The Quantum Devices EZ-Comm system is the fastest and most economical way to align an optical encoder’s commutation channels to a motor. EZ-Comm was designed to reduce assembly cost for high volume manufacturing. By eliminating multiple steps from the typical timing of an encoder and motor, EZ-Comm saves manufacturing time and reduces assembly cost. EZ-Comm is integrated into the high performance, low profile modular design of the QM35. QM35 EZ-Comm is ideal for high volume OEM applications and priced competitively for all sizes of motion control projects. As simple as a push of a button, EZ-Comm is the newest and simplest way to commutate your BLDC motors.

**DESIGN FEATURES**
- Programmable commutation
- Full complement outputs
- Bearingless modular design
- Low profile assembled height of 0.43”
- Resolutions up to 5000 lines per revolution
- 4, 6, 8, 10 or 14 pole commutation
- Easy lock-n-twist assembly feature
- Through bore sizes up to 0.375” diameter
- Up to 675 kHz frequency response
- High noise immunity
- RoHS construction
- Hub to shaft uses two #3-48 set screws
- Hermetically sealed LED
- Multiple mounting options including resolver size 15

**Connector:** JAE P/N FI-W15P-HFE

**Configuration Options:**

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Commutation</th>
<th>Output</th>
<th>Cover</th>
<th>Bore Size</th>
<th>Mounting</th>
<th>Index</th>
<th>Hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>E = Line Driver (ABZ) / Open Collector (UVW) with EZ-Comm</td>
<td>B = Closed Cover</td>
<td>D = 6 mm</td>
<td>B = 1.812”</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E = 8 mm</td>
<td></td>
<td>B = 90° A &amp; B</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L = 0.1875”</td>
<td></td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M = 0.250”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N = 0.3125”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M = 0.375”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Available Line Count and Pole Combinations**

<table>
<thead>
<tr>
<th>Poles</th>
<th>Line Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>500, 512, 1000, 1024, 2000, 2048, 2500</td>
</tr>
<tr>
<td>6</td>
<td>500, 512, 1000, 1024, 2000, 2048, 2500, 4000, 4096</td>
</tr>
<tr>
<td>8</td>
<td>500, 512, 1000, 1024, 2000, 2048, 2500, 4000, 4096, 5000</td>
</tr>
<tr>
<td>10</td>
<td>500, 512, 1000, 1024, 2000, 2048, 2500, 4000, 4096, 5000</td>
</tr>
<tr>
<td>14</td>
<td>2048</td>
</tr>
</tbody>
</table>

**Note:**
1) 4 poles has four states per revolution (2 pole pair), or two 360° electrical cycles per revolution
2) Mounting option A allows for resolver size 15
3) Consult factory for configurations not shown
4) Line Driver (RS-422) is compatible with Renco options: TTL, PP, VC or LD Open collector compatible with VO configurations
**ELECTRICAL SPECIFICATIONS**

- **Input Voltage**: 5 VDC ± 5%
- **Input Current Requirements**: 65 mA typical, 100 mA max plus interface loads
- **Input Ripple**: 2% peak to peak @ 5 VDC
- **Output Circuits**: D = 26C31 line driver (RS-422 or single-ended TTL)
  
  E = ABZ 26C31 line driver, UVW open collector (no U’ V’ W’)
- **Incremental Output Format**: Quadrature with A leading B for CCW rotation viewed from the encoder top
- **Max Operating Frequency**: • < 5000 PPR = 500 kHz or 15,000 RPM
  • 5000 PPR = 675 kHz
  • 1000LC-10P, 1024LC-10P, 2000LC-10P, 2048-10P and 2048LC-14P = 7000 RPM
- **Commutation Format**: Three phase 4, 6, 8, 10 or 14 poles (other pole counts upon request)
- **Commutation Accuracy (UVW)**: See EZ-Comm Specifications
- **Interpolation Factors**: 1000/1024 PPR = 2x
  2000/2048 PPR = 4x
  2500 PPR = 5x
  4000/4096 PPR = 8x
  5000 PPR = 10x

**ENVIRONMENTAL SPECIFICATIONS**

- **Storage Temperature**: -40 to 125°C
- **Operating Temperature**: -30 to 115°C
- **IP Rating**: IP40
- **Humidity**: 90% non-condensing
- **Vibration**: 20 g’s @ 25 to 2000 Hz
- **Shock**: 100 g’s @ 6 ms duration

**MECHANICAL SPECIFICATIONS**

- **Bore Minimum Diameter**: Bore size +0.0002”
- **Recommended Shaft Tolerance**: +0.0000/−0.0005”
- **Minimum Shaft Engagement**: 0.400” [10.2 mm]
- **Allowable Shaft Runout**: 0.002” [0.05 mm] TIR (± 0.001” shaft radial play from initial shaft position of assembled encoder)
- **Allowable Axial Shaft Movement**: ± 0.010” [± 0.25 mm]
- **Mounting**: A = 1.280” bolt circle/size 15 resolver, B = 1.812” bolt circle
- **Dynamic Commutation Adjustment Range**: 30° mechanical
- **Moment of Inertia**: 8.0 x 10° oz-in-s²

---

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**EZ-COMM SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Encoder Commutation Accuracy after Alignment Process</th>
<th>U V W edge position error (max), after Power On until the first Index: 4P = 4°e, 6P = 6°e, 8P = 8°e, 10P = 10°e, 14P = 14°e.</th>
<th>U V W edge position error (max), after first Index after Power On:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Count</td>
<td>4 Pole</td>
<td>6 Pole</td>
</tr>
<tr>
<td>500</td>
<td>1.0° e</td>
<td>2.4° e</td>
</tr>
<tr>
<td>512</td>
<td>1.0° e</td>
<td>2.8° e</td>
</tr>
<tr>
<td>1000</td>
<td>1.0° e</td>
<td>2.4° e</td>
</tr>
<tr>
<td>1024</td>
<td>1.0° e</td>
<td>2.8° e</td>
</tr>
<tr>
<td>2000</td>
<td>1.0° e</td>
<td>2.4° e</td>
</tr>
<tr>
<td>2048</td>
<td>1.0° e</td>
<td>2.8° e</td>
</tr>
<tr>
<td>2500</td>
<td>1.0° e</td>
<td>2.1° e</td>
</tr>
<tr>
<td>4000</td>
<td>2.0° e</td>
<td>2.6° e</td>
</tr>
<tr>
<td>4096</td>
<td>2.0° e</td>
<td>2.6° e</td>
</tr>
<tr>
<td>5000</td>
<td>2.5° e</td>
<td>2.9° e</td>
</tr>
</tbody>
</table>

Note: Accuracy specification does not include motor winding pole pair position and magnetizing inaccuracies.

**Power on Latency**

- Power on to valid UVW states: 22 ms

---

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**ELECTRICAL PIN FUNCTIONS**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Option D</th>
<th>Option E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>B'</td>
<td>B'</td>
</tr>
<tr>
<td>5</td>
<td>Z</td>
<td>Z</td>
</tr>
<tr>
<td>6</td>
<td>Z'</td>
<td>Z'</td>
</tr>
<tr>
<td>7</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>8</td>
<td>U'</td>
<td>NC</td>
</tr>
<tr>
<td>9</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>10</td>
<td>V'</td>
<td>NC</td>
</tr>
<tr>
<td>11</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>12</td>
<td>W'</td>
<td>NC</td>
</tr>
<tr>
<td>13</td>
<td>Vcc</td>
<td>Vcc</td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>15</td>
<td>NC</td>
<td>NC</td>
</tr>
</tbody>
</table>

---

**ELECTRICAL OUTPUT CIRCUITS**

- Output Option D: ABZ = 26C31 line driver (RS-422)
- UVW = 26C31 line driver (RS-422)

- Output Option E: ABZ = 26C31 line driver (RS-422)
- UVW = open collector

- 26C31 line driver is TTL compatible (can be wired single-ended)
- 26C31 sink/source 20mA max (meets RS-422 at 5 VDC supply)
- Open collector 30 mA sink max
- Open collector pull up voltage 30 VDC max

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- www.electromate.com
- sales@electromate.com

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*Quantum Devices*
BEFORE ALIGNMENT PROCESS
The waveforms below are the QM35 EZ-Comm encoder Index (Z), U, V, and W phases in relation to the motor back electromotive force (BEMF) phases, prior to any alignment process. The red segments indicate the desired states to be aligned.
AFTER ALIGNMENT PROCESS
The waveforms below are the QM35 EZ-Comm encoder Index (Z), U, V, and W phases in relation to the motor back electromotive force (BEMF) phases, after the Semi-Automatic Commutator Alignment. The green arrow indicates motor shaft position where the alignment process occurred. The U, V, and W phases are aligned to the BEMF phases of the motor. The index marks are not repositioned.
**MECHANICAL DIMENSIONS**

Model QM35 EZ-Comm – 1.280" Bolt Circle (Mounting Option A)

Model QM35 EZ-Comm – 1.812" Bolt Circle (Mounting Option B)

Note:
- Shown with Cover option A (hole in cover).
- Cover option B (closed) – Maximum shaft length up to 0.512" [13.0 mm]. Overall height increases from 0.43" [10.9 mm] to 0.57" [14.5 mm]. This additional height has a cylinder diameter 0.56" [14.2 mm], centered on the cover top.
- Cover option C (closed) – Maximum shaft length up to 0.450" [11.4 mm]. Overall height increases from 0.43" [10.9 mm] to 0.51" [13.0 mm]. This additional height has a cylinder diameter 0.56" [14.2 mm], centered on the cover top.

**MOUNTING REQUIREMENTS**

Mounting Option A (1.280" Bolt Circle)

Mounting Option B (1.812" Bolt Circle)

Servo Size 15 Mounting (Mounting Option A)

Patent Protection:
- US Patent 9,857,205
- US Patent 6,563,108

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**HARDWARE OPTIONS – ORDERING INFORMATION**

### MOUNTING OPTION A (1.280” BOLT CIRCLE)

- **#3-48 x 1/16” Set Screw**
  - 1/16” set screw required for 0.375” bore
  - English
  - Metric
  - Metric
  - Metric

- **#4-40 x 5/16” Button Head**
  - Black Ox #3-48 x 1/16”
  - 0.050” Hex
  - (Torque = 45 - 51 oz·in)
  - Part Number 1829ZG015
  - Part Number 1829ZG015

- **#2-56 x 8 mm Button Head**
  - M2.5 x 8 mm Button Head
  - 1.5 mm Hex
  - (Torque = 45 - 51 oz·in)
  - Part Number 1834AG150

- **Cover Screws (Qty. 2 each)**
  - Part Number 18326G002

### MOUNTING OPTION B (1.812” BOLT CIRCLE)

- **#3-48 x 3/32” Set Screw**
  - 3/32” set screw has deeper hex pocket to improve assembly tool life
  - English
  - Metric
  - Metric
  - English

- **#4-40 x 5/16” Button Head**
  - Black Ox #3-48 x 3/32”
  - 0.050” Hex
  - (Torque = 45 - 51 oz·in)
  - Part Number 1829ZG015

- **#2-56 x 8 mm Button Head**
  - M2.5 x 8 mm Button Head
  - 1.5 mm Hex
  - (Torque = 45 - 51 oz·in)
  - Part Number 1834AG150

- **Cover Screws (Qty. 2 each)**
  - Part Number 18326G002

### HARDWARE SELECTION BREAKOUT

**Set Screws (Qty. 2 each)**

<table>
<thead>
<tr>
<th>Option</th>
<th>Set Screws (Qty. 2 each)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>#3-48 x 1/16” Black Ox</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>B</td>
<td>#3-48 x 3/32” Black Ox</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>C</td>
<td>#4-40 x 5/16” Black Ox</td>
</tr>
<tr>
<td></td>
<td>(Torque = 37 - 43 oz·in)</td>
</tr>
<tr>
<td>D</td>
<td>#2-56 x 8 mm Button Head</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>E</td>
<td>#2-56 x 8 mm Button Head</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>F</td>
<td>#2-56 x 8 mm Button Head</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>G</td>
<td>#2-56 x 8 mm Button Head</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>H</td>
<td>#2-56 x 8 mm Button Head</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>I</td>
<td>#2-56 x 8 mm Button Head</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
<tr>
<td>J</td>
<td>#2-56 x 8 mm Button Head</td>
</tr>
<tr>
<td></td>
<td>(Torque = 45 - 51 oz·in)</td>
</tr>
</tbody>
</table>

**Mounting Screws (Qty. 2 each)**

- **Option A**
- **Option B**
- **Option C**

**Cover Screws (Qty. 2 each)**

- **Option L**
- **Option M**
- **Option N**

**Note:**

1.) Bore Size option N (0.375”) requires Hardware option A, B, D, E, K, L, M or N. This hardware can optionally be used with all other hub sizes.

2.) Hardware options F, G, H, J, P, Q, R and S have longer #3-48 set screws (3/32”) and are not compatible with Bore Size option N (0.375”).

3.) Hardware options D, E, H, J, M, N, R and S contain a thread lock which is applied to the mounting screws only. This preapplied thread locking product contains a microencapsulated epoxy resin that is suspended in a hardener. The force of thread engagement crushes the microscopic capsules of epoxy resin, mixing the reactant components, and initiating a chemical reaction which locks the parts together. This product series provides consistent and predictable torque values and requires no heat or primers for curing.

Product - ND Industries 5935.

*Quantum Devices, Inc. reserves the right to make changes in design, specifications and other information at any time without prior notice.*
One Meter Cable Both Ends Terminated:
2080AG039 = 14 conductor 28 AWG for UVW Commutation
Connector = JAE FI-W15S

Half Meter Cable One End Terminated:
2081AG019 = 114 conductor 28 AWG for UVW Commutation
Connector = JAE FI-W15S

Note:
1. Cable has internal foil shield with 28 AWG drain wire trimmed to jacket edge
2. Unused wires to be locally isolated from adjacent signal wires, Vcc and GND to prevent damage to encoder signals

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Encoder Pin Function</th>
<th>2080AG039 Wire Color</th>
<th>2081AG019 Wire Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>Brown</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A'</td>
<td>White</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>B'</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Z</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Z'</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>U</td>
<td>Violet</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>U'</td>
<td>Gray</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>V</td>
<td>White/Brown</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>V'</td>
<td>White/Red</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>W</td>
<td>White/Orange</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>W'</td>
<td>White/Yellow</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Vcc</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>No Connect</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

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**INSTALLATION INSTRUCTIONS FOR 1.280" BOLT CIRCLE**

**STEP 1**
Rotate printed circuit board (PCB) to expose the mounting holes. This is the Lock position. Mounting/motor surface must be clean and flat.

**STEP 2**
A. Install mounting screws through encoder into mounting/motor surface. Insert 1-2 turns. **DO NOT tighten screws.**

Note: Alignment of Z mark on hub to white mark on PCB is NOT required.

**STEP 3**
A. Press down on the hub with a force between 150 g (0.33 lb) and 700 g (1.5 lb). This will center the encoder assembly to the motor shaft.
B. Using slight forefinger and thumb force, verify no radial (side-to-side) movement of the encoder occurs.

Illustrated is accessory Q-Scale p/n 2160AG276. Proper downward force is indicated when pin is between the force lines.

**STEP 4**
A. Tighten hub set screws to motor shaft.
   #3-48 x 1/16" screw = 18-22 oz·in
   #3-48 x 3/32" screw = 28-32 oz·in
B. The downward force on the hub can be removed.
C. Tighten mounting screws to 45-51 oz·in.

TIP: Place Q-Scale point within the Z mark of hub.

**STEP 5**
Place cover on encoder. Observe the cover dowel pins positioned into mating PCB holes.

**STEP 6**
A. Twist cover/PCB to expose screw holes for cover screws.
B. Install cover screws and tighten to 37-43 oz·in.
C. Install cable to complete installation.

**Note:** Refer to Hardware Selection Breakout chart for driver sizes.

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QM35 EZ-COMM SET UP:

Connect Programmer Cable between encoder and EZ-Comm Programmer

QM35 EZ-COMM PROGRAMMING KIT, P/N: 2174AG001

Includes:
- EZ-Comm Programmer
- 19" Programmer Cable
  p/n: 2174AG002
- 9VDC, 6W Power Supply

LED 1 Flashing: Rotate Shaft to Align Commutation.
LED 1 Steady: Commutation Alignment Complete.
LED 2 Flashing: Rotate Shaft to Verify Installation.
LED 2 Steady: Encoder Installation is Good.
LED 3 Flashing: Error (repeat installation).
LED 4 Steady: Encoder has Power.

Plug power supply cube into 110 VAC supply. Connect +9v DC power plug into socket.

EZ-COMM ALIGNMENT PROCEDURE

A. Energize appropriate motor windings to align shaft to U rise position.
B. Press button to Start Alignment process.
   LED 1 will flash.
   LED 4 will illuminate, indicating power applied to encoder.
C. Remove power from motor windings applied in step A.
D. Rotate motor shaft (~one rotation) to align commutation.
   LED 1 will light steady when align is complete.
   LED 2 will flash.
E. Rotate motor shaft (~one rotation) to verify installation.
   LED 2 will light steady when installation verification is complete.
   LED 4 will extinguish removing power from encoder.

For multiple alignments, the power switch on the box side can remain in the ON position.
Rotational speed limited to 350RPM.

PROGRAMMER PINOUT

Pin 1 = Encoder power
Pin 2 = Ground
Pin 3 = Chan U
Pin 4 = Chan V
Pin 5 = Chan W
Pin 7 = Input Open Collector – ground and release to Start Alignment process, alignment procedure step B.
Pin 8 = Output TTL logic High during alignment procedure steps B, C and D.
Pin 15 = Output TTL logic High during alignment procedure step E.
Pin 14 = Output TTL logic High upon complete of step E to signal the installation was verified (passing).
Pin 13 = Output TTL High if an installation error occurs.

Repeat next assembly: First ground and release of Pin 7 to clear Pass or Fail from the previous alignment.

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