

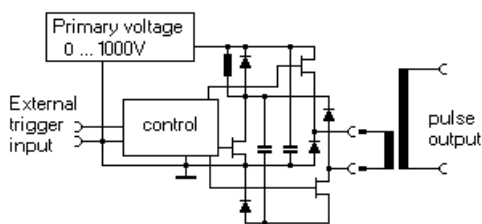
Tpuls3

Fast high voltage pulse generator for needle shaped pulses at capacitive loads

The pulse generator Tpuls3 ist designed for delivering short but powerful high voltage Pulses to the primary of a ferrite ring transformer. The output of the ferrite ring transformer then delivers needle shaped pulses to a capacitive load. Best results are achieved if the transformer is matched to the load. Typically achieved voltages are 1- 15 kV, depending on transformer and load.

For fastest rise time here 2 capacitors with each 1 kV max. are switched in series by SiC-transistors and so a voltage of 2kV (as + 1kV and -1kV) is delivered to the output. Nominal peak power is 240 kW with a frequency of up to 20 kHz.

The transformer at the output may be adjusted to a wide variety of loads, just rise time and peak voltage are limited for larger capacities.

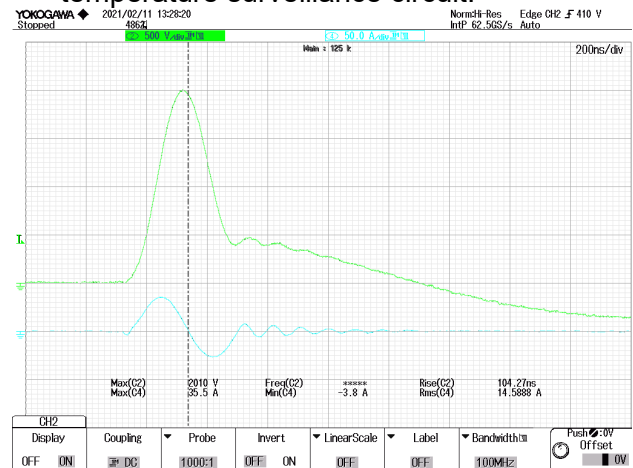


Principal schematic

Current and voltage, pulse shape and frequency

- The internal primary supply can be continuously adjusted to a voltage from 0-1000V and delivers a power of up to 300W respectively a current of up to 500 mA.
- During a pulse, double the primary voltage is switched to the output, here as +Up and -Up in respect to ground. At the end of the pulse, the output is completely switched off and diodes allow a reverse voltage up to Up to feed back the inductive energy of the output transformer back to the pulse generator capacitors.
- The output stage is designed to deliver periodically currents of up to 120A. In short circuit, currents may go up to 200A, however the pulse is switched off within 250 ns if currents >120A are detected.
- The pulse may be triggered internally or alternatively by an external TTL-Signal.

- Maximum frequency with internal trigger is 20 kHz. With external triggering the frequency may be even higher. However, with maximum peak power the frequency may also be reduced. The limits are set then by the internal power supply or by the temperature surveillance circuit.



Example: 3 nF on a R63 ferrite ring transformer, 8:5 windings. A rise time around 105 ns can be achieved at 2 kV. Oscilloscope 200 ns/div. Green: pulse voltage at load, 500V/div, blue: output current pulse generator 50A/div.

- The pulse shape, especially the pulse width is determined by the resonance of the transformer inductance with the load capacitance. The output pulse width may be adjusted in the range from 0.1 to 1.5 μ s just to fit to the waveform. Typically, the driving pulse width is just set such that the maximum peak voltage is achieved, typically the pulse just ends a bit after the voltage peak is reached.
- The intrinsic rise time of the transistors is about 30 ns, this is also about the shortest rise time achievable for small capacitive loads.

- The maximum load capacitance is determined by the possible peak current and transformer ratio; the maximum pulse width is determined by the 1.5µs driving pulse width and the saturation of the ferrite ring transformer.
- Overtemperature or overcurrent will terminate operation.
- Normally, rise time and fall time of the pulse are about the same and depend on transformer primary stray inductance, transformer ratio and load capacitance. However, if the transformer is used in nonlinear mode, so that it saturates just in voltage maximum, the fall time can be even faster than the rise time. This effect is also known as magnetic pulse compression. Frequency is limited with this mode as losses are quite high.

Front plate control, connections and display

- Power supply switch
- Pushbuttons for HV on and off
- 10-turn potentiometer for frequency 0-20 kHz
- 10-turn potentiometer for voltage
- 10-turn potentiometer for pulse width adjustment.
- BNC input for external control signal
- voltage monitor output 1:2000
- current monitor output 50 mV/A (type is current transformer with shunt).
- analog meters for primary power supply voltage and current.
- LEDs for overcurrent and overtemperature

rear side

- 2*4mm plugs pulse output for transformer connections.
- 4mm plug for voltage measurement.
- 4mm plug ground connection.

As the output plugs carry dangerous voltages they are behind a cover.

- Grid supply cable plug.
- Interlock connector

Mechanical, Environmental

- 19"-rack insert, 460mm deep, height 177 mm (4HE), width 482mm
- Environmental temperature range 0-35 °C
- humidity 0-80%, the device is designed to operate in dry laboratory rooms.
- protection class I, IP 20
- Supply rating 230VAC, 2A max.
- Manual includes design guide for suitable pulse transformers.

Optional included

- Customized internal ferrite ring transformer (Up to 10 kV peak).
- Customized external ferrite ring transformer.
- Large ferrite rings and unshielded HV cable suitable for doing pulse transformers.

Safety

Although the pulses are very short, the voltages of up to +/- 1kV at the output have to be considered dangerous and must not be touched in operation. The voltages after the transformer may have even higher voltages. It must be ensured by the user that the output nor anything connected to it cannot be touched in operation. For this, also the interlock connector may be used.

The internal power semiconductors are protected by overcurrent sensing and are under temperature surveillance. The output is short circuit proof.

This datasheet is preliminary smaller changes and improvements are reserved.

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