

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

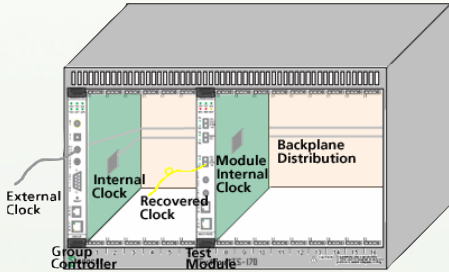
- 9.95328 Gbps (10GbE WAN and OC-192/STM-64 BERT)
- 10.037 Gbps (ODU2)
- 10.3125 Gbps (10GbE LAN)
- 10.51875 Gbps (10G FC)
- 10.709 Gbps (OTU2)
- 11.049 Gbps (10GbE LAN with FEC, no stuff bytes)
- 11.095 Gbps (10GbE LAN with FEC, stuff bytes)
- 11.270 Gbps (10G FC with FEC, no stuff bytes)

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 | | |

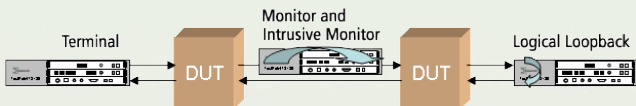
CLOCKING

- 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
- **CHDLIC:** Cisco-HDLIC 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.

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/e4c5c6c7 | 10 | 87 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| c0c1c2c3/c4c5c6c7 | 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/e4c5c6c7 | 10 | 87 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| c0c1c2c3/c4c5c6c7 | 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 Validate Correct

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 | e0 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: μ 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 of error monitoring statistics. The 'PCS' section includes: Sync (green), HI BER (green), Remote Fault (green), Local Fault (green), 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 includes: BW% (100), BW Mbits/s (10189), BW Frames/s (587099), Frames Oversized (0), Frames Undersized (0), and Frames Misaligned (0). The 'FC-2' section includes: 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

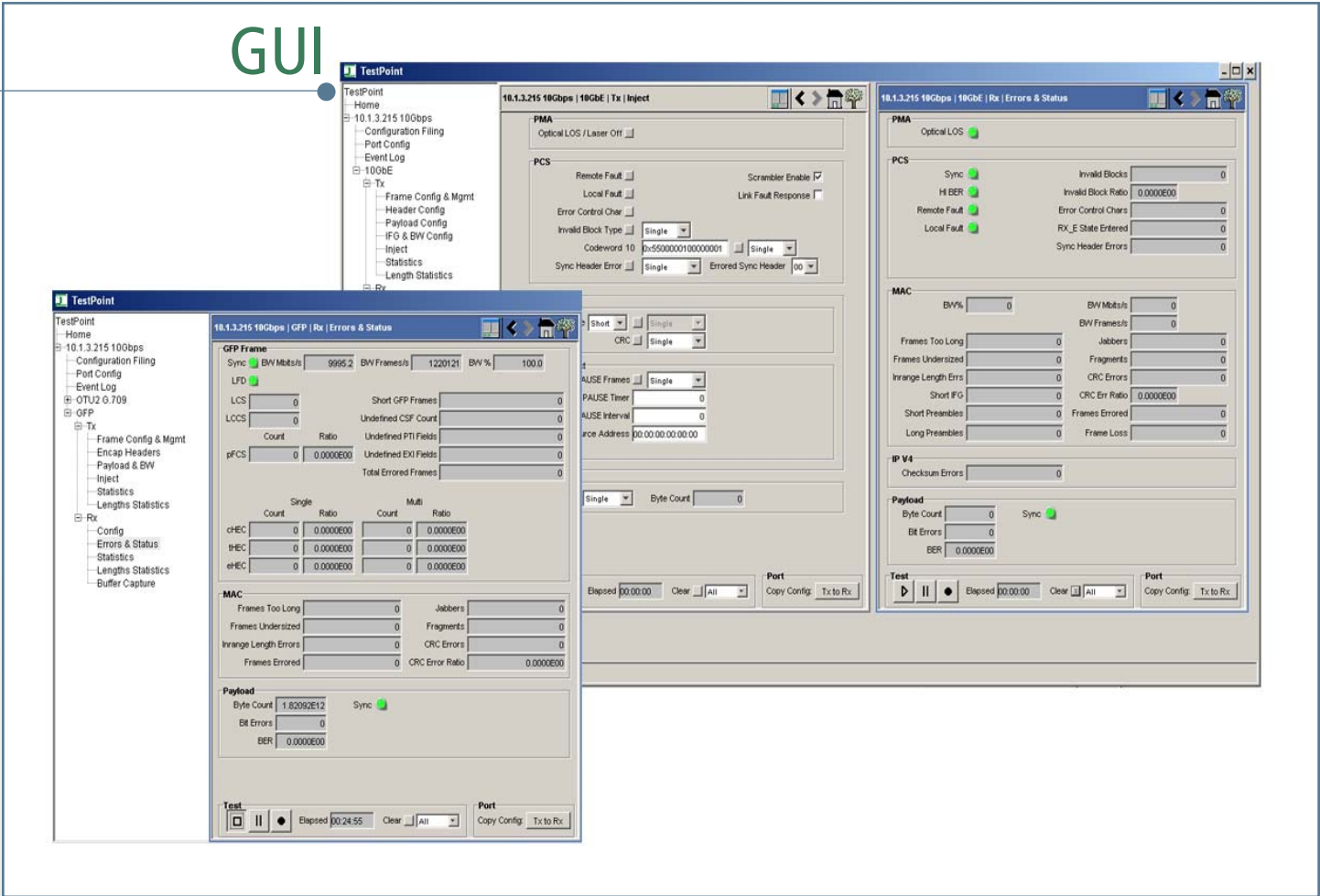
Safety

- 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.





BROADBAND
TEST
SOLUTIONS

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