INSTALLATION

OPERATION

MAINTENANCE

MELLTRONICS DRIVES

1235

EDDY CURRENT CONTROL

Melltronics Industrial, Inc.

MAIL: PO BOX 2368
INDIAN TRAIL, NC 28079-2368
SHIPPING: 3479 GRIBBLE ROAD
MATTHEWS, NC 28104-8114

PHONE: 704-821-6651
www.melltronics.com

SAFETY WARNINGS:

Improper installation or operation of this drive control may cause serious injury to personnel or equipment. Before you begin installation or operation of this equipment you should thoroughly read this instruction manual and any supplementary operating instructions provided. The drive must be installed and grounded in accordance with local and national electrical codes. To reduce potential of electric shock, disconnect all power sources before initiating any maintenance or repairs. Keep fingers and foreign objects away from ventilation and other openings. Keep air passages clear. Potentially lethal voltages exist within the control unit and connections. Use extreme caution during installation and start-up.

BRANCH CIRCUIT PROTECTION:
Branch circuit protection is to be provided by end user.

OVERLOAD PROTECTION:
Overload protection must be provided per national electric code article 430, Section C.

INITIAL CHECKS:
Before installing the drive control, check the unit for physical damage sustained during shipment. Remove all shipping restraints and padding.

INSTALLATION LOCATION OF CONTROL:
Controls are suitable for most factory areas where industrial equipment is installed. The control and operator's control station should be installed in a well-ventilated area. Locations subject to steam vapors or excessive moisture, oil vapors, flammable or combustible vapors, chemical fumes, corrosive gases or liquids, excessive dirt, dust or lint should be avoided unless an appropriate enclosure has been supplied or a clean air supply is provided to the enclosure. The location should be dry and the ambient temperature should not exceed 104^{o}F. If the mounting location is subject to vibration, the enclosure should be shock-mounted.
If the enclosure has a ventilating fan, avoid, wherever possible, and environment having a high foreign-matter content otherwise the filters will have to be changed more frequently or micron-filters installed. Should a control enclosure require cleaning on the inside, a low pressure vacuum cleaner is recommended, not an air hose, because of the possible oil vapor in the compressed air and its high pressure.

MELLTRONICS 1235 – RECEIVING INFORMATION

EDDY-CURRENT MODEL ____________________

PART NUMBER ____________________

SERIAL NUMBER ____________________

REVISION ____________________

HORSEPOWER RATING ____________________

VOLTAGE ____________________

MODIFICATIONS ____________________

ACCEPTANCE:
Carefully inspect shipment upon arrival and check items with packing list. Shortage or damage should be reported promptly to the carrier and your distributor.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TROUBLE SHOOTING CHARTS

SECTION 1
INTRODUCTION

This operating and maintenance manual contains necessary information for normal installation, operation and maintenance of Eddy Current Control Model 1235. The Operator and/or Maintenance Personnel should have access to a copy of this Instruction Book.

The purpose of this book is to provide basic operating and technical information applicable to the Eddy Current 1235 Control. It does not cover all details or variations in this equipment and should be applied in conjunction with specific schematics, drawings and engineering advice provided by Melltronics.

1.1 DESIGN

Eddy Current Drives utilize a design to maximize electronic response and operational efficiency. Compact rugged physical (solid state) construction allows control and drive to be located in adverse environments with reliable operation.

1.2 SAFETY

Multiple safety features protect the control and associated equipment from possible damage due to drive overload, line loss, transients and other electrical or mechanical failure.

Normal operator adjustments are located on isolated front panel to reduce hazards of possible electrical shock when system requires adjustment.

SECTION 2
GENERAL INFORMATION

2.1 STANDARD OPERATION FEATURES

1. Same basic low-cost control for all drive models 1 to 900HP
2. Compact 8” x 10” panel with single, printed circuit board construction
3. Net flexibility – many modular modifications possible with simple terminal connection installation
4. Encapsulated SCR power cube provides reliability and simplicity
5. Integrated circuit operational amplifier for high gain, fast response
6. Adjustable linear acceleration rate from 2 to 20 seconds supplied as standard
7. 2% regulation from standard AC tachometer feedback

2.2 STANDARD SAFETY FEATURES

1. Mov line transient SCR protection
2. “RC” SCR Protection
3. Isolated reference circuitry (except in torque mode)
4. Fused AC Overload Protection
5. Isolated Control Circuitry

2.3 STANDARD ADJUSTMENTS

P1 - Accel
P2 - Min Speed
P3 - Max Speed
P4 - Meter Calibration
P5 - Stability
P6 - Lead
P7 - Gain
P8 - Bias

2.4 AVAILABLE OPTIONS

The standard drive may be easily modified with simple terminal connection installation.
Options Include:

- Jog at independent adjustable jog speed
- Brake power supply
- Threading at present level
- Test meter
- Follower operation capable of following tachometer, generator or external voltage signal reference at an adjustable ratio
- Current limit – AC motor current
- Torque control regulation
- Zero speed detector
- Auto/manual selection
- Phase limit
- Dancer position
- Dancer trim
- Adjustable acceleration, deceleration
- Differential speed trip
- Operations may be incorporated in combinations to suit applications.

2.5 SPECIFICATIONS

Eddy Current Model	HP Range	VAC
1235-1	¾ -150	115
1235-45	150-900	115

INPUT TOLERANCE
Line voltage variations
should not exceed –5% to +10%

Frequency limitations 60HZ ± 2HZ

ALTITUDE
Up to 3300 feet. Consult factory for higher elevations.

AMBIENT TEMPERATURE 10^{O}C-40^{O}C

PERFORMANCE CHARACTERISTICS
Linear Acceleration 2-30 seconds
(Extended time optionally available)

SPEED REGULATION
Internal AC Tachometer-2% of top speed

DC Tachometer
5PY ½% regulation w/95% load change, 1% drift
BC42 ½% regulation w/95% load change, 1% drift
BC46 1% regulation w/95% load change

DIGITAL REGULATION .05% of set speed
over 10 to 1 speed range

SECTION 3
DESCRIPTION

3.1 SCHEMATICS

1235-1 Eddy Current Control
1235-45 Eddy Current Control (High Power)
1235-6 Brake Option
1235-7 Jog
1235-15 Dancer Feedback
1235-18 Threshold Detector
1235-19 Accel

Mechanical Drives
ED-80, 160
ED-320, 640, 1280, 4500

The 1235-1 Eddy Current Speed Control Printed Circuit Board Contains the following circuitry:

a. Power supply
b. Run relay
c. Speed reference
d. Speed feedback
e. Error amplifier
f. Phase control
g. SCR power output
h. Jog option board
i. Friction brake option board

3.2 ADJUSTMENTS

P1 - Accel
P2 - Min Speed
P3 - Max Speed
P4 - Meter Calibration
P5 - Stability
P6 - Lead
P7 - Gain
P8 - Bias

SECTION 4
THEORY OF OPERATION

4.1 DRIVE OPERATION

An Eddy Current drive system consists of AC Motor and Eddy Current coupling, a control and operator's control station.

The drive unit consists of an AC induction motor driving the input member or fan pole assembly of the magnetic drive. There is no mechanical linkage between input and output members of the drive. Torque is transmitted from the AC motor to the load by eddy current action when the clutch field coil is excited with DC current. (Figure 1)

The control supplies DC voltage to the drive field coils and automatically varies drive excitation to maintain desired speed, torque, tension, position, or horsepower, as determined by the feedback signal.

The associated operator's controls are those necessary for the operator to control the drive such as: START and STOP pushbuttons and SPEED.

4.2 OPERATION OF BASIC EDDY CURRENT CONTROL

The control is used to regulate speed of the output member of the eddy current drive unit. The control supplies regulated DC excitation to the magnetic drive field coil. Drive excitation determines drive speed. Speed regulation is accomplished by comparing signals which represent actual and desired speed. The resultant error is used to produce an increase or decrease in drive excitation until actual speed equals desired speed.

The regulator section of the control maintains drive speed constant with feedback signal approximately equal to reference signal. The basic regulator consists of a reference, feedback, stabilization circuitry and a power module.

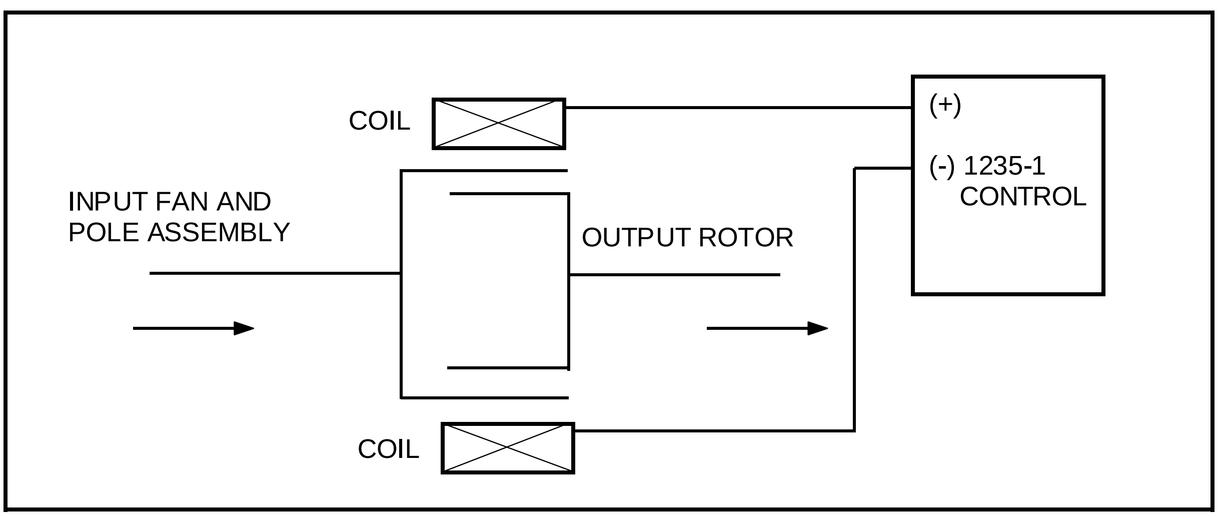

Figure 1: Eddy Current Drive Schematic

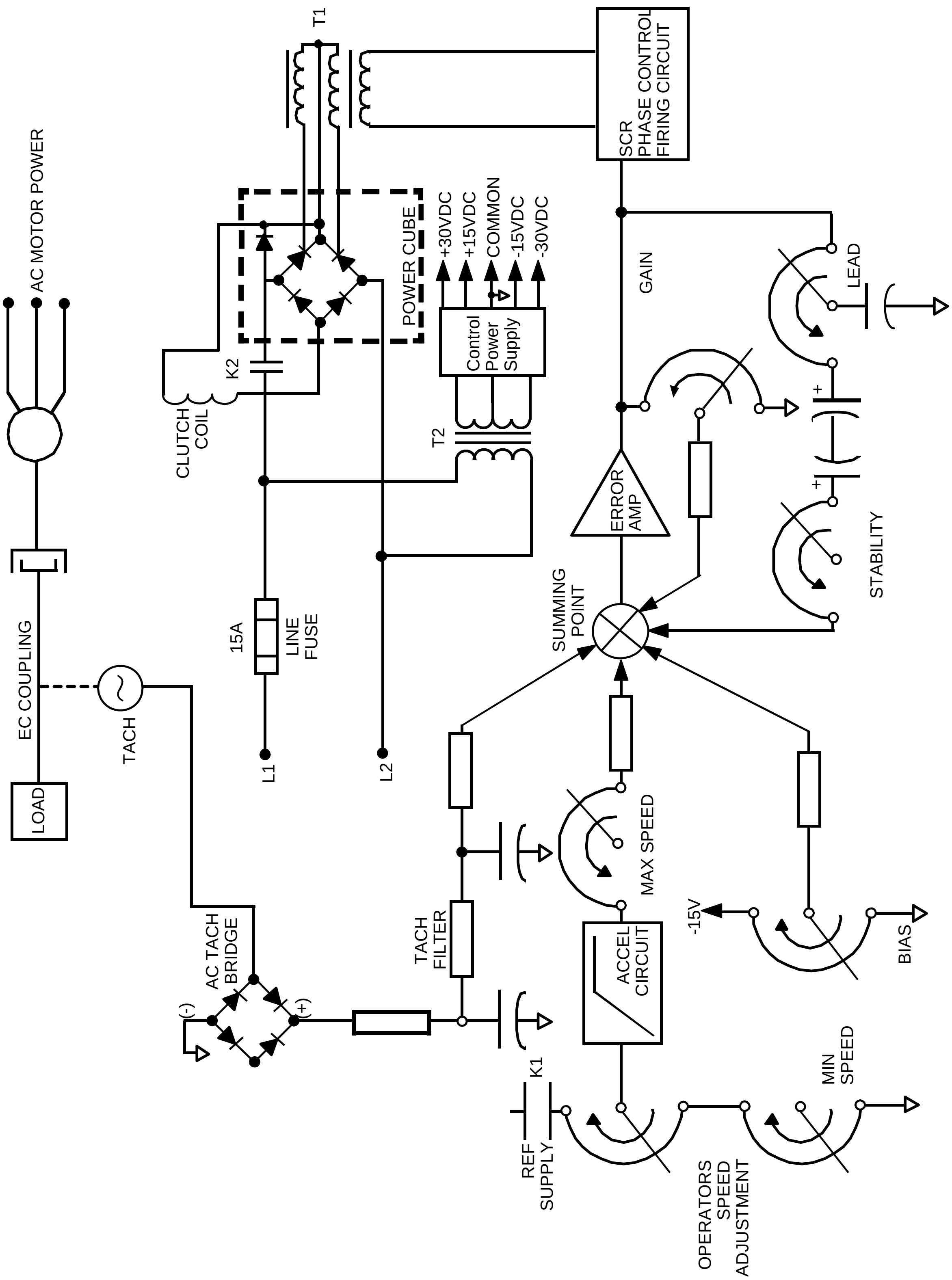

Figure 2: 1235 Eddy Current Control Basic Block Diagram

SECTION 5
CIRCUIT DESCRIPTION

5.1 POWER SUPPLY

5.1.1 OPERATION

The low voltage power supply converts 115VAC to unregulated ±30 and ±15 zener regulated DC voltage when 115 VAC is applied to the incoming line and K1 (run relay) is de-energized and no external load.

5.1.2 FUNCTIONAL DESCRIPTION

Transformer (T2) reduces 115VAC line voltage on the primary to 40 volts AC across 3 to 6 on the secondary. Connections 4 and 5 provide a center tapped secondary connection. WO6 rectifier provides full wave rectification of the secondary AC voltage.

Filter capacitor C1 has its positive terminal as common, the volts AC from centertap to 3 and 6 provide a voltage of 21VAC RMS. Since the peak of a 21VAC waveform is approximately 30 volts, the voltage on C1 negative terminal relative to common will be approximately 30 volts. This occurs as C1 charges to the peak value of the wave.

Filter capacitor C2, the negative 30 volt supply, is similar to the positive supply except that C2 charges through diode D1. At the anode of D1, an unfiltered DC voltage appears. This voltage is used to synchronize the phase control circuit with the AC line crossing.

Regulated +15 volt supply, zener diode and resistor and capacitor C16 compose the supply.

The zener diode, DZ1, is a 15V ±5% unit. Current for the load and zener is supplied from the +30V unregulated supply through R2. Capacitor C16 provides additional smoothing of the regulated supply and provides a low impedance bypass of the supply.

Regulated -15VDC volt supply zener diode and resistor and capacitor C17 compose the supply.

The zener diode, DZ2, is a 15V ±5% unit. Current for the load and zener is supplied from the -30V unregulated supply through R3. Capacitor C17 provides additional smoothing of the regulated supply and provides a low impedance bypass of the supply.

Varistor provides the power supply and its load with protection form over-voltage and from high voltage short duration spikes which are common in industrial environments.

RC1 provides a low impedance shunt path for fast rising noise and high voltage spikes.

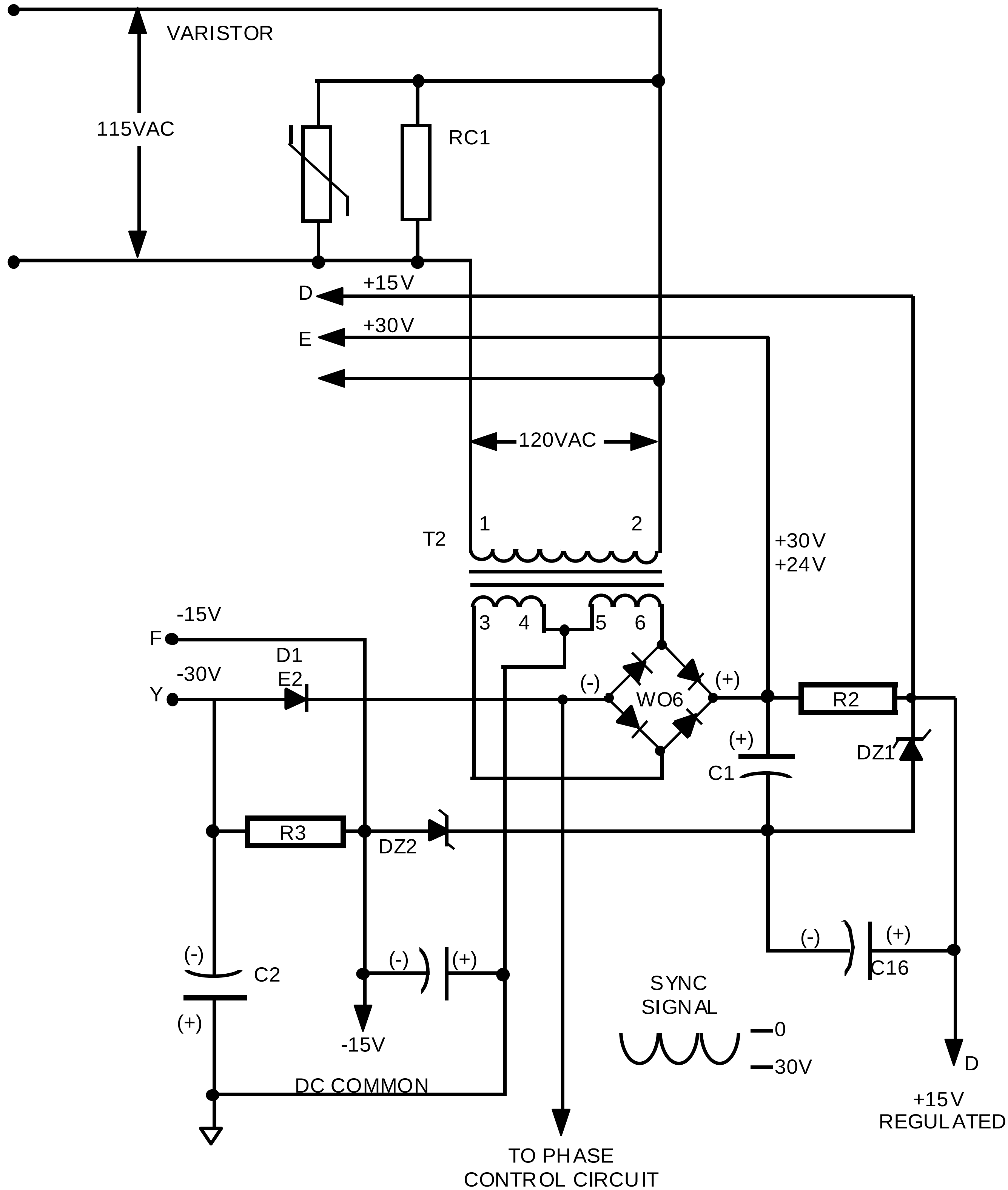

Figure 3: Power Supply Circuit

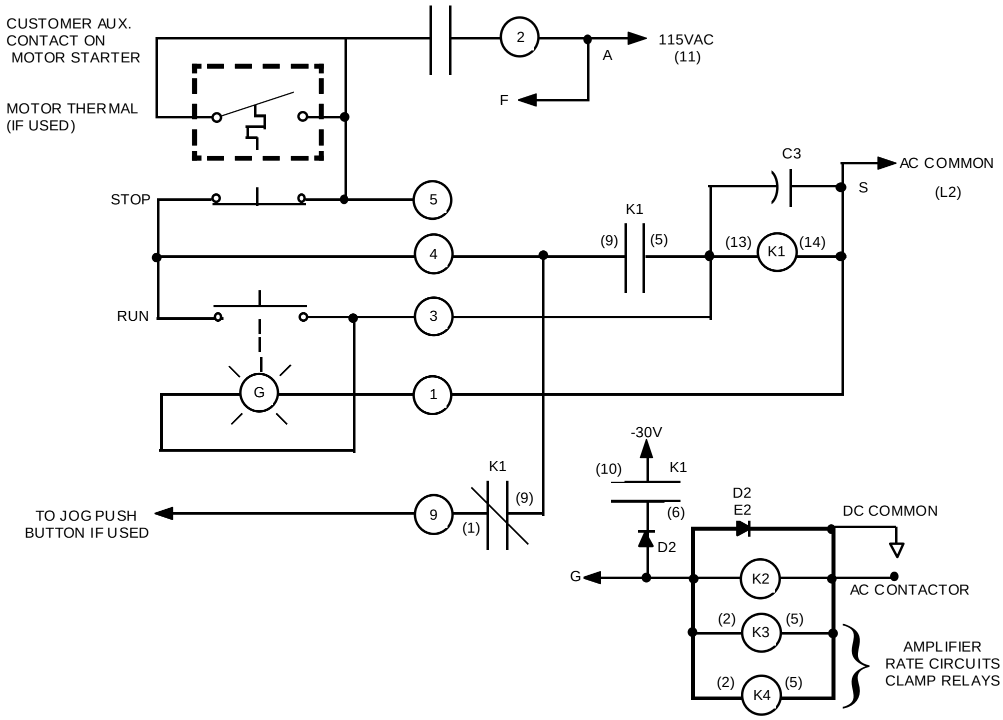

Figure 4: Run Relay Circuit

5.2 RUN RELAY CIRCUIT

5.2.1 OPERATION

The auxiliary contact of the AC motor starter is connected from terminal 2 to 5 on terminal board #1.

This prevents over-regeneration of the clutch coil If the control should be started without the AC motor running. If a drive over-temperature switch is used, connect in series with auxiliary contact as shown. Other remote normally-closed stop push-buttons may be in series with stop push-button (PB) if desired.

Start when run PB is pushed 115VAC is applied to relay K1 through auxiliary of motor starter, stop normally-closed PB contact, run PB, normally-open contact.

When run PB is released, relay K1 normally-open contact (9) – (5) which closed across run normally-open, PB maintains K1 relay energized.

Relay K1 normally-open contact (10) – (6) connects relays K2, K3 and K4 across 30VDC through diode D2. Relay K1 applies AC to the power bridge. (See SCR Power Output Control Circuit.) Relays K3 and K4 open their normally-closed contacts which unclamp the amplifier dynamic compensation capacitors.

K1 contact (9) – (5) also applies -30V to the speed reference circuit. (See description of Speed Reference Circuit.)

When auxiliary contact of starter opens, or stop push-button is pushed, 115VAC is removed form relay K1, K2, K3 and K4 drop out and the AC is removed from the power bridge. The capacitors in the amplifier circuit are discharged. The ramp capacitor C4 is discharged and the reference voltage is removed from the speed pot.

If the Jog option is used, the normally open jog pushbutton is connected from 9 of the control terminal strip #1 to 1 on the jog option board.

The jog push-button receives no power at customer connection pin number 9 unless:

1. Starter is closed,
2. Stop Push-button not depressed,
3. Thermal switch (if used) closed and
4. If the run circuit (K1) is not latched in. (See Jog Option description.)

The relays K2, K3 and K4 are energized through terminal G which is connected to the jog option board. (See Jog Option description.)

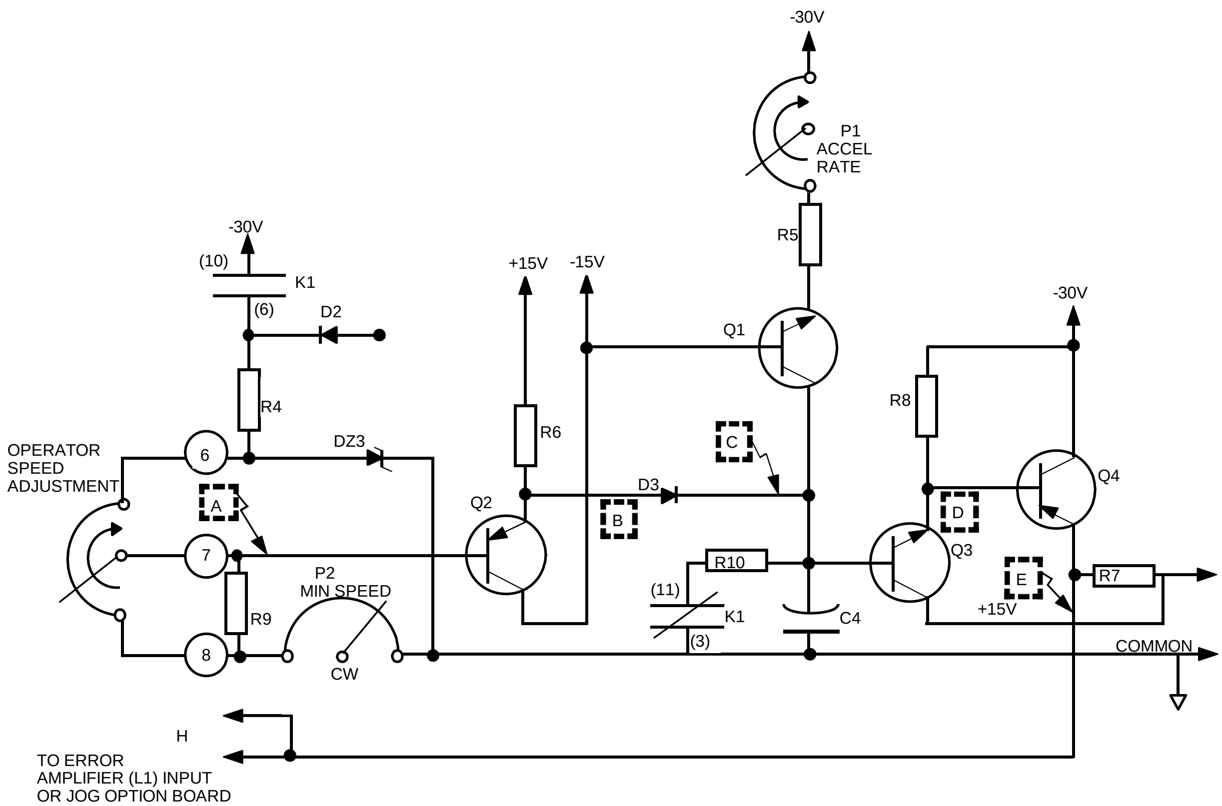

Figure 5: Speed Reference Circuit

5.3 SPEED REFERENCE CIRCUIT

5.3.1 OPERATION

With relay K1 de-energized normally-open contact (10)-(6) open, normally-closed contact (11)-(3) closed, speed pot fully clockwise.

- A- Approximately Zero
- B- Approximately plus (+) 0.5V
- C- Approximately Zero (0)
- D- Approximately Minus (-) 0.5V
- E- Approximately Zero (0)

With relay K1 energized:

- A- Minus (-) 10V ±5%
- B- Approximately voltage at [A] Minus (-) 0.5 V or approximately minus (-) 9.5V
- C- Ramping to approximately same as A
- D- Ramping to approximately same as C plus (+) 0.5V or minus 10.5V
- E- Ramping to approximately same as A

5.3.2 FUNCTIONAL DESCRIPTION OF OPERATION

With K1 relay de-energized or speed potentiometer turned down, voltages at [A] and [C] are zero and nearly equal. Current flowing through Q1 is diverted through D3 and R6. The emitter follower Q2, provides a low impedance sink for this current. The Q2 B-E voltage is cancelled approximately by the forward drop of D3.

K1 relay closure provides current for zener diode, DZ3, and the speed potentiometer through R4 from the minus (–) 30V unregulated supply. The reference voltage at terminal #6 provided by DZ3 will be –10V ±5%.

As voltage is applied to A, the current from Q1 which was diverted from charging C4 now charges C4.

The current is diverted into D3 when C4 reaches a voltage approximately equal to A.

Transistors Q3 and Q4 serve as a tandem emitter follower, providing a high impedance input to C4 negative, at the same time providing drive for the current input to the regulator, as well as other regulators or ratio potentiometers for other optional regulators.

Potentiometer P1 controls the charging rate of C4 by setting the current through Q1.

When K1 relay de-energizes, a normally-closed (N/C) contact, (3 and 11) closes, to quickly discharge C4 through R10
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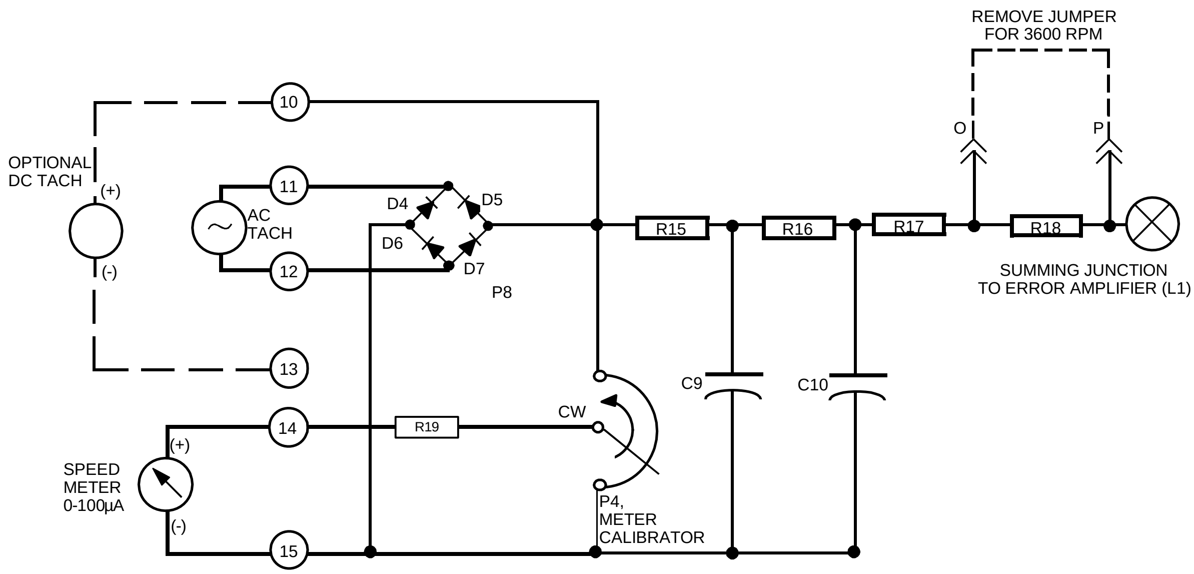


Figure 6: Speed Feedback Circuit

5.4 SPEED FEEDBACK CIRCUIT

5.4.1 OPERATION

Full-wave bridge rectifier diodes D4 through D7 rectifies AC tachometer voltage to DC. This voltage is applied to R15, R16 and R17 in series. Capacitor C9 and C10 provide filtering for the feedback signal.

NOTE: WHEN AN 1800RPM DRIVE IS USED, R18 IS JUMPERED OUT.

Since the summing junction of the error amplifier is at virtual ground the current is:

$$\frac{\text{Voltage at 10}}{R15 + R16 + R17} = I_{fb}$$

This current is the speed feedback current.

DC tachometer may be connected as shown above in place of an AC tachometer.

SPEED METER

Current for the speed meter is provided through R19 and meter calibrate potentiometer P4, supplied by the rectified AC tachometer voltage (or DC tachometer voltage).

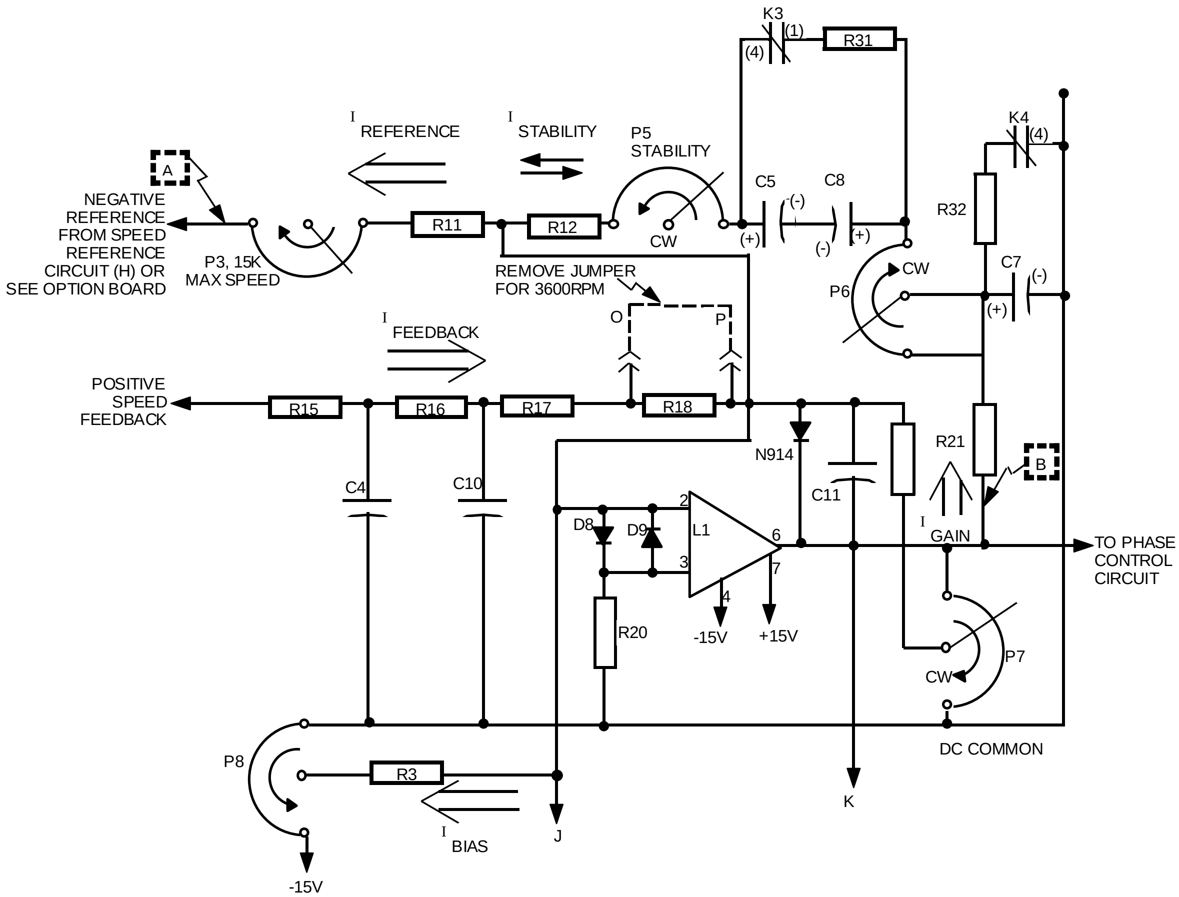


Figure 7: Error Amplifier Circuit

5.5 ERROR AMPLIFIER CIRCUIT

5.5.1 OPERATION

The voltage at [A], i.e bias potentiometer counter-clockwise, is generated by the output of the speed reference circuit, or if the jog option is used, is generated by the potentiometer across the minus (-) power supply. (See description of Jog Option Board.)

The voltage at [B] with voltage [A] is approximately zero at a level from minus (-) 0.5 to slightly positive.

As speed reference voltage is applied to [A] the output of L1 operational amplifier (See Figure 7) rises to a positive voltage at about 10 volts the phase controller will turn on the SCR's. As the drive coil is excited, torque is transmitted to the load and rotation of the output shaft and the tachometer occurs.

The speed feedback current reduces the output of L1 and the SCR output and equilibrium is reached where the drive speed is proportional to the voltage at [A].

Increasing the gain with P7, requires that less current be supplied by the speed feedback circuit, the drive speeds up. With higher gain a small change in speed, say due to drive loading, produces a greater change in error amplifier L1 and the SCR output.

Potentiometers (lead p6) and (stability P5) provide a means for matching the dynamics of the control to the drive and load.

Maximum speed (P3) ratios the value of reference current to the current obtained by the feedback generator and feedback circuit. Since the various feedback voltages may represent maximum speed of the drive and the volts per RPM ratio of tachometers vary.

BIAS ADJUSTMENT P8
Since the input signal at [A] may be produced at a very long rate, say 40 seconds or .25V per second, the offset in L1 may require a few seconds to get L1 up to a voltage where the phase controller will fire the SCR's. Bias adjustment will raise the amplifier L1 output up to nearly the "firing point".

At this level, a small reference input will "fire" the SCR's and hesitation with long-range inputs is eliminated.
Relays K3 and K4, normally-closed contacts remove the charge from the capacitors used to obtain dynamic compensation. Relays K3 and K4 de-energize when the line contactor K2 opens. (See Line Contactor Circuit description.)

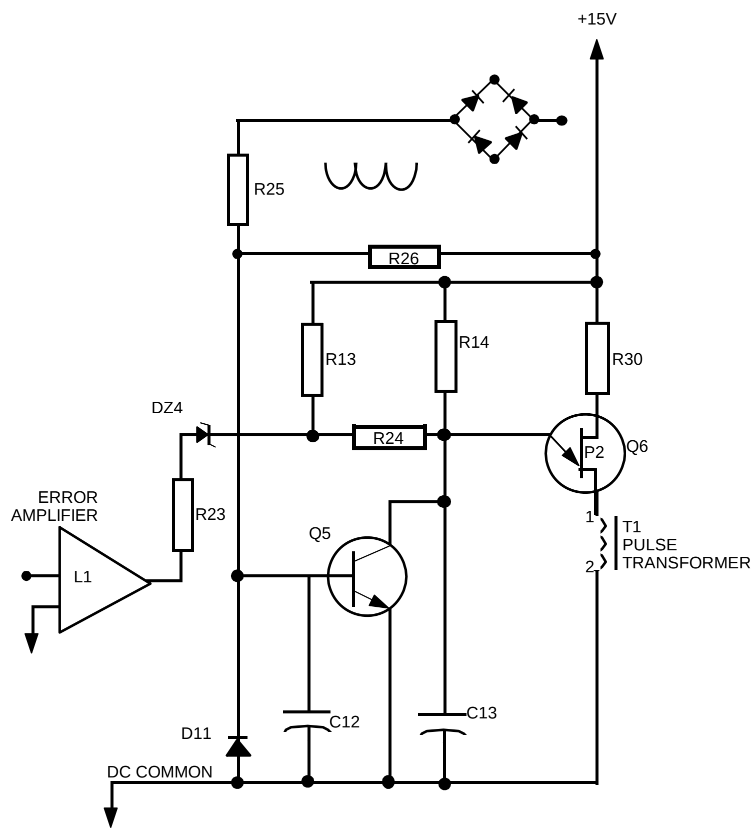


Figure 8: Phase Control Circuit

5.6 PHASE CONTROL CIRCUIT

5.6.1 OPERATION
Transistor Q5 operates to discharge the timing capacitor each time the AC line goes through zero. When the line is not near zero the negative unfiltered full wave DC voltage reverse biases the base emitter junction of Q5. Q5 turns off and C13 is able to charge. When the AC line crosses zero, the negative voltage becomes zero. Transistor Q5 becomes forward biased, with the base current supplied by the +15V supply through R26.

Each time the line crosses zero, Q5 turns on to discharge C13. Capacitor C12 provides a shunt path for noise which may cause false "firing" of Q5.

Diode D11 conducts when Q5 base emitter junction is reverse biased. This prevents breakdown conduction of the B-E junction.

After each line crossing, C13 is able to charge from the +15V regulated supply, through R14. Unijunction Transistor Q6 provides a means of providing an SCR trigger as a function of the time after line crossing.

On a 60HZ line a timing period begins every 8.3 milliseconds. If the capacitor C13 reaches the trigger voltage of the unijunction, C13 will discharge through the primary of T1 and the SCR's will be fired.

The charging rate of C13 is controlled by the output of the error amplifier.

When the input is negative or low positive, C13 does not receive enough current to charge it to the trigger level in 8.3 milliseconds. The charging current normally through R14 and R13 in series with R24 is diverted through zener DZ4.

As the DC input rises, further positive, C13 will charge at a faster rate and will reach the trigger voltage of the unijunction before 8.3 milliseconds have elapsed. When this happens the SCR, which is forward biased at that time, will be fired.

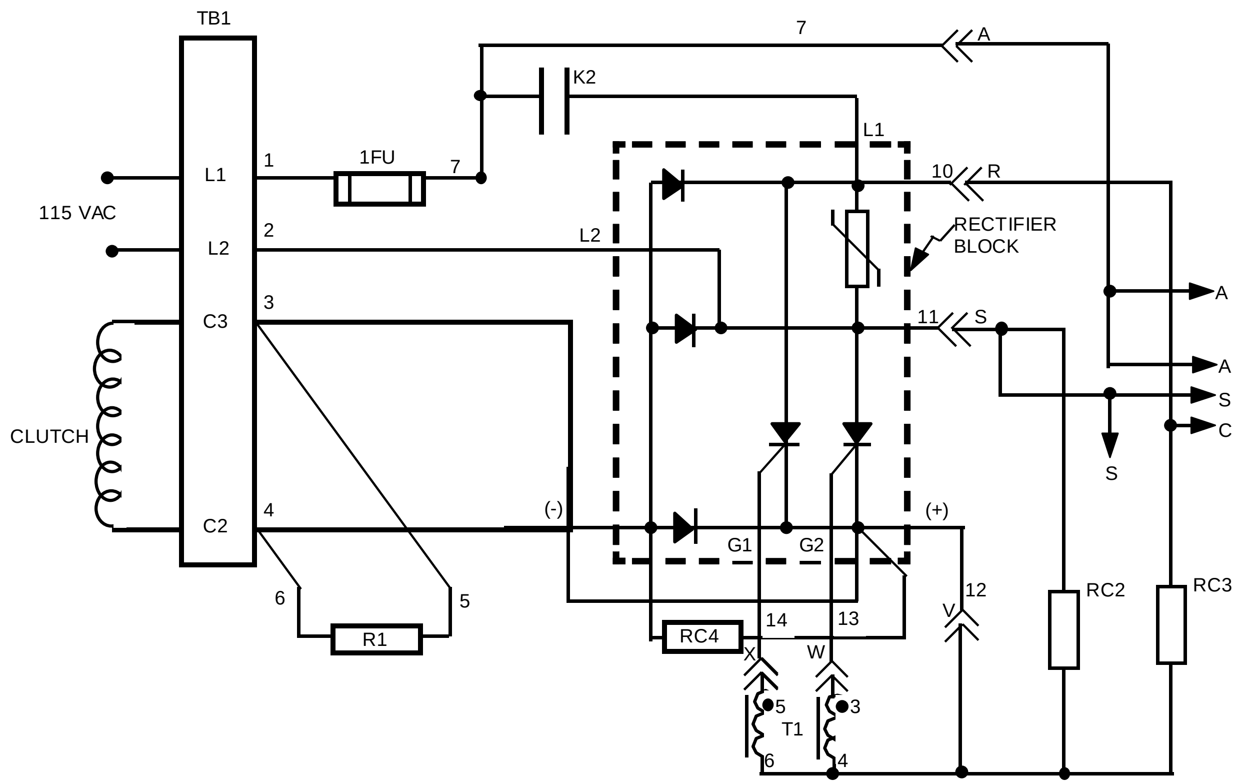


Figure 9: Power Output Circuit

5.7 POWER OUTPUT CONTROL

5.7.1 OPERATION

With K2 contact closed, 115VAC is applied to the full wave SCR bridge. With pulses applied to the SCR gates (See Figure 8) DC is applied to the clutch coil. A pulse transformer isolates the SCR output circuit from the rest of the control.

Conduction from the AC line through the bridge and clutch coil when L1 is positive relative to L2 is illustrated in Figure 10.

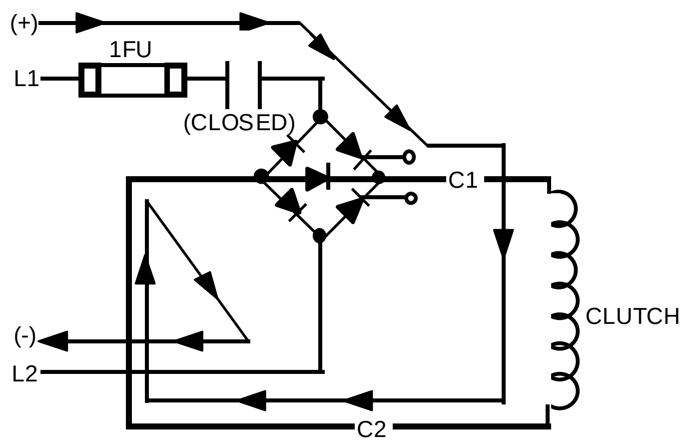


Figure 10: Bridge and Coil Current Conduction (L1+, L2 -)

Conduction from the AC line through the bridge and clutch coil when L2 is positive relative to L1 is illustrated in Figure 11.

Resistor R1 provides a minimum SCR current. Without this resistor the SCR may not conduct because the inductive load (clutch) may not allow holding current to be attained during the duration of the gate pulse.

Resistors RC2, RC3 and RC4 provide a low impedance shunt path for noise and line spikes which are prevalent in industrial environments.

A voltage suppressor provides over-voltage protection for the rectifier block.

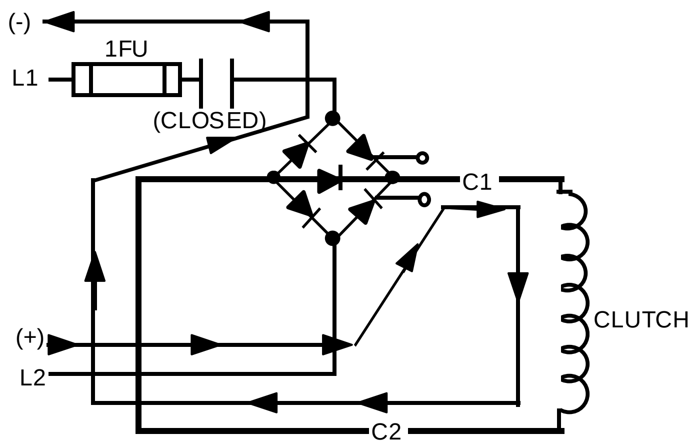


Figure 11: Bridge and Coil Current Conduction (L1-, L2 +)

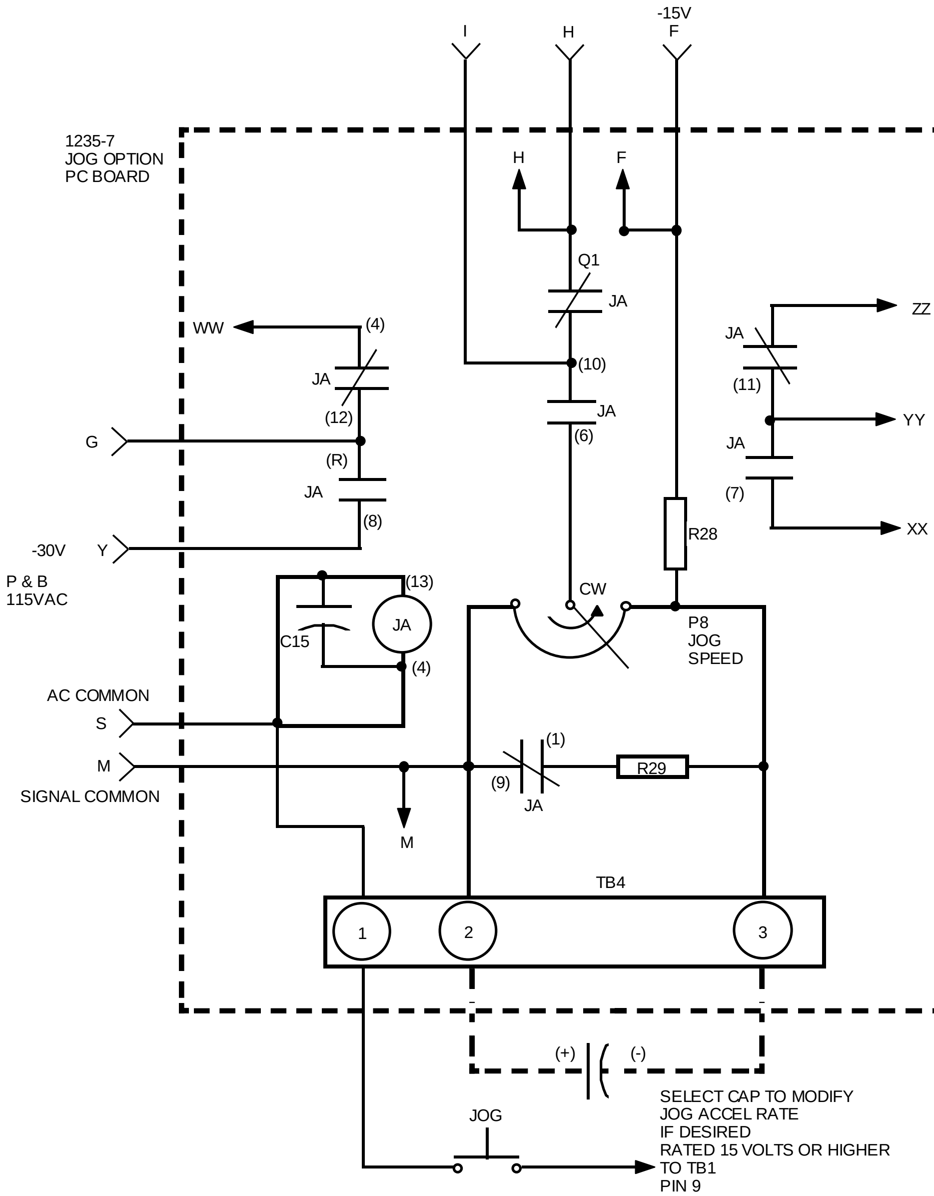


Figure 12: Jog Option Board

5.8 JOG OPTION BOARD

5.8.1 OPERATION

When jog option board is used the normal jumper connection between the output of the ramped reference H and the input to the error amplifier circuit I is opened and reconnected through H and I of the jog option board. When JA relay energizes a negative voltage is applied to the input of the error amplifier through the max speed potentiometer P3 and resistor R11. The connection to the ramp generator output is opened.

Normally open contact of JA (12)-(8) connect K2-K3 and K4 to –24VDC at Y. The function of these relays is the same as described (Figure 4).

Jog relay JA is inoperative when relay K1 (run relay) is energized, when Jog button is connected between TB4, terminal 1 and TB2, terminal 9.

If desired, the rate of acceleration to the jog speed may be modified by placing a capacitor, 15V rating or more, as shown in Figure 12.

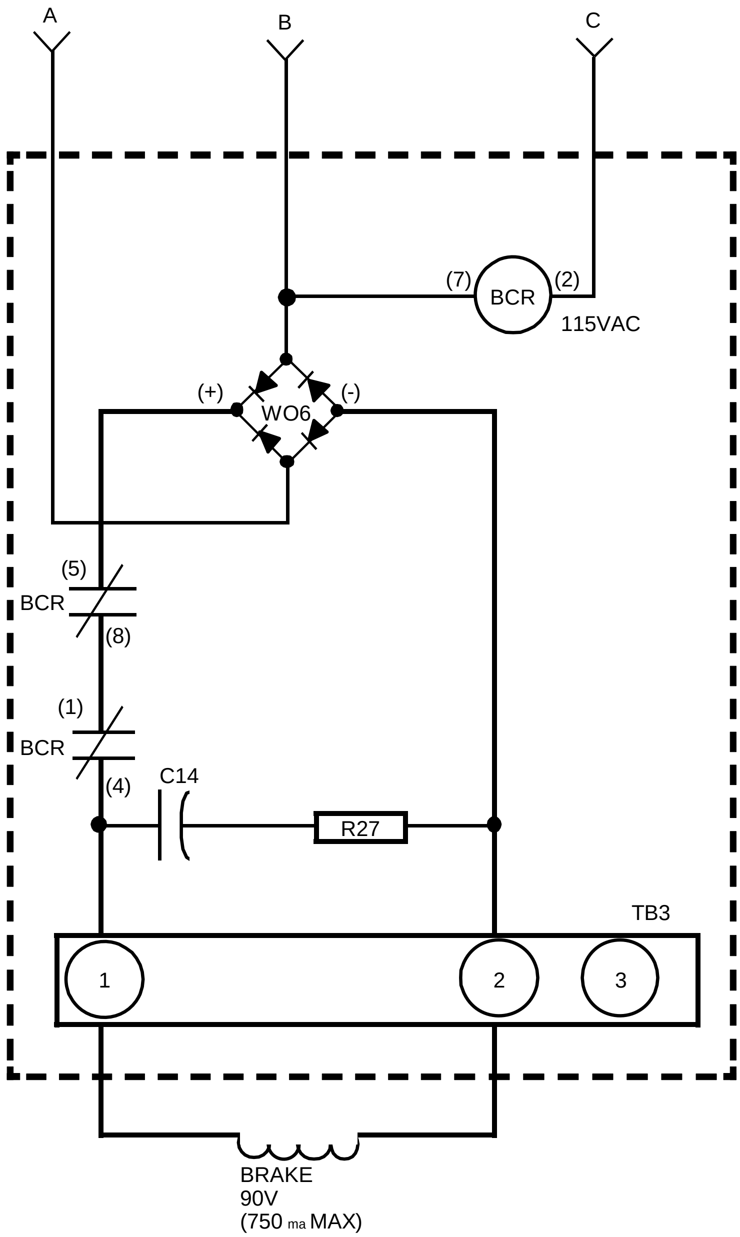


Figure 13: Friction Brake Option

5.9 FRICTION BRAKE OPTION BOARD

5.9.1 OPERATION

Wires A, S and C are connected to the main board to corresponding letters.

When K2 is energized and the main control de-energized, 90VDC (approximately) is applied to the friction brake. When K2 energizes relay BCR N/C contacts open and the friction brake is released.

This option is for a voltage engaged brake. Other brake options are available for voltage (AC or DC) released brakes (fail-safe) and for applying a variable DC voltage to the brake.

SECTION 6
INSTALLATION

6.1 DESIGN

The enclosure is designed for either floor or wall mounting depending on customer and horsepower requirement. The control should be installed in a well ventilated area.

Unless designed for special conditions, the enclosure cabinet should be located using the following criteria.

6.2 CRITICAL ENVIRONMENTAL FACTORS

Ambient Temperature should not exceed 104^{o}F (40^{o}C).

Ambient Temperature should not fall below 50^{o}F (10^{o}C).

Enclosure's circulating air should be clean, dry and free from flammable or combustible vapors, corrosive gasses, solids or liquids.

Enclosure should be shock mounted if location is subject to vibration.

Enclosure doors should have clearance to allow easy access to controls for inspection and maintenance.

WARNING:
EXTREME CARE MUST BE EXERTED DURING THE DRILLING AND/OR CUTTING PHASE WHEN INSTALLING ELECTRICAL CONDUIT. CARELESSNESS WILL CAUSE CHIPS AND PIECES OF METAL TO FORM SHORT CIRCUITS AND WILL RESULT IN NON-WARRANTY DAMAGE.

6.3 SHIELDED CABLE

To avoid stray signal interference provide Belden #8208 2 conductor and/or #8771 3 conductor shielded cable or their equivalents when interconnecting with:

- Speed potentiometer
- Jog potentiometer
- AC and DC tachometers
- Speed Indicators
- Ammeters

The shield should be connected **AT ONE POINT ONLY**. **This point is at common, not earth or chassis ground, unless otherwise shown on schematic**.

To avoid stray signal interference, **DO NOT** run reference signal interconnecting wires in the same conduit or in close proximity to power wiring. Armature leads and tachometer cable is to be routed separately for best operation. Keep wire length as short as possible.

6.4 EXTERNAL AC RELAYS

When external customer AC and DC relays are connected to control, adequate suppression networks are suggested across relay coil. Arc suppression networks (See Figure 15) prevent signal "noise" and extend life of relay contacts. Specific installation should be reviewed by a qualified engineer.

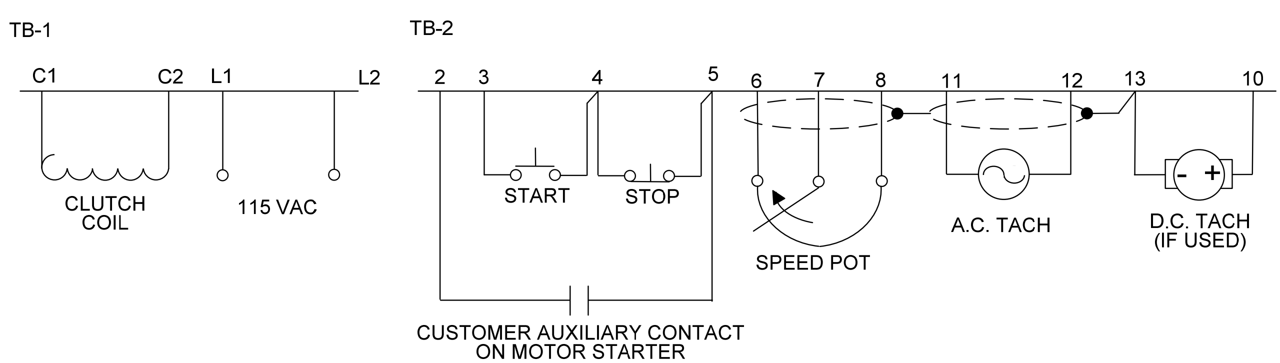


Figure 14: Basic Drive Operator Control Interconnections

6.5 ALLOWABLE AMPACITIES OF INSULATED COPPER CONDUCTORS

Not more than 3 conductors in raceway or cable or direct burial based on ambient temperature of 30°C, 86°F.

Size	Temperature Rating of Conductor							
AWG MCM	60°C (140°F)	75°C (167°F)	85°C (185°F)	90°C (194°F)	110°C (230°F)	125°C (257°F)	200°C (392°F)	250°C (482°F)
	Types RUW (14-2), T, TW	Types RH, RHW, RUH (14-2), THW, THWN, XHHW	Types V, M1	Types TA, TBS, SA, AVB, S1S, FEP, FEPB, RHH, XHHW** THWN	Types AVA, AVL	Types A1 (14-8), AA, FEP**	Types A (14-8), AA, FEP* FEPB*	Types TFE (Nickel or nickel-coated copper only)
14	15	15	25	30	30	30	30	40
12	20	20	30	30	35	40	40	55
10	30	30	40	40	45	50	55	75
8	40	45	50	50	60	65	70	95
6	55	65	70	70	80	85	95	120
***4	70	85	90	90	105	115	120	145
***3	80	100	105	105	120	130	145	170
***2	95	115	120	120	135	145	165	195
***1	110	130	140	140	160	170	190	220
***0	125	150	155	155	190	200	225	250
***00	145	175	185	185	215	230	250	280
000	165	200	210	210	245	265	285	315
0000	195	230	235	235	275	310	340	370
250	215	255	270	270	315	335		
300	240	285	300	300	345	380		
350	260	310	325	325	390	420		
400	280	335	360	360	420	450		
500	320	380	405	405	470	500		
600	355	420	455	455	525	545		
700	385	460	490	490	560	600		
750	400	475	500	500	580	620		
800	410	490	515	515	600	640		
900	435	520	535	555				
1000	455	545	585	585	680	730		
1250	495	590	645	645				
1500	520	625	700	700	785			
1700	545	650	735	735				
2000	560	665	775	775	840			

WARNING:
NO TERMINAL POINT IN THE CONTROL SHOULD BE EARTH GROUNDED EXCEPT WHERE SUCH GROUNDING IS EXPLICITLY SHOWN ON DRAWING.

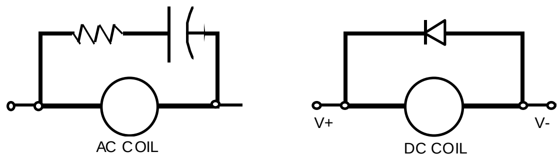


Figure 15: AC DC Relays

6.6 TRANSFORMERS

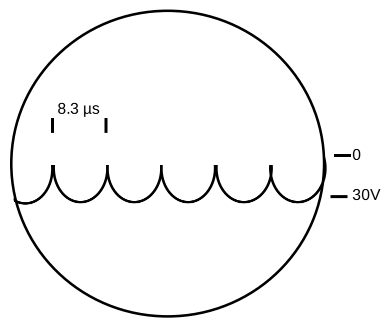
Transformers shall be connected to conform with data on the transformer nameplate to obtain correct voltage for input to control.

NOTE: SCOPE REFERENCE (COMMON) TO TB1-13 UNLESS OTHERWISE INDICATED.

6.6.1 TEST POINTS

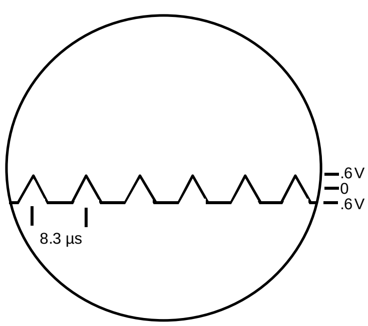
1. (-)WO6 or (Cathode D1)

   Negative going full-wave rectified waveform used to synchronize phase control circuit.



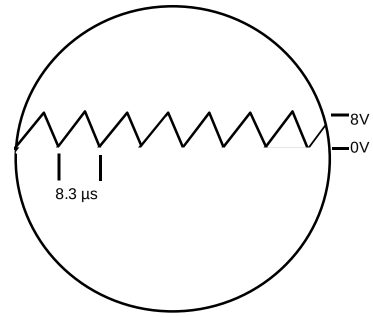
2. BASE Q5

   Positive pulse at base of Q5 turns on transistor Q5 to discharge timing capacitor C13 each time line goes to zero volts, synchronizing C13 to line.



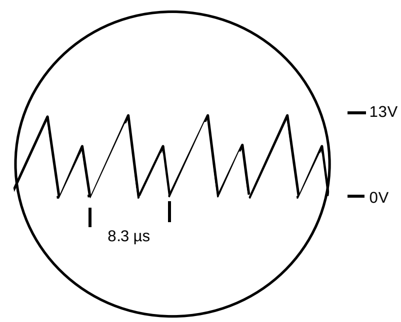
2. TEST POINT EE (NO RUN OR JOG)

   Capacitor C13 charges. This is not sufficient to fire Q6 before the next synchronizing pulse arrives.
   NOTE: Output error amplifier L1 will be approximately zero volts.



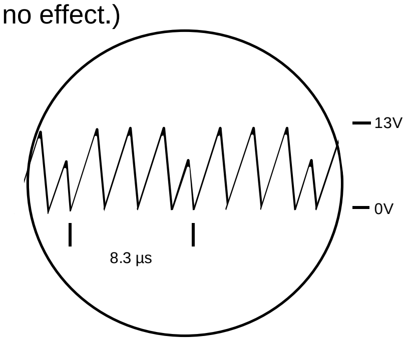
4. TEST POINT EE, DRIVE IN RUN OR JOG

   Low clutch voltage, 10 volts
   Note: Output of L1 positive approximately 5 volts. Q6 fires at indicated peaks.



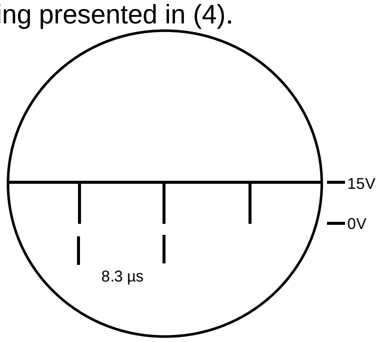
5. TEST POINT EE, DRIVE IN RUN

   High clutch voltage, 75 volts.
   Note: Output of L1 positive approximately 12 volts. Q6 fires each time charge on C13 reaches 13 volts. (First pulse turns on the SCR, the rest have no effect.)



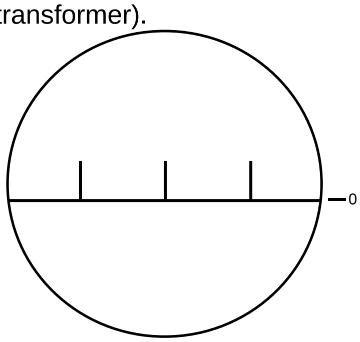
6. B2 of Q6, DRIVE IN RUN

Low clutch voltage, 10 volts. Sharp pulses coincide with Q6 firing presented in (4).



7. B1 of Q6

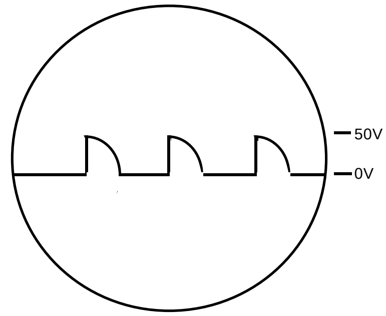
Same conditions as in (6). Firing pulses on primary of T1 (pulse transformer).



WARNING
THE FOLLOWING WAVE FORMS ARE REFERENCED TO THE AC LINE OR CLUTCH CIRCUIT (AS SPECIFIED). THE SCOPE COMMON MUST BE ISOLATED FROM THE AC LINE (POWER TO SCOPE) AND NOT TOUCHING GROUND IN ANY WAY. DO NOT TOUCH THE SCOPE LEADS OR CASE AND GROUND AT THE SAME TIME. HAZARDOUS VOLTAGES MAY BE PRESENT BETWEEN THE SCOPE AND GROUND.

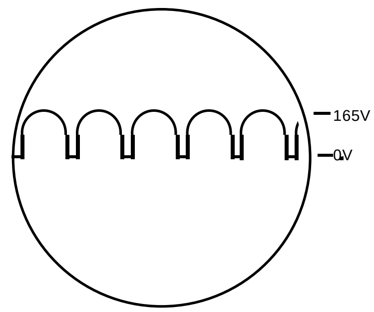
8. CLUTCH VOLTAGE, 10VDC

Scope connected across clutch, common to C2. Probe to C1. Drive condition same as (4).



8. Clutch voltage, 75VDC

Same hook-up as (8). Drive condition same as (5).



6.6.2 RESISTANCE MEASUREMENTS

NOTE: POLARITIES ON RESISTANCE READING INDICATE POLARITY OF TEST VOLTAGE (FROM OHMMETER) APPLIED TO TERMINAL UNDER TEST. CHECK POLARITY OF TEST VOLTAGE OF OHMMETER USED BEFORE ATTEMPTING TESTS. RECOMMENDED METER -- SIMPSON 260.

(+) Positive terminal is positive in ohms position with switch in +DC position.

(-) Common, terminal is negative.

Changing switch to -DC position reverses test voltage at terminals:
(+) Positive terminal is negative.
(-) Common, terminal is positive.

This meter allows the use of this switch to reverse the test voltage. Other meters, without this feature will require reversal of the test leads at the points under test.

Remove **ALL POWER from circuits when making Resistance measurements.** Approximate readings indicate readings depend on non-linear elements such as diodes, transistors, etc.
Large capacitors also cause some readings to deviate from stated resistance readings. A capacitor will cause the initial resistance to read zero ohms, then increase to some minimum value as stated. The rate at which the resistance increases depends on the size of the capacitor, resistances in the circuit and meter and current supplied by the meter to charge the capacitor.

Connect Meter common to TB2-15

NOTE: NO EXTERNAL CONNECTIONS ON TB1 OR TB2.

PINREADS

1. ∞ (Infinity)
2. ∞
3. ∞
4. ∞
5. ∞
6. +1K (- 30K)
7. +47K
8. 0 to 1K, depends on min speed pot setting
9. ∞
10. +50K (- 200ohms)
11. +50K (- 200ohms)
12. +50K (- 200ohms)
13. +10 ohms or less
14. Greater than 100K

6.7 CLUTCH CIRCUIT

(no external connections to L1, L3, L1 and L2)

Meter	+Lead To	-Lead To	
	C1	C2	+ 1K—400 ohms
	C1	C2	∞ (R1 removed)
	C2	C1	+600 ohms (R1 removed)
	C1	L1	Both directions (R1 removed) (SCR resistance)
	C1	L2	Both directions (R1 removed) (SCR resistance)
	C2	L1	+ 600 ohms – (Bridge Diode) (R1 removed)
	C2	L2	+ 600 ohms – (Bridge Diode) (R1 removed)

SECTION 7
START-UP INSTRUCTIONS

The operating and start-up adjustments outlined in this section describe the normal operating procedure.

Eddy current control model 1235 and associated drive system equipment has been tested and subjected to quality control inspection prior to shipment. However, visual inspection and preliminary testing must be performed before system is energized.

7.1 GENERAL START-UP PROCEDURE

Refer to applicable eddy current schematic and interconnecting diagram that is supplied with each system when connecting control and drive motor.

7.2 SAFETY PRECAUTION:

1. The drive will remain uncoupled from the load until preliminary testing is completed.
2. All personnel except operator shall remain clear of machinery and drives throughout initial start-up.

7.3 PRELIMINARY TESTS

WARNING:
PRIOR TO RESISTANCE CHECKS, DISCONNECT ALL AC POWER TO THE CONTROL.

Use an ohmmeter to measure resistance to ground**. DO NOT** use Megger, Bellringer, or Buzzer as damage to semi-conductors may result.

Measure resistance on all eddy current terminal strips, including coil to earth ground. Meter should read greater than 100,000 Ohms at all points.

7.3.1 VISUAL INSPECTION

1. Check all interconnecting wires for conformance to supplied schematics.

2. Check operation of movable components, switches, etc., manually for freedom of movement.

3. Check for damaged internal wires and components.

4. Check for AC supply voltage for correct frequency.

5. Check transformer output voltage prior to connecting to drive.

6. Check that the mechanical eddy current drive rotates freely by hand.

7. Check that the operators speed potentiometer is connected properly per the control connection diagram.

The speed reference potentiometer supplied with the control is S/N 990-35, 5K, 1 W, with a minimum of 500 volts insulation from the shaft (or mounting surfaces) to the electrical parts. The lead connections at the potentiometer should be taped, using high voltage insulation tape.

The operator's speed adjustment should be connected.

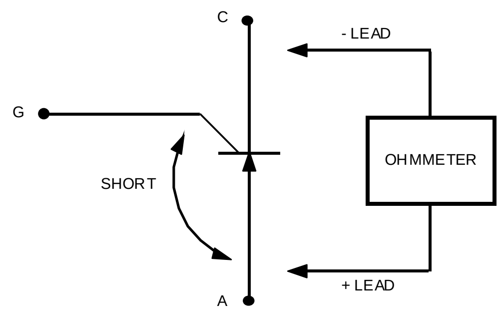


Figure 16: Operator's Speed Adjustment

8. Before proceeding insure start/stop circuitry is functional before attempting to rotate motor.

Control and Adjustment Location
Operator's Station

a. Run push-button (green), energizes relay K1
b. Stop push-button (black), de-energizes
c. E-Stop
d. Operator's Speed adjustment position of adjustment determines motor speed. Clockwise increases speed.

9. If a DC tachometer is used for feedback, place a DC voltmeter (+) positive lead on customer terminal strip #10 and (-) negative lead on terminal #13 and rotate drive in the normal running direction.

The voltmeter will measure positive voltage when the tachometer is correctly connected.

7.4 BASIC CONTROL SET-UP

1. Operator's Control Station
   Set speed potentiometer fully counterclockwise

2. 1235 control printed circuit board set controls:

- Minimum speed P2 fully counterclockwise
- Maximum speed P3 fully counterclockwise
- Bias P8 fully counterclockwise
- Stability P5 midrange
- Lead P6 midrange
- Gain P7 midrange
- Accel P1 fully counterclockwise
- Meter calibrate P4.. midrange*
- Jog speed P9 midrange*

*Optional Adjustments

3. If AC drive motor is 3600RPM, remove jumper O to P on the 1235 control.

7.5 EDDY CURRENT ADJUSTMENT

WARNING:
HIGH VOLTAGE MAY BE PRESENT AT SOME POINTS IN THE EDDY CURRENT CONTROL, REGARDLESS OF WHETHER THE AC SUPPLY IS GROUNDED OR NOT, THIS IS ALSO TRUE EVEN IF AN ISOLATION TRANSFORMER IS USED IN THE AC THREE PHASE INPUT, BECAUSE OF CAPACITIVE-COUPLING WITHIN THE ISOLATION TRANSFORMER, THE FOLLOWING PRECAUTIONS MUST BE TAKEN:
OPERATOR MUST NOT BE IN CONTACT WITH A GROUNDED SURFACE WHEN WORKING ON THE ENERGIZED CONTROL. STAND ON AN INSULATED SURFACE. WHEN A TEST INSTRUMENT IS BEING USED, CARE MUST BE TAKEN TO INSURE THAT ITS CHASSIS IS NOT EARTH GROUNDED EITHER BY A GROUNDING PLUG CONNECTION OR BY BEING IN CONTACT WITH A GROUNDED SURFACE. EXTREME CARE MUST BE TAKEN WHEN USING AN OSCILLOSCOPE SINCE ITS CHASSIS WILL BE ELECTRICALLY "HOT" TO GROUND WHEN CONNECTED TO THE CONTROL SYSTEM. OSCILLOSCOPE MUST ELECTRICALLY "FLOAT". NO PART OF THE CONTROL SHOULD BE GROUNDED.

7.5.1 SET-UP AND ADJUSTMENT PROCEDURE

1. Set controls, adjustments, and switches to initial positions.
2. Apply main power to the control and drive.
3. Press AC MOTOR START push-button. Listen to assure operating speed is attained prior to performing step #4.
4. Press RUN push-button.
5. Rotate SPEED control to 100% setting. As drive begins to rotate check for correct direction of rotation. If drive is running backwards, open main circuit and inter-change two AC motor connections at the AC motor.
6. Adjust MAX SPEED adjustment until maximum speed equals rated top speed indicated on nameplate.
7. Adjust operator's speed potentiometer fully counterclockwise.
8. Increase MIN SPEED adjustment setting until drive begins to rotate and then decrease setting until drive stops. If it is desirable to have drive rotate at some minimum speed with SPEED control set at zero, then increase setting of MIN SPEED adjustment until drive is rotating at desired speed.
9. Increase operator's SPEED control setting until drive is running at desired run speed.
10. Decrease STABILITY adjustment setting until drive instability or hunting occurs; then increase adjustment setting until hunting stops.
11. Set GAIN adjustment for desired regulation. Best regulation is attained at 100% setting. If drive instability or hunting occurs, reduce setting of this adjustment.

NOTE: GAIN AND STABILITY ADJUSTMENTS INTERACT. NORMALLY THEY ARE SET FOR OPTIMUM REGULATION WITHOUT HUNTING. IF IT IS NOT POSSIBLE TO ELIMINATE HUNTING WITH STABILITY ADJUSTMENT, REDUCE GAIN ADJUSTMENT SETTING.

12. Press STOP push-button.
13. Press RUN push-button. Note length of time it takes drive to reach run speed. Press STOP push-button. Increase ACCEL RATE adjustment setting to achieve desired acceleration rate. Acceleration time is adjustable from 2 to 30 seconds. Zero setting corresponds to approximately a 30 second acceleration time, 100% setting corresponds to approximately a 2 second acceleration time. Repeat procedure as necessary to obtain desired acceleration rate.
14. Press AC MOTOR STOP push-button. Set-up is complete.

SECTION 8
TROUBLESHOOTING

8.1 TROUBLE SHOOTING PROCEDURE

Common causes of drive malfunction after satisfactory operation are:

- Broken or loose interconnecting wires.
- Faulty insulation or interconnecting wires.
- Component failure.

A close visual inspection with **ALL AC POWER OFF** can save hours of needless troubleshooting. Component failure is often located by discoloring or ruptured appearance.

8.2 TEST METER

WARNING:
WHEN A TEST INSTRUMENT IS USED, CARE MUST BE TAKEN TO INSURE THAT ITS CHASSIS IS NOT GROUNDED EITHER BY GROUNDING PLUG CONNECTION OR BY ITS CASE BEING IN CONTACT WITH A GROUNDED SURFACE.

A multi-meter is the most common test instrument used in troubleshooting. Multi-meters having a sensitivity of 1,000 Ohms/volt on AC scale and 10,000 Ohms/volt on the DC scale are recommended.

CAUTION:
NEVER USE A MEGGER, BUZZER OR BELLRINGER TO CHECK CONTROL ON NON-CURRENT LIMITED CONTINUITY CHECKS OR ASSOCIATED CIRCUITS. THE MEGGER, BUZZER, OR BELLRINGER'S HIGH VOLTAGE WILL CAUSE ELECTRONIC COMPONENT DAMAGE.

8.2.1 VOLTAGE TEST

Voltage checks at critical points are measured using the test meter provided in each system. Turn selection switch to each position. (Refer to START-UP INSTRUCTIONS for correct readings.)

8.2.2 CONTINUITY TEST

When an incorrect voltage is located with the test meter or multi-meter **DE-ENERGIZE ALL AC POWER TO CONTROL**. The cause may be incorrect resistance in the problem circuit.
A multi-meter set on R x 1 scale will be used to measure the interconnecting wiring, which should read less than 2 Ohms.

Check across each circuit element, e.g. wires, contacts, relays, push-buttons, etc., for continuity.

8.3 OSCILLOSCOPE SIGNAL TEST

WARNING:
EXTREME CARE MUST BE TAKEN WHEN USING THE OSCILLOSCOPE SINCE ITS CHASSIS WILL BE ELECTRICALLY "HOT" TO EARTH GROUND WHEN CONNECTED TO THE CONTROL SYSTEM. ELECTRICALLY "FLOAT" OSCILLOSCOPE ABOVE EARTH GROUND.

8.3.1 SCR TEST

An oscilloscope is the only test instrument that can accurately check gate pulses. Refer to NORMAL CONTROL SIGNALS, for input and output. However, the following resistance test will measure for an open or failure in the gate.

1. Disconnect SCR module from control and test SCR while in module.
2. Connect the positive (+) ohmmeter lead to SCR cathode and Negative (-) meter lead to anode. Resistance should be one megohm or more.
3. Reverse meter leads. Resistance should be one megohm or more.
4. Temporarily jumper the gate to anode, with the meter connected (See Figure 17). Resistance should be one thousand ohms or less.

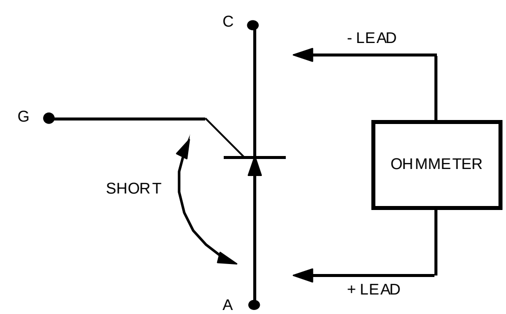


Figure 17: Temporary Jumper - Gate to Anode

8.4 COMPONENT TESTING

NOTE: DISCONNECT ALL AC POWER TO CONTROL PRIOR TO PERFORMING THE FOLLOWING COMPONENT TESTS.

Resistors - Fixed resistors can be tested in a circuit by disconnecting one lead and measuring resistance with ohmmeter on respective ohm scale.

Potentiometers – Tested by disconnecting all but one lead from the circuit and measuring resistance.

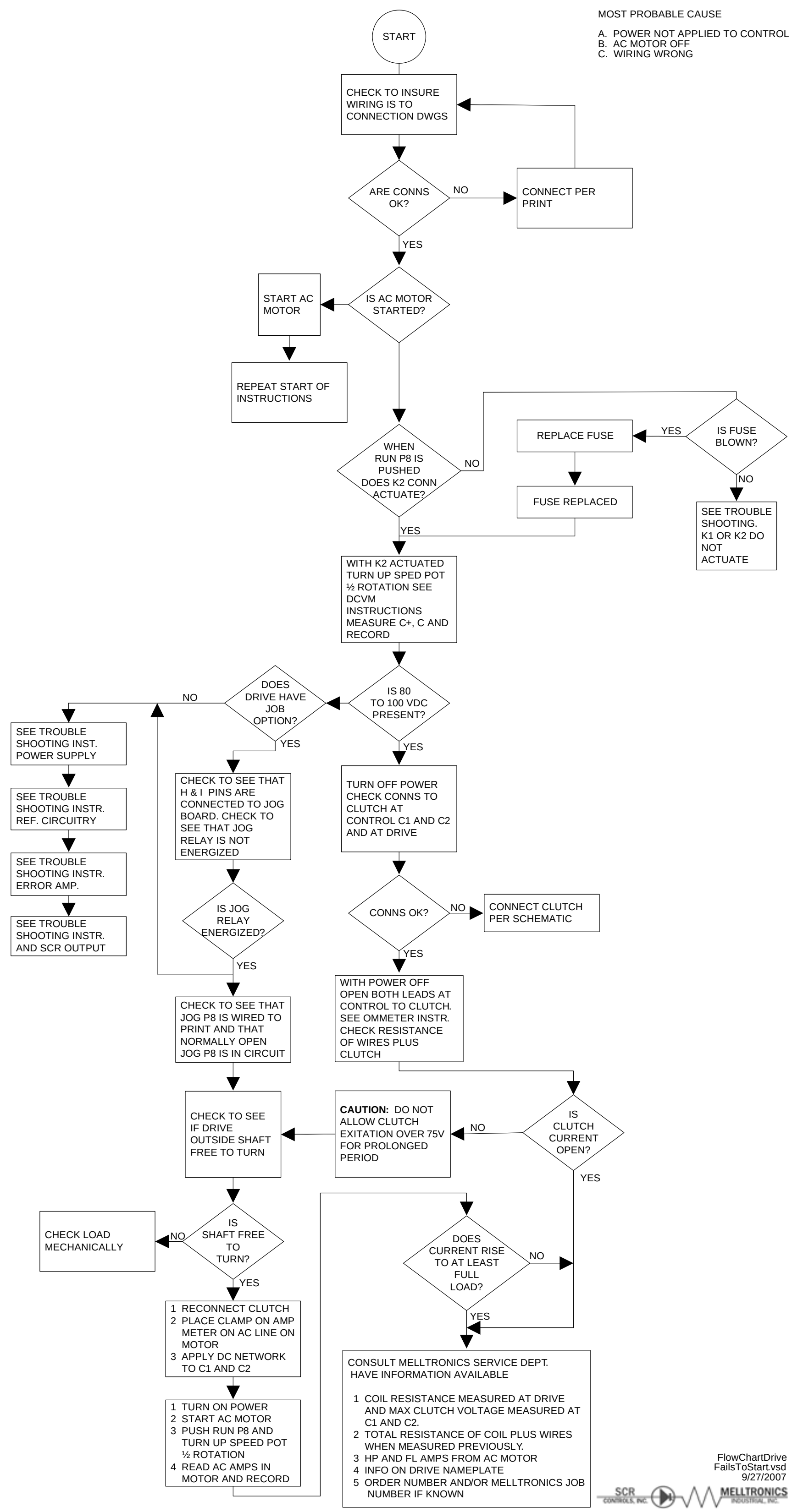
Transformers – Can be tested by continuity or short circuits by referring to winding connector drawing on nameplate.
Relays – Can be checked by a resistance test on the coil, continuity test across contacts or by replacement.

Capacitors – A good capacitor will cause ohmmeter needle to jump toward zero when leads are first connected. Then the needle will move toward the maximum scale.

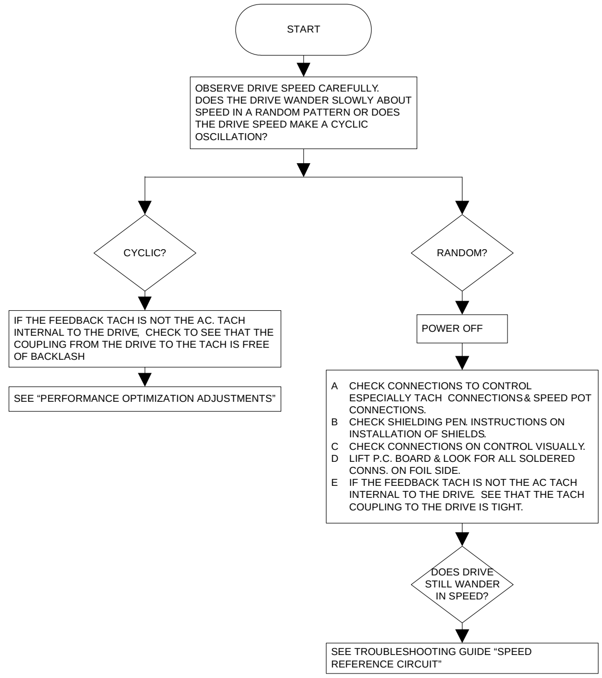
Open Capacitor – Ohmmeter needle will remain at maximum reading.

Shorted Capacitor – Zero Ohms

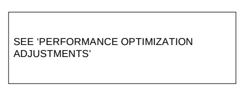
Leaky Capacitor – Fixed resistance reading.



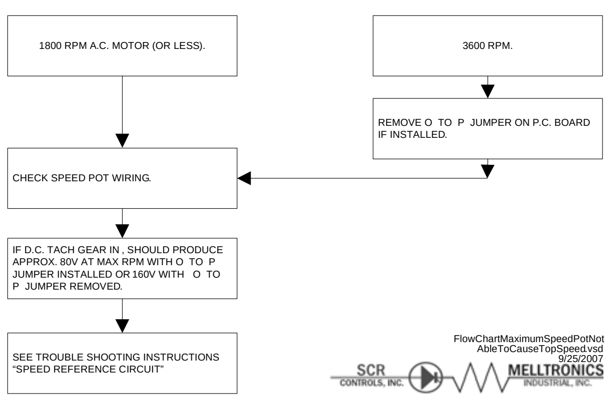
TROUBLESHOOTING CHART **1**: DRIVE FAILS TO START



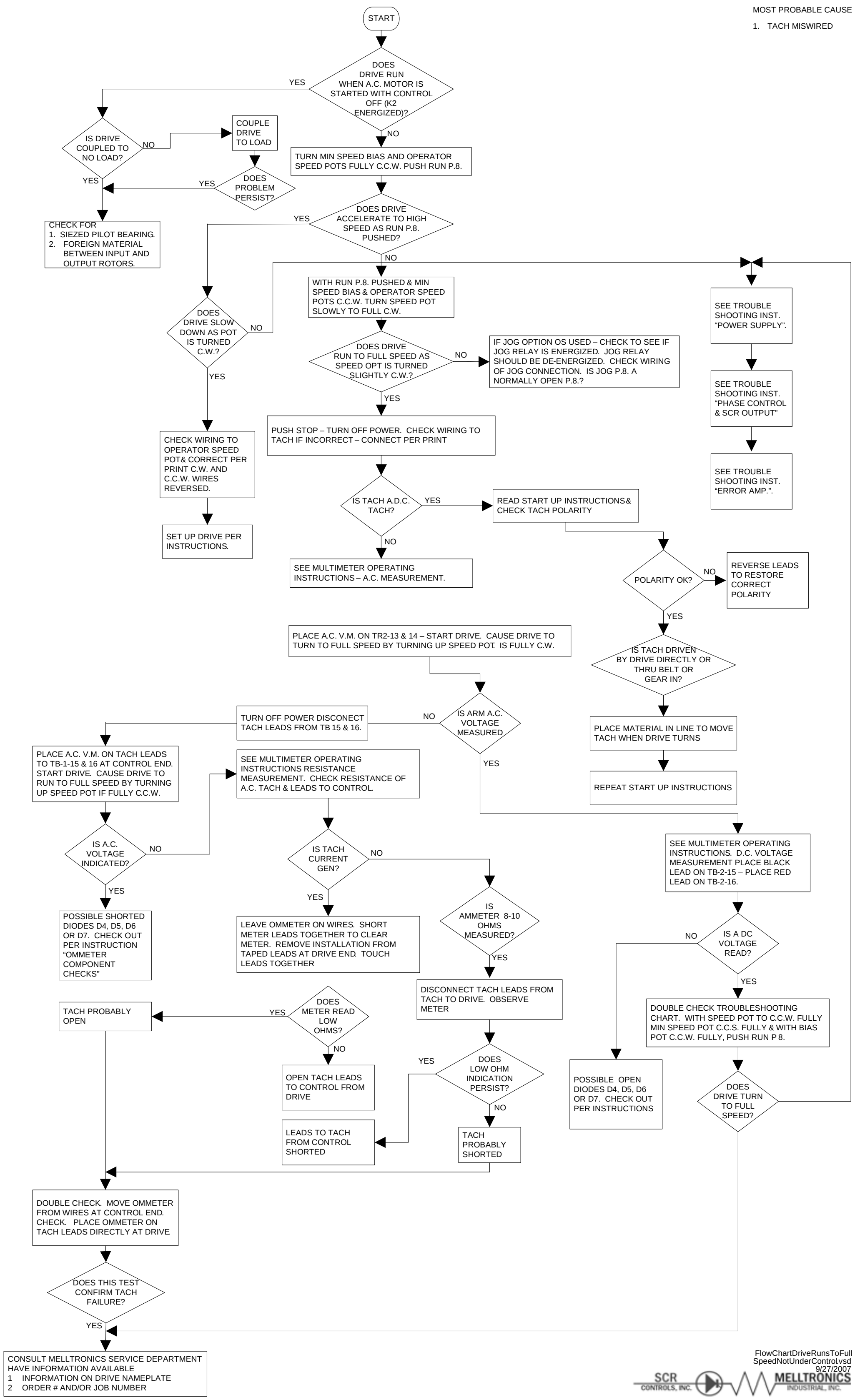
TROUBLESHOOTING CHART **2:** DRIVE SPEED UNSTABLE



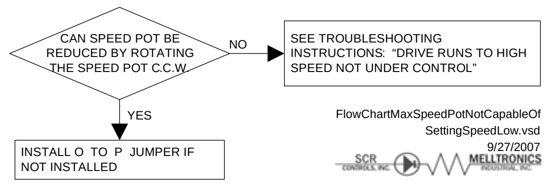
TROUBLESHOOTING CHART **3:** SPEED REGULATION NOT WITHIN SPECIFIED LIMITS



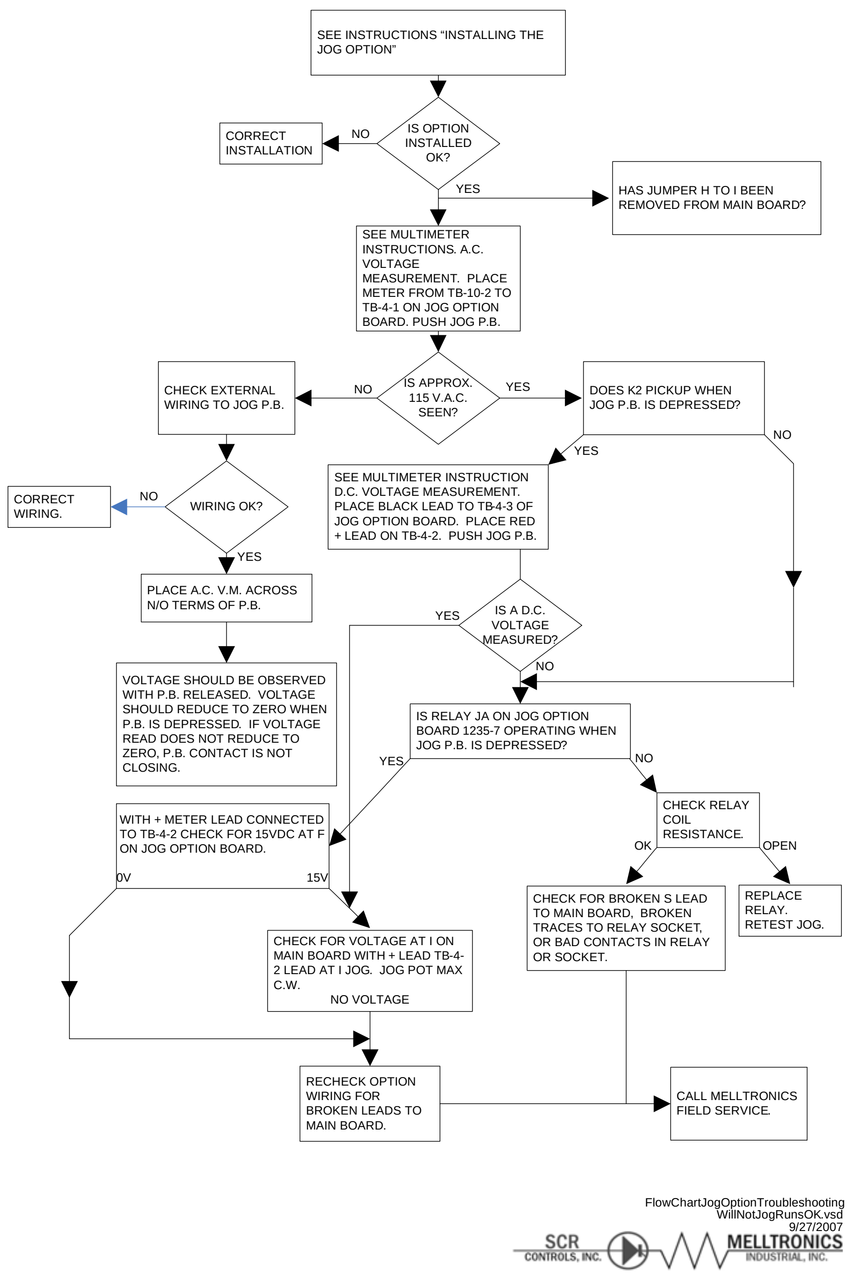
TROUBLESHOOTING CHART **4:** MAXIMUM SPEED POT NOT ABLE TO CAUSE TOP SPEED OF DRIVE



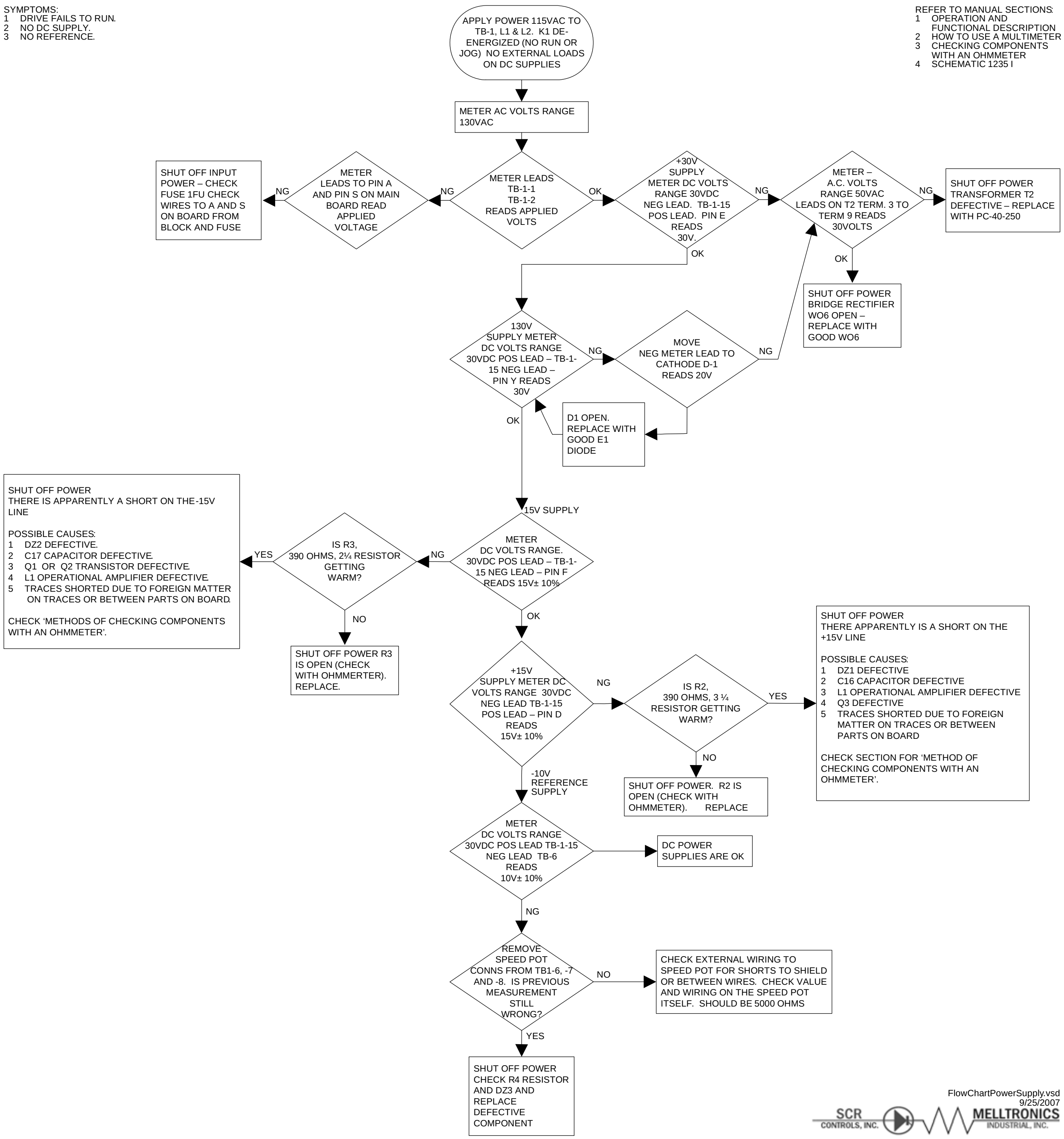
TROUBLESHOOTING CHART **5:** DRIVE RUNS TO FULL SPEED NOT UNDER CONTROL



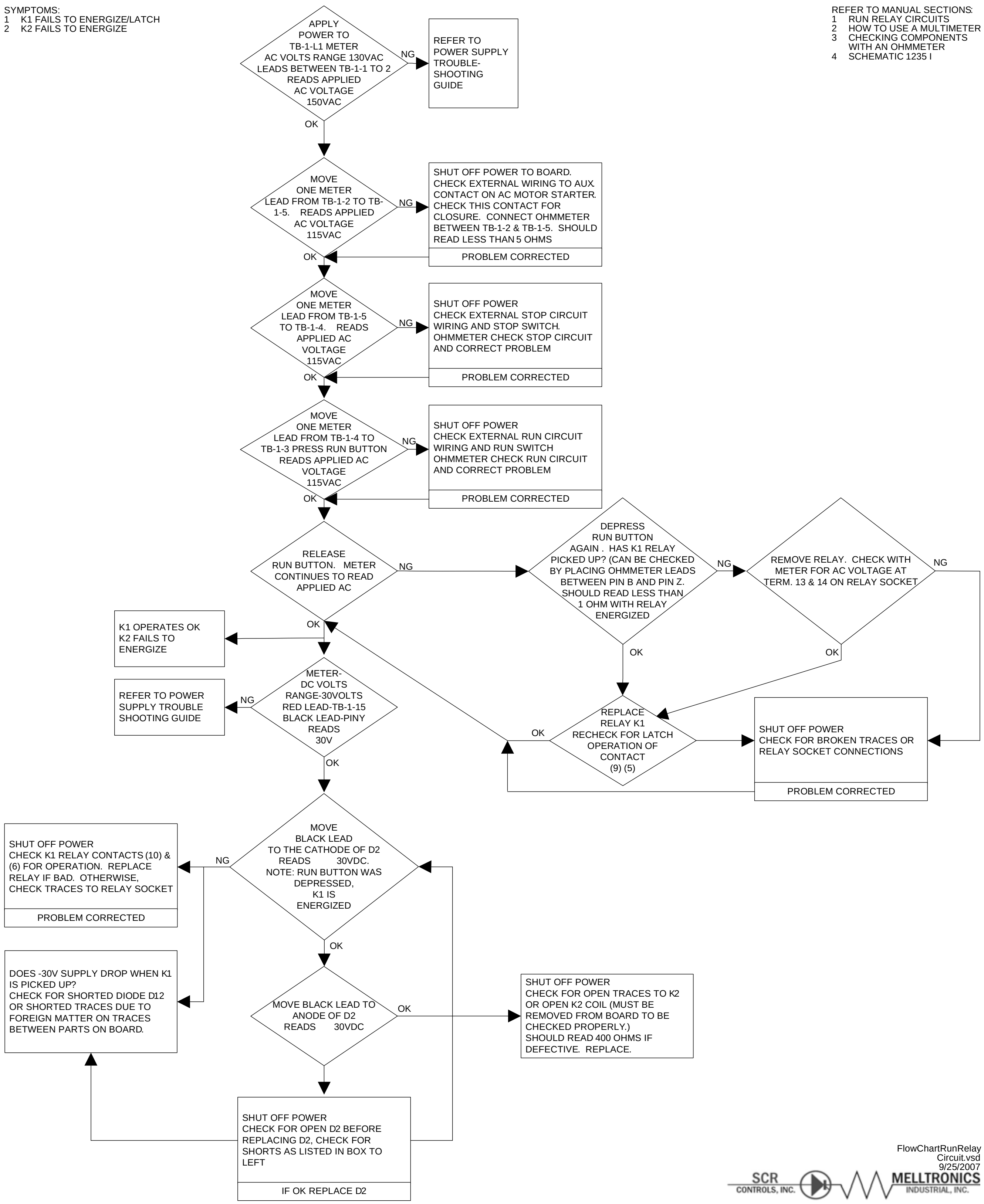
TROUBLESHOOTING CHART **6**: MAX SPEED POT NOT CAPABLE OF SETTING SPEED LOW ENOUGH



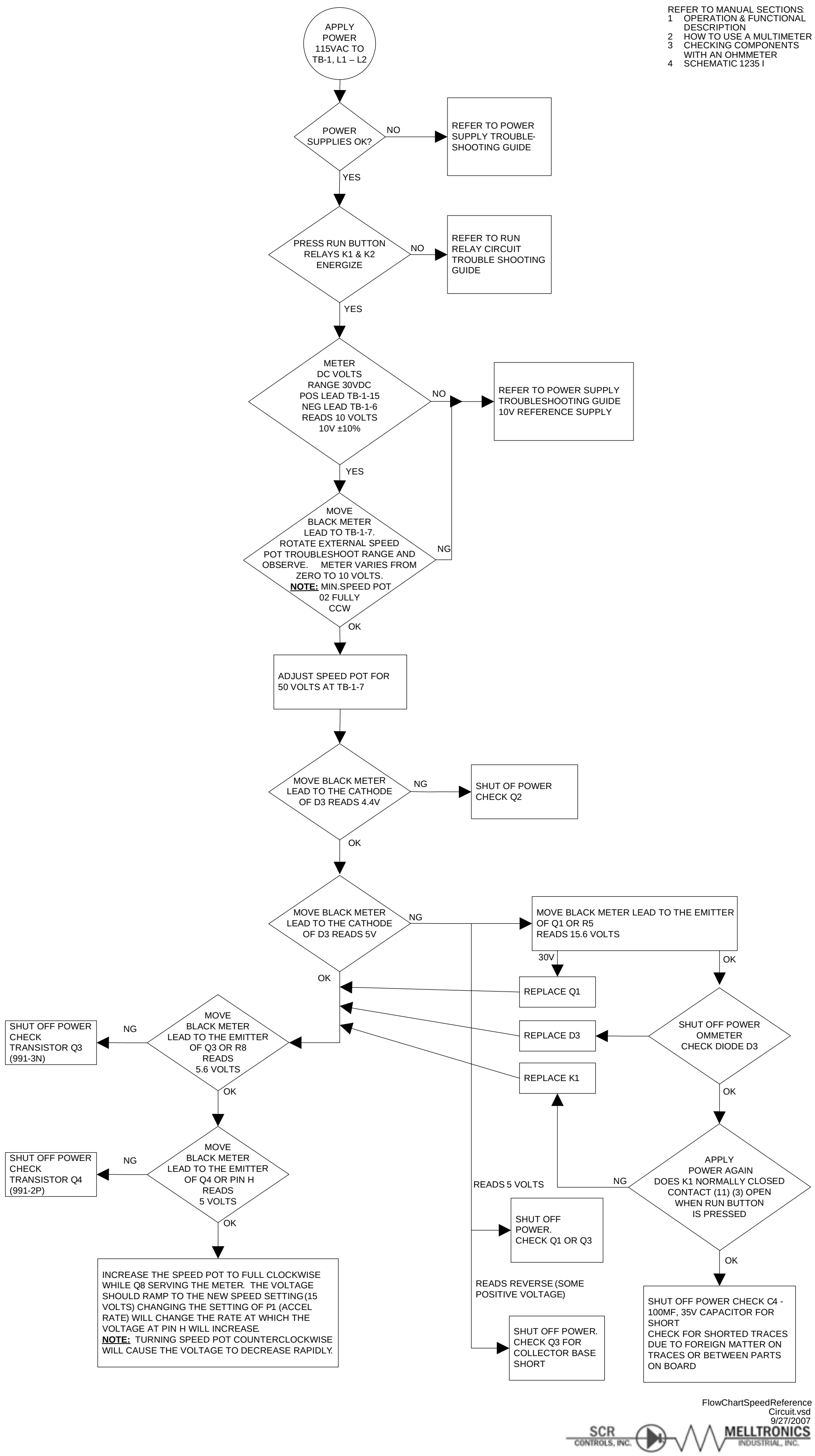
TROUBLESHOOTING CHART **7**: JOG OPTION – WILL NOT JOG – RUNS OK



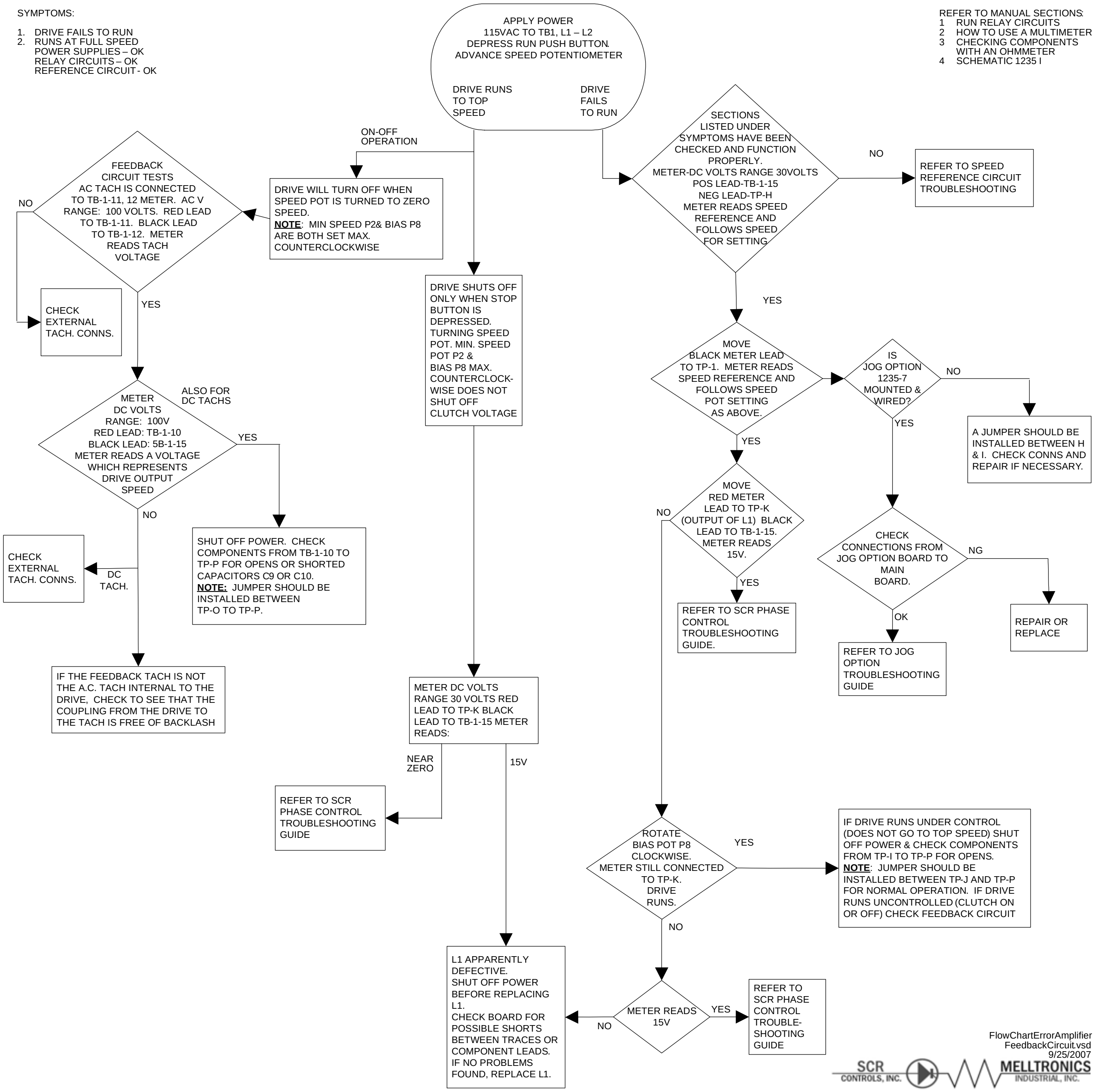
TROUBLESHOOTING CHART **8**: POWER SUPPLY



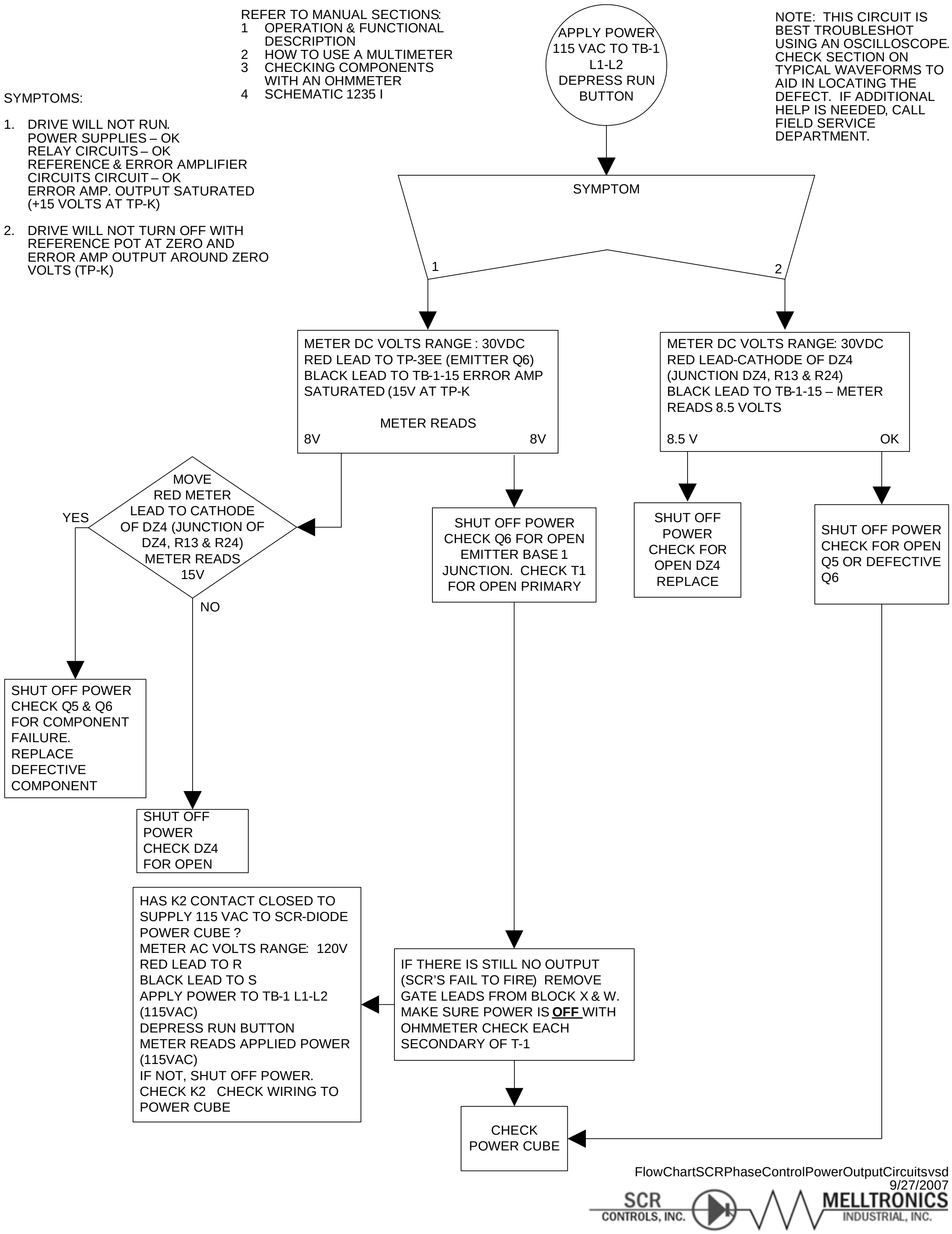
TROUBLESHOOTING CHART **9:** RUN RELAY CIRCUIT



TROUBLESHOOTING CHART **10:** SPEED REFERENCE CIRCUIT



TROUBLESHOOTING CHART **11:** ERROR AMPLIFIER & FEEDBACK CIRCUIT



TROUBLESHOOTING CHART **12:** SCR PHASE CONTROL & POWER OUTPUT CIRCUITS

SECTION 9
Spare Parts List

Quantity	Description	Part Number
5	Fuse	314015
1	Rectifier Block	WV2BE21C
1	Diode Bridge	WO6
2	Zener diode 15v	1N4744A
2	Zener Dioce 10v	1N4740A
2	Zener Diode 8,2	1N4738A
2	Diode	1N4003
2	Diode	1N914
1	Diode	1N93
2	Transistor	991-3N
2	Transistor	991-2P
1	Unijunction Transistor	2N4871
1	I.C. Linear Amp	LM741CN
1	Pot 1K 2W	916-7102
1	Pot 15K 2W	916-715-3
1	Pot 100K	3389P-1-104
1	Pot 500K	3389P-1-504
1	Relay 3510-001	4PDT-120VAC
1	Relay W88KDV-3	SPST-24VDC
1	Relay 78RE-24VDC	SPDT-24VDC

Electrostat Repair Kit 1235-45

1. Kit Less Rectifier Block
   Hi Par Driver P.C. Assy

SECTION 10
REVISION HISTORY

REV	DATE	DESCRIPTION	REVISIONS
NONE	12/23/03	1ST RELEASE	NONE
A	05/23/08	PAGE 21 FIG 14, BASIC CONTROL DRIVE INTERCONNECTIONS	CORRECTIONS, REDRAWN AND SUBSTITUTED

NOTES:

NOTES:

SECTION 11
WARRANTY

MELLTRONICS warrants to the Buyer whom purchases for use and not for resale that the equipment described in this instruction manual is sold in accordance with published specifications or the specifications agreed to in writing at the time of sale. Melltronics further warrants that such goods are free of defects in material and workmanship.

The warranty shall apply for a period of twelve months (12) from date of purchase, not to exceed eighteen months (18) from the date of manufacture.

If the goods fail to perform to Melltronics specifications as outlined in the warranty, then Buyer should contact Melltronics to obtain a “Material Return Authorization” (MRA), prepare the goods for shipment and return the goods to Melltronics for repair or replacement at Melltronics option. Buyer will bear all costs of transportation to and from Melltronics factory, risk of loss for goods not at Melltronics factory and any cost required to remove or prepare the goods for shipment to the repair facility, and to reinstall equipment subsequent to repair.

This warranty is effective only if written notification of any claim under this warranty is received by Melltronics at the address indicated below within thirty-days (30) from recognition of defect by Buyer.

The above indicates the full extent of Melltronics liability under this warranty. Melltronics specifically disclaims any liability for: (a) damage or failure due to improper use or installation; (b) damages in shipment; (c) damage or failure due to abnormal operation conditions of load, temperature, altitude or atmosphere whether intentional or unintentional; (d) non-authorized service, repair, modification, inspection, removal, transportation or installation; (e) misapplication or misuse, or; (f) consequential damages arising out of the use, operation or maintenance of the goods.

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Melltronics Industrial, Inc.

MAIL: PO BOX 2368
INDIAN TRAIL, NC 28079-2368
SHIPPING: 3479 GRIBBLE ROAD
MATTHEWS, NC 28104-8114

PHONE: 704-821-6651
www.melltronics.com