Product Brochure and Technical Datasheet
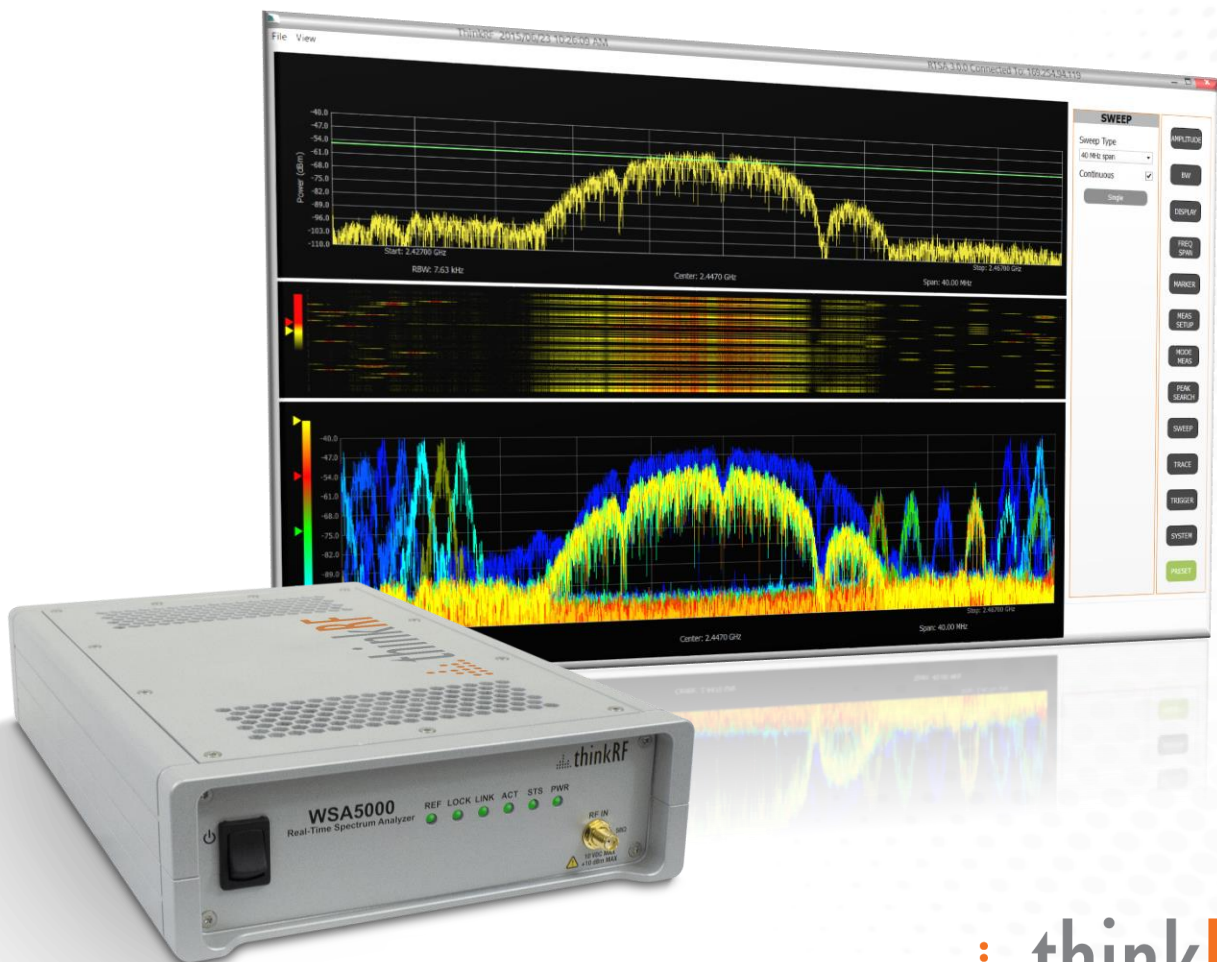Preliminary
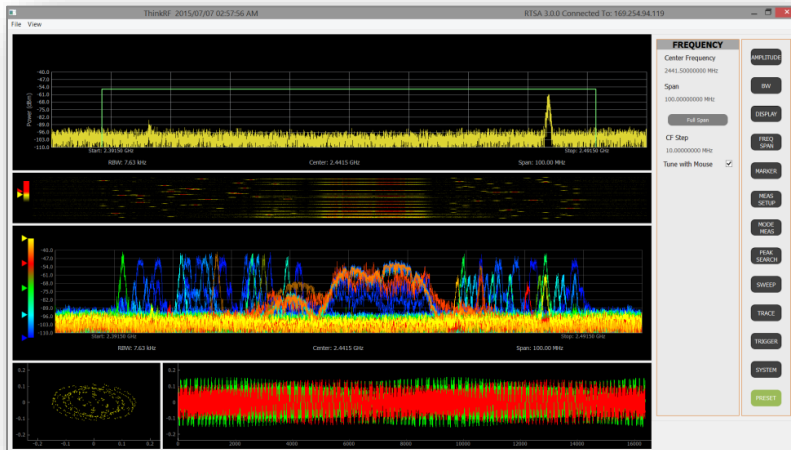
RTSA v3

Real-Time Spectrum Analyzer (RTSA)

100 kHz to 8 GHz / 18 GHz / 27 GHz

Featuring

- Real-Time Bandwidth (RTBW) up to 100 MHz

- Probability of Intercept (POI) as short as 1.02 µs

- Spurious Free Dynamic Range (SFDR) up to 100 dBc

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Introduction

What is a Real-Time Spectrum Analyzer?

A Real-Time Spectrum Analyzer (RTSA) processes RF signals at a speed fast enough as to not miss any signals for its given captured bandwidth, known as its Real-Time Bandwidth (RTBW) or Instantaneous Bandwidth (IBW). In addition an RTSA needs to provide views of the spectrum in the frequency and time domains, as well as power spectral density to enable analysis of signals that may be so fast as to be undetectable to the human eye. And finally an RTSA must provide the capability to trigger on events and capture them, and record them for playback enabling deeper analysis.
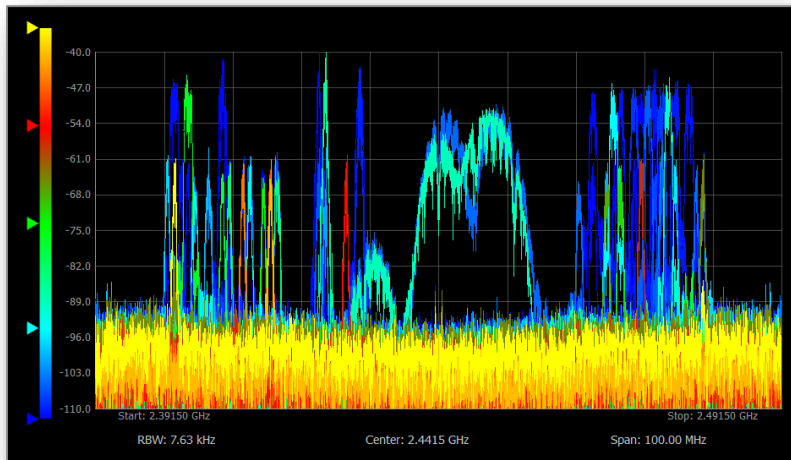
Who needs a Real-Time Spectrum Analyzer?

Anyone dealing with signals that may vary dynamically in amplitude or are agile in frequency. Examples include:

- Short duration intermittent signals such as pulsed radar systems, frequency-hopping spread spectrum radios, pulse modulated radios;

- Multi-signal environments such as ISM bands – 915 MHz, 2.4, 5.8, 24 GHz;

- Unwanted signals such as unintentional or self-interference, intentional interference (jammers), and listening devices (bugs).

What is the ThinkRF solution?

The RTSA v3 utilizes the WSA5000 which is a PC-controlled Wireless Signal and Spectrum Analyzer and includes:

- 100 kHz to 8, 18 or 27 GHz frequency range
- Real-time spectrum graph
- Real-time spectrogram view
- Real-time power spectral density display (persistence)
- Real-Time Triggering
- Real-time I/Q plots
- Real-Time Recording and Playback

The WSA5000 can be utilized anywhere in the wireless ecosystem – R & D, Education, Manufacturing, Deployment, and Monitoring.

RTSA v3 Displays

Spectrogram View

Along with the standard spectrum graph which plots Power versus Frequency the user can select the Spectrogram View. The Spectrogram View provides a 3-dimensional view of the spectrum adding the dimension of Time. Time zero is at the top of the Spectrogram view and measurements in the past scroll down. The color indicates the relative magnitude of the Power. In this case, red being the highest power. Several palettes are available to optimize for best viewing depending on the signals to be evaluated. By looking at Time, one can see the periodicity of any given signal.

Power Spectral Density Display

The Power Spectral Density Display is commonly called the Persistence Display. Both names give a partial description of what the display does. The color is an indication of how dense or how often the signal is present at the respective power level. In this case red represents the level the signal is at most of the time. And signals persist on the screen for a few seconds before fading out allowing you to see signals that come too fast to view in the spectrum graph. One can see the Wi-Fi signal, the Bluetooth Signals, and the Microwave Oven Signals that were present just a few seconds earlier.

I /Q Plots

The I/Q plot consists of two plots, the I/Q Constellation on the left, and the I/Q Time Domain on the right. The Constellation data displays the In-phase (I data) vs. the Quadrature (Q data). The Time domain plot shows a trace for the In-phase (I data in green) and a trace for the Quadrature (Q data in red, if available in the mode).

WSA5000 Interfaces

Extensibility of the WSA5000 for additional functionality and OEMs

- 10 MHz In for external references and a 10 MHz Out reference for multi-unit synchronization
- Analog I/Q Out enables OEM high speed digitizers and post-processing software tools
- GPIO for external triggers and exterior modules such as antenna switches, downconverters, and GPS
- 10/100/1000 Ethernet port for control and networking the WSA5000
- +12 V DC power input allowing drive testing with automobile 12 V DC sources and personal mobility with an external 12 Volt battery
- External support for 80 MHz and 160 MHz RTBW (optional)
- External Local Oscillator inputs for phase-coherent radio front-ends (not shown and optional)

### Industry-leading APIs for customization

ThinkRF utilizes industry-leading APIs/standards and open-source code for easy customization and remote control.

- Python™
- LabVIEW Base Development System for Windows
- MATLAB® R2014b
- C/C++ programming
- SCPI - Standard Commands for Programmable Instruments

Standard file formats for interoperability and/or deeper analysis:

- VITA Radio Transport (VRT) Protocol
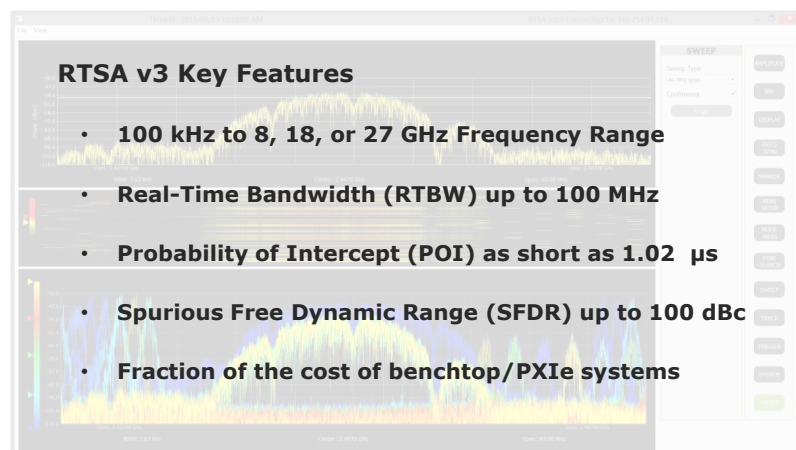- Comma Separated Values (CSV)

RTSA v3 Measurements
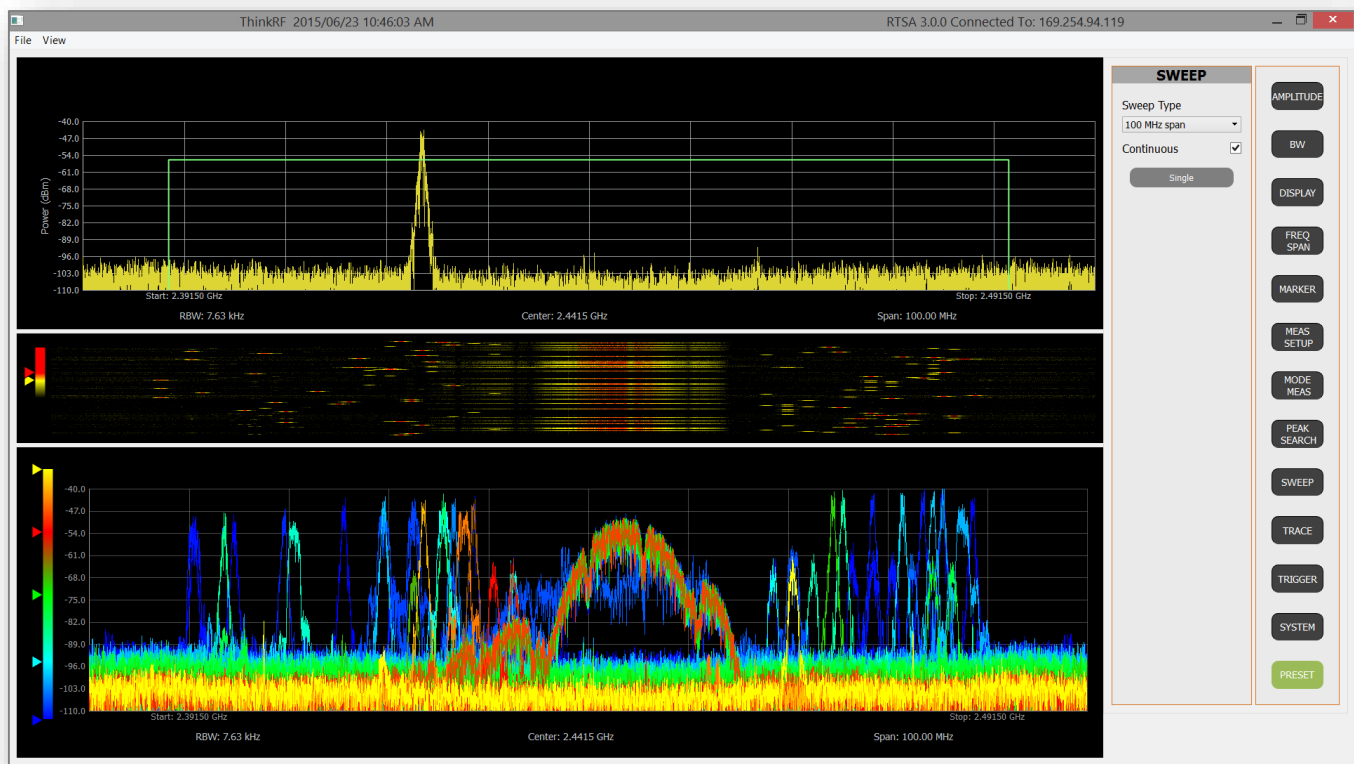
Make measurements locally or remotely

Measurement can be made remotely via the Internet around the globe. Ideal for remote monitoring applications.

- Up to six traces are available as Trace Normal, Trace Average, Max Hold, and Min Hold.
- Twelve Markers are available as Normal (tracking), Delta, and Fixed with Peak Search functions that can be assigned to any trace.
- The Real-Time Level Trigger only captures signals over a certain level and is useful for viewing signals over the Internet.
- For remote applications, Record data on the local PC and then use Playback to view the data without any Internet latency.
- The widescreen view of a laptop or PC monitor enables enhanced viewing not available on instruments with built-in screens.
- The intuitive GUI display makes it easy to operate for anyone familiar with a benchtop spectrum analyzer.

RTSA v3 Key Features

- **100 kHz to 8, 18, or 27 GHz Frequency Range**
- **Real-Time Bandwidth (RTBW) up to 100 MHz**
- **Probability of Intercept (POI) as short as 1.02 µs**
- **Spurious Free Dynamic Range (SFDR) up to 100 dBc**
- **Fraction of the cost of benchtop/PXIe systems**

ThinkRF in Real-Time

ThinkRF combines patented technology, low-cost digital software-defined radio technology, open source software, standard APIs, and a PC-controlled architecture to provide unparalleled performance for the price. If you are dealing with dynamic and agile signals and could be more productive with an RTSA but thought it was out of your budget, then ThinkRF. Only ThinkRF can deliver these Real-Time Spectrum Analysis features with this performance at a price that is affordable to everyone who can afford a spectrum analyzer. We invite you to ThinkRF in Real-Time!

Real-time spectrum analyzer mode

Display Modes	Real-time Spectrum	
	Real-Time Spectrogram	
	Real-Time Persistence Spectrum	
	Real-Time I and Q	
Real-time bandwidth (RTBW)	0.1 / 10 / 40 /100 MHz	
100% Probability of Intercept (POI)		
	1.02 µs minimum signal duration	976.56 kHz RBW
	8.19 µs minimum signal duration	122.07 kHz RBW
Spurious free dynamic range (SFDR)	≥ 60 dBc (nominal)	100 MHz RTBW
	≥ 70 dBc (nominal)	10 / 40 MHz RTBW
	≥ 100 dBc (nominal)	0.1 MHz RTBW
Data Acquisition		
A/D Converter Sampling Rate and Resolution	125 MS/s,12 bit	10 / 40 / 100 MHz RTBW
	300 kS/s, 24 bit	0.1 MHz RTBW
FFT lengths	128 to 524288 in powers of 2	
Resolution Bandwidth (RBW)		
Range	0.24 kHz to 976.56 kHz	10 / 40 /100 MHz RTBW
	0.62 Hz to 2543.12 Hz	0.1 MHz RTBW
Windowing	Hanning	
Traces	6	Clear/Write, Trace Average, Max Hold, Min Hold
Markers	12	
Modes	Normal (Tracking), Delta, Fixed	Peak Search, Next Peak, Next Peak Left/Right,
Marker Frequency Resolution	0.01 Hz	Mkr > Center, Mkr > Ref Level
Triggers	1	Real-Time Level Trigger
APIs	Python™	PyRF RTSA
	LabVIEW	LabVIEW Base Development System for Windows
	MATLAB®	MATLAB® Release 2014b
	C/C++	ISO/IEC 14882:2011
	SCPI	IEEE 488.2 - Standard Commands for Programmable Instruments
Record/Playback	VITA Radio Transport (VRT)	VITA-49.0 – 2007 Draft 0.21
Preferences	Save/Load Settings	Save settings for easy recall
Export Data	CSV	Comma Separated Values

Frequency

Frequency Ranges		
Sweep/RTSA Mode (100/40/10/0.1 MHz)	50 MHz to 8 GHz, 18 GHz or 27 GHz	
Baseband Mode	100 kHz to 62.5 MHz	Non-tunable
Frequency Reference	± 1.0 x 10−6 per year	Aging
	± 1.0 x 10−6 per year	Accuracy + aging

Amplitude

Amplitude Accuracy		
25 °C ± 5 °C	± 2.00 dB typical	100 kHz to 3 GHz
	± 2.75 dB typical	>3 GHz to 8 GHz
Amplitude Ranges		
Measurement Range	DANL to maximum safe input level	
Attenuator Range	0 or 20 dB	8 GHz only
	0 to 25 dB, 1 dB steps	IF Attenuator for 18 and 27 GHz only
Maximum Safe RF Input Level	+10 dBm, 0 V DC	

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Spectral Purity

SSB Phase Noise	at 1 GHz		Carrier Offset
	(as an RTSA)		
	-80 dBc/Hz typical		100 Hz
	-90 dBc/Hz typical		1 kHz
	-97 dBc/Hz typical		10 kHz
	-102 dBc/Hz typical		100 kHz
	-123 dBc/Hz typical		1 MHz

	408 w/o preamp	408P, 418, 427	Frequency
Displayed Average Noise Level (DANL)			
25 °C ± 5 °C	-151 dBm/Hz typical	-164 dBm/Hz typical	100 MHz
	-151 dBm/Hz typical	-163 dBm/Hz typical	500 MHz
	-150 dBm/Hz typical	-161 dBm/Hz typical	1000 MHz
	-149 dBm/Hz typical	-152 dBm/Hz typical	2000 MHz
	-145 dBm/Hz typical	-157 dBm/Hz typical	3000 MHz
	-140 dBm/Hz typical	-155 dBm/Hz typical	4000 MHz
	-142 dBm/Hz typical	-149 dBm/Hz typical	5000 MHz
	-134 dBm/Hz typical	-143 dBm/Hz typical	6000 MHz
	-134 dBm/Hz typical	-149 dBm/Hz typical	7000 MHz
	-131 dBm/Hz typical	-163 dBm/Hz typical	8000 MHz
		-162 dBm/Hz typical	9000 MHz
		-162 dBm/Hz typical	10000 MHz
		-160 dBm/Hz typical	11000 MHz
		-158 dBm/Hz typical	12000 MHz
		-156 dBm/Hz typical	13000 MHz
		-155 dBm/Hz typical	14000 MHz
		-159 dBm/Hz typical	15000 MHz
		-155 dBm/Hz typical	16000 MHz
		-152 dBm/Hz typical	17000 MHz
		-149 dBm/Hz typical	18000 MHz

Third Order Intercept/(TOI)	at 1 GHz
	+12 dBm, typical

General Specifications

PC Required	
Operating System	Windows XP (32 bit)
	Window 7 and 8 (32 or 64 bit)
RAM	2 GB
Hard Disk	1 GB

Status Indicators	PLL Lock / 10 MHz reference clock status
	Ethernet Link and Activity status
	CPU and Power status

Connectors		
RF In	SMA female, 50 Ω	
10 MHz Reference In and Out	SMA female, 50 Ω	0 or 35 MHz
Analog I and Q Out	SMA female, 50 Ω	
10/100/1000 Ethernet	RJ45	
USB Console	mini-USB	
GPIO	25-pin male D-Subminiature	
Coaxial Power	Type A: 5.5 mm OD, 2.5 mm ID	

Physical		
Power Supply	+12 V DC	
Power Consumption	18 W	
Operating Temperature Range	0 °C to +50 °C	
Storage Temperature Range	-40 °C to +85 °C	
Size		
	269 x 173 x 61 mm (10.58 x 6.81 x 2.40 inches)	with mounting feet (shipped installed on unit)
	269 x 173 x 55 mm (10.58 x 6.81 x 2.15 inches)	without mounting feet
Weight	2.7 kg (6 lbs.)	

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Regulatory Compliance

RoHS Compliance	RoHS/RoHS 2	
Marks	CE	European Union
EMC Directive 2014/30/EU	EN 61326-1:2013	Electromagnetic Compatibility
Low Voltage Directive 2006/95/EC	EN 61010-1:2010 Class 1	Safety

Ordering Information

8 GHz RTSA	WSA5000-308	100 kHz to 8 GHz, RTBW up to 10 MHz *
8 GHz RTSA	WSA5000-408	100 kHz to 8 GHz, RTBW up to 100 MHz
18 GHz RTSA	WSA5000-418	100 kHz to 18 GHz, RTBW up to 100 MHz
27 GHz RTSA	WSA5000-427	100 kHz to 27 GHz, RTBW up to 100 MHz
8 GHz Preamp	WSA5000-408-P	8 GHz spectrum analyzer with 100 kHz to 100 MHz RTBW with pre-amp and additional preselect filtering. Applicable only to the WSA5000-408.
80 MHz and 160 MHz RTBW Support	WSA5000-xxx-WBIQ **	External support for 80 MHz Super-Heterodyne and 160 MHz Zero-IF RTBW. The RTBW of 160 MHz is intended for IQ out only. The internal digitizer remains at 125 MSa/s.
External Local Oscillator Support	WSA5000-xxx-ELO **	External Local Oscillator inputs for phase-coherent radio front-ends
High IF	WSA5000-xxx-HIF **	Radio receiver front-end with IF output between 800 and 2500 MHz When this option is selected, the lower IF outputs at 0 or 35 MHz or the RF digitization will not be available
80 MHz and 160 MHz RTBW and External Local Oscillator Support	WSA5000-xxx-WBIQ-ELO **	Radio receiver front-end support for external Local Oscillator inputs and 80 MHz Super-Heterodyne and 160 MHz Zero-IF RTBW. The instantaneous BW of 160 MHz is intended for IQ out only. The internal digitizer remains at 125 MSa/s.
Software Included	RTSA	Real-Time Spectrum Analyzer software
Rack Shelf	WSA5000-RACK-SHELF	19" rack shelf supports two horizontally mounted WSA5000s
External Battery	EXTERNAL-BATTERY	20,000 mAh 12 V / 1.5 A battery, >3.5 hours typ.

* The 308 does not include 10 MHz Out or I/Q Out

* * xxx = 408, 418 or 427 for 8 GHz, 18 GHz, or 27 GHz models respectively

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