

AS38-H39E Series

39-Bit Energy-Harvesting Multi-Turn Absolute Encoder



Introduction

The Broadcom® AS38-H39E series encoder is a high-resolution optical absolute encoder that offers 23-bit single-turn and 16-bit multi-turn counts, hence a combined 39-bit high resolution. The AS38-H39E series encoder is a house encoder consisting of a patterned disk, a light source, and photosensitive elements to translate the mechanical motion into electrical signal.

The AS38-H39E series encoder has a built-in communication protocol that is supported by a full-duplex or half-duplex line transmissions drive, offering good noise immunity for more robust transmission of data up to 10 Mb/s in harsh industrial applications. Because the product is intended for industrial applications, ESD protection circuitry has been designed in to achieve Class 3 ESD immunity per IEC -61000-4-2 standard. The AS38-H39E series is also compliant with IP50 per IEC 60529 standard.

The key advantage of the AS38-H39E series is its multi-turn tracking that employs energy-harvesting technology by harvesting the magnetic energy as the encoder shaft rotates. It is the gearless multi-turn counting that eliminates the gear wear-out or acoustic noise issue that is encountered in conventional geared multi-turn encoders. When compared to battery backed-up multi-turn counting, this technology does not require periodic maintenance of the battery backup components and the down time associated with it.

Operating Theory

The encoder contains two main functional blocks: the single-turn optical engine block and the energy-harvesting multi-turn counter block. The single-turn engine comprises a Broadcom-developed high-performance optical detector ASIC, which is accompanied by high-precision amplifier circuitry, coupled with a special multi-track code disk that rotates between the LED emitter and detector IC.

The multi-turn counting is enabled utilizing energy-harvesting technology. When the shaft is rotating, the magnet mounted on the shaft moves in tandem. The energy-harvesting coil module cuts the moving magnet field, and generates energy as a result.

The beauty of the energy-harvesting effect is that the same amount of energy is generated independent of the rotation speed. The generated energy is sufficient to power-up the revolution tracking circuitry. Therefore, no miscounts occur even in the absence of an external power supply.

Features

- 39-bit resolution: 16-bit energy-harvesting multi-turn and 23-bit optical single-turn
- Built-in communication protocol (optional): BiSS C mode, SSI mode, and RS-485 half-duplex
- Overall encoder outer diameter Ø38 mm and maximum height of 40 mm
- Supporting ¼ inch, 6-mm and 8-mm diameter of the blind hollow shaft

Benefits

- No battery or capacitor required for position detection during power failure
- Immediate position detection on power up

Applications

- Robotics
- Factory automation
- Linear positioning system
- CNC machine tool
- Medical and lab equipment

NOTE: Broadcom encoders are not recommended for use in safety-critical applications, such as ABS braking systems, power steering, life support systems, and critical care medical equipment. Contact a sales representative if more clarification is needed.

Product Specifications

Electrical Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Current Consumption	Without load, $T_{amb} = 25^{\circ}\text{C}$	—	115	—	mA
Supply Voltage	—	4.5	5	5.5	V
Electrically Permissible Speed	—	—	—	6000	min^{-1}

Mechanical Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
System Accuracy	With electrical correction, $T_{amb} = 25^{\circ}\text{C}$	—	± 80	—	Arc-sec
Mechanical Permissible Speed	—	—	—	6000	min^{-1}
Shaft Radial Play	—	—	—	± 0.05	mm
Shaft Axial Play	—	—	—	± 0.1	mm
Starting Torque	$T_{amb} = 25^{\circ}\text{C}$	—	—	9.8×10^{-3}	N.m

Environmental Specifications

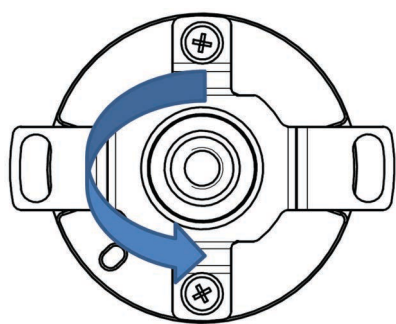
Parameter	Conditions	Min.	Typ.	Max.	Unit
Storage Temperature	—	-20	—	105	$^{\circ}\text{C}$
Operating Temperature	—	-20	—	105	$^{\circ}\text{C}$
Relative Air Humidity (Non-Condensing)	$T_{amb} = 40^{\circ}\text{C}$	—	90	—	RH%
Protection	—	—	IP50	—	
Vibration	Per IEC 60068-2-6	—	—	10G; 10~2000 Hz	
Shock	Per IEC 60068-2-27	—	—	6 ms; Half Sine; 200G	

Encoder Specifications

Parameter	Remarks
Resolution	Single-turn 23-bit (8388607 counts) and multi-turn 16-bit (65535 counts)
Counting Direction	Increase with Counter Clockwise (CCW) shaft rotation, view from coupling end (Figure 1)
Initialization Time	500 ms

NOTE: After encoder initialization duration of 500 ms upon power-up, perform an alarm clear command before starting to interface with the encoder.

Figure 1: Shaft Rotation



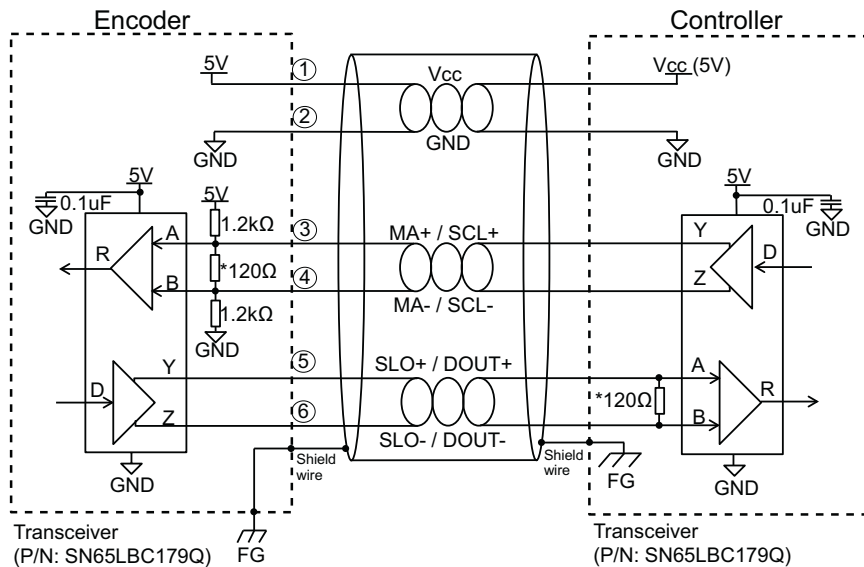
NOTE: Exposure to absolute maximum rating conditions for extended periods might affect reliability.

Interface Diagram

The following are examples of the circuit diagram of full-duplex and half-duplex transceiver.

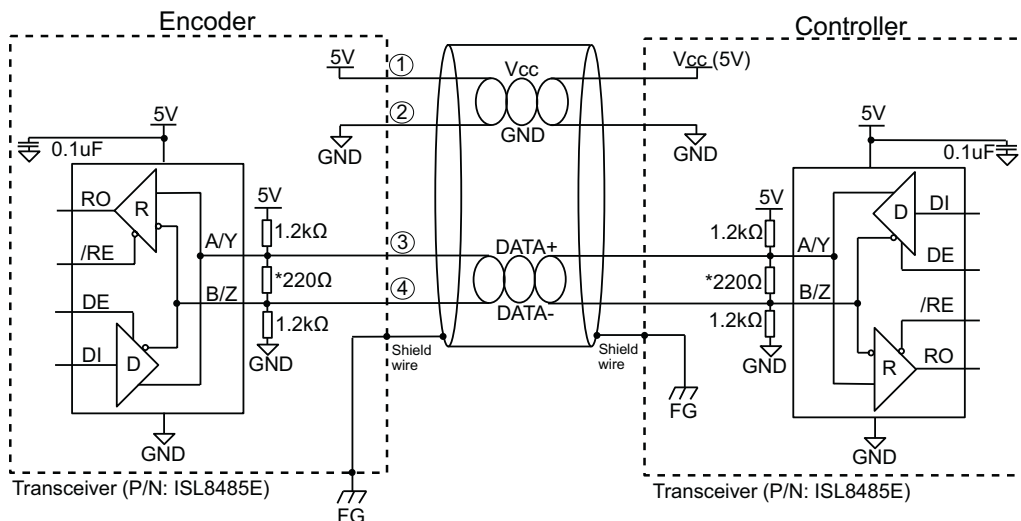
Full-Duplex Transceiver (BiSS C Mode/SSI Mode Protocol)

Figure 2: Circuit Diagram of Full-Duplex Transceiver



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

Figure 3: Circuit Diagram of Half-Duplex Transceiver



* Termination resistor, 120Ω and 220Ω are recommended but may depend on the characteristic impedance of cable used.

NOTE: Connect encoder chassis and cable shield to frame ground (FG) in application for enhanced noise immunity in harsh operating conditions.

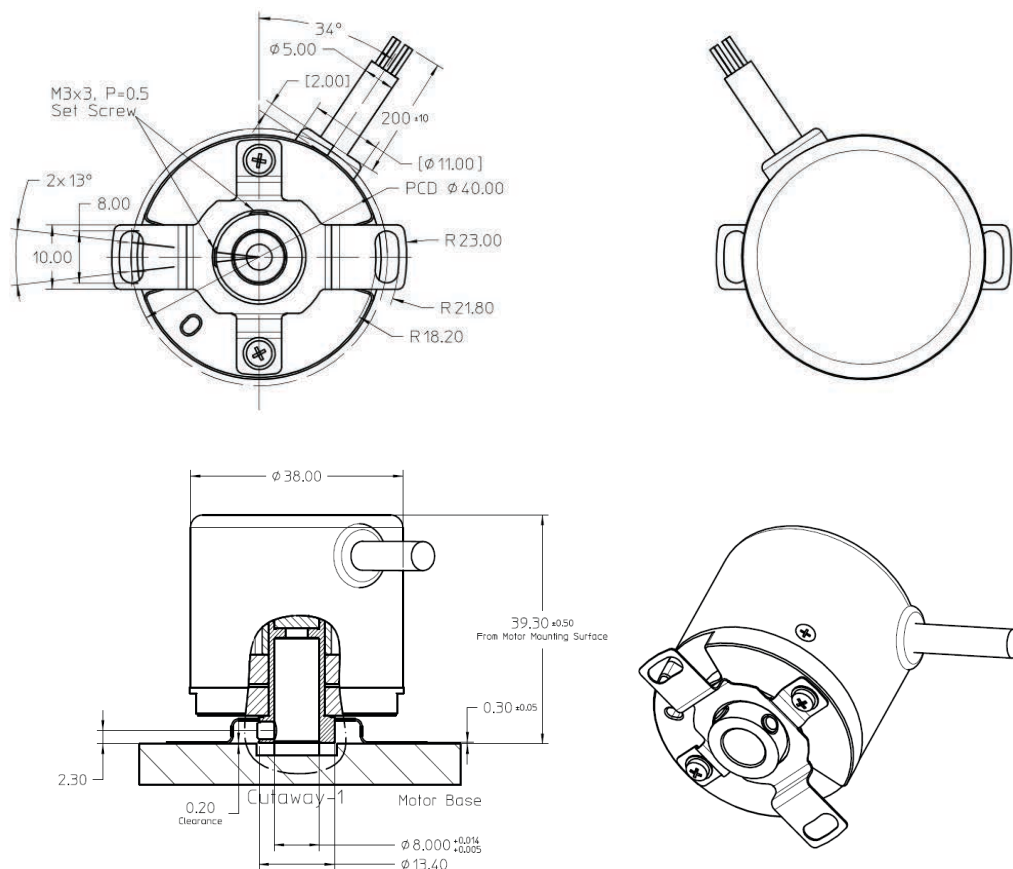
Cable Connection Information

No.	Cable Color	AS38-H39E-Bxxx (BiSS-C) (Output: 7-Core Cable)	AS38-H39E-Sxxx (SSI) (Output: 7-Core Cable)	AS38-H39E-Kxxx (RS-485 Half-Duplex) (Output: 5-Core Cable)
1	RED	V _{CC} , Positive Supply	V _{CC} , Positive Supply	V _{CC} , Positive Supply
2	BLACK	GND, Ground	GND, Ground	GND, Ground
3	BROWN	MA+	SCL+	DATA+
4	WHITE	MA–	SCL–	DATA–
5	ORANGE	SLO+	DOUT+	N/A
6	BLUE	SLO–	DOUT–	N/A
7	Cable Shield Strand	Cable shield, connect to chassis	Cable shield, connect to chassis	Cable shield, connect to chassis

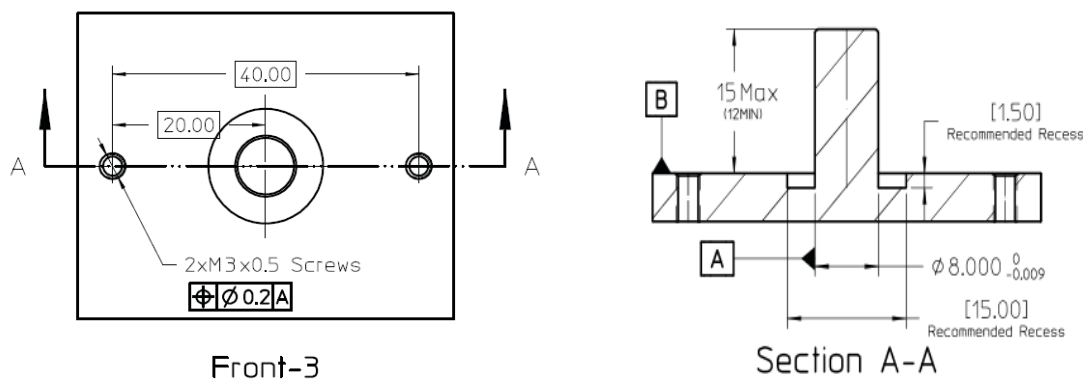
NOTE: Cable provided is 200 mm ± 10 mm (included pigtail length) with AWG28.

Mechanical Drawing

Package Dimensions



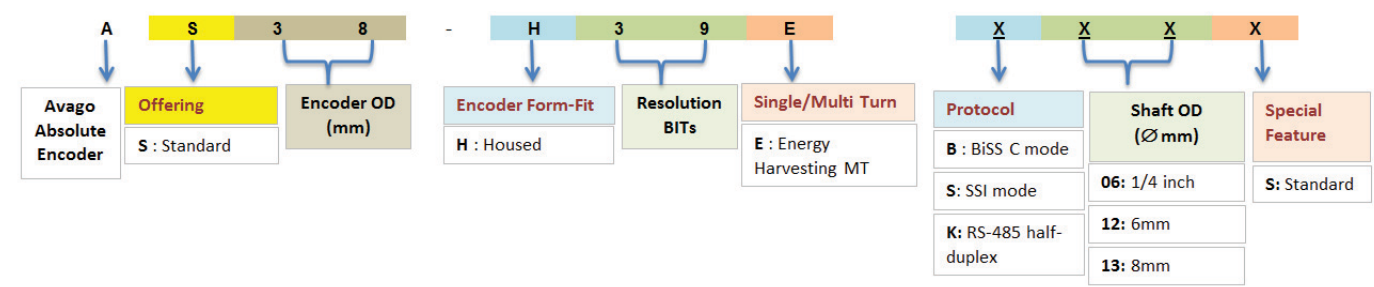
Recommended Shaft and Mounting Requirement



NOTE:

1. Dimensions are in millimeters.
2. 3rd angle projection.
3. Unless otherwise specified, all tolerances are within ± 0.5 mm.
4. It is recommended to have a recess on the motor mounting surface to prevent encoder shaft interference with motor base.

Ordering Information



NOTE: Contact Broadcom for sample orders and lead time.

Copyright © 2017–2025 Broadcom. All Rights Reserved. The term “Broadcom” refers to Broadcom Inc. and/or its subsidiaries. For more information, go to www.broadcom.com. All trademarks, trade names, service marks, and logos referenced herein belong to their respective companies.

Broadcom reserves the right to make changes without further notice to any products or data herein to improve reliability, function, or design. Information furnished by Broadcom is believed to be accurate and reliable. However, Broadcom does not assume any liability arising out of the application or use of this information, nor the application or use of any product or circuit described herein, neither does it convey any license under its patent rights nor the rights of others.