

PocketPico Picoammeter: Resistance Measurements

PocketPico limitations on input voltage and current.

I. INTRODUCTION

Resistance can be measured using the PocketPico by using the principle of Ohm's Law ($V = IR$) through setting a voltage, measuring the current and calculating the resistance. Proper grounding and shielding in the test setup can greatly improve the accuracy of resistance measurements.



Caution: The maximum voltage seen at V_{REF} or I_{IN} of the PocketPico must be between $-1V$ and $5V$ when referenced to ground. The PocketPico does not internally limit this voltage and instrument damage, electrical shock or death can occur [1].

II. FIXED VOLTAGE MEASUREMENT

V is the amount of force (Voltage) required to push mass over time of I (Current) through medium of R (Resistance). By fixing a known voltage and measuring a current, the resistance can be calculated for a device under test (DUT). For resistance values between $1k\Omega$ and $10M\Omega$, a low voltage source can be used. A example setup for resistance testing using the PocketPico is shown in Figure 1. The PocketPico is a current

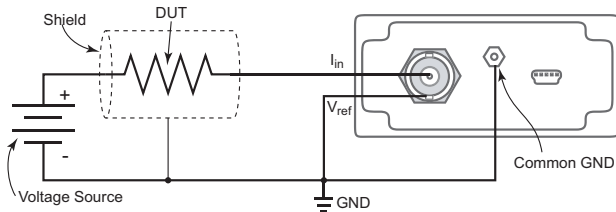


Fig. 1. The PocketPico is used as a current sink to facilitate the calculation of resistance.

sink, and therefore the reference voltage for the summing node must be less than the voltage at the source so that the PocketPico will sink current [1], [2]. Care should be taken to not have the current into the PocketPico device exceed the measurement range.

III. HIGH RESISTANCE MEASUREMENT

The PocketPico can be used to measure very high resistances with a high voltage source; however, care must be taken to not short the source directly to the PocketPico device. Furthermore, the failure mode of the DUT should be considered as some devices fail to a very low effective resistance. An external fuse is available as an option with the PocketPico and the fuse offers a level of protection against accidental shorts. A example setup for high-resistance testing using the PocketPico is shown in Figure 1.

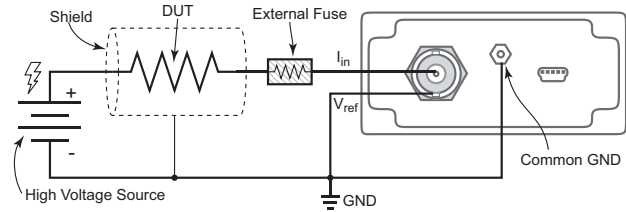


Fig. 2. The PocketPico is used as a current sink to facilitate the calculation of resistance with an external fuse between the PocketPico device and the DUT.

IV. PROTECTION CIRCUITRY

The PocketPico contains protection circuitry for electrostatic discharge (ESD), and this circuit governs the lower bounds of the measurement range of the PocketPico. The ESD protection circuit that sits before the current measurement circuit can be approximated by the schematic shown in Figure 3. The PocketPico attempts to remove current from a summing

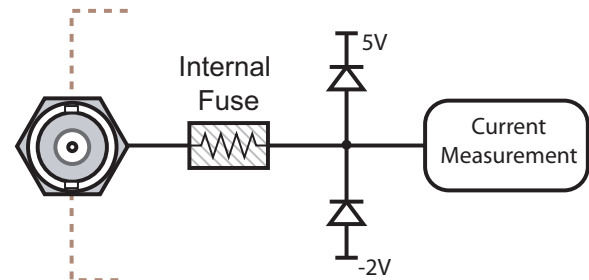


Fig. 3. An equivalent circuit that describes the ESD protection on the PocketPico.

node at the same rate at which the current is put on through the input[2]. Exceeding a current of $4mA$ will cause the voltage at the input to rise. This voltage will possibly cause the internal fuse to blow, the clamping diodes to require replacement or further damage to the PocketPico device or attached computer. For these reasons, caution should be used when using high-voltage sources or measuring low-resistance devices. Resistors to limit the current at the input are a possible method for protecting the PocketPico device when using high voltage sources.

REFERENCES

- [1] Ix Innovations, LLC., "Pocketpico picoammeter instruction manual," http://pocketpico.com/download/pp_manual_1.0.pdf.
- [2] Brian Degnan, "Ammeter theory of operation," <http://pocketpico.com/download/theoryofoperation.pdf>.