HEDS-8988

Magnetic Encoder IC Programming Kit

User Guide

Device Description

The Broadcom® AEAT-8800-Q24 is an angular magnetic rotary sensor used for accurate angular measurement and velocity over a full turn of 360 degrees. The sensor senses the magnetic field of a two-pole magnet, rotating over the center of the chip to determine the rotational position with a selectable and one time programmable resolution of 10, 12, 14, or 16 bits. The programmable incremental positions are indicated on ABI and UVW signals with user configurable CPR 32, 64, 128, 256, 512, 1024, 2048 and 4096 of ABI signals and pole pairs from 1 to 8 (2 to 16 poles) for UVW commutation signals. The index pulse width is configurable 90, 180, 270, or 360 electrical degree. Programming of AEAT-8800-Q24 can be performed with HEDS-8988, which is the programming kit for the AEAT-8800-Q24.

Optional incremental Zero Latency mode is configurable with the programming kit. It is useful for those applications with constant rotation speed that require low latency applications.

Programming Kit Content

The programming kit includes the following items:

- IC adapter socket
- Programming module
- 24-pin ribbon cable
- USB cable
- Installation CD

Figure 1 IC Adapter Socket

Figure 2 Programming Module

Figure 3 24-Pin Ribbon Cable

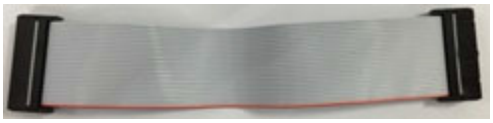
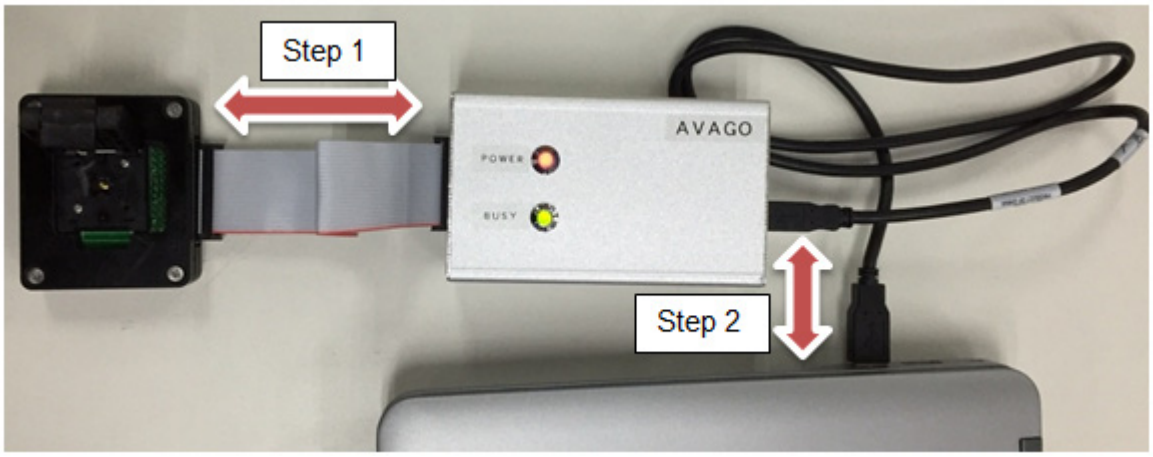


Figure 4 USB Cable

Set Up

1. Connect each end of the 24-pin ribbon cable to the IC adapter socket and the programming module, respectively.
2. Connect the USB cable from the programming module to the PC USB port.

Figure 5 Setup of the Programming Kit to the Computer



The pin assignments of the programming module connector are shown in Table 1.

Figure 6 Pins

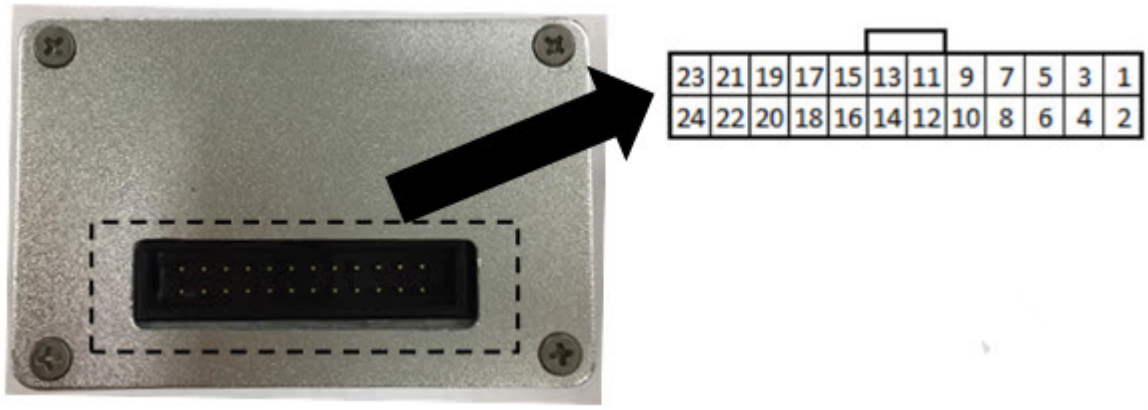


Table 1 Pin Assignments

Pin	Description	Function
1	GND / VSSA	Supply ground
2	GND / VSSA	Supply ground
3	NC	No connection
4	I	Index output (Incremental mode)
5	NC	No connection
6	B	B output (Incremental mode)
7	NC	No connection
8	A	A output (Incremental mode)
9	NC	No connection
10	SSI_SCL _SPI_CLK	SSI/SPI clock input
11	NC	No connection
12	SSI_SCL _ SPI_DIN	SSI/SPI data input
13	NC	No connection
14	SSI_DO_ SPI_DO	SSI/SPI data out
15	NC	No connection
16	W_ PWM	W commutation (Incremental mode)/PWM output
17	NC	No connection
18	V	V commutation output (Incremental mode)
19	NC	No connection
20	U	U commutation output (Incremental mode)
21	NC	No connection
22	SSI_SPI_SEL	SSI/SPI selection
23	VDDA	Supply input
24	VDDA	Supply input

Orientation

The pin 1 location of the sensor in the IC adapter socket is shown in Figure 8.

Figure 7 AEAT-8800-Q24 Pin Configuration

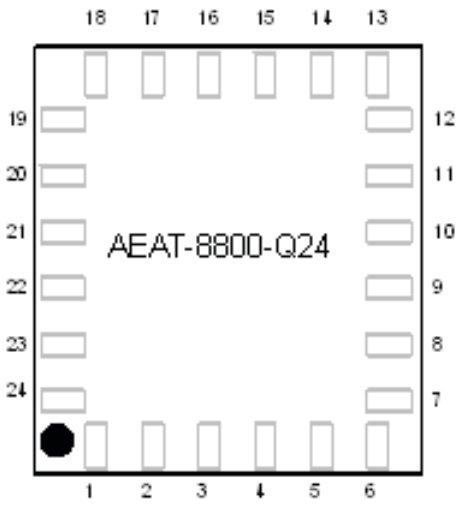
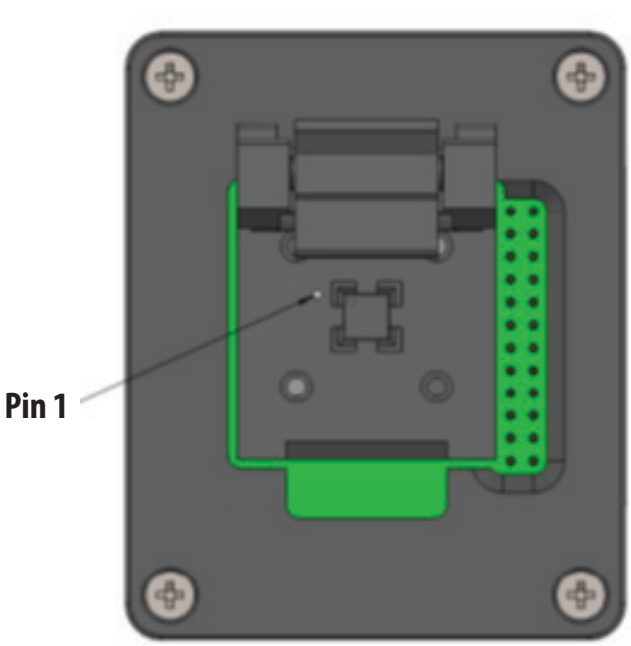


Figure 8 Programming Module Pin 1 as Highlighted Below

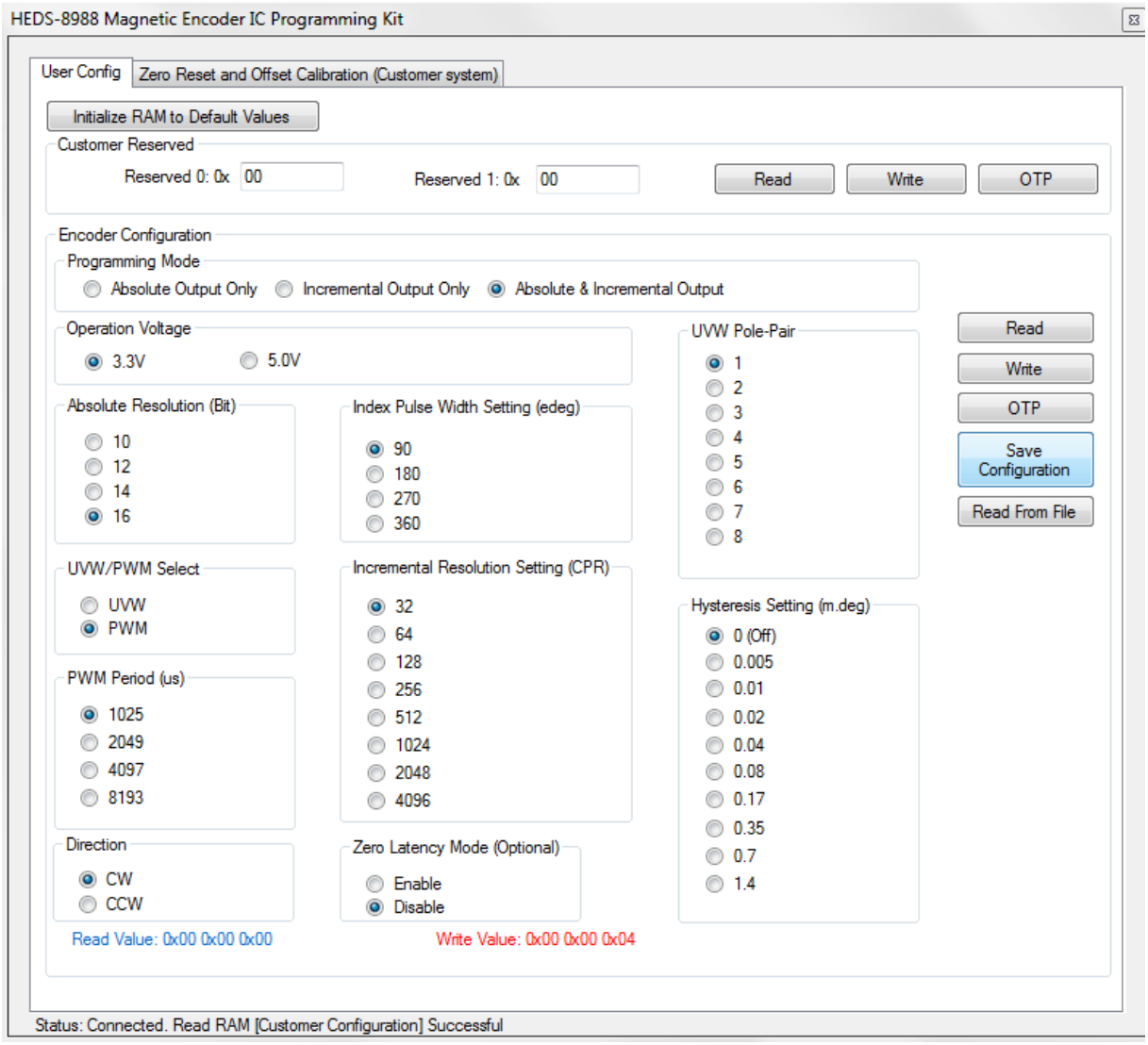


Program Installation

The installation CD contains this user guide and the programmer application software. To install the application software, double-click the software HEDS-8988 Magnetic Encoder IC Programming 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. Figure 9 shows the graphical user interface of the programming software.

NOTE The software is for PCs running on the Windows operating system. The minimum requirements are Window XP and .Net Framework 4.0.

Figure 9 Programming Interface



Functional Description

You should perform a zero reset and offset calibration after mounting the sensor on the motor system.

For detailed descriptions of each of the parameters, refer to the data sheet and the application note.

Table 2 Functional Description

Name	Description	Remark
Initialize RAM to Default Values	Click to set the setting to the default value	
Customer Reserve Byte 1	User programmable, for example: used for Chip ID	
Customer Reserve Byte 2	User programmable, for example: used for Chip ID	
Encoder Configuration	User can select three different encoder output modes	
Operating Voltage	User must select the operating voltage of the sensor	
Absolute Resolution (Bit)	Select the absolute resolution	
UVW/PWM Select	Select the UVW/PWM output mode	
PWM Period	Select the PWM period	
Direction	Select the magnet turning direction, whether to count up at clockwise or counter-clockwise per rotation	View from the top of the IC and the magnet. See Direction for details.
Index Pulse width Setting	Select the index pulse width	
Incremental Resolution Setting	Select the incremental signal CPR	
Zero Latency Mode[a]	Enable or disable the prediction for 0 latency	
UVW Pole Pair	Select the UVW pole pair	
Hysteresis Setting	Select the angular hysteresis value	
Read	Read the current configuration/selection from RAM	
Write	Transfer the displayed configuration to RAM	
OTP	Permanently program values of the OTP shadow registers to OTP	
Save Configuration	Save the existing encoder setting for future use	
Read From file	Recall the encoder setting file from the saved location	
Status	Show the connection status of the programming kit to the PC and the programming status of sensor	

a. Zero Latency Mode is only applicable from 32cpr ~1024cpr.

Read RAM: Read the current configuration/selection from RAM.

Write RAM: Transfer the displayed configuration to RAM.

NOTE

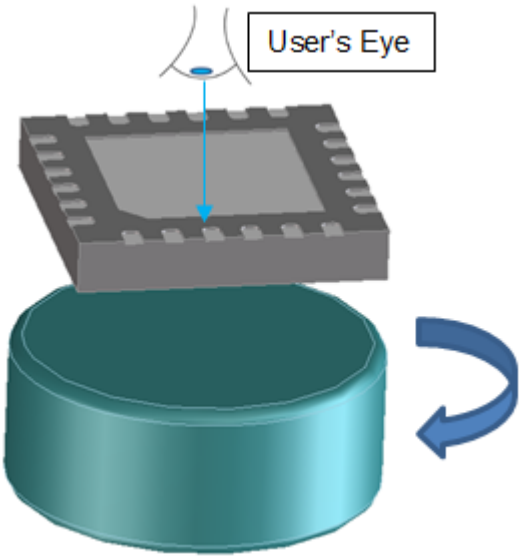
- The user is advised to perform zero reset and offset calibration after mounting the sensor on the motor system.
- For a detailed description of each of the parameters, refer to the data sheet and application note.

Direction

The direction must be defined whether to count up clockwise or counterclockwise per rotation.

The direction must be defined whether to count up clockwise or counterclockwise per rotation. Per the default setting, if the magnet is spinning in a clockwise manner, based on the user's line of sight (see Figure 10), then AEAT 8800 will count up.

Figure 10 Direction Definition when the Magnet Rotates Clockwise and Facing AEAT 8800

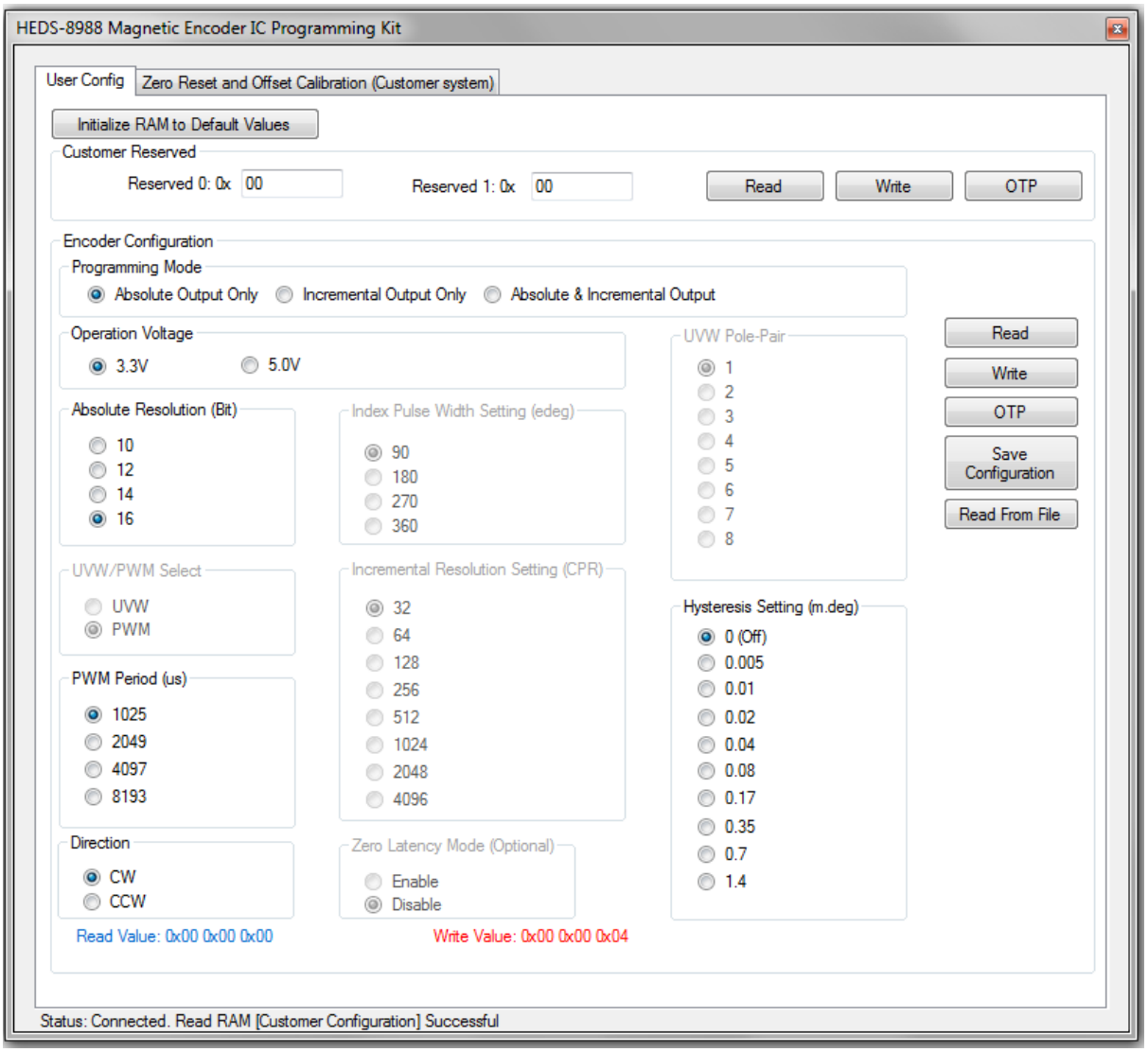


Programming

1. Before starting the programming, make sure that the programming kit is connected properly to the PC as shown in Figure 5.
2. Insert the sensor inside the socket with pin 1 following the dot mark on the socket, and close the lid. When the programming module detects the existence of the sensor in the socket, the status (at the left bottom of the table) shows `Connected`. If no sensor is inside the socket or the orientation of the sensor is wrong, the status shows `Connected. IC Not Present`.
3. If the sensor is detected, select the output mode. This selection enables the configuration register to be configured.

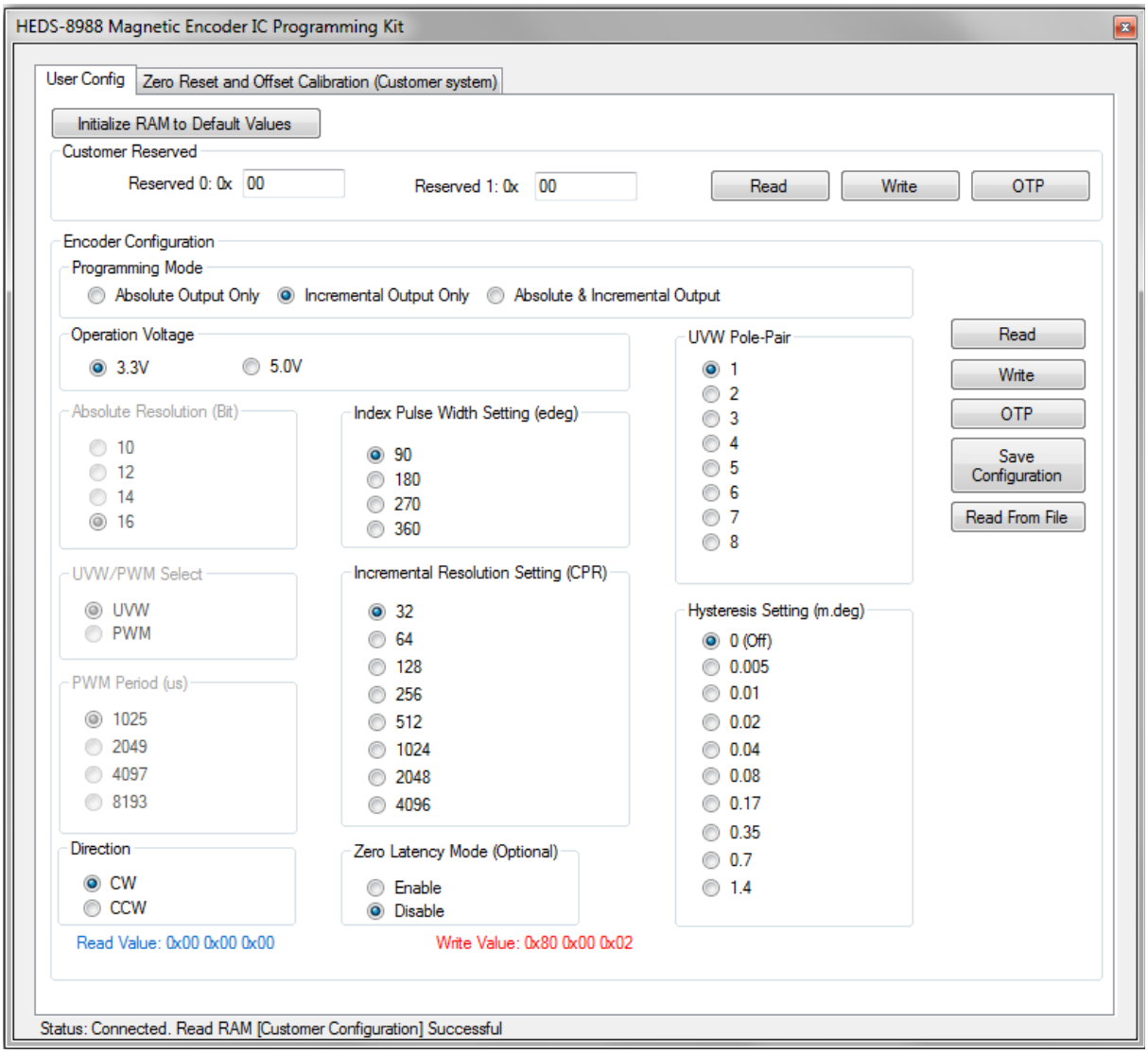
   If **Absolute Output Only** is selected, only **Operation Voltage**, **Absolute Resolution**, **PWM Period**, **Direction**, and **Hysteresis** settings are enabled, as shown in Figure 11.

Figure 11 Enabled Configuration Settings When Absolute Output Only Is Selected



If **Incremental Output Only** is selected, **Operating Voltage**, **Direction**, **Index Pulse Width Setting**, **Incremental Resolution**, **Zero Latency Mode**, **UVW Pole-Pair**, and **Hysteresis Setting** are enabled, as shown in Figure 12.

Figure 12 Enabled Configuration Setting When Incremental Output Only Is Selected

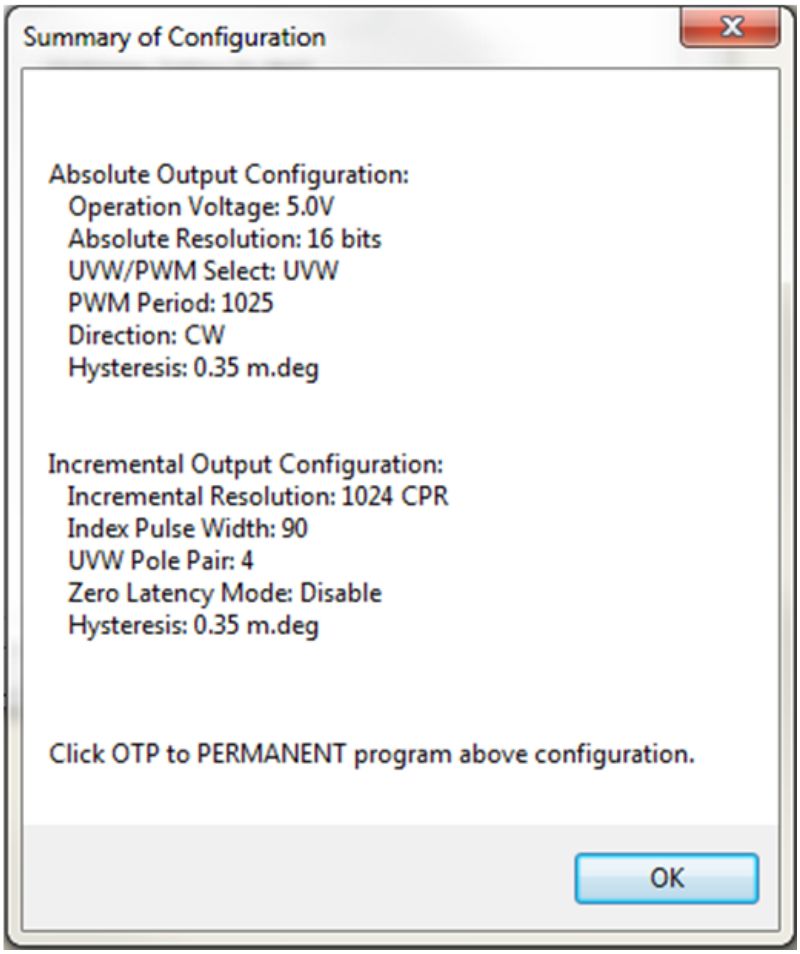


If **Absolute & Incremental Output** is selected, all the configuration settings will be enabled, as shown in Figure 9.

NOTE If **Zero Latency Mode** is enabled when either **Incremental Output Only** and **Absolute & Incremental Output** mode is selected, the incremental resolution setting is visible only for 32 cpr to 1024 cpr only.

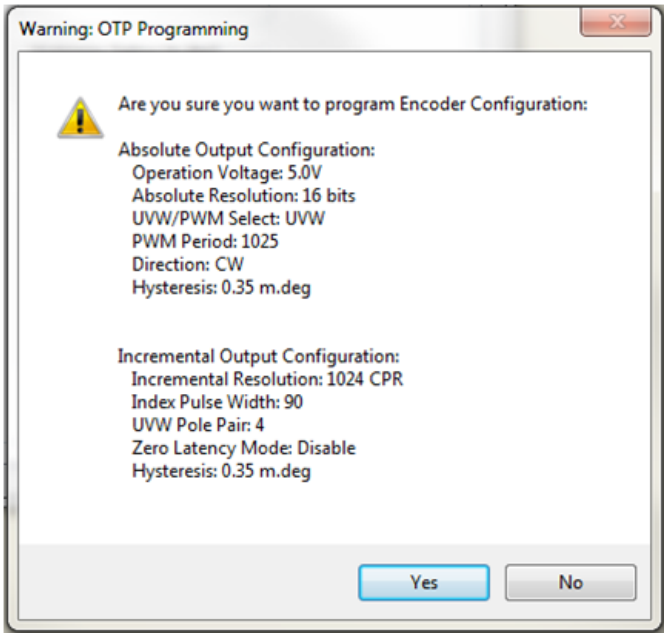
4. After the configuration setting is complete, click **Write** if you want to transfer the displayed configuration to RAM. A summary message shows the data to be written to the memory, as shown in Figure 13.

Figure 13 Summary of Configuration when the Write Button Is Clicked



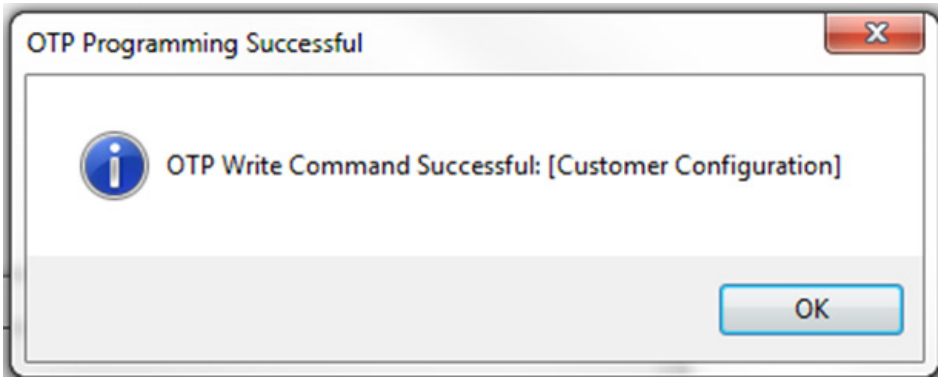
Take note of the configuration in the sensor. It returns to the default value when the programming kit is powered off. To make the setting permanent, write the configuration to the sensor by clicking **OTP**. A confirmation message shows the data to be written to the memory, as shown in Figure 14. Click either **Yes** to proceed with the programming or **No** if reconfiguration is required.

Figure 14 Popup Window to Confirm the OTP



As shown in Figure 15, if the programming is successful, a popup message box shows `OTP Write Command Sucessful`.

Figure 15 OTP Programming Successful

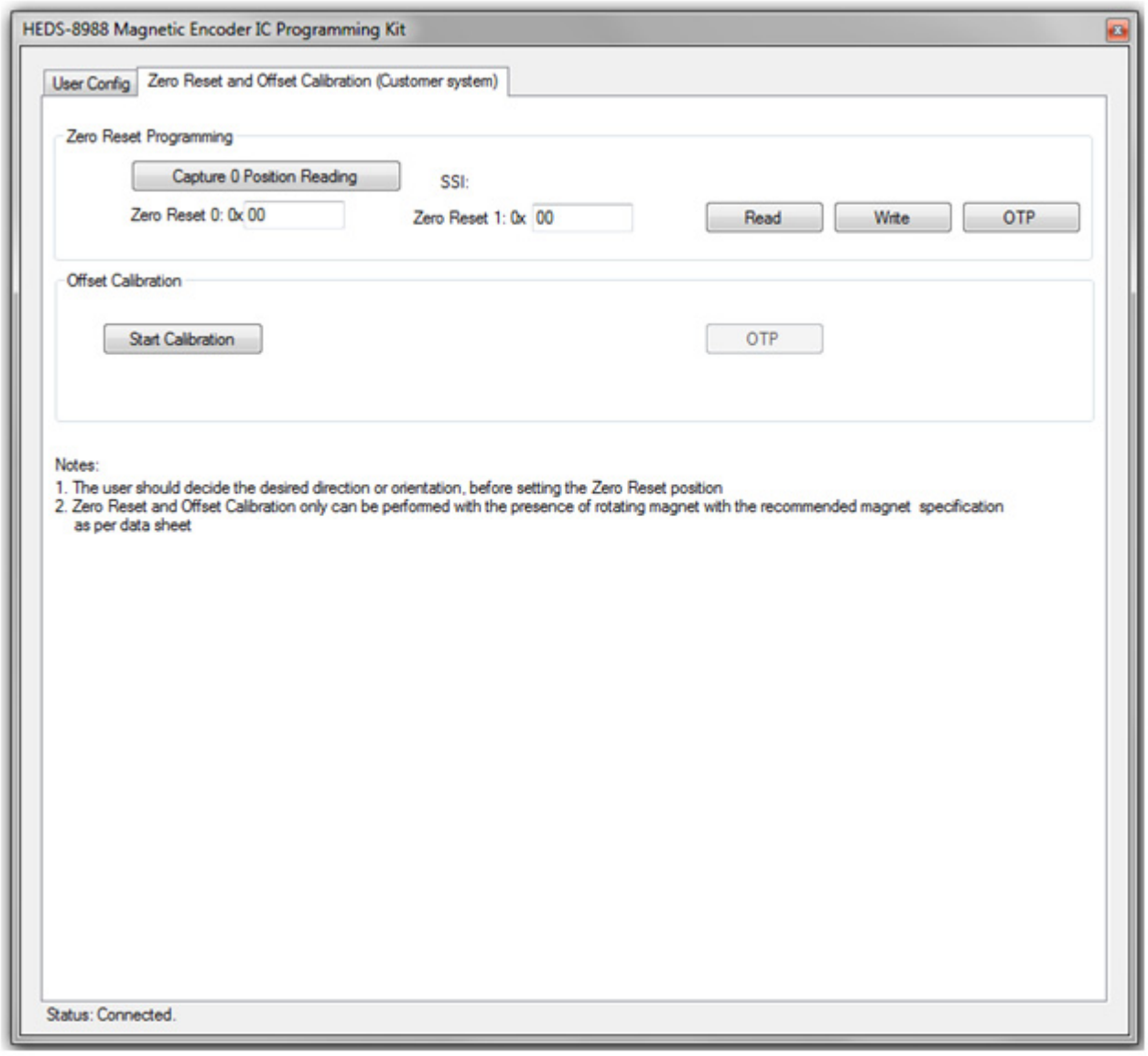


If more than one encoder must be programmed with the same settings, enter the setting only once and click the **Save Configuration File** button to save the encoder settings. Select **Read From File** to recall th encoder settings and then click the **OTP** button.

Zero Reset and Offset Calibration (Use with Customer Encoder System with Magnet)

Zero reset and offset calibration features are targeted in the final encoder installation and calibration use with a rotating magnet. You have an option to interface the programming module with the ribbon cable connector to the customer encoder system, respectively.

Figure 16 Programming the Zero Reset and Offset Calibration interface



You should perform zero reset and offset calibration after mounting the sensor on the motor system. The programming module must be connected to IC AEAT-8800-Q24 on the system following the pinout as described in Table 1.

NOTE Zero reset and offset calibration can be performed only with the presence of rotating magnet with the recommended magnet specification as per data sheet.

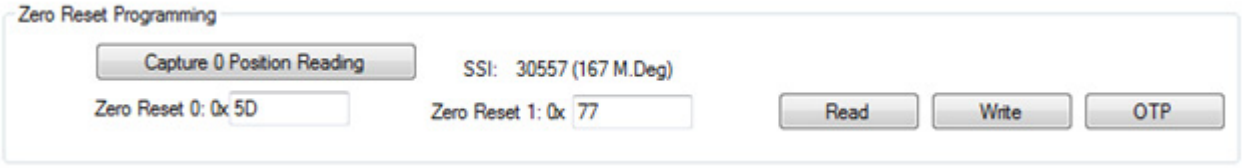
You should decide the desired direction or orientation, before setting the zero reset position.

The zero reset position value is stored at Zero Reset 0 (lower 8-b) and Zero Reset 1 (upper 8-b). To set the zero position, perform the following steps:

1. Stop the motor at position X (for example).
2. Click **Capture 0 Position Reading**.

   The lower 8-b and upper 8-b is captured in Zero Reset 0 and Zero Reset 1, respectively. Position in decimal and mdeg are shown beside SSI, as shown in Figure 17.

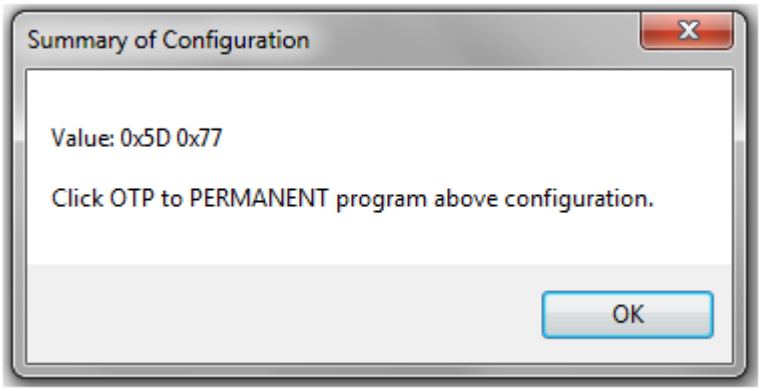
Figure 17 Zero Reset Programming



3. Click **Write** to write the Zero position to OTP shadow register.

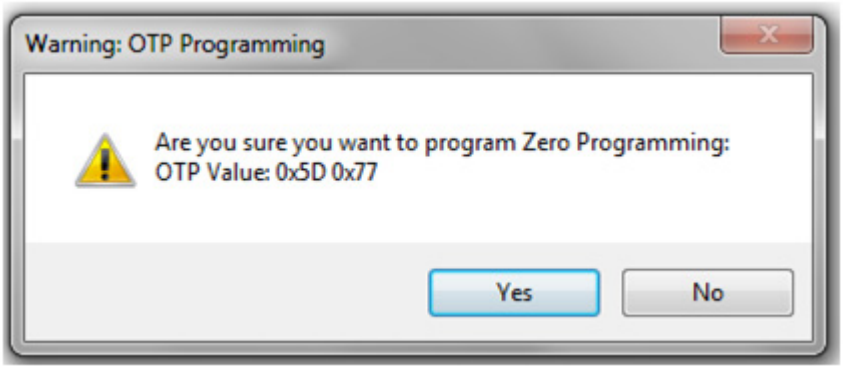
   A message shows the Zero Reset position to be written, as shown in Figure 18.

Figure 18 Summary of Configuration



4. Click **Read** to reconfirm the Zero position is captured correctly in Zero Reset 0 and Zero Reset 1.
5. To permanently save the Zero Reset position, click **OTP**. A confirmation message shows the value to be OTP, as shown in Figure 19. Click either **Yes** to proceed with the programming or **No** if reconfiguration is required.

Figure 19 Popup Window to Confirm the OTP



6. Without rotate the motor shaft, power-cycle the IC, and reconfirm the Zero Position by clicking **Capture 0 Position Reading**. The Zero Reset 0 and Zero Reset 1 show value of 00 (SSI reading shows a value of 0mdeg). (Remark: excluding step jumps incurred by noise.)

Before starting calibration, you must make sure the magnet is rotating at speed ≥ 200 rpm. When **Start Calibration** is clicked, it take about 7s to complete the process. When complete, the result is shown at the bottom of **Start Calibration** button. The result can be one of the following possibilities:

1. The magnet is too close or too far
2. The magnet alignment is beyond the limit
3. The magnet is not present or it is not spinning
4. The calibration is successful

Result 1 and result 2 show that the calibration failed. You must adjust the magnet position accordingly.

If result 3 appears, You must make sure that the magnet is present and spinning in the system.

If the calibration completes successfully, the **OTP** button is enabled, as shown in Figure 21.

Figure 20 Calibration Successful

You must click **OTP** to set the value permanently. A confirmation message popup appears, as shown in Figure 21. Click either **Yes** to proceed with the programming or **No** if reconfiguration is required.

Figure 21 Confirmation Popup