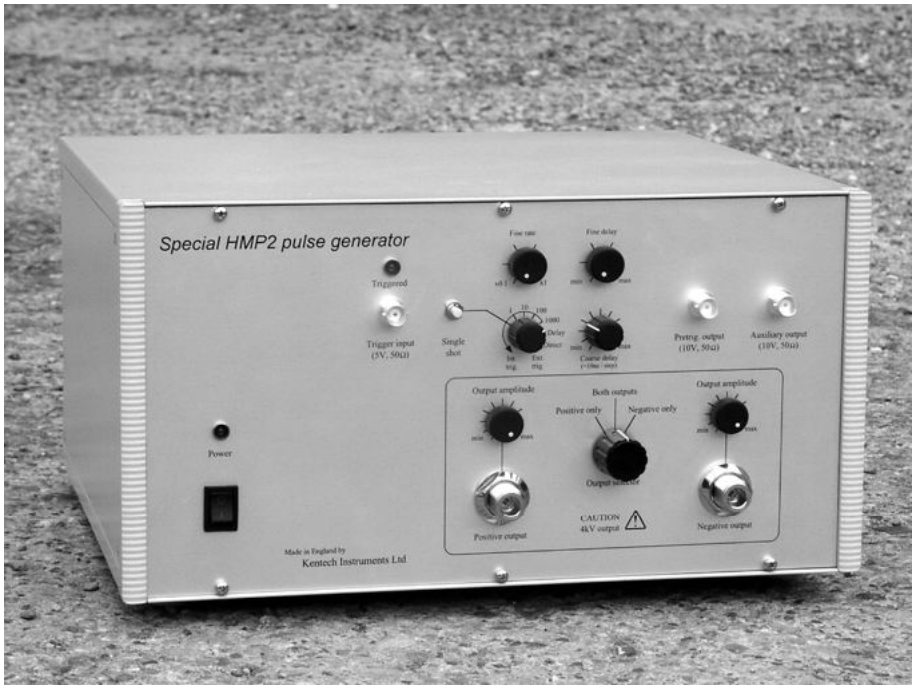
Notes on the use of

Kentech Instruments Ltd.
Special HMP2 pulse generator
Serial No. *(special)*



23th September 2003

Kentech Instruments Ltd.,Unit 9,Hall Farm Workshops, South Moreton,Oxon OX11 9AG, UK

UK Tel: 01235 510748
UK Fax: 01235 510722
Int. Tel: +44 1235 510748
Int. Fax: +44 1235 510722
Email: anyone@kentech.co.uk

VAT Registration number: GB394526620
Registered in England No. 1742794
Registered office: 114 Nibthwaite Road, Harrow, Middlesex HA1 1TG, UK

Directors: P.A. Kellett B.A.(Oxon), A.K.L. Dymoke-Bradshaw PhD, J.D. Hares PhD.

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 and corrupt data stored in computer and microprocessor based systems. It can cause terminal failure of vital medical electronic systems such as pacemakers. This equipment is supplied on the understanding that the user will analyse these risks, accept responsibility for them and take appropriate precautions in the use of this instrument.

The output from this pulse generator will destroy many types of power attenuators and electronic test equipment. It is the users 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 (4kv) present in this pulser when the unit is operating. Do not remove the covers, return to Kentech Instruments Ltd or its appointed agent for servicing.

The accessible terminals of this instrument are protected from hazardous voltages by basic insulation and protective grounding via the IEC power input connector. It is essential that the ground terminal of this connector is earthed via the power lead to maintain this protection.

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.

We are not able to guarantee compliance with arbitrary loads but to minimise emissions we recommend:-

1) that any load is fully contained within a conductive metal screened box, with all joint surfaces gasketed or fitted with conductive fasteners at less than 5cm intervals.
2) that the load is connected to the pulser output with semi-rigid cable, the cable outer must be carefully connected to the N type output connector at one end, and must be connected directly to the screened box containing the load at the point of entry. Flexible cables should only be used with caution, in particular RG303 type cable will need additional screening to control emissions.

Introduction

Our range of solid state pulsers (ASG, SPS, HMPS and PBG series) allows very high voltage, fast rising pulses to be obtained from compact bench top units. Voltage pulses as short as 100ps FWHM, in excess of 4kV 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 ≥1000Hz, although special units with a PRF >50kHz can be supplied. The high repetition rates allow sampling oscilloscopes to be used to characterise 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.C. power and a trigger signal to operate. The trigger signal can be generated internally or applied externally. When external triggering is used, the trigger signal, which is applied to the Trigger input (BNC), should be ≥5 volts with a fast rising edge (<5ns) to maintain the low jitter of the system.

A selector switch sets the trigger source, delay mode and internal repetition rate. When triggered the Triggered LED on the front panel will flash.

In the internal trigger, single shot and "Delayed" modes there is an internal delay which may be adjusted by the user. There are coarse (10ns per step) and fine (~12ns full scale) delay controls.

A Pretrigger output (BNC) is available before the internal delay, timing fixed to the trigger input. An Auxiliary output (BNC) is provided after the internal delay, timing fixed with respect to the main output. It appears approximately 10ns before the main output.

In "Direct" mode the trigger is applied directly to the avalanche stack and the low level circuitry is bypassed. In this mode the trigger delay is at a minimum of ~20ns. There are no Pretrigger or Auxiliary outputs in this mode.

There are two outputs, one positive, one negative, using N type connectors, driven from the same trigger. The outputs of the unit are fast rising pulses with an approximately exponential fall. Internal timing adjustments enable the leading edges of the pulses to be coincident. Each pulse output has a maximum amplitude of greater than 4kV into 50Ω and may be individually adjusted by means of front panel mounted single turn potentiometers.

A rotary selector switch allows the outputs to be disabled individually by removing power from the output circuits. The maximum repetition rate is 1000Hz.

If it is necessary to monitor or characterise the pulse output then suitable attenuators should be used.

Do not trigger the pulser without an output cable or attenuator attached to the outputs because the high voltage pulses may damage the output connectors.

Caution

The output of this unit will damage or destroy many types of high voltage and high power attenuators. We recommend the use of a high voltage, high speed attenuator manufactured by Barth™ as the first in a series. Consult the attenuator manufacturer before using any other configuration.

The output may be observed with a high bandwidth oscilloscope. This may either be a fast (>3GHz) direct access type or a sampling type.

The jitter is less than 10ps RMS (typically 20ps p-p) with a suitably reproducible and fast rising trigger signal.

Lifetime

Solid state high voltage avalanche pulsers have a long but finite lifetime, generally characterised by the integrated number of output pulses. Fast risetime and high voltage lead to high electrical stress and such processes as partial discharges and other minor breakdown effects can gradually degrade insulation and reduce the lifetime.

With this in mind we recommend that pulsers are not operated unnecessarily and that arrangements are made to remove the trigger pulses when the pulse output is not required. This is most important when pulsers are operated near their maximum repetition frequency.

SPECIFICATIONS

General:

Number of outputs	2
Output voltages	>4kV into 50Ω
Output polarities	One positive, one negative.
Pulse shape	Fast rise, approximately exponential fall.
Pulse width	Approximately 5ns FWHM.
Rise time	Approx. 90ps (10-90%).
Trigger	>5V into 50Ω, <5ns rise time.
Jitter	<10ps RMS
Trigger delay	~20ns (BNC trigger input to main outputs - set to Direct))
Repetition rates	≥100Hz
Power supply	100-240V AC 50-60Hz Maximum power <50W.

Outputs:

Pulse outputs	N type	+4kV pulse.
	N type	-4kV pulse
Auxiliary output	BNC	~10V into 50Ω after delay (i.e. fixed timing with respect to main output).
Pretrigger output	BNC	~10V into 50Ω. Leads main output by the delay (when delay is active).

Inputs:

Trigger input	BNC	>5V into 50Ω.

Controls:

Output selector	Switches power to the output circuits so that either output is enabled individually or simultaneously.
Output amplitudes	Individual single turn potentiometers enables each output amplitude to be independantly set.
Coarse rate/mode	Sets one of the following modes: Single shot (delay active) 0.1-1 Hz (delay active) 1-10 Hz (delay active) 10-100 Hz (delay active) 100-1000Hz (delay active) External trigger delay (delay active) External trigger direct (delay inactive)
Fine rate	Single turn potentiometer varies internal rate by ratio of 10:1 (x0.1 - x1.0).
Coarse delay	Sets internal delay in steps of 10ns up to 100ns.
Fine delay	Single turn potentiometer continuously adjusts internal delay up to ≈12ns.
Single shot	Depressing this button causes a single trigger.
Power	Switches AC power in the pulser.

Indicators:

Power	Shows that AC power is applied and the unit is switched on.
Triggered	Illuminates while the unit is being triggered.

Environmental:

Dimensions:	H = 177, H+feet = 187, W = 342, D = 307.
Weight:	Approx. 7kg.
Ambient temperature	5 to 35°C
Humidity	< 95% non-condensing
Altitude	< 3000m

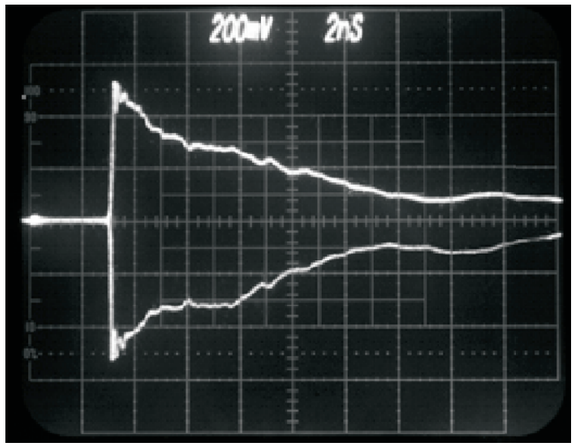
Test data

Kentech Instruments Ltd.
Special Pulse generator model HMP2/D/F/W/Q Serial No. xxxxx

Test equipment:

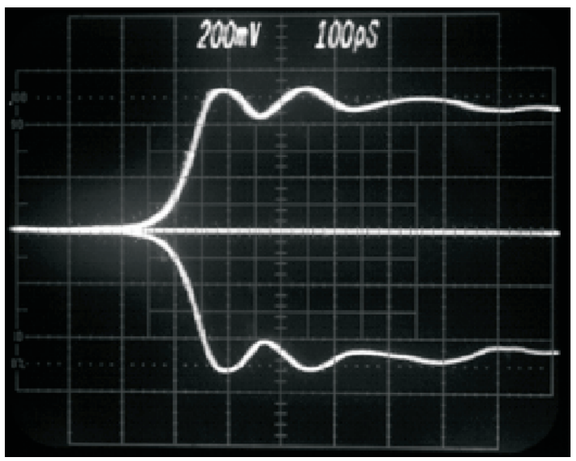
Scope:	Tek 7438, 7S11+S4, 7T11
Attenuators:	First two - Barth 142(x10), second two - Radial SMA(x10) Total attenuation x10000
Trigger:	Kentech APG1

Pulser output waveforms



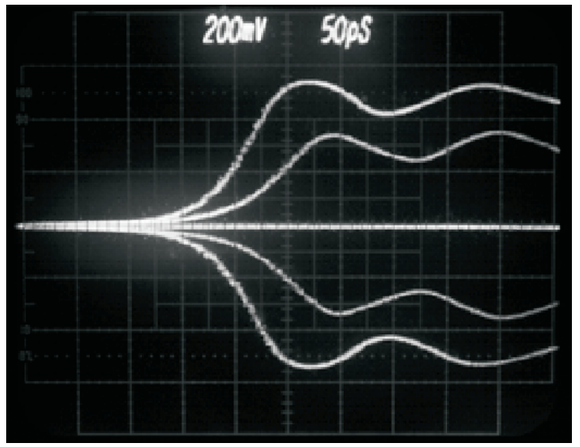
Both outputs superimposed showing pulse shape.

Vertical: 2kV/div
Horizontal: 2ns/div
Rep. rate: 1kHz
Amplitude: Maximum



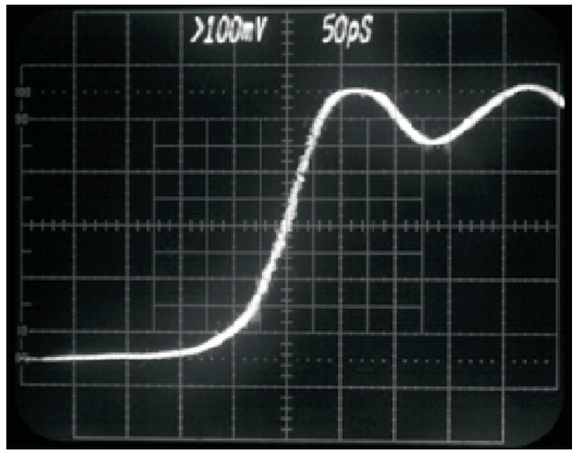
Both outputs superimposed showing time relationship.

Vertical: 2kV/div
Horizontal: 100ps/div
Rep. rate: 1kHz
Amplitude: Maximum



Both outputs superimposed showing maximum and minimum amplitude.

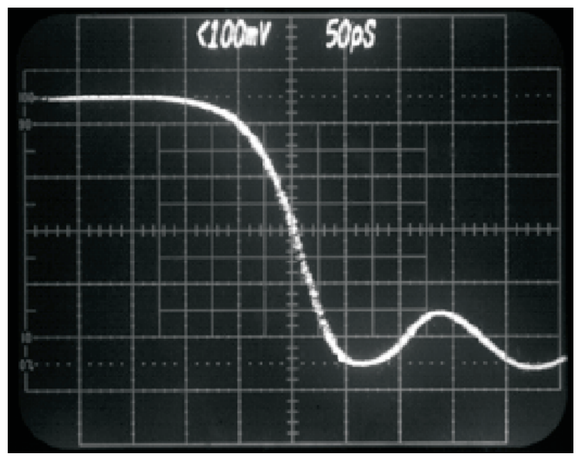
Vertical: 2kV/div
Horizontal: 50ps/div
Rep. rate: 1kHz



Positive output

Risetime and jitter with scope set to display between dotted lines.
Risetime(10-90%) ~85ps
Jitter less than 20ps p-p

Vertical: approx. 1kV/div
Horizontal: 50ps/div
Rep. rate: 1kHz
Amplitude: Maximum



Negative output

Risetime and jitter with scope set to display between dotted lines.
Risetime(10-90%) ~85ps
Jitter less than 20ps p-p

Vertical: approx. 1kV/div
Horizontal: 50ps/div
Rep. rate: 1kHz
Amplitude: Maximum