HAMPTON

Installation, Operation and Maintenance Manual

Cycletrol® 150 Instruction Manual

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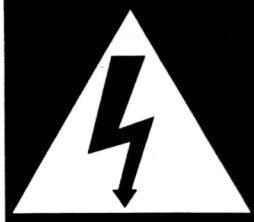
FORWARD

The Cycletrol 150 is a convenient way to start and stop a DC motor rapidly and repeatedly and at the same time control its running speed. This control continuously adjusts the electrical power to the motor to maintain the desired speed regardless of the load on the motor provided, of course, that the motor load is less than the current limit setting. On command this control turns off power to the motor and turns on an electronic dynamic brake for rapid stopping. To simplify the use of this control its features include:

1. Speed control, the speed may be continuously varied by a potentiometer or by process signal;
2. Internal adjustments to limit minimum and maximum speed and to limit maximum motor current;
3. Start/Stop logic that operates directly from momentary push buttons or other signals without using a latching relay;
4. Rapid acceleration starts at currents in excess of running current limit and rapid dynamic braking stops;
5. A brake or coast to stop switch that allows gentle stops;
6. A timer that may be used for automatic restart or timed run;
7. Color coded light emitting diodes to indicate control actions.

The remainder of this manual will cover the Cycletrol 150 in much more detail.

WARNING



The Cycletrol 150 motor controller contains dangerous voltages when connected to line voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the controller may cause equipment failure, serious injury or death.

Follow this manual and National Electrical Codes and local safety codes.

CAUTION

It is the responsibility of the user or the person installing the controller to provide proper grounding, as well as motor overload and branch circuit protection according to the National Electrical Code and local codes.

SPECIFICATIONS

INPUT POWER...	95 T0 135VAC on 120VAC Models 195 to 260VAC on 240VAC Models 50/60 Hz Single Phase (Refer to table on facing page)
OUTPUT.	Armature: 0-90VDC on 120VAC Models 0-12.2A, 1/8 to 1 HP 0-180VDC on 240VAC Models 0-10.8A, 1/4 to 2 HP or 0-16A, 1/4 to 3 HP intermittent (Refer to table on facing page)
ENCLOSURE.....	Chassis (IP00) or NEMA 12 (IP54)
AMBIENT TEMPERATURE RANGE..	0° to 50°C Chassis (IP00) at rated load, 0° to 40°C NEMA 12 (IP54) at rated load, –30° to 65°C storage and transport.
POWER DISSIPATION.....	Chassis (IP00) est. 115 Watt at 3 HP NEMA 12 (IP54) est. 80 Watt at 2 HP
MOUNTING POSITION.....	Vertical
OPERATOR CONTROL PROVISIONS.....	Start, Stop, Jog, Override Stop, Reset, Run Speed, Timer
INTERNAL CONTROLS.	Max. Speed, Min. Speed, Current Limit, Programmable Switches
PROCESS SIGNAL INPUT.....	0-10 V dc control signal input. Input resistance 200K ohm. Also usable for 1-5 mA, 4-20 mA 10-50 mA with external resistor.
TACHOMETER GENERATOR FEEDBACK INPUT.....	21VDC/1000 RPM
SPEED VARIATIONS DUE TO LINE FLUCTUATIONS.....	The control will compensate to less than 1% armature voltage change in less than 500 milliseconds within input power range.
SPEED VARIATIONS DUE TO THERMAL DRIFT.	Control: Less than 3% Motor: Depends on motor and application System with Tachometer Feedback: Less than 1%.
SPEED VARIATIONS DUE TO LOADING.. (90% LOAD CHANGE)	Armature Feedback: Typical application 5% of full speed. Tachometer Feedback: less than ± 0.5% of Set Speed or ± 0.25% of full speed, which ever is greater.
MAX RUN SPEED....	Adjustable from approx. 1/2 to full speed.
MIN RUN SPEED.....	Adjustable from 0 to approx. 1/2 of full speed.

ACCELERATION..... Fixed at approx. 0.20 seconds, nonlinear. Other times are available, consult factory.

CURRENT LIMIT. Adjustable from 0-125% of full rated output. Four times setting permitted for 0.2 seconds during starting acceleration. Four times feature may be defeated.

APPROVALS..... UL, cUL, CE

DRIVE PART NUMBER	RATED INPUT		RATED OUTPUT						
			AS A SPEED CONTROL			AS A CYCLING CONTROL			
	VOLTS	AMPS	HP	VOLTS	AMPS	MAX CPM [2]	TOTAL INERTIA [3] LB•IN²	[KG•M²]	STEADY STATE MOTOR CURRENT
NEMA 12 (IP54) VERSIONS									
176B6000 176B8021 [4]	120	17	1	0-90	12.2 CONT	60	13.4	[0.0039]	2.4 A
176B6001	240	8.5	1	0-180	6.1 CONT	60	13.4	[0.0039]	1.2 A
176B6002	240	15	2	0-180	10.8 CONT	20	43.1	[0.0126]	2.2 A
176B6003	240	22	3	0-180	16.0 INT [1]	15	50.1	[0.0147]	3.2 A
CHASSIS (IP00) VERSIONS									
176B6004	120	17	1	0-90	12.2 CONT	60	13.4	[0.0039]	2.4 A
176B6005	240	22	3	0-180	16.0 CONT	30	50.1	[0.0147]	3.2 A

(1) Intermittent duty as a speed control operating at full load only.
Duty Cycle: 40% at 16 A, not longer than 24 minutes continuously, 60% stopped.
This does not affect cycling.

(2) Cycling rates (Cycles Per Minute) are based on cycling duty DC motors accelerating from zero to rated speed and braking to zero with:

- A motor having the same HP rating as the drive;
- A load inertia reflected to the motor shaft of not more than 25% of the motor inertia; and
- A steady state friction load corresponding to a motor current of not more than 20% of drive current rating while operating at rated motor speed.

(3) Motor Inertia + Load Inertia refelected to the motor shaft.

(4) Special

OPERATIONAL CHARACTERISTICS

EXTERNAL CONTROLS

START (Terminals 1 & 4, Normally Open Contact):
A start contact closure latches the Cycletrol 150 into a run mode and lights the RUN mode LED (yellow) indicator. A START command can be overridden by a STOP or OVERRIDE STOP command.

STOP (Terminal 3 & 4, Normally Closed Contact):
An open contact at STOP unlatches the RUN command and causes the motor to stop. This function can be modified by changing the "O" and "J" switches found on the printed circuit assembly. See page 5. The units are shipped from the factory with the "O" and "J" switches in the closed (up) position.

JOG (Terminals 2 & 4, Normally Open Contact):
A contact closure in JOG causes a Cycletrol 150 to go into the RUN mode and lights the RUN LED (yellow) as long as the contact is closed. Jog does not latch. The Cycletrol 150 will stop when JOG is opened. JOG may be maintained for continuous running. OVERRIDE STOP and STOP override a JOG command.

OVERRIDE STOP (Terminals 6 & 4, Normally Closed):
OVERRIDE STOP is an alternate means of stopping the Cycletrol 150. OVERRIDE STOP always overrides a START, JOG or a timer generated START command. A momentary contact opening of OVERRIDE STOP latches the Cycletrol 150 into the OVERRIDE STOP mode and lights the BRAKE LED (red). OVERRIDE may be reset by momentarily closing RESET or by cycling AC power. OVERRIDE STOP overrides RESET.
OVERRIDE STOP always causes the Cycletrol to brake to a stop.

CAUTION: OVERRIDE STOP IS A LOGIC CONVENIENCE AND SHOULD NOT BE USED AS AN EMERGENCY STOP. OVERRIDE STOP CANNOT OVERRIDE A CATASTROPHIC DRIVE FAILURE. A SYSTEM EMERGENCY STOP FUNCTION NECESSARY TO PROTECT PERSONNEL OR EQUIPMENT SHOULD ALWAYS REMOVE AC POWER FROM THE CYCLETROL 150.

RESET (Terminals 5 & 4, Normally Open Contact):
RESET unlatches an OVERRIDE STOP condition. OVERRIDE STOP will override RESET.

These five external control logic terminals have a nominal open circuit voltage of about 24 volts DC measured from terminal 4 (COMMON) which is (–), and a closed circuit current of about 13 mA each. Use switch or relay contacts that are designed to operate reliably at these levels. Gold, gold alloy, and fine silver switch or relay contacts and most silver cadmium-oxide pilot duty switch and relay contacts will perform adequately.

Solid state devices may be used to operate these circuits provided they meet the following specifications:
1. OFF state voltage withstand 36 VDC minimum;
2. OFF state leakage less than 1 mA;
3. ON state current rating is greater than 15 mA; and
4. ON state voltage drop less than 1 V at 15 mA.

All logic and speed control terminals are isolated from power circuits and from ground. The logic common terminal (4) or the speed common terminal (11) may be connected to earth/ground.

Enclosed controls have a START-JOG/STOP switch on the cover wired to the START, JOG and COMMON terminals. Press up to start, press down and release to stop or jog. Additional control wiring from external equipment can be connected in addition to the front cover START-JOG/STOP switch. The STOP and OVERRIDE STOP terminals must be jumpered to COMMON unless external circuits are connected for those functions.

SPEED CONTROL

The Cycletrol 150 provides infinitely variable speed control. There is compensation for line voltage variation and variations in motor loading. At a given speed potentiometer setting and with a constant load, the motor armature voltage will vary less than 1% with an input voltage change of ± 10% of nominal. If tachometer feedback is used, the speed variations will be less than 1/2% regardless of motor temperature or load. A major design parameter of this control was to limit overshoot, undershoot and settling time. These characteristics are more than adequate for almost all applications.

PROCESS CONTROL SIGNALS

A 0-10V dc control signal input may be used by connecting process signal (+) to SP2 and process (–) to SP3. With tachometer feedback, the motor speed will track the process voltage to better than 1% linearity. The input impedance is approx. 50K ohms.

Current process signals may be used with an additional resistor. A 1-5 mA signal can be accommodated by shunting SP2 and SP3 with a 2.0K ohms, 1/2 watt resistor; for 4-20 mA, use a 500 ohms , 1/2 watt. Set the "P" switch in the closed (up) position, to allow the Cycletrol 150 to operate with current process signals.

TACHOMETER FEEDBACK

For application requiring more accurate speed regulation and/or wider speed range of full torque, the Cycletrol 150 can accept an analog tachometer feedback signal. By removing the RA resistor, (See page 16 for location) a 20.8 VDC/100 RPM tach can be used for close-loop operation. The tachometer leads should be appropriately connected to TB1 terminals T+ and T–.

CAUTION: Connect correct polarity. Reversed tachometer polarity will cause the drive to accelerate the motor to the maximum speed the available AC line voltage will support.

Shielded twisted pair cable is recommended for the tachometer. The shield should be fully insulated from ground along its full length. The shield should be grounded at the drive end at the earthground terminal ⏚.

WARNING: TB1 TERMINALS T+ AND T– ARE AT RECTIFIED AC LINE VOLTAGE (–) AT ALL TIMES POWER IS APPLIED TO THE DRIVE WHETHER OR NOT THE DRIVE IS TURNING THE MOTOR.

TIMER

Most application requiring automatic cycles such as timed run or cycle on demand or requiring delayed start or delayed stop can be accomplished using the programming switch sections A, B, C, D, and T. The time is set by a resistor connected between terminals V + (7) and TIME (8). A direct connection results in minimum time, approximately 1/4 second. The maximum recommended resistance, 2 meg ohms, yields about 30 seconds.

The control is shipped with the timer disabled (T is up) and completely disengaged from the rest of the circuit (A,B, C, and D are down). For automatic cycles see the application section. For other timer applications, consult the factory.

WARNING: DO NOT LEAVE THE TIME TERMINAL CIRCUIT OPEN OR " FLOATING" WHEN THE T SWITCH IS DOWN OR RANDOM TIMER OPERATION MAY RESULT. DO NOT OPERATE WITH BOTH C AND D SWITCHES UP (CLOSED) SINCE UNPREDICTABLE CONTROL OPERATION WILL RESULT. THIS MAY INCLUDE AN UNSTOPPABLE RUN WHEN POWER IS ON. DO NOT OPERATE WITH SWITCHES A AND B BOTH UP (CLOSED) SINCE TIMER OPERATION WILL BE AMBIGUOUS.

INTERNAL CONTROLS

MIN SPEED:

The speed corresponding to the minimum setting of the SPEED CONTROL may be adjusted by this trim potentiometer on the printed circuit assembly. The range is from zero to about 1/2 speed.

MAX SPEED:

The speed corresponding to maximum setting of the RUN SPEED CONTROL is adjusted by this trim potentiometer and can be set at any value between about 1/2 and full output. The SPEED CONTROL adjustment will vary the motor speed smoothly and linearly between the speeds set by the MIN SPEED and MAX SPEED.

CURRENT LIMIT:

The Cycletrol 150 is provided with an adjustment current limit circuit which can be set to limit the torque output of the motor over a range of near zero to 125% of control rating. This circuit will not affect the motor speed until the motor current (loading) increase to the set point. When the motor current is greater than the current limit setting, the control will reduce the motor speed as much as necessary to keep motor current from exceeding the set value; even to zero speed. For about .2 seconds following a START type command, the current limit will permit motor currents up to 4 times setting. This extra inrush allows faster cycling and may be defeated by moving resistor R40 when not desired (see page 16 for location).

PROGRAMING SWITCHES:

Several switches have been designed into the Cycletrol 150 to allow it to be tailored to many applications, The unit is shipped configured for the most common use but may be changed by opening or closing the switches .

COAST-BRAKE:

The solid state dynamic brake may be turned off by moving the COAST-BRAKE switch on the printed circuit assembly to the COAST position. This allows the motor to coast to a stop following JOG or STOP operations. OVERRIDE STOP or POWER OFF will always operate the bake with the switch in either position.

T (TIMER DISABLE):

Automatic timing is disabled by having this switch closed (up). Once opened (down) the timer will always be active unless disabled by external circuit or by OVERRIDE STOP. The control is shipped with this switch closed (up), and with a jumper installed between TB2 terminals 4 and 8, which will need to be removed to use the timer function.

A, B (TIMER INITIATION):

These switches determine whether the control stops or starts following the timer interval. Normal factory shipments have the "A" and "B" switches in the open (down) position. For automatic restart, place the "A" switch closed (up) and "B" switch open (down). For a timed run followed by automatic stop, open (down) "A" switch and close (up) "B" switch.

CAUTION: Do not operate with both A and B switches closed (up) since timer operation will be unpredictable.

C, D (TIMER FUNCTION):

The action initiating the timer interval is selected by these switches. Normal factory shipments "C" and "D" switches in the open (down) position. For and automatic restart after a delay in initiated by the STOP circuit, close (up) switch "C". The closed (up) "D" switch should be used when the START circuit is to start the motor and also the timer. This switch may be opened and external circuits to the TIMER terminal can then be used for delayed start or delayed stop operations. Consult the factory.

CAUTION: Do not operate with both C and D switches closed (up) since timer operation will be unpredictable. This may include unstoppable run while power is applied.

J (STOP FUNCTION):

Leaving the "J" switch in the closed)up) position allows the drive logic to continuously act on any switch or relay contact connected to the STOP terminal. Changing the "J" switch to the open (down) position forces the drive to ignore all but the opening transition of the STOP contact.

Cycle on demand applications may be simplified by opening the "J" switch since the drive will ignore a continuing STOP signal even if system motion stops quickly enough to leave the STOP contacts open. Use in conjunction with the "O" switch

O (LOGIC PRIORITY):

The " O" switch, when closed (up), causes a STOP command to override START, or JOG. Opening (down) the "O" switch causes a START or JOG command to override STOP. Normal factory shipments have "O" switch closed (up).

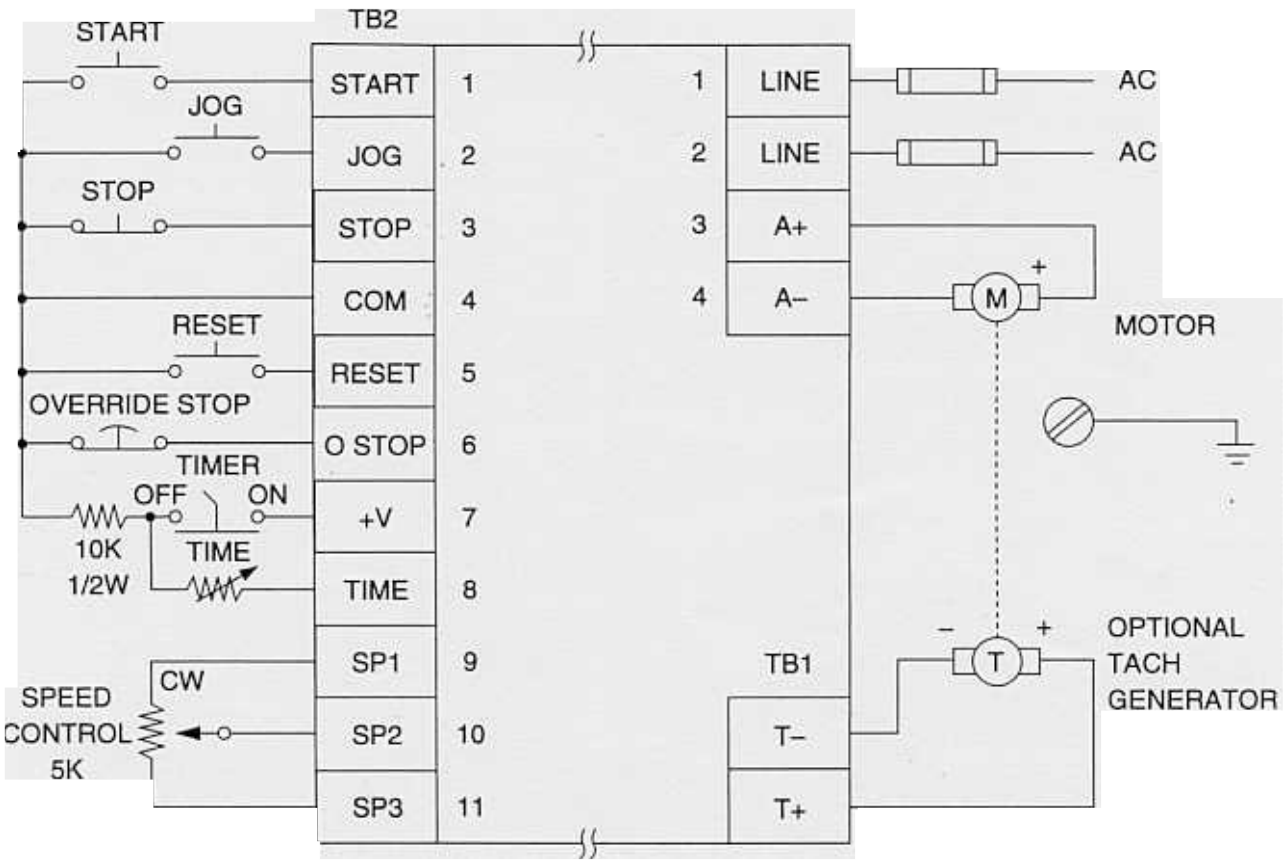
P (PROCESS SIGNAL OFFSET):

The "P" switch modifies voltage offset at terminal SP2 (speed control input). Normal factory shipments have "P" switch open (down). When using a process signal such as 4-20 mA, close (up) the "P" switch.

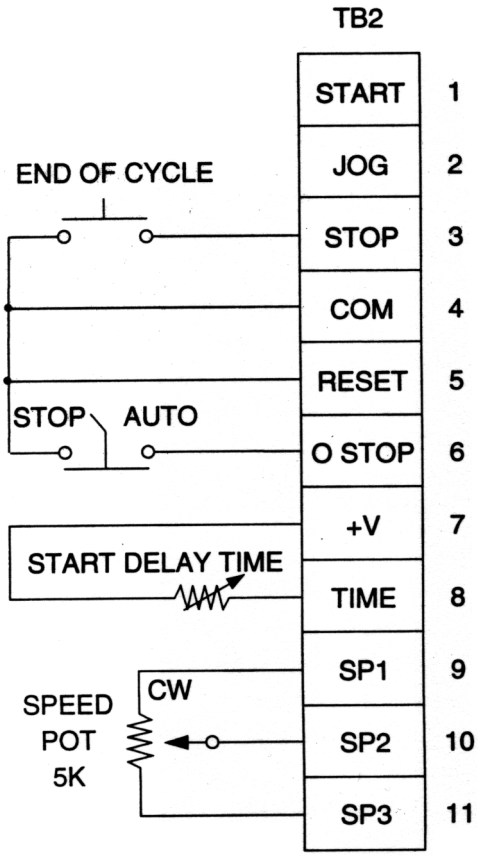
Applications

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.

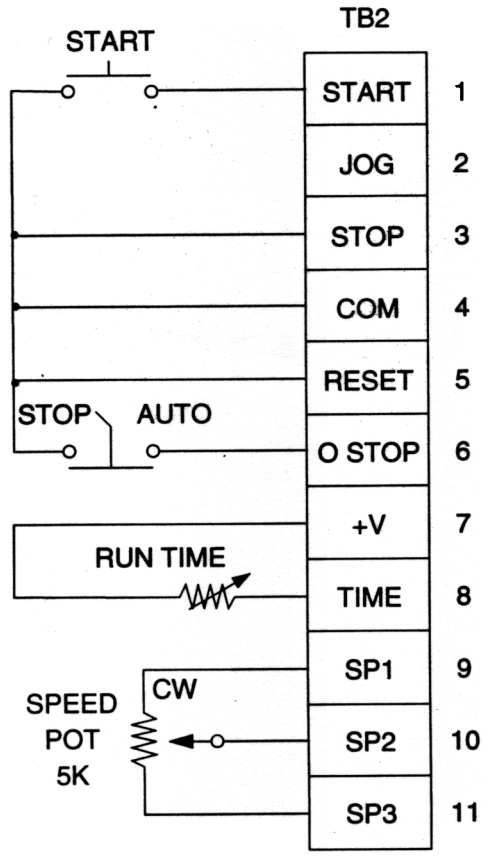
This circuit shows the use of all functions and tach feedback. Many applications do not require all these features. All features need not be connected. The OVERRIDE STOP terminal (4) must be jumpered to the COM terminal (6) if the OVERRIDE STOP feature is not used.



WARNING: TB1 TERMINALS T+ AND T– ARE AT RECTIFIED AC LINE VOLTAGE AT ALL TIMES POWER IS APPLIED TO THE DRIVE WHETHER OR NOT THE DRIVE IS TURNING THE MOTOR.



Typical Automatic Cycle
Time dwell between cycles with automatic start.
Open (down) switch "T", close (up) switches "A" & "C", open (down) switches "B" & "D".

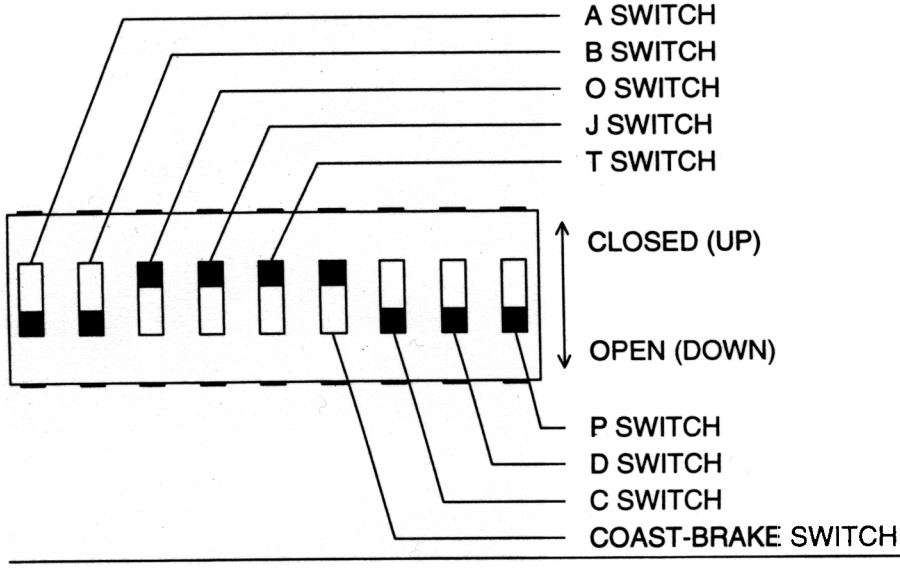


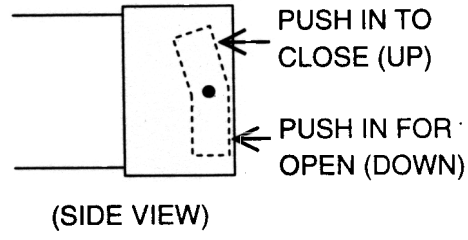
Typical Automatic Cycle
Timed run following start.
Open (down) switch "T", open (down) switches "A" & "C", close (up) switches "B" & "D".

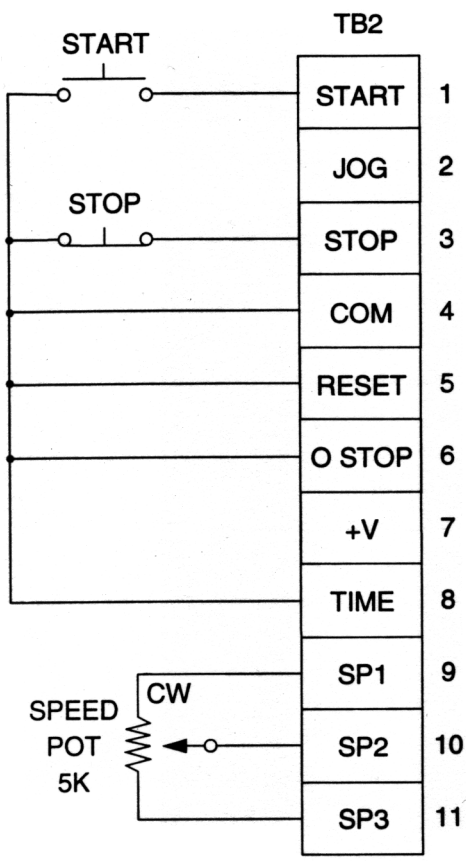
WARNING: TB1 TERMINALS T+ AND T– ARE AT RECTIFIED AC LINE VOLTAGE AT ALL TIMES POWER IS APPLIED TO THE DRIVE WHETHER OR NOT THE DRIVE IS TURNING THE MOTOR.

PROGRAMMABLE SWITCH

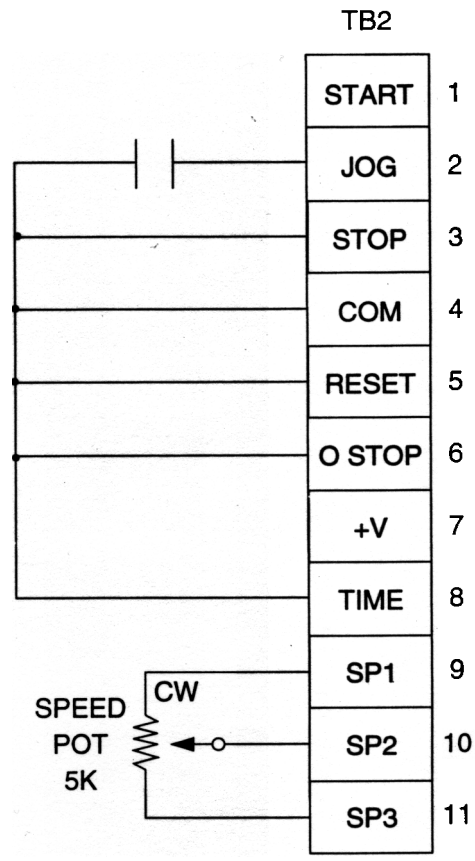
Switch positions shown in configuration as they are shipped from the factory.



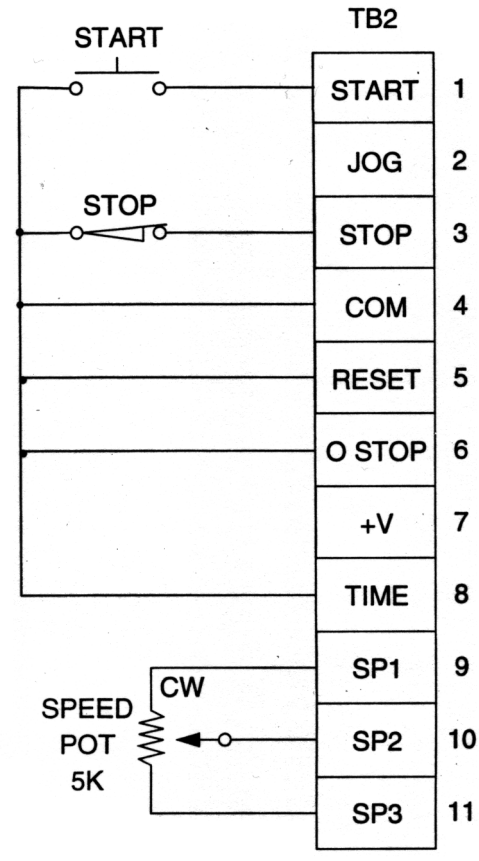




OPEN SWITCHES (DOWN)
"A", "B", "C" & "D"



OPEN SWITCHES (DOWN)
"A", "B", "C" & "D"



OPEN SWITCHES (DOWN)
"O" & "J", "A", "B", "C" & "D"
SEE PAGE 5

3-WIRE SPEED CONTROL

- Momentary START closure latches the Cycletrol into the RUN mode.
- Momentary STOP opening "unlatches RUN mode.
- STOP overrides START.

BASIC SPEED CONTROL

- Control RUNS/STOPS from a single input command.
- Closure on JOG puts Cycletrol into a RUN mode.
- Opening the JOG produces a STOP command.

BASIC CYCLE ON DEMAND

- Momentary START closure latches the Cycletrol into the RUN mode regardless of STOP limit switch.
- Momentary STOP limit switch opening unlatches RUN mode.
- START overrides STOP.

WARNING: TB1 TERMINALS T+ AND T– ARE AT RECTIFIED AC LINE VOLTAGE AT ALL TIMES POWER IS APPLIED TO THE DRIVE WHETHER OR NOT THE DRIVE IS TURNING THE MOTOR.

INSTALLATION

WARNING: Improper installation of motor and controller may cause death or personal injury or equipment failure. Only a competent electrician should carry out the electrical installation. Follow this instruction manual, National Electrical Codes, local and state codes for proper installation. It is the responsibility of the user or the person installing the controller to provide branch circuit protection per the National Electrical Code and local codes.Always disconnect all power to controller before making any wiring changes, or before inspecting the controls or equipment.

1. A fused disconnect in incoming AC power is required. See page 20 for recommended fuse types.

2. The Cycletrol 150 should be mounted vertically for coolest operation. During heavy loads, the controller may reach temperatures HOT to the touch. This is normal and expected. However, under the most extreme conditions, the surface of the controller should never exceed 75° C.

3. All electronic controls are subject to line spikes and noise generated by equipment such as arc welders, solenoids, dielectric heaters, etc. The Cycletrol 150 provides the latest devices for protection against such an environment. However, it is suggested as an additional protection that shielded wire be used for run and speed control circuits into the controller. The shield should be fully insulated from ground along its full length. The shield should be grounded at the drive end at the earthground terminal ⏚. Logic common, terminal 4, should also be connected to earthground if the application permits.

WARNING: Circuit breaker on the cover of enclosed units does not disconnect AC line from the line and motor terminals.
WARNING: Terminals T+ and T– have high voltage with respect to ground present whenever AC power is turned on.

CAUTION: To insure avoiding personal injury, disconnect the AC line to insure positive shutdown of controller and motor before working on this control or any equipment or machinery it is controlling.

GROUNDING: The controller enclosure, motor and remote operator's stations (when used) must be connected to building earth ground for the safety of the operation personnel.

4. When making internal adjustments on NEMA 12 controllers, support cover to prevent stress on wiring harnesses. See page 18.

5. When remote mounting speed adjust potentiometer and function switches, keep in mind the T+ and T– terminals are at rectified line potential with respect to ground.

6. DO NOT apply AC line voltage to any terminals except AC1 and AC2. If voltages are applied to any other terminals, permanent damage may occur. Use only isolated contact closures for all other connections as shown in Wiring Information.

7. All remote connections to the controller such as speed potentiometers, run circuits and process signals should be shielded cable. Shields must be insulated and should be connected to the logic common terminal. The logic common terminal should be connected to ground.

8. The Cycletrol 150 is normally shipped as a speed control with braking. The timer is disabled and a stop signal will suppress start. To convert to cycle on demand operation, open (down) the "O" switch to allow start to operate regardless of stop switch, and open (down) the "J" switch. (See page 5).

9. Automatic restart is normally disabled by the "T" switch when the control is shipped. This feature may be used by connecting a timing resistor or rheostat circuit as shown on page 6 and by opening (down) the "T" switch.

WARNING: Once the "T" switch is open (down) the control will start automatically. Automatic restart may be converted to timed run.

10. Current Limit is set for the largest motor with which the controller is designed to be used. Current Limit must be reduced by the customer to safely work with motors rated lower than the full control rating. Refer to the motor nameplate.

11. The SP2 terminal should not be operated with connected wires and an open circuit (improperly organized switching among speed control potentiometers, for instance) since any electrical noise picked up by floating connected wiring will be added to the MIN speed when the drive is running.

START-UP PROCEDURE

Use caution during these procedures because line voltage will be present on the power and motor terminals and on the printed circuit assembly when the power is on. Indicators, switches, and adjustments on the printed circuit assembly are labelled. Illustrations located in the back of the manual show locations.

1. If inadvertent equipment motion in either direction is undesirable, uncouple the motor by removing belts, disengaging a shaft coupling, or other appropriate means. If the motor is removed from the equipment but still connected, block it securely.

WARNING: A loose motor must be blocked securely to avoid damage to wiring and danger to persons in the area.

2. With AC power disconnected or turned off outside the control, remount cover upside down as shown in the illustration on page 18 (enclosed models).

3. With AC power still off, recheck to make sure that all connections are made properly according to the instruction manual, state, local and national safety codes.

4. Set SPEED CONTROL to zero speed.

5. Jumper O STOP and STOP to COMMON.

6. Switch off timer. (If timer function is to be used).

7. Verify the COAST-BRAKE switch is in the BRAKE position (up).

8. Turn on power to the control. Turn on the control circuit breaker (enclosed models). The green POWER ON and red BRAKE LED indicators on the printed circuit assembly should be lighted on chassis versions but only the BRAKE indications will light on the enclosed versions. The others should be off. The POWER ON pilot light on the cover of an enclosed model should be on.

9. Momentarily close the RUN circuit. On enclosed models use the RUN switch on the front cover. The yellow RUN LED indicator should turn on and the red BRAKE indicator on the printed printed circuit assembly should turn off.

10. Momentarily open the STOP circuit. The RUN LED should turn off and the BRAKE LED should turn on.

11. Close the JOG circuit. The switch on the cover of the enclosed model may be used for this. The RUN LED should be on and the BRAKE LED should be off while the JOG circuit is held closed.

12. Momentarily close the RUN circuit. The RUN indicator should turn on.

13. Momentarily open the OVERRIDE STOP circuit. The RUN indicator should turn off and the BRAKE indicator should turn on.

14. Momentarily close the JOG then the RUN circuits. The RUN indicator should not turn on and the BRAKE indicator should turn on.

15. Momentarily close the RESET circuit. The BRAKE indicator should turn off and the RUN indicator should remain off.

This completes the starting and stopping logic tests. The next group of steps test the timer. If the timer is not used these steps may be omitted. Test only the timer mode being used. *For automatic start following timed dwell switches "A" and "C" closed (up), "B" and "D" open (down).*

16. Turn on the timer. After the dwell time determined by timer control the yellow RUN indicator should turn on.

17. Open the STOP circuit momentarily. The RUN indicator should turn off for the dwell time set by the timer and then turn on again.

For automatic stop following run switches "A" and "C" open (down), "B" and "D" closed (up).

18. Turn on the timer.

19. Momentarily close the RUN circuit. The yellow RUN indicator should turn on for the length of time set by the timer then turn off again.

This completes testing for the timer.

20. Move the COAST-BRAKE switch to the COAST position (down).

21. Momentarily close the RUN circuit. Slowly turn the SPEED CONTROL knob clockwise. The motor should start turning smoothly and increase speed as the control is turned further clockwise. Check for smooth operation at all speeds and during acceleration.

22. Verify the motor is turning the correct direction. If not, stop the drive, turn off power, and reverse the A+ and A– connections either at the drive or at the motor. Retest direction.

23. With the motor running at or near full speed, momentarily open the STOP circuit. The motor should coast smoothly to a stop.

24. Start the control and again allow the motor to reach some high speed.

25. Turn off AC power to the control. The motor should brake abruptly to a stop.

26. Turn power back on. The motor should not start turning.

27. Move the COAST-BRAKE switch to the BRAKE position (up). Start and stop the control. The motor should brake abruptly to a stop.

28. Turn off power. If an external OVERRIDE STOP circuit is to be used remove the jumper between OVERRIDE STOP and COMMON, otherwise leave it jumpered permanently. Remove the stop jumper. Recouple the motor to the equipment. Set the COAST-BRAKE switch to the desired position. This completes the start up checkout procedure.

ADJUSTMENTS AFTER START-UP

MAXIMUM SPEED ADJUSTMENT

This setting has been factory adjusted. However, if a higher or lower setting is required:

1. Start motor and allow it to warm up at least 30 minutes, fully loaded. (Motor speed will increase with a rise in motor temp. unless using tach feedback).
2. With motor driving a full load the speed pot turned all the way up, adjust the max. speed trimpot until desired speed is set. Clockwise increases speed.
3. Check the minimum speed adjustment, as there may be some interaction.

MINIMUM SPEED ADJUSTMENT

1. Turn speed adjustment potentiometer to minimum.
2. Start control and adjust the MIN trimpot on the printed circuit assembly 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. Clockwise increases speed.
3. Re-check MAX adjustment, as some interaction is probable.

CURRENT LIMIT

The current limit (I LIM) trimpot is located near the MIN trimpot. The point at which the control starts current limit is identified by the red I LIM indicator turning on. There are two methods of setting this:

METHOD 1;

Turn off AC power and lock up the motor shaft in such a way that no damage will occur. Connect a DC ammeter in series with the motor armature. Turn the current limit trimpot fully counter-clockwise. Turn on AC power. Start the control and turn the SPEED CONTROL knob up to about 1/3 speed. Adjust the I LIM pot for the desired motor current. Do not set for current greater than the motor or control nameplate rating. Clockwise rotation increases current limit setting. Turn off AC power, disconnect the ammeter and unlock the motor shaft.

METHOD 2;

Start the machine and apply maximum load. Turn the I LIM trimpot counter-clockwise until the red I LIM indicator starts to turn on and the machine starts to slow down. Turn the I LIM adjustment back clockwise until the I LIM indicator just turns off.

TROUBLE SHOOTING

MOTOR WILL NOT RUN

1. Make sure circuit breaker, when provided, and line disconnects are turned on.
2. Check line fuses to see if they are good.
3. Make sure override stop is closed and reset.
4. Make sure speed is not turned to zero.
5. With power OFF and motor leads disconnected, check for worn or improperly seated motor brushes.
6. Faulty printed circuit assembly, go through start up procedures and check indicators.

CIRCUIT BREAKER TRIPPING

1. Improper wiring, recheck wiring for misrouting, shorts, and shorts to ground.
2. Motor brushes worn or improperly seated.
3. Motor load is too heavy. Check for "jam-up", or excessive load.
4. Power module failure. (See test on page 14).

NO SPEED CONTROL AND/OR ZERO SPEED

1. Speed control potentiometer or wiring defective.
2. Make sure OVERRIDE STOP is closed and reset.
3. Faulty printed circuit assembly.

MOTOR RUNS AT VERY LOW SPEED

1. Motor limit may be over loaded;
2. Current limit may be set too low;
3. If BRAKE LED is on, motor was not allowed to stop before being restarted;
4. Brake resistor open;
5. Printed circuit assembly failure.

MOTOR WILL NOT RUN AT 1800 RPM

1. Improper setting of maximum speed potentiometer. Turn clockwise to increase speed.
2. Motor may be overloaded. (Motor horsepower is less than required for load).
3. Low line voltage.
4. Current limit set too low.

MOTOR COAST TO STOP (NO DYNAMIC BRAKING)

1. Coast/Brake switch position incorrect.
2. Brake resistor failure. (See test on page 14).
3. Printed circuit assembly failure. (Consult factory).

MOTOR JUMPS AFTER STOP AND BEFORE START SIGNAL

1. Consult factory.

MOTOR SPEED ERRATIC

1. Worn brushes.
2. Speed adjust potentiometer or associated circuit may be defective.
3. Erratic load changes.
4. Defective printed circuit assembly. (Consult factory).

MOTOR WILL NOT SHUT OFF WITH STOP COMMAND

1. Faulty wiring in control circuit.
2. Faulty printed circuit assembly. Go through start up procedure.
3. If motor runs at approx half speed or full speed during stop, power module failure. See page 14 for checking procedure.
   Always check motor and motor wiring before replacing a failed power module.

MOTOR WILL NOT STAY ON AFTER START COMMAND

1. Check wiring of Stop functions.
2. Faulty printed circuit assembly. Go through start up procedure.

PLEASE CALL OUR FACTORY FOR ANY FURTHER ASSISTANCE: 724-861-0150

TEST PROCEDURE FOR PRINTED CIRCUIT ASSEMBLY LOGIC

The following tests are to conclude that the printed circuit assembly is good or bad.

PREPARATION BEFORE LOGIC TEST

1. Turn OFF line disconnect, if this is a NEMA 12 version remount cover as shown in illustration on page 18.
2. Place Brake/Coast switch in Brake position (up).
3. Turn speed pot to zero speed.
4. Remove all connections to TB2 terminals on printed circuit assembly.
5. Place circuit breaker on control cover, when provided, in "ON" position.
6. Turn on line disconnect.
7. Green POWER ON light is on and red BRAKE light is ON.

CAUTION: LINE VOLTAGE IS PRESENT ON CIRCUIT BOARD AND MOTOR TERMINALS WHENEVER AC POWER IS ON EVEN IF THE MOTOR ISN'T TURNING.

LOGIC TEST

COAST/BRAKE SWITCH

Move COAST/BRAKE switch down to COAST position. No changes.

OVERRIDE STOP AND RESET

Place Jumper from OVERRIDE STOP to COMMON and STOP to COMMON. This should cause BRAKE Red light to go OFF. No other changes.

RUN

Momentarily short RUN to COMMON. This should cause RUN light, (yellow), to turn on.

STOP

Momentarily open STOP to COMMON. RUN light should turn off.

JOG

A closure from JOG to COMMON will cause the RUN light to turn ON and reopening will cause it to turn off.

TIMER (ONLY IF USED)

Do not perform this test if timer is not used. Add a jumper from TIMER to V+. Make a quick momentary closure from STOP to COMMON. Yellow RUN light will go off for about 1/2 second.

NOTE: If test results agree with above procedure, check external wiring for malfunction or consult factory.

TEST PROCEDURE FOR POWER COMPONENTS

The following tests are to conclude that the components are good or bad.

CAUTION: DISCONNECT ALL POWER FOR THE FOLLOWING TESTS.

POWER MODULE

1. Pull off all "fast on" connections. Set V.O.M. to R x 10K scale or DIODE scale if available.
2. Check resistance from both AC terminals to (+) terminal. 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 (or 1 diode) 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 50K (or 1 diode) in the other direction.

BRAKE SCR

1. Remove "fast on" connector from PCA terminals marked BK and A+.
2. Check resistance between PCA terminals BK and A+. Resistance should indicate open in both directions (greater than 1 Megohm).

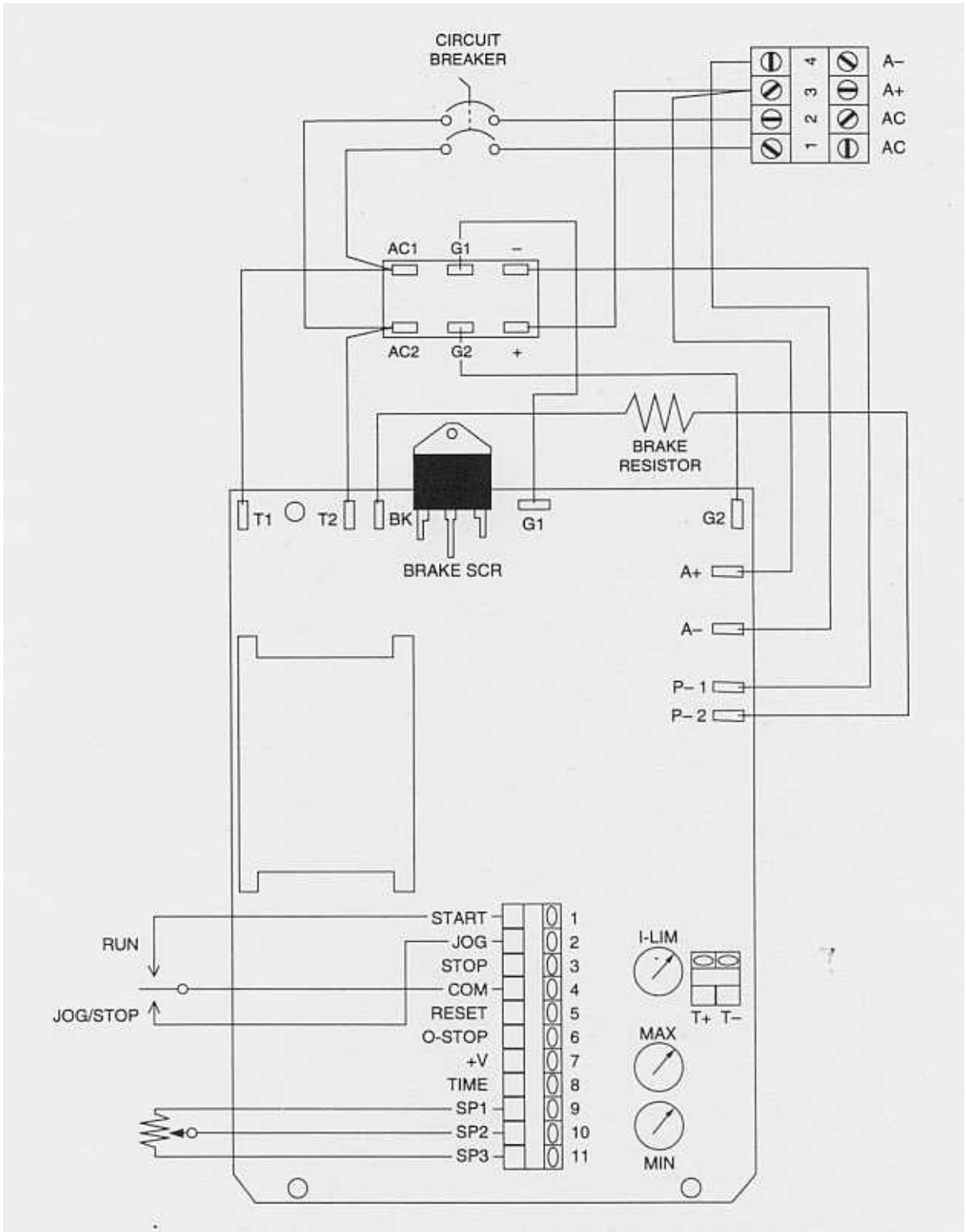
BRAKE RESISTOR

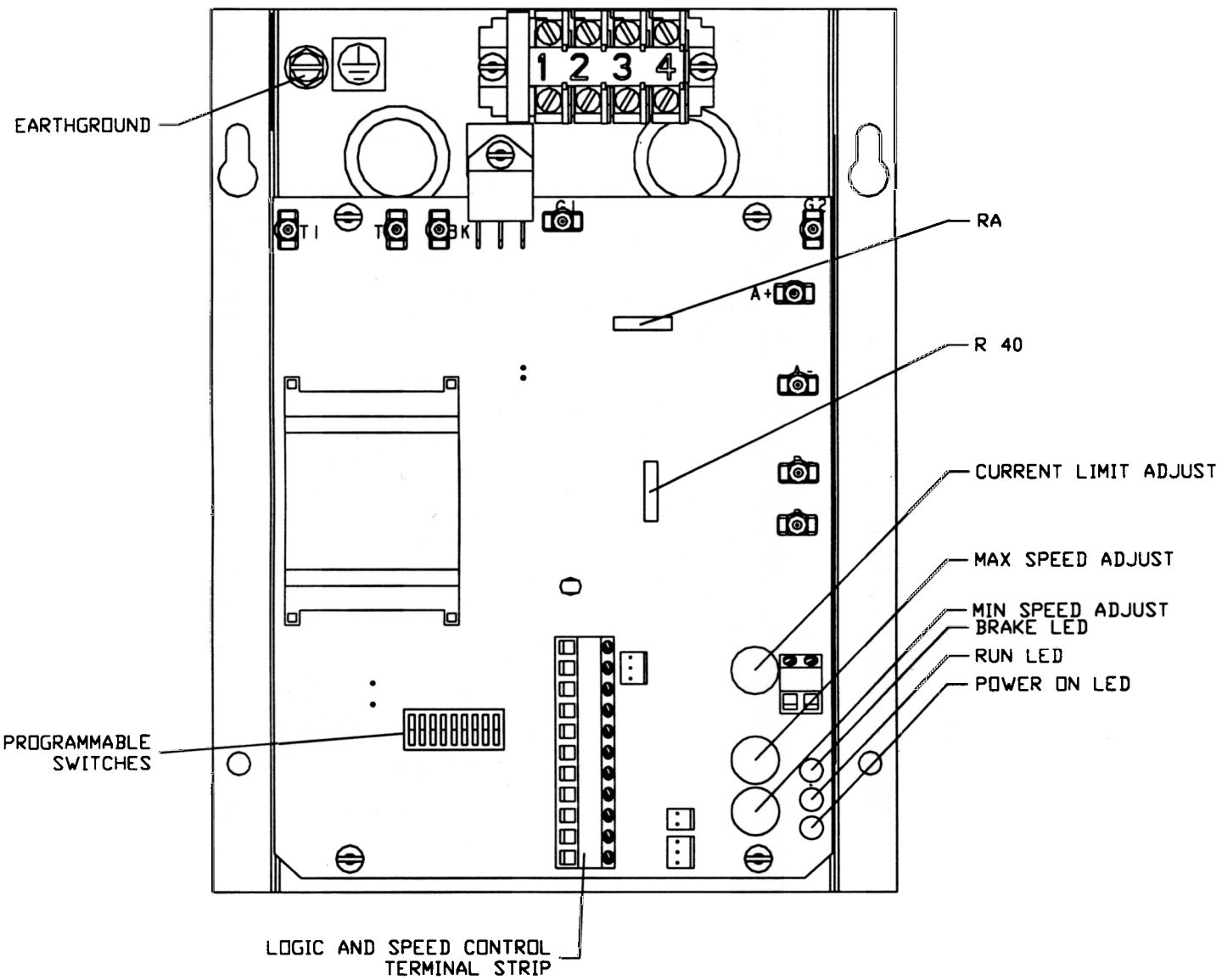
Remove "fast on" connections to resistor, set V.O.M. to R x 1 scale. Resistance should be approximately 4 ohms (note, for 176B8021 version, 18 ohms) from terminal to terminal and the open circuit from either terminal to case.

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

If test results agree with above procedure and your problem is not solved, please feel free to call our factory for assistance: 724-861-0150.

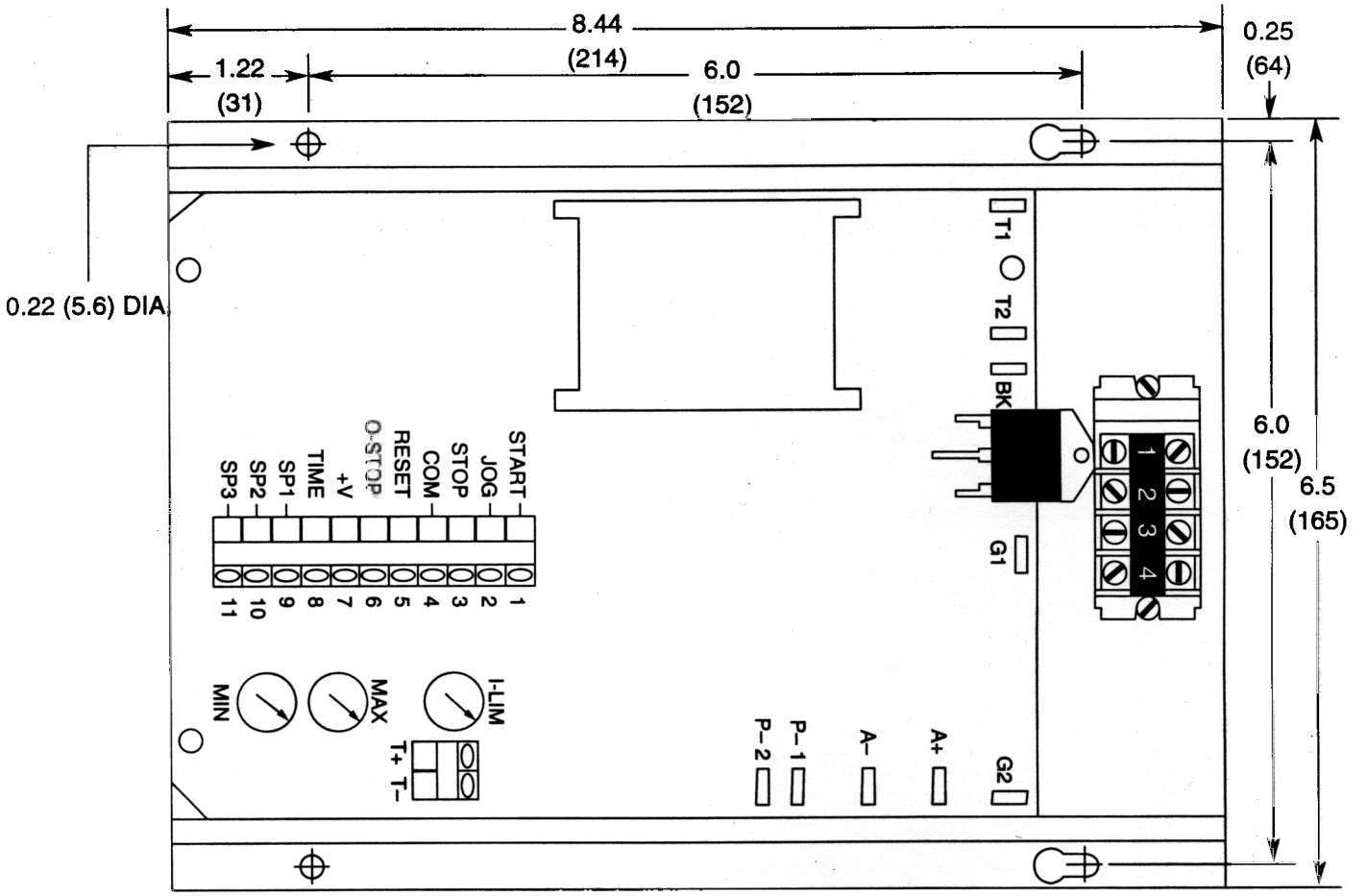
1/8 - 3 HP DIAGRAM

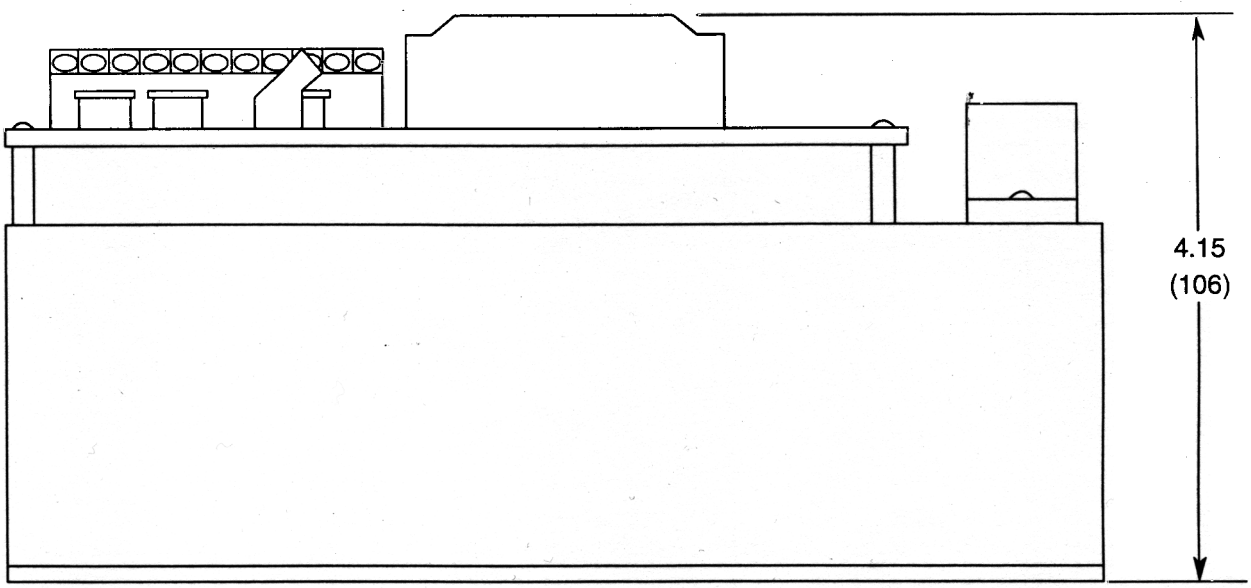


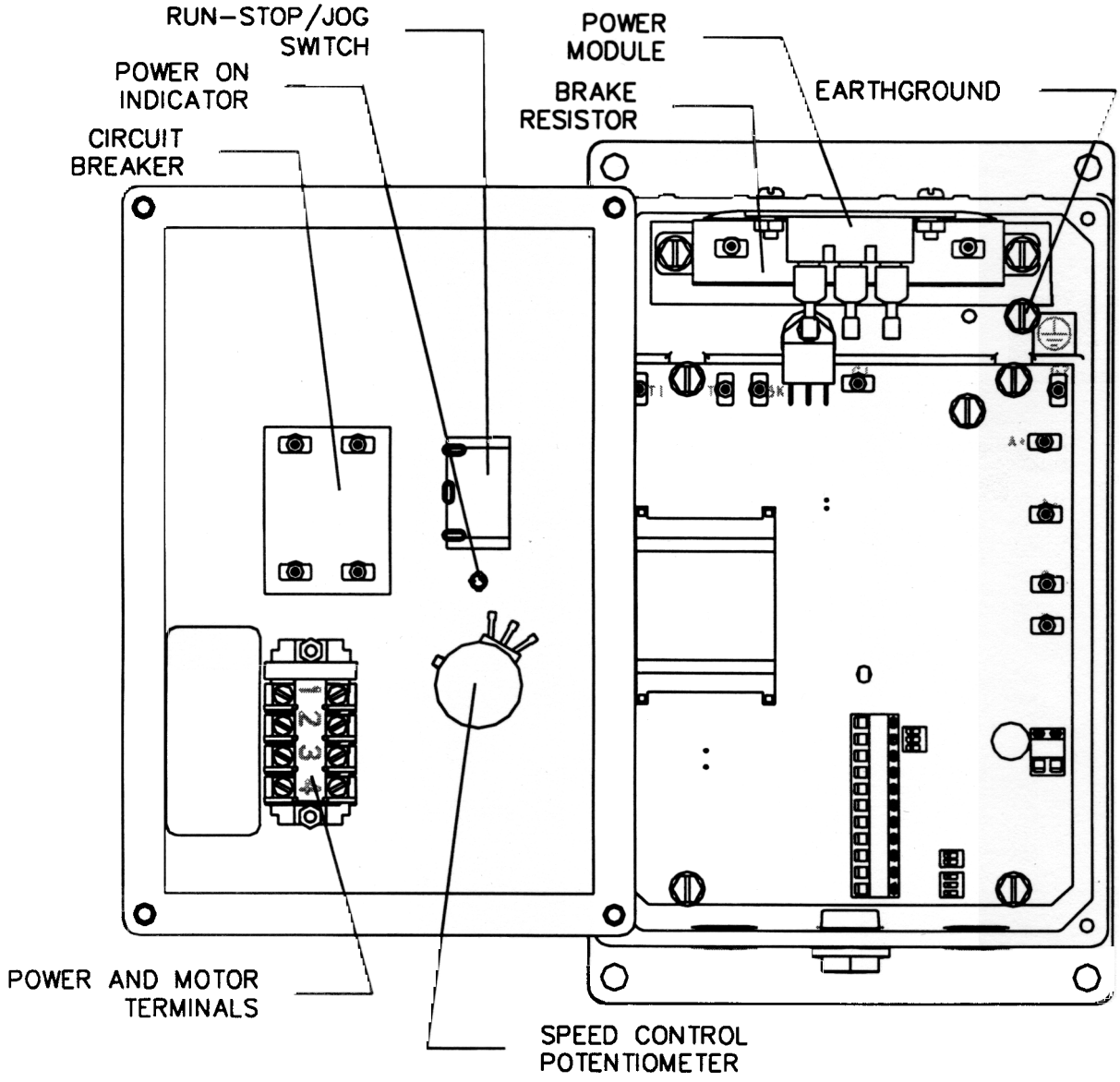

EARTHGROUND
1 2 3 4
RA
A+
R 40
CURRENT LIMIT ADJUST
MAX SPEED ADJUST
MIN SPEED ADJUST
BRAKE LED
RUN LED
POWER ON LED
PROGRAMMABLE SWITCHES
LOGIC AND SPEED CONTROL TERMINAL STRIP

CHASSIS DIMENSIONS

in inches and (mm)

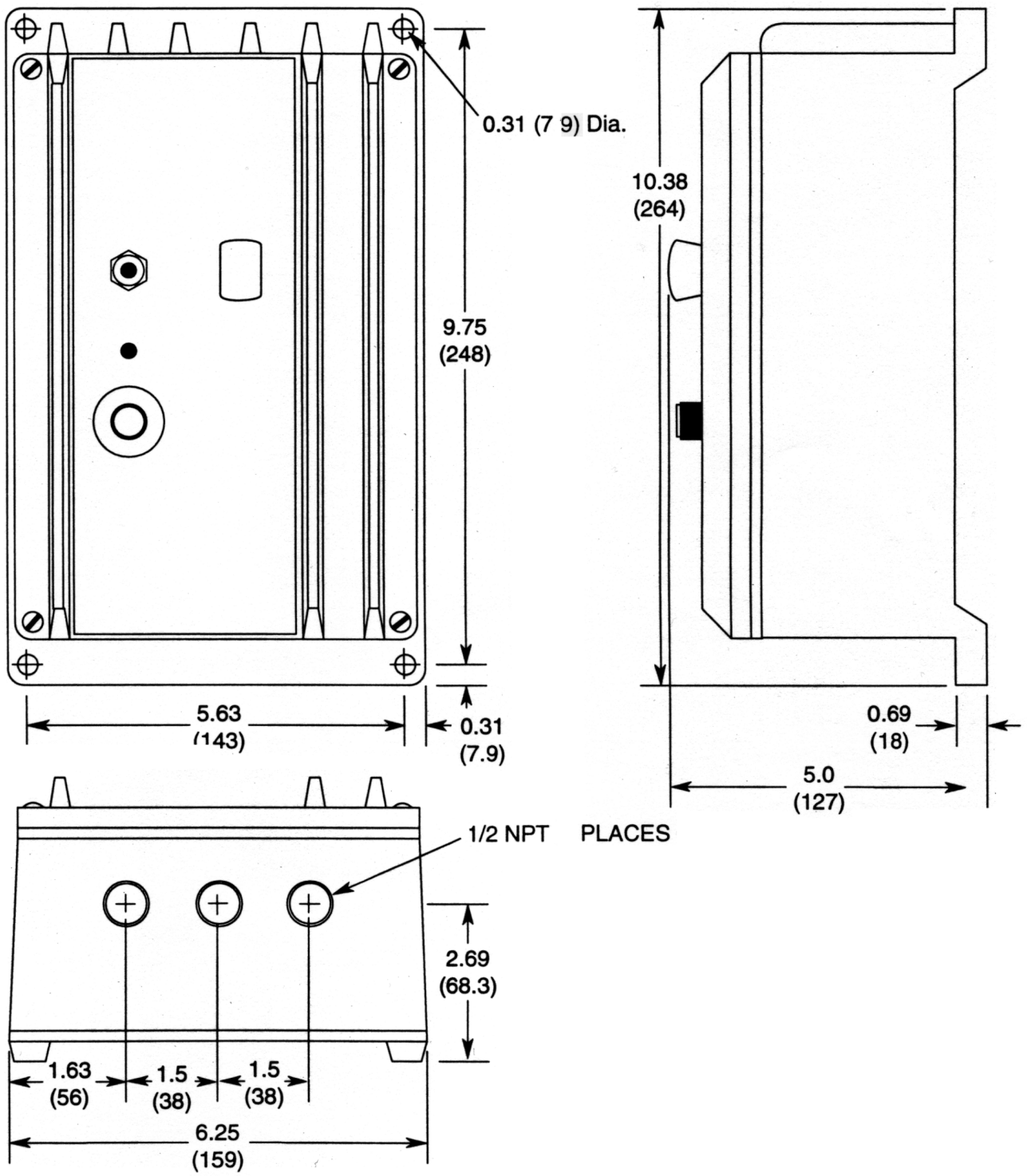





RUN–STOP/JOG SWITCH
POWER ON INDICATOR
CIRCUIT BREAKER
POWER MODULE
BRAKE RESISTOR
EARTHGROUND
POWER AND MOTOR TERMINALS
SPEED CONTROL POTENTIOMETER

ENCLOSUR DIMENSIONS

in inches and (mm)



RECOMMENDED AC LINE PROTECTION

The customer is responsible for branch circuit protection such as Bussmann FWX or exact equivalent according to the table below.
A circuit breaker by itself does not meet UL requirements for branch circuit protection or drive protection.

AC LINE VOLTAGE	MOTOR HP	SEMICONDUCTOR FUSES
120	1/8	4
	1/4	5
	1/3	8
	1/2	10
	3/4	15
	1	20
240*	1/8	2
	1/4	3
	1/3	4
	1/2	5
	3/4	8
	1	10
	1.5	15
	2	20
	3	30

* 240 VAC line requires protection in both AC lines.

NOTE:
The Cycletrol® 150 may be operated from AC lines having up to 5000 amp short circuit rating when protected by Bussmann FWX or exact equivalent fuses sized according to the table above. Use Bussmann FWX fuses or exact replacement only (Bussmann FWX series fuses comply with IEC 269-1 to -4.

REPLACEMENT PARTS LIST

PART DESCRIPTION	PART#
MOV, 120VAC	701
MOV, 240VAC	702
Brake Resistor for 176B6000-6005	926
Brake Resistor for 176B8021	9750
Circuit Breaker, 2 Pole, 25A, 240VAC, 3HP	2009
Circuit Breaker, 2 Pole, 10A, 240VAC, 1HP	2010
Circuit Breaker, 2 Pole, 15A, 240VAC, 2HP	2011
Circuit Breaker, 1 Pole, 20A, 120VAC, 1HP	20126
N12 Panel Lamp, 120 and 240VAC	2111
Diode Bridge	2335
SCR, Brake	2365
Power Module for 120 and 240VAC, 1 and 2HP	2385
Power Module for 240VAC, 3HP	2386
Speed Potentiometer & cable assembly	27531
Run/Jog Switch & cable assembly	27532
Printed Circuit Assembly, 1HP, 120VAC, N12	176B0070
Printed Circuit Assembly, 2HP, 240VAC, N12	176B0071
Printed Circuit Assembly, 3HP, 240VAC, N12	176B0072
Printed Circuit Assembly, 1HP, 120VAC, CHM	176B0073
Printed Circuit Assembly, 3HP, 240VAC, CHM	176B0074

CE

The European Union has introduced the CE label as a way of indicating that a product complies with the relevant EU directives, avoiding technical trade difficulties within European Free Trade Association (EFTA) and the EU. The directives of concern are:

- Machine Directive 89/392/EEC:
  All machines with critical moving parts are covered by the machinery directive. The CYCLETROL® 150 dc drive has no moving parts, and therefore does not fall under the machinery directive. However, if a dc drive is supplied for use in a machine, we will provide information on the safety aspects relating to the dc drive.
- Low Voltage Directive (LVD) 73/23/EEC:
  DC drives must be CE labeled in accordance with the low voltage directive. This directive applies to all electrical equipment and appliances used in the voltage range from 50 to 1000 volts ac and from 75 to 1500 volts dc.
- Electromagnetic Compatibility (EMC) Directive 89/336/EEC:
  Compliance with the EMC directive means that the mutual interference among different components / appliances is so small that the functioning of the components / appliances is not affected. The directive distinguishes among components, appliances, systems, and installations.

CYCLETROL® 150 part numbers 176B6000, 176B6001, 176B6002, 176B6003, 176B6004,176B6005, and 176B8021 are CE labeled in accordance with the low voltage directive and the EMC directive. A CYCLETROL® 150 complies with all applicable requirements of these directives when properly installed using the recommended ac line filter, shielded motor cable, shielded control cable, and proper grounding.

WARNING:
The Cycletrol® 150 motor controller contains dangerous voltages when connected to line voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the controller may cause equipment failure, serious injury or death. Follow this manual and National Electrical Codes and local safety codes.

EMC

The installer is responsible for the final EMC properties for the installation. The CYCLETROL® 150 contribution to the overall EMI environment will be within the EMC directive limits of the following recommendations:

For the IP00 / chassis versions of the drive to meet Class B:

- The CYCLETROL® 150 is to be installed on a well grounded (earthed) bare metal back panel inside a grounded metal enclosure;
- The ac mains filter, part number 176B6050, is to be mounted to the grounded bare metal back panel as close as possible to the Cycletrol® 150 ac mains terminal;
- The shielded (screened) motor cable should be as short as possible and must not exceed 80 feet (25m) in length. The shield on the motor cable should be grounded as close as possible to the cable entrance into the enclosure and should also be grounded to the motor frame in the motor junction box;
- Shield grounding should be clamps or cable hardware that engages the circumference of the shield. If pigtails are used, make them as short and direct as possible;
- If external controls are used, a screened cable, not to exceed 4 feet (1.2m) in length is to be used to connect the external controls to the drive enclosure;
- Cables with sensitive signals should be routed separately from motor cables and power cables. A spacing of at least 8 inches (200mm) is a recommended minimum, more if possible or if the cables are parallel over a substantial distance. Signal cables should not share a conduit or wire way section with motor cables or power cables;
- If cables with sensitive signals must cross motor cables, they should cross at an angle of 90°;
- The enclosure cover is to remain closed during normal operation.

For the IP54 / NEMA 12 versions of the drive to meet Class B:

- The CYCLETROL® 150 is to be installed on a grounded bare metal surface;
- The ac mains filter, part number 176B6050, is to mounted to a well grounded bare metal back panel in a suitable metal enclosure installed on the same bare metal surface as the dc drive. The surface of this enclosure should also be clean and bare (free of paint) for good RF electrical contact with the bare metal surface to which it is mounted. This enclosure must be located as close as possible to the CYCLETROL® 150. AC from the filter output should be connected to the dc drive using a shielded (screened) mains cable as short as possible. The shield on this power cable should be grounded at each end and as close as possible to the cable entrance into the enclosure;
- Shield grounding should be clamps or cable hardware that engages the circumference of the shield. If pigtails are used, make them as short and direct as possible;
- The shielded (screened) motor cable should be as short as possible and must not exceed 80 feet (25m) in length. The shield on the motor cable should be grounded as close as possible to the cable entrance into the enclosure and should also be grounded to the motor frame in the motor junction box. See preferred grounding preceding;
- If external controls are used, a screened cable, not to exceed 4 feet (1.2m) in length is to be used to connect the external controls to the drive enclosure;
- Cables with sensitive signals should be routed separately from motor cables and power cables. A spacing of at least 8 inches (200mm) is a recommended minimum, more if possible or if the cables are parallel over a substantial distance. Signal cables should not share a conduit or wire way section with motor cables or power cables;
- If cables with sensitive signals must cross motor cables, they should cross at an angle of 90°;
- The enclosure cover is to remain closed during normal operation.

Tests have been conducted by a nationally recognized test laboratory to certify that the CYCLETROL® 150 complies with the following basic standards when properly installed as outlined:

1. Emissions:
   EN55011 Class A Group 1 and Class B Group 1
   a) Conducted • 2 power lines, 150Khz to 30MHz
   b) Radiated • 30MHz to 1000MHz
2. Immunity:
   a) IEC1000-4-4 2KV test level, Burst
      - power lines (Dir. Coupling Network)
        1 shielded motor cable
        1 unshielded motor cable
        1 shielded control clamp
        1 unshielded control cable
   b) IEC1000-4-5 power lines Surge
      2KV/12 ohm, CM
      1KV/2 ohm, DM
   c) IEC1000-4-2 Electrostatic Discharge
      Enclosure 6/8KV
   d) IEC1000-4-3 Radiated Electromagnetic Field
      10V/m
   e) EN50141 RF-Common Mode voltage; 10Vrms CM
      - 2 power lines
        1 shielded motor cable
        1 unshielded motor cable
        1 shielded control clamp
        1 unshielded control cable

LVD

The installer is responsible for the following items to comply with the Low Voltage Directive:

- Double or reinforced insulation between the lower half of the circuit board, including control circuit terminal wiring, and the line (mains) wiring, the motor wiring and the tach terminal wiring when required by local codes (CE). This can be accomplished by using double or reinforced insulated wires or maintaining at least a .22 inch (5.5 mm) air gap between wires within the enclosure;
- Outputs are considered conditionally short circuit proof.

WARNING:
Residual current operated protected devices (RCD) are not recommended for use.

LINE FILTER OPTION

P/N 176B6050

Ratings:

240 VAC, 50/60 Hz
30 Amp
Single phase