HEDC-55xx/HEDC-56xx

Two or Three Channel Quick Assembly Encoders With Connector Latch

Avago
TECHNOLOGIES

Data Sheet

Description

The HEDC-5xxx-xxx, while similar to the industry standard HEDS-5xxx kit encoder, provides a connector latch on the cover housing to improve connector retention. This device is built upon the HP/Agilent/Avago HEDS-9000 series encoder module, and provides the same performance, low cost, high reliability, high resolution, and ease of assembly customers have come to expect.

Each encoder contains a lensed LED source, an integrated circuit with detectors and output circuitry. A codewheel (disk) which rotates between the emitter and detector IC generates two square waves in quadrature. Three channel units include an index pulse (high state) of 90°e, which is generated once for each full rotation.

HEDC-5xxx-xxx provides resolutions from 50 to 1024 CPR, and accommodating shaft diameters from 2 mm to 8 mm.

This kit encoder may be quickly and easily mounted to a motor. The electrical interface is through five (single ended) or ten (differential versions) 0.025 inch square pins on 0.100 centers. Interface cable assemblies to meet customer requirements are available also.

The differential (line driver) version offers enhanced performance when the encoder is used in noisy environments, or when it is required to drive long cables. It uses an industry standard RS422 compatible line driver IC, AEIC 7272, which provides differential outputs for each of the encoder channels. Suggested line receivers are 26LS32 and 26LS33.

Features

- Available in two or three channel encoder A, B and I
- Latching connector design
- Single 5 V supply
- Resolution of up to 1024 CPR
- TTL compatible, with single ended or differential output.
- Quick assembly
- No signal adjustment required
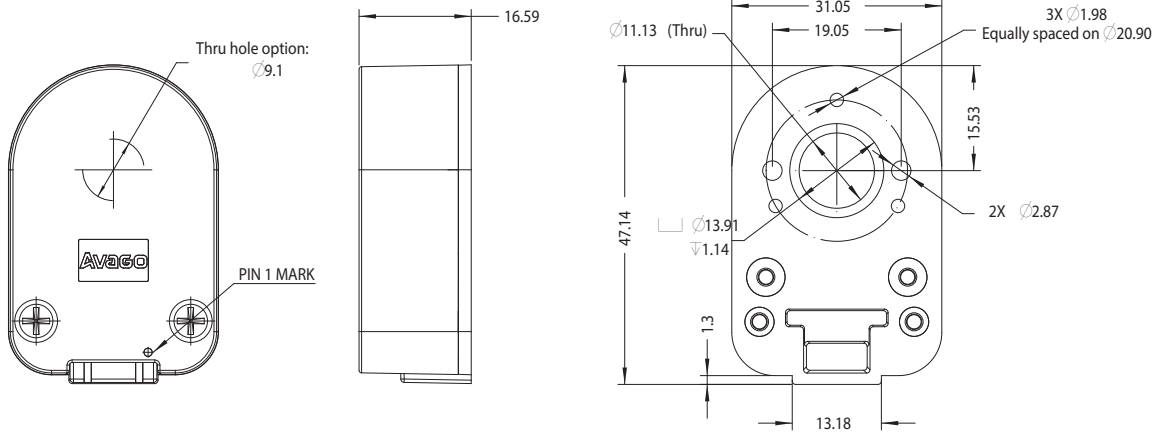- Small size -40° C to 100° C operating temperature

Applications

High volume applications such as printers, plotters, tape drives, textile machines, positioning tables and also automatic handlers among others.

Package Dimensions - HEDC-55xx / HEDC-56xx Single ended output:

Standard mounting considerations

16.59

Thru hole option:
∅9.1

PIN 1 MARK

31.05
19.05
∅11.13 (Thru)
3X ∅1.98
Equally spaced on ∅20.90
15.53
47.14
∅13.91
1.14
2X ∅2.87
1.3
13.18

Single ended output with standard mounting base plate

External ear mounting considerations

16.59
3.43

Thru hole option:
∅9.1

PIN 1 MARK

53.71
46.02
31.05
19.05
∅11.13 (Thru)
3X ∅1.98
Equally spaced on ∅20.90
2X ∅2.87
15.53
47.14
∅13.91
1.14
2X ∅2.87
1.3
13.18
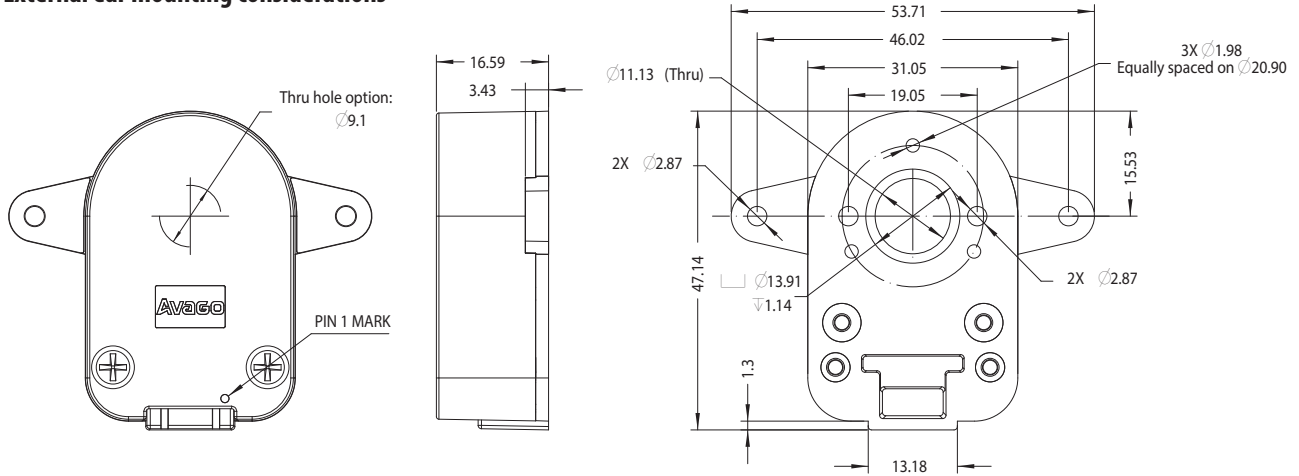
Single ended output with external ear mounting base plate

Package Dimensions

	single ended	differential/ line driver	unit
width	31.05	31.05	mm
height	16.59	16.59	mm
length	47.14	51.76	mm

A latching connector design is used on both versions.

47.14   **31.05**

16.59
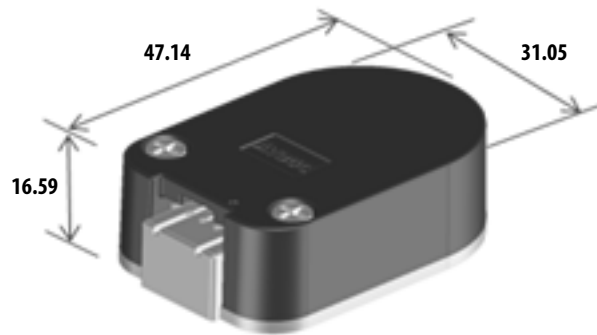
Single Ended Output Signals

Note: All dimensions are in millimeters

Package Dimensions - HEDC-55xx / HEDC-56xx Differential output:

Standard mounting considerations

THRU HOLE OPTION: ⌀9.1

PIN 1 MARK

16.59

⌀11.13 (Thru)

31.05

19.05

15.53

51.76

3X ⌀1.98
Equally spaced on ⌀20.90

2X ⌀2.87

⌀13.91
▽1.13

0.65

17.13

Differential output with standard mounting base plate

External ear mounting considerations

THRU HOLE OPTION: ⌀9.1

PIN 1 MARK

16.59

3.43

⌀11.13 (Thru)

53.71

46.02

31.05

19.05

15.53

51.76

3X ⌀1.98
Equally spaced on ⌀20.90

2X ⌀2.87

2X ⌀2.87

⌀13.91
▽1.13

0.65

17.13

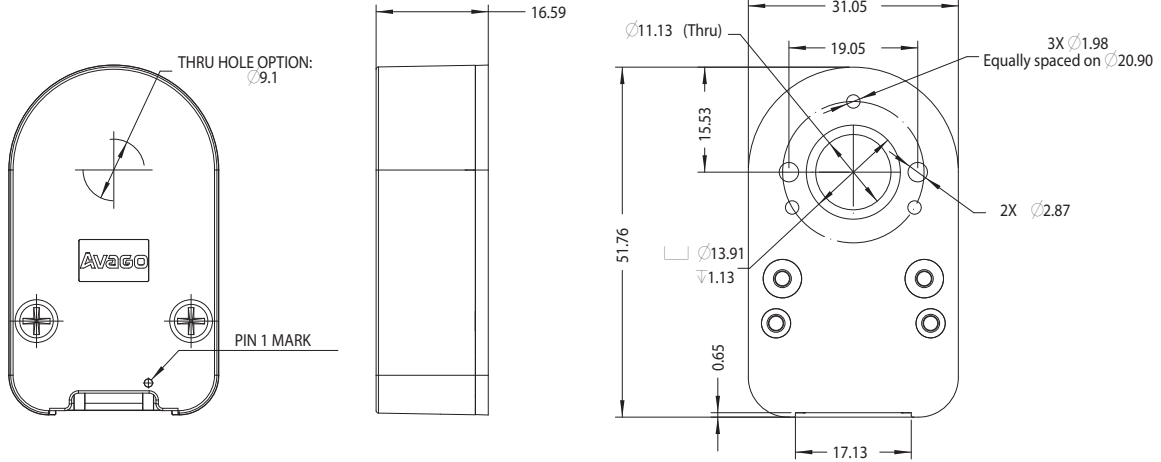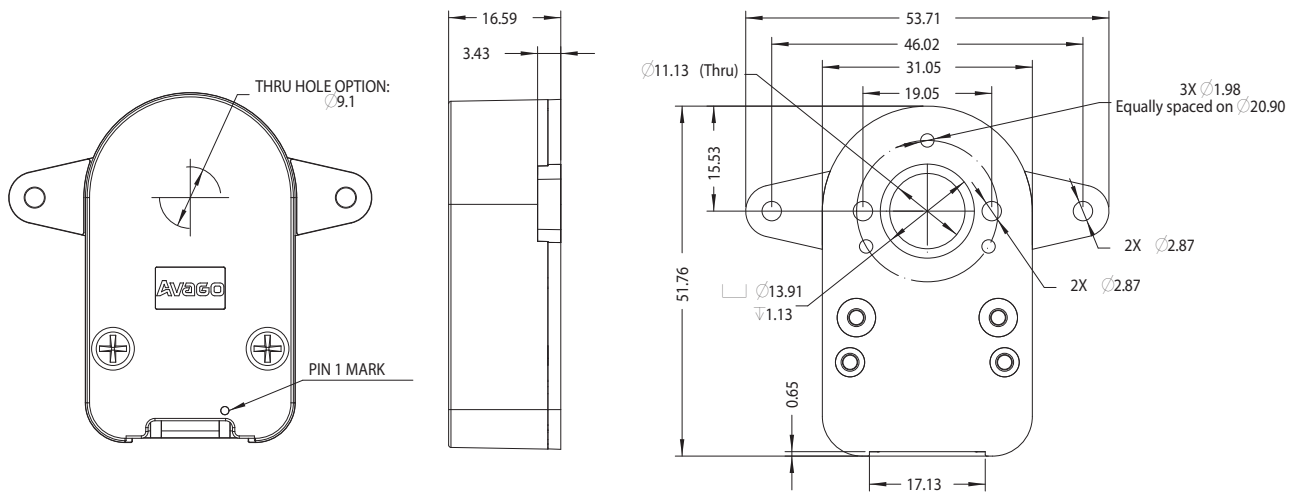**Differential output with external ear mounting base plate**

Package Dimensions

	single ended	differential/ line driver	unit
width	31.05	31.05	mm
height	16.59	16.59	mm
length	47.14	51.76	mm

A latching connector design is used on both versions.

51.76

31.05

16.59
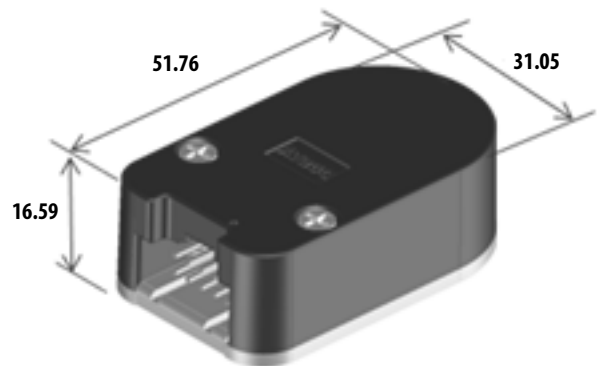
Differential Output Signals

Note: All dimensions are in millimeters

3

Theory of Operation

This encoder translates rotary motion of a shaft into a two or three-channel digital output.

As shown in the block diagram, these encoders 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 codewheel. The photodiode outputs are then fed through the signal processing circuitry resulting in A, A-Bar, B and B-Bar (also I and I-Bar for 3-channel units). 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).

The output of the comparator for I and I-Bar is sent to the index processing circuitry along with the outputs of channels A and B.

The final output of channel I is an index pulse PO which is generated once for each full rotation of the codewheel. This output PO is a one state width (nominally 90 electrical degrees), high state true pulse which is coincident with the low states of channels A and B.

Block Diagram

EMITTER SECTION   CODE WHEEL   DETECTOR SECTION
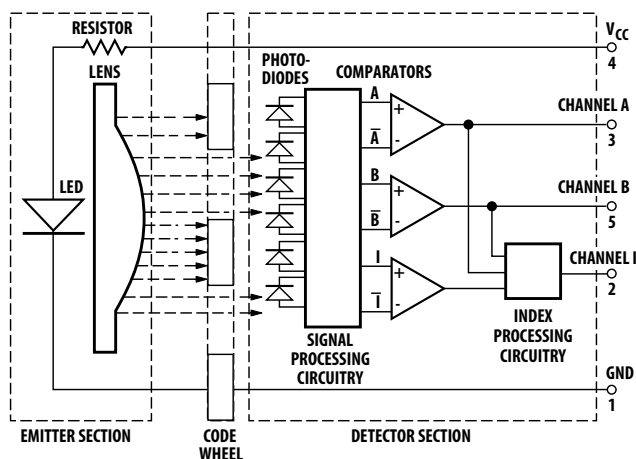
Definitions (see phase diagram)

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 (ΔC): 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 ½ cycle.

Pulse Width Error (ΔP): 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 neighbouring transition in the output of channel B. There are 4 states per cycle, each nominally 90°e.

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

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

Index Pulse Width (P_0): The number of electrical degrees that an index output is high during one full shaft rotation. This value is nominally 90°e or ¼ cycle.

Absolute Maximum Ratings

Parameter	
Storage Temperature, T_S	-40° C to 100° C
Operating Temperature, T_A	-40° C to 100° C
Supply Voltage, V_{CC}	-0.5 V to 7 V
Output Voltage, V_O	-0.5 V to V_{CC}
Output Current per Channel, I_{OUT} (Single ended)	-1.0 mA to 5 mA
Vibration	20 g, 5 to 1000 Hz
Shaft Axial Play	± 0.25 mm (± 0.010 in)
Shaft Eccentricity Plus Radial Play	0.1 mm (0.004 in)
Velocity	30,000 RPM
Acceleration	250,000 rad/sec^2

Direction of Rotation: When the codewheel rotates in the clockwise direction (as viewed from the encoder end of the motor), channel A will lead channel B. If the codewheel rotates in the counter-clockwise direction, channel B will lead channel A.

Index Pulse Width (P_0): The number of electrical degrees that an index output is high during one full shaft rotation. This value is nominally 90°e or ¼ cycle.
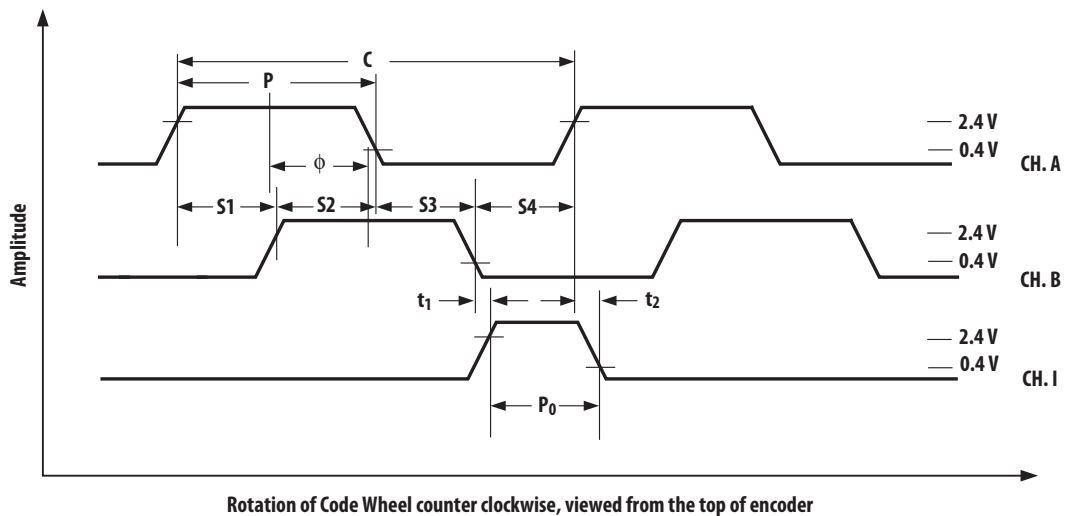
Output Waveform Phase Diagram

Clockwise Rotation – A leads B

Rotation of Code Wheel counter clockwise, viewed from the top of encoder

Recommended Operating Conditions

Parameter	Sym.	Min.	Typ.	Max.	Units	Notes
Temperature	T_A	-40		100	°C	
Supply Voltage	V_{CC}	4.5	5.0	5.5	Volts	Ripple < 100 mV_{p-p}
Load Capacitance	C_L			100	pF	2.7 kΩ pull-up
Count Frequency	f			100	kHz	Velocity (rpm) x N/60

Electrical Characteristics

Electrical Characteristics over Recommended Operating Range.

Part No.	Parameter	Sym	Min	Typ.*	Max.	Units	Notes
2 channel	Supply Current	I_{CC}		17	40	mA	
	High Level Output Voltage	V_{OH}	2.4			V	I_{OH} = -40 µA max
	Low Level Output Voltage	V_{OL}			0.4	V	I_{OL} = 3.2 mA
	Rise Time	t_r		200		ns	C_L = 25 pF
	Fall Time	t_f		50		ns	RL = 11 kΩ pull-up
3 channel	Supply Current	I_{CC}	30	57	85	mA	
	High Level Output Voltage	V_{OH}	2.4			V	I_{OH} = -200 µA max
	Low Level Output Voltage	V_{OL}			0.4	V	I_{OL} = 3.86 mA
	Rise Time	t_r		180		ns	C_L = 25 pF
	Fall Time	t_f		40		ns	RL = 2.7 kΩ pull-up
Line Driver	Rise/Fall time	t_r		120**		ns	C_L = 40 pF
		t_f					RL = 100 Ω

* Typical values specified at V_{CC} = 5.0 V and 25° C and for single ended, unless otherwise stated.
**Applicable for line driver output version.

Mechanical Characteristics

Parameter	Symbol	Dimension	Tolerance	Units
Codewheels Fit These Shaft Diameters		2, 3, 4, 5, 6, 8	+0.000 -0.015	mm
		5/32, 1/8, 3/16, 1/4	+0.0000 -0.0007	in
Moment of Inertia	J	0.6 (8.0 x 10^{-6})		g-cm^2 (oz-in-s^2)
Required Shaft Length		14.0 (0.55)	± 0.5 (± 0.02)	mm (in.)
Bolt Circle[3]	2 screw mounting	19.05 (0.750)	± 0.13 (± 0.005)	mm (in.)
	3 screw mounting	20.90 (0.823)	± 0.13 (± 0.005)	mm (in.)
	external mounting ears	46.0 (1.811)	± 0.13 (± 0.005)	mm (in.)
Mounting Screw Size	2 screw mounting	M 2.5 or (2-56)		mm (in.)
	3 screw mounting	M 1.6 or (0-80)		mm (in.)
	external mounting ears	M 2.5 or (2-56)		mm (in.)
Encoder Base Plate Thickness		0.33 (0.130)		mm (in.)
Hub Set Screw		(2-56)		(in.)

Notes
1. An optional cover provides an 8.9 mm (0.35 inch) diameter hole through the housing for longer motor shaft.
2. Encoder must be aligned as shown in the "Encoder Mounting and Assembly" instructions.
3. The recommended mounting screw torque for 2 screw mounting is 1.0 kg-cm (0.88 in-lbs). The recommended mounting screw torque for 3 screw mounting is 0.50 kg-cm (0.43 in-lbs).

Encoding Characteristics

Encoding characteristics are applicable per the Recommended Operating Conditions, unless otherwise specified. Values are for the worst case error over the full rotation.

	Description		Sym.	Min.	Typ.*	Max.	Units
Two Channel	Pulse Width Error		ΔP		7	45	°e
	Logic State Width Error		ΔS		5	45	°e
	Phase Error		$\Delta \Phi$		2	20	°e
	Position Error		$\Delta \Theta$		10	40	min. of arc
	Cycle Error		ΔC		3	5.5	°e
Three Channel	Pulse Width Error		ΔP		5	45	°e
	Logic State Width Error		ΔS		5	35	°e
	Phase Error		$\Delta \Phi$		2	15	°e
	Position Error		$\Delta \Theta$		10	40	min. of arc
	Cycle Error		ΔC		3	5.5	°e
	Index Pulse Width		P_O	55	90	125	°e
	CH.I rise after CH.A or CH. B fall	-40° C to +100° C	t_1	-300	100	250	ns
	CH.I fall after CH.A or CH. B rise	-40° C to +100° C	t_2	70	150	1000	ns

Electrical Interface

To ensure reliable encoding performance, the three channel single ended encoders require 2.7 kΩ (±10%) pull-up resistors on output pins 2, 3 and 5 (Channels A, B and I) as shown in Figure 1. These pull-up resistors should be located as close to the encoder as possible (within 4 feet). Each of the outputs can drive a single TTL load in this configuration. The two channel version does not normally require pull-up resistors. However, 3.2 kΩ pull-up resistor on output pins 3 and 5 (Channel A and B) are recommended to improve rise times, especially when operating above 100 KHz frequencies.

For the line driver option, differential loading of 100 Ω and 40 pf (RS422 configuration), yields rise and fall times of 120 ns typical, with approximately 60 ns of skew. Driving moderate to long lengths of cable un-terminated reduces power consumption and can reduce skew to < 10 ns.
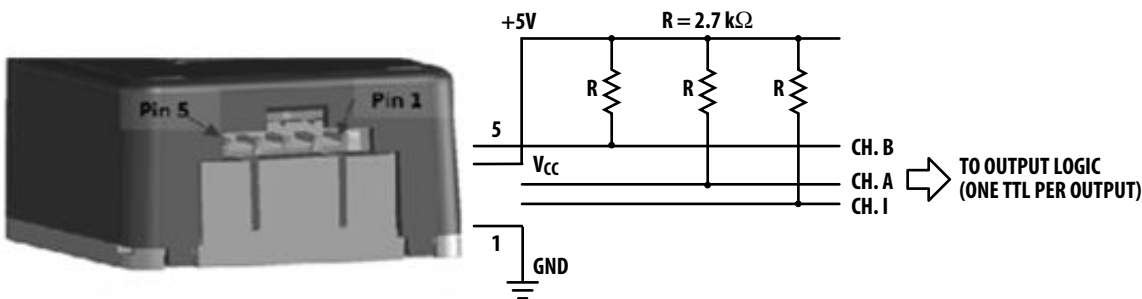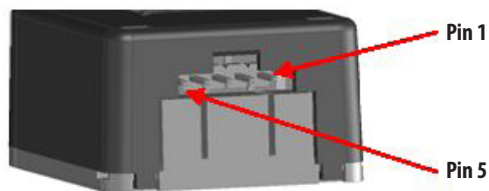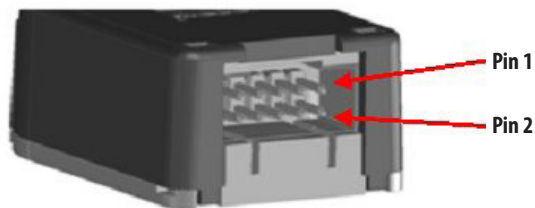

Figure 1. Pull-up resistors on 3 Channel encoder output

Pin out descriptions

5 Pin (Single Ended) Version

10 Pin (Differential Line Driver) Version

Pin #	Description
1	Ground
2	CH I (*)
3	CH A
4	+ 5 VDC
5	CH B

Pin #	Description Standard	Description HP/Agilent Option
1	Ground	No connection
2	Ground	+ 5 VDC
3	Ch I- (*)	Ground
4	Ch I+ (*)	No connection
5	Ch A-	CH A –
6	Ch A+	CH A +
7	+5VDC	CH B –
8	+5VDC	CH B +
9	CH B-	CH I – (*)
10	CH B+	CH I + (*)

(*) – Applicable to 3 channel units only

Standard Cable options

Cable Description (All include one end terminated with the mating latching connector, and the other end has flying leads.)	Part Number	Shielded Cable Length
5 conductor, unshielded 22 ga (for single ended use)	HEDC-8520-0060	600 mm
8 conductor, shielded, 24 ga (for line driver use) – Standard option	HEDC-8850-0060	600 mm
8 conductor, shielded, 24 ga (for line driver use) – HP/Agilent/Avago option	HEDC-8851-0060	600 mm

For other cable options or customization request, please contact your Avago representative or distributor.

Connector (HEDC-8520-0060)

Twisted & tinned pig tail

5 ±1.00
70 ±3.00
⌀5.00 ±0.50
25 ±2.00
600 ±30.00

Front1
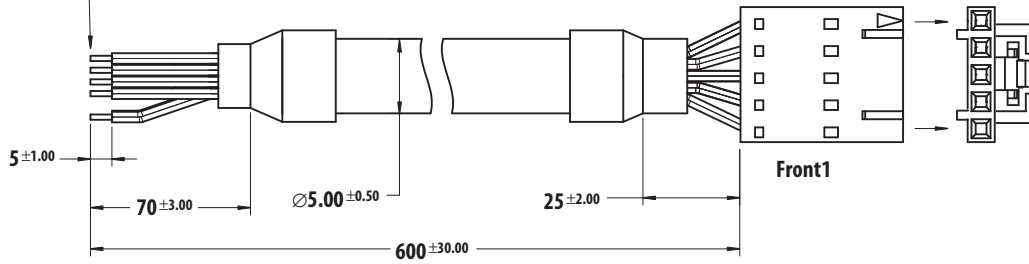
Pin 1: Color: Black (GND)
Pin 2: Color: Green (I)
Pin 3: Color: White (A)
Pin 4: Color: Red (+5VDC)
Pin 5: Color: Brown (B)

Right1

Connector (HEDC-88xx-0060)

Twisted & tinned pig tail

5 ±1.00
70 ±3.00
⌀7.00 ±0.50
25 ±2.00
600 ±30.00

Front1

Standard connector pin out (HEDC-8850-0060)

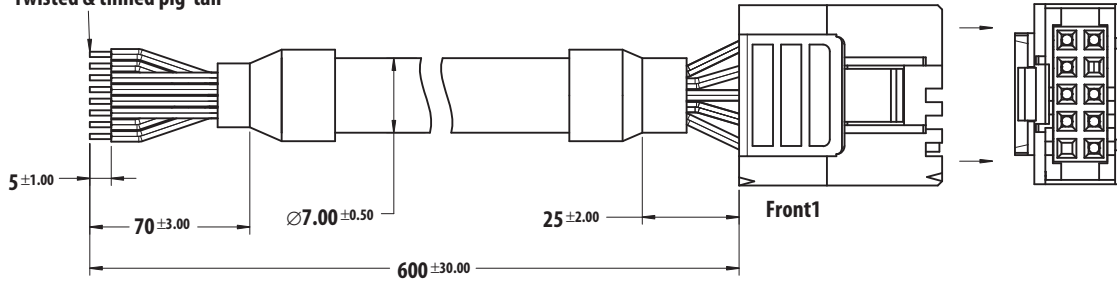|		
Color: White/Brown Stripe (B-)	Pin 9:	Pin 10: Color: Brown/White Stripe (B+)
Color: White/Green Stripe (+5VDO)	Pin 7:	Pin 8: Not connected
White/Blue Stripe (A-)	Pin 5:	Pin 6: Color: Blue/White Stripe (A+)
White/Orange Stripe (I-)	Pin 3:	Pin 4: Color: Orange/White Stripe (I+)
Not connected	Pin 1:	Pin 2: Color: Green/White Stripe (GND)

Right1
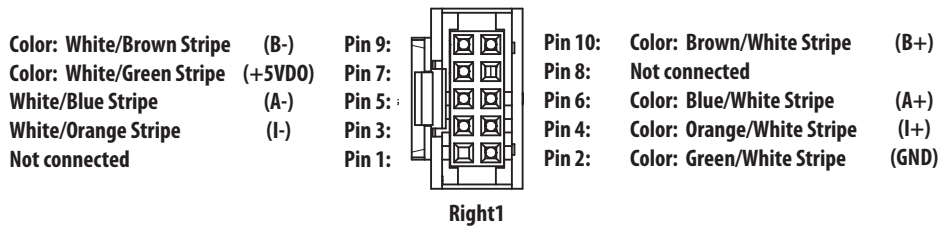
HP/Agilent/Avago connector pin out (HEDC-8851-0060)

Color: White/Brown Stripe (I-)	Pin 9:	Pin 10: Color: Brown/White Stripe (I+)
Color: White/Green Stripe (B-)	Pin 7:	Pin 8: Color: Green/White Stripe (B+)
White/Blue Stripe (A-)	Pin 5:	Pin 6: Color: Blue/White Stripe (A+)
White/Orange Stripe (GND)	Pin 3:	Pin 4: Not connected
Not connected	Pin 1:	Pin 2: Color: Orange/White Stripe (+5VDC)

Right1

9

Ordering Information

| H | E | D | C | – | 5 | 5 | 2 | 0 | – | E | 0 | 1 |

Through Hole

0	None
1	Cover Extension
2	Hole in Cover

Resolution CPR

S	50
K	96
C	100
D	192
E	200
F	256
G	360
H	400
A	500
I	512
B	1000
J	1024

Shaft Diameter

01	2 mm
02	3 mm
03	1/8 in
04	5/32 in
05	3/16 in
06	1/4 in
11	4 mm
14	5 mm
12	6 mm
13	8 mm
16	5/16 in

Output

2	2 Channel – Voltage (*)
3	2 Channel – Differential (*)
5	3 Channel – Differential (AVAGO)
6	3 Channel – Voltage (*)
7	3 Channel – Differential (*)

Mounting Type

5	Standard
6	External Mounting Ear

Avago Part Number	Cross – Reference US Digital E5 Part Number	Mounting	Channels	Pinout	Option	Through hole	cpr	Shaft ⌀
HEDC-5520 - B03	E5-1000-125-N-S-D-D	Standard	Two	Standard	single ended	none	1000cpr	1/8 inch
HEDC-5520 - B04	E5-1000-156-N-S-D-D	Standard	Two	Standard	single ended	none	1000cpr	5/32 inch
HEDC-5520 - H03	E5-400-125-N-S-D-D	Standard	Two	Standard	single ended	none	400cpr	1/8 inch
HEDC-5520 - H14	E5-400-197-N-S-D-D	Standard	Two	Standard	single ended	none	400cpr	5mm
HEDC-5522 - H14	E5-400-197-N-S-H-D	Standard	Two	Standard	single ended	cover	400cpr	5mm
HEDC-5520 - A06	E5-500-250-N-S-D-D	Standard	Two	Standard	single ended	none	500cpr	1/4 inch
HEDC-5520 - J14	E5-1024-197-N-S-D-D	Standard	Two	Standard	single ended	none	1024cpr	5mm
HEDC-5520 - B14	E5-1000-197-N-S-D-D	Standard	Two	Standard	single ended	none	1000cpr	5mm
HEDC-5520 - B13	E5-1000-315-N-S-D-D	Standard	Two	Standard	single ended	none	1000cpr	8mm
HEDC-5560 - B14	E5-1000-197-I-S-D-D	Standard	Three	Standard	single ended	none	1000cpr	5mm
HEDC-5562 - E06	E5-200-250-I-S-H-D	Standard	Three	Standard	single ended	cover	200cpr	¼ inch
HEDC-5560 - B14	E5-1000-197-I-S-D-D	Standard	Three	Standard	single ended	none	1000cpr	5mm
HEDC-5660 - B13	E5-1000-315-I-S-D-G	External Ear	Three	Standard	single ended	none	1000cpr	8mm
HEDC-5560 - E14	E5-200-197-I-S-D-D	Standard	Three	Standard	single ended	none	200cpr	5mm
HEDC-5652 - H06	E5-400-250-I-L-H-G	External Ear	Three	Avago	differential	cover	400cpr	1/4 inch
HEDC-5652 - H16	E5-400-313-I-L-H-G	External Ear	Three	Avago	differential	cover	400cpr	5/16 inch
HEDC-5652 - B06	E5-1000-250-I-L-H-G	External Ear	Three	Avago	differential	cover	1000cpr	1/4 inch
HEDC-5550 - H14	E5-400-197-I-L-D-D	Standard	Three	Avago	differential	none	400cpr	5mm
HEDC-5552 - H14	E5-400-197-I-L-H-D	Standard	Three	Avago	differential	cover	400cpr	5mm
HEDC-5570 - B03	E5-1000-125-I-D-D-D	Standard	Three	Standard	differential	none	1000cpr	1/8 inch
HEDC-5570 - B14	E5-1000-197-I-D-D-D	Standard	Three	Standard	differential	none	1000cpr	5mm
HEDC-5570 - A14	E5-1000-500-I-D-D-D	Standard	Three	Standard	differential	none	500cpr	5mm
HEDC-5670 - B12	E5-1000-236-I-D-D-D	External Ear	Three	Standard	differential	none	1000cpr	6mm

For other options or customization requests, please contact your Avago representative or distributor.

Disclaimer: All the above information is preliminary and subjected to change. Please contact factory for further information.

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

Avago
T E C H N O L O G I E S

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

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