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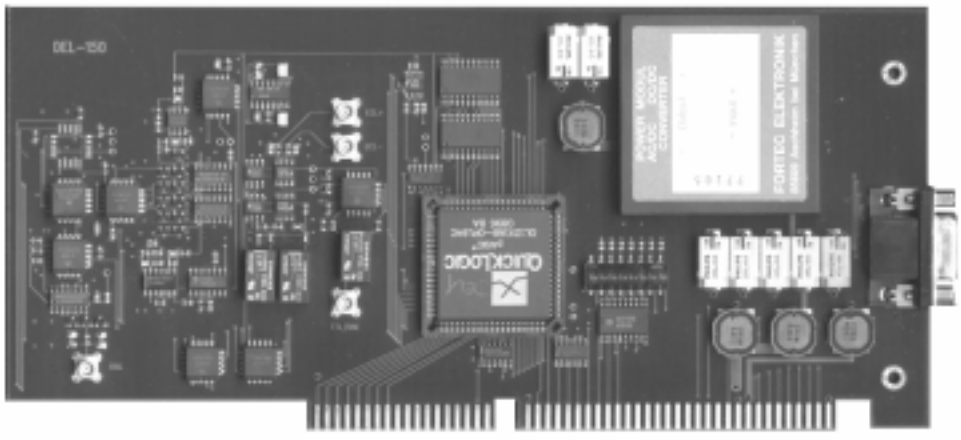
ps Delay Module DEL-150

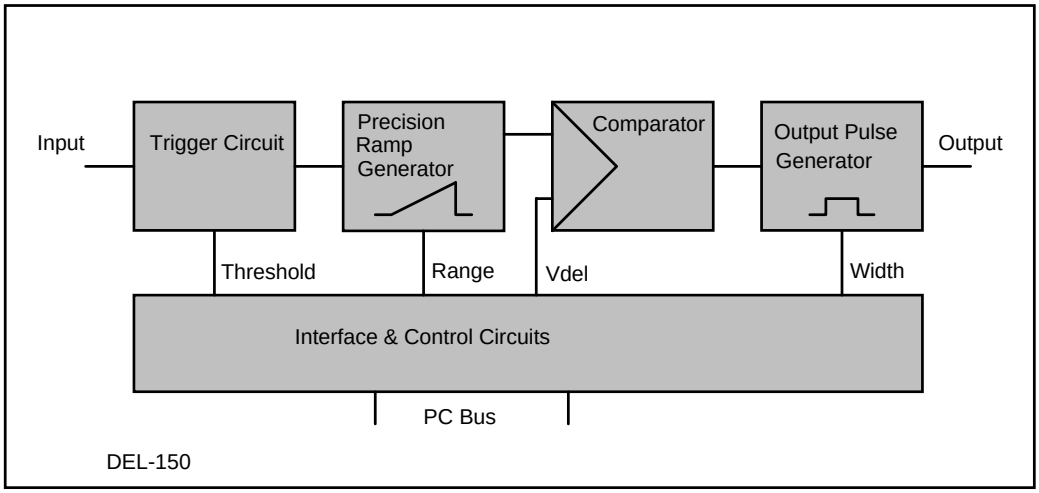
- **Delay Resolution down to 2.5 ps**
- **Low Jitter: 10 ps or 0.05 % of Delay Range**
- **Delay Range 20 ns to 20 us**
- **Input Trigger Threshold -2V to + 2V**
- **Output TTL, ECL or NIM**
- **Output Pulse Duration 2 ns to 200 ns**
- **PC plug-in Module for PC 386, 486 or Pentium**



Introduction

A basic block diagram of the DEL-150 module is shown in the figure below. The module contains a fast trigger circuit, a fast and accurate ramp generator, a comparator and a generator for the output pulses.

When the input voltage exceeds a selectable threshold the trigger circuit responds and the ramp generator is started. A comparator compares the ramp signal to the delay control voltage Vdel. When the ramp voltage reaches Vdel the comparator triggers the output pulse generator.



The DEL-150 provides pulse delay times from the ns range to the us range with a delay resolution down to 2.5 ps. Its low jitter and short intrinsic delay makes it useful for a variety of triggering and pulse shaping applications.

All module parameters are controlled by the DEL-150 Windows software. For user programmed special applications a DLL library of the basic module functions is available.

Specification

Input Impedance	50 Ω (SMA Connector)
Input Trigger Threshold	-2 V to + 2 V
Input Pulse Amplitude	50 mV to 4 V
Delay Range	10 ns to 100 us
Absolute Delay Accuracy	5 %
Delay Resolution	12 bit
Minimum Delay	10 ns + 0.05 Delay Range
Delay Jitter (rms)	0.05 % of delay range, min. 10 ps
Output Pulse Width	2 ns to 200 ns
Output Signals	2 differential ECL Signals 1 TTL / NIM Output
Output Impedance	50 Ω (SMA Connectors)
Operation Environment	PC 386, 486 or Pentium
Bus Connection	ISA 16 bit
Dimensions	PC board 236 x 110 mm

Installation

Requirements to the Computer

The computer must be a PC 386, 486 or Pentium. Although not absolutely required, we recommend to use a computer with a speed of at least 50 MHz for convenient working with the DEL. The DEL standard software runs under Windows 3.1, Windows for Workgroups 3.11 or Windows 95. The computer should have at least 8 Mb memory. The standard software requires approximately 2 MB hard disk space.

Installation of the DEL-150 Software

The installation of the DEL software is simple. Start WINDOWS and put the installation disk into drive A or B. Call the file manager and start setup.exe from the disk drive.

The DEL software is based on 'LabWindows / CVI' by National Instruments. Therefore the so-called 'CVI Run-Time Engine' is required to run the DEL software. The 'Run-Time Engine' contains the library functions of LabWindows CVI and is loaded together with the DEL software. The installation routine suggests a special directory to install the Run-Time Engine. However, if you have the Run-Time Engine already installed on your hard disk, it can be shared by several LabWindows CVI applications. If you want to use a Run-Time Engine already installed, you should check whether it is the correct version. If you have a CVIRTE.EXE in the Run-Time Engine directory, the version is correct. If not, install it once more - but in a new directory, otherwise your old application may refuse to work.

Hardware-Installation

Upgrading PCs with measurement modules often causes problems such as system crashes, malfunctions of special hardware or software components or other mysterious effects. To our experience such problems normally arise from interrupt and memory conflicts between different components. Therefore, the DEL-150 module has been designed without interrupts and direct memory access. So the installation of the DEL-150 usually does not cause any problems.

To install the device, switch off your computer and insert the DEL module into a free slot. To avoid damage due to electrostatic discharge we recommend to touch the module at the metallic back shield. Then touch a metallic part of the computer with the other hand. After that insert the module into a free slot of the computer. Keep the DEL-150 as far as possible apart from loose cables or other computer modules to avoid noise pick up.

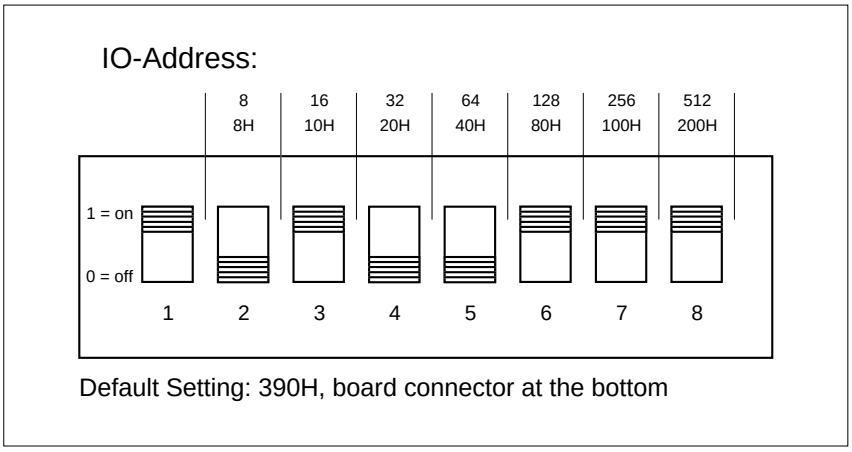
When the module is installed switch on, start Windows and start the DEL software. If no error is returned, you can expect that the module works correctly.

Should there be any malfunction after installing the DEL-150 either the capacity of the power supply is exceeded or - which is more probable - there is another module in the PC which has the same I/O address as the DEL-150. In this case change the module address as described in 'Changing the Module Address'. If there are only the standard modules in your computer the default address range (380h to 387h) should be free.

Changing the Module Address

If the computer contains other measurement devices which occupy the DEL-150 default address, the DEL module address must be changed.

The module is controlled by a block of eight subsequent IO addresses. The start address of this block must be dividable by eight and is the 'Module Base Address'. The module base address is set by a DIP switch on the DEL-150 board (see figure below).



Default Setting: 390H, board connector at the bottom

The software (standard software or library functions) reads the addresses of the DEL module from the configuration file DEL150.INI. Therefore, the DIP switch setting and the address in DEL150.INI must be the same. The DEL150.INI file can be edited with any ASCII editor (e.g. Norton Commander). The address information is given as 'baseadr=0x390' for the default value of 390h. For other values please type in the new address instead.

Using the DEL-150 Software without the DEL-150 Module

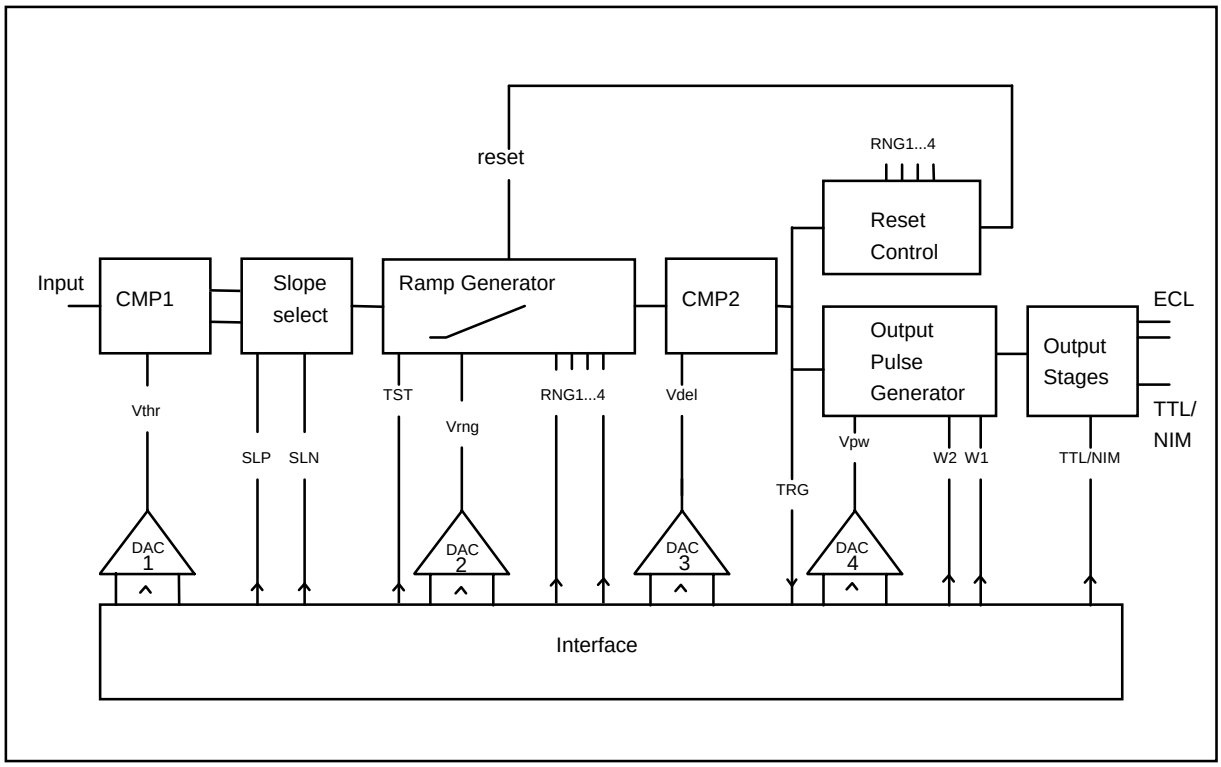
You can use the DEL-150 software also without the DEL-150 module. The software will display a warning that the module is not present. If you accept this warning the software will start in a special mode with the module functions being simulated.

When a DEL-150 module is present, the software can be forced into the simulation mode by typing 'hardware=0' instead of 'hardware=1' in the DEL150.INI file (under the header DEL_base). A second possibility is to add the command line parameter '-s' in the command line of the DEL_WIN.EXE call.

Internal Control Functions

In this section the internal control functions of the DEL-150 module are described. The reading of this section is recommended to users only who are going to create their own application software by using the DEL-150 DLL functions. A detailed block diagram of the DEL-150 is given in the figure below.

The input comparator threshold is set by DAC1. The threshold can be set in the range of -2 V and +2 V so that the input characteristic can be fit to the most common logic families (TTL, CMOS, ECL, NIM pulses).



Controlled by the bits SLP and SLN, in the slope select circuit either the positive or the negative edge of the input pulse can be selected for triggering the subsequent ramp generator. If neither SLP nor SLN are set triggering of the DEL-150 is disabled.

The slope speed of the ramp generator is controlled by the range select bits RNG1..4 in conjunction with the Vrng signal from DAC2. By RNG1 through RNG4 one of four delay ranges (10 to 100ns, 100 to 1000ns, 1us to 10us or 10us to 100us) is selected. Vrng provides for a fine adjustment inside the selected range. Since Vrng has a resolution of 12 bit virtually any ramp duration from 10ns to 100us can be set.

The comparator CMP2 compares the ramp voltage to the 12 bit delay control signal Vdel. When the ramp voltage reaches Vdel, CMP2 triggers the output pulse generator. At the same time the reset sequence of the ramp generator is initiated. Since the recovery time of the ramp generator is range-dependent, the duration of the reset pulse is controlled by the same range select bits which control the ramp generator. Furthermore, there is the TRG bit to inform the software that the module has been triggered. This bit is set by a trigger event and reset by reading the TRG bit.

The delay time from the trigger pulse to the output pulse is

$$Tdel = Range(RNG1..4) \frac{Vdel}{Vrng} + T0$$

With

Range = 10ns, 100ns, 1us or 10 us depending on RNG1..4
T0 = Intrinsic delay of trigger, slope select logic, ramp generator and output stages

Consequently, there are two possibilities to control the delay value - via the Vdel and via Vrng. Controlling via Vdel yields a linear characteristic and is used for delay scanning in conjunction with gated signal recording devices such as boxcars or gated photon counters. Controlling via Vrng at maximum Vdel is recommended to set fixed delay values with minimum jitter.

The output pulse width is controlled by the 12 bit signal Vpw and the width range bits W1 and W2. The output stages deliver two complementary ECL pulses and a TTL or NIM pulse. The selection of TTL or NIM level is done by the TTL/NIM bit.

The equation for the output pulse width is

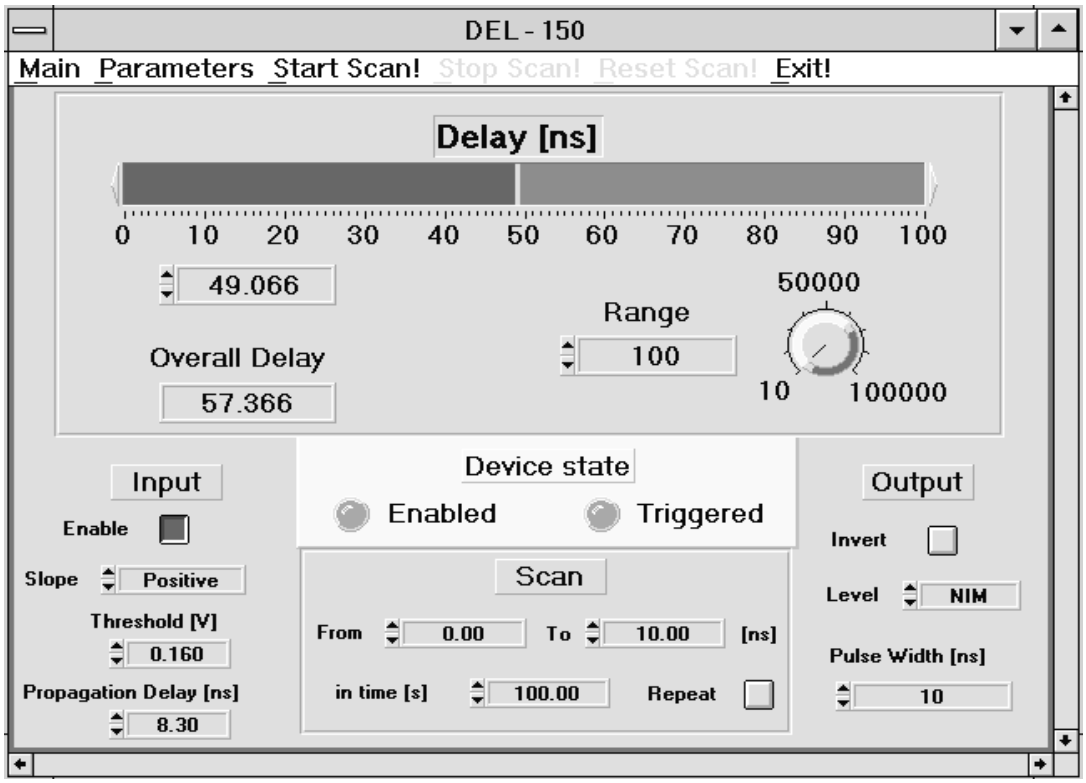
$$Width = WRNG(W1..2) \frac{4095}{Vpw}$$

with WRNG = 2ns, 20ns and 200ns depending on the width select bits W1 and W2
Vpw = 0 .... 4095 (digital value applied to the internal control DAC)

In addition to the functions described above the DEL-150 module device incorporates some test facilities which are used to test the module in the initialisation phase. There is a TST bit whose positive going edge triggers the ramp generator. In the test sequence, it is used to initiate a normal working cycle and to test the state of the TRG bit. To test the DACs for Vdel, Vrnd, Vpw and Vthr these voltages are fed to comparators which respond at the corresponding half-range voltage. By sending both 0 and the full scale values to the DACs and reading the comparator bits the basic function of the DACs is tested.

User Interface

The main window of the DEL-150 software is shown in the figure below.



Module Parameters

Input

The settings under 'Input' allow to select the trigger slope (positive or negative), the trigger threshold (from - 2 V to + 2 V) and to enable or disable the triggering.

To include cable delays or the response time of a device triggered by the DEL-150, the 'Propagation Delay' parameter can be used. This value is added to the delay of the DEL-150 and displayed as 'Overall Delay'.

Delay and Delay Range

The 'Range' setting represents the overall duration of the delay ramp. The actual delay can be set to any value inside the 'Range' value with a resolution of 12 bit. Both the 'Range' and the 'Delay' can be set either numerically or by moving the 'Range' knob or the 'Delay' bar by the mouse.

To include cable delays or the response time of a device triggered by the DEL-150, an 'Overall Delay' value is displayed. This delay is the sum of the delay of the DEL-150 and any additional delay specified by the parameter 'Propagation Delay'.

Output

The output parameters control the output pulse duration, polarity and the setting of the TTL / NIM output. Caution: Although the TTL/NIM output is set to 'NIM' by the power-on reset of the computer, care should be taken not to damage a connected NIM device by possible TTL levels.

Scan

Delay scanning is controlled by the scan parameters. Start delay ('from') and stop delay ('to') and the overall time for the scanning operation can be specified. Scanning is repeated automatically if the 'repeat' button is pressed. The start and stop delay values must be both inside the current 'Range' setting. Furthermore, the DEL-150 software must be active during the scanning operation.

Scanning is started by pressing 'StartScan' and stopped by pressing 'StopScan' in the menu bar. When stopped, the scan operation can be restarted from the current delay by 'StartScan', or reset by 'ResetScan'.

Device State

The device state panel informs about the current state of the module. The indicators turn on (green) if the trigger circuit is enabled and if a trigger pulse has been received.

Menu Bar

Main: Under 'Main' facilities for loading and saving of the module parameters are available.

Parameters: The 'Adjust Parameters' contain adjust values and manufacturing information for the particular module. These parameters are not stored in a file, but in an EEPROM on the DEL-150 module.

StartScan, StopScan. and ResetScan control the delay scanning. Scanning is started by pressing 'StartScan' and stopped by pressing 'StopScan' in the menu bar. When stopped, the scan operation can be restarted from the current delay by 'StartScan', or reset by 'ResetScan'.

Exit: The DEL-150 software is left by 'Exit'. When the program is left, the system parameters are saved in a file 'auto.set'. This file is loaded automatically at the next program start. Thus the system will come up in the same state as it was left. If you do not want to save the current settings you can reject saving by switching off the 'save data on exit' knob.

Technical Support

We are pleased to support you in all problems concerning the measurement of fast electrical or optical signals. This includes the installation of the DEL-150 module, its application to your measurement problem, the technical environment and physical problems related to short time measurement techniques. Simply call us!

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