Keysight N2820A/21A
High-Sensitivity, High Dynamic Range Current Probes
See the details without losing sight of the big picture
Key features and specifications

- Measure current as low as 500 nA
- Measure current 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 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

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.

<table>
<thead>
<tr>
<th>20 mΩ</th>
<th>100 mΩ</th>
<th>User-defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 500 mW</td>
<td></td>
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<tr>
<td>- 250 μA to 5 A</td>
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<tr>
<td>- ± 1% tolerance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- For smaller voltage drop or lower burden on your circuit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Order N2822A for replacement head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 500 mW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 50 μA to 2.2 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- ± 1% tolerance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- For higher sensitivity, bandwidth and lower noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Order N2824A for replacement head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Use your own sense R on your target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Choose between 1 mΩ to 1 MΩ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check the resistor power rating (P = IR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Order N2825A for replacement head</td>
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<td></td>
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</tbody>
</table>

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.](image-url)
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.

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.

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.
### Probe characteristics

| Bandwidth (–3 dB) | Zoom-out channel: DC to 3 MHz  
| Probe characteristics | Zoom-in channel: DC to 500 kHz  
| Class | Zoom-out channel: < 0.116 μsec  
| Probe characteristics | Zoom-in channel: < 0.7 μsec  
| Minimum measurable current |  
| Probe characteristics | 250 μA (with N2822A 20 mΩ, 500 mW)  
| Probe characteristics | 50 μA (with N2824A 100 mΩ, 500 mW)  
| Probe characteristics | 5 mA (with N2825A user-defined 1 mΩ, 500 mW)  
| Probe characteristics | 500 nA (with N2825A user-defined 1 kΩ, 500 mW)  
| Maximum measurable current |  
| Probe characteristics | 5 A (with N2822A 20 mΩ, 500 mW)  
| Probe characteristics | 2.2 A (with N2824A 100 mΩ, 500 mW)  
| Probe characteristics | 5 A  
| Probe characteristics | 1.2 mA  
| Probe characteristics | Gain |  
| Probe characteristics | 300 ± 3% (Zoom-in channel)  
| Probe characteristics | 1.97 ± 3% (Zoom-out channel)  
| Output voltage rate |  
| Probe characteristics | 6 V/A (with N2822A 20 mΩ)  
| Probe characteristics | 30 V/A (with N2824A 100 mΩ)  
| Probe characteristics | 0.04 V/A (with N2822A 20 mΩ)  
| Probe characteristics | 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 * Rsense  
| Dynamic range | 20,000:1, 86 dB (N2820A)  
| Probe characteristics | 1,000:1, 60 dB (N2821A)  
| Output impedance | 1 MΩ  
| Noise (ACrms) |  
| Probe characteristics | 150 μA (with N2822A 20 mΩ, hi res mode on)  
| Probe characteristics | 240 μA (with N2822A 20 mΩ, hi res mode off)  
| Probe characteristics | 30 μA (with N2824A 100 mΩ, hi res mode on)  
| Probe characteristics | 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  
| Probe characteristics | Probe cable: 1.2 m  
| Temperature | Operating: 0 to +40 °C  
| Probe characteristics | Non-operating: –40 to +70 °C  
| Humidity | Operating: tested at 95% RH at +40 °C  
| Probe characteristics | Non-operating: tested at 90% RH, +65 °C  
| ESD | 8 kV HBM  
| Standard accessories |  
| Probe characteristics | 1 each 20 mΩ resistor sensor head  
| Probe characteristics | 5 each MBB headers  
| Probe characteristics | 1 each 100 mΩ resistor sensor head  
| Probe characteristics | 5 each MBB receptacles  
| Probe characteristics | 1 each user defined resistor sensor head  
| Probe characteristics | 1 each ground lead  
| Probe characteristics | 5 each twisted leads (22 AWG) with sockets  
| Probe characteristics | 1 each screw driver  
| Probe characteristics | 5 each twisted leads (22 AWG) without sockets  
| Probe characteristics | 1 each passive cable (with N2820A only)  
| Probe characteristics | 1 each user guide manual (English)  
| Compatible oscilloscopes | InfiniiVision 3000 X-Series (with software version 2.30 or higher)  
| Probe characteristics | InfiniiVision 4000 X-Series (with software version 3.10 or higher) and 6000 X-Series  
| Probe characteristics | Infiniium S, 9000A, 9000 H-Series (with software version 4.20 or higher)  

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. Infinium V, 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.
### Product configuration

<table>
<thead>
<tr>
<th>Model numbers</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2820A</td>
<td>High-sensitivity</td>
</tr>
<tr>
<td></td>
<td>2-ch current probe</td>
</tr>
<tr>
<td>N2821A</td>
<td>High-sensitivity</td>
</tr>
<tr>
<td></td>
<td>1-ch current probe</td>
</tr>
</tbody>
</table>

### Replacement part numbers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2822A</td>
<td>20 mΩ resistor tips</td>
</tr>
<tr>
<td>N2824A</td>
<td>100 mΩ resistor tips</td>
</tr>
<tr>
<td>N2825A</td>
<td>User-defined resistor tips</td>
</tr>
<tr>
<td>N2826A</td>
<td>Replacement wires (15.5 cm, 22 AWG bare wires) (qty 5)</td>
</tr>
<tr>
<td>N2827A</td>
<td>Passive cable (for N2820A secondary channel)</td>
</tr>
<tr>
<td>N2828A</td>
<td>Replacement MBB (Make Before Break) headers (qty 5)</td>
</tr>
<tr>
<td>N2829A</td>
<td>Replacement MBB (Make Before Break) receptacles and 15.5 cm, AWG 22 socketed wires (qty 5 each)</td>
</tr>
</tbody>
</table>

![Figure 7. Minimum/Maximum current range with N2822A/N2824A head, 500 mW sense R, solder attached, High resolution mode on.](image1)

![Figure 8. N2825A head.](image2)
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