# HEDB-9100 and HEDB-9000

Two Channel Optical Incremental Encoder Modules Bundle With Codewheel

## Data Sheet



### Description

The HEDB-9100 and HEDB-9000 series are two channel optical incremental encoder modules offered with a codewheel. When used with a codewheel, these low cost modules detect rotary position. Each 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, these modules are extremely tolerant to mounting misalignment.

The HEDB-9100 and 9000 has two channel quadrature outputs.

The HEDB-9100 is designed for use with a HEDS-5120 codewheel which has an optical radius of 11.00 mm (0.433 inch).The HEDB-9000 is designed for use with a HEDS-6100 codewheel which has an optical radius of 23.36 mm (0.920 inch).

The quadrature signals and the single 5V supply input are accessed through five 0.025 inch square pins located on 0.1 inch (pitch) centers.

### Features

- High Performance
- Resolution from 96 CPR Up To 1000 CPR (Counts Per Revolution)
- Low Cost
- Easy to Mount
- No Signal Adjustment required
- Small Size
- Operating Temperature: -40°C to 100°C
- TTL Compatible
- Two Channel Quadrature Output
- Single 5V Supply

### Applications

The HEDB-9100 and 9000 provide sophisticated motion control detection at a low cost, making them ideal for high volume applications. Typical applications include printers, plotters, tape drives, and industrial and factory automation equipment.

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

## Theory of Operation

The HEDB-9100 and 9000 is emitter/detector modules. Coupled with a codewheel, these modules translate the rotary motion of a shaft into a two-channel digital output.

As seen in Figure 1, the modules contain a single Light Emitting Diode (LED) as its light source. The light is collimated into a parallel beam by means of a single polycarbonate 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 digital waveforms.

The codewheel rotates between the emitter and detector, causing the light beam to be interrupted by the pattern of spaces and bars on the codewheel.

The photodiodes which detect these interruptions are arranged in a pattern that corresponds to the radius and design of the code-wheel. 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 then fed through the signal processing circuitry resulting in A, Abar, B, Bbar. Two comparators receive these signals and produce the final outputs for channels A and B. Due to this integrated phasing technique, the digital output of channel A is in quadrature with that of channel B (90 degrees out of phase).

## Definitions

Note: Refer to Figure 2

**Count (N)**: The number of bar and window pairs or counts per revolution (CPR) of the codewheel.

**One Cycle (C)**: 360 electrical degrees (°e), 1 bar and window pair.

**One Shaft Rotation**: 360 mechanical degrees, N cycles.

**Position Error ($\Delta\Theta$)**: The normalized angular difference between the actual shaft position and the position indicated by the encoder cycle count.

**Cycle Error ($\Delta$C)**: An indication of cycle uniformity. The difference between an observed shaft angle which gives rise to one electrical cycle, and the nominal angular increment of 1/N of a revolution.

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

**Pulse Width Error ($\Delta$P)**: 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 4 states per cycle, each nominally 90°e.

**Phase ($\phi$)**: 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 ($\phi$)**: The deviation of the phase from its ideal value of 90°e.

**Direction of Rotation**: When the codewheel rotates in the clockwise direction viewing from top of the module (direction from V to G), 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.

## Specification

For encoder electrical, mechanical specifications, codewheel technical specifications and additional informations pls refer to :

- HEDS-9000 /9100 Datasheet.
- HEDS/HEDG/HEDM – 51xx/61xx Codewheel Datasheet

## Block Diagram

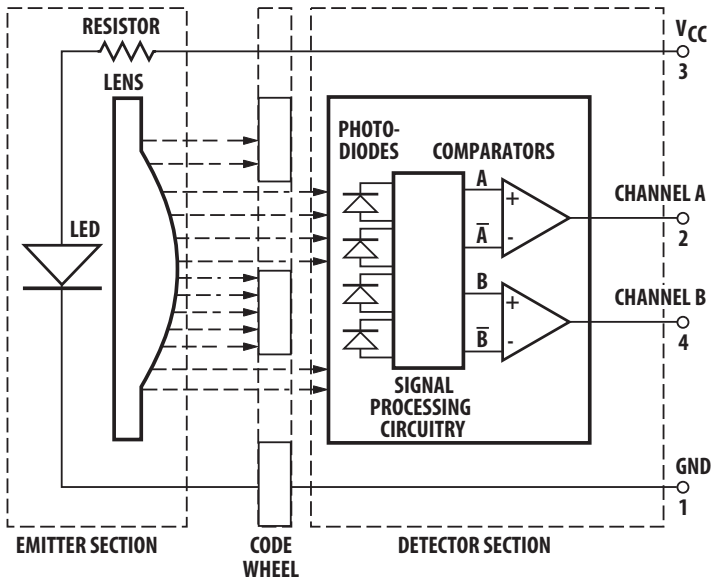



**Figure 1. Block Diagram**

## Output Waveforms

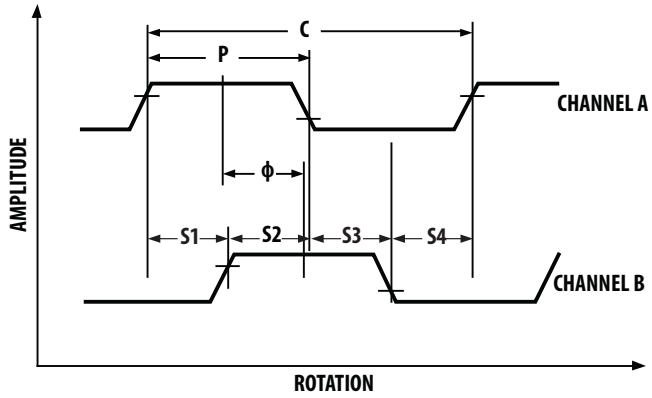
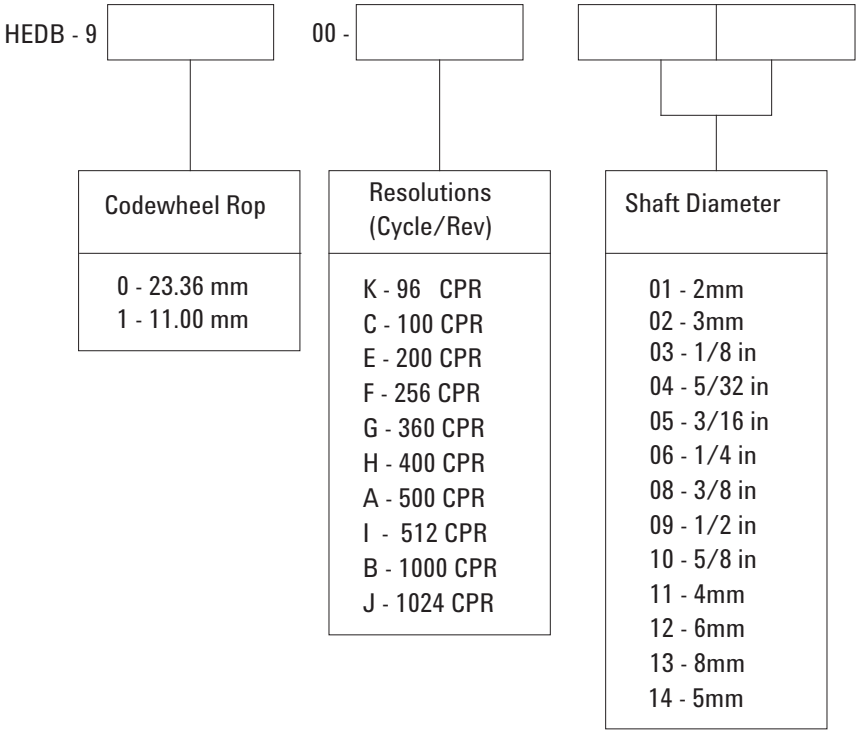



**Figure 2. Output waveforms**

## Ordering Information

Three Channel Encoder Modules with Codewheel, 11 mm and 23.36 Optical Radius




## Available Options

| | | Shaft Diameter Options | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Part Number** | **CPR** | **01** | **02** | **03** | **04** | **05** | **06** | **08** | **09** | **10** | **11** | **12** | **13** | **14** |
| HEDB-9100 | K | | • | | | | | | | | | | • | |
| | C | | • | | | | • | | | | • | • | • | • |
| | E | | | | | | • | | | | | • | | |
| | G | | • | • | | • | • | | | | • | | | • |
| | H | | • | | | • | • | | | | • | • | • | • |
| | A | • | • | • | • | • | • | | | | • | • | | • |
| | I | | • | | • | | • | | | | • | • | • | |

| | | Shaft Diameter Options | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Part Number** | **CPR** | **01** | **02** | **03** | **04** | **05** | **06** | **08** | **09** | **10** | **11** | **12** | **13** | **14** |
| HEDB-9000 | A | | | | | | | | • | | | • | • | |
| | B | | | | | | • | • | • | • | | | | |

## Bundle Part Number Breakdown List

HEDB - 9100 - [CPR] [Shaft Diameter]

- Encoder Module : HEDS-9100 - [CPR] 00
- Codewheel : HEDS - 5120 - [CPR] [Shaft Diameter]

HEDB - 9000 - [CPR] [Shaft Diameter]

- Encoder Module : HEDS-9000 - [CPR] 00
- Codewheel : HEDS - 6100 - [CPR] [Shaft Diameter]

Note : The bundle part HEDB-9100/9000 consists of HEDS-9100/9000 and HEDS-5120/6100. The diagram below provides the breakdown list.

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

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