MANUAL 7149

AC BRUSHLESS SERVO DRIVE

DRIVE P/N 714-510-110-S002

SEPTEMBER, 1991

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AC DRIVE PRODUCT

WARRANTY

Baldor Sweodrive warrants that the drive products sold will be free from defects in material and workmanship and perform to Seller's applicable published specifications for a period of two (2) years from date of shipment from Seller's plant. Seller extends this limited warranty to each buyer of the drive for the sole purpose of resale and to the original purchaser for use. (Use shall be defined as installation and application of power.) The liability of Seller hereunder shall be limited to replacing or repairing, at its option, any defective units or parts thereof which are returned F.O.B. Seller's plant, Bellevue, Washington. In no event shall Seller be liable for any consequential or incidental damages.

Equipment or parts which have been subject to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation are not covered by warranty. Seller shall make the final determination as to the existence and cause of any alleged defect. No liability is assumed for expendable items such as fuses. No warranty is made with respect to custom equipment or products produced to Buyer's specifications except as specifically stated in writing by Seller in the contract for such custom equipment.

This warranty is the only warranty made by Seller with respect to the goods delivered hereunder, and may be modified or amended only by a written instrument signed by a duly authorized officer of Seller and accepted by Buyer.

Warranty of any product purchased by Seller from others is limited in time and scope to any warranty given Seller by such suppliers.

Except as hereinabove provided, SELLER MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

1.0 GENERAL INFORMATION

1.1 INTRODUCTION

The purpose of this manual is to provide installation, start-up, operating and maintenance instructions for a Model 714-XX-110 SWEODRIVE AC Brushless Servo Drive. The 714 series drive are expressly designed to drive permanent magnet synchronous ac motors equipped with Tachsyn (TM) position and velocity transducers. Each drive is factory tested and adjusted to operate the brushless ac motor specified on the title sheet. Proper settings of drive system adjustments are summarized on a setup sheet, included herein.

Manual Sections 1 through 4 contain a general explanation for a Sweo ac brushless drive. The Title page, Fuse List, (section 5) and Drawing list (section 6 with attached drawings, including setup sheet) contain information specific to this drive system.

1.2 SAFETY NOTICE

WARNING

This equipment contains voltages which may be as high 800 volts and rotating parts on motors and driven machines. High voltage and moving parts can cause serious or fatal injury. Only qualified personnel familiar with this manual and any driven machinery should attempt to start-up or troubleshoot this equipment. Observe these precautions:

1. **USE EXTREME CAUTION, DO NOT TOUCH any circuit board, power device or motor electrical connection without insuring unit is properly grounded and no high voltage is present. DO NOT apply ac power before grounding per instructions herein. DO NOT open cover for 2 minutes after removing ac power to allow capacitors to discharge.**

2. **BE CERTAIN that possible violent motion of motor shaft and driven machinery due to improper control operation will not cause injury to personnel or damage to equipment. Peak torques of several times rated motor torque can occur during a control failure.**

3. **Motor circuit may have high voltage present whenever ac power is applied, even when motor is not rotating.**

1.3 DRIVE DESCRIPTION (See Figure 1, Drawings 7148 & 7153)

The 714 series drives are especially adapted for high performance industrial servo control systems. They operate directly from three phase 460 VAC power and can control a 5 to 40 HP permanent magnet synchronous ac motor. Operation on a single phase power source with reduced performance, is also possible. Outline and mounting dimensions of the drive enclosure is specified on drawing 7153.

The drive consists of the following major elements in a compact enclosed assembly:

1. Mounting base with grounded heat sink, on which are mounted: bus capacitors C1 through C3, the main power transistors Q1, Q2, and Q3, output current sensing resistors R2 and R3, three phase diode bridge BR1, input filter inductor L1, soft start resistor R1, soft start bypass SCR (part of Q5 module), regenerated energy regulator transistor Q4 and the power terminal block. Units rated over 20 amps rms also have a fan for circulation of cooling air.

2. Base drivers A5, A6 and A7 mounted over the three main power transistor modules.

3. Swing-out circuit mounting plate with mod-demod assembly A4 and power supply assembly A3 mounted on the inside surface.

4. Control board A1 mounted on the outside surface of the swing-out plate.

The functional block diagram of Figure 1 and drawing 7148 shows the internal connection of the elements listed above.

1.4 INTERCONNECTIONS

Figure 2 illustrates typical connections from a drive to: ac power, customer I/O signals and a brushless motor. The interconnection diagram specific to this particular drive system is among the drawings included at the end of this manual (see Section 6). All power connections are made to the terminal block at the end of the drive. All signal connections are made to plug-in terminal strips J1 and J2 on control board A1.

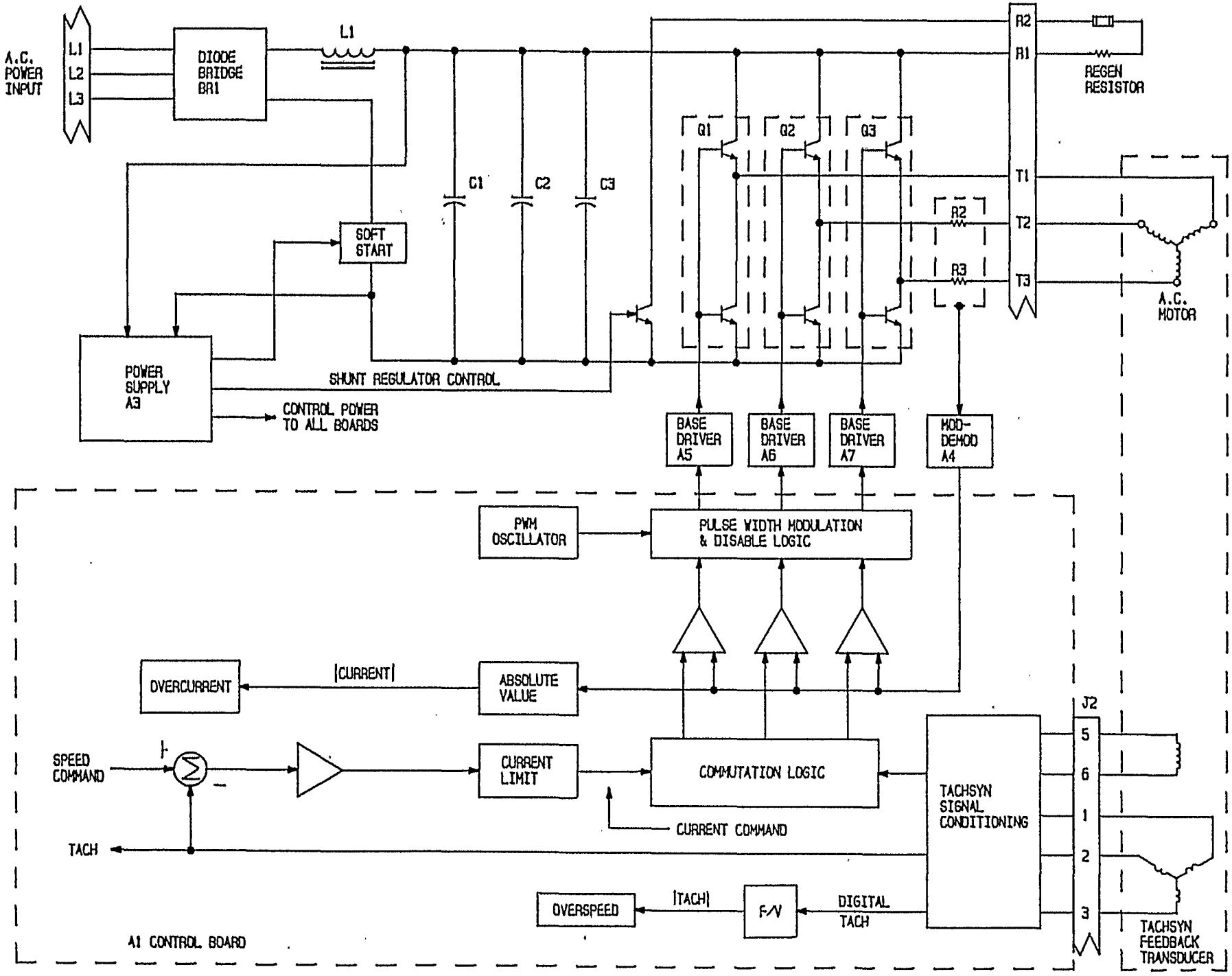


FIGURE 1 FUNCTIONAL BLOCK DIAGRAM

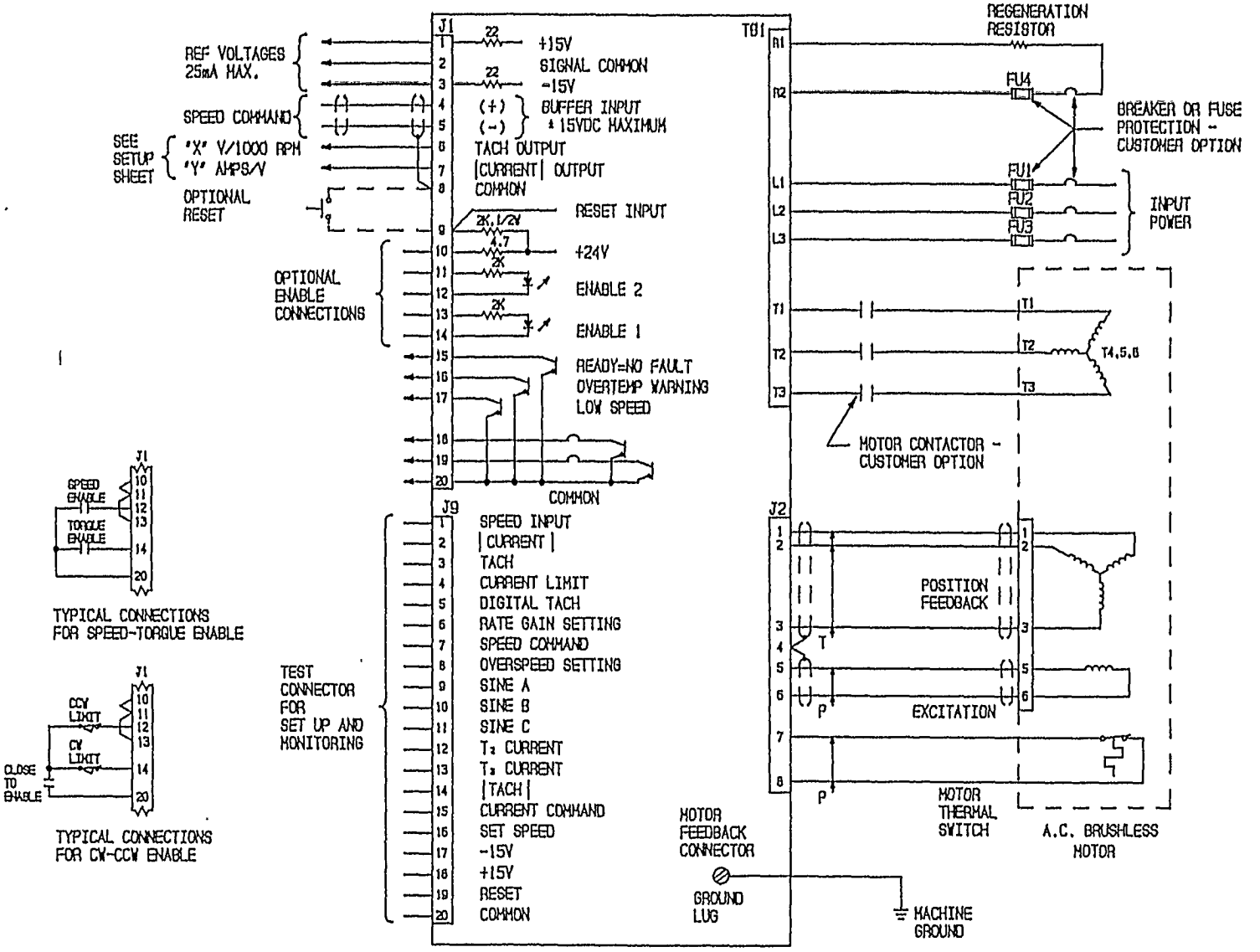


FIGURE 2

TYPICAL INTERCONNECTION DIAGRAM
FOR A.C. BRUSHLESS DRIVE

1.5 INDICATORS, ADJUSTMENTS AND TEST POINTS

Drive status and fault LED indicators are located on control board, A1. All adjustments are made with the pots and jumper located on control board A1. The 40 pin personality platform PL1 plugs into control board A1 and contains all selected components for a particular drive and motor combination. Test connector J6 and board edge testpoints TP1 - TP6 provide setup, adjustment and monitoring points as identified in Figure 2.

1.6 DRIVE CIRCUIT FUNCTIONAL DESCRIPTION (See Figure 1)

The functional arrangement of the drive and ac motor is given in Figure 1. The voltage and frequency for the motor is generated by the three main power transistor pairs Q1, Q2 and Q3. The transistors convert dc voltage to three phase ac voltage by means of pulse width modulation (PWM). The dc bus voltage is provided by the three phase diode bridge BR1, inductor L1 and bus capacitors C1 through C3. Input three phase ac power is supplied to bridge BR1 through drive terminals L1, L2 and L3. Power Supply Board, A3 is powered directly from the dc bus.

Power Supply Assembly, A3 furnishes several functions:

1) Controls the soft start circuit which limits charging current to the bus capacitors. This prevents excessive inrush currents when ac power is applied.

2) Controls the shunt regulator transistor Q4 to prevent an overvoltage condition on the bus supply by dissipating regenerated energy through an external resistor.

3) Develops regulated control power to operate the other circuit boards in the system.

4) Enables drive operation if power conditions are proper.

5) Connects a safety bleed resistor across the capacitor bank when ac line power is removed.

Each main power transistor pair is controlled and monitored by its associated Base Driver Assembly 5, A6 or A7. These base drivers amplify the PWM control signals and monitor the operation of the power transistors for fault conditions. In the event of an overload condition, the transistors are shut off, there by inherently protecting the drive against short circuits between outputs and between an output and ground.

Motor currents through terminals T2 and T3 are sensed with shunt resistors and Mod-Demod assembly A4. The Mod-Demod isolates the power circuit from the control circuits and provides gain and offset trimming of the current feedback signals.

Three current control loops individually regulate current in the motor phases. Transistor base signals are produced by modulating the outputs of the current error amplifiers with the triangle wave generated by the PWM oscillator. The fault disable logic suppresses transistor base signals when a fault occurs. The commutation logic transforms the speed error amplifier output into the three current commands. The commutation and tach feedback signals are developed from the Tachsyn (TM) brushless transducer output by the signal conditioning circuitry. Both digital and analog tach signals are generated; the analog tach is used as the feedback signal for the speed control loop and the digital tach is used for overspeed protection.

1.7 PROTECTIVE FEATURES

This drive includes extensive fault monitoring circuits to insure safe reliable operation and to aid in troubleshooting. The following latching red LED fault indicators are supplied:

Ø1 (D1)	Fault at output T1 latches and lights this indicator. Fault may be loss of adequate transistor base drive, output short or ground fault.
Ø2 (D2)	Fault at output T2 latches and lights this indicator. Fault may be loss of adequate transistor base drive, output short or ground fault.
Ø3 (D3)	Fault at output T3 latches and lights this indicator. Fault may be loss of adequate transistor base drive, output short or ground fault.
±15 (D4)	Latches and lights upon low or missing +15V or -15V control power.
OL (D5)	Lights when the drive output current exceeds the drive continuous current ratings for long time periods. User selectable for latching or current-limit pullback mode.
OS (D6)	Latches and lights upon motor overspeed, independent of tachometer voltage. Overspeed setting is user adjustable.
UV (D7)	Lights when a dc bus undervoltage condition occurs.
OV (D8)	Lights when a dc bus overvoltage condition occurs.

OT (D7 & D8) The two LEDs D7 and D8 will simultaneously latch and light when the motor thermostat opens.

All faults indicated by these indicators may be reset either by removing and reapplying ac power (power-up reset) or by applying a reset input to J1-9.

The following open collector output provides fault status information at J1:

READY Opto-isolated output indicates drive ready. J1-15 to J1-16 are closed when the drive is ready, and ready LED D10 is on (see below).

1.8 STATUS INDICATORS AND OUTPUTS

The following green LED indicators show drive status:

READY (D10) Lights when power is applied, no fault conditions exist and reset is not applied. Normally lights 3 seconds after ac power is applied or reset is removed.

ENABLE (D11) Lights when either the FWD ENABLE (J1-10) or REV ENABLE (J1-11) inputs are present.

1.9 ADJUSTMENTS

1.9.1 CONTROL BOARD A1

All normal user adjustments are located on the control board A1. Adjust per setup instructions in Section 2.

R1	CURRENT LIMIT	Adjusts maximum current the drive will supply to the motor, CW to increase limit.
R2	OVERSPEED	Adjusts overspeed setting, CW to increase overspeed setting.
R3	RATE GAIN	Adjusts rate servo loop gain, CW to increase gain.
R4	ZERO TRIM	Adjusts zero offset of speed loop input.
R5	TACH SCALE	Adjusts scale factor of drive tach feedback, CW to increase tach signal.

R6	MAX SPEED	Adjusts max motor speed for a given speed command input, CW to increase motor speed.

1.9.2 MOD-DEMOD A4

These adjustments are factory preset and normally require no field adjustment.

R14	T3-OFFSET	Adjusts offset of T3 current signal.
R15	T3-SCALE	Adjusts scale factor of T3 current signal.
R30	T2-OFFSET	Adjusts offset of T2 current signal.
R29	T2-SCALE	Adjusts scale factor of T2 current signal.

1.9.3 TACHSYN PHASING

This motor adjustment requires setting only if the motor is not shipped directly from the factory. The drive includes an alignment mode to check and adjust phasing between the tachsyn and motor. The adjustment procedure is given in section 2.4 of this manual.

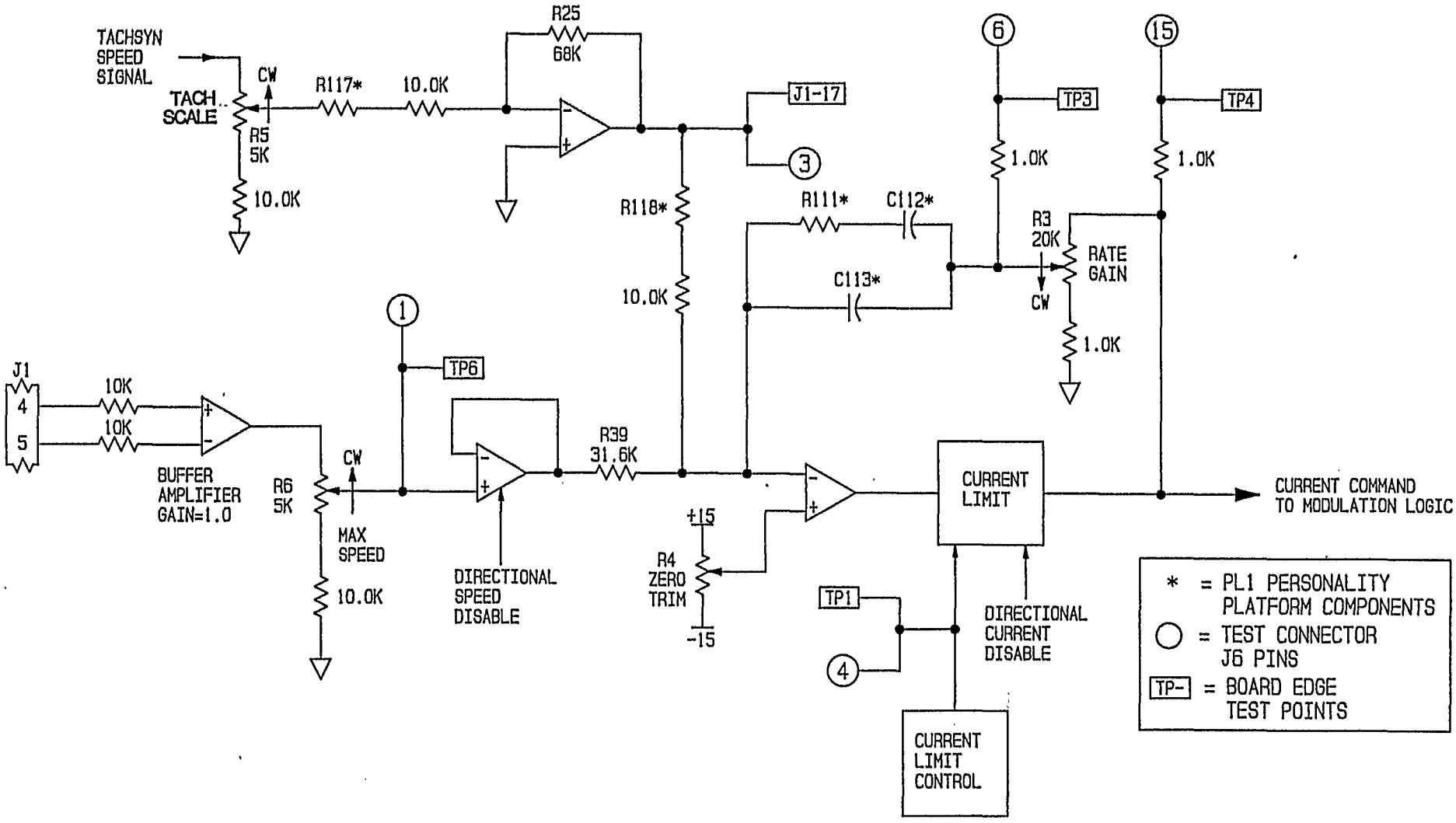


FIGURE 3

SIMPLIFIED SCHEMATIC DIAGRAM SPEED CONTROL CIRCUITS

2.0 INSTALLATION AND START-UP

Check motor nameplate and power source voltage to insure they match the drive nameplate and information contained in this manual. DO NOT USE THIS DRIVE ON ANY OTHER VOLTAGES OR MOTORS without factory approval.

2.1 MOUNTING (See Drawing 7153)

This drive is designed for panel mounting. Mount in a clean dry enclosure with an internal ambient temperature of not greater than +50 degrees C. DO NOT mount drive above transformer or other heat source. DO provide 2" minimum clear area above and below the drive to allow free flow of air over heat sink on the back of the enclosure.

Mounting dimensions are shown in drawing 7153. Note that both power and signal connections are made at the end of the drive. Provide access to the front of the module to adjust potentiometers and to observe indicators. Allow room for swinging the hinged circuit board panel out to gain access to the power components.

2.2 WIRING

All wiring shall be in accordance with the National Electric Code and applicable local codes. External or remote motor overload protection must be provided in accordance with the National Electrical Code, or equivalent. Install wiring as shown in Figure 2 and the Interconnect Diagram included in the Drawings section (Section 6) of this manual.

2.2.1 POWER WIRING

This drive requires input power protection in the form of either a circuit breaker or fuses. Recommended sizes and types of circuit breakers and fuses for this particular drive are given in section 5.0

Connect drive terminals L1, L2 and L3 to the load side of the customer supplied protective device. The drive may be powered with nominal 460 VAC line-line three phase power or single phase power. Phase sequence of incoming power is not important. If single phase power is to be used, connect power to drive terminals L1 and L2. Note that drive capacity is restricted to 60% of normal when operated on single phase power.

Wire the three phase motor stator to drive terminals T1, T2 and T3 using appropriately sized wire. Connect the drive to the motor either directly or indirectly through a dc rated contactor. A motor circuit contactor is recommended whenever

a positive disconnection is required to prevent motor motion which could pose a safety hazard to personnel or equipment.

Ground **both** the chassis ground lug and motor frame to machine or plant ground with the same sized wire used for the ac connections.

High inertia and overhauling loads require an external regeneration resistor with suitable fuse or breaker protection. Minimum resistor resistance is limited by the regeneration capacity of the drive. Dissipation rating of the resistor must be selected to suit the average regeneration of overhauling load. The protective fuse or breaker must be rated at 800 VDC minimum with sufficient capacity to interrupt, in the event of a control failure, a continuous connection of the resistor across the dc bus (560 to 700 VDC). Sweo Controls supplies a number of kits for this purpose, see section 5 for recommendations. Connect regeneration resistor and associated fuse or breaker between drive terminals R1 and R2.

2.2.2 SIGNAL WIRING

All motor signal and control wires are terminated on plug-in terminal strip J2. Use twisted shielded pairs and triplets as shown in Figure 2, with shields terminated on drive end only. Maximum cable length between J2 and the ac motor is 150 feet using shielded cable with 22 AWG minimum wire size and maximum wire to wire capacitance of 60 pf/foot.

All customer control and signal wiring is terminated on plug-in terminal strip J1. Common on this terminal strip is isolated from the power circuits and grounded to the chassis. All signal and control inputs are relative to chassis common except the Buffered Speed Command Input, the opto-isolated Fwd. Enable, Rev. Enable, and Reset inputs, and the opto-isolated Ready output.

Speed Command is applied at terminals J1-4 & J1-5. Standard scaling for this signal is: 10V $\pm$2 V = Max Speed. This input is buffered to provide 40 db minimum common mode isolation up to $\pm$15 volts common mode input relative to common. Either input may be grounded at the signal source so long as the common mode range is not exceeded.

The J1-6 and J1-17 Tach Outputs are available for speed monitoring or metering. The J1-6 output is a buffered Absolute Value Tach and the J1-17 output is a Bipolar Tach. Both outputs have the same scaling as listed on the set-up sheet (see section 6.0).

The J1-9 Reset, J1-10 Foreward Enable, and J1-10 Reverse Enable are all bipolar opto-isolated inputs with J1-12 as a common return. J1-12 may be connected to +24 VDC (J1-19) or Common (J1-20) depending on whether HIGH = ON or LOW

= ON inputs are preferred. The J1-9 Reset input may be used to reset any fault condition except power supply loss. This input must be open to operate the drive.

2.3 CONTROL BOARD JP1 JUMPER SELECTION

This jumper selects a latching or non-latching mode for the D5 overload indicator. A push-on jumper in place sets the drive in the latching mode which shuts down the drive in the event of overload. The non-latching mode with JP1 open reduces the current limit in the event of extended drive overcurrents to protect the drive without latching. Drives are factory set with a jumper in place for the latching mode.

2.4 TACHSYN PHASING ADJUSTMENT

The tachsyn feedback device on the motor shaft must be precisely aligned for proper operation of the system. Normally all motors shipped directly from Sweo Controls are aligned by the factory. Any Pacific Scientific motors are always aligned by Pacific Scientific and may also be used without alignment. Any other motors including motors used previously with the older style of Sweo drives sold before July, 1989 must be aligned per the following procedure.

WARNING: THE INTERCONNECTION OF THE MOTOR TO AXIS MODULE IS CRITICAL TO THIS PROCEDURE. SEE THE INTERCONNECT DIAGRAM INCLUDED IN SECTION 6 FOR THE PROPER CONNECTIONS OF THE MOTOR AND TACHSYN.

PROCEDURE:

With the motor electrically connected to the drive and the motor shaft disconnected from its load, connect ac power to the drive with enable inputs J1-10 and J1-11 open. Connect the tachsyn align input J1-13 to common (J1-20) to put the drive in tachsyn align mode. Connect a voltmeter from TP1 to common and adjust R1 (Current Limit) to the recommended tachsyn alignment level listed on the set-up sheet for the drive and motor (see section 6.0). Enable the drive with the application of voltage to J1-10 and J1-11. This will cause current to flow through motor windings T2 and T3 while in alignment mode. The current level in this mode is set by the adjustment of R1. The motor shaft will rotate to a position of minimum torque; rotate the shaft slightly about this position by hand to confirm that motion is unrestricted by friction.

To check for proper tachsyn phasing, observe the commutation LEDs D11 and D12 on the control board. Rotate the motor shaft slightly back and forth from its minimum torque position by hand. D11 and D12 should alternately light as the shaft is moved. In addition, an exact measurement of tachsyn alignment may be

made by checking the voltage at connector J6-10 relative to common (J6-20 or J1-20). This voltage will be less than ± 0.05 VDC with either D11 or D12 lit for a properly aligned tachsyn.

If the phasing requires adjustment, loosen the 3 clamps holding the tachsyn stator to the motor end-bell and rotate the stator until the above criterion is met. Re-tighten the clamps and re-check the voltage at J6-10 to confirm proper alignment.

An alternative to using the commutation LEDs is to check the tachsyn output on the J6 connector. A properly phased tachsyn will give these three voltages:

J6-9 to J6-20	+2.5 to +3.5 VDC
J6-10 to J6-20	Less than ± 0.05 VDC
J6-11 to J6-20	-2.5 to -3.5 VDC

After the alignment procedure is completed, disable the drive and open the connection to J1-13 to take the drive out of alignment mode. Re-set the current limit pot R1 to the position specified in the set-up sheet.

2.5 CONTROL BOARD POTENTIOMETER ADJUSTMENTS

Make all measurements described below with DVM common on J1-20 or J6-20 except as otherwise noted. Use either the testpoints TP1-TP6 along with the J1 connector at the board edge or the J6 test connector near the center of the board for adjustments. See Setup Sheet in section 6 for factory recommended settings. Complete drive set-up should be done in the order listed on the Set-up sheet.

2.5.1 R2 OVERSPEED - TEST POINT TP2 OR J6-4

Make this adjustment with ac power applied, READY on, and both enable inputs open or disconnected (FWD & REV off). Set potentiometer R2 for desired overspeed setting, up to the maximum overspeed allowed per the attached set up sheet.

CAUTION:

MECHANICAL DAMAGE MAY OCCUR AT MOTOR SPEEDS ABOVE THE MAXIMUM OVERSPEED ALLOWED

2.5.2 R1 CURRENT LIMIT - TEST POINT TP1 OR J6-4

Use set-up of 2.5.1. Set potentiometer R1 for desired Current Limit up to the maximum per attached set up sheet.

2.5.3 R3 RATE GAIN - TEST POINT TP3 OR J6-6

The gain setting listed on the set-up sheet may be made using the set-up of 2.5.1. First re-set the Current Limit (R1) to 1.0 VDC per 2.5.1. Jumper TP4 to J1-1 and jumper J6-19 to J6-20. Check first that the D10 READY indicator is off then enable the drive in the FWD and REV directions with the J1-10 and J1-11 inputs. Adjust R3 to give the desired setting measured at TP3. Remove the enable inputs from J1-10 and J1-11 then disconnect the two jumpers. Re-set the current limit pot R1 to the desired setting per 2.5.1.

To adjust Rate Gain for a load other than that indicated in the setup sheet, complete other adjustments below, then enable drive and apply step speed commands. Observe the motor tach output at J6-3 with an oscilloscope and set R3 for the desired response, adjusting CW to increase gain setting. Too CW a gain setting will cause overshoot and may cause oscillations in the drive; too CCW a setting will cause sluggish response. If load is variable in the application (e.g., the coupling ratio between motor and load can change), check gain setting with both extremes of load and select best compromise between ideal settings for each load. Measure resulting gain setting using procedure described above, and record on setup sheet for future reference.

2.5.4 R4 ZERO TRIM - MONITOR MOTOR SHAFT ROTATION

With ac power applied and READY on, apply zero speed command and activate both Fwd and Rev Enable inputs; then adjust R4 for zero motor shaft rotation.

2.5.5 R5 TACH SCALE-TEST OUTPUTS J1-17 OR J6-3

With setup per 2.5.4, increase speed command to cause tach output measured with DVM at J1-17 to agree with requirement on set-up sheet in the input column to within $\pm$ 0.1 volt. Then using an independent tachometer, adjust R5 until the motor speed agrees with the speed on the output column of the setup sheet. A check of this adjustment may be made by connecting a voltmeter from J1-17 to J1-6. The reading should be less than $\pm$0.05 VDC, confirming that the digital tach and the tachsyn speed output have the same scaling.

2.5.6 R6 MAX SPEED - TEST POINT TP6 OR J6-1

With setup per 2.5.5 and after Zero Trim adjustment (2.5.4) is complete, raise speed input to desired maximum voltage, then adjust R6 to attain desired maximum speed measured with DVM at J1-17.

2.6 CURRENT COMMAND CONFIGURED DRIVES

These brushless motor drives may be factory configured to operate in a current command mode by proper factory selection of the PL1 platform components (see Section 2.7). This type of configuration allows the speed control loop to be included in user circuitry external to the Sweo drive. Check the setup sheet in Section 6.0 to see if the particular drive supplied with this manual is configured for a current command.

Drives configured in this manner are operated by the input of a voltage to the differential inputs J1-4 to J1-5. The drive output current will be proportional to the input command with the input to output scaling given on the setup sheet.

Current command configured drives should be set up with the same procedure as outlined in section 2.5 for speed command configured drives. The functionality of some of the potentiometer settings is slightly different as listed below:

RATE GAIN R3:	This pot is not used.
ZERO TRIM R4:	This pot adjusts for offsets in the zero current command.
MAX SPEED R6:	This pot adjusts the scaling of the input current command at J1-4 to J1-5.

2.7 PL1 PERSONALITY PLATFORM PLACEMENT (Figure 4)

The 40 pin PL1 personality platform is located near the center of the A1 control board on the outside of the drive. This platform contains all factory selected components needed to customize any brushless drive to the particular motor and application. All drives are shipped from the factory with this platform in place, and the only case in which the user will need to change it is when the drive configuration is changed.

Each platform is marked with a part number on both the front and back which is unique to the particular components on the platform. This part number should agree with the part number listed on the setup sheet in Section 6.0 for this particular drive. Contact the factory if any change in the drive configuration is required.

When the platform is plugged in, care must be taken to line up pin 1 of the platform, marked in white, with pin 1 as marked on the A1 control board. See Figure 4 for an outline of the platform. If the platform is replaced with one of a different part number, the drive must be set up per a new setup sheet on which the particular platform part number being used is referenced. See section 2.5 for the setup procedure.

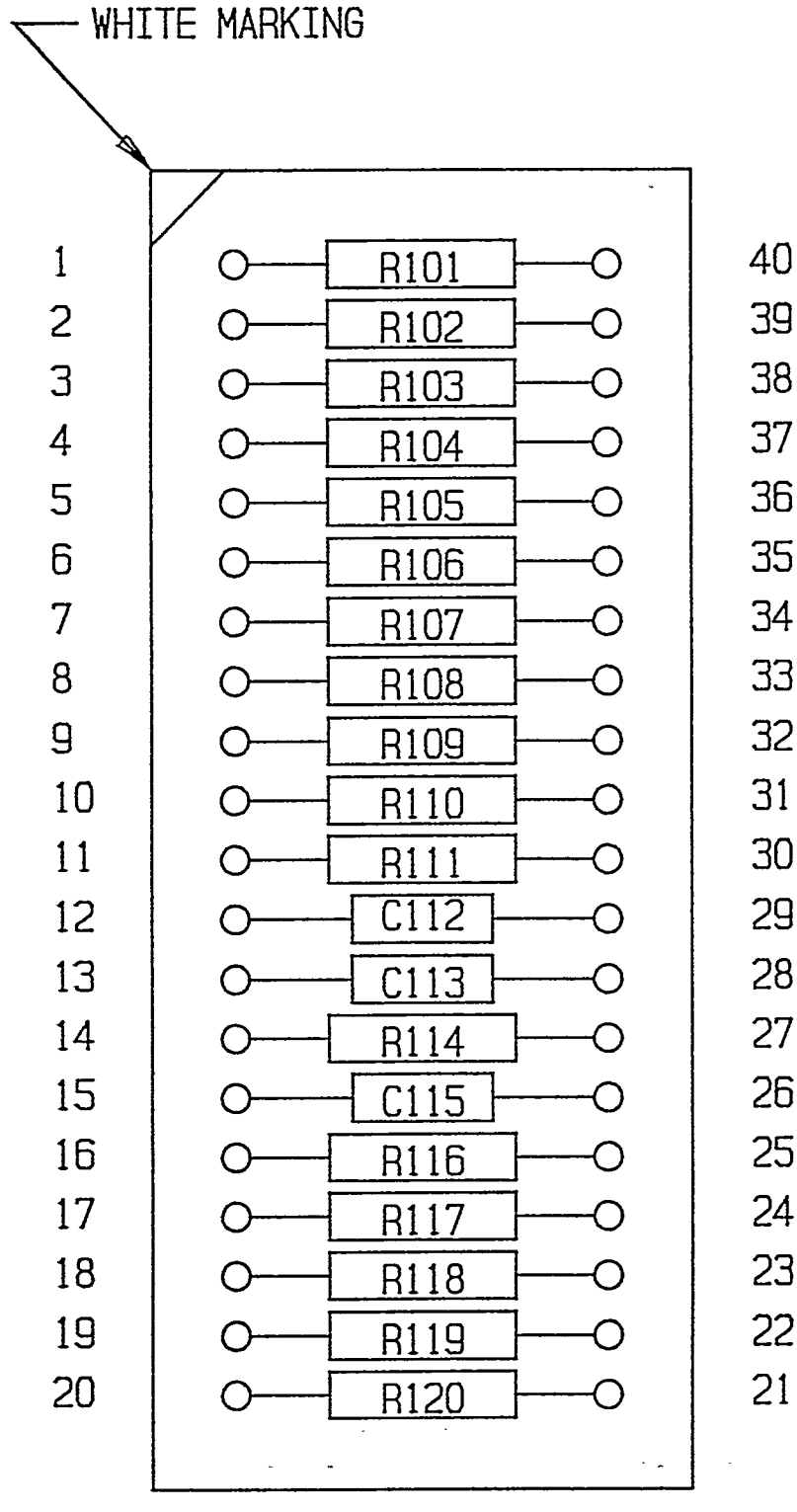


FIGURE 4
PL1 PLATFORM OUTLINE

3.0 THEORY OF OPERATION

3.1 MOTOR ASSEMBLY

The ac permanent magnet synchronous motor has a 3 phase Y connected stator as illustrated in Figure 1. The motor rotor position and speed are sensed by a Tachsyn (TM) mounted on the rear of the motor. This frameless brushless electromagnetic transducer has its rotor mounted directly on the motor shaft and its stator is mounted with 3 synchro clamps to the motor rear end-bell. Phasing of the Tachsyn to the motor is accomplished by loosening the synchro clamps, rotating the Tachsyn stator and reclamping.

3.2 DRIVE BUS POWER SUPPLY (Figure 1 and Drawing 7148)

Drawing 7148 shows the interconnection of the power components. Incoming ac power, at terminals L1 through L3, is full-wave rectified by diode bridge BR1 then filtered by inductor L1 and bus capacitors C1 through C3. The inductor reduces current ripple on the bus capacitors, maximizes input power factor and minimizes EMI interference which might otherwise be conducted from the drive to the ac lines. The capacitors store dc bus energy to provide a safe operating voltage for the power transistors by absorbing a limited amount of regenerated energy. Normal bus power supply voltages range from 550 VDC under heavy load at low line voltage to 695 VDC with no load at high line voltage. Motor regeneration will increase the dc bus voltage causing operation of the shunt regulator which limits the dc bus voltage below 755 VDC.

Excessive current inrush upon power application is prevented by the soft start circuit composed of R1, A8 fuses F1-F2 and the SCR in Q5. Operation of the soft start function is supervised by power supply A3. The SCR is fired to bypass charging resistor R1 only after the voltage drop on R1 is less than 30 VDC and the dc bus is over 450 VDC. Power supply A3 is interlocked with the control board A1 to prevent operation of the main output transistors until the capacitors are charged and the soft start SCR is turned on.

The dc bus voltage is continuously monitored by power supply A3 which controls the shunt regulator transistor Q4. When the bus voltage approaches 750 VDC, Q4 is turned on to draw current through the external regeneration resistor thus dissipating the regenerated energy. The peak energy that can be absorbed is limited by the maximum resistor current that can be controlled by Q4. The drive will limit bus capacitor voltage to 750 volts; for example a 20 ohm regeneration resistor connected to the drive will absorb 28 KW peak.

3.3 DRIVE POWER SUPPLY A3 (See Drawing 7148)

The power supply assembly operates directly from the main dc bus of 400 to 750 VDC derived from the full wave rectified 460 VAC line and accomplishes the following:

1) Supplies a 27 kHz, 50 VAC RMS regulated square- wave, nominally rated 100 watts for base drive and auxiliary loads.

2) Supplies a precision regulated plus and minus 15.0 VDC supply at 400 mA each.

3) Supplies a regulated plus 24 VDC for auxiliary relay and dc fan use, nominally rated at 25 watts total.

4) Delays power supply operation upon power application to ensure the external dc bus capacitors have charged sufficiently to start the power supply.

5) Limits the internally regulated intermediate 180 VDC bus voltage and current levels on a pulse-by-pulse basis. Overvoltage shutdown backs up the voltage limit in the event of a regulator transistor short thus preventing excessive output voltages.

6) Provides the gate signal to an external soft start bypass SCR which is coordinated with ac line voltage presence, bus to line differential voltage, and bus undervoltage.

7) Generates the base drive current to an external power transistor to shunt regulate the dc bus voltage during motor drive regeneration.

8) Provide independent opto-isolated status signals for bus undervoltage, bus overvoltage and shunt regulator transistor drive.

9) Turns on the safety bleed transistor during absence of all ac line power to connect the dc bus capacitors to an external discharge resistor.

The power supply assembly monitors the soft start resistor voltage and dc bus voltage for the following conditions:

1) Soft Start Resistor Voltage over 30 VDC, which inhibits turn on of the soft start circuit and the power output circuit.

2) DC Bus Voltage under 450 VDC, which inhibits turn-on of the soft start circuit and the power output circuit.

3) DC Bus Voltage over 750 VDC, which turns on the shunt regulator transistor Q4.

4) DC Bus Voltage over 770 VDC, which inhibits operation of the power output circuit.

Conductor spacings on the power supply are sufficient to provide a voltage isolation exceeding 1000 volts between the power circuit and control circuit common which is connected to chassis ground.

3.4 DRIVE POWER OUTPUT CIRCUIT

The power output circuit consists of six Darlington power transistors connected in a three phase bridge configuration. Clamping diodes are included on each transistor to provide a path for load current to return to the dc bus. Two transistors and their associated clamp diodes are contained in an isolated mounting type power module. Output currents are sensed with the two current shunts, resistors R2 and R3. The current sensors are 0.01 ohm on drives rated up to 75 amps peak and 0.005 ohm on drives rated above 75 amps peak.

The output transistors are driven and monitored by the base drivers (A5, A6 and A7). Control board A1 generates pulse width modulation (PWM) base signals for control of the transistors. One transistor in each pair must always be off at any given time to avoid shorting out the bus supply and damaging the output transistors.

3.5 DRIVE MOD-DEMOD A4

The mod-demod assembly consists of two independent and identical modulator-demodulator circuits for isolating the current feedback signals from the power circuitry. A carrier frequency of approximately 500 kHz modulates the voltage developed across a current sensing resistor. The resulting ac signal is transformer coupled to a demodulator which recovers the original signal. The offset of the amplified and isolated output is trimmed with R14 for the T3 channel and R30 for the T2 channel. Gain adjustment is provided to compensate for component tolerances, (including the sensing resistor) using R15 for the T3 channel and R29 for the T2 channel. These adjustments are factory made with the gain set for the current scale factor specified in the setup sheet of section 6. The mod-demod is operated from $\pm$15 VDC supplied by the power supply A3.

Conductor spacings on the mod-demod assembly are sufficient to provide a voltage isolation exceeding 1000 volts between the current sensing resistors and control circuit common which is connected to chassis ground.

3.6 DRIVE BASE DRIVERS A5, A6 & A7.

A base driver assembly consists of two independent base driver circuits, one for each transistor of a dual Darlington power transistor module. Each channel has a transformer isolated power supply, an opto-isolated base driver and collector-emitter voltage desaturation detector.

The isolated ± 8 VDC power supply is obtained from the 27kHz 50 volt square-wave source provided by power supply A3. The supply furnishes the current required for turning on and off the power transistors. The opto-isolated base driver circuit includes base current limiting which forces the Darlington transistor to pull out of saturation when its collector current exceeds the transistors capacity. The base driver circuit also provides a high current reverse base drive for fast turn off of the power transistor. The desaturation detector monitors the power transistors' collector-emitter voltage and shuts it off when an overload current causes this voltage to exceed a safe level. This shutdown creates an output fault signal which is opto- isolated and sent to the control board A1. Fault monitoring circuits on the control board shuts down the drive, latches the fault and turns on the corresponding indication.

3.7 CONTROL BOARD A1 (See Figures 1 & 3)

The control board operates to:

1) Provide Tachsyn sensor excitation and signal conditioning.

2) Provide pulse width modulated (PWM) outputs to the base drivers in response to current loop error signals.

3) Provide three current loops operating from commutated current command inputs with current feedback from the A4 mod-demod.

4) Commutate the current command developed by the speed loop using the conditioned Tachsyn outputs from the motor rotor position feedback.

5) Provide a speed control loop to develop the current command from the speed command and the Tachsyn tach feedback.

6) Provide current command limiter.

7) Provide speed command conditioning.

8) Provide latching and indication of: overtemperature, overspeed, overcurrent, control power supply failure, bus undervoltage, bus overvoltage, and output fault conditions.

9) Provide opto-coupled enable circuits.

10) Provide an opto-coupled ready output.

11) Provide a digital tachometer signal independent of the tachsyn feedback signals for overspeed protection.

All A1 control boards with the same part number are identical. All components which are selected to suit a particular motor are located on the PL1 plug-in personality platform located near the center of the control board. All PL1 personality platforms with the same part number are identical. The part number for each platform is on the back of the platform.

3.7.1 TACHSYN SIGNAL CONDITIONING (FOR STANDARD 4 POLE MOTOR)

The Tachsyn is excited through A1J2-5 and 6 at 10 kHz by an oscillator on the control board. The Y connected Tachsyn output at J2 contains both speed (low frequency) and position (10 kHz modulated) information which is processed by the signal conditioner to yield:

1) Two cycle per motor revolution sine wave position output for each phase, approximately 4 volts peak amplitude. These outputs are phased at 120 electrical degrees to each other (60 degrees of shaft rotation) with a 4 pole motor and may be monitored at A1J6-9, 10 and 11.

2) Bipolar dc tach output, supplied to the Tach scale pot, A1R5. The scaled and buffered tach signal is available on A1J1-17 or A1J6-3 with the scale factor specified on the setup sheet.

3) Logic outputs to the commutation circuit.

3.7.2 OUTPUTS TO BASE DRIVERS

The base signal outputs are PWM waveforms, one for each of the six power output transistors. These signals are developed by three independent current loops, one per output phase. The current command for each loop is generated by the commutation logic which switches the speed error signal in response to the rotor position information. Current feedback for two phases is supplied from the A4 mod-demod, the third feedback signal is the algebraic sum of the other two phases. Each current loop sums its respective command and feedback signals

to produce a current error signal. The current error is compared to a triangle wave to produce a pulse width modulated (PWM) waveform. Changes in the PWM pulse widths control the three main power transistor pairs to regulate motor currents.

The current loop compensation components (PL1 R105, R106, R107) are located on the PL1 personality platform to allow them to be selected to suit the motor being controlled. All other base driver control circuitry is located on the control board.

3.7.3 COMMUTATION LOGIC

The signal out of the speed error amplifier is proportional to the torque required by the motor to maintain commanded speed. A current limit function imposes bounds on the torque signal to limit the motor current. The torque or dc current command may be monitored at control board TP1 or J6-15. The commutation logic, as a function of rotor position, transforms the torque command signal into three current command signals. The resulting current commands are three phase 12-step sine wave representations of the motor currents. The 12 step sine wave approximation gives minimal machine torque ripple compared to the more standard square wave current commands.

3.7.4 SPEED CONTROL LOOP

The speed control loop, shown in Figure 3, accepts a speed command from differential inputs A1J1-4 to A1J1-5, a tach feedback signal from the tach buffer (monitored at A1J1-17 or A1J6-3) and a zero trim input from control board Zero Trim pot R4. The sum of these signals is amplified by the speed error amplifier. This error signal is amplified by the integrating amplifier with a rate gain set by pot R3 and limited by the current limit circuit described in the next section to develop the current command output.

Some drives may be configured to operate with a current command at A1J1-4 to A1J1-5 and no speed control loop. See Section 2.6. On these drives the speed loop is bypassed and the differential command at A1J1-4 to A1J1-5 is used as a current command rather than a speed command input.

3.7.5 CURRENT LIMITER

Peak current is limited by limiting the current command voltage applied to the commutation logic. The A1 control board current limit circuitry responds to the current limit levels from four independent control board circuits. The circuit that supplies the lowest level at any instant in time over-rides all others to give the current limit in effect. This level may be measured at control board TP1 or J6-4. The four circuits are as follows:

1) Current Limit Pot: The pot R1 sets the maximum possible current limit per the current limit setting listed on the set-up sheet.

2) Regenerative Current Limit: This circuit monitors an input from the Power Supply A3 to lower the drive output current during motor regeneration at high speeds. This protects the drive Shunt Regulator Transistor (Q4) and external Regenerative Load Resistors from overcurrent.

3) External Current Limit: This circuit reduces the current limit to the level of the voltage input by the user to connector A1J1-14. This input is scaled per the current scaling listed on the Set-up sheet. When A1J1-14 is left open this circuit has no effect.

4) Inverse Time Overload: This circuit reduces the current limit level to a setting corresponding to the continuous rating of the drive under overload conditions. Drive overload conditions are defined as exceeding 200% of the continuous drive rating for longer than 3 seconds or 150% of the continuous drive rating for longer than 60 seconds.

3.7.6 SPEED COMMAND CONDITIONING

Figure 3 illustrates the speed command conditioning circuits. The speed command signal applied at terminals J1-4 & J1-5 of the control board is buffered with a differential amplifier. The common mode isolation provided by this amplifier is a minimum of 40 db for common mode voltages less than $\pm$15 VDC.
The speed command input is scaled with the Max Speed pot R6, adjustable for 8 to 12 volts = Max speed. This point is monitored at A1 TP6 or J6-1.

Drives configured for a current command input (See Section 2.6) have the same input buffer described above for the speed command.

3.7.7 LATCHING FAULT PROTECTION AND INDICATION

Fault conditions are detected, latched and indicated by red LEDs on control board, A1. The following indicators and their associated detectors are provided:

1) Ø1, Ø2 or Ø3: Each transistor base driver fault output is monitored. The drive shuts down whenever an excessive voltage drop occurs (indicating an output overload) or driver supply failure occurs. See section 3.6. The fault is latched and indicated on the appropriate LED indicating which output connection, transistor pair or base driver caused the fault.

2) $\pm$15: A power supply failure detector monitors the $\pm$15 volt power supplies. The drive is shut down whenever either 15 volt supply drops below 12 volts.

A complete loss of +15 volt power will not cause an indication since the logic operates on +15 volts, this condition will turn off all red and green LED indicators.

3) OL: This LED lights under drive overload conditions as described in 3.7.5. This LED will only latch and shut down the drive when A1JP1 is in place. See section 2.3.

4) OS: An overspeed detector compares absolute value of tach voltage to A1R2 overspeed pot setting. Drive shuts down, latches and indicates whenever speed voltage exceeds the overspeed setting. Setting of pot A1R2 can be measured at test point A2 TP2.

5) UV: Monitors the fault output of power supply assembly, A3, for an undervoltage fault indication. This condition shuts down the drive and turns on the UV LED.

6) OV: Monitors the fault output of power supply assembly, A3, for an overvoltage fault indication. This condition shuts down the drive and turns on the OV LED.

7) OT (UV & OV): Both the UV and OV LEDs light simultaneously in the event of drive or motor overtemperature. Overtemperature is indicated by the opening of either the drive heat sink thermostat TS1 (set at 80 degrees C), or the motor winding thermostat. Shut down, latch and indication occurs when either thermostat opens.

3.7.8 ENABLE LOGIC

The control board includes two opto-coupled enable inputs, both of which must be applied for normal bi-directional motor operation. These inputs operate in a Foreward - Reverse enable mode. The FWD Enable input to J1-10 enables drive current and speed in the FWD direction only. The REV Enable input to J1-11 enables drive current and speed in the REV direction only. The definition of FWD and REV depends on motor connection; see the connection diagram for the particular drive (section 6.0). J1-10 and J1-11 are bipolar inputs: for connections see 2.2.2.

3.7.9 OPEN COLLECTOR READY OUTPUT

An opto-isolated logic output rated 75 mA, 30 VDC maximum is supplied from J1-15 to J1-16 for external indication of a READY logic condition. This output is closed when the drive is ready, meaning that no fault outputs are latched and the reset input is open.

3.7.10 F/V CONVERTER

The U34 F/V converter converts the commutation frequency input from the A1 control board to a positive absolute value tachometer signal, which operates the overspeed circuit and is available for external speed indication.

4.0 TROUBLESHOOTING

WARNING

This equipment contains voltages which may be as high as 800 volts and rotating parts on motors and driven machines. High voltage and moving parts can cause serious or fatal injury. Only qualified personnel familiar with this manual and any driven machinery should attempt to start-up or trouble-shoot this equipment. Observe these precautions:

1. **USE EXTREME CAUTION, DO NOT TOUCH any circuit board, power device or motor electrical connection without insuring unit is properly grounded and no high voltage is present. DO NOT apply ac power before grounding per instructions herein. DO NOT open cover for 2 minutes after removing ac power to allow capacitors to discharge. ALWAYS check dc voltage between two bus bars on large capacitors when opening enclosure and bleed down to 10 volts maximum with resistor before servicing.**

2. **BE CERTAIN that possible violent motion of motor shaft and driven machinery due to improper control operation will not cause injury to personnel or damage to equipment. Peak torques of several times rated motor torque can occur during a control failure.**

3. **Motor circuit may have high voltage present whenever ac power is applied, even when motor is not rotating.**

4.1 INSTRUMENTS

Most troubleshooting can be performed using only a digital voltmeter (DVM) having an input impedance exceeding 1 megohm. Setup of speed loop response and evaluation of output current waveforms require a 1 MHz minimum bandwidth two channel oscilloscope.

4.2 TROUBLESHOOTING GUIDE

4.2.1 NO READY (RDY) LIGHT AND NO RED FAULT INDICATIONS

1. Check ac power connections and line fuses or breaker. AC voltage at terminals L1-L2, L2-L3, L3-L1 must be in the range of 380 to 506 VAC to operate the drive. If incoming power breaker or fuses are open, remove ac power and check resistance between L1, L2 and L3 terminals with ohmmeter. Low resistance may indicate either a failed diode bridge or SCR. Observe WARNING precautions and replace BR1 or Q5 (SCR module).

2. Check supply voltages at test connector J1-1 (+15 VDC) and J1-3 (-15 VDC) relative to common, J1-20. Both voltages must be within $\pm$1 volt of nominal for proper operation.

WARNING

High voltage on electrolytic capacitors C1 through C3 decays slowly. DO NOT TOUCH. CHECK DC VOLTAGE BETWEEN THE TWO BUS BARS ON THE LARGE CAPACITORS WITH VOLTMETER and bleed with resistor to 10 volts dc maximum for safe servicing. DO NOT REMOVE PLUG A3P2 FROM POWER SUPPLY ASSEMBLY, A3. This will disconnect the safety bleed resistor, R5 from the dc bus.

Verify that fuses A8F1 and A8F2 are good, then re-apply input power while observing POWER SUPPLY ON light, located on power supply board, A3. If this LED does not turn on, check fuse A3F1. If A3F1 is blown, turn off power wait 2 minutes and replace it. If A3F1 fails a second time, replace power supply board, A3. If POWER SUPPLY ON light does not turn on and A3F1 is OK turn off input AC, disconnect plug in J3 and apply power. If POWER SUPPLY ON light does not turn on replace power supply board A3, if it does turn on inspect all other circuit boards for control power overloads.

3. Check Reset Input J1-9 to J1-12 and be sure no voltage is applied. Voltage below +10 volts, relative to common, at either input will prevent Ready.

4. If ac power and resets are OK, switch power OFF for 10 seconds then ON to reset power supply protection circuitry. Ready should light within 3 seconds.

5. If Ready does not occur with above steps, replace power supply A3 after observing precautions of (2) above. DO NOT remove any connectors or boards without removing power and ensuring main bus supply voltage is less than 10 volts DC.

4.2.2 "UV" FAULT INDICATION

This latching fault indication occurs when main bus supply voltage has been too low, even momentarily.

1. Apply Reset input (momentary input to J1-9) to reset latch. Ready will occur within 3 seconds after Reset Input is removed if a momentary low bus

caused the tripoff. Momentary low bus voltage is usually caused by one ac line opening.

2. If Reset does not clear fault, check that input ac voltage is within the range 380 to 506 VAC line-line. If the line voltage is OK, turn off power, wait 2 minutes and check A8 F1 and F2. If either is failed, replace and apply power to the drive. If either fuse fails again this indicates faulty power circuitry and the drive must be returned to the factory for repair.

4.2.3 "OV" FAULT INDICATION

This latching fault indication occurs when main bus supply voltage has been too high, even momentarily.

1. Apply Reset input to reset latch. Ready will occur within 3 seconds after Reset Input is removed if a momentary high bus caused the tripoff. Momentary high bus voltage is usually caused by regeneration of the motor with inadequate or open regeneration resistor circuit. See section 6 for the factory recommended regeneration resistors for the drive.

4.2.4 "Ø1", "Ø2" OR "Ø3" (PHASE) FAULT INDICATION

These faults are usually a result of an excessive load on the drive output. The fault condition can be permanent occurring when the drive is enabled, or intermittent occurring randomly during otherwise normal operation.

Make note of which LED is on (0/1, 0/2 or 0/3) and reset the drive by either turning off and on input power or by momentarily shorting J1-9 to J1-8 (shorting J9-19 to J9-20 produces the same result). If, after resetting, the drive trips immediately after enabling, follow the suggestions listed under PERMANENT FAULTS. If the drive operates normally for a time period before tripping again, see the suggestions listed given INTERMITTENT FAULTS.

PERMANENT Ø1, Ø2, OR Ø3 FAULTS:

1. Power transistor may be shorted. Remove ac power, wait 2 minutes, open enclosure observing WARNING precautions, bleed capacitor dc voltage to 10 volts maximum with resistor and then shunt the two capacitor bus bars. Inspect power transistors and base drivers for burned components and other obvious signs of damage. Test transistors by removing shunt between bus bars, then measuring resistance from each bus bar to output terminals T1, T2 and T3 using ohmmeter polarity to back bias power transistor diodes shown in Figure 1. Any resistance less than 500K ohms indicates fault in transistor or internal wiring. Replace power transistor and

its associated base driver for any outputs showing less than 500K resistance (power transistor failure usually damages its base driver).

2. Motor may have a short circuit. If only one indicator is on, a ground fault on that output line is possible. If two or three indicators are on, the fault is most likely line-line. Remove ac power, disconnect output lines from control and check wiring and motor resistance line-line and line to ground.

3. A base driver circuit board may be failed, follow the suggestions given in step 5 of INTERMITTENT FAULTS.

INTERMITTENT Ø1, Ø2, OR Ø3 FAULTS:

1. Drive and motor may be mismatched. Check that the motor being used is the one identified on the set-up sheet.

2. Control board personality platform PL1 may not be matched to motor. Check set-up sheet for proper motor, personality platform PL1 and control board part numbers.

3. Electrical noise may be disturbing the drive. Check that motor and chassis is well grounded. Check Tachsyn wiring to be sure wires are properly shielded with shields terminated at drive per connection diagram. Make sure signal wires are routed separately from power wires.

4. Drive may be overheating. Check that drive air inlets and outlets are unobstructed and that the incoming air temperature is less than 50 degrees C.

5. There may be intermittent connections. Remove ac power, wait 2 minutes, open enclosure observing WARNING precautions, bleed capacitor dc voltage to 10 volts maximum with resistor and then shunt the two capacitor bus bars. Inspect and retighten if necessary, all electrical connections including the 22 AWG wires between the base drivers and power transistors.

6. If the fault consistently occurs in the same phase the base driver maybe faultily. Replace the suspected base driver with a known good unit. If a spare board is unavailable interchange the suspected board with one of the other phases to determine if the fault will "move" to the other phase. If the phase fault follows the base driver board it must be replaced.

7. If the fault occurs randomly in different phases or base driver replacement does not eliminate faults, replace the control board.

8. Current loop compensation may be mismatched with motor being used. Individual phase currents can be monitored with oscilloscope at J9-12 & -13 relative to J9-20, maximum current on any output can be monitored at J9-2. Contact factory for assistance in optimizing current loop compensation.

4.2.5 "OS" (OVERSPEED) FAULT INDICATION

1. Excessive speed command may have been applied to cause overspeed.

2. Overspeed setting may be too low, see setup sheet for proper setting and readjust if necessary.

3. Improper motor grounding will cause excessive noise leading to overspeed trips. Check that the motor and chassis is well grounded per section 2.2.1.

4.2.6 "OT" (OVERTEMPERATURE) FAULT INDICATION

1. Check continuity of normally closed motor thermal switch input, at J2-7 to J2-8.

2. Drive heat sink may overheat due to excessive load, failed fan or clogged cooling fins. If indication persists with cool heat sink check the continuity of normally closed switch TS1 and its wiring.

4.2.7 "±15" (CONTROL POWER SUPPLY) FAULT INDICATION

1. This latched fault indication will occur upon momentary reduction of ±15 volts below allowable levels, possibly due to external load on these supplies. Apply Reset Input (momentary closure between J1-9 & -8 or J9-19 & -20) to reset latch.

2. Check ±15 volt outputs at J1-1 & J1-3 to common J1-2, either voltage 20% below normal will cause the indication. Check control and personality board IC chips and resistors for possible overheating indicating fault overloading the power supply. Replace power supply A3, observing WARNING precautions, if either 15 volt supply is low and no apparent fault exists on control board.

4.2.8 ENABLE INDICATOR OFF WITH ENABLE(S) APPLIED

1. Check voltages J1-10 to -12 for FWD and J1-11 to -12 for REV; these voltages must be 10 volts dc minimum with either polarity to operate the enable circuits.

2. Replace control board if the proper voltages are present.

4.2.9 NO TORQUE WITH BOTH READY AND ENABLE INDICATORS ON

1. Current Limit may be near zero. Check limit setting with DVM at TP1 or J6-4 relative to common (J1-20).

2. Commutation signals may be missing. Check Tachsyn phasing per Section 2.4.

3. Replace control board.

4.2.10 NO MOTOR SHAFT ROTATION

1. READY and ENABLE indicators must be ON, see 4.2.1 or 4.2.8 if not.

2. Control may be in the alignment mode, connector J1-13 must be open to run the motor.

3. If shaft rotates with little or no resisting torque, see 4.2.9.

4. Speed command may be zero, input buffer output may be monitored at TP6 or J6-1.

5. See 4.2.11 if erratic or jittery motion of shaft occurs in response to speed command.

6. Discontinuity may exist between drive output and motor terminals.

4.2.11 ERRATIC OR JITTERY SHAFT ROTATION

1. Commutation signals may be misaligned or partially missing. Check alignment per Section 2.4.

2. Motor may be connected with opposite phase rotation to that of Tachsyn. Remove ac power and reverse motor connections by interchanging drive terminals T1 and T2. Then re-align transducer per Section 2.4 and re-try.

3. Tachsyn signals may be noisy. Check wiring to be sure wires from Tachsyn are properly shielded with shields terminated at drive per connection diagram.

4. Rate loop gain may be too high, set lower by turning control board pot R3 CCW.

5. Control board personality platform PL1 may not be matched to motor. Check setup sheet for proper motor, personality platform PL1 and control board part numbers.

4.2.12 WRONG RESPONSE TO SPEED COMMANDS

1. Input common mode voltage may be exceeded. Maximum common mode at J1-4 & -5 is $\pm$15 volts relative to chassis common. Connect control input source common to the drive common to minimize common mode voltage.

2. Tach polarity may be reversed. Check the interconnect diagram (see section 6.0) for proper J2 tachsyn connections.

5.0 PROTECTIVE DEVICES - 714-510-110-S002

5.1 INPUT PROTECTION

Each of these drives must be provided with a suitable input power protective device. A listing of the suggested fuses or circuit breakers is as follows:

Circuit Breaker - Three phase, 480VAC, 60A, thermal magnetic. G.E. TED series are typical.

Fuses	600VAC, 80A fast blow type. Buss KTS 80 and NOS 80 are typical.
	600VAC, 60A slow-blow type Buss FRS 60 and LPS 60 are typical

Wire the drive, protective devices and motor with wire size AWG #8 wire or larger.

5.2 INTERNAL FUSE LIST

QTY	RATING	SWEO PN	COMMERCIAL EQUIV.	REF. DES.
2	2A, 500VAC	4342000	Buss FNQ 2 Littlefuse FLQ 2	A8F1, A8F2
1	1 1/2A, 600VAC	4331500	Buss KTK 1 1/2 Littlefuse KLK 1 1/2	A3F1

5.3 REGEN RESISTOR KIT

The minimum resistance of the regeneration resistor is 12 ohms for this drive. BALDOR=SWEODRIVE supplies three kits coordinated with this drive.

R3 300 watts continuous, one 12 ohm, 300 Watt resistor with Buss KLK 30 fuse and holder.

R6 600 watts continuous, two 25 ohm 300 watt resistors to be used in parallel, with Buss KLK 30 fuse and holder.

R9 900 watts continuous, three 40 ohm, 300 watt resistors to be used in parallel, with Buss KLK 30 fuse and holder.

6.0 **DRAWINGS** (7149)

SU 7225	Control Board Setup Sheet
PL714-510-110-S002	Parts List - Drive
PL0714046	Parts List - Drive
PL0074001	Parts List - Control Board
PL0740308	Parts List - Personality Board
7520	Interconnect Diagram
7148	Wiring Diagram - AC Brushless Servo Drive
7153	Outline and Mounting - AC Brushless Drive
0700	Installation Drawing - Regen Resistor Kit

SU 7225 CONTROL BOARD SETUP SHEET
DRIVE +714-510-110-S002
(WAS CONTROLLER PN 0714613)

CONTROL BOARD PN 0074001
PERSONALITY PLATFORM PN 0740325
CONTROL BOARD JP1: CLOSED

MOTOR: PAC-SCI R8AG

RECOMMENDED CURRENT LIMIT SETTING FOR TACHSYN ALIGNMENT: 1.5VDC

SPEED SCALING FOR 10.0 VDC AT J1-4,5: 2000 RPM

CURRENT SCALING 20.0 A/V TACH SCALING 4.0 VDC/1000 RPM

CONTROLLER POT ADJUSTMENT	INPUT	OUTPUT	DVM READING VDC *	
1. R2 OVERSPEED	___	TP2	+	9.6
2. R6 MAX SPEED	J1-4 TO J1-5 = 10.0 VDC	TP6	+	8.0
3. R3 RATE GAIN				
SET R1 CURRENT LIMIT		TP1	+	1.0
THEN R3 RATE GAIN	JUMPER J6-19 TO J6-20 - JUMPER TP4 TO J1-1 ENABLES ON	TP3	+	0.3
4. R1 CURRENT LIMIT	ENABLES OFF	TP1	+	6.5
5. R5 TACH SCALE	ADJUST SPEED COMMAND	J1-17	+	4.0
	ADJUST TACH SCALE	1000 RPM		---
	CHECK	J1-6 to J1-17	Less than ± 0.05	
6. R4 ZERO TRIM	ZERO SPEED COMMAND	NO SHAFT ROTATION		---

* All Measurements Made With DVM on DC, Common to J1-20 Except As Noted.

OBJECT #: 714-510-110S2 OBJ TYPE: MP REV: D STATUS: PRD/L

OBJ DESC: ,460V,714,-/-/-,,DYN,BRUSHLESS TACHSYN
REV DESC: CHANGED MANUAL TO A REQUIRED PART

PART #	SEQ	TY	RV	PART DESCRIPTION		QTY	UOM	USE
BRUSHLESS	003	DR	D	BRUSHLESS CONTROL PRODUCT (GENERI		0.0000	EA	
NP0826	025	PT	D	NP- HARMONIZED INVERTER/VECTOR		1.0000	EA	
V0074001	035	PT	A	CONT BD,TACHSYN COMM		1.0000	EA	
				A1				
V0740325	040	PT	-	PERSONALITY PLATFORM		1.0000	EA	
				PL1				
V1008684	045	PT	F	LABEL, CAUTION; GM NAMEPL		1.0000	EA	
V1008933	050	PT	A	LABEL, UL LISTED,		1.0000	EA	
V1767702	055	PT	-	BOARD COVER SUB-ASSY	REV G	1.0000	EA	
V6020108	060	PT	A	CONN.PHOENIX #1754660,	MSTB 2.5/	1.0000	EA	
				MFG: PCD	ELFP08110G			
				MFG: PHOENIX CONTACT	1754562			
				P2				
V6020120	065	PT	A	CONN.5MM,HOR, 20 POS; URSPHOENIX 1		1.0000	EA	
				MFG: PHOENIX CONTACT	1754805			
				P1				
V6502406	070	PT	-	STANDOFF 6-32 X 3/8		3.0000	EA	
				MFG: AMATOM	8213-B-0632-28			
V6910205	075	PT	-	STUD, 1/4 TURN FLUSH		2.0000	EA	
				MFG: SOUTHCO	82-28-220-16			
V6910450	080	PT	-	RETAINER, SPLIT RING		2.0000	EA	
				MFG: SOUTHCO	82-32-101-20			
V1077371	085	PT	-	LABEL, SHIPPING BOX		1.0000	EA	
V1007621	090	PT	-	LABEL, PRODUCT IDENTIFICATION		1.0000	EA	
V0714046	095	PT	E	POWER BASE 714-510-S		1.0000	EA	
V#7149	105	PT	-	INSTRUCTION MANUAL		1.0000	EA	

*** END OF REPORT ***

OBJECT #: V0714046 OBJ TYPE: PT REV: E STATUS: PRD/L

OBJ DESC: POWER BASE 714-510-S
REV DESC: REPLACED V3510010 WITH TX0076A01

PART #	SEQ	TY	RV	PART DESCRIPTION		QTY	UOM	USE
V6910620	005	PT	-	THERMAL PAD, SM DIODE/SCRPOW.D; AL		1.0000	EA	
				MFG: POWER DEVICES INC.	AL-364-081			
				;Q5				
V6910621	010	PT	A	THERMAL PAD, SM XSTR, 2 HOLE		1.0000	EA	
				MFG: POWER DEVICES INC.	AL-370-134			
				;Q4				
V6910643	015	PT	A	THERMAL PAD, LG XSTR, 4 HOLE		3.0000	EA	
				MFG: POWER DEVICES INC.	AL-425-244			
				;Q1-Q3				
V6910644	020	PT	-	THERMAL PAD - THERMAL SW		1.0000	EA	
				MFG: POWER DEVICES INC.	AL-120-082			
				;THERMAL SWITCH				
V6910646	025	PT	-	THERMAL PAD, 3 PH BRIDGE POW.D; AL		1.0000	EA	
				MFG: POWER DEVICES INC.	AL-256-189			
				;BR1				
V1070821	030	PT	-	HEAT SINK, 12", AC BRLS		1.0000	EA	
V1070732	035	PT	-	PANEL MTG CHASSIS - LONG		1.0000	EA	
V3615112	040	PT	-	TRANSISTOR-DUAL,DARL	FUJI 2DI	3.0000	EA	
				MFG: FORT SMITH	TX0086A04			
				MFG: FUJI	2DI150Z-120			
				Q1-Q3				
TX0076A01	045	PT	B	TRANS. SINGLE DARL 100A, 1000V		1.0000	EA	
				MFG: POWEREX	KS221K10			
				MFG: SEMIKRON	SK100DA100D			
				Q4				
V3710616	050	PT	A	DIODE BRIDGE, 3PH, 60A, 1600V; SE		1.0000	EA	
				MFG: SEMIKRON	SKD-60/16			
				BR1				
V3750612	055	PT	-	DIODE/SCR 55A 1200V		1.0000	EA	
				MFG: FORT SMITH	DI0067A00			
				MFG: SEMIKRON	SKKH-56/12D			
				Q5				
V18162200	060	PT	B	DUAL HALL EFFECT ASSY		1.0000	EA	
V1004181	065	PT	-	LABEL, TERMINAL BLOCK, USD		1.0000	EA	
				;TB1				
V6105208	070	PT	-	TERM BLOCK, 90A, 8POS	USD #1400	1.0000	EA	
				;TB1				
V6280014	075	PT	A	SCREW LUG 12-2 AWG	PENN-UNIO	1.0000	EA	
				MFG: ILSCO	TA-2			
				MFG: PENN-UNION	LA-2			
V1071307	080	PT	-	CABLE, AC CONTROLLER		1.0000	EA	
V1071353	085	PT	D	CABLE ASSY		1.0000	EA	
V7417825	090	PT	B	CAP, ALUM ELECT, 2900MFD, 400VDC		4.0000	EA	
				MFG: REDMOND				
				C1-C4 ; POS A,B,D,E				
				;POS A,D TO Q1				
				;POS B,E TO Q3				
V7999107	095	PT	-	BOOT, INS VERT 3.0" DIA.	CAPLUGS S	4.0000	EA	
				MFG: CAPLUGS DIVISION	SC-3			

OBJECT #: V0714046 OBJ TYPE: PT REV: E STATUS: PRD/L

OBJ DESC: POWER BASE 714-510-S
REV DESC: REPLACED V3510010 WITH TX0076A01

PART #	SEQ	TY	RV	PART DESCRIPTION		QTY	UOM	USE
V7999000	100	PT	-	VERT,MTG,CLAMP 3" DIA	MALLORY V	4.0000	EA	
				MFG: MALLORY	VR12B			
V8344047	105	PT	-	RES, REB, 47, 10% 110W	P/N 18-72	1.0000	EA	
				MFG: MILWAUKEE RESISTOR	18-72-47R W/SQC			
				;R1				
V8364236	110	PT	-	RES,R-TM,3650,5% 65W		1.0000	EA	
				MFG: MILWAUKEE RESISTOR	01120723650.0E			
				;R5				
V8399003	115	PT	-	CENTER WASH, 3/4 CR	MILWAUKEE	2.0000	EA	
				MFG: MILWAUKEE RESISTOR	RESISTOR			
				MFG: OHMITE	6001			
V8399023	120	PT	-	MICA WASH, 3/4 CR	12-800-00	2.0000	EA	
				MFG: MILWAUKEE RESISTOR	RESISTOR			
				MFG: OHMITE	6013			
V8399005	125	PT	A	CENTER WASH, 1 1/8 CR		2.0000	EA	
				MFG: MILWAUKEE RESISTOR	RESISTOR			
				MFG: OHMITE	6003			
V8399025	130	PT	A	MICA WASH, 1 1/8 CR		2.0000	EA	
				MFG: MILWAUKEE RESISTOR	RESISTOR			
				MFG: OHMITE	6017			
V8399216	135	PT	-	BOLT 10-32 X 5		2.0000	EA	
				MFG: MILWAUKEE RESISTOR	RESISTOR			
V1000462	140	PT	A	SUPPORT BRKT 4-40		3.0000	EA	
				;POS B,C,E				
V6911431	145	PT	A	TIE ANCHOR 10 SCRW;BNSTCKPRIEB-PAN		1.0000	EA	
				MFG: PANDUIT	TA1S10			
V6911432	150	PT	A	TIE MT,SM ADHESIVE BK, 1" X 1"		3.0000	EA	
				MFG: PANDUIT	ABM2S-A			
				MFG: FORT SMITH	HW3214A00			
V1004041	155	PT	-	BRIDGE MINUS STRAP		1.0000	EA	
V1070811	160	PT	-	BUS BAR W SNUBR PROV	REV C	2.0000	EA	
V7001347	165	PT	A	CAP,POL, .047 ,1200		2.0000	EA	
				MFG: S.B. ELECTRONICS	715P47391	2MD3 OR 512MD3		
				MFG: MALLORY	PVC16147			
				;C7,C8				
V8392D10	170	PT	-	RES,AX,1.00,3W,NON I		2.0000	EA	
				MFG: DALE	NS-2B			
				;R6,R7				
V6291004	175	PT	-	TERMPOST,INS 6 X.581	VEN.#2509	2.0000	EA	
V6293206	180	PT	-	TERM,LCKWSHR 2HL #6		2.0000	EA	
V6293210	185	PT	-	TERM,LCKWSHR 2HL#10 UNCNTA/W; ZEIR		2.0000	EA	
V2050013	190	PT	-	INDUCTOR,LNK 60A200U	PCI	1.0000	EA	
				;L1				
V3235626	195	PT	B	DIODE RECT 5A 600V		2.0000	EA	
				MFG: FORT SMITH	DI0061A00			
				MFG: GENERAL ELECTRIC	1N5626			
				;D1,D2				
V1071287	200	PT	A	CABLE, AC CONTROLLER		1.0000	EA	
V17880060	205	PT	B	CABLE, 8 GA BLK, 600V, 2.5 IN.		2.0000	EA	

OBJECT #: V0714046 OBJ TYPE: PT REV: E STATUS: PRD/L

OBJ DESC: POWER BASE 714-510-S
REV DESC: REPLACED V3510010 WITH TX0076A01

PART #	SEQ	TY	RV	PART DESCRIPTION		QTY	UOM	USE
V1071301	210	PT	A	CABLE, AC CONTROLLER		1.0000	EA	
V17880036	215	PT	B	CABLE, 8 GA BLK 600V, 18 IN.		2.0000	EA	
				;Q2 THRU NANA SENSOR				
				;CLOSEST TO TB1,				
				;CONNECT TO TB1-T2.				
				;Q3 THRU NANA SENSOR				
				;CLOSEST TO Q2,				
				;CONNECT TO TB1-T3.				
V1071305	220	PT	A	CABLE, AC CONTROLLER		1.0000	EA	
V1071286	225	PT	A	CABLE, AC CONTROLLER		1.0000	EA	
V1071308	230	PT	A	CABLE, AC CONTROLLER		1.0000	EA	
V17840014	235	PT	B	CABLE, 8 GA BLK 600V, 10.25 IN		1.0000	EA	
V1071312	240	PT	A	CABLE ASSY,230/460		1.0000	EA	
V1071322	245	PT	A	CABLE ASSY,230/460		1.0000	EA	
V1071342	255	PT	A	CABLE ASSY,460 VAC		2.0000	EA	
V1071360	260	PT	A	CABLE, AC CONTROLLER		1.0000	EA	
V1071361	265	PT	A	CABLE, AC CONTROLLER		1.0000	EA	
V0070872	270	PT	A	POWER SUPPLY ASSY		1.0000	EA	
				;A3				
V17860016	275	PT	C	CABLE, 22 GA RED UL1015,6.25IN		1.0000	EA	
V17860017	280	PT	C	CABLE, 22 GA WHT UL1015, 4.0IN		1.0000	EA	
V1864902	285	PT	-	COMPONENT ASSY, 22 OHM 2W		1.0000	EA	
				;R4				
V1074385	290	PT	A	CABLE, SINGLE AXIS C9 TO BUS		1.0000	EA	
V1070792	295	PT	-	BRKT, LV BASE DRIVER	REV H	1.0000	EA	
V1070791	300	PT	-	BASE DR SUPPORT BRKT	REV H	1.0000	EA	
V6911166	305	PT	-	SUPPORT,EDGE 5/8		6.0000	EA	
				MFG: RICHCO	EHCBS-10-19			
V0070842	310	PT	B	SNUBBER ASSY 460V	TURNKEY S	1.0000	EA	
				;A8				
V0725216	315	PT	A	BASE DRIVER, Z-TYPE		3.0000	EA	
				A5-A7				
V1077161	320	PT	-	SIDE PANEL - LONG VERSION	REV C	1.0000	EA	
V1077151	325	PT	-	UNIT COVER - SUB-ASSY,	REV B	1.0000	EA	
V6911314	330	PT	-	SNAP BUSHING 15/16 ID		2.0000	EA	
				MFG: HEYCO MOLDED PRODUCT	2182			
				MFG: MICRO PLASTICS, INC	22MP11815			
V6910353	335	PT	-	RECEPTACLE, 1/4 TURN,		4.0000	EA	
				MFG: SOUTHCO	82-47-113-15			
V6910205	340	PT	-	STUD, 1/4 TURN FLUSH		2.0000	EA	
				MFG: SOUTHCO	82-28-220-16			
V6910450	345	PT	-	RETAINER, SPLIT RING		2.0000	EA	
				MFG: SOUTHCO	82-32-101-20			
V1076831	350	PT	-	END PANEL, SINGLE FAN	REV C	1.0000	EA	
EF0025A00	355	PT	A	24VDC 110CFM COOLING FAN;IEC; EBM		1.0000	EA	
				MFG: REDMOND	6950010			
V6950400	360	PT	A	FINGER GUARD, 4 IN.	EBM LZ	1.0000	EA	

OBJECT #: V0714046 OBJ TYPE: PT REV: E STATUS: PRD/L

OBJ DESC: POWER BASE 714-510-S
REV DESC: REPLACED V3510010 WITH TX0076A01

PART #	SEQ	TY	RV	PART DESCRIPTION		QTY	UOM	USE
				MFG: PAPST	LZ30			
				MFG: HOWARD	6-182-033			
V7912520	365	PT	-	CAP,DC,OVAL, 2,1000V		1.0000	EA	
				MFG: FORT SMITH	CC0058A01			
				MFG: RONKEN	86A81205K12			
				;C9				
V7999150	370	PT	A	CAPACITOR TERMINAL BOOT		1.0000	EA	
				MFG: FORT SMITH	CC0062A00			
				;C9				
V7999014	375	PT	-	BRACKET,LAY DOWN	RONKIN P/	1.0000	EA	
				MFG: RONKEN	25A011201			
				;C9				
V1079231	380	PT	A	CABLE, CONTROL BD TO NANA		1.0000	EA	
V1072084	385	PT	G	CABLE ASSY, 460V DRIVE		1.0000	EA	
V1082291	390	PT	-	IDENTIFICATION LABEL		1.0000	EA	
V1007622	395	PT	-	LABEL, RECOMMENDED TORQUES		1.0000	EA	
V1005751	400	PT	-	LABEL GRD		1.0000	EA	
V6911400	405	PT	A	CABLE TIE MIN .87DIA		10.0000	EA	
				MFG: AMP INCORPORATED	2-604771-9			
				MFG: PANDUIT	PLT1M			

*** END OF REPORT ***

OBJECT #: V0074001 OBJ TYPE: PT REV: A STATUS: PRD/L

OBJ DESC: CONT BD,TACHSYN COMM
REV DESC: 1989-03-30 - IDL - PT:2

PART #	SEQ	TY	RV	PART DESCRIPTION		QTY	UOM	USE
V1000008	005	PT	A	SELECT AT TEST C38,C39; SELECT FOR ;SWITCHING FREQ. R38; CMMR ON INPUT ;BUFFER R42; SELECT FOR ;10 KHZ TACHSYN ;EXCITATION FREQ. R71; SELECT FOR ;FREQ - VOLTS ;CONVERTER		5.0000	EA	
V3250001	010	PT	-	LED, RED T-1 3/4; ALMAC MFG: HEWLETT PACKARD D1-D8	HEWLETT P HLMP-3300	8.0000	EA	
V3250002	015	PT	-	LED, GRN T-1 3/4 MFG: HEWLETT PACKARD D9,D10	HLMP-3502	2.0000	EA	
V8200250	020	PT	-	POT,TRIM,SQ,1T 5K R5,R6	BOURNS 33	2.0000	EA	
V8200320	025	PT	-	POT,TRIM,SQ,1T 20K R1-R4	BOURNS, 3	4.0000	EA	
V1074003	030	PT	A	CONT BD, TACHSYN COMM ;TEST PER 0027 ;BURN-IN PER ;STD PROCEDURE	TURNKEY A	1.0000 BUBBLE (001)	EA	

*** END OF REPORT ***

OBJECT #: V0740308 OBJ TYPE: PT REV: - STATUS: PRD/L

OBJ DESC: PERSONALITY PLATFORM
REV DESC: 1990-01-03 - IDL - PT:3

PART #	SEQ	TY	RV	PART DESCRIPTION		QTY	UOM	USE
V8103309	005	PT	-	RES,MF, 309. K 1/10W	RN55C3093	1.0000	EA	
				;R101, PINS 1 TO 40				
V810D000	010	PT	A	ZERO OHM JUMPER; TRW	TTI;	1.0000	EA	
				MFG: KOA	Z-25Y2.5-T52 (52MM REEL)			
				MFG: TRW	ZEROHM			
				MFG: FORT SMITH	RR0108A00			
				;R102, PINS 2 TO 39				
V8103698	015	PT	-	RES,MF, 698. K 1/10W; TTI		1.0000	EA	
				;R103, PINS 3 TO 38				
V8102348	020	PT	-	RES,MF, 34.8 K 1/10W	RN55C3482	1.0000	EA	
				MFG: GENERIC	RN55C3482F MIL-R-10509			
				;R104, PINS 4 TO 37				
V8103200	025	PT	-	RES,MF, 200. K 1/10W; TTI		3.0000	EA	
				MFG: GENERIC	RN55C2003F MIL-R-10509			
				;R105, PINS 5 TO 36				
				;R106, PINS 6 TO 35				
				;R107, PINS 7 TO 34				
V8102422	030	PT	-	RES,MF, 42.2 K 1/10W		1.0000	EA	
				;R108, PINS 8 TO 33				
V8101634	035	PT	-	RES,MF, 6.34K 1/10W; TTI		1.0000	EA	
				MFG: GENERIC	RN55C6341F MIL-R-10509			
				;R109, PINS 9 TO 32				
V8102200	040	PT	A	RES,MF, 20.0 K 1/10W		1.0000	EA	
				;R110, PINS 10 TO 31				
V8103243	045	PT	-	RES,MF, 243. K 1/10W	TTI	1.0000	EA	
				;R111, PINS 11 TO 30				
V7007410	050	PT	B	CAP,MKT,LYR .1 +/-10% 63V		1.0000	EA	
				MFG: MALLORY	168104K100H			
				;C112, PINS 12 TO 29				
V7007210	055	PT	A	CAP,MKT,LYR .001 +/-10% 63V		1.0000	EA	
				MFG: MALLORY	168102K100A			
				;C113, PINS 13 TO 28				
V1000001	060	PT	B	NOT USED		1.0000	EA	
				;R114, PINS 14 TO 27				
V7007310	065	PT	-	CAP,MKT,LYR .01 +/-10%	63V	1.0000	EA	
				MFG: MALLORY	168103K100A			
				;C115, PINS 15 TO 26				
V8102127	070	PT	-	RES,MF, 12.7 K 1/10W	TTI; RN55	1.0000	EA	
				;R116, PINS 16 TO 25				
V8102143	075	PT	-	RES,MF, 14.3 K 1/10W	RN55C1432	1.0000	EA	
				MFG: GENERIC	RN55C1432F MIL-R-10509			
				;R117, PINS 17 TO 24				
V8101976	080	PT	-	RES,MF, 9.76K1/10W		1.0000	EA	
				;R118, PINS 18 TO 31				
V8102698	085	PT	-	RES,MF, 69.8 K 1/10W		1.0000	EA	
				;R119, PINS 19 TO 22				
V1000008	090	PT	A	SELECT AT TEST		1.0000	EA	
				;R120, PINS 20 TO 21				

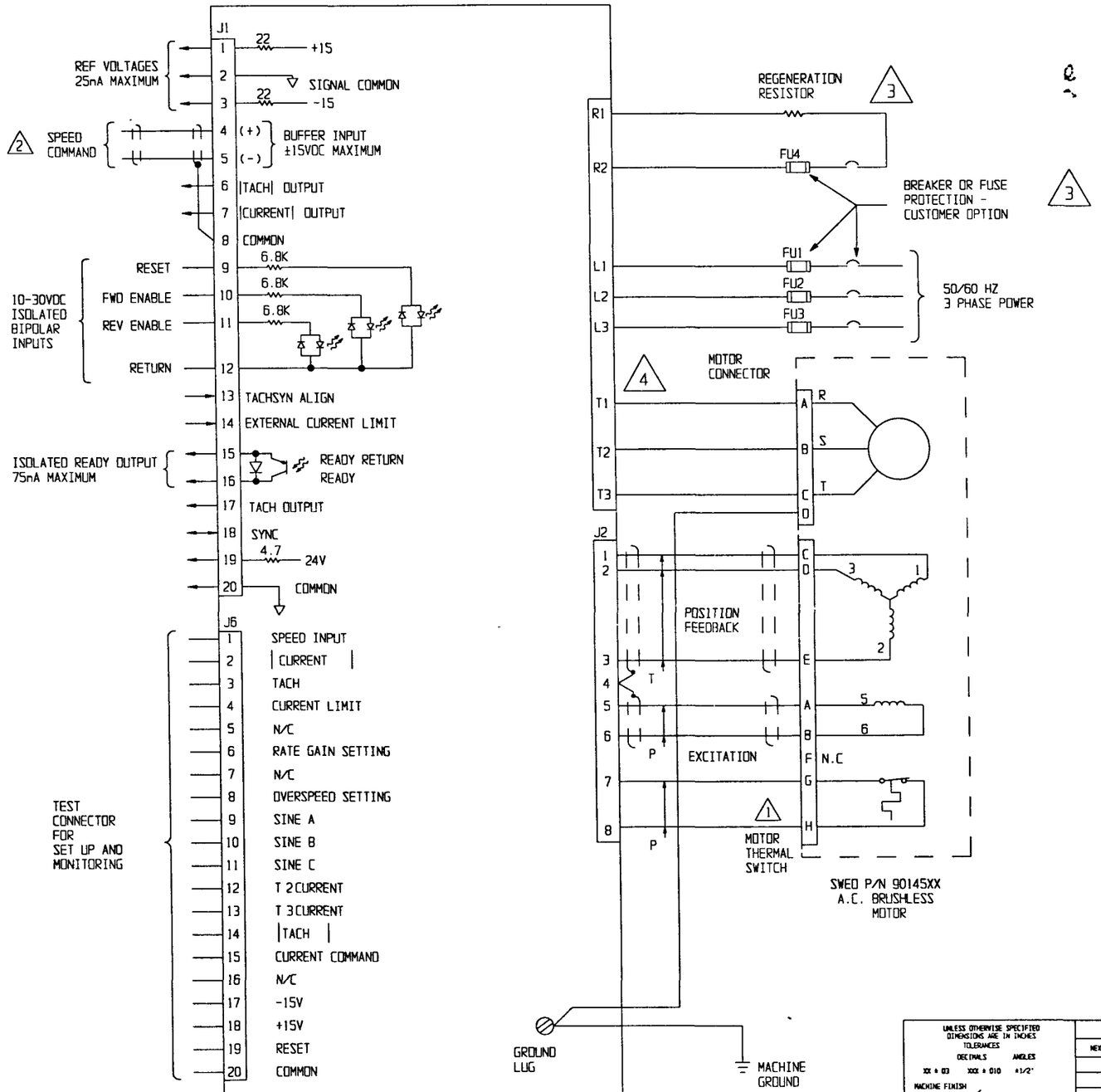
OBJECT #: V0740308 OBJ TYPE: PT REV: - STATUS: PRD/L

OBJ DESC: PERSONALITY PLATFORM
REV DESC: 1990-01-03 - IDL - PT:3

PART #	SEQ	TY	RV	PART DESCRIPTION	QTY	UOM	USE
				;SCALING =2.0V/100HZ			
				;TEST BOX VOLTS =			
				;4.0VDC			
V6010309	095	PT	A	PLUG ADAPT. 40 PIN;PRIEBECIRC.ASSY	1.0000	EA	
				MFG: CIRCUIT ASSEMBLY CA-40P-T02			
				MFG: ROBINSON NUGENT FPB-406			

*** END OF REPORT ***

REVISIONS					
LTR	DESCRIPTION	DR	CHK	DOC CONT	DATE
A	ZN C3. DELETED "208VAC, 230VAC" FROM NOTE FOR FU1, FU2, FU3 ADDED NEW LOGO ADDED MOTOR IDENTIFICATION ABOVE TITLE BLOCK	JL			



NOTES:

1. MOTOR THERMAL SWITCH IS CONNECTED TO PINS F AND R WHEN MOTORS WITH AN ENCODER AND 17 PIN CONNECTOR ARE USED.
2. POSITIVE SPEED COMMAND AT J1-4,5 CAUSES MOTOR ROTATION IN THE FOREWARD DIRECTION. FOREWARD ROTATION IS DEFINED TO BE CW SHAFT ROTATION AS VIEWED FROM THE DRIVE SHAFT END FOR P/N 90145XX MOTORS.
3. CUSTOMER SUPPLIED. FUSE AND RESISTOR KITS ARE AVAILABLE.
4. IF EXTERNAL CONTACTOR IS REQUIRED CONTACT FACTORY FOR WIRING DETAILS.

PAC-SCI MOTORS ONLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS ANGLES
XX ± 03 XXX ± 010 ±1/2°
MACHINE FINISH ✓
DO NOT SCALE DRAWING
MATERIAL

APPLICATION	
NEXT ASSEMBLY	DASH NO

CONTRACT NO

PREPARED	B. J.	DATE 6/21/89
CHECKED	T L	DATE 22/6/89
APPD	T L	DATE 22/6/89
DOC CONT.		DATE

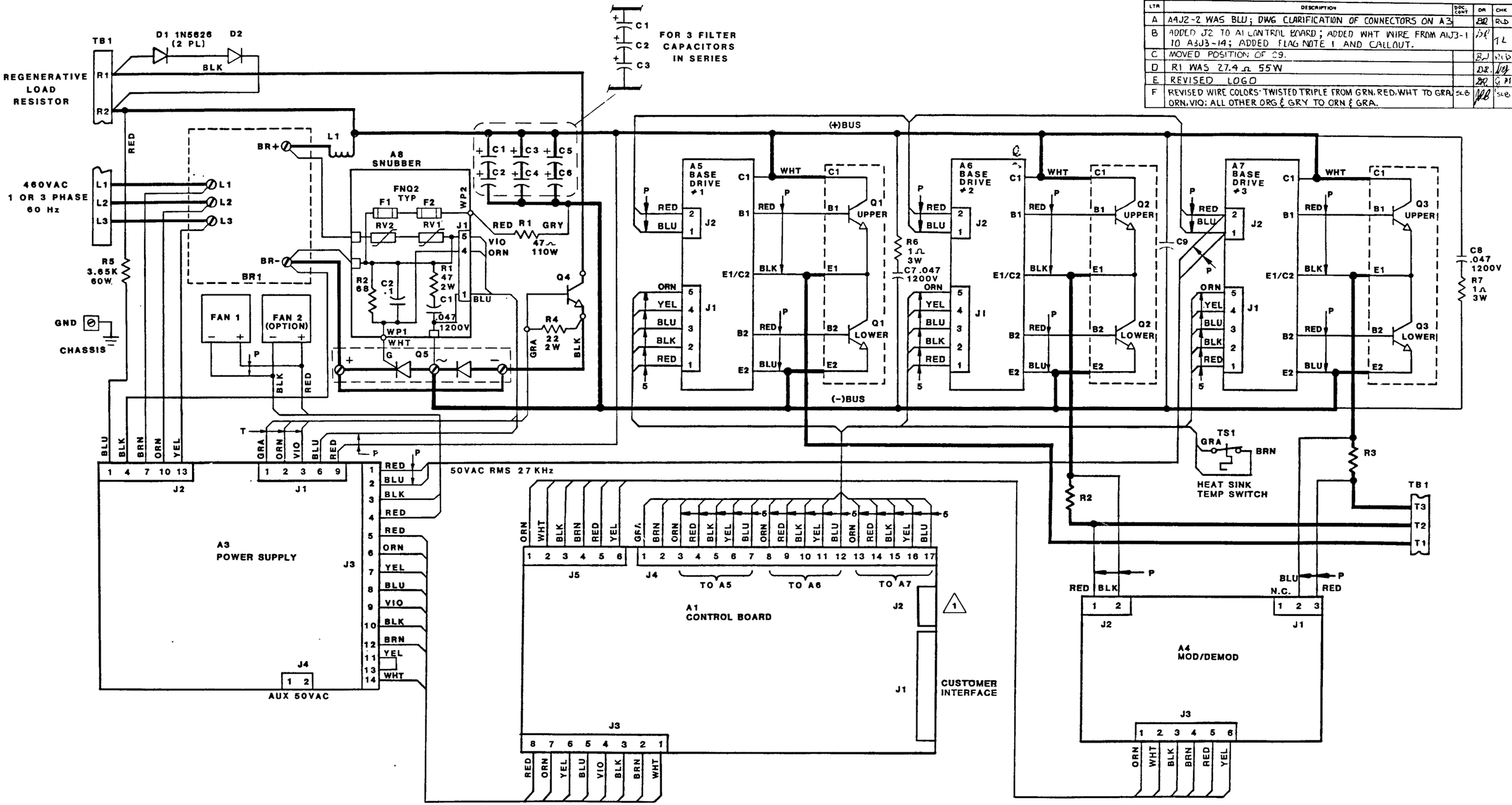
BALDOR SWEODRIVE

INTERCONNECT DIAGRAM
BRUSHLESS TACHSYN SINGLE-AXIS
P/N 90145XX MOTORS

SIZE	FSCM NO		
D	45586	7520	A

SCALE NONE | 7520A | SHEET 1 OF 1

REVISIONS					
LTR	DESCRIPTION	DOC CONT	DR	CHK	DATE
A	A4J2-2 WAS BLU; DWG CLARIFICATION OF CONNECTORS ON A3		BD	RCD	5/10/88
B	ADDED J2 TO A1 CONTROL BOARD; ADDED WHT WIRE FROM A1J3-1 TO A3J3-14; ADDED FLAG NOTE 1 AND CALLOUT.		JSP	TL	5/3/89
C	MOVED POSITION OF C9.		BJ	RCD	10/6/89
D	R1 WAS 27.4Ω 55W		DR	MB	3/20/91
E	REVISED LOGO		BD	G MB	6/27/91
F	REVISED WIRE COLORS: TWISTED TRIPLE FROM GRN, RED, WHT TO GRA, ORN, VIO; ALL OTHER ORG & GRY TO ORN & GRA.	SLB	MB	SLB	2/24/92



1 J2 MOTOR FEEDBACK CONNECTOR ONLY EXISTS ON SERVO MODELS

APPLICATION		CONTRACT NO	
NEXT ASSEMBLY	DASH NO		
		PREPARED B. J.	DATE 12-11-87
		CHECKED	DATE
		APPD	DATE
		DOC CONT.	DATE

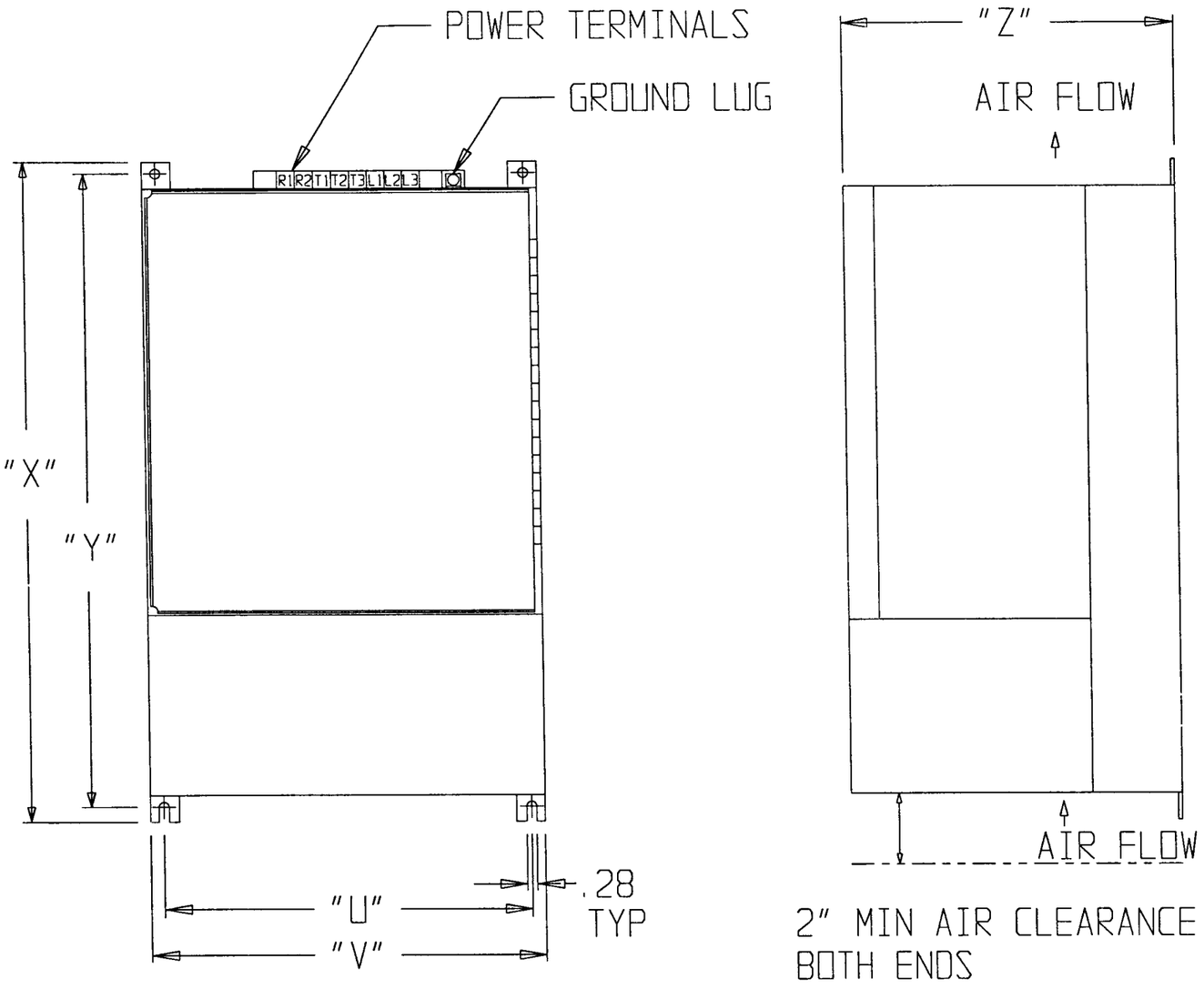
BALDOR SWEODRIVE

CONNECTION DIAGRAM 460V A.C. MOTOR CONTROLLER

SIZE	CODE IDENT NO.		
D	4S586	7148	F

SCALE | SHEET 1 OF 1

REVISIONS				
LTR	DESCRIPTION	DR	CHK	DATE
A	ADDED "C" SIZE CONTROLLER AND Z,U & V DIMS	DR	DET	1 APR 91
B	ADDED (CM) DIMS	JRB		



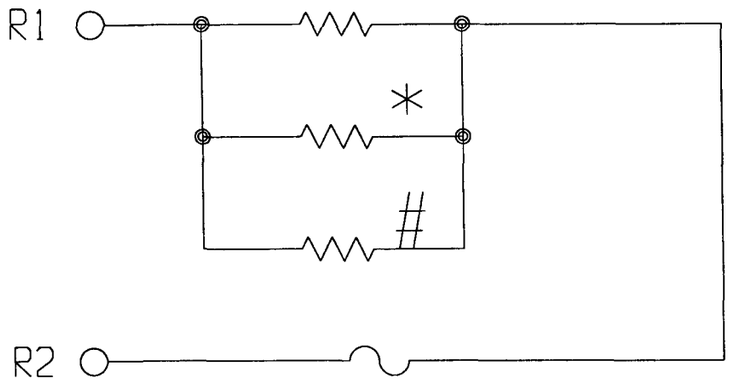
2" MIN AIR CLEARANCE
BOTH ENDS

SIZE	"U"	"V"	"X"	"Y"	"Z"
A	10.25 (26,0)	11.00 (28,0)	18.50 (47,0)	17.75 (45,1)	10.00 (25,4)
B	10.25 (26,0)	11.00 (28,0)	22.50 (51,2)	21.75 (55,2)	10.00 (25,4)
C	13.00 (33,0)	14.50 (36,8)	41.00 (104,2)	40.00 (101,6)	11.00 (28,0)

DIMENSIONS IN INCHES (CM)

APPLICATION		CONTRACT NO	
NEXT ASSEMBLY	DASH NO		
PREPARED	DATE	SWEO CONTROLS INC. BELLEVUE, WA. 98005	
D. ROUSSEAU	11/2/87		
CHECKED	DATE	OUTLINE AND MOUNTING SINGLE AXIS	
R. OETERING	11/2/87		
APPD	DATE	SIZE D	FSCM NO 4S586
APPD.	DATE	SCALE NONE	7153 B
			SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

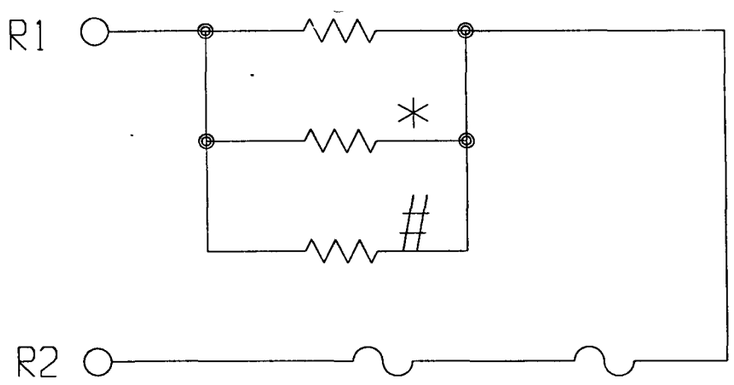


LOW VOLTAGE UNITS

* USED ON: 0007002, 0007012, 0007003 & 0007013 ONLY

\# USED ON: 0007003 & 0007013 ONLY

LOW VOLTAGE REGEN KITS			
PART NO.	RESISTORS	EQUIV. RESISTANCE	MAX DISSIPATION
0007001	1 x 10	10	300W
0007002	2 x 20	10	600W
0007003	3 x 40	13	900W
0007011	1 x 6	6	300W
0007012	2 x 12	6	600W
0007013	3 x 20	6.7	900W



HIGH VOLTAGE UNITS

* USED ON: 0007022, 0007032, 0007023 & 0007033 ONLY

\# USED ON: 0007023 & 0007033 ONLY

HIGH VOLTAGE REGEN KITS			
PART NO.	RESISTORS	EQUIV. RESISTANCE	MAX DISSIPATION
0007021	1 x 20	20	300W
0007022	2 x 40	20	600W
0007023	3 x 60	20	900W
0007031	1 x 12	12	300W
0007032	2 x 25	12.5	600W
0007033	3 x 40	13	900W

SWEO CONTROLS INC.

REGEN KIT INSTALLATION DWG.

DRAWN	SIZE	FSCM NO.	DWG NO.	REV
D. ROUSSEAU	B	45586	0700	
APP'D.	SCALE 1:1		SHEET 1 OF 1	