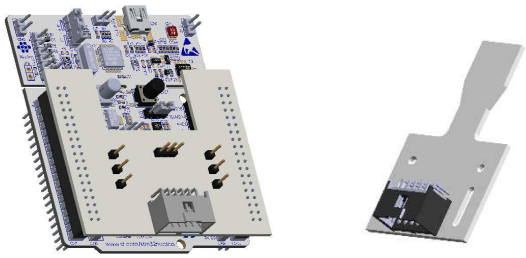
User Guide

HEDS-9933PRGEVB
HEDS-9933EVB

Magnetic Encoder IC Programming Kit Evaluation Board



Description

The Broadcom® AEAT-9933 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 perpendicular. Wide magnetic field sensor configurations allow On Axis (end of shaft) or Off Axis (side of shaft) modes in the application. The AEAT-9933 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 14 bits.

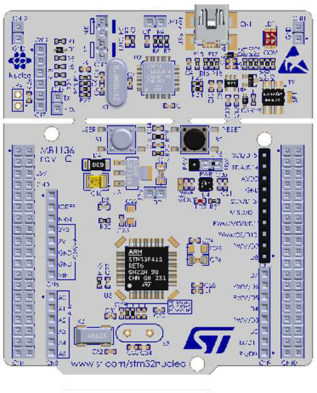
When selected, its positioning data is then represented in its digital form to be assessed through a standard SSI (parity) and SPI (with CRC and Parity option) communication protocol. Where desired, users may also choose to receive its absolute angle position in PWM- encoded output signals (with CRC). The incremental positions are indicated on ABI and UVW signals with wide user configurable resolution from 1 CPR and up to 1024 CPR of ABI signals and pole pairs from 1 to 32 pole pairs (2 to 64 poles) for UVW commutation signals.

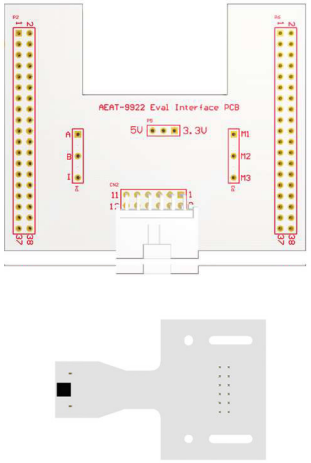
For ease of setup, Broadcom has made available development tools to perform the calibration process without other measurement equipment. These programming kits and evaluation boards are available through the normal Broadcom sales channels.

HEDS-9933PRGEVB Programming Kit Contents

The programming kit contains the following items.

Item	Quantity
STM32-Nucleo 64 Programming Board	1
AEAT-9922 Interface Board	1
HEDS-9933EVB	2
NdFeb 35SH 6 mm (d) × 2.5 mm (h) Dipole magnet	2
12-pin ribbon Cable (2 ft)	1
Micro USB Cable	1
USB Drive	1

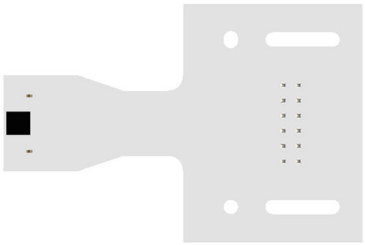




HEDS-9933EVB Board Content

The board kit includes the following item.

Item	Quantity
AEAT-9933 mounted on board	1

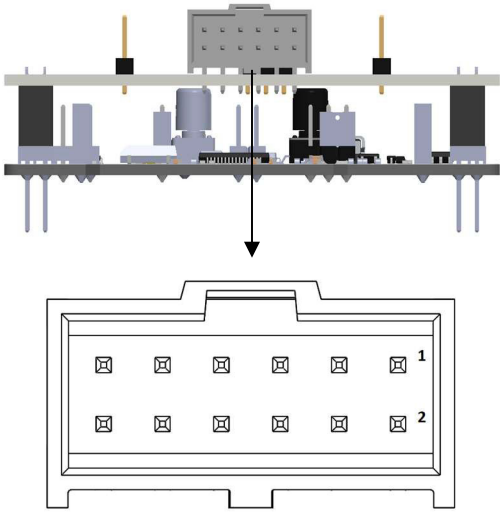


Pin-Outs

HEDS-9933PRGEVB Programming Kit Pin-Out

The following 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 Figure 1 (MATS table)
8	M3	I/O pad. See Figure 1 (MATS table)
9	M0	I/O pad. See Figure 1 (MATS table)
10	M1	I/O pad. See Figure 1 (MATS table)
11	VDDA	Supply Input
12	VSSA	Supply Ground



HEDS-9933EVB Evaluation Board Pin-Out

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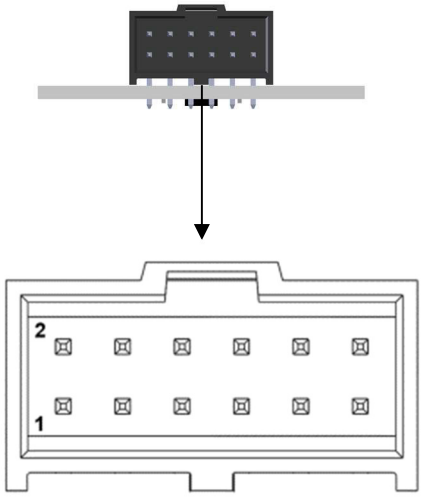


Figure 1: Configurable Interface I/O and Selection Table [MATS Table] (UVW Mode, M1=U and M2=V)

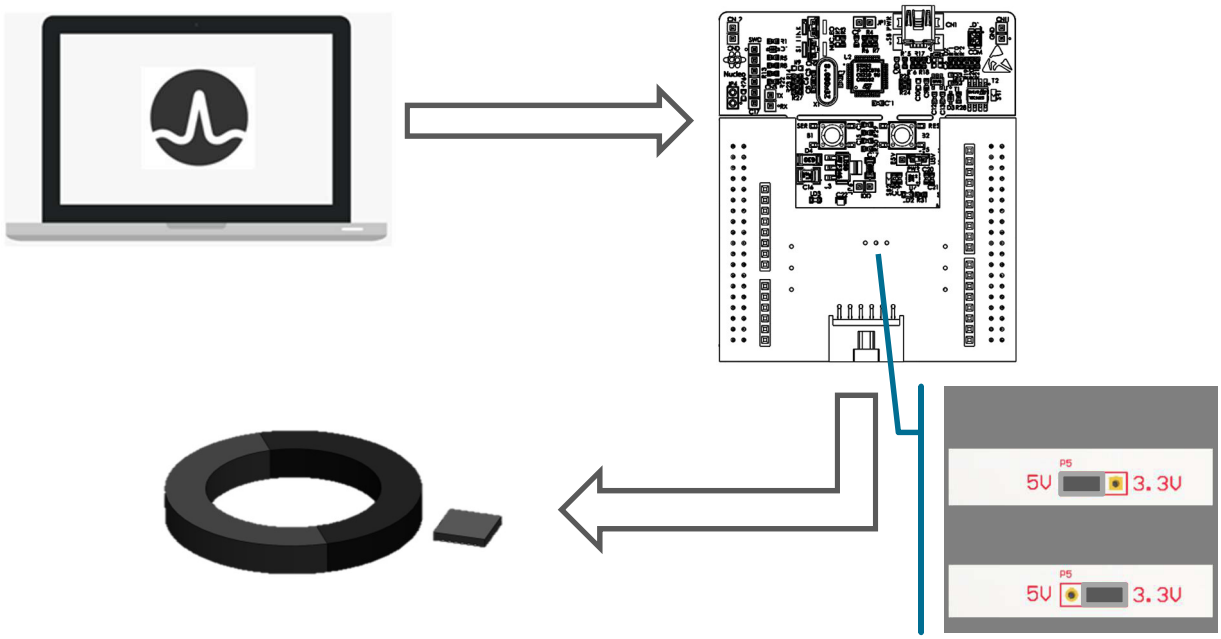
Mode / Pin	SPI-3	SSI-3(A)	SSI-3(B)	SSI-2(A)	SSI-2(B)	SPI-4(A)	SPI-4(B)	UVW	PWM	Remarks
MSEL	0	0	0	0	0	1	1	1	1	I/O Pin
PSEL[1]	x	x	x	x	x	0	0	1	1	Memory
PSEL[0]	x	0	1	0	1	0	1	0	1	Memory
M0	0	1	1	1	1	NCS	NCS	ERR	ERR	I/O Pin
M1	DIN	NSL	NSL	0	0	MOSI	MOSI	U	N/A	I/O Pin
M2	SCK	SCL	SCL	SCL	SCL	SCK	SCK	V	N/A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

NOTE:

1. PSEL[1], PSEL[0] are configured through memory.
2. MSEL, M0, M1, M2, M3 are configured through I/O pads.

Hardware Setup

1. Connect the STM32-Nucleo to the PC using the 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

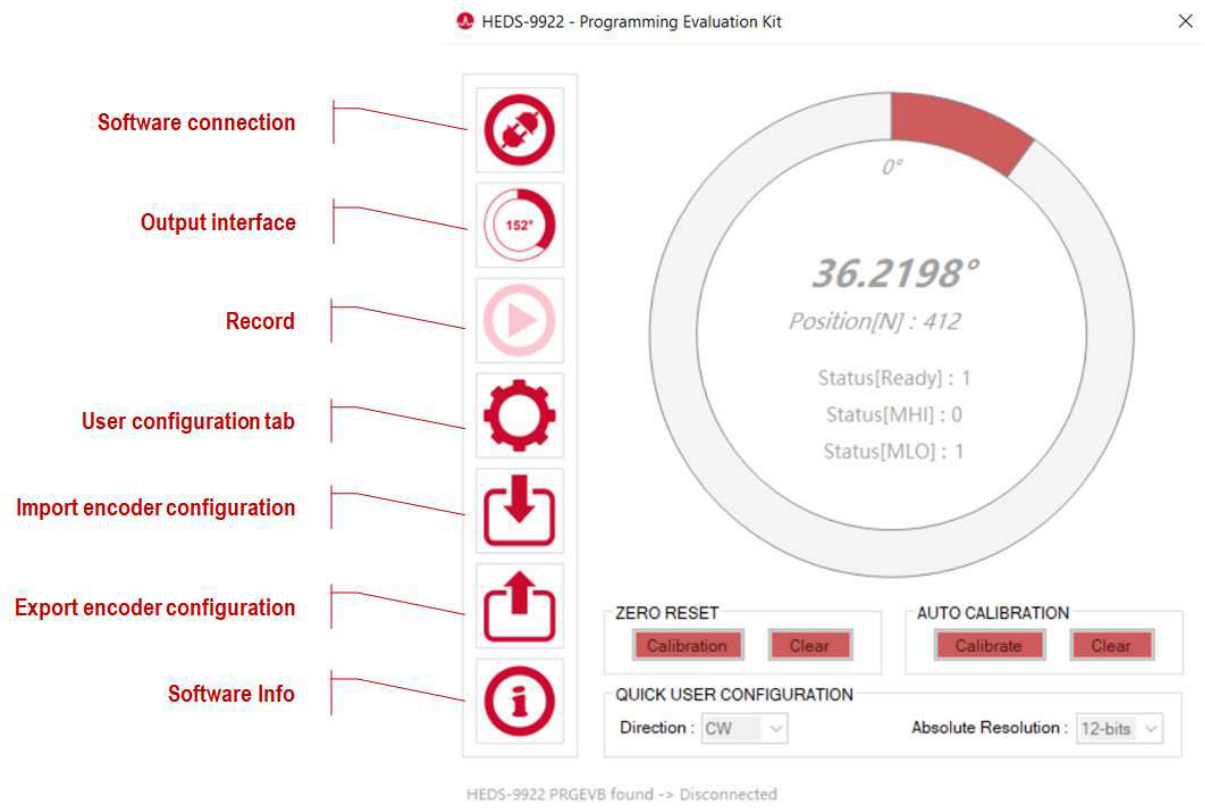
The installation software for the programming kit is available in the USB drive provided. To install the application software, double-click the software **HEDS-9933 PRGEVB Programming Evaluation Kit.msi** and follow the on-screen instructions to finish the installation.

After the installation is complete, the program is available in the selected working directory. For the latest software update, visit this link HEDS-9933 Software.

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

User Interface of Calibration Software

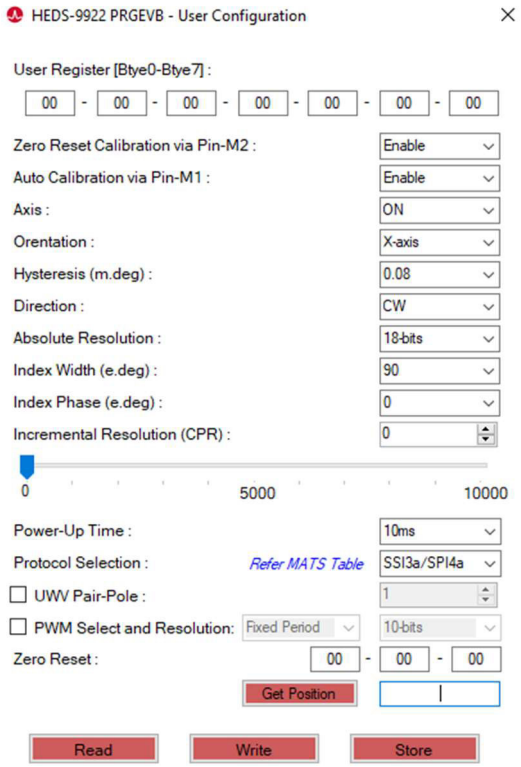
Main Tab



The functional description of each item is shown in the following table.

Name	Description
Software connection	Enable software connection to 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 encoder configuration from saved file
Export encoder configuration	Save existing encoder configuration to file
Software Info	Software revision
Zero Reset	Calibrate: Reset single-turn position Clear: Erase reset data
Auto Calibration	Calibrate: Initiate calibration sequence Clear: Erase calibration data
Direction	Select the counting direction with respect to magnet turning
Absolute resolution	Select the absolute resolution

User Configuration Tab

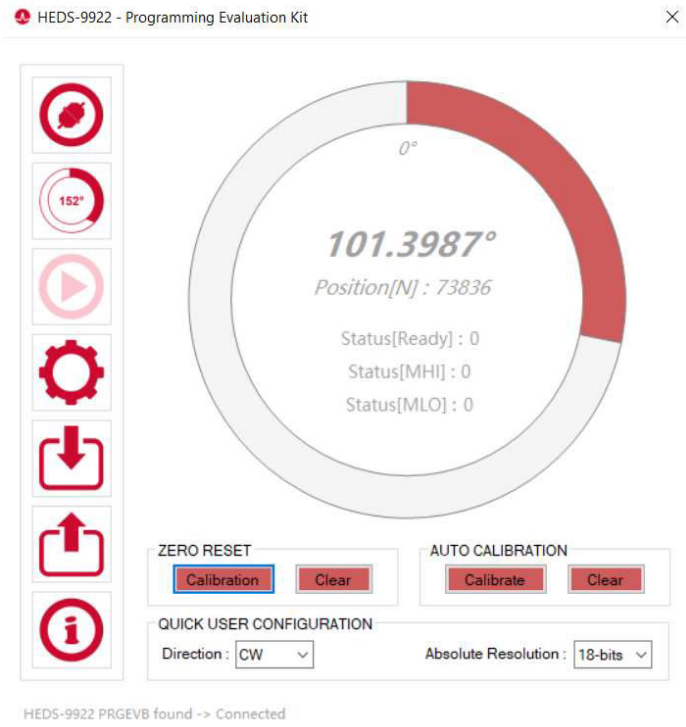


The functional description of each item is shown in the following table.

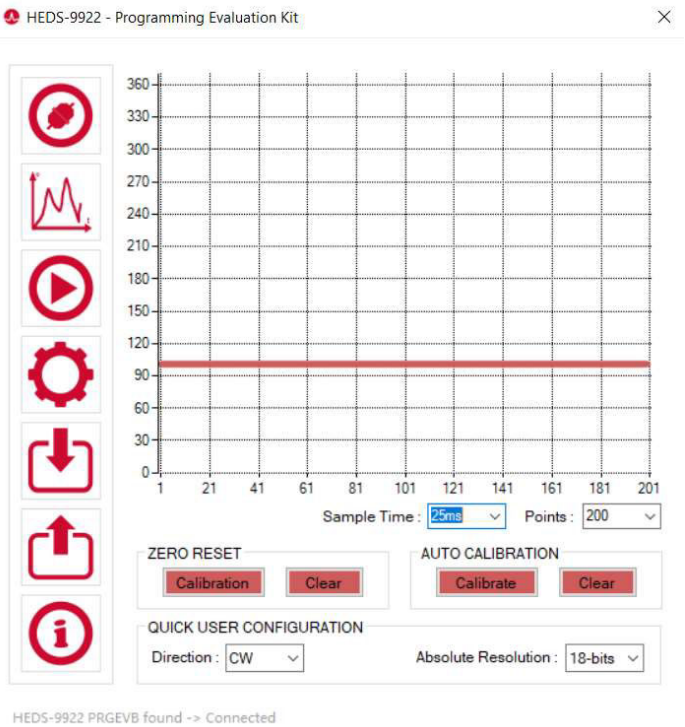
Name	Description
User Register [Byte0-Byte7]	User programmable memory
Zero Reset Calibration via M2	Enable calibration through hardware pin **M2**
Auto Calibration via M1	Enable calibration through hardware pin **M1**
Axis	Select **On-Axis** or **Off-Axis**
Hysteresis	Select the incremental hysteresis
Direction	Select the counting direction with respect to magnet turning
Absolute Resolution	Select the absolute resolution
Index Width	Select the index width
Index Phase	Select the index location
Incremental Resolution (CPR)	Select the incremental resolution
Protocol Selection	Select the protocol per the MATS table
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 get the encoder configuration from memory. Click **Write** to put 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:

- A 360 mechanical degree chart.
- An X-Y mechanical degree chart (X-axis: Position, Y-axis: nsamples/time based).

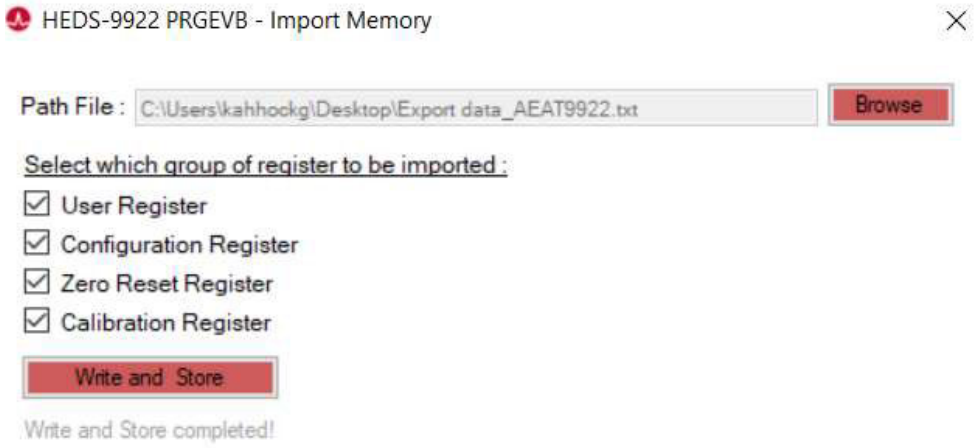
Record Tab

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

The following is the record procedure:

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

Import Encoder Configuration Tab



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

The following is the import encoder configuration procedure:

1. Click the **Import Encoder Configuration** tab.
   The preceding figure is displayed.
2. Click **Browse**, and select the targeted file.
3. Select the checkbox 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 following is the export encoder configuration procedure:

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

Calibration Process

When the encoder is assembled (SMT) to the PCB, mount to the motor system with a magnet setup per 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. The constant speed range is between 10 rpm to 2000 rpm.
2. When the speed stabilizes, initiate the calibration sequence by performing these substeps:
   a. Software
      i. Run SPI commands using the PC software interface.
         The calibration status is displayed when the process is complete.
   b. Hardware
      i. Send high pulse > 50 ms to I/O pin M1.
         The calibration status is displayed on the A B I pin.
3. The calibration data is automatically saved in memory at the end of the sequence.

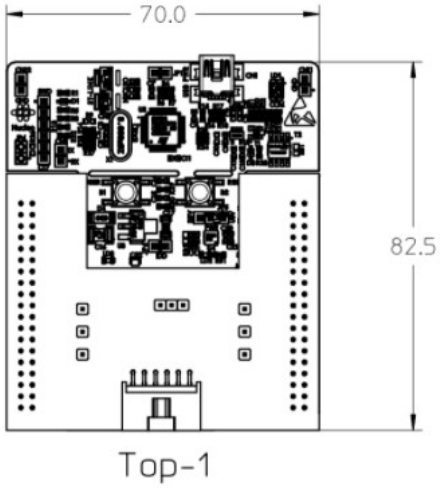
Zero Reset Calibration

1. Stop the magnet at the reset position.
2. Initiate the reset calibration sequence by performing these substeps:
   a. Software
      i. Run SPI commands using the PC software interface.
         The calibration status is displayed when complete.
   b. Hardware
      i. Send high pulse > 50 ms to I/O pin M2.
         The calibration status is displayed on the A B I pin.
3. The calibration data is automatically saved in memory at the end of the sequence.

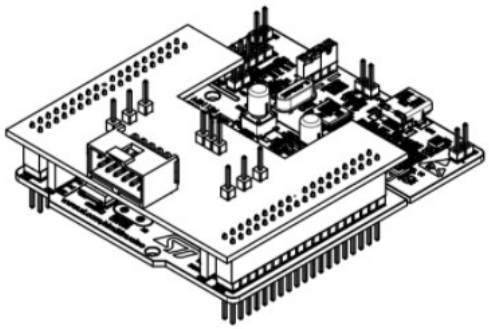
NOTE: For a detailed description of each of the parameters, refer to the data sheet and application note.

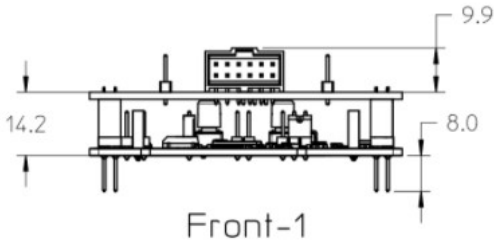
Mechanical Dimensions

HEDS-9933PRGEVB

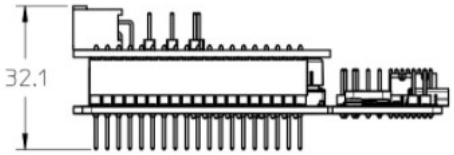


Top-1


Iso-1

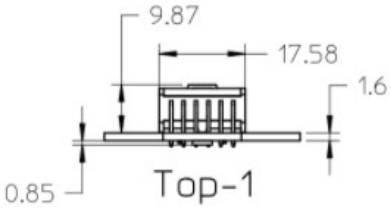


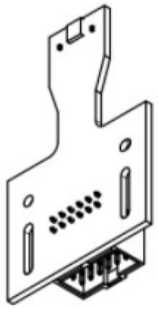
Front-1

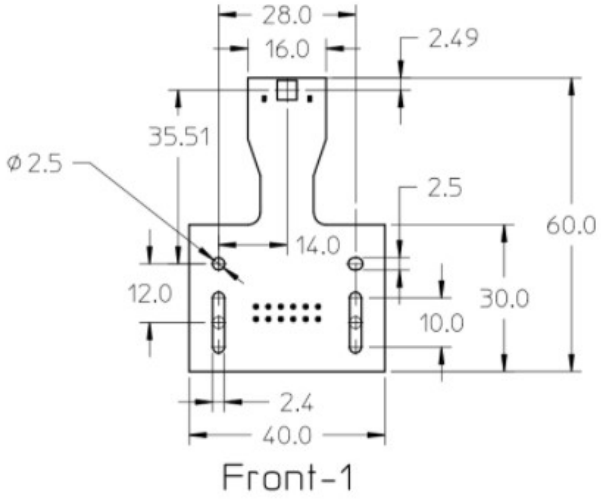


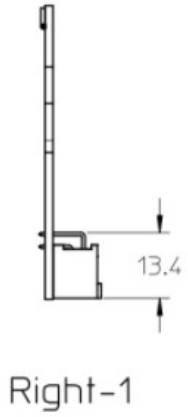
Right-1

HEDS-9933EVB









Ordering Information

Ordering Part Number	Product Description
HEDS-9933PRGEVB	AEAT-9933 Programming Kit, Evaluation Board and Magnet
HEDS-9933EVB	AEAT-9933 Evaluation Board