Notes on the use of

Kentech Instruments Ltd
J13   , RTV 40
reverse terminated
nanosecond pulser

May 2013

CAUTION

This pulser produces high frequency electrical signals and if connected to an unsuitable load may produce RF interference.

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 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 designed to comply with the above standard when operated into a suitable load.

INTRODUCTION

The RTV40 reverse terminated pulser is designed to produce a programmable impulse at an amplitude up to 35V with a pulse width adjustable from 300 psecs to 20 nsecs. The maximum trigger rate is 100kHz. It consists of two fast switches, one of which dumps a 22 ns charge line into the load and the other grounds the far end of the charge line via a 50 ohm terminating resistor which sets the timing of the falling edge and provides a well matched reverse termination. A programmable delay generator on the falling edge allows adjustment of the duration. The amplitude is continuously adjustable from 1V to 35V and the polarity may be set via a front panel selectable inverter.

The pulser is triggered from the rising edge of the input trigger signal and the maximum repetition rate is 100 kHz.

The pulser is well reverse terminated and will absorb a large fraction of any reflected signal. Note that at late times (>1 usec) the internal switches re-open and the reverse termination becomes worse.

The pulser has an internal rate generator and may also be triggered externally via the TTL level trigger input. The input impedance on this unit is set to 10Kohm. Switching to an input impedance of 50ohm requires an internal link to be made.

There is a TTL monitor output which leads the main pulse output by about 40ns. This may be used for scope triggering. The trigger delay using an external trigger is about 54ns (trigger in to pulse out).

The internal micro-controller controls all functions which are also available via a USB link on the front panel.

SPECIFICATION

Amplitude into 50ohms	>30V at 300ps pulse width
	>35V for pulse widths >= 400ps
Amplitude adjustment	approx 25% to 100%
Pulse width	<300ps to 20ns adjustable
Rise/falltime	<=300ps
Max PRF	100kHz
Polarity	Switchable
Trigger	External
	Internal, adjustable 10Hz to 10kHz
Jitter	<20ps RMS
Local or remote control of	Amplitude
	Pulse widith
	Trigger enable/disable
	Trigger source/mode
	Internal trigger rate
	Polarity

Local control is by keypad/LCD
Remote control by USB

AC power	100-240V ac, <100VA
Cooling	Forced air

Controls and indicators

LCD/keypad
Triggered LED
Power LED

Connectors

AC power	IEC (rear panel)
Trigger	BNC
Monitor	BNC
Pulse output	SMA

Control interface

USB via virtual COM port, Future Technology Devices International Ltd. UM232R
Driver available at:

http://www.ftdichip.com/Drivers/VCP.htm

Operation of the pulser

All pulser parameters can be set up from the front panel via the keypad and LCD display.
The settings are accessed via the pulser control page. To move from one page to another move the cursor to the > or < characters.
The pulser will power up with the pulse parameter edit page displayed. This is a typical display:

```
<Amp = 35.0 V local
 Wid = 10000 ps
 Trig = Int Pol = P
 Rate = 20000 Hz
```

This indicates that the pulser is set to 35V amplitude, 10ns pulse width, internal triggering at 20kHz and positive polarity.
The 'local' message indicates that front panel keyboard 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 from which another left key will bring up the SAVE page:

```
 Edit user .....        >
 Save = NO
```

Move the cursor under NO and use the up/down buttons to select either YES or NO. When the cursor moves 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 take the cursor to the top right and one more right button will select the page.

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

Amplitude   `Amp = `<u>`35.0`</u>` V`
Range 1.0V to 35.0V

Width   `Wid = `<u>`10000`</u>` ps`
Range 300 ps - 20000 ps

Trigger source   `Trig = `<u>`Int`</u>
Options Internal, External, Off

Polarity   `Pol = `<u>`P`</u>
Options N, P

Internal trigger rate `Rate = `<u>`20000`</u>` Hz`
Range 10 - 100000Hz

Note that there are small temperature drifts in the delay which result in a change in the pulse width over the first few minutes of operation. This is most noticable when minimum pulse width is selected.

All the pulser parameters may be set via the USB interface. A virtual COM port driver may be found at:

The virtual COM port should be set to 115200 baud, no parity, no flow control, 1 stop bit.

Upon receipt of any character via the USB link the internal firmware will go into remote mode, issue a banner message and wait for commands via link. In this mode the front panel keyboard is inactive and the LCD displays the current setting plus the REMOTE message showing that control is given over to the USB interface:

```
Amp = 35.0 V remote
Wid = 100000 ns
Trig = Int Pol = P
Rate = 20000 Hz
```

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

Note that power cycling will interrupt the USB protocol and the host will need to re-establish the USB link.

Commands are not case sensitive. All commands are followed a 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 350

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

***xxxxx* !width <cr>**   (Set the pulse width)
xxxxx is the pulse width in ps, in the range 300 to 20000

?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)

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

?polarity <cr>   (Read back the polarity)

***xxx* !rate <cr>**   (Set the internal trigger rate)
xxx is the trigger rate in the range 10 to 100000

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

local <cr>   (Return to front panel control)

forcetrig <cr>   (Force a software trigger)
This command will work in all trigger modes

We recommend that communications with the pulser are first tested using a terminal emulator programme such as Hyperterminal.

When the virtual COM port driver is installed and the pulser is connected Hyperterminal will be able to connect to the COM port. Use 115200 baud, no flow control, no parity, 1 stop bit.

A typical command dialogue is shown below.

This is the list of commands used in the dialogue together with the description (the \ character means a comment):

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

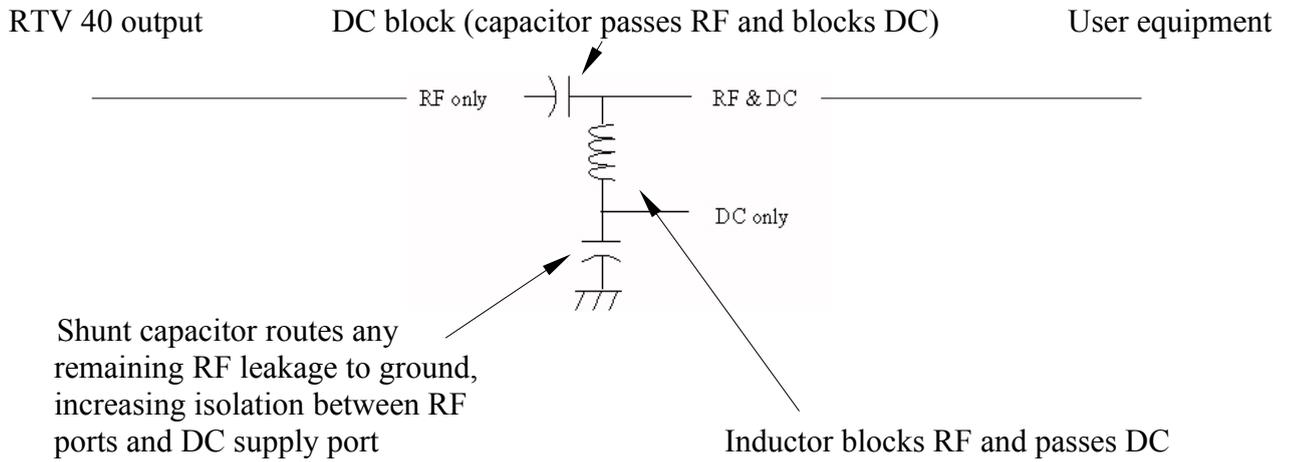Below is a dialogue as displayed in a terminal emulator when these commands are issued.

Typical control dialogue:

```
******************************          banner message when remote mode starts
MPE ROM PowerForth for Cortex-M3
v7.06 [build 0244] 24 Sep 2012, 12:09:20
******************************
19480 bytes free

 ok
10000 !width  ok
5500 !width  ok
?width 5500  ok
250 !amplitude  ok
?amplitude 250  ok
0 !polarity  ok
1 !polarity  ok
0 !trigger  ok
1 !trigger  ok
2 !trigger  ok
?trigger 2  ok
5000 !rate  ok
?rate 5000  ok
local                                   control returned to the front panel
```

Applying a DC bias at the output of the RTV 40.

A DC bias can be applied to the output of the pulser by use of a DC block. A suitable connectorised dc block has been included with the RTV 40. However, the dc injection components need to be supplied by the user and coupled in a way to preserve the performance of the RTV-40.

RTV 40 output   DC block (capacitor passes RF and blocks DC)   User equipment

RF only   RF & DC

DC only

Shunt capacitor routes any remaining RF leakage to ground, increasing isolation between RF ports and DC supply port

Inductor blocks RF and passes DC

Atlternatively, a Bias Tee can be used. This is a fully connectorised unit with the dc injection port built in.

Declaration of Conformity

We:- **Kentech Instruments Ltd
Isis Building
Howbery Park
Wallingford
Oxon   OX10 8BA, UK**

Certify that this apparatus:-

**Kentech RTV pulser
serial nos. J13**** only.**

Conforms with the protection requirements of European Community
Directives:-

73/23/EEC	**Low Voltage Directive**
89/336/EEC	**Electromagnetic Compatibility Directive**
93/68/EEC	**CE Marking Directive**

The following harmonized 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 J13***

Name: J Hares

On behalf of Kentech Instruments Ltd

Position: Director   **Issued:**   16 July 2013