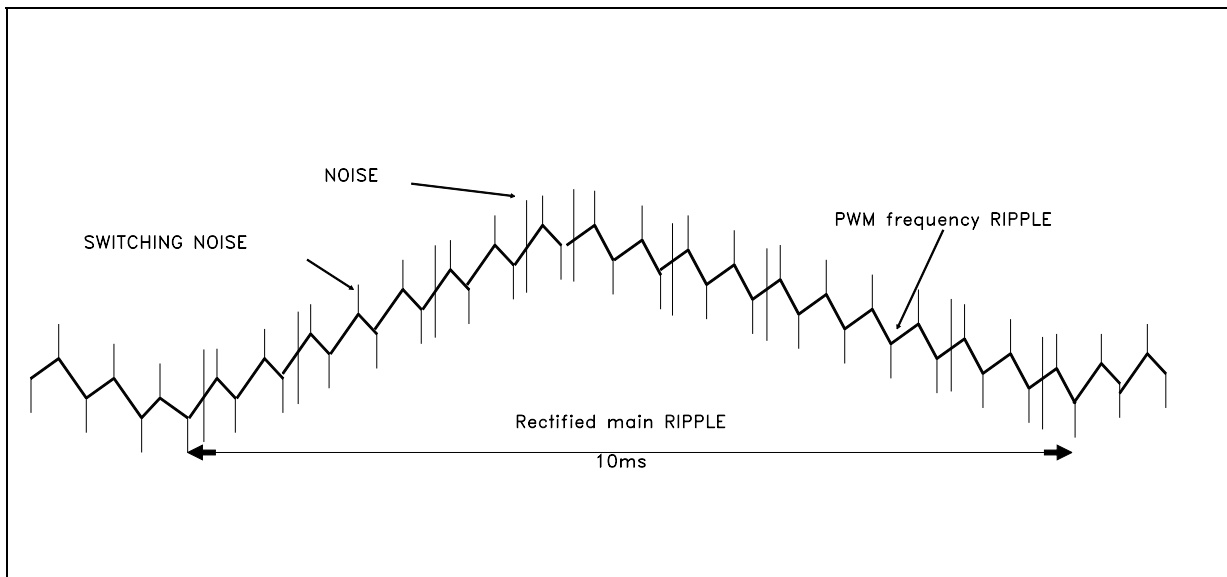


## HOW TO TEST OUTPUT RIPPLE AND NOISE OF POWER SUPPLIES

The switching power supplies (either step-down regulators, or isolated DC-DC converters, or OFF-LINE power supplies) have the fundamental advantage of high efficiency i.e. low power dissipation when compared to linear voltage regulation.

However the switching technique, that is beneficial to raise the efficiency, has an associated weakness i.e. the output voltage has always an AC content. The typical output ripple and noise of a switching power supply is as shown in fig. 1.

**Figure 1. Output ripple and noise of a switching power supply**



Four AC components can be identified:

- low frequency ripple at  $2f$  being  $f$  the AC mains frequency
- high frequency ripple due to Pulse Width Modulation (PWM) to obtain the required line and load regulation.
- the switching noise that has the same frequency of the switching PWM
- the aperiodic random noise that is not related to the AC source frequency and/or the switching frequency.

The above mentioned parameters are normally specified by the peak to peak amplitude so that the best method for testing is by an oscilloscope with a bandwidth of 20 MHz.

Care must be taken when using the scope probe.

Fig. 2 shows a wrong method because the ground wire of the probe can collect radiated noise and the scope display is strongly dependent on the probe position.

Fig. 3 shows a better method because the collection of the radiated noise is minimized.

## How to test the output ripple and noise of power supplies

Figure 2. Wrong output ripple and noise test

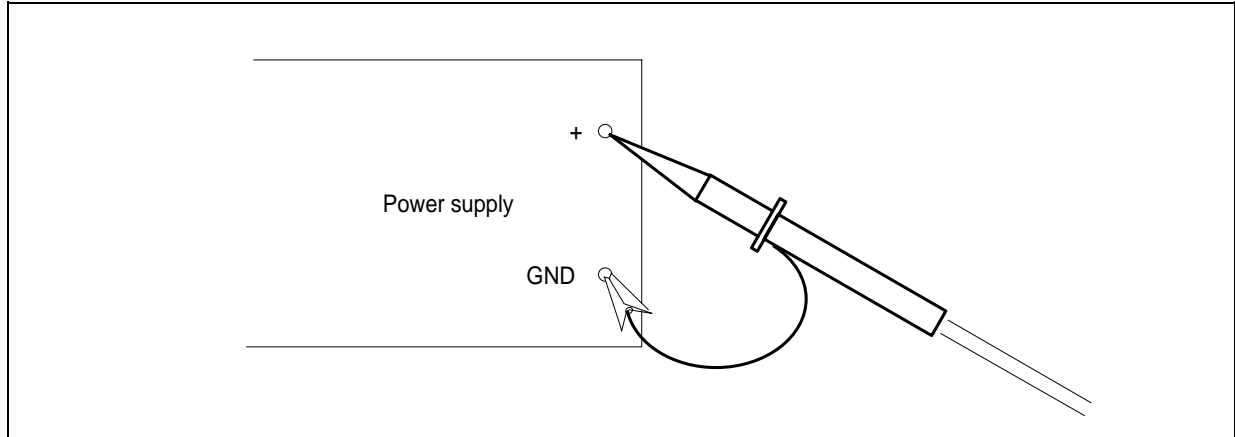
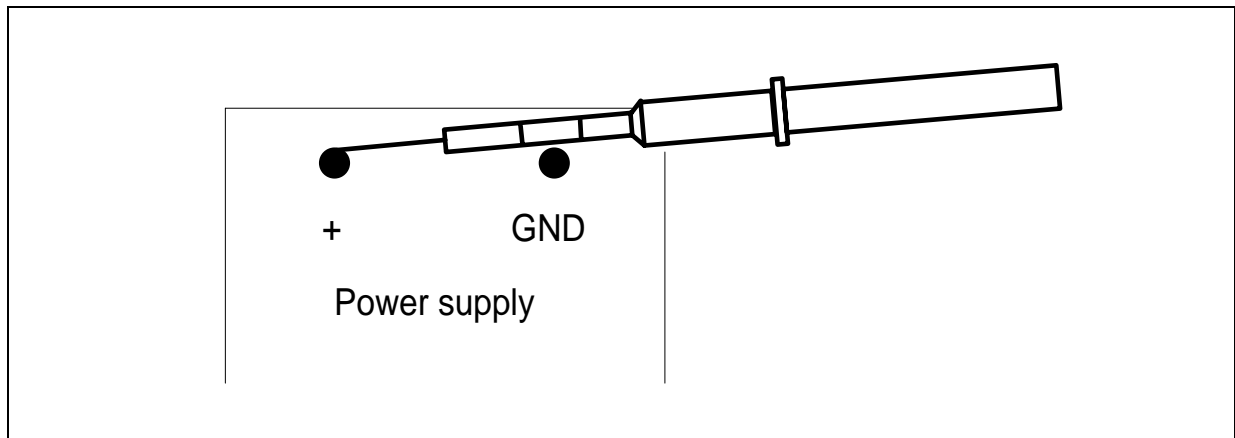


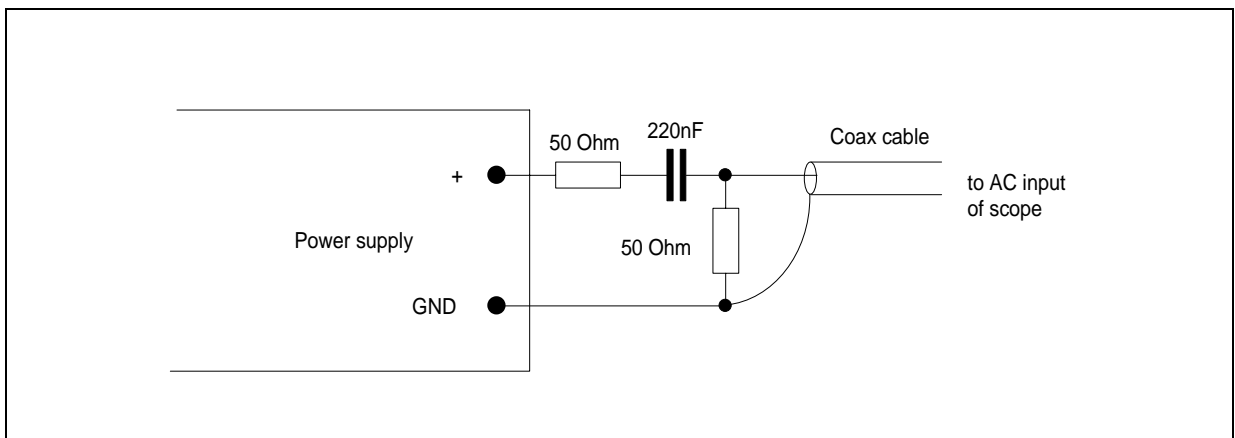
Figure 3. Correct output ripple and noise test



The ground ring of the probe is pressed directly against the output ground of the power supply and the tip is in contact with the output voltage pin.

A preferred method is shown in fig. 4: the waveform displayed on the scope must be multiplied by a factor 2.

Figure 4. Preferred method to test output noise and ripple



## How to test the output ripple and noise of power supplies

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