MightyWatt Application Note 002 – True Zero Voltage Using a Bias Source

Application note revision: A (2017-02-05)

Introduction

Electronic loads typically use a transistor or an array of them to create a programmable resistance. Because even a fully-opened transistor has some minimum resistance, the load cannot measure zero voltage under non-zero current. Besides the transistor(s) in the load, other sources of resistance, such as connectors and cables, also contribute to the minimum possible resistance. This resistance can be compensated for using a bias source, which is a power supply capable of delivering the same current as the device under test (DUT).

Choosing the bias source

The main characteristic of the bias source is its current source capability. The bias source will have to supply the same current as the DUT.

The total dissipated power in the entire system is then the voltage at the DUT + the voltage of the bias source multiplied by the current. Some of the power will be dissipated on cables and connections but the majority will be dissipated in the load. Although by using such a setup it will be possible to achieve true zero voltage at the DUT, the power dissipation in the load will be generally higher. The DUT must be galvanically isolated from the load.

Connecting for compensation

The bias supply is connected with its negative terminal to the negative terminal of the load (Figure 1). The positive terminal of the bias supply goes to the negative terminal of the DUT. In this way, the negative terminal of the DUT will be above zero volts. The positive terminal of the DUT is connected to the positive terminal of the load. The load then has to go as low as the voltage at the negative DUT terminal / positive bias supply to reach 0 volts across the DUT. The true voltage at the DUT is sensed on a separate pair of cables using the 4-wire method. The bias source should be, if possible, set to the minimum voltage that would achieve 0 volts on the DUT.

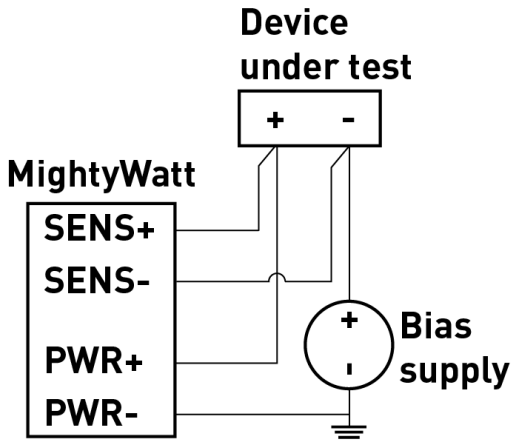

Figure 1: Connection schematic to compensate for minimum resistance using a bias supply.