

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.

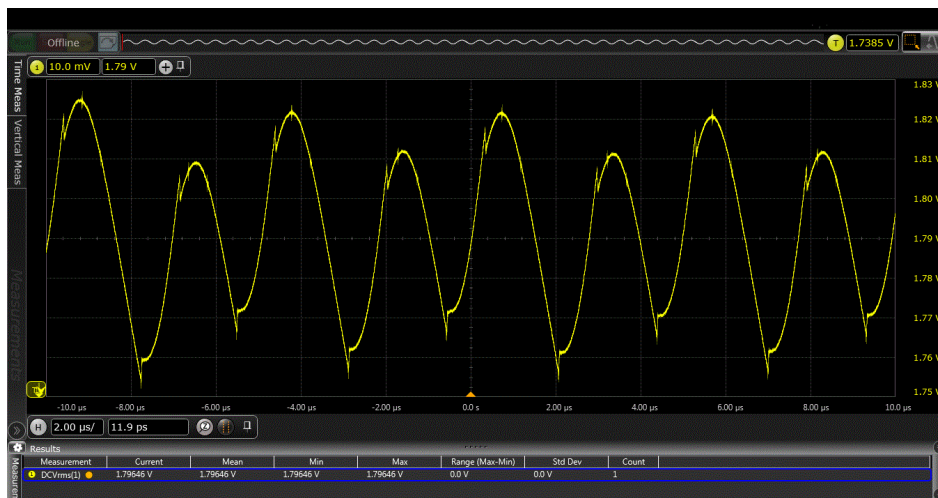
Developed specifically to help engineers with precise DC power rail testing, the N7020A power rail probe was designed to minimize noise and maximize the offset range of the measurement system while providing high bandwidth and low target loading.

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 $50\ \text{K}\Omega$ DC resistive loading, to see the AC and DC components of a DC power rail.

Key probe characteristics

The N7020A power rail probe is a low noise, large offset range oscilloscope probe that enables users to measure small signals riding on top of DC supplies.

Large offset range: +/-24V of probe offset. This enables users to center the signal on screen while placing the oscilloscope at its maximum vertical sensitivity to zoom-in on the signal.

Low noise: The N7020A power rail probe is a 1:1 attenuation ratio active probe. As a general rule, the higher a probe's attenuation ratio, the noisier the signal will be on the oscilloscope. The N7020A only increases the baseline noise of the oscilloscope it is connected to by 10%.

Large input signal range: The N7020A power rail probes' +/-850 mV input signal range, in addition to its large offset range, means that users can measure up to +/-850 mV deviations of their DC supplies. This is very useful for measuring programmable supplies like those used in microcontroller power saving modes.

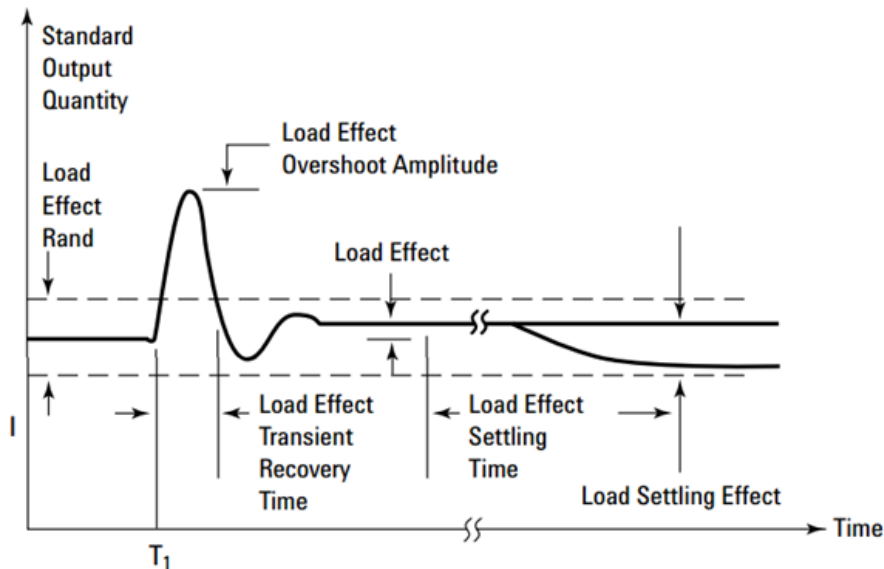
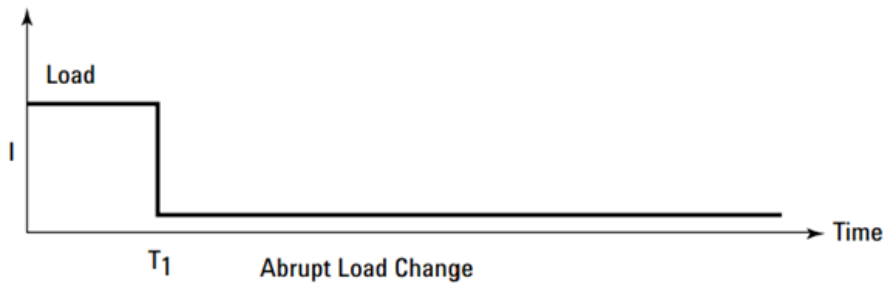
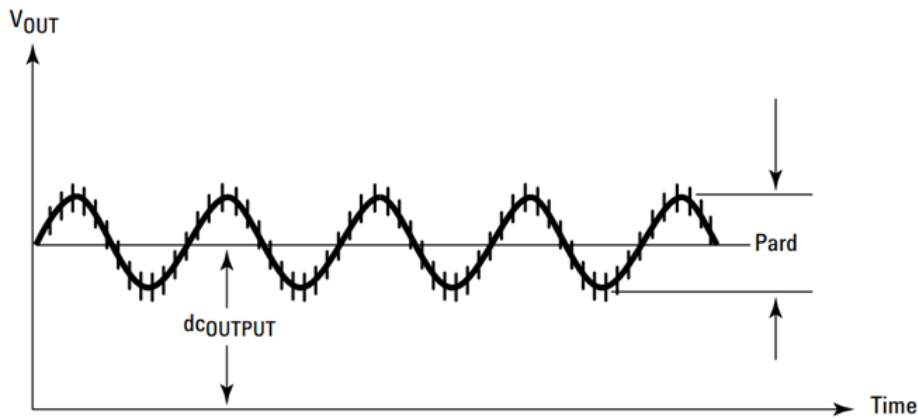
Low DC loading: The N7020A power rail probe has 50 k Ω input impedance at DC, minimizing the probe's DC loading of the power rail.



The Keysight N7020A power rail probe for power integrity measurements.

Key measurements

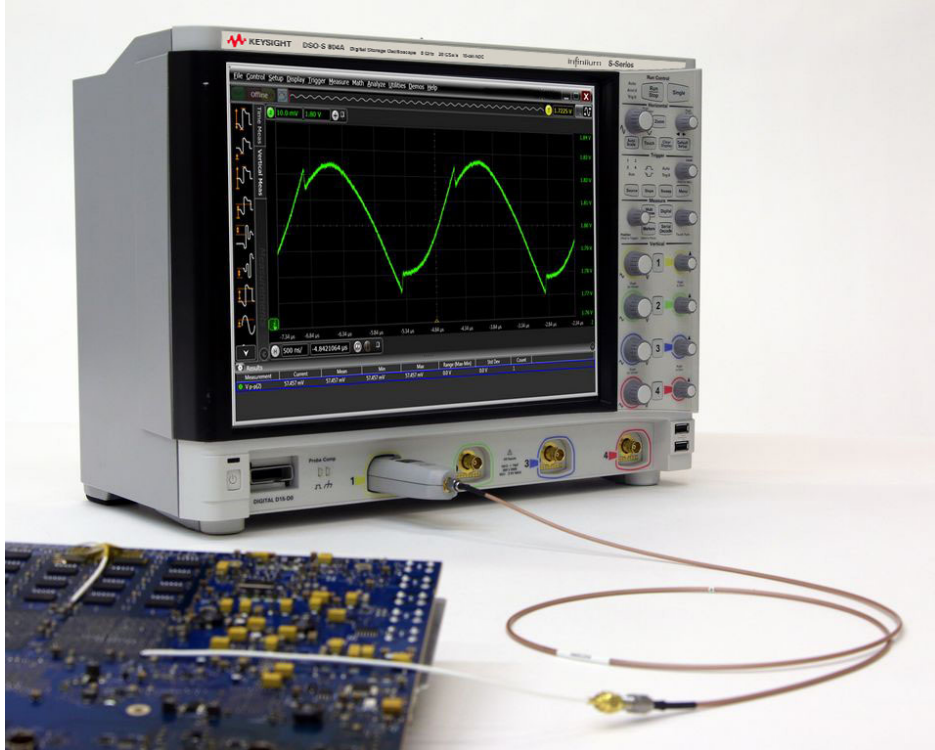
- Supply drift: Because the probe passes through both AC and DC signal components to the oscilloscope, it is possible to accurately measure low frequency DC supply drift or supply compression.
- PARD (Periodic and Random Disturbances): The probe's extremely low noise means that it will not contribute 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.



Characteristics and specifications: N7020A Power Rail Probe	
Probe bandwidth (-3dB)	2 GHz
Attenuation ratio	1:1
Offset range	± 24V
Input impedance @ DC	50 kΩ
Input dynamic range	± 850 mV
Probe noise	10% of oscilloscope noise
Probe type	Single-ended
Included accessories	N7021A – coaxial probe head (qty. 3) N7022A – main cable
Maximum non-destructive input voltage	±30V (DC + peak AC)
Output impedance	50 Ω
Cable length	N7021A main cable: 48” N7022A coaxial probe head: 8”
Ambient operating temperature	Probe pod: 0 – 40°C, N7021A main cable, N7022A coaxial probe head: 0 – +55° C
Ambient non-operating temperature	Probe pod: -40 to 70 °C, N7021A main cable, N7022A coaxial probe head: -40 – +55° C
Operating humidity	Probe pod up to 95% RH at +40 °C
Non-operating humidity	Probe pod up to 90% RH at +65 °C
Operating altitude	4,600m
Non-operating altitude	15,300m
Standard warranty	1 year (extended warranty available at cost)
Recommended Keysight oscilloscopes	Infiniium 9000 and S-Series

Compatible oscilloscopes

The N7020A power rail probe can be used with the Keysight Infiniium S-Series DSO and MSO high-definition oscilloscopes and the Infiniium 9000 Series DSO and MSO oscilloscopes running software revision 5.20 or newer.



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 μV . S-Series noise at 1 mV/div with 1 GHz bandwidth is 90 $\mu\text{V}_{AC\text{ rms}}$, 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.

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.

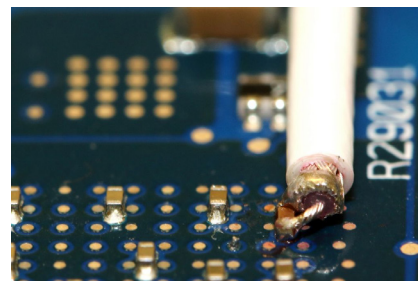
Durable: Constructed of high-quality materials to withstand repeated flexing, twisting, and bending.

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.



The Keysight N7020A Power Rail Probe and included accessories



N7021A pigtail cable solder attached to a bypass capacitor on the backside of a BGA. Solder connections enable users to make robust, high-fidelity connections to their power rails. The N7021A can be reused.

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