AN90004

Probing considerations for fast switching applications

Rev. 1 — 17 October 2018 Application note

Document information

Information	Content
Keywords	GaN FET, fast switching measurement, oscilloscope probe, ground spring
Abstract	Accurate voltage waveform measurements of fast switching circuits require special care and attention in the use of the oscilloscope probe. This Application note details the use of a probe ground spring to achieve the best results.

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1. Introduction

The latest GaN FET devices from Nexperia are capable of very fast switching of high voltages and currents. This requires special care to be taken in the measurement of the switching waveforms.

In order to accurately measure voltages on fast switching nodes, best measurement practices should be followed. It should be noted that unless efforts are made to follow best practice as closely as possible, then the voltages seen on the oscilloscope may be an artefact of the measurement rather than a true representation of the real voltage on the node.

An example of a fast switching waveform is shown in Fig. 1 below. Note the difference between measurements results with a) the oscilloscope probe ground connection made using a standard probe ground wire and b) the same measurement with the ground connection made using a probe ground spring.

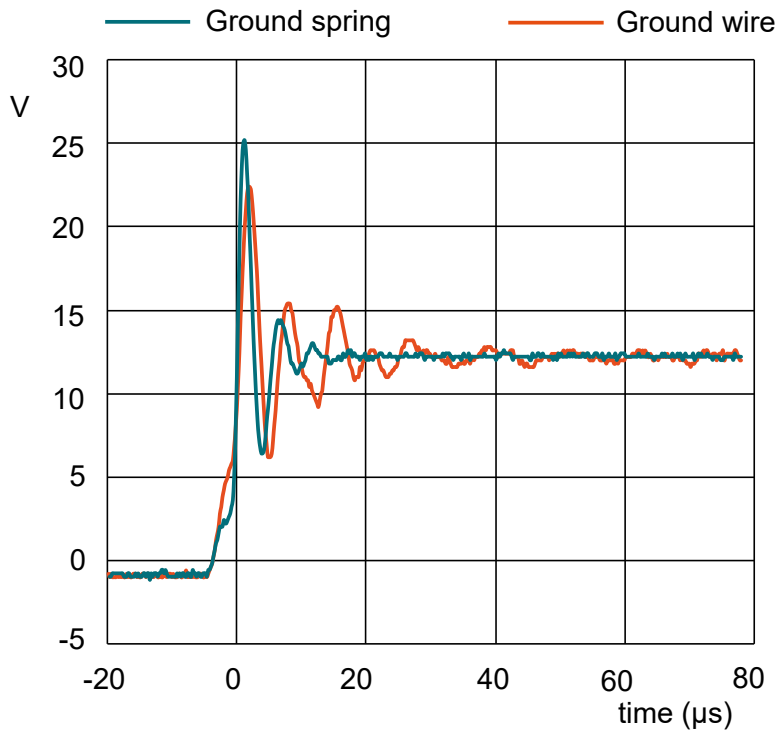

Fig. 1. Switching waveform; probe grounding method comparison

2. Oscilloscope probe ground spring

The ground lead length of the oscilloscope probe can have a very detrimental effect on the measurements taken. If you use the standard 10 cm loop supplied with the scope probe, the measurements that you make will be prone to noise and pickup, as the loop acts as an aerial and picks up noise in proportion to the loop area.

In order to make switching node measurements that are less prone to noise and pickup, the following type of oscilloscope probe connections should be made:

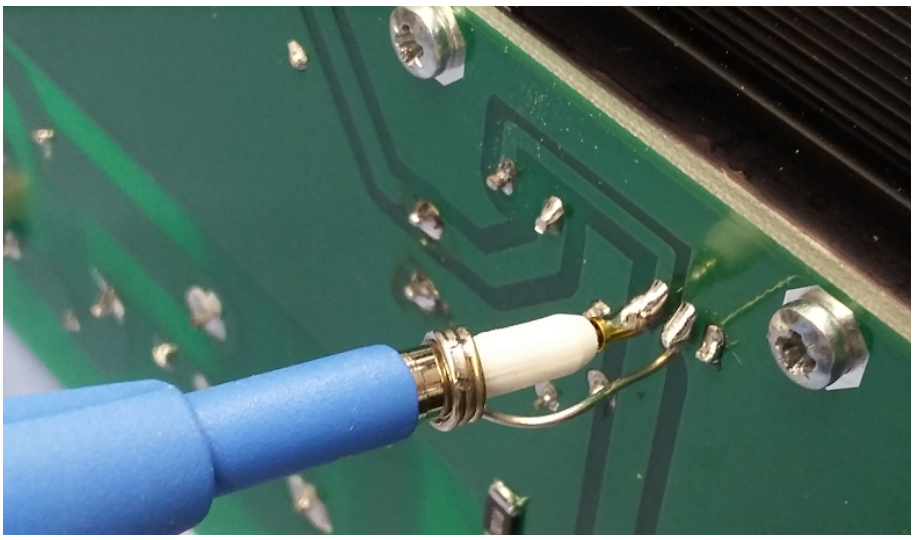

Fig. 2. Probing a fast switching node

Note that the oscilloscope probe ground connection is made via a test probe ground spring, see Fig. 3. It is important that the ground wire is kept in parallel with the probe tip and the loop area is kept to an absolute minimum.

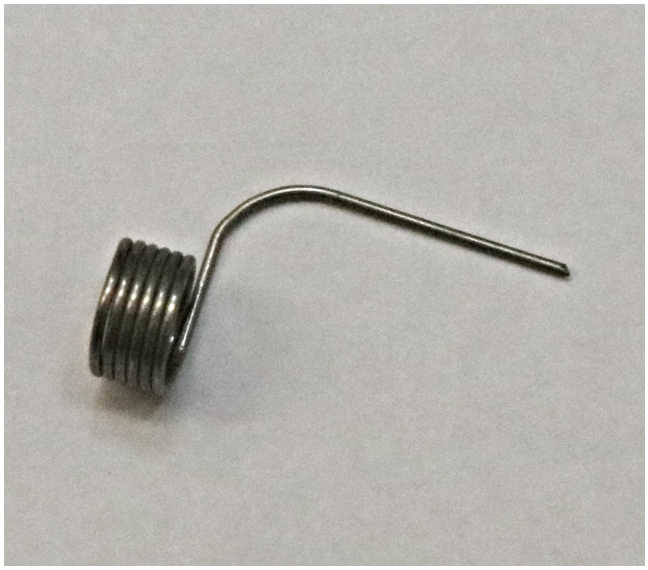

Fig. 3. Probe ground spring

These oscilloscope probe accessories are available from electronic test equipment distributors and retailers - e.g. Mouser Electronics Part No: 940-PK1-5MM-118 (Mfr. Part No: PK1-5MM-118).

Fig. 4. Oscilloscope probe with ground spring attached

It is possible to make your own probe ground spring using TCW25 tinned copper wire, see (Fig. 2). Form the spring around the probe, remove and apply a little flux and solder to hold it in place. Trim the ends and use appropriately.

3. Oscilloscope and probes

When measuring fast switching nodes always use a high-quality oscilloscope that does not introduce unwanted parasitic capacitance, especially in the sensing loop.

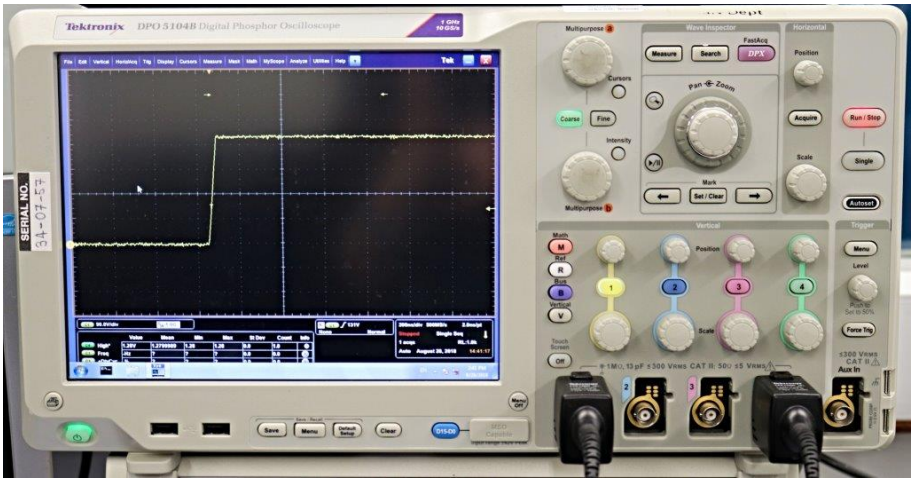

Fig. 5. Typical oscilloscope used in a Nexperia measurement lab

To make accurate measurements, the best quality scope probes should be used. These should have high input impedance: preferably 100 MΩ or greater, and very low capacitance: less than 4 pF. Also, the greatest bandwidth scope probes should be used in line with the switching edges that are being measured.

The impedance and capacitance of the scope probe can have an effect on the voltage that is being measured. By using high input impedance and very low capacitance the effect of the probe on the node being measured is minimised.

Always check that the oscilloscope probe you are using has the correct maximum voltage rating for the signal being measured. Do not exceed the manufacturer's recommendations - voltages close to a probe's maximum rating should be avoided.

Detailed information about probes and advice on measurement best practice is often available from probe manufacturers. As an example, Tektronix publish a comprehensive guide - ABCs of Probes Primer, (http://info.tek.com/www-abcs-of-probes-primer.html).

4. Probe positioner

When measuring high voltages extreme caution should be taken and best practices adhered to.

With this in mind, the use of a probe positioner is highly recommended. The oscilloscope probes can be adjusted to make contact with the required measurement points, leaving the test setup to be operated “hands free”.

The following probe positioner is recommended: Type : MSA100 3D PROBE POSITIONER Farnell part number 1552771.

Fig. 6. Probe positioner

5. Revision history

Table 1. Revision history

Revision number	Date	Description
1.0	2018-10-17	Initial version of the document

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For sales office addresses, please send an email to: salesaddresses@nexperia.com
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