2-Way Injector™
User Guide

A GUIDE TO USING THE 2-WAY INJECTOR WITH YOUR MICROTEST PENTASCANNER

MICROTEST®

Contents

INTRODUCTION

The 2-Way Injector, when used with the PentaScanner, provides the ability to measure Near End Crosstalk (NEXT) from both ends of a link, without having to swap measurement devices at the ends of the link.

The 2-Way Injector performs wire map, signal generation for Attenuation, and end of link termination for other measurements. In addition, it measures NEXT at the Injector end of the link and reports the results to the PentaScanner. As part of the PentaScanner Autotest, NEXT and ACR results are stored for both ends of the link. Data from the Injector end of the link can be displayed in any of the Autotest view modes and printed as part of Autotest Reports.

➤**Note:** The 2-Way Injector supports PentaScanner Software version 3.0 and later. Refer to the PentaScanner user guide for instructions on updating the PentaScanner to the appropriate software version.

A LOOK AT THE INJECTOR
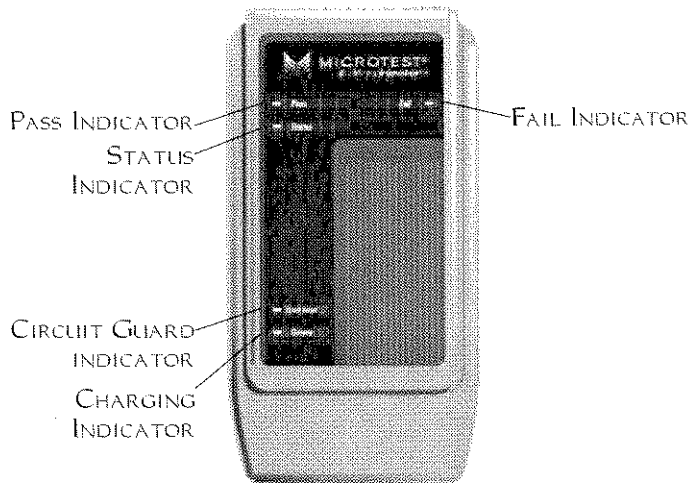
The 2-Way Injector features LED indicators and an audible tone generator. Each is described in the following sections:

PASS INDICATOR (GREEN)

The PASS Indicator (Green) is located at the upper left of the 2-Way Injector and is lit when the overall Autotest result is PASS.

FAIL INDICATOR (RED)

The FAIL Indicator (Red) is located at the upper right of the 2-Way Injector and is lit when the overall Autotest result is FAIL.

STATUS INDICATOR (GREEN)

The Status Indicator (Green) is located at the upper left of the 2-Way Injector, just below the PASS Indicator. The Status Indicator shows the 2-Way Injector's status as follows:

Indicator State	Description
ON, steady state	2-Way Injector is powered ON and waiting for communication with PentaScanner.
OFF, steady state	2-Way Injector is powered OFF (or charging battery if AC adapter is attached). See Charging Indicator for charging status.
BLINKING, rapidly	Executing command or measurement in progress.
BLINKING, slowly (approximately once per second)	Battery is LOW.

CIRCUIT GUARD INDICATOR (RED)

The Circuit Guard Indicator (Red) is located at the lower left of the 2-Way Injector, just above the Charging Indicator. The Indicator blinks when a voltage level greater than 15 volts is detected on any wire pair. When this condition exists, you should remove the 2-Way Injector immediately to prevent damage. An audible alarm will sound until 5 seconds after the hazard condition is cleared.
➢**Note:** The PASS and FAIL Indicators will also blink during an overvoltage condition.

CHARGING INDICATOR (RED)

When the 2-Way Injector is powered OFF and the AC adapter is plugged in, the Ni-Cd battery pack is being charged. The Charging Indicator shows the state of charging as follows:

Indicator State	Description
ON, steady state	2-Way Injector is powered ON, the AC adapter is present and the battery pack is being charged at the maximum rate.
OFF, steady state	Battery or AC adapter is not present.
BLINKING (once every 10 seconds)	AC adapter is present, the battery pack is fully charged and the 2-Way Injector is in trickle charge mode.

TONE GENERATOR

The Tone Generator provides the following information/status:

Status	Description
Autotest PASS	A series of ascending tones (higher in frequency) is generated to indicate an Autotest PASS result.
Autotest FAIL	A series of descending tones (lower in frequency) is generated to indicate an Autotest FAIL result.
Hazard	A steady tone is generated to indicate that a high voltage condition is detected on the link under test. Circuit Guard indicator (and the PASS and FAIL LEDs) are also illuminated. The alarm ceases 5 seconds after the hazard is removed.

SERIAL NUMBER/VERSIONS/STATUS

2-Way Injector status is displayed on the PentaScanner:

➤ Use the patch cord to connect the PentaScanner and the 2-Way Injector.

PATCH CORD

PENTASCANNER   2-WAY INJECTOR
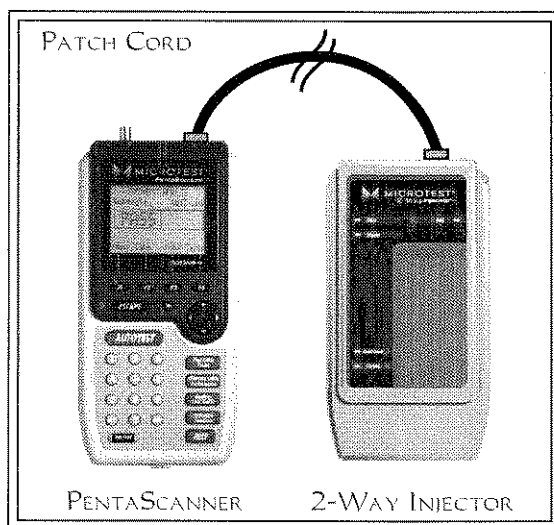
➤ From the PentaScanner **Ready!** screen, press
(button); then select **Injector Status** to display 2-Way Injector information on the PentaScanner screen:

LAST CALIBRATION DATE & TIME

SOFTWARE VERSION

HARDWARE VERSION

SERIAL NUMBER

```
      MICROTEST
        PentaScanner
    INJECTOR STATUS
Calibrated at 10:00 16-Oct
Battery:      OK
SW Version:  1.00a
HW Version:  1.00a
  Serial #00123456789
                  100MHz
```

BATTERY STATUS:
OK IF GOOD,
LOW IF NOT

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POWER/BATTERY

When operating from its internal battery pack, the 2-Way Injector is powered on by the PentaScanner. When active, the Status Indicator will indicate the current mode of operation. (*See the section titled STATUS INDICATOR for details*). After 10 seconds of inactivity, the 2-Way Injector will automatically shut itself off to preserve battery life.

When operating with the AC adapter plugged in, the 2-Way Injector is always on. If it is inactive (i.e. not performing measurements), the 2-Way Injector recharges its battery pack. The Charging LED will indicate the state of the battery. (*See the section titled CHARGING INDICATOR for details*). Battery charging is disabled while the 2-Way Injector is performing a measurement function. After 10 seconds of inactivity, the 2-Way Injector automatically returns to charging mode.

RECHARGEABLE BATTERY

The 2-Way Injector is powered by a rechargeable Ni-Cd battery pack. The battery is recharged by plugging the AC adapter into the 2-Way Injector (with the battery in place), or by using the battery charger (optional accessory available from your distributor).

Capacity:	1200 mAh
Battery Life:	6-8 hours daily operation
Average Recharge Time:	14 hours (using AC Adapter)
	2-3 hours (using Battery Charger)

REMOVING THE BATTERY PACK

Remove the 2-Way Injector battery pack by sliding the arrow-shaped tab (on the back of the Injector) downward and lifting up the battery pack.
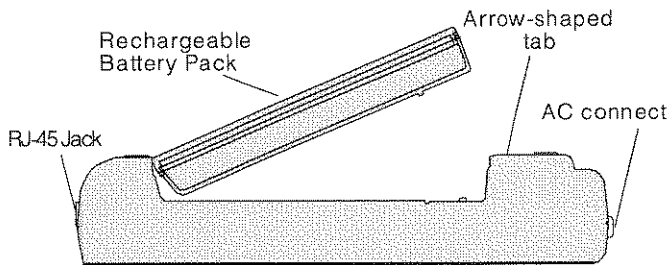
The 2-Way Injector is powered by a rechargeable, recyclable Nickel Cadmium (Ni-Cd) battery pack. Under various state and local laws, it may be illegal to dispose of this battery pack into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal.

HIGH VOLTAGE PROTECTION

When attached to twisted-pair cabling, the 2-Way Injector detects the presence of voltage greater than 15 volts. The Injector turns on the Circuit Guard LED, PASS and FAIL indicators, causing all three to blink approximately once every half second. An audible alarm will sound for the duration of the hazard. The Injector should be removed within 20 seconds time to prevent damage.

Hazard Voltage Threshold: ±15 volts

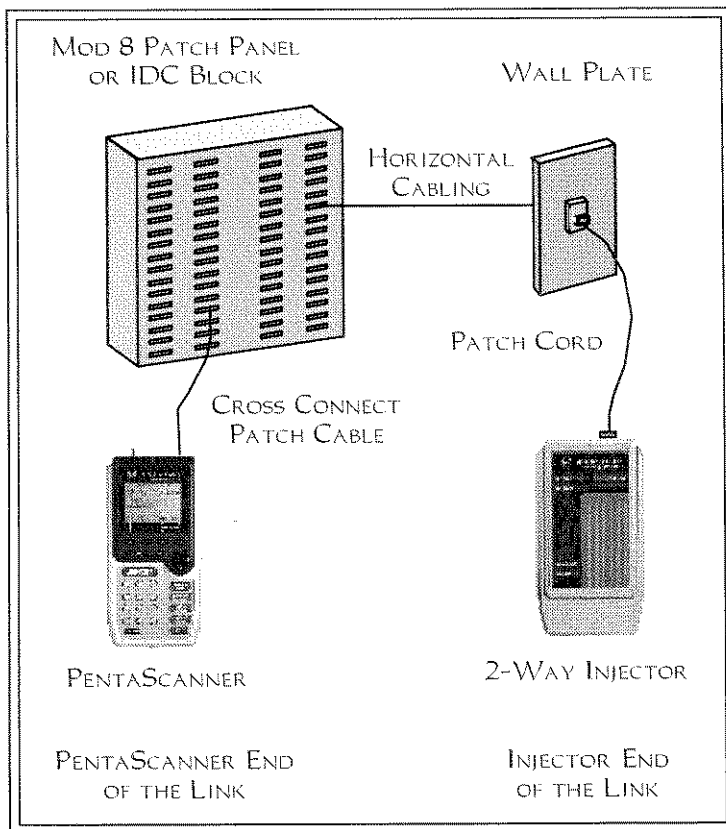Maximum time to withstand hazard: 20 seconds

WHEN TO USE

Some measurements require the use of the 2-Way Injector at the Injector end of the cable. For other measurements, the 2-Way Injector can be connected but its use is optional. The PentaScanner automatically detects the presence of the 2-Way Injector and configures the Injector for the measurement to be performed.

The following table outlines when to use the 2-Way Injector:

Measurement	2-Way Injector Required?	Description
Attenuation	Yes	The 2-Way Injector generates the frequencies and the PentaScanner measures the signal to determine signal loss.
Autotest	Yes	The 2-Way Injector is required for Attenuation, NEXT measurements, Resistance and Wire Map during Autotest.
Capacitance	No	If connected, the 2-Way Injector provides an "OPEN" for the duration of the measurement.
Impedance	No	If connected, the 2-Way Injector provides an "OPEN" termination for the duration of the measurement.
Length	No	If connected, the 2-Way Injector provides an "OPEN" termination for the duration of the measurement.
NEXT (PentaScanner End)	Yes	The 2-Way Injector provides a 100 ohm termination while the PentaScanner measures NEXT.
NEXT (Injector End)	Yes	The 2-Way Injector generates a frequency sweep and measures the coupling from the transmit to the receive pair. The PentaScanner provides a 100 ohm termination for the duration of the measurement.
Loop Resistance	Yes	If connected, the 2-Way Injector is used to "SHORT" the wire pair under test and the PentaScanner measures loop resistance. If the 2-Way Injector is not connected, the PentaScanner will display "OVR" (Over range).
Wire Map (Find Cable Faults)	Yes	The PentaScanner communicates with the 2-Way Injector across the link under test to determine the wire connection from the PentaScanner end to the Injector end.
Noise	No	The 2-Way Injector is not required to measure impulse noise or peak-to-peak noise.

Connections

The PentaScanner and the 2-Way Injector are used together to perform measurements which allow the PentaScanner to verify installed links or assist in the diagnosis of network problems at the physical layer. To accomplish these measurements, the PentaScanner and the 2-Way Injector are connected at both ends of a network cabling link. The end at which the PentaScanner is connected is referred to as the "PentaScanner end". The end at which the 2-Way Injector is connected is referred to as the "Injector end".

Mod 8 Patch Panel or IDC Block

Wall Plate

Horizontal Cabling

Patch Cord

Cross Connect Patch Cable

PentaScanner

2-Way Injector

PentaScanner End of the Link

Injector End of the Link

CALIBRATION

Two types of calibration are required for the 2-Way Injector – signal amplitude calibration and internal measurement circuitry calibration. Calibration of the Injector's signal amplitude is required for accurate Attenuation measurements and requires user intervention. Calibration of the internal measurement circuitry is required to account for temperature changes and is performed automatically. The only effect you may notice is an occasional slight increase in test times while internal calibration is being performed. The following sections describe the calibration processes:

2-WAY INJECTOR
SIGNAL AMPLITUDE CALIBRATION

The PentaScanner and 2-Way Injector are connected through their respective RJ-45 ports using a high quality patch cable (provided with each instrument).

➤**Note:** Do not use a patch cable longer than 15 feet (4.572 meters) for calibration – the calibration process will not be allowed to proceed.

The amplitude of each frequency generated by the 2-Way Injector is measured by the PentaScanner. The resulting calibration values are stored in the PentaScanner according to the 2-Way Injector's serial number. The PentaScanner maintains 5 sets of 2-Way Injector calibration data simultaneously. The calibration sequence is required once per calendar day and expiration of calibration data is automatically detected by the PentaScanner.

CALIBRATION PROCEDURE

1. Connect the PentaScanner and the 2-Way Injector using the patch cable supplied with the PentaScanner.

2. Power on the PentaScanner.

3. Press [button].

4. Select **Calibrate Injector**.

The PentaScanner will display:
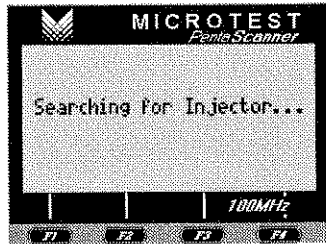
5. On finding the Injector, the PentaScanner displays:

➤**Note:** You can press [button] **Cancel** to stop the calibration.

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6. When the calibration is complete, the PentaScanner displays:

Press **F1** OK to return to the **Extended Functions** menu.

2-WAY INJECTOR INTERNAL CALIBRATION

Periodically, the 2-Way Injector and the PentaScanner require calibration of their internal measurement circuitry. The PentaScanner will determine when internal calibration is required for itself and the 2-Way Injector. If required, the PentaScanner directs the 2-Way Injector to perform the calibration. At the same time, the PentaScanner performs its own internal calibration, synchronizing the calibration times of both devices. Before the PentaScanner performs Attenuation or NEXT measurements, the last calibration time is checked to see if recalibration is required.

AUTOTESTS

During Autotest, the 2-Way Injector provides the far end termination for measurements made by PentaScanner. In addition, it generates signals of programmable frequency for measurement by the PentaScanner to determine one-way Attenuation. The 2-Way Injector also generates swept frequency signals and measures the Near End Crosstalk at its end of the installed link. The PentaScanner acts as the termination device while NEXT is being measured by the 2-Way Injector.

When measuring Attenuation or running an Autotest, the PentaScanner attempts to communicate with the 2-Way Injector to determine the serial number. If communication fails, the PentaScanner displays an error message that the Injector was not found:
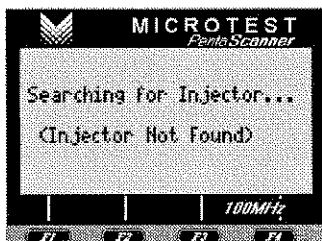
If communication is successful, the PentaScanner requests the 2-Way Injector's serial number, which is used to index the calibration records. If a calibration record is not found for the 2-Way Injector or if the record is outdated, the PentaScanner displays:

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SELECTING THE TESTS TO RUN

➤ ➤ ➤ To Display This Screen ◄ ◄ ◄

Press ⬛**Extended Functions**; then select **Setup**; then select **Autotests**; then highlight the Autotest to edit; then press ⬛ **Edit**; then select **Tests to Run**.

This screen lets you enable or disable the tests to run during Autotest. Press the ▲ or ▼ arrow key to highlight the test(s) to enable or disable.

Press ⬛ **Select** (or **Unsel**) to enable (or disable) the highlighted test. Enabled tests are marked with a ⊠. Disabled tests are marked with a ☐.

After all test selections have been made, press ⬛ **Save** to save the list of selected tests for this Autotest.

Press ⬛**ESCAPE** to exit the screen without saving.

➤**Note:** ACR will not be computed unless the NEXT and Attenuation tests are enabled (since ACR computations are based on NEXT and Attenuation measurements). The PentaScanner will automatically disable ACR if NEXT and Attenuation are not enabled.

Wire Map

The 2-Way Injector plays an integral part in determining the wire map for a given link. With the PentaScanner and the 2-Way Injector connected at opposite ends of a link or cable, the wire map can be determined. When running **Find Cable Faults** or **Autotest**, the PentaScanner and the 2-Way Injector communicate to determine how the link is wired. The PentaScanner/2-Way Injector combination identifies the following wiring configurations:

Straight Through Wiring
Straight through wiring is displayed as:
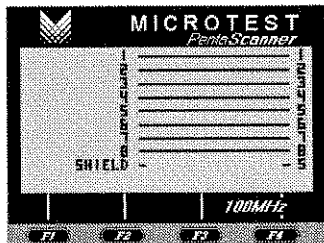
➢**Note:** Straight through wiring is the expected case.

Cross Wiring
Cross wiring is displayed as:
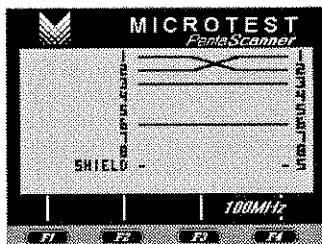
SHORT AT THE INJECTOR END

A short at the Injector end of the link is displayed as:

SHORT AT THE PENTASCANNER END

A short at the PentaScanner end of the link is displayed as:

➢**Note:** The 2-Way Injector is not required in order to detect a short at the PentaScanner end of the link.

SHORT AT BOTH ENDS OF THE LINK

A short at both ends of the link is displayed as:

NEAR END CROSSTALK (NEXT)

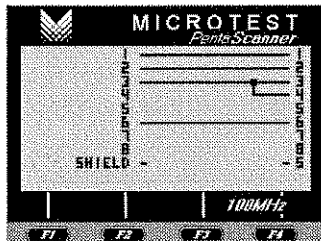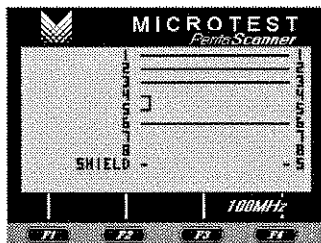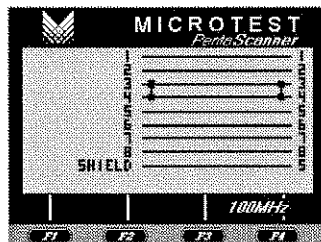Near End Crosstalk is a measure of the amount of signal coupled from the transmit pair to the receive pair in the link. The 2-Way Injector allows NEXT to be measured at both ends of the link without having to swap the PentaScanner and the Injector end devices. When the PentaScanner is measuring NEXT, the 2-Way Injector provides a 100 ohm termination at the Injector end. The PentaScanner transmits a signal which is varied (or swept) through a frequency range. The signal is monitored on the receive pair through a narrow band receiver. The received signal amplitude is compared to the transmitted signal and the difference is reported as the NEXT value (in dB).

When measuring Injector end NEXT, the roles of the devices are reversed. The PentaScanner provides the 100 ohm termination for the 2-Way Injector measurements and the 2-Way Injector transmits a signal which is varied (or swept) through a frequency range. The signal is monitored by the 2-Way Injector on the receive pair through a narrow band receiver and the difference in the transmitted and received signal levels is reported as the Injector end NEXT (in dB).

NEXT TEST RESULTS (VIA EXTENDED FUNCTIONS)

SWEEP RANGE
FREQUENCY
INCREMENTS

PAIRS

```
      MICROTEST
        PentaScanner
      NEXT (Penta)
Range: 0.7 to 100.0 MHz
Step: Linear 200 KHz
Worst Case:
12/36  47.0 dB at 99.7MHz
Graph  Sweep  Pair   Inj
                     100MHz
 F1     F2     F3     F4
```

WORST CASE
NEXT RESULT
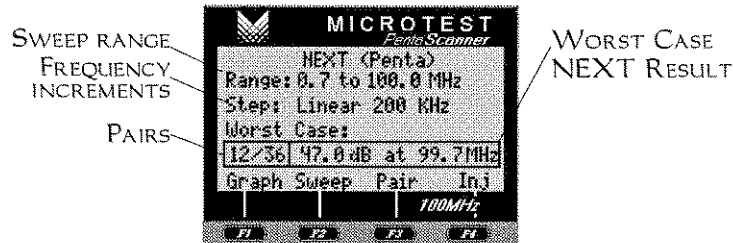
> ➤ ➤ ➤ **To Display This Screen ◄ ◄ ◄**
>
> Press 🔲 **Extended Functions**; then select **NEXT**.

This screen is displayed by connecting the PentaScanner and the 2-Way Injector to opposite ends of the link and selecting **NEXT** from the **Extended Functions** menu. The top line of the display indicates if NEXT is being reported from the PentaScanner end or the Injector end of the link.

Press 🔲 **Graph** to display a graph of NEXT test results.

Press 🔲 **Sweep** to display or modify the frequency sweep range for all pairs.

Press 🔲 **Pair** to toggle through the NEXT results for each pair combination.

Press 🔲 **(Penta or Inj)** to toggle the display of NEXT results between the PentaScanner end and the Injector end of the link.

Press 🔲 to exit.

➤**Note:** Both the PentaScanner and the 2-Way Injector use the same range and step size settings.

NEXT RESULTS (VIA AUTOTEST)
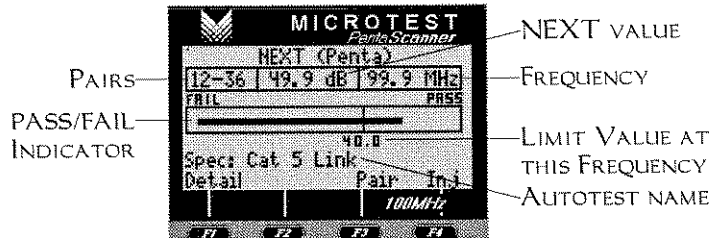
> > > To Display This Screen < < <
>
> > > After Running an Autotest < < <

Press ▇ View from the **Autotest Results** screen; then press the ▼ arrow key until this screen is displayed.

> > > To Display This Screen < < <
>
> > > From Saved Autotest Results < < <

Press ▇; then select **Memory**; then highlight the Autotest to edit; then press ▇ View; then press ▇ View again; then press the ▼ arrow key until this screen is displayed.

This screen displays **NEXT** results from **Autotest**. The top line of the display indicates if NEXT is being reported from the PentaScanner end or the Injector end of the link.

Press ▇ **Detail** to display the Frequency Sweep range and NEXT test results for all pairs.

Press ▇ **Pair** to toggle through the Autotest NEXT results for each pair combination.

Press ▇ **(Penta** or **Inj)** to toggle the display of Autotest NEXT results between the PentaScanner end and Injector end of the link.

Press ▇ to exit.

ATTENUATION

Attenuation is a measure of signal loss in a cabling link. The 2-Way Injector generates a signal at specific frequencies which are in turn measured by the PentaScanner. The 2-Way Injector signal level output is determined during calibration. The signal level measured on the link under test is compared to the calibration value to determine the signal loss in dB.

The screens displayed for Attenuation test limits and measurements are the same for both the PentaScanner end and the Injector end of the link.

ATTENUATION TO CROSSTALK RATIO (ACR)

Attenuation to Crosstalk Ratio (ACR) is an indication of how much larger the received signal is, compared to NEXT on the same pair. ACR reports the difference between NEXT and Attenuation on the link. ACR results are computed by the PentaScanner for both ends of the link from the measured NEXT and Attenuation. The worst case ACR is then reported for each pair combination at each end of the link.

ACR RESULTS (VIA AUTOTEST)

PAIRS —
PASS/FAIL — INDICATOR

— ACR VALUE
— FREQUENCY
— LIMIT VALUE AT THIS FREQUENCY
— AUTOTEST NAME
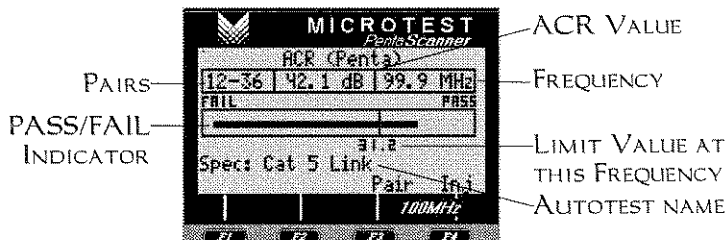
> ➤ ➤ ➤ To Display This Screen ◄ ◄ ◄
> ➤ ➤ ➤ After Running an Autotest ◄ ◄ ◄
>
> Press **F1** View from the **Autotest Results** screen; then press the ▼ arrow key until this screen is displayed.
>
> ➤ ➤ ➤ To Display This Screen ◄ ◄ ◄
> ➤ ➤ ➤ From Saved Autotest Results ◄ ◄ ◄
>
> Press ▮▮▮; then select **Memory**; then highlight the Autotest to view; then press **F1** View; then press **F1** View again; and press the ▼ arrow key until this screen is displayed.

This screen displays Autotest **ACR** results. The top line of the display indicates if ACR is being reported from the PentaScanner end or the Injector end of the link.

Press **F3** **Pair** to toggle through the Autotest ACR results for each pair combination.

Press **F4** **(Penta** or **Inj)** to display Autotest ACR results from the PentaScanner end or the Injector end of the link.

Press **ESCAPE** to exit.

VIEWING AUTOTEST RESULTS SUMMARY
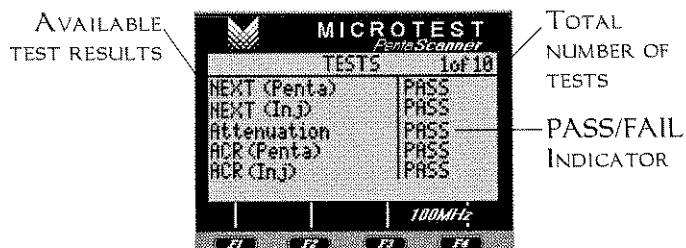
AVAILABLE TEST RESULTS

TOTAL NUMBER OF TESTS

PASS/FAIL INDICATOR

> ➤ ➤ ➤ To Display This Screen ◀ ◀ ◀
>
> ➤ ➤ ➤ After Running an Autotest ◀ ◀ ◀
>
> From the **Autotest Results** screen press 🔲 **Tests.**

> ➤ ➤ ➤ To Display This Screen ◀ ◀ ◀
>
> ➤ ➤ ➤ From Saved Autotest Results ◀ ◀ ◀
>
> Press 🔲; then select **Memory**; then highlight the Autotest results to view; then press 🔲 View; then press 🔲 **Tests.**

The PASS/FAIL status for the individual tests can be viewed after running an Autotest, or from Autotest results that have been stored in PentaScanner's memory.

Press the ▲ or ▼ arrow key to scroll through the list of tests and their PASS/FAIL results.

Press 🔲 to exit.

SAMPLE AUTOTEST REPORT

The PentaScanner Autotest report contains NEXT and ACR data for the PentaScanner and Injector end:

```
                        Microtest
                 Cable Certification Report
                        CAT5 Link

 Circuit ID:      1-BCA               Date:          21-Sep-94
 Test Result:     Fail               Cable Type:    Cat 5 UTP
 Owner:           PentaScanner
                                      Gauge:
 Serial Number:   38S94BB0054        Manufacturer:
 SW Version:      3.0                 Connector:
                                      User:          ①

 Building:                           Floor:
 Closet:
 Rack:                               Hub:
 Slot:                               Port:

 Test          | Expected Results  |    Actual Results
 --------------|-------------------|----------------------------
 Wire Map      | Near: 12345678    |   Near: 12345678     ③
               | Far:  12345678    |   Far:  12345678
 --------------|-------------------|----------------------------
               | Min      Max      | Pair 12  Pair 36  Pair 45  Pair 78
               | ----    -----     | -------  -------  -------  -------
 Length    ft  | 10       328      |   53       53       49       53
 Impedance ohms| 80.0     125.0    | *150     *152     *155     *150
 Resistance ohms| 0.0     18.8  ④  |   2.6      2.6      2.6      2.7
 Capacitance pF| 50       5600     |  721      716      715      716
 Attenuation dB|       ②           |   3.2      3.0      3.9      3.3
   aFreq    MHz|                   |  100.0    100.0    100.0    100.0
   Limit    dB |                   |   24.0     24.0     24.0     24.0
 --------------|-------------------|----------------------------
 Penta Pair Combinations  | 12/36   12/45   12/78   36/45   36/78   45/78 ⑤
 -------------------------|-------  -------  ------  ------  ------  ------
 NEXT Loss           dB   | 44.4    41.0    40.9    36.2    39.3    37.0
   aFreq 0.7-100.0   MHz  | 99.3    83.1    96.1    99.3    99.5    97.1
   Limit: Cat 5 formula dB| 27.1    28.5    27.4    27.1    27.1    27.3
 Active ACR          dB   | 41.6    44.7    43.3    32.5    36.2    44.3
   aFreq 0.7-100.0   MHz  | 100.0   100.0   31.2    100.0   100.0   31.2
   Limit: Derived    dB   | 3.1     3.1     22.9    3.1     3.1     22.9
 -------------------------|-------  -------  ------  ------  ------  ------
 Injector Pair Combinations | 12/36  12/45   12/78   36/45   36/78   45/78
 --------------------------|------  -------  ------  ------  ------  ------
 NEXT Loss           dB   | 35.0    37.1    45.6    33.9    41.4    41.3
   aFreq 0.7-100.0   MHz  | 99.1    99.9    99.9    94.3    99.1    97.1
   Limit: Cat 5 formula dB| 27.1    27.1    27.1    27.5    27.1    27.3
 Active ACR          dB   | 34.1    36.2    44.9    33.5    40.5    40.6
   aFreq 0.7-100.0   MHz  | 100.0   100.0   100.0   100.0   100.0   100.0
   Limit: Derived    dB   | 3.1     3.1     3.1     3.1     3.1     3.1
 --------------------------------------------------------------

 Signature:                          Date:
 ----------------------------        -------------
```

① Circuit ID Heading identifies the cable being tested. The Circuit ID is filled in as you save each test result.

② Expected results (factory or user-defined)

③ Actual test results for pairs tests in the link

④ An asterisk (*) indicates that the test result is outside of the limits set for the test

⑤ NEXT and ACR results for each pair combination in the link

UPDATING THE 2-WAY INJECTOR SOFTWARE

The 2-Way Injector contains Flash memory that can be updated electronically through the Microtest Bulletin Board System (BBS). This can be done without having to open the 2-Way Injector or return it to the factory.

WARNING: If you have any Autotest results stored in the PentaScanner, print or download them to a PC before updating the 2-Way Injector. The update process will erase all test results stored in PentaScanner's memory.

To dial in to the BBS:

1. Use a communications package for the modem on your PC* and set the following parameters:

    ➢   Baud rate of 1200 to 14,400

    ➢   8 Data Bits

    ➢   1 Stop Bit

    ➢   No Parity

    ➢   ANSI Terminal Emulation

    * PC must have 80286 (or better) processor.

2. Dial in to the Microtest BBS:
    (602) 957-7716   (U.S.) or
    +31 (0) 2503 51702   (International)

3. If this is your first time dialing in to the BBS, follow the prompts to register as a new user. Have your serial numbers ready.

4. Join the BBS conference by selecting the letter 'J' (**Join Conference**) from the Main Menu. You can then select 'L' to view a list of conferences. After accessing the appropriate conference, select 'F' (**File Menu**) then 'L' (**List Files**).

5. Follow the BBS prompts to download the file.

6. The file you download will have a **.EXE** extension. This is a "self-extracting archive" program that you will run to decompress the update program, Flash image and "README" files. For example, if the file you downloaded is named **HELLO.EXE**, type **HELLO** and press the **Enter** key on your PC to decompress the update program, Flash image and "README" files.

7. Connect the 2-Way Injector and the PentaScanner via the supplied patch cable.

8. Connect the PentaScanner to an IBM-compatible PC's serial communication port (COM 1 or COM 2) via the supplied DB9-DB9 serial cable.

9. Plug the AC adapter in to the PentaScanner.
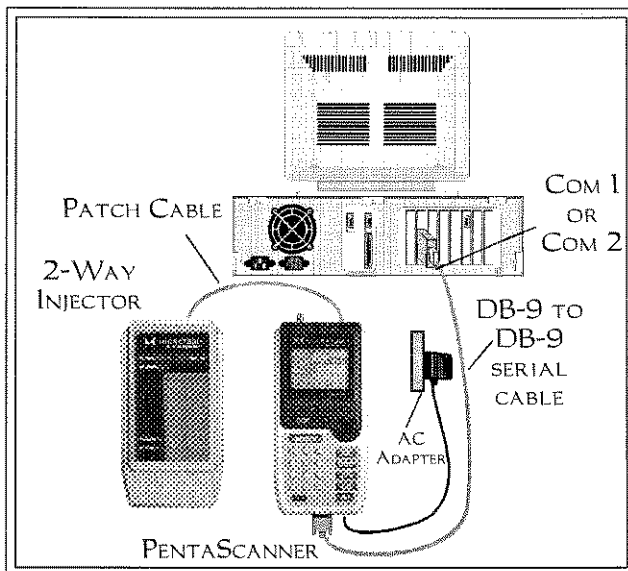
10. Follow the directions in the "README" file to run the update program and to download the new Flash version.

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SPECIFICATIONS

LED DISPLAYS

Pass Indicator (GREEN) for test result
Fail Indicator (RED) for test result
Status Indicator (GREEN) for 2-Way Injector status
Charging Indicator (RED) for battery status
Hazard Indicator (RED) for high voltage input protection warning

AUDIBLE FEEDBACK

Programmable tone generation through a piezo-electric transducer

RECHARGEABLE BATTERY

Removable, rechargeable Nickel Cadmium (Ni-Cd) battery

Capacity: 1200 mAh

Battery Life: 6-8 hours daily operation

Charging Time: 14 hours (via AC Adapter)
                   2-3 hours (via Battery Charger)

HIGH VOLTAGE PROTECTION

Hazard Voltage Threshold: ±15 volts
Maximum time to withstand hazard: 20 seconds

RAM BATTERY BACKUP

Battery backup of RAM is provided to retain any measurement data or configuration information across power on/off cycles

FLASH MEMORY
128K FLASH memory is provided to allow for software updates in the field

POWER CONTROL
AC Adapter or Battery
Auto-shutoff when operating on battery
Power on under PentaScanner control

NEXT TO 100MHz
Near End Crosstalk from 0.7 - 100 MHz

NEXT STEP SIZE
User selectable; 100, 200 and 500 KHz

FREQUENCY GENERATION TO 100 MHz
Frequency generation:
    512, 772 KHz,
    1.0, 2.0, 4.0, 5.0, 8.0, 10.0, 16.0 MHz,
    20.0, 25.0, 31.25, 62.5, 100.0 MHz

INJECTOR END TERMINATION TO SUPPORT PENTASCANNER MEASUREMENTS
OPEN (during Impedance, Capacitance, and Length measurements and during Communication)

SHORT (during Loop Resistance measurements)

100 Ohm Termination (during NEXT measurements)

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