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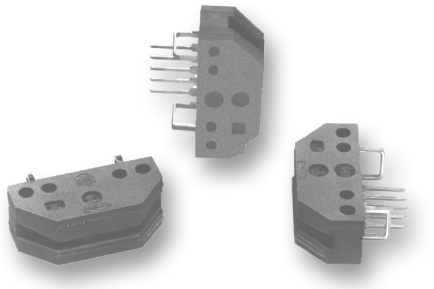
HEDS-9202
Two Channel Optical Incremental Encoder Modules 200 LPI Analog Output

Data Sheet



Description

The HEDS-9202 is a high-performance, low-cost, optical incremental encoder module. When operated in conjunction with either a codewheel or codestrip, this module detects rotary or linear position. The encoder module consists of a lensed LED source and a detector IC enclosed in a small C-shaped plastic package. Due to a highly collimated light source and a unique photodetector array, the module is extremely tolerant to mounting misalignment.

The two channel analog outputs and 5 V supply input are accessed through five 0.025 inch square pins located on 0.1 inch centers. The standard HEDS-9202 is designed for use with an appropriate optical radius codewheel, or linear codestrip.

Features

- Low cost
- Multiple mounting options
- 200 lpi resolution
- Linear and rotary options available
- No signal adjustment required
- Insensitive to radial and axial play
- –10°C to 100°C operating temperature
- Two channel analog output
- Single 5 V supply
- Wave solderable

Applications

The HEDS-9202 provides sophisticated motion detection at a low cost, making closed-loop control very cost-effective. Typical applications include printers, plotters, copiers, and office automation equipment.

Note: Avago Technologies' encoders are not recommended for use in safety critical applications, e.g., ABS braking systems, power steering, life support systems, and critical care medical equipment. Please contact sales representatives if more clarification is needed.

Theory of Operation

The HEDS-9202 is a C-shaped emitter/detector module. Coupled with a codewheel, it translates rotary motion into a two-channel analog output. Coupled with a codestrip, it translates linear motion into analog outputs. The module contains a single Light Emitting Diode (LED) as its light source. The light is collimated into a parallel beam by means of a single lens located directly over the LED. Opposite the emitter is the integrated detector circuit. This IC consists of multiple sets of photodetectors and the signal processing circuitry necessary to produce the analog waveforms. The codewheel/codestrip moves between the emitter and detector, causing the light beam to be interrupted by the pattern of spaces and bars on the codewheel/codestrip. The photodiodes which detect these interruptions are arranged in a pattern that corresponds to the radius and count density of the codewheel/codestrip. These detectors are also spaced such that a light period on one pair of detectors corresponds to a dark period on the adjacent pair of detectors. The photodiode outputs are fed through the signal processing

circuitry, which produces the final outputs for channels A and B. Due to this integrated phasing technique, the analog output of channel A is in quadrature with channel B (90 degrees out of phase).

Definitions

Count (N) = The number of bar and window pairs or Counts Per Revolution (CPR) of the codewheel, or the number of Lines Per Inch of the codestrip (LPI).

1 Shaft Rotation = 360 mechanical degrees
= N cycles
1 cycles (c) = 360 electrical degrees (°e)
= 1 bar and window pair

Pulse Width (P): The number of electrical degrees that an output is high during one cycle. This value is nominally 180°e or 1/2 cycle.

Pulse Width Error (DP): The deviation, in electrical degrees, of the pulse width from its ideal value of 180°e.

State Width (S): The number of electrical degrees between a transition in the output of channel A and the neighboring transition in the output of channel B. There are four states per cycle, each nominally 90°e.

State Width Error (DS): The deviation, in electrical degrees, of each state width from its ideal value of 90°e.

Phase (F): The number of electrical degrees between the center of the high state of channel A and the center of the high state of channel B. this value is nominally 90°e for quadrature output.

Phase Error (DF): The deviation of the phase from its ideal value of 90°e.

Direction of Rotation: When the codewheel rotates counterclockwise, as viewed looking down on the module (so the marking is visible), channel A will lead channel B. If the codewheel rotates in the opposite direction, channel B will lead channel A.

Optical Radius (Rop): The distance from the codewheel's center of rotation to the Optical Center (O.C.) of the encoder module.

Mounting Position (RM): Distance from Motor Shaft center of rotation to center of Alignment Tab receiving hole.

Absolute Maximum Ratings

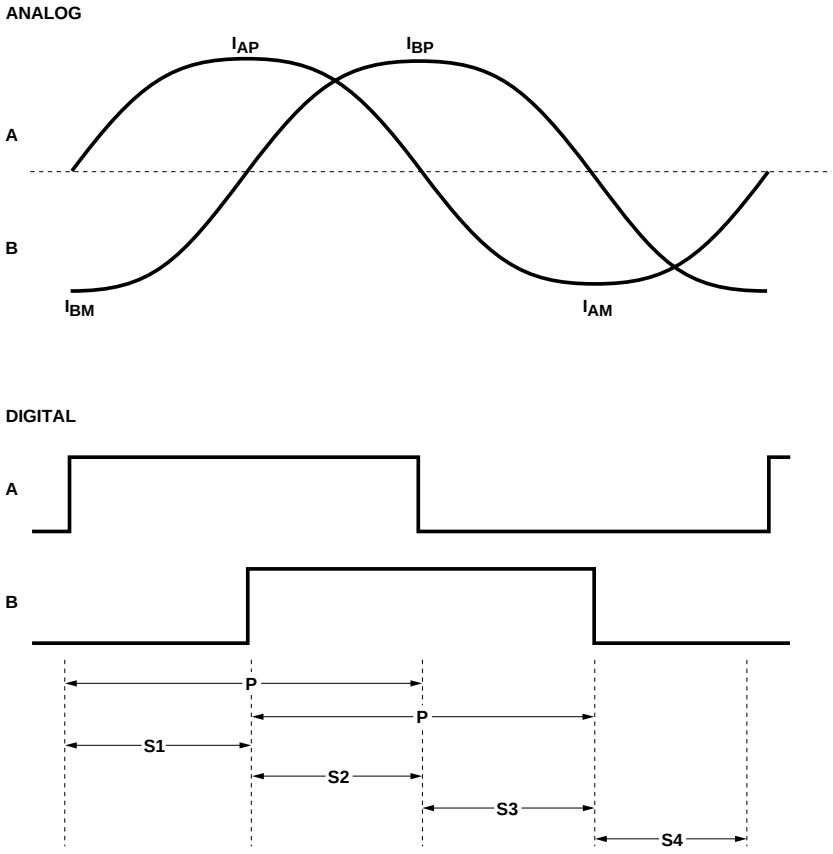
Subjecting the part to stresses beyond those listed under this section may cause permanent damage to the device. These are stress ratings only and it is not implied that devices function beyond these ratings. Exposure to the extremes of these conditions for extended periods may affect device reliability.

Parameter	Symbol	Min.	Max.	Unit	Notes
Storage Temperature	T_S	–40	100	°C	
Operating Temperature	T_A	–10	100	°C	
Supply Voltage	V_{CC}	–0.5	7	V	
Soldering Temperature			260	°C	t ≤ 5 sec.

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Temperature	T	–10	25	100	°C	
Supply Voltage	V_{CC}	4.8	5	5.2	V	Ripple < 100 mV_{p-p}
Count Frequency			8	120	kHz	(Velocity (rpm) x N) 60

Waveform Definition



Name	Parameter	Definition	Label
Analog Peak		The absolute value, in µA, of the magnitude of the analog signal (i.e., one-sided reading).	I_{AP}, I_{BP}, I_{AM}, I_{BM}
Analog Peak to Peak	I_{PP}	The peak to peak signal magnitude, in µA, of the analog signal.	I_{APP} I_{BPP}
Analog Offset	I_{OFFSET}	The offset, in µA, from the mid-point of the analog peak to peak signal to the zero current point.	
State Width	State Width	The number of electrical degrees between a transition in channel A and the neighboring transition in channel B. There are 4 states per cycle, each nominally 90°e. **The transitions are determined by where the analog signal crosses the Zero point.**	State 1 State 2 State 3 State 4
State Width Error	State Width Error	The deviation, in electrical degrees, of each state width from its ideal value of 90°e.	
Pulse Width	Pulse Width	The number of electrical degrees that an analog output is greater than zero during one cycle. This value is nominally 180°e or 1/2 cycle.	P
Pulse Width Error	Pulse Width Error	The deviation, in electrical degrees, of each pulse width from its ideal value of 180°e.	

Electrical/Optical Characteristics

Electrical Characteristics over Recommended Operating Range, Typical at 25°C.

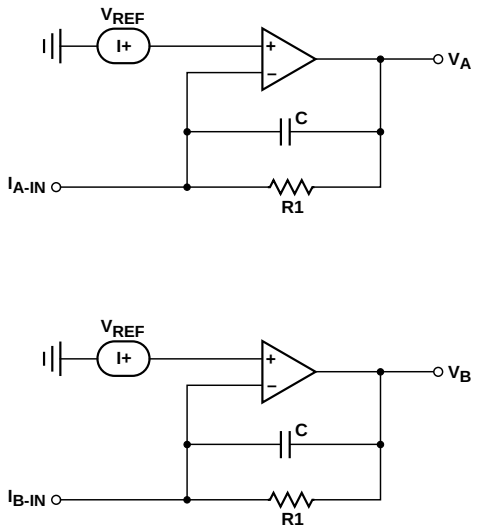
Parameter	Symbol	Min.	Typ.	Max.	Units	Notes
Supply Current	I_{CC}	16	18	30	mA	

Encoding Characteristics

Encoding Characteristics over Recommended Operating Range and Recommended Mounting Tolerances. These characteristics do not include codewheel/codestrip contributions.

	Units			Typ.
Radial	microns	±400		0
Tangential	microns	±500		0
Gap (codewheel from detector surface)	microns	50 - 850		250
Temp	°C	–10 to 100		25
O.R.	mm	15 to linear		23.36
CPR	count	744 to linear		1156
Codewheel Slot/Spoke	ratio	.9 - 1.1		1
		Min.	**Max.**	
I_{PP}	µA	10	85	60 - 70
I_{OFFSET}	µA	–4	+4	1
State Width Error	e°	–40	+40	4
Pulse Width Error	e°	–40	+40	8

Analog Encoder Interface Circuit



V_{REF} = 1.4 V ± 0.2 $V_{(DC)}$

The circuit shown can be used to convert the current output to a voltage. Resistor value, R1, and Capacitor, C, are specified to attain required gain and low pass filtering which are application specific. The gain is chosen to attain maximum output swing and not clamp the op-amp. V_{REF} should be set to 1.4 V + 0.2 V. A 0.1 µF bypass capacitor is recommended to be placed within 1 cm of the encoder for optimal power supply noise rejection. Outputs are high impedance (typical 1 MΩ) and susceptible to EMI.

Ordering Information

Device	Lead	Resolution
HEDS-9202	straight	R00 (200LPI)

Mounting Considerations

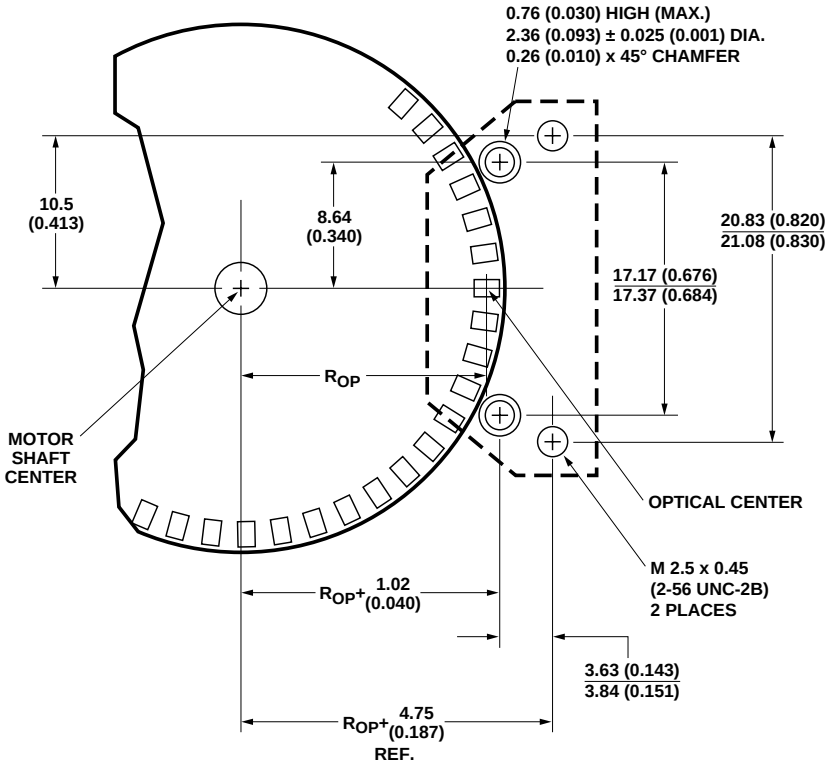


Figure 1. Mounting plane side A.

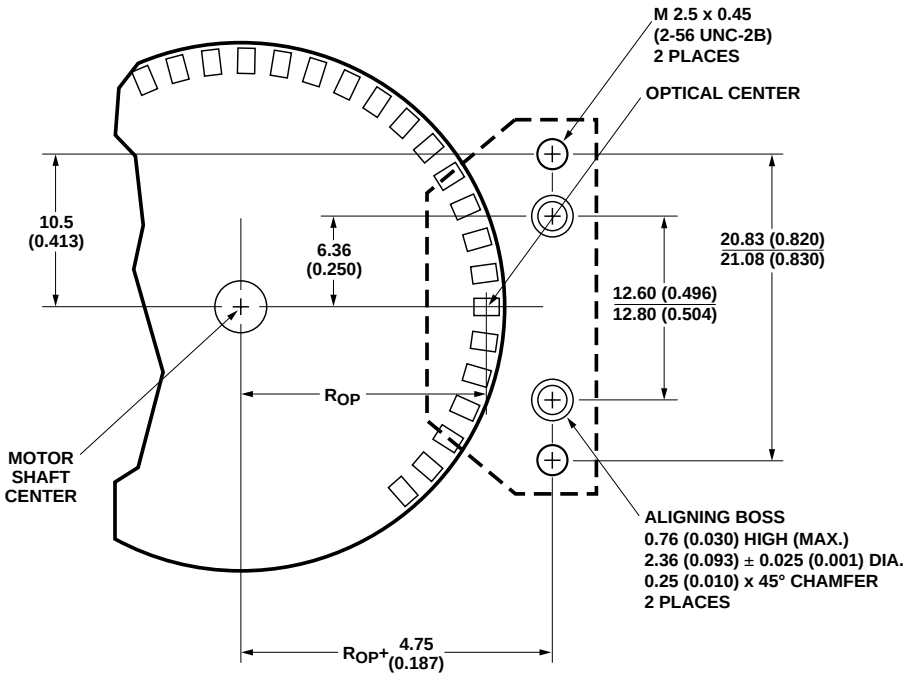
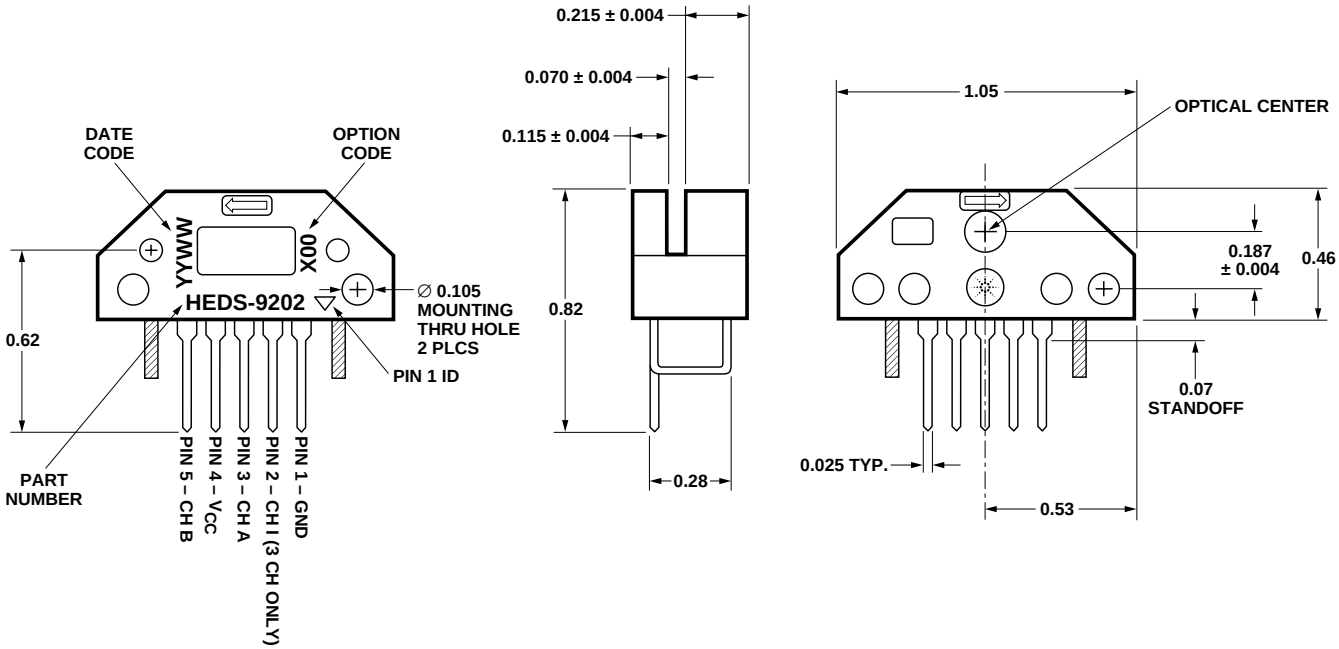


Figure 2. Mounting plane side B.

Package Dimensions



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