



# Bulletin 1370

## Motion Detector Kit

### Description

The Motion Detector Kit is designed to detect machine rotation in a direction that may cause damage. Position information is provided to the circuit by a pulse encoder which when phased properly will allow the circuit to determine if the machine is moving in a direction that may cause damage. Once a preset shaft position has been exceeded, the circuit will open a relay contact to annunciate the condition (Fault) and alert the operator. The Fault may be cleared by cycling the board power or activating the board mounted Reset switch.

The following components are contained in the kit:

- (1) Motion Detector Board
- (1) Mounting Bracket
- (1) Mounting Hardware

Specifications for the encoder being used with the kit are:

Input Voltage at Encoder Terminals	+ 5 to + 24V DC
Maximum Encoder Pulses per Revolution	1024 PPR
Maximum Encoder RPM	2500 RPM

### Installation



**WARNING:** To avoid an electrical shock hazard, Remove Power *before* attempting to perform the following procedure.



**CAUTION:** This assembly may contain ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference U.S. Department of Defense, DOD-HDBK-263, Electrostatic Discharge Control Handbook for Protection of Electronic Parts, Assemblies and Equipment or A-B Drives, Q.A.P. 3.14, ESD Policy-6.0 General Precautions or any other applicable ESD Protection Handbook.

Refer to the following procedure for the required installation steps.

- 1. Ensure that all power to the Drive has been removed.

If the Drive has an F to V Module, proceed to step 3.

- 2. Locate the area that the Kit is to be mounted. Using Figure 1 and the Mounting Bracket as a guide, mark and drill two (2) 1/4" (6.35mm) holes. Proceed to step 4.

Installation  
 (Continued)

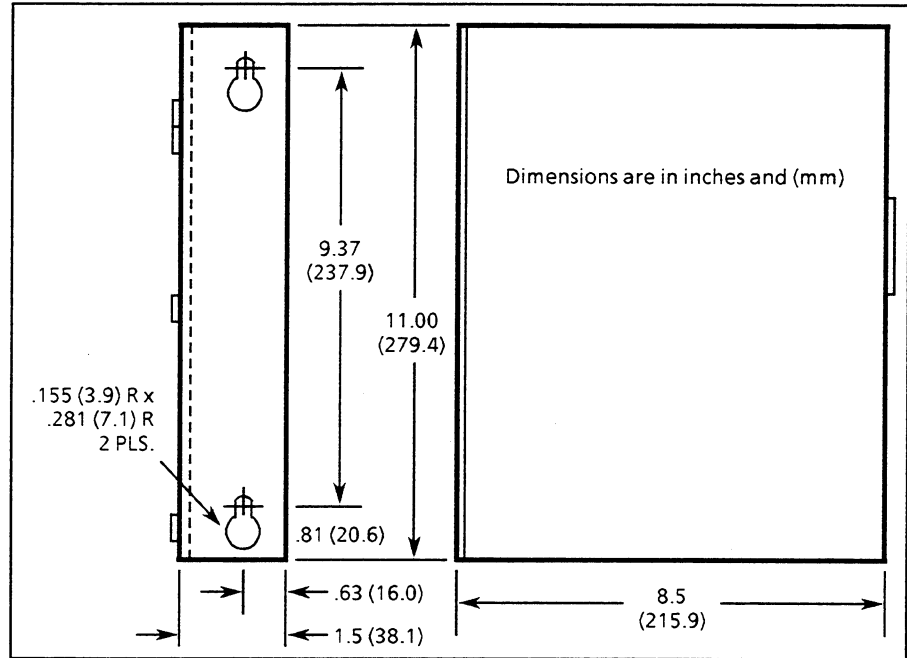


Figure 1 - Bracket Mounting Dimensions

3. a) Remove the F to V Module and bracket from the Drive. Replace the mounting hardware in the rear panel, but do not tighten.
- b) Remove the Module from the mounting bracket and discard the mounting bracket.
- c) Using the hardware just removed, mount the F to V Module to the Motion Detector Board Mounting Bracket.

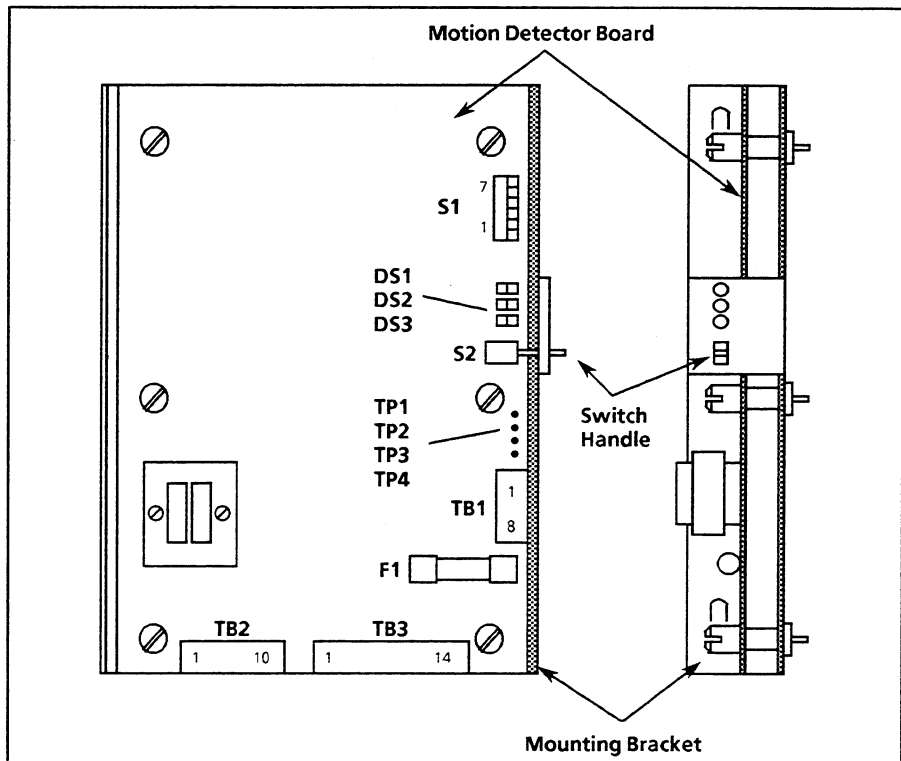


Figure 2 - Board Orientation and Component Locations

**Installation**  
(Continued)

- 4. Carefully position the Motion Detector Board on the supplied bracket, inserting the Test/Reset switch handle through the panel opening (see Figure 2). Secure the board to the bracket using the captive screws supplied.

**IMPORTANT:** If an F to V Module is being used, ensure that the mounting screws for the F to V Module **Do Not** touch the bottom side of the Motion Detector Board.

- 5. Secure the bracket to the Drive. In some cases it may be necessary to trim the plastic wire tray to achieve a proper fit.

**Wiring**

Refer to Figures 3 and 4 for general wiring connections and Figure 2 for component locations.



**CAUTION:** To guard against erratic machine operation and/or damage due to induced electrical interference, the encoder leads must be connected as shown in Figure 3. Additionally, the encoder leads must be run in conduit separate from power wiring.

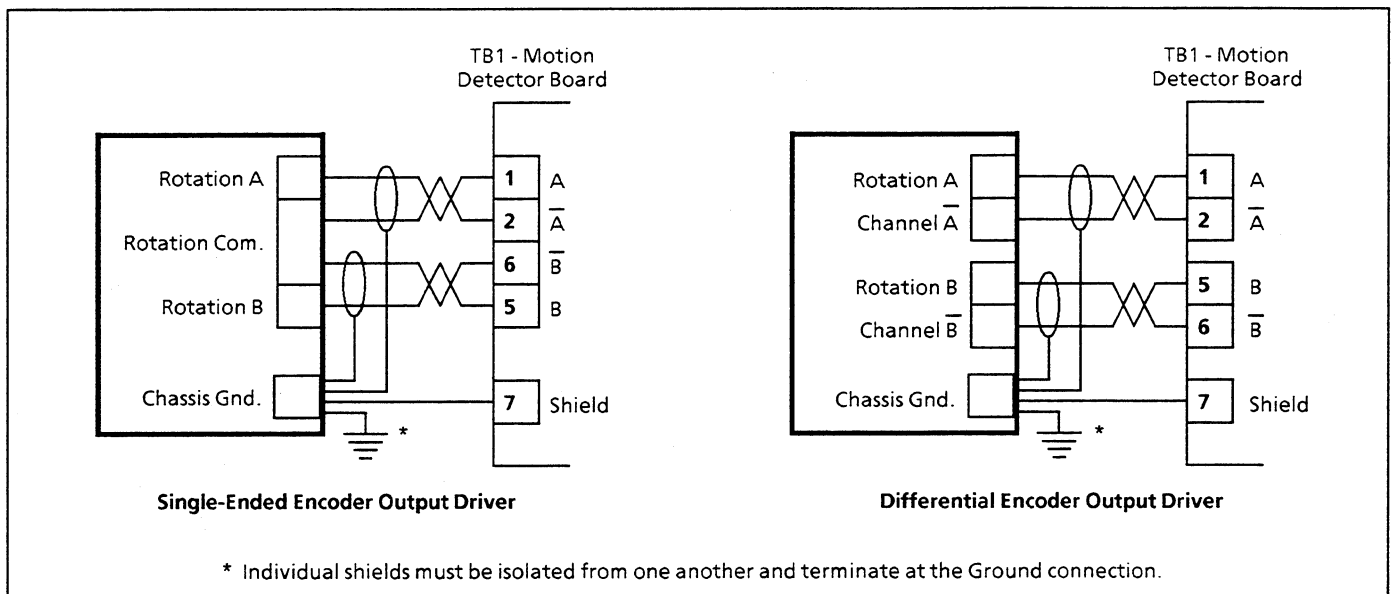
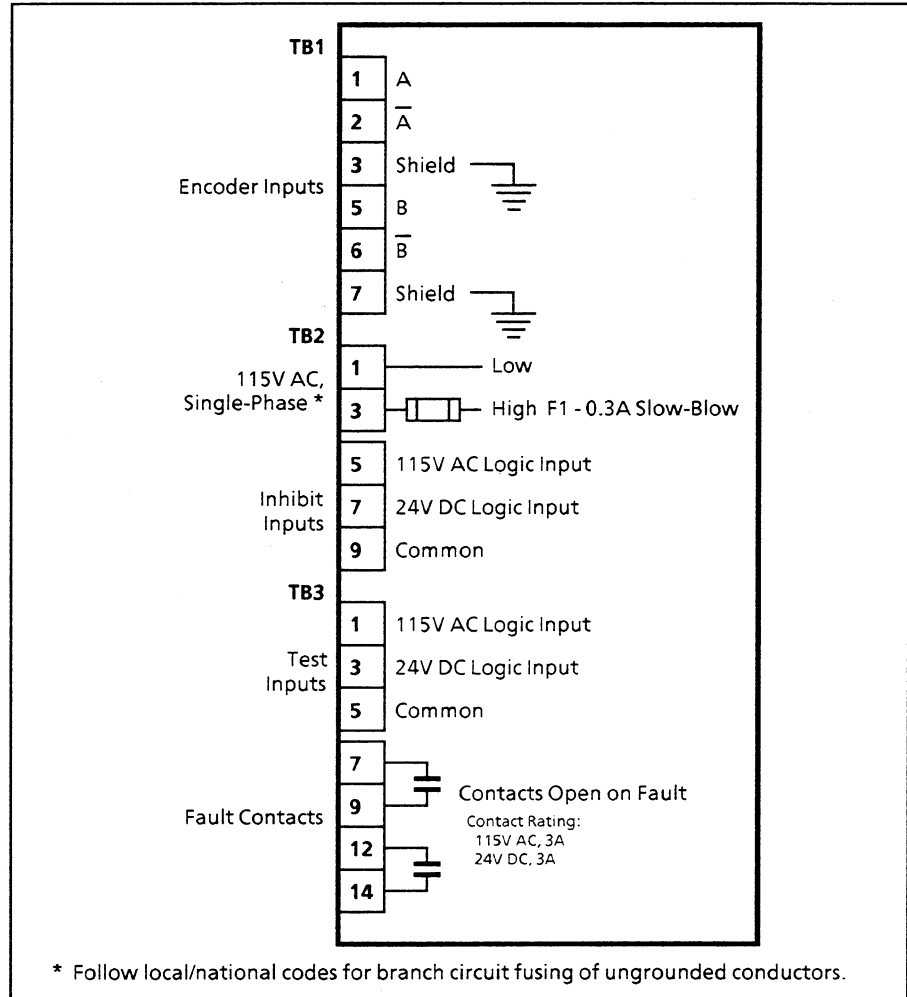


Figure 3 – Encoder Connections

**Wiring**  
(Continued)



**Figure 4 – Motion Detector Kit Terminal Connections**

**Theory of Operation**

The Phase A and Phase B encoder signal connections may be single-ended or differential (a differential termination is preferred for better noise rejection) as shown in Figure 3. The Phase A and Phase B signals are then buffered and squared-up by the input stage of the board circuitry. The resulting signals are fed through a filter section to reject spurious noise on the encoder channels. After filtering, the signals become the input to the quadrature detection circuitry. The quadrature detector provides a signal indicating the direction as well as detecting the state of the encoder signals to determine shaft position. This information is used to direct a 12-bit counter which determines the shaft position. If the machine is moving in the normal direction, the counter is continuously cleared. However, when the machine changes direction and moves in the Fault direction, the counter will start to accumulate encoder counts. If the counter reaches a threshold which is preset by the Fault Threshold switch (S1), the circuit will latch the Fault and open the relay contacts. If the machine were to start moving in the normal direction before the threshold was reached, the counter would count down until it clears and then resume normal operation (counter continuously clears itself). The Fault position of the shaft is always measured from the point where the machine changes direction. The Fault may be cleared by cycling the board power off and on or by activating the board mounted Test/Reset switch.

## Operation

### Fault Conditions

The Motion Detector Board will produce a Fault condition (relay contacts will open) if any of the following conditions occur:

1. Detection of motion in the Fault direction exceeding the preset threshold set by S1.
2. Board generated low voltage power supply is out of tolerance.
3. Failure to select a Fault count with S1.
4. Loss of internal clock circuitry.
5. Failed Test mode.
6. Loss of 115V AC supply voltage to Board.

Faults 1 through 5 are latched and will cause the red FAULT LED (DS1) to illuminate. The Fault(s) may be cleared by cycling the 115V AC to the board or by activating the manual Test/Reset switch (S2) mounted on the board. A Fault that persists will not allow the reset action to occur. Note that as long as the Reset switch is activated, the relay contacts will remain open. When the Fault condition has been corrected and reset, the green READY LED (DS3) will illuminate, indicating normal board operation.

### Self Test Mode

The board employs a self testing capability to confirm circuit operation. Applying an external voltage of 115V AC or 24V DC to the Test input or activating the board mounted Test/Reset switch (S2) will initiate the test cycle. The yellow TEST LED (DS2) will illuminate when the test cycle is active. During the test, the external encoder inputs are locked out of the circuit. The test circuitry generates artificial encoder signals which are fed into the detection circuitry, causing the counter to accumulate counts and generate a Fault. The Fault is then detected by internal relay contacts and fed back into the test logic. If both contacts open before a timer in the test logic counts out, the circuit is functioning normally and will reset itself causing the external contacts to close. However, if one or both contacts remain closed when the test timer counts out, a Fault will be generated and the circuit will not reset itself. The entire test cycle requires approximately 1.2 seconds to complete.



**CAUTION:** Do Not initiate the "Test" cycle during normal machine operation. The Motion Detector Board will perform the Test routine and open the Fault relay contacts. Reset will occur automatically at the end of the test. Damage to equipment or product may occur if the machine is stopped at an undesirable speed, position or operation.

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### Inhibit

Applying an external voltage of 115V AC or 24V DC to the Inhibit input will allow the machine to move in the reverse direction without causing the circuit to Fault. The Inhibit line causes the 12-bit counter to be held in a reset condition, ignoring any encoder generated counts.

Setup



**WARNING:** Power must be applied to the board to perform many of the adjustments specified in the following paragraphs. Some of the voltages on the board are at incoming line potential. To avoid injury to personnel and/or damage to equipment, only qualified service personnel should perform the following setup procedure. Thoroughly read and understand the following procedure before beginning the setup process. If an event does not occur while performing the setup, **Do Not Proceed. Remove Power** and correct the malfunction before continuing.

- 1. Prior to operating the Motion Detector Kit, the Fault Threshold switch (S1) must be properly set. The switch setting allows selection of levels corresponding to 16, 32, 64, 128, 256, 512 or 1024 counts of the encoder.

The quadrature detector (refer to *Theory of Operation*) outputs a count for each of the four encoder states in the forward or reverse direction. Therefore, each encoder pulse is multiplied by 4 to obtain the selected count as shown in the following example.

**Example**

Assume a 1024 pulse encoder. If S1 is set at 1024, the circuit would open the contact after 90 degrees of encoder shaft rotation from the point where the reverse motion originated.

$$1024 \text{ Pulses/Revolution} \times 4 \text{ Counts/Pulse} = 4096 \text{ Counts/Revolution}$$

$$\frac{1024 \text{ Counts/Fault}}{4096 \text{ Counts/Revolution}} = 0.25 \text{ Revolution/Fault} = 90 \text{ Degrees}$$

Using the information provided above and Table A, set switch S1.

**Table A**  
**Fault Threshold Switch Settings**

Level	S1 Switch Setting						
	1	2	3	4	5	6	7
16	ON	OFF	OFF	OFF	OFF	OFF	OFF
32	OFF	ON	OFF	OFF	OFF	OFF	OFF
64	OFF	OFF	ON	OFF	OFF	OFF	OFF
128	OFF	OFF	OFF	ON	OFF	OFF	OFF
256	OFF	OFF	OFF	OFF	ON	OFF	OFF
512	OFF	OFF	OFF	OFF	OFF	ON	OFF
1024	OFF	OFF	OFF	OFF	OFF	OFF	ON

- 2. Apply power to the Motion Detector Board. If the green READY LED (DS3) is illuminated proceed to step 3.
  - If the red FAULT and green READY LED's are not illuminated:
    - Check the 115V AC power
    - Check fuse F1
  - If the red FAULT LED is illuminated, but the green READY LED is not, move the Test/Reset switch momentarily to the Reset position. If the FAULT LED remains illuminated, replace the board. If the Fault LED extinguishes, proceed to step 3.

**Setup**  
(Continued)

- 3. Initiate the Test mode by momentarily moving the Test/Reset switch to the TEST position. The yellow TEST LED (DS2) will illuminate, indicating that the test is in progress. The length of time that the TEST LED is illuminated will depend on the number of counts selected by the Fault Threshold switch (S1).  
The test is successful if both LED's (TEST and FAULT) extinguish. If the FAULT LED (DS1) remains illuminated after the TEST LED extinguishes, the board must be replaced.
- 4. This procedure will select the direction of rotation that will produce a Fault. The circuitry is designed to detect a motion generated Fault when the Phase B encoder input leads the Phase A encoder input as shown in Figure 5.

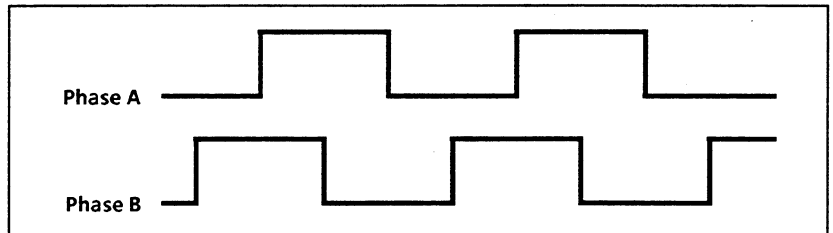


Figure 5 – Encoder Input

Connect a digital voltmeter between Test Point 1 (up/down or direction indication) and Test Point 2 (signal common) and manually rotate the encoder. The voltmeter indication will be 0V DC with proper direction of rotation and approximately 12V DC when the encoder is rotated in a direction which will cause a Fault.

If the output is incorrect for the intended application, interchange the phase A and phase B input signal leads.

- 5. **Remove Drive and Motion Detector Board power.**
- 6. The following steps will verify that the Motion Detector Board will indicate a Fault without physically reversing the motor. These steps can also be used to verify user logic that interfaces with the motion detector Fault relay.
  - a) Remove and interchange the channel A and B encoder termination blocks from TB1. **Do Not** remove wiring.
  - b) Apply Drive and board power.
  - c) Initiate a Start command to the Drive.



**WARNING:** Machine movement will occur. Hazard of injury exists from accidental contact with moving parts. Advise all maintenance personnel and operators to keep clear of the machine.

**Setup**  
*(Continued)*

- d) When the motion detector senses the number of counts selected by the Fault Threshold switch, the Fault contacts will open and the red FAULT LED will illuminate.
  - e) If the motion detector does not indicate a Fault, the encoder wiring must be checked. Remove power and check encoder wiring for improper connections.  
Repeat steps a through d. If the condition persists, replace the Motion Detector Board.
7. Remove power. Return channel A and B encoder termination blocks to their original positions.



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