DATA SHEET

RF360xx 802.11ac Test Solution and WBW 360x Traffic Generator / Analyzer

Complete 802.11ac Testing

Incorporating the functionality of three separate test products, Ixia's RF360xx is the world's only test solution capable of testing from the RF layer to the application layer in a single, integrated solution. For the first time, developers will be able to use the same system to:

- Measure RF transmission characteristics such as EVM and spectral compliance
- Benchmark RF receiver performance using highly diverse and realistic traffic
- Generate MAC, IP, and layer 4-7 traffic to characterize a fully integrated device's ability to forward traffic efficiently at rates up to the maximum possible with 802.11ac
- Apply different RF impairments at layer 1 on a frame-by-frame or client-by-client basis

Ixia's 802.11ac solution introduces a radically new architecture that advances the state of the art for RF measurements in communication systems. Built from the ground up to be a full-rate, lab-grade RF and traffic test system without compromise, the solution includes the RF360xx series of RF Traffic Generator /Analyzer modules (L1-7) and WaveBlade Wi-Fi (WBW) 360x Traffic Generator Analyzer (L2-7).

Highlights

- Real-time PHY layer frame generation and analysis
- Simple point-and-click application support for PHY layer testing
- Up to 500 fully independent, stateful 802.11a/b/g/n/ac clients per port enable precise measurement of critical performance metrics at data rates reaching up to maximum theoretical limits
- Highly scaled setup in a single test-bed to assess real-world deployment levels of controllers, APs, and clients
- Built-in channel models help determine real-world performance in six typical WLAN multi-path scenarios in accordance with recommendations by the IEEE 802.11n task group
- Full support of legacy IEEE 802.11 a/b/g/n traffic generation and analysis for all existing IxVeriWave test suites, applications, and WaveAutomation capabilities.

Rather than limit the design by using the memory-buffer techniques common in existing Vector Signal Analyzers (VSA) and Vector Signal Generators (VSG), the RF360xx was engineered with sufficient on-board horsepower to process each and every frame in real time. This approach drives improved testing cycles by dramatically improving test coverage while simultaneously reducing test time.

As a signal generator, the RF360xx is much easier to use than traditional VSG solutions. In combination with Ixia's WaveGen software, users can create a wide range of stimuli --- from simple tones to advanced, time-variant 802.11a/b/g/n/ac frames — using a simple point-and-click user interface. There's no need to develop complex mathematical models to create IQ sequences as this functionality is entirely embedded.

Since the solution has no memory-length limitations, long aggregate frames can be easily created in order to test receivers' ability to handle the performance-boosting aggregate frames. Users can generate complex sequences of frames that test receivers' abilities to dynamically adjust to varying power levels, channel impairments, PHY rates, and so forth as a complex sequence of frames are received. With no need to download waveforms into a memory buffer from the user's PC, the RF360xx performs dramatically faster than previous solutions.

Breakthrough capabilities also result from the RF360xx's architectural advancements and true real-time analysis capabilities lacking in traditional VSAs. Most significantly, the ability to measure every frame means true, worst case measurements can be obtained over extended periods of time.

RF engineers must often determine whether a critical but infrequent issue has been fully resolved. Traditional memory-based VSAs limited by short sample intervals simply miss many events. The RF360xx continues to run all measurements at full rate and can therefore produce min, max, and average results over time. This approach provides RF engineers with a much improved level of confidence in measurements as, without the limits of memory buffers, long aggregate frames critical to 802.11n and 802.11ac performance boosts can be received and analyzed to ensure they are being transmitted coherently for their entire duration.

As with all IxVeriWave products from Ixia, the RF360xx WaveBlade also functions as a Layer 2 to 7 load module. Once RF testing is complete, users can begin leveraging the same load module to assess the performance of the fully integrated design. Capable of behaving as up to 500 fully independent, fully stateful clients, the RF360xx is the fastest, most complete method of verifying the functionality, benchmarking the performance, and conducting system testing of 802.11ac access points (APs).

Engineers can immediately leverage the full suite of existing IxVeriWave applications in conjunction with RF360xx WaveBlades and utilize the IxVeriWave solution's wide array of test tools and methodologies. As an added bonus, users can switch between RF metrics and L2-7 metrics without having to change test setups or re-cable, thus dramatically improving test coverage while reducing test times once again.

RF / PHY Layer Test Configuration

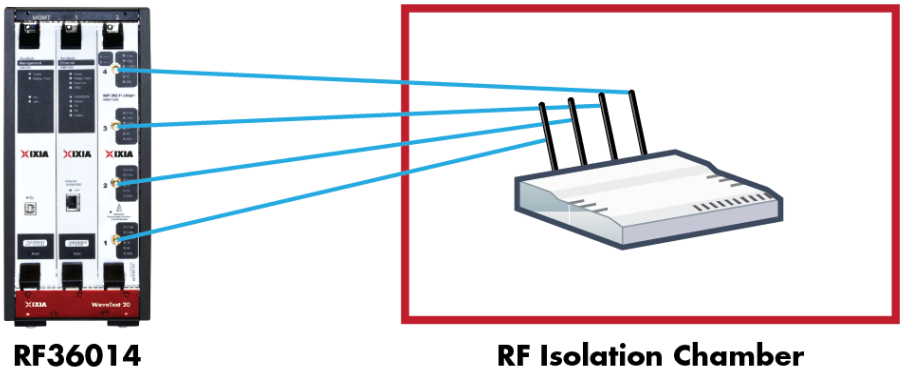

Figure 1: When used for RF testing, the RF36014 is typically directly connected to the device under test via RF cables.

L2-7 Test Configuration

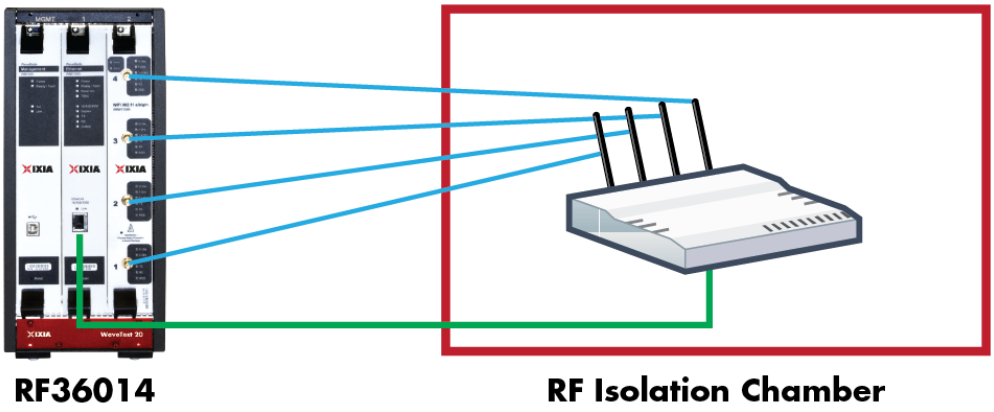

Figure 2: When used for L2-7 testing, the RF36014 is typically directly connected to the 802.11 antennas via RF cables and an Ethernet port used to source and sink traffic from the LAN infrastructure.

Key Features

- Real-time PHY layer frame generation and analysis
- Simple point-and-click application support for PHY layer testing
- Up to 500 fully independent, stateful 802.11a/b/g/n/ac clients per port enable precise measurement of critical performance metrics at data rates reaching up to maximum theoretical limits
- Highly scaled setup in a single test-bed to assess real-world deployment levels of controllers, APs, and clients
- Built-in channel models help determine real-world performance in six typical WLAN multi-path scenarios in accordance with recommendations by the IEEE 802.11n task group
- Full support of legacy IEEE 802.11 a/b/g/n traffic generation and analysis for all existing IxVeriWave test suites, applications, and WaveAutomation capabilities.

Specifications

General Parameters		
802.11 versions supported	802.11a/b/g/n/ac	
Frequency Range / Channels Supported	2.4 GHz	1-14
	4.9 GHz	21, 25
	5.0 GHz	34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60, 64
		100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140
		149, 153, 157, 161, 165
RF Connectors	Male 50 Ω SMA Connector	

Baseband Control Characteristics	
Supported Modulation Schemes	DBPSK DQPSK CCK (4bits) CCK (8bits) BPSK (1/2) BPSK (3/4) QPSK (1/2) QPSK (3/4) 16-QAM (1/2) 16-QAM (3/4) 64-QAM(2/3) 64-QAM (3/4) 64-QAM (5/6) 256-QAM (3/4) 256-QAM (5/6)
Supported CCK Preamble Types	Short and long
OFDM guard Intervals	400 and 800 nS
PLCP Type	Legacy and Mixed Mode
IEEE Channel Models	• Model A - typical home/small office environment • Model B - typical medium office environment • Model C - typical large office environment • Model D - typical open space environment • Model E - typical large open space environment • Model F - complex environment with many scatters • By-pass mode - to not impose any channel conditions

NOTE: Specifications listed are maximum values unless otherwise noted.

RF Frequency Control		
Frequency Accuracy	Initial Accuracy	+/- 0.2 ppm
	Aging per year	+/- 0.05 ppm

RF Receivers					
Rx Maximum Input Power Level	+15dBm				
RSSI Accuracy	+/- 0.25 dBm TYP, +/- 0.4 dBm MAX (over input range of 0 to +15 dBm)				
	+/- 1 dBm (over input range of -1 to -60 dBm)				
	+/- 1.25 dBm (over input range of -60 to -82 dBm)				
Rx Minimum Sensitivity (typical)	Modulation	Coding Rate	Minimum sensitivity (dBm) 20 MHz channel Spacing	Minimum sensitivity (dBm) 40 MHz channel Spacing	Modulation
	BPSK	½	-82	-79	BPSK
	BPSK	¾	-81	-78	BPSK
	QPSK	½	-79	-76	QPSK
	QPSK	¾	-77	-74	QPSK
	16-QAM	½	-74	-71	16-QAM
	16-QAM	¾	-70	-67	16-QAM
	64-QAM	2/3	-66	-63	64-QAM
	64-QAM	¾	-65	-62	64-QAM
	64-QAM	5/6	-64	-61	64-QAM
	256-QAM	¾	-59	-56	256-QAM
	256-QAM	5/6	-57	-54	256-QAM
	Receiver performance criteria are based on achieving a frame error rate of less than 10% using 4096 octet frames.				
RX EVM	The relative constellation RMS error, averaged over subcarriers, OFDM frames and packets for a data rate of 64-QAM with a coding rate of 5/6 is less than -41dB(0.891%) TYP, -40dB(1%) MAX for power levels less than -10dBm.				

<table>
<tr><th colspan="5">RF Transmitter</th></tr>
<tr><td>Transmit Center Frequency Tolerance</td><td colspan="4">Typical, 2.5ppm over all operating conditions</td></tr>
<tr><td>Transmit Power</td><td colspan="4">+14dBm to -50dBm</td></tr>
<tr><td>Transmit Power Control Resolution</td><td colspan="4">1 db</td></tr>
<tr><td>Transmit Power Absolute Accuracy</td><td colspan="4">Any single frame shall be generated with an absolute accuracy of +/- 1.0dB measured over the burst of that frame.

Multiple consecutive frames from the same client shall be generated such that the initial frame shall have an absolute accuracy of +/- 1.0dB. Subsequent frames from that client shall be generated with an absolute accuracy of +/- 0.8dB.</td></tr>
<tr><td rowspan="4">Transmit Constellation Error*</td><td colspan="4">The relative constellation RMS error, averaged over subcarriers, OFDM frames and packets for a data rate of 64-QAM with a coding rate of 5/6 is less than:</td></tr>
<tr><td colspan="2">Power level greater or equal to -10dbm</td><td colspan="2">Power level less than -10dBm</td></tr>
<tr><td>Typical</td><td>Max</td><td>Typical</td><td>Max</td></tr>
<tr><td>-36dB (1.585%)</td><td>-34db (1.995%)</td><td>-36dB (1.585%)</td><td>-34db (1.995%)</td></tr>
<tr><td></td><td colspan="4">*Measured on a per radio basis transmitting a single 20MHz spatial stream.</td></tr>
<tr><td rowspan="5">Minimum Signal to Noise Ratio</td><td>Power</td><td colspan="3">Bandwidth (MHz)</td></tr>
<tr><td>(dBm)</td><td>20</td><td>(dBm)</td><td>20</td></tr>
<tr><td>-34 to +15</td><td>62 db</td><td>-34 to +15</td><td>62 db</td></tr>
<tr><td>-40 to -35</td><td>57 db</td><td>-40 to -35</td><td>57 db</td></tr>
<tr><td>Below -41</td><td>Power + 97 (db)</td><td>Below -41</td><td>Power + 97 (db)</td></tr>
</table>

Analyzer Measurements	
Power	Average Power
	Peak Power
	Power Spectral Density
	Power Peak Excursion
Frequency	Center Frequency Tolerance
	Symbol Clock Frequency Tolerance
	Preamble Frequency Error
	RF Carrier Suppression
Spectral	Transmit Spectrum Mask
	Spectral Flatness
	Transmit Center Frequency Leakage
	CCDF
	Occupied Bandwidth
Modulation	Constellation Error
	Error Vector Magnitude (EVM)
	Transmitter Modulation Accuracy
I/Q	Gain Mismatch
	Phase Mismatch

Generation Controls	
Frame Generation	Encoding
	Length
	Frame Transmission Rate
Modulation	a/b/g/n /ac PHY Rates
	Preamble
	FEC
Impairments	Frequency Offset
	Pre/post Encoder Bit Errors
	IEEE Channel Models A-F

Generation Controls					
	RF36011	**RF36012**	**RF36013**	**RF36014**	**RF36024**
Antenna Connections per Test Port	1	2	3	4	4
Number of Test Ports per WaveBlade	1 x 802.11 a/b/g/n/ac				2 x 802.11 a/b/g/n/ac
MIMO Configuration	1x1	1x1 or 2x2	1x1, 2x2, or 3x3	1x1, 2x2, 3x3, or 4x4	1x1, 2x2, 3x3, or 4x4
PLCP Mode	Legacy or Mixed Mode				
IEEE Channel Models	• Model A - typical home/small office environment • Model B - typical medium office environment • Model C - typical large office environment • Model D - typical open space environment • Model E - typical large open space environment • Model F - complex environment with many scatters • By-pass mode - to not impose any channel conditions				
Guard Interval	400 or 800 nS				
Maximum Number of Spatial Streams	1	2	3	4	4
Channel Bandwidth	20 MHz, 40 MHz, 80 MHz				
Aggregation	Tx and Rx: A-MPDU and Block-ACK Rx only: A-MSDU				
Traffic Timestamp Accuracy	50 nS				
Maximum Number of Stateful Clients	500				
Maximum Number of Traffic Flows Generated per Port	1000				

Maximum Number of Traffic Flows Analyzed per Port	131,000
802.11 MAC Control (all parameters)	Independent per client
802.1ax Authentication	PEAP/MSCHAPv2, TLS, LEAP/EAP-FAST, TTLS
Encryption Support	WEP-40 and WEP-104, TKIP (WPA), AES-CCMP (WPA2)
OSI Layer 3 and Layer 4 (IP, UDP, TCP, etc.) Control (all parameters)	Independent per client
Port Counters	Comprehensive set of layer 2, 3 and 4 frame types
Flow and Flowgroup Counters	Frames sent / received, bytes sent / received, out-of-order frames, payload integrity, latency histogram
IPv6	• NDP: Neighbor/router discovery and address assignment • ICMPv6 & DHCPv6 • Multicast Listener Discover (MLDv1. MLDv2) • Dual stack operation of both IPv4 and IPv6 • UDP, RTP, stateful TCP, and multicast flows • Max of 32 IPv6 addresses per client: One Link-local, up to 31 Global
Capture Buffer	256 Mbytes Captures all transmitted and received frames during normal testing Adds IxVeriWave RadioTap header to provide additional debugging information such as PHY rate, RF power, aggregation, detected errors on per-frame basis

Calibration

IxVeriWave chassis and management modules do not require periodic adjustment or calibration. RF360xx modules are calibrated at the factory, and must be recalibrated every 12 months to maintain compliance with stated RF specifications. RF blades that are not calibrated periodically will still meet WBW specifications for as long as they remain in use.

Ordering Information

980-2039
IxVeriWave WBW3601 1 Port, 4 SS, TGA IxVeriWave WBW3601, single port, four spatial stream per port, IEEE 802.11ac multi-client Traffic Generator and Performance Analyzer

980-2040
IxVeriWave WBW3602 2 Port, 4 SS, TGA IxVeriWave WBW3602, dual port, four spatial stream per port, IEEE 802.11ac multi-client Traffic Generator and Performance Analyzer

980-2041
IxVeriWave RF36011 1 Port, 1 SS RF Test, TGA IxVeriWave RF36011, single port, one spatial stream per port, IEEE 802.11ac multi-client Traffic Generator and Performance Analyzer, IEEE 802.11ac Signal Generator and Signal Analyzer WaveBlade.

980-2042
IxVeriWave RF36012 1 Port, 2 SS RF Test, TGA IxVeriWave RF36012, single port, two spatial stream per port, IEEE 802.11ac multi-client Traffic Generator and Performance Analyzer, IEEE 802.11ac Signal Generator and Signal Analyzer WaveBlade.

980-2043
IxVeriWave RF36013 1 Port, 3 SS RF Test, TGA IxVeriWave RF36013, single port, three spatial stream per port, IEEE 802.11ac multi-client Traffic Generator and Performance Analyzer, IEEE 802.11ac Signal Generator and Signal Analyzer WaveBlade.

980-2044
IxVeriWave RF36014 1 Port, 4 SS RF Test, TGA IxVeriWave RF36014, single port, four spatial stream per port, IEEE 802.11ac multi-client Traffic Generator and Performance Analyzer, IEEE 802.11ac Signal Generator and Signal Analyzer WaveBlade.

980-2045
IxVeriWave RF36024 2 Port, 4 SS RF Test, TGA IxVeriWave RF36024, dual port, four spatial stream per port, IEEE 802.11ac multi-client Traffic Generator and Performance Analyzer, IEEE 802.11ac Signal Generator and Signal Analyzer WaveBlade.