

Differential Probe P9000-01/-02

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Abstract—The Differential Probe P9000-01/-02 is a compact differential probe that complies with the safety requirements associated with CAT III 1000 V measurement. This paper provides an overview of the product and describes its hardware and example characteristics.

I. INTRODUCTION

When measuring high voltages, it is necessary to consider the overall safety of the measurement system, including the individual making the measurements. Failure to do so not only may damage the measurement target and measuring instrument, but also place the individual making the measurement at risk. Use of measuring instruments with isolated inputs, like Hioki's Memory HiCorder series, is an effective way to ensure safety. However, applications such as measuring the battery voltage in electric vehicles and new energy sources such as solar power increasingly exceed the standard Memory HiCorder's maximum voltage to ground rating, and this trend looks set to continue. Furthermore, there is a high level of demand for instruments with excellent environmental durability, particularly in terms of suitability for use in a broad range of temperatures. As a result, Hioki developed the P9000-01/-02 with the goal of providing an easy-to-use differential probe that would deliver the safety and compatibility with a broad temperature range required by such applications.

II. OVERVIEW

Differential probes are a standard tool for safely measuring high voltages. However, by and large this class of devices does not deliver a good user experience due to issues such as excessive size and the need for a separate power supply. The P9000-01/-02 is a compact differential probe that provides ease of measurement along with an input range of 1000 V AC and DC while ensuring CAT III 1000 V safety.

III. FEATURES AND FUNCTIONS

A. Compact, Lightweight Design

Thanks to a compact, lightweight design, the P9000-01/-02 is less than half the size (by volume) of the previous Hioki Differential Probe 9322, and it weighs just 170 g.

B. CAT III 1000 V Compliance

The P9000-01/-02's maximum input-to-ground voltage complies with CAT III 1000 V requirements, allowing the



Appearance of the P9000-02.

device to accommodate input of 1000 V AC or DC across its terminals. It also provides voltage division ratios of 1:100 and 1:1000, allowing selection of the optimal output for the input being measured.

C. Broad Operating Temperature Range

The P9000-01/-02 has an operating temperature range of -40°C to 80°C (-40°F to 176°F) so that it can be used in applications such as environmental load testing of automobiles.

D. Three-Way Power Supply

The optional AC Adapter Z1008 provides power for the P9000-01/-02, which can also be driven directly by a DC power supply, in which case it supports a broad range of voltages from 2.7 V to 15 V DC. The device also has a micro-USB port, which allows it to be operated on USB bus power when used with an instrument that has a USB port.

E. RMS Output

The P9000-02 can output AC RMS values. The output RMS value reflects the voltage division ratio, which is applied to the AC-coupled input.

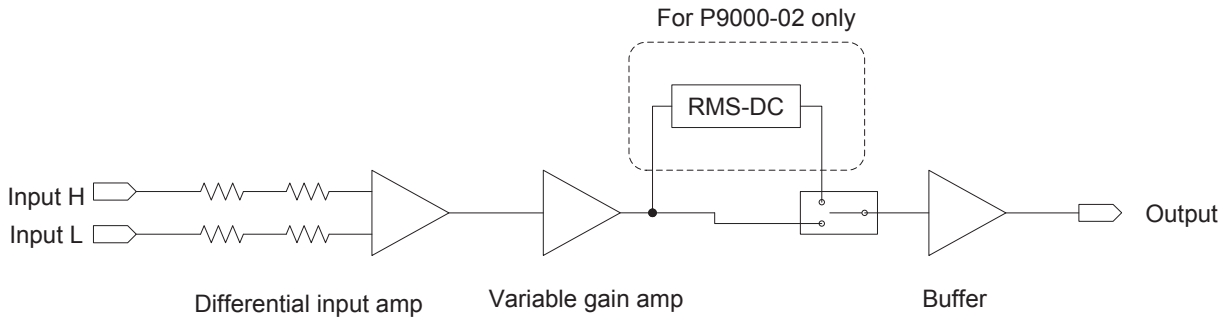


Fig. 1. Block diagram.

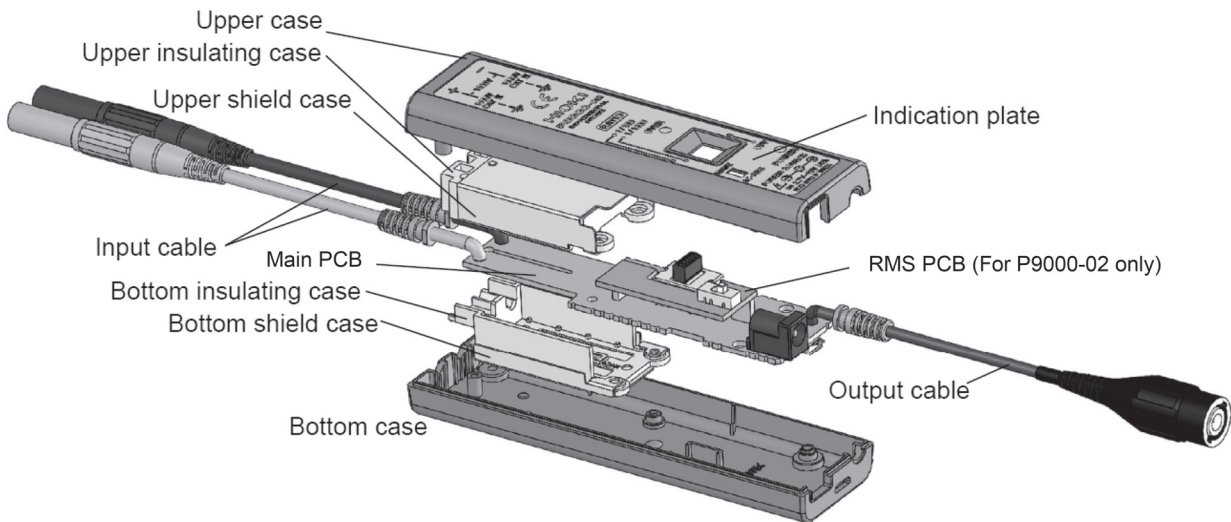


Fig. 2. Structural diagram.

IV. ARCHITECTURE

A. Hardware Architecture

Fig. 1 provides a block diagram for the P9000-01/-02. The RMS conversion unit is unique to the P9000-02. Current is limited by the input block's impedance, providing a level of safety that is equivalent to a double-insulated CAT III 1000 V device.

B. Structure

Fig. 2 provides a structural diagram of the device. Upper and lower insulating cases ensure a safe amount of separation from the high-voltage portion of the circuitry. The upper and lower cases as well as the insulating cases are made from robust PPE that is heat-resistant to 80°C (176°F).

V. EXAMPLE CHARACTERISTICS

Figs. 3 through 11 illustrate example characteristics. Although it exceeds the device's specifications, heat characteristics data for 90°C (194°F) has been included for reference purposes. This data comprises representative

examples and does not constitute a guarantee of product characteristics.

VI. CONCLUSION

Hioki commercialized the P9000-01/-02 as a probe that is capable of measuring high voltages safely and easily. The company expects the product to be used in a wide range of applications as an option for a variety of measuring instruments.

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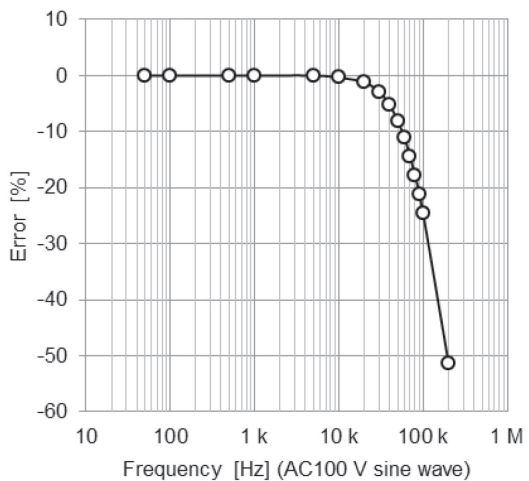


Fig. 3. Frequency characteristics.

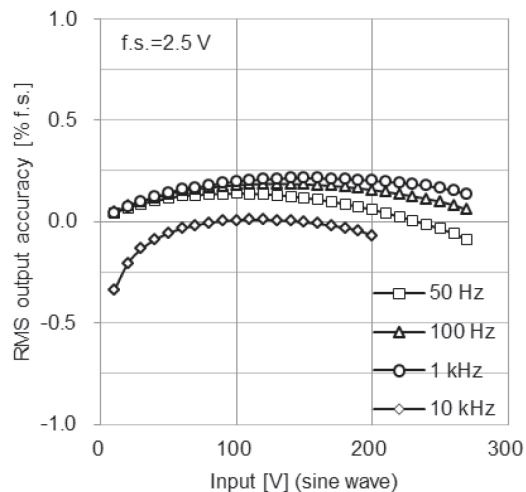


Fig. 6. RMS output accuracy (voltage division ratio: 1/100).

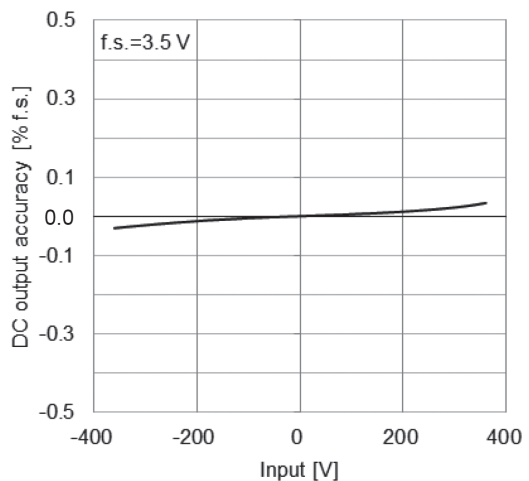


Fig. 4. DC output accuracy (voltage division ratio: 1/100).

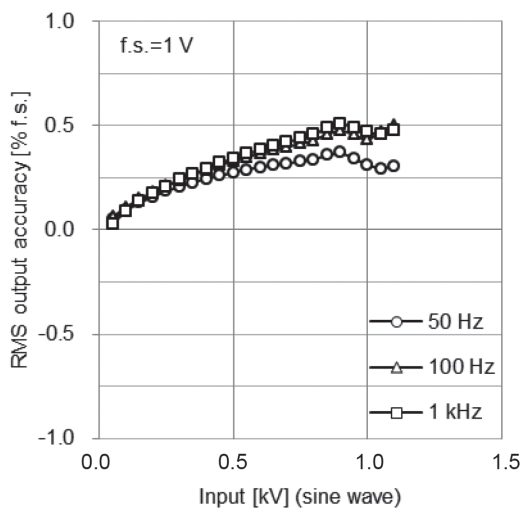


Fig. 7. RMS output accuracy (voltage division ratio: 1/1000).

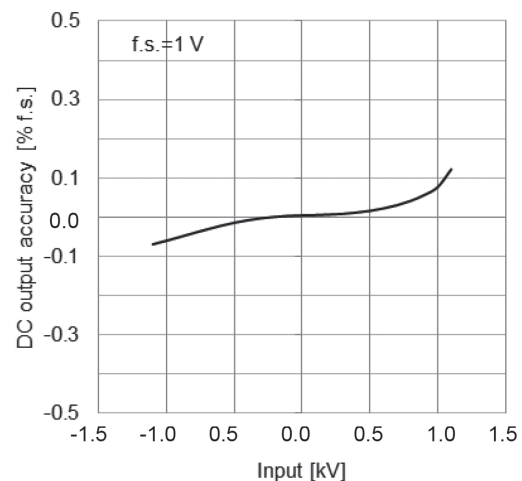


Fig. 5. DC output accuracy (voltage division ratio: 1/1000).

Differential Probe P9000-01/-02

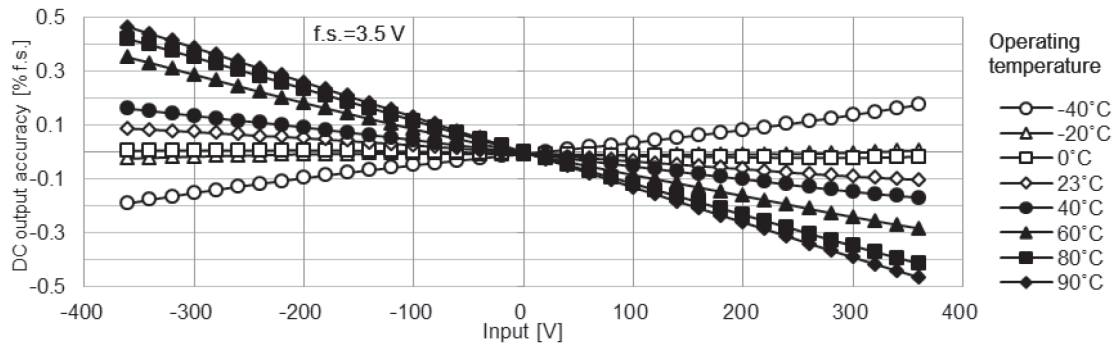


Fig. 8. DC output accuracy/temperature characteristics (voltage division ratio: 1/100).

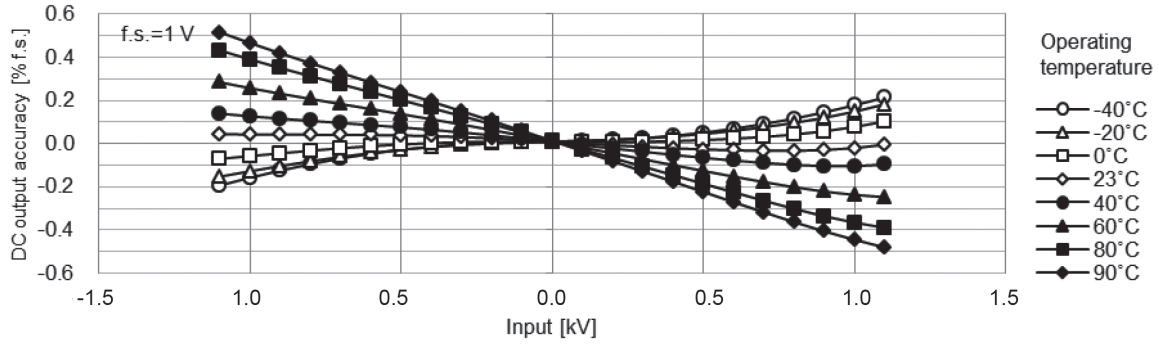


Fig. 9. DC output accuracy/temperature characteristics (voltage division ratio: 1/1000).

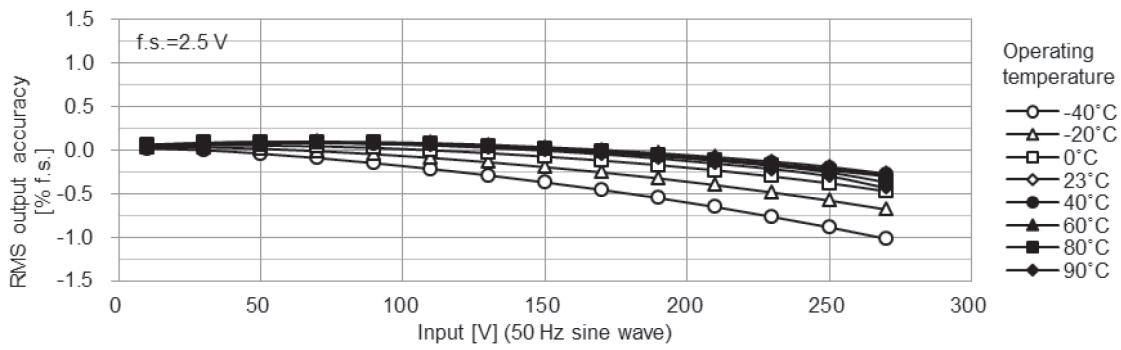


Fig. 10. RMS output accuracy/temperature characteristics (voltage division ratio: 1/100).

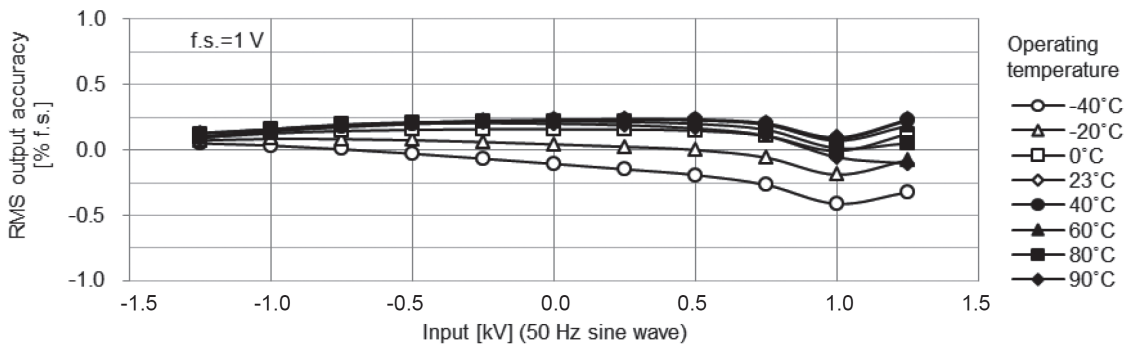


Fig. 11. RMS output accuracy/temperature characteristics (voltage division ratio: 1/1000).