

AS35-M23S Series

23 Bits Single-Turn Absolute Encoder Module



Description

The Broadcom® AS35-M21S/M23S series encoder is a high-resolution optical absolute encoder module, which offers up to 23 bits single-turn resolution. This absolute encoder series is a module encoder consisting of a patterned disk, a light source, and photosensitive elements to translate the mechanical motion into electrical signals. The single-turn encoder is available with an RS-485 standard compliant communication protocol and supported by a half-duplex differential line transmissions driver. These features offer good noise immunity for a robust data transmission at 2.5Mb/s in harsh industrial applications. Alternatively, the industry standard single-directional Synchronous Serial Interface (SSI) protocol is offered at a data transmission rate of 1 MHz.

One of the key advantages of the AS35-M23S series is the low-profile module assembly. After assembly, the encoder module is only 16.5 mm in overall height. With fast installation and easy one-touch calibration process, the AS35-M23S series is well suited for direct motor assembly into small motors size of 40 mm and above. As the product is intended for industrial applications, ESD protection circuitry has been designed to meet the industry standard of IEC-61000-4-2 for class 4 applications.

Features

- Selectable resolution up to 23 bits
- High accuracy: ± 300 arc-sec
- Selectable communication protocol: Half-duplex RS485, SSI 1 MHz
- Wide operating temperature range: -40°C to 105°C
- High response speed up to 12 kRPM
- Compact size: $\varnothing 35$ mm, and height 16.5 mm
- Hassle-free installation with one-touch calibration

Benefits

- High accuracy: ± 300 arc-sec (12 bits)
- High precision for position or speed control
- Fast installation and calibration for motor assembly
- Suitable for industrial operating temperature
- Compact size to cater for a 40-mm motor
- Modular solution for ease of integration into systems
- Cost-effectiveness solution

Applications

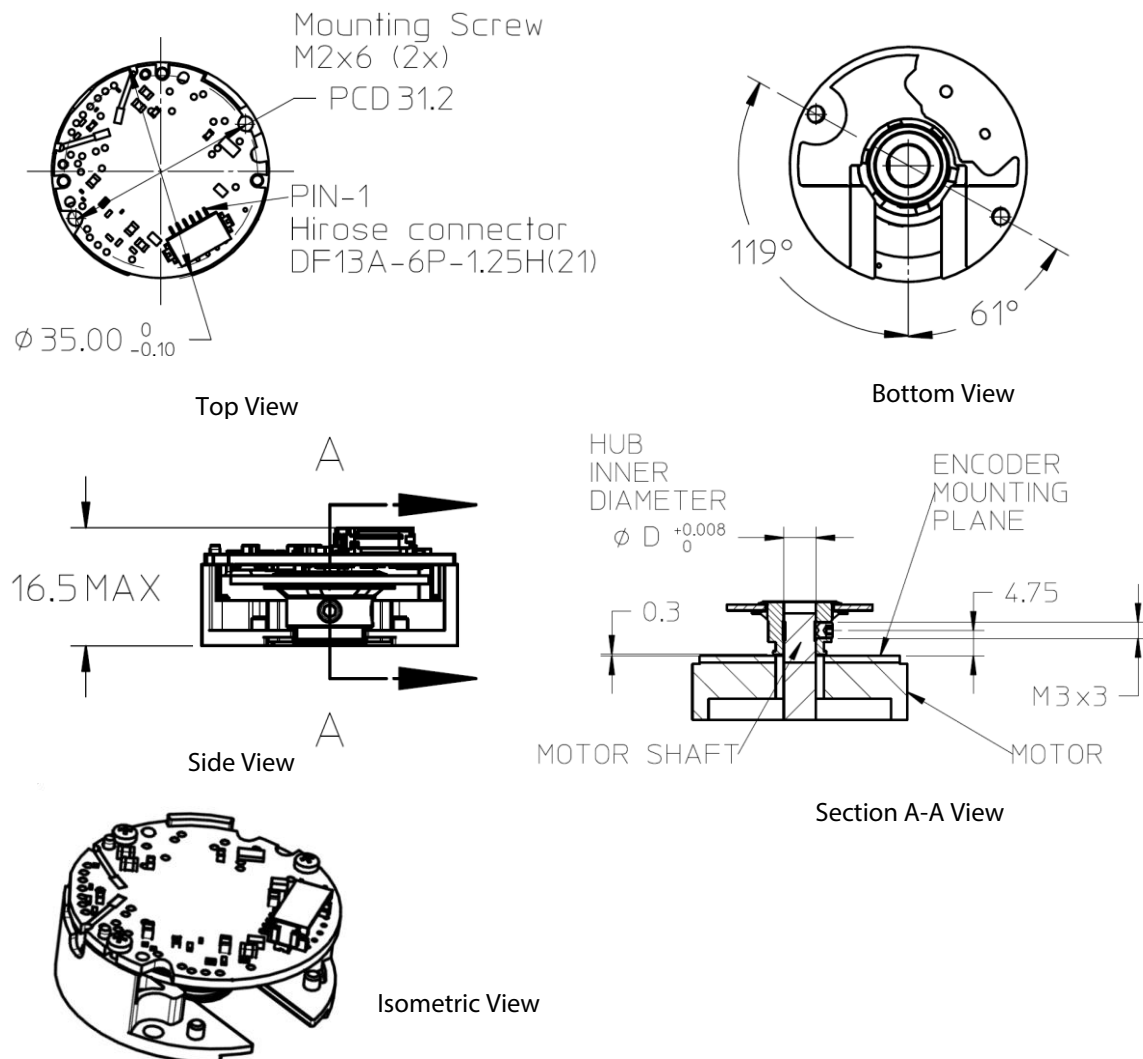
- Servo motor
- Robotic engineering and automation
- Factory and automotive automation
- Specialized equipment

NOTE: Broadcom encoders are not recommended for use in safety-critical applications; for example, ABS braking systems, power steering, life-support systems and critical-care medical equipment. Contact your Broadcom sales representative for more clarification.

Mechanical Outlines

Standard Blind Hollow Hub Option (Ø D)

Figure 1: Encoder Outline Dimensions

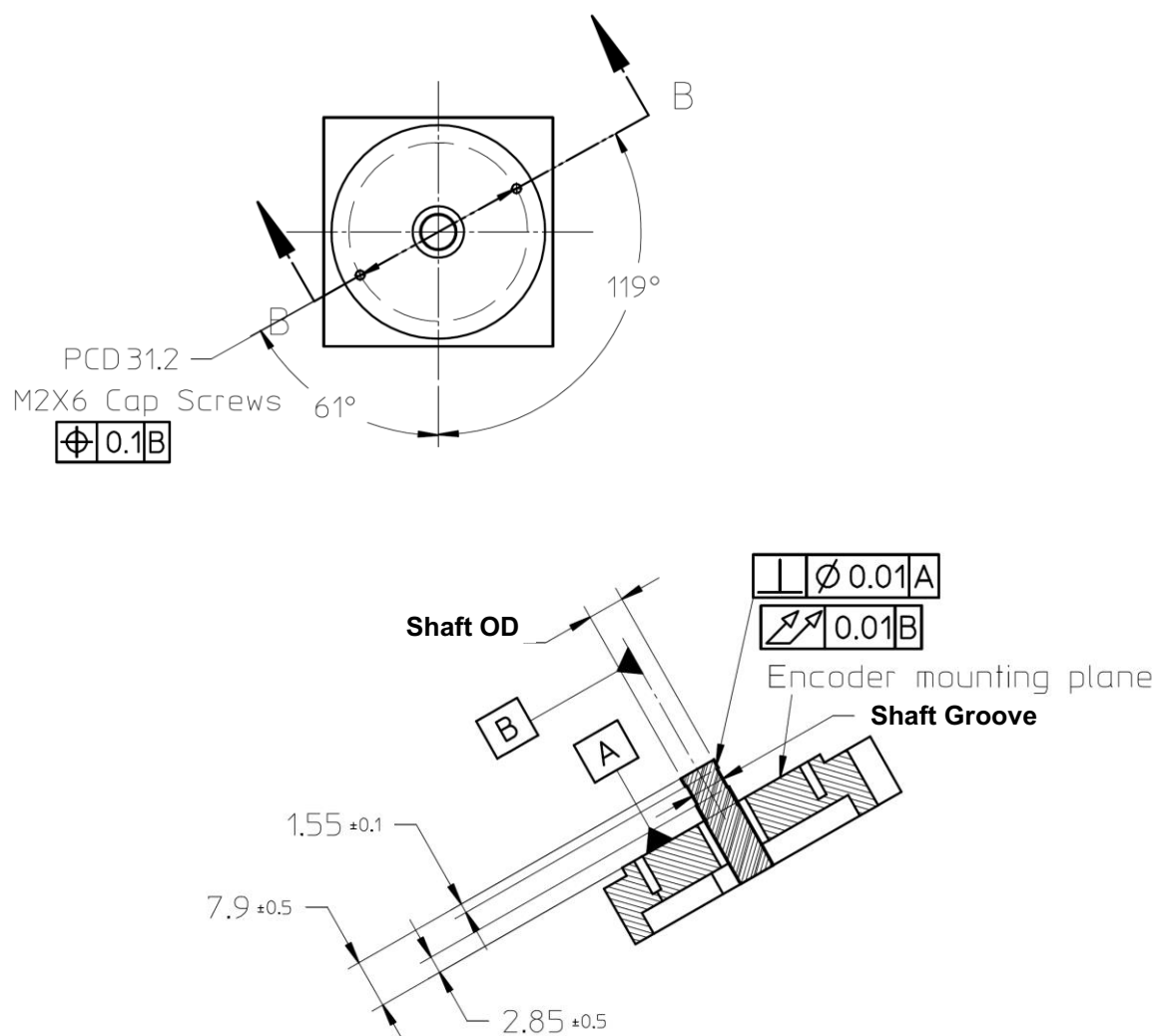


NOTE:

1. Dimensions are in millimeters.
2. Third-angle projection.
3. Unless otherwise specified, all tolerances are within ± 0.5 mm.
4. See [Table 3](#) for available shaft diameter options.

Recommended Shaft and Mounting Requirements

Figure 2: Recommended Customer Shaft and Motor Base



NOTE:

1. Dimensions are in millimeters.
2. Third-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 the motor base.
5. See [Table 3](#) for the required shaft OD and groove tolerances.

Product Specifications

Encoder Operating Conditions

Table 1: Recommended Operating Conditions

Parameter	Symbol	Value			Units	Notes
		Min.	Typical	Max.		
DC Supply Voltage	V_{CC}	+4.5	+5.0	+5.5	V	
Current Consumption	I_{CC}	—	80	120	mA	Without load, $T_{amb} = 25^{\circ}\text{C}$
Ripple of Supply Voltage		—	—	100	mVpp	100 kHz
Spikes provided by Supply Voltage		—	—	200	mVpp	20 MHz
Operating Temperature	T_{op}	−40	+25	+105	$^{\circ}\text{C}$	Motor temperature
Storage Temperature	$T_{storage}$	−40	+25	+105	$^{\circ}\text{C}$	
Encoder Shaft Speed		—	—	12,000	min^{-1}	Also applicable from stationary
Electrically Permissible Acceleration		—	—	1.0×10^5	rad/s^2	
Relative Humidity	RH	—	—	90	%	$T_{amb} = 40^{\circ}\text{C}$, IEC61800-2, non-condensing

Mechanical Specifications

Table 2: Motor and System Specifications

Parameter	Value	Units	Notes
System Accuracy	± 300	Arc-sec	$T_{amb} = 25^{\circ}\text{C}$
Mechanical Permissible Speed	12,000	min^{-1}	
Shaft Radial Play	± 0.05	mm	
Shaft Axial Play	± 0.15	mm	
Codewheel Set Screw Size	M3x3.0		2 pieces

Motor Shaft Specifications

Table 3: Motor Shaft Specifications

Shaft OD and Tolerance (mm)			Shaft Groove and Tolerance (mm)		
Nominal	Lower	Upper	Nominal	Lower	Upper
5.0	−0.004	−0.014	4.5	−0.2	+0.2
6.0	−0.004	−0.014	5.5	−0.2	+0.2
6.35	−0.004	−0.014	5.85	−0.2	+0.2

Encoder Specifications

Table 4: Encoder Specifications

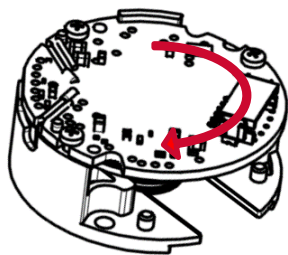
Parameter	Remarks
Resolution	Single turn: up to 23 bits (8,388,607 counts)
Counting Direction	Increase with clockwise shaft rotation, view from the encoder PCB top surface (Figure 3)
User-accessible Memory Size	5K bits (RS485 option only)

Environmental Specifications

Table 5: Encoder Environmental Specifications

Parameters	Conditions	Specifications
Vibration	Per IEC 60068-2-6	10G; 10 to 2000 Hz
Shock	Per IEC 60068-2-27	6 ms; half sine; 200G
Discharge of Static Electricity (ESD)	Per IEC 61000-4-2	±8 kV contact discharge, ±12 kV air discharge
Electrical Fast Transient/Burst Immunity	Per IEC 61000-4-4, Capacitive Coupling	±2 kV, 5 kHz, 15 ms
Dielectric Resistance	Leakage <1 mA	1000 Vac, 1 minute
Insulation Resistance	At 1kV	10 MΩ

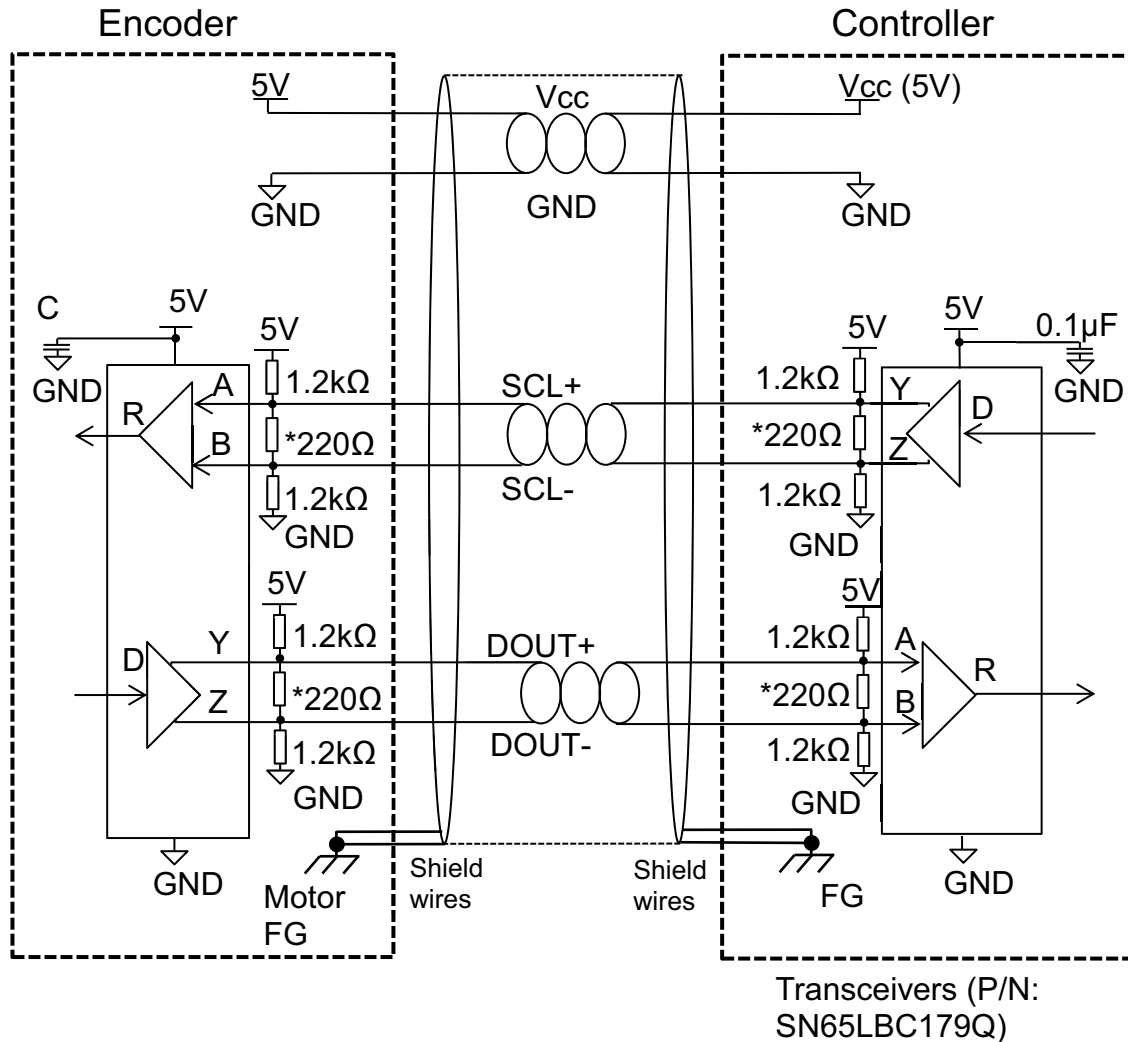
Figure 3: Encoder Counting Direction



Electrical Connection

Full-Duplex Transceiver (SSI Mode Protocol)

Figure 4: Circuit Diagram of a Full-Duplex Transceiver

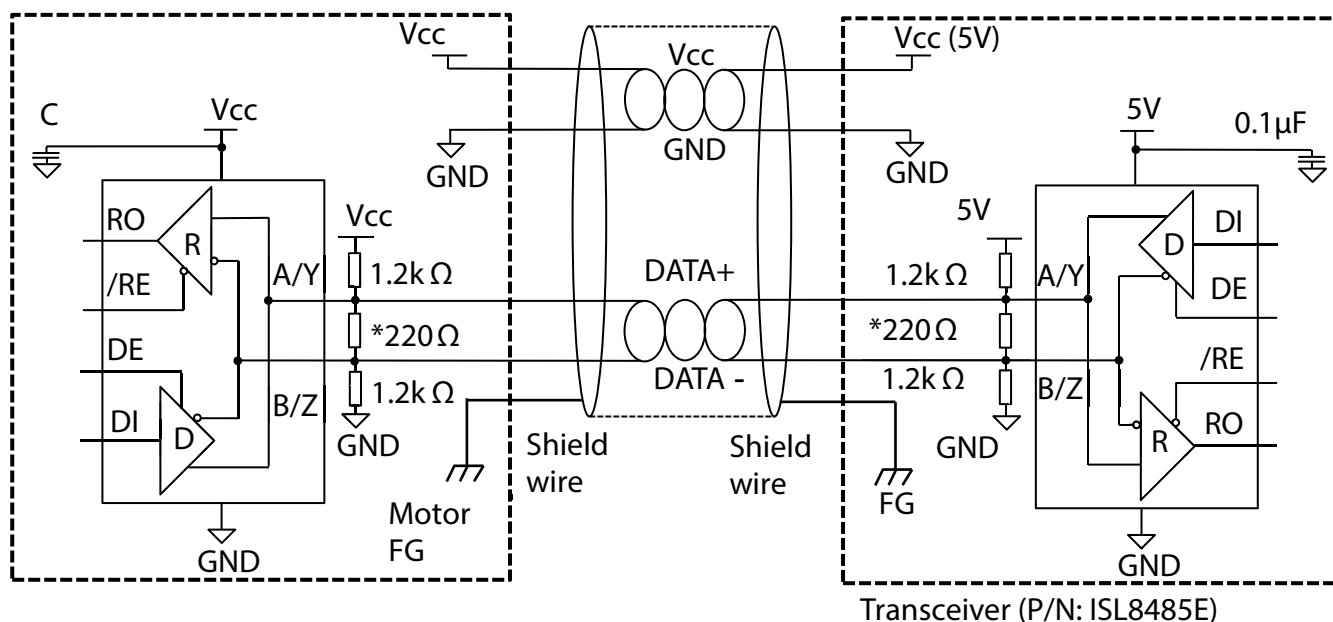


NOTE:

1. Use a termination resistor, *220Ω, but it may depend on the characteristic impedance of the types of cable being used.
2. The recommended differential transceiver part number: SN65LBC179Q.
3. Use a shielded, twisted-pair cable, and connect the cable shield to frame ground (FG) in applications for enhanced noise immunity in harsh operating conditions.
4. Maximum cable length: 25m.

Half-Duplex Transceiver (RS485 Half-Duplex Protocol)

Figure 5: Circuit Diagram of Half-Duplex Transceiver



NOTE:

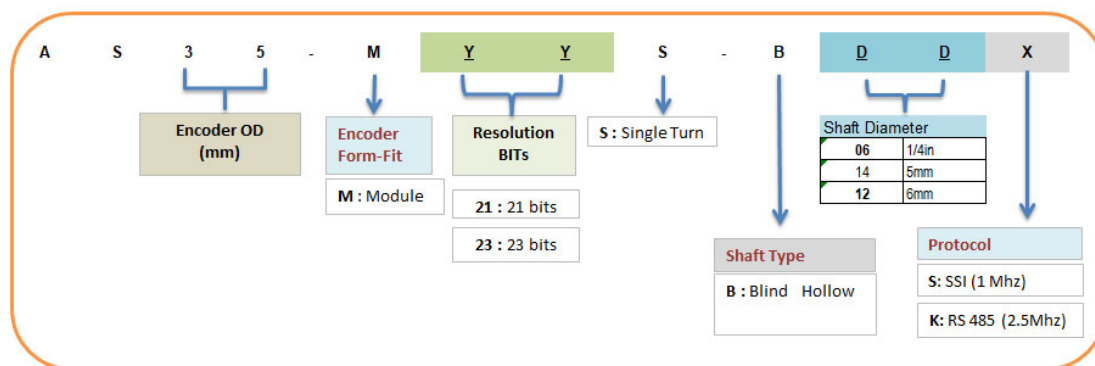
1. Use a termination resistor, *220Ω, but it may depend on the characteristic impedance of the types of cable being used.
2. The recommended differential transceiver part number: ISL8485E.
3. Use a shielded, twisted-pair cable, and connect the cable shield to frame ground (FG) in applications for enhanced noise immunity in harsh operating conditions.
4. Maximum cable length: 25m.

Connector Pin Output Assignments

Pinout	Description (RS485 Protocol)	Description (SSI Protocol)
1	GND, Ground	GND, Ground
2	VCC, Encoder Supply	VCC, Encoder Supply
3	Data –	DOUT–
4	Data +	DOUT+
5	N/A	SCL–
6	N/A	SCL+

Ordering Information

Encoder Part Numbers



NOTE: Refer to the factory for sample order and lead time.

Calibration Kit and Alignment Tools

1. AS35-M23S-0010 Set Height and Radial Alignment Jig
2. AS35-M23S-02K Electronic Phase Calibration Kit – RS485 Option
3. AS35-M23S-02S Electronic Phase Calibration Kit – SSI Option

Definitions of Terms

Abbreviation/Term	
Arc-sec or Arc-second	Angular measurement where 1 mechanical degree (°) is 60 arc-minutes, 1 arc-minute = 60 arc-seconds
ASIC	Application Specific Integrated Circuit
CRC	Cyclic redundancy check, Checksum
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMC	Electromagnetic compatibility
FG	Frame ground
IC	Integrated circuit
min-1	Rotational speed in revolutions per minute
MT	Multi turn
PCB	Printed circuit board
RPM	Revolutions per minute, angular rotational speed of a motor or an encoder shaft
sec or s	Second, a time unit
ST	Single turn
tbd	To be defined or to be determined

Broadcom, the pulse logo, Connecting everything, Avago Technologies, Avago, and the A logo are among the trademarks of Broadcom and/or its affiliates in the United States, certain other countries, and/or the EU.

Copyright © 2019 Broadcom. All Rights Reserved.

The term “Broadcom” refers to Broadcom Inc. and/or its subsidiaries. For more information, please visit www.broadcom.com.

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.