Springburo

HV Pulse Generator

Operating Instructions

Version: 1.1

EC Declaration of Conformity

This is an initial prototype of the High Voltage Pulse Generator (HVPG), to be used only for demonstrations, and is not to be sold or passed to end customers for professional use.

It is the intention of Springburo to formally certify the product in the vent of potential sales to end-customers.

EU RoHS Compliance

The HVPG and it's accessories conform to the 2011/65/EU RoHS2 Directive, as they have been classified as Industrial Monitoring and Control Equipment (per Article 3, Paragraph 24).

General Safety Information

Observe generally accepted safety procedures in addition to those listed here to avoid personal injury or damage to equipment. **The overall safety of any system incorporating the HVPG is the responsibility of the person using the system.**

Because of its application area (the measurement of high voltages), it is particularly important to read the connection instructions and safety instructions listed below. The HVPG has been designed to be intrinsically safe, delivering a maximum of 20mJ of energy. It is not in anyway threatening to life.

Connect & Disconnect Properly:

The HVPG has 2 high voltage outputs (Output 1 and Output2), and one low voltage “Current Sense” output. Only High Voltage designated probes should be connected to Output 1 and Output 2, or a specially designed High Voltage device, such as the “Clipper Test Probe”.

High Voltage Warning:

The HVPG is designed to generate short pulses (100nS) of 1000V DC, which is generated using a charge pump from AA batteries. Before “triggering” the HVPG switching on the device under test, make sure there is no part of the body within 30cm of the outputs. Do not leave the HVPG unattended in the Lab, switch off immediately after making the tests.

Environment:

The HVPG is designed for Laboratory use only. Do not use in wet or explosive atmosphere.

Cleaning:

Do not immerse the unit in water. Use a soft moist cloth to clean surfaces. The HVPG must be completely dry before use

Power Supply and Auto OFF

The HVPG is powered only by 4 AA batteries, inserted in the battery compartment on the rear of the unit.

To conserve batteries, the HVPG will switch off completely after around 15 minutes of non-use. While powered on, the power consumption is very small anyway.

It is not known how long the battery lifetime is when being triggered continuously.

OPERATION

Functional Description:

The HVPG in this version (1.0) has been designed to demonstrate the function of the Clipper Test Probe (another Springburo product).

The Output terminals (1 & 2) are basically the Drain-Source terminals of an internal SiC MOSFET. The Gate of this MOSFET is switched ON for a period of between 20 and 90uS and the OFF for approx. 100nS. During the ON period, the drain current flows into an Inductive load as shown below:

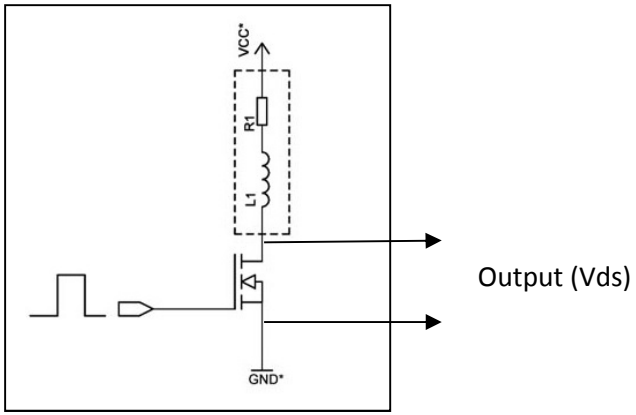


Fig1: Basic internal design:

The MOSFET is the switched off for 100nS, and then switched on again. In total this is repeated 4 times, with gradually increasing current. (0.5A, 1A, 3.5A, 5.2A).

Hence, the problem of measuring a small Drain-Source voltage, in the present of a High Voltage (in this case 1000V) can be demonstrated. By attaching a Clipper to Output 2, and the Oscilloscope direct to Output 1 (with a High Voltage probe) the quality of the measurements can be compared.

As the current increases with successive pulses, the non-linear saturation and heating effects of the MOSFET can be seen. These measurements are impossible to see properly with the direct channel, but can be seen clearly with the Clipper attached.

Description of HV Pulse Generator

The HVPG looks like this:

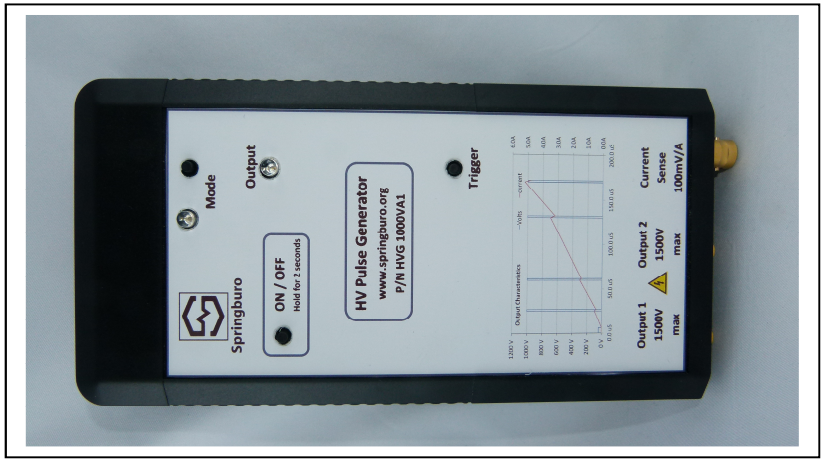


Fig 2: Front Panel of the HVPG

Buttons:

ON/OFF: Pressing this for longer than 2 seconds switches on the unit. The green "Mode" light will illuminate. Pressing again will switch off the unit.

TRIGGER: Pressing the Trigger button briefly will start the pulse generation sequence, with the "Output" LED lighting to indicate the outputs are active.

MODE: This button is not yet used, and is reserved for future use.

Setting up the Unit for Demonstration Purposes

With the unit switched OFF, connect a high voltage (1000V) Oscilloscope probe to Output 1. (Osci CH1, 200V/Div, Yellow)

A Clipper Test Probe can be connected to Output 2, (Osci CH2, 2V/Div, Blue). Initially set to "Hi" mode.

Osci CH3 is connected to the "Current Sense" Output. (CH3, 100mV/Div, Purple) . With x10 probe is 1A/Div.

Fig 3: Attaching Clipper for measurements

Evaluating the Waveforms:

Once the unit has been setup, the Oscilloscope can be set to trigger on "Single Trigger" mode (CH1 initially), and the "TRIGGER" button can be pressed.

The following Scope traces can be viewed:

Overview Pulse Shape: Just looking at Channel 1, the pulse waveform can be seen: 100nS width, 1000V, 30nS fall time. (33V(nS)

Fig 4: Basic HV Pulse shape (Vds - Output 1) without Clipper

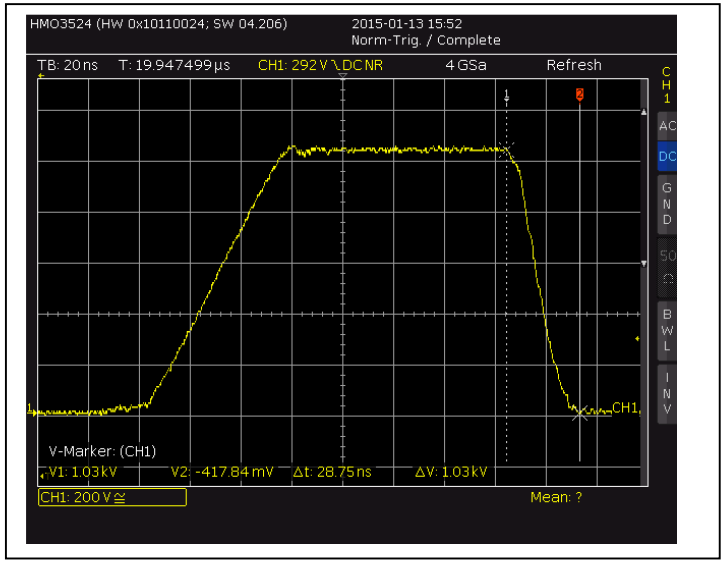
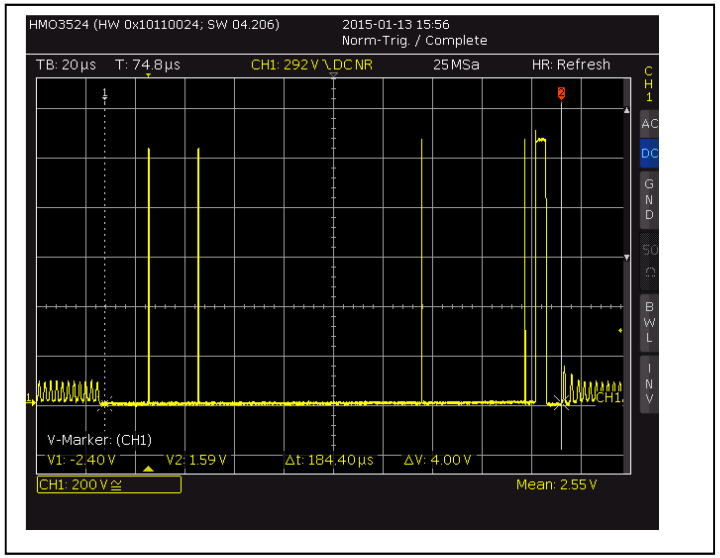


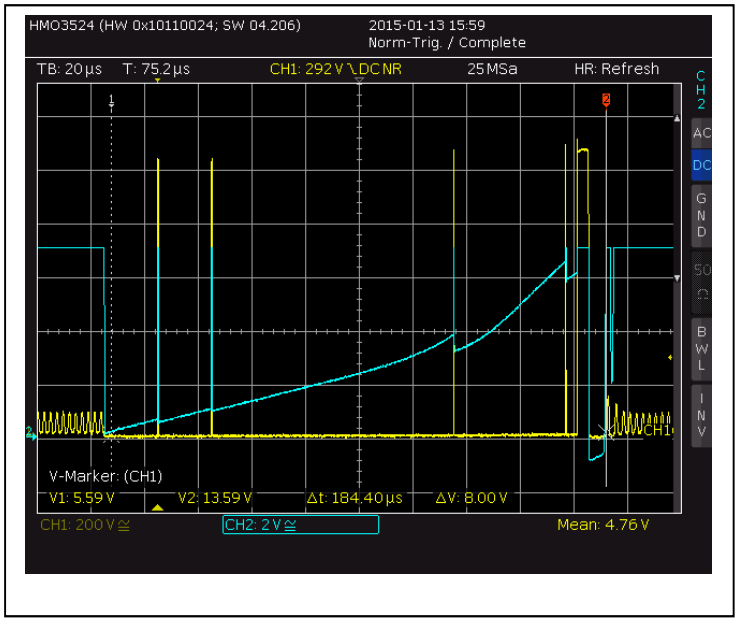
Fig 5: Vds Measurement (Output 1) - 4 pulse sequence



The detailed pulse sequence is as follows:

- **MOSFET initialised with 40V, and switched on for 20us. Inductor charging begins at 0.5A.**
- **MOSFET switched off for 100nS**
- **Drain Voltage increased to 1000V**
- **MOSFET switched on for 20uS at 1A**
- **MOSEFT switched off for 100nS**
- **MOSFET switched on for 90uS at 3.5A**
- **MOSEFT switched off for 100nS**
- **MOSFET switched on for 50uS at 5.2A**
- **MOSEFT switched off.**

Fig 6: The Clipper measurement (CH2 – Output 2) is added, on HI mode.



On CH2, all voltage above approx. 12V has been removed, allowing the Oscilloscope resolution to be increased to 2V/Div (blue trace).

Tip: For the next traces, use the Scope Trigger on CH3, so that different portions of the waveform can be viewed depending on load current.

Fig 4: Looking at the initial inductor charging period with Clipper on LO range (500mV /Div). CH3 is measuring the Inductor current at 500mA/Div (using x10 Probe).

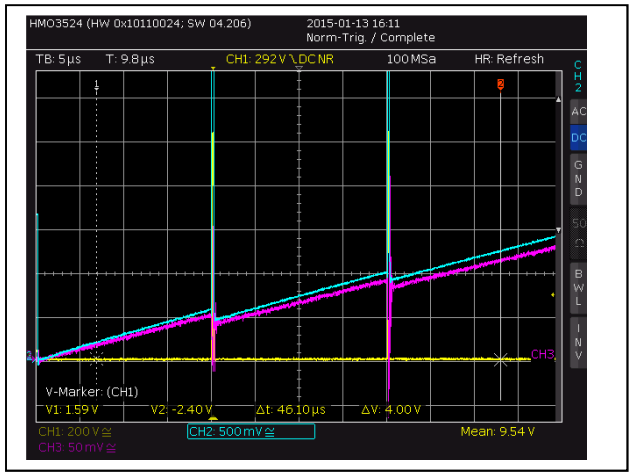


Fig 5: MATH function (RED CH2/CH3) shows stable RdsON before and after OFF pulse. Actual resistance= datasheet = 1.1Ohm

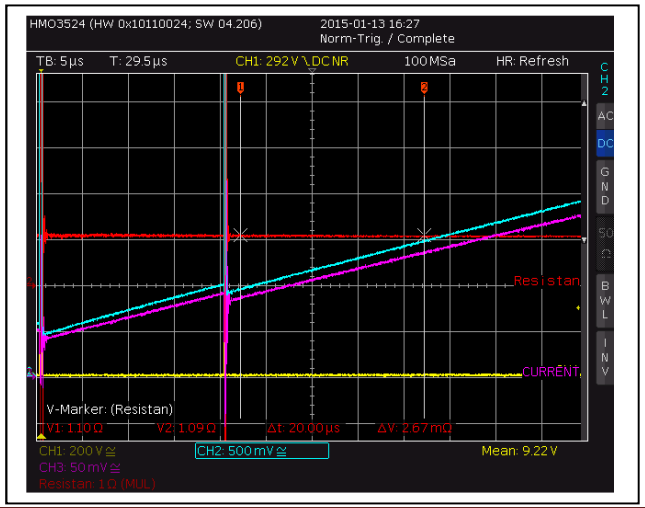


Fig 6: Final charging segment, where current is increasing to 5.2A. Important here is the increase in the RdsON (shown by the MATH function (Vds/Ids) with RdsON increasing from 1.2 to 1.5 Ohm over the 40uS ON period. This is a very fast (dynamic) measurement of the ON resistance, and indicates that the device is in saturation, or that there is a thermal problem (eg not enough heatsinking).

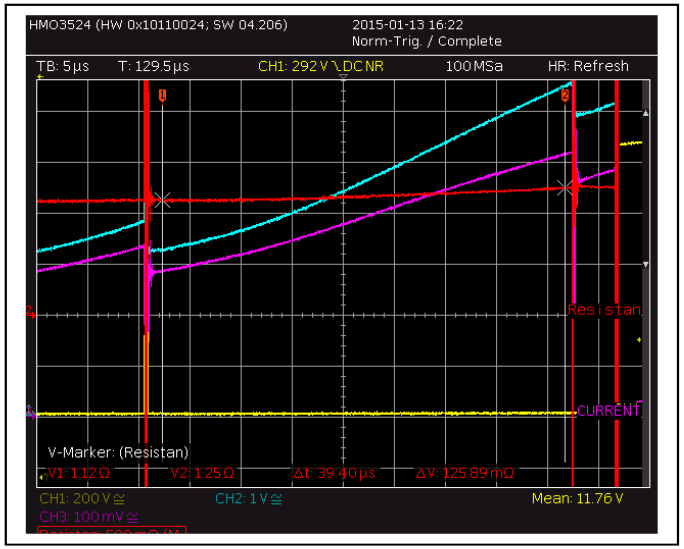
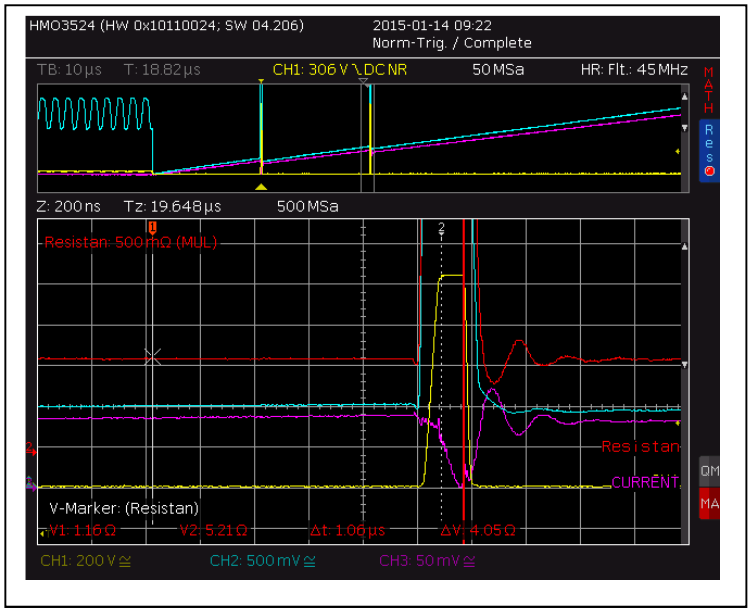


Fig 7: And finally, the transition between ON OFF and ON again for the MOSFET is important, and can be viewed in high resolution. Seeing the RdsON identical before and after the OFF pulse, is a good indication that the waveforms are a true representation of the MOSFET's actual performance.



Conclusion:

The HVPG is intended to be a useful tool for demonstrating the high resolution measurement of high voltage switching devices. Using the inbuilt SiC MOSFET switched at varying currents, a range of operating areas can be viewed, and the real value of the Clipper can be demonstrated.

DISTRIBUTORS

The product is supported by trained field technicians in the following regions:

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