



# SERVO DUTY FEEDBACK GUIDE

## DYNAPAR 2010

Rotary encoders designed for servomotor duty face special challenges such as high temperatures, high peak speeds, and commutation chores. Ease of installation is equally important, so Dynapar offers “One Size Fits All” mounting— Our size 15 frameless resolvers, absolute encoders, and commutation encoders are physically interchangeable. This gives the brushless motor customer unlimited flexibility in feedback options, while using the same motor shaft and endbell.

Dynapar’s Servo Motor Duty encoders offer:

- High 120°C operating temperatures that won’t downgrade motor ratings
- Up to 10,000PPR and commutation tracks up to 32 pole at 12,000 rpm
- Drop-in replacement for all mounting configurations

To meet the lightning-quick communication response brushless servomotors require, Dynapar offers the Acuro™ absolute encoder family designed especially for high-performance servo feedback. These encoders provide features such as:

- Fast response with either SSI or BiSS communication protocol
- High 22 bit resolution for the ultimate in low-speed smoothness
- Integrated diagnostics that monitor temperature and other safety parameters to monitor system performance

Dynapar also provides Harowe™ brand ultra-performance resolvers, long recognized as the benchmark in the brushless motor industry. Harowe resolvers provide reliable analog output in some of the harshest conditions where shock, vibration, temperature extremes, and even radiation are present. The new HaroMax line of frameless resolvers combine traditional resolver reliability with:

- Machine-wound stators for unparalleled accuracy
- Tough anodized aluminum housings with low mass for weight savings
- Ultra-high 155°C temperature rating for the toughest servo applications

For those OEM customers with special requirements, Dynapar has an engineering team ready to tackle custom modifications whether electrical, mechanical, or environmental. With these custom products manufactured across the globe, Dynapar supports today’s servomotor manufacturer by combining high performance with fast delivery.

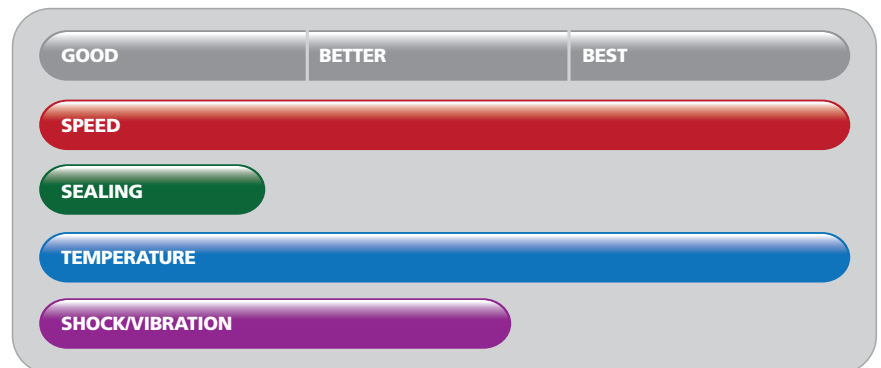


This class of encoders and resolvers is specifically suited to use on small-to mid-size stepper and servo motors. They typically have limited sealing due to their use inside motor housings, but are capable of very high speeds and high temperatures, a benefit due to being in such close proximity to motor windings. These encoders typically come from the factory ready to mount to common motor back shafts.





AD35 Pictured.

#### SERVO DUTY ENCODER GENERAL PERFORMANCE DATA













## OPTICAL - ABSOLUTE

				
Product	AD34	AD35	AD36	AD25
Shaft/Bore Sizes	6mm	8mm	8mm	10mm
Available Resolutions (Bits)	Up to 19 bit Singleturn	Up to 22 bit Singleturn	Up to 22 bit Singleturn, 12 bit multiturn	Up to 22 bit Singleturn, 12 bit multiturn
Input Voltage (VDC)	5 or 7 to 30	5 or 7 to 30	5 or 7 to 30	5
Operating Temperature (°C)	-15 to +120	-15 to +120	-15 to +120	-15 to +120
Enclosure Rating	IP40	IP40	IP40	IP40
Key Features	Unique one-step notched shaft mounting	Short mounting depth	Up to 22 bit singleturn resolution	Unique conical shaft for concentric motor mounting
Page Number	3.04	3.06	3.08	3.10

## INDUCTIVE - RESOLVER

		
11	R11	
0.120" (3.05mm)	0.120" (3.05mm)	
+/- 3 arcmin	+/- 6 arcmin	
2 to 26	2 to 6	
Up to 155	Up to 155	
N/A	N/A	
Brushless construction	Brushless construction	
3.40	3.40	

## OPTICAL - INCREMENTAL

							
Product	M602/M832 Module	LM/LAM	E9	M9	M14	M15	
Shaft/Bore Sizes	1/4" to 10mm	N/A	1.5 to 4mm, .125", .156"	1.5 to 4mm, .125", .156"	3 to 8mm, .1248", .375"	1/8" or 3/8" 6 to 10mm	
Available Resolutions (PPR)	1 to 5000 (M832) 1 to 3600 (M602)	Up to 720 CPI/500 CPI	100 to 512	100 to 512	200 to 1024	200 to 1024	
Input Voltage (VDC)	5	5	5	5	5	5 or 12	
Operating Temperature (°C)	-40 to +100	-40 to +100	-20 to +100	-20 to +100	-20 to +100	-20 to +120	
Enclosure Rating	IP00	IP00	N/A	N/A	N/A	NEMA 1/ IP50 (w/cover)	
Key Features	Tool-less gapping	Choice of Digital or Analog Output	Super-compact size for small motors	Up to 512 PPR resolution	Short mounting depth	Easy installation without special tools	
Page Number	3.12	3.15	3.18	3.20	3.22	3.24	



INDUCTIVE - RESOLVER

Frameless 10	Frameless 15	Frameless 21	Frameless 31	Frameless 55	HaroMax® 15	HaroMax® 21	Product
0.25" (6mm)	0.472" (12mm)	0.800" (20mm)	1.576" (40mm)	3.651" (93mm)	0.472" (12mm)	0.800" (20mm)	Shaft size/ Max bore size
+/- 15 arcmin	+/- 10 arcmin	+/- 7 arcmin	+/- 20 arcmin	+/- 30 arcmin	+/- 5 arcmin	+/- 5 arcmin	Accuracy (Single Speed Only)
2 to 12	2 to 12	2 to 12	2 to 12	2 to 12	2 to 12	2 to 12	Input Voltage (Vrms)
Up to 200	Up to 200	Up to 200	Up to 200	Up to 200	Up to 200	Up to 200	Operating Temperature (°C)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Enclosure Rating
Compact mounting depth	Compact mounting depth	Compact mounting depth	Compact mounting depth	Compact mounting depth	Machine wound stator for high accuracy	Machine wound stator for high accuracy	Key Features
3.41	3.41	3.41	3.41	3.41	3.42	3.43	Page Number

OPTICAL - INCREMENTAL

M53	F10	F14	F15	F18	F21	HC20	Product
1/4" to 1/2" 6 to 12mm	6mm	1/4", 6mm, 8mm	3/8"	1/4" to 1/2" 6 to 12mm	1/2"	6mm, 8mm hub or hollow, 9mm tapered	Shaft/Bore Sizes
500 to 2500	1024 to 2048	200 to 5000	1024 to 2048	500 to 1000	1024 to 2048	500 to 2500	Available Resolutions (PPR)
5 or 12	5	5	5	5	5	5 or 5 to 26	Input Voltage (VDC)
0 to +120	0 to +120	0 to +120	0 to +120	0 to +120	0 to +120	0 to +120	Operating Temperature (°C)
NEMA 1/ IP50 (w/cover)	N/A	NEMA 1/ IP40 (w/cover)	N/A	NEMA 1/ IP40 (w/cover)	N/A	IP51	Enclosure Rating
Up to 2500PPR with commutation tracks	Compact 1.0" diameter servo ring mount	Non-marring hollow shaft	Industry standard size 15 servo mounting	Under 2.0" dia package with high 10,000PPR capability	Industry standard size 21 servo mounting	Economical servomotor feedback	Key Features
3.26	3.28	3.30	3.32	3.34	3.36	3.38	Page Number

# SERIES AD34

# ACURO™ brand

## Single Turn Absolute Encoder

### Key Features

- **Special Notched Shaft Installs Easily in One Step and Eliminates Coupling Issues**
- **Up to 19 bits of Singleturn Absolute Positioning**
- **Wide -15° to +120°C Operating Temperature Covers Majority of Servomotor Applications**



### NEW!



## SPECIFICATIONS

### ELECTRICAL

**Supply Voltage:** 5 VDC -5 %/+10 % or 7 - 30 VDC

**Max. Current w/o Load:** 50 mA

**Resolution Singleturn:** 12 -17 Bit

**Output Code:** Gray

**Drives:** Clock and Data / RS422

**Incremental signals:** Optional Sinus-Cosinus 1 Vpp

**Number of Pulses:** 2,048

**3dB Limiting Frequency:** 500 kHz

**Absolute Accuracy:** ±35°

**Repeatability:** ±7°

**Alarm Output:** Alarm bit (SSI-Option), warning bit and alarm bit (BiSS)

### MECHANICAL

**Housing Diameter:** 37.5 mm (1.48")

**Shaft Diameter:** 6 mm (Notched Shaft)

**Mounting:** Spring Tether

**Protection Class (EN 60529):** IP40 Housing & Shaft

**Shaft Speed (maximum):** 10,000 RPM (continuous), 12,000 RPM (peak)

**Torque:** 0.01 Ncm

**Moment of Inertia:** approx.  $2.5 \times 10^{-6}$  kgm<sup>2</sup>

**Weight:** approx. 80g (2.8 oz.)

**Connections:** Cable, radial; PCB connector, 12 pole

### ENVIRONMENTAL

**Vibration:** 100 m/s<sup>2</sup> (10 to 2,000 Hz) (DIN EN 60068-2-6)

**Shock:** 1,000 m/s<sup>2</sup> for 6 msec duration (DIN EN 60068-2-27)

**Operating Temperature:** -15°C to +120°C

**Storage temperature:** -15°C to +85°C (due to packaging)

## CONNECTIONS

PIN	1b	2b	3b	4b	5b	6b
Function	DC 5V / 7-30V (U <sub>p</sub> )	Clock	B -	OV (U <sub>n</sub> )	A -	Data
Color	White	Yellow	Gray/Pink	Brown	Brown/Green	Pink
PIN	1a	2a	3a	4a	5a	6a
Function	Data	A +	OV -Sen	B +	Clock	5V Sensor
Color	Gray	White/Green	Black	Red/Blue	Green	Violet

U<sub>p</sub> = power Supply

Sensor is connected to Power Supply and OV (U<sub>n</sub>)

Shield connected to case



# SERIES AD35

# ACURO™ brand

## Single Turn Absolute Encoder

### Key Features

- Short Mounting Depth Allows Installation in Tight Motor Endbells
- Up to 10,000RPM Speed Capability for Majority of Servomotor Applications
- 8mm Hubshaft Mount for Easy Installation



### NEW!



## SPECIFICATIONS

### ELECTRICAL

**Supply Voltage:** 5 VDC -5 %/+10 % or 10 - 30 VDC

**Max. Current w/o Load:** 50 mA

**Resolution Singleturn:** 17 Bit

**Output Code:** Gray

**Lines/Drives:** Clock and Data / RS422

**Incremental signals:** Sine-Cosine 1 Vpp

**Number of Increments:** 2,048

**3dB Limiting Frequency:** 500 kHz

**Absolute Accuracy:** ±35°

**Repeatability:** ±7°

**Alarm Output:** Alarm bit (SSI); Warning bit and alarm bit (BiSS)

### MECHANICAL

**Housing Diameter:** 37.5 mm (1.48")

**Material Shaft/ Flange/ Housing:** Stainless steel/ aluminum/ plastic

**Shaft Diameter:** 6 mm solid shaft (8 mm hub shaft optional)

**Mounting:** Spring Tether (Hub Shaft)

**Protection Class:** IP40 Housing & Shaft

**Shaft Speed (maximum):** 10,000 RPM (continuous), 12,000 RPM (peak)

**Torque:** ≤1 Ncm

**Moment of Inertia:** approx. 25 gcm<sup>2</sup>

**Shaft Load (solid-shaft):** Axial ≤5 N; Radial ≤10 N

**Shaft Load (hubshaft):** Spring Tether Tolerance: Axial ±0.5mm; Radial ±0.05mm

**Weight:** Approx. 80g (2.8 oz.)

**Connections:** Cable, PCB connector, 12 pole

### ENVIRONMENTAL

**Vibration:** 100 m/s<sup>2</sup> (10 to 500 Hz) (IEC 68-2-6)

**Shock:** 1,000 m/s<sup>2</sup> for 6 msec duration (IEC 68-2-27)

**Operating Temperature:** -15°C to +100°C

**Storage temperature:** -15°C to +85°C (due to packaging)

## CONNECTIONS

PIN	1b	2b	3b	4b	5b	6b
Function	DC 5V /7-30V (U <sub>p</sub> )	Clock	B -	OV (U <sub>n</sub> )	A -	Data
Color	Yellow/Black	White	Red	White/Green	Yellow	Black
PIN	1a	2a	3a	4a	5a	6a
Function	Data	A +	OV -Sen	B +	Clock	5V Sensor
Color	Violet	Green	Brown/Green	Blue	Brown	Red/Black

U<sub>p</sub> = power Supply

Sensor is connected to Power Supply and OV (U<sub>n</sub>)

Shield connected to case

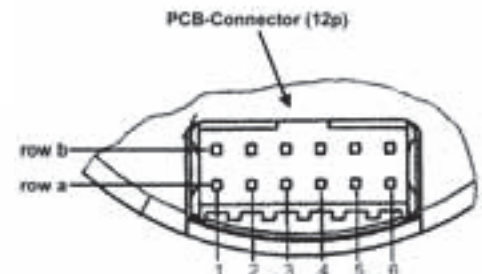
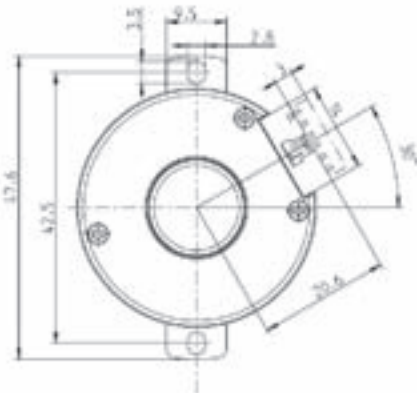
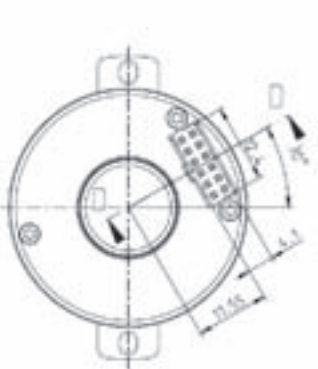
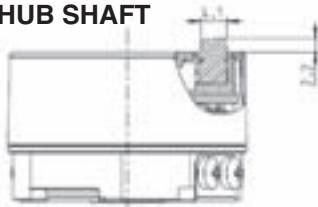
### Ordering Information

To order, complete the model number with code numbers from the table below.

Code 1: Mdel	Code 2 Resolution	Code 3 Voltage	Code 4 Flange/Protection/Shaft	Code 5 Output	Code 6 Connection
<b>AD35</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>
<b>AD35</b> ACURO Absolute Encoder	<b>0012</b> 12 Bit ST <b>0013</b> 13 Bit ST <b>0014</b> 14 Bit ST <b>0017</b> 17 Bit ST <b>0019</b> 19 Bit ST <b>0022</b> 22 Bit ST	<b>A</b> 5VDC* <b>E</b> 7-30VDC  * No Inverse polarity protection	<b>F.O.C</b> Optional, Spring Tether, IP40, 8mm Hub Shaft	<b>BI</b> BISS <b>SC</b> SSI Gray +1Vpp	<b>O</b> PCB Connector, 12 pole <b>B</b> Cable Radial, 0.5m

### Dimensions (mm)

#### HUB SHAFT



12 pin PCB connector  
manufacture Berg, type Mnitek



# SERIES AD36

# ACURO™ brand

## Single- / Multi- Turn Absolute Encoder **NEW!**

### Key Features

- **Compact Dimensions Compatible with Size 15 Resolvers**
- **Up to 22 Bit Singleturn and 12 Bit True Multiturn Absolute Positioning**
- **Optional Sinewave 1Vp-p Output for Easy Integration Into Older Controls**



## SPECIFICATIONS

### ELECTRICAL

**Supply Voltage:** 5 VDC -5 %/+10 % or 10 - 30 VDC  
**Max. Current w/o Load:** Single-Turn: 50 mA; Multi-Turn: 100 mA  
**Resolution Singleturn:** SSI: 13 Bit; Biss: 19 Bit  
**Output Code:** Gray  
**Lines/Drives:** Clock and Data / RS422  
**Incremental Signals:** Sine-Cosine 1 Vpp  
**Number of Increments:** 2,048  
**3dB Limiting Frequency:** 500 kHz  
**Absolute Accuracy:**  $\pm 35''$   
**Repeatability:**  $\pm 7''$   
**Alarm Output:** Alarm bit (SSI); Warning bit and alarm bit (BiSS)

### MECHANICAL

**Housing Diameter:** 37.5 mm (1.48")  
**Material Shaft/ Flange/ Housing:** Stainless steel/ aluminum/ plastic  
**Shaft Diameter:** 8 mm solid shaft  
**Mounting:** Spring Tether (Hollow Shaft)  
**Protection Class:** IP40 Housing & Shaft  
**Shaft Speed (maximum):** 10,000 RPM (continuous), 12,000 RPM (peak)  
**Torque:** 0.01 Ncm  
**Moment of Inertia:** approx. 25 gcm<sup>2</sup>  
**Shaft Load (solid-shaft):** Axial  $\leq 5$  N; Radial  $\leq 10$  N  
**Shaft Load (hollowshaft):** Spring Tether Tolerance: Axial  $\pm 0.5$ mm; Radial  $\pm 0.05$ mm  
**Weight ST/MT:** 80g (2.8 oz.) / 130g (4.6 oz.)  
**Connections:** Cable, PCB connector, 12 pole

### ENVIRONMENTAL

**Vibration:** 100 m/s<sup>2</sup> (10 to 500 Hz) (IEC 68-2-6)  
**Shock:** 1,000 m/s<sup>2</sup> for 6 msec duration (IEC 68-2-27)  
**Operating Temperature:** -15°C to +120°C  
**Storage temperature:** -15°C to +85°C (due to packaging)

## CONNECTIONS

PIN	1b	2b	3b	4b	5b	6b
Function	DC 5V / 7-30V (U <sub>p</sub> )	Clock	B -	OV (U <sub>n</sub> )	A -	Data
Color	Yellow/Black	White	Red	White/Green	Yellow	Black
PIN	1a	2a	3a	4a	5a	6a
Function	Data	A +	OV -Sen	B +	Clock	5V Sensor
Color	Violet	Green	Brown/Green	Blue	Brown	Red/Black

U<sub>p</sub> = power Supply

Sensor is connected to Power Supply and OV (U<sub>n</sub>)

Shield connected to case

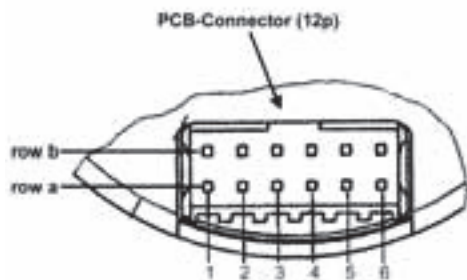
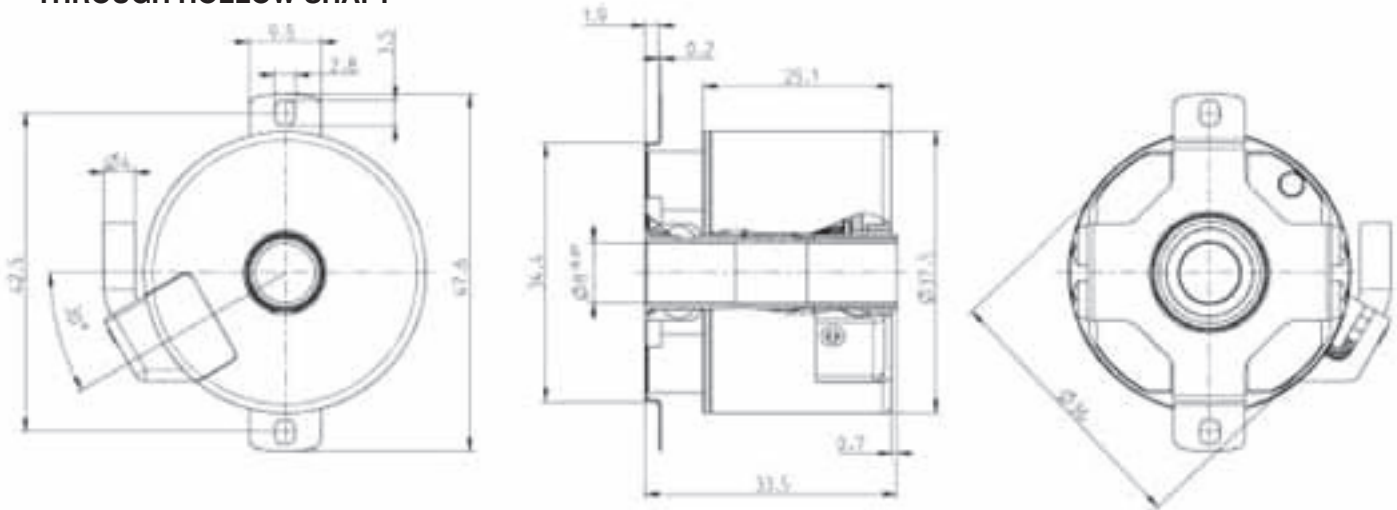
### Ordering Information

To order, complete the model number with code numbers from the table below.

Code 1: Mdel	Code 2 Resolution	Code 3 Voltage	Code 4: Flange/Protection/Shaft	Code 5 Output	Code 6 Connection
<b>AD36</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>
<b>AD36</b> ACURO Absolute Encoder	<b>0012</b> 12 Bit ST <b>0013</b> 13 Bit ST <b>0014</b> 14 Bit ST <b>0017</b> 17 Bit ST <b>0019</b> 19 Bit ST (Biss) <b>0022</b> 22 Bit ST <b>1213</b> 12 Bit MF +13 Bit ST <b>1217</b> 12 Bit MF +17 Bit ST <b>1219</b> 12 Bit MF +19 Bit ST (Biss) <b>1222</b> 12 Bit MF +22 Bit ST	<b>A</b> 5VDC* <b>E</b> 7-30VDC  * No Inverse polarity protection	<b>F.OC</b> Optional, Spring Tether, IP4Q, 8mm Through Hollow Shaft  <b>F.OR</b> Spring Tether, IP4Q, 8mm Hub Shaft	<b>BI</b> BiSS (1 Vss redundant optional)  <b>SC</b> SSI Gray +1Vpp	<b>0</b> PCB Connector, 12 pole <b>B</b> Cable Radial, 0.5m

### Dimensions (mm)

#### THROUGH HOLLOW SHAFT



12 pin PCB connector  
manufacture Berg, type Mnitek

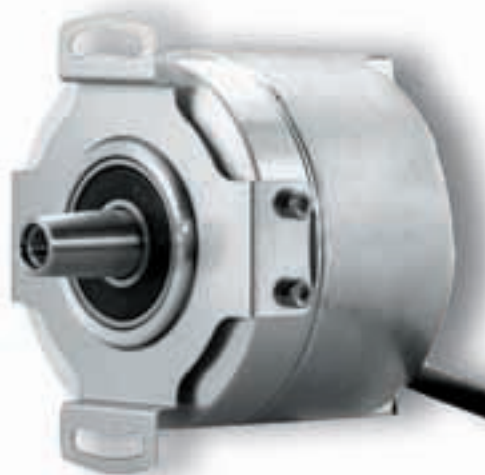
# SERIES AD25

# ACURO™ brand

## Single- / Multi- Turn Absolute Encoder

### Key Features

- **Special Conical Shaft for Concentric Motor Mounting**
- **Up to 22 Bits of Singleturn Absolute Positioning for Smooth Low Speed Motor Performance**
- **Integrated On-Board Diagnostics to Monitor Encoder Health**



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Supply Voltage:** 5 VDC, +10% / -5%

**Current Consumption (w/o output current):**

*Single-turn:* £ 45 mA (at 5V)

*Multi-turn:* £ 85 mA (at 5V)

**Absolute Accuracy:** ± 0.01° mechanical (36 arc-sec.)

**Repeatability:** ± 0.002° mechanical (7.2 arc-sec.)

**Connection:** 1 ft. Cable (30 cm)

**Incremental Signals (SSI models only)**

**Resolution:** 2048

**Format:** A, B Quadrature, 1 Vpp Sine wave

**SSI Interface**

**Resolution:**

**Single-turn:** 13 Bits

**Multi-turn resolution:** 12 Bits

**Interface:**

**Number of lines:** 4 unidirectional (2 for clock; 2 for data)

**Electrical Interface:** RS 422

**Transmission speed:** 70 kHz to 2 MHz per SSI definition

**BiSS Interface**

**Resolution:**

**Single-turn resolution:** 22 Bits

**Multi-turn resolution:** 12 Bits

**Interface:**

**Signals:** Clock unidirectional (from master to encoder);  
Data unidirectional (from encoder to master)

**Electrical Interface:** RS 422

**Number of lines:** 4 unidirectional (2 for clock and 2 for data)

**Transmission speed:** 70 kHz – 10 MHz

**Transmission security:** 1 start bit, 1 stop bit, 6 Bit CRC

**Diagnostic functions:** possible failure modes are constantly checked with the following functions

**LED current sensing:** Pollution, condensation, over-temperature

**Single-step check:** Disk pollution or damage, condensation, mechanical overload

**Temperature monitoring:** Warning message if the user-defined limits have been reached/exceeded

*For further information on the BiSS interface please consult: <http://www.biss-ic.de/>*

### MECHANICAL

**Shaft Size:**

**Tapered solid shaft:** 10 mm diameter;  
Cone 1:10

**Tapered hub shaft:** 10 mm diameter;  
Cone 1:10

**Shaft Loading:** 5 lb axial, 20 lb radial

**Shaft Speed:** 10,000 RPM (continuous), 12,000 RPM (peak-ST only)

**Starting Torque:** < 1.4 in-oz

**Weight:** 6.2 oz.

**Diameter:** 2.28"

**Length:** 1.85"

### ENVIRONMENTAL

**Operating Temperature:** -15 to +120° C

**Storage Temperature:** -25 to +85° C (due to packaging)

**Enclosure Rating:** IP40

**Shock:** 100 g's for 6 msec duration

**Vibration:** 10 g's (10 to 2000 Hz)

## CONNECTIONS

PIN	1b	2b	3b	4b	5b	6b
Name	Power Supply (U <sub>p</sub> )	Clock	B -	OV (U <sub>n</sub> )	A -	Data
Color	Gray/Pink	White	Red	White/Green	Yellow	Black
PIN	1a	2a	3a	4a	5a	6a
Name	Data	A +	OV -Sen	B +	Clock	U <sub>p</sub> Sensor
Color	Violet	Green	Brown/Green	Blue	Brown	Blue/Red

U<sub>p</sub> = power Supply

Sensor is connected to Power Supply and OV (U<sub>n</sub>)

Shield connected to case

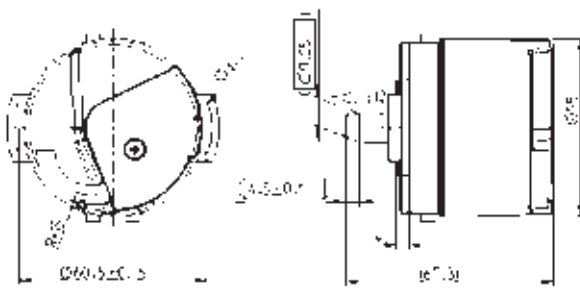
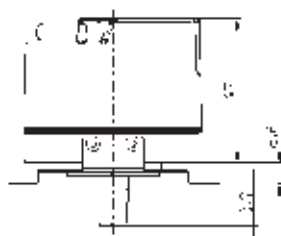
### Ordering Information

To order, complete the model number with code numbers from the table below.

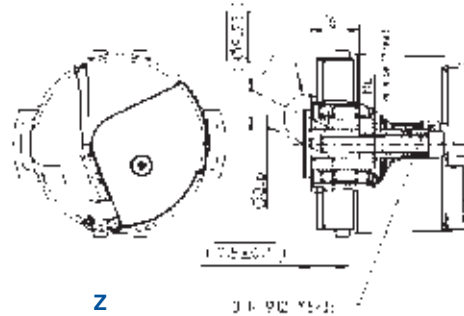
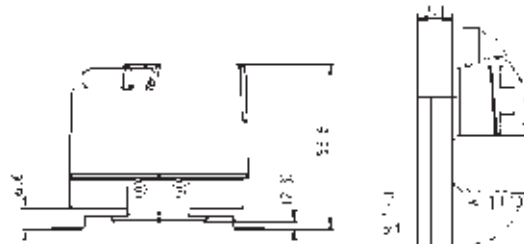
Code 1: Model	Code 2 Bits	Code 3: Mounting	Code 4 Shaft Size	Code 5 Protocol	Code 6 Electrical	Code 7: Connector
<b>AD25</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>AD25</b> Size 25 Acuro Absolute Encoder	<b>Single-Turn</b> <b>0013</b> 13 Bit <b>0022</b> 22 Bit	<b>4</b> Spring Tether	<b>Y</b> 10mm Shaft (1Q.1 Taper) <b>Z</b> 10mm Hub Shaft (1Q.1 Taper)	Available when Code 2 is 0022 or 1222 <b>A</b> BiSS	<b>0</b> 5VDC	<b>M</b> Drive cable, 1 foot (30 cm)
	<b>Multi-Turn</b> <b>1213</b> 12 Bit Multi- Turn, 13 Bit Single-Turn <b>1222</b> 12 Bit Multi- Turn, 22 Bit Single-Turn			Available when Code 2 is 0013 or 1213 <b>F</b> SSI-Gray Code, + 1Vpp		

### Dimensions (mm)

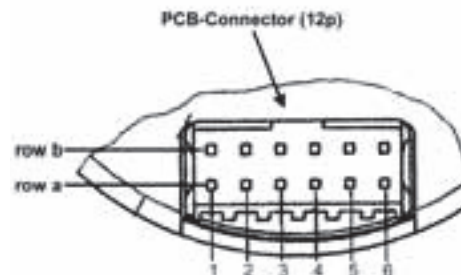
#### Code 4: Shaft Size



**Y**  
10mm (1Q.1 taper) Shaft



**Z**  
10mm Hub Shaft



12 pin PCB connector  
manufacture Berg, type Minitek

# SERIES M602 & M832

**Dynapar™ brand**

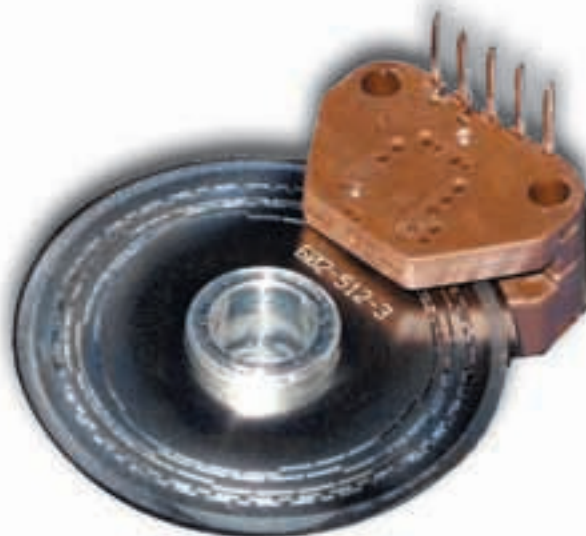
## Kit Encoder

### Key Features

- Compact Size for Easy Integration
- Advanced Phased-Array Sensor Technology with Digital or Analog Output
- Available with Unbreakable Plastic or Stainless Code Discs
- Commutation Tracks Available for Brushless Motor Commutation
- Line Driver Output Board Available



**NEW!**



## SPECIFICATIONS

### ELECTRICAL

**Code:** Incremental  
**Resolution:** See ordering information for standard resolutions  
**Supply Voltage:** 5Vdc + 10% at 60mA maximum  
**Output Format:** Dual channel quadrature  
**Output Format Options:** Index and commutation. *ComTracks available on Digital version only*  
**Output Type – Digital:** Square wave, TTL and CMOS compatible, 10mA sink  
**Output Type – Analog:** Current Source  
**Frequency Response:** 125 kHz (data and index)

### MECHANICAL

**Dimensions:** See module outline dimensions  
**Weight:** <0.25 ounces  
**Termination:** .025 sq. discrete pins

### Materials

**Module:** Molded PPS 40% glass (R-4)  
**Pins:** gold plated  
**Disc:** mylar or etched metal  
**Hub:** aluminum

### Disc Interface

**Runout:** 0.005 inches TIR  
**Endplay:** + 0.010 inches  
**Optical Radius (data):** 0.602 or 0.832 inches

### Motor Interface

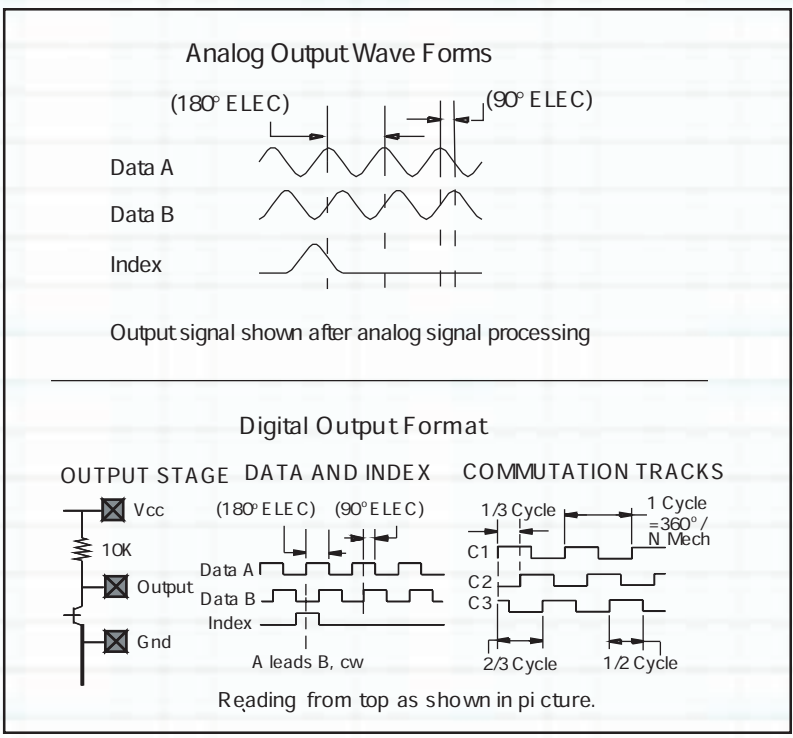
**Mounting Holes:** See recommended mounting

### Connector Interface

**Molex Connector:** P/N 50-57-9005  
**Molex Socket:** P/N 16-02-0069  
**AMP Connector:** P/N 87499-9  
**AMP Socket:** P/N 87667-3

### ENVIRONMENTAL CONDITIONS

**Operating Temperature:** -40° to 100°C (non-condensing)  
**Storage Temperature:** -40° to 100°C  
**Enclosure:** Unsealed housing





# SERIES M602 & M832

## ORDERING INFORMATION

To order, complete the model number with code numbers from the table below.

Encoder Module (Rotary)	Code Disc and Hub
<b>Digital M</b> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">602</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">1000</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">3T</div> <span>-</span> <div style="border: 1px solid black; padding: 2px; font-size: small;">See Note</div> </div> <div style="display: flex; justify-content: space-around; font-size: x-small; margin-top: 5px;"> <span>1.</span> <span>2.</span> <span>3.</span> </div>	<b>DH</b> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">602</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">1000</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">0</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">25</div> </div> <div style="display: flex; justify-content: space-around; font-size: x-small; margin-top: 5px;"> <span>1.</span> <span>2.</span> <span>3.</span> <span>4.</span> </div>
<b>Analog AM</b> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">602</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">2000</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">6T</div> </div> <div style="display: flex; justify-content: space-around; font-size: x-small; margin-top: 5px;"> <span>1.</span> <span>2.</span> <span>3.</span> </div>	<b>Code Disc Only (no Hub)</b> <b>D</b> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">602</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">1000</div> <span>-</span> <div style="border: 1px solid black; padding: 2px;">0</div> </div> <div style="display: flex; justify-content: space-around; font-size: x-small; margin-top: 5px;"> <span>1.</span> <span>2.</span> <span>3.</span> </div>

<p><b>1. Optical Radius</b></p> <p>0.602 inches ..... 602</p> <p>0.832 inches ..... 832</p> <p><b>2. Standard Resolutions</b></p> <p><b>Digital 602 Module</b></p> <p>Resolutions from 35 to 3600.</p> <p>See "Current Resolutions" list</p> <p><b>Digital 832 Module</b></p> <p>Resolutions from 360 to 5000</p> <p>See "Current Resolutions" list</p> <p><b>Analog 602 Module</b></p> <p>Available Resolutions: 1000 &amp; 1024</p> <p><b>Analog 832 Module</b></p> <p>Available Resolutions: 2000 &amp; 2048</p> <p><b>3. Lead Positions</b></p> <p><b>Digital</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Side Exit</td> <td style="width: 50%;">Top Exit</td> </tr> <tr> <td>A ..... 1S</td> <td>A ..... 1T</td> </tr> <tr> <td>AB ..... 2S</td> <td>AB ..... 2T</td> </tr> <tr> <td>ABZ ..... 3S</td> <td>ABZ ..... 3T</td> </tr> <tr> <td></td> <td>ABZ + COMS ..... 6T</td> </tr> </table> <p><b>Analog</b></p> <p>Top Exit</p> <p>ABZ ..... 6T</p>	Side Exit	Top Exit	A ..... 1S	A ..... 1T	AB ..... 2S	AB ..... 2T	ABZ ..... 3S	ABZ ..... 3T		ABZ + COMS ..... 6T	<p><b>1. Disc Outside Diameter</b></p> <p>1.30 inches ..... 602</p> <p>1.75 ..... 832</p> <p><b>2. Standard Resolutions</b></p> <p>See "Current Resolutions" list</p> <p><b>3. Commutation Tracks (Option)</b></p> <p>(Available on 6T digital module only)</p> <p>Not required ..... 0</p> <p>Specify 2, 3, 4, 6 or 8 motor pole pairs</p> <p><b>4. Hub Bore Size*</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">1/4 inch</td> <td style="width: 33%;">..... 25</td> <td style="width: 33%;">6mm</td> <td>..... 6M</td> </tr> <tr> <td>3/8 inch</td> <td>..... 38</td> <td>8mm</td> <td>..... 8M</td> </tr> <tr> <td></td> <td></td> <td>10mm</td> <td>..... 10M</td> </tr> </table> <p>*Consult factory for other sizes</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>NOTE: When ordering Modules with Index add a "G" to the end of the part number for GATED INDEX or "U" for UNGATED INDEX.</b></p> <p><b>When ordering Modules in 1000 or 1024PPR to specify DOUBLER CIRCUIT add a "D" to the last digit. Example: M602-1000-3T-UD</b></p> </div>	1/4 inch	..... 25	6mm	..... 6M	3/8 inch	..... 38	8mm	..... 8M			10mm	..... 10M
Side Exit	Top Exit																						
A ..... 1S	A ..... 1T																						
AB ..... 2S	AB ..... 2T																						
ABZ ..... 3S	ABZ ..... 3T																						
	ABZ + COMS ..... 6T																						
1/4 inch	..... 25	6mm	..... 6M																				
3/8 inch	..... 38	8mm	..... 8M																				
		10mm	..... 10M																				

## RESOLUTIONS

### M602 Digital Modules

1, 24, 25, 35, 40, 60, 100, 120, 192, 200, 240, 250, 256, 300, 360, 500, 512, 600, 625, 720, 1000\*, 1024\*

\* Available as direct read or doubler

**Doubler:** 1000, 1024, 1200, 1250, 1440, 2000, 2048, 2500, 2540, 2600 3600

With Commutation for Brushless Motors:

CPR	Pole Pairs
500	5 or 6
512	3 or 6

### M832 Digital Modules

**Direct Read:** 360, 1000, 1024

**Doubler:** 2000, 2048, 3600, 4096, 5000

With Commutation for Brushless Motors:

CPR	Pole Pairs
1000	2, 3, 4, 6 or 8
1024	6

### AM602/AM832 Analog Modules

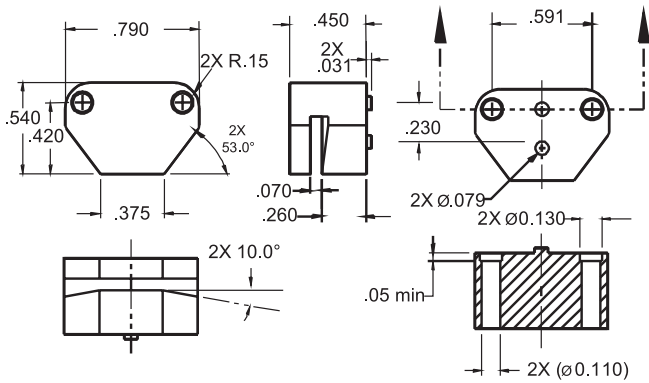
AM602	AM832
1000,	1024 2000, 2048

Analog Modules available in -6T configuration only  
 For new Disc resolutions or radii please consult factory for availability and NRE. We are constantly adding new resolutions so if the one you require is not listed please call the factory for availability

# SERIES M602 & M832



### Module Outline Dimensions

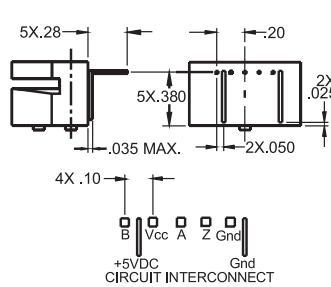


### Pin Layouts

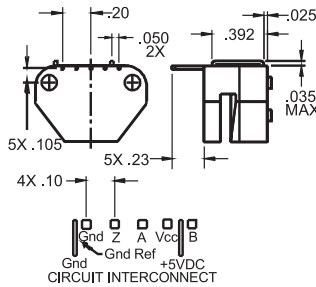
The Optical Encoder Modules come standard in either top mount or side mount with A,B, and Index Channels. Commutation Channels are optionally available for Digital modules in top-mounted configurations only.

### ABZ CONFIGURATION 5X .025 square pins

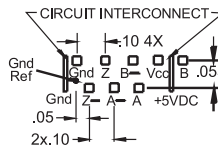
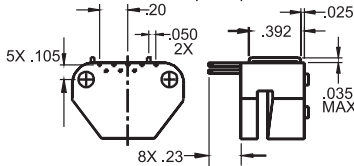
#### SIDE MOUNT (-1S, -2S, -3S)



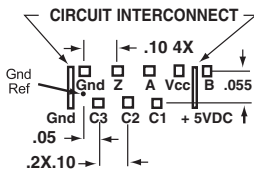
#### TOP MOUNT (-1T, -2T, -3T)



### ANALOG CONFIGURATIONS (-6T) 8X .025 square pins



Analog Pinouts



Digital Pinouts

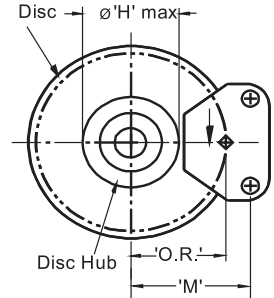
### Module Interface

#### Module 602

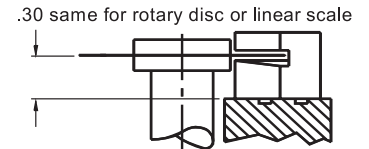
'O.R.' – Optical Radius .....0.602 in.  
'M' – Mounting dimension ..0.756 in.  
Ø 'H' – Hub Maximum O.D. ...061 in.

#### Module 832

'O.R.' – Optical Radius ..... 0.832. in.  
'M' – Mounting dimension...0.986 in.  
Ø 'H' – Hub maximum O.D...1.07 in.



### DISC MOUNTING



### Disc and Hub Dimensions

#### Module 602 Disc and Hub

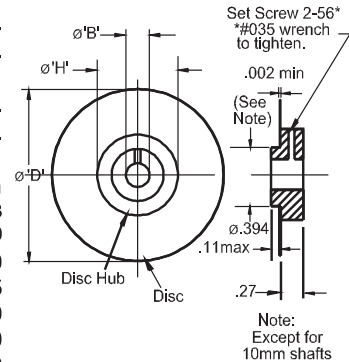
Ø'D' – Disc O.D. .... 1.30 in.  
Ø 'H' – Hub O.D. .... 0.61 in.

#### Module 832 Disc and Hub

Ø'D' – Disc O.D. .... 1.75 in.  
Ø 'H' – Hub O.D. .... 1.00 in.

#### Shaft Size Hub Bore Sizes

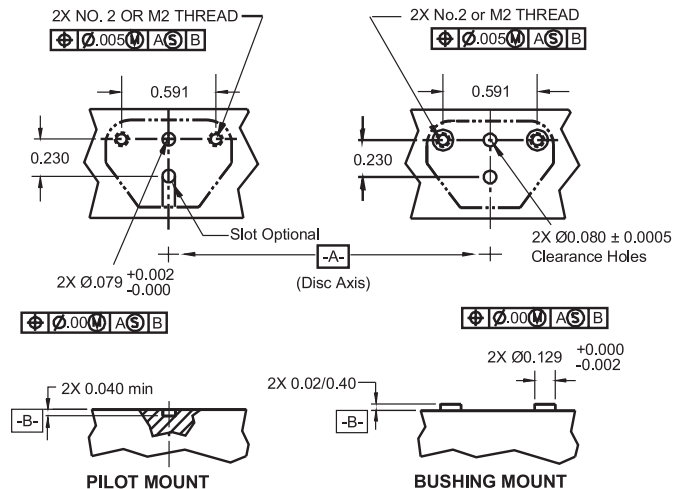
	Ø'B' in.	Ø'B' mm
	+0.0005	+0.013
	+0.0000	-0.000
1/4 in.	.2500	6.350
3/8 in.	.3750	9.525
6 mm	.2362	6.000
8 mm	.3150	8.000
10 mm	.3937	10.000



#### Disc only

.3942 I.D. x .002 min. thick

### Recommended Mounting Configurations



# SERIES LM & LAM

# Dynapar™ brand

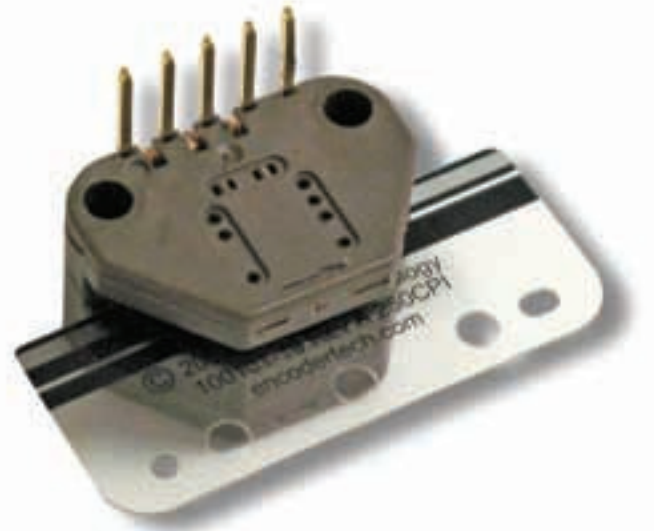
## Kit Encoder

### Key Features

- Compact Size for Easy Integration
- Advanced Phased-Array Sensor Technology with Digital or Analog Output
- Rugged Plastic or Metal Scale Material



## NEW!



## SPECIFICATIONS

### ELECTRICAL

**Code:** Incremental

**Resolution:** See ordering information for standard resolutions

**Supply Voltage:** 5Vdc + 10% at 60mA maximum

**Output Format:** Dual channel quadrature

**Output Format Options:** Index

**Output Type – Digital:** Square wave, TTL and CMOS compatible, 10mA sink

**Output Type – Analog:** Output from diode array

**Frequency Response:** 125 kHz (data and index)

### MECHANICAL

**Dimensions:** See module outline dimensions

**Weight:** <0.25 ounces

**Termination:** .025 sq. discrete pins

### Materials

**Module:** Molded PPS 40% glass (R-4)

**Pins:** gold plated

**Scale:** Mylar or etched metal

### ENVIRONMENTAL CONDITIONS

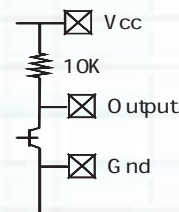
**Operating Temperature:** -40° to 100°C (non-condensing)

**Storage Temperature:** -40° to 100°C

**Enclosure:** Unsealed housing

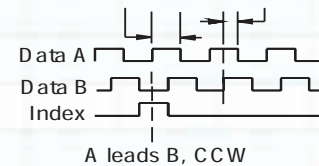
### Digital Output

#### Output Stage



#### Data and Index

(180° ELEC) (90° ELEC)



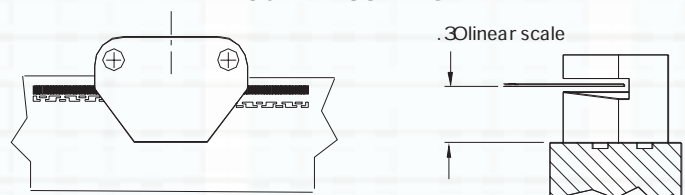
### Analog Output Wave Forms

(180° ELEC) (90° ELEC)



Output signal shown after analog signal processing

### SCALE MOUNTING

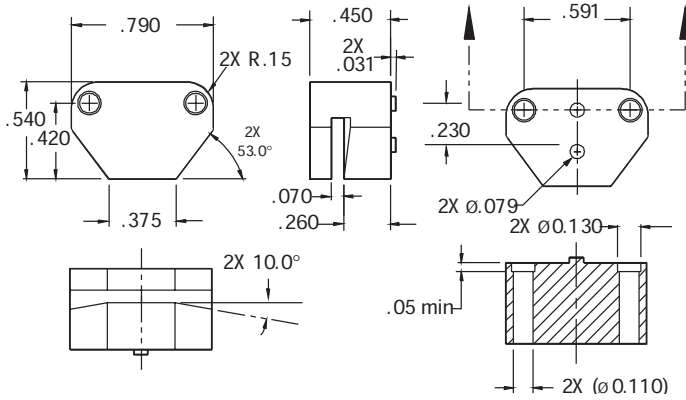


Linear Module Scale made to order: contact factory

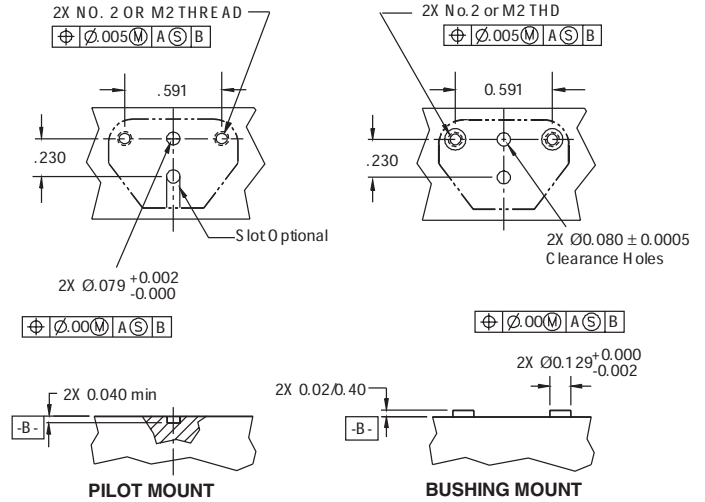




### Module Outline Dimensions



### Recommended Mounting Configurations

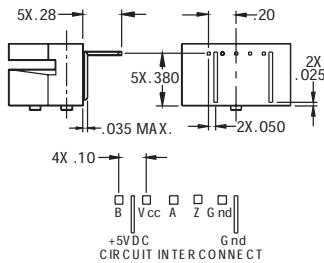


### Pin Layouts

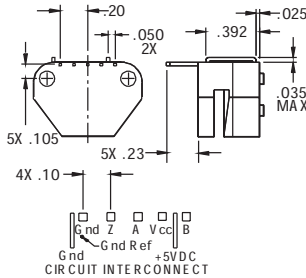
The Optical Encoder Modules come standard in either top mount or side mount with A, B, and Index C channels.

#### ABZ CONFIGURATION 5X .025 square pins

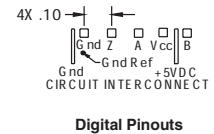
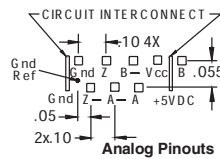
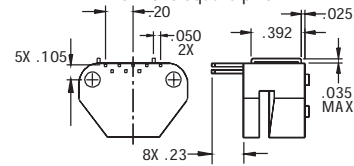
SIDE MOUNT (-1S, -2S, -3S)



TOP MOUNT (-1T, -2T, -3T)



#### ANALOG CONFIGURATIONS (-6T) 8X .025 square pins



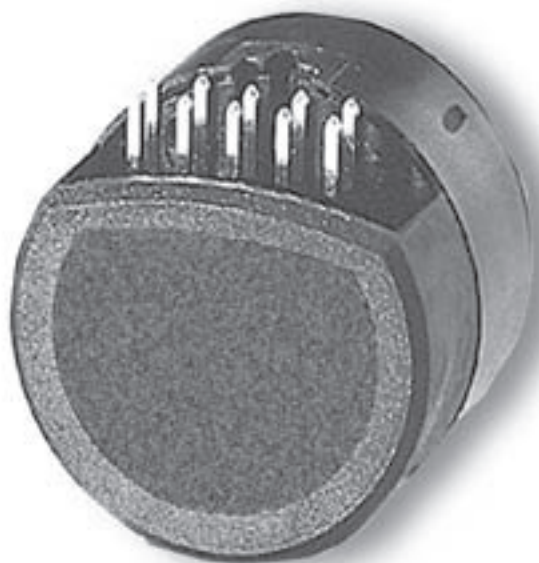
# SERIES E9

**Dynapar™ brand**

## Miniature Encoder

### Key Features

- Super-Compact Modular Encoder for Small Servo and Stepper Motor Feedback
- Differential Outputs Available
- Low-Power Standby Mode is Ideal for Battery Powered Applications



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental, Optical  
**Resolution:** Incremental pulses per revolution; 100 to 512  
**Phasing:** 90° ±18° electrical degrees  
**Symmetry:** 180° ±18° electrical  
**Index Pulse Width:** 90° ±36° electrical

### ELECTRICAL

**Supply Voltage:** 5 VDC ±10%  
**Supply Current:** 10 mA, typ.  
**Standby Current:** 50 µA, max.

**Output Signals:** 2.5 V min. high ( $V_{OH}$ ); 0.5 V max. low ( $V_{OL}$ ). 3 mA sink/source (25°C), 2 mA (100°C)  
**Frequency Response:** 200 kHz  
**Termination:** 10 pin header (accessory connector/12" ribbon cable, part no. CA0040012)  
**Recommended Mating Connector:** Thomas & Betts part number 622-1030

### MECHANICAL

**Weight:** 0.18 oz (5.07 g)  
**Moment of Inertia:** 0.28 x 10<sup>-5</sup> oz-in-sec<sup>2</sup> (0.20 gm-cm<sup>2</sup>)  
**Hub Bore:** 1.5, 2.0, 2.5, 3.0, 4.0 mm; 0.125, 0.156 inch

**Hub Dia. Tolerance:** +0.0004"/-0.0000" (+0.010 mm/-0.000 mm)  
**Mating Shaft Length:** See table  
**Mating Shaft Runout:** 0.001 TIR  
**Mating Shaft Endplay:** >256 ppr: ±0.003" (±0.076mm); 250, 256 ppr: +0.005/-0.003" (+0.127/-0.076mm); <250 ppr: +0.007/-0.003" (+0.178/-0.076mm)

### ENVIRONMENTAL

**Operating Temperature:** -20° to 100°C  
**Storage Temperature:** -50° to 125°C  
**Relative Humidity:** 90% non-condensing

### OUTPUT WAVEFORMS & CONNECTIONS (direction viewing encoder cover)

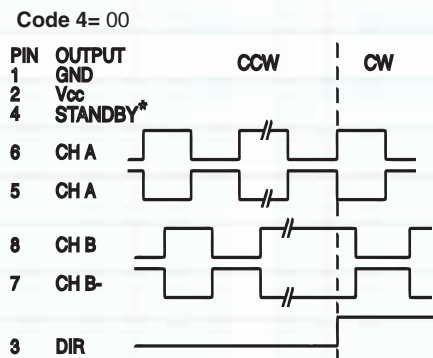


Figure 1

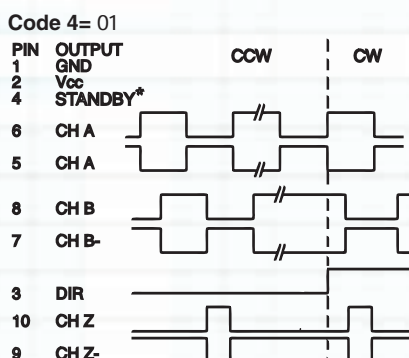


Figure 2

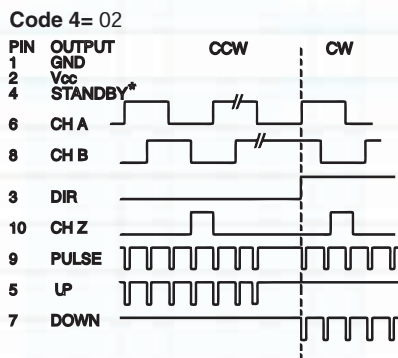


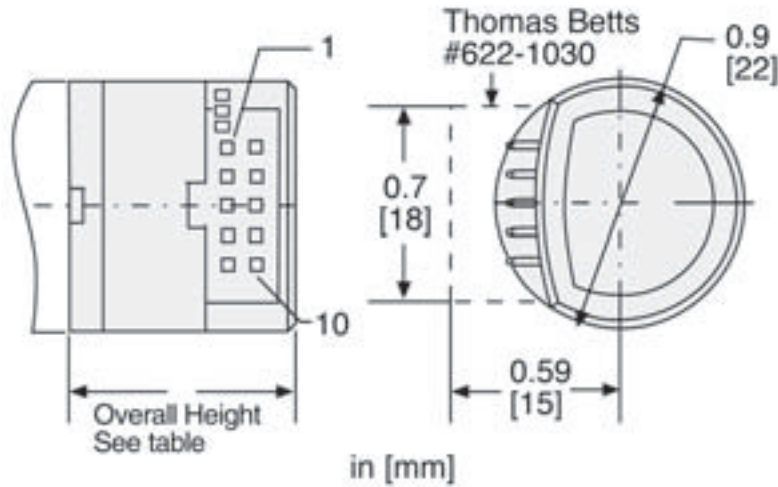
Figure 3

\* For operation, connect STANDBY (4) to Vcc (2)



# SERIES E9

## DIMENSIONS/INSTALLATION



Base (Code 3)	Overall Height inch (MM)	Motor Shaft Length inch (MM)	
		Max.	Min
A	0.795 (20.20)	0.479 (12.16)	0.467 (11.86)
C, D, E	0.929 (23.60)	0.613 (15.56)	0.581 (14.76)

Bases C and D provide clearance for motor-bosses with maximum dimensions of 0.5 in, Dia. x 0.15 in. high. Base E provides clearance for motor-bosses with maximum dimensions of 1.0 in. x 0.15 in. high

## ORDERING INFORMATION

To order, complete the model number with code numbers from the table below.

Code 1: Model	Code 2: PPR	Code 3: Hub Bore	Description	Code 4: Output	Description	Code 5: Mounting	Description
<b>E9</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/>	
Ordering Information							
<b>E9</b>	0.9" Diameter Incremental Modular Encoder	<b>0100</b>	<b>1.5</b> 1.5 mm	<b>00</b> See Figure 1		<b>0</b>	No mounting base
		<b>0144</b>	<b>2.0</b> 2.0 mm	<b>01</b> See Figure 2		<b>A</b>	4x M1.6 on 0.728" BC
		<b>0200</b>	<b>2.5</b> 2.5 mm	<b>02</b> See Figure 3		<b>C</b>	2x #2-56 on 0.75" BC
		<b>0256</b>	<b>3.0</b> 3.0 mm			<b>D</b>	3x #0-80 on 0.823" BC
		<b>0300</b>	<b>4.0</b> 4.0 mm			<b>E</b>	2x #2-56 On 1.812" BC
		<b>0360</b>	<b>125</b> 0.125 in				
		<b>0500</b>	<b>156</b> 0.156 in				
		<b>0512</b>					

**IMPORTANT:** To properly install Series E 9, a specialized mounting kit must be purchased. Only one kit is required to install any number of encoders with the same hub bore size.

Kit Part Number: MK E 9  *Code 3 (from Models Table, above) designating Hub Bore requirement*

Example: Kit for installing encoders with 3.0 mm hub Bore= **MK E9 3.0**

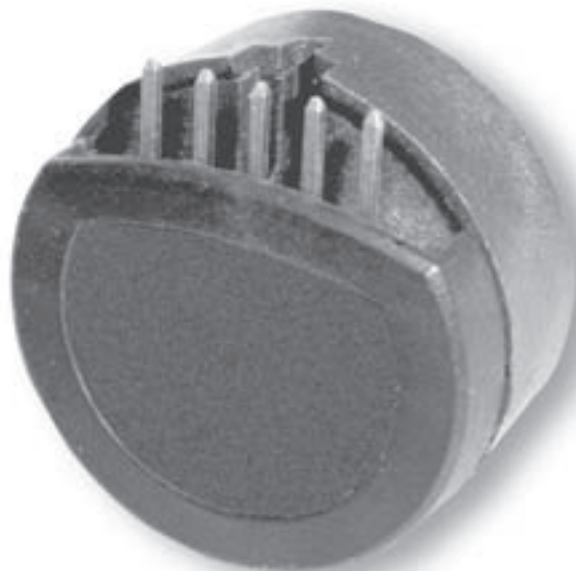
# SERIES M9

# Dynapar™ brand

## Miniature Encoder

### Key Features

- Super-Compact Modular Encoder for Small Servo and Stepper Motor Feedback
- Integrated ASIC for Enhanced Reliability and Accuracy
- Up to 512 PPR Resolution



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental, Optical

**Resolution:** Incremental pulses per revolution; 100 to 512

**Phasing:** 90° ±18° electrical

**Symmetry:** 180° ±18° electrical

**Index Pulse Width:** 90° ±36° electrical

### ELECTRICAL

**Supply Voltage:** 5 VDC ±10%

**Supply Current:** 10 mA, typ.

**Output Signals:** 2.5 V min. high ( $V_{OH}$ ); 0.5 V max. low ( $V_{OL}$ ), 6 mA sink/source (25°C), 4 mA (100°C)

**Frequency Response:** 200 kHz

**Termination:** 5 pin header (accessory 12" wires w/connector, part no. CA0050012) or flying leads

**Recommended Mating Connector:** AMP part number 103675-4

### MECHANICAL

**Weight:** 0.15 oz (4.14 g)

**Moment of Inertia:** 0.15 x 10<sup>-5</sup> oz-in-sec<sup>2</sup> (0.11 gm-cm<sup>2</sup>)

**Hub Bore:** 1.5, 2.0, 2.5, 3.0, 4.0 mm; 0.125, 0.156 inch

**Hub Dia. Tolerance:** +0.0004"/-0.0000" (+0.010 mm/-0.000 mm)

**Mating Shaft Length:** See table

**Mating Shaft Runout:** 0.001 TIR

**Mating Shaft Endplay:** >256 ppr: ±0.003" (±0.076mm); 250, 256 ppr: +0.005/-0.003" (+0.127/-0.076mm); <250 ppr: +0.007/-0.003" (+0.178/-0.076mm)

### ENVIRONMENTAL

**Operating Temperature:** -20° to 100°C

**Storage Temperature:** -50° to 125°C

**Relative Humidity:** 90% non-condensing

## OUTPUT WAVEFORMS & CONNECTIONS

PIN	FUNCTION	CABLE WIRE
1	GND	BLACK
2	CH Z	BLUE
3	CH A	WHITE
4	Vcc	RED
5	CH B	BROWN

(Direction CCW viewing encoder cover)



# SERIES M14

# Dynapar™ brand

## Miniature Encoder

### Key Features

- Ideal Economical Choice for Stepper and Servo Motor Feedback
- Short .678" Mounting Depth and 1.5" Diameter
- Up to 1024PPR Resolution with Index



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental, Optical

**Resolution:** Incremental pulses per revolution; 200 to 1024

**Phasing:** 90° ±18° electrical

**Symmetry:** 180° ±18° electrical

**Index Pulse Width:** 90° ±36° electrical

### ELECTRICAL

**Supply Voltage:** 5 VDC ±10%

**Supply Current:** 10 mA, typ.

**Output Signals:** 2.5 V min. high ( $V_{OH}$ ); 0.5 V max. low ( $V_{OL}$ ), 6 mA sink/source (25°C), 4 mA (100°C)

**Frequency Response:** 200 kHz

**Termination:** 5 pin connector (accessory connector w/12" wires, part no. CA0060012)

**Recommended Mating Connector:** Amp Part Number 103969-4

### MECHANICAL

**Weight:** 0.22 oz (6.2 g)

**Moment of Inertia:** 0.16 x 10<sup>-5</sup> oz-in-sec<sup>2</sup> (0.13 gm-cm<sup>2</sup>)

**Hub Bore:** 3.0, to 8.0 mm; 0.125, to 0.375 inch

**Hub Dia. Tolerance:** +0.0004"/-0.0000" (+0.010 mm/-0.000 mm)

**Mating Shaft Length:** 0.525" (13.3 mm) max.; 0.436" (11.07 mm) min.

**Mating Shaft Runout:** 0.001 TIR

**Mating Shaft Endplay:** >512 ppr: ±0.003" (±0.076mm); 500, 512 ppr: +0.005/-0.003" (+0.127/-0.076mm); <500 ppr: +0.007/-0.003" (+0.178/-0.076mm)


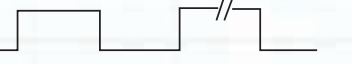

### ENVIRONMENTAL

**Operating Temperature:** -20° to 100°C

**Storage Temperature:** -50° to 125°C

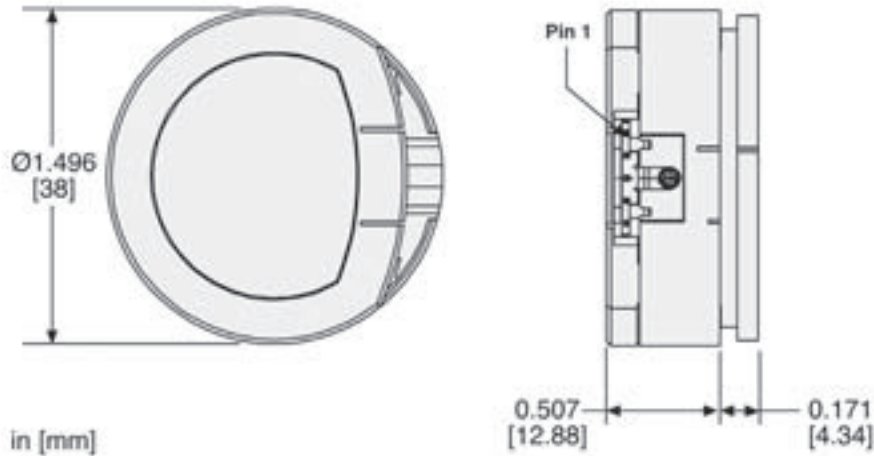
**Relative Humidity:** 90% non-condensing

### OUTPUT WAVEFORM AND CONNECTIONS

PIN	FUNCTION	CABLE WIRE
5	GND	BLACK
4	CH Z 	BLUE
3	CH A 	WHITE
2	Vcc	RED
1	CH B 	BROWN

Direction: CCW viewing encoder cover

## Dimensions/Installation



### Ordering Information

To order, complete the model number with code numbers from the table below.

Code 1: Model	Code 2: PPR	Code 3: Mounting	Description	Code 4: Hub Bore	Description
<b>M14</b>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> /0	<input type="text"/>		<input type="text"/> <input type="text"/> <input type="text"/>	
Ordering Information					
<b>M14</b>	1.5" Diameter	<b>0200/0</b>	<b>0</b>	No mounting base	<b>3.0</b> 3.0 mm
	Incremental	<b>0400/0</b>	<b>A</b>	2x #2-56 on 1.28" BC	<b>4.0</b> 4.0 mm
	Modular	<b>0500/0</b>	<b>B</b>	3x #0-80 on 0.823" BC	<b>5.0</b> 5.0 mm
	Encoder	<b>0512/0</b>	<b>C</b>	2x #2-56 on 0.75" BC	<b>6.0</b> 6.0 mm
		<b>1000/0</b>			<b>8.0</b> 8.0 mm
		<b>1024/0</b>			<b>125</b> 0.1248 in
					<b>187</b> 0.1873 in
				<b>249</b> 0.2498 in	
				<b>250</b> 0.2501 in	
				<b>312</b> 0.3123 in	
				<b>374</b> 0.3748 in	
				<b>375</b> 0.3750 in	

**IMPORTANT:** To properly install Series M14, a specialized mounting kit must be purchased. Only one kit is required to install any number of encoders with the same hub bore size.

Kit Part Number: MK M14   — Code 4 (from Models Table, above) designating Hub Bore requirement

Example: Kit for installing encoders with 0.1248" hub Bore = **MK M14 125**



# SERIES M15

**Dynapar™ brand**

## For Stepper & Small Servo Motors

### Key Features

- **Modular Encoder with Easy Installation Requiring No Special Gapping Tools or Parts**
- **Phased Array Sensor Technology Allowing .030" Axial Shaft Play**
- **Wide -20 to 120C Operating Temperature Range**



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental

**Resolution:** (pulses/revolution)

Incremental: 200 to 1024 PPR;

Commutation: 4, 6, or 8 pole

**Accuracy:**

Incremental:  $\pm 5$  arc-mins. max. edge to edge;

Commutation:  $\pm 6$  arc-mins. max.

**Sense:** (viewing encoder mounting surface)

Incremental: A leads B by  $90^\circ$  for CCW rotation of motor shaft;

Commutation: U leads V, V leads W by  $120^\circ$  for CW rotation of motor shaft

**Phasing:**

Incremental:  $90^\circ \pm 18^\circ$  electrical

Commutation: 8 Pole:  $30^\circ$ ; 6 Pole:  $40^\circ$ ; 4 Pole:  $60^\circ$  mechanical

Index to U Channel:  $\pm 1^\circ$  mechanical - Index center to U channel edge

**Symmetry:**

Incremental:  $180^\circ \pm 18^\circ$  electrical

Commutation: 8 Pole:  $45^\circ$ ; 6 Pole:  $60^\circ$ ; 4 Pole:  $90^\circ$  mechanical

**Index Pulse Width:**  $180^\circ \pm 36^\circ$  electrical (Gated

with B low) standard

### ELECTRICAL

**Input Power Requirements:**

Incremental: 5 or 12 VDC  $\pm 10\%$  at 100 mA max. (excluding output load);

Incremental w/Commutation: 5 or 12 VDC  $\pm 10\%$  at 120 mA max. (excluding output load)

**Output Signals:**

7272 Line Driver: 40 mA sink/source max.;

Open Collector w/2.0 k $\Omega$  pull-ups: 16 mA sink max.

**Frequency Response:** 200 kHz min.

**Termination:**

Connector: PCB mounted dual row head with 0.1" x 0.1" pin spacing, 10 pins (incremental only), 14 pins (w/commutation);

Cable: conductors - 28 AWG, stranded (7/36), insulation - black, PVC; Shield: aluminum/polyester foil plus tinned, copper drain wire (28 AWG, 7/36)

**Noise Immunity:** Conforms to EN50082-1 Light Industrial for Electro-Static Discharge, Radio Frequency Interference, Electrical Fast Transients, and Magnetic Fields (for models or applications with shielded cable)

### MECHANICAL

**Weight:**

Connector: 0.8 oz. (23 gm) typ.

Connector w/cover: 1.0 oz. (28 gm) typ.

Cable: 1.3 oz (37 gm) typ.

Cable w/cover: 1.5 oz. (43 gm) typ.

**Dimensions:**

Outside Diameter: 1.60" (40.7 mm) max. w/cover,

1.50" (38.2 mm) max. without cover;

Height: 1.27" (32.3 mm) max. (w/cover, excluding connector);

Emitter to Detector Gap: 0.070" (1.8 mm) min.

**Material:**

Base, Housing, & Cover: high temperature, glass

filled polymer;

Hub: Aluminum; Disk: 0.030" thick glass

**Finish:**

Base & Housing: black;

Cover: RAL 7010 (dark grey)

**Moment of Inertia:**  $3.40 \times 10^{-6}$  in-oz sec.<sup>2</sup> (2.4 gm-cm<sup>2</sup>)

**Hub Diameters:** 1/8", 1/4", 3/8", 3/16", 6 mm,

8 mm, 10 mm nominal

**Hub Dia. Tolerance:**  $+0.001"/-0.000"$  ( $+0.026$  mm/ $-0.000$  mm)

**Mating Shaft Length:** 0.45" (12 mm) min.; 0.85" (22 mm) max. inside cover

**Mating Shaft Runout:** 0.002" (0.05 mm) max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Endplay:**  $+0.015"/-0.015"$  ( $+0.38$  mm/ $-0.38$  mm) nominal ("+" indicates away from mounting face)

**Mounting:**

Base: (2) #4-40 (M2.5) #1 Phillips fillister head cap screw on 1.812" (46 mm) B.C., or (2) #2-56 (M2.0) hex socket cap screw on 1.28" (32.5 mm)

B.C.; 0.01" (0.254 mm) true position to shaft.

Shaft: split hub w/collar clamp, #2-56 hex socket cap screw (5/64" hex wrench included)

**Electrical/Mechanical Alignment Range:**  $\pm 15^\circ$  mechanical

**Acceleration:** 100,000 rad/sec.<sup>2</sup> max.

**Velocity:** 12,000 RPM max.

### ENVIRONMENTAL

**Operating Temperature:**  $0^\circ$  to  $120^\circ\text{C}$

**Storage Temperature:**  $-40^\circ$  to  $85^\circ\text{C}$

**Shock:** 50 G's for 11 msec duration

**Vibration:** 2.5 G's at 5 to 2000 Hz

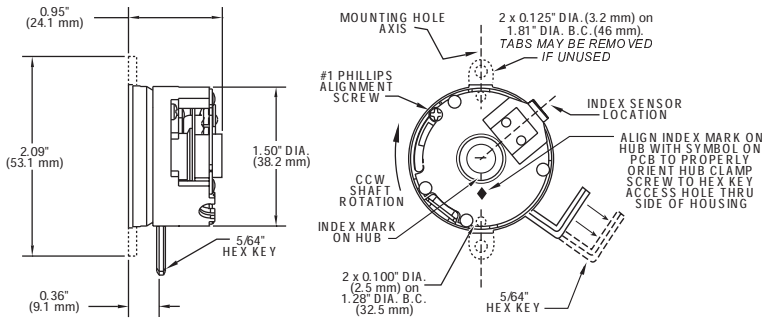
**Relative Humidity:** 90% non-condensing

**Enclosure Rating:** NEMA 1 / IP40 dirt-tight (for models with cover)

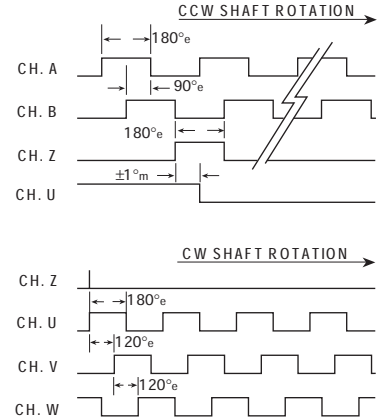


# SERIES M15

### Dimensions/Installation



### Output Waveforms (For clarity, compliments are not shown.)



### Installation Instructions:

Incremental only models: Drawing #200638-0001  
 Commutation models: Drawing #200638-0002

### Code 6: Terminations (Not all signals present on all models)

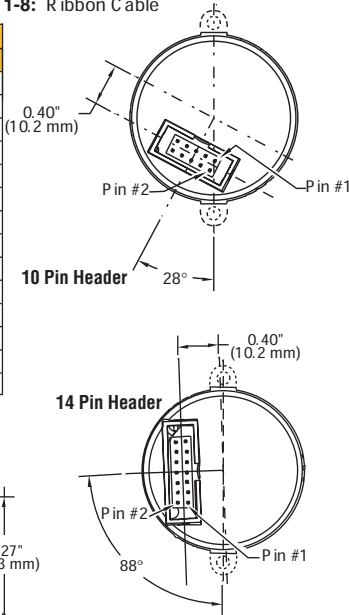
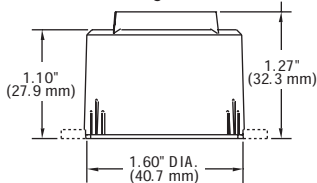
0: Pin Header

1-8: Ribbon Cable

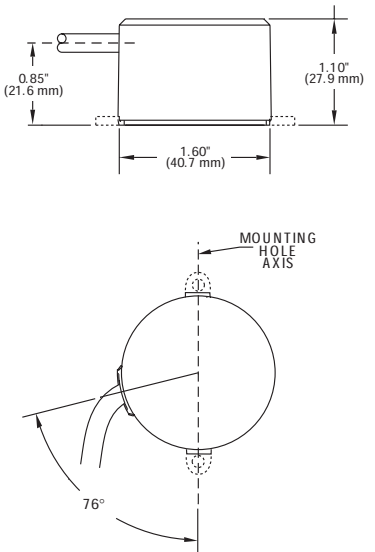
A-H: Shielded Cable

Pin	10 Pin		14 Pin
	O.C.	L.D.	
1	A	—	Vcc
2	Vcc	Vcc	U
3	GND	GND	U'
4	—	—	V
5	—	A'	V'
6	—	A	W
7	—	B'	W'
8	B	B	A'
9	—	Z'	A
10	Z	Z	B
11	—	—	B'
12	—	—	Z
13	—	—	GND
14	—	—	Z'

Mating Cable Assembly:  
 10 pin, 109524-000x  
 14 pin, 110527-000x  
 x= length in feet



Function	Wire Color	
	Incr. Only	Incr. & Comm.
Vcc com	—	RED/WHT
Vcc Inc	RED	RED
GND Inc	BLK	BLK
GND com	—	BLK/WHT
A'	RED/BLK	BLU/BLK
A	GRN	BLU
B'	WHT/BLK	GRN/BLK
B	ORN	GRN
Z'	BLU	VIO/BLK
Z	WHT	VIO
U'	—	BRN/BLK
U	—	BRN
V'	—	GRY/BLK
V	—	GRY
W'	—	WHT/BLK
W	—	WHT



### Ordering Information

To order, complete the model number with code numbers from the table below.

Code 1: Model	Code 2: PPR, Poles	Code 3: Cover	Code 4: Electrical	Code 5: Hub	Code 6: Termination
<b>M15</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ordering Information							
<b>M15</b>	Size 15 Commutating Modular	Incremental channels only		<b>0</b> No cover <b>1</b> Enclosed, end-of-shaft mount <b>2</b> Through shaft	<b>0</b> 5V in, open collector out incremental only <b>1</b> 12V in, open collector out incremental only <b>3</b> 5V in, line driver out incremental only  Available when Code 2 is XXXX/4, XXXX/6, or XXXX/8 <b>6</b> 5V in, line driver out incr.; 5V in, open collector out comm. <b>7</b> 5V in, line driver out incr.; 12V in, open collector out comm. <b>9</b> 5V in, line driver out incr.; 5V in, line driver out comm.	<b>0</b> 1/4 in. <b>1</b> 3/8 in. <b>4</b> 6 mm <b>5</b> 8 mm <b>6</b> 10 mm <b>8</b> 3/16 in. <b>9</b> 1/8 in.	Available when Code 4= 0,1,3,6 or 9 <b>0</b> Pin Header <b>1-8</b> Mating ribbon cable included; 1=1 ft., 2=2 ft., etc.  Available when Code 4= 0-9 <b>A-H</b> Shielded cable; A=1 ft., B=2 ft., etc.
		Incremental plus Commutation channels					
		<b>0200/0</b>	<b>1000/0</b>				
		<b>0400/0</b>	<b>1024/0</b>				
		<b>0500/0</b>					
		<b>0500/6</b>	<b>1024/4</b>				
		<b>1000/4</b>	<b>1024/6</b>				
		<b>1000/6</b>	<b>1024/8</b>				
		<b>1000/8</b>					

# SERIES M53

# Dynapar™ brand

## For Stepper & Small Servo Motors

### Key Features

- **2.0" Diameter Modular Encoder with Easy Installation Requiring No Special Gapping Tools or Parts**
- **Phased Array Sensor Technology Allowing .020" Axial Shaft Play**
- **Up to 2048 PPR with Commutation Tracks**



## NEW!



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental

**Resolution:** (pulses/revolution)

Incremental: 500 to 2048 PPR

Commutation: 4, 6 or 8 pole

**Accuracy:**

Incremental:  $\pm 5$  arc-mins. max. edge to edge;

**Sense:** (viewing encoder mounting surface)

Incremental: A leads B by  $90^\circ$  for CCW rotation of motor shaft;

Commutation: U leads V, V leads W by  $120^\circ$  for CW rotation of motor shaft

**Phasing:**

Incremental:  $90^\circ \pm 18^\circ$  electrical

Commutation: 8 Pole:  $30^\circ$ ; 6 Pole:  $40^\circ$ ; 4 Pole:

$60^\circ$  mechanical

Index to U Channel:  $\pm 1^\circ$  mechanical - Index

center to U channel edge

**Symmetry:**

Incremental:  $180^\circ \pm 18^\circ$  electrical

Commutation: 8 Pole:  $45^\circ$ ;

6 Pole:  $60^\circ$ ; 4 Pole:  $90^\circ$  mechanical

**Index Pulse Width:**  $90^\circ \pm 36^\circ$  electrical (Gated with A and B high)

### ELECTRICAL

**Input Power Requirements:**

Incremental: 5 VDC or 12 VDC  $\pm 10\%$  at

100 mA max. (excluding output load);

Commutation: 5 VDC or 12 VDC  $\pm 10\%$  at 75 mA max. (excluding output load)

**Output Signals:**

7272 Line Driver: 40 mA sink/source max.;

Open Collector w/2.0 k $\Omega$  pull-ups: 16 mA sink max.

**Frequency Response:** 200 kHz min.

**Termination:**

Connector: PCB mounted dual row head with 0.1" x

0.1" pin spacing, 10 pins (incremental only), 16

pins (w/commutation); Cable: conductors - 28

AWG, stranded (7/36), insulation - black, PVC;

Shield: aluminum/polyester foil plus tinned, copper drain wire (28 AWG, 7/36)

**Noise Immunity:** Conforms to EN50082-1 Light

Industrial for Electro-Static Discharge, Radio

Frequency Interference, Electrical Fast Transients,

Conducted Interference, and Magnetic Fields (for

models or applications with shielded cable)

### MECHANICAL

**Weight:**

Connector: 1 oz. (28 gm) typ.

Connector w/cover: 1.5 oz. (43 gm) typ.

Cable: 2.5 oz (71 gm) typ.

Cable w/cover: 3 oz. (85 gm) typ.

**Dimensions:**

Outside Diameter: 2.1" (53 mm) max. w/cover, 2.0"

(51 mm) max. without cover; Height: 0.8" (20.3

mm) (w/cover, excluding connector);

Emitter to Detector Gap: 0.070" (1.8 mm) min.

**Material:**

Base, Housing, & Cover: high temperature, glass

filled polymer;

Hub: Aluminum; Disk: 0.030" thick glass

**Finish:**

Base & Housing: black;

Cover: RAL 7010 (dark grey)

**Moment of Inertia:**  $6.64 \times 10^{-5}$  in-oz sec.<sup>2</sup> (4.7 gm-cm<sup>2</sup>)

**Hub Diameters:** 1/4", 3/8", 7/16", 1/2", 6 mm, 8 mm, 10 mm, 12 mm nominal

**Hub Dia. Tolerance:**  $+0.001"/-0.000"$  ( $+0.026$  mm/ $-0.000$  mm)

**Mating Shaft Length:** 0.45" (12 mm) min. blind hub clamp screw, 0.65" (16.5 mm) exposed hub clamp screw; 0.75" (19 mm) max. inside cover

**Mating Shaft Runout:** 0.002" (0.05 mm) max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Endplay:**  $+0.011"/-0.008"$  ( $+0.30$  mm/ $-0.21$  mm) nominal ("+" indicates away from mounting face)

**Mounting:**

Base: (2) #4-40 (M2.5) #1 Phillips fillister head

cap screw on 1.812" (46 mm) B.C., 0.01" (0.254

mm) true position to shaft; Shaft: split hub w/

collar clamp, #2-56 hex socket cap screw (5/64"

hex wrench included)

**Electrical/Mechanical Alignment Range:**  $\pm 15^\circ$  mechanical

**Acceleration:** 100,000 rad/sec.<sup>2</sup> max.

**Velocity:** 12,000 RPM max.

### ENVIRONMENTAL

**Operating Temperature:**  $0^\circ$  to  $120^\circ\text{C}$

**Storage Temperature:**  $-40^\circ$  to  $85^\circ\text{C}$

**Shock:** 50 G's for 11 msec duration

**Vibration:** 2.5 G's at 5 to 2000 Hz

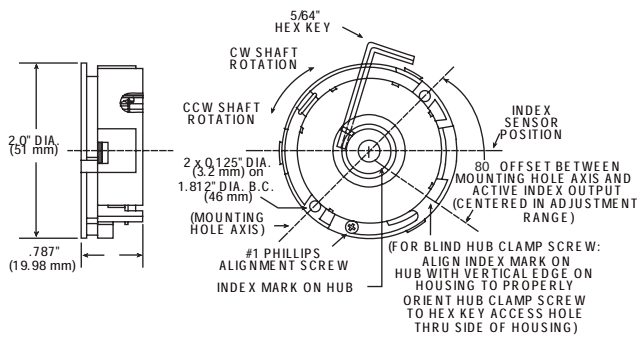
**Relative Humidity:** 90% non-condensing

**Enclosure Rating:** NEMA 1 / IP50 dirt-tight (for models with cover)

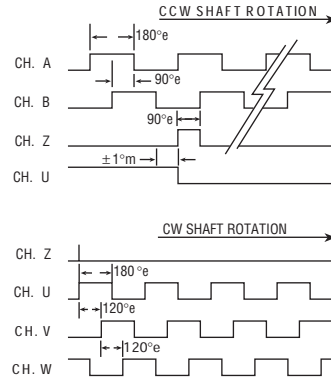


# SERIES M53

Dimensions/Installation



Output Waveforms (F or clarity, compliments are not shown.)

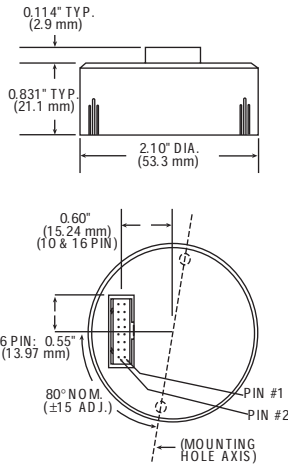


Code 6: Terminations (Not all signals present on all models)

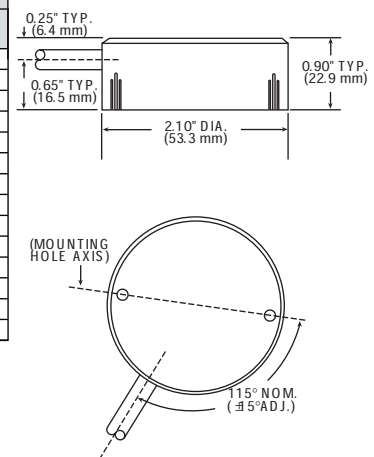
0: 16 Pin JST connector 1-8: Shielded Cable with JST connector

A-H: Shielded Cable

Pin	16 Pin
1	Vcc
2	U
3	GND
4	V
5	A
6	W
7	A'
8	NC
9	B
10	U'
11	B'
12	V'
13	Z
14	W'
15	Z'
16	NC



Function	Wire Color	
	Incr. Only	Incr. & Comm.
Vcc	RED	RED
GND	BLK	BLK
A	GRN	BLU
A'	RED/BLK	BLU/BLK
B	ORN	GRN
B'	WHT/BLK	GRN/BLK
Z	WHT	VIO
Z'	BLU	VIO/BLK
U	-	BRN
U'	-	BRN/BLK
V	-	GRY
V'	-	GRY/BLK
W	-	WHT
W'	-	WHT/BLK



### Ordering Information

To order, complete the model number with code numbers from the table below.

Code 1: Model	Code 2: PPR, Poles	Code 3: Cover	Code 4: Electrical	Code 5: Hub	Code 6: Termination
<b>M53</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ordering Information

M53 Size 20 Commutating Modular	Incremental channels only	<b>0</b> No cover <b>1</b> Radial exit cover (for shielded cable) <b>2</b> Axial exit (for shielded cable with JST connector)	<b>0</b> 5V in, open collector out incremental only <b>1</b> 12V in, open collector out incremental only <b>3</b> 5V in, line driver out incremental only <b>A</b> 12V in, 5V line driver out incremental only <b>B</b> 12V in, 12V line driver out incremental only Available when Code 2 is XXXX/4, XXXX/6, or XXXX/8 <b>6</b> 5V in, line driver out incremental open collector out Comm <b>9</b> 5V in, line driver out incremental line driver out Comm <b>C</b> 12V in, 5V line driver out incremental, open collector <b>D</b> 12V in, 12V line driver out incremental, open collector <b>E</b> 12V in, 5V line driver out incremental, 5V line driver out Comm out Comm out Comm <b>F</b> 12V in, 12V line driver out incremental, 12V line driver out Comm	Exposed hub clamp screw: <b>A</b> 1/4 in. <b>B</b> 3/8 in. <b>C</b> 7/16 in. <b>D</b> 1/2 in. <b>E</b> 6 mm <b>F</b> 8 mm <b>G</b> 10 mm <b>H</b> 12 mm	<b>0</b> JST connector <b>1-8</b> Shielded cable with connector; 1=1 ft., 2=2 ft., etc. Available when Code 4 is 3 or higher: <b>A-H</b> Shielded cable; A=1 ft., B=2 ft., etc.
	Incremental plus Commutation channels				

# SERIES F10

**Dynapar™ brand**

## For Stepper & Small Servo Motors

### Key Features

- Digital Encoder Replaces size 10 Pancake Resolver
- Up to 2048PPR with Commutation Tracks
- Up to 120C Temperature Range Doesn't Limit Motor Performance



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental with commutation option, Optical

**Resolution:** 1024 or 2048 PPR incremental with 6 pole commutation channels

**Accuracy:** Incremental:  $\pm 2.5$  arc-mins. max. edge to any edge; Commutation:  $\pm 6$  arc-mins. max.

**Phasing for CCW rotation of motor shaft :**

A leads B by  $90^\circ$  and U leads V leads W by  $120^\circ$ .

**Minimum edge separation A to B is  $45^\circ$ .**

**Index to U channel:** +/-  $1^\circ$  mech. index pulse center to U channel edge.

**Index Pulse Width:**  $90^\circ$  gated A and B high

### ELECTRICAL

**Input Power Requirements:**  $5 \pm 10\%$  VDC at 100 mA max (incremental and commutation), excluding output load

**Output Signals:**

**Incremental:** 26LS31 Differential Line Driver, sink / source 40 mA max.

**Commutation:** Open Collector w/2.0 k $\Omega$  pull-ups, 8 mA sink max.; or 26LS31 Differential Line Driver, sink / source 40 mA max.

**Frequency Response:** 300 kHz, max.

**Termination:** Flying leads, stranded 26 AWG, twisted pair, PVC insulation, 6.5" length  $\pm 0.5$ "

### MECHANICAL

**Weight:** 1.6 oz. (45 gm) typ.

**Dimensions:** Outside Diameter : 1.25" (31.7mm), max.; Height: 0.89" (24.1mm), max.

**Material:** Housing: cast-aluminum; Servo Ring: glass reinforced engineering resin; Hub: Brass; Disk: 0.030" (0.76mm) thick glass

**Moment of Inertia:**  $2.22 \times 10^{-5}$  in-oz-sec.<sup>2</sup> (1.6 gm-cm<sup>2</sup>)

**Bore Diameter:** 6mm

**Bore Dia. Tolerance:**  $+0.001"/-0.000"$  (+0.025 mm/-0.000 mm)

**Mating Shaft Runout:** 0.002" (0.05 mm) max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Axial movement:**  $\pm 0.010"$  ( $\pm 0.25$  mm)

**Mounting:** 1.030" (26.16mm) servo ring with integral flexure (size 10 pancake resolver equivalent)

**Acceleration:** 100,000 rad/sec.<sup>2</sup> max.

**Velocity:** 5,000 RPM continuous; 12,000 RPM peak

**Bearing Life:**  $[(3.6 \times 10^9) / \text{RPM}]$  Hours ; e.g. 605,000 hours @6,000 RPM

### ENVIRONMENTAL

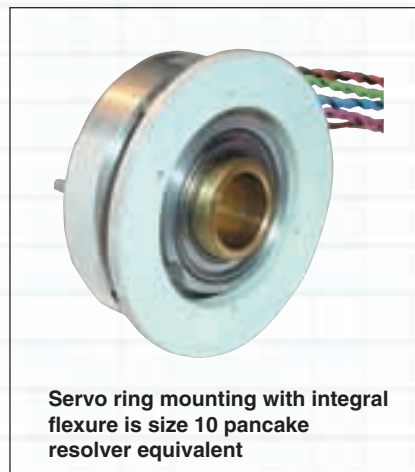
**Operating Temperature:**  $0^\circ$  to  $+120^\circ\text{C}$

**Storage Temperature:**  $0^\circ$  to  $+120^\circ\text{C}$

**Shock:** 50 Gs for 6 msec duration

**Vibration:** 2.5 Gs at 5 to 2000 Hz

**Relative Humidity:** 90% non-condensing

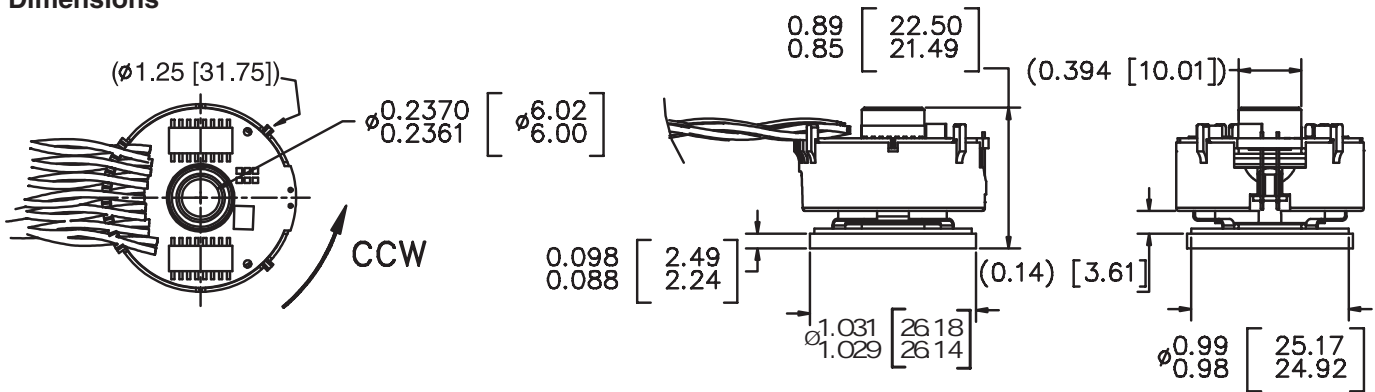


Servo ring mounting with integral flexure is size 10 pancake resolver equivalent



# SERIES F10

## Dimensions

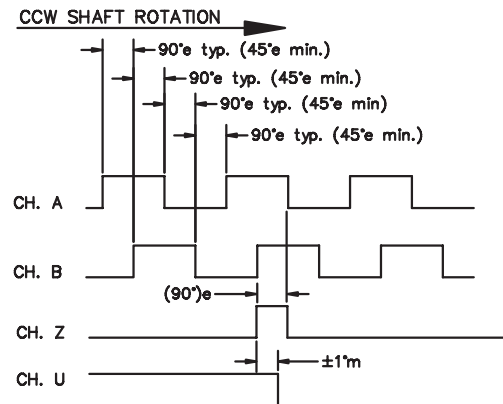


## Connections

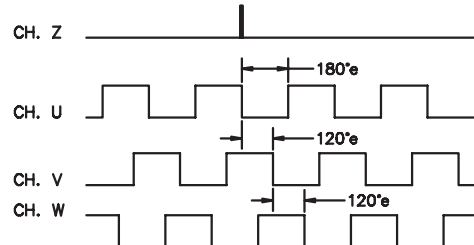
Function*	Cable Wire Color
VCC	RED
GND	BLACK
A <sup>-</sup>	BLUE/BLACK
A	BLUE
B <sup>-</sup>	GREEN/BLACK
B	GREEN
Z <sup>-</sup>	VIOLET/BLACK
Z	VIOLET
U <sup>-</sup>	BROWN/BLACK
U	BROWN
V <sup>-</sup>	GRAY/BLACK
V	GRAY
W <sup>-</sup>	WHITE/BLACK
W	WHITE

\* Function availability dependant on Model

## Waveforms



Waveforms below show relationship between CH. Z, U, V & W (scale differs from above)



## Ordering Information

To order, complete the model number with code numbers from the table below:

Code 1: Model	Code 2: PPR, Poles	Code 3: Mount	Code 4: Electrical	Code 5: Shaft/Bore	Code 6: Termination
<b>F10</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/>	<b>0</b>	<input type="checkbox"/>	<b>4</b>	<b>0</b>

### Ordering Information

<b>F10</b> Size 10 Commutating Encoder	Incremental channels only <b>1024/0</b> <b>2048/0</b>	<b>0</b> Servo mount 1.030 Diameter x .095 thick	Available when Code 2 is XXXX/0 <b>3</b> 5V in, line driver out incremental only	<b>4</b> 6mm thru bore	<b>0</b> 6.5" ±0.5" Twisted Pair Flying Leads
	Incremental plus Commutation channels <b>1024/6</b> <b>2048/6</b>		Available when Code 2 is XXXX/6 <b>6</b> 5V in, line driver out for incremental; 5V in, open collector out for commutation <b>9</b> 5V in, line driver out for incremental; 5V in, line driver out for commutation		

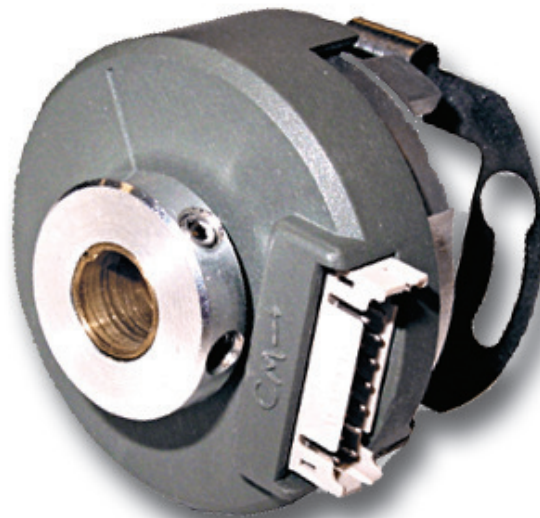
# SERIES F14

# Dynapar™ brand

## For Stepper & Small Servo Motors

### Key Features

- Easy to install non-marring hollowshaft design with flex tether
- Up to 5000PPR for smooth low-speed motor control
- Up to 120C temperature range doesn't limit motor performance



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental with commutation option, Optical

**Resolution:** 200, 400, 500, 1000, 1024, 2000, 2048, 2500, 4096, 5000 PPR incremental with 4, 6 and 8 pole commutation channels

**Accuracy:** Incremental:  $\pm 2.5$  arc-mins. max. edge to any edge; Commutation:  $\pm 6$  arc-mins. max.

**Phasing for CCW rotation of motor shaft** (viewing encoder cover): A leads B by  $90^\circ$  and U leads V leads W by  $120^\circ$ .

**Minimum edge separation** A to B is  $45^\circ$ .

**Index to U channel:**  $\pm 1^\circ$  mech. index pulse center to U channel edge.

**Index Pulse Width:**  $90^\circ$  gated A and B high; ( $180^\circ$  gated B high gating options available - consult factory)

### ELECTRICAL

**Input Power Requirements:**  $5 \pm 10\%$  VDC at 150 mA max (incremental only); 175 mA max. (incremental and commutation), excluding output load

#### Output Signals:

Line Driver: sink / source 40 mA max.,  
Open Collector Incremental ( $\leq 1024$  PPR): 16 mA sink max.  
Open Collector Commutation: 30 mA sink max. (2.0 k $\Omega$  pull-ups in encoder)

### Frequency Response:

PPR  $\leq 1024$ : 250 kHz; PPR  $> 1024$ : 500 kHz

**Termination:** 16 pin, fully shielded, 2mm pitch, double row header. Accessory mating cable assembly available: 26 AWG twisted pair, jacketed and shielded with copper drain wire

### MECHANICAL

**Weight:** 1.6 oz. (45gm) typ.

**Dimensions:** Outside Diameter with cover: 1.55" (39.8mm), without cover 1.45" (36.8mm); Outside collar height 1.36" (34.6mm), inside collar height 1.28" (32.4mm)

**Material:** Bearing housing: aluminum; Cover: high temperature, glass filled polymer; Hub: Brass; Disk: 0.030" thick glass

**Finish:** Cover: RAL 7010 (dark grey)

**Moment of Inertia:**  $8.2 \times 10^{-5}$  in-oz sec.<sup>2</sup> (5.8 gm-cm<sup>2</sup>)

**Hub Diameters:** 1/4", 6mm, 8mm standard

**Bore Dia. Tolerance:**  $+0.001"/-0.000"$  ( $+0.025$  mm/ $-0.000$  mm)

**Mating Shaft Length:** 1.35" (34.3 mm) minimum for outside shaft collar. 0.50 inch minimum for inside shaft collar

**Mating Shaft Runout:** 0.002" (0.05 mm) max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Axial movement:**  $\pm 0.060"$  ( $\pm 1.52$  mm)

**Mounting:** Two standard configurations are available for tethers. A choice of U.S. or Metric screws are included. Mounting holes should be 0.01" (0.254 mm) true position to shaft for best encoder operation.

**Shaft clamp:** 2 #6-32 set screws in collar around hub shaft (will not mar shaft)

Electrical/Mechanical Alignment Range:  $\pm 15^\circ$  mechanical typical (see tether options)

**Acceleration:** 100,000 rad/sec.<sup>2</sup> max.

**Max. Velocity:** RPM = (Frequency / PPR) x 60; or 12,000 RPM, whichever is less;

**Bearing Life:**  $[(1.4 \times 10^9) / \text{RPM}]$  Hours; e.g. 230,000 hours @ 6,000 RPM

*(Based on bearing manufacturer's suggested calculation for 6801ZZ with 44N equivalent dynamic load - including preload and tether reaction loads - at 6000 RPM continuous with adequate lubrication)*

### ENVIRONMENTAL

**Operating Temperature:**  $0^\circ$  to  $+120^\circ\text{C}$

**Storage Temperature:**  $-40^\circ$  to  $+120^\circ\text{C}$

**Shock:** 100 Gs for 6 msec duration

**Vibration:** 2.5 Gs at 5 to 2000 Hz

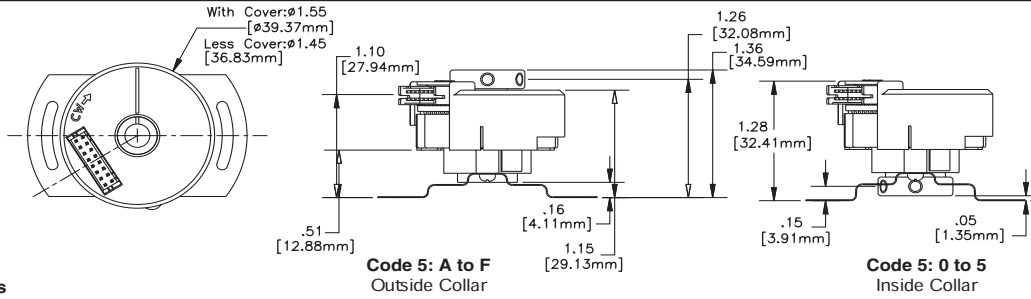
**Relative Humidity:** 90% non-condensing

**Enclosure Rating:** NEMA 1 / IP40 (for models with cover)

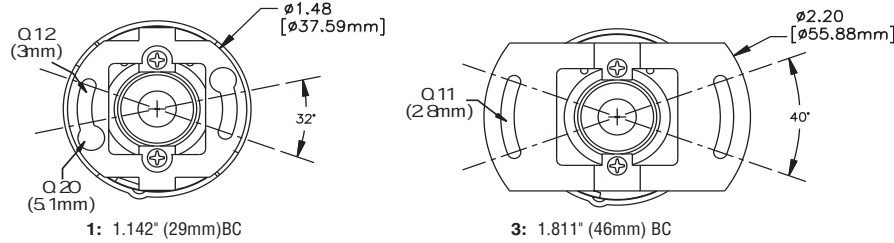


# SERIES F14

**Dimensions**



**Code 3: Tethers**



**Electrical Connections**

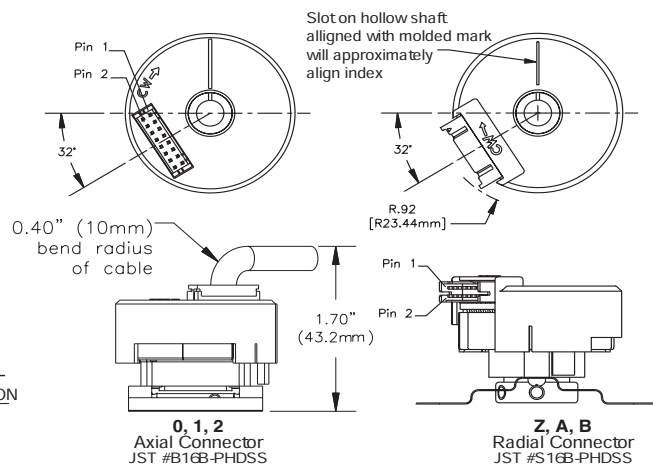
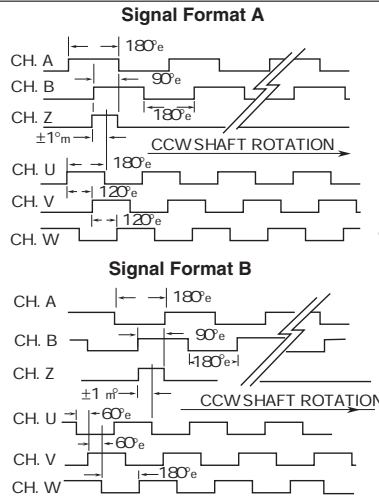
Pin	Function*	Cable Wire Color
1	VCC	RED
2	U	Brown
3	GND	BLACK
4	V	GRAY
5	A	BLUE
6	W	WHITE
7	A <sup>-</sup>	BLUE/BLACK
8	NONE	NONE
9	B	GREEN
10	U <sup>-</sup>	BROWN/BLACK
11	B <sup>-</sup>	GREEN/BLACK
12	V <sup>-</sup>	GRAY/BLACK
13	Z	VIOLET
14	W <sup>-</sup>	WHITE/BLACK
15	Z <sup>-</sup>	VIOLET/BLACK
16	NONE	NONE

\* Function availability dependent on Model

**Mating Cable Assembly:**

Incremental only, 111752-000x  
 Incremental + Comm., 111753-000x  
 x = length in feet

**Output Waveforms**



**Ordering Information**

To order, complete the model number with code numbers from the table below:

Code 1: Model	Code 2: PPR, Poles	Code 3: Tether	Code 4: Electrical	Code 5: Shaft/Bore	Code 6: Termination
<b>F14</b>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Ordering Information					
<b>F14</b>	Size 14 Commutating Encoder	Incremental channels only	<b>0</b> No Tether <b>1</b> 2 #2 on 1.181" Diameter <b>3</b> 2 #4 on 1.811" Diameter <b>6</b> 2 M2.5 on 30 mm Diameter <b>8</b> 2 M3 on 46 mm Diameter	Available when Code 2 is ≤ 1024/0	Inside Collar: <b>0</b> 1/4 in. <b>4</b> 6 mm <b>5</b> 8 mm  Outside Collar: <b>A</b> 1/4 in. <b>E</b> 6 mm <b>F</b> 8 mm
		0200/0    2000/0 0400/0    2048/0 0500/0    2500/0 1000/0    4096/0 1024/0    5000/0		Available when Code 2 is XXXX/0	
		Incremental plus Commutation channels		Available when Code 2 is XXXX/4, XXXX/6, or XXXX/8	
		0500/†    2048/† 1000/†    2500/† 1024/†    4096/† 2000/†    5000/†		<b>3</b> 5V in, line driver out incremental only - Format A <b>4</b> 5V in, line driver out incremental only - Format B <b>6</b> 5V in, line driver out incr.; 5V in, open collector out comm. Format A <b>E</b> 5V in, line driver out incr.; 5V in, open collector out comm. - Format B <b>9</b> 5V in, line driver out incr.; 5V in, line driver out comm. Format A <b>F</b> 5V in, line driver out incr.; 5V in, line driver out comm. - Format B	Code Connector/Cable   Wire   Length Axial   Radial   Pigtail <b>0</b> Z N/A None <b>1</b> A J 1 Ft. <b>2</b> B K 2 Ft. <b>3</b> C L 3 Ft. <b>4</b> D M 4 Ft. <b>5</b> E N 5 Ft. <b>6</b> F P 6 Ft. <b>7</b> G Q 7 Ft. <b>8</b> H R 8 Ft.
		† Available with 4, 6 or 8 pole. e.g. 1000/6 is 1000PPR with 6 poles			<b>CONNECTION OPTIONS</b> You may choose an integral connector mounted in axial or radial position. Available with or without mating connector/cable. Alternatively, a direct-solder pigtail cable is offered.



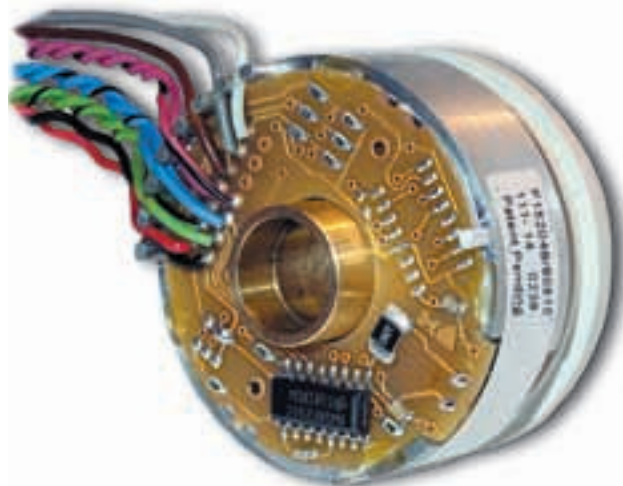
# SERIES F15

**Dynapar™ brand**

## For Stepper & Small Servo Motors

### Key Features

- **Digital Encoder with Flex Servo Ring Easily Replaces Size 15 Resolver**
- **Short 0.88" Mounting Depth with Jam Nut Shaft Fixing Makes Installation Easy**
- **Superior +/-2.5° Arc-Min Accuracy**



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental with commutation option, Optical

**Resolution:** 1024 or 2048 PPR incremental with 6 or 8 pole commutation channels

**Accuracy:** Incremental:  $\pm 2.5$  arc-mins. max. edge to any edge; Commutation:  $\pm 6$  arc-mins. max.

**Phasing for CCW rotation of motor shaft :**

A leads B by 90° and U leads V leads W by 120°.

**Minimum edge separation A to B is 45°.**

**Index to U channel:** +/- 1° mech. index pulse center to U channel edge.

**Index Pulse Width:** 90° gated A and B high

### ELECTRICAL

**Input Power Requirements:** 5±10% VDC at 100 mA max (incremental and commutation), excluding output load

**Output Signals:**

**Incremental:** 26LS31 Differential Line Driver, sink / source 40 mA max.

**Commutation:** Open Collector w/2.0 k $\Omega$  pull-ups, 8 mA sink max.; or 26LS31 Differential Line Driver, sink / source 40 mA max.

**Frequency Response:** 300 kHz, max.

**Termination:** Flying leads, stranded 26 AWG, twisted pair, PVC insulation, 6.5" length  $\pm 0.5$ "

### MECHANICAL

**Weight:** 1.6 oz. (45 gm) typ.

**Dimensions:** Outside Diameter : 1.45" (36.8mm), max.; Height: 0.87" (22.1mm), max.

**Material:** Housing: cast-aluminum; Servo Ring: glass reinforced engineering resin; Hub: Brass; Disk: 0.030" (0.76mm) thick glass

**Moment of Inertia:** 3.59X10<sup>-5</sup> in-oz-sec.<sup>2</sup> (2.5 gm-cm<sup>2</sup>)

**Bore Diameter:** 0.375" (9.53mm)

**Bore Dia. Tolerance:** +0.001"/-0.000" (+0.025 mm/-0.000 mm)

**Mating Shaft Runout:** 0.002" (0.05 mm) max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Axial movement:**  $\pm 0.010$ " ( $\pm 0.25$  mm), max.

**Mounting:** 1.435" (36.45mm) servo ring with integral flexure (size 15 pancake resolver equivalent)

**Acceleration:** 100,000 rad/sec.<sup>2</sup> max.

**Velocity:** 5,000 RPM continuous; 12,000 RPM peak

**Bearing Life:** [(3.6 X 10<sup>9</sup>) / RPM] Hours ; e.g. 605,000 hours @6,000 RPM

### ENVIRONMENTAL

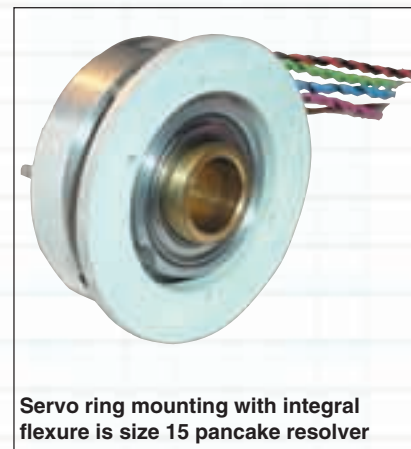
**Operating Temperature:** 0° to +120°C

**Storage Temperature:** 0° to +120°C

**Shock:** 50 Gs for 6 msec duration

**Vibration:** 2.5 Gs at 5 to 2000 Hz

**Relative Humidity:** 90% non-condensing

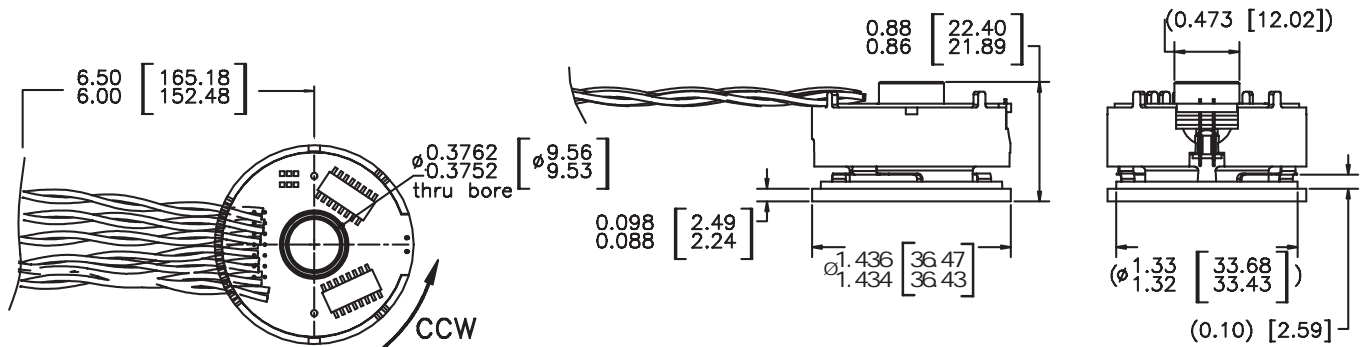


Servo ring mounting with integral flexure is size 15 pancake resolver



# SERIES F15

## Dimensions

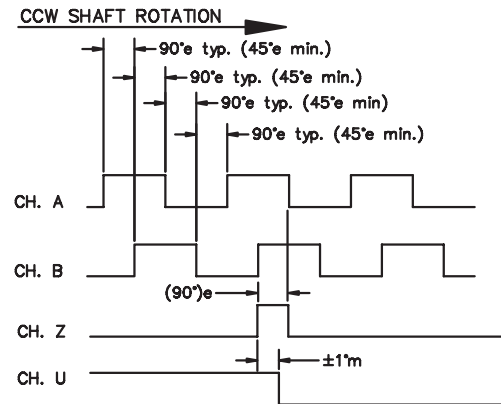


## Connections

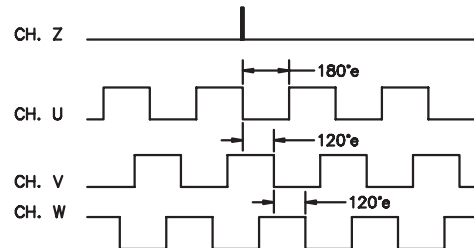
Function*	Cable Wire Color
VCC	RED
GND	BLACK
A <sup>-</sup>	BLUE/BLACK
A	BLUE
B <sup>-</sup>	GREEN/BLACK
B	GREEN
Z <sup>-</sup>	VIOLET/BLACK
Z	VIOLET
U <sup>-</sup>	BROWN/BLACK
U	BROWN
V <sup>-</sup>	GRAY/BLACK
V	GRAY
W <sup>-</sup>	WHITE/BLACK
W	WHITE

\* Function availability dependant on Model

## Waveforms



Waveforms below show relationship between CH. Z, U, V & W (scale differs from above)



## Ordering Information

To order, complete the model number with code numbers from the table below.

Code 1: Model	Code 2: PPR, Poles	Code 3: Mount	Code 4: Electrical	Code 5: Shaft/Bore	Code 6: Termination
<b>F15</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/>	<b>0</b>	<input type="checkbox"/>	<b>1</b>	<b>0</b>
Ordering Information					
<b>F15</b> Size 15 Commutating Encoder	Incremental channels only <b>1024/0</b> <b>2048/0</b>	<b>0</b> Servo mount 1.435 Diameter x .095 thick	Available when Code 2 is XXXX/0 <b>3</b> 5V in, line driver out incremental only	<b>1</b> 3/8 in. thru bore	<b>0</b> 6.5" ±Q5" Twisted Pair Flying Leads
	Incremental plus Commutation channels <b>1024/6</b> <b>2048/6</b> <b>1024/8</b> <b>2048/8</b>		Available when Code 2 is XXXX/6 or 8 <b>6</b> 5V in, line driver out for incremental; 5V in, open collector out for commutation <b>9</b> 5V in, line driver out for incremental; 5V in, line driver out for commutation		

# SERIES F18

# Dynapar™ brand

## For Stepper & Small Servo Motors

### Key Features

- Under 2.0" Diameter Package with High 10,000PPR Capability
- Easy to Install Hollowshaft and Spring Tether Design
- Up to 120°C Temperature Range Doesn't Limit Motor Performance



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental with commutation option, Optical

**Resolution:** 500, 512, 1000, 1024, 2000, 2048, 2500, 4096, 5000, 8192, 10,000 PPR incremental with 4, 6, 8 or 12 pole commutation channels

**Accuracy:** Incremental:  $\pm 2.5$  arc-mins. max. edge to any edge; Commutation:  $\pm 6$  arc-mins. max.

**Phasing for CCW rotation of motor shaft** (viewing encoder cover): A leads B by  $90^\circ$  and U leads V leads W by  $120^\circ$ .

**Minimum edge separation** A to B is  $45^\circ$ .

**Index to U channel:**  $\pm 1^\circ$  mech. index pulse center to U channel edge.

**Index Pulse Width:**  $90^\circ$  gated A and B high; ( $180^\circ$  gated B high gating options available - consult factory)

### ELECTRICAL

**Input Power Requirements:**  $5 \pm 10\%$  VDC at 150 mA max (incremental only); 175 mA max. (incremental and commutation), excluding output load

#### Output Signals:

Line Driver: sink / source 40 mA max.,  
Open Collector Incremental ( $\leq 2048$  PPR): 16 mA sink max.  
Open Collector Commutation: 30 mA sink max. (2.0 k $\Omega$  pull-ups in encoder)

#### Frequency Response:

PPR  $\leq 2048$ : 250 kHz; PPR  $> 2048$ : 500 kHz

**Termination:** 16 pin, fully shielded, 2mm pitch, double row header. Accessory mating cable assembly available: 26 AWG twisted pair, jacketed and shielded with copper drain wire

### MECHANICAL

**Weight:** 4 oz. (110 gm) typ.

**Dimensions:** Outside Diameter with cover: 1.96" (49.8mm), without cover 1.85" (47.0mm); Outside collar height 1.71" (43.4mm), inside collar height 1.50" (38.1mm)

**Material:** Bearing housing: aluminum; Cover: high temperature, glass filled polymer;

Hub: Brass; Disk: 0.030" thick glass

**Finish:** Cover: RAL 7010 (dark grey)

**Moment of Inertia:**  $5.3 \times 10^{-4}$  in-oz sec.<sup>2</sup> (37.3 gm-cm<sup>2</sup>)

**Hub Diameters:** 1/4", 3/8", 7/16", 1/2", 6mm, 8mm, 10mm, 12mm standard

**Bore Dia. Tolerance:**  $+0.001/-0.000$ " ( $+0.025$  mm/ $-0.000$  mm)

**Mating Shaft Length:** 1.62" (41 mm) minimum for outside shaft collar. 0.50 inch minimum for inside shaft collar

**Mating Shaft Runout:** 0.002" (0.05 mm) max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Axial movement:**  $\pm 0.060$ " ( $\pm 1.52$  mm)

**Mounting:** Four standard configurations are available for tethers. A choice of U.S. and Metric screws are included. Mounting holes should be 0.01" (0.254 mm) true position to shaft for best encoder operation.

**Shaft clamp:** 2 #6-32 set screws in collar around hub shaft (will not mar shaft)

Electrical/Mechanical Alignment Range:  $\pm 15^\circ$  mechanical typical (see tether options)

**Acceleration:** 100,000 rad/sec.<sup>2</sup> max.

**Max. Velocity:** RPM = (Frequency / PPR) x 60; or 12,000 RPM, whichever is less;

**Bearing Life:**  $[(3.6 \times 10^9) / \text{RPM}]$  Hours; e.g. 605,000 hours @ 6,000 RPM

*(Based on bearing manufacturer's suggested calculation for 6803ZZ with 37N equivalent dynamic load - including preload and tether reaction loads - at 6000 RPM continuous with adequate lubrication)*

### ENVIRONMENTAL

**Operating Temperature:**  $0^\circ$  to  $+120^\circ\text{C}$

**Storage Temperature:**  $-40^\circ$  to  $+120^\circ\text{C}$

**Shock:** 100 Gs for 6 msec duration

**Vibration:** 2.5 Gs at 5 to 2000 Hz

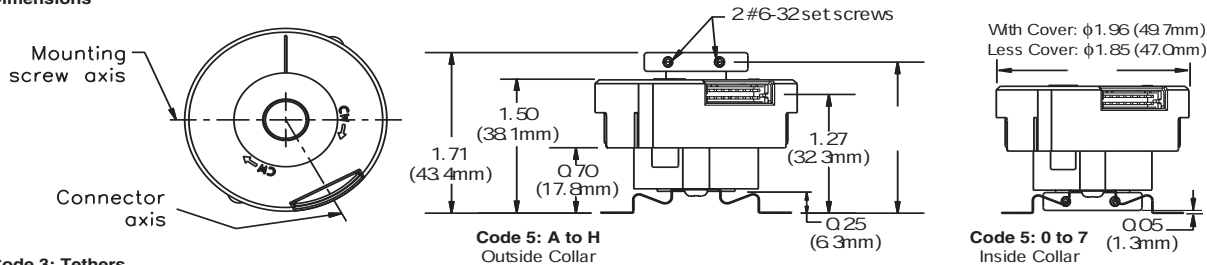
**Relative Humidity:** 90% non-condensing

**Enclosure Rating:** NEMA 1 / IP40 (for models with cover)

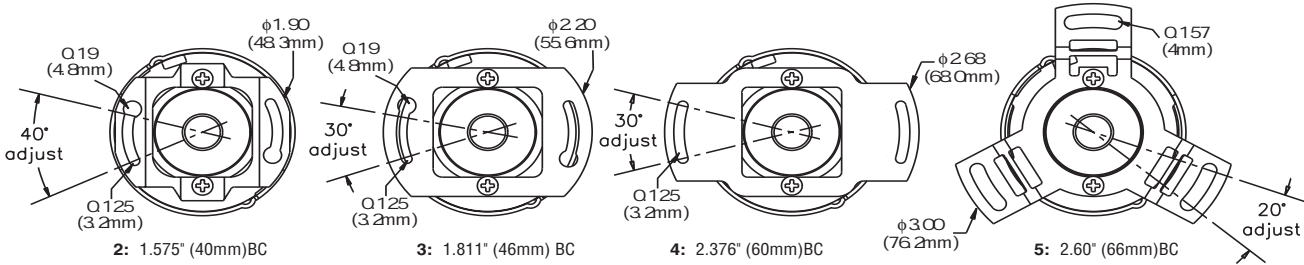


# SERIES F18

**Dimensions**



**Code 3: Tethers**



**Electrical Connections**

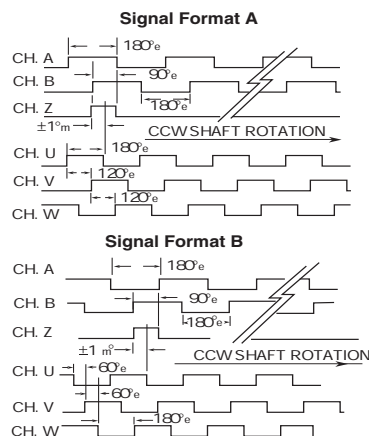
Pin	Function*	Cable Wire Color
1	VCC	RED
2	U	Brown
3	GND	BLACK
4	V	GRAY
5	A	BLUE
6	W	WHITE
7	A <sup>-</sup>	BLUE/BLACK
8	NONE	NONE
9	B	GREEN
10	U <sup>-</sup>	BROWN/BLACK
11	B <sup>-</sup>	GREEN/BLACK
12	V <sup>-</sup>	GRAY/BLACK
13	Z	VIOLET
14	W <sup>-</sup>	WHITE/BLACK
15	Z <sup>-</sup>	VIOLET/BLACK
16	NONE	NONE

\* Function availability dependant on Model

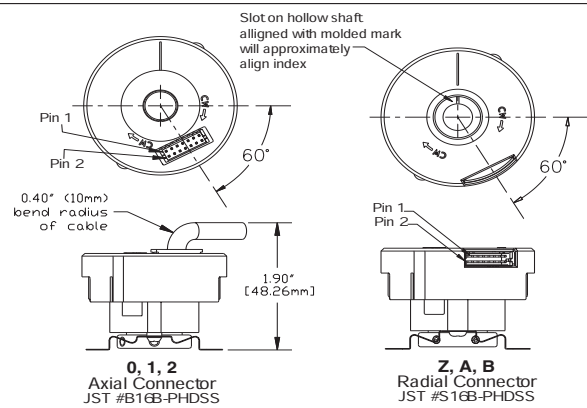
**Mating Cable Assembly:**

Incremental only, 111752-000x  
 Incremental + Comm., 111753-000x  
 x = length in feet

**Output Waveforms**



**Code 6: Termination**



**Ordering Information**

To order, complete the model number with code numbers from the table below:

Code 1: Model	Code 2: PPR, Poles	Code 3: Tether	Code 4: Electrical	Code 5: Shaft/Bore	Code 6: Termination
<b>F18</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Ordering Information**

F18	Size 18 Commutating Encoder	Incremental channels only		0 No Tether 2 2 #2 on 1.575" Diameter 3 2 #4 on 1.811" Diameter 4 2 #4 on 2.376" Diameter 5 3 #4 on 2.60" Diameter 7 2 M2.5 on 40 mm Diameter 8 2 M3 on 46 mm Diameter 9 2 M3 on 60 mm Diameter A 3 M3 on 66 mm Diameter	Available when Code 2 is ≤ 2048/0 0 5V in, open collector out incremental only C 5V in, open collector out incremental only - reverse phase Available when Code 2 is XXXX/0 3 5V in, line driver out incremental only D 5V in, line driver out incremental only - reverse phase Available when Code 2 is XXXX/4, XXXX/6, XXXX/8 or XXXX/C 6 5V in, line driver out for incremental; 5V in, open collector out for commutation E 5V in, line driver out for incremental; 5V in, open collector out for commutation - reverse phase 9 5V in, line driver out for incremental; 5V in, line driver out for commutation F 5V in, line driver out for incremental; 5V in, line driver out for commutation - reverse phase	Inside Collar: 0 1/4 in. 1 3/8 in. 2 7/16 in. 3 1/2 in. 4 6 mm 5 8 mm 6 10 mm 7 12 mm Outside Collar: A 1/4 in. B 3/8 in. C 7/16 in. D 1/2 in. E 6 mm F 8 mm G 10 mm H 12 mm	Code			Length
		Connector/Cable	Wire				Pigtail			
		0500/0	2500/0			0	Z	N/A	None	
		0512/0	4096/0			1	A	J	1 Ft.	
		1000/0	5000/0			2	B	K	2 Ft.	
		1024/0	8192/0			3	C	L	3 Ft.	
		2000/0	10E3/0*			4	D	M	4 Ft.	
		2048/0	*= 10000/0			5	E	N	5 Ft.	
		0500/†	2500/†			6	F	P	6 Ft.	
		0512/8	4096/†			7	G	Q	7 Ft.	
		1000/†	5000/†			8	H	R	8 Ft.	
		1024/†	8192/†			<b>CONNECTION OPTIONS</b> You may choose an integral connector mounted in axial or radial position. Available with or without mating connector/cable. Alternatively, a direct-solder pigtail cable is offered.				
		2000/†	10E3/†*							
		2048/†	*= 10000/†							
		† Available with 4, 6, 8 or 12 pole. (12 pole is designated by character "C")								
		Examples: 1024/8 is 1024PPR, 8 pole; 2000/C is 2000PPR, 12 pole								

# SERIES F21

**Dynapar™ brand**

## For Stepper & Small Servo Motors

### Key Features

- Digital Encoder with Flex Servo Ring easily Replaces Size 21 Resolver
- Short Mounting Depth with Jam Nut Shaft Fixing makes Installation Easy
- Up to 2048PPR with Commutation Channels



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental with commutation option, Optical

**Resolution:** 1024 or 2048 PPR incremental with 8 or 10 pole commutation channels

**Accuracy:** Incremental:  $\pm 2.5$  arc-mins. max. edge to any edge; Commutation:  $\pm 6$  arc-mins. max.

**Phasing for CCW rotation of motor shaft :**  
A leads B by  $90^\circ$  and U leads V leads W by  $120^\circ$ .

**Minimum edge separation** A to B is  $45^\circ$ .

**Index to U channel:**  $\pm 1^\circ$  mech. index pulse center to U channel rising edge.

**Index Pulse Width:**  $90^\circ$  gated A and B high

### ELECTRICAL

**Input Power Requirements:**  $5 \pm 10\%$  VDC at 100 mA max (incremental and commutation), excluding output load

**Output Signals:**

**Incremental:** 26LS31 Differential Line Driver, sink / source 40 mA max.

**Commutation:** Open Collector w/2.0 k $\Omega$  pull-ups, 8 mA sink max.; or 26LS31 Differential Line Driver, sink / source 40 mA max.

**Frequency Response:** 300 kHz, max.

**Termination:** Flying leads, stranded 26 AWG, twisted pair, PVC insulation, 6.5" length  $\pm 0.5$ "

### MECHANICAL

**Weight:** 3.5 oz. (90 gm) typ.

**Dimensions:** Outside Diameter : 2.062" (52.4mm), max.; Height: 1.01" (25.65mm), max.

**Material:** Housing: cast-aluminum; Servo Ring: glass reinforced engineering resin; Hub: Brass; Disk: 0.030" (0.76mm) thick glass

**Moment of Inertia:**  $2.66 \times 10^{-4}$  in-oz-sec.<sup>2</sup> (18.8 gm-cm<sup>2</sup>)

**Bore Diameter:** 0.50" (12.7mm)

**Bore Dia. Tolerance:**  $+0.001"/-0.000"$  ( $+0.025$  mm/ $-0.000$  mm)

**Mating Shaft Runout:** 0.002" (0.05 mm) max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Axial movement:**  $\pm 0.010"$  ( $\pm 0.25$  mm), max.

**Mounting:** 2.047" (51.99mm) servo ring with integral flexure (size 21 pancake resolver equivalent)

**Acceleration:** 100,000 rad/sec.<sup>2</sup> max.

**Velocity:** 5,000 RPM continuous; 12,000 RPM peak

**Bearing Life:**  $[(3.6 \times 10^9) / \text{RPM}]$  Hours ; e.g. 605,000 hours @6,000 RPM

### ENVIRONMENTAL

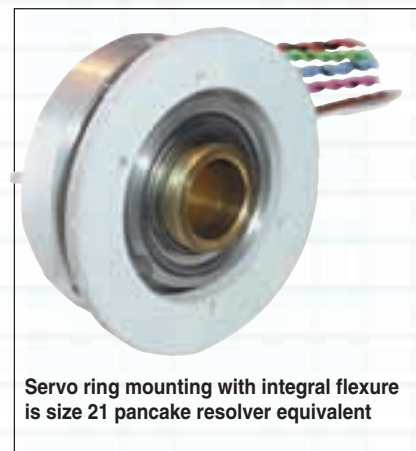
**Operating Temperature:**  $0^\circ$  to  $+120^\circ\text{C}$

**Storage Temperature:**  $0^\circ$  to  $+120^\circ\text{C}$

**Shock:** 50 Gs for 6 msec duration

**Vibration:** 2.5 Gs at 5 to 2000 Hz

**Relative Humidity:** 90% non-condensing

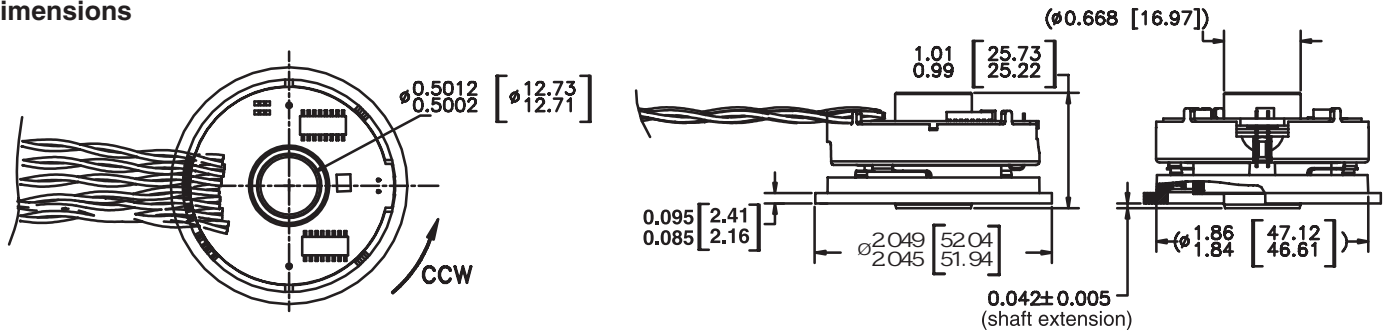


Servo ring mounting with integral flexure is size 21 pancake resolver equivalent



# SERIES F21

## Dimensions

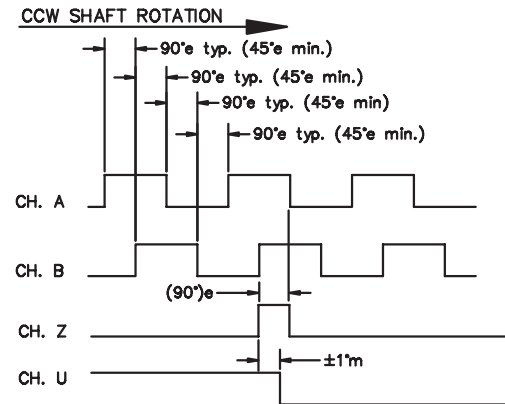


## Connections

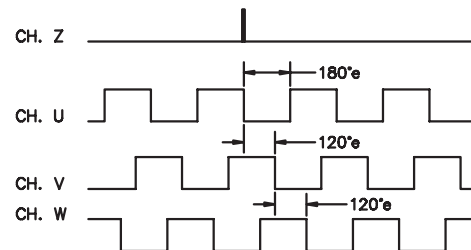
Function*	Cable Wire Color
VCC	RED
GND	BLACK
A	BLUE/BLACK
A	BLUE
B	GREEN/BLACK
B	GREEN
Z	VIOLET/BLACK
Z	VIOLET
U	BROWN/BLACK
U	BROWN
V	GRAY/BLACK
V	GRAY
W	WHITE/BLACK
W	WHITE

\* Function availability dependant on Model

## Waveforms



Waveforms below show relationship between CH. Z, U, V & W (scale differs from above)



## Ordering Information

To order, complete the model number with code numbers from the table below:

Code 1: Model	Code 2: PPR, Poles	Code 3: Mount	Code 4: Electrical	Code 5: Shaft/Bore	Code 6: Termination
<b>F21</b>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/>	<b>0</b>	<input type="checkbox"/>	<b>3</b>	<b>0</b>
Ordering Information					
<b>F21</b> Size 21 Commutating Encoder	Incremental channels only	<b>0</b> Servo mount 2.047 Diameter x.090 thick	Available when Code 2 is XXXX/0	<b>3</b> 1/2 in. thru bore	<b>0</b> 6.5" $\pm 0.5$ " Twisted Pair Flying Leads
	Incremental plus Commutation channels		Available when Code 2 is XXXX/8 or C		
	<b>1024/0</b> <b>2048/0</b>		<b>3</b> 5V in, line driver out incremental only		
	<b>1024/8</b> Note: "C" = 10 poles. Consult factory for other configurations <b>2048/8</b> <b>1024/C</b> <b>2048/C</b>		<b>6</b> 5V in, line driver out for incremental; 5V in, open collector out for commutation <b>9</b> 5V in, line driver out for incremental; 5V in, line driver out for commutation		

# SERIES HC20

# Dynapar™ brand

## For Stepper & Small Servo Motors

### Key Features

- Economical Servomotor Feedback with New Phased Array ASIC
- High 120°C Operating Temperature Won't Limit Motor Performance
- Up to 2500PPR Direct-Read with Commutation Channels



## NEW!



## SPECIFICATIONS

### STANDARD OPERATING CHARACTERISTICS

**Code:** Incremental

**Resolution:** 500 to 2500 PPR

**Commutation:** 4/6/8 pole

**Format:** Two channel quadrature (AB) with optional Index (Z) and complementary outputs

**Phase Sense:** Phasing for CCW rotation of motor shaft (viewing from encoder cover side): A leads B by  $90^\circ \pm 22.5^\circ$  electrical, and U leads V leads W by  $120^\circ$

**Accuracy:**

- Incremental: 40 arc-sec. max. edge to any edge;
- Commutation:  $\pm 6$  arc minutes max.

**Index:**  $90^\circ$  electrical (gated A and B high)

**Waveforms:** Squarewave with rise and fall times less than 1 microsecond into a load capacitance of 1000 pF

**Connection:**

Pin	Signal	Color
1	Vcc	Red
2	U	Brown
3	GND	Black
4	V	Gray
5	A	Blue
6	W	White
7	$\bar{A}$	Blue/Black
8	N.C.	—
9	B	Green
10	$\bar{U}$	Brown/Black
11	$\bar{B}$	Green/Black
12	$\bar{V}$	Gray/Black
13	Z	Violet
14	$\bar{W}$	White/Black
15	$\bar{Z}$	Violet/Black
16	N.C.	—

### ELECTRICAL

**Supply Voltage:** DC 5V  $\pm 10\%$  (SELV)

**Max. Current (w/o load):**

- Incremental: 150mA
- Incremental + Commutation: 175mA

**Max. Output Frequency:**

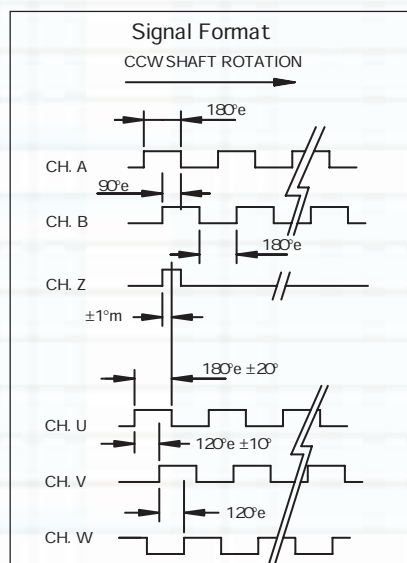
- 250 kHz (up to 1024 ppr)
- 500 kHz (> 1024 ppr)

**Signal Level:**

- NPN: Open Collector
- Differential Line Driver: RS 422

**Output Current:** RS422:  $\pm 40$  mA (26LS31); NPN O.C.: 16mA (2k. int. pull up)

**Connection:** Axial or Raidal cable available



### MECHANICAL

**Weight:** 120g typical

**Dimensions:**

- Outside Diameter with Cover: 50 mm
- Mounting Depth: 36mm

**Material:**

- Bearing Housing: Aluminium;
- Cover: Aluminium;
- Shaft: Brass: 699477-0001

**Shaft Style (dependant on model):**

- Blind Hole Shaft: 8.00mm dia; 20mm depth
- Hollow Shaft: 6.00 or 8.00mm dia
- Taper Shaft: 9.00mm dia. nominal; 2.8624°+0.2289/- 0 Taper

**Mating Shaft Runout:**  $\pm 0.2$ mm max. (Includes shaft perpendicularity to mounting surface)

**Mating Shaft Axial Movement:** max.  $\pm 0.8$ mm.

**Max. Velocity:** RPM= (Frequency/PPR) x 60 or 2000 min<sup>-1</sup>, whichever is less

### ENVIRONMENTAL

**Operating Temperature:** 0...+120°C

**Storage Temperature:** -40...+120°C

**Shock Resistance:** 1000 m/s<sup>2</sup> (6 ms)

**Vibration Resistance:** 25 m/s<sup>2</sup> (5...2000 Hz)

**Protection Class:** IP51 (cable must be oriented downwards)

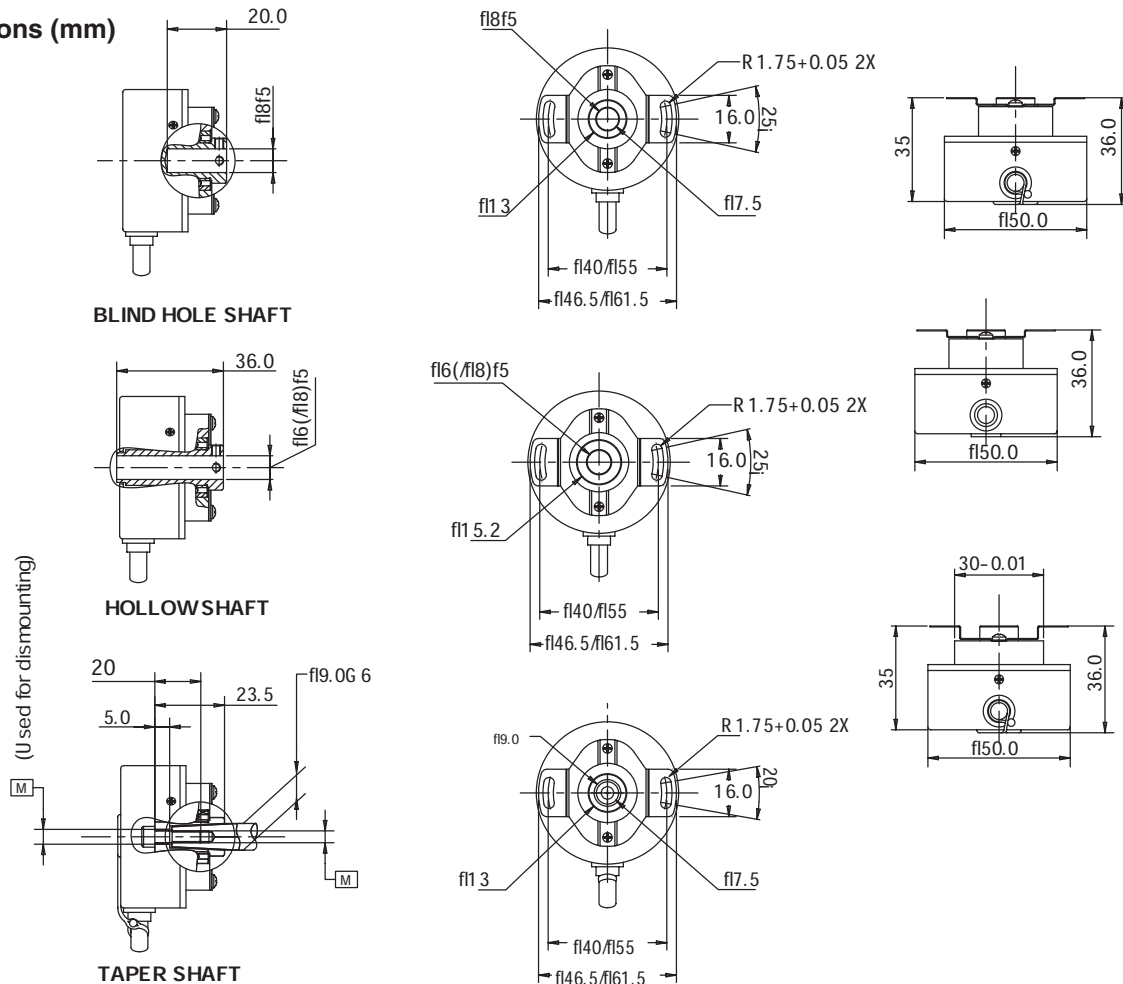
### Ordering Information

To order, complete the model number with code numbers from the table below:

Code 1: Model	Code 2: PPR Incremental <sup>2</sup>	Code 3: Poles Commutation <sup>2</sup>	Code 4: Mounting	Code 5: Electrical <sup>1</sup>	Code 6: Shaft	Code 7: Connection																																													
<b>HC20</b>	□□□□	□	□	□	□	□																																													
Ordering Information																																																			
<b>HC20</b> Compact Hollowshaft Encoder	<b>0500 2000</b> <b>0512 2048</b> <b>1000 2500</b> <b>1024</b>	<b>0</b> None <b>4</b> 4 Pole <b>6</b> 6 Pole <b>8</b> 8 Pole	<b>0</b> No tether <b>Tether</b> <b>1</b> 1.575" (40mm) TK <b>2</b> 2.166" (55mm) TK	incremental only, <=2048/0 (ppr/poles) <b>0</b> U <sub>inc</sub> = DC 5V; output <sub>inc</sub> = NPN-O.C. incremental only without commutation <b>2</b> U <sub>inc</sub> = DC 5-26V; output <sub>inc</sub> = RS 422 <b>3</b> U <sub>inc</sub> = DC 5V; output <sub>inc</sub> = RS 422 incremental plus commutation signals <b>6</b> U <sub>inc</sub> = DC 5V; output <sub>inc</sub> = RS 422 U <sub>com</sub> = DC 5V; output <sub>com</sub> = NPN-O.C. <b>9</b> U <sub>inc</sub> = DC 5V; output <sub>inc</sub> = RS 422 U <sub>com</sub> = DC 5V; output <sub>com</sub> = RS 422	<b>0</b> Taper shaft(Ø9,1:10) <b>1</b> Blind vertical shaft Ø6 <b>2</b> Blind vertical shaft Ø8 <b>3</b> Hollow shaft Ø6 <b>4</b> Hollow shaft Ø8	<b>Axial plug</b> <b>1</b> 1 Ft. cable <b>2</b> 2 Ft. cable <b>3</b> 3 Ft. cable <b>4</b> 4 Ft. cable <b>5</b> 5 Ft. cable <b>6</b> 6 Ft. cable <b>7</b> 7 Ft. cable <b>8</b> 8 Ft. cable																																													
	<table border="1"> <thead> <tr> <th colspan="5">Available Combinations (PPR/Poles)</th> </tr> <tr> <th rowspan="2">Incremental PPR</th> <th colspan="4">Number of Poles</th> </tr> <tr> <th>0</th> <th>4</th> <th>6</th> <th>8</th> </tr> </thead> <tbody> <tr> <td>0500</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> <tr> <td>0512</td> <td></td> <td></td> <td></td> <td>x</td> </tr> <tr> <td>1000</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> <tr> <td>1024</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> <tr> <td>2000</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> <tr> <td>2048</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> <tr> <td>2500</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> </tbody> </table>		Available Combinations (PPR/Poles)					Incremental PPR	Number of Poles				0	4	6	8	0500	x	x	x	x	0512				x	1000	x	x	x	x	1024	x	x	x	x	2000	x	x	x	x	2048	x	x	x	x	2500	x	x	x	x
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2500	x	x	x	x																																															

1 U<sub>inc</sub>: Supply voltage incremental, U<sub>com</sub>: Supply voltage commutation (only if commutation is selected); 2 See available combinations (pulses/poles)

### Dimensions (mm)





# SERIES 11/R11

**Harowe™ brand**

## Heavy Duty Brushless Resolvers

### Key Features

- Brushless Construction is Ideal for Brushless Servo Motors
- Shortest Mounting Depth in the Industry for Easy Mounting
- Up to 125°C Temperature Range
- Radiation Hardened Models Available



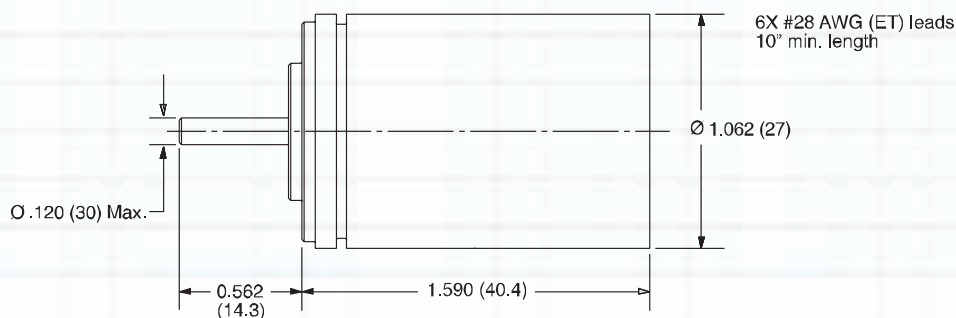
by **DYNAPAR™**



## SPECIFICATIONS

Family Model	Speed*	Primary Winding	Accuracy ± Arc-Min	Input Voltage (Vrms)	Frequency (Hz)	Maximum Input Current (mA)	Transformation Ratio (V out / V in) ± 10%	Phase Shift (degrees)	Total Null Voltage (mV)
11BR W -300-B	1	Stator	10	12.0	400	10.9	1.75	12	30
11BR W -300-F	1	Stator	7	12.0	2,500	3.1	0.50	-2	30
11BR W -300-M	1	Stator	7	10.0	5,000	8.3	0.50	-5	30
11BRCT -300-F	2	Stator	10	12.0	2,500	8.3	0.50	0	15
11BRCT -300-M	2	Stator	10	11.8	2,500	70.0	1.02	-1	30
11BRCT -300-T	4	Stator	5	12.0	2,500	6.0	0.53	-2	15
11BRCT -300-P	5	Stator	4	12.0	2,500	1.4	0.39	-7	15
11BRCX-300-A	1	Rotor	7	7.5	4,000	13.5	0.54	-2	20
11BRCX-300-B	1	Rotor	7	7.5	4,000	40.0	1.07	-2	15
11BRCX-300-C	1	Rotor	7	6.0	1,000	15	0.45	4	15
11BRCX-300-G	1	Rotor	7	26.0	400	40.0	0.45	12	30
11BRCX-300-J	1	Rotor	7	7.0	5,000	10.9	0.95	-6	15
11BRCX-300-N	1	Rotor	7	8.5	1,000	14.0	1.00	3	30
11BRCX-300-M	2	Rotor	7	7.0	5,000	10.9	0.95	-2	30
11BRCX-300-T	4	Rotor	7	7.0	5,000	11.0	0.84	7	20
11BRCX-300-P	5	Rotor	6	10.0	5,000	5.0	0.55	-3	20
R11-S01F-1A	1	Rotor	20	1.88	2,250	21.0	1.40	11	15
R11-S01F-1B	1	Rotor	20	6.00	2,000	12.0	0.454	8.5	15
R11-S01F-1A	1	Rotor	6	1.88	2,250	21.0	1.40	11	15

\*Speeds are defined as follows: 1 = single speed; 2 = 2-speed; etc.



# FRAMELESS SERIES

# Harowe™ brand

## Heavy Duty Brushless Resolvers

### Key Features

- Wide Range of Sizes from 10 to 55
- Multi-Speed Available
- Up to 200°C Temperature Range
- Radiation-Hardened Models Available

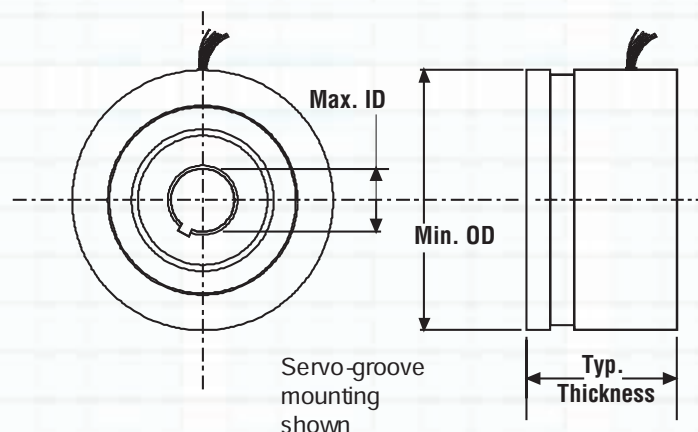
by  **DYNAPAR™**



## SPECIFICATIONS

Model*	Typical Thickness in (mm)	Minimum OD in (mm)	Maximum ID in (mm)
10BRCX	.65 (16.5)	1.05 (26.5)	.237 (6.0)
15BRCX	1.00 (25.4)	1.45 (36.8)	.472 (12.0)
21BRCX	1.25 (31.8)	2.06 (52.4)	.8007 (20.34)
31BRCX	1.25 (31.8)	3.05 (77.5)	1.5763 (40.04)
55BRCX	1.25 (31.8)	5.50 (139.7)	3.6515 (92.75)

\*Available as transmitter and control transformer types.



# HaroMax Series 15

# Harowe™ brand

## Heavy Duty Brushless Resolvers

### Key Features

- Frameless size 15 Servo Mounting
- Anodized Aluminum Housing with Low Mass
- Machine Wound Stator for High Accuracy



by  **DYNAPAR™**



## SPECIFICATIONS

Part Number	Input Volts	Input Khz	Transfer Ratio	Speed	Mounting	Bore	Connections
15BRX700-B04AB	5.0	10.0	0.42	1	Servo	3/8 in	40 in leads
15BRX700-B10AA	2.0	10.0	0.98	1	Servo	3/8 in	2 in leads
15BRX700-B10AA	2.0	6.0	0.90	1	Servo	3/8 in	2 in leads
15BRX700-D10AA	8.0	8.0	0.50	1	Servo	3/8 in	12 in leads
15BRX700-D10AA	4.0	5.0	0.50	1	Servo	3/8 in	12 in leads
15BRX700-D10AA	7.0	10.0	0.48	1	Servo	3/8 in	12 in leads
15BRX700-D10AC	8.0	8.0	0.50	1	Servo	3/8 in	21 in cable
15BRX700-D10AD	8.0	8.0	0.50	1	Servo	3/8 in	4.25 in leads
15BRX700-D10AE	8.0	8.0	0.50	1	Servo	3/8 in	18 in cable
15BRX700-F10AA	4.0	5.0	0.50	1	Servo	3/8 in	12 in leads

# HaroMax Series 21

# Harowe™ brand

## Heavy Duty Brushless Resolvers

### Key Features

- Frameless size 21 Servo Mounting
- Anodized Aluminum Housing with Low Mass
- Machine Wound Stator for High Accuracy



by  **DYNAPAR™**



## SPECIFICATIONS

Part Number	Input Volts	Input Khz	Transfer Ratio	Speed	Mounting	Bore	Connections
21BRX700-B42AA	2.0	10.0	1.00	1	Servo	1/2 in	6.5 in leads
21BRX700-B42AA	2.0	6.0	1.00	1	Servo	1/2 in	6.5 in leads
21BRX700-B42AA	3.5	10.0	1.03	1	Servo	1/2 in	6.5 in leads
21BRX700-D11AC	11.3	8.0	0.52	1	Servo	17 mm	12 in leads
21BRX700-D42AA	8.0	8.0	0.50	1	Servo	1/2 in	6.5 in leads
21BRX700-D42AA	10.0	10.0	0.50	1	Servo	1/2 in	6.5 in leads
21BRX700-D42AA	4.0	4.0	0.50	1	Servo	1/2 in	6.5 in leads
21BRX708-H06AA	4.0	4.0	0.45	1	Flange	16 mm	12 in leads
21BRX708-H06AA	6.0	6.0	0.45	1	Flange	16 mm	12 in leads
21BRX709-E03AA	6.0	6.0	0.31	1	Flange	8 mm	9 in leads