4.2 Measuring cable routing

There is the possibility of influence from external noise sources when using long, unshielded measuring cables. Although they allow uncomplicated measurement, the problem arises that the cable is located within the range of another mains-powered electrical device and therefore interference may be coupled into the cable, which causes measurement errors. It is therefore essential that no mains cable is located in the immediate vicinity of the probe, because even the power socket of the isolating transformer can be susceptible to capacitive coupling.

In order to avoid coupling of electromagnetic fields into cable loops, the supply and return lines should always be twisted. The use of shielded measurement cables is recommended.

4.3 Compensation of the probe

The measurement results should not depend on the probe used. Therefore, prior to each measurement, the probe should be matched to the particular oscilloscope input.

This can be achieved by adjusting the probe. Oscilloscopes have a calibration connector for this purpose, which provides a perfectly shaped square wave to which the proble is attached. The signal displayed on the screen is tuned at the probe until there is no overshoot or undershoot on the rising and falling slope. This allows fast signal (e.g. DC/DC converter switch node) to be measured correctly.

4.4 Selection of the duty cycle

Different probes (divider ratios) have a considerable influence on the measurement result, which is very clearly shown with two measurement curves (Fig. 4.2).

As the layout of standard EVAL boards is optimized and therefore shows no input signal with steep edges, an unfavorable layout design with a high level of ripple is taken to explain the issue. The voltage peaks occurring here are strongly attenuated with a 1:1 probe in contrast to a 1:10 probe. This is explained by the fact that the 1:10 probe has a higher internal resistance (10 MΩ versus 1 MΩ) than the 1:1 probe and therefore hardly influences the rise time of the voltage signal. Furthermore, the probe's high bandwidth avoids an incorrect visualisation of the measurement voltage. Signals such as the switch node voltage that show a low rise and fall time can realistically only be recorded using a probe with a bandwidth of > 100 MHz and an input divider of 1:10.

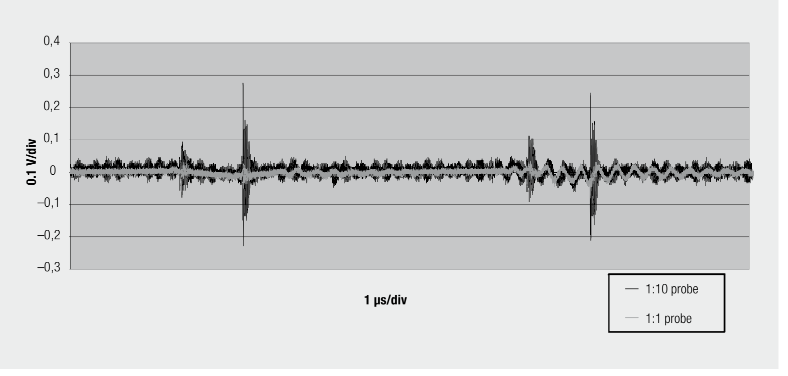

Fig. 4.2: Comparison probe attenuation 1:1 and 1:10

4.5 Ground connection of probes

Output ripple

Inductive influences of PCB tracks or THT components can cause unwanted coupling into the probe at different locations of the switching regulator. Through the use of the probe's long ground conductor, additional parasitic effects are coupled into the circuit. For this reason, the probe's original ground cable should not be used for the ground contact. Instead, a ground spring should be used for the probe tip, as in Figure 4.3, as shown with the output ripple of an unfavorable layout. Measurement of the output ripple with a probe with ground spring should be done directly at the output capacitor.

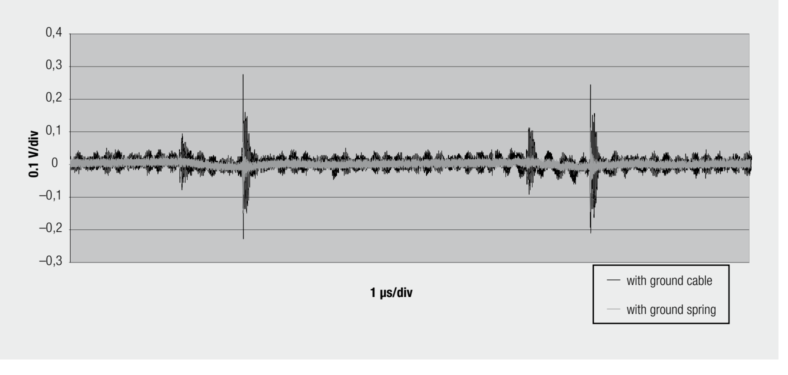

Fig. 4.3: Difference in ground connection taking the example of the ground cable/ spring

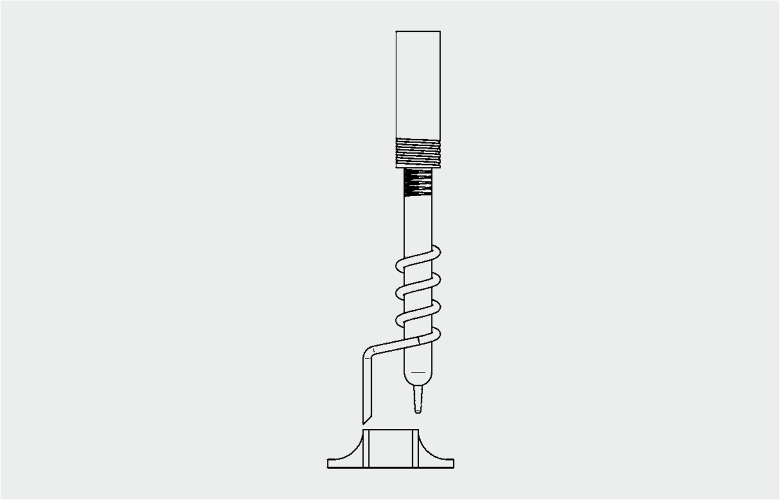

Fig. 4.4: Probe connection for correct measurement of the output/input ripple

4.6 Probe compensation

Probes are usually adapted to the input characteristics of certain oscilloscope models. It is observed, however, that there may be differences between the individual oscilloscope models and even between individual probe inputs of a device, which distort the measurement results.

So the aim should be to eliminate such differences. Some devices offer automatic compensation for this purpose, whereby the manual variant, in which the square wave generator output is used, is preferable.

It is therefore recommended to check the compensation setting when first connecting the probe to the oscilloscope or when changing the input.

4.7 Attenuation of oscillations

As described already, oscillations in the probe may occur with unfavorable circuit layouts. These are caused by transients e.g. through parasitic lead inductances or junction capacitances in the semiconductor components. It is possible to attenuate these couplings using a resistor (e.g. 2.2 kΩ) between the probe and the measurement object and therefore to present the curve profile better.

4.8 Common mode rejection

Common mode noise

Common mode noise can be coupled via the probe cable and cause deviations in the measurement results. This effect can be reduced with a snap ferrite from Würth