M4 PART NUMBERS AND AVAILABLE OPTIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>Bore Size</th>
<th>Mounting Style</th>
<th>Line Driver</th>
<th>Left &amp; Right Output Range</th>
<th>BASE PPR</th>
<th>Marker</th>
<th>Connector</th>
<th>Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>M4-A</td>
<td>0- Non-Standard 7</td>
<td>J- 2 1/8&quot;</td>
<td>T- Thru Shaft</td>
<td>1- 5 to 24 VDC</td>
<td>48- 480</td>
<td>Z- None</td>
<td>000-None</td>
<td>Shaft</td>
</tr>
<tr>
<td></td>
<td>3- 5/8&quot;</td>
<td>B- 12mm</td>
<td>G- End of Shaft with Grounding</td>
<td>2- 5 to 18 VDC</td>
<td>51- 512</td>
<td>-</td>
<td>003- Torque Arm Mount 016- 6.5&quot; C-Face</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A- 3/4&quot;</td>
<td>C- 16mm</td>
<td>3- 16 to 24 VDC</td>
<td>18- 24 VDC</td>
<td>60- 600</td>
<td>-</td>
<td>005- -40° C Rating Mount</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4- 1&quot;</td>
<td>F- 25mm</td>
<td>4- 5 to 24 VDC</td>
<td>5 V fixed out</td>
<td>7- 72</td>
<td>-</td>
<td>008- 4.5&quot; C-Face Mount</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5- 1 1/8&quot;</td>
<td>G- 48mm</td>
<td>5- None</td>
<td></td>
<td>8- 99</td>
<td>-</td>
<td>009- Northstar Pinout 015- Stainless Steel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8- 1 1/2&quot;</td>
<td>E- 58mm</td>
<td>6- Low Range</td>
<td></td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9- 1 5/8&quot;</td>
<td>D- 52mm</td>
<td>7- Medium Range</td>
<td></td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6- 2&quot;</td>
<td>H- 60mm</td>
<td>8- High Range</td>
<td></td>
<td></td>
<td>-</td>
<td></td>
<td></td>
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CAUTION
Be careful not to damage clamping fingers during handling. Do not tighten clamping collar before installation onto motor shaft. Damaging clamping fingers can affect the quality of installation.

NOTE
In some cases units are shipped with a protective plug in the hollow shaft to help prevent damage. If it is present, it must be removed prior to final installation.

INSTALLATION
Equipment needed for installation

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<tr>
<td>1. M4 Encoder</td>
<td>7. Washer, Flat 1/4 (2)</td>
</tr>
<tr>
<td>2. Clamping Collar</td>
<td>8. Washer, Spring Lock 1/4</td>
</tr>
<tr>
<td>4. Thread Locker (blue)</td>
<td>10. Nut, Hex 1/4-20</td>
</tr>
<tr>
<td>5. Screw, Button Hd., 3/8-16 x .50 (2)</td>
<td>11. Washer, Shoulder, Insulating</td>
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CAUTION
Do not tighten the clamping collar before installation onto the motor shaft. Damaging the clamping fingers can affect the quality of installation.

NOTE
In some cases units are shipped with a protective plug in the hollow shaft to help prevent damage. If it is present, it must be removed prior to final installation.

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CAUTION
Do not tighten the clamping collar before installation onto the motor shaft. Damaging the clamping fingers can affect the quality of installation.

NOTE
In some cases units are shipped with a protective plug in the hollow shaft to help prevent damage. If it is present, it must be removed prior to final installation.
Corrective Action for Excess Housing Movement (Wobble)

The hollow shaft M4 design eliminates the potential for bearing and coupling failures from misalignment, however, excessive housing movement (wobble) may cause undesirable vibrations. The higher the RPM, the more severe the vibration will be from housing movement. In a typical installation a housing movement of 0.007” TIR or less (as measured at the outside diameter of the main encoder body) will not have an adverse effect. If excessive housing movement is detected in the installation:

1. Check the shaft the M4 is mounted on for excessive shaft runout. NEMA MG1 calls for 0.002” TIR or less.
2. Verify that the M4 engagement with the motor shaft conforms to the engagement rules on page 4. In general, maximizing engagement will minimize housing movement.
3. Verify that the mounting shaft diameters conform to the rules on page 4. Excessive housing movement occurs when the clearance between the motor shaft and pulse generator shaft allows the two center lines to miss match.
4. Loosen the clamping collar and rotate the motor shaft 180° within the M4 hollow shaft sleeve.
5. Make sure the clamping collar is tightened equally on both sides.
6. Move the split in the clamping collar over a solid portion of the M4 shaft.

If excessive housing movement still exists after the above steps, it may be necessary to physically bias the attitude of the encoder on the motor shaft while the clamping collar is being tightened. Either by eye or using dial indicators, note the position around the outside diameter of the encoder that is most out of position from true while turning the motor shaft slowly. With the motor shaft no longer turning, loosen the clamping collar. While applying moderate force by hand against the outside diameter of the encoder on the side opposite where the out of true position was observed, retighten the clamping collar. Several iterations may be necessary if the first attempt under or over compensates. This method may be used to help compensate for undersized shafts, shaft runout, bent clamping fingers, and other problems.

**BREATHER/DRAIN CONSIDERATIONS**

Because the M4 incorporates magnetoresistive sensing technology it can be fitted with a breather drain. The M4 is shipped standard with a breather/drain in the bottom. The breather is to equalize pressure if the tach is exposed to temperature variations. With a sealed encoder, pressure variations can potentially lead to contamination of bearing grease when the encoder is exposed to rapid temperature changes typically associated with being washed down. The drain function allows condensation an escape path from the encoder. The breather/drain must be located at the lowest point of the encoder and have a clear, unrestricted drainage path. If for any reason the breather/drain cannot be located at the lowest point or have a clear, unrestricted drainage path it must be replaced with a 1/8” NPT pipe plug and the M4 operated as a sealed tach.

**SPECIFICATIONS**

### ELECTRICAL

A. Operating Power (Vin)
1. Volts .............................. See Line Driver Options
2. Current .............................. 120mA, no load

B. Output Format
1. 10 ...................... Connector Options H & J
2. 20 (A & B) ..................... Connector Options E & F
   N,T,W,X,& Z (differential line driver)
4. Marker .......................... 1/Rev
C. Signal Type ............... Incremental, Square Wave, 50 ±10%
D. Direction Sensing ......... Ø A leads Ø B for CW rotation as viewed from the back of the tach looking at the non-drive end of the motor.
E. Transition Slop ......... 15% minimum
F. Frequency Range ....... 0 to 150,000 Hz.
G. PPR .......................... 240, 256, 300, 480, 512, 600, 900, 1024, 1200
H. See Line Driver Options

### MECHANICAL

A. Shaft Inertia .................... 0.08 to 0.23 oz. In.
B. Acceleration .................... 5,000 RPM/Sec.
C. Speed .................... 5,000 RPM for all M4 models, except those shown below
   3,600 RPM for M4-6, M4-7, M4-D, M4-E, M4-G, M4-H, M4-J
D. Weight ........................... 7 lbs (3.2kg).

**LINE DRIVER OPTIONS**

<table>
<thead>
<tr>
<th>Output Options</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Input (Vin)</td>
<td>5-24 VDC</td>
<td>5-18 VDC</td>
<td>18-24 VDC</td>
<td>5-24 VDC</td>
</tr>
<tr>
<td>Output High (Volts)</td>
<td>(Vin) -2 (typ)</td>
<td>(Vin) -1 (typ)</td>
<td>330 ohm pull up</td>
<td>5 VDC</td>
</tr>
<tr>
<td>Output High (milliamps)</td>
<td>80 (max.)</td>
<td>80 (avg.), 1500 (peak)</td>
<td>330 ohm pull up</td>
<td>80 (max.)</td>
</tr>
<tr>
<td>Output Low (Volts)</td>
<td>0.5 (typ)</td>
<td>0.5 (typ)</td>
<td>1 (max.)</td>
<td>0.5 (typ)</td>
</tr>
<tr>
<td>Output Low (milliamps)</td>
<td>80 (max.)</td>
<td>80 (avg.), 1500 (peak)</td>
<td>50 (avg.)</td>
<td>80 (max.)</td>
</tr>
<tr>
<td>Protection</td>
<td>Reverse Voltage, Transient, Short Circuit (high &amp; low)</td>
<td>Reverse Voltage, Transient, Short Circuit (none)</td>
<td>Reverse Voltage, Transient, Short Circuit (low)</td>
<td>Reverse Voltage, Transient, Short Circuit (high &amp; low)</td>
</tr>
<tr>
<td>Maximum Cable Drive(Feet)</td>
<td>1000 ft. @ 5 V</td>
<td>500 ft. @ 12 V</td>
<td>200 ft. @ 24 V</td>
<td>2000 ft.</td>
</tr>
</tbody>
</table>

- E. Starting Torque .......... 1.5 to 20 oz. In.
- F. Shaft Dia. Tolerance: See drawing on last page.
- G. Shaft Engagement:... See drawing on last page.

**ENVIRONMENTAL**

A. Enclosure Rating...... Sealed against dust and water ingress.
B. Operating Temp......... -20° to 85°C

* -40°C optional
WIRING INSTRUCTIONS

CAUTION
Be sure to remove power before wiring the encoder.
Be sure to ground the cable shield: It can be connected
to case ground at the encoder, or grounded at the
receiving device, but should not be grounded on both
ends.

The M4 can be wired for single phase, two-phase, either with or
without complements, with or without markers. See connector options
and wiring diagrams below.

For bidirectional operation of the encoder, proper phasing of the two
output channels is important. Phase A channel leads phase B channel
for clockwise shaft rotation as viewed from the anti-drive or accessory
end of the motor (M4 mounting end).

CORRECTIVE ACTION FOR PHASE REVERSAL
1) Remove Power.
2) Exchange wires on cable, either at encoder cable end, or at
speed controller end (but not both).
   a) Single Ended 2 Phase Wiring (see wiring diagram)
      Exchange A and B at the use end of the wires.
   b) Differential 2 Phase Wiring (see wiring diagram)
      Exchange either A with A in the phase A pair OR B with B
      in the phase B pair but NOT both.
3) Apply Power.

4) Verify encoder feedback is correct, using hand rotation of
   shaft, or jog mode of the speed controller.

Interconnecting cables specified in the wire selection chart are based
on typical applications. Refer to the system drawing for specific cable
requirements where applicable.

Physical properties of cable such as abrasion, temperature, tensile
strength, solvents, etc., are dictated by the specific application.

General electrical requirements are: stranded copper, 22 thru 16
gauge (Industrial EPIC Connector options can use 14 AWG), each wire
pair individually shielded with braid or foil with drain wire, 0.05 uF
maximum total mutual or direct capacitance, outer sheath insulator,
1,000 ft. max. See Wire Selection Chart for some suggested cables.

NOTE
When using the industrial connector ("G", "P", "V", "X",
or "Z" options), the minimum wire size is 20 gage, and
20 gage (only) wire ends must be tinned with solder
before connection at the screw terminals.

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WIRING DIAGRAMS

DIFFERENTIAL TWO PHASE WIRING APPLICATIONS
(USE CONNECTOR OPTION "L" FOR M738 AND M785 REPLACEMENTS)

SIGNAL CODING TABLE

<table>
<thead>
<tr>
<th>SIGNAL</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM</td>
<td>+V</td>
</tr>
<tr>
<td>SIGNAL</td>
<td></td>
</tr>
</tbody>
</table>

REF

030

OPTION

W & "N"

OPTION

"A" "B" "C"

OPTION

"K" "L" "M"

OPTION

"P" "V"

OPTION

"X" & "Z"

OPTION

"T"

With Mod.

030

DIFFERENTIAL TWO PHASE WIRING APPLICATIONS
(USE CONNECTOR OPTIONS "E" & "F" FOR M737A REPLACEMENTS)

SINGLE ENDED TWO PHASE WIRING APPLICATIONS
(USE CONNECTOR OPTIONS "E" & "F" FOR M737A REPLACEMENTS)

SINGLE ENDED SINGLE PHASE WIRING APPLICATIONS
(USE CONNECTOR OPTIONS "H" & "J" FOR M727A REPLACEMENTS)

TYPICAL WIRE SELECTION CHART
for 18 AWG, multiple pair, individually shielded

<table>
<thead>
<tr>
<th>Belden</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 pair</td>
<td>9368</td>
</tr>
<tr>
<td>3 pair</td>
<td>9369</td>
</tr>
<tr>
<td>4 pair</td>
<td>9388</td>
</tr>
<tr>
<td>6 pair</td>
<td>9389</td>
</tr>
</tbody>
</table>

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When using the industrial connector ("G", "P", "V", "X",
or "Z" options), the minimum wire size is 20 gage, and
20 gage (only) wire ends must be tinned with solder
before connection at the screw terminals.

NOTES:
Marker output for connector options "E" & "F" - Pin "D"
Marker output for connector options "H" & "J" - Pin "C"
Avtron standard warranty applies. Copies available upon request.
Specifications subject to change without notice.