

Vari Speed 180

HAMPTON CONTROLS

P.O. Box 187

Wendel, PA 15691

1-724-861-0150 Phone

sales@hamptoncontrols.com

Vari Speed 180**TABLE OF CONTENTS**

SPECIFICATIONS	3
OPERATIONAL CHARACTERISTICS	4
INSTALLATION	7
WIRING DIAGRAMS	8
START-UP PROCEDURES	9
ADJUSTMENTS AFTER START-UP	10
TROUBLESHOOTING GUIDE	12
SPARE PARTS	15
FUNCTIONAL DIAGRAM	16
ILLUSTRATION - CHASSIS MOUNT	17
ILLUSTRATION - NEMA 12 ENCLOSURE	18
DIMENSIONS - CHASSIS MOUNT	19
DIMENSIONS - NEMA 12 ENCLOSURE	20

**INSTRUCTION
MANUAL****Vari Speed 180****SPECIFICATIONS**

INPUT POWER	(95 to 135 VAC) or (195 to 260 VAC) 50/60 Hz, Single phase
HORSEPOWER RATING	Fractional to 5
ENCLOSURES AVAILABLE	Chassis or NEMA 12 enclosure
AMBIENT TEMPERATURE RANGE	32°F - 122°F (0 - 50°C)
MOUNTING POSITION	Vertical mounting
OPERATOR CONTROL PROVISIONS	Run/Stop, Speed Adjustment
INTERNAL CONTROLS	Range, MIN Speed, Current Limit, IR Compensation, Accel, Threshold, Feedback Selector
PROCESS SIGNAL INPUT	0 - 10 VDC Input resistance - 75k ohm 1-5 mA, 4-20 mA, 10-50 mA
TACHOMETER FOLLOWER INPUT	Up to 50 VDC or 35 VRMS AC Input Resistance - 100k ohms
TACHOMETER FEEDBACK INPUT	7 VDC/1000 RPM and 20.8 VDC/1000 RPM
CURRENT LIMIT	Adjustable from near 0 to 25 Amps Motor will stall with a sustained load exceeding the current set point.
SPEED VARIATIONS DUE TO LINE VOLTAGE FLUCTUATIONS	The control will compensate to less than 1% speed change in less than 500 MS within input power range.
SPEED VARIATIONS DUE TO THERMAL DRIFT	Control: < than 3% System with Tach.: < than 1%
SPEED VARIATIONS DUE TO LOADING (90% LOAD CHANGE)	Armature: Typical application ±3% of base speed Tach: < than 1/2% of set speed or 4 RPM whichever is greater.
FULL TORQUE SPEED RANGE	Armature: 50:1 Tachometer: 200:1
MIN SPEED ADJUSTMENT	Approx. 0% to motor's rated base speed
RANGE ADJUSTMENT	MIN speed to 110% of motor's rated base speed
IR COMP RANGE	Approx. 0 to 18 ohms

**INSTRUCTION
MANUAL****Vari Speed 180****ACCELERATION**

Accel is linear and adjustable from .2 to 5 sec to set speed.

THRESHOLD CONTROL

Approx. 0 to base speed

INTERLOCK

Contact max. rating 200 VDC or .5 amp, or 10VA resistive loads. Contact opens for loss of AC power or motor load in excess of current limit longer than approx. (one) 1 second.

ISOLATION

1500 VRMS isolation to ground. Interlock, Run, Tach, Follower, Speed Control and Tach. Feedback are all isolated from the AC line and motor terminals.

OPERATIONAL CHARACTERISTICS**RUN:**

The RUN function causes the control to run when a closure is made and stop when re-opened. RUN condition is indicated by a yellow LED (light emitting diode) mounted on the PC board.

SPEED CONTROL:

The Vari Speed 180 provides for infinitely variable speed control of a permanent magnet DC motor by incorporating a NEMA code K output configuration (2 SCR's, 2 diodes, and a freewheeling diode). Compensation is made for line voltage variation and motor load variations. At a given speed potentiometer setting and with a constant load, the motor speed will vary less than 1% with an input voltage change of $\pm 10\%$ of nominal. Adjustable IR Comp. allows the no load to full load variations to be less than 3%, unless Tachometer Feedback is used, in which case the speed variations will be less than 1/2% regardless of motor temperature or load. A major design parameter of the Vari Speed 180 was to limit overshoot, undershoot and settling time. These characteristics are more than adequate for almost all applications.

CURRENT LIMIT:

The Vari Speed 180 is provided with an adjustable Current Limit circuit which can be set to limit the torque output of the motor over a range of near zero to about 25 amps. This circuit will not affect the motor speed until motor current (loading) increases to the set point. At the set point, the red LED comes on and the control will supply no more than 5% additional current (torque).

CONTROLLED ACCEL:

The linear ramp for controlling acceleration is adjustable. The time required for the motor to accelerate from zero speed to set speed can be adjusted from .2 to 5 sec as supplied.

PROCESS CONTROL SIGNALS:

A control signal input is provided by connecting process signal (+) to SP2 and process (-) to SP3. With Tachometer Feedback, the motor speed will track the process voltage to better than 3% linearity. The input voltage required is 0-10VDC. The input impedance is approx. 75k ohms shunted by a .47 microfarad capacitor in series with about 75k ohms of resistance. A 1- 5 mA signal can be accommodated by shunting SP2 and SP3 with a 2k ohm, 1/2 watt resistor; for 4-20mA, use a 500 ohm, 1/2 watt; for 10-50 mA, use a 200 ohm, 1 watt resistor. Consult factory for more information on current process control.

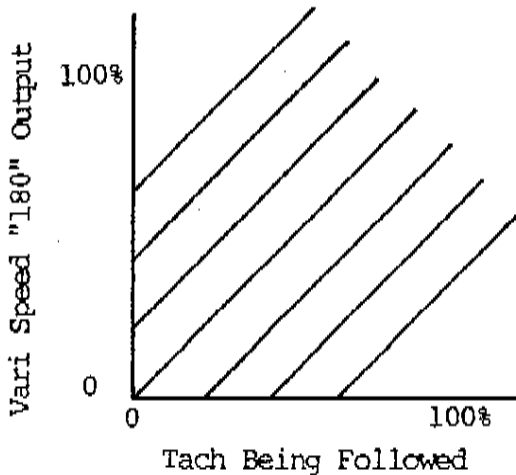
TACH FOLLOWER SIGNALS:

The Vari Speed 180 can track other machines which have tachometer outputs by using the TF1, TF2, and TF3 terminals. Direct tracking of DC tachs up to 50 VDC can be done by connecting (-) to SP3, and (+) to TF2 provided the Threshold is set at zero. If Threshold is to be used with a DC tach follower, use TF1 or TF2 for the (+) connection.

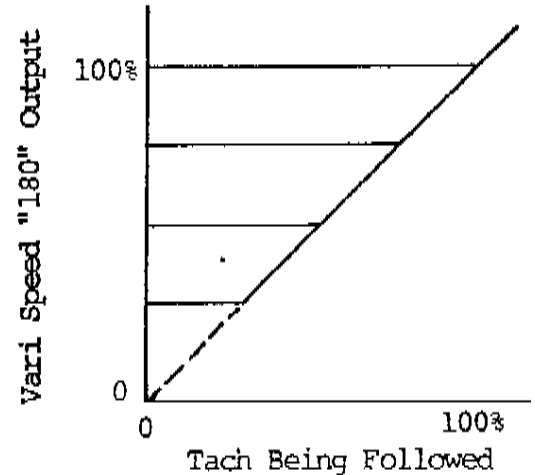
INSTRUCTION MANUAL

Vari Speed 180

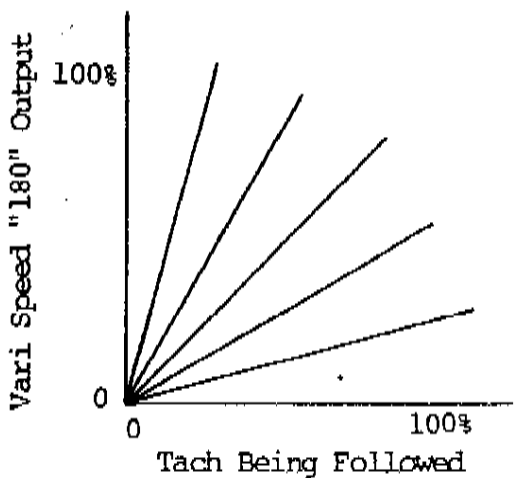
The tach signal will be offset about .6 volts by an internal diode. AC tachs up to 35 VRMS may be connected to TF1 and TF2 which use a full wave bridge for rectification. The bridge will offset the tach signal by about 1.2 volts. The lowest speed the drive can run can be set by the Threshold Potentiometer Adjustment. Several tracking examples are:



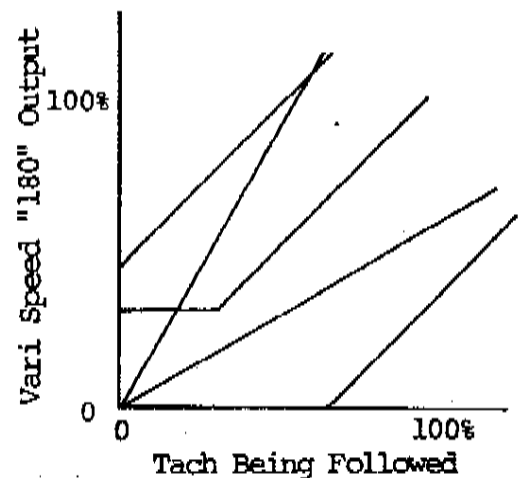
Changes from changing MIN speed while Threshold and Range remain constant.



Changes from changing Threshold while MIN speed and Range remain constant.



Changes from changing Range while MIN speed and Threshold remain constant.



A few of many possibilities.

All of these are using a DC tach connected between TF2 and SP3, or an AC tach between TF1 and TF2.

Vari Speed 180**INTERLOCK:**

A relay contact is available for customer use to indicate when the Vari Speed 180 is operating in a Current Limiting condition. This relay is normally open and held closed in normal operation. It closes shortly after AC power is turned on and remains closed until the drive has been in Current Limit about one second. This one second time delay does not start until after the controlled acceleration time on start or a speed control change is complete. The contact recloses immediately when the overcurrent condition stops. The Vari Speed 180 does not turn the motor off when the contact opens, but the customer may use the contact to operate relays to turn off the Vari Speed 180, or shut down the entire equipment, or whatever is desired.

UNIVERSAL POWER:

All models of the Vari Speed 180 may be operated at any AC line voltage between 95 and 260V, 50/60 Hz. Permanent magnet motor speed will remain almost constant as long as the line voltage is high enough to provide the DC voltage required for that speed. A 90 VDC, permanent magnet motor can be operated at full speed and load as the AC line voltage varies over the entire range. A 180 VDC, PM motor can be operated at full speed and load as the AC line varies from 190V to 260V.

All models have a split primary on the transformer mounted on the printed circuit board. The black with blue tracer and black with white tracer leads have 1/4" fast-on connectors for easy field conversions between 120 VAC and 240 VAC lines.

- For 120 VAC line operation, the black with blue tracer wire connects to the PC terminal AC 1, and the black with white tracer wire connects to the AC 2 terminal.
- For 240 VAC line operation, both leads connect to the terminals labeled 240 VAC P2 P3.

MOTOR VOLTAGE SELECTION:

A movable jumper on the printed circuit board is used to select motor armature voltage or tach feedback voltage. The selections are:

- A. 180V motor
- B. 144V motor
- C. 108V motor
- D. 90V motor
- E. 7V/1000 RPM tach
- F. 20.8V/1000 RPM tach

Only one pair of pins should be jumpered.

FIELD:

On some models a full wave field is provided between terminals F+ and F-. Available voltage:

120 VAC line - 105 VDC field

240 VAC line - 210 VDC field

**INSTRUCTION
MANUAL**
Vari Speed 180
INSTALLATION

- WARNING!** Improper installation of motor and controller may cause severe personal injury or equipment failure. Follow instruction manual, local, state and national safety codes for proper installation. Always disconnect power to controller before making any wiring changes or before inspecting the controls or equipment.
- AC line and DC motor wiring should be 12 AWG or larger wire.
- A fused disconnect or circuit breaker on incoming AC power is required. Suggested protection is a magnetic circuit breaker with a 3 second delay at 200% current or fuses with an approximately similar lag to minimize nuisance tripping or fuse blowing. Current ratings are based on motor size.

120 VAC Operation

1/3 HP 5 Amps
2/3 HP 10 Amps
1 HP 15 Amps

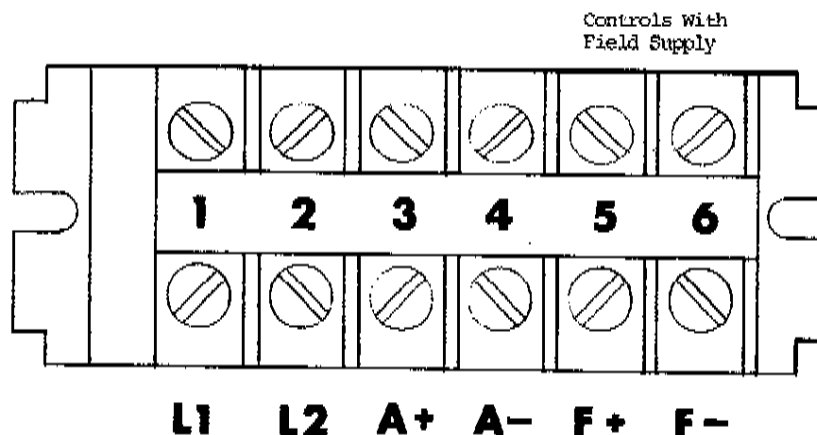
240 VAC Operation

1 HP 7 Amps
1 1/2 HP 10 Amps
2 HP 13 Amps
3 HP 20 Amps
5 HP 35 Amps

- The controller, motor, and remote operator stations (when used) must be connected to building ground for the safety of the operating personnel.
- The Vari Speed 180 should be mounted vertically for the most coolest operation. During heavy loads the normal operating temperature of the controller may be too hot to touch. This is expected, however, the aluminum near the power module should never exceed 167°F (75°C).
- Switches or contacts used to operate RUN must be capable of reliable operation switching 20 VDC at 15 mA. Contacts used to switch speeds must operate at even lower voltages and currents.
- All remote connections to the controller should use shielded wire: Speed Adjust Potentiometers - 3 conductor shielded; Run Circuit, Tach Feedback, Tach Follower, and voltmeters connected to Tach Generators - 2 conductor shielded. Shields should be grounded at the control end only. The other end should be insulated to avoid accidental grounding. Route these conductors separately from motor and power wiring. The protection against electrical noise provided by the techniques and circuitry in the controller and the use of shielded wiring will minimize the effects of most electrical noise. Severe problems, such as nearby RF heating or welding, may require additional protection. Additional protection used might be, for example, a line filter, isolation transformer, additional shielding, or signal line filters.

AC POWER AND MOTOR CONNECTIONS

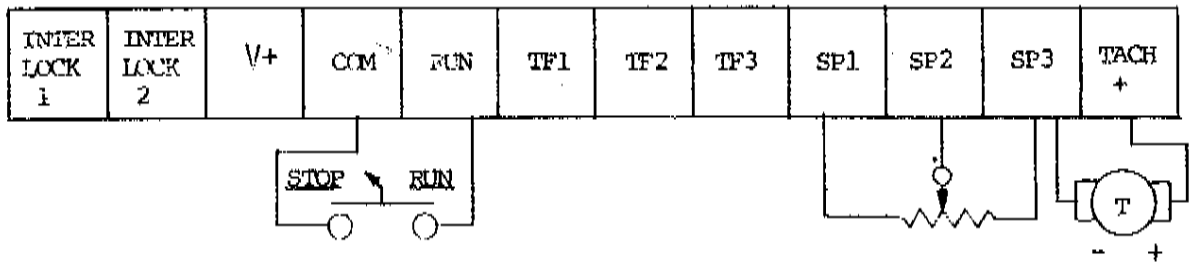

Connect Building
Ground



Varl Speed 180

CONTROL CONNECTIONS TO TERMINAL STRIP ON CIRCUIT BOARD

TYPICAL SPEED CONTROLLER

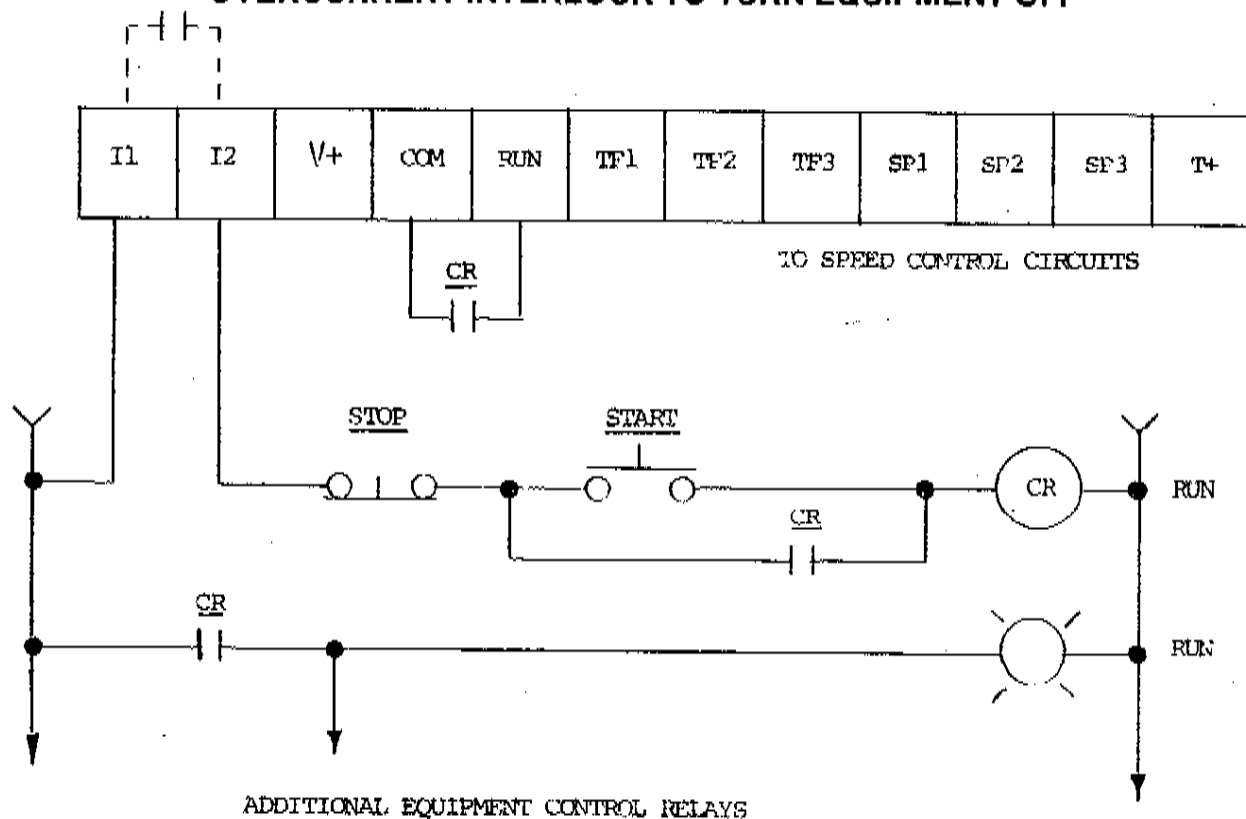


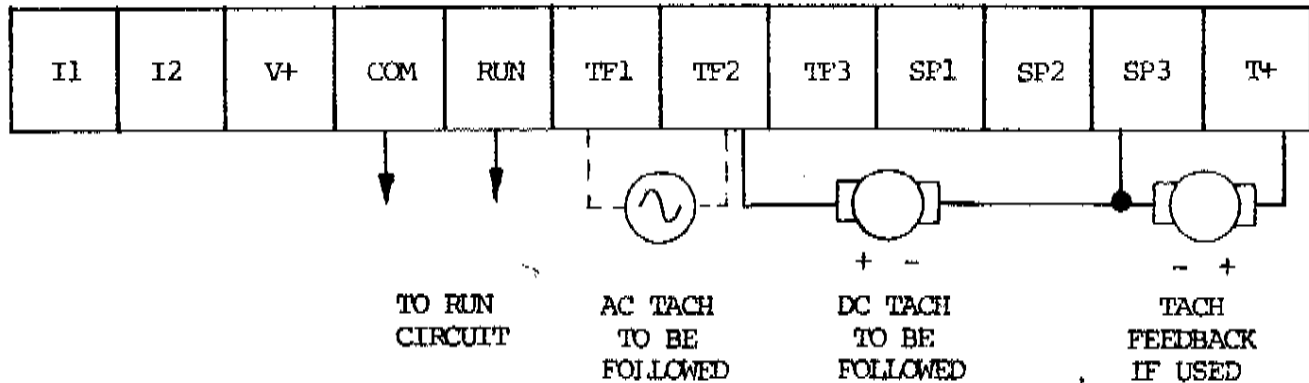
Switch contacts may be replaced by relay contacts, programmable controller, limit switch, etc.

SPEED CONTROL (SUPPLIED)

TACH GENERATOR IF USED

OVERCURRENT INTERLOCK TO TURN EQUIPMENT OFF



**INSTRUCTION
MANUAL****Vari Speed 180****TACH FOLLOWER CONNECTIONS**

Because of the many possible circuits only these typical circuits for each type of operation are shown. If you have any questions about these or other control circuits, please consult the factory.

START-UP PROCEDURES

Adjustments on the printed circuit board are labelled. Illustrations located in the back of the manual show locations of adjustments.

1. Use caution during these procedures because line voltage will be present on the power and motor terminals and on the circuit board when the power is on.
2. Recheck to make sure that all connections are made properly according to the instruction manual, state, local, and national safety codes.
3. Move the Feedback Selector jumper to the correct pair of pins, using this table:

180V Motor - uses pins marked - A
 144V Motor -uses pins marked - B
 108V Motor - uses pins marked - C
 90V Motor -uses pins marked - D
 7V/1000 RPM Tach - uses pins marked - E
 20.8V/1000 RPM Tach - uses pins marked - F

Only one pair of pins should be jumpered.

4. Turn the Threshold Adjustment to zero.
5. Set speed pot to zero speed.
6. Turn fused line disconnect (or circuit breaker) on.
7. Green LED should light up demonstrating that power is being supplied to board and that the internal power supply is working.
8. Give the control a start signal (a closure from run to common). Yellow LED will come on.

Vari Speed 180**INSTRUCTION
MANUAL**

9. Slowly advance speed pot. Motor should start slowly and smoothly increase speed as pot. is advanced. If motor runaway occurs, check Tach Feedback polarity (If Tach Feedback is used) or Feedback Selector position.
10. Open the run circuit. Yellow LED goes off and motor comes to rest.

ADJUSTMENTS AFTER START-UP**MIN SPEED ADJUSTMENT
(Clockwise Increases MIN Speed)**

1. Turn speed adjustment potentiometer to minimum.
2. Start control and adjust trimpot on board until desired minimum speed is set. If desired minimum speed is zero, adjust trimpot so that motor just barely stops turning. This setting will give the best speed setting to motor speed linearity.

**RANGE ADJUSTMENT
(Clockwise Increases Range)**

1. Start motor and allow it to warm up at least 30 minutes fully loaded. (Motor speed will increase with a rise in motor temperature unless using Tach Feedback).
2. With motor driving a full load and the speed pot turned all the way up, adjust the Range Speed Trimpot until desired maximum speed is set.

**CURRENT LIMIT
(Clockwise Increases Current)**

The point at which the control starts Current Limit is identified by the red LED turning on.

Method One

1. Start the machine and apply maximum load to the motor, and turn I-LIM trimpot fully clockwise.
2. Turn the I-LIM trimpot counter-clockwise until the I-LIM indicator (Red) lights, and the machine starts to slow down.
3. Turn the I-LIM trimpot clockwise until the I-LIM Indicator just turns off.

Method Two

1. Turn AC power off.
2. Lock up the motor shaft, taking care not to cause damage.

**INSTRUCTION
MANUAL****Vari Speed 180**

3. Connect a DC ammeter in series with the motor armature.
4. Turn I-LIM trimpot fully counter-clockwise.
5. Turn speed pot fully counter-clockwise.
6. Turn on AC power and start control (Red I-LIM indicator should be on).
7. Turn speed pot clockwise to about 1/3 speed setting.
8. Adjust I-LIM trimpot clockwise for desired motor current. (Do not set for current greater than either the motor or control nameplate rating).
9. Turn off AC power, disconnect ammeter, and unlock motor shaft. I-LIM may be adjusted from 0 to 150% of control rating.

**IR COMPENSATION
(Clockwise Increases Compensation)**

If Tach Feedback is being used (jumper on E or F), set IR COMP to zero. If Armature Feedback is used (jumper on A, B, C, or D):

1. Start control with machine at no load. Set speed at about 2/3 and measure RPM's.
2. Load machine to full capacity or motor rated load whichever is lower. Adjust IR COMP until no load and full load speeds match.
3. Repeat no load measurements since there is some interaction. Do not overcompensate.
4. Recheck MIN SPEED adjustment. IR COMP may affect MIN SPEED.

CONTROLLED ACCELERATION

This control adjusts the rate of motor acceleration to set speed. As the trimpot is turned clockwise, the motor accelerates faster.

**THRESHOLD
(Clockwise Increases Setting)**

This adjustment is used with Tach Followers only and should be turned to zero in all other cases.

Adjust for minimum speed desired. The control will start tracking the tach being followed when the Tach Follower signal exceeds the Threshold setting.

TROUBLESHOOTING**MOTOR WILL NOT RUN**

1. Is power LED (Green) on? If not, go to #2. If it is, go to #5.
2. Make sure wires on the transformer primary are connected as outlined on page six, "Universal Power".
3. Check that the AC line circuit breaker and/or line fuses are OK.
4. Use a DC voltmeter and measure the voltage between V+ (#3) and Com (#4) on the logic terminal block. Should read approximately +15 VDC. If not, unit has power supply failure.
5. Verify that Current Limit LED (Red) is not on. If it is on, make sure I-Lim potentiometer is not turned too far counter-clockwise. With power removed, check that the motor's armature leads are not grounded with an ohmmeter.
6. Make sure RUN LED (Yellow) is on. If it is not lit, check run contact and its wiring to terminals #4 and #5 on the terminal block. With an open (STOP) contact on #4 and #5, 15 VDC should be present between them with reference to #4.
7. Check speed pot wiring on terminals #9, #10, and #11. The pot wiper must go to terminal #10. With a DC voltmeter between terminals #10 and #11, adjust the speed pot to produce a 0-10 VDC signal on #10.
8. The Accel, MIN SPEED or RANGE adjustments on the circuit board may be turned too far counter-clockwise.
9. With power off and motor leads disconnected, check for worn or improperly seated motor brushes.
10. Faulty power module, use the test procedure on page 15.
11. Faulty circuit board.

NOTE: Any time the Current Limit is active, the control will not respond properly.

CIRCUIT BREAKER TRIPPING OR FUSES BLOWING IMMEDIATELY ON POWER UP

1. Shorted power module, verify with the test procedure on page 15.
2. Improper wiring - recheck wiring for shorts and shorts to ground particularly motor wiring.
3. Verify transformer wiring by following procedure for Universal Power on page 6.
4. Motor brushes worn or improperly seated.

**INSTRUCTION
MANUAL****Vari Speed 180**

CIRCUIT BREAKER TRIPPING OR FUSES BLOWING

1. Motor brushes worn or improperly seated.
2. Motor load too heavy. An appropriately rated DC ammeter can be used to check the current draw on the motor. Check for any mechanical binding in the system.
3. Field not connected. (Wound field motors only).
4. Make sure that circuit breaker or fuse are proper size and type for system. See page 7.

NO SPEED CONTROL

1. Check speed potentiometer's wiring and resistance value. (5k ohms is suggested for pot).
2. MIN speed adjust on circuit board misadjusted, turn counter-clockwise to correct.
3. RANGE adjust misadjusted, turn clockwise to correct.
4. If using Tachometer Feedback, check the tach's polarity.
5. Verify that the motor voltage selection is correct for application. See page 6.
6. Check power module wiring as shown on page 15.
7. Faulty power module, use the test procedure on page 15.
8. Check motor's wiring for any shorts or shorts to ground.

MOTOR WILL NOT RUN AT 1725 RPM

1. RANGE adjustment on circuit board misadjusted, turn clockwise to increase speed.
2. Verify that Current Limit LED (Red) is not on. If it is, refer to page 11 for adjustment procedure.
3. Check speed potentiometer wiring on terminals #9, #10, and #11. A 10 VDC signal on #10 should produce full speed if RANGE is adjusted near 100%.
4. Verify that the motor voltage selection is correct for application. See page 6.
5. Motor may be overloaded. (Motor horsepower is less than required for load).
6. Check that incoming AC line is within tolerances. See page 3.
7. Verify transformer wiring by following procedure for Universal Power on page 6.

Vari Speed 180**INSTRUCTION
MANUAL****MOTOR JUMPS AFTER STOP AND BEFORE START SIGNAL**

1. Check that external wiring for logic commands (START/STOP and SPEED POT) use shielded wire.
2. Verify the shield is connected to ground at controller side only.
3. Disconnect all external logic wiring and simulate logic and speed inputs at drive's terminal block. If the problem is solved, noise is being picked up by the external wiring. Take a continuity check of the shield in the logic wiring harness. Check the routing of the wiring harness through the machine. Try to separate it from AC and DC power lines as far as possible. If the problem still exists, continue to step 4.
4. Verify that the START/STOP contacts are switching correctly.
5. Check for AC line disturbances such as high line, low line or noise spikes. Other equipment on the AC line may be producing line transients which are transmitting through the system.

NOTE: The logic inputs on the drive are operating at a low DC voltage and current. Be sure that the external contacts are rated to reliably switch logic-level signals.

MOTOR SPEED ERRATIC

1. IR Comp on the circuit board is misadjusted. Turn adjustment counter-clockwise to decrease compensation.
2. Speed potentiometer or its wiring may be defective. Check for proper connections and continuity to terminals #9, #10, #11.
3. If Tachometer Feedback is used, verify proper tach polarity.
4. Verify that the motor voltage selection is correct for application. See page 6.
5. Motor brushes may be worn or not properly seated. If motor is new, run it for 2 hours to help seat the brushes.
6. Check that incoming AC line is within tolerances. See page 3.
7. Logic on circuit board may be defective.

MOTOR WILL NOT SHUT OFF WITH STOP COMMAND

1. Make sure RUN LED (Yellow) is going off. If not, check that contact across terminals #4 and #5 is opening for a STOP command.
2. Check for a short or short to ground on terminal #5 (RUN) on the logic terminal block.
3. Power module may be defective, use the test procedure on page 15.
4. Check motor's wiring for any shorts or shorts to ground.
5. Verify that the motor voltage selection is correct for application. See page 6.
6. If Tachometer Feedback is being used, check for proper polarity.
7. Faulty circuit board.

**INSTRUCTION
MANUAL****Varl Speed 180****TEST PROCEDURE FOR POWER COMPONENTS**

NOTE: The following tests are to conclude if the components are good or bad.

CAUTION: Turn OFF all power for the following tests.

POWER MODULE

1. Pull off all "fast on" connections. Set V.O.M. to R X 10K scale.
2. Check resistance from both AC terminals to (+) terminal. For both directions, resistance should be greater than 1 Meg ohm.
3. Check resistance from both AC terminals to (-) terminal. Resistance should be greater than 1 Meg ohm in one direction and less than 50k in the other direction.
4. Check resistance from (+) terminal to (-) terminal. Resistance should be greater than 1 Meg ohm in one direction and less than 50 K in the other direction.

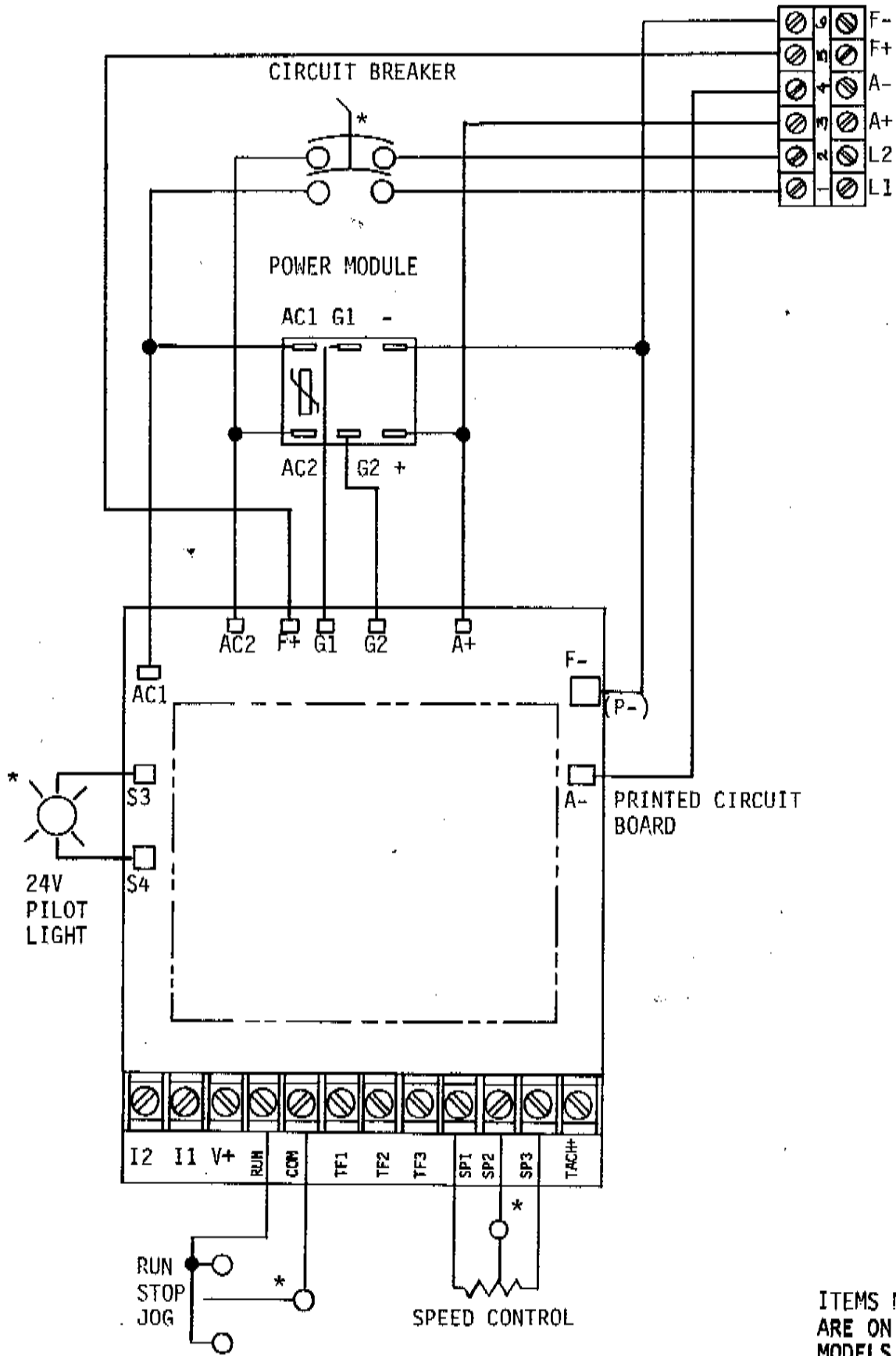
NOTE: When using a digital meter, use the diode test position for all SCR and tests.

REPLACEMENT OF SPARE PARTS

Description	Part Number
Circuit Board Sub-assembly	701300 (specify horsepower)
Power Module, 1 HP, 120 VAC	2320
Power Module, 2 HP, 240 VAC	2320
Power Module, 3 HP, 240 VAC	2306
Power Module, 5 HP, 240 VAC	2326
Run/Stop/Jog Switch	2206
Speed Control Potentiometer	943
Transformer	1604

Vari Speed 180

FUNCTIONAL DIAGRAM



**INSTRUCTION
MANUAL**

Vari Speed 180

ILLUSTRATION - CHASSIS MOUNT

1/8 - 3 Horsepower

**POWER IN/OUT
TERMINAL STRIP**

**POWER MODULE
(5 HP UNDER CIRCUIT BOARD;
ALL OTHERS APPROX. HERE)**

**120 VAC
AC1 - AC2
FIELD
CONVERSION
TERMINALS**

**CURRENT
SENSE
RESISTOR**

**240 VAC
P2 - P3
FIELD
CONVERSION
TERMINALS**

**RED
CURRENT
LIMIT
INDICATOR**

**GREEN
POWER
ON INDICATOR**

**YELLOW
RUN
INDICATOR**

**IR
COMPENSATION
ADJUST
(25 TURN)**

**CURRENT
LIMIT
ADJUST
(25 TURN)**

**FEEDBACK
SELECTOR**

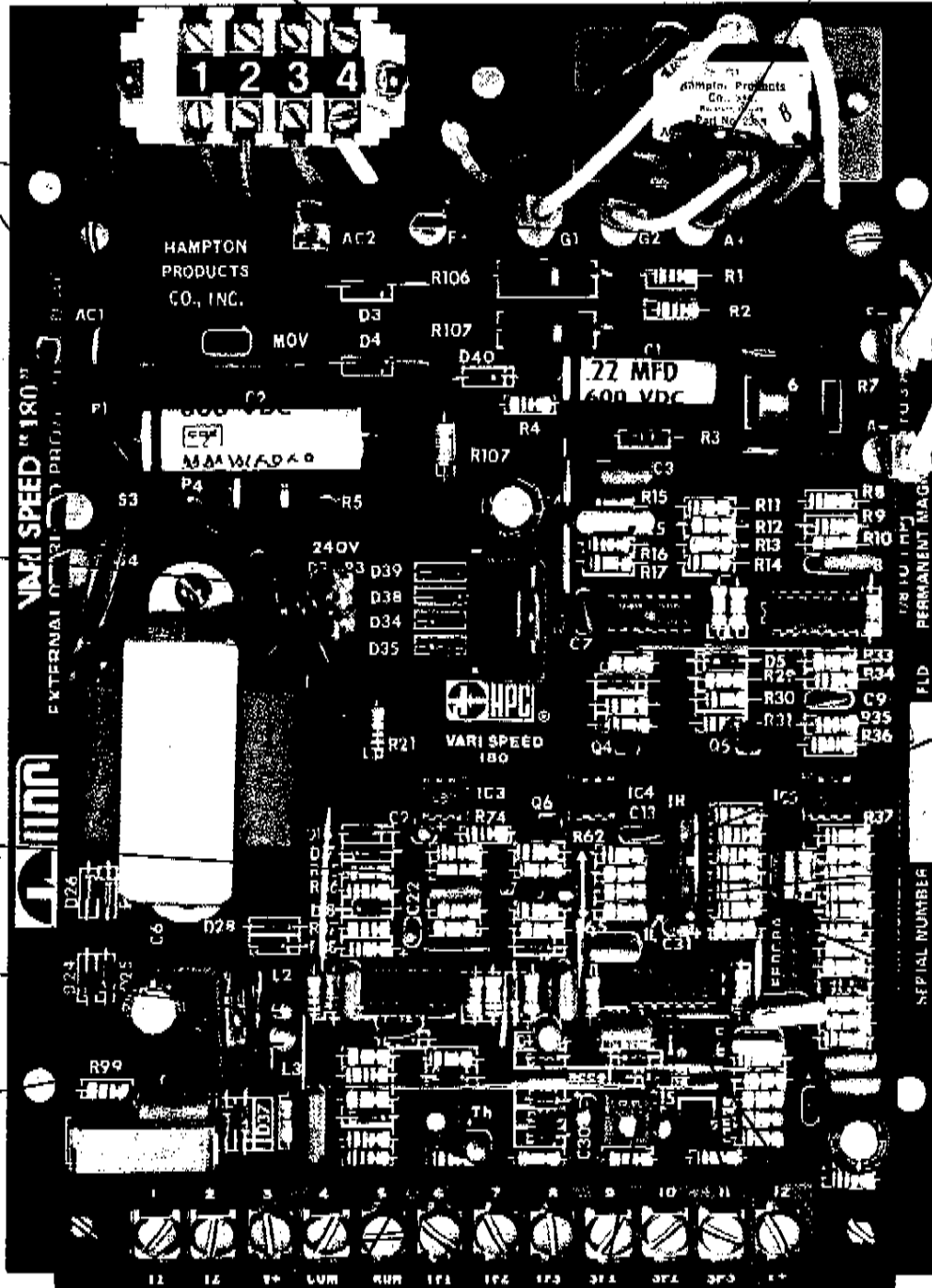
**LOGIC WIRING
TERMINAL STRIP**

MINIMUM SPEED ADJUST

THRESHOLD ADJUST

SPEED RANGE ADJUST

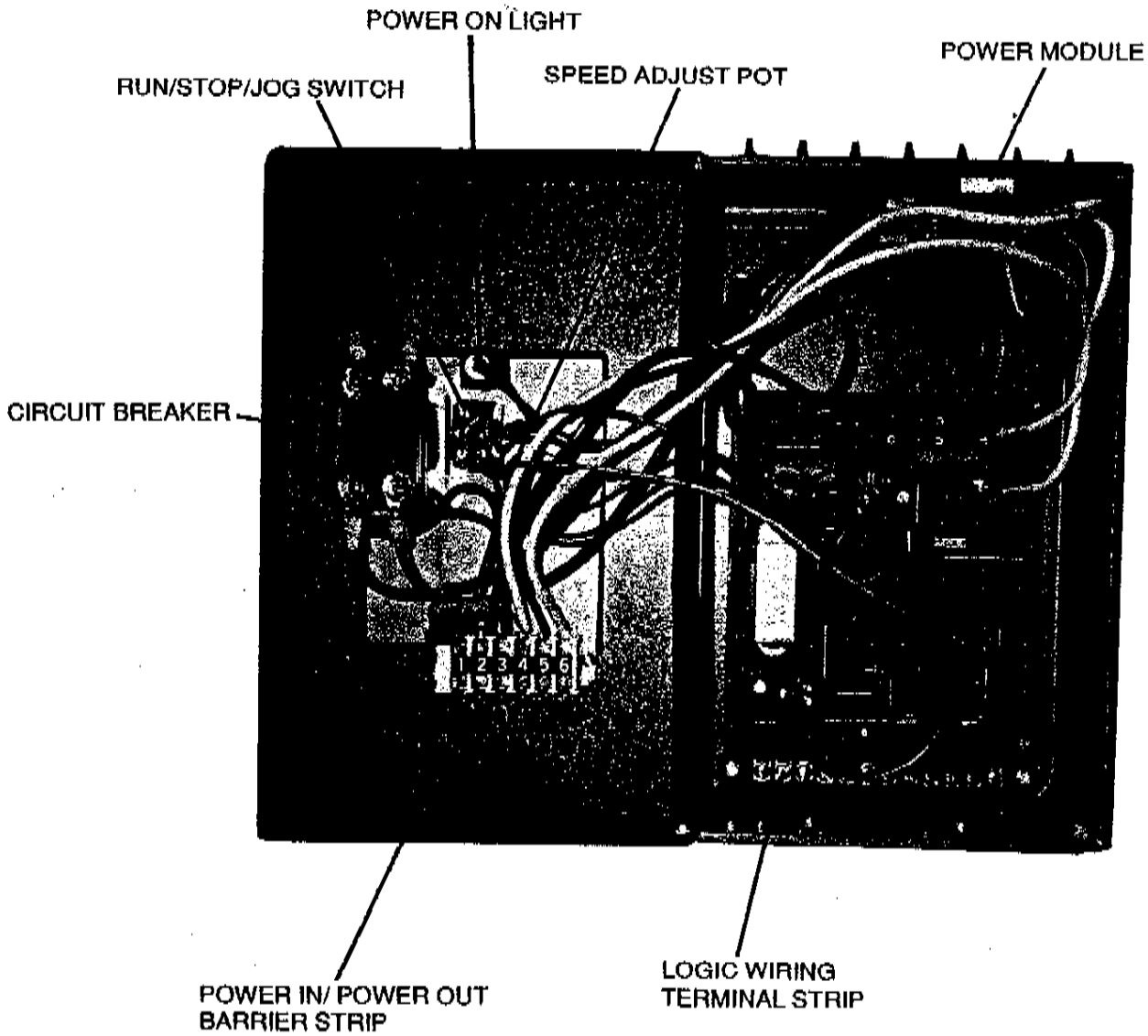
ACCELERATION ADJUST



Vari Speed 180

**INSTRUCTION
MANUAL**

**ILLUSTRATIONS - NEMA 12 ENCLOSURE
5 Horsepower**

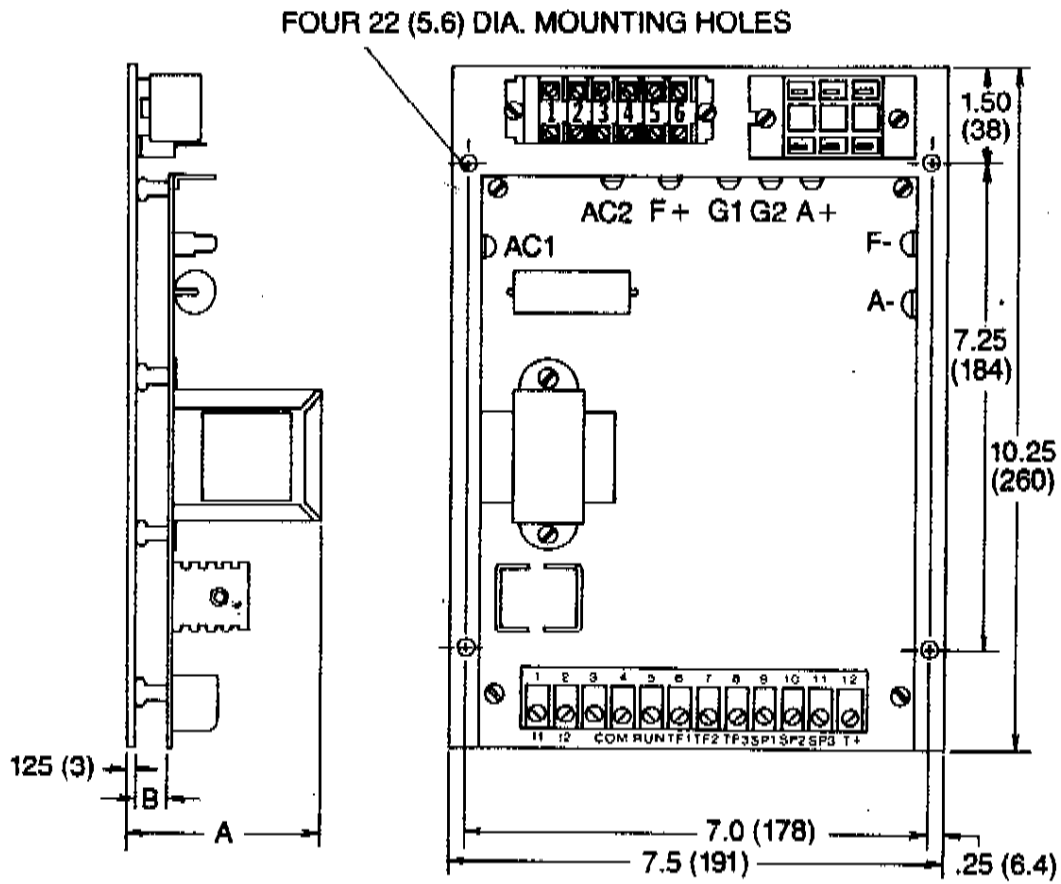


NOTE: For specific location of common circuit board components, see Illustration Chassis Mount on the preceding page.

**INSTRUCTION
MANUAL**

Vari Speed 180

DIMENSIONS - CHASSIS MOUNT

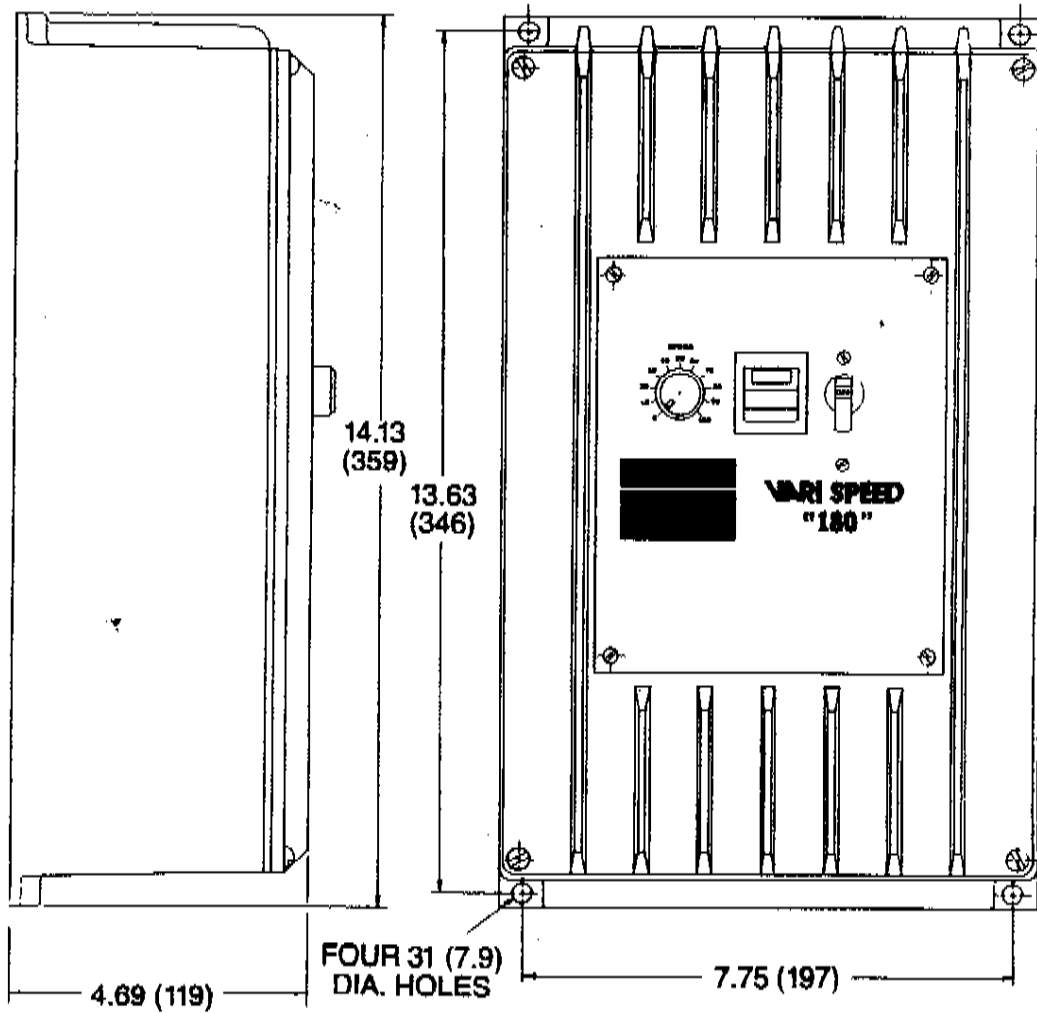


HP	A	B
1/8-3	3.0 (76)	0.5 (13)
5	4.625 (117.5)	2.125 (54)

Vari Speed 180

**INSTRUCTION
MANUAL**

DIMENSIONS - NEMA 12 ENCLOSURE



FOUR 31 (7.9)
DIA. HOLES

TWO 5.14 NPT HOLES

