RXT-8000 Cable Expert Test Module

Super-Tech Maintenance Tool for CATV

VeEX

RXT-1200

Modular Test Platform

Designed for the MSO Super-Tech, the RXT-8000 Module provides an abundance of test features addressing RF, DOCSIS, MPEG, and Ethernet applications. Additionally, the RXT-1200 platform provides access to a 100G Carrier Ethernet Test Module, as well as Optical Test tools including an OTDR, OSA, and Fiber Inspection scope.

Platform Highlights

The RXT modular test platform defines the test set of the future, offering a full range of link and service testing capabilities covering all wired communication technologies, including OTN, SDH/SONET, PDH/DSn, Carrier Ethernet, SyncE, 1588v2 PTP, CPRI/OBSAI (DAS), Fibre Channel, OTDR, OSA, xDSL, Outside Plant, QAM/DOCSIS, Fiber Optics, Teleprotection (IEEE C37.94), down to legacy Datacom and VF TIMS testing. All supported by a single rugged hand-held test platform.

- Fast test results transfer via USB memory stick
- Intuitive graphical user interface for easy operation
- 7" color LCD with touch screen
- Ultra high capacity field-exchangeable Li-ion battery pack
- WiFi Wiz with InSSiDer SSID Analysis*
- WiFi Spectrum Analyzer*
- VoIP and IPTV*
- Extend field testing time using interchangeable LiIon
- Ethernet LAN management port for remote control, back office applications and workforce management
- Maintain instrument software, manage test setups and channel tables, process measurement results and generate customer test reports using included ReVeal™ PC software

Key Features

- Frequency range from 5 MHz to 1 GHz
- Comprehensive SLM measurements (Single Channel, System Scan, Tilt and Installation Check)
- True Spectrum Analyzer with 30 ms sweep time to capture fast transient and impulse noise
- MPEG Explorer: QAM channel MPEG-TS analysis*
- DOCSIS 3.0 certified Cable Modem with up to 24x8 Channel Bonding*
- Upstream Generator* (CW, QPSK, QAM 16/64/128/256 modulation)
- 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)
- FCC POP including Digital POP*
- Ethernet up to GigE with SLA validation tests including BERT, Throughput, RFC2544 and Y.1564 SAM
- Headend Check auto test for the entire selected Channel Table lineup*
- VeTest Throughput*
- QAM Wiz DOCSIS Burst Demodulator*

*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 RXT-8000.

In **analog** mode, video and audio levels, adjacent channels, gated C/N, gated CSO, CTB, and HUM are measured.
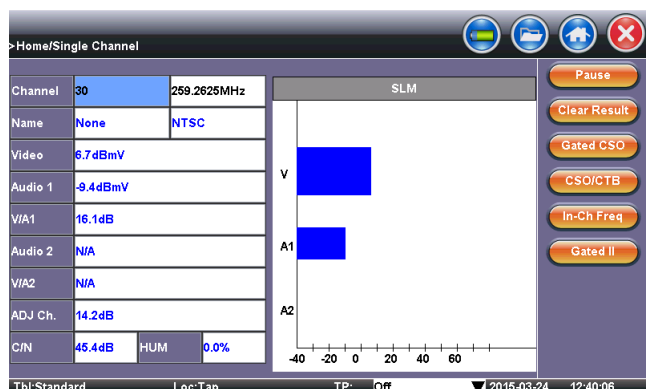
In **digital** mode, average power, MER, Pre-BER, Post-BER, Error seconds and constellation diagram are displayed. User programmable location thresholds and test point compensation are useful utilities enabling fast, simple and automated testing of carrier signals.
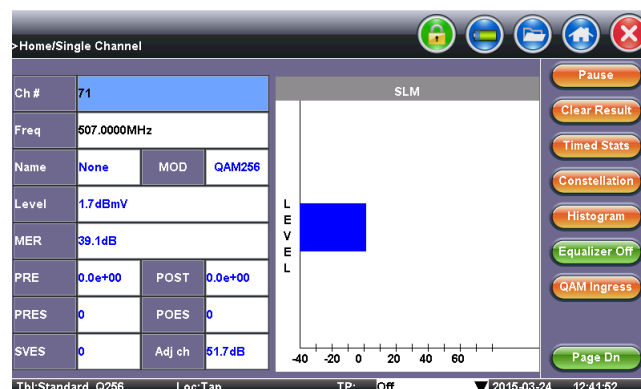

Advanced Digital Channel Analysis

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 RXT-8000 can be turned off to make troubleshooting marginal amplifiers, ingress, CPD and related impairments easier.
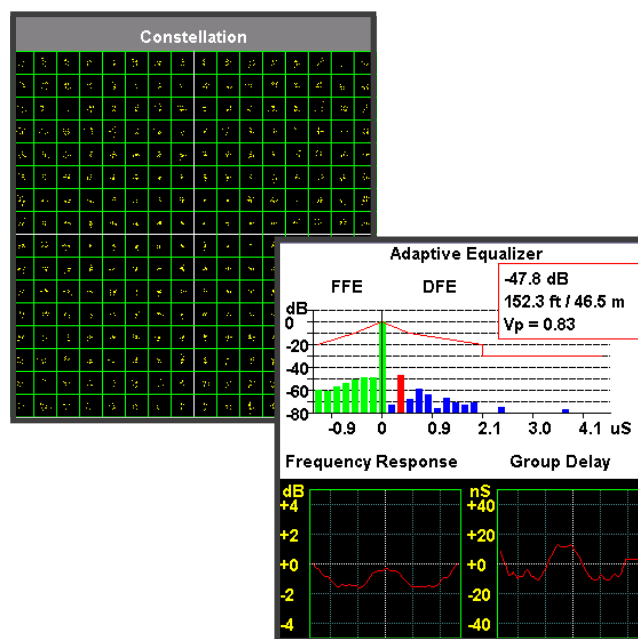

System Scan

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.
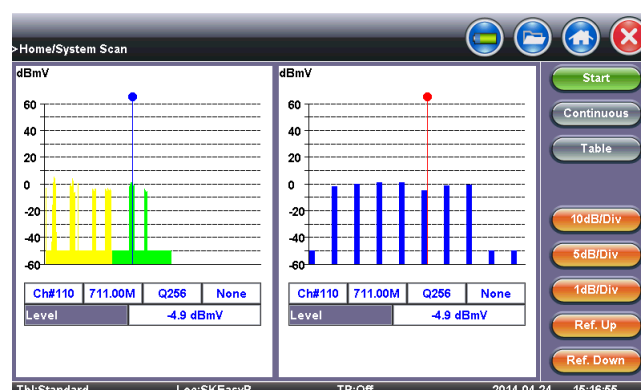
SLM Features *cont'd*

Histogram Analysis

Noise impulses can suddenly disrupt a digital carrier but it's difficult to detect without monitoring the carrier over a period time.
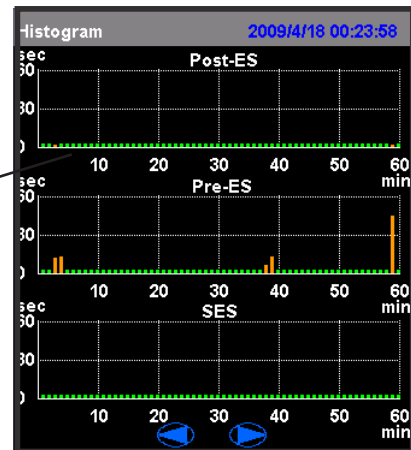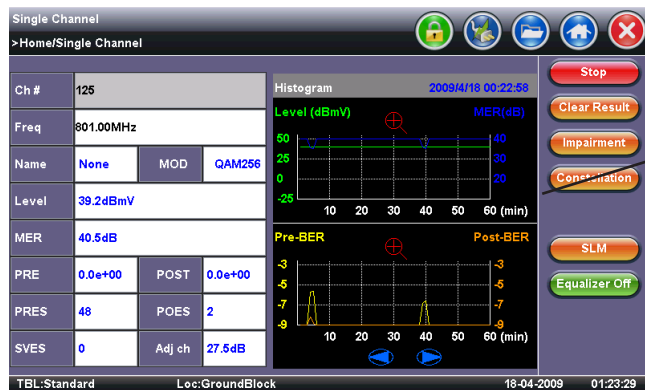
The histogram feature records level, MER, Pre-BER, Post-BER and Error Seconds on per second time bucket for up to 60 minutes. The results are shown in graphical format that allows easy correlation of measured parameters down to one-second resolution.

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.
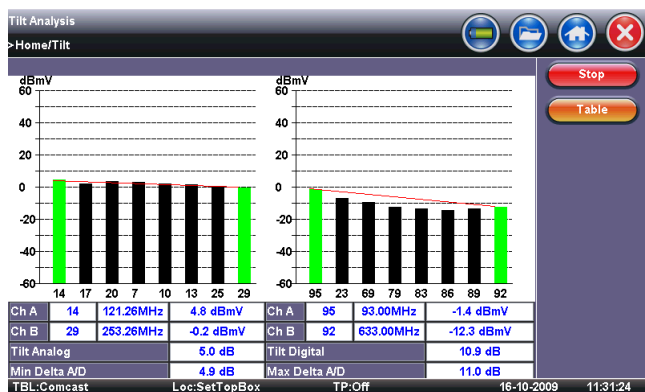
Installation Check

Up to 16 analog and 16 digitals are checked against preset location thresholds. The feature is particularly useful to verify and turn up of 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 RXT-8000 can store up to 20 channel tables each of with can be pre-programmed with channels to be used for installation check.

FCC POP

Proof of Performance tests are required by the FCC for MSOs to periodically prove their analog networks are within specified guidelines for performance. Carriers' networks evolving to all-digital necessitates Digital POP tests.

The optional FCC POP Feature consists of various Auto Tests, including Digital POP and 24-Hour Analog Levels. Test Channels are based on a user configurable Channel Table. Standard test results are supported in both CSV and PDF Formats.


Headend Check

The optional Headend Check feature is a more in-depth Installation Check. There is no channel limit, as it tests all of the channels that are configured and enabled in the selected Channel table. Key metrics are Level, MER, and BER for each Channel.

True Spectrum Analyzer

The RXT-8000 offers a true Spectrum Analyzer, vastly superior to SLM-based measurements found in typical field meters. It incorporates advanced DSP technology to capture transient ingress across a wide 5 MHz to 1000 MHz frequency range, with 60 dB dynamic range. Adjustable sweep time, RBW and VBW settings optimize signal representation and noise floor performance.

The large 7" high resolution TFT LCD features a fast refresh rate, preserving and displaying the finest spectrum details. Touch-screen control allows rapid on-the-fly changing of test parameters and simplifies measurements while horizontal and vertical markers and min/max hold displays signal values instantly and varying signal parameters over time.

Test profiles consisting of user-settable parameters such as CF, Span, RBW, VBW and Marker positions can be saved and recalled for repeated testing. Waveform storage enables a user to compare and contrast a captured signal versus a current measurement, in both superimposed or split screen views.
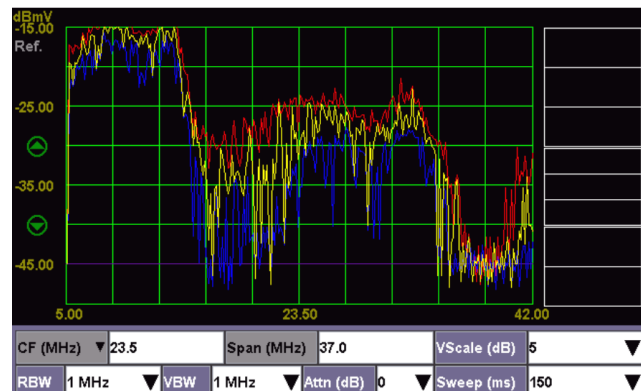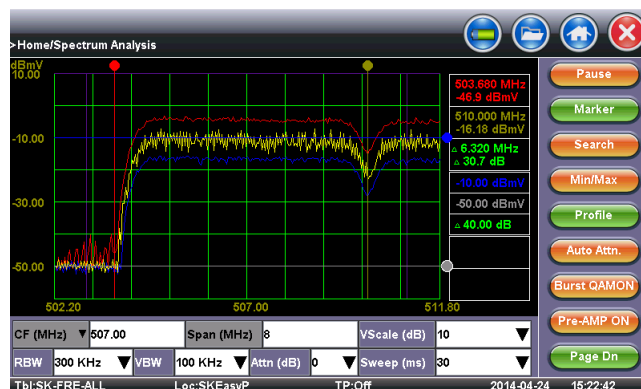
QAM Wiz: DOCSIS Burst Demodulator

The optional QAM Wiz DOCSIS Burst Demodulator helps identify rogue Cable Modems that contribute harm to the plant. QAM Wiz does the following:

- Captures all available Upstream Channel Descriptors provided by the CMTS from a specific downstream DOCSIS channel.
- For a selected UCD, captures and demodulates burst Cable Modem signals.
- Assesses QAM health for the UCD by measuring Upstream MER, burst constellations, codeword error rates and Equalizer Taps.
- Identifies associated Cable Modem MAC Addresses, which helps identify rogue Cable Modems.

MPEG Explorer
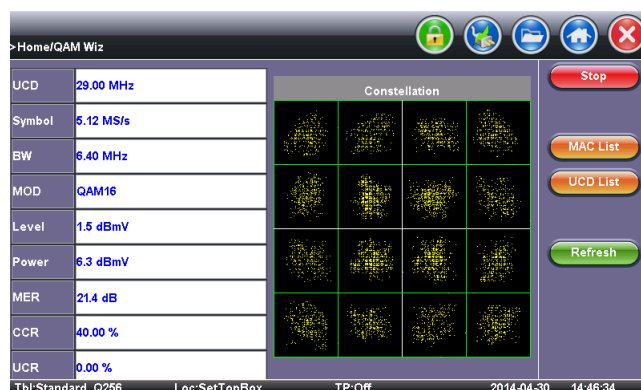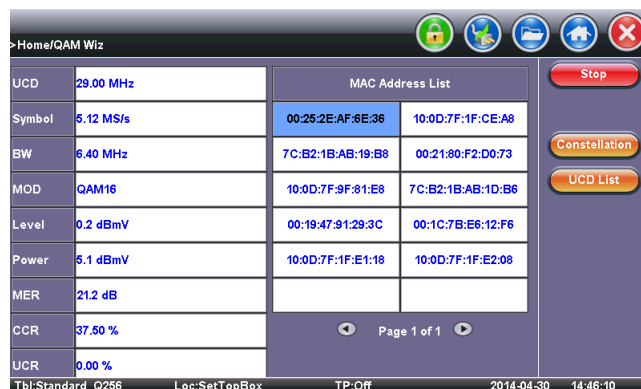
Cable Operators nowadays have to ensure that both the RF characteristics and digital payload of their QAM carriers are within defined limits, and simply viewing the QAM carrier "hay stack" is not enough to evaluate the protocol layer. The RXT-8000 MPEG Explorer option extracts MPEG Transport Stream payloads from the QAM carrier and decodes them to check transport and programming content. A real-time output (ASI) allows access to the data stream for further analysis.

Media-Stream-Based Algorithm

A proprietary and sophisticated algorithm analyzes the IP stream to assess and derive video quality and improve accuracy of quality scores.

- **Frame structure/GoP detection** – Identifies I, B and P frames in both unscrambled and encrypted video streams, to determine GoP length and the rate and distribution of packet loss in each frame.
- **Per-frame quality computation** – Quality in each frame using the frame type, frame size, codec type, bandwidth and packet loss data. For P and B frames, RXT-8000 models the loss propagated from earlier reference (I or P) frames.
- **Bandwidth estimation** – the bandwidth used by certain types of video frames is analyzed to estimate the quantization level applied by the video encoder.

Program Identifier (PID) Statistics

PID statistics provide critical information about the MPEG transport stream. The bandwidth and packets associated with each individual stream are listed allowing the technician to check the video, audio and data content and to check for any "illegal" PIDs. Identification of uncorrected packet errors provides valuable clues to picture impairments.

Transmission Quality Score

MOS scores associated with the particular video/audio codec used and transmission quality are reported. **VSTQ** (Video Service Transmission Quality), is a codec-independent scoring that rates the ability of the network to reliably transport video.

Quality of Service (QoS) Measurements

QoS parameters are evaluated and presented in an intuitive manner so that technicians unfamiliar with MPEG signals are able to make accurate decisions to ensure maximum service availability. To compare quality in different video service types such as HDTV and SDTV, both Absolute and Relative MOS scores are reported:

Perceptual Quality Metrics

- **MOS-V** – Video MOS, a score that considers the effects of the video codec, frame rate, packet loss distribution and GoP structure on video quality.
- **MOS-A** – Audio MOS, a score that considers the effects of the audio codec, bit rate, sample rate and packet loss on viewing quality.
- **MOS-AV** – Audio-Video MOS, a score that considers the effects of both picture and audio quality and the audio-video synchronization on the overall user experience.
- **Absolute MOS-V** – considers the image resolution, frame rate, codec and compression level, the effects of transmission impairments and frame loss concealment, but not the physical size of the display.
- **Relative MOS-V** – a MOS score relative to the ideal for the particular codec and image resolution in use.

I/B/P Frame Statistics

Packet loss in the video stream may or may not be apparent to viewers, depending on whether encoding errors affect I, B or P frames in the Group of Pictures. To accurately assess Quality of Experience (QoE), it is necessary to know which frame types were affected.

Detailed statistics for each frame type (I, B, P), including the number of received, lost and discarded frames and the proportion of each frame type impaired by packet loss and discard are reported. These metrics can be useful for troubleshooting and can help determine which GoP type and length should be used to obtain the best performance from the video service.

TR 101 290 Support

The ETSI TR 101 290 recommendation is a very good indicator of when a MPEG Transport Stream has been transported error-free across a network. The MPEG Explorer option features a dedicated measurement tab displaying Priority 1 alarms which are key indications of synchronization, continuity errors and major table errors while Priority 2 impairments which include transport error indicators, Cyclic Redundancy Check (CRC), errors in elementary streams and PCR timing impairments are also displayed.

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.
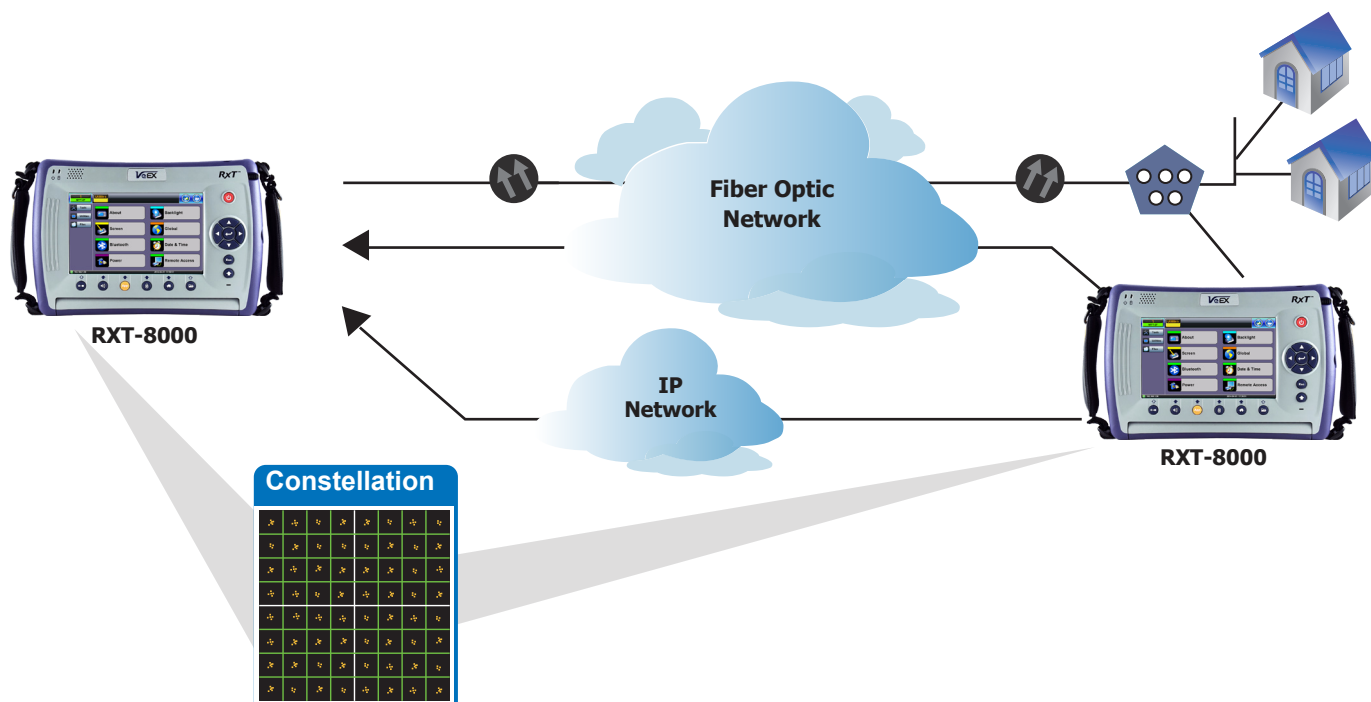
The USG function fitted with Forward Error Correction (FEC) capability, is compatible with the Return Path analysis options found on other VeEX products, including the CX180R RPM System, CX3XX Series and CX150-D3+ CATV test sets, as well as select 3rd party CATV QAM analyzers. Depending on the companion 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.
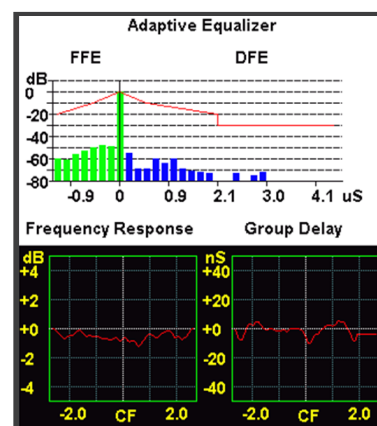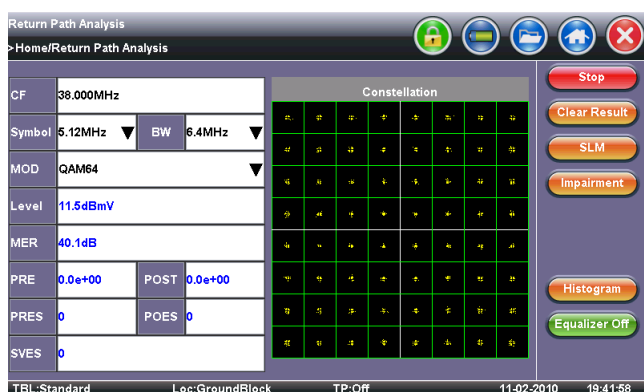
Return Path Sweep

The RXT-8000 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 Series handheld unit or a CX180R RPM 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.
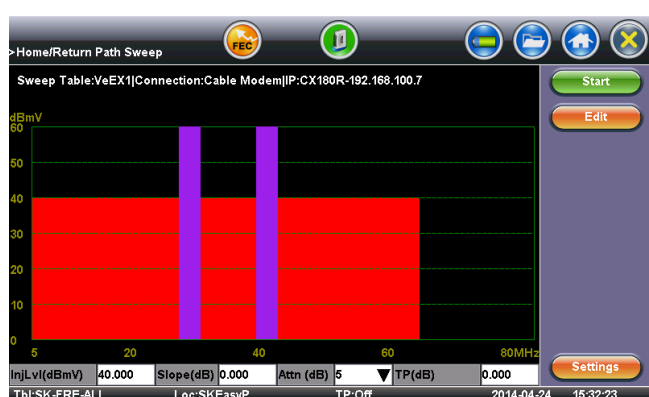
Remote View

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

Utilizing a wired (10/100BaseT 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 Series or CX180R RPM System 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 RXT-8000 or CX180R spectrum analyzer can also be viewed, thus making it a truly unique solution for upstream testing and characterization.
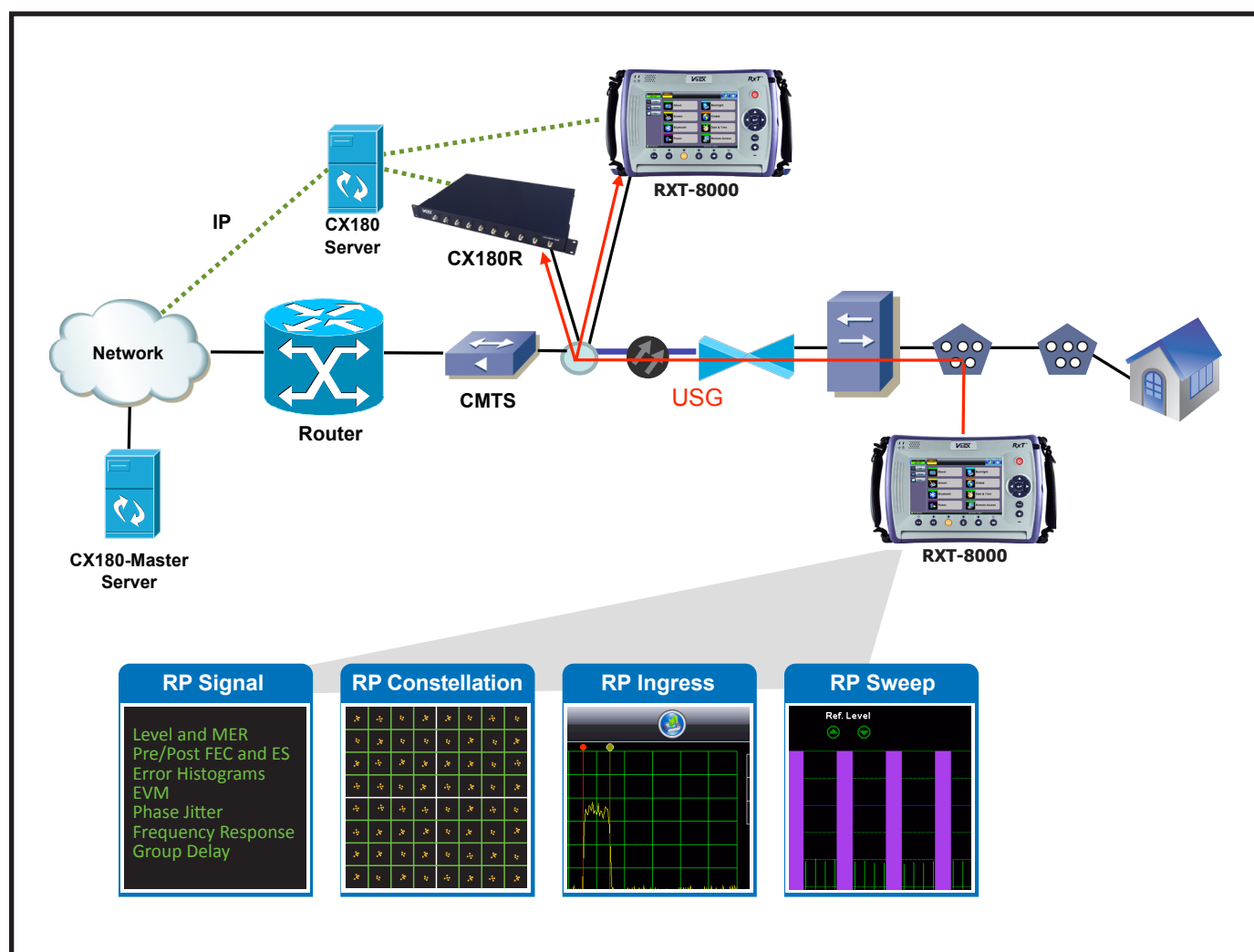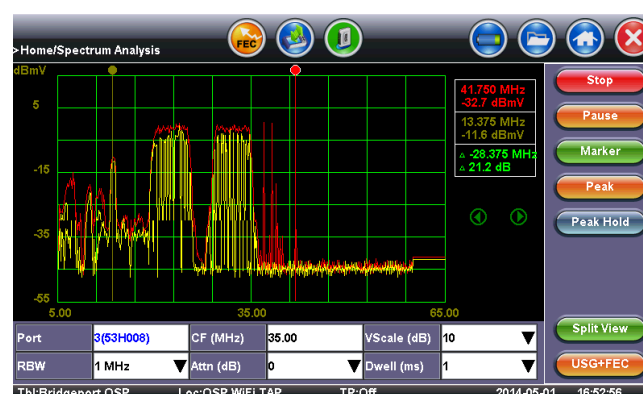
DOCSIS© 3.0

DOCSIS 3.0 Modem Emulation

Equipped with a CableLabs® certified 24x8 DOCSIS 3.0 Cable Modem, the RXT-8000 enables technicians to perform actual modem connection tests, without having to carry a separate modem on service calls.

Intuitive Results

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

Link Statistics

A range of downstream and upstream link connection parameters including frequency, power, modulation, symbol rates and SNR are evaluated and displayed.

Additional DOCSIS 3.0 Modem Features

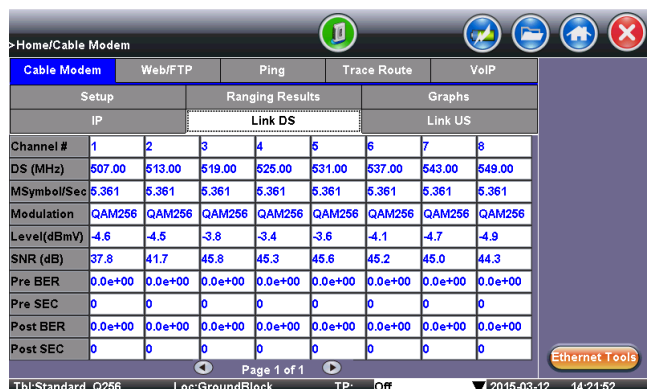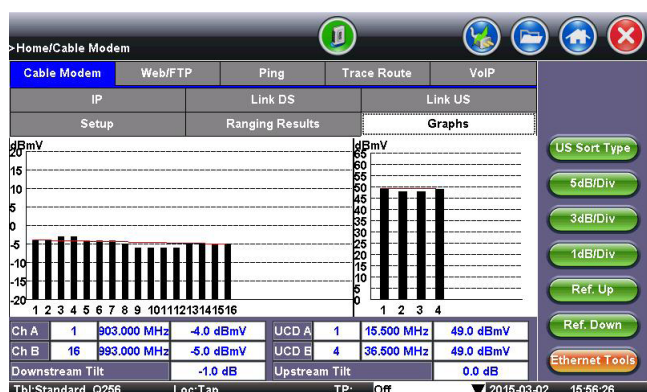- Enhanced Security – Advanced Encryption Standard (AES)
- Pass-Through testing – modem emulation to verify high bandwidth data transfer between PC and Network

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.
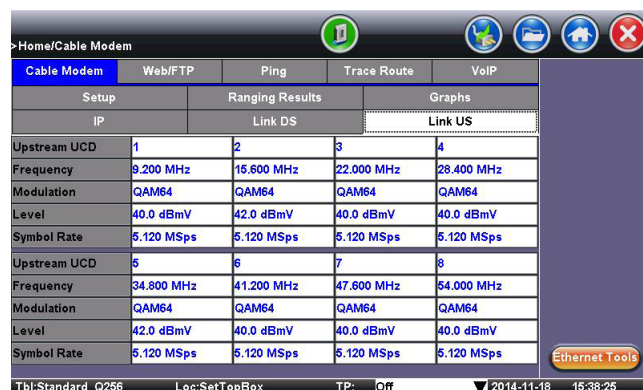
IPv6 Support and Network Server Verification

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.

VeTest Throughput

VeTest enables download and upload throughput testing to various customer specific servers.
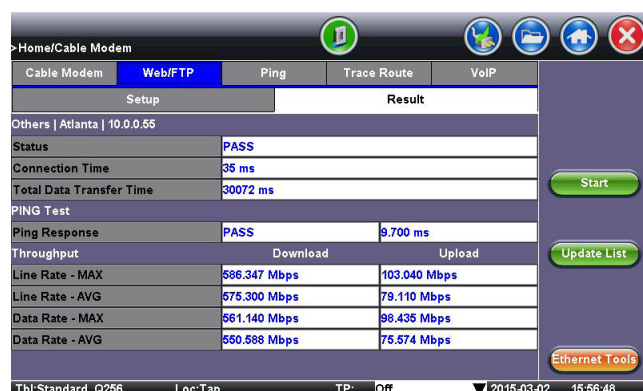
Ethernet

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.

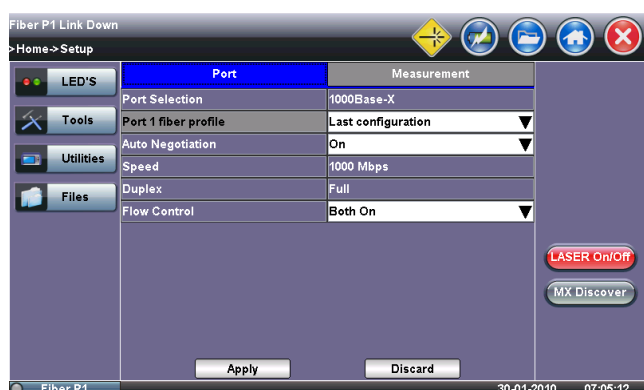## RFC2544 Compliance Testing

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.
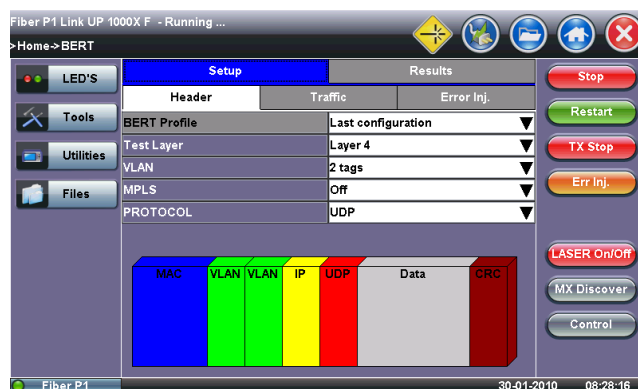
Throughput Testing

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.

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 o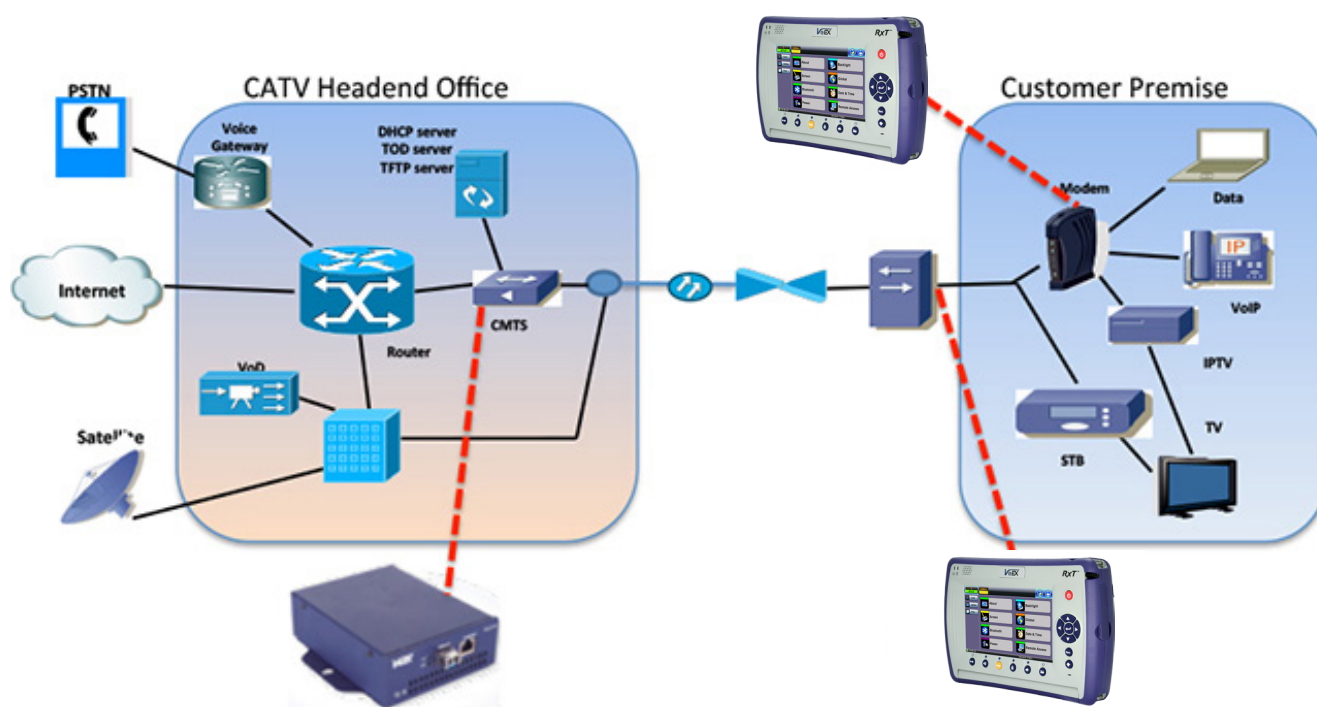n the test port. The RXT-8000 functions as the Controller via the RF or Ethernet interface, running the RFC2544 Asymmetric test suite.

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 RXT-8000 can generate traffic over the DOCSIS test port to verify bi-directional, end-to-end DOCSIS throughput 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 RXT-8000 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.

True Gigabit Ethernet Throughput SLA

Actual Cable Modem CPE verification can be performed by connecting the RXT-8000'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.

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 RXT-8000 is possible over the DOCSIS Cable Modem and Gigabit Ethernet test ports. *Note: IPTV is offered on the Gigabit Ethernet interface only.*
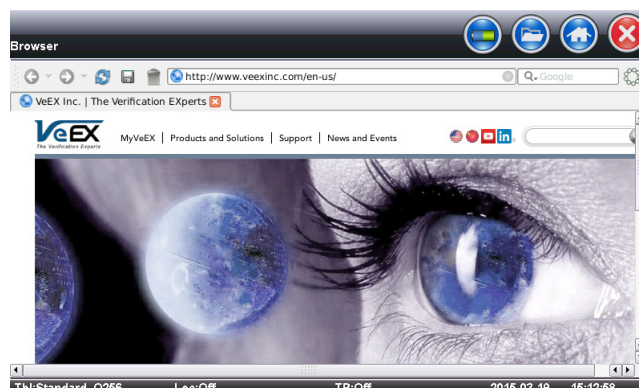
VoIP Testing

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.

IPTV Explorer

IPTV Service Providers nowadays have to ensure the transport layer and MPEG payload are both within defined limits, because simply checking packet loss, jitter and related impairments of the Ethernet distribution network is not enough to evaluate the quality of the IPTV content carried in the upper protocol layers. The IPTV Explorer option extracts the MPEG payloads from the Ethernet streams, decodes and displays them to check transport and programming content so that QoS and QoE can all be assessed. *Note: this feature requires the Ethernet option.*

Media-Stream-Based Algorithm

A proprietary and sophisticated algorithm analyzes the IP stream to assess and derive video quality and improve accuracy of quality scores.

- **Frame structure/GoP detection** – Identifies I, B and P frames in both unscrambled and encrypted video streams, to determine GoP length and the rate and distribution of packet loss in each frame
- **Per-frame quality computation** – Quality in each frame using the frame type, frame size, codec type, bandwidth and packet loss data. For P and B frames, TX300S models the loss propagated from earlier reference (I or P) frames
- **Bandwidth estimation** – the bandwidth used by certain types of video frames is analyzed to estimate the quantization level applied by the video encoder

Program Identifier (PID) Statistics

PID statistics provide critical information about the MPEG transport stream. The bandwidth and packets associated with each individual stream are listed allowing the technician to check the video, audio and data content and to check for any "illegal" PIDs.

Transmission Quality Score

QoS parameters are evaluated and presented in an intuitive manner so that technicians unfamiliar with MPEG signals are able to make accurate decisions to ensure maximum service availability.

- Audio and Video MOS scores associated with the particular video/audio codec used and transmission quality are reported
- VSTQ (Video Service Transmission Quality), is a codec-independent scoring that rates the ability of the network to reliably transport video
- ETSI TR 101 290 metrics are good indicator of transport associated errors

ReVeal PC Software

ReVeal PC Software provides an easy-to-use interface that provides the following productivity tools:

- Convenient test profile management, including Channel Tables and Location Thresholds
- Flexible test results management
- Test report generation
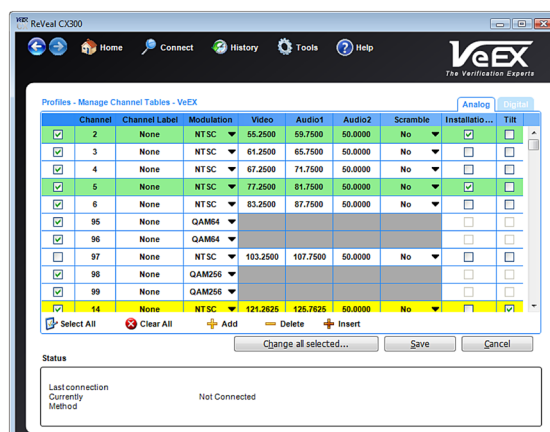
VeSion R300 Productivity Server

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.

Advanced Management

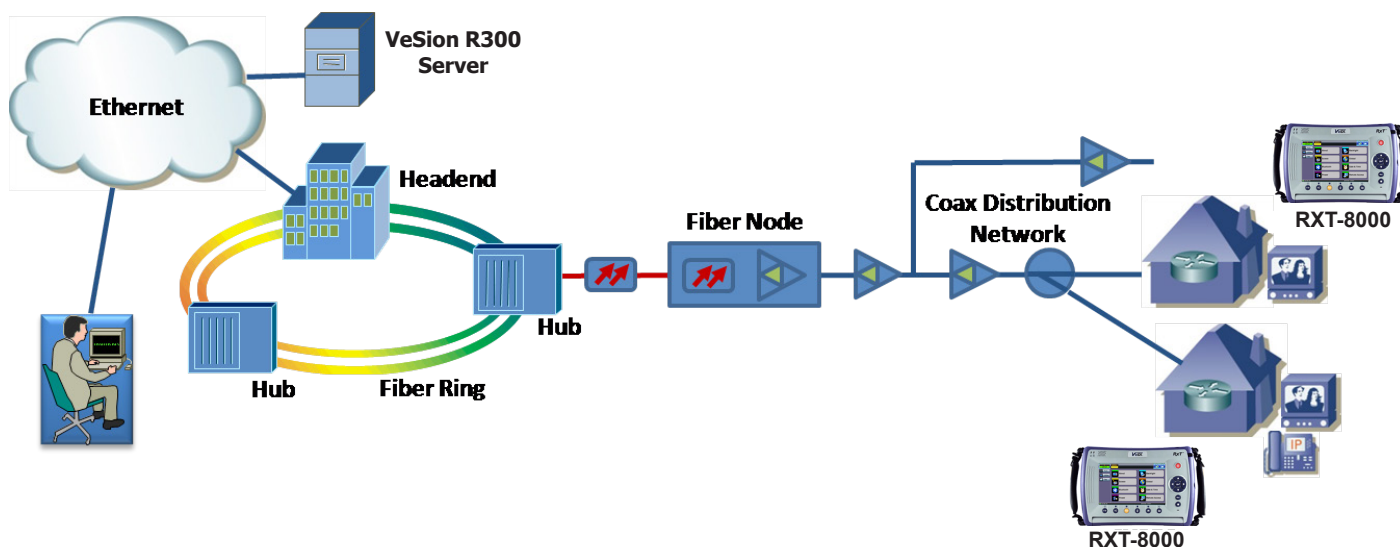Authorized test sets register with specific VeSion R300 Server/s to download new channel tables, test profiles, measurement thresholds and job cards. Test results can be uploaded via LAN interface or DOCSIS connection running over the existing RF network. Signature Pad electronically captures the customer 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

Specifications

General

Input Impedance: 75Ω
Frequency Range: 5 MHz to 1 GHz
Input Level Range: -50 dBmV to +60 dBmV
Dynamic Range: 60 dB
Display Range: 70 dB
Vertical Scale: 1, 2, 5, 7, 10 dB
Attenuation: 0 to 50 dB in 5 dB steps
Frequency Reference: ± 2 ppm typical

Analog Channel Measurement

Level Range: -50 dBmV to +60 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: C/N, HUM, CSO/CTB

Digital Channel Measurement

Level Range: -50 dBmV to +60 dBmV
Level Accuracy: ± 1.5 dB
Level Resolution: 0.1 dB
Modulation: QAM 16/64/256, Annex A/B/C
Symbol Rate: 1 to 7 MHz programmable
Constellation Display: QAM 16/64/256 with zoom
Minimum QAM Locking Level: -15 dBmV
Adaptive Equalizer Display
MER Range: 22 dB to > 40 dB, ± 1.5 dB
Adjacent Channel
Pre & Post BER Range: 0 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
Timed Stats
Advanced Digital Measurements (software option)
  • Group Delay, MaxAC, Phase Jitter, Symbol Rate Error, Frequency Error, Frequency Response, HUM, EVM, Carrier to Noise, Carrier to Ingress, QAM Ingress

Spectrum Analysis

Span: 5 MHz to 1 GHz, zero span
Resolution Bandwidth: 1 MHz, 300 kHz, 100 kHz, 30 kHz, 10 kHz
Video Bandwidth: 1 MHz, 100 kHz, 10 kHz, 100 Hz
Minimum Sweep Time: 30 ms

Other Measurements

System Scan: typical 30 seconds
Tilt: up to 8 Analog plus 8 Digital channels
Programmable Pass/Fail Threshold: 10 sets
Programmable Channel Table: 20 tables
Test Point Compensation: 10 sets

Options

MPEG Transport Stream Analysis

Analyze MPEG-2 TS signal quality in a QAM channel
Measurement parameters: Total packets, video packets, audio packets, jitter, delay, rates

MPEG Transport System Analysis Summary	
Test Result	Definition and Description
Summary Status	Summary of all alarms (packet loss, MPEG layer alarms, MDI, etc.)
Program Name	Program name for the video stream
PMT PID	Represents PID for the PMT inside the MPEG stream
#PIDs	Number of PIDs inside the MPEG stream
Video Packet Statistics	Includes video bandwidth and video packet statistics inside the program
MOS_V	Mean Opinion Score for Video perceptual quality
I/B/P Frame Statistics	Statistics for the I/B/P frames (for unscrambled video), including packet loss and bandwidth for each type of video frame
Audio Packet Statistics	Includes audio bandwidth and audio packet statistics inside the program
MOS_A	Mean Opinion Score for Audio perceptual quality
TR 101 290	Includes result parameters per TR 101 290, such as Sync loss and Sync byte, PAT, CC, PMT, PCR and CRC errors, etc.
PID Map	Detail description for each PID inside the MPEG TS

Upstream Signal Generator

CW Generator

Frequency Range: 5 MHz to 65 MHz
Level Range: 0 to +58 dBmV
Level Accuracy: ± 1 dB
Level Adjustable Step: ± 1 dB
Frequency Adjustable Step: 125 kHz/step
Frequency Accuracy: 5 ppm
Settling Time: less than 2 ms

QAM Generator

Modulation Type: QAM 16/64/128/256 Annex A/B
Symbol Rate: 1.28 MHz, 2.56 MHz, 5.12 MHz, programmable 1 to 7 MHz
Frequency Range: 5 to 65 MHz
Level Range: 0 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

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: 9×10^{-3} to 9×10^{-9}
Errored and Severely Errored Seconds

Cable Modem DOCSIS/EuroDOCSIS 3.0/2.0/1.1 compliant

Downstream/Receiver
- Demodulation: QAM 64/256/1024
- Frequency Range
  – DOCSIS: 105 MHz to 1002 MHz
  – EuroDOCSIS: 108 MHz to 1002 MHz
- Bandwidth
  – DOCSIS: 6 MHz
  – EuroDOCSIS: 8 MHz
- Channel Bonding: Up to 24 channels
- Maximum Speed: Up to 900+ Mbps (EuroDOCSIS with 24 DS Bonding)
- 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
- Channel Bonding: Up to 8 channels
- Maximum Speed: Up to 300+ Mbps (EuroDOCSIS with 8 US Bonding)
- 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

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: 550m
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

IPTV

Requires Ethernet option

Mode: Monitor

Stream configuration: Unicast, multicast, IP address, Port number

Codecs: MPEG2, MPEG4 (Part2) and MPEG4 Part10 (H.264)

Probe function with streams auto-detection

IPTV image viewer for channel identification (does not decode encrypted streams)

Stream Analysis

- PIDs count
- PID MAP
- Transport Error count
- Data rates: Video, Audio, Data (Bandwidth and Packet Counts)

Video Analysis

- MOS_Video, Video Service Transmission Quality (VSTQ), Estimated Peak Signal to Noise Ratio (EPSNR ATIS)
- I/B/P Frame statistics (Bandwidth, # Frames Received, Lost, Impaired)

Audio Analysis

- MOS_Audio

TR 101 290 Metrics

- Sync loss, sync byte error, PAT/PAT2 error, Continuity error, PMT/PMT2 error, PID error, transport error, CRC error, PCR discontinuity, PCR accuracy error

IP Testing

Ping, Trace Route, ARP, FTP/Web tests, Web-browser. These tests are done via the chassis 10/100Base-T port, Cable Modem emulation or USB WiFi adaptor. VeTest, a throughput test, is supported for the Cable Modem and Ethernet test ports.

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

VeEX
The Verification Experts