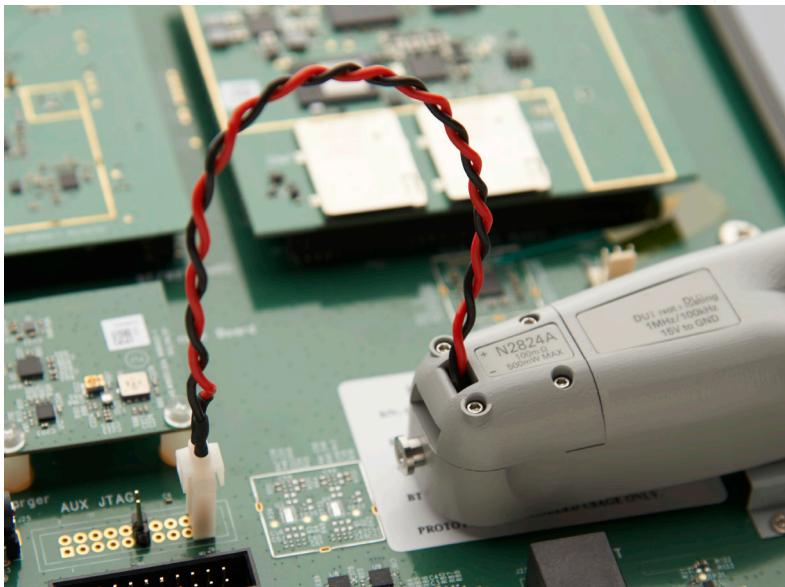


# N2820A/21A High-Sensitivity, High Dynamic Range Current Probes

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See the details without losing sight of the big picture



## Key features and specifications

- Measure current as low as 100 nA\*
- Measure current as high as 120 A\*
- Measure AC and DC
- Bandwidth
  - \* 3 MHz - Zoom-Out channel
  - \* 500 kHz - Zoom-In channel
- 2-channel vertical zoom mode enables accurate peak and idle current measurements
- New oscilloscope measurement current consumption over time (Charge)
- AutoProbe interface driving 1 MΩ input to oscilloscope
- Wide dynamic range - > 20,000:1 or 86 dB
- Probe accessories included with the probe or available separately: interchangeable Rsense heads (20 mΩ, 100 mΩ, and user-defined), MBB receptacles, headers, and hook-up wire

\* With the N2825A user defined head used



Figure 1. Keysight's ultra sensitive N2820A/N2821A current probes excel at measuring small current levels typically found in battery powered devices.

## Industry's highest sensitivity, highest dynamic range AC/DC current probes

As modern battery-powered devices and integrated circuits become more 'green' and energy efficient, there is a growing need to make low level, wide dynamic range current measurements to ensure the current consumption of these devices is within acceptable limits.

The new N2820A Series high-sensitivity current probes address the need for high-sensitivity current measurements with a wide dynamic range. These probes also offer the advantage of small physical connections to the DUT because today's application environments require an extremely small form factor. The N2820A Series probes have higher sensitivity - up to 200X greater than existing clamp-on current probes with sub-milliampere low level sensitivity.

See the details without losing sight of the big picture

This N2820A current probe comes with two parallel amplifiers possessing different gain settings. The low gain side allows you to see the entire waveform (or the 'zoomed out' view) and the high gain amplifier provides a 'zoomed in' view.

The precision sense resistor is positioned in the interchangeable Rsense head that is plugged into the probe body. The probe body can be found at the same location as the differential amplifier. On the 'user-defined' sense head, there is no resistor, which allows the probe to be used with the user's sense resistor on the target. The user will need to enter the sense resistor value into the scope.

- 500 mW
- 250  $\mu$ A to 5 A
- $\pm$  1% tolerance
- For smaller voltage drop or lower burden on your circuit
- Order N2822A for replacement head

20 mΩ



- 500 mW
- 50  $\mu$ A to 2.2 A
- $\pm$  1% tolerance
- For higher sensitivity, bandwidth and lower noise
- Order N2824A for replacement head

100 mΩ



- Use your own sense R on your target
- Choose between 1 mΩ to 1 MΩ
- Check the resistor power rating ( $P = I^2R$ )
- Order N2825A for replacement head

## User-defined



Figure 2. Types of sense resistor heads.

The supplied Make-Before-Break (MBB) connectors allow you to quickly probe multiple locations on your DUT without having to solder or unsolder the leads. The MBB header may be mounted on the user's target board. It fits into standard 0.1" spacing for 0.025" square pins. Users should plan their PCB layouts accordingly. The MBB can be used with all sense resistor probe heads including the user-defined probe head. The MBBs are a great way to easily connect and disconnect across multiple locations on the target board without interrupting the circuit under test.



Figure 3. Probing with the MBB connector.

## Two channel versus one channel

Keysight offers two current probe models in the N2820A Series: N2820A two-channel and N2821A one-channel. The N2821A looks identical to the N2820A probe but does not include the secondary cable that is shown in Figure 4. The N2820A probe connects to two oscilloscope channels to provide simultaneous low and high gain views for wider dynamic range measurement, while the N2821A probe provides one user-selectable view at a time.



Figure 4. The N2820A 2-channel high-sensitivity current probe. The N2821A does not include the secondary cable.

## Current consumption over time measurement

With current waveforms captured, you now want to calculate the average current consumption of the system over time. Keysight's Infiniium oscilloscopes provide an area under the curve measurement (Charge) where you can easily calculate the integrated current consumptions over time.

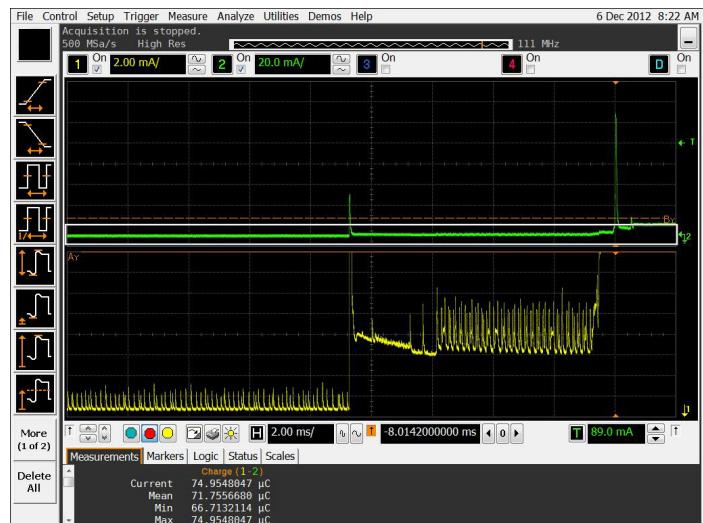


Figure 5. Infiniium oscilloscope coupled with the N2820A current probe provides the area under the curve measurement for accurate current consumption measurement.

## Oscilloscope compatibility

The N2820A and N2821A current probes are compatible with Keysight oscilloscopes shown in the characteristics table. The N2820A Series current probes, together with Keysight's Infiniium S-Series high-definition oscilloscopes with 10 bit vertical resolution, deliver the ultimate high definition measurement solution, letting users view and resolve small current details not traditionally seen on 8-bit oscilloscopes.

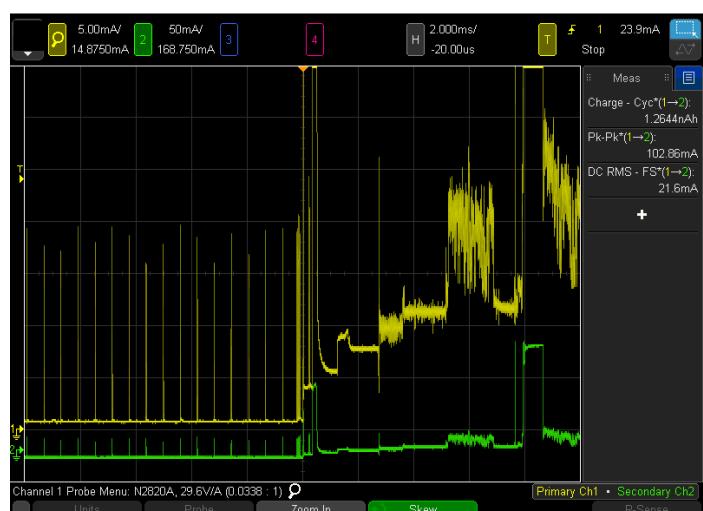


Figure 6. The Infiniivision 3000 X- or 4000 X-Series oscilloscope can also be paired with the N2820A/21A current probes to provide the same simultaneous low- and/ or high-gain views for wider dynamic range current measurement.

## Probe characteristics

Bandwidth (-3 dB)	Zoom-out channel: DC to 3 MHz Zoom-in channel: DC to 500 kHz		
Risetime (Tr = 0.35/bandwidth, 10 to 90%)	Zoom-out channel: < 0.116 $\mu$ sec Zoom-in channel: < 0.7 $\mu$ sec		
Minimum measurable current <sup>1</sup>	250 $\mu$ A (with N2822A 20 m $\Omega$ , 500 mW) 50 $\mu$ A (with N2824A 100 m $\Omega$ , 500 mW) 5 mA (with N2825A user-defined 1 m $\Omega$ , 500 mW) 100 nA (with N2825A user-defined 1 k $\Omega$ , 500 mW)		
Maximum measurable current	5 A (with N2822A 20 m $\Omega$ , 500 mW) 2.2 A (with N2824A 100 m $\Omega$ , 500 mW) 5 A <sup>2</sup> (with N2825A user-defined 1 m $\Omega$ installed, 500 mW) 1.2 mA <sup>2</sup> (with N2825A user-defined 1 k $\Omega$ installed, 500 mW) 120 A (with N2825A user-defined 10 $\Omega$ installed, 20 W)		
Gain <sup>5</sup>	Zoom-in channel: 300 $\pm$ 3% Zoom-out channel: 1.97 $\pm$ 3%		
Output voltage rate	Zoom-in channel: 6 V/A (with N2822A 20 m $\Omega$ ) 30 V/A (with N2824A 100 m $\Omega$ ) Zoom-out channel: 0.04 V/A (with N2822A 20 m $\Omega$ ) 0.2 V/A (with N2824A 100 m $\Omega$ )		
DC amplitude accuracy	$\pm$ 3% or 10 $\mu$ A (whichever is greater)		
Max input voltage	$\pm$ 12 V		
Burden voltage (voltage drop on Rsense)	Measured current <sup>1</sup> Rsense		
Dynamic range	20,000:1, 86 dB (N2820A) 1,000:1, 60 dB (N2821A)		
Output impedance	1 M $\Omega$		
Noise (ACrms)	150 $\mu$ A rms (with N2822A 20 m $\Omega$ , hi res mode on) <sup>3</sup> 240 $\mu$ A rms (with N2822A 20 m $\Omega$ , hi res mode off) 30 $\mu$ A rms (with N2824A 100 m $\Omega$ , hi res mode on) <sup>3</sup> 50 $\mu$ A rms (with N2824A 100 m $\Omega$ , hi res mode off)		
Sensor resistor accuracy	$\pm$ 1% (N2822A, N2824A)		
Sensor resistor power rating	500 mW (N2822A, N2824A)		
Temperature coefficient of sensor resistor	< 20 ppm/ $^{\circ}$ C		
Cable lengths	Sensor leads: 16 cm Probe cable: 1.2 m		
Temperature	Operating: 0 to +40 $^{\circ}$ C Non-operating: -40 to +70 $^{\circ}$ C		
Humidity	Operating: tested at 95% RH at +40 $^{\circ}$ C Non-operating: tested at 90% RH, +65 $^{\circ}$ C		
ESD	8 kV HBM		
Standard accessories	1 each 20 m $\Omega$ resistor sensor head	5 each MBB headers	
	1 each 100 m $\Omega$ resistor sensor head	5 each MBB receptacles	
	1 each user defined resistor sensor head	1 each ground lead	
	5 each twisted leads (22 AWG) with sockets	1 each screw driver	
	5 each twisted leads (22 AWG) without sockets	1 each passive cable (with N2820A only)	
		1 each user guide manual (English)	
Compatible oscilloscopes	InfiniiVision 3000 X-Series (with software version 2.30 or higher) InfiniiVision 4000 X-Series (with software version 3.10 or higher) and 6000 X-Series Infiniium S, 9000A, 9000 H-Series (with software version 4.20 or higher) <sup>4</sup>		

1. V<sub>supply</sub> is equal to 5 V, solder attached.

2. Max current varies with max resistor power rating. The examples in the Figure 8 and 9 assume 500 mW power rating.

3. With scope with high resolution mode on, sampling rate < 2.5 MSa/s, 20 MHz low pass filter on.

4. Infiniium UXR, V, Z, 90000A, 90000 X-, and 90000 Q-Series are not compatible with N2820A/21A current probe.

5. Denotes warranted specification after 20-minute warm up. All others entries in the table are characteristics.

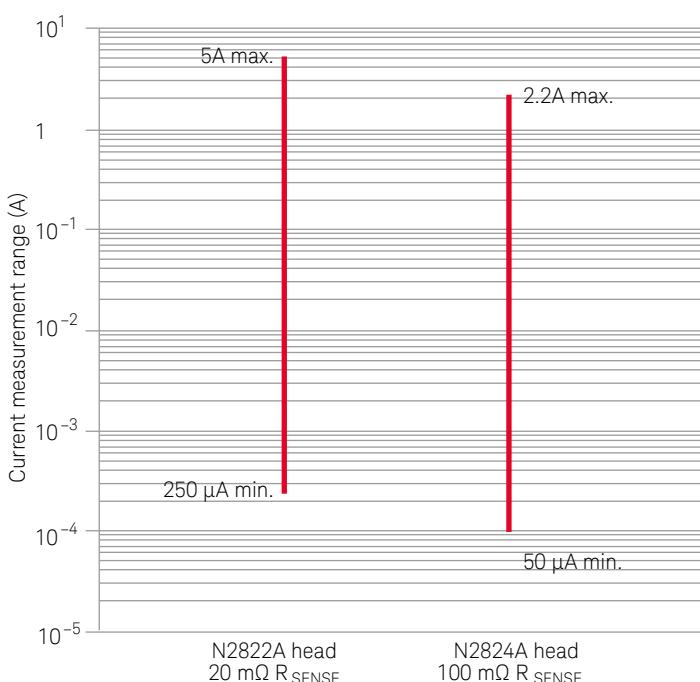


Figure 7. Minimum/Maximum current measurement range with N2822A/N2824A head, 500 mW sense R, solder attached, High resolution mode on.

## Product configuration

Model numbers	Descriptions
N2820A	High-sensitivity 2-ch current probe
N2821A	High-sensitivity 1-ch current probe

## Replacement part numbers

N2822A	20 mΩ resistor tips
N2824A	100 mΩ resistor tips
N2825A	User-defined resistor tips
N2826A	Replacement wires (15.5 cm, 22 AWG bare wires) (qty 5)
N2827A	Passive cable (for N2820A secondary channel)
N2828A	Replacement MBB (Make Before Break) headers (qty 5)
N2829A	Replacement MBB (Make Before Break) receptacles and 15.5 cm, AWG 22 socketed wires (qty 5 each)

N2825A with 0.5 W sense R, High Res Mode ON

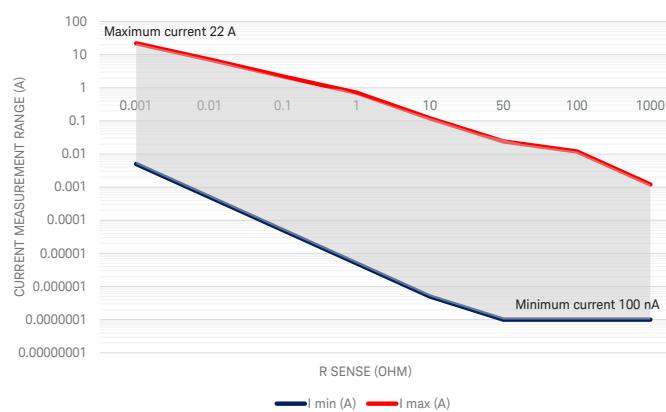


Figure 8. Minimum/maximum current measurement range with N2825A head, 500 mW sense R, solder attached, high resolution mode on

N2825A with 20 W sense R, High Res Mode ON

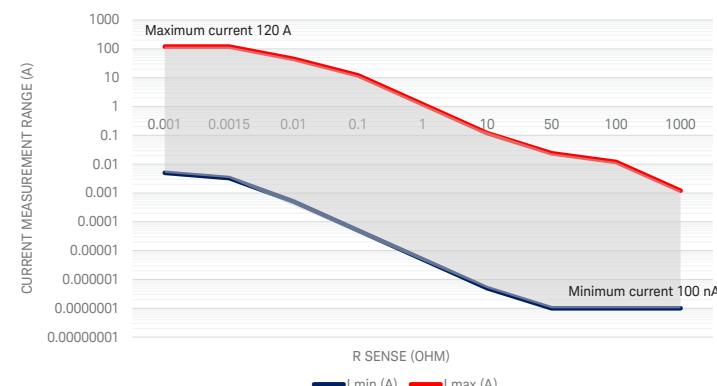


Figure 9. Minimum/maximum current measurement range with N2825A head, 20 W sense R, solder attached, high resolution mode on

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