# User Manual

# Model TE3222

## PXIbus
## SINGLE CHANNEL
## WIDEBAND AMPLIFIER

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***Tabor Electronics Ltd.***

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## WARRANTY STATEMENT

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.

### Duration of Warranty

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.

### Return of Product

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: service@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 auto-transformer, 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” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.
2. 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.
9 Hatasia Street, Tel Hanan
ISRAEL 36888

declare, that the 40Vp-p Signal Amplifier

# Model 3222

meet the intent of Directive 89/336/EEC for Electromagnetic Compatibility and the requirements of the Low Voltage Directive 73/23/EEC amended by 93/68/EEC. 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:**
EN 50081-1 Emissions:
EN 55022 - Radiated, Class B
EN 55022 - Conducted, Class B
EN 50082-1 Immunity:
IEC 801-2 (1991) - Electrostatic Discharge
IEC 801-3 / ENV50140 (1993) - RF Radiated
IEC 801-4 (1991) - Fast Transients

The tests were performed on a typical configuration.

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# Chapter 1
# PORTRAYAL

## What's In This Chapter

This chapter contains general and functional description of the Model TE3222 wideband amplifier. It also describes the front panel connectors and operational modes and provides description of all features available with the instrument.

## Introduction

The Model 3222, as shown in Figure 1-1, is a 3U single-slot, PXI-based power amplifier. The amplifier is used for signal amplification purposes. Offering unprecedented signal purity, the model 3222 amplifies signals from dc to over 20 MHz. The unit has a fixed gain of x10 however; one may order the same amplifier with custom gain without jeopardizing signal purity and amplifier performance.

Common problem with PXI equipment is the inability to produce high voltages, which results from low power supply rails. For example, waveform generators, or similar signal source devices, draw power from ±12V rails. Consequently, they can not produce signals above16Vp-p. The model 3222 solves this problem by using dc/dc converters to increase rail voltage to ±24V. In turn, the increase of rail voltage plus custom components and unique design permits amplification of input signals to 40Vp-p into high impedance, or 20Vp-p into 50Ω. The power amplifier draws current only from the +5V rail, leaving the other power supply rails free to supply their full current rating to other devices.

The Model 3222 is supplied with floating input and output connectors. Therefore, the amplifier can float from ground level up to 250Vdc. The only limiting factor is that both the input and output grounds must connect to the same level. This capability is extremely important in applications where the amplifying device should reside on the same ground level as its source. The floating capability can be added or removed using a simple, user-accessible, jumper connection.

The wideband amplifier occupies just one PXI slot however, its performance is unique and outstanding by any standards. With 40Vp-p and over 20 MHz bandwidth one can use the Model 3222 in every possible task.

## 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.

## TE3222 Series Feature Highlights

- Single-width PXI card
- Large signal bandwidth to 20 MHz
- Small signal bandwidth to 50 MHz
- High amplitude to 40Vp-p (high impedance)
- Low distortion
- Custom Configuration of:
  Gain
  Input Impedance
  Output Impedance
  Output Polarity
  Signal Ground


*Figure 1-1, TE3222*

## Functional Description

Detailed functional description of the features, operation and options available with the TE3222 is given in the following paragraphs. The wideband amplifiers can be ordered with different configurations such as input/output impedance, gain, etc. therefore read the following description carefully and make sure your amplifier is configured correctly for your application before you install and use this card.

## Options

Model TE3222 must be ordered from the factory already configured for your application. There will be no schematics, nor instructions how to modify the amplifier for other configurations as any configuration change may affect the amplifier performance.

Below, you'll find a list of optional configurations for the wideband amplifier:

**Input Impedance** – determines the matching impedance at the input connector. Two options are available: 50Ω and 1MΩ,

**Output Impedance** – determines the output impedance matching for the load impedance. Three options are available: 50Ω, 75Ω and 600Ω

**Gain** – specifies gain magnitude of the input signal. Factory default setting is 10 however, any custom gain up to 100 can be specified. Note that some characteristics of the output section may change for gain setting above 10.

**Output Polarity** – specifies the main characteristics of the amplifier. Two options are available: normal and inverted.

**Circuit Ground** – determines if the amplifier ground is floated or tied to case ground. Note that this is the only option that is user accessible and may be changed by adding or removing a jumper connection.

As explained above, all options must be specified at the time of your purchase and the TE3222 is supplied fully configured. Reconfiguration of fielded cards can only be done by qualified personnel.

## 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 matching impedance, after 30 minutes of warm up time, and within a temperature range of 20°C to 30°C. Specifications outside this range are degraded by 0.1% per °C.

## Front Panel Connectors

The TE3222 has 2 BNC connectors on its front panel, designated as INPUT and OUTPUT. These connectors are described below.

## Input

The input connector accepts signals within the range of DC to over 20 MHz and amplifies them by a fixed gain. Input impedance is factory pre-conditioned and has one of the following values: 50Ω, or 1MΩ. 1MΩ input impedance can be used for low frequency signals (up to 100KHz) however, higher frequencies require 50Ω termination at the input of the amplifier to eliminate standing waves and reflections in the input cable, which can cause excessive ringing and aberrations at the output.

The amplifier input can not tolerate high voltage on its 50Ω resistance. Therefore, before applying the cable to the input connector, make sure your signal will not exceed input rating, as specified in Appendix A of this manual.

## Output

The output connector outputs amplified signals. The output connector may generate inverted signals, depending on the amplifier configuration. Gain at this output is fixed at 10 (or another gain factor that was specified at the time of your purchase). Output source impedance is one of: 50Ω, 75Ω or 600Ω.

Knowing source impedance is very important because the output gain is calibrated for its source impedance only and therefore, any unmatched load impedance may have an affect on output level accuracy. For example, with properly terminated signals at the input and output connectors (say 50Ω each), an input of 2Vp-p will generate an output of 20Vp-p. On the other hand, if you increase your load impedance by a large factor, the output will increase by a factor of:

$$Vout = 40Vp\text{-}p - 40Vp\text{-}p \times 50\Omega / 50\Omega + X\Omega$$

where X = your load impedance

If you look at the equation above, with exactly 50Ω load impedance, the output will be 20Vp-p and as you increase the load impedance, the output increases proportionally until, at very high load impedance, the output is doubled to 40Vp-p.

40Vp-p is the maximum amplitude level this amplifier can produce however, only into high impedance loads.

***WARNING***

**Applying the output signal on inductive or capacitive loads may damage the amplifier.**

## Grounding Considerations

Understanding how to connect your ground path could be critical to preserving the integrity of your output signal. If you are using a single-ended output then it will probably be safe for you to connect the circuit ground to case ground. However, in applications requiring floated ground connection, it is imperative that the amplifier ground be made floating as well. In this case, refer to Chapter 2 and Figure 2-1 for instructions how to float the circuit ground. Always bear in mind the following warning:

***WARNING***

**Input and output grounds are tied together and therefore, it is absolutely forbidden to connect the output ground to a different level than the input ground. Failure to adhere to this limitation may damage the TE3222 and the surrounding equipment connected to its I/O connectors.**

Also note:

***NOTE***

**Normal amplifier operation is recommended with circuit ground connected to case ground (float disabled), thus minimizing susceptibility to system noise. Enable float configuration for floated application only.**

## Operating Instructions

Being a passive device, there are no controls, nor computer programming required to operate the Model 3222. The following procedure is recommended for proper operation of the power amplifier:

1. Make sure your card is configured for input and output impedance, gain and grounding

2. Follow the installation instructions given in Chapter 2 of this manual

3. Connect the output terminal to your load
4. Connect the input terminal to your source
5. Turn on power to your PXI system

***WARNING***

**There is no switch control to power the Model 3222 on and off and therefore, the amplifier is active immediately after you power up your PXI chassis. Always make sure your load is protected from inadvertent power up conditions before you turn on your PXI chassis.**

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# Chapter 2
# INSTALLATION

## Installation Overview

This chapter contains information and instructions necessary to prepare the Model TE3222 for operation. Details are provided for initial inspection, grounding requirements, repackaging instructions for storage or shipment and installation information.

## 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 and associated computer. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

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. The following sections contain information and cautions that must be observed to keep the TE3222 operating in a correct and safe condition.

**CAUTION**

**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 chassis. 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.**

## Operating Environment

The TE3222 is intended for operation within a PXI chassis as a plug-in module. Ensure the PXI chassis being used to host the TE3222 fully conforms to the latest PXI specifications.

The TE3222 is intended for indoor use and should be operated in a clean, dry environment with an ambient temperature within the range of 0 °C to 40 °C.

***WARNING***

**The TE3222 must not be operated in explosive, dusty, or wet atmospheres. Avoid installation of the module close to strong magnetic fields.**

The design of the TE3222 has been verified to conform to EN 61010-1 safety standard per the following limits: Installation (Overvoltage) Category I (Measuring terminals) Pollution Degree 2

Installation (Overvoltage) Category I refers to signal level, which is applicable for equipment measuring terminals that are connected to source circuits in which measures are taken to limit transient voltages to an appropriately low level.

Pollution Degree 2 refers to an operating environment where normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation must be expected

## Power Requirements

The TE3222 operates from within a PXI chassis. DC Voltages are supplied to the instrument from the PXI backplane. The instrument requires a variety of DC voltages as outlined in the Specifications section (Appendix A). Ensure the PXI chassis is capable of delivering required voltages and has sufficient current to drive the amplifier.

***CAUTION***

**Disconnect power to the PXI Chassis before installing or removing the TE3222.**

## Grounding Requirements

To conform to the applicable safety and EMC requirements, ensure that the TE3222 instrument panel and the PXI chassis are “earth” grounded.

***CAUTION***

**The outer shells of the front panel terminals (Input, Output) can float from case ground. Refer to Figure 2-1 and the instructions in this manual to disconnect/connect the circuit ground from/to case ground.**

## Floating the Input/Output Grounds

The TE3222 ground circuit is designed so it can float from case ground. The only limitation is that the input and output grounds must reside on the same ground level.

Looking at the front panel, you will notice that the BNC connectors are housed in plastic material and therefore are isolated from the front panel metal. The amplifier circuit is also floated from the backplan power supply ground through isolated DC/DC converters and therefore the amplifier ground circuit can be configured to float from case ground in applications requiring isolation from circuit to case grounds.

***WARNING***

**Input and output grounds are tied together and therefore, it is absolutely forbidden to connect the output ground to a different level than the input ground. Failure to adhere to this limitation may damage the TE3222 and the surrounding equipment connected to its I/O connectors.**

The TE3222 can be ordered from the factory already configured with the required ground setting however, ground can be configured differently for various applications using a simple jumper connection. Use the following procedure to enable/disable floated ground configuration.

1. Locate LK2 near the bottom of the board, as shown in Figure 2-1
2. Remove the shorting jumper if you want to float the input/output grounds
3. Leave the jumper on LK2 if you want to connect circuit ground to case ground

***NOTE***

**Normal amplifier operation is recommended with circuit ground connected to case ground (float disabled), thus minimizing susceptibility to system noise. Enable float configuration for floated application only.**

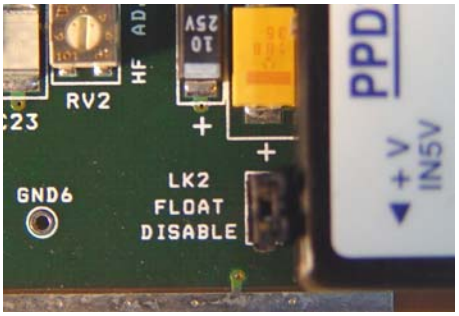


*Figure 2-1. Float Enable/Disable Jumper*

## Calibration

The recommended calibration interval is three years. Calibration should be performed by qualified personnel only.

## Abnormal Conditions

Operate the TE3222 only as intended by the manufacturer. If you suspect the TE3222 has been impaired, remove it from the PXI Chassis and secure against any unintended operation. The TE3222 protection is likely to be impaired if, for example, the instrument fails to perform the intended operation or shows visible damage.

*WARNING*

**Any use of the TE3222 in a manner not specified by the manufacturer may impair the protection provided by the instrument**

## Long Term Storage or Repackaging For Shipment

If the instrument is to be stored for a long period of time or shipped immediately, proceed as directed below. If you have any questions, contact your local Tabor representative or the Tabor 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.
4. 

*NOTE*

**If the instrument is to be shipped to Tabor 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 returned authorization order number (RMA) as well as the date and method of shipment. ALWAYS OBTAIN A RETURN AUTHORIZATION NUMBER FROM THE FACTORY BEFORE SHIPPING THE INSTRUMENT TO TABOR.**

## Preparation For Use

Preparation for use includes removing the instrument from the bag and installing the TE3222 inside the PXI chassis.

## Removing the Instrument from the Bag

The TE3222 is supplied in an antistatic bag. Check the seal on the bag to make sure the bag was not opened in a static-unsafe environment. Place the enveloped card on static free surface and hook yourself up with a grounding strap. Only then break the seal and remove the card from the envelope. Hold the card at the metal panel end. Refrain from touching the instrument with your finger at all times.

## Installation

Plug the TE3222 into your PXI chassis and lift the extractor to the upright position. Push the card firmly until the metal panel makes contact with the metal edge of the PXI chassis. Using a suitable screwdriver, tighten the two retaining screws, top and bottom.

***CAUTION***

**Disconnect power to the PXI Chassis before installing or removing the TE3222. An attempt to insert or remove the instrument while the power is connected to the chassis will result in severe damage to the instrument and will automatically revoke your warranty.**

***CAUTION***

**Once the TE3222 is installed in the chassis cover all remaining open slots to ensure proper airflow. Using the TE3222 without proper airflow will result in damage to the instrument.**

# Appendix A

# SPECIFICATIONS

## Input Characteristics

| | |
|---|---|
| Connector | BNC |
| Impedance | 50Ω or 1MΩ, DC, coupled |
| Damage Level | 10Vp-p |
| Frequency Range | DC to 20MHz |

## Output Characteristics

**General**

| | |
|---|---|
| Connector | BNC |
| Impedance | 50Ω, 75Ω, or 600Ω, DC coupled |
| Protection | Short-circuit, 10 seconds |
| Gain | x10, fixed (can be ordered from factory with different gain setting) |
| Polarity | Output normal, or inverted |
| Amplitude | 0 to 20Vp-p into matching impedance (50Ω, 75Ω, or 600Ω); 0 to 40Vp-p into high impedance |

**Square Wave Characteristics**

| | |
|---|---|
| Transition Time | <20ns |
| Aberrations | <7% |

**Sine Wave Characteristics**

| | |
|---|---|
| Small Signal | |
| Bandwidth | 50 MHz, at 2Vp-p (-3dB) |
| Accuracy | ±(2% of full-scale amplitude range + 25mV), Square wave at 1KHz |
| Flatness (10Vp-p) | ±5% of amplitude to 1MHz; ±10% of amplitude to 10MHz |
| THD | 0.1%, 10Hz to 100KHz |
| Harmonics | <-50dBc, 100KHz to 5MHz<br><-40dBc, 5MHz to 20MHz (10Vp-p) |

## General

| | |
|---|---|
| Physical Size | Single-slot, 3U high PXI module |
| Power Requirements | 7.2W maximum |
| Current Consumption | +5V – 3.5 A maximum |
| Signal Ground | Floated to the same level as the source, 250V dc maximum |
| EMC Certification | CE marked |
| Reliability | MTBF per MIL-HDBK-217E, 25 °C, Ground Benign |
| Safety | Designed to meet IEC EN61010-1, UL 3111-1 |
| Workmanship Std. | Conform to IPC-A-610D |

## Environmental

| | |
|---|---|
| Operating Temperature | 0 °C - 50 °C, RH 80% (non-condensing) |
| Storage Temperature | -30 °C - 80 °C |

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