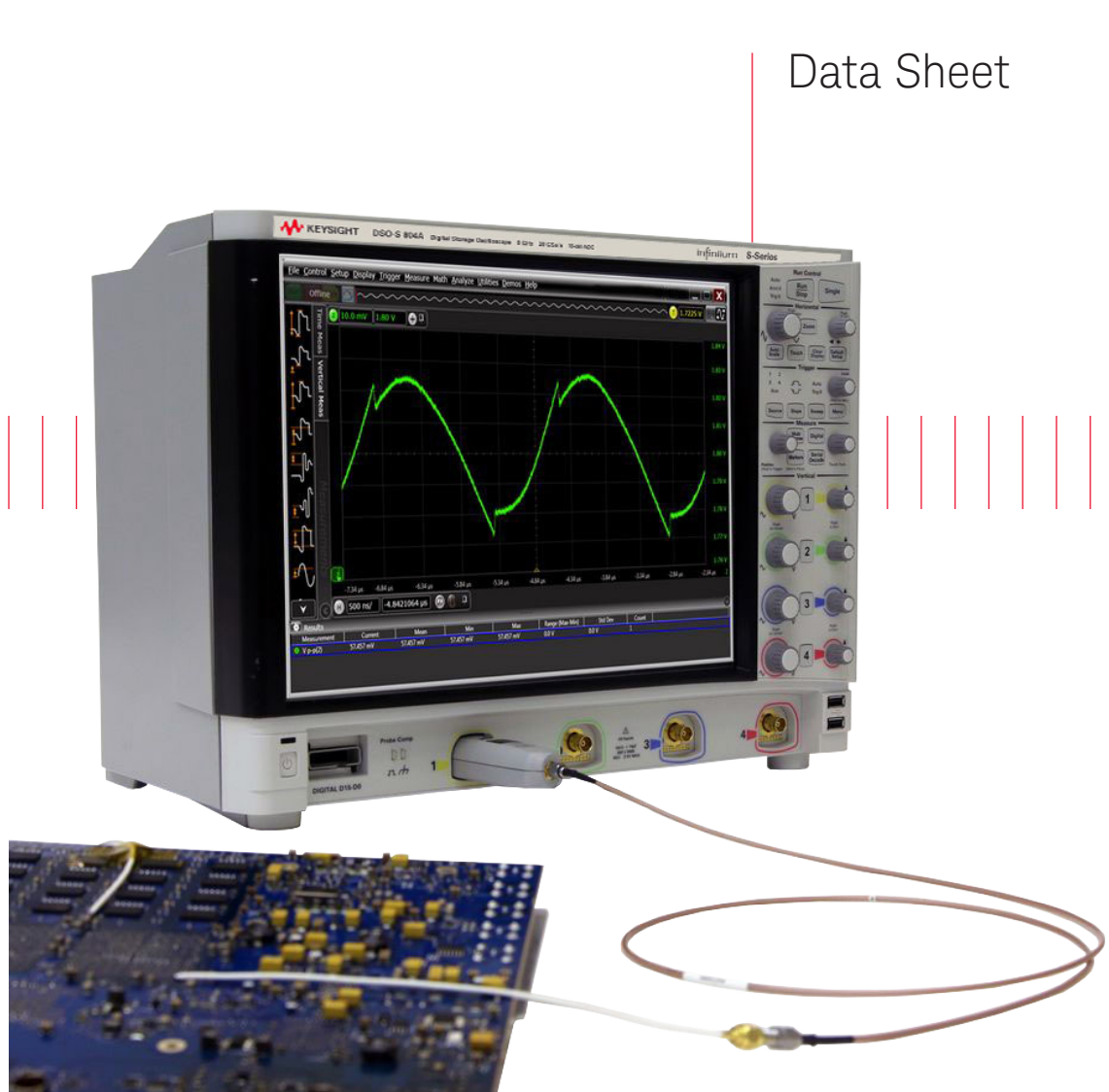


Keysight

# N7020A Power Rail Probe for Power Integrity Measurements

The Right Tool for the Right Job

Data Sheet



## The need for a specialized power integrity probe

Would you like to minimize oscilloscope and probe noise when measuring DC power rails? Do you need more offset than is available in your oscilloscope so you can zoom-in to view and analyze small signals on top of DC power supplies? Would you like to have input impedance greater than 50  $\Omega$  at DC so your oscilloscope doesn't load your DC power rails? Do you need more bandwidth so you can track down transients on your DC power supplies that can adversely affect your clock and data? If so, the N7020A power rail probe is the right tool for the job.

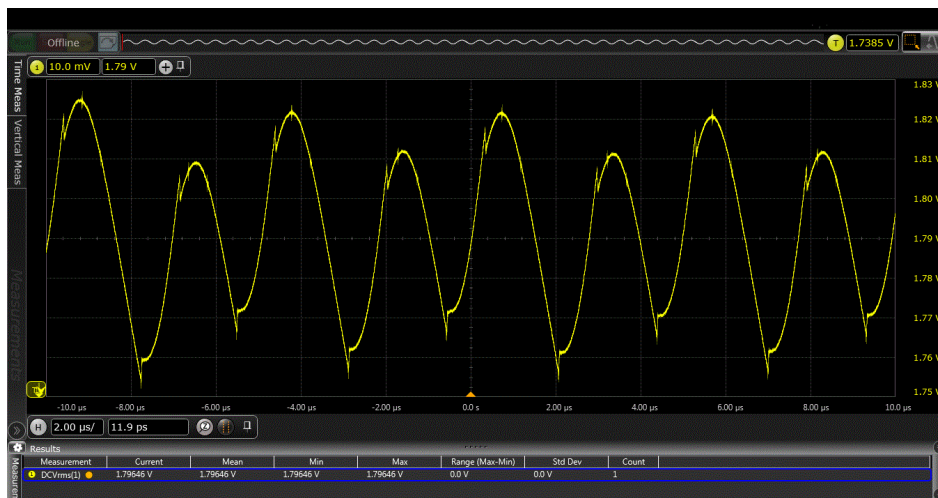
Developed specifically to help engineers with precise DC power rail testing, the N7020A power rail probe was designed to minimize noise and maximize the offset range of the measurement system while providing high bandwidth and low target loading.

## The challenge

The increased functionality, higher density, and higher frequency operation of many modern electronic products has driven the need for lower supply voltages. It is common in many designs today to have 3.3, 1.8, 1.5 and even 1.1V DC supplies—each of them having tighter tolerances than in previous product generations.

Engineers need to zoom-in on power rails to look for transients, measure ripple, and analyze coupling. An oscilloscope often does not have enough offset to be able to shift the DC power rail to the center of the screen for the required measurements. Placing a DC blocking capacitor in the signal path eliminates the offset problem but also eliminates relevant DC information such as DC supply compression or low frequency drift.

A low noise measurement solution is of paramount importance so it doesn't confuse the noise of the probe and oscilloscope with the noise and ripple of the DC supply being measured. Using probes (active or passive) that are higher than 1:1 attenuation can help with the offset difficulty but will also decrease the signal-to-noise ratio and negatively affect measurement accuracy. Using the oscilloscope's 50  $\Omega$  input with a passive coaxial cable offers a 1:1 attenuation ratio probing method but results in higher-than-desired DC loading of the supply being measured and has the offset limitations mentioned earlier. Ripple, noise, and transients riding on DC supplies are a major source of clock and data jitter in digital systems. Dynamic loading of the DC supply by the processor, memory, or similar items occurs at the clock frequency and can create high speed transients and noise on the DC supply. Designers need high-bandwidth tools to evaluate and understand high-speed noise and transients on their DC power rails.



Using the N7020A power rail probe, with 2 GHz bandwidth and 50 K $\Omega$  DC resistive loading, to see the AC and DC components of a DC power rail.

## Key probe characteristics

**Low noise:** The N7020A power rail probe is a 1:1 attenuation ratio active probe. This low attenuation ratio provides a superior signal-to-noise ratio compared to other probes, both passive and active. This means users are not giving up margin to measurement system noise and get a clear picture of all the details of their signal.

**Large offset range:** +/-24V of probe offset. This enables users to center the signal on screen and zoom-in to observe and measure signal details.

**Low DC loading:** The N7020A power rail probe has a large 50 k $\Omega$  DC input impedance, minimizing the probe DC loading of the rails it probes.

**High bandwidth:** With 2 GHz bandwidth, the N7020A power rail probe can capture fast transients and noise caused by switching currents within the user's system.



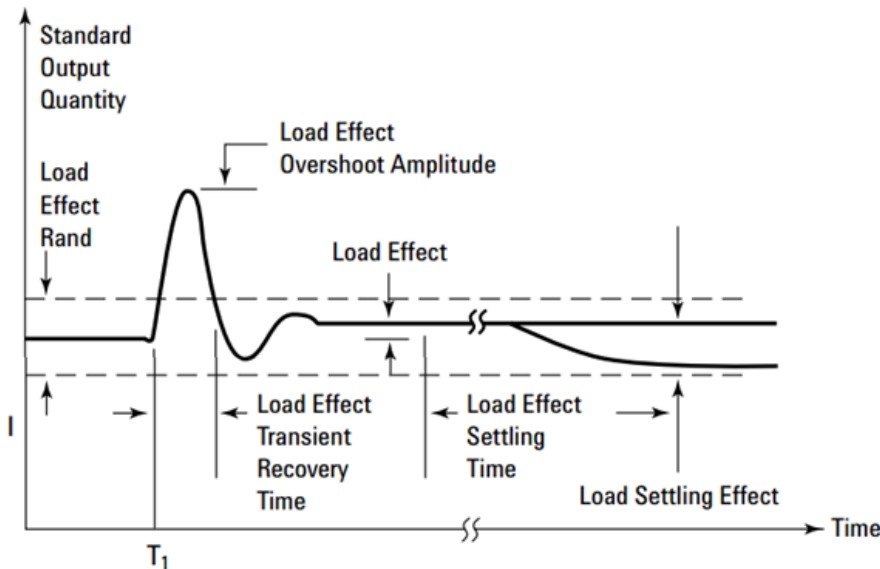
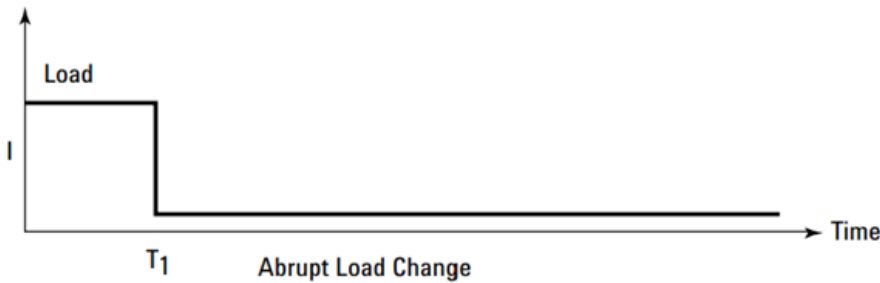
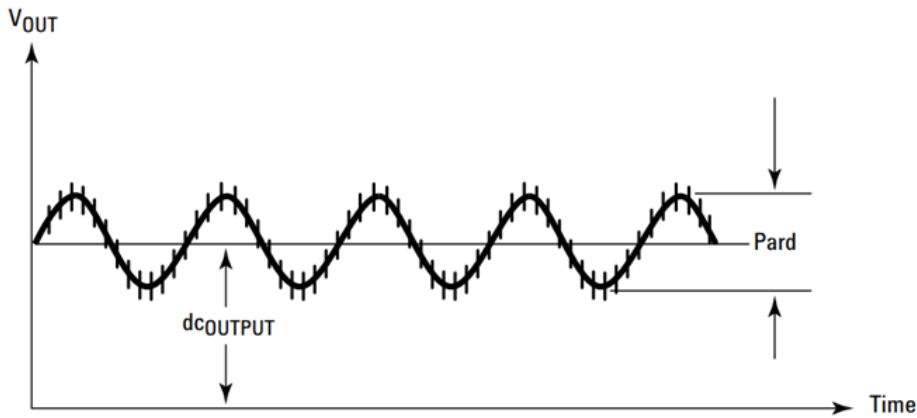
The Keysight N7020A power rail probe for power integrity measurements.



N7020A power rail probe and included accessories: N7021A coaxial "pigtail" probe heads, N7022A main cable and N7023A browser.

## Key measurements

- Supply drift: Because the probe passes through both AC and DC signal components to the oscilloscope, it is possible to accurately measure low frequency DC supply drift or supply compression.
- PARD (Periodic and Random Disturbances): The probe's extremely low noise means that it will not contribute significant error to measurements of the DC supplies ripple and noise.
- Load response: The large input active voltage range of the N7020A power rail probe makes it possible to analyze large deviations of the DC supply that may result from dynamic loading.
- High-frequency transient and noise characterization: With 2 GHz of bandwidth, the probe can help characterize transients and noise on the DC supply that may be offensive to clocks and digital data.



	Probe with N7022A main cable and N7021A pigtail cable	Probe with N7023A browser
Probe bandwidth (-3 dB)	2 GHz	350 MHz
Attenuation ratio		1:1
Risetime (calculated, 10-90%)	175 ps	1.0 ns
Offset range		± 24 V
*Input impedance @ DC		50 kΩ
Input dynamic range		± 850 mV
Probe noise	10% of the noise of the oscilloscope that it is attached to	
Probe type	Single-ended	
Included accessories	N7021A coaxial pigtail probe head (qty. 3) N7022A main cable N7023A browser	
Maximum non-destructive input voltage	± 30 V (DC + peak AC)	
Output impedance	50 Ω	
Cable length	N7021A coaxial pigtail probe head: 8" N7022A main cable: 48" N7023A browser: 45"	
Ambient operating temperature	Probe pod: -10 - 55°C N7021A main cable, N7022A coaxial pigtail probe head: -40 - 85°C N7023A browser: -10 - 55°C	
Ambient non-operating temperature	Probe pod: -30 - 70°C N7021A main cable, N7022A coaxial pigtail probe head: -40 - 85°C N7023A browser: -30 - 70°C	
Operating humidity	Probe pod: up to 85% RH N7021A main cable, N7022A coaxial pigtail probe head: up to 85% RH N7023A browser: up to 80% RH at 31°C, decreasing linearly to 40% at 50°C	
Non-operating humidity	Probe pod: up to 85% RH N7021A main cable, N7022A coaxial pigtail probe head: up to 85% RH N7023A browser: up to 85% RH	
Operating altitude	4,600 m	
Non-operating altitude	15,300 M	
Standard warranty	1 year (extended warranty available at cost)	

\* Denotes specification.

## Compatible oscilloscopes

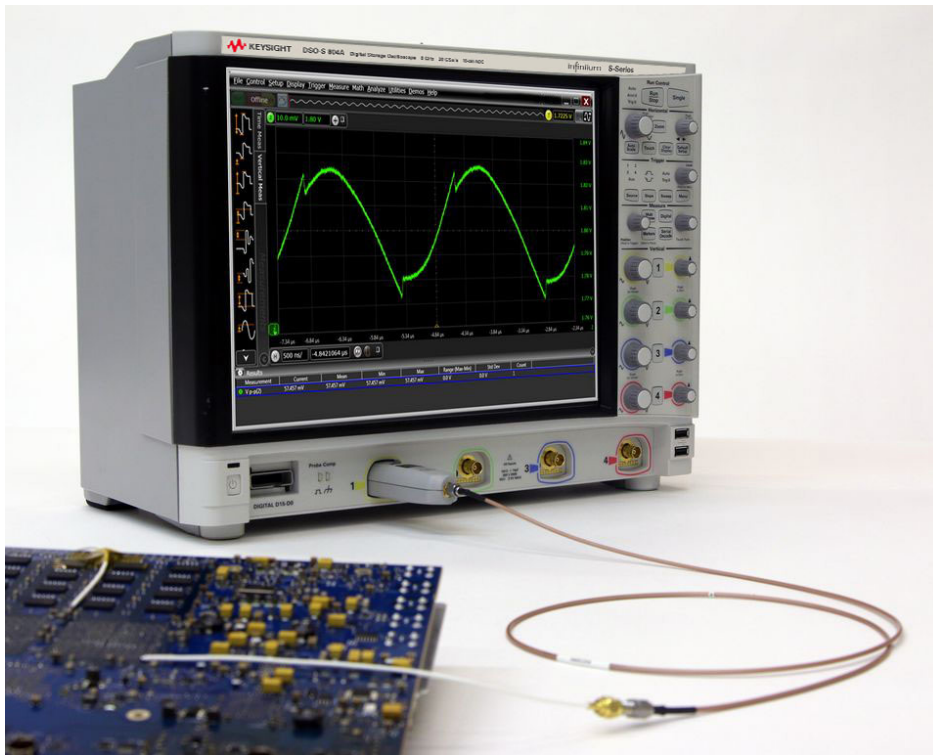
The N7020A probe is compatible with the Keysight oscilloscopes shown below. Up to four probes can be connected to the oscilloscope at the same time. The table also lists the minimum required firmware version for the oscilloscope.

The N7020A probe is designed for oscilloscopes with 50  $\Omega$  AutoProbe interface channel inputs. The AutoProbe interface provides the power to the probe.

Table 5. Compatible oscilloscopes

Infiniium oscilloscopes	Required firmware version
S-Series	$\geq 5.20$
9000 Series	$\geq 5.20$
6000 X-Series	$\geq 6.10$
4000 X-Series	$\geq 4.00$
3000T X-Series	$\geq 4.00$
3000A X-Series	$\geq 2.39$

Is your oscilloscope software up-to-date? Keysight periodically releases software updates to support your probe, fix known defects, and incorporate product enhancements. To download the latest firmware, go to [www.keysight.com](http://www.keysight.com) and search for the oscilloscope's topic. Click on the "Drivers, Firmware & Software" tab.



When using a N7020A probe with an Infiniium S-Series oscilloscope, users will achieve precise measurements. Infiniium S-Series oscilloscopes provide support for 10 vertical bits in hardware for vertical sensitivities as small as 16 mV full screen. This means all 10 bits of the ADC are used to produce a resolution of 16.6  $\mu\text{V}$ . S-Series noise at 1 mV/div with 1 GHz bandwidth is 90  $\mu\text{V}_{AC\ rms}$ , and lower noise levels can be achieved by averaging or additional bandwidth limiting.



The N7020A power rail probe comes with a set of three N7021A pigtail cables and an N7022A main cable.

## N7021A pigtail cables

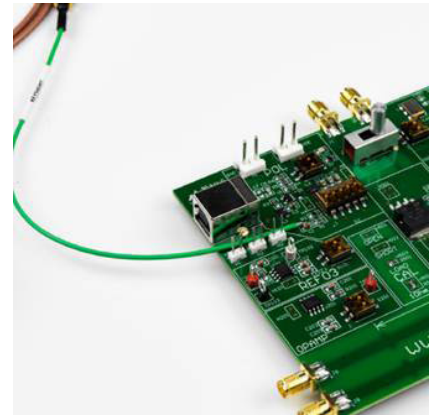
The N7021A pigtail cables are a replaceable accessory for use with the N7020A oscilloscope power rail probe. These cables are intended to be solder-connected to the power rail of interest and connected to the N7020A power rail probe's main cable. The cables have a small diameter so they occupy less space and are very flexible. They are constructed of high-quality materials, and their solid center conductor can withstand multiple soldering and unsoldering cycles so the cables can be reused.

**Small size:** Constructed of small-diameter flexible coax to minimize intrusions into target systems.

**Durable:** Solid center conductor can be soldered and unsoldered multiple times allowing these cables to be reusable.

**Convenient:** Pre-trimmed—no cable preparation necessary—and come three to a package.

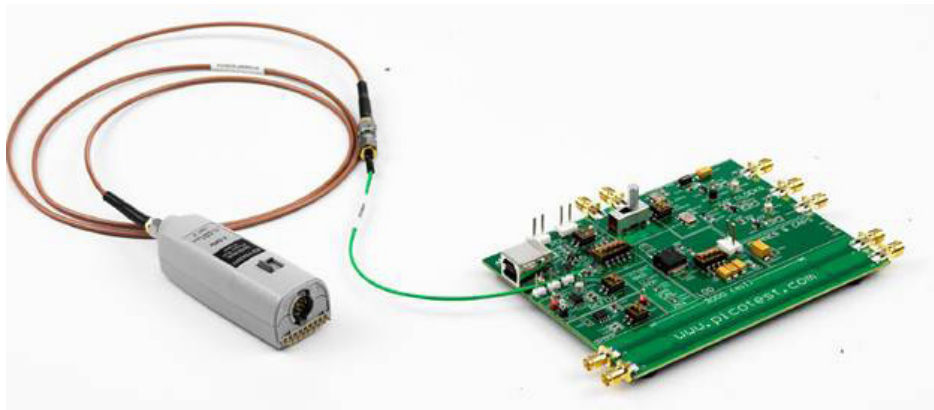
**SMA termination:** Have SMA terminations for easy, reliable connection to the N7020A power rail probe.



The Keysight N7020A Power Rail Probe and included accessories



High temperature capable: can be used to make measurements inside temperature chambers from -40 to + 85 degrees Celsius.



High temperature capable: can be used to make measurements inside temperature chambers from -40 to + 85 degrees Celsius.

## N7022A main cable

The N7022A main cable is a replacement cable for the Keysight N7020A oscilloscope power rail probe. It is designed to be flexible and durable while still providing high signal fidelity.

**Durable:** Constructed of high-quality materials to withstand repeated flexing, twisting, and bending.

**Convenient:** 1.2M (48") length makes for easy connection to the target without the need to have the oscilloscope nearby.

**SMA termination:** Has SMA terminations for easy, reliable connection to the N7020A power rail probe.

## Included accessories



## Keysight N7023A power rail probe browser and included browser accessories

The N7023A power rail probe browser is intended for use with the Keysight N7020A power rail probe. The N7023A browser leverages the mechanical components from our popular passive probes to create a convenient browsing style accessory for the N7020A power rail probe.

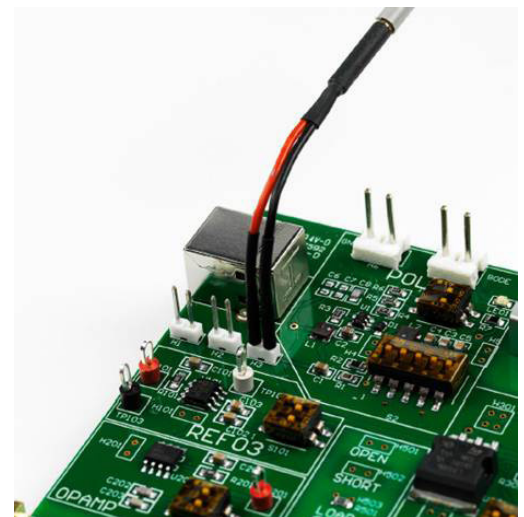
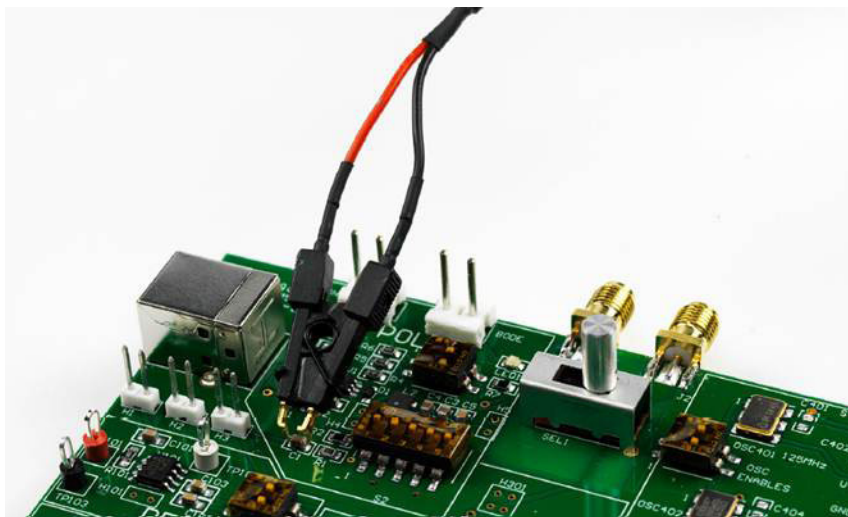
350 MHz bandwidth

1:1 attenuation ratio

SMT clip for hands-free probing of capacitors

Twin lead adapter for connecting to 2-pin headers or other accessories

Replacement spring loaded and rigid tips included



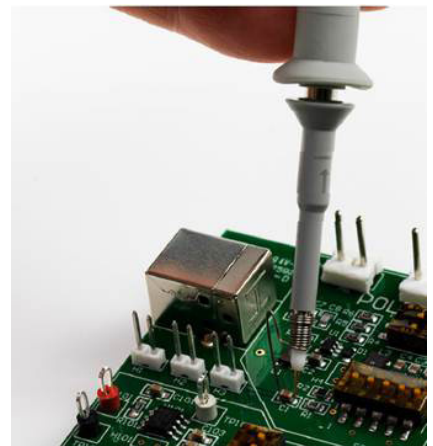


## Included Browser Accessories

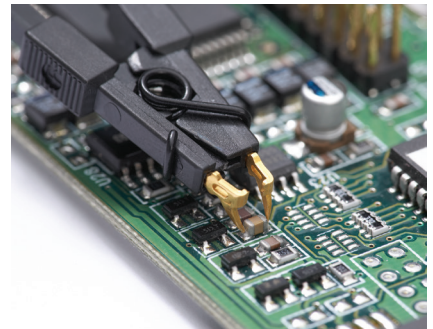
2.5 mm ground spring: The ground spring provides the highest performance connection for the N7023A power rail probe browser. Its flexible construction makes it easy to vary the span between the input and ground to accommodate the device being probed.



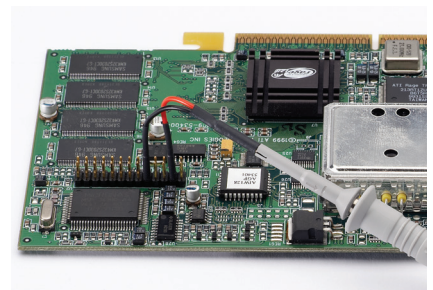
15 cm ground lead: This ground lead can be used to reach grounding locations that are farther away from the probing location than can be reached by the ground spring.



Dual lead adapter: The dual lead adapter allows you to easily connect the N7023A power rail probe browser to popular 0.1" pin headers with 0.025" square pins. This dual lead adapter has no shorting hazards since all external metal surfaces are insulated.



Dual lead adapter with Micro SMD clip: The Micro SMD clips were designed to provide fast and convenient hands-free probing of surface mount capacitors. The Micro SMD clip is used in conjunction with the dual lead adapter.



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