VePAL CX350

Advanced CATV Analyzer

CATV Network Testing Simplified

VeEX® VePAL CX350 is a portable, all-in-one test solution for legacy analog and digital Cable TV networks, supporting SLM, DOCSIS, Ethernet, and T1 test capabilities.

Platform Highlights

- Robust, lightweight chassis packed with powerful features for demanding environments and test conditions
- High resolution color 7” touch-screen with graphical user interface
- Fast system power up time in less than 20 seconds
- Ethernet LAN management port for remote control, back office applications, and workforce management
- Fast and efficient test result transfer to USB memory stick or FTP upload via LAN or DOCSIS ports
- Maintain instrument software, manage test setups and channel tables, process measurement results and generate customer test reports using included ReVeal™ PC software
- Extend field testing time using interchangeable LiIon battery pack/s
- Ability to lock user interface to prevent unwanted human interference during long-term testing
- Supports Triple Play test applications such as VoIP, IPTV and high speed Internet access via Ethernet management port, DOCSIS test port, or USB WiFi adaptor

Key Features

- Frequency range from 5 MHz to 1 GHz
- Comprehensive SLM measurements (single channel, system scan, tilt, and installation check)
- Video and Audio power level measurements (Annex A, B, C signals)
- Forward and Return path QAM measurements (MER, Pre/Post BER, Constellation diagram, Histogram, and Equalizer on/off mode)
- Advanced Digital measurements* (HUM, EVM, Phase Jitter, Symbol Rate Error, Frequency Response, Group Delay)
- Dual band DOCSIS 3.0/Euro-DOCSIS 3.0 compliant Cable Modem*
- 8 x 4 Channel Bonding (8DS x 4DS)
- Spectrum view to capture impulse noise and interference
- Home Installation Procedure (HIP) with user defined test limits
- Built-in Upstream Generator* (CW, QPSK, QAM 16/64/128/256 modulation)
- Single 10/100/1000-T/X Ethernet port (BERT, Throughput, RFC2544 and Loopback testing)*
- Built-in TDR* supports up to 2 km/6000 ft of standard coaxial cable
- Single DS1 Transmitter/Receiver with Balanced (100 Ω) interfaces* for full Rate DS1 and Fractional Nx 64 kbps or Nx56 kbps testing
- ISDN PRI (ANSI and ETSI) call setup*

**Optional features*

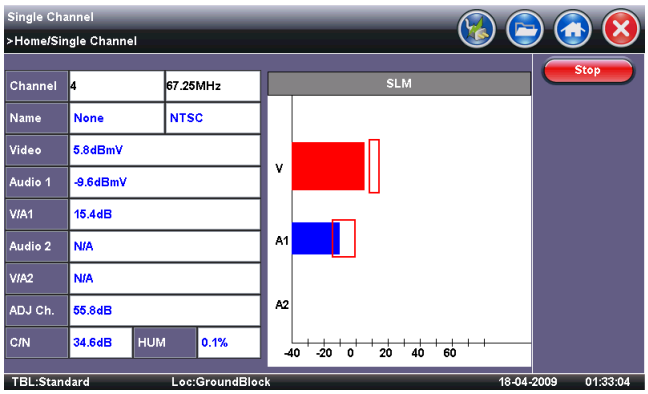
SLM Features

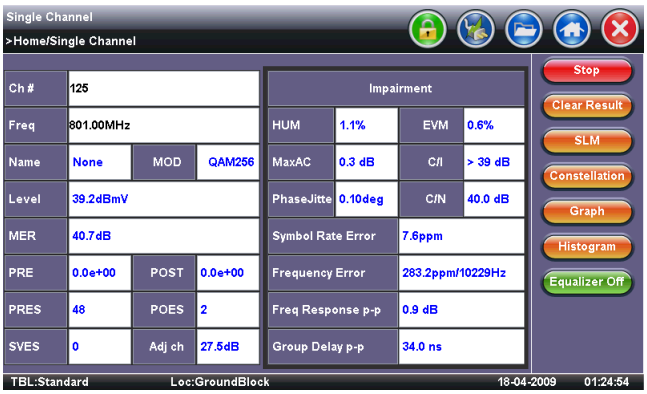
Single Channel Measurement

Analog and digital carriers are very different in terms of signal content and power distribution and thus require the advanced SLM techniques supported in the CX350.

In **analog** mode, video and audio levels, V/A, Gated C/N, Adjacent channels, gated CSO, CSO/CTB, and HUM are measured.

In **digital** mode, average power, MER, Pre-BER, Post-BER, Error seconds, and constellation diagram are displayed. User programmable location thresholds and test point compensation are useful utilities enabling fast, simple and automated testing of carrier signals.



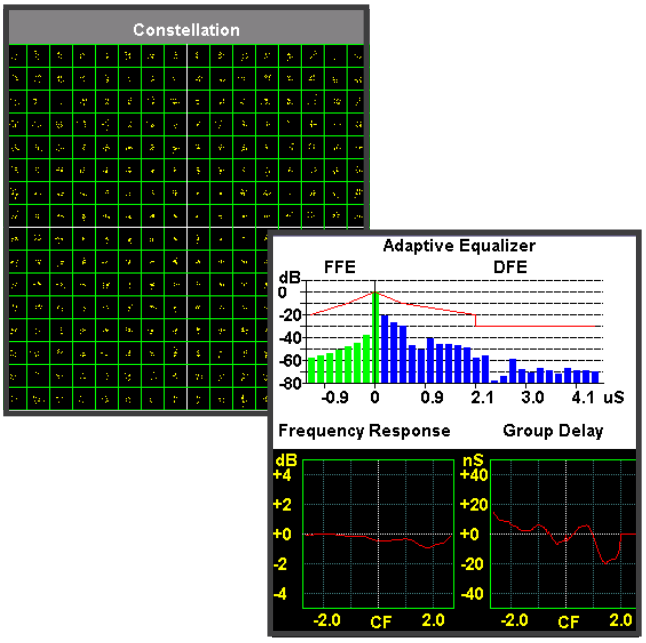


Advanced Digital Channel Analysis

Digital pictures do not show signal impairment until it is too late because the margin between acceptable quality and failure is quite small.

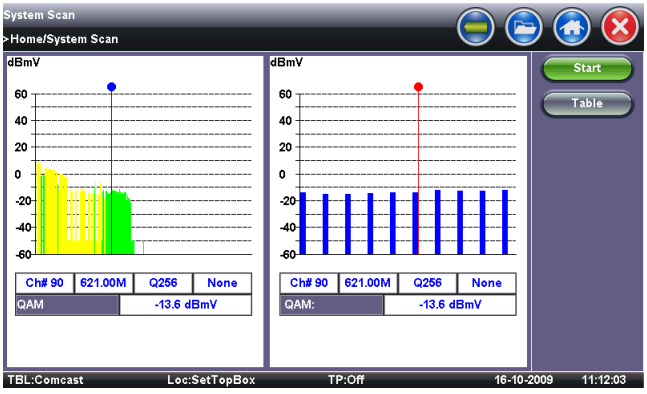
Constellation diagrams – A valuable tool to help detect the presence of noise, phase jitter, interference, gain compression, laser clipping and ingress, all of which impact overall signal quality and thus reduces Modulation Error Ratio (MER). The Advanced Digital Analysis option has added in depth analysis of a QAM carrier with Phase Jitter, Group Delay, Symbol rate error, Frequency error, Maximum Amplitude Change, HUM, C/I, C/N, and Frequency response measurements.

Adaptive Equalization – The built-in equalizer does a great job of improving MER of a QAM signal, but it is also important for technicians to know how hard the system is working to ensure adequate margin for system degradation. The adaptive equalizer in the CX350 can be turned off to make troubleshooting marginal amplifiers, ingress, CPD and related impairments easier.



System Scan

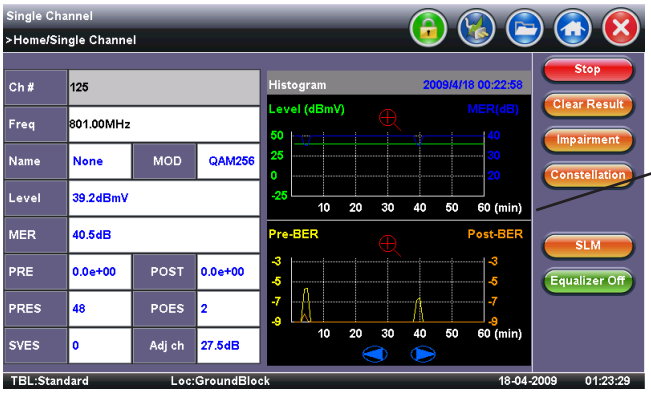
Within seconds, all analog and digital channels at a service location are measured. Signal parameters including channel number, channel name, frequency, modulation type and power levels are measured. Signal degradation or tilt can be easily pinpointed using on-screen markers and the zoom mode.

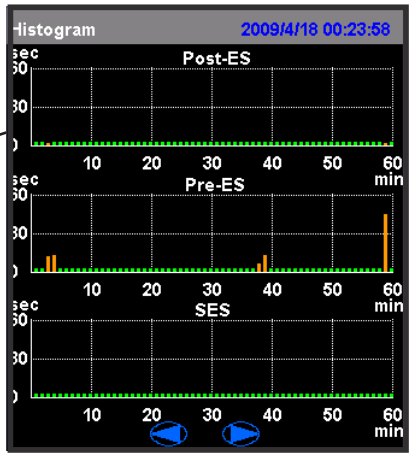


SLM/TDR Features

Histogram Analysis

Noise impulses can suddenly disrupt a digital carrier but it is difficult to detect without monitoring the carrier over a period time.

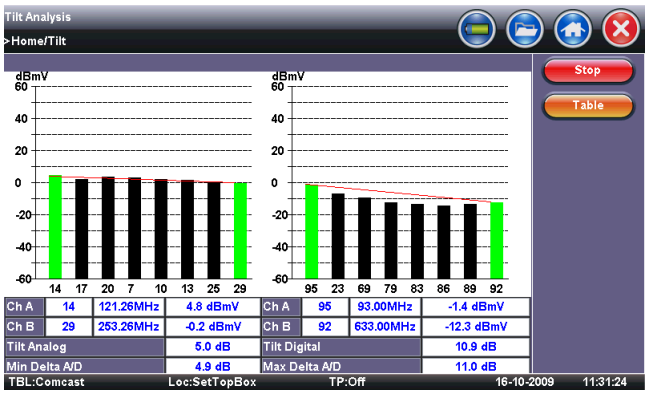




The histogram feature records level, MER, Pre-BER, Post-BER, and Error seconds on per second time bucket for up to 60 minutes. The results are shown in graphical format that allows easy correlation of measured parameters down to one-second resolution.

Tilt

Tilt measurements identify distortion over the frequency range allowing technicians to apply correct equalization or compensation to the HFC network. Up to eight analog signals and digital carriers including DOCSIS channels can be predefined on a channel table and selected to perform the tilt measurement. The measurement can be performed between the lowest and highest channel or any user selectable channel by tapping the applicable bar on screen.

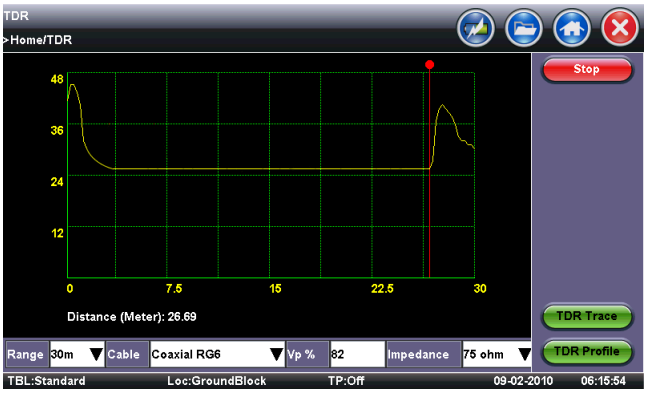


Installation Check

Up to 16 analog and 16 digitals are checked against preset location thresholds. The feature is particularly useful to verify and turn up service at new installations or after service is restored, Pass and Fail conditions are color coded for easy interpretation and test results are clearly displayed. This automatic test procedure adds consistency to the final service qualification. The CX350 can store up to 20 channel tables each of with can be pre-programmed with channels to be used for installation check.

Time Domain Reflectometer (TDR)

The CX350 applies advanced signal processing techniques to detect opens, short circuits, splices, taps, water ingress and other elusive impedance mismatches on coaxial cables up to distances of 2 km (6,000 ft) with ± 1% accuracy.



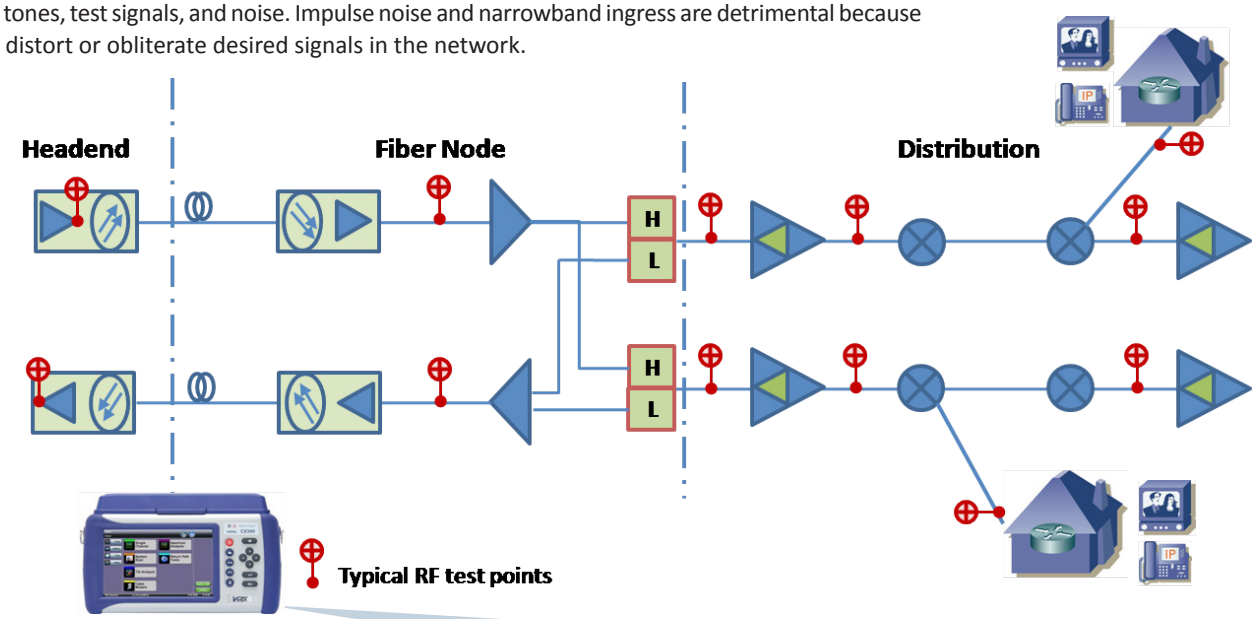
The cable under test is scanned within seconds, allowing the user to view the full run and to identify faults quickly.

Novice TDR users will appreciate the pre-set gain and pulse width feature which automatically adjust the vertical position of the trace for each range setting. All major operating and setting parameters can be easily accessed using only 4 tabs located at the bottom of the screen.

Experienced technicians will benefit from selectable impedance settings and adjustable Velocity Propagation (VP) factors to perform various tests on different cables.

Spectrum Analysis

Throughout a CATV system, power is distributed in the form of QAM, QPSK, TV and FM carriers, pilot tones, test signals, and noise. Impulse noise and narrowband ingress are detrimental because they distort or obliterate desired signals in the network.



The CX350 is equipped with powerful spectrum analyzer features including a high dynamic range, markers, peak hold, variable resolution bandwidth (RBW) and variable dwell time (sweep speed) to help troubleshoot, identify and fix interference related problems.

DOCSIS Transmission

DOCSIS 2.0/3.0 standards include recommendations and limits for downstream and upstream RF performance. Forward Error Correction (FEC) and deep interleaving techniques help protect IP data against radio frequency (RF) noise impairments; however network performance is often impaired by interference. Cable modems transmitting on frequencies with high levels of noise are susceptible to packet loss and uncorrectable FEC errors are indicative of degraded upstream performance and poor data throughput.

Upstream Ingress

The return path is more susceptible to RF impairments because the frequency spectrum is heavily used for Hum and Citizen Band radio transmissions. Interference is not only limited to RF transmissions; Impulse noise generated by electric motors, switches, lightning strikes, high voltage power lines, vehicle ignitions, or household electrical appliances at the subscriber premise are particularly damaging to data transmissions where short bursts of interference can seriously reduce data throughput.

The return path is also very vulnerable to a phenomenon known as Noise funneling. The summation of all unwanted noise (Gaussian, ingress and impulse noise) coming from both subscribers and the cable plant itself affects the return transmission system and needs to be monitored.

Laser Clipping

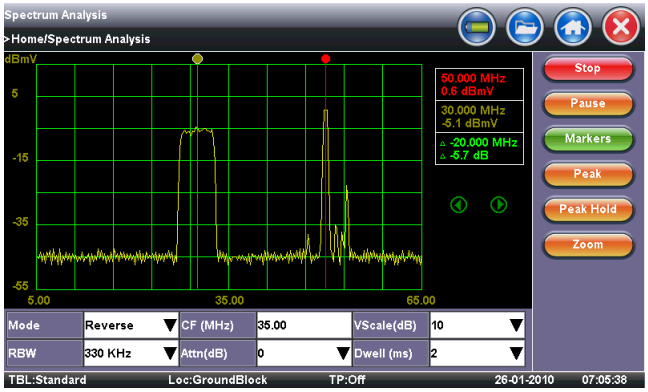
Ingress and impulse noise can cause signal clipping when upstream fiber amplifier inputs are presented with excessive power levels. As more carriers are added to the return path using channel bonding, composite power to the laser will increase.

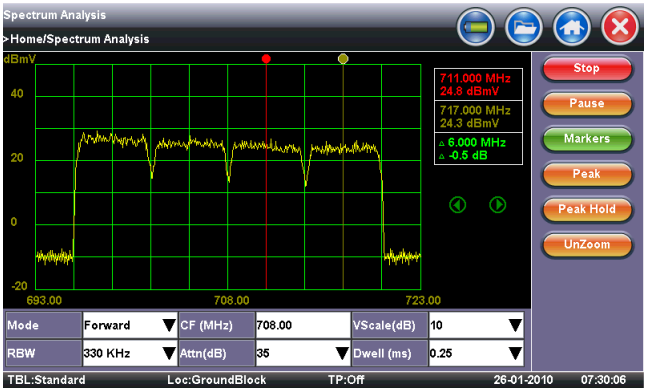
Common Path Intermodulation Distortion (CPID/CPIM)

Spurious signals appearing in the upstream composed of distortion products of the downstream signals. Lower frequency components are passed through the diplex filter and amplified by the return amplifier. Common Path Distortions are intermittent by nature and are directly related to poor connections, corrosion, kinks and radial cracks in the cable.

Downstream Ingress

Interference originating outside the CATV system (co-channel and ingress) or generated within the system (inter-mod, hum and cross modulation) occur frequently in the forward path.

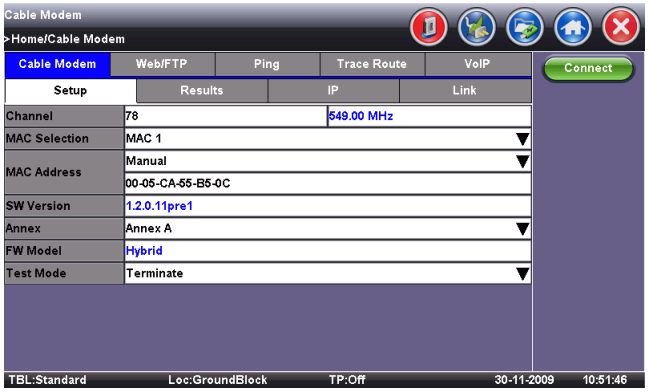




DOCSIS© 3.0

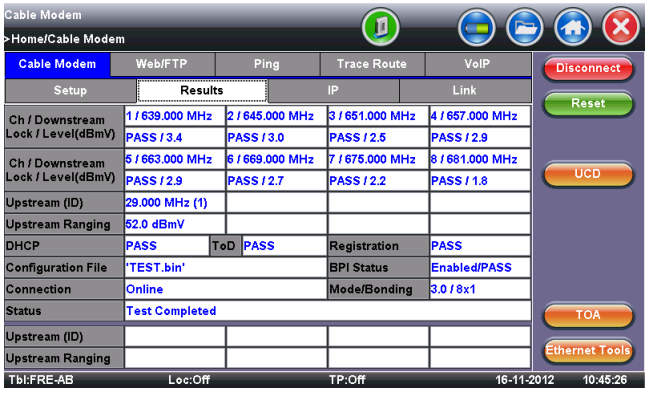
DOCSIS 3.0/Euro-DOCSIS 3.0 Modem Emulation

Equipped with a CableLabs® certified cable modem based on latest generation DOCSIS 3.0 technology, the CX350 enables technicians to perform dual band RF connection tests, without having to carry a separate test modem on service calls.



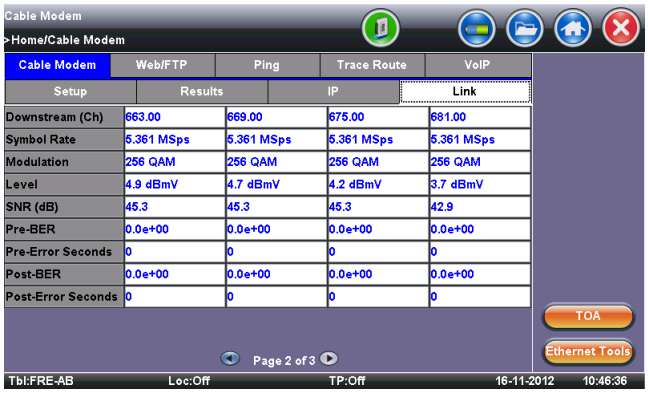
Intuitive Results

At a glance, the technician is able to view a summary of the ranging and registration process, check AES and Baseline Privacy (BPI+) encryption status and identify which connection parameters have passed or failed.



Link Statistics

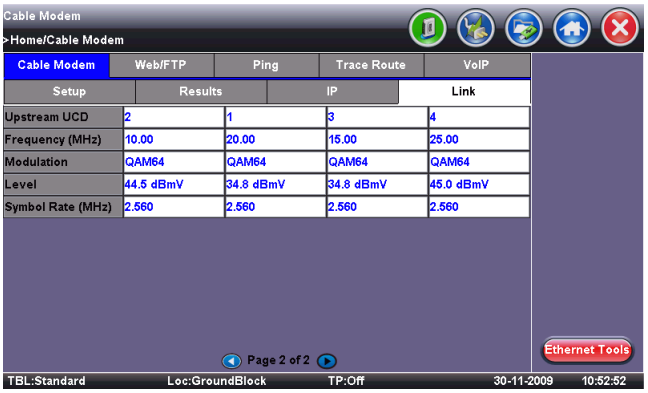
The cable modem offers data transmission speeds up to 220 Mbps (downstream) and 100 Mbps (upstream) using four-channel bonding technology. A range of downstream and upstream link connection parameters including frequency, power, modulation, symbol rates and signal margins are evaluated and displayed.



Verifying Upstream Channel Bonding

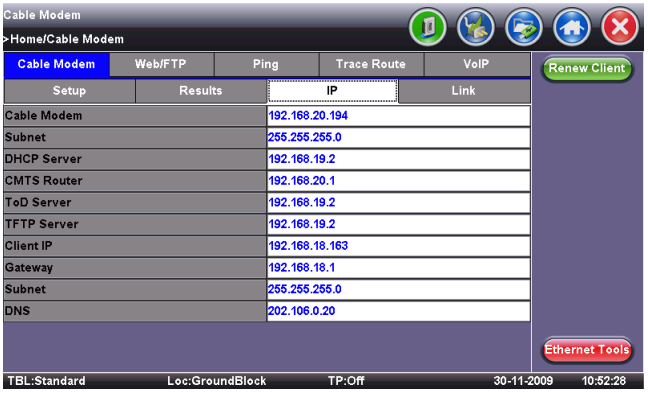
DOCSIS 3.0 provides several enhancements, most notably channel bonding giving cable operators a flexible way to increase bandwidth to customers. Upstream speeds in particular have come under a lot of pressure due to a sharp increase in user generated content such as video and photo uploads, driven by the proliferation of social and networking sites.

Checking RF Levels - Significant consideration must be given to the cumulative RF power loading that is realized with upstream channel bonding. Four upstream DOCSIS channels transmitting simultaneously can result in a large contiguous channel loading. To avoid excess power hitting the return path fiber-optic transmitter and to reduce the possibility of laser clipping, the power levels of each channel can be carefully monitored in the link measurement tab.



IPv6 Support and Network Server Verification

Once successful upranging is complete, the DOCSIS 3.0 modem registers with the Cable Modem Termination System (CMTS) and checks for an IPv6 address before looking for an IPv4 address. IP addresses from the network servers (DHCP, TFTP, TOD, and DNS) are discovered and clearly displayed.

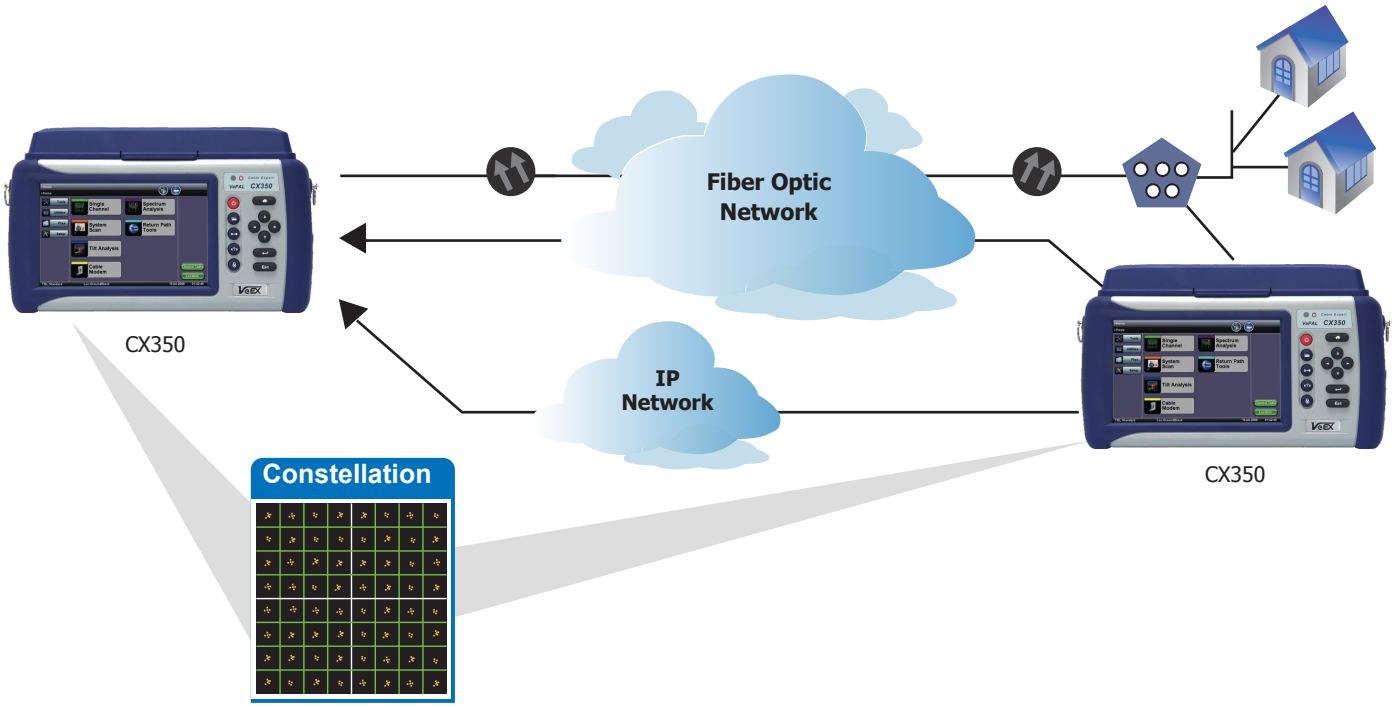


Additional DOCSIS 3.0 Modem Features

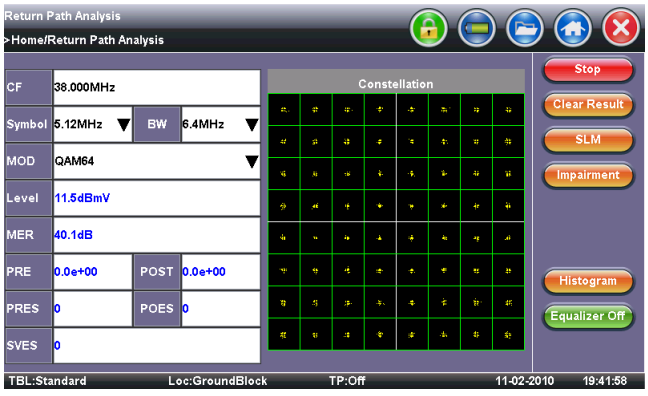
- Enhanced Security – Advanced Encryption Standard (AES) support
- Pass-Through testing – modem emulation to verify high bandwidth data transfer between PC and Network

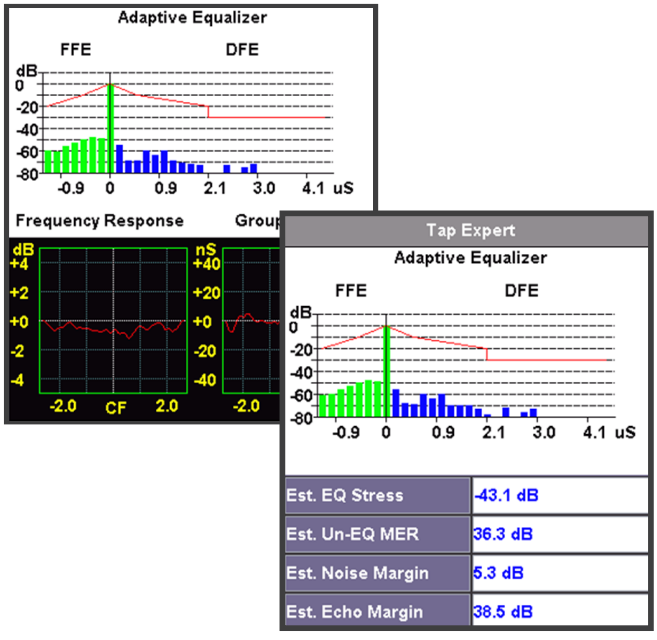
Upstream Signal Generator (USG)

Evaluate the bandwidth and noise performance characteristics of the reverse path with a choice of CW, QPSK, 16 QAM, 64 QAM and 128 QAM modulation types using industry standard symbol rates. Transmitting a known reference signal between 5-65 MHz (Annex A) or 5-42 MHz (Annex B) into the reverse path at a user defined power level and modulation, allows a technician to evaluate phase and amplitude distortions resulting from any misalignment present in the network. Injected reference signals can be used to determine the headroom in the reverse path and to identify laser clipping resulting from signal overload.



The USG function fitted with Forward Error Correction (FEC) capability, is compatible with the Return Path analysis options found on VeEX CX180+, CX180R, CX350 and CX380 CATV test sets including selected 3rd party CATV QAM analyzers. Depending on the companion analyzer used, Digital channel power, MER (equalized and unequalized), Pre/Post FEC, EVM, Phase Jitter, Hum, Group Delay and Symbol rate errors can all be evaluated. These tests are invaluable to characterize the in-channel flatness, in-channel group delay, and adaptive equalizer operation.



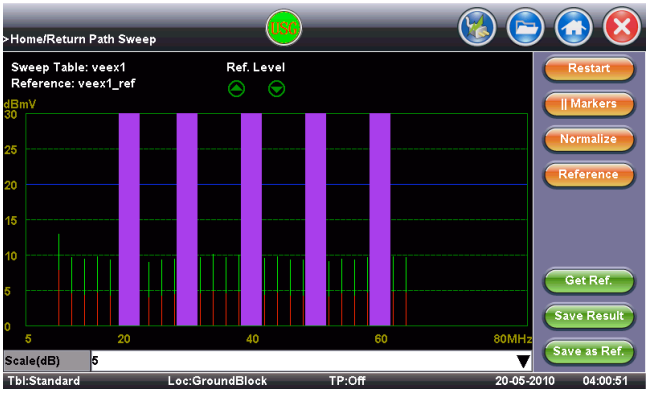


Return Path Sweep

The CX350 incorporates a sweep transmitter (USG) capable of generating sweep tones over a 5 MHz to 65 MHz frequency range with 125 kHz resolution, and amplitude levels ranging from 0 to 58 dBmV with 1 dB resolution.

When paired with a companion CX380 handheld unit or a CX180R rack mount Ingress system located in the Headend, the entire return path frequency spectrum can be precisely characterized for DOCSIS 3.0 communications. Protection "Guard Bands" can be pre-configured to prevent test tones interfering with active DOCSIS transmissions.

The sweep system communicates the user defined sweep tables and measured test data over the Internet, freeing up valuable downstream bandwidth typically used by conventional telemetry systems found in competitor systems.

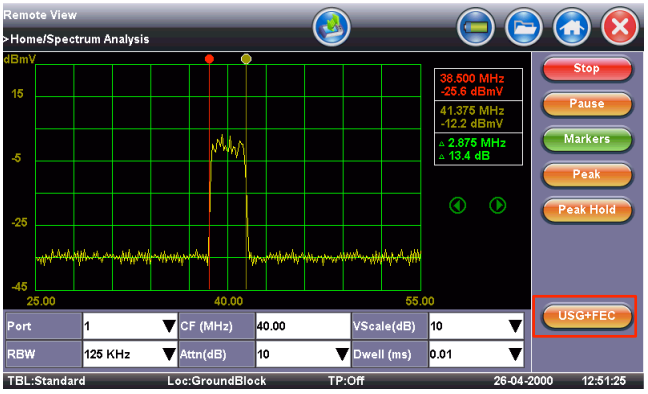


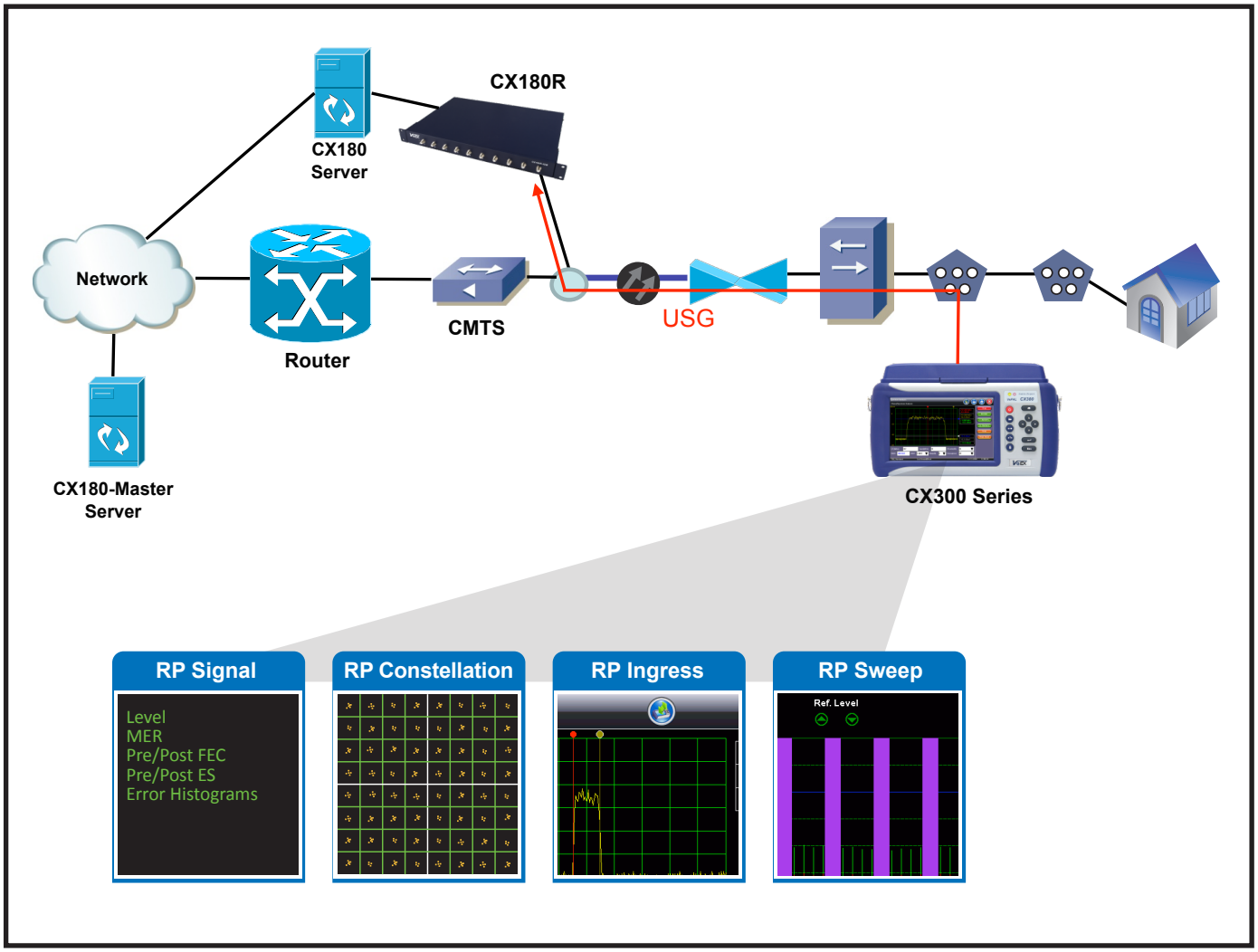
Remote View

Return path troubleshooting and testing is simplified when the CX350 is equipped with the Remote View option.

Utilizing a wired (10/100Base-T or DOCSIS) or wireless (3G UMTS or 802.11 WiFi) Internet connection, a technician operating the unit in the field is able to view real time measurements being performed by the companion CX380 or CX180R located in an upstream Node or Headend itself.

Developed specifically for dual ended test applications, evaluating MER, BER and Constellation and other advanced measurements like group delay and frequency response is extremely fast and convenient. In addition to sweep, real-time return path ingress measurements performed in the Headend by the CX380 or CX180R spectrum analyzer can also be viewed, thus making it a truly unique solution for upstream testing and characterization.





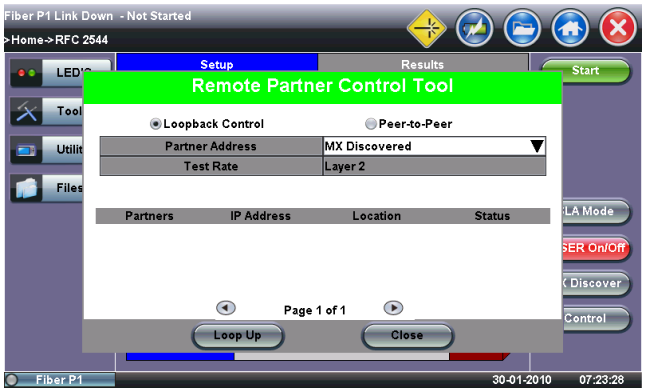
Ethernet

Test Interfaces

Single copper (RJ45) and optical test ports (SFP) support 100% wire speed traffic generation and reception for 10/100/1000Base-T, 1000Base-SX, 1000Base-LX or 1000Base-ZX full-duplex networks at all packet sizes.

RFC2544 Compliance Testing

Automated test suite performs throughput, latency, frame loss, and back-to-back frame tests, and checks all industry recommended frame sizes (including two user defined frame sizes) up to full line rate. The test can be performed with a far end test partner in loopback mode (symmetrical traffic) or peer-to-peer mode (asymmetrical traffic). User defined test thresholds ensure accurate SLA assurance/verification while an advanced SLA mode generates background streams to closely approximate actual live traffic conditions.



Intelligent Loopbacks

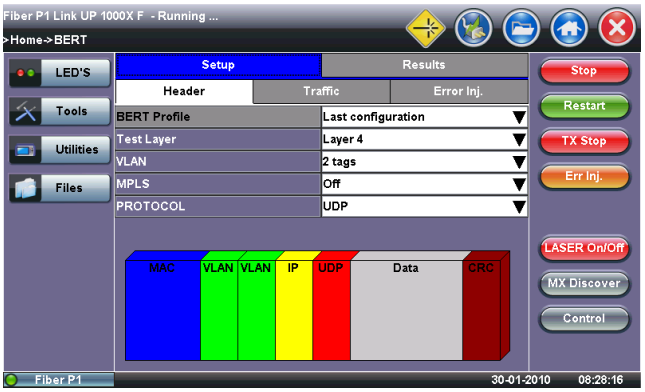
Four modes are available for looping test traffic:

- Layer 1 - incoming traffic is looped back unaltered
- Layer 2 - incoming unicast traffic is looped back with MAC source/destination addresses swapped
- Layer 3 – same as layer 2 with both MAC and IP addresses swapped
- Layer 4 – same as Layer 3, with UDP/TCP ports swapped

BERT

Layer 1, 2, 3, and Layer 4 BER tests are supported. PRBS, stress or user defined test patterns simulate various conditions. Service disruption measurements including CRC error checking are performed. BER testing is possible using a physical loop at the far end (Layer 1), or using a second test unit or intelligent loopback device in Smart Loop or in Peer-to-Peer mode.

VLAN stacking (Q-in-Q) is supported for Metro and Carrier Ethernet applications. Up to three tags makes provision for carrier/service provider assigned VLANs, while retaining the VLAN of customer traffic.



Throughput Testing

Testing with multiple streams enables service providers to simulate and qualify a variety of applications and perform Ethernet QoS measurements.

- **Multiple Streams Generation**
  Up to eight individual traffic streams can be configured with independent VLAN stacking (802.1ad Q-in-Q), VLAN ID (802.1Q), VLAN Priority (802.1p), ToS and DSCP settings.

- **Delay and Jitter Measurements**
  Frame delay (PDV) and inter frame delay variation (IPDV) measurements based on RFC3393 recommendations are performed on test traffic during BER or throughput tests when unit is equipped with the Jitter software option.

Ethernet over DOCSIS

Today's cable operator network infrastructure, which combines a 40G/10G backbone with DOCSIS 3.0 over HFC, has strongly positioned MSOs to offer business class Ethernet based services to small and medium businesses. Key service offerings include guaranteed data, hosted voice, online backup and security, and other cloud based services.

Using its built-in Ethernet test traffic engine, the CX350 can generate traffic over the DOCSIS test port to verify bi-directional, end-to-end DOCSIS throughtput rates with a far-end Ethernet test device. Verification is done from the Customer Premise to the Headend CMTS.

In Ethernet over DOCSIS mode, the CX350 emulates the Cable Modem and simulates the customer's Ethernet traffic, up to maximum DOCSIS 3.0 throughput rates. This unique capability is ideal for MSOs to verify their Metro and Carrier Ethernet Service offerings.

Throughput Testing

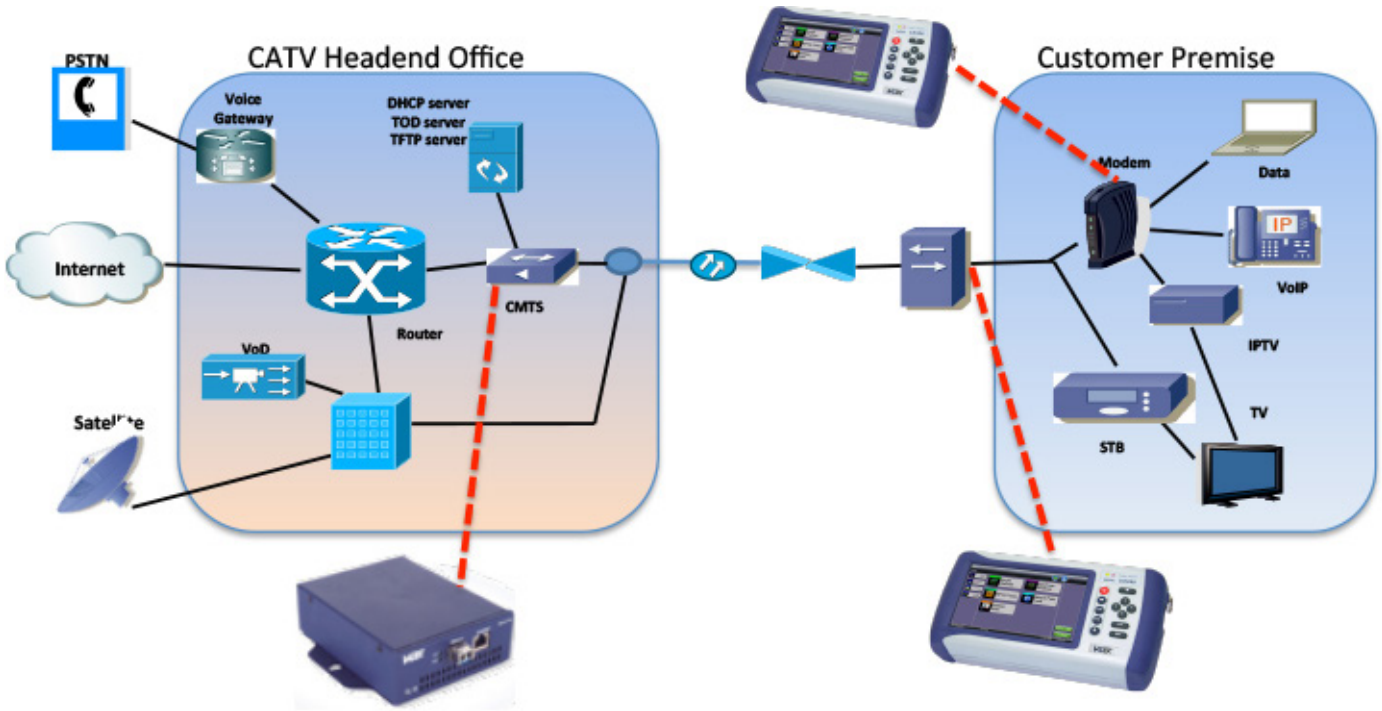
Actual Cable Modem CPE verification can be performed by connecting the CX350's Ethernet test port to the Cable Modem's Ethernet port and generate test traffic to the far-end Ethernet test device connected behind the CMTS.

Benefits

- The Asymmetric RFC2544 test suite offers an automated verification of throughput rates.
- The Throughput application enables for deeper troubleshooting and verification with differentiation of traffic flow types (Constant, Ramp, and Burst) and different frame size configurations.

Testing Premise

From the Customer Premise, test directly at the RF interface or through the real Cable Modem's Ethernet interface. At the CATV Headend office, connect a MPX100 or any other VeEX Ethernet test set behind the CMTS. Here the MPX functions as a Responder, with only an IP address needed to be configured on the test port. The CX350 functions as the Controller via the RF or Ethernet interface, running the RFC2544 Asymmetric test suite.



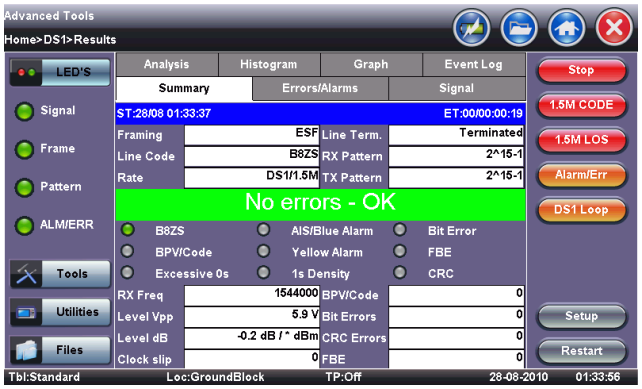
T1 Testing

Quick and Easy 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. Taking this into account, the test interface, signal structure, and test pattern setup boxes are structured logically so the user can quickly and efficiently configure the unit via an intuitive graphical menu.

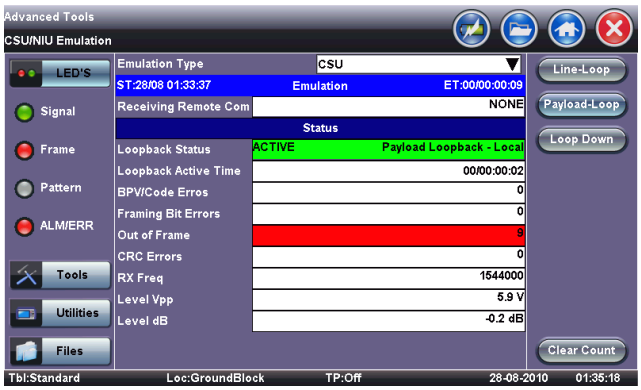
Performance Analysis Summary

A detailed summary screen clearly displays the signal status and Pass/Fail criteria for each major performance parameter alerting the user to any problems. Color LEDs provide information about the current status of the instrument's receiver - indicators toggle from green to red when an alarm conditions occur. Summary indicators are coupled to the high level Alarm/Error LEDs which can be hidden or viewed depending on operator preference.



CSU/NIU Emulation

The unit incorporates CSU and NIU emulation which helps to isolate problematic T1 circuits. Loopback status, Code and Frame errors including Level measurements are presented in an easy to read table. Dedicated function buttons are immediately accessible to initiate different loopback commands.



DS1 Loopback

Loopbacks are a simple, yet effective method to locate the source of alarms and errors, and are often the quickest route to resolve a problem.

Several pre-defined codes (Inband, ESF FDL, HDSL and USER) are available to loop up/down network elements and this can quickly identify impaired spans over a large area.

View Rx Data

The DS1 receiver can be used to monitor a live T1 circuit for status and alarms throughout the network. The real-time View RX Data feature or ABCD bits display quickly help find timing and protocol problems in CAS type signaling protocols.

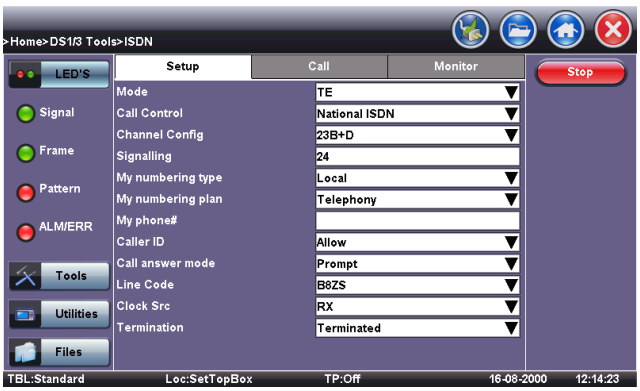
VF Tasks

Talk and listen operations as well transmitting and measuring tones on an individual user defined PCM channel is possible in the Advanced Tools mode. TIMS measurements including Level and Frequency can be performed to identify problematic timeslots.

ISDN PRI Testing

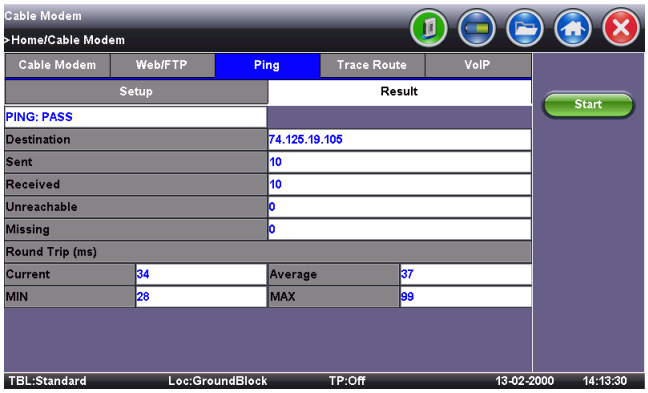
The option provides key functionality necessary for testing and troubleshooting T1 Primary Rate connections. Operating in TE or NT modes, the unit is able to setup and receive ISDN calls with user-defined parameters including call control protocol, called number and related facilities.

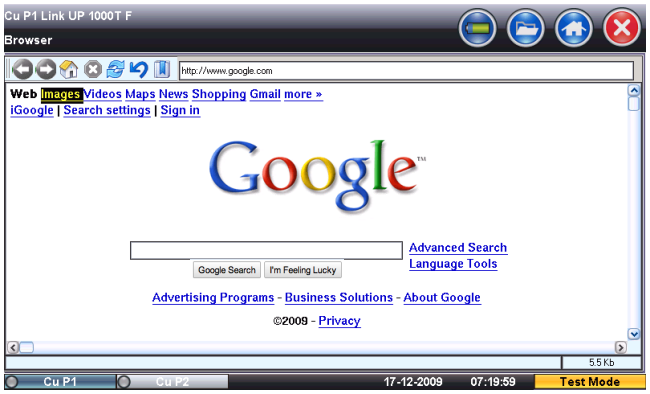
Protocol functions feature detailed signaling statistics, message monitoring and decode, and complete result presentation. Equipped with these capabilities, analysis of international and national ISDN, and other access protocols is possible.



IP Testing

Triple Play services are IP centric, so IP test functions are no longer considered a luxury. On a daily basis, technicians verify network connections during service installation and restoration, so Ping test, Trace Route, ARP, Web browser, FTP throughput, VoIP Call emulation and IPTV measurement have become routine measurements. IP verification on the CX350 is possible over the DOCSIS Cable Modem and 10/100Base-T Ethernet test ports, while a subset of these tools is available using the USB WiFi adaptor.

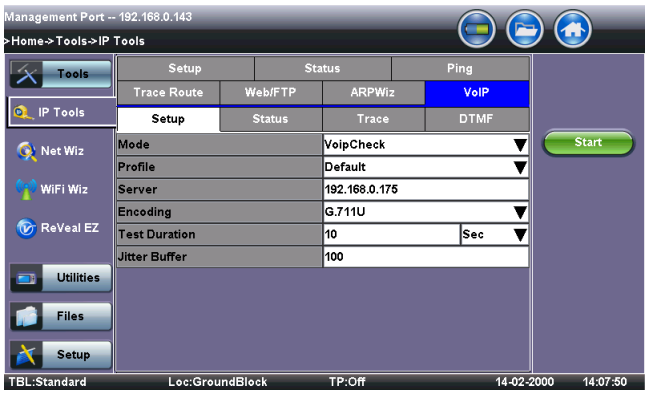


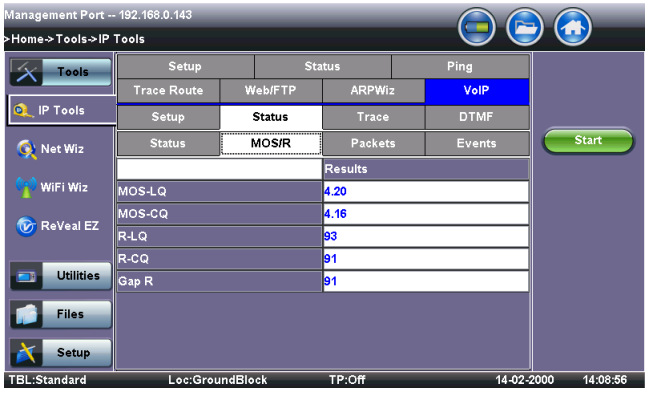


VoIP Testing

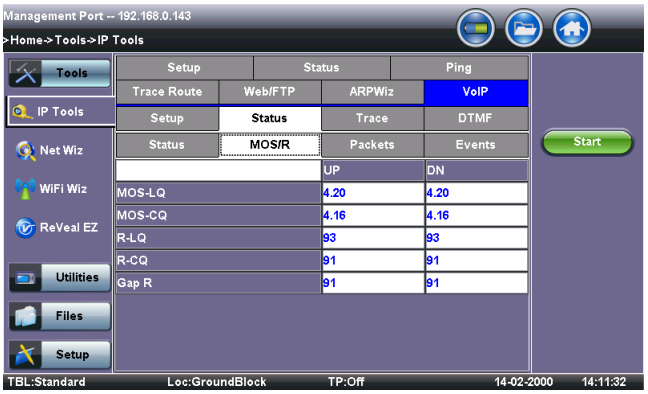
Take advantage of the three software options offering different test methods to verify and provision your VoIP network. Testing can be performed over any of the Ethernet or DOCSIS test ports.

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

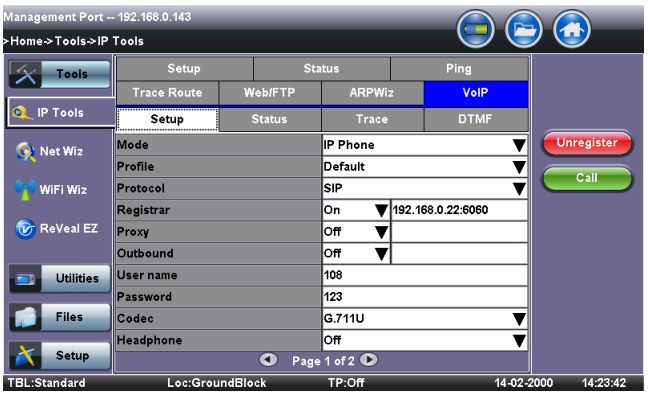




VoIP Expert – Generates industry standard wave files to verify MOS and R-factor values of upstream and downstream paths and includes QoS measurements such as packet jitter, packet loss, and delay. Compatible with all VeEX testers including VX1000 VoIP server software.

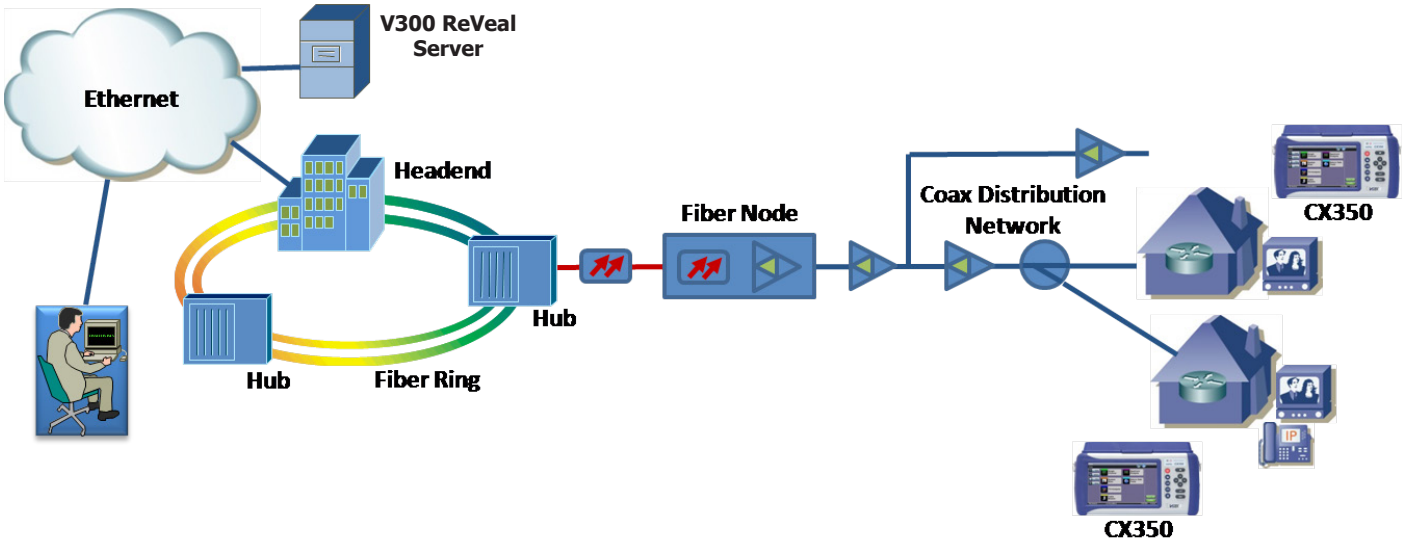


VoIP Call Expert – Emulates an IP phone and can place and receive calls using SIP or H.323 protocols. Comprehensive Codec support and call destination options verify voice encoding and translation provisioning. Real-time evaluation of subjective voice quality (MOS and R-factor) is made possible using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



V300 ReVeal Server Productivity Suite

A software application specifically designed for medium-to-large CATV operators facing the enormous challenge of coordinating hundreds of installations per day, collecting the field test results for billing/record purposes and having to maintain a large inventory of test sets in parallel. When used in conjunction with the Home Installation Process (HIP) and Signature Pad features, the application becomes a powerful tool to reduce customer call-backs and associated truck rolls, maximizing workforce efficiency and lowering operational costs.



Home Installation Process (HIP)

A customized test procedure that can be downloaded and programmed into each test set. The step-by-step script eliminates guesswork and rogue installation practices ensuring consistent service turn-up and delivery. This disciplined technique ensures the "Birth Certificate" of each new installation conforms to operating guidelines and ISO quality standards.

Advanced Management

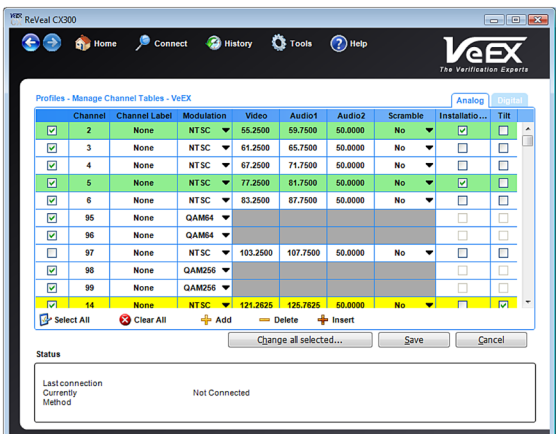
Authorized test sets register with specific ReVeal CX Server/s to download new channel tables, test profiles, measurement thresholds and job cards. Test results can be uploaded via LAN interface or DOCSIS connection running over the existing RF network. Signature Pad electronically captures the customer signature which is automatically appended to the test results upon work order completion.

Benefits

- Centralized storage of test profiles, software versions, and measurement thresholds
- Registered test sets are informed of new test profiles, software versions and channel tables
- Test set software versions are maintained and synchronized
- Results are collected electronically while technician is on site, thus billing transactions can be processed sooner
- Operates with Operator and Contractor owned test sets giving operational statistics for both activities
- Provides theft prevention, test set lockout, time lock and other security features

ReVeal CX300 PC Tool

A software package shipped standard with each CX test set. Channel tables, location thresholds, and other installation data can be created and edited on a PC for upload to the test set via USB, LAN or DOCSIS 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.



Specifications

General

Input Impedance: 75 Ω
Frequency Range: 5 MHz to 1 GHz

Analog Channel Measurement

Level Range: -45 dBmV to +55 dBmV
Level Accuracy: ± 1.5 dB
Level Resolution: 0.1 dB
Standards: NTSC, PAL, SECAM
Channels: Video, Audio 1 and Audio 2, and FM V/A1, V/A2 Adjacent
Advanced Analog Measurements (option)

- C/N
- HUM

Digital Channel Measurement

Level Range: -45 dBmV to +55 dBmV
Level Accuracy: ± 1.5 dB
Level Resolution: 0.1 dB
Modulation: QAM 64/256, J.83 Annex A/B/C
Symbol Rate: 1 to 7 MHz programmable
Constellation Display: QAM 64/256 with zoom
Minimum QAM Locking Level: -15 dBmV
MER Range: 21 dB to 40 dB, ± 1.5 dB typical
Pre & Post BER Range: 1 x 10^{-9} to 9 x 10^{-3}
Errored and Severely Errored Seconds
Histogram Analysis: up to 60 min per minute and per second

- MER, Pre BER, Post BER, Errored Sec, Severely Errored Sec

Advanced Digital Measurements (option)

- DFE and FFE gain/tap
- Group Delay Peak to Peak (ns)
- MaxAC (dB)
- Phase Jitter (˚)
- Symbol Rate Error (ppm and Hz)
- Frequency Error (ppm and Hz)
- Frequency Response Peak to Peak (dB)
- HUM (%)
- EVM (%)
- Carrier to Noise (C/N)
- Carrier to Ingress (C/I)

Spectrum Analysis

Reverse Scan Range: 5 to 42 MHz/65 MHz
Forward Scan Range: 54/108 to 1000 MHz
Range: -45 to +55 dBmV
Dynamic Range: 50 dB
RBW: 125, 330, 1000 kHz
Attenuation: 0 to 50 dB, 10 dB/step

Other Measurements

System Scan: typical 30 seconds per channel table
Tilt: 8 Analog plus 8 Digital channels
Programmable Pass/Fail Threshold: 10 sets
Programmable Channel Table: 20 tables

Options

Cable Modem DOCSIS/EuroDOCSIS 3.0/2.0/1.1 compliant

Downstream/Receiver

- Demodulation: QAM 64/256/1024
- Frequency Range
  – DOCSIS: 88 MHz to 1002 MHz
  – EuroDOCSIS: 108 MHz to 1002 MHz
- Maximum Speed: 320 Mbps (EuroDOCSIS with 8 D/S bonding)
- Channel Bonding: Up to 8 channels (contiguous or non-contiguous)
- Bandwidth
  – DOCSIS: 6 MHz
  – EuroDOCSIS: 8 MHz
- Input Power Level: -15 dBmV to +15 dBmV

Upstream/Transmitter

- Modulation: QPSK, QAM 8/16/32/64/128
- Frequency Range
  – DOCSIS: 5 to 42 MHz
  – EuroDOCSIS: 5 to 65 MHz
- Maximum Speed: 160 Mbps (EuroDOCSIS with 4 U/S bonding)
- Channel Bonding: Up to 4 channels
- Output Signal Level
  – QAM 32/64: +8 to +54 dBmV
  – QPSK: +8 to +58 dBmV
  – S-CDMA: +8 to +53 dBmV

General

- IPv4 and IPV6 support
- DHCP client obtains IP and DNS server address from DHCP server automatically
- Time of Day (ToD) support for local & MSO time synchronization
- TFTP Client support for cable modem configuration file download
- Security: BPI+ and AES support
- Pass-Through testing (1000BaseT port): Verify high bandwidth data transfer between PC and Network

Return Path QAM Analysis

Modulation: QPSK, QAM 16/64/128/256
Symbol Rate: 1.28 MHz, 2.56 MHz, 5.12 MHz, programmable
Minimum QAM Locking Level: -15 dBmV typical
Constellation Diagram
MER Range: 22 dB to > 40 dB, ± 1 dB
Adaptive Equalizer Display
Pre & Post BER Range: 9 x 10^{-3} to 9 x 10^{-9}
Errored and Severely Errored Seconds

Upstream Signal Generator

Modulation Type: CW, QPSK, QAM 16/64/128/256 Annex A/B
Symbol Rate: 1.28 MHz, 2.56 MHz, 5.12 MHz, programmable
Frequency Range: 5 to 42 MHz / 65 MHz
Level Range: 8 to +58 dBmV; Level Accuracy: ± 1 dB
Level Adjustable Step: ± 1 dB
Frequency Adjustable Step: 250 kHz/step
Frequency Accuracy: 5 ppm
Settling Time: less than 5 ms
Forward Error Correction (FEC): Continuous

TDR

Range: 2 km / 6,000 ft
Range Selection: Manual range control
Accuracy: 1% of selected range
Resolution: Approximately 1% of range
Velocity Factor: Adjustable from 1% to 99%
Output Pulse Width: 3 ns to 3 ms, automatic with range
Output Pulse: 5 Volts peak-peak (into an open circuit)
Output Impedance: Selectable 25, 50, 75 and 100 Ω
Scan Rate: 2 scans/second

Ethernet

Interfaces

Single 10/100/1000Base-T Ports: RJ45 connector, IEEE 802.3 compliant
Single 1000Base-X SFP Ports: SFP, LC connector

1000Base-SX

Wavelength: 850 nm
TX level: -9 to -3 dBm
RX level sensitivity: -20 dBm
Max reach: 550 m
TX bit rate: 1.25 Gbps
RX bit rate: 1.25 Gbps
Jitter Compliance: According to IEEE 802.3 recommendations
Ethernet Classification: According to IEEE 802.3 recommendations
Eye Safety: Class 1

1000Base-LX

Wavelength: 1310 nm
TX level: -9.5 to -3 dBm
RX sensitivity: -22 dBm
Max reach: 10 km
TX bit rate: 1.25 Gbps
RX bit rate: 1.25 Gbps
Jitter Compliance: According to IEEE 802.3 recommendations
Ethernet Classification: According to IEEE 802.3 recommendations
Eye Safety: Class 1

1000Base-ZX

Wavelength: 1550 nm
TX level: 0 to +5 dBm
RX sensitivity: -22 dBm
Max reach: 80 km
TX bit rate: 1.25 Gbps
RX bit rate: 1.25 Gbps
Eye Safety: Class 1

Ethernet Features

Auto Negotiation
Full and Half Duplex
Flow Control

Modes of Operation

Terminate
Monitor
Pass through
Loopback

Traffic Generation

IEEE 802.3 and Ethernet II (DIX) frames
Configurable MAC, Ethernet Type, VLAN, MPLS, IP, UDP header fields
Constant, Ramp, and Burst traffic profiles with configurable bandwidth % utilization
Jumbo Frame Support (10,000 bytes)
Fixed, multiple, and random frame size generation
Traffic prioritization via VLAN priority field, MPLS CoS field and the IP TOS/DSCP fields
Up to 3 VLAN and MPLS tags can be added to each user configured traffic stream

RFC2544 Compliance Testing

Automated tests 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, and 1518 bytes including 2 user configurable frames

Bit Error Rate Testing

Patterns: PRBS 2^31 -1, PRBS 2^23 -1, PRBS 2^20 -1, PRBS 2^15 -1, PRBS 2^11 -1, CRPAT (Layer 1 only), CSPAT (Layer 1 only), CRTPAT (Layer 1 only), Normal and inverted patterns
Error Injection: Bit, CRC, Symbol, IP Checksum
One configurable stream with one fixed frame size

Traffic Filters

Up to eight traffic filters can be configured with MAC, VLAN, and IP fields for Monitor and Loopback modes

Multiple Streams Throughput Testing

Up to eight independent traffic streams with configurable MAC, VLAN, MPLS, and IP fields including traffic prioritization via the VLAN tag priority field and the IP header TOS/DSCP field
% of bandwidth allocation is configurable for each stream
Different traffic profiles (constant, ramp, or bursty) may be configured for different streams
Different frame sizes are user configurable per stream

Smart Loop

Layer 1: loops back all incoming traffic
Layer 2: all incoming unicast traffic is looped back with MAC source and destination addresses swapped
Layer 3: all incoming unicast traffic is looped back with MAC and IP source and destination addresses swapped
Layer 4: all incoming unicast traffic is looped back with MAC, IP, and UDP/TCP ports swapped

Key Measurements

Error Measurements: Bit, CRC, symbol, IP checksum, jabber frames, runt frames, collisions, late collisions
Alarm Detection: LOS, pattern loss, service disruption
Frame/Packet Statistics: Multicast, broadcast, unicast, pause frames, frame size distribution, bandwidth utilization, frame rate, line rate, data rate, frame loss, frame delay variation

IP Testing

Ping, Trace Route, ARP, FTP/Web tests, Web-browser. These tests are done via the chassis 10/100-T port, Cable Modem emulation or USB WiFi adaptor. Also supports VeTest, a throughput test, in Cable Modem emulation mode.

VoIP Testing

VoIP Check
- Simulates VoIP call to the nearest router/CMTS
- Round Trip MOS score

VoIP Expert
- MOS and R-factor measurement
- Packet Statistics: packet loss, jitter, delay

VoIP Call Expert
- VoIP call setup with VoIP USB adaptor
- Supports SIP and H.323 protocols

Codec: G.711U, G.711A, Optional G.723, G.729

T1 Testing

Interfaces

Dual Bantam (100 Ω balanced)
Rates and line code
- 1.544 Mbps, AMI & B8ZS
- 2.048 Mbps, HDB3 & AMI (optional)

Compliant to ITU-T G.703, G.823, G.824, G.772 and ANSI T1.102 recommendations where applicable
Clock recovery (pulling range) per ITU-T G.703
Receiver Sensitivity
For 1.544 Mbps (DS1)
- Terminate: ≤ 6 dB (cable loss)
- Monitor (PMP): ≤ 26 dB (20 dB resistive, 6 dB cable loss)
- Bridge: ≤ 6 dB (cable loss)

Clock Synchronization

Internal: ± 3.5 ppm stability per ITU-T G.812
Recovered: from the incoming signal
External reference via RX2 balanced
- Signal: 1.544 Mbps (B8ZS)

Tx Frequency Offset
- Up to 50 ppm in steps of 0.1 ppm for electrical interfaces

Operating Modes

Terminate mode
Monitor mode
Intrusive Thru mode
Bridge

Signal Structure

1.544 Mbps (DS1)
- Unframed or Framed SF (D4), ESF per ANSI and Telcordia standards where applicable
- Test signal in N x 64 kbps, N x 56 kbps where N=1 to 24

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
- 1.544 Mbps (DS1): Code, FAS, Bit, Frame, CRC

Measurement
- 1.544 Mbps (DS1): Code, FAS, Bit, Frame, CRC

Alarms

Generation
- 1.544 Mbps (DS1): AIS, yellow, idle, LOS, LOF
- Mode: Static (Enable/Disable)

Measurement
- 1.544 Mbps (DS1): LOS, AIS, LOF, AIS, yellow, idle and LSS

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 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 FAS, CRC or Code
- Out of Service measurement (OOS) using bit errors (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
- 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

ISDN PRI Testing

Bidirectional monitoring and call analysis
National ISDN, AT&T Custom, and Northern Telecom DMS compatible
NT and TE emulation
Voice and data call setup and receive
Data Call BERT measurement
Via Headset for B-channel talk/listen
Supports multirate N x 64 k data call

Common Functions and Measurements

Frequency Measurement

Electrical Interfaces: Hz & bit/s in ppm
Resolution: 1 Hz

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 DS1 Alarms/Errors displaying historical events and conditions

General Specifications

Size	11.40 x 5.50 x 2.60 in (W x H x D) 290 x 140 x 66 mm
Weight	Less than 5.5 lb (less than 2.5 kg)
Battery	LiIon smart battery 5200 mAh 10.8VDC
Battery Operating Time	> 4 hours continuous measurement > 9 hours idle
AC Adaptor	Input: 100-240 VAC, 50-60 Hz Output: 15VDC, 6A
Operating Temperature	32˚F to 113˚F (0˚C to 45˚C)
Storage Temperature	-4˚F to 158˚F (-20˚C to 70˚C)
Humidity	5% to 95% non-condensing
Display	TFT 7" full color touch-screen display
Ruggedness	Survives 3 ft (1 m) drop to concrete on all sides
Interfaces	USB 2.0, RJ45, 10/100-T Ethernet, Bluetooth 2.0 (optional)
Languages	Multiple languages support

Ordering Information

Z02-00-020P	VePAL CX350 CATV Signal Analyzer, incl. Annex A and Annex B SLM

Cable Modem

Z66-00-037G	DOCSIS 3.0 CM 8x4 Annex A+B

Hardware Options

Z66-00-023P	TDR Option
Z66-00-033P	USG (USG CW, QAM 16/64/128/256 with FEC)
Z66-00-035P	T1 Testing
Z66-00-056P	OFDM Option

Interfaces/Test Options

499-05-039	Reverse Path QAM Signal Analysis
499-05-072	Advanced Management
499-05-073	Home Installation Process
499-05-115	Advanced Digital Channel Measurement
499-05-118	In Service Forward Path Sweep
499-05-125	10/100/1000T BERT, Throughput, RFC2544, Loopback
499-05-163	1000Base-X (enables optical interface on chassis; requires separate SFP)
499-05-126	RP Balancing (requires Cable Modem or USG+FEC hardware option Z66-00-033P)
Z33-00-009	Remote View, incl. Remote Control option
Z33-00-010	Return Path Sweep, incl. Remote View and Remote Control options (requires USG+FEC hardware option Z66-00-033P)
Z88-00-012G*	ISDN PRI (ANSI) Call Setup, incl. Earpiece

Additional Options (via USB or 10/100 Base-T Management Port)

499-05-001	Web Browser (requires Advanced IP option)
499-05-002	NetWiz
499-05-003	Remote Control
499-05-095	VoIP G.723 Codec
499-05-096	VoIP G.729 Codec
499-05-102	VoIP Check
499-05-157	USB Data Card Support (for IP connection via Data Card modem and GPS)
499-05-175*	USB Bluetooth Dialing and File Transfer Support (USB Bluetooth adaptor not included)
Z33-00-001	VoIP Expert, incl. VoIP Check option
Z88-00-001G	WiFi Wiz, incl. USB WiFi Adaptor
Z88-00-001P	VoIP Call Expert, incl. VoIP USB Adaptor & Earpiece
Z88-00-005G	Advanced IP, incl. Ethernet Cable
Z88-00-007G	WiFi Spectrum Analyzer, incl. USB WiFi Spectrum Dongle

Recommended Accessories

C02-00-003G	Carrying Pouch for V300
C02-00-010G	Extended Carrying Pouch with top connector protection for V300 (the plastic protection cover on the tester needs to be removed)
D02-00-020P	Quick Reference Guide, Fiber Scope Inspector
D02-00-029P	Quick Reference Guide, V300 VoIP Call Expert
D09-00-007	CX350 Test Report
F01-00-001G	Coaxial Cable, Male to Male F Type, 2 m (6 ft)
F02-00-025G	USB Extended Cable for GPS/Data Card
F99-00-005G	AC/DC Isolator
Z77-00-011G	Car Adaptor for V300
Z77-00-014G	Fiber Inspection Probe w/Tips, Pouch and Box
Z77-00-015G	USB Data Card (Mfg option 452 - supports most Intl 3G/UMTS wireless carriers), incl. L shape USB adaptor (requires 499-05-157)
Z99-00-005G	USB GPS/Data Card (AT&T-USA wireless carrier), incl. L shape USB adaptor (requires 499-05-157)
Z99-99-006G	Lock Mechanism Option, incl. Locking Hook on Unit and Cable/Lock
Z99-99-007G	USB Bluetooth Adaptor (requires 499-05-175)
Z99-99-011G	USB Hub with 4 Ports

**Check factory for availability*

VeEX
The Verification Experts

VeEX Inc.
2827 Lakeview Court
Fremont, CA 94538 USA
Tel: +1.510.651.0500
Fax: +1.510.651.0505
www.veexinc.com
customercare@veexinc.com

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