Active Power Rail Probes
TPR1000 and TPR4000 Datasheet

The TPR1000 and TPR4000 probes provide a low noise, large offset range solution for measurement of ripple on DC power rails ranging from –60 to +60 VDC. Tektronix's power rail probes offer industry leading low noise and high offset range required to measure AC ripple between 200 $\mu V_{p\text{-}p}$ and 800 $mV_{p\text{-}p}$ at up to 4 GHz.

Key performance specifications

- Compatible with the 6 Series MSO, 5 Series MSO, 4 Series MSO, 3 Series MDO, MDO3000 , MDO4000C, MSO/DPO5000B, DPO7000C, and DPO70000C/DX/SX oscilloscopes. Due to software incompatibilities between the TPR1000 and TPR4000 probes and the MDO3000 and MDO4000C oscilloscopes, the accuracy of probe measurements is reduced when these oscilloscopes are used in vertical scale settings less than 2 mV/ division. For all other vertical scale settings, the specified accuracy of the probe is maintained. DPO70000 oscilloscopes require the optional TCA-VPI50 adapter.
- Bandwidth:
  - DC coupling mode:
    - TPR1000: DC to 1 GHz
    - TPR4000: DC to 4 GHz
  - DC reject mode:
    - TPR1000: 10 kHz to 1 GHz
    - TPR4000: 10 kHz to 4 GHz
  - Frequency response optimized for <1 Ω source impedance.
  - Through SMA-to-SMA cable or Solder Micro-Coax tip.
- Linear dynamic range: Up to 60 V DC, 1 $V_{p\text{-}p}$ to bandwidth. Max AC RMS of 1 V.

- Attenuation: 1.25x. Frequency response optimized for <1 Ω source impedance.
- Measurement accuracy:
  - DC linearity: <0.1%
  - Step response long-term aberrations: ±1%
- Noise:
  - <300 $\mu V_{p\text{-}p}$ noise on 6 Series MSO (20 MHz BW Limit)
  - <1 $mV_{p\text{-}p}$ noise on 6 Series MSO (Full Bandwidth)
- Input impedance:
  - 50 kΩ DC to 10 kHz
  - 50 Ω AC > 100 kHz
- Temperature range at tip:
  - –40 to +125 °C (standard accessories)
  - –40 to +155 °C (high temperature cable option)
  - Comp box and oscilloscope temperature range limited to 0 to +55 °C.
- Offset:
  - ±60 V offset range
  - Offset setting error: ±2 mV max, ±0.4 µV typical

Applications

- Probing chipsets for power rail voltage supply and control in automotive, industrial and consumer markets
- Probing digital power management, memory and Ethernet connectivity
- Probing noise sources on high-frequency power rails

Why use a power–rail probe?

The added functionality, higher density, and faster switching speeds of modern electronic products drive the need for lower supply voltages. Designers need to zoom-in on power rails to look for high-frequency intruder signals, measure ripple and analyze coupling effects with tighter tolerances. Oscilloscopes often don't have enough offset to shift the noise and ripple on DC rails to the center of the screen to make the needed measurements.

The TPR1000 and TPR4000 probes provide a low-noise measurement solution (oscilloscope and probe), which is critical to not confuse the noise of the oscilloscope and probe with the noise and ripple of the DC supply being measured. The higher input impedance in the probes minimize the oscilloscope loading effect on DC rails (50 kΩ at DC).
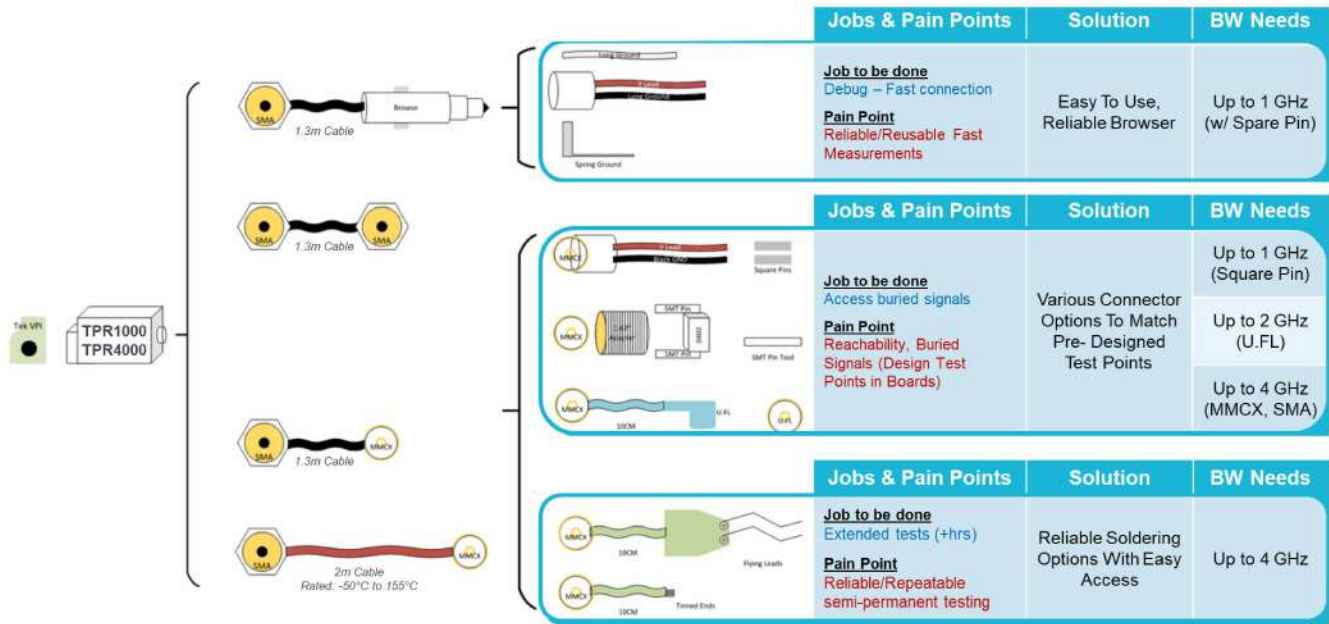
The probes provide higher bandwidth to see more signal content (harmonics, faster ripples, etc.) on DC rails that could affect data signals, clocks, etc.

The TPR1000 and TPR4000 provide a best-in-class integrity solution for power integrity and validation engineers in the high speed (µP), low power (mobile) and switched-mode power supply markets. The probes are designed to offer the lowest noise with high bandwidth at 60 V

offset, flexible connectivity options to cover customers challenges, and software packages to cover the digital power management market.

Connectivity using probe accessories

The available probe accessories provide solutions for reliable and repeatable power rail measurements.

Jobs & Pain Points	Solution	BW Needs
Job to be done Debug – Fast connection **Pain Point** Reliable/Reusable Fast Measurements	Easy To Use, Reliable Browser	Up to 1 GHz (w/ Spare Pin)

Jobs & Pain Points	Solution	BW Needs
Job to be done Access buried signals **Pain Point** Reachability, Buried Signals (Design Test Points in Boards)	Various Connector Options To Match Pre- Designed Test Points	Up to 1 GHz (Square Pin) Up to 2 GHz (U.FL) Up to 4 GHz (MMCX, SMA)

Jobs & Pain Points	Solution	BW Needs
Job to be done Extended tests (+hrs) **Pain Point** Reliable/Repeatable semi-permanent testing	Reliable Soldering Options With Easy Access	Up to 4 GHz

Probe accessories to enable connectivity

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

Bandwidth	TPR1000: 1 GHz
	TPR4000: 4 GHz
Offset voltage range	±60 V
Dynamic range	±1 V
Input resistance	50 kΩ DC 50 Ω AC
Input coupling	DC, LF reject
Accuracy	1 mV
System noise	<300 µV$_{P-P}$ (with 20 MHz bandwidth limit)
	<1.3 mV$_{P-P}$ (at full bandwidth of oscilloscope)
	Using 6 Series MSO oscilloscopes. With grounded input and maximum sensitivity set to 1.3 mV/Div.
Attenuation	1.25x
	Frequency response optimized for <1 Ω source impedance.
Connectivity and accessories	New browser, solder-in and snap-on

Ordering information

TPR1000	1 GHz, Single-Ended TekVPI® Power-Rail Probe; includes one TPR4KIT accessory kit
TPR4000	4 GHz, Single-Ended TekVPI® Power-Rail Probe; includes one TPR4KIT accessory kit

Accessory kits

Accessory kits provide flexible and modular connectivity options. Each of the kits are orderable separately.

Description		TPR4KIT	TPR4KITHT	TPRBRWSR1G	TPR4SIAFLEX	TPR4SIACOAX
		(std. accessory)	(high temp.)	(1 GHz browser)	(flex tips)	(micro-coax tips)
1.3 m cable, SMA male-to-MMCX male, 50 Ω (Orderable outside of TPR4KIT) PN: 174749700		✓				
1.3 m cable, SMA male-to-SMA male, 50 Ω		✓				
Y-lead adapter, MMCX female-to-0.8 mm sockets (Orderable outside of TPR4KIT) PN: 174749600		✓				
Adapter cable, MMCX female-to-U.FL female, 50 Ω (Orderable outside of TPR4KIT) PN: 174749500		✓				
Adapter, MMCX female-to-square pin (0.062 centers)		✓				
DUT interface solder pins, set of 20		✓				
Soldering aide tool, 0.062 solder pins over SMT		✓				

Table continued…
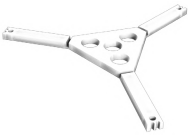
Description		TPR4KIT	TPR4KITHT	TPRBRWSR1G	TPR4SIAFLEX	TPR4SIACOAX
		(std. accessory)	(high temp.)	(1 GHz browser)	(flex tips)	(micro-coax tips)
Probe tip tripod support (with living hinge)		✓				
Marker bands, set of 5 (for probe identification)		✓				
Wire card, solderable enameled self-fluxing copper wire (for use with the solder-in tips)		✓				
Solder-in cable adapter, MMCX female-to-solder micro-coax tip, 50 Ω, set of 3		✓	✓			✓
Solder-in cable adapter, MMCX female-to-solder flex-paddle tip, 50 Ω, set of 3		✓	✓		✓	
2 m high-temperature cable, SMA male-to-MMCX male, 50 Ω			✓			
1 GHz browser				✓		
Ground leads (blade, 0.5 mm spring, 15 cm alligator)				✓		
Y-lead adapter, browser tip-to-0.8 mm sockets				✓		
Micro-SMD clip				✓		

Table continued…

Description		TPR4KIT	TPR4KITHT	TPRBRWSR1G	TPR4SIAFLEX	TPR4SIACOAX
		(std. accessory)	(high temp.)	(1 GHz browser)	(flex tips)	(micro-coax tips)
Replacement 0.5 mm browser tips (2 solid tips, 2 spring tips)				✓		

Tektronix is ISO 14001:2015 and ISO 9001:2015 certified by DEKRA.

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit *www.tek.com*.

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