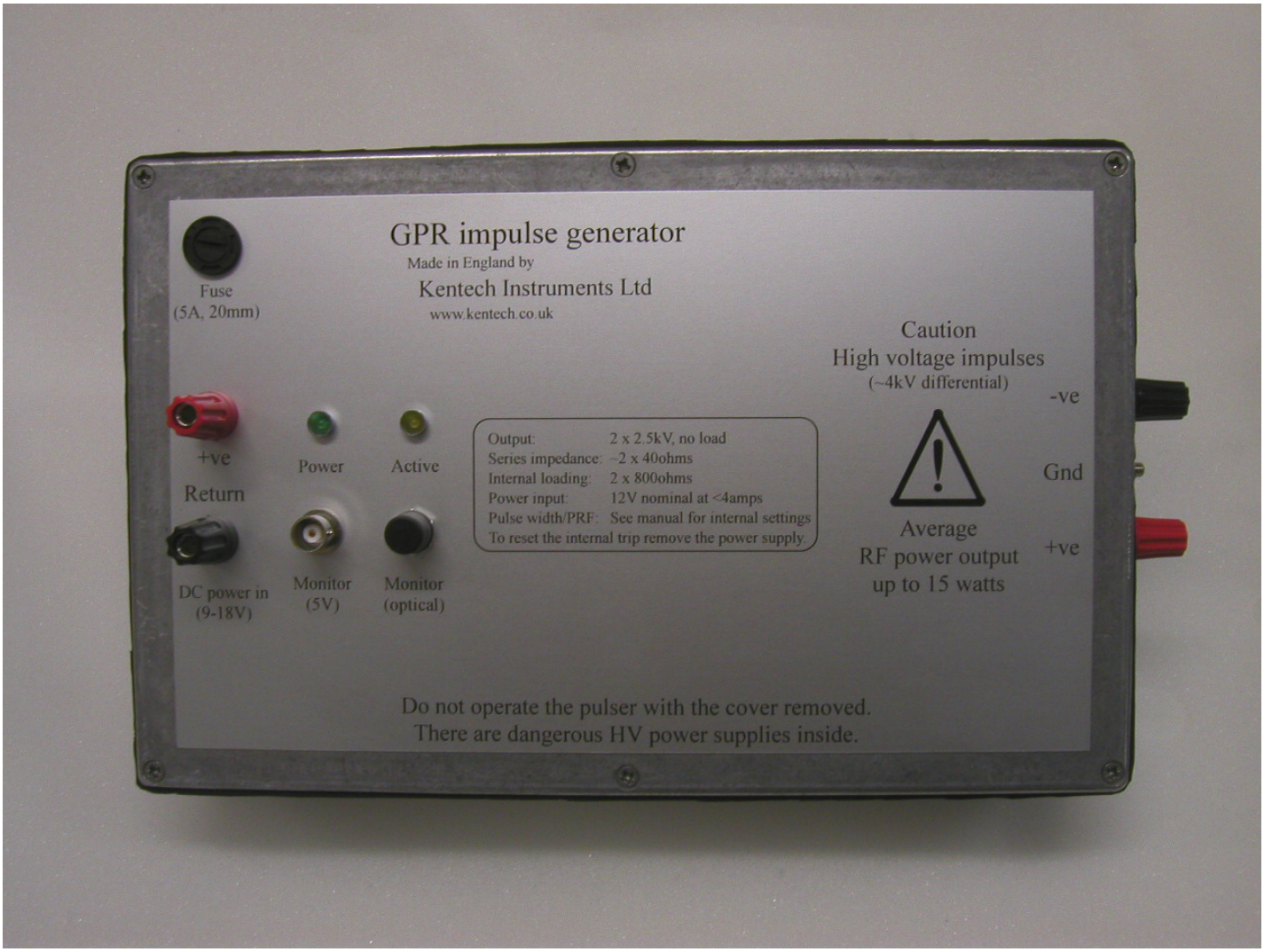
Notes on the use of

Kentech Instruments Ltd.
GPR pulser
Serial No. J10*****-1 and 2



Tuesday, March 23rd, 2010

Kentech Instruments Ltd. ,The Isis Building, Howbery Park, Wallingford, Oxon OX10 8BA, UK

VAT Registration number: GB394526620
Registered in England No. 1742794
Registered office: 6a 1st Floor, Popin Business Ctr., South Way, Wembley, London HA9 0HF, UK
Directors: P.A. Kellett B.A.(Oxon), A.K.L. Dymoke-Bradshaw PhD, J.D. Hares PhD.

UK Tel: 01491 821 601
UK Fax: 01491 821 602
Int. Tel: +44 1491 821 601
Int. Fax: +44 1491 821 602
Email:info@kentech.co.uk
Website: www.kentech.co.uk

CAUTION

With an appropriate load, this unit is safe for use by an educated user in a laboratory environment. You are warned however that the radiation from the system with an antenna or inappropriate load attached can damage sensitive equipment. The output from this pulse generator will destroy some types of attenuators and electronic test equipment. It is the user's responsibility to ensure that any apparatus connected to the output is suitably rated.

Kentech Instruments Ltd accepts no responsibility for any damage or liabilities incurred in the operation of this equipment.

Please read the manual before applying power.

There are high voltages present in this pulser when the unit is operating. Do not operate the pulser with the covers removed.

If cleaning is necessary this should be performed with a soft dry cloth or tissue only.

RF emissions and EC directive 89/336/EEC

This equipment is a research tool that has been intentionally designed to generate short high energy electromagnetic pulses and the EM emissions will be highly sensitive to the load applied by the user, for example the radiation just from some types of output cable may exceed EC permitted levels.

The level of RF radiation generated by the circuit boards within the instrument is inevitably high but the emissions are largely contained by the instrument enclosure. It is therefore very important that all fasteners are securely fastened - do not operate the pulser with the covers removed. The pulser may still interfere with sensitive equipment at short range.

We believe that with this type of unit it has to be the system builders' responsibility to verify that his pulser/load system complies with the EC directive unless the system is used in a screened electromagnetic environment.

Introduction

Our range of solid state high voltage pulse sources (CPS and PBG series) allows very high voltage, fast rising pulses to be obtained from compact bench top units. Voltage pulses rising in less than 200ps, in excess of 40kV peak voltage into 50Ω, and with a pulse repetition frequency (PRF) >1kHz can be produced. The performance of our compact, convenient and reliable pulsers is to our knowledge exceeded only by laser driven photoconductive switches in terms of voltage switching speeds. These pulsers will find applications in many fields such as high speed camera research, electro-optic switching, triggering systems and radar.

A large range of output pulse lengths can be provided by the incorporation of internal passive pulse forming networks. There is very little jitter in the output of the pulsers and two independent pulsers can be used in parallel to drive low impedances. This aspect makes the pulsers particularly useful for driving microchannel plate systems. Transformers with output impedances as low as 5Ω are available.

The standard drivers and speed-up modules have a life of $>10^{10}$ pulses and have a PRF of ≥100Hz, although special units with a PRF >20kHz can be supplied. The high repetition rates allow sampling oscilloscopes to be used to characterize a system and verify the pulse shape.

The pulsers can feed into a short circuit load without damage. This allows them to be used in sub-nanosecond pulse chopping systems by feeding through a pockels cell into a shorting stub. Variations on the standard driver are available.

Use

The pulser requires a nominal 12V DC power source connected into its front panel 4.0 mm sockets. A 5 Amp fuse is fitted to the unit and is accessible from the front panel. The green ‘Power LED’ is illuminated when a power source is applied.

The pulser is self-triggering and produces the main +/-2kV output at the side 4.0 mm connectors. The pulser also generates a 5V monitor pulse for triggering external equipment. An optical monitor output is also available. The monitor pre-trigger delay is approximately 250ns.

The repetition rate of the pulser is set internally by an 8-way switch, initially set to 1kHz when supplied. It is possible for the user to adjust the repetition rate; however, when making this adjustment, care must be taken not to exceed the maximum recommended output capacitance.

This pulser contains an over-current trip circuit which will inhibit the output under fault conditions. If the pulser is inhibited by an over-current fault, the unit must be reset by removing the power source. The pulser will also inhibit the output if the internal temperature exceeds safe operating limits, but will return to normal operation when the temperature drops. An amber 'Active LED' is illuminated when the pulser is operating normally.

Important

The pulser dissipates approximately 30 watts which must be conducted from the metal case. To avoid thermal cut-out and interruptions to the output, it is important that this case is mounted in such a way that air may freely circulate over it. In open air without additional cooling the case will reach a temperature approximately 15°C above ambient.
To assist cooling, the pulser may be mounted on a cool metal surface or heat sink so heat is carried away from the bottom, reducing the dissipation from the top surface. This pulser must NOT be housed in a thermally insulating enclosure without adequate provision for conducting away the heat.

Specification

>=+/-2kV, ~4 ns step rise, exponential fall
Loading in pulser 800ohms each side
Balanced outputs (2kV each, 4kV differential)
12V battery powered (9-18V dc)
Internal adjustable rate generator (initially factory supplied set to 1kHz)
Fibre-optic trigger output (HFBR-1412TMZ or equivalent emitter)
Additional electrical trigger output, BNC connector, amplitude ~5volts
Current consumption > 4amps (2.4 amps typical @12v dc)
Temp range -20C to +25C *
Housing - metal die-cast box, 175 x 275 x 65mm.
Power input and pulse output connections: 4mm terminals

Normal operation:
Output pulse characteristics set by combined 1nF and 1.5nF paralleled series-coupling capacitors and 800ohm loading
PRF 1kHz

Enhanced PRF operation:
Output pulse characteristics set by 200pF paralleled series-couplingcapacitors and 800ohm loading.
PRF 5kHz

It is possible for the user to change the series-coupling capacitors and the PRF with only simple hand tools. This operation is not recommended in the open air, however.

Connections and controls

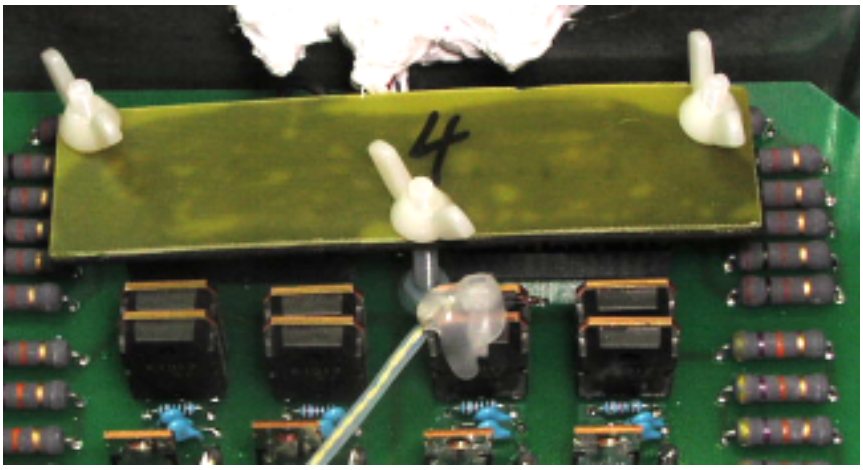
12V Input Power	4.0mm terminals, 9-18V
Fuse Holder	20mm 5A
Output Ground	4.0mm terminals, +/-2kV pulse and
Active Light	Amber LED
Power Light	Green LED
Monitor Output, 5V	BNC, 5V 8us pulse
Monitor Output, Optical	ST, 8us pulse

PRF and pulse width

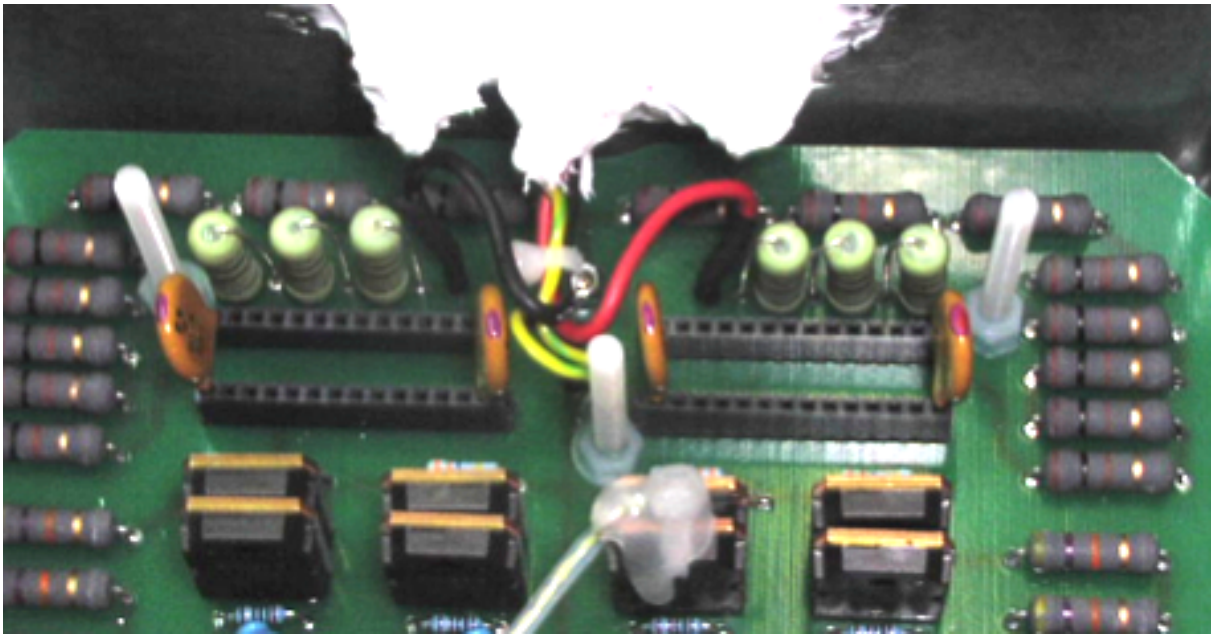
The PRF is set by an 8-way switch. The maximum recommended capacitance per output channel depends on the PRF and may be calculated:

$$C(F) = \frac{10\text{-}6}{PRF(Hz)}$$

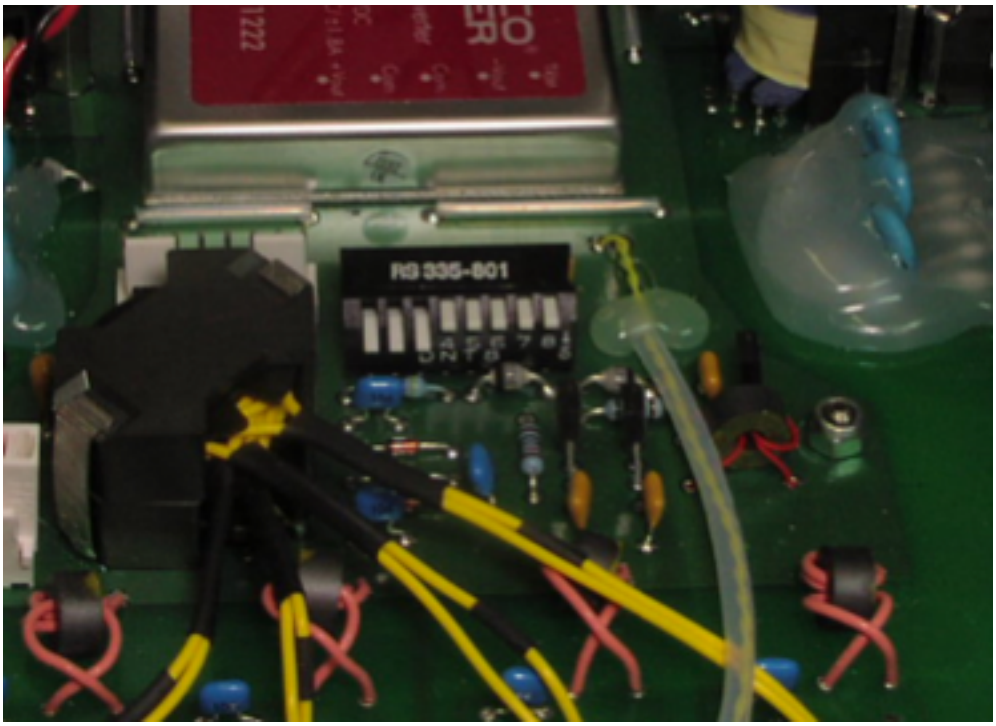
The output capacitors are secured under a protective cover (see below) to prevent them becoming dislodged during transport.



Unscrew the nylon wing-nuts and remove the cover. The output capacitors are arranged in two banks of high voltage ceramic disc capacitors (one bank for +2kV and one for -2kV). The capacitors are inserted into rows of 0.1 inch sockets. The figure below shows the arrangement for 5kHz (200pF per bank). Please note that from mid-2009 the capacitors used are now Murata (Blue) 6kV types, and that those pictured below are the earlier 3kV types.



The 8-way switch used to set the PRF is shown below. The MSB is marked as 8, and logic 1 is down. The binary number shown in the photo is therefore 00000111 (decimal 7) and this would give a repetition frequency of 500Hz.



The table below gives other PRF values and the corresponding binary value.

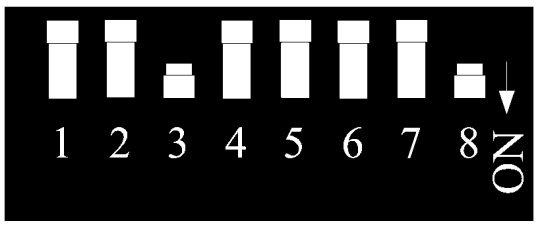
GPR Impulse Generator J0412051

Pulse repetition-rate is programmed with an 8-way switch.

Desired Freq (Hz)	Actual Freq (Hz)	Programmed value (decimal)	Programmed value (binary) *	Maximum capacitance (pF, per channel)
1000	1000.00	132	10000100	1000
2000	1984.13	194	11000010	504
3000	2976.19	215	11010111	336
4000	4032.26	226	11100010	248
5000	5000.00	232	11101000	200
6000	5952.38	236	11101100	168
7000	6944.44	239	11101111	144
8000	7812.50	241	11110001	128
9000	8928.57	243	11110011	112
10000	9615.38	244	11110100	104

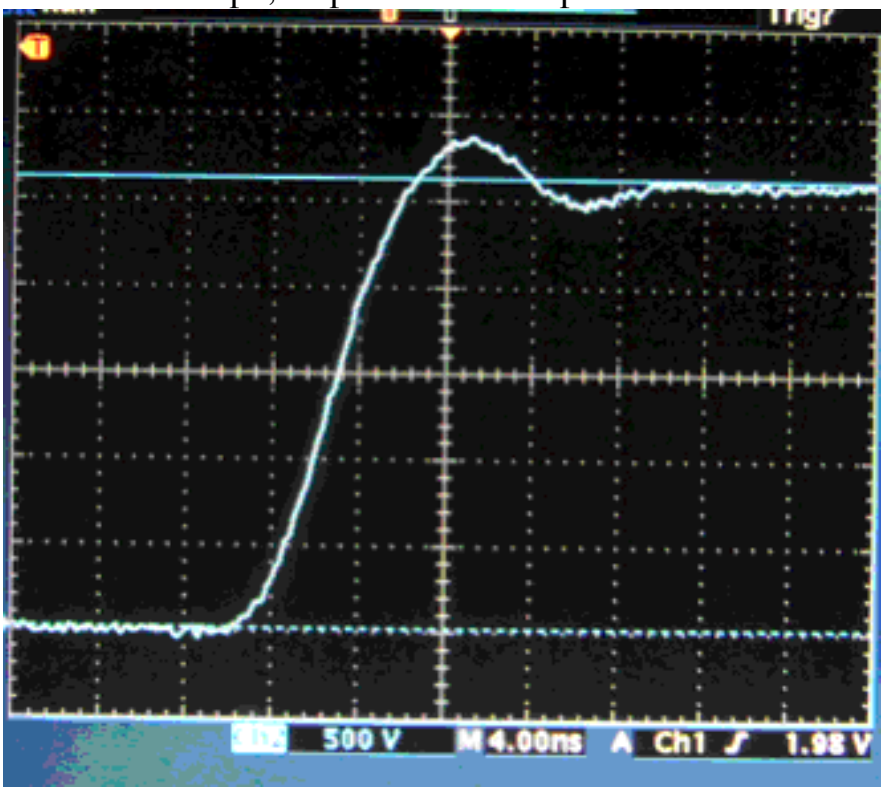
* MSB is marked as switch 8, LSB is marked as switch 1. Push switch down for logic 1.

1000Hz = 10000100

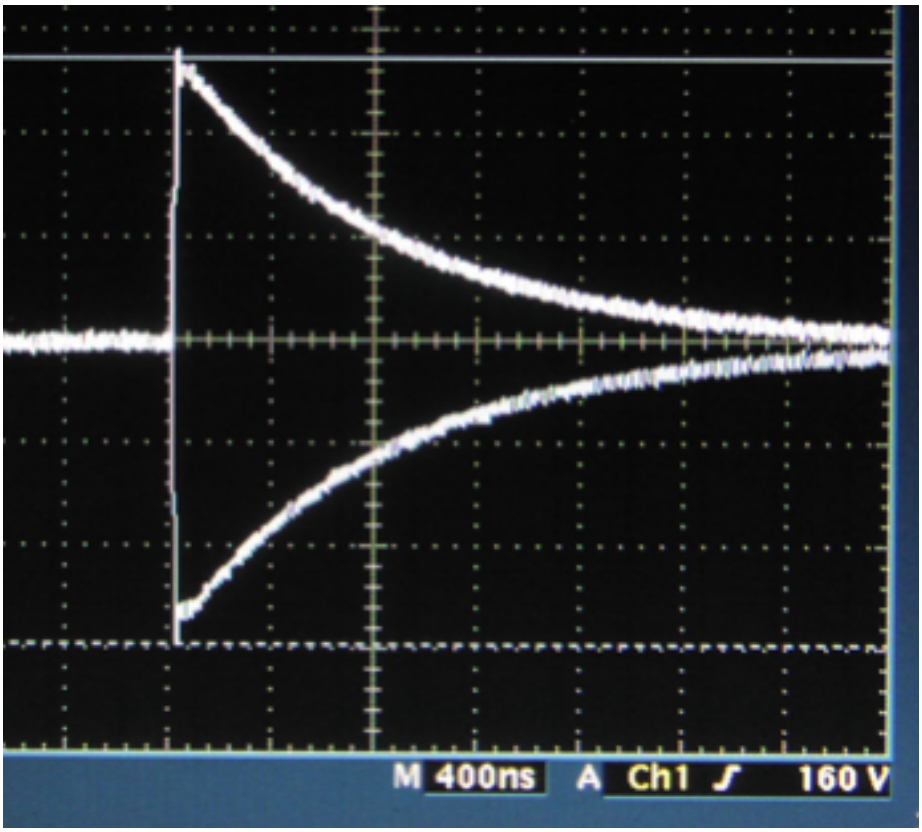


Typical output signals

Tek 3052B scope, Isoprobe II 1000x probe.



Step output, 500V/4ns per division



Both outputs, 1000V/400ns per division

Engineer: DJPC, Tuesday, March 23rd, 2010 @ 16:43