

## 10 Position Encoder Resolution Data Sheet

### MTR-10-10E

#### MM-3M-ST, -F, -FOS, -EX, MM-4M-F

80 TPI Lead Screw (0.3175 mm/turn)		10 position encoder <sup>1</sup>
GH <sup>2</sup> Ratio	Max Travel Rate <sup>3</sup> (mm/sec)	Resolution (µm/count)
16:1	6.614	0.4961
64:1	1.653	0.1240
256:1	0.413	0.0310
1024:1	0.103	0.0078

#### MM-3M-ST, -F, -EX, MM-4M-F

40 TPI Lead Screw (0.635 mm/turn)		10 position encoder <sup>1</sup>
GH <sup>2</sup> Ratio	Max Travel Rate <sup>3</sup> (mm/sec)	Resolution (µm/count)
16:1	13.229	0.9922
64:1	3.307	0.2481
256:1	0.827	0.0620
1024:1	0.207	0.0155

#### Notes:

1. The 10mm motors used with both linear and rotary stages incorporate dual channel, 10 position, magnetic encoders. The quadrature output is equivalent to 40 encoder counts per motor armature revolution.
2. Gearhead ratio is denoted by GH.
3. Maximum travel rate is calculated with the motor armature turning at a maximum rate of 20,000 RPM.

#### Linear Travel

##### Travel rate calculations

Lead screw RPM = motor RPM/(gearhead ratio)  
 Distance per minute = (lead screw RPM) x lead; (lead = 0.3175 mm for 80 TPI screw and 0.635 mm for 40 TPI screw)  
 Distance per second = (distance per minute)/60  
 Distance in inches = (distance (mm))/(25.4)

**Example calculation:** with motor RPM = 20,000; GH ratio = 16:1; lead = 0.3175 mm

Distance per second = [(20000 RPM)/(16)] x (0.3175 mm) x (min/60 sec) = 6.6145 mm/sec

##### Encoder resolution calculations

Encoder counts per lead screw revolution = (encoder counts per motor revolution) x (gearhead ratio)  
 Distance per encoder count = lead/(encoder counts per lead screw revolution)

**Example calculation:** with motor GH ratio = 16:1; lead = 0.3175 mm; 40 encoder counts per motor revolution

Distance per encoder count = (0.3175 mm)/(40 x 16) = 0.4961 µm/count

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

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## 10 Position Encoder Resolution Data Sheet (cont.)

**MTR-10-10E**

**MM-3M-R**

80:1 Worm Drive Ratio			10 position encoder <sup>1</sup>
GH <sup>2</sup> Ratio	Final Output	Max Travel Rate <sup>3</sup> (rad/sec)	Resolution (μrad/count)
16:1	1,280:1	1.636	122.7185
64:1	5,120:1	0.409	30.6796
256:1	20,480:1	0.102	7.6699
1024:1	81,920:1	0.025	1.9175

**Notes:**

1. The 10mm motors used with both linear and rotary stages incorporate dual channel, 10 position, magnetic encoders. The quadrature output is equivalent to 40 encoder counts per motor armature revolution.
2. Gearhead ratio is denoted by GH.
3. Maximum travel rate is calculated with the motor armature turning at a maximum rate of 20,000 RPM.

### Rotary Travel

#### Travel rate calculations

$$\begin{aligned} \text{Rotor travel rate (RPM)} &= (\text{motor RPM}) / [\text{gearhead ratio}] \times (\text{worm drive ratio}) \\ \text{Rotor travel rate (rad/sec)} &= [\text{rotor travel rate (RPM)}] \times (\text{min}/60 \text{ sec}) \times (6.283185 \text{ rad/revolution}) \end{aligned}$$

**Example calculation:** with motor RPM = 20,000; GH ratio = 16:1; lead = 0.3175 mm

$$\text{Rotor travel rate (rad/sec)} = (20000 \text{ RPM}) / (16 \times 80) \times (\text{min}/60 \text{ sec}) \times (6.283185 \text{ rad/revolution}) = 1.63624 \text{ rad/sec}$$

#### Encoder resolution calculations

$$\begin{aligned} \text{Encoder counts per lead screw revolution} &= [(\text{encoder counts per motor revolution})] \times (\text{gearhead ratio}) \times (\text{worm drive ratio}) \\ \text{Angular resolution} &= (6.283185 \text{ rad/revolution}) / (\text{encoder counts per lead screw revolution}) \end{aligned}$$

**Example calculation:** with motor GH ratio = 16:1; lead = 0.3175 mm; 40 encoder counts per motor revolution

$$\begin{aligned} \text{Angular resolution} &= (6.283185 \text{ rad per lead screw revolution}) / [(40 \text{ counts per motor revolution}) \times (16 \text{ motor revolutions per gearhead revolution}) \times (80 \text{ gearhead revolutions per lead screw revolution})] \\ &= 122.718 \mu\text{rad/count} \end{aligned}$$

#### Conversion:

$$\begin{aligned} 1 \text{ inch (in)} &= 25.4 \text{ mm} \\ 1 \text{ inch} &= 25,400 \mu\text{m} \\ 1 \text{ millimeter (mm)} &= 39.37\text{E-}3 \text{ inch} \\ 1 \text{ micron } (\mu\text{m}) &= 39.37\text{E-}6 \text{ inch} \\ 1 \text{ deg} &= 0.01745329252 \text{ rad} \end{aligned}$$

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