

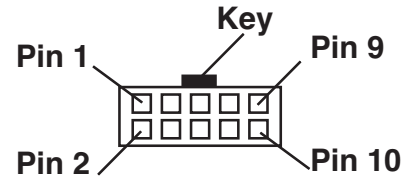
MTR-13-16E-HT MicroMini™ Motor (High Torque, 13 mm diameter, 6 Vdc, 16 position encoder)

Linear 80 TPI/Rotary 90:1 Connection Specifications

Motor Connector Pin Assignments:

Motor Type: MTR-13-16E
Connector Type: Dual Row IDC
***Mate Part # (Male Pin):**
Pancon Part #057-010-115

| Pin # | Name | Pin # | Name |
|-------|---------------|-------|-----------------|
| 1 | Motor+ | 6 | Motor - |
| 2 | Encoder+V | 7 | Limit ground |
| 3 | Encoder Ch A | 8 | No connection** |
| 4 | Encoder Ch B | 9 | Reverse limit |
| 5 | Ground (case) | 10 | Forward limit |



**10 pin motor
female connector
(front view)**

****Optional: +5V with Optical Limit Switches**

Electrical Specifications:

| | |
|---|--------|
| Supply Voltage Nom. (Volts) | 6 |
| Armature Resistance (Ohm) ±12% | 2.83 |
| Maximum Power Output (watts) ⁽¹⁾ | 3.11 |
| Maximum Efficiency (%) ⁽¹⁾ | 81 |
| No Load Speed (RPM) ±12% ⁽¹⁾ | 10,600 |
| Friction Torque (at no-load speed)(mNm) | 0.12 |
| No Load Current (mA) ±50% ⁽²⁾ | 22 |
| Stall Torque (mNm.) ⁽¹⁾ | 11.2 |
| Velocity Constant (RPM/Volt) | 1,790 |
| Back EMF Constant (mV/RPM) | 0.560 |
| Torque Constant (mNm/A) | 5.35 |
| Armature Inductance (mH) | 0.07 |
| Maximum permissible speed (RPM) | 12,000 |
| Maximum continuous current (mA) | 810 |
| Maximum continuous torque (mNm) | 3.2 |

Encoder Specifications:

| | |
|-----------------------------|--|
| Supply Voltage | 5 Vdc Nom. |
| Max Supply Voltage | 5.5 Vdc |
| Operating Current | 6 mA Nom. @ 5 Vdc |
| Signal Phase Shift | 90° |
| Maximum Signal Frequency | 20 Khz |
| Operating Temperature Range | -30°C to +85°C |
| Signal Rise Time | 0.1 µs max. |
| Phase Relationship | Ch. A leads Ch. B when motor rotation is clockwise as viewed from shaft end. |
| Pulses Per Revolution | 16 (2 channels) |
| Quadrature | 64 encoder counts |
| Output signal | CMOS and TTL compatible |

Mechanical Specifications (Motor):

| | |
|---|----------------|
| Mechanical Time Constant (ms) ⁽¹⁾ | 7 |
| Armature Inertia (g cm ²) | 0.71 |
| Angular Acceleration (x 10 ³ rad/sec ²) ⁽¹⁾ | 160 |
| Rotor Temperature Range | -30°C to +85°C |
| Maximum Shaft Load | |
| Radial at 3,000 RPM 3 mm from bearing(N) | 1.2 |
| Axial @ standstill (N) | 20 |
| Weight | 19 g |
| Maximum Rotor Temperature. | 125°C |

(1) Specified at nominal supply voltage.

(2) Specified with shaft diameter = 1.5mm at no-load speed.

* Mating connectors may be purchased from National Aperture, Inc.

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.

16 Position Encoder Resolution Data Sheet

MTR-13-16E-HT

MM-4M-EX

| 80 TPI Lead Screw (0.3175 mm/turn) | | | 16 position encoder ¹ |
|------------------------------------|-------------------|---------------------------------------|----------------------------------|
| GH ² Ratio | Actual Gear Ratio | Max Travel Rate ³ (mm/sec) | Resolution (µm/count) |
| 14:1 | 13.795918367:1 | 7.671 | 0.3596 |
| 43:1 | 42.920634921:1 | 2.466 | 0.1156 |
| 66:1 | 66.220408163:1 | 1.598 | 0.0749 |
| 134:1 | 133.530864198:1 | 0.792 | 0.0372 |
| 159:1 | 159.419501134:1 | 0.664 | 0.0311 |
| 246:1 | 245.961516035:1 | 0.430 | 0.0202 |
| 415:1 | 415.429355281:1 | 0.255 | 0.0119 |
| 592:1 | 592.129575640:1 | 0.178 | 0.0084 |
| 989:1 | 988.891428571:1 | 0.107 | 0.0050 |
| 1526:1 | 1,525.718204082:1 | 0.069 | 0.0033 |
| 2608:1 | 2,625.740771277:1 | 0.040 | 0.0019 |
| 4365:1 | 4,385.142457309:1 | 0.024 | 0.0011 |
| 5647:1 | 5,666.953329446:1 | 0.018 | 0.0009 |
| 40 TPI Lead Screw (0.635 mm/turn) | | | 16 position encoder ¹ |
| GH ² Ratio | Actual Gear Ratio | Max Travel Rate ³ (mm/sec) | Resolution (µm/count) |
| 14:1 | 13.795918367:1 | 15.342 | 0.7192 |
| 43:1 | 42.920634921:1 | 4.931 | 0.2312 |
| 66:1 | 66.220408163:1 | 3.196 | 0.1498 |
| 134:1 | 133.530864198:1 | 1.585 | 0.0743 |
| 159:1 | 159.419501134:1 | 1.327 | 0.0622 |
| 246:1 | 245.961516035:1 | 0.860 | 0.0403 |
| 415:1 | 415.429355281:1 | 0.509 | 0.0239 |
| 592:1 | 592.129575640:1 | 0.357 | 0.0168 |
| 989:1 | 988.891428571:1 | 0.214 | 0.0100 |
| 1526:1 | 1,525.718204082:1 | 0.138 | 0.0065 |
| 2608:1 | 2,625.740771277:1 | 0.080 | 0.0038 |
| 4365:1 | 4,385.142457309:1 | 0.048 | 0.0023 |
| 5647:1 | 5,666.953329446:1 | 0.037 | 0.0018 |

Notes:

- The 13 mm motors used with both linear and rotary stages incorporate dual channel, 16 position, optical encoders. The quadrature output is equivalent to 64 encoder counts per motor armature revolution.
- Gearhead ratio is denoted by GH.
- 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 = 13.795918367:1; lead = 0.3175 mm
 Distance per second = [(20000 RPM)/13.795918367] x (0.3175 mm) x (min/60 sec) = 7.6714 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 = 13.795918367:1; lead = 0.3175 mm; 64 encoder counts per motor revolution
 Distance per encoder count = (0.3175 mm)/(64 x 13.795918367) = 0.3595945821096348 µm/count

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16 Position Encoder Resolution Data Sheet (cont.)

MTR-13-16E-HT

MM-4M-R

| 90:1 Worm Drive Ratio | | | 16 position encoder ¹ |
|-----------------------|-------------------|--|----------------------------------|
| GH ² Ratio | Actual Gear Ratio | Max Travel Rate ³ (rad/sec) | Resolution (μrad/count) |
| 14:1 | 13.795918367:1 | 1.687 | 79.0691 |
| 43:1 | 42.920634921:1 | 0.542 | 25.4151 |
| 66:1 | 66.220408163:1 | 0.351 | 16.4727 |
| 134:1 | 133.530864198:1 | 0.174 | 8.1691 |
| 159:1 | 159.419501134:1 | 0.146 | 6.8425 |
| 246:1 | 245.961516035:1 | 0.094 | 4.4350 |
| 415:1 | 415.429355281:1 | 0.056 | 2.6258 |
| 592:1 | 592.129575640:1 | 0.039 | 1.8422 |
| 989:1 | 988.891428571:1 | 0.023 | 1.1031 |
| 1526:1 | 1,525.718204082:1 | 0.015 | 0.7150 |
| 2608:1 | 2,625.740771277:1 | 0.009 | 0.4154 |
| 4365:1 | 4,385.142457309:1 | 0.005 | 0.2488 |
| 5647:1 | 5,666.953329446:1 | 0.004 | 0.1925 |

Notes:

1. The 13 mm motors used with both linear and rotary stages incorporate dual channel, 16 position, optical encoders. The quadrature output is equivalent to 64 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 = 13.795918367:1; lead = 0.3175 mm

$$\text{Rotor travel rate (rad/sec)} = (20000 \text{ RPM}) / (13.795918367 \times 90) \times (\text{min}/60 \text{ sec}) \times (6.283185 \text{ rad/revolution}) = 1.68680728 \text{ rad/sec}$$

Encoder resolution calculations

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

Example calculation: with motor GH ratio = 13.795918367:1; worm drive ratio = 90:1; lead = 0.3175 mm; 64 encoder counts per motor revolution

$$\begin{aligned} \text{Angular resolution} &= (6.283185 \text{ rad per rotor revolution}) / [(64 \text{ counts per motor revolution}) \times (13.795918367 \text{ motor revolutions per gearhead revolution}) \times (90 \text{ gearhead revolutions per rotor revolution})] \\ &= 79.069 \mu\text{rad/count} \end{aligned}$$

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