VisIC Technologies

Probing for GaN Half Bridge

Application Note

CONTENTS

1. Introduction

Voltage measurements in high speed applications is very critical. The new GaN power transistors enabling the design engineers to operate at very high frequency up to 10 times the traditional switching frequency of silicon MOSFET transistors.

The herein measurements were performed on pulses at the mid-point of GaN Half Bridge board.

In this case selecting a probe tool is very critical. when the probe tool is not compatible, it might cause unreal ringing at the measurement from the high speed switching.

The difference between the probes can be seemed from the measurements.

We will get better results with a suitable probe tool. With the regular probe we will get wrong results and in addition, the regular probe tool is effecting the wave's shape dramatically.

2. Half bridge board

The Half bridge that was tested in this example is made with very high speed GaN transistors, the slew rate of current and voltage are 3.5nSec/100V (GaN transistors can operate in speeds up to 1nSec/100V). Bus voltage is 400VDC. Power output is 1.6KW.

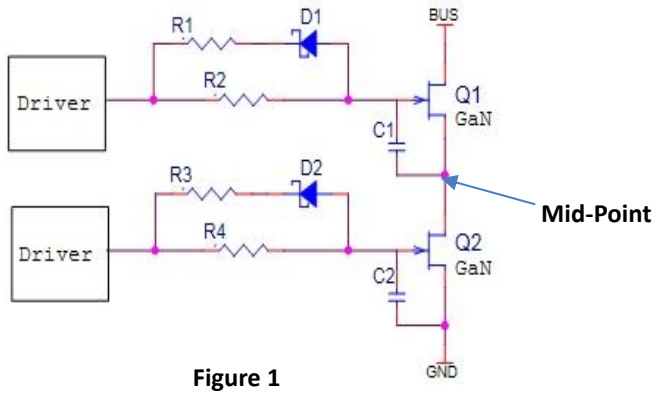

Figure 1

Figure 1 shows basic circuit of half bridge that tested at this experiment.

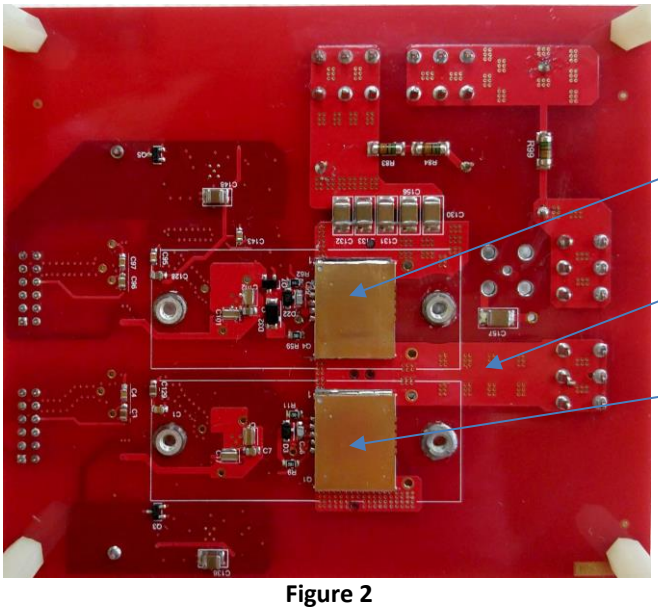

Figure 2

Figure 2 shows the board that was tested at this experiment.

3. About the probes:

3.1. PHVS 1000-RO High Voltage Passive Probe – 1000:1, 400MHz, 50MΩ, 7.5pF.

Figure 1

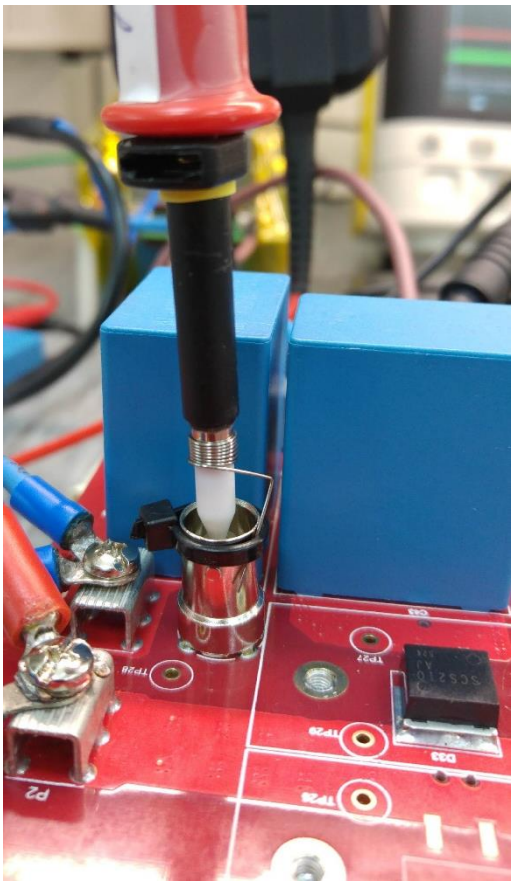

Figure 3

Figure 4

PHVS 1000-RO High Voltage Passive Probe.

The PHV 1000-RO is a 400 MHz, standard sized, 1000:1 passive probe designed for instruments having 50 MΩ input resistance. This probe is recommended for probing applications in service and development environments and is adjustable for low and high frequencies.

Figure 3. Special BNC connector that was designed in the Half Bridge board for a standard probe with very short GND lead (spring type). This technic is effective to reduce loop noises picking-up.

3.2. BumbleBee® Differential HV-Probe – 500:1, 400MHz, 10MΩ, 2pF.

Figure 5

Figure 5 - BumbleBee is a 400MHz, 1kV CAT III high-voltage, differential probe, that can be used with any oscilloscope or device providing 50Ω termination. The probe is very effective in power device evaluation, switching power supplies and frequency converters.

BumbleBee is also very effective in fast transient measurements with bandwidths up to 400MHz.

Figure 6 - The differential probe that used for the measurement.

Figure 7 - The differential probe connected to the half bridge board.

4. Results of measurements

PHVS 1000-RO High Voltage Passive Probe

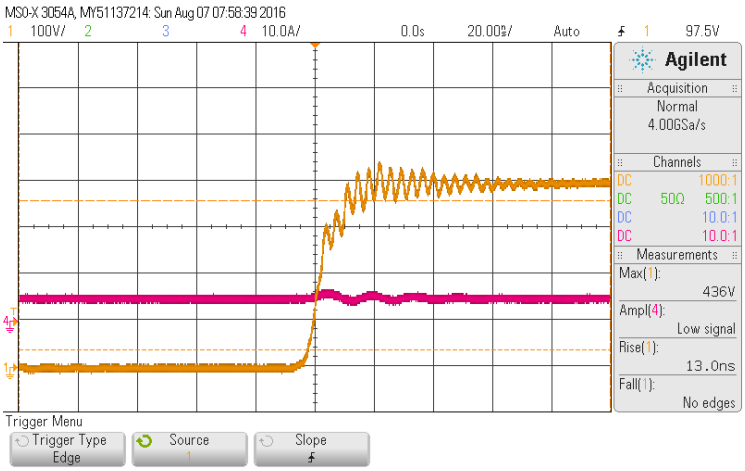

Figure 8

BumbleBee® Differential HV-Probe

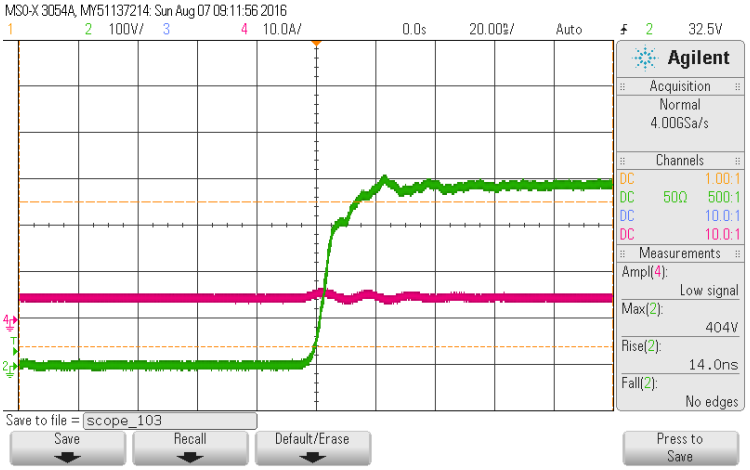

Figure 9

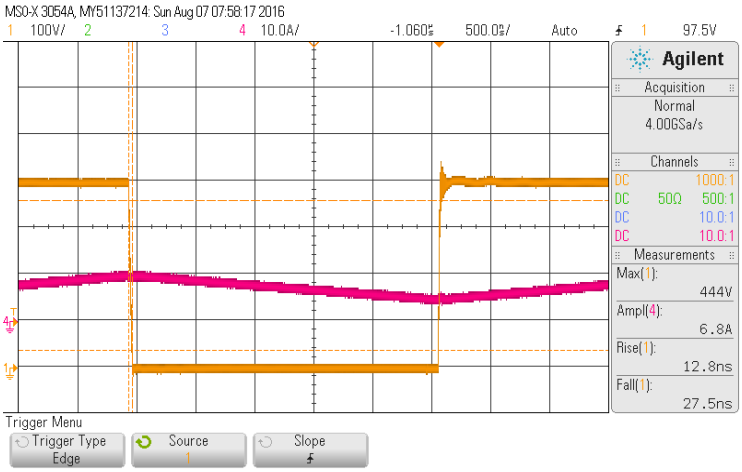

Figure 10

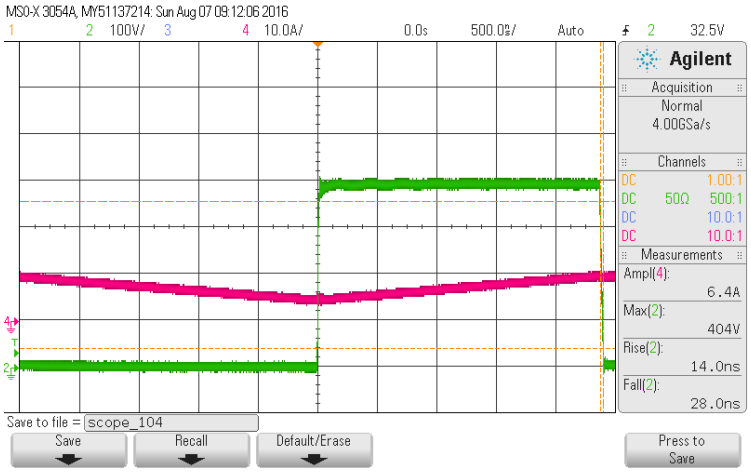

Figure 11

Figure 8 shows a lot of noise (ringing) at the rising time. Figure 9 shows that with the differential probe we got a smoother rise.

It is possible to see in figure 10 that there is a spike that cause by the regular probe. With the differential probe we don't get this spike and there is less noise.

We can also see in figure 10 that the maximum voltage is 444V instead of 400V that we supplied, that caused also from the probe that is not compatible with high speed measurements. At figure 11 we can see that the maximum voltage is 404V. Higher voltage then the required might damage the circuit.

5. Conclusions

- In very high speed measurements the traditional method of measure with 1000:1 probe with short GND is not practical. Measure with that probe tool might add a fault and make a wrong shape of the original wave. The probe effects the wave's shape in a parasitic way.

- Differential probes with 400MHz+ bandwidth, high impedance and especially low capacitance are very important for a correct and precise measure.