Multi LAN 350

MI 2016

User Manual

Version 2.2, Code No. 20 750 745

METREL®

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CE Mark on your equipment certifies that this equipment meets the requirements of the EU (European Union) concerning safety and electromagnetic compatibility regulations.

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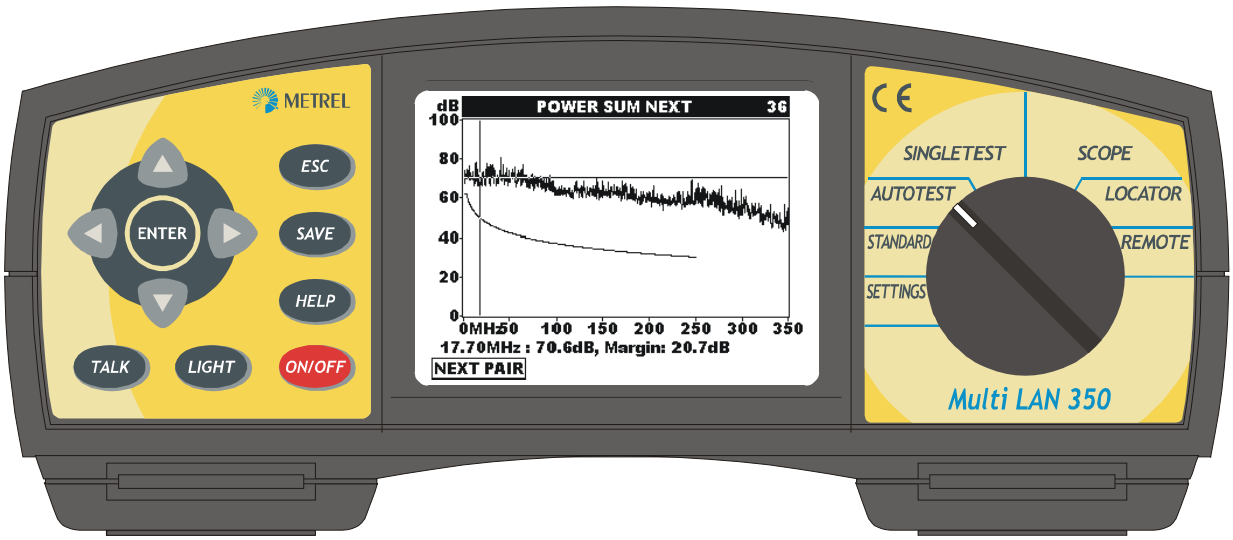
1 Multi LAN 350

Multi LAN 350 is a portable cable tester for complete testing and verification of LAN cabling up to 350MHz.



Main features

- Complete function set needed for verification of LAN cabling, including Cat 6 / Class E installations.
- Powerful troubleshooting tools such as high resolution TDR and TDCrosstalk
- Supports UTP, STP, ScTP and FTP cables, Permanent and Channel link testing
- Supports fiber optic cable testing in combination with compatible Optical testing instrumentation, eg. Optical Power Meter PM420.
- 2 way Autotest function for fast and reliable testing
- Talk & Trace interface provides full duplex communication and is also intended for locating cables
- Locators for locating cables
- Main test standards and cable types (copper and fiber) are preprogrammed
- Large memory capacity for storing measured data
- Powerful Windows software for data analysis and Test report evaluation
- Graphical representation of results on instrument's display and PC
- Simple firmware upgrading

This manual provides information for connection, operation, test procedures and maintainance of the Multi LAN 350.
The manual is divided into five sections, each covering a particular aspect of the operation.

2 General information

2.1 Safety and operational precautions

2.1.1 Warnings

To ensure a high level of operator's safety while carrying out various measurements and tests using the Multi LAN 350 and MultiLAN350 RU, as well as ensuring that the test equipment remains undamaged, it is necessary to consider the following general warnings:

⚠ **The test equipment is intended for / to be used (safety extra low voltage) environment only.**
Do not connect the instrument to public telephone network!
Never connect the test equipment to an active network.
Service is allowed to be carried out only by an authorised person!
Use only standard or optional test accessories supplied by your distributor!
Use only connector types equivalent to those built in the instrument to avoid damage to the instrument components.

2.1.2 Batteries

Replacement
Note
Insert cells correctly, otherwise the instrument will not operate and the batteries could be discharged.
If the instrument is not to be used for a long period of time remove all batteries from the battery compartment.

Warnings!
When battery cells have to be replaced, before opening battery cover disconnect any measuring accessory connected to the instrument and turn power off on the instrument.
Use only power supply /charger delivered from manufacturer or distributor of the test equipment to avoid possible fire or electric shock.
The real time clock setup will be lost if the batteries are removed for more than 15 minutes !
Stored measurement graphs will be lost immediately after the batteries are removed.

Precautions on charging of new batteries or batteries unused for a longer period

Unpredictable chemical processes can occur during charging of new batteries or batteries that were unused for a longer period of time (more than 3 months). NiMH and NiCd batteries are affected to a various degree (sometimes called as memory effect).

As a result the instrument operation time can be significantly reduced at the initial charging/discharging cycles.

Therefore it is recommended:
- To completely charge the batteries (at least 14h with in built charger).
- To completely discharge the batteries (can be performed with normal working with the instrument).
- Repeating the charge/discharge cycle for at least two times (four cycles are recommended).

When using external intelligent battery chargers one complete discharging /charging cycle is performed automatically.

After performing this procedure a normal battery capacity is restored. The operation time of the instrument now meets the data in the technical specifications.

Notes
The charger in the instrument is a pack cell charger. This means that the batteries are connected in series during the charging so all batteries must be in similar shape (similarly charged, same type and age).
Even one deteriorated battery (or just of an another type) can cause an improper charging of the entire battery pack (heating of the battery pack, significantly decreased operation time).

If no improvement is achieved after performing several charging /discharging cycles the shape of individual batteries should be determined (by comparing battery voltages, checking them in a cell charger etc). It is very likely that only some of the batteries are deterirated.

The effects described above should not be mixed with normal battery capacity decrease over time. All charging batteries lose some of their capacity when repeatedly charged/discharged. The actual decrease of capacity versus number of charging cycles depends on battery type and is provided in the technical specification from battery manufacturer.

Information on batteries
Only rechargeable NiMH batteries (size C) can be used. The operating hours are given for a nominal capacity of 3500 mAh.
Do not use standard batteries !

2.1.3 Power supply considerations

When using the original power supply adapter / charger A1135 the instrument is fully operational immediately after switching it on. The batteries are charged at the same time, nominal charging time is 16 hours.
The batteries are charged whenever the power supply/charger is connected to the instrument. Inbuilt protection circuits control the charging procedure and assure maximal battery lifetime.

2.1.4 Factory Calibration, Self Calibration

Factory Calibration
It is essential, that all measuring instruments are regularly calibrated. For occasional daily use, we recommend an annual factory calibration to be carried out. When the instrument is used continuously every day, we recommend a factory calibration every sixth months.
Contact the manufacturer or your local distributor for further information.

Self Calibration (with the Attenuation calibration module)
The test calibration serves to perform a fast check up of the instrument and remote unit hardware. If using an other remote unit as delivered it is obligatory to perform it.
The calibration can be performed with the Attenuation calibration module ACM-350.
When the instrument is used continuously every day we recommend to perform self calibration at at least once per month.
The user should run it at least one per month.

Note:
The main and remote unit should be switched on at least 1 minute before performing the self calibration.
The self calibration should be performed at room temperature.

2.1.5 Service

For repairs under or out of warranty time please contact your distributor for further information.

Name and address of manufacturer

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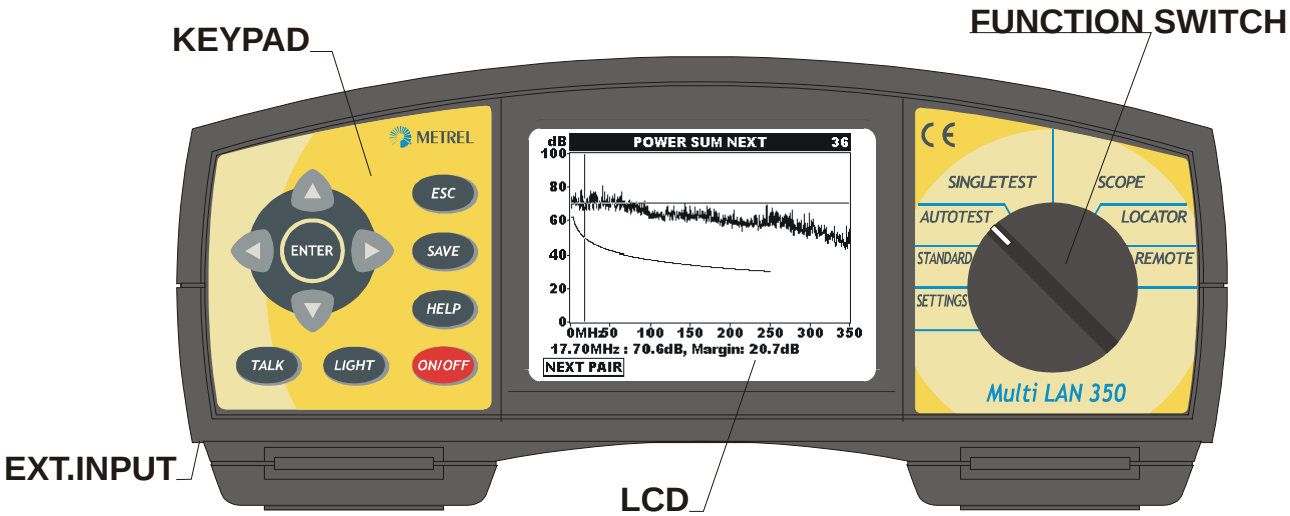
http://www.metrel.si
E-mail: metrel@metrel.si

2.2 Description

2.2.1 Instrument MultiLAN 350

2.2.1.1 Front panel



Front panel layout

Function switch selects one of eight fuctional/operating menus:

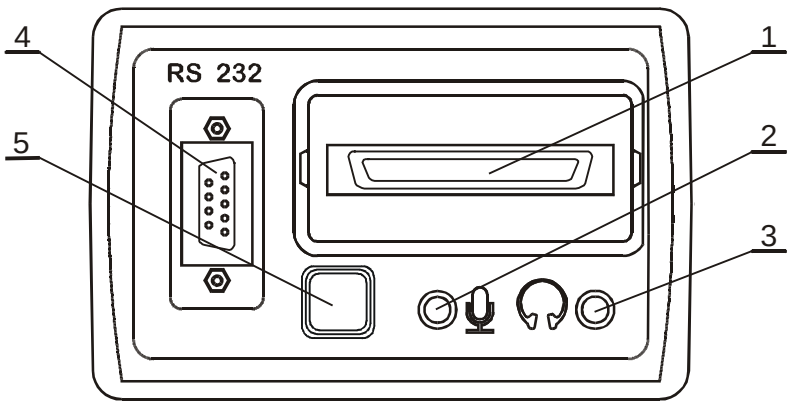
Functional Menu	Description
SETTINGS	adjustment of system parameters, such as time, RS232 settings etc.
STANDARD	selection of test standard,cable type, test procedures
AUTOTEST	performs predefined Autotests
SINGLETEST	performs single tests in full detail
SCOPE	high resolution time domain reflectometer
LOCATOR	special mode for tracing cables and sockets with locators
REMOTE	the instrument is used as a Remote unit; far end measurements are enabled

Front panel keypad

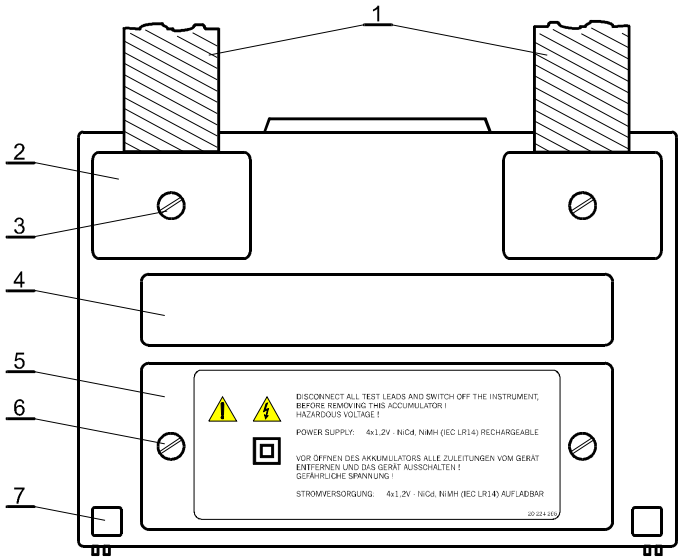
ESC …….....Return to previous page in menu
HELP…….....On Line information and warnings
ON/OFF…. …….....To turn on or off the instrument (Auto off after 10 minutes)
TALK…….....Talk & Trace interface for talking over cable
LIGHT…….....Two level LCD backlight normal/ bright/ OFF
backlight automatically turns OFF after 30s if no keys used
LIGHT + right arrow…....Increase display contrast
LIGHT + left arrow.…....Decrease display contrast
ARROW keys……....Move cursor and select parameters
ENTER….. ……....Starts test procedures, confirmation of selected items
SAVE……....Memorizing Autotest results
LCD……....Graphic display with backlight, 320x240 dots
CHARGER INPUT…….....To connect the charger/power supply

2.2.1.2 Connector panel

1. Baseline interface connector
2. Audio jack: Microphone input
3. Audio jack: Phone output
4. RS232 connector
5. USB connector



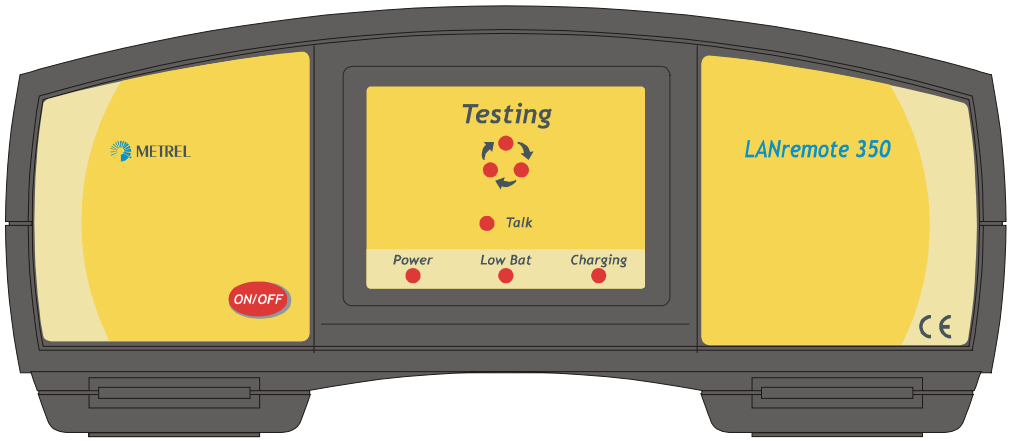
2.2.1.3 Bottom



Bottom View Layout

1. Nylon strap (allows the instrument to be slung round the neck)
2. Plastic cover (fixes nylon strap to the instrument). There is a screw under this cover which needs to be unscrewed when opening the instrument for service and calibration purposes.
3. Screw (unscrew to remove carrying strip or to open the instrument)
4. Information label
5. Battery compartment cover
6. Retaining screw (unsrew to replace batteries)
7. Rubber foot

2.2.2 Remote unit MultiLAN 350 RU



Front panel keypad

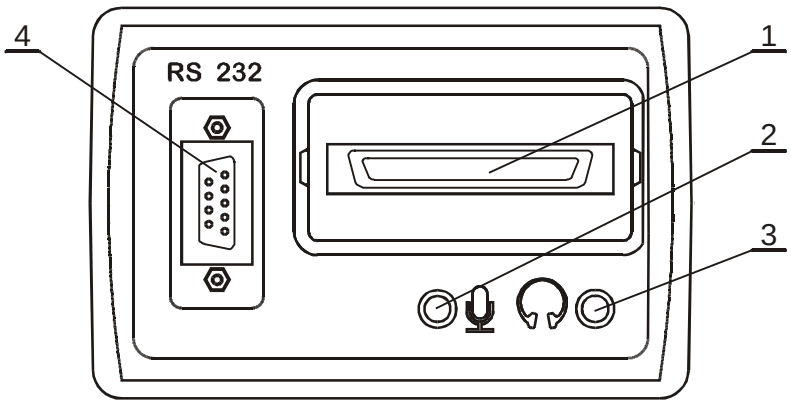
ON/OFF…. ……To turn the instrument on or off (Auto off after 10 minutes)

Meaning of LEDs

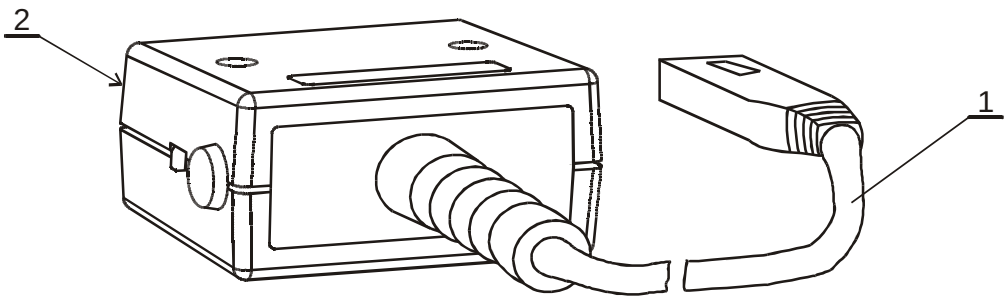
TESTING ……On: testing in progress
TALK ….....……..On: talk & trace mode
POWER ……...…On: Power on
LOW BAT……Empty battery
PASS…….....Autotest passed
FAIL…….....Autotest failed

2.2.2.1 Remote unit connector panel

1. Baseline interface connector
2. Audio jack: Microphone input
3. Audio jack: Phone output
4. RS232 connector

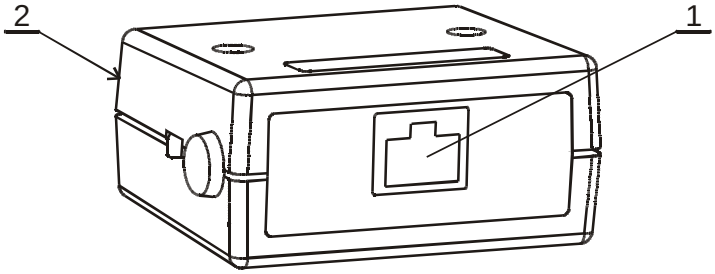


2.2.3 Permanent Link adapter



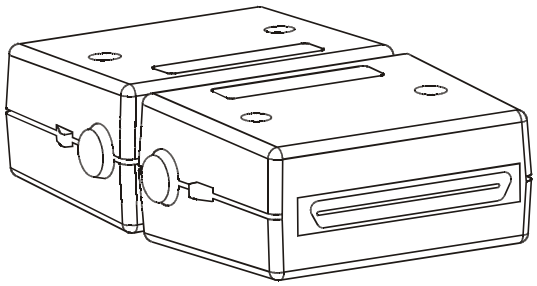
1. High performance CAT6 RJ45 plug
2. Baseline interface plug

2.2.4 Channel Link adapter

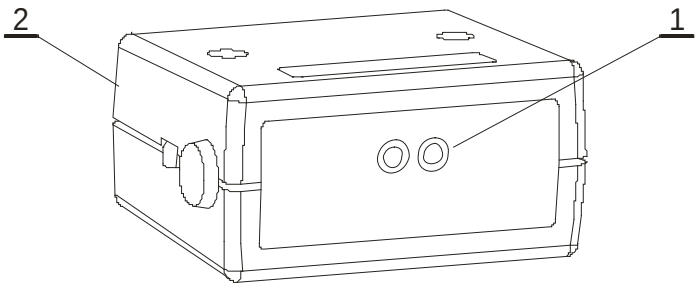


1. High Quality CAT6 RJ45 jack
2. Baseline interface plug

2.2.5 ATTENUATION Calibration module



2.2.6 IR adapter for testing fiber cables



1. IR receiver
2. Baseline interface plug

3 Specifications

3.1 Standard set (Ordering code MI 2016 ST)

Instrument MultiLAN 350
Remote unit MultiLAN 350 RU
Permanent Link Adapter, 2 pcs
Channel Link Adapter, 2 pcs
Carrying bag 2 pcs
LANlink PC Software
RS 232 cable
USB cable
User Manual
Locator set I (#1.-.#4)
Attenuation Calibration module
Power supply / adapter
Headphones set, 2 pcs
NiMH battery pack 12 pcs

3.2 Professional set (Ordering code MI 2016 PS)

Instrument MultiLAN 350, 2 pcs
Permanent Link Adapter, 2 pcs
Channel Link Adapter, 2 pcs
Carrying bag 2 pcs
LANlink PC Software
RS 232 cable
USB cable
User Manual
Locator set I (#1.-.#4)
Attenuation Calibration module
Power supply / adapter, 2 pcs
Headphones set, 2 pcs
NiMH battery pack 12 pcs

3.3 Optional accessories

	Ordering code:
Power supply / adapter	***A 1135***
NiMH battery pack	***S 2019***
Locator set II (#5.-.#16)	***A 1043***
Locator set III (#17.-.#28)	***A 1044***
MultiLAN350 Field Calibration set	***S 2018***
Battery cell charger with 6 NiMH batteries	***A1148***

3.4 Technical specifications

Performance of reference plane of the baseline interface:
conforms to TIA/EIA-568-B.2-1-2002 requirements (Annex B, table B.1), view Appendix A

Performance of reference plane of the permanent link adapter:
conforms to TIA/EIA-568-B.2-1-2002 requirements (Annex B, table B.2), view Appendix A

Performance of reference plane of the channel adapter:
conforms to TIA/EIA-568-B.2-1-2002 requirements (Annex B, table B.3), view Appendix A

Summary reporting results
conforms to TIA/EIA-568-B.2-1-2002 requirements (Annex B, table I.1), view chapter 5.2

3.4.1 Length

Range	Resolution	Accuracy
0.0 - 99.9 m 100 – 300 m	0.1 m	±(3 % of reading + 5dig) ±(4 % of reading)

Propagation velocity rate	0.50c - 0.99c considers set value in STANDARD main menu

Additional error sources that must be considered:
Uncertainity of NVP (nominal propagation speed)
Pulse attenuation and widening at high frequencies effects the accuracy at long distances (over 100 m).

3.4.2 Propagation Delay

Range	Resolution	Accuracy
0 – 500 ns 501 – 4000 ns	1 ns 1 ns	±(3 % of reading + 5 dig) ±(3 % of reading)

3.4.3 Delay skew

Range	Resolution	Accuracy
0 – 500ns	1ns	±(10dig)

3.4.4 Characteristic Impedance

Range	Resolution	Accuracy
35 – 180 Ω	1 Ω	±(10 % + 3 dig)

The test can be run only on cables longer then 5 m.

3.4.5 DC Resistance

Range	Resolution	Accuracy
0.0 – 199.9 Ω	0.1 Ω	±(10 % + 5 dig)

3.4.6 Attenuation

Frequency Range	Resolution	Accuracy
1 MHz – 250 MHz	1 MHz	better than calculated accuracy model (TIA/EIA 568-B.2) Perm. Link Channel < ±1.3 dB ±1.4 dB at 100 MHz < ±2.2 dB ±2.5 dB at 250 MHz
Amplitude Range		
0 – 60 dB	0.1 dB	defined up to 3 dB over category 6 limit

3.4.7 NEXT, Remote NEXT

Frequency Range	Resolution	Accuracy
1 MHz – 350 MHz	0.15 MHz	better than calculated accuracy model (TIA/EIA 568-B.2) Perm. Link Channel < ±2.0 dB ±2.9 dB at 100 MHz < ±3.3 dB ±4.2 dB at 250 MHz
Measuring Range		
0.0 – 90.0 dB	0.1 dB	defined up to 3 dB over category 6 limit, 65 dB max

3.4.8 PSNEXT, Remote PSNEXT

Frequency Range	Resolution	Accuracy
1 MHz – 350 MHz	0.15 MHz	better than calculated accuracy model (TIA/EIA 568-B.2) Perm. Link Channel < ±2.2 dB ±3.3 dB at 100 MHz < ±3.2 dB ±4.3 dB at 250 MHz
Measuring Range		
0.0 – 90.0 dB	0.1 dB	defined up to 3 dB over category 6 limit, 62 dB max

3.4.9 ELFEXT, Remote ELFEXT

Frequency Range	Resolution	Accuracy
1 MHz – 350 MHz	0.15 MHz	better than calculated accuracy model (TIA/EIA 568-B.2) Perm. Link Channel < ±2.1 dB ±3.2 dB at 100 MHz < ±3.7 dB ±4.7 dB at 250 MHz
Measuring Range		
0.0 – 90.0 dB	0.1dB	defined up to 3 dB over category 6 limit, 65 dB max

3.4.10 PSELFEXT

Frequency Range	Resolution	Accuracy
1 MHz – 350 MHz	0.15 MHz	better than calculated accuracy model (TIA/EIA 568-B.2) Perm. Link Channel < ±2.1 dB ±3.6 dB at 100 MHz < ±3.7 dB ±4.8 dB at 250 MHz
Measuring Range		
0.0 – 70.0 dB	0.1 dB	defined up to 3 dB over category 6 limit, 62 dB max

3.4.11 Return Loss, Remote Return Loss

Frequency Range	Resolution	Accuracy
1 MHz – 350 MHz	0.15 MHz	better than calculated accuracy model (TIA/EIA 568-B.2) Perm. Link Channel < ±3.5 dB ±2.8 dB at 100 MHz < ±4.2 dB ±4.8 dB at 250 MHz
Measuring Range		
0.0 – 40.0 dB	0.1 dB	3 dB over test limit, 23 dB max

3.4.12 ACR, Remote ACR

ACR is computed from NEXT and Attenuation results.

ACR (f) = NEXT (f) - Attenuation (f)

The accuracy is calculated from the NEXT and Attenuation accuracies.

3.4.13 PSACR, Remote PSACR

PSACR is computed from PSNEXT and Attenuation results.

PSACR (f) = PSNEXT (f) - Attenuation (f)

The accuracy is calculated from the NEXT and Attenuation accuracies.

3.4.14 TDR (Time Domain Reflectometer)

Distance Range/ Pulse length	Resolution (ns, m at NVP=0.69 c)	Distance Accuracy
0-10 (50, 100) m 0-200 m 0-400 m	1 ns, 0.1 m 2 ns, 0.2 m 4 ns, 0.4 m	±(3 % + 5 dig) ±(5 %) ±(5 %)
Amplitude Range	Resolution	Accuracy
in percents	1 %	not defined

Selectable propagation velocity rate	0.50c – 0.99c
Gain	autogain, 6 stages

Note:
Additional error sources that affect the distance measurements:
-Uncertainy of NVP (nominal propagation speed)
-Attenuation at high frequencies dramatically influences the accuracy at long distances (over 200m).
-Accuracy of distance is defined only on cable opens or shorts.
-Percentage of amplitude is scaled to nominal pulse amplitude into 100Ω (100%).

3.4.15 Time Domain Crosstalk

Distance Range/Pulse length	Resolution	Distance Accuracy
0-10 (50,100) m 0-200 m	1 ns, 0.1 m 20 ns, 0.2 m	±(3 % + 5 dig) ±(5 %)
Amplitude Range	Resolution	Accuracy
in percents	0.1 %	not defined

Selectable propagation velocity rate	0.50c – 0.99c
Gain	autogain, 6 stages

Note:
Additional error sources that affect the distance measurements:
Uncertainty of NVP (nominal propagation speed)
Attenuation at high frequencies influences the accuracy at longer distances.
-Percentage amplitude is scaled to nominal pulse amplitude into 100 Ω (100 %).

Note:
All specifications for tests apply to cable with characteristic impedance of 100 Ω and at the temperature of 25 °C. In case the instrument is moistened, it must be dried at least 2 hours before use.
Accuracy is defined in the frequency range given from 1 MHz – 250 MHz). Because of simplicity the accuracy of Attenuation, NEXT, ELFEXT and Return Loss accuracy is given only at 100 MHz and 250 MHz. Contact the manufacturer for more detailed information.

4 General specifications

4.1 General Data

Instrument MultiLAN 350

Autotest time:	55 sec, standard CAT6 test
Display:	LCD Graphic type, 320 x 240 dots, EL backlight
Memory: 500 Autotests typical	Copper and/or fiber
Operating temperature range:	5 °C ÷ 40 °C (intrinsic accuracy is specified at 25 °C)
Storage temperature range:	0 °C ÷ 70 °C
Relative humidity:	85 % up to 40 °C declining to 70 % up at 45 °C non condensing
Pollution degree:	2
Protection degree:	IP40
Power supply main unit:	6 x 1.5 NiMH type C rechargeable batteries
Charger/External supply input:	12 V – 15 V,
Charging time:	12 hours
Typical battery life:	8 hours
Memory backup:	unlimited
Communication:	RS232 serial interface for connection to a PC. Selectable 2400 -115200 baud. 9 pin D connector. USB connection to a PC.

Auto Off time: 10 min

Remote Unit MultiLAN 350 RU

Operating temperature range:	5 °C ÷ 40 °C
Storage temperature range:	0 °C ÷ 70 °C
Relative humidity:	85 % up to 40 °C declining to 70 % at 45 °C (non-condensing)
Pollution degree:	2
Protection degree:	IP40
Power supply:	6x1.5 LR14 alcaline or rechargeable batteries
Charger/External supply input:	12V – 15V
Charging time:	12 hours
Typical battery life (alkaline batteries):	15 hours
Communication:	RS232 serial interface for connection to a PC. Selectable 2400 - 115200 baud. 9 pin D connector.
Auto Off time:	10 min

Cable wiring standard: T568B

Pair 1:	wire 5, blue-white
	wire 4, blue
Pair 2:	wire 1,orange-white
	wire 2, orange
Pair 3:	wire 3, green-white
	wire 6, green
Pair 4:	wire 7,brown-white
	wire 8, brown

5 Multi LAN 350 Operation

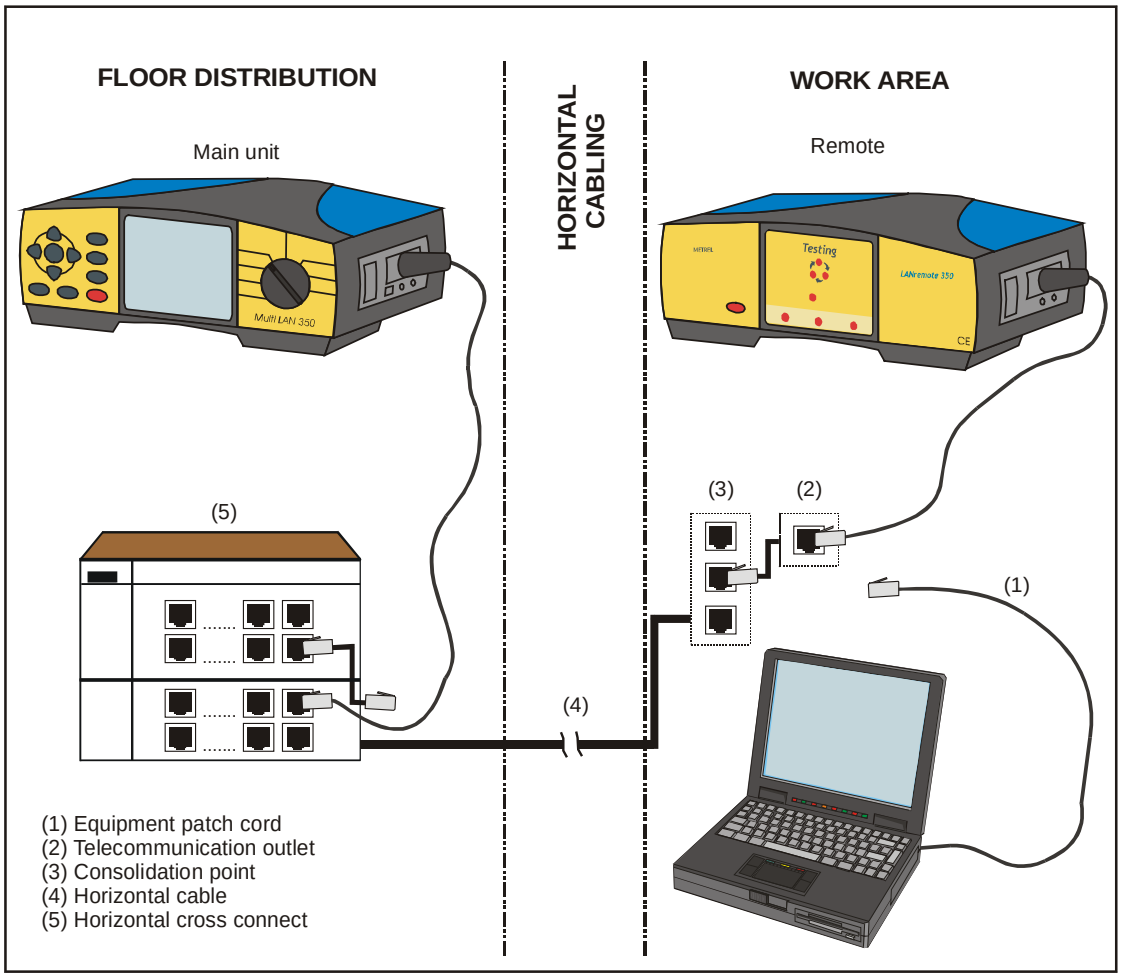
5.1 Test connections

5.1.1 Permanent link connection

Permanent Link connection is used when the fixed installed section of cabling is tested. On figure below, the network connection for a permanent link test can be seen. It consists of:

- one connection at the patch panel
- a horizontal cable segment (up to 90m long)
- a consolidation point (optional)
- connection at the telecommunications outlet.

The important feature is that in the Permanent link the test equipment cables don't influence the result.



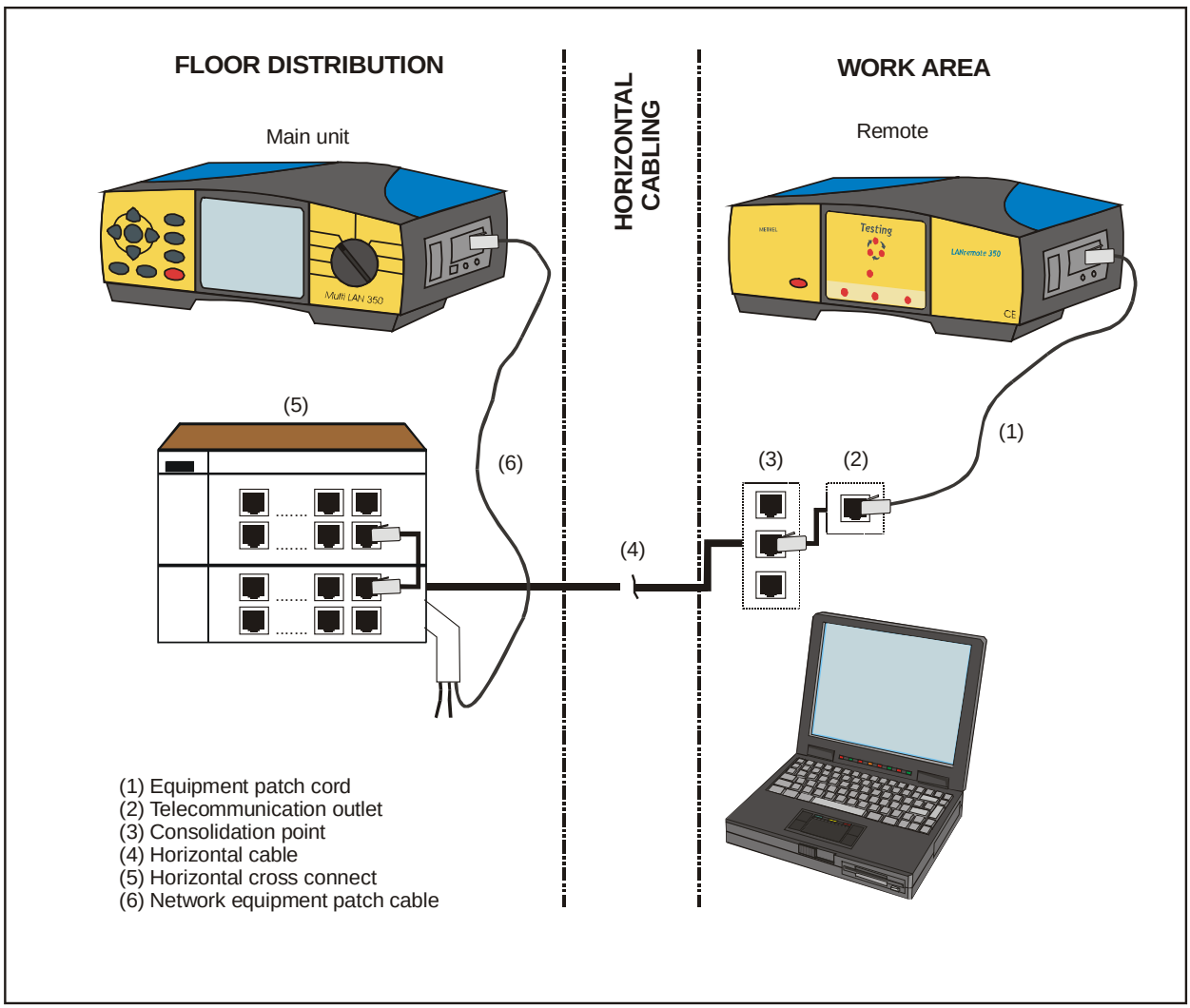
Maximal test connection for a Permanent Link

5.1.2 Channel connection

The Channel connection is used when performance of the complete cabling (including equipment patch cables) is tested.

On the figure below the maximum network connection can be seen. It consists of:
- Equipment patch cable to the horizontal cross connection point
- horizontal cross connection
- a horizontal cable segment (up to 90m long)
- up to 10m of equipment patch cables with transition connector and outlet connector

In the Channel test the network equipment patch cables influence the result therefore the test limits are looser than for the Permanent link configuration.



Maximal test connection for a Channel test

5.1.3 Basic link connection

Similar to Permanent Link the Basic Link connection is used when the fixed installed section of cabling is tested. When measuring basic link use reference (test equipment) patch cables together with the channel adapter.

This connection is no longer recognized in latest versions standards and can be replaced with a newer permanent link.

5.1.4 Optical fiber connection

Refer to with MultiLAN350 compatible Optical power meter User Manual to learn more about test connections and setups for testing fiber optic cables.

The results from the optical power meter can then be sent to MultiLAN350 that offers:

- comparison of results against limits in common LAN cable standards,
- storing measuring results into MultiLAN350 memory base,
- creating Test Reports with LANlink.

5.2 Presentation of results

5.2.1 Summary results - Copper cables

NEXT, PSNEXT, ELFEXT, RETURN LOSS, ATTENUATION, ACR, PSACR

Presentation as worst margin values with respect to the applied test limit

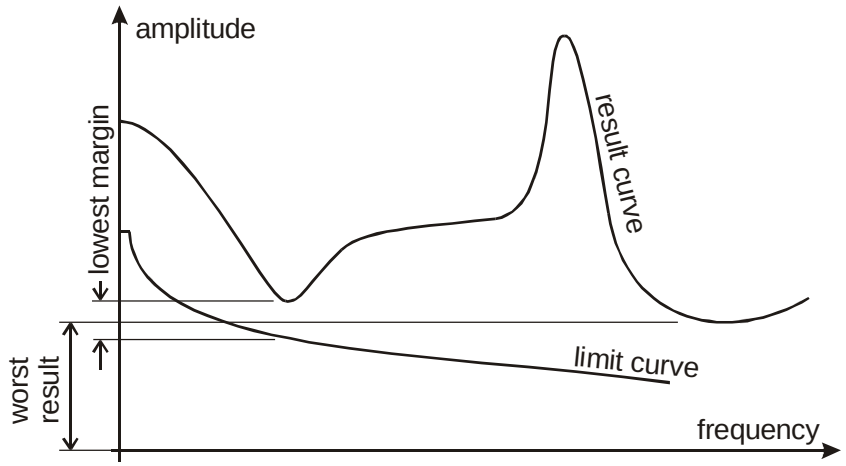
The result is presented as the worst case margin to the given limit together with the associated frequency, limit and pair. The worst pair (pair combination) is marked with a point.

Specialities
The worst case margin is not reported for attenuation.
The return loss margin is not relevant where attenuation is below 3 dB.

Presentation as worst result value

The result is presented as the worst measurement value, which may not necessarily come closest to the applied test limit. In Autotest the associated frequency, limit and pair are stored.

Speciality
The return loss result is not relevant where attenuation is below 3 dB.



Example for worst result and margin

Wire Map
All connections, including shield (if present) are shown.

Length
Cable length and test limit are shown.

Propagation Delay, Delay Skew, Resistance, Impedance
Results and test limit (if applied) are shown.

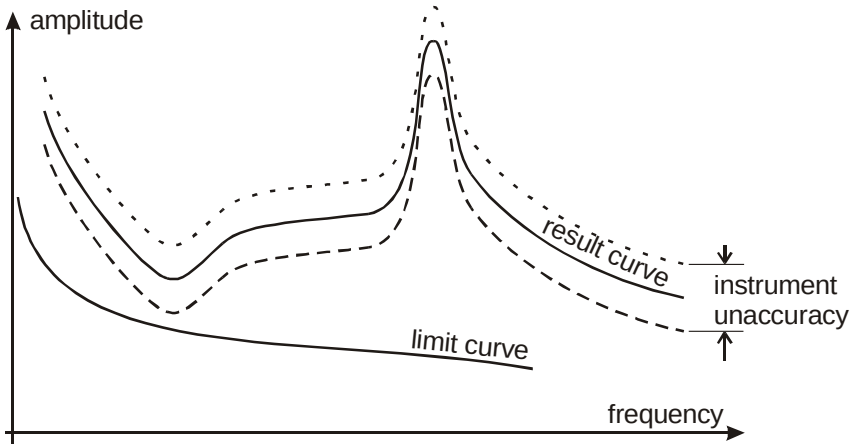
5.2.2 PASS / FAIL decistions

Individual PASS / FAIL
Each result is equipped with a Pass/Fail judgement that applies to a limit, limit curve or connectivity defined in the selected test standard. The worst result from all pairs or pair combinations (worst margin or worst result) is marked with a bullet in front of the result.

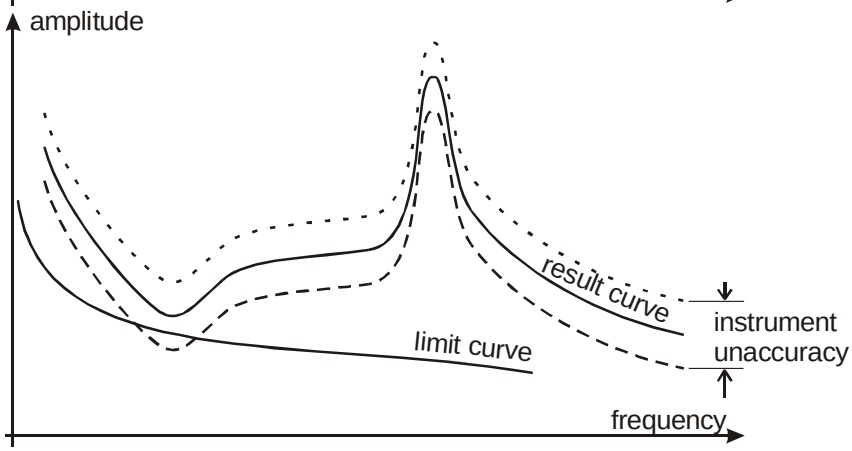
Overall PASS / FAIL in Single Test
Each Single Test is equipped with an overall Pass/Fail judgement (the marked result is considered for it).

Overall PASS / FAIL and Headroom in Autotest
At the end of Autotest an overall Pass/Fail (if all tests passed) result and Headroom are shown on the display. Headroom is the worst case margin in the NEXT test that can be used as a measure of the installation's condition when doing periodic inspections.

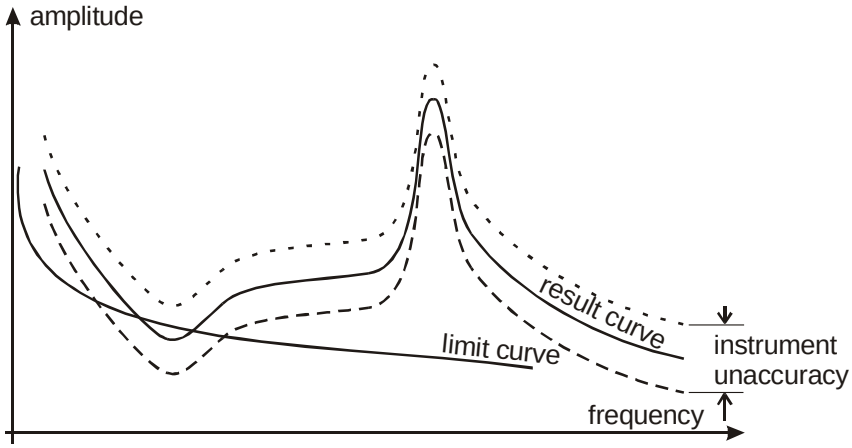
PASS /FAIL marked with an asterisk
When the measured results are close to the given test limit the accuracy of the instrument could lead to an irregular Pass/Fail judgment. Such Pass/Fail warnings are marked with an asterisk. In general it is recommended to treat such test results as failed.



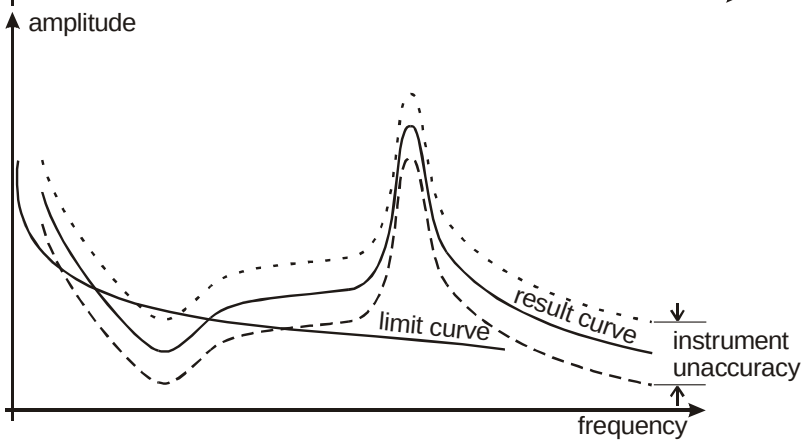
Result = PASS



Result = PASS*



Result = FAIL*



Result = FAIL

5.2.3 Detailed measuring results, information on plots and cursors

Plots
The resultant plots contain the measured results over the complete frequency range and the test limit curves if applied in the selected test standard. Plots can be shown individually or all at once for each test.

Vertical cursor (moves along frequency)
The margin and result values at cursor position value are shown under the graphs. If no limits are applied then only the actual test result is shown.
The cursor can be moved with Left/Right keys).
Initially the cursor points to the frequency where the worst margin or result occures.

Horizontal cursor (moves along amplitude scale)
The horizontal cursor is useful when comparing measurement results against a predetermined amplitude result.
The cursor can be moved with Up/Down keys.

Note on saving detailed test results
Only summary results are saved when memorizing an Autotest. The plots are temporarily stored in a reservised part of the memory and can be downloaded to a PC untill data from a new Autotest or Single Test overrun them.

5.2.4 Summary result - Optical fiber

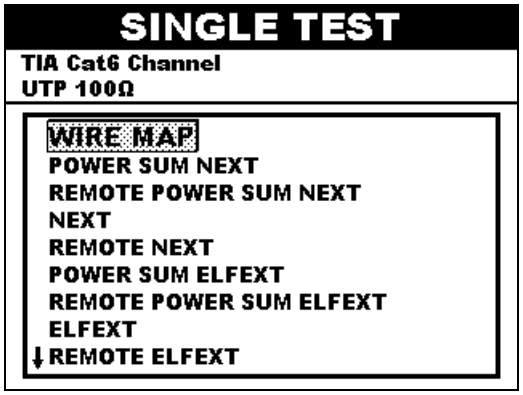
OPTICAL INSERTION LOSS
The actual measured value is displayed as a result.

Individual PASS / FAIL
Each of the eight results is equipped with a Pass/Fail judgement that applies to the limit defined in selected test standard. The worst result is considered in the Headroom result.

Overall PASS / FAIL and Headroom in Autotest
Overall Pass/ Fail result and Headroom are shown on the display. Headroom is shown as the margin to the applied limit of the worst individual result. Headroom can be used as a measure of the installation condition when doing periodic inspections.
Example:
Worst result = 7.19dB Limit = 5.23dB **Headroom = 1.96dB**

5.3 Single test

In Single Test Menu individual tests can be run. This is especially helpful if we suspect faults in the tested wiring. The Main Single Test Screen is shown below. The selected Test Standard and Cable Type are shown in the upper display part. Individual measurements can be selected by using Up or Down key and started with ENTER.
The limits defined for the selected Cable Type and Test Standard are used for Pass/Fail decisions.



Main Single Test Screen

5.3.1 Wire map

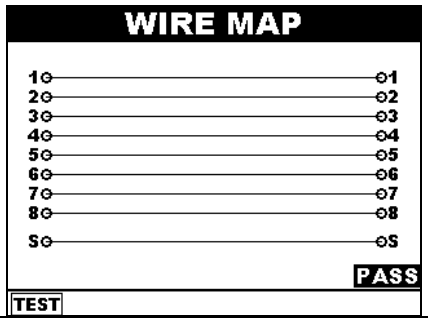
Wire Map test verifies the pin to pin wiring and shield continuity. Shield wiring is not considered in pass/fail decision if UTP cable is selected in Cable Type Menu.

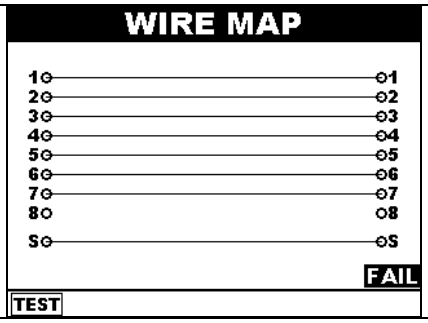
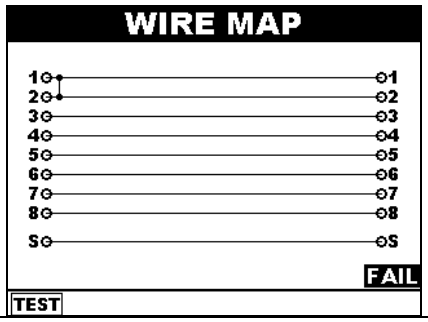
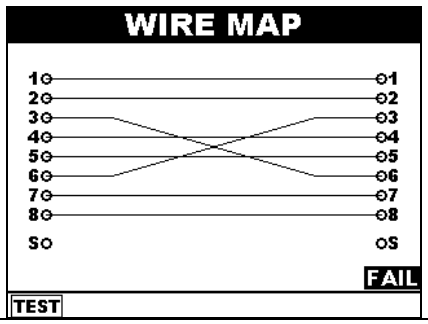
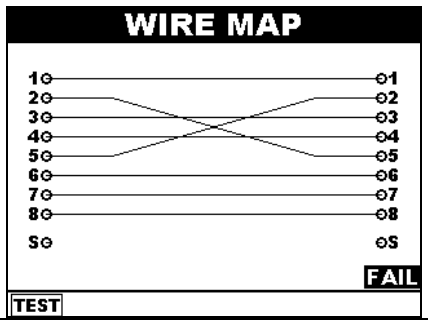
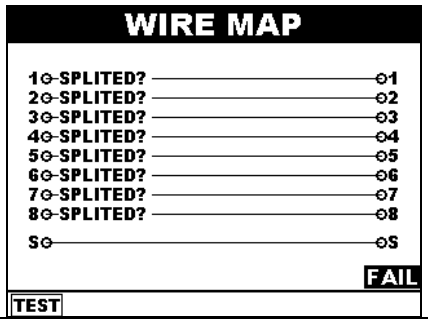
Test procedure:

Make sure that the Remote unit is connected on the other side of the cable.
Select and start the Wire Map test. After the main unit is connected with the Remote unit and the test is finished, the result is shown on the display together with an overall Pass/Fail decision. Following actions can now be performed:

ESC key: return to Single Test main screen
TEST: repeat the test.
REPEAT: the Wire Map test is performed continuously.
This enables the operator to find faults like bad contacts or broken wires.
The test can be stopped by using STOP key.

The following table presents different correct and incorrect wirings. Anyl connection fault can be found with Multi LAN 350. If a fault is found a FAIL warning appears on the screen.

Condition	Example	Display example
Correct wiring	Wires and shield are connected properly.	
Open	Wire 1 and shield are open.	

		
Short	Wire 1 and 2 are shorted.	
Reversed pair	Wires 3 and 6 are reversed.	
Crossed wires	Wire 2 in channel 2 is crossed with wire 5 in channel 1	
Split pairs	Split pair occurs if a wire from one pair is mistakenly twisted with a wire from an other pair. If the crosstalk between two pairs is extraordinarily high the instrument warns that the split pairs could be the reason.	

Note:
Split pairs cannot be found with simple continuity checks. They are detected with a simplified NEXT measurement. The reason for high crosstalk is not necessarily a split pair- unsuitable and careless assembled connectors or cable faults can also cause a

split pair warning. The real error source can be easily defined with the TDCross function.
The point of error can be easily found by using the TDR function.
At least one pair must be connected properly to assure correct operation of the instrument.

Wire Map test without using the Remote unit

If the Remote unit is not detected on the far cable end within 1 second, the instrument proceeds with the test (NO REMOTE is displayed). The following can be found:

Far cable end open	**Far cable end terminated**
- broken wire before the cable end - short between two wires, short to shield - crossed wire - split pair - cable length	- broken wire - short between two wires, short to shield - split pair - crossed wire

This feature is very helpful when performing fast checks when installing the wiring since most frequent faults can be detected by only one user, without the remote unit on the far cable end.

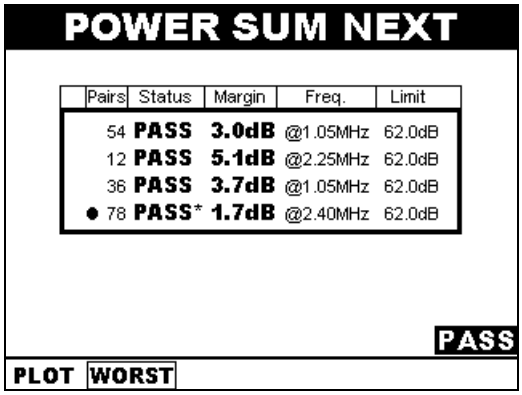
5.3.2 PSNEXT, Remote PSNEXT

PSNEXT (Power Sum Near End Crosstalk) defines the coupling on one cable pair from all other pairs. The PSNEXT is calculated from individual NEXT results and represents the expected worst case coupling. Similar to NEXT the coupled signal from other pairs can cause data corruption, retransmittions and other problems. This is especially critical in multipair data protocols.
The main result is given as the worst case margin in dB to the test standard limit.

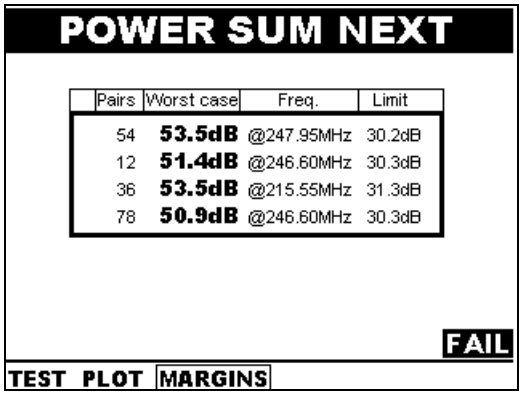
Test procedure:

Make sure that the Remote unit is connected on the far end of the cable.
Select and run the PSNEXT test. After the main unit is connected with the Remote unit and the test is finished, the worst PSNEXT results are shown on the display. The following actions can now be performed:

ESC key:	return to Single Test main screen
TEST:	repeat the test.
PLOT:	select PSNEXT Plot screens
WORST:	select worst case result screen
MARGINS:	select margin result screen



PSNEXT margin result screen



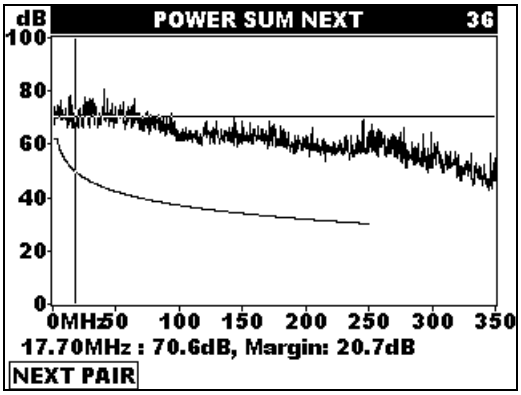
PSNEXT worst case result screen

Note: if no remote is detected then the instrument continues testing after 1s. In this case the operator must ensure a proper termination.

PSNEXT PLOT screen

After entering this screen individual or all PSNEX plots together with test standard limit curve are shown on the display. Margin and result at the cursor position are displayed under the graph.
The following actions can now be performed:

ESC key:	return to PSNEXT result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency
Up, Down key:	move cursor up and down along the amplitude axis



PSNEXT plot screen

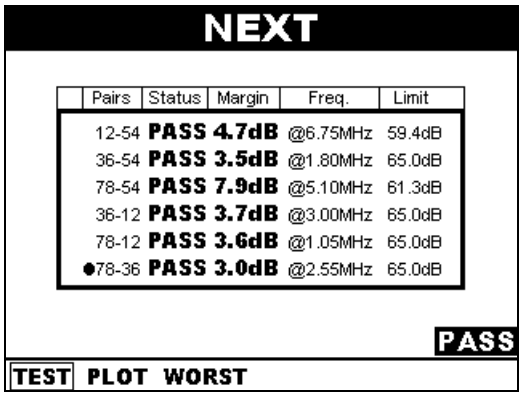
5.3.3 NEXT, Remote NEXT

NEXT (near end crosstalk) defines the coupling between adjacent pairs. High level signals transmitted in one pair on a cable end can induce a substantial disturbance signal in the neighbouring pairs, on the same (transmitter) side. This signal added to the signals transmitted from the other cable can cause data corruption, retransmittions and other problems. The most common causes for NEXT problems are poor twisting on connector points, non matched connection components, split pairs etc.
The main result is given as the worst case margin in dB to the test standard limit.

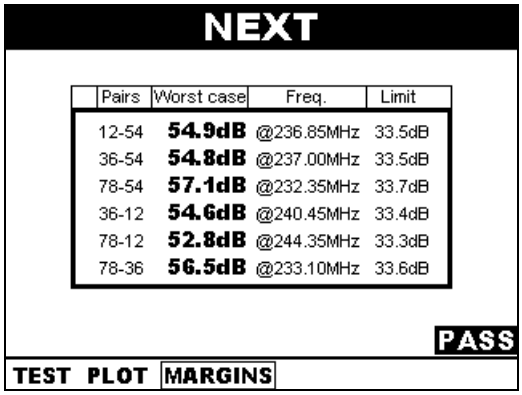
Test procedure:

Make sure that the Remote unit is connected on the far end of the cable.
Select and run the NEXT test. After the main unit is connected with the Remote unit and the test is finished, the NEXT results are shown on the display. The following actions can now be performed:

ESC key:	return to Single Test main screen
TEST:	repeat the test.
PLOT:	select NEXT Plot screen
WORST:	select worst case result screen
MARGINS:	select margin result screen



NEXT margin result screen



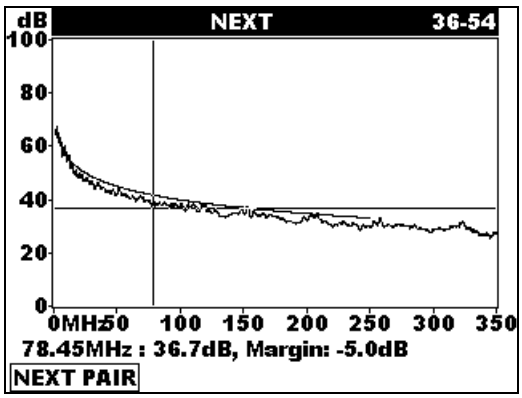
NEXT worst case result screen

Note: if no remote is detected, then the instrument continues testing after 1s. In this case the operator must ensure a proper termination.

NEXT PLOT screen

After entering this screen individual or all NEXT (frequency) plots together with test standard limit curve are shown on the display. Margin and NEXT at the cursor position are displayed under the graph.
The following actions can now be performed:

ESC key:	return to NEXT result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency
Up, Down key:	move cursor up and down along the amplitude axis



NEXT plot screen

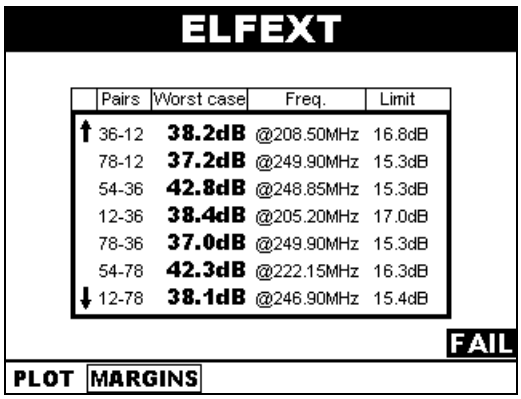
5.3.4 ELFEXT, Remote ELFEXT

FEXT (Far End Crosstalk) defines crosstalk caused by the coupling of a signal from a pair transmitted on one cable side into an adjacent pair with the receiver on the other side.
ELFEXT (Equivalent Level Far End Crosstalk) is calculated from FEXT and the attenuation on the receiver pair.
The main result is given as the worst case margin in dB to the test standard limit. High ELFEXT causes typical crosstalk problems: data corruption, retransmittions etc.

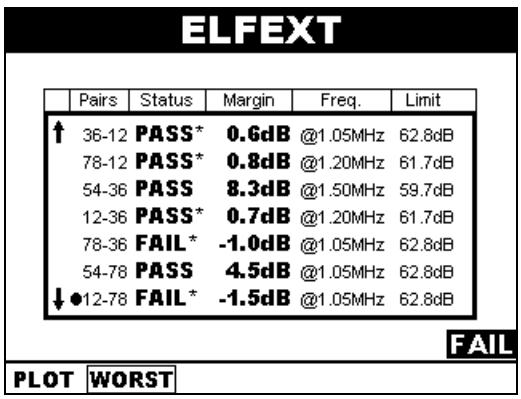
Test procedure:

Make sure that the Remote unit is connected on the far end of the cable.
Select and run the ELFEXT test. After the main unit is connected with the Remote unit and the test is completed, all twelve ELFEXT results and an overall Pass/Fail decision are shown on the display. The following actions can now be performed:

ESC:	return to Single Test main screen
TEST:	repeat the test.
PLOT:	select ELFEXT Plot screen
WORST:	select worst case result screen
MARGINS:	select margin result screen
Up, Down:	view other pairs



ELFEXT margin result screen



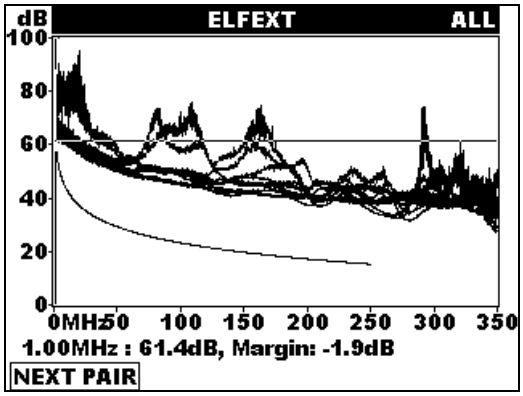
ELFEXT worst case result screen

Note: The ELFEXT measurement can't be performed without the remote unit.

ELFEXT PLOT screen

After entering this screen individual or all ELFEXT (frequency) plots together with the test standard limit curve are shown on the display. Margin and result at the cursor position are displayed under the graph.
The following actions can now be performed:

ESC key:	return to ELFEXT result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency
Up, Down key:	move cursor up and down along the amplitude axis.



ELFEXT plot screen

5.3.5 PSELFEXT, Remote PSELFEXT

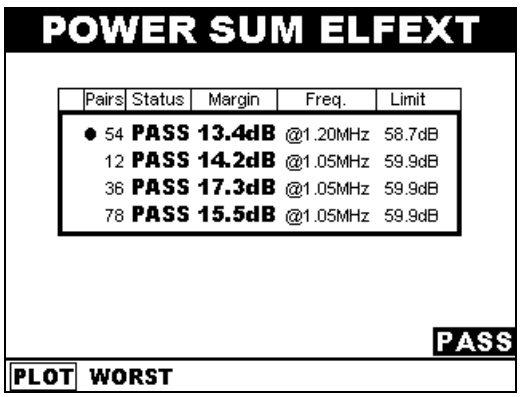
PSFEXT (Power Sum Far End Crosstalk) defines crosstalk caused by the coupling of signals into a cable pair from other pairs. The receiver of crosstalk signals is on one cable side and the transmitters on the other cable side on another pair. The main result is given in dB as ate worst case margin to the test standard limit.

PSELFEXT (Power Sum Equivalent Level Far End Crosstalk) is calculated from PSFEXT and the attenuation on the receiver pair.
High PSELFEXTs cause typical crosstalk problems: data corruption, retransmittions etc. The main result is given in dB as the worst case margin to the test standard limit.

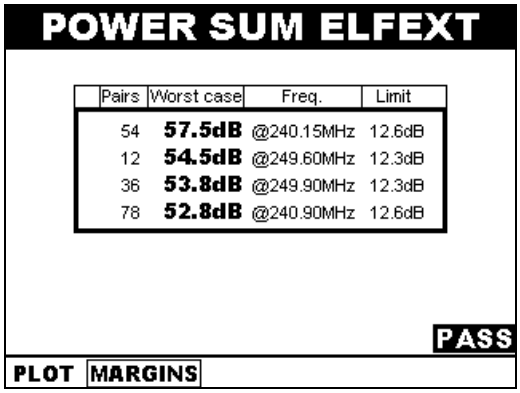
Test procedure:

Make sure that the Remote unit is connected on the far end of the cable.
Select and run the PSELFEXT test. After the Remote unit is connected and the test is completed, all nine ELFEXT results and an overall Pass/Fail decision are shown on the display. The following actions can now be performed:

ESC key:	return to Single Test main screen
TEST:	repeat the test
PLOT:	select PSELFEXT Plot screen
WORST:	select worst case result screen
MARGINS:	select margin result screen



PSELFEXT margin result screen



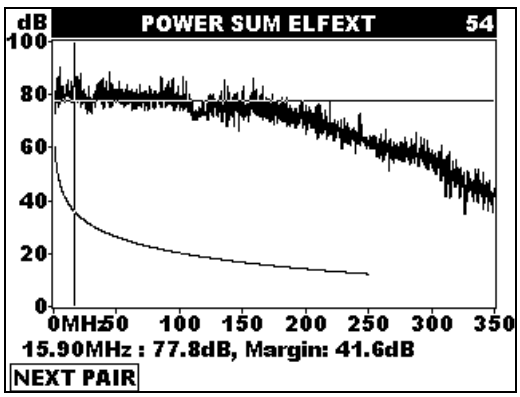
PSELFEXT worst case result screen

Note: The PSELFEXT measurement can't be performed without the remote unit.

PSELFEXT PLOT screen

After entering this screen individual or all PSELFEXT (frequency) plots together with the test standard limit curve are shown on the display. Margin and result at the cursor position are displayed under the graph.
The following actions can now be performed:

ESC key:	return to PSELFEXT result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency.
Up, Down key:	move cursor up and down along the amplitude axis.



PSELFEXT plot screen

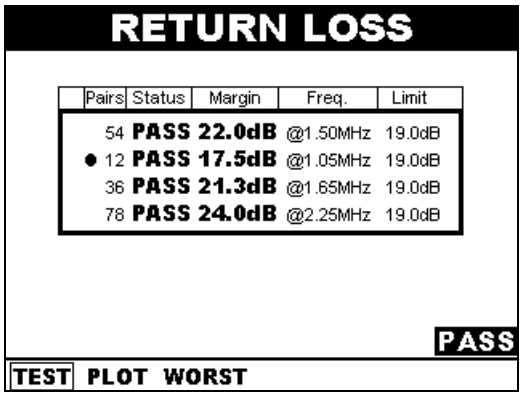
5.3.6 RETURN LOSS, Remote RETURN LOSS

Return loss is the ratio between transmitted and reflected signals at the transmission end. High return loss rates are often caused by local impedance mismatching and decrease the signal strength on the receiver end.
The main result is given in dB as the worst case margin to the test standard limit.

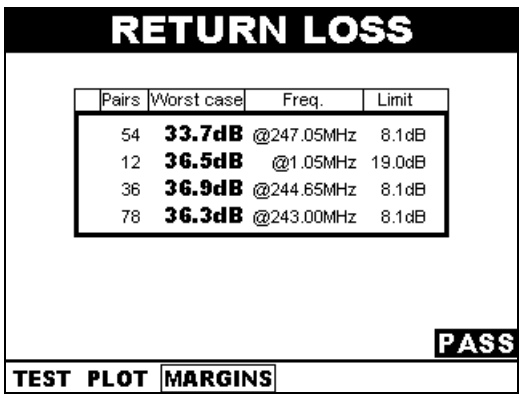
Test procedure:
Make sure that the Remote unit is connected on the far end of the cable.
Select and run the Return Loss test. After the Remote unit is connected and the tests are completed, all four Return Loss results and an overall Pass/Fail decision are shown on the display. The following actions can now be performed:

Make sure that the Remote unit is connected on the far end of the cable.

ESC key:	return to Single Test main screen
TEST:	repeat the test
PLOT:	select Return Loss PLOT screen
WORST:	select worst case result screen
MARGINS:	select margin result screen



Return Loss margin result screen



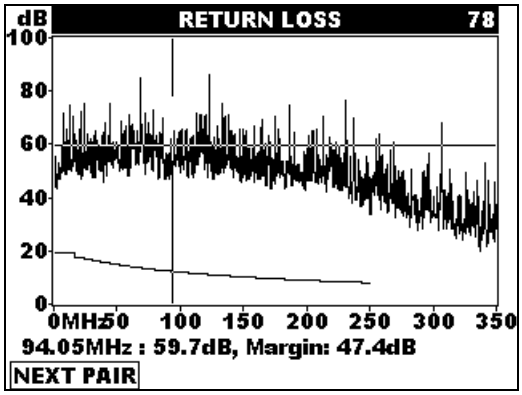
Return Loss worst case screen

Note: The Return Loss measurement can't be performed without the remote unit.

Return Loss PLOT screen

After entering this screen individual or all Return Loss (frequency) plots together with the test standard limit curve are shown on the display. Margin and result at the cursor position are displayed under the graph.
The following actions can now be performed:

ESC key:	return to Return Loss result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency.
Up, Down key:	move cursor up and down along the amplitude axis.



Return Loss plot screen

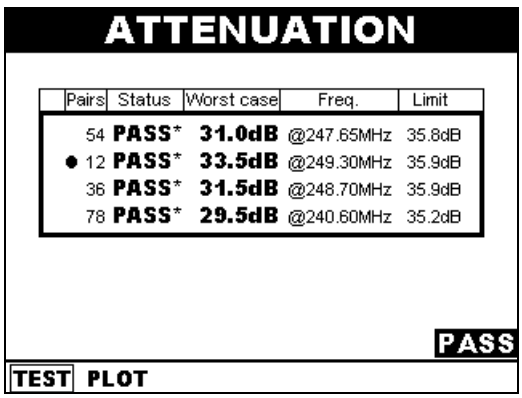
5.3.7 Attenuation

Attenuation is the measured loss of signal strength in a pair from one cable end to the other. It increases with frequency and cable length so it has to be measured over the complete frequency range. Attenuation is one of the main cable parameters that dramatically influences the maximum bit rate of data stream allowed. The main result is given as the worst case value in dB.

Test procedure:

Make sure that the Remote unit is connected on the other end of the cable.
Select and start the Attenuation test. After the Remote unit is connected and the test is completed, all four attenuation results and an overall Pass/Fail decision are shown on the display. The following actions can now be performed:

ESC key: return to Single Test main screen
TEST: repeat the test.
PLOT: select Attenuation Plot screen
WORST: Select worst case result screen



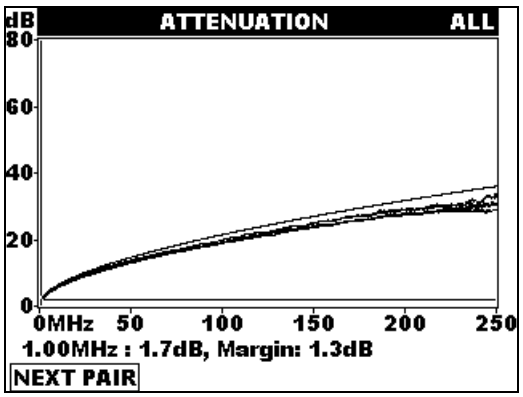
Attenuation worst case result screen

Note: The Attenuation measurement can't be performed without the remote unit.
Attenuation PLOT screen

After entering this screen individual or all Attenuation (frequency) plots together with the test standard limit curve are shown on the display. Margin and result at the cursor position are displayed under the graph.

The following actions can now be performed:

ESC key:	return to Attenuation result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency
Up, Down key:	move cursor up and down along the amplitude axis.



Attenuation plot screen

5.3.8 PSACR, Remote PSACR

PSACR (Attenuation to crosstalk ratio) is a comparison of the attenuated regular signal and disturbing crosstalk signals from other pairs on the receiver side. PSACR is computed from Attenuation and PSNEXT.

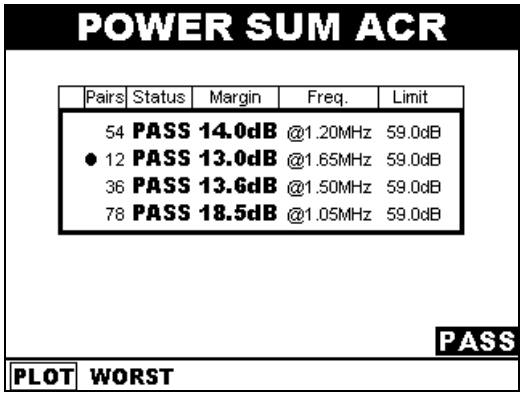
PSACR(f) = PSNEXT(f) - Attenuation(f)

PSACR results consider Attenuation and PSNEXT. It is taken in account that at shorter cables the PSNEXT could be higher without degradation of the link performance. Therefore it is very suitable for the estimation whether the crosstalks are critical or not.

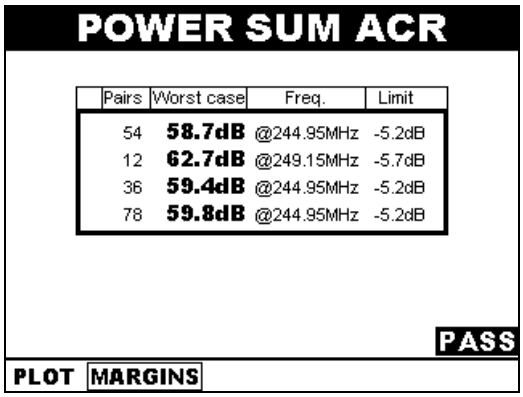
Test procedure:

Make sure that the Remote unit is connected on the far end of the cable.
Select and start the PSACR test. After the Remote unit is connected the test is completed, all four PSACR results together with an overall Pass/Fail decision are shown on the display. The following actions can now be performed:

ESC key:	return to Single Test main screen
TEST:	repeat the test
PLOT:	select PSACR Plot screen



PSACR margin results screen



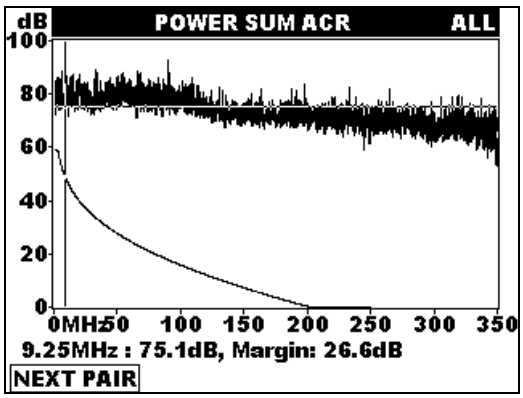
PSACR worst case results screen

Note: The PSACR measurement can't be performed without the remote unit.

PSACR PLOT screen

After entering this screen individual or all PACR (frequency) plots together with test standard limit curve are shown on the display. Margin and result at the cursor position are displayed under the graph.
The following actions can now be performed:

ESC key:	return to PSACR result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency
Up, Down key:	move cursor up and down along the amplitude axis



PSACR plot screen

5.3.9 ACR, Remote ACR

ACR (Attenuation to crosstalk ratio) is a comparison of the attenuated regular signal and disturbing crosstalk signals on the receiver side. High ACR values indicate a high performance connection where the crosstalk levels are small in comparison with attenuation. ACR is computed from Attenuation and NEXT.

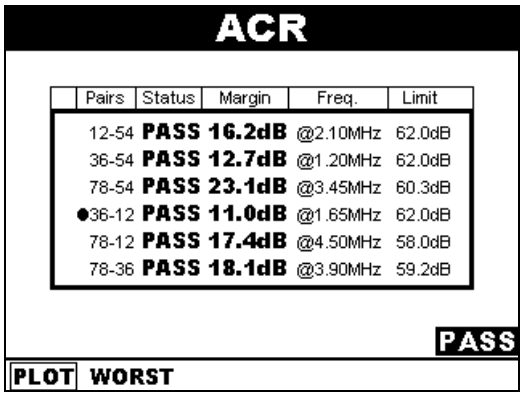
ACR(f) = NEXT(f) - Attenuation(f)

The ACR results consider Attenuation and NEXT. It is taken in account that at shorter cables the NEXT could be higher without degradation of the link performance. Therefore ACR is very suitable for the estimation whether the crosstalks are critical or not.

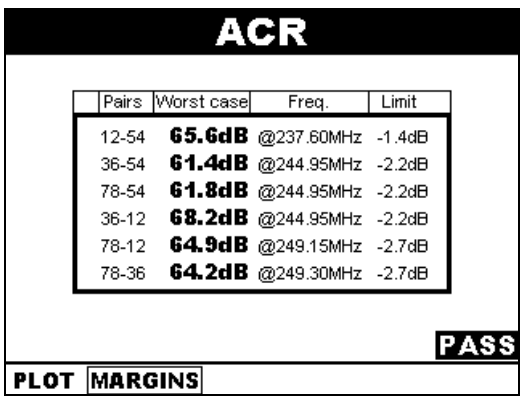
Test procedure:

Make sure that the Remote unit is connected on the far end of the cable.
Select and start the ACR test. After connecting with the Remote unit and completing the test, all six ACR results together with an overall Pass/Fail decision are shown on the display. The following actions can now be performed:

ESC key: return to Single Test main screen
TEST: repeat the test
PLOT: select ACR Plot screen



ACR margin result screen

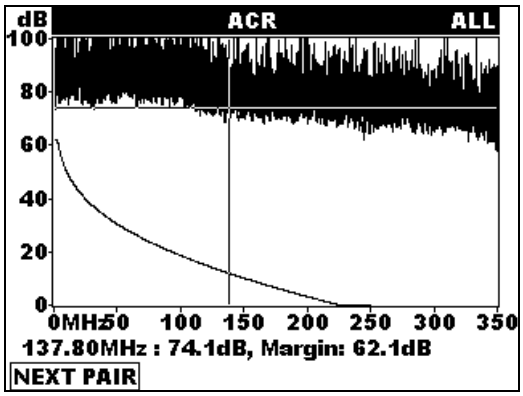


ACR worst case result screen

ACR PLOT screen

After entering this screen individual or all ACR (frequency) plots together with test standard limit curve are shown on the display. Margin and result at the cursor position are displayed under the graph.
The following actions can now be performed:

ESC key:	return to ACR result screen
NEXT PAIR:	view next plot
Left, Right key:	move cursor left and right to view margin and result at selected frequency
Up, Down key:	move cursor up and down along the amplitude axis



ACR plot screen

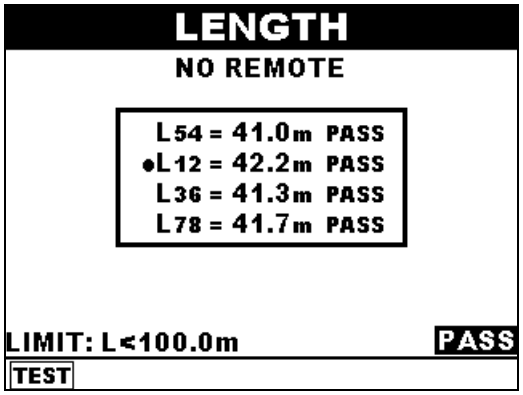
5.3.10 Length

The length test measures the length of each cable pair.

The cable length is determined from the time it takes for a pulse to travel along the cable. To get the right result the pulse propagation speed has to be known. The NVP factors can be set (nominal velocity propagation factor, given by percents of light speed) for cables in the Cable Type Menu. Since they aren't exactly defined from the manufacturer (variations can occur through ageing, different materials, temperature, number of twists etc) the length results are only indicative. The problem intensifies at longer lengths. Better results can be obtained with the Scope functions.
Test procedure:

Make sure that the Remote unit is connected on the other end of the cable.
Select and start the Length test. After connecting with the Remote unit and completion of the test, the lengths, Pass/Fail information and the applied limit are shown on the display. The following actions can now be performed:

ESC key:	return to Single Test main screen
TEST:	repeat the test.



Length result screen

Note: If no remote is detected, the instrument continues testing after 1s. In this case the operator must ensure that the cable end is opened or shorted.

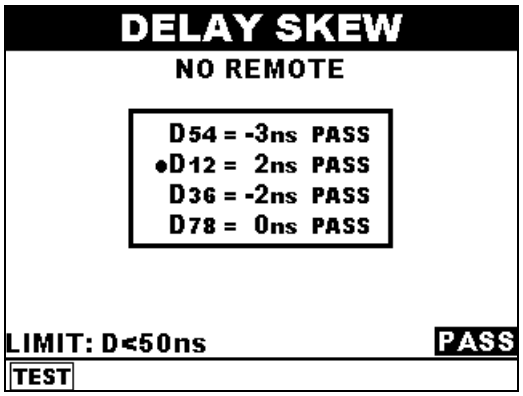
5.3.11 Delay Skew

Delay skew is the difference in propagation delays between test pulses through different cable pairs. The shortest delay is referenced to 0ns. High delay skews can cause trouble especially when fast multipair data protocols are used.

Test procedure

Make sure that the Remote unit is connected on the far end of the unit under test. Select and start the Delay skew test. After the Remote unit is connected and the test is completed, the results, Pass/Fail information and the applied limit are shown on the display. The following actions can now be performed:

ESC key: return to Single Test main screen
TEST: repeat the test.



Delay skew screen

Note: If no remote is detected, the instrument continues testing after 1s. In this case the operator must ensure that the cable end is opened or shorted.

5.3.12 Propagation Delay

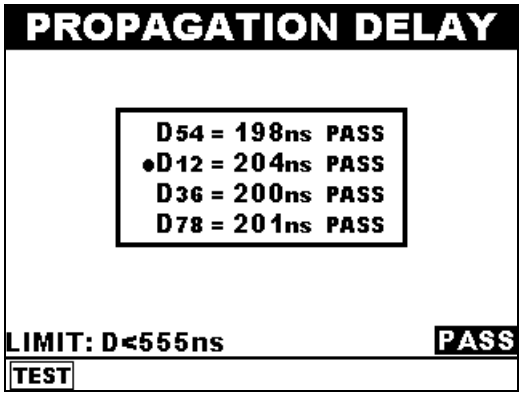
Propagation delay is the time it takes a test pulse to travel the length of each cable pair.

Test procedure

Make sure that the Remote unit is connected on the far end of the unit under test.

Select and run Propagation delay test. After the Remote unit is connected and the test is completed, the results, Pass/Fail information and limit are shown on the display. The following actions can now be performed:

ESC key: return to Single Test main screen
TEST: repeat the test.



Propagation delay result screen

Note: If no remote is detected, the instrument continues testing 1s after start button is pressed. In this case the operator must ensure that the cable end is open.

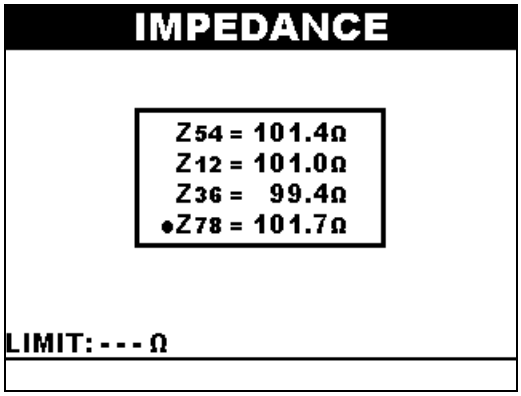
5.3.13 Impedance

Impedance is a characteristic of the cable. In general the characteristic impedances in high frequency systems must be matched to ensure a regular data flow.
Every change in impedance along the link will cause a reflection and decrease the signal strength on the receiver end.
A change in impedance can occur if using unproper cables, cable components or the cable is damaged.

Test procedure:

Make sure that the Remote unit is connected on the far end of the unit under test.
Select and run Impedance test. After the Remote unit is connected and the test is completed, the results, Pass/Fail information (if a limit is applied) and the limit are shown on the display. Following actions can now be performed:

ESC key: return to Single Test main screen
TEST: repeat the test.



Impedance result screen

Note: The instrument continues testing if no remote is detected within 1s. In this case the operator must ensure a proper cable termination.
The test can be run only on cables longer then 5m. A warning will be displayed in this case.

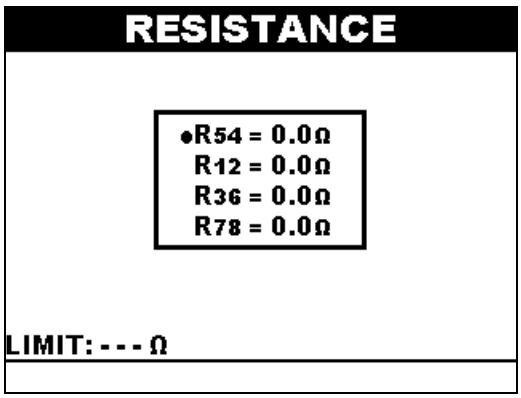
5.3.14 DC Resistance

DC resistance test verifies that the loop resistances (sum of resistances of both wires) in individual pairs are within the given limits.

Test procedure:

Make sure that the Remote unit is connected on the far end of the unit under test. Select and start the Resistance test. After the Remote unit is connected and the test is completed, the results, Pass/Fail information (if a limit is applied) and the limit are shown on the display. The following actions can now be performed:

ESC key: return to Single Test main screen
TEST: repeat the test.



DC resistance result screen

Note: If no remote is detected within 1s, the instrument continues with testing. In this case the operator must ensure correct termination (shorts) at the cable end..

5.4 Scope functions

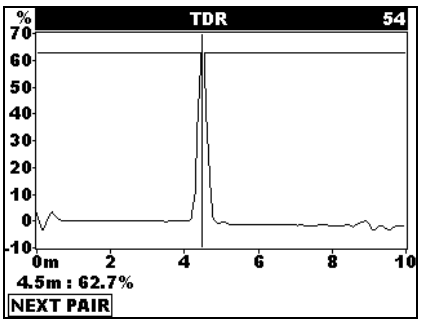
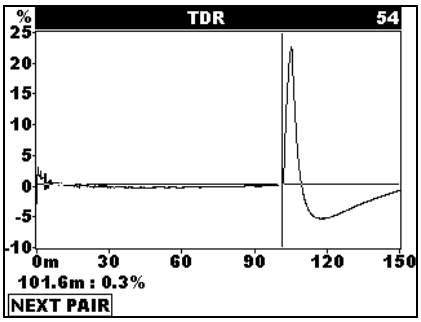
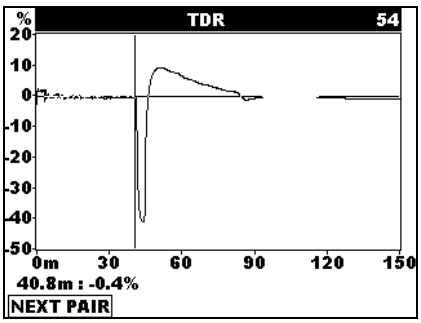
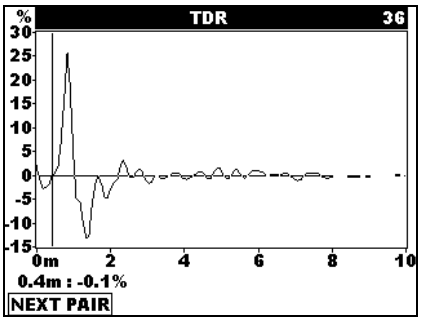
5.4.1 Background of TDR and TDnext

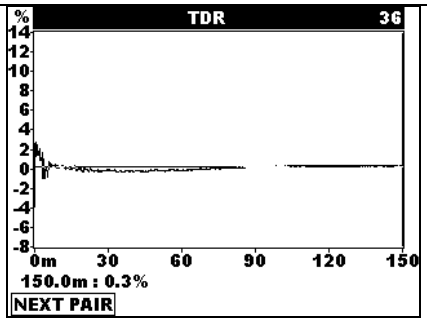
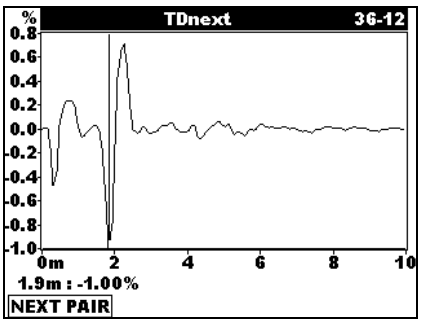
The Scope functions are powerful tools for troubleshooting and analysing cable problems. They are based on the time domain representation of events on a line. After transmission a pulse travels down the line (cable) and reflects back at the places where anomalies occur. Anomalies can be caused by impedance mismatching, damaged cable, incorrect termination or simply by an open or shorted cable end. On the base of the shape of the reflected signal the anomaly reason can be found.
If the pulse propagation speed is known, the fault place can be easily located from the time it takes the reflected pulse to return back to the transmitting end.

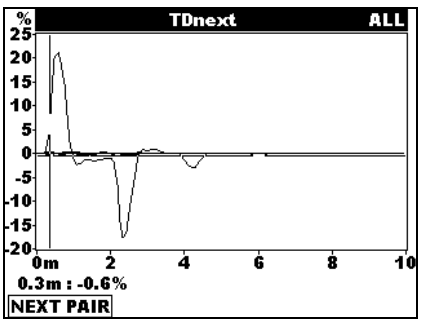
Two basic functions can be selected in SCOPE menu: TDR and TDnext.

In general TDR test helps to determine whether there are impedance anomalies on the tested pair or cable. It is also possible to locate and determine the type of anomaly. TDnext is used to crosstalk problems.

Some typical TDR and TDnext pictures together with comments are collected in the following table.

Situation	Comment	TDR Display
Open cable, cable break, incorrect termination etc. (at short distance) $Z_{anom}>Z_{cable}$	The pulse is reflected back at the anomaly point. If the instrument's output impedance isn't matched to the cable's then more than one reflection can be seen. Note: Cable length and cable quality can be checked in this way	
Open cable, cable break, incorrect termination (at long distance) $Z_{anom}>Z_{cable}$	The pulse is reflected back at the anomaly point. Through increasing attenuation especially at high frequencies the pulse's width is extended and amplitude reduced. Note: Cable length and cable quality can be checked in this way	
Shorted cable, incorrect termination (at middle distance) $Z_{anom}<Z_{cable}$	The pulse is completely reflected back and inverted at the anomaly point. Note: Cable length and cable quality can be checked in this way	
Problem at the near connection point	A part of the pulse is reflected back at the very beginning. The problem on the picture was caused by a badly assembled 1m patch cable.	
Proper termination, no anomalies in	The pulse travels over the cable without any reflections. If the cable is correctly	

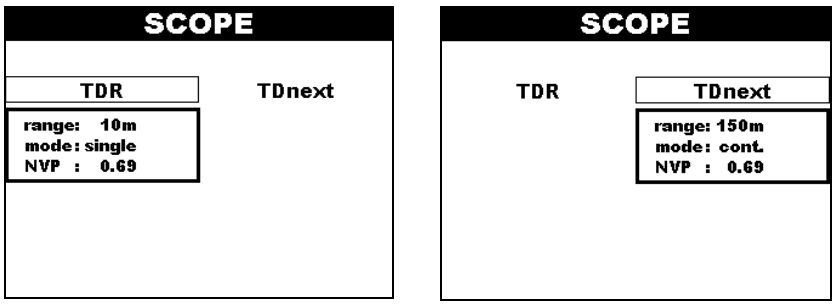
cable	terminated at the end no reflections will occur.	
High crosstalk problem	A high coupling signal due to a crosstalk problem occures on the adjacent pair - unmatched connectivity components.	

Split pair	A very high coupling signal in the adjacent pair. Split pairs in patch cable have caused this problem.	

5.4.2 Scope Test procedure

Scope Main Screen

In Scope Main Screen the user can choose between TDR or TDnext (Left, Right keys). Under the selected function, the associated parameters are shown (the selected item is underlined) which can be accessed with Up, Down keys and set with Left, Right keys. Testing can always be started with ENTER. In TDR all 4 pairs are tested. In TDnext all six crosstalks combinations are tested.



Scope main screen - TDR and TDnext

Parameters in Scope Menu

Range: setting the expected length range of interest. The instrument will automatically adjust the optimal pulse length for the given range. A properly set range enables the operator to view the reflections in full detail.
Mode: Single mode is usually used (one measurement is performed). In continuous mode the measurement is repeated until the STOP key is pressed. This can be useful when searching for a bad contact, cable damage etc.
NVP: Setting the NVP factor.
After the instrument is reinitialized the NVP of the cable selected in the Cable Type Menu is used as the default value. Later the manually set NVP in this menu is used.

Scope Result Screens

In TDR Result screen a TDR graph (amplitude/distance) for the selected pair is shown on the display. Amplitude and distance at the cursor position are displayed under the graph. Amplitude is shown as a percentage of nominal pulse amplitude (amplitude in a 100Ω test cable).
The following actions can now be performed:

ESC key:	return to Scope Main screen
NEXT PAIRS:	view next adjacent pairs graph
Left, Right key:	move cursor left and right to view amplitude at selected distance
STOP	(during continuity mode): stop the test.

In TDnext Result screen a TDnext graph (amplitude/distance) for the selected pair is shown on the display. Amplitude and distance at the cursor position are shown under the graph. Amplitude is shown as a percentage of nominal pulse amplitude (amplitude in a 100Ω test cable).
Following actions can now be performed:

ESC key:	return to Scope Main screen
NEXT PAIRS:	view next adjacent pairs graph
Left, Right key:	move cursor left and right to view crosstalk amplitude at selected distance
STOP	(during continuity mode): stop the test.

5.5 Autotest - copper cables

Autotest is the fastest and easiest way to test and certify LAN installations. By one press of a button preprogrammed sequence runs. All tests needed for the verification of the selected cable/installation system are performed. A complete cable test that conforms to CAT6 regulations is finished in less than 60 seconds.

The preprogrammed test procedure depends on the selected Autotest type.
In the SETTING - CABLE TYPE menu copper or fiber optic measuring mode can be set. Test standard, Cable type and Test sequence are set in the Test Standard Menu (chapter 5.6.).

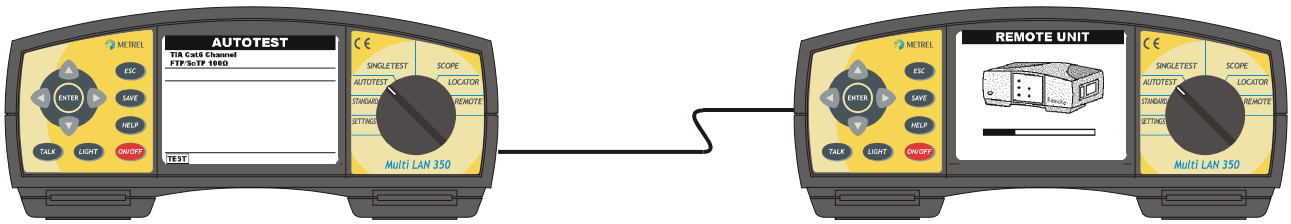
5.5.1 Complete, Near End, Far End Autotest

Three types of Autotest configurations are available:

Autotest Type	Included tests	Device on the remote side
Complete Autotest	Performs ALL selected measurements (can be set in Settings menu)	Instrument MultiLAN 350
Near End Autotest	Performs all selected measurements, except: Remote NEXT Remote PSNEXT Remote ACR Remote PSACR Remote Return Loss	Remote unit MultiLAN 350 RU
Far End Autotest	Performs the following measurements, if selected: Remote NEXT Remote PSNEXT Remote ACR Remote PSACR Remote Return Loss	

For a complete cable test NEXT, PSNEXT, ACR, PSACR and Return Loss measurements must be performed on both (near and far end) cable sides.
During Remote tests the device on the far cable end acts as the main unit (performs the measurements) while the device on the near cable side acts as the Remote unit (terminates the cable).

Complete cable test when using another Multi LAN 350 on the far end



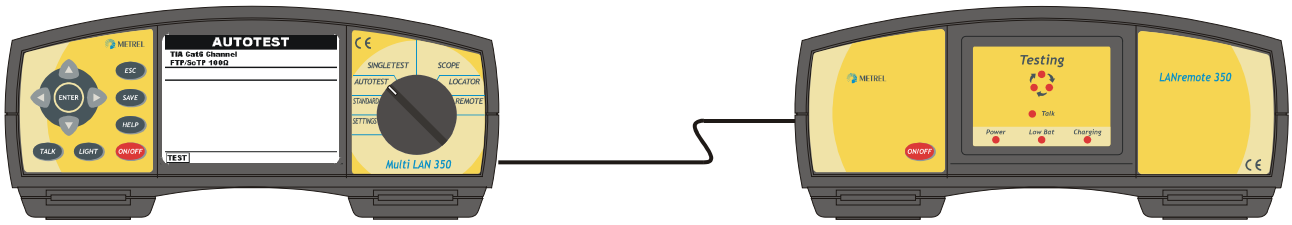
All Remote tests can be performed. After completion of a remote test the measured results are transfered via the measured cable pair to the main unit and displayed.
The Multi LAN 350 connected to the far cable end must be set in position REMOTE and powered on.

A complete cable test can be performed without interchanging the measuring instruments.
Each instrument's memory location has two separate segments for the Near End and Far End tests. When storing complete Autotest data, the results are stored simultaneously in both segments.

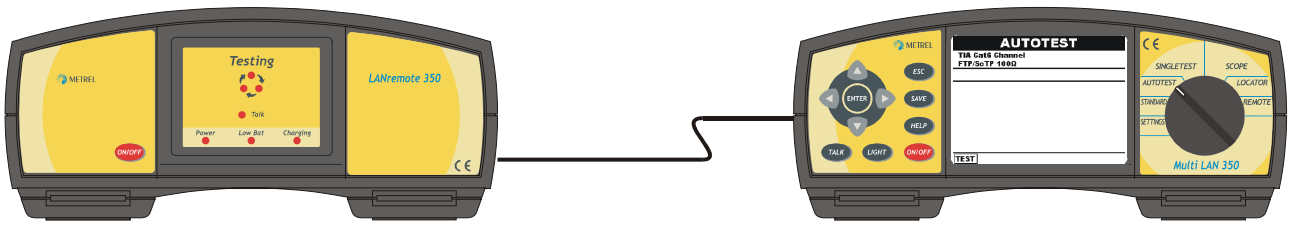
Complete cable test when using the Remote unit MultiLAN 350 RU on the far end

When working with the Remote unit MultiLAN 350 RU a complete Autotest consists of two steps :

1. Near End Autotest



2. Interchange the location of both instruments and perform the Far End Autotest

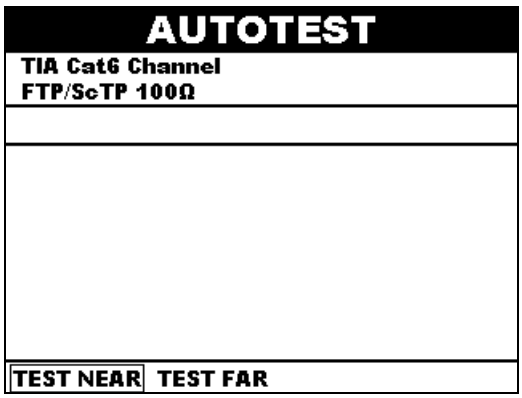


It is not neccessary to execute both steps one after another. The second test can be made and stored later.

Each instrument's memory location has two separate segments for the Near End and Far End tests. The results from a Near End and a Far End tests that are stored in the same memory location are unified and considered as a complete Autotest.

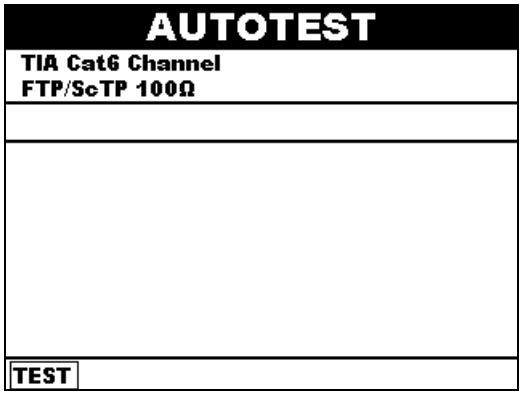
5.5.2 Selecting the Autotest Type

After the Autotest function is selected with the rotary switch the main Autotest menu is displayed :
The selected Test Standard and Cable Type are shown in the upper part of the display.



Autotest Main menu screen when working with the MultiLAN350 Remote unit. The apropriate type can be confirmed with Up/Down and started with the ENTER key.

TEST NEAR: perform near end tests
TEST FAR: perform far end tests



Autotest Main menu screen when working with another MultiLAN350. All selected tests will be performed.

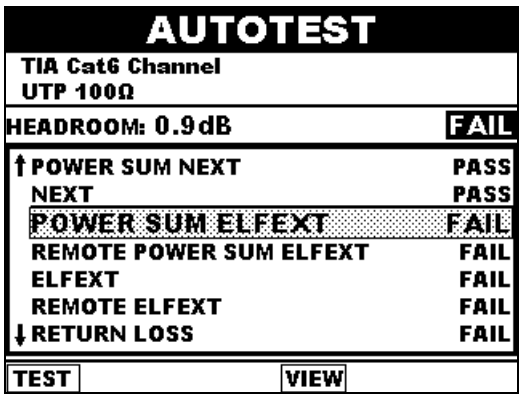
5.5.3 Testing procedure

Make sure that the Remote unit is connected at the far cable end and that the right Autotest parameters (test standard, cable type, Autotest type) are set.
Press ENTER to start Autotest. When both units are connected all selected tests will be performed in succession. Appropriate information and warnings about the currently running tests are shown on the display.
Refer to chapters 5.8 and 5.11 for information about working with the instrument on the remote cable side.

At the end of Autotest the overall Pass/Fail decision and Headroom information are shown on the display. Headroom is the worst case margin that can be used as a measure of the installation's condition when doing periodic inspections (view chapter 5.2.2).

The following actions can now be performed:

TEST:	repeat the Autotest
ESC:	return to previous screen
Up/Down :	select a result
VIEW:	the selected measurement result is shown in full details. The result screens are the same as in Single Test Menu.
SAVE :	saves the Autotest



Complete Autotest overall result screen

5.6 Autotest - fiber optic

The autotest feature performs a complete optical cable verification.
The results from the compatible Optical measuring instrument are received via the IR port and further analysed with MultiLAN350.

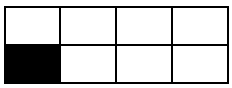
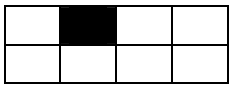
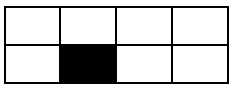
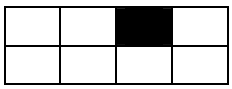
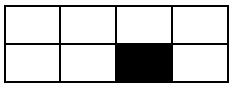
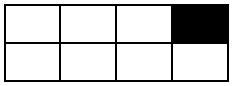
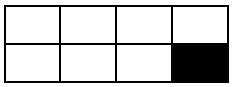
In the SETTING - CABLE TYPE menu the fiber measuring mode can be set. Test standard, cable type and parameters are set in the Test Standard Menu (chapter 5.8.).

The received results:
- are compared against the given or calculated limits. MultiLAN350 provides the limits on base of selected test standard, length and link parameters.
- can be sorted in a clear and simple way as proposed for MM LAN fiber installations
- can be stored in a way which enables creation of detailed verification reports.

5.6.1 Types of testing - configurations

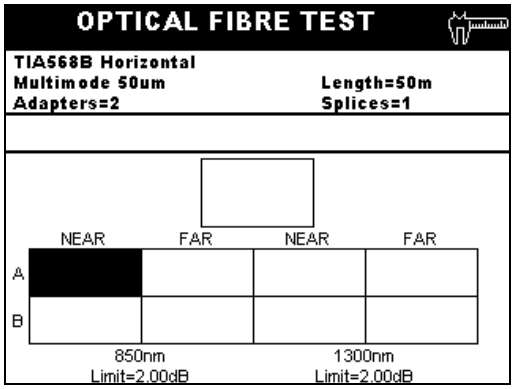
Up to 8 measurements can be performed and stored as one fiber optic link autotest.
The 8 measurements test corresponds with the demands for a complete verification of a typical duplex fiber optic link.
In general the 8 measurement test provides the most exhaustive information about the shape of the fiber optic cable link (both cables of the duplex link, both wavelengths, near and far end test).
Simpler testing is also possible (individual tests, one way testing, testing at one wavelength). For instance, one side testing at both wavelenghts is also often used (tests 1,2,5,6).

In the table below the 8 measurement test organization is shown:

No. of test	Measurement	Cable	Wavelength	Device on the near side	Device on the far side
1		A	850nm	optical power meter	optical source
2		B	850nm	optical power meter	optical source
3		A	850nm	optical source	optical power meter
4		B	850nm	optical source	optical power meter
5		A	1300nm	optical power meter	optical source
6		B	1300nm	optical power meter	optical source
7		A	1300nm	optical source	optical power meter
8		B	1300nm	optical source	optical power meter

5.6.2 Testing procedure

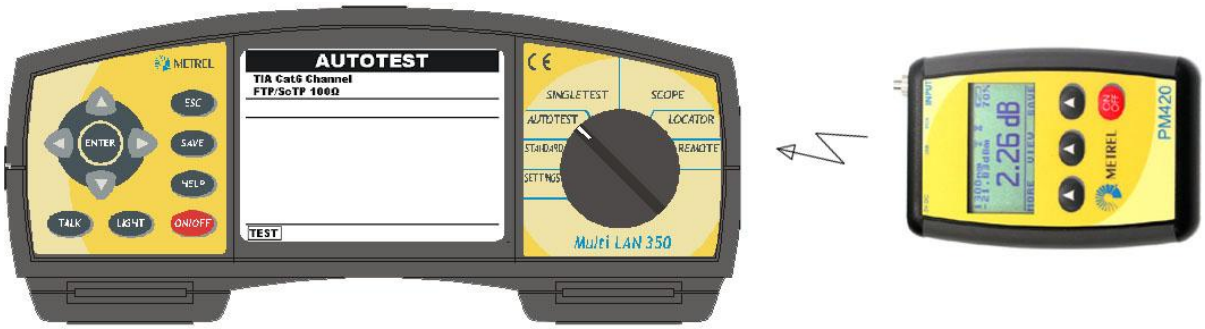
Make sure that the FIBER OPTICAL cable type is set and the IR adapter is inserted in the instrument. Set AUTOTEST with rotary switch.
Check if Cable standard, Cable type, No. of adapters, No. of splices and length are set correctly.
The Test standard and belonging parameters can be changed in the TEST STANDARD menu. Refer to chapters 5.8 for more information.



Initial Optical fiber test screen

Perform Fiber optic attenuation test with Optical measuring instrument.
After completing the test send the results to MultiLAN350 via IR communication port.
Refer to Optical measuring instrument User Manual for more information.

To assure a succesfull data transfer place both instruments as shown in figure below:

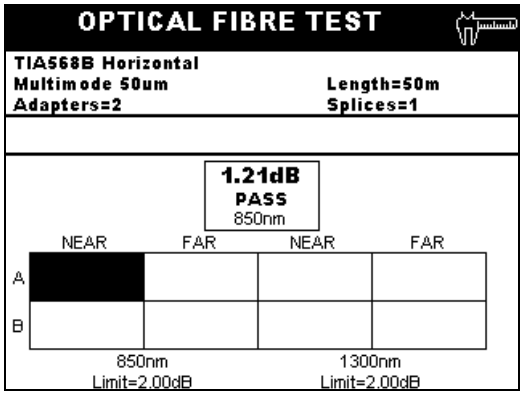


Placing Optical power meter for optimum data transfer

There is a confirmation (long+short) beep if the data was received successfully. In case that the data transfer failed there is a warning (long) beep.

The send result and wavelength are displayed in the received result field, together with the PASS/ FAIL decisition. The following actions can be performed now:

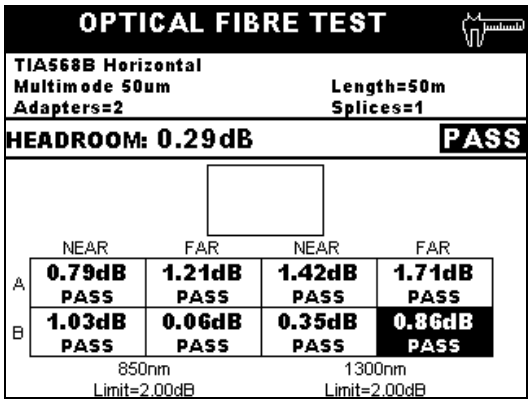
Up, Down, Left, Right:	select the appropriate measurement (inverted field)
Enter:	move the result to the selected location. After the result was moved the receiving result windows is emptied. If an occupated location is selected the result will be overwritten !



Data in received result field

By repeating the steps above locations 1 to 8 can be filled with measurement results.

The following actions can be performed with the entered results:



Data prepared in preset locations

Up, Down, Left, Right	select a result (inverted)
TEST:	clears the selected result
SAVE :	saves the results (refer to chapter 5.11 for more information)

Note:
Typical causes for a failed tranfer can be:

- distance between Optical power meter and MultiLAN350 too long,
- wrong placing of IR ports of Optical instrument and MultiLAN350,
- obstacles between both IR ports,
- wrong results are sent from the optical instrument (wrong measurement, wrong wavelength, etc).

5.7 Setting copper cable standard

Refer to chapter 5.13.10 on how to select copper cable measuring mode.
The test standard, cable type and Autotest sequence can be set in the Test Standard Menu.

There are preprogrammed test parameters for each selected standard or cable type and Pass/Fail limits. The preprogrammed limits and parameters are used in Autotest and Single test functions

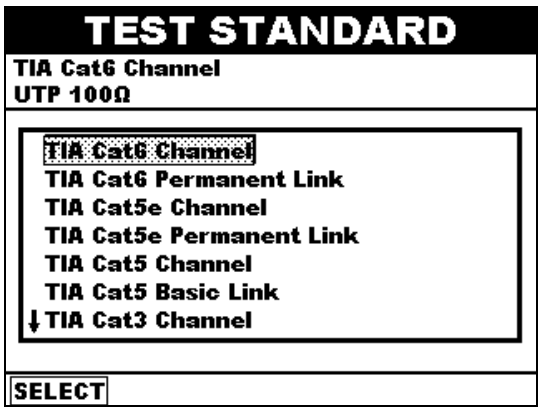
In the Autotest tests menu the default test sequence can be altered manually by switching On and Off each test.
For each selected standard, the tests with limits applied are set On by default. Tests that have no associated limit in the selected cable standard are switched Off by default.

In Appendix 2 a table with preprogrammed test standards and cable types with associated preprogrammed test and parameter settings can be found. For frequency dependent limits only data at some typical frequencies are given for the reason of simplicity. However the complete limit curves are preprogrammed in the instrument.

5.7.1 Test standard selection

After the Standard Menu is selected with the rotary switch the Test Standard main screen is displayed. In the upper rows the actual set test standard, cable type and NVP are displayed. The following actions can be performed now:

Up, Down: select a new test standard
Enter: enter the Cable Type menu



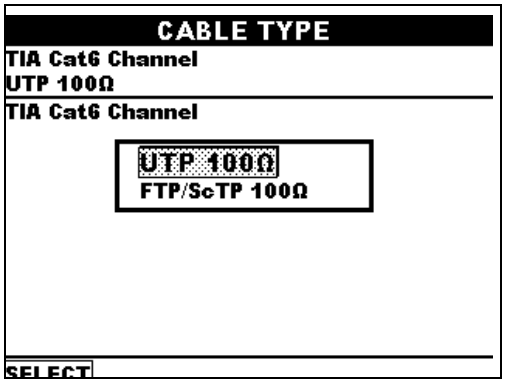
Test Standard main screen

5.7.2 Cable type selection

Different cable types associated with the selected test standard can be set in this screen.

In the upper rows the actual test standard, cable type and NVP are displayed. The following actions can be performed:

ESC key: return to the Test Standard screen. New settings are not considered.
Up, Down: select the cable type
Enter: Enter the NVP setup menu



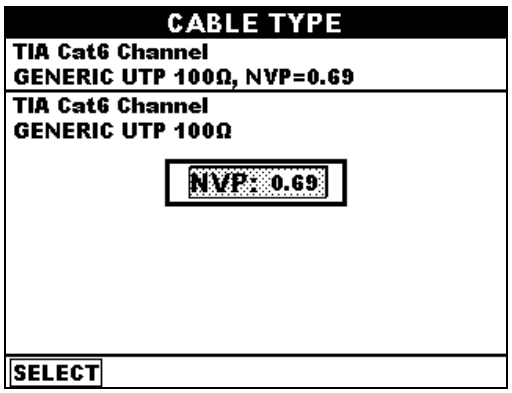
Cable Type screen

5.7.3 Setting cable NVP

Cable NVP can be set in this screen. It is recommended to use this option if the exact cable NVP is known.

In the upper rows the actual test standard, cable type and NVP are displayed. The following actions can be performed:

ESC key: return to the Cable type screen. New settings are not considered
Up, Down: select the NVP value. Default NVP value for the selected cable type is offered as the initial value.
Enter: Enter the Autotest Tests menu

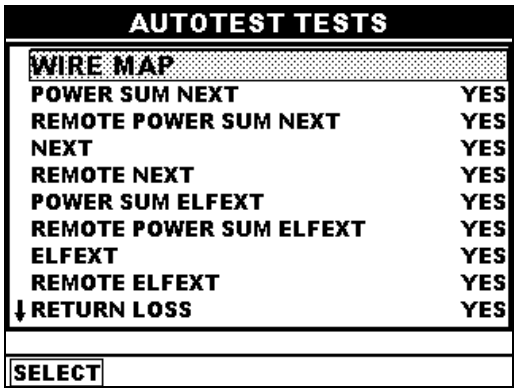


Cable NVP screen

5.7.4 Autotest sequence configuration

In this screen the tests attributed to the selected test standard are displayed. Whichever measurement can be set On or Off manually.
For each selected standard, the tests that have limits applied for the selected cable standard are set On by default.

ESC:	returns to the Test Standard screen. New settings are not considered
ENTER:	the set configuration is stored. The instrument returns to Test Standard screen
Up, Down:	select measurement
Left, Right:	set measurement On (Yes) or Off (No).



Autotest sequence screen

Note: All three screens must be confirmed with ENTER to accept the new setup!
The user can recall the default settings in the Settings menu or by setting the Autotest sequence according to data in Appendix 2 (the tests with limits applied are set On, other Off).

5.8 Setting optical fiber cable standard

Refer to chapter 5.13.10 for how to select fiber cables measuring mode.
Test standard, fiber cable type an other fiber link parameters can be set in the Test Standard Menu.

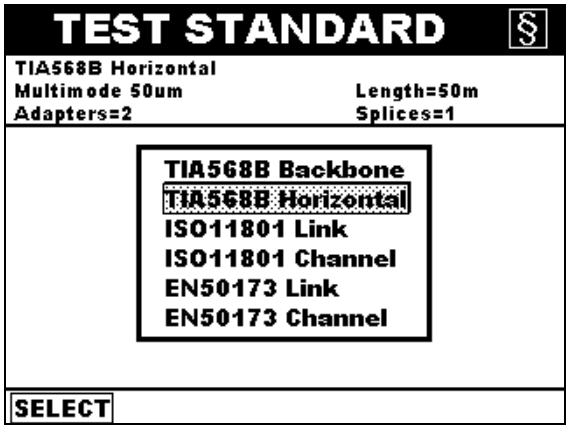
Pass/Fail limits are calculated on basis of selected standard and entered cable data. The limits and parameters are then used in the Autotest function.

In Appendix 3 a table with preprogrammed test standards and cable types with associated test and parameter settings can be found.

5.8.1 Optical fiber test standard selection

After Standard Menu is selected with the rotary switch the Test Standard main screen is displayed. In the upper rows the actual set test standard, cable type, no. of adapters, no. of splices and length are displayed. The following actions can be performed now:

Up, Down:	select a new test standard
Enter:	enters the Cable Type menu



Optical fiber test standard main screen

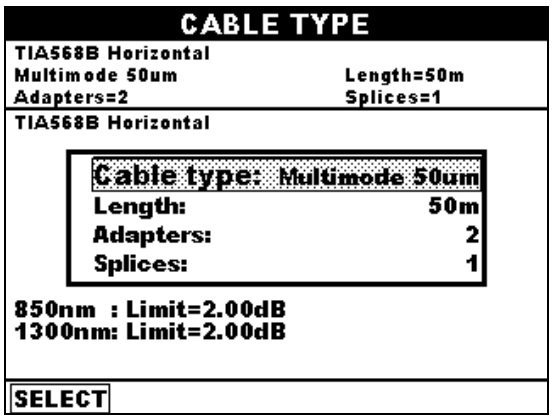
5.8.2 Cable type selection

Different cable types associated with the selected test standard and other fiber link parameters can be set in this screen.

In the upper rows the actual set fiber link parameters are displayed. The following actions can be performed now:

ESC key:	returns to the Test Standard screen. New settings are discarded
Up, Down:	select the cable type and fiber link data
Left, Right	select the data
Enter:	set configuration is stored. The instrument returns to Test Standard main screen

While changing data the limits for both wavelenghts are on line calculated and displayed in the lower part of the display.



Cable Type screen

Parameters in Scope Menu

Cable type:	fiber optic cable / optic channel types regarding to set test standard
Length:	length of the link
Adapters:	no. of adapters (connectors) in the link
Splices	no. of adapters (connectors) in the link

Warning:
The fiber cable attenuation PASS/FAIL limit depends on the cable length for some standards!

If entering a length lower than the actual this could lead to wrong interpretation of results (PASS instead of FAIL could be reported). Therefore the correct length should be entered. If in doubt it is recommended to enter a value that is certainly not too low!

5.9 Talk & trace interface

The in built Talk & Trace interface enables full duplex voice communication over the measured copper cable. The communication works perfectly regardless of the cable length and attenuation.
The same hardware can be used for locating cables. When the remote unit is found a connection 'beep' is heard on both units. No headphones are used when using this function.

5.9.1 Establishing a voice communication

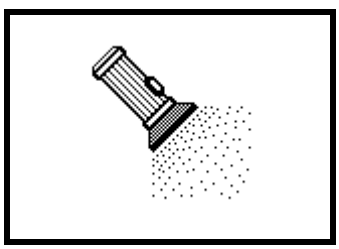
Both operators must put on the headphones before talking. Both jacks (mic and phone) must be plugged in all the units.
The instrument can be set in Talk & Trace mode simply by pressing the Talk key regardless of the function which is currently set (except in positions Remote and Locator).
After the Talk command the instrument will try to connect itself with the Remote unit. Until the Remote unit is found 'Searching for Remote' warning is flashing on the 'Remote Finder' screen.
When the Remote unit is found and succesfully connected the 'Talking' screen appears and the communication can begin. At the same time the Talk LED on the remote unit lights up.
If the communication between both units is broken (e.g. when changing to another plug in a patch panel), the main unit returns to 'Remote Finder' screen ('Searching for Remote') so the communication can proceed immediately after the remote unit is reconnected.

5.9.2 Breaking off the connection

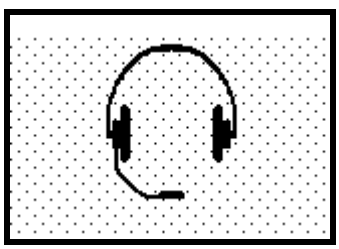
The connection can be concluded at any time from the Main unit by pressing TALK key again or ESC key. The instrument returns to the state before the connection.

5.9.3 Locating cables

The procedure described in 8.1 and 8.2 can be used when locating cables in patch cables, computer rooms etc. This can be done without using headphones.



The ‘Remote Finder’ sign



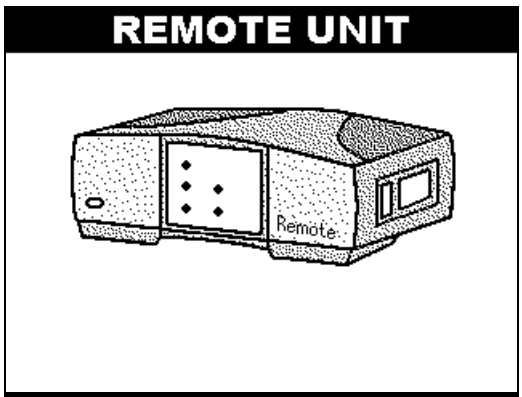
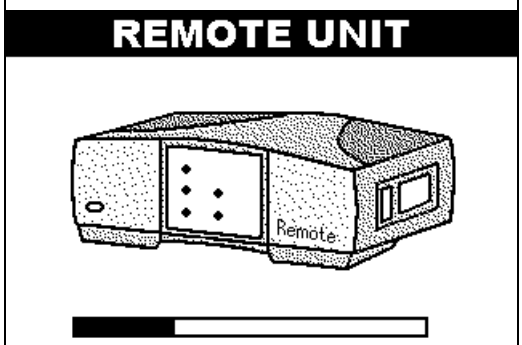
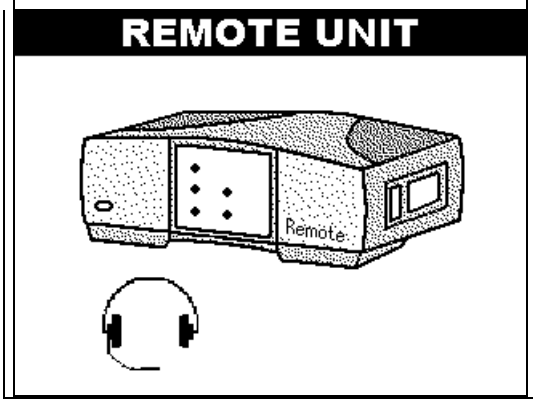
The ‘Talking' sign

Note: At least one cable pair must be connected correctly to ensure proper operation.

5.9.4 Remote

In this position the MultiLAN350 behaves as a Remote Unit. It terminates the far cable end in accordance with commands from the Main unit on the near end. The main advantage in comparison with the Remote Unit MultiLAN 350 RU is the fact that Remote measurements can be performed. This saves a lot of time since the operator does not need to interchange the measuring tools on both cable sides to make a complete cable test.

Remote screens:

	Remote main screen
	Remote screen during operation Commands from the main unit are executed.
	Remote screen in Talk mode Both units are in talk mode. This allows the operator on the remote side to recognize that the operator on the main side wants to establish a voice connection (Main unit is set in Talk & Trace mode) or that the remote unit is found. Use headphones if communicating.

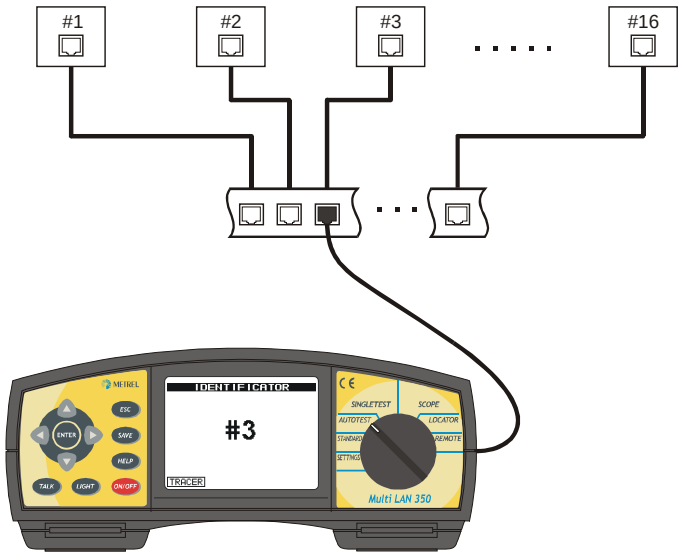
Note: When the rotary switch is in REMOTE position TALK key has no function.

5.10 Locator

This function is a powerful tool for finding the correct cable connector in wiring closets, patch panels etc.
In this mode the instrument decodes which locator is connected to the far cable end.

Test procedure:

Connect the coded (the code is printed on the locator) RJ45 locators in cable end sockets. Select Locator menu and connect the instrument onto the near cable end (e.g. in a patch panel). On the display the code of the locator on the far cable end is shown.



Locator test

Note:
Locators #1 to #6 can be also used on links where only pairs 1 and 3 (wires 3,5,4,6) are connected.
Locators #7 to #12 can be also used on links where only pairs 2 and 4 (wires 1,2,7,8) are connected.
When using Locators #13 to #28 all pairs have to be connected.

5.11 Memorizing results

MultiLAN 350 is capable of storing up to 500 Autotest reports that can be viewed, analysed and printed out with LANlink PC SW. The reports contain all essential data needed for a complete cable verification. Test standard, cable type, test limits, worst case results and margins, overall headroom etc. are included. Refer to section IV for more information about the Test Report.

The latest plot results are automatically stored in a reserved memory place and can be downloaded to PC until a new measurement is done.

5.11.1 Saving the latest PLOTS

The plots of the latest:
- NEXT and Remote NEXT,
- PSNEXT and Remote PSNEXT
- ELFEXT and Remote ELFEXT
- Attenuation
- Return Loss and Remote Return Loss
- ACR and Remote ACR
- PSACR and Remote PSACR
- TDR
- TDnext

Tests are automatically stored in a reserved memory place (reserved by default) and can be downloaded to a PC and analysed with LANlink.
Each of the plots will stay in memory untill a new measurement will be performed.

Note:
The plot data will be lost:
- when the batterie is empty
- the batteries are removed
- when changing the batteries

Refer to Section IV for further information about downloading, documentation and analysis of plots.

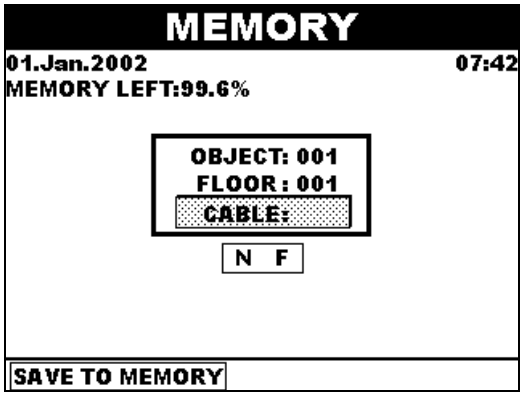
5.11.2 Saving Complete Autotest / Near End Autotest / Remote Autotest results

In the MEMORY menu the MultiLAN 350 memory structure is displayed. The structure is divided into three numbered levels that define a location. The level names used are OBJECT, FLOOR and CABLE. Each location has assigned all three level attributes to enable the operator to store the results as logical manner as possible.
All objects, floor and cable numbers can be set between 000 and 200. In the upper right corner of the screen the remaining memory place (in percents) is displayed.

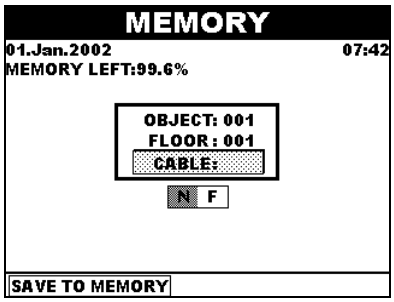
When saving new Autotest result the CABLE number is automatically increased (OBJECT and FLOOR remains the same as previous) and offered for confirmation (CABLE is flashing).

In each location one Complete Autotest can be stored.

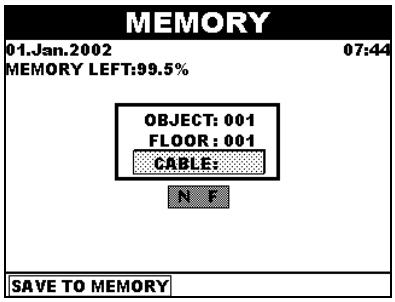
Saving Autotest results for copper cables:
A Complete Autotest can be composed from one Near End Autotest and one Far End Autotest (to allow complete cable verification when working with the Remote Unit MultiLAN350 RU). Refer to chapter 5.5.2 for more information about Autotest types.



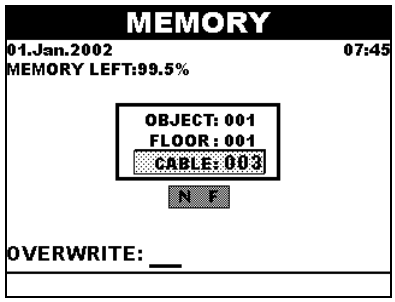
An empty memory location.
A complete Autotest, Near End or Far End test can be stored.



Memory screen – location with an already stored Near End Autotest
A Far End test can be stored.



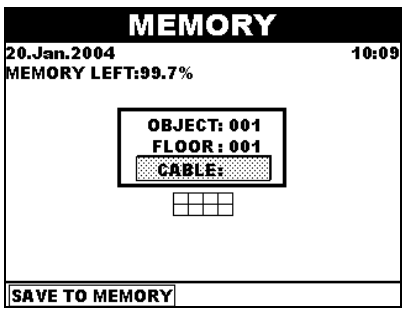
An occupated memory location.



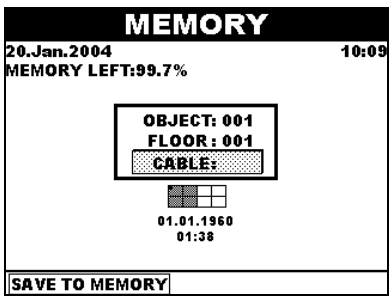
It is possible to overwrite the data that are already stored.
The user will be asked for confirmation (YES).

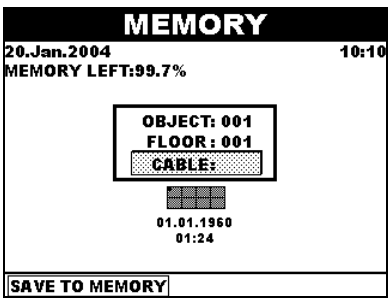
Saving Autotest results for optical fiber cables:

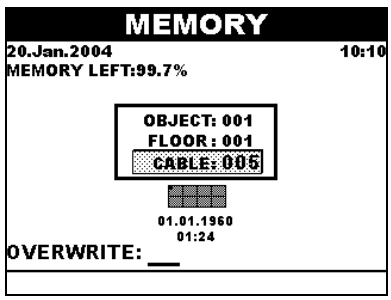
An Autotest can be composed from one to eight tests. Refer to chapter 5.6 for more information about Autotest types.



An empty memory location.
A complete fiber optic Autotest can be stored.







Memory screen – location with already stored tests.	An occupated memory location.	It is possible to overwrite the data that are already stored. The user will be asked for confirmation (YES).

Saving procedure - general

After performing an Complete Autotest / Near End Autotest / Remote Autotest / Fiber optic Autotest press SAVE key.

The MEMORY menu is displayed.
The following actions can now be performed:

Left, Right:	change the CABLE, OBJECT or FLOOR number (the actual item is underlined, number is flashing). If a result under the selected location already exists a warning is displayed.
Up, Down:	switch between CABLE, OBJECT or FLOOR
SAVE:	save the Autotest result in the selected location. If the location is occupated the user will be asked for confirmation.
ESC:	cancel the saving procedure

After the saving procedure the previous menu is displayed.

Note: The Autotest results are stored in a FLASH memory that doesn't need any battery backup. The data will not be lost even if the batteries are removed from the instrument.

5.11.3 Downloading data / results to PC

Refer to chapters 5.13.13 and 1.

5.12 Remote unit MultiLAN 350 RU operation

The Remote unit is used to correctly terminate the far cable end during different measurements. It executes commands received from the Main unit (instrument). Seven LEDs indicate the current unit status.
The meaning of keys and LEDs are described in chapter 2.2.2.

Testing mode

While executing measurement commands from the Main Unit the *TESTING* LEDs are lighting.

Switching the unit On Off

After powering up the Power LEDs is lit on. When the Remote Unit is connected with the main unit it now follows the commands from the Main Unit .
If there is no command from the Main Unit for more than 10 minutes the Remote Unit automatically switches off. The unit must be powered On again.

Talk & Trace mode

A lit on *TALK* LED and a 1sec 'beep' indicate that both units are connected. This allows the operator on the remote side to recognize side that the remote unit was found and is prepared for measuring or that the operator on the main wants to establish a voice connection (Main unit is set in Talk & Trace mode) or Use headphones to communicate. After the Main unit has been disconnected from the Talk & Trace mode the TALK LED is switched off.

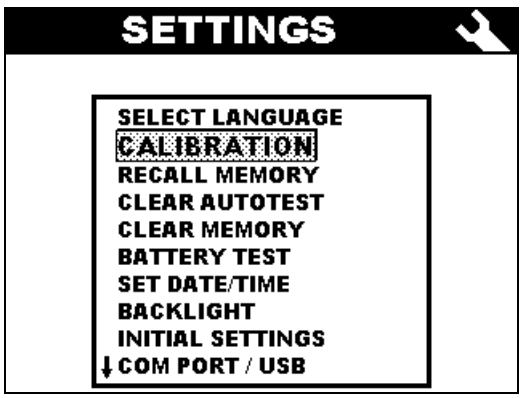
Low battery indication

A flashing LOW BAT LED indicates that the battery voltage is too low for proper operation. The power supply battery must be recharged.

5.13 Settings

Different actions can be taken from this menu:
- selecting the user language
- performing a calibration
- recalling memory results
- clearing individual Autotests
- clearing the complete memory content
- checking the batterie power
- setting the date/time
- setting the backlight mode
- setting the default (initial) instrument setting
- setting the noise filter
- factory settings
- setting the com port

Different actions can be acessed by selecting them with Up/Down and ENTER.



Settings main screen

5.13.1 Language selection

The instrument supports different languages (depending on FW version).

Setting a new language

Up,Down	select new language
OK	leave menu, selected language adopted
ESC	leave menu without changes

5.13.2Calibration

To ensure maximum accuracy of test results, the instrument is capable (in addition with the Attenuation Calibration Module) of autocalibration.
To get the best results it is recommended that the autocalibration should be performed at least once per month (once per week if frequently used), at room temperature (20 - 25°C).

Calibration procedure
Use the Attenuation Calibration module to connect the main unit with the remote unit. Press ENTER to perform the calibration. A confirmation is displayed if the procedure is completed succesfully.

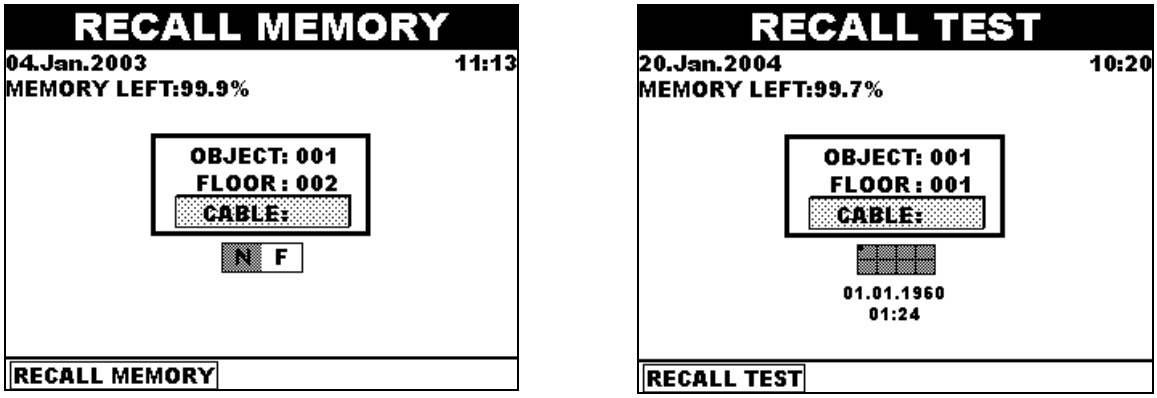
Refer to chapter 2.1.4 for more information about calibration of the instrument.

Important warning:
Whenever the Remote unit is changed a new calibration MUST be performed !

5.13.3 Recall Autotest

In this menu stored Autotest results can be recalled. The following actions can be taken after entering this menu:

Left, Right :	select the CABLE, OBJECT or FLOOR number (the actual item is underlined, number is flashing).
Up, Down:	Switch between CABLE, OBJECT and FLOOR
ESC:	return to previous screen
RECALL AUTOTEST:	The Overall Autotest result screen is recalled (refer to chapter 5.5.3). Check if any data are stored under the set location (some of the fields under the location must be grey scaled). If the fields are blank there are no data to recall.



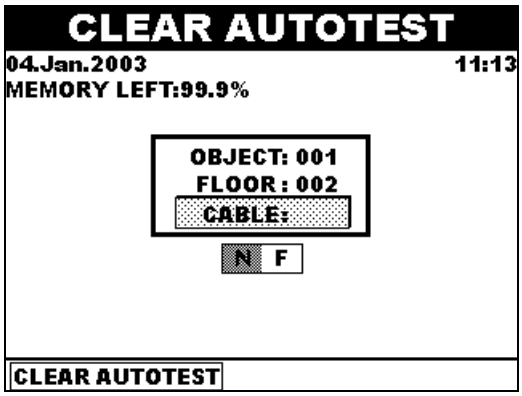
Examples of Recall memory screens

Note: Plots aren't stored and therefore can't be recalled !

5.13.4 Clear Autotest

In this menu individual Autotests can be deleted:

Left, Right :	select the CABLE, OBJECT or FLOOR number (the actual item is underlined, number is flashing).
Up, Down :	switch between CABLE, OBJECT or FLOOR
ESC:	return to previous screen
CLEAR MEMORY:	delete Autotest results.



Clear Autotest screen

5.13.5 Clear Memory

The complete memory content can be cleared In this menu. The content is cleared when pressing CLEAR. The memory content will not be erased when leaving the menu with ESC.

5.13.6 Battery Test

In this menu the battery power indication together with the battery voltage is shown.

Note: The displayed battery power indicator is valid only for original NiMH batteries in good condition. Otherwise the indication can be wrong since the charge/voltage ratio depends on the battery type and condition.

If the supply voltage drops below 6.5V the instrument switches itself off to prevent uncontrolled behaviour because of too low supply.

5.13.7 Set Date/Time

Date and time are attached to the saved results in the memory.

Setting procedure
After entering this menu the selected item flashes.The following actions can now be performed:

Left, Right keys	select next or previous item
Up, Down keys	select date/month/year/hour/minute
OK	confirm the set date/time
ESC	leave menu without any changes

5.13.8 Backlight mode

After entering this menu the following actions can be performed:

Left, Right keys	switch between available modes
OK	leave menu and confirm the selected mode
ESC	leave menu without changes

Two backlight modes are available:
AutoOff mode: the backlight is automatically switched off after 20 seconds.
Normal mode: no Autooff.

In order to save battery power it is recommended to use the Autooff mode.

5.13.9 Noise Filter

Excessive noise degrades the measuring performance. Presence of noise often results in:
- permanent FAILs (mostly on NEXT and ELFEXT)
- too low HEADROOM is reported
- spikes in result plots.

Typical noise sources are:
- active electrical equipment near the tested LAN wiring
- live network traffic in adjacent cables and connectors
- other HF signal sources near the tested LAN wiring (cable TV, xDSL, …).

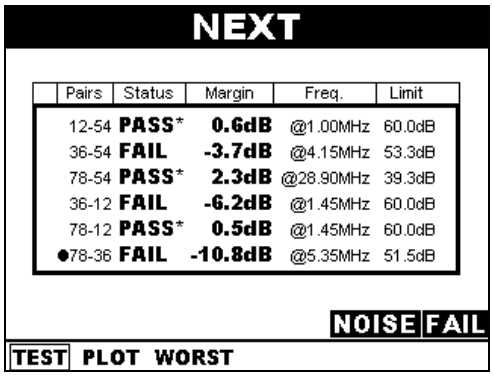
To improve the results the following actions can be taken:
- Use one of the two built-in filters
- Determine the noise sources and switch them off.

The instrument checks for excessive noise before each test.
Two filters are available:
No: filters are switched off
Low: the noise is reduced by averaging the results (autotest last 3 times longer)
High: the noise is reduced by averaging the results (autotest last 5 times longer)

After entering this menu the following actions can be performed:

Left, Right keys	switch between available noise filters
OK	leave menu and confirm the selected mode
ESC	leave menu without changes

The filters are activated only if the noise level is high enough to degrade the accuracy of MultiLAN 350 (NOISE is reported).



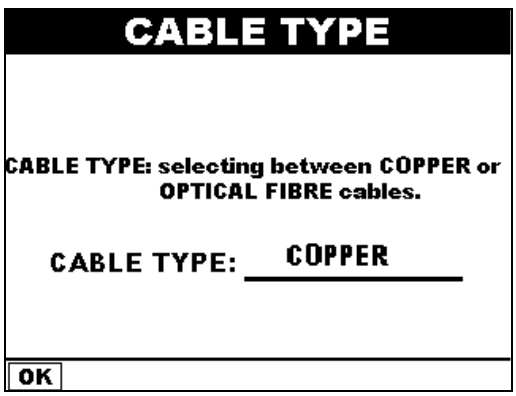
Example of NEXT result screen with noise reported

Note: The measurement results are likely to be be impaired in presence of noise !
If the results are still impaired despite the noise filter is switched on, the noise source must be found and switched off.

5.13.10 Cable Type

In this menu it can be switched between two instrument operation modes:
- measuring fiber optic cables,
- measuring copper cables,
- Auto selection (Recommended setup) - sets optical fiber mode if IR adapter is connected to the instrument.

Left, Right keys	switch between available modes
OK	leave menu and confirm the selected mode
ESC	leave menu without changes



Typical Cable type screen

5.13.11 Initial settings

In this menu the following parameters and settings can be set to initial (factory) values:

- Test standard, Cable type, Autotest tests
- Contrast
- Backlight mode
- Language
- TDR and TDNext settings will be set to default.

Stored Autotest data will stay in the memory.
Stored plots will be deleted.

5.13.12 Factory settings

The factory settings menu is password protected and not accessible to the user.

5.13.13 COM port

In this menu communication port can be selected. After entering this menu the following actions can be taken:

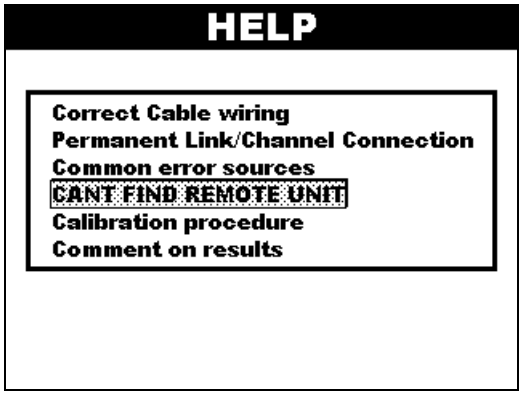
Up, Down keys	switch between desired communication ports
SET	leave menu and confirm the selected port
ESC	leave menu without changes

If it is possible, use of USB communication is recommended because it is quicker than RS232 communication. USB port is not supported under Windows 95/95 OSR2/NT 4.0.

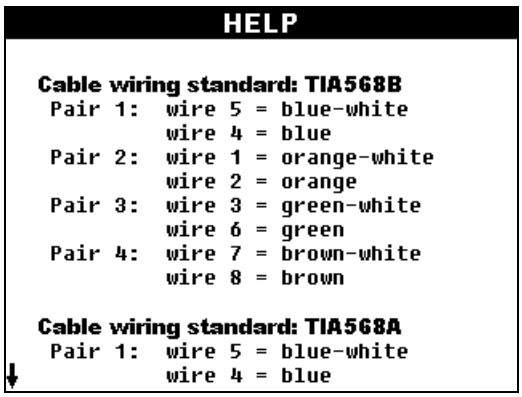
5.14 HELP function

The HELP function can be accessed anytime by pressing the HELP key:

Up, Down:	select item of interest
ENTER, Up, Down:	more HELP
ESC:	exit Help Menu



Initial Help screen



Help screen example

6 LAN Link Software package

The Multi LAN 350 is supplied with a powerful suite of Windows software that can be used for:

- downloading and viewing memorized Autotest results from the instrument
- evaluation and printout of different Test Reports
- redefining original names of tested items
- downloading and viewing results graphs
- saving of results for later purposes

This chapter provides some basic information about LANlink. Refer to LANlink Help menu for more information.

Supported OS for running this application are Windows 9x/NT/2000/XP.

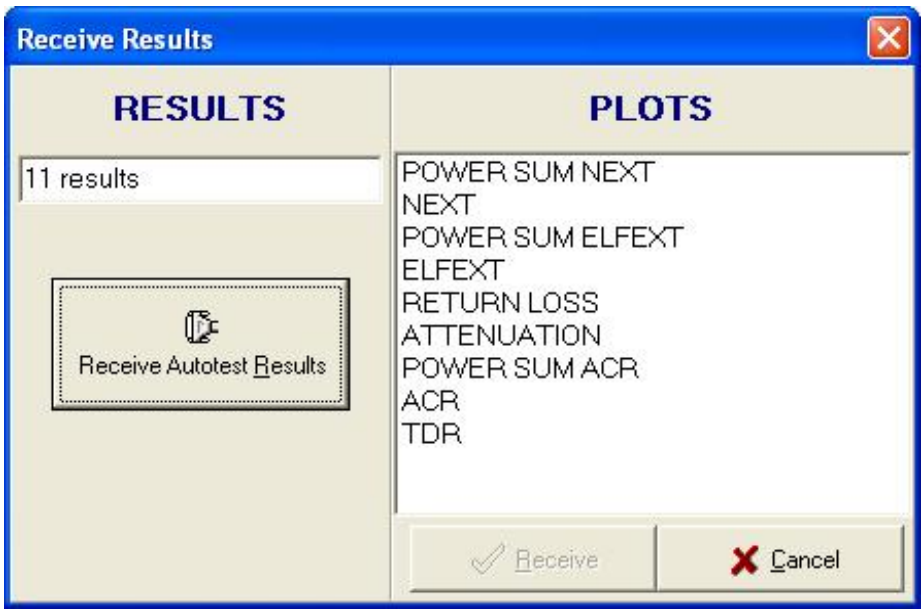
The opening screen is the starting point for all actions. It provides access to all functions by clicking on toolbar buttons or of selecting pull-down menus.

File: In this menu files can be opened, previewed and printed, saved, exported to other programmes etc.
Instrument: This menu enables receiving stored data from the instrument and viewing factory set instrument data.

Configuration: In this menu the communication port and language are set.
Printout heading: In this menu individual data (operator name, test site) and comments can be entered.

Help: This menu contains a detailed explanation of this software package.

After connecting the Multi LAN 350 to a PC, Plots or stored Autotest Results can be downloaded (Receive Results command).



Receive results window

6.1 Creating test reports

When ***Receive Measurements*** in ***Receive Results*** window is selected, the LANlink Result Screen appears.
The following actions can now be taken:

6.1.1 Defining original location names

After opening a file the memory structure with stored data is displayed on the left side of the screen, named Installation Structure Editor. The results that are received from the instrument are defined with numbers only.
After clicking on an object, floor or cable number it can be changed to any alphanumeric name. The new name is stored by pressing Enter.

6.1.2 Adding operator/test site header and comments

When selecting the Operator/Test site menu the operator can create his own Test Report Header and Footer. BMP logo can be added.
When selecting Comments menu any text can be added to the Test Report Header.

6.1.3 Selecting complexity of Test Reports

If large installations are tested, the Test Reports with complete measuring results becomes very complex and difficult to examine.
Therefore the operator can choose between three detail levels (and also print them out):

Full Detail Report:

Full Detail Report provides the most complete information about the performed measurements (including Pass/Fail decisitions for performed measurements, overall headroom, results or margins for individual pairs).

Medium Detail Report:

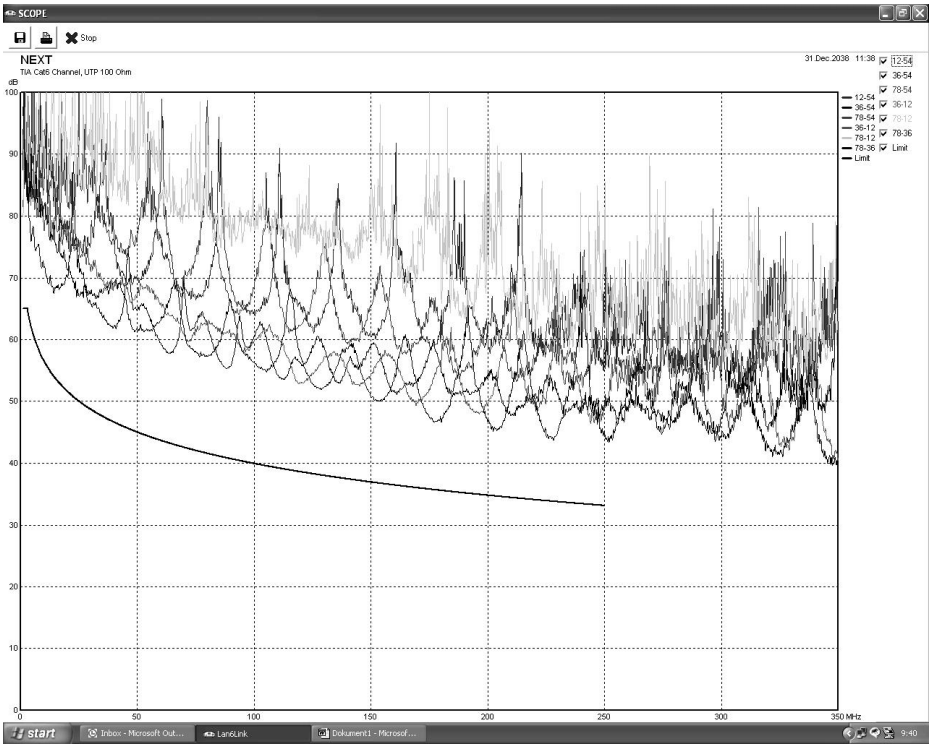
In the Medium Detail Report Pass/Fail decisition for performed measurements and the overall headroom for individual cables are displayed.

Low Detail Report:

In Low Detail Report result column the overall Pass/Fail decisition and headroom for individual cables are displayed. Low Detail Report enables you to make a clear and simple Test Report providing essential information.

6.1.4 Viewing Plots

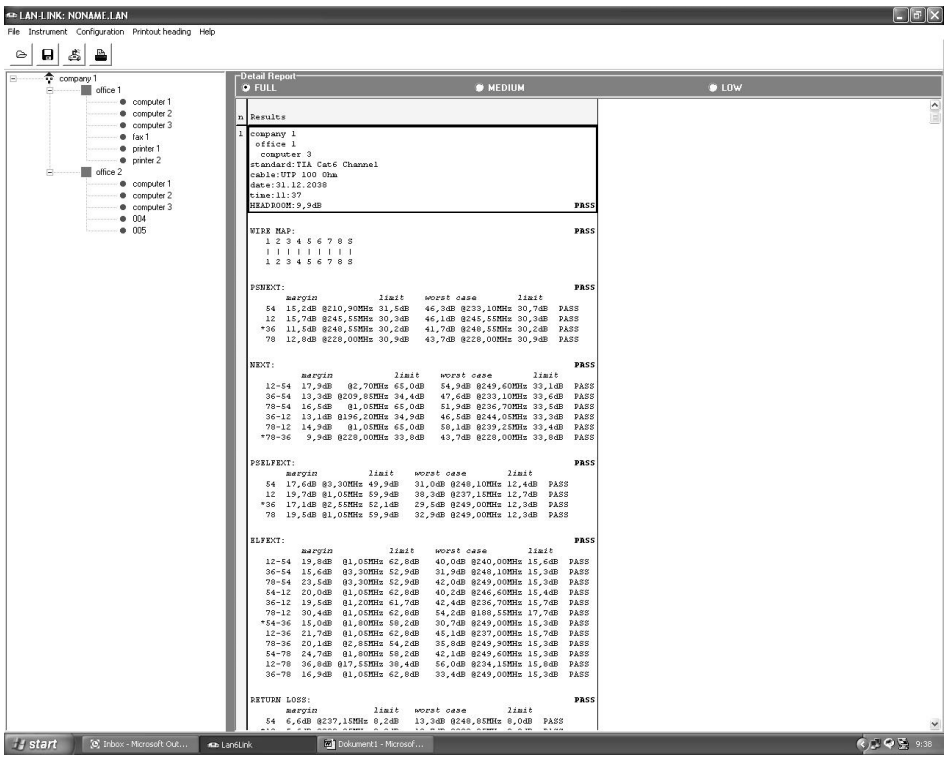
NEXT, ELFEXT, PSNEXT, PSELFEXT, Attenuation, Return Loss, ACR, PSACR, TDR and TDnext plots that are selected in ***Receive Results*** window, can be viewed and modified for printing in this window. On the right side pairs, adjacent pairs and limits can be switched on or off. The plots contain additional information about Test Standard and Cable Type, date & time of measurement etc.
From this screen the plots can be saved or printed out.



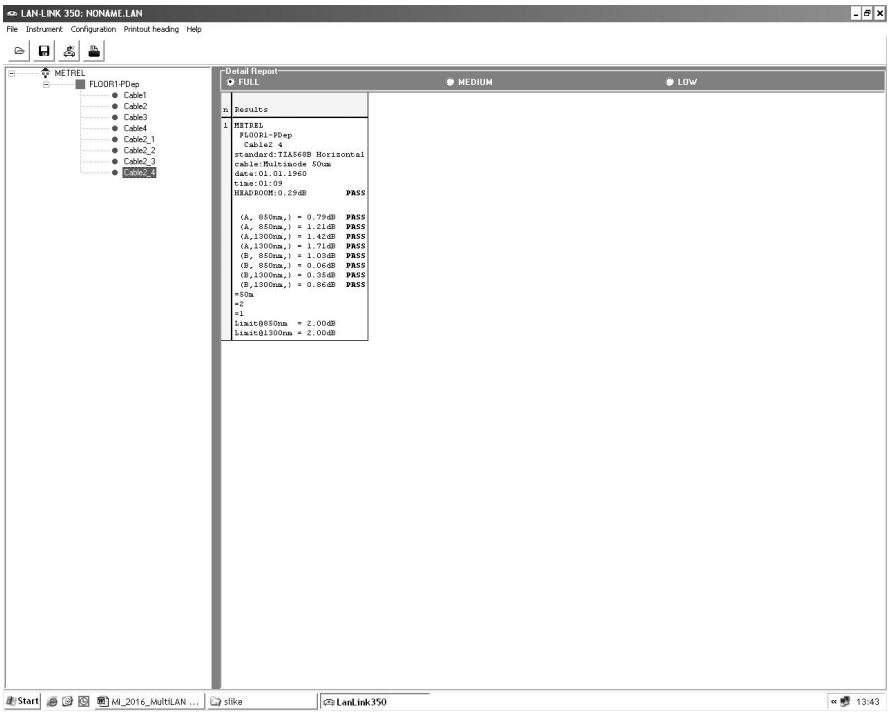
Typical Plot window

6.1.5 Saving Autotest Result or Plots for Documentation Purposes

Complete Autotest results (together with the installation structure) and plots can be saved for documentation purposes.



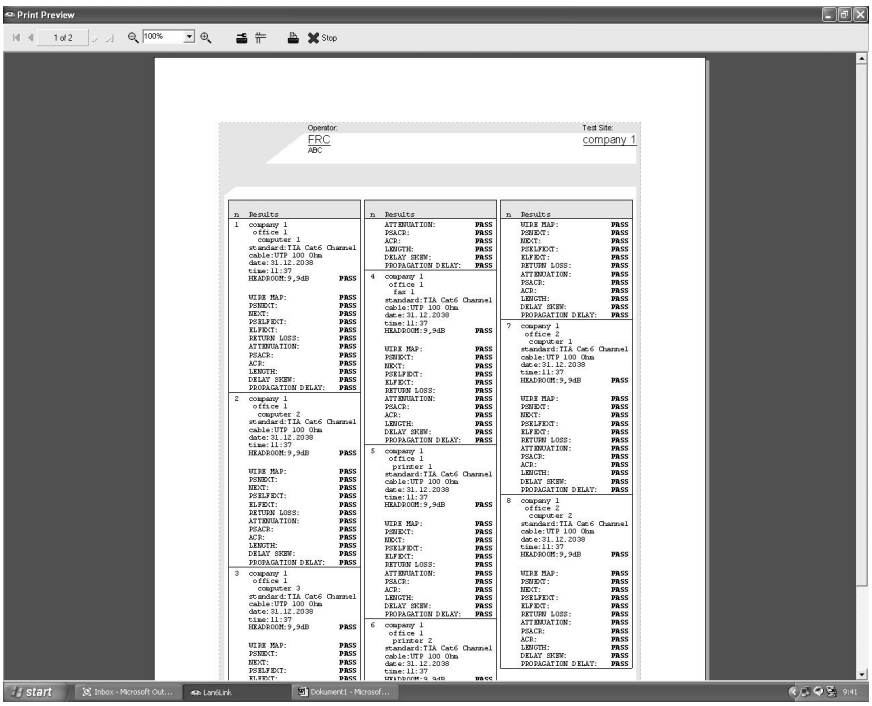
Example of Autotest result window - cupper cable



Example of Autotest result window – optical fiber cable

6.2 Printing out a test report or plot

After the test report is edited (locations renamed, comments added, test site data etc) it can be printed out. A confirmation print out preview always appears.
s



Test Report print preview

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