built-in standard modulating waveforms only is affected.

Response
The PM8572A will return the present modulating waveform frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:FREQuency:RASTer<arb_fm_freq>(?)

Description
This command will set the sample clock frequency for the arbitrary modulating waveform. Arbitrary modulating waveforms must be created in an external utility and downloaded to the FM arbitrary waveform memory before this function can be used.

Parameters

Name	Range	Type	Default	Description
<arb_fm_freq >	1 to 2.5e6	Numeric	1e6	Programs the sample clock frequency of the arbitrary modulating waveform in units of S/s.

Response
The PM8572A will return the present sample clock of the arbitrary modulating waveform value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:MARKer<frequency>(?)

Description
This function programs marker frequency position. FM marker can be placed inside the following range: (carrier frequency ± deviation frequency / 2). The marker pulse is output from the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<frequency>	10e-3 to 100e6	Numeric	1e6	Programs the marker frequency position in units of Hz.

Response
The PM8572A will return the present marker frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:DATA#<header><binary_block>

Description

This command will download FM modulating waveform data to the arbitrary FM memory. Arbitrary modulating waveform table data is loaded to the PM8572A using high-speed binary transfer in a similar way to downloading waveform data with the trace command. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. Remember, downloading data to the arbitrary FM waveform memory is very different than loading arbitrary waveform data. Waveform data programs amplitude domain therefore, every point programs an amplitude level. On the other hand, FM modulating waveform data programs frequency domain therefore, every point sets different sample clock frequency.

```
FM:DATA#3100<binary_block>
```

This command causes the transfer of 10 bytes of data to the arbitrary FM waveform memory. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "3" designates the number of digits that follow.
- "100" is the number of bytes to follow. This number must divide by 4.

The generator accepts binary data as 32-bit integers, which are sent in five-byte words. Therefore, the total number of bytes is always three times the number of arbitrary FM waveform points. For example, 100 bytes are required to download 20 arbitrary FM waveform points. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1 (refer to the TRACe subsystem). The transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as sequence data and will not cause unexpected termination of the arbitrary block data.

Downloading data to the arbitrary FM waveform memory is very different than loading arbitrary waveform data. Waveform data programs amplitude domain therefore, every point programs an amplitude level. On the other hand, FM modulating waveform data programs frequency domain therefore, every point sets different frequency. The FM modulating waveform data is made of 32-bit words. However, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 32-bit words and rearranged as five 8-bit words before it can be used by the PM8572A as FM modulating waveform data. Figure 4-8 shows how to prepare the 32-bit word for the FM modulating waveform.

There are a number of points you should be aware of before you start preparing the data:

1. The FM function is shared by both channels
2. The number of bytes in a complete FM modulating waveform data must divide by 4. The Model PM8572A has no control over data sent to its FM waveform during data transfer. Therefore, wrong data and/or incorrect number of bytes will cause errors
3. The LSBit on the last byte sets marker position. “0” = sets no marker and “1” sets marker. You can set as many markers as you want.
4. The SYNC output serves as marker output when you have the PM8572A set to operate in FM mode. Normal SYNC level is TTL low. The SYNC output is set to TTL high at the position of the marker. This way you can use the SYNC output to mark frequency occurrences during FM operation.
5. Data download is terminated with the MSBit of the last byte set to 1.

The following sequence should be used for downloading arbitrary FM Waveforms:

1. Prepare your FM waveform data points using the following relationship:

   N = Frequency[Hz] x 14.31655765

2. Use an I/O routine such as ViMoveAsync (from the VISA I/O library) to transfer binary blocks of data to the generator.

Parameters

Name	Type	Description
<binary_block >	Binary	Block of binary data that contains information on the arbitrary modulating waveform.

AM modulation Programming

Use the following command for programming the AM parameters. AM control is internal. The commands for programming the amplitude modulation function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

AM:FUNCtion:SHAPe(SINusoid|TRIangle|SQUare|RAMP}(?)

Description
This command will select one of the waveform shapes as the active modulating waveform.

Parameters

Name	Type	Default	Description
SINusoid	Discrete	SIN	Selects the sine shape as the modulating waveform
TRIangle	Discrete		Select the triangular shape as the modulating waveform
SQUare	Discrete		Select the square shape as the modulating waveform
RAMP	Discrete		Selects the ramp shape as the modulating waveform

Response
The PM8572A will return SIN, TRI, SQU, or RAMP depending on the selected function shape setting.

AM:FREQuency<am_freq>(?)

Description
This command will set the modulating wave frequency for the built-in standard modulating waveform library.

Parameters

Name	Range	Type	Default	Description
<am_freq>	10e-3 to 1e6	Numeric	10e3	Programs the frequency of the modulating waveform in units of Hz. The frequency of the built-in standard modulating waveforms only is affected.

Response
The PM8572A will return the present modulating waveform frequency value. The returned value will be in

standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

AM:DEPth<depth>(?)

Description
This command will set the modulating wave frequency for the built-in standard modulating waveform library.

Parameters

Name	Range	Type	Default	Description
<depth>	0 to 100	Numeric	50	Programs the depth of the modulating waveform in units of percent.

Response
The PM8572A will return the present modulating depth value.

Sweep Modulation Programming

Use the following command for programming the sweep parameters. Sweep control is internal. The frequency will sweep from start to stop frequencies at an interval determined by the sweep time value and controlled by a step type determined by the sweep step parameter.

There are two sweep modes: Linear, where the step of which the generator increments from start to stop frequency is linear and Logarithmic, where the step of which the generator increments from start to stop frequency is logarithmic

The commands for programming the frequency sweep function are described below.

SWEep:STARt<start_freq>(?)

Description
This specifies the sweep start frequency. The PM8572A will normally sweep from start to stop frequencies however, if the sweep direction is revered, the output will sweep from stop to start frequencies. The start and stop frequencies may be programmed freely throughout the frequency of the standard waveform frequency range.

Parameters

Name	Range	Type	Default	Description
<start_freq>	10e-3 to 100e6	Numeric	10e3	Programs the sweep start frequency. Sweep start is programmed in units of Hz.

Response
The PM8572A will return the present sweep start frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

SWEep:STOP<stop_freq>(?)

Description

This specifies the sweep stop frequency. The PM8572A will normally sweep from start to stop frequencies however, if the sweep direction is revered, the output will sweep from stop to start frequencies. The start and stop frequencies may be programmed freely throughout the frequency of the standard waveform frequency range.

Parameters

Name	Range	Type	Default	Description
<stop_freq>	10e-3 to 100e6	Numeric	1e6	Programs the sweep stop frequency. Sweep stop is programmed in units of Hz.

Response

The PM8572A will return the present sweep stop frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

SWEep:TIMe<time>(?)

Description

This specifies the time that will take the PM8572A to sweep from start to stop frequencies. The time does not depend on the sweep boundaries as it is automatically adjusted by the software to the required interval. At the end of the sweep cycle the output waveform maintains the sweep stop frequency setting except if the PM8572A is in continuous run mode where the sweep repeats itself continuously.

Parameters

Name	Range	Type	Default	Description
<time>	1.4e-6 to 40	Numeric	1e-3	Programs the sweep time. Sweep time is programmed in units of s.

Response

The PM8572A will return the present sweep time. The returned value will be in standard scientific format (for example: 100ms would be returned as 100e-3 – positive numbers are unsigned).

SWEep:DIRection(UP|DOWN}(?)

Description

This specifies if the PM8572A output will sweep from start-to-stop (UP) or from stop-to-start (DOWN) frequencies. Sweep time does not affect the sweep direction and frequency limits. At the end of the sweep cycle the output waveform normally maintains the sweep stop frequency setting but will maintain the start frequency, if the DOWN option is selected except if the PM8572A is in continuous run mode where the sweep repeats itself continuously.

Parameters

Name	Type	Default	Description
UP	Discrete	UP	Selects the sweep up direction
DOWN	Discrete		Select the sweep down direction

Response

The PM8572A will return UP, or DOWN depending on the selected direction setting.

SWEep:SPACing(LINear|LOGarithmic}(?)

Description

This specifies the sweep step type. Two options are available: logarithmic or linear. In linear, the incremental steps between the frequencies are uniform throughout the sweep range. Logarithmic type defines logarithmic spacing throughout the sweep start and stop settings.

Parameters

Name	Type	Default	Description
LINear	Discrete	LIN	Selects the linear sweep spacing
LOGarithmic	Discrete		Select the logarithmic sweep spacing

Response

The PM8572A will return LIN, or LOG depending on the selected spacing setting.

SWEep:MARKer<frequency>(?)

Description

This function programs marker frequency position. Sweep marker can be placed in between the start and the stop frequencies. The marker pulse is output from the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<frequency>	10e-3 to 100e6	Numeric	505e3	Programs the marker frequency position in units of Hz.

Response

The PM8572A will return the present marker frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FSK Modulation Programming

Use the following command for programming the FSK parameters. FSK control is internal. The frequency will shift from carrier to shifted frequency setting at a rate determined by the baud value and controlled by a sequence of bits in the FSK data table. The commands for programming the frequency shift keying function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

FSK:FREQuency:SHIFted<shift_freq>(?)

Description

This programs the shifted frequency. The frequency shifts when the pointer in the data array points to “1”.

Parameters

Name	Range	Type	Default	Description
<shift_freq>	10 to 100e6	Numeric	100e3	Programs the shifted frequency value in units of Hz.

Response

The PM8572A will return the present shifted frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FSK:FREQuency:BAUD<baud>(?)

Description

This allows the user to select FSK word rate. The word rate is the interval of which the bit streams in the FSK data array are clocked causing the output frequency to hop from carrier to shifted frequency values and visa versa.

Parameters

Name	Range	Type	Default	Description
<baud>	1 to 10e6	Numeric	10e3	Programs the rate of which the frequency shifts from carrier to shifted frequency in units of Hz.

Response

The PM8572A will return the present baud value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FSK:FREQuency:MARKer<index>(?)

Description

Programs where on the data stream the PM8572A will generate a pulse, designated as FSK marker, or index point. The marker pulse is generated at the SYNC output connector. Note that if you intend to program marker position, you must do it before you load the FSK data list.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 4000	Numeric (integer only)	1	Programs a marker pulse at an index bit position.

Response

The PM8572A will return the present marker position.

FSK:DATA<fsk_data>

Description

Loads the data stream that will cause the PM8572A to hop from carrier to shifted frequency and visa versa. Data format is a string of "0" and "1" which define when the output generates carrier frequency and when it shifts frequency to the FSK value. "0" defines carrier frequency,"1" defines shifted frequency. Note that if you intend to program marker position, you must do it before you load the FSK data list.

Below you can see how an FSK data table is constructed. The sample below shows a list of 10 shifts. The PM8572A will step through this list, outputting either carrier or shifted frequencies, depending on the data list: Zero will generate carrier frequency and One will generate shifted frequency. Note that the waveform is always sinewave and that the last cycle is always completed.

Sample FSK Data Array

0 1 1 1 0 1 0 0 0 1

Parameters

Name	Type	Description
<fsk_data>	ASCII	Block of ASCII data that contains information for the generator when to shift from carrier to shifted frequency and visa versa.

ASK Modulation Programming

Use the following command for programming the ASK parameters. ASK control is internal. The amplitude will toggle between two amplitude settings at a rate determined by the baud value and controlled by a sequence of bits in the ASK data table. The commands for programming the amplitude shift keying function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

ASK<amplitude>(?)

Description

This programs the normal amplitude setting. The amplitude shifts when the pointer in the data array points to “1”.

Parameters

Name	Range	Type	Default	Description
<amplitude>	0 to 16	Numeric	5	Programs the amplitude setting in units of volt.

Response

The PM8572A will return the present amplitude value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

ASK:SHIFted<shift_ampl>(?)

Description

This programs the shifted amplitude. The amplitude shifts when the pointer in the data array points to “1”.

Parameters

Name	Range	Type	Default	Description
<shift_ampl>	0 to 16	Numeric	1	Programs the shifted amplitude setting in units of volt.

Response

The PM8572A will return the present shifted amplitude value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

ASK:BAUD<rate>(?)

Description

This allows the user to select ASK word rate. The word rate is the interval of which the bit streams in the ASK data array are clocked causing the output amplitude to hop from one level to shifted amplitude level values and visa versa.

Parameters

Name	Range	Type	Default	Description
<rate>	1 to 2.5e6	Numeric	10e3	Programs the rate of which the frequency shifts from carrier to shifted frequency in units of Hz.

Response
The PM8572A will return the present baud value. The returned value will be in standard scientific format (for example: 100kHz would be returned as 100e3 – positive numbers are unsigned).

ASK:FREQuency:MARKer<index>(?)

Description
Programs where on the data stream the PM8572A will generate a pulse, designated as ASK marker, or index point. The marker pulse is generated at the SYNC output connector. Note that if you intend to program marker position, you must do it before you load the ASK data list.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 1000	Numeric (integer only)	1	Programs a marker pulse at an index bit position.

Response
The PM8572A will return the present marker position.

ASK:DATA<ask_data>

Description
Loads the data stream that will cause the PM8572A to hop from one amplitude level to shifted amplitude level and visa versa. Data format is a string of "0" and "1" which define when the output generates base level and when it shifts amplitude to the ASK value. "0" defines base level amplitude,"1" defines shifted amplitude level. Note that if you intend to program marker position, you must do it before you load the ASK data list.

Below you can see how an ASK data table is constructed. The sample below shows a list of 10 shifts. The PM8572A will step through this list, outputting either base or shifted amplitudes, depending on the data list: Zero will generate base level and One will generate shifted amplitude. Note that the waveform is always sinewave and that the last cycle is always completed.

Sample ASK Data Array

0 1 1 1 0 1 0 0 0 1

Parameters

Name	Type	Description
<ask_data>	ASCII	Block of ASCII data that contains information for the generator when to shift from base to shifted amplitude and visa versa.

Frequency Hopping Modulation Programming

Use the following command for programming the frequency hop parameters. Hop control is internal. The frequency will hop from frequency to frequency at a rate determined by the dwell time value and controlled by a sequence of frequencies in the HOP data table.

There are two hop modes: Fixed Dwell, where the rate of which the generator hops from frequency to frequency is constant and Variable Dwell, where the rate of which the generator hops from frequency to frequency is programmable for each hop.

The commands for programming the frequency hopping function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

FHOP:DWELl:MODe(FIXed|VARiable}(?)

Description
This selects between fixed or variable dwell-time for the frequency hops. Select the fixed option if you want each frequency to dwell equally on each step. The variable option lets you program different dwell times for each frequency hop. The PM8572A output hops from one frequency to the next according to a sequence given in a hop table. The variable dwell time table contains dwell time data for each step however, the fixed dwell time table does not contain any dwell time information and therefore, if you select the fixed option, make sure your dwell time is programmed as required.

Parameters

Name	Type	Default	Description
FIXed	Discrete	FIX	Selects the fixed dwell time frequency hops mode
VARiable	Discrete		Select the variable dwell time frequency hops mode

Response
The PM8572A will return FIX, or VAR depending on the selected dwell setting.

FHOP:DWELl<dwell_time>(?)

Description
This selects the dwell time for frequency hops when the selected mode is Fixed dwell time hops. The dwell time table in this case does not contain the dwell time per step parameters and therefore, the value which is programmed with this command remains constant for the entire hop sequence.

Parameters

Name	Range	Type	Default	Description
<dwell_time>	200e-9 to 20	Numeric	200e-9	Programs dwell time for the fixed dwell-time frequency hop function. The same dwell time will be valid for each frequency hop. Dwell time is programmed in units of s.

Response

The PM8572A will return the present dwell time value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FHOP:FIX:DATA<fix_hop_data>

Description

This command will download the data array that will cause the instrument to hop through the frequency list. The dwell time for each frequency list item is fixed and can be programmed using the HOP:DWEL command. Note that if you intend to program marker position, you must do it first and then load the frequency hops list.

Below you can see how a hop table is constructed. The file sample below shows a list of 10 frequencies. The PM8572A will hop through this list, outputting the next frequency each time it hops. Note that the carrier waveform is always sinewave and that the last cycle is always completed even if the dwell time is shorter than the period of the waveform. For example, if you program dwell time of 1ms and the frequency step has frequency of 1Hz (1s period), the frequency step will last 1 second although the dwell time is 1ms.

Sample Frequency Hops Data Array

1e+6 2e+6 3e+3 4e+6 5e+5 6e+2 7e+1 8e+6 9e+3 10e+5

Parameters

Name	Type	Description
<fix_hop_data>	Double	Block of binary data that contains information of frequency values.

FHOP:FIX:DATA<var_hop_data>

Description

This command will download the data array that will cause the instrument to hop through the frequency list. The dwell time for each frequency list item is variable and is supplied in the variable hop table data array. Note that the HOP:DWEL command has no effect on this sequence. Also note that if you intend to program marker position, you must do it first and then load the frequency hops list.

Below you can see how a hop table is constructed. The file sample below shows a list of 10 frequencies and their associated dwell times. The PM8572A will hop through this list, outputting the next frequency each time it hops. Note that the carrier waveform is always sinewave and that the last cycle is always completed even if the dwell time is shorter than the period of the waveform. For example, if you program dwell time of 1ms and the frequency step has frequency of 1Hz (1s period), the frequency step will last 1 second although the dwell time is 1ms.

Sample Frequency Hops Data Array

1e+6 100 2e+6 2000 3e+3 3e4 4e+6 40 5e+5 5e3 6e+2 6000 7e+1 0.7 8e+8e2 6 9e+3 90 10e+51000

In the above example, the first number is the frequency value and the second number is its dwell time. Therefore, only even number of sets can be located in this table.

Parameters

Name	Type	Description
<var_hop_data>	Double	Block of binary data that contains information of frequency hop values and their respective dwell time.

FHOP:MARKer<index>(?)

Description

Programs where on the frequency list the PM8572A will generate a pulse, designated as Hop marker, or index point. The marker pulse is generated at the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 1000	Numeric (integer only)	1	Programs a marker pulse at an index frequency hop position.

Response

The PM8572A will return the present marker position.

Amplitude Hopping Modulation Programming

Use the following command for programming the amplitude hop parameters. Hop control is internal. The amplitude will hop from amplitude level to amplitude level at a rate determined by the dwell time value and controlled by a sequence of amplitudes in the HOP data table.

There are two hop modes: Fixed Dwell, where the rate of which the generator hops from amplitude level to amplitude level is constant and Variable Dwell, where the rate of which the generator hops from amplitude level to amplitude level is programmable for each hop.

The commands for programming the amplitude hopping function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

AHOP:DWELl:MODe(FIXed|VARiable}(?)

Description

This selects between fixed or variable dwell-time for the amplitude hops. Select the fixed option if you want each amplitude level to dwell equally on each step. The variable option lets you program different dwell times for each amplitude hop. The PM8572A output hops from one amplitude level to the next according to a sequence given in a hop table. The variable dwell time table contains dwell time data for each step however, the fixed dwell time table does not contain any dwell time information and therefore, if you select the fixed option, make sure your dwell time is programmed as required.

Parameters

Name	Type	Default	Description
FIXed	Discrete	FIX	Selects the fixed dwell time amplitude hops mode
VARiable	Discrete		Select the variable dwell time amplitude hops mode

Response
The PM8572A will return FIX, or VAR depending on the selected dwell setting.

AHOP:DWELl<dwell_time>(?)

Description
This selects the dwell time for amplitude hops when the selected mode is Fixed dwell time hops. The dwell time table in this case does not contain the dwell time per step parameters and therefore, the value which is programmed with this command remains constant for the entire hop sequence.

Parameters

Name	Range	Type	Default	Description
<dwell_time>	200e-9 to 20	Numeric	200e-9	Programs dwell time for the fixed dwell-time amplitude hop function. The same dwell time will be valid for each amplitude hop. Dwell time is programmed in units of s.

Response
The PM8572A will return the present dwell time value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

AHOP:FIX:DATA<fix_hop_data>

Description
This command will download the data array that will cause the instrument to hop through the amplitude list. The dwell time for each amplitude list item is fixed and can be programmed using the HOP:DWEL command. Note that if you intend to program marker position, you must do it first and then load the amplitude hops list.

Below you can see how a hop table is constructed. The file sample below shows a list of 10 amplitudes. The PM8572A will hop through this list, outputting the next amplitude each time it hops. Note that the carrier waveform is always sinewave and that the last cycle is always completed even if the dwell time is shorter than the period of the waveform. For example, if you program dwell time of 1ms and the amplitude step has frequency of 1Hz (1s period), the frequency step will last 1 second although the dwell time is 1ms.

Sample Amplitude Hops Data Array

0 1e0 2e0 3e0 4e+0 5e+0 100e-3 200e-3 300e-3 400e-3 500e-3

Parameters

Name	Type	Description
<fix_hop_data>	Double	Block of binary data that contains information of amplitude values.

AHOP:FIX:DATA<var_hop_data>

Description

This command will download the data array that will cause the instrument to hop through the amplitude list. The dwell time for each amplitude list item is variable and is supplied in the variable hop table data array. Note that the HOP:DWEL command has no effect on this sequence. Also note that if you intend to program marker position, you must do it first and then load the amplitude hops list.

Below you can see how a hop table is constructed. The file sample below shows a list of 10 amplitudes and their associated dwell times. The PM8572A will hop through this list, outputting the next amplitude each time it hops. Note that the carrier waveform is always sinewave and that the last cycle is always completed even if the dwell time is shorter than the period of the waveform. For example, if you program dwell time of 1ms and the amplitude step has frequency of 1Hz (1s period), the amplitude step will last 1 second although the dwell time is 1ms.

Sample Amplitude Hops Data Array

1e0 100 2e0 2000 3e0 3000 4e0 4000 5e0 5000 6e0 6000 7e0 7000 8e0 8000 9e0 9000 10e0 10000

In the above example, the first number is the amplitude value and the second number is its dwell time. Therefore, only even number of sets can be located in this table.

Parameters

Name	Type	Description
<var_hop_data>	Double	Block of binary data that contains information of amplitude hop values and their respective dwell time.

AHOP:MARKer<index>(?)

Description

Programs where on the amplitude list the PM8572A will generate a pulse, designated as Hop marker, or index point. The marker pulse is generated at the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 5000	Numeric (integer only)	1	Programs a marker pulse at an index amplitude hop position.

Response

The PM8572A will return the present marker position.

3D Modulation Programming

Use the following command for programming the 3D modulation parameters. 3D modulation requires an external utility to download the modulation coordinates into the 3D memory location. In case you intend to build your own 3D profiles, use the examples as given in the IVI drivers that are supplied with the PM8572A.

The commands for programming the 3D function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

3D:DATA<data_array>

Description

The 3D modulation allows simultaneous profiling of amplitude, frequency and phase. Amplitude profiles can be different for each channel however, frequency and phase are common to both channels. There are 30,000 waveform points that are allocated for the 3D modulation of which can be clocked using a 3D sample clock generator from 1 Hz to 2.5 MHz and thus generating up to 30,000 increments of simultaneous amplitude, frequency and phase profiles within the programmed period.

3D data must be downloaded to the PM8572A before it can generate 3D profiles. The best way to generate such data would be by using the supplied ArbConnection program. Information how to use ArbConnection is given in a separate chapter of this manual. To generate the data, open the 3D Composer and create your profiles, then store the profiles with a known name. You can then use the stored files as data entry for the 3D data array input. Another way to create 3D data is by using the supplied IVI driver. The IVI driver has sample programs and software routines that show how to generate 3D data.

Regardless if you select to use ArbConnection or the IVI driver, you are always welcomed to contact the Tabor Electronics support center for information and help with this function.

Parameters

Name	Type	Description
<data_array>	Double	Block of binary data that contains information of the 3D profiles. Data contains amplitude sweeps for both channels as well as, frequency and phase sweep parameters for the 3D waveform.

3D:MARKer<index>(?)

Description

Programs where on the 3D profile the PM8572A will generate a pulse, designated as 3Dop marker, or index point. The marker pulse is generated at the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 30000	Numeric (integer only)	1	Programs a marker pulse at an index 3D position.

Response

The PM8572A will return the present marker position.

3D:RASTer<3D_freq>(?)

Description

This command will set the sample clock frequency for the 3D modulation profiler. The 3D waveforms must be created using an external utility and downloaded to the 3D memory before this function can be used.

Parameters

Name	Range	Type	Default	Description
<3D_freq>	1.5 to 2.5e6	Numeric	1e6	Programs the sample clock frequency of the 3D modulating waveform in units of S/s.

Response

The PM8572A will return the present sample clock of the 3D modulating waveform value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

PSK Modulation Programming

Use the following command for programming the PSK parameters. The following commands will be divided into two groups: PSK commands and (n)PSK commands. The PSK function can shift from start to shifted phase setting, within the range of 0 to 360°, at a frequency determined by the rate value and controlled by a sequence of bits in the PSK data table. The (n)PSK functions use pre-defined table settings. In case the standard table do not suit the application you can design your own (n)PSK data using the User PSK data table entry option. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

PSK:TYPE{PSK|BPSK|QPSK|OQPSK|8PSK|16PSK|USER}(?)

Description

This selects between the various (n)PSK modulation schemes. Note that PSK and BPSK are almost identical functions except PSK can be programmed to shift from any phase to any phase and the BPSK toggles between two pre-determined values only – 0° and 180°.

Parameters

Name	Type	Default	Description
PSK	Discrete	PSK	Selects the PSK modulation function. In this mode, the instrument shifts from any phase to any phase as programmed by the PSK:PHAS and PSK:PHAS:SHIF commands. The rate of which the PSK toggles phase values is programmed using the PSK:RATE command.

BPSK	Discrete	Selects the Binary Phase Shift Keying (BPSK) modulation type. In this mode, the instrument shifts from 0° to 180° at a rate determined by the PSK:BAUD command and in a sequence as programmed by the PSK:DATA table.
QPSK	Discrete	Selects the Quadrature Phase Shift Keying (QPSK) modulation type. In this mode, the instrument responds to 2 input bits that correspond to four phases of the carrier wave. The symbols are shifts at a rate determined by the PSK:BAUD command and in a sequence as programmed by the PSK:DATA table.
OQPSK	Discrete	Selects the Offset Phase Shift Keying (OPSK) modulation type. The mapping is the same as for the QPSK except the element of I is moved first and then the element of Q is moved if the status changes from one to another. These two steps are carried out within the time of one step of QPSK. By shifting the movement of the Q element, the status can be changed without going through the origin even if a change of 180° occurs. Because one symbol period is calculated in two steps, an even value must be used for oversampling. The symbols are shifts at a rate determined by the PSK:BAUD command and in a sequence as programmed by the PSK:DATA table.
DQPSK	Discrete	Selects the Π/4-shifted Differentially encoded QPSK modulation type. In this mode, the symbol is located at the position where the phase is shifted from the current symbol position by 45° from the value of the next data symbol. The first symbol position is defined by QPSK. pre-defined values. Π/4DQPSK uses both the QPSK and another four-point table rotated by 45°.The symbols are shifts at a rate determined by the PSK:BAUD command and in a sequence as programmed by the PSK:DATA table.
8PSK	Discrete	Selects the 8-phase Shift Keying (8PSK) modulation type. In this mode, the instrument shifts through eight symbols with 3 bits. The symbols are shifts at a rate determined by the PSK:BAUD command and in a sequence as programmed by the PSK:DATA table.
16PSK	Discrete	Selects the 16-phase Shift Keying (16PSK) modulation type. In this mode, the instrument shifts through sixteen symbols with 4 bits. The symbols are shifts at a rate determined by the PSK:BAUD command and in a sequence as programmed by the PSK:DATA table.
USER	Discrete	Selects the User PSK modulation type. There are no pre-assigned symbols for this mode and therefore, the symbols must first be designed using the PSK:USER:DATA table. The number of bits are user

definable. The symbols are shifts at a rate determined by the PSK:BAUD command and in a sequence as programmed by the PSK:DATA table.

Response
The PM8572A will return PSK, BPSK, QPSK, OPSK, DPSK, 8PSK, 16PSK, or USER on the selected PSK type setting.

PSK:PHASe:<start_phase>(?)

Description
This programs the start phase of the carrier waveform. The start phase shifts when the pointer in the data array points to “0”.

Parameters

Name	Range	Type	Default	Description
<start_phase>	0 to 360	Numeric	0	Programs the start phase for the carrier waveform in units of degrees.

Response
The PM8572A will return the present start phase value.

PSK:PHASe:SHIFted<shift_phase>(?)

Description
This programs the shifted phase. The phase shifts when the pointer in the data array points to “1”.

Parameters

Name	Range	Type	Default	Description
<shift_phase>	0 to 360	Numeric	180	Programs the shift phase for the carrier waveform in units of degrees.

Response
The PM8572A will return the present shift phase value.

FSK:RATE<rate>(?)

Description
This allows the user to select PSK word rate. The word rate is the interval of which the bit streams in the PSK data array are clocked, causing the output phase to hop from start to shifted phase values and visa versa. Note that this command is dedicated for programming the PSK modulation function only.

Parameters

Name	Range	Type	Default	Description
<baud>	1 to 10e6	Numeric	10e3	Programs the rate of which the phase shifts from start to shifted frequency in units of Hz.

Response

The PM8572A will return the present baud value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

PSK:DATA<psk_data>

Description

Loads the data stream that will cause the PM8572A to hop from phase to phase. Data format is a string of "0" and "1" which define when the output generates the various phases. The size of the data word depends on the PSK function. For PSK and BPSK there are only two bits - "0" defines start phase,"1" defines shifted phase. 16PSK has 4 bits of which 0000 defines the first phase vector 0001 defines the second, 0000 the third and 1111 defines the 16th phase vector. Note that if you intend to program marker position, you must do it before you load the PSK data list.

Below you can see how an PSK data table and a 16PSK data table are constructed. The PSK data table sample below shows a list of 10 shifts. The PM8572A will step through this list, outputting either start or shifted phases, depending on the data list: Zero will generate start phase and One will generate shifted phase. Note that the output waveform is always sinewave and that the last cycle is always completed. The 16PSK data array has 10 shifts as well except this time the shifts are a bit more complex.

Sample PSK Data Array

0 1 1 1 0 1 0 0 0 1

Sample 16PSK Data Array

0000 0100 1010 0111 1111 0001 0010 0111 0101 1111

Parameters

Name	Type	Description
<psk_data>	ASCII	Block of ASCII data that contains information for the generator when to step from one phase setting to another.

PSK:MARKer<index>(?)

Description

Programs where on the data stream the PM8572A will generate a pulse, designated as PSK marker, or index point. The marker pulse is generated at the SYNC output connector. Note that if you intend to program marker position, you must do it before you load the PSK data list. The PSK:MARK command is common to all PSK modulation functions.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 4000	Numeric (integer only)	1	Programs a marker pulse at an index bit position.

Response
The PM8572A will return the present marker position.

PSK:BAUD<baud>(?)

Description
This allows the user to select (n)PSK baud. The baud is the interval of which the symbols stream in the (n)PSK data array as they are clocked with the baud generator. Note that this command is dedicated for programming the (n)PSK modulation function only and will have no effect on the PSK function.

Parameters

Name	Range	Type	Default	Description
<baud>	1 to 10e6	Numeric	10e3	Programs the baud of which the symbols stream in the (n)PSK data table. Baud is programmed in units of Hz.

Response
The PM8572A will return the present baud value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

PSK:CARRier:STATe{OFF|ON|0|1}(?)

Description
This command will toggle the carrier waveform (CW) on and off. This command affects all (n)PSK function and has no effect on the PSK function. The carrier off function is especially useful as direct input for I & Q vector generators that need the digital information only and supply the carrier information separately.

Parameters

Range	Type	Default	Description
0-1	Discrete	1	Sets the carrier output on and off

Response
The PM8572A will return 1 if the output is on, or 0 if the output is off.

PSK:USER:DATA<user_data>

Description
Loads the user phase data for the (n)PSK modulation function. The data contains a list of phase values within the range of 0° to 360°. The user data table is associated with the User PSK function only where symbols can be freely designed as non-standard vectors. After you enter the symbol data in this table, you must generate the symbol sequence using the PSK:DATA command, as shown earlier in this section.

Below you can see an example of the User PSK data table. The symbol index is automatically incremented from 0 to n so there is no need to provide index numbers in this table.

Sample User PSK Symbols Data Array

5.5 50 95 120 150 190.4 210 225.8 265 280 307 90.7 180.2

Parameters

Name	Type	Description
<user_data>	Binary	Block of binary data that contains phase information for the (n)PSK modulation function.

QAM Modulation Programming

Use the following command for programming the QAM parameters. The QAM commands allow selection of the (n)QAM type, programming the QAM baud, placing the marker position, turning the carrier waveform (CW) on and off function and designing data symbols.

QAM:TYPE{16QAM|64QAM|256QAM|USER}(?)

Description

This selects between the various (n)QAM modulation schemes. The 16QAM, 64QAM and 256QAM types have standard symbol configuration. In case you need a non-standard symbol constellations, use the User QAM to design your own symbol data.

Parameters

Name	Type	Default	Description
16QAM	Discrete	16QAM	Selects the 16 Quadrature Amplitude Modulation (16QAM) modulation type. 16QAM is a 4-level modulation method that uses 16 phases/amplitude symbols. The first two bits define at which event of the IQ plane the phase exists (00: upper right, 01: upper left, 10: lower left, 11: lower right) and the rest of the 2 bits defines the position of the symbol in each event. The instrument steps through these events in a sequence as listed in the QAM:DATA table and at a frequency which is programmed using the QAM:BAUD parameter.
64QAM	Discrete		Selects the 64 Quadrature Amplitude Modulation (64QAM) modulation type. 64QAM is a 6-level modulation method that uses 64 phases/amplitude symbols. The first two bits define at which event of the IQ plane the phase exists (00: upper right, 01: upper left, 10: lower left, 11: lower right) and the rest of the 4 bits defines the position of the symbol in each event. The instrument steps through these events in a sequence as listed in the QAM:DATA table and at a frequency which is programmed using the QAM:BAUD parameter.
256QAM	Discrete		Selects the 256 Quadrature Amplitude Modulation (256QAM) modulation type. 64QAM is a 8-level modulation method that uses 256 phases/amplitude symbols. The first two bits define at which event of the IQ plane the phase exists (00: upper right, 01: upper left, 10: lower left, 11: lower right) and the rest of the 6 bits defines the position of the symbol in each event.

		The instrument steps through these events in a sequence as listed in the QAM:DATA table and at a frequency which is programmed using the QAM:BAUD parameter.
USER	Discrete	Selects the User QAM modulation type. There are no pre-assigned symbols for this mode and therefore, the symbols must first be designed using the QAM:USER:DATA table. The instrument will then step through the programmed symbols in a sequence as listed in the QAM:DATA table and at a frequency which is programmed using the QAM:BAUD parameter.

Response

The PM8572A will return 16QAM, 64QAM, 256QAM, or USER depending on the selected QAM type setting.

QAM:BAUD<baud>(?)

Description

This allows the user to select (n)QAM baud. The baud is the interval of which the symbols stream in the (n)QAM data array as they are clocked with the baud generator.

Parameters

Name	Range	Type	Default	Description
<baud>	1 to 10e6	Numeric	10e3	Programs the baud of which the symbols stream in the (n)QAM data table. Baud is programmed in units of Hz.

Response

The PM8572A will return the present baud value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

QAM:CARRier:STATe{OFF|ON|0|1}(?)

Description

This command will toggle the carrier waveform (CW) on and off. The carrier off function is especially useful as direct input for I & Q vector generators that need the digital information only and supply the carrier information separately.

Parameters

Range	Type	Default	Description
0-1	Discrete	1	Sets the carrier output on and off

Response

The PM8572A will return 1 if the output is on, or 0 if the output is off.

QAM:DATA<qam_data>

Description

Loads the data stream that will cause the PM8572A to hop from vector to vector. Data format is a string of "0's" and "1's" which define when the output generates the various vectors. The size of the data word depends on the QAM type. For 16QAM there are only four bits and for 256QAM there are 8 bits. Note that if you intend to program marker position, you must do it before you load the PSK data list.

Below you can see how a 16QAM data table is constructed. The 16QAM data table sample below shows a list of 10 shifts. The PM8572A will step through this list, outputting the various vectors in a sequence as defined by the data list.

Sample 16QAM Data Array

0000 0100 1010 0111 1111 0001 0010 0111 0101 1111

Parameters

Name	Type	Description
<qam_data>	ASCII	Block of ASCII data that contains information for the generator when to step from one vector setting to another.

QAM:MARKer<index>(?)

Description

Programs where on the data stream the PM8572A will generate a pulse, designated as QAM marker, or index point. The marker pulse is generated at the SYNC output connector. Note that if you intend to program marker position, you must do it before you load the QAM data list. The QAM:MARK command is common to all QAM modulation types.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 4000	Numeric (integer only)	1	Programs a marker pulse at an index bit position.

Response

The PM8572A will return the present marker position.

Half Cycle Control Commands

Use the following command for programming the half cycle functions and their associated parameters. There are three half cycle functions: Sine, Triangle and Square. The specifications and limitations of the half cycle functions are specified in Appendix A.

HALFcycle:DELay<delay>(?)

Description
This command will program the interval of which the output idles between half cycles. The idle level is normally 0 V except if programmed otherwise with the volt:offs command.

Parameters

Name	Range	Type	Default	Description
<delay>	200e-9 to 20	Numeric	1e-6	Will set the delay time interval between half cycles in units of seconds.

Response
The PM8572A will return the half cycle delay value in units of seconds.

HALFcycle:DCYCle<duty_cycle>(?)

Description
This command will program the duty cycle of the square waveform when the half cycle square shape is selected. Note that this command has no effect on the standard square wave duty cycle.

Parameters

Name	Range	Type	Default	Description
<duty_cycle>	0 to 99.99	Numeric	50	Will set the delay time interval between half cycles in units of seconds.

Response
The PM8572A will return the square wave duty cycle value in units of percent.

HALFcycle:FREQuency<freq>(?)

Description
This command programs the frequency of the half cycle waveforms in units of hertz (Hz). It has no affect on the frequency of other waveform functions.

Parameters

Name	Range	Type	Default	Description
<freq>	10e-3 to 1e6	Numeric	1e6	Will set the frequency of the half cycle waveform in units of Hz. This parameter does not affect the frequency of other waveform functions.

Response
The PM8572A will return the present half cycle frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

HALFcycle:PHASe<phase>(?)

Description
This command programs the start phase of the half cycle sine and triangle waveform. This command has no affect on other waveform functions.

Parameters

Name	Range	Type	Default	Description
<phase>	0 to 360	Numeric	0	Programs the start phase parameter for the half cycle sine and triangle waveforms in units of degrees. The phase can be programmable with resolution of 0.05° throughout the entire frequency range of the half cycle function.

Response
The PM8572A will return the present start phase value.

HALFcycle:SHAPe{SINusoid|TRIangle|SQUare}(?)

Description
This command defines the type of half cycle waveform that will be available at the output connector.

Parameters

Name	Type	Default	Description
SINusoid	Discrete	SIN	Selects the half cycle sine waveform.
TRIangle	Discrete		Selects the half cycle triangular waveform.
SQUare	Discrete		Selects the half cycle square waveform.

Response
The PM8572A will return SIN, TRI, or SQU depending on the present PM8572A setting

Counter Control Commands

Use the following command for programming the counter/timer measuring function and its associated parameters. The counter/timer function is created digitally however, it closely simulates a stand-alone instrument so its functions are programmed just as they would be programmed on a dedicated instrument. The specifications and limitations of the counter/timer are specified in Appendix A.

Table 5-9, Counter Commands

Keyword	Parameter Form	Default
	Counter/Timer Commands	
:COUNter		
:DISPlay		0
:MODe	NORMal | HOLD	NORM
:GATe		0
[:TIMe]	100e-6 to 1	1
:FUNCtion	FREQuency | PERiod | APERiod | PULSe | GTOTalize | ITOTalize	FREQ
:READ		
:RESet		

COUNter:DISPlay:MODe{NORMal|HOLD(?)}

Description

This command will program the display time mode for the counter/timer. The two modes are normal for continuous display readings and hold for single reading after arming the counter input.

Parameters

Name	Type	Default	Description
NORMal	Discrete	NORM	Will select the continuous reading mode. In this case, the counter input is self-armed, which means that every valid signal that is sensed at the trigger input connector will be counted and measured processed and results placed on the interface port.
HOLD	Discrete		Will select the single reading mode. In this case, the counter input is armed first and the first valid signal that is sensed at the trigger input connector will be counted and measured and its result processed and placed on the interface port.

Response

The PM8572A will return NORM, INV or COMP depending on the present polarity setting

COUNter:GATe<interval>(?)

Description
This command will program the gate time interval for frequency, period averaged and totalize in gated mode. Measurements will be taken only after the input has been armed and valid signal available at the input connector. Notice however, that the gate time internal must be larger than the period of the measure signal.

Parameters

Name	Range	Type	Default	Description
<interval>	100e-6 to 1	Numeric	1	Will program the gate time interval in units of seconds. In continuous mode, the counter is self-armed and therefore every valid signal at the counter input will open the gate and initiate a measurement cycle. In hold mode, the counter must be armed before the gate can open. Always make sure the programmed gate time interval is larger than the period of the measured signal.

Response
The PM8572A will return the present gate time value in units of seconds.

COUNter:FUNCtion{FREQuency|PERiod|APERiod|PULSe|ITOTalize|GTOTalize(?)}

Description
This command will program the measurement function for the counter/timer. Each measurement can be set up with its gate time (where applicable) and display mode.

Parameters

Name	Type	Default	Description
FREQuency	Discrete	FREQ	Will select the frequency measurement function. Frequency is measured on continuous signal only. The result of the frequency measurement has gate-dependent resolution. The PM8572A displays 7 digits of frequency reading in one second of gate time. If the gate time is decreased, the number of displayed digits decreases proportionally to the gate time interval. Reduce the gate time when you want to accelerate the reading process however, always make sure that the period of the signal is smaller than the gate time setting.
PERiod	Discrete		Will select the period measurement function. Period can be measured on either continuous or non-repetitive signals. Since the period of the signal is directly proportional to the gating time, the number of displayed digits decreases proportionally to the period of the signal. If you need to have more resolution and you signal is

		repetitive, use the period averaged measurement function. The best resolution in period measurements is 100 ns.
APERiod	Discrete	Will select the period averaged measurement function. Period averaged can be measured continuous signals only. In fact, this is the inverse function of frequency and therefore, gate time determines the resolution of the reading. Reduce the gate time when you want to accelerate the reading process however, always make sure that the period of the signal is smaller than the gate time setting.
PULSe	Discrete	Will select the pulse width measurement function. Pulse width can be measured on either continuous or non-repetitive signals. Since the width of the signal is directly proportional to the gating time, the number of displayed digits decreases proportionally to the pulse width of the signal. The best resolution in period measurements is 10 ns.
GTOTalize	Discrete	Will select the gated totalize measurement function. In this mode, the gate opens when the first valid signal is sensed at the counter input and closed at the end of the gate time interval. The number of pulses that enter during the gate time interval is displayed until cleared and the counter is armed for the next measurement cycle. The counter can accumulate 8 digits before it will overflow. An overflow indication is available.
ITOTalize	Discrete	Will select the totalize measurement function. In this mode, the gate opens when the first valid signal is sensed at the counter input and remains open until programmed otherwise. Pulse are counted and displayed continuously until intervened externally. The counter can accumulate 8 digits before it will overflow. An overflow indication is available.

Response

The PM8572A will return FREQ, PER, APER, PULS, GTOT or ITOT depending on the present measurement function setting.

COUNter:READ

Description

This command will interrogate the counter/timer for a reading. Note that the read command must follow a valid gate time interval otherwise reading will not be available and the interface bus will be held until the measurement cycle has been completed and result available to be read.

Response

The PM8572A will return the result of the present measurement function reading. The returned value will be in standard scientific format (for example: 10 MHz would be returned as 10e6 – positive numbers are unsigned).

COUNter:RESet

Description
This command will reset the counter/timer and arm the instrument for its next reading.

Digital Patterns Control Commands

This group is used to control the data at the digital pattern output connector. Use this group of commands to define the source of the data and the rate of which the data is clocked at the output connector.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-10, Digital Pattern Commands Summary

Keyword	Parameter Range	Default
:DIGital		
:DATA		
:SOURce	FIXed | USER	FIX
:RATe	5 to 25e6	10e3
[:STATe]	OFF | ON | 0 | 1	0

DIGital:DATA<pattern_block>

Description

This command will download digital patterns. Similar to waveform data, the pattern data is downloaded to a predefined memory cell. There are two options to store pattern data: 1) Dedicated memory that can store up to 128k patterns, or 2) any arbitrary memory segment that can store from 16 to 1M (2M/4M optional) patterns. The difference between the two options is that the dedicated pattern memory can be displayed on the front panel while the arbitrary segments can not be displayed. The location where you intend to store digital patterns is selectable using the DIG:DATA:SOUR command.

Digital patterns are generated from channel 1 only. Since this function can be turned on and off regardless of the output mode, one could mix digital and analog data output by generating digital patterns from channel 1 while generating arbitrary waveforms from channel 2. While in arbitrary mode of operation, the digital patterns can be turned on for simultaneous generation of analog signal and its equivalent digital pattern.

The rate of which the patterns change is defined by the baud parameter. Digital patters are input to the PM8572A in 16-bit hex words.

Parameters

Name	**Type**	**Description**
<pattern_block>	Integer	Contains an array of 16-bit hex pattern data.

DIGital:RATe<rate>(?)

Description

This command will programs the rate of which digital patterns change state at the output connector.

Parameters

Name	Range	Type	Default	Description
<rate>	5 to 25e6	Numeric	10e3	Programs the rate for the digital patterns. Note that although the rate range is specified to 25 Mpps, the highest baud depends on the quality of the cable and may deteriorate the high limit dramatically. Full rate is possible with the interconnecting circuit connected directly at the rear-panel Digital Pattern output connector.

Response

The PM8572A will return the current rate value.

DIGital:DATA:SOURce{FIXed|USER}(?)

Description

This command will select the source of the digital pattern data.

Parameters

Range	Type	Default	Description
FIXed	Discrete	FIX	Allocates a dedicated memory for the digital patterns with a finite size of 128k. The data that is stored using this option can be viewed from the front panel. Using the FIX option, generation of arbitrary waveforms is purged.
USER	Discrete		Allocates storage of digital patterns in any arbitrary segment up to 1M pattern length (2M/4M optional) however, in this case, the data cannot be viewed from the front panel.

Response

The PM8572A will return FIX, or USER depending on the current setting.

DIGital{OFF|ON|0|1}(?)

Description

This command will toggle the digital pattern output on and off. The command is available for all output functions including standard, arbitrary, sequenced and modulated waveforms however, meaningful output can be controlled in the arbitrary and sequenced function modes only.

Parameters

Range	Type	Default	Description
0-1	Discrete	0	Sets the digital pattern output on and off

Response

The PM8572A will return 1 if the output is on, or 0 if the output is off.

System Commands

The system-related commands are not related directly to waveform generation but are an important part of operating the PM8572A. These commands can reset or test the instrument, or query the instrument for system information.

Table 5-11, System Commands Summary

Keyword	Parameter Form	Default
:RESet (*RST)		
:SYSTem		
:ERRor?		
:LOCal		
:VERSion?		
:INFOrmation		
:CALibration?		
:MODel?		
:SERial?		
:IP		
[:ADDRess]	<IP_address>	
:MASK	<mask>	
:GATeway	<gate_way>	
:BOOTp	OFF | ON | 0 | 1	0
HOSTname:	<host_name>	
:KEEPalive		
:STATe	OFF | ON | 0 | 1	1
:TIMEout	2 to 300	45
PROBes	2 to 10	2
:TEMPerature?		

RESet, or *RST

Description
This command will reset the PM8572A to its factory defaults.

SYSTem:ERRor?

Description
Query only. This query will interrogate the PM8572A for programming errors.

Response
The PM8572A will return error code. Error messages are listed later in this manual.

SYSTem:LOCal

Description
This command will deactivate the active interface and will restore the PM8572A to local (front panel) operation.

SYSTem:VERSion?

Description
Query only. This query will interrogate the PM8572A for its current firmware version. The firmware version is automatically programmed to a secure location in the flash memory and cannot be modified by the user except when performing firmware update.

Response
The PM8572A will return the current firmware version code in a format similar to the following: 1.35

SYSTem:INFormation:CALibration?

Description
Query only. This query will interrogate the instrument for its last calibration date.

Response
The generator will return the last calibration date in a format similar to the following: 24 Oct 2006 (10 characters maximum).

SYSTem:INFormation:MODel?

Description
Query only. This query will interrogate the instrument for its model number in a format similar to the following: PM8572A. The model number is programmed to a secure location in the flash memory and cannot be modified by the user.

Response
The generator will return its model number either PM8571A or PM8572A.

SYSTem:INFormation:SERial?

Description
Query only. This query will interrogate the instrument for its serial number. The serial number is programmed to a secure location in the flash memory and cannot be modified by the user.

Response
The generator will return its serial number in a format similar to the following: 000000451 (10 characters maximum).

SYSTem:IP<ip_adrs>(?)

Description
This command programs the IP address for LAN operation. The programming must be performed from either USB or GPIB controllers.

Parameters

Name	Range	Type	Description
<ip_adrs>	0 to 255	String	Programs the IP address for LAN operation. Programming must be performed from USB or GPIB interfaces. Current IP address can be observed on LAN Properties front panel display.

Response
The PM8572A will return the present IP address value similar to the following: 192.168.0.6

SYSTem:IP:MASK<mask_adrs>(?)

Description
This command programs the subnet mask address for LAN operation. The programming must be performed from either USB or GPIB controllers.

Parameters

Name	Range	Type	Description
<mask_adrs>	0 to 255	String	Programs the subnet mask address for LAN operation. Programming must be performed from USB or GPIB interfaces. Current subnet mask address can be observed on LAN Properties front panel display.

Response
The PM8572A will return the present IP address value similar to the following: 255.255.255.0

SYSTem:IP:BOOTp{OFF|ON|0|1}(?)

Description
Use this command to toggle BOOTP mode on and off.

Parameters

Range	Type	Default	Description
0-1	Discrete	0	Toggles BOOTP mode on and off. When on, the IP address is administrated automatically by the system

Response
The PM8572A will return 0, or 1 depending on the present BOOTP setting.

SYSTem:IP:GATeway<gate_adrs>(?)

Description
This command programs the gateway address for LAN operation. The programming must be performed from either USB or GPIB controllers.

Parameters

Name	Range	Type	Description
<gate_adrs>	0 to 255	String	Programs the gateway address for LAN operation. Programming must be performed from USB or GPIB interfaces. Current gateway address can be observed on LAN Properties front panel display.

Response
The PM8572A will return the present IP address value similar to the following: 0.0.0.0

SYSTem:IP:HOSTname<name>(?)

Description
This command programs the host name address for LAN operation. The programming is performed in the factory and it is highly suggested that users do not change the host name without first consulting a Tabor customer service person.

Parameters

Name	Type	Description
<name>	String	Programs the host name for LAN operation.

Response
The PM8572A will return a string containing the host name. String length is 16 characters.

SYSTem:KEEPalive:STATe{OFF|ON|0|1}(?)

Description
Use this command to toggle the keep alive mode on and off. The keep alive mode assures that LAN connection remains uninterrupted throughout the duration of the LAN interfacing.

Parameters

Range	Type	Default	Description
0-1	Discrete	1	Toggles the keep alive mode on and off. When on, the PM8572A constantly checks for smooth LAN connection at intervals programmed by the syst:keep:time command. The LAN will be probed as many times as programmed by syst:keep:prob parameter to check if there is an interruption in the LAN communication. When communication fails, the PM8572A reverts automatically to local (front panel) operation.

Response
The PM8572A will return 0, or 1 depending on the present keep alive setting.

SYSTem:KEEPalive:TIMEout<time_out>(?)

Description
This command programs the keep alive time out. The keep alive mode assures that LAN connection remains uninterrupted throughout the duration of the LAN interfacing.

Parameters

Name	Range	Type	Default	Description
<time_out>	2 to 300	Numeric	45	Programs the keep alive time out in units of seconds. The time out period is initiated when the LAN is idle for more than the time out period. The LAN will be probed as many times as programmed by syst:keep:prob parameter to check if there is an interruption in the LAN communication. When communication fails, the PM8572A reverts automatically to local (front panel) operation.

Response
The PM8572A will return the present keep alive time out value.

SYSTem:KEEPalive:PROBes<probs>(?)

Description
This command programs the number of probes that are used by the keep alive sequence. The keep alive mode assures that LAN connection remains uninterrupted throughout the duration of the LAN interfacing.

Parameters

Name	Range	Type	Default	Description
<time_out>	2 to 10	Numeric	2	Programs the number of probes that are used by the keep alive sequence. The time out period is initiated when the LAN is idle for more than the time out period and the LAN will be probed as many times as programmed by this parameter to check if there is an interruption in the LAN communication. When communication fails, the PM8572A reverts automatically to local (front panel) operation.

Response
The PM8572A will return the present keep alive number of probes.

SYSTem:TEMPerature?

Description
Query only. This query will interrogate the PM8572A for its internal temperature reading.

Response
The PM8572A will return the current internal temperature value in units of degrees C, similar to the following: 40.00

Mass Memory Store/Recall Commands

The Mass Memory Store/Recall commands are used in conjunction with an external storage media. Use these commands to store or recall setups from a disk-on-key media. The recall command is used in conjunction with an external cd drive only. Also included with this section is a description of the text file that is used for storing and recalling instrument setups, waveforms and tables (sequence table, hop table, etc.).

NOTE

Using one of the Mass Memory Store/Recall Commands assumes that a storage media has already been connected to the rear-panel USB input and mounted on the operating system. If you are not sure, refer to Chapter 3 for information on this topic.

Table 5-12, Mass Memory Store/Recall Commands Summary

Keyword	Parameter Form	Default
:MMEMory		
:CLEar		
[:CELL]	1 to 99	1
:STORe		
[:CELL]	1 to 99	1
:RECall		
[:CELL]	1 to 99	1

MMEMory:CLEar<cell_number>

Description

Use this command to clear the contents of a memory cell. This command can be used in conjunction with a USB stick media only.

Parameters

Range	Type	Default	Description
1 to 99	Discrete	1	Clears the contents of a selected memory cell.

MMEMory:STORe<cell_number>

Description

Use this command to store setups to a specific memory cell. This command can be used in conjunction with a USB stick media only. Note that the store operation does not store waveforms but it does store segment size definitions.

Parameters

Range	Type	Default	Description
1 to 99	Discrete	1	Stores the current setting of the PM8572A to a selected cell number. Using this command, the entire image of the 8572A will be stored, including settings and tables however, waveforms coordinates are not stored.

MMEMory:RECall<cell_number>

Description

Use this command to store recall to a specific memory cell. Use this command to recall settings from a USB stick media or from a cd drive.

Parameters

Range	Type	Default	Description
1 to 99	Discrete	1	Reads a stored file and updates the PM8572A with the contents of the stored file. Information how to create and maintain the file image is given hereinafter.

The Store/Recall Folder Structure

Bear in mind that the flexibility of the embedded operating system within the PM8572A is not the same as the Windows OS and therefore, strict adherence to the folder and file structure are required for the store and recall operation. The following paragraphs explain how to create and maintain the correct folder and file images; this is done automatically when a USB stick is used and the store operation is done from the front panel.

The simplest option is of course to start with an empty stick. The folders must be placed in the root directory. Each setup is stored in a separate folder and each setup folder must have a unique name that associates itself with the cell number. For example, folder name Setup1 is legal but folder name Setup5_created_May_2011 is illegal. Figure 5-6 shows legal folder names for using the stored data on a USB stick.

In Figure 5-6, note that each setup is stored in a separate folder. Folders are named Setup1 through Setup4. Setup1 contains three files: Setup.txt, which includes instrument settings, Arbitrary_Sine_10MHz.pwav, Arbitrary_Sine_20MHz.pwav and Arbitrary_Sine_30MHz.pwav, which contain waveform coordinated in binary format for generating arbitrary waveforms and Arbitrary_FM_SYNC.wvf, which contains waveform data for the arbitrary FM function. Instructions how to use setup file names is given in the following.

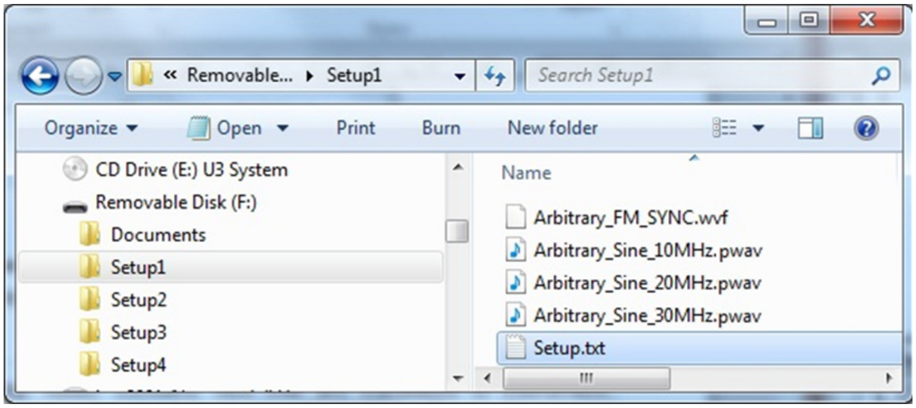

Figure 5-6, Store/Recall Folders Structure Example

The Store/Recall File Names

The setup folder contains files that are translated to instrument settings when downloaded to the PM8572A. These files have specific and unique file names for the OS to be able to read them properly. Failure to name the files as requested and understood by the PM8572A will result in false expectations that the settings were loaded to the instrument. Therefore, use the names and extensions exactly as given below. Note that where it says User_Wave or User_Table below, the names can be anything that is clear to the user however, the name in the setup file and the names that are stored with the extensions must be identical.

setup.txt - is the main image file name (case sensitive!). It contains the settings and names of waveforms that are required for the download to the generator. The file can be written and edited using MS word or any other word processor but it must be saved as a text file without attributes and characters that are not recognized by the PM8572A OS. If arbitrary waveforms are required to be downloaded as part of the image, these must be included in the same directory and named exactly as written in the setup file.

User_Wave.pwav – is a binary file that contains arbitrary waveform coordinates in binary format. Information how to create this file is given in this chapter. Another option to create this file easily is using the waveform composer in ArbConnection. Information how to use ArbConnection to generate an arbitrary waveform is given in Chapter 4. Note in Figure 5-6 that three arbitrary waveform files are shown; each is downloaded to a different segment so the setup file has provisions to define and accept data for three different segments. The following paragraphs will show examples how this can be done.

User_Wave.wvf – is a binary file that contains arbitrary FM waveform coordinates in binary format. Information how to create this file is given in this chapter. Another option to create this file easily is using the waveform composer in ArbConnection. Information how to use ArbConnection to generate an arbitrary FM waveform is given in Chapter 4. Note in Figure 5-6 that there is only one arbitrary FM waveform file shown and this is because the PM8572A can generate only one arbitrary FM function at a time.

User_Table.seq – is a binary file that contains sequence table values. Only one list is allowed per setup. Use ArbConnection to generate an example of a sequence table.

User_Table.fsk – is an ASCII file that contains a list of FSK values. Only one list is allowed per setup. Use ArbConnection to generate an example of an FSK file.

User_Table.ask – is an ASCII file that contains a list of ASK values. Only one list is allowed per setup. Use ArbConnection to generate an example of an ASK file.

User_Table.hpf – is a binary file that contains a list of frequency hopping values. Only one list is allowed per setup. Use ArbConnection to generate an example of a frequency hopping file.

User_Table.hpv – is a binary file that contains a list of frequency hopping and their associate dwell time values. Only one list is allowed per setup. Use ArbConnection to generate an example of a frequency hopping file.

User_Table.ahpf – is a binary file that contains a list of amplitude hopping values. Only one list is allowed per setup. Use ArbConnection to generate an example of an amplitude hopping file.

User_Table.ahpv – is a binary file that contains a list of amplitude hopping and their associate dwell time values. Only one list is allowed per setup. Use ArbConnection to generate an example of an amplitude hopping file.

User_Table.psk – is an ASCII file that contains a list of phase shift values. Only one list is allowed per setup. Use ArbConnection to generate an example of phase shift keying file.

User_Table.upsk – is a binary file that contains a list of random phase shift values. Only one list is allowed per setup. Use ArbConnection to generate an example of user phase shift keying file.

User_Table.qam – is an ASCII file that contains a list of QAM values. Only one list is allowed per setup. Use ArbConnection to generate an example of QAM file.

User_Table.uqam – is a binary file that contains a list of random QAM values. Only one list is allowed per setup. Use ArbConnection to generate an example of user QAM file.

User_Table.dig – is a binary file that contains a list of random digital values. Only one list is allowed per setup. Use ArbConnection to generate an example of digital file.

The Store/Recall File Structure

If you perform a store operation, the file shown below shows the entire image of the PM8572A. Of course, the values may look differently but the contents of the file will be similar. You may use the file example below to start exerting and compiling your external file. There are some guidelines that you can use, which will help you minimize the amount of work that you have to do; note the following:

1. The image file contains all of the commands that control the generator. The file below shows the default values and the range of the parameters for each of the commands. If you do not intend to change parameter values, reset the generator before the recall operation and then recall the stored cell. The instrument will change those parameters that are listed in the file and will not modify default values that need not be touched.
2. Colon (:) designates a command must follow. Double forward slashes designate remarks and are being ignored. In case you wish the image file as is and only modify parameters that you want, you may place double slashes in front of every command that you want to remain untouched. However, the author of this manual does not recommend this method. If you want to be efficient, save the image file and copy only the parts that you want to be recalled for your operation. Examples are given below.
3. If the image commands look familiar, this is because these are exactly as the SCPI commands that are being used for remote programming. If you are familiar with the SCPI concept then it should be very easy for you to comprehend the usage of the image commands.
4. Channel dependent commands are separated from commands that are common for both channels. It is recommended that the order of programming remain as in the sample image file but it is up to the user’s discretion to rearrange the commands in an order more familiar or friendlier for his application.
5. The image allows users to specify waveform files and tables that can be used in conjunction with the arbitrary waveform function. Each waveform that is specified in the image file must have a counter file in the setup directory, bearing exactly the same name as in the setup file. The names of the file are user defined; upper or lower case letter are re-formatted, as long as the names are the same.
6. Following SCPI rules, commands can be used in short or long format. The complete image file example is given with the long commands but examples 1 and 2 below use the short format.

```
// Model 8572A Complete Imgae File Format Example


<Channel 1 Control Commands>
:INSTument:SELect 1        // Select channel 1 for subsequent programming
:OUTPut:LOAD 50            // 50 to 1e6. Selects the actual load impedance
:OUTPut 0                  // {0|1} Turnes output on and off
:OUTPut:SYNC:POSition 0    // 0 to 1e6-1. Programs sync position
:OUTPut:FILTer NONE        // {NONE|25M|50M|60M|120M} Selects an active filter
:VOLTage 5                 // 16e-3 to 10. Programs the amplitude level
:VOLTage:OFFSet 0          // -4.992 to 4.992. Programs the offset level
:PHASe 0                   // 0 to 1e6. Programs the phase offset from the
                           // adjacent channel
:TRIGger:BURSt:COUNt 1     // 1 to 1,000,000. Programs the burst counter

<Channel 2 Control Commands>
:INSTument:SELect 2        // Select channel 2 for subsequent programming
:OUTPut:LOAD 50            // 50 to 1e6. Selects the actual load impedance
:OUTPut 0                  // {0|1} Turnes output on and off
:OUTPut:SYNC:POSition 0    // 0 to 1e6-1. Programs sync position
:OUTPut:FILTer NONE        // {NONE|25M|50M|60M|120M} Selects an active filter
:VOLTage 5                 // 16e-3 to 10. Programs the amplitude level
:VOLTage:OFFSet 0          // -4.992 to 4.992. Programs the offset level
:PHASe 0                   // 0 to 1e6. Programs the phase offset from the
                           // adjacent channel
:TRIGger:BURSt:COUNt 1     // 1 to 1,000,000. Programs the burst counter

<Instrument Control Common Commands>
:ROSCillator:SOURce INT          // {INTernal|EXTernal}
:FREQuency 1e6                   // 10e-3 to 100e6
:FREQuency:RASTer 1e7            // 5 to 200e6
:FREQuency:RASTer:SOURce INT     // {INTernal|EXTernal}
:FUNCtion:MODE PULS              // {PULSe | FIXed | USER | SEQuence |
                                 // MODulation | HALFcycle | COUNter} Selects //
                                 an output function
:OUTPut:SYNC:SOURce 1            // {1|2} Associates the sync output with
                                 // channel 1
:OUTPut:SYNC 0                   // {0|1} Toggles sync output on and off

<Run Mode Common Commands>
:INITiate:CONTinuous 1           // {1|0} Programs continuous or interrupted
                                 // operation
:TRIGger:IMMediate               // Software trigger
:TRIGger:BURSt 0                 // {0|1} Toggles burst function on and off
:TRIGger:DELay 0                 // {0|1} Toggles delayed trigger on and off
:TRIGger:DELay:TIME 200e-9       // 200e-9 to 20. Programs delayed trigger
                                 // interval
:TRIGger:GATE 0                  // {0|1} Toggles gated function on and off
:TRIGger:LEVel 1.6               // -5 to 5. Programs trigger level
:TRIGger:SOURce EXT              // {BUS|EXTernal|MIXed|INTernal} Selects
                                 // the trigger source
:TRIGger:RETRigger 0             // {0|1} Toggles re-trigger function on
                                 // and off
:TRIGger:RETRigger:TIME 200e-9   // 200e-9 to 20. Programs re-trigger delay
:TRIGger:TIMer 1e-3              // 100e-9 to 200e-3. Programs internal trigger
```

```
                                  // period
:TRIGger:SLOPe POS                // {POSitive|NEGative} Selects edge
                                  // sensitivity for the trigger input

<Pulse Waveform Common Commands>
:PULSe:PERiod 1e-3                // 20e-9 to 10. Programs pulse period
:PULSe:MODULation:SOURce SIN      // {SINusoidal | TRIangular | SQUare | PRAMp
                                  // | NRAMp}. Selects PWM waveform
:PULSe:MODULation:PERiod          // 100e-9 to 1. Programs modulating waveform
                                  // period
:PULSe:MODULation:DEViation 50    // 0 to 99. Programs modulating waveform
                                  // deviation

<Pulse Waveforms Commands - Channel 1>
:INSTrument:SELect 1      // Select channel 1 for subsequent
                          // programming
:PULSe:MODE SING          // {SINGle|DELayed|DOUBle|HOLDdcycle|EWIDth|PWM1}
                          // EWID and PWM1 on CH1 only
:PULSe:WIDTh 100e-6       // 7e-9 to 10. Programs pulse width
:PULSe:DCYCle 50          // 1 to 99. Programs pulse duty cycle
:PULSe:DELay 0            // 0 to 10. Programs pulse delay
:PULSe:DOUBle:DELay 0     // 0 to 10. Programs double pulse delay
:PULSe:LEVel HLOW         // {HLOW|AOFFset|POSitive|NEGative} Selects methode
                          // of pulse amplitude programming
:PULSe:LEVel:HIGH +2.5    // -4.983 to 5. Programs pulse high level
:PULSe:LEVel:LOW -2.5     // -5 to 4.983. Programs pulse low level
:PULSe:LEVel:AMPLitude 5  // 16e-3 to 5. Programs pulse amplitude
:PULSe:LEVel:OFFSet 0     // -4.992 to 4.992. Programs pulse level
:PULSe:POLarity NORM      // {NORMal|COMPlement|INVerted} Selects pulse
                          // output polarity
:PULSe:TRANsition:STATe FAST    // {FAST | LINear|SYMMetrical} Selects
                                // transition type
:PULSe:TRANsition 10e-6         // 5e-9 to 5e-3. Programs rise time
:PULSe:TRANsition:TRAiling 10e-6// 5e-9 to 5e-3. Programs fall time
:PULSe:BURSt 1                  // 1 to 65535. Programs burst count

<Pulse Waveforms Commands - Channel 2>
:INSTrument:SELect 2      // Select channel 2 for subsequent programming
:PULSe:MODE SING          // {SINGle|DELayed|DOUBle|HOLDdcycle}
:PULSe:WIDTh 100e-6       // 7e-9 to 10. Programs pulse width
:PULSe:DCYCle 50          // 1 to 99. Programs pulse duty cycle
:PULSe:DELay 0            // 0 to 10. Programs pulse delay
:PULSe:DOUBle:DELay 0     // 0 to 10. Programs double pulse delay
:PULSe:LEVel HLOW         // {HLOW|AOFFset|POSitive|NEGative} Selects methode
                          // of pulse amplitude programming
:PULSe:LEVel:HIGH +2.5    // -4.983 to 5. Programs pulse high level
:PULSe:LEVel:LOW -2.5     // -5 to 4.983. Programs pulse low level
:PULSe:LEVel:AMPLitude 5  // 16e-3 to 5. Programs pulse amplitude
:PULSe:LEVel:OFFSet 0     // -4.992 to 4.992. Programs pulse level
:PULSe:POLarity NORM      // {NORMal|COMPlement|INVerted} Selects pulse
                          // output polarity
:PULSe:TRANsition:STATe FAST    // {FAST | LINear|SYMMetrical} Selects
                                // transition type
:PULSe:TRANsition 10e-6         // 5e-9 to 5e-3. Programs rise time
:PULSe:TRANsition:TRAiling 10e-6// 5e-9 to 5e-3. Programs fall time
:PULSe:BURSt 1                  // 1 to 65535. Programs burst count
```

```
<Standard Waveform Commands - Channel 1>
:INSTrument:SELect 1      // Select channel 1 for subsequent programming
:SHAPe SIN                // {SIN|TRI|SQU|SPUL|RAMP|SINC|GAUS|EXP|NOIS|DC}
                          // Select an output function
:SINusoid:PHASe 0         // 0 to 360. Program sine start phase
:TRIangle:PHASe 0         // 0 to 360. Program triangle start phase
:SQUare:DCYCle 50         // 1 to 99.99. Program square wave duty cycle
:SPULse:DELay 10          // 0 to 99.99. Program pulse delay
:SPULse:WIDth 10          // 0 to 99.99. Program pulse width
:SPULse:TRANsition 10           // 0 to 99.99. Program pulse rise time
:SPULse:TRANsition:TRAiling 10  // 0 to 99.99. Program pulse fall time
:RAMP:DELay 10                  // 0 to 99.99. Program ramp delay
:RAMP:TRANsition 60             // 0 to 99.99. Program ramp rise time
:RAMP:TRANsition:TRAiling 30    // 0 to 99.99. Program ramp fall time
:SINC:NCYCle 10                 // 4 to 100. Program number of zero crossings
:GAUSsian:EXPonent 20           // 10 to 200. Program gaussian exponent
:EXPonent:EXPonent 1            // -100 to 100. Program exponential exponent
:DC 5                           // -5 to 5. Program dc level

<Standard Waveform Commands - Channel 2>
:INSTrument:SELect 2      // Select channel 2 for subsequent programming
:SHAPe SIN                // {SIN|TRI|SQU|SPUL|RAMP|SINC|GAUS|EXP|NOIS|DC}
                          // Select an output function
:SINusoid:PHASe 0         // 0 to 360. Program sine start phase
:TRIangle:PHASe 0         // 0 to 360. Program triangle start phase
:SQUare:DCYCle 50         // 1 to 99.99. Program square wave duty cycle
:SPULse:DELay 10          // 0 to 99.99. Program pulse delay
:SPULse:WIDth 10          // 0 to 99.99. Program pulse width
:SPULse:TRANsition 10           // 0 to 99.99. Program pulse rise time
:SPULse:TRANsition:TRAiling 10  // 0 to 99.99. Program pulse fall time
:RAMP:DELay 10                  // 0 to 99.99. Program ramp delay
:RAMP:TRANsition 60             // 0 to 99.99. Program ramp rise time
:RAMP:TRANsition:TRAiling 30    // 0 to 99.99. Program ramp fall time
:SINC:NCYCle 10                 // 4 to 100. Program number of zero crossings
:GAUSsian:EXPonent 20           // 10 to 200. Program gaussian exponent
:EXPonent:EXPonent 1            // -100 to 100. Program exponential exponent
:DC 5                           // -5 to 5. Program dc level

<Arbitrary Waveforms Commands - Channel 1>
:INSTrument:SELect 1      // Select channel 1 for subsequent programming
:TRACe:SELect 1           // 1 to 10000. Select an active memory segment
:TRACe:DEFine             // <1 to 10000>,<16 to 1e6>. Define the active
                          // segment
:LOAD:TRACe User_Wave     // User_Wave.pwav (Binary file, generated using
                          // ArbConnection)

<Arbitrary Waveforms Commands - Channel 2>
:INSTrument:SELect 2      // Select channel 2 for subsequent programming
:TRACe:SELect 1           // 1 to 10000. Select an active memory segment
:TRACe:DEFine             // <1 to 10000>,<16 to 1e6>. Define the active
                          // segment
:LOAD:TRACe: User_Wave    // User_Wave.pwav (Binary file, generated
                          //using ArbConnection)
```

```
<Sequence Waveforms Common Commands>
:SEQuence:ADVance AUTO          // {AUTOmatic|STEP|SINGle|MIX} Select
                                //  sequence advance mode

<Sequence Waveforms Commands - Channel 1>
:INSTrument:SELect 1            // Select channel 1 for subsequent
                                //  programming
:SEQuence:SELect 1              // 1 to 10 . Select an active sequence for
                                // programming
:SEQuence:DEFine                // <step>,<seg_number>,<repeat>,<adv_mode>,
                                // <sync_bit>. Define sequence
:SEQuence:SYNC LCOM             // {BIT|LCOM} Select sync type
:LOAD:SEQuence User_table       // User_Table.seq (Binary file, generated using
                                // ArbConnection)

<Sequence Waveforms Commands - Channel 2>
:INSTrument:SELect 2            // Select channel 2 for
                                // subsequent programming
:SEQuence:SELect 1              // 1 to 10 . Active sequence for programming
:SEQuence:DEFine                // <step>,<seg_number>,<repeat>,<adv_mode>,
                                // <sync_bit>. Define sequence
:SEQuence:SYNC LCOM             // {BIT|LCOM} Select sync type
:LOAD:SEQuence User_table       // User_Table.seq (Binary file, generated using
                                // ArbConnection)

<Modulated Waveforms Common Commands>
:MODulation:TYPE OFF            // {OFF|FM|AM|SWE|FSK|ASK|FHOPping|AHOPping
                                // |PSK|QAM} Selects the modulation function
:MODulation:CARRier 1e6         // 10 to 100e6
:MODulation:BASeline CARR       // {CARRier|DC}

<FM Commands>
:FM:DEViation 100e3             // 10e-3 to 100e6
:FM:FUNCtion:SHAPe SIN          // {SINusoid|TRIangle|SQUare|RAMP|ARB}
:FM:FREQuency 10e3              // 10e-3 to 250e3
:FM:FREQuency:RASTer 1e6        // 1 to 2.50e6
:FM:MARKer 1e6                  // 10e-3 to 100e6
:LOAD:FM:DATA User_Wave         // User_Wave.wvf (File generated using
                                // ArbConnection)

<AM Commands>
:AM:FUNCtion:SHAPe SIN          // {SINusoid|TRIangle|SQUare|RAMP}
:AM:MODulation:FREQuency 10e3   // 10e-3 to 1e6
:AM:DEPTh 50                    // 0 to 100

<Sweep Commands>
:SWEep:STARt 10e3               // 10 to 100e6
:SWEep:STOP 10e3                // 10 to 100e6
:SWEep:TIME 1e-3                // 1.4e-6 to 40
:SWEep:DIRection UP             // {UP|DOWN}
:SWEep:SPACing LIN              // {LINear|LOGarithmic}
:SWEep:MARKer 505e3             // 10 to 100e6
```

```
<FSK Commands>
:FSK:FREQuency:SHIFted 100e3    // 10 to 100e6
:FSK:BAUD 10e3                  // 1 to 10e6
:FSK:MARKer 1                   // 1 to 4000
:LOAD:FSK:DATA User_Table       // User_Tabel.fsk (File generated using
                                // ArbConnection)

<ASK Commands>
:ASK 5                          // 0 to 5
:ASK:SHIFted 1                  // 0 to 5
:ASK:BAUD 10e3                  // 1 to 2.5e6
:ASK:MARKer 1                   // 1 to 1000
:LOAD:ASK:DATA User_Table       // User_Tabel.ask (File generated using
                                // ArbConnection)

<Frequency Hopping Commands>
:FHOPping:DWELl:MODE FIX              // {FIX|VARiable}
:FHOPping:DWELl 200e-9                // 200e-9 to 20
:LOAD:FHOPping:FIX User_Table         // User_Tabel.hop (File generated using
                                      // ArbConnection)
:LOAD:FHOPping:VARiable User_Table    // User_Tabel.hpv (File generated
                                      // using ArbConnection)
:FHOPping:MARKer 1                    // 1 to 1000

<Amplitude Hopping Commands>
:AHOPping:DWELl:MODE FIX              // {FIX|VARiable}
:AHOPping:DWELl 200e-9                // 200e-9 to 20
:LOAD:AHOPping:FIX User_Table         // User_Tabel.ahpf (File generated
                                      // using ArbConnection)
:LOAD:AHOPping:VARiable User_Table    // User_Tabel.ahpv (File
                                      // generated using ArbConnection)
:AHOPping:MARKer 1                    // 1 to 5000

<PSK Commands>
:PSK:TYPE PSK                   // {PSK|BPSK|QPSK|OQPSK|8PSK|16PSK|USER}
:PSK:PHASe 0                    // 0 to 360
:PSK:PHASe:SHIFted 180          // 0 to 360
:PSK:RATE 10e3                  // 1 to 10e6
:LOAD:PSK User_Table            // User_Tabel.psk (File generated using
                                // ArbConnection)
:PSK:MARKer 1                   // 1 to 4000
:PSK:BAUD 10e3                  // 1 to 10e6
:PSK:CARRier:STATe 1            // {1|0}
:LOAD:PSK:USER User_Table       // User_Tabel.upsk (File generated using
                                // ArbConnection)

<QAM Commands>
:QAM:TYPE 16QAM                 // {16QAM|64QAM|256QAM|USER}
:QAM:CARRier:STATe 1            // {1|0}
:QAM:BAUD 10e3                  // 1 to 10e6
:LOAD:QAM User_Table            // User_Tabel.qam (File generated using
                                // ArbConnection)
:QAM:MARKer 1                   // 1 to 4000
:LOAD:QAM:USER User_Table       // User_Tabel.uqam (File generated using
                                // ArbConnection)
```

```
<Half Cycle Waveforms Commands>
:HALFcycle:DELay 1e-6           // 200e-9 to 20
:HALFcycle:DCYCle 50            // 0 to 99.99
:HALFcycle:FREQuency 1e6        // 10e-3 to 1e6
:HALFcycle:PHASe 0              // 0 to 360
:HALFcycle:DELay 1e-6           // 200e-9 to 20
:HALFcycle:SHAPe SIN            // SINusoid | TRIangle | SQUare

<Digital Pattern Commands>
:LOAD:DIGital User_Table        // User_Tabel.dig (File generated using
                                // ArbConnection)
:DIGital:DATA:SOURce FIX        // {FIXed|USER}
:DIGital:RATE 10e3              // 5 to 25e6
:DIGital 0                      // {0|1}

<Counter Commands>
:COUNter:FUNCtion FREQ          // {FREQuency|PERiod|APERiod|PULSe|GTOTalize
                                // |ITOTalize} Selects counter measurement
:COUNter:DISPlay:MODE NORM      // {NORMal|HOLD} Selects display mode
:COUNter:GATE:TIME 1            // 100e-6 to 1. Programs measurement gate
                                // time
:COUNter:RESet                  // Resets counter reading
```

Recall Setup1 Example

The Removable Disk folder structure is shown in Figure 5-7 and the Setup file image is given below. Note that there are four arbitrary waveform files in this folder.

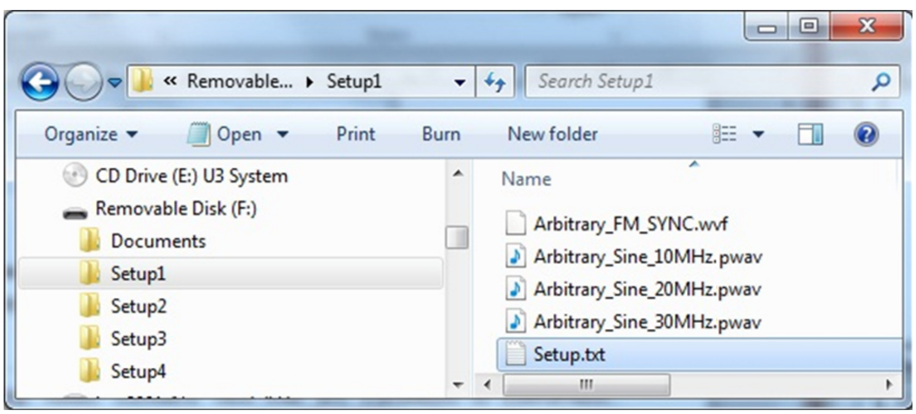

Figure 5-7, Setup1 Example Folder

```
// Model 8572A Setup Imgae File Format Example

<Instrument Control Common Commands>
:FUNC:MODE USER                 // {PULS|FIX|USER|SEQ|MOD|HALF|COUN} Selects
                                // an output function
:FREQ:RAST 10.7e6               // 5 to 200e6
:OUTP:SYNC 1                    // {0|1} Toggles sync output on and off
```

```
<Run Mode Common Commands>
:INIT:CONT 0                      // {1|0} Programs continuous or interrupted
                                  // operation
:TRIG:LEV -2.5                    // -5 to 5. Programs trigger level
:TRIG:SLOP NEG                    // {POS|NEG} Selects edge
                                  // sensitivity for the trigger input
<Channel 1 Control Commands>
:INST:SEL 1                       // Channel 1 for subsequent programming
:OUTP 1                           // {0|1} Turnes output on and off
:VOLT 1.000                       // 16e-3 to 10. Programs the amplitude level

<Arbitrary Waveforms Commands - Channel 1>
:INST:SEL 1                       // Channel 1 for subsequent programming
:TRAC:SEL 1                       // 1 to 10000. Active memory segment
:TRACe:DEFine 1,4096              // <1-10000>,<16-1e6>. Define segment length
:LOAD:TRAC Arbitrary_Sine_10MHz // User_Wave.pwav (Binary file,
                                  // generated using ArbConnection)
:TRAC:SEL 2                       // 1 to 10000. Active memory segment
:TRACe:DEFine 2, 2048             // <1-10000>,<16-1e6>. Define segment length
:LOAD:TRAC Arbitrary_Sine_20MHz // User_Wave.pwav (Binary file,
                                  // generated using ArbConnection)
:TRAC:SEL 1                       // 1 to 10000. Active memory segment

<Channel 2 Control Commands>
:INST:SEL 2                       // Channel 2 for subsequent programming
:OUTP 1                           // {0|1} Turnes output on and off
:VOLT 3.000                       // 16e-3 to 10. Programs the amplitude level

<Arbitrary Waveforms Commands - Channel 2>
:INST:SEL 2                       // Channel 2 for subsequent programming
:TRAC:SEL 1                       // 1 to 10000. Active memory segment
:TRACe:DEFine 1,1024              // <1-10000>,<16-1e6>. Define segment length
:LOAD:TRAC Arbitrary_Sine_30MHz // User_Wave.pwav (Binary file,
                                  // generated using ArbConnection)
:TRAC:SEL 2                       // 1 to 10000. Active memory segment
:TRACe:DEFine 2,512               // <1-10000>,<16-1e6>. Define segment length
:LOAD:TRAC Arbitrary_Sine_40MHz // User_Wave.pwav (Binary file,
                                  // generated using ArbConnection)
:TRAC:SEL 1                       // 1 to 10000. Active memory segment
```

The above setup image example, when recalled from Cell number 1 field will do the following (not in the same order as programmed in the file):

1. Two segments, 1 and 2 on each channel are defined and loaded with two different arbitrary waveforms, each channel: Arbitrary_Sine_10MHz and Arbitrary_Sine_20MHz in channel 1 and Arbitrary_Sine_30MHz and Arbitrary_Sine_40MHz in channel 2. The active output waveform is set as segment 1.

Note that you may use ArbConnection to create the arbitrary waveforms. The names of the waveforms were chosen randomly but the length of the waveforms is important because the generator must be defined to the same length as the waveform segment length.

2. Output function is selected to be arbitrary (User)
3. Channels 1 and 2 are turned on but channel 1 will output 1 V and channel 2 will output 3 V.
4. SYNC output is turned on
5. Sample clock is programmed to 10.7 MSa/s
6. Instrument is place in triggered run mode
7. Trigger threshold is programmed to -2.5 and the PM8572A is programmed to trigger on negative transitions.

Connect a trigger source to the rear-panel trigger input, set the trigger signal to cross the programmed trigger threshold and verify that you have the required waveform on an oscilloscope.

Recall Setup2 Example

The Removable Disk folder structure is shown in Figure 5-8 and the Setup file image is given below. Note that there are four arbitrary waveform files in this folder.

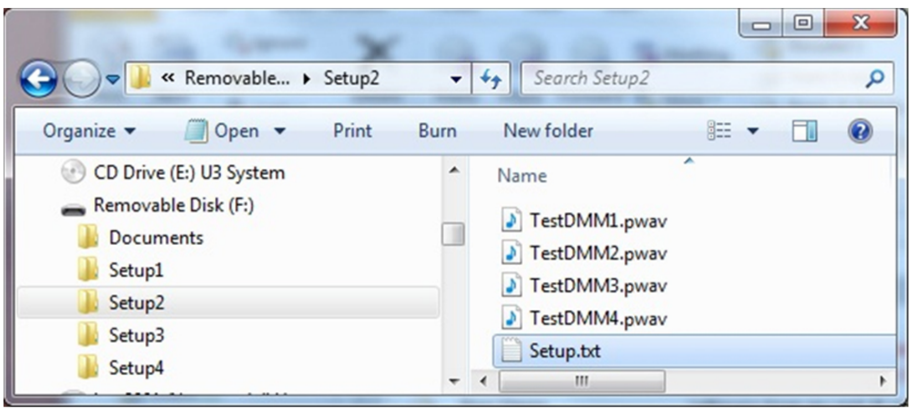

Figure 5-8, Setup2 Example Folder

```
// Model 8572A Setup Imgae File Format Example

<Instrument Control Common Commands>
:FREQuency:RASTer 250e6         // 5 to 200e6
:FUNCtion:MODE SEQ              // {PULS|FIX|USER|SEQ|MOD|HALF|COUN}
                                // Selects an output function
:OUTPut:SYNC 1                  // {0|1} Toggles sync output on and off

<Arbitrary Waveforms Commands - Channel 1>
:TRACe:SELect 1                 // 1 to 10000. Active memory segment
:TRACe:DEFine 1,10000           // <1 to 10000>,<16 to 1e6>. Define segment
:LOAD:TRAC TestDMM1             // User_Wave.wav (Binary file, generated
                                //  using ArbConnection)
:TRACe:SELect 2                 // 1 to 10000. Active memory segment
:TRACe:DEFine 2,16000           // <1 to 10000>,<16 to 1e6>. Define segment
```

```
:LOAD:TRAC TestDMM2             // User_Wave.pwav (Binary file, generated
                                // using ArbConnection)
:TRACe:SELect 3                 // 1 to 10000. Active memory segment
:TRACe:DEFine 3,32000           // <1 to 10000>,<16 to 1e6>. Define segment
:LOAD:TRAC TestDMM3             // User_Wave.pwav (Binary file, generated
                                // using ArbConnection)
:TRACe:SELect 4                 // 1 to 10000. Active memory segment
:TRACe:DEFine 4,64000           // <1 to 10000>,<16 to 1e6>. Define segment
:LOAD:TRAC TestDMM4             // User_Wave.pwav (Binary file, generated
                                // using ArbConnection)

<Sequence Waveforms Commands - Channel 1>
:SEQuence:DEFine 1,2,5,0,0      // <step>,<seg_number>,<repeat>,<adv_mode>,
                                // <sync_bit>. Define sequence
:SEQuence:DEFine 2,3,27,0,0     // <step>,<seg_number>,<repeat>,<adv_mode>,
                                // <sync_bit>. Define sequence
:SEQuence:DEFine 3,1,222,1,0    // <step>,<seg_number>,<repeat>,<adv_mode>,
                                // <sync_bit>. Define sequence
:SEQuence:DEFine 4,4,330,0,0    // <step>,<seg_number>,<repeat>,<adv_mode>,
                                // <sync_bit>. Define sequence
:SEQuence:SYNC BIT              // {BIT|LCOM} Select sync type

<Channel 1 Control Commands>
:OUTPut 1                       // {0|1} Turnes output on and off
:VOLTage 1.5                    // 16e-3 to 10. Programs the amplitude level
:VOLTage:OFFSet 1.0             // -4.992 to 4.992. Programs the offset level
```

The above setup image example, when recalled from Cell number 2 field will do the following (not in the same order as programmed in the file):

1. Program channel 1 only
2. Define four segments and download waveforms: TestDMM1, TestDMM2, TestDMM3 and TestDMM4 to the predefined segments
3. Define a four-step sequence table
4. Define the SYNC output to be BIT and output this bit every time step 3 is encountered
5. Select output function to be sequenced waveforms
6. Program the sample clock to 250 MSa/s
7. Turn output on
8. Turn output SYNC on
9. Set amplitude to 1.5 V and offset to 1 V

Note that you may use ArbConnection to create the arbitrary waveforms. The names of the waveforms were chosen randomly but the length of the waveforms is important because the generator must be defined to the same length as the waveform segment length.

IEEE-STD-488.2 Common Commands and Queries

Since most instruments and devices in an ATE system use similar commands that perform similar functions, the IEEE-STD-488.2 document has specified a common set of commands and queries that all compatible devices must use. This avoids situations where devices from various manufacturers use different sets of commands to enable functions and report status. The IEEE-STD-488.2 treats common commands and queries as device dependent commands. For example, *TRG is sent over the bus to trigger the instrument. Some common commands and queries are optional, but most of them are mandatory.

The following is a complete listing of all common-commands and queries, which are used by the PM8572A

***CLS** - Clear the Status Byte summary register and all event registers.

***ESE** <enable_value> - Enable bits in the Standard Event enable register. The selected bits are then reported to the status byte.

***ESE?** - Query the Standard Event enable register. The generator returns a decimal value, which corresponds to the binary-weighted sum of all bits, set in the register.

***ESR?** - Query the Standard Event register. The generator returns a decimal value, which corresponds to the binary-weighted sum of all bits, set in the register.

***IDN?** - Query the generator's identity. The returned data is organized into four fields, separated by commas. The generator responds with its manufacturer and model number in the first two fields, and may also report its serial number and options in fields three and four. If the latter information is not available, the device must return an ASCII 0 for each. For example, Model PM8572A response to *IDN? is:

Tabor,PM8572A,0,1.0

***OPC** - Set the "operation complete" bit (bit 0) in the Standard Event register after the previous commands have been executed.

***OPC?** - Returns "1" to the output buffer after all the previous commands have been executed. *OPC? is used for synchronization between a controller and the instrument using the MAV bit in the Status Byte or a read of the Output Queue. The *OPC? query does not affect the OPC Event bit in the Standard Event Status Register (ESR). Reading the response to the ***OPC?** query has the advantage of removing the complication of dealing with service requests and multiple polls to the instrument. However, both the system bus and the controller handshake are in a temporary hold-off state while the controller is waiting to read the *OPC? query response.

***OPT?** - Returns the value “0” for a PM8572A with no options.

***RST** - Resets the generator to its default state. Default values are listed in Table 5-1.

***SRE** <enable_value> - Enables bits in the Status Byte enable register.

***SRE?** - Query the Status Byte enable register. The generator returns a decimal value in the range of 0 to 63 or 128 to 191 since bit 6 (RSQ) cannot be set. The binary-weighted sum of the number represents the value of the bits of the Service Request enable register.

***STB? -** Query the Status Byte summary register. The *STB? command is similar to a serial poll but is processed like any other instrument command. The *STB? command returns the same result as a serial poll, but the "request service" bit (bit 6) is not cleared if a serial poll has occurred.

***TRG** - Triggers the generator from the remote interface. This command effects the generator if it is first placed in the Trigger or Burst mode of operation and the trigger source is set to "BUS".

*__WAI__ – Wait for all pending operations to complete before executing any additional commands over the interface.

The SCPI Status Registers

The Model PM8572A uses the Status Byte register group and the Standard Event register group to record various instrument conditions. Figure 5-1 shows the SCPI status system.

An Event Register is a read-only register that reports defined conditions within the generator. Bits in an event register are latched. When an event bit is set, subsequent state changes are ignored. Bits in an event register are automatically cleared by a query of that register or by sending the *CLS command. The *RST command or device clear does not clear bits in an event register. Querying an event register returns a decimal value, which corresponds to the binary-weighted sum of all bits, set in the register.

An Event Register defines which bits in the corresponding event register are logically ORed together to form a single summary bit. The user can read from and write to an Enable Register. Querying an Enable Register will not clear it. The *CLS command does not clear Enable Registers but it does clear bits in the event registers. To enable bits in an enable register, write a decimal value that corresponds to the binary-weighted sum of the bits required to enable in the register.

The Status Byte Register (STB)

The Status Byte summary register contains conditions from the other registers. Query data waiting in the generator's output buffer is immediately reported through the Message Available bit (bit 4). Bits in the summary register are not latched. Clearing an event register will clear the corresponding bits in the Status Byte summary register. Description of the various bits within the Status Byte summary register is given in the following:

Bit 0 - Decimal value 1. Not used, always set to 0.

Bit 1 - Decimal value 2. Not used, always set to 0.

Bit 2 - Decimal value 4. Not used, always set to 0.

Bit 3 - Decimal value 8. Not used, always set to 0.

Bit 4 - Decimal value 16. Message Available Queue Summary Message (MAV). The state of this bit indicates whether or not the output queue is empty. The MAV summary message is true when the output queue is not empty. This message is used to synchronize information exchange with the controller. The controller can, for example, send a query command to the device and then wait for MAV to become true. If an application program begins a read operation of the output queue without first checking for MAV, all system bus activity is held up until the device responds.

Bit 5 - Decimal value 32. Standard Event Status Bit (ESB) Summary Message. This bit indicates whether or not one or more of the enabled ESB events have occurred since the last reading or clearing of the Standard Event Status Register.

Bit 6 - Decimal value 64. Master Summary Status (MSS)/Request Service (RQS) Bit. This bit indicates if the device has at least one condition to request service. The MSS bit is not part of the IEEE-STD-488.1 status byte and will not be sent in response to a serial poll. However, the RQS bit, if set, will be sent in response to a serial poll.
Bit 7 - Decimal value 128. Not used, always set to 0.

Reading the Status Byte Register

The Status Byte summary register can be read with the *STB? common query. The *STB? common query causes the generator to send the contents of the Status Byte register and the MSS (Master Summary Status) summary message as a single <NR1 Numeric Response Message> element. The response represents the sum of the binary-weighted values of the Status Byte Register. The *STB? common query does not alter the status byte.

Clearing the Status Byte Register

Removing the reasons for service from Auxiliary Status registers can clear the entire Status Byte register. Sending the *CLS command to the device after a SCPI command terminator and before a Query clears the Standard Event Status Register and clears the output queue of any unread messages. With the output queue empty, the MAV summary message is set to FALSE. Methods of clearing other auxiliary status registers are discussed in the following paragraphs.

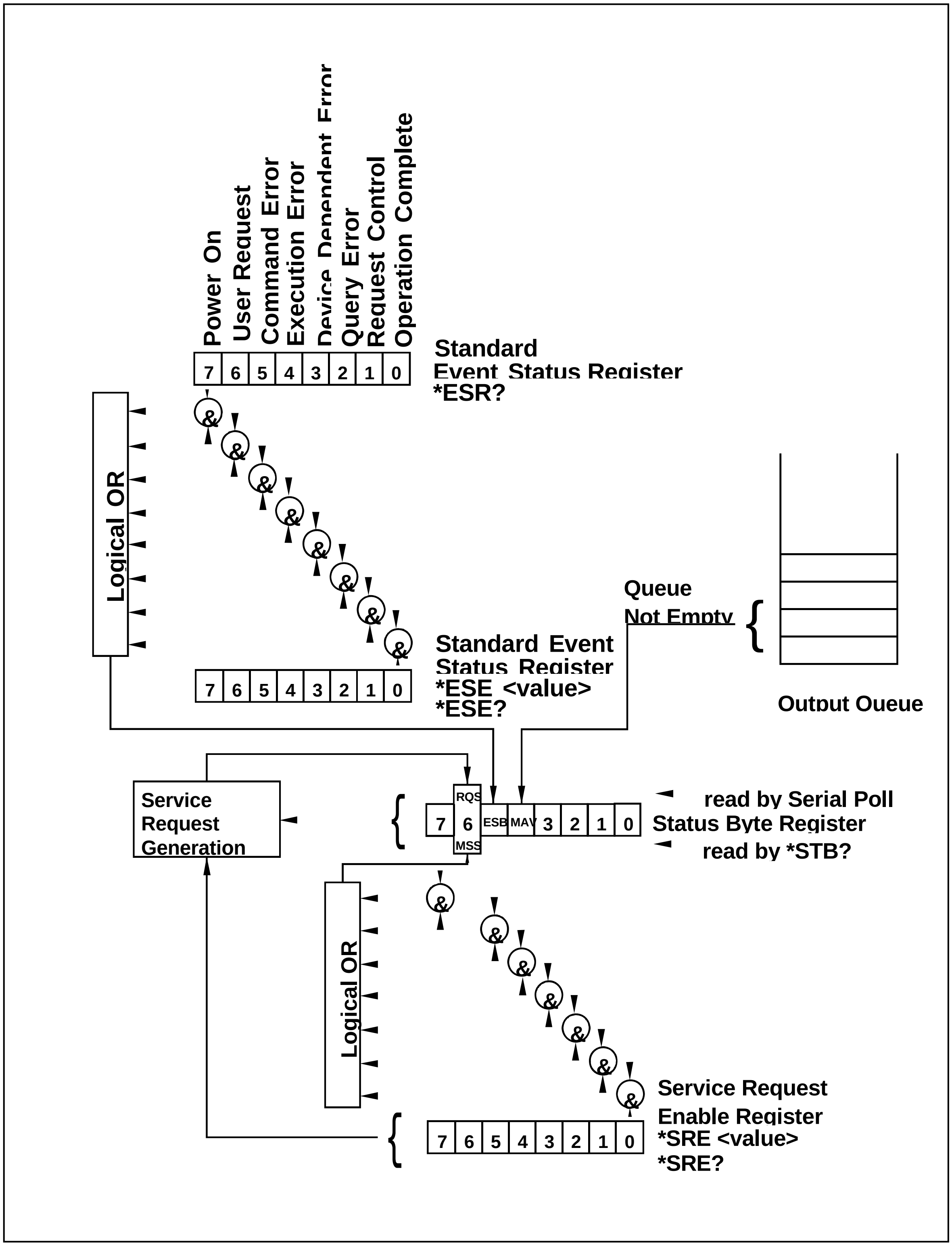

Figure 5-9. SCPI Status Registers

Service Request Enable Register (SRE)

The Service Request enable register is an 8-bit register that enables corresponding summary messages in the Status Byte Register. Thus, the application programmer can select reasons for the generator to issue a service request by altering the contents of the Service Request Enable Register.

The Service Request Enable Register is read with the *SRE? common query. The response to this query is a number that represents the sum of the binary-weighted value of the Service Request Enable Register. The value of the unused bit 6 is always zero.

The Service Request Enable Register is written using the *SRE command followed by a decimal value representing the bit values of the Register. A bit value of 1 indicates an enabled condition. Consequently, a bit value of zero indicates a disabled condition. The Service Request Enable Register is cleared by sending *SRE0. The generator always ignores the value of bit 6. Summary of *SRE commands is given in the following.

***SRE0** - Clears all bits in the register.
***SRE1** - Not used.
***SRE2** - Not used.
***SRE4** - Not used.
***SRE8** - Not used.
***SRE16** - Service request on MAV.
***SRE32** - Service request on ESB summary bit.
***SRE128** - Not used.

Standard Event Status Register (ESR)

The Standard Event Status Register reports status for special applications. The 8 bits of the ESR have been defined by the IEEE-STD-488.2 as specific conditions, which can be monitored and reported back to the user upon request. The Standard Event Status Register is destructively read with the *ESR? common query. The Standard Event Status Register is cleared with a *CLS common command, with a power-on and when read by *ESR?.

The arrangement of the various bits within the register is firm and is required by all GPIB instruments that implement the IEEE-STD-488.2. Description of the various bits is given in the following:

Bit 0 - Operation Complete. Generated in response to the *OPC command. It indicates that the device has completed all selected and pending operations and is ready for a new command.

Bit 1 - Request Control. This bit operation is disabled on the Model PM8572A.

Bit 2 - Query Error. This bit indicates that an attempt is being made to read data from the output queue when no output is either present or pending.

Bit 3 - Device Dependent Error. This bit is set when an error in a device function occurs. For example, the following command will cause a DDE error:

```
VOLTage 5;:VOLTage:OFFSet 2
```

Both of the above parameters are legal and within the specified limits, however, the generator is unable to generate such an amplitude and offset combination.

Bit 4 - Execution Error. This bit is generated if the parameter following the command is outside of the legal input range of the generator.

Bit 5 – Command Error. This bit indicates the generator received a command that was a syntax error or a command that the device does not implement.

Bit 6 - User Request. This event bit indicates that one of a set of local controls had been activated. This event bit occurs regardless of the remote or local state of the device.

Bit 7 - Power On. This bit indicates that the device's power source was cycled since the last time the register was read.

Standard Event Status Enable Register (ESE)

The Standard Event Status Enable Register allows one or more events in the Standard Event Status Register to be reflected in the ESB summary message bit. The Standard Event Status Enable Register is an 8-bit register that enables corresponding summary messages in the Standard Event Status Register. Thus, the application programmer can select reasons for the generator to issue an ESB summary message bit by altering the contents of the ESE Register.

The Standard Event Status Enable Register is read with the *ESE? Common query. The response to this query is a number that represents the sum of the binary-weighted value of the Standard Event Status Enable Register.

The Standard Event Status Enable Register is written using the *ESE command followed by a decimal value representing the bit values of the Register. A bit value one indicates an enabled condition. Consequently, a bit value of zero indicates a disabled condition. The Standard Event Status Enable Register is cleared by setting *ESE0. Summary of *ESE messages is given in the following.

***ESE0** – No mask. Clears all bits in the register.
***ESE1** – ESB on Operation Complete.
***ESE2** – ESB on Request Control.
***ESE4** – ESB on Query Error.
***ESE8** – ESB on Device Dependent Error.

***ESE16** – ESB on Execution Error.
***ESE32** – ESB on Command Error.
***ESE64** – ESB on User Request.
***ESE128** – ESB Power on.

Error Messages

In general, whenever the PM8572A receives an invalid SCPI command, it automatically generates an error. Errors are stored in a special error queue and may be retrieved from this buffer one at a time. Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was stored. When you have read all errors from the queue, the generator responds with a 0,"No error" message.

If more than 30 errors have occurred, the last error stored in the queue is replaced with -350, “Queue Overflow”. No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the generator responds with 0,"No error".

The error queue is cleared when power has been shut off or after a *CLS command has been executed. The *RST command does not clear the error queue. Use the following command to read the error queue:

```
SYSTem:ERRor?
```

Errors have the following format (the error string may contain up to 80 characters):

-102,"Syntax error"

A complete listing of the errors that can be detected by the generator is given below.

-100,"Command error". When the generator cannot detect more specific errors, this is the generic syntax error used.

-101,"Invalid Character". A syntactic element contains a character, which is invalid for that type.

-102,"Syntax error". Invalid syntax found in the command string.

-103,"Invalid separator". An invalid separator was found in the command string. A comma may have been used instead of a colon or a semicolon. In some cases where the generator cannot detect a specific separator, it may return error -100 instead of this error.

-104,"Data type error". The parser recognized a data element different than allowed.

-108,"Parameter not allowed". More parameters were received than expected for the header.

-109,"Missing parameter". Too few parameters were received for the command. One or more parameters that were required for the command were omitted.

-128."Numeric data not allowed". A legal numeric data element was received, but the instrument does not accept one in this position.

-131,"Invalid suffix". A suffix was incorrectly specified for a numeric parameter. The suffix may have been misspelled.

-148,"Character data not allowed". A character data element was encountered where prohibited by the instrument.

-200,"Execution error". This is the generic syntax error for the instrument when it cannot detect more specific errors. Execution error as defined in IEEE-488.2 has occurred.

-221,"Setting conflict". Two conflicting parameters were received which cannot be executed without generating an error. Listed below are events causing setting conflicts.

1. Sum of pulse or ramp parameters is more than 100 percent. Corrective action: Change parameters to correct the problem.
2. ampl/2 + |offset| is more than 16 Vp-p. Corrective action: Reduce offset to 0, then change amplitude-offset values to correct the problem.
3. Activating filters when the PM8572A is set to output the built-in sine waveform, or activating the built-in sine waveform when one of the PM8572A filters is turned on. Corrective action: If in sine, select another function and activate the filter(s).
4. Activating burst mode when the PM8572A is set to sequence mode, or activating sequence mode when the PM8572A is set to burst mode. Corrective action: Remove the PM8572A from burst or sequence and then selected the desired mode.
5. Changing operating mode from triggered to continuous when the PM8572A is set to single sequence advance, or changing the operating mode from continuous to triggered when the PM8572A is set to automatic sequence advance mode. Corrective action: Observe the PM8572A advance mode while setting sequence advance.

There are other setting conflict errors, which are exclusively dedicated for the pulse function. These errors are listed and described in Chapter 3, under the pulse function description

-222,”Data out of range”. Parameter data, which followed a specific header, could not be used because its value is outside the valid range defined by the generator.

-224,”Illegal parameter value”. A discrete parameter was received which was not a valid choice for the command. An invalid parameter choice may have been used.

-300,”Device-specific-error”. This is the generic device-dependent error for the instrument when it cannot detect more specific errors. A device- specific error as defined in IEEE-488.2 has occurred.

-311,”Memory error”. Indicates that an error was detected in the instrument’s memory.

-350,”Queue Overflow”. The error queue is full because more than 30 errors have occurred. No additional errors are stored until the errors from the queue are removed. The error queue is cleared when power has been shut off, or after a *CLS command has been executed.

-410,”Query INTERRUPTED”. A command was received which sends data to the output buffer, but the output buffer contained data from a previous command (the previous data is not overwritten). The output buffer is cleared when power is shut off or after a device clear has been executed.

Chapter 6
Performance Checks

Title	Page

What's in This Chapter

This chapter provides performance tests necessary to troubleshoot the Model PM8572A Universal Waveform Generator.

WARNING

The procedures described in this section are for use only by qualified service personnel. Many of the steps covered in this section may expose the individual to potentially lethal voltages that could result in personal injury or death if normal safety precautions are not observed.

CAUTION

ALWAYS PERFORM PERFORMANCE TESTS IN A STATIC SAFE WORKSTATION.

Performance Checks

The following performance checks verify proper operation of the instrument and should normally be used:

1. As a part of the incoming inspection of the instrument specifications;
2. As part of the troubleshooting procedure;
3. After any repair or adjustment before returning the instrument to regular service.

Environmental Conditions

Tests should be performed under laboratory conditions having an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. If the instrument has been subjected to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the adjustment procedure.

Warm-up Period

Most equipment is subject to a small amount of drift when it is first turned on. To ensure accuracy, turn on the power to the Model PM8572A and allow it to warm-up for at least 30 minutes before beginning the performance test procedure.

Initial Instrument Setting

To avoid confusion as to which initial setting is to be used for each test, it is required that the instrument be reset to factory default values prior to each test. To reset the Model PM8572A to factory defaults, use the Factory Rest option in the Utility menu.

Recommended Test Equipment

Recommended test equipment for troubleshooting, calibration and performance checking is listed in Table 6-1 below. Test instruments other than those listed may be used only if their specifications equal or exceed the required characteristics.

Table 6-1, Recommended Test Equipment

Equipment	Model No.	Manufacturer
Oscilloscope (with jitter package)	LT342	LeCroy
Distortion Analyzer	6900B	Krohn Hite
Digital Multimeter	2000	Keithley
Freq. Counter	6020R	Tabor Electronics
Spectrum Analyzer	E4411	HP
Pulse/Function Generator (with manual trigger)	8551	Tabor Electronics

Test Procedures

Use the following procedures to check the Model PM8572A against the specifications. A complete set of specifications is listed in Appendix A. The following paragraphs show how to set up the instrument for the test, what the specifications for the tested function are, and what acceptable limits for the test are. If the instrument fails to perform within the specified limits, the instrument must be calibrated or tested to find the source of the problem.

Frequency Accuracy

Frequency accuracy checks tests the accuracy of the internal oscillators. Both channels same the same output frequency and the same reference oscillators and therefore, the accuracy is tested on channel 1 only.

Frequency Accuracy, Internal Reference

Equipment: Counter

Preparation:

1. Configure the counter as follows:
   Termination: 50Ω, DC coupled
2. Connect the PM8572A Channel 1 output to the counter input – channel A
3. Configure the PM8572A, channel 1 as follows:
   Waveform: Squarewave
   Amplitude: 2V
   Output: On
   Frequency: As specified in Table 6-2

Test Procedure:

1. Perform frequency Accuracy tests using Table 6-2

Table 6-2, Frequency Accuracy

PM8572A Setting	Error Limits	Counter Reading	Pass	Fail
10.000000000Hz	±10µHz			
1.0000000000kHz	±1mHz			
100.00000000kHz	±100mHz			
1.0000000000MHz	±1Hz			
100.000000000MHz	±100Hz			

Frequency Accuracy, External 10MHz Reference

Equipment: 10MHz reference (at least 0.1ppm), Counter

Preparation:

1. Leave counter setting and PM8572A connections as in last test
2. Connect the 10MHz reference oscillator to the PM8572A rear panel input
3. Configure the PM8572A channel 1 as follows:
   Ref Oscillator: External
   Waveform: Squarewave
   Amplitude: 2V
   Output: On
   Frequency: As specified in Table 6-3

Test Procedure

1. Perform frequency Accuracy tests using Table 6-3

Table 6-3, Frequency Accuracy Using External 10MHz Reference

PM8572A Setting	Error Limits	Counter Reading	Pass	Fail
10.000000000MHz	±1Hz			
50.000000000MHz	±5Hz			

Amplitude Accuracy

Amplitude accuracy checks tests the accuracy of the output amplifier and attenuators. Each channel has its own set of amplifiers and attenuators and therefore, the accuracy is tested on each channel separately. Amplitude path is checked for both the DAC route (arbitrary and standard waveforms) and the DDS route (CW and modulated waveforms).

Amplitude Accuracy, DAC Output

Equipment**:** DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: ACV
2. Connect PM8572A Channel outputs to the DMM input
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Output: On
   Amplitude: As specified in Table 6-4

Test Procedure

1. Perform amplitude Accuracy tests on both channels using Table 6-4

Table 6-4, Amplitude Accuracy, DAC output

PM8572A Amplitude Setting	Error Limits	DMM Reading		Pass	Fail
		CH 1	CH 2		
(*) 16.00V	5.657V, ±112mV				
10.00V	3.535V, ±59mV				
1.000V	353.5mV, ±7mV				
100.0mV	35.35mV, ±2.1mV				

Amplitude Accuracy, DDS Output

Equipment: DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: ACV
2. Connect PM8572A Channel outputs to the DMM input
3. Configure the PM8572A as follows:
   Waveform: Modulated
   Modulation: OFF
   CW Frequency: 1kHz
   Output: On
   Amplitude: As specified in Table 6-5

Test Procedure

1. Perform amplitude Accuracy tests on both channels using Table 6-5. (*) denotes not applicable with option 4.

Table 6-5, Amplitude Accuracy, DDS output

PM8572A Amplitude Setting	Error Limits	DMM Reading		Pass	Fail
		CH 1	CH 2		
(*) 16.00V	5.657V, ±112mV				
10.00V	3.535 V, ±59mV				
1.000V	353.5 mV, ±7mV				
100.0mV	35.35mV, ±2.1mV				

Offset Accuracy

Offset accuracy checks tests the accuracy of the offset generators. Each channel has its own set of offset generators and therefore, the accuracy is tested on each channel separately. Offset path is checked for both the DAC route (arbitrary and standard waveforms) and the DDS route (CW and modulated waveforms).

Offset Accuracy, DAC Output

Equipment**:** DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: DCV
2. Connect PM8572A Channel 1/2 output to the DMM input
3. Configure the PM8572A as follows:
   Frequency: 1MHz
   Amplitude: 20mV
   Output: On
   Offset: As specified in Table 6-6

Test Procedure

1. Perform Offset Accuracy tests on both channels using Table 6-6. (*) denotes not applicable with option 4.

Table 6-6, Offset Accuracy, DAC Output

PM8572A Offset Setting	Error Limits	DMM Reading		Pass	Fail
		CH 1	CH 2		
(*) +7.800V	7.800V ±83mV				
+4.000V	4.000V ±45mV				
0.000V	0V ±5.2mV				
-4.000V	-4.000V ±45mV				
-7.800V	-7.800V ±83mV				

Offset Accuracy, DDS Output

Equipment**:** DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: DCV
2. Connect PM8572A Channel 1/2 output to the DMM input
3. Configure the PM8572A as follows:
   Waveform: Modulated
   Modulation: OFF
   CW Frequency: 1MHz
   Amplitude: 20mV
   Output: On

Test Procedure

1. Perform Offset Accuracy tests on both channels using Table 6-7. (*) denotes not applicable with option 4.

Table 6-7, Offset Accuracy, DDS Output

PM8572A Offset Setting	Error Limits	DMM Reading		Pass	Fail
		CH 1	CH 2		
0.000V	0 ±5.2mV				

Squarewave Characteristics

This tests the characteristics of the square waveform. It includes transition times, aberrations and skew between channels. Each channel has its own set of amplifiers and attenuators and therefore, the characteristics are tested on each channel separately.

Squarewave Checks

Equipment: Oscilloscope, 50 ohms 20dB attenuator feed through

Preparation:

1. Configure the Oscilloscope follows:
   Termination: 50 ohms 20dB attenuator feed through at the oscilloscope input
   Setup: As required for the test
2. Connect PM8572A Channel 1/2 output to the oscilloscope input
   Configure the PM8572A as follows:
   Frequency: 1MHz
   Waveform: Squarewave
   Amplitude: 10V
   Output: On

Test Procedure

1. Perform Squarewave Characteristics tests on both channels using Table 6-8

Table 6-8, Square wave Characteristics

Parameter Tested	Error Limits	Oscilloscope Reading		Pass	Fail
		CH 1	CH 2		
Rise/Fall Time	<5ns				
Ringing	<5% + 10mV				
Over/undershoot	<5% + 10mV				

Skew Between Channels

Equipment: Oscilloscope, 50 ohms 20dB attenuator feed through

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 50 ohms 20dB attenuator feed through at the oscilloscope 50 ohms input. Use two identical cables to connect with Ch1/2.
   - Setup: As required for the test
2. Connect PM8572A Channel 1/2 output to the oscilloscope input
3. Configure the PM8572A as follows:
   - Frequency: 1MHz
   - Waveform: Arbitrary
   - SCLK: 250MS/s
   - Amplitude: 6V
   - Output: On

Test Procedure

1. Using ArbConnection prepare and download the following waveform (both channels):
   - Wavelength: 1024
   - Waveform: Square
2. Measure the skew between the channels to be less than 1ns ± 1 SCLK.
3. Program the skew from 1 to 10 and check the phase offset between channels is increased by 4nsec with every offset step.

Test Results	Pass		Fail	

Sinewave Characteristics

This tests the characteristics of the sine waveform. It includes distortions, spectral purity and flatness. Each channel has its own set of amplifiers and attenuators and therefore, the characteristics are tested on each channel separately. Tests are done for both the DAC route (arbitrary and standard waveforms) and the DDS route (CW and modulated waveforms).

Sinewave Distortions, DAC Output

Equipment: Distortion Analyzer, Spectrum Analyzer, and ArbConnection

Preparation:

1. Connect PM8572A Channel 1/2 output to the distortion analyzer input. Configure the PM8572A as follows:
   SCLK: As required by the test
   Waveform: Arbitrary
   Amplitude: 5V
   Output: On
2. Using ArbConnection prepare and download the following waveform:
   Wavelength: As required by the test
   Waveform: Sinewave

Test Procedure

1. Perform Sinewave distortion tests on both channels using Table 6-9

Table 6-9, Sinewave Distortion, DAC Output Tests

PM8572A SCLK Settings	Sinewave Points	PM8572A Frequency	Reading Limits	Distortion CH 1	Distortion CH 2	Pass	Fail
4MS/s	4000	1.000kHz	< 0.1%				
40Ms/s	4000	10.00kHz	< 0.1%				
200Ms/s	2000	100.00kHz	< 0.1%				

Sinewave Spectral Purity, DAC Output

Equipment: Spectrum Analyzer

Preparation:

1. Connect PM8572A Channel 1/2 output to the spectrum analyzer input. Use 50Ω and 20dB feedthrough termination at the spectrum analyzer input
2. Configure the PM8572A as follows:
   Amplitude: 5V
   Output: On
   Frequency: As required by the test

Test Procedure

1. Perform sinewave spectral purity, DAC waveforms tests using Table 6-10

Table 6-10, Sinewave Spectral Purity, DAC Output Test

PM8572A Freq Settings	Reading Limits	Spectrum Analyzer, Settings & Results				Pass	Fail
		Start	Stop	CH 1	CH 2		
10MHz	>43dBc	1M	100M				
50MHz	>30dBc	10M	200M				
100MHz	>25dBc	10M	250M				

Sinewave Spectral Purity, DDS Output

Equipment: Spectrum Analyzer

Preparation:

1. Connect PM8572A Channel 1/2 output to the spectrum analyzer input. Use 50Ω and 20dB feedthrough termination at the spectrum analyzer input
2. Configure the PM8572A as follows:
   Waveform: Modulated
   Modulation: OFF
   Amplitude: 5V
   Output: On
   CW Frequency: As required by the test

Test Procedure

1. Perform sinewave spectral purity, DDS Waveforms tests on both channels using Table 6-11

Table 6-11, DDS CW Spectral Purity Test.

PM8572A CW Freq	Reading Limits	Spectrum Analyzer, Settings & Results				Pass	Fail
		Start	Stop	CH 1	CH 2		
10MHz	>43dBc	1M	100M				
50MHz	>30dBc	10M	200M				
100MHz	>25dBc	10M	250M				

Sinewave Flatness, DAC Output

Equipment: Oscilloscope

Preparation:

1. Configure the Oscilloscope follows:
   Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   Setup: As required for the test
2. Connect PM8572A Channel 1/2 output to the oscilloscope input
3. Configure the PM8572A as follows:
   Amplitude: 6V
   Output: On

Frequency: Initially, 1MHz then, as required by the test

Test Procedure

1. Adjust the vertical controls of the Oscilloscope to get 6 division of display
2. Perform Sine flatness, DAC waveforms tests on both channels using Table 6-12

Table 6-12, Sinewave Flatness, DAC Output Test

PM8572A Sine Frequency	Error Limits	Oscilloscope Reading		Pass	Fail
		CH 1	CH 2		
1MHz	6 Divisions	Reference	Reference	X	X
10MHz	6 ±0.3 Divisions				
50MHz	6 ±1.2 Divisions				
100MHz	6 ±1.2 Divisions				

Sinewave Flatness, DDS Output

Equipment: Oscilloscope

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   - Setup: As required for the test
2. Connect PM8572A Channel 1/2 output to the oscilloscope input
3. Configure the PM8572A as follows:
   - Waveform: Modulated
   - Modulation: OFF
   - Amplitude: 6V
   - Output: On
   - CW Frequency: Initially, 1MHz then, as required by the test

Test Procedure

1. Adjust the vertical controls of the Oscilloscope to get 6 division of display
2. Perform Sine flatness, DDS waveforms tests on both channels using Table 6-13

Table 6-13, Sinewave Flatness, DDS Output Test

PM8572A Sine Frequency	Error Limits	Oscilloscope Reading		Pass	Fail
		CH 1	CH 2		
1MHz	6 Divisions	Reference	Reference	X	X
10MHz	6 ±0.3 Divisions				
50MHz	6 ±1.2 Divisions				
100MHz	6 ±1.2 Divisions				

Trigger operation Characteristics

This tests the operation of the trigger circuit. It includes tests for the triggered, gated and counted bursts run modes. It also tests the operation of the trigger advance options, the delayed trigger and re-trigger functions, as well as the trigger input level and slope sensitivity. The run modes are common to both channels and therefore the tests are performed on channel 1 only.

Trigger, Gate, and Burst Characteristics

Equipment: Oscilloscope, function generator, counter

Preparation:

1. Configure the Oscilloscope follows:
   Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   Setup: As required for the test
2. Connect PM8572A Channel 1/2 output to the oscilloscope input
3. Configure the function generator as follows:
   Frequency 1MHz
   Run Mode: As required by the test
   Wave: TTL Square
4. Connect the function generator output to the PM8572A TRIG IN connector
5. Configure the PM8572A as follows:
   Frequency: 28MHz
   Waveform: Sinewave
   Burst Count: 1e6 counts, each channel
   Amplitude: 1V
   Trigger Source: External
   Output: On

Test Procedure

1. Perform trigger and gate tests using Tables 6-14
2. Configure the counter to TOTB Measurements and perform burst tests using Tables 6-14. Set counter trigger level to 100mV.

Table 6-14, Trigger, gate, and burst Characteristics.

PM8572A Run Mode	External Trigger Pulse	Oscilloscope Reading		Pass	Fail
		CH 1	CH 2		
Triggered	1MHz, Continuous	Triggered waveform	Triggered waveform		
Gated	1MHz, Continuous	Gated Waveform	Gated Waveform		
Burst	Single shot	Burst, 1e6 waveforms	Burst, 1e6 waveforms		

Mixed Trigger Advance Test

Equipment: Oscilloscope, function generator, ArbConnection

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   - Setup: As required for the test
   - Run Mode: Single
2. Connect PM8572A Channel 1 output to the oscilloscope input
3. Configure the function generator as follows:
   - Frequency 100kHz
   - Run Mode: Continuous
   - Wave: TTL Square from the main output.
4. Connect the function generator output to the PM8572A TRIG IN connector
5. Configure the PM8572A, channel 1 only, as follows:
   - Frequency: 28MHz
   - Waveform: Sinewave
   - Run Mode: Burst
   - Burst Count: 5 counts, each channel
   - Trigger Delay: On
   - Delay: 5s
   - Amplitude: 5V
   - Trigger Source: Mixed
   - Output: On

Test Procedure

1. Note that no signal is shown on the oscilloscope
2. From ArbConnection, press the MAN TRIG button.
3. Note and record the time that lapsed from when you pressed MANUAL Trigger button until you first see the burst of 5 sine waveforms. Lapsed time should be 5 seconds

Test Results	Pass		Fail	

4. Modify oscilloscope setting to Auto, or Normal and observe that bursts of 5 sine cycles appear at 10μs intervals

Test Results	Pass		Fail	

Delayed Trigger Characteristics

Equipment: Function generator, 50Ω “T” connector, Counter, ArbConnection CAD

Preparation:

1. Configure the Function generator as follows:
   Amplitude: 1V
   Frequency: 1MHz
   Trigger Mode: Triggered.
   Wave: Squarewave
2. Place the “T” connector on the output terminal of the function generator. Connect one side of the “T” to the PM8572A TRIG IN connector and the other side of the “T” to the channel A input of the counter
3. Connect the PM8572A output to channel B input of the counter
4. Configure the counter to TI A to B measurements
5. Using ArbConnection prepare and download the following waveform:
   Wavelength: 100 points
   Waveform: Pulse, Delay = 0.1, Rise/Fall = 0, High Time = 99.99
6. Configure the PM8572A, channel 1 only, as follows:
   SCLK: 200MHz
   Waveform: Arbitrary
   Run Mode: Triggered
   Trigger Level 0V
   Trigger Delay: On
   Delay: As required for the test
   Amplitude: 5V
   Trigger Source: External
   Output: On

Test Procedure

1. Perform trigger delay tests using Tables 6-15

Table 6-15, Trigger Delay Tests

PM8572A Delay Setting	Error Limits	Counter Reading	Pass	Fail
1μs	1μs ±230ns			
1ms	1ms ±50μs			
1s	1s ±50ms			

Re-trigger Characteristics

Equipment: Counter, ArbConnection

Preparation:

1. Configure the counter to pulse width measurements as follows:
   Function: Pulse Width Measurement
   Ch A Slope: Negative

2. Connect the counter channel A to the PM8572A output
3. Using ArbConnection prepare and download the following waveform to both channels:
   Wavelength: 100 points
   Waveform: Pulse, Delay = 0.1, Rise/Fall = 0, High Time = 99.99
4. Configure the PM8572A, channel 1 only, as follows:
   SCLK 200MHz
   Waveform: Arbitrary
   Amplitude: 5V
   Run Mode: Triggered
   Trigger Level 0V
   Re-trigger: On
   Re-trigger Delay: As required by the test
   Output: On

Test Procedure
1. Manually trigger the instrument
2. Perform trigger delay tests using Tables 6-16

Table 6-16, Re-Trigger Delay Tests

PM8572A Delay Setting	Error Limits	Counter Reading	Pass	Fail
1μs	1μs ±85ns			
1ms	1ms ±50μs			
1s	1s ±50ms			

Trigger Slope

Equipment: Oscilloscope, function generator

Preparation:
1. Configure the Oscilloscope follows:
   Termination: 20dB, 50Ω feed through attenuator at the oscilloscope input
   Setup: As required for the test
   Trigger Source: External
2. Connect PM8572A Channel 1/2 output to the oscilloscope input
3. Configure the function generator as follows:
   Frequency 10kHz
   Run Mode: Continue
   Waveform: TTL Output
4. Connect the function generator TTL output to the PM8572A TRIG IN connector
5. Connect the function generator main output to the 2nd channel of the oscilloscope
6. Configure the PM8572A as follows:
   Frequency: 1MHz
   Waveform: Sine wave
   Run Mode: Triggered
   Output: On

Test Procedure

1. Toggle PM8572A trigger slope from positive to negative visa versa
2. Verify on the oscilloscope that the PM8572A transitions are synchronized with the slope of the trigger

Test Results	Pass		Fail	

Trigger Level

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the Oscilloscope as follows:
   Termination: 20dB, 50Ω feed through attenuator at the oscilloscope input
   Setup: As required for the test
2. Connect PM8572A Channel 1 output to the oscilloscope input
3. Configure the function generator as follows:
   Frequency 10kHz
   Run Mode: Continuous
   Waveform: Squarewave.
   Amplitude: 1V
4. Connect the function generator output to the PM8572A TRIG IN connector
5. Configure the PM8572A as follows:
   Frequency: 1MHz
   Waveform: Sine wave
   Run Mode: Triggered
   Trigger level: 0V
   Ch1 Output: On

Test Procedure

1. Verify that the PM8572A outputs triggered waveforms spaced at 0.1ms
2. Modify the function generator offset to +2V and change the PM8572A trigger level to +4V. Verify that the PM8572A outputs triggered waveforms spaced at 0.1ms
3. Modify the function generator offset to -2V and change the PM8572A trigger level to -4V. Verify that the PM8572A outputs triggered waveforms spaced at 0.1ms

Test Results	Pass		Fail	

Sequence operation

This tests the operation of the sequence generators. Each channel has its own sequence generator and therefore operations are tested on each channel separately. This also checks the sequence advance options.

Automatic Advance

Equipment: Counter

Preparation:

1. Configure the Counter as follows:
   Function: TOTB Measurement
2. Connect the counter channel B to the PM8572A output
3. Configure the PM8572A as follows (both channels):
   SCLK 225MS/s
   Waveform: Sequence
   Run Mode: Trigger
   Amplitude: 2V
   Output: On
4. Using ArbConnection prepare and download the following waveform to both channels:
   Segments: 1 to 5
   Wavelength: 128 points
   Waveform: 1 cycle square
5. Using ArbConnection, build and download the following sequence table:
   Step 1: Segment 1, loop 100,000
   Step 2: Segment 2, loop 100,000
   Step 3: Segment 3, loop 100,000
   Step 4: Segment 4, loop 100,000
   Step 5: Segment 5, loop 100,000

Test Procedure

1. From ArbConnection, click on the Manual Trigger button and observe that counter reading is 500,000 counts. Reset counter and repeat the test a few times. Every time the counter reading should be 500,000 counts exactly

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Step Advance

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the Oscilloscope as follows:
   Termination: 20dB, 50Ω feed through attenuator at the oscilloscope input
   Setup: As required for the test
2. Connect PM8572A Channel 1 output to the oscilloscope input
3. Configure the function generator as follows:
   Frequency 10kHz
   Run Mode: Triggered
   Waveform: Squarewave.
   Amplitude: Adjust for TTL level on 50Ω
4. Connect the function generator output to the PM8572A TRIG IN connector
5. Connect PM8572A Ch1 to the Oscilloscope input
6. Configure the PM8572A as follows:
   SCLK 200MS/s
   Waveform: Sequence
   Seq Advance: Step
   Amplitude: 2V
   Trigger Source: External
   Output: On
7. Using ArbConnection prepare and download the following waveform to both channels:
   Segment 1: Sine, 1000 points
   Segment 2: Triangle, 1000 points
   Segment 3: Square, 1000 points
   Segment 4: Sinc, 1000 points
   Segment 5: Gaussian Pulse, 1000 points
8. Using ArbConnection, build and download the following sequence table:
   Step 1: Segment 1, loop 1
   Step 2: Segment 2, loop 1
   Step 3: Segment 3, loop 1
   Step 4: Segment 4, loop 1
   Step 5: Segment 5, loop 1

Test Procedure

1. Press the manual trigger button on the function generator and observe that the waveforms advance through the sequence table repeatedly

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Note

Leave the same setup for the next test

Single Advance

Equipment: Oscilloscope, function generator

Preparation: (Same preparation as for previous step, except change mode to single sequence advance)

1. Change Oscilloscope configuration to single

Test Procedure

1. Press the manual trigger button on the function generator and observe that one cycle waveform advances through the sequence table repeatedly with each external trigger signal. Note that you need to press the Single mode on the oscilloscope for each trigger advance

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Modulated Waveforms Characteristics

This tests the operation of the modulation circuits. It includes tests for the various modulation functions: FM, AM, FSK, PSK, Frequency hops and Sweep. Since the run modes are common to all modulation functions, they are being tested on the FM function only. The tests are performed on each channel.

FM - Standard Waveforms

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 50μs
   Sampling Rate: 50MS/s at least.

Trace A View:	Jitter, Type: FREQ, CLK.
Trigger source:	Channel 2, positive slope
Amplitude:	1V/div

2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:

Waveform:	Modulated
Modulation:	FM
Carrier Freq:	1MHz
Mod Frequency:	10kHz
Deviation:	500kHz
Sync:	On
Output:	On

Test Procedure:

1. Verify FM operation on the oscilloscope as follows:

Waveform:	Sine
Frequency:	10kHz
Max A:	1.25MHz
Min A:	750kHz

Test Results	Pass		Fail	

2. Modify PM8572A modulating waveform to triangle, then square and ramp and verify FM waveforms as selected

Test Results	Pass		Fail	

3. Move PM8572A marker position to 1.25MHz and verify marker position

Test Results	Pass		Fail	

4. Remove the cable from PM8572A channel 1 and connect to channel 2
5. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Triggered FM - Standard Waveforms

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the oscilloscope as follows:

   Time Base: 0.2 ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure the function generator as follows:

   Frequency 1kHz
   Run Mode: Continuous
   Waveform: Squarewave.
   Amplitude: 2V
   Offset: 1V
5. Connect the function generator output connector to the PM8572A TRIG IN connector
6. Configure model PM8572A controls on both channels as follows:

   Waveform: Modulated
   Modulation: FM
   Mod Run Mode: Triggered
   Carrier Freq: 1MHz
   Mod Frequency: 10kHz
   Deviation: 500kHz
   Sync: On
   Output: On

Test Procedure:

1. Verify triggered FM – standard waveforms operation on the oscilloscope as follows:

   Waveform: Triggered sine waves
   Sine Frequency: 10kHz
   Trigger Period: 1ms
   Max A: 1.25MHz
   Min A: 750kHz

Test Results	Pass		Fail	

FM Burst - Standard Waveforms

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.2ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure the function generator as follows:
   Frequency 1kHz
   Run Mode: Continuous
   Waveform: Squarewave.
   Amplitude: Adjust to TTL level on 50Ω
5. Connect the function generator output connector to the PM8572A TRIG IN connector
6. Configure model PM8572A controls on both channels as follows:
   Waveform: Modulated
   Modulation: FM
   Modulation Run Mode: Burst
   Burst: 5
   Carrier Freq: 1MHz
   Mod Frequency: 10kHz
   Deviation: 500kHz
   Sync: On
   Output: On

Test Procedure:

1. Verify triggered FM – standard waveforms operation on the oscilloscope as follows:
   Waveform: Burst of 5 Sine waveforms
   Sine Frequency: 10kHz
   Burst Period: 1ms
   Max A: 1.25MHz
   Min A: 750kHz

Test Results	Pass		Fail	

Gated FM - Standard Waveforms

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.2 ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure the function generator as follows:
   Frequency 1kHz
   Run Mode: Continuous
   Waveform: Squarewave.
   Amplitude: 2V
   Offset: 1V
5. Connect the function generator output connector to the PM8572A TRIG IN connector
6. Configure model PM8572A controls on both channels as follows:
   Waveform: Modulated
   Modulation: FM
   Mod Run Mode: Gated
   Carrier Freq: 1MHz
   Mod Frequency: 10kHz
   Deviation: 500kHz
   Sync: On
   Output: On

Test Procedure:

1. Verify triggered FM – standard waveforms operation on the oscilloscope as follows:
   Waveform: Gated sine waveforms
   Sine Frequency: 10kHz
   Gated Period: 1ms
   Max A: 1.25MHz
   Min A: 750kHz

Test Results	Pass		Fail	

Re-triggered FM Bursts - Standard Waveforms

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.2ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:
   Waveform: Modulated
   Modulation: FM
   Modulation Run Mode: Burst
   Burst Count: 5
   Carrier Freq: 1MHz
   Mod Frequency: 10kHz
   Deviation: 500kHz
   Sync: On
   Re-trigger: On
   Re-trigger Delay: 200μs
   Output: On

Test Procedure:

1. Verify re-triggered FM burst – standard waveforms operation on the oscilloscope as follows:
   Waveform: Repetitive burst of 5-cycle sine waveforms
   Sine Frequency: 10kHz
   Re-trigger delay: 200μs
   Max A: 1.25MHz
   Min A: 750kHz

Test Results	Pass		Fail	

FM - Arbitrary Waveforms

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 0.2ms
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: FM
   - Mod Waveform: Arbitrary
   - Carrier Freq: 1MHz
   - FM SCLK: 2.5MS/s
   - Sync: On
   - Output: On
5. Using ArbConnection prepare, open the FM Composer and download the following waveform:
   - Wavelength: 4000 points
   - Waveform: 4 cycles sinewave
   - Deviation: 0.5MHz

Test Procedure:

1. Verify FM operation on the oscilloscope as follows:
   - Waveform: Sine
   - Frequency: 2.5kHz
   - Max A: 1.25MHz
   - Min A: 750kHz

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

AM

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.5 ms
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:
   Waveform: Modulated
   Modulation: AM
   Carrier Freq: 1MHz
   Mod Frequency: 1kHz
   Mod Depth: 50%
   Mod Wave Ch1 Sine
   Mod Wave Ch2 Triangle
   Sync: On
   Output: On

Test Procedure:

1. Verify AM operation on the oscilloscope as follows:
   Waveform: Amplitude modulated sine
   Mod depth: 50% ±5%

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2 but observe a triangle modulating wave form.

Test Results	Pass		Fail	

FSK

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.2ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div.
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:
   Waveform: Modulated
   Modulation: FSK
   Carrier Freq: 2MHz
   Shift Frequency: 4MHz
   Baud Rate: 10kHz
   Marker Index: 1
   Sync: On
   Output: On
5. Using ArbConnection, prepare and download 10-step FSK list with alternating “0” and “1”

Test Procedure:

1. Verify FSK operation on the oscilloscope as follows:
   Waveform: Squarewave
   Period: 0.2ms
   Max Freq.: 4MHz
   Min Freq.: 2MHz

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

PSK

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 50μs
   Amplitude: 1V/div.
2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:
   Reset
   Waveform: Modulated
   Modulation: PSK
   Carrier Freq: 10kHz
   Shift Phase: 180 degrees
   Baud Rate: 10kHz
   Sync: On
   Output: On
5. Using ArbConnection, prepare and download 10-step PSK list with alternating "0" and "1"

Test Procedure:

1. Verify PSK operation on the oscilloscope as follows:
   Waveform: Sinewave
   Period: 0.1ms
   Phase: Every 0.1ms change 180 degrees

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Variable Dwell Time Frequency Hops

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:

Time Base:	0.5ms
Sampling Rate:	50MS/s at least.
Trace A View:	Jitter, Type: FREQ, CLK.
Trigger source:	Channel 2, positive slope
Amplitude:	1V/div

2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:

Waveform:	Modulated
Modulation:	Hop
Hop Mode:	Variable
Sync:	On
Output:	On

5. Using ArbConnection prepare, open the Hop Table composer and download the following table (both channels):

Frequency	**Dwell Time**
1.0e6	50e-6
1.2e6	100e-6
1.4e6	150e-6
1.6e6	200e-6
1.8e6	250e-6
2.0e6	300e-6
2.2e6	350e-6
2.4e6	400e-6
2.6e6	450e-6
2.8e6	500e-6

Test Procedure:

1. Verify Hop operation on the oscilloscope as follows:

Waveform:	Frequency steps, increasing dwell time from 50μs to 500μs
Max A:	2.8MHz
Min A:	1.0MHz
Period:	2750μs

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Fix Dwell Time Frequency Hops

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:

Time Base:	0.5ms
Sampling Rate:	50MS/s at least.
Trace A View:	Jitter, Type: FREQ, CLK.
Trigger source:	Channel 2, positive slope
Amplitude:	1V/div

2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:

Waveform:	Modulated
Modulation:	Hop
Hop Mode:	Fix
Dwell Time:	50μs
Sync:	On
Output:	On

5. Using ArbConnection prepare, open the Hop Table composer and download the following table (both channels):

Frequency
1.0e6
1.2e6
1.4e6
1.6e6
1.8e6
2.0e6
2.2e6
2.4e6
2.6e6
2.8e6

Test Procedure:

1. Verify Hop operation on the oscilloscope as follows:

Waveform:	Frequency steps, fixed dwell time of 50μs
Max A:	2.8MHz
Min A:	1.0MHz
Period:	500μs

Test Results	Pass		Fail	

2. Remove the cable from PM8572A channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Sweep

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:

Time Base:	0.2ms
Sampling Rate:	50MS/s at least.
Trace A View:	Jitter, Type: FREQ, CLK.
Trigger source:	Channel 2, positive slope
Amplitude:	1V/div

2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:

Waveform:	Modulated
Modulation:	Sweep
Start Frequency:	1MHz
Stop Frequency:	2MHz
Sweep Time:	1ms
Sweep Type:	Linear
Sync:	On
Output:	On

Test Procedure:

1. Verify Sweep operation on the oscilloscope as follows:

Waveform:	Ramp up
Frequency:	1kHz
Max A:	2MHz
Min A:	1MHz

Test Results	Pass		Fail	

2. Move PM8572A sweep marker position to 1.5MHz and verify marker position at the middle of the ramp

Test Results	Pass		Fail	

3. Reverse between Start and Stop frequencies and verify oscilloscope reading as before except the ramp is down

Test Results	Pass		Fail	

4. Change sweep step to logarithmic and verify oscilloscope exponential down waveform with properties as in 3 above

Test Results	Pass		Fail	

5. Remove the cable from PM8572A channel 1 and connect to channel 2
6. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Digital Pattern Generator Characteristics

This tests the operation of the digital pattern generator and the output connector on the rear panel. The output is associated with channel 1. This test requires connection of a special test board to the rear panel connector. This board is available at specific service centers around the world and is not available for individuals. Therefore, if you suspect that there are problems with the digital pattern output, contact your nearest service center for details how to obtain access to the test board.

Digital Patterns

Equipment: Oscilloscope, Digital pattern test board, Dual DC power supply

Preparation:
1. Turn power OFF
2. Connect +3.3V to the test board
3. Chook up the test board on the digital output connector
4. Turn power ON
5. Turn power supply power ON

WARNING

Do not attempt to connect the test board to the PM8572A connector while power is ON as this may result in

permanent damage to the PM8572A. Always turn power OFF before connecting or disconnecting the test board to the PM8572A.

6. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
7. Configure model PM8572A channel 1 controls as follows:
   Waveform: Digital
   Pattern Rate: 2pps
8. Using ArbConnection prepare, open the Digital Pattern Stimulation List Table and download the following table:

Index	Stimulation List (Hex)
1	1
2	2
3	4
4	8
5	10
6	20
7	40
8	80
9	100
10	200
11	400
12	800
13	1600
14	3200
15	6400
16	12800

Test Procedure:

1. Watch the LED's on the test board. The 16 MSD LED's light in sequence. Each LED lights for about 0.25 second
2. Set up the oscilloscope and check the output levels. Verify output levels are LVDS

Test Results	Pass		Fail	

3. Turn power off and remove the cable from the PM8572A

SYNC Output operation

This tests the operation of the SYNC output. There are two parameters being tested, the qualifier and the sync source. The sync output has fixed TTL level amplitude into an open circuit.

SYNC Qualifier - Bit

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: As required by the test
   Amplitude: 2V/div
2. Connect PM8572A SYNC output to the oscilloscope input
3. Configure model PM8572A as follows:
   Ch1 Waveform: Sine
   Ch1 Output: On
   SYNC: On

Test Procedure:

1. Verify trace on the oscilloscope shows synchronization pulses at 1µs intervals

Test Results	Pass		Fail	

SYNC Qualifier - LCOM

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: As required by the test
   Amplitude: 2V/div
2. Connect the PM8572A CH1 output to the oscilloscope input (1)
3. Connect the PM8572A SYNC output to the oscilloscope input (2)
4. Configure model PM8572A channel as follows:
   Waveform: Sine
   Run Mode: Burst
   Burst Count: 10
   Re-trigger On
   Re-trig period: 10µs
   Output: On

Test Procedure:

1. Manually trigger the PM8572A
2. Verify trace on the oscilloscope shows synchronization pulse having 9µs pulse width. Verify the SYNC is high for the duration of the burst.

Test Results	Pass		Fail	

SYNC Source

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: As required by the test
   Amplitude: 2V/div
   Trigger Source: Channel 1
2. Connect PM8572A SYNC output to the oscilloscope input, channel 1
3. Connect PM8572A CH1 output to the oscilloscope input, channel 2
4. Connect PM8572A CH2 output to the oscilloscope input, channel 3
5. Configure model PM8572A channel 1 and 2 controls as follows:
   Function: Arbitrary
   Output: On
   SYNC: On
6. Using ArbConnection prepare and download the following waveform:
   Ch1: 64 points sine waveform
   Ch2: 100 points sine waveform

Test Procedure:

1. Verify that the trace on the oscilloscope is synchronized with the PM8572A channel 1 waveform

Test Results	Pass		Fail	

2. Modify the PM8572A SYNC Source from channel 1 to channel 2
3. Verify that the trace on the oscilloscope is synchronized with the PM8572A channel 2 waveform

Test Results	Pass		Fail	

Waveform Memory Operation

This tests the integrity of the waveform memory. The waveform memory stores the waveforms that are being generated at the output connector and therefore, flaws in the memory can cause distortions and impurity of the output waveforms. Each channel has its own working memory and therefore each channel is tested separately.

Waveform memory

Equipment: Distortion Analyzer, ArbConnection

Preparation:

1. Connect PM8572A Channel 1/2 output to the distortion analyzer input. Configure the PM8572A as follows:
   SCLK: As required by the test
   Waveform: Arbitrary
   Amplitude: 5V
   Output: On
2. Using ArbConnection prepare and download the following waveform:
   Wavelength: 1M points (2M/4M with an option installed)
   Waveform: Sine wave
   SCLK 250MHz

Test Procedure

1. Perform Sine wave distortion. It should be less than 0.1%

Test Results	Pass		Fail	

Remote Interfaces

This tests the communication with the PM8572A using the various interface options. Connecting and setting up the PM8572A for operation with the various interface options is described in Chapter 2. Before you proceed with and of the following tests, make sure first that the PM8572A is configured to operate with the selected test. GPIB operation requires setting of the GPIB address, LAN operation requires correct setting of the LAN parameters and USB operation requires that the USB port is configured correctly and USB driver installed on the host computer.

GPIB Control

Equipment: Distortion Analyzer, ArbConnection

Preparation:

1. Set up the PM8572A for GPIB operation and connect the instrument to a host controller
2. Connect PM8572A Normal output to the distortion analyzer input.
3. Configure the PM8572A as follows:
   SCLK: 250 MS/s
   Waveform: Arbitrary
   Output: On
4. Using ArbConnection prepare and download the following waveform:
   Wavelength: 1M points (2M/4M with an option installed)
   Waveform: Sine wave

Test Procedure

1. Check the resulting trace on the oscilloscope

2. Perform Sine wave distortion. It should be less than 0.5 %

Test Results	Pass		Fail	

USB Control

Equipment: Distortion Analyzer, ArbConnection

Preparation:
1. Set up the PM8572A for USB operation and connect the instrument to a host controller
2. Connect PM8572A Normal output to the distortion analyzer input.
3. Configure the PM8572A as follows:
   SCLK: 250 MS/s
   Waveform: Arbitrary
   Output: On
4. Using ArbConnection prepare and download the following waveform:
   Wavelength: 1M points (2M/4M with an option installed)
   Waveform: Sine wave

Test Procedure
1. Check the resulting trace on the oscilloscope
2. Perform Sine wave distortion. It should be less than 0. 5 %

Test Results	Pass		Fail	

LAN Control

Equipment: Distortion Analyzer, ArbConnection

Preparation:
1. Set up the PM8572A for LAN operation and connect the instrument to a host controller
2. Connect PM8572A Normal output to the distortion analyzer input.
3. Configure the PM8572A as follows:
   SCLK: 250 MS/s
   Waveform: Arbitrary
   Output: On
4. Using ArbConnection prepare and download the following waveform:
   Wavelength: 1M points (2M/4M with an option installed)
   Waveform: Sine wave

Test Procedure
1. Check the resulting trace on the oscilloscope
2. Perform Sine wave distortion. It should be less than 0.5 %

Test Results	Pass		Fail	

Auxiliary Counter/Timer Operation

This tests the operation of the auxiliary counter/timer function. Note that when you select the counter/timer function all other PM8572A waveform generation are automatically purged and the instrument is transformed to a stand-alone counter/timer. Waveform generation is resumed as soon as the counter/timer function is turned off.

Frequency

Equipment: Function Generator with at least 1 ppm accuracy

Preparation:

1. Configure the function generator as follows:
   Frequency: As required by the test
   Wave: Square
   Amplitude 500 mV
2. Connect the function generator to the PM8572A TRIG IN connector
3. Configure the PM8572A, as follows:
   Auxiliary Function: Counter/Timer
   Function: Frequency
   Trigger Level: 0 V

Test Procedure:

1. Perform Frequency Measurement Accuracy tests using Table 6-13

Table 6-17, Frequency Measurement Accuracy

Function Generator Setting	Error Limits	PM8572A Counter Reading	Pass	Fail
1.000000 MHz	±2 Hz			
100.00000 MHz	±100 Hz			
100.00000 MHz	±200 Hz			

2. Change the display time to Hold
3. Press the Reset/Arm button and verify that the frequency reading is 100.000000 MHz, ±200 Hz

Test Results	Pass		Fail	

Period, Period Averaged

Equipment: Function Generator with at least 1 ppm accuracy

Preparation:

1. Configure the function generator as follows:
   Frequency: As required by the test
   Wave: Square
   Amplitude 500 mV
2. Connect the function generator to the PM8572A TRIG IN connector
3. Configure the PM8572A, as follows:
   Auxiliary Function: Counter/Timer
   Function: Period
   Trigger Level: 0 V

Test Procedure:

1. Perform Period Accuracy tests using Table 6-14

Table 6-18, Period Measurement Accuracy

Function Generator Setting	Error Limits	PM8572A Counter Reading	Pass	Fail
10 kHz	100.0 µs ±200 ns			
100 kHz	10.00 µs ±200 ns			
1 MHz	1.000 µs ±200 ns			

2. Change the counter/timer function to Period Averaged
3. With the last function generator setting in Table 6-14, verify that the period reading is 1.000000 µs ±20 ps

Test Results	Pass		Fail	

Pulse Width

Equipment: Function Generator with at least 1 ppm accuracy

Preparation:

1. Configure the function generator as follows:
   Frequency: As required by the test
   Wave: Square
   Duty Cycle: As required by the test
   Amplitude 500 mV
2. Connect the function generator to the PM8572A TRIG IN connector
3. Configure the PM8572A, as follows:
   Auxiliary Function: Counter/Timer
   Function: Pulse Width
   Trigger Level: 0 V

Test Procedure:

1. Perform Pulse Width Accuracy tests using Table 6-15

Table 6-19, Pulse Width Measurement Accuracy

Function Generator Setting		Error Limits	PM8572A Counter Reading	Pass	Fail
Frequency	Duty Cycle				
10 kHz	50 %	50.00 µs ±200 ns			
100 kHz	50 %	5.000 µs ±200 ns			
1 MHz	50 %	500.0 ns ±200 ns			

2. Change the counter/timer slope to Negative
3. With the last function generator setting in Table 6-15, change the function generator duty cycle to 70%
4. Verify that the pulse width reading is 3.000 µs ±200 ns

Test Results	Pass		Fail	

Totalize, Gated

Equipment: Function Generator with at least 1 ppm accuracy

Preparation:

1. Configure the function generator as follows:
   Frequency: 1 MHz
   Wave: Square
   Amplitude 500 mV
2. Connect the function generator to the PM8572A TRIG IN connector
3. Configure the PM8572A, as follows:
   Auxiliary Function: Counter/Timer
   Function: Totalize, Gated
   Gate Time: As required by the test
   Trigger Level: 0 V

Test Procedure:

1. Perform Totalize, Gated Accuracy tests using Table 6-16

Table 6-20, Totalize, Gate Measurement Accuracy

PM8572A Gate Time Setting	Error Limits	PM8572A Counter Reading	Pass	Fail
1.000 s	1000000 ±30			
100.0 ms	100000 ±30			

2. Change the function generator run mode to Burst and set Burst Count to 100
3. Press the Reset/Arm button on the PM8572A to reset and arm the totalize function
4. Manually trigger the function generator and verify that the PM8572A counter reading is 100 ±1

Test Results	Pass		Fail	

Totalize, Infinite

Equipment: Function Generator with at least 1 ppm accuracy

Preparation:

1. Configure the function generator as follows:
   Frequency: 150 MHz
   Wave: Square
   Amplitude 500 mV
2. Connect the function generator to the PM8572A TRIG IN connector
3. Configure the PM8572A, as follows:
   Auxiliary Function: Counter/Timer
   Function: Totalize, Infinite
   Trigger Level: 0 V

Test Procedure:

1. Verify that the display is updated continuously with the totalized counts
2. Verify that the reading is held at 4000000000 counts and that the overflow indication turns on

Test Results	Pass		Fail	

3. Change the function generator run mode to Burst and set Burst Count to 1’000’000
4. Press the Reset/Arm button on the PM8572A to reset and arm the totalize function
5. Manually trigger the function generator and verify that the PM8572A counter reading is 1000000 ±2

Test Results	Pass		Fail	

Pulse Generator Characteristics

This tests the characteristics of the pulse generator. It tests all pulse and run modes, as well as accuracy of the programmed pulse parameters. Each channel has its own set of amplifiers and attenuators and therefore, the characteristics that apply to these parts are tested separately on each channel. Common parameters are tested on channel 1 only.

Period Accuracy

This tests the accuracy of the pulse period. Pulse period is specified in two run modes: continuous and interrupted. In continuous mode, the accuracy is controlled by a DDS circuit and hence the accuracy is much higher then in the interrupted run mode, where the accuracy there is controlled by an analog circuit. The accuracy is tested in two modes, continuous and gated only because the controlling circuit is the same for all of the interrupted run modes. To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

Period Accuracy, Continuous Run Mode Tests

Equipment: Counter/timer

Preparation:

1. Configure the counter/timer as follows:
   - Function: Period Averaged
   - Trigger Level: 0 V
   - Termination: 50 Ω
2. Connect PM8572A Channel 1 output to the counter/timer input. Configure the PM8572A as follows:
   - Waveform: Single Pulse
   - High Level: 2 V
   - Low Level: -2 V
   - Output: On
   - Period: As required by the tests

Test Procedure

1. Perform period accuracy, continuous run mode tests using Table 6-21

Table 6-21, Period Accuracy, Continuous Run Mode Tests

PM8572A Period Setting	Error Limits	Counter Reading	Pass	Fail
100.0000000 ms	±100 ns			
10.000000 ms	±10 ns			
1.000000 ms	±1 ns			
100.000 µs	±100 ps			
10.000 µs	±10 ps			
1.000 µs	±1 ps			

Period Accuracy, Gated Run Mode Tests

Equipment: Counter/timer, Pulse Generator

Preparation:

1. Configure the counter/timer as follows:
   Function: Period
   Trigger Level: 0 V
   Termination: 50 Ω
2. Connect PM8572A Channel 1 output to the counter/timer input. Configure the PM8572A as follows:
   Waveform: Single Pulse
   High Level: 2 V
   Low Level: -2 V
   Run Mode: Gated
   Output: On
   Period: As required by the tests
3. Configure the pulse generator as follows:
   Waveform: Single Pulse
   Period: 4 s
   Width: 2 s
   High Level: 2 V
   Low Level: 0 V
4. Connect the pulse generator output to the PM8572A rear-panel TRIG IN connector

Test Procedure

1. Perform period accuracy, gated run mode tests using Table 6-22. Note that the reading will be stable during 2 seconds when the external pulse generator opens the gate. Discard other readings as irrelevant.

Table 6-22, Period Accuracy, Gated Run Mode Tests

PM8572A Period Setting	Error Limits	Counter Reading	Pass	Fail
100.0000000 ms	±3 ms			
10.000000 ms	±300 µs			
1.000000 ms	±30 µs			
100.000 µs	±3 µs			
10.000 µs	±300 ns			
1.000 µs	±30 ns			

Pulse Width Accuracy

This tests the accuracy of the pulse width. To eliminate counter threshold hysteresis problems the tests are performed with the fastest transitions only and at ranges that will not be effected by counter errors.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

Pulse Width Accuracy Tests

Equipment: Counter/timer

Preparation:

1. Configure the counter/timer as follows:
   - Function: Pulse Width Averaged
   - Trigger Level: 0 V
   - Termination: 50 Ω
2. Connect PM8572A Channel 1 output to the counter/timer input. Configure the PM8572A as follows:
   - Waveform: Single Pulse
   - High Level: 2 V
   - Low Level: -2 V
   - Period: 100 ms
   - Output: On
   - Pulse Width: As required by the tests

Test Procedure

1. Perform pulse width accuracy tests using Table 6-23

Table 6-23, Pulse Width Accuracy Tests

PM8572A Pulse Width Setting	Error Limits	Counter Reading CH1	Counter Reading CH2	Pass	Fail
10.00000 ms	±300 µs				
1.000000 ms	±30.0 µs				
100.000 µs	±3.00 µs				
10.000 µs	±300.5 ns				
1.000 µs	±30.5 ns				
100 ns	±3.5 ns				

Pulse Delay, Double Pulse Delay Accuracy

This tests the accuracy of the pulse delay circuit. To eliminate counter threshold hysteresis problems the tests are performed with the fastest transitions only and at ranges that will not be effected by counter errors. For your information, the pulse delay and the double pulse delay share the same circuits. Also, the measurement of delayed pulse is more complicated because it involves manual subtraction of the the SYNC to start delay and therefore, only double pulse delay is performed in this test and the results will verify the accuracy of the delayed pulse as well.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

Double Pulse Delay Accuracy Tests

Equipment: Counter/timer

Preparation:

1. Configure the counter/timer as follows:
   Function: Period
   Trigger Level: 0 V
   Termination: 50 Ω
2. Connect PM8572A Channels 1/2 outputs to the counter/timer input. Configure the PM8572A as follows:
   Waveform: Double Pulse
   Run Mode: Triggered
   High Level: 2 V
   Low Level: -2 V
   Period: 100 ms
   Pulse Width: 10 ns
   Output: On
   Dbl Pulse Delay: As required by the tests

Test Procedure

1. Manually trigger the PM8572A for each test.
2. Perform double pulse delay accuracy tests using Table 6-24. Reset counter reading after each test.

Table 6-24, Double Pulse Delay Accuracy Tests

PM8572A Double Pulse Delay Setting	Error Limits	Counter Reading CH1	Counter Reading CH2	Pass	Fail
10.00000 ms	±300 µs				
1.000000 ms	±30.0 µs				
100.000 µs	±3.00 µs				
10.000 µs	±300.5 ns				
1.000 µs	±30.5 ns				
100 ns	±3.5 ns				

Hold Duty Cycle Pulse Mode Accuracy

This tests the accuracy of the hold duty cycle pulse mode. Actually, the hold duty cycle mode is a special case of the single pulse mode except, in single pulse mode, the pulse width remains constant regardless of the period settings and in the hold duty cycle pulse mode, the ratio between the pulse width and the period remains constant regardless of the period settings. Note that each channel can have a unique duty cycle setting.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

Hold Duty Cycle Pulse Mode Accuracy Tests

Equipment: Counter/timer

Preparation:

1. Configure the counter/timer as follows:
   Function: Pulse Width Averaged
   Trigger Level: 0 V
   Termination: 50 Ω
2. Connect PM8572A Channels 1/2 outputs to the counter/timer input. Configure the PM8572A as follows:
   Waveform: Hold DCycle
   High Level: 2 V
   Low Level: -2 V
   Duty Cycle: 10%
   Output: On
   Period: As required by the tests

Test Procedure

1. Perform pulse width accuracy tests using Table 6-25

Table 6-25, Hold Duty Cycle Pulse Mode Accuracy Tests

PM8572A Period Setting	Counter Period Reading Limits	Counter Reading CH1	CH2	Pass	Fail
100.0000000 ms	10 ms ±300 µs				
10.000000 ms	1 ms ±30 µs				
1.000000 ms	100 µs ±3 µs				
100.000 µs	10 µs ±300.5 ns				
10.000 µs	1 µs ±30.5 ns				
1.000 µs	100 ns ±3.5 ns				

Linear Transitions Accuracy

This tests the accuracy of the transitions when the pulse is set to have linear transitions. Linear transitions imply that the slopes of the rise and fall times can be adjusted to have variable angles, other than the fastest upslope and down slope transitions. The transition times are measured from 10% to 90% of the amplitude setting, regardless of the high and low amplitude level settings. Linear transition control is independent for each channel however, one must keep in mind that the leading and trailing edges must remain within the same slope range boundaries and that the leading edge is the governing parameter, which means that the leading edge setting defines the transition range and the trailing edge must follow through.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

Linear Transitions Accuracy Tests

Equipment: Counter/timer

Preparation:

1. Configure the counter/timer as follows:
   Function: Rise Time Measurement function
   Termination: 50 Ω
2. Connect PM8572A Channels 1/2 outputs to the counter/timer input. Configure the PM8572A as follows:
   Transitions: Symmetrical
   Period: As required by the test
   Width: As required by the test
   High Level: 2 V
   Low Level: -2 V
   Output: On
   Leading Edge: As required by the tests

Test Procedure

1. Perform the leading edge linear transitions accuracy tests using Table 6-26

Table 66-26, Leading Edge Transitions Accuracy Tests

Leading Edge Setting	Period	CH1/2 Width	Counter Rise Time Reading Limits	Counter Reading CH1	CH2	Pass	Fail
1.000 ms	10 ms	5 ms	1 ms ±100 µs				
100.0 µs	1 ms	0.5 ms	100 µs ±10 µs				
10.00 µs	100 µs	50 µs	10 µs ±1 µs				
1.000 µs	10 µs	5 µs	1 µs ±102 ns				
100 ns	1 µs	0.5 µs	100 ns ±12 ns				
10 ns	100 ns	50 ns	10 ns ±3 ns				

2. For the following tests modify the leading and trailing edge settings to be the identical. Modify the leading edge first.
3. Perform the trailing edge linear transitions accuracy tests using Table 6-27

Table 6-27, Trailing Edge Transitions Accuracy Tests

Trailing Edge Setting	Period	CH1/2 Width	Counter Fall Time Reading Limits	Counter Reading CH1	CH2	Pass	Fail
1.000 ms	10 ms	5 ms	1 ms ±100 µs				
100.0 µs	1 ms	0.5 ms	100 µs ±10 µs				
10.00 µs	100 µs	50 µs	10 µs ±1 µs				
1.000 µs	10 µs	5 µs	1 µs ±102 ns				
100 ns	1 µs	0.5 µs	100 ns ±12 ns				
10 ns	100 ns	50 ns	10 ns ±3 ns				

Pulse Amplitude Accuracy

This tests the accuracy of the amplitude of the pulse. Amplitude can be programmed in four separate modes: High/Low Level, Amplitude/Offset, Positive and Negative. The first two modes allow adjustment of the pulse window along the "Y" axis and the last two options fix either the negative or the positive values at the 0 V level.

Since normal measuring devices, such as digital multi meters measure amplitudes at relatively low frequency and therefore, the accuracy is specified and measure at a frequency around 1 KHz (1 ms period). Each channel can be programmed to have different amplitude settings however, the level setting is common for both channels. For example, if you chose to program using the positive level mode, both channels will be programmed the same way.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

Pulse Amplitude Accuracy Tests

Equipment**:** DMM

Preparation:
1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: ACV
2. Connect PM8572A Channel outputs to the DMM input
3. Configure the PM8572A as follows:
   Pulse Mode: Hold DCycle
   Duty Cycle: 50%
   Level Mode: Ampl/Offset
   Period: 1 ms
   Output: On
   Amplitude: As specified in Table 6-4

Test Procedure
1. Perform amplitude Accuracy tests on both channels using Table 6-28.

Table 6-28, Pulse Amplitude Accuracy Tests

PM8572A Amplitude Setting	Error Limits	DMM Reading		Pass	Fail
		CH 1	CH 2		
16.00V	8 V, ±160 mV				
10.00V	5 V, ±120 mV				
1.000V	500 mV, ±15 mV				
100.0mV	50 mV, ±5.5 mV				

External Pulse Width Mode Operation

This tests the operation of the external pulse width mode. This mode is particularly useful for reconstructing pulses from a week signal. Period and pulse width are derived from the trigger level and slope settings. The controlling signal is applied to the rear-panel TRIG IN connector. When the signal crosses the trigger threshold, it generates a pulse of which its width is determined by the inverse transition of the signal. Positive and negative slope settings determine if the width is derived from the positive trigger level crossing or the negative trigger level crossing.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

External Pulse Width Operation Tests

Equipment**:** Oscilloscope, Function Generator., 50Ω feedthrough termination

Preparation:

1. Configure the function generator as follows:
   Waveform: Sine
   Amplitude: 2 V
   Offset: 0 V
   Frequency: 100 kHz
2. Connect the function generator to the PM8572A rear-panel TRIG IN connector. Use 50Ω feedthrough termination at the trigger input end.
3. Connect PM8572A Channel 1/2 outputs to the oscilloscope input
4. Configure the PM8572A as follows:
   Pulse Mode: Ext. Width
   Trigger Level: 0 V
   Output: On

Test Procedure

1. Verify that the PM8572A generates pulses with the following properties:
   Period: 10 μs
   Pulse width: 5 μs

Test Results	Pass		Fail	

2. Modify the offset of the function generator output and verify that the period remains stable but the pulse width follows the function generator offset settings.

Test Results	Pass		Fail	

3. Change the PM8572A slope setting to negative and observe that the offset has a reverse impact on the pulse width.

Test Results	Pass		Fail	

PWM Operation

This tests the operation of the pulse width modulation. The modulating waveforms are built in and there is a choice of sine, triangle, ramp up and ramp down waveforms. The parameters that control the modulation are: shape, period and deviation of the modulating waveform.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only. Note that PWM is available for channel 1 only and therefore only channel 1 setting is critical for this test.

PWM Operation Tests

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:

   Time Base: 20 ms
   Sampling Rate: 50 MS/s at least.
   Trace A View: Jitter Type: PW.
   Trigger source: Channel 2, positive slope
   Amplitude: 1 V/div.

2. Connect PM8572A Channel 1 output to the oscilloscope input, channel 1
3. Connect the PM8572A SYNC output to the oscilloscope input, channel 2
4. Configure model PM8572A controls on both channels as follows:

   Pulse Mode: PWM
   Period: 1 ms
   Pulse Width: 100 µs
   PWM Source: Sine
   PWM Period: 100 ms
   PWM Deviation: 50 %
   Sync: On
   Output: On

Test Procedure:

1. Verify PWM operation on the oscilloscope as follows:

   Waveform: Sine wave
   Period: 100 ms
   Max PW.: 150 µs
   Min PW.: 50 µs

2. Change the PM8572A PWM Source setting to triangle and observe that waveform on the oscilloscope changes to triangle

with the same values as in the first test.

Test Results	Pass		Fail	

3. Change the PM8572A PWM Deviation setting to 40 % and observe that the amplitude of the modulating waveform follows the new setting.

Test Results	Pass		Fail	

Pulse Run Modes Operation

This tests the operation of the two specific pulse run modes: Internal Trigger and Internal Burst. Although all run modes characteristics are shared across the entire functionality of the PM8572A, these two modes are specific for the pulse output. Operation of other run modes was tested under separate headings in this chapter.

To perform the tests without error conditions, reset the instrument and modify parameters that are specified in the tests only.

Pulse Run Modes Operation Tests

Equipment**:** Oscilloscope, Counter, Function Generator

Preparation:
1. Connect PM8572A Channel 1/2 outputs to the oscilloscope input
2. Configure the PM8572A as follows:
   Pulse Mode: Single
   Pulse Width: 100 μs
   Pulse Period: 200 μs
   Run mode: Internal Trigger
   Internal Timer: 1 ms
   Output: On

Test Procedure
1. Verify that the PM8572A generates pulses with the following properties:
   Period: 1 ms
   Pulse width: 100 μs

Test Results	Pass		Fail	

2. Change the PM8572A run mode setting to Burst and change the Burst Count setting to 3. Observe that 3 pulses are visible at every cycle of 1 ms.

Test Results	Pass		Fail	

3. Remove the PM8572A output from the oscilloscope input and connect to the counter input.'
4. Change the counter function to Totalize
5. Change the PM8572A run mode to external trigger
6. Change the PM8572A burst count to 1,000
7. Reset counter and observe that the counter reading increments 1,000 counts every second, after every external trigger.

Test Results	Pass		Fail	

Chapter 7
Adjustments and Firmware Update

What's in This Chapter

This chapter provides adjustment information for the PM8572A dual channel waveform generator. The same procedures are used for the Model PM8571A except all references to the second channel should be ignored.

WARNING

The procedures described in this section are for use only by qualified service personnel. Many of the steps covered in this section may expose the individual to potentially lethal voltages that could result in personal injury or death if normal safety precautions are not observed.

CAUTION

ALWAYS PERFORM DISASSEMBLY, REPAIR AND CLEANING AT A STATIC SAFE WORKSTATION.

Performance Checks

Do not attempt to calibrate the instrument before you verify that there is no problem with the functionality of the product. A complete set of specification is listed in Appendix A. If the instrument fails to perform within the specified limits, the instrument must be tested to find the source of the problem.

In case there is a reasonable suspicion that an electrical problem exist within the PM8572A, perform a complete performance checks as given in Chapter 6 to verify proper operation of the instrument.

Environmental Conditions

The PM8572A can operate from 0°C to 50°C. Adjustments should be performed under laboratory conditions having an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. Turn on the power to the PM8572A and allow it to warm up for at least 30 minutes before beginning the adjustment procedure. If the instrument has been subjected to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the adjustment procedure.

Warm-up Period

Most equipment is subject to a small amount of drift when it is first turned on. To ensure accuracy, turn on the power to the Model PM8572A and allow it to warm-up for at least 30 minutes before beginning the performance test procedure.

Recommended Test Equipment

Recommended equipment for adjustments is listed in Table 7-1. Instruments other than those listed may be used only if their specifications equal or exceed the required minimal characteristics. Also listed below are accessories required for calibration.

Table 7-1, Recommended calibration for Adjustments

Equipment	Model No.	Manufacturer
Oscilloscope (with jitter package)	LC684	LeCroy
Digital Multimeter	2000	Keithley
Frequency Counter (Rubidium reference)	6020R	Tabor Electronics
Function Generator (with manual trigger)	8020	Tabor Electronics
Accessories	BNC to BNC cables	
	50Ω Feedthrough termination	
	Dual banana to BNC adapter	

Adjustment Procedures Base Generator

Use the following procedures to calibrate the base generator of the Model PM8572A. This does not include the calibration of the pulse generator section; Calibration of the pulse generator section is performed separately after you complete the calibration of the base unit. The following paragraphs show how to set up the instrument for calibration and what the acceptable calibration limits are.

Calibration is done with the covers closed and the PM8572A connected through an interface to a host computer. Any interface can be used from the following: USB, LAN, or GPIB. Calibration requires that ArbConnection utility be installed and interfaced to the instrument.

Calibration is performed from the Calibration Panel in ArbConnection. To invoke this panel, one requires a password that is available to service centers only. Contact your nearest Tabor service center for information and permit to obtain your calibration password. Use the following procedure to calibrate the generator:

1. Invoke ArbConnection
2. Click on the UTIL icon on the Panels bar
3. On the Utility Panel click on Calibration and expect to be prompted with the following dialog box

Figure 7-1, Calibration Password

4. Type your User Name Password and click on OK. The Calibration Panel as shown in Figure 2 will appear.

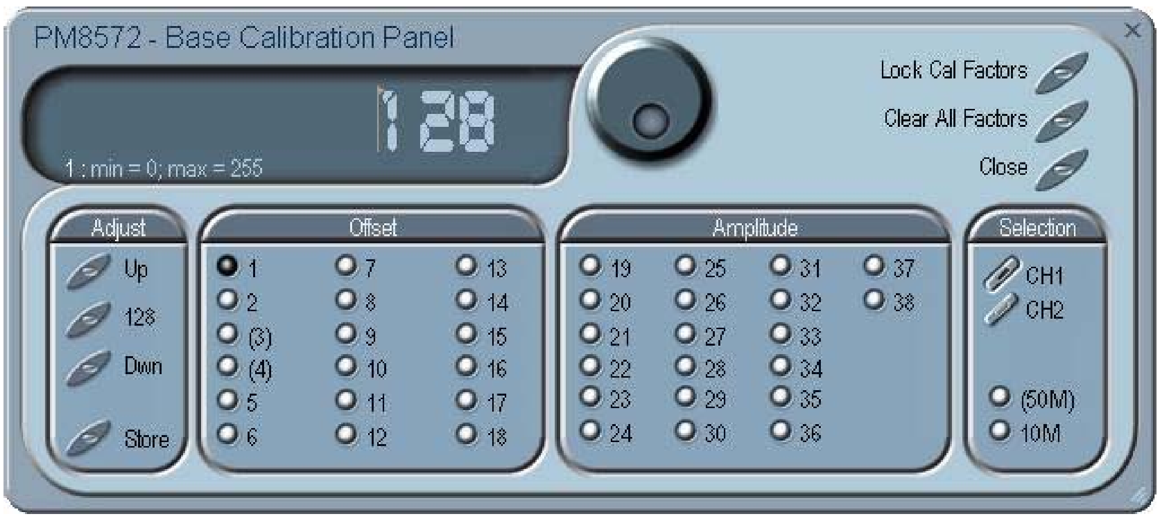

Figure 7-2, Calibration Panel

NOTE

Initial factory adjustments require that the covers be removed from the instrument. Field calibration does not require re-adjustments of these factory settings unless the unit was repaired in an authorized service center. Factory adjustments are enclosed in parentheses to differentiate from normal field calibration setups; bypass these adjustments when performing field calibration.

Calibrations are marked with numbers from 1 to 38 and, except the (50M) and 10M adjustments in the Selection group, should be carried out exactly in the order as numbered on the panel. There are separate adjustments for Channel 1 and Channel 2 so make sure that the output cables are connected to the appropriate channel during the adjustments.

The numbers that are associated with each adjustment are identified as Setup Number at the title of each of the adjustments in the following procedure.

Remote adjustments have the range of 1 through 256 with the center alignment set to 128. Therefore, if you are not sure of the direction, set the adjustment to 128 and add or subtract from this value. If you have reached 1 or 256 and were not able to calibrate the range, there is either a problem with the way you measure the parameter or possibly there is a problem with the instrument. In either case, do not leave any adjustment in its extreme setting but center the adjustment and contact your nearest service center for clarifications and support.

Note in the following procedures that although configuration of the PM8572A is done automatically, some of the configuration is shown for reference. There is no requirement to change configuration of the PM8572A during the remote adjustment procedure except in places where specifically noted.

Power Supply Adjustment

Use this procedure to adjust the power supply so that the amplitude level on the pulse board is exactly 3.3 V. This adjustment is a pre-requisite to the proceeding adjustments because it will affect the performance of the pulse generator. This procedure also assures that the amplitude levels that are applied to the output amplifier do not exceed the required voltage.

Power Supply Adjustment

3.3 V Supply

Equipment: DMM

Preparation:

1. Remove the power supply cover to reveal the adjustment resistors on top of the part.
2. Identify the 3.3 V adjustment resistor
3. Using the DMM test probes, connect the black probe to a ground point and the red probe to a 3.3 V on the pulse generator board.

Adjustment:

1. Adjust the power supply resistor for a DMM reading of 3.3 V ±1%

⚠ ***Warning***

You probably notice there are no references to parts numbers and test points in this adjustment. This information is given on a need-to-know basis because it is critical to the operation of the instrument and can be performed only by persons who were trained to do this adjustment. Removing the cover from the power supply by untrained persons is dangerous and could inflict injuries and even cause death. Do not attempt to do this adjustment without proper training!

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2. After you complete with the above adjustment, remove the probes from the 3.3 V and verify that the supply voltages to the power amplifiers measure ±19.0 V, ±1%
3. Replace the power supply cover and tighten the screws as required.

Reference Oscillators Adjustments

Use this procedure to adjust the reference oscillators. The reference oscillators determine the accuracy of the output frequency so if you suspect that there is an accuracy issue, proceed with the calibration of the reference oscillators

(Setup 50M)

50MHz Gated Oscillator Adjustment

Equipment: Counter, Function Generator, BNC to BNC cables,

Preparation:

4. Configure the counter as follows:

Termination:	50Ω DC
Function:	TI A -> B
Slope B:	Negative

5. Connect the PM8572A Channel 1 output to the oscilloscope input

6. Connect an external function generator to the rear panel TRIG IN connector
7. Using ArbConnection prepare and download the following waveform:

Wavelength:	100 points
Waveform:	Pulse: Delay = 0.01%, Rise/Fall Time = 0%, High Time = 99.99%

8. Configure the PM8572A as follows:

Function Mode:	Arbitrary
Run Mode:	Triggered
Retrigger Mode:	On
Retrigger Delay:	20μs

9. Using an external function generator, manually trigger the PM8572A

Adjustment:

4. Adjust C18 for a period of 20μs, ±5%

Setup 10M

10MHz TCXO Frequency

Equipment: Counter, BNC to BNC cables

Preparation:

1. Configure the counter as follows:

Function:	Freq A
Termination:	50Ω

2. Connect the PM8572A Channel 1 output to the counter input.
3. Configure the PM8572A as follows:

Frequency:	10MHz
Ch1 Output:	On
Ch1 Amplitude	2V
Wave:	Square

Adjustment:

4. Adjust CAL:SETUP57 for counter reading of 10MHz, ±2Hz

Channel 1 Adjustments

The following procedures pertain to the channel 1 output only. Therefore, make sure that your connections are made to the channel 1 connectors.

Base Line Offset Adjustments

The base line offset adjustments assure that the AC signal is symmetrical around the 0V line. Use this procedure if you suspect that there is a base line accuracy issue.

Setup 1

Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feedthrough termination
3. Configure the PM8572A as follows:
   CAL:SERV 1

Adjustment:

4. Adjust CAL:SETUP1 for DMM reading of 0V, ±20mV

Setup 2

Pre-Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CAL:SERV 2

Adjustment

4. Adjust CAL:SETUP2 for DMM reading of 0V, ±5mV

(Setup 3)

Base Line Offset, Low Range, Amplifier Out – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Mode: Modulation
   Ch1 Amplitude: 510mV

Adjustment

4. Note DMM reading

(Setup 4)

Base Line Offset, High Range, Amplifier Out – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Mode: Modulation
   Ch1 Amplitude: 1.590V

Adjustment

4. Adjust CAL: SETUP 6 for DMM reading the same as Setup 3
5. Repeat Setup 3 and Setup 4 until the DMM readings are the same +/-10mV.
6. Adjust RV1 for DMM readings of 0V+/-10mV.

Setup 5

Base Line Offset, Amplifier In – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV

Range: 100mV

2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude: 6V

Adjustment

4. Adjust CAL:SETUP 5 for DMM reading of 0V, ±20mV

Setup 6

Base Line Offset, Amplifier Out – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation**:**

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude: 1V

Adjustment:

4. Adjust CAL:SETUP 6 for DMM reading of 0V, ±5mV

Setup 7

Base Line Offset, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Output: On
   Ch1 Amplitude: 6V

Adjustment:

4. Adjust CAL:SETUP 7 for DMM reading of 0V, ±20mV

Setup 8

Base Line Offset, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Output: On
   Ch1 Amplitude: 1V

Adjustment:

4. Adjust CAL: SETUP 8 for DMM reading of 0V, ±5mV

Offset Adjustments

The offset adjustments assure that the DC offsets are within the specified range. Use this procedure if you suspect that the offset accuracy is an issue.

Setup 9

Offset (+1V) Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 2V
   Ch1 Offset +1V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 61 for DMM reading of +1V, ± 5mV

Setup 10

Offset (+3V) Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 2V
   Ch1 Offset +3V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 60 for DMM reading of +3V, ± 15mV

Setup 11

+5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset +5V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 59 for DMM reading of +5V, ± 25mV

Setup 12

(Not application with option 4)

+7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset +7V
   Ch1 Output: On

Adjustment:
4. CAL: SETUP 58 for DMM reading of +7V, ± 35mV;

Setup 13

-1V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:
1. Configure the DMM as follows:
   Function: DCV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 2V
   Ch1 Offset -1V
   Ch1 Output: On

Adjustment:
4. CAL: SETUP 62 for DMM reading of -1V, ± 5mV

Setup 14

-3V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:
1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 2V
   Ch1 Offset -3V
   Ch1 Output: On

Adjustment:
4. CAL: SETUP 63 for DMM reading of -3V, ± 15mV

Setup 15

-5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:
1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V

2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset -5V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 64 for DMM reading of -5V, ± 25mV

Setup 16

(Not application with option 4)

-7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset -7V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 65 for DMM reading of -7V, ± 35mV

Setup 17

(+) Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset +1V
   Ch1 Output: On

Adjustment:

4. CAL:SETUP14 for DMM reading of +1V, ±5mV; Note reading

Setup 18

(-) Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset -1V
   Ch1 Output: On

Adjustment:

4. CAL:SETUP14 for DMM reading of -1V, ±5mV; note reading
5. Repeat steps Setup 17 and Setup 18 until errors are balanced between the steps

Amplitude Adjustments

The amplitude adjustments assure that the AC levels are within the specified range. Use this procedure if you suspect that the amplitude accuracy is an issue.

Setup 19

10V Amplitude - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 10V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude: 10V

Adjustment:

4. Adjust CAL:SETUP17 for DMM reading of 3.535V ±30mV

Setup 20

3V Amplitude - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination,

Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude: 3V

Adjustment:

4. Adjust CAL:SETUP18 for DMM reading of 1.0606V ±7mV

Setup 21

1V Amplitude, Output Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   CAL:SERV 5

Adjustment:

4. Adjust CAL:SETUP19 for DMM reading of 353.5mV ±3mV

Setup 22

500mV Amplitude, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz

Ch1 Output: On
CAL:SERV 6

Adjustment:

4. Adjust CAL:SETUP20 for DMM reading of 176.7mV ±1.5mV

Setup 23

100mV Amplitude, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   CAL:SERV 7

Adjustment:

4. Adjust CAL:SETUP21for DMM reading of 35,35mV ±0.3mV

Setup 24

50mV Amplitude, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   CAL:SERV 8

Adjustment:

4. Adjust CAL:SETUP22 for DMM reading of 17,67mV ±0.15mV

Setup 25

1V Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination,

Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude 1V

Adjustment:

4. Adjust CAL:SETUP23 for DMM reading of 353.5mV ±3mV

Setup 26

500mV Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude 500mV

Adjustment:

4. Adjust CAL:SETUP24 for DMM reading of 176.7mV ±1.5mV

Setup 27

100mV Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz

Ch1 Output: On
Ch1 Amplitude 100mV

Adjustment:

4. Adjust CAL:SETUP25 for DMM reading of 35,35mV ±0.3mV

Setup 28

50mV Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude 50mV

Adjustment:

4. Adjust CAL:SETUP26 for DMM reading of 17,67mV ±0.15mV

Setup 29

10V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 10V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude: 10V

Adjustment:

4. Adjust CAL:SETUP27 for DMM reading of 3.535V ±30mV

Setup 30

3V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination,

Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude: 3V

Adjustment:

4. Adjust CAL:SETUP28 for DMM reading of 1.0606 ±7mV

Setup 31

1V Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   CAL: SERV 5

Adjustment:

4. Adjust CAL:SETUP29 for DMM reading of 353.5mV ±3mV

Setup 32

500mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω

Feed through termination

3. Configure the PM8572A as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch1 Output:	On
CAL:SERV	6

Adjustment:

4. Adjust CAL:SETUP30 for DMM reading of 176.7mV ±1.5mV

Setup 33

100mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	100mV

2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch1 Output:	On
CAL:SERV	7

Adjustment:

4. Adjust CAL:SETUP31for DMM reading of 35,35mV ±0.3mV

Setup 34

50mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	100mV

2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch1 Output:	On
CAL: SERV	8

Adjustment:

4. Adjust CAL:SETUP32 for DMM reading of 17,67mV ±0.15mV

Setup 35

1V Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude 1V

Adjustment:

4. Adjust CAL:SETUP33 for DMM reading of 353.5mV ±3mV

Setup 36

500mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude 500mV

Adjustment:

4. Adjust CAL:SETUP34 for DMM reading of 176.7mV ±1.5mV

Setup 37

100mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function: ACV
Range: 100mV

2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude 100mV

Adjustment:

4. Adjust CAL:SETUP35 for DMM reading of 35,35mV ±0.3mV

Setup 38

50mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

   Function: ACV
   Range: 100mV

2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude 50mV

Adjustment:

4. Adjust CAL:SETUP36 for DMM reading of 17,67mV ±0.15mV

Pulse Response Adjustments

The pulse response adjustments assure that the rise and fall times, as well as, the aberrations are within the specified range. Use this procedure if you suspect that the pulse response is an issue.

(Setup 39)

Pulse Response, Amplifier Out

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the PM8572A as follows:
   Function: Square
   Amplitude: 1.5V
2. Connect the PM8572A Channel 1 output to the oscilloscope input. Set oscilloscope input impedance to 50Ω
3. Set oscilloscope vertical sensitivity to 20mV

Adjustment:

4. Adjust vertical trace to 6 divisions
5. Adjust RV3 for best pulse response (4ns type, 5% aberrations)

(Setup 40)

Pulse Response, Amplifier In

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the PM8572A as follows:
   Function: Square
   Amplitude: 6V
2. Connect the PM8572A Channel 1 output to the oscilloscope input. Use 20dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50Ω
4. Set oscilloscope vertical sensitivity to 0.1V

Adjustment:

5. Adjust vertical trace to 6 divisions
6. Adjust C1036 for best pulse response (4ns type, 5% aberrations)

Channel 2 Adjustments

The following procedures pertain to the channel 2 output only. Therefore, make sure that your connections are made to the channel 1 connectors.

Base Line Offset Adjustments

The base line offset adjustments assure that the AC signal is symmetrical around the 0V line. Use this procedure if you suspect that there is a base line accuracy issue.

Setup 1

Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CAL:SERV 3

Adjustment:

4. Adjust CAL:SETUP 3 for DMM reading of 0V, ±20mV

Setup 2

Pre-Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CAL:SERV 4

Adjustment:

4. Adjust CAL:SETUP4 for DMM reading of 0V, ±5mV

(Setup 3)

Base Line Offset, Low Range, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Mode: Modulation
   Ch2 Amplitude: 510mV

Adjustment:

Note DMM reading

(Setup 4)

Base Line Offset, High Range, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Mode: Modulation
   Ch2 Amplitude: 1.590V

Adjustment:

4. Adjust CAL: SETUP 12 for DMM reading the same as in Setup 3
5. Repeat Setup 3 and Setup 4 until the DMM readings are the same +/-10mV.
6. Adjust RV2 for DMM readings of 0V+/-10mV.

Setup 5

Base Line Offset, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV

Range: 100mV

2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Mode: Modulation
   Ch2 Output: On
   Ch2 Amplitude: 6V

Adjustment:

4. Adjust CAL:SETUP 11 for DMM reading of 0V, ±20mV

Setup 6

Base Line Offset, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Output: On
   Mode: Modulation
   Ch2 Amplitude: 1V

Adjustment:

4. Adjust CAL:SETUP 12 for DMM reading of 0V, ±5mV

Setup 7

Base Line Offset, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Output: On
   Ch2 Amplitude: 6V

Adjustment:

4. Adjust CAL:SETUP 9 for DMM reading of 0V, ±20mV

Setup 8

Base Line Offset, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Output: On
   Ch2 Amplitude: 1V

Adjustment:

4. Adjust CAL:SETUP 10 for DMM reading of 0V, ±5mV

Offset Adjustments

The offset adjustments assure that the DC offsets are within the specified range. Use this procedure if you suspect that the offset accuracy is an issue.

Setup 9

+1V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Amplitude: 2V
   Ch2 Offset +1V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 69 for DMM reading of +1V, ± 5mV

Setup 10

+3V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:

   Ch2 Amplitude: 2V
   Ch2 Offset +3V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 68 for DMM reading of +3V, ± 15mV

Setup 11

+5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:

   Ch2 Amplitude: 20mV
   Ch2 Offset +5V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 67for DMM reading of +5V, ± 25mV

Setup 12

(Not application with option 4)

+7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:

   Ch2 Amplitude: 20mV
   Ch2 Offset +7V
   Ch2 Output: On

Adjustment:
4. CAL: SETUP 66 for DMM reading of +7V, ± 35mV

Setup 13

-1V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:
1. Configure the DMM as follows:
   Function: DCV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Amplitude: 2V
   Ch2 Offset -1V
   Ch2 Output: On

Adjustment:
4. CAL: SETUP 70 for DMM reading of -1V, ± 5mV

Setup 14

-3VOffset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:
1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Amplitude: 2V
   Ch2 Offset -3V
   Ch2 Output: On

Adjustment:
4. CAL: SETUP 71for DMM reading of -3V, ± 15mV

Setup 15

-5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Amplitude: 20mV
   Ch2 Offset -5V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 72 for DMM reading of -5V, ± 25mV

Setup 16

(Not application with option 4)

-7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Amplitude: 20mV
   Ch2 Offset -7V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 73for DMM reading of -7V, ± 35mV

Setup 17

(+)Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Ch2 Amplitude: 20mV
   Ch2Offset +1V
   Ch2 Output: On

Adjustment:

4. CAL:SETUP16 for DMM reading of +1V, ±5mV; Note reading

Setup 18

(-)Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   - Function: DCV
   - Range: 10V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the 50Ω Feed through termination
3. Configure the PM8572A as follows:
   - Ch2 Amplitude: 20mV
   - Ch2Offset -1V
   - Ch2 Output: On

Adjustment:

4. CAL:SETUP16 for DMM reading of -1V, ±5mV; note reading
5. Repeat Setup 17 and Setup 18 until errors are balanced between the steps

Amplitude Adjustments

The amplitude adjustments assure that the AC levels are within the specified range. Use this procedure if you suspect that the amplitude accuracy is an issue.

Setup 19

10V Amplitude – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   - Function: ACV
   - Range: 10V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   - Frequency: 1kHz
   - Ch2 Output: On
   - Ch2 Amplitude: 10V

Adjustment:

4. Adjust CAL:SETUP37 for DMM reading of 3.535V ±30mV

Setup 20

3V Amplitude – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 3 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude: 3V

Adjustment:

4. Adjust CAL:SETUP38 for DMM reading of 1.0606V ±7mV

Setup 21

1V Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   CAL:SERV 9

Adjustment:

4. Adjust CAL:SETUP39 for DMM reading of 353.5mV ±3mV

Setup 22

500mV Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 2 output to the DMM input.

Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   CAL:SERV 10

Adjustment:
4. Adjust CAL:SETUP40 for DMM reading of 176.7mV ±1.5mV

Setup 23

100mV Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:
1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   CAL:SERV 11

Adjustment:
4. Adjust CAL:SETUP41for DMM reading of 35,35mV ±0.3mV

Setup 24

50mV Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:
1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   CAL:SERV 12

Adjustment:
4. Adjust CAL:SETUP42 for DMM reading of 17,67mV ±0.15mV

Setup 25

1V Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude 1V

Adjustment:

4. Adjust CAL:SETUP43 for DMM reading of 353.5mV ±3mV

Setup 26

500mV Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude 500mV

Adjustment:

4. Adjust CAL:SETUP44 for DMM reading of 176.7mV ±1.5mV

Setup 27

100mV Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω

Feed through termination

3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude 100mV

Adjustment:

4. Adjust CAL:SETUP45 for DMM reading of 35,35mV ±0.3mV

Setup 28

50mV Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude 50mV

Adjustment:

4. Adjust CAL:SETUP46 for DMM reading of 17,67mV ±0.15mV

Setup 29

10V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 10V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   Ch2 Amplitude: 10V

Adjustment:

4. Adjust CAL:SETUP47 for DMM reading of 3.535V ±30mV

Setup 30

3V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   Ch2 Amplitude: 3V

Adjustment:

4. Adjust CAL:SETUP48 for DMM reading of 1.0606V±7mV

Setup 31

1V Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   CAL:SERV 9

Adjustment:

4. Adjust CAL: SETUP49 for DMM reading of 353.5mV ±3mV

Setup 32

500mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V

2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch2 Output:	On
CAL:SERV	10

Adjustment:

4. Adjust CAL: SETUP50 for DMM reading of 176.7mV ±1.5mV

Setup 33

100mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	100mV

2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch2 Output:	On
CAL:SERV	11

Adjustment:

4. Adjust CAL:SETUP51 for DMM reading of 35,35mV ±0.3mV

Setup 34

50mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	100mV

2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch2 Output:	On
CAL:SERV	12

Adjustment:

4. Adjust CAL:SETUP52 for DMM reading of 17,67mV ±0.15mV

Setup 35

1V Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	1V

2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50Ω Feed through termination
3. Configure the PM8572A as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch2 Output:	On
Ch2 Amplitude	1V

Adjustment:

4. Adjust CAL:SETUP53 for DMM reading of 353.5mV ±3mV

Setup 36

500mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	1 V

2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50 Ω Feed through termination
3. Configure the PM8572A as follows:

CW Frequency:	1 kHz
Mode:	Modulation
Ch2 Output:	On
Ch2 Amplitude	500 mV

Adjustment:

4. Adjust CAL:SETUP54 for DMM reading of 176.7 mV ±1.5 mV

Setup 37

100mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50 Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   - Function: ACV
   - Range: 1 V
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50 Ω Feed through termination
3. Configure the PM8572A as follows:
   - CW Frequency: 1 kHz
   - Mode: Modulation
   - Ch2 Output: On
   - Ch2 Amplitude 100 mV

Adjustment:

4. Adjust CAL:SETUP55 for DMM reading of 35,35 mV ±0.3 mV

Setup 38

50mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50 Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   - Function: ACV
   - Range: 100 mV
2. Connect the PM8572A Channel 2 output to the DMM input. Terminate the PM8572A output at the DMM input with the, 50 Ω Feed through termination
3. Configure the PM8572A as follows:
   - CW Frequency: 1 kHz
   - Mode: Modulation
   - Ch2 Output: On
   - Ch2 Amplitude 50 mV

Adjustment:

4. Adjust CAL:SETUP56 for DMM reading of 17,67 mV ±0.15 mV

Pulse Response Adjustments

The pulse response adjustments assure that the rise and fall times, as well as, the aberrations are within the specified range. Use this procedure if you suspect that the pulse response is an issue.

(Setup 39)

Pulse Response, Amplifier Out

Equipment: Oscilloscope, BNC to BNC cable, 20 dB Feedthrough attenuator

Preparation:

1. Configure the PM8572A as follows:
   Function: Square
   Amplitude: 1.5 V
2. Connect the PM8572A Channel 2 output to the oscilloscope input. Use 20 dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50 Ω
4. Set oscilloscope vertical sensitivity to 20 mV

Adjustment:

5. Adjust vertical trace to 6 divisions
6. Adjust RV4 for best pulse response (4 ns typ., 5% aberrations)

(Setup 40)

Pulse Response, Amplifier In

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the PM8572A as follows:
   Function: Square
   Amplitude: 6 V
2. Connect the PM8572A Channel 2 output to the oscilloscope input. Use 20 dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50 Ω
4. Set oscilloscope vertical sensitivity to 0.1 V

Adjustment:

5. Adjust vertical trace to 6 divisions
6. Adjust C1073 for best pulse response (4 ns typ., 5% aberrations)

Adjustment Procedures – Pulse Generator

Use the following procedures to calibrate the pulse generator section of the Model PM8572A. The following paragraphs show how to set up the instrument for calibration and what the acceptable calibration limits are.

Calibration is done with the covers closed and the PM8572A connected through an interface to a host computer. Any interface can be used from the following: USB, LAN, or GPIB. Calibration requires that ArbConnection utility be installed and interfaced to the instrument.

Calibration is performed from the Calibration Panel in ArbConnection. To invoke this panel, one requires a password that is available to service centers only. Contact your nearest Tabor service center for information and permit to obtain your calibration password. Use the following procedure to calibrate the generator:

1. Invoke ArbConnection
2. Click on the UTIL icon on the Panels bar
3. On the Utility Panel click on Pulse Calibration and expect to be prompted with the following dialog box

Figure 7-3, Calibration Password

4. Type your User Name Password and click on OK. The Calibration Panel as shown in Figure 2 will appear.

NOTE

Initial factory adjustments require that the covers be removed from the instrument. Field calibration does not require re-adjustments of these factory settings unless the unit was repaired in an authorized service center. Factory adjustments are enclosed in parentheses to differentiate from normal field calibration setups; bypass these adjustments when performing field calibration.

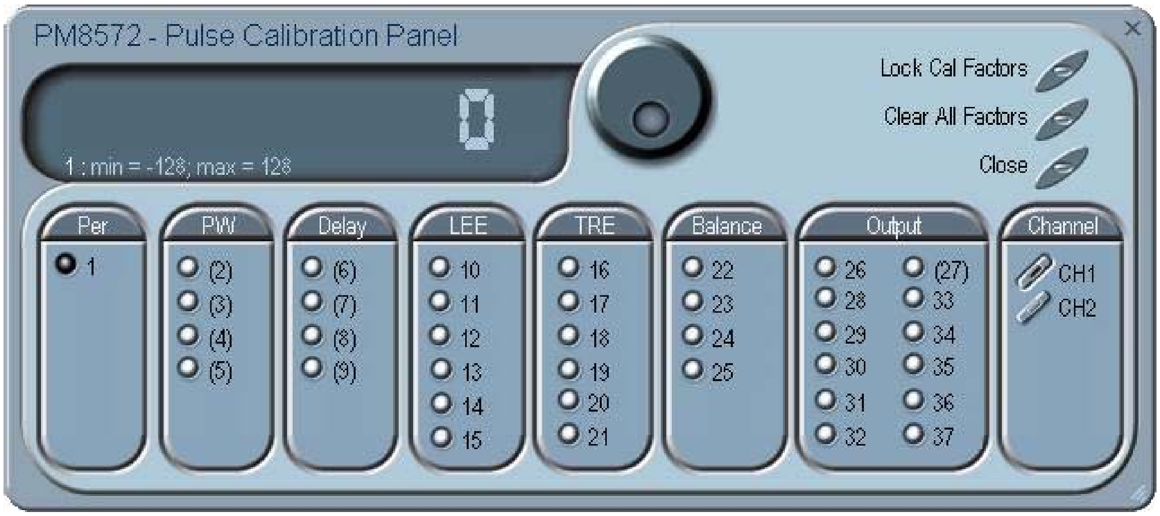

Figure 7-4, Pulse Generator Calibration Panel

Calibrations are marked with numbers from 1 to 37. Perform the adjustments using the same order as listed in the calibration procedure. There are separate adjustments for Channel 1 and Channel 2 so make sure that the output cables are connected to the appropriate channel during the adjustments.

The numbers that are associated with each adjustment are identified as Setup Number at the title of each of the adjustments in the following procedure.

Remote adjustments have the range of -256 through +256 with the center alignment set to 0. Therefore, if you are not sure of the direction, set the adjustment to 0 and add or subtract from this value. If you have reached the top or bottom limits and were not able to calibrate the range, there is either a problem with the way you measure the parameter or possibly there is a problem with the instrument. In either case, do not leave any adjustment in its extreme setting but center the adjustment and contact your nearest service center for clarifications and support.

Note in the following procedures that although configuration of the PM8572A is done automatically, some of the configuration is shown for reference. There is no requirement to change configuration of the PM8572A during the remote adjustment procedure except in places where specifically noted.

NOTE

The following procedure details calibration procedures for a single channel version - Model PM8571A. Use exactly the same procedure to calibrate the second channel in case you calibrate the Model PM8572A except make sure that you select the CH2 button in the calibration panel.

Also note, the 3.3V supply should be adjusted so that the 3.3V level is measured on the pulse board, not on the main board. Adjustment procedure is given hereinbefore.

Pulse Period Adjustments

The pulse period adjustments assure that the period of the pulse generator is within the specified limits. Note that clock generator is common to both channels and therefore, the adjustment of the period can be performed on either channel. Use this procedure if you suspect that the pulse period is not within range.

Setup 1

Pulse Period

Equipment: Counter, BNC to BNC cable

Preparation:

1. Configure the counter as follows:
   Function: Period A
   Termination: 50 Ω
2. Connect the PM8572A Channel 1 output to the counter input.

Adjustment:

1. Select setup 1 in the PER group.
2. Using the up and down arrow keypads adjust the period for counter reading of 1 ms, ±1 µs.

Pulse Width Adjustments

The pulse width adjustments assure that the widths of the generated pulses are within the specified limits. Note that each channel has its own width adjustments and therefore, after you do the adjustments on channel 1 continue with the same adjustments on channel 2. Use this procedure if you suspect that the pulse width is not within range.

(Setup 2)

100 µs Pulse Width

Equipment: Counter, Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the counter as follows:
   Function: Pulse A

Termination: 50 Ω

2. Connect the PM8572A Channel 1 output to the counter input.

Adjustment:

1. Select setup 2 in the PW group.
2. Using the up and down arrow keypads adjust the pulse width for counter reading of 100 µs ±0.1 µs.
3. Note the setup 2 reading and calculate K0, where

   K0 = 1 / [1 + (setup2 reading + 128) / 1000]

Example:
For a setup 2 reading of -15:

K0 = 1 / [1+ (-15 +128) / 1000] = 0.89847

4. Connect an oscilloscope probe on U417, pin 3 (U422, pin 3 for channel 2).
5. Adjust RV1 (RV2 for channel 2) for vertical symmetry about the 0 V line

(Setup 3, Setup 4)

Pulse Width Balance

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 5 ns/div
   Termination: 50 Ω.
   Measurement: Pulse Width
2. Connect the PM8572A Channel 1 output to the Oscilloscope input

Adjustment:

1. Select setup 3 in the PW group and note the pulse width reading in units of ns. Record this reading as PWA
2. Select setup 4 in the PW group and note the pulse width reading in units of ns. Record this reading as PWB
3. Select the best value for R62 (R65 on Channel 2) for the following relationship: PWB = (PWA – 10 x K0) ±0.4 ns; use K0 from setup 2 procedure

(Setup 5)

Low Range Pulse Width Balance

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 5 ns/div
   Termination: 50 Ω.
   Measurement: Pulse Width
2. Connect the PM8572A Channel 1 output to the Oscilloscope input.

Adjustment:

1. Select setup 5 in the PW group.
2. Using the up and down arrow keypads adjust the pulse width for counter reading of Pulse Width = (10 x K0) ±0.4 ns; use K0 value from setup 2 procedure

Pulse Delay Adjustments

The pulse delay adjustments assure that the delays of the generated pulses are within the specified limits. Note that each channel has its own delay adjustments and therefore, after you do the adjustments on channel 1 continue with the same adjustments on channel 2. Use this procedure if you suspect that the pulse delay is not within range.

(Setup 6)

100 µs Delay

Equipment: Counter, BNC to BNC cables

Preparation:

1. Configure the counter as follows:
   Function: Period A
   Termination: 50 Ω
2. Connect the PM8572A Channel 1 output to the counter input.

Adjustment:

1. Select setup 6 in the Delay group.
2. Using the up and down arrow keypads adjust the delay for counter reading of 100 µs ±0.1 µs.
3. Note the setup 6 reading and calculate K1, where

   K1 = 1 / [1 + (setup 6 reading + 128) / 1000]

Example:
For a setup 6 reading of 64:
K1 = 1 / [1+ (64 +128) / 1000] = 0.8389

(Setup 7, Setup 8)

Delay Balance

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope (channels 1 and 2) as follows:
   Vertical: 1 V/div.
   Horizontal: 5 ns/div
   Termination: 50 Ω.
   Measurement: Time Interval (Sync to output)
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 7 in the Delay group and note the delay reading in

units of ns. Record this reading as DLYA
2. Select setup 8 in the Delay group and note the delay reading in units of ns. Record this reading as DLYB
3. Select the best value for R26 (R27 fro channel 2) for the following relationship: DLYB = (DLYA – 20 x K1) ±0.2 ns; use K1 from setup 6 procedure

Setup 9

Zero Delay Compensation.

Equipment: Oscilloscope, BNC to BNC cables

Preparation:
1. Configure the Oscilloscope as follows:
   - Vertical: 1 V/div.
   - Horizontal: 5 ns/div
   - Termination: 50 Ω.
   - Measurement: Time Interval (Sync to output)
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:
1. Select setup 9 in the Delay group.
2. Adjust C12 (C13 for channel 2) for the same DLYB reading as in setup 8, ±0.4 ns.

Pulse Leading Edge Adjustments

The pulse leading edge adjustments assure that the leading edge transition times of the generated pulses are within the specified limits. Note that each channel has its own leading edge adjustments and therefore, after you do the adjustments on channel 1 continue with the same adjustments on channel 2. Use this procedure if you suspect that the leading edge timing is not within range.

Setup 10

50 ns Leading Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:
1. Configure the Oscilloscope as follows:
   - Vertical: 1 V/div.
   - Horizontal: 10 ns/div.
   - Termination: 50 Ω.
   - Measurement: Rise Time
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 10 in the LEE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 50 ns ±2 ns

Setup 11

200 ns Leading Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	50 ns/div.
Termination:	50 Ω.
Measurement:	Rise Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 11 in the LEE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 200 ns ±10 ns

Setup 12

2 μs Leading Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	500 ns/div.
Termination:	50 Ω.
Measurement:	Rise Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 12 in the LEE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 2 μs ±50 ns

Setup 13

20 μs Leading Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	5 µs/div.
Termination:	50 Ω.
Measurement:	Rise Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 13 in the LEE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 20 µs ±0.5 µs

Setup 14

200 µs Leading Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	50 µs/div.
Termination:	50 Ω.
Measurement:	Rise Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 14 in the LEE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 200 µs ±5 µs

Setup 15

2 ms Leading Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	0.5 ms/div.
Termination:	50 Ω.
Measurement:	Rise Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 15 in the LEE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 2 ms ±50 µs

Pulse Trailing Edge Adjustments

The pulse trailing edge adjustments assure that the trailing edge transition times of the generated pulses are within the specified limits. Note that each channel has its own trailing edge adjustments and therefore, after you do the adjustments on channel 1 continue with the same adjustments on channel 2. Use this procedure if you suspect that the trailing edge timing is not within range.

Setup 16

50 ns Trailing Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	10 ns/div.
Termination:	50 Ω.
Measurement:	Fall Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 16 in the TRE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 50 ns ±2 ns

Setup 17

200 ns Trailing Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	50 ns/div.
Termination:	50 Ω.
Measurement:	Fall Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 17 in the TRE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 200 ns ±10 ns

Setup 18

2 μs Trailing Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 500 ns/div.
   Termination: 50 Ω.
   Measurement: Fall Time
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 18 in the TRE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 2 µs ±50 ns

Setup 19

20 µs Trailing Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 5 µs/div.
   Termination: 50 Ω.
   Measurement: Fall Time
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 19 in the TRE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 20 µs ±0.5 µs

Setup 20

200 µs Trailing Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 50 µs/div.
   Termination: 50 Ω.
   Measurement: Fall Time
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 20 in the TRE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 200 µs ±5 µs

Setup 21

2 ms Trailing Edge

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	0.5 ms/div.
Termination:	50 Ω.
Measurement:	Fall Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 21 in the TRE group.
2. Using the up and down arrow keypads adjust the rise time for a counter reading of 2 ms ±50 µs

Setup 22

Balance 1

Equipment: Oscilloscope, BNC to BNC cables.

Preparation:

1. Configure the Oscilloscope as follows:

Vertical:	1 V/div.
Horizontal:	0.2 ms/div.
Termination:	50 Ω.
Measurement:	Fall Time

2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 22 in the Balance group.
2. Using the oscilloscope vertical position, align the waveform so it is exactly symmetrical about the vertical center line.

Setup 23

Balance 2

Equipment: Oscilloscope, BNC to BNC cables.

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 0.2 ms/div.
   Termination: 50 Ω.
   Measurement: Fall Time
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 23 in the Balance group.
2. Using the up and down arrow keypads align the waveform so it is exactly symmetrical about the vertical center line.

Setup 24

Balance 3

Equipment: Oscilloscope, BNC to BNC cables.

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 0.2 ms/div.
   Termination: 50 Ω.
   Measurement: Fall Time
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 24 in the Balance group.
2. Using the up and down arrow keypads align the waveform so it is exactly symmetrical about the vertical center line.

Setup 25

Balance 4

Equipment: Oscilloscope, BNC to BNC cables.

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 0.2 ms/div.
   Termination: 50 Ω.
   Measurement: Fall Time
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 25 in the Balance group.
2. Using the up and down arrow keypads align the waveform so it is exactly symmetrical about the vertical center line.

3. Repeat setups 22 through 25 for best vertical alignment

Pulse Output Stage Adjustments

The pulse output stage adjustments assure that the output stage does not distort the pulse shape and that is generates the correct amplitude levels and offsets within the specified limits. Note that each channel has its own output stage adjustments and therefore, after you do the adjustments on channel 1 continue with the same adjustments on channel 2. Use this procedure if you suspect that the output stage performance is not within range.

Setup 26

Pulse Offset

Equipment: DMM, BNC to BNC cables, 50 Ω feedthrouth

Preparation:

1. Configure the DVM as follows:
   Mode: DC.
   Range: 100 mV
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals.

Adjustment:

1. Select setup 26 in the Output group.
2. Using the up and down arrow keypads adjust the DC level to be 0 V +/- 20 mV.

Setup 27

Pulse Response

Equipment: Oscilloscope, BNC to BNC cables

Preparation:

1. Configure the Oscilloscope as follows:
   Vertical: 1 V/div.
   Horizontal: 10 ns/div.
   Termination: 50 Ω.
2. Connect the PM8572A Channel 1 output to the oscilloscope channel 1 input and connect the PM8572A Sync output to the oscilloscope channel 2 input.
3. Synchronize the oscilloscope on the Sync input.

Adjustment:

1. Select setup 27 in the Output group.
2. Identify C1089 on the main board (C1091 for channel 2) and adjust the pulse response for best rise time and lowest overshoot.

Setup 28

10 V Amplitude, Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 10 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 28 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 5 V, ±50 mV

Setup 29

3 V Amplitude, Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 29 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 1.5 V, ±10 mV

Setup 30

1 V Amplitude, Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 30 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 500 mV, ±5 mV

Setup 31

500 mV Amplitude, Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 31 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 250 mV, ±2.5 mV

Setup 32

100 mV Amplitude, Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 32 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 50 mV, ±0.5 mV

Setup 33

50 mV Amplitude, Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at

the DMM terminals

Adjustment:

1. Select setup 33 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 25 mV, ±0.5 mV

Setup 34

1 V Amplitude, Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 34 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 500 mV, ±5 mV

Setup 35

500 mV Amplitude, Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 35 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 250 mV, ±2.5 mV

Setup 36

100 mV Amplitude, Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV

Range: 1 V

2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 36 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 50 mV, ±0.5 mV

Setup 37

50 mV Amplitude, Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1 V
2. Connect the PM8572A Channel 1 output to the DMM input. Terminate the BNC cable with a 50 Ω feedthrouth termination at the DMM terminals

Adjustment:

1. Select setup 37 in the Output group
2. Using the up and down arrow keypads adjust the amplitude for a DMM reading of 25 mV, ±0.5 mV

Updating PM8572A Firmware

WARNING

Only qualified persons may perform Firmware updates. DO NOT even attempt to perform this operation unless you were trained and certified by Tabor as you may inflict damage on the instrument. Always verify with the factory that you have the latest firmware file before you start with your update.

Before you update the firmware of your PM8572A, check the revision level which is installed in your instrument. Each firmware update was done for a reason and therefore, if you want to update the firmware for a problem in your system, check the readme file that is associated with the update to see if an update will solve your problem. The revision level of your firmware can be displayed as shown in Figure 7-3. To access this screen, select the TOP menu, then select the Utility soft key and scroll down to the System option. Press Enter and the screen will show with the system information. Check both the Software Version and the Version Date as both should match with the latest release.

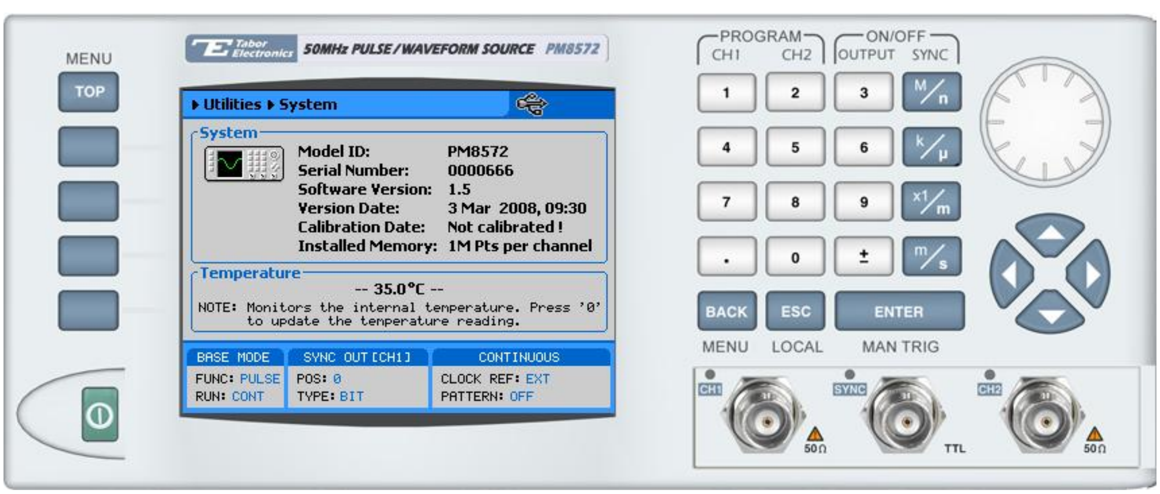

Figure 7-5, Software Version Screen

NOTE

Firmware updates are performed with the LAN set as the active interface and with the PM8572A communicating with the PC through the network.

To update the PM8572A firmware, you will have to run the **NETConfig** utility. If you do not have this utility installed on your computer, run the installation procedure from the enclosed CD. You will not be able to update firmware without the NETConfig utility. To invoke this utility, complete the following steps:

1. Turn power **OFF** on your PM8572A
2. Click on NETConfig shortcut on the desktop or select Start »Programs» Tabor Electronics» NETConfig» NETConfig 1.0

The NETConfig window lists Tabor devices found on your subnet. Figure 7-4 shows an example of this display.

3. Click on the “Use wait message” to select this option as shown in Figure 7-4.

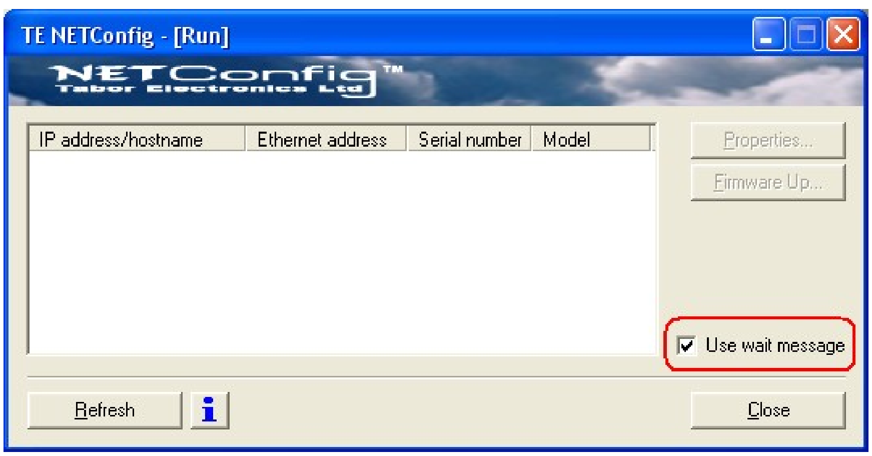

Figure 7-6, The NETConfig Utility

4. Turn power **ON** on your PM8572A and observe that the progress bar, as shown in Figure 7-5, is advancing from left to right. Do not do anything on the PM8572A until the progress bar completes its travel to the right end.

Tips

If the progress bar is not moving check the following for possible problems:

1. If you are connecting to a LAN network, make sure your device is connected with standard LAN wire to your wall plug

2. If you use direct connection from your PC to the PM8572A, your cable should be cross wired. You can get such cable from any computer store near your area

3. If your network is using a managed switch, it is possible that it is configure to break the package with broadcast address and therefore, the only way to use NetConfig is to connect the instrument directly to the PC with a cross wired cable

Figure 7-7, Check for Progress Bar Movement

5. As soon as the progress bar reached the far right hand of the bar, click on the Refresh button. If your device was connected and booted correctly, the device address will appear in the device list, as shown in Figure 7-6.

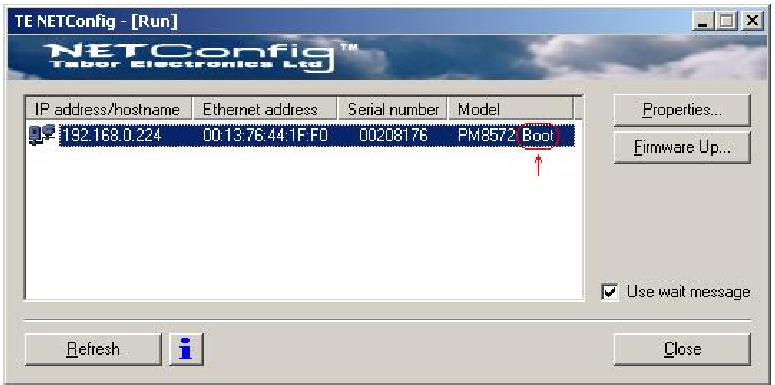

Figure 7-8, WWPM8572A has been Detected on the LAN Network

NOTES

Click Refresh again if you do not see your device in the list of Ethernet devices. If you cannot detect your device after a few attempts check that you have not lost the connection as described in previous paragraphs.

You can only update instrument(s) that appear in the NETConfig window.

Point and click on the device you want to update. The selected device will now have blue background. Click on the Firmware Up... button. The firmware Update dialog box as shown in Figure 6-7 appears.

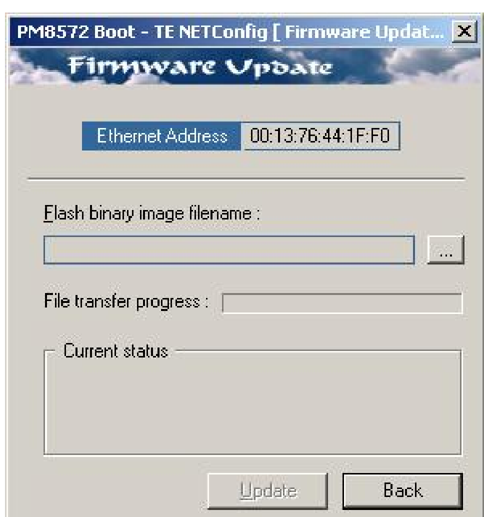

Figure 7-9, The Firmware Update Dialog Box

In the TE NETConfig [Firmware Update] dialog box click on the  button to browse and locate the upgrade file. After you select the file its complete path will be displayed in the Flash binary image filename field as shown in Figure 7-8. Make sure the file in the path agrees with that specified by your supervisor. To complete the update process, click on Update and observe the File Transfer Progress bar. The update will complete with a Firmware Update d Successfully message, as shown in Figure 7-9.

Click on Back to close NETConfig Firmware Update dialog box and turn off the power to the PM8572A. The next time you power up the instrument, the device automatically reboots with the new firmware in effect.

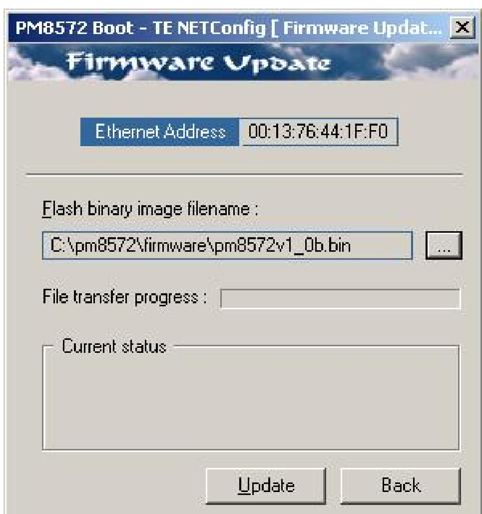

Figure 7-10, Firmware Update Path

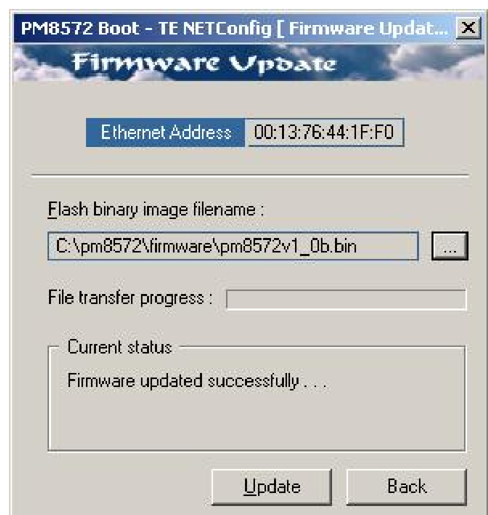

Figure 7-11, Firmware Update Completed

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Appendices

Appendix	Title	Page

Appendix A
Specifications

Configuration

Output Channels	PM8571A – single channel; PM8572A – dual channels

Operating Modes

Description	The PM8572A can source multiple waveform shapes and functions. It can be programmed to operate as one of the following: Function Generator, Arbitrary and Wireless Waveform Generators, Sequence Generator, Pulse Generator, Modulation Generator, Digital Pattern Generator and Half Cycle Generator. It can also be operated as a stand-alone Counter Timer

Inter-Channel Dependency

Separate Controls	Output on/off, amplitude, offset, standard waveforms, user waveforms, user waveform size, sequence table
Common Controls	Sample clock, frequency, period, reference source, trigger modes, trigger advance source, SYNC output, Modulation

Leading Edge Offset

Description	Start of Channel 2 waveform trails channel 1 waveform by a programmable number of points.
Offset Units	Waveform points
Range	0 to 1M points (2M/4M optional)
Resolution and Accuracy	1 point
Skew Between Channels	1 ns ±1 SCLK (50 Ω cables, equal length)

Multiple Instruments Synchronization

Description	Multiple instruments can be daisy-chained and synchronized to provide multi-channel systems. Phase (leading edge) offset between master and slave units is programmable. This feature is available for Function and Arbitrary Generators only
Initial Skew	<±25 ns + 1 sample clock cycle, depending on cable length and quality, typically with 1 meter coax cables

Synchronized Waveforms	Standard, Arbitrary and Sequenced using the automatic sequence advance mode only
Synchronized Run Modes	Continuous, Triggered, Gated and Counted Burst
Trigger Delay	200 ns to 20 s, separately programmable for each synchronized instrument
Trigger Delay Resolution	20 ns
Synchronization Frequency Range	
Standard Waveforms	1.5 kHz to 100 MHz
Arbitrary and Sequenced Waveforms	2.5 MS/s to 250 MS/s (typically 300 MS/s)

Leading Edge Offset

Description	Leading edge offset is programmable for master and slave units. Operates in conjunction with the continuous run mode only
Offset Range	200 ns to 20 s
Resolution and Accuracy	20 ns

Frequency/Time Accuracy

Internal Reference	≥0.0001% (1 ppm TCXO) initial tolerance from 19°C to 29°C; 1ppm/°C below 19°C and above 29°C; 1 ppm/year aging rate
External Reference	
Connector	Rear Panel BNC
Frequency	10 MHz
Impedance and Level	10 kΩ ±5%, TTL, 50% ±2% duty cycle, or 50 Ω ±5%, 0 dBm, selectable using an internal jumper

Outputs

Main Outputs

Connector	Front panel BNC, each channel Impedance: 50 Ω ±1%
Protection	Short Circuit to Case Ground, 10s max
Standby	Output On or Off (Output Disconnected)
Amplitude	32 mV to 32 Vp-p, into open circuit 16 mV to 16 Vp-p, into 50 Ω
Display	Programmable for load impedance of 50 Ω to 1 MΩ
Resolution	4 digits
Accuracy (measured at 1 kHz into 50Ω)	12 V to 16 Vp-p: ±2% 1.6 V to 11.99 Vp-p: ±(1% + 70 mV) 160 mV to 1.599 Vp-p: ±(1% + 10 mV) 16 mV to 159.9 mVp-p: ±(1% + 5 mV)
DC Offset Range	0 to ±8 V
Resolution	1 mV
Accuracy	±(1% ± 1% from Amplitude ±5 mV)

Square Wave, Pulse Performance

Rise/Fall Time (10%-90%)	<5 ns, 16 mV to 16 Vp-p
Aberration	<6%, 16 mV to 10 Vp-p; <8%, to 16 Vp-p

Sync Outputs

Connector	Front panel BNC
Level	>1V, 50Ω; TTL, open circuit
Sync Type	Pulse with Arbitrary and Standard Waves; LCOM in Sequence and Burst Modes (including Burst Modulation); Marker with Modulation Mode only,

	programmable position
Position	Point 0 to maximum segment size, programmable with 4-point resolution

Filters

Description	Filters can be switch in and out freely except in standard waveform shape where the filters are automatically used by the instrument to reconstruct the sine shape. Each channel has its own set of filters.
Type	25 MHz Bessel 50 MHz Bessel 60 MHz Elliptic 120 MHz Elliptic

General Run Modes

Description	Define how waveforms start and stop. Run modes description applies to all waveform types and functions, except where noted otherwise.
Continuous	Continuously free-run output of a waveform. Waveform generation can be enabled and disabled from a remote interface only.
Triggered	Upon trigger, outputs one waveform cycle. Last cycle always completed
Burst	Upon trigger, outputs a single or multiple pre-programmed number of waveform cycles. (Does not apply to Sequence Mode). Burst is programmable from 1 through 1M cycles
Gated	Transition enables or disables generator output. Last cycle always completed
Mixed	Same as triggered except first output cycle is initiated by a software trigger. Consequent output requires external triggers through the rear panel TRIG IN connector

Trigger Characteristics

Trigger Sources	
External	Rear panel BNC, or front panel manual trigger button
BUS	Trigger commands from a remote controller only
Mixed	Operates in conjunction with the Mixed Run Mode.

External Trigger Input

Impedance	10 kΩ
Trigger Level Range	±5 V
Resolution	1 mV
Sensitivity	100 mV
Damage Level	±12 V
Frequency Range	DC to 2.5 MHz
Slope	Positive/Negative transitions or both, selectable
Minimum Pulse Width	≥10 ns
System Delay (Trigger input to waveform output)	6 sample clock cycles+150ns
Trigger Delay (Trigger input to waveform output)	
Pulse	[(0; 100ns to 20s) + system delay]
All Others	[(0; 200ns to 20s) + system delay]
Trigger Resolution	

Pulse	10ps; limited by 5 digits
All Others	20ns
Trigger Delay Error	
Pulse	±(3% of setting + 500ps)
All Others	6 sample clock cycles+150ns

Pulse Generator Characteristics

General

Description	Using this mode of operation, the instrument is converted to a full-featured, dual-channel pulse generator.
Value Changes	Glitch-free and drop-out free
State	On, or Disabled
Channel Dependency	Both channels share period and run modes. All other pulse parameters are independent
Mode	Single, Delayed, Double or, Fixed Duty Cycle, External Width
Polarity	Normal, inverted or complemented
Value Changes	Glitch-free and drop-out free

Run Modes

Continuous	Continuously generates pulse waveforms
Triggered	Each trigger generates a single pulse
Burst	Each trigger generates a burst of pulses
Counted Pulses	1 to 65535
Gated	High level at the trigger input enables the output. Low level disables the output. Last pulse always completed
Trigger Control	
External	Rear panel TRIG IN connector
Input Characteristics	As described above
Internal	An internal timer repeatedly generates triggers
Period Control	100 ns to 200 ms, programmable in time domain
Resolution	5 digits
Accuracy	All pulse modes except PWM, same as reference source; ±3%, PWM
Manual	Front panel push button simulates an external trigger signal
Bus	Remote control triggers
Jitter	10 ps rms
Delayed Output	
Description	Output lags trigger by a programmable interval
Range (Trigger to pulse output)	[(0; 100 ns to 20 s) + system delay]
System Delay (Trigger to pulse output)	6 sample clock cycles+150 ns
Resolution	20 ns

Output

Level Setting Modes	High/Low, Amplitude/Offset, Positive, Negative
High Level Range	-7.983 V to +8.000 V, into 50 Ω; -15.966 to +16.000 V, into open circuit
Low Level Range	-8.000 V to +7.983 V, into 50 Ω; -16.000 to +15.966 V, into open circuit
Amplitude Range	16 mV to 16 Vp-p, into 50 Ω; 32 mV to 32 Vp-p, into open circuit

Offset Range	0 to ±7.992 V, into 50 Ω; 0 to ±15.984 V, into open circuit
Positive Level Range (Low level fixed at 0 V)	8 mV to +8.000 V, into 50 Ω; 16 mV to +16.000 V, into open circuit
Negative Level Range (High level fixed at 0 V)	-8 mV to -8.000 V, into 50 Ω; -16 mV to -16.000 V, into open circuit
Resolution	4 digits

Period

Range	20 ns to 10 s
Resolution	11 digits, continuous; 3 digits, gated and burst
Accuracy	Same as reference accuracy, continuous; ±3%, gated and burst
Jitter	<(10 ppm + 20 ps) rms, Continuous; <(100 ppm + 20 ps) rms, Gate, Burst

Pulse Width, Double Pulse

Range	8 ns to 10 s
Delay	0 to 10 s
Resolution	5 digits limited by 10 ps
Accuracy	±(3% of setting + 500 ps)
Jitter	<(100 ppm + 15 ps) rms

Linear Transitions

Description	Adjustable rising or falling edge, measured from 10% to 90% of amplitude
Range	5 ns to 5 ms in 6 overlapping ranges
In-range Span	20:1
Resolution	4 digits
Linearity	±3% of setting, above 100 ns
Accuracy	±(10% of setting + 2 ns)

Hold Duty Cycle Mode

Description	Output duty cycle remains constant regardless of period setting
Range	1% to 99%
Resolution	0.001%
Accuracy	±(3% of setting + 500 ps)

External Width

Description	The pulse shape can be recovered whilst the period and width of an external input signal are maintained
Input	Rear panel TRIG IN connector
Level and Slope	Trigger parameters apply

Pulse Width Modulation

Description	Pulse width is modulated using built-in standard waveforms
Pulse Width Range	10 ns to 500 ms
Resolution	0.625 ns
Modulation Source	
Waveforms	Sine, Triangle, Pulse, Ramp UP or Ramp Down
Period	500 ns to 1 s
Resolution	Pulse width period

Accuracy	Same as reference + 1 Pulse Width Period
Deviation	1% to 99% limited by 10 ns min and 10 s max
Deviation Resolution	0.1% to $0.1e10^{-7}$% from 1 s to 100 ns, respectively; limited by 675 ps

Function Generator Characteristics

Description	One may select from a list of a built-in library of standard waveforms. The waveforms are computed every time a waveform is selected. The integrity of the waveform and its upper frequency limit depend on the programmed frequency value and the number of waveform points that are used for computing one cycle interval
Frequency Range	
Sine, Square	700 μHz to 100 MHz
All other waveforms	700 μHz to 32 MHz
Frequency Resolution	11 digits
Accuracy & Stability	Same as frequency standard

Sine

Start Phase Range	0-360.0°
Start Phase Resolution	0.1°

Sine Wave Performance

THD	0.1% to 100 kHz, STD and CW
Harmonics & Spurious at less than 3 Vp-p	28dBc, <100 MHz 35dBc, <50 MHz 50dBc, <10 MHz 55dBc, <1 MHz
Harmonics & Spurious at less than 5 Vp-p	25dBc, <100 MHz 30dBc, <50 MHz 43dBc, <10 MHz 48dBc, <1 MHz
Harmonics & Spurious at less than 10 Vp-p	23dBc, <100 MHz 28dBc, <50 MHz 35dBc, <10 MHz 37dBc, <1 MHz
Flatness at less than 5 Vp-p	5% to 10 MHz 20% to 100 MHz
Flatness at less than 10 Vp-p	5% to 10 MHz 20% to 100 MHz

Triangle

Start Phase Range	0-360.0°
Start Phase Resolution	0.1°

Square

Duty Cycle Range	0% to 99.9%

Pulse

Delay, Rise/Fall Time, High Time Ranges	0%-99.99% of period (each independently)

Ramp

Delay, Rise/Fall Time, High Time Ranges	0%-99.9% of period (each independently)

Gaussian Pulse

Time Constant Range	10-200

Sinc Pulse

"Zero Crossings" Range	4-100

Exponential Pulse

Time Constant Range	-100 to 100

DC Output Function

Range	-8 V to +8 V

Arbitrary Waveforms Generator Characteristics

Description	Arbitrary Waveforms are created on a remote computer and downloaded to the instrument through one of the available remote interfaces. The frequency of the waveform is calculated from its programmed sample clock value and the number of waveform points that were used for creating the waveform
Sample Clock Range	
Continuous Run Mode	5 S/s to 250 MS/s (300 MS/s, typically at 25°C)
All Other Run Modes	5 S/s to 220 MS/s
Resolution	11 digits (10 digits thought the front panel)
Accuracy and Stability	Same as reference
Vertical Resolution	16 bits (65,536 amplitude increments)
Waveform Segmentation	Permits division of the waveform memory into smaller segments.
Number of Memory Segments	1 to 10k
Waveform Segments, size and resolution	4 points size increments from 16 to 1M points (2M and 4M optional)
Custom Waveform Creation Software	ArbConnection software allows instrument control and creation of custom waveforms either freehand, with equations or built-in functions or with imported waveforms

Wireless Signal Generation Characteristics

Description	Wireless signals are generated using Modular software. These signals are downloaded to the PM8572A through GPIB, LAN or USB interface. The output was characterized using the following test conditions: Sample Clock = External; Sample Clock Frequency = as specified; Modulation = QPSK; Baseband Filter = Raised Cosine; Alfa = 0.35. ACLR was characterized using the following test conditions: BW = Symbol Rate; Offset = 1.35 x Symbol Rate

EVM

	0.1 MSymbols/s	1 MSymbols/s	5 MSymbols/s
10 MHz	0.15% (1)	0.30% (1)	1.40% (1)
80 MHz	0.25% (2)	0.50% (2)	1.20% (2)
100 MHz	0.25% (3)	0.50% (3)	1.20% (3)

ACPR

	0.1 MSymbols/s	1 MSymbols/s	5 MSymbols/s
10 MHz	73 dB (1)	73 dB (1)	65 dB (1)
80 MHz	64 dB (2)	64 dB ((2)	60 dB (2)
100 MHz	64 dB (3)	64 dB (3)	60 dB (3)

(1) Sample Clock Frequency = 100 MS/s
(2) Sample Clock Frequency = 200 MS/s
(3) Sample Clock Frequency = 250 MS/s

Sequenced Waveforms Generator Characteristics

Description	Segments may be linked and repeated in a user-selectable order. Segments are advanced using either a command or a trigger
Advance Modes	
Automatic Sequence Advance	No trigger required to step from one segment to the next. Sequence is repeated continuously per a pre-programmed sequence table.
Stepped Sequence Advance	Current segment is sampled continuously until a trigger advances the sequence to the next programmed segment and sample clock rate.
Single Sequence Advance	Current segment is sampled the specified number of repetitions and then idles at the end of the segment. Next trigger samples the next segment the specified repeat count, and so on.
Mixed Sequence Advance	Each step of a sequence can be programmed to advance either a) automatically (Automatic Sequence Advance), or b) with a trigger (Stepped Sequence Advance)
Sequencer Steps	1 to 4096
Segment Loops	1 to 1M
Minimum Segment Duration	500 ns
Minimum Segment Size in a Sequence	16 points

Modulated Waveforms Generator Characteristics

General

Description	Using this mode of operation, one may select from a list of built-in modulation schemes. The modulated waveform is always a sine waveform (CW)
Carrier Waveform (CW)	Sinewave
Modulation Source	Internal
Inter-Channel Phase Relationship	Channel 2 output is phase offset by 90° relative to channel 1 output
Run Modes	Off (outputs CW), Continuous, Triggered, Delayed Trigger, Re-trigger, Burst and Gated
Interrupted Modulation Carrier Idle Mode	On or Off, programmable
Run Mode Advance Source	Front panel manual trigger, Rear panel TRIG IN, Software commands
Trigger Delay (Trigger input to modulation output)	[(0; 200 ns to 20 s) + system delay]
Resolution	20 ns
Error	6 sample clock cycles + 150 ns
Re-trigger Delay (Modulation end to modulation restart)	200 ns to 20 s
Resolution	20 ns
Error	3 sample clock cycles + 20 ns
Trigger Parameters	All trigger parameters such as level, slope, jitter, etc. apply

AM

Channel Dependency	Both channels share AM parameters except envelop waveform and modulation depth
Modulated Waveform	Sinewave
Carrier Frequency Range	10 Hz to 100 MHz
Envelop Waveform	Sine, square, triangle and ramp
Envelop Frequency	10 mHz to 1 MHz
Modulation Depth	0% to 100%

FM

Channel Dependency	Both channels share FM parameters
Modulated Waveform	Sine wave
Modulating Waveforms	Sine, square, triangle, Ramp
Carrier Frequency Range	10 Hz to 100 MHz
Modulating Frequency Range	10 mHz to 350 kHz
Peak Deviation	Up to 50 MHz
Marker Position	Programmable at a selectable frequency

Arbitrary FM

Description	Operated from an external utility only such as ArbConnection. The modulating waveform can be designed as an arbitrary waveform
Channel Dependency	Both channels share Arbitrary FM parameters
Modulated Waveform	Sine wave
Carrier Frequency Range	10 Hz to 100 MHz
Modulating Waveform	Arbitrary waveform
Modulating Waveform Sampling Clock	1.5 S/s to 2.5 MS/s
Number of frequencies	2 to 10,000
Marker Output	Programmable at the selected frequencies

Sweep

Channel Dependency	Both channels share sweep parameters
Swept Waveform	Sine wave
Sweep Step	Linear or log
Sweep Direction	Up or Down
Sweep Range	10 Hz to 100 MHz
Sweep Time	1.4 μs to 40 s
Marker Output	Programmable marker at a selected frequency.

Frequency Hops

Channel Dependency	Both channels share Frequency Hop parameters
Hopped Waveform	Sine wave
Hop Frequency Range	10 mHz to 100 MHz
Resolution	11 digits (10 digits through the front panel)
Hop Table Size	2 to 1000
Dwell Time Mode	Fixed or Programmable for each step
Dwell Time	200 ns to 20 s
Dwell Time Resolution	20 ns
Marker Position	Programmable on a selected step

Amplitude Hops

Channel Dependency	Amplitude Hop parameters are separate for each channel except hop table size
Hopped Waveform	Sine wave
Frequency Range	10 Hz to 100 MHz
Resolution	11 digits (9 digits though the front panel)
Hop Amplitude Range	0 to 16 Vp-p
Resolution	Maximum amplitude/4096
Hop Table Size	2 to 5000
Dwell Time Mode	Fixed or Programmable for each step
Dwell Time	200 ns to 20 s
Dwell Time Resolution	20 ns
Marker Position	Programmable on a selected step

3D

Description	Operated from an external utility only such as ArbConnection, the carrier waveform can be programmed to freely sweep in three dimensions: amplitude, frequency and phase. Each channel has its own amplitude profile but both channels share frequency and phase. Channel 2 is always 90° phase shifted from channel 1.
Modulated Waveform	Sine
Carrier Frequency Range	10 Hz to 100 MHz
Modulating Sampling Clock	1.5 S/s to 2.5 MS/s
Number of profile indexes	2 to 30000
Marker Output	Programmable at the selected index point

ASK

Description	Amplitude Shift Keying
Channel Dependency	Both channels share ASK parameters
Shifted Waveform	Sine wave
Carrier Frequency Range	10 Hz to 100 MHz
Amplitude Shift Range	0 V to 16 Vp-p
Resolution	Maximum amplitude/4096
Baud Range	1 bit/sec to 2.5 Mbits/sec
ASK Data Bits Length	2 to 1000
Marker Output	Programmable marker at a selected step

FSK

Channel Dependency	Both channels share FSK parameters
Shifted Waveform	Sine wave
Carrier/Shifted Frequency Range	10 Hz to 100 MHz
Baud Range	1 bit/sec to 10 Mbits/sec
FSK Data Bits Length	2 to 4000
Marker Output	Programmable marker at a selected step

PSK

Channel Dependency	Both channels share PSK parameters
Shifted Waveform	Sine wave
Carrier Frequency Range	10 Hz to 100 MHz
Phase Shift Range	0° to 359.9°
Baud Range	1 bits/sec to 10 Mbits/sec
PSK Data Bits Length	2 to 4000
Marker Output	Programmable marker at a selected step

I & Q Modulation - PSK and QAM

Operation	The Model PM8572A can generate I & Q signals using channels 1 and 2 outputs. Carrier waveform can be turned off to directly drive vector generator inputs. I & Q Modulation functions are not available on PM8571A
Modulation Schemes	(n)PSK, (n)QAM and User QAM
Carrier Waveform	Sine wave
Carrier Waveform Control	On or Off, programmable
Carrier Frequency	10 Hz to 62.5 MHz (75 MHz typical)
Modulation Type	
PSK	BPSK, QPSK, OQPSK, π/4 DQPSK, 8PSK, 16PSK
QAM	16QAM, 64QAM, 256QAM
User Defined QAM Symbols	2^1 to 2^8 proprietary symbols

Symbol Rate Range	1 symbol/s to 1e6 symbols/s
Symbol Period Accuracy	±(500 ns + Carrier Period)
Table Size	2 to 4000

Half-Cycle Waveforms Generator Characteristics

Description	Half Cycle waveforms are the same as the standard functions except waveforms are generated as a sequence of half cycles. The delay between the half cycles is programmable
Function Shape	Sine, Triangle, Square
Frequency Range	0.01 Hz to 1 MHz
Phase Start Range	0° to 360.0° (Sine and triangle only)
Start Phase Resolution	0.1°
Duty Cycle Range	0% to 99.9% (Square only)
Duty Cycle Resolution	0.1%
Run Modes	Continuous, Triggered
Delay Between Half Cycles	200 ns to 20 s (Applies to continuous run mode only)
Resolution	20 ns

Digital Pattern Generator Characteristics

Description	Pattern data is connected to the channel 1 DAC and in parallel, to the rear-panel digital pattern connector and hence can be used separately or simultaneously with one of the arbitrary waveform output. Pattern data is created externally and downloaded to the data memory from a remote interface
Connector	Rear panel SCSI-2 type, 68-pin VHDC, CH 1 only
Output Level	LVDS
Pattern Width	16-bits, differential
Pattern Length and Source	1 to 128 k, dedicated pattern memory; 16 to 1M (2M and 4M optional) using the arbitrary memory space, user selectable
Update Frequency	5 pps to 25 Mpps (Usable above this frequency however, depends on the cable quality and length)

Counter/Timer Characteristics

Operation	The PM8572A has a special mode where the instrument type is transformed to operate as a counter/timer. When this mode is selected, the operation of the arbitrary waveform and its outputs are disabled
Measurement Functions	Frequency, Period, Period Averaged, Pulse Width and Totalize

Frequency, Period Averaged

Frequency Range	20 Hz to 100 MHz (typically >120 MHz)
Period Averaged Range	10 ns to 50 ms
Resolution	7 digits in one second of gate time, reduced proportionally with lower gate times

Period, Pulse Width

Range	500 ns to 50 ms
Resolution	100 ns

Totalize

Frequency Range	20 Hz to 100 MHz
Accumulation Range	10^{12}-1
Overflow Indication	LED, turns on when capacity is exceeded

General

Input	Rear Panel TRIG IN, BNC connector
Trigger Level Range	±5 V
Sensitivity	500 mVp-p
Damage Level	±12 V
Minimum Pulse Width	≥10 ns
Slope	Positive/Negative transitions, selectable
Gate Time	100 µs to 1 s
Display Modes	
Repetitive	Continuous measurements are executed when signal is present at the input
Hold	Single measurement is executed upon command
Gated	Active in Gated Totalize mode only
Time Base	
Type	TCXO
Temperature Stability	1 ppm, 0°C - 40°C
Long Term Stability	1 ppm, 1 year

Remote Interfaces

GPIB

Connector	Rear panel 25-pin D connector
GPIB Revision	IEEE-488.2
SCPI Revision	1993.0
Logical Address Settings	1 - 31, configured via front panel programming
DMA	Downloads arbitrary waveform data, arbitrary FM waveform data and sequence table data. DMA support is required by the controller

Ethernet

Connector	Rear panel RJ-45, female
Physical Layer	Twisted pair 10/100 Base-T
IP address	Programmed from the front panel or through the USB port
Baud Rate	10/100 Mbit/sec with auto negotiation
Protocol	SCPI commands over TCP/IP.

USB

Connector	Type A receptacle
Specifications	Version 1.1
Protocol	SCPI commands over USB

General

Front Panel Display	Color LCD, 3.8” reflective, 320 x 240 pixels, back-lit
Front Panel Indicator LED's	
Output On	Green – Output on / off (Separate for each channel)
SYNC On	Green – SYNC on / off
Power Requirements	
Mains Input Range	85 to 265Vac, 47-63 Hz
Maximum Total Module Power	60W
Mechanical	

Dimensions	212 x 88 x 415 mm (W x H x D)
Weight	Approximately 3.5 Kg
External Storage:	Direct USB Disk-on-key or CD/DVD-ROM support
Environmental	
Operating temperature	0°C - 50°C, RH 85% to 45%, respectively. Specifications are valid within an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. Below 20°C and above 30°C, the specifications are degraded by 0.1% for every ±1°C change
Relative Humidity:	
10°C - 30°C	5 to 95%
30°C - 40°C	5 to 75%
40°C - 50°C	5 to 45%
Storage temperature:	-40°C to + 70°C.
EMC Certification	EN61000-6-1, EN61000-6-3
Safety	EN61010-1, 2nd revision, CE marked

Options

Description	All PM8572A options are factory installed. Therefore, if you want to purchase any of the options, make sure your order specifies the required option at the time of your purchase
Format	Options are designated by numeral digits. For example, if you require option -2, specify PM8572A-2
Option 1	2M arbitrary memory. Extends the arbitrary memory from the standard 1M points to 2M points
Option 2	4M arbitrary memory. Extends the arbitrary memory from the standard 1M points to 4M points
Option 3:	20Vp-p into 50Ω
Option 4:	±5V DC, 50Ω protection (10Vpp)

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Appendix B
Option 3 – Specifications Amendment

Outputs

Main Outputs

Amplitude	21 mV to 20 Vp-p, into 50 Ω 42 mV to 32 Vp-p, into open circuit
Accuracy (measured at 1 kHz into 50Ω)	
16 Vp-p to 20 Vp-p:	±5%
DC Offset Range	0 to ±10 V

Square Wave, Pulse Performance

Rise/Fall Time (10%-90%)	<6 ns, 16 V to 20 V
Aberration	<8%, 16 V to 20 Vp-p

Pulse Generator Characteristics

Output

Level Setting Modes	High/Low, Amplitude/Offset, Positive, Negative
High Level Range	-9.979 V to +10.000 V, into 50 Ω; -15.966 to +16.000 V, into open circuit
Low Level Range	-10.000 V to +9.979 V, into 50 Ω; -16.000 to +15.966 V, into open circuit
Amplitude Range	21 mV to 20 Vp-p, into 50 Ω; 42 mV to 32 Vp-p, into open circuit
Offset Range	0 to ±9.989 V, into 50 Ω; 0 to ±16 V, into open circuit
Positive Level Range (Low level fixed at 0 V)	10 mV to +10.000 V, into 50 Ω; 21 mV to +16.000 V, into open circuit
Negative Level Range (High level fixed at 0 V)	-10 mV to -10.000 V, into 50 Ω; -21 mV to -16.000 V, into open circuit

Function Generator Characteristics

DC Output Function

Range	-10 V to +10 V

Modulated Waveforms Generator Characteristics

ASK

Amplitude Shift Range	0 V to 20 Vp-p

Amplitude Hops

Hop Amplitude Range	0 to 20 Vp-p

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Appendix C
Option 4 – Specifications Amendment

Outputs

Main Outputs

Amplitude	16 mV to 10 Vp-p, into 50 Ω 32 mV to 16 Vp-p, into open circuit
DC Offset Range	0 to ±5 V

Pulse Generator Characteristics

Output

Level Setting Modes	High/Low, Amplitude/Offset, Positive, Negative
High Level Range	-4.983 V to +5.000 V, into 50 Ω; -9.966 to +10.000 V, into open circuit
Low Level Range	-5.000 V to +4.983 V, into 50 Ω; -10.000 to +9.966 V, into open circuit
Amplitude Range	16 mV to 10 Vp-p, into 50 Ω; 32 mV to 32 Vp-p, into open circuit
Offset Range	0 to ±5 V, into 50 Ω; 0 to ±10 V, into open circuit
Positive Level Range (Low level fixed at 0 V)	8 mV to +5.000 V, into 50 Ω; 16 mV to +10.000 V, into open circuit
Negative Level Range (High level fixed at 0 V)	-8 mV to -5.000 V, into 50 Ω; -16 mV to -10.000 V, into open circuit

Function Generator Characteristics

DC Output Function

Range	-5 V to +5 V

Modulated Waveforms Generator Characteristics

ASK

Amplitude Shift Range	0 V to 10 Vp-p

Amplitude Hops

Hop Amplitude Range	0 to 10 Vp-p

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