Keysight Technologies
N6841A RF Sensor for Signal Monitoring Networks

Data Sheet

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Key Features

- Environmentally rugged IP67-rated weatherproof enclosure. Sealed unit with no moving internal parts
- Small footprint for ease of setup and teardown
- Wideband RF receiver with 20 MHz to 6 GHz frequency range
- Digital IF bandwidth adjustable up to 20 MHz
- Signal LOOKback memory (4.8 secs at 20 MHz BW)—enables reliable detection, processing and location of short duration signals or interference
- I/Q streaming up to 2 MHz bandwidth for recording or off board signal processing
- Integrated GPS for sensor location and time synchronous applications
- High precision measurement synchronization and time-stamping
- AM/FM demodulated audio streaming
- Two Type-N RF input ports (switched) for multiple antennas
- Well documented API for user programming and application development
- Wide range of Sensor applications to meet your specific monitoring, analysis or location requirements
- Embedded Application support for autonomous spectrum monitoring or "leave behind" use model.

"I've got bursting interferers that need to be reliably detected, classified, identified and located. I've already done the easy ones with my older generation equipment..."

Overview

The Keysight Technologies, Inc. N6841A RF Sensor represents an entirely new concept in spectrum monitoring. Communication signals have evolved dramatically and continue to do so as new and emerging wireless standards are defined and deployed. These new generation signals are wider bandwidth, more complex, time variant and low power. Traditional methods of monitoring communication signals from outside the city limits, a crowded vehicle or walking with a handheld analyzer just don't work well on these new standards or today's interference problems.

The Keysight N6841A RF Sensor offers a cost effective solution to placing a fully capable RF monitoring station where you need it, when you need it for as long as you need it, without complex siting constraints or physical infrastructure.

Use Models for RF Sensors

- Spectrum survey with signal classification and database operations
- Interference detection, collection, classification, identification and location
- Band Clearing/spectrum occupancy/utilization monitoring
- Border or regional area RF monitoring and emitter geolocation
- Range monitoring
- Spectrum awareness associated with RF testing
- Enforcing your organization's spectrum policy

Customers

- Military and Intelligence operations
- Frequency Regulatory Agencies
- Mobile Service Providers
- Government Range Managers
- Spectrum/Frequency Managers
- RF Test Managers
- Anyone monitoring or working with "off the air" RF signals

Measurements you can make with the RF Sensor and its applications

- 24/7 Real time remote spectrum monitoring and analysis from the comfort of your office
- High speed spectral search and signal isolation
- I/Q recording and signal classification, demodulation and decoding
- Analog and digital signal analysis
- Comprehensive ITU signal measurements
- Emitter location
- Custom applications using the Sensor Access Library (SAL) API

Deployments

The N6841A RF Sensor has a weatherproof and dustproof IP67-rated (Standard IEC 60529 International Protection 67) enclosure plus a wide operating temperature range to withstand harsh environments without additional expensive protective enclosures. The unit is conductively cooled, silent and contains no moving parts. It operates over a temperature range of –15 °C to 55 °C. The range can be extended by use of commercially available enclosures that provide heat and ventilation as needed for extreme temperature conditions.

This receiver has a small footprint with no external switches or status indicators making it extremely discreet. The low-profile form factor offers many mounting options, including tripod, roof-top, pole-top, rack-mount, vehicle-mount or man-pack deployments. Relative to other solutions, the N6841A RF Sensor requires a minimum of installation engineering, and is likely to gain easy approval from building managers. It is also very well suited to temporary installations.

On-board diagnostics include complete self-test of the internal RF signal path and a watchdog reset timer. This reduces the need for on-site troubleshooting. Installation and configuration of the RF sensor is simple with only RF input, GPS antenna (optional), power and network connections.

More detailed information regarding installation is provided in the N6841A Installation Guide (Publication Number N6841-90002).

Antennas

The N6841A RF Sensor can be used with any passive or active antenna element. A specific antenna is not stipulated for use with the RF Sensor to ensure maximum flexibility of the solution. The new Keysight N6850A Antenna has excellent broadband omni-directional characteristics and provides good coverage to make the measurements needed without excessive expense or additional power.

Power Considerations

The N6841A RF Sensor is powered by DC voltage ranging from 15 to 24VDC and it draws less than 30W. Option SP1 provides a 120/240 VAC power supply suitable for indoor (protected) installations. Off-the-shelf batteries are available from a number of suppliers that can power the RF Sensor for up to eight hours. There are also power supplies rated for outdoor use available commercially. The RF Sensor ships with an extra power connector for use with an alternate power source.

Network Connections

Many times, a wired Internet connection is not possible for the ideal RF Sensor location. In these cases, either a 3G or 4G modem, mesh radio network, or Wi-Fi backhaul may be an option. Standard Wi-Fi radios with directional antennas can easily service the data connection to an RF Sensor over 1 to 2 km. If greater distances are needed, a cellular modem provides the freedom to site the sensor anywhere in the cellular coverage area. If wired Ethernet is available for your installation, shielded cable is highly recommended to reduce the chance of interference.

Physical Mounting

The N6841A RF Sensor ships with a complete mounting kit for attachment to a rack, wall or pole. The mounting bracket includes provision for security locks, attachment of the GPS antenna and the RF Sensor. Aside from the RF Antenna, only one connection to the pole is required for a new RF monitoring station.

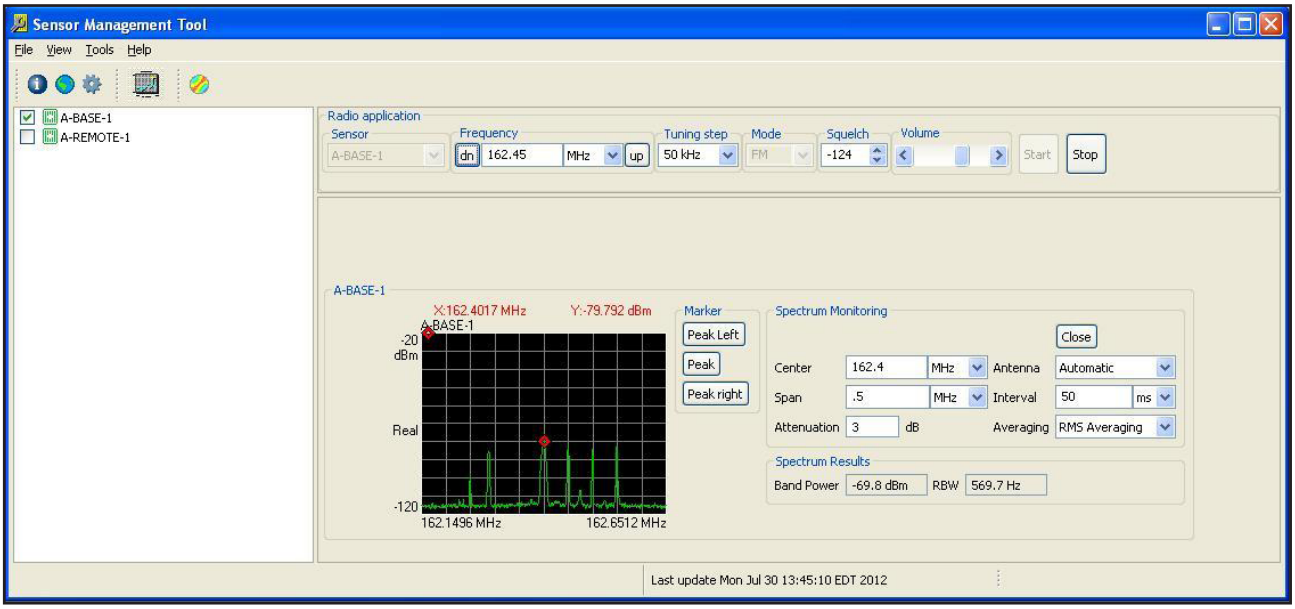
Multiple Sensors

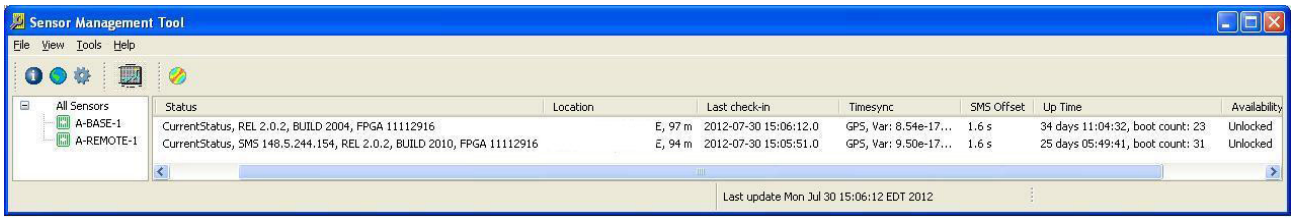
One of the benefits of deploying multiple sensors is improved RF detection range and the ability to make time synchronous I/Q and spectral measurements. This capability opens the door to emitter location and direction finding applications, propagation studies and other applications. N6841A RF Sensors can be synchronized using two different methods: GPS (for outside deployments) and IEEE-1588 (for indoor deployments or wherever GPS may not be available).

Sensor Software Applications

Sensor Management Tool (SMT)

The N6841A RF Sensor ships with the latest release of SMT. This application provides the user with a quick and easy way of setting up the RF Sensor remotely on their network, connecting, configuring and managing the sensor network. SMT also provides health and status monitoring of each sensor as well as a simple Spectrum Viewer and Radio application. This software is also available for download at **www.keysight.com/find/RFSensor**

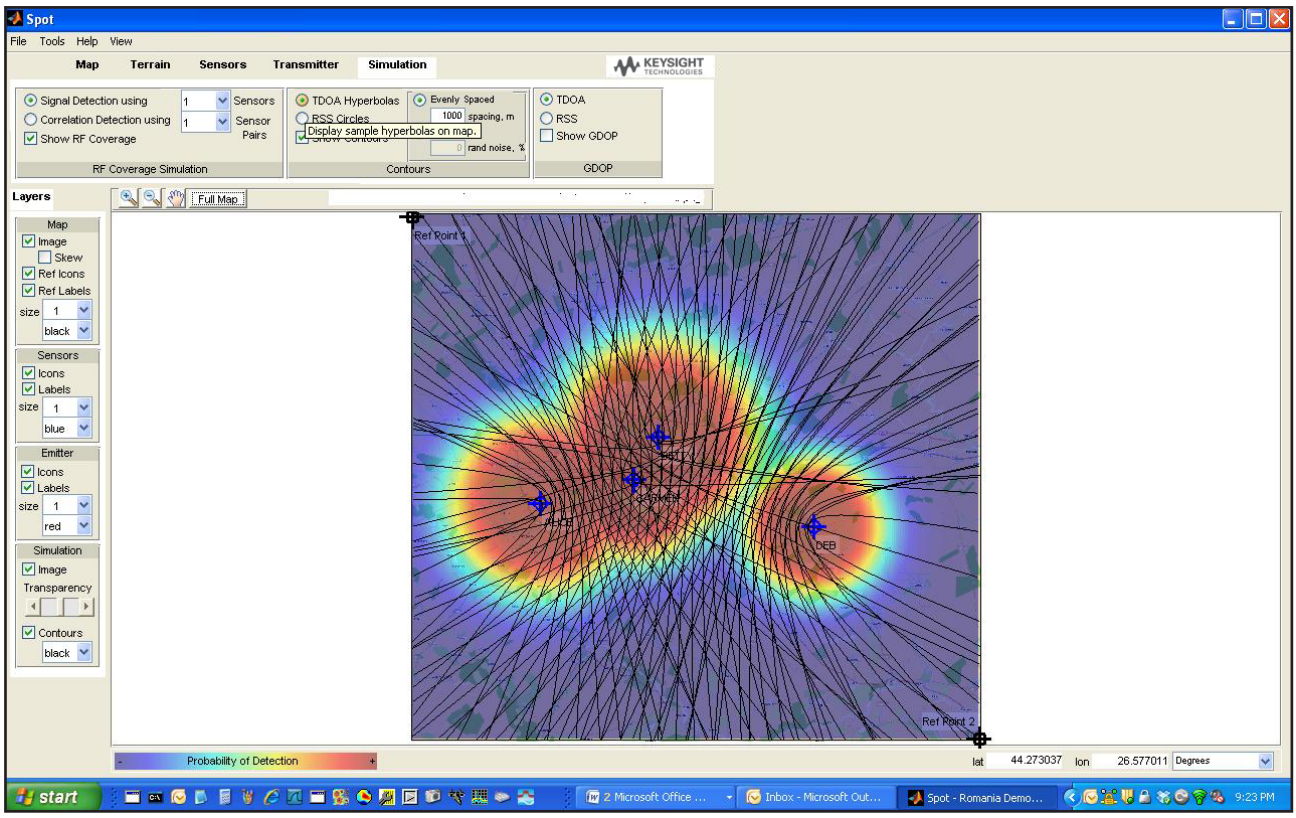




Sensor Software Applications

Sensor Placement and Optimization Tool (SPOT)

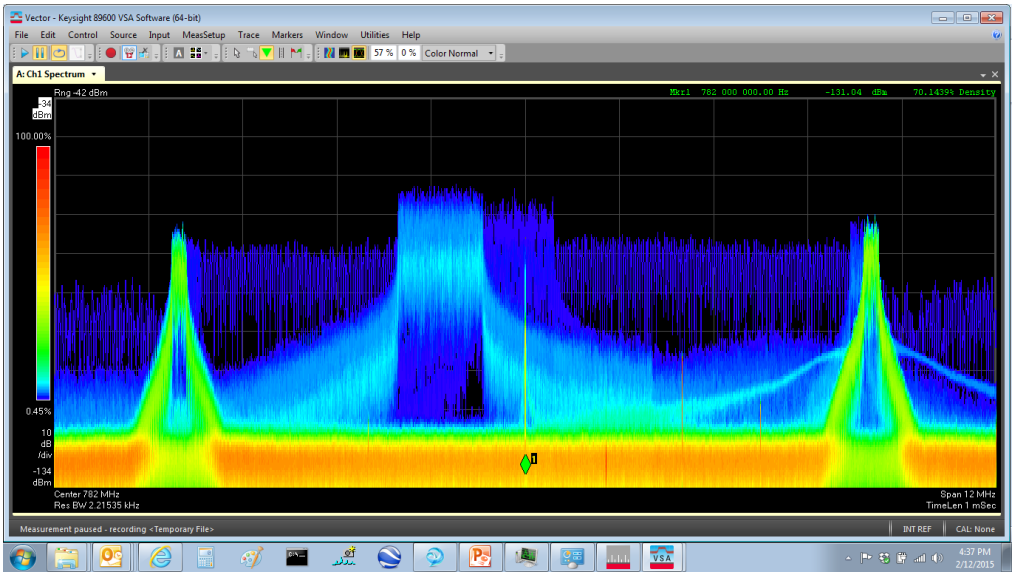
SPOT is supplied with SMT and is an invaluable tool for planning sensor deployments. SPOT allows a map image to be imported and calibrated. It then simulates the RF coverage that can be expected from the exact locations selected for the RF Sensor network. SPOT can determine how well the sensor network will perform against a radio transmitter operating at a specific center frequency, bandwidth and power output. Each sensor location is defined not only by its latitude and longitude, but also by elevation, antenna pattern, pre-amplifier effects as well as other parameters. SPOT also provides insight into the effectiveness of the sensor geometry in performing geolocation measurements. GDOP and lines of constant time or power difference can be displayed to aid in system design.

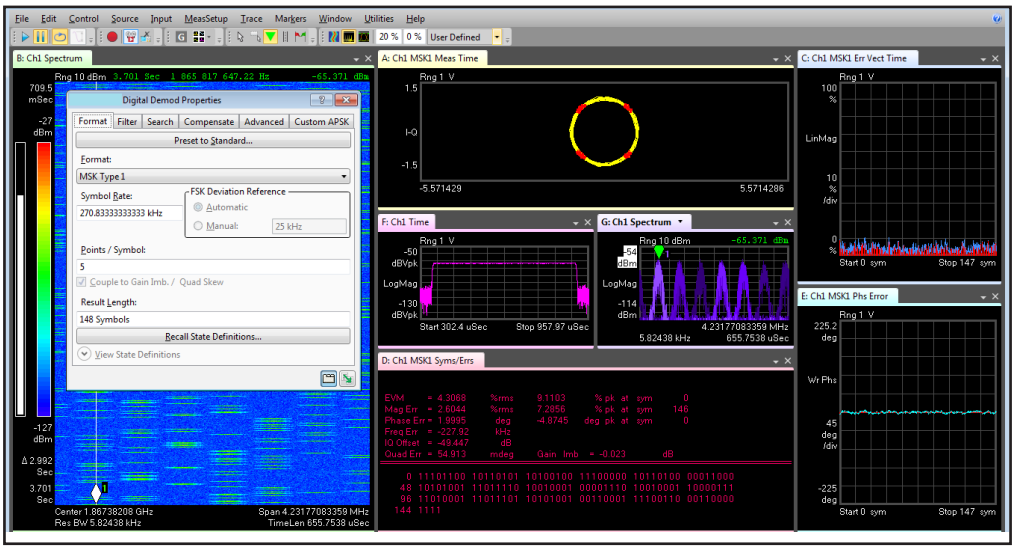


Sensor Software Applications

Vector Signal Analysis (VSA)

Keysight's VSA software is an industry standard used throughout the wireless communications and aerospace/defense industries for collection and processing of all forms of RF signals. It has an extensive library of wireless communications demodulators and decoders. The VSA software will turn the N6841A RF Sensor into a world class signal collection and analysis tool that can be operated literally from across the world. Additionally, VSA software is referenced in Recommendation ITU-R SM.1600, "*Technical Identification of Digital Signals*" as a valuable tool for collection of IQ data and flexible modulation analysis.

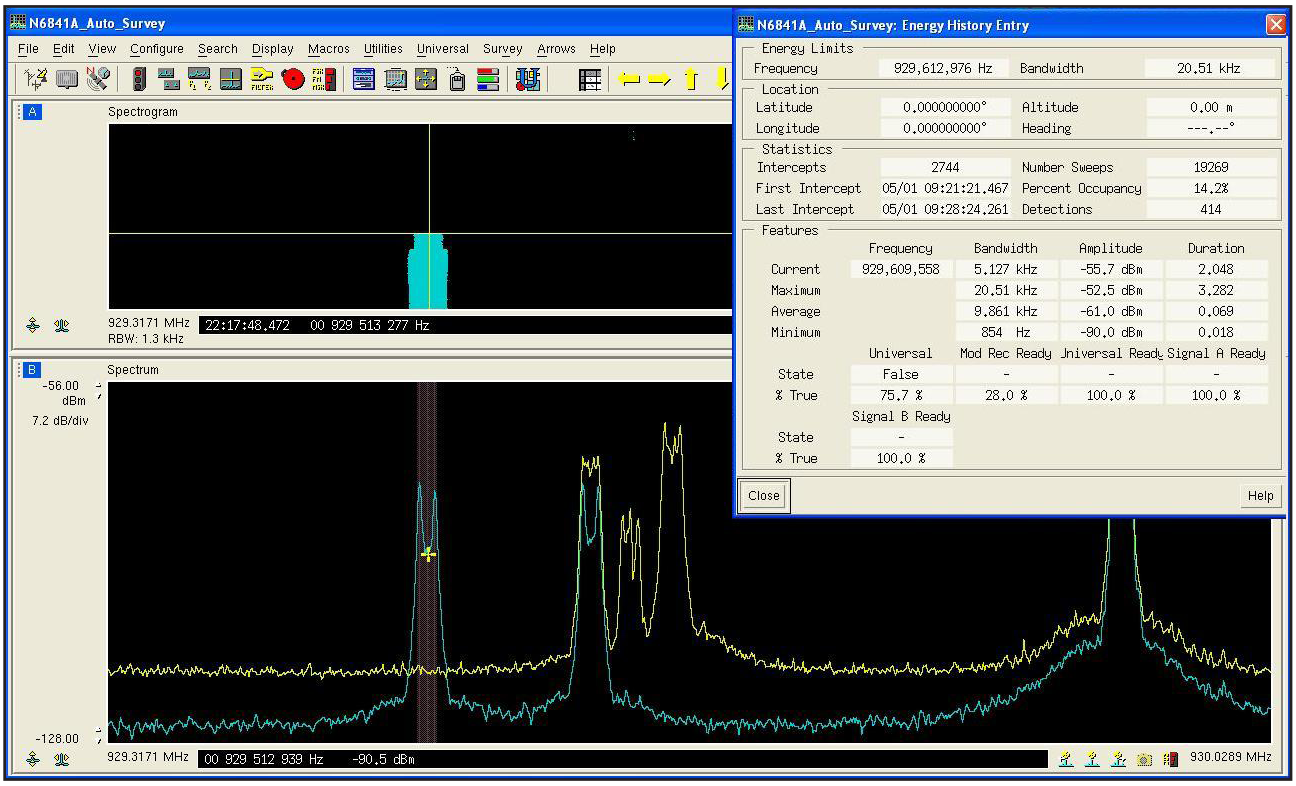


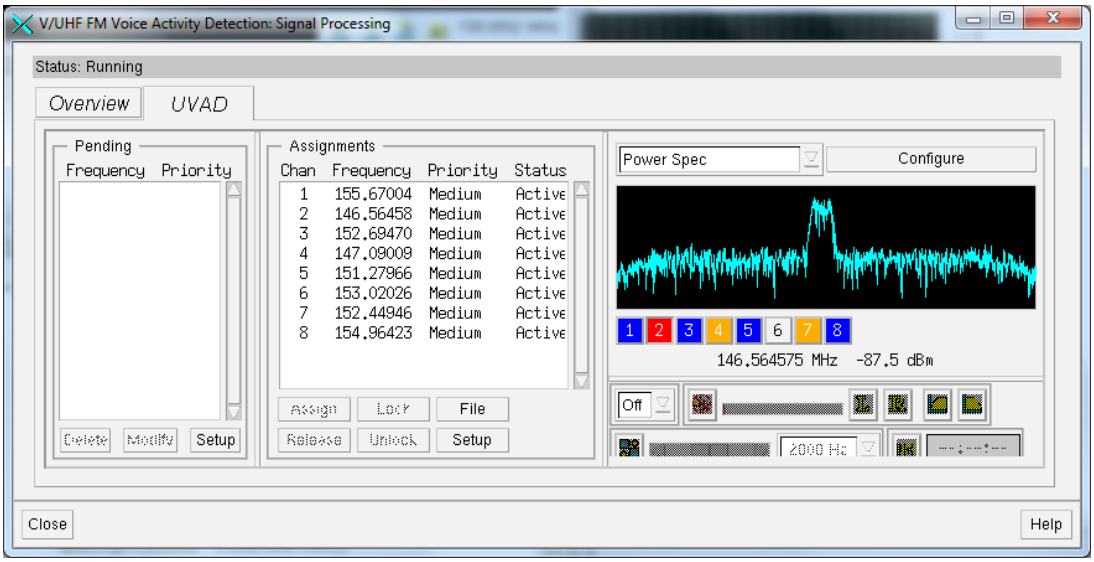


Sensor Software Applications

Signal Surveyor 4D

This application provides high speed spectral search, advanced energy detection and signal isolation algorithms. Depending on the option set, signal classification and automated modulation recognition routines are also available. Automation of search, collection, classification and location tasks are possible with this powerful application. For a more detailed description of Signal Surveyor, visit www.keysight.com/find/N6820ES





With Release 4.1.0 of Signal Surveyor 4D, users will have more direct control over the Digital Down Converters and the option to purchase multiple DDC's (using option N6841A-MFP). This option will provide up to eight DDC's with bandwidths up to 200 kHz.

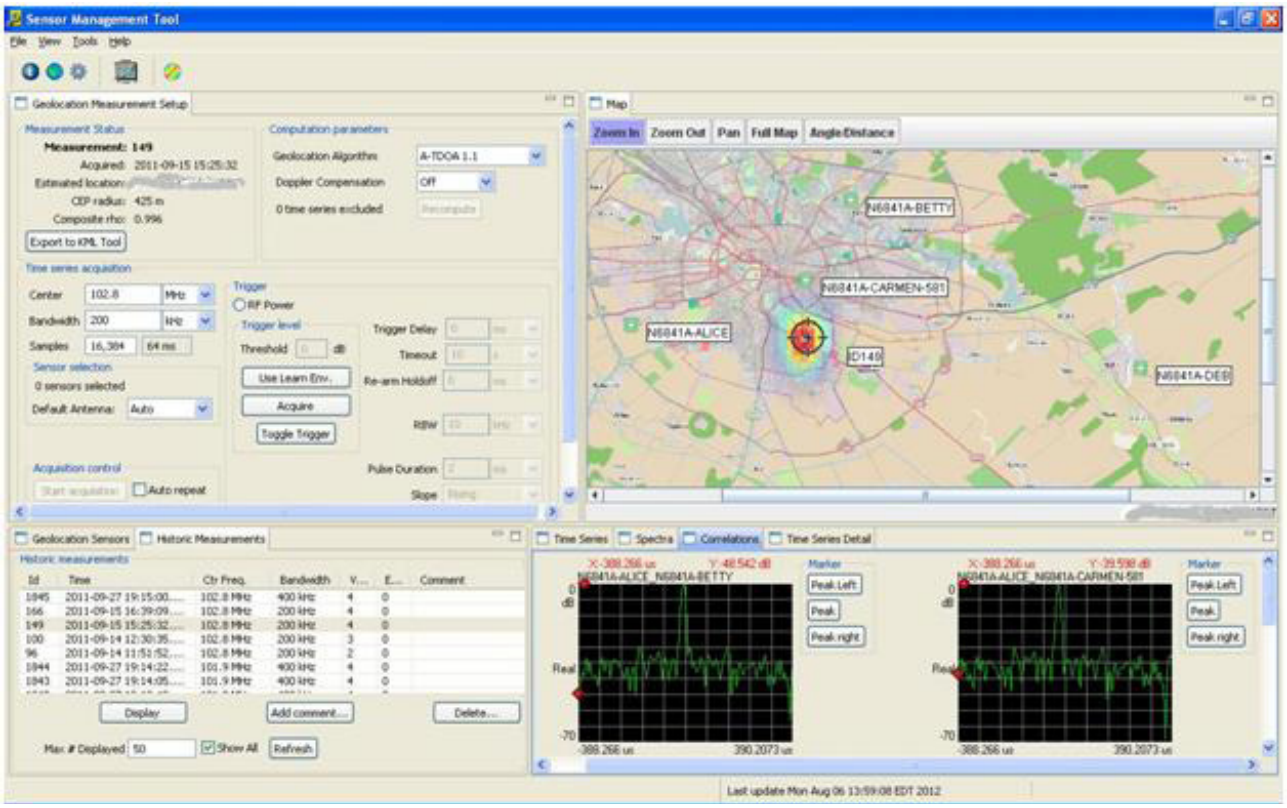
Sensor Software Applications

Keysight GEO Server Software (GEO)

GEO is a licensed application that embeds within SMT and enables the user to easily make geo-location measurements on signals of interest using either time or power based triggering. This application offers three different geolocation algorithms:

- Time Difference of Arrival (TDOA)
- Received Signal Strength (RSS)
- Hybrid (an adaptive algorithm that uses both time and power information)

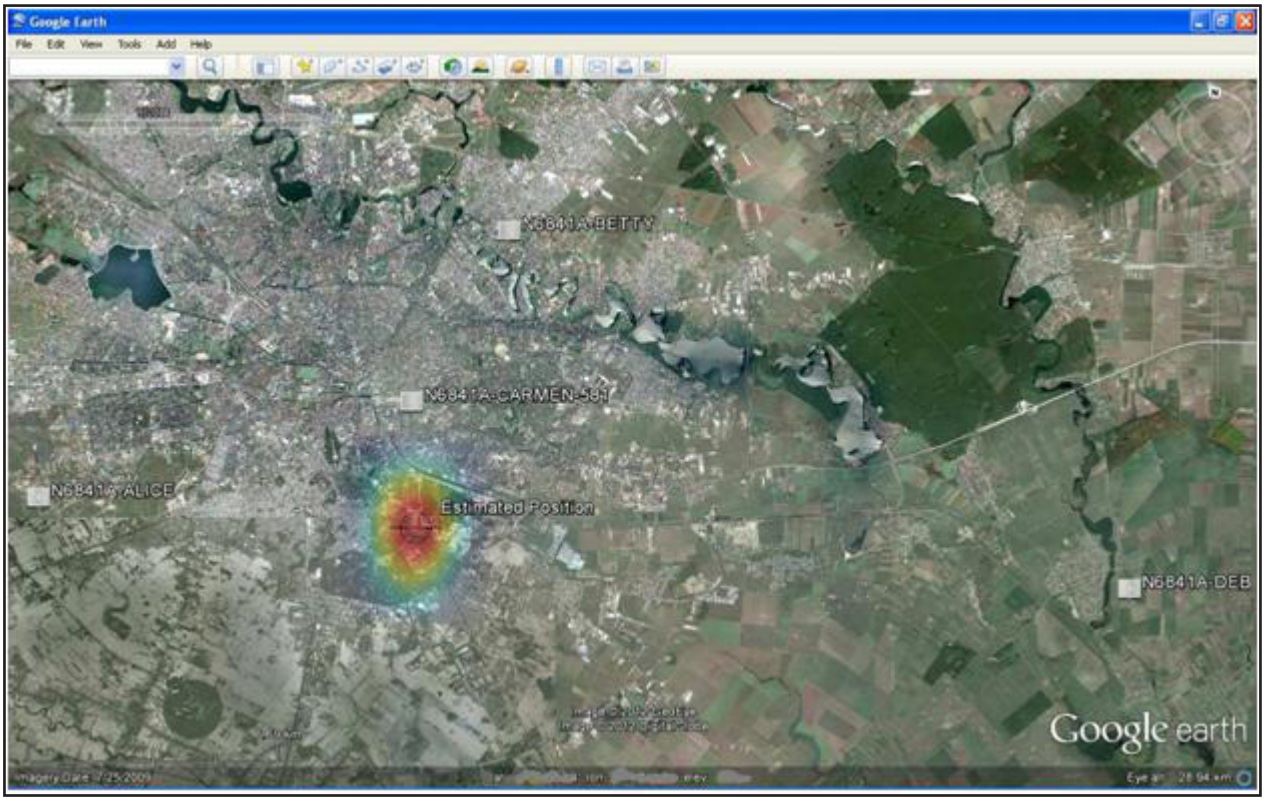
GEO makes measurements either manually or automatically when integrated with Signal Surveyor. The results (including the I/Q data) are stored in a signals database to allow the user to revisit the geolocation measurements, try different algorithms and include or exclude data from any of the sensors used in the original measurement.



Sensor Software Applications

N6854A to KML Software

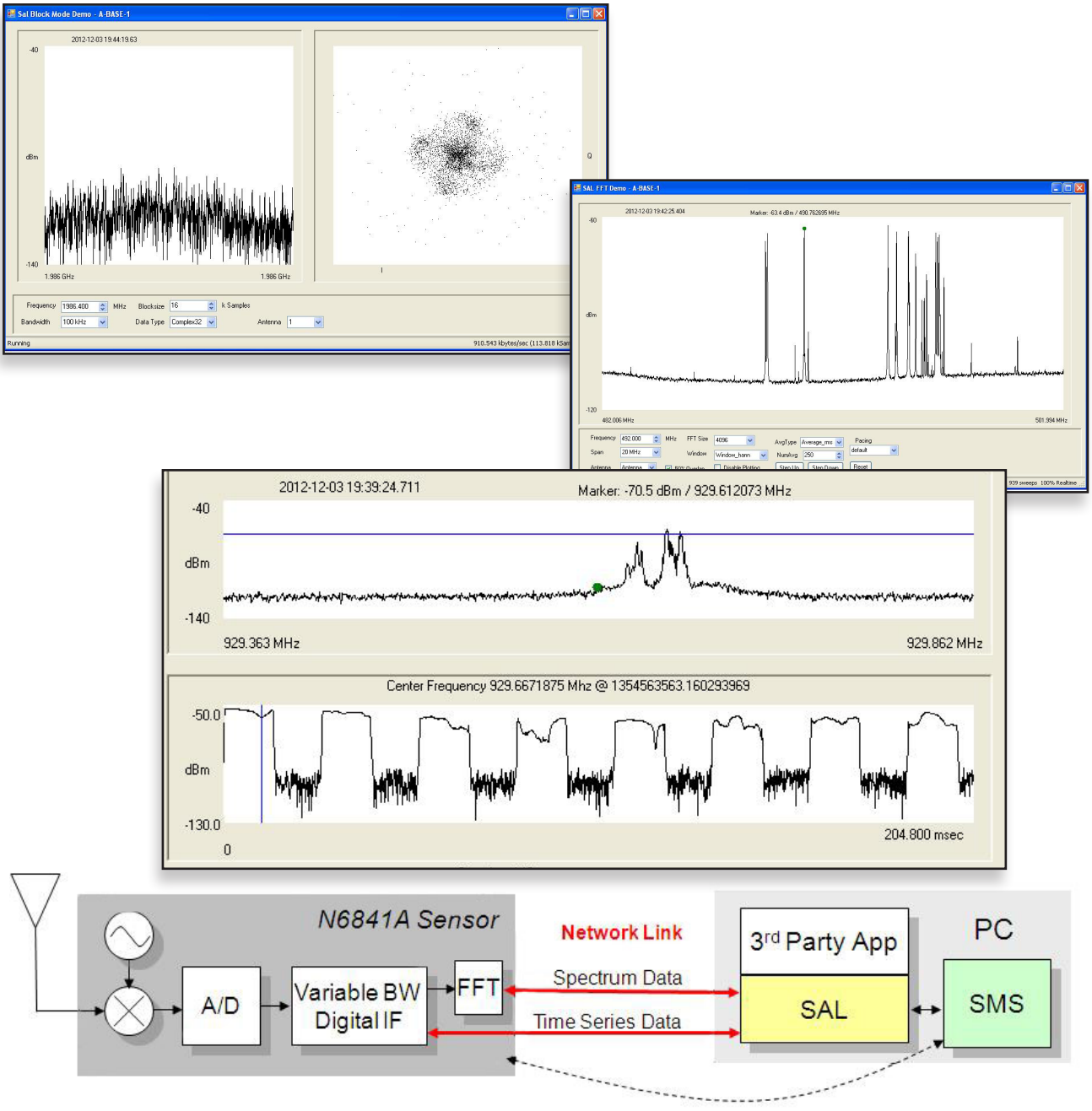
Included with GEO is a KML export tool which can refine the location results further and display them in commonly used geographic information systems. This powerful Geo-Analytics software package is an essential part of any modern spectrum monitoring system.



Sensor Software Applications

User-defined enterprise software applications

Some customers have developed monitoring or location algorithms that serve very specific needs, but need rugged and reliable receiver hardware that will support fixed, mobile and temporary installations. The Keysight Sensor Access Library (SAL) provides a comprehensive API that allows programmers to interface the N6841A into an existing enterprise system. SAL offers over 50 callable routines that provide access to FFT, I/Q and audio data in single or multiple (synchronized) measurements. Full command and control of the RF Sensor is possible from any third party Windows application.



Configuration and Ordering Information

Part number	Description
RF Sensor Hardware	
N6841A	RF Sensor Includes SMT, SPOT, KML software, connector and mounting kit
N6841A-GPS	Adds GPS capability, includes cable and active antenna
N6841A-SP1	Adds 120/240 VAC power adapter (indoor mount only)
N6841A-GFP	Geolocation enabler
N6841A-MFP	Multiple DDC enabler (requires SMT version 2.0.5 or later)
Signal Surveyor	
N6820ES	Signal Surveyor Software for the RF Sensor
N6820ES-114	Basic Search, intercept and collection software
N6820ES-USD	Universal Signal Detector
N6820ES-MR1	Host-Based Modulation Recognition
N6820ES-ASD	User Programming
N6820ES-UTP	UHF/VHF FM Voice Activity Detector (ITAR controlled software option) requires Surveyor 4D version 4.1.0 or later.
N6820ES-1RU	1 year of software updates and factory support
N6820ES-2RU	2 years of software updates and factory support
N6820ES-B02	Software bundle includes all options plus 1RU (except for N6820ES-UTP)
Geolocation Server	
N6854A	Provides a license for the Geolocation Server Software
Vector Signal Analyzer	
89601B	Keysight Vector Signal Analyzer
89601B-200	Basic software
89601B-AYA	Flexible Demodulation capability
Broadband Omni-directional Antenna	
N6850A	Compact 20 MHz to 6 GHz antenna for use with the RF Sensor

Contact your local Keysight Field Engineer to assure your VSA configuration is complete for your application.

Keysight Broadband Omni-Directional Antenna with 1.5 m Type-N RF cable for the RF Sensor

Technical Specifications and Operating Characteristics

All performance data is 80%/80% typical at room temperature unless otherwise indicated.

Frequency		
Frequency range	20 MHz to 6 GHz	
Frequency reference accuracy	± 20 ppb (with GPS or IEEE1588/GPS Grandmaster)	
Frequency tuning resolution	0.01 Hz	
Frequency Span	Adjustable from 5 Hz to maximum frequency range	
Max IF bandwidth	20 MHz (Digital only)	
Tuner settling time	< 5 ms	
Sweep Speed	> 4 GHz/sec with 10 kHz RBW	
Phase noise @ 1 GHz	10 kHz offset: 100 kHz offset:	–82 dBc/Hz –98 dBc/Hz
Pre-selection filters	7 bands: 20-1800 (preamp off), 750-1800 (preamp on), 1800-2700, 2700-3250, 3250-4150, 4150-5050, 5050-6000 MHz	
Resolution Bandwidth (RBW)	Selectivity	Adjustable Shape factor: 2.6, 4.0 and 9.0 to 1 (with N6820ES Surveyor 4D software)
	Range	Using N6820ES software and shape factor 9.0: 5 Hz, 10 Hz, 40 Hz, 90 Hz, 170 Hz, 330 Hz, 650 Hz, 1.29 kHz, 2.57 kHz, 5.13 kHz, 10.26 kHz, 20.51 kHz, 41.01 kHz, 82.04 kHz, 164.07 kHz, 328.13 kHz, 656.25 kHz Using SAL API: 5 Hz to 1.67 MHz

Zero Span/Time Domain				
N6841A offers Digital IF. I/Q recordings can be made with bandwidths and durations as indicated below.				
I/Q recording				
Signal Bandwidth	21.9 MHz	10.9 MHz	5.5 MHz	2.7 MHz
I-Q Recording Time (seconds)	4.8	9.6	19.2	38.4
	For bandwidths below 2 MHz, streaming to disk is an effective way to record I/Q data provided the connection from the sensor to the computer is full 100 Base T. This is achieved with Surveyor 4D NarrowBand Recorder (in version 4.1.0 or later) or via SAL programming.			
Time Domain Display modes	Amplitude, Phase, Frequency, I and Q versus Time, Constellation diagrams and Vector Demodulation modes (using 89601B Vector Signal Analysis software)			

Technical Specifications and Operating Characteristics

Trigger		
Trigger Type	Free Run; Frequency/Amplitude/Bandwidth/Duration Selective Trigger functions; Auto, File and Environmental Mask Trigger; Time paced (x sweep per second); Counter (x sweeps then stop)	
Universal Signal Detection	Spectral Shape (Correlation) trigger; Limit lines; "Peaks" trigger for FSK formats (assumes Signal Surveyor 4D with option USD)	
Trigger Slope	Positive or Negative	
Display		
Display Range	User adjustable Reference Level and Scale to .01 dB per division Ten Division grid available, also grids for Energy History, Frequency List, Alarm Regions and Handoffs (Signal Surveyor 4D)	
Trace Update Rates	Span 20 MHz, RBW 10 kHz, 32 averages: Span 6 GHz, RBW 10 kHz, 4 averages:	> 320 updates/second (nominal) > 1 update/second (nominal)
Number of traces	4 (with Signal Surveyor) 20 (with VSA - limited only by PC performance)	
Number of Averages	1 to 1,024 (with Surveyor) Up to 16,384 (with SAL API)	
Amplitude		
Max input power	+20 dBm	
Input attenuator range	40 dB range (via SMT and SAL programming), in 1 dB steps 62 dB range of settings in 1 dB steps (via Signal Surveyor 4D)	
Input range (VSA)	+20 dBm to –42 dBm	
Antenna port isolation	> 30 dB below 600 MHz > 24 dB above 600 MHz	
RF Input VSWR	< 2.5:1	
ADC	14 bit @ 56 MS/sec	
Amplitude accuracy (Power measurement, Center of IF)	User atten ≤ 20 dB: User atten > 20 dB, 20 MHz to 5.9 GHz: User atten > 20 dB, 5.9 to 6 GHz:	± 2.0 dB ± 3.0 dB ± 4.0 dB

Noise figure, sensitivity and displayed Average Noise Level DANL
(with amplitude corrections, user attenuation set to -16 dB, center of IF)

Frequency	Noise Figure	Sensitivity (25 KHz RBW)	DANL (10 Hz RBW)
750 - 1240 MHz (preamp* on)	< 13.2 dB	< –116.8 dBm	< –150.8 dBm
1250 - 1700 MHz (preamp* on)	< 14.3 dB	< –115.7 dBm	< –149.7 dBm
1700 - 1800 MHz (preamp* on)	< 16.6 dB	< –115.4 dBm	< –149.4 dBm
20 - 60 MHz	< 22.0 dB	< –108.0 dBm	< –142.0 dBm
60 - 800 MHz	< 18.0 dB	< –112.0 dBm	< –146.0 dBm
800 - 1850 MHz	< 22.0 dB	< –108.0 dBm	< –142.0 dBm
1850 - 2550 MHz	< 19.5 dB	< –110.5 dBm	< –144.5 dBm
2550 - 2850 MHz	< 22.0 dB	< –108.0 dBm	< –142.0 dBm
2850 - 3650 MHz	< 20.0 dB	< –110.0 dBm	< –144.0 dBm
3650 - 4650 MHz	< 23.5 dB	< –106.5 dBm	< –140.5 dBm
4650 - 6000 MHz	< 26.0 dB	< –104.0 dBm	< –138.0 dBm

* Pre-amp in table refers to a banded pre-amp which, when engaged, operates in the frequency range of 750 – 1800 MHz

Cable loss between antenna and receiver (minimal due to collocation of antenna and IP67 receiver):
1 to 2 dB

Technical Specifications and Operating Characteristics

Amplitude (continue)

Second Order Intercept SOI
(mixer level = –10 dBm)

Frequency	SOI (IP2), dBm
20 - 850 MHz	> 26
850 - 1450 MHz	> 58
1450 - 2400 MHz	> 39
2400 - 2800 MHz	> 29

Third Order Intercept TOI
(IP3, 0 dB user attenuation, 200 kHz tone spacing, both in IF, mixer level = –10 dBm)

Frequency	TOI (IP3), dBm
20 - 850 MHz	> 7.7
850 - 2700 MHz	> 8.5
2700 - 2900 MHz	> 5.0
2900 - 5900 MHz	> 6.6
5900 - 6000 MHz	> 5.9

IF/Image/Spurious Rejection

Frequency	IF/Image/Spurious Rejection
20 - 200 MHz	> 48.0
200 - 650 MHz	> 52.5
650 - 2650 MHz	> 53.0
2650 - 2750 MHz	> 48.0
2750 - 3850 MHz	> 53.5
3850 - 3880 MHz	> 48.5
3880 - 6000 MHz	> 51.0

Time and Location

Clock synchronization methods	GPS or Precision time protocol (IEEE-1588, 2008 compatible)	
PTP clock modes	Grandmaster/Master/Slave	
Time reference accuracy to UTC	With GPS < 20 nanoseconds With PTP < 40 nanoseconds	
Data timestamp resolution	18 nanoseconds	
GPS	Receiver	Trimble Resolution-SMTx (built into RF Sensor unit)
	Operating modes	Fixed or mobile (Land)
	GPS horizontal accuracy	< 9 meters (90%)
	GPS altitude accuracy	< 18 meters (90%)
	GPS antenna	Remote active (3.3V) antenna with 3 meter cable

Technical Specifications and Operating Characteristics

Signal processing		
Usable information bandwidth	20 MHz	
Data types	I/Q time series FFT spectrum	16 or 32 bit resolution Up to 16k points, 50% overlapped
Data transfer modes	I/Q and FFT (simultaneous) Streaming or Block mode	
Data streaming rates (Gapless) on 100BT network	I/Q time series FFT spectrum	Up to 2 MHz signal bandwidth Full 20 MHz FFT spectrum
Signal LOOKBack capture memory	512 MBytes (This provides 4.8 seconds of 20 MHz wide IQ time series capture or lookback)	
LOOKBack refers to the ability to stream wideband I/Q data into the First In First Out (FIFO) memory located in the RF Sensor. When short duration bursts occur, LOOKBack enables the user to detect and locate these short bursts.		
Tune and listen (in signal surveyor)	Audio demodulation types	AM, FM
	Audio output	Streams gap-free Stereo, Left and/or Right channel
	Receiver bandwidth	Adjustable from 6 kHz to 200 KHz
	Squelch range	–135 to –20 dBm
	Audio recording length	Streams to disk, limited by file or drive size.
	Audio filtering	High and Low Pass Filters available for voice enhancement

Digital Downconverters (DDC's)

The standard N6841A has one DDC with a dynamic bandwidth ranging up to 20MHz. This DDC is used by the Surveyor 4D application for audio streaming, IQ recording, modulation recognition or geolocation functions.

When the N6841A-MFP option is purchased, it enables a new FPGA image that has up to 8 DDC's each with bandwidth up to 200kHz. The DDC bandwidth can be adjusted globally but is fixed across all eight channels and can be used for narrowband signal processing by the Surveyor 4D application or via the SAL programming interface.

Sensor management and software		
Sensor host PC	Operating System CPU RAM Hard Drive	Win7 (32/64 bit), Win8 > 2 GHz, minimum 2 processors > 4 GB > 300 GB
RF Sensor health & status monitor	Hardware watchdog checks in once per minute	
RF Sensor diagnostics	Remote controlled self-test	
RF Sensor data security	RAM memory cleared at power-off or reboot	
Included applications	Sensor Management AM/FM audio streaming* Spectrum Viewer Emitter Geolocation (with N6854A software)	
	*AM/FM Audio streaming provided with the RF Sensor software offers AM, FM and FM-W demodulation and requires only 0.2% of a 100Mbps link to stream FM-W audio back from the RF Sensor. Spectrum Viewer requires about .5% of a 100Mbps link to bring a gap free 20 MHz spectrum into view.	
Networking interface	10/100 Ethernet TCP	
Networking IP address type	Auto / DHCP / Static	
Network configuration options	Sensor Alias IP address Host Name Subnet Mask Gateway IP DNS1, DNS2	

Technical Specifications and Operating Characteristics

Programmatic interface		
Sensor Access Library (SAL)	C language API supported in both Windows and Linux OS	
Functions available	Over 50 callable routines/functions for sensor control and remote data access	
Data retrieval	I/Q time series or FFT spectrum data	
Embedded Applications	Allows user defined programs to run autonomously on the RF sensor's embedded Linux processor (requires SMT Version 2.0.5 or later)	
General		
Power requirements	15 - 24 VDC nominal (optional 120/240 VAC indoor adapter)	
Power consumption	30 Watts maximum; 25 Watts typical	
Enclosure	Sealed Aluminum case	
Dimensions	Length Width Height	29.2 cm (11.5 in) 24.6 cm (9.7 in) 5.4 cm (2.1 in)
Weight	3.5 kg (7.7 lb)	
Connectors	RF input ports (2) Power LAN GPS	Type-N (50 ohm) electronically switched Switchcraft SF6382-2SG-520 standard circular connector Ethernet RJ45, ruggedized and weatherproof Type-TNC (female)
Enclosure rating	IP67 (for ingress of dust and water)	
Operating temperature range	–15 °C to +55 °C (–31 °F to 131 °F) not in direct sunlight; unit is operational to –35 °C but requires additional heating/insulation below –15 °C. All temperature specs assumed at sea level.	
Humidity	15 – 95%	
Altitude	6400 m (21,000 feet) maximum	
EMI compliance	IEC 61326-1:2005, EN 61326-1:2006: Immunity table 2: Industrial locations, CISPR 11:2003: Emissions group 1 Class B: Domestic locations	
Safety compliance	IEC 61010-1:2001, EN 61010-1:2001	
ITU-R Compliance	ITU-R SM.377 between 20-6000MHz (frequency and frequency offset measurements) ITU-R SM.378 (field strength measurements) ITU-R SM.328 (bandwidth measurements)	
Pole-top mount	7.6 cm (3 inches) maximum diameter pole or rail mount	
Rack-mount	19 inch rack 2U height	
Accessories supplied	Mounting Bracket with assembly hardware to attach and secure the RF Sensor Ruggedized Ethernet RJ45 connector to attach to RF Sensor Switchcraft connector for power cable to source RF Sensor Installation Guide	

www.axiestandard.org

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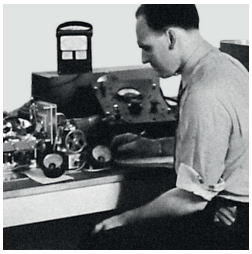

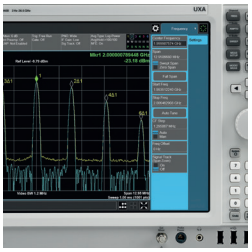

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Published in USA, September 24, 2015
5990-3839EN
www.keysight.com