

DOCSIS 3.1  
1.8 GHz Spectrum

NEW

VeEX



## VePAL CX380s-D3.1 Super-Tech Maintenance Tool for CATV

### CATV Network Testing Simplified

Key Maintenance Tools including enhanced Spectrum Analysis with 1.8 GHz range, DOCSIS 3.1 OFDM Analysis, Digital Channel, Sweep, MPEG Analysis, and 10 Gigabit Ethernet 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
- 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, DOCSIS, USB WiFi, USB data modem or USB Bluetooth
- 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 Lilon battery pack/s
- Ability to lock user interface to prevent unwanted human interference during long-term testing
- WiFi Wiz with InSSiDer SSID Analysis\*
- WiFi Spectrum Analyzer\*
- VoIP and IPTV\*
- Digital Fiber Inspection Scope\*
- OPX-BOXe OTDR USB accessory\*

### Key Features

- True Spectrum Analyzer with 30 ms sweep time to capture fast transient and impulse noise
- Spectrum Analysis frequency range from 5 MHz to 1.2 GHz, with optional 1.8 GHz extension
- Comprehensive SLM measurements (Single Channel, System Scan, Tilt, Installation Check and VeCheck)
- MPEG Explorer: QAM channel MPEG-TS analysis\*
- 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)
- DOCSIS 3.0 Cable Modem with up to 32x8 Channel Bonding
- DOCSIS 3.1 Cable Modem\*
- FCC POP including Digital POP\*
- Ethernet up to 10 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\*
- Full compatibility with CaLan 3010H+ Sweep System, for Forward Path to 1.8 GHz and and Return Path to 204 MHz\*

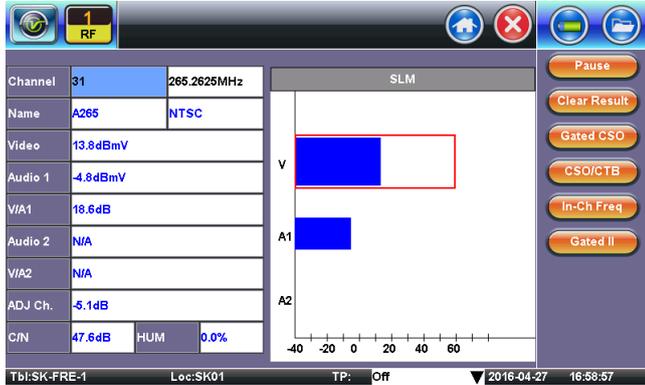
\*Optional features

## SLM Features

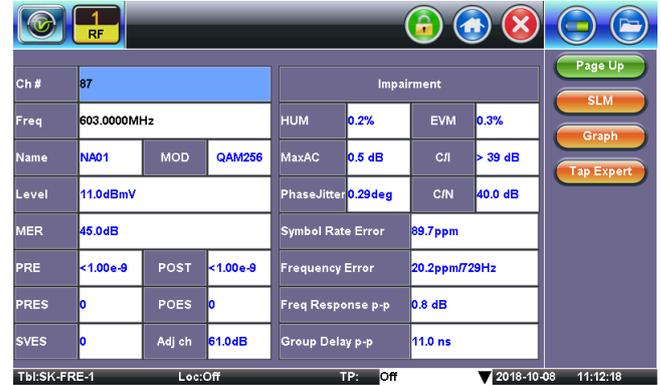
### Single Channel Measurement

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 CX380s-D3.1.

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.

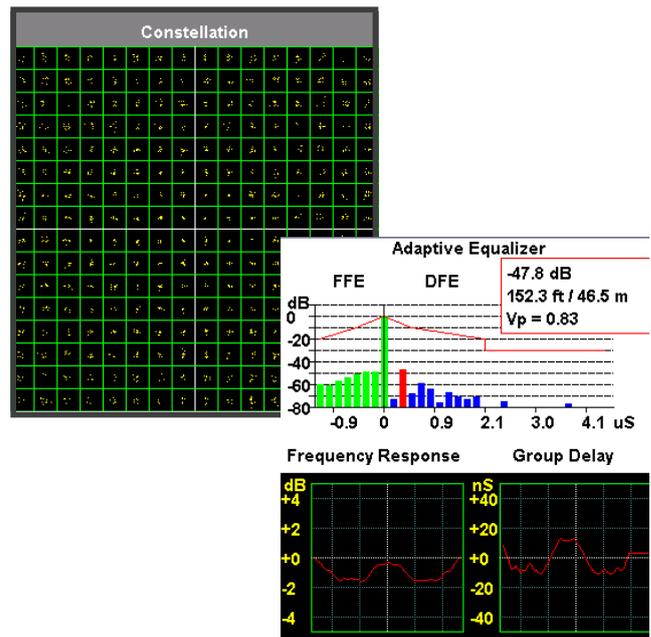


### Advanced Digital Channel Analysis

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

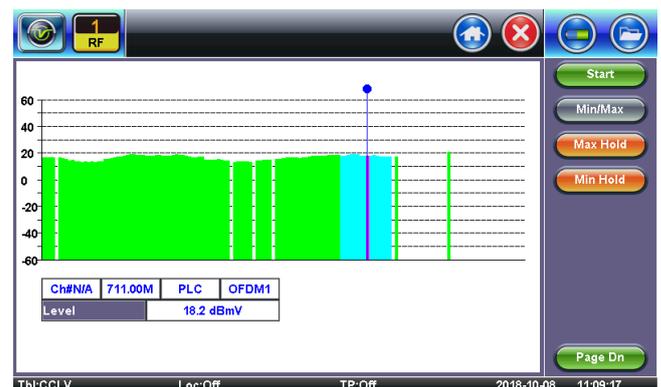
**Constellation diagrams** – A valuable tool to help detect the presence of noise, phase jitter, interference, gain compression, laser clipping and ingress, all of which impact overall signal quality and thus reduces Modulation Error Ratio (MER). The Advanced Digital Analysis option has added in depth 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 CX380s-D3.1 can be turned off to make troubleshooting marginal amplifiers, ingress, CPD and related impairments easier.



### System Scan

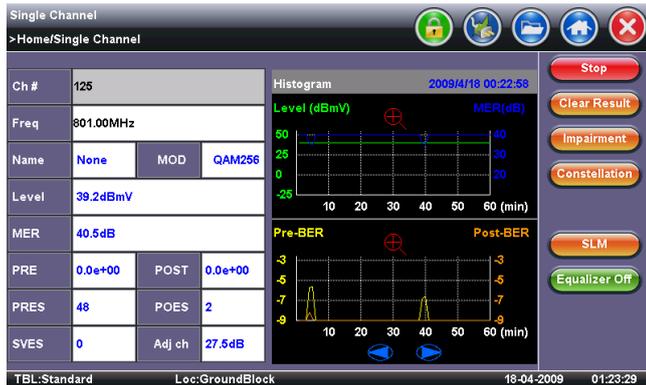
Within seconds all analog, digital, and OFDM channels at a service location are measured. Signal parameters including channel number, channel name, frequency, modulation type and power levels are measured. Signal degradation or tilt can be easily pinpointed using on-screen markers and the zoom mode.



## 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.

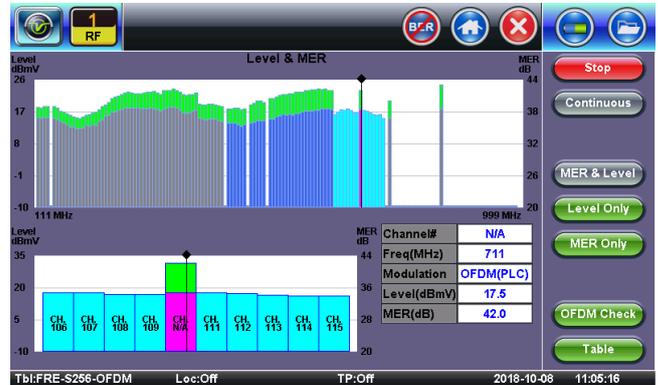


The histogram feature records level, MER, Pre-BER, Post-BER and Error Seconds on per second time bucket for up to 60 minutes. The results are shown in graphical format that allows easy correlation of measured parameters down to one-second resolution.

### VeCheck

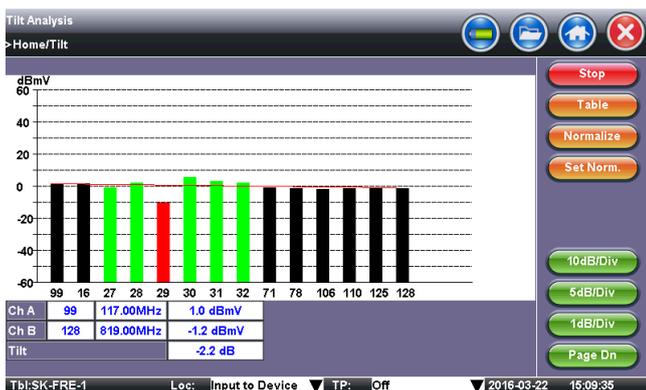
VeCheck is a fast and powerful Full Band Scan for the Forward Path, covering up to 1218 MHz. It is a 'One-Button Test' for verifying QAM, Single-Carrier DOCSIS QAM, and D3.1 OFDM. Key metrics include Level, Modulation Type, MER and BER, presented in easy to view graphical and tabular formats.

*Note: Requires Enhanced Hardware revision.*



### 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 CX380s-D3.1 can store up to 20 channel tables each of which 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.

Digital POP Part I				Digital POP Part II			
Channel	Freq (MHz)	Name	Level (dBmV)	MER (dB)	Pre-BER	Post-BER	Freq Resp (dB)
63	459.00	D2B1	7.8	39.3	0.0e+00	0.0e+00	2.3
93	639.00	None	7.4	39.3	0.0e+00	0.0e+00	0.7
94	645.00	None	8.6	39.0	0.0e+00	0.0e+00	2.5
95	651.00	None	8.4	39.3	0.0e+00	0.0e+00	3.0
96	657.00	None	6.4	38.4	0.0e+00	0.0e+00	2.0
97	663.00	None	6.6	39.2	0.0e+00	0.0e+00	2.1
98	669.00	None	7.1	39.4	0.0e+00	0.0e+00	2.0
99	675.00	None	7.6	39.2	0.0e+00	0.0e+00	1.7
100	681.00	None	6.6	38.6	0.0e+00	0.0e+00	1.3

### 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 CX380s-D3.1 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 frequency range, with 60 dB dynamic range. Adjustable sweep time, RBW and VBW settings optimize signal representation and noise floor performance. The default frequency range is now 5 MHz to 1200 MHz. An extended frequency range option to 1800 MHz is available, fully supporting the DOCSIS 3.1 specification.

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.

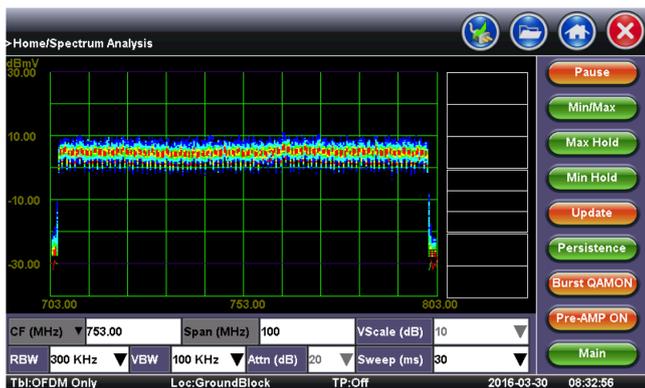
Test profiles consisting of user-settable parameters such as CF, Span, RBW, VBW and Marker positions can be saved and recalled for repeated testing. Waveform storage enables a user to compare and contrast a captured signal versus a current measurement, in both superimposed or split screen views.

### 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)

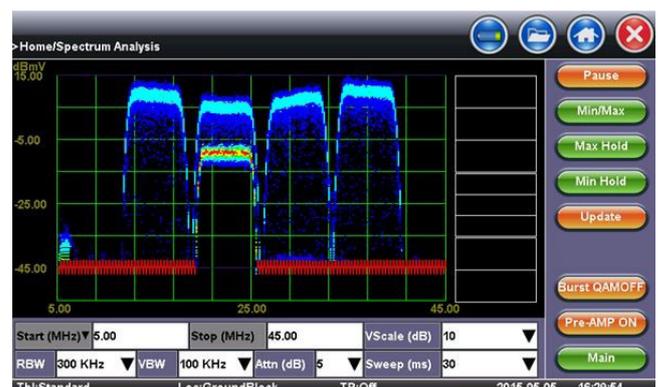
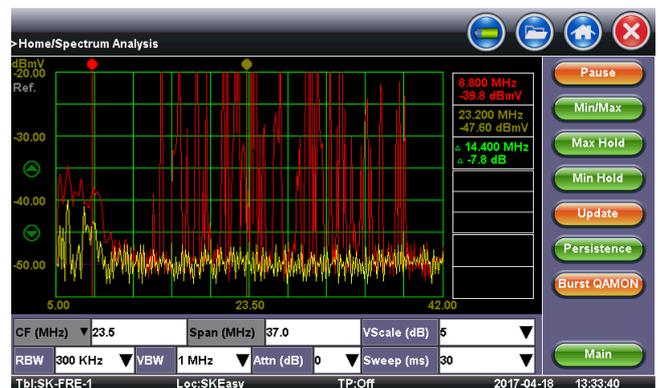
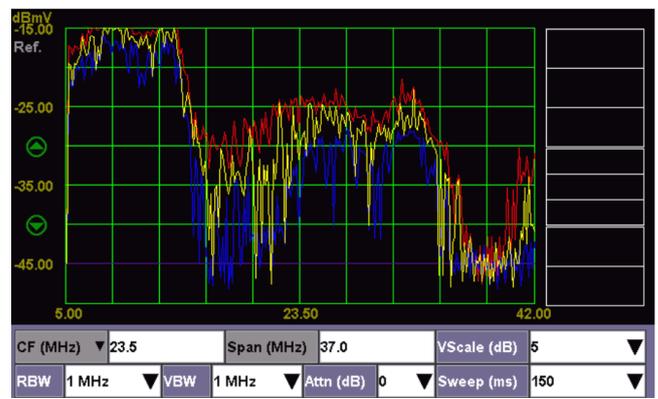
Spurious signals appearing in the upstream composed of distortion products of the downstream signals. Lower frequency components are passed through the diplex filter and amplified by the return amplifier. Common Path Distortions are intermittent by nature and are directly related to poor connections,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



### Upstream Ingress

The return path is more susceptible to RF impairments because this frequency spectrum is heavily used for Ham 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.



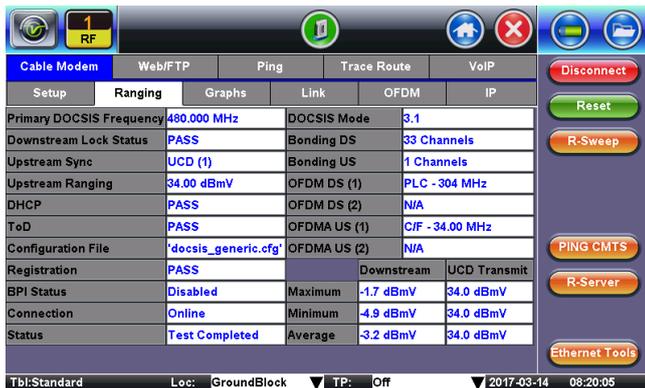
## DOCSIS® 3.1/3.0

### DOCSIS 3.1/3.0 Modem Emulation

Equipped with a 32x8 DOCSIS 3.0/3.1 Cable Modem, the CX380s-D3.1 enables technicians to perform actual modem connection tests, without having to carry a separate modem on service calls.

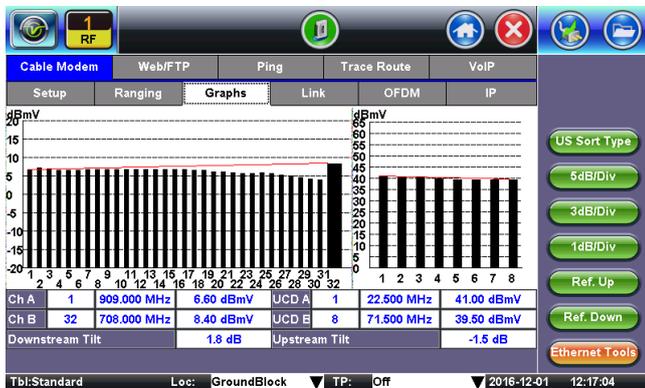
### Intuitive Ranging Results

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.



### Channel Power Graphs

Provides a single screen graphical overview of all DOCSIS Downstream carriers and active UCDs. Perform Tilt analysis.



### Link Statistics

A range of live link connection parameters for all bonded DOCSIS downstream and upstream channels. Measurements include power level, SNR, and Pre and Post BER.



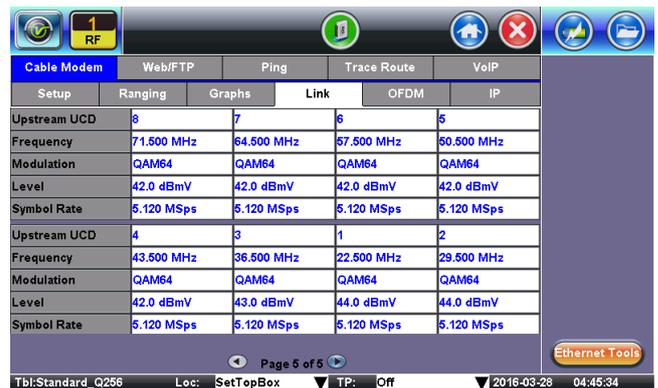
### Additional DOCSIS Modem Features

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

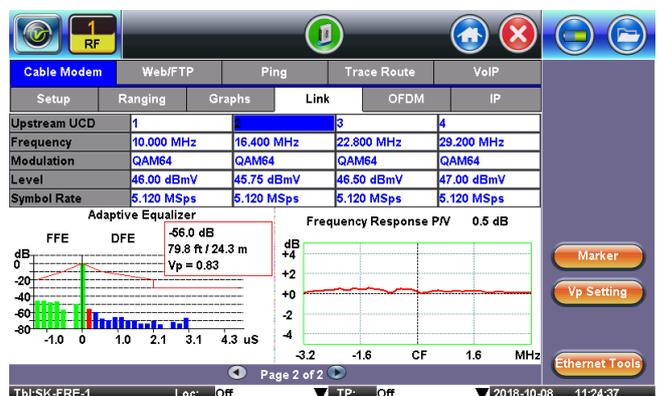
### Verifying Upstream Channel Bonding

DOCSIS 3.0/3.1 channel bonding provides 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. Up to eight upstream DOCSIS channels, plus optional OFDMA, 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.



For advanced troubleshooting, Upstream Pre-Equalization Adaptive EQ parameters and In Channel Frequency Response can be viewed by tapping on the desired UCD number.



## DOCSIS 3.1 OFDM Testing

OFDM, combined with Low Density Parity Check (LDPC) advanced FEC technology, are the basis for DOCSIS 3.1 transmission. Key DOCSIS 3.1 measurements are derived from its OFDM/LDPC building blocks, which consist of the PHY Link Channel (PLC), Next Codeword Pointer Channel (NCP) and Modulation Profiles.

The Phy Link Channel PLC is used as a message channel for bringing new Cable Modems online. The PLC contains critical information on how to decode the OFDM signal.

An OFDM Phy Channel consists of numerous multiplexed subcarriers. Each subcarrier can be either 25 kHz or 50 kHz wide. As an example, a single 192 MHz OFDM Channel can contain up to 3840 50 kHz wide subcarriers.

When Codewords (CW) are mapped to OFDM subcarriers within a symbol, a pointer is needed to identify where a data CW starts. This is known as the Next Codeword Pointer (NCP).

A Modulation Profile is a list of modulations that are used for the subcarriers within an OFDM channel.

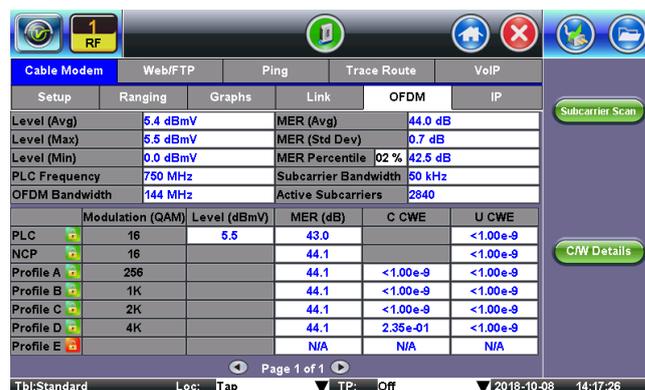
- Profile A is the boot profile that cable modems first receive when they initialize and register with the CMTS. All DOCSIS 3.1 Cable Modems must support the base Profile A, as it is a prerequisite for D3.1 transmission
- Profiles B, C, D: line conditions are continuously monitored and when a sufficiently high SNR threshold is achieved for a given OFDM subcarrier, higher modulation schemes can be used for greater spectral efficiency. The Profiles can be tailored to the line conditions of each subcarrier

## Powerful Built-in OFDM Analyzer

- The fundamental D3.1 test pertains to locking to the PLC. Key PLC measurements include Level, MER performance, Corrected CW and Uncorrected CW
- NCP based tests include verification for lock status, MER, Corrected and Uncorrected CW
- Modulation Profile analysis, for the Boot Profile A and higher modulation profiles, are done to check for Lock status, MER, and Corrected/Uncorrected CW
- OFDM Channel status for actual bandwidth, subcarrier bandwidth, and the active number of subcarriers
- An overall OFDM channel performance assessment, including average overall MER, and the worst performing subcarriers based on a user settable MER Percentile setting

## OFDM Check

The OFDM Check feature allows for true OFDM Signal Analysis without having to go online in Cable Modem mode. This is extremely valuable if the DOCSIS signal is impaired or is not available, which can be the case at some test points. OFDM Check only requires locking on the downstream PLC signal and provides a wealth of OFDM measurements.



Another valuable tool is the OFDM PLC Search, which removes the guesswork for the PHY Link Channel frequency, if it is not known.

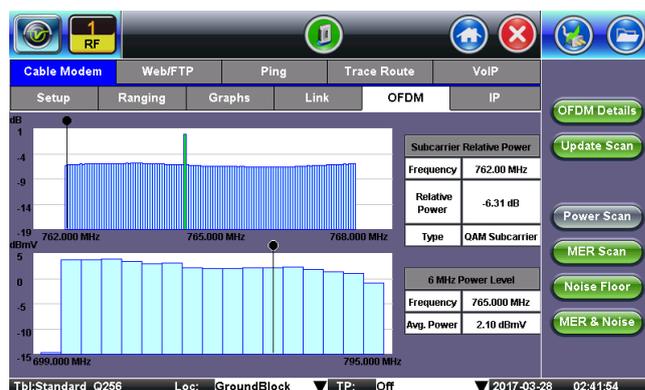


## OFDM Subcarrier Scans

In depth OFDM analysis is made possible with detailed subcarrier scans, which are presented in intuitive, graphical format.

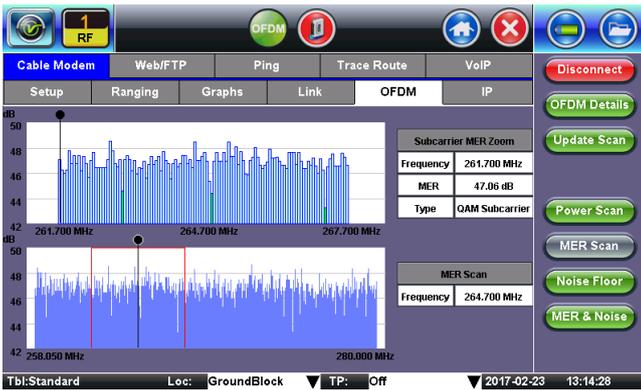
## Subcarrier Power Scan

More precise OFDM power levels can be measured using the Power Scan. The OFDM channel is sectionalized to provide 6 MHz power measurements. Color coding clearly identifies the QAM modulated subcarriers, PLC subcarriers, and continuous pilots.



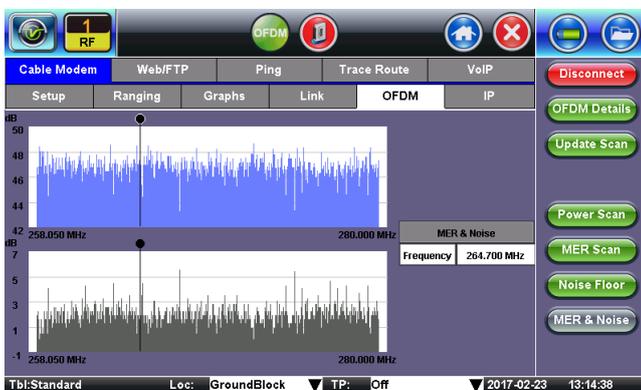
### Subcarrier MER Scan

The full MER scan is presented on a per subcarrier basis.



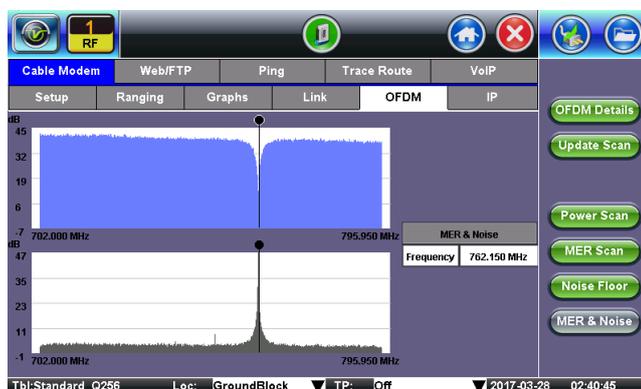
### Subcarrier Noise Scan

A full OFDM noise floor scan provides insightful indications of disturbers that may be present.



### Detect Noise Under the OFDM Channel

The MER and Noise subcarrier scans can be overlaid in a MER and Noise graphical view, which ultimately can help identify service impacting plant impairment issues, namely hidden noise under the OFDM Channel.



### IPv6 Support and Network Server Verification

Once successful upranging is complete, the DOCSIS 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.

	IPv4	IPv6
Cable Modem	6.1.131.61	fd00:ca57:6152:10:2:2b0a:128
Subnet	255.255.255.0	N/A
DHCP Server	6.4.0.32	fe80::ea65:49ff:feb8:b419
CMTS Router	6.1.131.254	fe80::ea65:49ff:feb8:b419
TOD Server	10.45.16.53	fd00:ca57:6260:5:53
TFTP Server	10.90.190.61	2001:420:3045:2402::61
Client IP	6.1.133.169	fd00:ca57:6152:10:2:abd0
Gateway	6.1.133.254	fe80::ea65:49ff:feb8:b419
Subnet	255.255.255.0	:::0
DNS	10.45.15.53	fd00:ca57:6260:5:53

### VeTest Throughput

The VeTest feature qualifies network HTTP protocol performance by downloading and uploading files to a customer specific VeTest HTTP server. It can test up to the full line rate, depending on the server specifications and limitations. Connection time to the server, data transfer time, and line rate throughput rates are reported during the tests.

Setup	Result	
Others   Atlanta   10.0.0.45		
Status	Pass	
Connection Time	121 ms	
Total Data Transfer Time	271360 ms	
PING Test		
Ping Response	PASS 7.900 ms	
Throughput		
	Download	Upload
Line Rate - MAX	1461.964 Mbps	443.404 Mbps
Line Rate - AVG	958.169 Mbps	210.851 Mbps
Data Rate - MAX	1400.492 Mbps	423.587 Mbps
Data Rate - AVG	917.889 Mbps	201.428 Mbps

# 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, and 10GE LAN/WAN 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

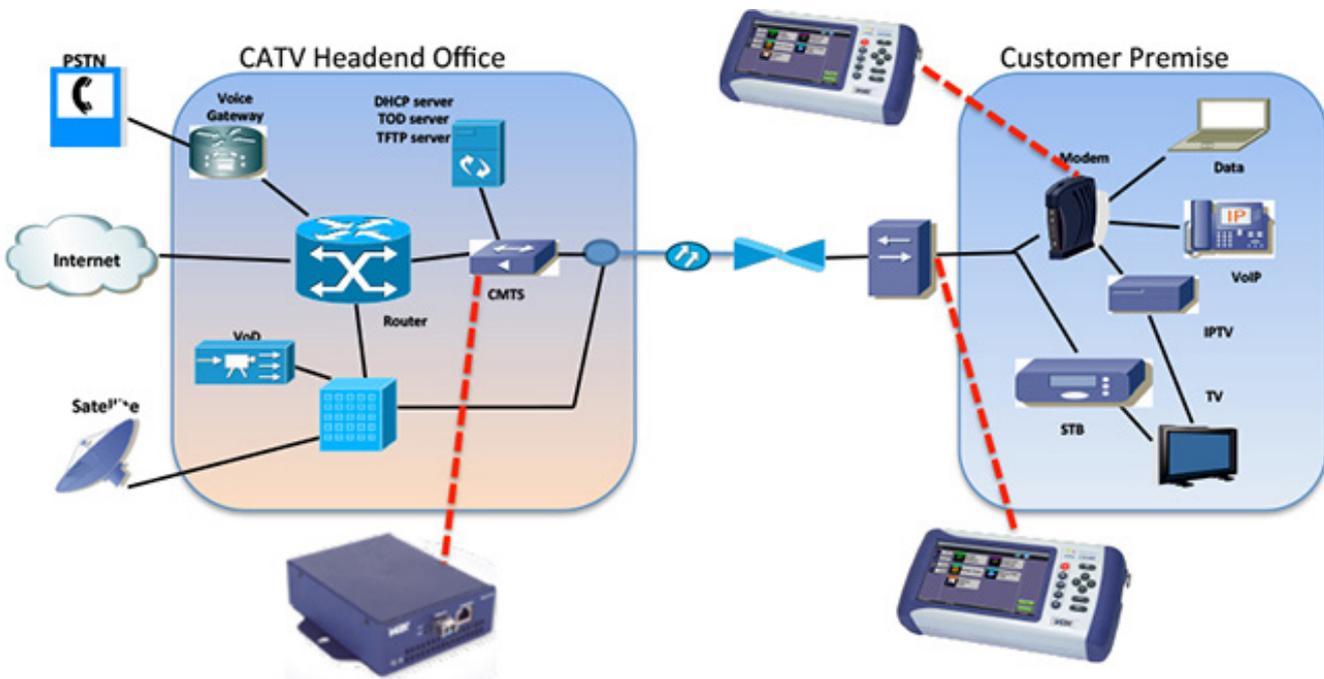
Testing with multiple streams enables service providers to simulate and qualify a variety of applications and perform Ethernet QoS measurements.

- **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 on the test port. The CX380s-D3.1 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 CX380s-D3.1 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 CX380s-D3.1 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

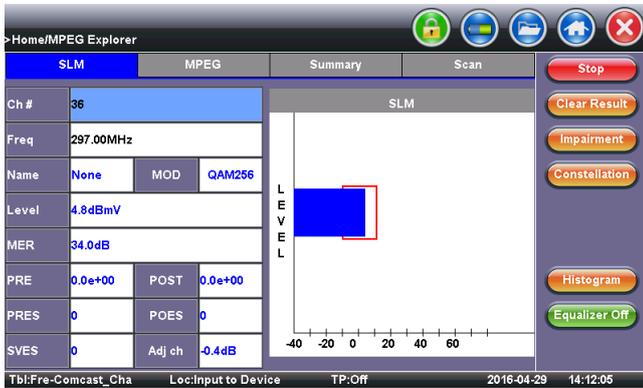
Actual Cable Modem CPE verification can be performed by connecting the CX380s-D3.1's Ethernet test port to the Cable Modem's Ethernet port and generate test traffic to the far-end Ethernet test device connected behind the CMTS.

#### 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.

## 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 CX380s-D3.1 MPEG Explorer option extracts MPEG Transport Stream payloads from the QAM carrier and decodes them to check transport and programming content.



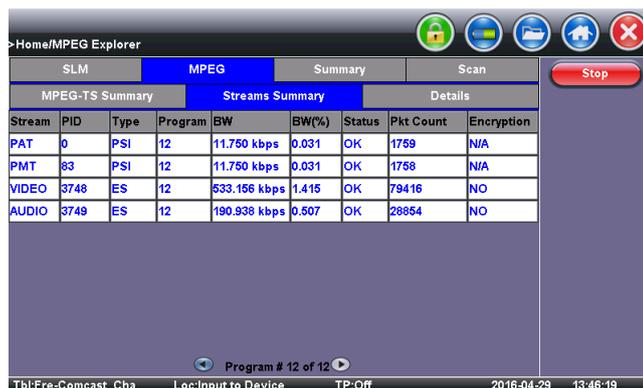
### MPEG-TS Analysis

Detects the number of MPEG programs per channel. Provides PID MAP and streams information. Per program video, audio, and data streams rates and received packets count. Per steam PID numbers and Codec information.



### Encryption Detection

Detects the encryption status of each stream (video and audio)



### TR 101 290 Support

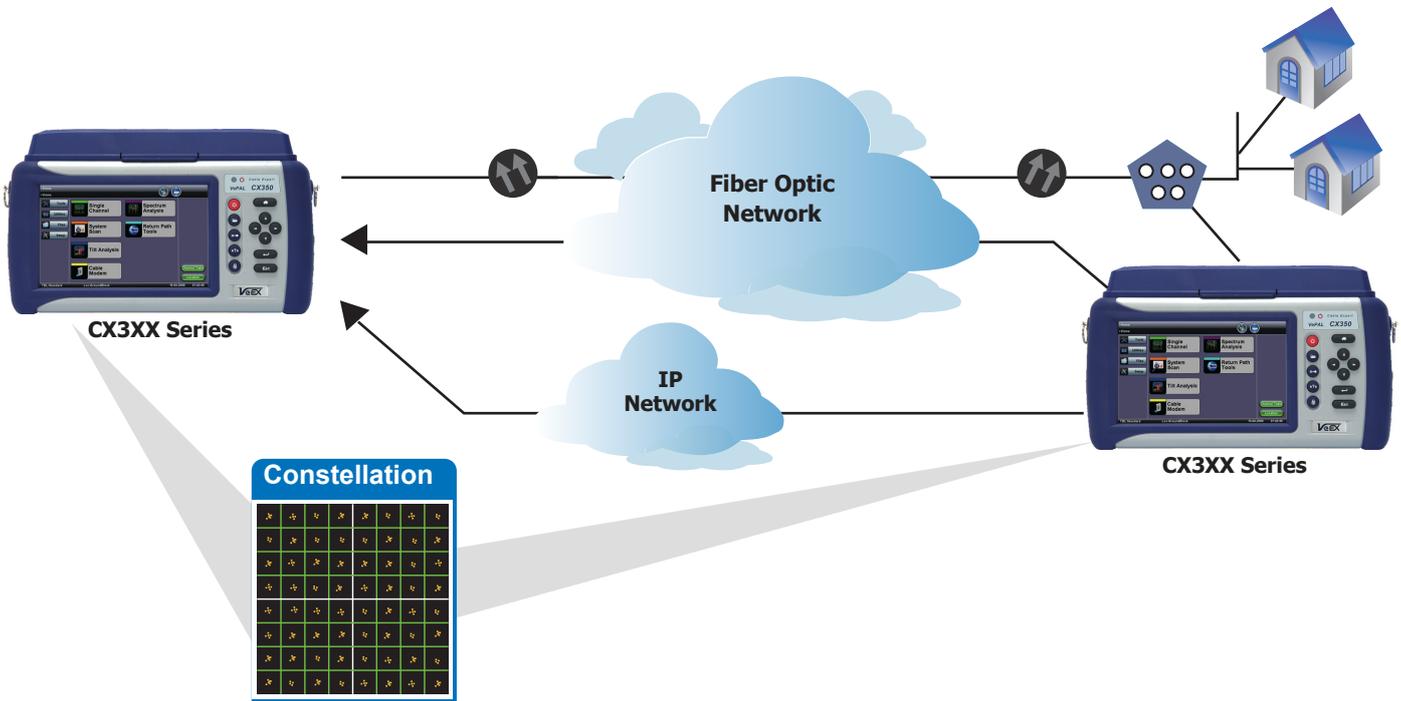
The ETSI TR 101 290 recommendation is a very good indicator of when a MPEG Transport Stream has been transported error-free across a network. The MPEG Explorer option features a dedicated measurement tab displaying Priority 1 alarms which are key indications of synchronization, continuity errors and 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.



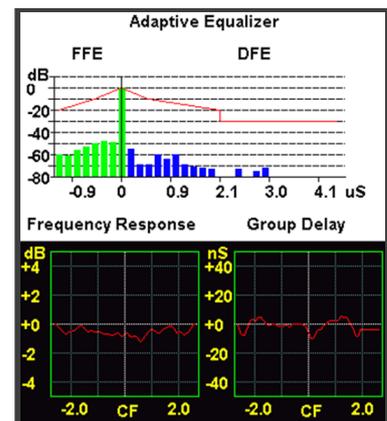
MPEG Transport System Analysis Summary	
Test Result	Definition and Description
PMT PID	Represents PID for the PMT inside the MPEG stream
#PIDs	Number of PIDs inside the MPEG stream
Video Packet Statistics	Includes video bandwidth and video packet statistics inside the program
Audio Packet Statistics	Includes audio bandwidth and audio packet statistics inside the program
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
Encryption Status	Detection of scrambling status for each Video and Audio stream

## 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.

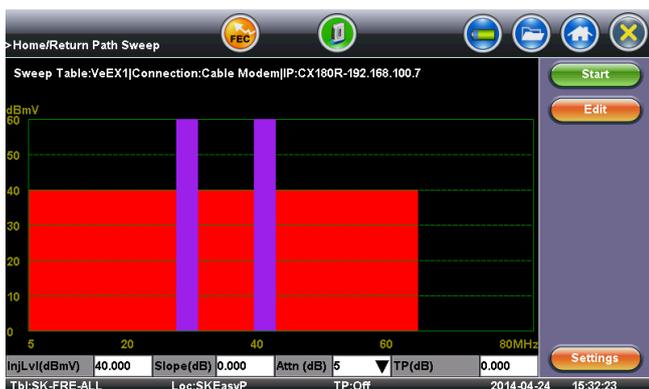


## Return Path Sweep

The CX380s-D3.1 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.

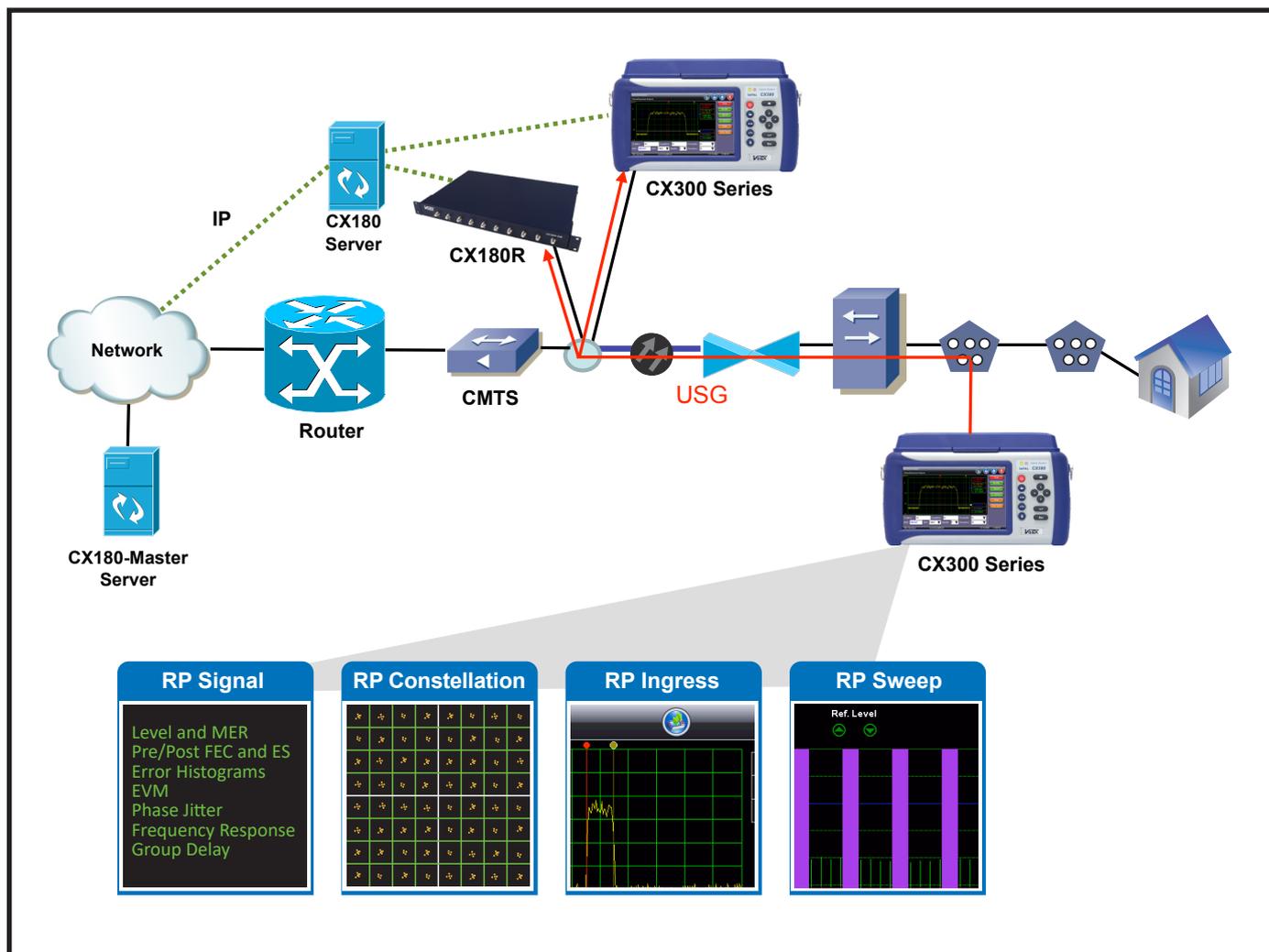
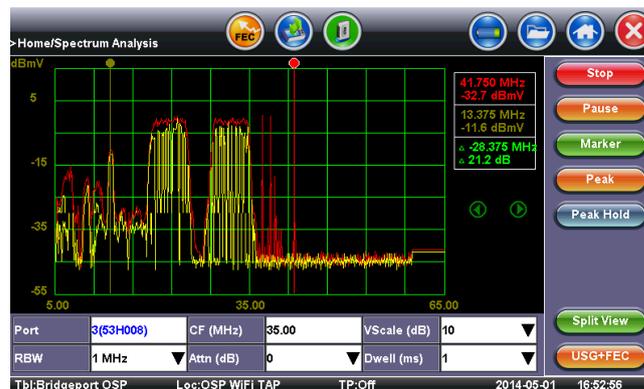


## Remote View

Return path troubleshooting and testing is simplified when the CX380 Series is equipped 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 CX380s-D3.1 or CX180R spectrum analyzer can also be viewed, thus making it a truly unique solution for upstream testing and characterization.



## 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 CX380s-D3.1 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 software options offering different test methods to verify and provision your VoIP network.

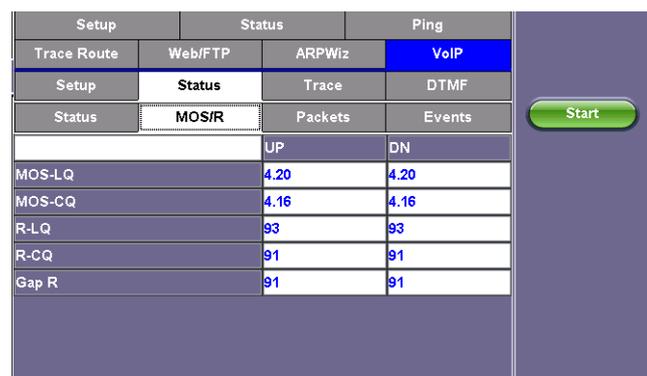
**VoIP Check** – Simulates a VoIP call to the nearest router and measures the round trip MOS score and related VoIP parameters.

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

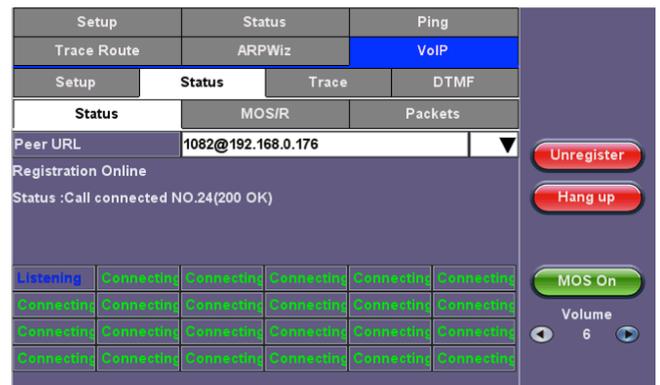
**VoIP Expert** – VoIP Expert is a simple and effective tool for pre-qualifying VoIP service and verifying triple play implementations.

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

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



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



## VoIP Testing

Codecs: G.711  $\mu$ -law, G.711 A-law

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

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

VoIP Check

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

VoIP Expert

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

VoIP Call Expert

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

\*Note: these optional features require the Cable Modem or Ethernet option.

## 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

*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

Setup	Analysis			Viewer
IPTV-TS Summary		Streams Summary		Details
PID Map	Video		Audio	ETR 290
	Min	Max	Avg	Below Threshold(%)
Absolute MOS_V	1.00	2.67		0.000
Relative MOS_V	1.09	3.20		0.000
MOS_AV	1.52	2.55	1.81	0.000
VSTQ	50.00			
EPSNR				
EPSNR ATIS	42.58dB			

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## WiFi Spectrum Analyzer\*

The CX380s-D3.1 offers a powerful portable spectrum analyzer on a USB dongle that displays all RF activity in the WiFi bands. With dual 2.4 GHz and 5 GHz bands support, the analyzer covers all 802.11a/b/g/n/ac networks and is the ideal tool for enterprise environments with a mix of wireless technologies.

With multiple graphical format displays it helps to visualize and locate RF signals in the spectrums as well as locate and eliminate interference sources (cordless phones, microwave ovens, Bluetooth devices, etc.), discover and remedy competing access points.

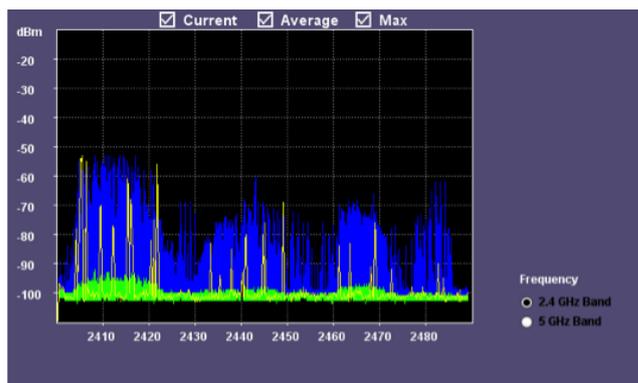
Supports 802.11 a/b/g/n/ac

Frequency Range: 2.400 to 2.495 GHz and 5.150 to 5.850 GHz

Amplitude Range: -100 to -6.5 dBm

Antenna: RP-SMA

Planar, topographic, spectral view

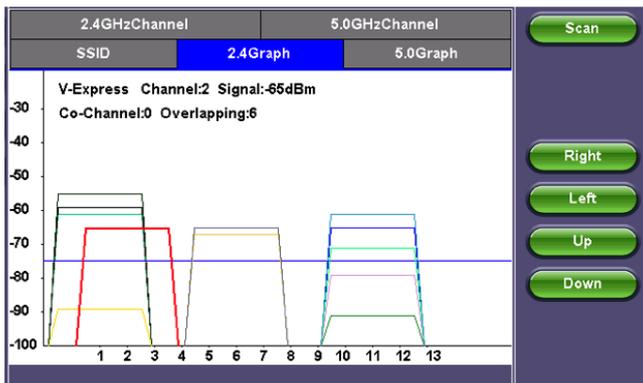


## WiFi InSSIDer

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

Network scan results in Graphical or table format

Lists: Network names, BSSID, encryption type, channel allocation, signal strength, co-channels and overlapping channels



## WiFi Wiz

The WiFi Wiz function with USB WiFi adapter for 802.11 a/b/g/n/ac wireless in 2.4 GHz and 5 GHz bands makes troubleshooting WiFi connectivity issues a simple task. Scan for available networks and view all access points detailed information along with SSID, signal strength and channel allocation. Connect to Access Points with WEP/WPA or WPA2 encryption and verify IP capabilities to ensure the wireless network is properly installed and configured. A full suite of IP testing features is supported (ping, trace, web browser, etc.).

Requires compatible USB WiFi adapter for a/b/g/n/ac networks in 2.4 GHz and 5 GHz bands

Access Points scan with signal level and link quality measurement  
WEP/WPA1/WPA2 encryption

IP Connectivity test (Ping, trace route, ARPWiz, Web browser)

Provides WiFi LAN access to the test set (e.g. VeExpress, R-Server, Remote Control, ReVeal)



## Fiber Optic Tools

### Digital Fiber Inspection Scope

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

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

Visual Inspection

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

### Auto-Focus Detection and Analysis option

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

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

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

### Optical Power Meter GUI\*\*

Supports USB OPM dongles

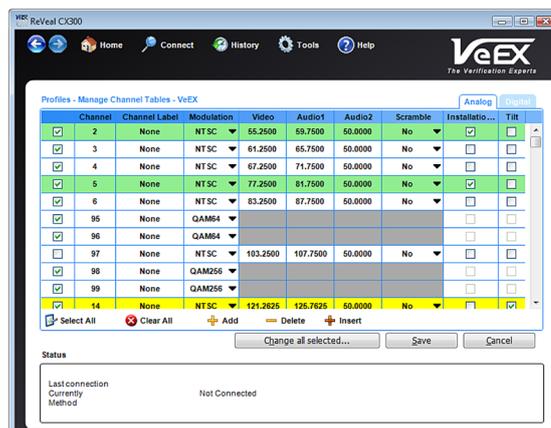
The optional OPM helps checking for proper output power from optical ports before safely making an optical connection or running a test

- Numerical and bar graph readings
- Hold function
- Display Units: dBm, mW and  $\mu$ W
- User definable Maximum and Minimum power limits, with color-coded Pass/Fail indication
- Optical Loss Meter function with zero reference calibration
- Loss limit settable in dB, dB/km and dB/mi

\*\* OPM dongle sold separately. For available Wavelength Range, Calibrated Wavelengths, Power Range, Accuracy and Connectors, refer to the USB dongle specs

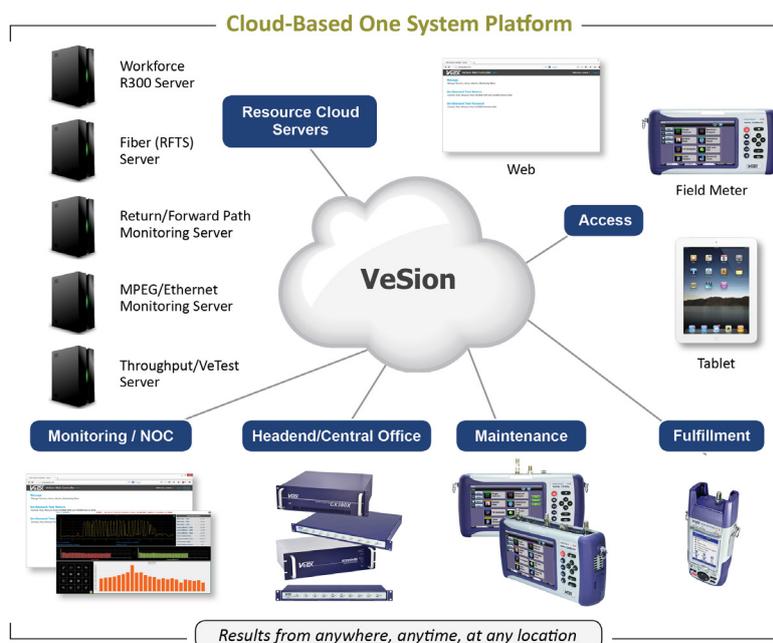
## ReVeal CX300 PC Software

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.



## 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  
 SLM 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 45 dB\*  
 Adjacent Channel  
 Pre & Post BER Range: 0 to  $9 \times 10^{-3}$   
 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: 1000 ns max
- Max Amplitude Change: 5 dB max
- Phase Jitter: 10% max
- Symbol Rate Error: 10000 ppm max
- Frequency Error: 6920 ppm (250 kHz max)
- Frequency Response: +/-4 dB max
- HUM: 0 to 10%
- EVM: 1 to 5%
- Carrier to Noise: 50 dB max
- Carrier to Ingress: 45 dB max
- Est. EQ Stress: -35 to -40 dB
- Est. Un-EQ MER: 25 to 35 dB
- Est. Noise Margin: 1 to 12 dB
- Est. Echo Margin: -32 to 63 dB

### Spectrum Analysis

Frequency Range: 5 MHz to 1.2 GHz, with optional extension to 1.8 GHz\*  
 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

### 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  
 Adaptive Equalizer Display  
 Pre & Post BER Range:  $9 \times 10^{-3}$  to  $9 \times 10^{-9}$   
 Errored and Severely Errored Seconds

### Cable Modem DOCSIS 3.0/3.1

#### Downstream/Receiver

- Frequency Range
  - 108 to 1218 MHz (with 85 MHz Diplexer option)
  - 258 to 1218 MHz (with 204 MHz Diplexer option)
- Bandwidth
  - 6 or 8 MHz DOCSIS carriers and 25 or 50 kHz OFDM Sub-carriers
- Channel Bonding: Up to 32 Single Channel QAM and Dual 192 MHz OFDM Channels (with DOCSIS 3.1 option)
- Maximum Speed: Up to 4 Gbps
- Input Power Level: -15 dBmV to +15 dBmV per digital channel, typical

#### Upstream/Transmitter

- Frequency Range
  - 5 to 85 MHz (with 85 MHz Diplexer option)
  - 5 to 204 MHz (with 204 MHz Diplexer option)
- Channel Bonding: Up to 8 Single Channel QAM and Dual 96 MHz OFDMA Channels (with DOCSIS 3.1 option)
- Maximum Speed: Up to 1 Gbps
- Output Signal Level: Up to + 68 dBmV

#### OFDM

- OFDM input range: -20 dBmV to +30 dBmV
- OFDM MER range: 20 dB to > 45 dB
- Bandwidths: 24 MHz to 192 MHz
- FFT size
  - FFT size = 4k (50 kHz carrier spacing)
  - FFT size = 8k (25 kHz carrier spacing)
- Profiles: Supports up to 5

\*Requires enhanced hardware revision shipping from August 2017.

**Cable Modem** DOCSIS 3.0/3.1 *cont'd***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

Ethernet Classification: Per IEEE 802.3

Single 1GE and 10GE LAN/WAN SFP+ optical Ports: LC connectors

**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<sup>31</sup>-1, PRBS 2<sup>23</sup>-1, PRBS 2<sup>20</sup>-1, PRBS 2<sup>15</sup>-1, PRBS 2<sup>11</sup>-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

## General Specifications

Size	290 x 140 x 66 mm (W x H x D) 11.40 x 5.50 x 2.60 in
Weight	Less than 2.5 kg (less than 5.5 lb)
Battery	Lilon 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: 15 VDC, 6A
Operating Temperature	0°C to 45°C (32°F to 122°F)
Storage Temperature	-20°C to 70°C (-4°F to 158°F)
Humidity	5% to 95% non-condensing
Display	7" full color touch-screen display
Ruggedness	Survives 1m (3 ft) drop to concrete
Interfaces	USB 2.0, RJ45, 10/100-T Ethernet, Bluetooth 2.0 (optional)
Languages	Multiple languages support



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