

Notes on the use of
Kentech Instruments Ltd.
PBG1/S pulser
Serial No. xxxxxx



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

UK Tel: 01235 510748

UK Fax: 01235 510722

Int. Tel: +44 1235 510748

Int. Fax: +44 1235 510722

Email: anyone@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 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 $\geq 1000\text{Hz}$, although special units with a PRF $>50\text{kHz}$ 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 applied to the front panel trigger input (BNC) should be >5volts into 50Ω with a fast rising edge (<5ns) to maintain the low jitter of the system. When triggered the triggered light on the front panel will flash.

The output of the unit is a positive square pulse having a maximum amplitude of approximately 3.5kV which appears at the output front panel connector (N type). The output pulse width may be adjusted by means of plug in pulse forming cables plugged into the front panel mounted SHV connector. The pulse width is approximately 1.5ns when no pulse forming cable is used, with three cables supplied to give 3.5ns, 4.5ns, and 5ns.

The pulser is supplied with connecting cables for a pockels cell and a separate 50Ω terminator. The terminator unit also includes a 100:1 attenuator to give a monitor output (SMA type).

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

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 trigger delay from trigger input BNC to main output is approximately 18ns. The jitter is ~20ps RMS 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

Pulse generator - Serial No. xxxxxxxx:

General:

Output voltage	>3kV into 50Ω
Output polarity	Positive.
Pulse shape	Square.
Pulse width	1.5ns, 3.5ns, 4.5ns and 5ns adjustable using plug in cables.
Rise time	<150ps
Trigger	>5V into 50Ω, <5ns rise time.
Jitter	<20ps RMS
Trigger delay	~18ns (BNC trigger input to main output)
Repetition rates	≥100Hz
Power supply	100-240V AC 50-60Hz Maximum power <25W

Outputs:

Pulse output	N type >3kV pulse
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Inputs:

Trigger input	BNC >5V into 50Ω
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Controls:

Pulse width	SHV Pulse forming cables for 3.5, 4.5 and 5ns supplied.
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.

Optional extra terminator unit - Serial No. xxxxxx:

General:

Input voltage	Maximum 5kV/6ns square pulse.
Input impedance	50Ω.
Input connector	N type.
Monitor output	100:1 attenuated input level.
Output impedance	50Ω.
Output Connector	SMA.
Connecting cables	2 x RG303 with N plugs on each end. 2 metres and 1.3 metres in length.

Environmental:

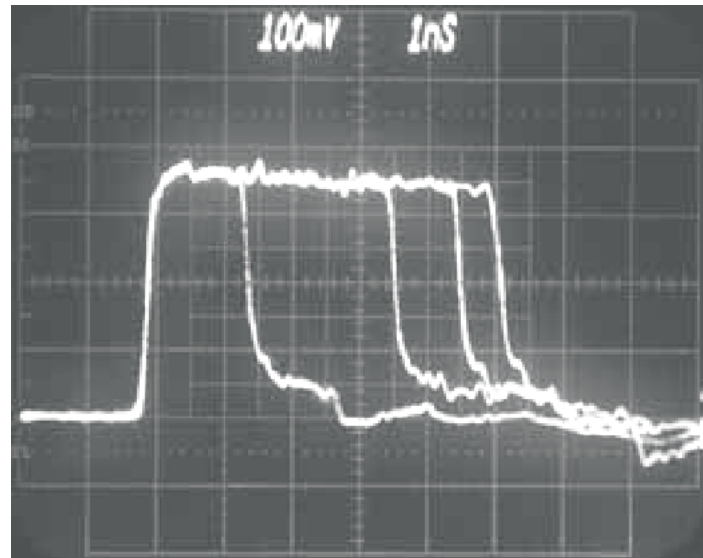
Ambient temperature	5 to 35°C
Humidity	< 95% non-condensing
Altitude	< 3000m
Dimensions	Pulser: H = 133, H+feet = 142, W = 235, D = 307. Terminator: L = 150, W = 82, H = 50.
Weight:	Pulser: 4.1kg, terminator: 400g

Test data

Kentech Instruments Ltd. Pulse generator model PBG1/S Serial No. xxxxx

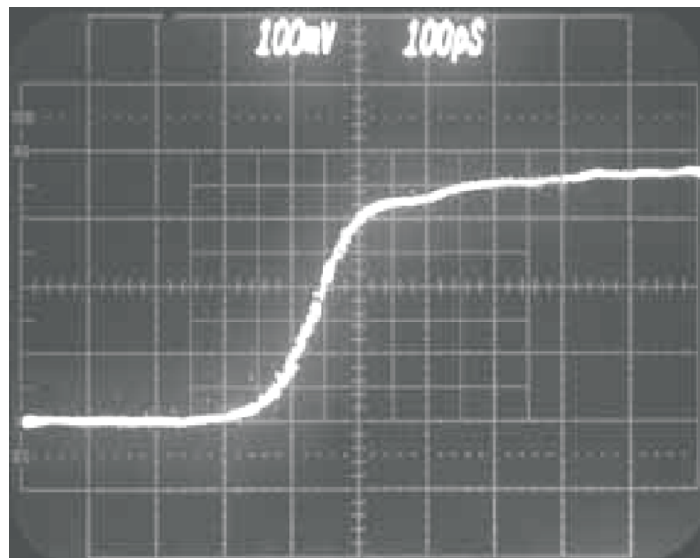
Test equipment:

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



Pulser output showing the 1.5, 3.5, 4.5 and 5ns pulse widths.

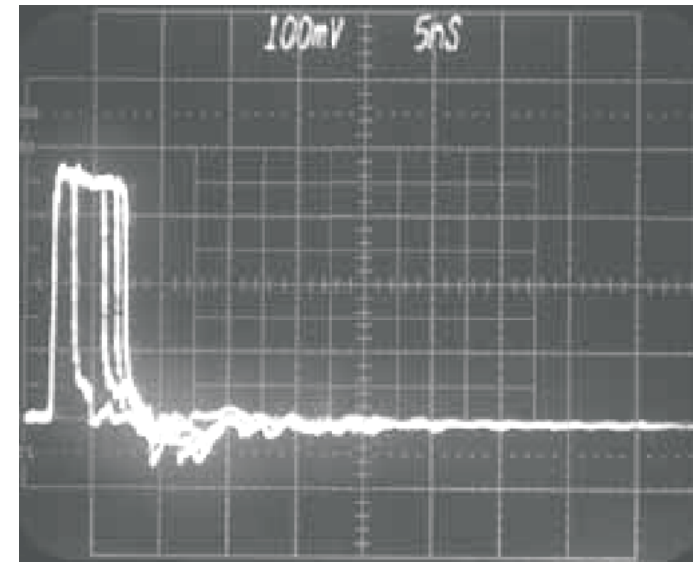
Vertical: 1kV/div
 Horizontal: 1ns/div
 Rep. rate: 100Hz



Pulser rise time and jitter. (same for all pulse widths)

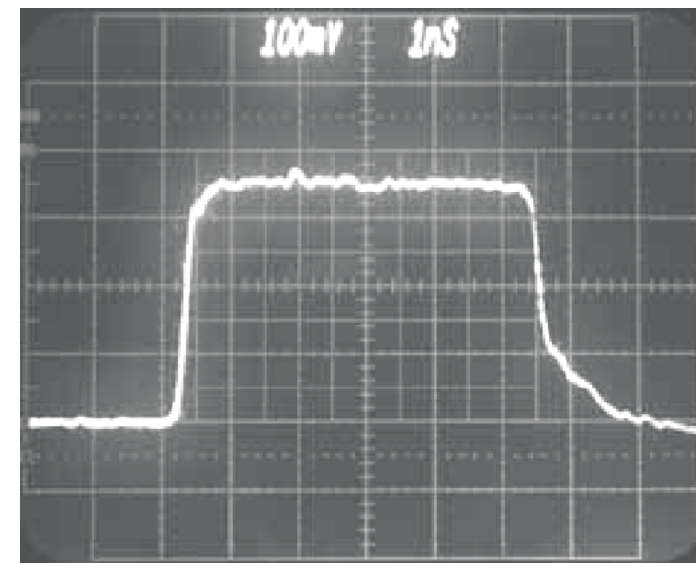
Vertical: 1kV/div
 Horizontal: 100ps/div
 Rep. rate: 100Hz

Test data



Post pulse noise

Vertical: 1kV/div
 Horizontal: 5ns/div
 Rep. rate: 100Hz



Monitor output from terminator with 5ns pulse forming.

Vertical: 10V/div
 Horizontal: 1ns/div
 Rep. rate: 100Hz