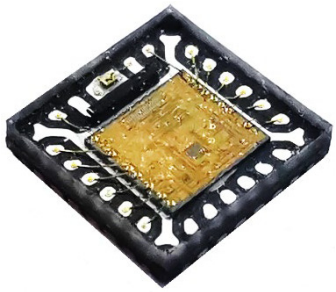
Application Note

AEDR-9830DP

Three-Channel Reflective Incremental Encoder with Analog or Digital Differential Output (318 LPI)



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 a three-channel digital differential A, B, and I output.

The AEDR-9830DP in analog encoder modes, with a two-channel differential analog output (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 encoder can be interfaced with most signal processing circuitries. Therefore, the encoder provides easy integration and flexible design-in 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.

Applications

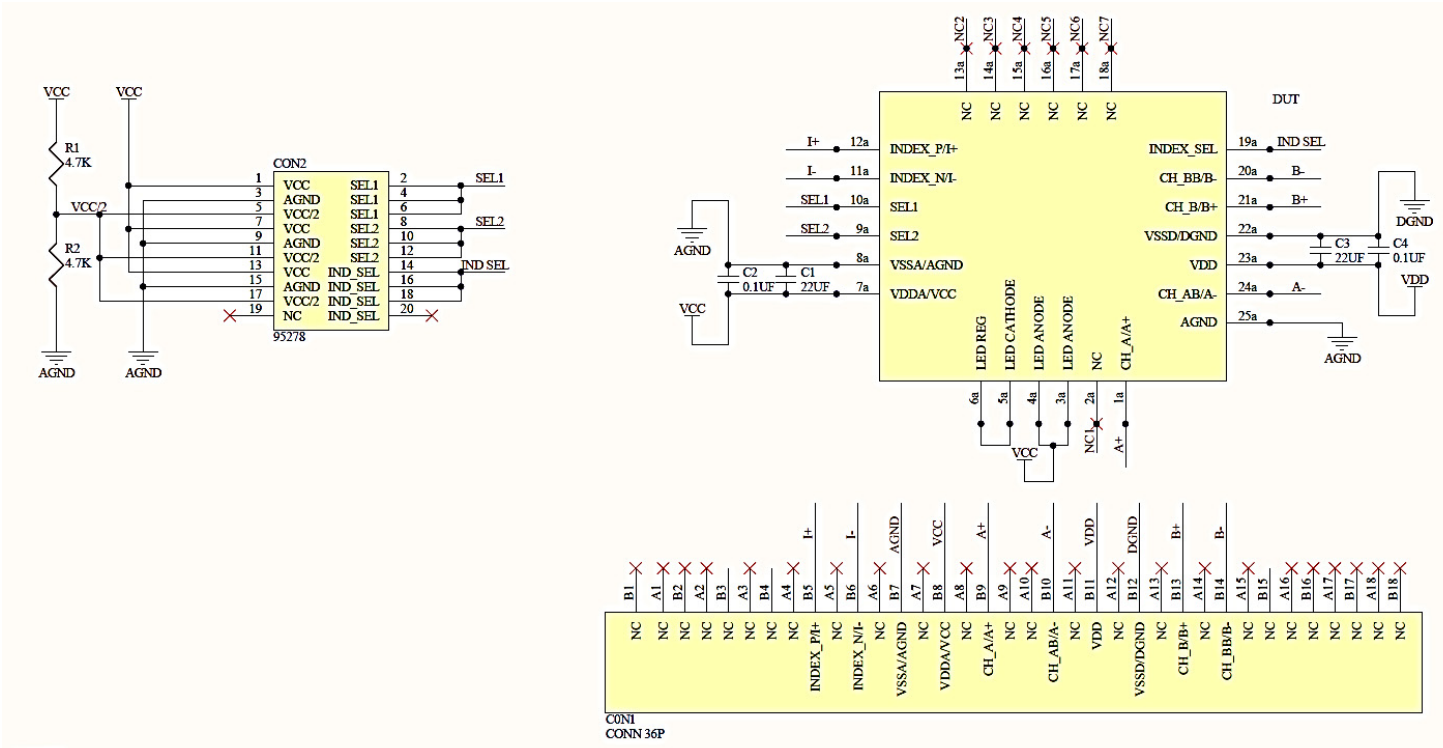
- Closed-loop stepper motors
- Small motors, actuators
- Industrial printers
- Robotics
- Card readers
- Pan-tilt-zoom (PTZ) cameras
- Portable medical equipment
- Optometric equipment
- Linear stages

Related Part Ordering Information

Ordering Information	Type
AEDR-9830DP-100	AEDR-9830, 318-LPI Incremental Encoder, 1000 pieces
AEDR-9830DP-102	AEDR-9830, 318-LPI Incremental Encoder, 100 pieces
HEDS-9830DPEVB	AEDR-9830DP Evaluation Board, 318-LPI Encoder, and Code Wheel
HEDS-9830DPEVBL	AEDR-9830DP Evaluation Board, 318-LPI Encoder, and Code Strip

Reference Schematic Design

Figure 1: Reference Schematic Diagram for AEDR-9830DP



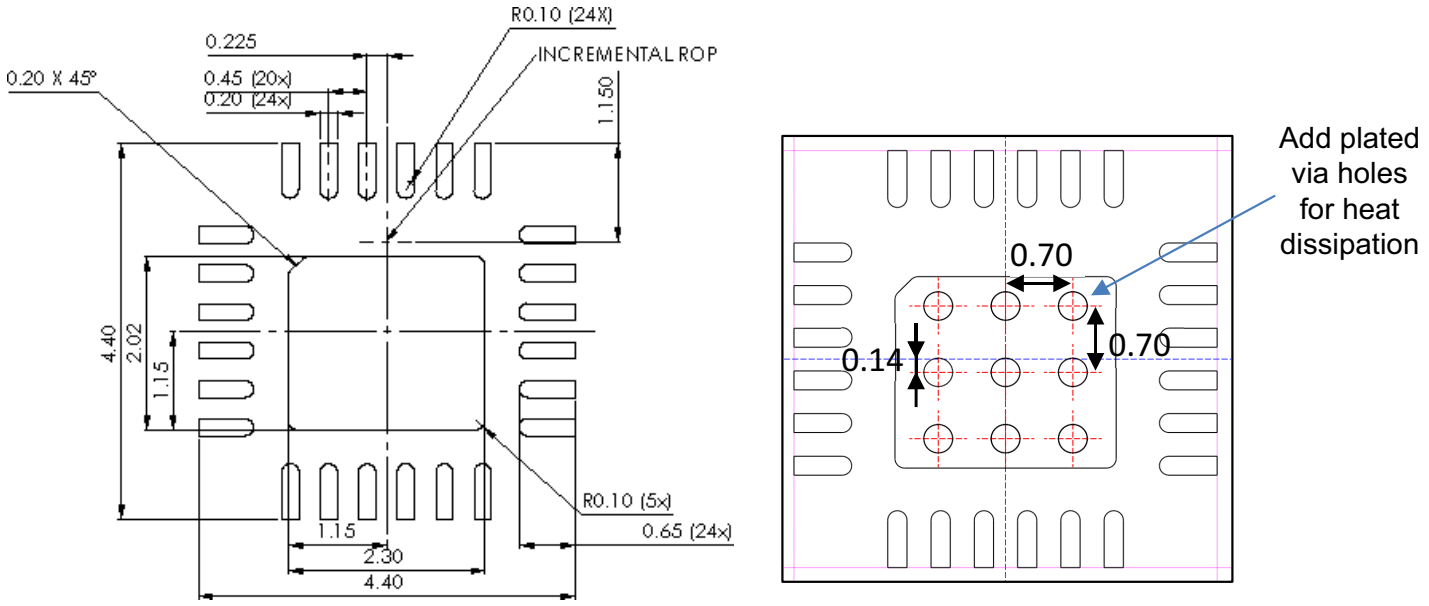
NOTE:

1. CAPACITOR PAIR 22UF AND 0.1UF PLACE AS CLOSE AS POSSIBLE TO UNIT
2. AVOID ROUTING INDEX TRACE IN PARELLEL AND CLOSE TO ANALOG SIGNAL
3. MINIMIZE TRACE LENGTH IF POSSIBLE
4. UNIT PIN 1 ORIENTATION PLACE AT BOTTOM RIGHT

Reference PCB Land Pattern

Figure 2 shows the recommended AEDR-9830DP 4x4-mm QFN package land pattern. For thermal management, add thermal vias with a 4-layer PCB as shown. Use at least 9x Ø0.30-mm plated through-hole (PTH) vias with a pitch of 0.70 mm.

Figure 2: AEDR-9830DP PCB Land Pattern

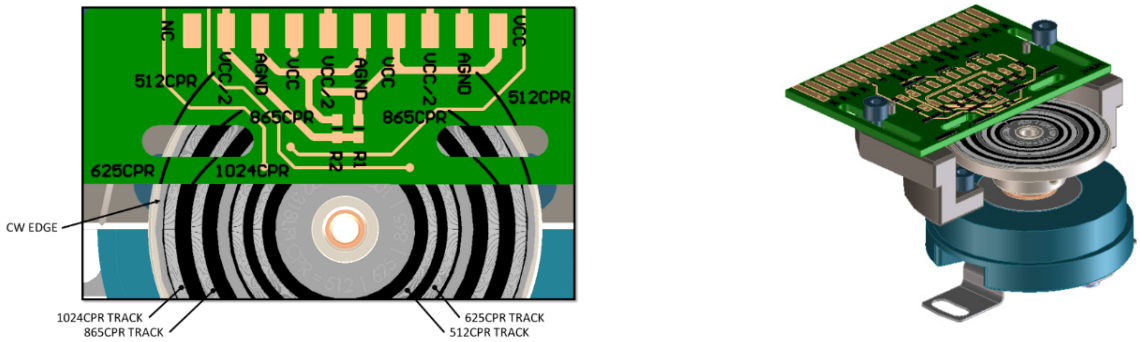


NOTE:

1. All dimensions are in millimeters (mm).
2. Optimize the center die paddle solder paste stencil opening for good SMD reflow yield.
3. Tolerances are x.xx ± 0.05 mm, unless otherwise specified.

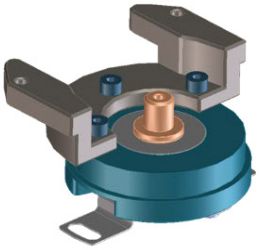
Evaluation Board Physical Alignment

Figure 3: Evaluation Board (AEDR-9830DP) Mounting Concept

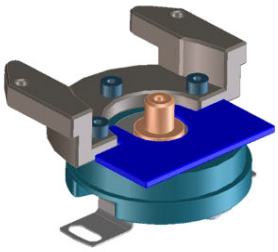


1. Place the mounting plate on the motor base.
2. Place the set-height jig on the motor base.
3. Install the code-wheel hub assembly into the motor shaft:
   a. With the aid of the set-height jig between the motor base and the hub's bottom surface, secure the hub with M3x3 set screws.
   b. Torque the M3x3 set screws to 0.15 Nm.
4. Use the guide pins to position the PCBA on the mounting plate. Use the silkscreen-printed guide lines to align the code-wheel hub assembly.
5. Secure the PCB with mounting screws. Torque the M2x6 cap screws to 0.15 Nm.

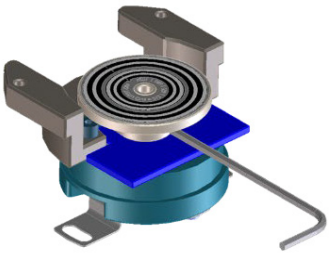
Figure 4: Evaluation Board Sample Mounting Bracket



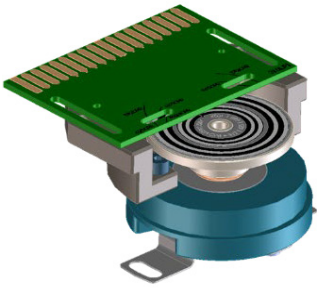
1. Assemble the mounting plate.



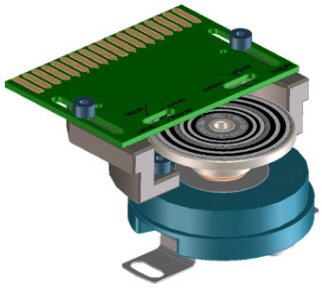
2. Place the set-height jig.



3. Assemble the hub.



4. Assemble the PCB.

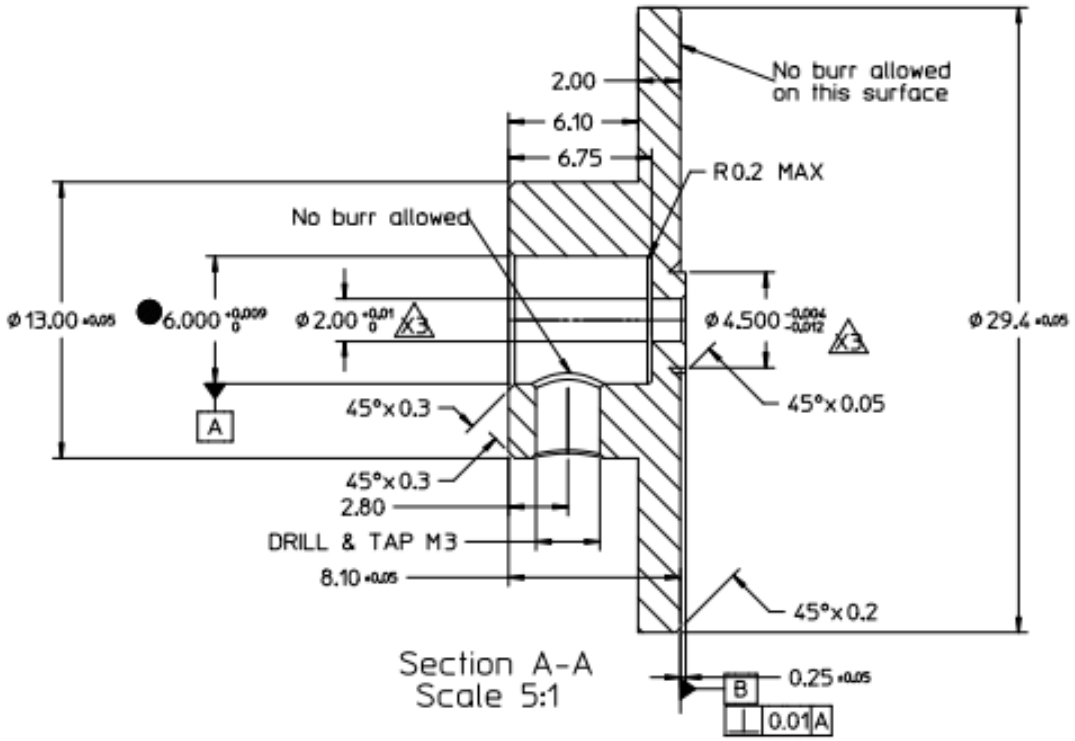


5. Verify alignment and tighten the mounting screws.

Hub Design Concept

Figure 5 shows the hub design concept for a multiple-track code wheel.

Figure 5: Hub Concept



Jig Design Concept

The following figures show jig designs based on the AEDR-9830DP with a 6-mm shaft mounting. Contact Broadcom for jig design details.

Figure 6: Mounting Jig

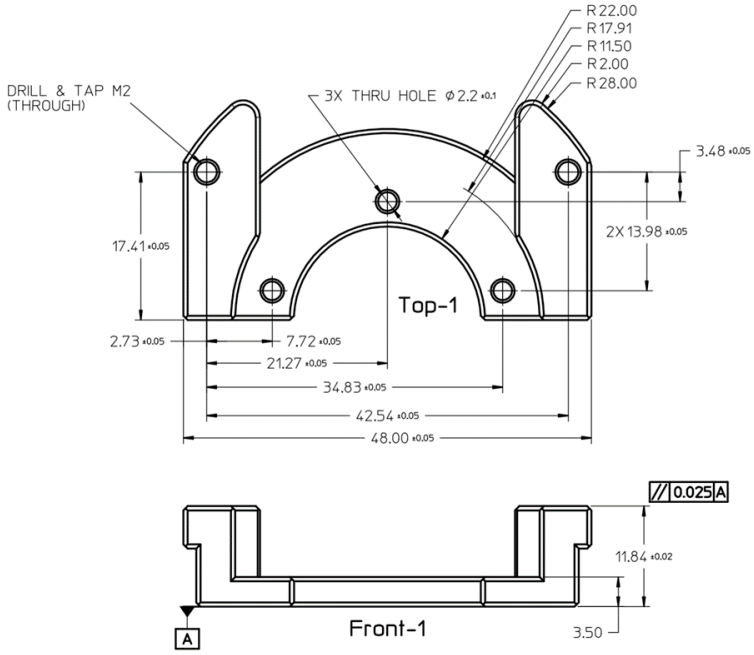
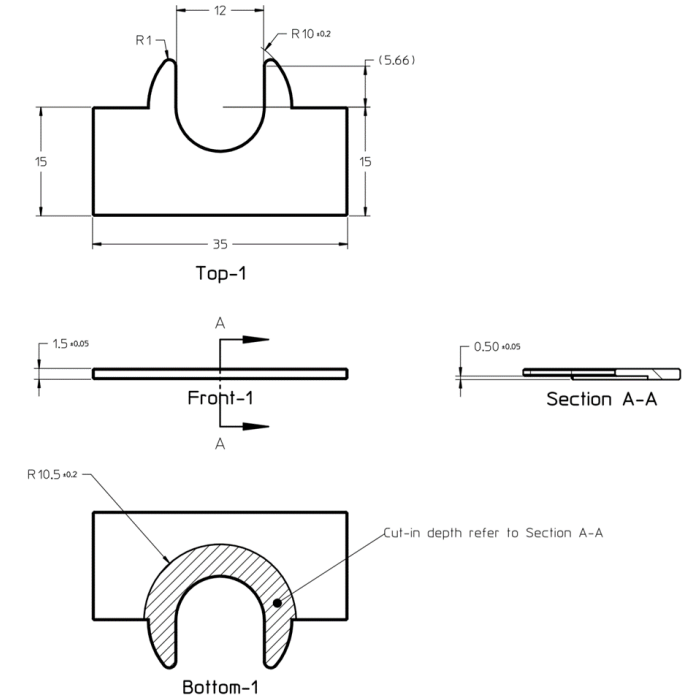


Figure 7: Set-Height Jig



Mounting Requirement

The mounting requirement shown in Figure 8 demonstrates how to set the encoder in the optimum position for typical encoder performance. This mounting requirement is applicable for the following parameters:

- AEDR-9830DP encoder-to-code-wheel operational gap
- Code-wheel placement

Figure 8: Mounting Requirement

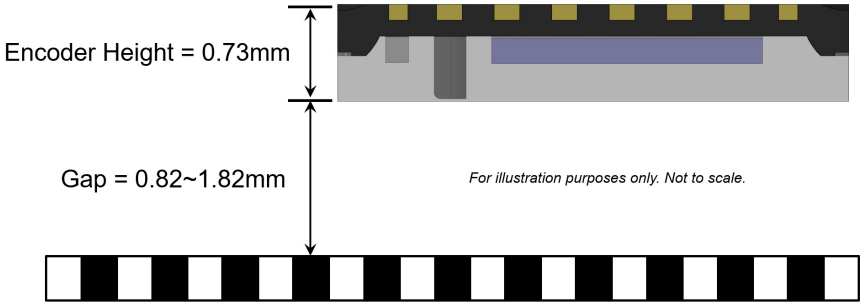
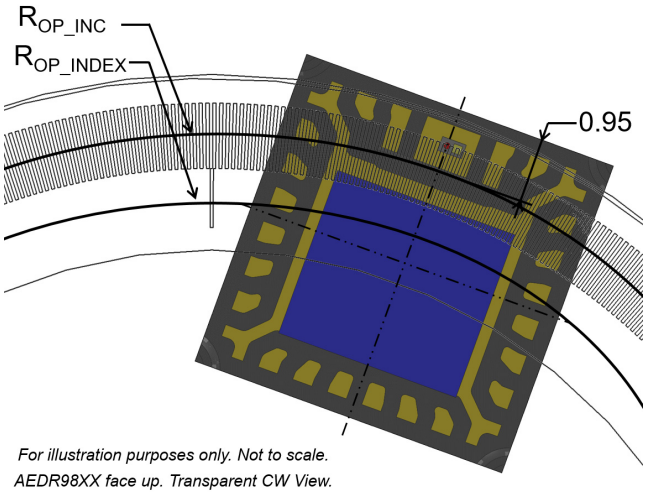
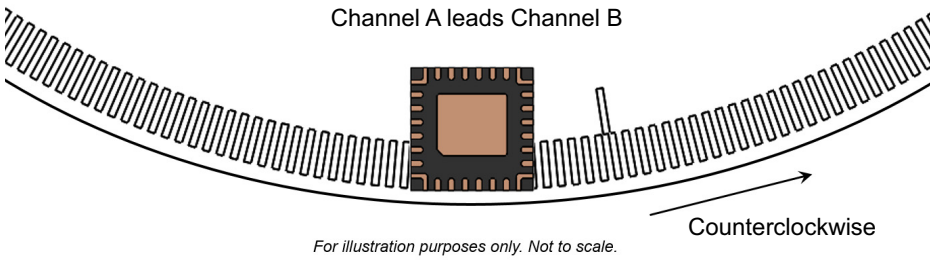


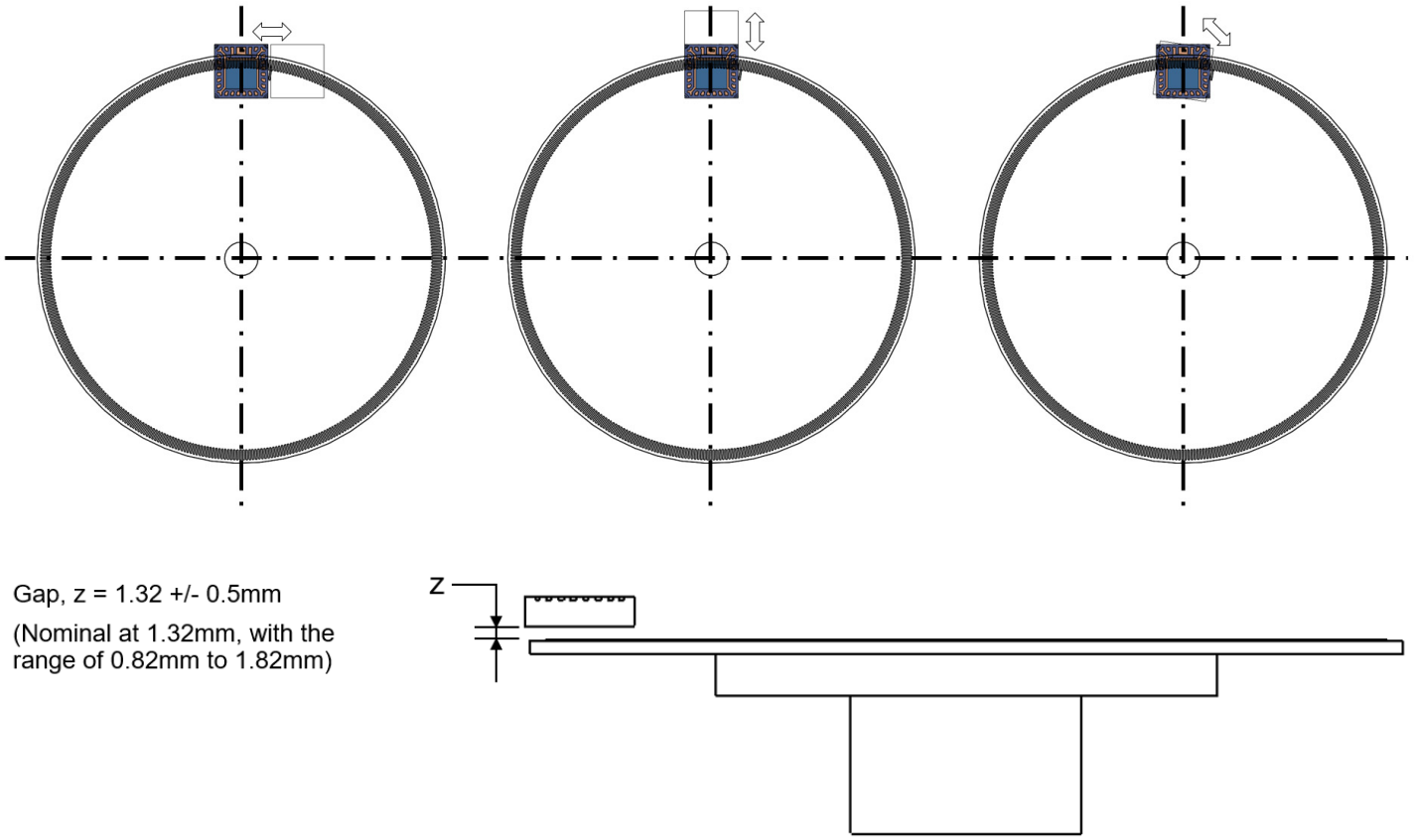
Figure 9: Channel A and Channel B Signal Orientation vs. Mounting Position





Spatial Tolerances

Figure 10: AEDR-9830DP Spatial Tolerances



NOTE:

1. Assemble the encoder in clean-room conditions, Class 100k or better.
2. Enclose the encoder in an IP50-rated enclosure.
3. The encoder is shipped with protective tape to prevent contamination. Remove the tape *only* after the surface-mount solder-reflow process is complete.

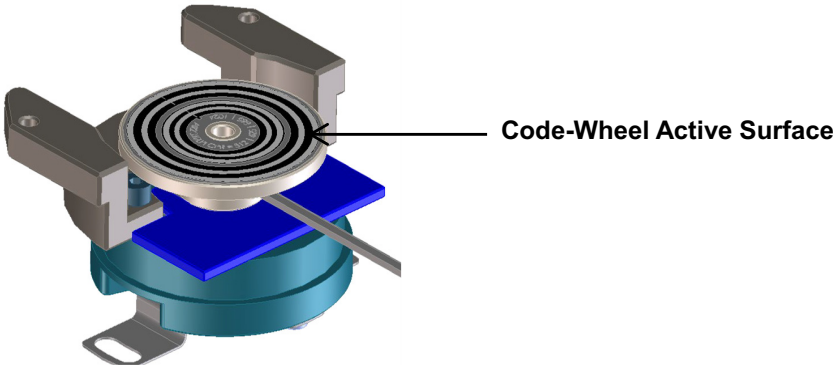
Recommended Shaft Tolerance

Hub ID (mm)	Hole Tolerance			Set Screw Size	Shaft OD (mm)	Shaft Tolerance		
	Lower	Upper	Hole Basis			Lower	Upper	Shaft Basis
6	0	0.008	H6	M3	6	–0.004	–0.009	g5
8	0	0.009	H6	M3	8	–0.005	–0.011	g5

Code-Wheel Handling

- Wear a finger cot to prevent touching the active area of the code wheel.
- Use only delicate task wipers with isopropyl alcohol to wipe the code wheel. Do not use cotton buds, because they are not lint free and will cause scratches that will contaminate the code wheel.

Figure 11: Code-Wheel Handling



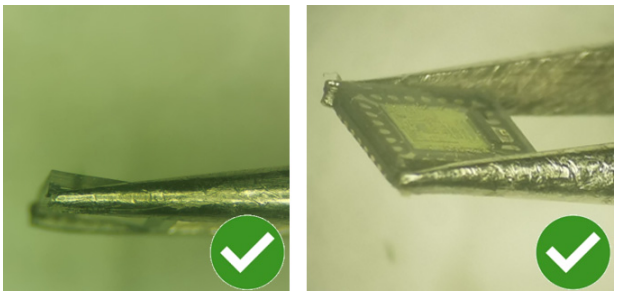
Good Code Wheel

Contaminated Code Wheel

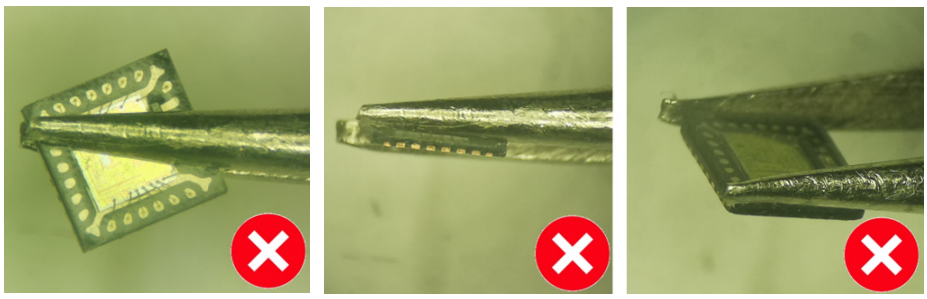
Handling the Encoder with Tweezers

1. The following figure shows the side view of the encoder. It can be split into two zones: the clear compound and the molded lead frame (MLF).

2. Hold the encoder on the MLF side surface or on both the MLF and clear-compound side surfaces.
3. The following figures illustrate the *correct* position to use when handling the encoder. The tweezers are holding the MLF side surface and then both the MLF and the clear-compound side surfaces. Use these positions when handling the encoder.

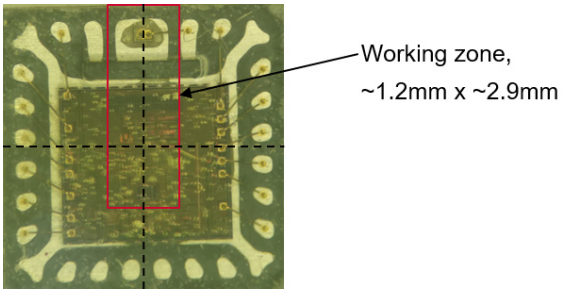


4. Do not hold the encoder by only the clear-compound top surface or by only the clear-compound side surfaces.
5. The following figures illustrate *incorrect* positions to use when handling the encoder. The tweezers are holding the top surface of the clear compound and then the clear-compound side surfaces only. Do not use these positions when handling the encoder.

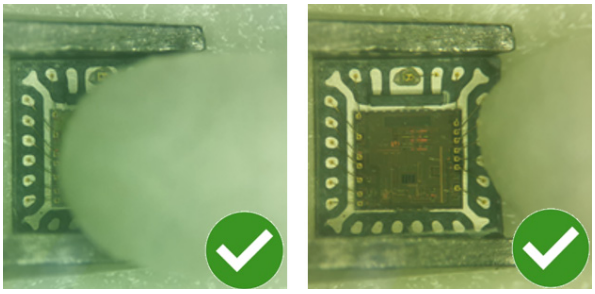


Handling Dust, Contaminant Exposure, and Sticky Surfaces

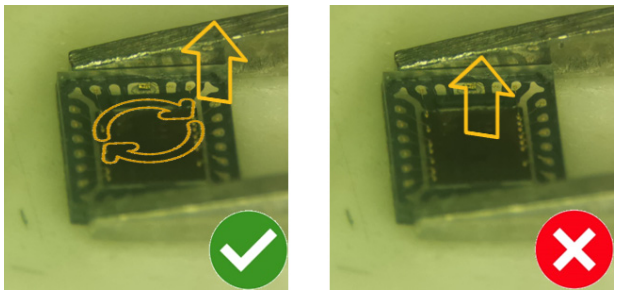
1. Do not expose the encoder to dust and debris.



2. Excessive dust and debris on the “working zone” may cause a drastic decrease in the performance of the encoder.
3. If the surface of the encoder requires cleaning, use a soft, lint-free swab and lab-grade isopropyl alcohol. Gently wipe away the contaminants. Do not press the top surface of the encoder.



4. The encoder should not come into contact with tape or sticky surfaces, regardless of whether the contact happens to the clear-compound surface or to the solder-pad surface.
5. If the encoder must be removed from a sticky surface, use the following procedure:
   a. Use tweezers to hold onto the MLF side surfaces.
   b. *Do not* pull or lift the encoder vertically.
   c. Do carefully rotate the encoder left and right (clockwise and counterclockwise) to break the bond between the encoder and the sticky surface before lifting up the encoder.

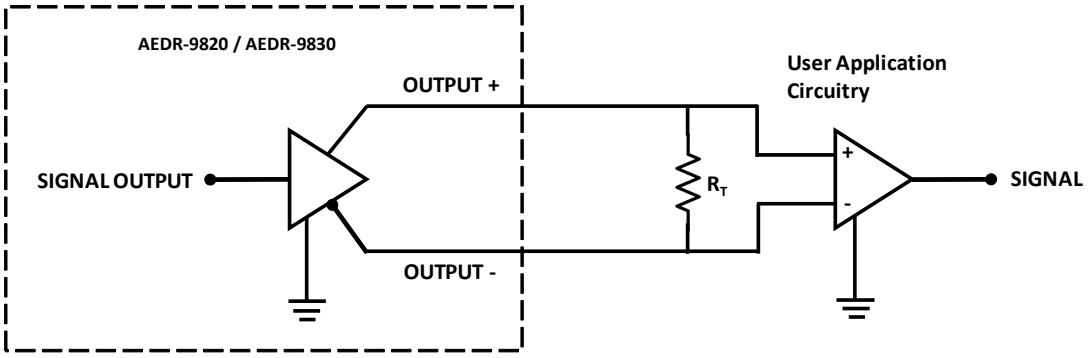


Electrical Interface

- Use the following power supplies with the encoder:
  - For a 5.0V supply, the V_{CC} must be within the range of 4.5V to 5.5V
  - For a 3.3V supply, the V_{CC} must be within the range of 3.0V to 3.6V
- For best noise immunity, use a twisted-pair shielded cable for the connection to the servo driver.
- To prevent undesirable signal reflection, terminate with 1200Ω resistors.

Differential I/O Connection

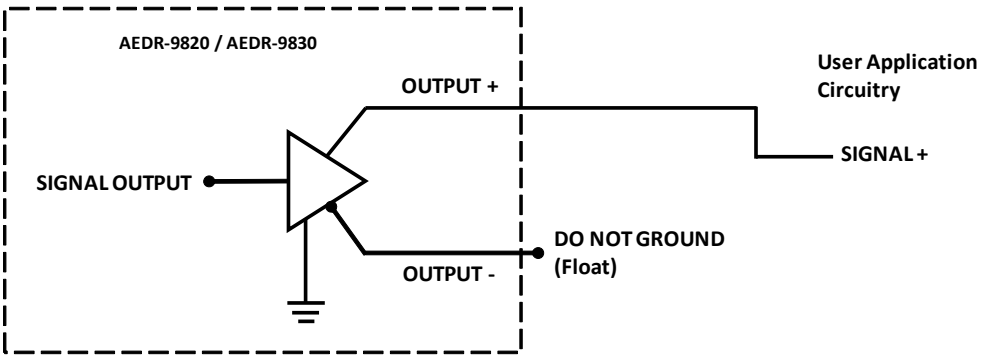
- Use the Broadcom AEIC-7272-S16 quad differential line receiver or a compatible product as the line receiver.
- Ground unused pins for noise reduction.
- Use shielded cable for better noise immunity.



NOTE:

1. Output+ represents the A+, B+, or I+ digital output from the encoder.
2. Output– represents the A–, B–, or I– digital output from the encoder.
3. Load resistance RT is optional, although highly recommended to reduce reflection.
4. The differential I/O connection is applicable only for digital output and is not recommended for analog output.

Single-Ended I/O Connection

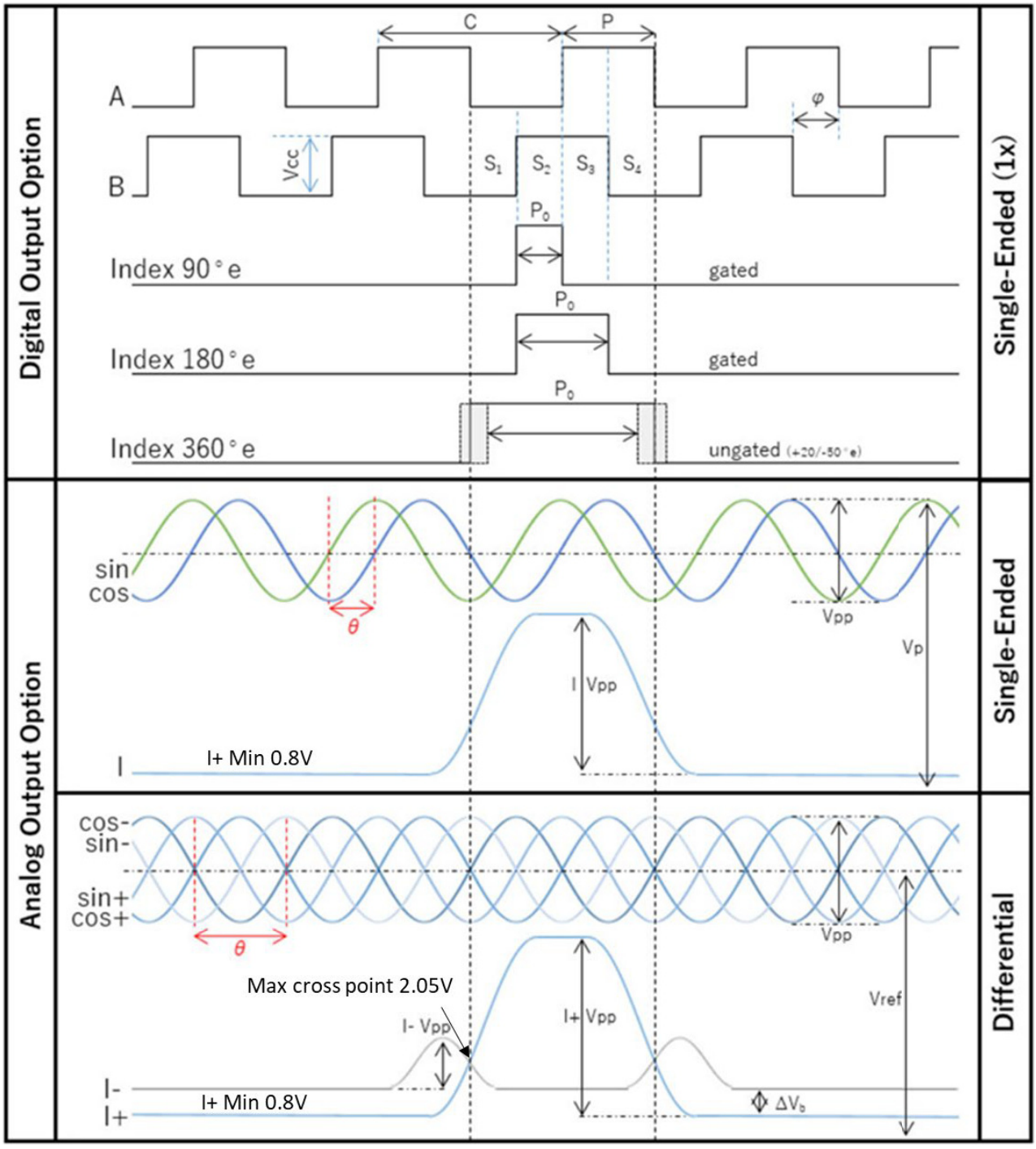


NOTE:

1. Output+ represents the A+, B+, or I+ digital output from the encoder.
2. Output– represents the A–, B–, or I– digital output from the encoder.
3. Do not ground the Output– from the encoder. Allow the output to float.

Output Waveform

The following figure shows an example of the output waveform digital signals A and B, gated index of 90°e and 180°e, and ungated index of 360°e when the code-wheel rotation is in the counterclockwise direction. The figure also shows an additional waveform output example for the analog output option with single-ended and differential modes.



NOTE: The minimum voltage of index plus must be more than 0.8V.