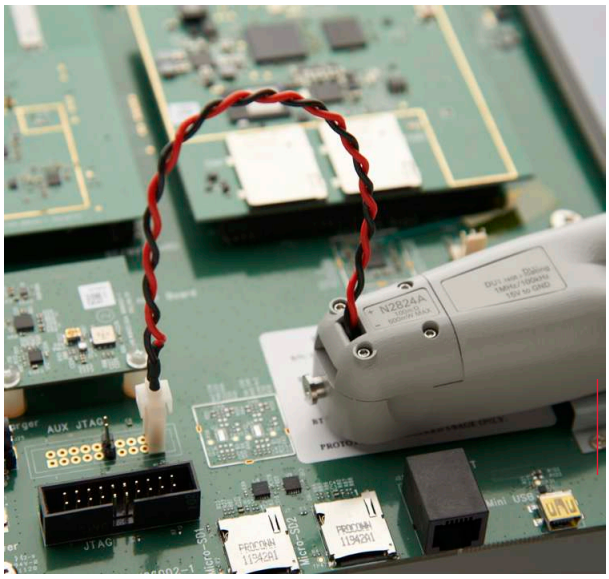
Keysight Technologies

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




Data Sheet

KEYSIGHT TECHNOLOGIES

## Key features and specifications

- Measure currents as low as 50 µA
- Measure currents as high as 5 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 idlecurrent 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

## 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 physically small 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-milliamphere low level sensitivity.

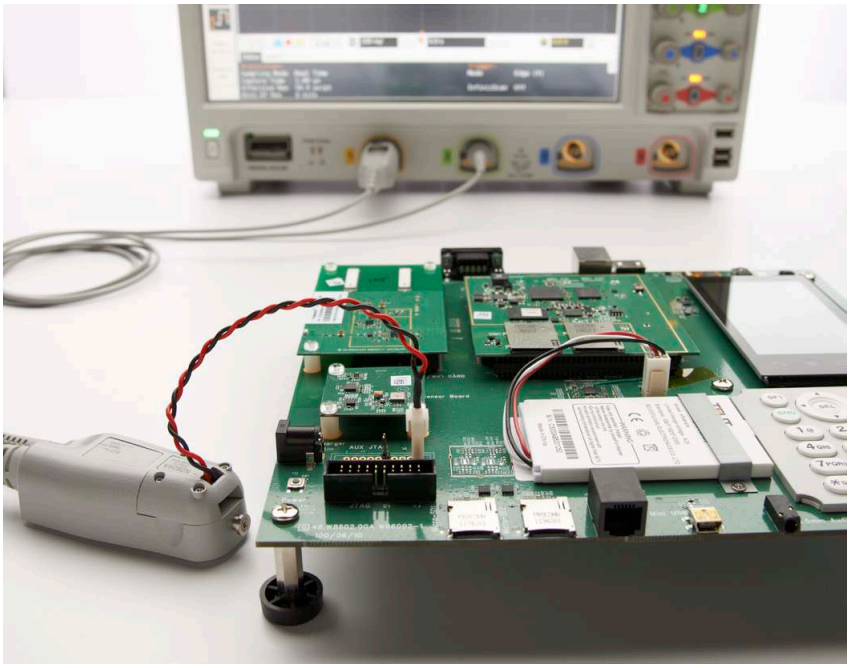


Figure 1. Keysight's ultra sensitive N2820A/N2821A current probes (with resolution as low as 50 µA) excel at measuring for small current levels typically found in battery powered devices.

## 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) of the waveform, and the high gain amplifier provides a “zoomed in” view for observing extremely small current fluctuations such as a mobile device’s idle state.

The precision sense resistor is positioned in the interchangeable Rsense head that is plugged into the probe body. The probe body is also where the differential amplifier is located. 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 µA - 5 A
- ± 1% tolerance
- For smaller voltage drop or lower burden on your circuit
- Order N2822A for replacement head

20 mΩ

- 500 mW
- 50 µA - 2.2 A
- ± 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.

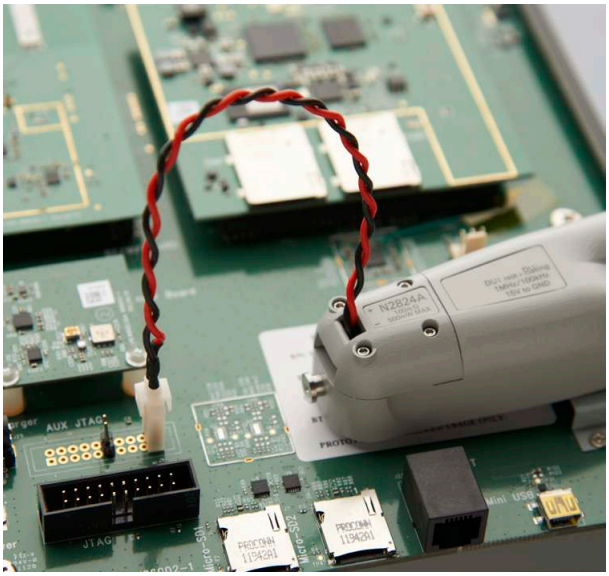



Figure 3. Probing with the MBB connector.

## Two channel vs. one channel

Keysight Technologies, Inc. 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.

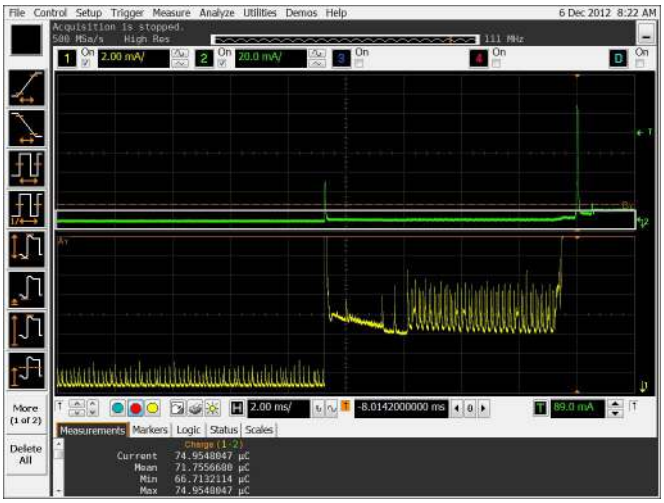



Figure 5. Infiniium oscilloscope coupled with the N2820A current probe provides the area under the curve measurement for accurate current consumption measurement.

## 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 9000 H-Series high-definition oscilloscopes, deliver the ultimate high definition measurement solution, letting users view and resolve small current details not traditionally seen on 8-bit oscilloscopes.

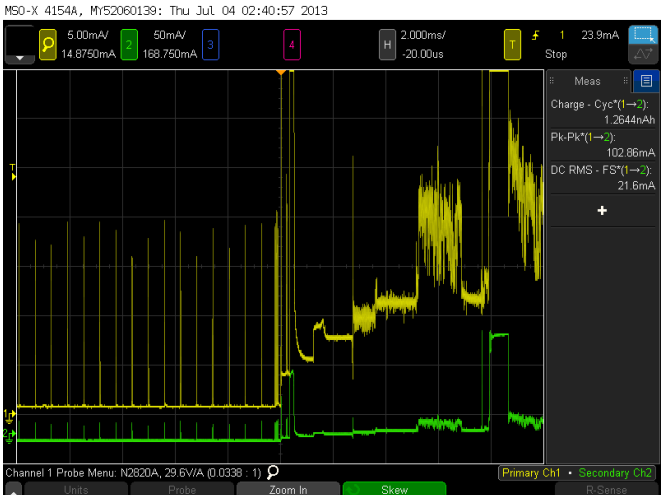
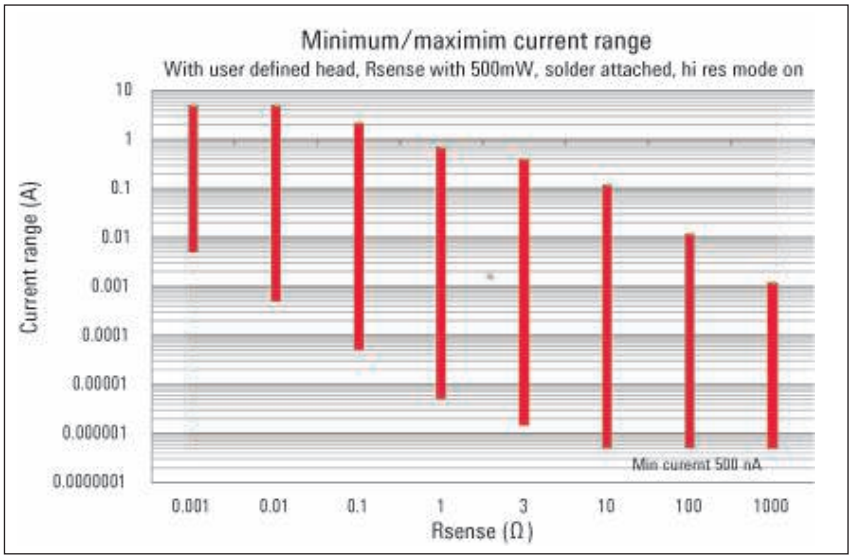
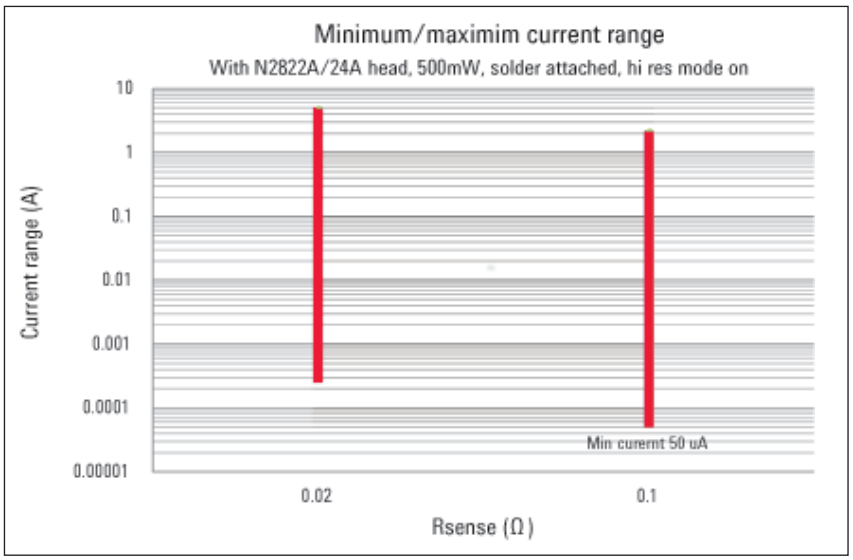



Figure 6. The InfiniiVision 3000 X- or 4000 X-Series oscilloscope can also be paired with the N2820A/21A current probes to provide the same simultaneous low- and/or high-gain views for wider dynamic range current measurement.

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

1. Vsupply is equal to 5 V, solder attached.
2. Max current varies with max resistor power rating. The examples in the table 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 90000A, 90000 X-, and 90000 Q-Series are not compatible with N2820A/21A current probe.
5. Denotes warrantied specification after 20-minute warm up. All others entries in the table are characteristics.




# 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) |

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