

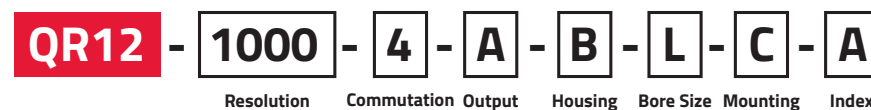
## QR12

### DESIGN FEATURES

- Low profile assembled height of 0.99"
- Bearing design simplifies encoder attachment
- Incremental resolutions up to 20,000 PPR
- Sin/Cos outputs available up to 1250 PPR
- 4, 6 or 8 pole commutation<sup>1</sup>
- 1.280", 1.575" or 1.812" bolt circle mounting
- Through bore sizes up to 0.375" (10 mm) diameter
- High noise immunity
- Cost competitive with modular encoders
- 500 kHz frequency response
- RoHS construction



Quantum Devices, Inc. Model QR12 provides an improved feedback solution in applications traditionally using modular encoders. With an overall height of less than one inch and the stability of a bearing encoder design, the model QR12 can provide significant performance upgrades in applications limited by modular encoder solutions. Outputs consist of two incremental quadrature channels with an index pulse and three-phase commutation. A flexible spring steel mount allows for much greater tail shaft run out and TIR than can be tolerated by modular encoder designs, while also providing 30 degrees of rotation for commutation timing.



### Configuration Options:

Resolution <sup>1</sup>	Commutation <sup>1</sup>	Output <sup>1</sup>	Housing	Bore Size	Mounting	Index
24 <sup>2</sup> , 256, 360, 500, 512, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000, 8000, 8192, 10000, 16000, 16384, 20000	0 = No Comm 4 = 4 Pole 6 = 6 Pole 8 = 8 Pole	A = Line Driver B = Line Driver ABZ / Open Collector UVW C = Sin/Cos <sup>3</sup> / Line Driver UVW D = Sin/Cos <sup>3</sup> / Open Collector UVW	B = Through Hole Cover C = Closed Cover	A = 3 mm B = 4 mm C = 5 mm D = 6 mm E = 8 mm F = 10 mm G = 7 mm J = 0.125" K = 0.1875" L = 0.250" M = 0.3125" N = 0.375"	A = 1.812" B = 1.575" C = 1.280"	A = 90° gated to A & B C = Ungated Square Wave (Sin/Cos Option Only) D = Ungated Sinusoidal (Sin/Cos Option Only)

### Note:

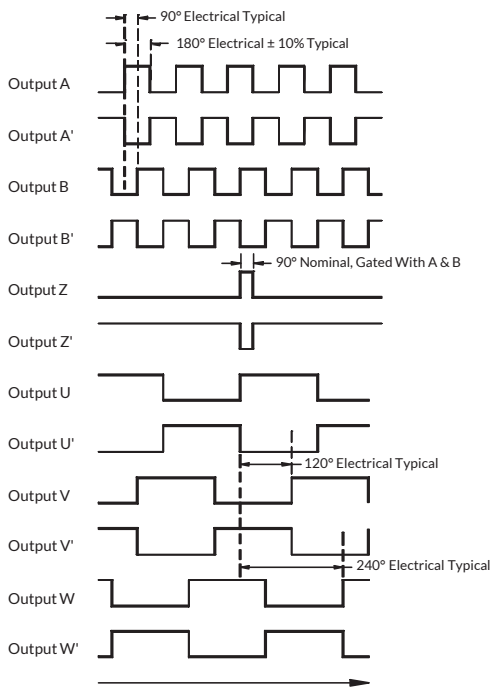
- 1.) Consult factory for configuration options not shown (e.g. resolution, commutation, output, etc.)
- 2.) 24 PPR only available with No Comm (Commutation option 0)
- 3.) Sin/Cos Outputs are limited to Resolutions between 500 and 1250 PPR

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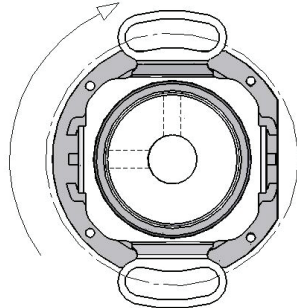
## OUTPUT WAVEFORMS



Clockwise Shaft Rotation as Viewed Looking at the Encoder Face (see figure below)

**Note:** Relationship of Z signals to U, V, W signals is not to scale. A & B signals have no relationship to U, V, W signals.

CW Rotation for Output Waveforms



## INCREMENTAL ELECTRICAL SPECIFICATIONS

Input Voltage	5 VDC $\pm$ 5%
Input Current Requirements	65 mA typical, 100 mA max plus interface loads
Input Ripple	2% peak to peak @ 5 VDC
Output Circuits	A = 26C31 line driver (RS-422 or single-ended TTL) B = ABZ 26C31 line driver, UVW open collector (no U' V' W')
Incremental Output Format	Quadrature with A leading B for CW rotation Index pulse true over A and B high
Max Operating Frequency	500 kHz
Symmetry	180° electrical $\pm$ 10% typical
Minimum Edge Separation	<4000 PPR = 54° electrical $\geq$ 4000 PPR = 45° electrical
Commutation Format	Three phase 4, 6 or 8 poles (other pole counts upon request)
Commutation Accuracy	$\pm$ 1° mechanical
Z Channel to U Channel	$\pm$ 1° mechanical

## ENVIRONMENTAL SPECIFICATIONS

Storage Temperature	-40 to 125°C
Operating Temperature	-20 to 115°C
IP Rating	IP40
Humidity	90% non-condensing
Vibration	20 g's @ 50 to 500 CPS
Shock	50 g's @ 11 mS duration

## MECHANICAL SPECIFICATIONS

Bore Diameter (Tolerance)	0.125", 0.1875", 0.250", 0.3125", 0.375", 3 mm, 4 mm, 5 mm, 6 mm, 7 mm, 8 mm, 10 mm (+0.0006/-0.0000")
Recommended Shaft Engagement	0.500" minimum
Allowable Shaft Runout	0.007" TIR
Axial Shaft Movement	$\pm$ 0.030"
Maximum Shaft Speed	8000 RPM
Interface Connector	Connector: JAE P/N FI-W15P-HFE
Mounting	1.280", 1.575", 1.812" bolt circle
Moment of Inertia	$9.1 \times 10^{-5}$ oz-in-s <sup>2</sup>
Acceleration	$1 \times 10^5$ radians/s <sup>2</sup>
Accuracy	Instrument error 1.5 arc minutes max

## 15 PIN CONNECTOR

JAE P/N: FI-W15P-HFE

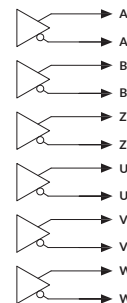
Pin Number	Function
1	A
2	A'
3	B
4	B'
5	Z
6	Z'
7	U
8	U'*
9	V
10	V'*
11	W
12	W'*
13	Vcc
14	GND
15	NC

\*U', V' and W' are "no connect" for Output option B (open collector UVW)

## ELECTRICAL OUTPUT CIRCUITS

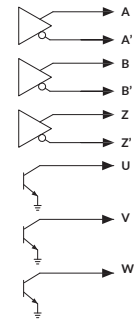
### Output Option A:

ABZ = 26C31 line driver (RS-422)  
UVW = 26C31 line driver (RS-422)



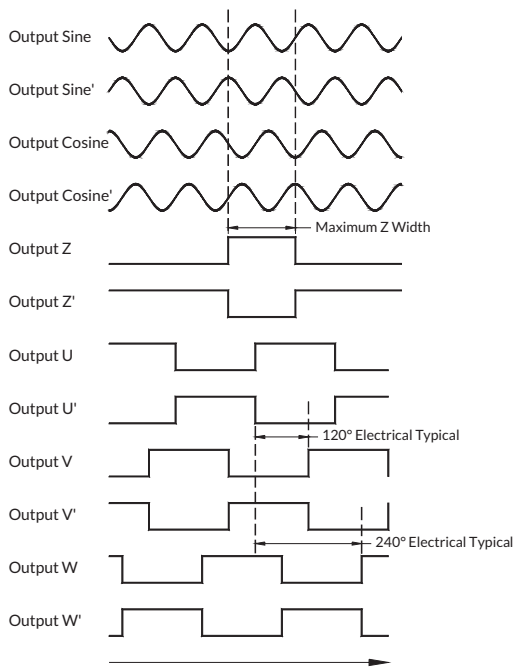
### Output Option B:

ABZ = 26C31 line driver (RS-422)  
UVW = open collector



- 26C31 line driver is TTL compatible (can be wired single-ended)
- 26C31 sink/source 20 mA max (meets RS-422 at 5 VDC supply)
- Open collector sink 30 mA max, pull up voltage 30 VDC max
- U, V and W are "no connect" for Commutation option 0

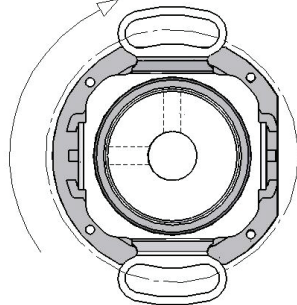
## SIN/COS OUTPUT WAVEFORMS



Clockwise Shaft Rotation as Viewed Looking at the Encoder Face (see figure below)

**Note:** Relationship of Z signals to U, V, W signals is not to scale. Sine & cosine signals have no relationship to U, V, W signals.

CW Rotation for Output Waveforms



## SIN/COS ELECTRICAL SPECIFICATIONS

Input Voltage	5 VDC $\pm$ 5%
Input Current Requirements	65 mA typical, 100 mA max plus interface loads
Input Ripple	2% peak to peak @ 5 VDC
Output Circuits	C = sine/cosine 1 Vpp (measured differentially), index**, UVW 26C31 line driver (RS-422 or single-ended TTL) D = sine/cosine 1 Vpp (measured differentially), index**, UVW open collector (no U' V' W')
Incremental Output Format	Quadrature sine/cosine with sine leading cosine for CW rotation. Ungated index pulse.
Max Operating Frequency	500 kHz
Sine/Cosine Amplitude	1 Vpp $\pm$ 5% (measured differentially)
Index Amplitude **	C = 1 Vpp $\pm$ 5% (measured differentially) square wave D = 1 Vpp $\pm$ 5% (measured differentially) sinusoidal
Commutation Format	Three phase 4, 6 or 8 poles (other pole counts upon request)
Commutation Accuracy	$\pm$ 1° mechanical
Z Channel to U Channel	$\pm$ 1° mechanical

## 15 PIN CONNECTOR JAE P/N: FI-W15P-HFE

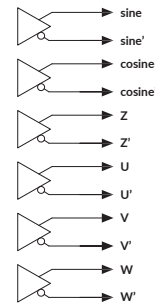
Pin Number	Function
1	sine
2	sine'
3	cosine
4	cosine'
5	Z
6	Z'
7	U
8	U'*
9	V
10	V'*
11	W
12	W'*
13	Vcc
14	GND
15	NC

\* U', V' and W' are "no connect" for Output option D (open collector UVW)

## ELECTRICAL OUTPUT CIRCUITS

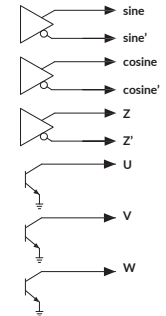
**Output Option C:**  
sin/cos = 1 Vpp sine/cosine  
line driver

UVW = 26C31 line driver (RS-422)



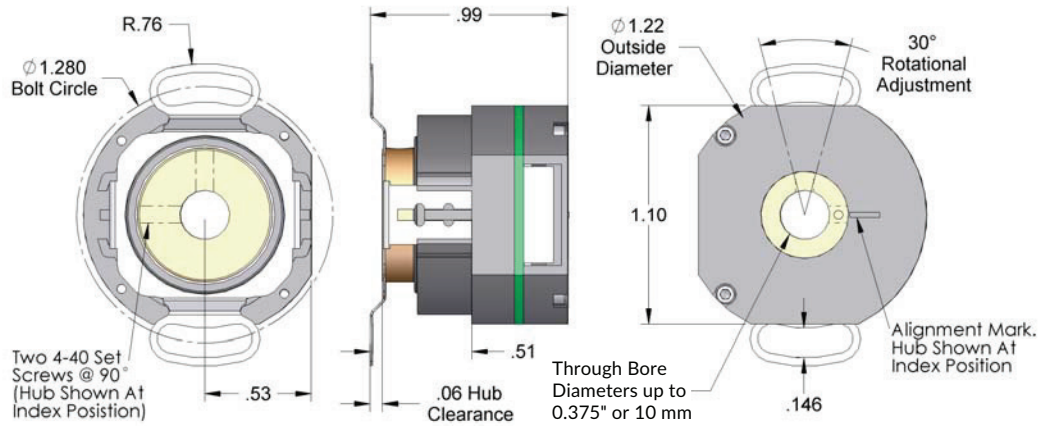
**Output Option D:**  
sin/cos = 1 Vpp sine/cosine  
line driver

UVW = open collector

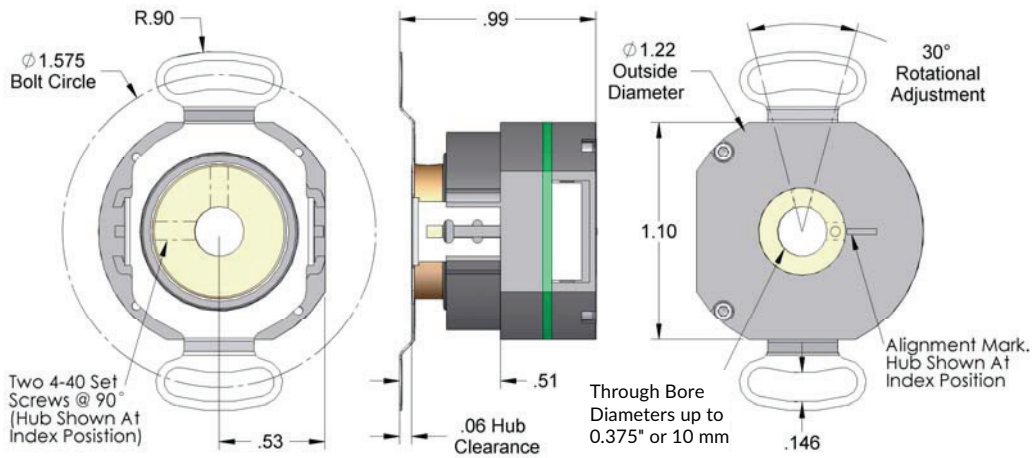


- 26C31 line driver is TTL compatible (can be wired single-ended)
- 26C31 sink/source 20 mA max (meets RS-422 at 5 VDC supply)
- Open collector sink 30 mA max, pull up voltage 30 VDC max
- U, V and W are "no connect" for Commutation option 0

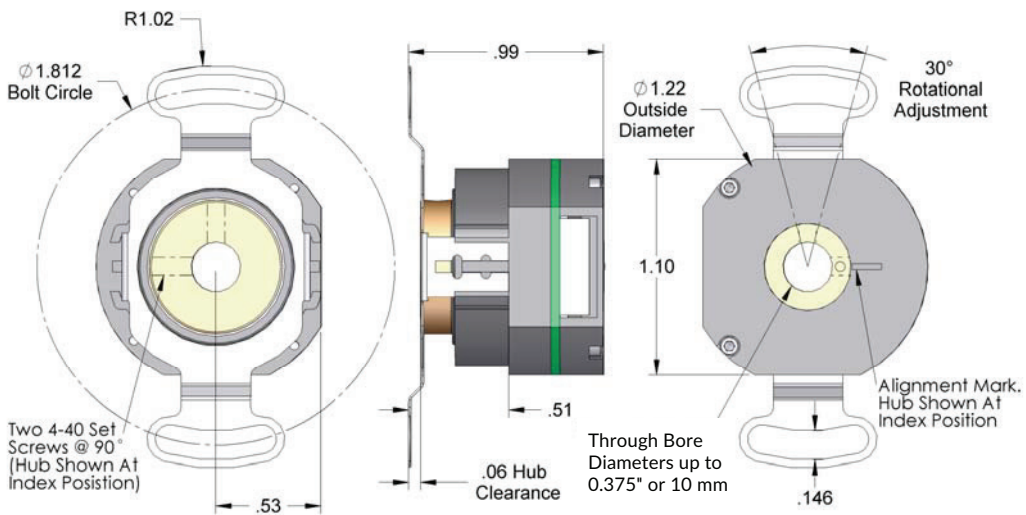
1.280" BOLT CIRCLE WITH BOTTOM MOUNT HUB



1.575" BOLT CIRCLE WITH BOTTOM MOUNT HUB



1.812" BOLT CIRCLE WITH BOTTOM MOUNT HUB



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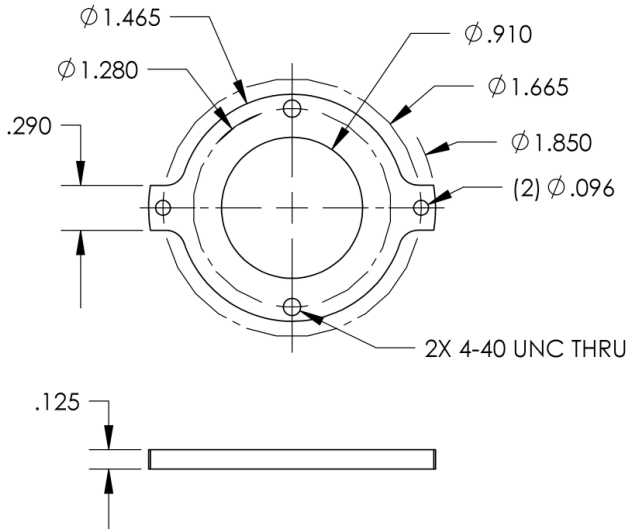
## SIZE 15 RESOLVER MOUNTS

Utilize the optional resolver mount adapters to mate the QR12 - 1.280" flex mount option to Size 15 Pancake Resolver motor configurations. Eliminate the expensive mounting servo clamps by attaching either the two or three point adapters directly to the servo clamp holes. Assemble the QR12 to the adapter plate using (2) #4-40 screws. For jam nut attachment to threaded motor shafts, refer to JR12 Jam Nut Mount Optical Encoder Literature.

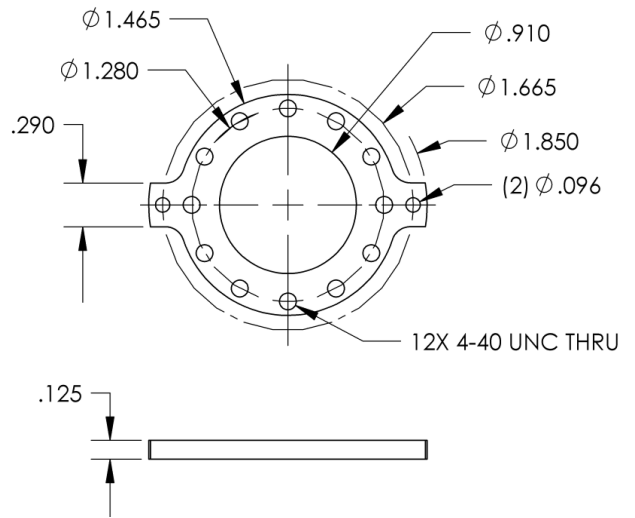
### DIMENSIONS

#### Optional Aluminum Resolver Adapters

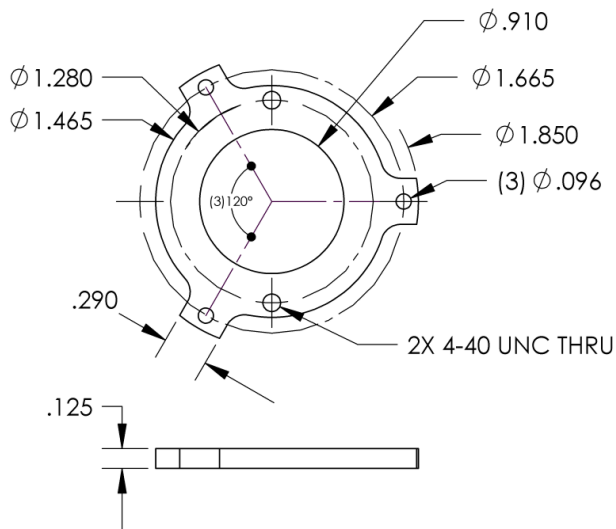
2074D024 - Two Point 30 Degree  
Commutation Adjustment Range



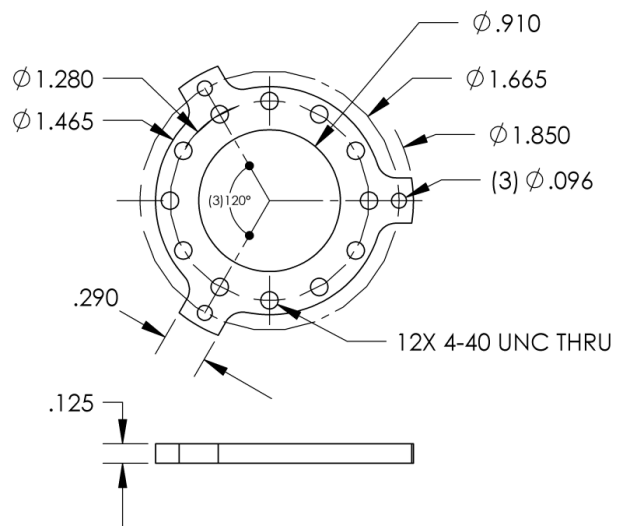
2074D025 - Two Point 360 Degree  
Commutation Adjustment Range



2074D026 - Three Point 30 Degree  
Commutation Adjustment Range



2074D027 - Three Point 360 Degree  
Commutation Adjustment Range

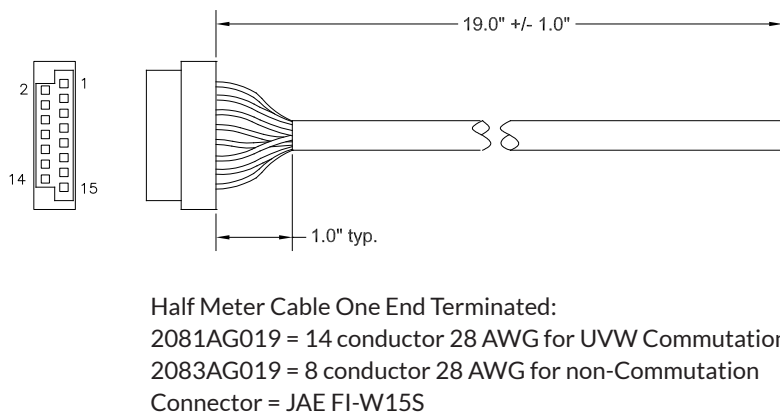
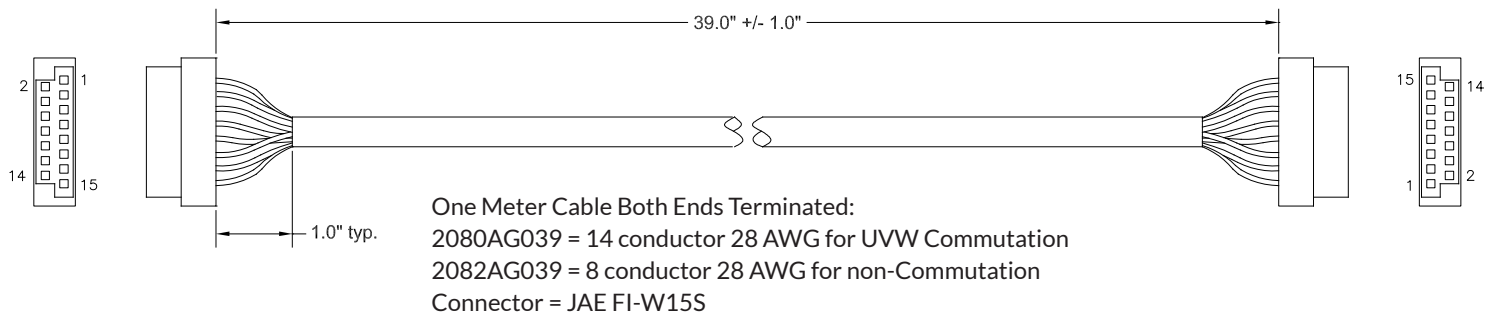


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## CABLE ACCESSORIES

(2080AG039, 2082AG039, 2081AG019, 2083AG019)

Consult Factory for Custom Lengths



Pin Number	Encoder Pin Function	2080AG039 2081AG019 Wire Color	2082AG039 2083AG019 Wire Color
1	A / sine'	Brown	Brown
2	A' / sine'	White	White
3	B / cosine	Blue	Blue
4	B' / cosine'	Green	Green
5	Z	Orange	Orange
6	Z'	Yellow	Yellow
7	U	Violet	-
8	U'	Gray	-
9	V	White/Brown	-
10	V'	White/Red	-
11	W	White/Orange	-
12	W'	White/Yellow	-
13	Vcc	Red	Red
14	GND	Black	Black
15	No Connect	-	-

Note:

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

## ENCODER INSTALLATION INSTRUCTIONS

- Using two fingers slide the encoder onto shaft.
- For additional security, Loctite can be applied to the encoder hub set screws. Remove the encoder's set screws and using tip of toothpick apply appropriate amount of Loctite thread locking adhesive. A non-permanent adhesive is recommended.
- Insert and tighten encoder set screws using a 0.050" hex wrench. Torque range of 50 to 80 oz-in.
- Fixture the stainless steel flex mount to the mounting surface with #6-32 button head screws.

### For brushless motors requiring commutation timing:

- Encoder drawings indicate position of encoder hub to encoder body at Z (index). Rotating the hub to this position allows for known U channel transition state (prior to step one above).
- Powering appropriate motor windings allow for locking motor shaft location to match the appropriate U transition (prior to step one above).
- While mechanically back driving the motor, monitor motor winding EMF position to the powered encoder position. Rotate the encoder stainless steel flex mount to achieve accurate timing of encoder commutation feedback channels to the appropriate motor winding EMF. Tighten the screws retaining the encoder stainless steel flex mounts.

Additional installation and handling instruction available at: [www.quantumdev.com](http://www.quantumdev.com)

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