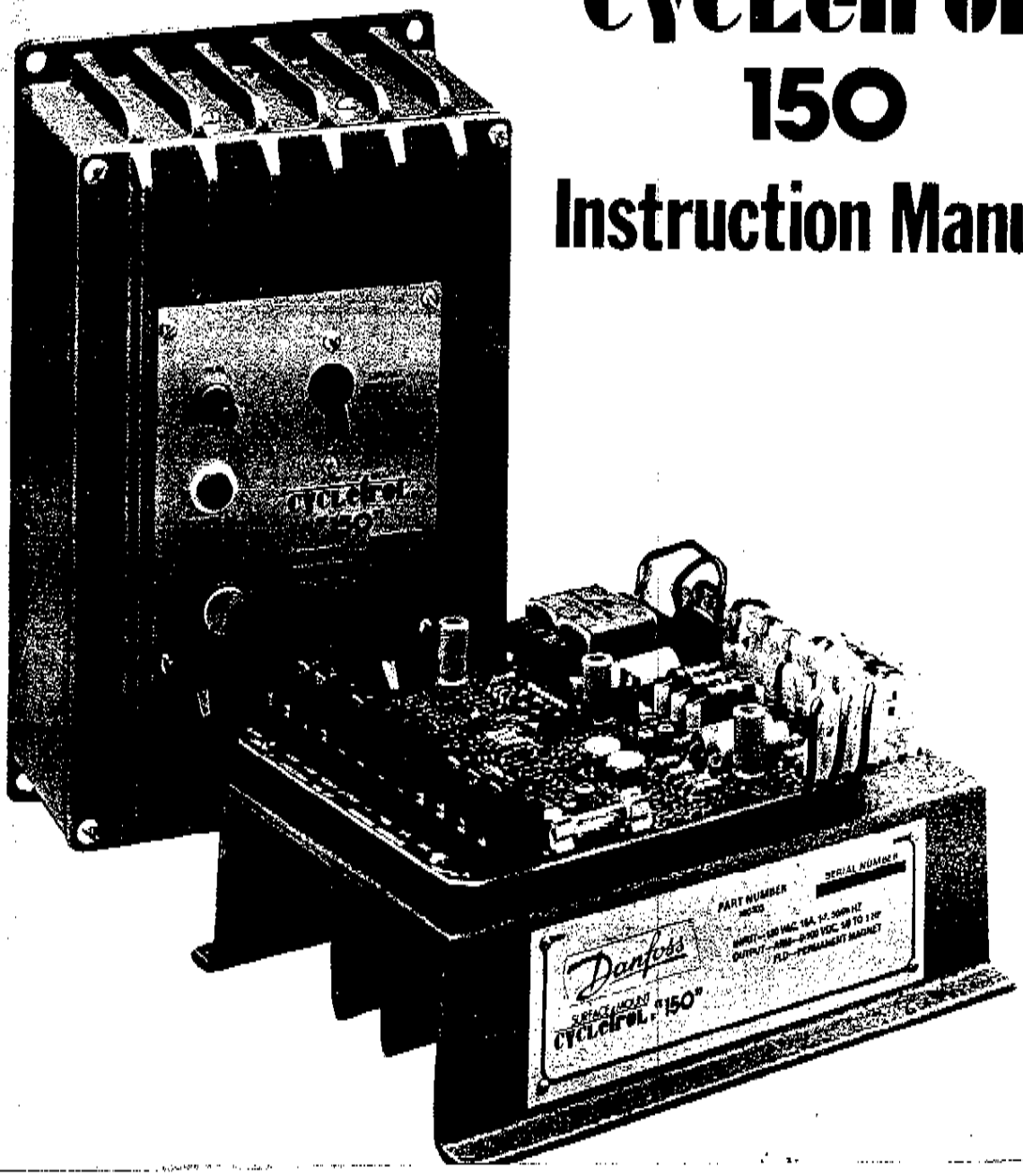
SURFACE MOUNT

cycletrol®

150

Instruction Manual



SURFACE MOUNT
cycletrol®
"150"

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This manual applies to serial number 607001 and after.

FOREWORD

The Cycletrol® 150 SM 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 motor 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, timed run, delayed start or delayed stop; and
7. Color coded light emitting diodes to indicate control actions.

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

SPECIFICATIONS

INPUT POWER	95 to 135VAC on 120VAC Models 195 to 260VAC on 240VAC Models 50/60 HZ Single Phase
OUTPUT	ARMATURE: 0-90VDC on 120VAC Models 0-10A ⅛-1HP 0-180VDC on 240VAC Models 0-10A or 0-15A ⅛-2HP or ⅛-3HP
ENCLOSURES AVAILABLE	Chassis or NEMA Enclosure
AMBIENT TEMPERATURE RANGE	0°to 50°C Chassis/ 0°to 40°C Enclosure
MOUNTING POSITION	Vertical Mounting
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	0-10V dc control signal input. Input Resistance-50K ohm. Also usable for 1-5 MA, 4-20 MA, 10-50 MA with external resistor (must be isolated).
TACHOMETER GENERATOR FEEDBACK INPUT	21VDC/1000 RPM
SPEED VARIATIONS DUE TO LINE VOLTAGE 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 Tach. Feedback: Less than 1%.
SPEED VARIATIONS DUE TO LOADING (90% LOAD CHANGE)	Armature Feedback: Typical application 5% of full speed. Tachometer Feedback: Less than ±½% of Set Speed or 4 RPM, whichever is greater.
MAX CYCLE RATE	⅛-1 HP, 60 cycles per min. 1½-3 HP, 30 cycles per min. If load inertia exceeds motor inertia, consult factory.
MAX RUN SPEED	Adjustable from approx. 1/2 to full speed.
MIN RUN SPEED	Adjustable from approx. 0 to 1/2 of full speed.
ACCELERATION	Fixed at approx. 0.20 sec. Nonlinear. Other times are available. Consult factory.
CURRENT LIMIT	Adjustable from near 0-125% of full rated output. Four times setting permitted for .2 seconds during starting acceleration.

OPERATIONAL CHARACTERISTICS

EXTERNAL CONTROLS

START: (Terminals 1 & 4, Normally Open Contact)

A start contact closure latches the Cycletrol 150 SM 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: (Terminals 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 board. See page 5.

Cycletrol 150 SM's are shipped from the factory with the "J" and "O" switches closed (up).

JOG: (Terminals 2 & 4, Normally Open Contact)

A contact closure in JOG causes a Cycletrol 150 SM to go into the RUN mode and lights the RUN LED (yellow) as long as this contact is closed. Jog does not latch. The Cycletrol 150 SM 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 Contact)

OVERRIDE STOP is an alternate means of stopping the Cycletrol 150 SM. OVERRIDE STOP always overrides a START, JOG, or a timer generated START command. A momentary contact opening of "O" OVERRIDE STOP latches the Cycletrol 150 SM 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 SM.

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 an 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. This generally requires gold contacts. Pilot duty contacts (silver cadmium) may not operate reliably.

Solid state devices may be used to operate these circuits provided they meet the following specifications:

1. 30 VDC maximum
2. 13 mA DC maximum
3. OFF state leakage less than 1 mA.

Logic inputs only are floating, terminal #4 (COMMON) may be grounded. Terminals 9, 10, 11, 12 are hot to ground.

Enclosed controls have a START-JOG/STOP switch on the cover wired to the START and 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.

OPERATIONAL CHARACTERISTICS (cont.)

SPEED CONTROL: The Cycletrol® 150 SM provides for 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 2K ohm, 1/2 watt resistor; for 4-20 mA, use a 500 ohm, 1/2 watt or for 10-50 mA, use a 200 ohm, 1 watt resistor. Set the "P" switch in the close (up) position, this will allow the Cycletrol® 150 SM to zero speed with these process signals.

TACHOMETER FEEDBACK: For applications requiring tighter regulation and/or wider speed range for full torque, the Cycletrol® 150 SM can accept an analog tachometer feedback signal. By removing the RA resistor, (See page 17 for location) a 20.8 VDC/1000 RPM tach can be used for close-loop operation. The tach's positive (+) lead should be wired to terminal 12, with the negative (-) going to terminal 11. It is recommended to use shielded wire for the tach, with the shield tied to earthground only at the Cycletrol® 150 side.

WARNING: TERMINALS SP1, SP2, SP3, & T+ ARE AT LINE POTENTIAL AND MAY BE HOT TO GROUND. ISOLATION MUST BE PROVIDED WHEN USING PROCESS SIGNALS.

TIMER:

Most applications 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 board. The range is from zero to about 1/2 speed.

MAX SPEED: The speed corresponding to the 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.

INTERNAL CONTROLS (cont.)

CURRENT LIMIT: The Cycletrol® 150 SM 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 125% of control rating. This circuit will not affect the motor speed until the motor current (loading) increases to the set point. When the motor load 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 an acceleration inrush of approximately four times the current limit setting. This extra inrush allows faster cycling and may be defeated by removing resistor R41 when not desired (see page 17 for location).

PROGRAMMABLE SWITCH Several switches have been designed into the Cycletrol 150 SM 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 board to the COAST position. This allows the moter to coast to a stop following JOG or STOP operations. OVERRIDE STOP or POWER OFF will always operate the brake 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 an external circuit or by OVERRIDE STOP. The control is shipped with this switch closed (up), and with a jumper installed between terminals 4 and 8, which will need to be removed to use the timer function.

A, B (TIMER FUNCTION) 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.

C, D (TIMER FUNCTION) The action initiating the timer interval is selected by these switches. Normal factory shipments have "C" and "D" switches in the open (down) position. For an automatic restart after a delay 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.

J (STOP FUNCTION) The "J" switch, when closed (up) causes an open contact at the STOP terminal to continuously create a STOP command. Opening (down) the "J" switch causes a STOP command to be only on the transition of an opening contact at the STOP point. Normal factory shipments have "J" switch closed (up).

Cycle on demand applications using limit switches to STOP are made easier by opening (down) the "J" switch. This converts the opening of the STOP circuit to a momentary STOP signal. The Cycletrol 150 SM will then accept a START command, even if the equipment stops in a position that holds the stop limit switch open.

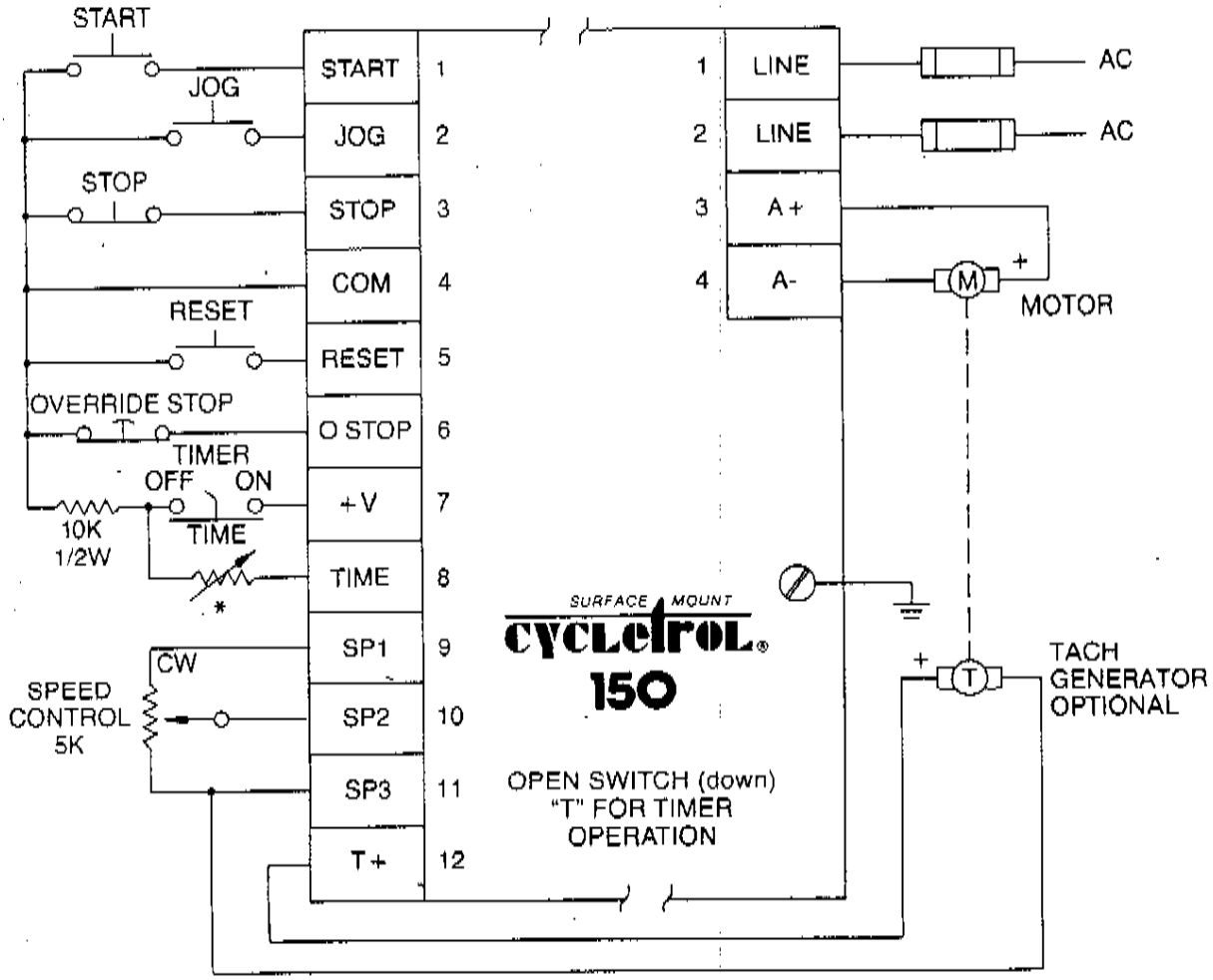
O (LOGIC PRIORITY) The "O" switch, when closed (up), causes a STOP command to override START, or JOG. Opening (down) the "O" switch causes a START or JOG command to override STOP. Normal factory shipments have "O" switch closed (up).

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.

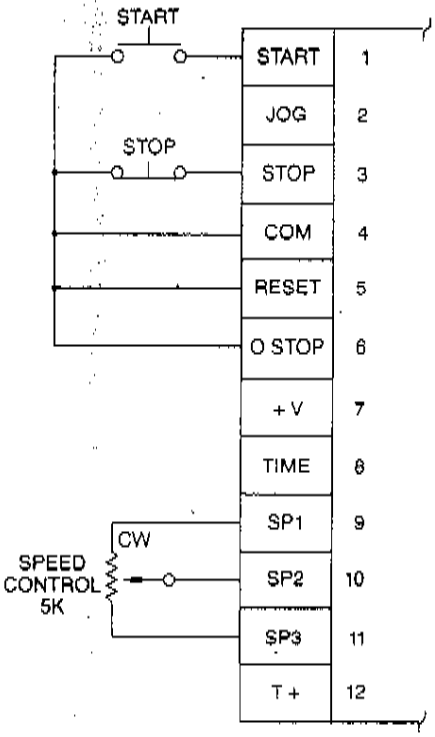
TYPICAL SPEED CONTROL APPLICATION



WARNING: SP1, SP2, SP3 & T+ INPUTS ARE AT LINE POTENTIAL AND MAY BE HOT TO GROUND. ISOLATION MUST BE PROVIDED.

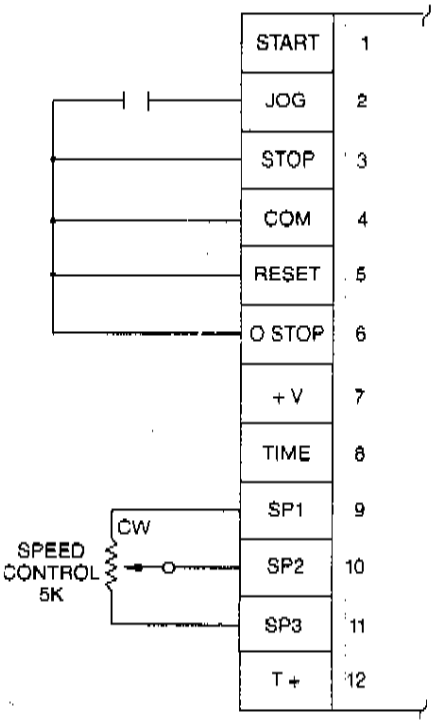
This circuit shows the use of all functions and tach feedback. Many applications do not require all these features. All features need not be connected. The OVERRIDE STOP terminal must be jumpered to the COM terminal if the OVERRIDE STOP feature is not used.

*Note: See page 4 for details on resistance sizing.



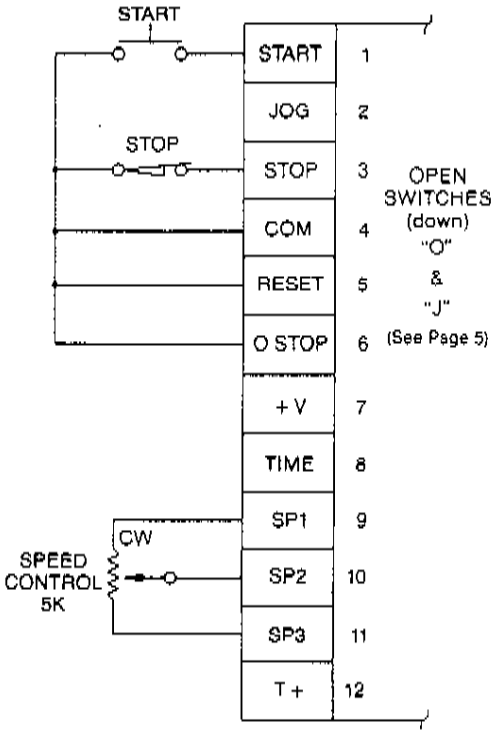
3-WIRE SPEED CONTROL

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



BASIC SPEED CONTROL

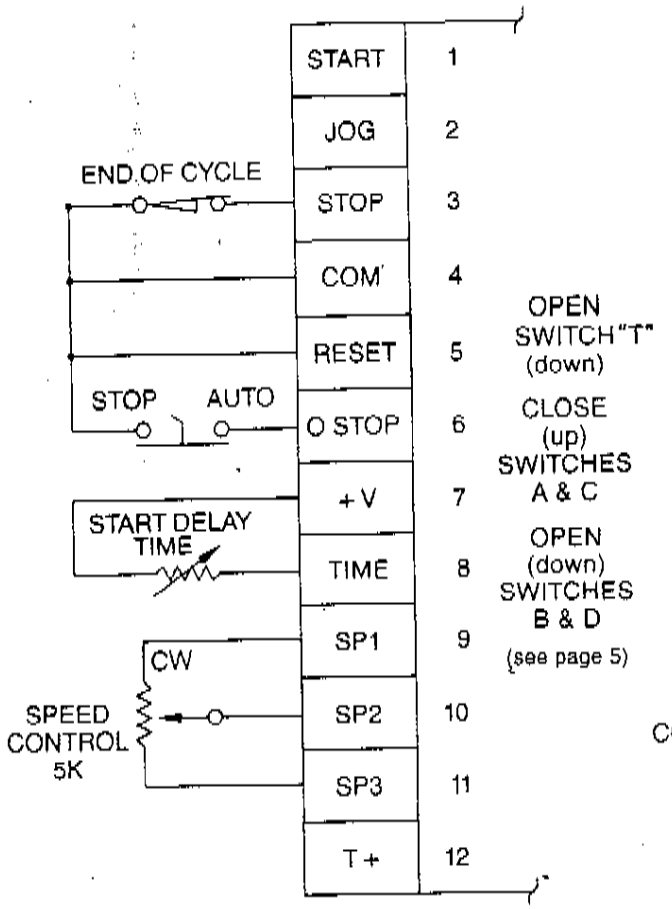
- Control RUNS/STOPS from a single input command.
- Closure on JOG puts Cycletrol into a RUN mode.
- Opening the JOG produces a STOP command.



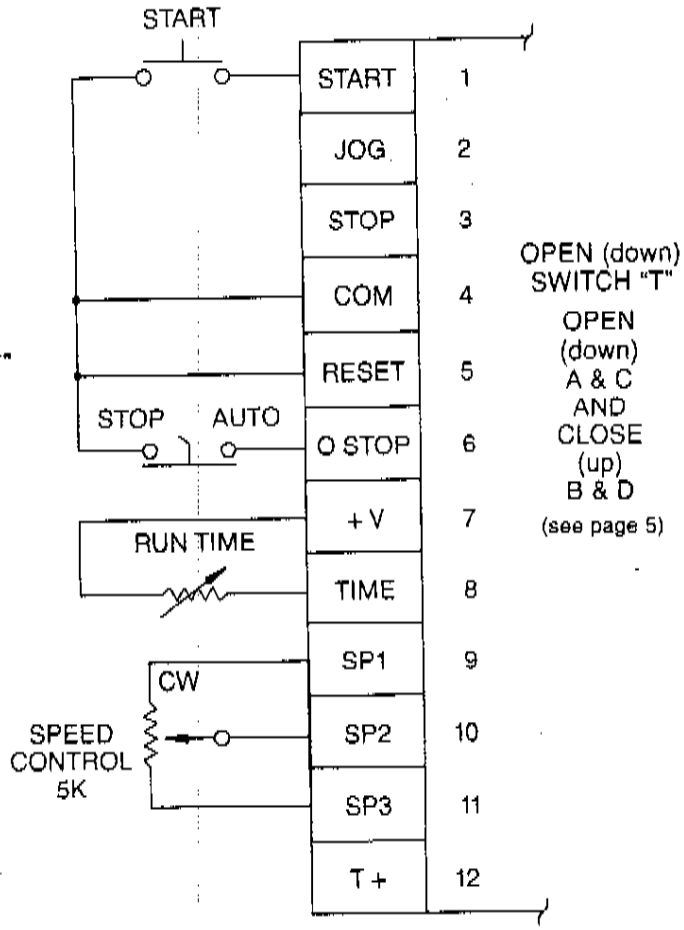
BASIC CYCLE ON DEMAND

- 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: SP1, SP2, SP3 & T+ INPUTS ARE AT LINE POTENTIAL AND MAY BE HOT TO GROUND. ISOLATION MUST BE PROVIDED.



TYPICAL AUTOMATIC CYCLE – TIMED DWELL BETWEEN CYCLES WITH AUTOMATIC START



TYPICAL AUTOMATIC CYCLE – TIMED RUN FOLLOWING START

WARNING: SP1, SP2, SP3 & T+ INPUTS ARE AT LINE POTENTIAL AND MAY BE HOT TO GROUND. ISOLATION MUST BE PROVIDED.

INSTALLATION

1. **WARNING:** IMPROPER INSTALLATION OF MOTOR AND CONTROLLER MAY CAUSE PERSONAL INJURY OR DEATH 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.

2. A fused disconnect, or circuit breaker, in incoming AC power is required. See page 21 for recommended fuse or circuit breaker ratings. The circuit breaker included in the enclosed models meets code requirements in many cases.

3. The Cycletrol® 150 SM 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.

4. All electronic controls are subject to line spikes and noise generated by equipment such as arc welders, solenoids, dielectric heaters, etc. Danfoss has provided all of 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 controller. Shields must be insulated and should be connected to the logic common terminal (4).

5. To insure avoiding personal injury, use an AC line disconnect or circuit breaker to insure positive shutdown of controller and motor before working on this control or any equipment or machinery it is controlling.

6. When making internal adjustments on NEMA 12 controllers, (e.g. min./max. speed) remount cover upside down as shown in illustration on page 18.

7. When remote mounting speed adjust potentiometer and function switches, keep in mind the SP1, SP2, SP3 & T+ terminals are at rectified line potential with respect to ground, and accidental grounding will open fuse (F1) and control will go to OVERRIDE STOP mode, or open the speed pot, and drive control to max speed.

8. **GROUNDING:** IT IS IMPERATIVE THAT THE CONTROLLER ENCLOSURE, MOTOR AND REMOTE OPERATOR'S STATIONS (WHEN USED) BE CONNECTED TO BUILDING GROUND FOR THE SAFETY OF THE OPERATION PERSONNEL.

9. 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.

10. Terminals SP1, SP2, SP3, & T+ have high voltage with respect to ground present whenever AC power is turned on.

11. All remote connections to controller such as speed potentiometers, run circuits, and process signals should use shielded cable. Shields must be insulated and should be connected to the logic common terminal. These shields will have field voltage present whenever AC power is on.

12. The Cycletrol 150 SM 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).

13. 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.

14. Current limit is factory 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 smaller than the full control rating.

15. The SP2 terminal must never be disconnected and left open or "floating" when AC power is on or the motor may run at any speed.

START-UP PROCEDURE

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. Indicators, switches, and adjustments on the printed circuit board are labelled. Illustrations located in the back of the manual show locations.

1. With AC power disconnected or turned off outside the control, remount cover upside down as shown in illustration on page 18 (enclosed models).
2. 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.
3. Set SPEED CONTROL to Zero speed.
4. Jumper O STOP and STOP to COMMON.
5. Switch off timer. (If installed)
6. Move the COAST-BRAKE switch to the BRAKE position (up).
7. 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 circuit board should be on. The other two should be off. The POWER ON pilot light on the cover of an enclosed model should be on.
8. 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 circuit should turn off.
9. Momentarily open the STOP circuit. The RUN LED should turn off and the BRAKE LED should turn on.
10. 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.
11. Move the COAST-BRAKE switch to the COAST position (down). Repeat steps 8-10. The RUN LED indicator should be on and off as before but the BRAKE LED should stay off throughout this repeated sequence.
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 not turn off.
15. Momentarily close the RESET circuit. The BRAKE indicator should turn off, but 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" & "C" closed (up), "B" & "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 timed run switches "A" & "C" open (down), "B" & "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.

The last part of the checkout procedure involves running the motor. If equipment operation is not desired it will be necessary to uncouple the motor by pulling off the belts or disengaging the shaft coupling or some other appropriate means. If the motor is lying loose on the floor it will roll around a lot during this test unless solidly blocked.

CAUTION: This may cause electrical wiring to short to ground or endanger the operator!

20. 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.
21. With the motor running at or near full speed, momentarily open the STOP circuit. The motor should coast smoothly to a stop.
22. Start the control and again allow the motor to reach some high speed.
23. Turn off AC power to the control. The motor should brake abruptly to a stop.
24. Turn power back on. The motor should not start turning.
25. Move the COAST-BRAKE switch to the BRAKE position (up). Start and then stop the control. The motor should brake abruptly to a stop.
26. 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 and 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 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. Clockwise increases speed.
3. Recheck 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 D.C. 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, disconect 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

SYMPTOM	SOLUTION
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 circuit board. 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 – Page 14).
NO SPEED CONTROL AND/OR ZERO SPEED	1. Speed control potentiometer or wiring defective. 2. Check fuse F1 to see if it is good. 3. Make sure OVERRIDE STOP is closed and reset. 4. Faulty circuit board.
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. Circuit board 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 circuit board. (Consult Factory)
MOTOR WILL NOT SHUT OFF WITH STOP COMMAND	1. Faulty wiring in control circuit. 2. Faulty circuit board. Go through start up procedure.
MOTOR WILL NOT STAY ON AFTER START COMMAND	1. Check wiring of Stop functions. 2. Faulty circuit board. Go through start up procedure.

PLEASE FEEL FREE TO CALL OUR FACTORY FOR ASSISTANCE: 815/398-2770

TEST PROCEDURE FOR CIRCUIT BOARD LOGIC

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

Preparation Before Logic Test

1. Turn OFF line disconnect and 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 barrier strip terminals on circuit board.
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 then momentarily short RESET 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 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: 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. 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 50K in the other direction.

*5. Check resistance from (+) terminal to BK terminal. Resistance should be greater than 1 Meg ohm in either direction.

BRAKE **SCR

1. Remove "fast on" connections from SCR to circuit board. Set V.O.M. to R X 10K scale.
2. Check resistance across the two largest terminals on SCR. Resistance should be greater than 1 Meg ohm in either direction.

BRAKE RESISTOR

Remove "fast on" connections to resistor, set V.O.M. to R X 1 scale. Resistance should be approximately 4 ohms.

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: 815/398-2770 or 1-800-4DANFOSS.

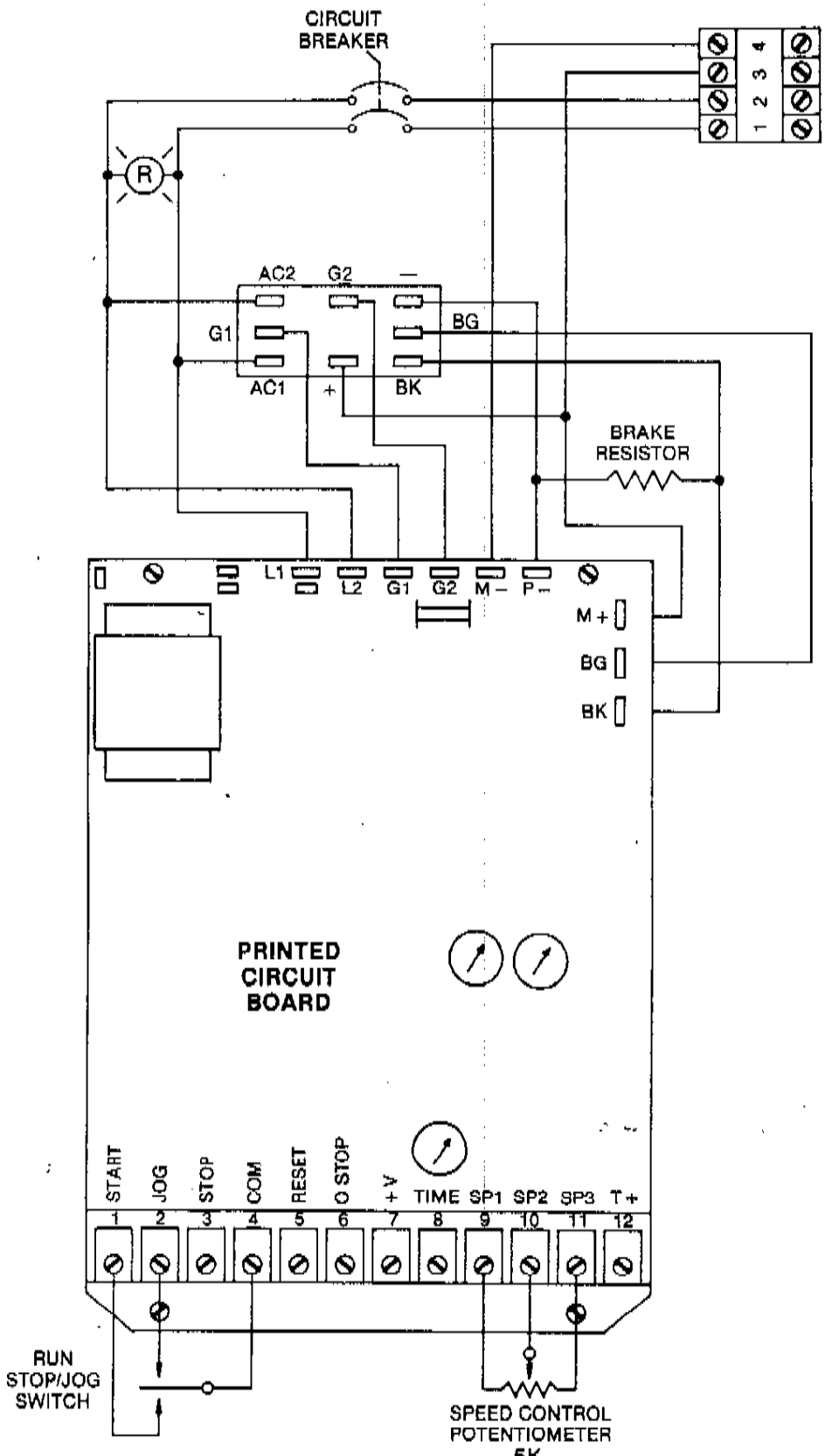
CYCLETROL® "150 SM" REPLACEMENT PARTS LIST

Part Description	Part Number
Brake Resistor	926
Brake SCR	2302
Power Module for 240 VAC, Input Power, 3 HP	2306
Power Module for 240 VAC, Input Power, 2 HP	2336
Power Module for 120 VAC, Input Power, 1 HP	2336
Speed Potentiometer	943
Circuit Breaker to 1 HP, 240 V Unit	2010
Circuit Breaker to 2 HP, 240 V Unit	2011
Circuit Breaker to 3 HP, 240 V Unit	2012
Circuit Breaker to 1/3 HP, 120 V Unit	2008
Circuit Breaker to 2/3 HP, 120 V Unit	2007
Circuit Breaker to 1 HP, 120 V Unit	2006
Run/Jog Switch	2211
3 AG Fuse (F1) .1 Amp rating (100mA)	2035

*Applies on 1/8 HP - 2 HP
**Applies on 3 HP

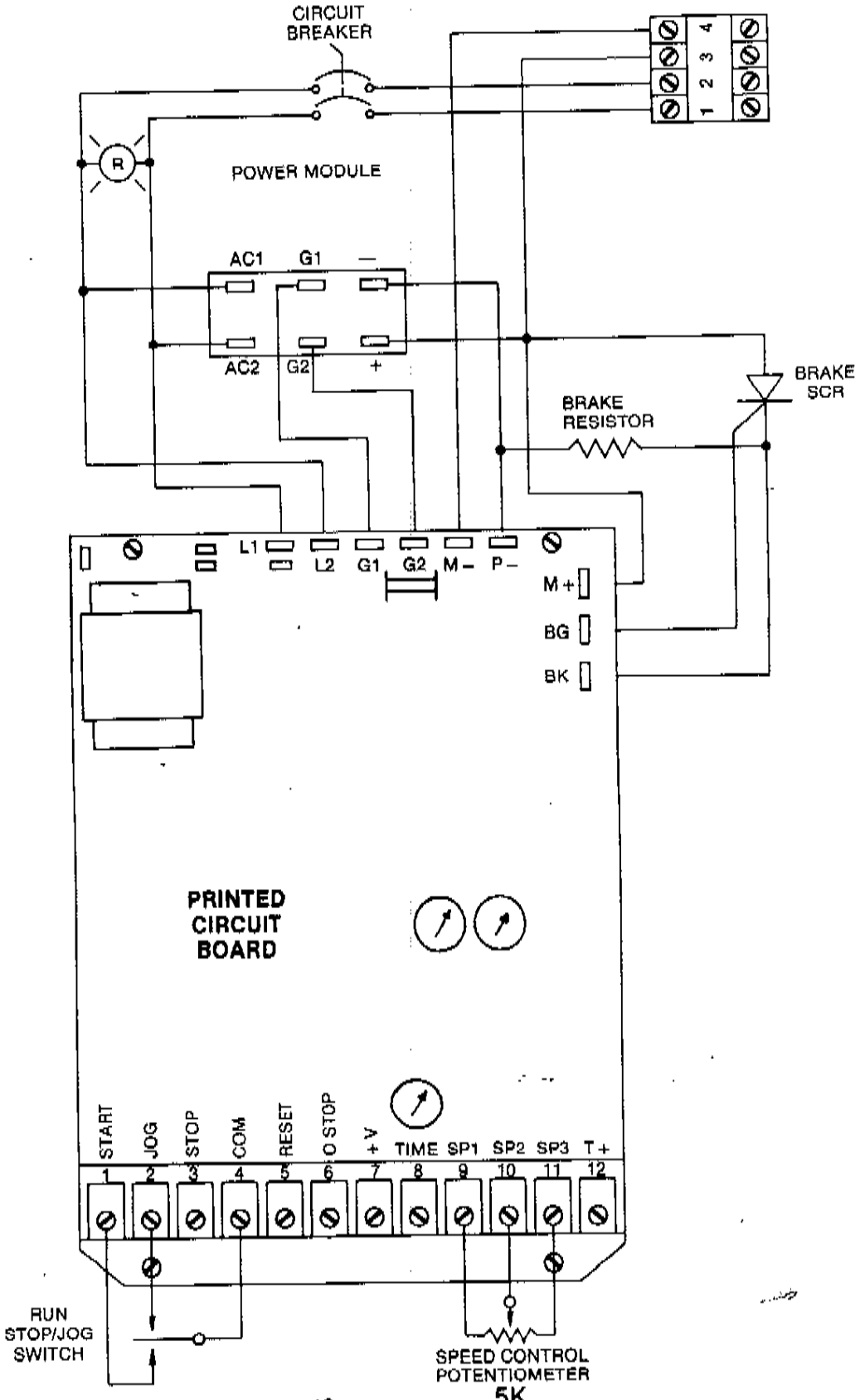
SURFACE MOUNT
cycletrol®
150

1/8 - 2 HP DIAGRAM

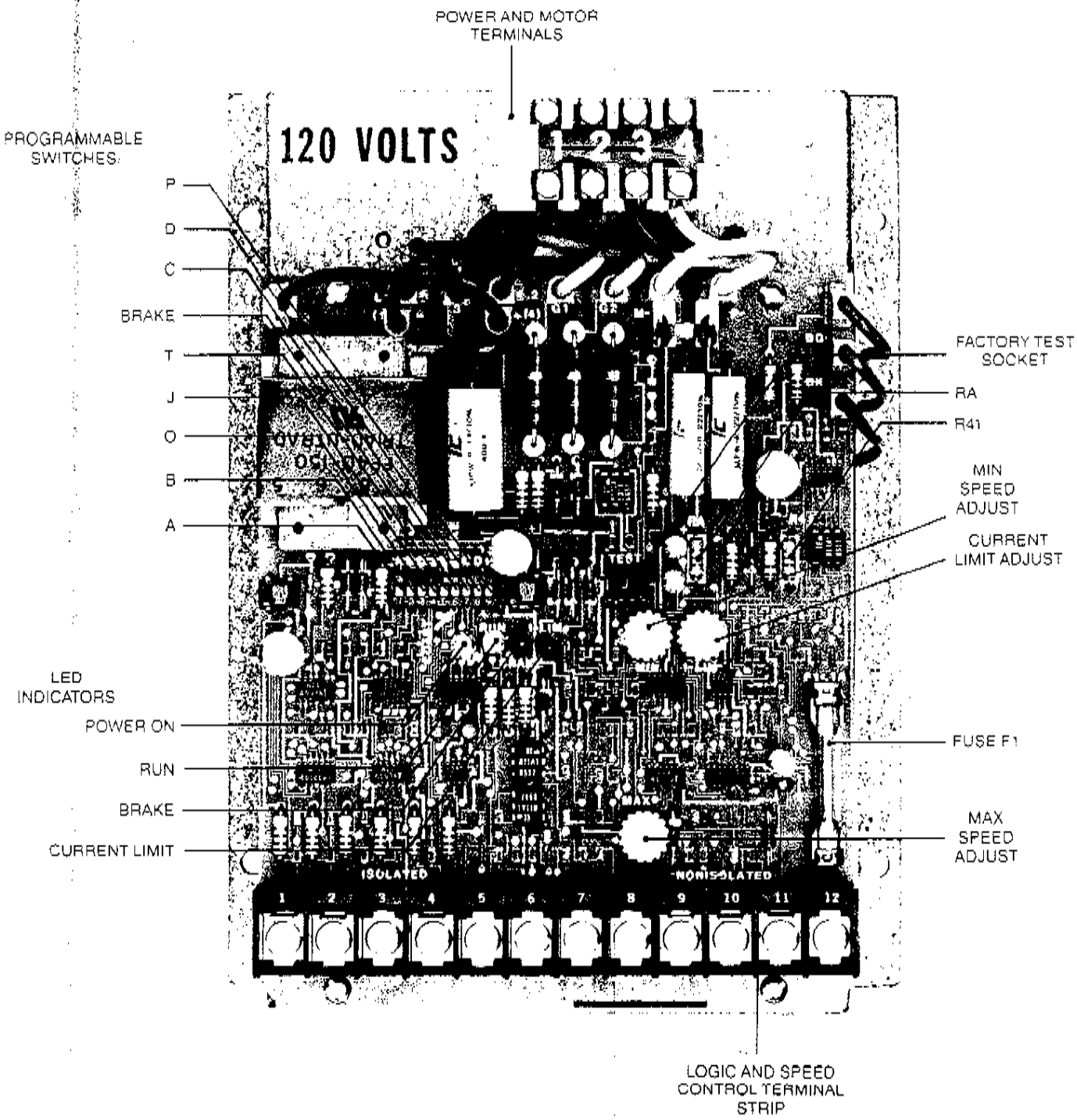


SURFACE MOUNT
cycletrol®
150

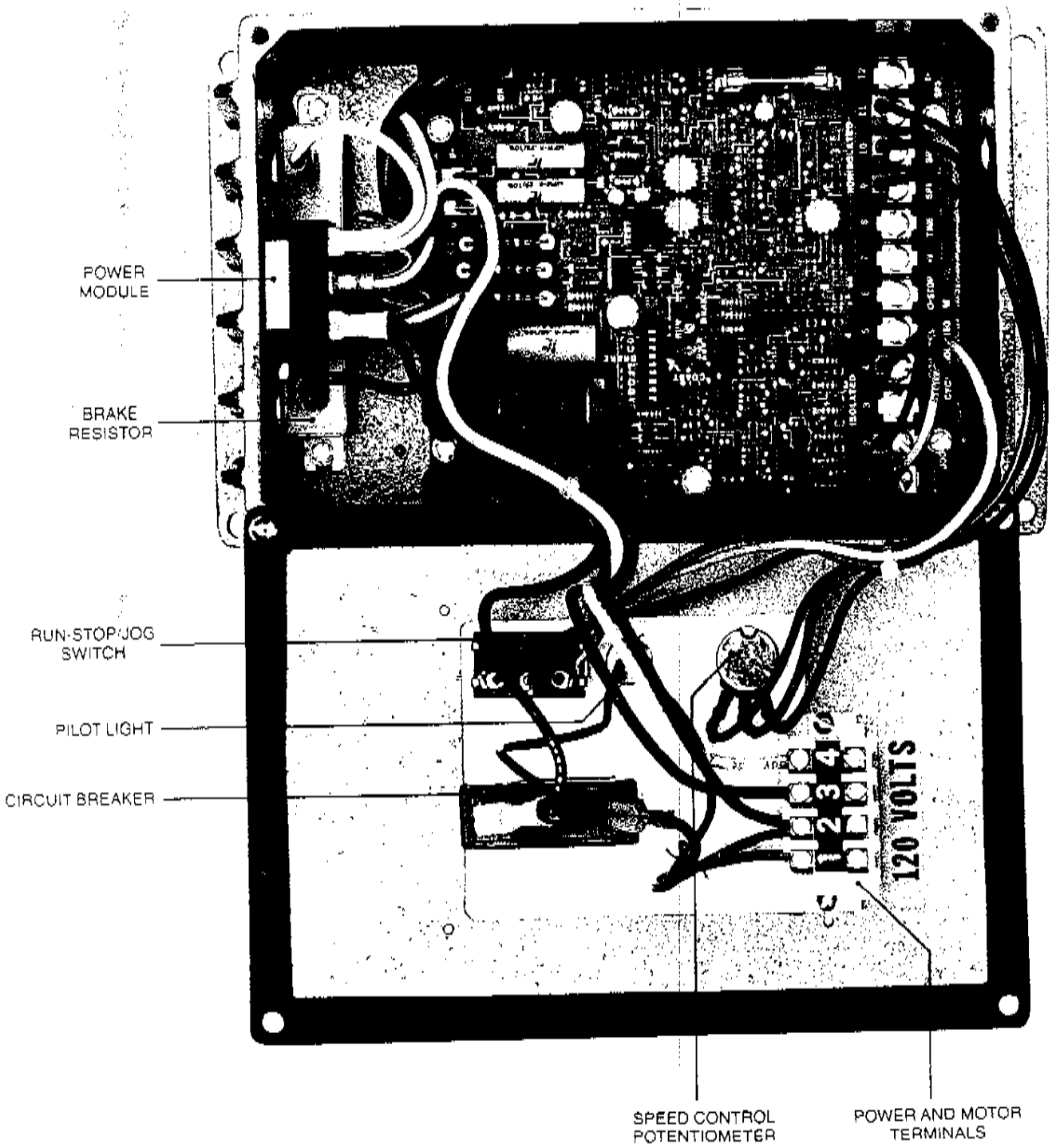
3 HP DIAGRAM



OPEN VERSION

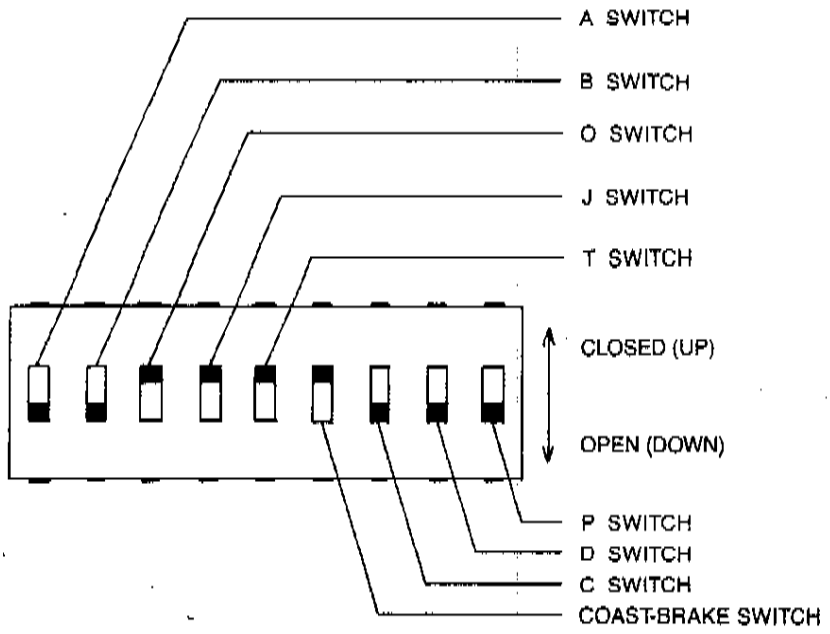


ENCLOSED VERSION



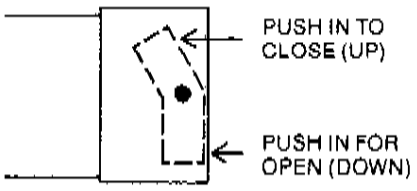
PROGRAMMABLE SWITCH ILLUSTRATION

The Cycletrol® 150 may be supplied with either of two types of switches



"SLIDE" TYPE SWITCH

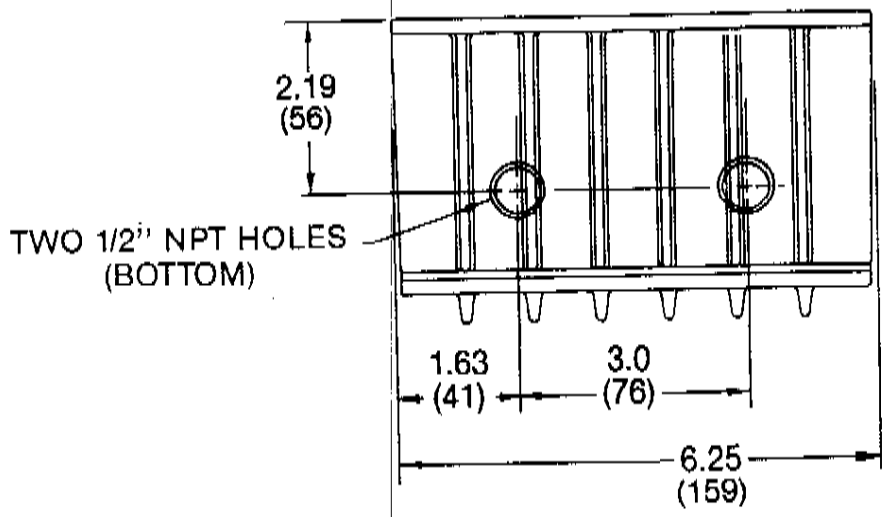
Switch positions shown in configuration are as sent from factory.

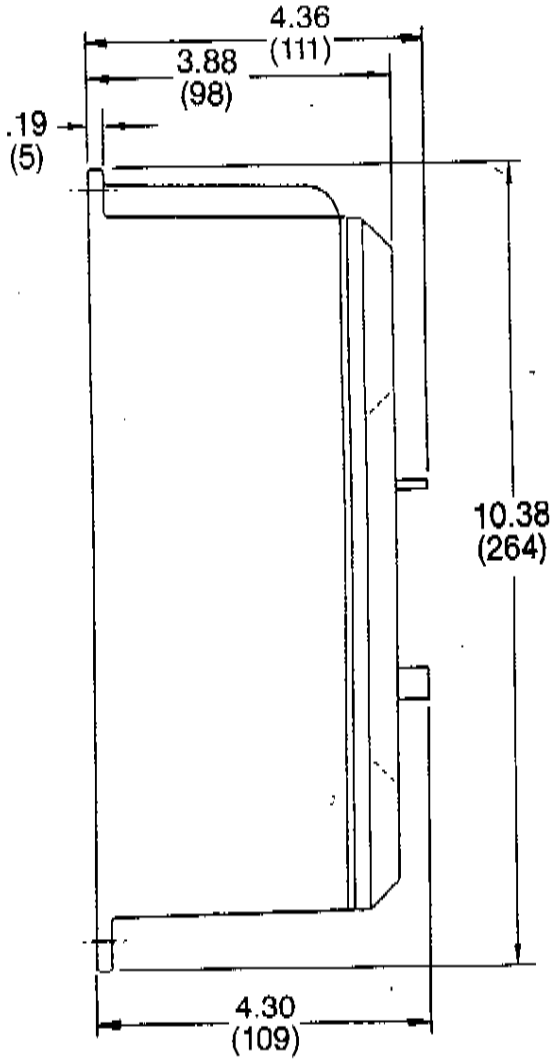


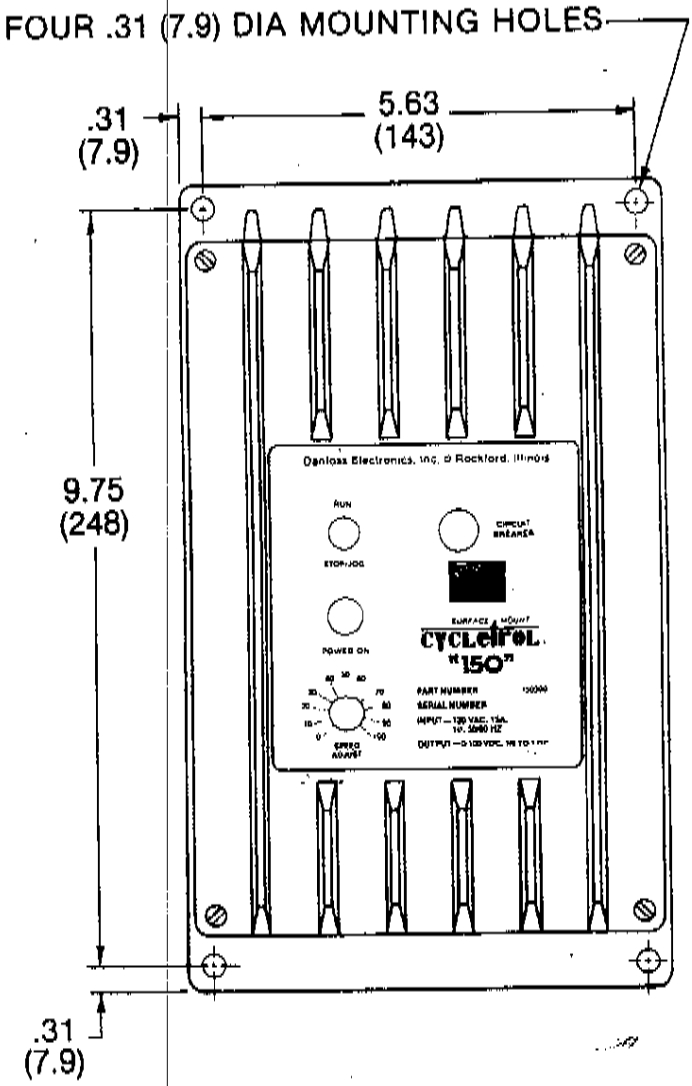
(SIDE VIEW)

"ROCKER" TYPE SWITCH

OUTLINE DIMENSIONS

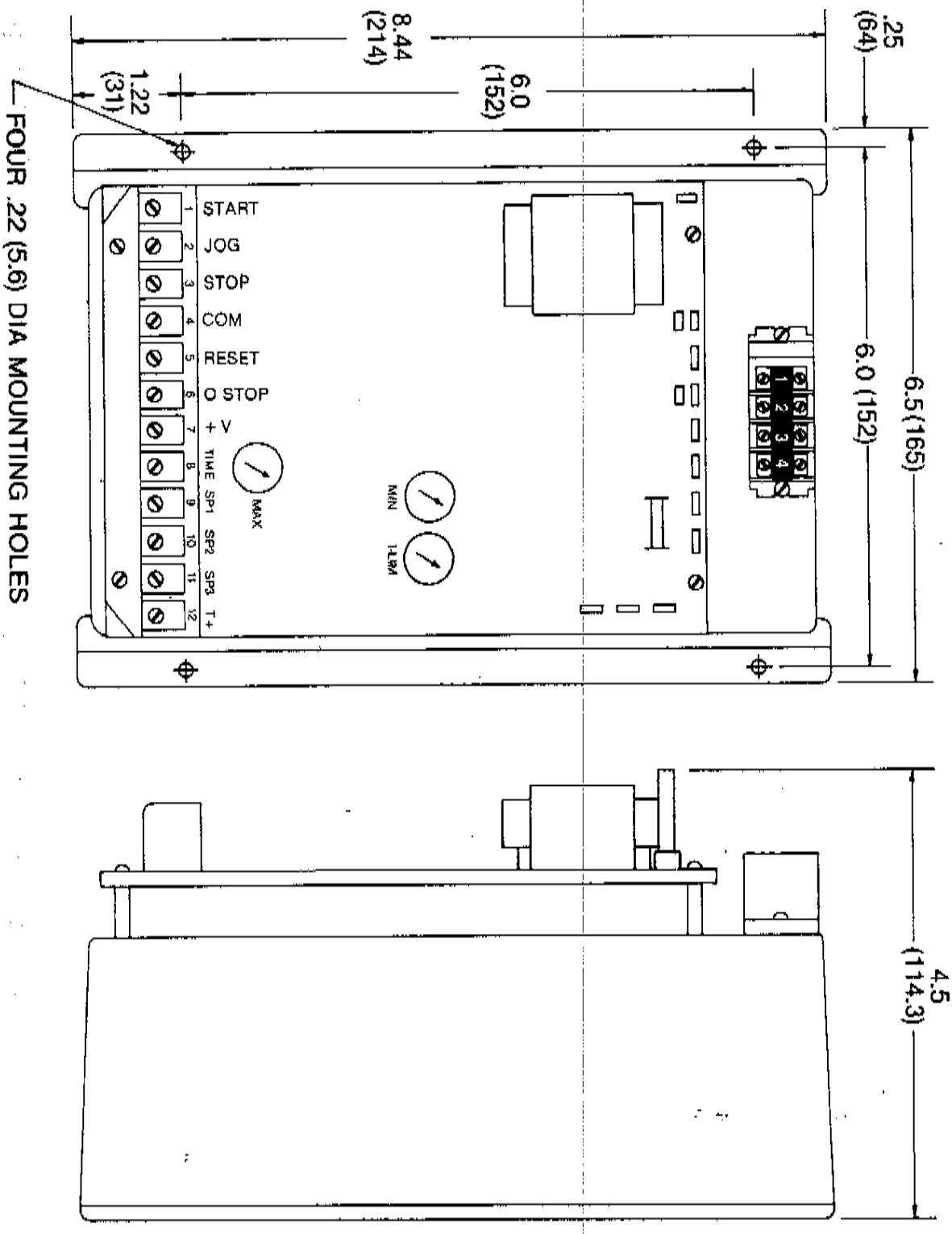






INCHES (MM)

OUTLINE DIMENSIONS



RECOMMENDED AC LINE PROTECTION

AC LINE VOLTAGE	MOTOR HP	DUAL ELEMENT FUSE AMPS	CIRCUIT BREAKER		
			AMPS	POLES	DANFOSS PART NO.
120	1/8	2-1/2	5	1	2008
	1/4	4	5	1	2008
	1/3	5	5	1	2008
	1/2	8	7-1/2	1	2014
	3/4	10	10	1	2007
	1	15	15	1	2006
240	1/8	1-1/2	5	2	2017
	1/4	2	5	2	2017
	1/3	2-1/2	5	2	2017
	1/2	4	5	2	2017
	3/4	5	5	2	2017
	1	8	10	2	2010
	1-1/2	10	10	2	2010
	2	15	15	2	2011
	3	20	20	2	2012

240 VAC LINE REQUIRES PROTECTION IN BOTH AC LINES

OPERATION AND MAINTENANCE INSTRUCTIONS

MOTORS ARE PERMANENT MAGNET FIELD DIRECT MOTORS.

REVERSAL: Standard rotation is ccw looking at shaft. To reverse motor direction, reverse the polarity on the motor terminals.

NAMEPLATE RATING: Consult nameplate for rating and part number. Values are for full load conditions. Do not use motor for prolonged periods at line currents greater than amperes given on nameplate.

TEMPERATURE LIMITATION: If the motor is totally enclosed, maximum safe operating temperature is 195°F as measured at key of rear end bell. If motor is open drip-proof, maximum is 160°F.

PERIODIC INSPECTION: The brushes of a DC motor should be inspected for wear periodically to insure uninterrupted service. The brush life is a function of load and motor speed. When replacing brushes, a visual inspection should be made of the commutator and any excessive carbon brush dust should be removed from the rear end bell. (Compressed air blown into open brush holders works well.) Suggested inspection hours for motors are as follows when used on DC supply under continuous full load conditions.

SUGGESTED MOTOR INSPECTION HOURS

DUTY	MODERATE	HEAVY	EXTRA HEAVY
HOURS	2000	1000	500

COMMUTATOR: When replacing brushes, check commutator for wear. If commutator is worn down more than 1/32 inch on the diameter, turning and undercutting is recommended. Usually three sets of brushes can be used for one commutator turning.

BEARINGS: Ball bearings are lubricated for life. Shielded or sealed bearings may be used depending on the application. Under good conditions, bearings will give over 20,000 hours of service.

MAGNETS: Material is oriented strontium ferrite (ceramic). Avoid dropping or sharp blows. There is no deterioration in magnetic properties with age. Demagnetizing will occur only with severe overvoltage (about 150% normal). If demagnetizing occurs, speed will increase slightly. Magnet and shell assembly can be remagnetized at the factory. Magnets can be purchased only as part of a magnet and shell assembly.