

PocketPico Picoammeter: Optical Measurements

Measurement approaches for diode devices.

I. INTRODUCTION

The PocketPico Ammeter enables current measurement from 20pA to 2mA, and therefore makes a platform for the analysis of exponential behavior of many junction devices. The PocketPico Ammeter is a current sink, and one must be mindful of the voltage limits of the input and the unidirectional behavior of the device. Proper grounding of the test setup can greatly improve the accuracy of any current measurement.



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. PHOTODIODE

The exponential current relationship to optical intensity can be used to characterize the performance of a photodiode or align an optical beam. A bias voltage must be applied that is a large enough for the device under test to operate properly. For a silicon photodiode, 2 volts is adequate. An example setup for resistance testing using the PocketPico is shown in Figure 1.

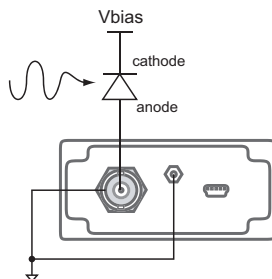


Fig. 1. The PocketPico is used to measure current from a photodiode.

III. PHOTOTUBE APPLICATIONS

The PocketPico can be used to measure the current induced by optical phonon in a phototube. Because the PocketPico Ammeter is a unidirectional device, care must be taken in biasing so that the current flows into the device. An example of positively biasing a phototube by connecting a positive source to the anode is shown in Figure 2.

IV. PROTECTION CIRCUITRY

The PocketPico Ammeter contains protection circuitry for electro-static discharge (ESD), and this circuit governs the lower bounds of the measurement range and bounds the voltage at the input of the device. It is possible for photodiodes

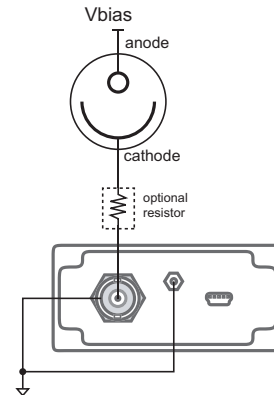


Fig. 2. The PocketPico is used as a current sink to measure the current induced in a phototube.

and devices that multiply current, such as photomultiplier tubes, to source more current than the PocketPico Ammeter can sink at the summing node[2], and exceeding a current of 4mA will cause the voltage at the input to rise.

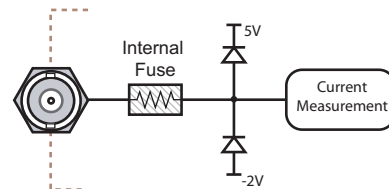


Fig. 3. An equivalent circuit that describes the ESD protection on the PocketPico.

The ESD protection circuit that sits before the current measurement circuit can be approximated by the schematic shown in Figure 3. 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>.