HEDS-9930PRGEVB

Evaluation Board and Programming Kit

User Guide
Version 1.0

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1 HEDS-9930EVB Evaluation Board

1.1 Top and Bottom Views

Figure 1: Bottom Side of the PCB HEDS-9930EVB

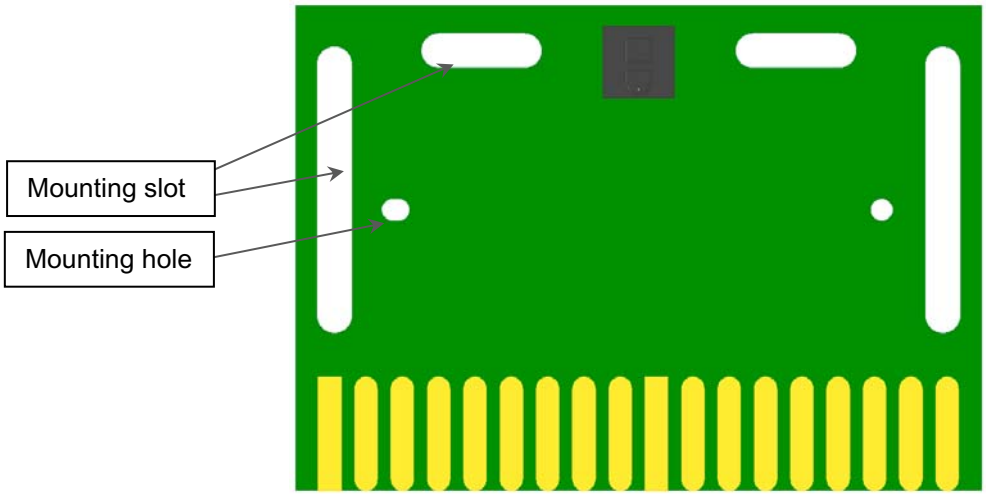
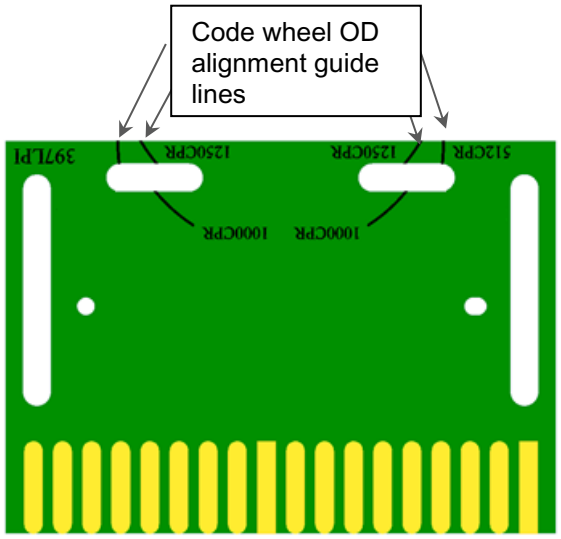


Figure 2: Top Side of the PCB 397 LPI



NOTE: Remove the protective kapton tape covering the encoder ASIC before use.

The silkscreen-printed guideline on the PCB provides visual alignment of the code wheel edge (outer diameter) for each of the different R_{OP} (CPR) tracks. Figure 3 is a sample diagram showing the position when the encoder is aligned to 625 CPR track.

Figure 3: Bottom of PCB with Code Wheel Edge for Different CPR Values

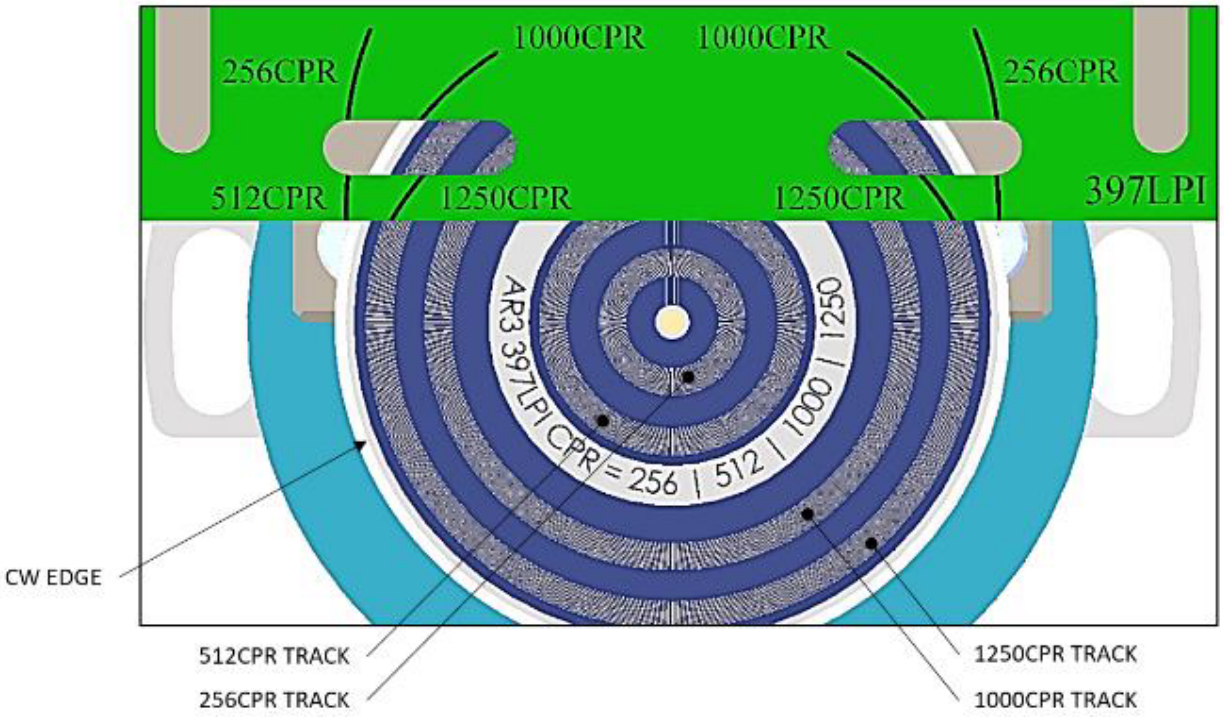
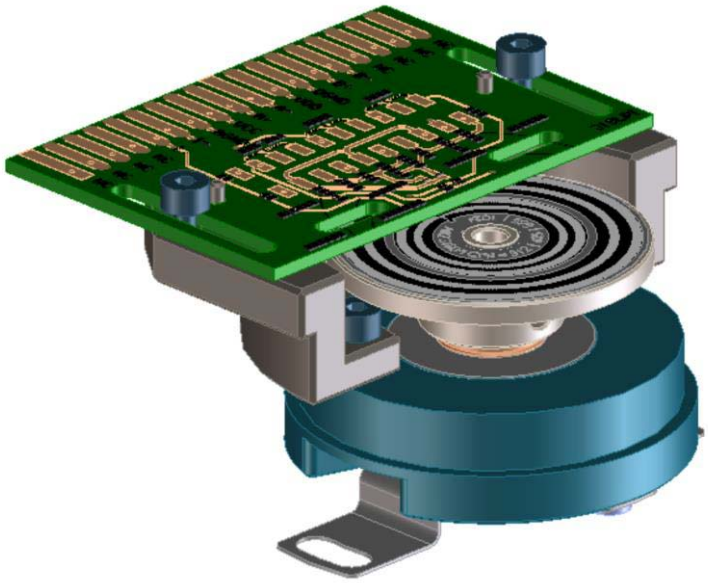


Figure 4: Sample Evaluation Board Mounting with Reference to Code Wheel



2 Select Options

2.1 Selection Table

Table 1: Selection Table for AEDR-9930 397 LPI

No.	SEL1	SEL2	SEL3	Interpolation Factor	IND SEL	Index
1	Low	Low	Low	1X	Low	Interpolation 1X - Index Gated 90°
					High	Interpolation 1X - Index Gated 180°
					Open	Interpolation 1X - Index Raw (Ungated)
2	High	Low	Low	2X	Low	Interpolation 2X - Index Gated 90°
					High	Interpolation 2X - Index Gated 180°
					Open	Interpolation 2X - Index Gated 360°
3	Open[a]	Low	Low	3X	Low	Interpolation 3X - Index Gated 90°
					High	Interpolation 3X - Index Gated 180°
					Open	Interpolation 3X - Index Gated 360°
4	Low	High	Low	4X	Low	Interpolation 4X - Index Gated 90°
					High	Interpolation 4X - Index Gated 180°
					Open	Interpolation 4X - Index Gated 360°
5	High	High	Low	5X	Low	Interpolation 5X - Index Gated 90°
					High	Interpolation 5X - Index Gated 180°
					Open	Interpolation 5X - Index Gated 360°
6	Open[a]	High	Low	6X	Low	Interpolation 6X - Index Gated 90°
					High	Interpolation 6X - Index Gated 180°
					Open	Interpolation 6X - Index Gated 360°
7	Low	Open[a]	Low	7X	Low	Interpolation 7X - Index Gated 90°
					High	Interpolation 7X - Index Gated 180°
					Open	Interpolation 7X - Index Gated 360°
8	High	Open[a]	Low	8X	Low	Interpolation 8X - Index Gated 90°
					High	Interpolation 8X - Index Gated 180°
					Open	Interpolation 8X - Index Gated 360°
9	Open[a]	Open[a]	Low	9X	Low	Interpolation 9X - Index Gated 90°
					High	Interpolation 9X - Index Gated 180°
					Open	Interpolation 9X - Index Gated 360°
10	Low	Low	High	10X	Low	Interpolation 10X - Index Gated 90°
					High	Interpolation 10X - Index Gated 180°
					Open	Interpolation 10X - Index Gated 360°
11	High	Low	High	11X	Low	Interpolation 11X - Index Gated 90°
					High	Interpolation 11X - Index Gated 180°
					Open	Interpolation 11X - Index Gated 360°
12	Open[a]	Low	High	12X	Low	Interpolation 12X - Index Gated 90°
					High	Interpolation 12X - Index Gated 180°
					Open	Interpolation 12X - Index Gated 360°

Table 1: Selection Table for AEDR-9930 397 LPI (Continued)

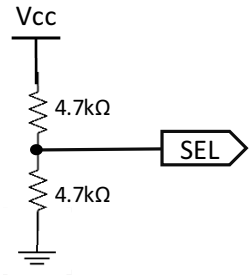
No.	SEL1	SEL2	SEL3	Interpolation Factor	IND SEL	Index
13	Low	High	High	13X	Low	Interpolation 13X - Index Gated 90°
					High	Interpolation 13X - Index Gated 180°
					Open	Interpolation 13X - Index Gated 360°
14	High	High	High	14X	Low	Interpolation 14X - Index Gated 90°
					High	Interpolation 14X - Index Gated 180°
					Open	Interpolation 14X - Index Gated 360°
15	Open[a]	High	High	15X	Low	Interpolation 15X - Index Gated 90°
					High	Interpolation 15X - Index Gated 180°
					Open	Interpolation 15X - Index Gated 360°
16	Low	Open[a]	High	16X	Low	Interpolation 16X - Index Gated 90°
					High	Interpolation 16X - Index Gated 180°
					Open	Interpolation 16X - Index Gated 360°
17	High	Open[a]	High	17X	Low	Interpolation 17X - Index Gated 90°
					High	Interpolation 17X - Index Gated 180°
					Open	Interpolation 17X - Index Gated 360°
18	Open[a]	Open[a]	High	18X	Low	Interpolation 18X - Index Gated 90°
					High	Interpolation 18X - Index Gated 180°
					Open	Interpolation 18X - Index Gated 360°
19	Low	Low	Open[a]	19X	Low	Interpolation 19X - Index Gated 90°
					High	Interpolation 19X - Index Gated 180°
					Open	Interpolation 19X - Index Gated 360°
20	High	Low	Open[a]	20X	Low	Interpolation 20X - Index Gated 90°
					High	Interpolation 20X - Index Gated 180°
					Open	Interpolation 20X - Index Gated 360°
21	Open[a]	Low	Open[a]	25X	Low	Interpolation 25X - Index Gated 90°
					High	Interpolation 25X - Index Gated 180°
					Open	Interpolation 25X - Index Gated 360°
22	Low	High	Open[a]	32X	Low	Interpolation 32X - Index Gated 90°
					High	Interpolation 32X - Index Gated 180°
					Open	Interpolation 32X - Index Gated 360°
23	High	High	Open[a]	64X	Low	Interpolation 64X - Index Gated 90°
					High	Interpolation 64X - Index Gated 180°
					Open	Interpolation 64X - Index Gated 360°
24	Open	High	Open[a]	128X	Low	Interpolation 128X - Index Gated 90°
					High	Interpolation 128X - Index Gated 180°
					Open	Interpolation 128X - Index Gated 360°
25	Low	Open[a]	Open[a]	256X	Low	Interpolation 256X - Index Gated 90°
					High	Interpolation 256X - Index Gated 180°
					Open	Interpolation 256X - Index Gated 360°
26	High	Open[a]	Open[a]	512X	Low	Interpolation 512X - Index Gated 90°
					High	Interpolation 512X - Index Gated 180°
					Open	Interpolation 512X - Index Gated 360°

Table 1: Selection Table for AEDR-9930 397 LPI (Continued)

No.	SEL1	SEL2	SEL3	Interpolation Factor	IND SEL	Index
27	Open[a]	Open[a]	Open[a]	SPI Mode	Low	SPI Mode: Program Selection
					High	SPI Mode: Output Enabled

a. Open selection must be connected to the middle of a voltage divider circuit.

Figure 5: Example of Voltage Divider Circuit



NOTE: Use 2 × 4.7 kΩ resistors (V_{CC} – GND).

The preceding digital interpolation factor may be used with the following equations to cater to various rotational speeds (RPM) and counts per revolution (CPR).

RPM = (Count Frequency × 60) / CPR

The CPR (at 1X interpolation) is based on the following equation that is dependent on radius of operation (R_{OP}).

CPR = LPI × 2π × R_{OP} (inch) or CPR = LP mm × 2π × R_{OP} (mm)

NOTE: LPmm (lines per mm) = LPI / 25.4.

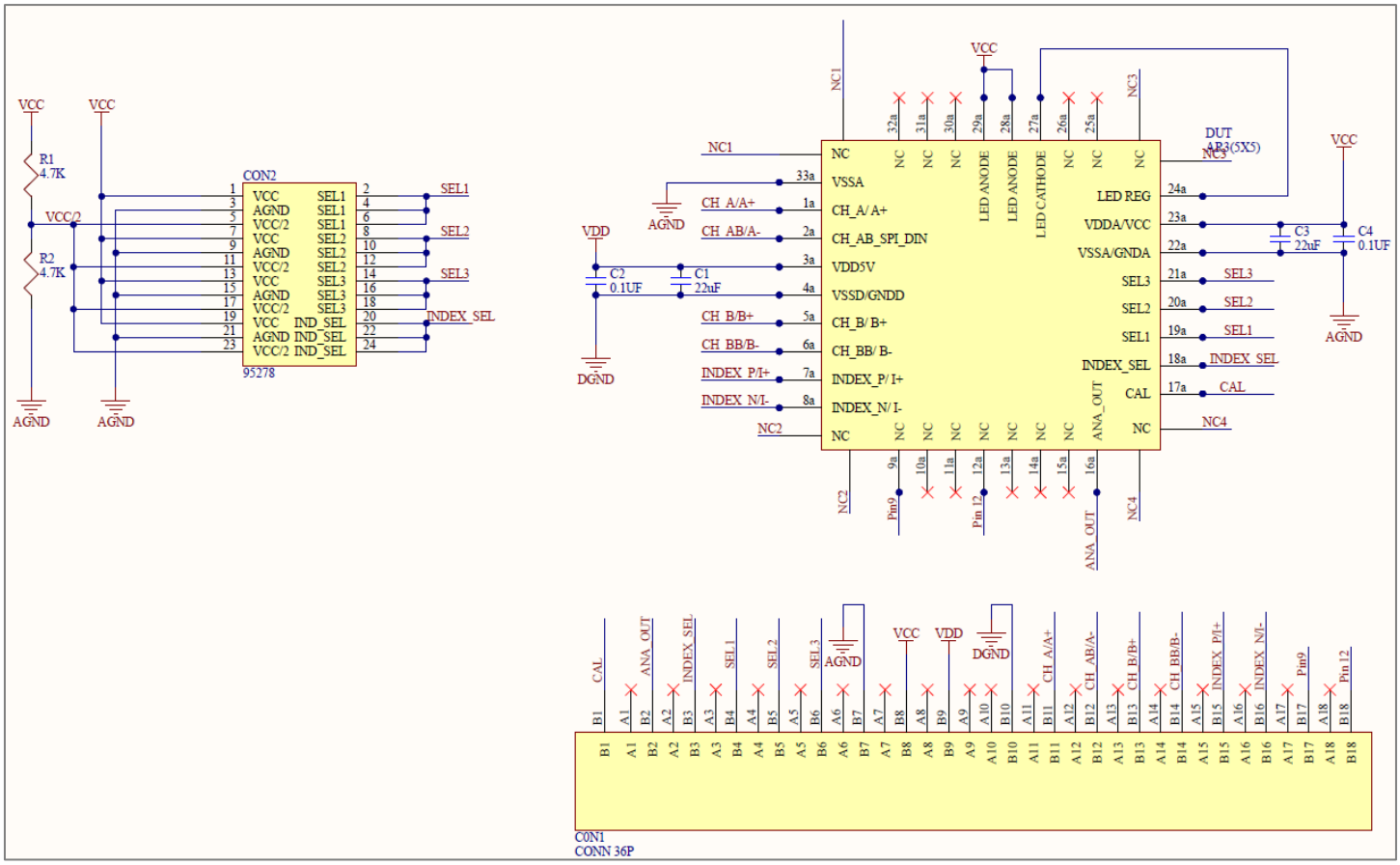
2.2 Programmable Select Options

The SPI is programmable with an interpolator factor from 1x to 1024x.

1. Configure the external selection to SPI Mode: Program Selection.
2. For signal output after configuration, set the external selection to SPI Mode: Output Enabled.

3 Board Schematic and Pin Assignment

Figure 6: HEDS-9930EVB Evaluation Board Schematic



3.1 Connector Assignment

Table 2: Connector 1 Pin Assignment

Connector 1 (Top Side)	Label
1	CAL
2	ANA OUT
3	INDEX_SEL
4	SEL1
5	SEL2
6	SEL3
7	AGND/VSSA
8	VCC
9	VDD
10	DGND/VSSD
11	CH_A/A+
12	CH_A/A– (SPI_DIN)
13	CH_B/B+
14	CH_BB/B– (SPI_CLK)
15	CH_I/I+(SPI_DOUT)
16	CH_I/I– (CLK_100KHz)
17	NC
18	NC

The finger design of Connector 1 matches either of the following card edge connectors:

- EDAC, CONN EDGE DUAL FMALE 36POS 0.100, P/N# 395-036-520-202
- SULLINS, CONN EDGE DUAL FMALE 36POS 0.100, P/N# EBC18DREH

The use of the preceding card edge connectors is not needed if the necessary connections can be made using manual soldering to the relevant card edge fingers.

For simplification of connections, VDD and VCC, and AGND and DGND can be shorted.

Table 3: Connector 2 Pin Assignment

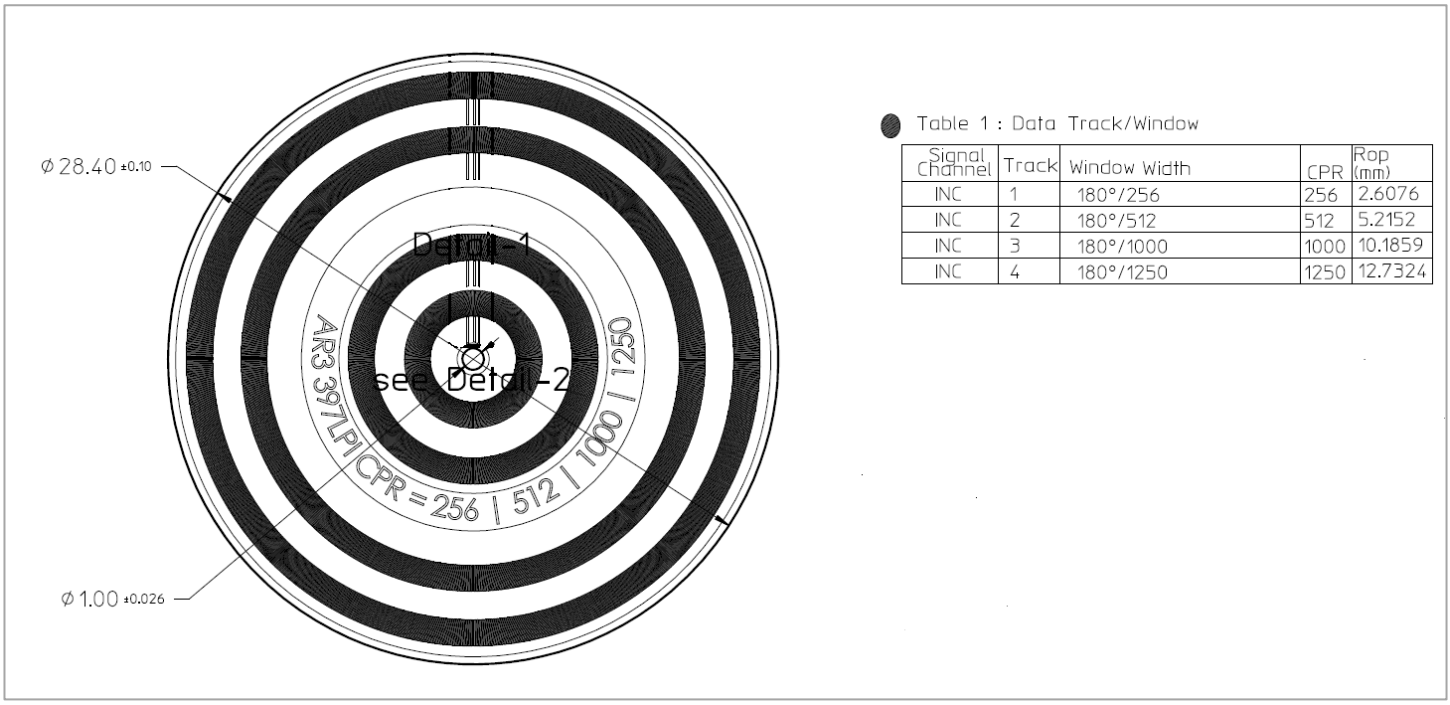
Connector 2 (Top Side)	Label	State
1	SEL1	VCC
2		AGND
3		OPEN
4	SEL2	VCC
5		AGND
6		OPEN
7	SEL3	VCC
8		AGND
9		OPEN
10	INDEX_SEL	VCC
11		AGND
12		OPEN

NOTE: See Table 1 for the various selection options available by changing the SEL1, SEL2, and SEL3 jumper position.

4 Code Wheel Drawing

For the AEDR-9930 evaluation board sample, the matching code wheel sample drawing is as shown in Figure 7.

Figure 7: AEDR-9930 397 LPI 4-Track (CPR) Code Wheel Drawing



Signal Channel	Track	Window Width	CPR	Rop (mm)
INC	1	180°/256	256	2.6076
INC	2	180°/512	512	5.2152
INC	3	180°/1000	1000	10.1859
INC	4	180°/1250	1250	12.7324

For the detailed drawing of the sample code wheel, ask your regional Sales/FAE.

NOTE:

- Ignore 256 CPR code wheel track; it is not valid to use with autocalibration.
- All other code wheel tracks with base resolution 512, 1000, and 1250 CPR require autocalibration.

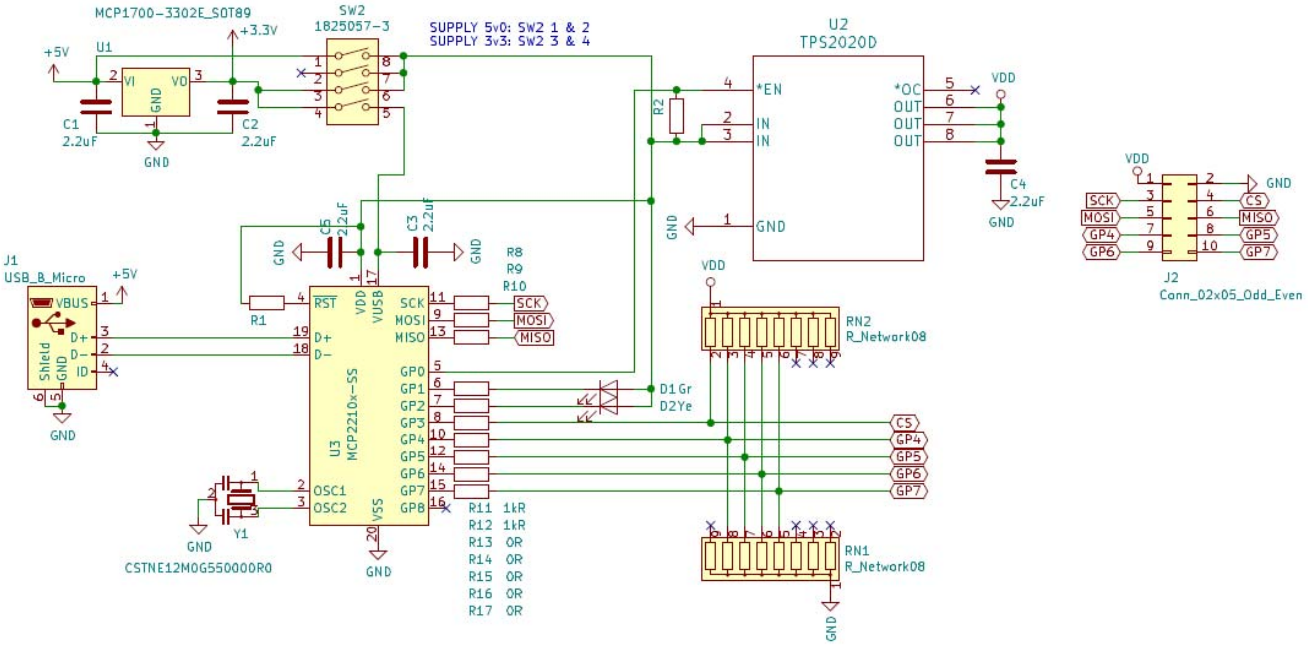
5 HEDS-9930PRGEVB Programming USB-SPI Kit

To program interpolation value other than the ones offered in Table 1 using the SEL1, SEL2, SEL3 option pins, you may connect to the AEDS-9930 encoder ASIC using the SPI interface.

Broadcom offers a simple USB-to-SPI programming kit, together with a PC-based custom program for you to program the desired interpolation value.

Figure 8: HEDS-9930PRGEVB USB-to-SPI Programmer Kit

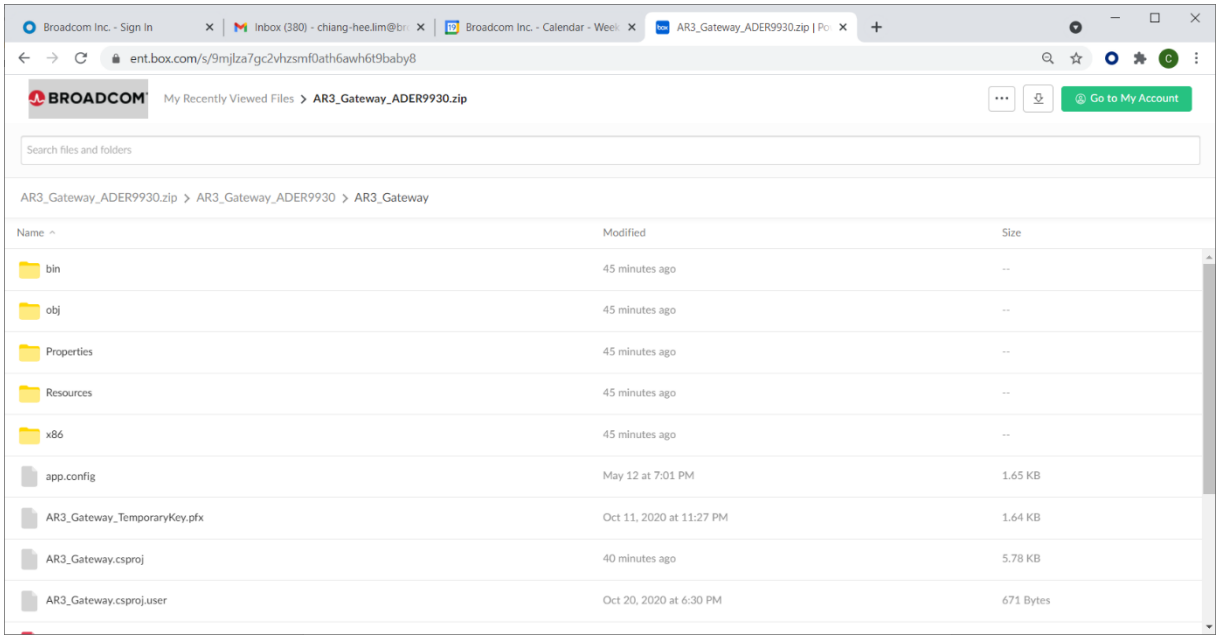
Figure 9: HEDS-9930PRGEVB USB-to-SPI Programmer Kit Schematic



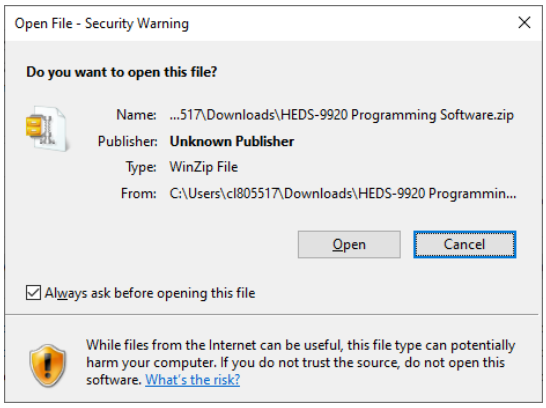
6 AEDR-9930 Gateway Programming GUI

Use the HEDS-9930PRGEVB kit together with the `AEDR_9930_Gateway.exe` to program the desired interpolation factor into the encoder ASIC.

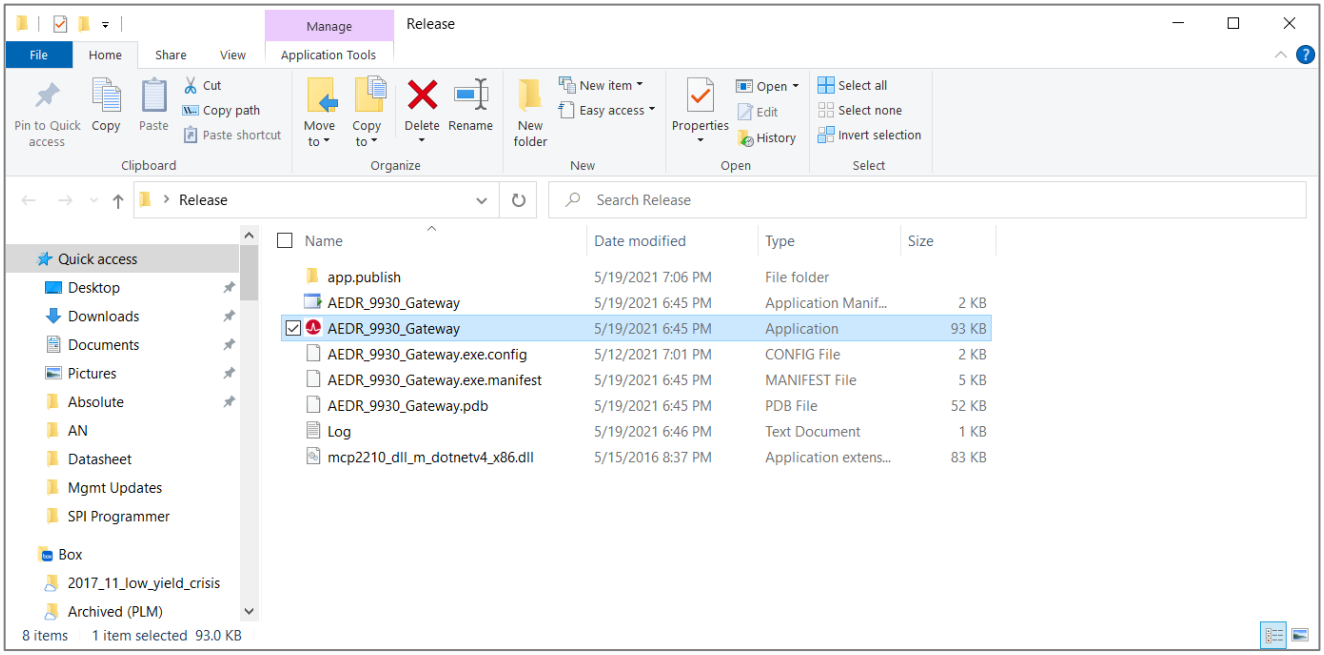
1. Download the zip file from:
   https://broadcom.box.com/v/AEDR-9930-Programming-Software



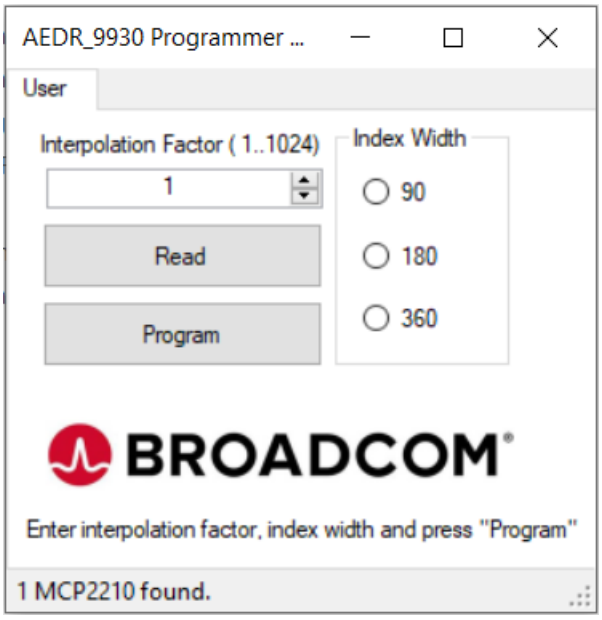
2. Save the zip file into a PC local drive.
3. Unzip the `AR3_AEDR-9930_Gateway programming software.zip` to a local folder of choice.



4. Select and double-click `AEDR_9930_Gateway.exe` file.

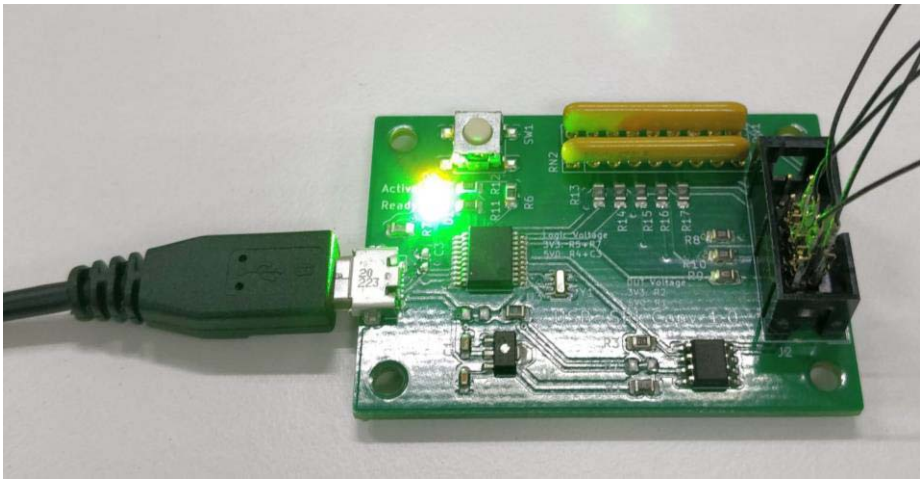


When the `AEDR_9930_Gateway.exe` program is running, the board should be detected.

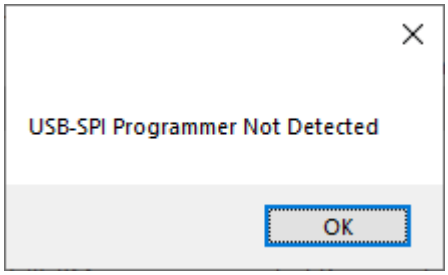


Both amber and green LEDs turn on when plugged into the USB port and the HEDS-9930PGREVB program is running.

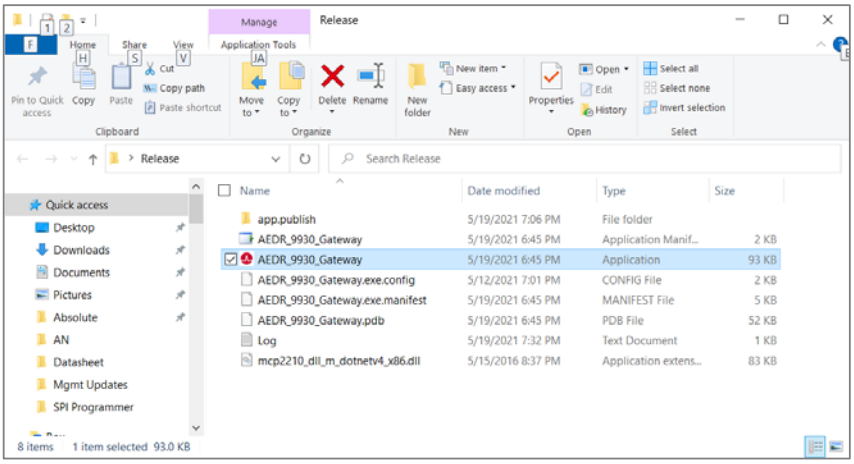
Figure 10: LEDS Indicating Program Is Running

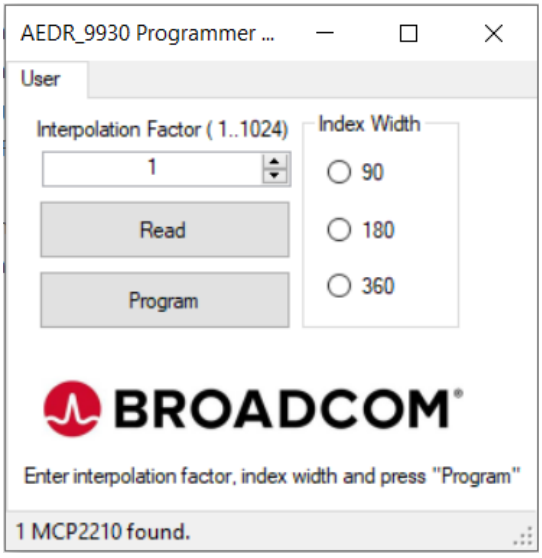


5. If the following message appears, check the board connections and try again.

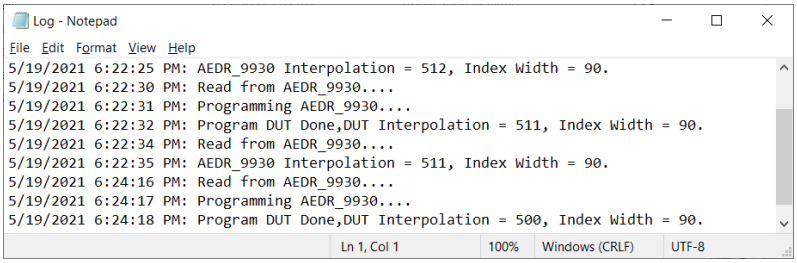


6. Click **Read** to read back the saved settings from AEDR-9930 encoder ASIC,
   a. If the existing settings are read out successfully, the Interpolation Factor and Index Width settings saved message is displayed as shown in the following example on the left.



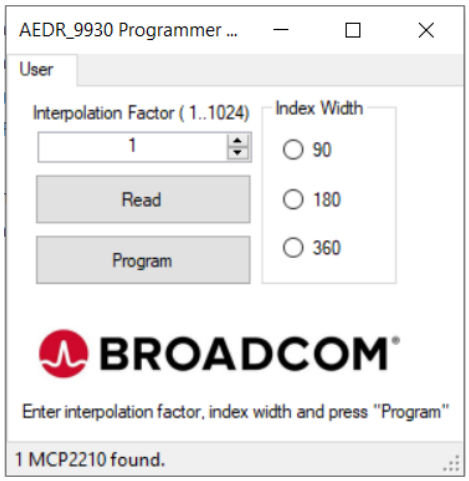


   b. If the AEDR-9930 is not connected or detected, the program terminates. Refer to the `log.txt` file in the same folder to check the failure status.

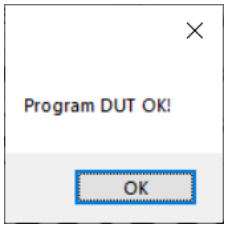


c. If a communication failure with AEDR-9930 exists, the program exits. Refer to the `log.txt` file in the same folder to check on the error message.

7. Enter the interpolation factor required (1 to 1024) and index width setting. Click **Program** to save the settings into AEDR-9930.



The **Program DUT OK!** message is displayed when the settings are saved successfully into the AEDR-9930.



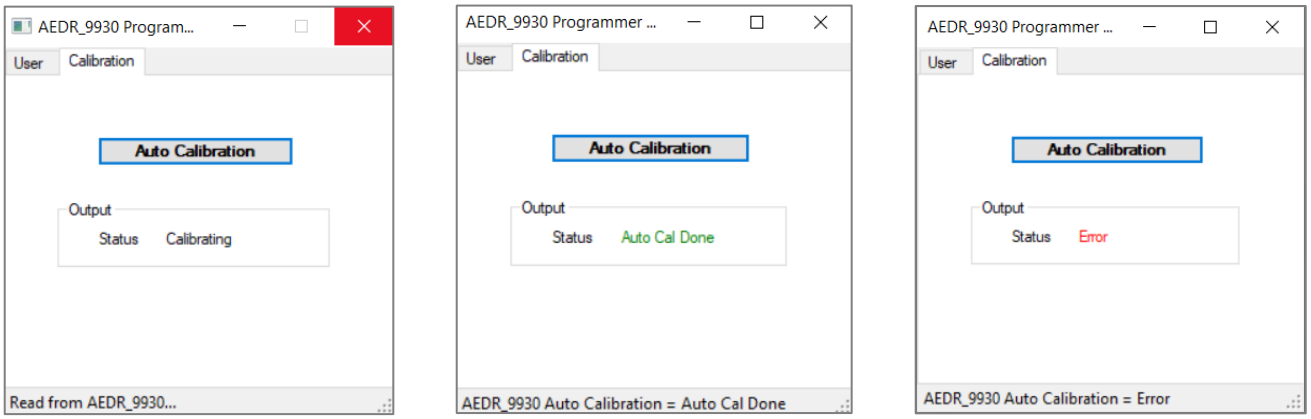
7 Using AEDR-9930 Gateway SPI Protocol to Perform Calibration

Motor rotation with minimal speed ripple or smooth linear movement is required during calibration. This is to enable Index signals to be automatically adjusted to obtain a good crossover.

Follow these steps:

1. Turn the motor at a constant speed of 500 rpm or linear stage reciprocal movement (stroke[50 mm/s]).
2. Click on **Auto Calibration**.
3. When the calibration is in progress, **Calibrating** will be shown in next to **Status**.
4. The calibration status will indicate **Auto Cal Done** if the calibration is successfully completed. Otherwise, it will indicate **Error**.

Figure 11: Samples of Screen Capture from AEDR-9930 Gateway Program to Perform Calibration



Revision History

Version 1.0, March 4, 2022

Initial document release.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