MANUAL 1131

MODEL NO. 843-1136EIF

PART NO. 0164921

REGENERATIVE DC ELEVATOR DRIVE

JULY, 1992

DRIVE CENTRE DC
Industrial Automation Systems Integrators

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TABLE OF CONTENTS

DC ELEVATOR APPLICATION WARRANTY

BALDOR SWEODRIVE warrants that the products sold will be free from defects in material and workmanship and perform to Seller's applicable published specifications for a period of one (1) year from date of shipment from Seller's plant. Seller extends this limited warranty to each buyer of the drive for the purpose of resale and to the original purchaser for use. 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 EQUIPMENT IS STANDARD INDUSTRIAL CONTROL EQUIPMENT AND CONTAINS NO SPECIAL PROVISIONS TO MEET THE SAFETY CODES AND REQUIREMENTS FOR ELEVATOR USE. ALL SUCH SAFETY PROVISIONS MUST BE ADDED BY THE CUSTOMER.

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, startup, operating and maintenance instructions for the BALDOR SWEODRIVE regenerative elevator DC drives. Either 3-lead fused or 6-lead impedance protected, these drives, available in the range from 3 to 250 HP, are adapted for high performance applications. Each is factory tested and adjusted to provide proper operation with the motor specified in the setup sheet. A setup sheet listing proper control settings for the drive is included after section 7.0.

These drives include the following features:

Tachometer Feedback
QUICK ON, Tripout on 12% Speed Error

J2-1	ON Output, LOW = ON
J2-2	5% Speed Output, less than 5% speed = ON
J1-11	Running Field Setting
Field	Econ to 45% Voltage

1.2 SAFETY NOTICE

WARNING

This equipment contains voltages which may be as high as 600 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 try to startup or troubleshoot this equipment. Observe these precautions:

1. USE EXTREME CAUTION, DO NOT TOUCH any board, SCR or motor electrical connection without insuring unit is properly grounded and no high voltage is present. DO NOT apply AC power before grounding unit according to instructions in this manual.

2. BE CERTAIN that possibly 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 up to ten times rated motor can occur during a control failure.

WARNING

3. Motor armature and field circuits may have high voltage present whenever AC power is applied, even when motor is not rotating.

1.3 DESCRIPTION (Model 840E Data Sheet)

The drive modules are 840E series drives with the elevator drive features listed in the Introduction, Section 1.1. Other specifications are listed in the 840E data sheet. These modules provide both armature and field circuit DC power conversion. Each module consists of the armature power converter parts and the field power converter module mounted on the panel mounting base. With most six (6) AC lead modules and with field current requirements in excess of 40 amperes, the field power converter module must be mounted separately.

Optional semiconductor protection fuses are mounted over the power converter parts on the top of the module and the control circuits are mounted over the power converter components on the lower portion. All control circuitry except for the feedback board is contained on two hinged plug together circuit boards mounted over these power converter parts. The boards are easily removed and swing out for easy access to the power circuit and feedback board. All control and signal circuits on these boards are isolated from the power circuits and grounded to cabinet ground.

Major elements of the module are:

ARMATURE POWER CONVERTER - The power converter uses the 12 SCR three phase full wave bridge connection illustrated in Drawing 0200B. Line reactors L1 to L6, RC snubbers and MOVs contained on the SCR interface boards protect the power devices against transients. SCRs are dual isolated base type with no heatsinks at power circuit voltage. Pulse transformers on the SCR Interface Board isolate the Firing Board from power circuit voltages.

FEEDBACK BOARD - This board provides isolated armature current and voltage feedback to the Firing and Control Boards. A Hall current sensor converts armature current to a proportional signal voltage. Current limiting voltage attenuating resistors in the armature voltage feedback circuit limit feedback voltage for safety. Feedback boards of the same part number are identical and interchangeable. Rated peak current is set by the number of turns through the Hall sensor and slightly by the control board scaling resistors.

FIRING BOARD This board provides ± 15 VDC power supplies and all firing circuit logic to convert a DC control voltage from the Control Board into properly phased firing pulses to control SCR gating. All circuitry on this board

is isolated from power circuit voltages. Firing boards of the same part number are identical and completely factory preset so that no field adjustment is necessary.

CONTROL BOARD This board provides control input-output connection through a plug-in terminal strip, plug-in tester connections and all circuitry necessary to control Firing Board operation. All circuitry on this board is isolated from power circuit voltages. This board contains all variations necessary to accommodate the specified motor and tachometer. All adjustments may be completely set up before starting the drive by using the tester connections provided.

MULTI-RATED FIELD POWER MODULES 0017020, 0017320 (DRAWINGS 0728, SK0031)

This power converter uses a single phase full wave SCR-diode power bridge with current transformer feedback. This module converts AC input power to DC field current under control of the Control Board. Maximum output current rating of the module family is 15 amperes DC, as determined by the placement of the Range Plug, (JP1) on the circuit board which is a component part of the Field Power Module. Five (5) ranges are provided with maximum ratings of 1.5 through 15 amperes. Available output current ratings are 15, 10, 5, 2.5, and 1.5 amperes selected by the respective JP1 positions of A, B, C, D, and E. Refer to SK0031 for illustration of JP1 location. Full-scale current of each range produces -2.5 volts DC at test connector J3, pin 14 on the drive control board.

1.4 PROTECTION FEATURES

PHASE LOSS / PHASE SEQUENCE / POWER LOSS

This detector is a latching LED indicated circuit which monitors incoming AC voltage for improper phase sequence,low line voltage or missing phase. Typical causes are blown line fuse or reference fuse or improper internal power supply voltages. Presence of any of these conditions will shut down the drive and remove READY LED indication. The external READY output will cause the READY RELAY to be energized which will interlock the armature control with the start-stop circuits and the armature contactor.

TACH LOSS / OVERSPEED

This circuit detects motor speed above a preset maximum, open armature circuit, tachometer failure or tachometer wiring open or shorted. This circuit will shut down the drive before damage to the motor, due to an overspeed, can occur. Shutdown is latched, LED indicated and removes READY indication.

FIELD LOSS
This circuit detects field current at less than 5% of the maximum range setting of the field power module. This circuit lights an LED indicator and removes the READY indication.

INSTANTANEOUS OVERCURRENT
This circuit detects instantaneous armature current over a preset limit, settable up to 150% over rated peak current for the control. This high speed shutdown protects power circuit and fuses from many overcurrent conditions due to faulty AC power, motor commutation failure, shorts in wiring, etc. Shutdown is latched, LED indicated and removes READY indication.

RMS OVERCURRENT
RMS overcurrent protection is to be customer provided by a thermal overload relay (OL) in the armature circuit. This thermal overload is to be sized to protect the motor and armature power convertor from exceeding their rated rms capacity.

CONTROL CIRCUIT FUSING
The module control and field circuits are fused on the module. Any failure of these fuses will shut down the drive and indicate power loss or field loss as described above.

POWER CIRCUIT FUSING
Power circuit fusing provisions for three (3) AC lead modules are supplied on the module and an optional fuse kit is available. Customer supplied fusing must meet requirements listed in Section 2.2.

ARMATURE LOOP CONTACTOR
A customer supplied armature loop contactor interlocked with the READY output is recommended. See requirements for wiring in Section 2.2.

1.5 ADJUSTMENTS

1.5.1 CONTROL BOARD 0033XXX (Drawing 0035E)

Set the following adjustments per section 3.3 and set-up sheet following Section 7 except as noted below.

R101 - MAX SPEED - Allows trimming drive max speed for ±10 volt input over range ±25% from nominal max speed listed in set-up sheet. Final setting must be made using the motor to be controlled since tach feedback voltage scale factor may be up to ±10% from nominal value. Use this pot to trim the top speed.

R73-ACCEL - Adjusts rate of change of output at J1-8 (ACC- DEC OUTPUT) for positive going speed command inputs.

R74-DECEL - Adjusts rate of change of J1-8 (ACC-DEC OUTPUT) for negative-going speed command inputs.

R57-ZERO TRIM - Adjusts zero offset of rate amplifier. Adjust in field to cause zero speed at motor for zero volts speed command applied to the control.

R56-RATE GAIN - Adjusts rate servo loop gain without affecting maximum speed or tach scale factor. Increasing this setting improves response but may cause speed overshoot or ringing, decreasing this setting slows the drive response.

R45-IOC - This "Instantaneous Over Current" trip pot sets peak current at which drive trips off due to Overcurrent. Full CW setting is 140% to 180% of maximum current limit setting.

R46-OVERSPEED - Sets tach voltage at which drive trips off due to Overspeed. Full CW setting is 125% of rated max speed.

R161-CURRENT LIMIT - Sets maximum current drive will supply. See set-up sheet for maximum pot setting.

R178-NULL FORCING - Adjusts increase in non-linear firing angle command at low current command levels (null region) used to linearize the control in the null region. Increasing this setting makes drive more responsive at null but causes more current overshoot, decreasing this setting slows response at null.

R197 - MAX ARM VOLTS - Adjusts armature voltage above which the automatic field regulator reduces field excitation with increasing speed, thus limiting maximum armature voltage. Full CW setting is about 115% of rated armature voltage, the normal setting for an elevator control.

R198 - MAX FIELD CURRENT - Adjusts field current at operating speeds below motor base speed. Full CW setting is about 110% of maximum rated field supply current. Maximum current may be limited by available field supply voltage and field circuit resistance. The MAX FIELD CURRENT sets the leveling or forcing value of Field current. The running field current is set by externally applying a less positive voltage than R198 is set to at J1-11.

1.5.2 FEEDBACK BOARD 0105

R7 - ZERO TRIM (FACTORY PRESET)
This pot is factory set for zero trim of the Hall transducer. Normally it should not be set in the field. If it must be field trimmed, set for zero ±10 mv balanced for both directions of current output measured on control board TP2 relative to TP1. **CAUTION:** This is a critical adjustment which can prevent drive turnaround or cause trip-off if mis-set.

1.6 INSTALLED OPTION DESCRIPTIONS

Field supply with approximately 45% voltage economizing level when not enabled.

Shutdown with Tach Loss/Overspeed indication when speed error exceeds approximately 12% of maximum speed. On later models, the user may defeat this feature by jumper selection on the control board .

J2-2 5% Speed Output, open collector, ON below 5% of maximum Speed.

J2-1 ON Output, open collector, ON when drive is enabled.

J1-11 Field current reduction to "RUNNING FIELD". J1-11 Running Field Input voltage sets the maximum field current over the voltage range of 0 to +12.5V corresponding to 12% to 100% of maximum field current on the selected field current range. With J1-11 open, MAX FIELD adjustment determines the field current.

QUICK ON shortens onset delay of armature current to 9 milliseconds after drive enable is applied to J2-6 and J2-7.

2.0 INSTALLATION AND STARTUP

Check motor nameplate and power source voltage to insure they match the drive nameplate. Information contained in this manual must also agree with the drive nameplate.

2.1 MOUNTING (Model 840E Data Sheet)

These drive controls are panel mounting. Mount in a clean dry enclosure with internal ambient temperature of + 55 degrees C or less. **DO NOT** mount control above transformer or other heat source. **DO** provide for a 4" minimum clear area above and below the control to allow free flow of air over heatsink on the back of the enclosure.

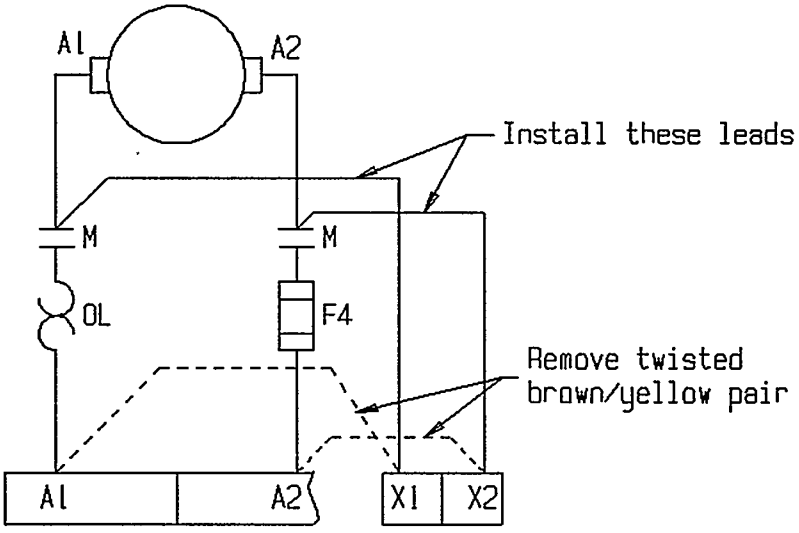
Mounting dimensions are shown in the Model 840E data sheet. Note that power connections are made to the top of the control and plug-in signal connections to the bottom. Provide access to the control board mounted adjustment potentiometer and indicators. Allow room for the hinged circuit boards to swing down for access to the power assembly components.

2.2 WIRING (Model 840E Data Sheet)

All wiring shall be in accordance with the National Electric Code and applicable local codes. Use the voltages and currents listed on the drive label. The currents on the label are the continuous ratings.

Install semiconductor protection power fuses F1-F4 (if required), thermal overload OL, and contactor M using parts selected per the continuous currents. Continuous Armature current is listed on the drive label as output Amps RMS. Fuses F1-F4 are listed in section 6.0 of the manual. Wire AC power and DC motor circuits per 840E data sheet schematic using wire sized to meet the National Electric Code with rated currents per the drive label. Connect motor shunt field for the DC voltage listed on the set-up sheet. Contact factory for other field voltages.

Install READY relay and wire Start-Stop circuits per 840E data sheet. If a contactor is used and drive will be operated above motor base speed, terminals X1 and X2 must be reconnected to the motor side of contactor as illustrated below:



CAUTION: Armature overvoltage may occur when M contactor is opened at high speed without X1 and X2 reconnected as shown.

Use transient suppressor on all coils of contactors, relays, or brakes.

Connect remainder of signal wiring per drawings furnished with this manual. The polarities for tach and armature connections must be followed to prevent drive runaway due to tach reversal. Use twisted pairs as shown and **DO NOT** route signal wires with power or control wires. The tach wiring may be carried in a common conduit with the armature and field leads if twisted and shielded wires are used as shown in the data sheet.

2.2.1 MODIFICATION FOR 50 HERTZ

DO NOT RUN CONTROLS SET UP FOR 60 Hz ON 50 Hz POWER OR VICE VERSA. Controls are shipped set up for 60 Hertz. Convert to 50 Hertz by removing jumpers R154 and R157 on control board.

2.2.2 FIELD SUPPLY CONNECTION

The Field Supply must be connected as shown in Sketch A to give a field voltage of that shown on the set-up sheet. Sketch A is included in the drawing section of the manual.

In an application using six (6) AC leads, the field power module is to be mounted adjacent to the armature module to receive drive power phases L1 and L2 and SCR firing pulses from the drive firing board. (Refer to Sketch A)

2.3 STARTUP

WARNING

This equipment contains voltages which may be as high as 600 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 try to startup or troubleshoot this equipment. Observe these precautions:

1. **USE EXTREME CAUTION: DO NOT TOUCH any circuit board, SCR 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.**

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 up to ten times rated motor torque can occur during a control failure.**

3. **Motor armature and field circuits may have high voltage present whenever AC power is applied, even when motor is not rotating.**

2.3.1 POWER APPLICATION

Check all wiring and grounds to be certain connections are proper. Check all hardware to be sure all equipment is mechanically and electrically secure. Clear area around motor and uncouple motor shaft from load if at all possible. OBSERVE PRECAUTIONS ABOVE. Check AC power voltage into disconnect before closing disconnect. Then close disconnect and observe READY indicator on control board; it should light within 10 seconds maximum. If no READY light, remove power and reverse one AC line pair at disconnect to reverse the phasing. If still no READY light, troubleshoot per troubleshooting section 5.0.

2.3.2 DRIVE STARTUP

Before starting the drive, set CURRENT LIMIT to about 20% of the setup sheet value. This will restrict current to a low value and prevent rapid motion if a runaway occurs. Note READY indicator is lit. Plug tester (if available) into control board of drive to be started and check AC and DC voltages and pot settings with DVM per setup sheet after Section 7.0. Apply zero speed input command, then apply momentary START input. Drive contactor M should close, ON indicator should light and drive should be energized at near zero speed. If CURRENT LIMIT indicator lights, slightly increase CURRENT LIMIT setting to provide enough torque for drive to move slowly. If drive tries to run away, limit speed by setting CURRENT LIMIT pot more CCW. Note ARM VOLTS and TACH indications on test meter. They will have the same polarity and about the same voltage at tester if tach connection is proper. Reverse polarities indicates reversed tach or armature connection, no tach voltage indicates fault in tach or tach wiring.

Command various speeds and see performance on tester, gradually increase current limit to full value per setup sheet. Drive is now ready to operate.

See troubleshooting section for guide to solving problems which may occur during startup.

3.0 MODEL 800 TESTER

The Model 800 Tester provides a convenient means of monitoring drive performance in operation, setting up spare or replacement control boards without applying current to the motor armature and troubleshooting control failures. The tester plugs into control board connector J3.

3.1 DESCRIPTION

The tester has a zero center analog meter for quick monitoring and an OUTPUT jack which allows accurate measurement with a DVM or oscilloscope. Switch toggle to METER to use the meter and to OUTPUT to measure with external instruments and during transportation (damps meter motion). All outputs are relative to the black test jack, signal common. The TACH and ARM CURR (armature current) test points are brought out to jacks and can be used at any time. The TACH output is scaled for approximately -8.0 volts = 100% forward speed. The ARM CURR output is scaled for +10.0 volts = 100% forward current.

The ON indicator lights whenever AC power is available on either of the AC line reference phases AB or BC. The FWD indicator lights when the forward SCR bridge is selected by the drive. This light is normally ON unless the control is providing reverse bridge current only.

The HP SET button is used to inject a test voltage at the control board to simulate armature voltage, thus allowing static measurement of the control board MAX ARM VOLTS setting. The G/F SET button is used to inject a test voltage into the control board current command circuit to allow static measurement of the control board RATE GAIN and NULL FORCING settings. The TEST button provides a 0 to +12 volt DC output at the TEST jack. All test voltages are set with the TEST potentiometer.

CAUTION

DO NOT PUSH HP SET or G/F SET when drive is supplying current to the motor. The test input from these buttons may interfere with normal operation.

The selector switch determines the output supplied to the test meter or OUTPUT jack.

3.2 SELECTOR POSITIONS

LINE AB, BC	These positions monitor AC line voltages by monitoring voltage from the drive reference transformers T1 and T2. Line voltage input corresponding to rated voltage causes 22 VAC at OUTPUT and 100% meter indication.
+15, -15	These positions monitor the drive regulated voltages. OUTPUT is ±15 VDC nominal and meter indicates +100% for normal +15V, and -100% for normal -15V.
SPEED CMD	Maximum forward speed is approximately +8.0 volts, +100% on the meter.
TACH	Maximum forward speed is approximately -8.00 volts, -100% on the meter.
CURR CMD	Rated peak current command is -10.0 volts, -100% on the meter.
FIRING CMD	This position monitors voltage supplied from the control board to the firing board. Maximum forward firing command is about -13 volts, -100% on the meter. Zero firing command is zero volts and maximum reverse firing command is +13 volts, +100% on the meter.
ARM CURR	Maximum forward armature current is +10.0 volts, +100% on the meter.
ARM VOLTS	Maximum forward armature voltage is -8.0 volts, -100% on the meter.
NULL FORCE	Maximum forward null forcing is approximately +13 volts, +100% on the meter.
GAIN SET	This position is used in measuring the rate gain setting per the procedure in the following section.
CURR LIMIT	This position always monitors current limit setting with or without drive enable. Zero volts is zero current limit, +10.0 volts is rated peak current limit as listed on the setup sheet.

IOC TRIP — Maximum instantaneous overcurrent trip setting is +10.0 volts, +100% on the meter, corresponding to 10 * IOC Scaling as listed on the setup sheet.

OSPD TRIP — Maximum overspeed trip setting is +10.0 volts, +100% on the meter. This corresponds to 125% of maximum speed rating at rated tach scale factor.

TEST VOLTS — This position measures output volts at TEST, button must be pushed to provide voltage output.

FIELD/IR COMP — This position monitors field current and is scaled such that -2.50 VDC (-120% on the meter) corresponds to the maximum current for the range selected at the field current regulator. Refer to SK0031 for currrent range selection. NOTE: THIS RATED OUTPUT MAY EXCEED MOTOR RATING, REFER TO SETUP SHEET FOR PROPER SETTING.

3.3 CONTROL BOARD SETUP

The following procedure is recommended for setting up a spare or replacement control board to match a control board being used in a system. The tester and a DVM allow precision adjustment to insure proper operation of the new board BEFORE power is applied to the motor armature.

Use the set-up sheet for each drive with any field changes noted. If a set-up functional control board is available for measurement by below listed procedure, the board to be set up can be matched to the previously set-up board.

With AC power OFF, plug control board into firing board and secure with five thumbscrews and two phillips screws. Plug in tester, plug DVM into tester OUTPUT, apply AC power, DO NOT enable drive.

Check AC line voltages and ±15 V on tester. AC voltage must be in range 90% to 110% and ±15 volts must each be in range 14.8 to 15.2 volts measured with DVM. Switch tester to OUTPUT for DVM readings.

1) **MAX SPEED** Initial Setting - Apply maximum speed command from elevator control or tester TEST output, adjust control board MAX SPEED (R101) for 8.0 volts DC on DVM with tester set to SPEED CMD position. It may be necessary to later trim MAX SPEED setting to suit individual tach scale factor.

2) **OVERSPEED** Setting - With tester in OSPD TRIP, set control board OVERSPEED (R46) to value shown in set-up sheet.

3) **RATE GAIN** - Setting - Place tester in CURR LIMIT position. Adjust control board CURRENT LIMIT (R161) for +1.00 volt measured at tester OUTPUT. Then switch tester to GAIN SET position, push and hold G/F SET and adjust control board RATE GAIN (R56) for DVM reading in set-up sheet. Full CCW pot setting (minimum gain) corresponds to + 1.00 volt and full CW setting (maximum gain) corresponds to about +0.08 volt. CURRENT LIMIT must be reset per (7) below after this test.

4) **NULL FORCING** Setting - Place tester switch in CURRLIMIT position. Adjust control board CURRENT LIMIT for DVM reading listed in set-up sheet. Then switch tester to NULL FORCE position, push and hold G/F SET and adjust control board NULL FORCING (R178) for 11.5 volts on DVM. CURRENT LIMIT must be reset per (7) below after this test.

5) **MAX ARM VOLTS** Setting -

   a) For operation only to motor base speed, set MAX ARM VOLTS (R197) in the fully CW position. No other adjustment is required.

   b) For operation at greater than motor base speed, set ARM VOLTS on tester to voltage listed in setup sheet using tester pot with HP SET pushed. With motor field connected, set control board MAX FIELD CURRENT full CW. With tester on FIELD/IR COMP position, see -0.3 VDC to -2.5 VDC. Slowly reduce control board MAX ARM VOLTS (R197) setting from full CW while alternately pushing and releasing tester MAX HP button. Set MAX ARM VOLTS to cause about 50% reduction in FIELD/IR COMP reading when HP set is pushed. Control board MAX FIELD CURRENT must be reset per (6) below after this adjustment.

6) **MAX FIELD CURRENT** Setting - With cold motor field connected, enable control with zero speed input, full CCW control board CURRENT LIMIT setting, and the input to J1-11 Open. Then set control board MAX FIELD CURRENT (R198) for DVM reading shown in set-up sheet. Approach this setting when rotating the control from the fully CCW position.

   CURRENT LIMIT must be reset per (7) below after this adjustment.

7) **CURRENT LIMIT** Setting - Place tester switch in CURR LIMIT position, adjust control board CURRENT LIMIT (R161) for DVM reading shown in set-up sheet.

8) **IOC** Setting - With tester in IOC TRIP, set control board IOC (R45) for DVM reading shown in set-up sheet.

9) Control board is now set up and can be enabled to run the motor. Set ZERO TRIM (57) with drive enabled (contactor closed) and zero speed command applied so that no motor rotation occurs.

4.0 THEORY OF OPERATION

The drawing 0078 shows internal electrical arrangement and connection of the drive control module to the three phase power, the motor and customer connections. This module includes all circuitry required to convert incoming three phase power to controlled DC to operate the DC motor armature and field in response to the control inputs. The drawing 0200 shows the schematic of a fused power base which consists of the SCR bridge, current feedback assembly, field module, reference transformers, and low voltage control interface with SCR bridge. The SCR interface assembly also contains an RC snubber connected across the SCR pair.

Drawing 0221 shows the schematic for an impedance protected power base. All features except for the power line connections are identical to that shown on drawing 0200. In an elevator application designed for six (6) power line fuses, the external customer furnished resistors would be replaced by appropriately sized fuses.

The armature drive uses a full time current feedback loop to provide accurate control and limiting of DC current. Tach feedback is provided for precision speed control. The SCR bridge converts three phase AC power to controlled DC to operate the DC motor armature. This same power input is used for the reference transformer input to operate power supplies and synchronizing circuits on the firing board. The logic outputs of the synchronizing circuits control the ramp generators and pulse distribution circuits. The firing pulses are supplied to the SCR gates through the pulse amplifiers and transformers.

The armature control allows only one direction of current flow at time. Either Forward or Reverse current flows depending upon the desired direction of current. When conditions are safe for current direction reversal, the firing board turnaround logic shuts off firing pulses to one half of the power bridge and enables firing pulses to the other half. This reversal is accomplished in about 3 milliseconds.

The input to the firing board is developed by the current amplifier and null forcing circuit outputs. The current amplifier sums the current command with the current feedback signal to provide the current feedback loop. The null forcing circuit provides a nonlinear advancement of firing angle command for small current commands. This is to reduce the nonlinearity of the control.

The current feedback signal is developed by the Hall current sensor (Hall crystal in toroidal core) through which the DC armature lead is passed. The resulting current signal is amplified and supplied to the current feedback scaling network for feedback, overcurrent detection and signal output.

The rate amplifier sums the speed command input, auxiliary input and tach feedback signal from the tach scaling network. The result is amplified and commands current through the di/dt limiter. This limiter sets the maximum rate of change of current to protect the motor commutator.

The maximum current is limited by the current limit circuit and is set by the current limit potentiometer. A current limit detector monitors operation of this circuit and lights an LED when the current is being limited.

The customer speed command input is buffered to provide common mode isolation. A MAX SPEED potentiometer on the buffer output allows trimming of the maximum drive speed corresponding to full speed command input to the drive.

The field regulator reduces field current when the armature voltage exceeds a preset limit (MAX ARM VOLTS). The current loop on the field regulator provides rapid response and allows maximum field current to be adjusted. Armature overvoltage protection on the field control circuit limits the armature current command during rapid speed command increases. The field regulator automatically limits maximum field voltage to that specified on the set-up sheet during normal operation. The field regulator further reduces the field (field economizing) to about 30% maximum when the Enable input is open.

In addition to the installed options listed in paragraph 1.6, this control includes at J1-12, a bipolar voltage signal proportional to motor armature current. The J1-12 output is scaled such that ±10 VDC corresponds to maximum rated current.

5.0 TROUBLESHOOTING

WARNING

This equipment contains voltages which may be as high as 600 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 try to start up or troubleshoot this equipment. Observe these precautions:

1. **USE EXTREME CAUTION. DO NOT TOUCH any circuit board, SCR 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.**

2. **BE CERTAIN that possibly 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 up to ten times rated motor torque can occur during a control failure.**

3. **Motor armature and field circuits may have high voltage present whenever AC power is applied, even when motor is not rotating.**

5.1 INSTRUMENTS

The recommended troubleshooting aids are the Model 800 Drive Tester, a good quality two-channel oscilloscope and digital voltmeter (DVM) with input impedances of 1 megohm or more. The Model 840E control test connector provides access to all normally required test points for troubleshooting. The Drive Tester provides convenient selection of test outputs, a test voltage source and a meter. The tester is useful for monitoring drive performance or adjustment settings.

5.2 TROUBLESHOOTING GUIDE

Plug tester into Control Board J3. If tester is not used, make measurements relative to Signal common, J3-1 or 20.

CAUTION

DO NOT UNPLUG ANY BOARDS WITH POWER ON.

5.2.1 NO READY LIGHT

1) If IOC, Field Loss or Tach Loss-Overspeed indicators are ON, see appropriate section below.

2) Check AC power, line fuses and control fuses with Tester in LINE BC and LINE AB positions. Both should indicate +90% to +110%. These AC voltages can be measured at J3-6 & 7. Proper voltage is 20 to 24 VAC. The correct input volts are listed on the drive label.

3) Check DC power with tester on +15V and -15V. Proper tester readings are ±95 to 105%. These voltages can be measured at test connector J3-2 and 3 and should be 14.8 to 15.2 volts.

4) On initial startup, AC line phase may be reversed. Reverse one three phase input power line pair to the drive and re-try.

5) Replace firing board first, then control board if new firing board does not correct the problem.

5.2.2 NO ON LIGHT, BOTH ENABLE INPUTS APPLIED, READY LIGHT ON

1) Check ENABLE voltages at J2-6 and 7 relative to J2-8. The voltage will be ±2 volts DC maximum if external circuits are properly closed.

2) Replace control board.

5.2.3 ON INDICATION, NO MOTOR TORQUE

1) Check CURRENT LIMIT indicator and Control Board Current limit (R158). Current Limit voltage must be +0.5 volt minimum (+5% on tester in CURR LIMIT position) at J3-4. A higher setting will normally be required to get adequate torque to move the load.

2) One ENABLE input may be open, preventing torque commanded by input signals in that direction.

3) Check for motor current on tester ARM CURR position on J3-13. If no current, check armature circuit connections, armature fuse and motor after items 1 and 2 above.

5.2.4 POWER FUSE BLOWING

1) Momentary low AC line or one phase missing due to:

   a) AC power system protective circuitry or other machine inrush loading. This can only be found by carefully monitoring AC voltage during operation.

   b) Excessive AC line impedance or poor connection on one phase. AC line voltages should not drop more than 10% maximum when drive is supplying current equal to the current limits setting. Check with tester or meter at J3-6 and 7 relative to J3-1.

2) Drive overspeeding due to runaway or oscillation. See below for overspeed correction. Reduce rate gain if oscillations exist.

3) Drive jam or friction causing sustained overcurrent. Check armature current on the tester while the drive is running.

4) SCR shorts are uncommon but may occur. TURN AC POWER OFF and check all 6 dual SCR packages by measuring resistance with DVM between the two power connections to each device. Measurements can be made to screws connecting SCR interface boards to each device. Measure with both polarities, all resistances should exceed 200 K ohms after initial surge due to circuit capacitance.

5) SCR misfire may cause tripout when regenerating at high currents. An SCR misfire is one or more SCRs not firing. Check all gate connectors where plugged into Firing Board and SCR Interface Boards. Possible misfires are most easily and safely monitored by observing armature current with an oscilloscope connected to J3-13 and common at J3-20. Check for missing current pulses in both forward and reverse directions since different SCRs are used for the two directions of current output.

6) Faults in firing board turnaround or pulse logic may cause tripout. Check feedback board per 5.2.7 (1). If OK,replace firing board first, then control board.

5.2.5 TACH LOSS/OVERSPEED INDICATION

1) An open armature circuit will cause this indication with no motor motion within a few seconds after ENABLE is applied. Check armature circuit fuse, contactor and armature circuit wiring.

2) A missing tach signal will cause this indication with tripout at about half speed. Check tach coupling, wiring and tach output voltage for notches due to faulty connections or commutator.

3) Reversed tach polarity will cause this indication with tripout at the OVERSPEED setting. Proper tach polarity and scale factor causes same polarity and approximately equal voltages on ARM VOLTS and TACH outputs. The tester is connected to J3-18 and 19. Tester voltages are read when motor shaft is rotated with field on.

4) Motor speed over OVERSPEED setting will cause tripout with this indication. DO NOT set OVERSPEED setting to allow more than 110% of rated armature volts. 110% armature volts corresponds to 110% meter indication on the tester, or 8.8V at J3-18.

5.2.6 FIELD LOSS INDICATION

Loss of field current will cause this indication before drive is enabled on. Check motor field and field supply for faulty connections or blown fuses.

5.2.7 OVERCURRENT (IOC) TRIPOUT

1) An unplugged connector to the Feedback Board will cause this indication. Before enabling drive ON, check that connectors are plugged in.

2) A failed Feedback Board will cause this same indication. Check ARM CURR with tester at J3-13 with control power applied but ENABLE off. Voltage should not exceed ±30 mv maximum on TP2 relative to TP1 measured with DVM. Replace feedback board if required. **CAUTION:** Wiring of replacement feedback board must have same number of turns and polarity as original. Wire from the SCRs goes down through the transducer and from the bottom side to A2.

3) Instantaneous overcurrent (IOC) setting may be too low. Normal setting of R49 is tester IOC trip voltage equal to or greater than tester CURR LIMIT voltage. If using a DVM, J3-9 to J3-20 is equal to or greater than J3-4 to J3-20. See setup sheet for recommended settings.

4) Conditions which may cause power fuse blowing often are detected by the IOC protection. Troubleshoot per 5.2.4 above.

5.2.8 **TURNAROUND FAULTS** (DRIVE FAILS TO RUN IN BOTH DIRECTIONS OR ACCELS BUT WILL NOT DECEL)

1) Check ARM CURRENT (J3-13) with power ON and ENABLE OFF. Voltage must be less than ±80 mv or turn-around problems will occur. If necessary, trim offset or replace Feedback Board per 5.2.7 (1).

2) Check both ENABLE inputs to be sure external circuit isn't preventing proper ENABLE in one direction.

3) Replace Firing Board.

5.2.9 **CONTACTOR WILL NOT CLOSE (For Drives That Have Output Contactor)**

1) See 5.2.1 if READY light is OFF.

2) Check start-stop circuit wiring and 120 VAC control voltage.

3) Check RDY relay when READY light is ON, it should then be closed. If not, Control Board READY output or wiring is faulty.

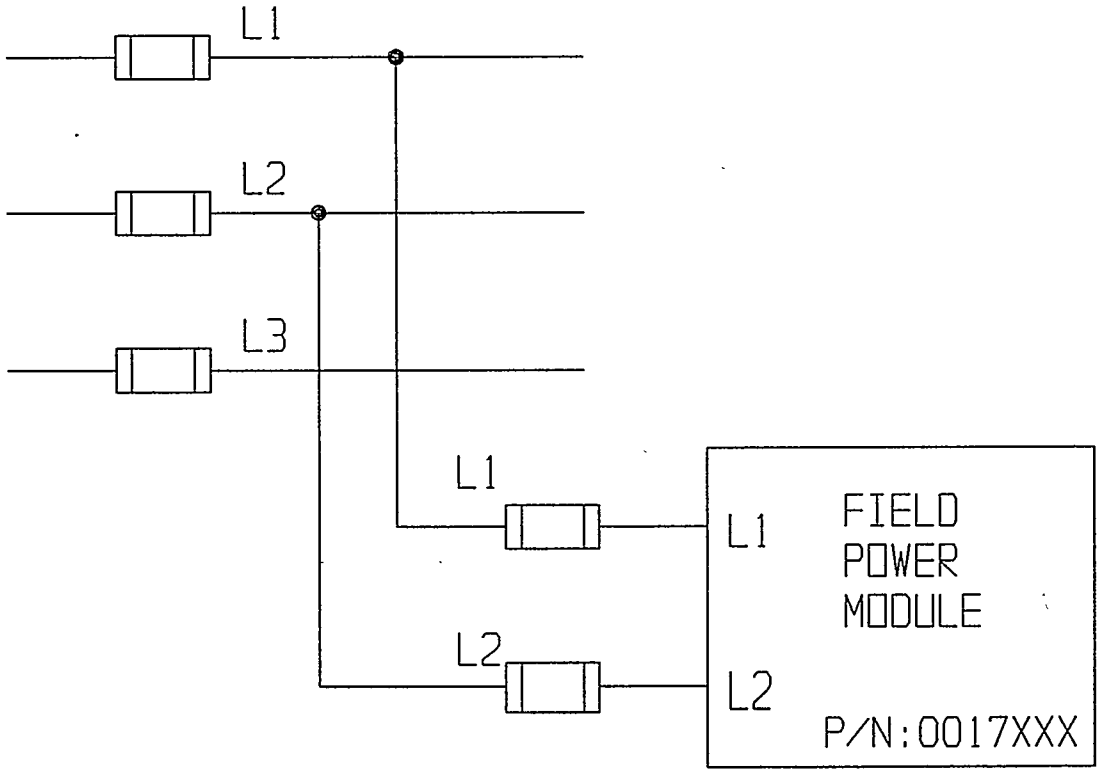
6.0 **FUSE LIST** (DRIVE MODULE 0164921)

QTY	RATING	SWEO PN	COMMER. EQUIV.	REF DES.
2	20 A 600 VAC	4339020	BUSSMAN KTK 20	A10F1, A10F2
3	1/10A 500 VAC	4340100	BUSSMAN FNQ 1/10 OR LITTLEFUSE FLQ 1/10	F1-F3

7.0 **DRAWINGS (1131)**

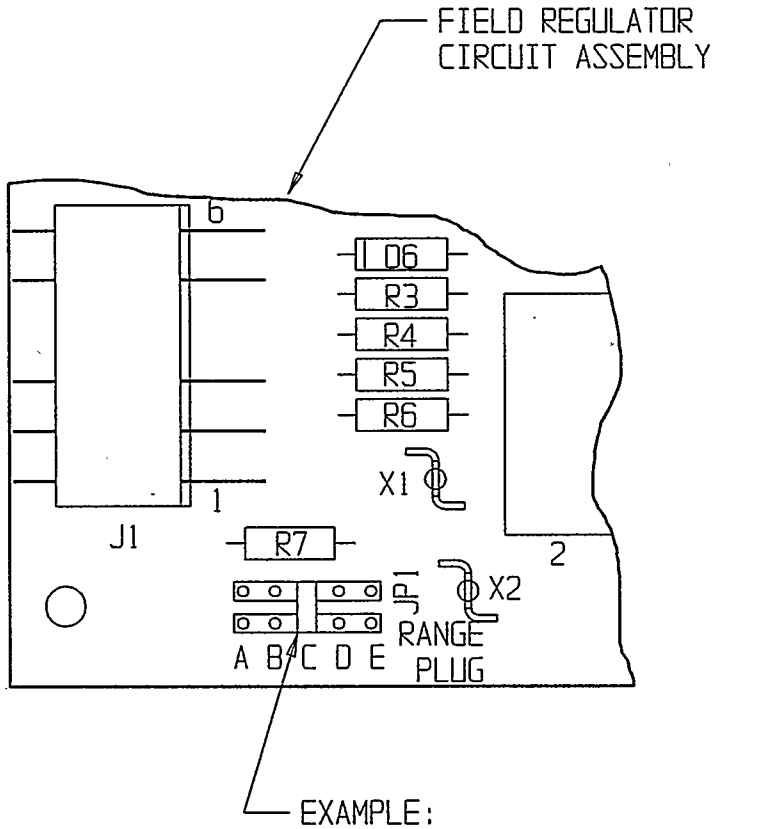
SK0001	SKETCH A - Field Supply Connection Diagram
SK0031	Field Regulator Current Range Adjustment (15A)
_____	Model 840E Data Sheet
_____	Tester Data Sheet
SU 1015	Control Board Setup Sheet
PL0164921	Drive Module Parts List
PL1164903	Power Base Parts List
PL0033625	Control Board Parts List
0035E	Schematic - Control Board, Field Regulator (2 sheets)
0078	Block Diagram - Regenerative DC Drive
0200	Schematic - Regenerative DC Drive Power Assembly (3-LEAD)
0221	Schematic - Regenerative DC Drive Power Assembly (6-LEAD)
0728	Schematic - 15 Amp Multi-Rated Field Power Module
B-0004	Fused Elevator Connections
1240	Impedance Protected Elevator Connections

STANDARD FIELD CONNECTION



SKETCH "A"

SK0001



RANGE PLUG POSITION	A	B	C	D	E
MAX. FIELD CURRENT RATING AMPS	15	10	5	2.5	1.5

FIELD REGULATOR CURRENT RANGE ADJUSTMENT

P/N 0017020
P/N 0017320

SK0031

SU 1015 CONTROL BOARD SETUP SHEET

DRIVE MODULE PN 0164921 CONTROL BOARD 0033625

MOTOR: 42.0 HP, 400V, 94.0A ARM, 184/184 RPM; 166V, 10.30 A Fld, TACH: 1000.0V/KRPM

Speed Scaling for 8.0 VDC SPEED CMD-MOTOR @ 184 RPM, TACH 184VDC

Armature Current Scaling 36.0 A/V IOC Scaling 54 A/V

FIELD POWER MODULE 0017020 FIELD CURRENT SCALING -4.0A/V

	CONTROLLER POT ADJUSTMENT	**TESTER SET POSITION**	**TESTER OUTPUT DVM READING-VDC**
1.	MAX SPEED*	SPEED CMD With J1-5 to J1-6 = 10.0 VDC & Jumper J1-9 TO J1-10	8.0
2.	OVERSPEED	OSPD TRIP	9.00
3.	RATE GAIN** Set CURRENT LIMIT	CURR LIMIT	+ 1.00
	Then RATE GAIN	GAIN SET With G/F SET Pushed	Field Set
4.	NULL FORCING** Set CURRENT LIMIT	CURR LIMIT	+ 0.9
	Then NULL FORCING	NULL FORCE With G/F SET Pushed	- 11.5
5.	MAX ARM VOLTS# Field weaken speed range disabled. Set MAX ARM VOLTS fully CW.		
6.	CURRENT LIMIT	CURR LIMIT	+ 6.01
7.	IOC	IOC TRIP	+ 5.96
8.	MAX FIELD CURRENT Set 0017020 RANGE PLUG JUMPER JP1 TO POSITION		"B"
	10.0 AMP SETTING	FIELD/IR (cold motor, Drive ON)	-2.58

* MAX SPEED may require trimming in the field.
** CURRENT LIMIT must be reset per 6 after adjustments 3 and 4.

Requested By: SWEO

Assembly: 0164921 Rev: Type: INTERMED ASSY.
CONTRLR, 843-1136EIF Ref: Obsolete:
SCR REGEN CONTROLLER, PNL MTG, 400 VAC,
42 HP, 184/184 RPM, 400VDC, 94ADC ARM;
138VDC RUN (RUN 100%, FORCE 120%, STAND
50%), 10.3ADC, 10.3 OHM FIELD; 184 VDC
@ 184 RPM

Last Revised By: SWE
Last Revised On: 7/20/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
	0033625 CONTROL BOARD, FR		1.000	EA	A1	Y	
	6020008 CONN,5MM,VERT, 8 POS		1.000	EA	P2		
	6020012 CONN,5MM,VERT,12 POS		1.000	EA	P1		
	'SU1015 SET UP SHEET		1.000	EA			
1	1164903 POWER BASE, SCR REGEN	A	1.000	EA	;843-1136EIF	Y	

Requested By: SWEO

Assembly: 1164903 Rev: A Type: INTERMED ASSY.
POWER BASE, SCR REGEN Ref: 6/24/92 Obsolete:
MODEL 843-1136E6F & EIF, PANEL MTG,
480V, 130A SCRS, 18 IN. HEATSINK

Last Revised By: SWE
Last Revised On: 7/22/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
1	1002311 HEAT SINK 18 INCH		1.000	EA			
2	1002371 PANEL MTG CHASSIS		1.000	EA	;MODIFY TO ACCEPT ;MOUNTING OF TERM. ;STRIP		
4	6990102 THREAD LOCKER		.010	OZ			
10	1003011 BRACKET, LOWER BLR		1.000	EA			
11	1000321 HINGE-CKT BD MTG		1.000	EA			
12	1000151 ATTACH ANGLE		1.000	EA			
13	1002461 RETAINER FAN BRACKET		1.000	EA			
14	1001571 FAN BRACKET		1.000	EA			
15	6950021 FAN 100CFM, 230V, 50/60 HZ 4IN		2.000	EA			
16	6950400 FINGER GUARD, 4 IN.		2.000	EA			
17	6950401 CORD & PLUG 24 INCH		2.000	EA			
18	1002291 SUPPORT BRACKET		1.000	EA			
19	1002292 SUPPORT BRACKET		1.000	EA			
24	6910640 THERMAL PAD, LG DIODE/SCR		6.000	EA	Q1-Q6		

Requested By: SWEO

Assembly: 1164903 Rev: A Type: INTERMED ASSY.
POWER BASE, SCR REGEN Ref: 6/24/92 Obsolete:

Last Revised By: SWE
Last Revised On: 7/22/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
25	3413114 SCR-DUAL 130A 1400V		6.000	EA	Q1-Q6; IF OLD SCR ;WITH CAPTIVE NUT ;ASSY IS USED THEN ;SUBSTITUTE SUPP. ;BRKT #1001591 FOR ;-2 & 6502219 STAND- ;OFF FOR 6502217 & ;DO NOT USE INDUCTOR ;SHIM #1004171. ;NOTE ALL SUBS. ON ;TIMESHEET.		
26	2050005 INDUCTOR DI/DT 115A		6.000	EA	L1-L6 ;USE INDUCTOR ;SHIM #1004171 IF ;INDUCTOR HAS ;INFLEXIBLE LEAD.		
27	1001591 SUPPORT BRKT		6.000	EA			
30	1002321 BUS BAR, 150HP CONT		2.000	EA			
32	6502219 STANDOFF 4-40X1 3/16		6.000	EA	;MOUNT TO SUPP. BRKT ;1001591.		
34	6390005 HEX BOLT 1/4-20 X 5/8		6.000	EA			
35	6420014 LOCK MED SPLIT 1/4		6.000	EA			
36	6400514 NUT HEX FIN 1/4-20		6.000	EA			
40	1005862 CABLE, FLD REG		1.000	EA			
60	1000693 CABLE ASSY, ARM VOLTS		1.000	EA			
62	0008092 SCR INTERFC ASSY, 460V		6.000	EA	A4-A9		
63	6109926 MOUNTING CHANNEL		.680	FT			

Requested By: SWEO

Assembly: 1164903 Rev: A Type: INTERMED ASSY.
POWER BASE, SCR REGEN Ref: 6/24/92 Obsolete:

Last Revised By: SWE
Last Revised On: 7/22/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
64	6109920 END BARRIER, CA/CD		1.000	EA			
65	6109910 TERM BLOCK, SEC. 60A		3.000	EA			
66	6109912 TERM BLOCK, SEC. 100A		6.000	EA	R1-R6		
67	6109913 TERM BLOCK, SEC. 165A		2.000	EA	A1,A2		
68	6109921 END BARRIER, CE		1.000	EA			
69	6109925 END ANCHOR		2.000	EA			
70	1002283 SUPPORT PLATE 18"		1.000	EA			
72	2040012 TRANSF REF 300/380/415 VAC		2.000	EA	T1,T2 ;CONNECT FOR 380V.		
73	1005791 INSULATOR,REF TRANS		2.000	EA			
74	4399923 FUSE BLK 3 POLE		1.000	EA			
76	1005972 CABLE, LINE TO TB1 #6		3.000	EA			
77	1005983 CABLE, ARM #1 4 GA.		1.000	EA		Y	
78	1005984 CABLE, ARM #2 4 GA.		1.000	EA	;1 TURN THRU A3.	Y	
79	1005971 CABLE, LINE TO TB1 #6		3.000	EA			
80	1002811 CABLE ASSY, FUSE BLK		1.000	EA			

Requested By: SWEO

Assembly: 1164903 Rev: A Type: INTERMED ASSY.
POWER BASE, SCR REGEN Ref: 6/24/92 Obsolete:

Last Revised By: SWE
Last Revised On: 7/22/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
81	1002804 CABLE ASSY,SIG & REF		1.000	EA			
83	1004261 SUPPORT, CURRNT XDCR		1.000	EA			
84	1002271 INSULATOR-CURR TRANS		1.000	EA			
85	6310212 SCREW F/H 4-40 X 3/4		4.000	EA			
86	6401304 NUT "K" TYPE 4-40		8.000	EA			
87	0001059 FB BOARD, 400AT, 380V		1.000	EA		Y	
100	6310708 SCREW F/H 10-32 X1/2		4.000	EA			
105	1002792 CABLE ASSY,FIRING		1.000	EA			
111	4340100 FUSE 1/10A 500VAC		3.000	EA	F1-F3		
148	6310408 SCREW F/H 6-32 X 1/2		4.000	EA			
200	0000252 FIRING BOARD		1.000	EA	A2	Y	
300	6911430 TIE ANCHOR 8 SCREW		2.000	EA			

Requested By: SWEO

Assembly: 0033625 Rev: Type: INTERMED ASSY.
CONTROL BOARD, FR Ref: Obsolete:
J2-1: ON OUTPUT, LOW = ON
J2-2: 5% SPEED, LOW = SLOW SPD
J1-11: RUN FIELD SETTING
QUICK ON, FIELD ECON TO 42% TYPICAL

Last Revised By: SWE
Last Revised On: 7/31/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
	1000001 NOT USED		27.000	EA	C17,C43,D41,D68,R24, R53,R59,R61,R62,R66, R72,R75,R85,R100, R110,R122,R123,R126, R138,R139,R148,R153, R180,R183,R222,RA, RB		
	1000002 REMOVE,NOT USED		2.000	EA	;R137 ;J1-2, INSULATE FOR ;HIGH VOLTAGE.		
	1000003 REPLACE STD PART		7.000	EA	;C46,R31,R113,R114, ;R120,R144,R177.		
	1000004 CUT TRACE		3.000	EA	;CIRCUIT SIDE AT ;C8A + PAD. ;CIRCUIT SIDE AT ;BOTTOM (J2-1 END) ;OF R218. ;CIRCUIT SIDE D63K ;TO R219.		
	1000005 ADD ADDITIONAL COMP.		1.000	EA	;R905 ;CIRCUIT SIDE D63K ;TO R219.		
	1000006 INSULATED JUMPER		3.000	EA	;W2,R126 @ U14-6 END ;TO D41 CATHODE. ;W3;C8A + TO D16 ;ANODE. ;W4;J1-11 TO BOTTOM ;(OLD J2-1 END) OF ;R218.		
	1000008 SELECT AT TEST		3.000	EA	R103,R146,R228 ;R103,COMPNSATE CMMR ;R146, SAT @U17-3=0V ;R228, 95 VDC ON 230 ;VAC		

Requested By: SWEO

Assembly: 0033625 Rev: Type: INTERMED ASSY.
CONTROL BOARD, FR Ref: Obsolete:

Last Revised By: SWE
Last Revised On: 7/31/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
	3214148 DIODE-SWITCHING		2.000	EA	D62,R218 ;R218 CATHODE TOWARD ;U20		
	3220961 ZENER 10V 5% 400MW		1.000	EA	D57		
	3220963 ZENER 12V 5% 400MW		2.000	EA	D45,D46		
	7000310 CAP,MYL, .01 , 100		1.000	EA	C16		
	7000333 CAP,MYL, .033 , 100		1.000	EA	C25		
	7000347 CAP,MYL, .047 , 100		1.000	EA	C31		
	7000410 CAP,MYL, .10 , 100		1.000	EA	C27		
	7000422 CAP,MYL, .22 , 100		1.000	EA	C46		
	7080520 CAP,MYL, 2. , 100		1.000	EA	C901 ;INSTALL C901 IN ;PARALLEL WITH C18.		
	7080540 CAP,MYL, 4. , 100		1.000	EA	C18		
	7100310 CAP,CER, .01 , 100		2.000	EA	C29,C36		
	7504522 CAP,TANT, 2.2, 35V		1.000	EA	C47		
	8000215 RES,CC, 1.5K,1/4W		1.000	EA	R905 ;D63K TO R219 ;CIRCUIT SIDE.		
	8000233 RES,CC, 3.3K,1/4W		1.000	EA	R136		

Requested By: SWEO

Assembly: 0033625 Rev: Type: INTERMED ASSY.
CONTROL BOARD, FR Ref: Obsolete:

Last Revised By: SWE
Last Revised On: 7/31/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
	8000433 RES,CC, 330. K,1/4W		1.000	EA	R217		
	810*000 ZERO OHM JUMPER		5.000	EA	D53,R113,R114,R121, R125		
	8101100 RES,MF, 1.00K 1/10W		1.000	EA	R177		
	8101887 RES,MF, 8.87K 1/10W		1.000	EA	R26		
	8102100 RES,MF, 10.0 K 1/10W		1.000	EA	R213		
	8102169 RES,MF, 16.9 K1/10W		1.000	EA	R229		
	8102200 RES,MF, 20.0 K 1/10W		1.000	EA	R120		
	8102453 RES,MF, 45.3 K 1/10W		1.000	EA	R147		
	8102536 RES,MF, 53.6 K 1/10W		1.000	EA	R145		
	8102634 RES,MF, 63.4 K 1/10W		1.000	EA	R903 ;R903 IN SERIES WITH ;R111.		
	8102649 RES,MF, 64.9 K 1/10W		1.000	EA	R67		
	8102665 RES,MF, 66.5K 1/10W		3.000	EA	R31,R109,R111, ;9MS TOTAL DELAY		
	8102715 RES,MF, 71.5 K 1/10W		1.000	EA	R106		
	8102825 RES,MF, 82.5 K 1/10W		1.000	EA	R18		
	8103169 RES,MF, 169. K 1/10W		1.000	EA	R171		

Requested By: SWEO

Assembly: 0033625 Rev: Type: INTERMED ASSY.
CONTROL BOARD, FR Ref: Obsolete:

Last Revised By: SWE
Last Revised On: 7/31/92

Seq	Part Number / Description	Rev	Quant	Um	Comment	P	Se
	8103280 RES,MF, 280. K 1/10W		1.000	EA	R144		
	8103383 RES,MF, 383. K 1/10W		1.000	EA	R92		
	8103442 RES,MF, 442. K 1/10W		1.000	EA	R112		
	8200250 POT,TRIM,SQ,1T 5K		2.000	EA	R197,R198		
1	1000333 FR CONT BD SUB-ASSY		1.000	EA			