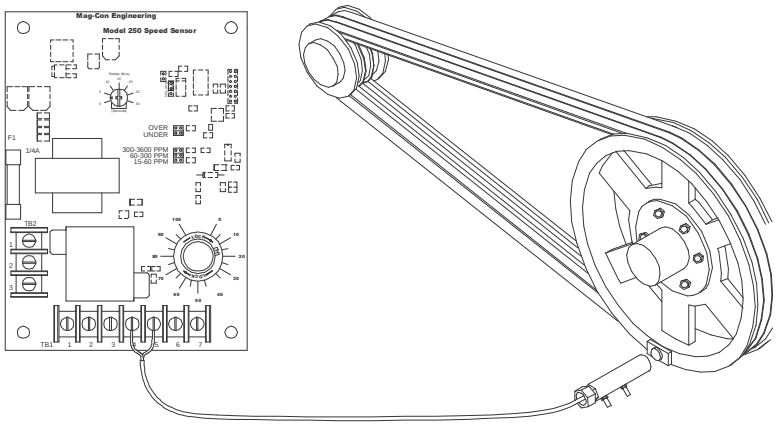


Model 250 Rotary Speed Sensor
Installation and Operation Instructions

1.0 PRINCIPLE OF OPERATION

The Badger Magnetics Rotary Speed Sensor system consists of a speed sensor board, a sense head, and a magnetic “mark”. The mark is mounted on a rotating or moving device, such as a pulley or belt, and the sense head is mounted on a stationary section in such a way that the mark periodically passes parallel to the face of the sensor. The sense head is connected to the speed sensor board through a shielded cable. The speed sensor board contains a single relay with two Form-“C” contacts that are available for connection to external alarm or shutdown circuits. This relay is energized during normal operation, and so provides fail-safe operation. If power is disconnected from the board, or if an internal board failure occurs, the relay will de-energize, causing a fault condition.

In operation, the speed sensor board measures the period between mark passes and compares it with a preset set point. With the speed sensor board set for Under Speed detection, if the period between mark passes exceeds the set point (the rotating machine is running too slow), the relay on the speed sensor board will de-energize, operating the alarm or shutdown circuit. With the speed sensor board set for Over Speed detection, if the period between mark passes is less than the set point (the rotating machine is running too fast), the relay will de-energize. In addition, in the Over Speed mode, if no mark passes are detected for 5 seconds, the relay will de-energize. This “missing head pulse” detector provides a fail-safe mode in the event that the sense head is damaged, the cable is broken, or the mark becomes damaged or dislodged.

If dual speed detection is required, such as a separate alarm and shutdown speed, or a high and low speed limit is needed, a second modified speed sensor may be connected to the same sense head. If a meter indication of actual speed is required, Badger Magnetics can supply a separate tachometer board that may also be connected to the same sense head. Consult the factory for information.

2.0 DESCRIPTION OF THE SYSTEM

2.1 Control Circuit

The control circuit is mounted on a printed circuit board. Power input, sense head wires, and output connections are made to two screw terminal strips, TB1 and TB2.

The output relay is dust-tight, and provides two Form-“C” contacts, each rated at 10A resistive, or 1/3 HP at 120VAC.

The board has two operating controls, the setpoint adjustment knob, the startup delay control, and two user-selectable jumpers, one for operating

range selection, and the other for underspeed or overspeed detection.

The only user-serviceable components are the replaceable relay and a 1/4A fuse.

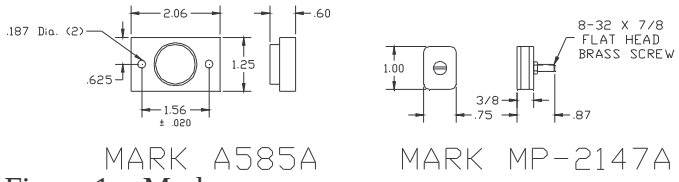


Figure 1 – Marks

2.2 Mark

The mark creates a magnetic field that is detected by the sense head. The standard mark (A585A) weighs approximately 3 ounces and measures approximately 0.6" high, 2" long, and 1.25" wide. It is to be mounted with two #8 screws through provided holes in the assembly. A low-profile mark (MP-2147A) is available for high-speed applications. This mark measures approximately 1" x 3/4", and is 3/8" high, and mounts in a single 8-32 tapped hole.

At least one mark is required, although multiple marks may be employed to extend the range of the control system and increase response time. For example, a device rotating at 15 PPM with one mark would have a 4 second period (60/15=4), whereas with two marks, the period would be 2 seconds. This would change the fault sensing time from one full revolution to 1/2 of a full revolution.

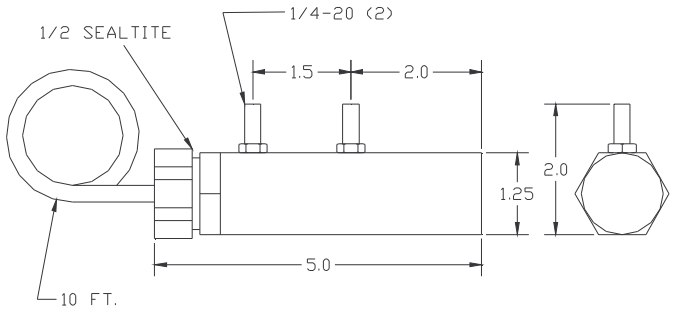


Figure 2 – Sense Head

2.3 Sensing Head

The sense head is a metal-jacketed epoxy-filled tube that contains the circuitry for detection of mark passes. The sense head is mounted with two protruding 1/4-20 studs, and is connected to the control circuit board via a 10 foot shielded cable. This cable exits the sense head through a sealtite conduit fitting. The sense head must be mounted in such a way that the rotating mark passes perpendicular to the axis of the sense head, and should be within 3/4" of the face of the mark, with 1/2" spacing recommended. Two sense heads are available, one for low-speed applications (60 PPM and under), and one for high-speed applications (greater than 60 PPM).

3.0 APPLICATION INFORMATION

3.1 Speed Range

The model 250 senses three speed ranges from 15 to 3600 PPM with a single mark. The low range setting is 15 to 60 PPM, the midrange setting is 60 to 300 PPM, and the high range setting is 300 to 3600 PPM. Range tolerances are approximately +/- 10%. For slow-speed applications under 15 PPM, or to increase response time (see 2.2, above), multiple marks may be employed. Multiple marks may also be used to shift an application from a point near the top or bottom of a particular range. For example, a device which may be designed to operate at a nominal speed of 60 PPM, but under varying loads may actually operate from 58-63 PPM may not work well at either the low range setting (15-60 PPM) or the midrange setting (60-300 PPM). However, by using two marks, the equivalent speed would be 116 to 126 PPM, and the midrange setting would then be a good choice. There is no theoretical limit to the number of marks that may be used, although practical mounting considerations usually limits the number to 10. Using the low range setting, that would allow a minimum operating speed of 1.5 PPM, with a fault indication within 1/10 of a revolution. Consult the factory for special applications assistance.

3.2 START-UP DELAY

Most machinery requires a few seconds to get up to operating speed. If the speed sensor is operating in an underspeed detection mode, the relay would indicate a fault condition until the machinery was up to minimum operating speed. A variable startup delay feature forces the speed sensor to remain in a non-fault condition for up to 30 seconds after power-up, eliminating the need for external timers to bypass the fault contacts. This startup delay may

be set from 0 seconds (no startup delay) to 30 seconds by rotating a small control on the printed circuit board. This feature is not normally needed for overspeed detection, and may be removed by rotating the control to 0 seconds.

Some equipment may require more than 30 seconds to get to minimum operating speed. For those applications, speed sensors with longer startup delays are available. Consult the factory for details.

4.0 MECHANICAL INSTALLATION

4.1 Mark Placement

The placement of the mark and sense head is the main concern during installation. The face of the mark must pass parallel to the face of the sense head, and the center of the mark must pass through the centerline of the sense head. There should be no more than 3/4" between the sense head and the mark, and 1/2" spacing is preferred. The mark must move at least 6" away from the sense head during operation, and in the case of multiple marks, they must be separated by a minimum of 6", and they must be exactly the same distance from each other. A typical installation on a conveyor belt system would monitor tail or idler pulley speed, and would preferably monitor a fixed pulley with little end play.

For a single mark installation, locate the edge of the mark at least 3" from the center of the shaft. Mount the mark by drilling and tapping two holes on 1.56" centers, and use two bolts and lockwashers to secure the mark. For a two-mark installation, the marks must be at least 3" from the center of the shaft, and exactly opposite each other.

One way to ensure proper mark placement is to scribe a circle on the pulley by holding a piece of chalk or other marker against the pulley at least 3" from the center of the shaft, then rotating the pulley through one full revolution. For multiple mark installations, scribe a straight line from the center of the shaft to the outer edge of the pulley and install the first mark where the circle and line intersect. Measure the circumference of the pulley, divide by the number of marks, and scribe a line on the circumference at that measurement. Then scribe a line from that measurement to the center of the shaft. Mount the second mark at the intersection of the circle and the new line. For example, for a 6 mark installation on a pulley with a 42" circumference, draw a line every 7" (42/6=7) on the circumference, then draw 6 lines, one from each 7" line to the center of the pulley. Scribe a circle of appropriate diameter (See Table, below), then mount one mark at the intersection of each radial line and the circle.

Number of Marks	Min. Mark path Dia	Number of Marks	Min. Mark path Dia
1	6”	6	12”
2	6”	7	14”
3	7”	8	16”
4	9”	9	18”
5	11”	10	20”

4.2 PLACEMENT OF THE SENSE HEAD

A bracket must be fashioned to support the sense head directly over the mark path. The sense head face must be essentially parallel to the mark face, and no more than 3/4" from the mark face (1/2" preferred). If the mark pulley is moveable, be sure that the sense head mounting moves with the pulley. Check any end play in the pulley, and verify that the mark cannot come in contact with the sense head and cannot move more than 3/4" from the sense head. The sense head mounting should be as free as practical from vibration, easily accessible for sense head servicing or replacement, and as protected as possible from falling material.

The standard sense head cable is 10 feet long, so if possible, mount the sense head within that distance from the control board. If that is not possible, the sense head can be mounted as far as 1500 feet from the control, and shielded cable (Belden 8790 or equivalent) may be used to interconnect the sense head and control board. A junction box is available to connect the extension cable to the sense head cable. In any case, the sense head cable (and extension cable, if used) should be run in a separate conduit, with no other wiring in the conduit. In installations using multiple sense heads, you may route multiple sense head cables in the same conduit. If possible, route the sense head cable conduit into the bottom of the control box.

Longer sense head cables of reasonable length (up to 100 feet) are available on a special-order

basis. Consult the factory for additional information.

4.3 CONTROL BOARD MOUNTING

The control board should be mounted in an enclosure. Single-board enclosures are available from the factory in NEMA 12, 4, and 9. Multiple boards may be mounted in the same enclosure or equipment bay. The preferred placement is within the range of the standard10-foot cable from the sense head. The control box should be mounted in a relatively vibration-free location, and must be accessible for adjustments. The mounting location should also be protected from mechanical damage.

5.0 ELECTRICAL INSTALLATION

Connect the sense head wires, 115VAC, and control/alarm circuit wiring as shown on Figure 3. To use the startup delay, the input power to the speed sensor control board must be interrupted whenever the driven equipment is shut down. Figure 4 shows a typical elementary conveyor control that is monitoring belt slippage in an underspeed detection mode.

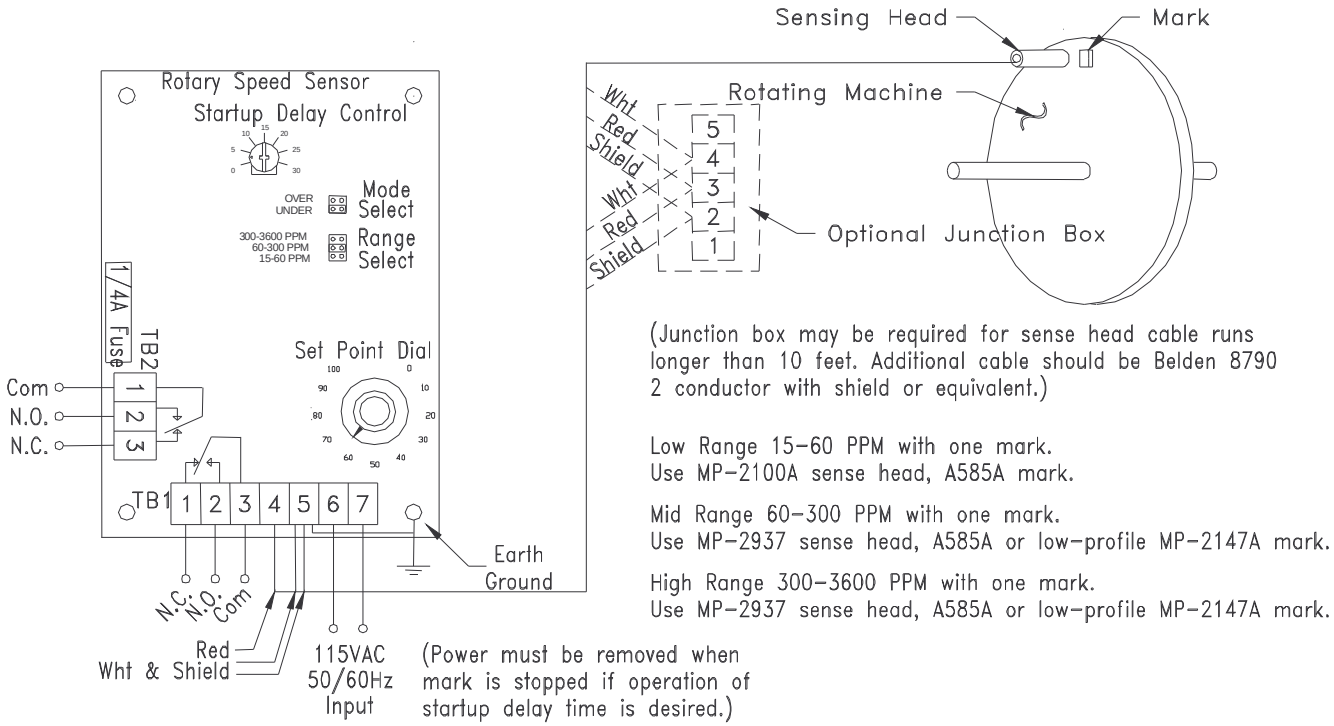


Figure 3 – Connection Diagram

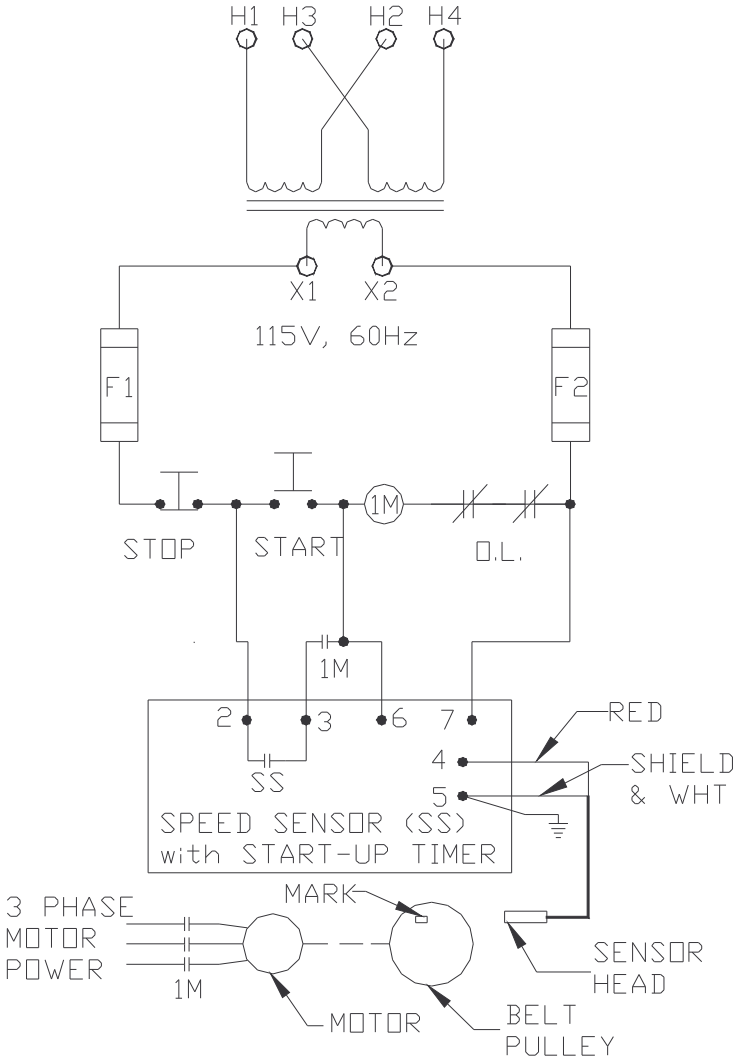


Figure 4 – Elementary Conveyor Control

Operating sequence:
1. Start button picks 1M coil and speed sensor.
2. 1M and SS contacts close to hold 1M and speed sensor.
3. Motor starts. If correct speed is reached before timeout, SS contacts remain closed ; otherwise SS opens, 1M drops, motor stops.
4. If speed sensor is set for underspeed detection and machine slows below setpoint, SS opens, 1M drops, and motor stops.
5. If speed sensor is set for overspeed detection and machine speed exceeds setpoint, SS opens, 1M drops, and motor stops.

6.0 OPERATION

6.1 Preliminary circuit tests.

If all connections are made as shown on the connection diagram, above, the system should be ready for power. To ensure proper wiring, perform a visual inspection and ring-out before power is applied for the first time.

6.2 Setup Procedure

If the speed sensor contacts are interlocking the RUN circuit as shown in Figure 4, they should be jumpered or bypassed until the sensor is set up. Select the operating range by moving the J5 jumper to the proper setting. Do not remove the J2 jumper or move it from the “run” position as erratic operation may occur.

6.2.1 Under Speed Detection

Move the J4 jumper to the lower (underspeed) location. If startup delay is desired, rotate the startup delay control to the desired time. Set the

speed dial fully clockwise (100). This puts the speed setpoint at maximum, which should be above the machinery speed. Start the machinery. The red lamp on the board near the relay should illuminate, and the relay should energize. After the startup delay, the lamp and relay should go off. Slowly turn the speed dial to lower speed settings until the lamp illuminates again. Adjust the speed dial a few points above and below the operating point until you are able to note the exact dial reading when the lamp just illuminates. Rotate the speed dial down to approximately 80% of that reading and lock the dial, being careful not to move the dial. If possible, load the machinery or operate it at a lower speed to check the actual dropout point. Readjust the speed dial as needed for correct operation.

6.2.2 Over Speed Detection

Move the J4 jumper to the upper (overspeed) position. The startup delay is not normally needed for overspeed detection, so you may want to rotate the startup delay control to 0. Turn the speed dial fully counterclockwise (0). This puts the speed setpoint at minimum, which should be below the machinery speed. Start the machinery. The red lamp on the board near the relay should not be illuminated, and the relay should not be energized. Slowly turn the speed dial to a higher setting until the lamp illuminates and the relay energizes. Adjust the speed dial a few points above and below the operating point until you are able to note the exact dial reading when the lamp just illuminates. Rotate the speed dial up to approximately 120% of that reading and lock the dial, being careful not to move the dial. If possible, operate the machinery at a higher speed to check the actual dropout point. Readjust the speed dial as needed for correct operation.

If possible, stop the machinery while leaving the speed sensor board energized. Within 7 seconds after the machinery completely stops, the lamp on the speed sensor board should extinguish, and the relay should de-energize. This checks out the "missing head detector" portion of the speed sensor. If it is not possible to stop the machinery and leave the sensor energized, carefully either disconnect the red lead coming from the sense head from the terminal board on the speed sensor, or short the white and red sense head leads at the speed sensor board. You must short or disconnect the sense head wires for at least 7 seconds. In either case, the relay should de-energize, and the lamp should extinguish. Be very careful to not short the power leads going to the speed sensor board or the shutdown or alarm circuits to the sense head wires while doing this.

7.0 TROUBLESHOOTING

7.1 Initial installation

The speed sensor boards, sense heads, and marks undergo extensive testing at the factory before they are shipped, and field failures are relatively rare. Trouble during initial installation is most often the result of a wiring error or improper mechanical installation of the sense head or mark. If the system does not operate properly during initial installation, recheck all wiring. If the wiring appears to be correct by both visual and electrical continuity checks, check the sense head and wiring as follows:

7.1.1 Problem - The speed sensor board lamp does not illuminate at any time:

Verify that the speed sensor board is receiving power. With a voltmeter, check that between 105 and 125 Volts AC is present at TB1 terminals 6 and 7. If not, check the wiring to the board. If the correct voltage is present, turn off the power, remove the fuse on the speed sensor board, and test it with an ohmmeter. If the fuse is open, verify that the power into the speed sensor does not exceed 125VAC. If the power is correct, replace the fuse. If it opens again, the speed sensor board is defective, and should be replaced.

7.1.2 Problem - The speed sensor board lamp illuminates when the power is applied, but it does not continue to operate after the startup delay period:

The sense head circuit should be checked. With all power off, disconnect the red sense head lead at the speed sensor board. Using an analog ohmmeter (Simpson 260 or equivalent) connect the positive lead (usually the red terminal) to the red sense head lead. Connect the other ohmmeter lead to the white lead and shield from the sense head. Set the ohmmeter on the R x 10 scale. Operate the machinery. Each time the mark passes the sense head, the meter should deflect at least past the

middle of the scale. If no deflection is observed, reverse the meter leads and try again. If no deflection is observed, check any junction box wiring between the sense head and the speed sensor board. If no open wires or wiring errors are found, verify that the mark passes parallel to the face of the sense head, and passes within 3/4" of the sense head. If the mark path appears to be correct, replace the sense head.

If more than a single mark is used, verify that the meter deflects each time a mark passes the sense head. If the ohmmeter shows meter deflection with some but not all marks, replace any mark that does not cause the meter to deflect.

7.1.3 Problem - The speed sensor appears to operate but the sensor does not operate the alarm or shutdown circuit (that is, you were able to see the lamp operate, and could set the speed dial as described above):

Check the alarm or shutdown circuitry, and be sure that the speed sensor relay is properly and fully inserted in its socket. If the circuitry appears to be correct, bypass the relay by shorting the appropriate terminals at TB1 or TB2. If the machinery then operates normally, the speed sensor board or relay may be defective and may need replacement.

7.2 Field Service

A field service engineer is available upon request to aid in installation, startup, and instruction of maintenance under the standard Badger Magnetics field rates. At least 5 working days notice is required to get an engineer to a site in the continental U. S. or Canada.

8.0 WARRANTY

"No item may be returned to the factory without an RGR (Returned Goods Request) number, which must be obtained from the factory. Items returned (freight prepaid) within one year from date of sale that Badger Magnetics determines to be faulty by reason of defective materials or workmanship will be repaired or replaced, at our discretion, free of charge. Items that show evidence of mishandling or misapplication may be returned by Badger Magnetics at customer's expense. No other warranties are intended or implied."

9.0 SPARE PARTS

None Required.

10.0 FIELD REPAIR

With the exception of the fuse and relay on the speed sensor board, there are no user-serviceable parts on any part of the system. All items for repair should be returned to the factory. Call us for a return goods number and further instructions.

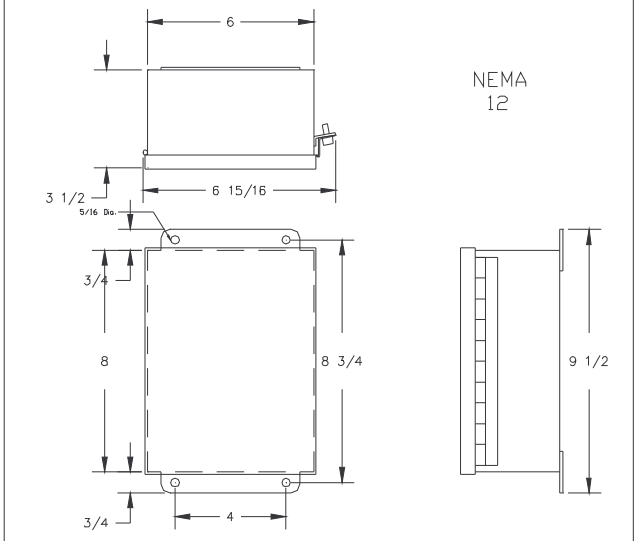
11.0 CONTACT US

Badger Magnetics, Inc.

Address:
501 Apollo Drive
Lino Lakes, MN 55014

Phone:
(651) 784-8888

Website:
badgermagnetics.com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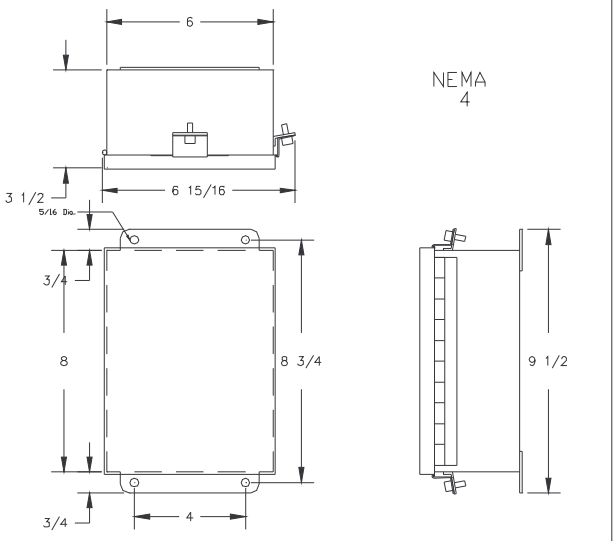
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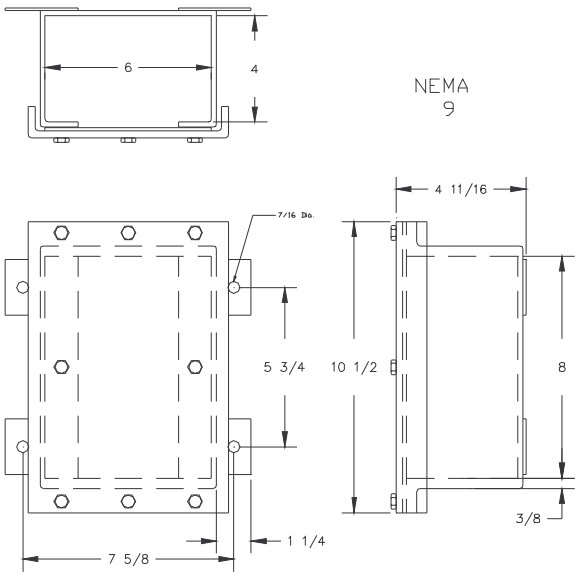
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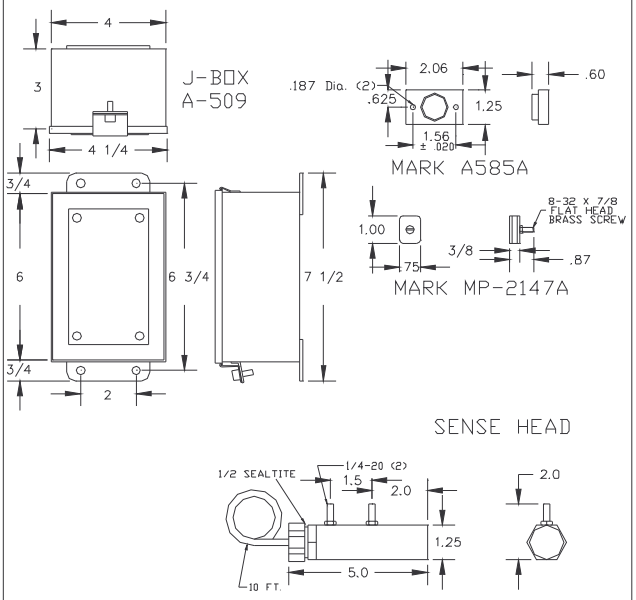
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1.56
± .020
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BRASS SCREW
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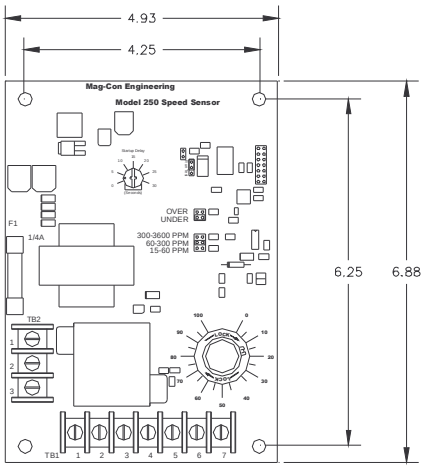
4.93
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Mag-Con Engineering
Model 250 Speed Sensor
OVER
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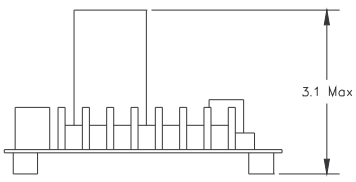
300-3600 PPM
60-300 PPM
15-60 PPM
TB2
TB1
6.25
6.88


3.1 Max