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# TestPoint

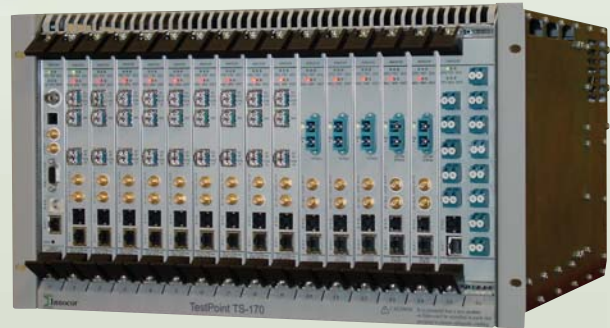
Broadband  
Test Solutions



TS-10



TS-30



TS-170

YOUR TEST  
REQUIREMENTS JUST GOT **BIGGER?**



10Gbps

 **Innocor**

Version 2.3.0

10Gbps Module



TS-10 10Gbps Configuration



10Gbps

## STANDARD OFFERING

There is 1 physical port equipped with fixed optics or XFP. Protocols include:

- **10GbE LAN**
- **10GbE WAN**
- **SONET/SDH BERT:** PRBS into OC-192c/VC-4-64c

## OPTIONS

- **Digital Wrapper and FEC:** 3 rates: OTU2 (10.709 Gbps); 11.049G (no fixed stuff); 11.095G (with fixed stuff)
- **10 Gigabit Fibre Channel:** 10G FC
- **GFP:** GFP-F directly in OTU2 (ITU-T G.709 section 17); or in OC-192/STM-64 (STS-192c/VC-4-64c); or in OC-192/STM-64 wrapped in OTU2
- **cHDL:** Cisco-HDLC in OC-192/STM-64 (STS-192c/VC-4-64c); or in OC-192/STM-64 wrapped in OTU2
- **FEC Extended Rates:** 2 rates: 11.270G (10G FC client); ODU2 (10.037Gbps)

## HIGH LEVEL FEATURE SUMMARY

- Multiple rates on one module/configuration
- Traffic generation capabilities with strong lower layer features
- 10 Gigabit Ethernet LAN and WAN (10GBase-CX4 is planned)
- BERT on SONET/SDH (STS-192c/VC-4-64c) and cHDL
- 10 Gigabit Fibre Channel
- OTN rates: OTU2 (10.709G), 11.049G, 11.095G, ODU2 (10.037G), 11.270G
- GFP-F mapped directly into OTU2 and in SONET/SDH (STS-192c/VC-4-64c)
- 64B/66B PCS (and MAC) capture feature
- 64B/66B PCS block editing and playback feature
- 128 traffic streams (MAC/Stacked VLAN, MPLS, IPv4, TCP, UDP) on 10GbE
- PRBS at all rates
- RFC 2544 (10GbE)
- Latency, sequencing, packet jitter
- Intrusive monitor mode on OTN and SONET/SDH
- Clock rate variations
- ARP and Ping on 10GbE

## LINE RATES

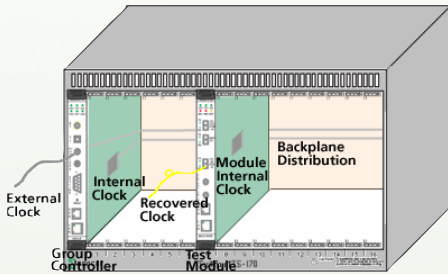
- 9.95328 Gbps (10GbE WAN and OC-192/STM-64 BERT)
- 10.037 Gbps (ODU2)
- 10.3125 Gbps (10GbE LAN)
- 10.51875 Gbps (10G FC)
- 10.709 Gbps (OTU2)
- 11.049 Gbps (10GbE LAN with FEC, no stuff bytes)
- 11.095 Gbps (10GbE LAN with FEC, stuff bytes)
- 11.270 Gbps (10G FC with FEC, no stuff bytes)

## INTERFACE SPECIFICATIONS

XFP			
Optical Connector	LC	LC	LC
Wavelength	850 nm	1310 nm	1550 nm
Optical Output Power (Rx power read)	-4 to -1.1 dBm	-6 to -1 dBm	-1 to +2 dBm
Optical Overload (min)	-1 dBm	0.5 dBm	2 dBm
Sensitivity (min)	-11.1 dBm	-11 dBm	-13.5 dBm
Fixed Optics			
Optical Connector	SC	SC	
Wavelength	1310 nm	1550 nm	
Optical Output Power (Rx power read)	-4 to +1 dBm	-1 to +2 dBm	
Optical Overload (min)	-1 dBm	-1 dBm	
Sensitivity (min)	-15 dBm	-16 dBm	
Clock Out	LVPECL signal, AC coupled on SMA connector		
LAN (Ethernet) Port	RJ-45 (10/100Base-T)		
Operator Port	RJ-11 into RS-232 serial cable		

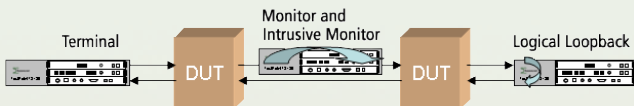
## CLOCKING

- Internal (+/- 4.6 ppm accuracy)
- Recovered
- External via Group Controller (TS-30/170)
- Clock rate variations
  - +/-30 ppm: 10GbE WAN, SONET/SDH, OTU2
  - +/-110 ppm: 10GbE LAN, 10G FC, 11.XG rates
- Clock out (LVPECL, AC coupled on SMA)



## CONNECTIVITY

- **Terminal:** Source and sink traffic (all rates)
- **Transparent Monitor:** Transparently monitors signal and retransmits unaltered (10 GbE, OTN rates, SONET/SDH)
- **Intrusive Monitor:** Can inject layer 1 errors and passes traffic on unaltered (OTN rates, SONET/SDH)
- **Logical Loopback:** Used to switch MAC and IP addresses to loop traffic back (10GbE LAN)



## APPLICATIONS

Descriptions of the following applications follow:

- **10 Gigabit Ethernet:**
  - 10GbE LAN: 10 Gigabit Ethernet directly on the line
  - 10GbE WAN: 10 Gigabit Ethernet into SONET/SDH
- **SONET/SDH:** OC-192/STM-64 (STS-192c/VC-4-64c)
- **Digital Wrapper and FEC:**
  - OTU2: ITU-T G.709; client can be 10GbE WAN or SONET/SDH BERT or GFP
  - 11.049G FEC: 10GbE LAN client; frame structure without fixed stuff
  - 11.095G FEC: 10GbE LAN client; frame structure with fixed stuff
  - 11.270G FEC: 10G FC client; frame structure without fixed stuff
  - ODU2: OTU2 frame structure without FEC
- **10G Fibre Channel**
- **GFP:** GFP-F directly in OTU2 (ITU-T G.709 section 17); or in OC-192/STM-64 (STS-192c/VC-4-64c); or in OC-192/STM-64 wrapped in OTU2
- **CHDLC:** Cisco-HDLC in OC-192/STM-64 (STS-192c/VC-4-64c); or in OC-192/STM-64 wrapped in OTU2

## 10 GIGABIT ETHERNET

Description covers 10GbE LAN and WAN.

### TRAFFIC SETTINGS

3 modes: Single Stream, Multiple Streams, PCS Play from Buffer

#### SINGLE STREAM

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

**Protocol Enables**

Tx: MAC  LLC/SNAP  IP   
 Rx: MAC  LLC/SNAP  IP

**Frame Length**

Mode: Fixed (dropdown menu)  
 Length: Fixed, Incrementing, Decrementing, Random, Sequence  
 Step: Random, Sequence  
 Padding Enable:   
 Minimum: 64  
 Maximum: 1518

**Transmit Rate**

Traffic Mode: IFG (dropdown menu)  
 Bandwidth (dropdown menu)  
 IFG (dropdown menu)

Bytes  
 Length: 12 Min: 15 Max: 4110

**Payload Tx**

Pattern: 2e31-1 (dropdown menu) Pattern Invert:   
 Fixed: 2e23-1 (dropdown menu)  
 2e31-1 (dropdown menu)  
 18 byte (dropdown menu)

**Send Mode:** Continuous / Burst of Frames

**Protocol Support:** MAC / Single/Stacked VLAN / LLC/SNAP / IPv4. User can set header values. For Destination/Source MAC addresses and VLAN IDs, 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 8 to 65535 bytes)

**Frame Payload:** PRBS 15, 23 or 31 / 16-byte Sequence

## MULTIPLE STREAMS

Used for traffic simulation and multi-protocol support.

Id	Frame Length	Frame Count	VLAN VID	Destination Address	Source Address	Source IP	Destination IP	IFG (byte)	ISG (byte)
1	814	1	1	27340:40:40:40:40:40	20:20:20:20:20:20	10.12.4.125	10.12.4.133	151	151
2	325	2	2	27440:40:40:40:40:41	20:20:20:20:20:21	10.12.4.126	10.12.4.134	69	70
3	517	1	1	27540:40:40:40:40:42	20:20:20:20:20:22	10.12.4.127	10.12.4.135	101	102
4	64	9	9	28040:40:40:40:40:50	20:20:20:20:20:30	10.12.4.125	10.12.4.133	26	26
5	64	9	9	28040:40:40:40:40:51	20:20:20:20:20:31	10.12.4.126	10.12.4.134	26	26

Total Target BW %  Total Actual BW %  Total FPS

Send Mode  Burst Size  Traffic Mode  Auto-scale BW

**Maximum Number of Streams:** 128

**Send Mode:** Continuous / Burst of Frames

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

**Frame size:** Range of 27 to 9600 bytes. Size can be: Fixed / Random 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

## PCS PLAY FROM BUFFER

Used to edit PCS Blocks, inject detailed errors, and create custom low-level patterns.

d0 d1 d2 d3 / d4 d5 d6 d7	01	68	1f	71	0d	b1	9e	c5	ff
t0e1c2c3/e4e5e6e7	10	87	00	00	00	00	00	00	00
c0e1c2c3/e4e5e6e7	40	1e	00	00	00	00	00	00	00
s0d1d2d3/d4d5d6d7	10	78	55	55	55	55	55	55	d5
d0d1d2d3/d4d5d6d7	01	44	44	44	44	44	44	22	22
d0d1d2d3/d4d5d6d7	01	22	22	22	22	81	00	00	00
d0d1d2d3/d4d5d6d7	01	00	2a	ae	36	0d	3e	40	f3
d0d1d2d3/d4d5d6d7	01	36	67	71	2a	15	46	0f	05
d0d1d2d3/d4d5d6d7	01	41	13	11	a1	8c	e8	c6	ab
d0d1d2d3/d4d5d6d7	01	e8	a2	18	16	a4	9a	4e	b8
INVALID	11	ff	6f	89	01	17	48	7d	e3
d0d1d2d3/d4d5d6d7	01	6d	c8	da	0f	83	2f	be	ee
t0e1c2c3/e4e5e6e7	10	87	00	00	00	00	00	00	00
c0e1c2c3/e4e5e6e7	40	1e	00	00	00	00	00	00	00
s0d1d2d3/d4d5d6d7	10	78	55	55	55	55	55	55	d5

Validate  Transmit

Sync Bits  Block Type  SOF/EOF Mismatch  MAC CRC

Validation Results:  
Errors: 2  
Block 18: Invalid sync  
Block 19: MAC CRC Error

MAC CRC

**Send Mode:** Continuous / Buffer Burst

**Protocol Support:** Raw Blocks / PCS / MAC

**PCS editing:** Load from PCS Capture File (auto-delineates MAC frames) / Manual from Scratch

**Auto-Validation:** Sync Header Bits / PCS Block Type Value / SOF and EOF Mismatch / MAC CRC

**Auto-Correction:** MAC CRC

**File Type:** Binary / ASCII. PCS66 format.

## 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/Stacked VLAN

**Data size:** 0 to 9572 bytes

**Replies:** Issued on port IP address match

## ERROR INJECTIONS

**PCS Sublayer:** LOS / Remote Fault / Local Fault / Error Control Character / User-Defined 64B/66B Block (single, rates) / Sync Header Error (single, HI BER, Loss of Sync) / 64B/66B Block Type Error (single, rates)

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

## ERROR MONITORING

**PMA**  
Optical LOS

**PCS**  
Sync  Invalid Blocks   
HI BER  Invalid Block Ratio   
Remote Fault  Error Control Chars   
Local Fault  RX\_E State Entered   
Sync Header Errors

**MAC**  
BW%  BW Mbits/s   
BW Frames/s   
Frames Too Long  Jabbers   
Frames Undersized  Fragments   
Inrange Length Errs  CRC Errors   
Short IFG  CRC Err Ratio   
Short Preambles  Frames Errored   
Long Preambles  Frame Loss

**IPv4**  
Checksum Errors

**Payload**  
Byte Count  Sync   
Bit Errors   
BER

**PCS Sublayer:** LOS / PCS Synchronization / HI BER / Remote Fault / Local Fault / Invalid 64B/66B Blocks / Sync Header Errors / Error Control Characters / RX\_E State

**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 / Single/Stacked 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: 64B/66B PCS, and MAC level

**PCS**

55	d0 d1 d2 d3 / d4 d5 d6 d7	01	0c	c3	52	2f	47	14	dc	0a
56	10 c1 c2 c3 / c4 c5 c6 c7	10	87		00	00	00	00	00	00
57	c0 e1 e2 e3 / e4 e5 e6 e7	10	1a	00	00	00	00	00	00	00
58	e0 d1 d2 d3 / d4 d5 d6 d7	10	78	55	55	55	55	55	55	d5
59	d0 d1 d2 d3 / d4 d5 d6 d7	01	44	44	44	44	44	44	22	22
60	d0 d1 d2 d3 / d4 d5 d6 d7	01	22	22	22	22	81	00	01	11
61	d0 d1 d2 d3 / d4 d5 d6 d7	01	03	ea	00	00	00	01	17	50

**Triggers:** Manual / PCS Sync Loss / Invalid 64B/66B Block / Sync Header Error / Remote Fault / Local Fault / Control Code Pattern Match / Block Type Field Match / Block Pattern Match (up to 8 bytes)

**Trigger Display:** Point: Start / Middle / End  
 Trigger Point / 64B/66B Blocks as in figure 49-7 IEEE 802.3ae-2002  
**Size:** 3,355,400 64B/66B Blocks  
**File Type:** Binary / ASCII. PCS66 format.

**MAC**

	T5 (µs)	Len	Dest Addr	Src Addr	VLAN	T/L	
26	0.8	1024	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	03 EA	00 00 00 00
27	0.0	1024	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	03 EA	00 00 00 00
28	0.8	1024	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	03 EA	00 00 00 00
29	1.7	1024	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	03 EA	00 00 00 00
30	2.5	1024	44 44 44 44 44 44	22 22 22 22 22 22	81 00 01 11	03 EA	00 00 00 00

**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 10 Gigabit Ethernet settings, errors, and statistics.

**DISRUPTION TIME**

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

**OPTICAL TEST PATTERNS**

**Square Wave:** Programmable between 4 and 11 bits

**Pseudo-Random:** Transmit and receive with block error count  
**PRBS31:** Transmit and receive with error injection and block error count

## SONET/SDH

### CHANNELIZATION

STS-192c / VC-4-64c

### ALARMS

Sonet SDH		Count	Ratio		
LOS	LOS	B1	0	0.0000E00	B1
LOF	LOF	B2	0	0.0000E00	B2
OOF	OOF	B3	0	0.0000E00	B3
AIS-L	MS-AIS	REI-L	0	0.0000E00	MS-REI
AIS-P	AU-AIS	REI-P	0	0.0000E00	HP-REI
LOP-P	AU-LOP				
RDI-P	HP-RDI				
UNEQ-P	HP-UNEQ				

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

### ERRORS

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

### 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

10 Gigabit Ethernet Client (10 GbE WAN) / PRBS 15, 23 or 31 / 4-Byte Sequence / GFP-F (requires option)

### DISRUPTION TIME

**Measurement:**  $\mu$ sec Resolution

**Triggers:** LOS / LOF / PRBS Sync

## DIGITAL WRAPPER AND FEC

Description covers OTU2, ODU2, 11.049G FEC, 11.095G FEC, 11.270G FEC. FEC does not apply to ODU2.

OTU		BIP8	0	FEC Errors	
LOS	<input checked="" type="checkbox"/>	BIP8 Ratio	0.0000E00	Correctable Bytes	0
AIS	<input checked="" type="checkbox"/>	BEI	0	Correctable Bits	0
LOF	<input checked="" type="checkbox"/>	BEI Ratio	0.0000E00	BER	0.0000E00
LOM	<input checked="" type="checkbox"/>			Uncorrectable Subrows	0
OOF	<input checked="" type="checkbox"/>			Error Correction	<input type="checkbox"/>
OOM	<input checked="" type="checkbox"/>				
BDI	<input checked="" type="checkbox"/>				
IAE	<input checked="" type="checkbox"/>				
BIAE	<input checked="" type="checkbox"/>				

ODU		AIS	LCK	OCI	BIAE	BDI	BIP8	BIP8 Ratio	BEI	BEI Ratio
TCM 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	0.0000E00	0	0.0000E00
TCM 2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	0.0000E00	0	0.0000E00
TCM 3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	0.0000E00	0	0.0000E00
TCM 4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	0.0000E00	0	0.0000E00
TCM 5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	0.0000E00	0	0.0000E00
TCM 6	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	0.0000E00	0	0.0000E00
PM	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	0.0000E00	0	0.0000E00

### 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

Justification Events		Client Frequency Offset (ppm from line)	0.0
Positive	0	Justification Ratio	0.000000
Negative	0		

**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
F8 F8 F8 28 28 28	99	00 32 01	00 00	00 00	00 00 00 00	00	00 32 01
F8 F8 F8 28 28 28	9A	00 B5 01	00 00	00 00	00 00 00 00	00	00 B5 01
F8 F8 F8 28 28 28	9B	00 C5 01	FF FF	00 00	00 00 00 00	00	00 C5 01
F8 F8 F8 28 28 28	9C	00 43 01	00 00	00 00	00 00 00 00	00	00 43 01
F8 F8 F8 28 28 28	9D	00 4B 01	00 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 / FTFI / 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)

## CLIENTS

**OTU2:** 10GbE WAN / SONET/SDH BERT / GFP-F (requires option)  
**ODU2:** SONET/SDH BERT  
**11.049G/11.095G:** 10GbE LAN  
**11.270G:** 10G FC

## FEC

**Settings:** Standard FEC / All-Zeros 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

# 10G FIBRE CHANNEL

## TRAFFIC SETTINGS

The screenshot shows two panels. The left panel, titled 'Frame Transmission', has a 'Send Mode' dropdown set to 'Continuous' and a 'Frame Count' field set to '16'. Below it, the 'FC Parameters' section includes 'Class Of Service 3', 'Buffer to Buffer Credits' checked and set to '128', 'Current' set to '0', and 'R\_RDY Enable' checked. The right panel, titled 'FC-2', lists various hexadecimal values: R\_CTL (0x00), D\_ID (0x000044), CS\_CTL/P (0x00), S\_ID (0x000022), Type (0x00), F\_CTL (0x390000), SEQ\_ID (0x00), DF\_CTL (0x00), SEQ\_CNT (0x0000), OX\_ID (0x0001), RX\_ID (0x0000), and Parameter (0x00000000).

**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 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 15, 23 or 31 / 16-byte Sequence

## ERROR INJECTIONS

**PCS Sublayer:** LOS / Remote Fault / Local Fault / Error Control Character / User-Defined 64B/66B Block (single, rates) / Sync Header Error (single, HI BER, Loss of Sync) / 64B/66B Block Type Error (single, rates)  
**FC-1:** Misaligned Frames (non-multiple of 4 bytes size)  
**FC-2:** CRC (single, rates)

## ERROR MONITORING

The screenshot shows three sections. The 'PCS' section has status indicators for Sync, HI BER, Remote Fault, and Local Fault, all with green circles. To the right are input fields for Invalid Blocks (0), Invalid Block Ratio (0.0000E00), Error Control Chars (0), RX\_E State Entered (0), Sync Header Errors (0), and Short IFG (0). The 'FC-1' section has a BW% field set to 100, and BW Mbits/s (10189) and BW Frames/s (587099) fields. Below are Frames Oversized (0), Frames Undersized (0), and Frames Misaligned (0). The 'FC-2' section has CRC Errors (0) and CRC Err Ratio (0.0000E00).

**PCS sublayer:** LOS / PCS Synchronization / HI BER / Remote Fault / Local Fault / Invalid 64B/66B Blocks / Sync Header Errors / Error Control Characters / RX\_E State / 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 64B/66B Block / Sync Header Error / Remote Fault / Local Fault / Control Code Pattern Match / Block Type Field Match / Block Pattern Match (up to 8 bytes)  
**Trigger Point:** Start / Middle / End  
**Display:** Trigger Point / 64B/66B Blocks as in figure 49-7 IEEE 802.3ae-2002

**Size:** 3,355,400 64B/66B Blocks  
**File Type:** Binary / ASCII. PCS66 format.

## TEST REPORT

Contains 10G FC settings, errors, and statistics.

## OPTICAL TEST PATTERNS

**Square Wave:** Programmable between 4 and 11 bits  
**Pseudo-Random:** Transmit and receive with block error count  
**PRBS31:** Transmit and receive with error injection and block error count

## GFP

There are 3 possible mappings for GFP-F: as direct OTU2 client (ITU-T G.709 section 17); in OC-192/STM-64 (STS-192c/VC-4-64c); or in OC-192/STM-64 wrapped in OTU2.

## 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 / Single/Stacked 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 15, 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, rates)

## 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 / Single/Stacked VLAN Tagged Frames / Frame Length Bins (including jumbo) / CRC Counts (total and lengths bins)

## FILTERS

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

## CAPTURES

TS	Len	GFP Core Header		GFP Payload Header				Ext	eHEC	Dest A
		PLI	cHEC	P/P/E	UPI	tHEC				
-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	95 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

## CHDLC

chDLC is Cisco-HDLC. There are 2 possible mappings: in OC-192/STM-64 (STS-192c/VC-4-64c); or in OC-192/STM-64 wrapped in OTU2.

### TRAFFIC SETTINGS

2 modes: Single Stream, Multiple Streams

#### SINGLE STREAM

Used for BERT testing.

**Send Mode:** Continuous / Burst of Frames

**Protocol Support:** IPv4 (can also support MAC / Single/Stacked VLAN directly in HDLC). User can set header values including Address / Control / Protocol.

**Frame Size:** Range of 9 to 65535 bytes. Size can be: Fixed / Incrementing.

**FCS Size:** CRC-32

**Transmission Rate:** Specified as Number of Flags (fixed) between 1 and 65535

**Frame Payload:** PRBS 15, 23 or 31 / 16-byte Sequence

#### MULTIPLE STREAMS

Used for traffic simulation and multi-protocol support.

Frame Length	Frame Count	Source IP	Destination IP	BW % Target	BW % Actual	Flags (byte)	ISF (byte)
1	811	10.12.4.125	10.12.4.133	20.0000	11.2621	272	273
2	319	410.12.4.125	10.12.4.134	20.0000	17.7631	108	108
3	512	210.12.4.125	10.12.4.135	20.0000	14.2302	172	173
4	841	110.12.4.125	10.12.4.136	20.0000	11.6782	282	283
5	1441	110.12.4.125	10.12.4.137	20.0000	20.0000	483	484

**Maximum Number of Streams:** 128

**Send Mode:** Continuous / Burst of Frames

**Protocol Support:** MPLS / IPv4 / TCP / UDP. User can set header values per stream (HDLC Address / Control / Protocol values are global).

**Frame size:** Range of 37 to 9600 bytes. Size is fixed within a stream.

**FCS Size:** CRC-32

**Transmission Rate:** BW % / Number of flags 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

### CONTROL PLANE

**SLARP:** Filters out SLARP packets from data stream.

### ERROR INJECTIONS

Abort (single) / FCS (single)

### ERROR MONITORING

FCS Errors / Frames Too Short (threshold) / Frames Too Long (threshold) / Address Mismatches / Control Mismatches / Abort Errors / Invalid Control Sequences / IPv4 Checksum Errors (single stream)

### STATISTICS

Bandwidth (% , Mbps, frames/s) / Frame Count / Octet Count / SLARP Packet Count / IPv4 Packet Count (single stream)

## 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. Test modules may occupy 16 of the 17 slots. 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 logs / 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

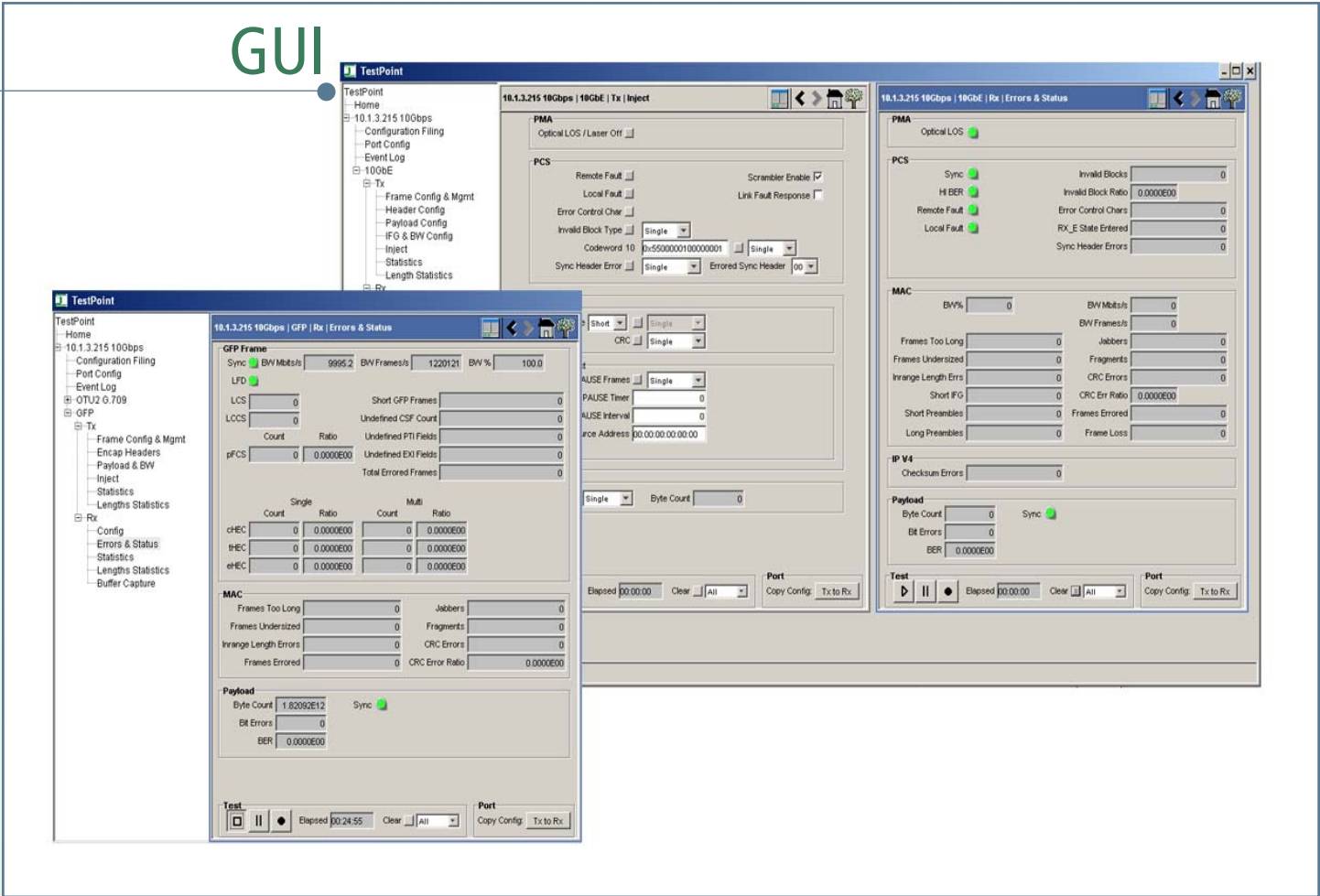
### Safety

- 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

# GUI



# INNOCOR

Established in 1995, Innocor designs, manufactures and markets Broadband Test Solutions that address multi-protocol and bit error rate testing from 10Mbps to 43Gbps. Innocor remains organically grown and is funded by its own success. Innocor is located in Kanata, Ontario, Canada.





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