

AS33-M50M Series

50-Bit Full Magnetic Energy Harvesting Multi-Turn Absolute Encoder



Introduction

Description

The Broadcom® AS33-M50M series encoder is an absolute magnetic encoder that offers 18-bit single-turn (ST) and 32-bit multi-turn (MT) counts, which results in a combined 50-bit high-resolution encoder. The design of the encoder features a state-of-the-art energy-harvesting MT encoder. To improve system integrity and simplicity, a single magnetic solution provides both ST and MT position generation.

The AS33-M50M series encoder provides patented energy-harvesting technology for revolution tracking. This technology converts the rotating magnetic field into electrical energy that powers the revolution tracking circuit. The energy-harvesting technology provides the same amount of energy that is generated independently of the encoder rotation speed and direction. The generated energy is sufficient to power up the MT counter circuitry. Therefore, no miscounts occur, even in the absence of an external power supply. Compared to battery backed-up MT counting, this technology does not require periodic maintenance of the battery backup components and the down time associated with it.

The AS33-M50M series encoder has a built-in communication protocol that is supported by a full-duplex or half-duplex line transmission drive that offers good noise immunity for a more robust transmission of data up to 10Mb/s in harsh industrial applications. The magnetic technology-based encoder can handle contamination, such as dust and fingerprints, on the sensing element. As a result, the encoder requires less stringent control in production handling and harsh environments.

Applications

- Small motors and linear actuators
- Robotic automation and engineering
- Drones
- Test and measurement equipment

NOTE: The encoder is not recommended for use in life critical applications; for example, ABS braking systems, power steering, life support and critical care systems and medical equipment. Contact your local Broadcom sales representative for more information.

Mounting Requirements and Guidelines

Figure 1: M3 Mounting Design Guidelines for Bottom Shield (Left) and Magnet/Hub (Right)

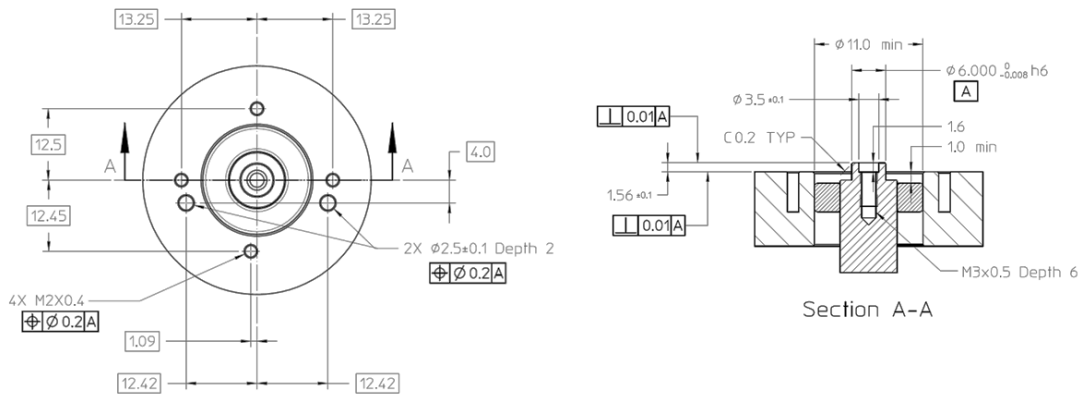


Figure 2: M4 Mounting Design Guidelines for Bottom Shield (Left) and Magnet/Hub (Right)

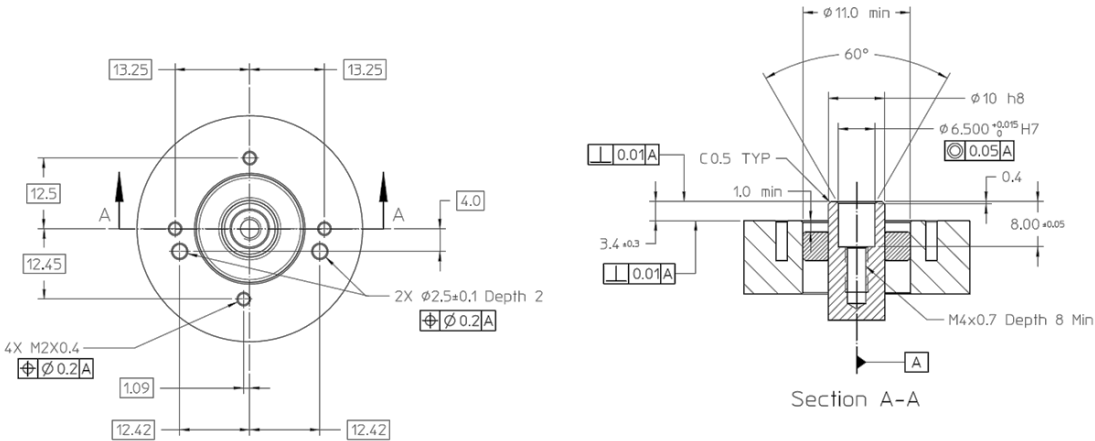
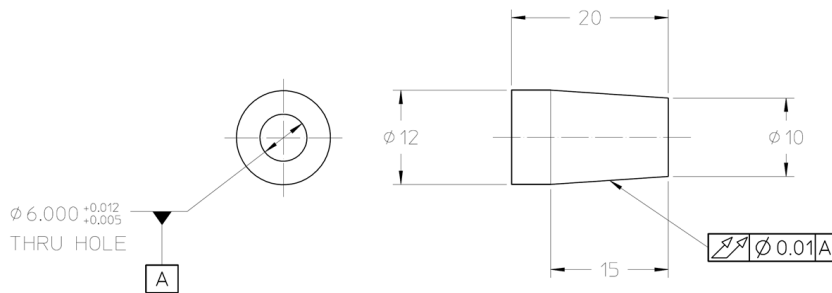


Figure 3: Centering Jig Design Guidelines

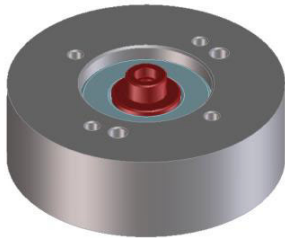


NOTE:

1. Dimensions are in millimeters.
2. Unless otherwise specified, all tolerances are within ± 0.5 mm.
3. Do not use a ferro-magnetic shaft for the motor.

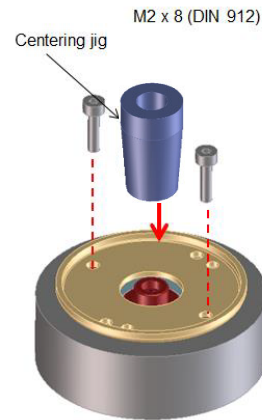
Encoder Mounting Steps

Figure 4: Encoder Mounting Steps



Step 1:

Prepare the mounting surface and the shaft as per the recommended design and dimensions.

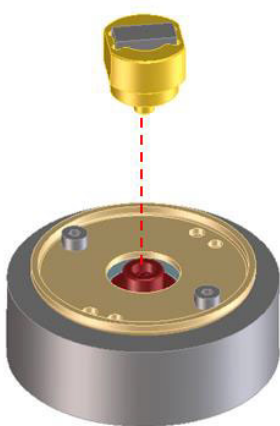


Step 2:

Place the bottom shield on the mounting surface with the screw holes of the bottom shield aligned to that mounting surface. Fit the centering jig to the shaft to align the center of the base plate against the shaft.

Secure the bottom shield to the mounting surface with two M2 screws at the recommended torque of 0.2 ± 0.02 nm. A thread lock is also recommended to prevent loosening of the screws.

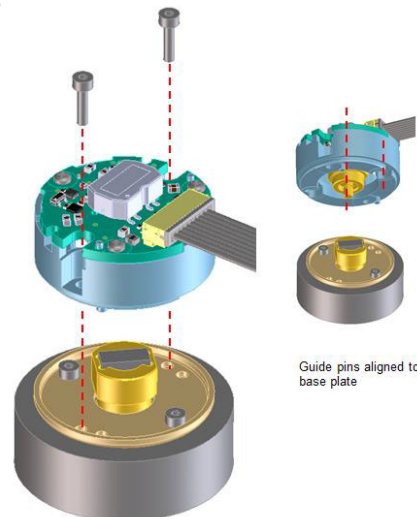
Remove the centering jig only after the bottom shield is properly installed.



Step 3:

Mount and fasten the magnet hub to the shaft at the recommended torque of 0.2 ± 0.02 nm.

A thread lock is recommended to prevent loosening of the magnet hub.



Step 4:

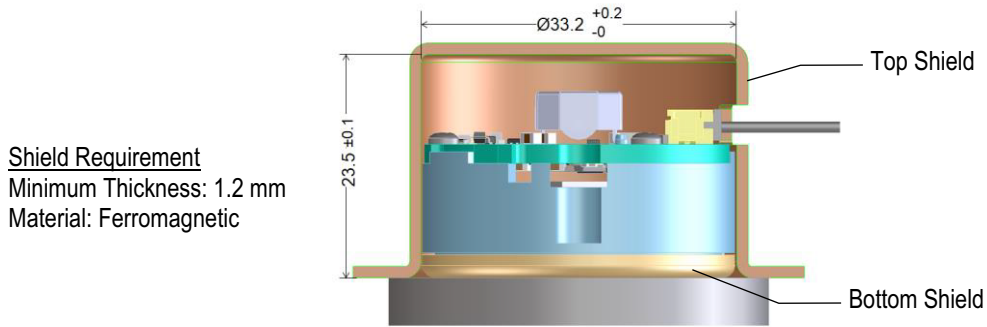
Install the module onto the bottom shield. Ensure that the guide pins underneath the module are aligned to the guiding hole on the bottom shield.

Secure the module to the bottom shield screw at the recommended torque of 0.2 ± 0.02 nm. A thread lock is recommended to prevent loosening of the screws.

Magnetic Shield Design Guidelines

To eliminate or minimize the influence of external magnetic field interference on the encoder operation, use of shielding is mandatory.

Figure 5: Magnetic Shield Design Requirements

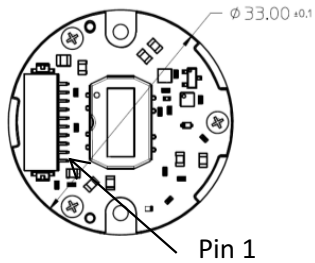


NOTE:

1. External magnetic interference varies by the application and operating environment.
2. Proper study of the external magnetic field and the appropriate shield design is required.
3. Consult the factory for technical assistance.

Connector Pin Configuration Information

Pin Number	SSI	BiSS C	RS485 Half-Duplex
1	GND	GND	GND
2	VDD	VDD	VDD
3	SCLK-	MA-	NC
4	SCLK+	MA+	NC
5	DAT-	SLO-	DATA-
6	DAT+	SLO+	DATA+
7	UART RX	NC	NC
8	UART TX	NC	NC
9	Zero reset	NC	NC
10	GND	GND	GND

Figure 6: Pin 1 Location Viewed from the Top of the Encoder

Recommended mating connectors:

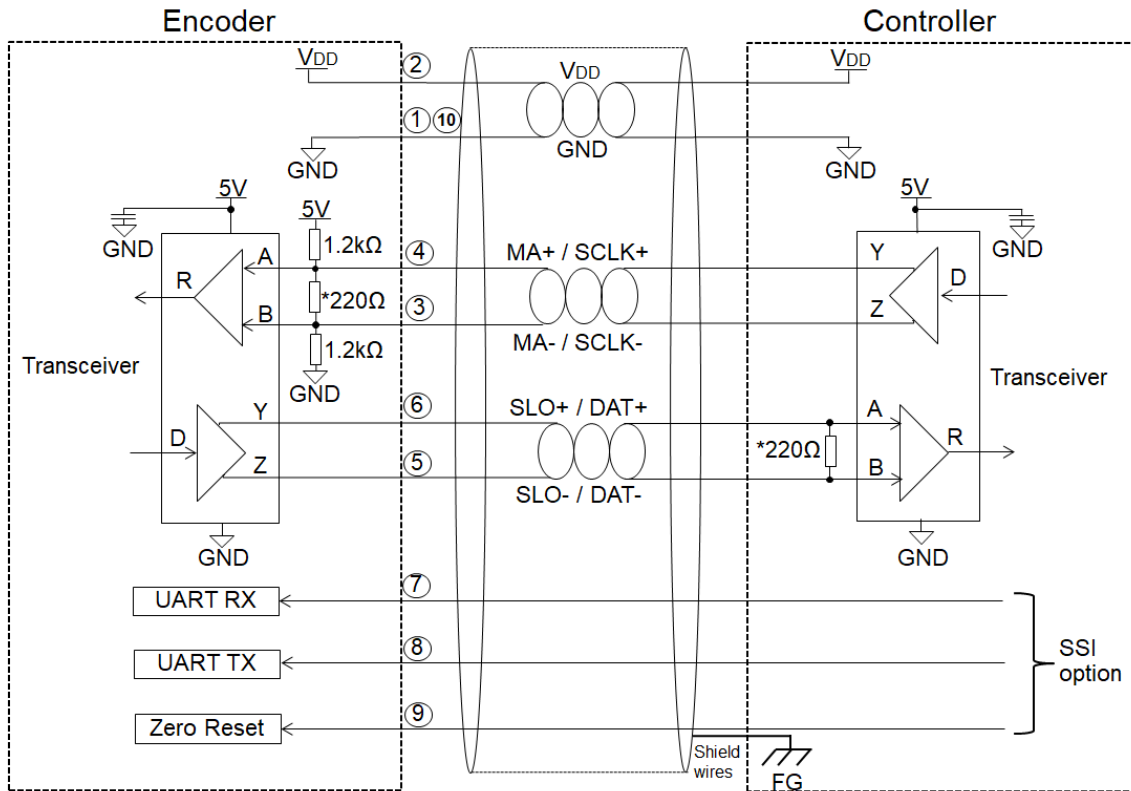
- Hirose Part No: DF13-10S-1.25C (CL No.536-0006-8)
- Hirose (Terminal Pin for Wire 26~30AWG): DF13-2630SCF (CL No.536-0300-5)

Recommended I/O Connection

1. Provide the encoder power supply as stated in the electrical specification in the data sheet.
2. Connect the encoder chassis and the cable shield to frame ground (FG) in applications for enhanced noise immunity in harsh operating conditions.
3. To prevent undesirable signal reflections, use the required the termination resistor. Use a termination resistor of 220Ω $1/4W$, but it may depend on the characteristic impedance of the cable used.

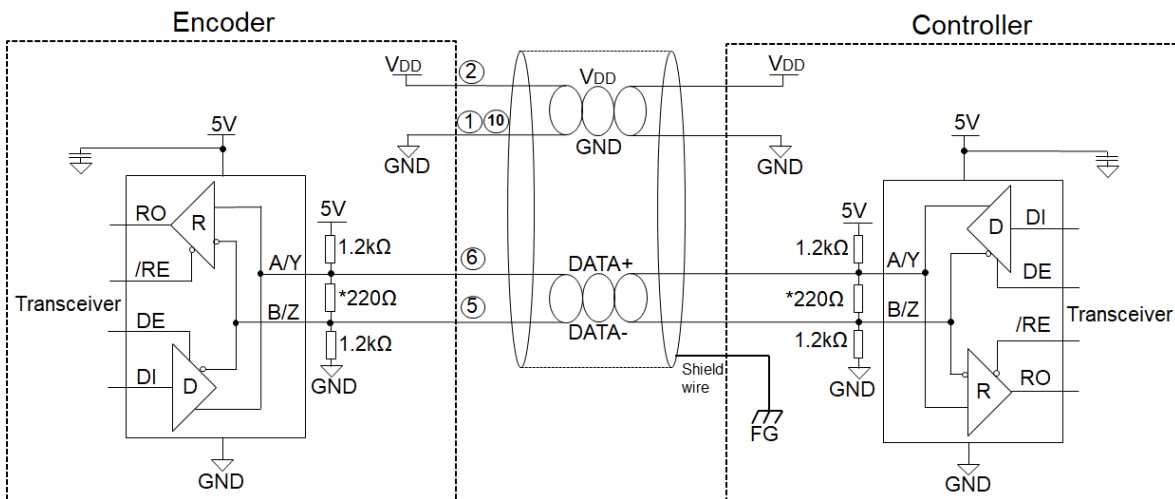
Full-Duplex Transceiver (BiSS C and SSI Protocol)

Figure 7: Circuit Diagram of a Full-Duplex Transceiver



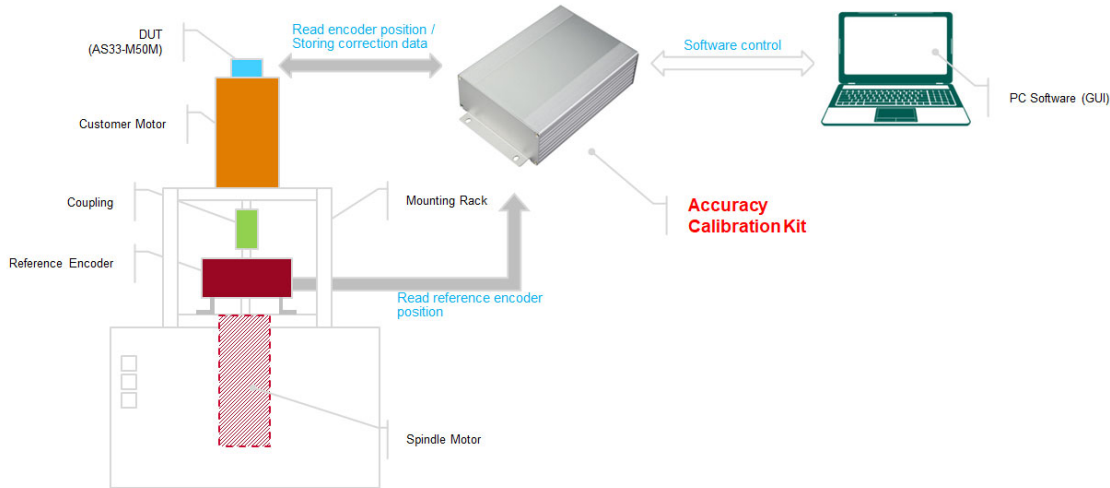
Half-Duplex Transceiver (RS-485 Half-Duplex Protocol)

Figure 8: Circuit Diagram of Half-Duplex Transceiver



Accuracy Calibration

Broadcom provides development tools to perform the calibration process. These accuracy calibration kits can be ordered through the normal Broadcom sales channels.

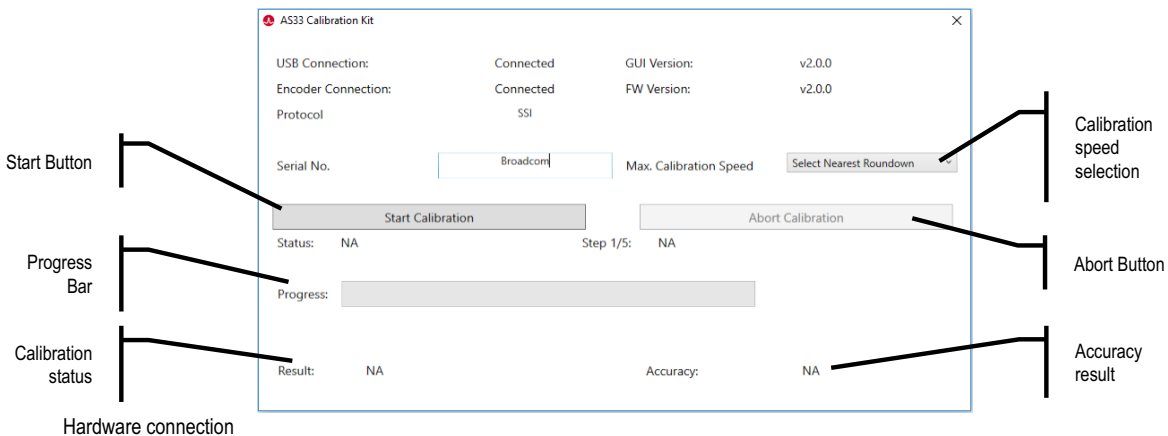


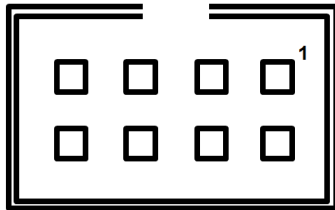
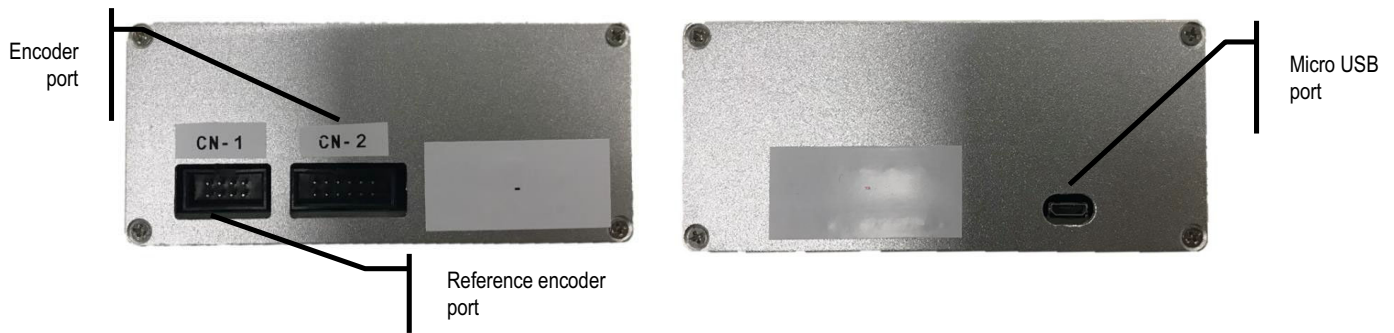
User System Requirement

Reference Encoder	Incremental reference encoder Count: 2048CPR Accuracy: 1/20 of the grating period
Spindle Motor	4-speed calibration with a selectable maximum speed
Mechanical Mounting	Concentricity is <math>< 10 \mu\text{m}</math> between the DUT and reference
Operating System	Windows 7 and above

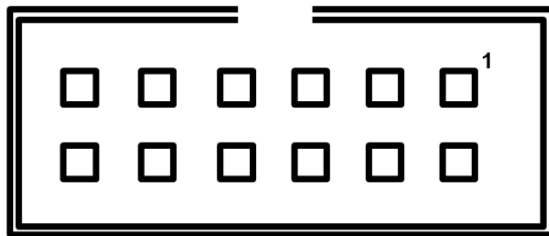
The installation CD/USB drive contains the programmer application software for the accuracy calibration kit. Install the application software, and follow the on-screen instructions to finish the installation into a user working directory.

After the installation is complete, the program is available in the selected working directory. The following shows the graphical user interface of the programming software.





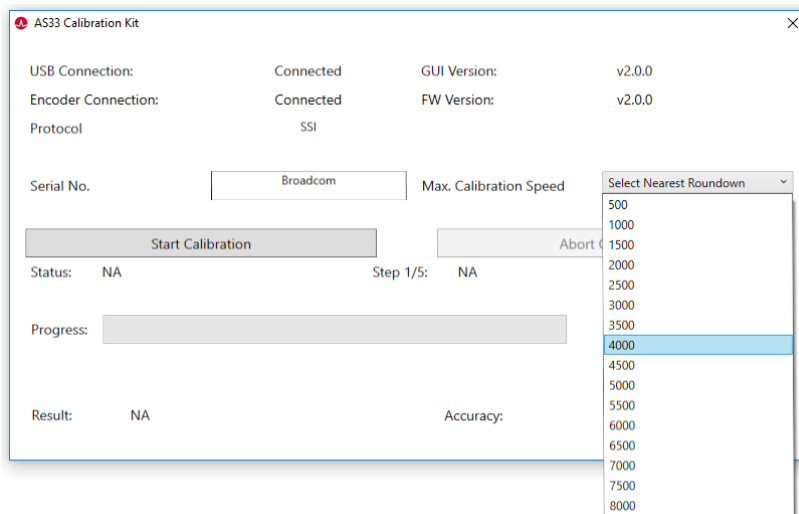
CN1			
1	I+	2	0V
3	I-	4	5V
5	B-	6	A-
7	B+	8	A+



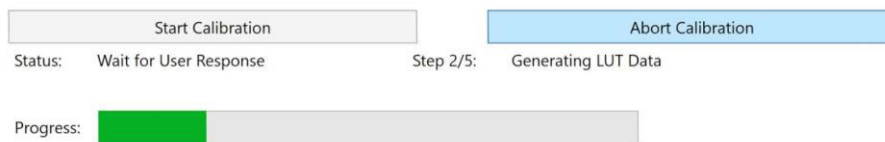
CN-2			
1	TX	2	RX
3	SCLK+	4	SCLK-
5	DAT+	6	DAT-
7	-	8	-
9	GND	10	GND
11	-	12	VDD

Step-by-Step Procedure

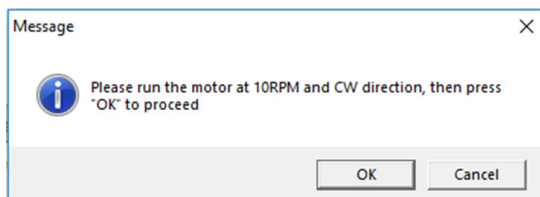
1. Connect both the reference encoder and the DUT to the calibration kit followed by the USB connection.
 - a. CL-1 to CN-1
 - b. CL-2 to CN-2
 - c. Micro USB to PC USB
2. Launch the calibration software.
3. Update the serial number for the datalog (optional).
4. Select the nearest maximum calibration speed (Rundown) from the drop-down menu. Note the highest calibration speed.



5. Click **Start Calibration** to start the calibration.



6. Set the motor speed and the direction according to the message box, and click **OK** when reaching the required speed. A total of four different speed settings are required for each direction.



NOTE: If the speed set does not match the requested speed, an error displays the "Retry" message.

The calibration is completed when the status changes to **Done**. The data automatically logs off at the end of the calibration. The file is generated in the `datalog.csv` installation folder.

Calibration Datalog

A comma-separated value (CSV) file is generated in the same folder as the installation folder of the calibration program. For every unit tested, a new line is recorded and appended to the `datalog.csv` file. Back up this file periodically to prevent data loss due to file corruption and to keep the datalog file size within a reasonable file size; for example, less than 1 MB.

Figure 9: Example of a datalog.csv File

Date	15/03/2019					
Time	16:35:03 PM					
Protocol	SSI					
Test No	Serial No	Mode	Accuracy 3RPM (+/- deg)	Accuracy 8KRPM (+/- deg)	Result	Test Time (s)
1		Calibration & Measurement	0.1	0.12	PASS	358.7
2		Measurement	0.1	0.13	PASS	55.52

Dos and Don'ts

Dos

- Ensure that the encoder power supply is within $5V \pm 10\%$ for AS33-M50M-x5x and within 7V ~ 12.5V for AS33 M50M x7x.
- Ensure that the cable pin configuration is correct as stated in the data sheet and the application notes.
- Observe all ESD precautions in handling and installing the encoder.
- Install the encoder as stated in the recommended guiding steps and with the correct screw size.
- Install the encoder shielding as stated in the recommended design.

Don'ts

- Do not expose the encoder to strong magnetic fields while it is in storage.
- Do not operate the encoder in the presence of magnetic fields without shielding.
- Do not over-tighten the screw during encoder installation.
- Do not overload the transceiver by using the incorrect termination resistor.
- Do not reverse the polarity of the power supply to the encoder.
- Do not operate the encoder beyond the recommended operating temperature.

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