Kentech Instruments Ltd.

Instruction Manual
for
Precision Programmable Delay Generator

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PLEASE READ THIS MANUAL CAREFULLY
BEFORE USING THE DELAY GENERATOR

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PRECISION PROGRAMMABLE DELAY GENERATOR

SPECIFICATION

- Maximum delay adjustment — 20ns
- Incremental delay step — 25ps
- Typical throughput delay at minimum setting — 6ns
- Interstep error — <± 0.5 steps, but reproducible.
- Jitter — effectively zero, mechanical device.
- Characteristic impedance — 50Ω.
- Voltage handling — D.C. 30 volts.
  With pulsed signals up to 30 volts the delay may be changed whilst the signal is propagating through the device.
  If the delay setting is not changed whilst the pulse is propagating, the pulse is limited to 1.8μamp coulombs. e.g. 1.5kv for 2ns.
  1.5kV is the maximum recomended voltage even for very short pulses.
- Fully functional controls via front panel keys and serial port.
- LCD display of status and functions.
- Serial port — RS232, 75 to 9600 baud, (rate is stored in EEPROM), requires simple text commands from a terminal or emulator.
- Delay — Absolute or relative.
- Memory — Nonvolatile memory of last manual delay setting and relative or absolute delay mode, absolute minimum delay and baud rate. (Note that when powered down the delay will revert to the minimum but the signal will still be transmitted.)
- Size — 270 x 210 x 87 mm^3
- Power requirements — Universal mains voltage at approximately 20 watts.

INTRODUCTION

The Kentech Programmable Delay Generator uses a passive delay line to form a compact unit designed for the critical timing adjustment of fast camera systems and other fast instrumentation. It will delay an arbitrary input signal over an adjustment range of 20ns in 25ps steps. The unit consists of a set of switched 50Ω calibrated delay lines together with a controlling microcomputer. The device has no inherent jitter, a risetime of better than 1ns and a high voltage capability for short pulses. The delay is set manually from the front panel or from an RS232 remote control interface. The current delay setting is shown on an LCD display and the unit features relative or absolute delay mode.

The delay is achieved by the switching in and out of various sections of delay line by a set of matched relays. Care has been taken to give a reproducible risetime over the entire adjustment range and the through risetime is better than 0.8ns for all delay settings. The unit may be used to delay short, relatively high voltage trigger signals. Many Kentech high voltage pulsers are able to use this feature to provide highly stable relative timing between two or more output pulse channels. This will find such applications as the adjustment of interframe timing in fast framing cameras and triggering or pulse shaping in laser systems.

USING THE PROGRAMMABLE PRECISION DELAY GENERATOR

In manual mode all that is required to operate the unit is to route the signal to be delayed via the two BNC connectors on the rear panel of the delay generator. The front panel controls may then be used to adjust the delay added by the unit over a range of approximately 6.5ns to 26.5ns in 25ps steps.

The unit provides various special functions which are available via the RS232 interface for which a computer or a terminal will be required. In particular the unit may be set to either absolute or relative mode. In relative mode (as shipped) the front panel display will range from 0ns to 20ns and the minimum internal delay is ignored. In absolute mode the indicated delay is the total delay and will range between the minimum setting and the minimum + 20ns (typically 6.5ns to 26.5ns).

When the unit is not powered up the signal will be delayed by the minimum setting. This is typically 6.5ns and the exact value is measured and stored in EPROM for each unit at the factory.

DELAYING A TRIGGER SIGNAL

Although care has been taken to maintain a constant risetime, the shape of a fast rising signal will change slightly as different delay line sections are switched in and out. In order that the triggering of some piece of equipment is most accurately delayed the trigger threshold of the equipment to be triggered should be set at around half the trigger amplitude. (The calibration procedure for the delay lines uses all four gates in a 74AC00 in parallel connected to a 50Ω cable in series with a 50Ω reverse terminating resistor as a driver and a single interminated gate in a 74AC00 as a detector.)

LOCAL/REMOTE MODES

The unit powers up in “Local Mode” in which the delay can be modified with the front panel controls. (If these controls do not work then the unit has been forced to “remote mode” via the RS232 link.) Local mode may be identified by the presence of a cursor below the delay setting. This is absent in remote mode. If the unit states that it is in “Remote Mode” this means that it is under computer control but that no remote delay has been set since it was last in manual mode. The unit will switch to remote mode as soon as any character is received at the serial interface. The unit will revert to local mode either by a remote command to do so or by cycling the power. As the unit switches to remote mode as soon as a character is received, the mode is transparent to a remote host. No characters are lost when switching from local to remote mode. To use remote mode simply connect an RS232 link and issue commands.

MANUAL OPERATION

The units powers up in “Local Mode” in which the delay can be modified with the front panel controls. In local mode there is a cursor below the delay setting. The cursor position and the delay value may be set with the front panel buttons. Note that many parameters are stored in non-volatile memory, such as the last manual delay setting, so cycling the power in local mode will not lose the delay setting.

ADJUSTING THE DELAY IN LOCAL MODE

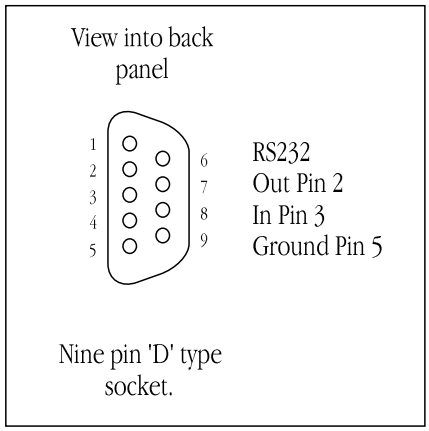
In local mode the four front panel push buttons can be used to change the delay setting. The left and right buttons move the cursor to the left and right respectively. The upper and lower ones increment and decrement respectively, the digit over the cursor. Note that incrementing a digit over 9 or below 0 carries over correctly so one may, for example, continue incrementing by 1ns by placing the cursor under the 1000ps column and pushing the UP button. The delay will increment 1ns every time the UP button is depressed until such an increment would take the delay above the maximum delay. Note that in the tens of ps column the delay increments by 25ps per push of the UP button as 25ps is the minimum step of the unit. Any attempt to increment beyond the maximum delay (or below the minimum) is ignored and an error message is issued. The most recent manually set delay is stored in memory and the unit will return to it after cycling the power. If the unit is in Remote Mode then cycling the power will reset it to Local Mode and set the delay to the last manual setting which will not necessarily be the last delay setting. It is assumed that a host computer will store any set up information required. It is not possible to switch between RELATIVE and ABSOLUTE delay modes from the front panel. The mode will be whatever it was last set to via the RS232 link.

REMOTE USE

The unit is connected to a terminal or computer via a female 9 pin ‘D’ type connector on the rear panel so a lead from your computer or terminal serial output with a male 9 pin connector will be required. The pin out is indicated on the rear panel.

The user will require a suitable terminal, computer with terminal emulation or must write a

simple program to be able to use the remote mode. Many terminal emulation programmes are available. The Baud rate is set to 9600 at the factory but may be reset with the terminal. The last used baud rate is stored in the non volatile memory for future use.



As soon as the unit receives a character it will enter Remote Mode. The delay will not be modified until a command that can change it is issued, e.g. a delay command or a change between relative and absolute modes. All commands must be in upper case and followed by a carriage return. Unrecognisable commands will result in an error message. The unit will echo all characters sent to it. When a new delay is set via the remote mode the LCD display is still updated.

The following is a list of all commands and their function.

ANY CHARACTER OR COMMAND WILL SET THE UNIT TO REMOTE MODE. THE FIRST CHARACTER IS NOT LOST.

HELP	gives list of simple commands
xxx PS	to set delay in picoseconds. xxx represents a 1 to 5 digit number of picoseconds delay. The nearest delay setting will be used. There is a space before PS.
?PS	to read delay and delay mode
LOCAL	return to keypad control
+HELP	advanced help
VERSION	returns firmware version number
RELATIVE	to ignore internal base delay
ABSOLUTE	to include internal base delay
CYCLE	to cycle through all 800 of the possible delay settings in turn
CYCLETIME	variable containing number of ms for CYCLE The format for this command is [number of milliseconds per step] CYCLETIME ! e.g. 24 CYCLETIME ! Note that spaces are important and the ! is a “store” command in the internal FORTH programming language. The default value is 50ms. Note there are spaces between the 24 and the CYCLETIME and between CYCLETIME and ! The maximum time step is 32769 milliseconds.
TESTRELAYS	exercise each of 12 relays in turn - the effect should be a sequence of 6 clicks repeated for each of the 12 internal delay relays
?BAUD	displayed stored baud rate
xxx SET_BAUD	set baud rate to 75, 300, 600, 1200, 2400, 4800 or 9600 which will have effect after next restart WARNING - IF YOU SET THIS TO A BAUD RATE AT WHICH YOU CANNOT COMMUNICATE YOU WILL LOSE COMMUNICATION. Should this happen call the factory.
++HELP	for service engineering

Note that the unit will find the closest setting a the requested delay (to within 25ps step limitation and the range limitation). The delay displayed at any time is the actual delay rather that the requested delay should this not be a multiple of 25ps. In remote mode the front panel display will indicate the current delay setting.

When switching between ABSOLUTE and RELATIVE modes the requested delay is preserved so a change between relative and absolute modes will result in an actual delay change.

Note that any RS232 command will set the unit to remote mode. No characters are lost and the mode change is transparent to the host. However, the unit needs a few seconds to boot up after the power is switched on, during this time characters sent to the RS232 port are lost. The unit has booted up when the front display indicates the delay setting. As only the locally programmed delay is stored in non-volatile memory, remote controlling software is responsible for ensuring that the delay is updated after power disconnection.-The SET_BAUD command does not take effect until a restart so it is a good idea to issue a ?BAUD command before a restart to confirm that a sensible baud rate has been stored. Note that only manual delay settings are stored in the non-volatile memory as it has a limited number of write cycles. Under computer control many delay changes can be made.

Here are some examples of commands and responses,
COMMANDS ISSUED ARE IN BOLD ITALICS

14000 PS
Delay = 14000 psecs
ok
RELATIVE ok
ABSOLUTE ok
?PS
Absolute mode
Delay setting = 14000 psecs
ok
9600 SET_BAUD ok
LOCAL

(Note that there is no response to this command. If another character is sent the unit returns to Remote mode and issues the OK prompt followed by the new command.)

ok
HELP
******** Easy Help **********

Delay range 0 - 20ns in 25ps steps
In ABSOLUTE mode the internal base delay is included
so the delay range is offset by this minimum delay
All numbers to be integers, no decimal points
The delay will be rounded to the nearest 25ps
All commands in upper case.

xxx PS (CR) ———————— to set delay in picosecs
?PS (CR) ———————— to read delay
LOCAL ———————— return to keypad control
+HELP ———————— advanced help
ok
******** Advanced Help **********

RELATIVE ———————— to ignore internal base delay
ABSOLUTE ———————— to include internal base delay
CYCLE ———————— to cycle through all delays
CYCLETIME ———————— variable containing no.
of ms for CYCLE
TESTRELAYS ———————— exercise each of 12 relays in turn
?BAUD ———————— displayed stored baud rate
xxx SET_BAUD ———————— set baud rate to 75, 300, 600,
1200, 2400, 4800 or 9600
which will have effect after next restart
++HELP ———————— for service engineering

++HELP
******** Service Help **********
**** Allow 20 minutes for warm up before calibrating *****

CALIBRATE ———————— does everything, requires calibrator
EEC=? ———————— number of missing codes - should be zero
GET_ABS_VAL ———————— measure internal base delay
STEP_SIZE ———————— measures all steps - requires calibrator
LOCALT ————————LOCAL plus measure delay, requires calibrator

ok