

Kentech Instruments Ltd.

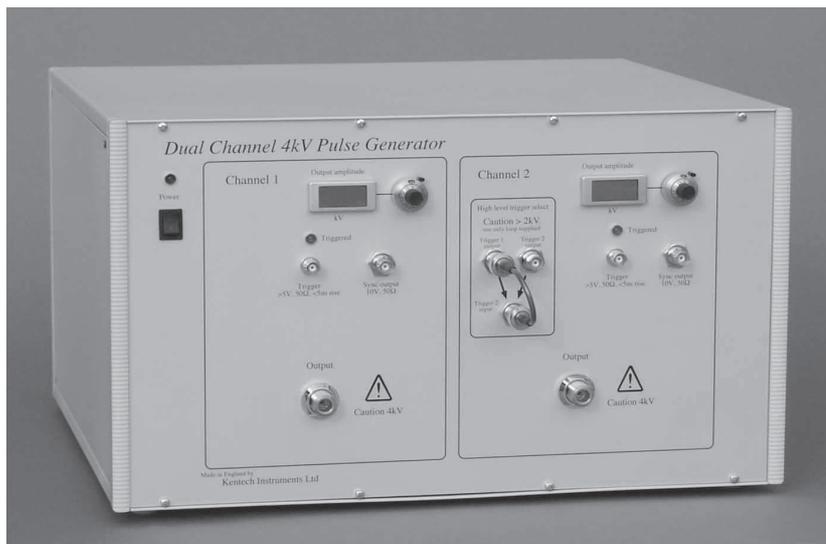
Notes on the use of

Dual channel 4kV

(J01*****/1 and J01*****/2)

and 8kV

(J01*****/3 and J01*****/4) pulsers



30th August 2001

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

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.

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 includes circuits 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 emissions from this pulser may exceed the limits specified in EN55011 "Emissions Specification for Industrial, Scientific and Medical equipment" and the unit may cause interference with other equipment in its immediate environment. It is suitable for use only in a laboratory or a sealed electromagnetic environment, unless it is used in a system that has been verified by the system builder to comply with EC directive 89/336/EEC. Use of this apparatus outside the laboratory or sealed electromagnetic environment invalidates conformity with the EMC Directive and could lead to prosecution.

We recommend the following precautions to minimise emissions from the load:-

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, and generally will need additional screening.

Introduction

Our range of solid state pulsed (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) $>1\text{kHz}$ can be produced. The performance of our compact, convenient and reliable pulsed is to our knowledge exceeded only by laser driven photoconductive switches in terms of voltage switching speeds. These pulsed 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 pulsed and two independent pulsed can be used in parallel to drive low impedances. This aspect makes the pulsed 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 pulsed 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 one or two trigger signals to operate.

The trigger signals applied to the front panel trigger inputs (BNC) should be >5volts into 50Ω with a fast rising edge (<5ns) to maintain the low jitter of the system. The maximum input applied to the trigger inputs should not exceed 15V. The two pulser channels may be triggered independently by individual trigger inputs, or channel 1 trigger input can simultaneously trigger both outputs. The two modes are selected by a semi rigid coaxial front panel link using TNC connectors, to avoid damage to the link always unscrew both link connectors when changing the link position.

Caution: The link carries an amplified trigger signal with an amplitude of more than 2kV, only use the link provided.

Channel 1 output is always triggered by channel 1 trigger input. Each trigger input has a LED above the BNC input connector which flashes when the channel is triggered.

The outputs of the unit are a nominal 6ns wide 4kV (8kV on 8kV units) positive pulse which appear at the output front panel connectors (N type on 4kV units, HN on 8kV units). Each output amplitude may be independently adjusted down to approximately 2.8kV (4kV units) or 5.4kV (8kV units) using the two 10 turn front panel mounted potentiometers. Each channel also has a front panel mounted DVM indicating the potentiometer setting. The reading on the DVM is related to an internal adjustable power supply and has a non linear relationship to output amplitude. The reading may vary while the pulser triggered.

The maximum repetition frequency of the pulser is 100Hz.

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

To avoid internal damage the outputs of the 8kV pulser it must have a load connected when the pulser is being triggered.

Caution

The output of this unit will damage or destroy many types of high voltage and high power attenuators. For the 4kV units we recommend the use of a high voltage, high speed attenuator manufactured by Barth™ as the first in a series. For the 8kV units we have used a Kentech 50Ω ‘suicide T’ network as the first in a series of attenuators. 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.

Each channel has a sync. output giving a 10V pulse approximately 10ns after the trigger input.

The trigger delay from trigger input BNC to main output is approximately 28ns. The trigger delay has been factory set to give the same timing for each channel using the supplied semi rigid trigger link.

The jitter is ~10ps RMS with a suitably reproducible and fast rising trigger signal.

SPECIFICATIONS 8kV units

General:

Number of channels 2

Each channel:

Output voltage 8kV adjustable to 5.4kV into 50 Ω
Output polarity Positive.
Pulse shape Rectangular.
Pulse width 6ns FWHM.
Rise time <140ps
Trigger >5V into 50 Ω , <5ns rise time. (max. amplitude 15V)
Jitter <10ps RMS
Trigger delay ~30ns (BNC trigger input to main outputs)
Repetition rates \geq 100Hz
Power supply 170-240V AC 50-60Hz
Maximum average power <100W

Outputs:

High level trigger outputs TNC 2kV Channel 1 and 2. not
for external use.
Pulse outputs HN type 8kV pulse (both channels)
Sync. output BNC 10V into 50 Ω . (both channels)

Inputs:

Trigger inputs BNC >5V into 50 Ω (both channels)
High level trigger input TNC 2kV Channel 2. input not
for external use.

Controls:

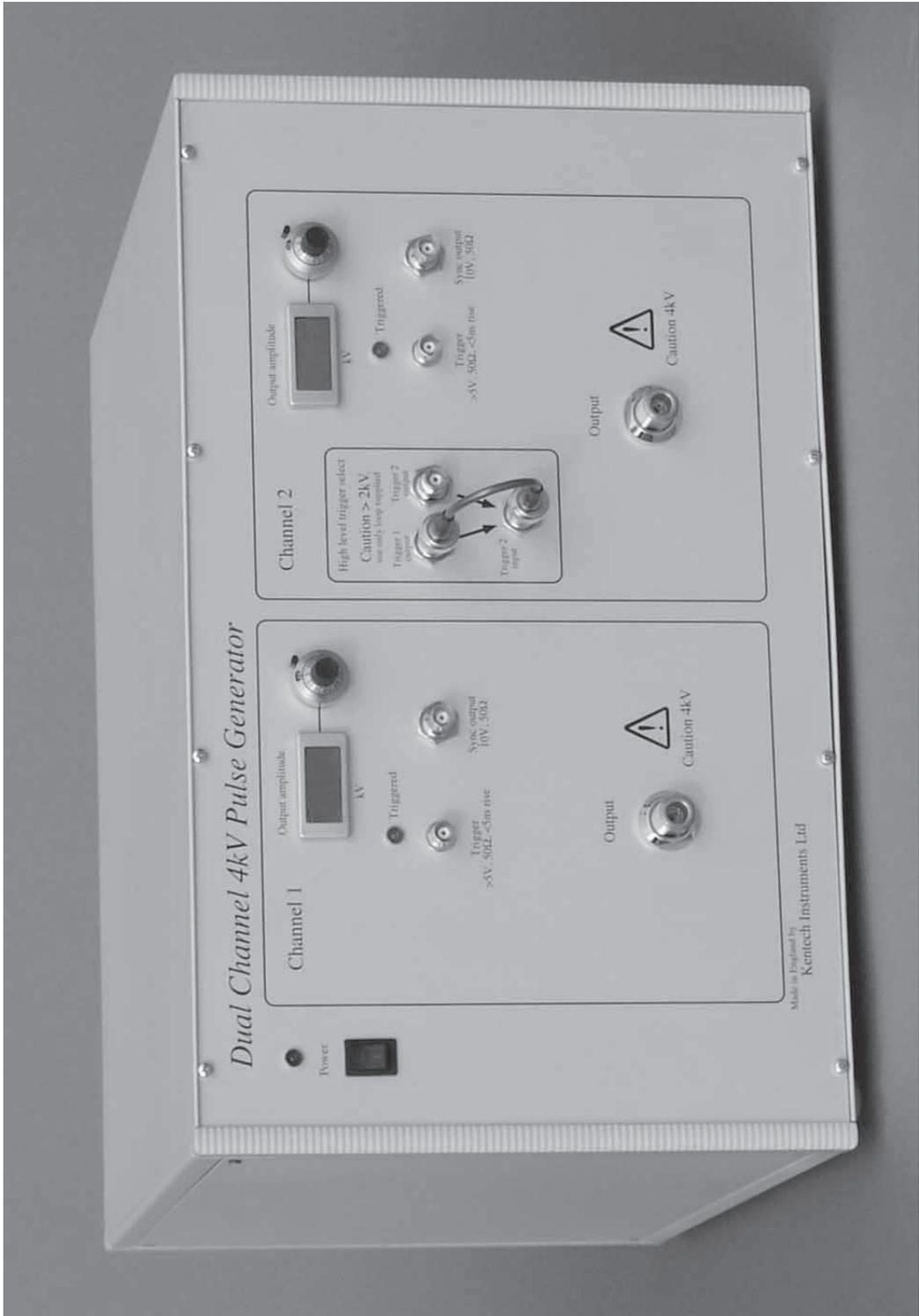
High level trigger mode TNC Semi rigid link to select trigger mode.
Amplitude 10 turn potentiometer with digital. (both channels)
Power Switches AC power in the pulser.

Indicators:

Amplitude DVM giving amplitude information. (both channels)
Power Shows that AC power is applied and the unit is switched on.
Triggered Illuminates when channel is triggered. (both channels)

Environmental:

Ambient temperature 5 to 35 $^{\circ}$ C
Humidity < 95% non-condensing
Altitude < 3000m



Test Data

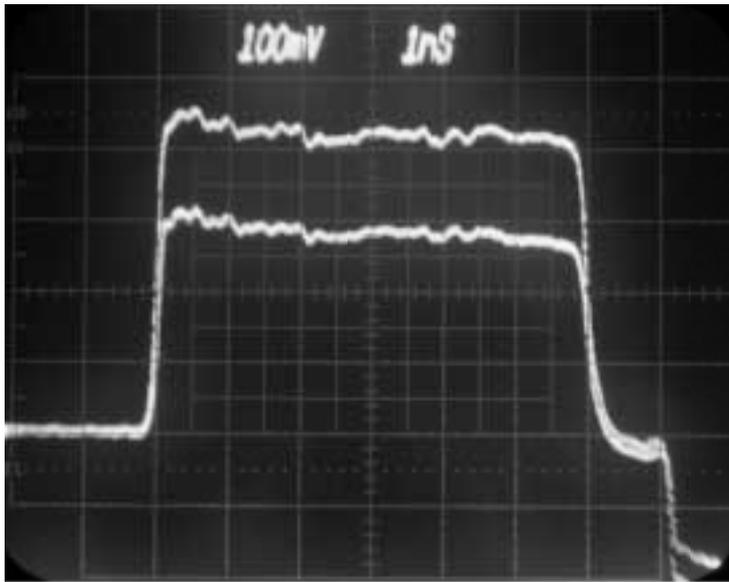
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Dual 8kV pulse generators J01*****/3 and J01*****/4

Test equipment: Scope: Tek 7834, 7S11 + S4, 7T11
Attenuators: Kentech 'Suicide T' (6dB)
Barth 142 (20dB) X2
Radial SMA (20dB) x2
Total attenuation 86dB (x20000)

Trigger source: Kentech APG1 (auxiliary output)

Output waveforms Unit J01*****/3



Channel 1

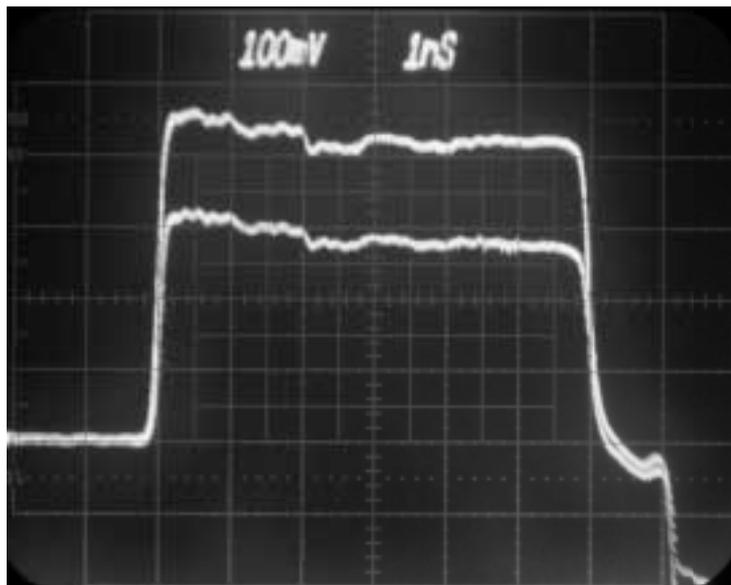
Max and Min amplitude

Vertical: 2kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz

Note: The negative step approx. 1ns after the falling edge of the output pulse is caused by the effect of the suicide T' and is not present on the pulser output.



Channel 2

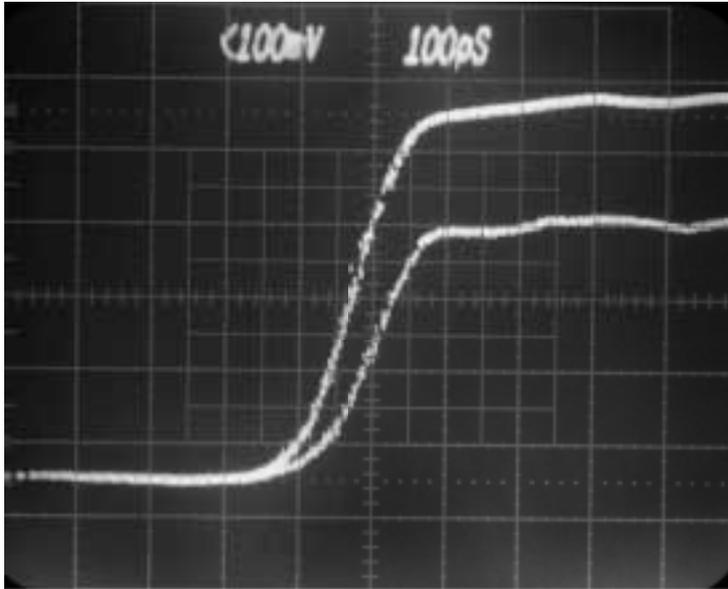
Max and Min amplitude

Vertical: 2kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz

Output waveforms Unit J01*****/3



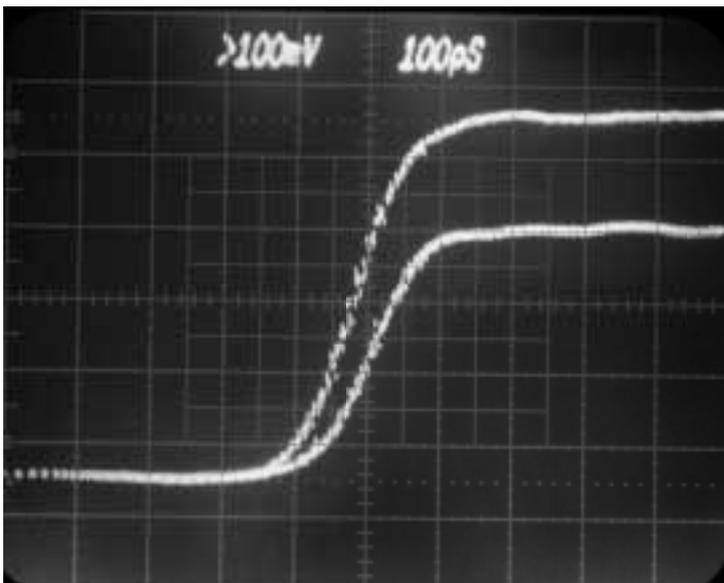
Channel 1

Max and Min amplitude

Vertical: ~2kV / Div
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz



Channel 2

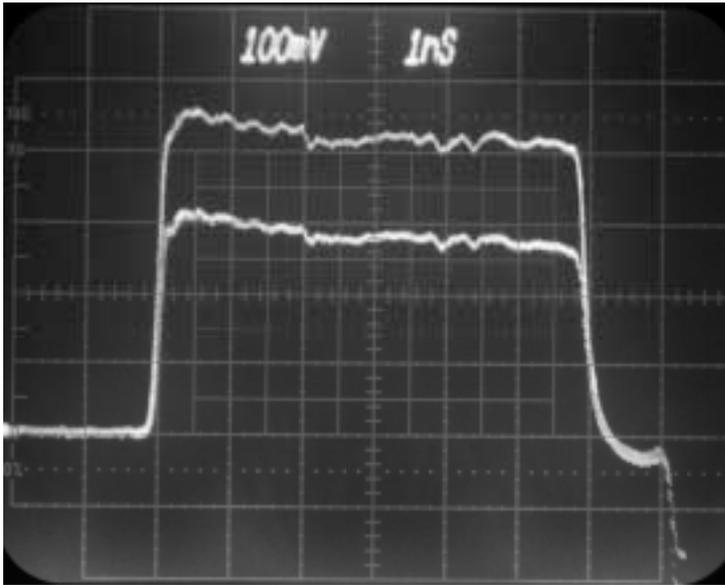
Max and Min amplitude

Vertical: ~2kV / Div
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz

Output waveforms Unit J01****/4



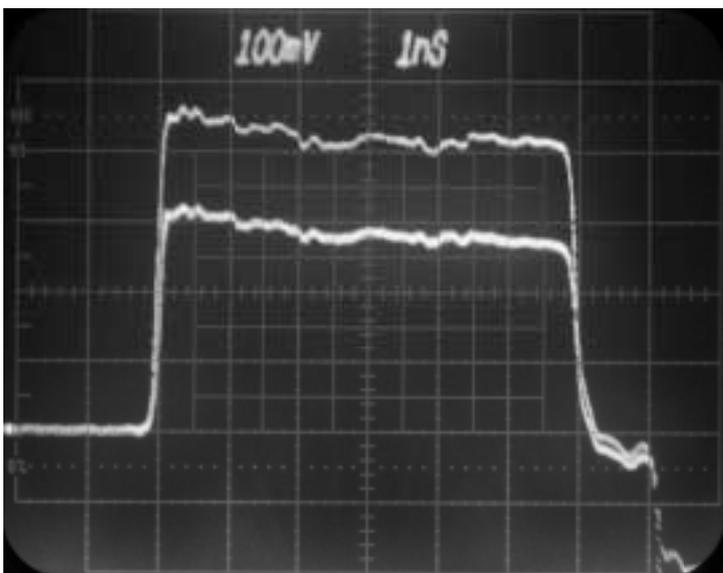
Channel 1

Max and Min amplitude

Vertical: 2kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz



Channel 2

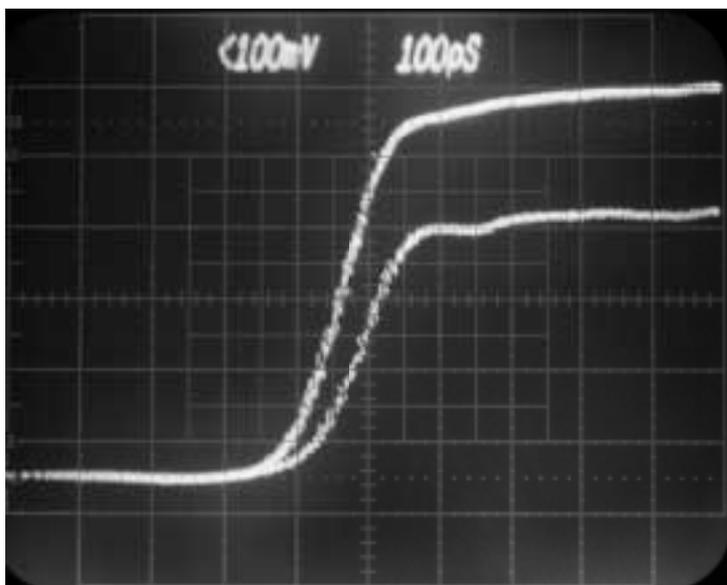
Max and Min amplitude

Vertical: 2kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz

Output waveforms Unit J01*****/4



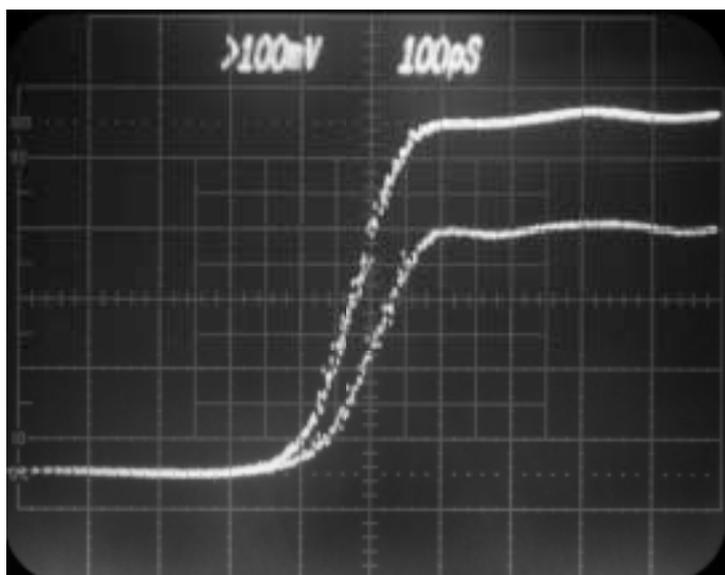
Channel 1

Max and Min amplitude

Vertical: $\sim 2\text{kV} / \text{Div}$
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz



Channel 2

Max and Min amplitude

Vertical: $\sim 2\text{kV} / \text{Div}$
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz

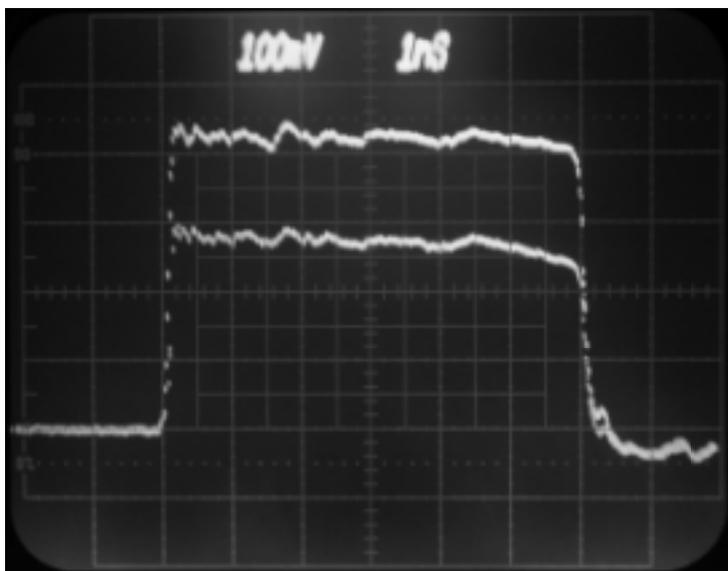
Test Data

Sheet 1 of 4

Dual 4kV pulse generators J01*****/1 and J01*****/2

Test equipment: Scope: Tek 7834, 7S11 + S4, 7T11
Attenuators: Barth 142 (20dB) X2
Radial SMA (20dB) x2
Total attenuation 80dB (x10000)
Trigger source: Kentech APG1 (auxiliary output)

Output waveforms Unit J01*****/1



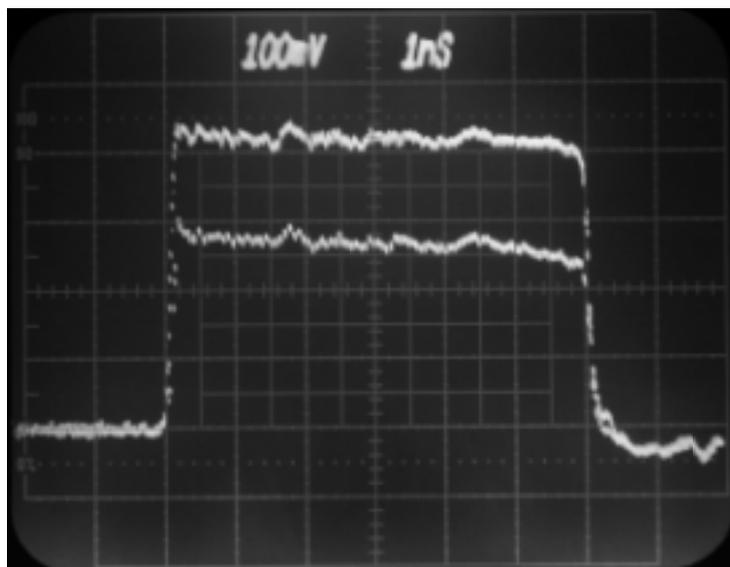
Channel 1

Max and Min amplitude

Vertical: 1kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz



Channel 2

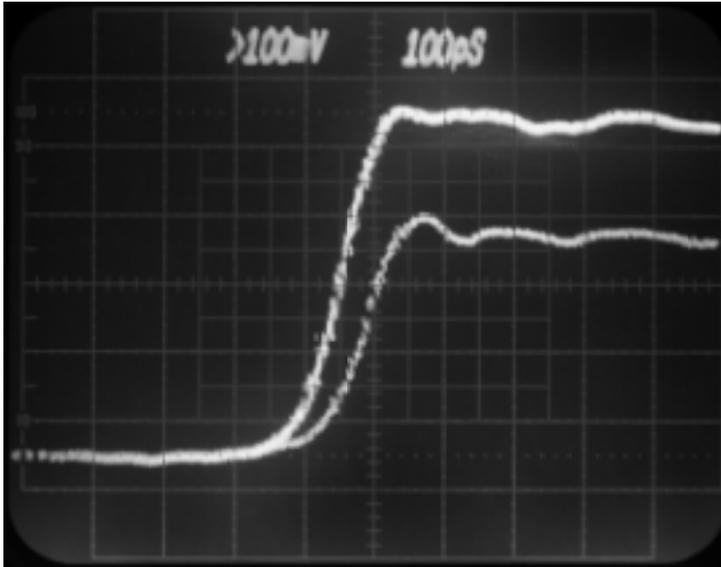
Max and Min amplitude

Vertical: 1kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz

Output waveforms Unit J01*****/1



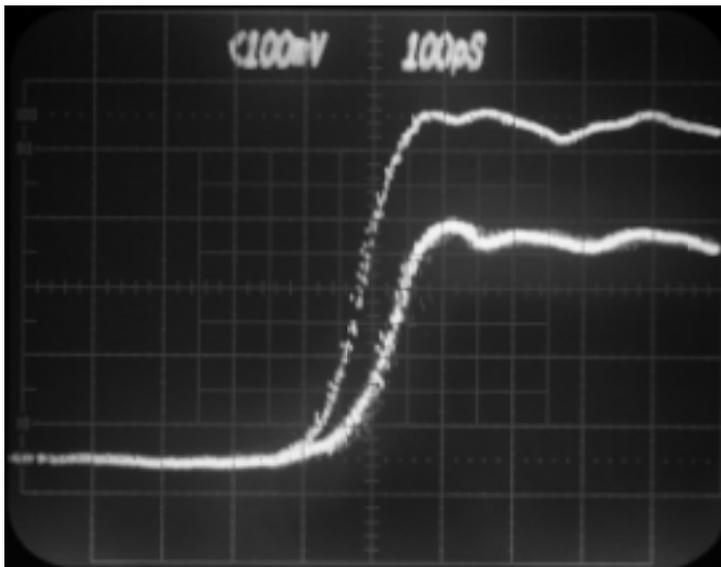
Channel 1

Max and Min amplitude

Vertical: ~1kV / Div
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz



Channel 2

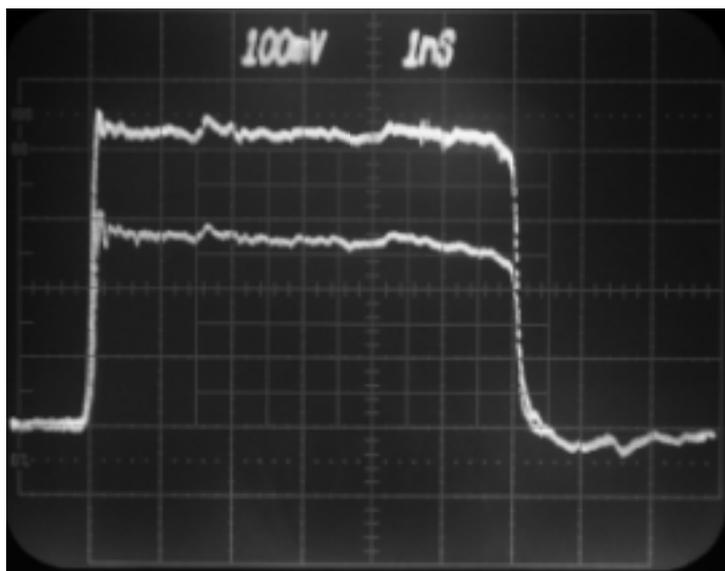
Max and Min amplitude

Vertical: ~1kV / Div
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz

Output waveforms Unit J01*****/2



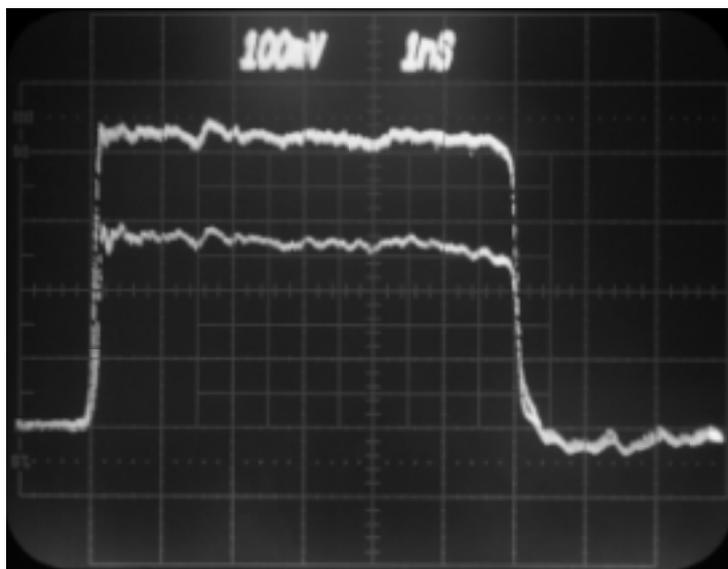
Channel 1

Max and Min amplitude

Vertical: 1kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz



Channel 2

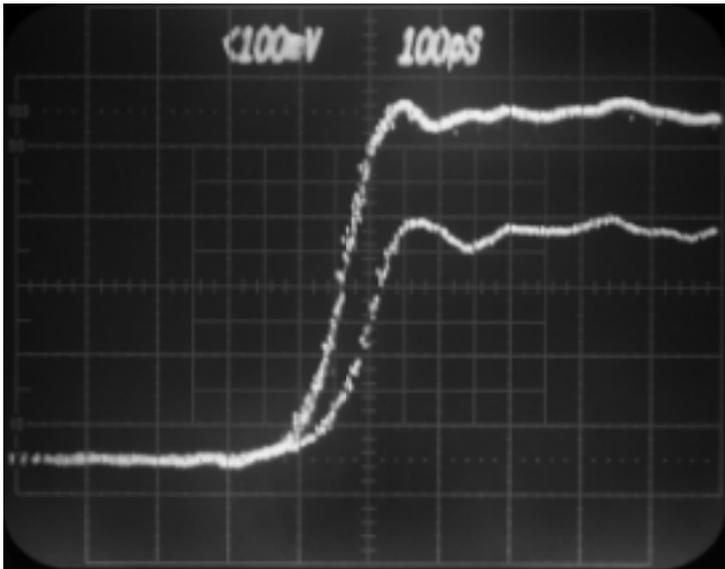
Max and Min amplitude

Vertical: 1kV / Div

Horizontal: 1ns / Div

Rep. rate: 100Hz

Output waveforms Unit J01****/2



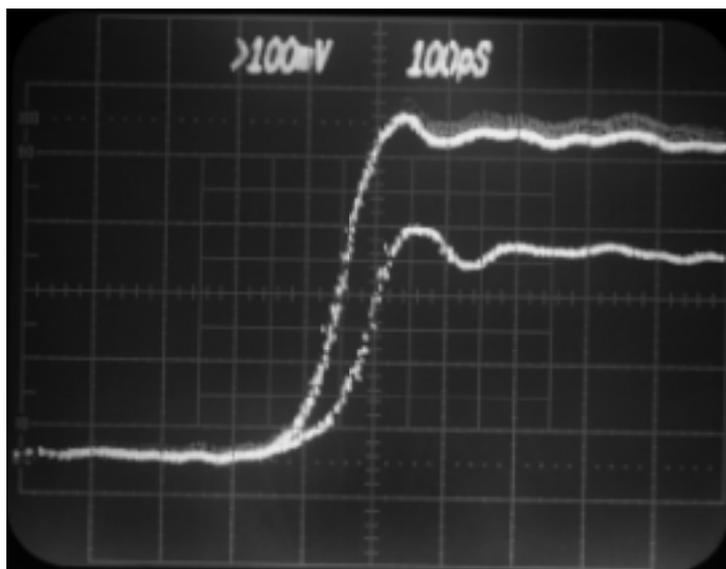
Channel 1

Max and Min amplitude

Vertical: ~1kV / Div
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz



Channel 2

Max and Min amplitude

Vertical: ~1kV / Div
(adjusted for 0-100%)

Horizontal: 100ps / Div

Rep. rate: 100Hz