

N6841A RF Sensor

Spectrum monitoring and emitter location networks

Introduction

The N6841A RF sensor offers a distributed and autonomous concept in spectrum monitoring. Communication signals have evolved dramatically and continue to do so as new and emerging wireless standards are defined and deployed. The new generation signals are wider bandwidth, more complex, time-variant, and low power.

Traditional methods of monitoring communication signals from outside the city limits, in a crowded vehicle, or walking with a handheld analyzer don't work well on these new standards or today's interference problems.

The 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.





Key features

- Environmentally rugged IP67-rated weatherproof enclosure. Sealed unit with no moving internal parts
- Small footprint for easy setup and teardown – ideal for fixed or temporary installations
- Wideband RF receiver with 20 MHz to 6 GHz frequency tuning range
- Digital IF bandwidth up to 20 MHz
- Signal LOOKback and capture 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 MSa/sec for recording and off board signal processing
- Integrated GPS for sensor location and time synchronous applications
- High precision measurement synchronization and timestamping
- 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

RF sensor use models

- 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 or facility spectrum policy

RF sensor users

- Frequency regulatory agencies
- Mobile service providers
- Government range managers
- Spectrum/frequency managers
- RF test managers
- Military and Intelligence operations
- Anyone monitoring or working with “off the air” RF signals

Deployment

The N6841A RF sensor has a weatherproof and dustproof IP67-rated (Standard IEC 60529 International Protection 67) enclosure with a wide operating temperature range to withstand harsh environments. The conductively cooled unit is silent and contains no moving parts and operates over a temperature range of –15 °C to 55 °C. You can extend the operating temperature range by using a commercially available enclosure that includes heat and ventilation for extreme temperature conditions.

The N6841A RF sensor 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, rackmount, vehicle-mount, or man-pack deployments. Relative to other solutions, the N6841A RF sensor requires minimal installation effort and is likely to gain easy mounting approval from building managers. It is also very well suited to temporary installations.

On-board diagnostics include a complete self-test of the internal RF signal path and a watchdog reset timer which 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 installation information is provided in the [N6841A Installation Guide](#) (Publication Number N6841-90002).

RF sensor antennas

You can use the N6841A RF sensor with any passive or active antenna element. For maximum flexibility of the solution, the RF sensor does not require a specific antenna. However, the Keysight [N6850A](#) antenna provides excellent broadband omnidirectional characteristics and good coverage, without excessive expense or additional power.

RF sensor power considerations

Power the [N6841A RF sensor](#) with 15 to 24 volts DC and expect to draw less than 30W. The N6841A-SP1 provides a 120/240 VAC power supply suitable for indoor (protected) installations. Off-the-shelf batteries are available from several 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

Often, a wired Internet connection is not possible for the ideal RF sensor locations. In these cases, either a cellular 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 several km. If you need greater distances, a cellular modem provides the freedom to site the sensor anywhere in the cellular coverage area. If wired Ethernet is available for your installation, a shielded cable is highly recommended.

Physical mounting

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

Multiple sensors

A benefit 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, direction-finding, propagation studies, and other time-correlated applications. You can synchronize N6841A RF sensors using two different methods: GPS (for outside deployments) and IEEE-1588 (for indoor deployments or wherever GPS is unavailable or unreliable).

Included Software

Sensor Management Tool (SMT)

The N6841A RF sensor ships with the latest SMT release. The SMT application provides the user with a quick and easy way of remotely setting up the RF sensor by connecting, configuring, and managing the sensors on their network. Additionally, SMT provides health and status monitoring for each sensor and a simple Spectrum Viewer and Radio application. SMT software is also available for download at

www.keysight.com/find/RFSensor

Sensor Placement and Optimization Tool (SPOT)

SPOT comes with SMT and is an invaluable tool for planning sensor deployments. SPOT enables the import and calibration of a map image. SPOT can also display a simulation of the expected RF coverage from the exact locations selected for the RF sensor network based on a selection of channel models. Additionally, 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, and other parameters. Additionally, SPOT provides insight into the effectiveness of the sensor geometry in performing geolocation measurements. Users can display the GDOP (geometric dilution of precision) and lines of constant time or power difference to aid in system design.

N6854A GEO server software

The N6854A is a licensed application that installs with SMT and enables the user to easily make geolocation 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)

N6854A to KML software

The N6854A software includes a KML export tool to refine the location results further and then 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 access library (SAL)

Occasionally, users develop monitoring or location programs to serve specific applications and 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 enables programmers to interface the N6841A RF sensor 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, LAN, power connectors, and mounting kit with hardware
N6841A-GPS	Adds GPS cable and active antenna
N6841A-SP1	Adds 120/240 VAC power adapter (indoor mount only)
N6841A-CFP	Enables N6841A to use a FieldFox analyzer as a downconverter to cover higher frequencies
N6841A-EFP	Enables N6841A to run embedded LINUX applications
N6841A-MFP	Enables N6841A to have multiple DDCs for time-domain narrowband processes

Specifications and Operating Characteristics

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

Frequency	Description
Frequency range	20 MHz to 6 GHz
Frequency reference accuracy	± 10 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 msec
Sweep speed	> 4 GHz/sec with 10 kHz RBW
Phase noise at 1 GHz	10 kHz offset: -82 dBc/Hz 100 kHz offset: -98 dBc/Hz
Pre-selection filters	7 bands: 20 MHz - 1800 MHz (preamp off), 750 MHz – 1800 MHz (preamp on), 1800 MHz – 2700 MHz, 2700 MHz – 3250 MHz, 3250 MHz – 4150 MHz, 4150 MHz – 5050 MHz, 5050 MHz – 6000 MHz
Resolution bandwidth (RBW)	Selectivity Adjustable shape factor: 2.6, 4.0, and 9.0 to 1
	Range 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 1.6 MHz (2 Msa/sec), streaming to disk is an effective way to record I/Q for long periods

Trigger

Trigger types	Manual, power level, absolute time
Trigger slope	Positive or Negative

Amplitude

Max input power	+20 dBm
Input attenuator range	40 dB in 1 dB steps
Input range	+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 at 56 MSa/sec			
Amplitude accuracy (Power measurement, Center of IF)	User atten ≤ 20 dB:		± 2.0 dB	
	User atten > 20 dB, 20 MHz to 5.9 GHz:		± 3.0 dB	
	User atten > 20 dB, 5.9 to 6 GHz:		± 4.0 dB	
Noise figure, sensitivity, and displayed Average Noise Level DANL (with amplitude corrections, user attenuation set to minimum, the center of IF)	Frequency	Noise figure	Sensitivity (25 KHz RBW)	DANL (10 Hz RBW)
	750 to 1240 MHz (preamp ¹ on)	< 13.2 dB	< -116.8 dBm	< -150.8 dBm
	1250 to 1700 MHz (preamp ¹ on)	< 14.3 dB	< -115.7 dBm	< -149.7 dBm
	1700 to 1800 MHz (preamp ¹ on)	< 16.6 dB	< -115.4 dBm	< -149.4 dBm
	20 to 60 MHz	< 22.0 dB	< -108.0 dBm	< -142.0 dBm
	60 to 800 MHz	< 18.0 dB	< -112.0 dBm	< -146.0 dBm
	800 to 1850 MHz	< 22.0 dB	< -108.0 dBm	< -142.0 dBm
	1850 to 2550 MHz	< 19.5 dB	< -110.5 dBm	< -144.5 dBm
	2550 to 2850 MHz	< 22.0 dB	< -108.0 dBm	< -142.0 dBm
	2850 to 3650 MHz	< 20.0 dB	< -110.0 dBm	< -144.0 dBm
	3650 to 4650 MHz	< 23.5 dB	< -106.5 dBm	< -140.5 dBm
	4650 to 6000 MHz	< 26.0 dB	< -104.0 dBm	< -138.0 dBm
	Cable loss between antenna and receiver (minimal due to collocation of antenna and IP67 receiver): 1 to 2 dB			
Second Order Intercept SOI (mixer level = -10 dBm)	Frequency	SOI (IP2), dBm		
	20 to 850 MHz	> 26		
	850 to 1450 MHz	> 58		
	1450 to 2400 MHz	> 39		
	2400 to 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 to 850 MHz	> 7.7		
	850 to 2700 MHz	> 8.5		
	2700 to 2900 MHz	> 5.0		
	2900 to 5900 MHz	> 6.6		
	5900 to 6000 MHz	> 5.9		
IF/Image/Spurious rejection	Frequency	IF/Image/Spurious rejection		
	20 to 200 MHz	> 48.0		
	200 to 650 MHz	> 52.5		
	650 to 2650 MHz	> 53.0		
	2650 to 2750 MHz	> 48.0		

	2750 to 3850 MHz	> 53.5
	3850 to 3880 MHz	> 48.5
	3880 to 6000 MHz	> 51.0
Time and location		
Clock synchronization methods	GPS or Precision time protocol (IEEE-1588v2 compatible)	
PTP clock modes	GM/M/S (Primary/secondary timing relationships)	
Time reference accuracy to UTC	With GPS < 20 nanoseconds	
	With PTP < 40 nanoseconds	
Data timestamp resolution	18 nanoseconds	
GPS	Receiver	Trimble RES SMT 360 (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 w/ 3-meter TNC cable
Signal processing		
Usable information bandwidth	20 MHz	
Data types	I/Q time series	16 or 32-bit resolution
	FFT spectrum	Up to 16k points, 50% overlapped, up to 16,384 fast trace averages
Data transfer modes	I/Q and FFT (simultaneous) Streaming or Block mode	
Data streaming rates (Gapless) on 100BT network	I/Q time series	Up to 2 MSa/sec (1.5625 MHz bandwidth)
	FFT spectrum	Full 20 MHz FFT spectrum
Signal LOOKBack capture memory	512 MBytes (provides 4.8 seconds of 20 MHz wide IQ time series for 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 are detected, LOOKBack enables the user to detect and locate these short bursts.	
Tune and listen	Audio demodulation types	AM, FM
	Audio output	Streams gap-free
	Receiver bandwidth	Adjustable from 6 kHz to 200 kHz
	Squelch range	-135 to 0 dBm
	Audio recording length	Streams to disk, limited by file or drive size

Digital Downconverters (DDCs)

The standard N6841A has one DDC with a dynamic bandwidth ranging up to 20 MHz. Use the DDC for audio streaming, IQ recording, IQ streaming, or geolocation measurements.

The optional N6841A-MFP enables a secondary FPGA image with up to eight DDCs, each with bandwidths up to 156 kHz. The DDC bandwidth is adjustable and fixed across all eight channels. Additionally, the Surveyor 4D application or the SAL programming interface can use the MFP option for narrowband signal processing.

Sensor management and software		
Sensor host PC	Operating system	Win 10
	CPU	> 2 GHz, minimum 2 processors
	RAM	> 4 GB
	Hard Drive	> 300 GB
RF Sensor health and status monitor	Hardware watchdog checks in once per minute	
RF Sensor diagnostics	Remote controlled self-test	
RF Sensor data security	RAM cleared at power-off or reboot	
Included applications	Sensor Management Tool (includes audio streaming, spectrum viewer, and emitter location)	
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	


Program 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	N6841A-EFP enables user-defined programs to run autonomously on the RF sensor's embedded Linux processor	
General		
Power requirements	15 to 24 VDC nominal (optional 120/240 VAC indoor adapter)	
Power consumption	30 Watts maximum; 25 Watts typical	
Enclosure	Sealed Aluminum case	
Dimensions	Length	29.2 cm (11.5 in)
	Width	24.6 cm (9.7 in)
	Height	5.4 cm (2.1 in)
Weight	3.5 kg (7.7 lb)	
Connectors	RF input ports (2)	Type-N (50 ohms) electronically switched
	Power	Switchcraft SF6382-2SG-520 standard circular connector
	LAN	Ethernet RJ45, ruggedized and weatherproof
	GPS	Type-TNC (female)
Enclosure rating	IP67 (for ingress of dust and water)	
Temperature Range	Operational: -15 °C to +55 °C (5 °F to 131 °F) Storage: -40 °C to +70 °C (-40 °F to 158 °F) Direct sunlight requires a heat shield. Extend the operating range below -15 °C by installing the sensor in a heated enclosure. All temperature specs are referenced at sea level.	
Humidity	.15 to 95%	
Altitude	6400 m (21,000 feet) maximum	
EMC/radio compliance	Complies with the essential requirements of the European Radio Equipment Directive (For more information see the N6841A Declaration of Conformity at: http://regulations.about.keysight.com/DoC) IEC 61326-1, EN 61326-1 Immunity table 2: Industrial locations, CISPR 11 Emissions group 1 Class B: Domestic locations (Requires a double shielded, Cat7 ethernet cable with the Keysight provided weatherproof boot).	
Safety compliance	IEC 61010-1:2010 / EN 61010-1:2010 (3rd Edition)	
ITU-R compliance	ITU-R SM.377 between 20 to 6000 MHz (frequency reference accuracy)	
	ITU-R SM.378 (field strength measurements)	
Pole-top mount	7.6 cm (3 inches) maximum diameter pole or rail mount	
Rack-mount	19-inch rack 2U height	
Accessories supplied	<ul style="list-style-type: none"> • Mounting bracket with assembly hardware to attach and secure the RF sensor • Ruggedized Ethernet RJ45 connector to attach to RF sensor • Switchcraft connector for the power cable to source RF sensor • Installation Guide 	

Confidently Covered by Keysight Services

Prevent delays caused by technical questions, or system downtime due to instrument maintenance and repairs with Keysight Services. Keysight Services are here to support your test needs with expert technical support, instrument repair and calibration, software support, training, alternative acquisition program options, and more.

A KeysightCare agreement provides dedicated, proactive support through a single point of contact for instruments, software, and solutions. KeysightCare covers an extensive group of instruments, application software, and solutions and ensures optimal uptime, faster response, faster access to experts, and faster resolution.

Keysight Services

Offering	Benefits
KeysightCare 	KeysightCare provides elevated support for Keysight instruments and software, with access to technical support experts that respond within a specified time and ensure committed repair and calibration turnaround times (TAT). KeysightCare offers multiple service agreement tiers, including KeysightCare Assured, Enhanced, and Application Software Support. See the KeysightCare data sheet for details.
KeysightCare Assured	KeysightCare Assured goes beyond basic warranty with repair services that include committed TAT and unlimited access to technical experts.
KeysightCare Enhanced	KeysightCare Enhanced includes all the benefits of KeysightCare Assured plus Keysight's accurate and reliable calibration services, accelerated, and committed TAT, and technical response.
Keysight Support Portal & Knowledge Center	All KeysightCare tiers include access to the Keysight Support Portal where you can manage support and service resources related to your assets such as service requests, and status, or browse the Knowledge Center.
Education Services	Build confidence and gain new skills to make accurate measurements, with flexible Education Services developed by Keysight experts. Including Start-up Assistance.
Alternative acquisition options	
KeysightAccess	Reduce budget challenges with a subscription service enabling you to get the instruments, software, and technical support you want for your test needs.

Recommended Services

Maximize your test system up-time by securing technical support, repair, and calibration services with committed response and turnaround times. 1-year KeysightCare Assured is included in every new instrument purchase. Obtain multi-year KeysightCare upfront to eliminate the need for lengthy and tedious paperwork and yearly requests for maintenance budget. Plus, you benefit from secured service for 2, 3, or 5 years.

Service	Function
KeysightCare Enhanced*	Includes tech support, warranty, and calibration
R-55B-001-1	KeysightCare Enhanced – Upgrade 1 year
R-55B-001-2	KeysightCare Enhanced – Extend to 2 years
R-55B-001-3	KeysightCare Enhanced – Extend to 3 years (Recommended)
R-55B-001-5	KeysightCare Enhanced – Extend to 5 years (Recommended)
KeysightCare Assured	Includes tech support and warranty
R-55A-001-2	KeysightCare Assured – Extend to 2 years
R-55A-001-3	KeysightCare Assured – Extend to 3 years
R-55A-001-5	KeysightCare Assured – Extend to 5 years
Start-Up Assistance	
PS-S40-01	Included – instrument fundamentals and operations starter
PS-S40-04	Recommended – instrument fundamentals and operations starter
PS-S40-02	Optional, technology & measurement science standard learning

* Available in select countries. For details, please view the [datasheet](#). R-55B-001-2/3/5 must be ordered with R-55B-001-1.

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