BROADCOM®

SELECTION GUIDE

# Motion Sensing and Control Products

## Your One-Stop Center for Precision Motion Solutions

## EHMT | Optical | Magnetic | Linear Encoder Solutions







broadcom.com

# Table of Contents

**Our Value Propositions** ..... 4
**Applications** ..... 4
**Product Overview** ..... 5
**What's Hot** ..... 7
EHMT PCBA Module Encoders ..... 7
Absolute ST EHMT Module Encoders ..... 7
Absolute Optical Encoders ..... 8
Magnetic Encoders ..... 9
Magnetic IC Encoders ..... 9
Reflective Incremental Encoders ..... 10
Voltage Monitor ICs ..... 11
Line Driver ICs with High-Voltage Quad Differential Output ..... 11
**Absolute Encoders: Energy-Harvesting Multi-Turn (EHMT) PCBA** ..... 12
QP39 Series ..... 12
**Absolute Encoders: Single-Turn (ST) + Energy-Harvesting Multi-Turn (EHMT)** ..... 13
AR49-M49M/M25S Series ..... 13
AS20-M42M Series ..... 15
AS33-M42M Series ..... 16
AS38-H39E Series ..... 18
**Absolute Encoders: Optical** ..... 19
AR18 Series ..... 19
AR25 Series,
AR25DP Series (Dust Protection) ..... 20
AR55 Series ..... 23
**Absolute Encoders: Magnetic** ..... 25
AEAT-901x Series ..... 25
AEAT-901B Series ..... 26
AEAT-9922/9933 Series ..... 27
AEAT-9955/9966 Series ..... 29
AEAT-9988M/MB Series ..... 31
**Incremental Optical Encoders: Transmissive Modules** ..... 33
AEDT-981x Series ..... 33
HEDL-90/91xx Series ..... 35
HEDS-90/91/92xx Series,
HEDT-90/91xx Series ..... 36
HEDS-97xx Series ..... 41

**Incremental Optical Encoders: Housed / Kit** ..... 42
AEDC-55/56xx Series,
HEDC-55/56xx Series ..... 42
AEDL-58xx Series,
HEDL-55/56xx Series ..... 44
AEDM-5xxx Series,
HEDS/HEDM-55/56xx Series ..... 46
AS22-M5xx Series ..... 48
HEDR-54xx Series ..... 49
HRPG-Axxx Series ..... 50
**Incremental Optical Encoders: Reflective Modules** ..... 51
AEDR-83xx Series ..... 51
AEDR-8400 Series ..... 52
AEDR-8500 Series ..... 53
AEDR-87xx Series ..... 54
AEDR-9820/9830 Series,
AEDR-9820A/9830A Series ..... 55
AEDR-9820E/9830E Series,
AEDR-9820EA/9830EA Series ..... 57
AEDR-9830DP Series (Dust Protection) ..... 59
AEDR-9920 Series ..... 61
AEDR-9930E2/E2L Series ..... 62
AEDR-9940/ER Series,
AEDR-9940A/ERA Series ..... 64
**Code Wheels/Code Strips** ..... 66
AR18-Sxx, AR25-Axxx,
AR55-RxxS, AR55-L20S Series,
HEDx-51/61xx Series ..... 66
**Integrated Circuits: Line Drivers** ..... 78
AEIC-7272/7273/2631 Series ..... 78
AELT-8000 Series ..... 79
**Integrated Circuits: Voltage Monitoring ICs** ..... 80
AEIC-3700 Series ..... 80
**Quick Product Selection Guide** ..... 81
Absolute Encoders ..... 81
Optical Incremental Encoder ICs ..... 86
Incremental Encoder Kits ..... 91
Integrated Circuits and Voltage Monitors ..... 93
**Encoder Fundamentals and Key Definitions** ..... 94
Definition of Key Terms ..... 94
Detector Sets ..... 95
Differential Signaling ..... 96
LPI Formula ..... 97
Cycle Count per Revolution Formula ..... 97
Converting CPR to LPI and LPmm ..... 98
Calculation for Customized Resolution ..... 99

# Our Value Propositions









## Customer Reach

Our extensive global network and experienced support ecosystem enable us to stay closer to our customers—efficiently providing responsive support and tailored solutions across diverse markets and regions.

## State-of-the-Art Technology

We deliver innovative, high-performance and customer-centric solutions by leveraging and innovating on the latest cutting-edge technologies in semiconductor, optics, and process manufacturing designed by our experienced pool of engineers.

## High-Quality Services

Quality is the cornerstone of our operations, underscored by rigorous stress testing and world-class engineering support throughout the product life cycle. Our dedicated field support teams ensure that every component meets the highest standards of reliability.

## One-Stop Center

We simplify your path to market by offering an end-to-end suite of services from specifications to volume productions. By consolidating the different fields of design, process, and manufacturing under one roof, our goal is to deliver greater value to our customers.

# Applications

Broadcom® products meet stringent requirements in a wide range of applications from medical healthcare and scanners to industrial automation servo and stepper motors, robotics arms, automated guided vehicles (AGVs), and semiconductor equipment.

**Industrial Automation**

- Wafer-handling machines
- Industrial sewing machines
- Robotics
- Machine tools

**Motor Manufacturers**

- DC motors
- Servo motors
- Stepper motors
- Piezo motors

**Medical/ Healthcare**

- Blood analyzers
- Life sciences
- Insulin pumps
- CT scans
- Medical robots

**Security Surveillance/ AGVs**

- LiDAR
- Virtual reality (VR)
- Drones
- Pan tilt zoom (PTZ) cameras
- AGVs/AMRs
- Humanoids

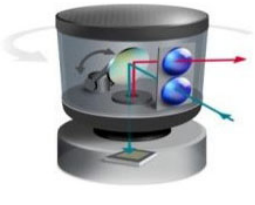
**Semiconductor Machines**

- Vision systems
- SMT machines
- Wire bonder machines











# Product Overview

Broadcom is a leading supplier of motion control encoders used to measure motor shaft position and speed. These encoders provide real-time feedback to motor control systems, enabling precise control of speed, position, and overall motion performance.

We offer a true one-stop solution with a broad portfolio of absolute and incremental encoders. Our products are designed with compact form factors, a wide range of resolutions, and a high level of integration to help reduce component count and shorten design cycles. Over decades of deployment across multiple industries, Broadcom encoder technologies have earned trust by delivering accurate and reliable motion feedback.

Our portfolio spans linear encoders, rotary encoders with patented energy-harvesting multi-turn (EHMT) technology for high-resolution multi-turn sensing, and both reflective and transmissive optical encoders for precise, contact-free measurement. For applications that demand high robustness and long-term durability, our magnetic encoders provide stable, maintenance-free performance even in harsh environments.

The portfolio also includes automotive-qualified encoders that meet AEC-Q100 requirements, with production conformance to IATF 16949 quality management standards. This compliance ensures consistent performance and reliability in safety-critical and high-volume applications.

Every Broadcom encoder is designed and manufactured with a strong focus on quality, consistency, and ease of integration. We prioritize repeatable accuracy and long-term reliability, helping customers optimize system performance and reduce development risk.

Whether an application requires high-speed motion control, precise linear positioning, or reliable operation in challenging conditions, Broadcom offers an encoder solution designed to meet these application demands. Beyond delivering high-quality products, we work closely with our customers to support new designs and advance modern motion control systems.

# Absolute Encoders

## EHMT PCBA


QP39-B154


QP39-T254

## Single-Turn (ST) + Energy-Harvesting Multi-Turn (EHMT)


AR49-M49M/M25S

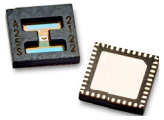

AS20-M42M


AS33-M42M

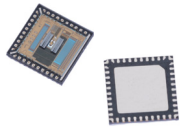

AS38-H39E

## Optical


AR18

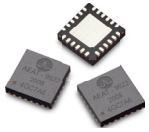

AR25


AR25DP


AR55

## Magnetic


AEAT-901x


AEAT-9922/9933


AEAT-9955/9966


AEAT-9988M/MB

# Incremental Encoders

## Transmissive Modules


AEDT-981x


HEDL-90/91xx


HEDS-90/91/92xx
HEDT-90/91xx


HEDS-97xx

## Housed / Kit


AEAT-901B


AEDC-55/56xx
HEDC-55/56xx


AEDL-58xx
HEDL-55/56xx


AEDM-5xxx
HEDS/HEDM-55/56xx

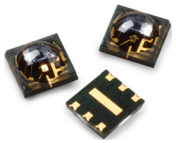

AS22-M5xx

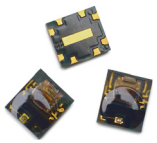

HEDR-54xx


HRPG-Axxx

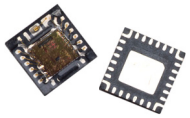
## Reflective Modules

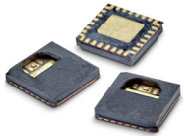

AEDR-83xx


AEDR-8400

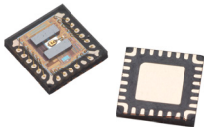

AEDR-8500
AEDR-8600
AEDR-87xx


AEDR-9820/30
AEDR-9820A/30A
AEDR-9820E/30E
AEDR-9820EA/30EA


AEDR-9830DP


AEDR-9920


AEDR-9930E2/E2L


AEDR-9940E/ER/EA

# Accessories

## Code Wheels / Code Strips


AEDM-5840
HEDx-51/61xx


AR55-RxxS


AR25-Axxx


AR55-L20S

## Line Drivers


AEIC-7272/7273/2631


AELT-8000

## Voltage Monitors


AEIC-3700

# What's Hot

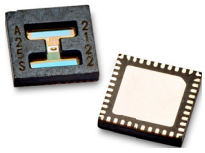
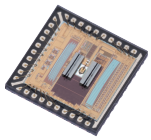
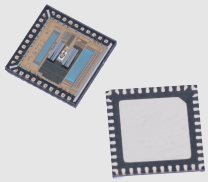
## EHMT PCBA Module Encoders

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **QP39-B154-S00**<br>**QP39-T254-S00***<br> | • Patented energy-harvesting technology<br>• Hollow-shaft option supports ID: up to Ø28 mm<br>• Customization for larger OD (refer to Broadcom sales)<br>• *Blind-hollow shaft option supports typical OD: Ø35 mm<br>• Operating temperature range: –40°C to 115°C<br>• 39-bit revolution count<br>• Communication protocol: SPI<br>• Easy integration when paired to the Broadcom AR25/AR55 absolute single-turn (ST) encoder | • Robotics<br>• Machine tools<br>• Semiconductor machinery<br>• Factory and industrial automation |

## Absolute ST EHMT Module Encoders

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AR49-M49M**<br> | • Patented energy-harvesting technology<br>• Encoder outer diameter: Ø35 mm<br>• Maximum height: 17.5 mm<br>• Operating temperature range: –40°C to 115°C<br>• Supply voltage: 5V<br>• Selectable communication protocols: RS-485/SSI/SPI/BiSS-C<br>• Optical 25-bit single-turn and 24-bit energy-harvesting multi-turn | • AC/DC servo motor feedback<br>• Medical and laboratory equipment<br>• Robotics<br>• Factory automation |
| **AS20-M42M**<br> | • Patented energy-harvesting technology<br>• Overall diameter: Ø20 mm<br>• Height: 22.5 mm<br>• Operating temperature range: –40°C to 115°C<br>• Supply voltage: 5V<br>• Selectable communication protocols: RS-485/SSI/SPI/BiSS-C<br>• All magnetic 18-bit single-turn (ST) and 32-bit multi-turn (MT) for a 50-bit combined resolution | • Miniature servo motors and drives<br>• Linear actuators<br>• Medical and laboratory equipment<br>• Robotics<br>• Automated guided vehicles (AGVs)<br>• Factory automation |
| **AS33-M42M**<br> | • Patented energy-harvesting technology<br>• Encoder outer diameter: Ø33 mm<br>• Height: 20 mm<br>• Operating temperature range: –40°C to 115°C<br>• Supply voltage: 5V/7V to 12V<br>• Selectable communication protocols: RS-485/SSI/BiSS-C<br>• All magnetic 18-bit single-turn (ST) and 24-bit multi-turn (MT) for a 42-bit combined resolution | • Small motors and linear actuators<br>• Robotic automation and engineering<br>• Drones and automated guided vehicles (AGVs)<br>• AC and DC servo motors<br>• Test and measurement equipment |

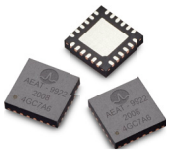
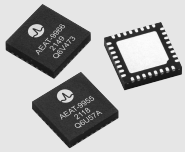
## Absolute Optical Encoders

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AR25-ASxx**<br>**AR25-ABxx**<br><br>**AR25DP**<br>**(Dust Protection)**<br> | • Package size: 6 mm (L) × 6 mm (W) × 1.05 mm (H)<br>• Package size: 6 mm (L) × 6 mm (W) × 0.7 mm (H) (AR25DP)<br>• Operating temperature: –40°C to 125°C<br>• Dual-mode operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 850 nm<br>• Selectable communication protocols: RS-485/ESL/SSI/SPI<br>• Communication protocol: BiSS-C (AR25-ABxx)<br>• Minimum product OD: ~30 mm<br>• Maximum shaft (through-hole) ID: 30 mm<br>• Multi-turn integration: EHMT, gear, or battery backup<br>• Auto-accuracy calibration with a constant speed that is one click away<br>• User-programmable absolute resolution:15 bits to 25 bits<br>• User-programmable incremental output (ABI) resolutions:<br>1 CPR to $2^{20}$ CPRs<br>• Dust protection (AR25DP) | • Robotics automation and engineering<br>• Factory automation and drones<br>• Medical and dentistry devices and equipment<br>• High-accuracy portable and handheld devices<br>• Miniature motors, servo motors, and linear actuators<br>• Through-shaft motors, gear motors, and speed reducers |
| **AR55-ASxx**<br>**AR55-ABxx**<br> | • Package size: 6 mm (L) × 6 mm (W) × 0.7 mm (H)<br>• Operating temperature: –40°C to 125°C<br>• Dual-mode operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 850 nm<br>• Selectable communication protocols: RS-485/ESL/SSI/SPI<br>• Communication protocol: BiSS-C (AR55-ABxx)<br>• Linear code strip pattern length: 10.2 mm to 8.33m<br>• Minimum product OD: ~ 63 mm<br>• Maximum shaft (through-hole) ID: ~2.66m or linear: ~8.33m<br>• Optical radius (ROP) flexibility: blind-hollow, through-hole, or linear application (ROP range: 25 mm to 1335 mm)<br>• Multi-turn integration: EHMT, gear, or battery backup<br>• Built-in calibration: Full-code or partial-code signal calibration/ Accuracy calibration with constant speed rotation or with a reference encoder<br>• User-programmable absolute resolution: 1 bit to 32 bits<br>• User-programmable incremental output (ABI) resolutions:<br>1 CPR to $2^{26}$ CPRs | • Robotics automation and engineering<br>• Industrial servo motors and linear actuators<br>• Through-shaft motors, gear motors, and speed reducers<br>• Factory automation and drones<br>• Medical and laboratory equipment |

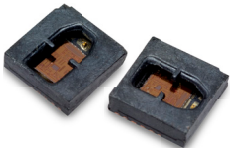
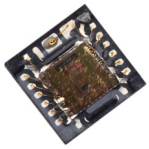
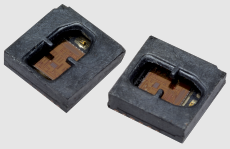
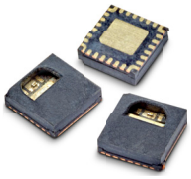
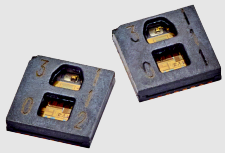
## Magnetic Encoders

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AEAT-901x Series**<br> | • Operating temperature range: –40°C to 125°C<br>• Supply voltage: 5V<br>• Resolution: 10, 12, 14, 16, or 18 bits<br>• Contactless sensing technologies<br>• Absolute angular position detection<br>• Synchronous serial interface (SSI) output for absolute position data (binary format)<br>• Typical code monotony error: ±1 LSB<br>• Easy assembly and no signal adjustment required | • Flow meters<br>• Angular detection<br>• Knob controls<br>• Rotary encoders |
| **AEAT-901B Series**<br> | • Operating temperature range: -40°C to 125°C<br>• Supply voltage: 5V<br>• Resolution: 256 counts per revolution (CPR)<br>• Contactless sensing technology<br>• 3-channel output<br>• Easy assembly and no signal adjustment required<br>• Direct connectivity through cable output | • Speed detection<br>• Knob controls<br>• Rotary encoders |

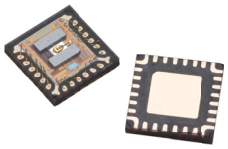
## Magnetic IC Encoders

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AEAT-9922**<br>**AEAT-9933**<br> | • Package: QFN-24 leads (4 mm × 4 mm)<br>• Operating temperature: –40°C to 125°C<br>• Operating voltage: 3.3V and 5V<br>• Selectable protocols: SPI/SSI<br>• Programmable 10 bits to 18 bits of absolute resolution<br>• Programmable 10 bits to 14 bits of absolute resolution (AEAT-9933)<br>• Flexible incremental ABI resolution: 1 CPR to 10,000 CPR<br>• Flexible incremental ABI resolution: 1 CPR to 1,024 CPR (AEAT-9933)<br>• User-programmable zero position, direction, index width, index position, and hysteresis<br>• Angular accuracy correction for high accuracy | • Brushless DC motors and stepper motors<br>• Resolver and potentiometer replacement<br>• Industrial automation and robotics<br>• Industrial sewing machines and textile equipment |
| **AEAT-9955**<br>**AEAT-9966**<br> | • Package: QFN-32 leads (5 mm × 5 mm)<br>• Operating temperature: –40°C to 125°C<br>• Operating voltage: 3.3V and 5V<br>• Selectable protocols: SPI/SSI<br>• Programmable 10 bits up to 18 bits of absolute resolution<br>• The incremental positions are indicated on ABI and UVW signals with a user-configurable CPR from 1 CPR to 20,000 CPR<br>• Qualified automotive standard Grade 0, AEC-Q100 (AEAT-9955)<br>• 300-µA current consumption in sleep mode<br>• Dedicated zero reset and error pin<br>• EEPROM architecture for multi-time user configuration<br>• Optional 56-bit memory lock function<br>• Automatic integral nonlinearity angle correction for high accuracy<br>• Designed conformance to ISO26262 ASIL-D and SIL3 with secondary chip for redundancy<br>• Multi-index with one revolution<br>• High-impedance output for multi-client network<br>• Two chips of magnetic encoder in one package (AEAT-9966) | • Brushless DC motors and stepper motors<br>• Resolver and potentiometer replacement<br>• Industrial automation and robotics<br>• Industrial sewing machines and textile equipment<br>• Light detection and ranging (LiDAR) |
| **AEAT-9988M**<br>**AEAT-9988MB**<br> | • Package: DFN-30 leads (8.2 mm × 5 mm)<br>• Operating temperature: –40°C to 125°C<br>• Operating voltage: 5V<br>• Selectable communication protocols: RS-485/SSI/SPI<br>• Communication protocol: BiSS-C (AEAT-9988MB)<br>• Programmable 16 bits up to 23 bits of absolute resolution<br>• Programmable incremental ABI resolution: 1 CPR to 65,536 CPRs<br>• 500-µA current consumption in sleep mode<br>• Dedicated zero reset and error pin<br>• Optional 56-bit memory lock function<br>• Programmable function to external hardware pin (GPIO)<br>• Built-in multi-turn counter with battery backup power-off mode operation | |

## Reflective Incremental Encoders

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AEDR-9820/9830**<br>**AEDR-9820A/9830A**<br>**(Automotive Grade 1)**<br><br>**AEDR-9830DP**<br>**(Dust Protection)**<br> | • Package size: 4.0 mm (L) × 4.0 mm (W) × 1.05 mm (H)<br>• Package size: 4.0 mm (L) × 4.0 mm (W) × 0.73 mm (H) (AEDR-9820/9830A)<br>• Operating temperature: –40°C to 115°C<br>• Operating temperature: –40°C to 125°C (AEDR-9820A/9830A)<br>• Operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 853 nm<br>• Encoding resolution:<br>– 225 LPI (lines per inch) or 8.86 LPmm (lines per mm) – AEDR-9820/9820A<br>– 318 LPI or 12.52 LPmm – AEDR-9830/9830A/9830DP<br>• Built-in interpolator: 1x, 2x, 4x, 8x, and 16x interpolation<br>• Maximum output frequency: 200 kHz to 2 MHz<br>• Automotive Grade 1, AEC-Q100 (AEDR-9820/9830A)<br>• Production/QMS conformance IATF16949 (AEDR-9820/9830A)<br>• Translucent protection compound (AEDR-9830DP) | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom (PTZ) cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages |
| **AEDR-9820E/9830E**<br>**AEDR-9820EA/9830EA**<br>**(Automotive Grade 1)**<br> | • Package size: 4.0 mm (L) × 4.0 mm (W) × 1.05 mm (H)<br>• Operating temperature: –40°C to 115°C<br>• Operating temperature: –40°C to 125°C (AEDR-9820EA/9830EA)<br>• Operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 853 nm<br>• Encoding resolution:<br>– 225 LPI or 8.86 LPmm – AEDR-9820E/9820EA<br>– 318 LPI or 12.52 LPmm – AEDR-9830E/9830EA<br>• Built-in interpolator: 1x, 2x, 4x, 8x, 16x, and 32x interpolation<br>• Maximum output frequency: 200 kHz to 4 MHz<br>• Built-in LED current regulation<br>• Automotive Grade 1, AEC-Q100 (AEDR-9820EA/9830EA)<br>• Production/QMS conformance IATF16949 (AEDR-9820EA/9830EA) | |
| **AEDR-9920**<br> | • Package size: 4.0 mm (L) × 4.0 mm (W) × 1.05 mm (H)<br>• Operating temperature: –40°C to 115°C<br>• Operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 853 nm<br>• Encoding resolution: 225 LPI or 8.86 LPmm<br>• Built-in selection interpolator: 1x, 2x, 4x, 8x, 16x, 32x, 64x, 128x, and 256x interpolation | |
| **AEDR-9930EA**<br>**(Automotive Grade)**<br> | • Package size: 5.0 mm (L) × 5.0 mm (W) × 1.05 mm (H)<br>• Operating temperature: –40°C to +125°C<br>• Operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 853 nm<br>• Encoding resolution: 397 LPI or 15.63 LPmm or 64 µm (pitch)<br>• Built in selection interpolator: 1x to 10x, 12x, 14x, 16x, 18x, 20x, 25x, 32x, 50x, 64x, 80x, 100x, 128x, 160x, and 256x to 512x<br>• LED status pins for functional operation, calibration, and error<br>• Automotive Grade 1, AEC-Q100 | |
| **AEDR-9930E2**<br>**AEDR-9930E2L**<br> | • Package size: 5.0 mm (L) × 5.0 mm (W) × 1.05 mm (H)<br>• Operating temperature: –40°C to +115°C<br>• Operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 853 nm<br>• Encoding resolution: 397 LPI or 15.63 LPmm or 64 µm (pitch)<br>• Built-in selection interpolators: 1x to 10x, 12x, 14x, 16x, 18x, 20x, 25x, 32x, 50x, 64x, 80x, 100x, 128x, 160x, and 256x to 512x<br>• User pin trigger calibration<br>• Off-scale to on-scale auto-trigger auto-calibration (AEDR-9930E2L)<br>• Internal auto power reset trigger with successful auto-calibration process<br>• LED status pins for functional operation, calibration, and error | |

## Reflective Incremental Encoders (Continued)

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AEDR-9940/9940ER**<br>**AEDR-9940A/9940ERA**<br>**(Automotive Grade 1)**<br> | • Package size: 4.0 mm (L) × 4.0 mm (W) × 0.7 mm (H)<br>• Operating temperature: –40°C to +115°C<br>• Operating temperature: –40°C to +125°C (AEDR-9940A/9940ERA)<br>• Operating voltage: 3.3V and 5V<br>• Typical LED wavelength: 660 nm<br>• Encoding resolution: 198.437 LPI or 7.812 LPmm or 128 µm (pitch)<br>• Built-in selection interpolators: 1x to 6x, 8x, 9x, 10x, 12x, 16x, 20x, 25x, 32x, 50x, 64x, 80x, 100x, 128x, 160x, 256x, 320x, and 640x to 1000x<br>• Translucent protection compound<br>• LED status pins for calibration and error<br>• Automotive Grade 1, AEC-Q100 (AEDR-9940A/9940ERA)<br>• Production/QMS conformance IATF16949 (AEDR-9940A/9940ERA) | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom (PTZ) cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages |

## Voltage Monitor ICs

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AEIC-3700 Series**<br> | • Package: SOT-23-6 (3.0 mm × 1.60 mm nominal)<br>• Operating temperature range: –40°C to 125°C<br>• Supply voltage: 2.8V to 6.5V<br>• Low quiescent current: 550 µA (typical)<br>• Internal hysteresis: 5 mV (typical)<br>• Two main inputs and outputs: (INA/INB and OUTA/OUTB) | • Control systems especially for industrial automation<br>• FPGA applications<br>• ASIC applications<br>• Microcontroller application systems |

## Line Driver ICs with High-Voltage Quad Differential Output

| Broadcom Encoders | Value Propositions | Key Applications |
|---|---|---|
| **AELT-8000 Series**<br> | • Operating temperature range: –40°C to 125°C<br>• Operating frequency: up to 5 MHz<br>• Driver supply range: 4.5V to 36V<br>• Pin compatible to 26xx31, xx7272<br>• Short-circuit-proof tri-state outputs<br>• Low propagation delay: 80 ns (typical)<br>• High impedance CMOS-compatible and TTL-compatible buffered inputs with hysteresis<br>• Overtemperature protection circuit<br>• Undervoltage monitoring | • Line driver for 5V to 36V control systems<br>• Rotary and linear encoder interfacing<br>• Industrial controls<br>• Sensor systems |

# Absolute Encoders: Energy-Harvesting Multi-Turn (EHMT) PCBA

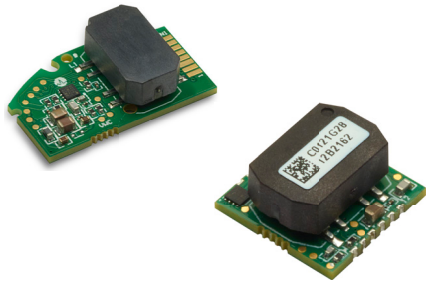
## QP39 Series

### Description

The QP39 series is an absolute multi-turn PCBA module based on the Broadcom proprietary energy-harvesting (EH) technologies. EH multi-turn (EHMT) offers batteryless and non-gear-based solutions, eliminating the need for maintenance and contamination prevention. The beauty of the EH effect is that the same amount of energy is generated independent of the rotation speed. The generated energy is sufficient to power the revolution tracking circuitry. Hence, revolution counts are ensured even in the absence of an external power supply. The QP39 offers 39 bits of multi-turn (MT) resolution output with an industry-standard SPI communication protocol, providing great flexibility to interface with a single-turn host. It is also designed to operate under the harsh industrial-grade temperature of –40°C to 115°C.

### Key Features

- Patented energy-harvesting technology
- 39-bit revolution count
- Blind-hollow shaft option supports typical outer diameter of Ø35 mm
- Hollow shaft option supports outer diameter of Ø60 mm to Ø90 mm
- Synchronization over serial peripheral interface (SPI) at 2.5-MHz to 10-MHz clock rate
- Operating temperature range: –40°C to 115°C
- Easy integration when paired to the Broadcom AR25 absolute single-turn encoder
- RoHS compliant



### Applications

- Robotics
- Machine tools
- Semiconductor machinery
- Factory and industrial automation

Ordering Information (Custom Part)

| Part Number | Description |
|---|---|
| QP39-B154-S00 | 39-Bit EHMT PCBA, Blind-Hollow Shaft with SPI 4-Wire Protocol |
| QP39-T254-S00 | 39-Bit EHMT PCBA, Through-Hole Shaft with SPI 4-Wire Protocol |

# Absolute Encoders: Single-Turn (ST) + Energy-Harvesting Multi-Turn (EHMT)

## AR49-M49M/M25S Series

### Description

The Broadcom AR49 series is an optical absolute encoder module that offers up to 25-bit single-turn (ST) position information and 24-bit multi-turn (MT) counts, hence a combined 49-bit high-resolution output. The ST block of the encoder consists of a patterned disk, a light source, and photosensitive elements to translate the mechanical motion into an electrical signal. The encoder is designed with a selection of serial communication protocols with a dedicated electronic circuit designed for robust signal communication.

Broadcom AR49 series encoders offer many intelligent features, such as a built-in temperature sensor, user programmable resolution, zero reset, and system alarm. They come with a recommended high-temperature range of –40°C to 115°C. One of the key advantages is their multi-turn tracking, which employs a proprietary energy-harvesting (EH) technology by harvesting the magnetic energy while the patterned disk with magnet rotates. The counter ASIC harvests the energy generated by the EH sensor for processing the rotational count, and it generates counting logic to nonvolatile memory, which updates and stores the count.

The entire operation of energy generation, counting, and storage processing is completed with limited energy and a short duration; hence, the kit encoder is suited for both low-speed and high-speed measurement.

### Key Features

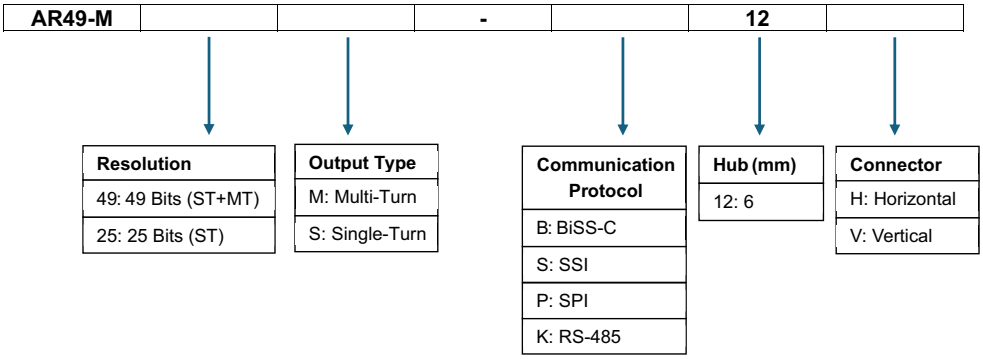
- 24-bit energy-harvesting multi-turn and 25-bit optical single-turn
- Accuracy upon calibration of ±30 arc-seconds
- Encoder fault and status bits with CRC
- Integrated differential transceiver for the SSI/BiSS-C/RS-485 communication protocols
- Single-ended Serial Peripheral Interface (SPI 4-wire option)
- Overall encoder outer diameter of Ø35 mm and maximum height of 17.5 mm
- 8 Kb of user-accessible memory in EEPROM
- Immediate position detection on power-up; no battery or capacitor required for position detection during a power failure
- RoHS compliant

### Applications

- AC/DC servo motor feedback
- Medical and laboratory equipment
- Robotics
- Factory automation



## Ordering Information




## Accessories Ordering Information

| Part Number | Description |
|---|---|
| AS20-C300 | 8-pin mating connector with 300-mm cable length. |
| AR49-M49-E01 | Programming kit (applicable for all protocol options). Contents: 1 unit of MCU-based programming kit, 1 unit of USB cable for the PC interface, the DUT cable, and the associated programming software. |
| AR25-AC25 | Accuracy calibration station for the AR25/AR49 series rotary reflective encoder. Contents: Mechanical setup including the servo motor control, high-accuracy reference encoder, programming kits, associated cable assemblies (for the PC interface, motor handler communication, DUT encoder connection), and the associated GUI programming software. |

# AS20-M42M Series

## Description

The Broadcom AS20 series miniature encoder is a magnetic absolute multi-turn kit encoder built on Broadcom's energy-harvesting technology. The energy-harvesting multi-turn system is battery free and has no gears, which removes the need for maintenance and avoids issues with contamination. The AS20 includes useful features such as a built-in temperature sensor, user programmable resolution, zero reset, and system alarms. It supports a wide operating temperature range from –40°C to 115°C. The counter ASIC collects the harvested energy, processes the rotational count, and writes the count data into nonvolatile memory.

The energy-harvesting effect produces the same amount of energy no matter the rotation speed or direction. This energy is enough to run the revolution tracking circuit, so the encoder keeps accurate multi-turn counts even when external power is not available. All energy generation, counting, and data storage happen within a very small energy budget and short time window. Consequently, the kit encoder works well for both low-speed and high-speed applications.

## Key Features

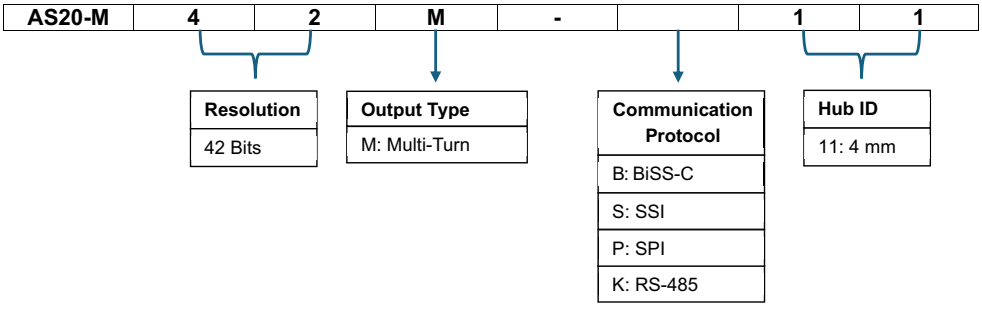
- Patented energy-harvesting technology
- All magnetic 18-bit single-turn (ST) and 32-bit multi-turn (MT) for a 50-bit combined resolution
- Overall diameter of Ø20 mm
- Operating temperature range: –40°C to 115°C
- SSI/RS-485/BiSS-C with integrated differential line transceivers
- SPI 4-wire single-ended output
- Up to a 10-Mb/s communication clock rate
- Easy integration with miniature motors
- RoHS compliant



## Applications

- Miniature servo motors and drives
- Linear actuators
- Medical and laboratory equipment
- Robotics
- Automated guided vehicles (AGVs)
- Factory automation

Ordering Information




Accessories Ordering Information

| Part Number | Description |
|---|---|
| AS20-C300 | AS-20 Series 300-mm 8-Pin Cable Connector |
| AS20-M42-010 | AS20 Series Set Height Jig |
| AS20-M42-E01 | AS20 Series Programming Kit |

# AS33-M42M Series

## Description

The Broadcom AS33-M42M series is an absolute magnetic encoder with 18-bit single-turn resolution and a 24-bit energy-harvesting multi-turn counter, providing a total of 42-bit resolution. It uses angular magnetic Hall sensing with advanced signal conditioning. Both the single-turn and multi-turn measurements come from one magnetic setup, which makes the system cleaner and more reliable.

Its main advantage is the patented energy-harvesting multi-turn technology. The encoder converts the rotating magnetic field into electrical energy that powers the multi-turn counter. The amount of energy produced stays the same no matter the rotation speed or direction. This ensures that the multi-turn count is always correct, even when external power is lost. Compared with battery-based designs, this approach removes battery maintenance and avoids downtime for replacements. It also reduces long-term service costs for motor systems.

The AS33-M42M series includes a built-in communication protocol that supports full-duplex and half-duplex transmission with strong noise immunity. It can send data up to 10 Mb/s in tough industrial conditions. Because it uses magnetic sensing, the encoder is resistant to dust and fingerprints on the sensing area. This lowers handling demands during production and makes it suitable for harsh environments.

## Key Features

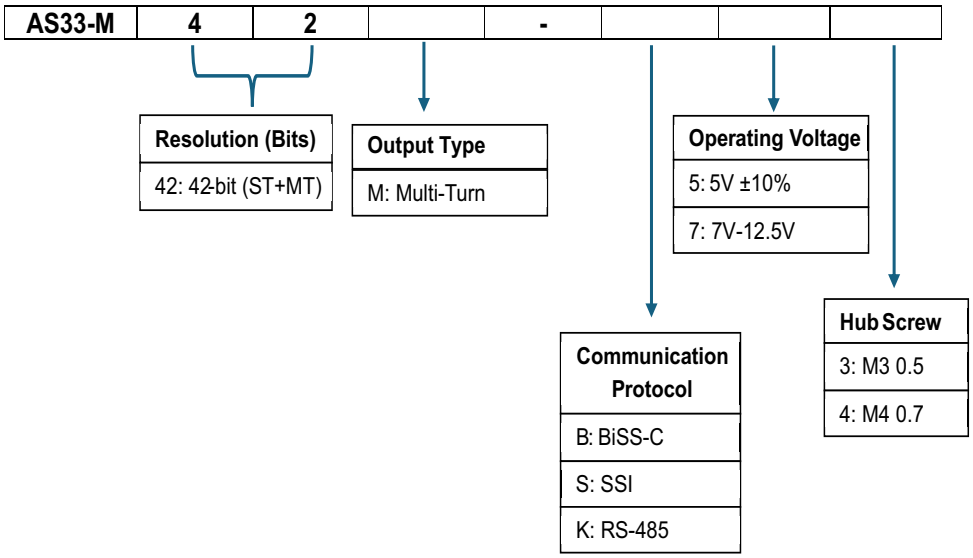
- Patented energy-harvesting technology
- Total 42-bit resolution with 18-bit single-turn and 24-bit multi-turn
- Low angular accuracy error of <0.1°
- Overall encoder outer diameter of Ø33 mm and maximum height of 20 mm
- Built-in temperature sensor
- Operating temperature range: –40°C to 115°C
- Built-in communication protocol (options): SSI/BiSS-C/RS-485

## Applications

- Small motors and linear actuators
- Robotic automation and engineering
- Drone and automated guided vehicles
- AC and DC servo motors
- Test and measurement equipment



Ordering Information




Accessories Ordering Information

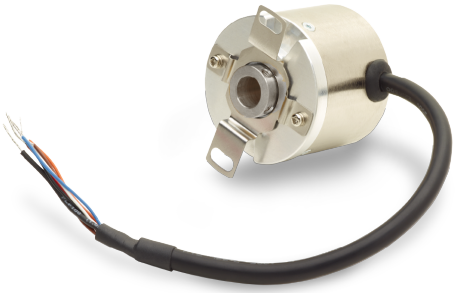
| Part Number | Description |
|---|---|
| AS33-M42-010 | Electronic Accuracy Calibration Kit |
| AS33-M42-023 | Radial Centering Jig for M3 Hub |
| AS33-M42-024 | Radial Centering Jig for M4 Hub |
| AS33-AC18 | Benchtop Accuracy Calibration Station |
| AS33-C150 | AS33 10-Pin Mating Connector with 150-mm Length Cable |

# AS38-H39E Series

## Description

The Broadcom AS38-H39E series is a high-resolution optical absolute encoder. It provides 23-bit single-turn and 16-bit multi-turn counts, providing a total of 39-bit resolution. It works as a housed optical encoder with a patterned disk, a light source, and photosensitive elements that convert shaft motion into electrical signals. It supports a built-in communication protocol that works over full-duplex or half-duplex transmission, and it can handle data rates up to 10 Mb/s. The interface has strong noise immunity to support harsh industrial environments. The encoder also includes ESD protection that meets IEC 61000-4-2 Class 3. It is rated IP50 under IEC 60529.

The main benefit of the AS38-H39E is its gearless multi-turn system that uses an energy-harvesting solution. As the shaft rotates, magnetic energy is captured and used to track revolutions. This avoids the wear, noise, and failures in geared multi-turn encoders. It also removes the need for batteries and the maintenance that comes with battery-backed systems. Inside the encoder, there are two core blocks. The single-turn block uses a Broadcom optical ASIC with precision amplifiers and a multi-track code disk placed between an LED emitter and the detector IC. The multi-turn block uses the energy-harvesting system. When the shaft rotates, a magnet on the shaft moves with it. A coil module cuts the magnetic field and produces energy. The energy output stays consistent regardless of the rotation speed and is enough to power the multi-turn counter. This prevents miscounts even when external power is lost.



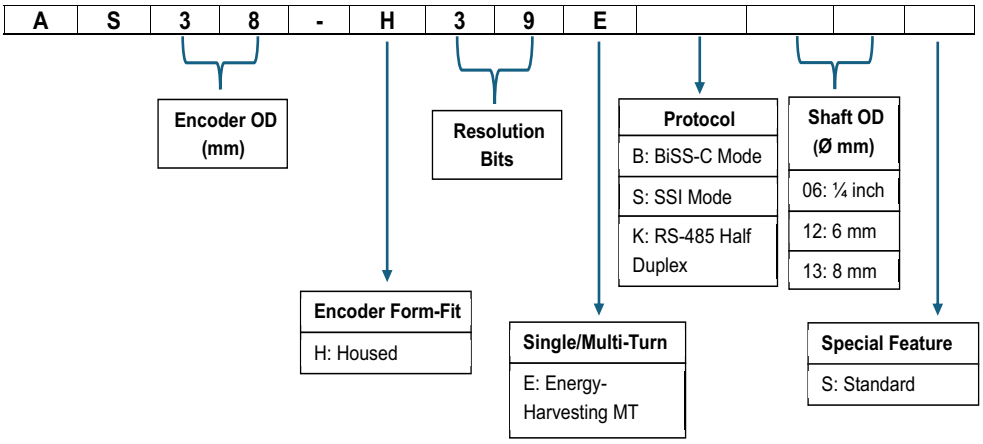
## Key Features

- 39-bit resolution: 16-bit energy-harvesting multi-turn and 23-bit optical single-turn
- Built-in communication protocol (option): BiSS-C mode, SSI mode, and RS-485 half-duplex
- Overall encoder outer diameter of Ø38 mm and maximum height of 40 mm
- Supporting a blind-hollow shaft diameter of ¼ inch, 6 mm, and 8 mm

## Applications

- Robotics
- Factory automation
- Linear positioning systems
- CNC machine tools
- Medical and lab equipment

Ordering Information



# Absolute Encoders: Optical

## AR18 Series

### Description

The Broadcom AR18 series miniature absolute encoder ASICs are designed to cater to the growing demand for space-constraint applications. The AR18 encoder has an overall diameter of 18 mm and offers user-programmable resolutions from 17-bit, 19-bit, and 21-bit single-turn absolute outputs.

The AR18 series provides incremental ABI and UVW in differential mode. Both come with a recommended temperature range of –40°C to 115°C suitable for most industrial applications. Dual-mode operating voltages of 3.3V and 5V are suitable for handheld and portable device applications. Employing the Broadcom-patented Reflective Optical Encoding Theory, the AR18 series offers high accuracy with correction, which is unattainable by magnetic encoders.

### Key Features

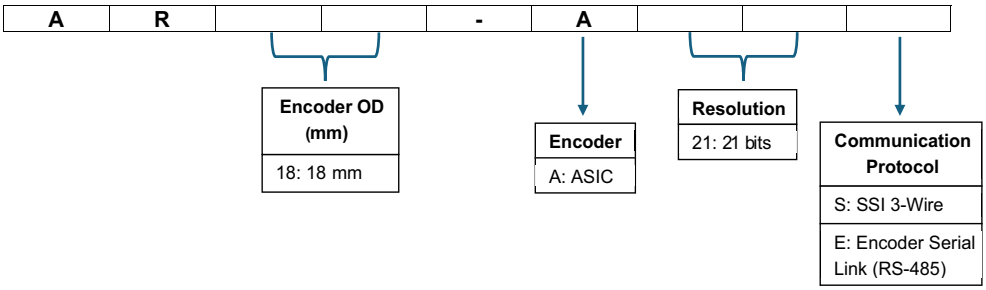
- Miniature absolute encoder ASIC surface-mount DFN package: 10.9 mm (L) × 9.1 mm (W) × 1.5 mm (H)
- User-programmable resolution ranging from 17-bit, 19-bit, and 21-bit single-turn
- User-programmable incremental output (ABI) resolution ranging from 128 CPR to 8192 CPR
- User-programmable commutation signal (UVW) ranging from 2, 3, 4, 5, 12, 30, and 32 pole pairs
- Differential output for ABI and UVW
- Operating temperature range: –40°C to 115°C
- Dual-mode operating voltage: 3.3V and 5V
- Selectable SSI mode communication protocol
- Selectable RS-485 mode communication protocol.
- RoHS compliance



### Applications

- Robotic automation and engineering
- Factory automation and drones
- Medical and dentistry devices and equipment
- High-accuracy portable and handheld devices
- Miniature motors, servo motors, linear actuators

Ordering Information




Accessories Ordering Information

| Part Number | Description |
|---|---|
| A21E-0010 | AR18/35 Electronic Calibration Kits |

# AR25 Series, AR25DP Series (Dust Protection)

## Description

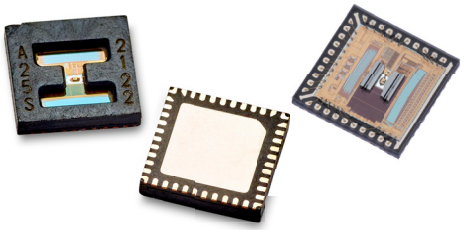
The Broadcom AR25/AR25DP is a miniature absolute encoder ASIC that is designed to cater to the growing demand for space-constrained applications. Employing the advanced reflective optical-encoding theory, the AR25/AR25DP series offers high position accuracy with a correction algorithm, which is unattainable by magnetic encoders.

The AR25/AR25DP series also supports integration with the Broadcom proprietary batteryless energy-harvesting multi-turn (EHMT) solution. Alternatively, other multi-turn solutions such as gear-based and battery backup are also supported by a dedicated MT interface port.

The AR25/AR25DP encoder is a one-chip solution that has the flexibility to cater to variable overall diameters, ranging from 30 mm to 55 mm. The product also supports through-hole solutions up to 30 mm in diameter. User-programmable resolutions are from 15-bit to 25-bit single-turn absolute outputs. In addition, both also provide differential analog sine/cosine or digital incremental ABIUVW signals with configurable CPRs and pole pairs. Its state-of-the-art auto-calibration feature simplifies integration into end-user systems.

## Key Features

- Miniature surface-mount QFN package:
  - AR25:
    6 mm (L) × 6 mm (W) × 1.05 mm (H)
  - AR25DP:
    6 mm (L) × 6 mm (W) × 0.7 mm (H)
- Min product OD: ~30 mm
- Max shaft (through hole) ID: 30mm
- User-programmable absolute resolution:15 bits to 25 bits
- User-programmable incremental output (ABI) resolutions ranging from 1 CPR to 220 CPRs
- User-programmable commutation signals (UVW) ranging from 1 to 32 pole-pairs
- High-temperature range:
  –40°C to 125°C
- Dual-mode operating voltages:
  3.3V and 5V
- Multi-turn integration: EHMT, gear, or battery backup
- Optical radius (ROP) flexibility:
  Blind-hollow or through-shaft applications
- Built-in line transceiver for protocol with selectable drivability strength
- Auto-accuracy calibration with a constant speed that is one click away
- Selectable communication protocols:
  RS485/ESL/SSI/SPI/BiSS-C
- External memory support up to 128 Kb
- Built-in temperature sensor
- Typical LED Wavelength: 850 nm
- RoHS compliance
- Dust protection (AR25DP)

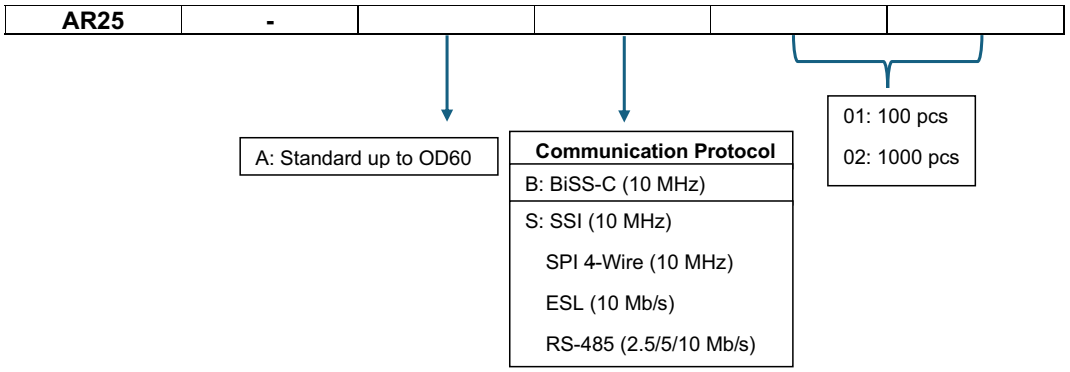


## Applications

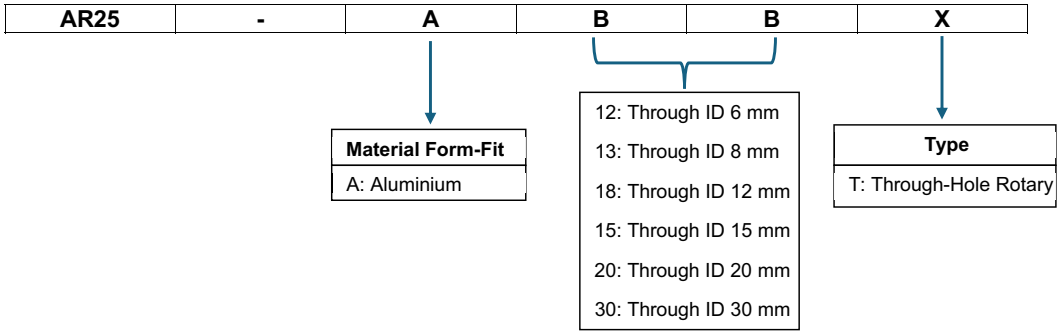
- Robotic automation and engineering
- Factory automation and drones
- Medical and dentistry devices and equipment
- High-accuracy portable and handheld devices
- Miniature motors, servo motors, and linear actuators
- Through-shaft motors, gear motors, and speed reducers

## Ordering Information

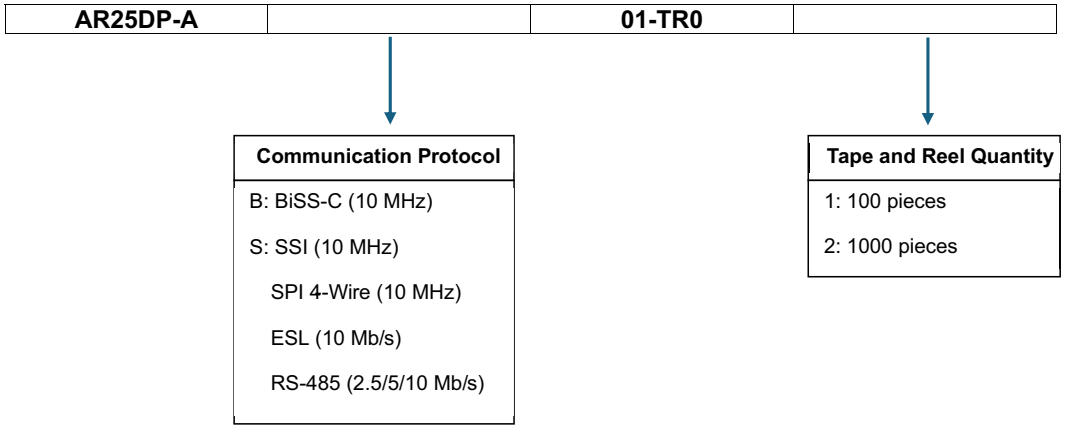
Encoder Product




Hub Metal Code Wheel Product




Dust Protection Version



## Accessories Ordering Information

| Part Number | Description |
|---|---|
| AR25DP-EVB-A12T | AR25DP PCBA with 512-CPR code wheel, 6-mm through-hollow, all protocols |
| AR25DP-EVB-A13T | AR25DP PCBA with 512-CPR code wheel, 8-mm through-hollow, all protocols |
| AR25DP-EVB-A18T | AR25DP PCBA with 512-CPR code wheel, 12-mm through-hollow, all protocols |
| AR25DP-EVB-A20T | AR25DP PCBA with 1024-CPR code wheel, 20-mm through-hollow, all protocols |
| AR25DP-EVB-A30T | AR25DP PCBA with 1024-CPR code wheel, 30-mm through-hollow, all protocols |
| AR25DP-PRGEVB-A12T | AR25DP evaluation set with AR25-E01 SPI-4W interface, electronic calibration kit, evaluation PCBA, 6-mm hub, 512-CPR code wheel |
| AR25DP-PRGEVB-A13T | AR25DP evaluation set with AR25-E01 SPI-4W interface, electronic calibration kit, evaluation PCBA, 8-mm hub, 512-CPR code wheel |
| AR25DP-PRGEVB-A18T | AR25DP evaluation set with AR25-E01 SPI-4W interface, electronic calibration kit, evaluation PCBA, 12-mm hub, 512-CPR code wheel |
| AR25DP-PRGEVB-A20T | AR25DP evaluation set with AR25-E01 SPI-4W interface, electronic calibration kit, evaluation PCBA, 20-mm hub, 1024-CPR code wheel |
| AR25DP-PRGEVB-A30T | AR25DP evaluation set with AR25-E01 SPI-4W interface, electronic calibration kit, evaluation PCBA, 30-mm hub, 1024-CPR code wheel |
| AR25-E01 | AR25/AR25DP reference design programming and calibration kit and software interface (SPI 4-wire) |
| AR25-AC25 | Accuracy calibration station for AR18/AR25/AR35/AR49/AR25DP series rotary reflective encoder |

# AR55 Series

## Description

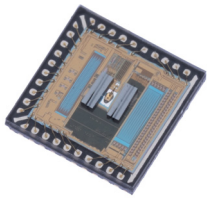
The Broadcom AR55 series is an absolute encoder ASIC designed for large-diameter rotary and linear motion applications. Using advanced reflective optical encoding technology, it achieves high positional accuracy that magnetic encoders cannot match.

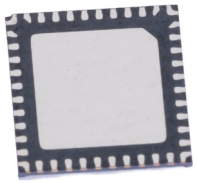
The AR55 is a one-chip solution that works with code wheels from 53 mm OD up to linear code strips of 8.33m. It supports blind-hollow shafts, through-hole shafts, and linear setups. Users can program single-turn resolutions from 1 bit to 32 bits and output differential analog sine/cosine or digital incremental ABIUVW signals with configurable counts per revolution and pole-pair settings. An auto-calibration feature makes system integration easier.

The AR55 is compatible with Broadcom's batteryless energy-harvesting multi-turn (EHMT) system and also supports gear-based or battery-backed multi-turn solutions through a dedicated interface. It operates on 3.3V or 5V and reliably handles temperatures from –40°C to 125°C. For flexible system integration, it supports multiple communication protocols, including encoder serial link (ESL), RS-485 half duplex, SSI, BiSS-C, and 4-wire SPI.

## Key Features

- Package size:
  6 mm (L) × 6 mm (W) × 0.7 mm (H)
- Operating temperature:
  –40°C to 125°C
- Dual-mode operating voltage:
  3.3V and 5V
- Typical LED wavelength: 850 nm
- Selectable communication protocols:
  RS-485/ESL/SSI/SPI/BiSS-C
- Linear code strip pattern length:
  10.2 mm to 8.33m
- Min product OD: ~63 mm
- Max shaft (through-hole) ID: ~2.66m
  or linear: ~8.33m
- Optical radius (ROP) flexibility:
  blind-hollow, through-hole, or linear application (ROP range: 25 mm to 1335 mm)
- Multi-turn integration: EHMT, gear, or battery backup
- Built-in calibration:
  - Full-code or partial-code signal calibration
  - Accuracy calibration with constant speed rotation or with a reference encoder
- User-programmable absolute resolution: 1 bit to 32 bits
- User-programmable incremental output (ABI) resolutions: 1 CPR to $2^{26}$ CPRs





## Applications

- Robotics automation and engineering
- Industrial servo motors and linear actuators
- Through-shaft motors, gear motors, and speed reducers
- Factory automation and drones
- Medical and laboratory equipment

## Ordering Information

| AR55-A | | 01-TR0 | |
|---|---|---|---|

| Communication Protocol |
|---|
| B: BiSS-C (10 MHz) |
| S: SSI (10 MHz) |
| SPI 4-Wire (10 MHz) |
| ESL (10 Mb/s) |
| RS-485 (2.5/5/10 Mb/s) |

| Tape and Reel Quantity |
|---|
| 1: 100 pieces |
| 2: 1000 pieces |

## Accessories Ordering Information

| Part Number | Description |
|---|---|
| AR55-EVBR | AR55 Evaluation Board (All Protocols) and Metal Code Wheel, 1250 CPR |
| AR55-EVBL | AR55 Evaluation Board (All Protocols) and Metal Code Strip, 200 mm |
| AR55-R30S | Code Wheel 1250 CPR, ID 41 mm, Metal |
| AR55-R60S | Code Wheel only 1850 CPR, ID 65.4 mm, Metal |
| AR55-L20S | Code Strip only 1640 CPR, 200 mm, Metal |
| W1202-495249 | Bearing Stage AR55 + R30S + QP39-T254<br>*(Refer to Broadcom factory/sales for customization)* |
| AR49-M49-E01 | Universal Programming Kit (applicable for all protocol options)<br>Contents: 1 unit of MCU-based programming kit, 1 unit of USB cable for PC interface, DUT cable and the associated programming software. |
| AR25-AC25 | Accuracy Calibration Station for AR18/AR25/AR35/AR49/AR55 Series Rotary Reflective Encoder<br>Contents: Mechanical setup including servo motor control, high accuracy reference encoder, programming kits, associated cables assemblies (for PC interface, motor handler communication, DUT encoder connection), and the associated GUI programming software. |

# Absolute Encoders: Magnetic

# AEAT-901x Series

## Description

The AEAT-901x series is a high-performance absolute magnetic kit encoder that provides precise angular position feedback. It offers 10-bit to 18-bit resolution options to suit different application needs. The kit comes with a housing that makes assembly and integration easier. Simple alignment tools eliminate the complicated process of aligning the encoder and magnet hub with a motor shaft.

The encoder operates across a wide temperature range of –40°C to 125°C and is resistant to oil and dirt, making it well suited for industrial automation. It uses a three-wire synchronous serial interface (SSI) to provide absolute position data in binary format. The AEAT-901x works with a single 5V supply and comes in a small form factor, making it easy to integrate into space-constrained applications.

## Key Features

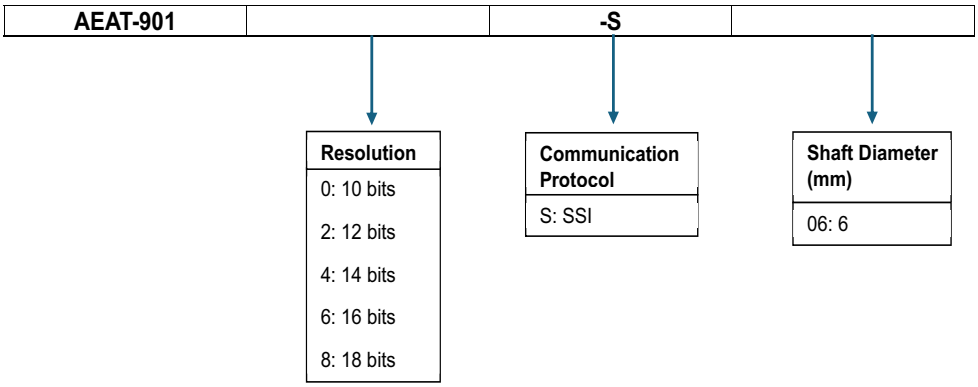
- Package size: 23 mm (Ø) × 19 mm (H)
- Temperature range: –40°C to 125°C
- Output voltage: 5V
- 10/12/14/16/18 bits resolution
- Contactless sensing technologies
- Absolute angular position detection
- Synchronous Serial Interface (SSI) output for absolute position data (binary format)
- Easy assembly, no signal adjustment required
- Direct connectivity through PCB
- RoHS compliant
- 6-mm shaft dimension



## Applications

- Flow meters
- Angular detection
- Knob controls
- Rotary encoders

Ordering Information




Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-8934 | A Set of Optional Centering and Gap Setting Jigs |

# AEAT-901B Series

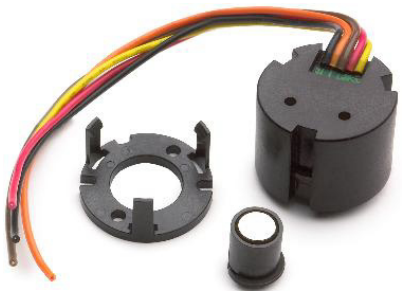
## Description

The AEAT-901B series is a high-performance, cost-effective incremental magnetic kit encoder for precise rotary position or motor speed feedback. It offers 256 to 10k CPR resolution options to meet different application needs. The encoder comes with a housing that simplifies assembly and integration, eliminating the need to manually align the encoder and code wheel with the motor shaft.

The AEAT-901B operates over a wide temperature range of –40°C to 125°C and is resistant to oil and dirt, making it suitable for industrial automation. It uses a single 5V power supply and includes a cable output for easy connection. Its small form factor allows integration into space-constrained applications.

## Key Features

- Package size: 23 mm (Ø) × 19 mm (H)
- Temperature range: –40°C to 125°C
- Output voltage: 5V
- Resolution of 256 CPR to 10,000 CPR
- Contactless sensing technologies
- Rotary position detection
- Cable output
- Easy assembly, no signal adjustment required
- Hub size of 6 mm
- RoHS compliant



## Applications

- Speed detection
- Knob controls
- Rotary encoders

Ordering Information

| AEAT-901B- | | 06 |
|---|---|---|

| Resolution (CPR) |
|---|
| F: 256 |
| I: 512 |
| J: 1024 |
| U: 2048 |
| R: 4096 |
| V: 8192 |
| E: 200 |
| G: 360 |
| H: 400 |
| A: 500 |
| M: 800 |
| B: 1000 |
| T: 2000 |
| W: 2500 |
| N: 4000 |
| Z: 5000 |
| P: 10000 |

Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-8934 | A Set of Optional Centering and Gap-Setting Jigs |

# AEAT-9922/9933 Series

## Description

The Broadcom AEAT-9922/9933 is an angular magnetic rotary sensor that provides accurate angular measurement over a full 360 degrees of rotation. It is a sophisticated system that uses integrated Hall sensor elements with complex analog and digital signal processing within a single device. A simple two-pole magnet generates the necessary magnetic field by rotating it in perpendicular. Wide magnetic field sensor configurations allow On-Axis (end of shaft) or Off-Axis (side of shaft) modes in application.

The Broadcom AEAT-9922/9933 is a versatile solution capable of supporting a broad range of applications with its robust architecture to measure and deliver both absolute and incremental signals.

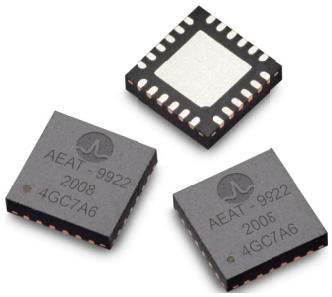
When selected, its positioning data is then represented in its digital form to be assessed through a standard SSI (parity) and SPI (with CRC and Parity option) communication protocol. Where desired, users may also choose to receive its absolute angle position in PWM-encoded output signals with initialization and error bits option.

## Key Features

- Package: QFN-24 leads (4 mm × 4 mm)
- Operating temperature: –40°C to 125°C
- Operating voltage: 3.3V and 5V
- Selectable protocols: SPI/SSI
- Programmable 10 bits to 18 bits of absolute resolution (AEAT-9922)
- Programmable 10 bits to 14 bits of absolute resolution (AEAT-9933)
- Flexible incremental ABI resolution: 1 CPR to 10,000 CPR (AEAT-9922)
- Flexible incremental ABI resolution: 1 CPR to 1,024 CPR (AEAT-9933)
- User-programmable zero position, direction, index width, index position and hysteresis
- Angular accuracy correction for high accuracy

## Applications

- Brushless DC motors and stepper motors
- Resolver and potentiometer replacement
- Industrial automation and robotics
- Industrial sewing machines and textiles equipment



Ordering Information

| Part Number | Description | Package | Delivery Form |
|---|---|---|---|
| AEAT-9922-100 | 18-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 1000 pieces | QFN 24 leads, 4 mm × 4 mm | Tape and Reel |
| AEAT-9922-102 | 18-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 100 pieces | QFN 24 leads, 4 mm × 4 mm | Tape and Reel |
| AEAT-9922-Q24 | 18-Bit Magnetic Encoder On-Off Axis, Tube, 73 pieces | QFN 24 leads, 4 mm × 4 mm | Tube |
| AEAT-9933-100 | 14-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 1000 pieces | QFN 24 leads, 4 mm × 4 mm | Tape and Reel |
| AEAT-9933-102 | 14-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 100 pieces | QFN 24 leads, 4 mm × 4 mm | Tape and Reel |
| AEAT-9933-Q24 | 14-Bit Magnetic Encoder On-Off Axis, Tube, 73 pieces | QFN 24 leads, 4 mm × 4 mm | Tube |

Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-9922PRGEVB | AEAT-9922 Programming Kit, Evaluation Board and Magnet Evaluation Set |
| HEDS-9922EVB | AEAT-9922 Evaluation Board |
| HEDS-9933PRGEVB | AEAT-9933 Programming Kit, Evaluation Board and Magnet Evaluation Set |
| HEDS-9933EVB | AEAT-9933 Evaluation Board |

# AEAT-9955/9966 Series

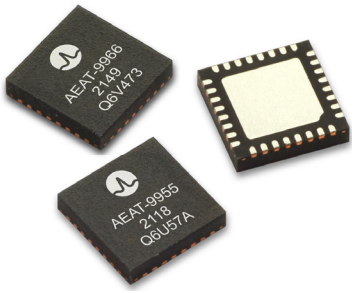
## Description

The Broadcom AEAT-9955/9966 are angular magnetic rotary sensors that provide precise 360° angle measurements. They combine integrated Hall sensors with advanced analog and digital signal processing in a single device. A simple two-pole magnet creates the magnetic field, and the sensors can be used in On Axis (shaft end) or Off Axis (side, axial, or radial) configurations. Their robust design allows them to support a wide range of applications, delivering both absolute and incremental signals.

Absolute angle measurements indicate the magnet's position with a selectable resolution of 10 to 18 bits. Data can be read digitally via standard SSI (with parity) or SPI (with CRC and parity) protocols. PWM-encoded output is also available. Incremental positions are provided through ABI and UVW signals. ABI resolution is user-configurable from 1 CPR to 20000 CPR, while UVW commutation supports 1 to 32 pole pairs (2 to 64 poles).

## Key Features

- Package: QFN-32 (5 mm × 5 mm)
- Operating temperature: –40°C to 125°C
- Operating voltage: 3.3V and 5V
- Selectable protocols: SPI/SSI
- Programmable 10 bits up to 18 bits of absolute resolution
- The incremental positions are indicated on ABI and UVW signals with a user-configurable CPR from 1 CPR to 20,000 CPR
- Qualified automotive standard Grade 0, AEC-Q100 (AEAT-9955)
- 300-µA current consumption in Sleep mode
- Dedicated zero reset and error pin
- EEPROM architecture for multi-time user configuration
- Optional 56-bit memory lock function
- Automatic integral nonlinearity angle correction for high accuracy
- Designed conformance to ISO26262 ASIL-D and SIL3 with secondary chip for redundancy
- Multi-index with one revolution
- High-impedance output for multi-client network
- Two chips of magnetic encoder in one package for redundancy (AEAT-9966)




## Applications

- Brushless DC motors and stepper motors
- Resolver and potentiometer replacement
- Industrial automation and robotics
- Industrial sewing machines and textile equipment
- Light detection and ranging (LiDAR)

Ordering Information

| Part Number | Description | Package | Delivery Form |
|---|---|---|---|
| AEAT-9955-100 | 18-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 1000 pieces | QFN 32 leads, 5 mm × 5 mm | Tape and Reel |
| AEAT-9955-102 | 18-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 100 pieces | QFN 32 leads, 5 mm × 5 mm | Tape and Reel |
| AEAT-9955-Q32 | 18-Bit Magnetic Encoder On-Off Axis | QFN 32 leads, 5 mm × 5 mm | Tube |
| AEAT-9966-100 | 18-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 1000 pieces | QFN 32 leads, 5 mm × 5 mm | Tape and Reel |
| AEAT-9966-102 | 18-Bit Magnetic Encoder On-Off Axis, Tape and Reel, 100 pieces | QFN 32 leads, 5 mm × 5 mm | Tape and Reel |
| AEAT-9966-Q32 | 18-Bit Magnetic Encoder On-Off Axis | QFN 32 leads, 5 mm × 5 mm | Tube |

Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-9966EVB | AEAT-9966 Evaluation Board |
| HEDS-9966PRGEVB | AEAT-9966 Programming Kit with Evaluation Board and Magnet |

# AEAT-9988M/MB Series

## Description

The Broadcom AEAT-9988M/MB is an angular magnetic rotary sensor that provides precise 360° angle measurements. Its robust design supports a wide range of applications, delivering both absolute and incremental signals. The sensor uses integrated Hall elements with advanced analog and digital signal processing. A dual-track magnet generates the magnetic field by rotating perpendicularly, with magnet ring sizes available from 20-mm to 50-mm inner diameter.

Absolute angle measurements offer selectable resolutions from 16 to 23 bits. Data can be read digitally via SSI, SPI, BiSS-C, or RS-485 protocols. PWM-encoded output is also available. The AEAT-9988M/MB includes a built-in multi-turn counter with battery backup, programmable from 10 to 16 bits. Incremental positions are output via ABI and UVW signals, with ABI resolution from 1 to 65536 CPR and UVW commutation supporting 1 to 64 pole pairs (2 to 128 poles).

## Key Features

- Package: DFN-30 leads (8.2 mm × 5 mm)
- Operating temperature: –40°C to 125°C
- Operating voltage: 5V
- Selectable communication protocols: RS-485/SSI/SPI
- Communication protocol: BiSS-C (AEAT-9988MB)
- Programmable 16 bits up to 23 bits of absolute resolution
- Programmable Incremental ABI resolution: 1 CPR to 65536 CPR
- 500-µA current consumption in Sleep Mode
- Dedicated zero reset and error pin
- Optional 56-bit memory lock function
- Programmable function to external hardware pin (GPIO)
- Built-in multi-turn counter with battery backup power-off mode operation




## Applications

- Brushless DC motors and stepper motors
- Resolver and potentiometer replacement
- Industrial automation and robotics
- Industrial sewing machines and textile equipment
- Light detection and ranging (LiDAR)

Ordering Information

| Part Number | Product Description | Package | Delivery Form |
|---|---|---|---|
| AEAT-9988M-D30 | High-accuracy magnetic encoder, 16-bit MT and 23-bit ST, SSI, SPI, RS-485 | DFN 30 leads, 8.2 mm × 5 mm | Tube, 44 pieces |
| AEAT-9988M-102 | High-accuracy magnetic encoder, 16-bit MT and 23-bit ST, SSI, SPI, RS-485 | DFN 30 leads, 8.2 mm × 5 mm | Tape and Reel, 100 pieces |
| AEAT-9988M-104 | High-accuracy magnetic encoder, 16-bit MT and 23-bit ST, SSI, SPI, RS-485 | DFN 30 leads, 8.2 mm × 5 mm | Tape and Reel, 500 pieces |
| AEAT-9988MB-D30 | High-accuracy magnetic encoder, 16-bit MT and 23-bit ST, SSI, SPI, RS-485, BiSS-C | DFN 30 leads, 8.2 mm × 5 mm | Tube, 44 pieces |
| AEAT-9988MB-102 | High-accuracy magnetic encoder, 16-bit MT and 23-bit ST, SSI, SPI, RS-485, BiSS-C | DFN 30 leads, 8.2 mm × 5 mm | Tape and Reel, 100 pieces |
| AEAT-9988MB-104 | High-accuracy magnetic encoder, 16-bit MT and 23-bit ST, SSI, SPI, RS-485, BiSS-C | DFN 30 leads, 8.2 mm × 5 mm | Tape and Reel, 500 pieces |

Accessories Ordering Information

| Part Number | Product Description |
|---|---|
| HEDS-9988MEVB | AEAT-9988M SSI, SPI, RS-485 Evaluation Board |
| HEDS-9988MBEVB | AEAT-9988MB SSI, SPI, RS-485, BiSS-C Evaluation Board |
| HEDS-9988PRGEVB | AEAT-9988MB Programming Kit with 2 units of evaluation board HEDS-9988MBEVB, 1 set of hub ring magnet, and 1 set of magnet without hub |

# Incremental Optical Encoders: Transmissive Modules

## AEDT-981x Series

### Description

The Broadcom AEDT-981x is a series of high resolution 3-channel optical incremental encoder modules designed for robust, high precision motion control applications. Using a Broadcom-developed opto ASIC with the built-in Interpolator circuit, AEDT-981x encoders enable wide resolution range from 1000 to 5000 counts per revolution with the rotary code wheel of 11-mm optical radius, offering a high resolution yet compact solution.

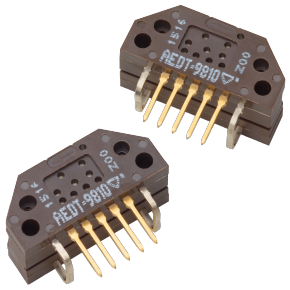
With the opto-ASIC's built-in automatic LED brightness regulation technique, the encoder current consumption can be significantly lowered (typical Icc: 20 mA) while maintaining optimal encoder performance across spatial corners. This LED brightness control feature also enables optimal LED current control; hence, LED life can significantly prolonged. With the state-of-the-art opto-mechanical design, AEDT-981x offers excellent spatial play of Ø 0.40 mm and code wheel gap range of ± 150 µm. This allows great flexibility and ease of installation to the user. Inheriting the indefeasible integrity in product robustness, repeatability and reliability, AEDT-981x series are designed for wide market employment withstanding wide application requirement and environment demand.

### Key Features

- Operating temperature: –40°C to 115°C
- Two-channel quadrature output with index pulse
- Single-ended output with ± 5 mA output sink/source current per channel
- Suitable for industrial applications
- Resolution up to 5000 counts per revolution
- Low power consumption (typical Icc: 20 mA)
- No signal adjustment required
- Pin compatible to legacy HEDS-9xxx series
- Spatial play tolerance of Ø 0.40 mm
- Allows motor shaft axial play of ± 0.15 mm
- ESD Immunity HBM 4kV (JESD22-A114D)

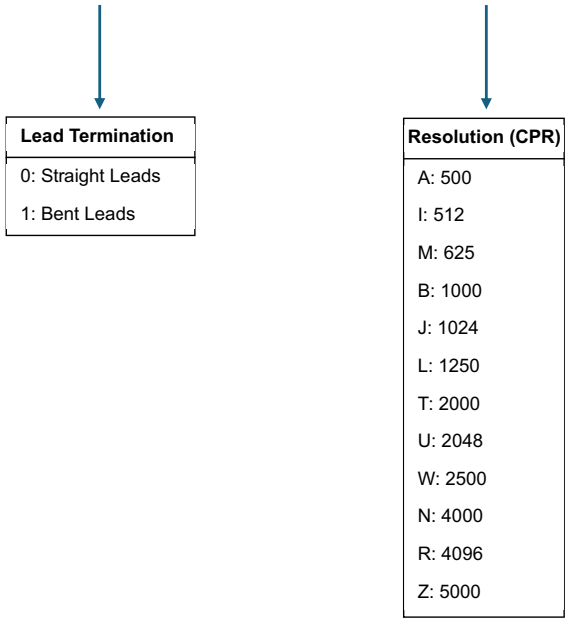
### Applications

- Wide range of commercial and industrial applications
- DC/AC servo motors
- Linear and rotary actuators
- Factory automation equipment
- 3D printers
- Robotics
- Unmanned aerial vehicles (UAVs) or drones



Ordering Information

| AEDT-981 | | - | | 00 |
|---|---|---|---|---|



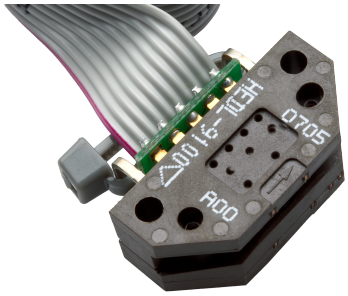
# HEDL-90/91xx Series

## Description

Line drivers are available for the HEDS-90/91xx series encoders. The line driver offers enhanced performance when the encoder is used in noisy environments or when it is required to drive long distances. The encoder line driver utilizes an industry-standard line driver IC, AM26C31Q, which provides complementary outputs for each encoder channel. Thus, the output of the line driver encoder is A, A, B, B, and I/I for three-channel versions.

## Key Features

- Operating temperature: –40°C to 100°C
- High performance
- High resolution
- Low cost
- Easy to mount
- No signal adjustment required
- Small size
- Two- and three-channel quadrature output
- TTL compatible output
- Count frequency: 100 kHz



## Applications

- Printers
- Plotters
- Tape drives
- Factory automation equipment

Ordering Information

| HEDL-90 | | 0 | Option | | 0 | 0 |
|---|---|---|---|---|---|---|

| Outputs |
|---|
| 4: 3-Channel |

| Resolution (Cycles/Rev) |
|---|
| B: 1000 CPR |

| HEDL-91 | | 0 | Option | | 0 | 0 |
|---|---|---|---|---|---|---|

| Outputs |
|---|
| 0: 2-Channel |
| 4: 3-Channel |

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

# HEDS-90/91/92xx Series, HEDT-90/91xx Series

## Description

**HEDS-90/91/92xx Series**

The HEDS-90/91/92xx series are three-channel optical incremental encoder modules. When used with a code wheel, these low-cost modules detect rotary position. Each module consists of a lensed LED source and a detector IC enclosed in a small plastic package. Due to a highly collimated light source and a unique photodetector array, these modules provide the same high performance found in the HEDS-9000/9100 two-channel encoder family.

**HEDT-90/91xx Series**

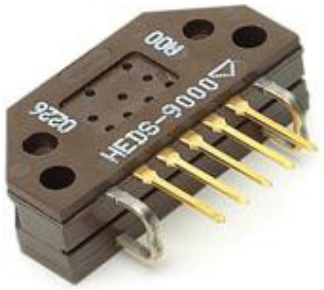
The HEDT-90/91xx series are high-performance, low-cost, optical incremental encoder modules that operate to 125°C. When used with a code wheel, these modules detect rotary position. The modules consist of a lensed (LED) source and a detector IC enclosed in a small C-shaped plastic package. Due to a highly collimated light source and unique photodetector array, these modules are extremely tolerant to mounting misalignment. The two-channel digital outputs and the single 5V supply input are accessed through five 0.025-inch square pins located on 0.1-inch centers.

## Key Features

- Operating temperature:
  –40°C to 100°C (HEDS-90/91/92xx)
  –40°C to 125°C (HEDT-90/91xx)
- Low cost
- Easy to mount
- No signal adjustment required
- Small size
- TTL compatible
- High performance and resolution
- Insensitive to radial and axial play (HEDT-90/91xx)

## Applications

- Printers
- Plotters
- Tape drives
- Factory automation equipment



## Ordering Information

Two-Channel Linear Encoder Modules – HEDS-9200 Series

| HEDS-9200 | | | |
|---|---|---|---|

| Resolution (Cycles/Rev) |
|---|
| 300: 300 LPI |
| Q00: 180 LPI |

Two-Channel Incremental Encoders – HEDS-910x Series

**NOTE:** To be used with an 11-mm optical radius code wheel.

| HEDS-910 | | Option | | 0 | 0 |
|---|---|---|---|---|---|

| Lead |
|---|
| 0: Straight Leads |
| 1: Bent Leads |

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

## Two-Channel Incremental Encoders – HEDS-914x Series

**NOTE:** To be used with an 11-mm optical radius code wheel.

| HEDS-914 | Option | | 0 | 0 |
|---|---|---|---|---|

| Lead |
|---|
| 0: Straight Leads |
| 1: Bent Leads |

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

## Two-Channel Incremental Encoders – HEDS-900x Series

**NOTE:** To be used with a 23.36-mm optical radius code wheel.

| HEDS-9000 | | 0 | 0 |
|---|---|---|---|

| Resolution (Cycles/Rev) |
|---|
| A: 500 CPR |
| B: 1000 CPR |
| T: 2000 CPR |

Three-Channel Incremental Encoders – HEDS-904x Series

**NOTE:** To be used with a 23.36-mm optical radius code wheel.

| HEDS-904 | | Option | | 0 | 0 |
|---|---|---|---|---|---|

| Lead |
|---|
| 0: Straight Leads |
| 1: Bent Leads |

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

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

| HEDT-910 | Option | | 0 | 0 |
|---|---|---|---|---|

| Lead |
|---|
| 0: Straight Leads |

| Resolution (Cycles/Rev) |
|---|
| C: 100 CPR |
| I: 512 CPR |

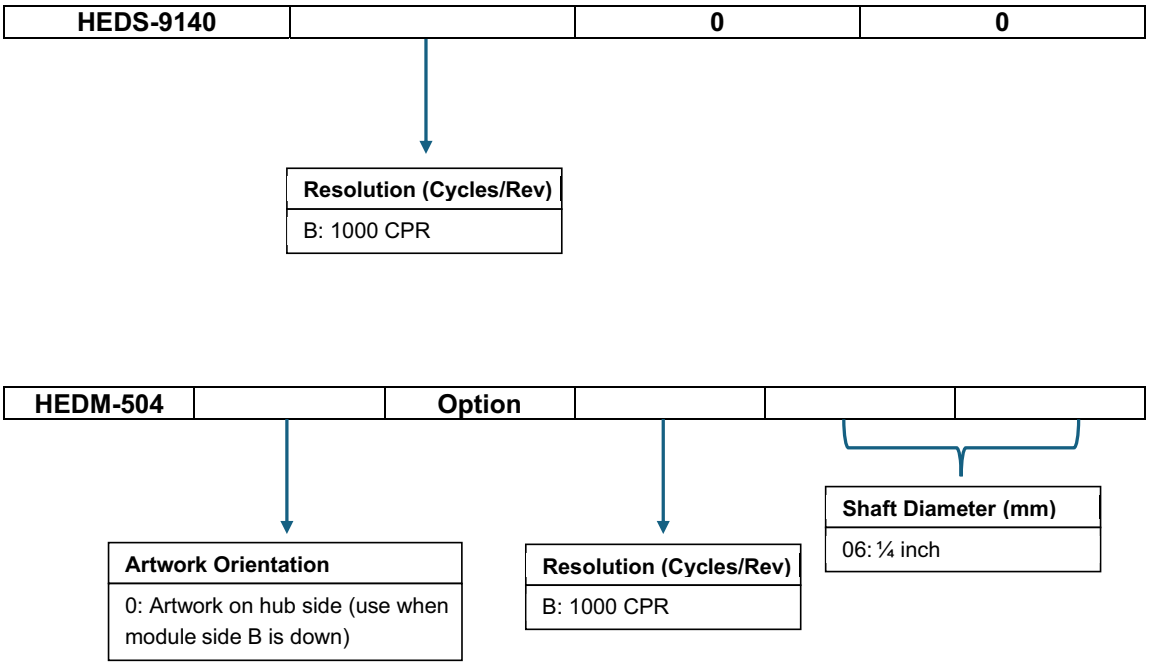
High-Temperature 140°C Three-Channel Optical Incremental Encoder Modules – HEDT-9040/9140 Series

| HEDT-914 | | Option | | 0 | 0 |
|---|---|---|---|---|---|

| Lead |
|---|
| 0: Straight Leads |

| Resolution (Cycles/Rev) |
|---|
| I: 512 CPR |
| J: 1024 CPR |

Three-Channel Encoder Modules and Code Wheel, 11.000 Optical Radius – HEDS-9140-B00 Option



# HEDS-97xx Series

## Description

The HEDS-9700 series is a high performance, low cost, optical incremental encoder module. When operated in conjunction with either a code wheel or a code strip, this module detects rotary or linear position. The module consists of a lensed LED source and a detector IC enclosed in a small C-shaped plastic package. Due to a highly collimated light source and a unique photodetector array, the module is extremely tolerant to mounting misalignment. The two-channel digital outputs and 5V supply input are accessed through four solder-plated leads located on 2.54-mm (0.1-inch) centers. The standard HEDS-9700 is designed for use with an 11-mm optical radius code wheel, or linear code strip. Other options are available. Contact factory for more information.

## Key Features

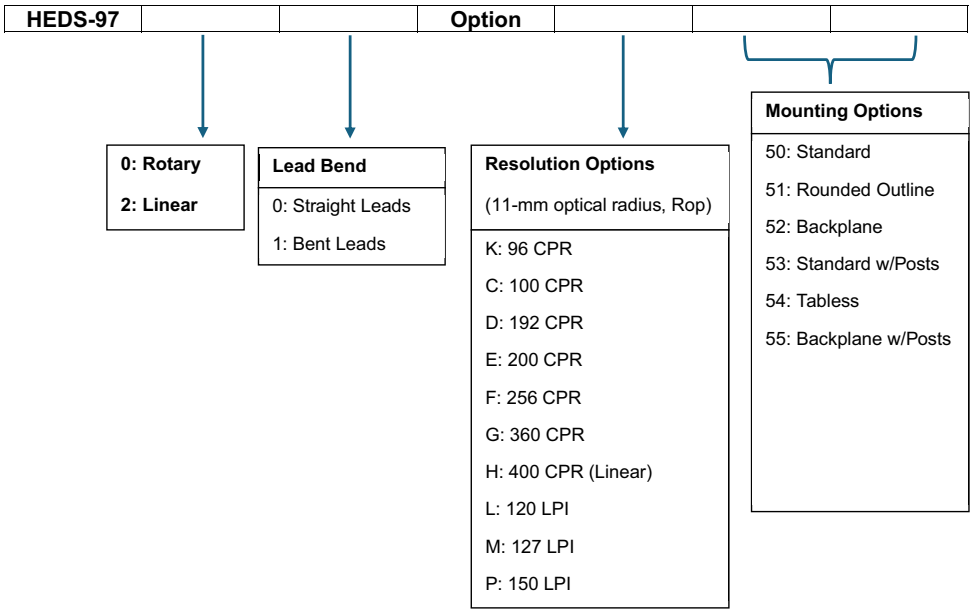
- Operating temperature: –40°C to +85°C
- Operating voltage: 5V
- Small size
- Low cost
- Multiple mounting options
- Wide resolution range
- Linear and rotary options available
- No signal adjustment required
- Insensitive to radial and axial play
- Two-channel quadrature output
- TTL compatible
- Wave solderable




## Applications

- Printers
- Plotters
- Copiers
- Office automation equipment

Ordering Information



# Incremental Optical Encoders: Housed / Kit

## AEDC-55/56xx Series, HEDC-55/56xx Series

### Description

**AEDC-55/56xx Series**

The AEDC-5xxx series encoders, while similar to the industry standard HEDS-5xxx series kit encoder, provides a connector latch on the cover housing to improve connector retention. This device is built upon the Broadcom AEDT-9810 series encoder module, and provides the same performance, low cost, high reliability, high resolution, and ease of assembly customers have come to expect. Each encoder contains a LED source with lens, an ASIC with integrated photo detector arrays, LED current regulation, interpolator and output driver circuitry, and a code wheel which rotates between the emitter and detector ASIC.

**HEDC-55/56xx Series**

The HEDC-5xxx-xxx, while similar to the industry-standard HEDS-5xxx kit encoder, provides a connector latch on the cover housing to improve connector retention. This device is built upon the Broadcom HEDS-9000 series encoder module and provides the same performance, low cost, high reliability, high resolution, and ease of assembly customers have come to expect. Each encoder contains a lensed LED source, an integrated circuit with detectors, and output circuitry. A code wheel (disk) that rotates between the emitter and the detector IC generates two square waves in quadrature.

### Key Features

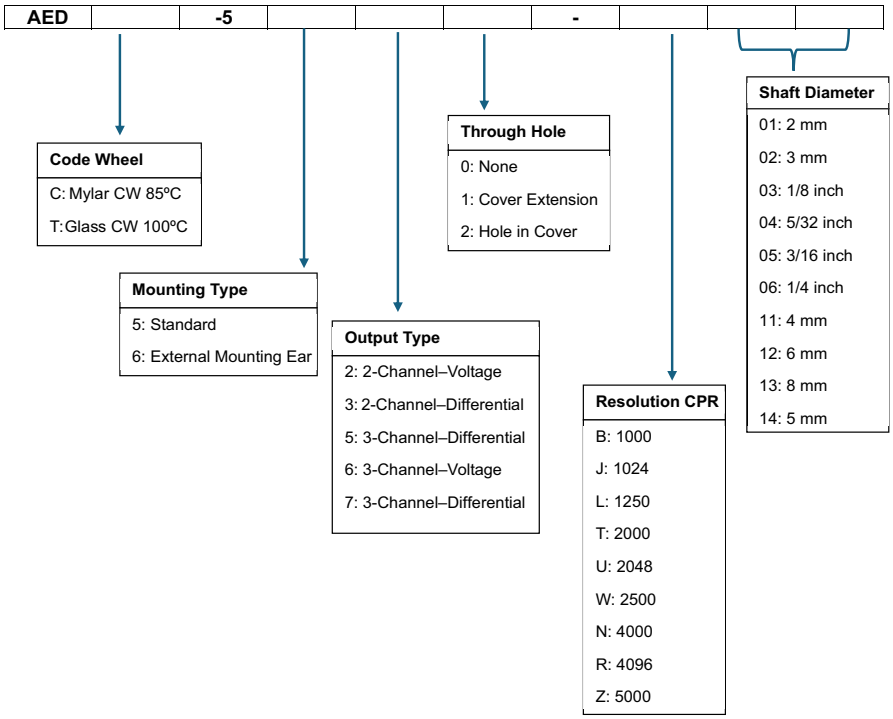
- Operating temperature:
  –40°C to 85°C (AEDC-55/56xx)
  –40°C to 100°C (HEDC-55/56xx)
- Operating voltage: 5V
- Available in two- or three-channel encoder A, B, and I
- Latching connector design
- Quick assembly
- No signal adjustment required
- TTL compatible with single-ended or differential output
- Resolution of up to 5000 CPR (AEDC-55/56xx)
- Resolution of up to 1024 CPR (HEDC-55/56xx)

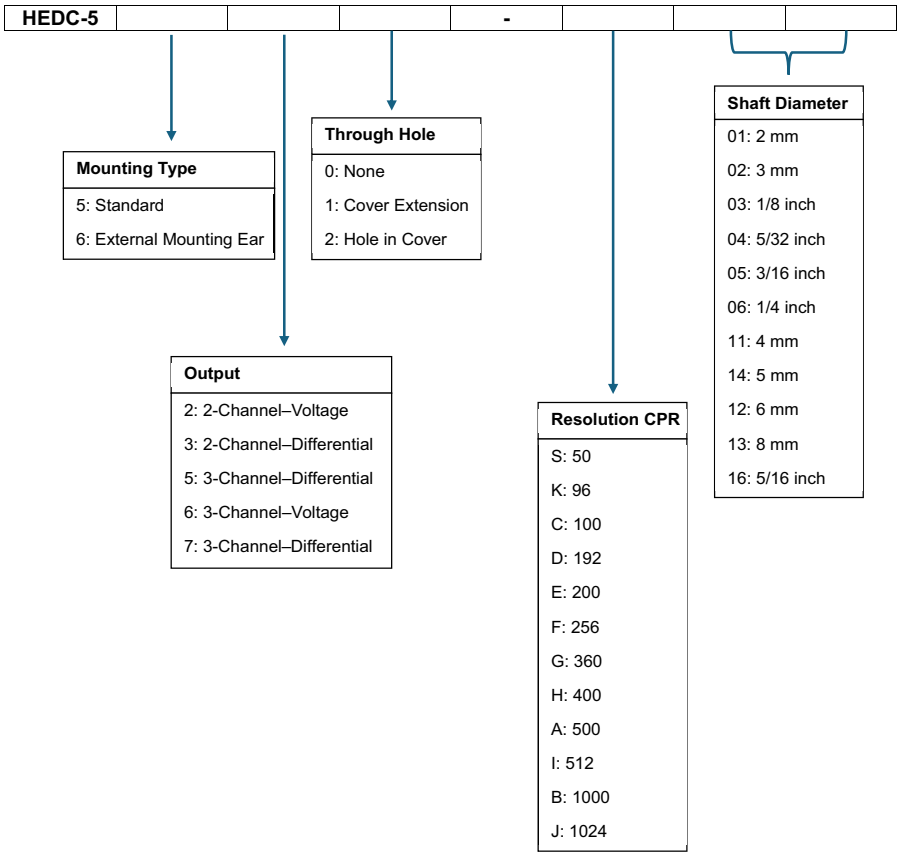
### Applications

- Printers
- Plotters
- Tape drives
- Textile machines
- Positioning tables
- Automatic handlers



## Ordering Information



# AEDL-58xx Series, HEDL-55/56xx Series

## Description

**AEDL-58xx Series**

Broadcom AEDL-5xxx series encoders are high-performance, low-cost, three-channel optical incremental encoders that offer line driver outputs. These encoders are designed with an emphasis on high reliability, high resolution, and easy assembly. Each encoder contains a LED source with lens, an ASIC with integrated photo detector arrays, LED current regulation, interpolator and output driver circuitry, and a code wheel which rotates between the emitter and detector ASIC. The output of the AEDL-5xxx is two square waves in quadrature. In addition, a third channel offers index signal, which is a 90 electrical degree, true index pulse which is generated once for each full rotation of the code wheel.

The AEDL-5xxx series utilizes a film code wheel allowing for resolutions to 5000 CPR. The line driver output option offers enhanced performance when the encoder is used in electronically noisy environments, or when it is required to drive long distances. AEDL-5xxx Series utilize an industry standard line driver IC, AM26C31Q, which provides complementary outputs for each encoder channel. Thus, the output of the line driver encoder is A, A/, B, B/, I, I/.

## Key Features

- Operating temperature: –40°C to 85°C
- Available with encoder kit housing
- High resolution up to 5000 CPR
- User friendly installation process
- Complementary outputs with industry-standard line driver IC
- Single 5V supply with ±10% tolerance
- Onboard decoupling capacitor for enhanced noise immunity

## Description

**HEDL-55/56xx Series**

Line drivers are available for the HEDS-55XX/56XX series. The line driver offers enhanced performance when the encoder is used in noisy environments or when it is required to drive long distances.

The 70°C version utilizes an industry-standard line driver IC (26LS31), which provides complementary outputs for each encoder channel. The 100°C version utilizes an industry-standard line driver IC, 26C31, which provides complementary outputs for each encoder channel. Thus, the output of the line driver encoder is A, A, B, B, and I/I for three-channel versions. Suggested line receivers are 26LS32 and 26LS33.

## Key Features

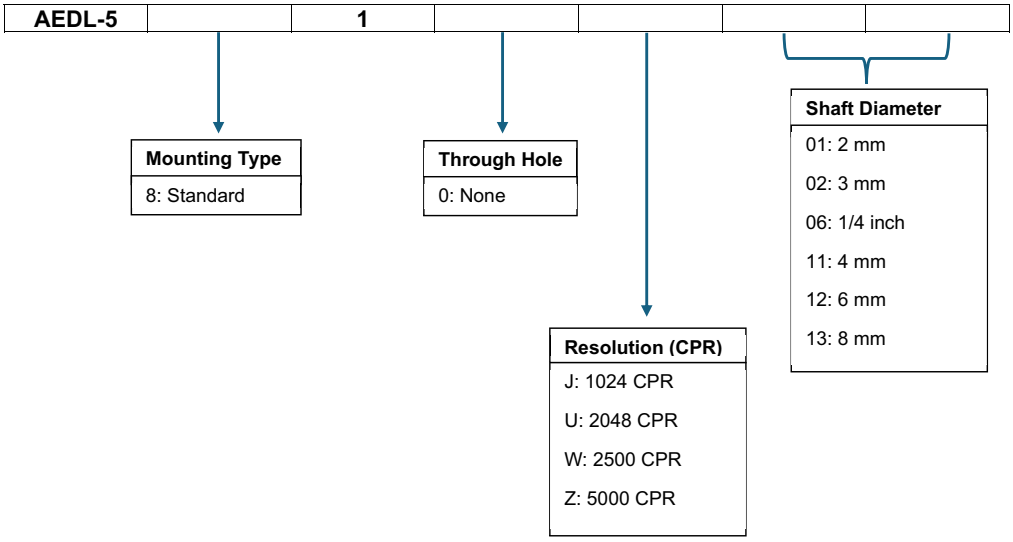
- Complementary outputs
- Industry-standard line driver IC
- Single 5V
- Onboard bypass capacitor
- 70°C and 100°C versions available

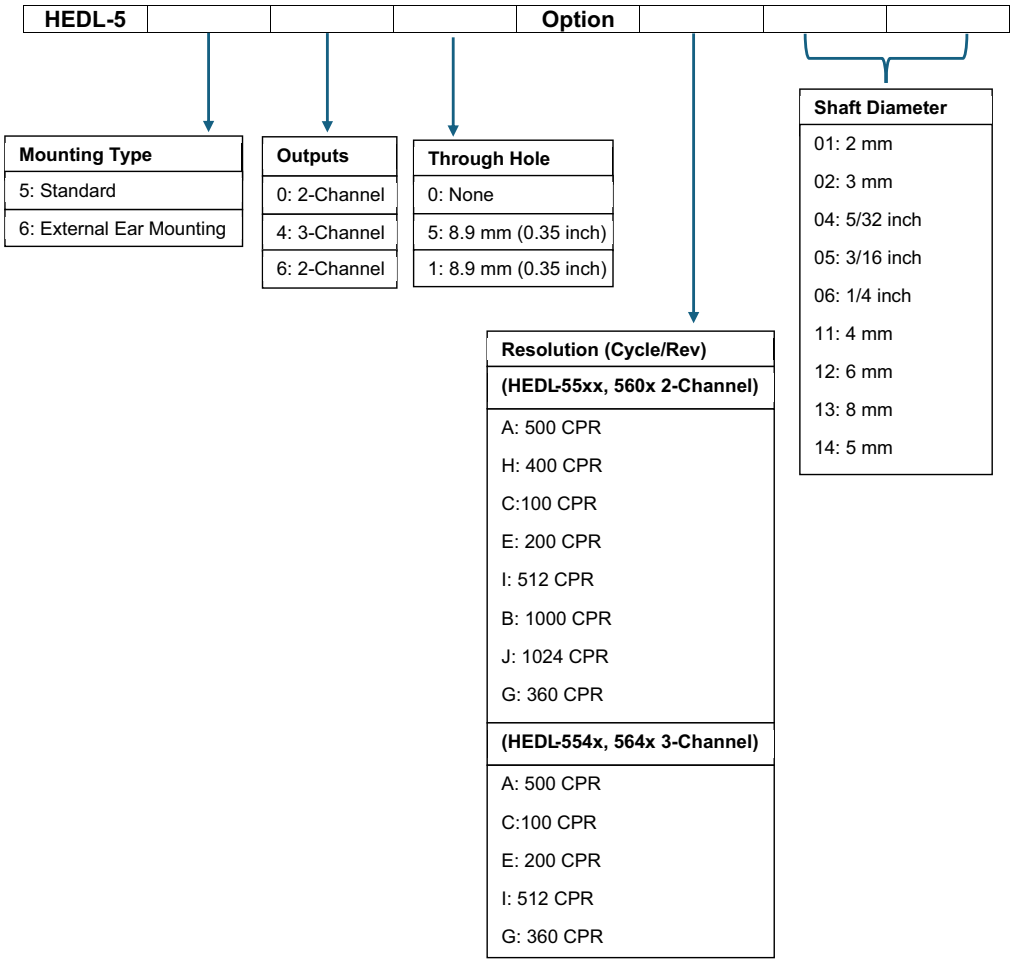


## Applications

- Printers
- Plotters
- Tape drives
- Positioning tables and automatic handlers

Ordering Information



# AEDM-5xxx Series, HEDS/HEDM-55/56xx Series

## Description

**AEDM-5xxx Series**

Broadcom AEDM-5xxx series encoders are high resolution and high performance three channel optical incremental encoders. These encoders emphasize on high reliability, high resolution, and easy assembly. Each encoder contains a LED source with lens, an ASIC with integrated photo detector arrays, LED current regulation, interpolator and output driver circuitry, and a code wheel which rotates between the emitter and detector ASIC.

The outputs of the AEDM-5xxx are two square waves in quadrature. In addition, a third channel offers index signal, which is a 90 electrical degree, true index pulse which is generated once for each full rotation of the code wheel. The AEDM-5xxx series utilizes a film code wheel allowing for resolutions up to 5000 CPR.

**HEDS/HEDM-55/56xx Series**

The HEDS-55/56xx and HEDM-55/56xx are high performance, low cost, two and three channel optical incremental encoders. These encoders emphasize high reliability, high resolution, and easy assembly. Each encoder contains a lensed LED source, an integrated circuit with detectors and output circuitry, and a code wheel which rotates between the emitter and detector IC.

The HEDS series utilizes metal code wheel, while the HEDM series utilizes a film code wheel allowing for resolutions to 1024 CPR.

## Key Features

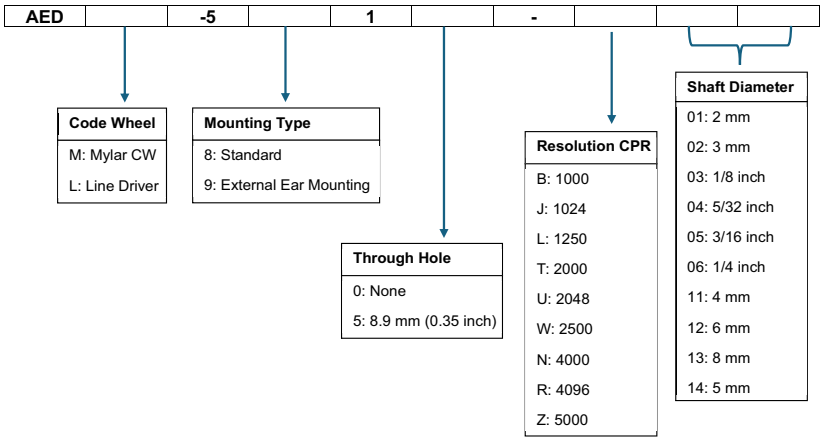
- Operating temperature:
  –40°C to 85°C (AEDM-5xxx)
  –40°C to 100°C (HEDS/HEDM-55/56xx)
- Operating voltage: 5V
- Two-channel quadrature output with index pulse
- Quick and easy assembly
- No signal adjustment required
- External mounting ears available
- TTL compatible
- Low cost
- High resolution up to 5000 CPR (AEDM-5xxx)
- Resolution up to 1024 CPR (HEDS/HEDM-55/56xx)

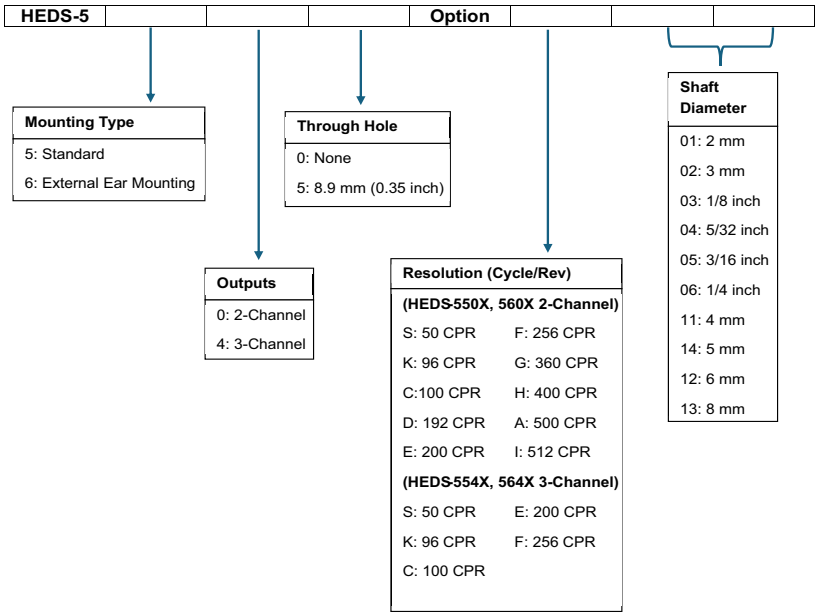
## Applications

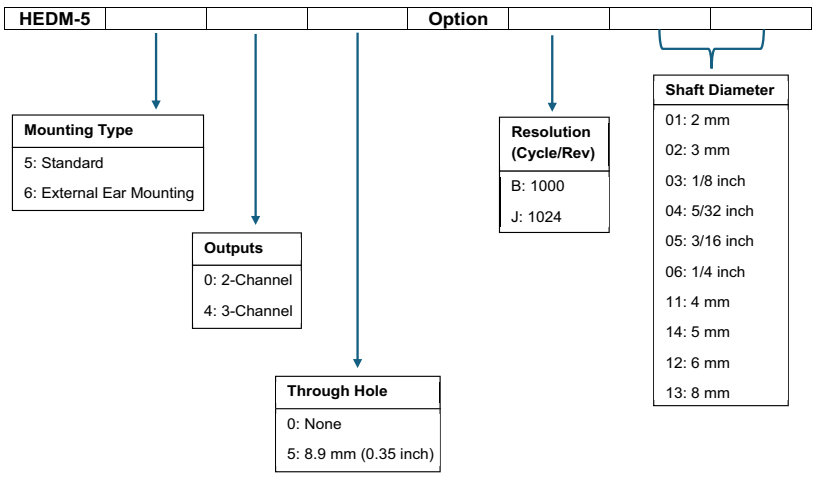
- Printers
- Plotters
- Tape drives
- Positioning tables
- Automatic handlers



## Ordering Information



# AS22-M5xx Series

## Description

The Broadcom AS22 Series kit encoder solution offers a compact size with an overall diameter of 22 mm and height of 10.9 mm for the space-constrained application. To meet the growing demand for high-precision application, the AS22 Series offers a wide range of incremental resolution, ranging from 360 CPR to 2048 CPR. The encoder provides A and B channel of incremental digital signal output, as well as a digital index pulse per revolution enabling the homing positioning operation.

The three-channel solution comes with the optional RS-422 compatible differential output offering the high transmission noise immunity for signal over cable. To cater to a wide selection of industrial applications, this encoder is designed to operate in a robust environment with the operating temperature ranging from –20°C to +100°C. The AS22 Series is designed for ease of use. The kit solution is engineered with the hassle-free installation, eliminating the need for a tedious alignment process.

## Key Features

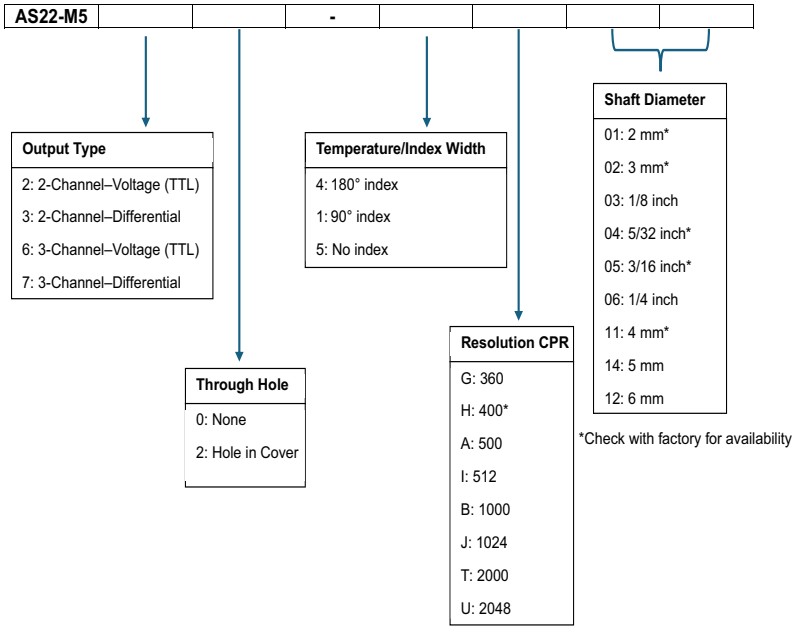
- Compact size: Ø22 × 10.9 mm
- Operating temperature: –20°C to 100°C
- Operating voltage: 5V
- Incremental A, B, and Index channels
- TTL and RS422 compatible differential output
- 360 CPR to 2048 CPR
- Shaft diameter from 2 mm up to ¼ inch
- Spatial play tolerance of Ø0.15 mm
- Allows motor shaft axial play of ±0.25 mm
- Hassle-free installation
- RoHS compliance



## Applications

- Industrial automation and robotics
- Industrial sewing and textiles machinery
- Stepper/servo motors
- Factory automation

Ordering Information



# HEDR-54xx Series

## Description

The HEDR-542x series are high performance, cost-effective, two-channel optional incremental housed encoders. These encoders emphasize high reliability, high resolution, and easy assembly. The HEDR-542x housed encoders use reflective technology to sense rotary position. This sensor consists of an LED light source and a photodetector IC in a single SO-8 surface mount package. The outputs of the HEDR-542x encoders are two square waves in quadrature. These encoders may be quickly and easily mounted to a motor.

## Key Features

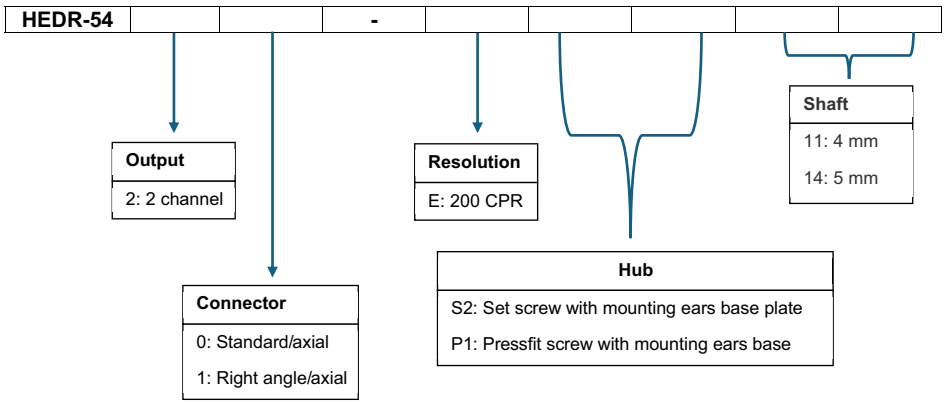
- Operating temperature: –10°C to +85°C
- Two-channel quadrature output
- Quick and easy assembly
- Cost-effective
- Ideal for small motor systems
- Right angle connector available
- Hub available in either a set screw configuration or a press-fit/adhesive mount configuration
- External mounting ears available



## Applications

- Vending machines
- Motor manufacturing applications
- Wafer handling machines

Ordering Information




Accessories Ordering Information

| Part Number | Product Description |
|---|---|
| HEDR-5900-00011 | Alignment tool, 4-mm shaft |
| HEDR-5900-00014 | Alignment tool, 5-mm shaft |

# HRPG-Axxx Series

## Description

The HRPG series is a family of miniature panel mount optical encoders, also known as rotary pulse generators (RPGs) and digital potentiometers. The HRPG is designed to be mounted on a front panel and used as a rotary, data-entry device. The HRPG is very flexible for numerous applications due to the many configuration options available. These options include detents or smooth, multiple terminations, versatile mounting capabilities, and different shaft configurations. The HRPG uses optical reflective technology providing accuracy and reliability to the encoder. An LED emits a beam of light onto the specular code-wheel surface. When the light strikes the surface, it projects the image of the code wheel back on the photo detector, causing the output to change. The entire detector circuit is on one IC; thus the part is less sensitive to temperature and other environmental variations.

## Key Features

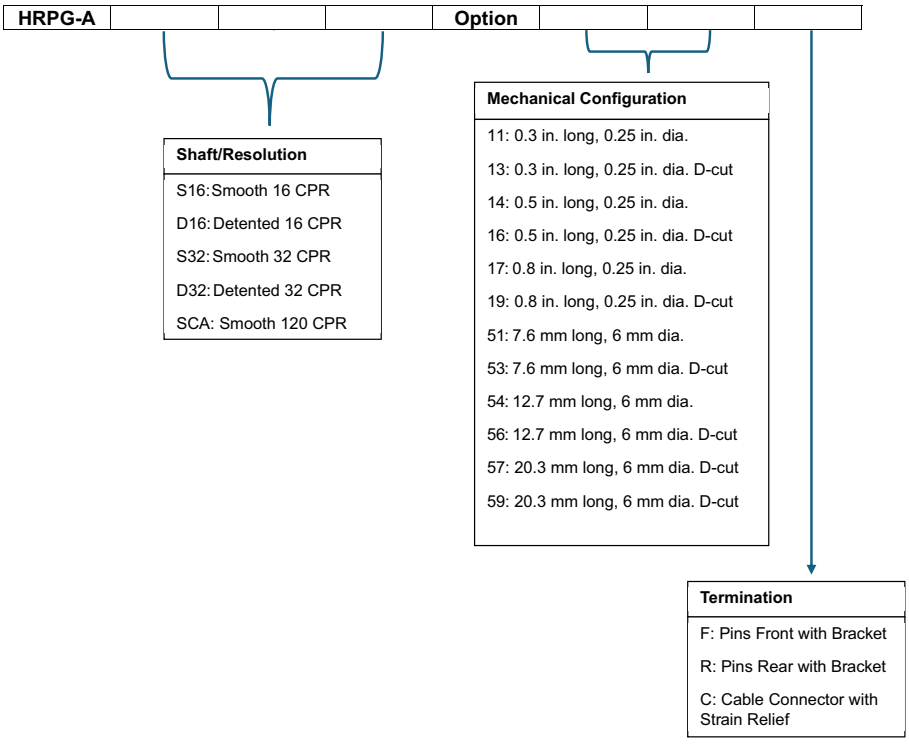
- Miniature size
- Smooth turning and detented options
- Multiple mounting bracket options
- Uses optical reflective technology
- Quadrature digital output
- Small footprint for versatile mounting
- TTL compatible



## Applications

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

Ordering Information



# Incremental Optical Encoders: Reflective Modules

# AEDR-83xx Series

## Description

The AEDR-8300 series is the smallest optical encoder employing reflective technology for motion control purposes. The encoder houses an LED light source and a photo-detecting circuitry in a single package. The AEDS-8300 series offers options of either single channel or two-channel quadrature digital outputs. Being TTL compatible, the outputs of the AEDR-8300 series can be interfaced directly with most of the signal processing circuitries. Hence the encoder provides great design-in flexibility and easy integration into existing systems. The AEDR-8300 series is available in four resolutions, namely 36, 75, 150, and 180 lines per inch (LPI) (1.42, 2.95, 5.91, and 7.09 lines per mm respectively). This range of resolutions caters for different design and application needs.

## Key Features

- Operating temperature: –20°C to 85°C
- Operating voltage: 5V
- Reflective technology
- Surface-mount small outline leadless package
- Single-channel incremental output
- Two-channel quadrature outputs for direction sensing
- TTL compatible output
- Encoding resolution options: 36, 75, 150, 180 (lines/inch) or 1.42, 2.95, 5.91, 7.09 (lines/mm)



## 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
- LiDAR
- AGVs
- Drones

Ordering Information

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

| Number of Channels |
|---|
| 1: One Channel |
| 0: Two Channels |

| Packaging |
|---|
| 1: Tape and Reel |

| Lines per Inch |
|---|
| 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 |

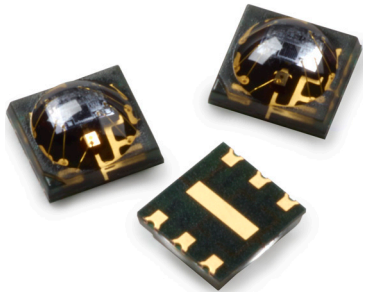
# AEDR-8400 Series

## Description

The AEDR-8400 encoder is the smallest optical encoder employing reflective technology for motion control purposes. The encoder houses an LED light source and a photodetecting circuitry in a single package. The AEDR-8400 encoder offers two-channel quadrature digital outputs. Being TTL compatible, the outputs of the AEDR-8400 encoder can be interfaced directly with most of the signal processing circuitries. Hence the encoder provides great design-in flexibility and easy integration into existing systems.

## Applications

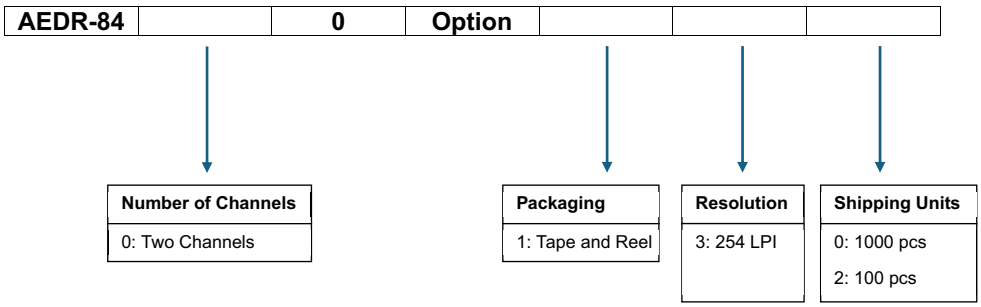
- Printers
- Copiers
- Card readers
- Scanners
- Digital still cameras
- Camcorders
- Camera phones
- Projectors
- Consumer product applications
- LiDAR
- AGVs
- Drones



## Key Features

- Operating temperature: –20°C to 85°C
- Operating voltage: 2.8V
- Reflective technology
- Surface-mount leadless package
- Two-channel quadrature digital outputs for direction sensing
- TTL compatible
- Encoding resolution: 254 (lines/inch) or 10 (lines/mm)

Ordering Information



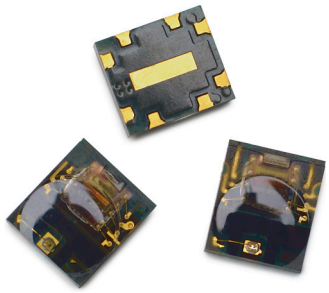
# AEDR-8500 Series

## Description

The AEDR-850X encoder is the smallest 3-channel optical encoder with digital outputs in the market employing reflective technology for motion control purposes. The encoder is designed to operate over –20°C to 85°C temperature range and hence suitable for both commercial and even industrial end applications. The encoder houses an LED light source and a photodetecting circuitry in a single package. The small size of 3.95 mm (L) × 3.4 mm (W) × 0.9562 mm (H) allows it to be even used in a wide range of miniature commercial application where size and space is a primary concern. The AEDR-850X encoder offers two-channel quadrature digital outputs and a third channel, index digital outputs. Being TTL compatible, the outputs of the AEDR-850X encoder can be interfaced directly with most of the signal processing circuitries. Hence the encoder provides great design in flexibility and easy integration into existing systems.

## Key Features

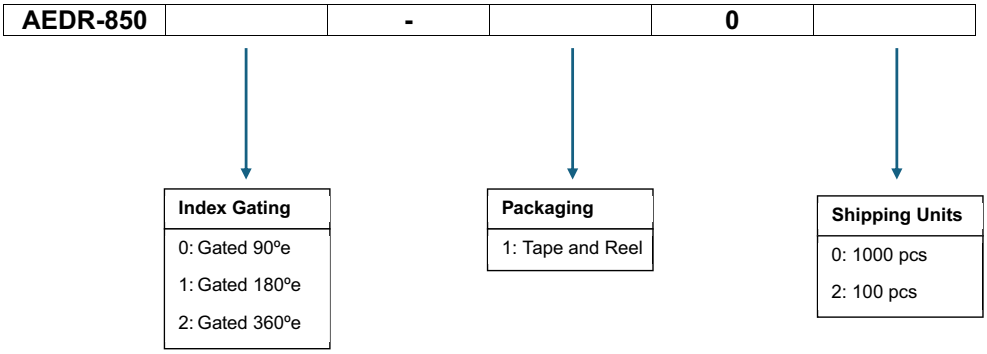
- Package size: 3.95 mm (L) × 3.4 mm (W) × 0.9562 mm (H)
- World smallest three-channel reflective technology encoder
- Operating temperature: –20°C to 85°C
- Operating voltage: 5V
- Three channels; two-channel quadrature digital outputs for direction sensing and a third channel, Index digital output.
- Built-in interpolator factor of 1x, 2x, and 4x selectable via external pinouts
- TTL compatible
- Encoding resolution: 294 to 304 (lines/inch)



## Applications

- Close-loop stepper motors
- Miniature motors
- Printers
- Copiers
- Card readers
- Scanners
- Projectors
- Consumer and industrial product applications

Ordering Information



# AEDR-87xx Series

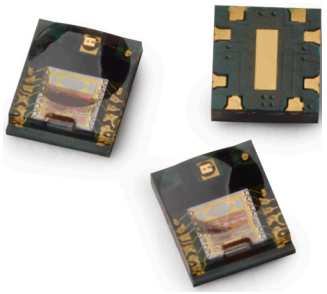
## Description

The Broadcom AEDR-87xx encoder is the smallest three-channel optical encoder with digital outputs that employs Reflective Technology for motion control. The encoder is designed to operate over the –40°C to 85°C temperature range and so is suitable for both commercial and industrial applications.

The AEDR-87xx offers high resolution (318 LPI) with built-in interpolation, enabling great flexibility and versatility in resolution range. The compact dimensions of 3.95 mm (L) × 3.4 mm (W) × 0.9562 mm (H) coupled with the low operating 3.3V or 5V option allows it to be used in a wide range of miniature commercial applications and portable devices in which space and power consumption is a primary concern.

## Key Features

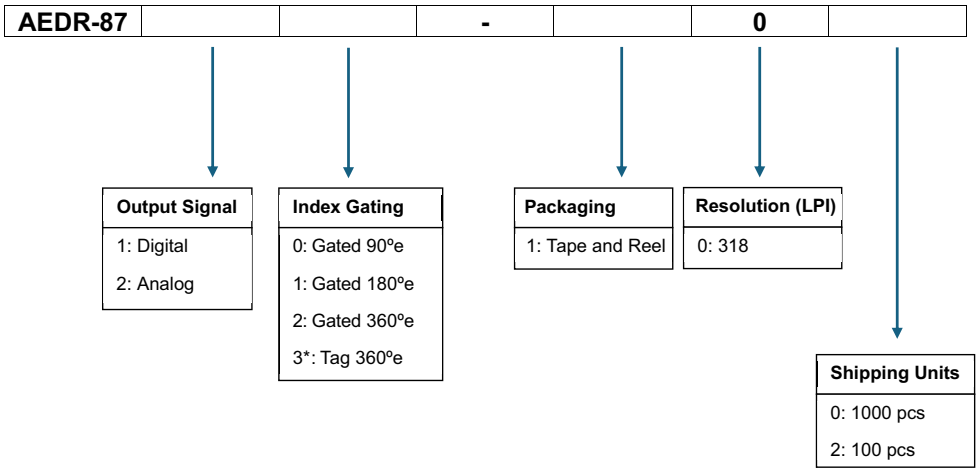
- Surface-mount leadless package: 3.95 mm (L) × 3.4 mm (W) × 0.9562 mm (H)
- World's smallest 3-channel reflective technology encoder
- Operating temperature: –40°C to 85°C
- Operating voltage: 3.3V or 5V
- Built-in LED current regulation, removing the need for external biasing resistor
- Encoding resolution: 318 (lines/inch)



## Applications

- Miniature motors/actuators (linear rotary)
- Miniature camera modules and systems
- Medical and laboratory diagnostic systems
- Robotic and semiconductor machines
- Portable measurement devices
- Consumer, commercial, and industrial applications where small encoder size matters

Ordering Information




**NOTE:**
- Digital: 3.3V and 5V operating modes
- Analog: 5V operating mode only
- Index gating: 3* applicable only for analog output

# AEDR-9820/9830 Series, AEDR-9820A/9830A Series

## Description

The Broadcom AEDR-98xx/98xxA series is a three-channel reflective optical encoder. It can be configured to analog or digital outputs using reflective technology for motion control purposes. The selectable options available are two-channel differential analog with a third-channel differential digital or analog index output or three-channel digital differential A, B, and I output.

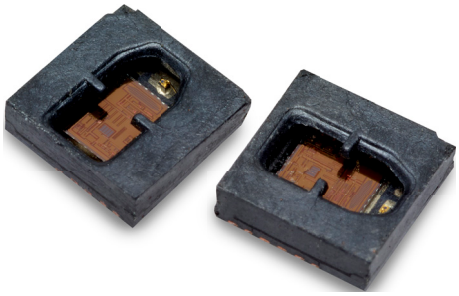
The AEDR-98xx/98xxA in analog encoder mode with two-channel differential analog outputs (Sin, /Sin, Cos, /Cos) can be interfaced directly with external interpolators.

The AEDR-98xx/98xxA in digital encoder mode offers two-channel (AB) quadrature digital outputs and a third-channel digital index output. Being TTL compatible, the outputs of the AEDR-98xx/98xxA encoder can be interfaced with most signal-processing circuitries. Therefore, the encoder provides easy integration into, and flexible design for, existing systems.

The encoder houses an infrared LED light source and photodetecting circuitry in a single package. The small size of 4.00 mm (L) × 4.00 mm (W) × 1.05 mm (H) allows it to be used in a wide range of miniature commercial applications where size and space are primary concerns.

## Key Features

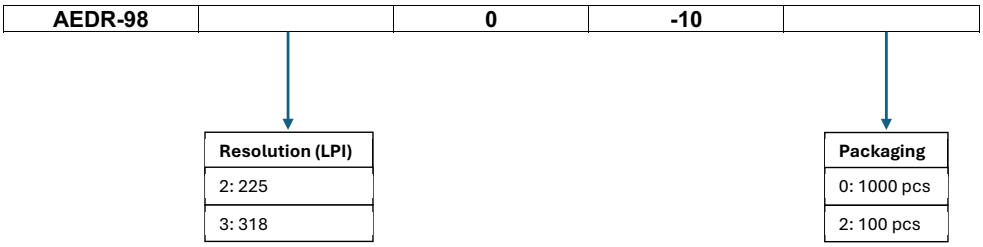
- Surface-mount leadless package: 4.0 mm (L) ×4.0 mm (W) × 1.05 mm (H)
- Operating temperature:
  –40°C to 115°C (AEDR-9820/9830)
  –40°C to 125°C (AEDR-9820A/9830A)
- Operating voltage: 3.3V and 5.0V
- Typical LED wavelength: 853 nm
- Encoding resolution: 225 LPI (lines/in.) or 8.86 LPmm (lines/mm) (AEDR-9820/9820A)
- Encoding resolution: 318 LPI (lines/in.) or 12.52 LPmm (lines/mm) (AEDR-9830/9830A)
- Analog output option: two-channel differential analog output and differential digital or analog index output
- Digital output option: three-channel differential or TTL compatible; two-channel quadrature (AB) digital outputs for direction sensing and a third-channel, index digital output
- Built-in interpolator for 1x, 2x, 4x, 8x, and 16x interpolation
- Built-in LED current regulation
- Maximum output frequency: 200 kHz to 2 MHz
- Automotive Grade 1, AEC-Q100 (AEDR-9820A/9830A)
- Production/QMS conformance IATF16949 (AEDR-9820A/9830A)

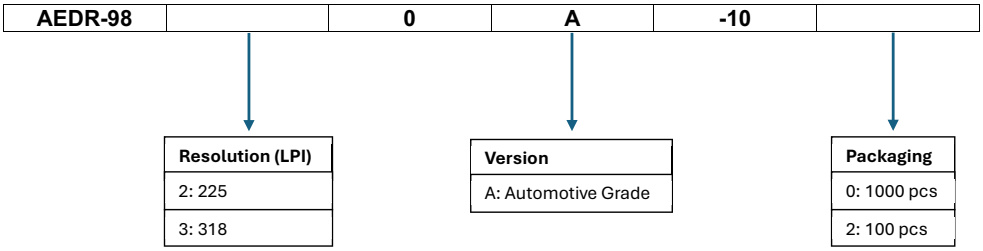


## Applications

- Closed-loop stepper motors
- Small motors, actuators
- Industrial printers
- Robotics
- Light detection and ranging (LiDAR)
- Pan-tilt-zoom cameras
- Automated guided vehicles (AGVs)
- Optometric equipment
- Linear stages

Ordering Information




Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-9820EVB | AEDR-9820, 225-LPI Evaluation Board and Code Wheel |
| HEDS-9830EVB | AEDR-9830, 318-LPI Evaluation Board and Code Wheel |

# AEDR-9820E/9830E Series, AEDR-9820EA/9830EA Series

## Description

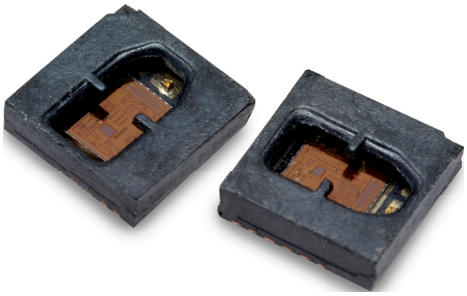
The Broadcom AEDR-98xxE/EA is a three-channel reflective optical encoder. It can be configured to analog or digital outputs employing reflective technology for motion control purposes. The selectable options available are two-channel differential analog with a third-channel differential digital or analog index output or three-channel digital differential A, B, and I output.

The AEDR-98xxE/EA in analog encoder mode offers two-channel differential analog outputs (Sin, /Sin, Cos, /Cos) and can be interfaced directly with available external interpolators. The AEDR-98xxE/EA in digital encoder mode offers two-channel (AB) quadrature digital outputs and a third-channel digital index output. Being TTL compatible, the outputs of the AEDR-98xxE/EA encoder can be interfaced with most signal-processing circuitries. Therefore, the encoder provides easy integration and flexible design into existing systems.

The encoder houses an infrared LED light source and photodetecting circuitry in a single package. The small size of 4.00 mm (L) × 4.00 mm (W) × 1.05 mm (H) allows it to be used in a wide range of miniature commercial applications where size and space are primary concerns.

## Key Features

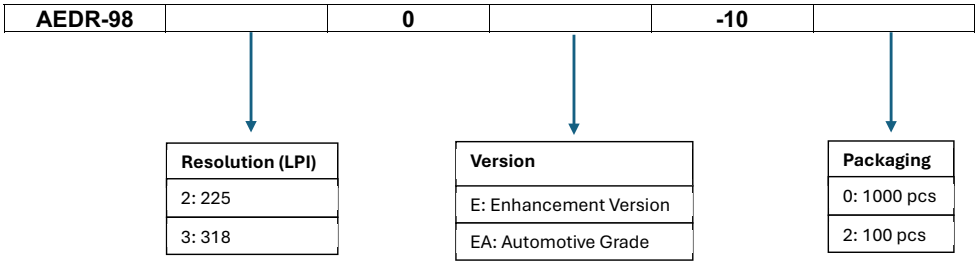
- Surface-mount leadless package: 4.0 mm (L) × 4.0 mm (W) × 1.05 mm (H)
- Operating temperature: –40°C to 115°C (AEDR-9820E/9830E)
- Operating temperature: –40°C to 125°C (AEDR-9820EA/9830EA)
- Operating voltage: 3.3V and 5.0V
- Typical LED wavelength: 853 nm
- Encoding resolution: 318 LPI (lines per inch) or 12.52 LPmm (lines per mm) (AEDR-9830E/9830EA)
- Encoding resolution: 225 LPI (lines per inch) or 8.86 LPmm (lines per mm) (AEDR-9820E/9820EA)
- Analog output option: two-channel differential analog output and differential digital or analog index output
- Digital output option: three-channel differential or TTL compatible; two-channel quadrature (AB) digital outputs for direction sensing and a third digital index channel
- Built-in interpolator for 1X, 2X, 4X, 8X, 16X, and 32X interpolation
- Built-in LED current regulation
- Enhanced compatibility to a wider range of code-wheel and code-strip material
- Operating frequency from 200 kHz up to 4 MHz (high interpolation)
- Automotive Grade 1, AEC-Q100 (AEDR-9820EA/9830EA)
- Production/QMS conformance IATF16949 (AEDR-9820EA/9830EA)



## Applications

- Closed-loop stepper and small motors
- Industrial printers
- Robotics
- Pan-tilt-zoom cameras
- Portable medical equipment
- Optometric equipment
- Actuators and linear stages

Ordering Information




Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-9820EEVB | AEDR-9820E, 225-LPI Evaluation Board with Code Wheel |
| HEDS-9820EEVBL | AEDR-9820E, 225-LPI Evaluation Board with Code Strip |
| HEDS-9830EEVB | AEDR-9830E, 318-LPI Evaluation Board with Code Wheel |
| HEDS-9830EEVBL | AEDR-9830E, 318-LPI Evaluation Board with Code Strip |

# AEDR-9830DP Series (Dust Protection)

## Description

The Broadcom AEDR-9830DP is a three-channel reflective optical encoder. It can be configured to analog or digital outputs employing reflective technology for motion control purposes. The selectable options available are two-channel differential analog with a third-channel differential digital or analog index output or three-channel digital differential A, B, and I output.

The AEDR-9830DP in analog encoder mode with two-channel differential analog outputs (Sin, /Sin, Cos, /Cos) can be interfaced directly with available external interpolators.

The AEDR-9830DP in digital encoder mode offers two-channel (AB) quadrature digital outputs and a third-channel digital index output. Being TTL compatible, the outputs of the AEDR-9830DP encoder can be interfaced with most signal-processing circuitries. Therefore, the encoder provides easy integration and flexible design into existing systems.

The AEDR-9830DP encoder is designed to operate over a –40°C to +115°C temperature range and is suitable for commercial, industrial, and automotive end applications.

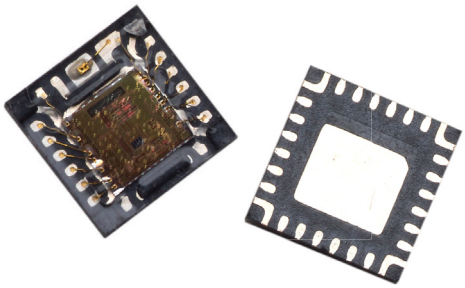
The encoder houses an infrared LED light source and photodetecting circuitry in a single package. The small size of 4.00 mm (L) × 4.00 mm (W) × 0.73 mm (H) allows it to be used in a wide range of miniature commercial applications, where size and space are primary concerns.

## Key Features

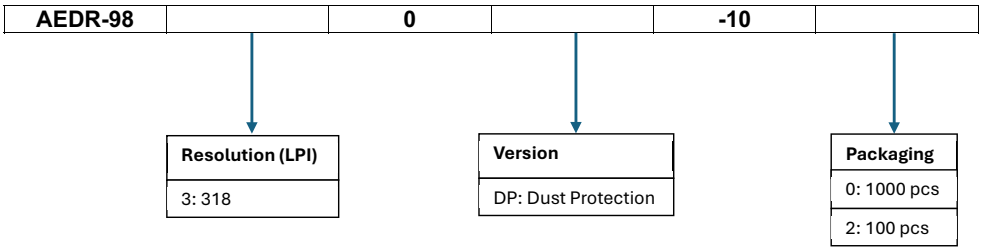
- Surface-mount leadless package: 4.0 mm (L) × 4.0 mm (W) × 0.73 mm (H)
- Analog output option: two-channel differential analog output and differential digital or analog index output.
- Digital output option: three-channel differential or TTL compatible; two-channel quadrature (AB) digital outputs for direction sensing and a third-channel index digital output.
- Built-in interpolator for 1x, 2x, 4x, 8x, and 16x interpolation.
- Operating voltage: 3.3V and 5.0V supply
- Built-in LED current regulation
- Operating temperature: –40°C to +115°C
- High encoding resolution: 318 LPI (lines per inch) or 12.52 LPmm (lines per mm)
- Translucent protection compound

## Applications

- Closed-loop stepper motors
- Small motors, actuators
- Industrial printers
- Robotics
- Card readers
- Pan-tilt-zoom (PTZ) cameras
- Portable medical equipment
- Optometric equipment
- Linear stages



Ordering Information




Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-9830DPEVB | AEDR-9830DP, 318-LPI Evaluation Board and Code Wheel |

# AEDR-9920 Series

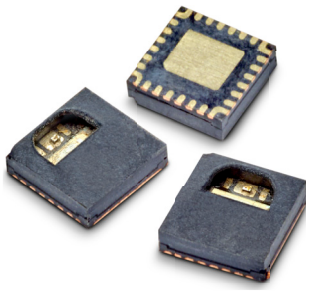
## Description

The Broadcom AEDR-9920 is a three-channel reflective optical encoder. The selectable and programmable options available are three-channel digital differential A, B, and I outputs. The AEDR-9920 digital encoder mode offers two-channel (AB) quadrature digital outputs and a third channel digital index output. Being TTL compatible, the outputs of the AEDR-9920 encoder can be interfaced with most of the signal processing circuitries. Therefore, the encoder provides easy integration and flexible design-in into existing systems.

The AEDR-9920 encoder is designed to operate over –40°C to 115°C temperature range and is suitable for commercial, industrial, and automotive end applications. The encoder houses an LED light source and a photodetecting circuitry in a single package. The small size of 4.00 mm (L) × 4.00 mm (W) × 1.05 mm (H) allows it to be used in a wide range of miniature commercial applications, where size and space are primary concerns.

## Key Features

- Surface-mount leadless package: 4.0 mm (L) × 4.0 mm (W) × 1.05 mm (H)
- Operating temperature: –40°C to 115°C
- Operating voltage: 3.3V and 5V
- Digital output option: three-channel differential or TTL compatible; two-channel quadrature (AB) digital outputs for direction sensing and a third channel, index digital output
- Built-in pin-selectable interpolator for 1x, 2x, 4x, 8x,16x, 32x, 64x, 128x, and 256x interpolation
- SPI programmable interpolator from 1x to 512x
- Built-in LED current regulation
- High encoding resolution: 225 LPI (lines/inch) or 8.86 LPmm (lines/mm)
- Typical LED wavelength: 853 nm



## Applications

- Closed-loop stepper motors
- Small motors, actuators
- Industrial printers
- Robotics
- Card readers
- Pan-tilt-zoom (PTZ) cameras
- Portable medical equipment
- Optometric equipment
- Linear stages
- LiDAR

Ordering Information

| AEDR-99 | 2 | 0-10 | |
|---|---|---|---|

| Resolution (LPI) |
|---|
| 2: 225 |

| Packaging |
|---|
| 0: 1000 pcs |
| 2: 100 pcs |

# AEDR-9930E2/E2L Series

## Description

The Broadcom AEDR-9930E2/E2L is a three-channel reflective optical encoder. The selectable and programmable options available are three-channel digital or analog differential A, B, and I outputs. The AEDR-9930E2/E2L in analog encoder modes, with three-channel differential analog outputs (Sine+, Sine-; Cos+, Cos-; I+, I-), can be interfaced directly with available external interpolators. The AEDR-9930E2/E2L digital encoder mode offers two-channel (AB) quadrature digital outputs and a third channel digital index output. Being TTL compatible, the outputs of the AEDR-9930E2/E2L encoder can be interfaced with most of the signal processing circuitries.

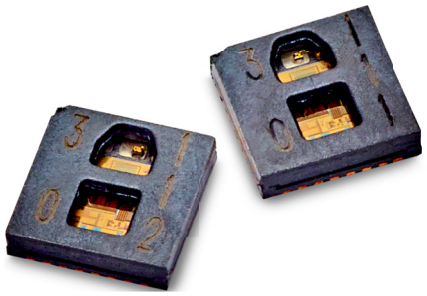
Therefore, the encoder provides easy integration and flexible design-in into existing systems. The AEDR-9930E2/E2L encoder is designed to operate over a –40°C to +115°C temperature range and is suitable for commercial, industrial, and automotive end applications. The encoder houses an LED light source and photodetecting circuitry in a single package. The small size of 5.00 mm (L) × 5.00 mm (W) × 1.05 mm (H) allows it to be used in a wide range of miniature commercial applications, where size and space are primary concerns.

## Key Features

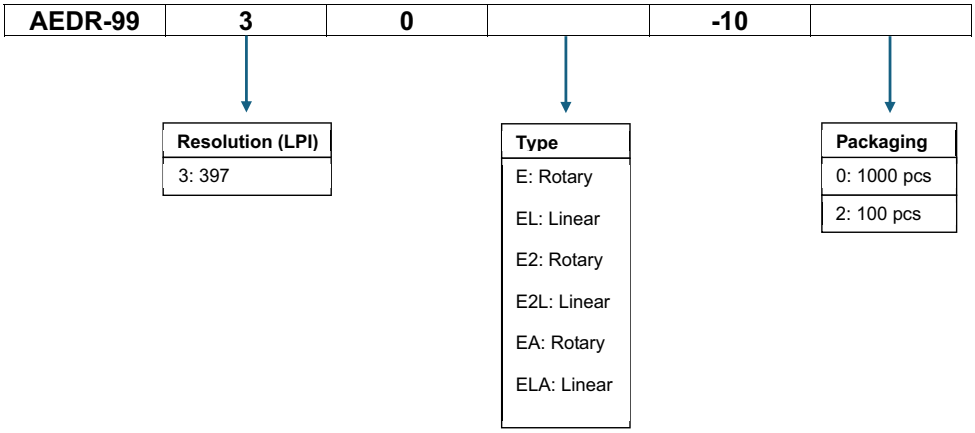
- Package size:
  5.0 mm (L) × 5.0 mm (W) × 1.05 mm (H)
- Operating temperature:
  –40°C to +115°C
- Operating voltage: 3.3V and 5V
- Typical LED wavelength: 853 nm
- Encoding resolution:
  397 LPI (lines per inch) or
  15.63 LPmm (lines per mm) or
  64 µm (pitch)
- Built-in selection interpolators:
  1x to 10x, 12x, 14x, 16x, 18x, 20x, 25x, 32x, 50x, 64x, 80x, 100x, 128x, 160x, 256x to 512x
- User pin trigger calibration
- AEDR-9930E2L – Off-scale to on-scale auto-trigger auto-calibration
- Internal auto power reset trigger with successful auto calibration process
- LED status pins for functional operation, calibration, and error

## Applications

- Closed-loop stepper motors
- Small motors, actuators
- Industrial printers
- Robotics
- Card readers
- Pan-tilt-zoom (PTZ) cameras
- Portable medical equipment
- Optometric equipment
- Linear stages



Ordering Information




Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-9930EEVB | AEDR-9930E Evaluation Board with 2 Units of Code Wheel Multiple Optical Radius 256, 512, 1024,1440 CPR Base |
| HEDS-9930E1EVB | AEDR-9930E Evaluation Board with 2 Units of Code Wheel Multiple Optical Radius 250, 625, 1000, 1440 CPR Base |
| HEDS-9930EPRGEVB | SPI Programming Kit with Evaluation Board, Including 2 units of Code Wheel Multiple Optical Radius 256, 512, 1024,1440 CPR Base |
| HEDS-9930E1PRGEVB | SPI Programming Kit with Evaluation Board, Including 2 units of Code Wheel Multiple Optical Radius 250, 625, 1000, 1440 CPR Base |
| HEDS-9930E2EVB | AEDR-9930E2 Evaluation Board with 2 Units of Code Wheel Multiple Optical Radius 256, 512, 1024, 1440 CPR Base |
| HEDS-9930E2PRGEVB | SPI Programming Kit with Evaluation Board, Including 2 Units of Code Wheel Multiple Optical Radius 256, 512, 1024, 1440 CPR Base |
| HEDS-9930E2LEVB | Linear Encoder Evaluation Board with 2 Units of Code Strip Bundling |
| HEDS-9930E2LPRGEVB | SPI Programming Kit with Linear Encoder Evaluation Board and 2 units of Code Strip Bundling |

# AEDR-9940/ER Series, AEDR-9940A/ERA Series

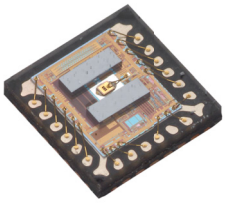
## Description

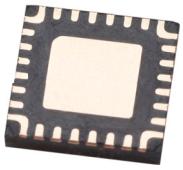
The AEDR-9940 series is a three-channel reflective optical encoder. Selectable and programmable options are available for three-channel digital or analog differential A, B, and I output. The AEDR-9940 series in analog encoder modes, with three channel differential analog outputs (Sine+, Sine-; Cos+, Cos-; I+, I-), can be interfaced directly with external interpolators available. The AEDR-9940 digital encoder mode offers two-channel (AB) quadrature digital outputs and a third channel digital index outputs.

Being TTL compatible, the outputs of the AEDR-9940 series encoder can be interfaced with most of the signal processing circuitries. Hence the encoder provides easy integration and flexible design-in into existing systems. The encoder houses an LED light source and photodetecting circuitry in a single package. The small size of 4.0 mm (L) × 4.0 mm (W) × 0.7 mm (H) allows it to be used in a wide range of miniature commercial applications where size and space are a primary concern.

## Key Features

- Package size:
  4.0 mm (L) × 4.0 mm (W) × 0.7 mm (H)
- Operating temperature:
  –40°C to +115°C
- Operating temperature:
  –40°C to +125°C (AEDR-9940A/ERA)
- Operating voltage: 3.3V and 5V
- Typical LED wavelength: 660 nm
- Encoding resolution:
  198.437 LPI (lines/inch) or
  7.812 LP mm (lines/mm) or
  128 µm (pitch)
- Built-in selection interpolators:
  1x to 6x, 8x, 9x, 10x, 12x, 16x, 20x, 25x, 32x, 50x, 64x, 80x, 100x, 128x, 160x, 256x, 320x, 640x to 1000x
- Translucent protection compound
- LED status pins for calibration, and error
- Automotive Grade 1, AEC-Q100 (AEDR-9940A/ERA)
- Production/QMS conformance IATF16949 (AEDR-9940A/ERA)

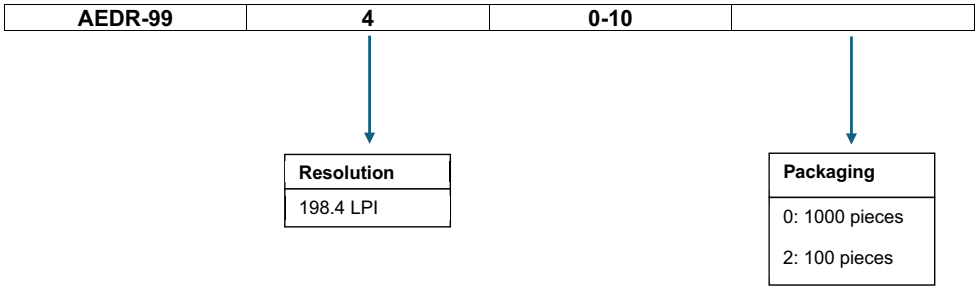




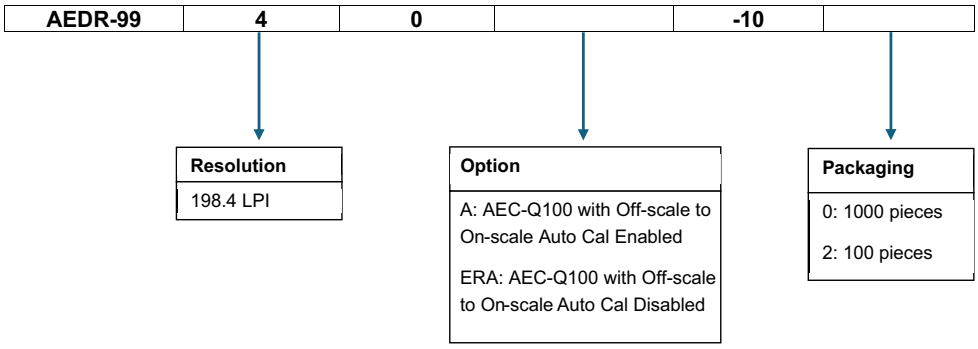
## Applications

- Closed-loop stepper motors
- Small motors, actuators
- Industrial printers
- Robotics
- Card readers
- PTZ cameras
- Portable medical equipment
- Optometric equipment
- Linear stages

Ordering Information




Automotive Version




Accessories Ordering Information

| Part Number | Description |
|---|---|
| HEDS-9940EVB | AEDR-9940 evaluation board with 2 units of code wheel, multiple optical radius 256, 400, 512, 720 CPR base |
| HEDS-9940EVB1 | AEDR-9940 evaluation board with 2 units of code wheel, multiple optical radius 200, 360, 500, 625 CPR base |
| HEDS-9940EVBL | AEDR-9940 evaluation board with 2 units of code strip, 128 µm |
| HEDS-9940PRGEVB1 | SPI programming kit with evaluation board bundling with 2 units of code wheel, multiple optical radius 200, 360, 500, 625 CPR base |
| HEDS-9940PRGEVB | SPI programming kit with evaluation board bundling, 2 units of code wheel. multiple optical radius 256, 400, 512, 720 CPR base |
| HEDS-9940PRGEVBL | SPI programming kit with evaluation board bundling, 2 units of code strip 128 µm |
| HEDS-9940EREVB | AEDR-9940ER evaluation board with 2 units of code wheel, multiple optical radius 200, 360, 500, 625 CPR base |
| HEDS-9940ER1EVB | AEDR-9940ER evaluation board with 2 units of code wheel, multiple optical radius 256, 400, 512, 720 CPR base |
| HEDS-9940ERLEVB | AEDR-9940ER evaluation board with 2 units of code strip, 128 µm |

# Code Wheels/Code Strips

## AR18-Sxx, AR25-Axxx, AR55-RxxS, AR55-L20S Series, HEDx-51/61xx Series

### Description

A wide range of code wheels are available for use with Broadcom encoders, designed to support different environments, applications, and cost targets.

For incremental encoder applications using the HEDS-90xx/91xx encoder modules, compatible code wheels are available in metal, mylar, and glass, with a selection of hub IDs.

For absolute applications, metal code wheels or linear code strips are available with the following configurations:

- AR18/AR25: Available with a hub. The hub ID can be selected based on application requirements.
- AR55: Available without a hub.

### Key Features

- Code wheel available in glass, film, and metal
- Available in two standard diameters
- Cost effective
- Full range of resolutions options possible from 400 CPR to 1024 CPR (AR25-Axxx)
- Through hollow 6 mm to 12 mm (512 CPR) (AR25-Axxx)
- Through hollow 15 mm to 30 mm (1024 CPR) (AR25-Axxx)
- Available in selected code-strip length (AR55-Lxxx)
- Full range of linear length options possible from 64 CPR (10 mm) to 65,535 CPR (8.3 meters) (AR55-Lxxx)

### Applications

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



| Part Number | Description |
|---|---|
| AR18-S01 | SS CW Rop 5.16 mm, hub 2 mm |
| AR18-S02 | SS CW Rop 5.16 mm, hub 3 mm |
| AR18-S11 | SS CW Rop 5.16 mm, hub 4 mm |
| AR25-A12T | Aluminium code wheel (512 CPR), through-hollow inner diameter (6 mm) |
| AR25-A13T | Aluminium code wheel (512 CPR), through-hollow inner diameter (8 mm) |
| AR25-A15T | Aluminium code wheel (512 CPR), through-hollow inner diameter (12 mm) |
| AR25-A18T | Aluminium code wheel (1024 CPR), through-hollow inner diameter (15 mm) |
| AR25-A20T | Aluminium code wheel (1024 CPR), through-hollow inner diameter (20 mm) |
| AR25-A30T | Aluminium code wheel (1024 CPR), through-hollow inner diameter 30 mm) |
| AR55-R30S | Code wheel 1250 CPR, ID 41 mm, metal |
| AR55-R60S | Code wheel only 1850 CPR, ID 65.4 mm, metal |
| AR55-L20S | Code strip only 1640 CPR, 200 mm, metal |

## Ordering Information: Metal Code Wheels

| HEDS-9100 | | 0 | 0 |
|---|---|---|---|

Option Modules

| 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 |

| HEDS-5120 | | | |
|---|---|---|---|

Option Code Wheels

**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 (mm) |
|---|
| 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 |

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

* Indicates available options.

## Ordering Information: Metal Code Wheels (Continued)

| HEDS-9140 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| C: 100 CPR |
| E: 200 CPR |
| F: 256 CPR |
| G: 360 CPR |
| A: 500 CPR |
| I: 512 CPR |

| HEDS-5140 | | | |
|---|---|---|---|

Option Code Wheels

**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 (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 |

| | | 01 | 02 | 03 | 04 | 05 | 06 | 08 | 09 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEDS-5140 | A | | * | | * | * | * | | | | * | * | * | * |
| | C | | | | * | | * | | | | | * | * | |
| | E | | | | | | * | | | | * | * | | * |
| | F | | | | * | | | | | | | * | | * |
| | G | | | | | | * | | | | | * | | * |
| | I | | * | | * | | * | | | | * | * | * | * |

* Indicates available options.

## Ordering Information: Metal Code Wheels (Continued)

| HEDS-9000 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| A: 500 CPR |
| B: 1000 CPR |

| HEDS-6100 | | | |
|---|---|---|---|

Option Code Wheels

| Resolution (Cycles/Rev) |
|---|
| A: 500 CPR |
| B: 1000 CPR |

| Shaft Diameter (mm) |
|---|
| 06: ¼ in. |
| 08: 3/8 in. |
| 09: 1/2 in. |
| 10: 5/8 in. |
| 11: 4 mm |
| 12: 6 mm |
| 13: 8 mm |

**ROP = 23.36 mm, 2 Channels**

**Assembly Tools**

| Centering | Gap-Setting |
|---|---|
| HEDS-8906 | HEDS-8901 |

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

* Indicates available options.

## Ordering Information: Metal Code Wheels (Continued)

| HEDS-9040 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| B: 1000 CPR |
| J: 1024 CPR |

| HEDS-6140 | | | |
|---|---|---|---|

Option Code Wheels

| Resolution (Cycles/Rev) |
|---|
| B: 1000 CPR |
| J: 1024 CPR |

| Shaft Diameter (mm) |
|---|
| 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 |

**ROP = 23.36 mm, 3 Channels**

**Assembly Tools**

| Centering | Gap-Setting |
|---|---|
| HEDS-8906 | HEDS-8906 |

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

* Indicates available options.

**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 are sometimes helpful in an assembly process.

## Ordering Information: Film Code Wheels

| HEDS-9100 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| B: 1000 CPR |
| J: 1024 CPR |

| HEDM-512 | | | | |
|---|---|---|---|---|

Option Code Wheels

| 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 |

| Shaft Diameter (mm) |
|---|
| 02: 3 mm |
| 06: 1/4 in. |
| 11: 4 mm |
| 12: 6 mm |

**ROP = 11 mm, 2 Channels**

**Assembly Tools**

| Centering | Gap-Setting |
|---|---|
| HEDS-8905 | HEDS-8901 |

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

* Indicates available options.

## Ordering Information: Film Code Wheels (Continued)

| HEDS-9000 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| T: 2000 CPR |
| U: 2048 CPR |

| HEDM-612 | | | | |
|---|---|---|---|---|

Option Code Wheels

**ROP = 23.36 mm, 2 Channels**

**Assembly Tools**

| Centering | Gap-Setting |
|---|---|
| HEDS-8906 | HEDS-8906 |

| 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 |

| Shaft Diameter (mm) |
|---|
| 06: 1/4 in. |
| 08: 3/8 in. |
| 12: 6 mm |
| 13: 8 mm |

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

* Indicates available options.

## Ordering Information: Three-Channel Encoder Modules and Code Wheels, 11.00 Optical Radius

| HEDS-9140 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| B: 1000 CPR |

| HEDM-504 | | | | |
|---|---|---|---|---|

Option Code Wheels

| 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 |

| Shaft Diameter (mm) |
|---|
| 01: 2mm |
| 02: 3 mm |
| 05: 3/16 in. |
| 11: 4 mm |
| 13: 5 mm |
| 14: 8 mm |

**Assembly Tool:**
**HEDS-8905**

## Ordering Information: Three-Channel Encoder Modules and Code Wheels, 11.00 Optical Radius (Cont.)

| HEDS-9040 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| T: 2000 CPR |

| HEDM-614 | | | | |
|---|---|---|---|---|

Option Code Wheels

| 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 |

| Shaft Diameter (mm) |
|---|
| 10: 5/8 in. |
| 12: 6 mm |

**ROP = 23.36 mm, 3 Channels**

**Assembly Tools**

| Centering | Gap-Setting |
|---|---|
| HEDS-8906 | HEDS-8906 |

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

* Indicates available options.

## Ordering Information: Glass Code Wheels

| HEDS-9100 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| B: 1000 CPR |
| J: 1024 CPR |

| HEDG-512 | | | | |
|---|---|---|---|---|

Option Code Wheels

| 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 |

| Shaft Diameter (mm) |
|---|
| 06: 1/4 in. |
| 14: 5 mm |

**ROP = 11 mm, 2 Channels**

**Assembly Tools**

| Centering | Gap-Setting |
|---|---|
| HEDS-8905 | HEDS-8932 |

| | | 01 | 02 | 03 | 04 | 05 | 06 | 08 | 09 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEDG-5121 | B | | | | | | * | | | | | * | | |
| | J | | | | | | | | | | | | | * |

* Indicates available options.

## Ordering Information: Glass Code Wheels (Continued)

| HEDS-9000 | | 0 | 0 |
|---|---|---|---|

Option Modules

| Resolution (Cycles/Rev) |
|---|
| T: 2000 CPR |
| U: 2048 CPR |

| HEDG-612 | | | |
|---|---|---|---|

Option Code Wheels

| Shaft Diameter (mm) |
|---|
| 12: 6 mm |

| Resolution (Cycles/Rev) |
|---|
| T: 2000 CPR |
| U: 2048 CPR |

**ROP = 11 mm, 2 Channels**

**Assembly Tools**

| Centering | Gap-Setting |
|---|---|
| HEDS-8906 | HEDS-8932 |

| | | 01 | 02 | 03 | 04 | 05 | 06 | 08 | 09 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEDG-6120 | B | | | | | | | | | | | * | | |

* Indicates available options.

# Integrated Circuits: Line Drivers

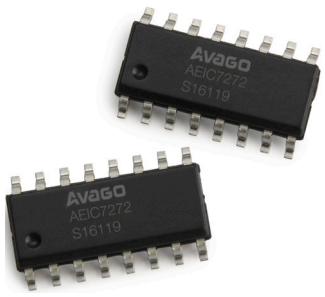
# AEIC-7272/7273/2631 Series

## Description

The devices is designed to meet industrial encoder standards, offering an SOIC line-driver package, RS-422A support, a high-temperature operating range, and operation up to 30V. It also includes current limiting and thermal shutdown for reliable use in harsh environments, making it a strong fit for encoder interfaces, sensor interfaces, PLC controllers, and servo systems.

## Key Features

- Supply voltage range:
  - 4.75V to 30V (AEIC-2631)
  - 3.5V to 30V (AEIC-7272/7273)
- CMOS and TTL compatible inputs
- Operation to 800 kHz
- Support for RS-422A
- High impedance buffered inputs with hysteresis
- Outputs short circuit protected
- Outputs protected by thermal shutdown
- Separate logic bias and driver supply pins (AEIC-7272)
- NPN open-collector outputs (AEIC-7273)
- Outputs short-circuit protected (AEIC-2631)




## Applications

- Industrial encoder interfacing
- Industrial sensor interfacing
- Proximity switches
- Industrial controllers PLC
- Light barriers
- MR sensor systems

Ordering Information

| Part Number | Description | Package |
|---|---|---|
| AEIC-7272-S16 | Quad Differential, Tristate Output | SOIC-16 in Tube |
| AEIC-7272-S16TR | Quad Differential, Tristate Output | SOIC-16 in Tape Reel |
| AEIC-7273-S16 | Quad Differential, Open Collector | SOIC-16 in Tube |
| AEIC-7273-S16TR | Quad Differential, Open Collector | SOIC-16 in Tape Reel |
| AEIC-2631-S16 | Quad Differential, No Enable, Up to 30V | SOIC-16 in Tube |
| AEIC-2631-S16TR | Quad Differential, No Enable, Up to 30V | SOIC-16 in Tape Reel |

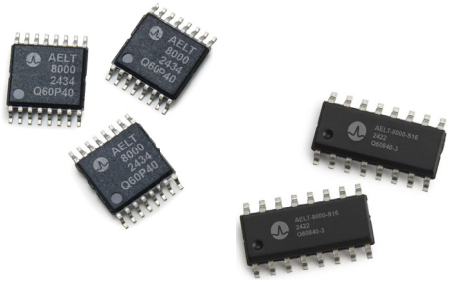
# AELT-8000 Series

## Description

The Broadcom AELT-8000 series is an industrial-power line driver featuring four identical short-circuit-proof differential line drivers, capable of handling up to 36V of driver supply with a joint enable function and operating at a maximum frequency of up to 5 MHz.The AELT-8000 is equipped with a thermal shutdown feature that provides overtemperature protection during overload conditions. Its high data rate, combined with its wide operating voltage and temperature range, makes it an ideal, versatile, and robust line driver suitable for typical industrial line driver applications. The small-outline SOIC and TSSOP packages offer excellent thermal power dissipation, making them suitable for use in space-limited applications.

## Key Features

- Operating frequency: Up to 5 MHz
- Driver supply range: 4.5V to 36V
- Pin compatible to 26xx31, xx7272
- Short-circuit-proof tristate outputs
- Low propagation delay: 80 ns (typical)
- High-impedance CMOS-compatible and TTL-compatible buffered inputs with hysteresis
- Operating temperature range: –40°C to 125°C
- Overtemperature protection circuit
- Undervoltage monitoring



## Applications

- Line driver for 5V to 36V control systems
- Rotary and linear encoder interfacing
- Industrial controls
- Sensor systems

Ordering Information

| Part Number | Description | Package |
|---|---|---|
| AELT-8000-S16 | High Voltage Quad Differential Line Driver | Tube, 48 Pieces |
| AELT-8000-S100 | High Voltage Quad Differential Line Driver | Tape and Reel, 1000 Pieces |
| AELT-8000-S102 | High Voltage Quad Differential Line Driver | Tape and Reel, 100 Pieces |
| AELT-8000-T16 | High Voltage Quad Differential Line Driver | Tube, 96 Pieces |
| AELT-8000-T100 | High Voltage Quad Differential Line Driver | Tape and Reel, 1000 Pieces |
| AELT-8000-T102 | High Voltage Quad Differential Line Driver | Tape and Reel, 100 Pieces |

Accessories Ordering Information

| Part Number | Description | Package |
|---|---|---|
| HEDS-8000SEVB | AELT-8000 (SOIC-16) Evaluation Board | 1 Piece of SOIC Evaluation Board |
| HEDS-8000TEVB | AELT-8000 (TSSOP-16) Evaluation Board | 1 Piece of TSSOP Evaluation Board |

# Integrated Circuits: Voltage Monitoring ICs

# AEIC-3700 Series

## Description

Broadcom's AEIC-3700 voltage monitor IC operates at a 2.8V to 6.5V supply voltage range. This device has two main input pads (INA/INB) that are used independently for voltage monitoring. INA and INB will take in external reference voltages in comparison with the IC internal reference signal.

This device has high-accuracy comparators, which are suitable for overvoltage and undervoltage monitoring.

## Key Features

- Supply voltage:
  2.8V to 6.5V
- Low quiescent current:
  550 µA (typical)
- Internal hysteresis:
  5 mV (typical)
- Operating temperature:
  –40°C to 125°C
- Two main inputs and outputs:
  INA/INB and OUA/OUTB
- Package:
  SOT-23-6 (3.0 mm × 1.6 mm nominal)




## Applications

- Control systems, especially for industrial automation
- FPGA applications
- ASIC applications
- Microcontroller application systems

Ordering Information

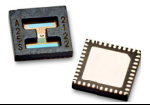
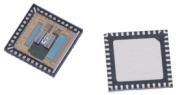
| Part Number | Description | Package |
|---|---|---|
| AEIC-3700-S01TR | Voltage monitor IC | Tape and reel, 100 pieces |
| AEIC-3700-S30TR | Voltage monitor IC | Tape and reel, 3000 pieces |

Accessories Ordering Information

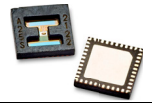
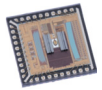
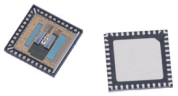
| Part Number | Description | Package |
|---|---|---|
| AEIC-3700-EVB | Evaluation set | 1 piece of nReset evaluation board<br>1 piece of 5V OV/UV evaluation board<br>1 piece of 3.3V OV/UV evaluation board<br>4 pieces of AEIC-3700 IC |

# Quick Product Selection Guide

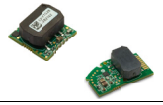
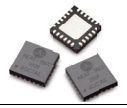
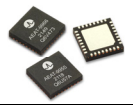
## Absolute Encoders

| Product Category | Reflective Optical Absolute Encoders | | | | Magnetic Absolute EHMT Encoders | |
|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |
| **Product Part Number** | **AR18** | **AR25** | **AR25DP** | **AR55** | **AS20-M42M** | **AS33-M42M** |
| **Fit** | | | | | | |
| **Bore/Shaft Diameter (mm)** | Up to 4 | Up to 30 | Up to 30 | Up to 2660 | 4 | 6 (M3)<br>6.5 (M4) |
| **SMT** | Yes | Yes | Yes | Yes | No | No |
| **Modular** | No | No | No | No | Yes | Yes |
| **Overall Dimensions (mm)** | 9.1×10.9×1.5<br>(W×L×H) | 6×6×1.05<br>(W×L×H) | 6×6×0.7<br>(W×L×H) | 6×6×0.7<br>(W×L×H) | 20×22.5<br>(Ø×H) | 33×20<br>(Ø×H) |
| **Lead Free** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Resolution** | | | | | | |
| **Incremental AB (CPR)** | 128 to 8192 | 1 to $2^{20}$ | 1 to $2^{20}$ | 1 to $2^{26}$ | — | — |
| **Single-Turn (Bit)** | Up to 23 | Up to 25 | Up to 25 | Up to 32 | Up to 18 | Up to 18 |
| **Linear Resolution (µm)** | — | — | — | 128 (pitch)<br>0.050 (optimum)<br>0.00023 (smallest) | — | — |
| **Multi-Turn Option** | No | Yes (Supports multi-turn counter input) | Yes (Supports multi-turn counter input) | Yes (Supports multi-turn counter input) | Yes (Up to 24 bits) | Yes (Up to 24 bits) |
| **Code Wheels / Code Strips** | | | | | | |
| **Code-Wheel Outer Diameter (mm)** | 13.6 | 20, 25, 45 | 20, 25, 45 | 53 to 2672 | — | — |
| **Part Number** | AR18-Sxx | AR25-AxxT | AR25-AxxT | AR55-RxxS, AR55-L20S | — | — |
| **Applications** | | | | | | |
| | • Robotic automation and engineering<br>• Factory automation and drones<br>• Medical and dentistry devices and equipment<br>• High-accuracy portable and handheld devices<br>• Miniature motors, servo motors, linear actuators | • Robotic automation and engineering<br>• Factory automation and drones<br>• Medical and dentistry devices and equipment<br>• High-accuracy portable and handheld devices<br>• Miniature motors, servo motors, and linear actuators<br>• Through-shaft motors, gear motors, and speed reducers | • Robotic automation and engineering<br>• Factory automation and drones<br>• Medical and dentistry devices and equipment<br>• High-accuracy portable and handheld devices<br>• Miniature motors, servo motors, and linear actuators<br>• Through-shaft motors, gear motors, and speed reducers | • Housed encoder makers<br>• Linear motor applications<br>• Robotics automation and engineering<br>• Hollow-shaft servo motors<br>• Linear actuators<br>• Factory automation<br>• Medical and laboratory equipment | • Miniature servo motors and drives<br>• Linear actuators<br>• Medical and laboratory equipment<br>• Robotics<br>• Automated guided vehicles (AGVs)<br>• Factory automation | • Small motors and linear actuators<br>• Robotics automation and engineering<br>• Drones and automated guided vehicles (AGVs)<br>• DC and AC servo motors<br>• Test and measurement equipment |

# Absolute Encoders (Continued)

| Product Category | Reflective Optical Absolute Encoders | | | | Magnetic Absolute EHMT Encoders | |
|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |
| **Product Part Number** | **AR18** | **AR25** | **AR25DP** | **AR55** | **AS20-M42M** | **AS33-M42M** |
| **Output Type** | | | | | | |
| **ABI** | Yes | Yes | Yes | Yes | No | No |
| **Sin Cosine** | Yes | Yes | Yes | Yes | No | No |
| **Differential Output** | ABI, UVW, SSI, ESL | RS-485, ESL, SSI, BiSS-C | RS-485, ESL, SSI, BiSS-C | RS-485, ESL, SSI, BiSS-C | RS-485, SSI, BiSS-C | RS-485, SSI, BiSS-C |
| **Protocol** | SSI, ESL | RS-485, ESL, SSI, BiSS-C | RS-485, ESL, SSI, BiSS-C | RS-485, ESL, SSI, BiSS-C | SSI, SPI, RS-485, BiSS-C | SSI, BiSS-C, RS-485 |
| **Maximum Baud Rate (Mb/s)** | 10 | 10 | 10 | 10 | 10 | 2 (SSI)<br>10 (BiSS-C, RS-485) |
| **Absolute Maximum Ratings** | | | | | | |
| **Storage Temperature – $T_S$ (°C)** | –40 to 115 | –40 to 125 | –40 to 125 | –40 to 125 | –40 to 115 | –40 to 115 |
| **Operating Temperature – $T_A$ (°C)** | –40 to 115 | –40 to 125 | –40 to 125 | –40 to 125 | –40 to 115 | –40 to 115 |
| **Recommended Operating Conditions** | | | | | | |
| **Temperature – T (°C)** | –40 to 115 | –40 to 125 | –40 to 125 | –40 to 125 | –40 to 115 | –40 to 115 |
| **Supply Voltage – Vcc (V)** | 4.5 to 5.5 | 4.5 to 5.5 (5V)<br>3.0 to 3.6 (3.3V) | 4.5 to 5.5 (5V)<br>3.0 to 3.6 (3.3V) | 4.5 to 5.5 (5V)<br>3.0 to 3.6 (3.3V) | 4.5 to 5.5 | 4.5 to 5.5<br>7 to 12.5 |
| **Accessories and Tools** | | | | | | |
| **Alignment/Gapping Tools and Cable Assembly** | — | — | — | — | AS20-M42-010 | AS33-M42-023<br>AS33-M42-024<br>AS33-C150 |
| **Programming Kit/Calibration Tool** | A21E-0010<br>AR35-AC25 | AR25-E01<br>AR25-AC25 | AR25-E01<br>AR25-AC25 | AR49-M49-E01 | AS20-M42M-E01 | AS33-M42-010<br>AS33-AC18 |

# Absolute Encoders (Continued)

| Product Category | Optical Absolute EHMT Encoders | | | EHMT Absolute Encoders | Magnetic Absolute Encoders | | | |
|---|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |  |
| **Product Part Number** | **AS38-H39E** | **AR49-M49M**<br>**AR49-M25S** | **QS35-SIL3** | **QP39-B154**<br>**QP39-T254** | **AEAT-9010**<br>**AEAT-9012**<br>**AEAT-9014**<br>**AEAT-9016**<br>**AEAT-9018** | **AEAT-9922**<br>**AEAT-9933** | **AEAT-9955**<br>**AEAT-9966** | **AEAT-9988M**<br>**AEAT-9988MB** |
| **Fit** | | | | | | | | |
| **Bore/Shaft Diameter (mm)** | 6, 8, 6.35 | 6 | 6 | 28 (Through Hollow ID) | 6 | Up to 20 | Up to 20 | Up to 65 |
| **SMT** | No | No | No | Yes (QP39-B154) | No | Yes | Yes | Yes |
| **Modular** | No | Yes | Yes | Yes | Yes | No | No | No |
| **Overall Dimensions (mm)** | 38×40<br>(Ø×H) | 35×17.5<br>(Ø×H) | 35×21<br>(Ø×H) | 15×15×7.9<br>(QP39-B154)<br>25×15×7.9<br>(QP39-T254) | 23×19<br>(Ø×H) | 4×4 | 5×5 | 8.2×5 |
| **Lead Free** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Resolution** | | | | | | | | |
| **Incremental AB (CPR)** | — | — | — | — | — | Yes<br>1 to 10000<br>(AEAT-9922)<br>1 to 1024 (AEAT-9933) | Yes<br>1 to 20,000 | Yes<br>1 to 65,536 |
| **Single-Turn (Bit)** | Up to 23 | Up to 25 | Up to 25 | — | 10 to 18 | 10 to 18 (AEAT-9922)<br>10 to 14 (AEAT-9933) | 10 to 18 | 16 to 23 |
| **Linear Resolution (µm)** | — | — | — | — | — | — | — | — |
| **Multi-Turn Option** | Yes (Up to 16 bits) | Yes (Up to 24 bits) | Yes (Up to 24 bits) | 39 bits | — | — | — | 10 to 16 bits |
| **Code Wheels / Code Strips** | | | | | | | | |
| **Code-Wheel Outer Diameter (mm)** | — | — | — | — | — | — | — | — |
| **Part Number** | — | — | — | — | — | — | — | — |

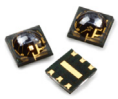
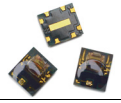
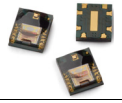
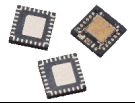
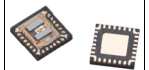
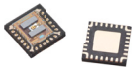
# Absolute Encoders (Continued)

| Product Category | Optical Absolute EHMT Encoders | | | EHMT Absolute Encoders | Magnetic Absolute Encoders | | | |
|---|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |  |
| **Product Part Number** | **AS38-H39E** | **AR49-M49M**<br>**AR49-M25S** | **QS35-SIL3** | **QP39-B154**<br>**QP39-T254** | **AEAT-9010**<br>**AEAT-9012**<br>**AEAT-9014**<br>**AEAT-9016**<br>**AEAT-9018** | **AEAT-9922**<br>**AEAT-9933** | **AEAT-9955**<br>**AEAT-9966** | **AEAT-9988M**<br>**AEAT-9988MB** |
| **Applications** | | | | | | | | |
| | • Robotics<br>• Factory automation<br>• Linear positioning systems<br>• CNC machine tools<br>• Medical and lab equipment | • AC/DC servo motor feedback<br>• SCARA or multi-axis robots<br>• Medical and laboratory equipment<br>• Robotics<br>• CNC machine tools<br>• Factory automation | • Servo motors<br>• SCARA or multi-axis robots<br>• Factory automation<br>• Linear positioning systems<br>• CNC machine tools<br>• Medical and laboratory equipment | • Robotics<br>• Machine tools<br>• Semiconductor machinery<br>• Factory and industrial automation | • Flow meters<br>• Angular detection<br>• Knob controls<br>• Rotary encoders | • Brushless DC motors and stepper motors<br>• Resolver and potentiometer replacement<br>• Industrial automation and robotics<br>• Industrial sewing machines and textile equipment | • Brushless DC motors and stepper motors<br>• Resolver and potentiometer replacement<br>• Industrial automation and robotics<br>• Industrial sewing machines and textile equipment<br>• Light detection and ranging (LiDAR) | • Industrial automation<br>• Hollow-shaft servo motors<br>• SCARA or multi-axis robots |
| **Output Type** | | | | | | | | |
| **ABI** | No | No | No | No | No | Yes | Yes | Yes |
| **Sin Cosine** | No | No | No | No | No | No | No | No |
| **Differential Output** | RS-485, SSI, BiSS-C | RS-485, SSI, BiSS-C | ESL-Safety | — | — | — | — | RS-485, SSI, BiSS-C, UVW |
| **Protocol** | BiSS-C, SSI, RS-485 | SPI, SSI, BiSS-C, RS485 | ESL-Safety | SPI | SSI | SSI, SPI, PWM | SSI, SPI, PWM | RS-485, SSI, BiSS-C, SPI |
| **Maximum Baud Rate (Mb/s)** | 1 (SSI)<br>2.5 (RS-485)<br>10 (BiSS-C) | | 10 | 10 | 10 | 4 (SSI)<br>10 (SPI) | 4 (SSI)<br>10 (SPI) | 10 |
| **Absolute Maximum Ratings** | | | | | | | | |
| **Storage Temperature – $T_S$ (°C)** | –20 to 105 | –40 to 125 | –20 to 105 | –40 to 115 | –40 to 125 | –40 to 125 | –40 to 125 | –40 to 125 |
| **Operating Temperature – $T_A$ (°C)** | –20 to 105 | –40 to 115 | –20 to 105 | –40 to 115 | –40 to 125 | –40 to 125 | –40 to 125 | –40 to 125 |
| **Recommended Operating Conditions** | | | | | | | | |
| **Temperature – T (°C)** | –20 to 105 | –40 to 115 | –20 to 105 | –40 to 115 | –40 to 125 | –40 to 125 | –40 to 125 | –40 to 125 |
| **Supply Voltage – Vcc (V)** | 4.5 to 5.5 | 4.5 to 5.5 | 4.5 to 5.5 | 4.5 to 5.5 | 4.5 to 5.5 | 4.5 to 5.5 (5V)<br>3.0 to 3.6 (3.3V) | 4.5 to 5.5 (5V)<br>3.0 to 3.6 (3.3V) | 4.5 to 5.5 |

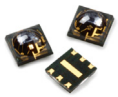
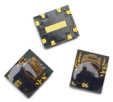
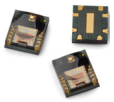
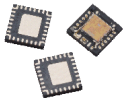
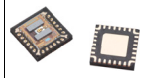
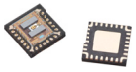
## Absolute Encoders (Continued)

| Product Category | Optical Absolute EHMT Encoders | | | EHMT Absolute Encoders | Magnetic Absolute Encoders | | | |
|---|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |  |
| **Product Part Number** | **AS38-H39E** | **AR49-M49M**<br>**AR49-M25S** | **QS35-SIL3** | **QP39-B154**<br>**QP39-T254** | **AEAT-9010**<br>**AEAT-9012**<br>**AEAT-9014**<br>**AEAT-9016**<br>**AEAT-9018** | **AEAT-9922**<br>**AEAT-9933** | **AEAT-9955**<br>**AEAT-9966** | **AEAT-9988M**<br>**AEAT-9988MB** |
| **Accessories and Tools** | | | | | | | | |
| **Alignment/Gapping Tools and Cable Assembly** | — | AS20-C300 | — | — | HEDS-8934 | — | — | — |
| **Programming Kit/Calibration Tool** | — | AR49-M49-E01<br>AR25-AC25 | AR25-AC25 | — | — | HEDS-9922PRGEVB<br>HEDS-9933PRGEVB | HEDS-9955PRGEVB | HEDS-9988PRGEVB |

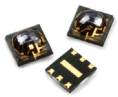
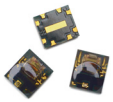
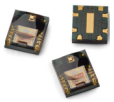
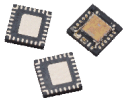
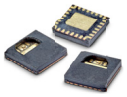
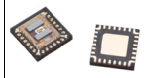
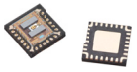
# Optical Incremental Encoder ICs

| Product Category | Reflective Optical Incremental Encoders | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Picture |  |  |  |  |  |  |  |  |  |  |  |  |
| Product Part Number | AEDR-83xx | AEDR-8400 | AEDR-8500 | AEDR-87xx | AEDR-9820<br>AEDR-9830<br>AEDR-9820E<br>AEDR-9830E | AEDR-9820A<br>AEDR-9830A | AEDR-9830DP | AEDR-9920 | AEDR-9930E2<br>AEDR-9930E2L | AEDR-9930EA | AEDR-9940<br>AEDR-9940ER | AEDR-9940A<br>AEDR-9940ERA |
| **Fit** | | | | | | | | | | | | |
| Bore/Shaft Diameter (mm) | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear | Variable diameter | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear |
| SMT | S0-6 | S0-6 | QFN-8 | QFN-8 | QFN-24 | QFN-24 | QFN-24 | QFN-24 | QFN-32 | QFN-32 | QFN-24 | QFN-24 |
| Modular | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Overall Dimensions (mm) | 4×5.1×1.6 (W×L×H) | 3×3.28×1.26 (W×L×H) | 3.4×3.95×0.95 62 (W×L×H) | 3.4×3.95×0.95 62 (W×L×H) | 4×4×1.05 (W×L×H) | 4×4×1.05 (W×L×H) | 4×4×0.73 (W×L×H) | 4×4×1.05 (W×L×H) | 5×5×1.05 (W×L×H) | 5×5×1.05 (W×L×H) | 4×4×0.7 (W×L×H) | 4×4×0.7 (W×L×H) |
| Lead Free | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Resolution** | | | | | | | | | | | | |
| Ranges (CPR) | — | — | — | — | — | — | — | — | — | — | — | — |
| Currently Available Option (CPR) | — | — | — | — | — | — | — | — | — | — | — | — |
| (Lines per Inch) | 36, 75, 150, 180 | 254, 318 | 304 | 318 | 225, 318 | 225, 318 | 318 | 225 | 397 | 397 | 198.4 | 198.4 |
| **Code Wheels / Code Strips** | | | | | | | | | | | | |
| Optical Radius – Rop (mm) | 11 | 11 | — | — | — | — | — | — | — | — | — | — |
| Part Number | HEDR-5120 | — | — | — | HEDS-9830EEVB<br>HEDS-9830EEVBL<br>HEDS-9820EEVB | HEDS-9830EVB<br>HEDS-9830EVB | AEDR-9830DPEVB | HEDS-9920EVB | HEDS-9930E2EVB<br>HEDS-9930E2LEVB | HEDS-9930EEVB | HEDS-9940EVB<br>HEDS-9940EVB1<br>HEDS-9940EVBL<br>HEDS-9940EREVB<br>HEDS-9940ER1EVB<br>HEDS-9940ERLEVB | HEDS-9940EVB<br>HEDS-9940EVB1<br>HEDS-9940EVBL<br>HEDS-9940EREVB<br>HEDS-9940ER1EVB<br>HEDS-9940ERLEVB |

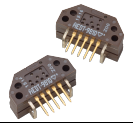
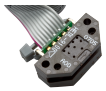
# Optical Incremental Encoder ICs (Continued)

| Product Category | Reflective Optical Incremental Encoders | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |  |  |  |  |  |
| **Product Part Number** | **AEDR-83xx** | **AEDR-8400** | **AEDR-8500** | **AEDR-87xx** | **AEDR-9820<br>AEDR-9830<br>AEDR-9820E<br>AEDR-9830E** | **AEDR-9820A<br>AEDR-9830A** | **AEDR-9830DP** | **AEDR-9920** | **AEDR-9930E2<br>AEDR-9930E2L** | **AEDR-9930EA** | **AEDR-9940<br>AEDR-9940ER** | **AEDR-9940A<br>AEDR-9940ERA** |
| **Applications** | | | | | | | | | | | | |
| | • Printers<br>• Copiers<br>• Card readers<br>• Scanners<br>• Cameras<br>• Motor solutions<br>• Medical equipment<br>• Wafer handling machines<br>• Vending machines<br>• Low servo systems<br>• ATM machines<br>• Textile machines<br>• Industrial sewing machines<br>• Consumer product applications | • Printers<br>• Copiers<br>• Card readers<br>• Scanners<br>• Digital still cameras<br>• Camcorders<br>• Camera phones<br>• Projectors<br>• Consumer product applications | • Close loop stepper motors<br>• Miniature motors<br>• Printers<br>• Copiers<br>• Card readers<br>• Scanners<br>• Projectors<br>• Consumer and industrial product applications | • Miniature motors/ actuators (linear rotary)<br>• Miniature camera modules and systems<br>• Medical and laboratory diagnostic systems<br>• Robotic and semiconductor machines<br>• Portable measurement devices<br>• Consumer, commercial, and industrial applications where small encoders size matters | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages<br>• LiDAR | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages<br>• LiDAR | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages<br>• LiDAR | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages<br>• LiDAR | • Closed-loop stepper motors<br>• Small motors, actuators<br>• Industrial printers<br>• Robotics<br>• Card readers<br>• Pan-tilt-zoom cameras<br>• Portable medical equipment<br>• Optometric equipment<br>• Linear stages<br>• LiDAR |
| **Output Type** | | | | | | | | | | | | |
| **ABI** | AB | AB | ABI | ABI | ABI | ABI | ABI | ABI | ABI | ABI | ABI | ABI |
| **Sin Cosine** | No | No | No | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |
| **Differential Output** | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Absolute Maximum Ratings** | | | | | | | | | | | | |
| **Storage Temperature – $T_S$ (°C)** | –40 to 85 | –40 to 85 | –20 to 85 | –20 to 85 | –40 to 125 | –40 to 150 | –40 to 125 | –40 to 125 | –40 to 125 | –40 to 150 | –40 to 125 | –40 to 125 |
| **Operating Temperature – $T_A$ (°C)** | –20 to 85 | –20 to 85 | –20 to 85 | –20 to 85 | –40 to 115 | –40 to 125 | –40 to 115 | –40 to 115 | –40 to 115 | –40 to 125 | –40 to 115 | –40 to 125 |
| **Supply Voltage – Vcc (V)** | –0.5 to 7 | –0.5 to 7 | 4.5 to 5.5 | –0.5 to 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 5.5 |

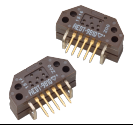
# Optical Incremental Encoder ICs (Continued)

| Product Category | Reflective Optical Incremental Encoders | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |  |  |  |  |  |
| **Product Part Number** | **AEDR-83xx** | **AEDR-8400** | **AEDR-8500** | **AEDR-87xx** | **AEDR-9820<br>AEDR-9830<br>AEDR-9820E<br>AEDR-9830E** | **AEDR-9820A<br>AEDR-9830A** | **AEDR-9830DP** | **AEDR-9920** | **AEDR-9930E2<br>AEDR-9930E2L** | **AEDR-9930EA** | **AEDR-9940<br>AEDR-9940ER** | **AEDR-9940A<br>AEDR-9940ERA** |
| **Recommended Operating Conditions** | | | | | | | | | | | | |
| **Temperature – T (°C)** | 0 to 80 | –20 to 80 | –20 to 85 | –20 to 85 | –40 to 115 | –40 to 125 | –40 to 115 | –40 to 115 | –40 to 115 | –40 to 125 | –40 to 115 | –40 to 125 |
| **Supply Voltage – Vcc (V)** | 5.0 | 2.8 | 5.0 | 3.3 / 5.0 | 3.3 / 5.0 | 3.3 / 5.0 | 3.3 / 5.0 | 5.5 | 3.3 / 5.0 | 3.3 / 5.0 | 3.3 / 5.0 | 3.3 / 5.0 |
| **Accessories and Tools** | | | | | | | | | | | | |
| **Alignment/Gapping Tools** | — | — | — | — | — | — | — | — | — | — | — | — |
| **Programming Kit** | — | — | — | — | — | — | — | HEDS-9920PGREVB | HEDS-9930E2PRGEVB<br>HEDS-9930E2LPRGEVB | HEDS-9930EPRGEVB | HEDS-9940PRGEVB<br>HEDS-9940PRGEVB1<br>HEDS-9940PRGEVBL | HEDS-9940PRGEVB<br>HEDS-9940PRGEVB1<br>HEDS-9940PRGEVBL |

# Optical Incremental Encoder ICs (Continued)

| Product Category | Transmissive Optical Incremental Encoders | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |  |
| **Product Part Number** | **HEDS-90xx**<br>**HEDS-91xx**<br>**HEDS-92xx** | **HEDS-9202** | **HEDT-90xx**<br>**HEDT-91xx** | **HEDT-904x**<br>**HEDT-914x** | **AEDT-981x** | **HEDL-90xx**<br>**HEDL-91xx** | **HEDS-97xx**<br>**HEDS-973x**<br>**HEDS-974x**<br>**HEDS-978x** | **HEDS-971x** |
| **Fit** | | | | | | | | |
| **Bore/Shaft Diameter (mm)** | Up to 8 | Up to 8 | Up to 8 | Up to 8 | Variable diameter / Linear | Up to 8 | Refer to factory | Refer to factory |
| **SMT** | — | — | — | — | — | — | — | — |
| **Modular** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Overall Dimensions (mm)** | 26.7×20.8×10.2 (W×L×H) | 26.7×20.8×10.2 (W×L×H) | 26.7×20.8×10.2 (W×L×H) | 26.7×20.8×10.2 (W×L×H) | 26.7×20.8×10.2 (W×L×H) | 26.7×20.8×10.2 (W×L×H) | 20.2×12.6×10.8 (W×L×H) | 20.2×12.6×10.8 (W×L×H) |
| **Lead Free** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Resolution** | | | | | | | | |
| **Ranges (CPR)** | Up to 2048 | — | Up to 1024 | Up to 2048 | Up to 5000 | Up to 2048 | 96 to 2048 | — |
| **Currently Available Option (CPR)** | — | — | 100, 200, 360, 400, 500, 1000, 1024 | 512 | 500, 512, 625, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000 | 500, 512, 1000, 2048 | 96, 100, 192, 200, 256, 360, 400, 500, 1000, 1024, 2000, 2048 | — |
| **(Lines per Inch)** | 18 to 360 | 200 | 36 to 360 | 36 to 360 | 180 to 230 | 346 | 120, 127, 150, 180, 300, 360 | 200, 360 |
| **Code Wheels / Code Strips** | | | | | | | | |
| **Optical Radius – Rop (mm)** | 11, 23.36 | — | 11, 23.36 | 11, 23.36 | 11 | 11, 23.36 | — | — |
| **Part Number** | HEDS-51xx/61xx<br>HEDG-51xx/61xx<br>HEDM-51xx/61xx | Refer to factory | HEDS-5120/6100<br>HEDG-5120/6100 | HEDS-5140/5145<br>HEDS-6140/6145 | — | HEDS-51xx/61xx<br>HEDG-51xx/61xx<br>HEDM-51xx/61xx | Refer to factory | Refer to factory |
| **Applications** | | | | | | | | |
| | • Printers<br>• Plotters<br>• Tape drives<br>• Factory automation | • Printers<br>• Plotters<br>• Tape drives<br>• Factory automation | • Printers<br>• Plotters<br>• Tape drives<br>• Factory automation | • Printers<br>• Plotters<br>• Tape drives<br>• Factory automation | • DC servo motors<br>• Linear and rotary actuators<br>• Factory automation equipment<br>• 3D printers<br>• Robotics<br>• Unmanned aerial vehicles (UAVs) or drones | • Printers<br>• Plotters<br>• Tape drives<br>• Factory automation | • Printers<br>• Plotters<br>• Copiers<br>• Factory automation | • Printers<br>• Plotters<br>• Copiers<br>• Factory automation |

# Optical Incremental Encoder ICs (Continued)

| Product Category | Transmissive Optical Incremental Encoders | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |  |
| **Product Part Number** | **HEDS-90xx<br>HEDS-91xx<br>HEDS-92xx** | **HEDS-9202** | **HEDT-90xx<br>HEDT-91xx** | **HEDT-904x<br>HEDT-914x** | **AEDT-981x** | **HEDL-90xx<br>HEDL-91xx** | **HEDS-97xx<br>HEDS-973x<br>HEDS-974x<br>HEDS-978x** | **HEDS-971x** |
| **Output Type** | | | | | | | | |
| **ABI** | AB | AB | AB | ABI | ABI | ABI | AB | AB |
| **Sin Cosine** | No | No | No | No | No | No | No | No |
| **Differential Output** | No | No | No | No | No | Yes | No | No |
| **Absolute Maximum Ratings** | | | | | | | | |
| **Storage Temperature – $T_S$ (°C)** | –40 to 100 | –40 to 100 | –40 to 125 | –40 to 140 | –40 to 125 | –40 to 70 or 100 | –40 to 70 or 85 | –40 to 85 |
| **Operating Temperature – $T_A$ (°C)** | –40 to 100 | –10 to 100 | –40 to 125 | –40 to 140 | –40 to 115 | 0 to 70 or 100 | –40 to 70 or 85 | 0 to 85 |
| **Supply Voltage – Vcc (V)** | –0.5 to 7 | –0.5 to 7 | –0.5 to 7 | –0.5 to 7 | –0.5 to 7 | –0.5 to 7 | –0.5 to 7 | –0.5 to 7 |
| **Recommended Operating Conditions** | | | | | | | | |
| **Temperature – T (°C)** | –40 to 100 | 25 | –40 to 125 | –40 to 140 | –40 to 115 | 0 to 70 or 100 | 25 | 15 to 45 |
| **Supply Voltage – Vcc (V)** | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| **Accessories and Tools** | | | | | | | | |
| **Alignment/Gapping Tools** | HEDS-8905<br>HEDS-8906 | — | HEDS-8905<br>HEDS-8906 | HEDS-8905<br>HEDS-8906 | — | — | — | — |
| **Programming Kit** | — | — | — | — | — | — | — | — |

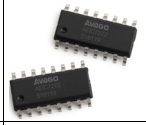
# Incremental Encoder Kits

| Product Category | Transmissive Optical Incremental Encoders | Reflective Optical Incremental Encoders | Rotary Pulse Generators | Magnetic Optical Incremental Encoders | Reflective Optical Incremental Encoders | Transmissive Optical Incremental Encoders | |
|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |
| **Product Part Number** | **AEDL-58xx<br>HEDL-55xx<br>HEDM-55xx<br>HEDS-55xx<br>HEDL-56xx<br>HEDM-56xx<br>HEDS-56xx** | **HEDR-54xx** | **HRPG-Axxx** | **AEAT-901B** | **AS22-M5xx** | **AEDC-55/56xx<br>HEDC-55/56xx** | **AEDM-5xxx** |
| **Fit** | | | | | | | |
| **Bore/Shaft Diameter (mm)** | Up to 8 | 2, 3, 4, 5, & 1/8 inch | 0.25 inch / 6 mm | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear | Variable diameter / Linear |
| **SMT** | No | No | No | No | No | No | No |
| **Modular** | No | No | No | No | No | No | No |
| **Overall Dimensions (mm)** | 41.7×52.1×18.3<br>(W×L×H) | 23×17.9<br>(Ø×H) | 21×17.5<br>(W×H) | 23×19<br>(W×H) | 22×10.9<br>(Ø×H) | 31.05×51.76×16.59<br>(W×L×H) | 30×41.1×18.3<br>(W×L×H) |
| **Lead Free** | — | — | — | — | — | — | — |
| **Resolution** | | | | | | | |
| **Ranges (CPR)** | Up to 1024 | 200 | Up to 120 | 256 to 10000 | 360 to 2048 | Up to 5000 | Up to 5000 |
| **(Line per Inch)** | — | — | — | — | — | — | — |
| **Currently Available Option (CPR)** | 50, 96, 100, 192, 200, 256, 360, 400, 500, 512, 1000, 1024 | 200 | 16, 32, 120 | 256, 512, 1024, 2048, 4096, 200, 360, 400, 500, 800, 1000, 2000, 2500, 5000, 10000 | 360, 400, 500, 512, 1000, 1024, 2000, 2048 | 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000 | 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000 |
| **(Line per Inch)** | — | — | — | — | — | — | — |
| **Code Wheels / Code Strips** | | | | | | | |
| **Optical Radius (mm) – Rop** | — | — | — | — | — | — | — |
| **Part Number** | — | — | — | — | — | — | — |

# Incremental Encoder Kits (Continued)

| Product Category | Transmissive Optical Incremental Encoders | Reflective Optical Incremental Encoders | Rotary Pulse Generators | Magnetic Optical Incremental Encoders | Reflective Optical Incremental Encoders | Transmissive Optical Incremental Encoders | |
|---|---|---|---|---|---|---|---|
| **Picture** |  |  |  |  |  |  |  |
| **Product Part Number** | **AEDL-58xx<br>HEDL-55xx<br>HEDM-55xx<br>HEDS-55xx<br>HEDL-56xx<br>HEDM-56xx<br>HEDS-56xx** | **HEDR-54xx** | **HRPG-Axxx** | **AEAT-901B** | **AS22-M5xx** | **AEDC-55/56xx<br>HEDC-55/56xx** | **AEDM-5xxx** |
| **Applications** | | | | | | | |
| | • Printers<br>• Plotters<br>• Tape drives<br>• Factory automation | • Vending machines<br>• Motor manufacturing applications<br>• Wafer handling machines | • Front-panel instruments<br>• Audio/visual boards<br>• Other devices requiring digital output from a turning knob | • Speed detection<br>• Knob controls<br>• Rotary encoders | • Industrial automation and robotics<br>• Industrial sewing and textile machinery<br>• Stepper/servo motors<br>• Factory automation | • Printers<br>• Plotters<br>• Tape drives<br>• Textile machines<br>• Positioning tables<br>• Automatic handlers | • DC servo motors<br>• Linear and rotary actuators<br>• 3D printers<br>• Factory automation equipment<br>• Robotics<br>• Unmanned aerial vehicles (UAVs) or drones |
| **Output Type** | | | | | | | |
| **ABI** | ABI | AB | AB | ABI | ABI | ABI | ABI |
| **Sin Cosine** | No | No | No | No | No | No | No |
| **Differential Output** | Yes (HEDL 5xxxx) | No | No | No | Yes | Yes | Yes |
| **Protocol** | — | — | — | — | — | — | — |
| **Absolute Maximum Ratings** | | | | | | | |
| **Storage Temperature – $T_S$ (°C)** | –40 to 70 or 100 | –40 to 85 | –40 to 85 | –40 to 125 | –40 to 100 | –40 to 85 | –40 to 85 |
| **Operating Temperature – $T_A$ (°C)** | –40 to 70 or 100 | –10 to 85 | 0 to 70 | –40 to 125 | –20 to 100 | –40 to 85 | –40 to 85 |
| **Supply Voltage – Vcc (V)** | –0.5 to 7 | –0.5 to 7 | –0.5 to 7 | –0.3 to 6 | –0.5 to 7 | –0.5 to 7 | –05 to 7 |
| **Recommended Operating Conditions** | | | | | | | |
| **Temperature – T (°C)** | –40 to 70 or 100 | –10 to 85 | 0 to 70 | –40 to 125 | –20 to 100 | –40 to 85 | –40 to 85 |
| **Supply Voltage – Vcc (V)** | 5.0 | 5.0 | 4.5 to 5.5 | 5.5 | 5.5 | 5 | 5.5 |
| **Accessories and Tools** | | | | | | | |
| **Alignment/Gapping Tools** | HEDS-8910 | HEDR-5900 | — | HEDS-8934 | — | — | HEDS-8902<br>HEDS-8903 |
| **Programming Kit** | — | — | — | — | — | — | — |

# Integrated Circuits and Voltage Monitors

| Product Category | Integrated Circuits | Voltage Monitors |
|---|---|---|
| **Picture** |  |  |
| **Product Part Number** | **AEIC-2631**<br>**AEIC-7272**<br>**AEIC-7273**<br>**AELT-8000** | **AEIC-3700** |
| **Package Type** | 16-pin SOIC | SOT-23-6 |
| **Applications** | | |
| | • Industrial encoder interfacing<br>• Industrial sensor interfacing<br>• Proximity switches<br>• Industrial controller PLC<br>• Light barriers<br>• MR sensor systems | • Control systems, especially for industrial automation<br>• FPGA applications<br>• ASIC applications<br>• Microcontroller application systems |
| **Absolute Maximum Ratings** | | |
| **Storage Temperature – $T_S$ (°C)** | –55 to 125 (AEIC-2631)<br>–55 to 125 (AEIC-7272/7273)<br>–40 to 150 (AELT-8000) | –40 to 150 |
| **Operating Temperature – $T_A$ (°C)** | –40 to 125 (AEIC-2631)<br>–55 to 125 (AEIC-7272/7273)<br>–40 to 150 (AELT-8000) | –40 to 125 |
| **Supply Voltage – $V_{DD}$ (V)** | 4.75 to 30 (AEIC-2631)<br>3.5 to 30 (AEIC-7272/7273)<br>40 (AELT-8000) | 2.8 to 7 |
| **Recommended Operating Conditions** | | |
| **Temperature – T (°C)** | –55 to 125 (AEIC-2631)<br>–55 to 125 (AEIC-7272/7273)<br>–40 to 150 (AELT-8000) | –40 to 125 |
| **Supply Voltage – $V_{DD}$ (V)** | 4.75 to 30 (AEIC-2631)<br>3.5 to 30 (AEIC-7272/7273)<br>40 (AELT-8000) | 2.8 to 7 |
| **Supply Current $I_{DD}$ (µA)** | — | 550 |

# Encoder Fundamentals and Key Definitions

## Definition of Key Terms

| Product Technology | Description |
|---|---|
| Absolute Encoder | A type of encoder that generates a unique code for each position, unlike an incremental encoder, which only generates 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 via an integrated gear, in which the code representation for each revolution is unique. Combined with the 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 operations, upon power-up. |
| Batteryless | Batteryless technology without using external power, eliminating batteries and wear and providing robust, self-powered position sensing for motors and industrial automation. |
| Code Wheel and Code Strip | Code wheels and code strips are patterned discs or strips that translate a mechanical position into a representative electrical signal when used with an optical encoder. A code wheel is used for rotary motion, whereas a code strip is used for side-to-side motion.<br>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. |
| EHMT | Energy-harvesting multi-turn. Multi-turn counter based on energy-harvesting technology. |
| Housed Encoder | An enclosed encoder with a 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 incremental only 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 for designers who need to measure linear movement in high resolution. |
| Magnetic Encoder | Contactless magnetic sensing absolute rotary encoders suitable for dusty and high-temperature environments. |
| 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 code wheel/code strip. |
| Rotary Encoder | Also known as a shaft encoder. A type of incremental encoder that converts the angular position of a shaft or axle into a digital code. Rotary encoders can also be used to measure linear motion, with the use of a ballscrew system, to translate linear motion into rotary motion. |
| Transmissive Encoder | Consists of an emitter and detector, each positioned at opposite sides of the code wheel/code strip. |

# Detector Sets

**Single Detector**

- A single detector looks at only the window or bar.
- Defects at individual windows or bars cause errors.

**Multiple Photodetectors**

- Multiple photodetectors look at many windows or bars.
- They minimize errors due to defects at individual windows or bars.
- They increase the detected signal strength.

Broadcom encoders employ multiple detector sets. Each set consists of differential outputs with push/pull circuitry. See Diagram 2. The differential signaling operation is explained in the next section.

Diagram 1: Single and Multiple Detector Elements

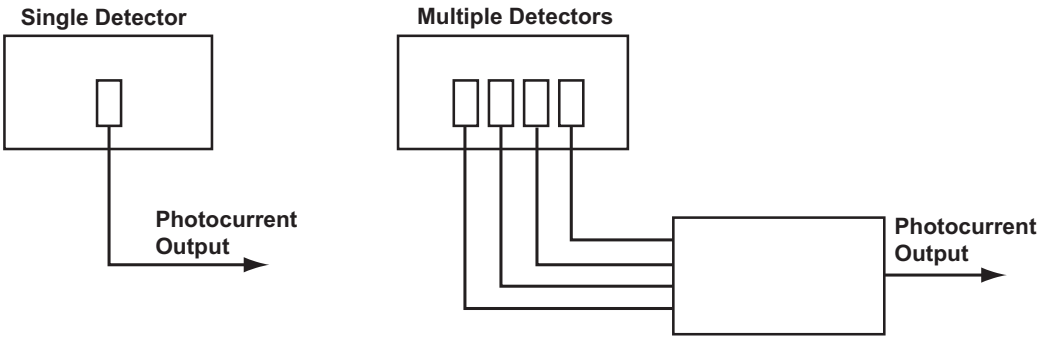
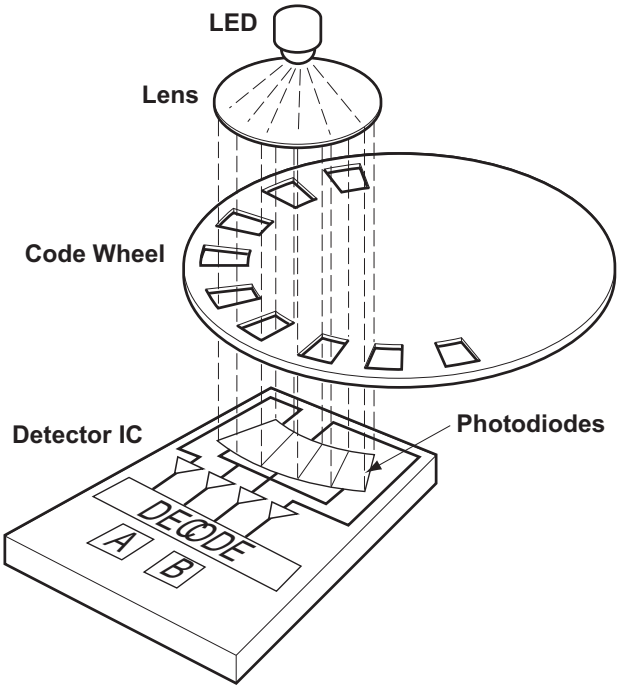



Diagram 2: Multiple Detector Elements

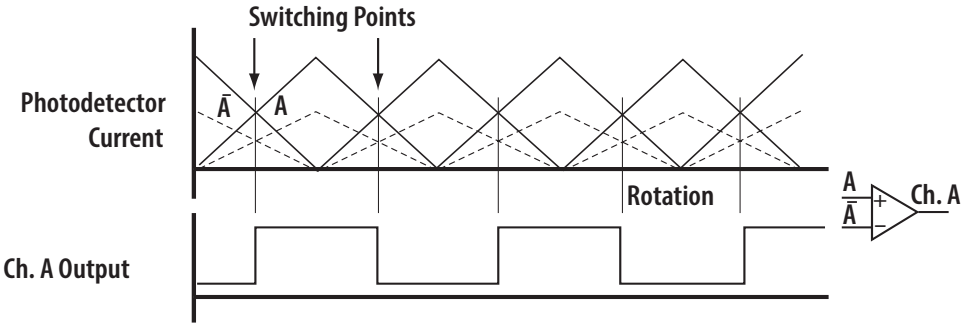


# Differential Signaling

Why use differential signaling?

- Differential signaling is insensitive to variations in light.
- Hysteresis in comparators prevents oscillation.
- Switching points remain the same, independent of the level of light.
- Differential signaling negates the effect of variations in the light level.

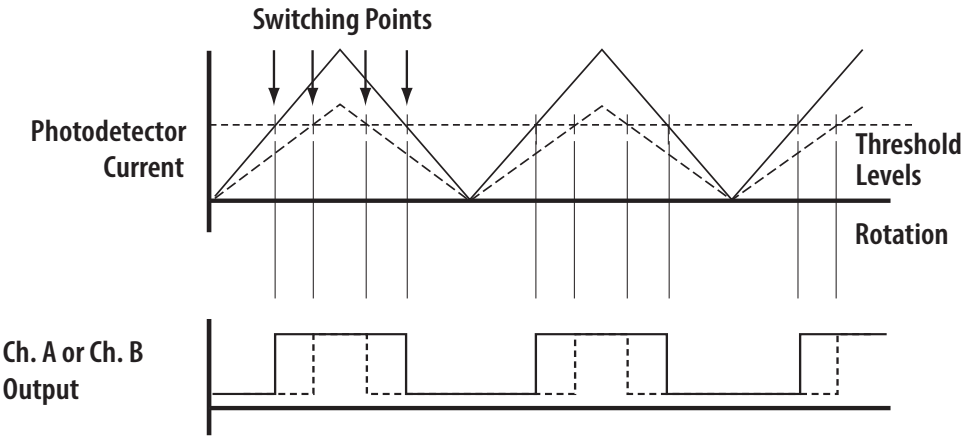
Diagram 3: Differential Detector Output



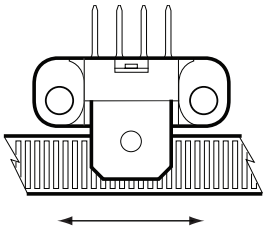

How does differential signaling work?

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

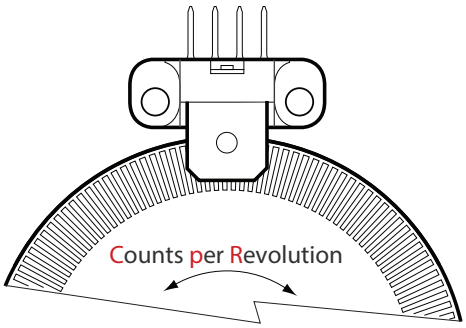
Diagram 4: Single-Channel Detector Output



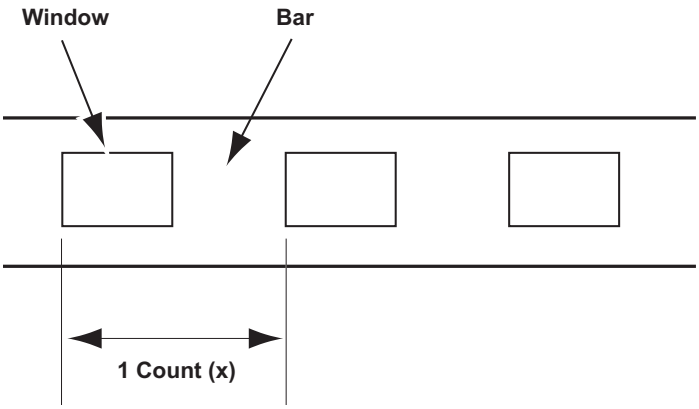
**LPI:**




**CPR:**




# LPI Formula



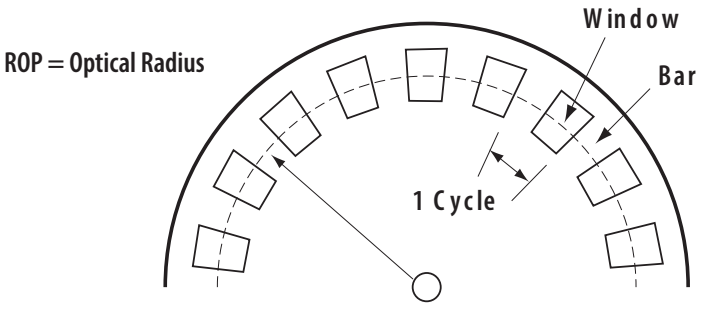

LPmm (lines per mm) can be used instead of LPI (lines per inch). The method of calculation for LPmm is the same as for LPI. The only difference is that mm replaces inch as the standard measurement of length.

The formulas for LPI and LPmm are as follows:

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

Where x = Length of the window and bar pair.

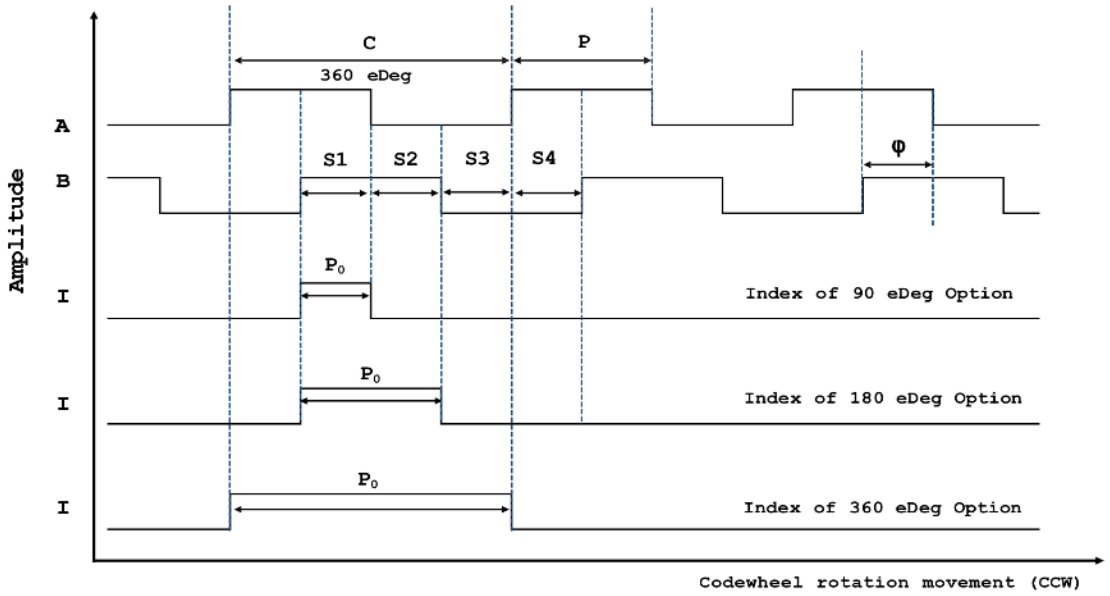
# Cycle Count per Revolution Formula




1 cycle = The mechanical rotation that corresponds to one pair of window and bar.

CPR = The number of window and bar pairs over a full rotation.

Sample of Output Waveforms




Quadrature Signals A,B and I

Digital Parameter Definitions

| Test | Parameter | Definition |
|---|---|---|
| Count | N | The number of bar and window pairs or counts per revolution (CPR) of the code wheel. |
| Cycle | C | 360 electrical degrees (°e), 1 bar and window pair.<br>One shaft rotation: 360 mechanical degrees, N cycles. |
| Cycle Error | ΔC | An indication of cycle uniformity. The difference between an observed shaft angle that gives rise to one electrical cycle and the nominal angular increment of 1/N of a revolution. |
| Pulse Width (Duty) Error | ΔP | The deviation, in electrical degrees, of the pulse width from its ideal value of 180°e. |
| State | S | The number of electrical degrees between a transition in the output of channel A and the neighboring transition in the output of channel B. There are four states per cycle, each nominally 90°e. |
| Phase | φ | The number of electrical degrees between the center of the high state of channel A and the center of the high state of channel B. This value is nominally 90°e for quadrature output. |
| Optical Radius | $R_{OP}$ | The distance from the code wheel's center of rotation to the optical center (O.C.) of the encoder module. |
| Index Pulse Width | $P_0$ | The number of electrical degrees that an index is high during one full shaft rotation. |

# Converting CPR to LPI and LPmm

$$\text{Count Density} = \frac{\text{Number of Window and Bar Pairs}}{\text{Arc Length}} = \frac{\text{CPR (Count over Full Rotation)}}{2\pi\text{Rop (Arc Length over Full Rotation)}}$$

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

# 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 in order for the encoder to operate properly.

The formulas described on the preceding page can be used to calculate the new code-wheel dimension. To retain the same LPI or LPmm, increase the CPR, and the ROP will increase accordingly. If the CPR is decreased, the ROP will also decrease accordingly.

For example, the HEDS-9000-Txx is an encoder with 2000 CPR at an ROP of 23.36 mm. Let's assume the use of a customized code wheel that has 4000 CPR with the HEDS-9000-Txx encoder, which has 2000 CPR.

The following table simplifies the problem statement. The encoder and custom code-wheel 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 code wheel to ensure that the new code-wheel LPmm matches that of the encoder specifications. We must identify the new code-wheel 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:

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

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

$$LPmm = 13.6245$$

The new 4000-CPR code wheel must also match this 13.6245 LPmm. Next, find the appropriate ROP for 4000 CPR:

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

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

$$ROP(mm) = 46.72\ mm$$

The new 4000-CPR code wheel must have an ROP of 46.72 mm to be used with a 2000-CPR 23.36-mm encoder.

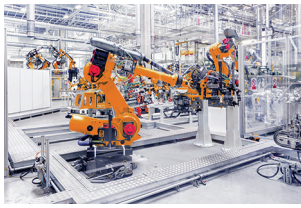
| | Encoder Specification | Custom CW Specification |
|---|---|---|
| **CPR** | 2000 | 4000 |
| **ROP** | 23.36 mm | 46.72 mm |
| **LPmm** | 13.6245 | |

**NOTE:** The LPI or LPmm for the code wheel and the encoder must match for the encoder to operate properly.

# Connecting everything®







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April 13, 2026; Motion-Sensing-Control-SG100