NETminer ™ model NM-70

Link Monitor & BER Tester for Fibre Channel & Gigabit Ethernet

User's Manual

Revision: 1.2a
April 2, 2006

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 040206 P/N 89028-012

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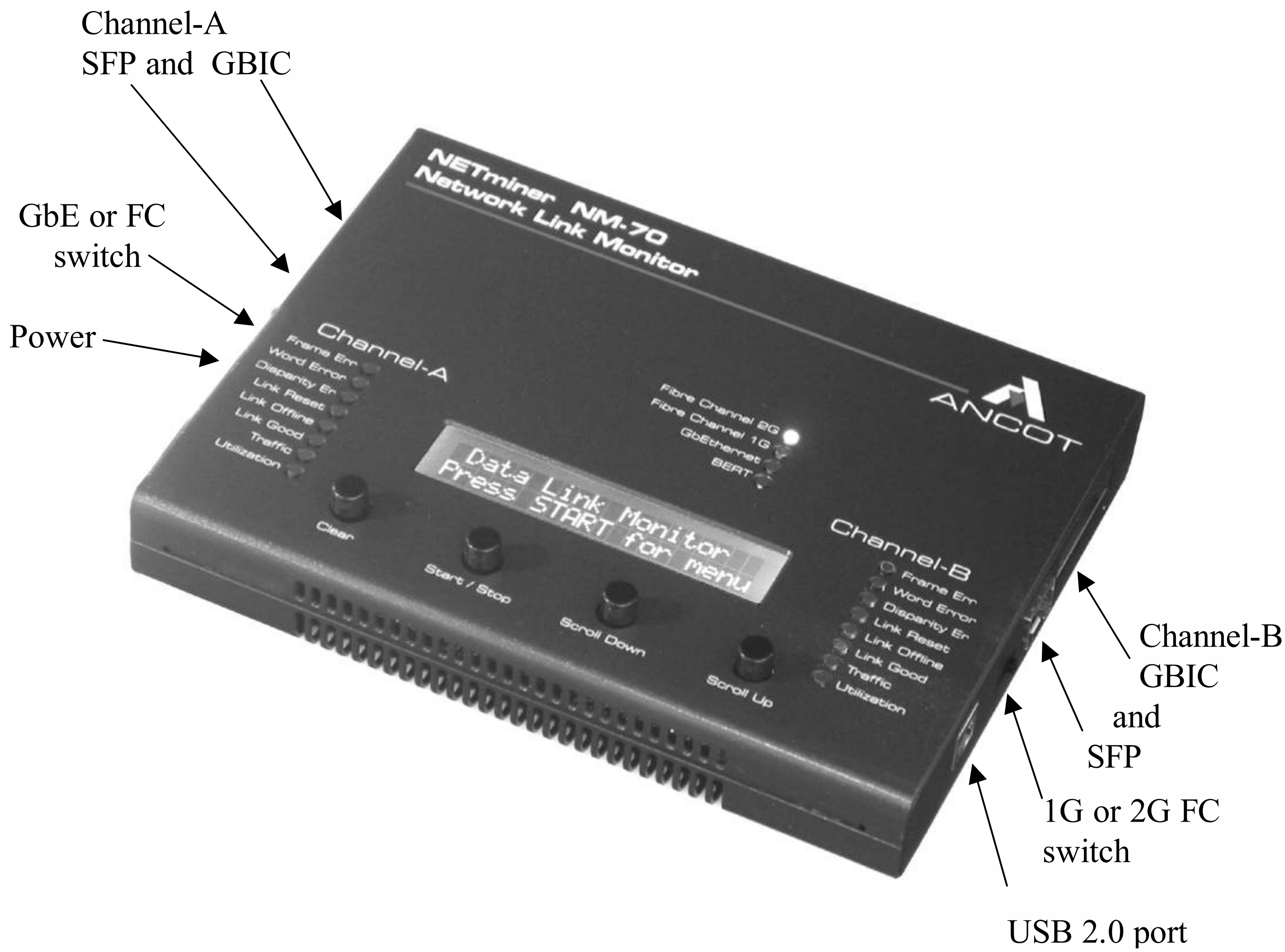
Channel-A
SFP and GBIC
GbE or FC
switch
Power
NETminer NM-70
Network Link Monitor
Channel-A
Frame Err
Word Error
Disparity Er
Link Reset
Link Offline
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Fibre Channel 2G
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DESCRIPTION OF EQUIPMENT

1.1 INTRODUCTION

There were times when we could repair almost any equipment in our house. At the beginning of the twentieth century, any blacksmith could repair the Ford model-T. Even in the Middle Ages (understand the 1940's and almost through the 1970's) we could fix our Chevy or Buick with a screwdriver and a hammer. Today's cars require specialized equipment and we must go to the dealer even though we hate the high price they charge us. The mechanics in the dealers shop then need to use specialized instruments to diagnose the problems. Then when they do the tune-up they have to read certain numbers on their testers and compare them to tables in their manuals, without understanding what these numbers represent. Similarly, we could fix a light bulb, or even the radio or the famous RS232 interface, but now, the Fibre Channel, the GigabitEthernet (GbE) and other similar protocols require specially trained technician or an engineer with specialized and expensive equipment to do the work.

When working with communications protocols like Fibre Channel or GbE, you cannot see simply "from the outside" whether the link is up, whether the traffic is running smoothly or is making errors, or if it is running a t all. Before you know what is happening on the wire, you must de-serialize the incoming (serial) signal, detect where the byte or word starts by detecting the "coma" characters (K28.5) in the serial bit stream. Then you must decode the incoming 10B codes by translating them to 8B and verify that only the selected legal codes are being used, you must monitor running disparity, recalculate and check the CRC (Cyclic Redundancy Check code) and check the end of every frame to verify that the frame format is correct.

The NETminer (or any such tool) is physically spliced (daisy-chained) in the FC link, so both signals of the full duplex link must be repeated and retransmitted. In most instruments (including the NETminer) the signal must be re-clocked (i.e.

cleaned up before retransmission). This requires synchronization with a new crystal clock, which in turn requires using an "elasticity buffer" that allows insertion or deletion of Idle words between frames.

I hope that it is clear to you by now that there is no simple, quick, and cheap way of monitoring, diagnosing, or troubleshooting an FC or GbE link. If you want to race with the Porsches or Ferraries, you have to train more and spend more $$$. Times of the venerable old Ford model T are history.

The NETminer is an instrument that can be used for monitoring traffic on Fibre Channel and/or Gigabit Ethernet links and for performing bit error rate testing (BERT) on cables and data transceiver modules (i.e. SFPs or GBICs). It supports standard Fibre Channel speeds of either 1.062Gbps or 2.125Gbps, and the Gigabit Ethernet at 1.25Gbps. It is intended for use by technicians working in the field, in the lab, or in production, as well as for use by engineers developing FC or GbE devices.

The NETminer has been designed for maximum flexibility, portability, and universality. It is a standalone instrument, packaged in a small, lightweight aluminum enclosure (5.5" x 7.3" x 1.1"). It uses standard GBIC and SFP transceivers. When used for link monitoring, it displays the link activity on eight LEDs (per channel), and on a 2 x 20 character LCD screen. Besides blinking LEDs showing the traffic in Real Time, it also counts frames, bytes, errors, and detects bus reset conditions and shows the total counts on the LCD. It also shows utilization of the link (in %) in a bar graph on the LCD.

Applications include FC or GbE link monitoring, performance estimation, copper/optical media conversion, or cable extension. The simple BERT tester mode allows Go/NoGo testing of cables, GBICs, or SFPs, reading SFP/GBIC module ID information, and measuring latency in the cable and cable length estimating.

The BERT function generates and transmits test pattern traffic that consists out of frames carrying strings of bytes and bits designed specifically to stress test the link for testing cables or transceivers. On the receiving side it checks for CRC errors and displays the test results together with elapsed time.

Catalyst expects that some customers may require specific additional functions, different packaging, private label, etc. If interested, contact the factory for a quote.

1.2 OVERVIEW

1.2.1 FEATURES

GENERAL FEATURES

- Supports Fibre Channel (FC) and GigabitEthernet (GbE) protocols
- Two pairs of 1.0625/2.125/1.25 Gbps SFP or GB IC based Fibre Channel or GbE ports
- Dedicated Elasticity buffers and Re-timing circuitry
- Supports Fibre Channel Point to Point and Fabric topologies
- Monitors both channels simultaneously
- Dedicated LEDs for reporting status and errors on each channel
- Single LCD (2 x 20 chars) screen for displaying selected statistics and functions
- Push-button switches for selecting functions
- Low cost BERT using standard jitter test patterns for testing cables and GBIC/SFP
- any SFP type transceivers supported
- any 5-volt type GBIC transceivers supported

MISCELLANEOUS FEATURES

External data port is USB 2.0 compatible. The USB port is used for transferring status information (statistics counts) about each channel to a PC host for further processing. The USB port will also be used for downloading new revisions of the FPGA code for updates/upgrades in the field (Phase-3)

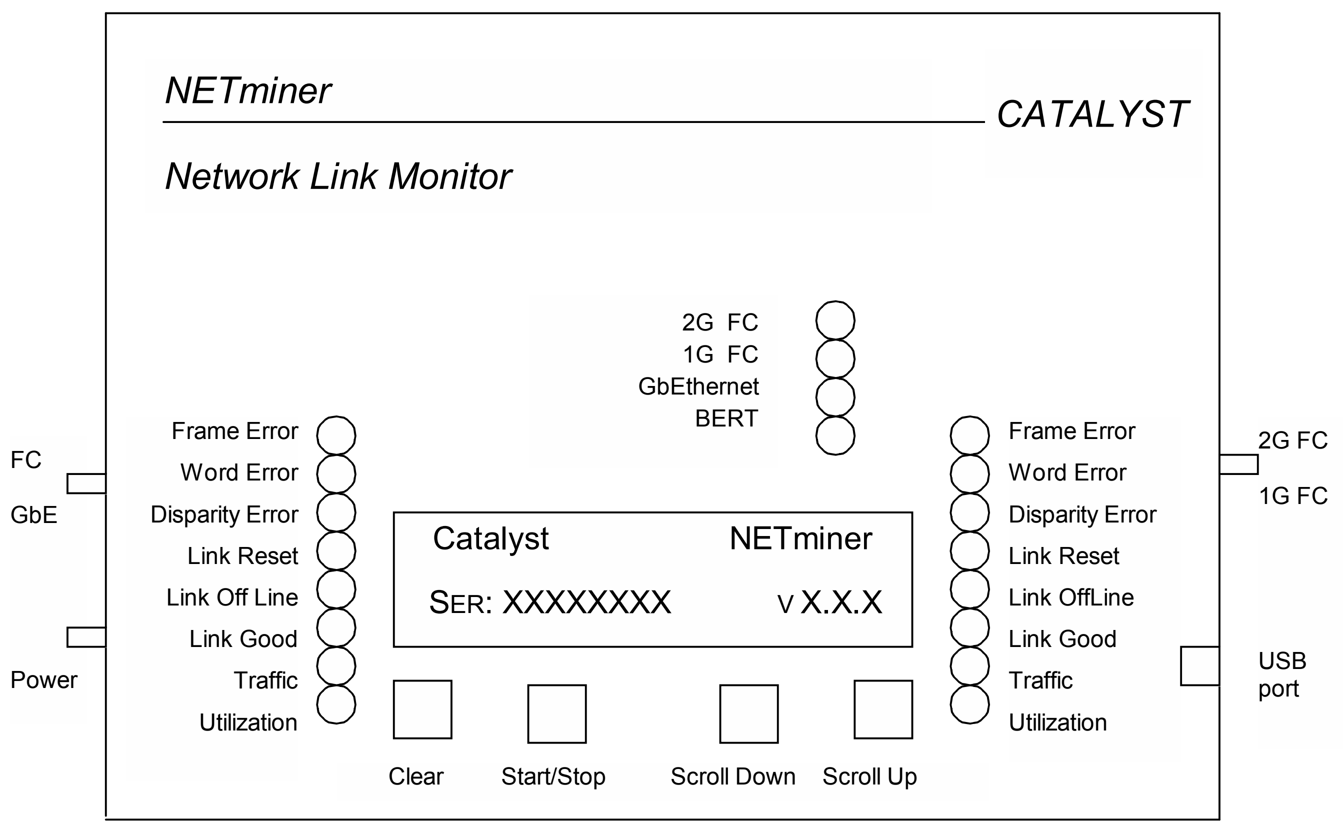
The Fibre Channel functions and the GbE functions each use its own separate configuration internal EEPROM. Selection of the EEPROM is done with a slider switch located on the left side of the case. The NETminer is configured for the FC or the GbE on power-up. Use the power switch located on the left side of the case.

1.2.2 PACKAGING AND POWER

The NETminer is packaged in a compact, high quality aluminum enclosure.
Dimensions: 5.5"x 7.3" x 1.1"
Power consumption: 1.5Amp max at 5Volt DC
Power supply: external 110/220 volt, 50-60Hz auto-ranging

1.2.3 THE CONTROL PANEL

The control panel has four push-button switches, twenty LED indicators and a two line, twenty characters per line LCD screen. Below is an illustration of the control panel layout. The circles represent the LEDs while the squares are the push-button switches.



1.2.4 LED ERROR INDICATORS

The following list details the operation of the error indicators for each channel. All error indicators are red color LEDs.

Frame Error
This LED monitors errors associated with a frame transmission.
In the FC mode this includes CRC errors and wrong EOF.
In the GbE mode this includes CRC errors and truncated frames.

Word Error
This LED monitors transmission words for illegal 10B encoding.

Link Reset
In FC mode this LED monitors the channel for the occurrence of any LR, LRR or LIP primitives.
In GbE mode This LED checks for a configuration primitive.

Link Off-line
In FC mode this LED monitors the channel for the occurrence of the NOS or OLS primitives.
In GbE mode this LED checks for a configuration primitive with the Off-line bit encoding.

Disparity Error
This LED monitors the channel for the occurrence of disparity errors in the received data.

1.2.5 LED MONITOR STATUS INDICATORS

The following list details the operation of the status indicators for each channel.

Link Good (green)
This LED is driven by the Loss of Sync (LOS) state machine. This LED is off until the receiver has achieved word sync. If the actual speed of the traffic on the link does not match the speed selected (by the 1G / 2G FC switch on the right or the GbE / FC switch on the left side) this LED stays off.

Link Traffic (yellow)
This LED monitors the channel for any non-fill words. An FC fillword is defined as an IDLE or any ARB. A GbE fillword is defined as an IDLE (I2) or

Carrier Extent. If a non-fill word or a frame is detected on the link this LED

blinks (turns On for a few hundred milliseconds).

Link Utilization (yellow)

This LED indicates the level of link utilization. Link utilization is defined as the ratio of non-fill words to the total bandwidth. This LED stays off if the utilization is less than 20%. If utilization is between 20% and 50% the LED blinks slowly, if it is between 50% and 80% the LED blinks rapidly, and if it is over 80% the LED stays on.

1.2.6 OTHER LED INDICATORS

FC or GbE Protocol Indicators (yellow)

At the center of the NETminer top panel there are three LED indicators that show whether the device is configured as a Fibre Channel 1G / 2G or GbE tool.

Speed Indicators (yellow) - The two FC (Fibre Channel) indicators show what speed is currently selected when the NETminer is monitoring Fibre Channel traffic. The lower LED indicates the 1.062Gbps operation and the upper LED indicates the 2.125Gbps. Moving the FC Speed Select switch (on the right side of the enclosure) toggles between the two speeds. The speed is set immediately, as soon as the switch is changed, however we recommend that you restart the unit (by switching the Power Of and On again) because some of the internal counters may have counted errors during this transition. If the GbE functionality (is included in the unit and) is enabled, the FC Speed Select switch is ignored, the two FC speed indicators stay Off and the GbE LED indicator is On.

BERT (yellow)

This LED blinks while the BERT test patterns are being generated during cable or SFP/GBIC testing.

1.2.7 CONTROL PANEL SWITCHES

The following is a list of the control panel switches, push-buttons, with descriptions of their function.

Configuration Select
This is a slide switch that selects between Fibre Channel or GbE functionality. It is located on the left side panel of the unit.

Power On
This is a toggle switch that reloads the FPGA with the appropriate code selected by the Configuration Select switch (FC or GbE), then it restarts the tool. The switch is located next to the Configuration Select slider on the left side of the enclosure.

Speed Select
This slide switch, located on the right side panel of the unit, selects between 1.062 Gbps and 2.125 Gbps for the Fibre Channel mode. The appropriate speed LED turns On in response to this input. If the NETminer is connected to a live FC link and the speed switch is selected wrong, the device will not recognize the incoming signal and the Link Good LED stays off. Always restart NETminer (turn the power Off and On) if you change the speed selection.
This speed select switch is ignored if GbE mode is enabled.

Clear
This push-button switch, when pressed, clears all latched error flags, the elapsed time counter, and the maximum latch of the utilization bar graph. If pressed when a BERT is running, all error counters (and latches) and the timer will be cleared, but the BERT operation will continue without interruption.

Start / Stop
This switch is used to start or stop the BERT operation and execute various selections.

Scroll Up & Down
These switches are used to scroll through the list of functions on the LCD. Each time they are pressed the LCD displays the next or previous function in a predefined list.
Read Section 2.4 for a detailed description of operation of these four push-buttons.

1.2.8 LIQUID CRYSTAL DISPLAY (LCD)

The LCD is a small, two-line display with 20 characters per line. It is used to display various statistics about each channel. Below is a list of the functions displayed by the LCD. Each display shows the statistics for Channel A on the top and Channel B on the bottom row.
On power up (use the switch on the left side of the unit) the initial screen is displayed.

```
Catalyst
NETminer SN:
```

The "SN: XXXX" on the left bottom is the serial number of the unit.
The " v.X.X.X" on the right is the revision number of the embedded SW.
This initial screen stays for about five seconds following Power Up; after about five seconds, or when any of the push-buttons is pressed, it is replaced by the Data Link Monitor starting screen. The initial screen cannot be entered using the push-buttons.

```
  Data Link Monitor
 Press START for
```

From this point on, use the Scroll Up or Down push-buttons to go sequentially through all the other selections in a circular fashion. The initial screen is shown only once and will not be shown again unless the NETminer is restarted.

The generic format of the statistics counters data displays is as follows:

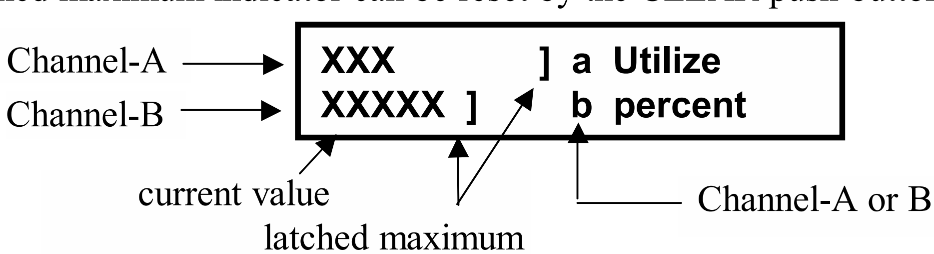
```
value for   →   12345678    A  LABEL
Channel-A   →   123456 78   B
```

Channel-A and Channel-B designators

There are two numbers shown, each is up to 10 digits long: the upper one is a value for Channel-A and the lower one is for Channel-B. The maximum count is 4,294,967,295. When this value is reached, the counter stops counting and a "overflow" message is displayed instead.
Some of the displays show "filtered" or "other" frames or data. In the FC mode the "filtered frames" or "filtered data" are the "solicited" kind which have a value of x01 in the R_CTL field of the FC frame header. In the GbE mode the "filtered frames" are the IP protocol kind which have a value of 08-00 in the link type field. There are no "filtered data" shown in the GbE mode. The term "solicited" as defined by the Fibre Channel specification is data that has been specifically solicited. It is sometimes also called "Data data" or "Data frames". The term "unsolicited" refers to data associated with a command or status which is sometimes called "Overhead data". As an example, a Read command executes as a series of frames: First, a command frame with the op-code = Read and several parameters is sent to the target, then the target device responds by sending the frames requested, followed by a frame that carries the status. In this case, the command frame and the response (status) frame carry "unsolicited data" in their payload, and the data frames sent by the target carry the "solicited data". The word "filtered" refers to an internal filter that is programmed to exclude a certain part of the traffic to be counted. In standalone applications, this filter is set up as described above. If an external PC (laptop or other) is used to control the NETminer (via the USB 2.0 port) then a client utility can be used to change the filter setting.

Link Utilization

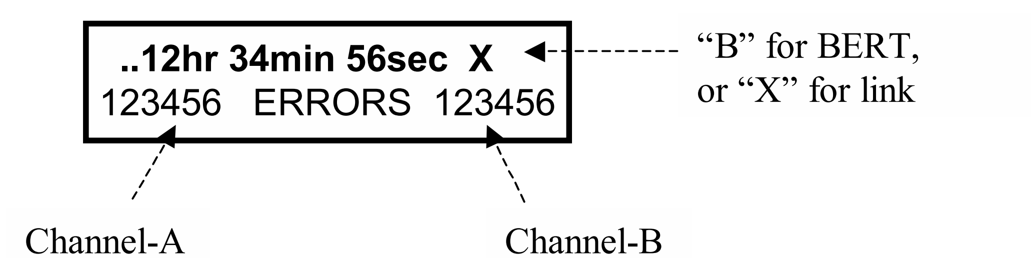
This function displays the current and the maximum link utilization value. Link utilization is defined as the ratio of all non-fillwords to the total available bandwidth. In FC, a fillword is defined as either an IDLE or (any of the) ARB.
In GbE a fillword is an IDLE or Carrier Extent. Link utilization is displayed as a bar graph in 100 steps. The left part of the bar (shown here as "XXX ") represents the current value. The "]" to the right of the bar is the latched maximum indicator. The latched maximum indicator can be reset by the CLEAR push-button.



Data Counts
This is the total data count in bytes calculated by counting only payload bytes. There are two data count displays: one for data in filtered data frames only and one for data in all other frames. In the FC mode the “filtered data frames” are the “solicited” kind, which have a value of x01 in the R_CTL field of the frame header. The data counters are not available in the GbE mode.

Frame Counts
The total frame count is displayed as Frames. There are two different frame displays: one for “filtered frames” only and one for all “other frames”.
In the FC mode the “filtered data frames” are the “solicited” kind, which have a value of x01 in the R_CTL field of the frame header.
In the GbE mode the “filtered frames” are the “IP” kind, which have a value of 08-00 in the link type field.

Elapsed Time and Error Count
This display shows the elapsed time and the total accumulated error count for each channel since the last time the CLEAR switch was pressed. This screen is also used during the BERT. During BERT testing, the LCD shows a “B” in the upper right corner. During link monitoring it shows an “X”.



Note that when the error counters reach their maximum displayable value of 999,999, they stop counting and a message “Overflow” is displayed on the screen. The NETminer stops counting at this point assuming that if the actual count is too high, it does not add to the clarity of the information. Errors should not occur at all in live systems, but if there are errors, it may be useful to know whether there was a single isolated error or a few sporadic intermittent errors. When there are very many errors, usually more than a dozen or possibly a hundred, we know that we have a serious problem which needs to be addressed, and the exact error count does not add anything to the information we already have.

The “X” or “B” marker in the upper right corner indicates the Link Monitoring or the BERT mode respectively.
If there is no signal detected in the Channel-A or Channel-B receiver the “No Sig” message is displayed for that channel.
The time counter can count up to 9,999 hours, which would be over a year before it would wrap around.
The error count and the time can be reset by pressing the CLEAR push-button.

Counters Capacity Summary:

Error counters	999,999
Data or frame counters	9,999,999,999
Elapsed Time counters	9999 hours, 59 minutes, 59 seconds (which is well over a year)

1.2.9 FIBRE CHANNEL TRANSMISSION SPEED SELECTION

The Fibre Channel traffic can operate at two different speeds: the 1.062Gbps and the 2.125Gbps. The NETminer is a test tool that must be transparent to the FC link under test; therefore it cannot participate in the speed negotiation cycle. The speed in the NETminer must be selected (manually) by the user. When in the FC mode (selected by the slider switch on the left side of the case) the 1G or 2G speed can be selected by a similar slider switch located on the right side of the case. When switched, a corresponding crystal is enabled to drive the internal circuitry. The switching occurs instantly, however we still recommend that you restart the unit, since it could have counted errors during the transition. If the GbE mode is selected the FC speed selection switch is ignored and the crystal corresponding to the GbE speed of 1.25Gbps is internally enabled.

1.2.10 PLUGGABLE TRANSCEIVERS (SFPs & GBICs)

The NETminer supports both types of transceivers. The newer transceivers are called SFP (Small Form Pluggable) and the older ones are called GBIC. The GBIC is the original transceiver that was initially introduced for the 1.062Gbps FC and is still used in many 1G FC systems and in many 1.25Gbps GbE systems. The SFP was introduced later when the FC speed was increased to 2.125Gbps, and is now used in almost all (1/2G FC as well as GbE) systems shipped today. The SFP module AC characteristics are better suited for the higher speeds.

There are four receptacle sockets provided on the NETminer, two for SFPs and two for GBICs. One SFP and one GBIC on the left side of the case are for channel-A. Similarly, one SFP and one GBIC on the right side of the case are for channel-B. Either the SFP or GBIC can be used, its presence is detected automatically when the module is inserted, cable is connected, and the signal is applied. If both transceivers (the SFP and GBIC) are activated on one side at the same time, then the NETminer selects the SFP and ignores the GBIC. Note that the two transmitters in the GBIC and SFP (on each channel) are driven with the same signal even though the receiver on one of them is ignored.

The plug-in transceivers are available for all standard speeds and media: for FC 1G, FC 2G, or dual FC speed, GbE 1.25G speed, copper, optical Multimode or SingleMode. They are available for all levels of standard output and input power.

S E C T I O N 2

FUNCTIONAL OVERVIEW

2.1 INTRODUCTION

The NETminer is designed to be used in two basic applications:

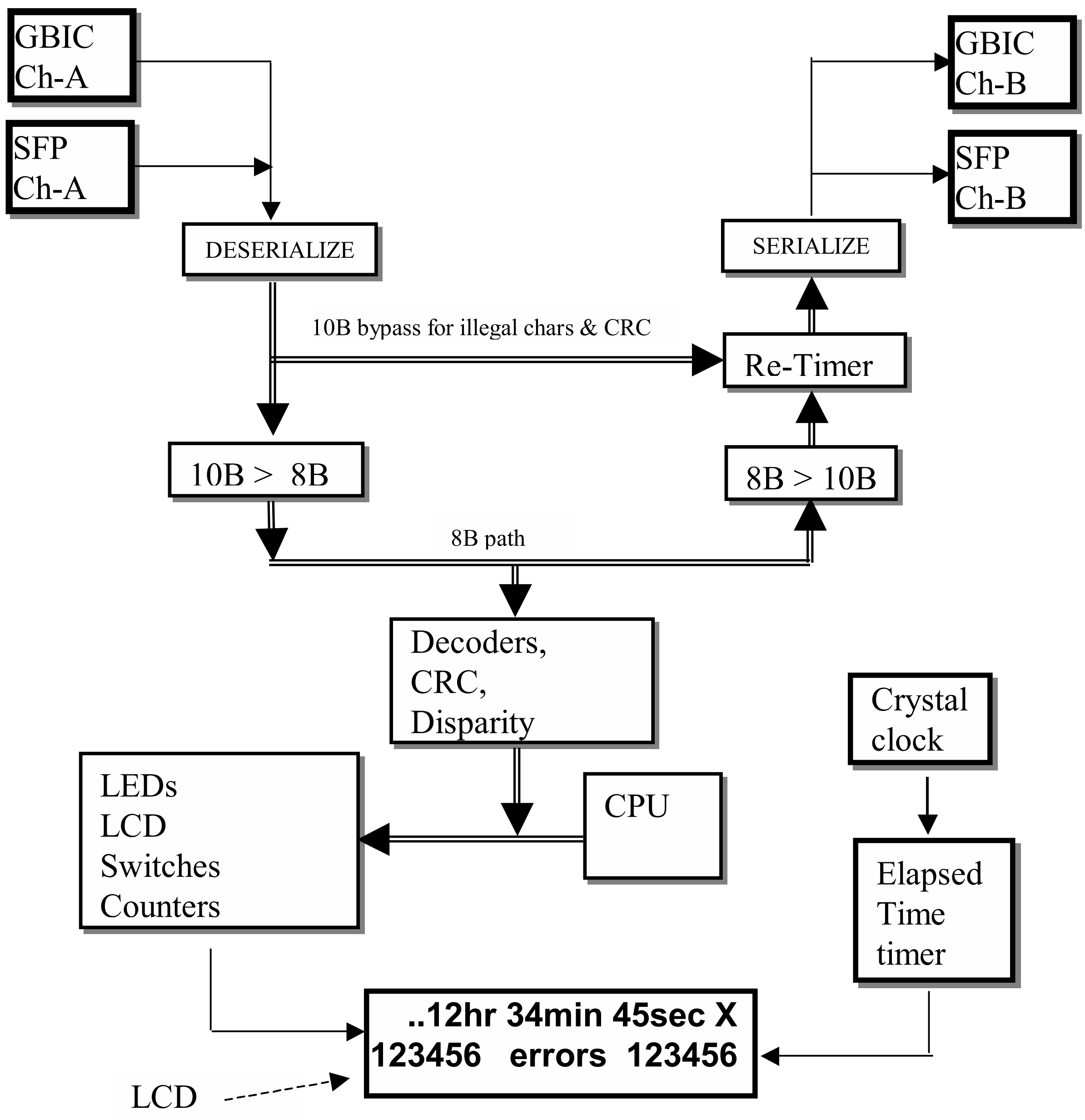
1. As a passive FC or GbE Link Monitor, media converter (copper to optical, optical MM to SM, etc), cable extension, SFP to GBIC conversion.
2. As a BERT (Bit Error Rate Tester) for testing SFPs, GBICs, copper or optical cables, and for qualification of installed wiring systems.

2.2 FC LINK MONITORING

The NETminer is designed to passively monitor an Fibre Channel or GbE link and to report various errors and statistics relevant to traffic on each channel of the full duplex FC link. Error conditions are reported via dedicated LEDs while most of the statistics are displayed on a small liquid crystal display (LCD). The front panel has several push-button switches for selecting various functions and for controlling the LCD. Red LEDs indicate errors, green LED indicates Link Up, and yellow LEDs indicate traffic activity or utilization. Each error condition causes the red LED to flash once for each occurrence of an event. Occurrence of an error event is also saved in a history latch. Once the history latch is set, the error LED stays on constantly, but the LED blinks (to the off level) at every new occurrence of an error. Pressing the CLEAR push-button resets the history latches. The green and yellow LEDs are used as additional status indicators
The LCD is used to display various summary statistics about each channel such as data byte count, frame count, or link utilization (in real time). The UP and DOWN scroll push-button switches allow selecting one of the statistics data to show on the LCD. Each pressing of these switches scrolls the menus (on the LCD) up or down to the next page in a predefined order. If a displayed function requires the user to make a choice, then pressing the START switch initiates the selected function. As an example, the BERT is one of the functions that require the START.

2.2.1 CONNECTING THE NETminer TO THE LINK

When the NETminer is used for monitoring an FC or GbE link it is daisy-chained in the link connecting the two ports on both ends. See the block diagram below.



The incoming serial signal is deserialized, converted from 10B to 8B code, checked for errors, decoded, and statistics counters are updated. On the way out the signal is converted back to 10B, re-timed and serialized. The FC or GbE link carries a full duplex signal; there are two identical sets of circuits, one for each direction.
Note that when an illegal 10B character or a bad CRC is detected, it is passed through to the output port without change. This guarantees that the NETminer is transparent to the devices connected to the monitored link.
Also note that an illegal 10B character will most likely cause a disparity error at the receive end of the link.

2.3 BIT ERROR RATE TEST (BERT)

The BERT function allows the user to check the quality of the link. When the BERT is started, a stream of frames carrying a specific test pattern is transmitted while the receive side of the BER tester monitors for CRC errors. Difference of the BERT executed in FC or GbE modes is only in the frame formats used and the transmit speeds. BERT function is initiated by pressing the START and is terminated by pressing the STOP push-button switch. Actually, the Start/Stop is a single push-button switch that toggles between the two.
The BERT uses three jitter test patterns defined by the standards specifications, the CJTPAT (Compliant Jitter Tolerance Pattern), the CRPAT (Compliant Random Data Pattern), and the CSPAT (Compliant Supply Noise Test Sequence Pattern). Each of these test patterns tests a different type of jitter tolerance and the user can select which one to use.
The test patterns are formatted to look like normal FC or GbE frames respectively. The test frames use a specific start of frame (SOF) delimiter followed by the test pattern, then CRC and an end of frame (EOF) delimiter. Note that the test pattern data covers the entire frame including what would normally be the header; only the SOF, CRC, and EOF words are added. Note again that the BERT counts CRC errors and therefore it reports counts of bad frames, not counts of bad bits.
The three test patterns are defined by the ANSI, T11 Fibre Channel Jitter Working Group in their T11.2/Project 1316-DT/Rev 10.0 document, and the IEEE Draft P802.3z/D3.0 document. See Appendix-A for abbreviated explanation.
The BERT can be started from the following screen by pressing the START.

BER Test CJT
pattern

Once started, the screen changes to the 'time & error' format with the "B" in the upper right corner (the "B" stands for BERT mode).

1234hr 56min 78s B
123456 errors 123456

Channel-A Channel-B

After the START is pressed, the 'time & error' counter screen is shown, and the time and errors start counting from zero. The time and error counters can be reset at any time by pressing the CLEAR push-button without disturbing the BERT function. The timer wraps around to zero after 9999 hours (about 416 days).
The BERT can be stopped by pressing the STOP push-button. While the BERT is running, the UP or DOWN push-buttons are ignored. You must STOP the test before using the UP or DOWN push-buttons to exit the BERT screen.
During the BERT, the LCD shows the "B" character in the upper right corner, it shows the "X" while link monitoring.

2.3.1 DURATION OF THE BER TEST

Depending on what are you trying to accomplish with the test, you may need to run it for just a few seconds, for several minutes, or for a day or two.

a) The "a few seconds" test will tell you whether your tested cable is wired correctly (as a "null modem") or whether the wires in the cable are basically good.

If you do not get the "Link Good" light, try to swap the two signals in the connector on one side of the cable (the fibers in optical connectors can usually be easily taken apart and reassembled, wires in copper cables may need to be re-soldered). You would want to run this test when you unpack a new cable or transceiver before installing it. This test gives you confidence that the part had not been damaged in transport to your receiving site.

b) The "several minutes" test will tell you whether you have gross cable quality problems in addition to whether your cable is wired correctly. You would run this test immediately after installing individual cables in the field.

c) The "day or two" test will confirm the quality of the cable to insure that it complies with the FC or GbE specification requiring 10^{-12} maximum error rate. You would run this test when qualifying new (vendor) cables, in the lab during cable development, or after installation in the field as the final acceptance test.
It is true that it takes only about 15 minutes to transmit 10^{12} bits across a 1Gbps link, but if you do not get any errors detected during this time window, it could have been because you were just plain lucky during this time. The long duration (like a day or two) of the compliance test is needed from the practical standpoint if you want to get a better statistical reading.

These rules apply equally for testing of the copper as well optical cables or transceivers (SFPs or GBICs).

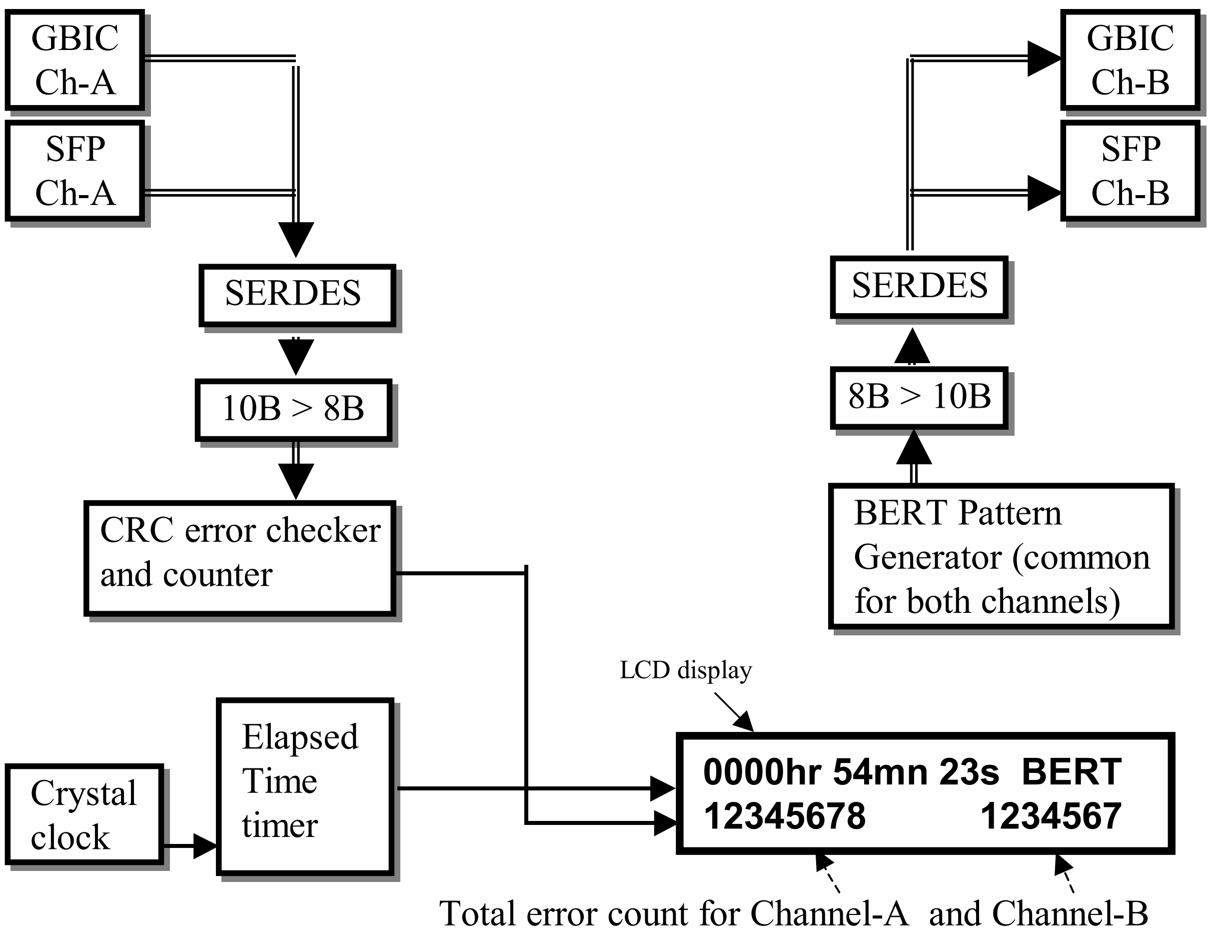
2.3.2 SELECTING THE TRANSFER RATE ("speed" of the link)

It is important to test the cables, the SFPs, or the GBICs at the speed they are rated for. Copper cables rated for 2Gbps usually will pass the test at 1Gbps, however cables rated for 1Gbps may not pass at 2Gbps. Optical cables should work the same at both speeds.
The transceivers are rated for a specific speed and/or a specific protocol like FC or GbE. Some transceivers are rated for a range of speeds. It is not unusual to have a 1.25G rated GbE transceiver that would not run without errors at 1.062G FC speed, or a 2.125G FC transceiver that would not run without errors at 1.25G GbE or 1.062G FC speeds. It is recommended that you test transceivers at each speed that

you intent to use them, regardless for which speed they were rated.

2.3.3 BERT IMPLEMENTATION

The NETminer, in addition to standard receiver and transmitter circuitry, uses a BERT pattern generator to drive the transmitters, and CRC checkers to detect potential CRC errors on the receiver sides. The pattern is transmitted through transceivers on both channels simultaneously.



The receivers synchronize on the incoming test frames and check for bit errors by monitoring the CRC. Note that the NETminer checks for CRC errors, therefore it counts and reports bad frames rather than the number of bad bits.

It is possible to check the received signal on either channel of the NETminer (examples "Case #1 and #2 on pages 36-37). It is also possible to do the BERT checking on very long cables using another NETminer located at the other end of the tested cable (case #3 on page 38).

2.4 NAVIGATING THE MENU TREE

The following charts show structure of the menu system.
On power up (the power switch is located on the left side of the case), the initial screen is displayed and after about 5 seconds it is replaced by the first screen of the Main Menu loop, which is the Data Link Monitor selection.

2.4.1 MAIN MENU LOOP & THE LINK MONITOR

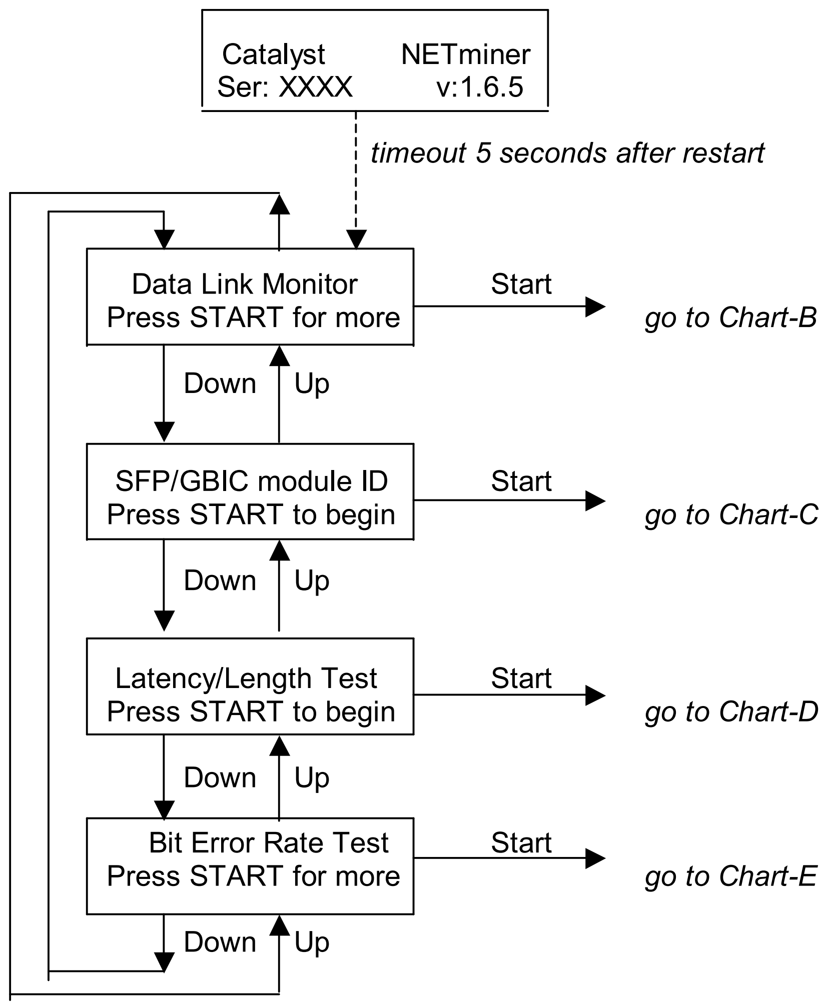


Chart-A - the Main Menu loop

The Main Menu loop shown above on Chart-A leads you through the four main functions selection. Use the Scroll DOWN and UP buttons to move around in this loop. Choose one of the four functions and press the START button to enter its menu selection sub-loop. Use the STOP or DOWN/UP buttons to return to the Main Menu loop.

Note that the START and STOP functions are the same physical push-button switch.

Use the Scroll DOWN and UP buttons to move through selections in the sub-menus.

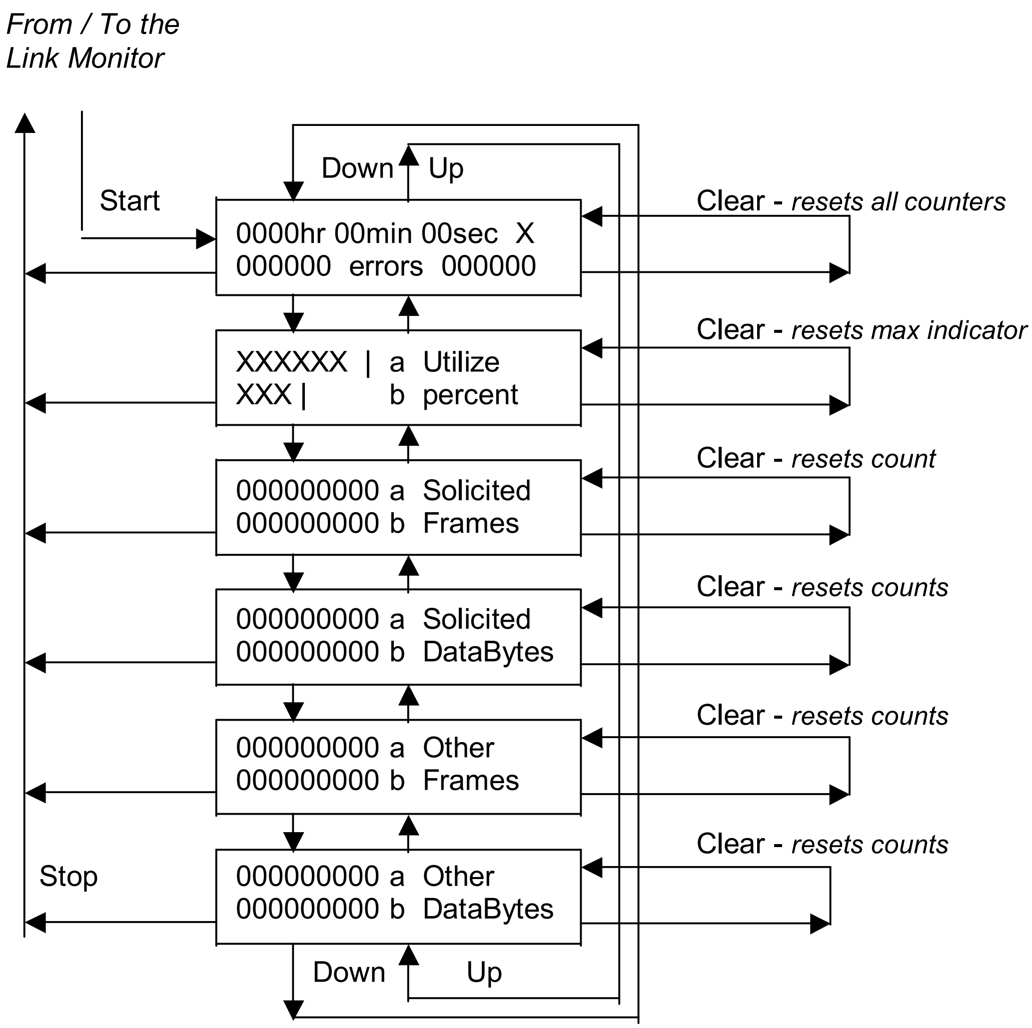


Chart-B - the Link Monitor sub-menu

The Data Link Monitor sub-loop:
Use the START button to enter this loop from the “Data Link Monitor” screen.
The Data Link Monitor runs all the time measuring elapsed time and counting errors, frames and bytes. The base screen (shown as the top screen on Chart-B) counts elapsed time in the upper row. In the lower row, it shows two error counters. The one on the left counts errors detected in Channel-A and the one on the right counts errors detected in Channel-B. The upper row in all other screens holds statistics counter for channel-A (marked “a”) and the lower row for Channel-B (marked “b”).
The CLEAR button resets all counters, it can be used at any time.
Use the Scroll DOWN and UP buttons to view different counters during link monitoring.
The “Utilize” screen (the second one on Chart-B) monitors utilization (in percent) of the link bandwidth for both channels, in real time. The resolution is in 100 steps, 1% per step. The maximum marker on the right of each horizontal bar shows the maximum utilization value detected during the session. This value is latched and can be reset by the CLEAR button (together with the other counters). The bargraph in the upper row is for channel-A and the one in the lower row is for channel-B
The statistics counters screens (the third to seventh ones on Chart-B) show the total counts of frames or data bytes. In the FC mode the term “solicited”, sometimes also called “data- data”, is used by the FC users to designate data or frames that were solicited by the read/write commands. In the GbE mode the “MAC Control” frames or data bytes are counted.
If the NETminer is under external control (via the USB 2.0 port), then the user can choose different filtering criteria for the “filtered” data or frames, other than the solicited/IP types.
The term “other” is used for all other frames or data.
Exit the Link Monitoring mode by pressing the STOP button.
Note that the START and STOP are the same physical push-button switch.

2.4.2 SFP and GBIC MODULE Serial ID INFORMATION

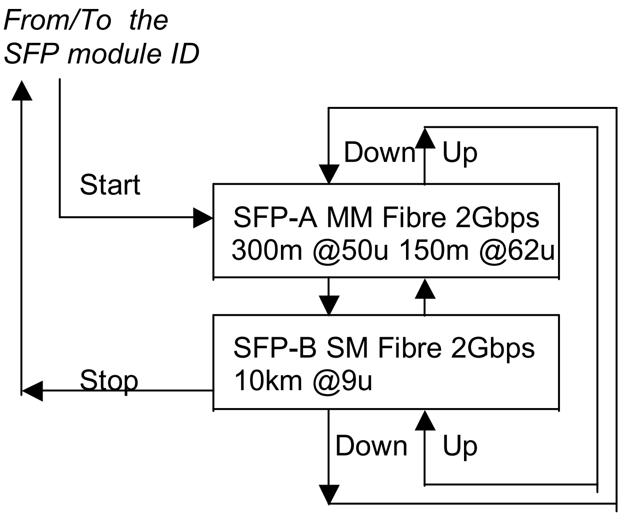


Chart-C: the SFP/GBIC module ID sub-menu

This function reads the Serial ID from the module and displays a part of the information on the LCD screen.

> *Note that some transceiver modules (most of the older GBICs) do not have the Serial ID implemented and the NETminer may display "No Data" message on the LCD in most such cases.*

The SFP/GBIC module ID:
Use the START button to enter this loop from the "SFP/GBIC module ID" screen.
Use Scroll DOWN and UP buttons to move sequentially between modules.
Use the STOP (= Start) buttons to return back to the "SFP/GBIC module ID" screen.
The CLEAR button is ignored in this menu loop.
Note that the START and STOP are the same physical push-button switch.

Note that you can read and display the full contents of the ID and EEPROM diagnostic data from the SFP module using a PC connected to the NETminer via an USB port, see ChannelTrack™ description in Section 9 and Appendix-C

2.4.3 LATENCY & CABLE LENGTH MEASUREMENT

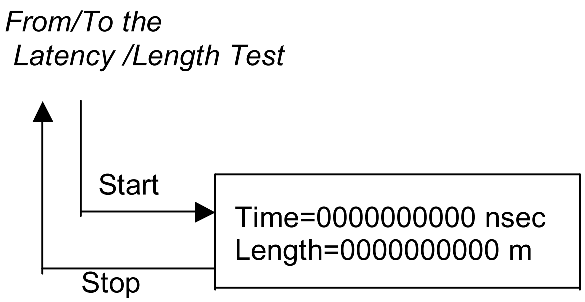


Chart – D: the Latency and Cable Length Test sub-menu

This function sends out a certain transmission word through the cable and measures the time elapsed until it is received back. The cable length is calculated under the assumption that propagation speed of the signal in copper or optical media is 4.895 nsec/meter (approximately 200,000 km/sec).

The Latency/Length Test:

Use the START button to enter this function from the Main Menu loop.

Use the START button again to start the test.

Press STOP and START button to execute another test.

While in the stopped state, use the DOWN or UP buttons to exit this function and return to the Main Menu loop.

The CLEAR button is ignored in this mode.

The Scroll DOWN or UP buttons are ignored unless in the stopped state.

Note that the START and STOP are the same physical push-button switch.

2.4.4 BIT ERROR RATE TEST MEASUREMENT

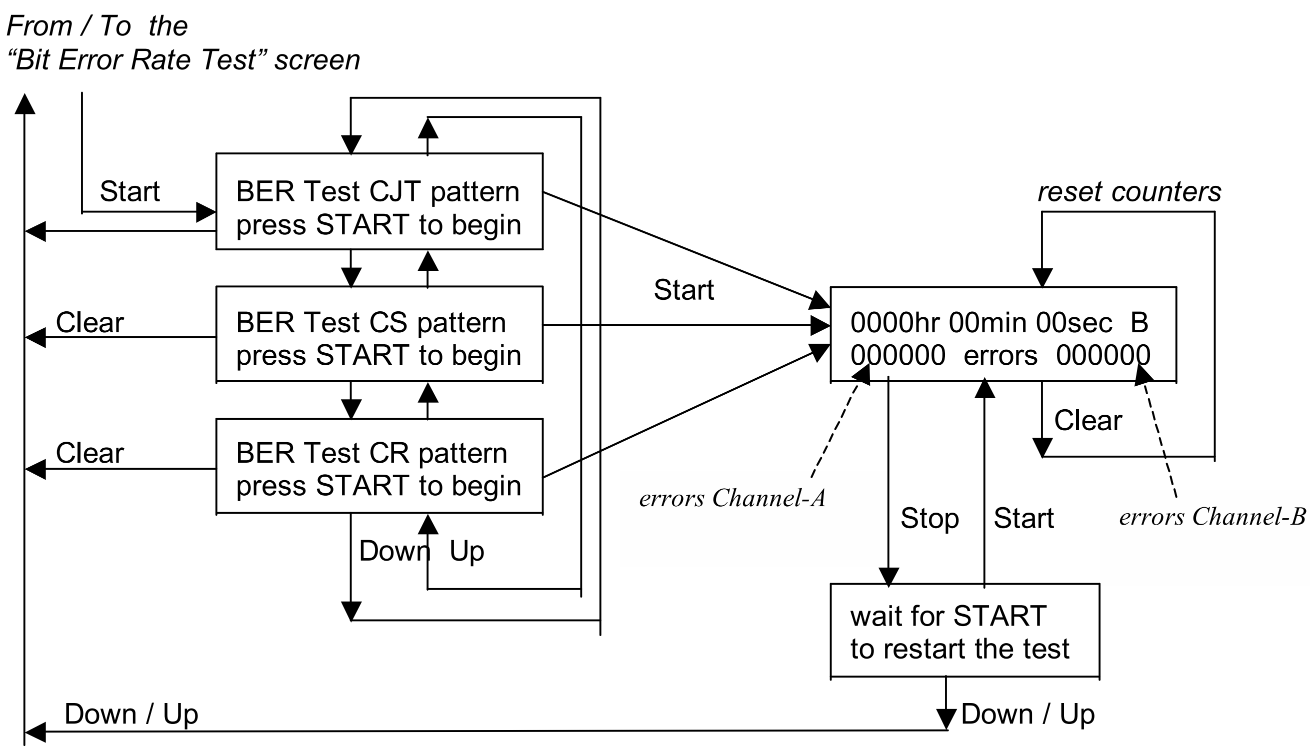


Chart-E – the Bit Error Rate Test sub-menu

Use the START button to enter the BERT selections from the "Bit Error Test" main screen.
Use Scroll DOWN and UP buttons to move between selections of the test patterns.
Use the START button again to start the test.
Use the CLEAR button anytime during the test to reset the time and error counters. Note that the CLEAR button merely resets the counters however it does not stop the test.
Use the STOP (=Start) button to freeze the test so that you can read the counters, then use the START button to restart the test again. While in the stopped mode, you can press the Scroll DOWN or UP buttons and return to the test pattern selection screen that you entered this test from. Use the DOWN or UP buttons again to move around to select another test pattern, and press START to start a new test. While the test is running, the DOWN and UP buttons are inactive.

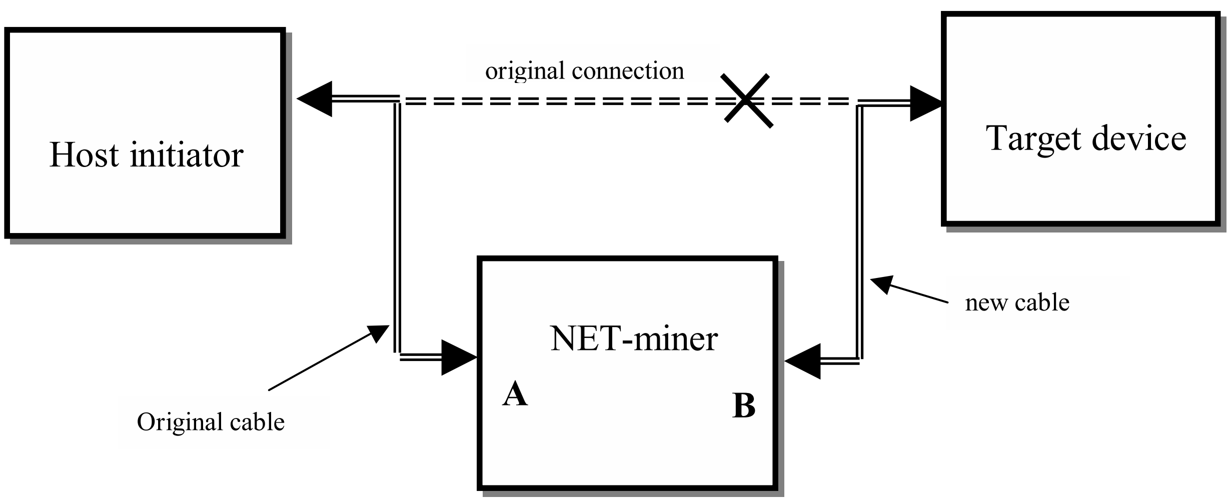
To stop and terminate the BER Test, stop the current test by pressing the STOP then use the DOWN / UP buttons to return to the main menu loop.
Note that the START and STOP are the same physical push-button switch.
It is recommended running the Latency/Length Test to verify that the cable is connected correctly before starting the cable BERT test or when you cannot see loopback on the other end of the cable.
The only difference between the BERT run for the FC or the GbE is in the format of the encapsulating frame, but the test patterns themselves are the same. Select the FC or GbE mode using the sliding switch on the left side of the case and restart the unit by turning the power switch off and On.

S E C T I O N 3

APPLICATIONS

3.1 SIMPLE LINK MONITORING

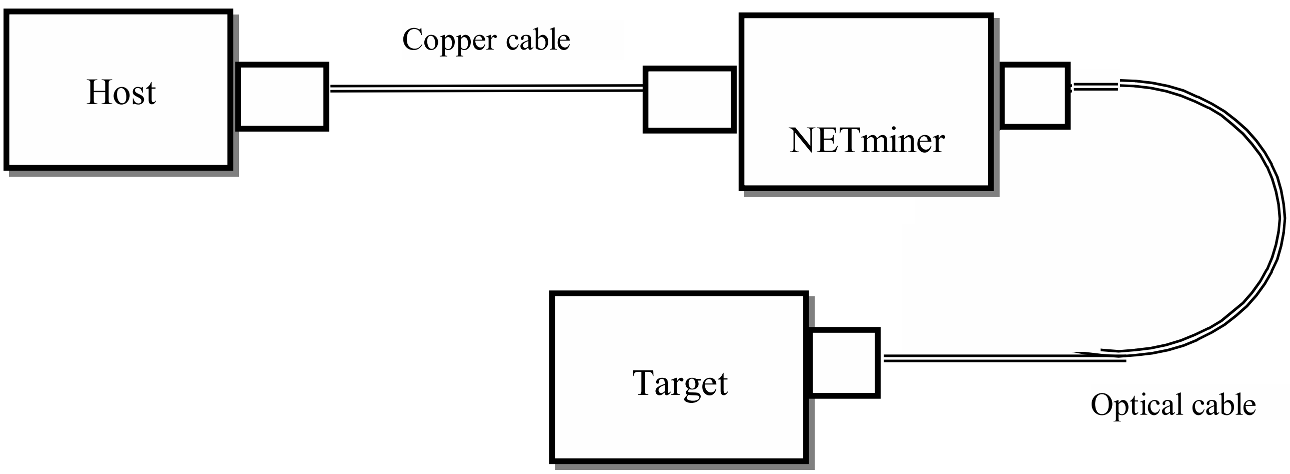
Basic function of the NETminer is monitoring an FC or GbE link. The NETminer, daisy-chained in the FC or GbE full duplex link, repeats without modification all incoming traffic and passes it over to the output ports in both directions. At the same time it detects, counts and displays the characteristics of the traffic, including errors. The block diagram in Section 2.2.1 shows the path of the signal and the monitoring circuits in the NETminer.
The following diagram shows how the NETminer is cabled (daisy-chained) in the FC link:



Originally, the Host is connected to the Target by a straight cable from the host to the target. When inserting the NETminer in the link, disconnect the original cable from the Target and connect it to port A in the NETminer. Then take a new cable, and connect port B on the other side of the NETminer to the Target. The link should come up automatically if the Host and Target are started, and you should see the "Link Good" LEDs for both channels on the NETminer to turn green.

3.2 MEDIA CONVERSION

The NETminer uses removable (pluggable) transceiver modules to connect the cables of the FC or GbE link. These modules are available for all standard media types; for copper as well as optical, Multimode and SingleMode. Both SFPs and GBICs are commercially available from multiple vendors. If interested, contact Catalyst for more information.
Both sides of the NETminer are independent and can use different type modules. For example, you can use copper SFP (or GBIC) on one side and optical (MM or SM) SFP (or GBIC) on the other side.

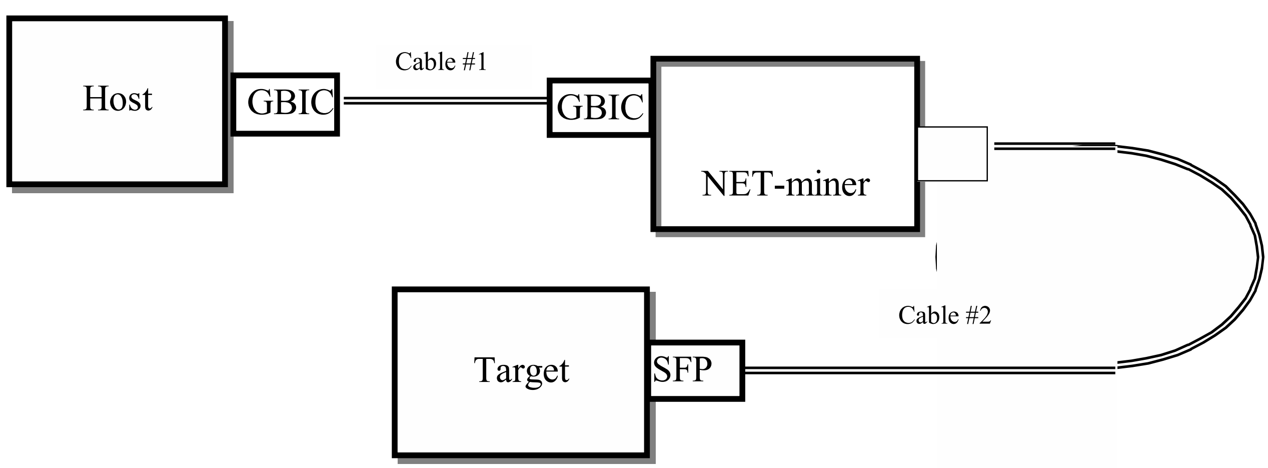


In this example, the first link uses copper cable and copper GBICs, the second link uses optical cable and optical SFPs.

3.3 GBIC/SFP CONVERSION

The NETminer uses removable (pluggable) transceiver modules to connect to the cables of the FC or GbE link. Both channels have two sockets each, one for the GBIC and the other for the SFP plug-in module. Any of the two (GBIC or SFP) can be used independently on both channels, the internal circuitry on each channel automatically detects which one of the two has a signal, and enables the corresponding internal path. For example, if you have the SFP and the GBIC in the same channel (on the same side of the NETminer) plugged in, but only the GBIC has the cable connected to an active device on the other end, the NETminer enables the GBIC connection and ignores the SFP. If both the SFP and the GBIC, on the same side are receiving signal at the same time (have the module plugged in and cables connected to an active device), then the SFP connection is selected and enabled, and the GBIC is ignored.

Both sides of the NETminer are independent and can use different type modules, for example for SFP to GBIC conversion, Channel-A can use SFP and Channel-B the GBIC, or vice versa.



In this example the Host uses GBIC and the Target uses the SFP transceiver. Using cables with the same connectors on both ends, the NETminer acts as a GBIC to SFP translator. The only requirement is that both GBICs on cable #1 use copper, or both use optical. The same rules apply to cable #2.

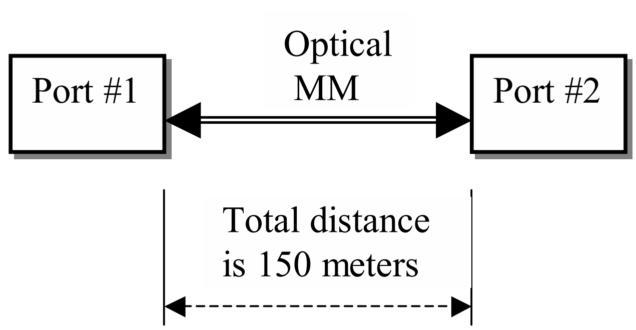
Note that if the Host and the Target use the same type of media (both use copper or both use optical) then the same connection could be accomplished using a single cable with different connectors on each end, one for the SFP and the other for the GBIC. You would use this cable if you do not need to monitor this link.

3.4 CABLE EXTENSION

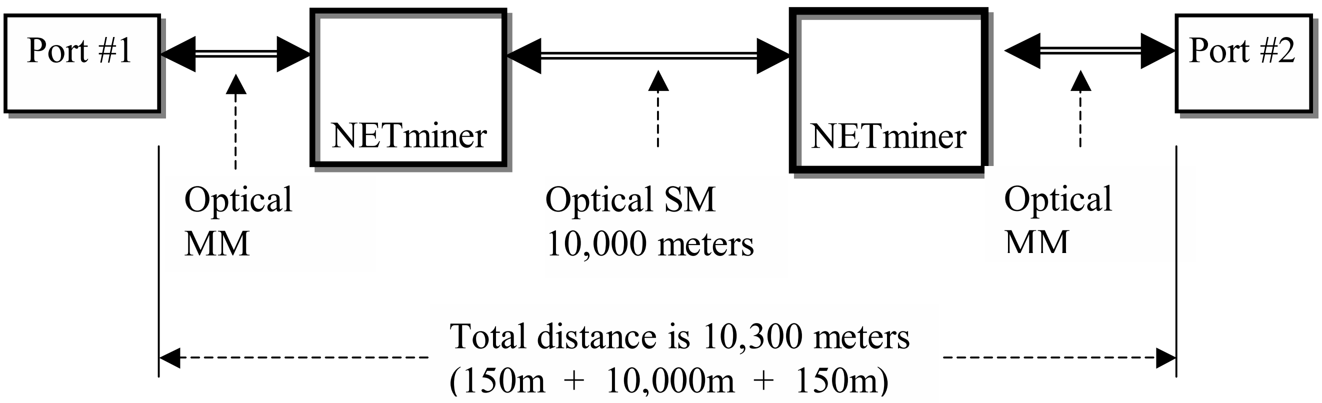
Propagation of optical signal over fiber is not unlimited. Over distance, there is accumulation of power loss, and degradation of the quality of the signal by dispersion. For this reason, the FC protocol specification defines maximum distances for different types of media. For example, a Multimode optical over 50u fiber is specified for use up to a 500meter distance with 1Gbps signal, or 300 meters with 2Gbps signal. For more on this see Appendix-B.
The NETminer receives a signal, re-times it and retransmits it. Transceivers (copper or optical) on each side generate a new, fresh signal, therefore the maximum allowed cable length applies to each cable segment. By inserting the NETminer in the link, the maximum distance between end ports can be significantly extended.

See the following examples:

Original 2Gbps FC link can reach up to 150 meters:



2Gbps FC link extended to 10,300 meters:



3.5 TESTING CABLES

3.5.1 USING BERT FOR TESTING CABLES

There are many things that can cause transmission errors in cables. The optical fiber itself can be damaged, connectors can be bad or sloppily installed, or the mating surfaces in the connectors can be poorly polished or just dirty. The copper cables can be faulty as well; usually, the copper wire itself would be god, but connections in the connectors can be bad, or the contacts can be dirty.

Why do we need to test cables?

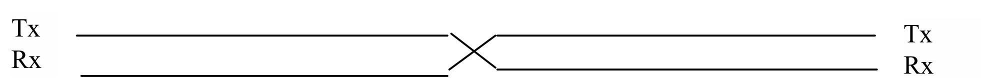
Connectors - The NETminer can test both kinds of cables, the optical as well as the copper type with all standard connectors. Using matching transceivers (SFP / GBIC), the following connectors can be used: copper: HSSDC and HSSDC2, optical: LC/LC, SC/SC, and LC/SC. Catalyst offers plug-in transceiver modules for testing copper cables as well as optical Multimode and SingleMode.

Output power - In addition to matching the physical connectors, you also need to provide adequate output power when testing cables. When testing copper cables, you can choose active or passive transceivers depending on the output power required. When testing optical cables, you need to supply enough output power (in the transceiver) to overcome the power loss in the cable. If you need to know the output and inoput power used, check the specifications for the SFPs (or GBICs) you use.

Transfer rates - Cables rated for a particular speed should be tested at that speed; the 1G rated cables probably would not pass a test at 2G. Cables rated for 2G would pass the 1G test but they should be tested at 2G also. Make sure that for tests at 2G you use transceivers also rated for 2G. Select the BERT transfer rate by the GbE / FC and the 1G / 2G FC slider switches and restart the unit (push-button on the left side). When you switch to 1G or 2G or GbE, a corresponding LED on the control panel will light up.

When testing cables, use only known GOOD transceivers so that the only unknown part is the cable to be tested. All standard transceiver modules are available from Catalyst.

Correct wiring - cables (copper as well as optical) used in FC and GbE networks are wired in a “null modem” (i.e crossed) fashion which is different from simple “extender” cables. This is because cable should connect the transmitter on one end to the receiver on the other end and vice versa.



Are the mating surfaces of optical cables good? - Terminating the optical cables is not an easy task. Mating ferrules must be precisely centered and well-polished to guarantee minimum light power loss in transition. Good precise contact of the two fibers is important for the MM 62.5u fiber, even more so for the MM 50u fiber, and it is extremely critical for the SM 9u fibers. One way to test whether the ends are well polished is by gently wiggling the cable as it is plugged in the SFP/GBIC; you should not be getting any errors unless you move the cable too much.

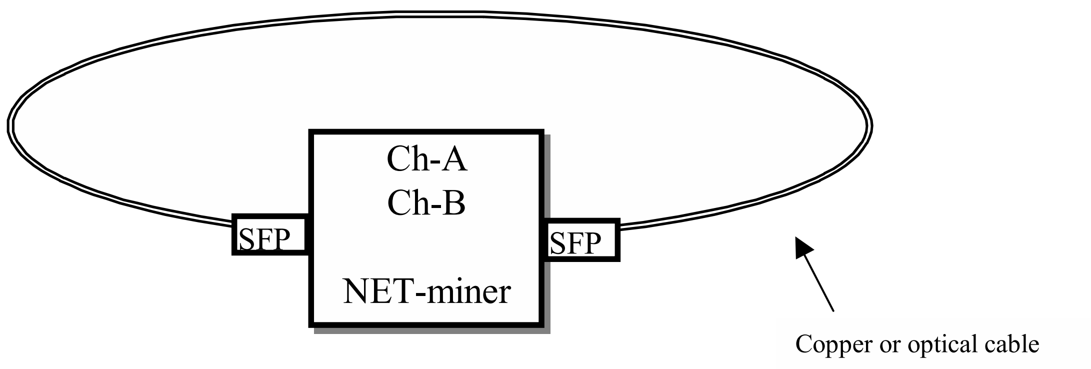
Crosstalk in Copper cables - Copper cables have wires for one signal direction running parallel with wires for the other signal direction. Even though the FC or GbE uses differential signals and twisted pairs to minimize the crosstalk, there is always some residual coupling that results in interference between the two signals (of the FDX link). We recommend using test method described as Case #3 for testing for presence of the crosstalk coupling. This test method which uses two separate NETminer units controlled by independent and therefore asynchronous clocks better approximates the actual situations in the field.

Duration of the test – varies, it depends on what are you trying to accomplish by the test. The BER test can take a few seconds, several minutes, or a day or two. See Section 2.3.1 for more information on this issue.

Cables can be tested using the following three methods:

Case #1.

If the cable starts and ends in the same physical location, both of it's connectors can be connected to the transceivers of the same NETminer; one to the transceiver of channel-A and the other to the transceiver of channel-B. See the following illustration:

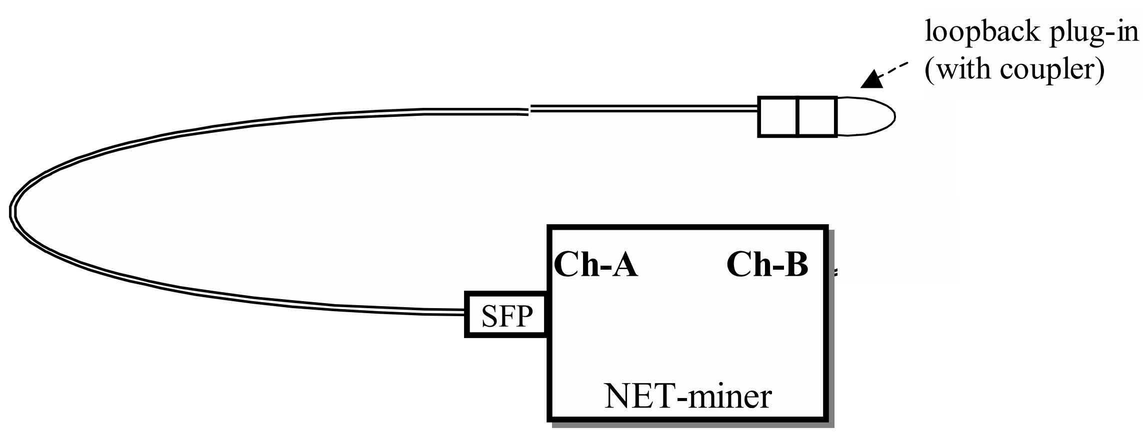


In this configuration, the transceivers on both sides are transmitting test patterns at the same time while the receivers on both sides are checking for errors, thus performing concurrent tests on both wires of the full duplex cable. The LED indicators and error counters (shown on the LCD screen) of both channels monitor the signal for errors in each of the two pairs of wires (of the full duplex cable) separately.

Using this method, you also verify that the cable ends are routed correctly (in "null modem" fashion). If the ends of the cable are swapped, then the transmitter on one end is connected to the transmitter on the other end, and the receiver on one end is

connected to the receiver on the other end. In such a case, the receivers on both sides will be detecting the "Loss of Signal" state and all LEDs will be blank.
When you initially plug in both ends of the cable and before you start the first test, there is no traffic on the cable. When you start the BERT test for the first time, the link-up is established and the BERT test pattern traffic starts. Whenever you pause the BERT test the Idle transmission words will be circulating, maintaining the link (in both directions). At this point, and if the cable is wired correctly, you should see the "Link Good" LED on.
After this you can start the BERT test (or restart it by pressing the START) and the test pattern traffic starts in both directions. During the test, you should see only the "Link Good", "Traffic" and "Utilization" LEDs steady On and the" BERT" LED flashing. You should not see any red LEDs indicating errors if the cable is good.
Duration of the test can vary widely depending on what you are trying to achieve. Quick test verifying routing of wires in the cable may take a second, and a full-blown BERT test may take a day or two. See Section 2.3.1 "Duration of Test".

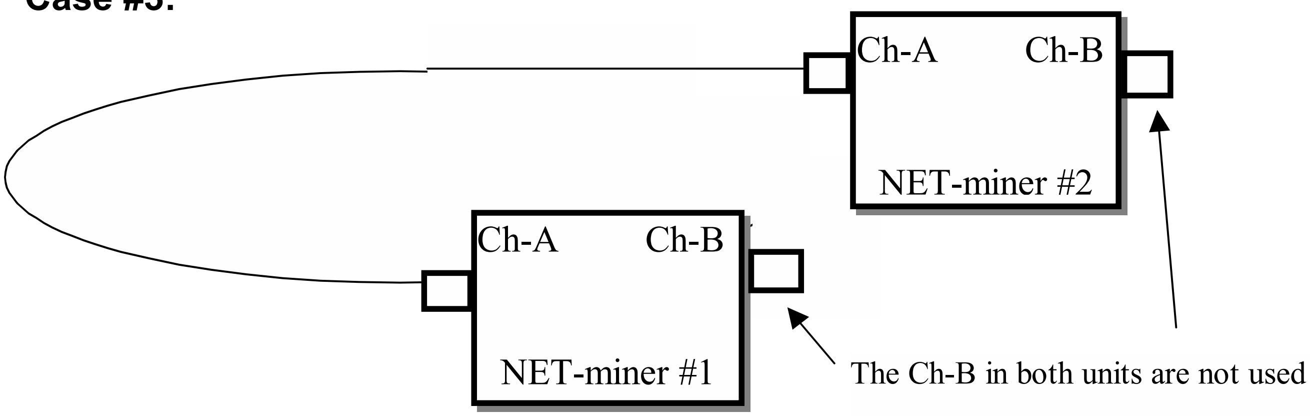
Case #2.
If the cable is laid such that the other end is far away and cannot be brought back and to plugged into the other port of the NETminer easily, then plug the connector of the local end to the NETminer (on either channel) and plug the loopback connector in the connector of the far end of the cable as illustrated in the following figure.



In this setup, LED indicators of Ch-A monitor the signal going through both wires of the cable and LED indicators of Ch-B are all Off indicating no signal.

Remember that when using the loopback method the signal has to travel the full length of the cable out and the same distance back. This makes the length of the cable appear twice as long to the transceiver. Therefore, if you are using the maximum allowed cable length, you may exceed the available power budget. In such a case you must use method described in case #3 below instead.
When using the optical loopback, you need to use a special vinyl cable coupler (supplied with the optical loopback if purchased from Catalyst) in order to mate the male connector of the cable and male connector (marked "Loopback") of the loopback. When testing copper cables, use the copper loopback. The copper loopback, supplied with the copper cable kit (by Catalyst), has two circuits, one loopback with HSSDC and another one with HSSDC2 connector.

Case #3:



This setup with two independent NETminers can be used because the BERT test patterns are formatted as standard FC or GbE frames, and the receivers on both ends only need to recognize the FC or GbE frame and check for CRC errors. Actually, the test is a little more strenuous if you use different NETminers on each end. This is because all transmitters and receivers in the same unit are synchronized to the same (internal) clock, but using the transmitter in one unit and the receiver in another unit, each running from a different clock, a little more jitter is added in the receivers and the cable must be a little better quality to pass the test.
Using this test setup, the LED indicators in Ch-A of the NETminer #1 monitor one signal (of the full duplex cable) and LED indicators in Ch-A of the NETminer #2 monitor the other signal of the cable. You will see the LEDs "Link Good", Traffic" and "Utilization" all On. The LED indicators in channel-B of both NETminers should be off.

3.5.2 MEASURING CABLE LENGTH & LATENCY

Length of cables is measured indirectly by measuring the propagation delay of a signal sent through the cable. The resolution is one transmission word (37.77nsec at 1Gbps, 18.8nsec at 2Gbps, and 16nsec at 1.25G GbE) that translates to less than 5 meters in cable length at 2Gbps. We do not recommend using this method for measuring length of cables shorter than 5 meters.

To perform the measurement, connect the ends of the cable as shown in illustration Case#1 (in the previous section). You will have one end of the cable plugged in SFP/GBIC of one channel and the other end in SFP/GBIC of the other channel. You can also connect one end of the cable into the SFP/GBICs for Channel-A (!!) and plug the loopback in one end of the cable as shown for Case#2. Note that you should use only the Channel-A SFP/GBIC, Channel-B cannot be used for this type of measurement. Data is transmitted from both the A and B channels but only the Channel-A receiver checks for reception errors.
To execute the measurement select “Latency/Length Test” screen on the LCD and press START and the screen will show the measured latency and length. To repeat the test simply press the START button and the test is repeated.
Remember that if you use the second method with the loopback (Case#2) the actual latency/length is one half of the value displayed for Case#2; this is because the signal has to travel through the cable twice the distance – once out to the loopback and then back.

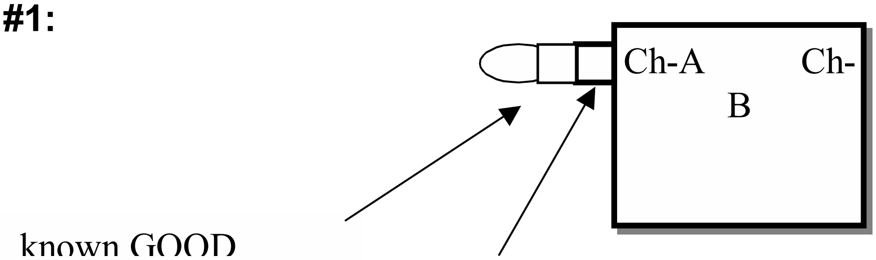
3.6 TESTING TRANSCEIVERS

3.6.1 TEST TRANSCEIVERS (SFPs & GBICs) USING BERT

Testing transceivers is very similar to testing cables. The BERT transmitter sends out test patterns and the receiver checks for CRC errors. The rules for choosing the duration of the test are the same as for testing cables. See Section 2.3 for more information.
Test setup shown for cables as Case #1 or Case #2 can be used. If you use the Case #1, make sure that you use a known GOOD cable and known GOOD transceiver on the other end, so that only the transceiver under test is unknown.

The simplest method is testing one transceiver with a loopback plugged in it

Case #1:

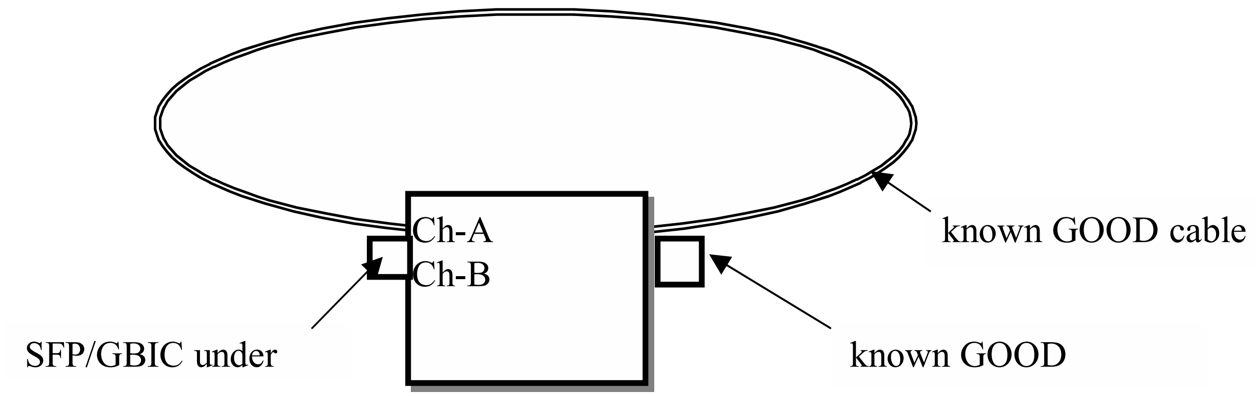


SFP or GBIC under test

In this setup, LED indicators of Channel-A monitor the receiver of the same transceiver (SFP of GBIC). The LEDs for Channel-B are Off indicating no signal in Channel-B. Using this method, you cannot tell if the transmitter or the receiver of your transceiver module is bad if you detect errors. However, in practice, if a part of the transceiver is bad then it does not matter which one it was, because the entire transceiver has to be replaced.

Using this method, two transceivers can be tested independently at the same time, one on each side of the NETminer.

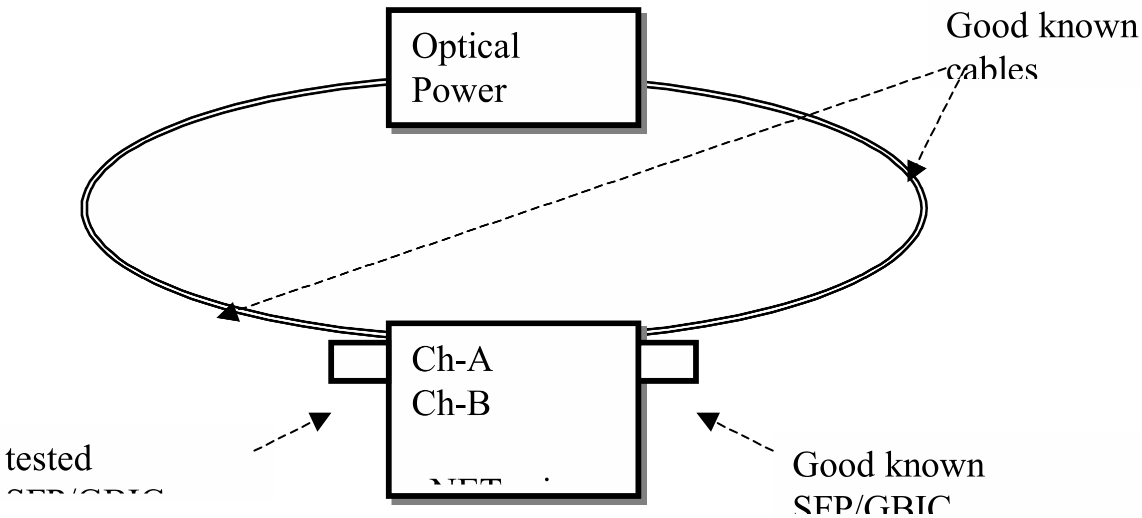
Case #2:



In this setup, LED indicators of Channel-A monitor the receiver of the tested SFP/GBIC, and LEDs of Channel-B monitor the transmitter operation. As you can see, you get separate readings for the receiver and for the transmitter.
Remember that you are testing the transceiver and therefore all other components of the circuit must use known GOOD parts. If you use the method shown as a case #1 above, the loopback must be guaranteed good. If you use the method shown as case #2, the cable and the second transceiver must be guaranteed good.

3.6.2 TESTING OUTPUT POWER OF TRANSCEIVERS IN SFP/GBIC

The transceiver (laser or LED) in the SFP or GBIC may degrade and lose power over time. The NETminer, together with an (external) attenuator, can be used to verify the output power of an optical transceiver. The test setup is shown below:



Make sure that you use GOOD known transceiver on the receiving side and GOOD known cables. Test by gradually increasing attenuation until you start receiving errors in the receiver.

3.6.3 IDENTIFY SFP TRANSCEIVER MODULES

There are situations when you need to know the type of a transceiver but the only information you have is vendor name and a part number printed on the module. To identify your module, you may need to find the specification document for that particular module and read it carefully.
It is much easier using NETminer and read identification information stored in an internal (read only) memory in the module (Serial ID). Simply insert the module in one of the SFP/GBIC sockets (in the NETminer), select “SFP module ID” function on the LCD screen and press the START button. Then use the Scroll DOWN / Up

buttons to cycle through the SFP and GBIC sockets; the NETminer reads the IDs from each module and tells you on the LCD whether it is a copper active/passive or optical MultiMode /SingleMode type, whether its speed is 1G, 1.25G or 2 Gbps, and maximum length.

Note that you also can read and display the full contents of the ID and diagnostic data from the SFP module using a PC connected to the NETminer via an USB port. The internal EPROM (in the SFP) memory contains detailed information describing the status of the module. In addition to the above mentioned data, you can read the transceiver laser power (=aging), its current temperature, etc, and other vendor specific data that can be useful to you. See Appendix C for an example printout.

To exit the test press the (START/) STOP button and the NETminer returns to the Main Menu loop.

S E C T I O N 4

ChannelTrack™ PERFORMANCE ANALYSIS

4.1 INTRODUCTION

ChannelTrack™ Performance Analysis is a stand-alone software utility for the NETminer that executes on a host PC. Connection between the host and the NETminer is via an USB cable. ChannelTrack™ can be used for monitoring the performance and activity of a FC Link and for identification of the SFP plug-in modules. When used as a FC link monitor, ChannelTrack™ operates in real time on an active FC link. It shows the following traffic characteristics: Link Utilization as a percentage of the available bandwidth, Frames per second, Bytes per second, and Frame size profile.

ChannelTrack™ consists of two main parts: a set of HW counters located on the NETminer (HW), and GUI software that periodically reads the counters and displays the readings.

4.2 ChannelTrack™ HARDWARE

In the monitoring mode, the following values are counted:

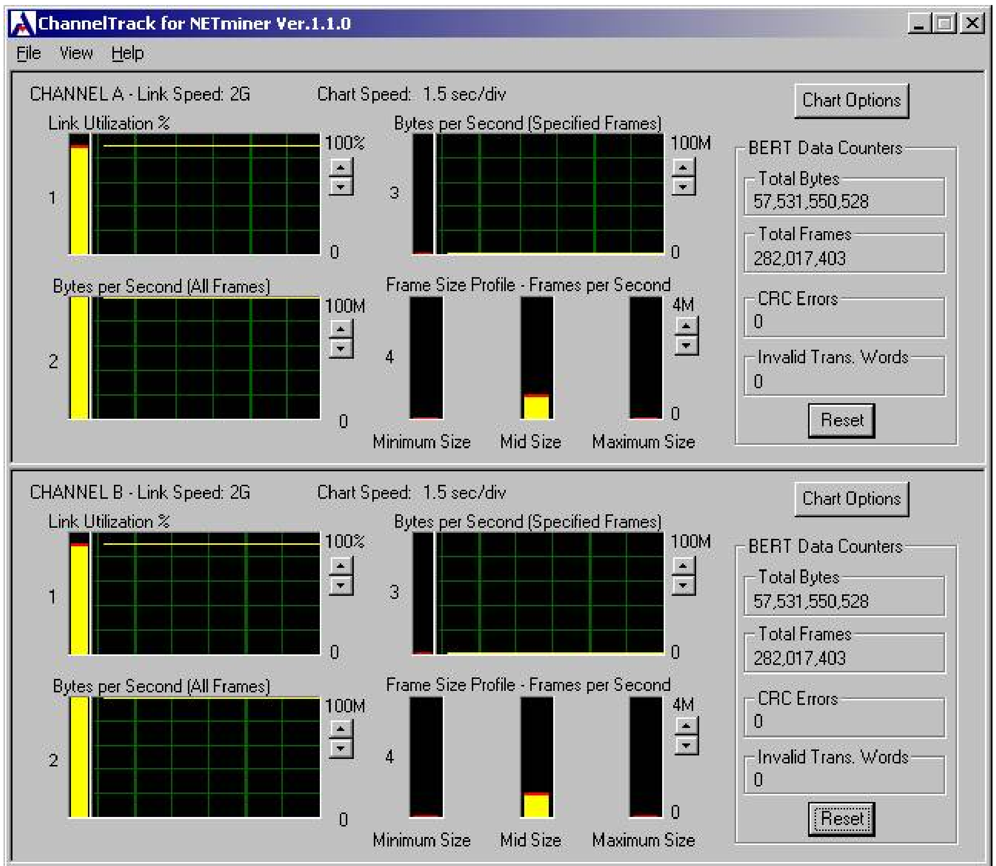
- Frames per second
- Bytes per second – solicited or all data
- CRC errors
- Illegal Characters
- Frames with sizes </= 32, 33 to 256, >256 bytes

All counters are free running and are automatically updated in real time at the full speed of the FC Link traffic. The GUI software reads the counters, and depending on the Chart-Speed selected, it updates the displayed charts. The counters are read at about 200 millisecond intervals.

4.3 ChannelTrack™ SOFTWARE

4.3.1 The Main Window

The main window:



The screen is divided into two channel windows, one for each channel: the upper half of the screen shows activity in Channel-A and the lower half shows activity in Channel-B.

Each channel window displays four charts on the left and four data counters on the right. Each of the charts has a "gauge indicator" on the left, and history field moving towards the right. The vertical scale of the chart can be adjusted using the + and - buttons on the right side.

The four charts display the following:

Chart 1: Link Utilization in percent - this is a ratio of traffic (everything except Idles) to available bandwidth.
Chart 2: This chart can show either Frames/second or Bytes/second. Solicited or unsolicited data.
Chart 3: Same as chart 2, which can be qualified by S_ID, D_ID, Type, or R_CTL.
Chart 4: Frame Size Profile - three groups of frame sizes are counted: frames shorter than 32 bytes, 33 to 256 bytes, and longer than 256 bytes.

The four counters on the right display the following:

1. Total bytes
2. Total frames
3. CRC errors
4. Invalid Characters

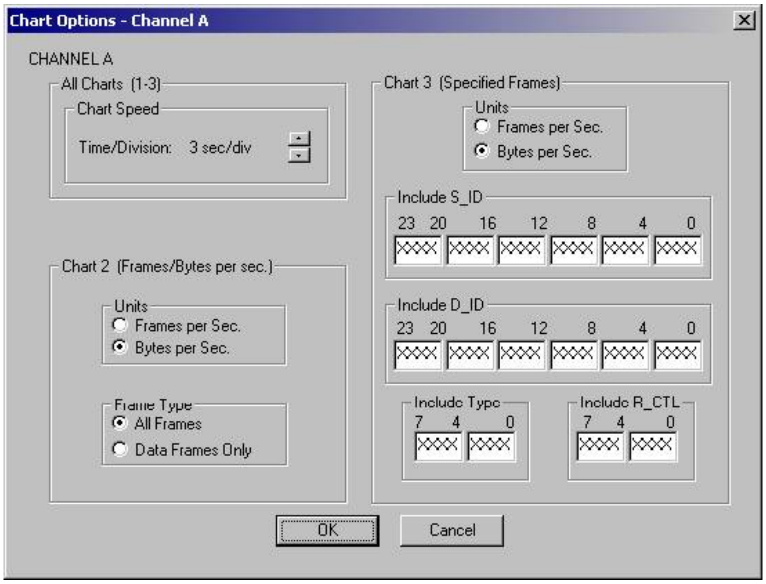
The 'Reset' button is for resetting the counters.

The menu bar at the top of the screen is for access to select options available in the ChannelTrack™ :

Using the **'File'** pulldown menu you can Open, Save, or Save As the data on the screen as text files. This Open/Save functions are available in the 'Counters & SFP EEPROM data' displays.
In the **'View'** pulldown menu you can select which screen to display: the main monitoring window, the small format, the counters screen, or the data read off the diagnostic EEPROM in the SFP module.
The **'Help'** selection identifies the GUI software version level.

4.3.2 Display Setup

The **'Chart Options'** button (in the main monitoring window) brings in a dialog box for selecting display options:



The following values can be selected:

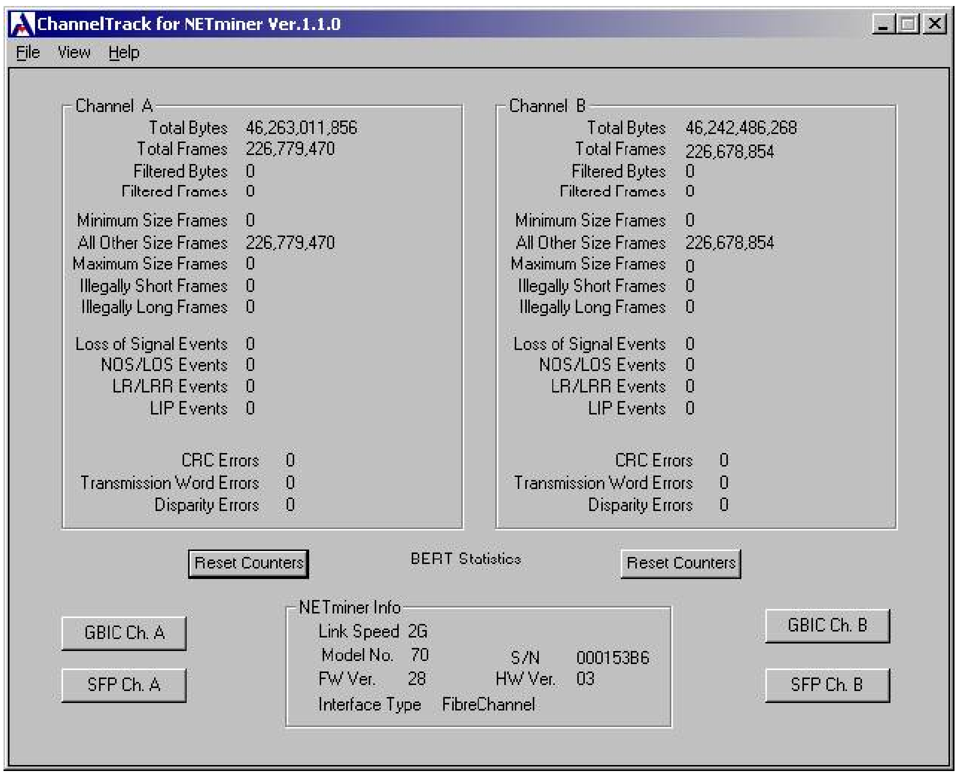
1. The Chart speed (time resolution) is selectable in:
   3, 6, 15, 30 seconds, 1, 5, 15 minutes, 1 hour.
   The speed selection is common to all charts of the same Channel.
2. Chart 2 can be configured to show Frames per second or Bytes per second. If Frames per second are selected, they can be qualified by either all frames or data frames only (solicited data)
3. Chart 3 can be configured to show Frames per second or Bytes per second. In addition, four filters are selectable for this chart: S_ID, D_ID, Type, and R_CTL. Selections of each is in binary, and a "1", "0", or "X" (Don't Care") can be used. Note that the filters apply to the chart-3 only.

4.3.3 The View Options

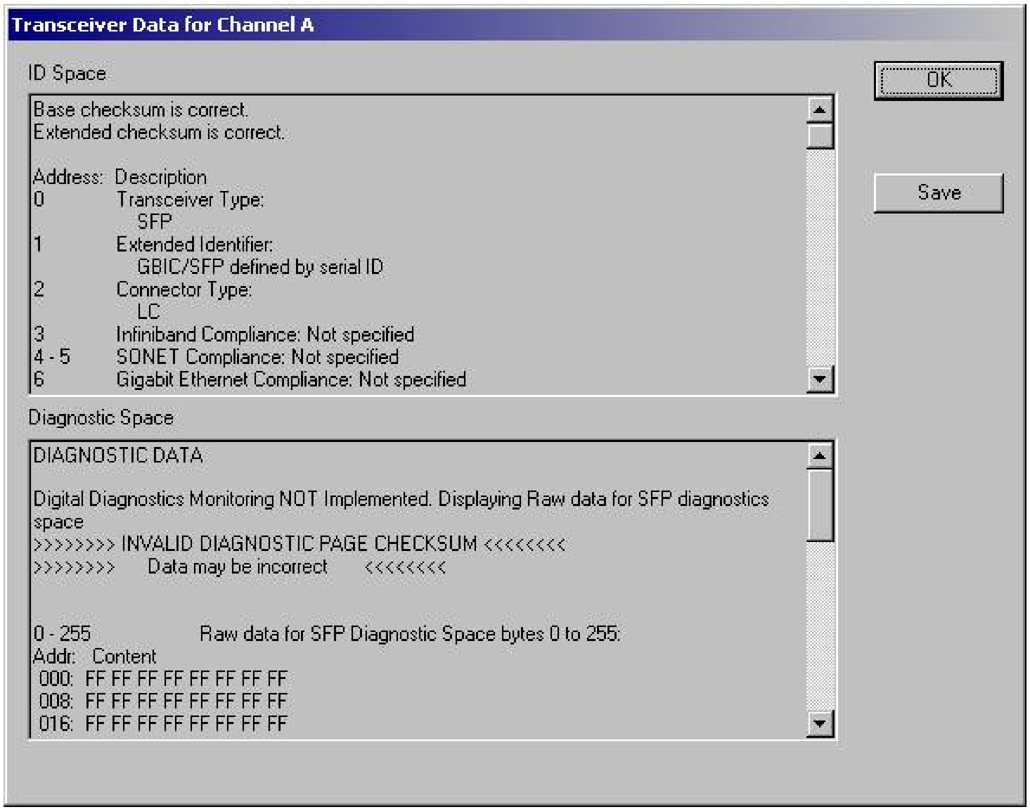
The following options are available:
- Large Display (this is the main monitoring window)
- Small Display
- Counters and Display SFP EEPROM

The 'Small Display' is a (drastically) simplified version of the 'Large Display'.

The 'Counters & SFP EEPROM' screen is:



Click on any of the four buttons at the bottom of this screen, and the NETminer reads the internal EEPROM diagnostic data out of a selected SFP or GBIC module. Both pages of the diagnostic data will then be displayed in the following format:



The SFP/GBIC diagnostic data can be saved on (internal) disk in the PC host. The saved file is in the .txt format and can be viewed using almost any word processor. See example of the SFP diagnostic data in Appendix-C.

4.4 Installing ChannelTrack™

Catalyst recommends that the software be installed before plugging the USB cable into the NETminer. If the USB cable is plugged in first, you may have to cancel the Plug and Play driver installation until the driver directory for the NETminer can be located.

A. NETminer software installed first (RECOMMENDED).

Step 1:
Double click on the "Setup.exe" file and follow the installation instructions. If you use all the defaults, the software is installed in C:\Program Files\Catalyst\NETminer and a shortcut is installed on the desktop.

The driver (needed in the next step) can be found in the drivers directory C:\Program Files\Catalyst\NETminer\Drivers.

Step 2:
Plug the USB cable into the PC, and plug the other end into the NETminer. Windows will respond with the "New Hardware Found" wizard. Follow the directions in the wizard and when asked for the drivers, point to the driver at C:\Program Files\Drivers\NETminer\Drivers or on the installation disk.

B. NETminer cable plugged in first

Step 1:
When you plug the USB cable into the NETminer, Windows will respond with the "New Hardware Found" wizard. Follow the directions in the wizard and when asked for the drivers, point to the driver directory on the installation disk.

Step 2:
Double click on the "Setup.exe" file and follow the installation instructions. If you use all the defaults, the software is installed in C:\Program Files\Catalyst\NETminer and a shortcut is installed on the desktop.

S E C T I O N   5

INSTALLATION

5.1 HARDWARE

The NETminer is a standalone instrument with an external power supply. It requires 5Volt DC, at a maximum 1.5Amp current.

5.2 UNPACKING

Inspect the shipping carton for signs of damage before opening. If there is any evidence of damage, notify the carrier and CATALYST immediately.
Remove the NETminer and all accessories from the shipping carton, and compare the contents with the parts list accompanying the package, or listed on the packing slip. If any equipment is missing, contact the CATALYST local representative or CATALYST directly (408/ 365-3846), as soon as possible.
Connect the external power supply and plug the AC cord in the wall outlet

5.3 CONNECTING the FC LINK CABLES

If the NETminer is used for monitoring an existing FC link connecting two ports, disconnect the cable from one of the devices and connect it to one side (use either one of the two – the SFP or the GBIC) of the NETminer. Then use another cable and connect the other side of the NETminer to the disconnected device. If the traffic between the two ports is active, you should see the “Link Good” LEDs for both Channels to be On, and possibly also some other LEDs may be lit depending on the characteristics of the traffic.

A P P E N D I X A

THE BERT

A.1 BERT – THEORY OF OPERATION

The Fibre Channel links or the GbE links may fail for many reasons. It could be for any part of the FC port on either end, but in most cases it is the cable, its connectors, or one of the transceivers (in the plug-in modules). Some sources indicate that in 80 % cases it is the cables, connectors, or the transceivers that fail. For this reason, it is important to insure that these components are good before using them and also verifying that they did not get damaged during installation. The method of Bit Error Rate Testing (BERT) is one way how to perform the test.

Test the 1G (FC) cables at 1Gbps speed, the 1.25G (GbE) cables at 1.25Gbps speed, and the 2G (FC) cables at 2Gbps speed. The 2Gbps test frequency is more strenuous, and there is a good chance that most of the 1G rated cables will pass test at 2G, although it is not guaranteed. The transceivers (SFPs and GBICs) have to be tested at a speed that they are certified for. Transceivers certified for dual or triple speed should be tested at all those speeds.

The standards committees that defined the Fibre Channel and GbE specifications recommend running specified test patterns through the link.

The three test patterns are:

1. CRPAT - Compliant Random Data Pattern
2. CJTPAT - Compliant Jitter Tolerance Pattern
3. CSPAT - Power Supply Noise Test Sequence

The test patterns are embedded into the standard FC or GbE frame construct in order to allow them to be also carried on active FC or GbE links. Each frame is followed by six Idle primitives. The FC frames start with SOFn3 and end with CRC and EOFn with negative or positive disparity. The GbE frames start with preamble, SFD and end with CRC and EOP. By embedding enough repeating (modified) base patterns in a frame, the spectral contribution of the frame delimiters, CRC and Idle primitives is minimized.

1. The **CRPAT** provides a data pattern with broad spectral content and minimal peaking. A flat spectral content pattern is used to insure that any peaking seen during TX jitter testing can be attributed to the component and not the spectral content of the data. The CRPAT pattern has a broad spectrum, which produces a worst-case scenario with regard to deterministic jitter generation.

The pattern itself consist of:

D30.5, D23.6, D03.1, D07.2
D11.3, D15.4, D19.5, D20.0
D30.2, D27.7, D21.1, D25.2 these three tr.words are repeated 16 times

In the FC frames this pattern is encapsulated in SOFn3 at the beginning of the frame and the CRC and EOFn at the end. In the GbE frames this pattern is encapsulated in preamble and SFD at the beginning of the frame and the CRC and EOP at the end.

The CRPAT can also be used for EMI testing.

2. The **CJTPAT** overall pattern alternates repeating low transition density patterns with repeating high transition patterns. The repeating 10B character durations are longer than the time constants in the receiver clock recovery circuit. This assures that the clock phase has followed the systematic pattern jitter and the data sampling circuitry is exposed to large systematic phase jumps. The CJTPAT has been designed mainly for receive jitter tolerance testing.

The pattern itself consists of:

D30.3, D30.3, D30.3, D30.3 - (low density transition pattern repeated 41 times)
D30.3, D30.3, D30.3, D20.3
D30.3, D11.5, D21.5, D21.5 - (low to high transition densities)
D21.5, D21.5, D21.5, D21.5 - (high density transition pattern repeated 12 times)
D21.5, D30.2, D10.2, D30.3
D30.3, D30.3, D30.3, D30.7 (high to low transition densities)

In the FC frames this pattern is encapsulated in SOFn3 at the beginning of the frame and the CRC and EOFn at the end. In the GbE frames this pattern is encapsulated in preamble and SFD at the beginning of the frame and the CRC and EOP at the end.

3. The **CSPAT** is a test pattern that simulates the worst-case power supply noise introduced by the transceiver.

The pattern itself consists of 512 times repeated transmission word: D31.3, D31.3, D31.3, D31.3
In the FC frames this pattern is encapsulated in SOFn3 at the beginning of the frame and the CRC and EOFn at the end. In the GbE frames this pattern is encapsulated in preamble and SFD at the beginning of the frame and the CRC and EOP at the end.

A.2 MORE INFORMATION

For more information on this topic we recommend reading the ANSI document T11.2/Project 1316-DT/Rev x.x –Working Draft titled: "Fibre Channel – Methodologies for Jitter Specification-2. Latest version is dated March 10, 2003 (as of June 2003) and the IEEE Draft P802.3z/D3.0 document dated June 20, 1997.

A P P E N D I X B

CABLES

B.1 CABLE LENGTHS

The ANSI Fibre Channel specification defines maximum lengths for the copper and optical cables:

Transfer rates	Copper	Optical MM 50u	Optical MM 62.5	Optical SM 9u
1 Gbps	N/A	500m	300m	10,000m
2 Gbps	N/A	300m	150m	10,000m

Note that the lengths for copper cables are not specified. The only requirement is that the signal at the other end of the cable be of sufficient power for the receiver. It is the responsibility of the designer to do the design and the measurements.

A P P E N D I X C

SFP EEPROM Diagnostic Data Readout example.

C.1 Readout Example

SFP Data - Fri Feb 17 11:54:24 2006
SFP Data for Channel B

SERIAL ID DATA (first page)

Base checksum is correct.
Extended checksum is correct.

Address: Description
0 Transceiver Type: SFP
1 Extended Identifier: GBIC/SFP defined by serial ID
2 Connector Type: LC
3 InfiniBand Compliance: Not specified
4 - 5 SONET Compliance: Not specified
6 Gigabit Ethernet Compliance: Not specified
7 FC Link Length: Intermediate Distance (I)
7 - 8 FC Transmitter Technology:
Shortwave Laser w/o OFC (SN)
9 FC Transmission Media:
Multi-mode,50m (M5)
Multi-mode,62.5m (M6)
10 FC Speed
400 MBytes/Sec
200 MBytes/Sec
100 MBytes/Sec
11 Encoding: 8B10B
12 Bit Rate (nominal) 4300 Megabits/Sec
13 Reserved
14 Link Length (9um)-km Not supported or unknown
15 Link Length (9um) Not supported or unknown
16 Link Length (50um) 150 meters
17 Link Length (62.5um) 70 meters
18 Link Length (Copper) Not supported or unknown
19 Reserved
20 - 35 Vendor Name: *(vendor name)*
36 Reserved
37 - 39 Vendor OUI: *00xxxx*
40 - 55 Vendor PN: *(xx-xx-xxx-xx…)*

56 - 59 Vendor Rev.: *(x)*
60 - 61 Laser Wavelength (nm): 850 nm
62 Reserved
63 Check Code - Base: Read = D1, Calculated = D1
PASSED
64 - 64 Options
RATE_SELECT is implemented
TX_DISABLE is implemented
TX_FAULT is implemented
Loss of Signal (inverted) is not implemented
Loss of Signal (per SFP MSA) is implemented
66 Bit Rate (Max) Not specified
67 Bit Rate (Min) Not specified
68 - 83 Vendor SN: 439PJZWH
84 - 91 Date Code: (MDY) 09-25-04 Lot
92 Diagnostic Monitoring Type
Digital monitoring implemented
Internally Calibrated
Power Measurement Type = Avg. Power
93 Enhanced Options
Alarm/warning flags implemented
Soft TX_DISABLE implemented
Soft TX_FAULT is implemented
Soft Loss of Signal implemented
Soft RATE_SELECT implemented
94 SFF-8492 Compliance:
SFF-8472 Rev 9.3 functionality
95 Check Code - Extended: Read = 42, Calculated = 42
PASSED
96 - 127 Vendor Specific:

Raw data for SFP ID space bytes 0 to 255
Addr: Content
000: 03 04 07 00 00 00 00 20
008: 40 0C 15 01 2B 00 00 00
.
.
.
248: 20 20 20 20 20 20 20 20

DIAGNOSTIC DATA (second page)

Digital Diagnostics Monitoring Implemented. Displaying formatted data.
Diagnostic page checksum is correct.
Using internal calibration

Alarm and Warning Values:
0 - 1 Temp High Alarm: 70.00 Deg C

2 - 3	Temp Low Alarm: 0.00 Deg C
4 - 5	Temp High Warning: 70.00 Deg C
6 - 7	Temp Low Warning: 0.00 Deg C
8 - 9	Voltage High Alarm: 4.00 Volts
10 - 11	Voltage Low Alarm: 2.70 Volts
12 - 13	Voltage High Warning: 3.43 Volts
14 - 15	Voltage Low Warning: 3.13 Volts
16 - 17	TX Bias Current High Alarm: 10.00 Milli-Amps
18 - 19	TX Bias Current Low Alarm: 0.10 Milli-Amps
20 - 21	TX Bias Current High Warning: 9.00 Milli-Amps
22 - 23	TX Bias Current Low Warning: 0.30 Milli-Amps
24 - 25	TX Power High Alarm: -1.50028 dBm (0.70790 mW)
26 - 27	TX Power Low Alarm: -11.00179 dBm (0.07940 mW)
28 - 29	TX Power High Warning: -2.50032 dBm (0.56230 mW)
30 - 31	TX Power Low Warning: -8.99974 dBm (0.12590 mW)

RX power represented as Average Received Power

32 - 33	RX Power High Alarm: 2.00002 dBm (1.58490 mW)
34 - 35	RX Power Low Alarm: -21.02373 dBm (0.00790 mW)
36 - 37	RX Power High Warning: 0.00000 dBm (1.00000 mW)
38 - 39	RX Power Low Warning: -16.98970 dBm (0.02000 mW)

Measured Values:

96 - 97	Temperature: 60.67 Deg C
98 - 99	Supply Voltage: 3.34 Volts
100 - 101	TX Bias Current: 4.88 Milli-Amps
102 - 103	TX Power Output: -4.50874 dBm (0.35410 mW)
104 - 105	RX Optical Power: -33.97940 dBm (0.00040 mW)

Optional Status/Control Bits:

110 Bit 7	TX Disable State: CLEARED
110 Bit 6	Soft TX Disable: CLEARED
110 Bit 4	RX Rate Select State: CLEARED
110 Bit 3	Soft RX Rate Select: CLEARED
110 Bit 2	TX Fault: CLEARED
110 Bit 1	Loss of Signal: SET
110 Bit 0	Data_Ready_Bar: CLEARED

Optional Alarm and Warning Flags:

112 Bit 7	Temp High Alarm: CLEARED
112 Bit 6	Temp Low Alarm: CLEARED
112 Bit 5	Vcc High Alarm: CLEARED
112 Bit 4	Vcc Low Alarm: CLEARED
112 Bit 3	TX Bias High Alarm: CLEARED
112 Bit 2	TX Bias Low Alarm: SET
112 Bit 1	TX Power High Alarm: CLEARED
112 Bit 0	TX Power Low Alarm: SET
113 Bit 7	RX Power High Alarm: CLEARED
113 Bit 6	RX Power Low Alarm: SET
116 Bit 7	Temp High Warning: CLEARED

116 Bit 6 Temp Low Warning: CLEARED
116 Bit 5 Vcc High Warning: CLEARED
116 Bit 4 Vcc Low Warning: CLEARED
116 Bit 3 TX Bias High Warning: CLEARED
116 Bit 2 TX Bias Low Warning: SET
116 Bit 1 TX Power High Warning: CLEARED
116 Bit 0 TX Power Low Warning: SET
117 Bit 7 RX Power High Warning: CLEARED
117 Bit 6 RX Power Low Warning: SET

120 - 127 Vendor Specific:
Addr: Content
120: 00 00 00 FF FF FF FF 00

128 - 247 User Writeable EEPROM:
Addr: Content
128: FF FF FF FF FF FF FF FF
136: FF FF FF FF FF FF FF FF
.
.
.
240: FF FF FF FF FF FF FF FF

248 - 255 Vendor Specific:
Addr: Content
248: 00 40 00 40 00 00 00 00

0 – 255 Raw data for SFP Diagnostic Space bytes 0 to 255:
Addr: Content
000: 46 00 00 00 46 00 00 00
008: 9C 40 69 78 85 FC 7A 44
.
.
.

240: FF FF FF FF FF FF FF FF
248: 00 40 00 40 00 00 00 00