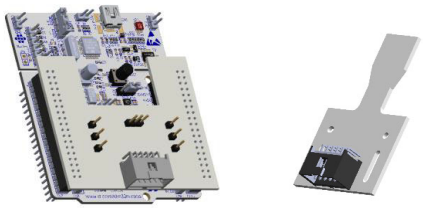
User Guide

HEDS-9922PRGEVB
HEDS-9922EVB

Magnetic Encoder IC Programming Kit
Evaluation Board



Description

The Broadcom® AEAT-9922 is an angular magnetic rotary sensor that provides accurate angular measurement over a full 360 degrees of rotation.

A sophisticated system uses integrated Hall sensor elements with complex analog and digital signal processing within a single device. A simple two-pole magnet generates the necessary magnetic field by rotating it in a perpendicular direction. Wide magnetic field sensor configurations allow On Axis (end of shaft) or Off Axis (side of shaft) modes in application. The AEAT-9922 is a versatile solution capable of supporting a broad range of applications with its robust architecture to measure and deliver both absolute and incremental signals.

The absolute angle measurement provides an instant indication of the magnet's angular position with a selectable and one-time programmable resolution from 10 to 18 bits.

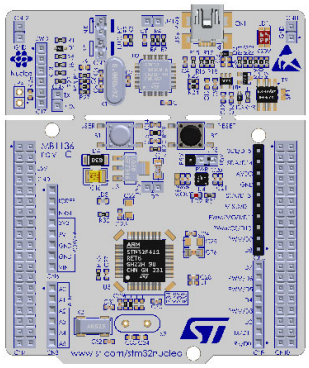
When selected, its positioning data is then represented in its digital form to be assessed through a standard SSI (parity) and SPI (with CRC and Parity option) communication protocol. Where desired, users may also choose to receive its absolute angle position in PWM-encoded output signals (with CRC). The incremental positions are indicated on ABI and UVW signals with wide user configurable resolution from 1 CPR and up to 10,000 CPR of ABI signals and pole pairs from 1- to 32-pole pairs (2 to 64 poles) for UVW commutation signals.

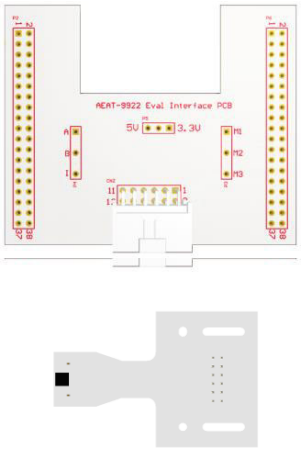
For ease of setup, Broadcom has made available development tools to perform the calibration process without other measurement equipment. These programming kits and evaluation boards are available through the normal Broadcom sales channels.

HEDS-9922PRGEVB Programming Kit Contents

The programming kits include following items:

- STM32-Nucleo 64 Programming Board x1
- AEAT-9922 Interface Board x1
- HEDS-9922EVB x2
- NdFeB 35SH 6mm(d) × 2.5mm(h) Dipole Magnet x2
- 12-pin Ribbon Cable (2 ft) x1
- Micro USB Cable x1
- USB Drive x1

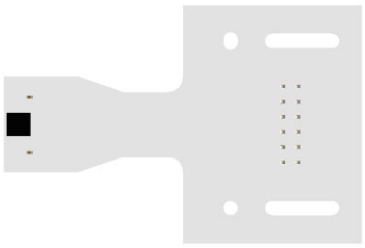




HEDS-9922EVB Board Contents

The board kits include following items:

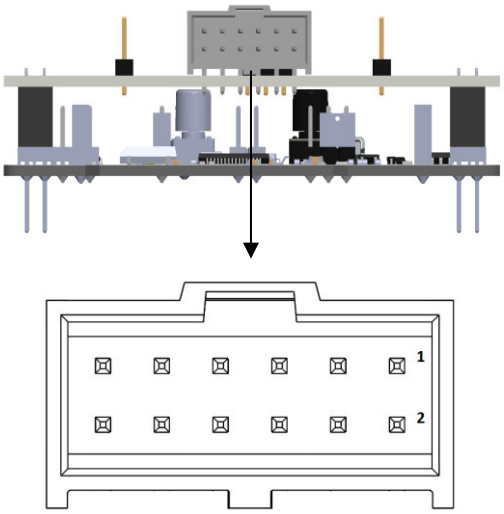
- AEAT-9922 mounted on board



HEDS-9922PRGEVB Programming Kit Pinout

The table shows the pin assignment for each I/O port.

Pin	Description	Function
1	A	Incremental Signal A
2	B	Incremental Signal B
3	VSS	Supply Ground
4	VDD	Supply Input
5	I	Incremental Signal Index
6	MSEL	Mode Selection
7	M2	I/O pad. See Table 1
8	M3	I/O pad. See Table 1
9	M0	I/O pad. See Table 1
10	M1	I/O pad. See Table 1
11	VDDA	Supply Input
12	VSSA	Supply Ground



HEDS-9922EVB Eval Board Pinout

The table shows the pin assignment for each I/O port.

Pin	Description	Function
1	A	Incremental Signal A
2	B	Incremental Signal B
3	VSS	Supply Ground
4	VDD	Supply Input
5	I	Incremental Signal Index
6	MSEL	Mode Selection
7	M2	I/O pad. See Table 1
8	M3	I/O pad. See Table 1
9	M0	I/O pad. See Table 1
10	M1	I/O pad. See Table 1
11	VDDA	Supply Input
12	VSSA	Supply Ground

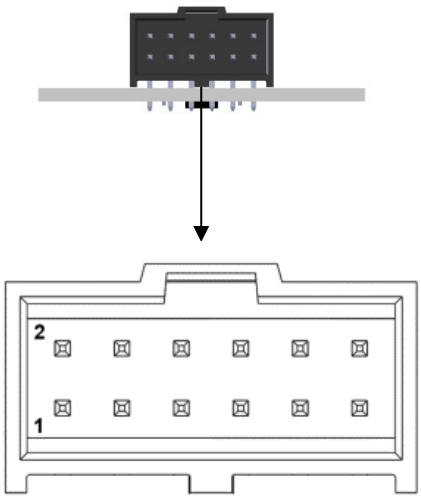


Table 1: Configurable Interface I/O and Selection Table (MATS Table)

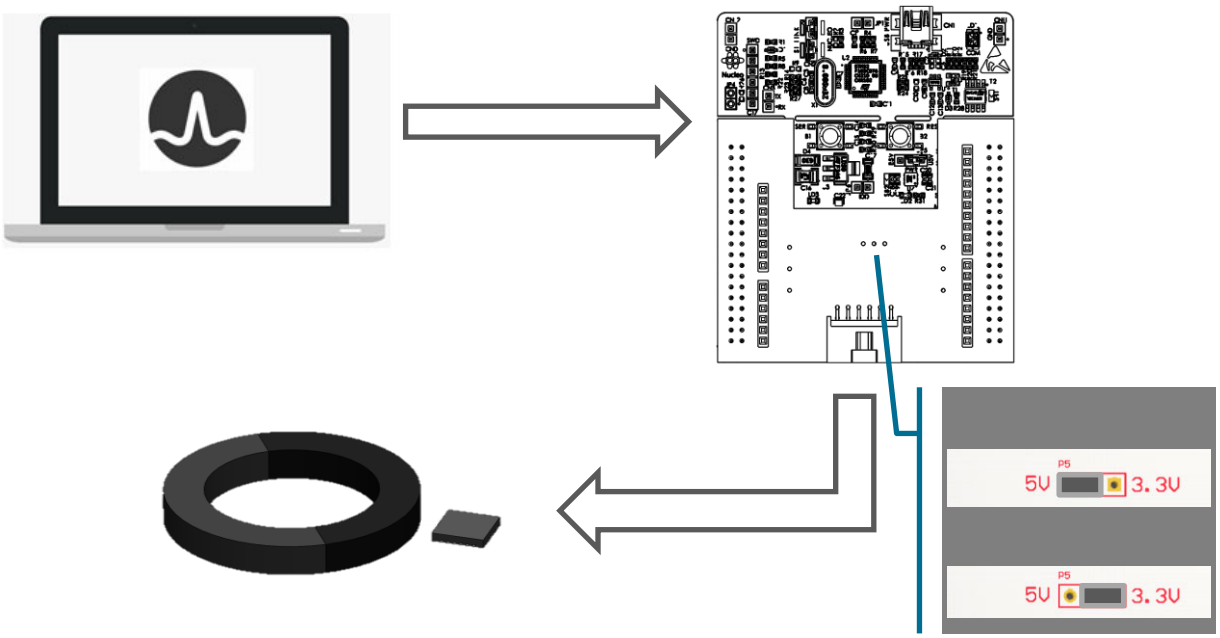
Pin	Mode									
	SPI-3	**SSI-3(A)**	**SSI-3(B)**	**SSI-2(A)**	**SSI-2(B)**	**SPI-4(A)**	**SPI-4(B)**	**UVW**	**PWM**	**Remarks**
MSEL[a]	0	0	0	0	0	1	1	1	1	I/O Pin
PSEL[1][b]	x	x	x	x	x	0	0	1	1	Memory
PSEL[0][b]	x	0	1	0	1	0	1	0	1	Memory
M0[a]	0	1	1	1	1	NCS	NCS	ERR	ERR	I/O Pin
M1[a]	DIN	NSL	NSL	0	0	MOSI	MOSI	U	N/A	I/O Pin
M2[a]	SCK	SCL	SCL	SCL	SCL	SCK	SCK	V	N/A	I/O Pin
M3[a]	DO	DO	DO	DO	DO	MISO	MISO	W	PWM	I/O Pin

a. MSEL, M0, M1, M2, M3 are configured through the IO pads.

b. PSEL[1] and PSEL[0] are configure through memory.

Hardware Setup

1. Connect the STM32-Nucleo to PC using a USB port.
2. Connect the 12-pin ribbon cable; one end to the interface board, the other to the encoder.
3. Select the operating voltage of sensor by connecting the jumper to either 3.3V or 5V.



Program Installation

The installation software for the programming kit is available in the USB drive provided. To install the application software, double-click the software HEDS-9922 PRGEVB Programming Evaluation Kit.msi and follow the onscreen instructions to finish the installation.

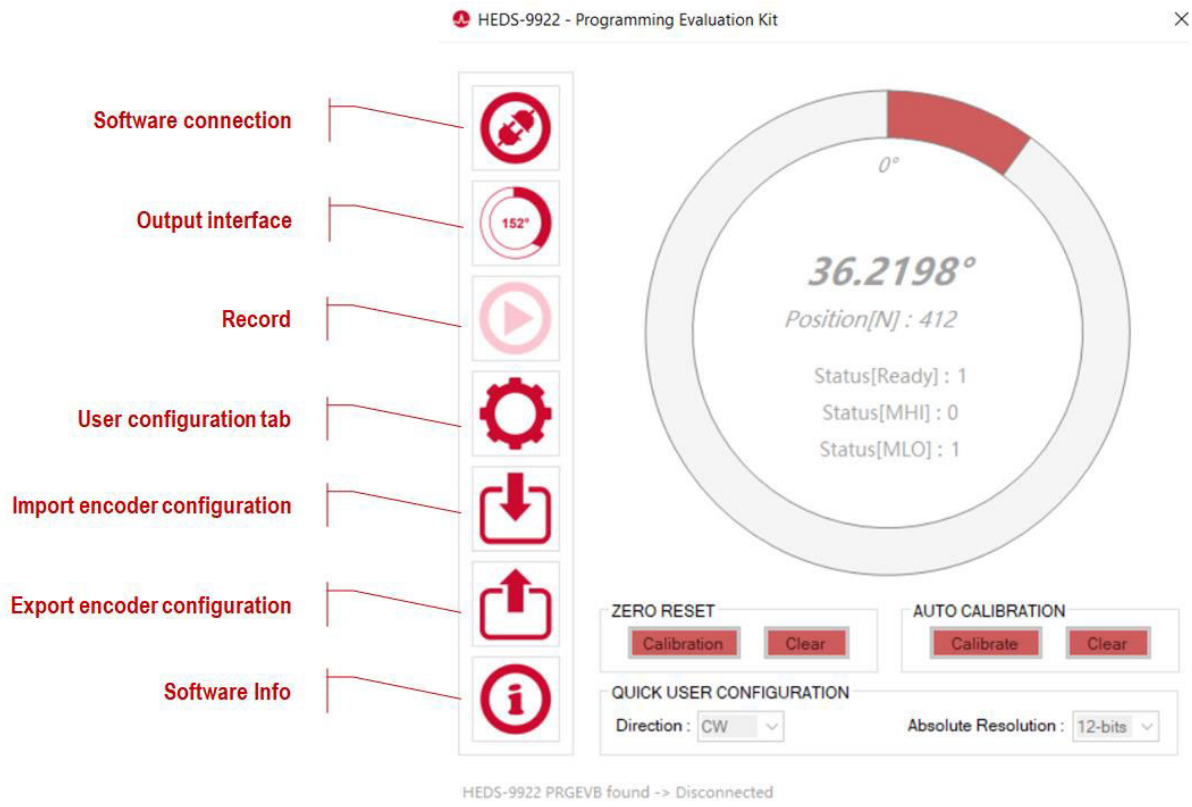
After the installation is complete, the program is available in the selected working directory

For latest software update, visit this link: https://broadcom.box.com/v/HEDS-9922-Programming-Software.

NOTE: The software is for PCs running on the Windows operating system. The minimum requirement is a Window 10 64-bit operating system.

User Interface of Calibration Software

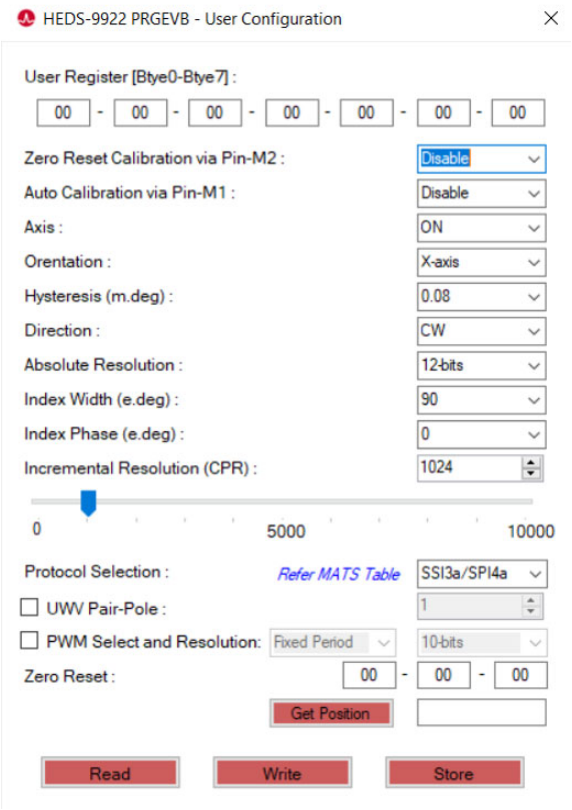
Main Tab



The following table provides a functional description of each button.

Name	Description
Software connection	Enable the software connection to the board
Output interface	Toggle between Fix mode and Chart mode
Record	Record position streaming in Fix mode
User configuration tab	Configure
Import encoder configuration	Recall the encoder configuration from the saved file
Export encoder configuration	Save the existing encoder configuration to a file
Software Info	Software revision
ZERO RESET	Calibrate: Reset single-turn position Clear: Erase reset data
AUTO CALIBRATION	Calibrate: Initiate the calibration sequence Clear: Erase the calibration data
Direction	Select the counting direction with respect to magnet turning
Absolute resolution	Select the absolute resolution

User Configuration Tab

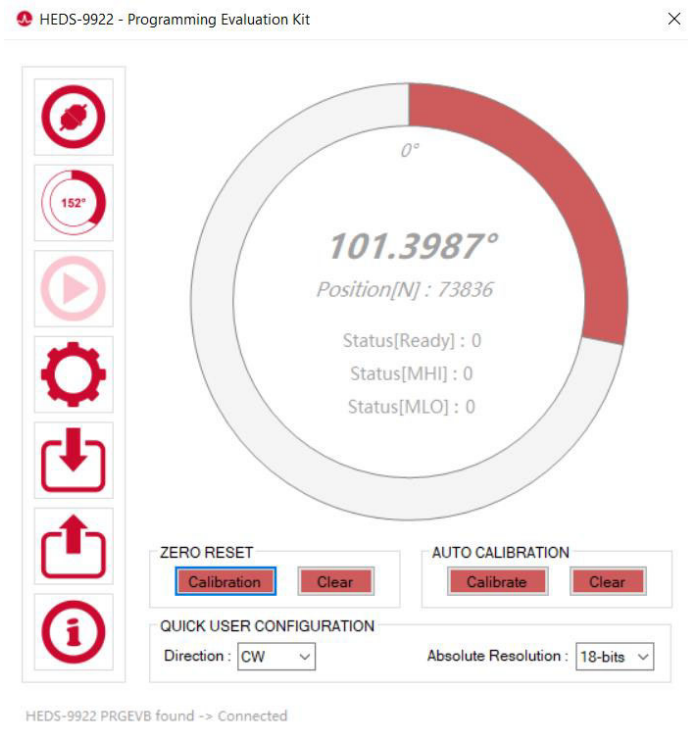


The following table provides a functional description of each button.

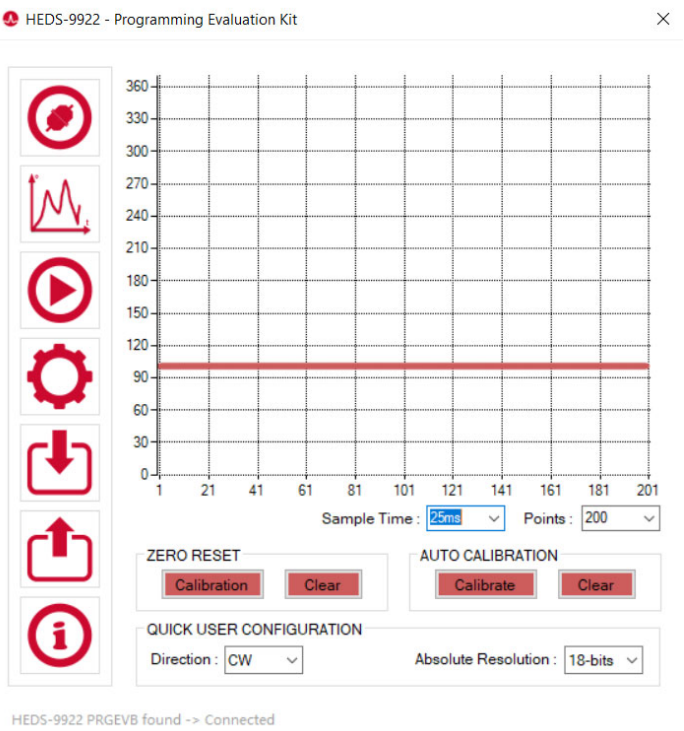
Name	Description
User Register [Byte0-Byte7]	User programmable memory
Zero Reset Calibration via Pin-M2	Enable calibration through hardware pin M2
Auto Calibration via Pin-M1	Enable calibration through hardware pin M1
Axis	Select On-Axis or Off-Axis
Hysteresis (m.deg)	Select the Incremental hysteresis
Direction	Select the counting direction with respect to magnet turning
Absolute Resolution	Select the absolute resolution
Index Width (e.deg)	Select the Index width
Index Phase (e.deg)	Select the Index location
Incremental Resolution (CPR)	Select the incremental resolution
Protocol Selection	Select the protocol per Table 1
UVW Pair-Pole	Select the UVW pole-pair resolution
PWM Select Resolution	Select the PWM type and resolution
Zero Reset	Input single-turn offset value

NOTE: Click **Read** to read the encoder configuration from memory, and click **Write** to write the configuration into memory after the selection. Click **Store** to store the configuration in memory to be available on the next power-up. Click **Get Position** to get the current absolute position

Output Interface Tab



360 mechanical degree chart



X-Y mechanical degree chart

The Output Interface consists of two types:

- 360 mechanical degree chart.
- X-Y mechanical degree chart. [X-axis: Position] [Y-axis: nsamples/time based]

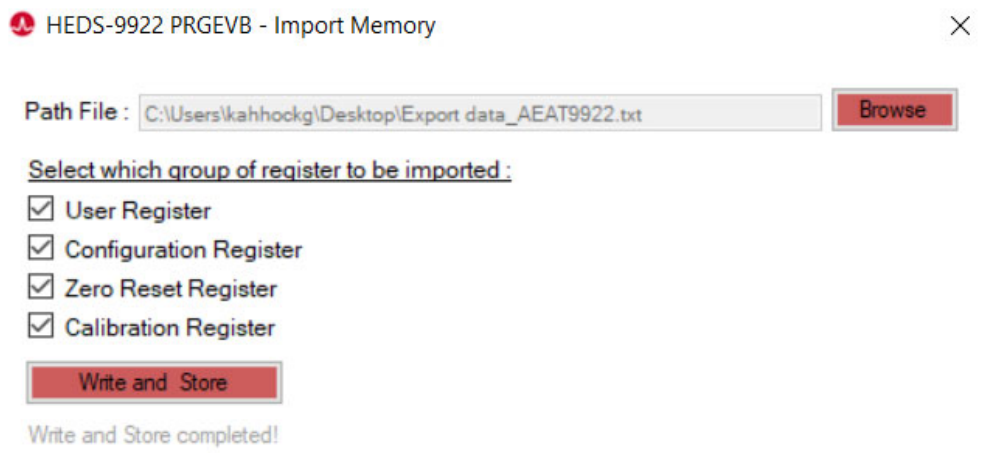
Record Tab

Positional recording is only available under the X-Y mechanical degree chart.

The record procedure follows:

1. Click **Output Interface** until it displays the X-Y mechanical degree chart.
2. Click the **Record** tab.
3. Enter the file name, select the file location, and click **Save**.
4. The position is continuously saved to the file until the **Record Tab [Stop Recording]** is clicked again.

Import Encoder Configuration Tab



The I**mport Encoder Configuration** tab consists of four groups of registers. Each group can be selected individually or in different combinations.

The import encoder configuration procedure follows:

1. Click the **Import Encoder Configuration** tab.
   The preceding figure is displayed.
2. Click **Browse** to select the targeted file.
3. Select the check box of the targeted register group.
4. Click **Write and Store**.
   The completion status appears below the **Write and Store** button.

Export Encoder Configuration Tab

The export encoder configuration procedure follows:

1. Click **Export Encoder Configuration**.
2. Enter the file name, select the file location, and click **Save**.

Calibration Process

When the encoder is assembled (SMT) to PCB, mount to the motor system with the magnet setup per the data sheet.

- Encoder configuration can be loaded before or after calibration.
- Perform auto-calibration followed by zero reset.

Auto-Calibration

1. Rotate the magnet at a constant-speed (any direction).
   a. Constant speed range is between 50 RPM to 2000 RPM.
2. When the speed stabilizes, initiate the calibration sequence by using the following items:
   a. Software
      i. SPI commands using the PC software interface.
      ii. Calibration status is displayed when complete.
   b. Hardware
      i. Send High pulse > 50 ms to I/O pin M1.
      ii. Calibration status is displayed on the ABI pin.
3. Calibration data is automatically saved in memory at the end of the sequence.

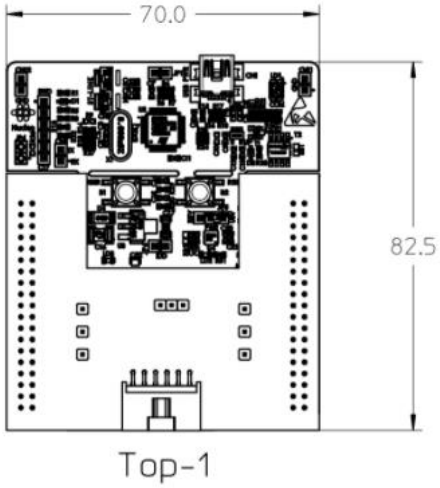
Zero Reset Calibration

1. Stop the magnet at the reset position.
2. Initiate the reset calibration sequence by using the following items:
   a. Software
      i. SPI commands using the PC software interface.
      ii. Calibration status is displayed when complete.
   b. Hardware
      i. Send High pulse > 50 ms to I/O pin M2.
      ii. Calibration status is displayed on the ABI pin.
3. Calibration data is automatically saved in memory at the end of the sequence.

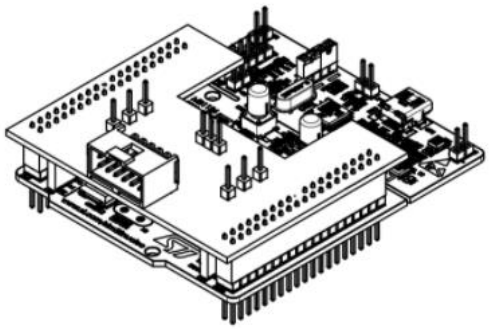
NOTE: For a detailed description of each of the parameters, refer to the data sheet and application note.

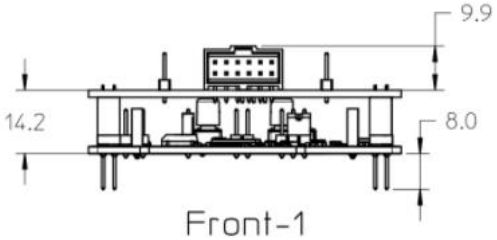
Mechanical Dimensions

HEDS-9922PRGEVB

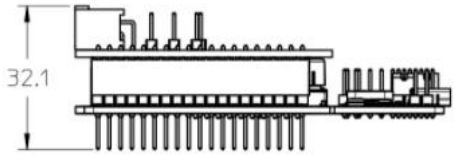


Top-1


Iso-1

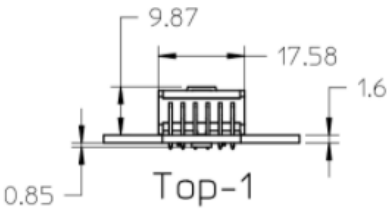


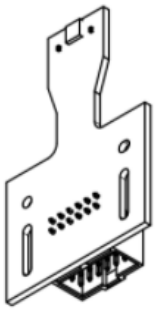
Front-1

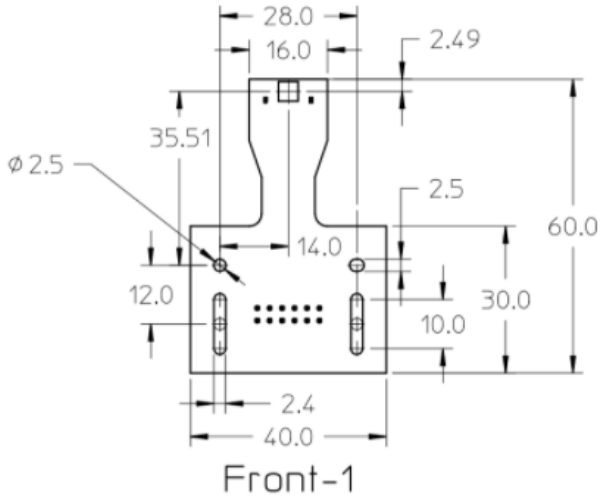


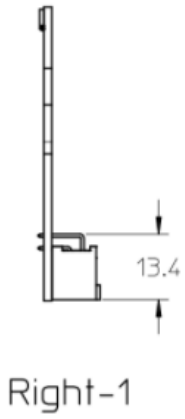
Right-1

HEDS-9922EVB









Ordering Information

Ordering Part Number	Product Description
HEDS-9922PRGEVB	AEAT-9922 Programming Kit, Evaluation Board, and Magnet
HEDS-9922EVB	AEAT-9922 Evaluation Board