Kentech Instruments Ltd.

UTV100P 1-100ns Pulser

User Manual

J19XXXXX

PLEASE READ THIS MANUAL CAREFULLY
BEFORE USING THE GENERATOR

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CAUTION

With an appropriate load, this unit is safe for use by an educated user in a laboratory environment. The generator is able to provide high frequency RF output and if connected to an unsuitable load may result in RF radiation. This equipment is supplied on the understanding that the user will analyse these emissions, accept responsibility for them and take appropriate precautions in the use of this instrument.

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 hazardous voltages present in this pulse generator 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 only.

1. Description

The UTV100P is designed to generate rectangular pulses into a 50Ω load. The unit is not reverse terminated. There is an interlock input which is used to enable or disable the trigger circuit. On receipt of a trigger pulse the UTV100P will generate a single output pulse. The trigger source may be internal or external. There is a Sync output (monitor) that may be used as a trigger for other equipment. The Sync output amplitude is 4.1V into 50Ω. The Pulse output duration and amplitude may be set within the range of 1 to 100ns and 1 to 100V. This may be done manually via the front panel button cluster or remotely via the USB, Ethernet or RS232 serial ports.

The unit is housed in a 3U 63HP enclosure and requires a 110/240Vac, 50/60Hz supply to operate.

Ideally the external trigger level should be about 5V into 50Ω, with a rise-time faster than 2ns for best jitter performance. Trigger pulse duration should be between 10ns and 1000ns. The trigger threshold level may be adjusted from 1.5V to 5.0V to further improve jitter performance.

The pulser trigger circuit is enabled externally by an interlock input on the front panel which must be shorted to ground. If this input is floating, no output pulse will be generated. This is a safety feature which may be used to inhibit the pulser output and prevent damage to sensitive equipment. An interlock lead (length 2m) is supplied with the pulser.

The UTV100P is designed to produce a programmable impulse at an amplitude up to 100V with a pulse width adjustable from 1 to 100ns. Due to the pulse risetime characteristics of the waveform, amplitudes may differ slightly for pulses of different widths. For this reason, the amplitude can be set to 105V maximum. This allows the full 100V output to be achieved for any pulse width.

The pulser has an internal rate generator that operates from 1Hz to 20kHz. This pulser is specified for up to 20kHz pulse repatition frequency. The rate of the external trigger is limited to a maximum of about 30kHz.

There is a TTL Sync output (monitor) which leads the main pulse output by about 13ns (see Figure 8). This may be used for scope triggering and can drive 50Ω. The trigger delay using an external trigger is about 68.3ns (see Figure 7).

The amplitude is continuously adjustable from 1V to 100V with a resolution of 0.1V. The polarity may be set via a front panel selectable inverter. The natural output of the pulser is negative. The positive polarity is produced via a transmission line inverting transformer. An RF relay selects between the two polarities. The inverted path shows a slightly greater loss and slightly slower transition times than that of the non-inverted output. The effect though is small.

The output amplitude can be set as high as 100V which may be damaging to some test equipment. Make sure adequate attenuation is provided when using sensitive

instrumentation.

If the user application requires many mate/de-mate cycles, it is recommended that the SMA output is fitted with the supplied ‘connector saver’ (SMA plug-jack adapter). It is easier to replace the connector saver when worn, rather than the output SMA. The output SMA incorporates an anti-rotation design so it is recommended that the output connection is torqued up using a suitable SMA wrench. This will produce the most consistent measurements.

In the first few minutes of operation, there are small temperature drifts in the internal delays which result in a small change in the pulse width and trigger delay. This is most noticeable when minimum pulse width is selected. Allow the pulser to reach thermal equilibrium before making critical measurements.

2. Specification

The UTV100P was designed to meet the following specification:

		Typical performance achieved
Amplitude:	0-100V, front panel or USB adjustable	0-100V
Polarity:	Positive or negative	Positive or negative
Load:	50Ω	50Ω
Pulse width:	1-100ns, front panel or USB adjustable	1ns -100ns
Trigger rate:	20kHz maximum internal	20kHz
	20kHz maximum external	30kHz
Trigger input:	3-10V, 50Ω	5V, 50Ω
Trigger duration:	10ns minimum	5ns minimum
Output rise-time:	<200ps 20-80%	171ps 20-80%
Output fall-time:	<500ps 80-20%	272ps 80-20%
Jitter:	<15ps rms, trigger input to output leading edge	4.7ps
	<15ps rms, sync output to output leading edge	2.3ps
Trigger delay:	Not specified	68.3ns approximately

3. Controls

The UTV100P is controlled locally by the push-button cluster on the front panel or remotely via the USB, Ethernet or RS232 ports.

Local or remote control of
- Amplitude
- Pulse width
- Trigger mode (enable/disable)
- Trigger source (internal/external)
- Trigger threshold voltage
- Internal trigger rate
- Polarity

4. Indicators

LCD - showing pulse parameters
Power LED - green
Triggered LED - yellow
Enabled LED - yellow

5. Connectors

AC power input	IEC (rear panel)
Trigger input	BNC (front panel)
Sync output	BNC (front panel)
Pulse output	SMA (front panel)
Interlock input	LEMO ‘00’ (front panel)

AC power	100-240Vac, <40VA
Cooling	Forced air
Dimension	approx. 150 x 235 x 285mm (H x W x D)
Weight	approx. 6kg

6. Manual control

All pulser parameters can be set up from the front panel via the button cluster and LCD display. The pulser will power up with the pulse parameter page displayed. This is a typical display:

```
<Amp =  30.0 V local
 Wid =  10000 ps
 Trig = Int Pol = P
 Rate = 20000 Hz
```

This indicates that the pulser is set to 30V amplitude, 10ns pulse width, internal triggering at 20kHz and positive polarity. The 'local' message indicates that front panel button control is active.

To edit a parameter move the cursor under the relevant character using the left and right buttons and use the up and down buttons to edit the parameter. The hardware responds immediately to changes.

The user may save the current pulser settings so that at next power up the settings are restored. To do this take the cursor to the top left hand corner, below the < character, from which another left key will bring up the SAVE page:

```
 Store settings?
<Save = NO
```

With the cursor under NO, use the up/down buttons to select either YES or NO. When the cursor is moved to the left with YES selected there is a message to confirm the new settings have been saved.

To return to the pulse parameter edit page, move the cursor to the left onto the < character. One more left button will return to the parameters page.

In the pulse parameter edit page the following parameters may be edited:

Amplitude `Amp = 30.0 V`
Range: 1.0V to 100.0V

Width `Wid = 10000 ps`
Range: 1000ps - 100000ps

Trigger source `Trig = Int`
Options: Internal, External, Off

Polarity `Pol = P`
Options: N, P

If Internal trigger source is selected, the Internal trigger rate can be adjusted:

Internal trigger rate `Rate = 20000 Hz`
Range: 10 - 20000Hz

If External trigger source is selected, the Trigger threshold voltage can be adjusted:

Trigger threshold `Vthr 1.500 V`
Range: 1.500 – 5.000V

Specifications may be subject to change.

7. Software control

All the pulser parameters may be set via the one of three serial interfaces: USB, Ethernet or RS232. When the UTV100P is switched on, it will select to the first serial interface that receives a character in its input buffer. From that time onwards, the selected interface will be enabled and the other two interfaces will be ignored. To use a different serial interface, the instrument must be switched off and on (power-cycled) so that it can once again scan for activity on each serial interface.

USB Interface:	USB via virtual COM port, Future Technology Devices International Ltd. UM232R. Driver available at: http://www.ftdichip.com/Drivers/VCP.htm The USB virtual COM port should be set to 115200 baud, no parity, no flow control, 1 stop bit.
Ethernet Interface:	Ethernet via virtual COM port, Lantronix Inc., Xport https://www.lantronix.com/products/xport There are two approaches to accessing Serial Mode. Make a Telnet connection to the network port (10001) or connect a terminal (or a PC running a terminal emulation program) to the unit's serial port. See Xport User Guide. MAC address = **00-80-A3-DA-80-D1**
RS232 Interface:	9-way D-Sub connector (Pins 2=RXD, 3=TXD, 5=GND) The RS232 virtual COM port should be set to 9600 baud, no parity, no flow control, 1 stop bit. Note that RS232 baud rate can be changed, see below.

Upon receipt of any valid command via the serial interface, the internal firmware will enter remote mode, issue a banner message and wait for commands via the link. In this mode the front panel buttons are inactive. The LCD displays the current setting plus the ***REM*** message showing that control is given over to the serial interface:

```
Amp =  30.0 V *REM*
Wid = 100000 ns
Trig = Int Pol = P
Rate = 20000 Hz
```

Control can be returned to the front panel buttons either by the " local " command or by cycling the power.

Note that power cycling will interrupt the serial protocol and the host will need to re-establish the link by sending a character (such as carriage return, "<cr>") to one of the three available serial interfaces.

Commands are not case sensitive. All commands are followed a carriage return, "<cr>". All parameters are integers and there must be a space between the parameter and the command. The command is echoed and when it is completed an "ok" response is issued.

***xxx* !amplitude <cr>** (Set the amplitude)
xxx is the amplitude in units of 0.1V, in the range 10 to 550

?amplitude <cr> (Read back the amplitude in units of 0.1V)

***xxxxxx* !width <cr>** (Set the pulse width)
xxxxxx is the pulse width in ps, in the range 1000 to 100000

?width <cr> (Read back the pulse width in ps)

***n* !trigger <cr>** (Select the trigger mode)
n = 0, 1 or 2 for OFF, EXTERNAL and INTERNAL trigger modes

?trigger <cr> (Read back the trigger mode)

***xxx* !threshold <cr>** (Set the amplitude)
xxx is the trigger threshold in units of 1mV, in the range 1500 to 5000

? threshold <cr> (Read back the trigger threshold in units of 1mV)

***n* !polarity <cr>** (Set the polarity)
n = 0 for NEGATIVE, 1 for POSITIVE

?polarity <cr> (Read back the polarity)

***xxx* !rate <cr>** (Set the internal trigger rate)
xxx is the internal trigger rate in the range 1 to 20000

?rate <cr> (Read back the internal trigger rate)

local <cr> (Return to front panel control)

forcetrig <cr> (Force a trigger in external trigger mode)

***xxx* !baud <cr>** (Change RS232 baud rate following a power cycle)
xxx is the desired RS232 baud rate (9600, 19200 or 115200) following the next power cycle. Note that a **save** command must be executed to store this option in EEPROM before cycling the power.

?baud <cr> (Read back the RS232 baud rate)

save <cr> (Save current settings to non-volatile memory)

We recommend that communications with the pulser are first tested using a terminal emulator program such as Hyperterminal. When the virtual COM port driver is installed and the pulser is connected, the terminal emulator will be able to connect to the COM port. A typical command dialogue is shown below.

Commands where a number is shown require an argument.

Below is a dialogue as displayed in a terminal emulator when these commands are issued.

```
*******************************        banner message when remote mode starts
MPE ROM PowerForth for Cortex-M3
v1.00 [build 0001] 28 Jan 2020, 14:51:23
*******************************
19432 bytes free

  ok                                   set the pulse width to 10 ns -  the units are ps
10000 !width  ok                       set the pulse width to 5.5 ns
5500 !width  ok                        read back the pulse width
?width 5500  ok                        set the amplitude to 25 volts - the units are 0.1V
250 !amplitude  ok                     read back the amplitude
?amplitude 250  ok                     set negative polarity
0 !polarity  ok                        set positive polarity
1 !polarity  ok                        select OFF trigger mode
0 !trigger  ok                         select EXTERNAL trigger mode
1 !trigger  ok                         select INTERNAL trigger mode
2 !trigger  ok                         read back the trigger mode
?trigger 2  ok                         set an internal rate of 5kHz
5000 !rate  ok                         read back the trigger rate
?rate 5000  ok                         return control to the front panel
local
```

8. Test equipment

The measurements below were obtained using the following test equipment:

Agilent DSO 80304B Oscilloscope 12GHz 40GSa/s	S/N MY46000706
Radiall attenuator, SMA Type R411-820-124,	20dB 6GHz
Highland P400 Digital Delay Generator (ext. trigger source)	S/N 0250

9. Test waveforms

The following test waveforms were obtained using a 5V trigger pulse of 100ns duration. The transition times were measured using 20-80% thresholds as specified.

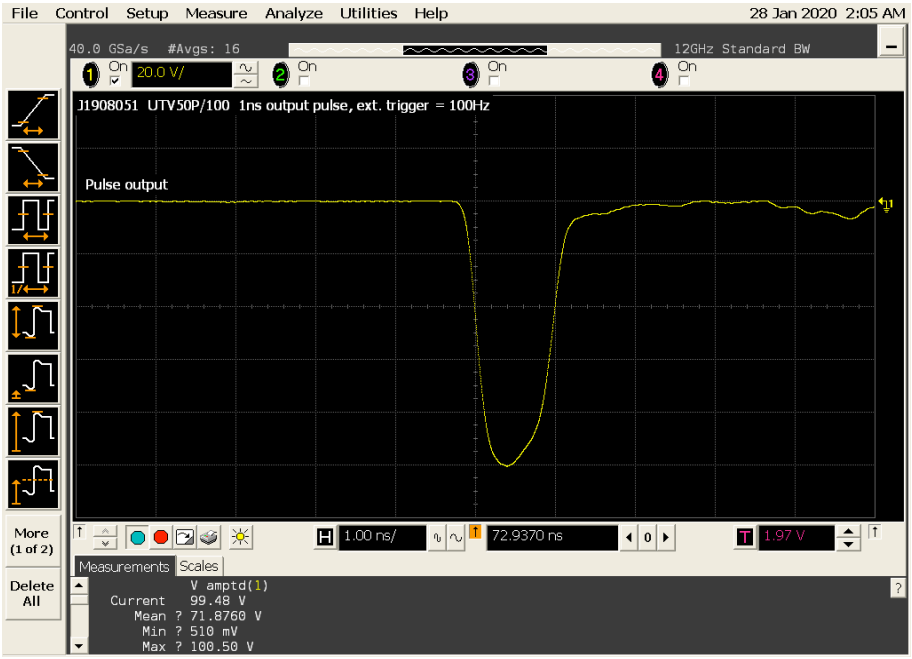


Figure 1: 1ns 100V negative pulse. Ext. trigger 100Hz

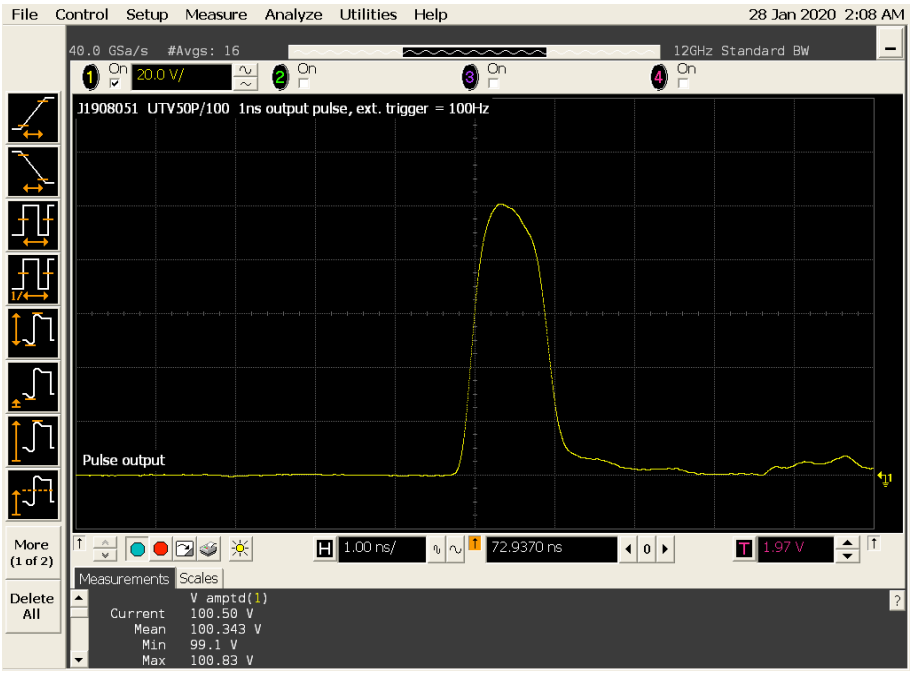


Figure 2: 1ns 100V positive pulse. Ext. trigger 100Hz

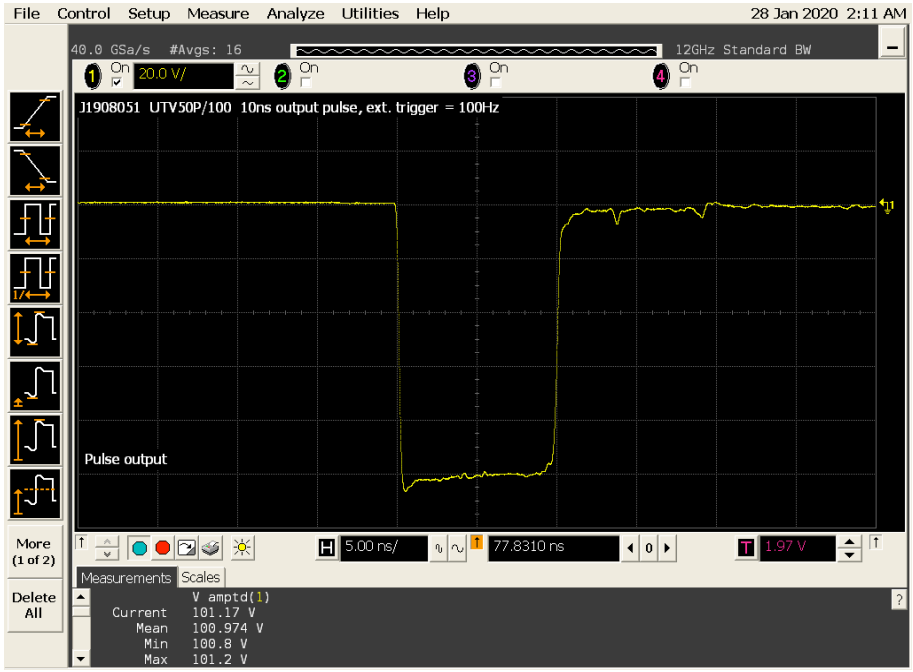


Figure 3: 10ns 100V negative pulse. Ext. trigger 100Hz

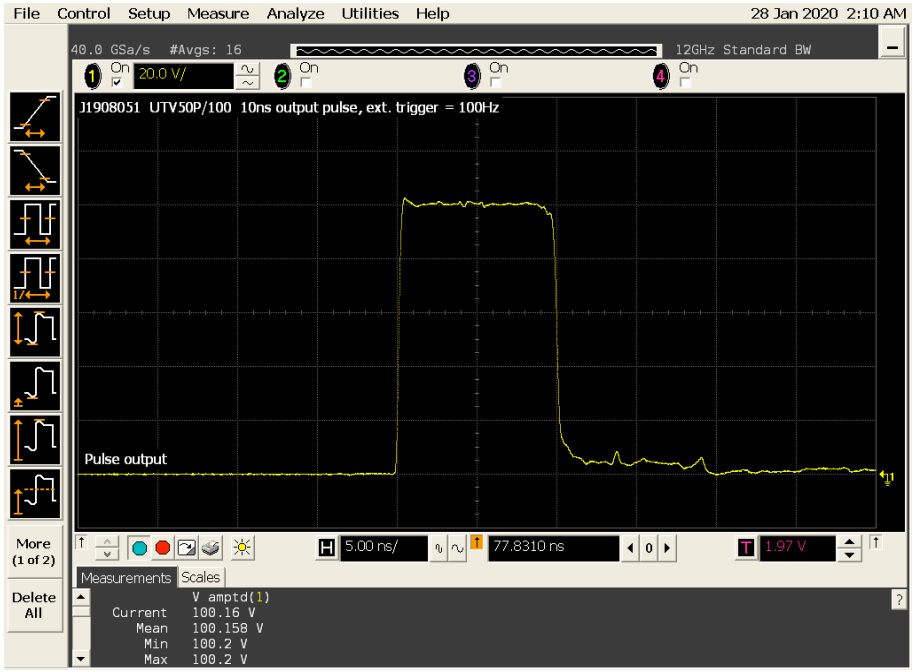


Figure 4: 10ns 100V positive pulse. Ext. trigger 100Hz

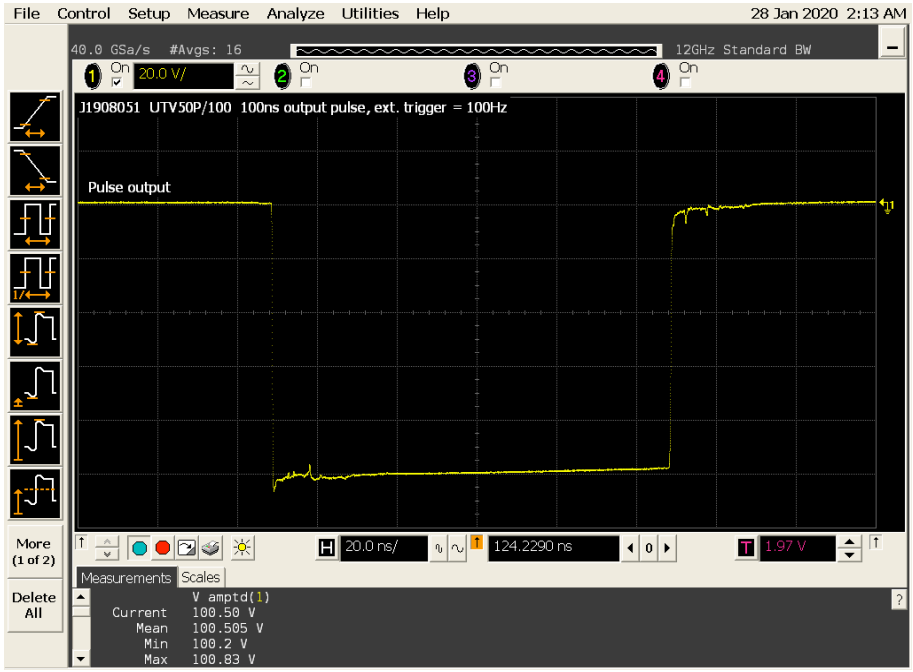


Figure 5: 100ns 100V negative pulse. Ext. trigger 100Hz

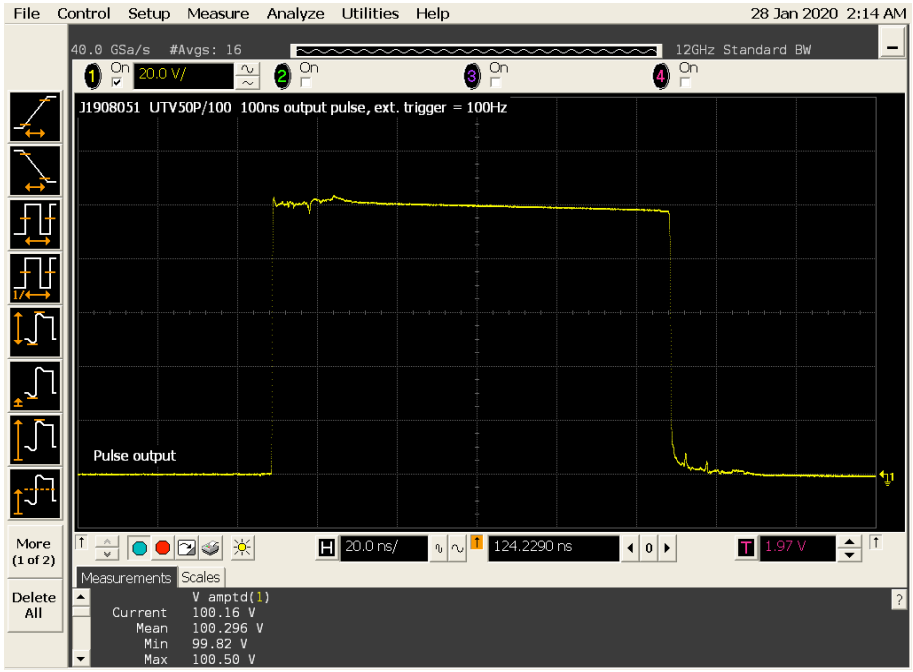


Figure 6: 100ns 100V negative pulse. Ext. trigger 100Hz

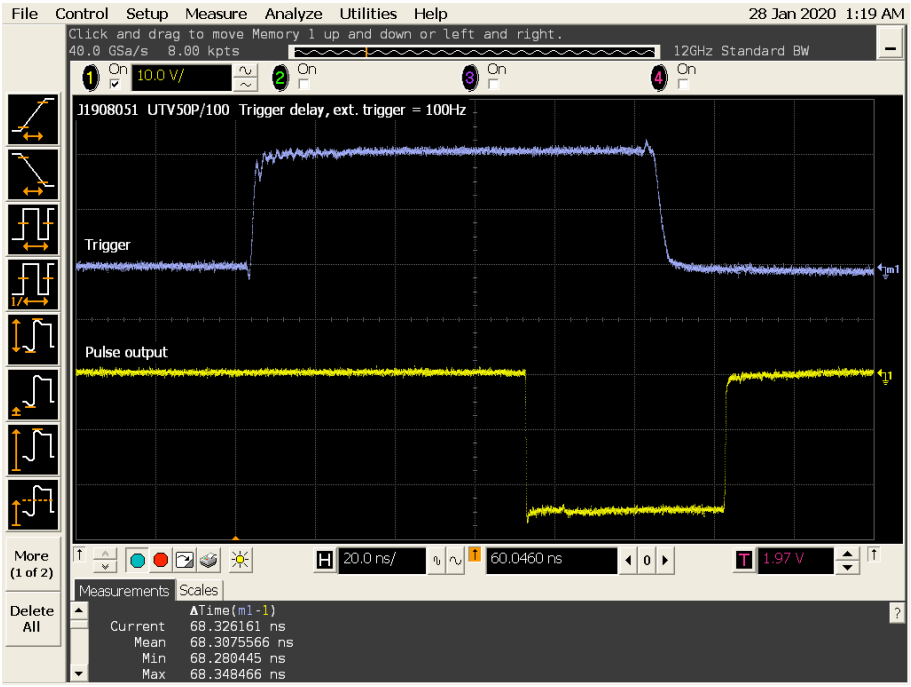


Figure 7: External trigger delay

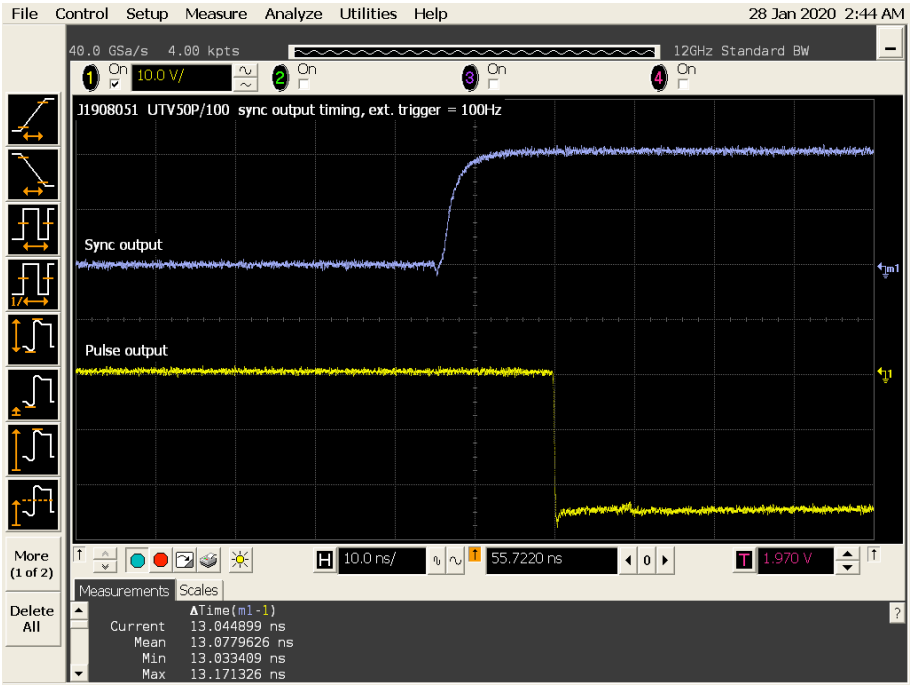


Figure 8: Internal trigger; monitor pulse timing

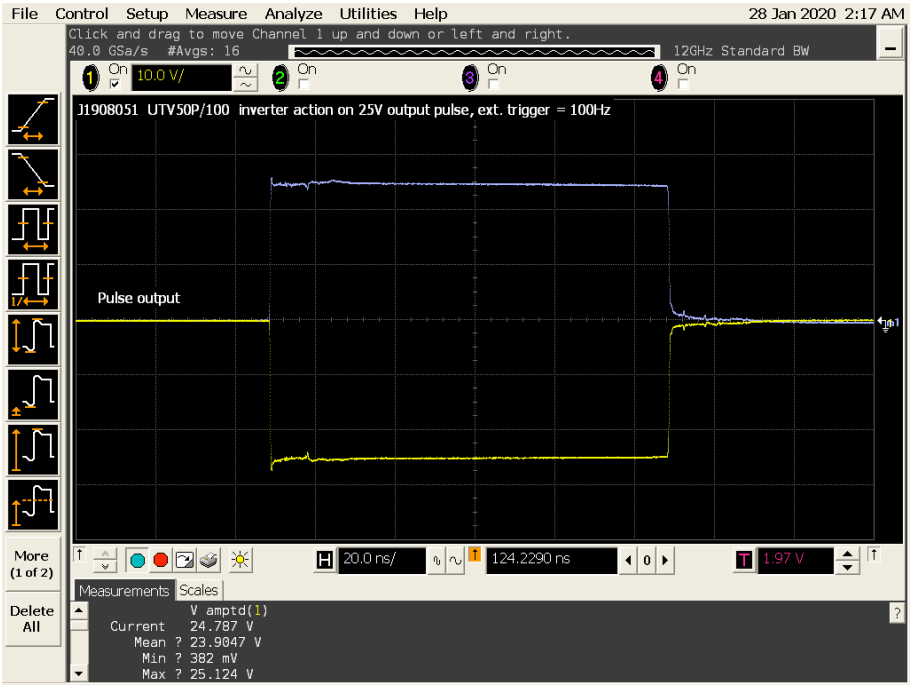


Figure 9: Inverter action

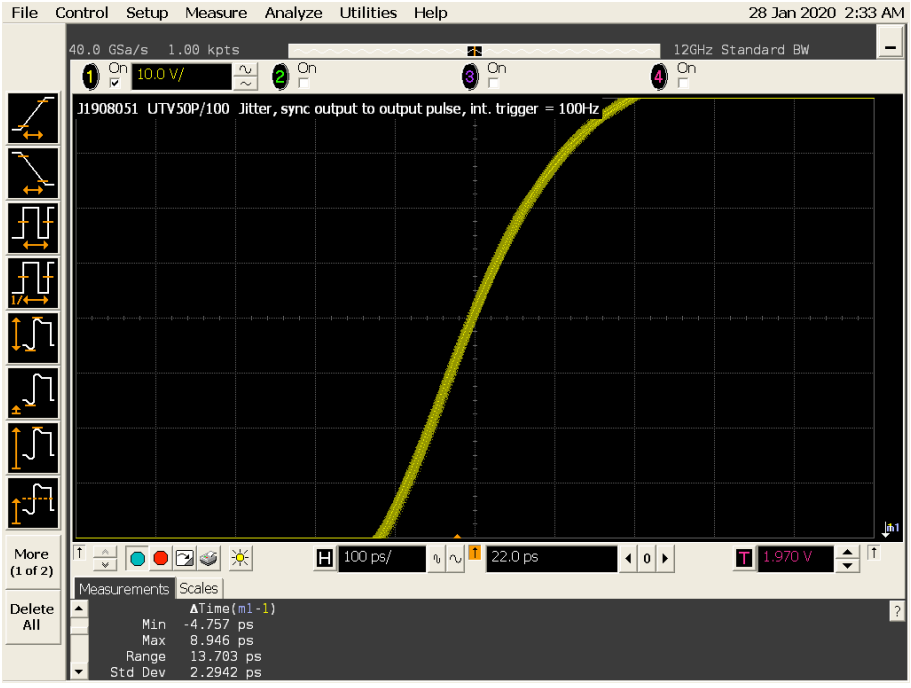


Figure 10: Pulse jitter, Sync output to Pulse output, Int. trigger

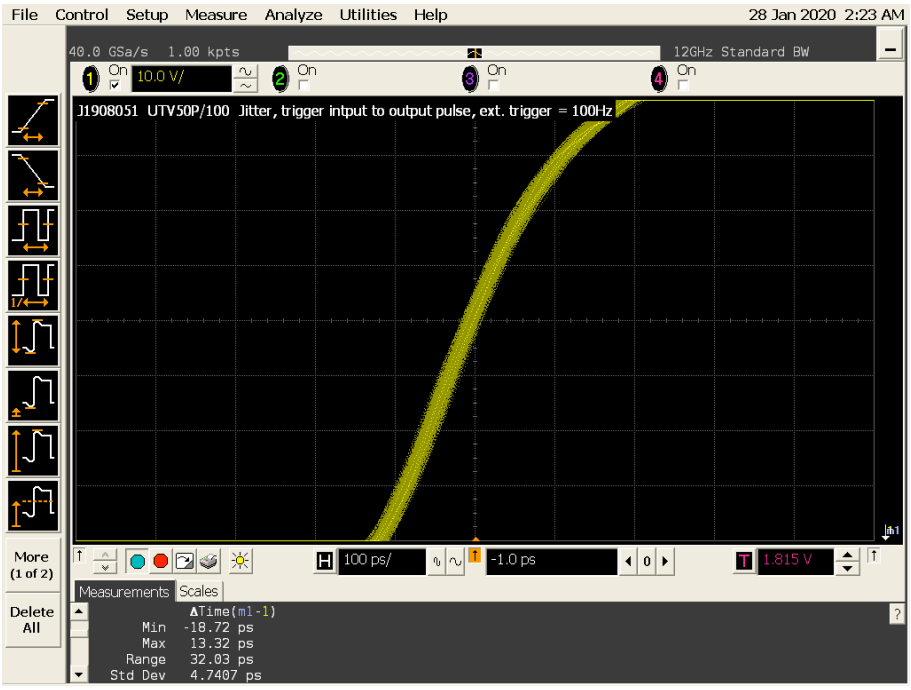


Figure 11: Pulse jitter, Trigger input to Pulse output, Ext. trigger

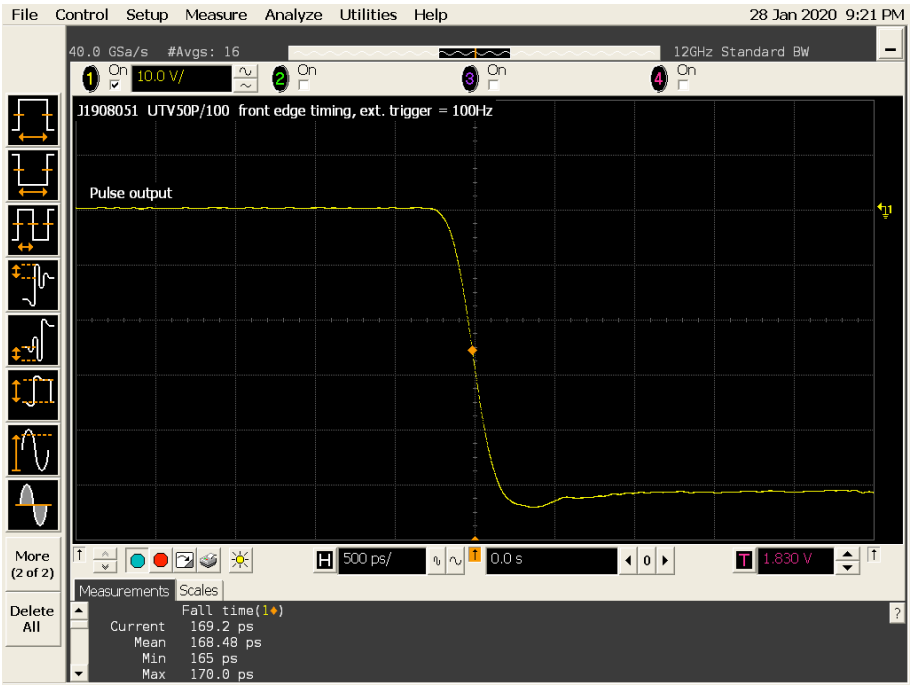


Figure 12: 50V negative output pulse, front edge timing

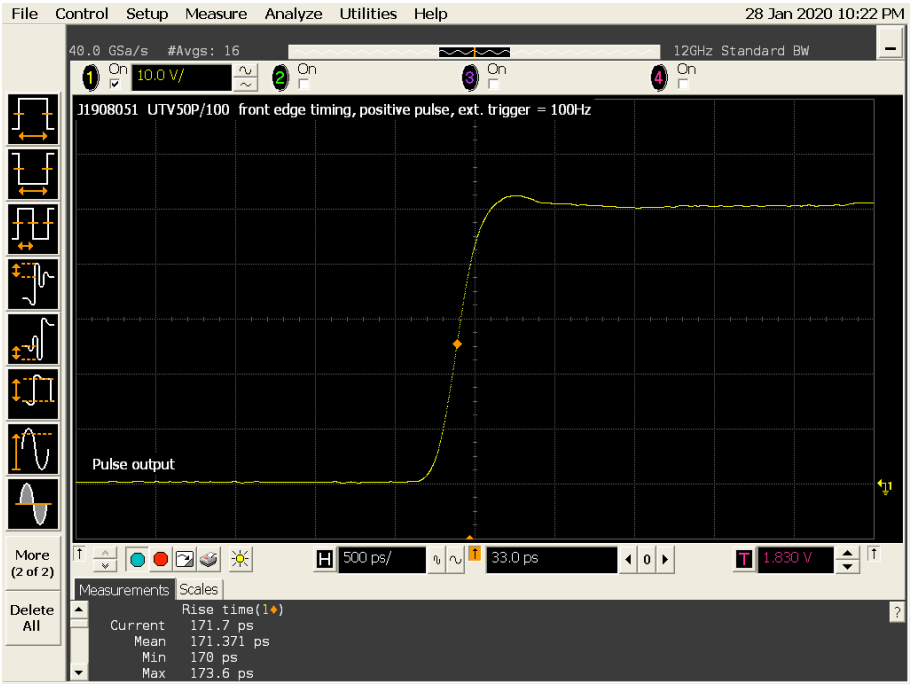


Figure 13: 50V positive output pulse, front edge timing

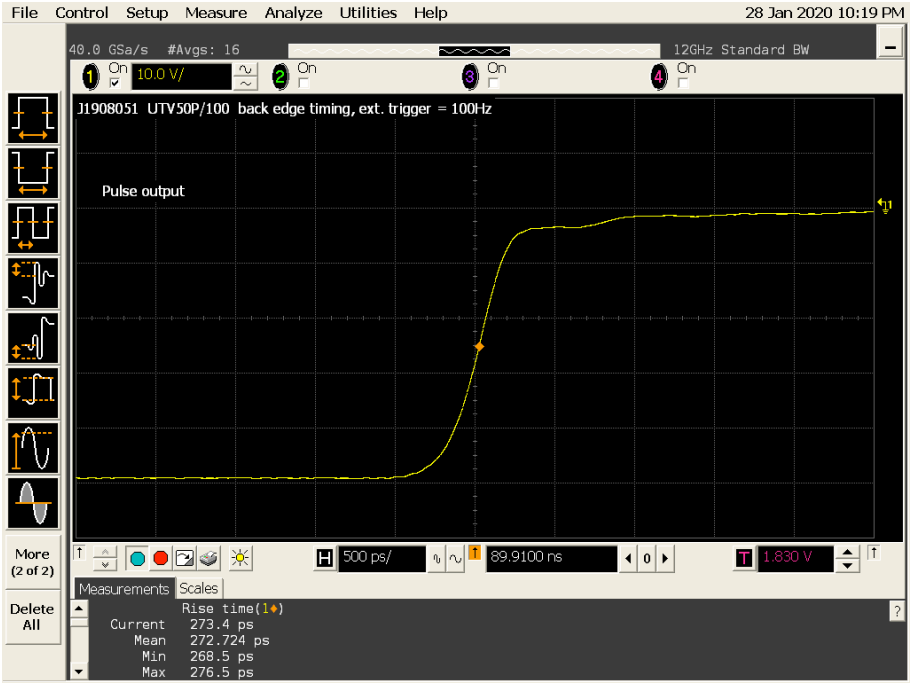


Figure 14: 50V negative output pulse, back edge timing

Declaration of Conformity

We:- **Kentech Instruments Ltd**
The Isis Building
Howbery Park
Wallingford
Oxfordshire OX10 8BD, UK

Certify that this apparatus:

Kentech Instruments UTV100P 1-100ns Pulser
Serial no: J19xxxxx

Conforms with the requirements of European Community Directives:

2014/35/EU	**Low Voltage Directive**
2004/108/EC	**EMC Directive**

The following harmonized standards have been applied:

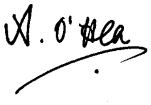
BS EN55011:2016 +A1:2017 Industrial, Scientific, Medical equipment – Radio-Frequency disturbance characteristics.

BS EN61000-6-2:2005 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments

BS EN 61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

The following documents contain additional relevant information:-
Kentech file reference J19xxxxx

Name: Adrian O'Hea **Signature:**



On behalf of Kentech Instruments Ltd

Position: Engineer **Date:** 28 January 2020