The series M122 magnetic rotary encoders are designed for light industrial applications that require up to thirteen bits of resolution (8192 words or counts/turn) in a very small package. The four models share these features:

- Shafted & non-contact, frictionless; bi-directional
- Maximum rotating speed: 30,000 RPM for blind shaft; 20,000 RPM for shaft
- Protection: IP53 to IP64 standard (IP 68 optional)
- Shock: 1000 m/s²; 6 ms, ½ sine
- Vibration: 100 m/s²; 55 to 2,000 Hz
- 22-mm body

Models Available:

M122-P Parallel binary at 9 bits
M122-S Synchro-serial interface (SSI) to 13 bits
M122-I Incremental 8192 counts/rev (after quadrature decode)
M122-A Analog (one SIN and COS wave over 360°)
M122 P  Binary Parallel Interface

Timing diagram:

Latch enable

Data

Data latched

Data

\( t_r = \text{reaction time} \leq 1 \mu s \)

Output increases with CW rotation

Maximum sampling rate is 500 kHz

Power Supply: 5V ±5%
Power Consumption: 5V ±5% for 9-bit resolution
23 mA for all other resolutions
20 mA
Output Voltage: \( V_o \geq 4V \) at \( I_o \leq 3 \) mA
\( V_o \leq 1V \) at \( I_o \leq 3 \) mA
max. 9 bits (4096 words/turn)
Resolution: 0.45 degrees
Hysteresis: ± 0.7 degrees
Accuracy: ≤ 0.07 degrees
Repeatability: D0 (LSB) - D8 (MSB) - natural binary
Output signals: LE - latch enable input signal, active high
Data inputs: Clock (RS422)
Max. Cable length: 100m (at 1 MHz)
Connection: DA-15P
Max. Weight: 83 g (with 1m cable and D-type connector)

Temp. Range: -25 C to 85 C; (-40C to +85C optional)

M122 S Binary Synchro-Serial Interface (SSI)

Timing diagram:

CLOCK

DATA

D8 D7 D6 D5 D4 D3 D2 D1 D0

LSB

MSB

Clock=≤1MHz

\( T_r = 20 \mu s \) to 40\( \mu s \)

Output increases with CW rotation

Power Supply: 5V ±5%
Power Consumption: 23 mA for 9-bit resolution
35 mA for all other resolutions
Resolution: max. 13 bits (8192 words/turn)
Hysteresis: see table below
Accuracy: see table below
Repeatability: ≤ 0.07 degrees
Output signals: Serial data (RS 422) - natural binary
Data inputs: Clock (RS422)
Max. Cable length: 100m (at 1 MHz)
Connection: DE-9P
Max. Weight: 83 g (with 1m cable and D-type connector)

Resolution options

<table>
<thead>
<tr>
<th>Resolution options (Counts per rev)</th>
<th>Maximum Speed (RPM)</th>
<th>Accuracy (in degrees)</th>
<th>Hysteresis (in degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind Shaft</td>
<td>Shaft</td>
<td>Blind Shaft</td>
<td>Shaft</td>
</tr>
<tr>
<td>320, 400, 500</td>
<td>30,000</td>
<td>20,000</td>
<td>+/-0.7</td>
</tr>
<tr>
<td>512</td>
<td>30,000</td>
<td>20,000</td>
<td>+/-0.7</td>
</tr>
<tr>
<td>800, 1000, 1024</td>
<td>20,000</td>
<td>20,000</td>
<td>+/-0.5</td>
</tr>
<tr>
<td>1600, 2000, 2048</td>
<td>10,000</td>
<td>10,000</td>
<td>+/-0.5</td>
</tr>
<tr>
<td>4096</td>
<td>5,000</td>
<td>5,000</td>
<td>+/-0.5</td>
</tr>
<tr>
<td>8192</td>
<td>2,500</td>
<td>2,500</td>
<td>+/-0.5</td>
</tr>
</tbody>
</table>
### M122 I Incremental Output

**Output diagram:**

![Output Diagram](image)

- **Power Supply:** 5V ±5%
- **Power Consumption:**
  - 23 mA for 9-bit resolution
  - 35 mA for all other resolutions
- **Output TTL signals:** A, B, I, /A, /B, /I (RS 422)
- **Resolution:**
  - 8192 counts/rev. (after quadrature decode)
- **Accuracy:** see table below
- **Max. cable length:** 50m
- **Connection:** DE-9P
- **Temp. Range:** -25 C to 85 C
- **Max. Weight:** 83 g (with 1 m cable and D-type connector)
- **Edge separation time:** 1μsec minimum

<table>
<thead>
<tr>
<th>Resolution options (Counts per rev)</th>
<th>Maximum Speed (RPM)</th>
<th>Accuracy (in degrees)</th>
<th>Hysteresis (in degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind Shaft</td>
<td>Shaft</td>
<td>Blind Shaft</td>
<td>Shaft</td>
</tr>
<tr>
<td>320, 400, 500</td>
<td>30,000</td>
<td>+/-0.7</td>
<td>+/-0.5</td>
</tr>
<tr>
<td>512</td>
<td>30,000</td>
<td>+/-0.7</td>
<td>+/-0.5</td>
</tr>
<tr>
<td>800, 1000, 1024</td>
<td>20,000</td>
<td>+/-0.5</td>
<td>+/-0.3</td>
</tr>
<tr>
<td>1600, 2000, 2048</td>
<td>10,000</td>
<td>+/-0.5</td>
<td>+/-0.3</td>
</tr>
<tr>
<td>4096</td>
<td>5,000</td>
<td>+/-0.5</td>
<td>+/-0.3</td>
</tr>
<tr>
<td>8192</td>
<td>2,500</td>
<td>+/-0.5</td>
<td>+/-0.3</td>
</tr>
</tbody>
</table>

### M122 A Analog Sinusoidal Outputs

- **Power Supply:**
  - Output, single ended
  - **Signal amplitude:** $V_{sa} = 5V ± 5% / 20 mA$
  - **Signal offset:** $V_{so} = 2 Vpp +/- 0.1 V$
  - **Vdd/2 +/- 5 mV**
- **Signal Characteristic:**
  - $|V_a - V_b| \leq 5 \text{ mV}$
  - $|V_{sa} - V_{sb}| \leq 5 \text{ mV}$
  - $|\varphi_a - \varphi_b| = 90^\circ ± 1^\circ$
- **Max. Output frequency:**
  - Blind shaft: 500Hz
  - Shaft: 333Hz
- **Max. Cable length:** 3 m
- **Connection:** DE-9P
- **Temp. Range:** -25 C to 125 C
- **Weight:**
  - 75 g (with 1 m cable & D type connector)
**M122 Dimensions**

### Pin Assignment / Wire Color

**DA9P**

**M122 S/I/A**

<table>
<thead>
<tr>
<th>Nr. Pin</th>
<th>M122 S</th>
<th>M122 I</th>
<th>M122 A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Function</td>
<td>Wire Color</td>
<td>Function</td>
</tr>
<tr>
<td>1</td>
<td>Shield</td>
<td>Shield</td>
<td>Shield</td>
</tr>
<tr>
<td>2</td>
<td>Clock</td>
<td>White</td>
<td>I</td>
</tr>
<tr>
<td>3</td>
<td>Clock</td>
<td>Brown</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td>V&lt;sub&gt;dd&lt;/sub&gt;</td>
<td>Red</td>
<td>V&lt;sub&gt;dd&lt;/sub&gt;</td>
</tr>
<tr>
<td>6</td>
<td>Data</td>
<td>Green</td>
<td>T</td>
</tr>
<tr>
<td>7</td>
<td>Data</td>
<td>Yellow</td>
<td>B</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>Blue</td>
<td>GND</td>
</tr>
</tbody>
</table>

**DA15P**

**M122 P**

<table>
<thead>
<tr>
<th>Pin</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Shield</td>
<td>D8</td>
<td>D7</td>
<td>D6</td>
<td>D5</td>
<td>D4</td>
<td>D3</td>
<td>+5V</td>
<td>D2</td>
<td>D1</td>
<td>D0</td>
<td>NC</td>
<td>NC</td>
<td>LE</td>
<td>GND</td>
</tr>
<tr>
<td>Wire Color</td>
<td>-</td>
<td>White</td>
<td>Brown</td>
<td>Green</td>
<td>Yellow</td>
<td>Gray</td>
<td>Pink</td>
<td>Red</td>
<td>Black</td>
<td>Violet</td>
<td>Orange*</td>
<td>-</td>
<td>-</td>
<td>Clear*</td>
<td>Blue</td>
</tr>
</tbody>
</table>

*Encoders with serial numbers 1100000 or lower; pin 11 wire color is Gray/Pink & pin 14 wire color is Red/Blue

### Mounting M122B

**Dimensions M122B**

Dimensions are for standard 6 mm shaft

*All dimensions are in millimeters*
**SPECIAL CAPABILITIES**

For special situations, we can optimize catalog encoders to provide higher frequency response, greater accuracy, wider temperature range, reduced torque, non-standard line counts, or other modified characteristics. In addition, we regularly design and manufacture custom encoders for user-specific requirements. These range from high-volume, low-cost, limited-performance commercial applications to encoders for military, aerospace and similar high-performance, high-reliability conditions. We would welcome the opportunity to help you with your encoder needs.

**WARRANTY**

Gurley Precision Instruments offers a limited warranty against defects in material and workmanship for a period of one year from the date of shipment.

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**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SHAFT</th>
<th>RES</th>
<th>IND</th>
<th>V</th>
<th>OUT</th>
<th>TEMP</th>
<th>BASE</th>
<th>CAB</th>
<th>EXIT</th>
<th>CONN</th>
<th>DIA</th>
<th>SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>M122</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SHAFT**

- B: Blind hollow shaft
- S: Solid shaft

**LINES** - Disc line count

<table>
<thead>
<tr>
<th>Line Count</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>00128, 00256</td>
<td>(OUT = I)</td>
</tr>
<tr>
<td>00512, 01024</td>
<td>(BEFORE 4x)</td>
</tr>
<tr>
<td>02048, 00512</td>
<td>(OUT = P)</td>
</tr>
<tr>
<td>00001, 00512, 01024</td>
<td>(OUT = A)</td>
</tr>
<tr>
<td>02048, 04096, 08192</td>
<td>(OUT = S)</td>
</tr>
</tbody>
</table>

**IND** - Index format

- Q: Quarter-cycle gated index (OUT = I)
- N: None (OUT = P, S, or A)

**V** - Input voltage

- 5: +5 Vdc

**OUT** - Output format

- P: Parallel natural binary
- S: SSI natural binary
- I: Incremental
- A: Analog

**TEMP** - Temperature

- A: -25°C to +125°C (OUT = P, A)
- B: -25°C to +85°C (OUT = I, S)

**BASE**

- A: Shaft, IP53, standard EMC grade
- E: Blind shaft, IP64, standard EMC grade
- F: Blind shaft, IP68, standard EMC grade
- B: Blind shaft, IP64, high EMC grade
- C: Blind shaft, IP68, high EMC grade

**CAB** - Cable length, meters

<table>
<thead>
<tr>
<th>Cab Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.0 meters (Standard)</td>
</tr>
<tr>
<td>30</td>
<td>3.0 meters</td>
</tr>
<tr>
<td>XX</td>
<td>X.X meters; 9.9 meters is maximum</td>
</tr>
</tbody>
</table>

**EXIT**

- S: Side-exit cable
- T: Top-exit cable

**CONN** - Connector

- P: Pigtaills (no connector)
- Q: DA-15P (OUT = P) (Standard)
- S: DE-9P (OUT = S, I, A) (Standard)

**DIA** - Shaft diameter

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>04M</td>
<td>4mm (standard for S solid shaft)</td>
</tr>
<tr>
<td>05M</td>
<td>5 mm</td>
</tr>
<tr>
<td>06M</td>
<td>6 mm (standard for B blind hollow shaft)</td>
</tr>
<tr>
<td>08M</td>
<td>8 mm</td>
</tr>
<tr>
<td>10M</td>
<td>10 mm</td>
</tr>
<tr>
<td>03E</td>
<td>3/16&quot;</td>
</tr>
<tr>
<td>04E</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>06E</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>000</td>
<td>supplied without a magnet carrier</td>
</tr>
</tbody>
</table>

**SF** - Special features

- N: No special features
- #: Issued at time of order to cover special customer requirements

**ACCESSORIES** (order separately)

- M01: Mating connector for DA-15P
- M06: Mating connector for DE-9P
- Magnet carrier: Call factory

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Online at www.gurley.com, e-mail: info@gurley.com