

Notes on the use of  
Kentech Instruments Ltd.  
HMP1/D/F/A1000/Q pulser  
Serial number J04\*\*\*\*\*



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# Caution

## HMP1/D/F/A1000/Q Pulser Serial No. J04\*\*\*\*\*

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.

With an appropriate load, the 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, we recommend the use of a Barth 142B x10 attenuator as the first in a series string. 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 (3kV) PRESENT IN THIS PULSER WHEN THE UNIT IS OPERATING. DO NOT REMOVE COVERS.**

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.

## 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  $50\Omega$ , and with a pulse repetition frequency (PRF)  $>1\text{kHz}$  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  $5\Omega$  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  $>10\text{kHz}$  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 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  $\geq 5$  volts with a fast rising edge ( $< 5$ ns) to maintain the low jitter of the system

When triggered the "triggered" light on the front panel will flash. A Pretrigger monitor pulse output (BNC) is available to establish remotely that the unit has triggered. This monitor may also be used to trigger ancillary pieces of equipment, e.g. intensifiers etc. In "External trigger delayed" mode it appears approximately 16ns after the trigger input.

The main output of the unit (N type) is a fast rising pulse having a peak amplitude of approximately 5kV, followed by an exponential decay with a time constant of approximately 5ns. The pulse amplitude may be adjusted using the single turn potentiometer on the front panel from 100% down to approximately 60%.

If it is necessary to monitor or characterise this pulse suitable attenuators should be used. We recommend the use of a high voltage, high speed attenuator manufactured by Barth<sup>TM</sup> as the first attenuator in a series.

### **The high voltage pulse from this unit is capable of destroying lower power attenuators.**

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

If the output of the pulser is to be used directly or via any passive network it is essential that cable lengths are kept as short as possible and that only high quality cable is used. This will enable the fast rising edge generated by the unit to reach the load without serious degradation.

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 ( $\sim 12$ ns full scale) delay controls.

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  $\sim 25$ ns. There is no pretrigger output in this mode.

There are thermal drifts in the delay generator which will stabilise after the pulser has been switched on for ~20 minutes.

### **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

Output voltage:	>4kV, 50 $\Omega$
Polarity:	Positive.
External trigger:	Requires $\geq 5V$ into 50 $\Omega$ , $\sim 5$ ns rise time.
Risetime:	$\leq 90$ ps rise.
Falltime:	approx. 5ns exponential fall.
Jitter:	$\leq 20$ ps rms.
Trigger delay:	$\sim 25$ ns in direct mode.
Max repetition rate:	1kHz
Power supply:	100 to 240V AC 50 to 60Hz

### **Outputs:**

Pulse output	N	4kV pulse
Pretrigger output	BNC	10V into 50 $\Omega$ , leads main output by the delay when the delay is active

### **Inputs:**

Trigger input	BNC	$\geq 5V$ , 50 $\Omega$
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### **Controls:**

Amplitude Single turn potentiometer to vary pulse amplitude from 60 to 100%.

Mode Sets one of the following modes:  
Internal trigger: Single shot (delay active)  
Internal trigger: 0.1-1Hz (delay active)  
Internal trigger: 1-10Hz (delay active)  
Internal trigger: 10-100Hz (delay active)  
Internal trigger: 100-1000Hz (delay active)  
External trigger: (delay active) "Delay"  
External trigger: (delay inactive) "Direct"

Fine rate Varies internal rate by a ratio of 10:1  
Delay (and fine delay) Sets internal delay, up to 100ns pretrigger delay  
Single shot button Depressing this button cause a single trigger when single shot mode selected  
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: Pulser: H = 140mm, W = 480mm, D = 450mm  
Weight: approx: 7kg.  
Ambient temperature 5 to 35 $^{\circ}C$   
Humidity < 95% non-condensing  
Altitude < 3000m

# *Declaration of Conformity*

**We:**           **Kentech Instruments Ltd**  
**Unit 9, Hall Farm Workshops**  
**South Moreton**  
**Didcot**  
**Oxon OX11 9AG, UK**

declare under our sole legal responsibility that the following products conform to the "Protection Requirements" of the European Community Directive 89/336/EEC on the approximation of the laws of member states relating to electromagnetic compatibility:-

**Kentech HMP1/D/F/A1000/Q pulse generator serial no. J04\*\*\*\*\* only**

to which this declaration relates are in conformity with the following relevant harmonised standards, the titles and references of which have been published in the Official Journal of the European Community:

EN55011 Emissions Specification (Group 2 Class A)  
Industrial, Scientific and Medical equipment

EN50082-2 Generic Immunity Standard  
Part 2 Industrial

following the provisions of the UK statutory instruments SI2372:1992 +  
SI3080:1994

The following documents contain additional relevant information:

Kentech File reference J04\*\*\*\*\*

**Name:** P. F. Rouse

**Signature:**

On behalf of Kentech Instruments Ltd

**Position:** Engineer

**Issued:** 24th September 2004