

CAT 5/5e/6 LAN PERFORMANCE VERIFIER

MODEL TS580A
USER'S GUIDE



Includes data transfer and printing instructions

 **BLACK BOX**
724-746-5500

The TS580A includes the following items:

- Main unit
- Remote probe
- Cat5e Patch Cables (2)
- 6' serial data transfer cable
- CD with data transfer software
- Protective case (zippered)
- Documentation tablet
- "Passed" stickers
- 9V battery (2)
- Illustrated user's guide

TS580A User's Guide
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Section I. Introduction

Over half of all network problems are caused by faulty cables. And with network speeds exponentially increasing, the need for affordable, sophisticated test equipment is more apparent than ever before.

The LAN Performance Verifier (LPV) is break-through-technology that brings cable and network testing to a whole new level of reality. It opens up a whole new world of testing opportunities to network cabling professionals and managers that, prior to the LAN Performance Verifier, could only dream of performing *speed tests* on their cable and LAN devices and *printing* the results.

Unlike traditional certifiers, the LPV uses digital circuitry and digital testing techniques to perform its tasks. These tests include traditional cable verification (opens, shorts, split pairs, wire map) plus sophisticated crosstalk, timing and cable parameter tests that yield the cable's category (CAT3, CAT5, CAT5E, CAT6) and speed capability (10, 100, 1000 MB)! And if you wish, the LPV can use your own network devices (hubs, switches, PCs) to test cables with real live data! And for network devices, the LAN Performance Verifier analyzes links and data from all types of hubs, switches and PCs. It performs both *single sided tests* for *advertised* speed (10, 100, 1000 MB and duplex) and *inline tests* (between devices) for *negotiated* speed. The engine of the LPV circuitry is capable of 1 nanosecond resolution.

What is LAN Performance Verification?

LAN Performance Verification means that a cable passed a prescribed battery of tests and is therefore not likely to cause problems later. The LAN Performance Verifier has two levels of verification:

LPV Level 1: Performed with the *Main Unit* and the *Remote Probe*, Level 1 tests the cable for length; opens, shorts, split pairs and

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distance to the fault; wire map (displays cable wiring); NEXT and FEXT (crosstalk tests); propagation delay (time to transit cable); skew (time delay between pairs); cable category (CAT3, 5, 5E, 6); and speed projection (10, 100, 1000 MB).

LPV Level 2: Includes all Level 1 tests plus takes advantage of a real live data source (hub, switch or PC) to test for attenuation and hot splits (split testing while connected to a LAN device). The result is LPV Level 2 speed verification of the cable and the LAN device.

Why use the LAN Performance Verifier?

The LAN Performance Verifier conducts a series of tests designed to eliminate cable problems before tackling network software issues.

Networks are installed using many steps. First the cables are installed. Then the hubs, switches and PCs are installed. Cables and network interfaces are known as the physical layer. The software provides higher communication layers such as addressing and file transfers. The problem is that if the physical layer (cables/ports) does not work then the communications layers (software) will not work either. Debugging cables, ports and network software all at the same time is time consuming, frustrating and ultimately very expensive. There are too many unknowns. LAN Performance Verifying cables first eliminates unknowns and therefore makes it easier to get a network up and running. And, once the hardware is operational you can run software layer tests from any workstation (see Appendix).

The best time to use the LAN Performance Verifier is when the installer is still readily available to repair any faults that are found. Installers should use the LAN Performance Verifier before they leave, so that they will not lose money by having to return to a job site to do in warranty repairs. Network professionals should use the LAN Performance Verifier before the warranty period expires.

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The LPV List of Functions

LAN Performance Verification Level 1 tests:

- ✓ Length measurement of each cable pair.
- ✓ Locates opens, shorts and distance to the fault.
- ✓ Locates split pairs and the distance to the split.
- ✓ Wire map. Graphs cables internal pairing.
- ✓ NEXT (near end) and FEXT (a far distance) crosstalk.
- ✓ Propagation delay (time for data to travel the length of the cable).
- ✓ Skew (time delay between pairs).
- ✓ Cable typing. CAT 3, 5, 5E, 6.
- ✓ Speed Projection: Displays test results as a graph projecting the cable's speed capability (up to 1 GIGABIT).

LAN Performance Verification Level 2 tests. All Level 1 tests plus:

- ✓ Attenuation. Graphs level of real live data from PC, hub or switch.
- ✓ Hot Splits. Split pairs and remote split pairs detected on a dead or live cable connected to a PC, hub or switch.
- ✓ Speed Verification (Level 2). Enhanced speed display samples real live data on active pairs to the limit of the device (1 Gig).

Note: The Level 2 test uses real data from your hub, switch or

Network Device Testing:

- ✓ Single Sided and INLINE port tests quickly check the ability of the hub, switch or PC to communicate by displaying their *advertised* and *negotiated* capabilities.
- ✓ Data signal strength. Single sided test exercises the suspect hub, switch or PC and displays the data signal strength of active pairs.

Printer and Toner Probe:

- ✓ Toner/probe. Includes a full featured toner/probe. Tones all 4 pairs individually to locate wires in crowded wiring closets. Non-conductive tip, volume control and wiremap interface.
- ✓ Printer memory. Stores test results from up to 250 tests for later printing (requires a PC with Excel®). Transfer cable included.

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Section II. The Three Phases of LAN Installation

The LPV is designed for both the network installer, the network repair person and the IT manager. The tests used during the three phases of LAN installation can just as well be used to troubleshoot LANs that are suffering operational problems.

The installation of a LAN is generally handled in phases. The cabling is installed; then the switches and PCs are installed; and then all is connected together. The LPV plays a role during all three phases, saving countless hours of troubleshooting.

Phase I. Use the LPV during cable installation (before the switches and PCs are installed). After the LAN cable has been pulled through the building and terminated, it is good practice to LAN Performance Verify that the cabling is terminated properly and test that the cable is proper for the intended use (e.g. CAT5E for gigabit networks).

Phase II. Use the LPV after the switches and PCs are installed. Before connecting the cables to the switches and PCs, verify that each switch port and PC are operational. This provides a wealth of information: It verifies that the device is ON (i.e. it is transmitting); the speed of the device (10, 100, 1000 MB/s) ; duplex; and other features.

Phase III. Use the LPV when connecting the cabling to the switches and PCs. With the cabling LAN Performance Verified (Phase I) and the switch and PCs checked out (Phase II), all that remains is 1) getting the equipment communicating and 2) verifying each LAN link is performing at the speed expected. To do this, use *LAN Performance Verifier Level 2* to test the cable and port combinations. And use the *Network Tests* INLINE capability to connect between 2 LAN devices to verify the negotiated speed of the link.

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Section III. LPV Faceplate Descriptions.

LPV MAIN UNIT

The MAIN UNIT connects to any 10, 100, or 1000 Base-T device and performs a host of tests needed for the installation and repair of LAN cables and devices. For certain tests, it can be inserted *inline* between two LAN devices. ①

Main Unit Jacks

LEFT, CROSS and RIGHT: Use the LEFT jack for CABLE TESTING. Use all three jacks for NETWORK TESTING. ②

"Printer" port

Use to transfer stored testing data (up to 250 tests) to a PC. Requires Excel®. Serial data transfer cable included. ③

Power and LCD backlighting

Press the recessed power button. To backlight the display, press the SEL button during the opening screen. The LPV powers OFF if there is no activity for 10 minutes. ④

Cursor and SELECT buttons

Use the cursor buttons to select the function to be performed. Press the SEL button to select the functions. ⑤

LPV REMOTE PROBE

The Remote Probe performs 2 functions:

Tracing cables: Use it as an inductive probe to trace cables with the tone generated by the Main Unit. ⑥

Far end cable termination: The Remote Probe's jack is used to terminate the far end of the cable when the wire map test is conducted. ⑦



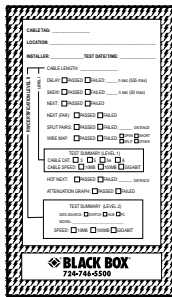
6

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Section IV. Documenting Testing Results

The LAN Performance Verifier includes 3 ways to document results.

- 1) A custom tablet can be used to fill in the test results (included).
- 2) "PASSED" stickers can be applied to wall outlets and LAN devices to LAN Performance Verify their capability (included).
- 3) Printer Memory that stores test results from up to 250 LAN Performance Verification tests for later printing (requires a PC with Excel®). A 6' serial transfer cable and software is included.



Documentation Tablet



"Passed" Stickers



Transfer readings to Excel® for printing (serial cable included)

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Section V OPERATION

Powering up and backlighting

Backlight selection screen (lighting the LCD display)



TURNING ON: Press the power button (PWR) for a second to turn ON the tester. The "backlighting" screen appears (above). Pressing the select (SEL) button while this screen is present turns on LCD lighting ("backlighting"). Backlighting is important when working in dim light but shortens battery life.

Note: Once enabled, the LCD will remain backlit until the tester is powered OFF. The *backlight selection screen* (above) is always lighted during the 3 second period that it is displayed. This allows you to turn the tester ON in a dark area and SELECT backlighting during the process.

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The Main unit's navigation button



How to navigate through the LAN Performance Verifier screen:

PWR. Power ON/OFF (see prior page for backlighting).

SEL (SELECT). Press to perform task. Appears as ► on LCD.

The UP arrow. Appears as ▲ on LCD.

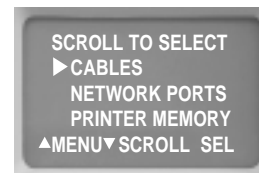
The DOWN arrow. Appears as ▼ on LCD.

The SELECT button's function *always* selects the task. But the function of the *UP and DOWN arrow* buttons may change with each screen. For example, the Main Menu (above) uses the *UP arrow button* to return the tester to the MAIN MENU and uses the *DOWN arrow button* to scroll the cursor.

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Main Menu

Main Menu



The MAIN MENU is the gateway to all of the LPV tests. Scroll the cursor with the *down arrow button* and press SELECT to perform the task.

► **CABLES:** Test and LAN Performance Verify cables with or without LAN devices (hubs, switches, PCs) connected. Move the cursor to CABLES and press SELECT. *Page 12.*

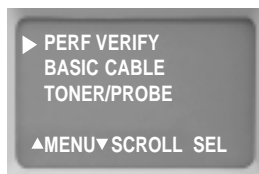
► **NETWORK PORTS:** Perform tests on LAN (hubs, switches, PCs) devices. Move the cursor to NETWORK PORTS and press SELECT. *Page 42.*

► **PRINTER MEMORY:** Printer memory is used to store the results of up to 250 LAN Performance Verify Level 1 and Level 2 tests for later printing ("Basic Cable Test" results are not stored). Move the cursor to PRINTER MEMORY and press SELECT if you want to *Review* the tests stored in memory or *Erase* memory. *Page 30.*

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Cable Testing Menu

Cable Testing
Main Menu



PERFORMANCE VERIFY ("LPV"): Move the cursor to PERF VERIFY and press SELECT to start LPV Level 1 testing of a cable. LPV tests have 2 levels: Level 1 uses the Main Unit and Remote Probe to perform the *Basic Cable Tests* (listed below)... plus *Speed Testing* (10, 100, 1000MB) and *Cable Category Testing* (CAT 3, 5, 5E, 6). When the Level 1 test is complete, you can choose to continue to Level 2 and use real data from your own hub, switch or PC to expand the testing. LPV is designed for 4 pair cable only (use BASIC CABLE TEST for other pairings). See *List of Functions* for a listing of tests. 250 LPV test results can be stored for later printing. *Page 13.*

BASIC CABLE TEST: Move the cursor to BASIC CABLE and press SELECT to test a cable for length, opens, shorts, split pairs (plus distance to these faults) and wire map. BASIC CABLE TESTS do not perform LAN Performance Verification (CAT 3, 5, 5E, 6, etc. tests). BASIC CABLE test results cannot be stored in memory. *Page 37.*

TONER/PROBE: Move the cursor to TONER/PROBE and press SELECT if you wish to energize a cable with a tone (plug the cable into the Main Unit's LEFT jack). The Remote Probe detects the tone at the far end of the cable. This is useful in locating cables in crowded wiring closets. When selected, tracer tones will stay ON for one hour.

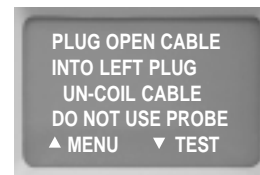
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Cable Testing / LP VERIFY / TESTING / LEVEL 1



Press down arrow
button after cable
is
connected

LP VERIFY / TESTING
Perform LAN Performance
Verification Level 1 (cables)
and Level 2 (cables and LAN
devices) tests



Follow the instructions. Only an uncoiled cable will give you accurate test results. At this point in the testing the far end of the cable should not be connected to any device. Note: If the cable is connected to a device you will be alerted to check the far end of the cable. When ready to proceed, press the down arrow (▼ TEST).

Error Messages: If there is a problem that stops the test from proceeding, one of the following error messages will be displayed:

CABLE IS ACTIVE: There is an active network port on the far end of the cable. You will need to unplug it to proceed.

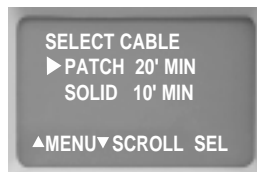
CHECK CABLE END: A voltage is present on one or more of the cable pairs or possibly the REMOTE PROBE is connected to the cable end when it is not needed. You will need to unplug it to proceed.

NO CABLE: There is no cable connected or an inactive port is plugged into the far end of the cable.

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Cable Testing / LP VERIFY / TESTING / LEVEL 1

**Stranded or
Solid wire
selection
screen**



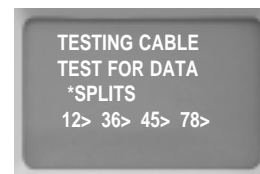
The LAN Performance Verifier has the unique ability to test both cables constructed of *stranded* wire (commonly called "patch" cables) and *solid* core wire. Scroll to select the cable and press SELECT. *How to tell the difference:* If the cable is installed in a wall, it is almost certainly a solid core wire. Preassembled cable with end fittings already attached is usually stranded cable. Also, stranded cable is more flexible than solid wire. If you bend the cable and it does not attempt to spring back to its original shape it is most likely solid cable. Note: The minimum length of each cable type is shown on the screen for LP VERIFY TESTS. If your cable is shorter than this, use the BASIC CABLE TEST. Once the selection is made, cable testing will automatically commence.

NOTE: Descriptions of all test result screens can be found in the LP VERIFY/REVIEW section of the manual.

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Cable Testing / LP VERIFY / TESTING / LEVEL 1

**Testing progress
is shown on the
screen**



**Any problems will
be displayed (See
appendix C)**



During this phase of testing, information about length, opens, shorts, split pairs, crosstalk, cable category and speed is being gathered and computed. If there are no cable problems, testing continues until you are prompted to connect the *Remote Probe* and perform the *Wire Map*. If all is OK, testing will finish (the LPV "speed" screen is displayed). Note: If there is a problem with the cable, the problem will be displayed, and testing will be halted. The problem *must be corrected* before testing can continue. See *Appendix C* for examples of cables failures. Complete results are immediately available for **Review** and **Saving** after the test is completed. This "test now, review later" feature greatly speeds up the test process when you have multiple cable installations.

Time to test: Short-cables take longer to test because fewer measurements per pass are possible. The thousand of measurements required are accomplished much faster on longer cables than shorter cables.

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Cable Testing / LP VERIFY / TESTING / LEVEL 1

Testing is halted until the Remote Probe is connected.



The **REMOTE PROBE** is required for the WIRE MAP to be constructed. Plug the Remote Probe into the far end of the cable. Tracer tones have been turned ON to help locate cables in crowded areas (press the TRACE button on the Remote Probe and hold it close to the cable to follow the tone). The Main Unit's wire map test is triggered when the Remote Probe is connected to the far end of the cable (there are no buttons to push). The wire map tests for correct cable pairing. Note: The wire map is displayed during the **Review** process. Not during the test.

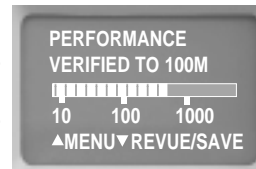
Remote Probe LEDs. The Remote Probe needs to be connected only for a brief period. *Flashing* LED(s) indicate the test is progressing. A *steady* LED indicates the test is completed. This saves you an extra trip to retrieve the probe. If LED(s) continue to flash the cable, the cable has a wiring problem. Disconnect the probe and go to the Main Unit to see the results. Note: If you plan to test to LAN Performance Verification Level 2, now is a good time to plug in the hub, switch or PC (it will save you a trip).



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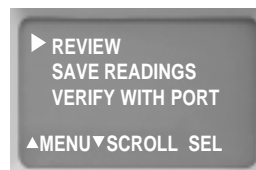
Cable Testing / LP VERIFY / TESTING / LEVEL 1

LPV Level 1 final screen (when you see this, Level 1 is completed and available for review)



When the above screen appears, the Level 1 verification is complete. You have the choice of discarding the readings ("MENU"); REVIEWING the reading; SAVING the readings in PRINTER MEMORY ; or continuing to Level 2 testing.

Review, Save or continue with Level 2 selection screen.



This menu allows you to REVIEW the Level 1 readings and decide to SAVE them now or add to them by proceeding with Level 2 testing (VERIFY WITH PORT). If you save them you cannot proceed to Level 2.

REVIEW: View the readings from the Level 1 test. *Page 21.*

SAVE READINGS: Store the readings in PRINTER MEMORY for later printing and do not continue to Level 2 testing. The next sequential READING NUMBER will be assigned.

VERIFY WITH PORT: Proceed to Level 2 testing.

Requires a PC, hub or switch to drive the cable. *Page 18.*



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Cable Testing / LP VERIFY / TESTING / LEVEL 2



LP VERIFY / TESTING LEVEL 2 Perform LAN Performance Verification Level 2 (cables and LAN devices) tests

If you have selected to continue with LAN Performance Verification Level 2, this screen appears.

```
PLUG IN PORT
GIG PORT MAY
VERIFY TO
10M 100M 1 GIG
▲ MENU ▼ VERIFY 2
```

LAN Performance Verification Level 2 adds to the battery of tests conducted in Level 1 by testing the cable with real live data. The source of this data can be any hub, switch or PC. Note: The screen (above) reminds you that the best source of data is a gigabit device. A gigabit device drives the cable with data up to a gigabit (1000 MB) on all 4 pairs. Connect the port to the cable and press ▼ to continue with Level 2.

FAQ: What is the difference between Level 1 and Level 2 and when do I use it? Level 1 tests for opens, shorts, split pairs (including distance to the fault) along with propagation delay, skew, NEXT, FEXT, and Cable Category measurements. Level 1 testing uses simulated digital signals to test the cable. Level 2 adds to the testing with the use of real live data from a NIC, hub, or switch. Use Level 1 for new cable installations or anytime a LAN device (hub, switch, PC) is not available.

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Cable Testing / LP VERIFY / TESTING / LEVEL 2

Testing
Link Pulses
from a
Gigabit device

```
12> 10M 100M FULL
      GIGABIT FULL
36> 10M 100M FULL
      GIGABIT FULL
▲ MENU ▼ DETAILS
```

Testing
Link Pulses
from a
100MB device

```
12> TESTING LINKS
36> 10M 100M HALF
▲ MENU ▼ DETAILS
```

The first step in the Level 2 process is to read the link pulses of the LAN device and determine its *advertised* capability. Every LAN device broadcasts its capability in terms of speed, duplex and other features (termed "advertised" capabilities) to other LAN devices.

First example (above): The LPV has found a gigabit device (1000MB) on pairs 1,2 and 3,6 that is capable of transmitting at 10MB, 100MB and 1000MB at full duplex. 1000 MB devices use all 4 pairs.

Second example (above): The LPV has found a 100MB device on pairs 3,6 that is capable of transmitting at 10MB and 100MB at half duplex. Typically, devices that transmit on pairs 1,2 are PCs and devices that transmit on 3,6 are hubs and switches.

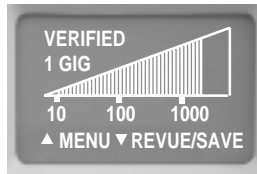
When completed, press the down arrow key (▼) to continue.

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Cable Testing / LP VERIFY / TESTING / LEVEL 2

Data Signal Levels: Immediately following the link pulse test, the Main Unit tests the data signal levels from the LAN device. The levels are not displayed at this time but are available during Review.

LPV Level 2 final screen (when you see this screen, Level 2 is completed and available for review).



When the above screen appears, the Level 2 testing is complete. The complete results of both the Level 1 and Level 2 readings are available for immediate review. You have the choice of discarding the test readings ("MENU") or REVIEWING or SAVING the Level 1 and Level 2 readings in Printer Memory ("REVUE/SAVE").

If Revue/Save was selected, press SELECT to Save or the down arrow to Review.



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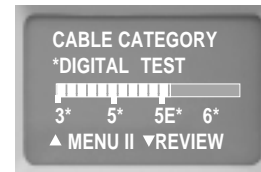
Cable Testing / LP VERIFY / REVIEW TEST

REVIEW

Review the readings from the most recent test or store the readings in Printer Memory. To review past readings stored in the memory see page 30.



Cable Category is the first screen of many that are stored



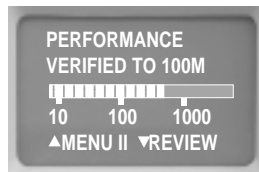
The "Cable Category" is universally accepted as the speed capability of the cable. Cat 3 was the original twisted pair cable that connected 10MB networks together. Then came Cat 5 (used in networks up to 100 MB). Followed by Cat 5E (generally considered adequate for up to 1000MB networks). As you become familiar with Cable Category, you will notice that few cables get rated higher than their factory labeling. This is because cables are manufactured and tested to minimum specifications. If the cable exceeds minimum specifications it passes the manufacturer's inspection.

When ready to proceed, press (▼) REVIEW.

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Cable Testing / LP VERIFY / REVIEW TEST

LP Verification
Level 1 Speed
Projection



LAN Performance Verification Level 1 displays the projected speed capability of the cable. The graph is a result of thousands of measurements used to project the speed of the cable. This is one of the most useful and money-saving displays. For instance, it is possible that some shorter, installed CAT5 cable (rated for 100MB) are capable of communicating at a 1000MB. This graph will indicate such. Many users conclude their cable testing with Level 1 and skip the Level 2.

Cable Testing / LP VERIFY / REVIEW TEST

Length / Timing
summary screen



Length: The length of the shortest cable pair (in feet). 330' is the longest cable allowed by the 802.3 standard. The LAN Performance Verifier can test cables up to 1250' in length.

Propagation delay: The time it takes for a data signal to travel the length of the cable (in nanoseconds). An abnormally long propagation delay indicates the cable is "too slow" for the application. Either the cable itself is too slow or there is an error in the wiring. The standard allows a maximum 555 nsecs propagation delay (Cat 6 cables).

Skew: The difference in the propagation delay between the slowest pair and the fastest pair in the cable (in nanoseconds). A small skew insures that data, on each pair, will arrive at the receiver at about the same time. A large skew reading causes errors. 50 nsecs is the maximum allowable skew.

To continue reviewing, press the down arrow key (▼).

Cable Testing / LP VERIFY / REVIEW TEST

LPV Level 1
Pass / Fail
Summary Screen

```
DELAY OK  SKEW OK
NEXT OK  FEXT OK
SPLIT OK  MAP  OK
PATCH   TOL  94%
▲ MENU II ▼ REVIEW
```

DELAY OK: The propagation delay of the cable is within specification. See page 23 for the definition of delay.

SKEW OK: The skew of the cable is within specification. See page 23 for the definition of skew.

NEXT OK, FEXT OK: Indicates that "near end crosstalk" (at the near connector) and at "crosstalk far end" (a distance removed from the near connector) is within acceptable limits. Crosstalk is interference created by signal coupling between adjacent wires of the cable.

SPLIT OK: The wire contains no split pairs. See Appendix D for a definition of "split pairs" and notes on making a correct cable.

MAP OK: The pair wiring of the cable is correct. See Appendix D.

PATCH/SOLID: The type of wire specified (see page 14).

TOL(TOLERANCE): A calculated value using cable length, delay, NEXT, FEXT, Cable Category (CAT 3,5,5E,6) and speed (10M, 100M, 1000M). Zero percent equals failure to meet

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Cable Testing / LP VERIFY / REVIEW TEST

specifications at a given speed. One percent is barely passing. 100 percent is maximum *tolerance*.

Tolerance is largely cable length driven. The longer the cable is, the less the tolerance. However, lower Category cables eat up tolerance faster than higher Category cables.

If *Tolerance* is below 15%, you may wish to consider using a repeater, hub or switch to shorten the cable run. This is especially true if you are in a "noisy" environment (large electromechanical machines, etc.).

Wire Map
A correct wire map
for a straight through
cable.

```
12> 203' === <12
36> 203' === <36
45> 201' === <45
78> 200' === <78
▲ MENU II ▼ REVIEW
```

WIRE MAP: The wire map displays the pairing of the wires in the cable. The example wire map indicates that the first pair (comprised of pins 1 and 2) is 203 feet long and terminates in pins 1 and 2 on the far end of the cable.

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Cable Testing / LP VERIFY / REVIEW TEST

Propagation and skew (per pair) screens

```
12> 309NS DELAY
36> 309NS DELAY
45> 305NS DELAY
78> 305NS DELAY
▲ MENU II ▼ REVIEW
```

```
12> 4NS SKEW
36> 4NS SKEW
45> 0NS SKEW
78> 0NS SKEW
▲ MENU II ▼ REVIEW
```

Timing data per pair: The next two screens give you the timing of the propagation delay and skew for each pair in the cable. Large variations between pairs indicate trouble.

Note: A given pair's skew is the difference in propagation delay between that pair and the slowest pair in the cable.

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Cable Testing / LP VERIFY / REVIEW TEST

The following screen only appears if Level 2 testing was performed.

Signal levels of real live data from a gigabit switch



Signal levels of real live data from a 100MB switch



The **signal level screen** is one of the most powerful tools used during Level 2 testing. It is a live signal attenuation display. If the level is below the DATA MIN line, you may experience faulty transmissions. If the signal is well above the DATA MIN line, you have plenty of "headroom". Press the down arrow key to continue.

The two examples shown show the differences between gigabit devices and 10MB and 100MB devices. With a gigabit device it is possible to view real live data on all 4 pairs whereas a 10MB and 100MB can only transmit on 1 pair. A gigabit device is a full duplex device that uses all 4 pairs therefore making it a perfect device to get a full view of all 4 pairs of the cable.

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Cable Testing / LP VERIFY / REVIEW TEST

The following screen only appears if LP Verification Level 2 was performed.

LAN Performance
Verification
Level 2
summary screen

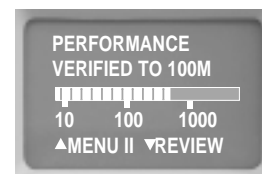


LAN Performance Verification Level 2 displays the LAN Performance Verification Level 2 speed capability of the cable. The display is the result of the data gathered during Level 1 testing (simulated data) and Level 2 testing (real data) into a graph that "LAN Performance Verifies" the speed capability of the cable.

Additional notes: The Level 2 testing adds real live data with the connection of a real live data source (a hub, switch or PC) to the far end of the cable. This adds an important test element: signal attenuation of live data. Adding this to the test data gathered during Level 1 testing creates Level 2 testing. The end result of LAN Performance Verification Level 2 is the speed graph shown above. It verifies the measured data speed capability of the cable. Use Level 2 verification whenever you want to test a cable with real live data. With the Level 2 testing you are LAN Performance Verifying both your cable and your network port at the same time (you can test your cable with the exact port that it will use in the network).

Cable Testing / LP VERIFY / REVIEW TEST

If you see this screen again, you are reviewing the same data again



Select MENU II at any time to stop the Review. MENU II gives you the option to either SAVE the readings in PRINTER MEMORY or discard them (selecting MENU). Or, if you choose, continue Reviewing.

Select MENU II at any time to stop the review. Then select to SAVE the Readings



Cable Testing / REVIEWING PRINTER MEMORY



PRINTER MEMORY
Review or Erase stored readings (memory stores up to 250 readings).

To Review or Erase stored readings, select **PRINTER MEMORY** from the Main Menu

SCROLL TO SELECT
CABLES
NETWORK PORTS
▶ **PRINTER MEMORY**
▲MENU▼SCROLL SEL

PRINTER MEMORY: "Printer memory" is the storage location for all SAVED test readings. It can store the results of up to 250 LAN Performance Verification Level 1 and combined Level 1 and Level 2 tests for later printing ("Basic Cable Test" results are not stored). After each test is conducted, you have the option to REVIEW and/or SAVE the test results (readings) in PRINTER MEMORY for later printing. This screen is used if you wish to REVIEW the readings *after* they have been stored. It is also used to ERASE all of the stored readings.

See page 32 for connecting the LAN Performance Verifier to the PC for data transfer and printing.

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Cable Testing / REVIEWING PRINTER MEMORY

Review or Erase selection screen

▶REVIEW MEMORY
ERASE MEMORY

▲MENU▼SCROLL SEL


REVIEW: Scroll to review the "NEXT" reading or the FIRST or LAST reading stored in Printer Memory. "NEXT" can be *incremented* by continuously pressing the down arrow key (▼).

REVIEW READINGS
▶NEXT = 1
FIRST = 1
LAST = 11
▲MENU▼SCROLL SEL

ERASE: Selecting the ERASE function erases *all* of Printer Memory. There is no way to selectively erase readings. **This screen verifies that you wish to erase all of Printer Memory.**

ERASE READINGS
ERASE ALL MEMORY
▶NO> NOT SURE
YES> VERY SURE
▲MENU▼SCROLL SEL

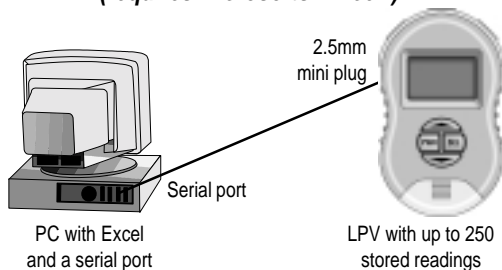
NONVOLATILE MEMORY: The test readings are stored in nonvolatile memory. The stored readings will remain until the "ERASE" function is performed. Powering OFF the tester or unplugging its battery will not affect the memory contents.

UNDERSTANDING THE READINGS: The display of the stored readings follows the same sequence as if you reviewed the test immediately after the test was conducted. See page 21. 

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Cable Testing / PRINTING FROM A PC

Transfer the test readings from the Main Unit to the PC using the supplied cable and software (requires Microsofts® Excel®)



INSTALLING THE SOFTWARE: The software provided with the tester is itself an Excel spreadsheet (with built-in macros that transfer the LPV's readings). No lengthy installation process is required. Just copy the Excel file (LPV.xls) from the CD to the folder on your hard drive where you store your Excel spreadsheets.

TRANSFERRING TEST READINGS (SUMMARY):

1) Plug the 6' cable into a serial port on your PC and the mini jack on the Main Unit. 2) Both devices must be ON. 3) Launch Excel on your PC and open the Excel file that was provided with your tester (see above for details). Follow the directions on the Excel screen to transfer the readings from the LPV's Printer Memory to the PC. 4) Make any modifications you wish to the spreadsheet and print some or all of the tests (each test prints on a separate sheet).

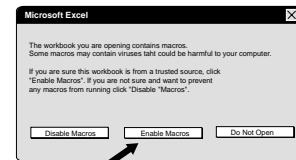
32

Cable Testing / PRINTING FROM A PC

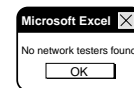
STEP-BY STEP INSTRUCTIONS FOR USING EXCEL:

1) After you have connected the Main Unit to the PC, launch Excel. Select **FILE, OPEN** and select LPV.xls (this is the spreadsheet that you copied from your CD in the previous step).

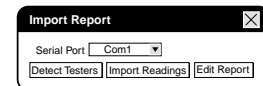
Excel asks you if you wish to "Enable macros". Select "Enable macros".



Excel alerts you that it has not found the tester. Click OK to continue and use the *Import Report* routine (below) to locate the tester. .



The *Import Report* screen appears. It has three buttons:



Detect Testers The first step is to find a COM (serial) port and tester. Press to search the PC ports (1 through 5). Once a port(s) is detected, data is sent to each in an attempt to detect the tester. The resulting list in the drop down box is of the serial ports with testers attached. The "Import Reading" button will only be enabled if at least one tester is detected on a serial port. If *Detect Testers* does not work, it will respond with the error message "No Network Testers found." Verify the tester's power is ON and try again.

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Cable Testing / PRINTING FROM A PC

Import Readings Press the *Import Readings* button next. It downloads data from the serial port specified in the drop down box. Press OK.

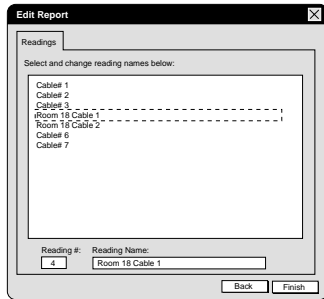


Other messages (if you see one, start over):
 "Please select a serial port with a network tester connected" appears if the serial port does not have a tester connected or if the tester is not ON.

"Unable to determine the number of readings on the network tester" appears if the user disconnects the network tester during communications with the PC. Or indicates a faulty serial cable.

Edit Report

After the readings are downloaded, press to launch the spreadsheet. If you wish to change the default Reading names of "Cable#1, Cable#2. etc" to something more specific, you can do it now or wait and do it in the spreadsheet. When satisfied, press *Finish*. The spreadsheet appears. One test per worksheet.



Cable Testing / PRINTING FROM A PC

The spreadsheet named "LPV.XLS" will appear. One cable test reading occupies one worksheet. You can do anything with this spreadsheet as would with any Excel spreadsheet (save it under a different name, change the names in the cells, etc.). When you are ready to print, select *FILE, PRINT* and in the *PRINT WHAT* dialog box select *ALL*. All of the cable test readings will print (one per page).

	A	B	C	D	E	F	G
1	Reading: Cable# 1						
2	Length	Delay	Skew	Patch/Solid			
3	25 ft	38ns	2ns	Patch			
4	VERIFY LEVEL 1: 1 GIG. 100% TO						
5	VERIFY LEVEL 2: 1 GIG. 100% TO						
6	NEXT PASSED (DIGITAL TEST)						
7	NEXT PASSED (DIGITAL TEST)						
8	SPLIT PAIR PASSED						
9							
10							
11	WIREMAP:		12> 25' ===	<12			
12			36> 26' ===	<36			
13			45> 26' ===	<45			
14			78> 26' ===	<78			
15							
16	PROPAGATION	12>	38ns DELAY	SKEW	12>	0ns	SKEW
17	DELAY (PER PAIR)	36>	39ns DELAY		36>	1ns	SKEW
18		45>	39ns DELAY		45>	1ns	SKEW
19		78>	39ns DELAY		78>	1ns	SKEW
20							
21							
22							

LPV.XLS spreadsheet

Cable Testing / PRINTING FROM A PC

Typical LAN Performance Verifier printout

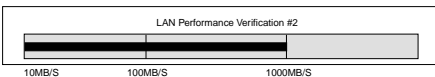
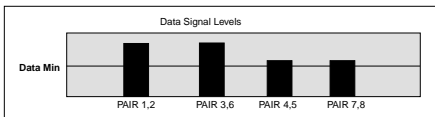
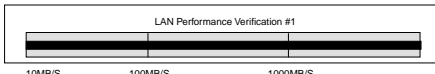
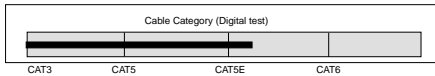
Note: If Level 2 testing was not performed, the Data Signal Levels and the LP Verification #2 charts will have no data.

```

Reading: Cable# 1
Length Delay Skew Patch/Solid
25 ft 38ns 2ns Patch
VERIFY LEVEL 1: 1 GIG, 100% TOL
VERIFY LEVEL 2: 1 GIG, 100% TOL
NEXT PASSED (DIGITAL TEST)
NEXT PASSED (DIGITAL TEST)
SPLIT PAIRS PASSED

WIREFMAP:
12> 25' === <12
36> 26' === <36
45> 26' === <45
78> 26' === <78

PROPAGATION DELAY (PER PAIR)
12> 38ns DELAY 12> 0ns SKEW
36> 39ns DELAY 36> 1ns SKEW
45> 39ns DELAY 45> 1ns SKEW
78> 39ns DELAY 78> 1ns SKEW
    
```



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Cable Testing / BASIC CABLE TESTING



BASIC CABLE TESTING
Use when you only require the more traditional cable tests (opens, short, split pairs, length, etc.)

Cable Testing
Main Menu

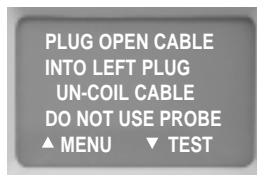


BASIC CABLE TEST: Move the cursor to BASIC CABLE and press SELECT to test a cable for length, opens, shorts, split pairs (plus distance to these faults) and wire map. BASIC CABLE TESTING is a quick test and does not perform LAN Performance Verification (CAT 3, 5, 5E, 6, etc. tests). BASIC CABLE test results cannot be stored in Printer Memory. BASIC CABLE TESTS can be used on 2 pair and 4 pair wiring (LAN Performance Verification can only be performed on 4 pair wire).

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Cable Testing / BASIC CABLE TESTING

Press down arrow
button after cable
is
connected



Follow the instructions on the screen (plug the cable you wish to test into the LEFT jack). Only an uncoiled cable will give you the most accurate length measurement. At this point in the testing, the far end of the cable should not be connected to any devices. Note: If the far end of the cable is connected to any device it will notify you to check the far end of the cable.

When ready to proceed, press the down arrow (▼ TEST).

Error Messages: If there is a problem that stops the test from proceeding, one of the following error messages will be displayed:

CABLE IS ACTIVE: There is an active network port on the far end of the cable. You will need to unplug it to proceed.

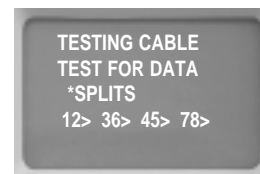
CHECK CABLE END: A voltage is present on one or more of the cable pairs or possibly the REMOTE PROBE is connected to the cable end when it is not needed. You will need to unplug it to proceed.

NO CABLE: There is no cable connected or an inactive port is plugged into the far end of the cable. Plug in the cable or disconnect the inactive port.

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Cable Testing / BASIC CABLE TESTING

Testing
progress
is
displayed



Cable testing has commenced. You can follow its progress on the display. During this phase of testing, information about length, opens, shorts, split pairs and crosstalk is being gathered and computed. If any cabling errors are encountered you will be alerted.

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Cable Testing / BASIC CABLE TESTING

Plug in probe
for wire map.
Tracer tones
are ON.



The **WIRE MAP** of the cable is now constructed. Follow the instructions on the screen and plug the REMOTE PROBE into the far end of the cable. Tracer tones have been turned ON if you need to search in a crowded area for the far end of the cable (press the TRACE button on the Remote Probe and hold it close to the cable to follow the tone). The Main Unit's wire map test is triggered when the Remote Probe is connected to the far end of the cable (there are no buttons to push). The wire map tests for correct cable pairing. Note: The wire map is displayed immediately (see the following page for an example).

Remote Probe LEDs. The Remote Probe needs to be connected only for a brief period. *Flashing* LED(s) indicate the test is progressing. A *steady* LED indicates the test is completed. This saves you an extra trip to retrieve the probe. If LED(s) continue to flash the cable, the cable has a wiring problem. Disconnect the probe and go to the Main Unit to see the results.



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Cable Testing / BASIC CABLE TESTING

Wire Map
A correct wire map
for a straight through
cable.



WIRE MAP: The wire map displays the pairing of the wires in the cable. The example wire map indicates that the first pair (comprised of pins 1 and 2) is 203 feet long and terminates in pins 1 and 2 on the far end of the cable. If there were any problems, they would be displayed.

Is the cable OK? If the BASIC CABLE TEST concludes with a wire map display and no reported errors, the cable is error free.

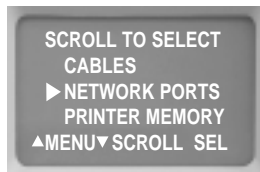


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Network Testing Menu



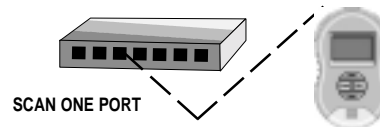
NETWORK PORTS
Display the advertised and negotiated speeds of LAN devices and view the signal levels of real live data.



NETWORK PORTS Select Network Ports to display the capabilities of a LAN device. All LAN devices broadcast their capability in terms of speed, duplex and other features (termed "advertised capabilities") to other LAN devices. When two LAN devices are connected together, they "negotiate" to attain the highest common denominator for communicating on the link. For instance, a gigabit switch with an advertised capability of 1000MB, full duplex will negotiate down to 100MB, half duplex when connected to a 100MB, half duplex LAN device. The LPV displays individual LAN devices advertised capabilities and also can connect INLINE between two LAN devices to display the negotiated results.

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Network Testing / SCAN ONE PORT



SCAN ONE PORT: Move the cursor to SCAN ONE PORT and press SELECT if you wish to display the advertised capability of a LAN device. You can connect to any LAN device using a patch cable or any cable of your choosing. The signal data levels of all active pairs will also be displayed. When *Scanning One Port*, the connection can be made to a live hub, switch or PC without affecting the communication of the other connected devices. See the following 2 pages for examples of *advertised capability* and the *Signal Data Level* display

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Network Testing / SCAN ONE PORT

Testing
Link Pulses
from a
Gigabit device



Testing
Link Pulses
from a
100MB device



The first step in the scanning process is to read the link pulses of the LAN device and display its *advertised* capability. Every LAN device broadcasts its capability in terms of speed, duplex and other features (termed "advertised" capabilities) to other LAN devices.

First example (above): The LPV has found a gigabit device (1000MB) on pairs 1,2 and 3,6 that is capable of transmitting at 10MB, 100MB and 1000MB at full duplex. 1000 MB devices use all 4 pairs.

Second example (above): The LPV has found a 100MB device on pairs 3,6 that is capable of transmitting at 10MB and 100MB at half duplex. Typically, devices that transmit on pairs 1,2 are PCs and devices that transmit on 3,6 are hubs and switches.

Press the down arrow key (▼) to continue.

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Network Testing / SCAN ONE PORT

Signal levels
of real live
data from a
gigabit switch



Signal levels
of real live
data from a
100MB switch



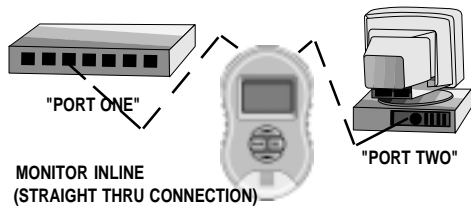
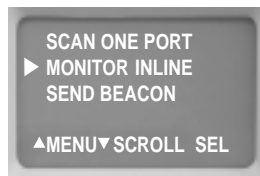
The signal level screen is a powerful tool. It is a live signal attenuation display. If the level is below the DATA MIN line, you may experience faulty transmissions. If the signal is well above the DATA MIN line, you have plenty of "headroom". Press the down arrow (▼) key to continue.

The two examples shown shows off the differences between gigabit devices and 10MB and 100MB devices. With a gigabit device it is possible to view real live data on all 4 pairs whereas a 10MB and 100MB can only transmit on 1 pair. A gigabit device is a full duplex device that uses 2 pairs to transmit and 2 pairs to receive data...and it can be tricked into displaying the data on the 2 receiving pairs... therefore making it a perfect device to get a full view of all 4 pairs of the cable.

HOT NEXT TEST: As a final step, a *split pairs* test is conducted (while the tester is connected to a live data source!)

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Network Testing / MONITOR INLINE



MONITOR INLINE: Move the cursor to MONITOR INLINE and press SELECT if you wish to view the *negotiated* results between two LAN devices. Note: Data communication can take place while the Main Unit is inline between two devices but only after the negotiation is complete.

The MONITOR INLINE TEST is methodical and mostly automatic. It arrives at the *negotiated speed* by:

- 1) First testing only PORT ONE for its capabilities.
- 2) Then testing only PORT TWO for its capabilities.
- 3) Then combining PORT ONE and PORT TWO and displaying the negotiated speed.

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Network Testing / MONITOR INLINE

Follow the steps and wait for directions. The tester will tell you when it is time for the next step.

"LEFT", "RIGHT" and "CROSS" are the names of the MAIN UNIT'S RJ45 sockets.

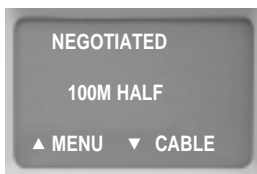
"PORT ONE" and "PORT TWO" refer to the first LAN port (also called "LAN device") that is connected to the tester and the second LAN port (or LAN device) connected to the tester (respectively).



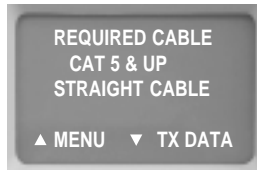
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Network Testing / MONITOR INLINE

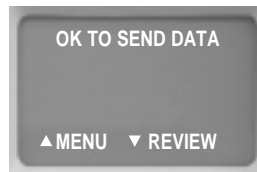
The *Negotiated Speed* of the link is displayed.



The minimum cable type and wiring required to support the negotiated speed is displayed.



The Monitor Inline test is complete. Data can be transmitted between the two LAN devices without removing the tester.



Note: Most network ports negotiate to the highest possible data rate. Some ports will negotiate to a maximum of the last data rate used. For example, if a PC and a switch communicate at 100 MB/s and a new gigabit switch is installed, the PC port may drag the switch down to 100 MB/s, even if the PC is capable of gigabit data rate. This may be solved by resetting the PC. Or use the SCAN ONE PORT option to read and *unstick* the port. If in doubt, use the tester to scan and unstick both ports one at a time.

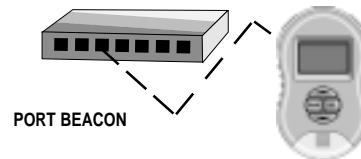
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Network Testing / SEND BEACON



SEND BEACON
Locate cable drops by lighting a link LED

Scroll down and select SEND BEACON

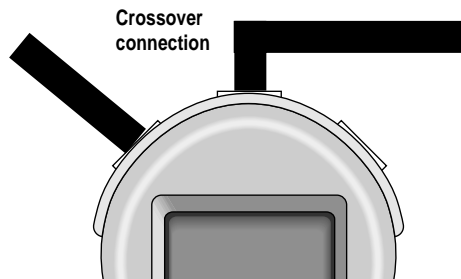
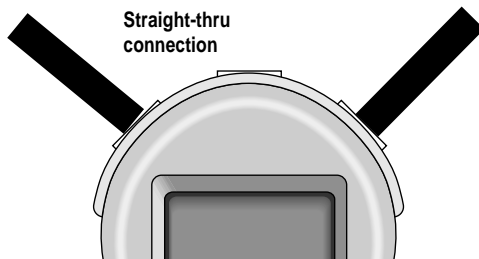


PORT BEACON: Use the Port Beacon to locate cable connections in crowded areas. To activate the port beacon, move the cursor to PORT BEACON and press SELECT. The Port Beacon is a link pulse that the Main Unit sends to the receiving device every 3 seconds. The Port Beacon causes the link LED to flash on the LAN device allowing you to spot the connection

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Appendix A. Straight and crossover connections

When installing or troubleshooting a LAN, you might need a straight-thru cable. Or possibly a crossover connection to help get two devices communicating. The LPV's Main Unit's 3 jacks makes it easy. The tester must be OFF to utilize this feature.



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Appendix B. Ping and TCP/IP debugging tools

What is TCP/IP: TCP/IP is set of standards first developed by ARPA (USA DOD's Advance Research Projects Agency) that define how information is routed over the Internet. And because of its internet popularity, TCP/IP is the most popular protocol operating over twisted pair cabling... and therefore is the most popular protocol used by Ethernet (the standard for local area networking).

Why learn about TCP/IP: Once the LPV has established that your cables and network devices are working at the hardware level your next step is to checkout the software level of your network. Understanding the basics of TCP/IP and gaining a familiarity with your operating system's built-in network debugging tools helps you diagnose and troubleshoot network problems at the software level.

TCP/IP basics: TCP/IP has 4 layers: 1) The lowest layer is the PHYSICAL layer that deals with cabling. 2) The next layer is the INTERNET layer. This is the "IP" layer (internet protocol) and it describes the assigning of an "ip" address to each data packet that is transmitted (all data on the internet must have a destination address associated with it and this is referred to as an "ip address"). The address can refer to a workstation on you local network or a server on the internet thousands of miles away. 3) The next layer is the TRANSPORT layer. Because data packets can travel through networks and the Internet using many different routes, they will not necessarily arrive in the same order as they were sent. There needs to be a mechanism that reassembles the packets in the proper sequence. This is the job of the "TCP" (transmission control protocol) and it resides in this layer. 4) Layer 4, the highest layer is the APPLICATION layer. This is where Ethernet and many other software tools reside.

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Because TCP/IP is so common, Windows and many UNIX systems have built-in tools to help you debug TCP/IP network problems. These debugging programs are executed at the command line prompt of the operating system (see the end of this section for more information about the command line).

ping

The most popular TCP/IP debugging program is called "ping" (after the name given to the operation of submarine sonar devices). Like the sonar, *ping* sends out a packet to an address that you specify and waits for a reply. Although very simple to use, *ping* is extremely powerful because it works at the IP level and often will respond even when the higher level TCP layer cannot. As mentioned above, pinging capability is included with most systems and there are also many shareware implementations.

USE: Determine if a workstation is connected to the network.

Routers, servers and workstations are identified by an "ip" address and possibly a "name". The ip address is a numeric string whose format is referred to as "dotted decimal" (example: 192.168.0.0.). The "name" can be any name given to a computer when it is installed or an internet URL. The ability to use a name is provided by a server's DNS (Domain Name Service). The DNS has a lookup table that cross references ip addresses to names. If a DNS service is not available you will need to use the ip address.

EXAMPLE OF USE: #1: I have problems connecting to the Black Box website from a workstation. I know the DNS name of the website is "www.blackbox.com". At the workstation's Command Prompt, enter "**ping www.blackbox.com**". If connected, I will receive back blackbox.com's IP address (e.g. 207.115.64.64) and the roundtrip time of my ping packet. #2) I am having a problem with one of my workstations communicating to a server. I know the server's ip address is 192.168.1.100. I enter "**ping 192.168.1.100**"

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on the workstation's Command Line. If the server is connected I will receive a response to my ping. Note: It's easy to find a computer's ip address. Go to the target computer (the one you wish to ping) and on its command line enter "ipconfig". The ip address (and other addresses will be displayed). More information on the ipconfig command can be found later in this section

The Ping program has endless uses. **Ping an address (as above):**

If you get a response using the IP address but do not get a response using the DNS address, there must be a problem with the DNS system. If you suspect this, try another debugging program "**nslookup**". **On the command line enter nslookup** followed by the DNS name (*enter nslookup www.blackbox.com*) and see if the IP address is displayed. If it is, your DNS appears to be working correctly. **Ping yourself:** You can use the ping command to ping yourself, either using your own IP address or what is known as the loopback address. The loopback address is a special reserved address that works on all systems:127.0.0.1 (*enter ping 127.0.0.1*). If you would like to try pinging your own workstation address but do not know it use the "**ipconfig**" **command (see below)**. Pinging yourself is the first test that should be conducted because if it fails it most likely means that TCP/IP is not properly loaded on the workstation. If it passes and you were using your own IP address (not the loopback address), it confirms that you are the only one on the network with that address. **Ping your gateway:** If you get a response it means that the packets are making it to the router (a gateway is a device on a network that serves as an entrance to another network). On business LANs the gateway is generally the router. In homes, the gateway is the ISP (internet service provider) that connects the user to the internet.

Ping notes: If you want to ping another workstation or server and

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you do not know its DNS name or IP address use **ipconfig** (below). To learn all of the ping command's option, enter **ping /?**.

ipconfig

USE: Determine the IP address and other related information about a workstation.

Enter **ipconfig /?** at the prompt to display the options possible with this command. The two most common entries: ipconfig and ipconfig /all.

EXAMPLES OF USE: I want to ping a remote server but I do not know its ip address. Go to the server and at the command line prompt enter "**ipconfig**". The server's IP address will be displayed. Return to the earlier workstation and perform the ping test to this address.

tracert

USE: Determines how many router hops a packet took to reach its destination. This can help determine why a network is slow (or not functioning). Enter **tracert /?** at the prompt to display the options possible with this command.

EXAMPLES OF USE: I want to determine how many routers between my system and the ISO that services Black Box. Enter tracert followed by the name or IP address of the destination system (enter www.blackbox.com).

Netstat

USE: Displays the current status of all listening TCP/IP ports. A TCP/IP port is where applications connect to the server or workstation.

EXAMPLES OF USE: I would like to see how many applications are tied to my system that use TCP/IP.

Executing troubleshooting programs from the command line

All of the programs discussed must be executed from the command line of your operating system. To reach the command line on Windows 95 and 98 systems, click on START>PROGRAMS and Select the MS DOS prompt. *Then enter your command.*

On Windows XP systems, click on START>PROGRAMS> and select ACCESSORIES then COMMAND LINE. *Then enter your command.*

On other systems select **Run** from the main menu and enter "**cmd**". *Then enter your command.*

TO EXIT THE COMMAND LINE: Enter EXIT.

Additional information:

The web has many interesting articles on network troubleshooting. Use your favorite search engine and search for Pinging, Pinging Devices, Network management, Network Monitoring Tools, Network Testing, etc.

Appendix C. Examples of cable faults

A good cable: A cable that passes its first set of cable tests will have summary screen similar to this:

**Length / Timing
summary screen
of a good cable**



Bad cable (Split pair): If errors are found, they will be displayed. Here are some examples of screens with bad cables.

**Bad cable:
Split pairs
at 154'**

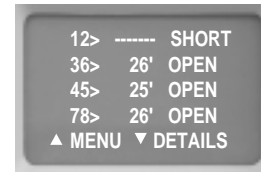


The screen shows a 330' cable with SPLIT pairs at 154'. If the cable goes through a wiring closet, it is possible the SPLIT pairs are in the closet (154' away). This screen shows one of the advantages the LPV has over testers costing thousands of dollars more. The LPV shows the distance to the SPLIT pair to help locate it and facilitate repair. High cost Certifiers display dBs of cross talk but do not help you locate the repairable SPLIT pair fault. Turn on the TRACE tones and use the probe to locate the cable in the wiring closet. Test each cable associated with the link (patch cables, etc).

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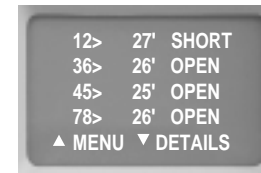
Bad cable (Near end short): The error is displayed as follows:

**Bad cable:
Near End Short**



The SHORT on 12> is most likely at the connector (near end). If the short is on the FAR END of the cable it would look like this:

**Bad cable:
Far End Short**



OPENS in cable pairs generate errors in both in SKEW tests and in wire map tests. The following example shows a 200' cable with a break in the middle on pair 78. The following is the first screen to show a problem.

**Bad cable:
Open**



Note there are two problems shown. The SKEW (difference in DELAY between pairs) is much greater than 50 NS. Another problem

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is that the cable LENGTH is only shown as 98'. Press DETAILS and continue the tests. All will become clear when cable map is displayed. Here is a sample cable map.

**Bad cable:
Wire map
of open
pair**

12>	199'	===	<12
36>	202'	===	<36
45>	202'	===	<45
78>	98'	===	OPEN
▲ MENU		▼ DETAILS	

The sample map clearly shows the problem. There is an OPEN at 98' on pair 78>. The SKEW was so large because the timing pulses travel about 200' on pairs 12, 36, and 45, but only travel 98' on pair 78. As always, retest cable after repairs are made.

During the wire map test you probably noticed that the indicator lights on the REMOTE PROBE (connected to the far end of the cable) continue to flash. This is another indication of a problem.

If a cable has a SHORT in the middle, the wire map looks like this:

**Bad cable:
Wire map
of shorted
pair**

12>	199'	===	<12
36>	202'	===	<36
45>	202'	===	<45
78>	102'	===	SHORT
▲MENU		▼DETAILS	

The LPV is both a LAN Performance Verifier and troubleshooting tool. It identifies the faults and gives you the distance to the OPENS, SHORTs and SPLIT pairs.

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Appendix D. Making a correct cable

Twisted Pair Cables: Twisted pair cable is used for Base-T applications because it is inexpensive, easy to use and has excellent noise cancelling capabilities. A minimum of two pairs of twisted pair wire are required for each computer that connects to the local area network:

- One pair of twisted pair wire to transmit data.
- One pair of twisted pair wire to receive data.

There are exceptions. 100 Base-T devices (called "T4") require 4 pairs of wires. Also, gigabit devices (1000MB) require 4 pair. In both cases, 2 pair are used for transmit and 2 for receive.

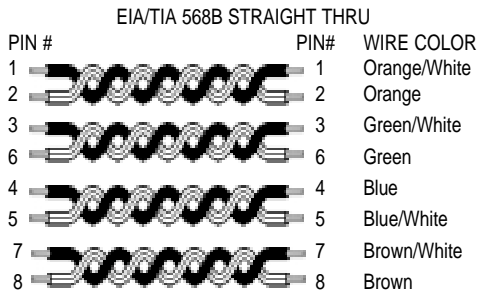
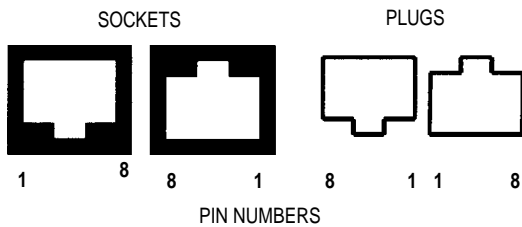
As mentioned above, twisted pair cable has separate pairs of wires twisted together to minimize crosstalk. If a wiring error is made and one pair of wire is "split" with another ("split pairs"), the excess crosstalk will most likely keep the link from operating properly.

To make a proper cable, first choose a twisted pair cable that is adequate for your application. For instance, CAT 5E cable for 100MB and 1000MB applications. Use solid core wire when pulling inside a wall. Use stranded cable ("patch cable") for jumpers.

- Remove the outer jacket of the twisted pair cable exposing about a 6" of wire on each end of the cable.
- Each pair of wire must be twisted together (after crimping, the wire should be twisted right up to the connector).
- Do not make the number one wiring mistake: "Split pairs" (a wire from one pair is swapped with a wire from another pair).
- To minimize mistakes, use a standard color code throughout your project. See the following page for the correct connector pin numbers associated with each Base-T pair.
- Use good quality connectors and tools

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RJ45 Connectors (sockets and plugs): The Base-T Standard uses RJ45 sockets and plugs. The RJ45 socket has 8 pins. The pins are numbered 1 to 8. Looking at the socket with insertion key facing down, pin number 1 is to the left.



Colors: The first color is the base color on the cable. Second color is the stripe color of the cable. *A straight-thru cable has identical ends.*

Note: The above color code is the most popular in use.