



ELECTRIC MOTORS, GEARMOTORS AND DRIVES

**SPEEDMASTER™
Variable Speed
D.C. Control
INSTRUCTION MANUAL**

This Book Covers Speedmaster™ Control
Numbers 174902 & 174903

LEESON ELECTRIC CORPORATION

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A. WARRANTY: LEESON Electric Corporation warrants that their products will be free from defects in material and workmanship for a period of one (1) year from date of shipment thereof. Within the warranty period LEESON Electric will repair or replace such products which are returned to LEESON Electric or to the nearest Branch Office, with shipping charges prepaid. At our option, all return shipments are F.O.B. LEESON Electric or its Branch Office. This warranty will not apply to any product which has been subjected to misuse, negligence; or misapplied; or repaired by unauthorized persons; or improperly installed. LEESON is not responsible for removal, installation or any other incidental expenses incurred in shipping the products to or from the repair point.

B. DISCLAIMER: The provisions of paragraph 'A' are LEESON'S sole obligation and exclude all other warranties of MERCHANTABILITY or use, express or implied. We further disclaim any responsibility whatsoever to the customer or to any other person for injury to person, or damage to or loss of property of value, caused by any product which has been subjected to misuse, negligence or accident; or misapplied; or modified or repaired by unauthorized persons; or improperly installed.

C. LIMITATION of LIABILITY: In the event of any claim for breach of any of LEESON'S obligations, whether express or implied, and particularly in the event of any claim of the warranty contained in paragraph 'A', or any other warranties, express or implied, or claim of liability, which might, despite paragraph 'B', be decided against us by any lawful authority, LEESON Electric shall under no circumstances be liable for any consequential damages, losses or expenses arising in connection with the use of, or inability to use, our product for any purpose whatsoever. An adjustment made under the warranty does not void the warranty, nor does it imply an extension of the original one (1) year warranty period. Products serviced and/or parts replaced on a no charge basis during the warranty period carry the unexpired portion of the original warranty only.

If for any reason any of the foregoing provisions shall be ineffective, the Company's liability for damages arising out of its manufacture or sale of equipment, or use thereof, whether such liability is based on warranty, contract, negligence, strict liability in tort or otherwise, shall not in any event exceed the full purchase price of such equipment.

Any action against the Company based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment or the use thereof, must be commenced within one year after the cause of such action arises.



*ELECTRIC MOTORS
GEARMOTORS AND DRIVES*

INTRODUCTION

- LEESON'S Speedmaster variable speed DC motor control is a versatile, general purpose control rated to 2 HP.
- The Speedmaster model has a dual voltage input (may accommodate either 120 or 240 VAC). It is available with an adjustable HP range of 1/8 thru 1 HP for 120 VAC, and 1/4 thru 2 HP for 240 VAC input.
- The control is designed for DC Permanent Magnet motors.
- Incoming AC voltage is also converted to adjustable full wave rectified DC voltage (via a packaged bridge) to operate the DC motor.
- The control incorporates transient voltage protection with adjustable current limit and an AC fuse for protection. It features adjustable minimum and maximum speeds along with adjustable acceleration and IR Compensation. Tach feedback is accomplished thru a connection to a pin (P2) on the printed circuit board.
- The Speedmaster Series has a linear acceleration/deceleration ramp.
- The control also has a barrier type terminal strip for all power and control wiring.
- The enclosed model uses a gasketed cover assembly that is rated NEMA 4/12.

COMMONLY ASKED QUESTIONS

Q. CAN I RUN TWO OR MORE MOTORS FROM THE SAME DRIVE?

A. Not recommended. The IR Comp (regulation) and Current Limit would have problems 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 input voltage you are using. The trimpots would need to be readjusted; see TRIMPOT CHART on page 11 for approximate settings.

Q. CAN I START AND STOP THE SPEEDMASTER WITHOUT BREAKING AC LINES?

A. Yes. Use the inhibit wiring instructions on page 12.

Q. CAN I USE THE SPEEDMASTER TO FOLLOW A VOLTAGE OR AS A TACH FOLLOWER?

A. Yes, the signal must be ungrounded. See TERMINAL STRIP on page 7.

Q. CAN I USE A MOTOR WITH A 90 VOLT ARMATURE WITH 240 VAC INPUT?

A. Not recommended. Motor or control damage could result from peak voltages.

CONTROL FEATURES

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

MAX. SPEED (maximum speed) - provides for adjustment of the motor speed when the speedpot is set at maximum (CW). This permits the user to eliminate the top end “deadband”, which will provide full speed at maximum rotation. Rotation of the “MAX” trimpot in the clockwise direction increases the maximum motor speed.

ACCEL (acceleration) - allows adjustment of the motor acceleration from a minimum of 0.5 seconds to approximately 0.8 seconds. The deceleration time depends on the ACCEL setting.

I. R. COMP (speed regulation) - adjusts the control output to compensate for speed changes caused by varying motor loads. As the motor load is increased, I.R. COMP increases the voltage output of the control. 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. Current limit adjustment (CUR LIM) is set at 125% of the rated motor current (torque) based on horsepower. Clockwise rotation of the “CUR LIM” trimpot increases the current (torque) the control will provide.

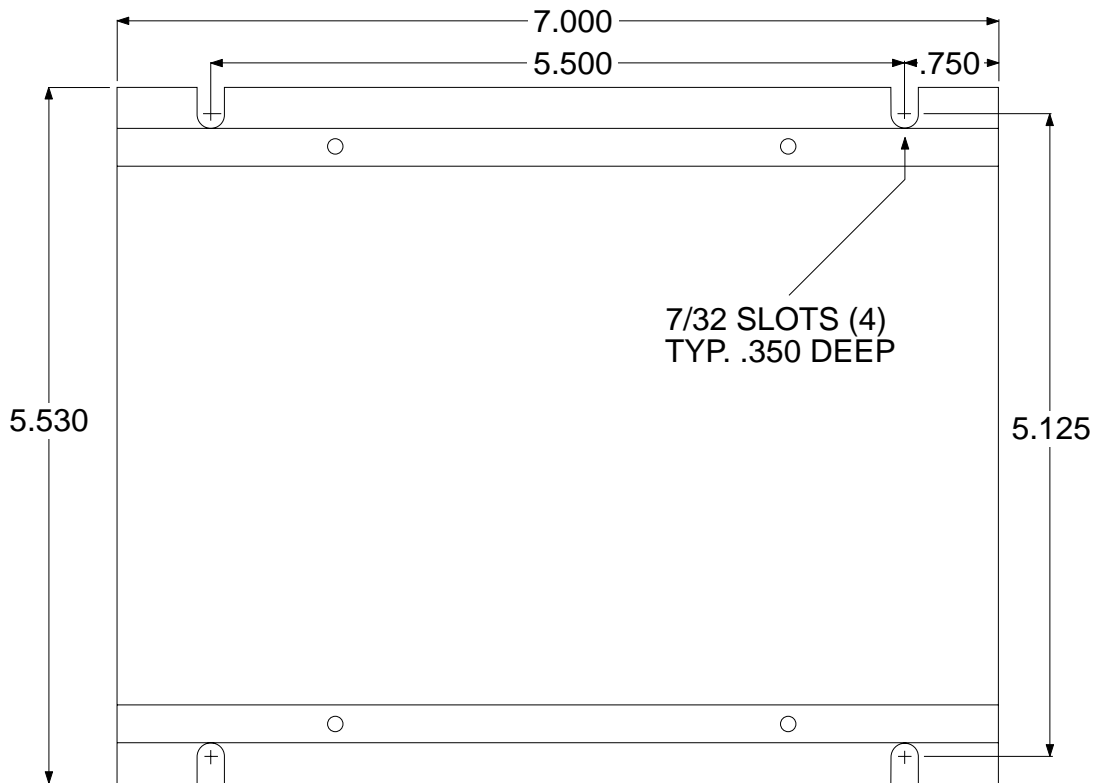
INHIBIT TERMINAL PIN (P2) - allows the user a choice of stopping and starting hard (fast) or stopping hard with a soft start through an adjustable acceleration ramp, without breaking the AC lines (see page 12).

TERMINAL STRIP - allows for connection of AC lines, motor leads, motor field (if needed), and speed potentiometer.

WARNING
AT NO TIME SHOULD CIRCUIT CONTINUITY
BE CHECKED BY SHORTING TERMINALS WITH
A SCREWDRIVER OR OTHER METAL DEVICE

DIMENSIONS

Allow 3.50" for height clearance, 7.40" for overall length.



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

MOUNTING

1. Four 7/32" diameter slots are provided for control mounting.
2. The chassis of the control can be used as a template.
3. Use standard hardware to mount.
4. Two threaded holes (1/2" NPT) are provided on the bottom side endplate near the terminal strip to facilitate wiring.

WARNING

1. Be sure the control housing is properly grounded.
2. Arm connections must not be switched or broken while the control is on. Serious damage may result.
3. For non-speedpot applications, the input connections to the Lo-Wiper-Hi leads must not be grounded. Serious control damage may result from a grounded input.

MODEL SELECTION

Note: The minimum current rating for this Speedmaster control is 150mA.

H.P.	Input Voltage	Output Voltage	Unidirectional	Reversing
1/8 1/4 1/3 1/2 3/4 1.0	120/240 VAC	0-90/0-180 VDC	174902	174903
1.5* 2.0*	240 VAC	0-180 VDC	174902	174903

* Not available with 120 VAC input - Input voltage determines maximum allowable H.P.

The Speedmaster will operate a 90 VDC motor in the H.P. range of 1/8 through 1 H.P., and a 180 VDC motor in the range of 1/4 through 2 H.P., using different trimpot settings.

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 #18 AWG or smaller as permitted by local code.
2. **Separate control wires** from all the Armature and AC line wires when routed in conduits or in wire trays. The Speedmaster has two threaded holes (1/2" NPT) in one endplate, located near the terminal strip, for this purpose.

CUSTOMER FUSING

The Speedmaster is provided with a fuse in AC line 1 (P1-11). This fuse is sized to open in the event of a shorted armature or if an armature line is shorted to earth ground. As long as 120 VAC input is connected properly, there is no additional fusing needed.

For 240 VAC applications, an external fuse may be used in AC line 2 (P1-10). This fuse should be a Bussman ABC10 or LittleFuse 314-010. This added fuse will provide protection on both AC legs to the control. If you desire not to fuse both legs, the fuse in the control will open in the event of excessive armature currents.

AC current is desired by motor characteristics. In a small number of applications it may be necessary to increase fuse value.

TERMINAL STRIP WIRING

The Speedmaster has an 11 position block type terminal strip for ease of connection.

- P1-1 (SPEEDPOT LO)** Connects to 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 follower) may be referenced to speedpot LO if the MIN trimpot adjustments are to be active. Otherwise, inputs may be referenced to -ARM, which will bypass the MIN trimpot. **NOTE: INPUT MUST NOT BE GROUNDED!!**
- P1-2 (SPEEDPOT WIPER)** Connects to wiper (red wire) of the 5K speedpot (center lead). For voltage follower applications, this **INPUT MUST NOT BE GREATER THAN +12 VOLTS MAXIMUM AND MUST NOT BE GROUNDED!**
- P1-3 (SPEEDPOT HI)** Connects to high side (white wire) of the 5K speedpot (CW end). This is internal +12 volts. For start-stop applications, the connection between this terminal and speedpot HI can be opened and closed by a SPST switch. See question #3 in "COMMONLY ASKED QUESTIONS". **NOTE: INPUT MUST NOT BE GROUNDED!!**
- P1-4 (-ARM)** Connects to minus (-) Armature wire (A2) on motor. For voltage follower applications where the MIN trimpot is bypassed, connect minus (-) of the follower to this terminal.
- P1-5 (+ARM)** Connects to plus (+) Armature wire (A1) on motor. 0-90 VDC for 120 VAC input OR 0-180 VDC for 240 VAC input. See "SPECIFICATIONS" for output rating.
- P1-6 (+FIELD)** DO NOT USE for permanent magnet motor. This supplies +Field voltage for a SHUNT WOUND MOTOR. Refer to Field Voltage table. For motors with dual voltage field (i.e. 50/100V or 100/200V), make sure highest value is connected.

FIELD VOLTAGE TABLE		
VAC INPUT	120	240
VDC FIELD	100	200

P1-7 (-FIELD) DO NOT USE for permanent magnet motor. Connect minus (-) Field wire of SHUNT WOUND MOTOR.

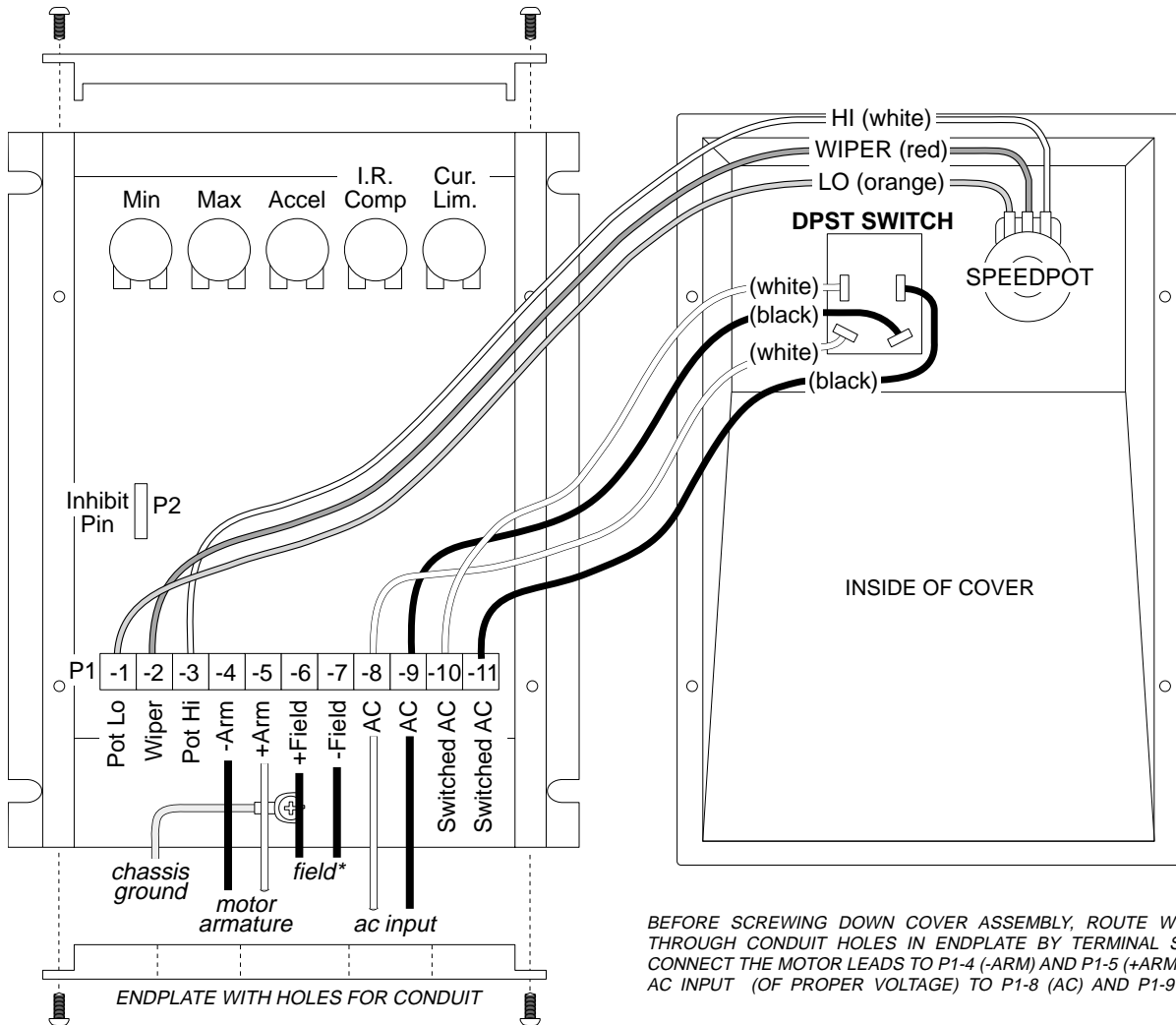
P1-8 } VERY IMPORTANT !!! Refer to "CUSTOMER FUSING" ON PAGE 6.

P1-9 } ENCLOSED VERSION: (AC) 120VAC - Connect incoming hot AC (black wire) to P1-9 and Neutral (white wire) to P1-8. Connect ground (green wire) to Chassis Ground, as shown in diagram - page 8.
240VAC - Connect both hot sides, one to P1-8 and one to P1-9. Also connect ground wire to Chassis Ground.

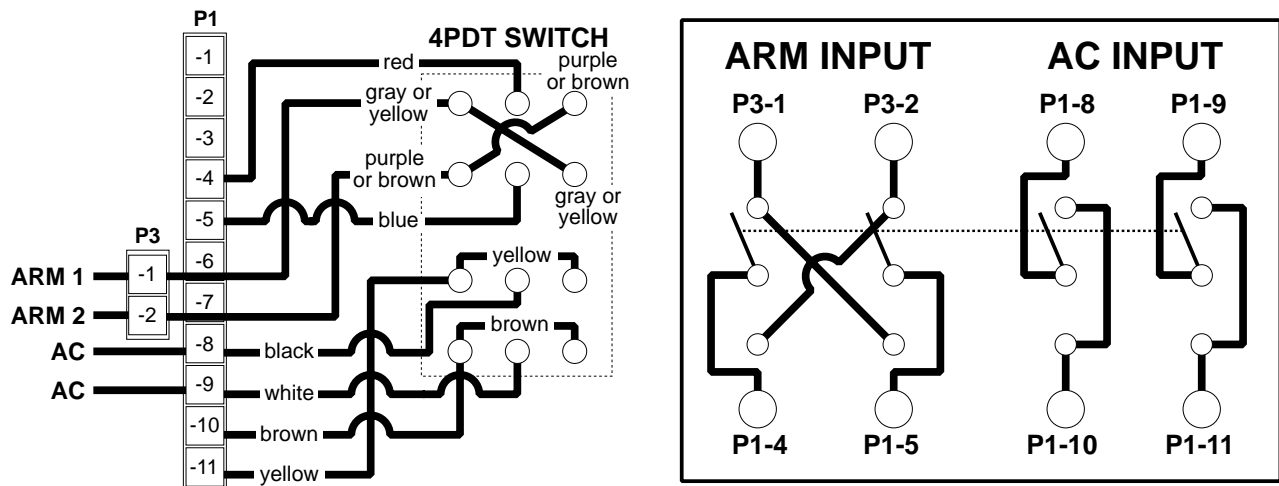
P1-10 } VERY IMPORTANT !!! Refer to "CUSTOMER FUSING" ON PAGE 6.

P1-11 } ENCLOSED VERSION: (SWITCHED AC) No connections to P1-10 and P1-11. This is for switched AC output. Note "FACTORY WIRING" (page 8). Pilot lights can be connected between these terminals. The voltage present at these terminals is AC input voltage.

SPEEDMASTER MODEL 174902 HOOK-UP DIAGRAM



SPEEDMASTER MODEL 174903 HOOK-UP DIAGRAM



START-UP PROCEDURE

WARNING:

ALL POWER MUST BE TURNED OFF BEFORE PROCEEDING !!!

1. Recheck all wiring. Accidental grounds, loose or pinched wires on armature or speedpot wires may damage the control when power is applied.
2. Check to see that incoming service is of correct voltage.
3. Turn speedpot to zero (fully CCW).
4. Turn power on and advance speedpot while observing motor.

WARNING: POWER MUST BE OFF BEFORE STEP 5 CAN BE ACCOMPLISHED!

5. If motor rotation is incorrect, turn power off at external disconnect and reverse +ARM and -ARM connections.
6. Check for satisfactory operation throughout the speed range.
7. If operation is satisfactory, no readjustments are needed.
8. If instability or surging is observed, or if maximum speed is higher than desired, proceed to "TRIMPOT ADJUSTMENT" on pages 10 and 11.
9. For other problems, consult page 14, "IN CASE OF DIFFICULTY".

ADJUSTMENTS

The trimpot adjustments, MIN, MAX, I.R. COMP, and CUR LIM are checked at the factory using a typical motor at 240 VAC input. Use the **TRIMPOT CHART** on page 11 to preset the trimpots for the proper setting for your application. The remaining trimpot - ACCEL, is a variable acceleration and should be set for your particular application.

The trimpot chart is approximate. The chart is valid when using the speedpot or a 0-10/12 VDC input signal to set speed.

These adjustments are permanent; periodic readjustment is normally not needed. Operation of the control beyond $\pm 10\%$ of normal line voltage could result in readjustments.

TRIMPOT ADJUSTMENT PROCEDURE

TRIMPOT	FUNCTION	ADJUSTMENT
MAX	<u>SETS MAXIMUM MOTOR SPEED</u> when speedpot is set at maximum (100% rotation CW). CW rotation of MAX trimpot increases maximum motor speed.	<ol style="list-style-type: none"> 1. TURN DRIVE POWER OFF!! 2. Connect DC Voltmeter: + to +ARM, - to -ARM. 3. Set meter voltage range: (90VDC or 180VDC). 4. Turn power on. Set speedpot at 100%. 5. Adjust MAX trimpot to rated motor armature voltage as shown on meter. <p>NOTE: A tachometer or strobe may be used in lieu of a meter. Follow preceding steps, except adjust MAX trimpot to rated motor base speed indicated by tachometer or strobe.</p>
MIN	<u>SETS MINIMUM MOTOR SPEED</u> when speedpot is set at zero. CW rotation will increase minimum motor speed.	<ol style="list-style-type: none"> 1. Set speedpot to zero (fully CCW). 2. Rotate MIN trimpot CW until motor rotates. 3. Slowly rotate MIN trimpot CCW until motor stops. <p>NOTE: If motor rotation at zero is desired, rotate MIN trimpot CW until desired minimum speed is reached.</p>
I.R. COMP.	<u>CALIBRATES SPEED REGULATION</u> - Provides a means of improving motor speed regulation in the armature feedback mode. If a slowdown due to load changes is of no concern, rotate this trimpot fully CCW.	<ol style="list-style-type: none"> 1. Set speedpot at 50%. 2. Observe motor speed at no load condition. 3. Apply a full load to the motor. 4. Adjust IR COMP trimpot CW to obtain the same motor speed as with no load.
CUR. LIM.	<u>LIMITS DC MOTOR ARMATURE CURRENT (Torque)</u> to prevent damage to the motor or control. The current limit is set for the rated motor current. CW rotation of this trimpot increases the armature current (or torque produced).	<ol style="list-style-type: none"> 1. TURN DRIVE POWER OFF !! 2. Connect a DC ammeter between A1 on the motor and +ARM on the control. This is in series with the motor. 3. Turn power on. 4. Set speedpot at the 50% position. 5. Set CUR LIM trimpot fully CCW. 6. Apply friction braking to the motor shaft until motor is stalled (zero RPM). 7. While motor is stalled, set current at 125% of rated nameplate motor armature current by adjusting the CUR LIM trimpot.
ACCEL	<u>ALLOWS ADJUSTMENT OF ACCELERATION</u> by user.	<ol style="list-style-type: none"> 1. CW rotation increases time of acceleration.

SPEEDMASTER TRIMPOT SETTING CHART

- * THESE SETTINGS APPLY WHEN USING A 5000 OHM MASTER SPEEDPOT.
- * THIS TRIMPOT CHART IS APPROXIMATE. USE IT IN CONJUNCTION WITH THE ADJUSTMENT PROCEDURES.

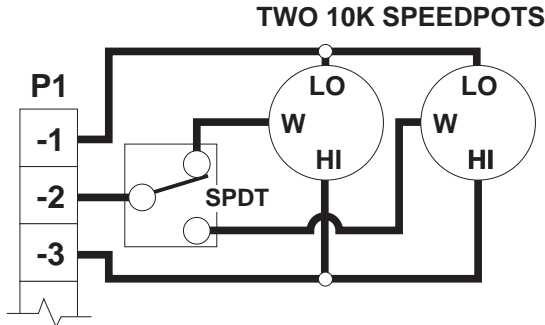
MIN	MAX	ACCEL	I.R.	C.L.	H.P.	INPUT VOLTAGE	OUTPUT VOLTAGE
					1/8	120VAC	0-90VDC
					1/4	120VAC	0-90VDC
					1/3	120VAC	0-90VDC
					1/2	120VAC	0-90VDC
					3/4	120VAC	0-90VDC
					1.0	120VAC	0-90VDC

MIN	MAX	ACCEL	I.R.	C.L.	H.P.	INPUT VOLTAGE	OUTPUT VOLTAGE
					1/4	240VAC	0-180VDC
					1/2	240VAC	0-180VDC
					3/4	240VAC	0-180VDC
					1.0	240VAC	0-180VDC
					1.5	240VAC	0-180VDC
					2.0	240VAC	0-180VDC

CONTROL MODIFICATIONS

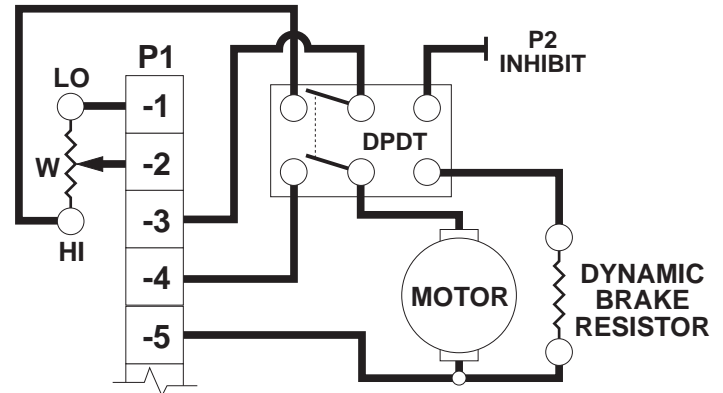
TWO SPEED OPERATION

Two pot operation is done using two 10K ohm speed potentiometers in parallel (both HI's to P1-3, both LO's to P1-1). The WIPER is switched using a SPDT switch.



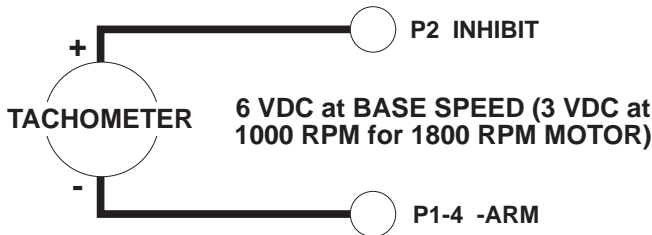
DYNAMIC BRAKING

A DPDT switch is used to inhibit the control and to connect the DBR. Typical values for the DBR (dynamic brake resistor) are 5 ohms for 120V, 10 ohms for 240V (both 35W to 50W). Note that motor horsepower, inertia, and cycle time effect sizing of the DBR. **NOTE: This modification cannot be used with the -17B option.**



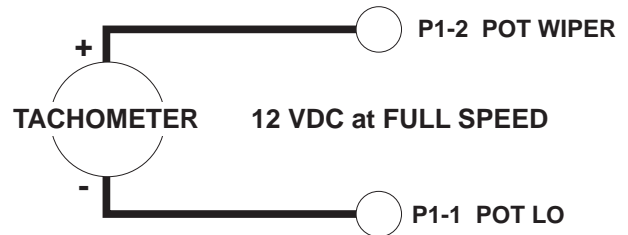
TACHOMETER FEEDBACK

Improves speed regulation to $\pm 1/2\%$ of base speed. Control goes to full output when input goes to zero, above and beyond MAX trimpot setting



TACHOMETER FOLLOWER

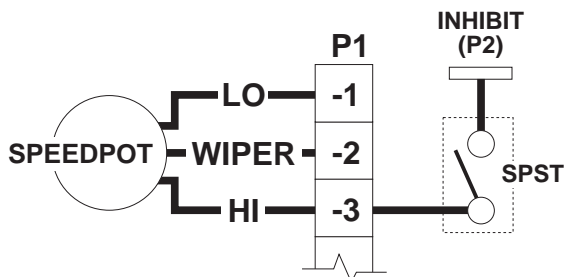
Allows control output to follow tachometer voltage.



NOTE: NEED 1% OR LESS - TACH OUTPUT RIPPLE

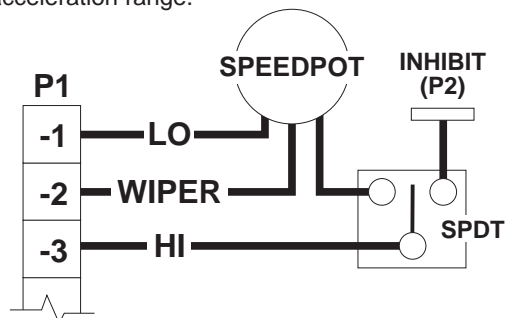
INHIBIT (USED INDEPENDENTLY)

The customer supplied SPST switch is connected in series between the speedpot HI (P1-3) and the Inhibit pin (P2). To inhibit, speedpot HI is closed to the Inhibit pin. To restart, the switch is returned to open. **NOTE: The control will stop and start fast, accel is bypassed.**



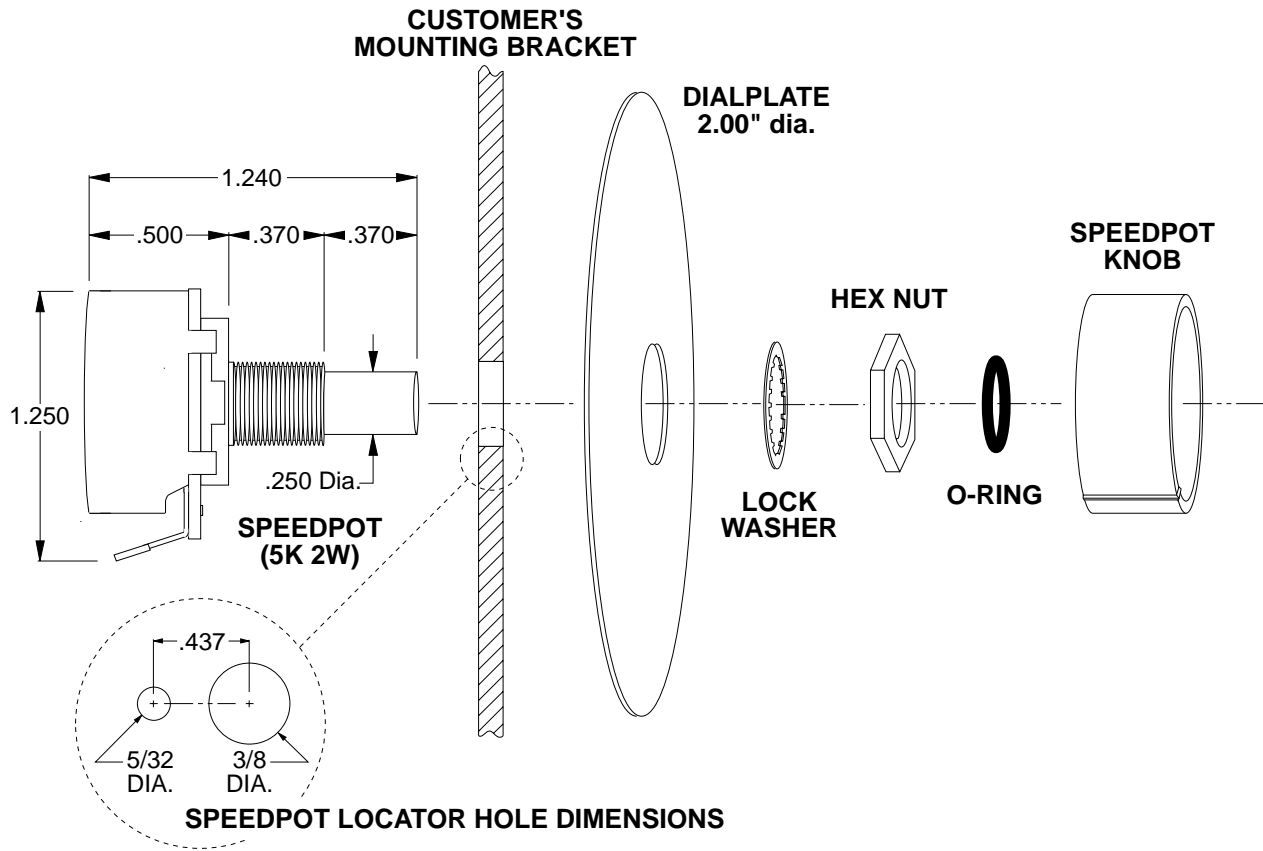
INHIBIT (USED WITH SPEEDPOT)

The Common of the SPDT switch is connected to control pot HI and is switched between Speedpot Hi and the Inhibit pin (P2). To inhibit (stop motor), speedpot HI is closed to the Inhibit pin. To restart, the switch is returned to Speedpot Hi. **NOTE: The control will stop fast and soft start through a fixed acceleration range.**



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.

SPEEDPOT DIMENSION INFORMATION



MAINTENANCE PROCEDURE

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

IN CASE OF DIFFICULTY

If a newly installed control will not operate, it is possible that a terminal or connection is loose. Check to make sure that all connections are secure and correct. If the control still doesn't operate, refer to the following chart:

PROBLEM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION(S)
Motor doesn't operate	<ul style="list-style-type: none"> - blown fuse - incorrect or no power source - speedpot set at zero - worn motor brushes 	<ul style="list-style-type: none"> replace fuse install proper service adjust speedpot CW to start replace motor brushes
Motor stalls, or runs very slowly with speedpot turned fully CW	<ul style="list-style-type: none"> - low voltage - overload condition - worn motor brushes - max speed set incorrectly 	<ul style="list-style-type: none"> check - should be above 108V reduce load replace motor brushes see ADJUSTMENT PROCEDURE
Motor hunts	<ul style="list-style-type: none"> - too much I.R. Comp. - motor is in current limit - motor not pulling enough current - max trimpot set too high - motor speed is above rated speed 	<ul style="list-style-type: none"> see ADJUSTMENT PROCEDURE see ADJUSTMENT PROCEDURE current must be greater than 150 mA D.C. see ADJUSTMENT PROCEDURE reduce speed
Repeated fuse blowing	<ul style="list-style-type: none"> - low voltage - overload condition - worn motor brushes - defective motor bearings - defective electrical component 	<ul style="list-style-type: none"> check - should be above 108V reduce load replace replace call LEESON Distributor / Representative
Motor runs but will not stop	<ul style="list-style-type: none"> - incorrect wiring (enclosed version) - defective wiring - defective component 	<ul style="list-style-type: none"> check TERMINAL STRIP WIRING for correct wiring instructions (note AC line connection in particular) check wiring call LEESON Distributor / Representative

If control still will not operate, consult your LEESON Distributor or Representative.

SPECIFICATIONS

AC input voltage $\pm 10\%$ of rated line voltage
Acceleration 0.5 to 8.0 seconds
Amps - DC output 150 mA to 10.8 Amps D.C.
Controller overload capacity 150% for one minute
Current limit trimpot range 1.0 to 15.0 Amps D.C.
Deceleration (dependent on acceleration time setting)06 to .80 second range
Dimensions and weight:

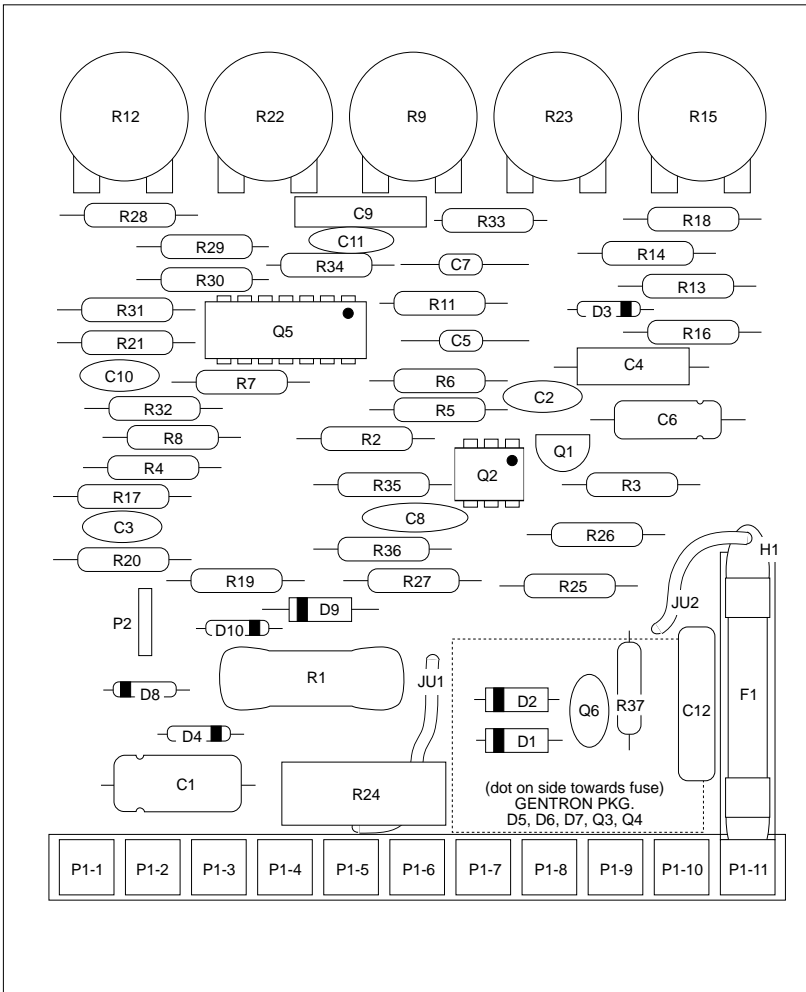
	WIDTH	LENGTH	HEIGHT	WEIGHT	MODEL #
ENGLISH	5.530"	7.250"	3.500"	26.80 oz.	174902
	5.530"	7.250"	3.500"	30.80 oz.	174903
METRIC	140mm	184mm	89mm	681 gms.	174902
	140mm	184mm	89mm	782 gms.	174903

Drive service factor 1.0
Efficiency 85% typical
Input frequency 50 or 60 Hertz
Max. trimpot speed range 66% to 110% of base speed
Min. trimpot speed range 0% to 30% of maximum speed
Minimum external impedance (pot hi to pot low) 5K ohms
Power devices packaged full wave bridge
Speed control via 5Kohms 2W linear potentiometer or 0-10VDC isolated signal
Speed range 50:1
Speed regulation $\pm 1\%$ of base speed
Temperature range -10° to 45° C. ambient (15° to 115° F.)
Transient protection G-Mov
Type ramp of accel/decel linear

TYPICAL MOTOR CURRENTS

Horsepower Rating	1/4	1/3	1/2	3/4	1.0	1.5	2.0
Typical AC Amps (120VAC)	3.50	4.40	6.50	9.30	13.20	-----	-----
Typical Arm Amps (120VAC)	2.70	3.40	5.00	7.20	10.20	-----	-----
Typical AC Amps (240VAC)	1.80	2.20	3.30	4.80	6.50	9.70	12.90
Typical Arm Amps (240VAC)	1.40	1.70	2.50	3.70	5.00	7.50	9.90

SPEEDMASTER PARTS PLACEMENT & LIST



RESISTORS

R1	15K 8W
R2	2.7K
R3	2.7K
R4	1.2M
R5	180K
R6	82K
R7	470K
R8	15K
R9	250K TRIMPOT (ACCEL)
R10	5K SPEEDPOT *
R11	10K
R12	5K TRIMPOT (MIN)
R13	470K
R14	300K
R15	5K TRIMPOT (C.L.)
R16	4.7K
R17	390K
R18	4.7K
R19	150K
R20	1K
R21	1K
R22	50K TRIMPOT (MAX)
R23	100 OHM TRIMPOT (I.R.)
R24	.01 OHM 5W
R25	390 OHM
R26	390 OHM
R27	1K
R28	20K 1% 1/4W
R29	10K
R30	180K
R31	390K
R32	47K
R33	470K
R34	100K
R35	470 OHM
R36	91K
R37	1 OHM

DIODES

D1	1N4005
D2	1N4005
D3	1N914B
D4	1N5242B
D5	L512FY131
D6	L512FY131
D7	L512FY131
D8	1N914B
D9	1N4005
D10	1N5233B

CAPACITORS

C1	10uf 35V
C2	.01uf 100V
C3	.001uf 1KV
C4	.033uf 400V
C5	.1uf 50V
C6	22uf 16V
C7	.1uf 50V
C8	.0047uf 1KV
C9	.22uf 250V
C10	.01uf 100V
C11	.01uf 100V
C12	.068uf 250V (across-the-line)

ACTIVE DEVICES

Q1	2N6027
Q2	3052 MOC
Q3	L512FY131
Q4	L512FY131
Q5	LM324N IC
Q6	275V G-MOV

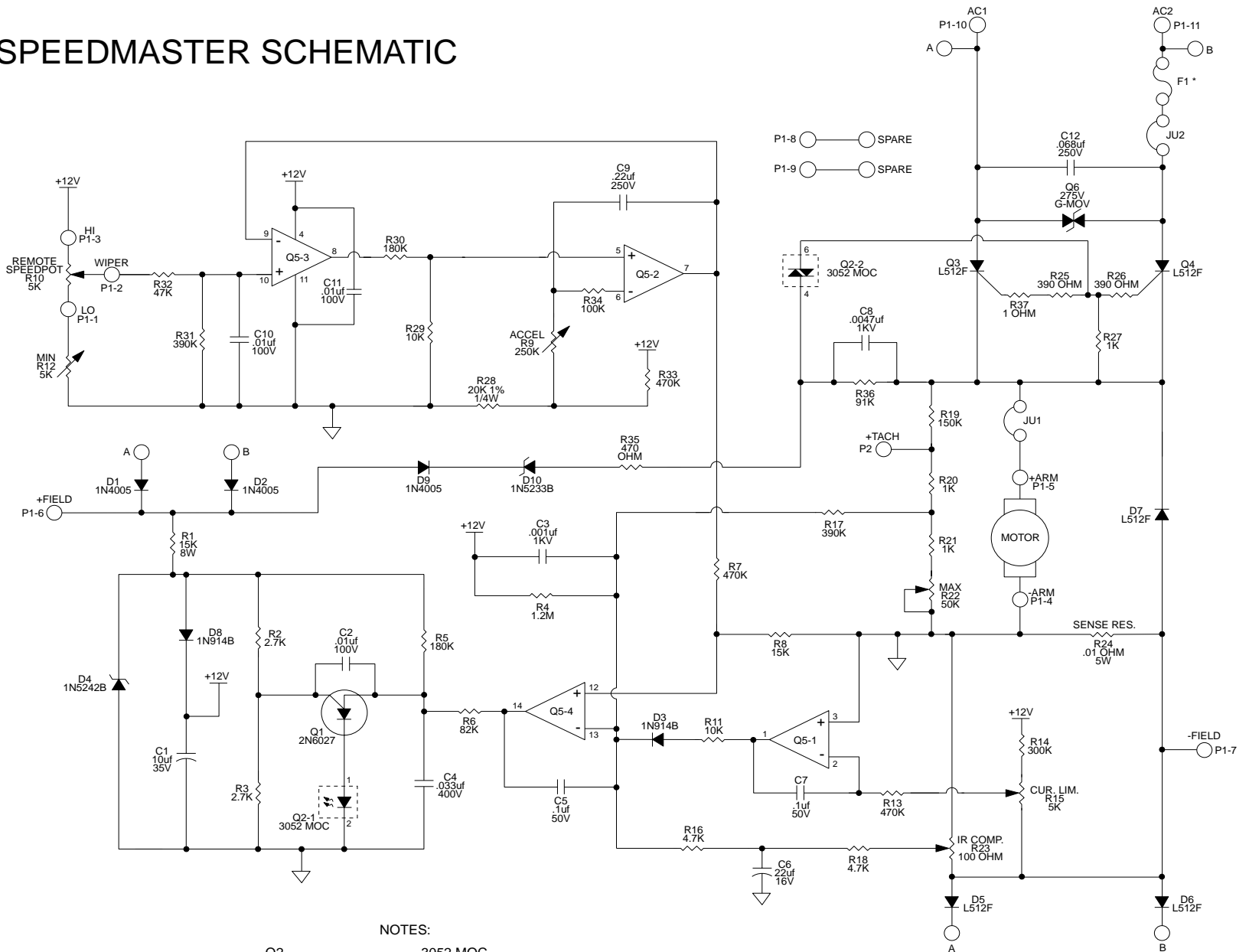
MISCELLANEOUS

F1	10 AMP FUSE (BUSSMAN ABC or LITTLEFUSE 314 SERIES CERAMIC FUSES)
H1	BUSSMAN S-8201-1X FUSE HOLDER
JU1	1.75" - 16GA. SOLID INSULATED WIRE
JU2	2.50" - 16GA. SOLID INSULATED WIRE
P1 (-1 THRU -11)	11 POS. TERMINAL STRIP
P2	1/4" SPADE PIN TERMINAL
PCB	A-4-1918D PRINTED CIRCUIT BOARD

NOTES:

ALL RESISTORS 1/2W UNLESS SPECIFIED.
* CUSTOMER WIRED SPEEDPOT

SPEEDMASTER SCHEMATIC



NOTES:

- Q2 3052 MOC
- Q3, Q4, D5, D6, D7 L512FY131 GENTRON
- Q5 LM324N IC
- F1 * BUSS ABC-10 or LITTLEFUSE 314010

ALL RESISTORS 1/2W UNLESS NOTED OTHERWISE

