# VePAL TX150+

## Handheld SDH/SONET/PDH/DSn Test Set


### SDH, SONET, PDH & DSn network testing simplified

VeEX® VePAL TX150+ and TX150E+ are rugged next generation portable field test solutions for SDH, PDH, SONET and DSn; transport, access links and services.

## Platform Highlights

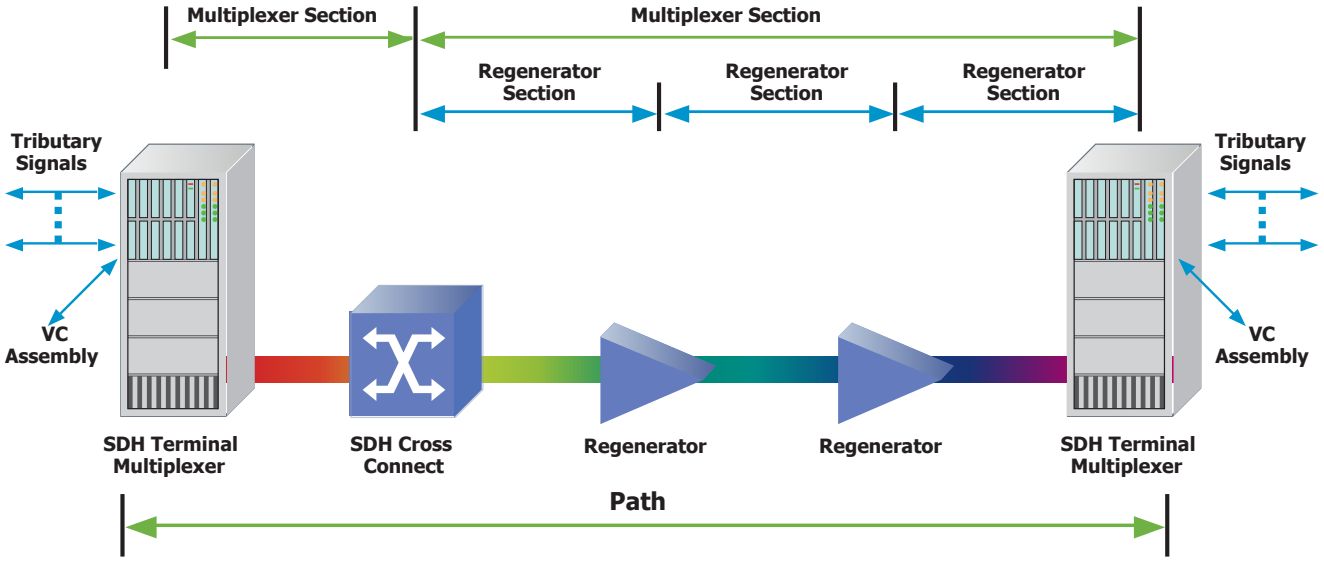
- Available in North American TX150+ (Bantam) and international TX150E+ (RJ48) versions
- Intuitive presentation of measurements with test graphics
- High resolution color touch-screen viewable in any lighting conditions fitted with protective cover
- Robust, handheld chassis packed with powerful and flexible features for demanding environments and test conditions
- Optimized for field engineers or technicians installing and maintaining TDM links and basic Ethernet services
- Ethernet port and connection for back office applications, workforce management and triple play service verification
- User defined test profiles and thresholds enable fast, efficient and consistent turn-up of services
- USB memory stick support and FTP upload capability for test result storage and file transfer respectively
- Maintain instrument software, manage test configurations, process measurement results and generate customer test reports using included ReVeal™ PC software
- Interchangeable Li-ion battery packs for extended field testing
- Perform remote testing and monitoring using the remote control option via standard Ethernet interface

## Key Features

- SDH and SONET testing. Optical and Electrical interfaces
- PDH (E1, E2, E3, E4) and DSn (DS1, DS3) testing options
- Balanced (120Ω) and Unbalanced (75Ω) interfaces for E1
- Dual E1, DS1 and DS3 Rx BERT
- Full Rate E1, DS1, Fractional N/M x 64kbps or 56kbps testing
- PDH analysis with Sa bit generation and SSM QL encode/decode
- Non-intrusive Pulse Mask Analysis at E1, E3, DS1, DS3 bit rates
- Flexible optical interface options using industry standard SFPs
- Optical Power, Level and Frequency measurements
- Auto Configuration
- Payload Mapping according to ITU-T G.707 recommendations
- Concatenated Payloads
- Bit Error and Performance Analysis
- Error and Alarm Generation and Analysis
- Path Trace Generation and Analysis
- Pointer Generation and Analysis
- Automatic Protection Switching/Service Disruption testing
- Histogram and Event analysis for errors and alarms
- Round Trip Delay on all interfaces and payload mappings
- Section and Path Overhead Monitoring, Byte Decoding
- Tandem Connection Monitoring
- Jitter analysis at E1, E3, DS3, STM-1o and OC-3 Wander measurements
- Supports advanced IP testing; Ping, Trace route, ARP Wiz, VoIP, Web browser, and FTP upload/download via Ethernet
- R-Server support for test results upload, download and workforce management

# Applications

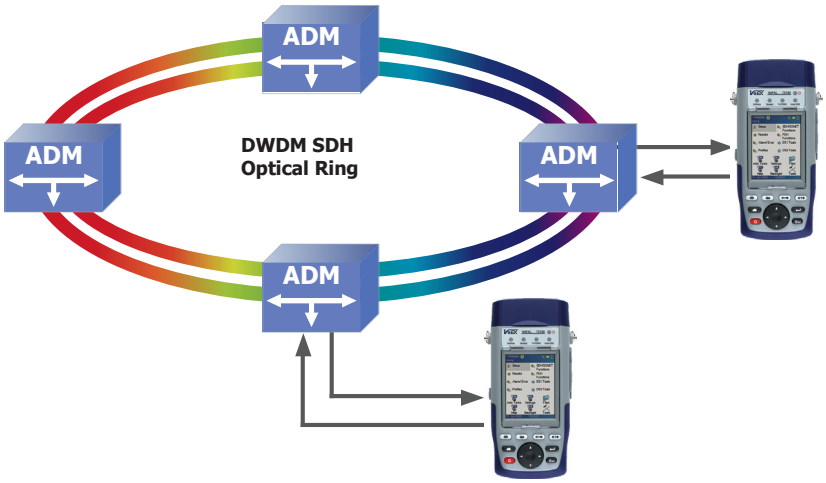
Installation, commissioning, monitoring and maintenance of SDH and PDH networks is simplified thanks to a combination of intuitive features and powerful test functions. SDH signals are often compromised by various impairments in the multiplexing process therefore defining the type of anomaly or defect 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.




## Out-of-Service Testing

Applications include:

- End-to-end BERT
- Tributary Mapping/de-Mapping
- Path/Section Trace Generation
- Bringing Into Service (M.2100)
- Pulse Mask Analysis (E1/E3/DS1/DS3)
- Mux Testing
- Round Trip Delay

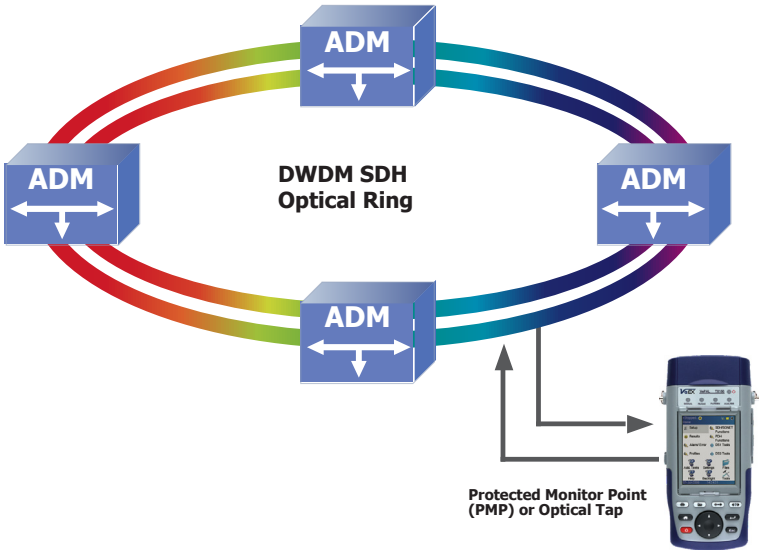


# Applications *cont'd*

## 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/Service Disruption
- Tandem Connection Monitoring
- Overhead Byte Control and Decode
- DCC Overhead BERT




## Payload Mappings Per ITU-T G.707 recommendations

The SDH Multiplexing principle consists of:

- Mapping - Tributaries are adapted into Virtual Containers (VCs) by adding justification bits and Path Overhead (POH)
- Aligning - Addition of a Pointer to a Tributary Unit (TU) and Administrative Unit (AU) for identification of the VC
- Multiplexing – Low order path signals are adapted into high order path signals, or high order signals are multiplexed

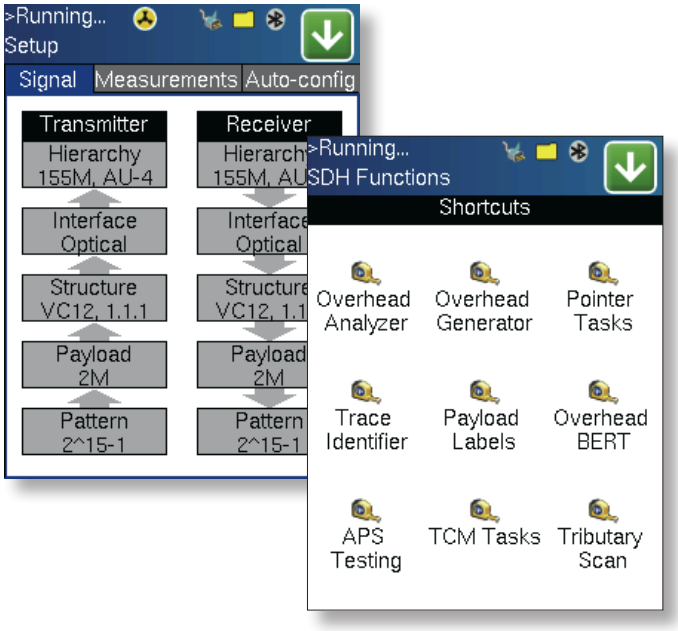
The TX150+ tests the proper operation of Add/Drop Multiplexers, Digital Cross Connectors and other Network Elements (NE) by verifying the mapping and de-mapping of different tributaries and payloads into SDH containers and monitors anomalies and defects associated with each process.

The Payload and Path Overhead of each SDH Container (VC) including the Pointer associated with the PDH tributary can also be monitored. Mapping of full bandwidth services such as IP, Multimedia and ATM is possible using concatenated payloads.

# SDH/SONET Features

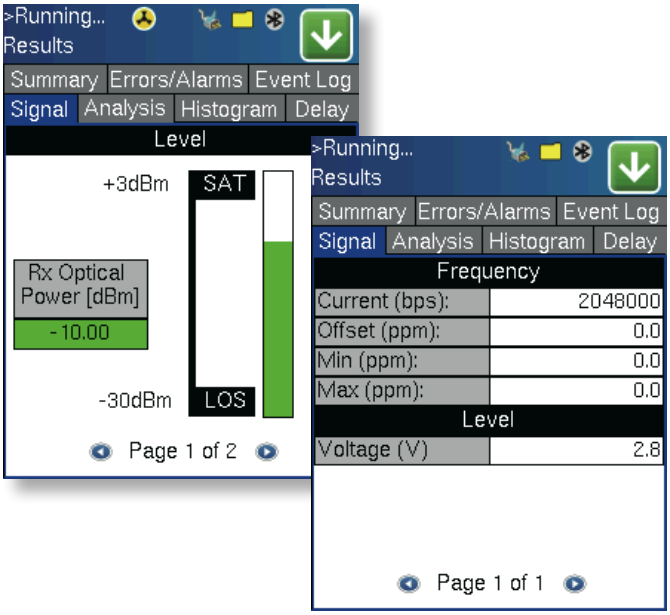
## Quick and Easy Graphical Setup

Encountering a variety of complex daily tasks is common in today's network environment, so technicians need a tester that is easy to configure and which doesn't require extensive product training beforehand. Respecting these issues, the test interface, signal structure, payload mapping and test pattern setup boxes are structured logically so that the user can quickly and efficiently configure the unit via an intuitive graphical menu. A list of shortcuts provides fast access to commonly used SDH or PDH test functions boosting productivity.



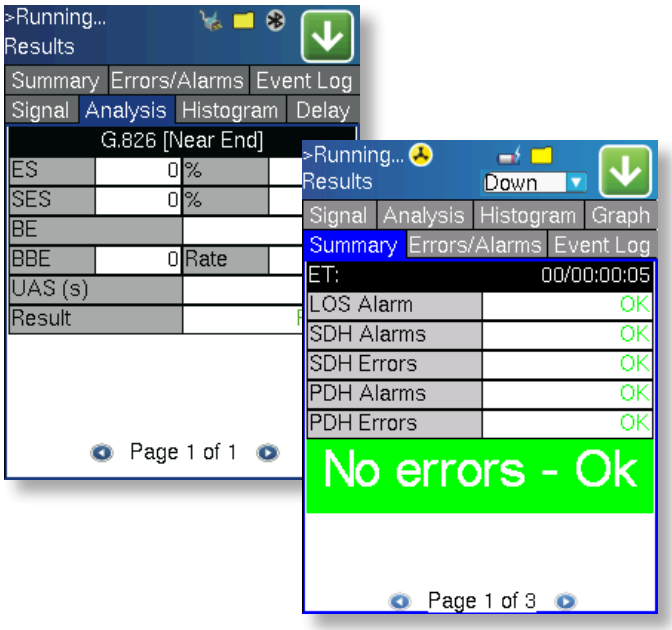

## Physical Layer Testing

Before performing any digital measurements, first confirm that analog parameters are within prescribed specifications and limits. High optical power levels can saturate receivers, while lower power levels are susceptible to noise which may result in bit errors. Clock frequency offset error is another analog parameter which is often overlooked. A series of clock tolerances for each signal hierarchy is clearly defined by ITU-T and Telcordia recommendations and should be verified as part of any acceptance/conformance test.



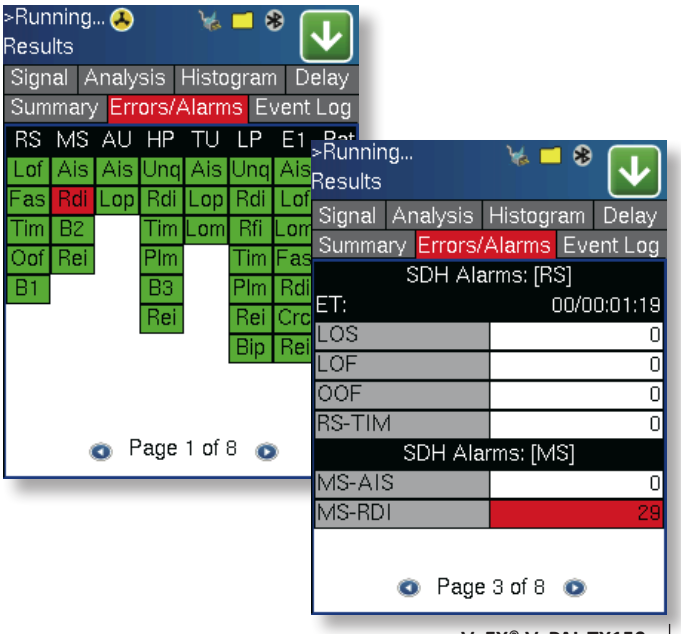

## Performance Analysis Summary

Performance of each hierarchy is based on Byte Interleaved Parity (BIP) checksums which are calculated on a frame-by-frame basis. These BIP checks are inserted into the Regenerator, Multiplexer and Path Overhead, which form an integral part of the performance monitoring capabilities of an SDH network. The TX150+ summary screen quickly shows Pass/Fail criteria for each performance parameter according to ITU-T recommendations where applicable.




## Errors and Alarms

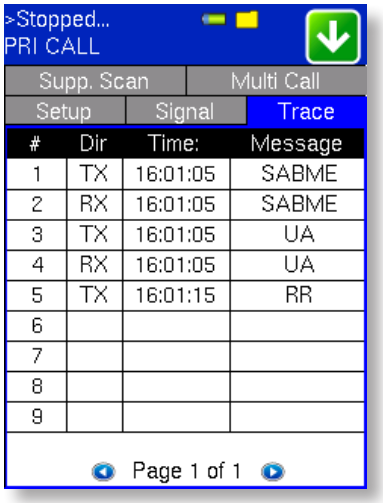
The SDH frame structure contains a large amount of overhead, some being associated with alarms and in-service monitoring. Major alarm conditions such as LOS, LOF and LOP cause Alarm Indication Signals (AIS) to be sent downstream, which in turn generate alarm signals in the upstream direction in a response to AIS detection. Anomalies (errors) and defects (alarms) are clearly displayed and recorded for each network segment by the TX150+, and are logged for further analysis.



## ISDN Testing

The ISDN option provides key functionality necessary for testing and troubleshooting DS1 or E1 Primary Rate connections. 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.

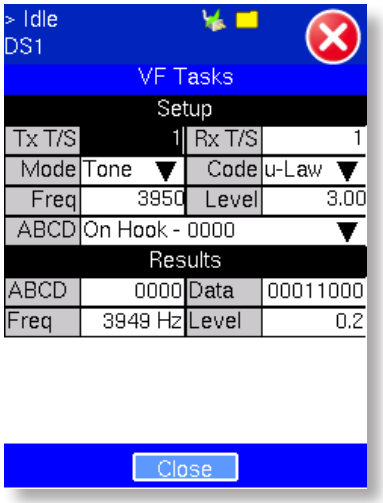
Protocol functions feature detailed signaling statistics, message monitoring and decode, and complete result presentation. With these capabilities, analysis of international and national ISDN, and other access protocols is possible.




## VF Testing

The Voice Frequency (VF) option 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 adaptor enables Talk/listen capability on a selected timeslot whilst a powerful function allows VF decoding at all DS3/DS1 and PDH rates.




## Jitter Measurements

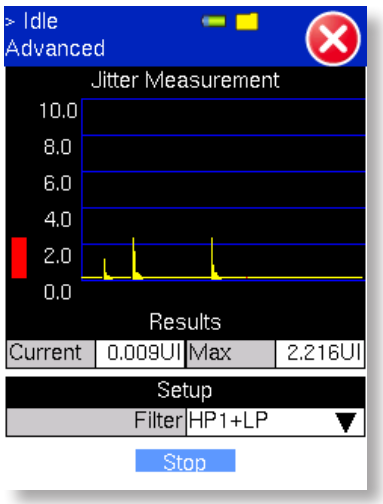
Data integrity in plesiochronous networks depends largely on the phase stability of clock and data signals, therefore excessive jitter can cause network outages. Because BER testing is the common method to diagnose network problems in the field, results often mislead the technician because only the effect of a problem and not the actual cause is reported. Ultimately, this makes fault identification more difficult, time consuming, and expensive.

The jitter software option of the TX150+ uses advanced digital measurement techniques for measuring intrinsic jitter, allowing technicians to easily determine when jitter is the source of errors.

### Jitter Metrics

Output jitter performance mandated by ITU-T and Telcordia standards is evaluated by measuring the recovered clock of the incoming signal (DS1, DS3, E1, E3) traversing the network.

While the test duration is not defined in the mentioned standards, a measurement period time of 1 minute is recommended. Specified in unit intervals (UI), the maximum Peak-to-Peak Jitter is the most important parameter because Max values are indicative of performance, as these extremes generally cause errors. While jitter is defined as any phase variations above 10Hz, the incoming signal must be filtered in order to measure jitter – the user is therefore able to select between Wide band and High band filters to adjust the measurement bandwidth as required.

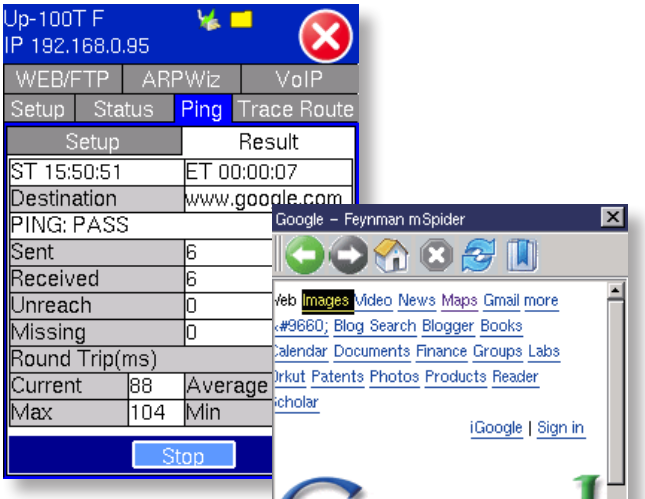


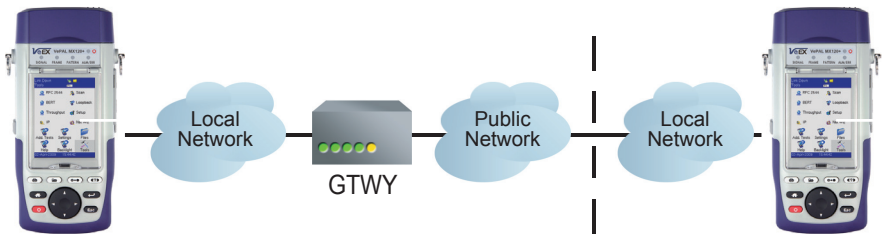
## IP Testing

Used initially only for Local Area Network (LAN) connectivity within the enterprise, the Internet Protocol (IP) has quickly grown to be the de-facto standard for multi-service network transport.

For Telco and IT technicians, it's no longer enough to validate equipment at the physical interface or connection protocol level only, so IP testing has become a routine task during service installation and restoration.

The TX150+ supports an array of IP test functions over the 10/100BaseT port including Ping, Trace Route and Triple Play measurement tasks. Web browsing, FTP throughput and VoIP tests can be performed at various points in the network to ensure customer satisfaction.

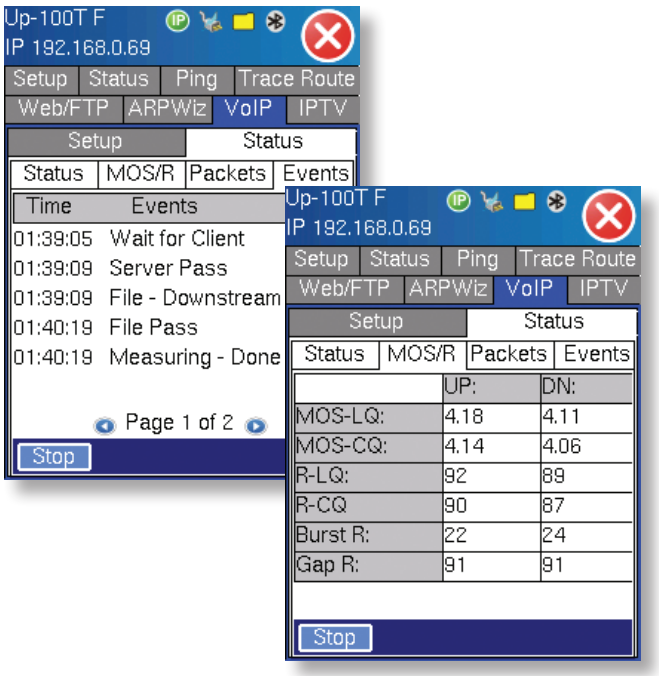



## VoIP Testing

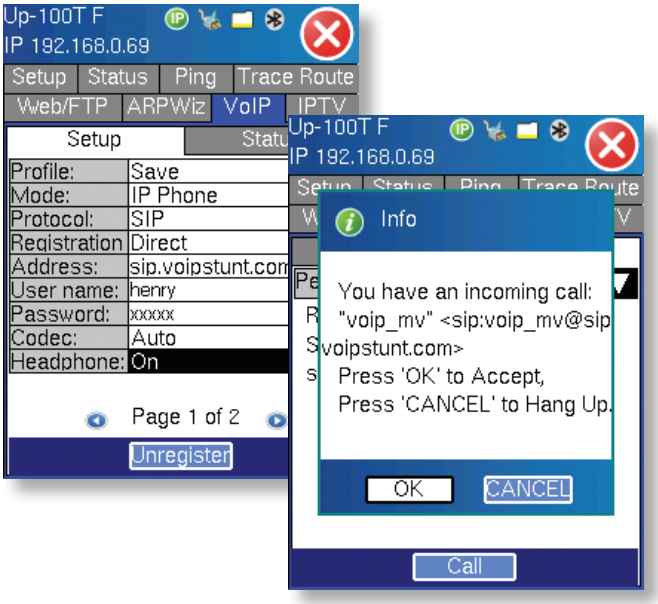
Take advantage of the three software options offering different test methods to verify and provision your VoIP network. Testing can be performed over any of the Ethernet test ports.

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



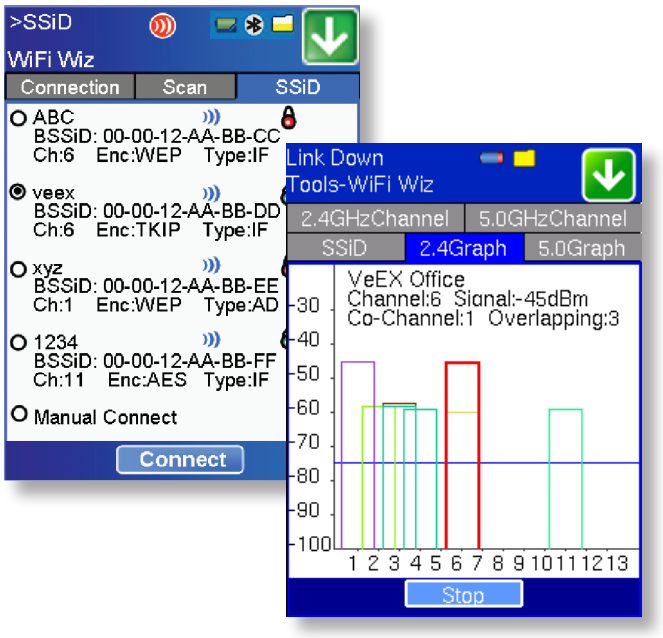

**VoIP Expert** – Generates industry standard wave files to verify MOS and R-Factor values of upstream and downstream paths and includes QoS measurements such as packet jitter, packet loss, and delay. Compatible with all VeEX testers including VX1000 VoIP server software.

**VoIP Call Expert** – Emulates an IP phone and can place and receive calls using SIP or H.323 protocols. Comprehensive Codec support and call destination options verify voice encoding and translation provisioning. Real-time evaluation of subjective voice quality is made possible using the Telchemy® test method.



## WiFi Wiz

All VePAL products adopt a USB WiFi adaptor to make 802.11 a/b/g/n/ac wireless installations a simple task. Scan for available networks or perform signal strength and quality measurements to determine the best location for a new wireless access point. The IP Ping capability ensures the wireless network is properly installed and configured. A full suite of IP testing features is supported.




## ReVeal MTX PC Tool

A software package shipped standard with each test set. Test and other installation profiles can be created and edited on a PC for upload to the test set via LAN connection. Test results can be downloaded and saved to a PC, where test data management and report generation can be performed. Users are able to check and upgrade their test sets without having to return the unit to the supplier, thus reducing downtime.

# PDH and E1/E3

## Electrical Interfaces

Dual RJ-48 (TX150E+ only)

- 2.048 Mbps, HDB3 & AMI, 120Ω balanced
- 1.544 Mbps, AMI & B8ZS, 100Ω balanced
- 64 kbps G.703 Codirectional, AMI, 120Ω Balanced (Optional)
- 3-pin 120Ω Banana converter cable (F02-00-009G) is available for E1 and Codirectional

Dual Bantam (TX150+ only)

- 2.048 Mbps, HDB3 & AMI, 100Ω balanced
- 1.544 Mbps, AMI & B8ZS, 100Ω balanced
- 64 kbps G.703 Codirectional, AMI, 100Ω Balanced (Optional)

BNC (75Ω unbalanced)

- 2.048 Mbps, HDB3 & AMI
- 8.448 Mbps, HDB3
- 34.368 Mbps, HDB3
- 51.84 Mbps, B3ZS
- 44.736 Mbps, B3ZS (Optional)
- 139.264 Mbps, CMI (Optional)
- 155.520 Mbps, CMI (Optional)

Compliant to ITU-T G.703, G.823, G.824, G.825, G.772 and ANSI T1.102 recommendations where applicable

Clock recovery (pulling range) per ITU-T G.703

Receiver Sensitivity

2.048 Mbps (E1)

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

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)

1.544 Mbps (DS1) (Optional)

- Terminate: ≤ 26 dB (cable loss only) at 0 dBdsx Tx
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)
- Bridge: ≤ 6 dB (cable loss)

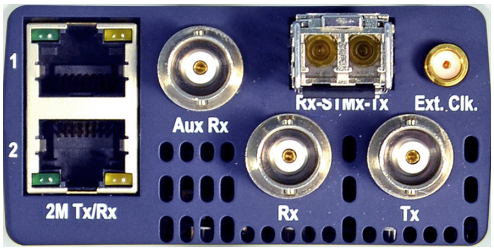
44.736 Mbps (DS3) and 51.84 Mbps (STS-1/STM-0E) (Optional)

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

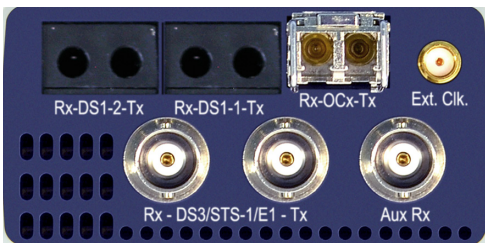
139.264 Mbps (E4) and 155.520 Mbps (STM-1E) (Optional)

- Terminate: ≤ 12 dB (E4), 12.7 dB (STM-1E) (coaxial cable loss only)

TX150E+




TX150+




## Clock Synchronization

Internal: 2.048 Mbps ± 3.5 ppm stability per ITU-T G.812

Recovered: 2.048 Mbps from the incoming signal

External reference via SMA connector

- Clock: 1.544 MHz, 2.048 MHz (sine wave or TTL)
- Signal: 1.544 Mbps (B8ZS), 2.048 Mbps (HDB3)
- 64 kbps co-directional

Tx Frequency Offset: Up to 25,000 ppm in steps of 0.1 ppm for both optical and electrical interfaces

## Optical Interfaces

SFP transceivers conforming to Multi-Source Agreement (MSA) specifications

ROHS compliant and Lead Free per Directive 2002/95/EC

Operating temperature range: -10˚C to 70˚C

Safety: Class 1, per FDA/CDRH, EN (IEC) 60825 eye safety and EN (IEC) 60950 electrical safety regulations

Compliant to ITU-T G.957 Optical interfaces and systems relating to SDH*

Optical Power Measurement: ± 2 dB accuracy, 1 dB resolution*

**VeEX supplied SFPs only.*

# SDH/SONET Functions

## Operating Modes

Terminate mode

Monitor mode

Intrusive Thru mode

- Modification of selected SOH bytes
- Alarm Generation and Error Insertion of selected defects and anomalies respectively

Non-intrusive Thru mode

- Pass entire signal through without modifying section and line overhead bytes

## Signal Structure

Comprehensive test payload mapping and multiplexing into SDH/SONET

- Concatenated Bulk (PRBS)
- SDH AU3 and AU4 support
- VC/VT Bulk (PRBS)
- PDH/DSn structure

## SDH Mappings (According to ITU-T G.707)

C-11 (unstructured or framed DS1)

C-12 (unstructured or framed E1, asynchronous or byte synchronous)

C-3 (unstructured or framed E3 or DS3) via AU-3 or AU-4

C-4 (unstructured or framed E4)

C-4-4c (STM-4 and STM-16)

C-4-16c (STM-16)

## SONET Mappings (According to Bellcore GR-253/ ANSI T1.105)

Bulk, VT, STS-1, STS-3C, STS-12C, STS-48C, mappings supplied

VT-1.5 (unstructured or framed DS1, asynchronous or float byte synchronous)

VT-2 (Bulk, E1 asynchronous or float byte synchronous)

STS-1 SPE (unstructured or framed E3 or DS3)

STS-3C SPE (Bulk)

STS-12C SPE (Bulk)

STS-48C SPE (Bulk)

# SDH/SONET Functions *cont'd*

### Patterns

The following test patterns can be generated:

- PRBS: $2^7$-1, $2^9$-1, $2^{11}$-1, $2^{15}$-1, $2^{20}$-1, $2^{23}$-1, $2^{31}$-1, QRSS
- Fixed: 0000, 1111, 1010, 1000, 1100, 1in8, 2in8, 3in24, DALY, NET55, OCT55
- 10 User programmable words up to 32 bits each
- Normal or inverted

### Errors

Insertion

- SDH: FAS, B1, B2, MS-REI, B3, HP-REI, LP-REI, LP-BIP, slips and bit
- SONET: FAS, S-BIP (B1), L-BIP (B2), REI-L, P-BIP (B3), REI-P, REI-V, BIP-V, slips and bit
- Mode: Single, Count (1 to 1000) and rate (1 x $10^{-3}$ to 5 x $10^{-6}$)

Detection

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

### Alarms

Generation

- SDH: LOS, LOF, MS-AIS, MS-RDI, RS-TIM, AU-LOP, AU-AIS, HP-UNEQ, HP-PLM, HP-RDI, HP-TIM, TU-LOM, TU-LOP, TU-AIS, LP-UNEQ, 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, TIM-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
- Mode: Enable/Disable, Continuous, Count (0.1, 1, 10, 100 seconds)

Monitoring and Detection

- SDH: LOS, LOF, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HPUNEQ, 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

### Automatic Configuration

Configures tester to the incoming signal - Bit rate, framing, line code and test pattern are identified in accordance with ITU-T G.707, G.703, O.151 and O.181 recommendations where applicable

### Overhead Analysis and Generation

Network Architectures supported

- Linear (per ITU-T G.783)
- Ring (per ITU-T G.841)

Analysis – Decode and Display

SOH/POH bytes in hexadecimal, binary or ASCII formats

- S1 synchronization status
- C2 HP/STS Path signal label
- J0 trace identifier (16 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 Path signal label

Generation - Programmable Bytes

RSOH

- J0 trace: 1 byte hexadecimal or 16 byte ASCII sequence with CRC-7

MS/Line Overhead

- 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)

- J1 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
- C2 signal label
- H4 Sequence/Multiframe 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 APS signaling

### DCC Overhead BERT

Generation and analysis of PRBS pattern in DCC channels (D1-D3 or D4-D12 bytes)

PRBS: $2^{11}$-1, $2^9$-1; inverted or non inverted

Bit error counter and errored seconds

### Pointer Analysis and Generation

Analysis

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

Generation

- Single pointer, increment, decrement, or increment/decrement
- Programming of SS bits

### Tributary Scan

Automatically scans VC-12, VT-1.5 or VT2 for errors, alarms and events using sequential BER

# PDH/DSn Functions

### Operating Modes

Terminate mode

Monitor mode

Bridge

### Signal Structure

1.544 Mbps (DS1)

- Unframed or Framed SF (D4), ESF per ANSI & Telcordia standards
- Test signal in N x 64 kbps, 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)
- Test signal in N/M x 64 kbps, N x 56 kbps where N=1 to 30/31

8.448 Mbps (E2)

- Unframed or Framed per 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 and C-Bit Parity per ITU-T G.752 or G.704

139.264 Mbps (E4)

- Unframed or Framed per ITU-T G.751

### Patterns

The following test patterns can be generated:

- PRBS: $2^7$-1, $2^9$-1, $2^{11}$-1, $2^{15}$-1, $2^{20}$-1, $2^{23}$-1, $2^{31}$-1, QRSS
- Fixed: 0000, 1111, 1010, 1000, 1100, 1in8, 2in8, 3in24, DALY, NET55, OCT55
- 10 User programmable words up to 32 bits each
- 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, FAS, Bit errors
- 34.368 Mbps (E3): Code, FAS, Bit errors
- Single, Count (1 to 1000) or continuous rate (1 x $10^{-3}$ to 5 x $10^{-6}$)
- 44.736 Mbps (DS3): Code, FAS, MFAS, P/C-Parity, Bit errors
- 139.264 Mbps (E4): Code, FAS, Bit errors

Measurements

- 1.544 Mbps (DS1): Code, FAS, Bit, Frame, CRC
- 2.048 Mbps (E1): Code, FAS, CRC, EBIT and Bit errors
- 34.368 Mbps (E3): Code, FAS, Bit errors
- 44.736 Mbps (DS3): Code, FAS, MFAS, P/C-Parity, Bit errors
- Code, FAS, MFAS, 2M CRC, P/C-Parity, Bit errors

### Alarms

Generation

- 1.544 Mbps (DS1): AIS, yellow, idle, LOS, LOF
- 2.048 Mbps (E1): LOS, AIS, LOF, RDI
- 8.448 Mbps (E2): LOS, AIS, LOF, RDI
- 34.368 Mbps (E3): LOS, AIS, LOF, RDI
- Mode: Enable/Disable, Continuous, Count (0.1, 1, 10, 100 seconds)
- 44.736 Mbps (DS3): LOS, LOF, OOF, AIS, Parity
- 139.264 Mbps (E4): AIS, FAS RDI

Measurement

- 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
- 1.544 Mbps (DS1): AIS, yellow, idle, LOS, LOF, LSS
- 44.736 Mbps (DS3): LOS, LOF, OOF, AIS, Parity, LSS
- LOS, AIS, LOF, OOF, RDI, idle, yellow, and LSS

### SSM QL

- SDH/SONET S1 clock quality encoding and decoding
- E1 Sa bits clock quality encoding and decoding
- Selectable Sa bits for SSM monitoring and generation

### 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, DM 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%
- User defined thresholds for Maintenance (MTCE) and Bringing into Service (BIS) objectives. In service measurements on both near and far ends of path using TSE, HP-BIP (B3), MS-BIP (B2), RS-BIP (B1) and LP-BIP (V5)

### G.703 64k Codirectional Testing Option

Interfaces

- RJ48 (120Ω) , Bantam (100Ω)
- Available RJ48 to 3-pin Banana converter

Transmit Clock

- Internal, External, Received
- Frequency offset generation to ±150.00 ppm

Measurements

- Bit, Code, LOS, AIS, pattern loss (LSS) with Histogram and Bar Graph representation
- G.821 performance evaluation
- Signal level, data rate and offset
- Time-stamped Events Log
- Round-trip Delay

Error and Alarm Generation

- Bit, Code, LOS, AIS

## DSn Functions (TX150+ only)

Besides bantam DS1 interfaces, the North American version offers application-oriented DS1 and DS3 streamlined GUI that is shared among other TX-Series test set.

### DS1 and DS3 Auto-Monitor

Quickly auto-configures to the received signal and runs a health check. Provides a summary screen with all alarm indications, frequency, signal level, BPV/code errors, FBE, clock slips Histogram and bar graph representation of errors and alarms Channelized DS3 support with selectable DS1 channel status.

### 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 and Measurements

### Auto Configuration

Available on all interfaces: Identification of received signal - instrument configuration based on network type, bit rate, line coding, framing, mapping, and test pattern

### Frequency Measurement

Optical and Electrical Interfaces: Hz in ppm
Resolution: 1Hz
TIE measurement on Pointer Justification Events

### Round Trip Delay

Available on all interfaces and mappings

- Measurement Range: 1µS to 10 seconds
- Resolution: ±1µs or 1 U.I.

### Event Logging

Date and time stamped events in tabular format

### Histograms

Available for all interfaces

- Display of Errors and Alarms versus time
- Resolution: Seconds, minutes, hours and days

### LED Indicators

Fixed LEDs for Signal, Framing, Pattern and Errors/Alarms
Soft LEDs for SDH/PDH Alarms/Errors displaying historical events and conditions

## SDH/PDH Measurement Options

### Pulse Mask Analysis

PDH (E1/E3)

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

DS1/DS3

- 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 with Conformance mask verification
Parameters: Width, Rise/Fall time, Overshoot/Undershoot

### Automatic Protection Switching (APS) and Service Disruption Measurement

Measurement of disruption time on SDH and PDH interfaces
Tributaries: PDH (E1), SDH
Pass/Fail range: 1 ms to 10 seconds
Resolution: 1 ms
Triggers: LOS, LOF, SDH FAS, B1, MS-AIS, MS-RDI, MS-REI, B2, MS-AIS, AU-AIS, AU-LOP, B3, HP-RDI, HP-REI, LSS
APS Byte (K1/K2) capture and decode
Service Disruption sensor events - LOS, LOF, AIS, TSE
Service Disruption measurements: Longest, shortest, total and average disruption time; Disruption count

### Pointer Analysis and Generation

Generation: ITU-T G.783 pointer sequences

### Tandem Connection Monitoring (TCM)

Generation and analysis of N1 and N2 bytes
Errors generated: TC-IEC, TC-BIP, TC-REI, OEI
Alarms generated: TC-RDI, TC-UNEQ, TC-LTC, TC-AIS, TC-ODI
Detection, display, analysis and storage of events: TC-IEC, TC-AIS, TC-REI, TC-RDI, TC-OEI, TC-LTC, TC-UNEQ, TC-ODI, TC-TIM
Analysis and generation of APId (Access Point Identifier)

## VF Measurement Options

VF (Talk, Tone) drop/insert via Headset
Time Slot: Channel to test for both transmitting and receiving

- E1: 1 – 30/31; DS1: 1 – 24

Code: u-Law or A-Law

### Tone Generation/Measurement

Setup

- Transmitted Frequency: 50 to 3950 Hz
- Transmitted Level: -60 to 3 dBm
- Programmable ABCD: Manual edit ABCD or ON-HOOK, OFF-HOOK, WINK for DS1, and IDLE, SEIZE for E1

Results

- Measure signal frequency and level in selected timeslot
- Listen to the voice channel in selected timeslot via external headset
- ABCD bits monitor and View Data in selected T/S channel

## ISDN PRI Testing Options

TE/NT Emulation
Place/Receive voice and data calls
D-channel monitor with full decode: Layer 2 (Q.921) and Layer 3 (Q.931)
Protocols

- DS1: National ISDN, AT&T, Nortel DMS
- E1: ETSI (Euro – ISDN)

Via Headset for B-channel talk/listen Protocols
Supports multirate N x 64k, N x 56k data call
Supplementary Services Test: Automatically tests the provisioning of the following: CLIP, CLIR, COLP, CFU, CFB, CFNR, SUB, MSN, DDI, HOLD, UUS, TP, AOC-S, AOCD, AOCE, MCID, CUG

## Jitter/Wander Analysis Options

### Jitter Measurement

Fully compliant to ITU-T O.171 and O.172.
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 (155M Optical) (500 Hz to 1.3 MHz)

HP2+LP (High-band Jitter) filter

- E1 (2M) (18 Hz to 100 kHz)
- E3 (34M) (10 Hz to 800 kHz)
- DS1 (1.5M) (18 Hz to 100 kHz)
- DS3 (45M) (30 Hz to 400 kHz)
- STM-1 (155M Optical) (65 Hz to 1.3 MHz)

Parameters: Current peak-peak, Maximum peak-peak
Units: UI (Unit Interval)
Resolution: 0.01 UI
Accuracy: Per ITU-T O.171 and O.172
Test Duration: Continuous

## Other Options

### IP Testing

Ping, Trace Route, ARP, FTP/Web tests, Web Browser

### VoIP Testing (Optional)

Codecs: G.711 µ-law, G.711 A-law, G.723.1 (optional), G.729 (optional)
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 mimicking VoIP traffic

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
- Configurable jitter buffer (fixed or dynamic)
- Incoming call Auto Answer
- STUN support
- Talk/Listen with USB headset
- DTMF test (RFC4733)
- Signaling trace with protocol decode
- Up to 24 simultaneous calls

### WiFi Wiz (Optional)

Supports 802.11 a/b/g/n/ac networks in the 2.4 and 5 GHz bands (requires optional Wi-Fi USB adapter supplied by VeEX)
SSID detection, infrastructure, Ad-hoc, and encryption
Signal strength and signal quality
IP connectivity (Ping, Trace Route, FTP upload/download, Web Test, VoIP Check and VoIP Expert)

## Platform Features

### Advanced Management (Optional)

This option allow users to append work order information to test results (e.g. Job ID, account, location, comments).

- Compatible with R300 Productivity Server (R-Server)
- Authorized test sets can register with specific VeSion R300 Server
- Test results can be uploaded via LAN, Wi-Fi or cellular data connection

### Remote Access

The TX150+ 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 MTX PC software
- Scripting via SCPI commands
- Connectivity: 10/100Base-T, Wi-Fi 802.11 a/b/g/n/ac*

### ReVeal MTX PC Software

Remote Control (optional)
Remote screen capture and movie capture
Remote Software management: software upgrade, software option management
Test results management
Advanced report generation with .pdf or .csv formats, combine test results, add logos and comments
Test profiles management online or offline test profile creation, upload and download
Wander files retrieval

### Test Profile Management

Save and Recall test profiles to internal memory

### Additional Test Features

Profiles: Save and recall test profiles
Screen capture: Screen shots in .bmp format via ReVeal MTX PC software
Remote control: via ReVeal MTX PC software
Results saving: 1000 results
Export test results via USB, FTP, or ReVeal MTX PC software

## General Specifications

| | |
|---|---|
| Size | 210 x 100 x 55 mm (H x W x D)<br>8.25 x 3.75 x 2.25 in |
| Weight | Less than 1 kg (less than 2.2 lbs) |
| Battery | LiIon battery, 2600 mAh 10.8VDC<br>Operating time > 3 hours |
| AC Adaptor | Input: 100-240 VAC, 50-60 Hz<br>Output: 15VDC, 3.5A |
| Operating Temperature | -10˚C to 50˚C (14˚F to 122˚F) |
| Storage Temperature | -20˚C to 70˚C (-4˚F to 158˚F) |
| Humidity | 5% to 95% non-condensing |
| Display | 3.5” QVGA 320x240 full color touch-screen |
| Ruggedness | Survives 1 m (3 ft) drop to concrete on all sides |
| Interfaces | USB 2.0, RJ45 10/100-T Ethernet |
| Languages | Multiple languages supported |

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