AVAGO
TECHNOLOGIES

Motion Sensing and Control Products

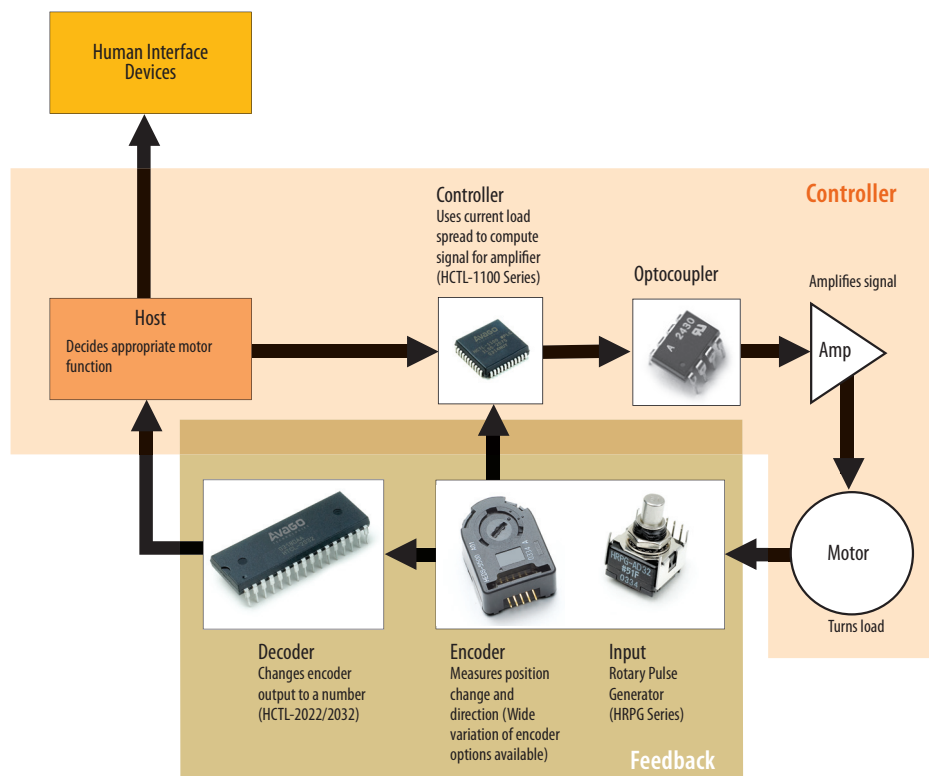## Selection Guide

Performance in Motion

Avago Technologies is the industry-leading supplier of motion control encoders.
Avago offers "one-stop shopping" with its extensive portfolio of encoders, decoders and controllers. We offer the industry's smallest form factors, widest range of resolutions, and highest level of integration to reduce the number of components needed and shorten time-to-market.

Introduction

Motion control, in broad definition, means converting mechanical movement from codewheel/codestrip into equivalent electrical signals to move an object in an accurate and precise manner.

High accuracy, ease of use, low cost and global support…these words are rarely spoken in the same breath to describe anything. With Avago's range of optical encoders, this is now a reality.

Avago started out designing and selling classical optical encoders and has progressed to designing and manufacturing ultra miniature optical encoders. With these technologies, Avago has enabled designers to miniaturize their design with full confidence of excellent performance. Avago is changing the landscape of rotary and linear motion control.

Human Interface Devices

Controller
Uses current load spread to compute signal for amplifier (HCTL-1100 Series)

Optocoupler

Amplifies signal

Controller

Host
Decides appropriate motor function

Amp

Motor

Turns load

Decoder
Changes encoder output to a number (HCTL-2022/2032)

Encoder
Measures position change and direction (Wide variation of encoder options available)

Input
Rotary Pulse Generator (HRPG Series)

Feedback

Encoder accuracy, large range of Counts Per Revolution (CPR) options, low cost and high reliability have been key customer requirements. With Avago's range of optical encoders, these criteria are met and exceeded. Also, as Avago's encoders are optics based, they are immune to RF interference.

For almost all closed-loop feedback systems, the encoder's role as positioning sensor is crucial in providing the direct measurement for position and movement within the system. Avago provides a whole range of encoders capable of meeting these stringent needs.

Applications

Avago's products meet the stringent requirements, in a wide range of applications from printers, copiers and scanners to servo and stepper motors, and robotic arms and wafer-handling machines.

Office Automation
- Printers
- Copiers
- Tape Drives
- Plotters

Consumer
- Cameras
- Card Readers
- Motor Control
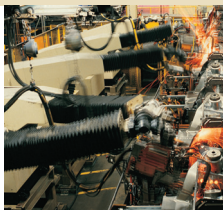
Motor Manufacturers
- DC Motors
- Stepper Motors
- Servo Motors

Instruments
- Audio & Visual Boards

Industrial Automation
- Wafer Handling Machines
- Industrial Sewing Machines
- Robotics
- CAD/CAM Dial Boxes
- Vending Machines

Medical
- Blood Analyzers
- Lab Sample Handling Equipment
- Surgical Robotics

Value Propositions

Customer Reach

Worldwide distribution/channels, with Technical Response Centers, supported by experienced Field Application Engineers

State-of-the-Art-Technology

Innovative designs by a vast pool of experienced software, hardware and IC designers to deliver the ultimate performance product

High Quality Services

ISO Certified, continuous process improvement, field support from all regions and quality management of supply chain

Our Commitment

Our worldwide support team will work with you to meet your requirements and put your designs in motion.

	Features	Benefits
Reliability	Longer lifespan for optical encoders due to elimination of mechanical parts.	Low maintenance cost.
Size	Integrated encoder solution comes in different packages (e.g. chip-size and SOIC packages vs. industrial-grade robust housing) and mountings that can be catered to customer's specific needs.	Small form factor. High performance in small package. Well suited for space-constrained applications.
Reduced Switching Glitch	Optical technology promotes quiet switching as no switching transients are generated without electrical contacts.	Accurate and precise motion sensing.
High Resolution	• Up to 80,000 counts per revolution (incremental) • Up to 65,536 positional data per revolution (absolute) • Up to 1 million or more positional data per revolution for customized solutions. Technology is not limited to quasi absolute/absolute.	Accurate and precise motion sensing.
Surface Mount	Smaller package delivers the same functionality as standard DIP.	Lower assembly cost. Easier, faster handling, improved solderability.
Cost-Effective, High Performance	Newest encoder module features reduced component and package sizes. Delivers higher performance, easier installation through patented alignment plug and play tool.	Reduced design cycles. Small form factor. Reduced cost.

Motion Control Products Overview

Optical Encoder							
Module					**Housed**		
Transmissive							

Incremental — Transmissive Module:
HEDS-90/91/92x HEDS-97xx AEDB-9140 AEDA-32xx AEDB-9340

HEDL-90/91xx HEDT-90/91xx AEDS-96xx AEDA-33xx

Incremental — Transmissive Housed:
HEDx-55/56xx HEDx-65xx HEDS-57xx (Rotary Pulse Generator)

HEDL-55/65xx

Reflective

AEDR-80xx AEDR-84xx
AEDR-83xx

HEDR-54xx HRPG-Axxx (Rotary Pulse Generator)

Optical Encoder		Codewheel/Codestrip	Integrated Circuit	
Module		**Metal/Mylar/Glass**	**Controller**	**Decoder/Counter**
Transmissive				

Absolute:
AEAS-7000/7500 AEAT-84/86AD HEDx-51/61xx HCTL-1100 HCTL-20xx

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Transmissive

Photointerrupters:
AEDS-9300 AEDS-9310

Note: Avago Technologies 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 your sales representative for further clarification.

Incremental Optical Encoders
Transmissive Module

HEDS-90xx/91xx/9200, HEDL-90xx/91xx Series, HEDT-90xx/91xx Series
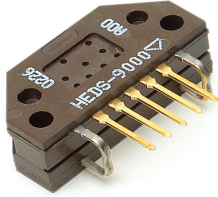
Description

HEDS-9000/9040/9100/9140 Series

- High-performance two/three channel rotary encoder

- Consists of a lensed (LED) source and a detector IC enclosed in a small C-shaped plastic package

- Extremely tolerant to mounting misalignment due to a highly collimated light source and unique photodetector array

- The single 5-V output supply input are accessed through five 0.025 inch square pins located on 0.1 inch centers

- HEDS-9000 resolution: from 500 to 2048 CPR when used with appropriate codewheel

- HEDS-9040 is designed for use with a HEDx-614x codewheel which has an optical radius of 23.36 mm (0.920 inch)

- HEDS-9100 resolution: from 50 to 1024 CPR when used with appropriate codewheel

- HEDS-9140 is designed for use with the HEDS-5140 codewheel which has an optical radius of 11.00 mm (0.433 inch)

HEDS-9200 Series

- Same features as listed above

- Detects linear position when operated in conjunction with a codestrip

HEDL-90xx/91xx Series

- Differential outputs

- Utilizes an industry-standard line driver IC, 26C31, which provides complementary outputs for each encoder channel

- Offers enhanced performance when the encoders are used in noisy environments, or when required to drive long distances

- Suggested line receivers are 26C32 and 26C33

- Quadrature signals are accessed through a cable and 10-pin female connector, which is manufactured by FCI, part number: 66900-310

- Mating connectors manufactured by FCI; straight type part number: 71912-010, right angle type part number: 71913-010

HEDT-90xx/91xx Series

- High performance

- Low cost

- Operates to 125°C

- Ideal for high volume automotive applications

HEDT-9040/9140 Series

- High temperature

- Three channels (two channel quadrature output plus a third channel index output)

- Operates up to 140°C

Features

- High performance

- High resolution

- Low cost

- Easy to mount

- No signal adjustment required

- Small size

- -40°C to 100°C operating temperature (up to 140°C for high temperature version)

- Two and three channel quadrature output

- TTL compatible output

- Single 5-V supply

- Count frequency of 100 KHz

Applications
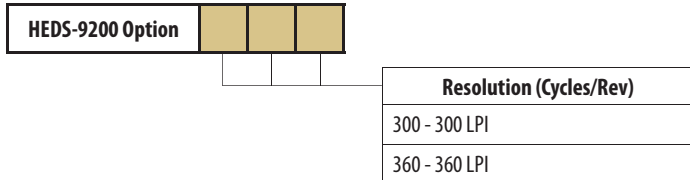
Ideal for high-volume applications:

- Printers

- Plotters

- Tape drives

- Factory automation equipment

Package Dimensions

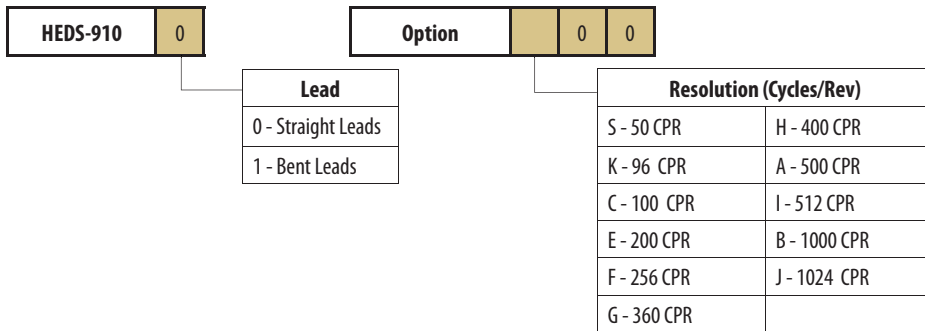- Refer to product datasheet for package dimensions

Ordering Information

Two Channel Linear Encoders Module – HEDS-9200 Series

HEDS-9200 Option ☐ ☐ ☐

Resolution (Cycles/Rev)
300 - 300 LPI
360 - 360 LPI

Two Channel Incremental Encoders – HEDS-910x series
Note: To be used with 11mm diameter codewheel

HEDS-910 0   **Option** ☐ 0 0

Lead
0 - Straight Leads
1 - Bent Leads

Resolution (Cycles/Rev)	
S - 50 CPR	H - 400 CPR
K - 96 CPR	A - 500 CPR
C - 100 CPR	I - 512 CPR
E - 200 CPR	B - 1000 CPR
F - 256 CPR	J - 1024 CPR
G - 360 CPR	

Available Options												
Part Number	Options											
	A	B	C	D	E	F	G	H	I	J	K	S	T	U
HEDS-9100	•	•	•		•	•	•	•	•	•	•	•		
HEDS-9101	•		•		•		•							
Refer to codewheel ordering information for recommended usage												

Three Channel Incremental Encoders – HEDS-914x series
Note: To be used with 11mm diameter codewheel

HEDT -914 0   **Option** ☐ 0 0

Assembly tool: HEDS-8905

Lead
0 - Straight Leads
1 - Bent Leads

Resolution (Cycles/Rev)	
S - 50 CPR	G - 360 CPR
C - 100 CPR	H - 400 CPR
E - 200 CPR	A - 500 CPR
F - 256 CPR	I - 512 CPR
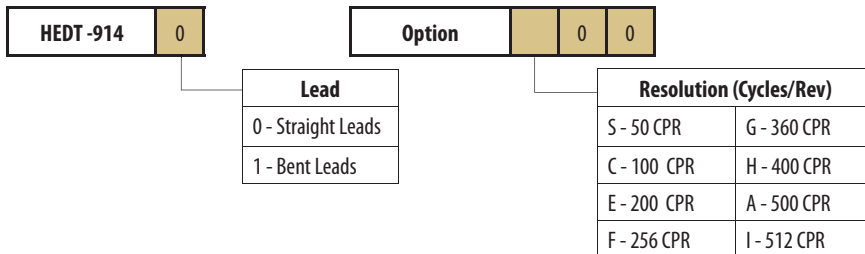
Available Options												
Part Number	Options											
	A	B	C	D	E	F	G	H	I	J	K	S	T	U
HEDS-9140	•		•		•	•	•	•			•			
HEDS-9141	•				•	•	•							
Refer to codewheel ordering information for recommended usage												

Ordering Information

Two Channel Incremental Encoders – HEDS-900x series
Note: To be used with 23.36mm diameter codewheel

HEDS-9000 Option		0	0

Resolution (Cycles/Rev)	
A - 500 CPR	B - 1000 CPR
J - 1024 CPR	T - 2000 CPR
U - 2048 CPR	

Available Options													
Part Number	Options												
	A	B	C	D	E	F	G	H	I	J	K	S	T	U
HEDS-9000	•	•								•			•	•
Refer to codewheel ordering information for recommended usage													

Three Channel Incremental Encoders – HEDS-904x series
Note: To be used with 23.36mm diameter codewheel

HEDS-904	0

Lead	
0 - Straight Leads	
1 - Bent Leads	

Option		0	0

Resolution (Cycles/Rev)
B - 1000 CPR
T - 2000 CPR
J - 1024 CPR

Available Options													
Part Number	Options												
	A	B	C	D	E	F	G	H	I	J	K	S	T	U
HEDS-9040		•								•			•	
HEDS-9041		•												
Refer to codewheel ordering information for recommended usage													

High Temp 125°C Two Channel Optical Incremental Encoder Modules – HEDT-9000/9100 series

HEDT -910	0

Lead	
0 - Straight Leads	
1 - Bent Leads	

Option		0	0

Resolution (Cycles/Rev)	
C - 100 CPR	G - 360 CPR
D - 192 CPR	A - 500 CPR
E - 200 CPR	I - 512 CPR

Available Options						
Part Number	Options					
	A	C	D	E	G	I
HEDT-9001	•					
HEDT-9100	•	•		•	•	•
HEDT-9101	•	•	•	•	•	•
Refer to codewheel ordering information for recommended usage						

Ordering Information

High Temp 140°C Three Channel Optical Incremental Encoder Modules – HEDT-9040/9140 series

HEDT-914	0

Lead
0 - Straight Leads
1 - Bent Leads

Option	0	0

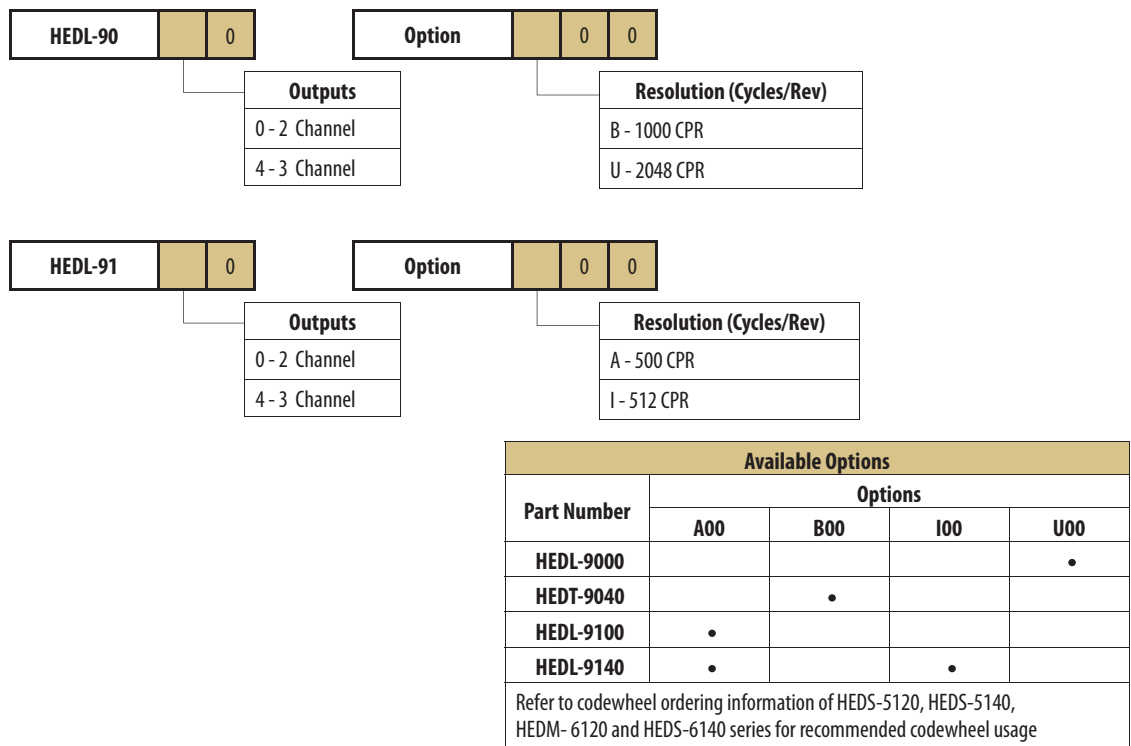**Resolution (Cycles/Rev)**
I - 512 CPR

Available Options									
Part Number	Options								
	A	B	C	D	E	F	G	H	I
HEDT-9140									•
HEDT-9141									•
Refer to codewheel ordering information for recommended usage									

HEDL-900xx/91xx Series

HEDL-90		0

Outputs
0 - 2 Channel
4 - 3 Channel

Option	0	0

Resolution (Cycles/Rev)
B - 1000 CPR
U - 2048 CPR

HEDL-91		0

Outputs
0 - 2 Channel
4 - 3 Channel

Option	0	0

Resolution (Cycles/Rev)
A - 500 CPR
I - 512 CPR

Available Options				
Part Number	Options			
	A00	B00	I00	U00
HEDL-9000				•
HEDT-9040		•		
HEDL-9100	•			
HEDL-9140	•		•	
Refer to codewheel ordering information of HEDS-5120, HEDS-5140, HEDM- 6120 and HEDS-6140 series for recommended codewheel usage				

Incremental Optical Encoders
Transmissive Module

HEDS-9700/973x/978x Series

Description

- High performance
- HEDS-973x is a high-resolution version of HEDS-9700
- Detects rotary or linear position when operated in conjunction with either a codewheel or codestrip
- Consists of a lensed (LED) source and a detector IC enclosed in a small C-shaped plastic package
- Extremely tolerant to mounting misalignments due to a highly collimated light source and unique photodetector array
- Two channel digital output
- 5 V supply input
- Four solder-plated leads located on 2.54 mm (0.1 inch) centers
- Standard HEDS-9700 is designed for use with 11-mm optical radius codewheel or linear codestrip. (Other options are available - refer to factory for further details)

Features

- Small size
- Wide resolution range
- No signal adjustment required
- Two channel quadrature output
- Single 5 V supply
- -40°C to 85°C operating temperature
- Multiple mounting options
- Linear and rotary options available
- Wave solderable
- RoHS compliant
- TTL compatible output
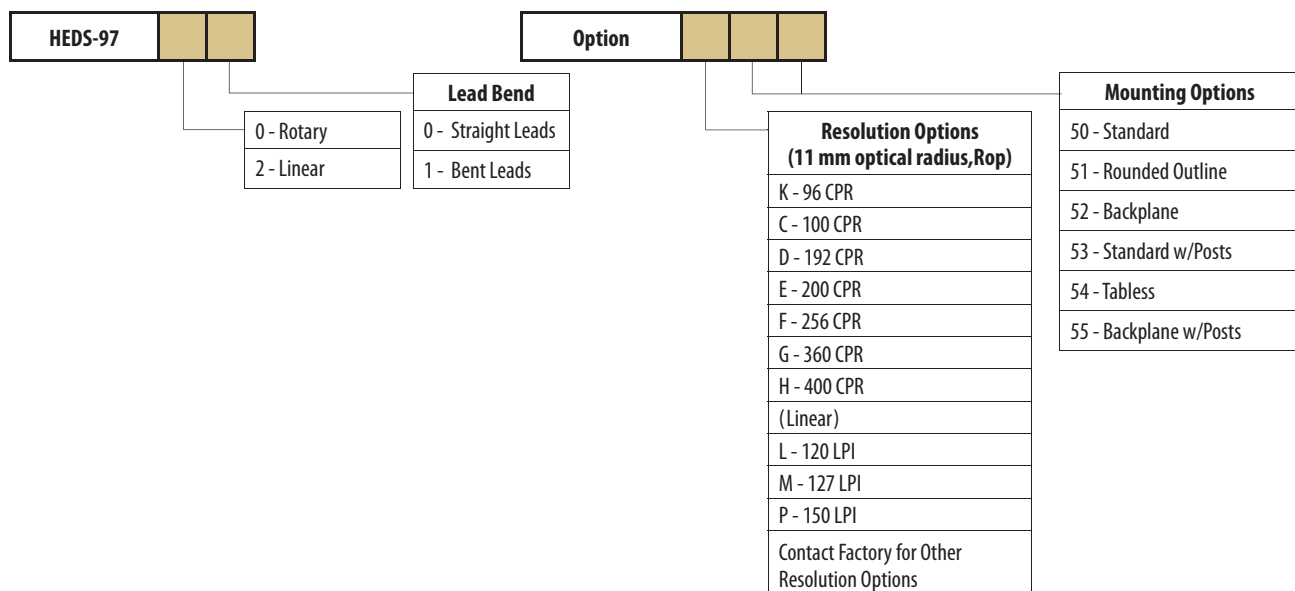- Count frequency 20 KHz to 80 KHz

Applications

- Printers
- Plotters
- Copiers
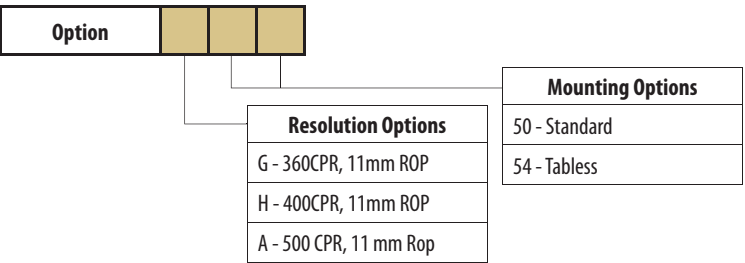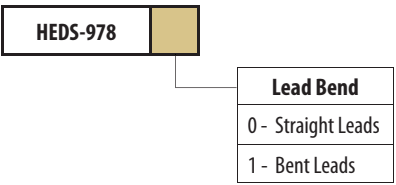- Office automation equipment

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

HEDS-97				Option			

		Lead Bend
0 - Rotary	0 - Straight Leads
2 - Linear	1 - Bent Leads

Resolution Options (11 mm optical radius, Rop)
K - 96 CPR
C - 100 CPR
D - 192 CPR
E - 200 CPR
F - 256 CPR
G - 360 CPR
H - 400 CPR
(Linear)
L - 120 LPI
M - 127 LPI
P - 150 LPI
Contact Factory for Other Resolution Options

Mounting Options
50 - Standard
51 - Rounded Outline
52 - Backplane
53 - Standard w/Posts
54 - Tabless
55 - Backplane w/Posts

Ordering Information

HEDS-973	▮

Lead Bend
0 - Straight Leads
1 - Bent Leads
2 - Straight Leads
3 - Bent Leads

Option	▮	▮	▮

Resolution Options
A - 500 CPR, 11 mm Rop
B - 1000 CPR, 11 mm Rop
J - 1024 CPR, 11 mm Rop
Q - 180 LPI, Linear
2 - 300 LPI, Linear
1 - 360 LPI, Linear
3 - 480 LPI, Linear
T - 2000 CPR, 23.36 mm Rop
U - 2048 CPR, 23.36 mm Rop

Mounting Options
50 - Standard
51 - Screwmount
52 - Backplane
53 - Standard w/Posts
54 - Tabless
55 - Backplane w/Posts

HEDS-978	▮

Lead Bend
0 - Straight Leads
1 - Bent Leads

Option	▮	▮	▮

Resolution Options
G - 360CPR, 11mm ROP
H - 400CPR, 11mm ROP
A - 500 CPR, 11 mm Rop

Mounting Options
50 - Standard
54 - Tabless

Available Options							
Part Number		**Options**					
		50	51	52	53	54	55
HEDS-9780	A	•					
	G	•				•	
	H	•				•	

Note: Contact factory for codewheel and codestrip information.

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Incremental Optical Encoders
Transmissive Module

HEDS-971x Series

Description

- High performance
- Detects rotary position when operates in conjunction with a codewheel
- Consists of a lensed (LED) source and a detector IC enclosed in a small C-shaped plastic package
- Extremely tolerant to mounting misalignment due to a highly collimated light source and unique photodetector array
- Two channel analog output
- 5V supply input
- Four solder plated leads located on 2.54 mm (0.1 inch) centers
- Designed for use with an appropriate optical radius codewheel. (Refer to factory for further details)

Features

- Small size
- Wide resolution range
- No signal adjustment required
- Single 5 V supply
- Two channel analog output
- 15° C to 45° C operating temperature
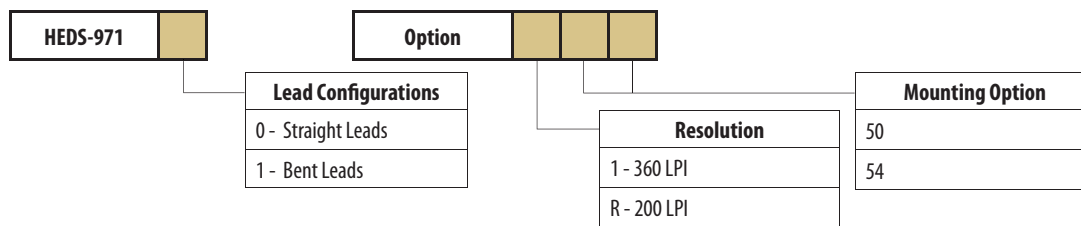- Multiple mounting options
- Wave solderable
- RoHS compliant

Applications

- Printers
- Plotters
- Copiers
- Office automation equipment

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

HEDS-971		Option			

Lead Configurations
0 - Straight Leads
1 - Bent Leads

Resolution
1 - 360 LPI
R - 200 LPI

Mounting Option
50
54

Note: Contact factory for codewheel and codestrip information.

Incremental Optical Encoders
Transmissive Module

AEDS-964x Series

Description

- High performance
- Ultra-miniature package
- Detects rotary or linear position when operated in conjunction with either a codewheel or codestrip
- Consists of lensed (LED) source and a detector IC enclosed in a small C-shaped plastic package
- Extremely tolerant to mounting misalignment due to a highly collimated light source and unique photodetector array
- Two channel digital output
- 3.3/5.0-V supply input
- Four solder plated leads located on 2.00 mm (0.1 inch) centers
- Supply input of LED rated at 16 mA, accessed through two leads located at 2.54 mm pitch
- Designed for use with an 11.00 mm optical radius codewheel or linear codestrip. (Other options are available – refer to factory for further details)

Features

- Low package height, small size
- Built-in codewheel and codestrip guide bumps
- For linear and rotary applications
- No signal adjustment required
- Insensitive to radial and axial play
- 0°C to 70°C operating temperature
- Wide resolution range
- Two channel quadrature output
- TTL, 3.3/5.0-V CMOS compatible
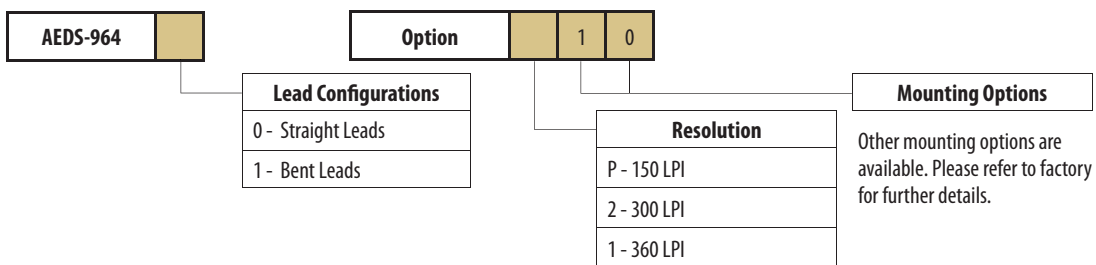- Wave solderable
- RoHS compliant

Applications

- Printers
- Plotters
- Copiers
- Office automation equipment

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

AEDS-964			Option		1	0

Lead Configurations
0 - Straight Leads
1 - Bent Leads

Resolution
P - 150 LPI
2 - 300 LPI
1 - 360 LPI

Mounting Options

Other mounting options are available. Please refer to factory for further details.

Note: Contact factory for codewheel and codestrip information.

Incremental Optical Encoders
Transmissive Module

AEDS-965x Series
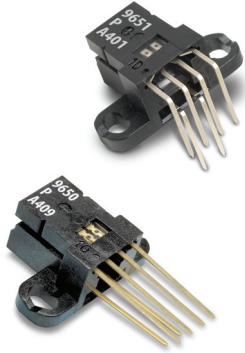
Description

- Very small, low package height and high performance incremental encoder module

- Consists of lensed (LED) source and a detector IC enclosed in a small C-shaped plastic package

- Due to the brighter LED, coupled with a photodetector array, which is less sensitive to light, the encoder is highly tolerant to aerosol environment

- This module is extremely receptive to mounting misalignment

- The two channel digital outputs and Vcc, supply voltage input, are accessed through four solder plated leads located on 2.00 mm (0.1 inch) centers

- The supply input of LED, rated at 16mA is accessed through two leads located at 2.54 mm

- Designed for use with a linear codestrip (Other options are available – refer to factory for further details)

Features

- Small size

- Built-in guide bumps for codewheel and codestrip

- Low package height

- Insensitive to radial, tangential and axial play

- 0°C to 70°C recommended operating temperature

- Two channel quadrature output

- TTL 3.3V or 5.0V CMOS compatible

- For linear and rotary application

- Wave solderable
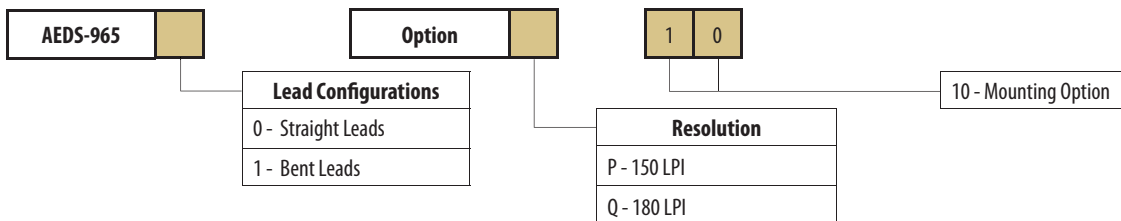
- RoHS compliant

- Aerosol tolerant

Applications

- Printers

- Copiers/ Fax

- Plotters

- Office automation equipment

Package Dimensions
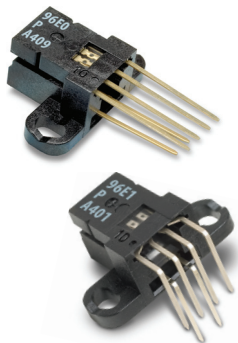
- Refer to product datasheet for package dimensions

Ordering Information

AEDS-965		Option		1	0

Lead Configurations
0 - Straight Leads
1 - Bent Leads

Resolution
P - 150 LPI
Q - 180 LPI

10 - Mounting Option

Note: Contact factory for codewheel and codestrip information.

Incremental Optical Encoders
Transmissive Module

AEDS-96Ex Series

Description

- Very small, high performance, low cost optical incremental encoder module

- Consists of a lensed (LED) source and a detector IC enclosed in small C-Shaped plastic package

- Due to highly collimated light source and a unique photodetector array, the module is extremely tolerant to mounting misalignment

- The two channel analog outputs and 3.3 V supply input are accessed through four leads located on 2.00 mm centers for the detector and two leads located on 2.54 mm center for the emitter

- Designed for use with an appropriate optical radius codewheel. Contact factory for more information

Features

- Small size

- Low package height

- Resolution: 200 LPI

- 0°C to 60°C recommended operating temperature

- For linear and rotary applications

- Two channel analog output

- Single 3.3V supply*

- Wave solderable

- 1.52V LED forward voltage (IF = 16mA)*

- Built-in guide bumps for codewheel

- Tolerant to radial, tangential and axial play
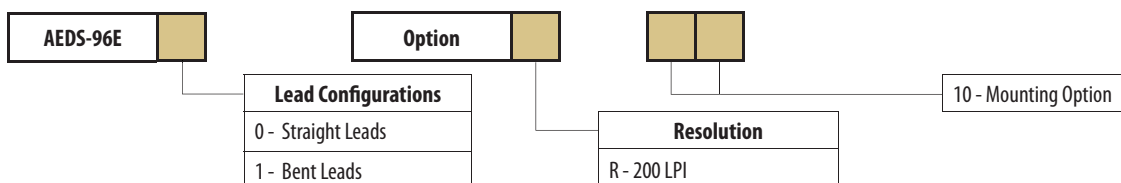
- RoHS compliant

* Typical conditions

Applications

- Printers

- Copiers/ Fax

- Plotters

- Office automation equipment

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

AEDS-96E		Option				

Lead Configurations
0 - Straight Leads
1 - Bent Leads

Resolution
R - 200 LPI

10 - Mounting Option

Note: Contact factory for codewheel and codestrip information.

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Incremental Optical Encoders
Transmissive Module

AEDA-3200/3300 Series

Description

- Ultra-miniature package with wide resolution ranges
- "One size fits all resolutions" concept makes it ideal for space-constrained applications
- Uses transmissive technology
- Consists of a lensed (LED) source, an integrated circuit with detectors and output circuitry, and an incremental track-glass codewheel that rotates between the emitter and detector IC
- Emitter and detector IC are housed in a C-shape module with the codewheel attached to a specially designed hub
- Eliminates customer need to design different platforms for different resolutions
- Extremely cost effective
- Specifically designed to serve the industrial market where applications require wide temperature ranges and high accuracy
- High operating frequencies
- Fits standard 2 mm customer solid shaft (Contact factory for other shaft sizes)

- AEDA-3200 Series modular unit offers a patented alignment tool which makes installation and assembly virtually plug & play. Eliminates the need for costly assembly machines and provides faster turn around time to manufacture. Encoder module comes in a C-shape module with a codewheel attached to a special hub
- AEDA-3300 series unit offers a pre-aligned and integrated bearing kit housing
- Assembled unit, offered at a slight cost increase, saves production cycle time. Encoder module comes in a pre-aligned and integrated bearing kit housing

Features

- AEDA-3200 - 17 mm Ø x 23.2 mm H (module size)
- AEDA-3300 - Bxx - 17 mm Ø x 24.0 mm H (module size)
- AEDA-3300 - Txx size - 28 mm Ø x 26.7 mm H (module size)
- Resolution ranges from 600 to 20,000 CPR (up to 80,000 after 4x decode)

- Wide operating temperature range from -40°C to 125°C
- Integrated line driver for long cable connection
- Easy assembly process with integrated bearing options
- Single 5V supply
- 1 MHz maximum frequency
- 12,000 RPM maximum speed
- AEDA-3200 series offers plug and play capability

Applications

- Servo motors
- Stepper motors
- Pick and place machines
- Die bonders
- Robotics
- Machine tools
- Textiles
- Factory automation

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

AEDA-3		0	0	Option			

Housing Type	
2	Modular
3	Pre-aligned Kit

Mounting Options	
T	Top-down
B	Bottom-up

Resolution Options		
	CPR	Counts (4X)
A4	600	2400
A6	1000	4000
A7	1024	4096
AB	2000	8000
AC	2048	8192
AJ	2500	10000
AM	3000	12000
AQ	4000	16000
AT	4096	16384
B1	5000	20000
B7	6000	24000

Resolution Options		
	CPR	Counts (4X)
BJ	7200	28800
BK	7500	30000
BM	8000	32000
BN	8192	32768
C1	10000	40000
C3	10240	40960
CH	12000	48000
CJ	12500	50000
CX	14400	57600
DM	18000	72000
E1	20000	80000

Note: AEDA-3200 is available for options of 7500 CPR or less, and in top-down mounting only. Contact the factory for availability of other CPR options.

Incremental Optical Encoders
Transmissive Module

AEDB-9140 Series
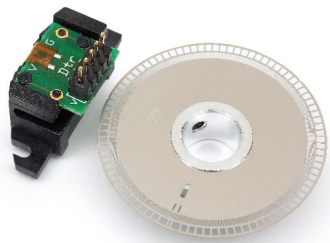
Description

- Three channels
- Low cost
- Detects rotary position when used with a codewheel
- Consists of a lensed (LED) source and detector IC enclosed in a small plastic package
- Extremely tolerant to mounting misalignment due to a highly collimated light source and unique photodetector array
- Two channel quadrature output, plus a third channel index output. (The index output is a 90 electrical degree high, true index pulse, which is generated once for each full rotation of the codewheel)
- Designed for use with a codewheel with an optical radius of 11.00 mm (0.433 inch)
- Quadrature signals and index pulse are accessed through five 0.46 mm square pins located on 1.27 mm (pitch) centers

Features

- Two channel quadrature output with index pulse
- Resolution from 100 CPR up to 500 CPR
- Low cost
- Easy to mount
- No signal adjustment required
- Small size
- -10° C to 85° C operating temperature
- TTL compatible output
- Single 5 V supply output

Applications

Ideal for high-volume applications, like:

- Printers
- Plotters
- Tape drives
- Industrial equipment
- Factory automation equipment

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

Three Channel Encoder Modules with Codewheel, 11 mm Optical Radius

AEDB-9140 Option

Resolutions (Cycle/Rev)
C – 100 CPR
E – 200 CPR
F – 256 CPR
G – 360 CPR
H – 400 CPR
A – 500 CPR

Shaft Diameter*
02 - 3 mm
04 - 5/32 in
05 - 3/16 in
06 - 1/4 in
11 - 4 mm
12 - 6 mm
13 - 8 mm
14 - 5 mm
* Contact factory for other shaft diameters

Available Options									
Part Number	CPR	Shaft Diameter Options							
		02	04	05	06	11	12	13	14
AEDB-9140	C		•		•		•	•	•
	E				•	•	•		•
	F		•				•		•
	G				•		•		•
	H				•				•
	A	•	•	•	•	•	•	•	•

Incremental Optical Encoders
Transmissive Module

AEDS / AEDB-9340 Series
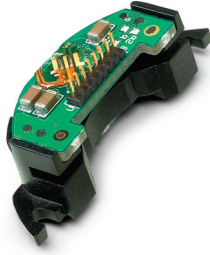
Description

- 6-channel optical incremental encoder modules with codewheel

- When used with a codewheel, these modules detect rotary position

- Each module consists of a collimated LED source and detector IC enclosed within a small plastic package

- Modules are extremely tolerant to mounting misalignment

- Ungated index output is a positive index pulse (360 electrical degrees high) that is generated once for each full rotation of the codewheel

- Designed for use with a codewheel that has an optical radius of 15 mm (0.590 inch)

- The quadrature, index, commutation signals and power supplied to the encoder are accessed through eight 0.46 mm square male connector pins located on 1.27 mm (pitch)

- Replaces conventional incremental encoder with Hall Switches

- With our encoder, the system will be more compact, have reduced alignment time with use of alignment jig, thus making assembly process much easier for housed encoder integration

- Superior switching accuracy due to much lower hysteresis when compared to a Hall Switches

- The commutation signals can be generated for Brushless DC motor of different rotor pole-pairs by simply changing with matching pole-pair codewheel
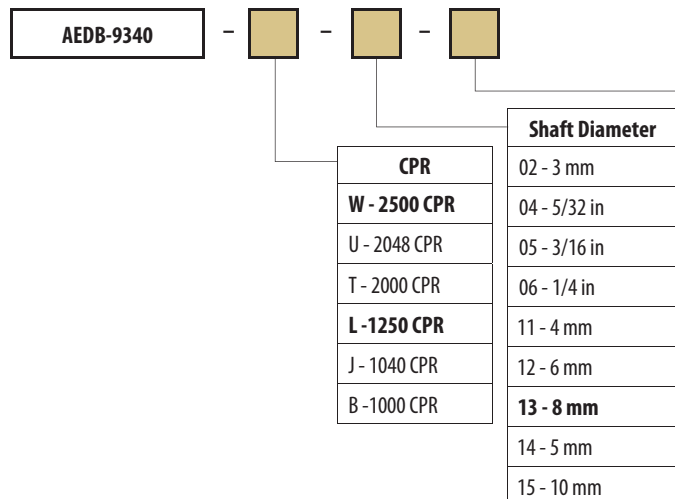
Features

- Two-channel quadrature output with ungated index pulse (A, B, I)

- Three-channel integrated commutation output (U, V, W)

- Up to 2500 Cycles Per Revolution (CPR)

- Easy assembly with alignment jig

- Designed to fit into circular shaped housing

- Up to 150 kHz frequency response

- −10°C to 85°C operating temperature

- TTL compatible

- Single 5 V supply

- Integrated feedback device for Brushless DC Motor

Applications

- Servo motors
- Stepper motors
- Pick and place machines
- Die bonders
- Robotics
- Machine tools
- Textiles
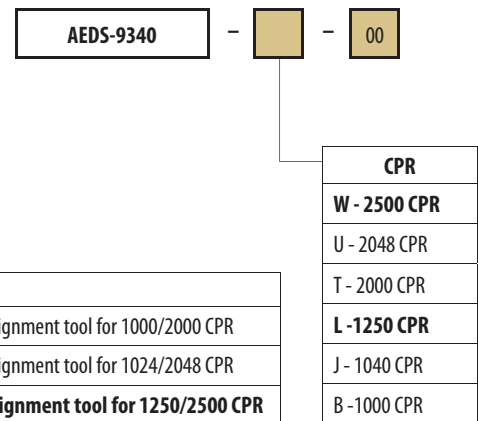- Factory automation

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

Three Channel Encoder Modules with Codewheel, 11 mm Optical Radius

AEDB-9340 – ☐ – ☐ – ☐

Pole Pair
A - 2 Pole Pairs
B - 3 Pole Pairs
C - 4 Pole Pairs

Shaft Diameter
02 - 3 mm
04 - 5/32 in
05 - 3/16 in
06 - 1/4 in
11 - 4 mm
12 - 6 mm
13 - 8 mm
14 - 5 mm
15 - 10 mm

CPR
W - 2500 CPR
U - 2048 CPR
T - 2000 CPR
L -1250 CPR
J - 1040 CPR
B -1000 CPR

Encoder Only

AEDS-9340 – ☐ – 00

CPR
W - 2500 CPR
U - 2048 CPR
T - 2000 CPR
L -1250 CPR
J - 1040 CPR
B -1000 CPR

Alignment Tool	
HEDS-8950	Alignment tool for 1000/2000 CPR
HEDS-8951	Alignment tool for 1024/2048 CPR
HEDS-8952	**Alignment tool for 1250/2500 CPR**

Note: Options highlighted in **Bold** are currently available to order. Contact factory for enquiries on all other options.

Incremental Optical Encoders
Transmissive Housed

HEDS-65xx, HEDM-65xx, HEDL-65xx Series

Description

HEDS-65XX Series

- High performance two and three channel optical encoders

- High reliability, high resolution and easy assembly

- Contains a lensed (LED) source or emitter, integrated circuitry and a codewheel which rotates between the emitter and detector IC

- HEDS-6500 series output features two single-ended square waves in quadrature

- HEDS-6540 series output has a third channel index output in addition to the two quadrature outputs. This index is an active high pulse that occurs once every full rotation of the codewheel

- Resolutions up to 1024 CPR available in two and three channel versions

HEDM-65XX Series

- Same features as listed above

- Comes with film codewheels

- Resolutions available in 2,000 and 2,048 CPR in two and three channel versions

HEDL-65XX Series

- Comes with differential outputs

- Utilizes an industry standard line driver IC (an integrated RS-422 differential line driver), which provides complementary output for each encoder channel and enables enhanced performance when the encoders are used in noisy environments or when they are required to drive long distances

- Suggested line receivers: 26C32 and 26C33

- Quadrature signals are accessed through a cable and 10-pin female connector, which is manufactured by FCI, part number: 66900-310. The mating connectors manufactured by FCI; straight type part number: 71912-010, right angle type part number: 71913-010

Features

- Two channel quadrature output with optional index pulse

- HEDS series features TTL-compatible, single-ended outputs

- Up to 70°C operating temperature for HEDM series

- Up to 100°C operating temperature for HEDL and HEDS series

- HEDL series features industry-standard 26C31 line driver IC

- Easy assembly, no signal adjustment necessary

- Up to 2,048 CPR

- Maximum shaft diameter of 5/8 inches

- Single 5V supply

- Count frequency of 100 KHz
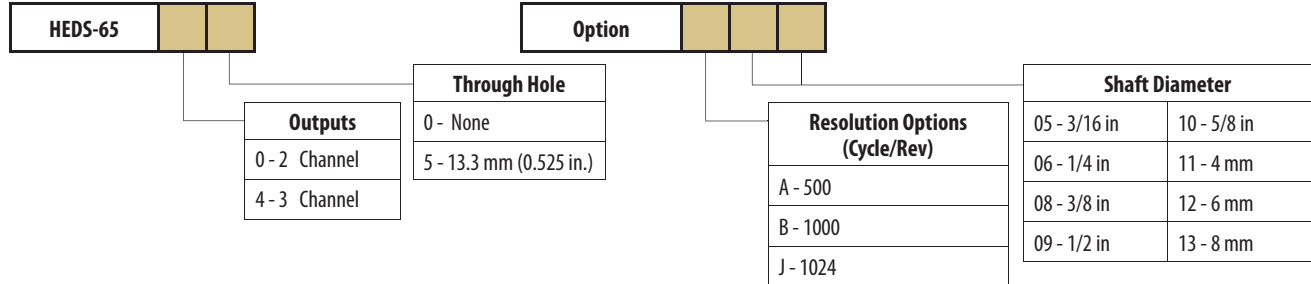
Applications

- Machine tools

- Textiles

- Photocopiers and printing machinery

- Pulp and paper

- Chemical and pharmaceutical

- Factory automation assembly

- Automatic handlers

Package Dimensions

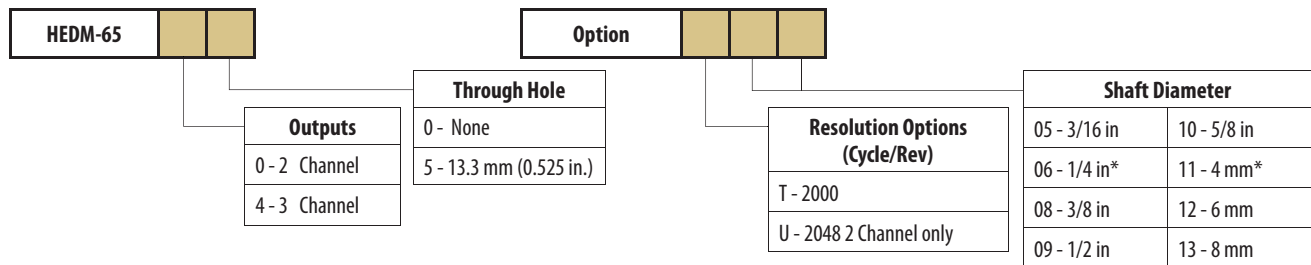- Refer to product datasheet for package dimensions

Ordering Information

Large Diameter Housed, 2 and 3 Channel Encoders with Metal Codewheels (up to 100°C) – HEDS-65xx Series

HEDS-65		

Outputs
0 - 2 Channel
4 - 3 Channel

Through Hole
0 - None
5 - 13.3 mm (0.525 in.)

Option			

Resolution Options (Cycle/Rev)
A - 500
B - 1000
J - 1024

Shaft Diameter

05 - 3/16 in	10 - 5/8 in
06 - 1/4 in	11 - 4 mm
08 - 3/8 in	12 - 6 mm
09 - 1/2 in	13 - 8 mm

Available Options									
Part Number		**Options**							
		05	06	08	09	10	11	12	13
HEDS-6500	A	•	•	•	•	•	•	•	•
	B	•	•	•	•	•	•	•	•
	J	•	•	•	•	•	•	•	•
HEDS-6505	A								
	B				•	•			
	J				•				
HEDS-6540	A	•	•	•	•	•	•	•	•
	B	•	•	•	•	•	•	•	•
	J	•	•	•	•	•	•	•	•
HEDS-6545	A			•		•			
	B			•					
	J		•		•				

Large Diameter Housed, 2 and 3 Channel Encoders with Film Codewheel (up to 70°C) – HEDM-65xx Series

HEDM-65		

Outputs
0 - 2 Channel
4 - 3 Channel

Through Hole
0 - None
5 - 13.3 mm (0.525 in.)

Option			

Resolution Options (Cycle/Rev)
T - 2000
U - 2048 2 Channel only

Shaft Diameter

05 - 3/16 in	10 - 5/8 in
06 - 1/4 in*	11 - 4 mm*
08 - 3/8 in	12 - 6 mm
09 - 1/2 in	13 - 8 mm

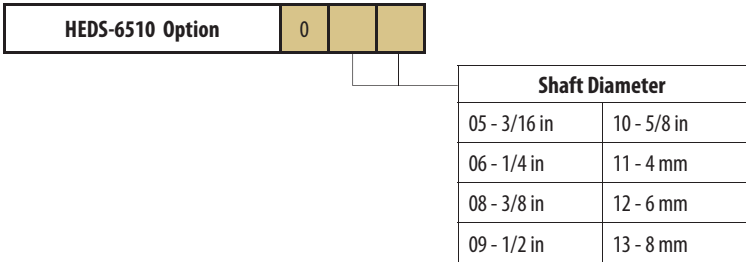| Available Options									
Part Number		**Options**							
		05	06	08	09	10	11	12	13
HEDM-6500	T		•	•					
	U		•						•
HEDM-6505	T		•	•					
	U								•
HEDM-6540	T						•		•
HEDM-6545	T								

Ordering Information

Large Diameter Housed, 2 and 3 Channel Encoders with Metal Codewheel and Line Driver (up to 70°C) — HEDL-65xx Series

HEDL-65		

Through Hole
0 - None
5 - 13.3 mm (0.525 in.)

Outputs
0 - 2 Channel
4 - 3 Channel

Option			

Resolution Options (Cycle/Rev)
A - 500
B - 1000
J - 1024

Shaft Diameter
08 - 3/8 in	11 - 4 mm
09 - 1/2 in	12 - 6 mm
10 - 5/8 in	13 - 8 mm
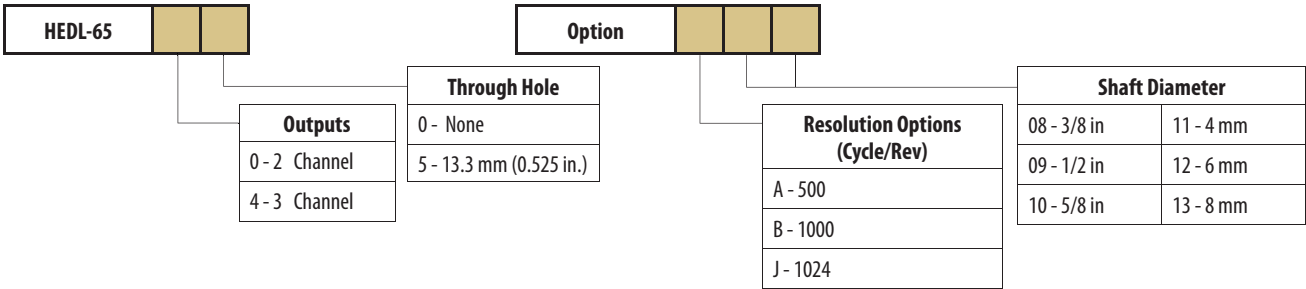
Available Options									
Part Number		**Options**							
		05	06	08	09	10	11	12	13
HEDL-6540	B						●		●
HEDS-6545	B				●				
	J		●	●	●				

Ordering Information for HEDS-6510 Centering Tools

HEDS-6510 Option	0		

Shaft Diameter
05 - 3/16 in	10 - 5/8 in
06 - 1/4 in	11 - 4 mm
08 - 3/8 in	12 - 6 mm
09 - 1/2 in	13 - 8 mm

Available Options									
Part Number		**Options**							
		05	06	08	09	10	11	12	13
HEDS-6510	0	●	●	●	●	●	●	●	●

The codewheel gapping tool for HEDS-65xx series is HEDS-6511

Incremental Optical Encoders
Transmissive Housed
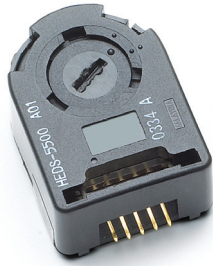
HEDL-5xxx, HEDS-550x/554x, HEDS-560x/564x, HEDM-550x/560x Series

Description

HEDS-550X/HEDM-550X/HEDS-560X and HEDS-554X/HEDS-564X Series

- High-performance, two and three channel incremental optical encoders

- High reliability, high resolution, easy assembly

- Contains a lensed (LED) source or emitter, an integrated circuit with detectors and output circuitry, and a codewheel which rotates between the emitter and detector IC

- HEDS-550X/HEDM-550X/HEDS-560X output is two square waves in quadrature

- HEDS-554X/HEDS-564X output has a third channel index output in addition to the two channel quadrature

- The index output is a 90 electrical degree, high true index pulse which is generated once for each full rotation of the codewheel

- Features quick and easy motor mounting

HEDM-55XX/56XX Series

- Features same as listed above

- Comes with film codewheels

HEDS-56XX and HEDM-56XX Series

- Features same as listed above

- Features mounting ears HEDL-55XX Series

- Features differential output

- Utilizes an industry-standard line driver IC (26C31), which provides complementary output for each encoder channel, offering enhanced performance when the encoders are used in a noisy environment, or when required to drive long distances

- Suggested line receivers: 26C32 and 26C33

- Quadrature signals are accessed through a cable and 10-pin female connector, manufactured by FCI, part number: 66900-310. Mating connectors are made by FCI; for straight type part number: 71912-010, right angle type part number: 71913-010

Features

- Two channel quadrature output with optional index pulse

- Quick and easy assembly

- No signal adjustment required

- External mounting ears available

- Low cost

- Resolutions up to 1,024 CPR

- Small size

- -40°C to 100°C operating temperature

- TTL compatible

- Single 5 V supply

- Count frequency of 100 KHz

Applications

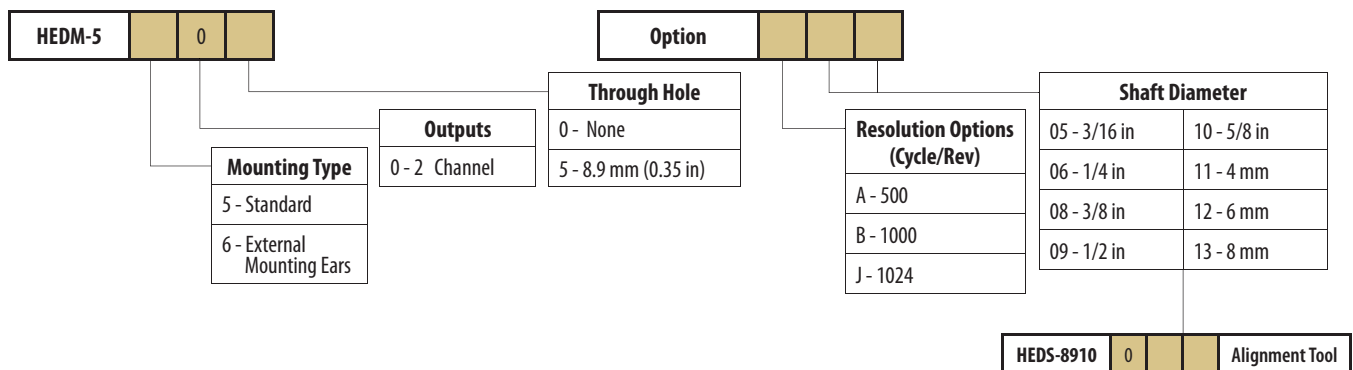**Ideal for high-volume applications, including:**

- Printers

- Plotters

- Tape drives

- Positioning tables and automatic handlers

Package Dimensions

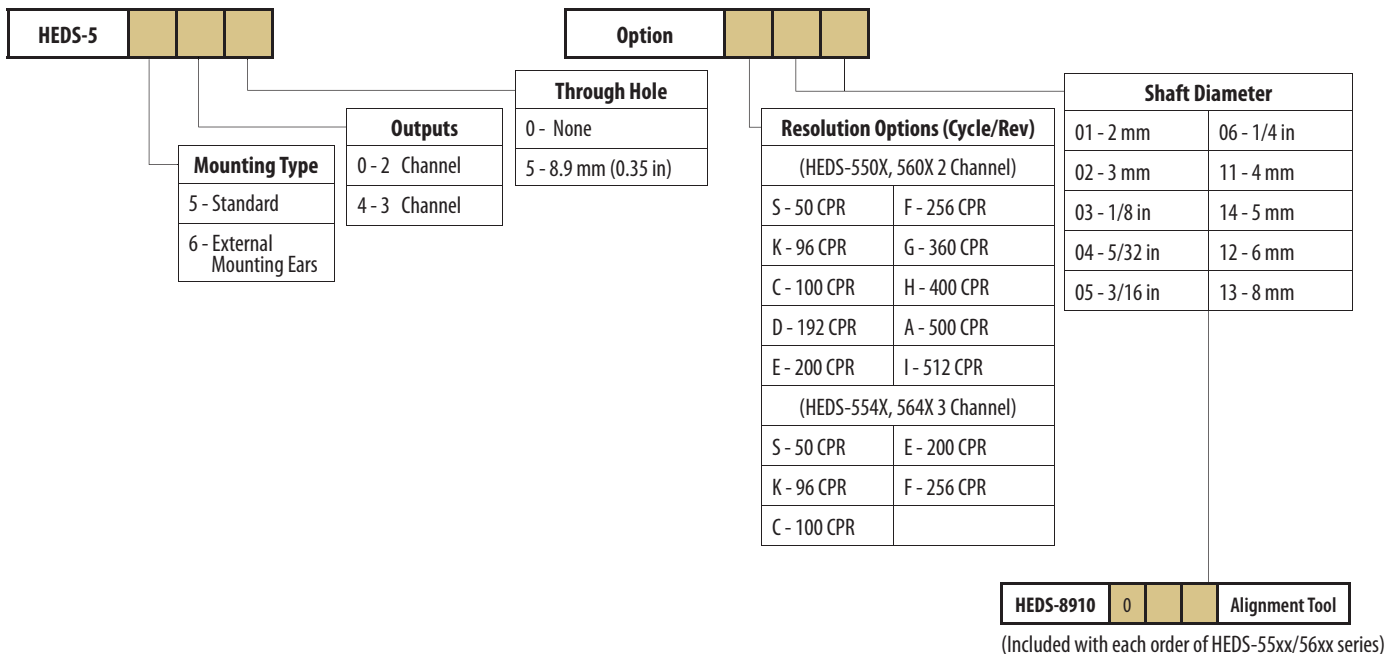- Refer to product datasheet for package dimensions

Ordering Information

Mid-Sized Housed Encoders with Film Codewheels – HEDM-550x/560x series

| HEDM-5 | | 0 | | | | | | Option | | | | | |

Through Hole
0 – None
5 – 8.9 mm (0.35 in)

Outputs
0 – 2 Channel

Mounting Type
5 - Standard
6 - External Mounting Ears

Resolution Options (Cycle/Rev)
A - 500
B - 1000
J - 1024

Shaft Diameter	
05 - 3/16 in	10 - 5/8 in
06 - 1/4 in	11 - 4 mm
08 - 3/8 in	12 - 6 mm
09 - 1/2 in	13 - 8 mm

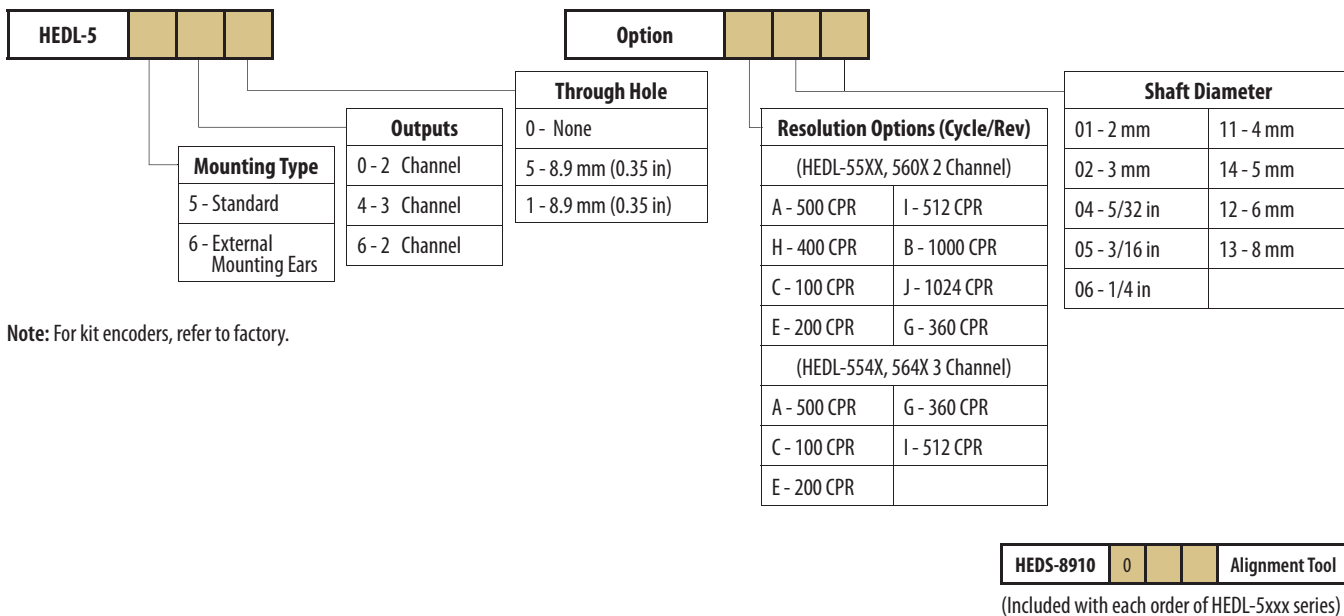| **HEDS-8910** | 0 | | | **Alignment Tool** |

(Included with each other of HEDM-550x/560x two channel encoders)

Ordering Information

Mid-Sized Housed Encoders with Metal Codewheels – HEDS-550x/554x/564x Series

HEDS-5			

Mounting Type
5 - Standard
6 - External Mounting Ears

Outputs
0 - 2 Channel
4 - 3 Channel

Through Hole
0 - None
5 - 8.9 mm (0.35 in)

Option			

Resolution Options (Cycle/Rev)	
(HEDS-550X, 560X 2 Channel)	
S - 50 CPR	F - 256 CPR
K - 96 CPR	G - 360 CPR
C - 100 CPR	H - 400 CPR
D - 192 CPR	A - 500 CPR
E - 200 CPR	I - 512 CPR
(HEDS-554X, 564X 3 Channel)	
S - 50 CPR	E - 200 CPR
K - 96 CPR	F - 256 CPR
C - 100 CPR	

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

HEDS-8910	0			Alignment Tool

(Included with each order of HEDS-55xx/56xx series)

Mid-Sized Housed Encoders with Line Drivers – HEDL-5xxx series

HEDL-5			

Mounting Type
5 - Standard
6 - External Mounting Ears

Outputs
0 - 2 Channel
4 - 3 Channel
6 - 2 Channel

Through Hole
0 - None
5 - 8.9 mm (0.35 in)
1 - 8.9 mm (0.35 in)

Option			

Resolution Options (Cycle/Rev)	
(HEDL-55XX, 560X 2 Channel)	
A - 500 CPR	I - 512 CPR
H - 400 CPR	B - 1000 CPR
C - 100 CPR	J - 1024 CPR
E - 200 CPR	G - 360 CPR
(HEDL-554X, 564X 3 Channel)	
A - 500 CPR	G - 360 CPR
C - 100 CPR	I - 512 CPR
E - 200 CPR	

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

Note: For kit encoders, refer to factory.

HEDS-8910	0			Alignment Tool

(Included with each order of HEDL-5xxx series)

Available Options

Part Number		Options									
		01	02	03	04	05	06	11	12	13	14
HEDL-5540	A	•	•			•	•	•	•	•	•
	C		•			•			•		
	E						•	•			
	G							•			
	I	•					•	•		•	
HEDL-5640	A						•			•	•
HEDL-5645	A						•			•	
	G						•				
HEDL-5500	A		•				•				
	E						•				
	G					•			•		
	H						•				
	I				•						
HEDL-5505	A						•				
	I									•	
HEDL-5560	B		•					•		•	
HEDL-5561	J						•				
HEDL-5600	A						•				
	H						•				
HEDL-5605	A						•				
	C										•
HEDM-5500	B	•	•				•	•	•	•	•
	J		•				•		•	•	•
HEDM-5505	B				•						
	J			•			•			•	
HEDM-5600	B						•			•	
	J						•				
HEDM-5605	B						•			•	
	J						•				
HEDS-5500	A	•	•	•	•	•	•	•	•	•	•
	C	•	•	•	•	•	•	•	•	•	•
	E		•		•	•	•	•	•		•
	F	•	•		•	•	•	•	•		•
	G		•			•	•	•	•		•
	H					•	•		•		•
	I	•	•	•	•	•	•	•	•	•	•
	K				•	•	•	•			
	S									•	

Available Options

Part Number		01	02	03	04	05	06	11	12	13	14
							Options				
HEDS-5505	A				•		•			•	•
	C				•		•		•		•
	E				•		•				•
	F				•		•				•
	G				•		•				
	H						•				•
	I				•		•			•	
	K				•						
HEDS-5540	A	•	•	•	•	•	•	•	•	•	•
	C	•	•				•	•	•	•	•
	E						•	•	•		
	F	•						•			•
	G						•				
	H						•				•
	I	•	•				•	•	•	•	•
HEDS-5545	A						•		•		•
	C								•		
	H						•				•
	I						•				
HEDS-5600	A						•		•	•	•
	C						•		•		•
	E						•				
	G						•			•	
	H						•		•		
	I	•						•			
HEDS-5605	A						•			•	
	C						•				
	E						•				
	F									•	
	G						•				
	H						•				•
	I						•				
HEDS-5640	A						•		•	•	
	E						•		•		
	F						•				
	H						•				
HEDS-5645	A						•		•	•	
	C									•	
	E									•	
	F									•	
	G									•	
	H						•		•		•
	I									•	

Incremental Optical Encoders
Transmissive Housed

HEDS-57xx Series (Rotary Pulse Generators)

Description

- Low cost
- High performance
- Comes with mounted shafts and bushings
- Available with tactile feedback for hand-operated panel mount applications, or with a free spinning shaft for applications requiring a pre-assembled encoder for position sensing
- Contains a collimated (LED) light source and special detector circuit which allows for high resolution, excellent encoding performance, long rotational life, and increased reliability
- Two digital output waveforms which are 90 degrees out of phase to provide position and direction information
- HEDS-5740 series provides a third index channel
- HEDS-5700 is quickly and easily mounted to a front panel using the threaded bushing. It can also be directly coupled to a motor shaft (or gear train) for position sensing applications

Features

- Two-channel quadrature
- Output with optional index pulse
- Available with or without static drag for manual or mechanized operation
- Resolution up to 512 CPR
- Long rotational life; >1 million revolutions
- -20°C to 85°C operating temperature
- TTL quadrature output
- Single 5V supply
- Available with color-coded leads
- Up to 2000 rpm operating speed

Applications

**HEDS-5700
(with static drag option)**

Ideal for applications requiring digital information from a manually operated knob. Front panel applications include:

- Instruments
- CAD/CAM systems
- Audio/video control boards

**HEDS-5700
(free spinning option)**

Ideal for low speed, mechanized operations:

- Copiers
- X-Y tables
- Assembly line equipment

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

HEDS-57				Option			

Outputs

0 - 2 Channel

4 - 3 Channel

Mechanical Configuration

0 - Pins

1 - 6 in. Coded Leads

Resolution (Cycles/Revolution)

HEDS-570X 2 Channel
K - 96 CPR
C - 100 CPR
F - 256 CPR
G - 360 CPR
A - 500 CPR
I - 512 CPR
HEDS-574X Three Channel*
A - 512 CPR
* Contact factory for other resolutions

Drag Option

0 - Free Spinning

1 - Static Drag

Shaft Configuration

0 - 1/4 in. dia. with no flat

1 - 6 mm dia. with no flat

2 - 1/4 in. dia. with flat
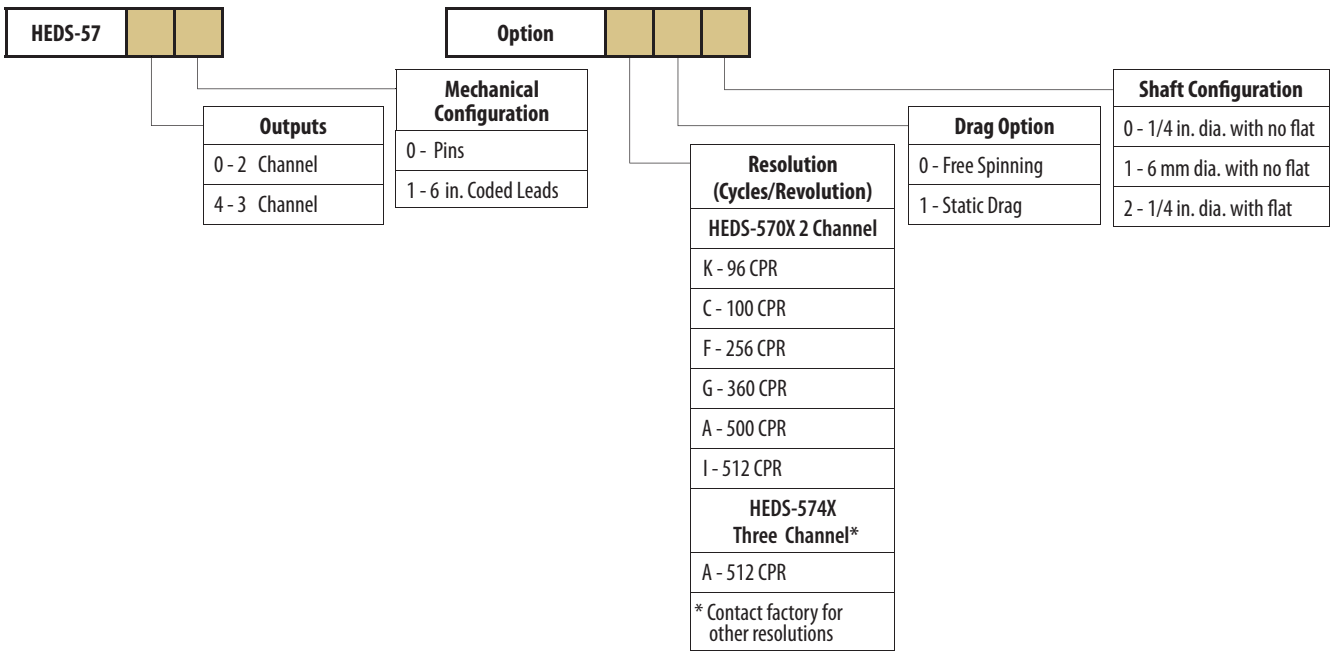
Available Options

		00	01	02	10	11	12
HEDS-5700	A		•	•	•		
	C		•	•	•	•	
	F	•				•	•
	G	•					
	I	•	•	•	•		•
	K		•		•		
HEDS-5701	A	•		•			•
	C				•		
	F	•	•		•	•	
	G	•					
	H		•				
	I			•			
HEDS-5740	I			•			

Incremental Optical Encoders
Reflective Module

AEDR-83xx Series

Description

- New generation encoder
- SMT and leadless package, ideal for applications with critical space constraints
- More accurate real-time position indicator
- Single-channel and two-channel motion sensing at a very low cost
- Uses reflective technology to sense rotary or linear position
- Consists of an LED light source and a photodetector IC in a single package
- Provides either single channel or two channel square wave outputs in quadrature for count and direction information
- TTL-compatible outputs correspond to the alternating reflective/non-reflective patterns of the codewheel or codestrip
- Can be used over a range of codewheel and codestrip resolutions
- RoHS compliant

Features

- Size: 5.12 mm (L) x 3.96 mm (W) x 1.63 mm (H)
- Resolutions of 36, 75, 150, 180 and 212 LPI
- 30 kHz, maximum operating frequency (60kHz for 212LPI)
- Rotary and linear motion sensing
- -20°C through 85°C absolute operating temperature
- One or two channel quadrature output for positioning and homing capabilities
- Single 5 V supply (3.3 V available for 212LPI)

Applications

Ideal for high-volume applications:

- Printers
- Copiers
- Card readers
- Scanners
- Cameras
- Motor solutions
- Medical equipment
- Wafer handling machines
- Vending machines
- Low servo systems
- ATM machines
- Textile machines
- Industrial sewing machines
- Consumer product applications

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

Pure Optical Leadless Array Optical Reflective Encoders – AEDR-8300

| AEDR-83 | | 0 | | Option | | | | | | |

Channels	
0 - Two Channel	
1 - One Channel	

Packaging Options
1 - Tape & Reel

Resolution
K - 75 LPI
P - 150 LPI
Q - 180 LPI
V - 36 LPI
W - 212 LPI

Shipping Units
0 - 1000 pcs
1 - 500 pcs
2- 100 pcs
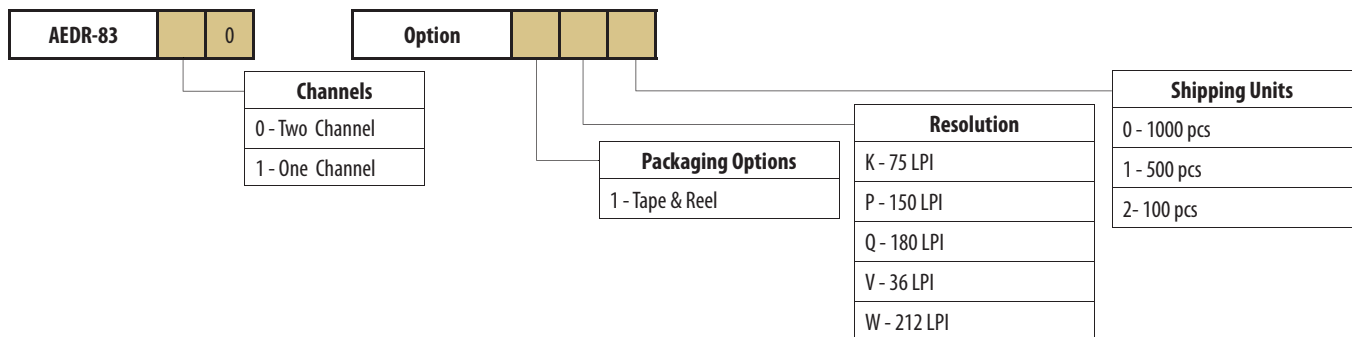
Note: Encoders are packed in tape of quantity 1000pcs, 500pcs or 100pcs.

Incremental Optical Encoders
Reflective Module

AEDR-8400 Series

Description

- Smallest optical encoder
- Houses an LED light source and a photo-detecting circuitry in a single package
- Offers two-channel quadrature digital outputs
- Outputs can be interfaced directly with most of the signal processing circuitries
- Provides great design in flexibility and easy integration into existing systems

Features

- Size: 3.00 mm (L) x 3.28 mm (W) x 1.262 mm (H)
- Encoding resolution: 254 (lines/inch) or 10 (lines/mm)
- Reflective technology
- Surface mount leadless package
- -20°C to 85°C absolute operating temperature
- Rotary or linear motion sensing
- Two channel quadrature digital outputs for direction sensing
- TTL compatible output
- Single 2.8 V supply
- 15 KHz operating frequency

Applications

Ideal for high volume applications:

- Printers
- Copiers
- Card readers
- Scanners
- Digital Still Cameras
- Camcorders
- Camera Phones
- Projectors
- Consumer Product Applications

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

AEDR-84		0		Option			

Channels
0 - Two Channels

Packaging Options
1 - Tape & Reel

Resolution
3 - 254 LPI

Shipping Units
0 - 1000 pcs
2- 100 pcs

Note: Encoders are packed in tape of quantity 1000pcs, 500pcs or 100pcs.

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Incremental Optical Encoders
Reflective Housed

HEDR-542x Series

Description

- High performance
- Cost-effective
- Two channels
- High reliability, high resolution and easy assembly
- Uses reflective technology to sense rotary position
- Consists of an LED light source and photodetector IC in a single SO-8 surface mount package
- HEDR-542X output - two square waves in quadrature
- Quick and easy motor mounting

Features

- Two channel quadrature output
- Quick and easy assembly
- Cost-effective
- Ideal for small motor systems
- Resolutions at 200 CPR
- 0°C to 85°C operating temperature
- Right angle connector available
- Hub available in either a set screw configuration or a press-fit/adhesive mount configuration
- External mounting ears available

Applications

- Wafer handling machines
- Vending machines
- Motor manufacturing applications

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

Mid-Sized Housed Encoders – HEDR-54XX Series

| HEDR-54 | | | – | | | | | | |

Shaft

| 01 - 2 mm |
| 02 - 3 mm |
| 03 - 1/8 in |
| 11 - 4 mm |
| 14 - 5 mm |

Hub

| S2 - Set screw with mounting ears baseplate |
| P1 - Pressfit without mounting ears baseplate |

Resolution

| E - 200 CPR |

Connector

| 0 - Standard/Axial |
| 1 - Right Angle/Radial |

Output

| 2 - 2 Channel |
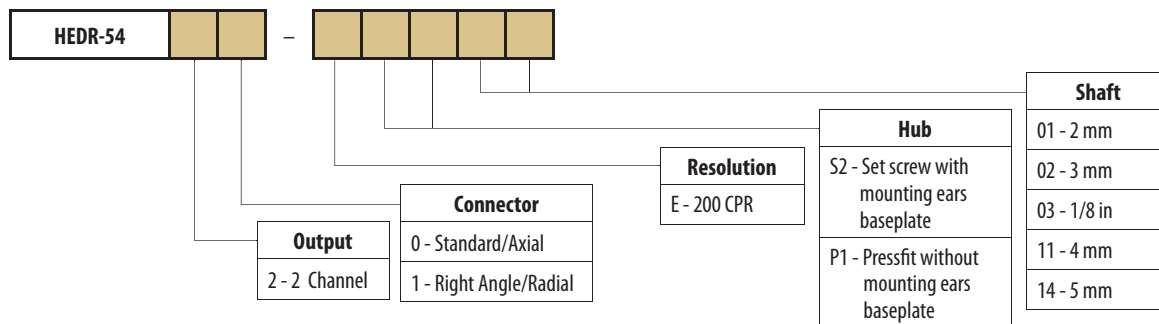
Note: Pressfit options will only have 2 mm, 3 mm and 4 mm shaft sizes available.

For kit encoders, refer to factory.

Available Options					
Part Number	Options				
	01	02	03	11	14
HEDR-5420ES2	•	•	•	•	•
HEDS-5421EP1				•	

Incremental Optical Encoders
Reflective Housed

HRPG Series (Rotary Pulse Generators)

Description

- Family of miniature panel-mount optical encoders and digital potentiometers
- Can be mounted on a front panel and used as a rotary, data-entry device
- Multiple configuration options accommodate a variety of different applications
- Available options include: detents or smooth, multiple terminations, versatile mounting capabilities, and different shaft configurations
- Uses optical reflective technology
- Single IC detector circuit makes the part less sensitive to temperature and other environmental variations

Features

- Miniature size
- Smooth turning and detented options
- Multiple mounting bracket options
- Quadrature digital output
- Small footprint for versatile mounting
- TTL compatible output
- Up to 120CPR
- 5 V operation
- 0°C to 70°C operating temperature
- Up to 300RPM rotation speed

Applications

- Front panel instruments
- Audio/visual boards
- Other devices requiring digital output from a turning knob

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

Miniature Panel Mount Optical Encoders – HRPG Series

| HRPG-A | | | | # | | | |

Termination

F - Pins Front with Bracket

R - Pins Rear with Bracket

C - Cable Connector with Strain Relief

Mechanical Configuration

Code	Description
11	0.3 in. long, 0.25 in. dia.
13	0.3 in. long, 0.25 in. dia. D-cut
14	0.5 in. long, 0.25 in. dia.
15	0.5 in. long, 0.25 in. dia. D-cut
17	0.8 in. long, 0.25 in. dia.
19	0.8 in. long, 0.25 in. dia. D-cut
51	7.6 mm long, 6 mm dia.
53	7.6 mm long, 6 mm dia. D-cut
54	12.7 mm long, 6 mm dia.
56	12.7 mm long, 6 mm dia. D-cut
57	20.3 mm long, 6 mm dia.
59	20.3 mm long, 6 mm dia. D-cut

Shaft Feel/Resolution

Code	Description
S16	Smooth 16 CPR
D16	Detented 16 CPR
S32	Smooth 32 CPR
D32	Detented 32 CPR
SCA	Smooth 120 CPR

Available Options

Part Number		Options 01	02	03
HRPG-AD32	11	•		•
	13	•	•	•
	14	•	•	•
	16	•	•	•
	17	•		
	19		•	•
	51	•	•	
	53	•	•	•
	54	•		•
	56	•		•
	57		•	
	59	•	•	•
HRPG-AS16	11			•
	14	•		
	17		•	
	51	•		
	53			•
	54		•	
HRPG-AS32	11			•
	13		•	•
	14	•		•
	53			•
	56		•	
	59	•		
HRPG-ASCA	11	•	•	•
	13	•		•
	14	•	•	•
	16	•	•	•
	17	•	•	•
	19	•	•	•
	51			•
	53	•	•	
	54	•	•	•
	56	•	•	•
	57		•	
	59	•	•	
HRPG-AD16	16	•	•	•
	51			•
	54		•	•
	56	•	•	
	59		•	

Note: For kit encoders, refer to factory.

Absolute Optical Encoders
Transmissive Module

AEAS-7x00 Series (Single-Turn Module)
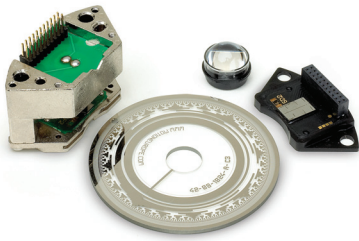
Description

- 16-bit absolute encoder module

- Feedback device which generates a unique binary 'word' for each encoder shaft position

- Encoder design provides positional information instantly upon power up, unlike incremental encoders that require codewheel movement to obtain such information

- Ideal for space-constrained applications

- Plug and play feature eliminates the need for multiple alignment adjustments, making installation very simple

- Contains 13 signal photodiode channels and 1 monitor photodiode channel - each accompanied by precision amplifiers and additional circuitry

- The integrated chip, together with a highly collimated light source and precision codewheel, outputs up to 16 bits of positional information to the user via a serial synchronous interface

Features

- Miniature size, consists of 2 components only

- -25°C to 85°C standard operating temperature

- Quick and easy assembly using plug and play tool

- Cost effective

- 11 digital tracks plus 2 sin/cos tracks to generate precise 16 bit gray code

- Ultra-fast, 1 μs cycle for serial data output word equals 16 MHz

- On-chip interpolation and code correction to compensate for mounting tolerance

- Internally built-in monitor track for tracking the light level

Applications

- Semiconductor automation machines

- Industrial sewing machine

- Robotics

- Automotive (body plant robot cells for assembly and welding)

- Machine tools

Ordering Information

1. AEAS-7000-1GSDO (13bit resolution)
2. AEAS-7000-1GSGO (16bit resolution)
3. AEAS-7500-1GSGO (16bit resolution)

Package Dimensions

- Refer to product datasheet for package dimensions

Absolute Optical Encoders
Transmissive Module

AEAS-84AD/AEAT-84AD/AEAT-86AD Series (Multi-Turn Module)
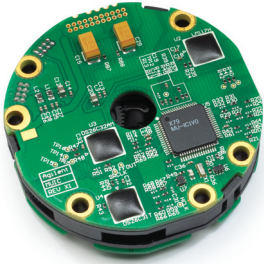
Description

- Optoelectronic-mechanical unit

- Provides multiturn capabilities when used with the AEAS-7000 single-turn absolute encoder

- When used together with AEAS-7000, the designer gains a complete multiturn absolute encoder with a total resolution of 30 bits (16-bit single turn, 14-bit multi turn)

- Enables the designer to count the number of rotations that the motor shaft has gone through

- Ideal for space constrained applications

- The plug and play feature eliminates the need for multiple alignment adjustments, making installation very simple

- Consists of an IR-LED circuit board, a phototransistor (PT) circuit board, and either 6 (12 bits) or 7 (14 bits) code wheels, arranged in between the PCBs. This construction enables AEAx-8xAD to provide absolute multiturn positioning information without battery backup

Features

- 12-bit and 14-bit resolution within small form factor

- -25°C to 85°C nominal operating temperature

- -40°C to 125°C maximum operating temperature

- Gearing system can tolerate up to 12,000 rpm of speed, making it ideal for fast spinning applications like servo motors

- Integrator chip (built-in option available – AEAT-86AD)

Applications

- Robotics

- Machine tools

- Industrial sewing machines

- Semiconductor automation machines

- Packaging machines

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

Standard Multiturn Encoder Module
1. AEAS-84AD-LBSC0 (12 bit, normal temp)
2. AEAS-84AD-LBSF0 (14 bit , normal temp)
3. AEAT-84AD-LBSC0 (12 bit, high temp)
4. AEAT-84AD-LBSF0 (14 bit , high temp)

Integrated Multiturn Encoder Module
1. AEAT-86AD-LASC0 (12 bit, high temp, binary code)
2. AEAT-86AD-LASF0 (14 bit, high temp, binary code)
3. AEAT-86AD-LCSC0 (12 bit, high temp, Gray code)
4. AEAT-86AD-LCSF0 (14 bit, high temp, Gray code

Integrated Circuits
Decoder

HCTL-2001/ 2017/ 2021 Series
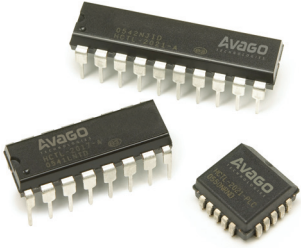
Description

- CMOS ICs that performs the quadrature decoder, counter, and bus interface function
- Improve system performance in digital closed loop motion control systems and digital data input systems
- Consist of a quadrature decoder logic, a binary up/ down state counter, and an 8-bit bus interface
- Allows reliable operation in noisy environments
- HCTL-2001 contains a 12-bit counter
- HCTL-2017/2021 contains a 16-bit counter and provides TLL/ CMOS compatible tri-state output buffers
- Operation is specified for a temperature range from -40°C to 85°C at clock frequencies up to 14MHz

Features

- Interfaces encoder to microprocessor
- 14 MHz clock operation
- High noise immunity: Schmitt Trigger Inputs and digital noise filter
- 16-bit binary up/down counter
- Latched outputs
- 8-bit tri-state interface
- 8, 12 or 16-bit operating modes
- Quadrature decoder output signals, up/down and count
- Cascade output signals, up/down and count
- Substantially reduced system software
- 5V operation (VDD-VSS)
- TTL/ CMOS compatible I/O
- Operating temperature: - 40°C to 85°C
- 16-Pin PDIP, 20-Pin PDIP, 20-Pin PLCC

Applications

- Interface quadrature incremental encoders to microprocessors
- Interface digital potentiometers to digital data input buses

Package Dimensions

- Refer to product datasheet for package dimensions

Ordering Information

Part Number	Description	Package
HCTL-2001-A00	14 MHz clock operation. 12-bit counter.	PDIP-16
HCTL-2017-A00	14 MHz clock operation. 16-bit counter.	PDIP-16
HCTL-2017-PLC	14 MHz clock operation. 16-bit counter.	PLCC-20
HCTL-2021-A00	14 MHz clock operation. 16-bit counter. Quadrature decoder output signals. Cascade output signals.	PDIP-20
HCTL-2021-PLC	14 MHz clock operation. 16-bit counter. Quadrature decoder output signals. Cascade output signals.	PLCC-20

Integrated Circuits

Decoder

HCTL-2022/2032 Series
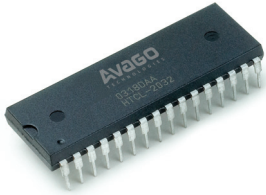
Description

- CMOS ICs that perform quadrature decoding, bus interfacing and counter functions
- Designed to improve system performance in digital, closed-loop motion control systems and digital data input systems. ICs interface the encoder to the microprocessor
- HCTL-2022 comes in a 20-pin PDIP (Plastic Dual In-Line Package)
- HCTL-2032 comes in a 32-pin PDIP
- HCTL-2032-SC comes in a 32-pin SOIC
- HCTL-2032/2032-SC are not pin-to-pin compatible with the HCTL-2000 series, but it is backward compatible in terms of functionality with some added enhancements
- HCTL-2032 IC supports single or dual-axis support. Cost savings realized due to decrease in on-board components
- HCTL-2022 is similar to the HCTL-2032 with only single-axis control
- Large counter allows the IC to operate without the support of extra memory, further reducing the number of supporting components needed on board and decreasing cost

- Features allow deeper penetration into the industrial automation market, such as the servo motor market
- Key advantages over competitors:
  - HCTL-2022/2032 operates at a wider range of temperatures, making it suitable for deeper penetration into the industrial automation market
  - Cascaded output signals allow design flexibility
  - A 32-bit counter size allows the product to operate without the need of external counters, reducing the component count on the PCB and therefore cost
  - Higher frequencies let the HCTL-2022/2032 operate with a wider range of encoders

Features

- Operates up to 33 MHz
- 32-bit binary up/down counter
- -40°C to 100°C operating temperature
- Programmable count modes (1x, 2x or 4x)
- Index channel support provides the ability to reset latched output when necessary

- High noise immunity. The Schmitt Trigger Input and Digital Noise Filter rejects noise on incoming quadrature signals
- Latched output, allowing stable output to microcontroller
- 8, 16, 24, or 32-bit operating modes
- Cascade-able output signals, up/down and count, trigger an external decoder or counter in case of an underflow/overflow situation
- Substantially reduced system software
- Comes with hardware built-in counters. Generally no external counters are required

Applications

- Machine tools
- Servo motors
- Sewing machines
- Robotics
- Measurement equipment
- Printers and printing machines
- Automobile service equipment

Package Dimensions

- Refer to product datasheet for package dimensions

Key Advantages Over Competitors

	LSI Computer Systems	Avago Technologies	
Part Number	LS7266	HCTL - 2022	HTCL - 2032/2032-SC
Operating Temperature (°C)	-25 to 80	-40 to 100	-40 to 100
Cascade Output Signals	No	Yes	Yes
Max Counter Size	24 bit	32 bit	32 bit
Max Frequency	30 MHz	33 MHz	33 MHz

Ordering Information

HCTL-20 [XX] – [XX]

32	Blank	32-PDIP Package
32	SC	32-SOIC Package
22	Blank	20-PDIP Package

Integrated Circuits
Controller

HCTL-1100 Series

Description

- High-performance general purpose motion control IC
- Fabricated in CMOS technology
- IC offloads the host processor by performing the time-intensive functions of digital motion control
- Programmability of all control parameters provides maximum flexibility and quick design of control systems with a minimum number of components
- Complete control system
- Consists of a host processor to specify commands, an amplifier, and a motor with an incremental encoder (such as the HEDS-5XXX, HEDS-6XXX or HEDS-9XXX series)
- No analog compensation or velocity feedback is necessary
- Accepts TTL-compatible outputs from 2- or 3-channel incremental encoders. Channels A and B are internally decoded into quadrature counts, which increment or decrement the 24-bit position counter
- The index channel is used only for the commutator and has a 3-bit filter on its input
- The output port drives a brushless motor or step motor. Its four pins can be programmed to energize each winding on a multiphase motor

Features

- Low-power CMOS
- PDIP and PLCC versions available
- DC, DC brushless and stepper motor control
- Position and velocity control
- Programmable digital filter and commutator
- 8-bit parallel and PWM motor command ports
- TTL compatible
- SYNC pin for coordinating multiple HCTL-1100 ICs
- 100 kHz to 2 MHz operation
- Encoder input port
- Encoder input pins
- PWM output port consists of the Pulse and Sign pins. The PWM port outputs the motor command as a pulse width modulated signal with the correct polarity
- Commutator output (PHA – PHD)
- Motor command port operates in two modes - bipolar and unipolar - when under control of internal software
- Trapezoid Profile Control performs point-to-point position moves and profiles the velocity trajectory to a trapezoid or triangle

Applications

- Printers
- Medical instruments
- Material handling machines
- Industrial automation
- Measurement equipment
- Sewing machines

Ordering Information

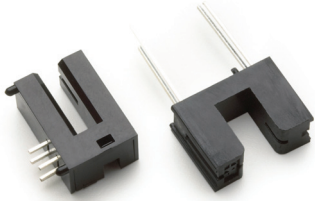HCTL-1100: 40 Pin DIP Package

HCTL-1100#PLC: 44 Pin PLCC Package

Package Dimensions

- Refer to product datasheet for package dimensions

Photointerrupters
Transmissive

AEDS-93xx Series

Description

- Photointerrupters act as an on / off switcher or to sense low-resolution rotary or linear motions
- Consists of a Gallium Arsenide infrared LED and an NPN silicon phototransistor built in a black plastic housing
- Transmissive subminiature photointerrupter
- Reliable – no wear and tear of product with its non-contact sensing feature
- Fast switching speed producing faster response to system
- Wide operating temperature
- Mounting and gap width are customizable to meet customers' requirements for high volume manufacturing (refer to factory for further details)

Features

- Non-contact sensing
- Infra-red wavelength
- Fast switching speed
- Mounting guide pins
- Dual-in-line socket mounting (for AEDS-9310 part number)
- -20°C to 85°C operating temperature
- Collector current Ic 0.8 10 mA (@IF = 20 mA, VCE = 5 V)
- 1.2V LED forward voltage (IF = 20 mA)*
- RoHS compliant

* Typical Conditions

Applications

Widely used in any applications that require single channel edge / position detections OR any optical switches, such as:

- Office Automation Equipments (Printers, Scanners, Copiers, Fax Machines, Optical Tape Drives)
- Electrical Appliances (Washing Machines, Dish Washers, Sewing Machines, Health Equipments)
- Others (ATM Machines, Vending Machines, Slot Machine Tickets, Film Cutter, Telephone Hook / Sensor)

Ordering Information

AEDS-9300 - Horizontal Mount with 2.7 mm Gap Transmissive Photointerrupter

AEDS-9310 - Vertical Mount with 5 mm Gap Transmissive Photointerrupter

Package Dimensions

- Refer to product datasheet for package dimensions

Codewheels
Transmissive

HEDS-51x0/61x0, HEDG-512x/612x, HEDM-512x/61xx Series

Description

- Wide range of codewheels for use with HEDS-90XX/91XX series encoder modules

- Designed for many environments, applications and budgets

- Available in glass, film and metal

- Resolutions from 96 to 1024 CPR on an 11-mm optical radius, and 500 to 2048 CPR on a 23.36-mm optical radius

- Each of the three codewheel materials offers certain advantages

HEDS-51X0/61X0 Series

- Metal codewheels are the most versatile

- Temperature rating up to 100°C

- HEDS-51X0 offers resolution up to 512 CPR

- HEDS-61X0 offers resolution from 500 to 1024 CPR

- 2 and 3 channels output

HEDM-512X/61XX Series

- Film codewheels offer higher resolution

- HEDM-512X offers resolutions of 1000 and 1024 CPR

- HEDM-61XX offers 2000 and 2048 CPR

- 70°C operating temperature

- 2 and 3 channels output

HEDG-512X/612X Series

- Glass codewheels combine the best of film and metal

- Operating temperature 100°C

- HEDG-512X offers resolution of 1000 and 1024 CPR

- HEDG-612X offers resolution of 2000 and 2048 CPR

Features

- Codewheels available in glass, film and metal

- Available in two standard diameters (11 mm and 23.36 mm optical radius)

- Cost effective

- For use with HEDS-90XX/ 91XX series two and three channel encoders

Applications

- Printers
- Plotters
- Tape drivers
- Industry automation equipment
- Factory automation equipment

Reflective

Customized. Consult factory for these special parts.

Ordering Information

Metal Codewheels

HEDS-9100 Option modules		0	0	HEDS-5120 Option codewheels				Rop = 11 mm, 2 Channels

Assembly Tools

Centering	Gap-Setting
HEDS-8905	HEDS-8901

Resolution (Cycles/Rev)

| K - 96 CPR |
| C - 100 CPR |
| D - 192 CPR |
| E - 200 CPR |
| F - 256 CPR |
| G - 360 CPR |
| H - 400 CPR |
| A - 500 CPR |
| I - 512 CPR |

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 |

HEDS-5120		01	02	03	04	05	06	08	09	10	11	12	13	14
	A	•	•	•	•	•	•				•	•		•
	C		•				•				•	•	•	•
	D					•								
	E					•						•		
	F				•									
	G		•	•		•	•				•			•
	H		•				•				•	•		•
	I		•		•		•				•	•	•	
	K		•										•	

HEDS-9140 Option modules		0	0	HEDS-5140 Option codewheels				Rop = 11 mm, 3 Channels

Assembly Tools

Centering	Gap-Setting
HEDS-8905	HEDS-8905

Resolution (Cycles/Rev)

| C - 100 CPR |
| E - 200 CPR |
| F - 256 CPR |
| G - 360 CPR |
| A - 500 CPR |
| I - 512 CPR |

Shaft Diameter

| 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 |

HEDS-5120		01	02	03	04	05	06	08	09	10	11	12	13	14
	A		•		•	•	•				•	•	•	•
	C				•		•					•	•	
	E					•					•	•		•
	F				•							•		•
	G					•						•		•
	I		•		•		•				•	•	•	•

Ordering Information

HEDS-9000 Option modules		0	0	HEDS-6100 Option codewheels			

Rop = 23 mm, 2 Channels

Resolution (Cycles/Rev)

A - 500 CPR
B - 1000 CPR

Shaft Diameter

06 - 1/4 in.
08 - 3/8 in.
09 - 1/2 in.
10 - 5/8 in.
11 - 4 mm
12 - 6 mm
13 - 8 mm

Assembly Tools

Centering HEDS-8906	Gap-Setting HEDS-8901

HEDS-6100		01	02	03	04	05	06	08	09	10	11	12	13	14
	A								•			•	•	
	B						•	•	•	•				

HEDS-9040 Option modules		0	0	HEDS-6140 Option codewheels			

Rop = 23.36 mm, 3 Channels

Resolution (Cycles/Rev)

B - 1000 CPR
J - 1024 CPR

Shaft Diameter

06 - 1/4 in.
08 - 3/8 in.
09 - 1/2 in.
10 - 5/8 in.
11 - 4 mm
12 - 6 mm
13 - 8 mm

Assembly Tools

Centering HEDS-8906	Gap-Setting HEDS-8906

HEDS-6140		01	02	03	04	05	06	08	09	10	11	12	13	14
	B						•	•	•	•	•	•	•	
	J						•		•			•	•	

Note: For the lower resolution, two channel encoders, (11 mm ≤ 512 CPR; 23.36 mm ≤ 1024 CPR) the centering tool and gap-setting shim are not necessary, but sometimes helpful in an assembly process.

Codewheels

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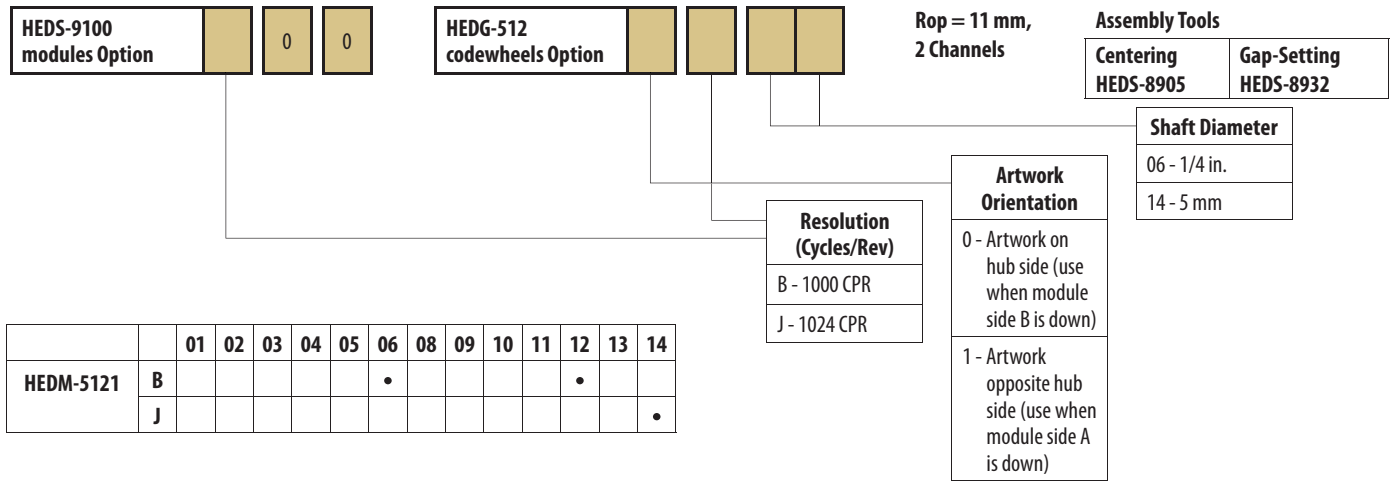# Ordering Information

Film Codewheels

	HEDS-9000 modules Option		0	0		HEDM-512 codewheels Option					Rop = 11 mm, 2 Channels

Assembly Tools

Centering HEDS-8905	Gap-Setting HEDS-8901

Shaft Diameter

02 - 3 mm
06 - 1/4 in.
11 - 4 mm
12 - 6 mm

Artwork Orientation

0 - Artwork on hub side (use when module side B is down)

1 - Artwork opposite hub side (use when module side A is down)

Resolution (Cycles/Rev)

B - 1000 CPR
J - 1024 CPR

		01	02	03	04	05	06	08	09	10	11	12	13	14
HEDM-5120	B		•				•				•	•		
	J					•					•			
HEDM-5121	B				•	•								
	J													

	HEDS-9000 modules Option		0	0		HEDM-612 codewheels Option					Rop = 23.36 mm, 2 Channels

Assembly Tools

Centering HEDS-8906	Gap-Setting HEDS-8906

Shaft Diameter

06 - 1/4 in.
08 - 3/8 in.
12 - 6 mm
13 - 8 mm

Artwork Orientation

0 - Artwork on hub side (use when module side B is down)

1 - Artwork opposite hub side (use when module side A is down)

Resolution (Cycles/Rev)

T - 2000 CPR
U - 2048 CPR

		01	02	03	04	05	06	08	09	10	11	12	13	14
HEDM-6120	T						•	•				•	•	
	U								•					
HEDM-6121	T								•					

Ordering Information

HEDS-9040 modules Option ☐ 0 0   **HEDM-614 codewheels Option** ☐ ☐ ☐ ☐   Rop = 23.36 mm, 3 Channels

Assembly Tools	
Centering HEDS-8906	**Gap-Setting** HEDS-8906

Shaft Diameter

10 - 5/8 in.
12 - 6 mm

Artwork Orientation

0 - Artwork on hub side (use when module side B is down)

1 - Artwork opposite hub side (use when module side A is down)

Resolution (Cycles/Rev)

T - 2000 CPR

		01	02	03	04	05	06	08	09	10	11	12	13	14
HEDM-6140	T											•		
HEDM-6141	T										•			

Glass Codewheels

HEDS-9100 modules Option ☐ 0 0   **HEDG-512 codewheels Option** ☐ ☐ ☐ ☐   Rop = 11 mm, 2 Channels

Assembly Tools	
Centering HEDS-8905	**Gap-Setting** HEDS-8932

Shaft Diameter

06 - 1/4 in.
14 - 5 mm

Artwork Orientation

0 - Artwork on hub side (use when module side B is down)

1 - Artwork opposite hub side (use when module side A is down)

Resolution (Cycles/Rev)

B - 1000 CPR

J - 1024 CPR

		01	02	03	04	05	06	08	09	10	11	12	13	14
HEDM-5121	B						•					•		
	J													•

HEDS-9000 modules Option ☐ 0 0   **HEDG-612 codewheels Option** ☐ ☐ ☐   Rop = 23.36 mm, 2 Channels

Assembly Tools	
Centering HEDS-8906	**Gap-Setting** HEDS-8932

Shaft Diameter

12 - 6 mm

Resolution (Cycles/Rev)

T - 2000 CPR

U - 2048 CPR

		01	02	03	04	05	06	08	09	10	11	12	13	14
HEDG-6120	U											•		

Applications Reference

Products	Incremental Optical Encoders								
	Transmissive Modules						Transmissive Housed		Rotary Pulse Generators
	HEDS-9xxx	HEDS-97xx	AEDS-96xx	AEDA-3xxx	AEDB-9140	AEDS/B-9340	HEDS-65xx	HEDx -5xxx	HEDS-57xx
Office Automation									
Printers / All-in-One Machines	•	•	•		•				
Copiers	•	•	•		•			•	•
Tape Drives	•	•	•		•				
Plotters	•	•	•		•			•	
Scanners		•	•			•			
CD/DVD Writers									
Fax Machines		•	•						
Consumer									
Card Readers	•	•	•						
Appliance Front Panels									•
Camera Phones									
Set-top Boxes									
TV Projectors									
Industrial Automation									
Wafer Handling Machines	•	•	•	•	•	•	•	•	
Industrial Sewing Machines	•		•	•	•	•	•	•	
Robotics	•			•	•	•	•	•	
CAD/CAM Dial Boxes								•	
Wire Bonders				•				•	
Vending Machines		•	•	•	•			•	
Seat Control and Alignment	•				•			•	
Industrial Fans				•		•	•	•	
A/C Ventilation Blades				•					
Tool Changer (Machine Tools)		•		•	•	•			
Robotics (Automotive)				•		•			
Medical									
Blood Analyzers	•	•	•	•	•			•	
Lab Sample Handling Equip.				•					
Surgical Robotics				•				•	
CAT Scan Machines				•					
Motor Manufacturers	•		•		•	•	•	•	
Instrumentation									
Audio Video									•
Front Panel Combo Knobs									•
Other									
ATM Machines		•	•		•				

Applications Reference

	Incremental Optical Encoders				Absolute Optical Encoders		Integrated Circuits		Photointerrupters
	Reflective Modules		Reflective Housed		Transmissive Modules		Decoders	Controllers	Transmissive
				Rotary Pulse Generators					
Products	AEDR-83xx	AEDR-8400	HEDR-542x	HRPG-Axxx	AEAS-7x00	AEAx-8xAD	HTCL-20xx	HCTL-1100	AEDS-93xx
Office Automation									
Printers / All-in-One Machines	•	•					•		•
Copiers	•	•		•			•		•
Tape Drives	•	•					•		•
Plotters	•	•	•	•			•		•
Scanners	•	•					•		•
CD/DVD Writers	•	•					•		•
Fax Machines	•	•					•		•
Industrial Automation									
Wafer Handling Machines					•	•	•	•	
Industrial Sewing Machines	•	•			•	•		•	
Robotics			•		•	•			
CAD/CAM Dial Boxes									
Wire Bonders					•	•	•		
Vending Machines	•	•	•						
Seat Control and Alignment	•	•			•	•	•	•	
Industrial Fans	•	•	•					•	
A/C Ventilation Blades	•	•	•						
Tool Changer (Machine Tools)					•	•	•	•	
Robotics (Automotive)					•	•	•	•	
Medical									
Blood Analyzers				•	•				
Lab Sample Handling Equip.					•				
Surgical Robotics					•	•			
CAT Scan Machines					•	•			
Motor Manufacturers	•	•		•	•	•	•	•	
Consumer									
Card Readers	•	•		•					
Appliance Front Panels				•					
Camera Phones	•	•							
Set-top Boxes	•	•							
TV Projectors	•	•							
Instrumentation									
Audio Video				•	•				
Front Panel Combo Knobs				•	•		•		
Other									
ATM Machines	•	•							•

Appendix: Definition of Key Terms

Product Technology	Description
Absolute Encoder	A type of encoder which generates a unique code for each position, unlike an incremental encoder, which only generate pulses proportional to position. An absolute encoder has the distinctive feature of being able to provide positional information instantly upon power up.
Absolute Multi-Turn Encoder	In addition to the Absolute Single-Turn Encoder, this type of Absolute Multi-Turn Encoder provides shaft revolution detection, usually through means of an integrated gear, in which the code representation for each revolution is unique. Combined with Absolute Single-Turn Encoder, it provides unique positional information beyond one revolution.
Absolute Single-Turn Encoder	A type of absolute encoder whereby each measurable angular position provides unique positional information, within one revolution, without the need of counter and homing operation, upon power up.
Codewheel and Codestrip	Codewheel and codestrip are patterned discs or strips that translate a mechanical position into a representative electrical signal when used with an optical encoder. A codewheel is used for rotary motion while a codestrip is used for side-to-side motion. In a transmissive encoder, the bars block light and the windows allow light to pass through. In a reflective encoder, the bars absorb light while the windows reflect light.
Controller IC	A PID Motor Controller IC commands the motor operation by taking the feedback signal from the encoder output. It frees the host processor for other tasks by performing all the time intensive functions of digital motion control.
Decoder / Counter IC	Interfaces the encoder to the microprocessor. A decoder and counter IC converts the incremental signal from the encoder to a binary number.
Housed Encoder	An enclosed encoder with protective housing that normally has a defined IP rating.
Incremental Encoder	A type of encoder that provides relative position, whereby the feedback signal is always referenced to a start or home position. On an incremental encoder, each mechanical position is not uniquely defined. The current position sensed is only incremental from the last position sensed.
Linear Encoder	A type of incremental encoder that provides high resolution linear incremental positioning information. The linear encoder is a good alternative to designers who need to measure linear movement in high resolution.
Module Encoder	A basic encoder unit that integrates the detector and emitter in a single unit.
Optical Encoder	Sensors that use light to sense the speed, angle and direction of a rotary shaft.
Reflective Encoder	Consists of an emitter and detector, each positioned on the same side of the codewheel/codestrip.
Rotary Encoder	Also known as a shaft encoder. A type of incremental encoder that converts angular position of a shaft or axle to a digital code. Rotary encoders can also be used to measure linear motion, with the use of a ballscrew systems, to translate linear motion into rotary motion.
Transmissive Encoder	Consists of an emitter and detector, each positioned at opposite sides of the codewheel/codestrip.

Appendix: Definition of Key Terms

Detector sets

Single Detector

- It looks at only the window or bar
- Defects at individual windows or bars cause error

Multiple Photodetectors

- It looks at many windows or bars
- Minimizes error due to defects at individual windows or bars
- Increases detected signal strength

Avago encoders employ multiple detector sets. Each set consists of differential outputs with push/pull circuitry. See diagram 2 below. An explanation on the operation of the differential signaling is described in the next item.

Diagram 1: Single and Multiple detector elements

Single Detector

Multiple Detector

Photocurrent Output

Photocurrent Output
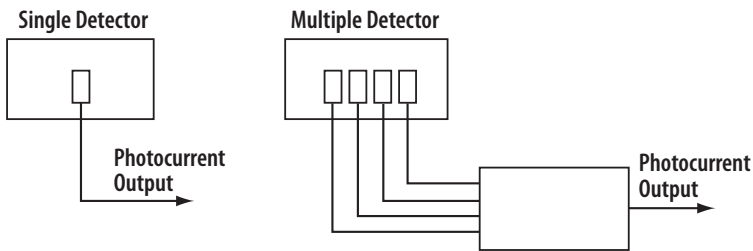
Diagram 2: Multiple detector elements

LED

Lens

Codewheel

Detector IC

Photodiodes

DECODE

A B
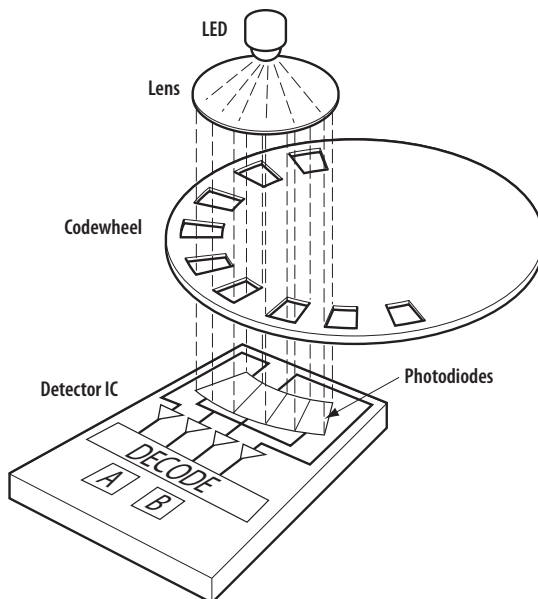
Appendix: Definition of Key Terms

Differential Signaling

Why use differential signaling?

- Insensitive to variations in light
- Hysteresis in comparators prevents oscillation
- Switching points remain the same, independent of light level
- Negates effect of light level variation

Diagram 3: Differential Detector output
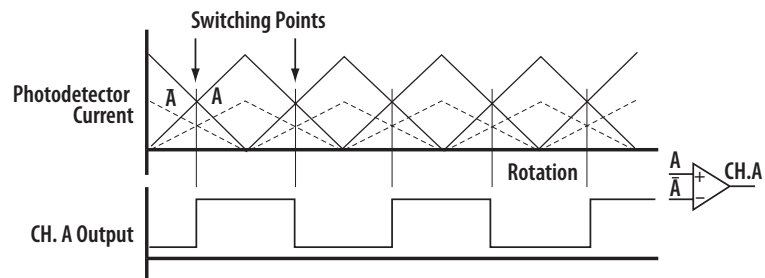
How does differential signaling work?

- Signals for A and its complement A(bar) are sent to comparator
- When A receives more light than A(bar), then Ch. A is high
- Otherwise, if A(bar) receives more light than A, then Ch. A is low

Diagram 4: Single channel detector output

Appendix: Definition of Key Terms

LPI:

Lines Per Inch

CPR:

Counts Per Revolution

LPI Formula

Window   Bar

1 Count (x)
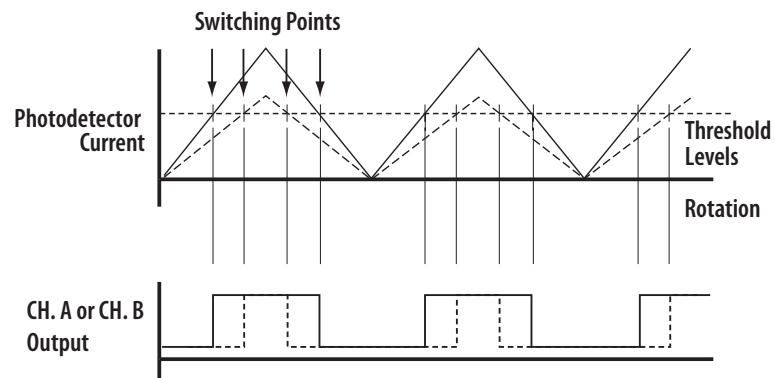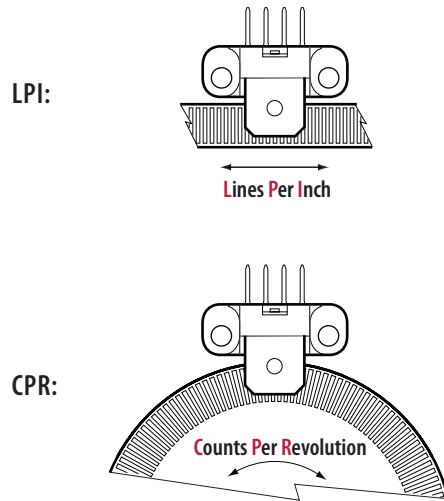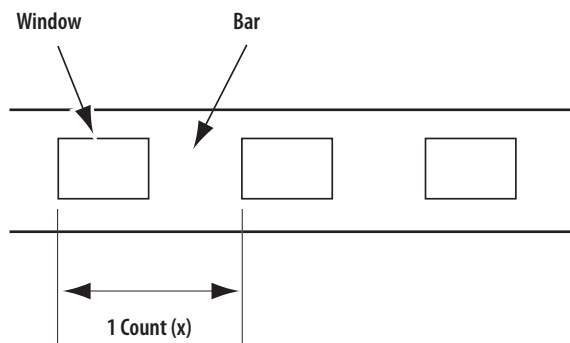
LPmm can be used instead of LPI (Lines Per Inch). LPmm means the number of 'Lines Per mm'. The method of calculation for LPmm is the same as LPI. The only difference is that the 'mm' replaces 'Inch' as the standard measurement of length.
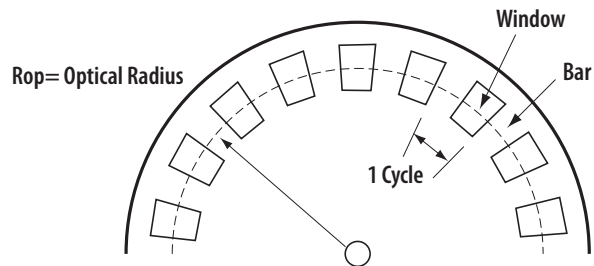
The formula for LPI and LPmm is as follows:

$$LPI = \frac{1}{x\,(Inch)} \qquad\qquad LPmm = \frac{1}{x\,(mm)}$$

Where x = length of Window and Bar pair length

Appendix: Definition of Key Terms

CPR Formula

1 Cycle = the mechanical rotation that corresponds to one pair of Window and Bar.

CPR = Number of Window and Bar pairs over full rotation

Converting CPR to LPI and LPmm

$$\text{Count Density} = \frac{\begin{array}{c}\text{Number of Window}\\\text{and Bar pair}\end{array}}{\text{Arc Length}} = \frac{\begin{array}{c}\text{CPR}\\\text{(count over full rotation)}\end{array}}{\begin{array}{c}2\pi\text{Rop}\\\text{(Arc length over full rotation)}\end{array}}$$

$$\text{LPI} = \frac{\text{CPR}}{2\pi\text{Rop(Inch)}} \qquad \text{LPImm} = \frac{\text{CPR}}{2\pi\text{Rop(mm)}}$$

Calculation for Customized Resolution

Assuming you would like to use an Encoder with a known CPR and Rop for a custom CPR resolution, the LPI or LPmm must match for the encoder to operate properly.

The formulas described on the previous page can be used to calculate the new codewheel dimension. To retain the same LPI or LPmm, increase the CPR, then the Rop will increase accordingly. If the CPR is decreased, the Rop will also decrease accordingly.

For example, for the case of HEDS-9000-Txx. This is a 2000CPR at 23.36mm Rop encoder. Assuming we want to use a customized codewheel with a CPR of 4000CPR with this 2000CPR encoder.

Appendix: Definition of Key Terms

The table below simplifies the problem statement. The encoder and custom codewheel LPI must match in order for the encoder to operate properly. The new CPR is known and the only unknown is the Rop of the custom Codewheel to ensure that the new codewheel, LPmm matches that of the encoder specifications. We have to identify what is the new Codewheel Rop.

	Encoder Specification	Custom CW Specification
CPR	2000	4000
Rop	23.36 mm	Unknown (x)
LPmm	13.6245	

First, calculate the LPmm of the encoder:

$$LPmm = \frac{CPR}{2\pi Rop(mm)}$$

$$LPmm = (2000)/(2\pi*23.36) \qquad \pi = 3.142$$

$$LPmm = 13.6245$$

The new 4000CPR codewheel must also match this 13.6245LPmm. Next, find the appropriate Rop for 4000CPR:

$$LPmm = \frac{CPR}{2\pi Rop(mm)}$$

$$13.6245 = 4000/(2\pi*x)$$

$$Rop(mm) = 46.72 \text{ mm}$$

The new Codewheel for 4000CPR must have a Rop of 46.72mm to be used with a 2000CPR 23.36mm encoder.

	Encoder Specification	Custom CW Specification
CPR	2000	4000
Rop	23.36 mm	46.72 mm
LPmm	13.6245	

Important: The LPI or LPmm for the codewheel and the encoder must match for the encoder to operate properly.

About Avago Technologies

Avago Technologies is a leading supplier of innovative semiconductor solutions for advanced communications, industrial and commercial applications. The company provides an extensive range of analog, mixed-signal and optoelectronic components and subsystems to more than 40,000 customers worldwide. Avago's products serve four end markets: industrial and automotive, wired infrastructure, wireless communications, and computer peripherals. It is recognized for providing high-quality products along with strong customer service and the industry's best on-time delivery. Avago's heritage of technical innovation dates back 40 years to its Agilent/Hewlett-Packard roots.

Avago
TECHNOLOGIES

Optical Encoder - Module[1,2]

Rotary Encoder | **Photo Interrupter**

Rotary Encoder: **Incremental** — Reflective / Transmissive - Digital Output / Transmissive - Analog Output; **Absolute** — Single-Turn / Multi-Turn.
Photo Interrupter: **Transmissive** — 2.7mm Gap Horizontal Mounting / 5mm gap/Vertical Mounting.

	Symbol	AEDR-8000 AEDR-8010 AEDR-8100	AEDR-83xx	AEDR-8300-1Wx	AEDR-8400	HEDS-90XX HEDS-91XX HEDS-92XXi	HEDB-9xxx	HEDT-900X HEDT-910X	HEDT-904X HEDT-914X	AEDB-9140	AEDB-9340	HEDL-90XX HEDL-91XX	HEDS-97XX HEDS-973X HEDS-974X HEDS-978X	AEDS-964X AEDS-965X	AEDA-32XX	AEDA-3300	HEDS-9202	HEDS-971X	AEDS-96EX	AEAS-7000	AEAS-7500	AEAS-84AD	AEAT-84AD	AEAT-86AD	AEDS-9300	AEDS-9310
Product Part Number		AEDR-8000 AEDR-8010 AEDR-8100	AEDR-83xx	AEDR-8300-1Wx	AEDR-8400	HEDS-90XX HEDS-91XX HEDS-92XXi	HEDB-9xxx	HEDT-900X HEDT-910X	HEDT-904X HEDT-914X	AEDB-9140	AEDB-9340	HEDL-90XX HEDL-91XX	HEDS-97XX HEDS-973X HEDS-974X HEDS-978X	AEDS-964X AEDS-965X	AEDA-32XX	AEDA-3300	HEDS-9202	HEDS-971X	AEDS-96EX	AEAS-7000	AEAS-7500	AEAS-84AD	AEAT-84AD	AEAT-86AD	AEDS-9300	AEDS-9310
Lead free		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	-	Yes	Yes
Resolution																										
Cycle per Revolution[6,7]		-	-	-	-	up to 2048	up to 1024	up to 1024	up to 512	up to 500	up to 2500	up to 2048	96 to 2048	-	2500 to 7500	600 to 20000	-	-	-	up to 16 bits	up to 16 bits	12, 14 bits	12, 14 bits	12, 14 bits	-	-
Line per Inch		75, 150, 180	36 to 180	212	254	up to 360	-	-	-	-	-	120 to 480	150, 180, 200,300,360	-	-	-	200	200, 360	200	-	-	-	-	-	-	-
Available option: Cycle per Revolution[2]		-	-	-	-	50,96,100,200,256 360,400,500,512 1000,1024,2000,2048	96,100,200,256 360,400,500,512 1000,1024	100, 200, 360, 400, 500,1000, 1024	512	100, 200, 256, 360 400, 500	1000,1024,1250, 2000,2048,2500	500,512,1000,2048	96, 100, 192, 200 256, 360, 400, 500 1000,1024,2000,2048	150,300,360 150,180 for 965X	2500, 5000, 6000 7200, 7500	600, 1000, 1024 2000, 2048, 2500 3000, 4000, 4096 5000, 6000, 7200	-	-	-	13, 16 bits	16 bits	12, 14 bits Multiplexed	12, 14 bits Multiplexed	12, 14 bits Binary/ Gray Serial	-	-
Line per Inch[8]		75, 150, 180	36, 75, 150, 180	212	254	180, 300,360	-	-	-	-	-	3468	120, 127, 150, 180, 300, 360	-	-	7500, 8000, 8192 10000, 10240, 12000 14400, 18000, 20000	200	200, 360	200	-	-	-	-	-	-	-
Codewheel / Codestrip[9] CW																										
Optical Radius(mm)	Rop	11	11	11	11	11, 23.36	11, 23.36	11, 23.36	11, 23.36	11	15	11, 23.36	-	-	5	5	-	-	-	Ø43 mm5	Ø43 mm5	-	-	-	-	-
Part number[10]		-	HEDR-5120	HEDR-5120	HEDR-5120	HEDS-51xx/61xx HEDG-51xx/61xx HEDM-51xx/61xx	Codewheel included	HEDS-5120/6100 HEDG-5120/6100	HEDS-5140/5145 HEDS-6140/6145	Codewheel included	Codewheel included	HEDS-51xx/61xx HEDG-51xx/61xx HEDM-51xx/61xx	Refer to factory	Refer to factory	Codewheel included	Codewheel included	Refer to factory	Refer to factory	Refer to factory	Codewheel included	Codewheel included	-	-	-	-	-
Enclosure Type																										
Ingress Protection Rating		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IP20	IP20	IP20	-	-	-	-
Output																				Refer to datasheet	Refer to datasheet	Refer to datasheet	Refer to datasheet	Refer to datasheet		
TTL Compatible		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	-	-	-	-
Transmission		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Serial	Serial	-	-	-	-	-
Single Channel		Yes	Yes	Yes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Two Channels		Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	Yes	Yes	Yes	-	-	Yes	Yes	Yes	Yes[12]	Yes[12]	-	-	-	-	-
Three Channels		-	-	-	-	Yes[1]	Yes	-	Yes	Yes	Yes	Yes	-	-	Yes	Yes	-	-	-	-	-	-	-	-	-	-
UVW		-	-	-	-	-	-	-	-	-	-	-	-	Yes	-	-	-	-	-	-	-	-	-	-	-	-
Absolute Maximum Ratings																										
Storage Temperature (°C)[13]	TS	-40 to 85	-40 to 85	-40 to 85	-40 to 85	-40 to 100	-40 to 100	-40 to 125	-40 to 140	-10 to 85	-40 to 85	-40 to 70 or 100	-40 to 70 or 85	-40 to 85	-40 to 125	-40 to 125	-40 to 100	-40 to 85	-40 to 85	-35 to 85	-35 to 85	-40 to 100	-40 to 125	-40 to 125	-40 to 85	-40 to 85
Operating Temperature (°C)[13]	TA	-20 to 85	-20 to 85	-20 to 85	-20 to 85	-40 to 100	-40 to 100	-40 to 125	-40 to 140	-10 to 85	-10 to 85	0 to70 or 100	-40 to 70 or 85	0 to 70	-40 to 125	-40 to 125	-10 to 100	0 to 85	0 to 70	-25 to 85	-25 to 85	-40 to 100	-40 to 125	-40 to 125	-40 to 85	-40 to 85
Supply Voltage (V)	VCC	-0.5 to 7	-0.5 to 7	-0.5 to 7	-0.5 to 7	-0.5 to 7V	-0.5 to 7V	-0.5 to 7V	-0.5 to 7V	-0.5 to 7V	-0.5 to 7V	-0.5 to 7V	-0.5 to 7	Refer to datasheet	4.5 to 5.5	4.5 to 5.5	-0.5 to 7	-0.5 to 7	-0.5 to 7	-0.3 to +6.0	-0.3 to +6.0	-0.3 to +6.0	-0.3 to +6.0	-0.3 to +6.0	5.5	5.5
Output Voltage (V)	VO	-0.5 to Vcc	-0.5 to Vcc	-0.5 to Vcc	-0.5 to Vcc	-0.5 to VCC	-0.5 to VCC	-0.5 to VCC	-0.5 to VCC	-0.5 to VCC	-0.5 to VCC	-0.5 to VCC	-0.5 to VCC	-0.5 to VCC	-0.5 to Vcc	-0.5 to Vcc	-	-	-	-0.3 to VD+0.3	-0.3 to VD+0.3	-0.5 to + Vcc +0.5	-0.5 to + Vcc +0.5	-0.5 to + Vcc +0.5	-0.5 to + Vcc +0.5	-0.5 to + Vcc +0.5
Recommended Operating Condition																										
Temperature (°C)[13]	T	0 to 80	0 to 85	-20 to 85	-20 to 85	-40 to 100	-40 to 100	-40 to 125	-40 to 140	-10 to 85	-10 to 85	0 to 70 or 100	25	0 to 70	25	25	25	15 to 45	0 to 60	-25 to 85	-25 to 85	-40 to 85	-40 to 125	-40 to 125	-40 to 85	-40 to 85
Supply Voltage (V)	VCC	5.0	5.0	3.3 / 5.0	2.8	5.0	5.0	5.0	5.0	5.0	5V	5.0	5.0	3.3 / 5.0	5.0	5.0	5	5.0	3.3	5.0	5.0	5.0	5.0	5.0	5	5
Count Frequency (kHz)[14]	f	30	15 / 30	60	15	100	100	100	50	100	150	100	20, 40, 80	50,60	750	650, 1000	120	40	50	16MHz15	16MHz15	-	-	-	-	-
Accessories and Tools																										
Alignment Tools		-	-	-	-	HEDS-8905 HEDS-8906	-	-	HEDS-8905	-	HEDS-8950 HEDS-8951	-	-	-	HEDS-8940	-	-	-	-	HEDS-8933 Refer to factory	- Refer to factory	-	-	-	-	-
Gapping Tools		-	-	-	-	HEDS-8901 HEDS-8910 HEDS-8932	-	-	-	-	HEDS-8952	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

1. This is an overview of the product range and specifications. For further product details and a complete list of distributors, visit the web site at www.avagotech.com/motioncontrol
2. Data subject to change. Refer to the latest datasheets available in our website.
3. Refer to factory for different product shaft or bore diameter sizes (this refers to the inner diameter of the bore, unless specified otherwise).
4. AEAT-8xAD series uses mechanical pinion gear for its mechanical linkage. Refer to factory for further details.
5. Data shown is an approximation of the actual dimensions. (W = width, L=length, H= height, Ø = diameter).
6. All given resolution is before full 4X multiplication or quadrature decode. For example, 2048 CPR (cycle per revolution) can be further decoded to 8192 PPR (pulse per revolution).
7. The resolution shown is typically based on CPR, unless specified otherwise .
8. For linear encoder option.
9. As some modular encoders can be used as both rotary and linear encoders, these encoders may be coupled with a codewheel or codestrip, dependent on application.
10. As there are diversified designs of matching codewheels or codestrips, refer to factory for further details. General information can be found in HEDS-51X0/61X0 series two and three channel codewheels.
11. Dimensions shown are referring to encoder module size only, excluding the codewheel size.
12. Two channels of analog / digital output are available.
13. The temperature range shown may vary as it is depending on selected options and types of codewheels.
14. The count frequency may vary according to different part numbers and options. The specified value indicates the maximum count frequency allowed.
15. This refers to the response frequency of the encoder.

		Optical Encoder - Housed[1,2]			
		Rotary Encoder			
		Incremental			
	Large Size	**Mid Size**	**Miniature Size**	**Panel Mount**	
Symbol				**Digital Potentiometer**	
Product Part Number	HEDL-65XX HEDM-65XX HEDS-65XX	HEDL-55XX HEDM-55XX HEDS-55XX HEDL-56XX HEDM-56XX HEDS-56XX	HEDR-54XX	HEDS-57XX	HRPG-AXXX
Product Picture					
Fit					
Bore / Shaft Diameter[3] (mm)	Up to 5/8"	up to 8	2,3,4,5 &1/8"	1/4" & 6 (OD)	0.25"/ 6 mm
SMT	-	-	-	-	-
Modular	-	-	-	-	-
Overall Dimension[5] (mm)	56x66x18.2 (ØxLxH)	41.7x52.1x18.3 (WxLxH)	23x17.9 (ØxH)	30x42x44.2 (WxLxH)	21x17.5 (WxH)
Resolution					
Cycle per Revolution[6,7]	500 to 2048	up to 1024	200	up to 512	up to 120
Line per Inch	-	-	-	-	-
Available option: (Cycle per Revolution)[2]	500, 1000, 1024 2000, 2048	50, 96, 100, 192, 200 256, 360, 400, 500, 512 1000, 1024	200	96, 100, 256, 360 500, 512	16, 32, 120
(Line per Inch) [8]	-	-	-	-	-
Enclosure Type					
Ingress Protection Rating	IP20	IP20	IP20	IP20	IP20
Output					
TTL Compatible	Y	Y	Y	Y	Y
Transmission	-	-	-	-	-
Single Channel	-	-	-	-	-
Two Channels	Y	Y	-	Y	Y
Three Channels	Y	Y	Y	Y	-
UVW	-	-	-	-	-
Absolute Maximum Ratings					
Storage Temperature (°C)[13]	TS	-40 to 70 or 100	-40 to 70 or 100	-40 to 85	-40 to 85	-40 to 85
Operating Temperature (°C)[13]	TA	-40 to 70 or 100	-40 to 70 or 100	-10 to 85	-20 to 85	0 to 70
Supply Voltage (V)	VCC	-0.5 to 7	-0.5 to 7	-0.5 to 7	-0.5 to 7	-0.5 to 7
Output Voltage (V)	VO	-0.6 to Vcc	-0.5 to Vcc	-0.5 to Vcc	-0.5 to Vcc	-0.5 to Vcc
Recommended Operating Condition					
Temperature (°C)[13]	T	-40 to 70 or 100	-40 to 70 or 100	-10 to 85	-20 to 85	0 to 70
Supply Voltage (V)	VCC	4.5 to 5.5	5.0	5.0	4.5 to 5.5	4.5 to 5.5
Count Frequency (kHz)[14]	f	100	100	16		
Accessories and Tools					
Alignment Tools		HEDS-6510	HEDS-8910	HEDR-5900	-	-
Gapping Tools		HEDS-6511	-	-	-	-

Note: the Symbol column values (TS, TA, VCC, VO, T, VCC, f) are shown for the Absolute Maximum Ratings and Recommended Operating Condition rows.

Notes:

1. This is an overview of the product range and specifications. For further product details and a complete list of distributors, visit our web site at www.avagotech.com/motioncontrol

2. Data subject to change. Refer to the latest datasheets available in our website.

3. Refer to factory for different product shaft or bore diameter sizes (this refers to the inner diameter of the bore, unless specified otherwise).

4. AEAT-8xAD series uses mechanical pinion gear for its mechanical linkage. Refer to factory for further details.

5. Data shown is an approximation of the actual dimensions. (W = width, L=length, H= height, Ø= diameter).

6. All given resolution is before full 4X multiplication or quadrature decode. For example, 2048 CPR (cycle per revolution) can be further decoded to 8192 PPR (pulse per revolution).

7. The resolution shown is typically based on CPR, unless specified otherwise .

8. For linear encoder option.

9. As some modular encoders can be used as both rotary and linear encoders, these encoders may be coupled with a codewheel or codestrip, dependent on application.

10. As there are diversified designs of matching codewheels or codestrips, refer to factory for further details. General information can be found in HEDS-51X0/61X0 series two and three channel codewheels.

11. Dimensions shown are referring to encoder module size only, excluding the codewheel size.

12. Two channels of analog / digital output are available.

13. The temperature range shown may vary depending on selected options and type of codewheels.

14. The count frequency may vary according to different part numbers and options. The specified value indicates the maximum count frequency allowed.

15. This refers to the response frequency of the encoder.

		Integrated Circuits[1, 2]		
		Controller	**Decoder**	
	Symbol	**General Purpose Motion Control IC**	**Quadrature Decoder / Counter Interface IC**	
Product Part Number		HCTL - 1100 HCTL - 1100#PLC	HCTL - 2032 HCTL-2032 - SC HCTL - 2022	HCTL-2001-A00 HCTL-2017-A00/PLC HCTL-2021-A00/PLC
Product Picture				
Package Type		40 pin - PDIP 44 pin - PLCC	32 pin - PDIP 32 pin - SOICC 20 pin - PDIP	16 pin - PDIP 20 pin - PDIP 20 pin - PLCC
Number of Axes		1	1, 2	1
Coordination between multiple HTCL-1100			-	-
Power Dissipation (mw)	PD	75	-	-
Binary Counter		-	8-bit, 16-bit, 24-bit, 32-bit	8-bit, 12-bit, 16-bit
Motor Type/Encoder Input Type		- DC motor - DC Brushless motor - Step motor	Quadrature Output Incremental Frequency 5.5 MHz (Max)3	Quadrature Output Incremental Frequency 2.3 MHz (Max)3
Functions				
		- Position control - Velocity control - Proportional velocity control - Trapezoidal profile control - Integral velocity control		
Features				
		- Low power CMOS - Programmable digital filter and commutator - 8-bit parallel and PWM motor command ports - TTL compatible - SYNC pin for coordinating multiple HTCL - 1100 - 100 kHz to 2 MHz operation - Quadrature incremental encoder interface with index pulse input - Programmable phase advance, phase overlap and phase offset	- 33 MHz clock operation - Programmable count mode / (1x,2x or 4x decode) - High noise immunity - Substantially reduced system software - Cascade output signal - Schmitt Trigger inputs and digital noise filter - TTL compatible I/O - Latched outputs - Index channel support - Single or dual axis support	- 14 MHz clock operation - 4x Decoding - High noise immunity - Substantially reduced system software - Cascade output signal (HCTL-2021 Only) - Schmitt Trigger inputs and digital noise filter - TTL compatible I/O - Latched outputs - Index channel support - Single axis
Absolute Maximum Rating				
Storage Temperature (°C)	TS	-55 to 125	-55 to 150	-55 to 150
Operating Temperature (°C)	TA	-20 to 85	-40 to 100	-40 to 85
Supply Voltage (V)	VDD	-0.3 to 7	-0.3 to 6.0	-0.3 to 6.0
Input Voltage (V)	VIN	-0.5 to VDD +0.3	-0.3 to VDD +0.3	-0.3 to VDD +0.3
Maximum Operating Clock Frequency	f CLK	2 MHz	33 MHz	14 MHz
Recommended Operating Condition				
Temperature (°C)	T	-20 to 85	25	25
Supply Voltage (V)	VDD	4.75 to 5.25	4.5 to 5.5	4.5 to 5.5
Supply Current	IDD	15mA	1mA	1mA

Notes:

1. This is an overview of product range and specifications. For further product details and a complete list of distributors, visit our web site at www.avagotech.com/motioncontrol

2. Data subject to change. Refer to the latest datasheets available in our website.

3. This refers to count frequency of the encoder output.