

500 CONTROL SERIES

DART

CONTROLS, INC.

Instruction Manual

Variable Speed DC Control



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WARRANTY

Dart Controls, Inc. (DCI) warrants its products to be free from defects in material and workmanship. The exclusive remedy for this warranty is DCI factory replacement of any part or parts of such product which shall within 12 months after delivery to the purchaser be returned to DCI factory with all transportation charges prepaid and which DCI determines to its satisfaction to be defective. This warranty shall not extend to defects in assembly by other than DCI or to any article which has been repaired or altered by other than DCI or to any article which DCI determines has been subjected to improper use. DCI assumes no responsibility for the design characteristics of any unit or its operation in any circuit or assembly. This warranty is in lieu of all other warranties, express or implied; all other liabilities or obligations on the part of DCI, including consequential damages, are hereby expressly excluded.

NOTE: Carefully check the control for shipping damage. Report any damage to the carrier immediately. Do not attempt to operate the drive if visible damage is evident to either the circuit or to the electronic components.

All information contained in this manual is intended to be correct, however information and data in this manual are subject to change without notice. DCI makes no warranty of any kind with regard to this information or data. Further, DCI is not responsible for any omissions or errors or consequential damage caused by the user of the product. DCI reserves the right to make manufacturing changes which may not be included in this manual.

WARNING

Improper installation or operation of this control may cause injury to personnel or control failure. The control must be installed in accordance with local, state, and national safety codes. Make certain that the power supply is disconnected before attempting to service or remove any components!!! If the power disconnect point is out of sight, lock it in disconnected position and tag to prevent unexpected application of power. Only a qualified electrician or service personnel should perform any electrical troubleshooting or maintenance. At no time should circuit continuity be checked by shorting terminals with a screwdriver or other metal device.

INTRODUCTION

The 500 Series is a high performance, versatile DC motor control which provides a wide range of standard features, with many options that extend its capabilities. The 500 Series will operate 1/8 through 1.0 horsepower at 120VAC input, and 1/4 through 2.0 horsepower at 240VAC input. A 3.0 horsepower model is available in 240VAC input, chassis mount only. Reference "Basic Model Selection" guide on page 16.

The 500 Series consists of three basic types:

- C** = Chassis mounted, no enclosure, no power relay.
- RC** = Chassis mounted, no enclosure, with power relay.
- RE** = Plastic enclosure with power relay - Nema 12 standard.

Note: The enclosed version (RE) is not available without the power relay.

The 500 Series is designed for Permanent Magnet, Shunt Wound, and some Universal Series (AC/DC) motors in the above horsepower ranges. The 500 Series chassis unit is recognized by the Component Program of Underwriters Laboratories, Inc., Standard 508, File E78180 (N). The 500 Series incorporates transient voltage protection with adjustable Current Limit and AC fuses for protection. Minimum and Maximum speeds are easily adjusted by trimpots, as is the I.R. Compensation. Acceleration and Deceleration are fully adjustable via individual trimpots.

COMMONLY ASKED QUESTIONS

Q. Can I run two or more motors from the same drive?

A. Not recommended. The I.R. Compensation (regulation) and Current Limit circuits would have difficulty sensing the different load on each motor.

Q. Can I change the horsepower of my motor and still use the same control?

A. Yes, provided you do not deviate outside the horsepower range for the voltage you are using. The trimpots would need readjustment; see "Trimpot Chart" (page 8) for approximate settings.

Q. Can I use the 500 Series as a Current Follower?

A. Yes, there is a field installable option shown on pages 12 and 13 to do this.

Q. Can I use the 500 Series on Tachometer feedback?

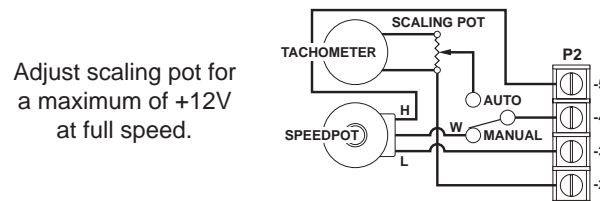
A. Yes, see +Tach (P2-9) under "Terminal Strip Wiring - P2" on page 6.

Q. Can I use the Stop (P2-11), Start (P2-13), and Common (P2-12) to stop-start the control on the "C" chassis version?

A. No. Terminals P2-11, P2-12, and P2-13 are only active on the relay versions; "RE" and "RC". These terminals are non-operative on the "C" version.

Q. Can the 500 Series be used as a Voltage or Tachometer Follower?

A. Yes. The voltage must be ungrounded and no more than +12 VDC (See "Terminal Strip Wiring" for proper hook-up). For ungrounded voltages greater than +12 volts, use the Scaling Pot diagram shown below. Note: Auto-Manual switch and speedpot can be removed if not needed.



Q. How would I proceed to stop/start the 500 Series with my own relay?

A. You can use the contact of your relay in place of the AMP REF to REV 1 (P2-2 to P2-7) jumper wire. Since this is a low level signal (12 volts at 2mA), you must use a logic type relay (preferably gold contacts). This cannot be done on controls using some options. Consult your Dart Representative if options are involved.

Q. Why is a jumper wire between AMP REF (P2-2) and REV 1 (P2-7) needed on drives with no options?

A. REV 1 (P2-7) and REV 2 (P2-8) are two identical stop inputs. One of these must be held low (to Amp Ref P2-2) for the control to run. If the drive has no options, this must be jumpered to satisfy the "OR" gate. This requirement is satisfied by some options. For these options, a connection must be made to these terminals. Instead of a jumper wire, the option is wired to these terminals. (See "Jumper Wires" on page 11).

CONTROL FEATURES

MIN SPEED - (Minimum speed) Allows adjustment of the motor speed when the speedpot is set at minimum. This permits the user to eliminate the "Deadband" on the main speed control, permitting zero calibration. Clockwise rotation of the "MIN" trimpot increases speed.

ACCEL - (Acceleration) Allows adjustment of the motor acceleration from a minimum of 0.2 seconds to a maximum of 10 seconds. The -15A option extends the maximum acceleration time to 30 seconds.

DECEL - (Deceleration) Allows adjustment of the motor deceleration from a minimum of 1 second to a maximum of 10 seconds. The -15A option extends the maximum deceleration time to 30 seconds.

MAX SPEED - (Maximum speed) Allows adjustment of the motor speed when the speedpot is set at maximum (CW). This permits the user to eliminate the "DEADBAND" of the speedpot, providing full speed at maximum rotation. Rotation of the "MAX" trimpot in the clockwise direction increases maximum motor speed. DO NOT SET MAX. ABOVE THE MAXIMUM OUTPUT RATING (90V for 120V input or 180V for 240V input).

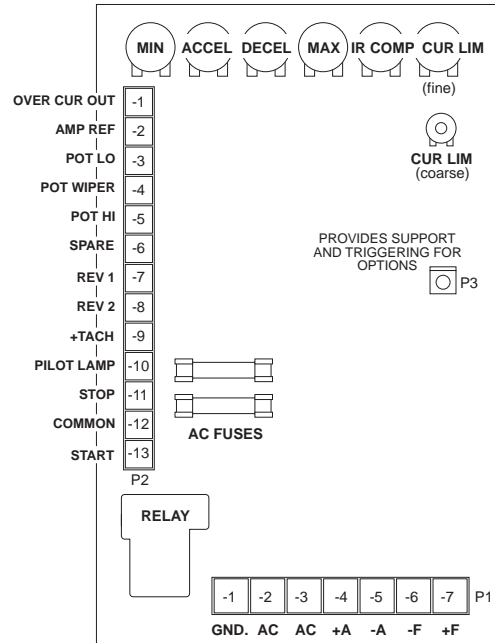
I.R. COMP - (Speed Regulation) Allows adjustment of the circuitry that controls the speed regulation of the motor. This feature controls armature speed by changing the armature voltage to compensate for increased or decreased motor loading. Clockwise rotation of the "I.R. COMP" trimpot will increase compensation.

CUR. LIM. - (Current Limit) Provides protection from excessive armature current by limiting the maximum armature current the control can provide. This enables adjustment of the maximum torque the motor can deliver. Set Current Limit (CUR. LIM.) at 125% of the rated motor current. Clockwise rotation of the "CUR. LIM." trimpot increases the torque (current) the control will provide.

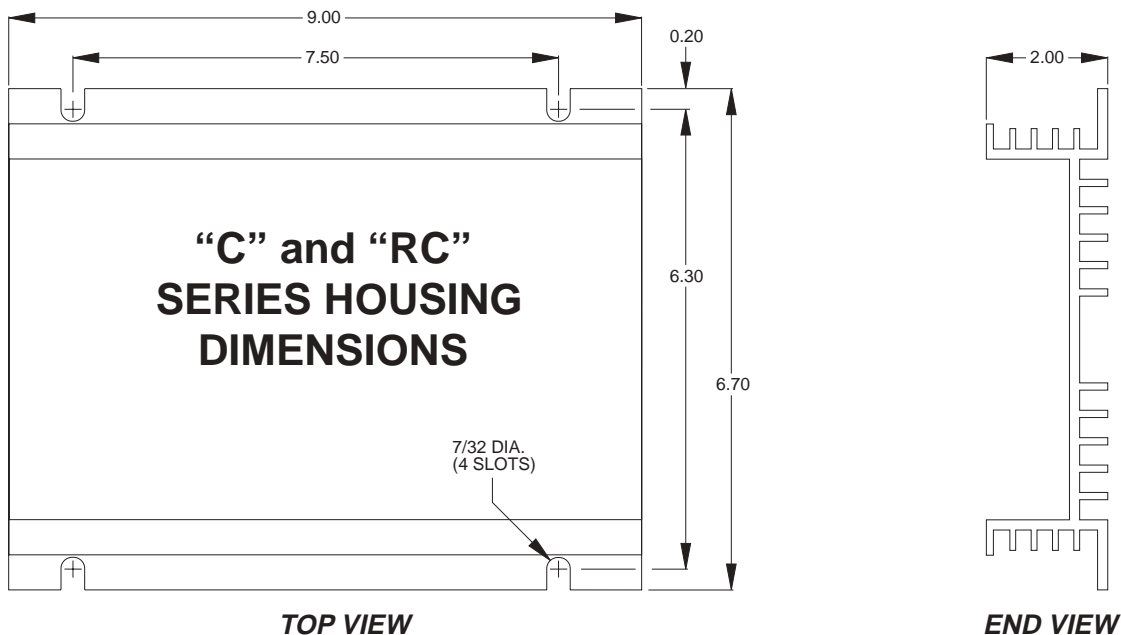
TERMINAL STRIP P1 - Barrier type terminal strip provides for connection of AC lines, motor leads, motor field (if necessary), and earth ground.

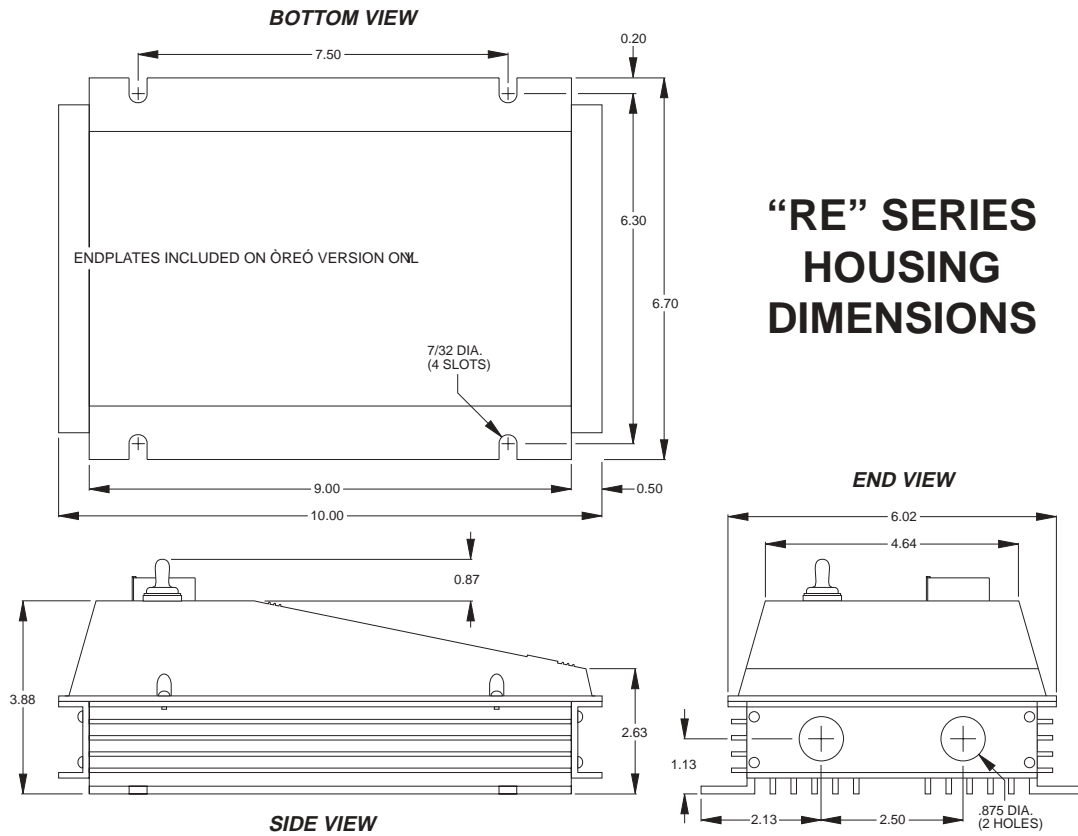
TERMINAL STRIP P2 - Barrier type terminal strip provides for connection of speed potentiometer and any accessories and/or jumper wires which control the drive.

RELAY - (Power Interrupt Relay) Available only on the "RC" and "RE" versions, the relay permits the switching of AC power with a low current signal. For the "RE" version, the relay will not allow start up after power failure without manually restarting.



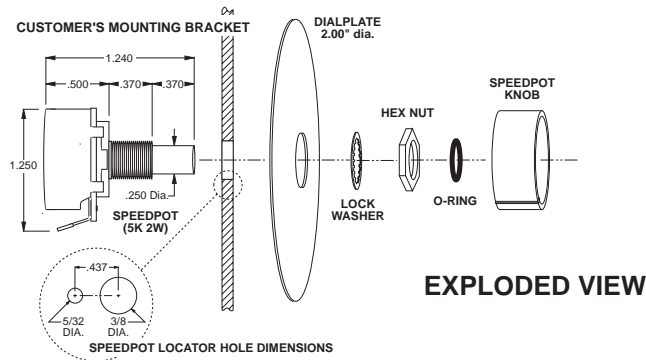
OVERALL CONTROL DIMENSIONS





SPEEDPOT MOUNTING DIMENSIONS

(For “C” and “RC” versions)



DO NOT MOUNT CONTROL WHERE AMBIENT TEMPERATURE IS OUTSIDE RANGE OF -10° to 45° C. (15° to 115° F.)

MOUNTING INSTRUCTIONS

1. Four 7/32" slots are provided for control mounting.
2. The 500 Series chassis can be used as a template.
3. Use standard hardware to mount.
4. For the “RE” version ONLY: Two 7/8" diameter holes are provided in one endplate to facilitate wiring. This allows for easy connection of 1/2" conduit.

NOTE: For enclosed models using 1 h.p. 90V or 2 h.p. 180V motors, the control MUST be mounted vertically.

CAUTION:

DO NOT ATTEMPT TO PERFORM HI-POT TEST ACROSS AC LINES WITH THE CONTROL IN CIRCUIT. THIS WILL RESULT IN IMMEDIATE OR LONG TERM DAMAGE TO THE CONTROL.

WIRING PROCEDURE

1. Size all wires which carry armature or line current to handle currents AS SPECIFIED BY NATIONAL, STATE, AND/OR LOCAL CODES. All other wires may be # 20AWG or smaller as permitted by local code.
2. Control wire (Pot, Tach, etc.) should be separated from all the Armature, Field (if Shunt Wound), and the AC wires when routed in conduits or in wire trays. The enclosed version has two holes on one endplate for this purpose. Conduit entry can be from top or bottom by interchanging the endplates.

TERMINAL STRIP WIRING - P1

CAUTION: BE SURE CONTROL HOUSING IS PROPERLY GROUNDED.

The 500 Series uses a 7 position barrier type terminal strip to handle the power connections.

P1-1 (EARTH GROUND) - Ground the control by connecting the ground wire to this terminal. NOTE: Terminals P1-5 (-ARM) and P2-2 (AMP REF) are electrically the same, which is the common reference point (low voltage common) for the control logic. The EARTH GROUND terminal (P1-1) is electrically different from common. If connected together, either at the amplifier or in any other fashion, fatal or hazardous operation may occur and permanent damage to the control WILL result!

P1-2 (AC1) 120VAC - Connect incoming hot AC (black wire) to this terminal. NOTE: This is fused (F1) on the control.
(AC1) 240VAC - Connect either hot side.

P1-3 (AC2) 120VAC - Connect the neutral AC (white wire) to this terminal. NOTE: This is fused (F2) on the control.
(AC2) 240VAC - Connect either hot side.

P1-4 (+ ARMATURE) - Connects to the plus (+) Armature wire on the motor. 0-90VDC for 120VAC input or 0-180VDC for 240 VAC input. See "SPECIFICATIONS" for output rating.

**CAUTION: ARMATURE CONNECTION MUST NOT BE SWITCHED OR BROKEN WHILE CONTROL IS ON
SERIOUS DAMAGE TO THE CONTROL MAY RESULT.**

P1-5 (- ARMATURE) - Connects to minus (-) Armature wire on the motor.

P1-6 (- FIELD) Connect minus (-) Field wire of the Shunt Wound motor (not used on PM motors).

FIELD VOLTAGE TABLE		
Model #	VAC Input	VDC Field
510	120	100
520/523	240	200

P1-7 (+ FIELD) - DO NOT use for Permanent Magnet motor. This supplies + Field voltage for a Shunt Wound motor. See table shown above for dual voltage Field Wound motors. This output is rated at 1 Amp maximum. For motors with dual voltage field (ie. 50/100V or 100/200V), make sure the highest value is connected.

TERMINAL STRIP WIRING - P2

The 500 Series uses a 13 position barrier type terminal strip for control connections.

CAUTION: NONE OF THE P2 TERMINALS SHOULD BE EARTH GROUNDED!

P2-1 (OVER CURRENT OUT) - Can be used to signal that the control is in current limit. It can also signal other devices or alarms. This is a low level logic signal which goes "high" when the current limit amplifier is in current limit. The logic of this control is +12 volts, while the output at this terminal is approximately 3 volts through a 1000 Ω resistor.

P2-2 (AMP REF) - This is the common point of the logic. It is used as common with OVER CURRENT OUT (P2-1), +TACH (P2-9), REV 1 (P2-7), REV 2 (P2-8), and WIPER (P2-4). NOTE: Never connect this terminal to earth ground!! Serious damage and injury may result!! This terminal is electrically the same point as -ARM (P1-5).

P2-3 (SPEEDPOT LO) - Connects to the low side (orange wire) of the 5K Speedpot (normally the CCW end). This input is raised and lowered by the MIN trimpot. Electronic speed input voltage (voltage follower) may be referenced to Speedpot LO if the MIN trimpot adjustments are to be active. Otherwise, inputs may be referenced to AMP REF (P2-2), which will bypass the MIN trimpot. INPUT MUST NOT BE GROUNDED!

**CAUTION FOR VOLTAGE FOLLOWER APPLICATIONS:
THE INPUT CONNECTION TO THE SPEEDPOT MUST NOT BE GROUNDED !!
SERIOUS DAMAGE TO THE CONTROL MAY RESULT FROM A GROUNDED INPUT.**

P2-4 (SPEEDPOT WIPER) - Connects to the wiper (red wire) of the Speedpot (center lead). Use this input for the plus (+) side of voltage follower operation or tach follower. The minus (-) side connects to AMP REF (P2-2). INPUT MUST NOT BE GREATER THAN +12V MAXIMUM AND MUST NOT BE GROUNDED!

P2-5 (SPEEDPOT HI) - Connects to high side (white wire) of the Speedpot (CW end). This is internal +12 volts. INPUT MUST NOT BE GROUNDED!

P2-6 (SPARE) This terminal is not connected to the control circuit. It can be used as a terminal for field modifications.

(P2 wiring continued)

P2-7 (REV 1) - REV 1 and REV 2 are identical quick stop inputs. One of them must be held low (to AMP REF) before the control will operate. The two are diode separated to form an "OR" gate. Since -ARM (P1-5) is also low in the system, these two inputs can be wired to the motor side of a reversing switch or relay. During the period of switching, neither input will be low, which will instantly return the set speed to zero and reset the acceleration ramp.

P2-8 (REV 2) - Identical to REV 1 (P2-7).

P2-9 (+TACH) Connect +Tach from a DC tachometer for tachometer feedback. The minus (-) lead from the tachometer goes to AMP REF (P2-2). Output voltage from the tachometer at full speed can range from 6 to 50 volts. The scale is corrected using the MAX speed trimpot. A 7 volt per 1000 RPM tachometer should be used.

P2-10 (PILOT LIGHT) - Full AC voltage is available for a pilot light. Current is limited through a 270Ω 2 Watt resistor. Connect the other side of the pilot light to COMMON (P2-12).

P2-11 (STOP) Install one or more normally closed stop switches (in series) between STOP (P2-11) and COMMON (P2-12). Not active on "C" version.

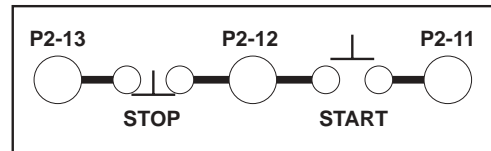
P2-12 (COMMON) - Mid point of Start-Stop switches. Not active on "C" version.

P2-13 (START) Install one or more normally open start switches (in parallel) between START (P2-13) and COMMON (P2-12). Not active on "C" version.

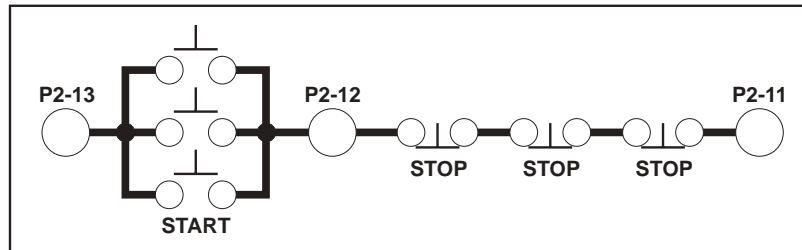
SWITCH LADDER CIRCUIT DIAGRAMS



START-STOP WIRING

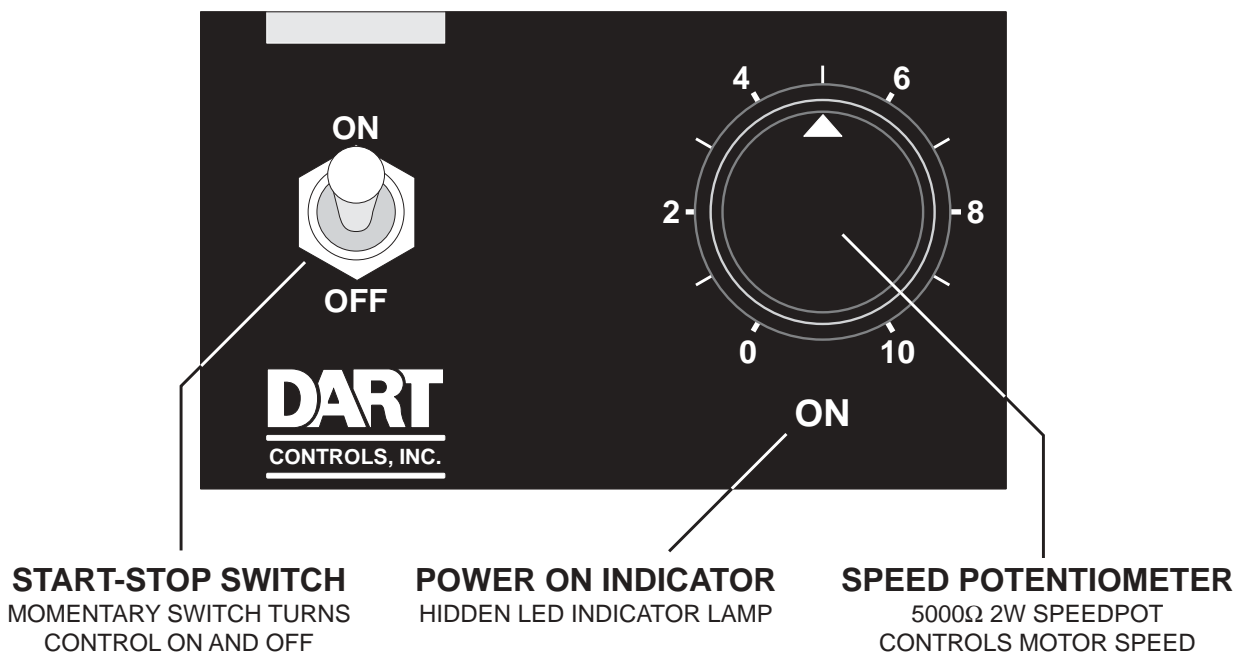


START-STOP WIRING (WITH 3 STATIONS)



Warning:
This diagram is for
ORCO and OREO versi
ONLY! DO NOT use
on OCÓ version.

CONTROL PANEL IDENTIFICATION



INITIAL START UP

1. Recheck all wiring. Accidental grounds, loose or pinched wires on armature or speed potentiometer wires will damage the control when power is applied.
2. Check to see that incoming service is of correct voltage.
3. See "ADJUSTMENT PROCEDURE" and observe the WARNINGS pertaining to cover removal for adjustments.
4. Preset trimpots for your horsepower by using the "TRIMPOT CHART". NOTE: Options may change the trimpot setting from this chart. If your control has an option, be sure to carefully read the section in "OPTIONS" that pertains to your option.
5. Turn speed potentiometer to zero (fully CCW).
6. Turn power on and advance speedpot while observing motor.
7. If motor rotation is incorrect, turn power off at external disconnect and reverse the +ARM and -ARM connections.
8. If operation is satisfactory, no re-adjustments are needed.
9. If instability or surging is observed, or if maximum speed is higher than desired, proceed to "ADJUSTMENT PROCEDURE".
10. For other problems, consult page 16, "IN CASE OF DIFFICULTY".

WARNING:

WHEN MAKING AN ADJUSTMENT, ALWAYS USE A SCREWDRIVER WITH AN INSULATED SHAFT TO AVOID THE SHORT CIRCUITING OF PC BOARD COMPONENTS. WHENEVER THE CONTROL COVER IS REMOVED, IT MUST BE SUPPORTED TO AVOID ACCIDENTAL CONTACT BETWEEN CONTROL CHASSIS AND LIVE COVER COMPONENTS.

ADJUSTMENT PROCEDURE

Four adjustments (MIN., MAX., I.R. COMP., and CUR. LIM.) are checked at the factory using a typical motor. Use the "TRIMPOT CHART" to adjust the trimpots to the approximate setting for your horsepower. The other two adjustments (ACCEL and DECEL), are the Acceleration and Deceleration adjustments and should be set for your particular application requirements. The "TRIMPOT CHART" is approximate and is valid when using a speedpot or a 0 to 12VDC input signal to control the speed. Operation of the control beyond $\pm 10\%$ of normal line voltage is not recommended and could result in readjustments. These settings are permanent; periodic readjustment is normally not needed. (NOTE: Use only an ungrounded voltmeter).

MAX. Sets maximum motor speed when speedpot is at 100% CW rotation. Clockwise rotation increases maximum motor speed.

- 1) Turn drive power OFF!
- 2) Connect a DC voltmeter; plus to +ARM and minus to -ARM.
- 3) Set meter voltage range to either 90 VDC or 180 VDC.
- 4) With no load on the motor, adjust the MAX trimpot to the rated armature voltage as seen on the meter.

NOTE: A tachometer or strobe may be used in place of a meter. Follow the above steps, but adjust the MAX trimpot to the rated motor base speed, indicated by tach or strobe.

MIN. Sets minimum motor speed when Speedpot is set at zero. Clockwise rotation of the MIN. trimpot will increase the minimum motor speed.

- 1) Set Speedpot to zero (fully CCW).
- 2) With no load on the motor, adjust the MIN trimpot clockwise until the motor starts to rotate.
- 3) Slowly back off the trimpot in the CCW direction until the motor stops.

NOTE: If motor rotation is desired at zero Speedpot setting, adjust the MIN trimpot clockwise until the desired minimum speed is reached.

I.R. COMP. Provides a means of improving speed regulation in the armature feedback mode. If a change in motor speed during a load change is of no concern, rotate this trimpot fully CCW.

- 1) Set speedpot at 50%.
- 2) Observe motor speed during a no load condition.
- 3) Apply a full load to the motor.
- 4) Adjust the I.R. COMP. trimpot clockwise (while the load is applied) until the no load motor speed is maintained.

CUR. LIM. Limits DC motor armature current (torque) to prevent damage to the motor or control. The current limit is set for 125% of the rated motor current. Clockwise rotation of this trimpot increases the armature current (or torque produced).

- 1) Turn drive power OFF!
- 2) Connect a DC Ammeter in series with the +ARM line (between +A on motor and +ARM on the control). Preset the current limit trimpot CCW.
- 3) Turn power on and set speedpot to 50%.
- 4) Increase the motor load until the motor stalls (zero RPM).
- 5) Set CUR. LIM. trimpot to 125% of the rated motor armature current (see "TRIMPOT CHART").

ACCEL Allows adjustment of acceleration by user.

- 1) Clockwise trimpot rotation increases acceleration time.

DECEL Allows adjustment of deceleration by user.

- 1) Clockwise trimpot rotation increases deceleration time.

TRIMPOT SETTING CHART

510-12 thru 100 (1/8 thru 1.0 HP) One control with multiple settings. 520-25 thru 200 (1/4 thru 2.0 HP) One control with multiple settings.

MIN	ACCEL	DECEL	MAX	I.R.	CUR LIM	HP	VOLTS	MIN	ACCEL	DECEL	MAX	I.R.	CUR LIM	HP	VOLTS
						1/8	120							1/4	240
						1/6	120							1/3	240
						1/4	120							1/2	240
						1/3	120							3/4	240
						1/2	120							1.0	240
						3/4	120							1.5	240
						1.0	120							2.0	240
<p>NOTES: These settings apply when using a 5000Ω speedpot. This chart cannot be used with certain Options (refer to Option section)</p>								<p>For 523-300C (3.0 H.P.) see 0ADJUSTMENT PROCEDURE0</p>				3.0	240		

500 SERIES 3 H.P. (523-300C)

The 523-300C for three horsepower applications has the following restrictions:

- Available in Chassis mount only.
- Available in 240VAC input only.
- Relay, start-stop, reversing, dynamic braking & jogging are not available from factory (they are customer supplied and wired).
- The isolation boards (-5 and -7 options) are available. The current limit shutdown (-6 option) is factory installed, however the customer must supply relay contactor.
- The "TRIMPOT CHART" cannot be used for setting the 523-300C control, see the "ADJUSTMENT PROCEDURE".

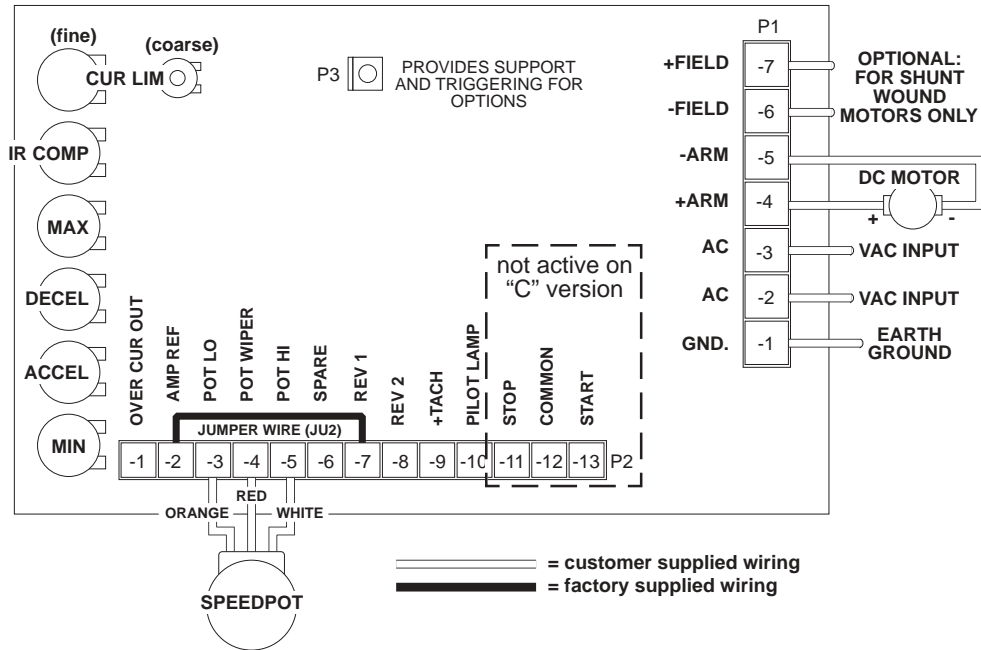
SHUNT WOUND MOTORS for the 500 SERIES

To prevent control failure (due to the combined in-rush current to the field and armature), we suggest the Acceleration trimpot be set so there is at least a 2 to 3 second acceleration time when using shunt wound motors.

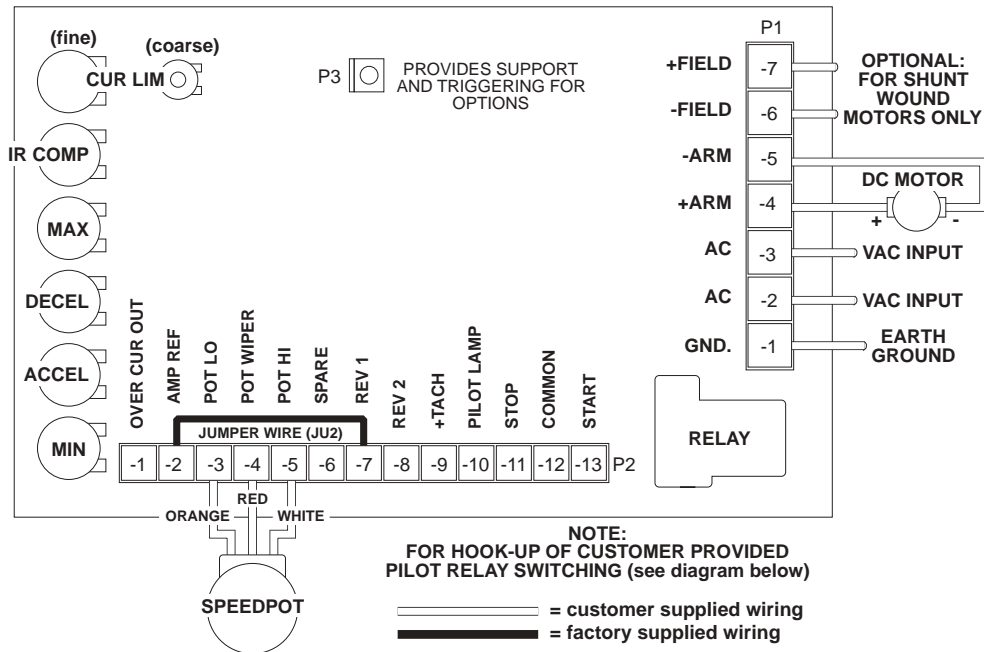
BASIC HOOK-UP DIAGRAMS WITHOUT OPTIONS

(If options are included on your control, see the option section of this manual).

"C" VERSION

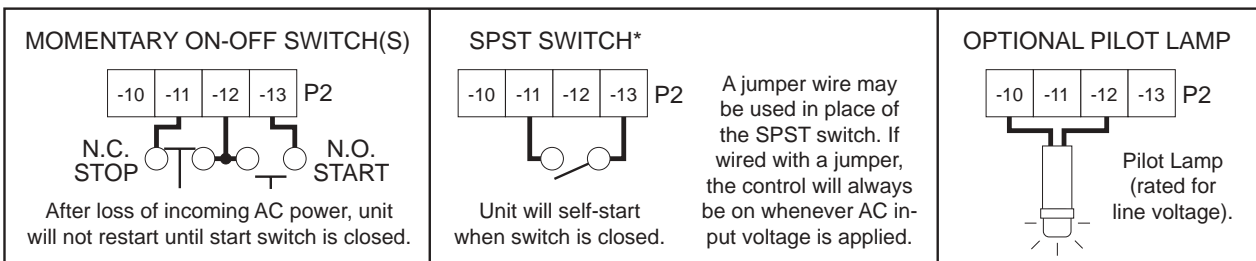


"RC" VERSION

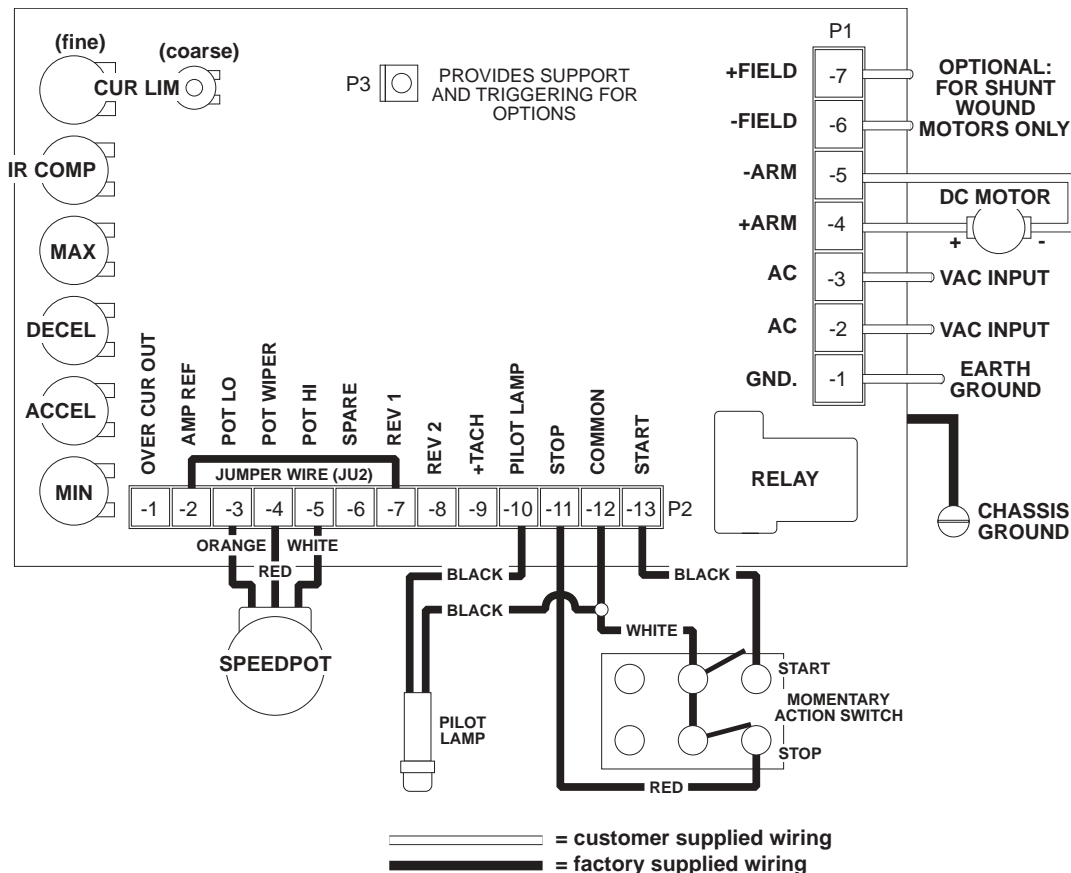


PILOT RELAY SWITCHING

(Customer supplied wiring for "RC" version)

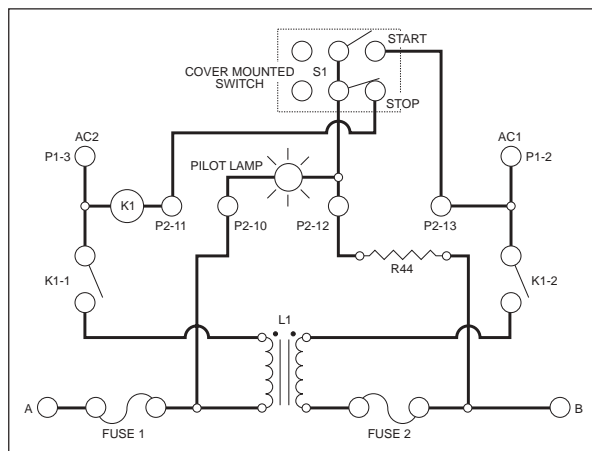


“RE” VERSION



RELAY OPERATION - ENCLOSED VERSIONS

TO START: AC power is applied to AC1 and AC2. When the switch is flipped to start, the contact between P2-13 and P2-12 closes momentarily. The full AC voltage is applied across the relay coil (K1) causing the relay contacts K1-1 and K1-2 to close. The switch returns to open and the relay coil remains energized through the following path: AC1 through K1-2 (closed contact); then through L1 and Fuse 2; then through R44 (current limit resistor), stop contacts, through K1 to AC2.



TO STOP: The switch is flipped to stop, which OPENS the stop contact between P2-12 and P2-11. This stops current to the coil which de-energizes the coil causing K1-1 and K1-2 contacts to open, disconnecting the AC power. NOTE: THE CONTROL RECEIVES POWER FROM POINTS A & B.

JUMPER WIRE SELECTION

NOTE: Jumper wires may be required on terminal strip P2 for the control to operate (refer to jumper chart below).

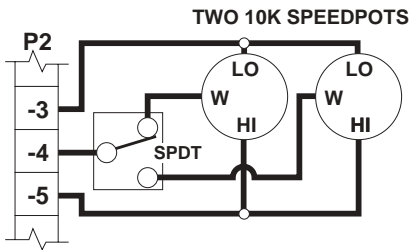
As explained in the "COMMONLY ASKED QUESTIONS" section, REV 1 (P2-7) and REV 2 (P2-8) are both stop inputs. One of these inputs must be held low to AMP REF (P2-2) for the control to operate. Jumpering is necessary between AMP REF and REV 1 or REV 2 to satisfy the "OR" gate. An option board may be installed on the control satisfying the "OR" gate. This jumper (between P2-2 and P2-7) is called JU2. At times JU2 may be replaced by a SPST switch.

YES = JUMPER REQUIRED		NO = JUMPER NOT USED				
OPTION	DESCRIPTION	PAGE #	JUMPER	"C"	"RC"	"RE"
NONE	STOCK CONTROL	9-10	JU2	YES	YES	YES
-4	JOG	12	JU2	YES	YES	YES
-5/-7	CURRENT FOLLOWER	12-13	JU2	YES	YES	YES
-6	CURRENT LIMIT INTERRUPT	13	JU2	YES	YES	YES
-36M/-38M	FWD / REV with ZERO SPEED and D.B.R.	14	JU2	NO	NO	NO
-51M/-52M	RUN / DYNAMIC BRAKE	15	JU2	NO	NO	NO

CONTROL MODIFICATIONS

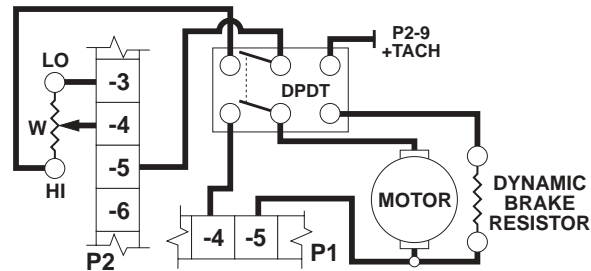
TWO SPEED OPERATION

Two pot operation is done using two 10KΩ speed potentiometers in parallel (both HI's to P2-5, both LO's to P2-3). The WIPER is switched using a SPDT switch.



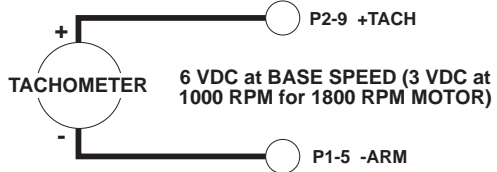
DYNAMIC BRAKING

A DPDT switch is used to inhibit the control and to connect the DBR. Typical values for the DBR (dynamic brake resistor) are 5Ω for 120V, 10Ω for 240V (both 35W to 50W). Note that motor horsepower, inertia, and cycle time effect sizing of the DBR. NOTE: On -15A Option, Decel must be fully CCW to use with DBR.



TACHOMETER FEEDBACK

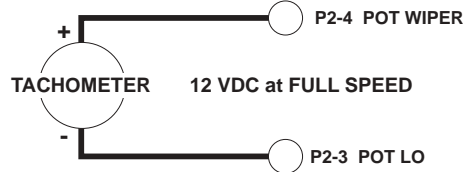
Improves speed regulation to ±1/2% of base speed.



NOTE: NEED 1% OR LESS - TACH OUTPUT RIPPLE

TACHOMETER FOLLOWER

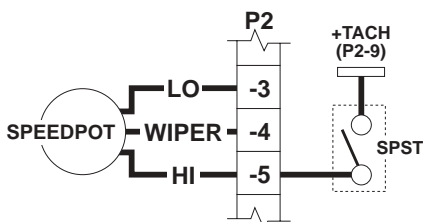
Allows control output to follow tachometer voltage.



INHIBIT (USED INDEPENDENTLY)

The customer supplied SPST switch is connected in series between the speedpot HI (P2-5) and the +TACH pin (P2-9). To inhibit, speedpot HI is closed to the +TACH pin. To restart, the switch is returned to open.

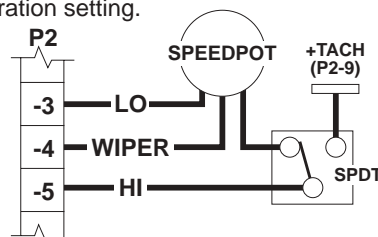
NOTE: The control will stop and start fast.



INHIBIT (USED WITH SPEEDPOT)

The customer supplied SPDT switch is connected in series between the speedpot HI (P2-5) and the +TACH pin (P2-9). To inhibit, speedpot HI is closed to the +TACH pin. To restart, the switch is returned to the run position.

NOTE: The control will stop fast and soft start through the acceleration setting.



NOTE: Permits starting and stopping of motor without breaking AC lines. In the event of SCR failure or false triggering, the Inhibit circuit will not stop motor.

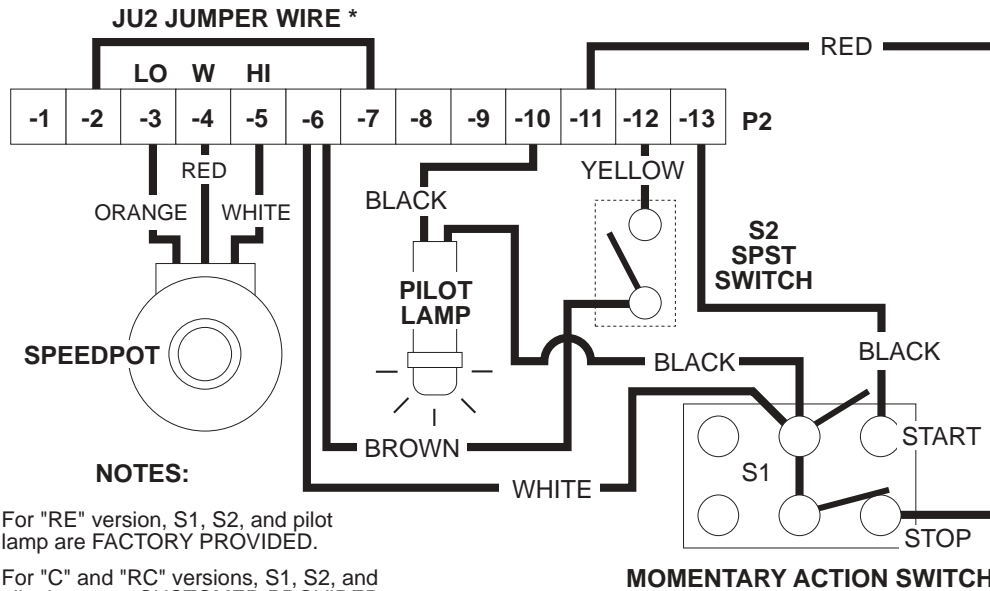
OPTIONS

NOTE: All options are specified by a suffix to the model number. This suffix starts with a dash (-). The more popular options are described on the following pages. When a combination of two or more of these options are used, the wiring procedure is beyond the scope of this manual. Please contact your Distributor or Representative.

-4 Option Jog

See below for installation and availability

This option is factory installed on the "RE" version only. "S2" is located on the cover and disables the latch circuit of the power relay, allowing the power switch to jog the drive. The "C" and "RC" versions use customer supplied switch and wiring, in addition the "C" version uses a customer supplied relay.

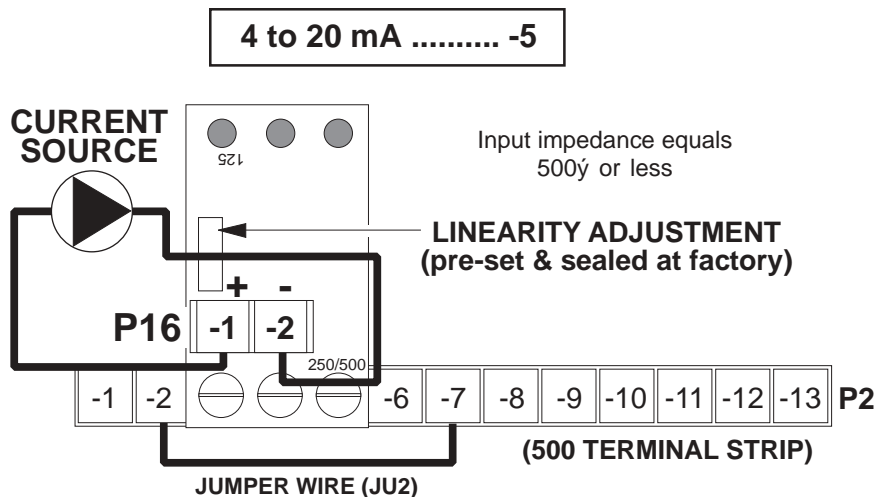


* This jumper wire is not used with some other options. Consult factory if more than one option is being wired.

-5 Option Signal Follower (Current)

*Available on "C" and "RC" models only
 Factory or Field installed
 (for Enclosed models use -7 Option)*

Permits control to follow current signal as follows:



The input can be grounded or ungrounded. The board sits on spacers screwed to terminals P2-3, P2-4, and P2-5. A current source is connected to the two position terminal strip on the option board. The maximum input impedance is 500 Ω . This option replaces the speedpot. The linearity trimpot is factory set and sealed (**DO NOT ADJUST LINEARITY IN FIELD**).

NOTE: Do not use MIN and MAX settings on the "TRIMPOT SETTING CHART" with this option.

-6 Option Current Limit Interrupt

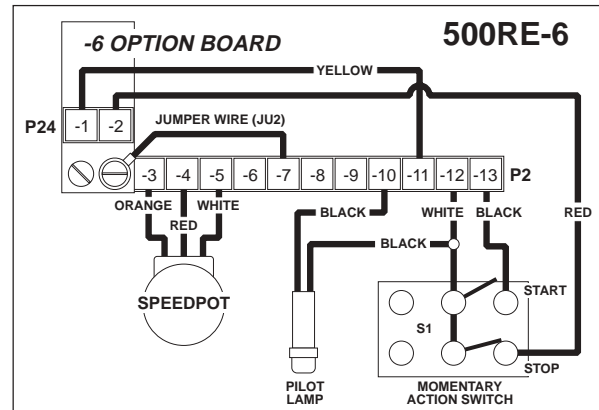
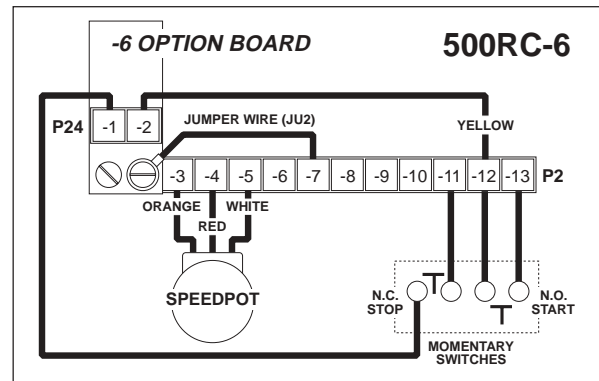
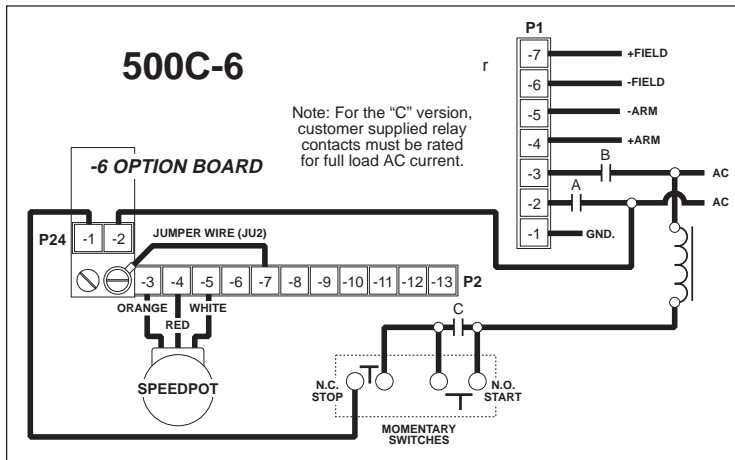
See diagrams below for availability
Factory installed only

The -6 option consists of a normally closed solid state switch that opens upon detection of the current limit set point. This option interrupts the latching circuit to the power relay. Upon clearing of the overload, this option must be turned "on" again to resume operation. The interrupt point is determined by the current limit setting.

NOTE: The -6 option requires factory modifications to the control.

-6A = 120 Volt Coil

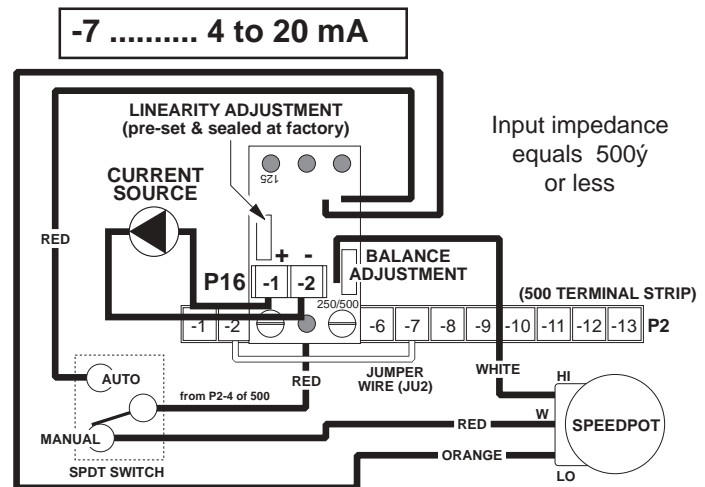
-6B = 240 Volt Coil



-7 Option Signal Follower (Current) with Auto / Manual Switch

Factory or Field installed Chassis unit
Factory only on Enclosed models
Available on all models

This option includes the appropriate -5 option board with pigtailed. With the -7 option, control of the speed setting is switched by a SPDT switch between the speedpot (manual operation) and the -7 option board (automatic operation). The current source is connected to P16-1 and P16-2 on the -7 option board terminal strip. This option board mounts on two spacers connected to terminals P2-3 and P2-5 (500 series PC board). The linearity adjustment is factory sealed - DO NOT ADJUST! To adjust the maximum motor speed in the manual mode, use the balance trimpot on the option board. It is adjusted so the maximum speed in the manual mode equals the maximum speed in the automatic mode. The MAX trimpot is used to set the maximum speed in the automatic mode. NOTE: DO NOT USE THE MIN & MAX SETTINGS ON THE "TRIMPOT SETTING CHART" WITH THIS OPTION. THE SPDT SWITCH IS CUSTOMER PROVIDED FOR THE CHASSIS VERSIONS ("C" and "RC").



-11 Option Ten Turn Speedpot

Field installed - ordered as separate item
Available on "C" and "RC" models only

Provides for a finer control of speed. Installation is the same as the standard speedpot.

-15A Option Extended Accel / Decel

Factory installed
Available on all models

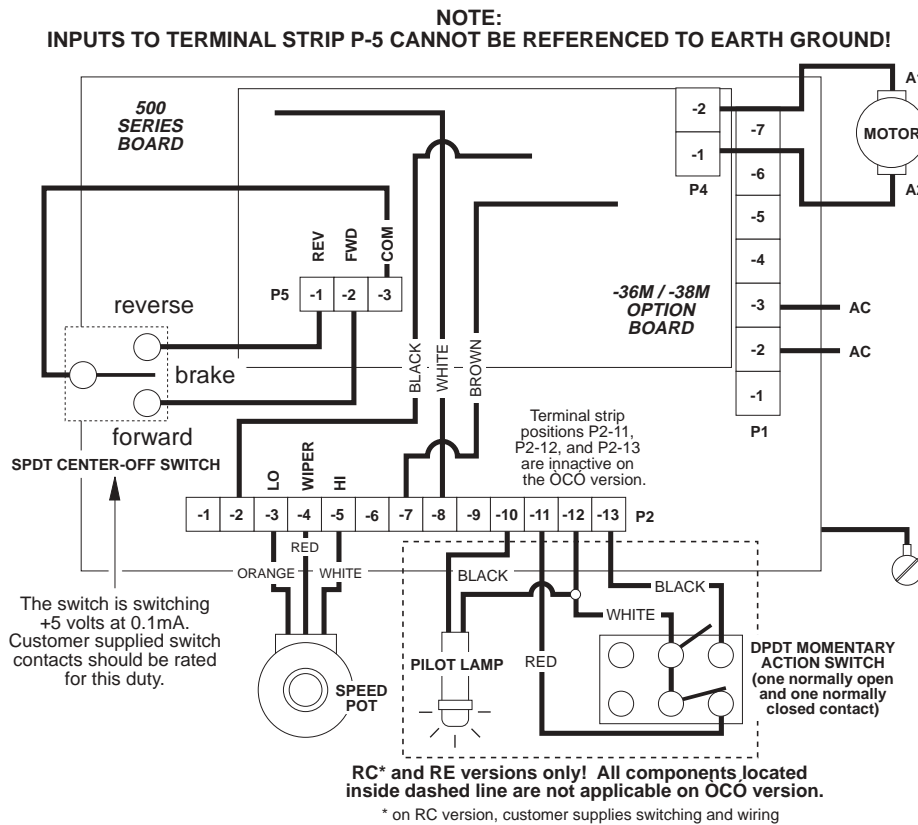
Extends acceleration / deceleration to 30 seconds (linear ramp).

-36M / -38M Option
Forward / Reverse with Zero Speed
Detect and Dynamic Brake

Factory or Field installed - see below
Available on all models except 3 H.P.

Option	AC Input	Installed	DBR Value	DBR location / placement
-36M	120VAC	factory or field	5 \dot{y} 30W	option board mounted
-36MA	120VAC	factory only	5 \dot{y} 50W	extrusion mounted
-38M	240VAC	factory or field	10 \dot{y} 30W	option board mounted
-38MA	240VAC	factory only	10 \dot{y} 50W	extrusion mounted

-36M / -38M HOOK-UP USING SPDT SWITCH OR CONTACT

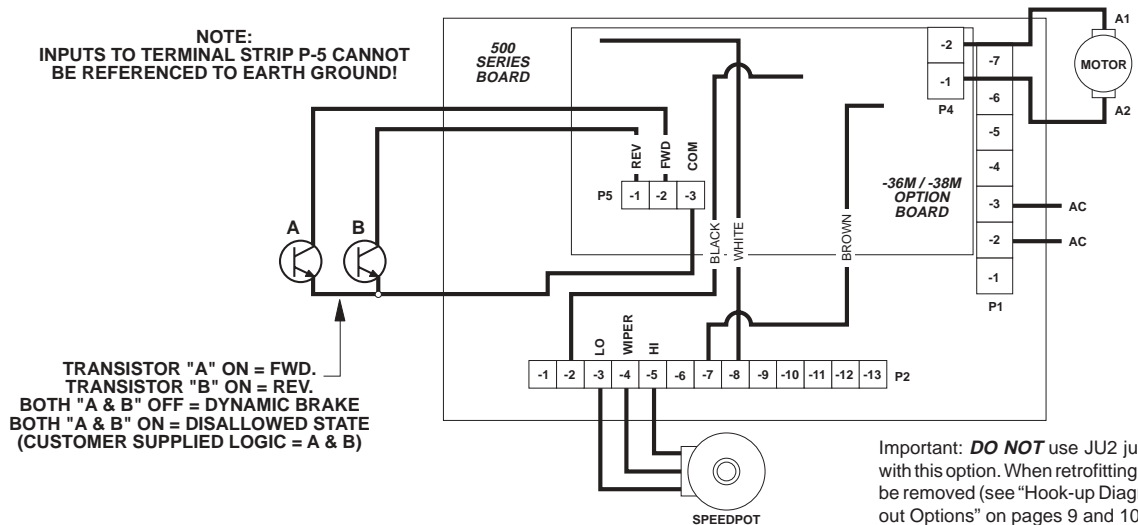


The -36M / -38M option automatically “brakes” to zero speed before reversing. The SPDT center-off switch is used to select direction. When the direction is reversed, relays K1, K2, and K3 connect the dynamic brake resistor to the armature. The motor “brakes” and at zero speed the relays reverse the armature leads, causing the motor to rotate in the opposite direction. When the switch is in the center (STOP) position, the motor armature is connected to the dynamic brake resistor. This option may also be field installed if the application uses a remote command signal to operate.

Notes: The start-stop switch is customer provided on the “RC” version (see Hook-up Diagrams for switch wiring, pages 9 and 10). The “RE” version requires a special cover that must be ordered for field installed -36M or -38M options. The Dynamic Brake Resistor is mounted accordingly per model (see above chart for placement).

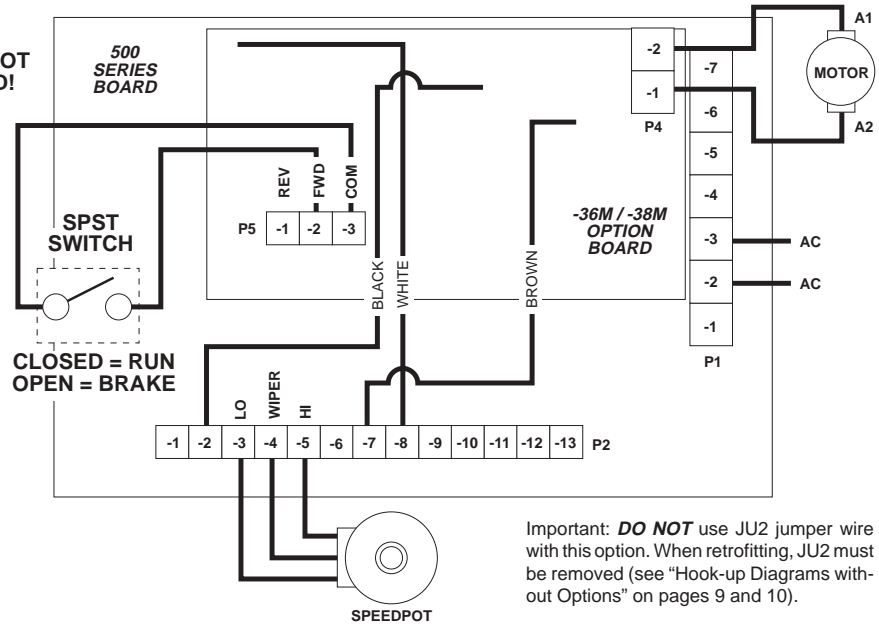
IMPORTANT: DO NOT USE JU2 JUMPER WIRE with this option. WHEN RETROFITTING, JU2 MUST BE REMOVED (see “Hook-up Diagrams without Options” on pages 9 and 10).

-36M / -38M HOOK-UP FOR NPN OPEN COLLECTOR DIRECTIONAL CONTROL



-36M / -38M HOOK-UP FOR UNIDIRECTIONAL RUN / DYNAMIC BRAKE

NOTE:
INPUTS TO TERMINAL STRIP P-5 CANNOT BE REFERENCED TO EARTH GROUND!



Important: **DO NOT** use JU2 jumper wire with this option. When retrofitting, JU2 must be removed (see "Hook-up Diagrams without Options" on pages 9 and 10).

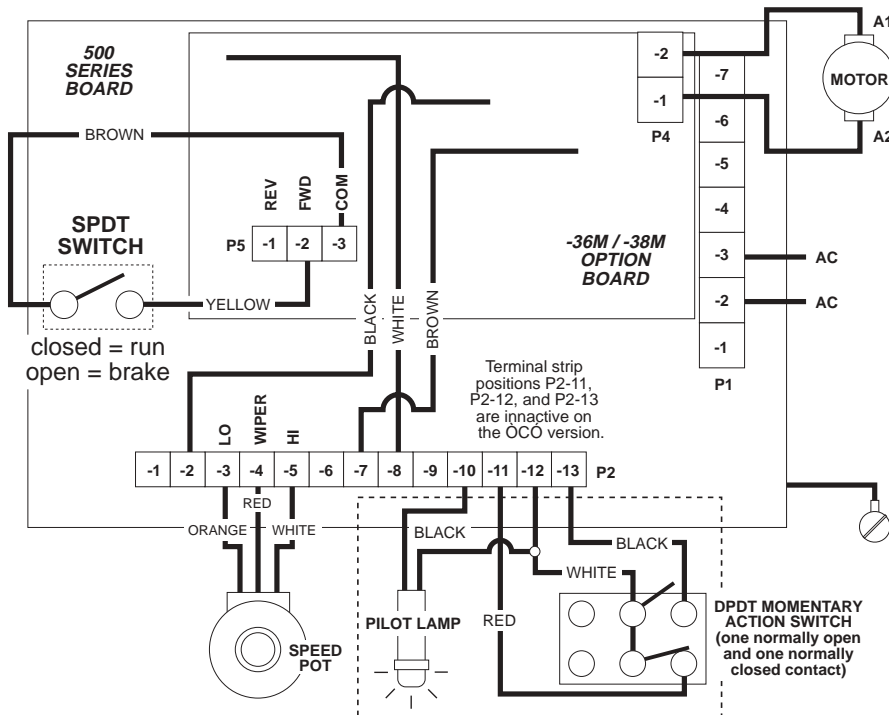
-51M / -52M Option Run / Dynamic Brake

Factory or Field installed - see chart below
Available on "RE" version only

Option	AC Input	Installed	DBR Value	DBR location / placement
-51M	120VAC	factory or field	5 \dot{y} 30W	option board mounted
-51MA	120VAC	factory only	5 \dot{y} 50W	extrusion mounted
-52M	240VAC	factory or field	10 \dot{y} 30W	option board mounted
-52MA	240VAC	factory only	10 \dot{y} 50W	extrusion mounted

-51M / -52M HOOK-UP FOR RUN / DYNAMIC BRAKE

NOTE: INPUTS TO TERMINAL STRIP P-5 CANNOT BE REFERENCED TO EARTH GROUND !



The -51M / -52M option provides "Run - Dynamic Brake" operation. The SPDT switch is used to select run or brake mode. When the switch is open the motor is connected to the dynamic brake resistor (DBR). The motor will automatically stop before returning to the run mode. This operation uses the appropriate -36M / -38M option board wired for unidirectional operation.

Note: For wiring procedure on the "RC" version (see Hook-up Diagrams for switch wiring, pages 9 and 10). The "RE" version requires a special cover that must be ordered for field installed -51M or -52M options. The Dynamic Brake Resistor is mounted accordingly per model (see above chart for placement).

IMPORTANT: DO NOT USE JU2 JUMPER WIRE with this option. **WHEN RETROFITTING, JU2 MUST BE REMOVED** (see "Hook-up Diagrams without Options" on pages 9 and 10). For "RC" version units, order the -36M / -38M option.

RC* and RE versions only! All components located inside dashed line are not applicable on OCO version.

* on RC version, customer supplies switching and wiring

MAINTENANCE PROCEDURE

In normal operation this control needs no routine maintenance. The cover may be cleaned with a mild detergent. Solvent type cleaners should not be used.

IN CASE OF DIFFICULTY

PROBLEM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION(S)
Motor doesn't operate	Blown fuse Incorrect or no power source Speedpot set at zero Worn motor brushes Improper or missing jumpers	Replace fuse Install proper service Adjust speedpot CW to start Replace motor brushes See "Jumper Chart" page 11
Motor stalls or runs very slowly with speed control turned fully CW	Low voltage Overload condition Worn motor brushes Max. speed set incorrectly	Should be above 108V or 216V Reduce load or re-adjust Current Limit Replace motor brushes See "Adjustment Procedure" page 7-8
Motor hunts	Too much IR Comp Motor is in Current Limit Motor speed is above rated speed	See "Adjustment Procedure" page 7-8 See "Adjustment Procedure" page 7-8 Reduce Max trimpot setting
Repeated fuse blowing	Low voltage Overload condition Worn motor brushes Defective motor bearings Failed electrical components	Should be above 108V or 216V Reduce load Relace motor brushes Replace motor bearings Return for repair
Motor runs but will not stop	Incorrect wiring Defective wiring Failed component	Check "Terminal Strip Wiring" sections Check wiring Return for repair

After using this section, if control will still not operate, consult your Dart Distributor or Representative or return unit for repair.

FUSING

The motor and control are protected against overloads by the current limit circuit. Additional protection is provided through 2 fuses, which are mounted on the main board. Use exact fuse replacements if the fuse requires changing. Before changing fuses, be sure the power to the control is disconnected at the power source. Note: Both sides of VAC input are fused.

HP: 1/8 - 2.0 H.P.	FUSE SIZE: 10 Amp*	FUSE TYPE: Bussman ABC-10 or Little Fuse 314010
HP: 3.0 H.P.	FUSE SIZE: 20 Amp	FUSE TYPE: Bussman ABC-20 or Little Fuse 314020

* Fuse size for 2 horsepower motors may need to be increased to 12-15 amps.

BASIC MODEL SELECTION

<i>120 VAC INPUT</i>		<i>0-90 VDC OUTPUT</i>		<i>100 VDC FIELD</i>	
HP RANGE	CHASSIS	RELAY CHASSIS	RELAY CHASSIS	RELAY ENCLOSED	RELAY ENCLOSED
1/8 - 1/0	510-100C	510-100RC	510-100RC	510-100RE	510-100RE
<i>240 VAC INPUT</i>		<i>0-180 VDC OUTPUT</i>		<i>200 VDC FIELD</i>	
HP RANGE	CHASSIS	RELAY CHASSIS	RELAY CHASSIS	RELAY ENCLOSED	RELAY ENCLOSED
1/4- 2.0	520-200C	520-200RC	520-200RC	520-200RE	520-200RE
3.0	523-300C		N/A		N/A

PARTS PLACEMENT & LIST

RESISTORS

R1	7.5K 5W
R2	1.5K
R3	5K SPEEDPOT**
R4	4.7K
R5	68K
R6	27K
R7	5K TRIM (MIN)
R8	470K
R9	22K
R10	10K
R11	2.2K
R12	47K
R13	1.2M
R14	10K
R15	1K
R17	470 OHM
R18	470 OHM
R19	47K
R20	470 OHM
R21	5K TRIM (MAX)
R22	100K
R23	47K
R24	1K TRIM (C.L. FINE)
R25	10 OHM
R27	10 OHM
R28	100 OHM TRIM (IR)
R29	.015 OHM 5W
R30	1K
R31	4.7K
R32	250K TRIM (ACCEL)
R33	1K
R34	27K
R35	250K TRIM (DECEL)
R36	47K
R37	1K
R38	250K TRIM (C.L.)
R39	4.7K
R40	100K
R41	1K
R42	4.7K
R43	1 OHM
R44	270 OHM 2W

ACTIVE DEVICES

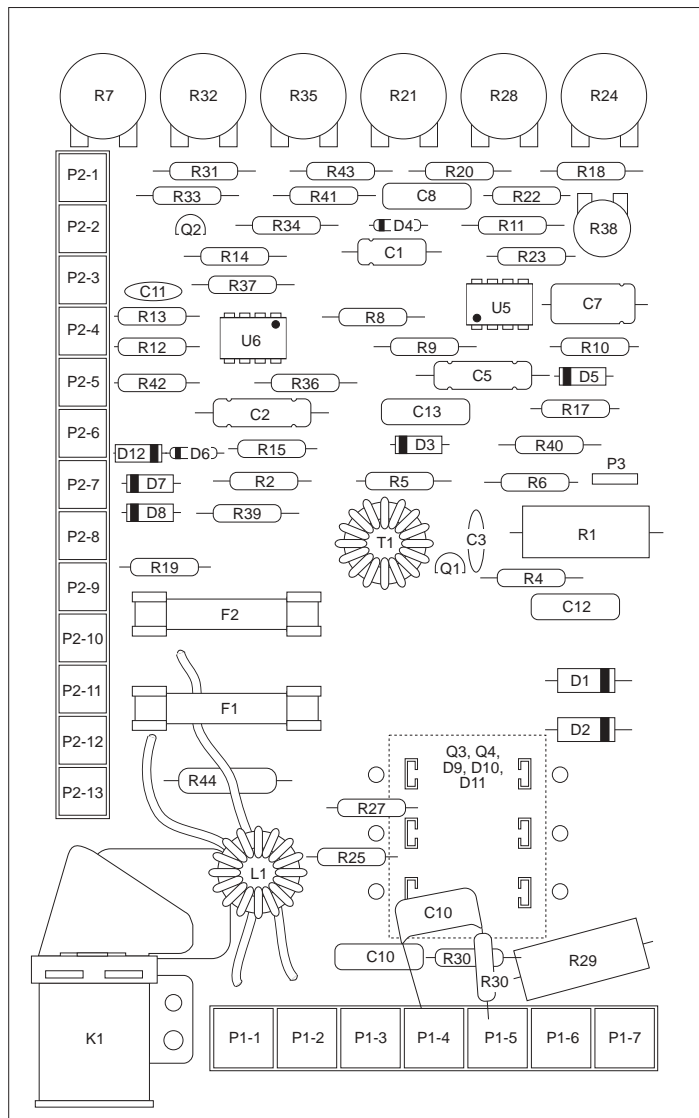
Q1	2N4871
Q2	2N4124
Q3	L512F-Y131*
Q4	L512F-Y131*
U5	LM358 IC
U6	LM358 IC

CAPACITORS

C1	47uf 16V
C2	1uf 50V N.P.
C3	.01uf 100V
C5	2.2uf 50V N.P.
C7	330uf 10V
C8	.22uf 250V
C10	.068uf 400V
C11	.01uf 100V
C12	.1uf 50V
C13	.1uf 50V

DIODES

D1	S6A4
D2	S6A4
D3	1N4005
D4	1N5242B
D5	1N4005
D6	1N5233B
D7	1N4005
D8	1N4005
D9	L512F-Y131*
D10	L512F-Y131*
D11	L512F-Y131*
D12	1N4005



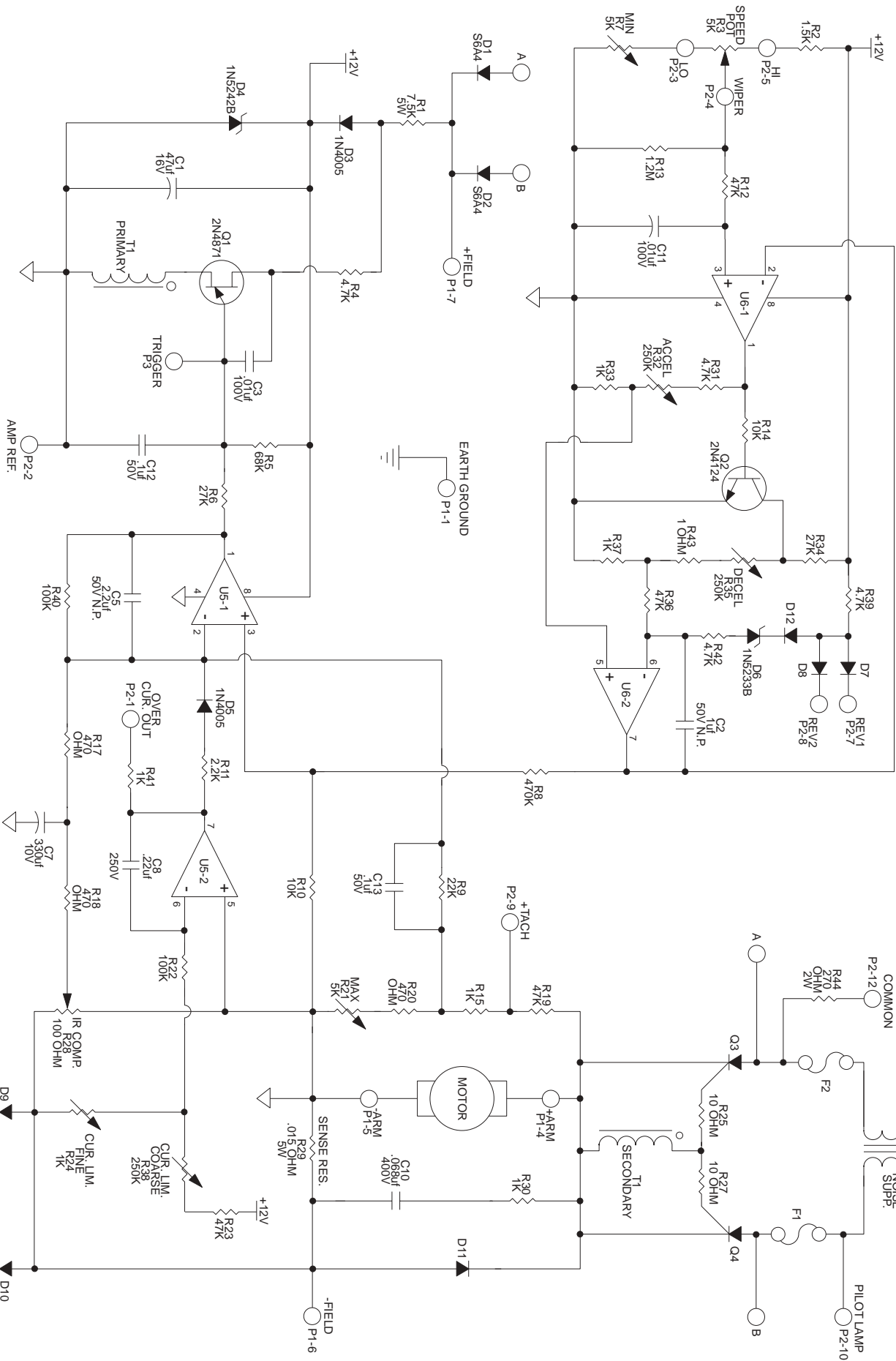
NOTES:

- FOR "C" VERSION, DELETE K1
- * B512F BRIDGE = D9, D10, D11, Q3, Q4 (S.N. C94 & EARLIER)
- * L512F-Y131 BRIDGE = D9, D10, D11, Q3, Q4 (S.N. D94 & LATER)
- U.L. VERSION = R30, C10 MOUNTED ON P1-4, P1-5 TERMINALS
- 523-300C CHANGES: R1 = 15K 6W, R6 = 10K, R23 = 220K, R29 = SENSE WIRE, (Q3,Q4,D9,D10,D11) = T612F, C12 = .22uf 400V, OMIT R5, C13
- 520 SERIES CHANGES: R1 = 25K 6W, R19 = 91K, R22 = 220K, OMIT C13
- "RE" VERSION: SEE "WIRING INSTRUCTIONS"
- 15A OPTION CHANGES: R36 = 180K
- ALL RESISTORS 1/4W UNLESS NOTED OTHERWISE
- ** REMOTE MOUNTED SPEEDPOT ON "C" AND "RC" VERSIONS

MISCELLANEOUS

- F1 REFER TO OFUSINGÓ
- F2 REFER TO OFUSINGÓ
- K1 S87R11A2B1D1 RELAY
- L1 NOISE SUPPRESSOR
- PCB A-4-0238B PC BOARD
- P1 7 POS. TERMINAL STRIP
- P2 13 POS. TERMINAL STRIP
- P3 1/4" MALE SPADE PIN
- T1 PULSE TRANSFORMER

SCHEMATIC DIAGRAM



NOTES:

D7, D8, D12 1N4005
 Q3, Q4, D9, D10, D11 B512F BRIDGE (S.N. C94 & EARLIER)
 Q3, Q4, D9, D10, D11 L512F-Y131 BRIDGE (S.N. D94 & LATER)

FOR RELAY CIRCUIT SCHEMATIC, SEE PAGE 10.
 ALL RESISTORS 1/4W UNLESS NOTED OTHERWISE.

NOTES:

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NOTES: