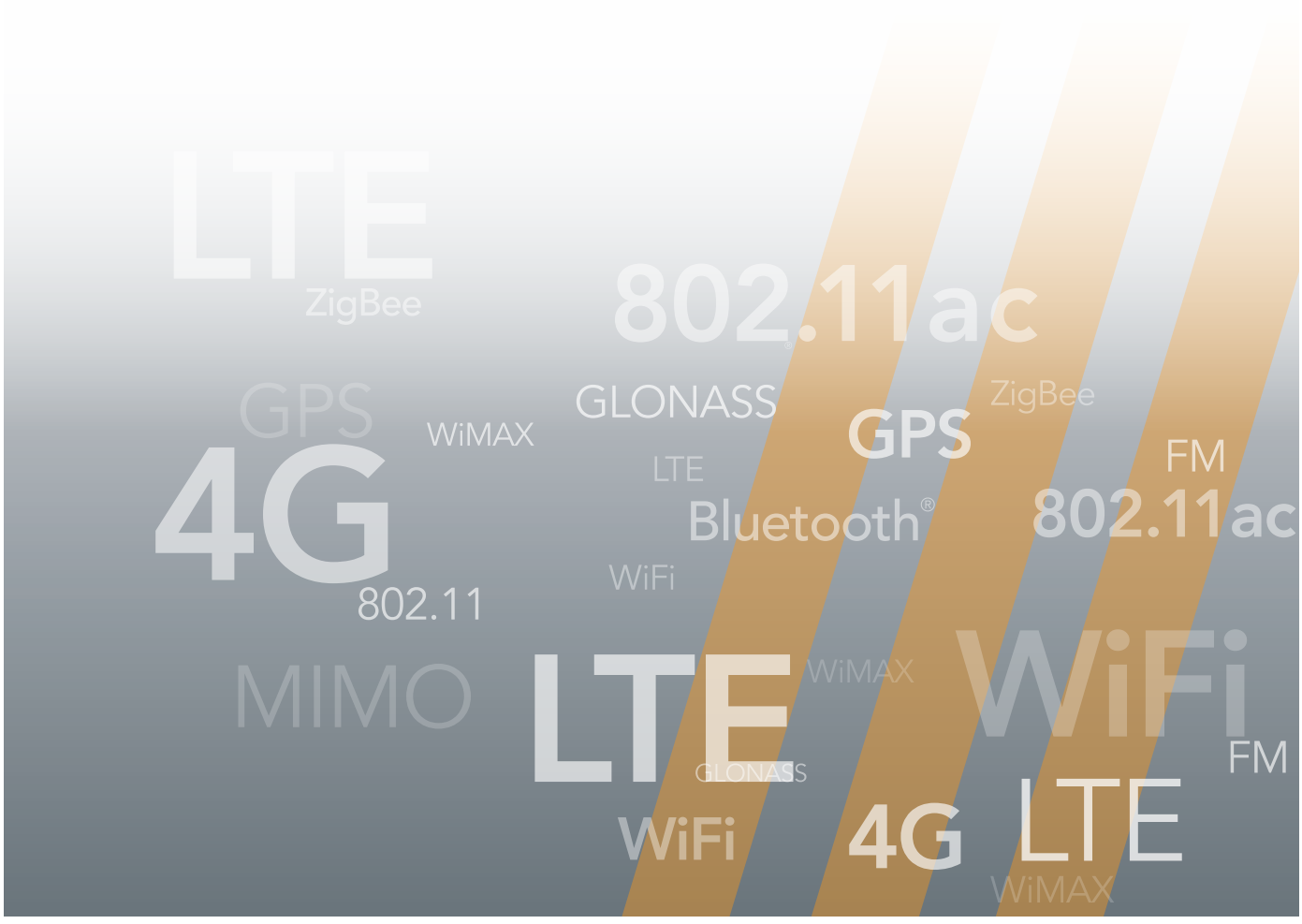
iQxel-M

TECHNICAL SPECIFICATIONS

IQxel-M™
Multi-DUT/Multicom Connectivity Test System



LITEPOINT

Overview of IQxel-M

The IQxel-M is a manufacturing oriented, Multi-DUT, Multicom™ test system, designed to calibrate and verify performance of wireless connectivity devices in high-volume production environments. The IQxel-M makes use of non-signaling physical layer test methods to significantly increase test throughput when compared to signaling based methodologies typical of R&D and conformance testing. Enabled by LitePoint's fifth generation Packet Engine™ processor, the IQxel-M is capable of performing simultaneous testing on up to four devices using synchronous and/or asynchronous parallel test methods. This maximizes test efficiency and minimizes the total cost of test of wireless connectivity products.

Highest Test Throughput for Multicom Wireless Connectivity Devices

The IQxel-M supports multiple connectivity technologies with banded frequency coverage from 60 MHz to 6,000 MHz. It provides full Tx/Rx physical layer testing of 802.11 a/b/g/n/j/p/ac, 802.11ah, Bluetooth 1.0-4.2, ZigBee, Z-Wave, WiSUN, LTE-U and DECT. It also provides receiver testing of GPS, GLONASS, COMPASS, Galileo, and FM. IQxel-M addresses the ever-increasing capabilities of smart connected devices with the ability to simultaneously test Wi-Fi/BT functionality on up to four (4) devices while concurrently performing navigation and broadcast tests further increases the throughput capabilities of the system.

General Technical Specifications

RF Analyzer

Parameter	Ports	Value	
Input frequency range	RF1 to RF4	860 to 1000 MHz 1770 to 2660 MHz 3300 to 3800 MHz 4900 to 6000 MHz	
IF bandwidth	RF1 to RF4	120 MHz	
Input power range	RF1 to RF4	+30 dBm peak (+25 dBm average)	
Input power accuracy[1]	RF1 to RF4	Specification:	± 0.75 dB (+20 to -75 dBm)
		Typical:	± 0.50 dB (+20 to -75 dBm)
Quantization		16 bits	
Input return loss	RF1 to RF4	≤1000 MHz, >10 dB >1000 MHz, >12 dB	
In band spurious	RF1 to RF4	< -55 dBc (50 kHz RBW) (CW, +20 to -40 dBm)	
Spectral flatness	RF1 to RF4	Specification:	± 0.50 dB (± 40 MHz)
		Typical:	± 0.25 dB (± 40 MHz)
Inherent spurious floor	RF1 to RF4	≤ -80 dBm	
Noise figure		≤ 30 dB at minimum input attenuation	
Integrated phase noise		≤ 0.3 degrees (100 Hz to 1 MHz) (860 to 1000 MHz) ≤ 0.3 degrees (100 Hz to 1 MHz) (1770 to 2660 MHz) ≤ 0.4 degrees (100 Hz to 1 MHz) (3300 to 3800 MHz) ≤ 0.4 degrees (100 Hz to 1 MHz) (4900 to 6000 MHz) 0.2 degrees (100 Hz to 1 MHz) typical, for all frequencies	
Signal to noise ratio		≥ 55 dB 100 kHz RBW	
Sampling data rate		10, 20, 40, 80, 160 MHz	
Waveform capture duration		at 10 MHz sampling data rate	3200 ms
		at 20 MHz sampling data rate	1600 ms
		at 40 MHz sampling data rate	800 ms
		at 80 MHz sampling data rate	400 ms
		at 160 MHz sampling data rate	200 ms

1 Input power accuracy specification applies after a warm up period of 2 hours or more

RF Analyzer — Signal Trigger

Parameter	Range	
Absolute minimum value	Wideband RF	-30 dBm
	Video	-40 dBm
Absolute maximum value	Limited by the maximum input power	
Trigger relative threshold	30 dB	
Level accuracy	< +/- 1 dB	

RF Generator

Parameter	Ports	Range	
Output frequency range	RF1 to RF4	860 to 1000 MHz 1770 to 2660 MHz 3300 to 3800 MHz 4900 to 6000 MHz	
IF bandwidth	RF1 to RF4	120 MHz	
Output power range (CW)	RF1 to RF4	1 port active: +10 to -95 dBm (≤ 2600 MHz) 0 to -95 dBm (> 2600 MHz) All ports active: +5 to -95 dBm (≤ 2600 MHz) -5 to -95 dBm (> 2600 MHz)	
Output power accuracy[1]		Specification:	± 0.75 dB (0 to -95 dBm)
		Typical:	± 0.50 dB (0 to -95 dBm)
Quantization		16 bits	
Output return loss	RF1 to RF4	≤1000 MHz, >10 dB >1000 MHz, >12 dB	
Spurious (in channel)	RF1 to RF4	Specification:	≤ -40 dBc or ≤ -95 dBm (80 MHz) (CW)
		Typical:	≤ -50 dBc or ≤ -95 dBm (80 MHz) (CW)
Spurious (out of channel)	RF1 to RF4	Out-of-band (>± 40 MHz from carrier):	≤ -45 dBc (CW, excluding harmonics distortions)
Spectral flatness	RF1 to RF4	Specification:	≤ ± 0.50 dB (± 40 MHz)
		Typical:	± 0.25 dB (± 40 MHz)
Integrated phase noise		≤ 0.3 degrees (100 Hz to 1 MHz) (860 to 1000 MHz) ≤ 0.3 degrees (100 Hz to 1 MHz) (1770 to 2660 MHz) ≤ 0.4 degrees (100 Hz to 1 MHz) (3300 to 3800 MHz) ≤ 0.4 degrees (100 Hz to 1 MHz) (4900 to 6000 MHz) 0.2 degrees (100 Hz to 1 MHz) typical	

1 Output power accuracy specification applies after a warm up period of 2 hours or more

Signal to noise ratio		Specification:	≥ 60 dB (100 kHz RBW), power level = -45 dBm
		Typical:	≥ 70 dB (100 kHz RBW), power level = -45 dBm
Carrier leakage		≤ -45 dBc (CW output) ≤ -90 dBm (between packets, when enhanced gap rejection enabled)	
Gap power		≤ -90 dBm/100 kHz	
Sampling data rate		10, 20, 40, 80, 160 MHz	
Waveform playback duration (non-repeat)		at 10 MHz sampling data rate	3200 ms
		at 20 MHz sampling data rate	1600 ms
		at 40 MHz sampling data rate	800 ms
		at 80 MHz sampling data rate	400 ms
		at 160 MHz sampling data rate	200 ms

Port Isolation

VSA to VSG isolation	≤ 2.7 GHz, 100 dB typical > 2.7 GHz, 90 dB typical

Timebase

Oscillator type	OCXO
Frequency	10 MHz
Initial accuracy (25°C, after 60 minute warm-up)	< +/- 0.05 ppm
Maximum aging	< +/- 0.1 ppm per year
Temperature stability	< +/-0.05 ppm over 0°C to 50°C range, referenced to 25°C
Warm-up time (to within +/-0.1 ppm at 25°C)	< 30 minutes

Navigation Signal Generator (VSG2)

Parameter	Range
Output frequency range	GPS: 1575.42 MHz GLONASS: 1598 to 1606 MHz COMPASS: 1561.098 (+/- 2.046) MHz Galileo: 1559 to 1593 MHz
Maximum Doppler offset	±10 kHz
Output power range	-60 to -145 dBm
Power resolution	0.1dB
Level accuracy	±0.7dB (-60 to -100 dBm) ±1dB (-100 to -145 dBm)
Output return loss	>15 dB
Spurious	Harmonic: < -40 dBc Non-Harmonic: < -40 dBc (+/- 10 MHz)

Low Frequency Communication (LFC) Signal Generator

Parameter	Range
Output frequency range	65 to 240 MHz 470 to 900 MHz
Output power range	+6 to -110 dBm
Frequency resolution	10 Hz
Power resolution	0.1 dB
Level accuracy	± 1.0 dB
Output return loss	>15 dB
Spurious	Harmonic: <-65 dBc (in band), <-40dBc (out of band) Non harmonic: <-60 dBc (in band), <-40dBc (out of band)

Wireless LAN (802.11 a/b/g/n/j/p/ac) Measurement Specifications

Measurement	Description	Performance
EVM	EVM averaged over payload based on standard requirements	Residual VSA EVM (full packet channel estimation): ≤ -45 dB (+20 to -20 dBm) ≤ -43 dB (-20 to -25 dBm) ≤ -38 dB (-25 to -30 dBm) Residual VSG EVM: ≤ -45 dB (-5 to -45 dBm) Residual VSA EVM (preamble only channel estimation): ≤ -42 dB (+20 to -20 dBm) ≤ -40 dB (-20 to -25 dBm) ≤ -35 dB (-25 to -30 dBm) Residual VSG EVM: ≤ -42 dB (-5 to -45 dBm) Note: - Averaged over 20 packets, 16 data OFDM symbols long - 802.11ac waveform, 80 MHz, MSC 9 (256QAM 5/6) - Measured in system loopback
Peak power	Peak power over all symbols (dBm)	VSA power accuracy: ± 0.75 dB (+20 to -35 dBm)
RMS power	All: average power of complete data capture (dBm)	
	No gap: average power over all symbols after removal of any gap between packets (dBm)	
Max avg power	Peak value of the amplitude as a moving average over 40 samples (dBm)	
I/Q amplitude error	I/Q amplitude imbalance (%) and approximate contribution to EVM (dB)	Residual VSA I/Q imbalance: ≤ 1% (+20 to -35 dBm) Residual VSG I/Q imbalance: ≤ 1% (-5 to -70 dBm)
I/Q phase error	I/Q phase imbalance (degrees) and approximate contribution to EVM (dB)	Residual VSA I/Q imbalance: ≤ 0.5 degree (+20 to -35 dBm) Residual VSG I/Q imbalance: ≤ 0.5 degree (-5 to -70 dBm)
Frequency error	Carrier frequency error (kHz)	(For 802.11n packet at 16 symbols, EVM better than -25 dB) VSA measurement error: ≤ ± 0.2 ppm calibrated

Measurement	Description	Performance
RMS phase noise	Integrated phase noise (degrees)	VSA integrated phase noise: < 0.5 degrees (100 Hz to 1 MHz)
PSD	Power spectral density (dBm/Hz) versus frequency offset center frequency ± 40 MHz	
Spectral mask	Transmit spectrum mask	Spectral mask view: ± 60 MHz
Spectral flatness	Reflects variation of signal energy as a function of OFDM subcarrier number 802.11a/g/p/n/j/ac OFDM signals only	VSA flatness over ≤ 80 MHz Ch BW: ± 0.5 dB
Sidelobe analysis (spectral mask, LO leakage)	Center peak and peaks of 1st and 2nd upper/lower sidelobes (dB) 802.11b/g DSSS signals only	
CCDF (complementary cumulative distribution function)	Probability of peak signal power being greater than a given power level versus peak-to-average power ratio (dB)	
Power on / power down ramp	On: relative power level (% of average) versus time (802.11b/g CCK signals only) Power-on time from 10% to 90% Power-on time from 90% power level to start of packet (Not provided for 802.11a/g/p/n/j/ac OFDM signals)	
	Off: relative power level (% of average) versus time (802.11b/g CCK signals only) Power-off time from 90% to 10% Power-off time from 90% power level to end of packet (Not provided for 802.11a/g/p/n/j/ac OFDM signals)	
Eye diagram	I and Q channels versus time (802.11b/g DSSS signals only)	
PSDU data	Recovered binary data sequence, including the MAC header and Frame Check Sequence, if present	
Raw capture data	I and Q signals versus time	
General waveform analysis	DC offset, RMS level, minimum/maximum amplitude, peak-to-peak amplitude, RMS I- and Q-channel levels	
CW frequency analysis	Frequency of CW tone	

Bluetooth® (1.0, 2.0, 2.1, 3.0) Measurement Specifications

Measurement	Description	Performance
TX output power	Transmit DUT output power (dBm)	VSA power accuracy: ± 0.75 dB (+20 to -35 dBm) ± 0.50 dB (+20 to -35 dBm) typical
TX output spectrum	Transmit DUT power spectral density	
20 dB bandwidth	Bandwidth between the +/- 20 dB down points of the modulation waveform	VSA frequency accuracy: ≤ ± 0.2 ppm calibrated
In-band emissions (Adjacent channel)	Spurious emission measured at +/- 5 MHz of DUT TX frequency only	VSA spurious: < -50 dBc (50 kHz RBW) (CW)
Modulation characteristics	Average and peak frequency deviation (Hz)	(For EVM better than -25 dB) VSA measurement error: ≤ ± 0.2 ppm calibrated
Carrier frequency tolerance	Carrier frequency offset (Hz)	
Carrier frequency drift	Carrier frequency change over the Bluetooth burst (Hz)	
Relative transmit power (EDR)	Average power of complete data capture (dBm)	VSA power accuracy: ± 0.75 dB (+20 to -35 dBm)
Carrier frequency stability (EDR)	Frequency drift over the Bluetooth EDR burst duration (Hz)	
Receive sensitivity[1]	Receive sensitivity test using LitePoint or user-generated waveforms. Includes Dirty Packets.	VSG power accuracy: ± 0.75 dB (+ 5 to -95 dBm)
Maximum input signal level	Assuming single-ended BER measurement	
RMS EVM (EDR)	RMS EVM for Bluetooth EDR	Residual VSA EVM: ≤ -35 dB (+20 to -25 dBm) Residual VSG EVM: ≤ -35 dB (-5 to -70 dBm)
Peak EVM (EDR)	Peak EVM for Bluetooth EDR	

1 IQxel-M support testing sensitivity with Dirty Packets

Bluetooth (4.0, 4.1, 4.2) Measurement Specifications

Measurement	Description	Performance
Output power at NOC[1]		VSA power accuracy: ± 0.75 dB (+20 to -35 dBm)
Output power at EOC[1]		
In-band emissions at NOC[1]	Spurious emission measured at +/- 5 MHz of DUT TX frequency only	VSA spurious: < -50 dBc (50 kHz RBW) (CW)
In-band emissions at EOC[1]		
Modulation characteristics	Average and peak frequency deviation (Hz)	VSA frequency accuracy: ≤ ± 0.2 ppm calibrated
Carrier frequency offset and drift at NOC[1]	Carrier frequency offset (Hz) and change over the Bluetooth burst (Hz)	
Carrier frequency offset and drift at EOC[1]		
Receiver sensitivity at NOC[1,2]	Receive sensitivity test using LitePoint or user-generated waveforms	VSG power accuracy: ± 0.75 dB (+ 5 to -95 dBm)
Receiver sensitivity at EOC[1,2]		
C/I and receiver selectivity performance[3]		VSA spurious: < -50 dBc (50 kHz RBW) (CW)
Blocking performance[3]		
Intermodulation performance		
Maximum input signal level	Assuming single-ended BER measurement	VSG maximum output power: +9 to -95 dBm CW 0 to -95 dBm modulated
PER report integrity	Verifies the DUT PER report mechanism	

1 NOC and EOC tests are the same except for the operating conditions which do not impact the test equipment requirements
2 External signal source required for these measurements (not LitePoint supplied)
3 IQxel-M provide the wanted signal only. No interfering signal is available

Bluetooth 5 Measurement Specifications

Bluetooth 5 introduced a couple of new test requirements:

Data Rate: New requirements for testing with 2 Mbps, 1 Mbps, 500 kbps, 125 kbps signal

Stable Modulation: Optional requirement for device to support smaller variation in the frequency deviation during modulation (modulation index between 0.495-0.505). This enhancement gives device stable and better range coverage and thus competitive advantage

IQxel-M is capable of testing for these new requirements

Measurement	Description	Performance
In-band emissions	Spurious emission measured at ± 5 MHz of DUT TX frequency only. Tested at 1 Mbps, 2 Mbps	VSA spurious: < -50 dBc (50 kHz RBW) (CW)
Modulation Characteristics	Average and peak frequency deviation (Hz). Tested at 1 Mbps, 2 Mbps, 125 kbps	VSA frequency accuracy: ≤ ± 0.2 ppm calibrated
Carrier Frequency offset and drift	Carrier frequency offset (Hz) and change over the Bluetooth burst (Hz). Tested at 1 Mbps, 2 Mbps, 125 kbps	
Stable Modulation Characteristics	Tested at 1 Mbps, 2 Mbps	VSA frequency accuracy: ≤ ± 0.2 ppm calibrated
Receiver Sensitivity	Receive sensitivity test using LitePoint or user-generated waveforms. Tested at 1 Mbps, 2 Mbps, 125 kbps	VSG power accuracy: ± 0.75 dB (+ 5 to -95 dBm)
Receiver Sensitivity – Stable Modulation Index	Tested at 1 Mbps, 2 Mbps, 500 kbps, 125 kbps	
Maximum Input signal level	Assuming single-ended BER measurement. Tested at 1 Mbps, 2 Mbps	VSG maximum output power: +9 to -95 dBm CW 0 to -95 dBm modulated
Maximum Input signal level – Stable Modulation Index	Tested at 1 Mbps, 2 Mbps	
C/I and Receiver Selectivity Performance	Tested at 1 Mbps, 2 Mbps, 500 kbps, 125 kbps	VSA spurious: < -50 dBc (50 kHz RBW) (CW)
Blocking Performance	Tested at 1 Mbps, 2 Mbps	
Intermodulation Performance	Tested at 1 Mbps, 2 Mbps	
PER Report Integrity	Verifies the DUT PER report mechanism. Tested at 1 Mbps, 2 Mbps,500 kbps, 125 kbps	

ZigBee (802.15.4)

Measurement	Description	Performance
Output power	Transmit DUT output power (dBm)	VSA power accuracy: ± 0.75 dB (+20 to -35 dBm) ± 0.50 dB (+20 to -35 dBm) typical
Power spectral density	Transmit DUT power spectral density	
Center Frequency Tolerance	Tx center frequency tolerance	VSA frequency accuracy: ≤ ± 0.2 ppm calibrated
EVM	Offset: compensate the I and Q offset in OQPSK Normal: no compensation applied	
Other modulation quality measurements	LO leakage, clock error, phase error, symbol clock error	
CCDF (complementary cumulative distribution function)	Probability of peak signal power being greater than a given power level versus peak-to-average power ratio (dB)	

Z-Wave (ITU-T G.9959)

Measurement	Description	Performance
Output Power	TX output power (dBm)	VSA power accuracy: +/- 0.75 dB (+20 to -35 dBm) +/- 0.50 dB (+20 to -35 dBm) typical
Power Spectral Density	TX power spectral density	
Carrier Frequency Offset	TX center frequency error	VSA frequency accuracy: <= +/- 0.2 ppm calibrated
Frequency Deviation	RMS, Min, Max Frequency Deviation	
Symbol Clock Error	Symbol Clock Error and Jitter	VSG output power: +9 to -95 dBm CW 0 to -95 dBM modulated
RX Power Level	RF Generator Output Level Range	

WiSUN MR-FSK (802.15.4g)

Measurement	Description	Performance
Output Power	TX output power (dBm)	VSA power accuracy: +/- 0.75 dB (+20 to -35 dBm) +/- 0.50 dB (+20 to -35 dBm) typical
Power Spectral Density	TX power spectral density	
Carrier Frequency Offset	TX center frequency error	VSA frequency accuracy: <= +/- 0.2 ppm calibrated
Frequency Deviation	RMS, Min, Max Frequency Deviation	
Symbol Clock Error	Symbol Clock Error and Jitter	
RX Power Level	RF Generator Output Level Range	VSG output power: +9 to -95 dBm CW 0 to -95 dBM modulated

DECT (ETSI EN 300 176-1)

Measurement	Description	Performance
Power	Normal Transmit Power	VSA power accuracy: ± 0.75 dB (+20 to -35 dBm) ± 0.50 dB (+20 to -35 dBm) typical
Power vs. time	Power time template	
Frequency offset	Frequency offset	VSA frequency accuracy: ≤ ± 0.2 ppm calibrated
Frequency drift	Frequency drift during packet transmission	
Frequency deviation	S field, B field, whole packet	

LET-U Small Cell

Standard Test	LTE Small Cell 3GPP TS 36.141
Maximum Output Power	6.2.2
Frequency Error	6.5.1
Occupied Bandwidth	6.6.1
Adjacent Channel Leakage Ratio	6.6.2
Error Vector Magnitude	6.5.2
Spectrum Emissions	6.2.6, 6.2.7, 6.6.3, 6.6.4
Transmitter OFF power	6.4.1

MIMO System Performance

The additional specifications in the table below apply to the complete IQxel MIMO system.

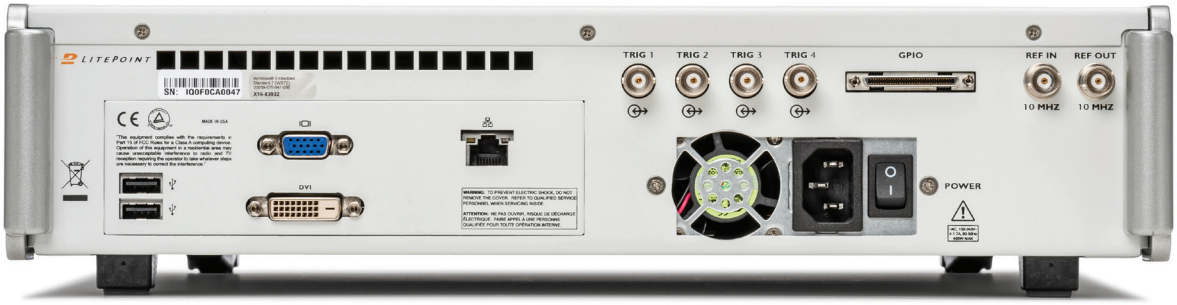
Parameter	Port Designations	Range
VSA capture trigger accuracy		≤ ± 3.5 ns
VSA start trigger accuracy		≤ ± 3.5 ns

Port Descriptions

Front Panel

I/O	Function	Type
Power switch	Power on/off	Pushbutton switch
RF1–RF4	VSA/VSG	N female
GNSS	Global Navigation Satellite System Signal Out	N female
LFC	Low frequency Communication (broadcast standard) Signal Out	N female
Power indicator	LED off - AC switch on the back panel is turned off or the AC power cable is not connected LED solid red - test system is in standby mode LED blinking red - test system is powering off LED blinking green - test system is booting up LED solid green - test system is powered on	LED indicator
Session active indicator	LED green - remote session active LED red - remote session lock	LED indicator
Status indicator	LED green - no faults/errors detected LED orange - Software error detected LED red - Hardware fault detected	LED indicator
GNSS/LFC indicator	LED green - GNSS on LED orange - LFC on LED red - both GNSS and LFC on	LED indicator
RF port 1 indicator	LED green - port is a VSA input LED red - port is a VSG output	LED indicator
RF port 2 indicator	LED green - port is a VSA input LED red - port is a VSG output	LED indicator
RF port 3 indicator	LED green - port is a VSA input LED red - port is a VSG output	LED indicator
RF port 4 indicator	LED green - port is a VSA input LED red - port is a VSG output	LED indicator
USB (2 ports)	USB 2.0 compatible connection to external controller	USB Type A

Rear Panel



General I/O

I/O	Function	Type
10 MHz ref input	The 10 MHz reference input has a 200 ohm impedance and accepts a sine wave ranging in amplitude from 0.3 Vpp to 4 Vpp.	BNC female
10 MHz ref output	10 MHz reference output	BNC female
Marker out / trigger in 1	TTL compatible	BNC female
Marker out / trigger in 2	TTL compatible	BNC female
Marker out / trigger in 3	TTL compatible	BNC female
Marker out / trigger In 4	TTL compatible	BNC female
USB (2 ports)	USB 2.0 compatible connection to external controller	USB Type A
AC in	AC power input	100 to 240VAC (automatically switched) 50 to 60 Hz Includes hard power switch
DVI port	Display LitePoint monitor	DVI-D
VGA port	Display LitePoint monitor	VGA-15 pin
Communication I/O LAN	1000 Base-T LAN	RJ-45
GPIO	Reserved for future use	50-pin connector

General and Environmental

Dimensions	Unit with handle: 15.5" W x 3.2" H x 20" D (370 mm W x 82 mm H x 508 mm D) Unit without handle: 14.7" W x 3.2" H x 20.5" D (373 mm W x 82 mm H x 521 mm D)
Weight	11.43 kg (25.2 pounds), 6 port
Power requirements	100 to 240 VAC, < 300 W, 50 to 60 Hz
Power consumption	<235 W (maximum), <10 W (standby)
Recommended PC	Intel Core i5 2.5 GHz with 1 GB of RAM or better
Recommended browser for optimal performance	Google Chrome R10 Release
Operating temperature	+10°C to +55°C (IEC EN60068-2-1, 2, 14)
Storage temperature	-20°C to +70°C (IEC EN60068-2-1, 2, 14)
Specification validity temperature	+20°C to +30°C
Operating humidity	15% to 95% relative humidity, non-condensing (IEC EN60068-2-30)
EMC	EN 61326 Immunity for industrial environment, Class A emissions
Safety	IEC 61010-1, EN61010-1, UL3111-1, CAN/CSA-C22.2 No. 61010-1-12
Mechanical vibration	IEC 60068, IEC 61010 and MIL-T-28800D, class 5
Mechanical shock	ASTM D3332-99, Method B
Recommended calibration cycle	12 months
Warranty	12 months hardware 12 months software updates

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