AT2500-3G

Next Generation Headend Maintenance Test Solution

Multi-Standards Testing Simplified

VeEX's new AT2500-3G is the industry's most complete 3 GHz advanced spectrum analyzer and multi-standards test solution. Incorporating a high-resolution color touch-screen, the AT2500-3G features 3 GHz spectrum analysis, digital channel, VeCheck, MPEG analysis and Ethernet test capabilities. Comprehensive SLM measurements include Single Channel, Fast Full Band and real-time plant level scan, Tilt, Headend Check, and FCC Digital POP tests.

Key Features

- 3 GHz high sensitivity advanced spectrum analyzer with built in automatic filters for increased dynamic range*
- Superior QAM demodulation capability and excellent BER performance, featuring MER capability up to 47 dB
- Annex A, B, C, DOCSIS 3.1 OFDM Signal Analysis, ISDB-T, DVB-S, DVB-S2
- Fast Full Band VeCheck up to 1.2 GHz
- Real-time Full Band Downstream Level Check
- Multiple trace display with detector selection and enhanced markers for added flexibility
- Comprehensive SLM measurements (Single Channel, System Scan and Tilt)
- MPEG Explorer: QAM channel MPEG-TS analysis*
- QAM Analyzer measurements (MER, Pre/Post BER, Constellation diagram, QIA Anaylzer, Histogram and Equalizer on/off mode)
- Advanced Digital measurements (HUM, EVM, Phase Jitter, Symbol Rate Error, Frequency Response, Group Delay)
- FCC Proof of Performance Tests
- Headend Check auto test for the entire selected Channel Table lineup*
- Isolates difficult to locate problems using comprehensive QAM Impairment Analysis

Platform Highlights

- High resolution color 10.4" touch-screen with graphical user interface
- Remote access and control via Web Browser, VNC® client and ReVeal PC software
- Ethernet LAN management port for remote control, back office applications and workforce management
- Fast and efficient test result transfer to USB memory stick
- Maintain instrument software, manage test setups and channel tables, process measurement results and generate customer test reports using included ReVeal PC software
- EZ-Remote for remote testing/monitoring, assistance and training across Internet connections
- View test results and create detailed reports by region, area, system, and technician, using R-Server centralized management
- Ability to lock user interface to prevent unwanted human interference during long-term testing
- Supports DOCSIS 3.1 test module*

*Optional features

True Spectrum Analyzer

The AT2500-3G is the industry's most complete 3 GHz advanced 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 0 MHz to 3000 MHz frequency range, with 80 dB dynamic range. Adjustable sweep time, RBW and VBW settings optimize signal representation and noise floor performance.

The large 10.4" 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.

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 AT2500-3G.

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 AT2500-3G 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.
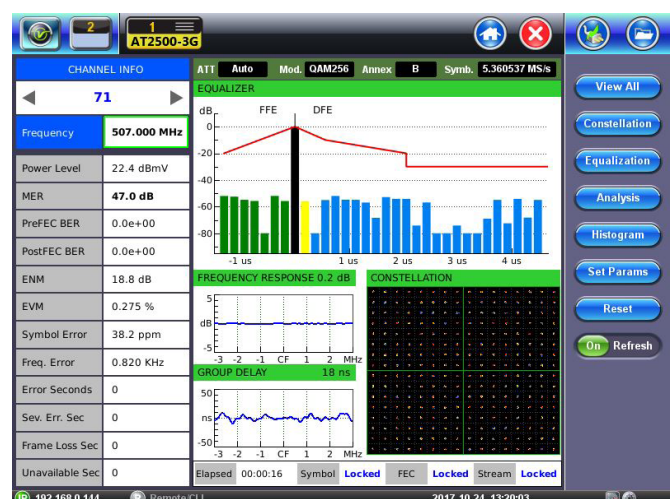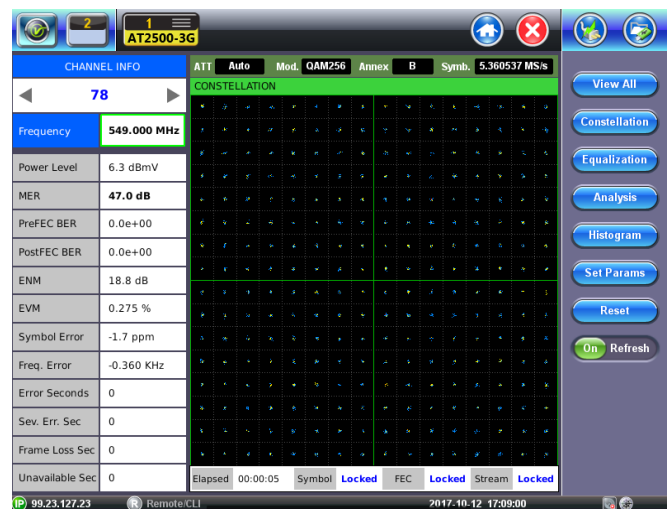
SLM Features *cont'd*

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.


Spectrum Persistence

For the overcrowded upstream spectrum range, traditional tasks use free regions to measure noise floor and monitor inteference. Using Peak hold in the spectrum mode is insufficinet to show ingress under the return path carrier, as it's typically the highest level of the affected upstream frequency range. Over time, the current values are overwritten permanently with higher amplitude traces where you see nice UCD haystacks from the peak hold. With ingress being transient noise and without a fixed amplitude, any evidence of ingress under these UCD carriers will be gone. AT2500-3G uses spectral persistence analysis and heat map technology which enable users to locate these transient and bursty signals hiding under QAM carriers.
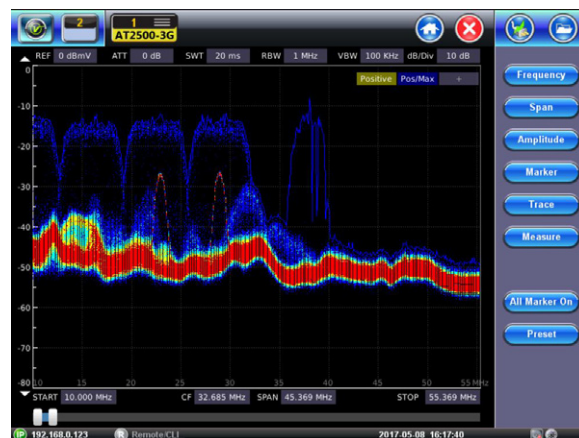
VeCheck

VeCheck is a fast and powerful Full Band Scan for the Forward Path, covering up to 1218 MHz. Key metrics include real-time full downstream Level Check, Modulation Type, and MER (up to 45 dB) for digital QAM, Single-Carrier DOCSIS QAM, and OFDM presented in easy to view graphs.
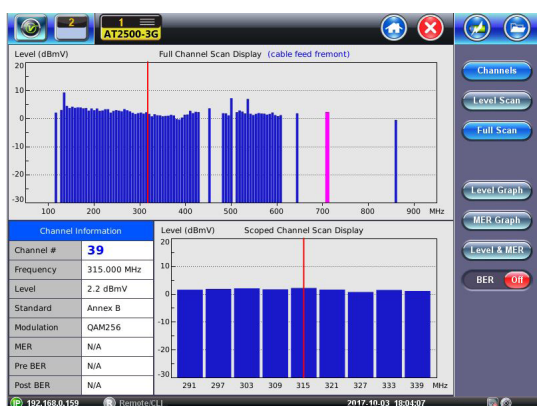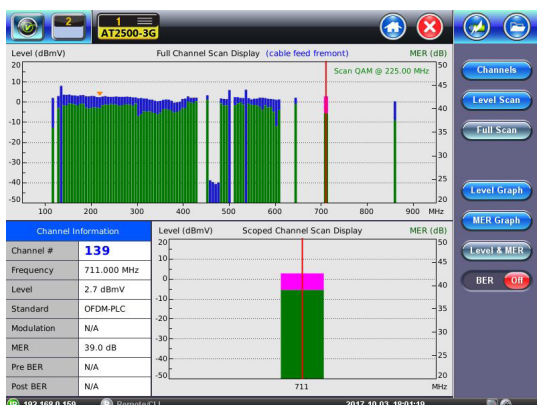
FCC POP

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

The optional FCC/Digital POP feature consists of a Digital POP Auto Test. Test Channels are based on a user configurable Channel Table. Standard test results are supported in both CSV and PDF Formats.

DOCSIS 3.1 OFDM Analyzer

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 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.
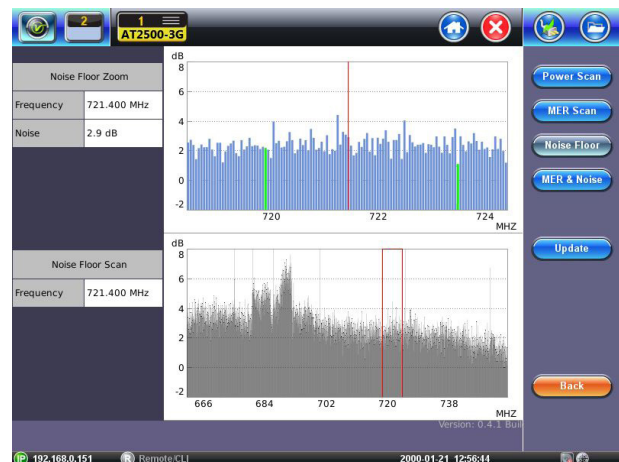- Profile A is the boot profile that cable modems first receive when they initialize and register with the CMTS. All DOCSIS 3.1 Cable Modems must support the base Profile A, as it is a prerequisite for D3.1 transmission.
- Profiles B, C, D: line conditions are continuously monitored and when a sufficiently 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.
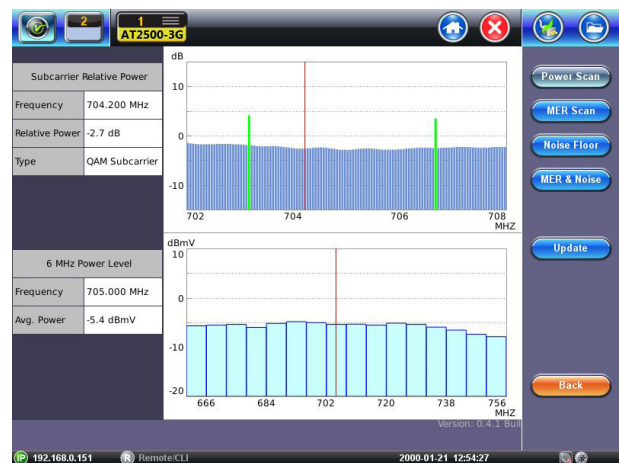
Key D3.1 OFDM Measurements
- The fundamental D3.1 test pertains to locking to the PLC using the PLC search function. Key PLC measurements include Level, MER performance, Corrected CW and Uncorrected CW.
- NCP based tests include verification for Level, MER, Corrected and Uncorrected CW.
- Modulation Profile analysis, for the Boot Profile A and higher modulation profiles, are done to check for Lock status, MER, and Corrected/Uncorrected CW.
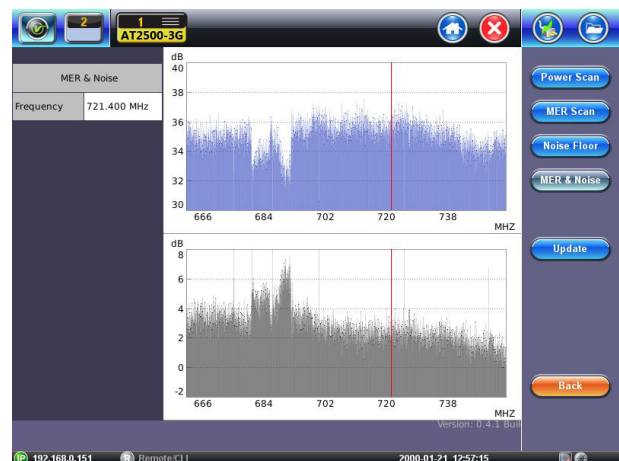- An overall OFDM channel performance assessment.

OFDM Channel Subcarrier MER Scan

OFDM Channel Noise Floor Scan

OFDM Channel Subcarrier Power Scan

OFDM Channel MER and Noise Scan

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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 AT2500-3G 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**
Summary Status	Summary of all alarms (packet loss, MPEG layer alarms, etc.)
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
Encryption Status	Detection of scrambling status of each video and audio stream
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
PSIP Errors	Detect PSIP errors on MPEG TS

VeSion™ R-Server

A web-based software application specifically designed for medium-to-large CATV operators facing the enormous challenge of coordinating asset and test data management.

Advanced Management
Authorized test sets register with specific VeSion R-Server to download new channel tables, test profiles and measurement thresholds. Upload test results to VeSion R-Server workforce and asset management server using a network connection.

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
- 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
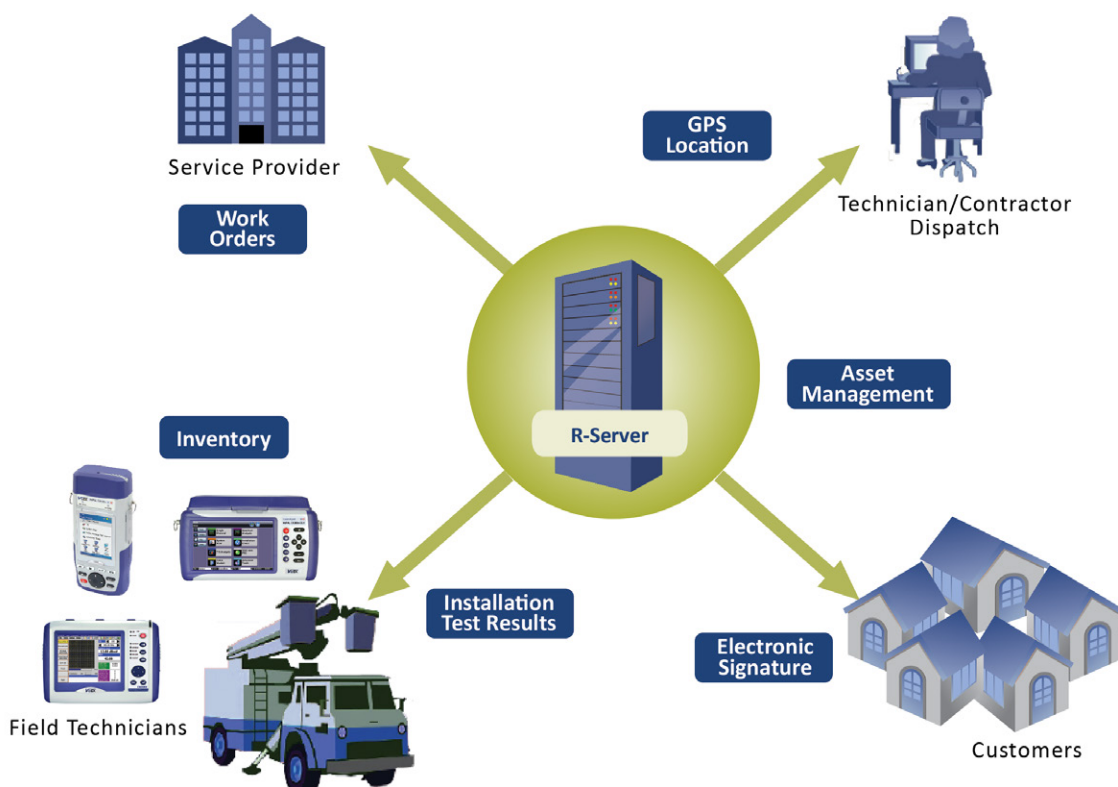
ISDB-T OFDM (Japan Standard Terrestrial Digital)

The ISDB-T OFDM option supports signal level, MER, BER, constellation, TMCC, and Layer switching to analyze the reception status of terrestrial digital.

- Automatic acquisition of TMCC information to selection of measurement layer (A, B, C)
- Delay measurement to assess multipath echos and their effect on signal quality
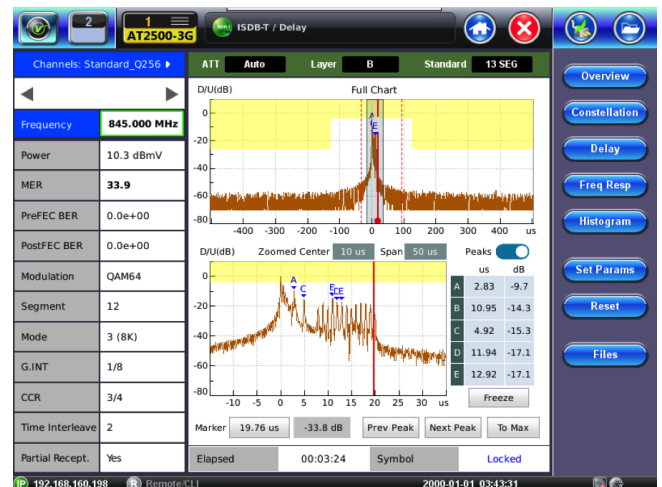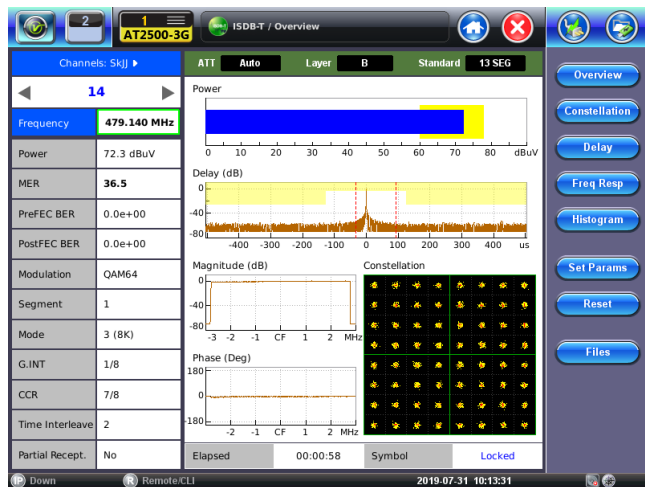
QAM Wiz

The optional QAM WIZ DOCSIS Burst Demodulator helps identify rogue Cable Modems that contribute harm to the plant.

- Captures IUC 4 Upstream Channel Descriptors provided by the CMTS from a specific downstream DOCSIS channel. Supports both DOCSIS Downstream SC-QAM and OFDM
- For a selected UCD: captures and demodulates burst Cable modem signals
- Assesses QAM health for the UCD by measuring Upstream MER, burst constellations, and codeword errors
- Identifies associated Cable Modem MAC addresses, which helps identify rogue Cable Modems

DOCSIS 3.1 Test Module*

Making the best-in-class AT2500-3G Analyzer even more powerful, now available is a plug-in Test Module adding DOCSIS 3.1 Cable Modem emulation functionality as well as 1GE Layer 4+ Throughput capabilities.

Key features include:

- **DOCSIS 3.1 Cable Modem –** supports true emulation mode for D3.1 OFDM and D3.0 32x8 SC-QAM
- **Ranging Results** - presented in an easy-to-view summary screen, along with live updates with the Link tab
- **OFDM Status –** easy-to-view OFDM summary screen with a clear presentation of critical D3.1 OFDM metrics, including the quality of the Phy Link Channel (PLC), Next Codeword Pointer (NCP) and modulation profiles
- **OFDMA Status** - OFDMA center frequency, transmit level and bandwidth
- **RF V-TEST –** Download and Upload Throughput rates measured at the Cable Modem test interface
- **Layer 4+ Throughput Tests –** verify actual throughput when connecting through a subscriber's CPE device at the 1G interface, supporting V-Test (Ookla HTTP), V-PERF (TCP), and V-FTP applications

Specifications

Spectrum Analysis

Frequency

Tuning Range: 0 – 3 GHz (0-1.5 GHz default)*
Calibrated Frequency Range: 5 MHz – 3 GHz
Frequency Reference Aging: ± 1 PPM / yr Frequency Reference
Temperature Stability: ± 1 PPM (0° to 50°C)
Frequency Counter Accuracy: ± 1 PPM ± 1 count
Frequency Counter Resolution: 10 Hz
Single Sideband Phase Noise at 10 kHz Offset
- Typical -97.5 dBc/Hz @ 10 kHz SSB

Resolution Bandwidth: 3 MHz, 1 MHz, 300 kHz, 100 kHz, 30 kHz, 10 kHz, 3 kHz, 1 kHz
Video Bandwidth: 1 MHz, 100 kHz, 10 kHz, 100 Hz

Spans

Max Span: 3 GHz/3000 MHz
Variable Spans: 0.1 MHz to 3 GHz, user programmable
Zero Span

Sweep Time

Max Span and > 1000 MHz: 30 ms
Other spans ≤1000 MHz: 20 ms to 5 s in 2, 5, 10, 20 sequence
Reduced Spans (≤500 MHz, ≤100 MHz, ≤50 MHz): 2, 4, 10 ms
Zero Span Horizontal Time: 0.05 ms to 500 in 1, 2, 5, 10 sequence

Amplitude

Input Impedance: 75Ω
Input Level Range: -64 dBmV to +70 dBmV @ RBW 300 kHz
Dynamic Range: 80 dB
Display Range: 80 dB
Sensitivity: -64 dBmV @ RBW 300 kHz
Level Accuracy: ±0.75 dB max. 5 MHz -3 GHz
Level Resolution: 0.25 dB
Vertical Scale: 1, 2, 5, 7, 10 dB Attenuation: 0 to 65 dB in 5 dB steps
Maximum Safe Input: 68 dBmV 220V AC/DC
Input Return Loss, Attenuator ≥ 5 dB
- 20 dB typical 14 dB min.

Input Return Loss, Attenuator = 0 dB
- 16 dB typical 10 dB min.

Noise Figure, 5 MHz – 3 GHz
- 8 dB typical 11 dB max.

Internally generated CTB
- Better than 65 dB (79 channel loading at Full Scale, ATT <20 dB)

Internally generated CSO
- Better than 70 dB (79 channel loading at Full Scale, ATT <20 dB)

Optional features

Notes:
1. Single Carrier QAM 64 Annex B/C

Analog Channel Measurement

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, Depth of Modulation, Differential Gain/Phase, Modulation Linearity, Y/C Delay/Gain

Digital Signal Measurement*

Level Range: -50 dBmV to +65 dBmV
Level Accuracy: ± 1 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
- -26 dBmV[1]

Adaptive Equalizer Display
MER Range: 20 dB to 47 dB (QAM Analzyer mode)
Pre & Post BER Range: 0 to 9×10^{-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

DVB-S2 (ETSI EN 302 307 and TR102-376)*
- Timing recovery +/-1000 ppm
- 1 to 45 MSymbol/s
- Modulations QPSK, 8 PSK, 16 APSK and 32 APSK
- Roll-off factors 0.35/0.25/0.20
- DSS compliant
- Lock Status, MER, BER, Modulation type, Uncorrectable Errors, Code Rate, Frequency Error and Pilots (On/OFF)

DVB-S (ETSI EN 300 421)*
- 1 to 45 MSymbol/s
- Measure Lock Status, MER, BER, Modulation type, Uncorrectable Errors, Code Rate and Frequency Error
- Modulation QPSK

ISDB-T*
Level Range: -50 dBmV to +65 dBmV
Level Accuracy: ± 1 dB
Level Resolution: 0.1 dB
MER Range: 20 dB to 40 dB
Pre & Post BER Range: 0 to 1.0 E-3
Measuring Layer: A,B,C (User Selectable)
Modulation: QPSK, 16QAM, 64QAM
Digital Tests: MER, BER, LEVEL, Constellation, Layer switching
Time delay measurement over 1 symbol time span

OFDM Analyzer*

Identify, measure and analyze DOCSIS 3.1 OFDM signals

OFDM Specifications
- 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

VeCheck

Level Scan: 55 MHz to 1.5 GHz (Real-time full band downstream scan)
Full Scan: 55 MHz to 1218 MHz (OFDM Engine Hardware required)*
   -Fast Signal Level, MER, BER Scan
   -MER up to 45 dB
   -Level graph, MER graph, Level and MER graphs

General Specifications

Display	TFT 10.4" full color touch-screen LCD
Size	350 x 273 x 139.8 mm (W x H x D)
	13.75 x 10.75 x 5.5 in
Weight	Less than 10 kg (less than 22 lb)
Battery	Li-ion smart battery
	6300 mAh 14.8 VDC
AC Adaptor	Input: 100-240 VAC, 50-60 Hz
	Output: 24 VDC, 7.5 A
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
Ruggedness	Survives 0.5m drop to concrete
Interfaces	USB 2.0, RJ45, 10/100/1000-T
	Bluetooth, WiFi (optional)
Languages	Multiple languages support

Optional features

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