sensL

CFD

Constant Fraction Discriminator

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Overview

Two Channel Constant Fraction Discriminator

SensL offers a solution for picosecond timing with ultra-fast detectors through the use of a 0.75 GHz Amplifier/ Constant Fraction Discriminator (CFD) module. The SensL CFD module comprises of two independent, fully programmable Constant Fraction Discriminators for interfacing with a wide range of detectors. The module setup parameters can be programmed via the USB using the SensL GUI.

Features

- All settings and adjustments are electronic, non-volatile (stored during powered-off state) and performed via USB port.
- Internal amplifier has 256 different gain settings allowing input signals to span more than 2 orders of magnitude. This allows direct interfacing to virtually any detector (PMT, APD, MCP).
- Compact, low power, rugged package allows the CFD to be placed in close proximity to the detectors and use short signal cables for best performance.
- Two independent channels
- Accepts both positive and negative polarity signals
- Input pulse rise time of 0.050ns to 5ns
- 750MHz internal bandwidth
- TTL level output pulse with selectable duration
- Interfaces directly to HRMTime
- Software control allows easy storing and automatic optimization of all settings and adjustments
- SMA input and output connectors
- Compatible with the SensL HRMTime module

Key Performance Parameters

- Number of channels: 2
- Over-current protected input
- Both polarities of the signal are accepted (software selectable)
- Delay line value selection: 1ns, 1.1ns, 1.5ns, 1.6ns
- Fraction selection: 15%, 25%, 35%, 60%
- Internal bandwidth: 750MHz
- Internal Amplifier gain range: +6dB to +51dB
- Time Walk: < ±50ps over 10:1 (typically)
- Time Jitter: <20ps FWHM (typically)
- 12-bit discriminator threshold adjustment
- 12-bit fine CFD discriminator tuning
- Input output connectors: SMA
- Output level: TTL
- Output pulse duration: 8ns or 270ns (s/w selectable)
- Power consumption < 6W

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CFD Operation

The input signals for CFDs are typically signals from light detection devices such as a Photomultiplier tubes (PMTs) or Silicon Photomultipliers (SPM). These devices are frequently used in low light applications such as LIDAR and Fluorescence Lifetime Measurement where the arrival time of the signal needs to be measured with an accuracy of tens of picoseconds. This level of accuracy means that standard threshold triggering is not suitable as it introduces an error as the amplitude of the signal varies. **Figure 1** shows two signals of different amplitudes. As can be seen, the threshold discrimina-

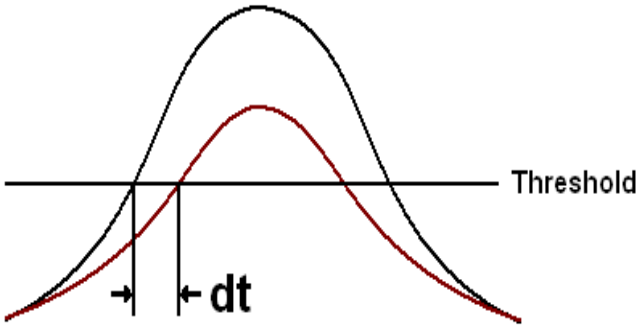


Figure 1

As the signal from devices such as PMTs or SPMs have identical rise times and pulse shapes, regardless of amplitude, the signal can be accurately timed based on a constant fraction of the peak height.

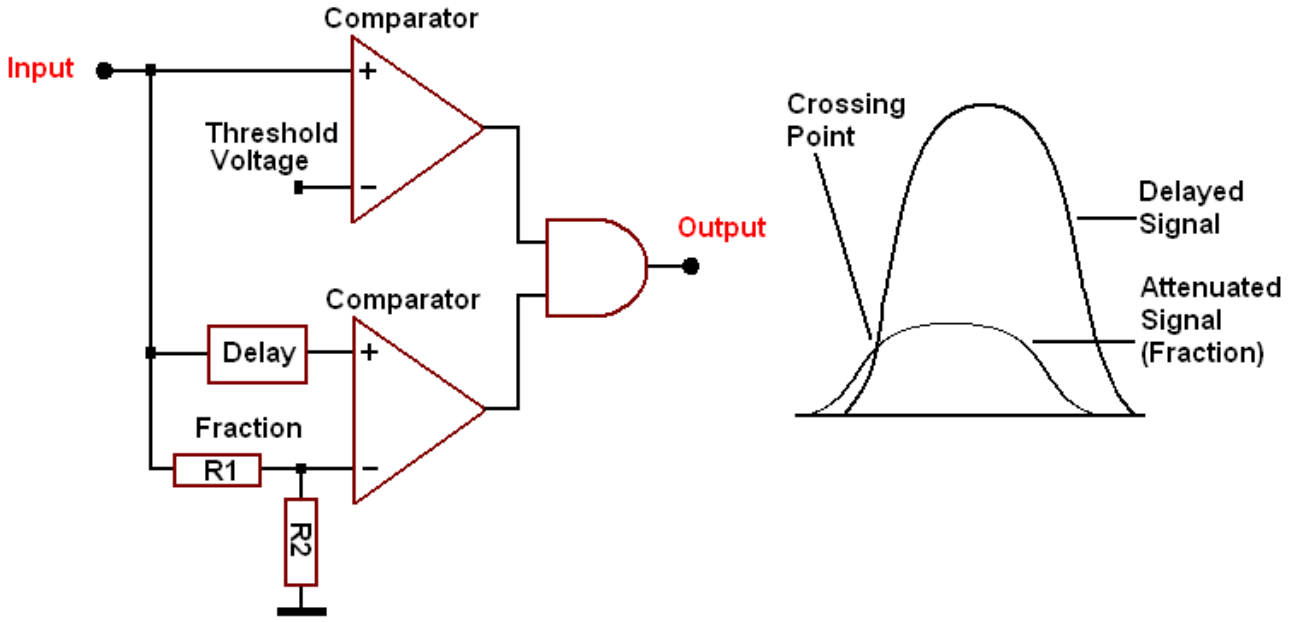


Figure 2

The top section comprises of a comparator that compares the input signal to a threshold voltage. This threshold voltage is set to a level that defines when a useful real signal is arriving at the input. The output of this comparator serves as an enable signal to qualify the output of the bottom CFD section of the circuit.

The bottom section comprises of a comparator with a delayed version of the input signal and an attenuated version of the input signal as inputs. Providing suitable delays and fractions are chosen for the input signal characteristics, the delayed signal will cross through the fraction signal at the same point in time regardless of

CFD Architecture

Figure 3 shows a block diagram of one of the two SensL CFD channels.

Each channel input has a fixed x10 amplifier followed by a programmable amplifier providing, an overall amplification of 0.6 to 500. This feature allows the CFD to be used on a wide range of input signal amplitudes. The programmable amplifier provides positive and negative outputs. The **Polarity Select** switch allows the CFD to cater for both positive and negative input signals.

The amplified signal is now fed to the threshold comparator, fraction attenuator and delay network. The fraction, delay and threshold are all programmable via the USB bus. Prior to input to the comparators, these 3 signals are all passed through a programmable DC offset network. These DC offset networks allows the user to raise the working values above the noise level of the system.

To fix the pulse width of the output, rather than use an 'and' gate (as shown in figure 1), a D-type flip-flop with a delayed CLR is used. The output of the threshold comparator is used as a qualifier for the CFD output. The delay before clear is selectable allowing either a short (8ns) or long (270ns) output pulse.

The configuration of the CFD parameters is all programmed by a FPGA controller. On power-up, the controller reads the configuration data from an on-board EEPROM and programs the various parameters accordingly.

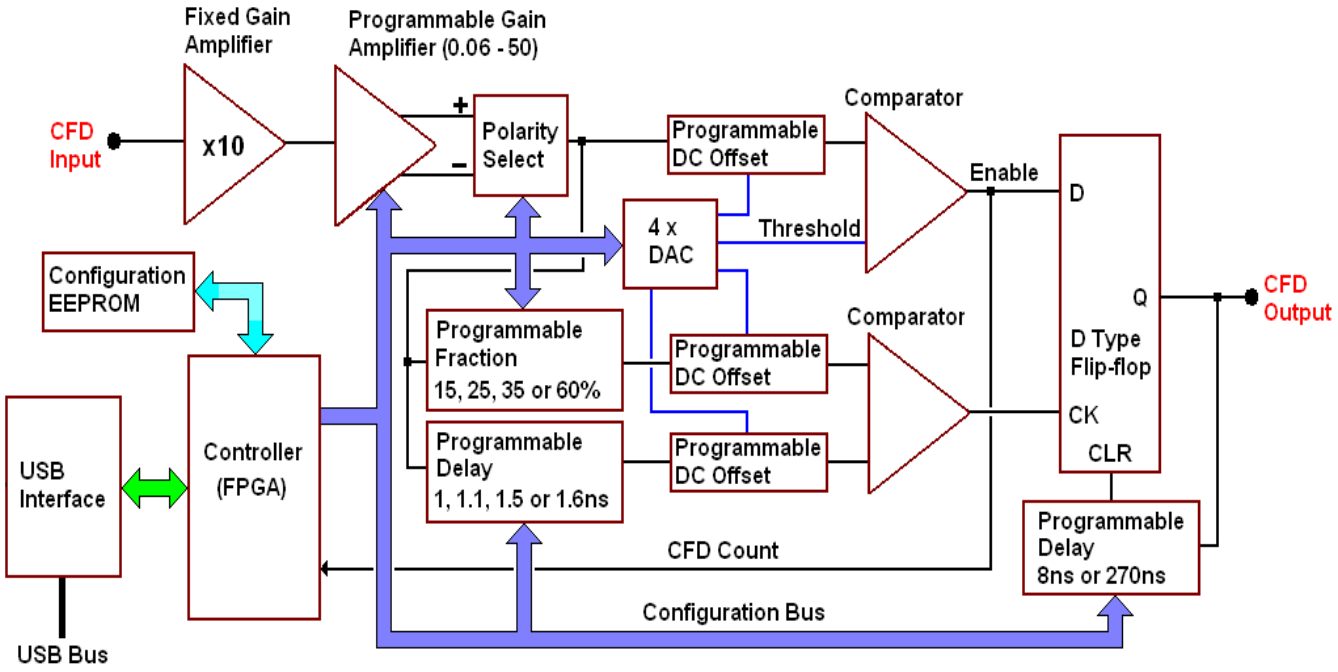


Figure 3

The controller can also communicate to a PC via a USB interface. Using the SensL software, the user can modify the parameters and store them in the EEPROM. Hence the CFD parameters are non-volatile. Once the user is satisfied with the chosen parameters, the USB connection is no longer required. The controller will, at power-up, will automatically configure the CFD with the desired settings.

Included Software

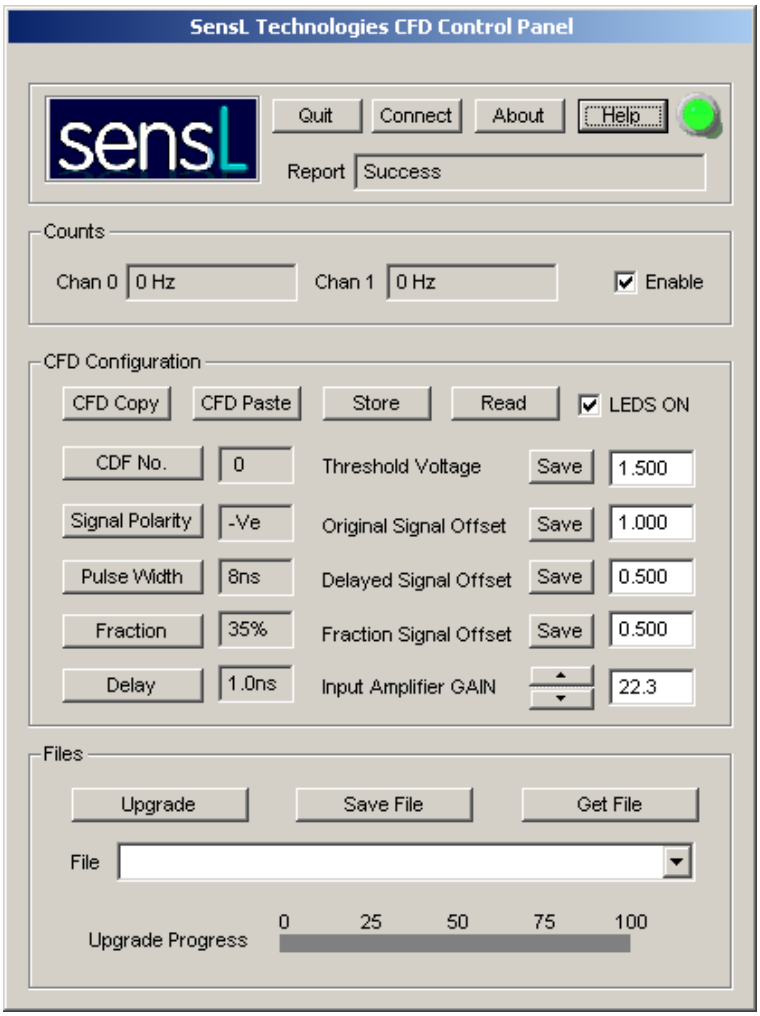
SensL provide an easy to use GUI software that communicates with the CFD module via the USB bus. This software is used for programming the module with the required settings.

Once the particular settings are chosen, the software can be directed to program the module so that these settings are automatically selected on power-up.

The software also allows the user to monitor the count rate of each of the CFD channels. This feature is particularly useful in experiments involving alignment of the source and detector to achieve the optimum count rate for the experiment.

An example of this would be a Lifetime measurement where the CFD module is connected to the SensL HRMTime for TCSPC histogramming. Using the count rate feature, the LASER and detector can be aligned to give the desired initial count rate.

Note:
The CFD module is fully compatible with the SensL HRMTime module.



Ordering Information

Product Code	Description
HRMTime-CFD	2 channel USB constant fraction discriminator (CFD)
Options	
W-HRMTime-CFD	Option: HRMTime-CFD 3-Year Extended Warranty

Related Products

The SensL CFD is ideal for use with the SensL HRMTime—High Resolution Timing Module either as a end user or OEM product. Additional information on our measurement instruments are available online at www.SensL.com.