Ripple and Noise Measurement of Brick & POL DC-DC Converters

Ripple and Noise performance is likely to be one of the most important parameters for a typical application for these types of converters. The question of how to reduce and measure ripple and noise is a complex one, so this application note focuses on suggesting basic solutions for certain specific applications.

The method of measurement that we suggest in this application note is intended for use by technical personnel to understand this specific measurement in order to set up test stations that will produce precise results.

NOTE: Additional capacitors at the input and output terminals are highly recommended for testing and for real applications. They are used in the solutions suggested in this application note.

Input filtering and Input reflected ripple - Test Set-up

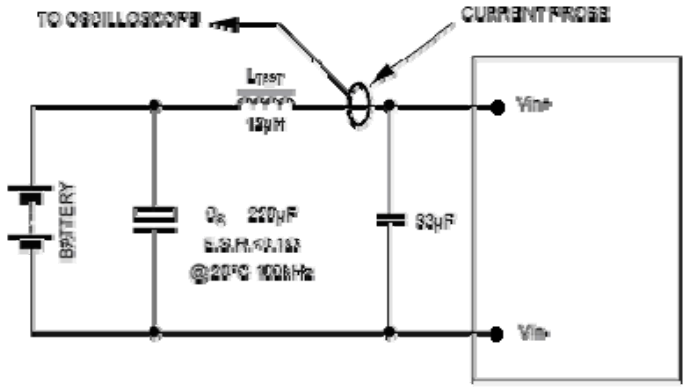

Figure 1: Input reflected Ripple Current Test Set-up.

The power module should be connected to a low AC impedance source. The measurement of the Input Reflected Ripple Current has to be taken with a simulated source inductance L_{test} of 12µH. Highly inductive source impedance can affect the stability of the power module.

C_s capacitor is connected to offset this possible battery impedance. 33µF electrolytic capacitor (ESR<0.7Ω at 100 kHz) is required across the input terminals in the test configuration to ensure a stability of the unit and proper operation.

Output Ripple and Noise Measurement - Test Set-up

Standard four-terminal or Kelvin measurement practices should always be observed. A voltage measurement on the output terminals of a DC-DC converter should be taken on separate contacts that do not carry load current. Taking measurements on contacts carrying load current may result in erroneous reading of many mV.

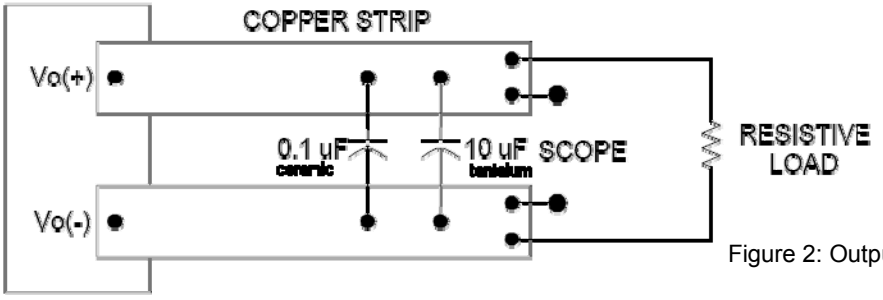

Figure 2: Output Ripple and Noise Measurement Test Set-up.

A 0.1µF X7R or NPO type ceramic capacitor, rated for two or three times the converter voltage, is recommended for use in the end application, mounted in close proximity to the module.

Testing method:

Copper strips with a minimum of 51mm (2 inches) in length need to be connected on the output terminals of the converter. For most of the applications, copper foil tape can be used. The copper strips are simulating PCB traces performance of the unit in the end application. The width and thickness of the copper strips should be calculated so that the combined voltage drop in both ends of the strip do not exceed 2% of the output voltage for the maximum output current of the model. Place the copper strips at a distance of 2.54mm (0.1 inch) of each other, which is the typical spacing for low-voltage PCB traces.

It is suggested that the above mentioned 0.1µF ceramic capacitor be soldered on 25.4mm (1 inch) from the output terminals of the converter to the copper strips. It provides filtering for the high-frequency noises picked up by the unshielded copper strips while only having a minimum effect on the ripple and noises generated by the converter. The 51 to 76mm (2 to 3 inches) strips are excellent receivers for high frequency radiated noises. In addition, the copper strips usually extend beneath the component, where magnetic fields might be present.

We recommend that a 10µF tantalum capacitor be mounted as close as possible to the oscilloscope to filter the noises that could be generated from the measuring probe.

Important notice:

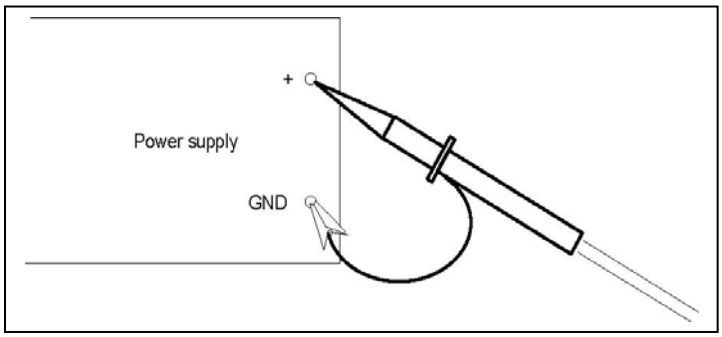

Figure 3: Not a recommended method for measuring Ripple and Noise.

The conventional ground clip of the oscilloscope probe should never be used in this type of measurements. This clip acts as an antenna or inductive pickup loop, creating an additional signal which is not a part of the output noises of the converter.

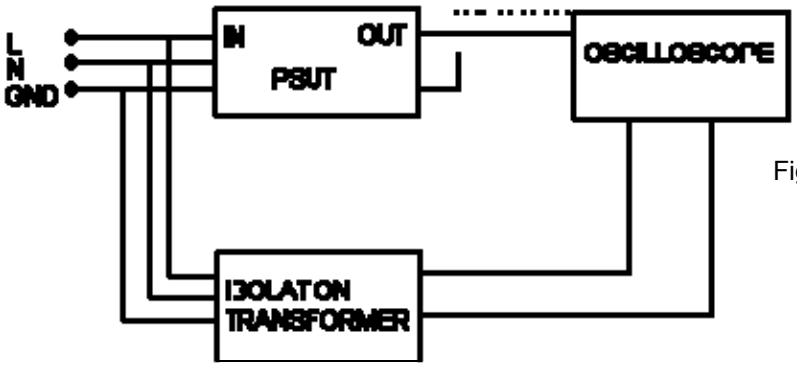

Figure 4: Oscilloscope setup to eliminate ground loops.

To avoid ground loops, it may be necessary to separate the oscilloscope ground from the power under test.