



2008 Global Test & Measurement  
Emerging Company of the Year Award



## VePAL TX150E

### Handheld SDH/PDH Test Set

#### SDH network testing simplified

VeEX™ VePAL TX150E is a next generation test solution for SDH/PDH networks transporting legacy and next generation services.

### Platform Highlights

- 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 SDH networks transporting legacy and next generation 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
- Extend field testing time using interchangeable LiIon battery pack/s. Greater battery autonomy provided in standby mode
- Supports advanced IP testing; Ping, trace route, ARP Wiz, VoIP, IPTV, WiFi, web browser, and FTP upload/download via Ethernet or USB port where applicable
- Perform remote testing and monitoring using the remote control option via standard Ethernet interface

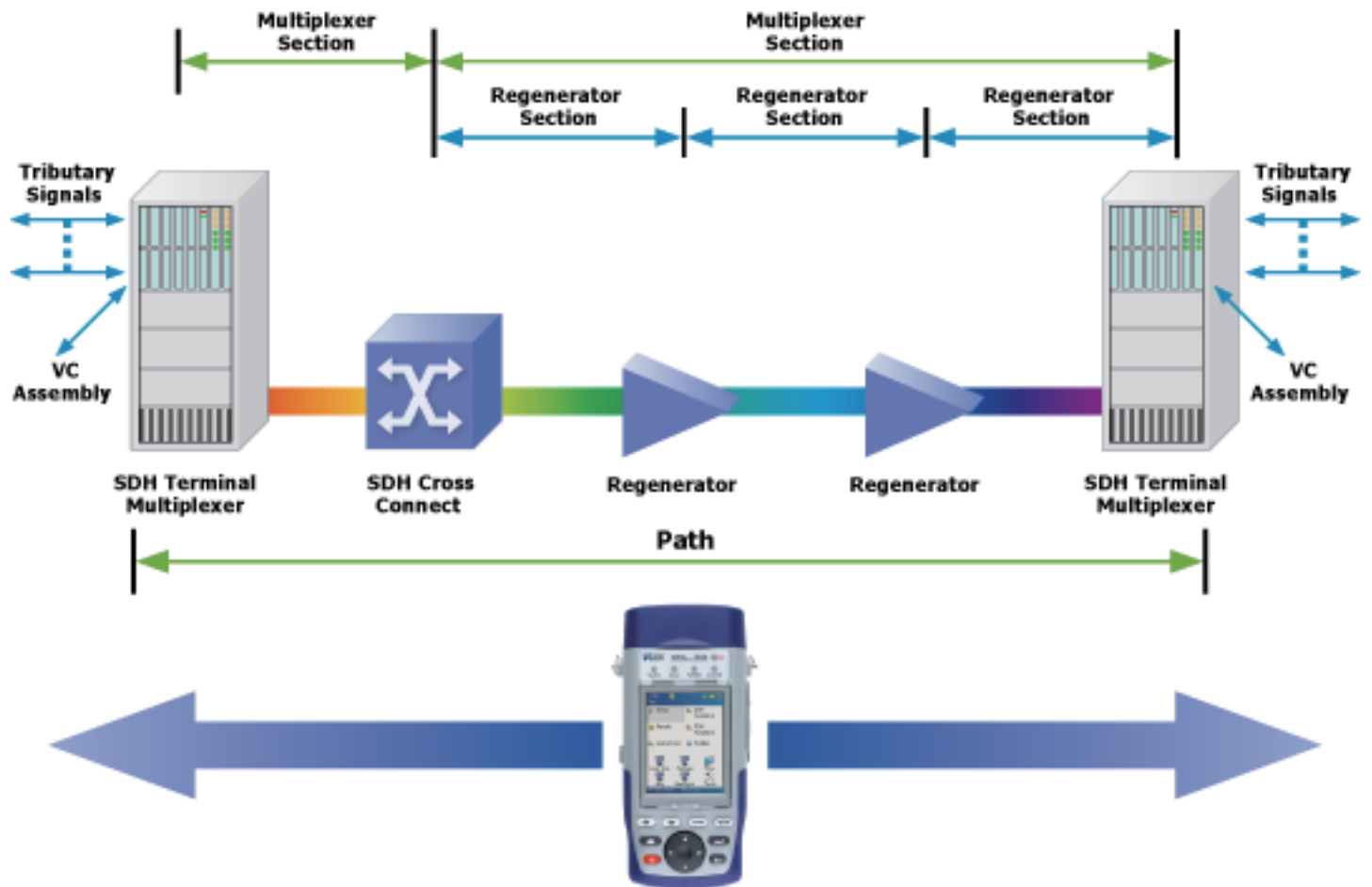
### Key Features

- PDH testing at E1, E3 bit rates. DS1, DS3 and E4 (Optional)
- Balanced (120Ω) and Unbalanced (75Ω) interfaces for E1
- Dual E1 Receivers for bi-directional monitoring
- Full Rate E1 and Fractional N, M x64 kbit/s testing
- PDH Analysis with Sa bit Generation
- Non intrusive Pulse Mask Analysis at E1, E3 and DS3 bit rates
- SDH testing at STM-1, STM-4 and STM-16 bit rates
- Flexible wavelength/bit rate options using industry standard SFPs conforming to the Multi Source Agreement (MSA)
- Optical Power, Level and Frequency measurements
- Auto Configuration of network type, bit rate, line coding, framing, mapping, and test pattern
- Payload Mapping according to ITU-T G.707 recommendations
- Concatenated Payloads
- Bit Error and Performance Analysis per ITU standards
- 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
- Transmit Frequency Offset to stress clock recovery circuits
- Section and Path Overhead Monitoring and Byte decoding
- Tandem Connection Monitoring

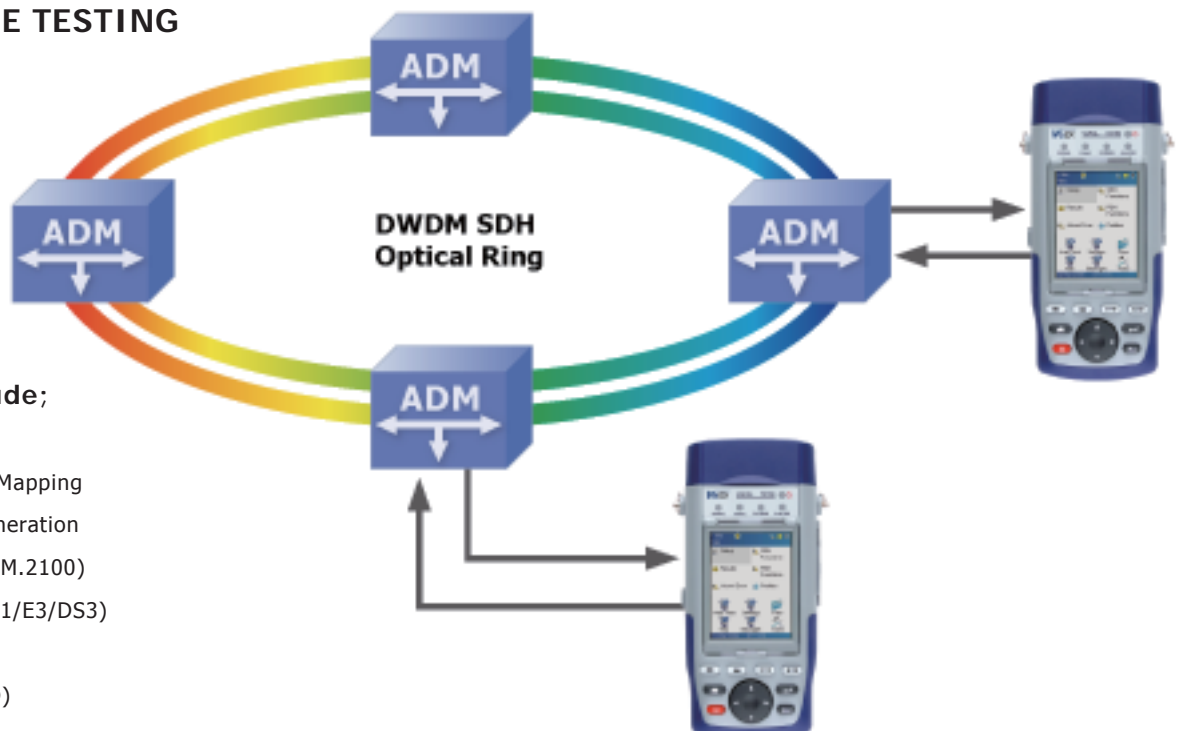
Transport Expert

## APPLICATIONS

Installation, commissioning, monitoring and maintenance of SDH and PDH networks simplified thanks to a combination of intuitive features and powerful test functions. When multiplexing several low order tributaries together, SDH signals are often compromised by various impairments in the process. Defining the type of anomaly or defect is crucial in isolating the network element or signal path causing the problem and reducing costly network downtime. 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.



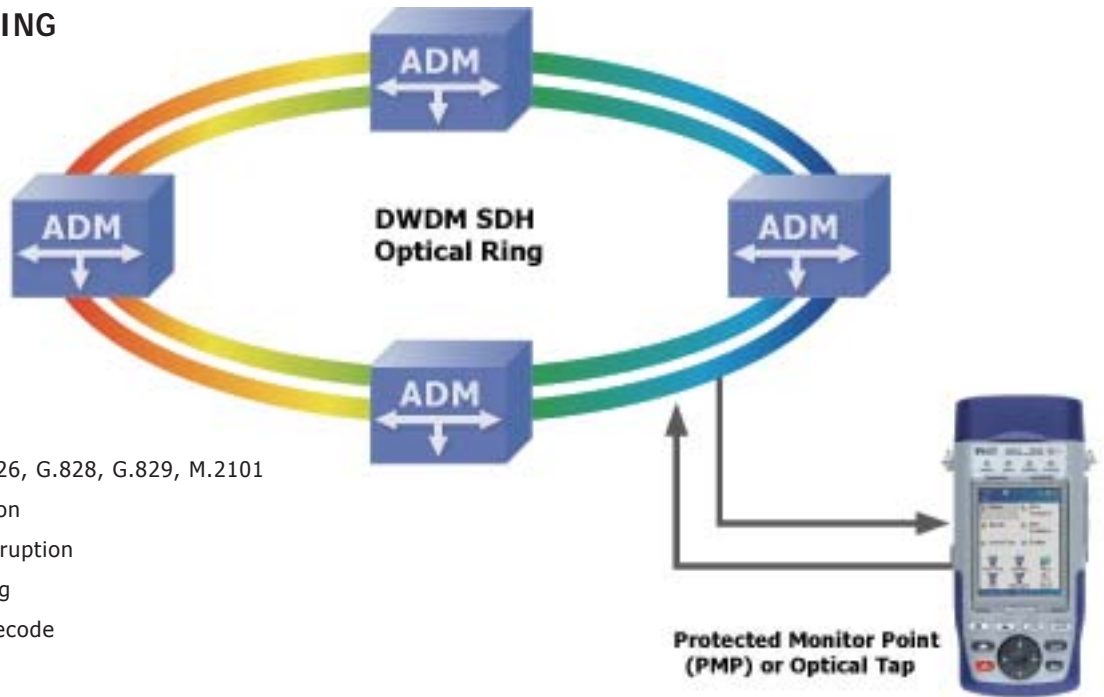
## OUT OF SERVICE TESTING



### Applications include;

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

# 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
- Overhead BERT

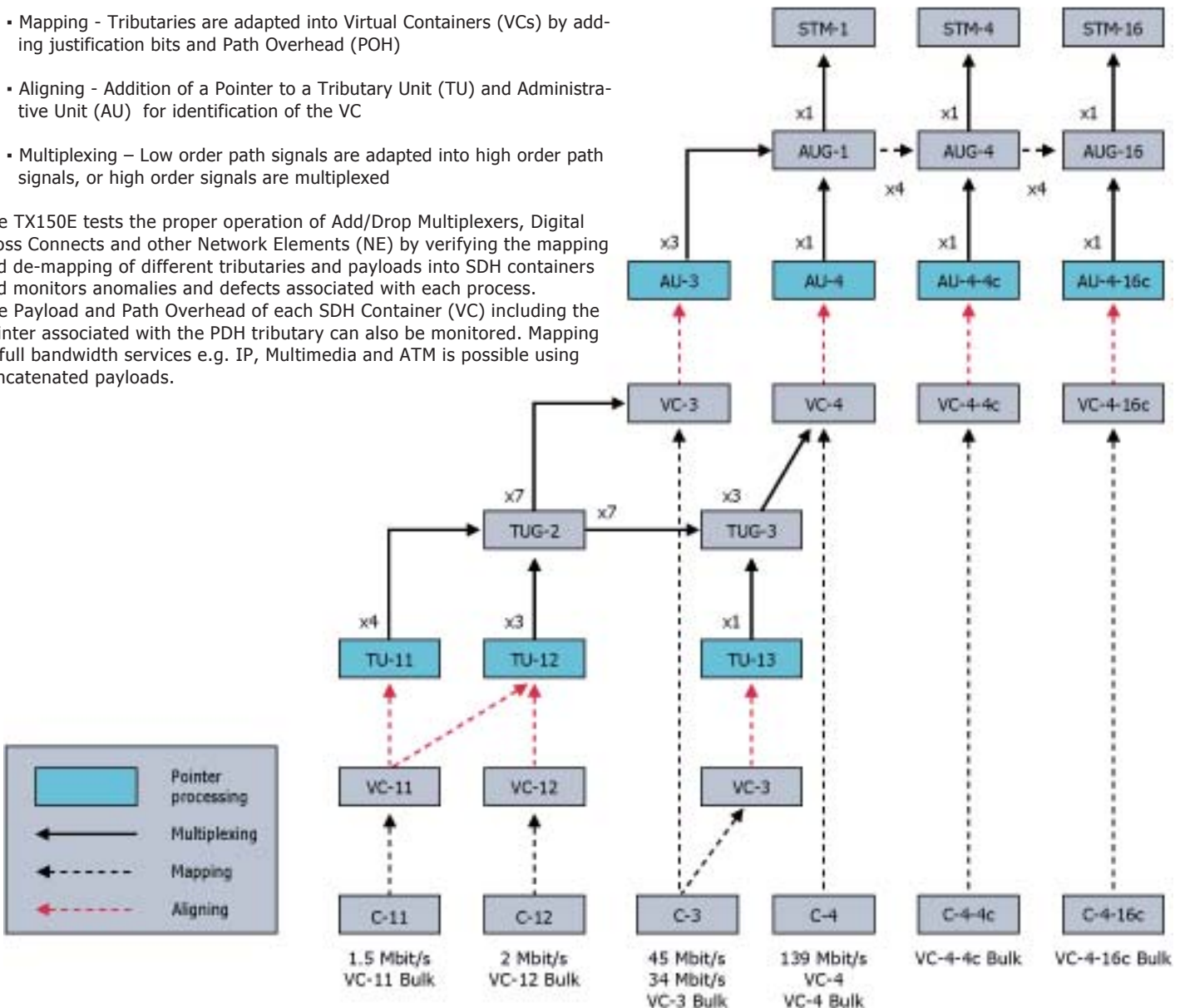
## PAYLOAD MAPPINGS SUPPORTED

(PER ITU-T G.707 RECOMMENDATIONS)

The SDH Multiplexing principle basically 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

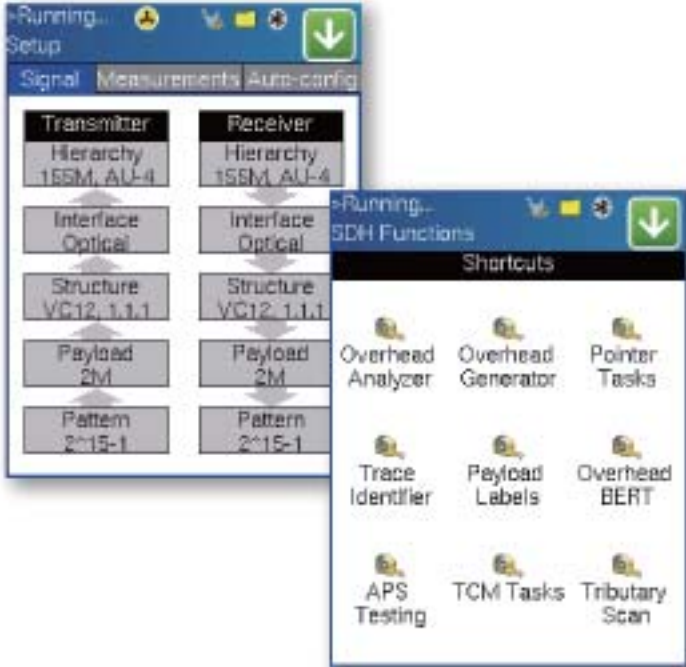
The TX150E tests the proper operation of Add/Drop Multiplexers, Digital Cross Connects and other Network Elements (NE) by verifying the mapping and de-mapping of different tributaries and payloads into SDH containers and monitors anomalies and defects associated with each process. The Payload and Path Overhead of each SDH Container (VC) including the Pointer associated with the PDH tributary can also be monitored. Mapping of full bandwidth services e.g. IP, Multimedia and ATM is possible using concatenated payloads.



## 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. Very high optical power levels can saturate or even damage receivers, while low power levels are susceptible to noise which may in turn cause bit errors.

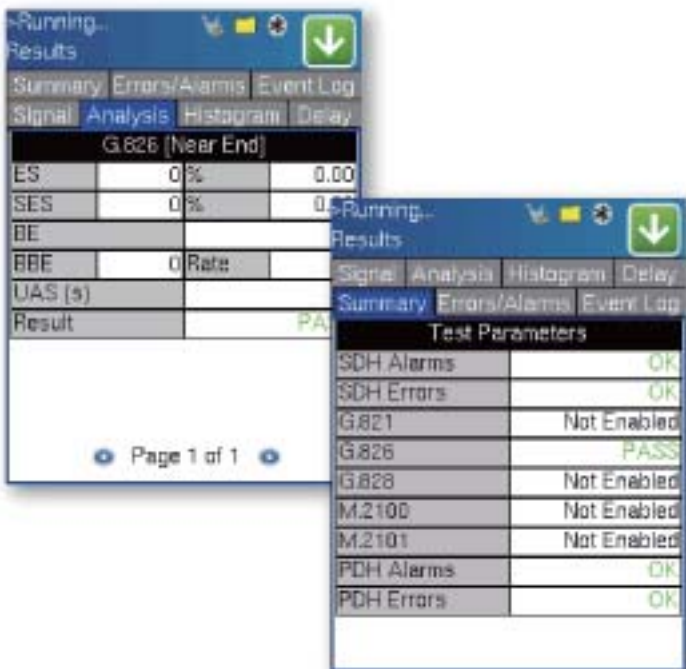
Clock frequency offset error is another analog parameter which is often overlooked. A series of clock tolerances for each signal hierarchy is clearly defined by ITU-T recommendations and should be verified as part of any acceptance/conformance test.



## 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 all of which form an integral part of the performance monitoring capabilities of an SDH network.

The TX150E 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 TX150E, and are logged for further analysis.



# SPECIFICATIONS

## ELECTRICAL INTERFACES

Dual RJ-48 (120 ohm balanced)

Rates and line code:

- 1,544 Mbit/s, AMI & B8ZS (Optional)
- 2,048 Mbit/s, HDB3 & AMI

BNC (75 ohm unbalanced)

Rates and line code:

- 2,048 Mbit/s, HDB3 & AMI
- 34,368 Mbit/s, HDB3
- 44,736 Mbit/s, B3ZS (Optional)
- 139,264 Mbit/s, CMI (Optional)
- 155,520 Mbit/s, 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:

For 2.048 Mbit/s (E1);

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

For 34,368 Mbit/s (E3);

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

### Optional

For 1.544 Mbit/s (DS1);

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

For 44,736 Mbit/s (DS3);

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

For 139,264 Mbit/s (E4) and 155,520 Mbit/s (STM-1E);

- Terminate: ≤ 12.7dB (cable loss)
- Monitor (PMP): ≤ 26dB (20dB resistive, 6dB cable loss)

## CLOCK SYNCHRONIZATION

Internal: 2,048Mbit/s, ± 3.5 ppm stability per ITU-T G.812

Recovered: 2,048 Mbit/s from the incoming signal

External reference via SMA connector

- Clock: 2,048 MHz (sine wave or TTL)
- Signal: 2,048 Mbit/s (HDB3)

Tx Frequency Offset:

- Up to 25,000 ppm in steps of 0.1 ppm for both optical and electrical interfaces

## OPTICAL INTERFACES

Small Form Factor Pluggable (SFP) transceivers compatible with Multi Source Agreement (MSA)

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 (VeEX supplied SFPs only)

Optical Power Measurement: ± 2dB accuracy, 1dB resolution (VeEX supplied SFPs only)



SFP optical transceiver selection table (Refer to ordering options)

Specifications	STM-1/4 (155/622 Mbps)			STM-1/4/16 (155/622/2488 Mbps)		
	301-01-004G	301-01-005G	301-01-006G	301-01-007G	301-01-008G	301-01-009G
<b>General</b>						
Optical option						
Wavelength (nm)	1310	1310	1550	1310	1310	1550
Range (km)	15	40	80	15	40	80
Line rate (Mbps)	Up to 622	Up to 622	Up to 622	Up to 2488	Up to 2488	Up to 2488
Connector	LC duplex	LC duplex	LC duplex	LC duplex	LC duplex	LC duplex
Line coding	NRZ	NRZ	NRZ	NRZ	NRZ	NRZ
<b>Transmitter</b>						
Laser type	Fabry Perot	DFB	DFB	DFB	DFB	DFB
Wavelength range (nm)	1274 to 1366	1280 to 1335	1480 to 1580	1270 to 1360	1280 to 1335	1500 to 1580
Spectral width (nm)	2.5	1	1	1	1	1
Output power (dBm)	-15 to -8	-3 to +2	-3 to +2	-5 to 0	-2 to +3	-2 to +3
<b>Receiver</b>						
Detector type	PIN	PIN	PIN	PIN	APD	APD
Sensitivity (dBm)						
@ 155 Mbps	-28 to -8	-28 to -8	-28 to -8	-23 to -10	-30 to -15	-30 to -15
@ 622 Mbps	-28 to -8	-28 to -8	-28 to -8	-22 to 0	-29 to -9	-29 to -9
@ 2.488 Gbps	N/A	N/A	N/A	-18 to 0	-27 to -9	-28 to -9
Wavelength range (nm)	1260 to 1600	1260 to 1600	1260 to 1600	1270 to 1600	1270 to 1600	1270 to 1600

# SDH FUNCTIONS

## OPERATING MODES

Terminated mode

Monitor mode

Intrusive Through mode

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

Non-Intrusive Through mode

- Pass entire signal through without modification of section and line overhead bytes

## SIGNAL STRUCTURE

STM-1 (VC-n container equipped with);

- Framed or unframed PDH test pattern (per ITU-T 0.150)

STM-4 (VC-n container equipped with);

- Framed or unframed PDH test pattern (per ITU-T 0.150)
- Bulk TSS (per ITU-T 0.181)

STM-16 (VC-n container equipped with);

- Framed or unframed PDH test pattern (per ITU-T 0.150)
- Bulk TSS (per ITU-T 0.181)

## MAPPINGS (According to ITU-T G.707)

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)

Optional

C-11 (unstructured or framed DS1)

## PATTERNS

The following test patterns can be generated:

- PRBS:  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$ ,  $2^{23}-1$ ,  $2^{31}-1$ : normal or inverted
- Fixed: 0000, 1111, 1010, 1000 and 1100
- User programmable word: user defined up to 24 bits

## ERRORS

Insertion of;

- FAS, B1, B2, MS-REI, B3, HP-REI, LP-REI, LP-BIP, slips and bit errors

Insertion mode:

- Single and rate ( $1 \times 10^{-3}$  to  $5 \times 10^{-6}$ )

Detection of;

- FAS, B1, B2, MS-REI, B3, HP-REI, LP-BIP, LP-REI, and bit errors

## ALARMS

Generation of;

- 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

Insertion mode: Static (Enable/Disable)

Monitoring and simultaneous detection of;

- 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

## AUTOMATIC CONFIGURATION

Configures tester to the incoming signal – Bit rate, framing, line coding and test pattern per ITU-T G.707, G.703, 0.151 and 0.181 recommendations where applicable

## OVERHEAD ANALYSIS AND GENERATION

Network Architectures supported

- Linear (per G.783) or Ring (per G.841)

Analysis – Decode and display;

SOH/POH bytes in hexadecimal, binary or ASCII formats;

- S1 synchronization status
- C2 HP 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 signal label

Generation - Programmable Bytes

RSOH:

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

MSOH:

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

HO-POH (VC-4, VC-3):

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

LO-POH (VC-3):

- 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):

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

## OVERHEAD BERT:

- Generation and analysis of PRBS pattern in DCC channels (D1-D3 or D4-D12 bytes) or E1, E2, F1, N1 and N2 bytes
- PRBS:  $2^{23}-1$ ,  $2^{20}-1$ ,  $2^{15}-1$ ,  $2^{11}-1$  (inverted or non inverted)
- Bit error counter, rate and errored seconds

## POINTER ANALYSIS/GENERATION

Analysis

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

Generation

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

## TRIBUTARY SCAN

Automatically scan VC-12s for errors, alarms and events using sequential BER

# PDH FUNCTIONS

## OPERATING MODES

Terminated mode

Monitor mode

Intrusive Thru mode (E1 only)

Bridge (E1 only, DS1 Optional)

## SIGNAL STRUCTURE

2,048 Mbit/s (E1)

- Unframed or Framed with/without CRC per ITU-T G.704 (PCM30, PCM30C, PCM31, PCM31C)
- Test signal in N/M x 64 kbit/s where N=1 to 30

34,368 Mbit/s (E3)

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

Optional

1,544 Mbit/s (DS1)

- Unframed or Framed SF (D4), ESF per ANSI and Telcordia standards where applicable
- Test signal in N x 64 kbit/s, N x 56 kbit/s where N=1 to 24

44,736 Mbit/s (DS3)

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

139,264 Mbit/s (E4)

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

## PATTERNS

The following test patterns can be generated:

- PRBS:  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$ ,  $2^{23}-1$ ,  $2^{31}-1$ : normal or inverted
- Fixed: 0000, 1111, 1010, 1000 and 1100
- User programmable word: user defined up to 24 bits

## ERRORS

Insertion;

- 2,048 Mbit/s (E1): Code, FAS, CRC, EBIT, Bit errors
- 34,368 Mbit/s (E3): Code, FAS, 2M FAS, 2M, Bit errors
- Single or continuous rate ( $1 \times 10^{-3}$  to  $5 \times 10^{-6}$ )

Optional

- 1,544 Mbit/s (DS1): Code, FAS, Bit, Frame, CRC
- 44,736 Mbit/s (DS3): Code, FAS, MFAS, P/C-Parity, Bit errors
- 139,264 Mbit/s (E4): Code, FAS, Bit errors

Measurement:

- 2,048 Mbit/s (E1): Code, FAS, CRC, E-BIT and Bit errors
- 34,368 Mbit/s (E3): Code, FAS, Bit errors

Optional (DS1, DS3 and E4) – where applicable

- Code, FAS, MFAS, 2M CRC, P/C-Parity, Bit errors

## ALARMS

Generation:

- 2,048 Mbit/s (E1): LOS, AIS, LOF, RDI
- 34,368 Mbit/s (E3): LOS, AIS, LOF, RDI, 2M LOF, 2M RDI
- Mode: Static (Enable/Disable)

Optional

- 1,544 Mbit/s (DS1): AIS, yellow, idle, LOS, LOF
- 44,736 Mbit/s (DS3): LOS, LOF, OOF, AIS, Parity
- 139,264 Mbit/s (E4): AIS, FAS RDI

Measurement:

- 2,048 Mbit/s (E1): LOS, AIS, LOF, LOMF, RDI and LSS
- 34,368 Mbit/s (E3): LOS, AIS, LOF, RDI and LSS

Optional (T-Carrier DS1/DS3)

- LOS, AIS, LOF, OOF, IDLE, YELLOW and LSS

## 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 recommendation: ES, EFS, SES, DM, and UAS with HRP 1% to 100%
- ITU-T G.826 recommendation: 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 (TSE)
- ITU-T G.828 recommendation: ES, EFS, SES, BBE, SEP, UAS with HRP 1% to 100%
- ITU-T G.829 recommendation: ES, EFS, SES, BBE, UAS on RSOH (B1), MSOH (B2) or TSE
- ITU-T M.2100 recommendation: 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 recommendation: 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)

## 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 & Electrical Interfaces: Hz & bit/s 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

- Bit rates: 2,048 Mbit/s (E1) and 34,368 Mbit/s (E3)
- Mode: Non-Intrusive
- Display: Pulse shape with Conformance mask verification
- Parameters: Width, Rise/Fall time, Overshoot/Undershoot
- Conformance Mask: G.703

#### T-Carrier

- Bit rates: 1,544 Mbit/s (DS1) and 44,736 Mbit/s (DS3)
- Conformance Masks: G.703, ANSI T1.102, T1.403, T1.404 where applicable

### AUTOMATIC PROTECTION SWITCHING (APS) / SERVICE DISRUPTION MEASUREMENT

- Measurement of disruption time on SDH & PDH interfaces
- Tributaries: PDH (E1), SDH
- Pass/Fail Range: 1 ms to 10 seconds
- Resolution: 1 ms
- Triggers: MS-AIS, AU-AIS, TU-AIS, B2
- 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/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)

## General Specifications

Size	210 x 100 x 55 mm (H x W x D) (8.25 x 3.75 x 2.25 in)
Weight	Less than 1 kg (less than 2.2 lbs)
Battery	LiIon Battery Pack, Operating time > 3 hours
AC Adapter	Input: 100-240 VAC, 50-60 Hz 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 1m (3 ft) drop to concrete on all sides
Water-resistance	May be used in heavy rain
Interfaces	USB 2.0 Host and Client, RJ45 10/100T Ethernet
Languages	Multiple languages can be supported

## ORDERING INFORMATION

Z04-00-001P VePAL TX150E Handheld SDH/PDH Test Set

### Interfaces/Test Options

499-05-040	1.544Mbit/s (DS1) and C-11 Mapping
499-05-041	45Mbit/s Testing
499-05-042	155Mbit/s Electrical Testing
499-05-043	155 Mbit/s Optical Testing (require SFP option)
499-05-044	155/622 Mbit/s Optical Testing (require SFP option)
499-05-045	155/622/2488 Mbit/s Optical Testing (require SFP option)
499-05-046	APS/Service Disruption Measurement
499-05-047	Tandem Connection Monitoring
499-05-048	ITU-T G.783 Pointer Test Sequences
499-05-049	2 Mbit/s and 34 Mbit/s Pulse Mask Analysis
499-05-050	1.5 Mbit/s Pulse Mask Analysis
499-05-051	45 Mbit/s Pulse Mask Analysis
499-05-052	139 Mbit/s Testing

### SFP Transceiver Options

301-01-004G	1310nm IR (15km), 155M/622M STM1/4 - OC3/12
301-01-005G	1310nm LR (40km), 155M/622M STM1/4 - OC3/12
301-01-006G	1550nm LR (80km), 155M/622M STM1/4 - OC3/12
301-01-007G	1310nm IR (15km), 155M/622M/2.5G STM1/4/16 - OC3/12/48
301-01-008G	1310nm LR (40km), 155M/622M/2.5G STM1/4/16 - OC3/12/48
301-01-009G	1550nm LR (80km), 155M/622M/2.5G STM1/4/16 - OC3/12/48

### Additional Options

499-05-001	Web Browser (require advanced IP option)
499-05-002	NetWiz
499-05-003	Remote Control
499-05-007	VoIP Expert
499-05-008	IPTV Expert
Z88-00-001G	WiFi Wiz, incl. USB WiFi Adaptor
Z88-00-001P	VoIP Call Expert, incl. VoIP USB Adaptor & Earplug
Z88-00-005G	Advanced IP, incl. Ethernet Cable

### Recommended Accessories

F02-00-008G	RJ48 to BNC Test Cable, 2 m
F02-00-009G	RJ48 to 3-Pin Banana Test Cable, 2 m
F02-00-010G	BNC to BNC Test Cable, 2 m
F05-00-005G	LCPC to LCPC Duplex Optical Patchcord, 2 m
F05-00-006G	LCPC to SCPC Duplex Optical Patchcord, 2 m
F05-00-007G	LCPC to FCPC Duplex Optical Patchcord, 2 m

### Replacement Items

405-02-001G	Screen Protector
A01-00-001G	AC Adaptor
A02-00-001G	Car Adaptor
B02-03-001G	Battery Pack
C01-00-001G	Carrying Case (Basic)
C02-00-002G	Carrying Pouch
C03-00-001G	Shoulder Strap
F02-00-001G	Ethernet Cable RJ45 to RJ45 2 m (6 ft)
F04-00-001G	Power Cord - US 2 m (6 ft)
F04-00-002G	Power Cord - EU 2 m (6 ft)
F04-00-003G	Power Cord - UK 2 m (6 ft)
Z77-00-001G	Stylus (pack of 5)



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