Application Note

AS33-M42M Series

42-Bit Full Magnetic Energy Harvesting Multi-Turn Absolute Encoder Module

Description

The Broadcom® AS33-M42M series is an 18-bit single-turn (ST) absolute magnetic encoder with a 24-bit energy harvesting multi-turn (MT) counter. Hence, the encoder solution has a combined 42-bit absolute resolution. Design of the encoder features state-of-the-art energy harvesting multi-turn technology and angular magnetic hall sensing with sophisticated signal conditioning algorithms. A single magnetic solution is thus responsible for both the ST and MT positions' generation; greatly improving overall feedback system integrity and simplicity.

Applications

- Small motors and linear actuator
- Robotic automation and engineering
- Drone and automated guide vehicle
- DC and AC servo motor
- Test and measurement equipment

NOTE: This product is not specifically designed or manufactured for use in any specific devices. Customers are solely responsible for determining the suitability of the product for its intended application and solely liable for all loss, damage, expense, or liability in connection with such use.

Mounting Requirement and Guideline

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

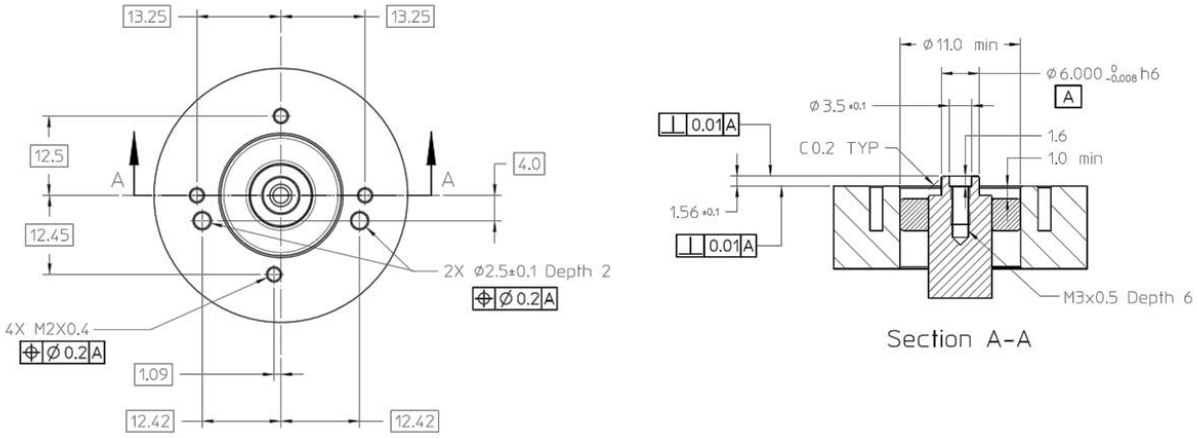
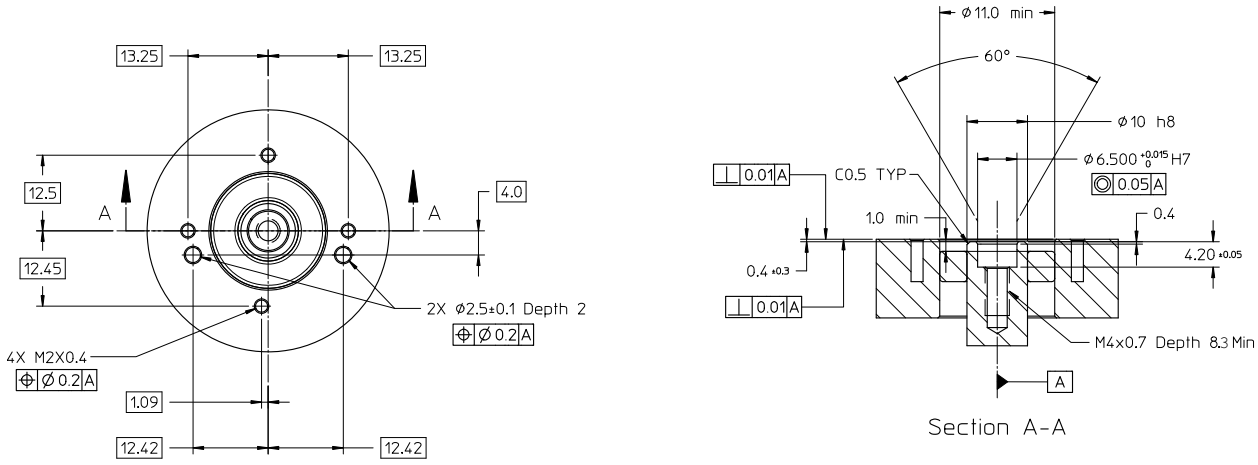


Figure 2: M4 Mounting Design Guideline for Bottom Shield (Left) and Magnet/Hub (Right)



NOTE:

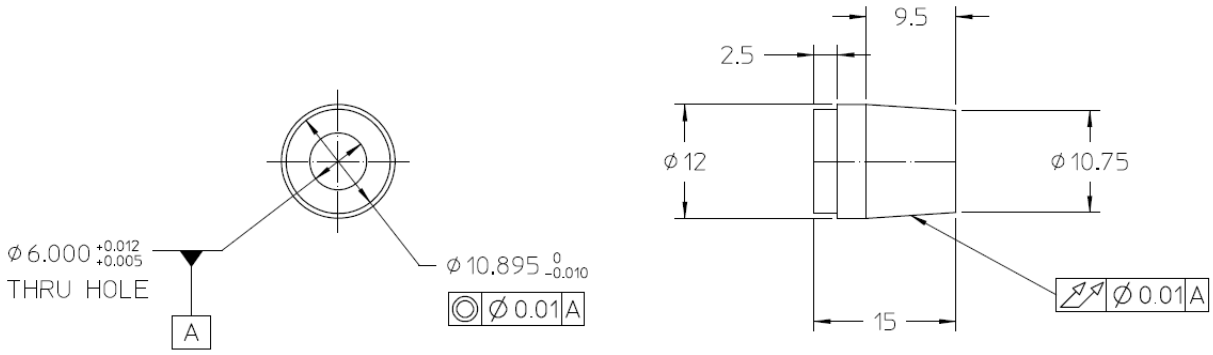
1. Dimensions are in millimeters.
2. Unless otherwise specified, all tolerances are within ±0.5 mm.
3. Use of a ferro-magnetic shaft may affect the magnetic system and hence encoder performance at the final applications. Users are advised to perform their own engineering assessments based on the actual use case.

Mounting and Alignment Tools

These centering jigs enable the alignment of the center of the bottom shield plate against the user motor shaft.

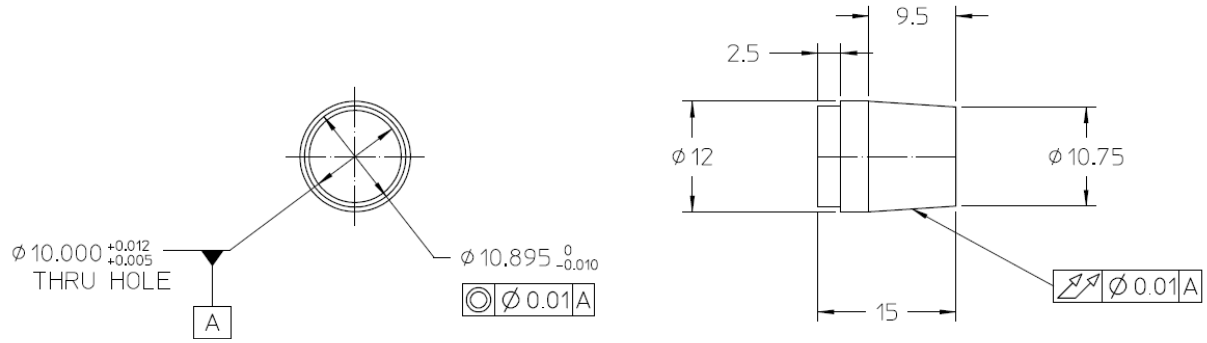
AS33-M42-023 M3 Centering Jig

Figure 3: M3 Centering Jig Design Guideline



AS33-M42-024 M4 Centering Jig

Figure 4: M4 Centering Jig Design Guideline

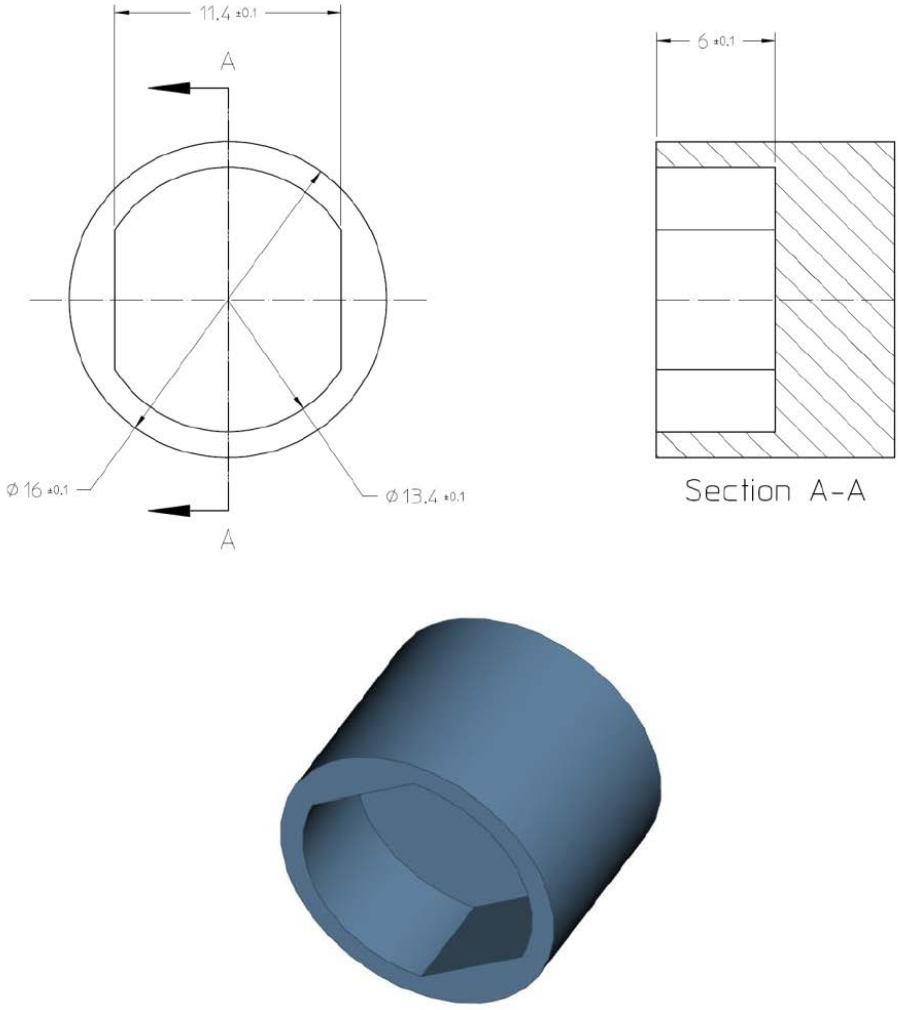


NOTE:

1. Dimensions are in millimeters.
2. Unless otherwise specified, all tolerances are within ±0.5 mm.
3. Material: Hardened steel.

Suggested Tool Design for AS33 Hub Locking

Figure 5: AS33 Hub Locking Design Guideline

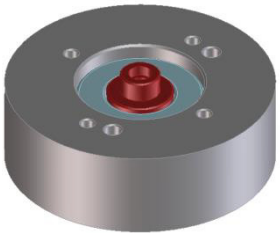


NOTE:

1. Dimensions are in millimeters.
2. Unless otherwise specified, all tolerances are within ±0.1 mm.
3. Suggested material: plastic, for example, Nylon.

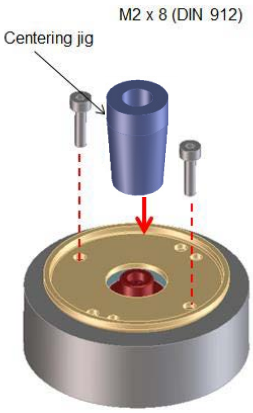
Encoder Mounting Steps

Figure 6: Encoder Mounting Steps



Step 1:

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

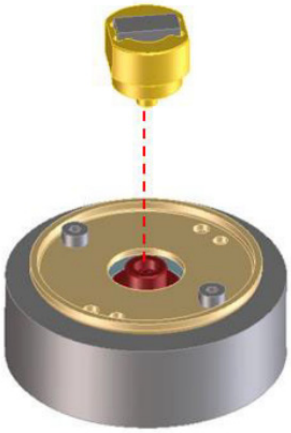


Step 2:

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

Secure bottom shield to the mounting surface with two M2 screws at recommended torque 0.2 +/-0.02Nm. Thread lock is also recommended to prevent loosening of screws.

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

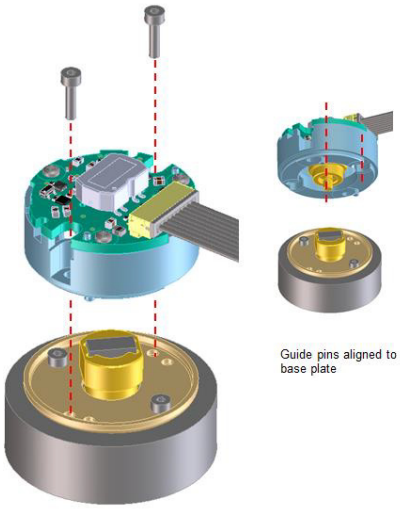


Step 3:

Mount and fasten magnet hub to the shaft at recommended torque as below:

Magnet Hub	Tightening Torque
M3	0.3 +/-0.02Nm
M4	0.7 +/-0.02Nm

Thread lock is recommended to prevent loosening of magnet hub.



Step 4:

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

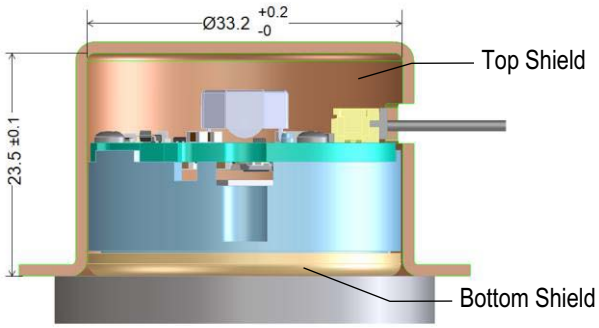
Secure module to bottom shield with the recommended screw at 0.2 +/-0.02Nm torque. Thread lock is recommended to prevent loosening of screws.

Magnetic Shield Design Guidelines

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

Figure 7: Magnetic Shield Design Requirement

Shield Requirement
Minimum Thickness: 1.2mm
Material: Mild Steel
Process: Vacuum Annealing at temperature 850°C for 1hour



NOTE:

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

Connector Pin Configuration Information

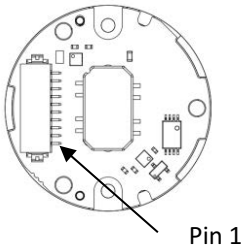
Pin Number	SSI	BiSS-C	RS485 Half-Duplex
1	GND	GND	GND
2	VDD	VDD	VDD
3	SCLK-	MA-	NC
4	SCLK+	MA+	NC
5	DAT-	SLO-	DATA-
6	DAT+	SLO+	DATA+
7	SPI CLK	SPI CLK / NC(1)	SPI CLK / NC(1)
8	SPI DO	SPI DO / NC(1)	SPI DO / NC(1)
9	Zero Reset/ SPI DIN	SPI DIN / NC(1)	SPI DIN / NC(1)
10	GND	GND	GND

NOTE: For calibration process only. Do not connect (NC) during operation.

*Recommended mating connector:

- Hirose Part No: DF13-10S-1.25C (CL No. 536-0009-6-00)
- Hirose (Terminal Pin for Wire 26~30AWG): DF13-2630SCF (CL No.536-0300-5)

Figure 8: Pin 1 Location Viewed from Encoder Top

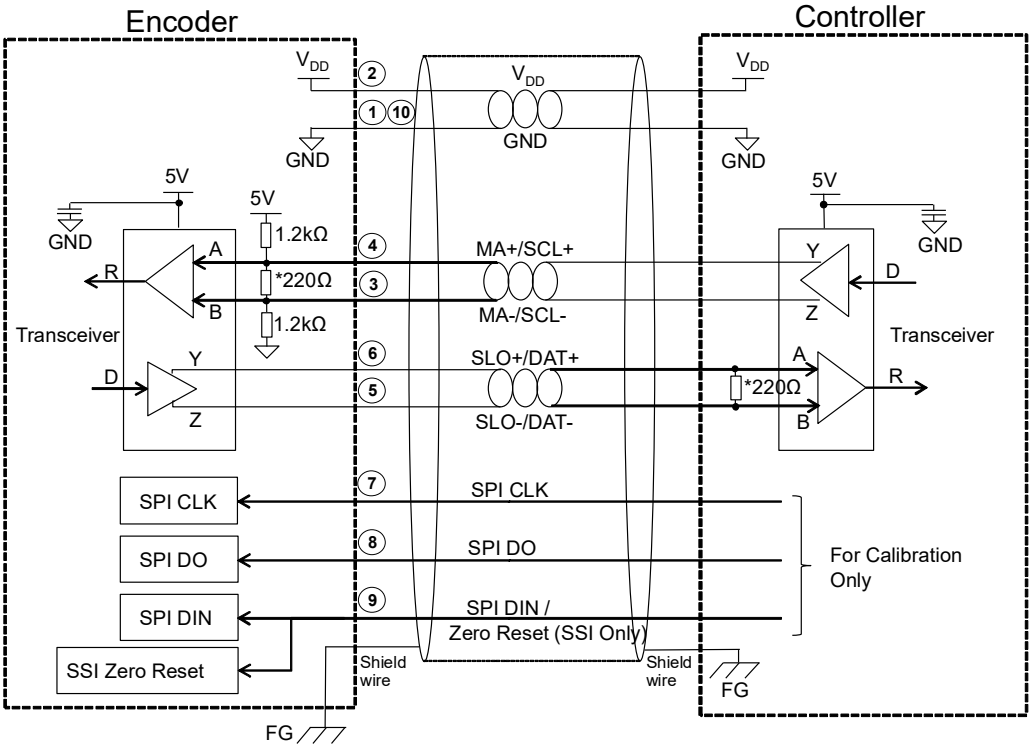


Recommended I/O Connection

1. Provide an encoder power supply following the electrical specifications in data sheet.
2. Connect the encoder chassis and cable shield to the frame ground (FG) in application for enhanced noise immunity in harsh operating conditions.
3. To prevent undesirable signal reflections, obtain the required termination resistor. Use termination resistors at 220Ω 1/4W; however, it may depend on the characteristic impedance of the cable used.

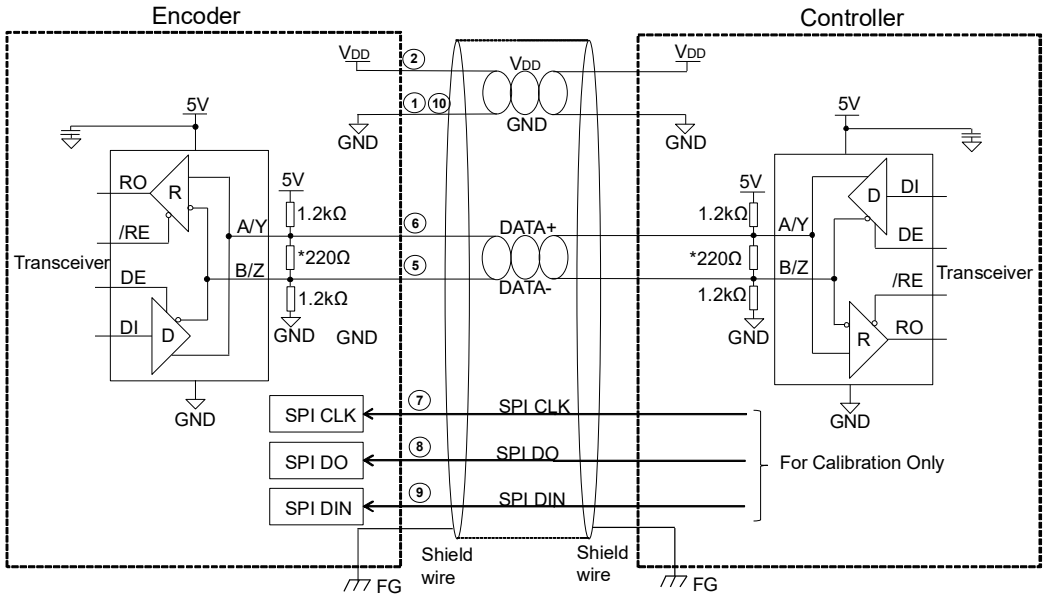
Full-Duplex Transceiver (BiSS-C and SSI Protocol)

Figure 9: Circuit Diagram of a Full Duplex Transceiver



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

Figure 10: Circuit Diagram of a Half-Duplex Transceiver



Accuracy Calibration

Accuracy calibration is required to achieve the specified accuracy performance. Refer to AS33-M42M Calibration-CA100 for detailed information. The calibration kit is available for order.

Accessories and Tools

1.	AS33-M42-010	Electronic Accuracy Calibration Kit
2.	AS33-M42-023	Radial Centering Jig for M3 Hub
3.	AS33-M42-024	Radial Centering Jig for M4 Hub
4.	AS33-AC18	Benchtop Accuracy Calibration Station
5.	AS33-C150	AS33 10-pin Mating Connector with 150-mm length cable

Dos and Don’ts

Do

- Ensure encoder power supply is within 5V ± 10% for AS33-M42M-x5x and 7V ~ 12.5V for AS33-M42M-x7x.
- Ensure cable pin configuration is per data sheet and application notes.
- Observe all ESD precautions in handling and installing the encoder.
- Install the encoder per the recommended guiding steps and with the correct screw size.
- Install encoder shielding per the recommended design.
- Ensure that the encoder is calibrated at 25°C ± 10°C ambient environment.

Don’t

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