Kentech Instruments Ltd.

Special CPS Ramp Generator

SN J05*****

23rd. May 2005

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

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 emissions from the pulser itself have been tested and found to be within certain EC limits, see the Declaration of Conformity. These tests were performed with a dummy load on the output. 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 connectors 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.

Declaration of Conformity

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

Certify that this apparatus:-

Kentech Special CPS
serial no. J97***** only.

Conforms with the protection requirements of European Community Directives:-

73/23/EECLow Voltage Directive
89/336/EEC Electromagnetic Compatibility Directive
93/68/EECCE Marking Directive

The following harmonised standards have been applied:-

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

BS EN50082-2 Generic Immunity Standard
Part 2 Industrial

BS EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

The following documents contain additional relevant information:-

Kentech file reference J01*****

Name: A. K. L. Dymoke-Bradshaw

Signature: A.K.L. Dymoke-Bradshaw

On behalf of Kentech Instruments Ltd

Position: Director Issued: 25th. September 1997

PLEASE READ THIS MANUAL CAREFULLY BEFORE USING THE PULSER

DISCLAIMER

This equipment contains high voltage power supplies. Although the current supply capacity is small, careless use could result in electric shock. It is assumed that this highly specialised equipment will only be used by qualified personnel.

The manufacturers and suppliers accept no responsibility for any electric shock or injury arising from use or misuse of this equipment. It is the responsibility of the user to exercise care and common sense with this highly versatile equipment.

1 INTRODUCTION

This manual describes the operation and use of the fast ramp generator for use with streak cameras.

1.1 SPECIFICATIONS

Voltage range	approximately ±2kV into an open circuit load.
Maximum repetition rate	100Hz.
Trigger input	5 volts 10ns f.w.h.m. into 50Ω.
Synchronisation Output	5 volts 5ns wide pulse into 50Ω approximately 8ns after trigger pulse*.
Main outputs	9ns after trigger pulse*.
Power input	Universal 85 to 264 volts A.C. at 47 to 440Hz. 2 amp fuse, type T (anti-surge) This unit contains an auto-resetting thermal trip rated at 70°C Maximum average power consumption 25watts.
Connectors	
Power	IEC
Trigger input	BNC
Sychronisation output	BNC
Main output	N type
Return output	N type

*Note . These times were obtained with a fast high voltage trigger pulse. For slow trigger pulses of similar total charge the times will be longer.

2 GETTING TO KNOW THE INSTRUMENT

The ramp generator consists of an avalanche pulser, a bias circuit and a transformer arrangement to produce a balanced output.

2.1 FRONT PANEL CONTROLS, CONNECTIONS AND INDICATORS.

The front panel is shown in figure 1.

The only non obvious control is the mode switch. This only affects the bias voltages. The ramp generator continues to function normally in all positions of the mode switch.

In focus mode there is no bias voltage, there may be some residual voltage indicated on the LCD at high repetition rates. This is from charge from the pulse feeding into the voltage measuring circuit and is not noticeable at low rates and not significant at high rates.

In synch. and operate modes the bias circuit is turned on. The modes are actually identical but have separate potentiometers on the rear panel to set the DC voltage added to the ramp outputs. By switching between these two modes one may quickly switch between two voltage settings. It is expected that the voltages will be set so that in synch. mode the voltage is enough to place the ramp start position just on screen, enabling timing of the ramp circuit. In operate mode it will be off screen to enable a more linear part of the ramp to be used.

There are two LEDs which indicate the Power On and a triggered indicator.

There are four front panel connectors. The trigger input, the synchronisation output and the two main outputs.

2.2 REAR PANEL CONNECTIONS

There is only one rear panel connections the power inlet switch. The power inlet is filtered and will accept IEC leads. It uses a universal supply that will run from a variety of voltages, both AC and DC, see specification.

3 USE

The ramp generator is designed for use with streak cameras observing short events. The voltage from the ramp circuits rises in around 200ps but falls back to zero in several ns. It is the fast rise that is used by the streak camera as

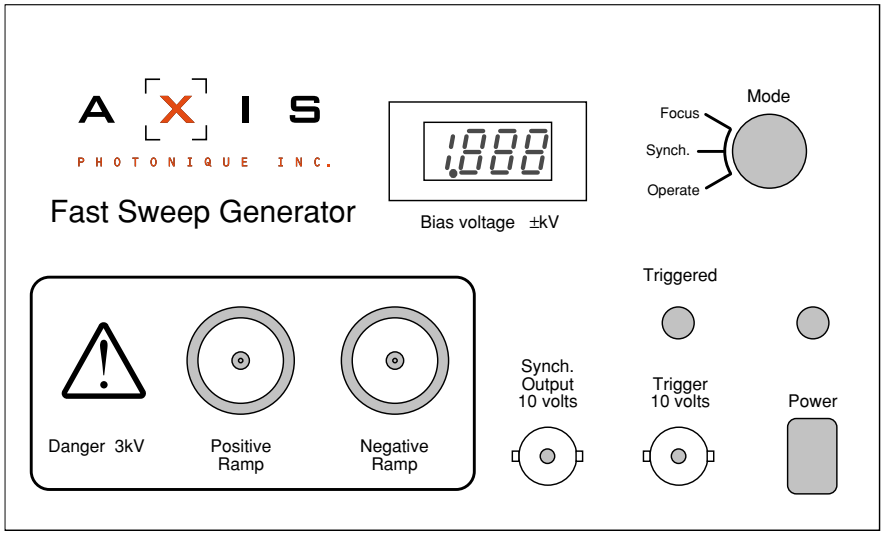


Figure 1 The front panel

the sweep drive. It is important that the user realise that the sweep will retrace the screen several ns after the initial sweep. It is important that the event under observation has stopped emitting the radiation being investigated by the time the ramp returns. It is also important during the timing phase of setting up the equipment that the user check that the fast edge has been used for the sweep. It is possible to time the system so that the slow falling edge of the pulse source is acting as a reverse direction sweep generator. The things to check are 1) that the sweep direction is from the negative sweep plate towards the positive. This is not always obvious from the data collected as the temporal direction may not be clear in the data. 2) That increasing the delay to the trigger input of the sweep circuit does indeed move the image towards the start point of the sweep. The latter test can provide an unambiguous check on the sweep direction and consequently on which side of the pulse is being used as the ramp. 3) That the sweep speed is reasonable. If the trigger jitter is low enough the sweep speed can be measured on a shot to shot basis by changing the timing of the trigger pulse and looking for the change in position of the swept image. When the jitter is too big for this scheme to work the sweep speed must be measured on a single shot by arranging for at least two events to be recorded on a single sweep.

4 CIRCUIT DESCRIPTIONS

The pulser circuit uses strings of avalanche transistors to switch a high voltage into the output. In order to avoid large DC voltages within the unit, the pulser is configured in several stages that are capacitively or inductively coupled. In this way the stage voltages can add up and the total output voltage can be larger than the DC voltage.

The single pulse output of the pulser is fed into two 50Ω cables. Into one it is fed into the inner and in to the other the outer. The other connections at the input to the cables are connected together with a small capacitor. This arrangement makes for a fairly symmetrical output waveform with equal but opposite on each cable. In order to improve the balance of the outputs they are fed through a balancing circuit that takes the difference of the two voltage waveforms and reapplies that difference to the main outputs as symmetrically as possible. As the waveforms have opposite polarity the difference is about twice that of either of them. This technique provides very symmetrical outputs.

Note that when applying the waveforms to the sweep plates of a streak tube it is important to maintain the potential at the centre of the sweep plates at zero (or at whatever voltage the various lens elements require). If this is not down then the electron bean in the tube can be defocussed. Consequently it is important to maintain the synchronism of the two outputs. As the two outputs are derived from one pulser there synchronism can only be changed by changing the length of one sweep lead.

5 PERFORMANCE

The output waveforms into a 50Ω load are shown in figures 2 and 3. The voltage into an open circuit or a capacitive load with RC less than the pulser risetime will be approximately twice this voltage. This must be remembered when calculating the anticipated sweep speed.

Absolute calculations of the sweep speed must allow for the transit time of the electrons past the sweep plates. If this is comparable to or longer than the pulse risetime, then this duration will determine the sweep speed not the pulser rise time.

Typical Data

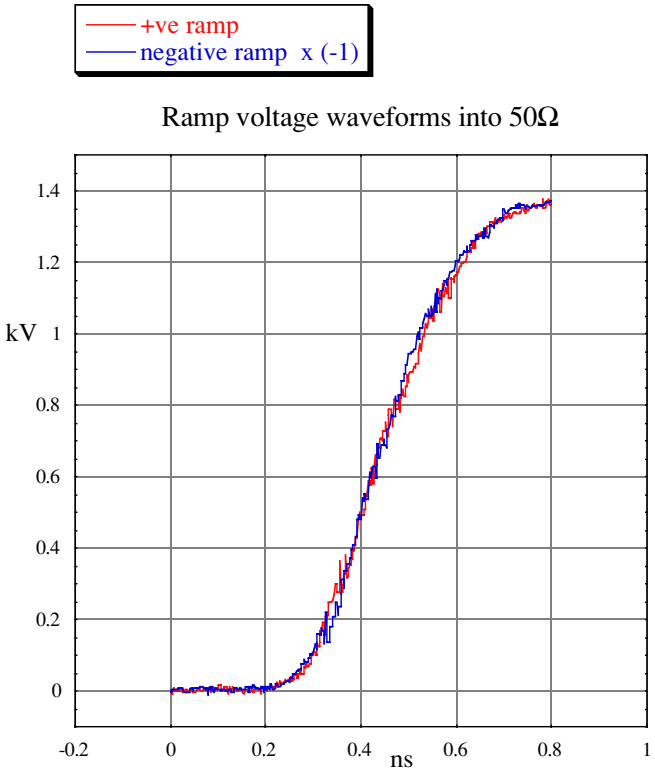


Figure 2
The two ramps superimposed. The negative ramps has been multiplied by (-1)

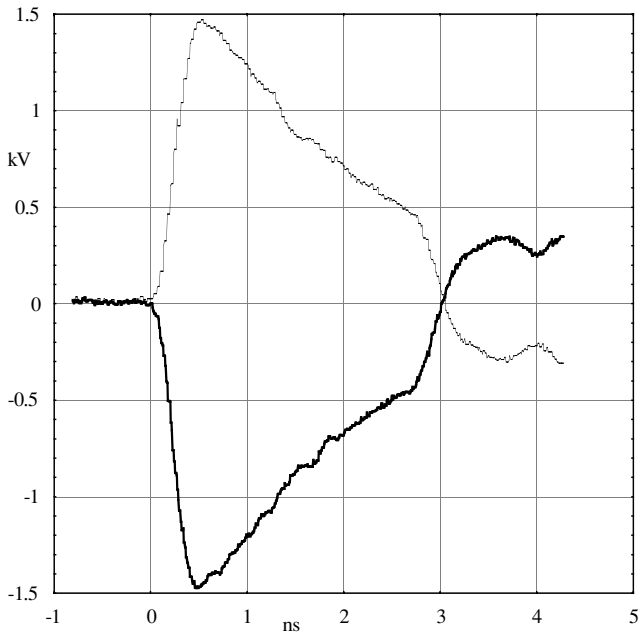
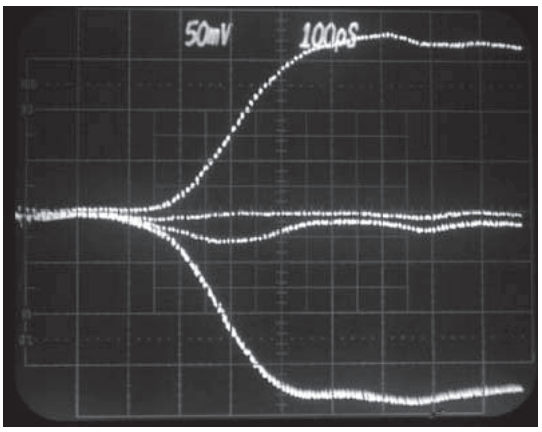


Figure 3
The two ramps superimposed showing the long time history.

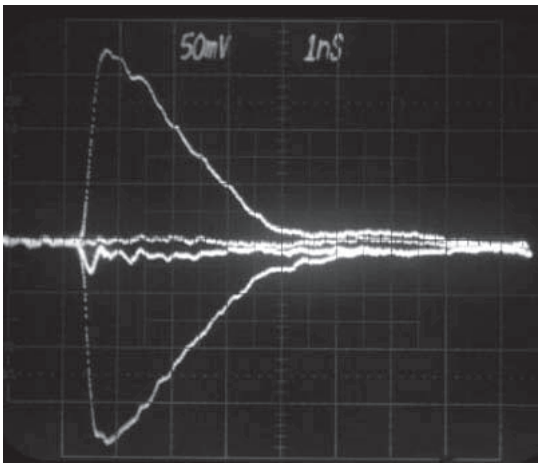
Actual data for J05*****



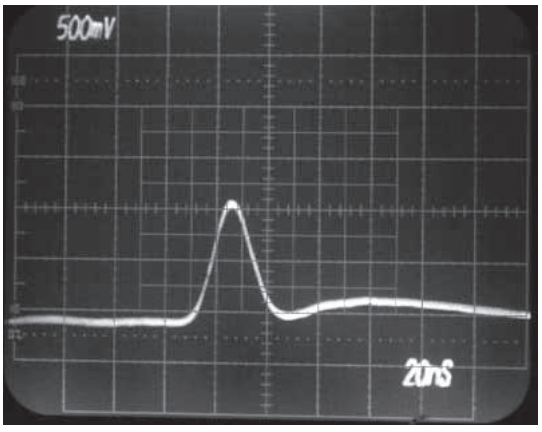
Output into 50 Ω with 80dB attenuation. gice vertical scale of 500V/div. The output will be twice this into an open circuit.
The three traces are:

1 positive ramp
2 Negative ramp
3 Sum of ramps showing small inbalance
4 base line showing some noise

100ps per div



1ns per div



Monitor pulse

20ns per div

5 volts per div