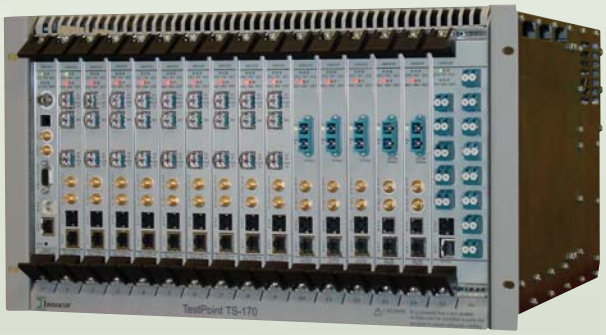
TestPoint

Broadband Test Solutions

TS-10

TS-30



TS-170

YOUR TEST REQUIREMENTS JUST GOT BIGGER?

Multi-rate

Innocor

Version 2.1.0

Multi-rate Module

TS-10 Multi-rate Configuration

Multi-rate

HIGH LEVEL FEATURE SUMMARY

- Multiple rates on one module/configuration
- Traffic generation capabilities with strong lower layer features
- SONET/SDH on OC-3/12/48 STM-1/4/16 with GFP and ATM support
- OTN testing at OTU1 (2.666G) and ODU1 (2.498G)
- Optical Gigabit Ethernet (10/100/1000Base-T and 100Base-FX are planned)
- 1G/2G Fibre Channel
- Support of Ethernet over PDH for DS1, E1, DS3, E3 (GFP-F, HDLC payload)
- RPR intrusive monitor mode on OC-48/STM-16
- 8B/10B PCS (and MAC) capture feature
- 128 traffic streams (MAC/VLAN, MPLS, IPv4, TCP, UDP) on GbE
- PRBS at all rates
- RFC 2544
- Clock rate variations
- Latency, sequencing, packet jitter
- ARP and Ping on GbE

INTERFACE SPECIFICATIONS

OC-48/STM-16 (SFP)			
Optical Connector	LC	LC	
Wavelength	1310 nm	1550 nm	
Optical Output Power (Rx power read)	-9.5 to -3 dBm	-5 to 0 dBm	
Optical Overload (min)	-3 dBm	0 dBm	
Sensitivity (min)	-18 dBm	-19 dBm	
OC-12/3/STM-4/1 (SFP)			
Optical Connector	LC	LC	
Wavelength	1310 nm	1550 nm	
Optical Output Power (Rx power read)	-15 to -8 dBm	-15 to -8 dBm	
Optical Overload (min)	-7 dBm	0 dBm	
Sensitivity (min)	-34 dBm	-28 dBm	
GbE/FC (SFP)			
Optical Connector	LC	LC	LC
Wavelength	850 nm	1310 nm	1550 nm
Optical Output Power (Rx power read)	-9.5 to -3.5 dBm	-9.5 to -3 dBm	-5 to 0 dBm
Optical Overload (min)	-3.5 dBm	-3 dBm	0 dBm
Sensitivity (min)	-20 dBm	-22 dBm	-23 dBm
Clock Out	LVPECL signal, AC coupled on SMA connector		
LAN (Ethernet) Port	RJ-45 (10/100BaseT)		
Operator Port	RJ-11 into RS-232 serial cable		

STANDARD OFFERING

There are 3 physical ports on the multi-rate. One is active at a time. The ports are OC-48/STM-16, OC-3/12 STM-1/4, and Ethernet/Fibre Channel. At least one SONET/SDH port must be licensed.

OPTIONS

- **OC-48/STM-16**
- **OC-3/12 STM-1/4**
- **Digital Wrapper and FEC:** OTU1 (2.666 Gbps) on the OC-48/STM-16 port
- **Ethernet:** Optical GbE (10/100/1000Base-T and 100Base-FX are planned)
- **Fibre Channel:** 1G and 2G FC
- **Ethernet over PDH:** DS1/E1 and DS3/E3 into OC-3/12/48 STM-1/4/16. PDH VCAT/LCAS is available on DS1/E1. MAC traffic on GFP-F/bit-HDLC/byte-HDLC (on DS1/E1 only).
- **Ethernet over SONET/SDH:** GFP-F on OC-3/12/48 STM-1/4/16; GFP-T and Higher-Order VCAT on OC-48/STM-16.
- **RPR:** Intrusive monitor mode on OC-48/STM-16 (STS-48c/VC-4-16c)
- **ATM:** On OC-3/12/48 STM-1/4/16
- **FEC Extended Rate:** ODU1 (2.498Gbps)

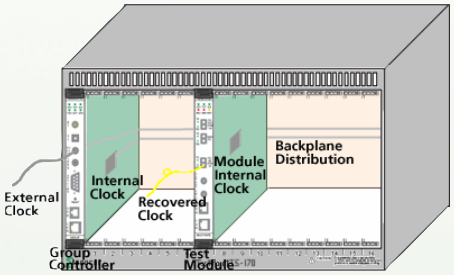
LINE RATES

- 155.52 Mbps (OC-3/STM-1)
- 622.08 Mbps (OC-12/STM-4)
- 1.0625 Gbps (1G FC)
- 1.25 Gbps (GbE)
- 2.125 Gbps (2G FC)
- 2.488 Gbps (OC-48/STM-16)
- 2.498 Gbps (ODU1)
- 2.666 Gbps (OTU1)

CLOCKING

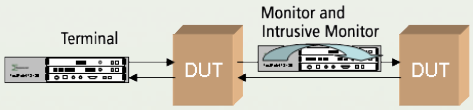
- Internal (+/- 4.6 ppm accuracy)
- Recovered
- External via Group Controller (TS-30/170)
- Clock rate variations

  +/-30 ppm: SONET/SDH, OTU1
  +/-110 ppm: GbE, 1G/2G FC
- Clock out (LVPECL, AC coupled on SMA)



CONNECTIVITY

- **Terminal:** Source and sink traffic (all rates)
- **Monitor:** Transparently monitors signal and retransmits unaltered (all SONET/SDH rates and OTU1)
- **Intrusive Monitor:** Intrusively injects errors while forwarding incoming traffic (RPR option only)



APPLICATIONS

Descriptions of the following applications follow:

- **SONET/SDH:** OC-3/12/48 and STM-1/4/16
- **Digital Wrapper and FEC:**

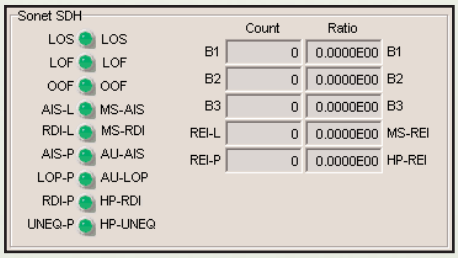
  OTU1: ITU-T G.709; OC-48/STM-16 client
  ODU1: OTU1 frame structure without FEC
- **Ethernet:** Optical GbE (10/100/1000Base-T and 100Base-FX are planned)
- **Fibre Channel:** 1G FC and 2G FC
- **Ethernet over PDH:** DS1/E1 and DS3/E3 into OC-3/12/48 STM-1/4/16. PDH VCAT/LCAS is available on DS1/E1. MAC traffic on GFP-F/bit-HDLC/byte-HDLC (on DS1/E1 only).
- **Ethernet over SONET/SDH:** GFP-F on OC-3/12/48 STM-1/4/16; GFP-T and Higher-Order VCAT on OC-48/STM-16.
- **RPR:** Intrusive monitor mode on OC-48/STM-16 (STS-48c/VC-4-16c)
- **ATM:** On OC-3/12/48 STM-1/4/16

SONET/SDH

CHANNELIZATION

OC-3:	STS-3c / STS-1
STM-1:	VC-4 / VC-3 (AU-3)
OC-12:	STS-12c / STS-3c / STS-1
STM-4:	VC-4-4c / VC-4 / VC-3 (AU-3)
OC-48:	STS-48c / STS-24c / STS-12c / STS-3c / STS-1
STM-16:	VC-4-16c / VC-4-8c / VC-4-4c / VC-4 / VC-3 (AU-3) / VC-3 (TUG-3)

ALARMS



LOS / LOF / OOF / AIS-L/MS-AIS / RDI-L/MS-RDI / LOP-P/AU-LOP / AIS-P/AU-AIS / ERDI-P/HP-ERDI / UNEQ-P/HP-UNEQ

VC-3 (TUG-3): TU-AIS / TU-LOP / LP-RDI / LP-UNEQ

ERRORS

Single / Rates for REI-L/MS-REI / REI-P/HP-REI / B1 / B2 / B3

VC-3 (TUG-3): Single / Rates for LP-REI / LP-BIP

OVERHEADS

Pointer adjustments: Increment/Decrement (single, rates) / NDF count / Pointer Value / SS Bits

Trace Messages: J0 / J1; 1, 16 or 64 bytes

Decoded Bytes: K1 / K2 / S1 / C2

Byte Diagram: User editable Overhead Fields (includes B1, B2, B3 xor masks) in two alternating overhead banks. Interleaving and Injection Counts in Frames / Continuous Injection support

TRAFFIC

PRBS 23 or 31 / 4-Byte Sequence

DISRUPTION TIME

Measurement: µsec Resolution
Triggers: LOS / LOF / PRBS Sync

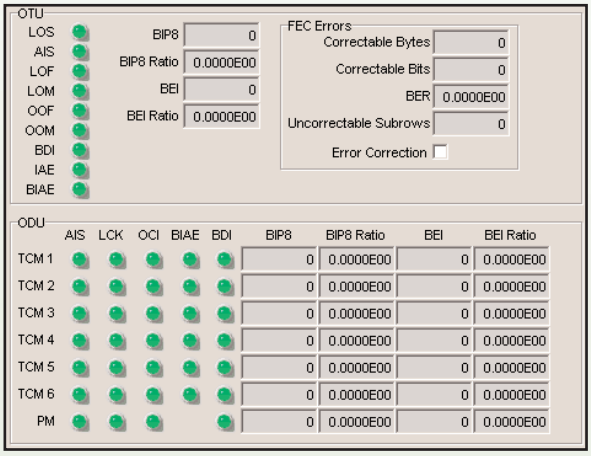
TRIGGER SIGNAL

OC-48/STM-16: Output pulse either on Received / Transmitted A2 byte

DIGITAL WRAPPER AND FEC

Covers OTU1, ODU1. FEC does not apply to ODU1.

ALARMS

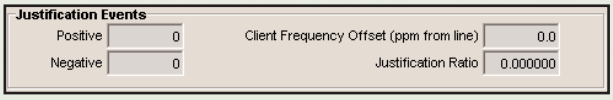


LOS / OOF / LOF / OOM / LOM / OTU-AIS (PN-11) / OTU-IAE / OTU-BDI / OTU-BIAE / ODU-AIS (PM/TCM1-6) / ODU-LCK (PM/TCM1-6) / ODU-OCI (PM/TCM1-6) / ODU-BDI (PM/TCM1-6) / ODU-BIAE (TCM1-6)

ERRORS

Single / rates for OTU-BIP8 / OTU-BEI / ODU-BIP8 (PM/TCM1-6) / ODU-BEI (PM/TCM1-6)

OVERHEADS



Multi Frame Structures: OTU-TTI / ODU-TTI (PM/TCM1-6) / ODU-FTFL / PSI

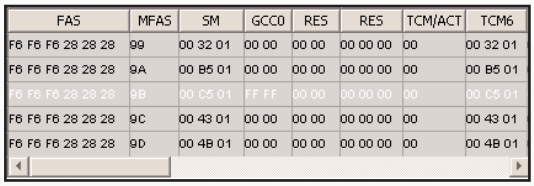
Justification Events: Sync (line-client locked) / Async (range +/- 70 ppm). Reporting of justification event ratio and line-client ppm offset.

Byte Diagram: User editable Overhead Fields / MFAS invert. Injection Count in Frames / Continuous Injection

Overhead PRBS: 3 independent PRBS 15 engines for GCC0-2 / RES (OTU, ODU, OPU) / TCM1-6 / TCM/ACT / EXP

Error Suppression: To optionally suppress incoming errors/alarms: FEC / TCM1-6 Errors / PM Errors / Client Errors

CAPTURES



FAS	MFAS	SM	GCC0	RES	RES	TCM/ACT	TCM6
F6 F6 F6 28 28 28	99	00 32 01	00 00	00 00	00 00 00	00	00 32 01
F6 F6 F6 28 28 28	9A	00 B5 01	00 00	00 00	00 00 00	00	00 B5 01
F6 F6 F6 28 28 28	9B	00 C5 01	FF FF	00 00	00 00 00	00	00 C5 01
F6 F6 F6 28 28 28	9C	00 43 01	00 00	00 00	00 00 00	00	00 43 01
F6 F6 F6 28 28 28	9D	00 4B 01	00 00	00 00	00 00 00	00	00 4B 01

Triggers: Manual / OOF / LOF / OOM / LOM / OTU-IAE / OTU-BDI / OTU-BIAE / OTU-BIP8 / OTU-BEI / ODU-AIS (PM/TCM1-6) / ODU-LCK (PM/TCM1-6) / ODU-OCI (PM/TCM1-6) / ODU-BDI (PM/TCM1-6) / ODU-BIP8 (PM/TCM1-6) / ODU-BEI (PM/TCM1-6) / ODU-BIAE (TCM1-6) / Positive Justification / Negative Justification / Overhead PRBS Bit Error / Pattern Match (equal, not equal) with Bit-Mask
Pattern Match Fields: FAS / MFAS / GCC0-2 / OTU RES / SM TTI / ODU RES1-3 / TCM/ACT / FTFL / EXP / APS/PCC / TCM1-6 TTI / PM TTI / OPU RES1-3

Trigger Point: Start / Middle / End

Display: Trigger Point / Hex values for all overhead fields

Size: Overhead of 256 frames

File Type: ASCii (csv)

CLIENT

OC-48/STM-16 signal

FEC

Settings: Standard FEC / All-Zeroes FEC. Enable / Disable error correction

Injection: Single and rates. Control of Errored Sub-Row (including all) / Errored Bytes per Sub-Row / Errored Bits per Byte / Skipped Rows between Errors. Up to 16 symbol errors.

Detection: Number of Correctable Byte Errors / Number of Correctable Bit Errors / Bit Error Rate / Number of Uncorrectable Sub-Rows

ETHERNET

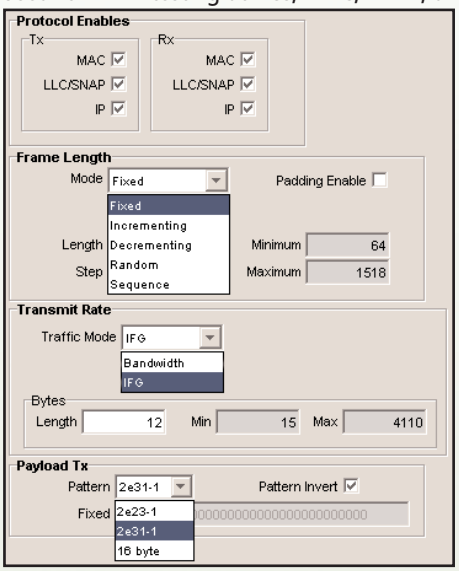
Covers optical GbE.

TRAFFIC SETTINGS

2 modes: Single Stream, Multiple Streams

Single Stream

Used for BERT testing at PCS, MAC, VLAN, and IPv4 layers.



Send Mode: Continuous / Burst of Frames

Protocol Support: MAC / VLAN / LLC/SNAP / IPv4. User can set header values. For Destination/Source MAC addresses and VLAN ID, support of Single / Incrementing value over a Range

Frame Size: Range of 19 to 65535 bytes. Size can be: Fixed / Incrementing / Decrementing / Random / User Sequence (up to 8)

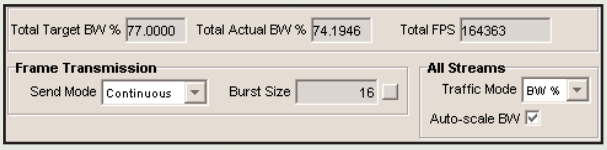
Transmission Rate: Specified as Bandwidth (%, Mbps) or Number of Inter Frame Gap (IFG) bytes (fixed / random / sequence up to 8; range 4 to 65535 bytes)

Frame Payload: PRBS 23 or 31 / 16-byte Sequence

Multiple Streams

Used for traffic simulation and multi-protocol support.

Id	Enable	Frame Length	Frame Count	VLAN VID	Destination Address	Source Address	BW % Target	BW % Actual
1	☑	811	2	273	40:40:40:40:40:40	20:20:20:20:20:20	11.0000	10.9270
2	☑	319	10	274	40:40:40:40:40:41	20:20:20:20:20:21	24.0000	22.2880
3	☑	512	6	275	40:40:40:40:40:42	20:20:20:20:20:22	22.0000	20.9862
4	☑	1500	1	640	40:40:40:40:40:50	20:20:20:20:20:30	10.0000	9.9934
5	☑	1501	1	640	40:40:40:40:40:51	20:20:20:20:20:31	10.0000	10.0000



Maximum Number of Streams: 128

Send Mode: Continuous / Burst of Frames

Protocol Support: MAC / VLAN / MPLS / IPv4 / TCP / UDP. User can set header values per stream.

Frame size: Range of 27 to 9600 bytes. Size is fixed within a stream.

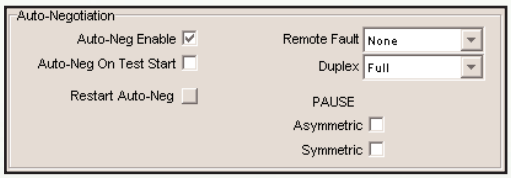
Transmission Rate: BW % / IFG Size in Bytes / Frames/s

Auto-scale BW: Scales bandwidth when total exceeds 100%.

Frame Payload: Fill Byte / Random / Custom (user defined byte-by-byte)

Stream Signature: Used for receive auto-detection

AUTO-NEGOTIATION



Settings: Enable / Disable. Remote Fault (offline, link failure, auto-neg error) / Pause Encoding / Operation Mode

Reporting: Auto-negotiation complete indicator. Remote Fault (offline, link failure, auto-neg error)

Capture: Using 8B/10B PCS Capture

CONTROL PLANE

Pause Frames: Single / Continuous with Interval. Pause Timer. Receiver throttles.

ARP: ARP request sent for each unique destination IP address; retry period and count support. ARP Reply sent on port MAC address match.

PING

Send Mode: Continuous / Packet Count

Transmission Period: 1000 to 4,294,967,295 msec

Protocol Support: IPv4 with No VLAN / Single VLAN

Data size: 0 to 9572 bytes

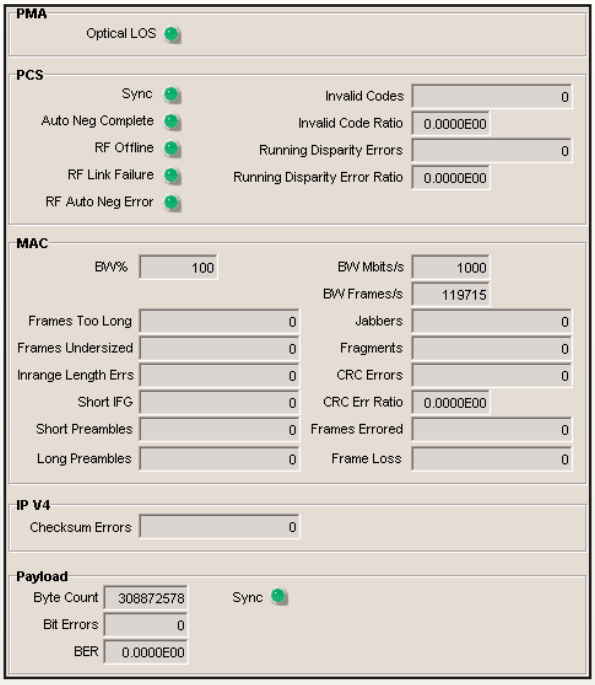
Replies: Issued on port IP address match

ERROR INJECTIONS

PCS Sublayer: LOS / Running Disparity Error (single, rates) / 8B/10B Coding Error (single, rates) / Random Bit Corruption

MAC Sublayer: Short Preambles (single stream) / Long Preambles (single stream) / CRC (single, rates in single stream; per-stream in multiple streams)

ERROR MONITORING



PCS Sublayer: LOS / PCS Synchronization / Running Disparity Errors / Invalid 8B/10B Codegroups

MAC Sublayer: Frames Too Long (> jumbo) / Jabbers / Undersized / Fragments / CRC Errors / Inrange Length Errors (802.3 frames) / Short IFGs (adjustable threshold)

IPv4: Checksum Errors (single stream)

STATISTICS

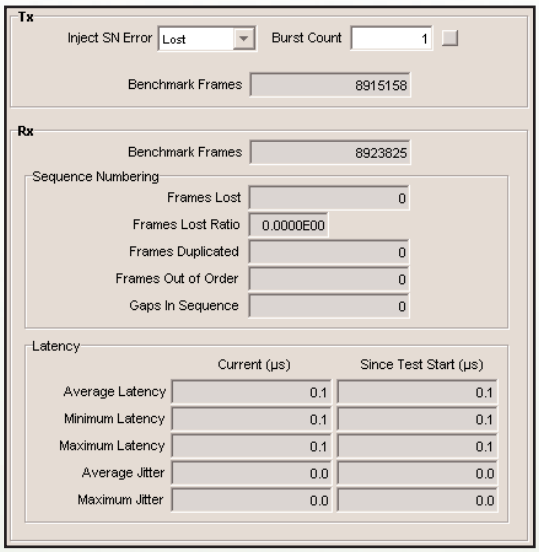
MAC: Bandwidth (%, Mbps, frames/s) / Frame Count / Octet Count / Unicast Frames / Multicast Frames / Broadcast Frames / VLAN Tagged Frames / Number of Pause Frames / ARP Frames / Frame Length Bins (including jumbo) / CRC Counts (total and lengths bins) / Short Preamble Count / Long Preamble Count

IPv4: Packet Count (single stream) / ICMP Packets

Per-Stream Statistics: Bandwidth (Mbps, %, frames/s) / Frame Count / Octet Count

LATENCY AND SEQUENCING

In single stream mode



Sequencing: Frame Loss / Out-of-Order / Duplicates. Can inject errors on transmit.

Timestamping: Latency (min, max, avg over test period and 0.5 sec window; bit forwarding / store and forward) / Packet Jitter

FILTERS

MAC: 8 MAC/VLAN filters with Accept/Discard criteria

Pattern Filter: Up to 6 bytes with offset from start of frame

CAPTURES

There are 2 modes: 8B/10B PCS, and MAC level

PCS

	Raw Data				Code Group Names			
21	1101101000	1010100101	1010100101	1010100101	K27.7	D21.2	D21.2	D21.2
25	1010100101	1010100101	1010100101	1010100110	D21.2	D21.2	D21.2	D21.6
29	1101010101	0010100101	1101010101	0010100101	D4.2	D4.2	D4.2	D4.2

21	1101101000	1010100101	1010100101	1010100101	FB	55	55	55
25	1010100101	1010100101	1010100101	1010100110	55	55	55	D5
29	1101010101	0010100101	1101010101	0010100101	44	44	44	44

Triggers: Manual / PCS Sync Loss / Invalid 8B/10B Codegroup / Running Disparity Error / Codegroup Pattern Match (up to 6 bytes)

Trigger Point: Start / Middle / End

Display: Trigger Point / 8B/10B codegroup and decode (D/K codes and hex)

Size: 8,250,000 8B/10B Codegroups

File Type: Binary / ASCii

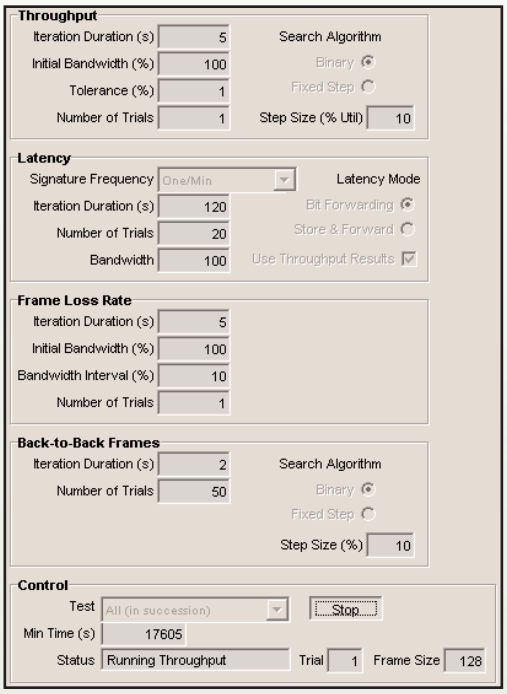
MAC

	TS (µs)	Len	Dest Addr	Src Addr	VLAN	T/L	
22	-1.8	128	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	00 6A	AA AA
23	-0.6	128	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	00 6A	AA AA
24	1.0	53	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	00 29	AA AA
25	1.2	128	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	00 6A	AA AA

Triggers: Manual / CRC error / Undersized Frame / Frame Too Long / In-range Length Error

Trigger Point: Start / Middle / End
Filters: MAC Filters / Pattern Filter
Display: Trigger Point / Timestamp / MAC Layer Decode
Size: 400,000 Frames / 32.4 Mbytes / Full Frame or Slicing (first 64 bytes)
File Type: Binary (Snoop compatible with Ethereal)

RFC 2544



Standard product feature in GUI/CLI. Provides throughput, latency, frame loss, and back-to-back measurements in single stream mode. Up to 10 frame sizes. Supports function to run all tests in succession. Logs results to file and generates graphics.

TEST REPORT

Contains Ethernet settings, errors, and statistics.

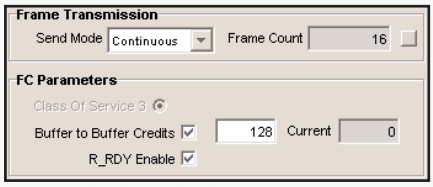
DISRUPTION TIME

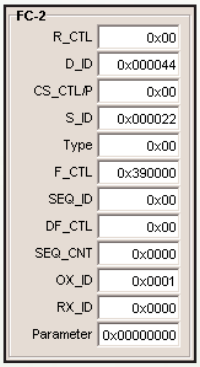
Measurement: µsec Resolution
Triggers: LOS / PRBS Sync

FIBRE CHANNEL

This covers 1G and 2G Fibre Channel. Used for BERT testing at the FC-1 and FC-2 layers.

TRAFFIC SETTINGS



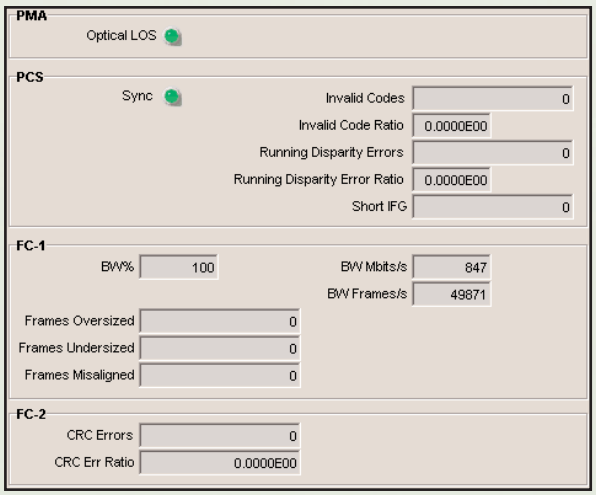


Send mode: Continuous / Burst of Frames
Frame size: Range of 12 to 4104 bytes (multiple of 4, includes SOF & EOF). Size can be: Fixed / Incrementing / Decrementing / Random / User Sequence (up to 8)
Transmission rate: Specified as Bandwidth (%, Mbps) / Number of Inter Frame Gap (IFG) bytes (fixed / random / sequence up to 8; range 8 to 65535 bytes)
FC-2 Framing: User can set the 24-byte header values.
Class Support: Class 3
Flow control: Manual buffer-to-buffer credit setting; range 1 to 4095. Sending of R_RDY may be Enabled / Disabled.
Frame Payload: PRBS 23 or 31 / 16-byte Sequence

ERROR INJECTIONS

PCS Sublayer: LOS / Running Disparity Error (single, rates) / 8B/10B Coding Error (single, rates) / Random Bit Corruption
FC-1: Misaligned Frames (non-multiple of 4 bytes size)
FC-2: CRC (single, rates)

ERROR MONITORING



PCS Sublayer: LOS / PCS Synchronization / Running Disparity

Errors / Invalid 8B/10B Codegroups / Short IFGs (adjustable threshold)

FC-1: Frames Oversized (> 2148 bytes) / Frames Undersized (< 36 bytes) / Frames Misaligned (non-multiple of 4 bytes)

FC-2: CRC Errors

STATISTICS

FC-1: Bandwidth (%, Mbps, frames/s) / Frame Count / Octet Count / Number of R_RDY

LATENCY AND SEQUENCING

Sequencing: Frame Loss / Out-of-Order / Duplicates. Can inject errors on transmit.

Timestamping: Latency (min, max, avg over test period and 0.5 sec window) / Packet Jitter

CAPTURES

At the PCS level

Triggers: Manual / PCS Sync Loss / Invalid 8B/10B Codegroup / Running Disparity Error / Codegroup Pattern Match (up to 6 bytes)

Trigger Point: Start / Middle / End

Display: Trigger Point / 8B/10B codegroup and decode (D/K codes and hex)

Size: 8,250,000 8B/10B Codegroups

File Type: Binary / ASCii

TEST REPORT

Contains FC settings, errors, and statistics.

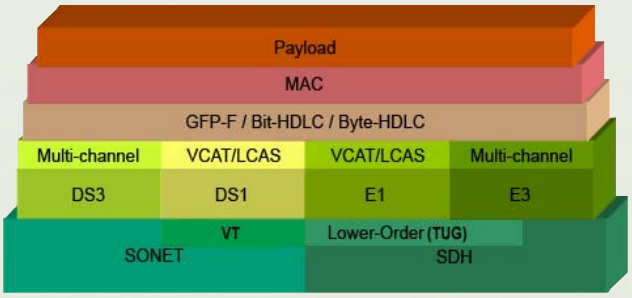
DISRUPTION TIME

Measurement: µsec Resolution

Triggers: LOS / PRBS Sync

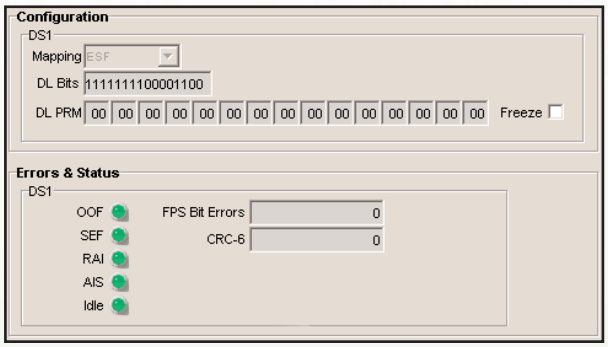
ETHERNET OVER PDH

EoPDH is based on ITU-T G.7043/7042 and G.8040.



DS1

Mapping onto SONET is via VT1.5. Supports PDH VCAT/LCAS.



Independent Channels: 336 on OC-12/48 / 84 on OC-3; for VCG member selection

Format: ESF / SF

PPM Offset: +/-130 ppm relative to line

ESF Overheads: DL (Data Link) 6-bit programmable value / PRM (Performance Report Message) 15-byte message injection and reporting

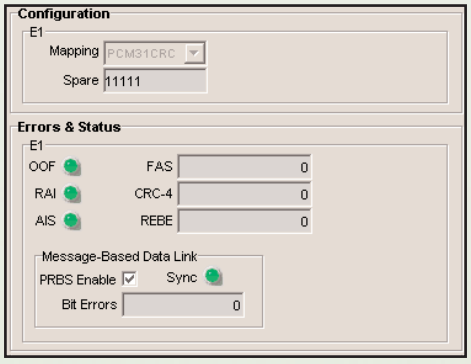
ESF Errors: OOF / SEF / AIS / RAI / Idle / FPS bits (burst with mask, 10^{-3} rate, error reporting) / CRC-6 (single, 10^{-3} rate, error reporting)

SF Errors: F_T OOF / F_T & F_S OOF / SEF / AIS / RAI / Idle / F_T & F_S bits (burst with mask, 10^{-3} rate, error reporting)

Payload: PRBS 15 or 23 / 4-byte Sequence into GFP-F, byte-HDLC, or bit-HDLC (RFC 1662 or LAPS) with MAC encapsulation.

E1

Mapping onto SDH is via VC-12 using AU-3 or TU-3 VC-3 multiplexing. Supports PDH VCAT/LCAS.



Independent Channels: 252 E1 channels on STM-4/16 / 63 E1 channels on STM-1; for VCG member selection

Format: PCM31CRC / PCM31

PPM Offset: +/-50 ppm relative to line

Overheads: Spare Bits 5-bit programmable / S_i 1-bit programmable (PCM31) / MDL (Message-Based Data Link) PRBS test

PCM31CRC Errors: OOF / AIS / RAI / FAS bits (burst with mask, 10^{-3} rate, error reporting) / Non-FAS Bit 2 (burst, continuous) / CRC-4 (burst, rates, error reporting) / REBE (single with mask, 10^{-3} rate, error reporting)

PCM31 Errors: OOF / AIS / RAI / FAS bits (burst with mask,

10-3 rate, error reporting) / Non-FAS Bit 2 (burst, continuous)

Payload: PRBS 15 or 23 / 4-byte Sequence into GFP-F, byte-HDLC, or bit-HDLC (RFC 1662 or LAPS) with MAC encapsulation.

DS3

Mapping onto SONET is via STS-1.

Independent Engines: 12 on OC-3/12/48; for parallel independent testing on each engine

Format: C-Bit Parity / Pseudo M23 / Unframed

PPM Offset: +/-90 ppm relative to line

Overheads: MDL (Maintenance Data Link) PRBS test

C-Bit Parity Errors: OOF / AIS / SEF / Idle / RAI / F-bits (single with value, 10^{-3} rate, error reporting) / M-bits (single with value, 10^{-3} rate, error reporting) / C-bit Parity Errors (single with mask, 10^{-3} rate, error reporting) / P-bit Parity Errors (single, 10^{-3} rate, error reporting) / FEBE (single, 10^{-3} rate, error reporting)

Payload: PRBS 15 or 23 / 4-byte Sequence into GFP-F, or bit-HDLC (RFC 1662) with MAC encapsulation.

E3

Mapping onto SDH is via VC-3 using AU-3 or TU-3 multiplexing.

Independent Engines: 12 on STS-1/4/16; for parallel independent testing on each engine

Format: G.832 (VLI on/off) / G.751 / Unframed

PPM Offset: +/-78 ppm relative to line

G.832 Overheads: Trace Message / MA Payload Type / MA SSM / Network Operator Byte / GC PRBS test

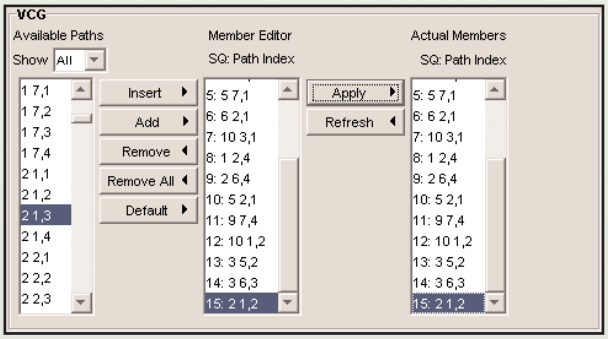
G.751 Overheads: National Bit

G.832 Errors: OOF / RDI / AIS / FAS (single with value, 10^{-3} rate, error reporting) / REI (single, 10^{-3} rate, error reporting) / BIP-8 (single, 10^{-3} rate, error reporting)

G.751 Errors: OOF / AIS / RAI / FAS (single with value, 10^{-3} rate, error reporting)

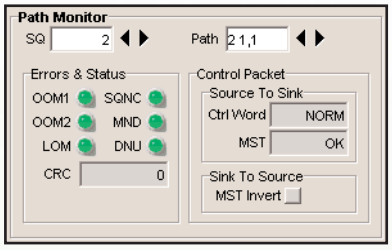
Payload: PRBS 15 or 23 / 4-byte Sequence into GFP-F, or bit-HDLC (RFC 1662) with MAC encapsulation.

PDH VCAT/LCAS



Number of Members: Up to 16 (DS1/E1)

Error Injections: OOM1 / OOM2 / LOM (MFI1, MFI2) / SQ overwrite / CTRL overwrite / RS_ACK toggle/suppress (LCAS) / MST invert (LCAS) / CRC (LCAS; single) / GID PRBS bit error (LCAS)



Error Monitoring: OOM1 / OOM2 / LOM / SQM (VCAT; Sequence Indicator Mismatch) / SQNC (LCAS; Inconsistent Sequence Numbers) / LOA (VCAT; Loss of Alignment) / MND (LCAS; Member Not Deskewable) / DNU (LCAS) / CRC error count (LCAS)

Error Suppression: To optionally suppress non-member or non-candidate errors/alarms

LCAS Status: Control Word value / MST value

LCAS Sink Config: User configures up to 32 candidate paths. Monitoring of CTRL packets from this list provides sink side VCG information

LCAS Statistics: Number of RS_ACK Toggles

GFP-F

Support on EoPDH.

TRAFFIC SETTINGS

Send mode: Continuous / Burst of Frames

Header Settings: PLI (auto-calculate on/off) / PTI / EXI / UPI / pFCS (on/off) / Linear Extension Header (on/off) / Channel ID / Spare. cHEC error correction on/off on receive.

Scrambler: Core Header Scrambler (enable/disable); Payload Header Scrambler (enable/disable)

Frame Size: Range of 9 to 65535 bytes (GFP frame). Size can be: Fixed / Incrementing / Decrementing (DS1/E1 only) / Random (DS1/E1 only).

Transmission Rate: Specified as Bandwidth (Mbps) / Number of GFP Idle Frames (fixed / random)

ERROR INJECTIONS

Loss of Client Signal (LCS) / Loss of Client Character Synchronization (LCCS) / Short GFP Frame / pFCS (single, rates on DS1/E1 only) / Idle GFP Frame (single, 16-bit xor mask) / Core Header (single, rates on DS1/E1 only; 16-bit xor mask) / Type Header (single, rates on DS1/E1 only; 16-bit xor mask) / Extension Header (DS1/E1 only; single, rates)

ERROR MONITORING

Loss of Frame Delineation (LFD) / LCS Count / LCCS Count / Short GFP Frames / Undefined fields (DS1/E1 only: Client Signal Fail, PTI, EXI) / pFCS Errors / Single-Bit cHEC Errors / Multi-Bit cHEC Errors / Single-Bit tHEC Errors / Multi-Bit tHEC Errors / Single-Bit eHEC Errors (DS1/E1 only) / Multi-Bit eHEC Errors (DS1/E1 only)

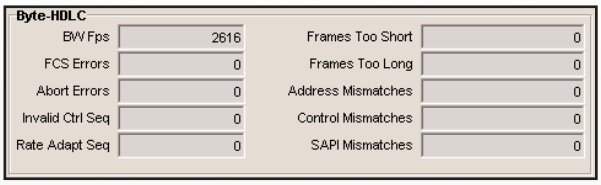
STATISTICS

Bandwidth (Mbps, %, frames/s) / Frame Count / Octet Count / Management Frame Count

HDLC

Bit-HDLC comes in two flavors, which are RFC 1662 and LAPS. RFC 1662 is supported on DS1/E1/DS3/E3, and LAPS is supported

on DS1/E1. LAPS Byte-HDLC (ITU-T X.86) is supported on DS1/E1.



Settings: RFC 1662 Bit-HDLC / LAPS Bit-HDLC (DS1/E1 only) / LAPS Byte-HDLC (DS1/E1 only)

Send mode: Continuous / Burst of Frames

Header Settings: Address / Control / Protocol or SAPI

Frame Size: Range of 7 to 65535 bytes. Size can be: Fixed / Incrementing.

Transmission Rate: Specified as Number of Idle Flags (fixed)

Error Injections: Abort (single) / FCS (single) / Rate Adaptation (byte-HDLC)

Error Monitoring: FCS Errors / Abort Errors / Frames Too Short (threshold) / Frames Too Long (threshold) / Address Mismatches / Control Mismatches (byte-HDLC) / Invalid Control Sequence (byte-HDLC) / Invalid Rate Adaptation Sequence (byte-HDLC)

Statistics: Bandwidth (frames/s) / Frame Count / Octet Count

MAC

MAC maps into GFP-F or HDLC. On DS1/E1, traffic maps on a VCG. On DS3/E3, twelve independent traffic engines are available on twelve channels.

Protocols: MAC / Single VLAN (DS1/E1/DS3/E3) / Stacked-VLAN with programmable Ethertype (DS3/E3). User can set header values.

Error Injections: CRC (DS1/E1 only; single, rates)

Error Monitoring: CRC Errors / DS1/E1 only: (frames too long / jabbers / undersized / fragments / inrange length errors)

Statistics: Frame Count / DS1/E1 only: (octet count / unicast frames / multicast frames / broadcast frames / VLAN Tagged Frames / frame length bins (HDLC only) / CRC error length bins (HDLC only))

ETHERNET OVER SONET/SDH

VCAT

One VCAT Group (VCG). Available on OC-48/STM-16 port.

Channelization: STS-3c-nV (8 members) / VC-4-nV (8 members) / STS-1-nV (24 members) / VC-3-nV (AU-3 / TUG-3; 24 members)

Error Injections: LOM (using MFI1 / MFI2) / SQM / Multi-Frame (16-frame) control packet editor

Error Monitoring: LOM (per-member) / SQM (per-member) / LOA (adjustable threshold)

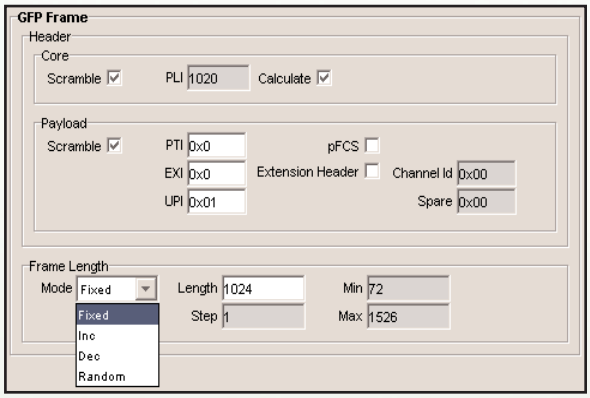
Error Suppression: To optionally suppress non-member errors/alarms

Differential Delay: Reporting of Max differential delay in VCG. Injection on one VCG member of up to 256 ms.

Capture: H4 Byte Capture over 8 Multi-Frames (of 16 Frames) for one VCG member.

GFP-F

Available on Contiguously Concatenated SONET/SDH (OC-3/14/48 STM-1/4/16) and VCAT (OC-48/STM-16).



TRAFFIC SETTINGS

Send mode: Continuous / Burst of Frames

Header Settings: PLI (auto-calculate on/off) / PTI / EXI / UPI / pFCS (on/off) / Linear Extension Header (on/off) / Channel ID / Spare. cHEC error correction on/off on receive.

Protocol support: MAC / VLAN. User can set header values.

Scrambler: Core Header Scrambler (enable/disable); Payload Header Scrambler (enable/disable)

Frame Size: Range of 9 to 65535 bytes (GFP frame). Size can be: Fixed / Incrementing / Decrementing / Random.

Transmission Rate: Specified as Bandwidth (Mbps) / Number of GFP Idle Frames (fixed / random; range 0 to 65535 bytes)

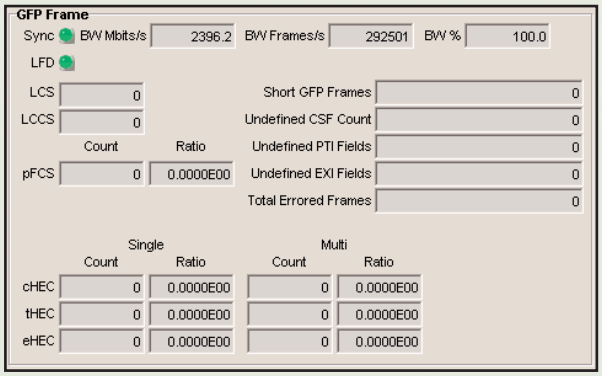
Frame Payload: PRBS 23 or 31 / 4-byte Sequence

ERROR INJECTIONS

GFP: Loss of Client Signal (LCS) / Loss of Client Character Synchronization (LCCS) / Short GFP Frame / pFCS (single, rates) / Idle GFP Frame (single, 16-bit xor mask) / Core Header (single, rates; 16-bit xor mask) / Type Header (single, rates; 16-bit xor mask) / Extension Header (single, rates; 16-bit xor mask)

MAC: CRC (single, rate)

ERROR MONITORING



GFP: Loss of Frame Delineation (LFD) / LCS Count / LCCS Count / Short GFP Frames / Undefined

fields (Client Signal Fail, PTI, EXI) / pFCS Errors / Single-Bit cHEC Errors / Multi-Bit cHEC Errors / Single-Bit tHEC Errors / Multi-Bit tHEC Errors / Single-Bit eHEC Errors / Multi-Bit eHEC Errors

MAC: Frames Too Long (> jumbo) / Jabbers / Undersized / Fragments / CRC Errors / Inrange Length Errors (802.3 frames)

STATISTICS

GFP: Bandwidth (Mbps, %, frames/s) / Frame Count / Octet Count / Management Frame Count / GFP Idle Frame Count

MAC: Frame Count / Octet Count / Unicast Frames / Multicast Frames / Broadcast Frames / VLAN Tagged Frames

FILTERS

Pattern Filter: Up to 6 bytes with offset from start of GFP frame

CAPTURES

		GFP Core Header		GFP Payload Header					
TS	Len	PLI	cHEC	P/P/E	UPI	tHEC	Ext	eHEC	Dest A
-126.9	1501	05 D9	A5 A1	00	01	10 21			44 44 44 44
-122.2	1502	05 DA	95 C2	00	01	10 21			44 44 44 44
-117.5	1503	05 DB	85 E3	00	01	10 21			44 44 44 44
0.0	16	05 DC	E5 05	00	01	10 21			44 44 44 44

Triggers: Manual / GFP LFD / Single-Bit cHEC Error / Multi-Bit cHEC Error / tHEC Error / eHEC Error / pFCS Error / Management Frame / Large GFP Frame (with threshold) / MAC CRC Error

Trigger Point: Start / Middle / End

Filters: Pattern Filter / Exclude GFP Idle option

Display: Trigger point / Timestamp / GFP and MAC Layer Decode

Size: 700,000 frames / 32.4 Mbytes / Full Frame or Slicing (first 64 bytes)

File Type: Binary (Snoop) / ASCii

GFP-T

Available on Contiguously Concatenated SONET/SDH and VCAT on OC-48/STM-16.

GFP SETTINGS

Header Settings: PLI (auto-calculate on/off) / PTI / EXI / UPI / pFCS (on/off) / Linear Extension Header (on/off) / Channel ID / Spare. cHEC error correction on/off on receive. Core Header Scrambler (enable/disable); Payload Header Scrambler (enable/disable)

Frame Size: Number of superblocks per frame

Transmission Rate: Specified as Number of GFP Idle Frames (fixed; range 0 to 65535 bytes) / Bandwidth (Mbps)

Client Adaptation: 65B_PAD injection rate in PPM to adjust the client line rate

Client Support: Ethernet (GbE); 1G Fibre Channel is planned

ETHERNET SETTINGS

Send mode: Continuous / Burst of Frames

Header Settings: MAC / VLAN. User can set header values. For Destination/Source MAC addresses and VLAN ID, support of Single / Incrementing value over a range

Frame Size: Range of 19 to 65535 bytes. Size can be: Fixed / Incrementing / Decrementing / Random

Transmission Rate: Specified as Number of Inter Frame Gap (IFG) bytes (fixed / random; range 4 to 65535 bytes)

Payload: PRBS 23 or 31 / 4-byte Sequence

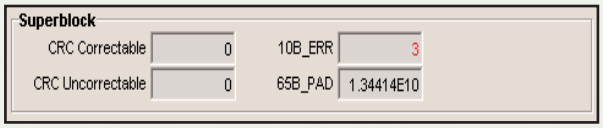
Auto-Negotiation: Available

ERROR INJECTIONS

GFP: Loss of Client Signal (LCS) / Loss of Client Character Synchronization (LCCS) / Short GFP Frame / pFCS (single, rates) / Idle GFP Frame (single, 16-bit xor mask) / Core Header (single, rates; 16-bit xor mask) / Type Header (single, rates; 16-bit xor mask) / Extension Header (single, rates; 16-bit xor mask) / Superblock CRC (burst, rates; 16-bit xor mask) / 64B/65B Flag Bit Errors (single, rates; 8-bit xor mask)

Ethernet: Running Disparity Error (single, rates) / 8B/10B Coding Error (single, rates) / CRC (single, rate)

ERROR MONITORING



GFP: Loss of Frame Delineation (LFD) / LCS Count / LCCS Count / Short GFP Frames / Undefined fields (Client Signal Fail, PTI, EXI) / pFCS Errors / Single-Bit cHEC Errors / Multi-Bit cHEC Errors / Single-Bit tHEC Errors / Multi-Bit tHEC Errors / Single-Bit eHEC Errors / Multi-Bit eHEC Errors / Correctable Superblock CRC Errors / Uncorrectable Superblock CRC Errors / 10B_ERR Count

Ethernet: PCS Synchronization / Invalid 8B/10B Codegroups / Frames Too Long (> jumbo) / Jabbers / Undersized / Fragments / CRC Errors / Inrange Length Errors (802.3 frame)

STATISTICS

GFP: Bandwidth (Mbps, %, frames/s) / Frame Count / Octet Count / Management Frame Count / GFP Idle Frame Count / Superblock Count / 65B_PAD Count

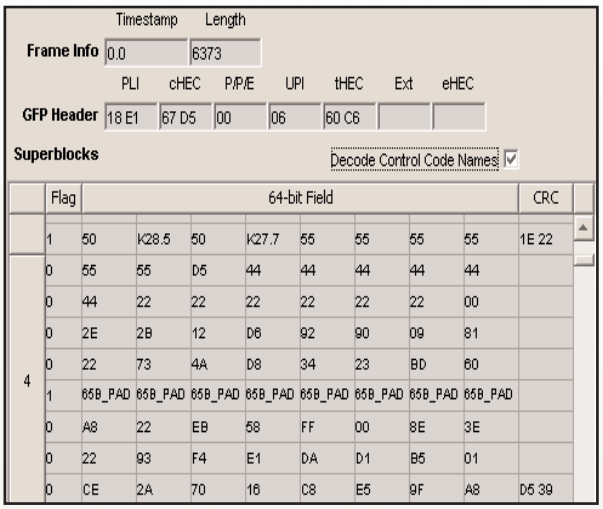
Ethernet: Bandwidth (Mbps, frames/s) / Frame Count / Octet Count / Unicast Frames / Multicast Frames / Broadcast Frames / VLAN Tagged Frames / Frame Length Bins (including jumbo) / CRC Counts (total and lengths bins)

Sequencing: Frame Loss / Out-of-Order / Duplicates. Can inject errors on transmit.

FILTERS

Pattern Filter: Up to 6 bytes with offset from start of GFP frame

CAPTURES



Triggers: Manual / GFP LFD / Single-Bit cHEC Error / Multi-Bit cHEC Error / tHEC Error / eHEC Error / pFCS Error / Management Frame / Large GFP Frame (with threshold) / Correctable Superblock CRC Errors / Uncorrectable Superblock CRC Errors / Control Code Match (1 code) / Data Pattern Match (up to 8 bytes)

Trigger Point: Start / Middle / End

Filters: Pattern Filter / Exclude GFP Idle option

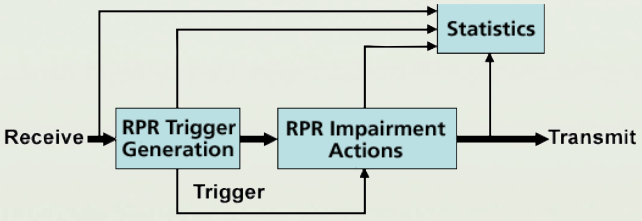
Display: Trigger point / Timestamp / GFP and Superblock decodes

Size: 700,000 frames / 32.4 Mbytes / Full Frame or Slicing (first 64 bytes)

File Type: Binary (Snoop) / ASCii

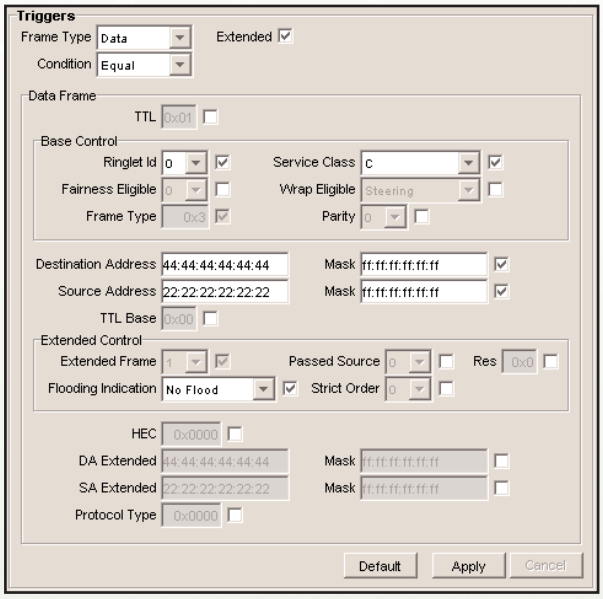
RPR

Intrusive monitor mode only on OC-48/STM-16 (STS-48c/VC-4-16c). RPR frames are encapsulated in GFP. RPR impairments are created based on triggering criteria applied to incoming frames.



TRIGGERING

An AND relation applies between the frame fields selected as available triggers for one specific frame type.



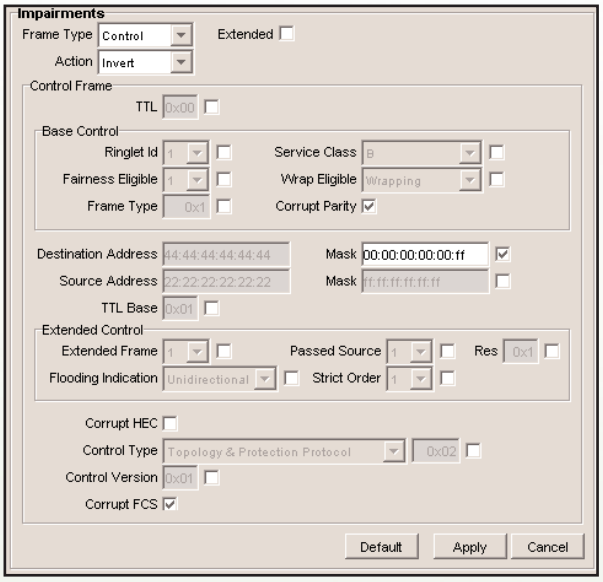
Frame Type: 1 choice from: Data (regular, extended) / Control / Fairness / Idle

Trigger Condition: Equal / Not Equal

Frame Fields: TTL (all) / Ringlet ID (all) / Fairness Eligible (all) / Service Class (all) / Wrap Eligible (all) / Parity (all) / Destination Address (data, control; with mask) / Source Address (data, control; with mask) / TTL Base (data, control) / Flooding Indication (data, control) / Passed Source (data, control) / Strict Order (data, control) / Res (data, control, fairness) / HEC (data, control) / Protocol Type (data) / DA Extended (data; with mask) / SA Extended (data; with mask) / Control Type (control) / Control Version (control) / SA Compact (fairness, idle; with mask) / Fairness Frame Type (fairness) / Fairness Rate (fairness)

IMPAIRMENTS

For the frames matching the triggering criteria, an impairment control engine narrows down the number of frames to impair. An AND relation applies between the selected fields to impair for a specific frame type.



Impairment Control: Continuous / Periodic (on/off periods) / Burst

Frame Type: 1 choice from: Data (regular, extended) / Control / Fairness / Idle

Impairment Action: Overwrite / Invert / Increment (TTL) / Decrement (TTL)

Frame Fields: TTL (all) / Ringlet ID (all) / Fairness Eligible (all) / Service Class (all) / Wrap Eligible (all) / Corrupt Parity (all) / Destination Address (data, control; with mask) / Source Address (data, control; with mask) / TTL Base (data, control) / Flooding Indication (data, control) / Passed Source (data, control) / Strict Order (data, control) / Res (data, control, fairness) / HEC (data, control) / Protocol Type (data) / DA Extended (data; with mask) / SA Extended (data; with mask) / Control Type (control) / Control Version (control) / SA Compact (fairness, idle; with mask) / Fairness Frame Type (fairness) / Fairness Rate (fairness) / Corrupt FCS (all)

ERROR MONITORING

GFP: Loss of Frame Delineation (LFD) / LCS Count / LCCS Count / Short GFP Frames / Undefined fields (Client Signal Fail, PTI, EXI) / pFCS Errors / Single-Bit cHEC Errors / Multi-Bit cHEC Errors / Single-Bit tHEC Errors / Multi-Bit tHEC Errors / Single-Bit eHEC Errors / Multi-Bit eHEC Errors

RPR: Frames Too Long (data, control) / Undersized (data, control) / HEC Error (data, control) / Invalid Length (fairness, idle) / Parity Errors / FCS Errors

STATISTICS

Incoming GFP: Bandwidth (Mbps, %, frames/s) / Frame Count / Octet Count / Management Frame Count

Incoming RPR Frames: Total Bandwidth (Mbps, frames/s) / Total Frame Count / Total Octet Count / Frame Count & BW (data, control, fairness, idle) / Octet Count (data, control, fairness, idle) / Per-Class Data Frames & BW (Class A A1, A A0, B CIR, B EIR, C) / Unicast Data Frames / Multicast & Broadcast Data Frames / Broadcast Data Frames / Jumbo Data Frames

Outgoing RPR Frames: Total Frame Count / Total Octet Count / Frame Count (data, control, fairness, idle) / Per-Class Data Frames (Class A A1, A A0, B CIR, B EIR, C) / Unicast Data Frames / Multicast & Broadcast Data Frames / Broadcast Data Frames / Jumbo Data Frames / Triggered Frame Count / Impaired Frame Count

CAPTURES

Frames are captured at the GFP level.

Triggers: Manual / GFP LFD / Single-Bit cHEC Error / Multi-Bit cHEC Error / tHEC Error / eHEC Error / pFCS Error / Management Frame / Large GFP Frame (with threshold) / MAC CRC Error

Trigger Point: Start / Middle / End

Filters: Pattern Filter up to 6 bytes with offset from start of GFP frame.

Display: Trigger point / Timestamp / GFP Layer Decode

Size: 700,000 frames / 32.4 Mbytes / Full Frame or Slicing (first 64 bytes)

File Type: Binary (Snoop) / ASCii

ATM

TRAFFIC SETTINGS

2 configuration options based on engine line-ups, which are: File Playback, PRBS, O.191 or Saturation Engine, PRBS, O.191.

File Playback: Plays cells as defined in a file. Two file types: ASCii / Binary (Snoop; expects IP packets, will encapsulate with AAL5)

Saturation Engine: Provides AAL0 background traffic. Simulates multiple VCs. User programs a VPI/VCI Range / GFC / PT / CLP / Fill Byte Payload.

O.191: Single VC with CRC, timestamp, sequence number for latency and sequencing. User programs a VPI / VCI / GFC / PT / CLP

PRBS: PRBS 23 or 31. User programs a VPI /VCI / GFP / PT / CLP

Idle Cells: To control link bandwidth

Send mode: Continuous / Buffer Burst for File Playback. Continuous / Burst for O.191. Continuous for Saturation Engine, PRBS

Transmission Rate: Specified as Mbps / Quantums (back-to-back cells for file playback / saturation engine / PRBS) / %

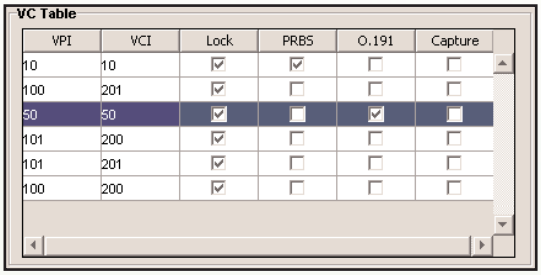
ERROR INJECTIONS

HEC: Continuous (single bit / multiple bits)

ERROR MONITORING

HEC: Single-Bit Correctable / Single-Bit Uncorrectable / Multiple-Bit; HEC Error. Error Correction Enable / Disable option.

STATISTICS



Port: ATM Sync / Bandwidth (Mbps, %, cells/s) / Cell Count

Per Connection: Up to 256 auto-detected connections. Bandwidth (Mbps, %, cells/s), Cell Count / CLP=1 Cells / F5 OAM Cells / Congestion Cells / Cell Inter-Arrival (min, max, avg)

LATENCY AND SEQUENCING

Uses O.191 cells.

Sequencing: Cell Loss / Misinserted Cell (out-of-order). Can inject errors on transmit.

Timestamping: Latency (min, max, avg over test period) / Peak-to-Peak CDV (one point)

CRC: Errored Cells. Can inject errors on transmit.

CAPTURES

Triggers: Manual

Filters: All / Per-VC

Display: Hex

Size: 20,000 cells

File Type: Binary (Snoop for IP packets) / ASCii

CHASSIS

TS-10 provides a fixed interface configuration. The TS-30 and TS-170 are slot-based and all modules support hot insertion.

TS-10

The TS-10 is a lightweight, easy to carry platform equipped with a handle.

Chassis Specifications

Height	5.6 cm; 2.25 inches	Depth	42.5 cm; 17 inches
Width	35 cm; 14 inches	Weight	3.7 kg; 8.1 lbs
Operating Temperature	0-35oC	Operating Humidity	0-85%

TS-30

The TS-30 provides 3 slots. It either comes with a rackmount kit or a handle and bumpers. The Group Controller module or any test module may use slot 0.

Chassis Specifications

Height	8.75 cm; 3.5 inches	Depth	37.5 cm; 15 inches
Width	42.5 cm; 17 inches	Weight	7.7 kg; 17 lbs
Operating Temperature	0-35oC	Operating Humidity	0-85%

TS-170

The TS-170 provides 17 slots. A maximum of 16 test modules may be present. Slot 0 is reserved for the optional Group Controller module. The TS-170 comes with a rackmount kit.

Chassis Specifications

Height	26.25 cm; 10.5 inches	Depth	52.5 cm; 21 inches
Width	42.5 cm; 17 inches	Weight	22.7 kg; 50 lbs
Operating Temperature	0-35oC	Operating Humidity	0-85%

SYSTEM

Connectivity and GUI

- Requires PC and 10/100Base-T LAN link. Static IP and DHCP (dynamic IP) are supported.
- GUI interface via web browser and Java plug-in. No PC software required.
- TS-30/170: PC connects to modules via the Group Controller (one LAN cable) or directly to each module's faceplate.
- TS-30/170: Group Controller supports multiple concurrent users.

Automation

- Via Command Line Interface (CLI) ASCii commands. Connection to CLI via Telnet, socket connections, or serial port.
- Automation toolkits available in: Python / C / TCL

Management Functions

- GUI installation tool provided for field software upgrades.
- Each module has non-volatile storage for: software loads / configuration files / event log / test results / capture files
- Result files (event logs / test results / RFC 2544 results) can be automatically transferred to the controlling PC
- TS-30/170: Group Controller module provides external clocking ports: T1 / E1 / GPS (10MHz) / and other rates

STANDARDS COMPLIANCE

Safety

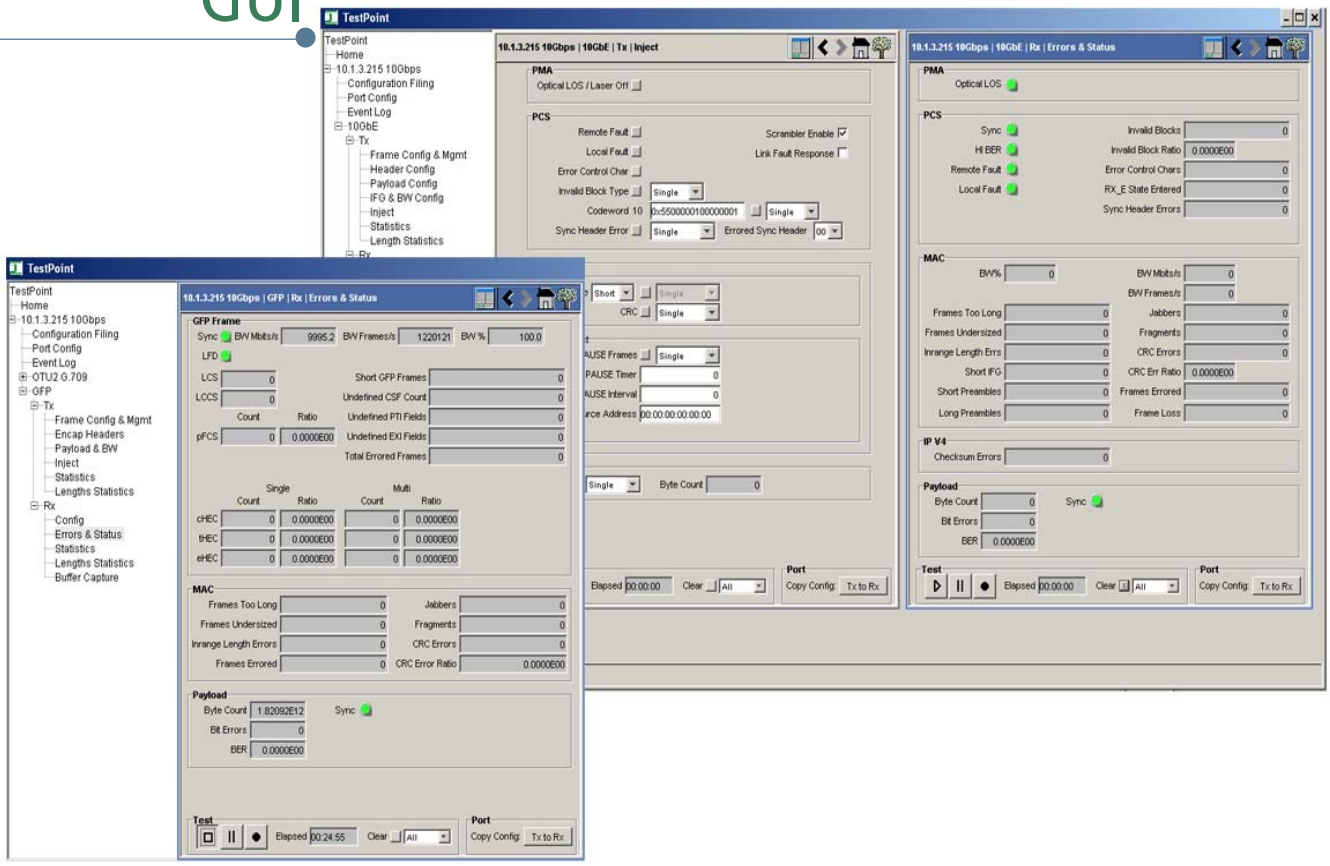
- CSA Certificate of Compliance to CAN/CSA C22.2 No 60950-1 (2003) & ANSI/UL 60950-1 (2003) with CSA Mark for Canada & USA
- CSA CB Certificate of Compliance to EN60950-1, IEC 60950-1 and National Deviations with CE Marking
- Class I Laser Product, with compliance to EN 60825, IEC 60825 and FDA/CDRH requirements

Electro-Magnetic Compatibility

- CE Mark EN61326: 1997/A1: 1998, A2:2001
- FCC Part 15 subpart B and ICES 003

TestPoint

GUI



INNOCOR

Innocor operates two strategic lines of business: Broadband Test Equipment, and Engineering Design Services. By maintaining a balance between these functions, and complete integration of technical staff, we have been able to grow organically, funded by our own success.

Innocor's services are strengthened and differentiated by the company's integrated process. With strategic resource planning, Innocor draws on its experienced team of technology developers for its products and services. The same design engineers who develop Innocor's Broadband Test Equipment are also used for its Engineering Design Services. Innocor is headquartered in Kanata, Ontario, Canada.

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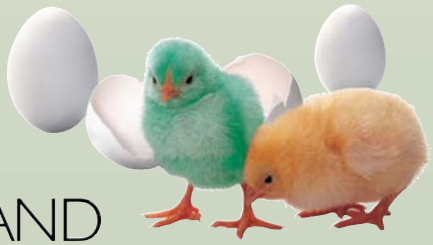

BROADBAND
TEST
SOLUTIONS

Innocor

362 Terry Fox Drive, suite 210
Kanata, Ontario, Canada
K2K 2P5

Global Sales: 1-613-599-4069

North America: 1-800-675-1915

sales@innocor.com

http://www.innocor.com