



STT® ONE

OTN and Next-Generation SDH/SONET Testing

DATA SHEET



The STT ONE is part of a family of test modules for the STT Platform

KEY Features

- OTN, EoS, SDH, SONET in one instrument
- Dual wavelength optical transmitters up to 2.66 Gbps
- Advanced differential delay measurement, generation, and payload reassembly
- Fully independent or can be combined with other test modules to enhance application
- Ethernet traffic generation over SDH/SONET without extra equipment
- Auto-configuration and Channel Master

Benefits

- All-in-one test solution
- Single, compact unit
- Extremely cost-effective
- Eliminates the need for multiple instruments
- Intuitive user-friendly GUI

Test features

The STT ONE allows the user to perform routine and advanced testing on transport and access networks, legacy and next-generation networks with a single test set. Its price to performance ratio makes this product ideal.

Optical Transport Network (OTN)

STT ONE provides Forward Error Correction (FEC), verifies conformance to ITU-T G.709 and a wide range of network performance standards, including end-to-end connectivity at OTU1 and OTU2 bit rates, and complete synchronous/asynchronous mapping of SDH/SONET client signals.

The STT Optical Network Expert (ONE) is a powerful and versatile test module for the Scalable Test Toolkit (STT) for testing emerging technologies such as OTN (ITU-T G.709) and next-generation SDH/SONET, as well as traditional SDH/SONET, offering service providers a complete solution for today's metro and core networks. By integrating OTN and EoS (VCAT, GFP, and LCAS) testing into a single, compact unit, the STT ONE module is extremely cost effective because it eliminates the need for multiple instruments.

- OTU1 (2.66 Gbps) and OTU2 (10.7 Gbps) interfaces
- ODU Time Division Multiplexing (ODU1 into OPU2)
- Synchronous/asynchronous mapping of SDH/SONET signals
- OTN/SDH, OTN/SONET mux test
- Error performance analysis per ITU-T G.8201 and M.2401
- OTU, ODU, OPU error injection & alarm generation
- OTU, ODU, and OPU bytes control and decode

Next-Generation SDH/SONET

With the growth of IP services and the increasing need to leverage existing SDH/SONET networks, service providers must routinely monitor and test NGN to ensure packet-based traffic is properly delivered across the network. STT ONE offers a complete solution for NGN.

In addition, high and low order virtual concatenation capabilities help verify end-to-end connectivity. Its differential delay detection and generation functions help measure the delay in the existing network and stress the far end payload assembly circuitry.

Virtual Concatenation (VCAT)

- Conforms to ITU-T G.707, Telcordia GR-253 & ANSI T1.105-2001
- SDH/SONET error performance analysis per ITU-T G.821, G.828, G.829, M.2101, M.2110, M.2120, and Telcordia GR-253
- Virtual Concatenation Testing, VC-4-X-v, VC-3-X-v, VC-12-X-v, VC-11-X-v / STS-3-X-v, STS-1-X-v, VT1.5-X-v, VT2-X-v
- Differential delay generation, measurement, and payload reassembly up to 256 ms
- Path overhead bytes control and decode on each member
- Error injection/alarm generation on each member

Generic Framing Procedure (GFP)

- Conforms to ITU-T G.7041 and ANSI T1.105-2001
- GFP-F, GFP-T support
- GFP header control, error injection, and error detection
- Mapping/demapping of GigE payloads into SDH via GFP-T port

Ethernet over SDH/SONET (EoS)

- Ethernet frames generation via GFP-F
- Layer 2, Layer 3 testing including VLAN and MPLS tags
- RFC 2544, IP Ping, and Ethernet packet capture

Link Capacity Adjustment Scheme (LCAS)

- Conforms to ITU-T G.7042 and ANSI T1.105-2001
- Emulation of Source and Sink state machines (per member)
- Generation and capture of member status information

Traditional SDH/SONET

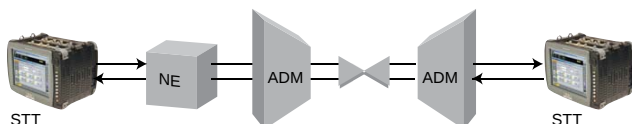
- Mapping/demapping of payloads from VC4-64c/STS-192c down to VC11, VC12/VT1.5, VT2
- SDH/SONET errors/alarms detection and generation
- SDH/SONET overhead control and decode
- Pointer monitoring and adjustment
- APS timing measurement

PDH/T-Carrier Testing

- Error performance analysis per ITU-T G.826, M.2100
- 1.5M, 2M, 34M, and 45M pulse mask analysis
- VF testing

Applications

STT ONE allows the user to perform testing on transport and access networks, legacy and next generation networks with a single product.

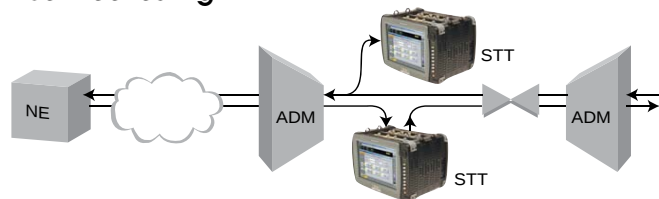


- End-to-end error free transmission verification
- SDH/SONET network routing verification

EoS (VCAT, GFP, and LCAS)

- End-to-end Ethernet over SDH/SONET tests
- Verification of path connectivity
- Stressing far end payload assembly structure by generating additional differential delay to each VCG member
- RFC 2544
- IP tests

In-Service Testing



- Through mode
- In-service monitoring through protected monitoring points or optical splitters
- Overhead bytes monitoring and decoding
- Pointer monitoring
- LCAS protocol monitoring
- VCAT and LCAS interaction monitoring
- Ethernet/IP packet capture and decode

Mux Test

OTN

- OTN/SDH, OTN/SONET Mux/demux testing
- Asynchronous/synchronous mapping/demapping of SDH/SONET client signals into OTU1/2

EoS

- Verification of proper mapping of Ethernet frames into GFP cells
- Testing GFP behavior

Mux Mode

OTN

- OTN/SDH, OTN/SONET Mux/demux emulation

Network Element Verification

OTN/SDH/SONET

- Error injection, alarm generation to verify NE remote indication
- FEC error generation to verify NE Forward Error Correction capabilities
- ODU Time Division Multiplexing test

VCAT/GFP/LCAS

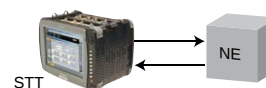
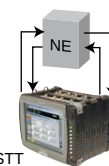
- VCAT bandwidth availability verification
- VCAT differential delay generation to stress NE payload assembly circuitry
- LCAS state machines generation to verify NE response by increasing or decreasing bandwidth

About STT Platform

The Scalable Test Toolkit is an advanced, modular, and flexible testing solution that addresses Layer 1 through Layer 7 requirements, from fiber optics to Quality of Service. Designed to meet the challenges of designing, installing, maintaining, and troubleshooting core, metro, and access networks, the STT combines an innovative test platform with revolutionary test features, supporting a complete suite of capabilities and technologies for the converging global communications market.

All STT modules are equipped with a unique standalone feature and can operate at 100% of their capabilities outside of the platform, maximizing test resources.

- STT Metro. 10/100/1000M Ethernet testing. Throughput and Bit Error testing across Layers 1, 2, and 3. Stacked VLAN (Q-in-Q) and MPLS. RFC 2544 benchmark testing. GPS antenna port for one-way latency measurements. IP connectivity testing. Bidirectional monitoring of live networks. Packet capture with decoding up to Layer 7.
- STT 10G Ethernet. 10 GigE LAN/WAN Ethernet testing. Throughput and Bit Error testing across Layers 1, 2, and 3. Advanced test features Stacked VLAN (Q-in-Q) and MPLS. RFC 2544 benchmark testing and packet capture and decode up to Layer 7.
- STT 40G 40/43G SDH/SONET and OTN 10/10.7G Drop and Insert. NRZ or DPSK modulation.



Specifications

Test Interfaces

OTN

10.7G Optical (OTU-2)

Port/Connector

- Universal interface with FC/SC (STT-6953)
- SCAPC 9 degrees (STT-6959)

Mode: Single

Line coding: NRZ

Complies to ITU-T G.709 and ITU-T G.959.1

Transmitter

Clock source

Internal

- Bit rate: 10.709225 Gbps $\pm$ 4.5 ppm
- Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz (SDH), 1.544 Mbps or 1.544 MHz (SONET)

Output power range

1550 nm Short Reach: -4 to +1 dBm

Receiver

Frequency recovery range: 10.709225 Gbps $\pm$ 50 ppm (OTN OTU-2)

Complies to ITU-T G.709 and ITU-T G.959.1

Wavelength: 1290 to 1600 nm

Input power range

1550 nm Short Reach, PIN detector: -15 to 0 dBm

Maximum input power: +7 dBm

2.66G Optical (OTU-1)

Port/Connector

- Universal interface with FC/SC (STT-6953)
- SCAPC 9 degrees (STT-6959)

Mode: Single

Line coding: NRZ

Complies to ITU-T G.709 and ITU-T G.959.1



Transmitter

Clock source

Internal

- Bit rate: 2.666057 Gbps $\pm$ 4.5 ppm
- Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz (SDH), 1.544 Mbps or 1.544 MHz (SONET)

Output power range

1310 nm Intermediate Reach: -5 to 0 dBm

1550 nm Long Reach: -2 to +3 dBm

Laser Safety: IEC825-1, Class 1, 21 CFR 1040.10 and 1040.11

Receiver

Frequency recovery range: 2.666057 Gbps $\pm$ 50 ppm

Complies to ITU-T G.709 and ITU-T G.959.1

Wavelength: 1280 to 1580 nm

Range

Single wavelength

– 1310 nm Intermediate Reach: 0 to -18 dBm

Dual wavelength

– 1310 nm Intermediate Reach/1550 nm Long Reach: -27 to -9 dBm

Maximum input power

Single wavelength

– 1310 nm Intermediate Reach: +5 dBm

Dual wavelength

– 1310 nm Intermediate Reach/1550 nm Long Reach: -5 dBm

Clock Output

Connector: 50 Ω SMA

Signal: 1v peak to peak

Frequency

10.7G: 669.324 MHz

2.66G: 166.628 MHz

SDH/SONET

10G Optical (STM-64/OC-192)

Port/Connector

- Universal interface with FC/SC (STT-6953)
- SCAPC 9 degrees (STT-6959)

Mode: Single and multi-mode compatible

Line coding: NRZ

Complies to ITU-T G.691 (SDH) and Telcordia GR-253 (SONET)

Transmitter

Clock source

Internal

- Bit rate: 9.95328 Gbps $\pm$ 4.5 ppm
- Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz (SDH), 1.544 Mbps or 1.544 MHz (SONET)

Output power range

1550 nm Short Reach: -4 to +1 dBm

Receiver

Frequency recovery range: 9.95328 Gbps $\pm$ 50 ppm
Complies to ITU-T G.691 and Telcordia GR-253
Wavelength: 1290 to 1600 nm
Input power range
1550 nm Short Reach, PIN detector: -15 to 0 dBm
Maximum input power: +7 dBm

52/155/622M/2.5G Optical (STM-0/1/4/16 / OC-1/3/12/48)

Port/Connector

Universal interface with FC/SC (STT-6953)
SCAPC 9 degrees (STT-6959)

Mode: Single and multi-mode compatible

Line coding: NRZ

Complies to ITU-T G.957 and Telcordia GR-253

Transmitter

Clock source

Internal

- Bit rates
 - 2.48832 Gbps $\pm$ 4.5 ppm
 - 622.080 Mbps $\pm$ 4.5 ppm
 - 155.520 Mbps $\pm$ 4.5 ppm
 - 51.840 Mbps $\pm$ 4.5 ppm
- Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz (SDH), 1.544 Mbps or 1.544 MHz (SONET)

Output power range

1310 nm Intermediate Reach: -5 to 0 dBm

1550 nm Long Reach: -2 to +3 dBm

Laser Safety: IEC825-1, Class 1, 21 CFR 1040.10 and 1040.11

Receiver

Frequency recovery range

- 2.48832 Gbps $\pm$ 50 ppm
- 622.080 Mbps $\pm$ 50 ppm
- 155.520 Mbps $\pm$ 50 ppm
- 51.840 Mbps $\pm$ 50 ppm

Wavelength: 1280 to 1580 nm

Range

Single wavelength

- 1310 nm Intermediate Reach: 0 to -18 dBm

Dual wavelength

- 1310 nm Intermediate Reach/1550 nm Long Reach: -27 to -9 dBm

Maximum input power

Single wavelength

- 1310 nm Intermediate Reach: +5 dBm

Dual wavelength

- 1310 nm Intermediate Reach/1550 nm Long Reach: -5 dBm

155M Electrical (STM-1/STS-3)

Port/Connector: 75 Ω unbalanced BNC (f)

Line coding: CMI

Complies to ITU-T G.707 & Telcordia GR-253 (September 2000 issue)

Transmitter

Clock source

Internal

- Bit rate: 155.520 Mbps $\pm$ 4.5 ppm
- Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz (SDH), 1.544 Mbps or 1.544 MHz (SONET)

Pulse shape: Conforms to ITU-T G.703

Framing: Conforms to GR-253 and ITU-T G.707

Receiver

Frequency recovery range: 155.520 Mbps $\pm$ 50 ppm

Input sensitivity

Terminate: 12.7 dB cable loss

Monitor: 0 to -12.7 dB (20 dB resistive loss plus 12.7 dB cable loss)

Jitter tolerance: Conforms to ITU-T G.825

52M Electrical (STM-0/STS-1)

Port/Connector: 75 Ω unbalanced BNC (f)

Line coding: B3ZS

Complies to Telcordia GR-253 (September 2000 issue) & ITU-T G.703

Transmitter

Clock source

Internal

- Bit rate: 51.840 Mbps $\pm$ 4.5 ppm
- Frequency offset: $\pm$ 50 ppm in with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz (SDH), 1.544 Mbps or 1.544 MHz (SONET)

Pulse shape: Conforms to GR-253 and ITU-R F.750-3

Framing: Conforms to GR-253 and ITU-T G.707

Receiver

Frequency recovery range: 51.840 Mbps $\pm$ 50 ppm

Input sensitivity: -26 dB from STX-1 (-20 dB plus 6 dB cable loss)

Jitter tolerance: Conforms to ITU-T G.825

Clock Output

Connector: 50 Ω SMA

Signal: 1v peak to peak

Frequency

10G: 622.080 MHz

2.5G, 622M: 155.520 MHz, 77.76 MHz

155M/52M: 19.44 MHz

PDH/T-Carrier STT-6250

139M (E4)

Port/Connector: 75 Ω unbalanced BNC (f)

Line coding: CMI

Framing: Unframed, Framed, Structured per ITU-T G.751

Transmitter

Pulse shape: Conforms to ITU-T G.703

Clock source

Internal

- Bit rate: 139.264 Mbps $\pm$ 4.5 ppm
- Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz

Receiver

Frequency recovery range: 139.264 Mbps $\pm$ 50 ppm

Input sensitivity

Term: 0 to 12 dB cable loss per ITU-T G.703

Jitter tolerance: Conforms to ITU-T G.823

45M (DS3)

Port/Connector: 75 Ω unbalanced BNC (f)

Line coding: B3ZS

Framing: Unframed, M13, and C-bit per GR-499

Transmitter

Pulse shape: Conforms to ITU-T G.703 and Bellcore GR-499-CORE

Transmit level (DSX) between 0.36 and 0.85 Volt peak; 0.7 Volt nominal

Clock source

Internal

– Bit rate: 44.736 Mbps $\pm$ 4.5 ppm

– Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 1.544 Mbps

Receiver

Frequency recovery range: 44.736 Mbps $\pm$ 50 ppm

Input sensitivity

DSX term: 5.7 dB cable loss at 22.368 MHz (0 to 450 feet [135 meters] of WECO 728A coax cable or equivalent)

DSX monitor jack: 20 dB resistive loss (due to monitor jack) plus 0 to 450 feet (135 meters) of WECO 728A coax cable or equivalent (refer to ANSI T1.102-1993)

Jitter tolerance: Conforms to GR-499 and ITU-T G.824

34M (E3)

Port/Connector: 75 Ω unbalanced BNC (f)

Line coding: HDB3

Framing: Framed, Unframed, Structured per ITU-T G.742, G.751

Transmitter

Pulse shape: Conforms to ITU-T G.703

Clock source

Internal

– Bit rate: 34.368 Mbps $\pm$ 4.5 ppm

– Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz

Receiver

Frequency recovery range: 34.368 Mbps $\pm$ 50 ppm

Input sensitivity

Term: 0 to 12 dB cable loss

Monitor: 20 dB resistive loss plus 12 dB cable loss

Jitter tolerance: Conforms to ITU-T G.823

8M (E2)

Port/Connector: 75 Ω unbalanced BNC (f)

Line coding: HDB3

Framing: Framed, Unframed, Structured per ITU-T G.742

Transmitter

Pulse shape: Conforms to ITU-T G.703

Clock source

Internal

– Bit rate: 8.448 Mbps $\pm$ 4.5 ppm

– Frequency offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz

Receiver

Frequency recovery range: 8.448 Mbps $\pm$ 50 ppm

Input sensitivity

Term: Adaptive equalization to -6 dB cable loss

Monitor: 20 dB resistive loss plus 6 dB cable loss

Jitter tolerance: Conforms to ITU-T G.823

2M (E1)

Port/Connector

75 Ω unbalanced BNC (f)

120 Ω balanced bantam (f)

Line coding: AMI, HDB3

Framing: Unframed, PCM-30, PCM-30C, PCM-31, PCM-31C per ITU-T G.704

Fractional E1

Error measurements, channel configuration verification

Nx64 kbps (consecutive) or Mx64 kbps (nonconsecutive),

N/M=1 to 30 or 1 to 31

Set Tx and Rx channels independently

Transmitter

Pulse shape: Conforms to ITU-T G.703 for balanced (120 Ω) or unbalanced (75 Ω) interfaces

Clock source

Internal

– Bit rate: 2.048 Mbps $\pm$ 4.5 ppm

– Freq. offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 2.048 Mbps or 2.048 MHz

Receiver

Frequency recovery range: 2.048 Mbps $\pm$ 50 ppm

Input sensitivity

Term, Bridge: $+6$ to -43 dB with ALBO

Monitor: 20 dB resistive loss plus 6 dB cable loss (conforms to ITU-T G.772)

Jitter tolerance: Conforms to ITU-T G.823

Impedances

Term, Monitor: 75 Ω unbalanced, 100 Ω balanced, 120 Ω balanced

Bridge: 1200 Ω or greater

1.5M (DS1)

Port/Connector: 100 Ω balanced bantam (f)

Line coding: AMI, B8ZS

Framing: Unframed, SF-D4, ESF, SLC-96* per GR-499, TR-TSY-000009, and ITU-T G.704 *SLC is a registered trademark of AT&T

Fractional T1

Error measurements, channel configuration verification

Nx64 or Nx56 kbps (consecutive or nonconsecutive), N=1 to 24

Set Tx and Rx channels independently

Transmitter

Pulse shape: Conforms to Bellcore GR-499-CORE and ITU-T G.703

Line Build Out (LBO): 0, -7.5, -15, -22.5 dB

Clock source

Internal

- Bit rate: 1.544 Mbps $\pm$ 4.5 ppm

- Freq. offset: $\pm$ 50 ppm with 1, 0.1, 0.01, or 0.001 ppm resolution

Receive: Recovered from received signal

External: Synchronization to external 1.544 Mbps

Receiver

Frequency recovery range: 1.544 Mbps $\pm$ 50 ppm

Input sensitivity

Terminate, Bridge: +6 to -36 dB cable loss

Monitor: 15 to 30 dB resistive loss

Jitter tolerance: Conforms to GR-499 and ITU-T G.824

Impedances

Term, Monitor: 100 Ω balanced, 75 Ω unbalanced

Bridge: 1000 Ω or greater

Clock Output

Connector: 50 Ω SMA

Signal: 1v peak to peak

Frequency: Line rate

Test Features

Application Modes

Standards

OTN, NGN SDH/SONET, Legacy SDH/PDH or SONET/T-Carrier

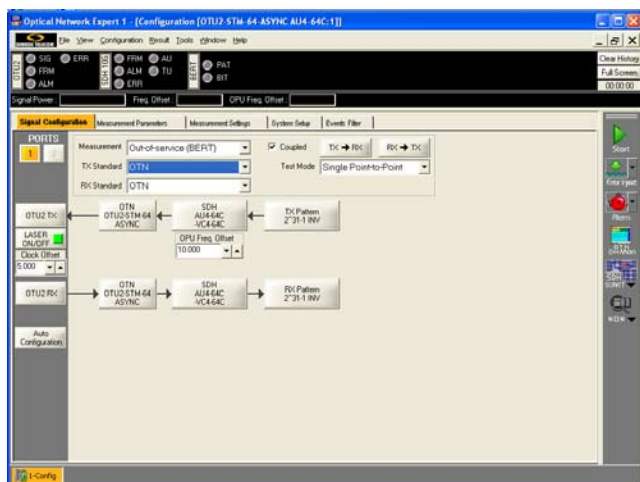
Measurement Modes

Out-of-service (BERT) or In-service (Live)

Tx and Rx

Coupled: Tx and Rx are coupled together and have the same configuration

Independent: Tx and Rx may be configured independently



Test Modes

Single Point-to-Point

Tx and Rx are set to the same rate

Through Mode Operation (all interface rates)

Line through

Passes entire signal through with no manipulation of overhead or injection of errors or alarms

Overhead can be monitored; alarms and errors measured

Payload through

Passes payload through

Passes path overhead through

SOH (SDH/SONET) / OPU (OTN) errors/alarms insertion/generation possible

SOH (SDH/SONET) / OPU (OTN) overhead control possible (except pointers)

OTN Mux Test

The test pattern is generated on SDH/SONET or OTN Tx, and the BERT is measured on the OTN or SDH/SONET Rx.

OTN Mux/Demux Mode

SDH/SONET payload is inserted/dropped to/from OTN signal

OTN

Frame/Payloads

Frame and mapping structure conforms to ITU-T G.709

Synchronous and asynchronous mapping of SDH/SONET payloads and PRBS test signals

Mapping/demapping of Ethernet over SDH/SONET (EoS) payloads via VCAT/GFP/LCAS

Test Patterns

PRBS: 2³¹-1, 2²³-1, 2²⁰-1, 2¹⁵-1

Fixed: All 1s, All 0s, Alt 1010, 1-4

User: 10 programmable 16-bit user patterns. Pattern names up to 10 characters.

Test pattern inversion

Error Injection

OTU-1/2: FAS (OA1, OA2), MFAS, SM-BIP-8, SM-BEI, correctable FEC errors, uncorrectable FEC errors

ODU-1/2: PM-BIP-8, PM-BEI

TCM1-6: BIP-8, BEI

Burst: 1 to 9999

Rate: 1x10⁻⁹ to 2x10⁻³ (depending on configuration)

Alarm Generation

LOS

OTU-1/2: LOF, OOF, OOM, LOM, AIS, SM-TIM, SM-IAE, SM-BDI

ODU-1/2: AIS, OCI, LCK, PM-TIM, PM-BDI

OPU-1/2: PLM

TCM1-6: OCI, AIS, LCK, TIM, BDI, IAE, LTC, BIAE

Measurements

Optical power measurement

Line (OTN) and payload (SDH/SONET) frequency measurement

Errors

OTU-1/2: FAS (OA1, OA2), MFAS, SM-BIP-8, SM-BEI, correctable FEC errors, uncorrectable FEC errors

ODU-1/2: PM-BIP-8, PM-BEI

TCM1-6: BIP-8, BEI

Payload bit errors

Alarms

LOS

OTU-1/2: LOF, OOF, OOM, LOM, AIS, SM-TIM, SM-IAE, SM-BDI

ODU-1/2: AIS, OCI, LCK, BDI, PM-TIM, PM-BDI

OPU: PLM

TCM1-6: OCI, AIS, LCK, TIM, BDI, IAE, LTC, BIAE

Error performance analysis: ITU-T G.8201, M.2401

Overhead Features

Overhead Monitor

Hex display of all bytes (OTU, ODU, and OPU)

Text decode of all applicable bytes (conforms to ITU-T G.709)

– TTI [SM (OTU), PM (ODU), TCM1-6], FTFL, APS/PCC, PSI

Overhead Programming

Hex input for all bytes except framing (FAS and MFAS), parity (BIP8, BEI) and justification (JC)

Trail Trace Identifier (TTI) Generation

– SM (OTU), PM (ODU), TCM1-6: SAPI/DAPI 16 bytes E.164 ASCII seq.

– Operation bytes: 32 bytes HEX or E.164 ASCII sequence

Automatic Protection Switching (APS)/Protection Communication

Channel (PCC) bytes control & decode per ITU-T G.709 and G.873

Fault Type Fault Locator (FTFL) control and decode. Forward and backward field structure per ITU-T G.709

Payload Structure Identifier

– Payload type generation/decode: Hex mode or text mode

– Conforms to ITU-T G.709, PT decode requires locking to MF #1

Overhead Sequence Generation

Bytes: TTI (SM, PM, TCM1-6) (1 to 64 bytes), GCC0 (2 bytes), GCC1 (2 bytes), GCC2 (2 bytes), APS/PCC (4 bytes), or any single overhead byte

Generates up to 256 elements, where each element (value) can be transmitted in up to 65536 consecutive frames

Overhead Sequence Capture

OA1/OA2 (6 bytes), TTI (SM, PM, TCM1-6) (1 to 64 bytes), GCC0 (2 bytes), GCC1 (2 bytes), GCC2 (2 bytes), APS/PCC (4 bytes), or any single overhead byte

Captures up to 4096 elements, where each element (value) can be detected in up to 65536 consecutive frames

GCC0, GCC1, or GCC2 Drop and Insert

GCC0, GCC1, or GCC2 BER Testing

ODU Time Division Multiplexing

ODU1 into OPU2 mapping

Asynchronous/synchronous mapping of STM-16/OC-48 payloads into ODU1 and multiplexed up to OPU2

Error injection

ODTU: FAS, MFAS

ODU1: PM-BIP8, PM-BEI

SDH/SONET errors

Payload bit errors

Burst: 1 to 9999

Rate: 1×10^{-9} to 2×10^{-3}

Alarm Generation

ODTU: LOF, LOM

ODU1: ODU-AIS, ODU-OCI, ODU-LCK, ODU-BDI, ODU-TIM

OPU: PLM

SDH/SONET alarms

Modes: Continuous, periodic, or single

Measurements

ODTU alarms: LOF, OOF, LOM, OOM

ODTU errors: Frame, MFAS

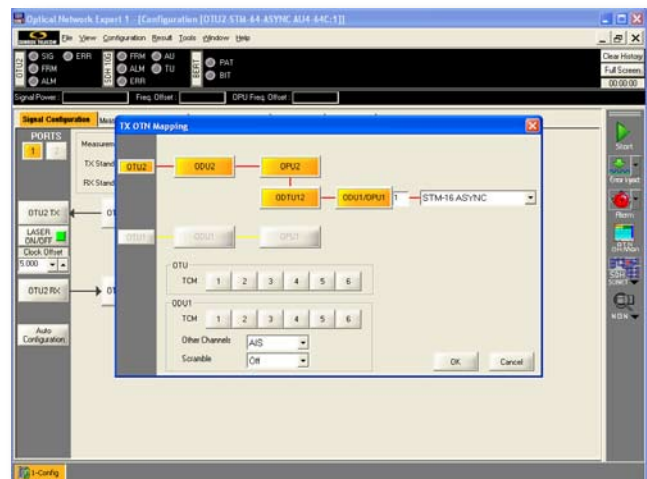
ODU alarms: ODU-AIS, ODU-OCI, ODU-LCK, ODU-BDI, ODU-TIM

ODU errors: PM-BIP8, PM-REI

OPU alarms: PLM

SDH/SONET alarms, SDH/SONET errors

Payload bit errors



SDH

Payloads

VC4-64c Bulk, VC4-16c Bulk, VC4-8c Bulk, VC4-4c Bulk, VC4-3c Bulk, VC4-2c Bulk, VC4 Bulk, 139M, VC3 Bulk, 45M, 34M, VC12 Bulk, 2M, VC11 Bulk, 1.5M

Test Patterns

PRBS: $2^{31}-1$ (2.5/10G), $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1

Fixed: All 1s, All 0s, Alt 1010, 1-4

User: 10 programmable 16-bit user patterns. Pattern names up to 10 characters.

Test pattern inversion

Error Injection

Code (52Me, 155Me), Bit, FAS (except at 10 Gbps), B1, B2, B3, LP-BIP, MS-REI, HP-REI, LP-REI

Burst: 1 to 8000

Rate: 1×10^{-9} to 2×10^{-3} (depending on configuration)

Alarm Generation

RS: LOS, LOF, RS-TIM

MS: MS-AIS, MS-RDI

AU: AU-LOP, AU-AIS

HP: HP-AIS, HP-UNEQ, HP-TIM, HP-RDI, HP-ERDI (Payload, Server, Connectivity)

TU: TU-LOP, TU-AIS, TU-LOM

LP: LP-UNEQ, LP-TIM, LP-RDI, LP-RFI, LP-ERDI (Payload, Server, Connectivity)

Measurements

Errors: Bit, B1, B2, B3, BIP-2, MS REI, HP/LP REI

Alarms: LOS, LOF, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-AIS, HP-PLM, HP-ERDI (Payload, Server, Connectivity), HP-TIM, HP-UNEQ, TU-LOM, TU AIS, TU-LOP, LP-PLM, LP-RFI, LP-ERDI (Payload, Server, Connectivity), LP-TIM, LP-UNEQ

Error performance analysis: ITU-T G.821, G.826, G.828, G.829, M.2101, M.2110

Overhead Features

Overhead Monitor

Hex display of all bytes (RS, MS, HP, and LP)

Text decode of all applicable bytes (K1/K2, S1, C2, etc.)

Overhead Programming

Hex input for all bytes except parity (B1/B2/B3), pointers (H1-H3, V1-V3), and undefined bytes

Text encoding of all applicable bytes (K1/K2, S1, C2, etc.)

Trace Generation

J0 Section trace: 1 byte, 16 bytes E.164 ASCII sequence + CRC-7 or 64 bytes E.164 ASCII sequence

J1/J2 Path trace: 16 bytes E.164 ASCII sequence + CRC-7 or 64 bytes E.164 ASCII sequence

Selection: Default, user, or through

Pointer Monitor

AU (bytes H1 and H2), TU (bytes V1 and V2)

Instantaneous pointer value display

Loss of pointer seconds

Total justification counts

Positive justification counts

Negative justification counts

New Data Flag (NDF) seconds

Pointer Adjustment

Programming of AU and TU pointer value, NDF, and SS bits

Pointer increase or decrease

Overhead Sequence Generation

Bytes: A1/A2 (6 bytes), J0/J1/J2 (1, 16, and 64 bytes), D1-D3 (3 bytes), D4-D12 (9 bytes), K1/K2 (2 bytes), or any single overhead byte

Generates up to 16 elements, where each element (value) can be transmitted in up to 65536 consecutive frames

Overhead Sequence Capture

Capture: A1/A2 (6 bytes), J0/J1/J2 (1, 16, and 64 bytes), D1-D3 (3 bytes), D4-D12 (9 bytes), K1/K2 (2 bytes), or any single overhead byte

Each new value is captured with a timestamp (absolute or elapsed) and duration (in ms or frames)

Trigger: Manual or user-defined value

Resolution: 125 ms (1 frame)

Captures up to 4096 elements, where each element (value) can be detected in up to 65536 consecutive frames

Data Communications Channel (DCC)

DCC BER testing: PRBS on D1-D3 or D4-D12 bytes (user-selectable) with G.821 analysis

DCC Drop/Insert

Pointer Test Sequences

Specifications: ITU-T G.783

Sequences: Single, burst, phase transient burst, periodic, 87-3, 26-1, opposite, and custom

Movement: Increase, decrease

Anomalies: Added, cancel, and none

Frequency offset: Positive, negative, and none

Sequence timing: Initialization, cool down, and measurement

Automatic Protection Switch Time Measurement

Resolution: 125 microseconds (1 frame)

Sensors: LOS, LOF, MS-AIS, MS-RDI, MS-REI, AU-AIS, HP-RDI, HP-REI, LP-RDI, LP-BIP, LP-REI, TU-AIS, B1, B2, B3

1 ms resolution with Pass/Fail indication

Programmable switch time and gate time

SONET

Payloads

STS-192c SPE, STS-48c SPE, STS-24c SPE, STS-12c SPE, STS-9c SPE, STS-6c SPE, STS-3c SPE, STS-1 SPE, DS3, E3, VT2, E1, VT1.5, DS1

Test Patterns

PRBS: $2^{31}-1$ (2.5/10G), $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1

Fixed: All 1s, All 0s, Alt 1010, 1-4

User: 10 programmable 16-bit user patterns. Pattern names up to 10 characters.

Test pattern inversion

Error Injection

Code (STS-1e, STS-3e), Bit, Frame (except at 10 Gbps), B1 (CV-S), B2 (CV-L), B3 (CV-P), BIP-V, REI-L, REI-P, REI-V

Burst: 1 to 8000

Rate: 1×10^{-9} to 2×10^{-3} (depending on configuration)

Alarm Generation

Section: LOS, LOF, TIM-S

Line: AIS-L, RDI-L

Path: LOP-P, AIS-P, UNEQ-P, TIM-P, RDI-P, ERDI-P

VT-Path: LOP-V, AIS-V, UNEQ-V, TIM-V, RDI-V, ERDI-V

Measurements

Errors: B1 (CV-S), B2 (CV-L), B3 (CV-P), BIP-V (CV-V), REI-V, REI-L, REI-P Alarms

LOS, LOF, TIM-S/P/V, AIS-L/P/V, RDI-L/P/V, ERDI-P/V, LOP-P/V, PLM-P/V, UNEQ-P/V, TIM-P (optional)

Failure indications for all alarms

Error performance analysis: Telcordia GR-253-CORE

Section: SEFS-S, CV-S (B1), ES-S, SES-S

Line near end: CV-L (B2), ES-L, SES-L, UAS-L, FC-L

Line far end: CV-LFE (REI-L), ES-LFE, SES-LFE, UAS-LFE, FC-LFE

Path near end: CV-P (B3), ES-P, SES-P, UAS-P, FC-P

Path far end: CV-PFE (REI-P), ES-PFE, SES-PFE, UAS-PFE, FC-PFE

VT Path near end: CV-V (BIP-2), ES-V, SES-V, UAS-V, FC-V

VT Path far end: CV-VFE (REI-V), ES-VFE, SES-VFE, UAS-VFE, FC-VFE

Pointers: PPJC-P/VDet, NPJC-P/VDet, PPJC-P/VGen, NPJC-P/VGen,

PJCDiff-P/V, PJCS-P/VDet, PJCS-P/VGen, plus Pointer Value and NDF-P/V counter

Overhead Features

Overhead Monitor

Hex display of all bytes (Section, Line, Path, and VT Path)

Text decode of all applicable bytes (K1/K2, S1, C2, etc.)

Overhead Programming

Hex input for all bytes except parity (B1/B2/B3), pointers (H1-H3, V1-V3), and undefined bytes

Text encoding of all applicable bytes (K1/K2, S1, C2, etc.)

Trace Generation

J0 Section trace: 1 byte, 16 bytes E.164 ASCII sequence + CRC-7 or 64 bytes E.164 ASCII sequence

J1/J2 Path trace: 16 bytes E.164 ASCII sequence + CRC-7 or 64 bytes E.164 ASCII sequence

Selection: Default, user, or through

Pointer Monitor

- STS (bytes H1 and H2), VT (bytes V1 and V2)
- Instantaneous pointer value display
- Loss of pointer seconds
- Total justification counts
- Positive justification counts
- Negative justification counts
- New Data Flag (NDF) seconds

Pointer Adjustment

- Programming of STS and VT pointer value, NDF, and SS bits
- Pointer increase or decrease

Overhead Sequence Generation

- Bytes: A1/A2 (6 bytes), J0/J1/J2 (1, 16 and 64 bytes), D1-D3 (3 bytes), D4-D12 (9 bytes), K1/K2 (2 bytes), or any single overhead byte
- Generates up to 16 elements, where each element (value) can be transmitted in up to 65536 consecutive frames

Overhead Sequence Capture

- Capture: A1/A2 (6 bytes), J0/J1/J2 (1, 16, and 64 bytes), D1-D3 (3 bytes), D4-D12 (9 bytes), K1/K2 (2 bytes), or any single overhead byte
- Each new value is captured with a timestamp (absolute or elapsed) and duration (in ms or frames)
- Trigger: Manual or user-defined value
- Resolution: 125 ms (1 frame)
- Captures up to 4096 elements, where each element (value) can be detected in up to 65536 consecutive frames

Data Communications Channel (DCC)

- DCC BER testing: PRBS on D1-D3 or D4-D12 bytes (user-selectable) with bit error performance analysis
- DCC Drop/Insert

Pointer Test Sequences

- Specifications: ANSI T1.105.03, Telcordia GR-253
- Sequences: Single, burst, phase transient burst, periodic, 87-3, 26-1, opposite, and custom
- Movement: Increase, decrease
- Anomalies: Added, cancel, and none
- Frequency offset: Positive, negative, and none
- Sequence timing: Initialization, cool down, and measurement

Automatic Protection Switch Time Measurement

- Resolution: 125 microseconds (1 frame)
- Sensors: LOS, LOF, AIS-L, AIS-V, RDI-L, AIS-P, REI-L, RDI-P, RDI-V, REI-P, REI-V, BIP-V, B1, B2, B3
- 1 ms resolution with Pass/Fail indication
- Programmable switch time and gate time

Common to OTN, SDH/SONET

Measurements

- Optical power level measurement
 - Accuracy: ± 1 dB
 - Wavelength: 1310 nm or 1550 nm
 - Optical saturation indication
- Service disruption measurement

PDH

Test Patterns

- PRBS: $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1 , 2^7-1 , 2^6-1 , QRSS
- Fixed: All 1s, All 0s, Alt 1010, 1-4, 1-8, 1-16, 3-24
- User: 10 user patterns defined up to 16 bits. Pattern names up to 10 characters.
- Test pattern inversion

Error Injection

- 139M: Code, Bit, and FAS
- 34M: Code, Bit, and FAS
- 8M: Code, Bit, and FAS
- 2M: Code, Bit, CRC-4, E-bit, and FAS
- Burst: 1 to 8000
- Rate: 1×10^{-9} to 2×10^{-3} (depending on configuration)

Alarm Generation

- 139M, 34M: LOS, LOF, AIS, FAS RAI
- 8M: AIS (Framed and Unframed), FAS RAI
- 2M: LOS, LOF, LOMF, AIS, FAS RAI, MFAS RAI

Measurements

- Payload: Bit, LOPS, Service Disruption
- 139M: LOS, LOF, AIS, FAS RAI, FASE, Code
- 34M: LOS, LOF, AIS, FAS RAI, FASE, Code
- 8M: LOS, LOF, AIS, FAS RAI, FASE, Code
- 2M: LOS, LOF, AIS, FAS RAI, MFAS RAI, FASE, CRC-4, E-BIT, Code
- Error and alarm data
 - Total error count or alarm seconds
 - Overall error rate
 - Current error rate (past one second)
- ITU-T G.821 analysis: Current Bit Errors, Current BER, Total Bit Errors, Overall BER, ES, %ES, SES, %SES, EFS, %EFS, AS, %AS, UAS, %UAS
- ITU-T G.826 analysis: Based on RAI. Near end and far end analysis for BE (Block Errors), BBE (Background Block Errors), BBE rate, ES, %ES, SES, %SES, AS, %AS, UAS, %UAS
- M.2100 analysis
 - Bringing-Into-Service (BIS) or maintenance
 - Programmable time period and %HRP
- Electrical signal level measurement: Vpeak, + level, - level for 2M, 34M electrical interfaces
- Pulse mask analysis for 2M and 34M electrical interfaces

T-Carrier

Test Patterns

- PRBS: $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1 , 2^7-1 , 2^6-1 , QRSS*, 55-Octet*, 55-Daly*, FOX*
- Fixed: All 1s, All 0s, Alt 1010, 1-4, 1-8, 1-16, 3-24
- User: 10 user patterns defined up to 16 bits. Pattern names up to 10 characters.
- Test pattern inversion (DS3 only)

*DS1 only

Error Injection

DS3: BPV (Code), Bit, Frame, C-bit, P-bit, FEBE
DS1: BPV (Code), Bit, CRC-6, and Frame
Burst: 1 to 8000
Rate: 1×10^{-9} to 2×10^{-3} (depending on configuration)

Alarm Generation

DS3: LOS, LOF, AIS (Blue), RAI (Yellow), Idle
DS1: LOS, LOF, AIS, Yellow, Idle

Measurements

Payload: Bit, LOPS, Service Disruption
DS3: LOS, LOF, AIS, YEL, IDLE, FBE, FEBE, PBIT, CBIT, BPV
DS1: LOS, LOF, AIS, YEL, IDLE, FBE, CRC, BPV
Error and alarm data
 Total error count or alarm seconds
 Overall error rate
 Current error rate (past one second)
Payload BERT analysis: Current Bit Errors, Current BER, Total Bit Errors,
 Overall BER, ES, %ES, SES, %SES, EFS, %EFS, AS, %AS, UAS, %UAS
Performance analysis
 DS3 near end: Based on PBIT errors, BE (Block Errors), BBE (Back-ground Block Errors), BBE rate, ES, %ES, SES, %SES, AS, %AS, UAS, %UAS
 DS3 far end: Based on FEBE errors, BE (Block Errors), BBE (Back-ground Block Errors), BBE rate, ES, %ES, SES, %SES, AS, %AS, UAS, %UAS
 DS1 near end: Based on CRC errors, BE (Block Errors), BBE (Back-ground Block Errors), BBE rate, ES, %ES, SES, %SES, AS, %AS, UAS, %UAS
 DS1 far end: Based on YEL, ES, %ES, SES, %SES, AS, %AS, UAS, %UAS
Electrical signal level measurement: Vpeak, + level, - level for DS1, DS3 electrical interfaces
Pulse mask analysis for DS1 and DS3 electrical interfaces

Common to PDH/T-Carrier

Voice Frequency Functions

Timeslot selection: Independent control of Tx and Rx timeslots
Operating mode: Tone, quiet, talk/listen
Audio selection: RJ-11 audio port for analog hand set (SS427) or speaker/microphone in STT Control Module
Audio volume control
Companding: μ -law (1.5M); A-law (2M)
Tx Supervision: Programmable ABCD/AB bits, with "Wink" and "Flash" buttons
Tx Tone Generation: 50 to 3950 Hz in 1 Hz steps; +3 to -60 dBm in 1 dB steps
Tx Idle Channel Supervision: Programmable ABCD/AB bits
Tx Idle Channel Code: Programmable 8 bit code
Rx Supervision: ABCD/AB bits; On-hook/Off-hook indication
Rx Data: 8 bit code sampling of data in received timeslot; Offset value; Peak Max value, Peak Min value
Rx Frequency measurement: 50 to 3950 Hz; Resolution: 1 Hz
Rx Level measurement: +6 to -60 dBm; Resolution: 0.1 dB
Rx Noise measurements: +30 to +96 dBm (1.5M); +6 to -60 dBm (2M); Resolution: 0.1 dBm

Rx Noise filters: 3kHz Flat, C-msg, and C-Notch (1.5M); 3kHz Flat, Pso-phometric, and 1010 notch (2M)
Rx Signal-to-Noise Ratio measurement: 0 to 40 dB; Resolution: 0.1 dB

PDH Structure Scan

Scans PDH/T-carrier structured/channelized signal identifying status of each tributary

Pulse Mask Analysis (45M/34/2/1.5M)

Measurements: Pass/Fail, high, pulse width
Resolution: 1 ns or 1%, as applicable
1.5M masks: ANSI T1.102, T1.403, AT&T CB119, Pub 62411, ITU-T G.703
45M masks: ANSI T1.102, T1.404, ITU-T G.703
2M and 34M masks: ITU-T G.703
Pulse masks storage and recall

E1 Overhead

FAS: Display of both send and receive data from timeslot 0 even frames
NFAS: Display of both send and receive data from timeslot 0 odd frames; control and decode of E-bit error; control and decode of FAS RAI alarm bits; control and decode of Sa bits.
MFAS (PCM30 and PCM30c framing only): Display of both send and receive data from timeslot 16; control and decode of "X" bits in frame 0; control and decode of MFAS RAI alarm bit in frame 0; control and decode of ABCD signaling bits for channels 1 to 30.
View Data: Snap shot of data being received on all timeslots. Pause control with view of eight frames.

Common to OTN, SDH/SONET, PDH/T-Carrier

Measurements

Frequency measurements: Current, max, min frequency
Clock slip measurements: Clock slips, frame slips, positive wander, negative wander, plus moving bar graph of slip count when reference clock set to External
Histogram analysis
 Errors/Alarms/Pointer graphic display in real-time
 Stores current results with 1-second resolution for the last 60 minutes, 1-minute resolution for the last 72 hrs, and 15-minute resolution for the last 60 days
 Compare two parameters to visually detect correlation
Propagation delay
Measurement setting
 Continuous measurement
 Programmable start time and duration
 Elapsed time, remaining time display
Measurement result management
 Save As: Save measurement results to the hard drive (or other removable media)
 Open: Open a previously saved measurement result
 Print: Print a measurement result report
 Export: Export a measurement result report file with comma separated values (which can be read by either a text editor, word processor, or spreadsheet program) or in pdf format (requires STT reporter software)

Next-Generation SDH/SONET (STT-6200)

Virtual Concatenation (VCAT)

SDH Virtual Concatenation per ITU-T G.707

High Order Paths: VC-4-X-v, X=1 to 16, VC-3-X-v, X=1 to 48

Low Order Paths: VC-11-X-v, VC-12-X-v, X=1 to 64 (from 12 different AU3 or 4 different AU4)

10G VCAT: Up to 16 VC4 from different AUG16

SONET Virtual Concatenation per ANSI T1.105-2001

High Order Paths: STS-1-X-v, X=1 to 48, STS-3-X-v, X=1 to 16

Virtual Tributary Paths: VT1.5-X-v, VT-2-X-v, X=1 to 64 (from 12 different STS-1s or 4 different STS-3s)

10G VCAT: Up to STS-3 from different STS-48

Measurements/Generation

Differential Delay Measurement & Generation (per group member)

Individual and group wide measurement

Measurement and generation range: 256 ms

VCAT reassembly range: Up to 256 ms

Errors (per group member)

SDH: Bit, B3, HP-REI, LP-BIP, LP-REI

SONET: Bit, B3 (CV-P), BIP-V, REI-P, REI-V

Alarms (per group member)

SDH: AU-AIS, AU-LOP, HP-AIS, HP-RDI, HP-ERDI (Payload, Server, Connectivity), HP-UNEQ, HP-TIM, TU-LOM, TU-AIS, TU-LOP, LP-RDI, LP-ERDI (Payload, Server, Connectivity), LP-UNEQ, LP-TIM

SONET: TIM-P/V, AIS-P/V, RDI-P/V, ERDI-P/V (Payload, Server, Connectivity), LOP-P/V, UNEQ-P/V, H4 LOM

Error performance analysis (per group member)

SDH: Per ITU-T G.821, G.826, G.828, M.2101, M.2120

SONET: Per Telcordia GR-253

Generic Framing Procedure (GFP-F)

Per ITU-T G.7041, G.707, and ANSI T1.105.02-2001

Traffic generation; Ethernet frames

Frame size: Up to 65539 bytes

Bandwidth dependent on Virtual Concatenation

GFP Payload type header control: PTI, PFI, EXI (linear and null), CID (linear only), and UPI

GFP-F (Frame) frames generation

Measurements: Idle frames, Total frames, Total octets, Client frames, Client frames with FCS, Client management frames, Extension header OK frames, Type header OK frames, Null extension frames, Linear frames, Ring frames, Ethernet mapped frames

Errors (GFP-F): Correctable cHEC errors, uncorrectable cHEC errors, correctable tHEC, uncorrectable tHEC, correctable eHEC, uncorrectable eHEC, payload FCS

Alarms: GFP Synchronization failure

GFP-T Testing

Per ITU-T G.7041, G.707, and ANSI T1.105.02-2001

GFP-T MuxMode: Mapping/demapping of external generated GigE payload into SDH/SONET using GFP Transparent [*Requires external SFP (SA580-850, SA580-1310 or SA580-1550)*]

GFP-T Header control and decode

Payload Type Identifier (PTI)

Payload FCS Indicator (PFI)

Frame Check Sequence (FCS)

Extension Header Identifier (EXI)

User Payload Identifier (UPI)

Channel ID (CID)

Superblock value N

GFP-T Error injection: Single and multiple

Core header (cHEC)

Payload type header (cHEC)

Extension Frame header (eHEC)

FCS (single only)

Superblock CRC-16.

10B Error (SINGLE ONLY)

GFP-T Alarm generation

Loss of Sync

Client Signal Failure (CSF)

Loss of Client Character Signal

GFP-T Measurements

Tx Statistics

– Idle Frames

– Total Frames

– Total Octets

– Total Superblocks

– 65B Pad Code Counters

Rx Statistics

– Idle Frames

– Total Frames

– Total Octets

– Total Client Frames

– Total Client Data Frames

– Total Client Management Frames

– Total Extension Header OK Frames

– Total Type Header OK Frames

– Total Null Extension Header Frames

– Total Linear Frames

– Total Ring Frames

– Total Frame-Mapped Ethernet Frames

– Invalid PTI Counter (except Client Data/Client Management Frames)

– Total Superblocks

– Total Codes

– D-Codes

– K-Codes

– 65B Pad Codes

– K28.5 Codes

– Client Signal Fail (Loss of Client Signal)

– Loss of Character Synchronization

– Loss of Synchronization

Rx Measurements/Histograms

– Core header errors (single and multiple)

– Payload type header errors (single and multiple)

– Linear Frame header errors (single and multiple)

– FCS errors

– Superblock CRC-16 errors (single and multiple)

– 10B Errors

GFP-T Superblock capture

Captures 96 superblocks

Values are displayed in HEX

Link Capacity Adjustment Scheme (LCAS)

Per ITU-T G.7042, G.707, and ANSI T1.105.02-2001

LCAS mode: Enable, disable

H4, K4/Z7 monitoring: Control packets

LCAS Protocol Emulation

Emulation of Source and Sink state machines (per group member)

Direct commands

- Source: Add/Remove member, Add/Remove members

- Sink: Add/Remove member, Add/Remove members

Overwrite received member status (source): OK, FAIL, AUTO

Overwrite generated member status (sink): FAIL, AUTO

Force resequence acknowledge: RX RS-Ack (source), TX RS-Ack (sink)

Force member status alarm (sink): MSU

Generation and Capture of Member Status Information

Transmitted (source) and received (sink) sequence numbers

Received (source) and transmitted (sink) resequence acknowledge

Source machine state decode: IDLE, ADD, NORM, DNU (Do Not Use), REMOVE

Sink machine state decode: IDLE, FAIL, OK

Source transmitted control word: ADD, NORM, EOS, IDLE, DNU

Sink received control word: ADD, NORM (normal transmission), EOS (End of Sequence indication and normal transmission), IDLE, DNU, FIXED (non-LCAS mode)

Sink received alarms: MSU (Member Status Unavailable), CRC Failure (excessive CRC errors)

Sink received errors: Failure of Protocol Excessive errors (CRC failure)

LCAS Errors Generation and Detection

Source (Tx): LCAS-CRC per member

Error injection: Single

Legacy SDH/SONET

Channel Master

Scans received OTN/SDH/SONET signal down to VC12, VC11/VT2, VT1.5 level

Displays OTN/SDH/SONET traces and signal label bytes

Requires STT-6200 option

Ethernet over SDH/SONET (EoS)

Test Layer

Layer 2: MAC

Layer 3: MAC + IP

User-defined IP Header

TOS, ID, Fragmentation, TTL, Protocol

VLAN

VLAN ID: 0 to 4095

Priority: 0 to 7

Stacked VLAN: Up to 3 VLAN tags

MPLS

Up to 3 MPLS tags

Unicast or Multicast

Frame Length*

60 to 12,000 bytes

Fixed

* Minimum frame lengths apply to Layer 2 traffic. Layer 3 traffic or the addition of VLAN or MPLS tags will affect this value.

Test Patterns

PRBS

$2^{31}-1$, $2^{23}-1$, $2^{20}-1$, $2^{15}-1$

User Patterns

Pre-defined: 1111, 0000, 1010

User-defined: 32-bits, 10 stored patterns per port

Error Injection

FCS/CRC, Bit, IP checksum

Modes: Single, burst, rate

Traffic Generation

Traffic shape: Constant, Ramp, Burst, Short Burst, Manual Burst

Bandwidth: 0.01% to 100.00%

Traffic streams: Up to 8 streams with unique MAC, VLAN, MPLS, IP address, and IP

Throughput Measurements

Aggregate Defects

Data errors: IP checksum, FCS/CRC, Lost frames, Bit errors

Tx/Rx Traffic Statistics

General: Total Frames, Total Octets

Allocated Line Rate, Real Line Rate and Data Rate

Frame rate: Current, Minimum, Maximum, Average

Utilization: Current, Minimum, Maximum, Average

Frame types: Unicast, Multicast, Broadcast, Non Test Traffic (Rx only),

Flow Control, Bad Frames (Rx only)

Frame size counters: Runt/Undersized, 64, 65-127, 128-255, 256-511, 512-1023, 1024-1518, Jumbo/Oversized

Per Stream Statistics

Data errors: IP checksum, Lost frames, Bit errors

Tx/Rx statistics: Total frames, Total octets

RFC 2544



Throughput

Duration: 4 to 60 seconds or 10k to 10,000k frames

Starting Rate: 1 to 100%

Resolution: Down to 0.01%

Latency

Duration: 4 to 3600 seconds

Warm-up Period: 4 to 3600 seconds

Repetitions: 1 to 50

Test Rate: Measured throughput rate or user-defined

Frame Loss Rate

Duration: 4 to 60 seconds or 10k to 10,000k frames

Starting Rate: 1 to 100%

Step Size: 1 to 100%

Back-to-back Frames

Duration: 2 to 100 seconds

Repetitions: 1 to 100

Resolution: Down to 1 frame or 0.01%

Frame Configuration

Preset Frame Lengths: 64*, 128, 256, 512, 1024, 1280, 1518, 4096, 12000

All frame lengths are user-configurable

* 64 bytes is not available for VLAN testing, except as user-defined frame length.

Extended Features

The following features go beyond the RFC 2544 standards, but they improve the ease, speed, and interpretation of the tests.

Quick Latency

The Quick Latency test is an alternative to the time-consuming RFC 2544 standard. When enabled, the Quick Latency test measures the latency of the frames during the Throughput test and requires no additional testing time.

Thresholds

The thresholds for Throughput and Latency provide a pass/fail indication for service compliance so that the RFC 2544 test results can be quickly and easily interpreted.

Network Element Test

The tests are performed as a ramp test, incrementally stepping through rates rather than finding optimum throughput rate. The user defines the step size and duration, as well as the starting & stopping rates. This is designed for burn-in testing and avoids problems associated with testing at maximum throughput rates.

IP Test

Ping Test Configuration

Ping Rate: 1 to 20 pings per second

Number of Pings: 1 to 9999 or Continuous

Frame Length: 64 to 1518 bytes

TTL: 1 to 255

Timeout: 1 to 5 seconds

Ping Destination: IP Address or URL

Ping Results

Sent: Number of pings sent to the network

Received: Number of correct Echo Response packets received

Unreached: Number of Echo Response packets w/unreached label received

Lost: Number of Echo Response packets missing

Time Exceeded: Number of pings that timed out per user configuration

Roundtrip: Measure of roundtrip delay, current, average, max., min.

Ping Response

Automatically responds to incoming Echo requests running continuously in background while an IP connection is in place.

Trace Route Test Configuration

TTL: 1 to 255

Timeout: 1 to 5 seconds

Ping Destination: IP Address or URL

Loopback

Loopback Layers

Layer 2: Frames are looped with their MAC Source and Destination addresses swapped

Layer 3: Frames are looped with their MAC and IP Source and Destination addresses swapped

Loopback Modes

Manual: Fully compatible with all other Ethernet devices

Loopback Commands: Loop Up, Loop Down

Packet Capture and Decode

The STT ONE module can capture thousands of Ethernet frames in real time. Captured packets can be analyzed immediately or saved and opened with another application. This feature is compatible with the most popular packet analysis software suites. Packet Capture is available in all Ethernet test modes.



- Identify active VLANs
- Inspect non-test traffic
- Measure delay between packets
- Troubleshoot higher layer protocols

Pre-Filter

Bitwise filter on frame header

Buffer Size

16 MB

Protocols Decoded

MAC/LLC: 802.1q (VLAN), 802.2 (LLC), 802.3 (ETH), 802.5 (TR), Ethernet II, Novell Raw, IEEE Vendor Code, MAC Control (TR), SNAP, Source Routing

Cisco: Cisco ISL

Bridge Protocol: BPDU, GARP, GMRP, GVRP

IP/SPX: IPX, SPX, SAP, RIP, NCP

TCP/IP: ARP, BGP, BOOTP, DHCP, DNS, FTP, GRE, HTTP, ICMP, IGMP, IP, NNTP, OSPF, POP3, RARP, RIP, RSVP, SMTP, SNMP, TCP, TELNET, TFTP, UDP

IpSec/Security: AH, ESP, Radius

NETBIOS: NetBIOS, NetBIOS Datagram, NetBIOS Name, NetBIOS Session, SMB

APPLETALK: AARP, ADRP, ADSP, AEP, ATP, DDP, NBP, RTMP, ZIP

PPP: PPP LCP protocol, PPPoE

VoIP: H.225, H.245, H.323, MGCP, PPTP, Q.931, RAS, RTCP, RTP, SIP, T.120 protocols

Product Description

Configuration

Auto-configuration: Automatically determines rate framing, payload structure, and test pattern

Configures Tx to match the receiver

Save/View/Load configurations: Save/reload configuration profiles

Upgrades: SW upgradable via CD-ROM, PCMCIA memory card, or USB memory device

Power consumption: 108 watts (powered from STT Platform Power Module or SA427)

TL1 commands for remote operation and test automation

Environmental

Operating temperature: 32 to 104°F (0 to 40°C)

Storage temperature: -4 to 158°F (-20 to 70°C)

Humidity: 5% to 90% noncondensing

Dimensions

Size: 12.6 x 8.7 x 5.9 in (320 x 220 x 150 mm)

Weight: 8.5 lb (3.86 kg)

Ordering Information

Control Module

STT-1001 STT Control Module
[STT Control and Display Module. Windows XP Professional SP2 OS. Includes STT Manager Software (STT-1000-SW1), STT User's Manual (SA920), Qty 2 Stylus (SA142), STT bus bridge case (SA144), Small Accessory Storage case (SA149), and one-year warranty on chassis, battery and accessories. Requires STT Power Module and Test Module(s)]

Power Module

STT-1501 Power Module, AC. 216 Watt maximum output.

STT-1521 Power Module, AC. 340 Watt maximum output.

STT-1525 Power Module, AC and Battery. 150 Watt maximum output.

STT ONE 2.5/2.66G Only (STT-6000)

STT-6001 STT-ONE 2.5G Module
SDH/SONET/OTN 2.5/2.66G analysis at transmission rates from 52M up to 2.66G. Supports 52M and 155M electrical interfaces with BNC connectors. Supports 52M, 155M, 622M, 2.5G, and 2.66G optical interfaces. *[Includes: OTN Testing (OTU1), Optical attenuator, FCPC, -10 dB (SA521) or SPCPC, -10 dB (SA531), Optical Network Expert Module Software (STT-6000-SW1), Optical Network Expert Module Users's Manual (SA925), one-year standard warranty and Certificate of Calibration.]*

2.5/2.66G Optics Options

[Mutually exclusive Option, must select one]

STT-6011 2.5/2.66G Single Wavelength. 1310 nm Intermediate Reach Tx/Rx optical transceiver for 2.66G, 2.5G, 622M, 155M, and 52M.

STT-6023 2.5/2.66G Dual wavelength. 1310 nm Intermediate Reach Tx, 1550 nm Long Reach Tx, Wideband Long Reach Rx for 2.66G, 2.5G, 622M, 155M, and 52M.

EOS/OTN Hardware Option

STT-6200 EoS HW option: VCAT, GFP, LCAS testing for all SDH/SONET rates. *[Includes GFP-T testing (STT-6350)]*

PDH/T-Carrier Hardware Option

STT-6250 PDH/T-Carrier Hardware Options. Primary Port for bit rates from 1.5/2M to 140M. Bantam connector for balanced 1.5/2M. BNC connector for 2M, 8M, 34M, 45M, and 140M. Auxiliary port: Unbalanced BNC for 2M and 34M.

Optical Connectors

[Mutually exclusive Option, must select one]

STT-6953 Standard universal optical based connectors with UPC termination. DEFAULT OPTION.

STT-6959 Optional: APC 9-Degree Connector. Replace all standard UPC connectors with APC 9-degree version *[Check with factory availability]*

STT ONE 10/10.7G (STT-6110)

STT-6001 STT-ONE 2.5G Module
SDH/SONET/OTN 2.5/2.66G analysis at transmission rates from 52M up to 2.66G. Supports 52M and 155M electrical interfaces with BNC connectors. Supports 52M, 155M, 622M, 2.5G, and 2.66G optical interfaces. *[Includes: OTN Testing (OTU1), Optical attenuator, FCPC, -10 dB (SA521) or SPCPC, -10 dB (SA531), Optical Network Expert Module Software (STT-6000-SW1), Optical Network Expert Module Users's Manual (SA925), one-year standard warranty and Certificate of Calibration.]*

10/10.7G Optics Options

[Mutually exclusive Option, must select one]

STT-6111 10/10.7G & 2.5/2.66G Single Wavelength. 1310 nm Intermediate Reach Tx/Rx optical transceiver for 2.66G, 2.5G, 622M, 155M, and 52M. 1550 nm 20 km Tx / PIN Rx optical transceiver for 10G and 10.7G. *[Includes: OTN Testing (OTU2) and ODU1-to-OPU2 Time Division Multiplexing, Optical Attenuator, FCPC, -10 dB (SA521) or SCPC, -10 dB (SA531).]*

STT-6123 10/10.7G Single & 2.5/2.66G Dual Wavelengths. 1310 nm Intermediate Reach Tx, 1550 nm Long Reach Tx, Wideband Long Reach Rx for 2.66G, 2.5G, 622M, 155M, and 52M. 1550 nm 20 km Tx / PIN Rx optical transceiver for 10G and 10.7G. *[Includes: OTN Testing (OTU2) and ODU1-to-OPU2 Time Division Multiplexing, Optical Attenuator, FCPC, -10 dB (SA521) or SCPC, -10 dB (SA531).]*

EOS/OTN Hardware Option

STT-6200 EoS HW option: VCAT, GFP, LCAS testing for all SDH/SONET rates. *[Includes GFP-T testing (STT-6350)]*

PDH/T-Carrier Hardware Option

STT-6250 PDH/T-Carrier Hardware Options. Primary Port for bit rates from 1.5/2M to 140M. Bantam connector for balanced 1.5/2M. BNC connector for 2M, 8M, 34M, 45M, and 140M. Auxiliary port: Unbalanced BNC for 2M and 34M.

Optical Connectors

[Mutually exclusive Option, must select one]

STT-6953 Standard universal optical based connectors with UPC termination. DEFAULT OPTION.

STT-6959 Optional: APC 9-Degree Connector. Replace all standard UPC connectors with APC 9-degree version *[Check with factory availability]*

Optional Items

Universal Connector Adapters

SA527 FC adapter for Universal Optical connector
[Replacement FC adapter for Universal Optical connector.]

SA528 SC adapter for Universal Optical connector.
[Replacement SC adapter for Universal connector.]

SA529 LC adapter for Universal Optical connector.
[Replacement LC adapter for Universal Optical connector. Check with factory for availability and lead time.]

SA530 ST adapter for Universal Optical connector.
[Replacement ST adapter for Universal Optical connector. Check with factory for availability and lead time.]

SA532 DIN adapter for Universal Optical connector.
[Replacement DIN adapter for Universal Optical connector. Check with factory for availability and lead time.]

SFPs for GFP-T Testing

SA580-850 850 nm SFP Optical Transceiver. *[850 nm Multimode transceiver plug-in for Gigabit Ethernet and 1G/2G Fibre Channel. LC Connector.]*

SA580-1310 1310 nm SFP Optical Transceiver. *[1310 nm Single-mode transceiver plug-in for Gigabit Ethernet and 1G/2G Fibre Channel. LC Connector.]*

SA580-1550 1550 nm SFP Optical Transceiver.
[1550 nm Single-mode transceiver plug-in for Gigabit Ethernet and 1G/2G Fibre Channel. LC Connector.]

STT-6000 Optical Accessories

SS427 Telephone Handset.

SA501 Optical Patch Cord, SMF, FCUPC to FCUPC, 6'

SA502 Optical Patch Cord, SMF, FCUPC to SCUPC, 6'

SA503 Optical Patch Cord, SMF, FCUPC to STUPC, 6'

SA504 Optical Patch Cord, SMF, FCUPC to FCAPC, 6'

SA508 Optical Patch Cord, SMF, LCUPC to SCUPC, 6'

SA509 Optical Patch Cord, SMF, LCUPC to FCUPC, 6'

SA511 Optical Patch Cord, SMF, SCUPC to SCUPC, 6'

SA512 Optical Patch Cord, SMF, SCUPC to STUPC, 6'

SA513 Optical Jumper, SMF, FCUPC to FCUPC, 1'

SA514 Optical Jumper, SMF, SCUPC to SCUPC, 1'

SA519 Optical Patch Cord, SMF, SCUPC to FCAPC, 6'

SA520 Optical Patch Cord, SMF, FCAPC to FCAPC, 6'

SA521 Optical Attenuator, FC-PC, -10 dB

SA523 Optical Connector Adapter, FCUPC to SCUPC
[Changes a FC (f) appearance to a SC (f) appearance.]

SA524 Optical Connector Adapter, SCUPC to FCUPC
[Changes a SC (f) appearance to a FC (f) appearance.]

SA531 Optical Attenuator, SC-PC, -10 dB

SA541 Optical Splitter, FC-PC, 90/10

SA545 Optical Splitter, FC-PC, 50/50

SA551 Optical Splitter, SC-PC, 90/10

SA555 Optical Splitter, SC-PC, 50/50

Optional Items *(continued)*

Electrical Cables and Adapters

SA301	Cable, Single Bantam (m) 120 Ω to 800 DSx plug (m) 120 Ω , 6'
SA302	Cable, Single Bantam (m) 120 Ω to two heavy test clips 120 Ω , 6'
SA332	Adapter, 9PIN(M) Mini D-Type to DB37F, 2m
SS106	Cable, Single Bantam (m) 120 Ω to Single Bantam (m) 120 Ω , 6'
SS108	Cable, Single Bantam (m) 120 Ω to Single 310 (m) 120 Ω , 6'
SS109	Cable, Single Bantam (m) 120 Ω to Alligator Clips 120 Ω , 6'
SS122B	Null Modem Adapter. DB-9 (f) to DB-9 (f) with Full Handshaking
SS210	Conversion Cable, BNC (m) 75 Ω to 3-pin banana CF (m) 120 Ω , 6'
SS211	Cable, BNC (m) 75 Ω to BNC (m) 75 Ω , 6'
SS212	Conversion Cable, Single Bantam (m) 120 Ω to BNC (m) 75 Ω , 6'
SS220	Conversion Cable, BNC (m) 75 Ω to 1.6/5.6 mm (m) 75 Ω , 6'
SS225	Cable, Bantam (m) 120 Ω to 3-pin banana CF (m) 120 Ω , 6'
SS227	Conversion Cable, BNC (m) 75 Ω to probe clips 120 Ω , 6'
SS303	Cable, BNC (m) 75 Ω to WECO 440A (m) 75 Ω , 6'
SS315	Cable, BNC (m) 75 Ω to WECO 358A (Large) (m) 75 Ω , 6'

Other Accessories

SA155-UK	3-prong power cord for use in United Kingdom.
SA155-EU	2-Prong power cord plus ground for use in Europe (Except UK)
SA155-NA	3-prong power cord for use in Latin America, North America, and Asia
SA427	Stand-Alone Accessory Package for the STT Modules, 130 Watt <i>[Includes:- Cable; 100 Ohm, CAT 5, RJ45 (m) to RJ45 (m), Cross-over, 6' (SA265),- Cable; 100 Ohm, CAT 5, RJ45 (m) to RJ45 (m), Straight 6' (SA266), - AC Power Adapter, 130 Watt (SA170), - STT Bus Case (SA144), - (4) Screw-on feet.]</i>
SA620	Semi-rigid Carrying Case with wheels and telescoping handle <i>[Semi-rigid Carrying Case with wheels and telescoping handle. Example STT combinations: Up to one 110mm module plus two 65mm module with STT-1501 or STT-1505A. One 150mm module with STT-1521 or STT-1525.]</i>
SA622	Hard Carrying Case with Wheels, STT

Replacement Manuals

SA925	ONE User's Manual, STT-6000 ONE Module.
SA170	STT Power Supply for stand-alone mode.



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