The Avtron Model M685 SMARTach™ is equipped with one or two M484 sensor modules. Each module has a two-phase output (A, B) 90° out of phase, and a marker pulse with complements (A, B), (A Quad B Output). A marker pulse with complement (Z) is available as an option.

Output resolution is determined by the rotor’s base PPR ( pulses per revolution), times an M484 sensor multiplier. The M484 sensor module can provide: the base PPR, 1/2 the base PPR, or double the base PPR (see table). With two sensor modules, the same encoder can provide: the base PPR, 1/2 the base PPR, or double the base PPR revolution), times an M484 sensor multiplier. The M484 sensor module on the other side for a process computer.

**INSTALLATION**

Equipment needed for installation includes:
1. M685 Encoder
2. Anti-Rotation Arm Kit
3. V/Ring Shaft Seal
4. Thread Locker (blue)
5. Synthetic Grease
6. Anti-Seize (copper)

The M685 encoder is immune to many contaminants that cause optical encoders to fail. These factors make the M685 ideal for rugged environments.

The M685 removable sensor assembly has a diagnostic package that includes Adaptive Electronics and a Fault-Check output. With this package, the SMARTach™ can provide an alarm if there is a problem before the problem causes unscheduled downtime.

**ADAPTIVE ELECTRONICS**

A perfect duty cycle consists of a waveform whose “high” and “low” conditions are of the same duration (50%/50%). It is possible over time for the duty-cycle to change due to component drift, temperature changes, or mechanical wear. The Adaptive Electronics extend the life of the M685 by constantly monitoring and correcting duty cycle over time.

**FAULT-CHECK**

If the Adaptive Electronics reach their adjustment limit, the Fault-Check alarm and LED will notify the drive and operator of an impending failure. This output occurs before a failure, allowing steps to be taken to replace the unit before it causes unscheduled downtime. Fault-Check annunciation is available as an “alarm” output through the connector or as an optional integral LED.

**NOTES:**
- All dimensions are approximate. Features and specifications subject to change without notice. Avtron standard warranty applies. All dimensions are in inches (mm).

*AV685*
The higher the RPM, the more severe the vibration will be from housing movement. In a typical installation a housing movement of 0.007” THR or less (as measured at the outside diameter of the main encoder body) will not be an adverse effect.

MACHINE SHAFT PREPARATION
Preparing the machine shaft prior to encoder installation is essential in providing an adequate barrier against environmental contamination. In some cases, a separate stub shaft (1.125” X 4.5” long) will be installed on the motor. To prepare the machine shaft that the M685 is to be installed on, conduct the following procedures (see figure):

1) Remove from the M685 the four 1/4-20 UNC machine screws which hold the end cap on the cover plate.
2) Remove the end cap, O-Ring, and wave spring, noting the location of each to assist in re-assembly.

ELECTRICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>LINE DRIVER</th>
<th>INPUT OPTIONS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPM</td>
<td>Voltage (V)</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>1500</td>
<td>6000 RPM for base PPR of 600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line Driver</td>
<td>Open collector, sink 100mA max, withstand 50V max</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed Range</td>
<td>4.8 - 26V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp Range</td>
<td>-20°C to 71°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE

- Two spanner wrenches, which are required for M685 installation, accommodate the 1-3/4”-20 UNC nuts found under the cap groove.
- If a keyway or flat exists on the shaft, provide a sealing medium, true or seal the shaft back to round using metal putty or equal.
- Return the compression sleeve to the M685 hub.
- Thread the 1-3/4”-20 UNC nut onto the M685 hub.

ENCODER INSTALLATION
Installing the M685 and Anti-Rotation Arm:

1) The free end of the anti-rotation arm must be secured by the customer to a stationary member such as the floor or machine frame. Refer to “Anti-Rotation Arm Mounting Guidelines” on the last page for general requirements.
2) Based on the location of the stationary point and the guidelines on page 4, attach the 1/4” thick mounting board to one of two positions on the M685 end cap.
3) Using two 1/4-20 UNC by 3/4” long machine screws provided.
4) Apply anti-seize to the machine shaft. A packet of silicone grease is provided to lubricate the following shaft seals: First, ALL M685s have an O-Ring inside their hollow shafts at the motor end. In addition, in THRU-SHAFT types, the clamping nut has an O-Ring on the inside, plus the outside of the clamping nut requires lubrication for the radial lip seal per step 8b. Slide the M685 onto the machine shaft, mounting the board first. Ideally, the M685 housing will be 1/2” to 1” from the motor or machine housing, but this may vary depending on the machine profile and the anti-rotation arm clearance requirements. Consider shaft end float when positioning the M685.
4a) FOR STUB SHAFT APPLICATIONS, place the M685 3/4”-14” onto the shaft. The end of the machine shaft must extend completely through the M685 compression sleeve and be approximately flush with the end of the 1-3/4” clamping nut.
4b) FOR THRU SHAFT APPLICATIONS, position the M685 as required.
5) Attach free end of the anti-rotation arm to the 1/4” mounting board using the shoulder bolt provided.
6) Remove 1-3/4”-14” clamping nut and apply liquid thread locker to the threads. (Locktite grade 242, supplied, should be used in most applications.)
**ELECTRICAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>LINE DRIVER</th>
<th>VOLTAGE (V)</th>
<th>INPUT OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>360 mA</td>
<td>1.2 - 15 V</td>
<td>1 - 2</td>
</tr>
<tr>
<td>360 mA</td>
<td>1.0 - 16 V</td>
<td>1 - 2</td>
</tr>
<tr>
<td>360 mA</td>
<td>0.8 - 22 V</td>
<td>1 - 2</td>
</tr>
</tbody>
</table>

**MECHANICAL SPECIFICATIONS**

2) Remove the end cap, O-Ring, and wave spring, noting the two screws which hold the end cap on the cover plate.

In some cases, a separate stub shaft (1.125” D x 4.5” long) will be required to mount the end cap. Prepare the machine shaft prior to encoder installation is essential to mount the end cap.

3) Apply anti-seize to the threads. (Locktite grade 242, supplied, should be used in most applications.)

First, the free end of the anti-rotation arm must be secured by the customer to a stationary member such as the floor or machine frame. Refer to “Anti-Rotation Arm Mounting Guidelines” on the last page for general requirements.

2) Based on the location of the stationary point and the guidelines on page 4, attach the 1/4” thick mounting board to one of two possible options (A or B). Use two 1/4-20 UNC by 3/4” long machine screws provided.

3) Apply anti-seize to the machine shaft. A packet of silicone grease is provided to lubricate the following shaft seals: First, ALL M885 shafts have an O-Ring inside their hollow shafts at the motor end. In addition, in THRU-SHAFT types, the clamping nut has an O-Ring on the inside, plus the outside of the clamping nut requires lubrication for the radial lip seal per step 8b. Slide the M685 onto the machine shaft, mount the anti-rotation arm, mount the board first. Ideally, the M685 housing will be 1/2” to 1” from the motor or machine housing, but this may vary depending on the machine profile and the anti-rotation arm clearance requirements. Consider shaft end float when positioning the M685.

4a) FOR STUB SHAFT APPLICATIONS, the M685 3/4”-14” shaft the end of the machine shaft must extend completely through the M685 compression nut. The stub shaft must be approximately flush with the end of the 1/34” clamping nut.

4b) FOR THRU-SHAFT APPLICATIONS, position the M685 as required.

5) Attach free end of the anti-rotation arm to the 1/34” mounting board using the shoulder bolt provided.

6) Remove 1/34” clamping nut and apply liquid thread locker to the threads. (Locotite grade 242, supplied, should be used in most applications.)

7) Replace 1/34” clamping nut and tighten so the gap is less than or equal to 0.05”, as shown in CLAMPING NUT sketch (approx. 15-20 lb-in.), holding the 2-1/2” bearing located in the nut. Spanner wrenches are required.

8a) FOR STUB SHAFT INSTALLATIONS, replace the end cap with the anti-rotation arm, and apply an amount of silicone grease (provided) to the seal surface on the 1/34” clamping nut. The radial lip seal in the end cap will seal on this surface.

8b) FOR THRU-SHAFT APPLICATIONS, prior to replacing the end cap (sleeve) after applying an amount of silicone grease (provided) to the seal, the bearing will seal on the 1/34” clamping nut. The radial lip seal will seal on this surface.

**ENVIRONMENTAL CONSIDERATIONS**

Special attention is to be given to conduit runs, interconnection wiring and NEMA dry area enclosure type mounting guidelines. In those applications where ambient temperatures are controlled within 20°C and high humidity/washdown are present, installation the encoder conduit with a slight sag to prevent any condensation from entering the encoder via conduit. In harsh environments, which include temperature extremes, high humidity, equipment washdown or atmosphere contamination, extra care is required. Follow these steps to reduce potential problems:

1) Always mount connection points, conduit couplings, junction boxes, etc., lower than actual encoder.

2) Return the compression sleeve to the M685 hub.

3) Thread the 1/34” clamping nut onto the M685 by hand until resistance is felt. DO NOT TIGHTEN at this time.

**WIRING DIAGRAMS**

**DIAGRAM**

- **FOR DIFFERENTIAL APPLICATIONS**
- **FOR SINGLE ENDED APPLICATIONS**

**WIRING INSTRUCTIONS**

For bidirectional operation of the 2-phase SMARTach, proper phasing of the two output channels is key. Phase “A” changes to phase “B” channel for clockwise shaft rotation as viewed from the anti-rotation arm, or clockwise rotation.

Wiring option "G" provides a pinout compatible with Northstar encoders, with a cable shield connection on pin 10. Note that this option does not ground the shield. Avont still recommends grounding the shield at the drive end and the cable for all wiring options.

**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)

b) Differential 2 Phase Wiring (see wiring diagram)

Exchange A and B at the use of the wires.

3) Apply Power.

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

**NOTE**

When using the plug-in industrial EPIC connector (Option "F", "P", or "Z" options), the wire ends must be tinned with solder before connection at the screw terminals.
**AVTRON INDUSTRIAL AUTOMATION, INC.**

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**REVIEWED:** REV: 07-21-06

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**ANTI-ROTATION ARM MOUNTING GUIDELINES**

The anti-rotation arm stabilizes the encoder and keeps it from rotating as the machine shaft rotates. To get the best performance, minimize generator movement by following these anti-rotation arm mounting guidelines as closely as possible:

1. Mount M685 with conduit entry ports positioned horizontally.
2. Fasten the 1/4" thick mounting board to the inboard side of the M685 in one of the two positions shown. Use the two 1/4-20 UNC x 3/4" long fasteners.
3. Mount anti-rotation arm perpendicular to motor shaft axis of rotation.
4. Mount anti-rotation arm approx. 90° to a line established between the mounting board mounting hole and shaft centerline (viewed from end).
5. Mount M685 as close as possible to the motor with the mounting board closest to the motor.
6. Establish a stationary (static) mounting point for the free end of the anti-rotation arm, using the guidelines above. Use the bolt provided to fasten arm to stationary point.
7. The anti-rotation arm is fully threaded and can be adjusted in length. The recommended length is 8" to 12".

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**GUIDELINES**

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**OUTLINE DIMENSIONS AND OPTION DETAILS**

**EU Declaration of Conformity:** The Model M685 SMARTach Encoder has been assessed and type tested against the following Harmonized European Standards: EN 50081-1:1992, EN 50082-1:1998. The Model M685 has been found to be compliant with the requirements of EU Directive 89/336/ECC provided that the following conditions are met: The electrical supply to the M685 must be within specified limits. The electrical supply must offer suitable protection from voltage surges unless the application does not require such protection. On behalf of Avtron Industrial Automation, Inc.: Stephen L D’Henin, Certification Manager, Epsilon Certification Service.

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**DESCRIPTION**

The Avtron Model M685 SMARTach™ (patents #5,502,376 and #5,545,985) is a severe duty incremental encoder (also known as a tachometer or rotary pulse generator). Its output is directly proportional to shaft position (pulse count) or speed (pulse rate). The M685 operates down to zero speed and can be used for both control and instrumentation applications.

When mounted to a machine shaft, the M685 design eliminates the need for shaft adapters, coupling flanges, or accessory mounting boxes. The unit employs a keyless shaft mount to lock the M685's rotor to a 1.125" diameter shaft. An anti-rotation arm prevents housing rotation while allowing for shaft end float.

The M685 utilizes magnetoresistive sensors. This proven technology is ideal for rugged environments since it is immune to many contaminants that cause optical encoders to fail. These factors make the M685 ideal for demanding industries like paper, metals, and chemical processing.

An Avtron M685 SMARTach™ is equipped with one or two M484 sensor modules. Each module has a two-phase output (A, B) 90° out of phase, with complements (A, B), (A Quad B Output). A mark pulse with complement (Z) is available as an option.

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**INSTALLATION**

Equipment needed for installation includes:

1. Mils Encoder
2. Anti-Rotation Arm Kit
3. V/Ring Shaft Seal

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**AVAILABLE RESOLUTIONS**

<table>
<thead>
<tr>
<th></th>
<th>48 OPTION</th>
<th>51 OPTION</th>
<th>60 OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>240</td>
<td>256</td>
<td>300</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>480</td>
<td>512</td>
<td>600</td>
</tr>
<tr>
<td>HIGH</td>
<td>960</td>
<td>1024</td>
<td>1200</td>
</tr>
</tbody>
</table>

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**M685 PART NUMBERS AND AVAILABLE OPTIONS (including M484)**

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Example: an M685 could use a M484 1024 PPR sensor output on one side for feedback to a drive system, and simultaneously use a M484 256 PPR sensor on the other side for a process computer.

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**Encoder Instructions**

M685 SMARTach™ INACTIVE DESIGN Replaced by Model AV685

1 1/8" HOLLOW SHAFT

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**M685 SMARTach™**: An encoder for demanding industries like paper, metals, and chemical processing. It is immune to many contaminants that cause optical encoders to fail. These factors make the M685 ideal for demanding industries like paper, metals, and chemical processing.

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**Features and specifications subject to change without notice.**

Avtron standard warranty applies. All dimensions are in inches (mm).

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