



Probing Solutions.
Made in Germany.

EN



HORNET[®] Series

High Voltage Differential Probes
with Universal BNC Interface

$\pm 4000 \text{ V}$, $> 300 \text{ MHz}$

PRELIMINARY

Datasheet



About HORNET® Probe Series

The state-of-the-art high voltage differential probe series HORNET® establishes itself as the best-in-class solution for the growing demands of wide bandgap power electronics design, e.g. double pulse testing of high-speed high-voltage switching devices of SiC technology, and IGBTs, thyristors, fast-switching HV diodes, and more.

HORNET®'s $\pm 4000\text{V}$ differential and common mode voltage capability provide engineers with the flexibility to tackle the most challenging high voltage applications in power electronics design.

With a bandwidth exceeding 300MHz, HORNET® ensures accurate and reliable measurements for fast-switching wide bandgap, SiC, power electronics, making it an essential tool for engineers working on advanced designs having a protected test environment.

HORNET® is engineered to deliver precise and consistent results, allowing designers to optimize the efficiency and performance of their power electronic systems with confidence.

The probe is designed with advanced safety features to safeguard both users and the equipment during high voltage measurements. Anyhow, HORNET® series probes are not for handheld use and for integration into full-automated or manual test stations for high-voltage safety reasons. HORNET® is therefore used as a voltage-measuring component (permanently attached device) of a test system.

The HORNET® series probes have a universal BNC output connector and are compatible with any oscilloscope in the lab with 50 Ω input impedance, or 1M Ω input impedance and a 50 Ω feed-through termination.

All HORNET® series models require a power supply, which is not included in the scope of delivery, and has to be ordered separately. Review the *Ordering Information* at the end of this document for more details. The interface box is powered by the required PMK power supply. The referring power supplies all have remote control capabilities and therefore a USB interface and optional additional LAN interface. As an alternative for most flexible use, the 1 channel battery pack power supply AP-01 provides >8h of portable and isolated operation but has no software remote control.

HORNET® series has the capability to be controlled from either remote control or the controls located on the interface box.

- For remote control PMK offers the software "PMK Probe Control" with graphical user interface, which is shipped with any PS2 and PS3 power supply, and is available for download at: <http://www.pmk.de/en/products/probecontrol>
- In addition, the Python package "PMK-probes" is available as a programming interface for controlling PMK's active probes. Installation instructions, examples and documentation is available at: <https://pmk-probes.readthedocs.io/en/latest/>

Measurement Principle

The high voltage differential probe series HORNET® consists of two balanced precision attenuators, which are differentially matched. The attenuators scale the input voltage before passing into the differential amplifier. The output of the differential is fed over a driver stage to the 50 Ω input of a measuring device.

Factory Calibration

All models are shipped with factory calibration certificates. Annual factory re-calibration is recommended. ISO17025 calibration upon delivery or as re-calibration is possible on request.

Specifications

Read the Instruction Manual before first use and keep it for future reference. A digital copy of the latest Instruction Manual revision can be downloaded at www.pmk.de.

Do not exceed the specifications. Allow the probe to warm up for 20 minutes. This probe comes with 1 year warranty. Each specification is determined at +23 °C ambient temperature. This probe series is not for hand-held use, and not rated for CAT II, III or IV.

Electrical Specifications

Electrical Specifications¹ that are not marked with (*) as guaranteed are typical.

Article number	HORNET4kV	
Attenuation* ($\leq \pm 1\%$ guaranteed)	1000:1, 500:1, 200:1, 100:1	
Bandwidth* (-3 dB)	$\geq 300\text{MHz}$	
Small Signal (guaranteed)		
Rise time (10 % - 90 %)	1000:1, 500:1: 1.0 ns	
Large Signal	200:1, 100:1: 1.1 ns	
Maximum Rated Input Voltages²		
No Measurement Category	4000 V rms + 4000 V transient overvoltage	
CAT Rating	not applicable	
Pollution Degree	2	
Maximum Differential Input Voltage (DC + AC peak)	1000:1 $\pm 4000\text{ V}$ 500:1 $\pm 2000\text{ V}$ 200:1 $\pm 800\text{ V}$ 100:1 $\pm 400\text{ V}$	
Common Mode Voltage	$\pm 4000\text{ V peak (2800 V RMS)}$	
DC Gain Accuracy ³	$\pm 1.5\%$ (preliminary)	
Propagation Delay ($\pm 0.5\text{ ns}$)	12 ns	
Noise (AC RMS) (Referred to Input)		
30 MHz bandwidth	400V: 0.11 V, 800V: 0.11 V 2000V: 0.13 V, 4000V: 0.14 V	
Full bandwidth	400V: 6.2 V, 800V: 5.2 V 2000V: 1.2 V, 4000V: 0.63 V	
Input Impedance⁴		
Each Input to Ground	10 M Ω $< 5\text{ pF}$	
Differential Input Impedance	20 M Ω $< 2.5\text{ pF}$	
Common Mode Rejection Ratio (CMRR) *preliminary*	DC: > 70 dB 100 kHz: > 60 dB 1 MHz: > 60 dB 3.2 MHz: > 60 dB	10 MHz: > 50 dB 50 MHz: > 40 dB 100 MHz: > 30 dB 300 MHz: > 25 dB

The use of a digital filter with BW=400MHz is recommended.



The electrical specifications are valid for use in a controlled environment, like a semi-conductor tester or test setup with protective cover.

Notes:

¹ Determined when using a PMK power supply PS-02 at +23°C ambient temperature.

² The rating is based on basic insulation in a controlled environment in accordance with IEC 61010-1. Also observe the definitions in the probe series' s instruction manual.

³ Input voltage $> 25\%$

⁴ Including input leads, cables in parallel, measurement frequency 1MHz.

Mechanical Specifications

Parameter	Specification
Weight (Probe only)	370 g
Length	2 m
Probe Input ¹	4mm safety banana (male)
Output Connector	BNC (male)

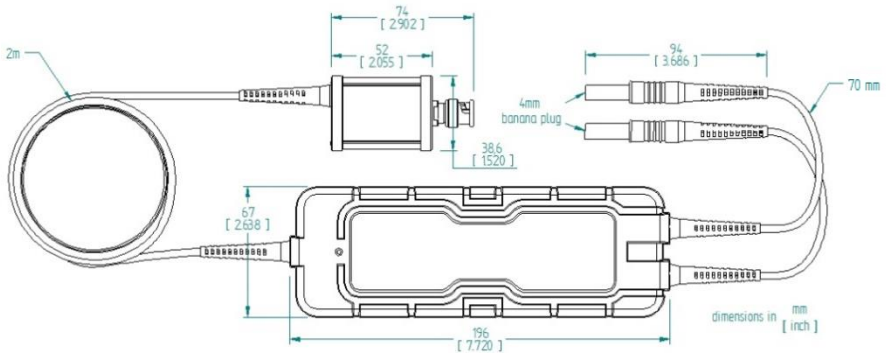
Notes:

¹ Different accessories for connectivity are available. Please review the section “Ordering Information”.

Environmental Specifications

Parameter		Specification
Temperature Range	Operating	0 °C to +50 °C
	Non-Operating	-40 °C to +71 °C
Maximum Relative Humidity	Operating	80 % relative humidity for temperatures up to +31 °C, decreasing linearly to 40 % at +50 °C
	Non-Operating	95 % relative humidity for temperatures up to +40 °C
Altitude	Operating	up to 2000 m
	Non-Operating	up to 15000 m

Dimensions



Probe’s power supply pin assignment



Probe’s power supply pin assignment “cable view”



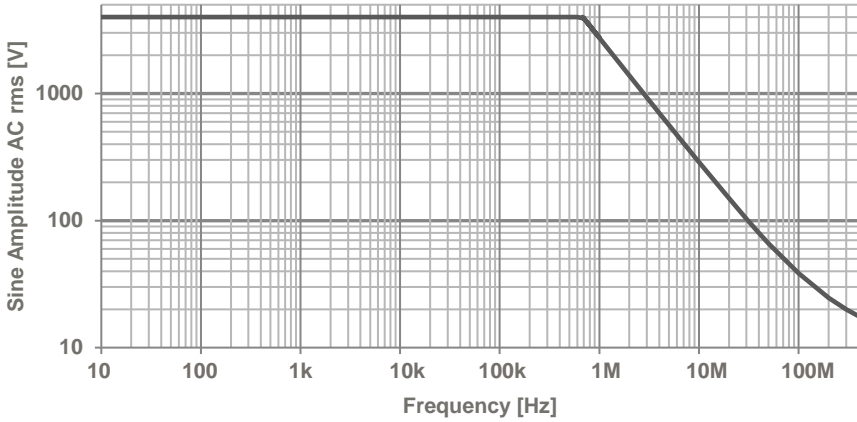
Observe the probe’s power supply pin assignment.

Typical Voltage Derating



Note that the maximum input voltage rating of the probe decreases as the frequency of the applied signal increases.

Typical Voltage Derating – HORNET4kV
No Measurement Category

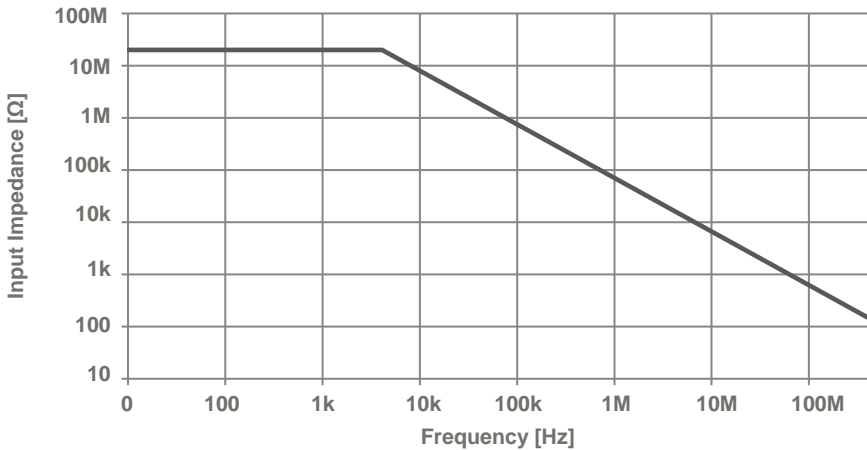


Typical Input Impedance

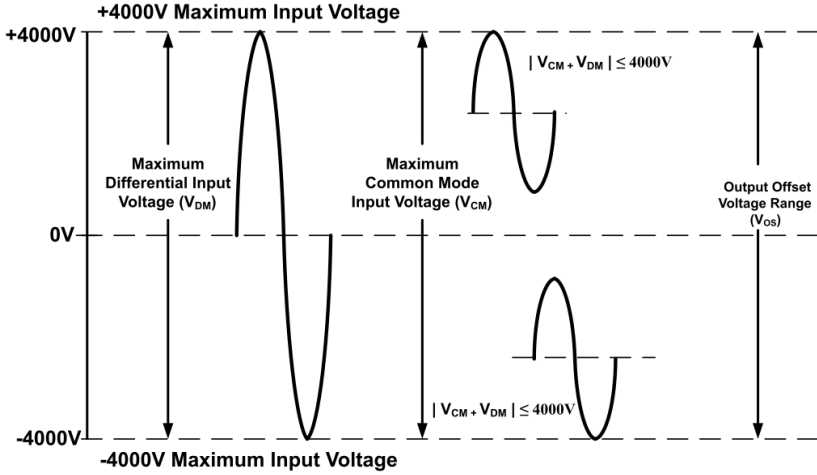


The input impedance of the probe decreases as the frequency of the applied signal increases.

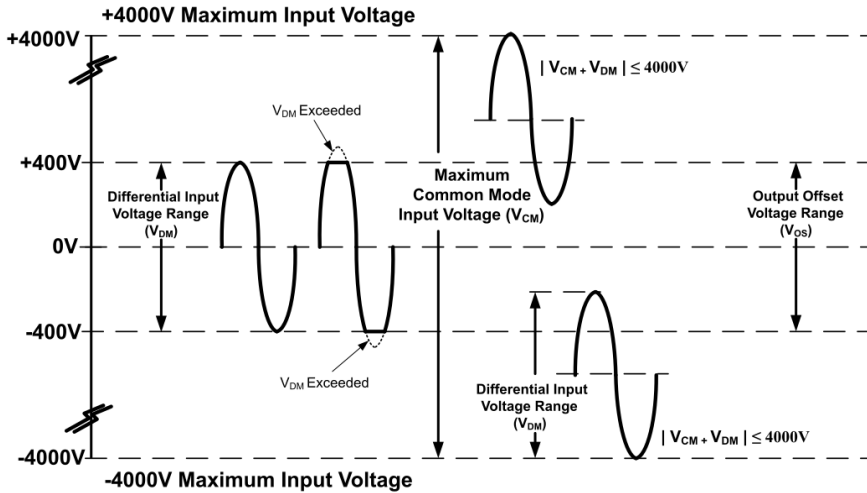
Typical Differential Input Impedance – HORNET4kV



Maximum Input Voltage, Example 4000V Model, 1000:1 Range



Maximum Input Voltage, Example 4000V Model, 100:1 Range



Scope of Delivery

A PMK power supply is required for all models. See chapter “Ordering Information” to review the selection.

Probe HORNET® series

Factory calibration certificate

Instruction manual



891-102-EMC

EMC Noise Suppression Kit for use in environments with high levels of Interference, like in DP tester applications (3x ferrites & opening key)



890-520-000

Power Supply Cable (0.5 m), 30VAC / 60V DC
(1.5m cable available as option)



890-880-103

Pair of Probe Tip Adaptors 4mm to 0.8mm (2x black)



2x 890-808-105

2-Footer



890-880-102

Set of 4 Spring Tips (fine)



890-880-101

Set of 10 Contact Pins 0.64mm



890-880-110

Pair of Spade Terminals, narrow (black / red), 30V AC / 60V DC



890-880-107

Pair of Spade Terminals, wide (black, red), 30V AC / 60V DC



Ordering Information

Step 1: Select the Probe

HORNET4kV

High voltage differential probe, 4000V, >300MHz, with four selectable dividing ranges, 1000:1, 500:1, 200:1, 100:1



Step 2: Select Additional Accessories

Note, that any additional accessory degrades the probe's performance. Always observe the lowest Maximum Input Voltage. Do not use any other accessories than recommended by PMK.

016-397-049

Carrying Case with Foam Inlay (black)



890-880-106

Pair of Mini Spring Tip Probes 4 mm (black, red), 600V CAT II



890-808-105

2-Footer



4mm-SMA-M

4mm safety banana socket to SMA plug adapter, for high-frequency voltage measurements, 500V DC + AC pk, 1000V peak pulse



4mm-SMA-F

4mm safety banana socket to SMA socket adapter, for high-frequency voltage measurements, 500V DC + AC pk, 1000V peak pulse



4mm-MMCX-M

4mm safety banana socket to MMCX plug adapter, for high-frequency voltage measurements, 250V DC + AC pk, 500V peak pulse



4mm-MMCX-F

4mm safety banana socket to MMCX socket adapter, for high-frequency voltage measurements, 250V DC + AC pk, 500V peak pulse



4mm-BNC-F

4mm safety banana socket to BNC socket adapter, for high-frequency voltage measurements, 750V DC + AC pk, 1500V peak pulse



4mm-WSQ-5.08

4mm safety banana socket to square pin adapter, 5.08mm, for high-frequency voltage measurements, 750V DC + AC pk, 1500V peak pulse



890-880-115

Pair of Clamps, Hook (black & red), 1000V CAT II



890-880-114

Pair of Clamps, Jaws (black & red), 1000V CAT III



Continues on next page...

890-880-113

Pair of Clamps, Rotating Grip Jaw (black & red)
1000V CAT II

**890-880-108**

Pair of Safety Alligator Clips, big (black & red), 1000V CAT III

**890-880-111**

Pair of Safety Alligator Clips, small (black & red), 600V CAT III

**890-880-112**

5x Pair of Rail Clip Connectors 4 mm (black, red), 600V CATIII

**890-880-116**

4 mm Coupler f-f (red), 30VAC / 60V DC

**890-880-109**

Pair of Magnet Connectors 4 mm (black/red), 30VAC / 60V DC

**D010031**

50Ω BNC feed-through for 1MΩ input oscilloscopes. >500MHz

**890-880-103**

Pair of Probe Tip Adaptors 4mm to 0.8mm (2x black) – spare part

**890-880-102**

Set of 4 Spring Tips (fine) – spare part

**890-880-101**

Set of 10 Contact Pins 0.64mm – spare part

**890-880-110**

Pair of Spade Terminals, narrow (black / red), 30V AC / 60V DC – spare part

**890-880-107**

Pair of Spade Terminals, wide (black, red), 30V AC / 60V DC – spare part



Step 3: Select Power Supply

A PMK power supply is required, and available separately.

889-09V-PS2	PS-02, 2ch power supply, with USB interface for remote control, for 100 -240V AC / 50 - 60Hz mains *
889-09V-PS2-L	PS-02-L, 2ch power supply, with LAN and USB interface for remote control, for 100 -240V AC / 50 - 60Hz mains *
889-09V-PS3	PS-03, 4ch power supply, with USB interface for remote control, for 100 -240V AC / 50 - 60Hz mains *
889-09V-PS3-L	PS-03-L, 4ch power supply, with LAN and USB interface for remote control, for 100 -240V AC / 50 - 60Hz mains *
890-520-915	Power Supply Cable, 1.5 m (0.5m cable included I scope of delivery)

Observe Connector Pin-Out for PMK power supply cables



The power supply pin assignment is different from other power supplies. Use only original PMK power supplies with PMK probes.

Step 4: Select Positioning System

893-350-010

3D positioner with steel base, 200 mm span width, twin holder, ideal for reliable positioning when the probe's inputs is equipped with spring loaded tips



893-350-015

3D positioner with steel base, 200 mm span width and probe holder



893-350-014

3D positioner with steel base, arm with 200 mm span width and probe head holder, arm with 130 mm span width and twin holder, ideal for reliable positioning of a BumbleBee® or HORNET® series probe when the probe inputs are equipped with spring loaded tips



893-350-013

BumbleBee® or HORNET® series probe head holder – spare part, for use with PMK's SKID positioning system for PCBs and probes



890-880-104

Twin holder M6 – spare part, for use with PMK's SKID positioning system for PCBs and probes



Step 5: Select Accredited Calibration

KAL-DAKKS-HORNET4kV ISO 17025 (re-)calibration

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Änderungen der Spezifikationen vorbehalten.