HEDS-9940PRGEVB

Evaluation Board and Programming Kit

User Guide

Version 1.0

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Chapter 1: HEDS-9940EVB Evaluation Board

1.1 Top and Bottom Views

Figure 1: Bottom View of the PCB

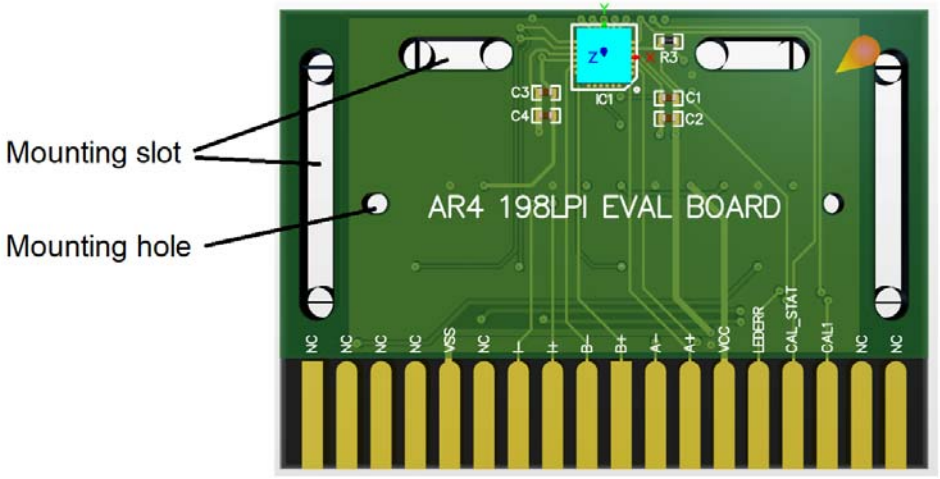
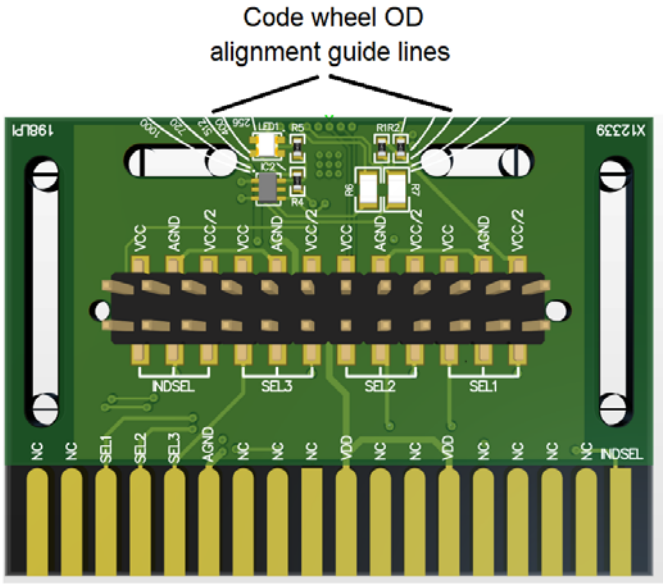


Figure 2: Top View of the PCB



The silk screen-printed guide line on the PCB is to help in providing visual alignment of the code wheel edge (outer diameter) for each of the different ROP (CPR) tracks. A sample diagram showing the position when the encoder is aligned to the 500 CPR track is shown in Figure 3.

Figure 3: Sample Encoder Aligned to 500 CPR Track (HEDS-9940EVB1/HEDS-9940PRGEVB1)

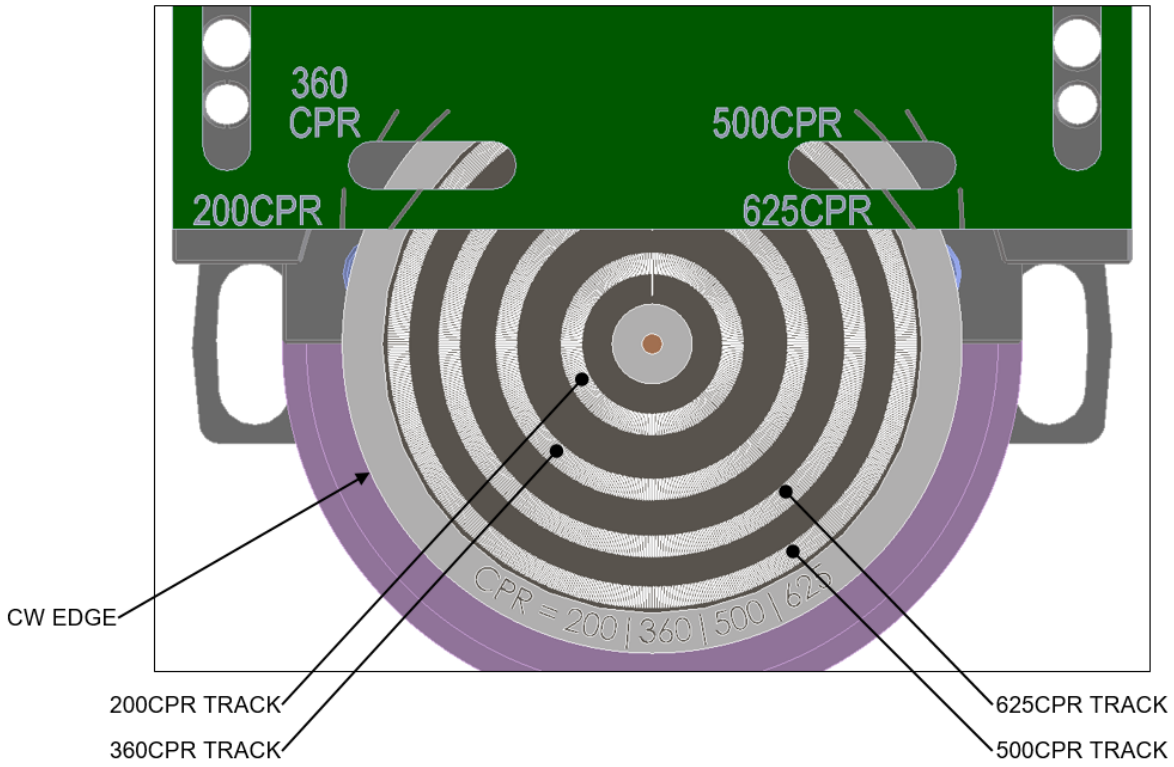
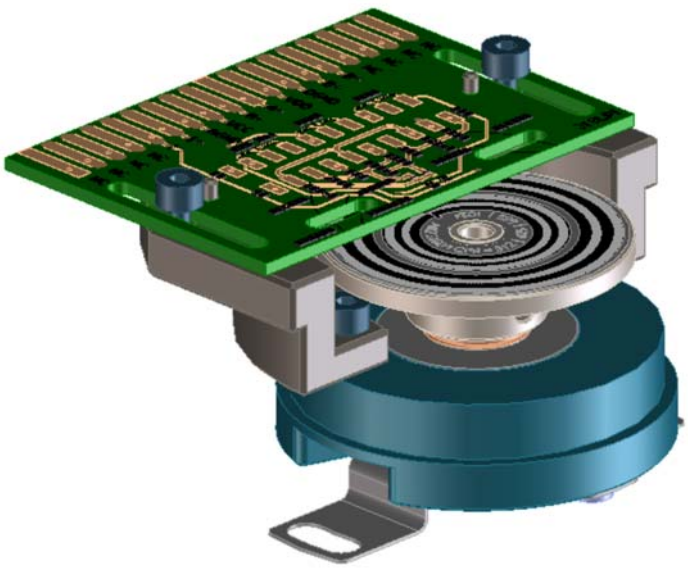


Figure 4: Sample Evaluation Board Mounting with Reference to Code Wheel



Chapter 2: Select Options

Table 1: Selection Table for AEDR-9940 198.4375 LPI

No.	SEL1	SEL2	SEL3	Interpolation Factor	INDEXSEL	Index
1	Low	Low	Low	1X	Low	Interpolation 1X - Index Gated 90 degrees
					High	Interpolation 1X - Index Gated 180 degrees
					Open	Interpolation 1X - Index Raw (Ungated)
2	High	Low	Low	2X	Low	Interpolation 2X - Index Gated 90 degrees
					High	Interpolation 2X - Index Gated 180 degrees
					Open	Interpolation 2X - Index Gated 360 degrees
3	Open[a]	Low	Low	3X	Low	Interpolation 3X - Index Gated 90 degrees
					High	Interpolation 3X - Index Gated 180 degrees
					Open	Interpolation 3X - Index Gated 360 degrees
4	Low	High	Low	4X	Low	Interpolation 4X - Index Gated 90 degrees
					High	Interpolation 4X - Index Gated 180 degrees
					Open	Interpolation 4X - Index Gated 360 degrees
5	High	High	Low	5X	Low	Interpolation 5X - Index Gated 90 degrees
					High	Interpolation 5X - Index Gated 180 degrees
					Open	Interpolation 5X - Index Gated 360 degrees
6	Open[a]	High	Low	6X	Low	Interpolation 6X - Index Gated 90 degrees
					High	Interpolation 6X - Index Gated 180 degrees
					Open	Interpolation 6X - Index Gated 360 degrees
7	Low	Open[a]	Low	8X	Low	Interpolation 8X - Index Gated 90 degrees
					High	Interpolation 8X - Index Gated 180 degrees
					Open	Interpolation 8X - Index Gated 360 degrees
8	High	Open[a]	Low	9X	Low	Interpolation 9X - Index Gated 90 degrees
					High	Interpolation 9X - Index Gated 180 degrees
					Open	Interpolation 9X - Index Gated 360 degrees
9	Open[a]	Open[a]	Low	10X	Low	Interpolation 10X - Index Gated 90 degrees
					High	Interpolation 10X - Index Gated 180 degrees
					Open	Interpolation 10X - Index Gated 360 degrees
10	Low	Low	High	12X	Low	Interpolation 12X - Index Gated 90 degrees
					High	Interpolation 12X - Index Gated 180 degrees
					Open	Interpolation 12X - Index Gated 360 degrees
11	High	Low	High	16X	Low	Interpolation 16X - Index Gated 90 degrees
					High	Interpolation 16X - Index Gated 180 degrees
					Open	Interpolation 16X - Index Gated 360 degrees
12	Open[a]	Low	High	20X	Low	Interpolation 20X - Index Gated 90 degrees
					High	Interpolation 20X - Index Gated 180 degrees
					Open	Interpolation 20X - Index Gated 360 degrees

Table 1: Selection Table for AEDR-9940 198.4375 LPI (Continued)

No.	SEL1	SEL2	SEL3	Interpolation Factor	INDEXSEL	Index
13	Low	High	High	25X	Low	Interpolation 25X - Index Gated 90 degrees
					High	Interpolation 25X - Index Gated 180 degrees
					Open	Interpolation 25X - Index Gated 360 degrees
14	High	High	High	32X	Low	Interpolation 32X - Index Gated 90 degrees
					High	Interpolation 32X - Index Gated 180 degrees
					Open	Interpolation 32X - Index Gated 360 degrees
15	Open[a]	High	High	50X	Low	Interpolation 50X - Index Gated 90 degrees
					High	Interpolation 50X - Index Gated 180 degrees
					Open	Interpolation 50X - Index Gated 360 degrees
16	Low	Open[a]	High	64X	Low	Interpolation 64X - Index Gated 90 degrees
					High	Interpolation 64X - Index Gated 180 degrees
					Open	Interpolation 64X - Index Gated 360 degrees
17	High	Open[a]	High	80X	Low	Interpolation 80X - Index Gated 90 degrees
					High	Interpolation 80X - Index Gated 180 degrees
					Open	Interpolation 80X - Index Gated 360 degrees
18	Open[a]	Open[a]	High	100X	Low	Interpolation 100X - Index Gated 90 degrees
					High	Interpolation 100X - Index Gated 180 degrees
					Open	Interpolation 100X - Index Gated 360 degrees
19	Low	Low	Open[a]	128X	Low	Interpolation 128X - Index Gated 90 degrees
					High	Interpolation 128X - Index Gated 180 degrees
					Open	Interpolation 128X - Index Gated 360 degrees
20	High	Low	Open[a]	160X	Low	Interpolation 160X - Index Gated 90 degrees
					High	Interpolation 160X - Index Gated 180 degrees
					Open	Interpolation 160X - Index Gated 360 degrees
21	Open[a]	Low	Open[a]	256X	Low	Interpolation 256X - Index Gated 90 degrees
					High	Interpolation 256X - Index Gated 180 degrees
					Open	Interpolation 256X - Index Gated 360 degrees
22	Low	High	Open[a]	320X	Low	Interpolation 320X - Index Gated 90 degrees
					High	Interpolation 320X - Index Gated 180 degrees
					Open	Interpolation 320X - Index Gated 360 degrees
23	High	High	Open[a]	640X	Low	Interpolation 640X - Index Gated 90 degrees
					High	Interpolation 640X - Index Gated 180 degrees
					Open	Interpolation 640X - Index Gated 360 degrees
24	Open[a]	High	Open[a]	1000X	Low	Interpolation 1000X - Index Gated 90 degrees
					High	Interpolation 1000X - Index Gated 180 degrees
					Open	Interpolation 1000X - Index Gated 360 degrees
25	Low	Open[a]	Open[a]	Ungated Digital	Low	Analog SIN/COS (500 mVpp), Digital Index (Ungated)
					High	Analog SIN/COS (500 mVpp), Digital Index (Ungated)
					Open	Analog SIN/COS (500 mVpp), Digital Index (Ungated)
26	High	Open[a]	Open[a]	Analog	Low	Analog SIN/COS (500 mVpp), Analog Index (1 Vpp)
				Ungated Digital	High	Analog SIN/COS (1 Vpp), Digital Index (Ungated)
				Analog	Open	Analog SIN/COS (1 Vpp), Analog Index (1Vpp)

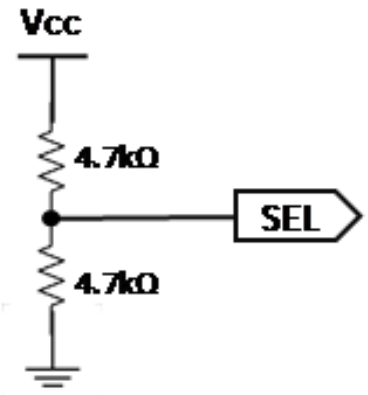
Table 1: Selection Table for AEDR-9940 198.4375 LPI (Continued)

No.	SEL1	SEL2	SEL3	Interpolation Factor	INDEXSEL	Index
27	Open[a]	Open[a]	Open[a]	SPI Mode	Low	SPI Mode: Program Selection
					High	SPI Mode: Output Enabled
					Open	SSI 3W Mode[b]

a. Open selection must be connected to the middle of a voltage divider circuit. See Figure 5.

b. SSI 3W mode is for monitoring purposes only.

Figure 5: Voltage Divider Circuit



Use 2 x 4.7-kΩ resistors (V_{CC} to GND).

The digital interpolation factor is based on the following equation for various rotational speeds (RPM) and count per revolution (CPR) values.

RPM = (Count Frequency x 60) / CPR

CPR (@ 1X interpolation) is based on the following equation that is dependent on radius of operation (ROP).

CPR = LPI x 2π x ROP (inch) or CPR = LP mm x 2π x ROP (mm)

NOTE: LP mm (lines per mm) = LPI / 25.4

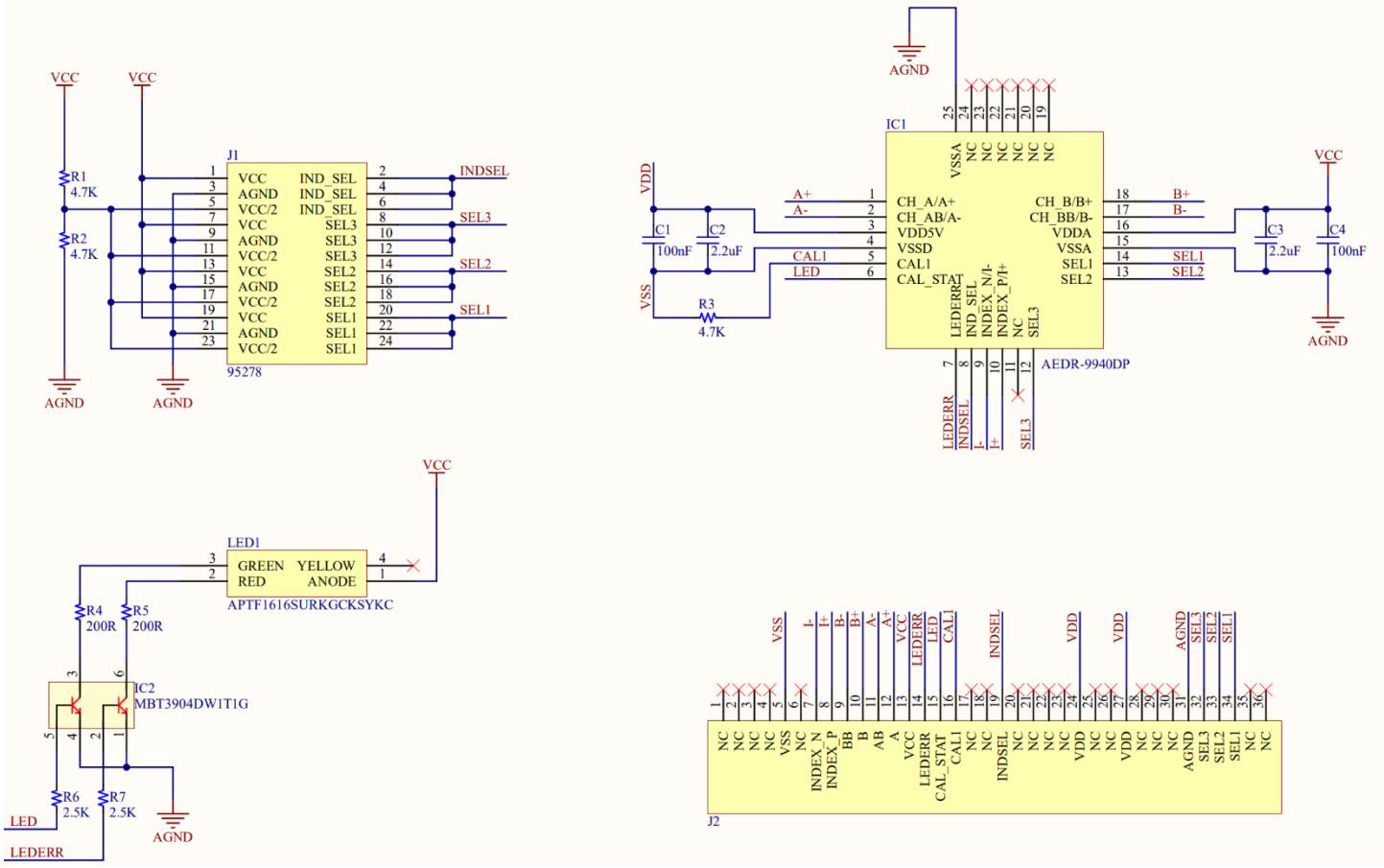
2.1 Programmable Select Options

SPI programmable with interpolation factor from 1X to 1024X.

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

Chapter 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	Connector 1 (Bottom Side)	Label
1	NC	1	NC
2	NC	2	NC
3	SEL1	3	CAL1
4	SEL2	4	CAL_STAT
5	SEL3	5	LEDERR
6	AGND	6	VCC
7	NC	7	A+
8	NC	8	A–
9	NC	9	B+
10	VDD	10	B–

Table 2: Connector 1 Pin Assignment

Connector 1 (Top Side)	Label	Connector 1 (Bottom Side)	Label
11	NC	11	I+
12	NC	12	I–
13	VDD	13	NC
14	NC	14	VSS
15	NC	15	NC
16	NC	16	NC
17	NC	17	NC
18	INDSEL	18	NC

The finger design of Connector 1 is a match to 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 above mentioned card edge connector is not needed if necessary connections can be made using manual soldering to the relevant card edge fingers.

Table 3: Connector 2 Pin Assignment

Connector 1 (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: Refer to Table 1, Selection Table for AEDR-9940 198.4375 LPI for the various interpolation selection options available by changing the SEL1, SEL2, and SEL3 jumper positions.

Chapter 4: Code Wheel Drawing

For the AEDR-9940 evaluation board sample, the matching code wheel sample drawings are shown in the following figures. For a detailed drawing of the sample code wheel, request from your regional FAE.

Figure 7: Code Wheel Multiple Optical Radius 200, 360, 500, 625 CPR Base

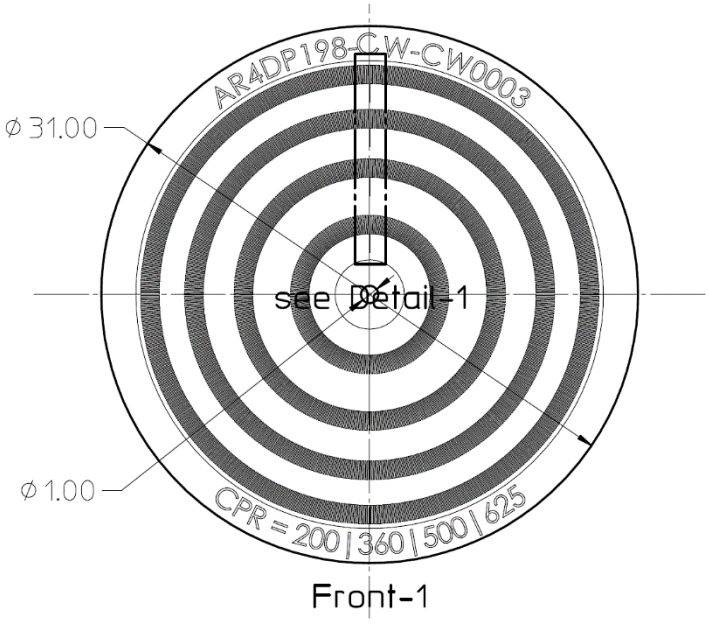


Table 1 : Data Track/Window

Signal Channel	Track	Window Width	CPR	INC Rop (mm)	INDEX Rop (mm)
INC	1	180°/200	200	4.074	2.924
INC	2	180°/360	360	7.334	6.184
INC	3	180°/500	500	10.186	9.036
INC	4	180°/625	625	12.732	11.582

Figure 8: Code Wheel Multiple Optical Radius 256, 400, 512, 720 CPR Base

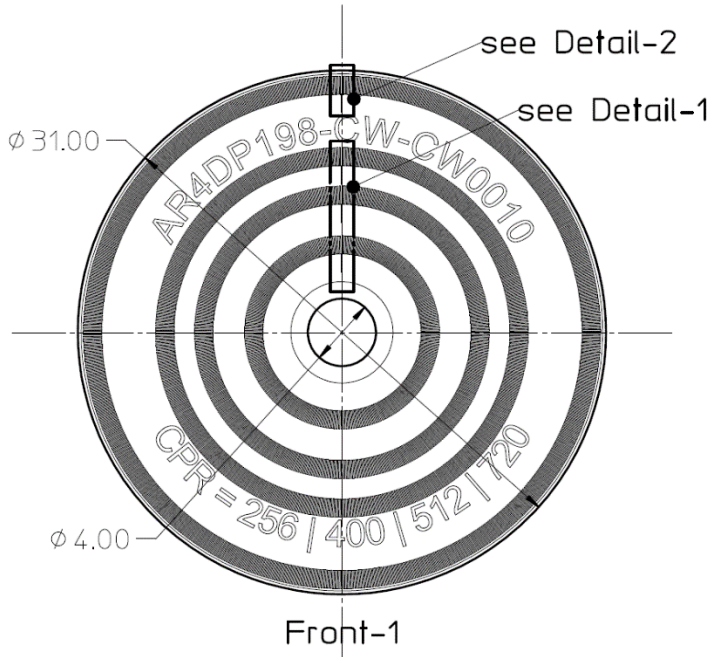


Table 1 : Data Track/Window

Signal Channel	Track	Window Width	CPR	INC Rop (mm)	INDEX Rop (mm)
INC	1	180°/256	256	5.215	4.065
INC	2	180°/400	400	8.149	6.998
INC	3	180°/512	512	10.430	9.280
INC	4	180°/720	720	14.668	13.517

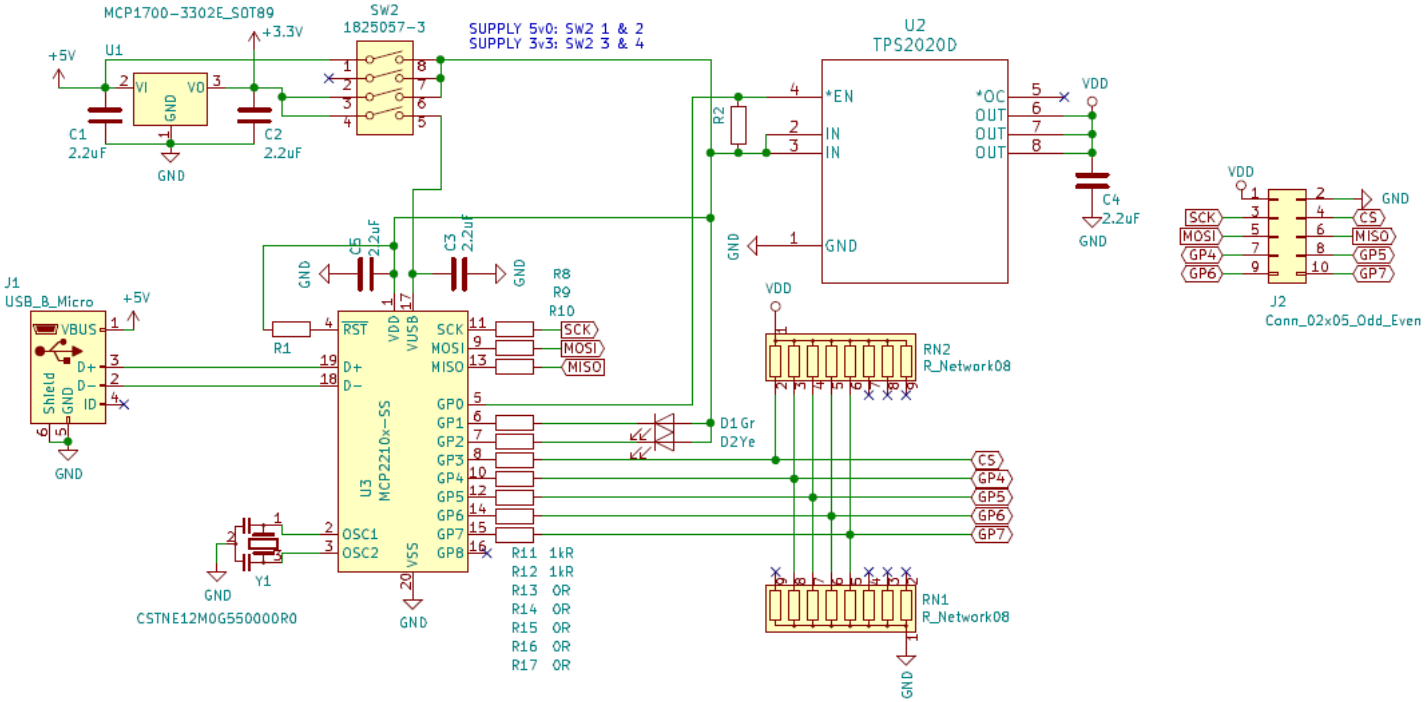
Chapter 5: HEDS-9940PRGEVB Programming USB-SPI Kit

In order to program interpolation value other than the ones offered in Table 1, Selection Table for AEDR-9940 198.4375 LPI using the SEL1, SEL2, and SEL3 option pins, you may connect to the AEDS-9940 encoder ASIC through 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 9: The HEDS-9940PRGEVB USB to SPI Programmer Kit

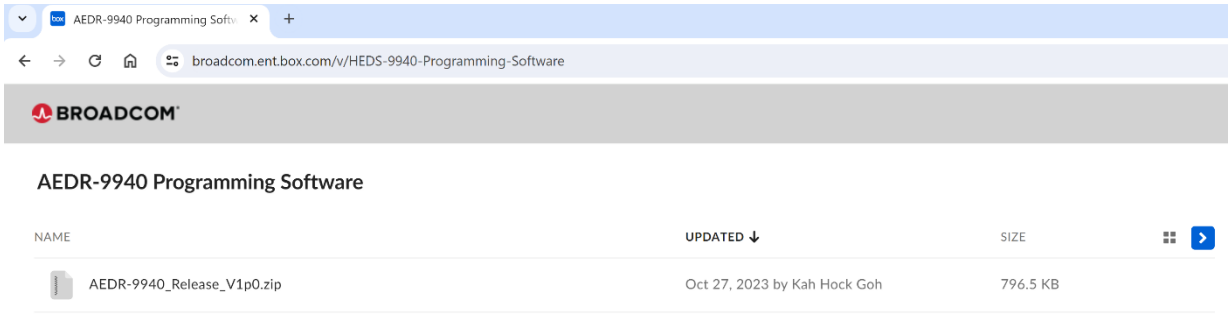
Figure 10: The HEDS-9940PRGEVB USB to SPI Programmer Kit Schematic



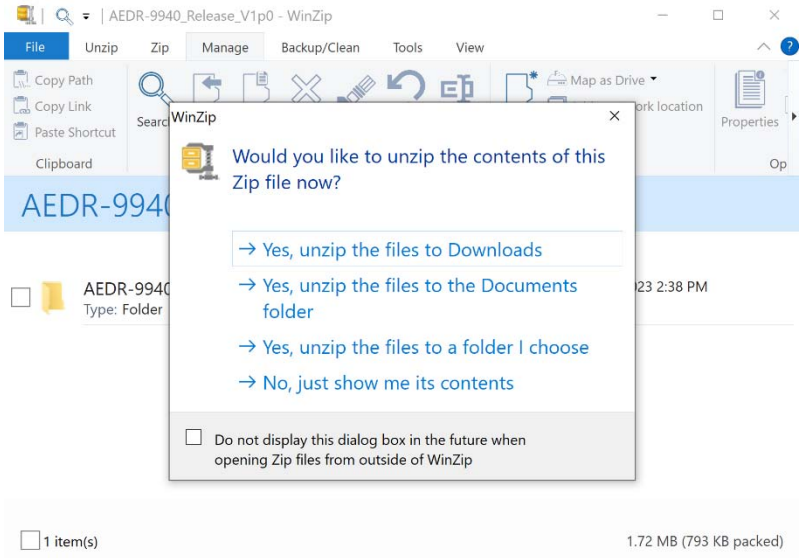
Chapter 6: AEDR-9940 Gateway Programming GUI

The HEDS-9940PRGEVB kit is to be used together with `AEDR_9940_Gateway.exe` to program the desired interpolation factor into the encoder ASIC.

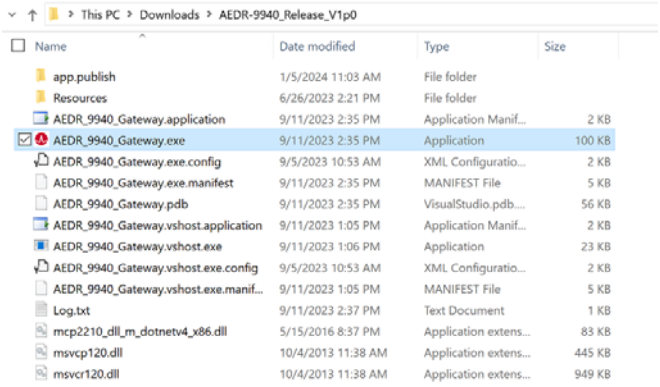
1. Download the zip file from:
   https://broadcom.box.com/v/HEDS-9940-Programming-Software



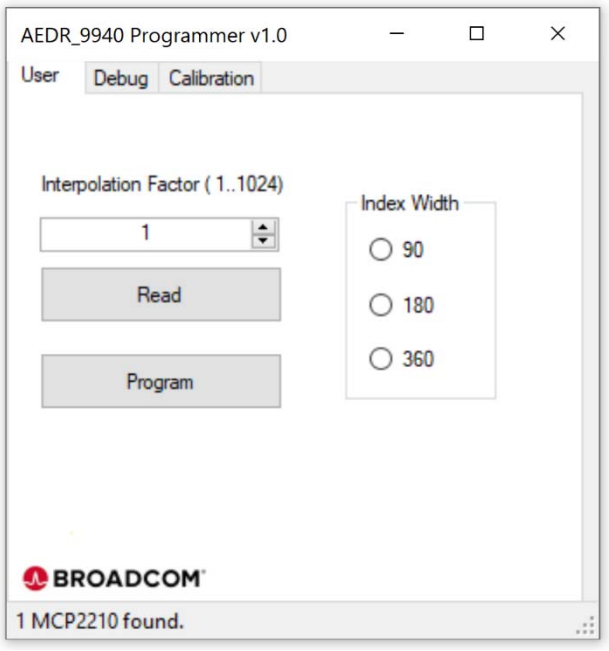
2. Save the zip file into a local drive on your PC.
3. Unzip `AEDR-9940_Release_Vxpx.zip` to a local folder of your choice.

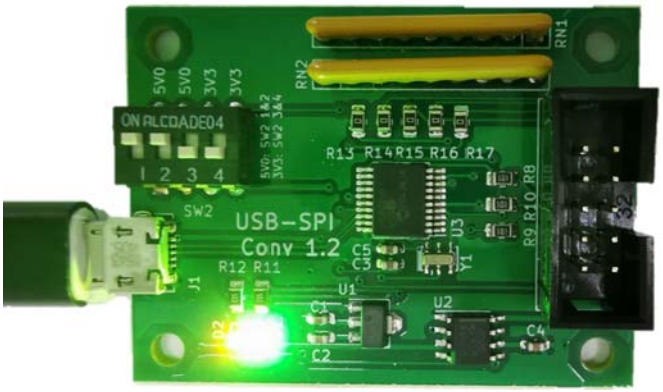


4. Double-click `AEDR_9940_Gateway.exe`.



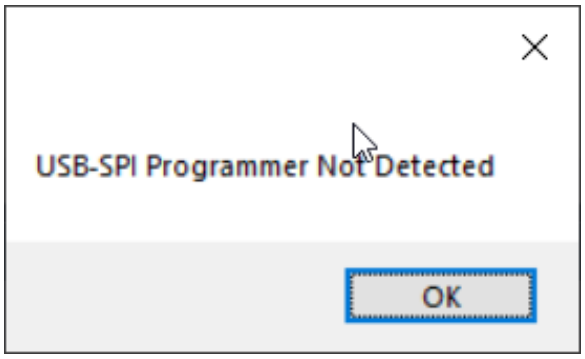
5. Once the `AEDR_9940_Gateway.exe` software is running, the board should be detected.



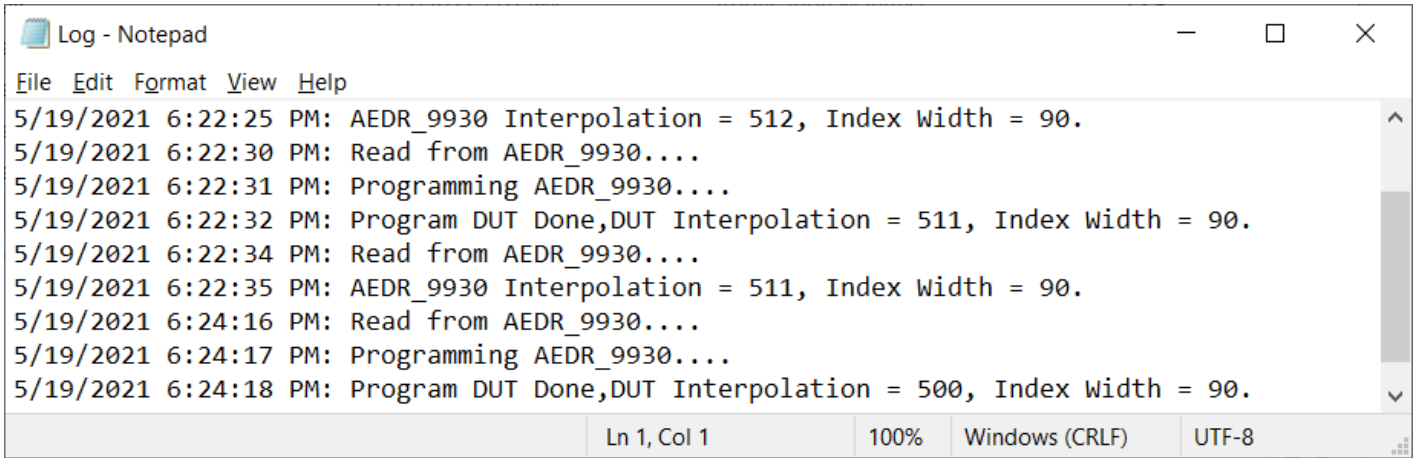


Both amber and green LEDs are detected by the `AEDR_9940_Gateway.exe` software.

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

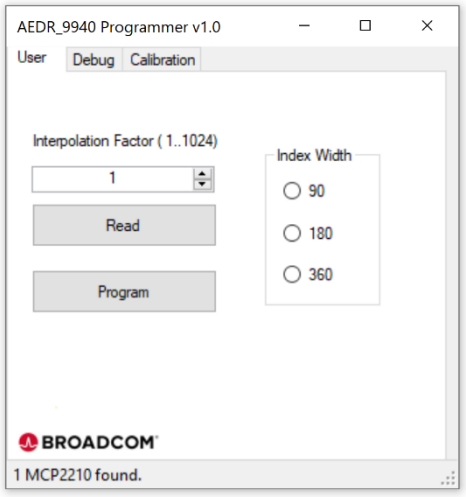


7. Click **Read** to read back saved settings from the AEDR-9940 encoder ASIC.
   a. If existing settings are read out successfully, it displays the saved Interpolation Factor and Index Width settings.

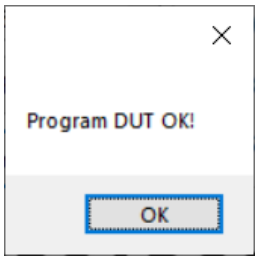


   b. If the AEDR-9940 is not connected or detected, the program terminates. Refer to `log.txt` in the same directory to check the failure status.
   c. If there is a communication failure with the AEDR-9940, the program exits. Refer to `log.txt` to check the error message.

8. Enter the interpolation factor required (1 to 1024) and index width setting. Click **Program** to save the settings.



9. The message `Program DUT OK!` displays when the settings are save successfully.

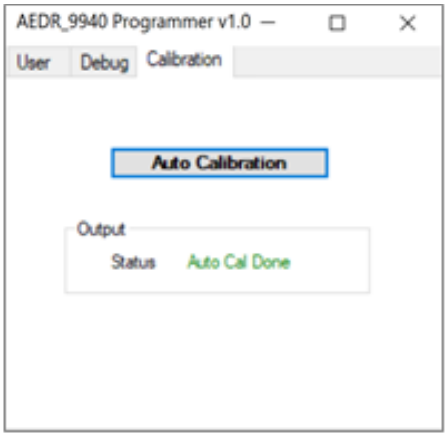


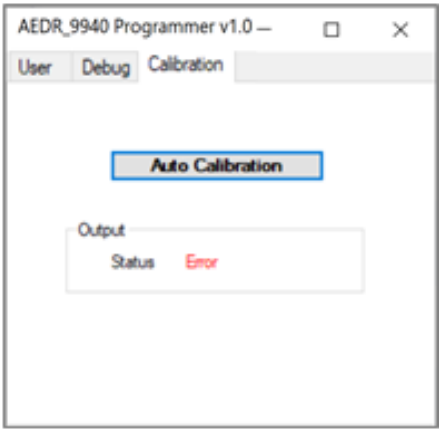
Chapter 7: Using the AEDR-9940 Gateway SPI Protocol to Perform Calibration

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.

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

NOTE: A calibration error may be caused by wide spatial displacement or failure to obtain index signals crossover.



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