# 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<sup>®</sup> 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

### SPECTRUM/SLM

## **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.

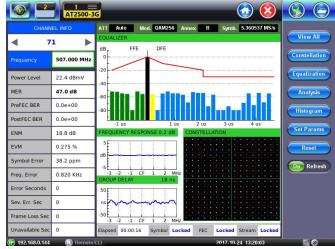
**Constellation diagrams** – A valuable tool to help detect the presence of noise, phase jitter, interference, gain compression, laser clipping and ingress, all of which impact overall signal quality and thus reduces Modulation Error Ratio (MER). The Advanced Digital Analysis option has added in depth 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.

CHANN	EL INFO	ATT	A	uto		Vlod.	QAM	256	Anr	ıex	В		Symb	5.	3605	37 M	S/s	
<b>4</b> 7	8 🕨	CON	STE	LLAT	ION					_								View All
Frequency	549.000 MHz	,							e.								-4	Constellati
Power Level	6.3 dBmV	8							•								•	Equalizatio
MER	47.0 dB	•															¥	Analysis
PreFEC BER	0.0e+00	÷															8	Histogram
PostFEC BER	0.0e+00	*															•	mstogran
ENM	18.8 dB	-							•								•	Set Paran
EVM	0.275 %																3	Reset
Symbol Error	-1.7 ppm	а															x	On Refre
Freq. Error	-0.360 KHz	•															÷	Refre
Error Seconds	0	*															¥	
Sev. Err. Sec	0	*															•	
Frame Loss Sec	0																8	
Unavailable Sec	0	Elaps	ed	00:0	0:05		Symbo	ol Le	ocked	1	FEC	Lo	cked	Str	eam	Loc	:ked	



### 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.

CHANN		AT	T A	uto	Mod	QAM2	6 Ann	ex	В	Symb.	5.360	537 N
<b>4</b> 7	8	HIS	STOG									
		40		l (dBm	V)						N	IER (dB)
	549.000 MHz		-								<b>.</b>	
Power Level	6.2 dBmV	20						Le		2 dBmV 47.0 dB		-
MER	47.0 dB	1.	-									
PreFEC BER	0.0e+00	1	_									
PostFEC BER	0.0e+00	-20	00:00	1	.0"	20"	30	<i>"</i>	40"		50"	00:01
ENM	18.8 dB	ε-3		EC BE	R						Post f	EC BER
EVM	0.275 %	1						Dee		0e+00		
Symbol Error	-1.7 ppm	1	-							.0e+00		
Freq. Error	-0.360 KHz	E-6	-									-
Error Seconds	0	1										
Sev. Err. Sec	0	E-9	00:00	) 1	0"	20"	30		40"	_	50"	00:01
Frame Loss Sec	0		•	Mark	er Time	• • 00:0	00:48	Time	e Scale	1 M	inute	•
Unavailable Sec	0	Ela	nsed	00:00	:51	Symbol	Locked	FE	C L	ocked	Stream	n Lock

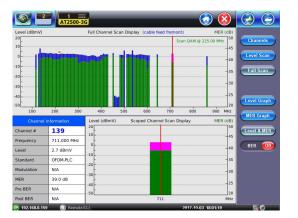
### Spectrum Persistence

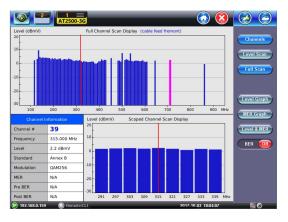
For the overcrowded upstream spectrum range, traditional tasks use free regions to measure noise floor and monitor inteference. Using Peak hold in the spectrum mode is insufficinet to show ingress under the return path carrier, as it's typically the highest level of the affected upstream frequency range. 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.

Setu	р	Meas	uremen	(Done)				Elapsed : 00	53:19	
Digital Tests	Ch#	Assigned Freq. (MHz)	Lock	Level (dBmV)	Adj. Channel (dB)	MER (dB)	Pre-BER	Post-BER	Fre	Start
Min Limit	N/A	N/A	N/A	-40.00	N/A	32.00	N/A	N/A		
Max Limit	N/A	N/A	N/A	65.00	3.00	N/A	0.00	0.00		Predefined
Predefined	108	699.000	Yes	10.5	-0.2	38.8	0.0e+00	0.0e+00		
Predefined	109	705.000	Yes	10.4	-0.1	38.6	0.0e+00	0.0e+00		All Test
Predefined	110	711.000	Yes	10.7	0.3	39.2	0.0e+00	0.0e+00		Level Only
Predefined	111	717.000	Yes	10.7	0.0	39.3	0.0e+00	0.0e+00		Level Only
Predefined	112	723.000	Yes	10.7	-0.0	39.9	0.0e+00	0.0e+00		No Test
Predefined	113	729.000	Yes	10.5	-0.1	38.8	0.0e+00	0.0e+00		Horest
Predefined	114	735.000	Yes	10.5	-0.1	39.3	0.0e+00	0.0e+00		Except HUI
Predefined	115	741.000	No	3.5	-7.0	N/A	N/A	N/A		
Predefined	116	747.000	No	3.5	0.0	N/A	N/A	N/A		Fast Scan
Predefined	117	753.000	Yes	10.2	6.6	39.5	0.0e+00	0.0e+00		
Predefined	118	759.000	Yes	10.2	-0.0	39.2	0.0e+00	0.0e+00		On Scrol
Predefined	119	765.000	Yes	10.2	0.0	38.2	0.0e+00	0.0e+00		
Predefined	120	771.000	Yes	10.6	0.4	38.7	0.0e+00	0.0e+00		Files
Predefined	121	777.000	Yes	9.8	-0.8	37.6	0.0e+00	0.0e+00	-	Files
									•	

### **OFDM Signal Analysis**

#### **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).

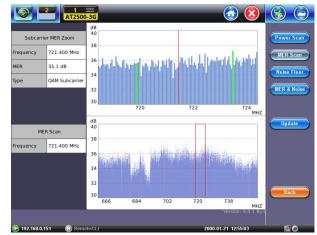
A Modulation Profile is a list of modulations that are used for the subcarriers within an OFDM channel.

- 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.

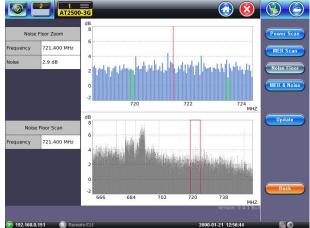
#### Key D3.1 OFDM Measurements

- 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.

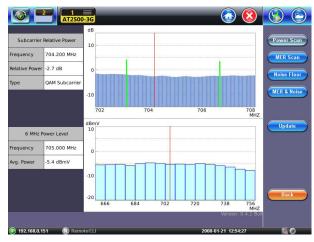
PLC Freq.		71	1.000 MHz					
								PLC Search
Level (Avg)		2.8 dBr	mV	MER (Avg)		39.4 di	3	Subcarrier
Level (Max)		2.9 dB	mV	MER (Std Dev)		0.9 dB		Subcallier
Level (Min)		2.8 dB	mV	MER Percentile	2%	37.5 di	3	
Bandwidth		96.000	MHz	Active Subcarrie	er	1880		
Elapsed Time		00:00:	11	Subcarrier Band	lwidth	50.000	KHz	
	Modulatio	n(QAM)				WE		
PLC								
PLC	16	8	2.9 dBmV	39.0	1.006	2+00	0.00e+00	
	16		2.9 dBmV	39.0 39.43	1.000		0.00e+00 0.00e+00	
			2.9 dBmV			2+00		
NCP	16	5	2.9 dBmV	39.43	1.006	e-02	0.00e+00	
NCP	16	5	2.9 dBmV	39.43 39.43	1.000	e-02 e-01	0.00e+00 0.00e+00	
NCP Profile A Profile B	16	5	2.9 dBmV	39.43 39.43 39.43	1.00e 1.22 3.33	e-02 e-01 /A	0.00e+00 0.00e+00 0.00e+00	



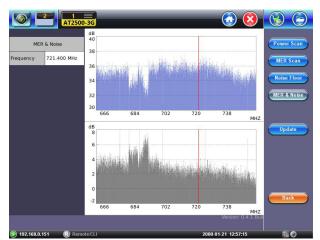
OFDM Channel Subcarrier MER Scan



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.

Channels: Star		ATT Auto MPEG								
4 4	7 Þ	MPEG-TS Summary Streams Summary Details							Constellat	
	363.000 MHz	Actual Prog	rams	Other Pr	ograms	Curren	nt Program	Transpor	rt Errors	Constena
Power Level	8.5 dBmV	13		1			1905	0		Equalizat
MER	41.2 dB	Туре	PI	D Count	BV	v	BW(%)	Pkt	Count	Analysi
PreFEC BER	0.0e+00	Total		76	38.077	MHz	100	3276	51011	
PostFEC BER	0.0e+00	Video		1	2.546	MHz	6.687	228	5910	Histogra
ENM	13.0 dB	Audio		1	234.62	4 KHz	0.616	202	2223	MPEG
EVM	0.535 %	Tables		2	36.096	KHZ	0.095	31	061	
Symbol Error	-47.8 ppm	Others		1	4.043	MHz	10.617	362	4155	Set Para
Freq. Error	0.976 KHz					Pro	gram# 1	/13 (	• •	Reset
Error Seconds	0									On Refr
Sev. Err. Sec	0									
Frame Loss Sec	0				S	top				
Unavailable Sec	0	Elapsed 00:	52:21		Locke	d FE	Locked	Stream	10000	

#### **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.

<b>C</b>	1 AT2500-3	G	_		<u></u>
Channels: Star		ATT Auto Ma MPEG	d. QAM256 A	nnex B	Symb. 5.360537 MS/s
4 4	7	MPEG-TS Summary	Streams Sun	nmary	Details
	363.000 MHz	PID Map	Video	Audio	ETR290
Power Level	8.5 dBmV	Program#	1905 🔻		Encrypted
MER	41.2 dB		PID		Description
PreFEC BER	0.0e+00	PAT	0	Progr	am Association Table
PostFEC BER	0.0e+00	PMT	78		ogram Map Table
POSTFEC BER		Video	4162	IS	0 13818-2 Video
ENM	13.0 dB	Audio	4163	-	AC-3 Audio
EVM	0.534 %	CAT	0×01		litional Access Table
Symbol Error	-47.8 ppm	ECM	286	Entitler	ment Control Message
Freq. Error	0.924 KHz				
Error Seconds	0	1			
Sev. Err. Sec	0				
Frame Loss Sec	0	1		Stop	
Jnavailable Sec	0	Elapsed 00:50:45	Symbol Lock	d FEC	Locked Stream Locked
9 192.168.0.144	R Remote	CLI			2000-10-03 18:19:53

<b>2</b>	1 AT2500-3	G						-		8
	dard_Q256 🕨	ATT Auto	Moc	I. QAM25	6 Anr	iex 🗾	B	Symb.	5.3605	37 MS/s
4 4		MPEG				_				
4 4	<u> </u>	MPEG-TS Sun	nmary	Stream	ns Sumi	mary		Detail	s	
	363.000 MHz	PID Map		Video		Audio	,	ET	R290	
Power Level	8.5 dBmV	Video PID		4162	2	Video	Pkt C	Count	2144	224
MER	41.2 dB			Min	м	ax	3	Avg	Cu	rrent
PreFEC BER	0.0e+00	Video BW	941.	504 KHz	6.505	MHz	3.0	67 MH2	3.13	87 MHz
		Video BW %	2.	.470	17.	086	8	8.055	8	.240
PostFEC BER	0.0e+00									
ENM	13.0 dB									
EVM	0.535 %									
Symbol Error	-47.4 ppm									
Freq. Error	0.976 KHz	1								
Error Seconds	0	1								
Sev. Err. Sec	0	<u> </u>								
Frame Loss Sec	0	1		(	S	op				
Inavailable Sec	0	Elapsed 00:51	:19	Symbol	Locked	FEC	: L	ocked	Stream	Locked
192.168.0.144	R Remote	CLI					2	000-10-	03 18:20	:27

#### **Encryption Detection**

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

Channels: Star	idard_Q256 🕨	ATT Auto M	lod. QAM256 A	nnex B	Symb. 5.3605371	MS/s	
4 4	7 🕨	MPEG-TS Summary Streams Summary Details					
Frequency	363.000 MHz	PID Map	Video	Audio	ETR290		
Power Level	8.4 dBmV	Program#	1905 🔻		Encrypte	ed	
MER	41.2 dB		PID		Description		
PreFEC BER	2.9e-12	PAT	0	-	gram Association Table	e	
PostFEC BER	0.0e+00	Video	78		Program Map Table		
ENM	13.0 dB	Audio	4163		AC-3 Audio		
EVM	0.536 %	CAT	0x01	Cor	nditional Access Table	2	
Symbol Error	-46.8 ppm	ECM	286	Entitl	ement Control Messag	ge	
Freq. Error	0.976 KHz						
Error Seconds	1						
Sev. Err. Sec	0						
Frame Loss Sec	0	1		Stop			
Unavailable Sec	0	Elapsed 02:22:51	Symbol Lock	ed FEC	Locked Stream Lo	ocked	

#### 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.

Channels: Star	ndard_Q256 🕨	ATT Aut	o Mod	QAM256	Annex	Symb. 5.	360537 MS/s	
4 4	7	MPEG					_	Overv
•	7	MPEG-TS :	Summary	Streams S	ummary	Details		Constell
Frequency	363.000 MHz	PID Ma	ρ	Video	Audio	ETR2	90	Consten
Power Level	8.4 dBmV		Priority	1		Priority 2	2	Equaliz
MER	41.2 dB	Sync	Loss	0	Tr	ansport	0	
MLIN		Sync Loss	Duration	0	-	CRC	0	Analy
PreFEC BER	2.8e-12	Sync	Byte	0	PCR	Repetition	0	Histog
PostFEC BER	0.0e+00	PA	T2	0	PCR D	Discontinuity	0	Chistog
	13.0 dB	PM	172	0	PCR	Accuracy	0	MPE
ENM	13.0 dB	Conti	nuity	6		CAT	0	
EVM	0.539 %	PI	D	0				Set Par
Symbol Error	-47.9 ppm	1						Set Par
Freq. Error	0.976 KHz	1						Rese
Error Seconds	1							On Re
Sev. Err. Sec	0							
Frame Loss Sec	0	1			Stop			
Unavailable Sec	0	Elapsed 0	2:26:40	Symbol Loc	ked FEC	Locked Str	eam Locked	
9 192.168.0.144	Remote:	си	_			2000-10-03	19:55:48	

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<sup>™</sup> R-Server

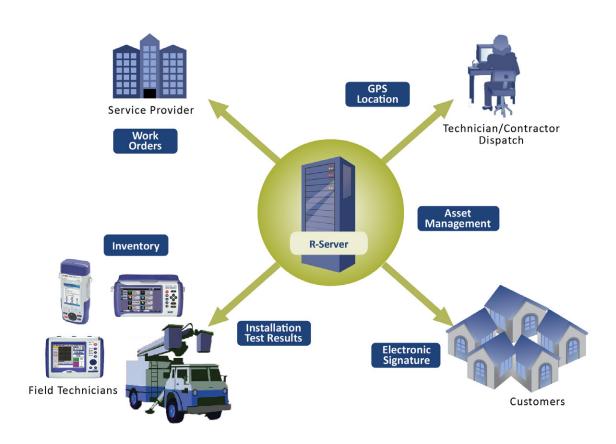
A web-based software application specifically designed for medium-to-large CATV operators facing the enormous challenge of coordinating asset and test data management.

#### **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

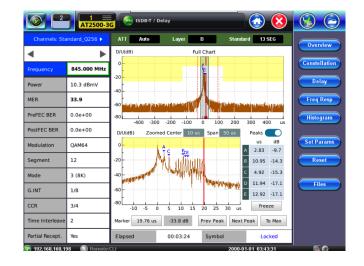


### ISDB-T OFDM (Japan Standard Terrestrial Digital)

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

2	1 AT2500-3	ISDB-T / Overview	🔞 🌍
Channe	ls: SkJJ ▶	ATT Auto Layer B Standard 13 SEG	Overview
<b>∢</b> 1	4	Power	
Frequency	479.140 MHz		Constellation
Power	72.3 dBuV	0 10 20 30 40 50 60 70 80 dBuV	Delay
MER	36.5	Delay (dB)	Freq Resp
PreFEC BER	0.0e+00	-40	Histogram
PostFEC BER	0.0e+00	-80 -400 -300 -200 -100 0 100 200 300 400 us	
Modulation	QAM64	Magnitude (dB) Constellation	Set Params
Segment	1	-40	Reset
Mode	3 (8K)	-80 -3 -2 -1 CF 1 2 MHz	
G.INT	1/8	Phase (Deg)	Files
CCR	7/8		
Time Interleave	2	-1802 -1 CF 1 2 MHz	
Partial Recept.	No	Elapsed 00:00:58 Symbol Locked	
Down	Remote/	Li 2019-07-31 10:13:31	



### 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

	\$ 79 555.00	MHz 🔻 DOCSIS	3.1	Start		JCD List
JCD#	Freq. (MHz)	Modulation	UC Type	Symbol (MS/s)	Channel Type	
1	9.000	QAM64	IUC 4	5.12	S-TDMA	
2	15.400	QAM32	IUC 4	2.56	S-TDMA	Analyze
3	21.800	QAM64	IUC 4	5.12	S-TDMA	
6	66.400	QAM64	IUC 4	5.12	S-TDMA	nstellatio
7	72.800	QAM64	IUC 4	5.12	S-TDMA	istogram
8	79.200	QAM64	IUC 4	5.12	S-TDMA	istografii



## **DOCSIS 3.1 Test Module\***

### **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

AT-3G		_	_	-	-	<b>3</b>	
Cable Modem			IP Tools			Disconnect	
Setup	Ranging	Graphs	Link	OF	DM	IP	Reset
Primary Freq	747.000 MHz		DOCSIS Mode 3.1			Reset	
DS Lock Status	Pass		Bonding DS 32 Cha		nnels		
US Sync	UCD (2)		Bonding US 7 Chan		nels		
US Ranging	42.80 dBmV		OFDM DS (1) PLC -		PLC - 5	55 MHz	
DHCP	Pass		OFDM DS (2) PL		PLC - 9	33 MHz	
ToD	Pass		OFDMA US (1) C/F - 4		C/F - 44	.00 MHz	Ping CMTS
Config File	'^1/0E0612B3/'		OFDMA US (2) N/A				
Registration	Pass			Downstream UC		UCD Transmit	
BPI+Status	Enabled/Pass		Maximum	10.0 dB	mV	44.0 dBmV	
Connection	Online		Minimum	6.4 dBm	۱V	38.2 dBmV	
Status	Test Completed		Average	8.2 dBmV		42.5 dBmV	
Th: Standard Q256 💙 Loc: GroundBlock 🔍 TP: Off 🛛 💙 2019-08-07 09:35:04							

		_	<u></u>			
Cable Mo	dem	IP T	Start			
VeTest/Web	Ping	Trace Route	ARPWiz			
Setu	p	Re				
Others   Atlanta 2   192.168						
Number of Active Test En	Update List					
Status	Pass	Pass				
Connection Time	156 ms	156 ms				
Total Data Transfer Time	61623 ms	61623 ms				
PING Test						
Ping Response	PASS	6.535 m				
Throughput	Download	Upload				
Line Rate - MAX	1659.465 Mbps	80.452 1	Vibps			
Line Rate - AVG	1195.649 Mbps	73.826	Vibps			
Data Rate - MAX	1589.208 Mbps	76.857	Vibps			
Data Rate - AVG	1145.019 Mbps	70.526 1	Vibps			
Tbl: Standard Q256	Loc: GroundBlog	k 🔽 TP: Off	2019	08-07 09:34:44		

## **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  $\leq$ 1000 MHz: 20 ms to 5 s in 2, 5, 10, 20 sequence Reduced Spans ( $\leq$ 500 MHz,  $\leq$ 100 MHz,  $\leq$ 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<sup>1</sup> Adaptive Equalizer Display MER Range: 20 dB to 47 dB (QAM Analzyer mode) Pre & Post BER Range: 0 to 9 x 10<sup>-3</sup> 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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