MTX150

Multi-service Installation & Maintenance Test Set

Ethernet
Fibre Channel
OTN
SDH/SONET
PDH/DSn
Datacom
IEEE C37.94™

The MTX150 is a fully-integrated and self-contained multi-service test solution for OTN, SDH, SONET, PDH, DSn, Ethernet, SyncE, Mobile Backhaul, and Fibre Channel (SAN). This all-in-one, rugged and ultra-portable field hand-held test set can be configured with interfaces and technologies required by field technicians to install, verify, maintain and troubleshoot Transport, Metro, Access communication links and services, including legacy applications.

Platform Highlights

- Optimized for field technicians installing, verifying, troubleshooting and maintaining Transport, Carrier Ethernet, Metro, Storage Area and legacy Networks, as well as fiber, backhaul, microwave and datacom links
- Robust, handheld chassis packed with powerful and flexible features for demanding environments and test conditions
- Flexible hardware configuration to meet each application's requirements and reduce CAPEX
- Field upgradeable licenses to optimize OPEX
- Full support for legacy PDH/DSn interfaces with standard connectors (no adapters required)
- Test set connectivity via micro-B USB and optional built-in Wi-Fi and Bluetooth® wireless interfaces; USB-A and 10/100Base-T are also available via OTG cables
- Remote access and control via Web Browser, VNC® client and ReVeal PC software. Compatible with VeEX EZ Remote collaboration services.
- User defined test profiles and thresholds enable fast, efficient and consistent turn-up of services
- Fast and efficient test result transfer to USB memory stick
- Li-Polymer battery pack for extended field testing autonomy

Key Features

- Ethernet, Fibre Channel, OTN, SDH/SONET, PDH/DSn, C37.94, Datacom and G.703 64K Codirectional Testing
- SFP Optical Interface for 100/1000Base-X, 4/2/1GFC, OTU1, STM16/4/1, STS48/12/3/1, and C37.94
- RJ45 for 10/100/1000Base-T
- BNC (75Ω unbalanced) for E1, E2, E3, E4, DS1, DS3, STM1, STM0, STS1 and STS3
- RJ48 (120Ω) or Bantam (100Ω) for DS1, E1 and G.703 64k Codirectional
- Datacom interface (DVI) for RS232 async, RS232/V.24 sync, X.21, V.35 and RS449/ V.36 (422/423), with DTE, DCE and Monitor modes
- VoIP and ISDN PRI call testing

Ethernet

- Throughput, BERT, IPv4/IPv6, Loopbacks, NetWiz, Ping, trace route, Scan, L2CP Transparency, Errors, Alarms, Events, Delay, Test Profile Auto Scripting/Sequencer
- RFC2544 Throughput, latency, frame loss and back to back tests
- V-SAM test suite compliant with ITU-T Y.1564 standard
- Q-in-Q (VLAN stacking), MPLS, MPLS-TP, PBB, and PPPoE support
- 8 Streams, 3 VLAN, 3 MPLS, TCP/UDP
- Layer 4+ test suite: V-TEST (speed test), V-FTP, RFC6349 V-PERF upload & download tests
- SyncE with ESMC/SSM and Wander Measurement

Fibre Channel

- Storage Area Networks (SAN) testing
- Throughput, BERT, Loopback, SDT, Errors, Alarms, Events, Delay
- RFC2544: Throughput, latency, frame loss, back to back tests

OTN, SDH, SONET, PDH, DSn & Datacom

- Advanced OTN, SDH/SONET, PDH/DSn test payload mapping and multiplexing
- Auto Configuration for TDM interface type, bit rate, line coding framing and test pattern
- Bit Error and Performance Analysis
- Overhead Monitoring and Byte decoding
- Service Disruption Time (SDT) and Automatic Protection Switching (APS)
- Round Trip Delay (RTD) on all TDM interfaces and payload mappings
- Tandem Connection Monitoring
- Pulse Mask Analysis at E1, E3 and DS1, DS3
- Jitter and wander for STM10/OC3, E3, E1, DS3, DS1
- ISDN PRI testing
- VF drop/insert via headset, tone generation and measurement
- G.703 64k Codirectional and Serial Datacom interfaces
- IEEE C37.94™ Testing

Fiber Optics Tools (Optional)

- OTDR Viewer with V-Scan Optical Link Mapper function, compatible with OPX-BOXe OTDR (wireless or wired)
- Fiber Inspection Scope and analysis via USB OTG
- OPM via USB OTG

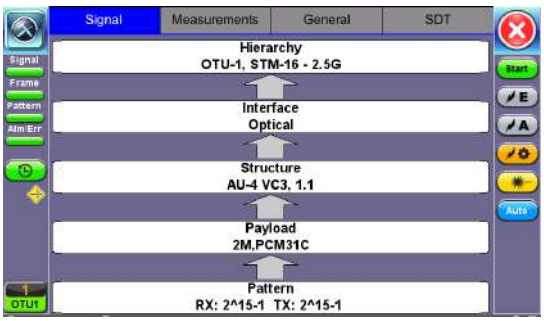
OTN, SDH, SONET, PDH, DSn

Key Features

- Flexible wavelength and bit rate options using industry standard pluggable optics
- OTN: OTU1
- SDH/SONET: STM-16/4/1/0, OC-48/12/3/1, STS-1
- PDH/DSn: DS1, DS3, E1, E2, E3, E4
- Tandem Connection Monitoring
- Service disruption testing (SDT) and APS
- Round trip delay on all interfaces and payload mappings

Quick and Intuitive Graphical Setup

The combination of OTN, SDH/SONET and PDH/DSn, common in today's network environment, can create complex test scenarios. Therefore technicians need a tool that is quick and easy to configure. Intuitive graphics, drop down menus and touchscreen operation greatly simplify test interface, signal structure, payload mapping and test pattern setup.



Test configuration, menus, and results are presented in VeEX's intuitive hierarchical test signal builder GUI, requiring little or no training for new or existing VePAL™ users, maintaining a consistent user experience from the lab to the field.
Framed signals can be equipped with unstructured or structured payloads with selected test pattern filling the entire test payload (Bulk) or a structured payload (SDH/SONET framed client signal) with or without PDH/DSn multiplexed clients.

Layer-based graphical configuration interface allow users to build the test signal in a logical layer by layer sequence

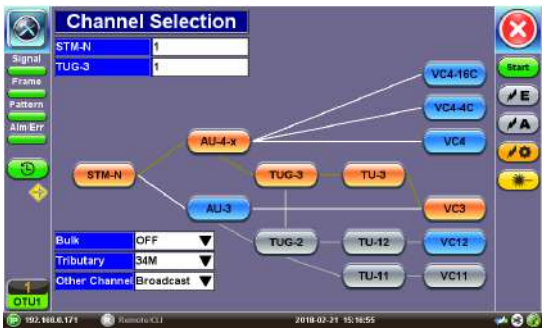
- OTN/SDH/SONET/PDH/DSn interface selection
- Optical or Electrical signal settings
- Mapping and Multiplexing
- Payload (Bulk, multiplexed, or Ethernet)
- Test Pattern (CBR) or Traffic (Packets)

Physical Layer Testing

Verifying that signals are within prescribed specifications and limits is recommended prior to performing framing and payload analysis. High optical power levels can saturate receiver equipment, while low power levels are susceptible to noise which result in bit errors. Clock tolerances for each individual signal hierarchy is clearly defined by Telcordia and ITU-T recommendations and should be verified as part of any acceptance/conformance test.

Advanced Payload Mapping and Multiplexing

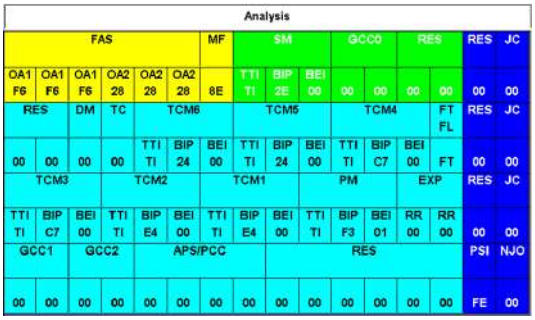
Test the operation of Add/Drop Multiplexers, Digital Cross Connects and other Network Elements (NE) by verifying the correct mapping and de-mapping of different tributaries and payloads into OTN, SDH and SONET containers, monitoring any anomalies and defects at every multiplex level, according to ITU-T and Telcordia recommendations.



PDH/DSn client can be multiplexed and mapped into SDH/SONET, which in turn can be mapped and multiplexed into OTN using bit-synchronous or asynchronous modes. In synchronous mode the Optical Payload Unit (OPU) clock is derived from the mapped client signal while in asynchronous the OPU clock is independent.

Complete Overhead Decoding and Generation

Binary, hexadecimal and detailed text decode of all applicable Section, Path overheads and Framing word bytes are performed through individual byte and bit selection or through dedicated test applications (e.g. TCMi, APS, Payload Labels, Pointer Tasks).



Overhead byte control allows the manipulation and easy encoding of transmitted overhead bytes in both terminated and payload through modes to stress the network responses to various conditions.

Tandem Connection Monitoring (TCM)

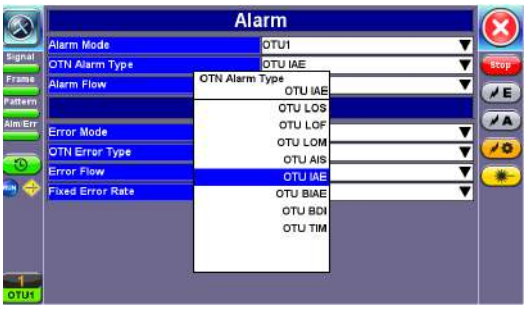
TCM helps segment the end-to-end path to diagnose, isolate and troubleshoot individual sections and resolve finger-pointing in inter-carrier and multi-region scenarios.

Service Disruption Time and APS

SDT and Automatic Protection Switch timing measurements use trigger events to measure outages and link recovery times at different levels and evaluate them against Pass/Fail criteria. It also provides detailed events recording to understand what happened during the service outage.

Error Insertion and Alarm Generation

Alarms and Errors can be inserted into any of the mapping or multiplexing layers, from OTN signal to the test payload itself. A full range of OTN, SDH/SONET and PDH/DSn defects and anomalies are supported depending on the signal structure setup. Single errors, preset rates or user-defined error rates are supported.



Intuitive Test Results

A summary screen quickly reports signal status and critical Error and Alarm parameters with easy-to-read Pass/Fail indicators. Additional screens accessed via a simple tab system display signal levels, anomalies and events.

Alarms and Errors overview with history indicators provide direct (touch) access to counters and statistics and complement the soft LEDs with a layered representation of all defects and anomalies.

Performance Analysis

Bringing-into-service (BIS), In-service and out-of-service performance evaluations according to GR-253, G.821, G.826, G.828, G.829, G.8201, M.2100, M.2101. The test set analysis screens present Pass/Fail criteria for each performance parameter, based on Telcordia/ITU-T recommendations.

Line and Payload Frequency Measurements

Frequency and offset present in the Optical Transport Unit (OTU) line, Optical Payload Unit (OPU), SDH/SONET client and PDH/DSn multiplexed layers are measured to verify basic master-slave synchronization settings.

TX Clock Sources

Internal: ± 3.5 ppm stability per ITU-T G.812
Recovered: from the incoming signal
External reference via CLK (SMA) connector

- 1.544 MHz, 2.048 MHz, 1.544 Mbps, 2.048 Mbps

Tx Frequency Offset: Up to 150 ppm (25,000 ppm for E1) in steps of 0.1 ppm for both optical and electrical interfaces
Clock recovery (pulling range) per ITU-T G.703

Measurement Clock References

Internal: ± 3.5 ppm stability per ITU-T G.812
External Clock Input

- Unbalanced 75Ω SMA
- 1.544 MHz, 2.048 MHz, 1.544 Mbps, 2.048 Mbps

Optical Interfaces

Pluggable transceivers conforming to Multi Source Agreement (MSA) specifications
Compliant to ITU-T G.957/G.691 Optical interfaces and systems relating to SDH
Optical Power Measurement: ± 2 dB accuracy, 1 dB resolution
Safety: Class 1, per FDA/CDRH, EN (IEC) 60825 eye safety regulations
Operating temperature range: -10˚C to 70˚C
ROHS compliant and Lead Free per Directive 2002/95/EC

OTN Testing

The test set offers a full range of OTN testing capabilities, including service-activation (Bringing-into-Service), performance verification, maintenance, and troubleshooting. It offers Multi-Layer testing for Physical layer, OTU/ODUk, multiplexed or bulk payloads.

Key Features

- OTU1
- Mapping of SONET/SDH signals, including multiplexed PDH/DSn payloads
- OTU, ODU, OPU overhead manipulation and monitoring
- OTU, ODU, OPU layer alarms/errors generation and analysis
- OTU, ODU, TCMi trace messages
- Forward error correction (FEC) testing
- Tandem Connection Monitoring
- Service Disruption Time measurement and Events tracking
- Frequency offset generation

OTN Interfaces

Standards: ITU-T G.709, ITU-T G.798, ITU-T G.872

- OTU1 2.666 Gbps

Operating Modes

Normal (terminal)

- The instrument terminates the line, serving as source and sink for the generated traffic
- Offers full access to Overhead and Payload alarms and error generation and monitoring

OTN Mappings

- ODU1-Bulk (test pattern)
- ODU1-STM-16 or OC-48
- ODU1-ODU0-STM4/1 or OC-12/3
- Synchronous and asynchronous, including all supported mappings and multiplexed tributaries, down to E1/DS1 (Nx64/Nx56k)
- Advanced sub-rate multiplexing and mappings of SDH/SONET payloads into OTN, including ODTU01, AMP, BMP and GMP support. VC/STS/VT and PDH/DSn sub-multiplexing are also supported
- OTU1: ODU1-Bulk, ODU1-STM16, ODU1-ODU0-STM4/1

OTU Layer

Alarm and Error Monitoring

- Alarms: LOF, OOF, LOM, OOM, OTU-AIS, OTU-IAE, OTU-BDI, OTU-BIAE, OTU-TIM
- Errors: OTU-FAS, OTU-MFAS, OTU-BIP, OTU-BEI, Correctable FEC, Uncorrectable FEC

ODU Layer

Alarm and Error Monitoring

- Alarms: ODU-AIS, ODU-OCI, ODU-LCK, ODU-BDI, ODU-TIM
- Errors: ODU-BIP-8, ODU-BEI

OPU Layer

Payload Type (PT): Generates and displays received PT value
Expected Payload label setting
Enable/Disable PLM monitoring
Alarm and Error Monitoring

- Alarms: OPU-PLM

BER Test

Alarm and Error Monitoring

- Alarms: LSS (Loss Sequence Synchronization)
- Errors: Bit (Test Sequence Error)

Test Patterns

The following test sequences can be generated to fill the payload

- PRBS: 2^{31}-1 , 2^{23}-1, 2^{20}-1, 2^{15}-1, 2^{11}-1, 2^{9}-1, 2^{7}-1, QRSS
- Fixed: 0000, 1111, 1010, 1100, 1in8, 2in8, 3in24, DALY, NET55 and OCT55
- User defined: Ten 32-bit and one 24-Bit Programmable sequences

Error Insertion

OTN

- OTU-FAS, OTU-MFAS, OTU-BIP, OTU-BEI, Correctable FEC, Uncorrectable FEC, ODU-BIP, PM-BEI

Payload

- Bit (Pattern)

Injection Modes

- Single, Count (# of errors), Fixed Rates (1E-9 to 1E-3)

Alarm Generation

Physical Layer

- LOS

OTN

- OTU-LOF, OTU-LOM, OTU-AIS, OTU-IAE, OTU-BDI, OTU-BIAE, OTU-TIM, ODU-AIS, ODU-OCI, ODU-LCK, ODU-BDI, ODU-TIM, OPU-PLM

Generation Modes

- Continuous (manual), Count (0.1, 1, 10, 100 seconds)

OTN Overhead Analysis and Generation

Analysis – Decode and Display

Byte Decoding

- On-screen Decode

OTUk bytes in hexadecimal, binary or ASCII formats

- SM-TTI (SAPI, DAPI, User), SM-BIP, SM-BEI/BIAE, SM-BDI, SM-IAE
- GCC0 bytes

ODUk bytes in hexadecimal, binary or ASCII formats

- DMp and DMti
- PM-TTI (SAPI, DAPI, User), PM-BIP, PM-BEI, PM-BDI, PM-STAT
- ODU-TCM-ACT, TCMi-TTI (SAPI, DAPI, User), TCMi-BIP, TCMiBEI/BIAE, TCMi-BDI, TCMi-STAT
- GCC1, GCC2 bytes
- PCC/APS bytes

OPUk bytes in hexadecimal and binary formats

- JC1, JC2, JC3, (JC4, JC5, JC6), PSI, NJO

Reserved bytes

Generation - Programmable Bytes and sequences

OTU and ODU Trace Generation

- SAPI (15 characters)
- DAPI (15 characters)

- User (31 characters)
- Copy from received trace

TCMi Trace Generation
- SAPI (15 characters)
- DAPI (15 characters)
- User (31 characters)
- Copy from received trace

Set TCMi Status
- ODU-TCM-ACT (Binary and Hex)

Programmable Expected Traces
- OTU and ODU SAPI, DAPI, and User
- Copy from received trace
- Enable/Disable TIM monitor

Tandem Connection Monitoring (TCM)

TCMi Monitoring (1 through 6)
- LTC, AIS, OCI, LCK, BDI, BIAE, IAE; count
- IEC, BEI; count and rate

Trace Identifier Monitoring and Generation
- Programmable SAPI, DAPI and User traces
- Copy trace from RX
- Enable/Disable TIM monitoring

SDH/SONET Testing

Installation, bring-into-service, and maintenance of SDH/SONET and PDH/DSn networks is simplified thanks to a combination of intuitive features and powerful test functions. SDH signals are often compromised by various impairments in the multiplexing process therefore defining the type of anomaly or defect to isolate the network element or signal path causing the problem is crucial. Fast troubleshooting and comprehensive analysis of transmission problems can be performed using intrusive, non-intrusive and monitoring test modes. Novice users will benefit from the easy-to-use Auto-configuration and Tributary Scan test modes, while experienced users will appreciate the array of advanced features such as Overhead Monitoring and Byte Control, Pointer Test Sequences, Path Trace Generation, Tandem Connection Monitoring and lots more.

SDH/SONET signals can be used as physical layer or as OTN payloads, and can contain multiplexed PDH/DSn clients, providing all the flexibility to address complex test scenarios.

Key Features

- STM-16/4/1/0 optical and electrical
- OC-48/12/3 and STS-3/1
- Bulk VC/STS/VT, PDH/DSn and multiplexed payloads
- Overhead manipulation and monitoring
- Alarms/errors generation and analysis
- Service Disruption Time (SDT) and APS
- Round Trip Delay
- Tributary Scan
- Tandem Connection Monitoring
- Pointer Test Sequences

Test Interfaces

Optical
- STM-16/OC-48 2.448 Gbps
- STM-4/OC-12 622 Mbps
- STM-1/OC-3 155 Mbps
- STM-0/OC-1 52 Mbps

Electrical
- BNC (75Ω unbalanced)
- STS-1/STM-0e, 51.84 Mbps, B3ZS
- STS-3/STM-1e, 155.520 Mbps, CMI

Receiver Sensitivity
- 51.840 Mbps (STS-1/STM-0e)
- Terminate: ≤ 10 dB (cable loss only)
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)
- 155.520 Mbps (STM-1e)
- Terminate: ≤ 12.7 dB (coaxial cable loss only)

Operating Modes

Normal (terminal)
- The instrument terminates the line, serving as source and sink for the generated traffic
- Offers full access to Overhead and Payload alarms and error generation and monitoring

Payload Through (intrusive)
- Instrument retransmits the received Payload and allows access to Overhead manipulation
- Offers access to Overhead alarms and error generation as well as Payload monitoring

Line Through (transparent)
- Instrument regenerates and retransmits the entire received signal
- Offers minimal interaction with the test signal
- Provides full access to Overhead and Payload alarms and error monitoring

Out-of-Service Testing

Applications include:
- BERT
- Tributary Mapping/de-Mapping
- Path/Section Trace Generation
- Bringing Into Service (M.2100)
- Round Trip Delay
- Pointer Test Sequences

In-Service Monitoring

Applications include:
- Optical Power and Frequency
- Tributary Scanning
- Performance Analysis per G.826, G.828, G.829, M.2101
- Pointer Analysis and Generation
- APS Measurement and Service Disruption (SDT)
- Tandem Connection Monitoring
- Overhead Byte Control and Decode

SDH Mappings

(According to ITU-T G.707)
- C-11 (Bulk/PRBS, unframed or framed DS1)
- C-12 (Bulk/PRBS, unframed or framed E1, asynchronous,bit or byte synchronous)
- C-3 (Bulk/PRBS, unframed, framed or channelized E3 or DS3) via AU-3 or AU-4
- C-4 (Bulk/PRBS, unframed or framed E4)
- C-4-4c (Bulk/PRBS)
- C-4-16c (Bulk/PRBS)

SONET Mappings

(According to Telcordia GR-253/ANSI T1.105)

- VT-2 (unstructured or framed E1)
- VT-1.5 (unstructured or framed DS1, asynchronous or float byte synchronous)
- STS-1 SPE (unstructured or framed E3 or DS3)
- STS-3c SPE (unstructured or framed E4)
- STS-12c SPE (Bulk) STS-48c SPE (Bulk)

Test Patterns

The following test patterns can be generated

- PRBS: 2^{31}-1 , 2^{23}-1, 2^{20}-1, 2^{15}-1, 2^{11}-1 , 2^{9}-1, 2^{7}-1, QRSS
- Fixed: 0000, 1111, 1010, 1100, 1in8, 2in8, 3in24, DALY, NET55 and OCT55
- User defined: Ten 32-bit and one 24-Bit Programmable sequences
- Mode: Normal or Inverted

Errors

Insertion

- SDH: FAS, B1, B2, MS-REI, B3, HP-REI, LP-REI, LP-BIP, and bit errors
- SONET: FAS, B1, B2, REI-L, B3, REI-P, REI-V, BIP-V, and bit errors
- Modes: Single, Count (# of errors), Fixed Rates (1E-9 to 1E-3)

Detection

- SDH: FAS, B1, B2, MS-REI, B3, HP-REI, LP-BIP, LP-REI, slips and bit errors
- SONET: FAS, B1, B2, REI-L, B3, REI-P, REI-V, BIP-V, slips and bit errors

Alarms

Generation

- SDH: LOS, LOF, MS-AIS, MS-RDI, RS-TIM, AU-LOP, AU-AIS, HPUNEQ, HP-PLM, HP-RDI, HP-TIM, TU-LOM, TU-LOP, TU-AIS, LPUNEQ, LP-PLM, LP-RDI, LP-RFI, LP-TIM, 2M AIS, 2M LOF, 2M RDI
- SONET: LOS, LOF, AIS-S, RDI-S, TIM-P, LOP-P, AIS-P, UNEQ-P, PLM-P, RDI-P, LOM-V, LOP-V, AIS-V, UNEQ-V, PLM-V, RDI-V, RFI-V, TIM-V, DS1-AIS, DS1-LOF, 2M-AIS, 2M-LOF, 2M-RDI, 45M-AIS, 45M-LOF
- Modes: Continuous (manual), Count (0.1, 1, 10, 100 seconds)

Monitoring and Detection

- SDH: LOS, LOF, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-UNEQ, HP-PLM, HP-TIM, HP-RDI, TU-LOM, TU-AIS, TU-LOP, LP-UNEQ, LP-PLM, LP-TIM, LP-RDI, LP-RFI
- SONET: LOS, LOF, OOF, AIS-S, RDI-S, TIM-P, LOP-P, AIS-P, UNEQ-P, PLM-P, RDI-P, LOM-V, LOP-V, AIS-V, UNEQ-V, PLM-V, RDI-V, RFI-V, TIM-V

Overhead Analysis and Generation

Analysis - Decode and Display SOH/POH bytes in hexadecimal, binary or ASCII formats

- S1 synchronization status
- C2 HP/STS signal label
- J0 trace identifier (1, 16 or 64 bytes) in ASCII format
- J1 trace identifier (16 or 64 bytes) in ASCII format
- J2 trace identifier (16 or 64 bytes) in ASCII format
- K1, K2 APS Control
- V5 LP/VT signal label

Generation - Programmable Bytes RSOH/Section

- J0 trace: 1 byte hexadecimal, 16 byte ASCII with CRC-7 and 64 byte with CR+LF

MSOH/Line

- K1, K2 APS bytes per ITU-T G.783 and G.841
- S1 synchronization status message

HO-POH (VC-4, VC-3)/STS-POH (STS-N SPE, STS-1 SPE)

- J1 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
- C2 signal label
- H4 Sequence/Multi-frame Indicator
- G1 (bit 5): End-to-end path status (RDI generation)
- K3 (bits 1-4) APS signaling

LO-POH (VC-3)/STS-POH (STS-1 SPE)

- J1 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
- C2 signal label
- G1 (bit 5): End-to-end path status (RDI generation)
- K3 (bits 1-4) APS signaling

LO-POH (VC-12, VC-11)/VT-POH (VT-1.5, VT-2)

- V5 (bits 5-7) LP/VT signal label
- J2 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
- K4 (bits 3-4) LP/VT APS signaling

Tributary Scan

Automatically scans VC-12, VC-11, VT-1.5 or VT-2 for errors, alarms and events using a sequential BER tests

Pointer Analysis and G.783 Test Sequences

Pointer movements monitoring and generation for SDH and SONET Monitor

- AU, TU, STS and VT pointer adjustments
- SS bits, LOP, New Data Flags (NDF)
- Current value, increments, decrements, sum, difference
- Tributary frequency offset (ppm of AU/TU or STS/VT)

Generation

- Pointer sequences: ITU-T G.783, Telcordia GR-253
- Pointer Types: AU, TU, STS, VT
- Single pointer, increment, decrement, or increment/decrement
- Sequence: Basic, Single Alternating, Regular Additive, Regular Cancel, Double Alternating, Burst, Transient Burst, 87/3, 87/3 Additive, 87/3 Cancel, Periodic Additive, Periodic Cancel
- Programming of SS bits
- Adjustments: Increment, Decrement, New Value
- Parameters: N, T1, T2, T3, T4

Tandem Connection Monitoring (TCM)

Generation and analysis of N1 (HP-TCM) and N2 (LP-TCM) bytes

Detection, display and analysis of events

- UNEQ, TC-AIS, TC-ODI, TC-IEC, TC-REI, TC-OEI, TC-LTC, TC-RDI

PDH/DSn Testing

While telecommunications network technologies have evolved to include long-distance high-capacity OTN,SDH/SONET or Ethernet trunks, PDH/DSn links and clients are frequently retained for voice, access, service delivery and for other economic reasons. As such, testing PDH/ DSn interfaces, payloads and services continue to play an important role in test and measurement.

This test set provides PDH/DSn interfaces, payload generation, access and testing capabilities for 140 Mbps (E4), 45 Mbps (DS3), 34 Mbps (E3), 2 Mbps (E1), 1.544 Mbps (DS1), down to N×64 and Nx56 kbps. PDH/DSn clients can be multiplexed into a higher PDH/DSn signal, mapped into SDH/SONET containers, and then mapped into OTN, giving it the flexibility to address complex test scenarios.

PDH/DSn Interfaces

Electrical

Balanced RJ-48 (120Ω) or Bantam (100Ω)

- DS1, 1.544 Mbps, AMI & B8ZS, 100Ω balanced
- E1, 2.048 Mbps, HDB3 & AMI, 120Ω balanced
- G.703 Codirectional, 64 Kbps, 120Ω balanced

Unbalanced BNC (75Ω)

- E1, 2.048 Mbps, HDB3 & AMI
- E2, 8.448 Mbps, HDB3
- E3, 34.368 Mbps, HDB3
- DS3, 44.736 Mbps, B3ZS
- E4, 139.264 Mbps, CMI

Compliant to ITU-T G.703, G.823, G.824, G.772 and ANSI T1.102

Receiver Sensitivity

1.544 Mbps (DS1)

- Terminate: ≤ 26 dB (cable loss only) at 0 dB DSX Tx
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)
- Bridge: ≤ 6 dB (cable loss only)
- Line Equalizer function provides increased dynamic range to support for LBO < -7.5 dB

2.048 Mbps (E1)

- Terminate: ≤ 6 dB (cable loss only)
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)
- Bridge: ≤ 6 dB (cable loss only)
- Line Equalizer function provides increased dynamic range to support for LBO < -7.5 dB

8.448 Mbps (E2)

- Terminate: ≤ 6 dB (cable loss only)
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)

34.368 Mbps (E3)

- Terminate: ≤ 12 dB (cable loss only)
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)

44.736 Mbps (DS3)

- Terminate: ≤ 10 dB (cable loss only)
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)

139.264 Mbps (E4)

- Terminate: ≤ 12 dB (coaxial cable loss only)

Operating Modes

Terminate, Monitor, Bridge (E1 & DS1)

Signal Structure

1.544 Mbps (DS1)

- Unframed or Framed SF (D4), ESF per ANSI/Telcordia standards
- Fractional test signal in N x 64 kbps or N x 56 kbps, where N=1 to 24

2.048 Mbps (E1)

- Unframed or Framed with/without CRC per ITU-T G.704 (PCM30, PCM30C, PCM31, PCM31C)
- Fractional test signal in N x 64 kbps, where N=1 to 30/31

8.448 Mbps (E2)

- Unframed or Framed according to ITU-T G.742

34.368 Mbps (E3)

- Unframed or Framed according to ITU-T G.751

44.736 Mbps (DS3)

- Unframed or Framed M13 & C-Bit Parity per ITU-T G.752/G.704

139.264 Mbps (E4)

- Unframed or Framed per ITU-T G.751

Test Patterns

The following test patterns can be generated

- PRBS: 2^{31}-1 , 2^{23}-1, 2^{20}-1, 2^{15}-1, 2^{11}-1 , 2^{9}-1, 2^{7}-1, QRSS
- Fixed: 0000, 1111, 1010, 1100, 1in8, 2in8, 3in24, DALY, NET55 and OCT55
- User defined: Ten 32-bit and one 24-Bit Programmable sequences
- Mode: Normal or Inverted

Errors

Insertion

- 1.544 Mbps (DS1): Code, FAS, Bit, Frame, CRC
- 2.048 Mbps (E1): Code, FAS, CRC, EBIT, Bit errors
- 8.448 Mbps (E2): Code, 8M FAS, 2M FAS, 2M CRC, 2M RDI, Bit errors
- 34.368 Mbps (E3): Code, 34M FAS, 8M FAS, 2M FAS, 2M CRC, 2M RDI, Bit errors
- 44.736 Mbps (DS3): Code, FAS, MFAS, P/C-Parity, Bit errors
- 139.264 Mbps (E4): Code, FAS, Bit errors
- Modes: Single, Count (# of errors), Fixed Rates (1E-9 to 1E-3)

Measurement

- 1.544 Mbps (DS1): Code, FAS, Bit, Frame, CRC
- 2.048 Mbps (E1): Code, FAS, CRC, EBIT and Bit errors
- 8.448 Mbps (E2): Code, FAS, Bit errors
- 34.368 Mbps (E3): Code, FAS, Bit errors
- 44.736 Mbps (DS3): Code, FAS, MFAS, P/C-Parity, Bit errors
- 139.264 Mbps (E4): FAS

Alarms

Generation

- 1.544 Mbps (DS1): AIS, yellow, idle, LOS, LOF
- 2.048 Mbps (E1): LOS, AIS, LOF, RDI
- 8.448 Mbps (E2): 8M AIS, 8M LOF, 8M RDI, 2M AIS, 2M LOF, 2M RDI
- 34.368 Mbps (E3): 34M LOS, 34M AIS, 34M LOF, 34M RDI, 8M AIS, 8M LOF, 8M RDI, 2M AIS, 2M LOF, 2M RDI
- 44.736 Mbps (DS3): LOS, LOF, OOF, AIS, Parity
- 139.264 Mbps (E4): LOS, AIS, LOF, RDI

Measurement

- 1.544 Mbps (DS1): AIS, yellow, idle, LOS, LOF, LSS
- 2.048 Mbps (E1): LOS, AIS, LOF, LOMF, RDI, and LSS
- 8.448 Mbps (E2): LOS, AIS, LOF, RDI, and LSS
- 34.368 Mbps (E3): LOS, AIS, LOF, RDI, and LSS
- 44.736 Mbps (DS3): LOS, LOF, OOF, AIS, Parity, LSS
- 139.264 Mbps (E4): LOS, AIS, LOF, RDI
- Modes: Continuous (manual), Count (0.1, 1, 10, 100 seconds)

Measurement Functions

Test Results

Error count, ES, %ES, SES, %SES, UAS, %UAS, EFS, %EFS, AS, %AS, and rate for all events: errors, alarms and pointer events

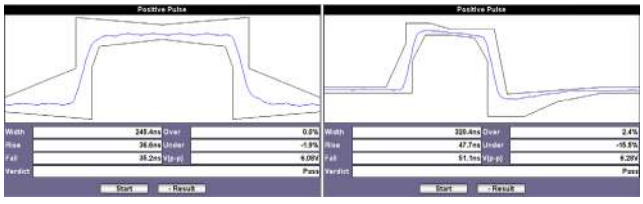
Performance Analysis

Measurements according to:

- ITU-T G.821: ES, EFS, SES and UAS with HRP 1% to 100%
- ITU-T G.826: EB, BBE, ES, EFS, SES, UAS; HRP of 1% to 100%
- In Service Measurement (ISM) using B1, B2, B3, FAS, CRC or Code (E1)
- Out of Service measurement (OOS) using bit errors (Test Sequence Error)
- ITU-T G.828: ES, EFS, SES, BBE, SEP, UAS with HRP 1% to 100%
- ITU-T G.829: ES, EFS, SES, BBE, UAS on RSOH (B1), MSOH (B2) or TSE
- ITU-T M.2100: ES, EFS, SES, UAS with HRP 1% to 100%
- User defined thresholds for Maintenance (MTCE) and Bringing into Service (BIS) objectives
- ITU-T M.2101: ES, EFS, SES, BBE, SEP, UAS with HRP 1% to 100%

Pulse Mask Analysis

PDH/DSn signals may fail pulse shape requirements due to interference, excessive cable length, improper impedance, open cable branches or poor transmitter characteristics. In such cases, G.703 Pulse Mask compliance verification is very useful in diagnosing related physical layer problems.



PDH

- Bit rates: 2.048 Mbps (E1) and 34.368 Mbps (E3)
- Conformance Mask: ITU-T G.703

DSn

- Bit rates: 1.544 Mbps (DS1) and 44.736 Mbps (DS3)
- Conformance Masks: ITU-T G.703, ANSI T1.102, T1.403, T1.404

Mode: Non-Intrusive

Display: Pulse shape graph with Conformance mask verification (Pass/Fail)

Parameters: Width, Rise/Fall time, Overshoot/Undershoot

E1/DS1 VF Measurements

The Voice Frequency (VF) is a basic diagnostic tool to install, verify and troubleshoot voice circuits. Digital to analog conversion tests are performed by inserting/measuring tones with user defined frequency and level on selected sub-rate channels.

A microphone/headset jack enables talk/listen capability on a selected timeslot while a powerful function allows VF decoding at all PDH/DSn and SDH/SONET rates

Codec: µ-Law or A-Law

Programmable ABCD

- Manual edit AB, ABCD or ON-HOOK, OFF-HOOK, WINK for DS1, and IDLE, SEIZE for E1

Independent Time Slot channel selection for TX and RX

- E1 channel: 1 -15, 17-31, 1 to 31
- DS1 channel: 1 to 24

Voice (Talk)

- VF drop/insert via headset
- 2.5 mm TRS audio jack for headset
- Listen to the audio channel in selected timeslot

Tone Generation and Measurement

- Transmit Frequency: 50 to 3950 Hz
- Transmit Level: -60 to 3 dBm

Results

- AB/ABCD bits monitor
- View Received Data in selected T/S
- Measure signal frequency and level in selected timeslot

DSn Functions

DS1 Loopback Commands

Enhanced DS1 Loopback command generation enable users to singlehandedly test DS1 links by activating automated loopbacks in the desired network elements.

In-band:

- CSU, NIU FAC1, NIU FC2 ESF Facility Data Link (FDL) Control

Line and payload HDSL Abbreviated (short)

- From Network (CO) or CPE
- NLOC, NDU1, NDU2, NREM

HDSL Long (In-band)

- From Network (CO) or CPE
- 2-wire and 4-wire
- HTU-C, H4R1, H4R2, H4R3, HTU-R
- Arm, Query Loop, Time-out override, Loopback Query, Loop Up, Loops down, Disarm commands
- Detailed confirmation messages

User Defined codes

- Programmable codes up to 16 bits
- Programmable time out

DS1 Multi-BERT™

Bring into service and troubleshoot DS1 links quickly by automatically generating different test patters in a sequential BER test. Since certain test patterns can help identify and test for specific problems or behaviors, the test sequence can be customized with specific test patterns and timings to target specific test scenarios, like checking for proper line coding settings, framing, or clock recovery.

- Sequential BER testing with up to eight test patterns (any standard test pattern in any order)
- Single cycle and Continuous operations
- Individual pattern timing up to 3599 seconds (1 hour)
- Bit, Code, FBE, ES, and total test time report, per pattern and totals
- Monitors signal frequency, level (dB and dBm) and CRC error count

Common Functions & Measurements

Service Disruption and APS Testing

Service disruption time (SDT) measurements are integrated to the regular BER tests, supporting multi-layer sensor monitoring and events table for OTN, SDH/SONET and PDH/DSn

OTN Sensors

- LOS, OTU-AIS
- OTU-LOF, OTU-LOM, OTU-IAE, OTU-BDI, SM-BIAE, ODU-AIS, ODU-LCK, ODU-OCI
- FAS, MFAS, OTU-BIP, OTU-BEI, ODU-BIP, ODU-BEI

SDH Sensors

- LOS, LOF, FAS
- B1, MS-AIS, MS-RDI, MS-REI, B2, AU-AIS, AU-LOP, B3, HP-RDI, HP-REI, TU-AIS
- PDH payload-related triggers
- LSS

SONET Sensors

- LOS, LOF, FAS
- S-BIP, AIS-L, RDI-L, REI-L, L-BIP, AIS-P, LOP-P, P-BIP, RDI-P, REI-P, AIS-V
- PDH payload-related triggers
- LSS

PDH (E1) Sensors

- E1-LOF, E1-AIS
- LSS

Pass/Fail range: 15 to 200 ms

Gate Time: 20 to 4000 ms

SDT Results Summary

- Last Service Disruption Time
- Longest Service Disruption Time
- Shortest Service Disruption Time
- Time stamps
- Resolution: 10 µs
- Total number of Service Disruptions events observed

Disruption Events Table

- Tracks every Service Disruption event for all layers
- Time stamp with 10 µs resolution
- Duration with 10 µs resolution
- Individual Pass/Fail Verdicts
- Tracks individual sensor events that occurred during the disruption period with time stamp and duration (10 µs resolution)

APS Testing

- SDH/SONET APS Byte (K1/K2) sequence capture and decode

Auto Configuration

Auto configure simplifies instrument setup when properties of the incoming test signal are unknown. This feature allows novice users to start performing measurements quickly.

- Available for SDH, PDH, SONET and DSn signals
- Identification of received signal - instrument configuration based on network type, bit rate, line coding, framing, mapping, and test pattern

Signal Level and Frequency Measurement

Available for Optical and Electrical Interfaces
Signal level
Optical power in dBm and Loss/Saturation graph
Electrical level in Volts peak-to-peak, dB and dBm
Frequency (Line and Payloads)
Resolution: 1 bit/s (bps)
Frequency Offset
Resolution: 0.1 ppm Current, Minimum and Maximum
Clock Slips (E1 and DS1)

Round Trip Delay

(Available for all interfaces & mappings)
Measurement Range: 1 µs to 10 seconds
Resolution: ±1 µs or 1 U.I.

Event Logging

Date and time stamped records of all error and alarm events occurred during a test, presented in tabular format

Soft LED Indicators

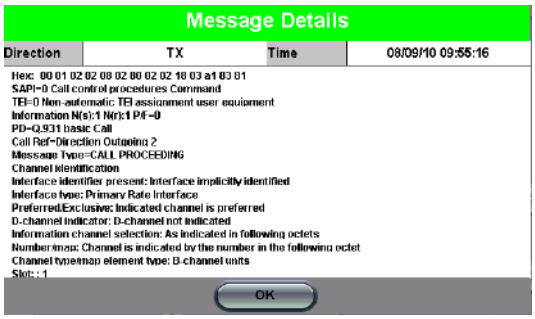
Summary indicators for Signal, Framing, Pattern sync and Errors/ Alarms
Dual LED row for Ethernet in EoOTN test mode
Display historical events and conditions
History reset function

- Clears the LED reminder without affecting the measurement counters

ISDN PRI Testing

The ISDN option provides functionality necessary for testing and troubleshooting DS1 or E1 Primary Rate connections like SIP trunking services. Operating in TE or NT modes, the unit is able to setup and receive ISDN calls with user-defined parameters including call control protocol, called number and related facilities.

Protocol functions feature detailed signaling statistics, message monitoring, capture and decode. With these capabilities, analysis of international and national ISDN, and other access protocols is possible.



TE and NT Emulation

- Place/Receive voice and data calls
- D-channel monitor with full decode: Layer 2 (Q.921) and Layer 3 (Q.931)
- 23B+D, 30B+D

Protocols

- DS1: National ISDN, AT&T, Nortel DMS
- E1: ETSI (Euro – ISDN)
- Bidirectional protocol capture and decode

Voice calls talk and listen via headset
In-band DTMF generation
Supports multi-rate N x 64k data calls
Parallel and sequential multi-call channel test

- All calls to a single number
- Multiple numbers from a programmable list

Supplementary Services Test
Automatically tests the provisioning of CLIP, CLIR, COLP, CFU, CFB, CFNR, SUB, MSN, DDI, HOLD, UUS, TP, AOC-S, AOCD, AOCE, MCID, CUG

Jitter Measurement Options

Complete SDH/SONET and PDH/DSn Jitter Test Suite

- Jitter Measurements
- Jitter Generation
- Maximum Jitter Tolerance test
- Jitter Transfer Function test

Graphical and tabular results

Output jitter performance mandated by ITU-T 0.171/0.172 and Telcordia GR-499/253 standards is evaluated by measuring the recovered clock of the incoming signal (E1, E3, STM-1o and DS1, DS3, OC-3) traversing the network. In SDH/SONET networks there is a great potential for the accumulation of jitter to degrade network performance, thus it is imperative that components and the network as a whole be tested and screened regularly for jitter to ensure that optimum levels of quality can be maintained.

Jitter Measurements

HP1+LP (Wide-band Jitter) filter

- E1 (2M) 20 Hz to 100 kHz
- E3 (34M) 100 Hz to 800 kHz
- DS1 (1.5M) 10 Hz to 40 kHz
- DS3 (45M) 10 Hz to 400 kHz
- STM-1/OC-3 (155M Optical) 500 Hz to 1.3 MHz

Wander Measurement Options

Recovered Clock Wander Measurements

These options measure the wander characteristics of the data clock recovered by the test set slave emulation, against an external reference connected to the CLK (SMA) port or the optional internal free-running or GPS-disciplined Atomic clock.

Signals Under Test (recovered clock)

- T1, T3, E1, E3, STM-1o, OC-3
- SyncE Slave

Clock References

- Frequency: 1.544, 2.048, 10 MHz
- Data: 1.544 and 2.048 Mbit/s
- Wander Resolution: 0.2 ns

Real-time Wander & Phase Data Logging

This option exports real-time TIE or Phase measurements to a USB memory for further post-processing using the built-in or PC-based MTIE & TDEV Wander Analysis applications.

Modes: E1, E3, DS1, DS3, STM-1o, OC-3, SyncE, IEEE 1588v2, external clock signals

Sampling rates: 1/s, 5/s, 10/s, and 30/s

Recording Time: Limited only by the size of the USB memory

File formats

- VeEX's native TIE and Phase (TE)
- Open CSV TIE and Phase (TE)

Built-in MTIE/TDEV Wander Analysis

This option enables the test set to analyze up to three days' worth of wander measurement data and compare it against standard masks for a PASS/FAIL assessment, without the need for a PC. The analysis can be performed while the test is still running for run-time verification.

- Provides further post-processing of clock stability data, such as MTIE and TDEV
- Real-time or post analysis modes
- Frequency offset calculation and removal for relative TIE analysis
- Standard MTIE and TDEV masks
- MTIE and TDEV results and mask export to CSV
- Direct PDF report generation to USB

VeEX MTIE/TDEV Wander Analysis PC software

- Provides further post-processing of clock stability data, such as MTIE and TDEV for long-term tests
- Frequency offset calculation and removal for relative TIE analysis
- Standard and user-programmable masks
- PDF report generation
- Fully resizable window, to accommodate any screen size and provide detailed zoom levels
- Compact stand-alone Windows® software. It can be carried in the same USB memory as the TIE data. No installation is necessary

Datacom Testing Option

Equipped with the datacom option, the MTX150 enables field technicians to install, troubleshoot and maintain datacom circuits operating over serial interfaces, such as RS232/V.24, V.35, RS449/V.36 (422 and 423) and X.21. It offers Data Terminating Equipment (DTE) and Data Communications Equipment (DCE) emulation modes, allowing technicians to quickly verify end-to-end error-free connectivity, troubleshoot clocking or configuration errors. It also offers a non-intrusive monitor mode.

Event Logging allows the monitoring of problematic devices or links over a period of time to isolate and capture intermittent faults. A time stamped record of events, errors, and alarms provide a valuable insight to the frequency and duration of network anomalies.

Interfaces

RS-232 async, RS-232 sync, RS-449/V.36 (422/423), X.21 and V.35
Uses VeEX's standard DCE and DTE datacom cables

Test Modes

DTE and DCE Emulation for all interfaces
In-service pass-through monitor (requires optional X cable)
Control Leads Generation and Monitoring
• RTS, DTR, RL, LL, CTS, DSR, DCD, I, C
Asynchronous Operation
• 50 bit/s to 128 kbit/s
• Parity selection: odd, even and none
• Data bits: 6, 7, or 8 bits
• Stop bits: 1, 2 bits
Synchronous Operation
• 50 bit/s to 2.048 Mbit/s

Measurements

LOS seconds, LSS seconds, Bit errors, BER
ITU-T G.821 performance analysis
RX Line Rate
RX Data Rate
Events log with 100ms time stamps

Error insertion

Bit error
• Single
• Count: 1 to 1000
• Rates: 1E-3 to 1E-9
Data LOS
• Continuous
• Count: 0.1, 1, 10, 100 seconds

Transmit Clock Sources

• Internal
• Recovered from test interface

IEEE C37.94™ Testing Option

This low rate optical interface plays a significant role in deploying Protection Relay circuits for the Power and Utilities industry.

Interfaces
- Wavelengths: 850 nm, 1310 nm MMF, 1310 nm SMF*
- Connectors: LC-PC**
- IEEE C37.94 framing, overhead and data structures

Transmit Clock
- Internal, External, Received
- Frequency offset generation up to ±25000 ppm, to stress the recommended ±100 ppm limits

Data Rates
- N = 1 to 12 (64 to 768 kbps)
- Automatic RX rate configuration (N)

Test Modes
- Terminal (TX1, RX1)

Measurements
- LOS (Signal and Frame), AIS, RDI (Yellow), FAS, Pattern Loss (LSS) and Bit Errors (TSE)
- Histogram and Bar Graph representation
- Time-stamped Events Log
- G.821 performance evaluation
- Signal level, data rate, offset, SFP information*
- Round Trip Delay (RTD) with 10 µs resolution
- View Received Data (Framing, Overhead, Data)

Error Injection
- Bit, FAS
- Single, Count and Rate

Alarm Generation
- LOS (Signal), LOS (Frame), AIS, RDI (Yellow)
- Continuous, Timed (Count)

** Dependent on SFP transceiver. Not all SFPs are compatible with C37.94.*

*** LC-to-ST (BFOC/2.5) converter cable may be required.*

Ethernet Specifications

Electrical Interfaces

10/100/1000Base-T: RJ45 connector
Ethernet Classification: Per IEEE 802.3

Optical Interfaces

1GE SFP or SFP+ optical Ports: LC connectors

***Data rates, performance, and supported transmission protocols are only guaranteed for SFP supplied by VeEX Inc. If selecting or using other vendors, users should excercise caution*

Modes of Operation

Terminate
Loopback

Traffic Generation

Layer 1 Framed, Layer 2, Layer 3, Layer 4
Test Frame Header

- IEEE 802.3 and Ethernet II (DIX) frames
- Configurable Source and Destination MAC and Ethernet Type
- VLAN stacking up to 3 Q-in-Q tags w/configurable priority & type
- Fully configurable IPv4 or IPv6 header
- MPLS up to 3 labels with configurable Label/S/CoS and TTL fields
- MPLS-TP label with configurable LSP, PW and CW fields
- UDP/TCP header with configurable Source & Destination ports
- Provider Backbone Bridge (PBB) support with configurable Backbone MAC Source and Destination, I-SID, PBB-VLAN ID and priority
- Point-to-Point Protocol over Ethernet (PPPoE) support with configurable PPPoE code and Session ID
- Fixed or Uniform distribution frame size from 64 to 10000 bytes (Layer 4 tests Fixed frame size up to 1518 only)
- Traffic Pattern: Constant, Ramp, Multi Bursts, Single Burst
- Error Injection: Single and Count; Bit, CRC, Pause, IP Checksum, TCP/UDP Checksum

Bit Error Rate Test (BERT)

Layer 1 framed, 2, 3, and Layer 4 BER testing are supported. The BER test can be configured to use regular PRBS test patterns, or user defined test patterns to simulate various conditions.

Test Patterns

- PRBS: 2^{31}-1, 2^{23}-1, 2^{15}-1, 2^{11}-1, normal and inverted patterns, All 0s, All 1s and User Defined (Layer 2,3,4)
- CRPAT, CJPAT, CSPAT (Layer 1 Framed)

Error Measurements: Bit/BER, FCS/CRC, Jabber/Runt frames, IP Checksum, TCP/UDP Checksum
Alarm Detection

- LOS, LOSync, PAT Loss, Service disruption (current, total, last, min/max, # of occurrences)

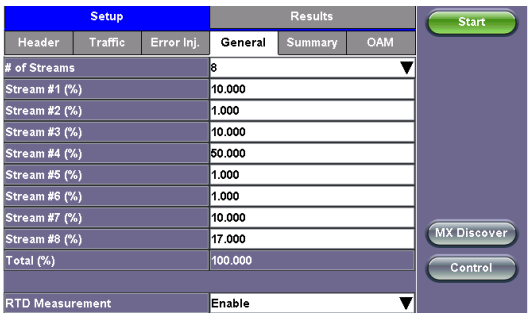
Frame/Packet Statistics

- Multicast, broadcast, unicast, pause frames, frame size distribution
- Rates (min, max, average and current): frame rate, bandwidth utilization, frame rate, line rate, data rate
- Frame arrival time (min, max, average and current), Frame Delay Variation

Multiple Streams Throughput Testing

Up to eight traffic streams can be independently configured with CoS (VLAN priority) and QoS (TOS/DSCP) prioritization. This traffic feature simulates multiple service conditions (e.g. Triple Play), and facilitates end-to-end QoS performance verification. The multiple stream throughput tests may be performed with a second test unit at the far end in Smart Loop mode or Peer-to-Peer mode.

Up to 8 independent traffic streams generation and analysis, with configurable filters on 1GE interface
Each stream can be set with independent frame size, bandwidth, traffic profile, and QoS levels
MAC flooding feature: generates test frames with up to 4096 incrementing Source and/or Destination MAC addresses



VLAN flooding feature: generates test frames with up to 4096 incrementing VLAN IDs
Test Patterns: PRBS: 2^{31}-1, 2^{23}-1, 2^{15}-1, 2^{11}-1, normal and inverted patterns, All 0s, All 1s and User Defined
Error Measurements: Bit/BER (Single Stream only), FCS/CRC, Jabber/Runt frames, IP Checksum, TCP/UDP Checksum, Frame Loss (count and %), Out of Sequence
Alarm Detection

- LOS, LOSync, Service disruption (current, total, last, min/max, # of occurrences)

Frame/Packet Statistics

- Multicast, broadcast, unicast, pause frames, frame size distribution
- Rates (min, max, average and current): frame rate, bandwidth utilization, frame rate, line rate, data rate
- Frame arrival time (min, max, average and current), Frame Delay Variation
- Round Trip delay (min, max, average and current) and Histogram distribution with configurable sampling period and threshold

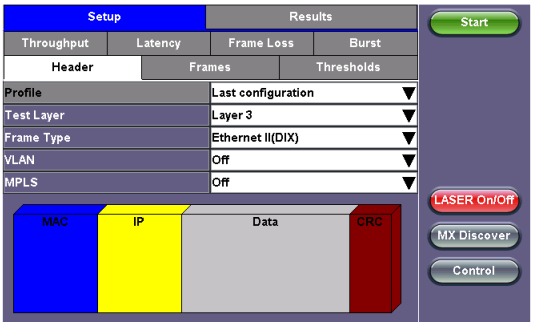
Service Disruption Time (SDT)

- Per stream inter-packet gap based measurement
- Configurable SDT measurement trigger and SDT violation threshold

RFC2544 Compliance Testing

Performs the RFC2544 automated test suite at all recommended frame sizes as well as user configurable frame sizes and up to full line rate. The test suite can be performed with the far end test partner in loopback mode or peer-to-peer mode - the latter allowing for symmetrical/asymmetrical testing. Thresholds may be configured for accurate SLA assurance and verification. The automated tests supported are throughput, latency, frame loss, and back-to-back frames.

In Advanced SLA Mode this feature combines the powerful multiservice throughput test capabilities with the RFC2544 industry test suite for SLA verification. Using this test function, service providers are able to verify SLAs while end-to-end QoS is assessed properly. By configuring one primary test stream and up to seven background streams each with independent frame size, bandwidth, and more importantly QoS levels, simulating different service applications is now realized. The Advanced RFC2544 SLA mode provides detailed visibility of the test parameters for each of the traffic streams being measured, providing an efficient in-depth qualification in a fast and automated way.



Automated tests compliant with RFC2544 with configurable threshold values and maximum transmit bandwidth settings

Throughput, Latency, Frame Loss, and Back-to-Back (burst) tests

Frame sizes: 64, 128, 256, 512, 1024, 1280, 1518 bytes and 2 user configurable frames

Tests can be done to a remote loopback or in Peer to Peer mode to a remote test set configured as a responder

Peer to peer mode allows asymmetric bandwidth RFC2544 test

RFC2544 Advanced SLA Mode

RFC2544 compliant test on primary test stream with up to 7 independent background traffic streams

Each background stream can be set with independent frame size, bandwidth, traffic profile, and QoS levels

ITU-T Y.1564 V-SAM Test

VeEX's V-SAM test suite is fully compliant with ITU-T Y.1564 and offers an efficient method to qualify and troubleshoot Ethernet Services. V-SAM addresses some of RCF2544 limitations by testing multiple services at once and providing simultaneous measurements of key SLA parameters.

With the Service Configuration test, services running on the same line are tested one by one to verify the correct service profile provisioning. With the Service Performance test, the services running on the same line are tested simultaneously over an extended period of time, to verify network robustness.

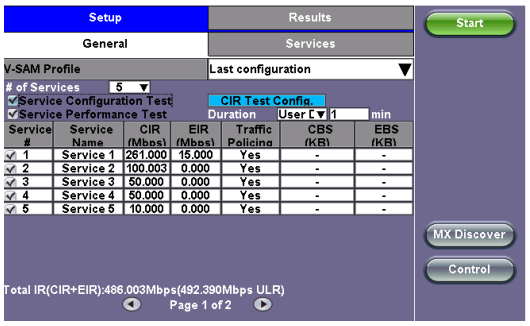
This test suite was designed with the end user in mind and allows for quick provisioning, execution and analysis of the test results, even without prior detailed knowledge of the standard.

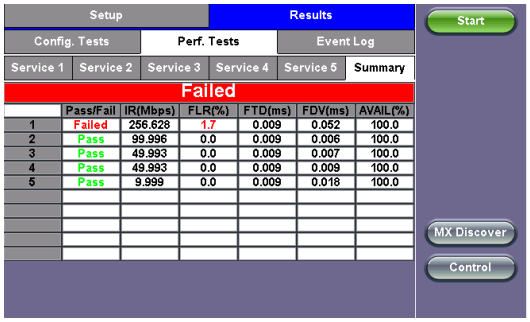
V-SAM test suite compliant with ITU-T Y.1564 standard

Support for Multi-stream traffic generation, Service Configuration and Service Performance tests

Independently configurable for each stream

- Frame size: Fixed or EMIX pattern
- Bandwidth profile parameters: CIR, EIR, CBS, EBS Traffic Policing
- Service acceptance criteria: FLR, FTD, IFDV, AVAIL





Simple summary Pass/Fail results tables and drill down capability with detailed measurements (Frame Loss, Frame Transfer Delay, Frame Delay Variation, Availability) for each service

Smart Loopback Mode

Four modes are available for looping back test traffic. At Layer 1, all incoming traffic is looped back unaltered. At Layer 2, all incoming unicast traffic is looped back with the MAC source and destination addresses swapped. At Layer 3, all incoming unicast traffic is looped back with the MAC and IP source and destination addresses swapped, and at Layer 4, all incoming unicast traffic is looped back with the MAC, IP, and UDP/TCP ports swapped.

Configurable traffic filters are supported on all MAC, IP, and VLAN fields to allow full control over looped traffic. Traffic is monitored while being looped and key traffic metrics such as frame type, rate, and error/alarms are displayed on screen. These can be compared to results at the far end to pinpoint issues more easily.

Layer 1: incoming traffic looped back unchanged

Layer 2: incoming traffic looped back with MAC source and destination addresses swapped

Layer 3: incoming traffic looped back with MAC and IP source and destination addresses swapped

Layer 4: incoming traffic looped with MAC, IP, and UDP/TCP ports swapped
Configurable traffic filters on MAC and IP source and destination addresses, VLAN ID and Priority, IP Precedence and TOS, UDP source and destination ports
All key measurements on received traffic provided on loopback unit

Intelligent Device Discovery & Remote Control

Easily discover and select another VeEX Ethernet tester or loopback device on the network under test. The local device will control the operation of the far end device, in either loopback or peer-to-peer mode (symmetrical or asymmetrical traffic generation mode). This feature greatly simplifies field testing since there is no need for a second technician to be at the far end configuring the test partner device.

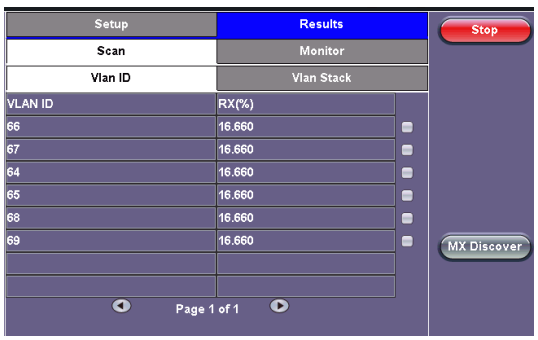
Discovery function to all VeEX devices within subnet or manual control of VeEX test sets in routed network
Remote Control of Loopback capability
Peer to Peer Controller/Responder configuration for RFC2544 test with asymmetric bandwidth test capability for end-to end RFC2544 test.

VLAN Scan and Monitor

VLAN Scan allows scanning up to 4096 VLAN IDs for switch configuration verification. Verify which VLAN IDs are the top bandwidth users and monitor up to eight live traffic streams (in terminate mode).
Scans incoming traffic and discovers all VLAN flows including Q-in-Q tagging
Key statistics on traffic rates, alarms and errors are reported for monitored streams (up to 8)

Layer 2 Control Protocol Transparency Test

To verify handling of Layer 2 Control Protocol (L2CP) frames accross Carrier Ethernet networks, the Layer 2 Control Protocol



Transparency Test feature transmits a set of L2CP frames and verifies that they are forwarded through the network. This feature supports common L2CP frame types (as per MEF 45 standard) as well as Cisco L2CP frame formats.

- Selectable Layer 2 Control protocol frames and configurable frames
- Supported L2CP frame types per MEF 45 standard
- Cisco L2CP frame formats
- Selectable frame rate and count
- TX and RX frames statistics

Protocol Support

With intuitive graphical based user interface, users can fully customize test traffic at the Layer 2 (MAC header), Layer 3 (IPv4 and IPv6 headers) and Layer 4 (TCP,UDP). The test set also offers a complete tool set of advanced network protocols.

Q-in-Q (VLAN stacking)

VLAN stacking, also known as Q-in-Q, makes a provision for carrier/service provider assigned VLANs (SP-VLAN), but also retains customer traffic's VLAN (CE-VLAN). Up to three layers of VLAN tagging supported with configurable VLAN ID, Priority, and VLAN type.

Multiprotocol Label Switching (MPLS)

MPLS technology allows for a more efficient routing of Ethernet/IP packets via the use of MPLS routers in the network. MPLS labels reside between the MAC (Layer 2) and IP layers (Layer 3). Up to three MPLS tags can be configured in the traffic stream with customizable Label, CoS, and TTL fields.

Provider Backbone Bridging (PBB)

Also known as MAC-in-MAC, PBB (802.1ah) provides a trunking mechanism that adds resiliency and configurable performance levels in the provider backbone network. PBB encapsulation is available for all Ethernet tests with all PBB fields configurable.

Point-to-Point Protocol over Ethernet (PPPoE)

PPPoE provides encapsulation of Ethernet frames with a PPP header commonly used for DSL Access or GPON.

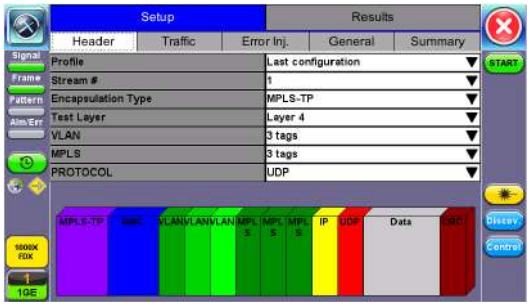
Multiprotocol Label Switching Transport Profile (MPLS-TP)

MPLS-TP, a Layer 2 packet-based transport mechanism, is gaining momentum as a transport of choice for access and aggregation networks requiring a technology that combines the operational simplicity of packet switched networks with the operations, administration and maintenance (OAM) tools

and fault resiliency capabilities of circuit switched networks. Fully configurable MPLS-TP header fields including LSP and Pseudowire.

IPv6

IPv6 compliant test traffic generation and analysis for all test applications (Y.1564 V-SAM, RFC2544, BERT and Multi-stream Throughput)
IPv6 Loopback capability
IPv6 Static or Stateless Auto Configuration, Ping and Trace Route functions



Layer 4-7 Features

RFC6349 V-PERF TCP Test

A common source of customer complaints come from file transfer speeds not matching the throughput rates guaranteed in the SLA. While many factors affect TCP applications performance, including customer's operating system hardware performance and settings (TCP window size), carriers need to prove SLA with a test tool that can show TCP performance independent of Operating System or Server limitations and present repeatable reliable results.

The test set V-PERF feature uses RFC6349 test methodology and metrics for qualifying network TCP performance. It offers a full line rate stateful TCP test with configurable window sizes, client and server modes as well as compatibility with iPerf servers.

TCP Throughput Compliant with RFC6349
Stateful TCP Test at line rate
TCP Client and Server modes
Compatible with iPerf Client/Server
MTU search per RFC4821
Round Trip Time Measurement
Configurable TCP Window sizes
Multi-Window size tests
Measurements: TCP Throughput rate (min, max, average), Transfer file size and duration, Transfer time ratio, TCP Efficiency %, Buffer Delay %

Quallity of Service (QoS) & Quality of Experience (QoE) Tests

FTP Throughput (V-FTP) and V-TEST features provide additional Layer 4-7 testing. The V-FTP Throughput feature allows the user to test up to full line rate FTP protocol performance to any FTP Server by uploading and downloading files. The V-TEST feature qualifies network TCP/HTTP protocol performance by testing against a V-TEST HTTP server. Both features can test up to the full line rate depending on the server specifications and limitations. Connection time to the server, data transfer time, line rate throughput rates, and protocol (FTP and HTTP) throughput rates key metrics are reported during the tests.

The V-TEST application is flexible enough to operate in different modes depending on user preference; VeEX Managed mode, Speedtest Powered™ mode based on Ookla® technology, and User Managed mode.

In VeEX Managed mode, the customer's servers are added to a customer server list that is maintained and managed by VeEX for the end-user's ease of use and convenience. The full list of server IP addresses or URLs are provided to VeEX. Once added, all the user has to do is select the server from their company list and initiate the test to the selected server.

In Speedtest Powered mode, the test follows Ookla's methodology and tests to the Speedtest® Server Network. In this mode, the test is compatible with Ookla's protocol/methodology; it will scan nearby servers in the local market and test to the server with the fastest (lowest latency) response.

In User Managed mode, the user is allowed to enter the server IP/URL and save it to a server list that they can maintain and manage on their own.

V-TEST HTTP Test

HTTP Throughput
Full line rate
HTTP client mode
Connection time to server
Total Data Transfer time
HTTP Throughput rates
Requires V-TEST Server

FTP Throughput Test

FTP Throughput
Full line rate
FTP client mode
Connection time to server
Total Data Transfer time
FTP Throughput rates
Compatible with Linux and Windows FTP servers

Auto Scripting

The Auto Scripting feature is the perfect tool for the lab environment where multiple short-term or long-term test configurations are required to stress the network equipment and/or network under test, in order to measure and qualify the performance capabilities. The feature is also important in field operations, not only to speed-up service turn-up times, but also to facilitate the entire workforce the same test profiles and test procedures for day-to-day operations.

The Auto Scripting application is an automated sequence of tests that can be carried out by selecting previously configured Throughput or BERT profiles. The profiles can be created with ReVeal and then loaded to the unit or created directly on the unit in the Throughput and BERT applications. Users can select up to ten profiles, each profile configured with its own duration. The duration can be in seconds, minutes, hours, or days. The test sequence will begin with the first profile configured with its corresponding duration, followed by each profile after that. At the end of each profile tested a results file will be stored automatically before the test sequence continues to the next profile. Users have the option to continue or stop the auto scripting test if errors or alarms are detected.

Network Troubleshooting Tools

Complementary to the transport layer tests provided with the RFC2544 and V-SAM Y.1564 test suites, the tester provides advanced application layer test capabilities with the following functions: Ping test, Trace route, and network discovery.

IP Tools

Provides basic Ethernet and Internet connectivity to the test set as well as connectivity troubleshooting tools to Ethernet test ports (10/100/1000BaseT, 100FX/1000BaseX) and Management port (10/100BaseT)

IP: IPv4 (Static, DHCP) and IPv6 (Static, Auto) and PPPoE
VLAN support
Ping, Trace Route check

Net Wiz

Network Discovery Tool

- Discovery: TX Frames, RX Frames, RX Errors, Advertised Speed, Advertised Duplex, Devices found, Networks found
- Devices: Total number, Routers, Servers, Hosts
- Device Details: Attribute, IP address, MAC address, Group Name, Machine Name, Ping OK
- Networks: IP Subnets, Hosts, Domains, Hosts Names

Wi-Fi Wiz

The Wi-Fi Wiz function with USB Wi-Fi adapter for 802.11 a/b/g/n/ac wireless in 2.4 GHz and 5 GHz bands makes troubleshooting Wi-Fi connectivity issues a simple task.

Scan for available networks and view all access points detailed information along with SSID, signal strength and channel allocation. Connect to Access Points with WEP/WPA or WPA2 encryption and verify IP capabilities to ensure the wireless network is properly installed and configured. A full suite of IP testing features is supported (ping, trace, web browser, etc.).

- Requires compatible USB Wi-Fi adapter for a/b/g/n/ac networks in 2.4 GHz and 5 GHz bands
- Access Points scan with signal level and link quality measurement
- WEP/WPA1/WPA2 encryption
- IP Connectivity test (Ping, trace route, ARPWiz, Web browser)
- Provides Wi-Fi LAN access to the test set (e.g. VeExpress, R-Server, Remote Control, ReVeal)

Wi-Fi inSSIDer

The Wi-Fi InSSIDer provides the best tools for Wi-Fi networks discovery and performance troubleshooting. With compatible USB Wi-Fi adapter for 802.11 a/b/g/n/ac wireless in 2.4 GHz and 5 GHz bands the inSSIDer provides a clear picture of the environment. It helps identify poor channel placement, low signal strength and interferences in easy to understand graphs and tables.

- Requires compatible USB Wi-Fi adapter for a/b/g/n/ac networks in 2.4 GHz and 5 GHz bands
- Network scan results in Graphical or table format
- Lists: Network names, BSSID, encryption type, channel allocation, signal strength, co-channels, and overlapping channels

VoIP Testing

Take advantage of software options offering different test methods to verify and provision your VoIP network.

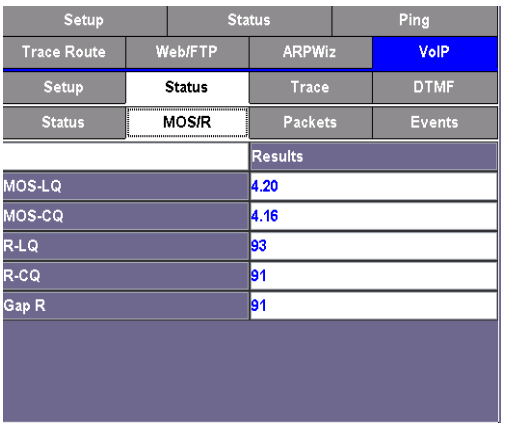
VoIP Check – Simulates a VoIP call to the nearest router and measures the round trip MOS score and related VoIP parameters.

The VoIP check mode tests the network readiness for VoIP without placing an active VoIP call. This mode allows for service verification before SIP/H.323 infrastructure is in place or if credentials are not known. This test focuses on packet transmission quality and metrics by sending traffic (ICMP Ping) matching VoIP call traffic properties.

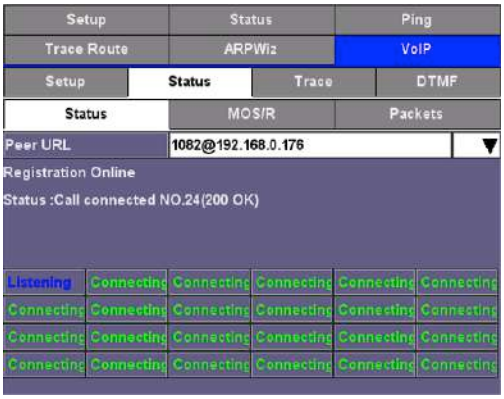
VoIP Expert – VoIP Expert is a simple and effective tool for pre-qualifying VoIP service and verifying triple play implementations.

The VoIP Expert Client/Server mode allows a test set connected to a VX1000 server to exchange upstream and downstream files to exercise the connection under VoIP calls conditions.

Bi-directional Mean-Opinion-Score (MOS), Transmission-Rating-Factor (R-factor) and other critical network related parameters are measured and test results are displayed on both field test units and the VX1000 software. The VX1000 software can be installed on any server and accepts up to 16 simultaneous VoIP test calls from compatible VePAL100+/300 series products.



VoIP Call Expert – Emulates an IP phone to place and receive calls using SIP or H.323 protocols. Real-time evaluation of voice quality with a complete set of measurements is available at the end of the call, including packet statistics, jitter statistics, and MOS and R-factor call quality scores. Support VoIP trunk test with bulk call generation of up to 24 simultaneous calls.



VoIP Testing Specifications

Codecs: G.711 µ-law, G.711 A-law

Measurements: MOS (CQ and LQ) and ITU-T G.107 R-factor (CQ and LQ)

Packet Statistics: Data throughput rate, packet loss, packet discard, OOS, duplicate, jitter

VoIP Check

- Simulates VoIP call to the nearest router by sending ICMP traffic with payload/rate matching VoIP traffic properties

VoIP Expert

- Client/Server mode provides bi-directional measurements
- Compatible with any VeEX field tester or centralized VeEX VX1000 Server software

VoIP Call Expert

- VoIP call setup: supports SIP and H.323 protocols
- Multi-call support: Up to 24 concurrent calls
- Configurable jitter buffer (fixed or dynamic)
- Incoming call Auto Answer
- STUN support
- Talk/Listen with built in microphone and speaker
- DTMF test (RFC4733)
- Signaling trace with protocol decode

Synchronous Ethernet

ITU-T G.8261 SyncE Master Clock Emulation Mode

The reference clock can be based on the internal precision clock or from an external clock source at 1.544 Mbps, 2.048 Mbps, 1.544 MHz, 2.048 MHz, 10 MHz, 25 MHz, 125 MHz, or 1 PPS rate. The output reference clock can be synchronized to 1.544 Mbps or 2.048 Mbps and provided at the DS1/E1 port or a 1.544 MHz, 2.048 MHz, 10 MHz, and 1 PPS clock signal can be made available on the unbalanced BNC port.

ITU-T G.8261 SyncE Slave Clock Emulation Mode

Extracts clock information from the incoming Ethernet signal at the 10/100/1000Base-T, 100Base-FX, 1000Base-X, and 10GBase-X interface. The recovered reference clock can be applied to a 1.544 Mbps or 2.048 Mbps signal at the DS1/E1 port or a 1.544 MHz, 2.048 MHz, 10 MHz, 25 MHz, 125 MHz, or 1 PPS clock signal can be made available on the unbalanced BNC port. Clock and Wander are measured against the reference clock.

ESMC SSM Clock Quality Messages

SDH/SONET (S1) and E1 (Sa) SSM QL message encoding and decoding

SyncE ESMC/SSM messages generation with configurable type and rate. Includes ESMC SSM messages TX/RX display, decode, counters and capture

IEEE 1588v2 clock class generation, decoding and message capture

Master/Slave clock emulation

- ESMC SSM generation: configurable message type and rate

Measurements

- ESMC SSM messages counters
- ESMC SSM messages display and decode
- ESMC SSM messages capture in pcap format

Synchronization Messages Capture

Message capture and decode for SyncE ESMC/SSM. Captures in pcap format for further analysis using built-in or external protocol analyzers.

Reference Clock

Reference Clock (Master Emulation and Wander/Phase Measurements)

- Internal
- External: 1PPS, 1.544 Mbps, 1.544 MHz, 2.048 Mbps, 2.048 MHz, 10 MHz, 25 MHz, 125 MHz

Recovered Clock Wander Measurements

These options measure the wander characteristics of the data clock recovered by the test set slave emulation, against an external reference connected to the CLK (SMA) port

Signals Under Test (recovered clock)

- SyncE Slave

Clock References

- Frequency: 1.544, 2.048, 10 MHz, internal Atomic 10 MHz
- Data: 1.544 and 2.048 Mbit/s
- Wander Resolution: 0.2 ns

Real-time Wander & Phase Data Logging

This option exports real-time TIE or Phase measurements to a USB memory for further post-processing using the built-in or PC-based MTIE & TDEV Wander Analysis applications.
Modes: SyncE
Sampling rates: 1/s, 5/s, 10/s, and 30/s
Recording Time: Limited only by the size of the USB memory
File formats

- VeEX's native TIE and Phase (TE)

Built-in MTIE/TDEV Wander Analysis

This option enables the test set to analyze up to three days' worth of wander measurement data and compare it against standard masks for a PASS/FAIL assessment, without the need for a PC. The analysis can be performed while the test is still running for run-time verification.

- Provides further post-processing of clock stability data, such as MTIE and TDEV
- Real-time or post analysis modes
- Frequency offset calculation and removal for relative TIE analysis
- Standard MTIE and TDEV masks
- MTIE and TDEV results and mask export to CSV
- Direct PDF report generation to USB

VeEX MTIE/TDEV Wander Analysis PC software

- Provides further post-processing of clock stability data, such as MTIE and TDEV for long-term tests
- Frequency offset calculation and removal for relative TIE analysis
- Standard and user-programmable masks
- PDF report generation
- Fully resizable window, to accommodate any screen size and provide detailed zoom levels
- Compact stand-alone Windows® software. It can be carried in the same USB memory as the TIE data. No installation is necessary

Fibre Channel

Key Features

- Full line rate traffic generation and analysis
- Primitive Sequence Protocol support
- Flow control support with Buffer-to-Buffer credits
- FC-1 and FC-2 BERT and Throughput
- RFC2544: Throughput, Latency, Frame Loss, and Back-to-Back frames tests
- FC-2 Smart Loop mode
- Service Disruption Measurement
- FC-2 Frame Header configuration
- Test traffic shaping: constant, ramp, and burst
- Frame Length configuration up to 2148 bytes

Throughput and Bit Error Rate Test (BERT)

The Fibre Channel protocol specifies a maximum allowable Bit Error Rate (BER) of ≤ 1×10^{-12} that must be achieved. The test set allows the user to stress FC-1 and FC-2 network layers to ensure accurate benchmarking.

For FC-1, frequency fluctuations, transceiver noise and phase jumps are tested using CRPAT, CSPAT, and CJPAT patterns. Data dependency and behavior of network components are checked with PRBS patterns, sequence number tracking, and time stamping to calculate frame loss, round trip delay, and other performance metrics.

RFC2544 Benchmarking

Based on the Ethernet test methodology, the RFC2544 routine has been adapted to Fiber Channel circuits where flow-control and buffer verification is important. The feature checks throughput and round trip delay at various buffer sizes to verify optimal buffer size and best possible link performance.

Fibre Channel Interfaces

1/2/4 Fibre Channel SFP or SFP+ optical Ports: LC connectors

Fibre Channel Rates

1.0625 Gbps, 2.125 Gbps, 4.25 Gbps

Modes of Operation

Terminate, Loopback

Fibre Channel Topology

Point-to-Point

Primitive Sequence Protocols

Link initialization, link rest, link failure

Flow Control

Buffer-to-Buffer Credit Configuration: 1-65535

Traffic Generation

FC-1 (with SOF and EOF frame delimiters) and FC-2 Frames
Class 3 Service frames
Scrambling/Descrambling (8.5 Gbps only)
Configurable Header fields
Configurable EOF (EOF_t, EOF_n), and SOF (SOF_i3, SOF_n3, SOF_f)
Traffic Shaping: constant, ramp, burst
Frame Length Configuration: 2148 bytes maximum

RFC2544 Compliance Testing

Automated tests compliant with RFC2544 with configurable threshold values for Throughput and Round Trip Delay (Latency) and maximum transmit bandwidth settings
Throughput, Latency, Frame Loss, and Back-to-Back (burst) tests
Frame sizes: 64, 128, 256, 512, 1024, 1280, and 2000 bytes including 2 user configurable frames

Bit Error Rate Testing

NCITS-TR-25-1999 Patterns (FC-1): CRPAT, CSPAT, CJPAT
PRBS Patterns (FC-2): 2^{31}-1, 2^{23}-1, 2^{15}-1, 2^{11}-1, normal and

inverted selections, and user defined patterns
Error Injection: Bit and CRC

Loopback Mode

FC-1
FC-2 (Layer 2): swaps the destination and source IDs (D-ID and S_ID)

Key Measurements

Optical power levels: transmit and receive optical levels in dBm
Error Measurements: Bit error count, BER, symbol, FCS/CRC, oversize, undersize, frame loss (count and %), out of sequence frame count
Alarm Detection: LOS, pattern loss, service disruption
Traffic Statistics: bandwidth utilization, data rate, frame count, byte count, frame size distribution, buffer-to-buffer credit count, RR_RDY count, frame loss count and round trip delay
Rates: line rate, framed rate, data rate, frames per second rate
Delay (min, max, avg, current): round trip delay, frame arrival delay

Fiber Optic Tools

Digital Fiber Inspection Scope

Dirty connectors can damage or degrade the performance of expensive optical modules, or produce inaccurate results. Inspecting and cleaning patch cords and pluggable optics connectors before mating them is always recommended.

This option allows digital video microscope probes* to be connected directly to the TX300s through a USB 2.0 port. Featuring live video feed on the TX300s screen for visual analysis. It offers image capture, compare (before and after), IEC 61300-3-3 Sect 5.4 Pass/Fail templates for SMF and MMF, save, export and generate report to USB flash drives.

Visual Inspection

- Visual file selector
- Image comparison for before-after reports

Auto-Focus Detection and Analysis option

Test set automatically detects when image is in-focus, captures the image and analyzes it. This process is faster than complex mechanically-driven auto-focus systems as it uses human fast reaction and finesse.

- Analysis per IEC 61300-3-3
- SMF and MMF templates (Core, Cladding, Adhesive and Contact areas)
- Dots or square to highlight contamination, debris and scratches
- Report Generation

**USB Fiber Scope sold separately. Check its datasheet for details.*

OTDR Viewer

Built-in OTDR Viewer and Client application provides full post-analysis of SOR traces, as well as control of OPX-BOX OTDR via direct USB connection or Bluetooth®

- Traces and Events table view
- Loss calculations
- V-Scout Link Mapper option
- Compatible with Fiberizer Cloud (upload and download)
- Controls external OPX-BOXe OTDR

OPX-BOXe OTDR Control

The VeEX OPX-BOXe is an ultra-compact OTDR that can be controlled by the test set using Bluetooth® or USB connection. Once paired or connected to the micro OTDR, the test set displays a virtual OTDR user interface that is used to control the OPX-BOXe and perform measurements. Since fibers are common place in access, metro and transport networks, having a companion add-on OTDR reduces truck rolls since there is less dependence to call on specialized fiber construction crews to verify or troubleshoot fiber related problems.

Platform Features & Options

ReVeal RXTS

This companion management PC software is included standard with each test set. The ReVeal provides an easy-to-use and intuitive interface that allows users to take full advantage of TX300s and RXT-1200 test sets by providing the following productivity tools:

- Convenient test profile management
- Flexible test results management
- Advanced report generation with html, pdf, or csv formats, combine test results, add logos and comments
- Test profiles management: Online or offline Ethernet test profile creation, upload and download

Compatible with Windows XP, 7, 8.1 and 10, 32 bits or 64 bits operating systems.

Remote Access

The TX300s offers multiple ways to Remote Control it or access the information remotely (e.g. test results, test profiles, etc.). The test set can be reached via:

- ReVeal PC software
- Web browser (Web Remote Control)
- EZ Remote
- VNC® Client
- SCPI Remote and Command Reference Tool PC software*
- Scripting via SCPI commands
- Connectivity: 10/100Base-T, Wi-Fi 802.11 a/b/g/n/ac*

** Not included*

EZ Remote

The EZ Remote functionality allows users to quickly connect to VeEX test sets all over the world, without the need for VPN, port forwarding or public IP addresses. This VeEX hosted cloud service takes care of all the complex tasks required, and presents users with a simple application. Connect online anytime, anywhere, with any computer, tablet, or smartphone, using standard web browsers for screen-sharing, remote control and access to test results. Use it for remote control, collaboration, technical support or training purposes.

- Remote Control functionality gives users full control of remote test sets (screen mirroring and control)
- Remote Access functionality allows users to View, Download, Rename, Delete, Convert to PDF the test results
- No VPN required
- Works through firewalls, no ports to open
- Web browser based
- Multi-platform support

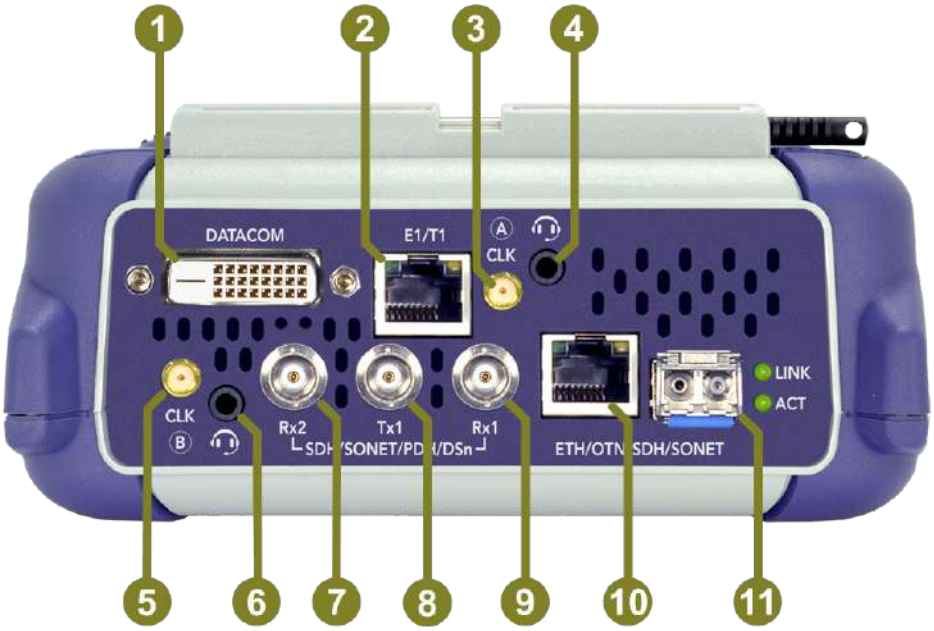
- No software to install
- Service included with test set (no extra charge)

File Manager

Profiles: Save and recall test profiles
Saves results to internal SD card View, Rename, Delete and Lock profile and result files
Filter and sort by Name, Test Mode, Test Type, Port, Date and Result/Profile
Report generation: Test results generation in PDF format
Export test results and profiles via USB memory, Bluetooth, web browser, Data Card or ReVeal RXTS companion PC software
File Backup and Retrieve to/from USB
Screen capture: Screen shots in PNG format

General Specifications

Display	5” WVGA 800x480 TFT color LCD touch-screen
Storage	internal 8GB flash (3.6 GB for user data)
Connectivity	Built-in: Wi-Fi 802.11b/g/n (optional), Bluetooth® (optional) micro-B USB 2.0 OTG USB A 2.0 via OTG cable 10/100Base-T via OTG adapter (optional)
Languages	Multiple languages supported
Size	150 x 150 x 68 mm (H x W x D)
Weight	994 gr (2.0 lb)
Battery	38 Wh Li-Po smart battery (10 Ah)
Battery Autonomy	Application dependent (>15h idle)
AC Adaptor	Input: 100-240 VAC, 50/60 Hz, 1.5A Output: 12 VDC, 5A
Operating Temperature	0˚C to 45˚C (32˚F to 113˚F)
Storage Temperature	-10˚C to 60˚C (-14˚F to 140˚F)
Humidity	0% to 95% non-condensing
Certifications	CE & ROHS compliant



1. Datacom: RS232A, RS232/V.24, V.35, RS449/V.36, X.21 (Uses VeEX’s standard DTE and DCE interface cables)
2. RJ48 or Bantam: E1, T1, G.703 Codirectional (Balanced)
3. SMA: External Reference Clock Input (PDH/DSn)
4. TRS 2.5mm: Headset jack (PDH/DSn VF)
5. SMA: External Reference Clock Input (SDH/SONET, SyncE)
6. TRS 2.5mm: Headset jack (Auxiliary)
7. BNC: STM1e/0e, STS-3/1, E4, E3, E2, E1, T3 (Auxiliary RX)
8. BNC: STM1e/0e, STS-3/1, E4, E3, E2, E1, T3 (TX)
9. BNC: STM1e/0e, STS-3/1, E4, E3, E2, E1, T3 (RX)
10. RJ45: 10/100/1000Base-T
11. SFP: 100/1000Base-X, 4/2/1G FC, OTU1, STM16/4/1/0, OC48/12/3/1

VeEX
The Verification Experts

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