Notes on the use of

Kentech Instruments Ltd.
HDG800
Modular Delay Generator

Rev 2, 6-5-2010

PLEASE READ THIS MANUAL CAREFULLY
BEFORE USING THE DELAY GENERATOR

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1 INTRODUCTION AND USE

The unit requires a 12 Volt D.C. supply at a maximum current of 1.6A when operating. The internal PSU is switched mode and a higher turn-on current may be drawn at power up so a supply with a capacity of 2.5A is recommended. Power is supplied to the unit via the front panel coaxial LEMO connector, indicated by the adjacent green LED.

The input RF signal is applied via the INPUT SMA. This is ac coupled internally but is terminated to 50ohms. Typically the amplitude will be ~1.5V p-p for minimum jitter however the unit will trigger at 200mV p-p.

The delayed output is presented at the SMA OUTPUT connector and the delay is set via the RS232 port. The output amplitude is ~600mV p-p into 50 ohms and is suitable for direct connection to a Kentech HRI.

Note: It is recommended that this unit is positioned to allow the free flow of air around the rear panel vents.

The PDG800 uses PECL delay lines to delay the applied RF signal and is designed for the critical timing adjustment of fast camera systems (eg an HRI) and other fast instrumentation. It will delay an input signal over an adjustment range of 30ns in 25ps steps and has a bandwidth extending to 800MHz. The unit consists of a series of temperature regulated PECL delay chips together with a controlling microcomputer. The unit provides various delay functions which are available via the RS232 interface for which a remote terminal or computer with terminal emulation will be required. The delay, polarity and threshold may be set, together with the option of an internal monostable which may be enabled in order to stretch a short trigger pulse (eg the signal from a photo-diode looking at a mode locked laser pulse train.

The temperature regulation system takes a while to stabilise and it is recommended that the unit be left powered up for at least ten minutes before critical timing measurements are to be performed. Do not block the vents in the rear of the unit as unobstructed airflow is required for correct temperature regulation.

The firmware includes a SCAN function in which the unit will cycle around a preset delay table in response to single character commands, allowing a fast delay scan to be performed.

The unit is connected to a terminal or computer via a female 9 pin ‘D’ type. The RS232 connections are Sout, Sin and Gnd on pins 2,3 and 5 respectively. The baud rate is fixed at 9600

There is an input threshold adjustment (see software section) which will normally be used to set a 50% output duty cycle. If the input duty cycle is far from 50% an internal monostable may be enabled which sets the output pulse length to 6ns. This will be useful when the unit is used to delay the output from a photodiode detector which is producing a train of narrow trigger pulses from a mode locked laser pulse train.

The firmware provides a GRAPHTHR function which allows to user to observe the effect on the output duty cycle of the trigger threshold adjustment. This allows the trigger threshold to be checked via a terminal programme.

If cleaning is necessary this should be performed with a soft dry cloth or tissue only.

2 SPECIFICATIONS

Frequency range	<80MHz to >800MHz
Delay adjustment	>= 4pi @ f >= 80MHz Maximum delay is 30ns*
Delay resolution	Incremental delay step 25ps
Trigger input	0.3 – 2.0V p-p, approx. 50/50 mark space ratio
Delayed output	0.6V p-p, 50/50 mark space , 50ohms
Power consumption	12V D.C. @ 1.6A (19W maximum) Internal thermal fuse Polarity reversal protection Over voltage protection
Input impedance	50ohms
Memory	Nonvolatile memory of user parameters which are used at power-up: Delay Polarity Monostable enable Trig threshold
Size	242 x 110 x 47 mm

* It is not recommended to delay by more than 4pi to maintain low jitter and drift.

Controls/indicators	
Input	SMA
Output	SMA
+12 Volt D.C. Input	LEMO 2-PIN FFA.00
Power On LED	Green
RS232	9-pin Cannon 'D-Type' socket

Word list for HDG800 V0.2
May 2010

The hardware settings are:

Delay in ps, rounded to nearest 25psecs (!ps)
Polarity (+pol. -pol)
Use monostable - to allow triggering from a short laser diode pulse (+usemono)
Threshold on input comparator (!thr)

Normal operating conditions are
-usemono
+pol
2410 !thr (varies from unit to unit)

If the input is short pulses from a laser diode use the +usemono function. This inserts a 6ns monostable allowing a reasonable mark space ratio to be produced from a narrow trigger pulse train.
Do not use the mono function for an input pulse width between 3ns and 8ns.

There is a graphing function which shows the effect of input threshold on output mark space ratio. Look at the dialogue file for an example. It uses the !thr command to set the threshold followed by the .oplevel to read the voltage at the output of the lasr PECL gate. This is a very quick way to check what is going on. The threshold should be set near the middle of the range for optimum jitter.

All user variables are stored in EPROM after a ee!user command and are active at the next power up.

All variable are integers

(set delay in ps, rounds to nearest 25ps)
xxx !ps

(print current delay setting)
.ps

(print status)
.user

(set the input bias level thr in DAC units)
xxx !thr

(tweak the thr level *)
tweakthr

(read the output level at the PECL gate)
.oplevel

(graph the effect of thr)
graphthr

(use internal monostable to allow triggering from short pulses)
+usemono (---)

(disable internal monostable)
-usemono (--)

(set polarity)
+pol (--)
-pol (--)

(Print the fw version number)
.version

(Save current user settings for next time)
ee!user

(tweak the delay in ps *)
tweak

(print some delay table values as a check)
.deltable

NB the tweak functions use the 1,2,3,4,5,6 keys.
1 and 2 make the delay increase or decrease by STEPSIZE
4,5,6,7 change the size of STEPSIZE

Scanning

The scanning operation is implemented as **scan** which is used to sequence through a number of different delay settings. **scan** sequences the delay setting in response to serial characters received.

There is a list of scan parameters consisting of 256 entries numbered from 0 to 255. Each entry in the list is a user requested delay in ps. The list can be stored in EEPROM and can be edited by RS232.

The following words edit the list in RAM, the data will be loss on power down unless it is stored subsequently in EEPROM (see below). On power up, the list is read from EEPROM.

xxx yyy !de (store xxx as delay of entry yy, range of xx 0 to 50,000 inclusive)
yyy .de (return delay of entry y)

Outside of the **scan** command, the delay user variable is used to determine the delay. On exiting the **scan** command the delay user variable will be replaced by the last delay set by **scan**. The scan is controlled by 2 variables, **e0** and **#e**. **e0** determines the first entry in the table to use for the scan, and **#e** is the number of entries to use in the scan, viz the scan length. **e0** and **#e** are editable and can be stored in EEPROM with the scan table. The following words are used for scan control:-

xxx !e0 (store xxx in e0, range of xx 0 to 255 inclusive)
.e0 (return e0)
xxx !#e (store xx in #e, range of xx 1 to 256 inclusive)
.#e (return #e)

scan (causes the HDG to sit in a loop where it accepts the following one byte parameters:-)
+ + (moves forward to the next table entry, wraps round to start if at scan end, echoes +)
- - (moves backward to previous entry (back to scan end if at scan start), echoes -)
r r (resets to scan start, echoes r)
{esc} (exits SCAN command and returns the normal “ok” prompt.)

Storing the scan table

ee!s To score the scan table in EEPROM
ee@s To recall the scan table from EEPROM

Typical terminal dialogue.
Comments in blue.

Power up:

```
HDG800 800MHz delay
Firmware version = 0.2
Copyright Kentech 2009

FINISHED EXECUTE

FINISHED EESTART

MPE H8S ANS ROM PowerForth  2148pk2.ctl 30 Sep 2008 PK
113074 bytes free

 ok
 ok
.user
Delay =    30000
Pol =      positive
Use mono = false
Thr =      2410
 ok
  ok
```

Set a delay

```
1234 !ps  ok
.ps 1225
 ok
```

-ve edge with monocycle

```
-pol  ok
+usemono  ok
```

print status

```
.user
Delay =    1225
Pol =      negative
Use mono = true
Thr =      2410
 ok
+pol  ok
-usemono  ok
10000 !ps  ok
.user
Delay =    10000
Pol =      positive
Use mono = false
Thr =      2410
 ok
```

see what the threshold is doing

```
graphthr
1500 **********
1547 **********
1595 **********
1642 **********
1690 **********
1737 **********
1785 **********
```

```
1832 **********
1880 **********
1927 **********
1975 **********
2022 **********
2070 **********
2117 **********
2165 **********
2212 **********
2260 **********
2307 **********
2355 **********        <- This would be a nice place to operate
2402 **********
2450 **********
2497 **********
2545 **********
2592 **********
2640 **********
2687 **************************************************
2735 **************************************************
2782 **************************************************
2830 **************************************************
2877 **************************************************
2925 **************************************************
2972 **************************************************
3020 **************************************************
3067 **************************************************
3115 **************************************************
3162 **************************************************
3210 **************************************************
3257 **************************************************
3305 **************************************************
3352 **************************************************
 ok
-pol  ok
          effect of thr is inverted because of -ve polarity
graphthr
1500 **************************************************
1547 **************************************************
1595 **************************************************
1642 **************************************************
1690 **************************************************
1737 **************************************************
1785 **************************************************
1832 **************************************************
1880 **************************************************
1927 **************************************************
1975 **************************************************
2022 ********************************************
2070 ****************************************
2117 ****************************************
2165 ************************************
2212 ************************************
2260 ************************************
2307 ************************************
2355 ************************************
2402 ************************************
```

```
2450 *********************************
2497 *********************************
2545 *********************************
2592 *********************************
2640 *********************************
2687 **********
2735 **********
2782 **********
2830 **********
2877 **********
2925 **********
2972 **********
3020 **********
3067 **********
3115 **********
3162 **********
3210 **********
3257 **********
3305 **********
3352 **********
 ok
+pol  ok
+usemono  ok
```

when using the mono there is no output if the threshold is not crossed hence back to zero when thr is high (ie 2687 and above)

```
graphthr
1500 **********
1547 **********
1595 **********
1642 **********
1690 **********
1737 **********
1785 **********
1832 **********
1880 **********
1927 **********
1975 **********
2022 ************************
2070 ************************
2117 **********************
2165 **********************
2212 **********************
2260 ************************
2307 ************************
2355 ************************
2402 ************************
2450 ************************
2497 ************************
2545 ************************
2592 ************************
2640 ************************
2687 **********
2735 **********
2782 **********
2830 **********
2877 **********
```

2925 **********
2972 **********
3020 **********
3067 **********
3115 **********
3162 **********
3210 **********
3257 **********
3305 **********
3352 **********
 ok
-usemono ok
  ok
  ok
2000 !thr ok
.oplevel 308
 ok
        now set to no mono, +pol and when we restore thr to the original value
        the output level returns to the middle of its range
2410 !thr ok
.oplevel 375
 ok