

2-Channel, USB, Programmable CFD Module

The SensL HRM-CFD provides a solution for picosecond timing with ultra-fast detectors. This compact, rugged and low-power instrument features two independent channels each with their own 0.75GHz amplifier. All settings and adjustments are programmed via USB using the SensL GUI provided, which also allows automatic optimization and easy storing of parameters in non-volatile memory (stored during power-off state). The HRM-CFD is fully compatible with the SensL HRM-TDC High Resolution TDC Module.



This document provides the user with a comprehensive description of the hardware and software of the HRM-CFD module.

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GETTING STARTED

Contact and Support

For all enquiries, please email,

support@sensl.com

Supporting documentation can be found on the SensL website at www.sensl.com/documentation/

Downloadable copies of the HRM-CFD software and firmware updates can be found at

www.sensl.com/support/sw/

Unpacking the System and Preparing for Use

Contents of the package:

- HRM-CFD Module
- Power Supply, with country specific adapter
- USB cable

Safety Considerations

1. Only use the power supply supplied with the HRM-CFD module.
2. The power supply should be disconnected from the mains supply when the module is not in use.
3. The module is not intended for outdoor use
4. The power supply should not be opened nor should the module covers be removed at any time as there are no user adjustable components or settings, except via the SensL software.
5. Liquids should not be spilled on or into the module.

SYSTEM CHARACTERISTICS AND SPECIFICATIONS

No. of channels	2
Input and output connectors	SMA
Output level	LVTTTL
Input impedance	50Ω
Input polarity	Positive OR Negative
Input protection	Over-current protected
Power consumption	<6W
Power supply	Mains (cable provided)
Weight	930g
Dimensions	179 x 118 x 36 mm ³
Temperature range	Operating: 0°C to +50°C Storage: -20°C to +70°C

Table 1 General parameters

Delay line value selection	1ns, 1.1ns, 1.5ns, 1.6ns
Fraction selection	15%, 25%, 35%, 60%
Internal bandwidth	750MHz
Internal amplifier gain range	0.6x – 500x (8-bit resolution)
Time walk	<±50ps over 10:1 (typical)
Time jitter	<20ps FWHM (typical)
Threshold adjustment range	0 – 2.5V (12-bit resolution)
Threshold LSB	0.61mV
Output pulse duration selection	8ns OR 270ns
DC offset range	0 – 2.5V (12-bit resolution)

Table 2 Performance parameters

SIGNAL INPUTS AND OUTPUTS

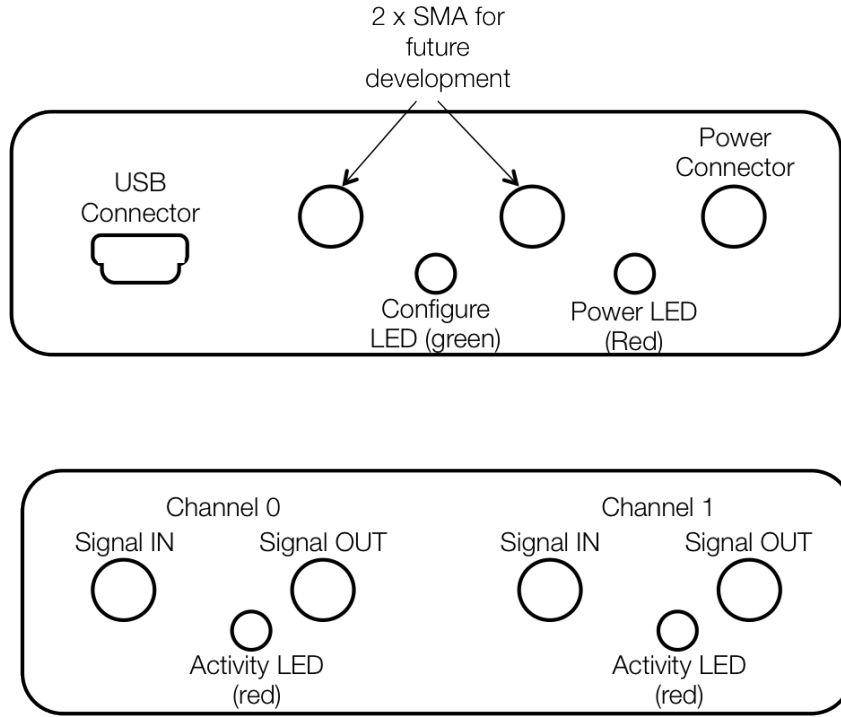


Figure 1 Module side panels

SYSTEM DESCRIPTION

Figures 2a and 2b shows simplified illustrations of how a CFD operates. The input signal is split into two parts.

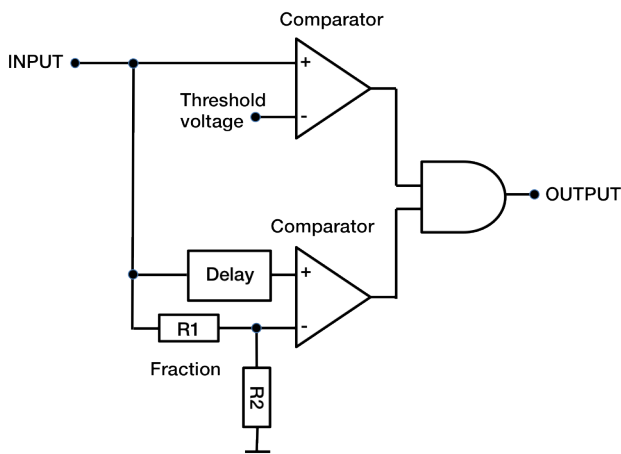


Figure 2a

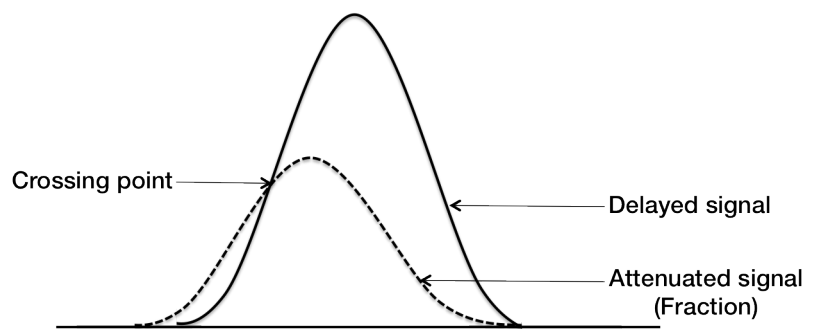


Figure 2b

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 is comprised 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 the amplitude of the input signal. Figure 3 shows the architecture of one of the two SensL HRM-CFD channels.

Each channel input has a fixed x10 amplifier followed by a programmable amplifier providing, an overall amplification of 0.6x to 500x. 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, 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 configurations of the CFD parameters are 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.

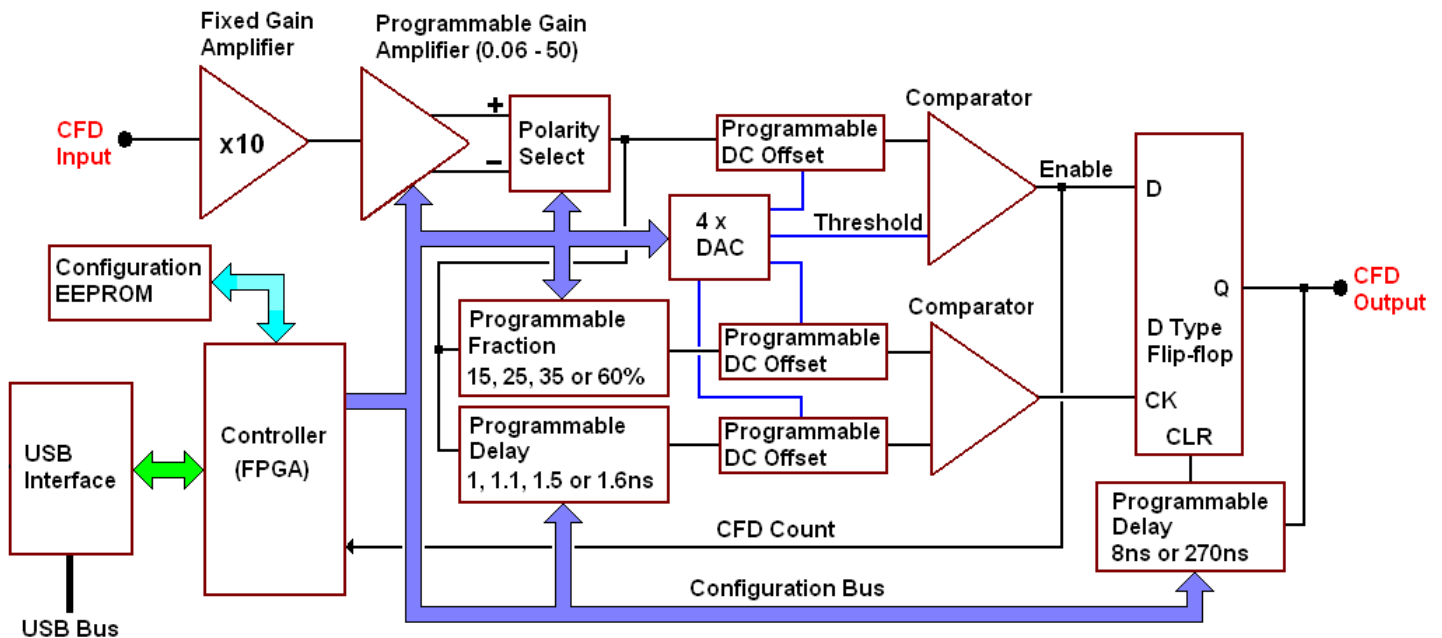


Figure 3 The architecture of one of the HRM-CFD channels

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.

SOFTWARE INSTALLATION

To install the CFD software and USB drivers, follow these steps:

1. Go to www.sensl.com/support/sw/ and download both the 'HRM-CFD Release Note' PDF and the 'HRM-CFD Software' EXE files.
2. Without the module connected to the PC, run **HRM-CFD_Install_XPXX.exe**, (where the XPXX denotes the revision number) and follow the instructions.
3. Once the installer is completed, power up the CFD module and connect the USB cable provided between the PC and the CFD module.
4. The PC will now detect a new USB device and start the wizard.
5. **DO NOT let the wizard search for the drivers.** Direct the wizard to the USB drivers provided. These drivers will be in the folder *C:\Program Files\SensL\HRM-CFD\drivers*.*
6. Once the USB drivers are installed run the program *SensL_CFD.exe* in the folder *C:\Program Files\SensL\HRM-CFD** to start the GUI.

* The folder paths in these instructions assume the default folder for installation was used.

N.B. If during power up of the module the **Power LED fails to light**, please turn off the power and then switch it back on again. The Power LED should now light. The location of the Power LED is shown in Figure 1.

SOFTWARE DESCRIPTION

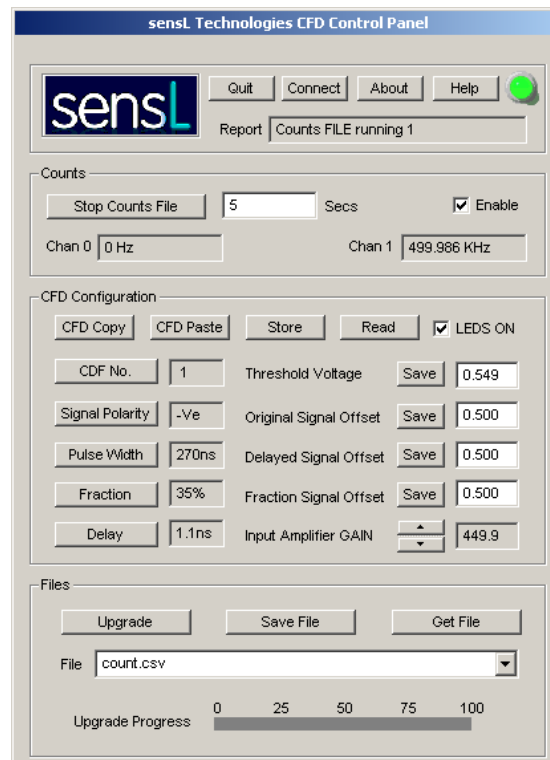


Figure 4 The SensL CFD software GUI

Quit Button

Press this button to QUIT the application.

Help Button

Press this button to display the help file.

About Button

Press this button to display the rev of the GUI and module firmware.

Connect Button

Press this button to connect to establish communication between the CFD module and the host computer via the USB bus. If the connection is successful the LED will turn GREEN.

Report Textbox

The Report textbox is used to display status and error messages.

Counts

Once communication is established between the module and the host computer, the software will periodically read the count rate of each module and update the count textboxes accordingly. The **Enable** checkbox can be used to enable or disable this process.

Stop / Start Counts File Button

The name of this button, at start up, will be **Start Counts File**. With the **Enable** checkbox true, clicking on this button will command the software to start recording the counts of each channel to file. Each measurement will be taken approximately once a second. The number of seconds to be recorded is specified in the text box to the right of this button. The name of the file for storing the results is defined in the File drop textbox. This file is of the form:

<filename>.CSV

The resulting file will be comma separated. This allows the file to be easily imported into a spreadsheet application such as EXCEL. Each entry in the file will have an accurate time-stamp (accurate to 10us) of when the reading was taken along with the current count of each channel, the change in count since the last reading and the corresponding average frequency of counts since the last reading. When the file is being saved, the name on this button will change to **Stop Counts File**. This button will revert back to the name **Start Counts File** when the time in the text box has expired or when the **Stop Counts File** button is pressed.

CFD Configuration

The **CFD Configuration** section is used to define the various CFD settings for each channel. After changing the various parameters they can be stored in the CFD. Alternatively, the current settings can be read back from the module.

CFD No Button

Use this button to toggle between the settings of CFD channels 0 and 1.

Signal Polarity Button

Use this button to specify the polarity (+Ve or -Ve) of the input signal.

Pulse Width Button

The CFD output signal can be programmed to be a short (8ns) or long (270ns) pulse. Use this button to select the desired pulse width.

Fraction Button

Use this button to select the fraction to be 15%, 25%, 35% or 60%.

Delay Button

Use this button to select the delay to be 1ns, 1.1ns, 1.5ns or 1.6ns.

Threshold Voltage

The threshold voltage is programmable from 0 to 2.5V. Type the voltage value in the **Threshold Voltage** text box and

press the Save button. Once saved, this value will be used when the CFD configuration is stored.

Original Signal Offset

The DC offset of the original input signal, used for the **Threshold Comparator**, is programmable from 0 to 2.5V. Type the voltage value in the **Original Signal Offset** text box and press the **Save** button. Once saved, this value will be used when the CFD configuration is stored.

Delayed Signal Offset

The DC offset of the delayed signal is programmable from 0 to 2.5V. Type the voltage value in the **Delayed Signal Offset** text box and press the **Save** button. Once saved, this value will be used when the CFD configuration is stored.

Fraction Signal Offset

The DC offset of the fraction signal is programmable from 0 to 2.5V. Type the voltage value in the **Fraction Signal Offset** text box and press the **Save** button. Once saved, this value will be used when the CFD configuration is stored.

Input Amplifier GAIN

The gain of the input stage is programmable. Use the **Input Amplifier GAIN** thumbwheel to select the gain from 0.6 to 500.

LEDS ON Checkbox

This checkbox is used to enable or disable the modules LED indicators. This is useful when the module is required to reside in a region such as a dark room where the LEDES would interfere with the experiment.

CFD Copy Button

Use this button to save the currently displayed CFD configuration data to temporary memory.

CFD Paste Button

Use this button to overwrite the currently displayed CFD configuration data with the data stored in temporary memory. The **CFD Copy** and **CFD Paste** buttons are used to easily copy the settings from one CFD to another.

Store Button

Use this button to transfer the CFD configuration data to the module. Once this is completed, the CFD module will be configured as requested. The data will be stored in non-volatile memory so that, from power-up, the module will automatically be configured with this data. If the **LEDS ON** Checkbox is set, during the **Store** process the green LED will light up.

Read Button

Use this button to read back the configuration data in the module's non-volatile memory back into the GUI. When complete, the current module's configuration will be displayed in the GUI. If the **LEDS ON** Checkbox is set, during the **Read** process the green LED will light up.

Files

The Files section is used to save and recall configuration settings and upgrade the modules firmware.

Save File Button

This button is used to save the current configuration settings to a file defined by the **File** drop textbox. The file name must be of the form:

<filename>.CFD

Get File Button

This button is used to fill the configuration settings with the configuration file defined by the **File** drop textbox. The **File** drop control can be used to display and select existing CFD files.

Upgrade Button

This button is used to upgrade the module's firmware with a new version. The **File** drop textbox defines the name of the upgrade file. This file is of the form:

<filename>.RPD

Once the upgrade starts the progress will be indicated by the **Upgrade Progress** bar.

NB:

1. This procedure must only be carried out under SensL supervision.
2. The RPD file **MUST** be a file provided by **SensL**.
3. The upgrade process takes several minutes to complete. Once started, do not attempt to cancel this process.