



AT2500-3G

CaTV/Satellite/Over-the-Air HDTV
Next Generation Test Solution



Multi-Standards Testing Simplified

Designed for digital cable TV, OFDM signal analysis for D3.1, Satellite and over-the-air digital TV signal analysis and measurements, 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 and Headend Check. It also supports FCC proofs requirement tests and report automation.

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, CaTV OFDM 3.1 Signal Analysis, ISDB-T, DVB-S, DVB-S2, DVB-T, DVB-T2*
- 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 Analyzer, 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
- RealPop (SaaS) for FCC Proof report automation*
- 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 operation from any standard web browser using VeSion ATWEB*
- 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, 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
- Ability to lock user interface to prevent unwanted human interference during long-term testing

*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

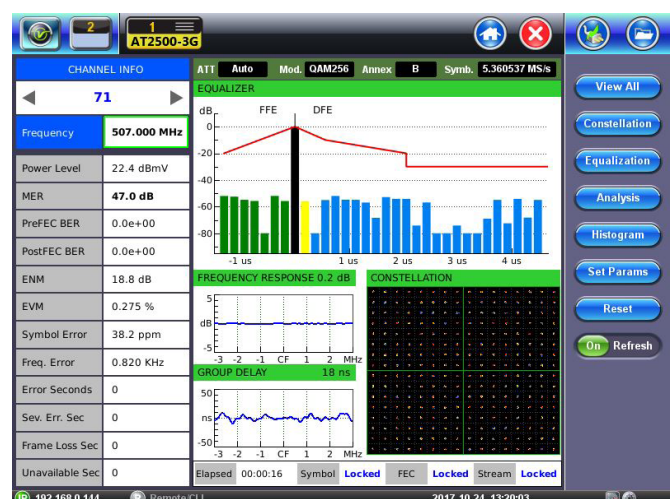
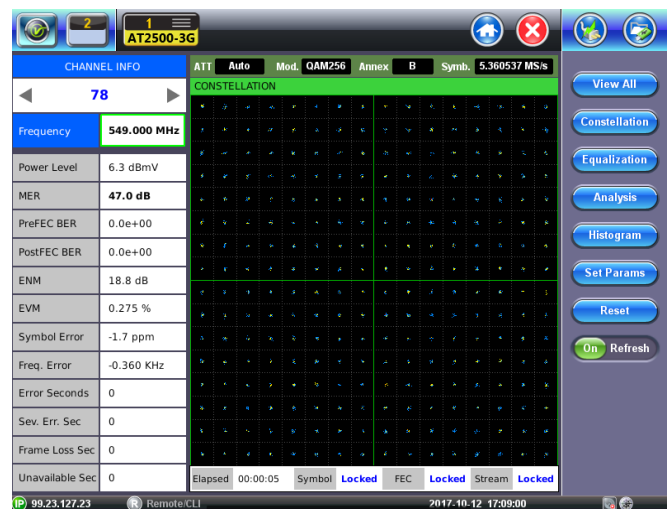
Digital pictures do not show signal impairment until it is too late because the margin between acceptable quality and failure is quite small.

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*

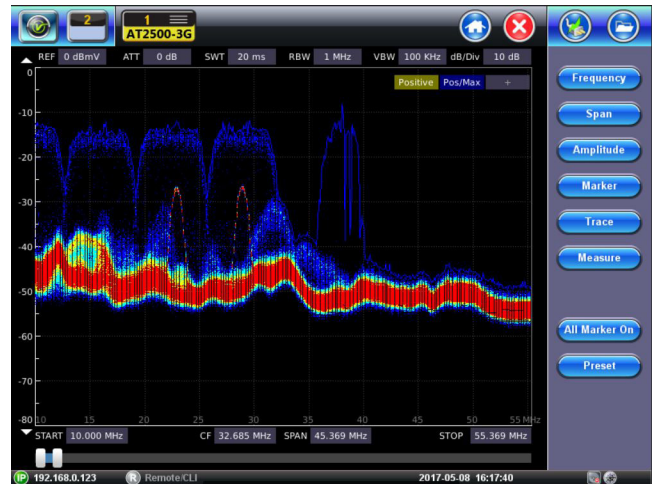
Histogram Analysis

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.



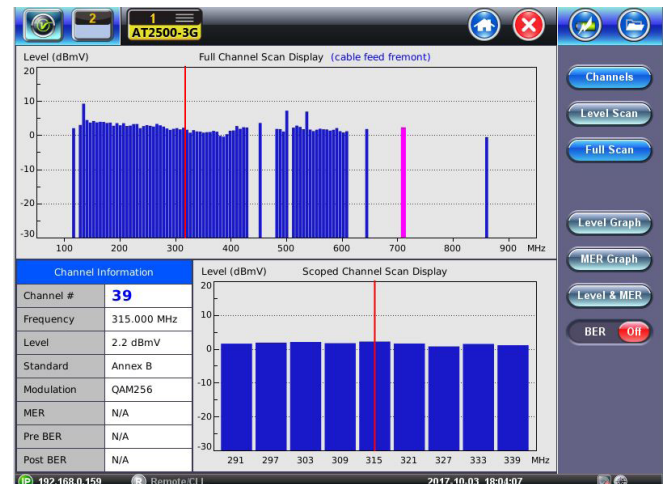
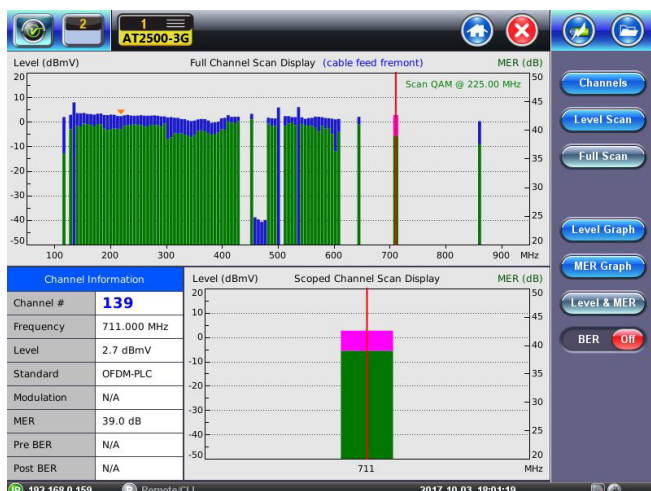
Spectrum Persistence

For the overcrowded upstream spectrum range, traditional tasks use free regions to measure noise floor and monitor interference. Using Peak hold in the spectrum mode is insufficient 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 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.

CaTV 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.

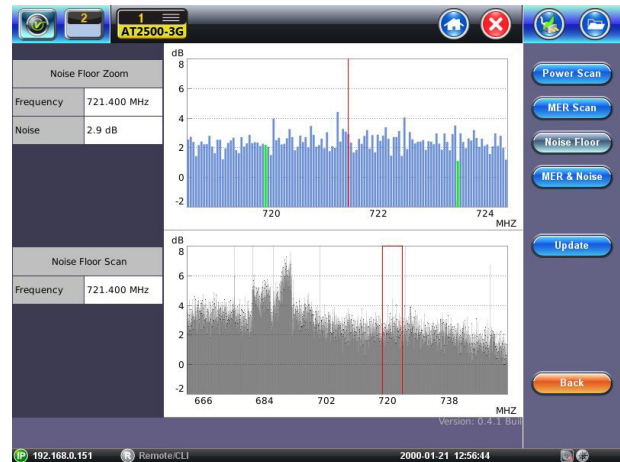
Key D3.1 OFDM Measurements

- 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.

| PLC Freq. | 711.000 MHz | | | |
|-----------------|-------------|----------------------|------------|----------|
| Level (Avg) | 2.8 dBmV | MER (Avg) | 39.4 dB | |
| Level (Max) | 2.9 dBmV | MER (Std Dev) | 0.9 dB | |
| Level (Min) | 2.8 dBmV | MER Percentile 2% | 37.5 dB | |
| Bandwidth | 96.000 MHz | Active Subcarrier | 1880 | |
| Elapsed Time | 00:00:11 | Subcarrier Bandwidth | 50.000 KHz | |
| Modulation(QAM) | Level | MER (dB) | C CWE | U CWE |
| PLC | 16 | 2.9 dBmV | 1.00e+00 | 0.00e+00 |
| NCP | 16 | 39.43 | 1.00e+00 | 0.00e+00 |
| Profile A | 256 | 39.43 | 1.22e-02 | 0.00e+00 |
| Profile B | 1K | 39.43 | 3.33e-01 | 0.00e+00 |
| Profile C | | N/A | N/A | N/A |
| Profile D | | N/A | N/A | N/A |
| Profile E | | N/A | N/A | N/A |



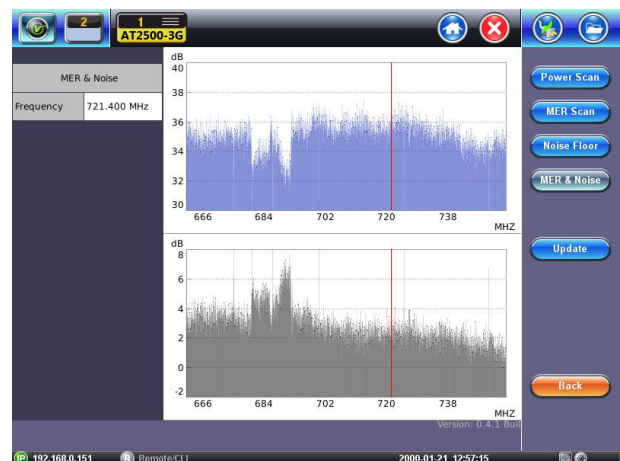
OFDM Channel Subcarrier MER Scan



OFDM Channel Noise Floor Scan



OFDM Channel Subcarrier Power Scan



OFDM Channel MER and Noise Scan

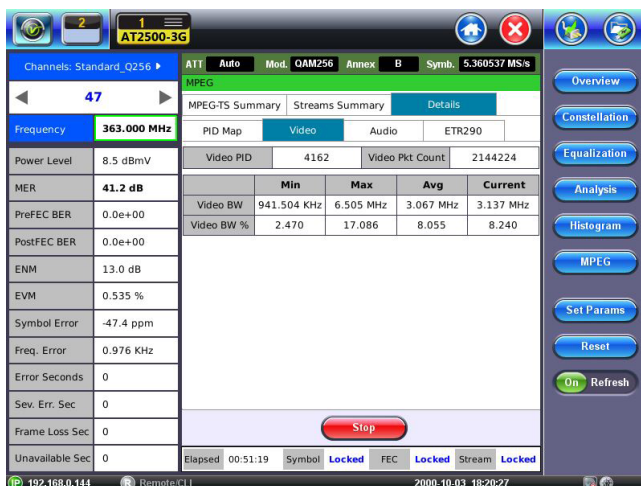
MPEG Explorer

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 R300

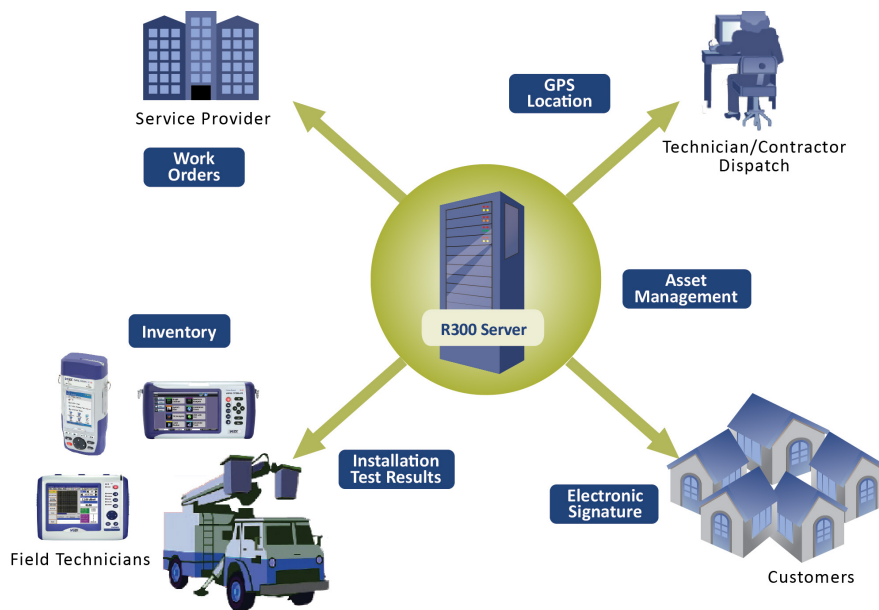
A web-based software application specifically designed for medium-to-large CATV operators facing the enormous challenge of coordinating asset and test data management.

Advanced Management

Authorized test sets register with specific VeSion R300 Server to download new channel tables, test profiles and measurement thresholds. Upload test results to VeSion R300 workforce and asset management server using a network connection.

Benefits

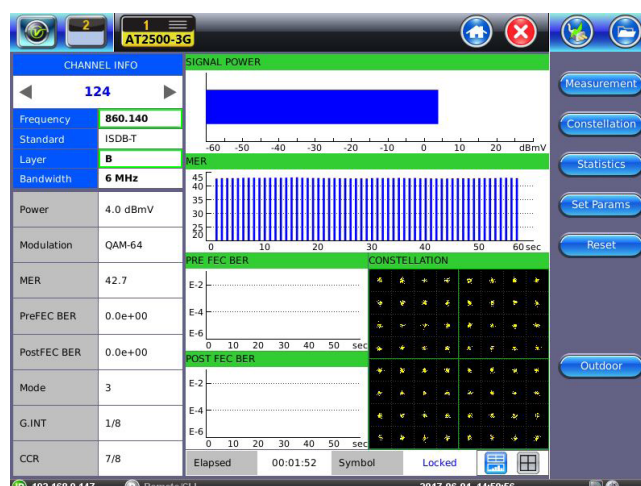
- Centralized storage of test profiles, software versions and measurement thresholds
- Registered test sets are informed of new test profiles, software versions and channel tables
- Test set software versions are maintained and synchronized
- Operates with Operator and Contractor owned test sets giving 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 has the function of signal level, MER, BER, constellation, TMCC, layer switching as a function to analyze the reception status of terrestrial digital. Measurement is started automatically by entering the channel number and frequency.

- Automatic acquisition of TMCC information to selection of measurement layer (A, B, C)
- A measurement up to 40 dB MER value (advanced OFDM option)
- Simultaneous display of the constellation function, MER, BER, and LEVEL, which is a visual judgment tool of reception status

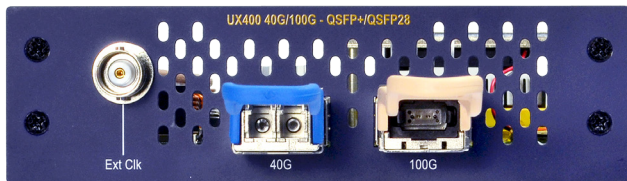


Available Test Modules*

40G/100G Module

Available with native support for all pluggable optics form factors, this high-speed OTN, SDH and Ethernet test module offers all the standard installation, commissioning and maintenance tests, as well as advanced features such as OTL/PCS, CAUI/XLAUI Lane BERT, overhead monitoring and byte control, Tandem Connection Monitoring, protocol capturing and decoding, traditional BERT and throughput test, and much more.

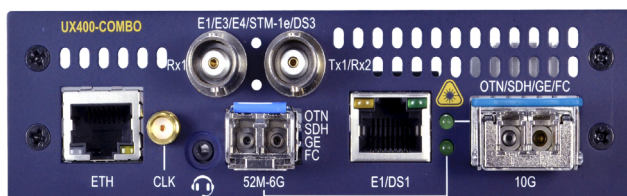
- 40GE and 100GE Layer2/3 Throughput/BERT, RFC2544, and PCS Layer testing
- OTU3, OTU4, STL-256.4 and STM-256/OC-768 testing
- IEEE 802.3ba and 802.3bj RS-FEC 100G Ethernet
- Available in CFP2, CFP4 and QSFP28 100G form factors and QSFP+ 40G
- No adapters required



Multi-Service Module

Convenient all-in-one test solution for OTN, SDH, SONET, PDH, DS_n networks, combined with extensive support for Mobile Backhaul technologies such as SyncE, 1588v2 PTP, Carrier Ethernet, Fibre Channel, CPRI/OBSAI and Synchronization testing. Ideal for modern multi-technology end-to-end service verification.

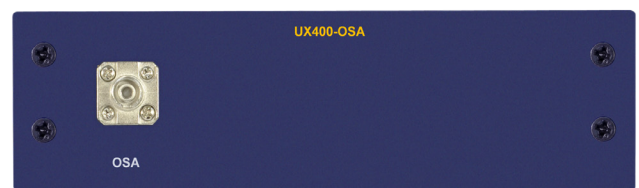
- Ethernet 10GE-LAN and 10GEWAN
- IEEE 1588v2/PTP, SyncE, Wander and Phase
- Fibre Channel 1/2/4/8/10G
- CPRI/OBSAI testing
- OTN OTU1, OTU2, OTU1e/2e, ODU0, ODUflex
- SDH STM-0/1/4/16/64 and SONET OC-1/3/12/48/192
- PDH E1/E3/E4 and DS_n DS1/DS3



OSA Module

Optical Spectrum and Advanced Channel Analyzer for CWDM and DWDM Networks. Using state-of-the-art micro-optic design and MEMS tuning technology, the UX400/R OSA module measures all key optical parameters with simplicity, accuracy and robustness. High reliability is achieved through a rugged mechanical design with no moving parts that does not require periodic calibration.

- Continuous fast-scanning spectrum analysis
- S, C and C+L band wavelength ranges
- Supports modulation schemes used for 10/40/100G
- Simultaneous measurements of up to 160 channels
- Wavelength, power and OSNR measurements



*See individual module data sheet for more details.

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
- Minimal -96 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: 75 Ω
 Input Level Range: -62 dBmV to +70 dBmV
 Dynamic Range: 80 dB
 Display Range: 80 dB
 Sensitivity: -62 dBmV
 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 70 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)

 Level Range: -50 dBmV to +60 dBmV Level Accuracy: ± 1 dB

*Optional features

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

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: -15 dBmV
 Adaptive Equalizer Display
 MER Range: 22 dB to 47 dB (QAM Analyzer 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-T2 (ETSI EN 302 755 V1.3.1)*

- 1.7, 5, 6, 7, or 8 MHz bandwidths
- DVB-T2 vs. DVB-T auto detection
- Modulations QPSK, 16 QAM, 64 QAM, 256 QAM
- Carrier recovery +/- 600 kHz
- Timing recovery +/-200 ppm
- T2-Lite compliant
- SISO and MISO support
- Lock status, MER, BER, Modulation, Uncorrectable errors, Frequency error, HP Rate, FFT Mode, Extended bandwidth support, Frame extension Flag, PLP number, Frame size and current PLP

DVB-T (ETSI EN 300 744)*

- 6, 7 or 8 MHz bandwidth
- Modulations QPSK, 16 QAM, 64 QAM
- Lock Status, MER, BER, Modulation, Uncorrectable Errors, Frequency Error, Guard Interval, Hierarchy Supported, HP Rate and LP Rate

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

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

*Optional features

General Specifications

| | |
|-----------------------|---|
| Display Size | TFT 10.4" full color touch-screen LCD 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 0.5 m drop to concrete |
| Interfaces | USB 2.0, RJ45, 10/100/1000-T Bluetooth, WiFi (optional) |
| Languages | Multiple languages support |



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D05-00-125P E00 2017/11