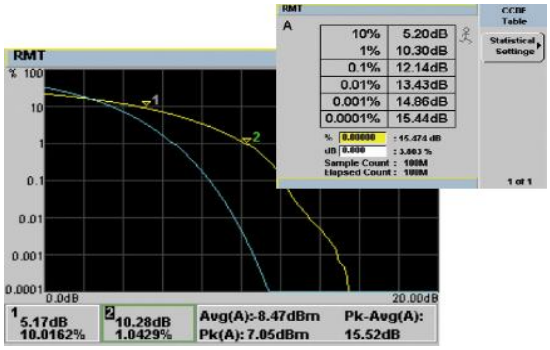
TECHNICAL
OVERVIEW

Power Meters and Power Sensors

Key Features

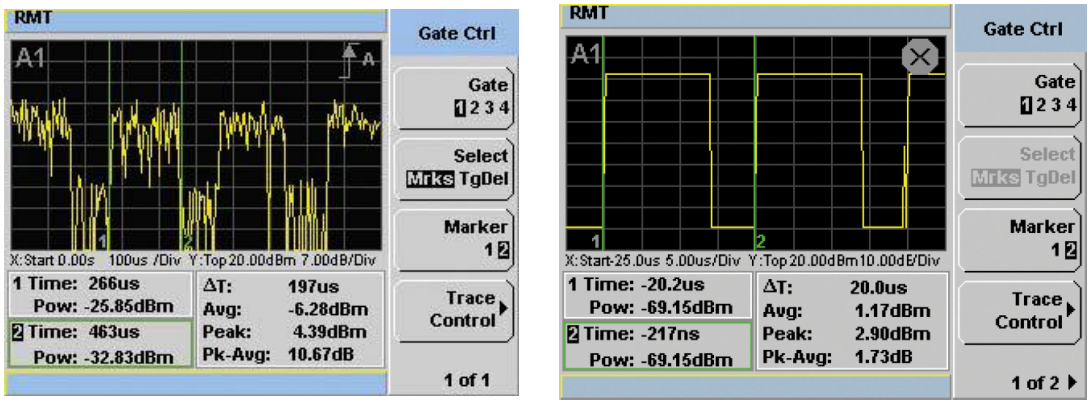
Designed for manufacturing

- Up to 100 MSa/s sampling rate and 1500 readings/s for high productivity with P-Series power meters
- Achieve super-fast measurement speed of 50,000 readings/s for higher manufacturing throughput with U/L2050/60 X-Series USB/LAN wide dynamic range power sensors
- Code-compatible with legacy power meter so you save time and effort in developing new codes
- Backward compatible with all legacy power sensors to protect sensor investment
- Wide selection of average and peak power sensors for various applications
- CCDF statistical measurement in graphical and tabular formats for wireless component manufacturing



Designed for R&D

- Calibration factors in EEPROM ensures accurate measurements
- Intuitive user interface enables quick setup time
- Graphical representation of delta measurements eases visualization and analysis
- Trace zoom helps in investigating glitches, overshoot, and rise/fall time
- Enable faster and easier testing with built-in wireless and radar presets for common signals such as DME, GSM, EDGE, WCDMA, WLAN and LTE



100 MSa/s continuous sampling ensures signal glitches are not missed Time-gated peak, average and peak-to-average ratio power measurements

Designed for installation and maintenance and remote measurements

- Light weight and palm size V3500A, U2050/60 X-Series, U2020 X-Series, U8480 Series and U2000 Series USB power sensors bring greater convenience in field tasks
- Lightweight U2049XA and L2050/60 X-Series LAN power sensors for remote operation via LAN network

When you need to take power measurements on the road or up a base station tower, smaller, lighter and fewer is better. With Keysight Technologies, Inc. USB/LAN power sensors, the only other thing you'll need is a laptop with BenchVue BV0007B Power Meter/Sensor Control and Analysis App.

Aerospace and defense applications

The U2020 X-series USB peak and average power sensors (13 ns rise/fall time), and the N1911/2A P-series power meters with the N1921/22A peak power sensors (13 ns rise/fall time) allow you to capture pulsed radar signals and evaluate several power and waveform parameters: peak, min, average, and peak-to-average ratio power, rise time, fall time, pulse width, pulse period, duty cycle, time to positive occurrence, and time to negative occurrence time.

The U2049XA Option TVA and L2066/67XT LAN Thermal Vacuum power sensors are meticulously designed by selecting components with minimum outgassing properties. The sensor is also subject to temperature cycling in a vacuum chamber to stabilize the materials and to remove outgassing particles.

Wireless applications

The U/L2050/60 X-Series USB/LAN power sensors have wide dynamic ranges (96/90 dB) and make very fast measurements (50,000 readings/second). Both these power sensors and the N1911/2A P-Series power meters with the N1921/22A power sensors allow you to easily set up and make the measurements with built-in wireless presets for common signals such as DME, GSM, EDGE, WCDMA, WLAN and LTE. You can also make CCDF statistical measurements in graphical and tabular formats.

Calibration lab applications

The N432A thermal power meter with the 478A and 8478B thermistor mount sensors provides metrology-class accuracy for instrument calibration.

The N8481S and N8487S Balance Thermocouple power sensors are intended to be used as measurement standards for RF power. They are suitable for use in a microcalorimeter-based primary measurement standard and as a secondary or reference measurement standard. The new balance thermocouple power sensors offer a broad frequency range DC up to 18/50 GHz, high maximum input power of +20dBm, fast measurement speed/settling time as well as ease of maintenance.

The N8480SBSA Balance Thermocouple Power Sensor Software Application performs a balancing algorithm and visualizes measurements for easier analysis with N848xS Balance Thermocouple Power Sensors along with the Source/Measure Units (SMU) and Digital Multimeters (DMM).

Various average power measurement solutions

- U8480 series USB thermocouple sensors have wide frequency ranges, in particular, the U8489A covers DC to 120 GHz. The power calibration of broadband RF/μW measurements such as network analyzers can be performed with a single connection of the U8480 series.
- The E/V/W8486 and N8486DD/DG waveguide power sensors with N1913/14B EPM power meter offer power measurements to microwave and millimeter waveguide banded applications.
- The U/L2050 X-Series USB/LAN power sensors have the widest dynamic range of 96 dB and achieve very fast measurements at 50000 readings/second and meet various power measurement needs in both R&D and manufacturing applications.
- The classic power meter and power sensor configuration with the N1913/14B EPM power meters with the E9300 E-series power sensors fit rack and stack style test systems.

Power Measurement Software for Simplified Data Capture

BenchVue software

The Keysight BenchVue software for the PC accelerates testing by providing intuitive, multi-instrument measurement visibility and data capture with no programming necessary. You can derive answers faster than ever by easily viewing, capturing, and exporting measurement data and screenshots.

The Power Meter/Sensor Control and Analysis App (BV0007B) for BenchVue enables control of power meters and power sensors to data log and visualize measurements in a wide array of display formats. It can control multiple meters/sensors from a single instance. Calibrations can be done fast with software buttons. Presets allow quick analysis of power levels of industry standard communications signals. Trial licenses can be started with one-click using the button to the left. Licenses may be purchased from Keysight or directly from your preferred Keysight Distributor. This app supports Keysight's USB/LAN power sensors and some power meters. Measurement Display options include:

- **Digital Meter View**: Displays precise and exact reading (up to 4 decimal points) measured by the instrument
- **Analog Meter View**: Displays measured reading in analog form for easier visualization of large measurement differences
- **Strip Chart**: Displays measured reading in a graphical form (Power/time)
- **CCDF View**: Displays the Complementary Cumulative distribution function
- **Trace View**: Displays traces of modulated signal
- **Multilist View**: Displays multiple power measurements

Highlights

- Visualize multiple measurements simultaneously
- Easily log data, screen images and system state
- Recall past state of your bench to replicate results
- Fast measurement data export in desired formats
- Quickly access manuals, drivers, FAQs and videos
- Monitor and control your bench from mobile devices

Key features and specifications

- Control and setup your Power meters and sensors
- Setup all necessary parameters for your critical measurements
- Control multiple power meters/sensors from one instance of the software
- Log and view measurement data in the format you need:
  - With 6 different display types seeing what you care about has never been easier or more flexible
- Export results in three clicks:
  - Export data quickly to popular tools such as MATLAB and Microsoft Excel or Word for documentation or further analysis.

Supported models

- U2021XA, U2022XA
- U2051XA, U2052XA, U2053XA, U2054XA, U2055XA, U2056XA, U2057XA, U2061XA, U2062XA, U2063XA, U2064XA, U2065XA, U2066XA, U2067XA, L2051XA, L2052XA, L2053XA, L2054XA, L2055XA, L2056XA, L2057XA, L2061XA, L2062XA, L2063XA, L2064XA, L2065XA, L2066XA, L2067XA, L2065XT, L2066XT, L2067XT
- U2000A, U2000B, U2000H, U2001A, U2001B, U2001H, U2002A, U2002H, U2004A
- U8481A, U8485A, U8487A, U8488A, U8489A
- N1911A, N1912A, N1913A, N1914A, N1913B, N1914B,
- N8262A

Peak power measurement		
N8262A **P-Series modular power meter**	**N1911A/12A** **P-Series power meters**	**E4416A/17A** **EPM-P Series power meters**
		
• 1U half-rack size • 100 MSa/s continuous sampling, single-shot 30 MHz VBW • Wireless presets include WLAN, radar and MCPA • Code-compatible with N1911/12A P-Series power meter	• 100 MSa/s continuous sampling, single-shot 30 MHz VBW • Includes time-gated and statistical (CCDF) power measurements • Wireless presets include WiMAX™, HSDPA and DME	• 20 MSa/s continuous sampling, 5 MHz VBW • Bundled analyzer software for pulse and statistical analysis • Wireless presets include GSM, *Bluetooth*® and W-CDMA

Average power measurement		
N1913A/14B **EPM Series power meters**	**N432A** **Thermistor power meter**	**N1913PM5B VDI Erickson** **PM5B MM-Wave Power Metter**
		
• Single, dual or four-channel measurements • Frequency range of 9 kHz to 120 GHz; power range of –70 to +44 dBm (depending on power sensor) • Compatible with U8480 Series, U2000 Series and U2050/60 X-Series USB power sensors (for average power measurement only) Power sensor options • 848xD Diode Sensors • N848x Thermocouple Sensors • 8486 Waveguide Sensors • E441x 1-Path Diode CW-only Sensors • E930x 2-Path Diode True-Average Sensors	• High accuracy (≤ 0.2% ± 0.5 µW), excellent for 1 mW transfer calibration (with 478A-H75/H76 and 8478B) • Built-in 6.5-digit ADC eliminates the need for an external DMM • Digital color LCD display and user-friendly interface	• 75 GHz to 110 GHz, and up to 1.5 THz with optional taper accessories • Controlled by VNA firmware via USB • Includes built-in calibration verification feature • Measures the output power of banded mmWave signal sources • Additional waveguide tapers are available to enable measurement of power up to 1.5 THz

Portable power measurement				
V3500A handheld RF power meter	**U2000 Series USB power sensors**	**U8480 Series USB thermocouple power sensors**	**U2020 X-Series USB peak and average power sensors**	**U/L2050/60 X-Series USB/LAN wide dynamic range power sensors**
				
• 10 MHz to 6 GHz • –60 to +20 dBm) • Absolute accuracy up to ± 0.21 dB • Built-in display with backlight and integrated power sensor • Internal power reference enables self-calibration before use • 3-ways power up capability (via AA batteries, USB interface, and AC power adaptor)	• 9 kHz to 6/18/24/ 26.5 GHz • –60 to +44 dBm • Quick and easy set up with USB connectivity • Internal zeroing without disconnecting from device under-test	• DC to 18/33/50/67/ 120 GHz • –35 to +20 dBm • Measurement speed of 900 readings/second and power linearity of < 0.8% • Real time measurement uncertainty feature	• 50 MHz to 18/40/ 50 GHz • –40 to +20 dBm (peak/gated), –45 to 20 dBm (average only mode) • 30 MHz VBW • 25,000 readings/second measurement speed (buffer mode) • Internal zero and calibration • Built-in trigger in/trigger out	• 10 MHz to 6/18/33/40/50/54/67 GHz • –70 to +20/26 dBm • 5 MHz VBW • USB/LAN connectivity sensors • 50,000 readings/second (fast/buffered mode) • Variable Sampling Rate 1M samples/sec and Long Memory 1M samples data storage (for U/L2060 X-Series only) • Real-time measurement with zero dead time to ensure every single continuous pulse is measured • Average mode time-selectivity function allows full dynamic range for average and time selectivity average power measurement

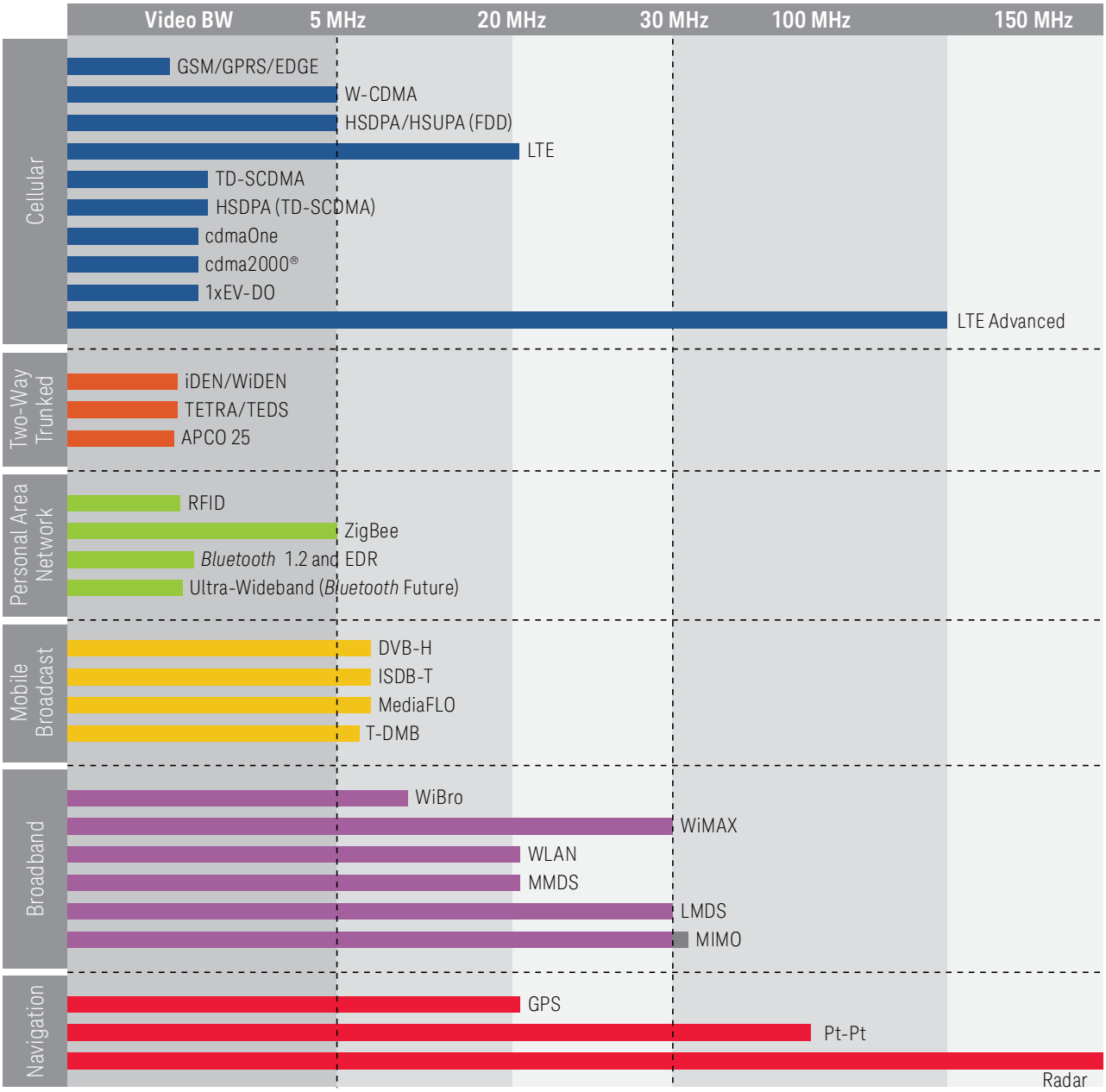
Peak and average power sensors		Average power sensors	
	• N1921A/22A P-Series power sensors (VBW: 30 MHz) • E9320 E-Series power sensors (VBW: 300 kHz, 1.5 MHz, 5 MHz)		• E4410, E9300 E-Series power sensors • N8480 Series thermocouple power sensors • 848xD Series, E/V/W8486A diode power sensors • 478A/8478B thermistor power sensors

Power Meters Selection Chart for Wireless Communication

Peak power measurement		
EPM-P E4416A/17A (VBW: 5 MHz)	**Power sensor options**	
	• E932x Peak-and-Average Sensors (300 kHz, 1.5 MHz, 5 MHz) • * Also compatible with all average power sensors	
P-Series N1911A/12A (VBW: 30 MHz)	**P-Series modular N8262A (VBW: 30 MHz)**	**Power sensor options for the P-Series meters**
		• N1921A/22A Wideband Sensors (30 MHz) • E932x Peak-and-Average Sensors (300 kHz, 1.5 MHz, 5 MHz) • * Also compatible with all average power sensors
U2020 X-Series USB power sensors (VBW: 30 MHz)	**U2049XA & U/L2060 X-Series USB/LAN power sensors (VBW: 5 MHz)**	
		

Average power measurement		
EPM N1913A/14B	**N432A thermistor power meter**	**U8480 Series USB thermocouple power sensors**
		
Power sensor options • 848xD Diode Sensors • N848x Thermocouple Sensors • 8486 Waveguide Sensors • E441x 1-Path Diode CW-only Sensors • E930x 2-Path Diode True-Average Sensors • Compatible with U8480 Series, U2000 Series and U2050/60 X-Series USB power sensors (supported average power measurement only)	Power sensor options • 478A and 8478B Thermistor Sensor	
U2000 Series USB power sensors	**U/L2050 X-Series USB/LAN power sensors**	**V3500A handheld RF power meter**
		

Power Meters Selection Chart for Wireless Communication



Power Meters and Sensors Compatibility Table

	POWER METERS								
POWER SENSORS			N432A	N1913/ 14B EMP	N1911/ 12A & N8262A P-Series	E4416/ 17A EPM-P	Product description/ Sensor tech.	Frequency range	Power range
	U/L2050/60 X-Series USB/LAN wide dynamic range sensors	U2049XA	–	–	–	–	LAN/TVAC Diode Power Sensor	10 MHz to 33 GHz	–70 (100 pW) to +20 dBm (100 mW)
		U2051XA	–	✓	–	–	USB Diode Power Sensor	10 MHz to 6 GHz	–70 (100 pW) to +26 dBm (398 mW)
		U2052XA	–	✓	–	–		10 MHz to 18 GHz	
		U2053XA	–	✓	–	–		10 MHz to 33 GHz	
		U2054XA	–	✓	–	–		10 MHz to 40 GHz	–70 (100 pW) to +20 dBm (100 mW)
		U2055XA	–	✓	–	–		10 MHz to 50 GHz	
		U2056XA	–	✓	–	–		10 MHz to 54 GHz	
		U2057XA	–	✓	–	–		10 MHz to 67 GHz	
		U2061XA	–	✓ [1]	–	–		10 MHz to 6 GHz	–70 (100 pW) to +26 dBm (398 mW)
		U2062XA	–	✓ [1]	–	–		10 MHz to 18 GHz	
		U2063XA	–	✓ [1]	–	–		10 MHz to 33 GHz	
		U2064XA	–	✓ [1]	–	–		10 MHz to 40 GHz	–70 dBm (100 pW) to +20 dBm (100 mW)
		U2065XA	–	✓ [1]	–	–		10 MHz to 50 GHz	
		U2066XA	–	✓ [1]	–	–		10 MHz to 54 GHz	
		U2067XA	–	✓ [1]	–	–		10 MHz to 67 GHz	
		L2051XA	–	–	–	–	LAN Diode Power Sensor	10 MHz to 6 GHz	–70 (100 pW) to +26 dBm (398 mW)
		L2052XA	–	–	–	–		10 MHz to 18 GHz	
		L2053XA	–	–	–	–		10 MHz to 33 GHz	
		L2054XA	–	–	–	–		10 MHz to 40 GHz	–70 (100 pW) to +20 dBm (100 mW)
		L2055XA	–	–	–	–		10 MHz to 50 GHz	
		L2056XA	–	–	–	–		10 MHz to 54 GHz	
		L2057XA	–	–	–	–		10 MHz to 67 GHz	
		L2061XA	–	–	–	–		10 MHz to 6 GHz	–70 dBm (100 pW) to +26 dBm (398 mW)
		L2062XA	–	–	–	–		10 MHz to 18 GHz	
		L2063XA	–	–	–	–		10 MHz to 33 GHz	
		L2064XA	–	–	–	–		10 MHz to 40 GHz	–70 (100 pW) to +20 dBm (100 mW)
		L2065XA	–	–	–	–		10 MHz to 50 GHz	
		L2066XA	–	–	–	–		10 MHz to 54 GHz	
		L2067XA	–	–	–	–		10 MHz to 67 GHz	
		L2065XT	–	–	–	–	LAN TVAC Diode Power Sensor	10 MHz to 53 GHz	–70 (100 pW) to +20 dBm (100 mW)
		L2066XT	–	–	–	–		10 MHz to 54 GHz	
		L2067XT	–	–	–	–		10 MHz to 67 GHz	

1. Support average power measurement only.

	POWER METERS								
			N432A	N1913/ 14B EMP	N1911/ 12A & N8262A P-Series	E4416/ 17A EPM-P	Product description/ Sensor tech.	Frequency range	Power range
POWER SENSORS	U8480 Series USB thermocouple sensors	U8481A	–	✓	–	–	USB Thermocouple Power Sensor	DC/10 MHz to 18 GHz	–35 (316 nW) to +20 dBm (100 mW)
		U8485A	–	✓	–	–		DC/10 MHz to 33 GHz	
		U8487A	–	✓	–	–		DC/10 MHz to 50 GHz	
		U8488A	–	✓	–	–		DC/10 MHz to 67 GHz	
		U8489A	–	✓	–	–		DC to 120 GHz	
	U2020 X-Series USB sensors	U2021XA	–	–	–	–	USB Diode Power Sensor	50 MHz to 18 GHz	–35 (316 nW) to +20 dBm (100 mW)
		U2022XA	–	–	–	–		50 MHz to 40/50 GHz	
	P-Series Wideband sensors	N1921A	–	–	✓	–	Diode Power Sensor	50 MHz to 18 GHz	–35 (316 nW) to +20 dBm (100 mW)
		N1922A	–	–	✓	–		50 MHz to 40 GHz	
	E-Series Peak-and-Average sensors	E9321A	–	–	✓	✓	Diode Power Sensor	50 MHz to 6 GHz	–65 (320 pW) to +20 dBm (100 mW)
		E9322A	–	–	✓	✓		50 MHz to 6 GHz	–60 (1 nW) to +20 dBm (100 mW)
		E9323A	–	–	✓	✓		50 MHz to 6 GHz	
		E9325A	–	–	✓	✓		50 MHz to 18 GHz	
		E9326A	–	–	✓	✓		50 MHz to 18 GHz	
		E9327A	–	–	✓	✓		50 MHz to 18 GHz	
	E-Series True Average sensors	E9300A	–	✓	✓	✓	Diode Power Sensor	10 MHz to 18 GHz	–60 (1 nW) to +20 dBm (100 mW)
		E9301A	–	✓	✓	✓		10 MHz to 6 GHz	
		E9304A	–	✓	✓	✓		9 kHz to 6 GHz	
		E9300B	–	✓	✓	✓		10 MHz to 18 GHz	–30 (1 µW) to +44 dBm (25 W)
		E9301B	–	✓	✓	✓		10 MHz to 6 GHz	
		E9300H	–	✓	✓	✓		10 MHz to 18 GHz	–50 (10 nW) to +30 dBm (1 W)
		E9301H	–	✓	✓	✓		10 MHz to 6 GHz	
	E-Series CW-only sensors	E4412A	–	✓	✓	✓	Diode Power Sensor	10 MHz to 18 GHz	–70 (100 pW) to +20 dBm (100 mW)
		E4413A	–	✓	✓	✓		50 MHz to 26.5 GHz	
	N8480/8480 Series Thermocouple and Diode sensors	N8481A	–	✓	✓	✓	Thermocouple Power Sensor	10 MHz to 18 GHz	–35 (316 nW) to +20 dBm (100 mW)
		N8482A	–	✓	✓	✓		100 kHz to 6 GHz	
		8483A 75 ohms	–	✓	✓	✓		100 kHz to 2 GHz	–30 (1 µW) to +20 dBm (100 mW)
		N8485A	–	✓	✓	✓		10 MHz to 26.5 GHz	–35 (316 nW) to +20 dBm (100 mW)
		N8487A	–	✓	✓	✓		50 MHz to 50 GHz	
		N8488A	–	✓	✓	✓		10 MHz to 67 GHz	
		N8481B	–	✓	✓	✓	High Power Thermocouple Sensor	10 MHz to 18 GHz	–5 (316 µW) to +44 dBm (25 W)
		N8482B	–	✓	✓	✓		100 kHz to 6 GHz	
		N8481H	–	✓	✓	✓		10 MHz to 18 GHz	–15 (32 µW) to +35 dBm (3 W)

POWER SENSORS	**N8480/8480 Series Thermocouple and Diode sensors**	N8482H	–	✓	✓	✓	High Power Thermocouple Sensor	100 kHz to 6 GHz	–15 (32 µW) to +35 dBm (3 W)
		8481D	–	✓	✓	✓	Diode Power Sensor	10 MHz to 18 GHz	–70 (100 pW) to –20 dBm (10 µW)
		8485D	–	✓	✓	✓		50 MHz to 26.5 GHz	
		8487D	–	✓	✓	✓		50 MHz to 50 GHz	
	Waveguide sensors	R8486D	–	✓	✓	✓	Waveguide Power Sensor	26.5 to 40 GHz	–70 (100 pW) to –20 dBm (10 µW)
		Q8486D	–	✓	✓	✓		33 to 50 GHz	
		N8486AR	–	✓	✓	✓	Thermocouple Waveguide Power Sensor	26.5 to 40 GHz	–35 (316 µW) to +20 dBm (100 mW)
		N8486AQ	–	✓	✓	✓		33 to 50 GHz	
		V8486A	–	✓	✓	✓	V-band Power Sensor	50 to 75 GHz	–30 (1 µW) to +20 dBm (100 mW)
		W8486A	–	✓	✓	✓	W-band Power Sensor	75 to 110 GHz	
		E8486A-100	–	✓	✓	✓	E-band Power Sensor	60 to 90 GHz	–30 (1 µW) to +20 dBm (100 mW)
		E8486A-200	–	✓	✓	✓			–60 (1 nW) to +20 dBm (100 mW)
		E8486A-201	–	✓	✓	✓		54 to 95 GHz	
		N8486DD-100	–	✓	–	–	D-band Power Sensor	110 to 170 GHz	–30 (1 µW) to +20 dBm (100 mW)
		N8486DD-200	–	✓	–	–			–52 (6.3 nW) to +10 dBm (10 mW)
		N8486DG-100	–	✓	–	–	G-Band Power Sensor	140 to 220 GHz	–30 (1 µW) to +20 dBm (100 mW)
		N8486DG-200	–	✓	–	–			–52 (6.3 nW) to +10 dBm (10 mW)
	Thermistor mount sensors	478A	✓	–	–	–	Coaxial Thermistor Mount	10 MHz to 10 GHz	–30 (1 µW) to +10 dBm (10 mW)
		8478B	✓	–	–	–		10 MHz to 18 GHz	
	Balance Thermocouple sensors	N8481S	–	–	–	–	Balance Thermocouple Power Sensor	DC to 18 GHz	–35 (316 µW) to +20 dBm (100 mW)
		N8487S	–	–	–	–		DC to 50 GHz	
	USB average sensors	U2000A	–	✓	–	–	USB Diode Power Sensor	10 MHz to 18 GHz	–60 (1 nW) to +20 dBm (100 mW)
		U2001A	–	✓	–	–		10 MHz to 6 GHz	
		U2002A	–	✓	–	–		50 MHz to 24 GHz	
		U2004A	–	✓	–	–		9 kHz to 6 GHz	
		U2000B	–	✓	–	–		10 MHz to 18 GHz	–30 (1 µW) to +44 dBm (25 W)
		U2001B	–	✓	–	–		10 MHz to 6 GHz	
		U2000H	–	✓	–	–		10 MHz to 18 GHz	–50 (10 nW) to +30 dBm (1 W)
		U2001H	–	✓	–	–		10 MHz to 6 GHz	
		U2002H	–	✓	–	–		50 MHz to 24 GHz	