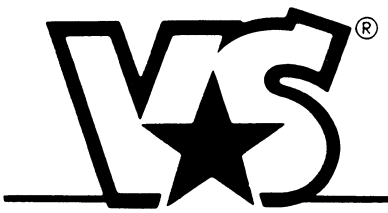
Regenerative
FlexPak Plus
(S2R)
D-C V★S Drive
and Modification Kits



DRIVES

Instruction Manual D-3936-4

December, 1991

RELIANCE ELECTRIC

TABLE OF CONTENTS

INDEX OF FIGURES

INDEX OF TABLES

SECTION 1
INTRODUCTION

1.0 General — This manual familiarizes the user with the Regenerative FlexPak™ Plus (S2R) D-C V★S® drive controller. (Refer to Figure 1.1.) It describes assembly and installation procedures, gives a general overview of operation, and contains information on trouble-shooting, maintenance, the ordering of spare parts, and specifications.

The manual should be read **before** performing installation or startup activities. Also, there are certain fundamental warnings which must be kept in mind **at all times.** These are:

DANGER
THE DRIVE SYSTEM SHOULD BE INSTALLED, ADJUSTED AND SERVICED BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF ALL EQUIPMENT IN THE SYSTEM. PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY OCCUR IF INDIVIDUALS ARE NOT FAMILIAR WITH THE HAZARDS RESULTING FROM IMPROPER OPERATION.

DANGER
CONTROLLER EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE POWER UNIT IN THE REGENERATIVE FLEXPAK PLUS (S2R) CONTROLLER. THUS, A-C POWER MUST BE REMOVED FROM THE UNIT BEFORE IT IS SAFE TO TOUCH INTERNAL PARTS OF THE CONTROLLER. PERSONAL INJURY MAY RESULT UNLESS POWER IS REMOVED.

WARNING
DO NOT OPERATE THE REGENERATIVE FLEXPAK PLUS (S2R) CONTROLLER ON POWER SUPPLIES WITH AVAILABLE SHORT-CIRCUIT CURRENTS IN EXCESS OF 5000 AMPERES. DAMAGE TO EQUIPMENT AND PERSONAL INJURY MAY OCCUR.

WARNING
THE NATIONAL ELECTRICAL CODE AND CANADIAN ELECTRICAL CODE REQUIRE THAT AN APPROVED FUSED DISCONNECT SWITCH OR CIRCUIT BREAKER BE USED AHEAD OF THE CONTROLLER AND POWER TRANSFORMER (IF USED) ON THE INCOMING A-C LINE. PERSONAL INJURY MAY RESULT IF AN EASILY ACCESSIBLE MEANS OF LINE VOLTAGE DISCONNECTION IS NOT PROVIDED.

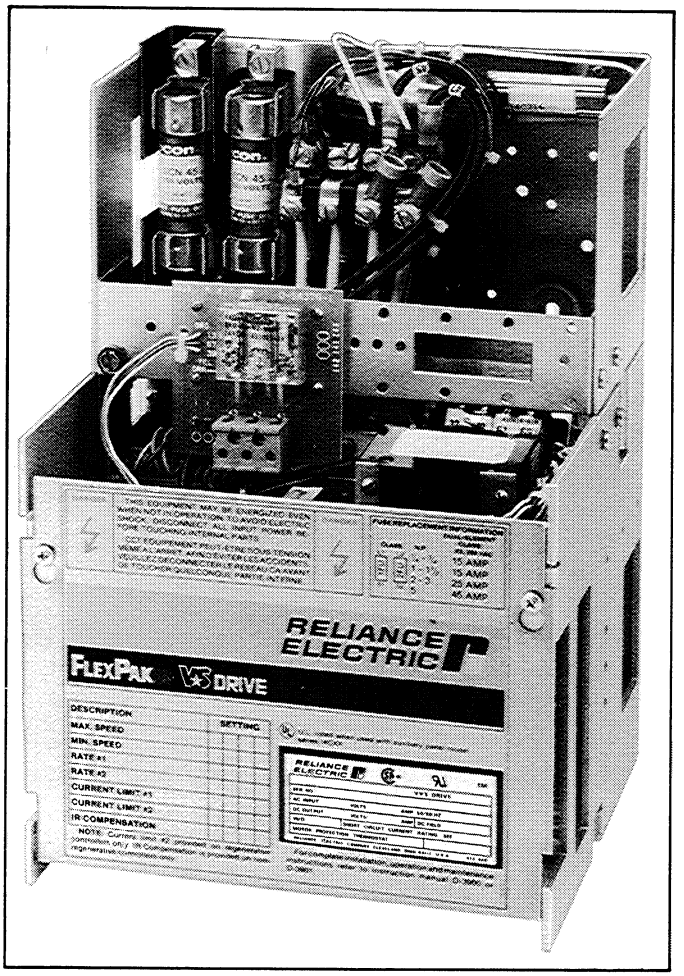


Figure 1.1. Typical Regenerative FlexPak Plus (S2R) Controller.

SECTION 2
GENERAL CONTROLLER INFORMATION

2.0 General — The Regenerative FlexPak Plus (S2R) D-C V★S drive controller may be applied to single-phase D-C drive applications with ratings within the following ranges:

- From ¼ to ¾ hp with a 115 VAC, 50/60 Hz input voltage
- From ½ to 5 hp with a 230 VAC, 50/60 Hz input voltage

The controller provides power-conversion and control circuits which convert the A-C line voltage into adjustable D-C voltage in order to effectively control the drive motor.

The Regenerative FlexPak Plus (S2R) controller is provided, as standard, in a chassis type configuration for panel mounting within a larger electrical enclosure. The Remote Operator Controls may then be placed on the larger enclosure's face or some distance away.

Optional Modification Kits conveniently expand the capability of the Regenerative FlexPak Plus (S2R) drive controller. Refer to Paragraph 2.3 and Figure 2.1.

The Regenerative FlexPak Plus (S2R) controller is U.L. Listed. The controller's features are summarized in Table 2.A. Refer to Table 2.D for the controller model numbers.

2.1 Operator's Controls — For proper operation of the Regenerative FlexPak Plus (S2R) controller, it is necessary to provide Remote Operator's Controls. Reliance Electric offers a wide variety of operator control stations which may include the following devices:

- SPEED control potentiometer (5K)
- RUN/JOG selector switch
- FORWARD/REVERSE selector switch
- START/STOP selector switch (pushbuttons or special)

2.2 D-C Drive Motors — Reliance Electric offers a complete power-matched drive system for the controller and the application. Thus, the choice of Reliance Electric motors assures optimum performance and unmatched single-source responsibility.

2.3 Modification Kits — The basic capability of the controller can be quickly and conveniently extended with the use of a variety of optional Modification Kits. (Refer to Figure 2.1.) These Modification Kits are:

- Process Line
- Position Loop
- Dynamic Braking
- Auxiliary M Contactor

Complete descriptions of each Kit are given in Section 5. Refer also to Table 5.A.

2.4 Specifications — The more important specifications for the Regenerative FlexPak Plus (S2R) controller are listed in Table 2.C. Refer also to Table 2.D where other ratings are indicated in relation to D-C motors of specific horsepower.

2.4.1 Line Frequency — The Regenerative FlexPak Plus (S2R) controller is able to operate without modification from a single-phase power source having a frequency range from 48 to 62 Hz. However, for optimum 50-Hz operation, it is recommended that two resistors be removed from the Regulator Module. (Complete details are given at Paragraph 3.6.) If the resistors are not removed, there is a slight loss of performance.

2.4.2 Voltage Tolerance — The Regenerative FlexPak Plus (S2R) controller delivers output current and voltage, as listed in Table 2.D. It will also operate within these controller specifications even with incoming line voltage at ±10% of nominal.

2.4.3 Line Impedance Requirements — The Regenerative FlexPak Plus (S2R) controller must be connected to a short-circuit protection system designed to operate on plant power supplies with maximum permissible available symmetrical RMS fault currents of 5000 amperes. (Refer to Table 2.D.)

WARNING
DO NOT OPERATE THE REGENERATIVE FLEXPAK PLUS (S2R) CONTROLLER ON POWER SUPPLIES WITH AVAILABLE SHORT-CIRCUIT CURRENTS IN EXCESS OF 5000 AMPERES. DAMAGE TO EQUIPMENT AND PERSONAL INJURY MAY OCCUR.

2.4.4 Relay Control Circuit — The regulator board is set up for use with main contactors having a coil resistance greater than or equal to 100 ohms. The control logic sequences the contactor and the control relay on the regulator so that current flow thru the main contactor is never broken in normal operation by the contacts. Refer to Figures 6.1 and 6.2.

The controller is supplied with an M contactor. An M contactor is required to provide positive power disconnect.

2.4.5 A-C Line Fuse Requirements — A-C line protection is provided with the Regenerative FlexPak Plus (S2R) controller. Refer to Table 2.B for proper fuse sizing.

Table 2.B. A-C line fuse requirements.

HP	A-C Line Volts	Dual Element Class K5, RK5 250 VAC Fuse	
		Quantity	Amp
¼-¾	115	1①	15
½-1½	230	2	15
2-3	230	2	25
5	230	2	45

① Install fuse in input line L1 (hot line).

Table 2.A. Summary of Regenerative FlexPak Plus (S2R) controller features.

Category	Feature
Controller Functions	• START/STOP • RUN/JOG • FORWARD/REVERSE • Speed selection (up to 100%) • Full four-quadrant operation with coast-to-rest on stop command standard. (Dynamic braking available as option.) • 20:1 controlled-speed range by means of armature voltage control. • Armature loop contactor removes power to drive motor. • Isolated armature voltage and current feedback decouples armature power from operator devices and provides additional noise immunity. • With tachometers specified in this manual, 0.5% or 1.0% speed regulation with a 95% load change. • Operates and delivers rated output speed with specified regulation tolerance limits even with A-C line variations of ±10% of nominal rated input voltage.
Speed Regulation	• Jumper reconnectable regulator circuits which allow armature (A) or tachometer feedback (T) regulation. • With voltage regulation, 3 to 5% speed regulation with 95% load change. • With tachometer specified, 1% speed regulation with a 95% load change. (Tachometers are 5PY or RE-020 D-C tachometer.) • With tachometer specified, 0.5% speed regulation with 95% load change. (Tachometer is BC42.)
User Adjustments	• Separately adjustable forward and reverse current limits (10 to 150% of full-load current). • Adjustable maximum speed (50 to 100% of base motor speed). Refer to Paragraph 4.3.2. • Adjustable minimum speed (up to 50% of base motor speed). Refer to Paragraph 4.3.3. • Separately adjustable linear acceleration and deceleration rates (0.5 to 30 sec.).
Safety	• Control circuitry guards against automatic restarting of equipment after resumption of interrupted A-C incoming power. • Regulator and Operator's Controls isolated from A-C line for personnel protection. • Armature voltage and current feedback isolated to assure separation of power and regulator circuits. • Motor thermostat protection (all horsepower ratings).
Hardware	• Conveniently located screw terminal connections for incoming A-C power allow easy cable entry and connection. • A-C line fuses protect Power Cubes from armature short circuit and power relays provide positive power disconnect. • Circuit breaker in armature circuit to prevent power module failure due to inverter fault. • Protection from momentary surges on A-C line and from D-C load transients. • D-C motor contactor for positive motor disconnection. • Contactor sequencing so that contactor closes and opens at zero armature current.

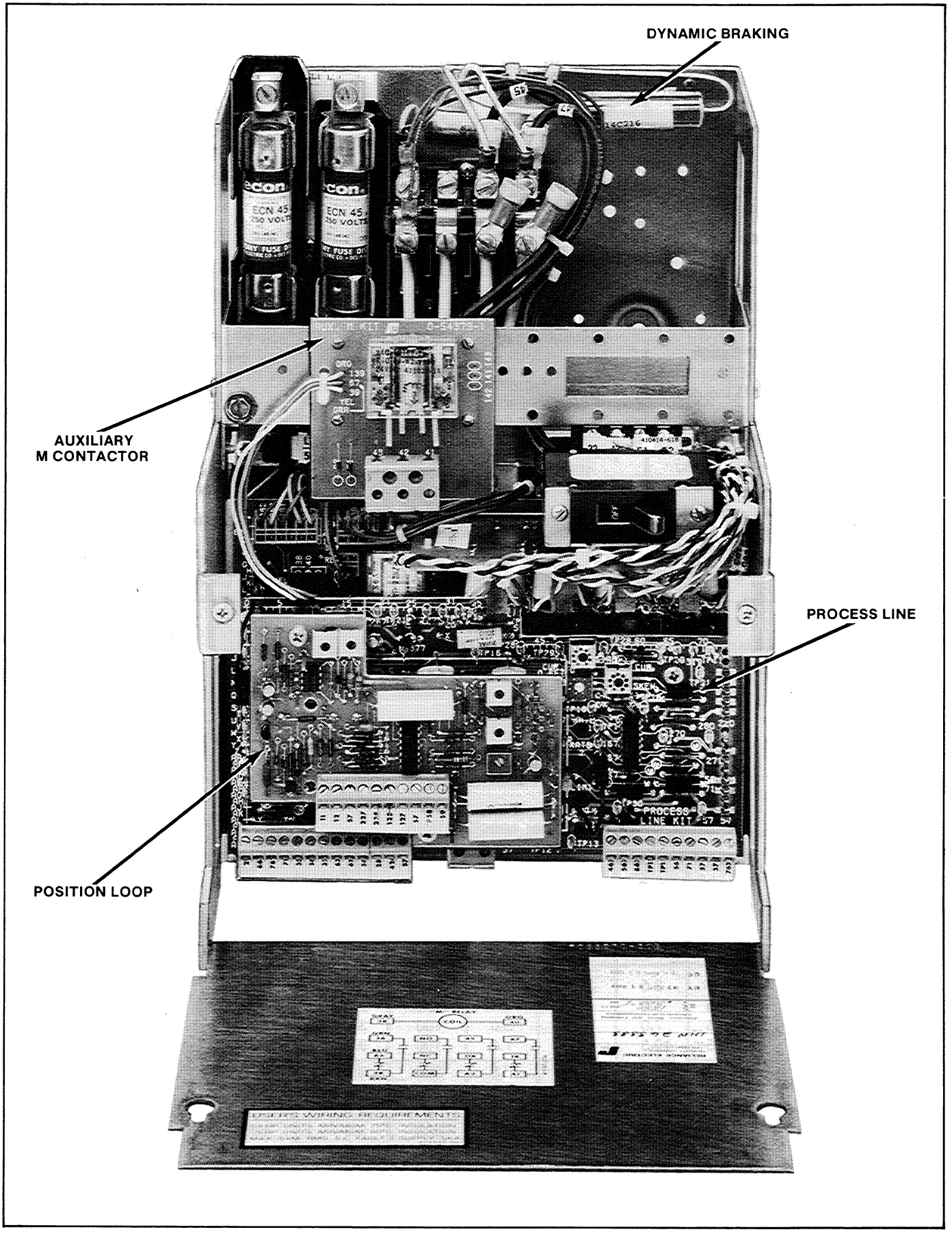


Figure 2.1. Modification Kit locations.

Table 2.C. Specifications.

A-C Line Input Voltage 115/230 VAC (nominal) single-phase only	**Operator Speed Adjustment** Infinitely adjustable with optional control pot (Up to 100% of base speed)	**Displacement Power Factor** 68% (typical) ②
Line Voltage Variation ±10% of nominal	**Current Limit** Factory shipped: 150% of full load User adjustable: 10 to 150% of full load (user separately adjustable positive and negative)	**Transient Protection** MOV, Output RC Circuit, and Thyristor RC Circuits (4)
A-C Line Frequency Single Phase, 50/60 Hz (Jumper selectable) ①	**Regulation (with 95% load change)** 3 to 5% with voltage feedback 1.0% with specified tachometer feedback 0.5% with specified tachometer feedback	**Controller Service Factor** 1.0
Line Frequency Range 48 to 62 Hz	**Minimum Load for Stable Operation** 5%	**Duty** Continuous
Output Voltages **(armature and field)** See Table 2.D	**Acceleration/Deceleration Rates** 0.5 to 30 sec. linear time (user-adjusted separately)	**Ambient Temperature** **(storage and operational)** 0° to 55° C (32° to 131° F)
Controller-Drive HP Range ¼-¾ hp (with 115 VAC input) ½-5 hp (with 230 VAC input)	**Armature Circuit Overload Capacity** 150% of armature current rating for 1 minute (max.)	**Relative Humidity** **(storage and operational)** 5 to 95% (without condensation)
Direction Control Forward/Reverse	**Efficiency (rated speed/rated load)** Controller only: 97% Complete drive including motor: 85% (typical) ②	**Operational Altitude** To 3300 ft (1000 m) above sea level without derating
Maximum Speed Adjustment 50 to 100% of base motor speed		**Controller Weight (approx.)** 11.0 lb (4.99 kg)
Minimum Speed Adjustment Up to 50% of base motor speed		**Controller Dimensions** **(LWD)** 11.97 x 8.37 x 7.93 inches (305 x 213 x 201 mm)
Controllable Speed Range 20:1		

① See Paragraph 3.6.

② Typical percent shown. Exact figure dependent on motor base speed and frame size.

Table 2.D. D-C motor, controller, and transformer specifications.

Controller Model Numbers	HP	VAC	A-C Amps (RMS) ①	D-C Arm. (Volts)	D-C Arm. Amps (Avg.)	Field Supply		Power Supply Capacity ②	Transformer	
						D-C Field Volts	Amp. Max.		Maximum kVA Per Phase	Full Load kVA
14C65	¼	115	3.5	90	2.5	100	3.0	5000	40	0.75
	⅓	115	5.2	90	3.7	100	3.0	5000	40	0.75
	½	115	7.0	90	5.0	100	3.0	5000	40	1.0
	¾	115	10.5	90	7.5	100	3.0	5000	40	1.5
14C66	½	230	3.5	180	2.5	200	3.0	5000	40	1.0
	¾	230	5.2	180	3.7	200	3.0	5000	40	1.5
	1	230	7.0	180	5.0	200	3.0	5000	40	2.0
	1½	230	10.5	180	7.5	200	3.0	5000	40	3.0
14C67	2	230	14.0	180	10.0	200	3.0	5000	40	5.0
	3	230	21.0	180	15.0	200	3.0	5000	40	5.0
14C68	5	230	35.0	180	25.0	200	3.0	5000	40	10.0

① Does not include current required for field supply.

② Maximum permissible available symmetrical RMS fault current with NEC or CEC external approved disconnect.

SECTION 3
INSTALLATION

3.0 General — This Section outlines the procedures that are to be followed in order to properly install a Regenerative FlexPak Plus (S2R) controller.

The D-C motor should be installed and wired in accordance with installation instructions supplied with each drive.

There are certain general warnings and cautions that should be kept in mind **before** planning begins. They should be considered a general checklist which, if followed, will minimize installation problems and decrease assembly time. As a user aid, they are listed here.

DANGER
THIS UNIT SHOULD BE INSTALLED, ADJUSTED AND SERVICED BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS TYPE OF EQUIPMENT. THEY SHOULD ALSO BE FAMILIAR WITH THE POTENTIAL HAZARDS INVOLVED. IF THIS WARNING IS NOT OBSERVED, PERSONAL INJURY OR EQUIPMENT DAMAGE MAY RESULT.

DANGER
BE ABSOLUTELY CERTAIN THAT A GROUND WIRE FROM THE INCOMING A-C POWER LINE IS PROPERLY CONNECTED TO THE CHASSIS GROUND TERMINAL PROVIDED. WITHOUT PROPER GROUNDING, PERSONAL INJURY MAY OCCUR.

WARNING
THE CONTROLLER REQUIRES A SINGLE-PHASE POWER SUPPLY THAT PROVIDES EITHER 115 VAC OR 230 VAC AT 50/60 HZ. IF CORRECT VOLTAGE IS NOT AVAILABLE, IT WILL BE NECESSARY TO INSTALL A TRANSFORMER BETWEEN THE POWER SUPPLY AND THE CONTROLLER. DO NOT OPERATE THE CONTROLLER ON POWER SUPPLIES WITH AVAILABLE SHORT-CIRCUIT CURRENTS IN EXCESS OF 5000 AMPERES. DAMAGE TO EQUIPMENT AND PERSONAL INJURY MAY OCCUR.

WARNING
THE USER IS RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE AND CANADIAN ELECTRICAL CODE WITH RESPECT TO MOTOR, CONTROLLER AND OPERATOR DEVICE INSTALLATION, WIRING AND STARTUP. THE USER IS ALSO RESPONSIBLE FOR UNDERSTANDING AND APPLYING ALL OTHER APPLICABLE LOCAL CODES WHICH GOVERN SUCH PRACTICES AS WIRING PROTECTION, GROUNDING, DISCONNECTS AND OVERCURRENT PROTECTION.

3.1 Layout Guidelines — This Paragraph lists recommended layout procedures common to all Regenerative FlexPak Plus (S2R) controllers.

Guideline 1 — The Regenerative FlexPak Plus (S2R) controller is designed as a panel-mounted unit. It is to be hung within 10° of vertical with the rear of the Chassis firmly resting against the mounting surface. (**Do not** position the Chassis on a horizontal surface.)

Guideline 2 — It is necessary to leave at least a 2-inch (50 mm) clearance between the top of one controller and the bottom of another controller. This unobstructed area allows for proper air circulation through the heat sink. **Do not** place the controller directly in a corner. Leave at least 8 inches (200 mm) from the top or 6 inches (150 mm) from the bottom of the enclosure. (Refer to Figure 3.1.) Heat builds up at the cabinet's top and may exceed the permissible inside ambient temperature upper limit. At the cabinet's bottom, the unit must be high enough to allow air to flow upwards.

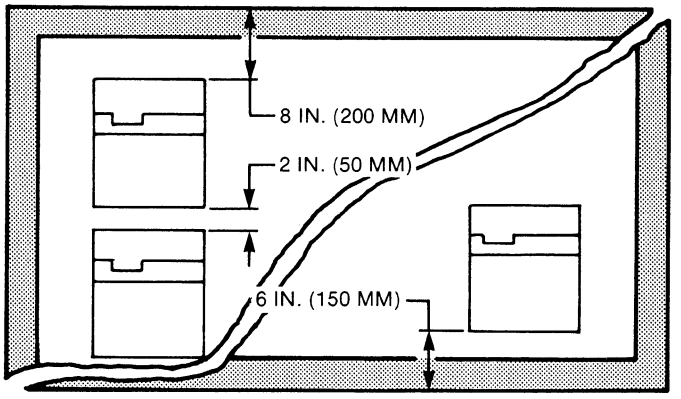


Figure 3.1. Minimum distances for enclosure mounting.

Guideline 3 — The user is responsible for providing ambient temperatures that meet the controller's specifications of 0° to 55° C (32° to 131° F). Relative humidity must be kept between 5 and 95% **without** condensation.

Guideline 4 — Due to the U-shaped panel design of the Regenerative FlexPak Plus (S2R), the controller must be mounted in the vertical position to allow for proper cooling.

The controller is also designed to allow for power wiring to enter from the top and for control and signal wiring to be routed in thru the openings in the sides of the controller or from the bottom. (Refer to Figure 3.2.)

Guideline 5 — **Do not** route the tachometer feedback signal cable, if used, with A-C or D-C control or power wiring. Also use the specified wire for this function. (Refer to Table 3.E.)

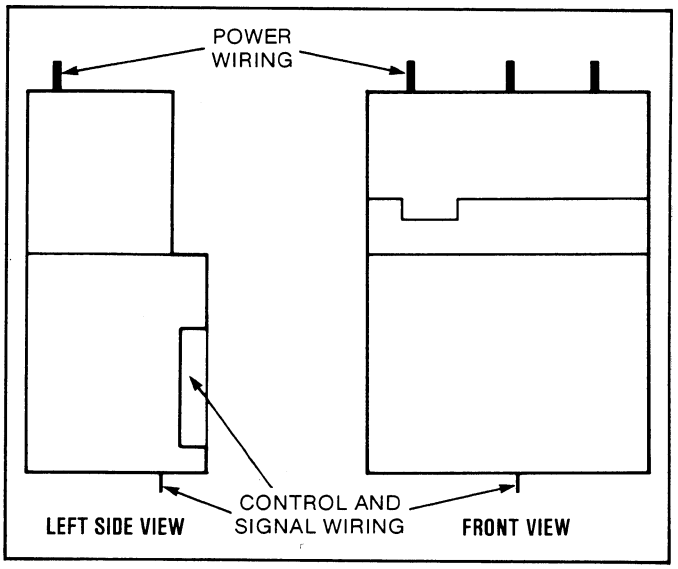


Figure 3.2. Mounting and wiring orientations.

Guideline 6 — Although auto-transformers may step up and step down A-C power supply voltage, they **do not** isolate the drive system from the A-C line. Users should consider using an isolation transformer if the application conditions warrant it.

If an isolation or auto-transformer is used ahead of the controller, the disconnect switch should be placed on the A-C power line between the power source and the transformer primary. Again, use a fused disconnect switch. (**Do not** use a circuit breaker type switch because of the high inrush of transformer equipment.) Refer to Table 3.A for sizes and types.

An isolation transformer is not necessary unless the application conditions require one. However, its use provides distinct advantages. With an isolation transformer:

- Personal injury is guarded against should accidental contact be made with an electrical conductor from the drive.
- A-C power line disturbances, or transients, are minimized by an isolation transformer, thereby reducing or eliminating damage to other solid-state equipment power-conversion components in the controller and other user-equipment on the same A-C line.
- The transformer provides electrical isolation between the A-C power lines and the drive motor. Damaging currents may be eliminated in instances where a D-C output accidentally becomes grounded in a unit where the A-C electrical system is grounded.

For detailed information, refer to Paragraph 3.5.

Guideline 7 — The National Electrical Code and Canadian Electrical Code require that a two-pole, fused disconnect switch be installed on the incoming A-C

Table 3.A. Typical wire and fuse sizes.①

HP	VAC	A-C Power (min. size/insul.)	D-C Armature (min. size/insul.)	D-C Field ② (min. size/insul.)	Disconnect Fuse Size ③ (amps)
¼	115	No. 14 AWG 75° C	No. 14 AWG 75° C	No. 14 AWG 75° C	8
⅓-½	115	No. 14 AWG 75° C	No. 14 AWG 75° C	No. 14 AWG 75° C	15
¾	115	No. 12 AWG 75° C	No. 12 AWG 75° C	No. 14 AWG 75° C	20
½	230	No. 14 AWG 75° C	No. 14 AWG 75° C	No. 14 AWG 75° C	8
¾-1	230	No. 14 AWG 75° C	No. 14 AWG 75° C	No. 14 AWG 75° C	15
1½	230	No. 12 AWG 75° C	No. 12 AWG 75° C	No. 14 AWG 75° C	20
2	230	No. 12 AWG 75° C	No. 12 AWG 75° C	No. 14 AWG 75° C	25
3	230	No. 10 AWG 75° C	No. 10 AWG 75° C	No. 14 AWG 75° C	35
5	230	No. 8 AWG 75° C	No. 8 AWG 75° C	No. 12 AWG 75° C	60

① Copper wire recommended.
② Permanent magnet motors do not require field supply.
③ Fuses must be dual-element, time-delay (slow-blow) type, or U.L. Class K5 or RK5.

line **ahead** of the controller to provide branch circuit protection. Fuses for this disconnect switch should be chosen from Table 3.A. They should be dual-element, slow blow type, or Class K5 or RK5.

It is recommended that the disconnect switch be placed within easy reach of operating and maintenance personnel. **Do not** place it inside a surrounding enclosure since cabinet doors may be locked. (Consult your local codes.)

Guideline 8 — It is necessary to connect the GND (green/ground) wire of the three-conductor incoming A-C line to the terminal provided on the Chassis. Ring type connectors are recommended. The user must be sure that the ground wire is connected to the plant ground at the source.

The motor frame should also be grounded. In many cases it is adequate to use a screw in the conduit box near the motor.

Guideline 9 — A thermostat is used to guard against motor overload protection. It is essential to properly connect the motor thermostat **in series** with the Operator's Control Station **STOP** selector switch at connections 32 and 132. Refer to Figure 6.4 which shows a typical motor thermostat connection.

CAUTION: An external overload device must be connected between terminals 32 and 132. The drive will not start without it.

Guideline 10 — When planning signal or control wire runs, as listed in Table 3.E, follow these practices:

- Conduits should be steel.
- If these conduits cross 440 VAC conductors, make sure the cross is at 90°.
- Do not route signal wires through junctions or terminal boxes that contain non-signal A-C or D-C (115/230/460 V) wires.

Guideline 11 — Operational altitude above sea level may not exceed 3300 ft (1000 m). Derate horsepower 3% for each 1000 ft (300 m) above this altitude.

3.2 Mounting — This Paragraph outlines the procedures to be followed to mount the Regenerative Flex-Pak Plus (S2R) controller.

Determine the exact placement of the Chassis on the panel. (Refer to Figure 3.3 for mounting dimensions.) Scribe the panel. Drill three holes large enough to accept #10 mounting bolts. Scrape the paint around the holes to allow washers and bolts to make a ground contact.

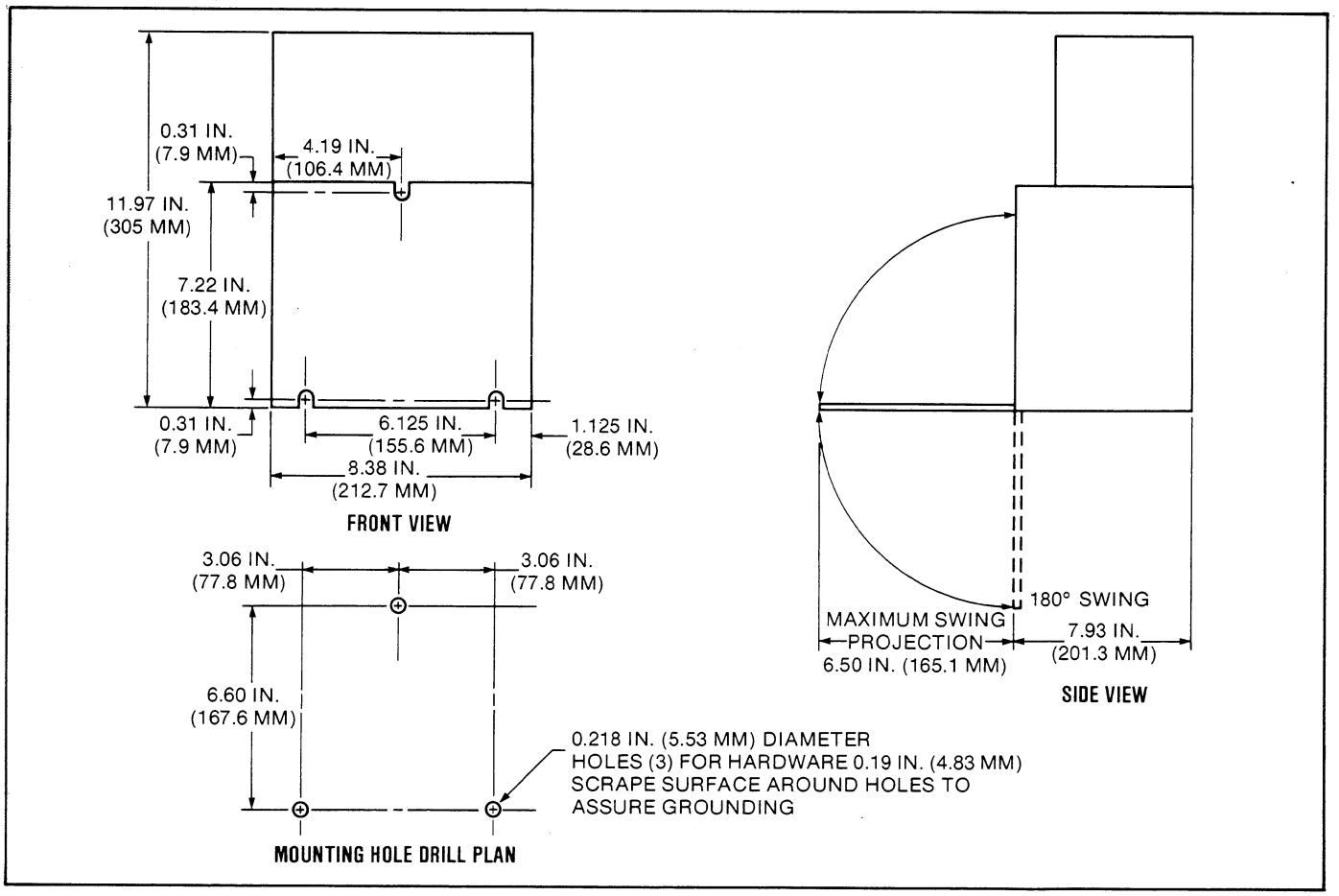
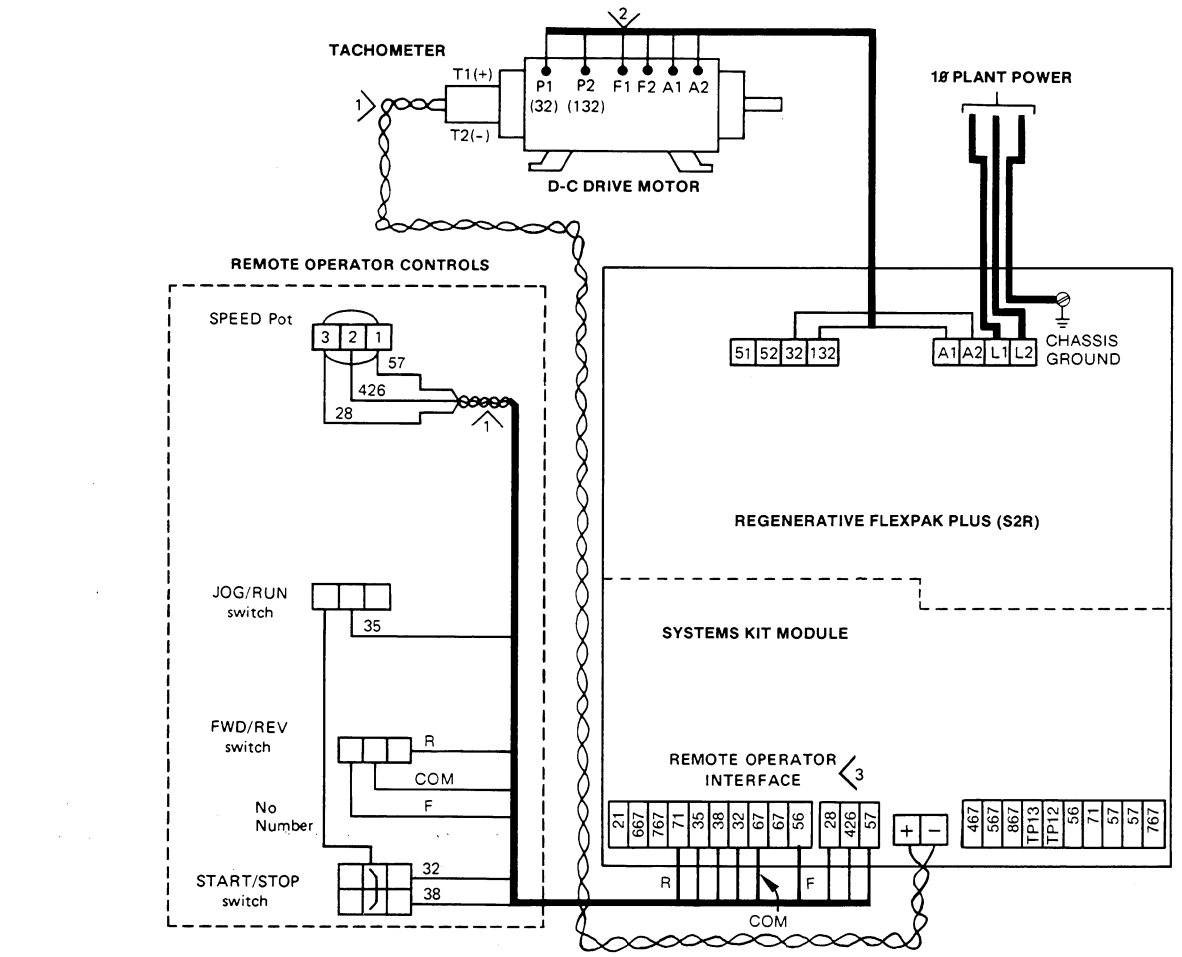
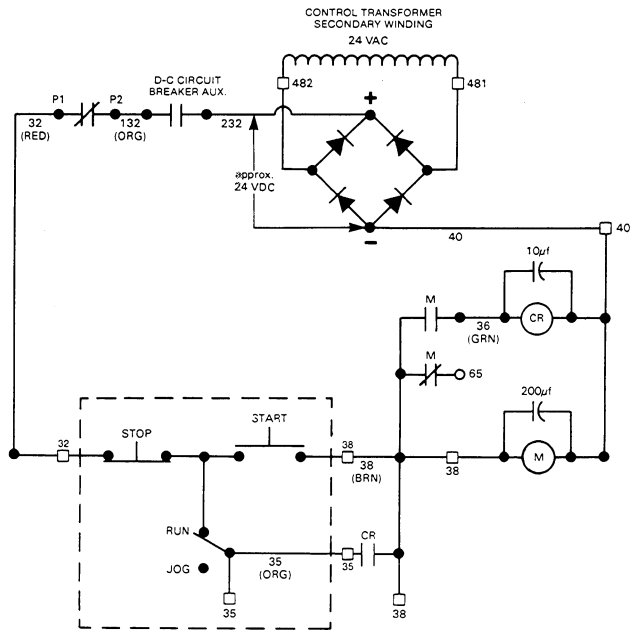


Figure 3.3. Mounting dimensions.





NOTES:

1. These signals must be run in a separate magnetic conduit to minimize the possibility of noise pickup. (Refer to Table 3.E for wire specifications.)
2. Motors with dual voltage shunt fields should be connected for the higher voltage.
3. Operator Control wiring of #14 AWG maximum size must connect to a remote operator interface, i.e., Process Line Module. DO NOT CONNECT DIRECTLY TO THE CONTROLLER.

Figure 3.4. System connection diagram.

3.3 Power Wiring — This Paragraph briefly outlines the procedures to be followed when wiring A-C power supply lines to the controller and D-C control circuits to the drive. A basic connection diagram is given at Figure 3.4.

DANGER
BEFORE WIRING, MAKE SURE THE A-C LINE DISCONNECT SWITCH IS LOCKED OPEN. EVEN IF POWER HAS NOT BEEN APPLIED TO THE INCOMING LINE, THIS PRACTICE ASSURES PERSONAL SAFETY. IF NO LOCKOUT DEVICE EXISTS, REMOVE THE FUSES WITH AN INSULATED TOOL AND PLACE A WARNING TAG ON THE BOX.

All interconnecting wire should primarily be sized and installed in conformance with N.E.C., C.E.C. or local codes. Refer to the controller and motor nameplates for electrical data. Typical wire sizes and types are listed in Table 3.A as a basic guideline. Note that long cable runs may require that a larger gauge be used to avoid excessive voltage drop. Use of stranded wire is also recommended. Wire according to Figure 3.4.

After wiring, examine all terminals to determine that connections are correctly made at **both** ends. Confirm wire identification. Examine the firmness of the connections.

Wires to the motor armature (A1 and A2) must be lugged with the provided lugs, or equivalent, before connection to the appropriate relay terminals. Lugs provided will accommodate:

¼ to 1½ hp — 12 AWG
1½ to 3 hp — 10 AWG
5 hp — 8 AWG

WARNING
DO NOT ALLOW CONDUCTORS TO GROUND ON THE CHASSIS. CHECK INTEGRITY OF ALL WIRE INSULATION BEFORE DRAWING. REMOVE ONLY ENOUGH INSULATION TO MAKE A FIRM TERMINAL CONNECTION. PERSONAL INJURY COULD RESULT IF A BARE WIRE TOUCHES THE CHASSIS.

3.4 Tachometer Feedback — The Regenerative Flex-Pak Plus (S2R) controller may be connected to a D-C tachometer. This requires the addition of the optional systems kit (Process Line, etc.). **An A-C tachometer cannot be used.**

CAUTION: Drive cannot regulate speed when AC tach is used for speed FDBK. Drive panel will go to maximum output with uncontrollable motor speed.

Not all drives require the use of a tachometer. This Paragraph should be read and followed **only** if the specific system requires one. If your drive system does not use a tachometer, proceed to Paragraph 3.5.

The following procedures assume that Guideline 5 has been considered. **These procedures are limited to preparing the incoming signal wires and wiring them at the tachometer.**

Note that a twisted pair signal wire **must** be used for the tachometer feedback circuit. It is specified in Table 3.E.

The cable run between the motor and the controller must be through a dedicated conduit. Under no circumstances attempt to use the A-C or D-C conduits.

Wire according to Figure 3.4 and the following procedure.

Step 1 — Connect the tachometer wires to the terminal strip on the systems kit module. Plus (+) is the left side, minus (−) the right. Do not strip off more than ⅛ inch (3 mm) of insulation since shorts occur at exposed points. Maintain the twist as long as possible.

Step 2 — The circuit is setup to accept standard 50 V/1000 rpm tachometers on a 1750 rpm machine. Other tachometers can be accommodated by selecting the divider resistor specified in Table 3.B that corresponds to the desired tachometer. On the motor's nameplate, find the base speed (rpm). On the tachometer's nameplate, find the output voltage per 1000 rpm. Take these two figures and relate them to Table 3.B. Read across to the right column, where the resistor (R_L) value is indicated. Clip and remove resistor R_L (5.11K) from the systems kit module. Place the specified resistor between pins 719 and 57 on the systems kit module (Process Line, etc.).

Step 3 — The Feedback Jumper on the Regulator Module must be connected for tachometer feedback. (Refer to Figure 3.5.) Place the Regulator Module's fixed black jumper on the pin marked T.

DANGER
IMPROPER TACHOMETER CONNECTION WITH RESPECT TO POLARITY WILL RESULT IN UNCONTROLLED MOTOR SHAFT ACCELERATION WHICH MAY RESULT IN SEVERE OR FATAL PERSONAL INJURY AND/OR EQUIPMENT DAMAGE.

Table 3.B. Tachometer voltage scaling.

Motor Base Speed (rpm)	Tachometer (volts/1000 rpm)	100% Voltage	Resistor (R_L) 719-57
1150	20 VDC	23	35.7K
1750	20 VDC	35	16.2K
1150	50 VDC	58	9.09K
3450	20 VDC	69	6.81K
1750	50 VDC	88	5.11K①
1150	100 VDC	115	3.92K
3450	50 VDC	175	2.43K
1750	100 VDC	175	2.43K

①Standard. Clip and remove if another tachometer is used.

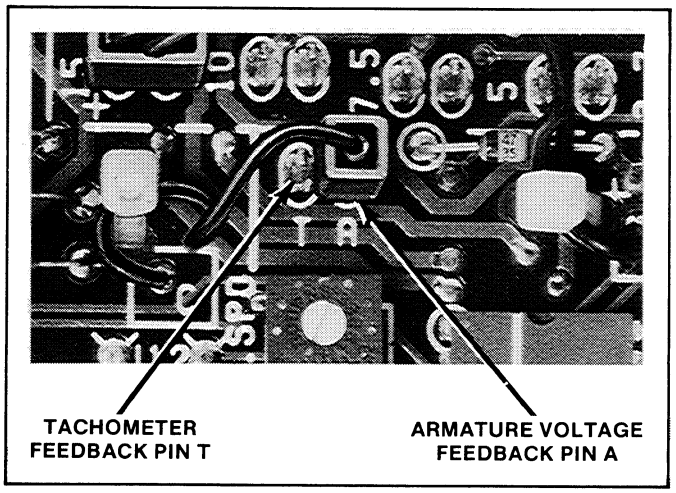


Figure 3.5. Tachometer feedback jumper on Regulator Module.

NOTE: *A recommended way to check the polarity of the tachometer is to run the controller as a Voltage Regulator while observing the tachometer output with a D-C voltmeter.*

Step 4 — This Step assumes that the complete drive system, including the controller, has been successfully started up and debugged according to Section 4 thru Paragraph 4.3.1. It is necessary to carry out a power-on test. Set the SPEED Potentiometer at approximately 25% of full rotation. Start the drive. It should run as set. If it accelerates to full speed, the tachometer is not providing a signal or is improperly connected.

Stop the drive, turn off all power, and check and correct the leads to the tachometer terminals on the systems kit module . Repeat the test with power on in order to confirm that proper feedback signals are being received by the regulator.

If erratic behavior continues, check the selection and placement of the scaling resistor R_L as detailed in Step 2 and the placement of the pig-tail jumper as detailed in Step 3.

3.5 Isolation Transformers — Although an auto-transformer may be required because of A-C line voltage levels, it is unable to provide a number of benefits standard with an isolation transformer.

The general requirements for an isolation transformer are:

- Single phase
- 3 to 8% impedance
- Nonregulated
- Sinusoidal output
- 50/60 Hz, as required
- 150% overload for 1 minute (max.)

Refer also to Table 2.D for specific information on transformer sizing requirements. In the "Transformer" column at the right, maximum kVA and full-load kVA figures are listed in relation to specific D-C motor hp/VAC ratings.

Reliance Electric offers a number of isolation transformers suitable for use with the Regenerative FlexPak Plus (S2R) controller. (Refer to Table 3.C.)

Table 3.C. Reliance Electric isolation transformers.

HP	kVA	Primary VAC	Secondary VAC	Order Number
¼-⅓	0.75	230/460	115	77530-10S
¼-⅓	0.75	575	115	Special Order
½	1.0	230/460	230	Special Order
½	1.0	575	115	Special Order
¾	1.5	115	115	77530-12V
¾	1.5	575	115	77530-11V
¾	1.5	230/460	115	77530-10V
¾	1.5	230/460	230	Special Order
¾	1.5	575	230	Special Order
1	2.0	230/460	230	77530-8W
1	2.0	575	230	Special Order
1½	3.0	230/460	230	77530-8X
1½	3.0	575	230	Special Order
2-3	5.0	230/460	230	77530-8Y
2-3	5.0	575	230	77530-9Y
5	10.0	230/460	230	77530-8RC
5	10.0	575	230	77530-9RC

3.6 50-Hz Operation — There may be cases when the Regenerative FlexPak Plus (S2R) controller is to be operated continuously on 50 Hz. If so, two resistors should be removed from the Regulator Module for optimum performance. (Refer to Figure 3.6.)

3.7 HP/Current Jumper — It is necessary to inspect the Current Scaling/Horsepower Jumper on the Regulator Module to be sure that it is connected correctly for a specific drive motor.

Step 1 — On the drive motor, locate the nameplate. Note the full-load current.

Step 2 — Or, if current is not shown on the nameplate, refer to Table 3.D. Relate the left or center columns in the table with known motor data. Read across to the right column marked "Motor Current." This figure indicates the proper jumper connection to make on the Module where a corresponding number is etched.

Step 3 — On the Regulator Module, locate the scaling pins. (Refer to Figure 3.7.) Near them, locate the black pig-tail type jumper. Do not move it if it is connected to the proper pair of pins. If it must be reconnected, carefully lift it straight up and off the pins. Slide the connector straight down over the proper set of pins.

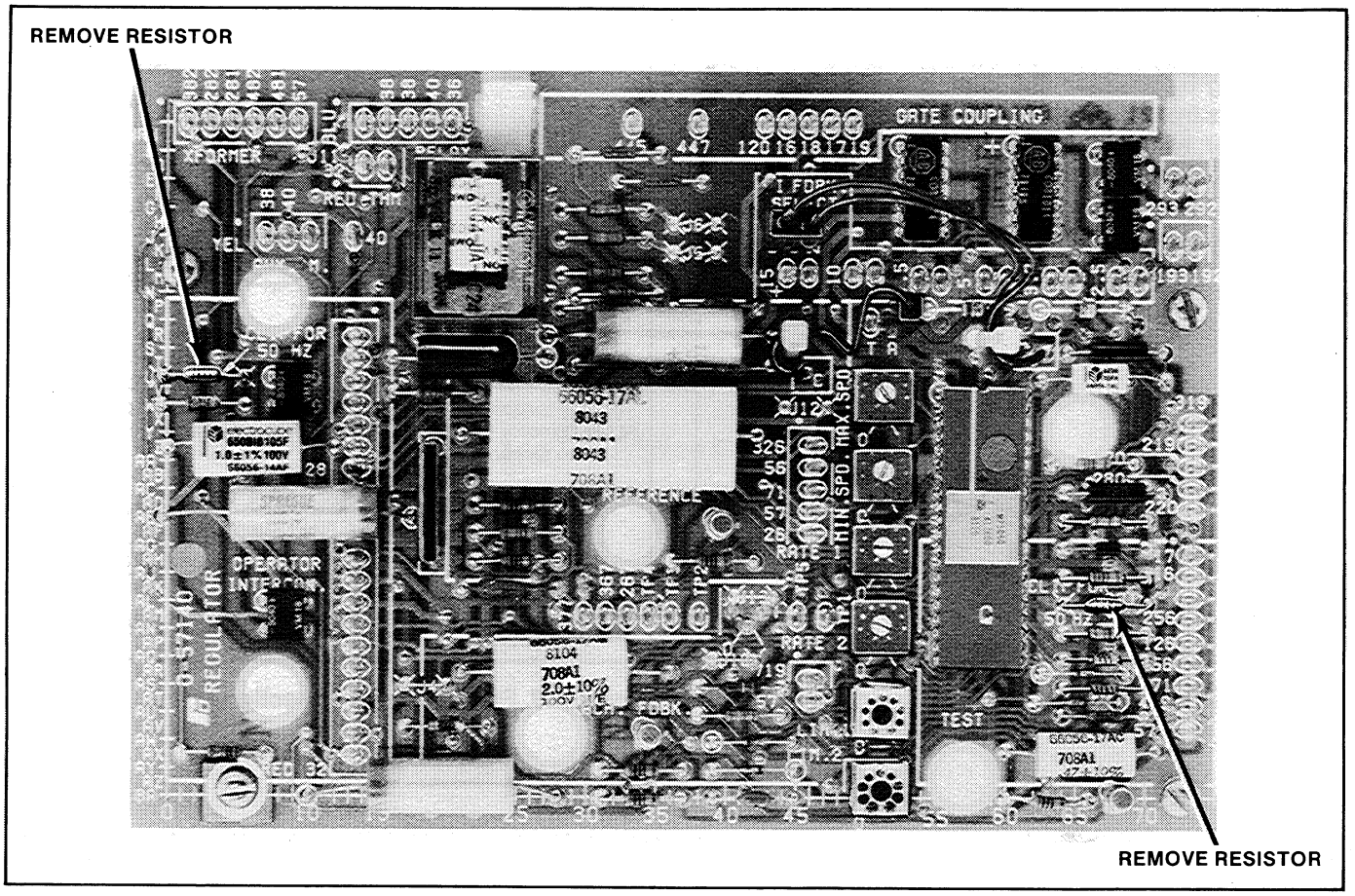


Figure 3.6. 50-Hertz resistor removal.

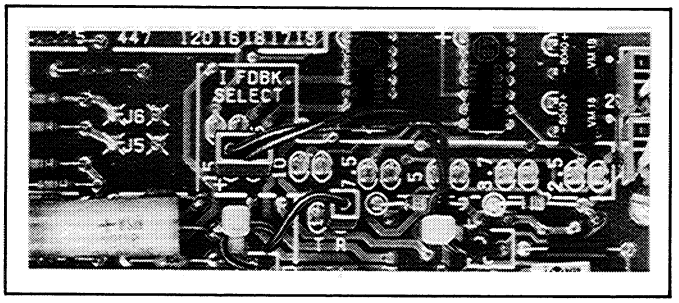


Figure 3.7. HP/Current scaling pins on Regulator Module.

Table 3.D. Horsepower calibration.

Motor HP		Motor Current/ Pin Connections
115 VAC	230 VAC	
1/4	1/2	2.5A
1/3	3/4	3.7A
1/2	1	5A
3/4	1 1/2	7.5A
—	2	10A
—	3	15A
—	5	25A

3.8 Regulation Mode Jumper — The Regenerative FlexPak Plus (S2R) controller offers two types of drive regulation. The first, which is factory shipped, is an armature voltage feedback (A). Optionally, the user may also use tachometer feedback (T) regulation. In order to use this mode, however, the Regulation Mode Jumper, one end of which is permanently fixed to the Regulator Module, must be moved to the (T) position. (Refer to Figure 3.5.) Details of jumper placement are noted in Paragraph 3.4.

DANGER
IF YOU ARE UNSURE WHICH REGULATION MODE A CONTROLLER SHOULD HAVE, IT IS IMPORTANT YOU FIND OUT. IF THE JUMPER IS NOT PROPERLY CONNECTED, PERSONAL INJURY MAY RESULT.

3.9 Field Supply — The standard Field Supply provides full-wave field excitation for shunt-wound D-C motors. (Refer to Figure 3.8).

D-C field supply voltage and maximum field amperes are listed in Table 2.D.

The Field Supply is assembly "A" (see drawing 705385-72 supplied with kit) consisting of a terminal block, a Field Supply Power Cube, and interconnecting harnesses. The user provides the F1/F2 conductors from the Field Supply terminal block to the drive motor. No other equipment is required.

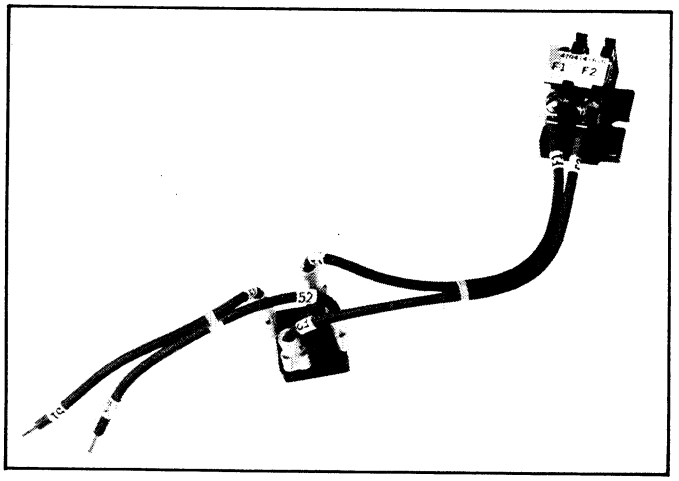
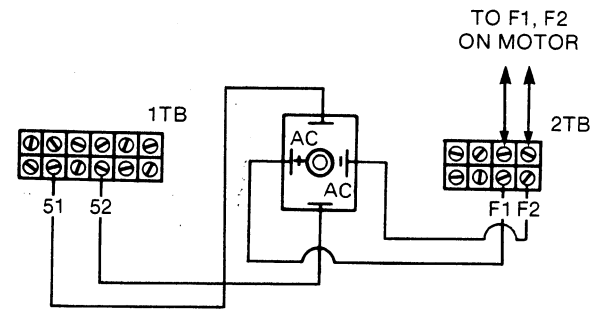


Figure 3.8. Field Supply.



NOTE: The field supply voltages listed in Table 2.D are full wave supplies. For half voltage or half wave supply connect motor lead F1, to terminal 51 on 1TB and motor lead F2 to terminal F2 on 2TB.

A-C Line Voltage	Field Supply Voltage	
	Half Wave	Full Wave
115	50	100
230	100	200

Figure 3.9. Field Supply connections.

Table 3.E. Wire specifications.

Use in Controller	Type Conductor	Required Characteristics	Acceptable Types
CONTROL WIRE			
Remote Operator Control Station: • JOG/RUN • FORWARD/REVERSE • START/STOP	• Single conductor and/or multi-conductor	• Stranded copper • AWG No. 16 • 600 VAC rating • Insulation: poly-vinyl chloride (PVC) • Temperature range: 40°-105° C (104°-221° F) • Unshielded	• Any single conductor meeting N.E.C. required characteristics
SIGNAL WIRE			
Remote Operator Control Station: • SPEED potentiometer	• Three-conductor • Twisted with two twists per inch	• Stranded copper (19 x 29) • AWG No. 16 • 600 VAC rating • Twist per foot: 24 (½-inch lay) • Insulation: poly-vinyl chloride (PVC) • Temperature range: 40°-105° C (104°-221° F)	• User may twist single conductors of required specifications • Reliance Part No. 417900-79X
• Tachometer Feedback	• Two-conductor • Twisted pair with two twists per inch		• User may twist single conductors of required specifications • Reliance Part No. 417900-76EAD

SECTION 4
STARTUP AND ADJUSTMENT

4.0 General — This Section provides startup and adjustment procedures to be followed after the assembly and installation of the controller is complete. All initial operation checks and final adjustments to the controller **must** be made in conformance to the procedures, warnings and recommendations listed here.

DANGER
THE CONTROLLER IS AT LINE VOLTAGE WHEN A-C LINE POWER IS CONNECTED TO THE POWER UNIT INSIDE THE CONTROLLER. BEFORE WORKING ON THE CONTROLLER OR TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER, REMOVE INCOMING A-C LINE POWER AT THE MAIN DISCONNECT SWITCH. PERSONAL INJURY MAY RESULT IF THIS WARNING IS NOT FOLLOWED.

DANGER
DURING INITIAL STARTUP, THE CONTROLLER AND ITS ASSOCIATED EQUIPMENT MUST BE OPERATED AND/OR ADJUSTED ONLY BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL. THESE INDIVIDUALS SHOULD BE FAMILIAR WITH THE DESIGN AND OPERATION OF THIS EQUIPMENT AND WITH THE HAZARDS INVOLVED. PERSONAL INJURY AND/OR DAMAGE TO THE CONTROLLER COULD RESULT IF THIS IS NOT HEEDED.

4.1 Power Off Inspection — It is necessary to make an inspection of the controller and its associated units. The purpose of this check is to look for possible physical damage or improper connections.

Inspect all plug-in Modification Kits. Test each for a firm mounting condition.

Each should be mechanically connected to the Regulator Module by means of mounting post screws. Each should be electrically connected to the Module by a series of parallel pins. If any of the pins are bent, improper operation could result. Examine the pins to make sure they are perfectly parallel and each pin aligns with its corresponding hole.

Inspect all screw terminal connections on the Modification Kits. Make sure the wires are firmly connected. Also make sure that there is enough insulation on the wires to prevent a short between the conductors.

Inspect the signal wiring from the Operator Control Station. A series of wires will connect to individual terminals on a terminal strip mounted on a systems kit (Process Line, etc.) which mounts on the Regulator Module. Determine that all wires are firmly seated in the terminal strip. Make sure all wires are connected.

CAUTION: Operator's control wiring cannot be directly connected to the controller. Damage to the controller could occur.

4.2 Motor Ground Check — It may be necessary to make a check of the drive motor to assure that no damaging grounds—other than earth ground—exist within the motor.

CAUTION: Although a megger may be used for this test, if one is used, all conductors between the drive motor and the controller are to be disconnected and moved aside. The megger's high voltage can cause damage to the controller's circuits.

Step 1 — Attach one lead from the ohmmeter to the motor frame to make a simple resistance check.

Step 2 — Touch the test probe to each of the two power, two thermostat, and two field leads to the motor.

If the reading to ground on any terminal is **less than** 100,000 ohms, a ground condition exists.

Step 3 — If a ground condition exists, inspect the motor thoroughly for internal shorts.

Step 4 — When the grounding condition is corrected, reconnect the conductors from the controller.

4.3 Power On Adjustments — Once all the preliminary power-off static adjustments have been performed with acceptable results, the A-C line power is to be applied to the controller, but the load is **not** connected. It is important to follow these steps closely. Observe all cautions and warnings.

DANGER
WITH A-C POWER APPLIED, HAZARDOUS VOLTAGE EXISTS IN THE CONTROLLER. EXERCISE EXTREME CAUTION WHEN PERFORMING THESE TESTS. PERSONAL INJURY CAN RESULT.

DANGER
IF CIRCUIT BREAKER HAS TRIPPED OR FUSES HAVE CLEARED, USER MUST INSPECT THE FIELD SUPPLY AND ITS WIRING FOR DAMAGE. RE-APPLYING POWER TO THE DRIVE, THE FIELD VOLTAGE MUST BE RE-CHECKED FOR PROPER VOLTAGE AT MOTOR TERMINALS F1, F2. IF THIS VOLTAGE IS BELOW 90% OF THE FIELD VOLTAGE SPECIFIED ON THE MOTOR NAMEPLATE, THE DRIVE MUST NOT BE STARTED UNTIL PROPER VOLTAGE IS OBTAINED. FAILURE TO FOLLOW THIS PROCEDURE COULD RESULT IN OVERSPEEDING THE MOTOR AND/OR THE MACHINERY COUPLED TO THE MOTOR SHAFT AND POSSIBLE FATAL INJURY. REFER TO SYMPTOM 1 IN TABLE 6.B.

4.3.1 Regulator Module Potentiometers — The Regulator Module has six adjustable potentiometers mounted on it. (Refer to Figure 4.1.) They control the following functions:

- Maximum speed (full CCW: 50% speed)①
- Minimum speed (full CCW: nearly zero speed)①
- Rate 1 (FORWARD acceleration, REVERSE deceleration)
- Rate 2 (REVERSE acceleration, FORWARD deceleration)
- Current limit 1(+) (factory-set at 150%)
- Current limit 2(−) (factory-set at 150%)

The potentiometers are factory preset for the safest or most conservative operation.

4.3.2 Maximum Speed (Voltage)① — The Maximum Speed Potentiometer on the Regulator Module has been factory preset for 50% of a typical motor base speed of about 1750 rpm. By means of adjustment, the maximum speed may be raised to suit the application. The result is the highest speed that can be set by the operator on the SPEED dial. The control range is 50 to 100% of rated speed.

①These adjustments are not accessible if a Process Line Kit is used with the drive. The maximum speed is controlled using the maximum speed potentiometer on a Process Line Kit. The minimum speed should remain at the factory setting.

There are two methods for determining if the motor and driven equipment are operating at an acceptable maximum speed for the application.

- Tachometer
- Visual inspection of machine operation

Locate the Maximum Speed Potentiometer on the Regulator Module. (Refer to Figure 4.1.) The letters MAX SPD are printed on the Module. Note that CW rotation represents an **increase** in speed. CCW represents a **decrease.**

DANGER
WHEN PERFORMING THIS ADJUSTMENT PROCEDURE, DO NOT ALLOW THE DRIVE MOTOR TO EXCEED ITS RATED MAXIMUM SPEED AS LISTED ON THE NAMEPLATE. EQUIPMENT DAMAGE AND SERIOUS PERSONAL INJURY COULD RESULT.

On the Operator Station, increase the SPEED dial slowly in the direction of 10, which is 100% of full travel. If, as the SPEED dial is turned toward the 10 setting, the speed exceeds the maximum acceptable speed, **immediately** decrease the maximum speed on the SPEED dial. Use a small insulated slot screwdriver.

In **some cases,** to avoid exceeding the maximum operating speed, it may be necessary to turn the Maximum Speed Potentiometer completely CCW before turning the SPEED dial completely CW.

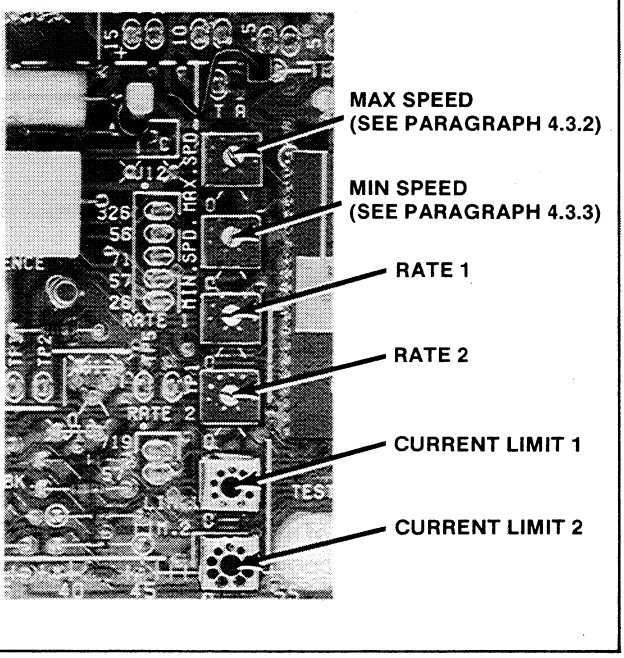


Figure 4.1. Regulator Module potentiometers.

If the 10 setting on the SPEED dial is lower than the desired speed, increase the setting on the Maximum Speed Potentiometer to the necessary speed. To increase the maximum speed, turn the potentiometer CW.

DANGER
USE ONLY ONE HAND TO HOLD THE SCREWDRIVER. KEEP YOUR OTHER HAND BEHIND YOU. DO NOT USE YOUR OTHER HAND TO BRACE YOURSELF AGAINST THE CONTROLLER, PANEL OR ENCLOSURE. PERSONAL INJURY COULD RESULT IF YOU ACCIDENTALLY TOUCH A COMPONENT AT LINE VOLTAGE.

NOTE: *A further adjustment may be needed, but it should be performed after completing Paragraph 4.3.3. Note that the maximum and minimum speed adjustments are interactive; a change in one affects the other.*

4.3.3 Minimum Speed (Voltage)② — The Minimum Speed Potentiometer on the Regulator has been factory preset for nearly zero speed. By means of adjustment, minimum speed may be raised or lowered. The result is the lowest moving speed the operator can set on the SPEED dial. The control range is up to 50% of rated speed.

Again, the motor speed can be determined by a tachometer or by visual inspection of machine operation.

With the SPEED dial at zero position and using a small, insulated slot screwdriver, carefully turn the Minimum Speed Potentiometer until the desired minimum is reached. Note that CW represents an **increase** in rate; CCW represents a **decrease** in rate.

NOTE: *Carefully recheck the maximum speed adjustment for desired setting. Since the maximum and minimum speed adjustments are interactive, a change in one affects the other. At times, it may be necessary to work back and forth for precise adjustments.*

4.3.4 Acceleration/Deceleration Rates — The RATE 1 and RATE 2 Potentiometers on the Regulator Module are provided to adjust FORWARD and REVERSE acceleration rates, respectively. RATE 1 also controls the deceleration rate when in the REVERSE mode, and RATE 2 controls the deceleration rate when in the FORWARD mode.

②The minimum speed adjustment is not utilized if a Process Line Kit is used with the drive. The minimum speed should remain at the factory setting.

These potentiometers have been factory preset for a typical linear acceleration rate of 6 seconds to maximum speed. This time can be adjusted over a range of 0.5 to 30 seconds from a fully stopped condition.

Step 1 — Place the SPEED dial in the 10 position.

Step 2 — Put the START/STOP rocker switch in the START position.

Step 3 — Have a hand-held tachometer or stopwatch held by a helper. Alternately, have an oscilloscope or chart recorder set up. On the Operator Control Station, press the START switch. Determine if the rate of acceleration is acceptable. If it is, proceed to Step 8. If not, continue with these steps.

Step 4 — Locate the RATE 1 potentiometer on the Regulator Module. (Refer to Figure 4.1.)

Step 5 — Using a small insulated slot screwdriver, carefully turn the RATE 1 Potentiometer a quarter turn. (CW represents an **increase** in rate; CCW represents a **decrease** in rate.)

Step 6 — Repeat Step 3. If the rate is acceptable, move on to Step 8. If the rate needs more adjustment, repeat Step 5.

Step 7 — Press the STOP switch.

Step 8 — Repeat Steps 1 thru 7 with the FORWARD/REVERSE selector switch in the REVERSE position. Use the RATE 2 Potentiometer on the Regulator Module.

NOTE: *RATE 1 and RATE 2 also control deceleration in REVERSE and FORWARD modes, respectively. The rate of deceleration can be timed with a tachometer and stopwatch for slower rates. An oscilloscope or chart recorder can be used for faster rates. For a controlled deceleration, the motor must be loaded such that it does not coast during the deceleration period.*

4.3.5 Current Limit 1 and 2 — Current Limit #1 and Current Limit #2 Potentiometers are provided for separate adjustment of the forward (+) and reverse (−) current limits, respectively. Although it will probably not be necessary to make any adjustment in the factory-set current limit values of 150% of rated load, it is possible to change this governing value. (Individual application speed changes or load changes on sustained overloads may require readjustment. Also, applications requiring torque limiting or accelerating of high inertia loads may require a change from this value.)

To reduce the torque output of the drive, turn the Current Limit Potentiometers CCW. Note, however, that turning CCW too far may prevent the drive accelerating to the desired speed.

SECTION 5
MODIFICATION KITS

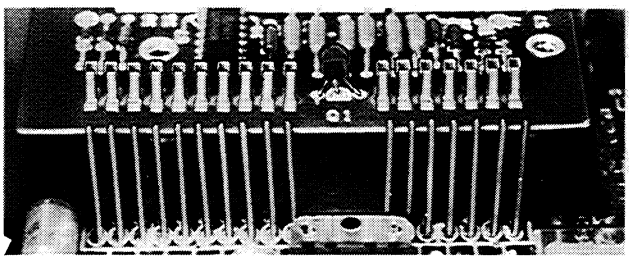
5.0 General — A number of optional features in the form of Modification Kits are offered with the controller. Each of these Kits extends the control of the unit and tailors its operation to specific application needs.

This Section describes the procedures that must be followed to install the Kits. Refer to Table 5.A for an informational listing.

DANGER
INSTALLATION OF MODIFICATION KITS IS TO BE DONE ONLY AFTER A-C LINE VOLTAGE IS DISCONNECTED AND LOCKED OUT AT THE MAIN DISCONNECT SWITCH. DO NOT INSTALL KITS WHEN POWER IS APPLIED TO THE CONTROLLER. SERIOUS PERSONAL INJURY AND EQUIPMENT DAMAGE COULD RESULT.

WARNING
INSTALLATION OF THE MODIFICATION KITS SHOULD BE PERFORMED ONLY BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE DESIGN AND OPERATION OF THIS EQUIPMENT. DAMAGE COULD RESULT IF THIS IS NOT HEEDED.

Some of the Modification Kits are designed to make electrical connection with the Regulator Module by means of pin-type connectors. These slide up through matching holes in the Modules that form part of the Kit. (Refer to Figure 5.1.)



PINS MUST BE PARALLEL

Figure 5.1. Pin alignment.

Table 5.A. Modification Kit summary.

Kit	Model Number	Manual Paragraph Number	Comments
Process Line	14C278	5.1	None
Dynamic Braking	14C214 thru 14C216	5.2	Refer paragraph 5.2.
Auxiliary M Contactor	14C219	5.3	Wire not to exceed #14 AWG. Refer to Table 3.E.
Position Loop	14C279	5.4	None

A common installation problem is caused by bent, broken or incorrectly placed pins. Since improper operation could occur, care must be taken. Exact alignment is critical. Visually check that only **one** pin extends to the top of **each** slot once the connection is made.

Some of the Modification Kits require the removal of one or more jumpers from the Regulator Module. In such cases, carefully clip the leads on **both** sides of each jumper and discard it. Use a sharp pair of dykes (diagonal cutters) to assure a complete cut. Do not twist the tool, since damage may result.

In cases in which the Kit is secured by mounting screws, be sure to tighten them firmly but **do not overtighten.** Excessive force can strip the threads.

5.1 Process Line — The Process Line Kit (Figure 5.2) allows the Regenerative FlexPak Plus (S2R) to be used in most process line applications without the need for additional hardware in separate racks. The Process Line Kit includes circuitry for remote operator interfacing, tachometer feedback and standby operation. Applications include web process lines where a drive would have multiple sources of feedback signals controlling the process.

This Kit contains the Process Line Module and three mounting screws. The Module has been designed to include standard values for interfacing but also provides for modifications via wire wrap pins in many areas. The operational limits of the Process Line Module are:

- Line speed 50 to 1.
- Draw speed range of 0 to 130% (not to exceed motor base speed).

- Current compounding 0 to 20%.
- Operating temperature 0° C to 70° C.

The Module circuitry is divided into seven major functions. (Refer to Figure 6.5.)

1. A summing amplifier type **active feedback** is used around a speed loop summing amplifier.
   - If the application **does** require active feedback, the standard feedback circuitry on the Regulator Module must be disabled by clipping and removing J13.
   - If the application **does not** require active feedback, remove resistor 1R (18.2K) on the Process Line Module.
2. A **D-C tachometer feedback divider** circuit is set up to accept a 50 V/1000 rpm tachometer on a 1750 rpm motor. Other tachometers can be accommodated. (Refer to Table 5.B for the proper voltage scaling and to Paragraph 3.4 for the proper installation procedure for other tachometers.) If a 2 microfarad capacitor is required across the tachometer output, connect the capacitor at terminals 119 and 57 or directly to the tachometer terminals. The circuit impedance is approximately 80K at the tachometer input. For some tachometers, greater loading will be necessary for stability.

Table 5.B. Tachometer output voltage scaling.

Motor Base Speed (rpm)	Tachometer (volts/1000 rpm)	100% Voltage	Resistor (R_L) 719-57
1150	20 VDC	23	35.7K
1750	20 VDC	35	16.2K
1150	50 VDC	58	9.09K
3450	20 VDC	69	6.81K
1750	50 VDC	88	5.11K①
1150	100 VDC	115	3.92K
3450	50 VDC	175	2.43K
1750	100 VDC	175	2.43K

①Standard. Clip and remove if another tachometer is used.

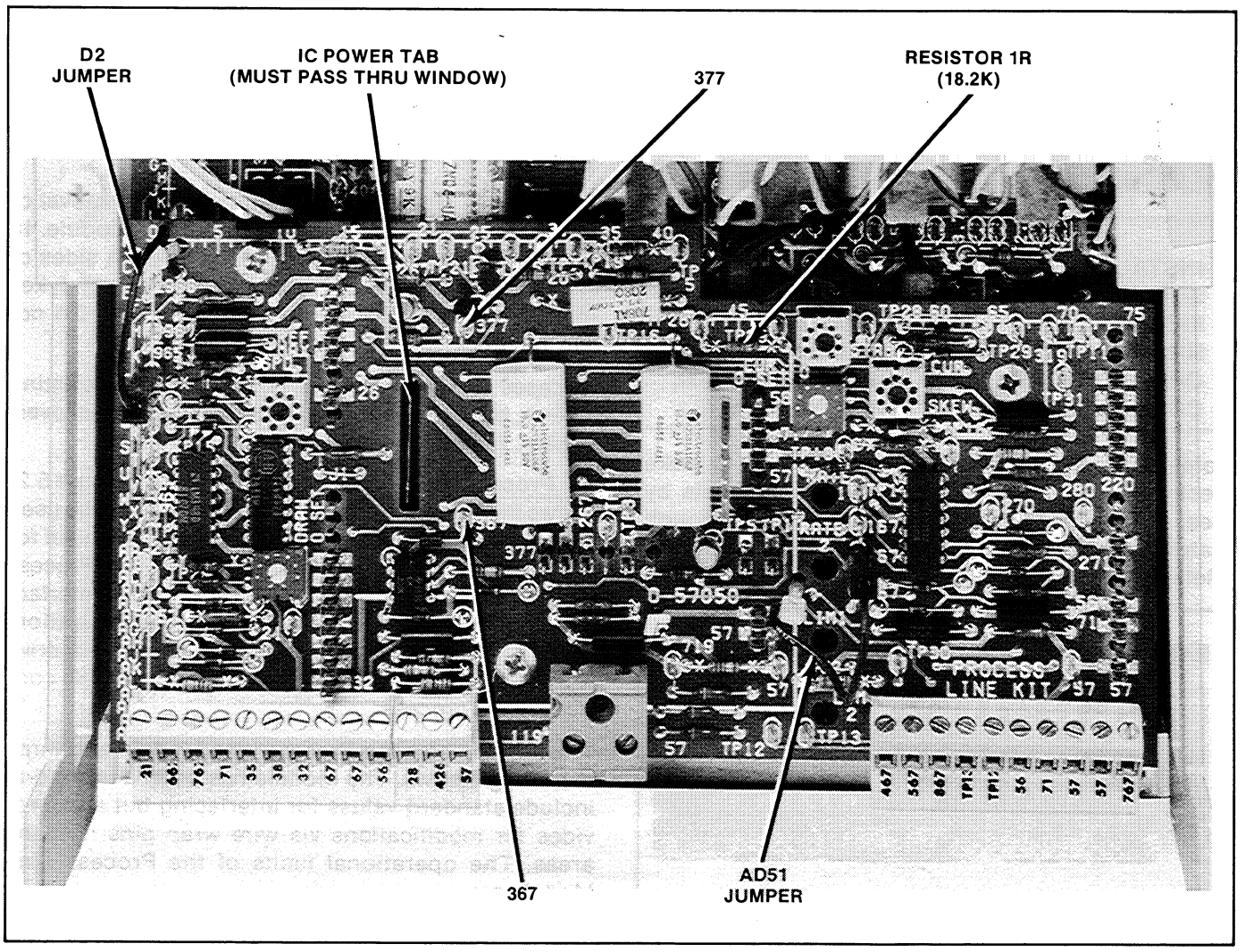


Figure 5.2. Process Line Kit installed on Regulator Module.

3. An **LVTU buffering and reference input** circuitry allows the Regulator Module to follow the internal LVTU or an external reference.
   - The standard (10K) Speed potentiometer is connected to terminals 28, 426 and 57.
   - The external reference terminal 467 of 8 volts is 100% output of the Regulator.
   - The buffer output (terminals 767 and 57) is for the Draw potentiometers (maximum of two 10K potentiometers) if used.
   - The LVTU timing may be extended from the standard 0.3 to 30 seconds to 0.6 to 60 seconds by adding capacitors (10μf maximum with less than 0.5 μA leakage over the operating temperature range of 0° C to 70° C) between terminals 367 and 377.
4. A **draw potentiometer and a draw summing amplifier** contains a summing amplifier, zero set signal, and a summed speed reference signal to the regulator major speed loop amplifier.
   - The Draw potentiometer (10K typical) is connected to terminals 767, 667 and 21. The minimum speed resistor (1K) between terminals 21 and 57 may be changed if required.
   - Extra terminals are provided on the input of the amplifier for additional signal inputs or for gain adjustment.
   - The summing amplifier output is available at terminals 567 and 57 for progressive draw applications. It can supply two 10K potentiometers.
   - If progressive draw is not used, the LVTU buffered output (terminal 767) may be jumpered to the input (terminal 667) of the summing amplifier.
   - A maximum speed potentiometer is provided on this Module to adjust the maximum drive speed reference.
5. **Current compounding/IR compensation** receives current related input(s) from the current scaling circuit on the Regulator Module.
   - The forward direction input (terminal 219) is a +1.0 V signal while the reverse direction input (terminal 220) is a −1.0 V signal.
   - The current signals are summed in the amplifier to give a maximum 0 to 20% input into the major loop amplifier.
   - The output of the summing amplifier can be used for IR compensation, speed increase with motor current increase; or current compounding, speed decrease with motor current increase. IR compensation is used with voltage regulators not speed regulators. Current compounding can be used with voltage or speed regulators which tends to "soften" or increase motor speed regulation.
6. **Remote operator interfacing** accepts Operator Control wiring (maximum of #14 AWG). Operator Control wiring cannot be connected directly to the controller.
7. **Standby circuitry.**

To install the Kit, follow these procedures.

Step 1 — Clip and remove jumper J10 on the Regulator Module.

Step 2 — Refer to Figure 6.3 and note that the shaded area on the Regulator Module is where the Process Line Module is to be mounted. Orient the Process Line Module over this area so the pin guides on the Module are aligned over the two sets of pins labeled GRN 28 and RED 32. **Check that the IC with the power tab is in an upright position and that all pins are aligned.**

NOTE: *The pins on all new Regulator Modules have been lubricated. Older Regulator Modules must have the contact pins cleaned and re-lubricated (Amp Lubricant 561232-1 or equivalent) before installing this Module.*

Lower the Process Line Module making sure all pins pass thru the corresponding pin guides and the mounting spacer seats in the mounting hole. Secure the Module with the three mounting screws.

Step 3 — Connect the black pig-tail jumper at location AD51 to pin 367 if the Position Loop Kit is not to be used, to pin 167 if the Position Loop Kit is to be used or to pin 467 for auxiliary reference inputs for specific applications.

Step 4 — Connect the black pig-tail jumper at location D2 to pin 965 if IR compensation or current compounding are **not** desired, to pin 966 for IR compensation, or to 967 for current compounding.

Step 5 — It is important that all modifications and interconnections made to the Process Line Module be duplicated onto any replacement Process Line Module used on the drive system. This inciudes jumpers, added/clipped components and external wiring. This will ensure maintaining the same performance and operating characteristics of the drive system.

5.2 Dynamic Braking — The standard controller allows a drive motor to coast to rest after the STOP switch is pressed. Optionally, a user may install a Dynamic Braking Kit. (Refer to Figure 5.3.) Its use allows a rapid, shockless stopping of the drive motor.

Dynamic Braking is **not** a mechanical holding brake. It will **not** hold the shaft in place, nor will it prevent the motor from turning once motion has stopped.

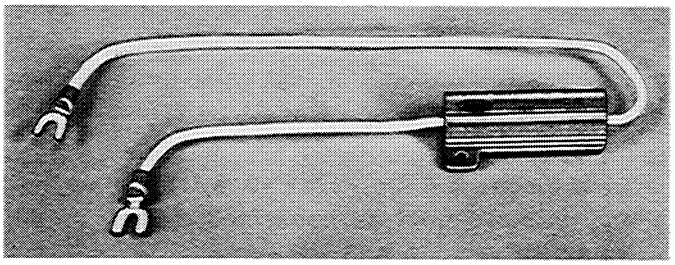


Figure 5.3. Dynamic Braking Kit.

The Dynamic Braking option is actually a resistor connected across the motor armature. It allows a motor to act as a generator; the rotating mechanical (kinetic) energy is converted into electrical energy that is dissipated in the form of heat by the Dynamic Braking resistor.

Note that the resistor is sized for infrequent stops. Thus, users must allow time between stops for heat dissipation.

When ordering the Kit, it is necessary to specify Model Numbers according to horsepower and voltage ratings. (Refer to Table 7.A.)

The Dynamic Braking Kit contains the resistor and two mounting screws. Mount the Kit in the upper right-hand corner of the controller as shown in Figure 5.4. Wire the Dynamic Braking Kit according to Figure 5.5.

NOTE: *The 3 and 5 horsepower controllers can be provided with higher rated dynamic braking resistors as follows:*

3 hp — one resistor (part 48267-L)
5 hp — one resistor (part 48267-J)

These higher rated resistors will mount remote to, rather than in, the controller.

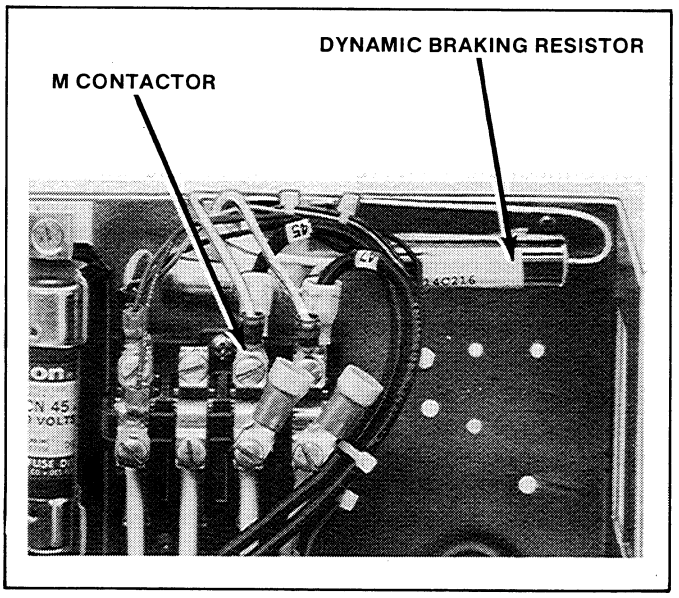


Figure 5.4. Dynamic Braking Kit installed.

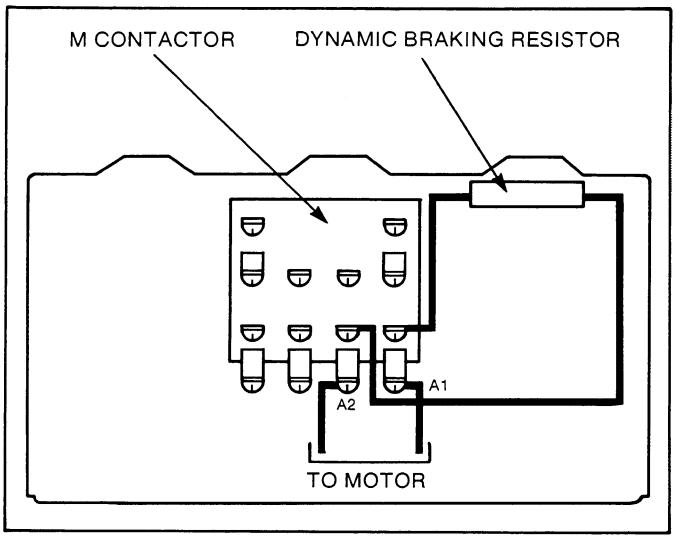


Figure 5.5. Dynamic Braking Kit connections.

5.3 Auxiliary M Contactor — With the optional Auxiliary M Contactor Kit, the ON/OFF status of the Regenerative FlexPak Plus (S2R) is able to be interlocked with user-supplied devices. (Refer to Figure 5.6.) Typical applications include pilot/indicator lights, alarms, and interlocking with other control circuits dependent on the drive system.

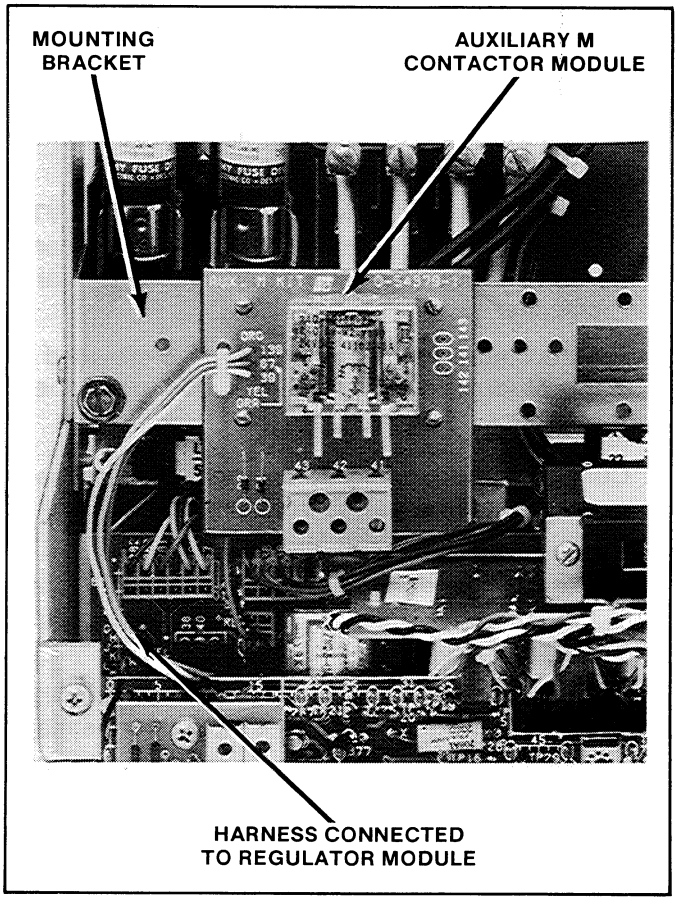


Figure 5.6. Auxiliary M Contactor Kit installed.

The Kit provides a single pair of Form C contacts, one normally open (NO) and one normally closed (NC). Both share a common terminal. (Refer to Figure 5.7.) These contacts function when the M contactor is energized.

The Kit contains only a Module that has a wire harness attached. Users supply the wiring to external devices. Size is dependent on the specific application. It should not exceed AWG No. 14.

The maximum rating of each contact is 1 ampere at 30 VDC (resistive) or 0.5 ampere at 120 VAC (resistive).

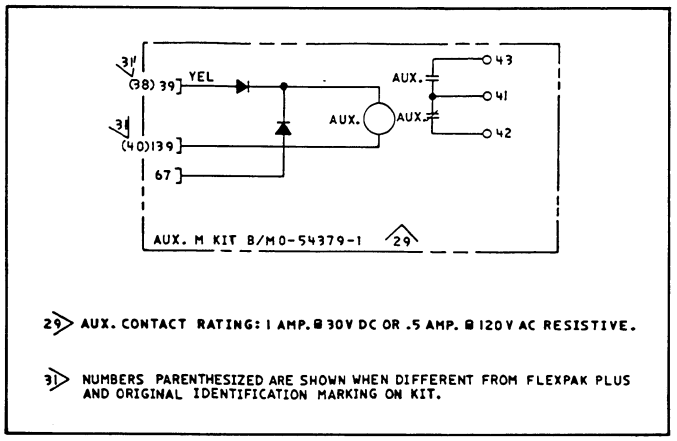


Figure 5.7. Auxiliary M Contactor schematic diagram.

Under **no** circumstances should these contacts be used to control brakes or other power loads.

To install the Kit, follow these procedures.

Step 1 — Mount the Auxiliary M Contactor Module on the Mounting Bracket. (Refer to Figure 5.6.) Note that orientation is important. The overhanging edge of the assembly **must** hang over the Regulator Module. Then snap the assembly into the Bracket.

Step 2 — Connect the three-wire harness to the Regulator Module. Locate the letters AUX. M printed on the Module near a three-pin connector. (Refer to Figure 6.3.) The connector fits on the bayonet pins. Note that the yellow (39) wire **must** connect with the pin marked YEL 38 on the Regulator Module.

Step 3 — Route external wiring to the Module's terminal block. Do not strip more than ¼ inch (6 mm) of insulation from the wires since shorts could occur at exposed points.

5.4 Position Loop — The Position Loop Kit (Figure 5.8) is used in conjunction with the Process Line Kit. It will provide the necessary electronics for most vernier and true position applications without the need of an additional rack and 44-pin module. It also provides the ability to be modified to serve for current or tension loop applications.

This Kit contains the Position Loop Module and two mounting screws. The circuit Module has been designed to include standard values for system interfacing but also provides for modifying the Module for specific applications. (Refer to Figure 6.6.)

To install the Kit, follow these procedures.

Step 1 — Orient the Position Loop Module over the Process Line Module so the pin guides on the Module are aligned over the pin connectors.

NOTE: *The pins on all new Modules have been lubricated. Older modules must have the contact pins cleaned and re-lubricated (Amp Lubricant 561232-1 or equivalent) before installing this Module.*

Step 2 — Connect the black pig-tail jumper at location AD51 on the Process Line Module to pin 167.

Step 3 — It is important that all modifications and interconnections on the Position Loop Module be duplicated onto any replacement Position Loop Module used on the drive system. This includes jumpers, added/deleted components and all external connections. This will ensure maintaining the same performance and operating characteristics of the drive system.

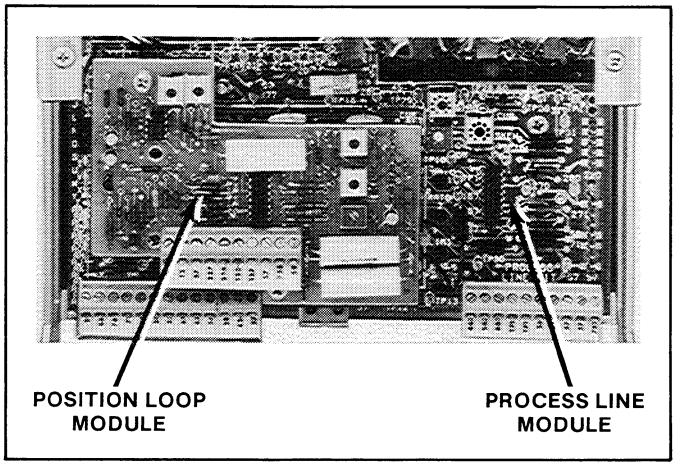


Figure 5.8. Position Loop Kit installed.

SECTION 6
TROUBLESHOOTING

6.0 General — This Section details troubleshooting information for the Regenerative FlexPak Plus (S2R) controller. Its organization is as follows:

- General troubleshooting concepts (Paragraphs 6.1, 6.2, 6.3 and 6.4)
- Specific symptom/probable cause/recommended procedures (Paragraph 6.5)
- Reference schematics of the controller (Paragraph 6.6)

DANGER
CONTROLLER EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE POWER UNIT IN THE CONTROLLER. THUS, A-C POWER MUST BE REMOVED FROM THE UNIT BEFORE IT IS SAFE TO TOUCH THE INTERNAL PARTS OF THE CONTROLLER. PERSONAL INJURY MAY RESULT UNLESS POWER IS REMOVED.

DANGER
THE CONTROLLER SHOULD BE SERVICED ONLY BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF ALL APPLICATION EQUIPMENT IN THE SYSTEM. PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY OCCUR IF INDIVIDUALS ARE NOT FAMILIAR WITH THE HAZARDS RESULTING FROM IMPROPER OPERATION.

In addition to step-by-step troubleshooting procedures, there are some generalized comments that should be kept in mind at all times. These may be divided into wiring errors (Paragraph 6.1), incoming A-C line problems (Paragraph 6.2), motor problems (Paragraph 6.3) and mechanical problems (Paragraph 6.4).

6.1 Wiring Errors — The single most common problem preventing normal D-C drive operation is incorrect wiring within a system. A maintenance person should carefully look over the wiring before taking active steps involving tests and replacement. Remember that a loose or grounded wire can occur in a controller that had previously been functioning correctly if initial wiring techniques were poorly performed.

For those not familiar with proper Regenerative FlexPak Plus (S2R) controller wiring, other Sections in this manual may be consulted. For more complex problems, Section 5 may be used to uncover wiring problems in the optional Modification Kits.

6.2 A-C Line Problems — The following are typical problems located on the incoming A-C line:

- A-C line voltage incorrect for the specific controller, which may operate on 115 **or** 230 VAC.
- Main disconnect switch contains fuses improperly rated for the drive. (The fuses must be large enough to prevent nuisance tripping yet small enough to protect the circuit and equipment on the circuit.) Refer to Table 3.A.
- A-C conductors must be of adequate size for the application. Refer to Table 3.A.
- If an isolation transformer is used, it must be sized according to the requirements of the drive system. The transformer itself must be wired for the correct output voltage (115/230 VAC) in relation to the Regenerative FlexPak Plus (S2R) controller.

6.3 Motor Problems — Do not overlook the possibility that the malfunction may be located in the drive motor. The following steps should become part of a troubleshooting routine:

- Recheck all motor connections for firmness and correct identification.
- Check that no obvious grounds have occurred on any of the wires. However, **do not** use a megger when checking for grounds unless the motor wiring to the Regenerative FlexPak Plus (S2R) controller is **completely** disconnected.
- A volt-ohmmeter (VOM) may be used for ground checking without disconnecting conductors to the Regenerative FlexPak Plus (S2R) controller.
- Check the field windings for open or short conditions.
- Check continuity through the armature and brushes. Use terminals A1 and A2 at the controller as test points.

6.4 Mechanical — It may be that the malfunction is a simple mechanical problem. The load on the drive motor may be too large, or it may have too high an inertia. The results are long stopping times and current-limit starting demands. Thus, the freedom of motion of the load device should be considered.

6.5 Controller Malfunctions — Table 6.B presents an organized troubleshooting sequence based on a symptom/probable cause/suggested procedure approach. It develops from the most simple, obvious malfunction to more complex ones.

Note that Reliance Electric color codes the wires to aid the identification of pin numbers, that is, locations. Table 6.A is a listing of these number-color combinations. These colors will be helpful in the following troubleshooting procedures.

6.6 Schematics, Diagrams — In order to aid with the troubleshooting process, various schematics and diagrams are included. Note that these drawings are the latest revisions as of the date of publication of this manual. The manufacturer cannot guarantee that subsequent changes will not occur; although, if any do, they should be minor. In cases of doubt, contact your local Reliance Electric Sales Office or Distributor.

Included are the following drawings:

- Figure 6.1 which is a simplified control circuit schematic for a controller.
- Figure 6.2 which is a timing chart for the relay control sequencing used with this controller.
- Figure 6.3 which is a copy of the screen used to mark the Regulator Module. It is useful in identifying locations on the board. Note that the shaded area indicates the systems kit location.
- Figure 6.4 which is a schematic for the controller.
- Figure 6.5 which is a schematic for the Process Line Kit.
- Figure 6.6 which is a schematic for the Position Loop Kit.
- Figure 6.7 which may be used to locate major assemblies in the controller. It also lists various technical data although all of this information is included in other parts of the manual.
- Figure 6.8 Position Loop Kit Module Screen.
- Figure 6.9 Process Line Kit Module Screen.

Table 6.A. Color-coding system.

Components	No.	Color
Wire Harness M Contactor	66 38 38 40 36	BLUE GRAY BROWN ORANGE GREEN
Thermostat Harness	32 132 232	RED ORANGE BLACK
Auxiliary M	38	YELLOW

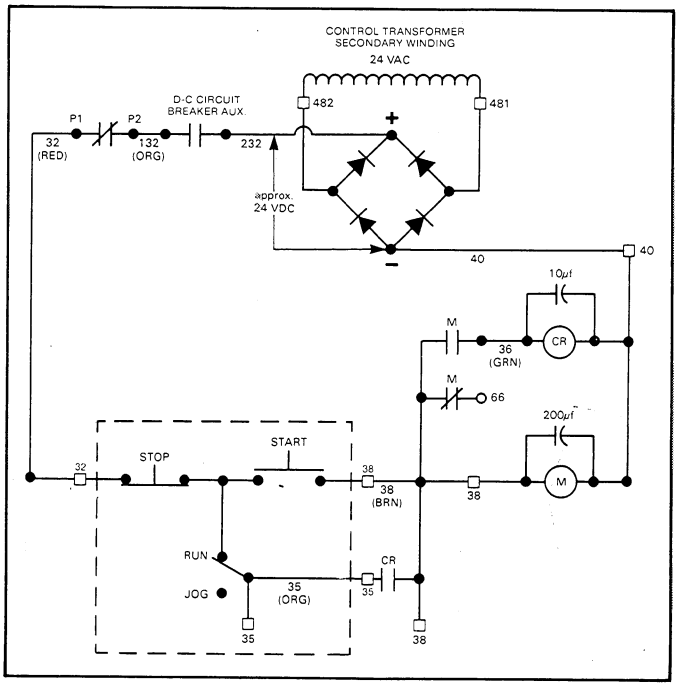


Figure 6.1. Simplified control circuit schematic.

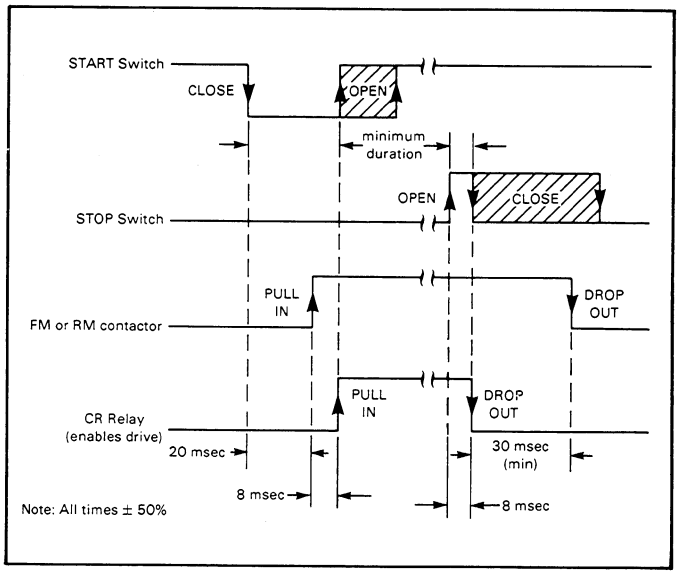


Figure 6.2. Relay control sequencing.

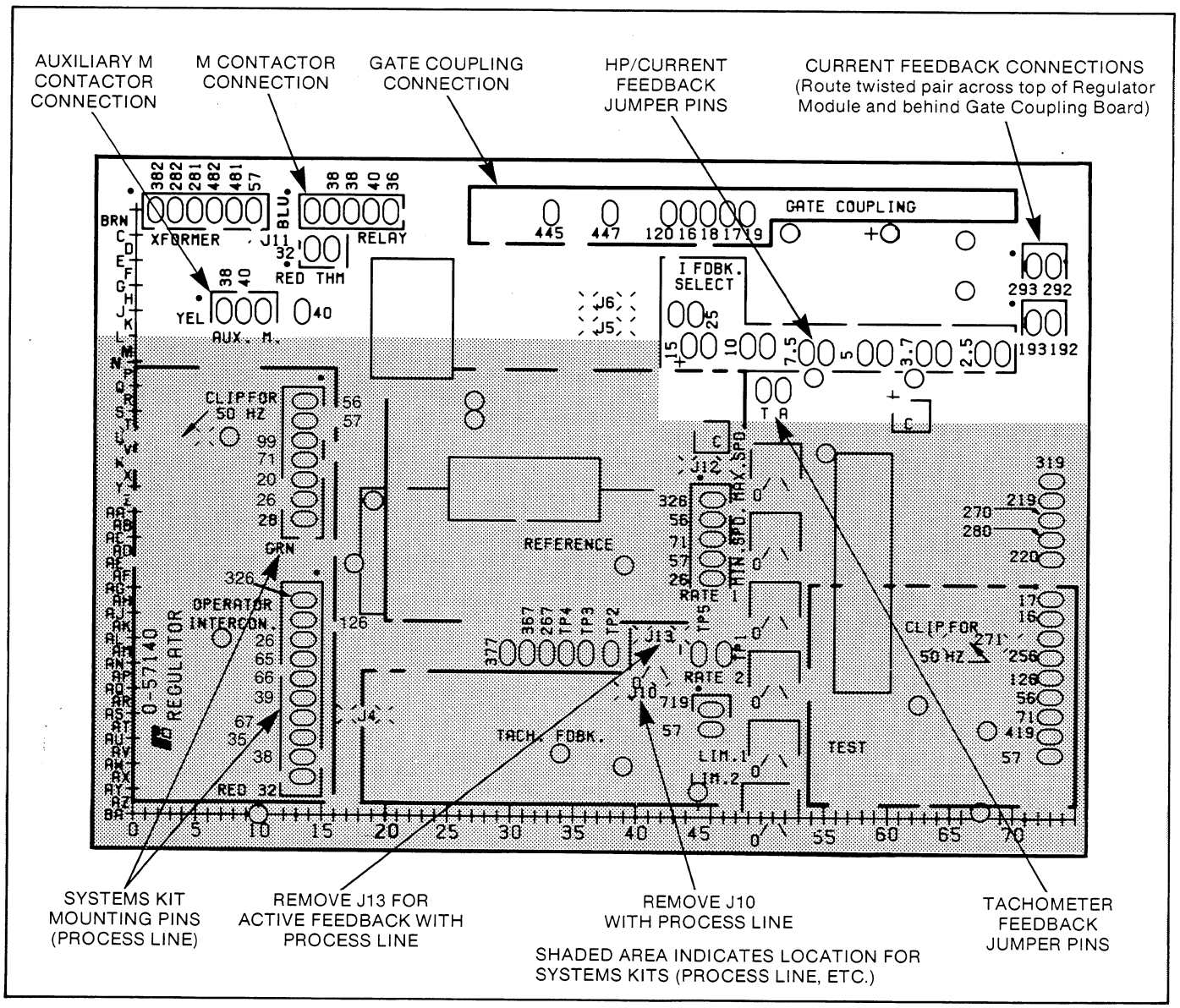


Figure 6.3. Regulator Module screen.

Table 6.B. Troubleshooting suggestions.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED PROCEDURES
1. POWER ON/OFF circuit breaker trips or fuses clear when power is applied.	Incorrect wiring connections to controller; from controller to motor; in motor.	**DANGER** **IF CIRCUIT BREAKER HAS TRIPPED OR FUSES HAVE CLEARED, USER MUST INSPECT THE FIELD SUPPLY AND ITS WIRING FOR DAMAGE. AFTER RE-APPLYING POWER TO THE DRIVE, THE FIELD VOLTAGE MUST BE RE-CHECKED FOR PROPER VOLTAGE AT MOTOR TERMINALS F1, F2. IF THIS VOLTAGE IS BELOW 90% OF THE FIELD VOLTAGE SPECIFIED ON THE MOTOR NAMEPLATE, THE DRIVE MUST NOT BE STARTED UNTIL PROPER VOLTAGE IS OBTAINED. FAILURE TO FOLLOW THIS PROCEDURE COULD RESULT IN OVERSPEEDING THE MOTOR AND/OR THE MACHINERY COUPLED TO THE MOTOR SHAFT AND POSSIBLE FATAL INJURY.** ☐ Remove A-C power at the disconnect. ☐ Remove leads to L1, L2, 45, 47 and, if used, F1, F2, on **incoming** side of controller's 1TB and 2TB. (Refer to Figure 3.4.) ☐ Open the power disconnect switch. ☐ Check for a ground condition at L1/181, L2/182, 45, 47, F1 and F2. Do this at controller (internal) side of 1TB and 2TB. If a ground is discovered, check wiring connections on POWER ON/OFF circuit breaker or fuse block and power disconnect. Also check connection to Power Cube and motor field terminals F1 and F2. ☐ If no ground exists, examine the controller chassis for loose wires and/or foreign objects. ☐ If no ground exists and if no foreign objects are discovered, reconnect the incoming conductors 45, 47 and, if used, F1 and F2. Then check for grounds at these terminals. ☐ If a ground is found, it is in the conductors to the motor or in the motor itself. ☐ Disconnect the motor from the conductors at the drive motor. ☐ Test 45, 47, F1 and F2 conductors for a ground. (If one exists, examine connections and insulation for areas where shorts could occur.) ☐ If no grounds are found in the conductors, check the motor for a ground condition. If a ground is located here, examine and/or replace the motor, as necessary.
	Short in Power Cube.	☐ Replace Power Cube.
	Short in Field Supply.	☐ Replace Diode Bridge in Field Supply. Inspect wires and connections to Field Supply. Replace all damaged wires and connectors.
	Short in Control XFMR.	☐ Replace Control XFMR.
2. Drive motor does not start.	Main A-C line disconnect not closed; or fuse blown; or no power applied ahead of disconnect.	☐ Check disconnect switch, fuses in it, and voltage on line.
	Drive interlocks preventing operation.	☐ Verify that all user-installed interlocks are in a state (physical condition and wiring connections) to allow a start.
	Drive motor thermostat wires not connected on controller terminals 32 and 132 on 2TB.	☐ Check connections to thermostat: at drive motor P1, P2; at controller 32, 132. ☐ Check for open thermostat inside motor. Make a resistance check of thermostat. (It should read a short, or low resistance, if it is closed.)
	External overload wires not connected on controller terminals 32 and 132 on 2TB.	☐ Check connections to external overload. ☐ Check for open overload. Make a resistance check to overload. (It should read a short, or low resistance, if it is closed.)
	D-C circuit breaker open.	☐ Check for motor ground conditions before resetting.
3. Controller's M contactor not picking up when START switch is pressed (closed).	Malfunctioning switches.	☐ Remove A-C line power at main disconnect. ☐ Check START/STOP switch. ☐ Connect ohmmeter to terminal 32 on the remote operator interface connector. ☐ Touch probe to terminal 38 on the remote operator interface connector. ☐ Place switch in the START (closed) position. ☐ If the switch is properly functioning, a short will be seen on the meter. ☐ Check the STOP function. Place the RUN/JOG switch in the RUN position. Connect the ohmmeter to terminals 32 and 35. Place the switch in the STOP position, which should open it if it is functioning correctly. If there is a short, it will be seen on the meter. If there is no short, the circuit is opened, and the switch is functioning correctly. ☐ Using similar techniques, test the RUN/JOG switch in the RUN position at terminals 32 and 35. When the switch is in the RUN position, a short should be read.
	M contactor malfunctioning.	☐ Open the power disconnect switch. ☐ Examine M contactor for proper wiring. ☐ On the M contactor, connect an ohmmeter on the brown (terminal 38) and blue (terminal 66) wires. A short should be read. ☐ Connect the ohmmeter on the orange (terminal 40) and brown (terminal 38) wires. The reading should be approximately 230 ohms. ☐ If these readings cannot be obtained, replace the M contactor. (Refer to Table 7.A.)

Table 6.B. Troubleshooting suggestions (continued).

SYMPTOM	PROBABLE CAUSE	RECOMMENDED PROCEDURES
4. M contactor picks up but remains in only when START pushbutton is pressed and held in.	RUN/JOG switch is in JOG position.	**DANGER** **THE PROCEDURE DESCRIBED HERE IS PERFORMED WITH LIVE A-C VOLTAGE APPLIED TO THE CONTROLLER. USE ONLY ONE HAND TO APPLY VOM LEADS/ PROBES. KEEP YOUR OTHER HAND BEHIND YOU AT ALL TIMES. DO NOT HOLD ONTO THE CONTROLLER FOR SUPPORT. PERSONAL INJURY MAY RESULT IF THESE PRECAUTIONS ARE NOT TAKEN.** ☐ Apply A-C power to the controller. ☐ Place the RUN/JOG switch in the RUN position.
	Cr relay not picking up.	☐ Connect a volt-ohmmeter on the remote operator interface. Place it on terminal 35. ☐ Non-reversing controllers, connect the second probe to the 40 (orange) wire connected to the M contactor. Reversing controllers, connect the second probe to the 40A terminal of the terminal board located on the bracket in front of the contactors. ☐ The reading should be +24 VDC for normal operation. (Refer to Figure 6.1 to see the logic of this test.) ☐ Next, shift the probe from the terminal 35 to terminal 38 on the same terminal board. However, leave the second probe where it is. ☐ Press the START switch. The reading should be approximately 24 VDC for normal operation. (Refer to Figure 6.1 to see the logic of this test.) ☐ Press the START/STOP switch to STOP, and then START. A 24 VDC (approximate) reading should continue to appear. If it does not, the CR relay is not picking up. In this case, replace the Regulator Module.
5. Drive motor does not run, but M contactor and Cr pull up.	No input signal from SPEED potentiometer on Control Station.	☐ Inspect the Regulator Module to determine that jumper J4 **is in place.** ☐ Check the SPEED potentiometer on the Control Station. First, open the power disconnect switch. ☐ Connect a volt-ohmmeter to the Regulator Module remote operator interface terminal inputs. Connect one lead to terminal 28. Connect the other to terminal 57. (Refer to Figure 3.4 for a Remote Station.) ☐ For proper operation, the reading should be 5K ohms. ☐ Disconnect the volt-ohmmeter lead from terminal 57. Connect it to terminal 426. ☐ Turn the SPEED potentiometer from 10 to 0. The resistance should vary from 5K to 0 ohms. If it does not, replace the potentiometer.
6. Drive motor does not run with M contactor picked up and SPEED potentiometer properly operating.	No output from Power Cubes.	☐ Open the power disconnect switch. ☐ Examine armature wiring. ☐ Check armature wiring for loose connections. ☐ Turn A-C power on again. **DANGER** **THE PROCEDURE DESCRIBED HERE IS PERFORMED WITH LIVE A-C VOLTAGE APPLIED TO THE CONTROLLER. USE ONLY ONE HAND TO APPLY VOM LEADS/ PROBES. KEEP YOUR OTHER HAND BEHIND YOU AT ALL TIMES. DO NOT HOLD ONTO THE CONTROLLER FOR SUPPORT. PERSONAL INJURY MAY RESULT IF THESE PRECAUTIONS ARE NOT TAKEN.** ☐ Connect a volt-ohmmeter to terminals A1 and A2 on 1TB. (Refer to Figure 3.4.) ☐ Place the START/STOP switch in the START position. ☐ Increase the speed reference by turning the SPEED dial in the direction of 10. ☐ The reading across A1 and A2 should be 0 to 90 VDC for 115 VAC controllers. It should be 0 to 180 for 230 VAC controllers. ☐ If no reading is obtained across A1 and A2, it may be necessary to replace the Power Cubes and/or the Regulator Module. In order to determine which, read on.
	Regulator Module suspected because no output reading at A1, A2.	☐ Test the Regulator Module for firing pulses. ☐ Open the power disconnect switch. ☐ Locate the 50μf capacitor at R27-43 and put the voltmeter (−) lead to R27. ☐ Locate the four diodes on the Gate Coupling board near the words "Gate Coupling Card." Connect the (+) meter lead to the anode of the left-most diode (D1). (The anodes are the leads nearest the pulse transformers and **without** the I.D. white circle.) Put the voltmeter on a low A-C volt scale. ☐ Restore A-C power to the controller. Put FORWARD/REVERSE switch in REVERSE. ☐ Place the START/STOP switch in the START position. ☐ Turn the SPEED pot up to about 5. ☐ The reading on the VOM should be about −0.7 VAC. ☐ Turn the START/STOP switch to STOP and remove A-C power. ☐ Repeat this test with (+) meter lead on the next diode to the right (D2). ☐ Repeat the test with FORWARD/REVERSE switch in the FORWARD position and the (+) meter lead on each of the two right-most diodes (D3 and D4). ☐ If any of the four readings cannot be obtained, replace the Regulator Module.
Continue this symptom on next page.		

Table 6.B. Troubleshooting suggestions (continued).

SYMPTOM	PROBABLE CAUSE	RECOMMENDED PROCEDURES
6. Drive motor does not run with M contactor picked up and SPEED potentiometer properly operating. (Continued)	Power Cubes suspected because no output reading at A1, A2.	☐ Establish that the Power Cubes are receiving pulse inputs at the connector on the Regulator Module. (Refer to "Regulator Module suspected," Symptom 6.) ☐ If the Power Cubes are receiving pulses yet there is no reading across A1 and A2, determine that the main contacts on the M contactor are closing. ☐ In order to check the contacts, replace the drive motor with a light bulb wired to the armature terminals 47 and 45 at 1TB (on 230 VAC controllers use two light bulbs in series). ☐ If the light does not light, replace the Power Cubes.
7. Motor runs but current peaks too high.	One phase not firing.	☐ Perform the procedure for "Regulator Module suspected," Symptom 6, because no output reading at A1, A2. If all pulses are present, one or more Power Cubes are faulty.

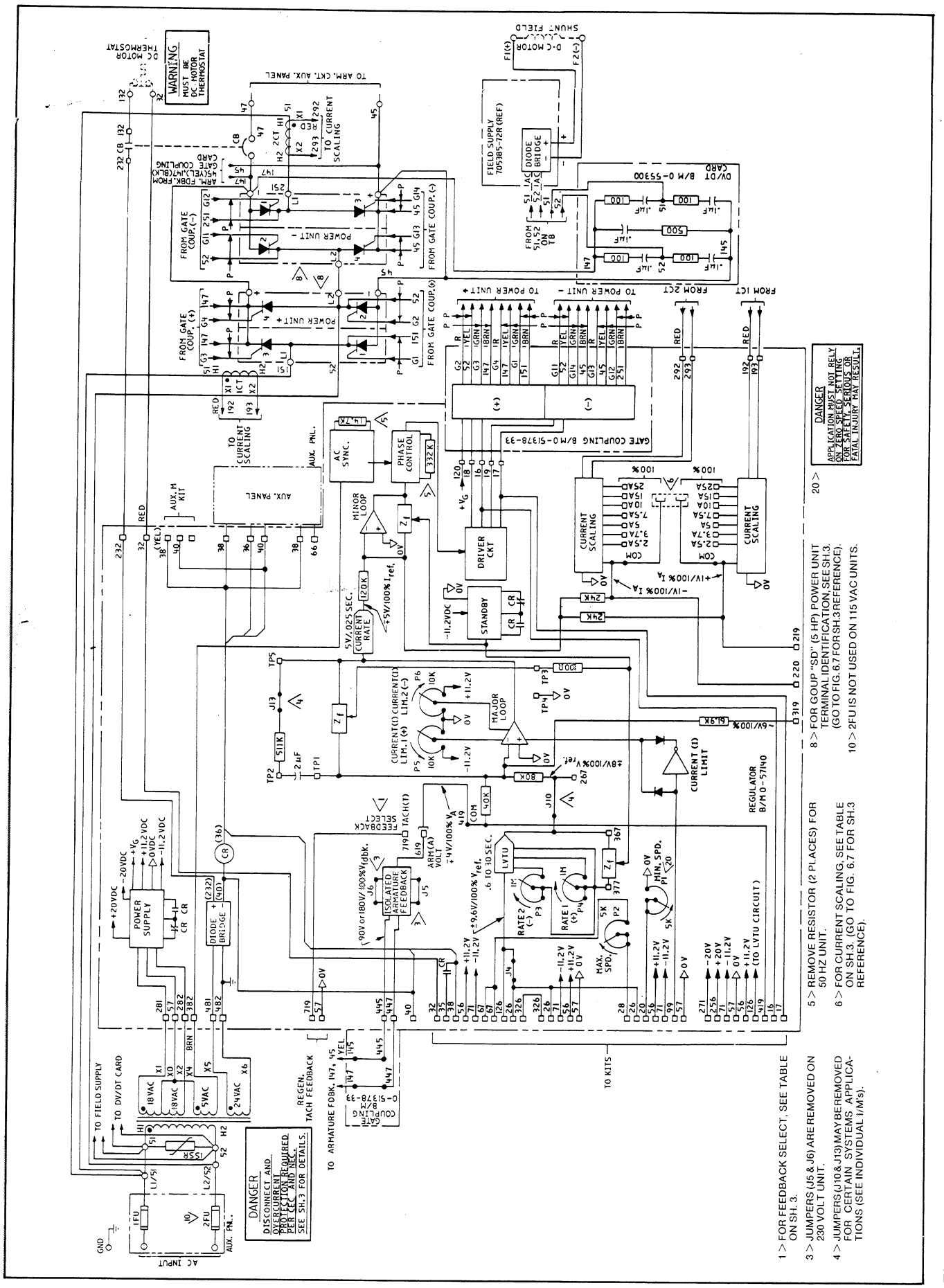


Figure 6.4. Typical controller schematic.

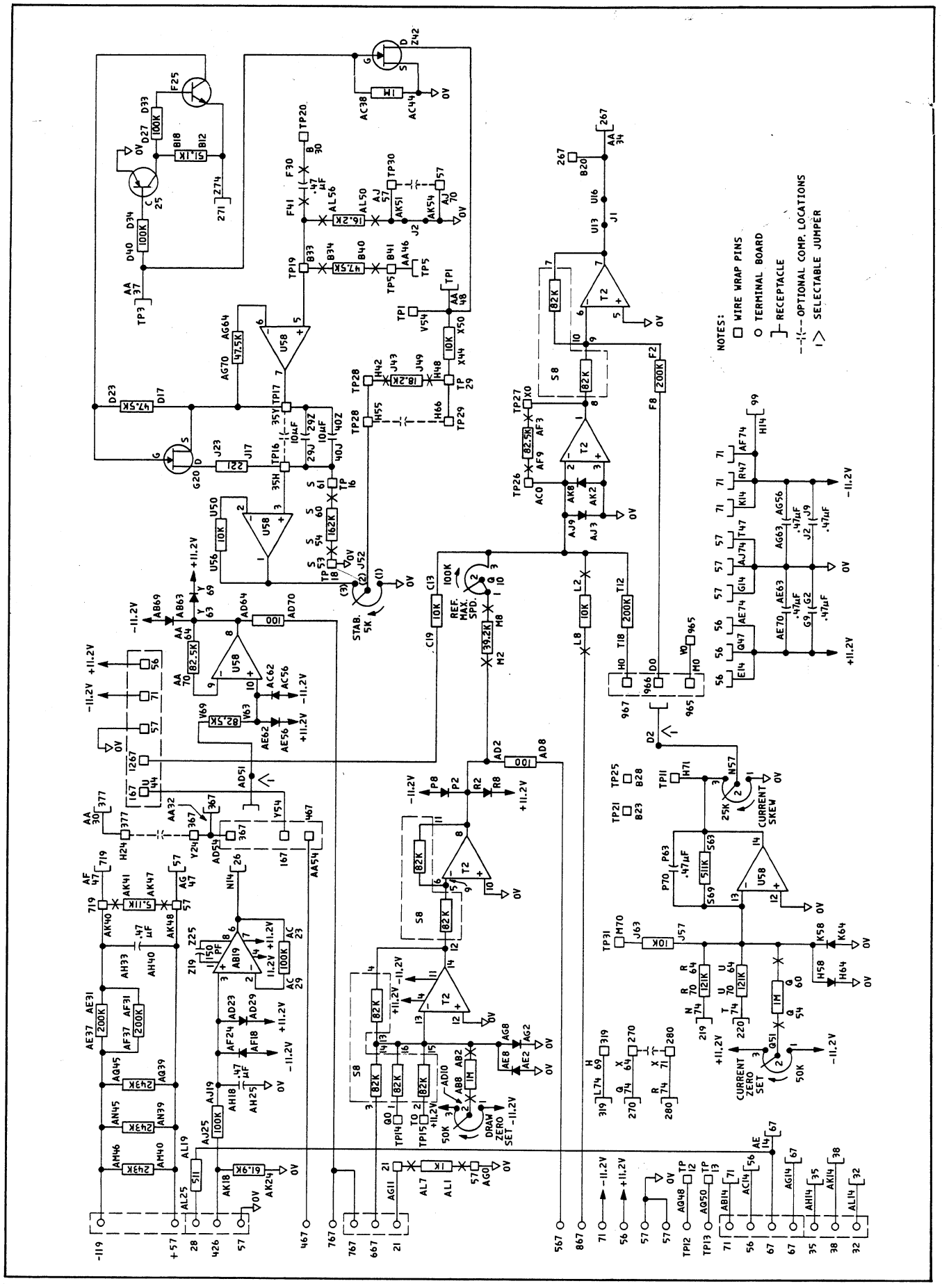


Figure 6.5. Process Line schematic.

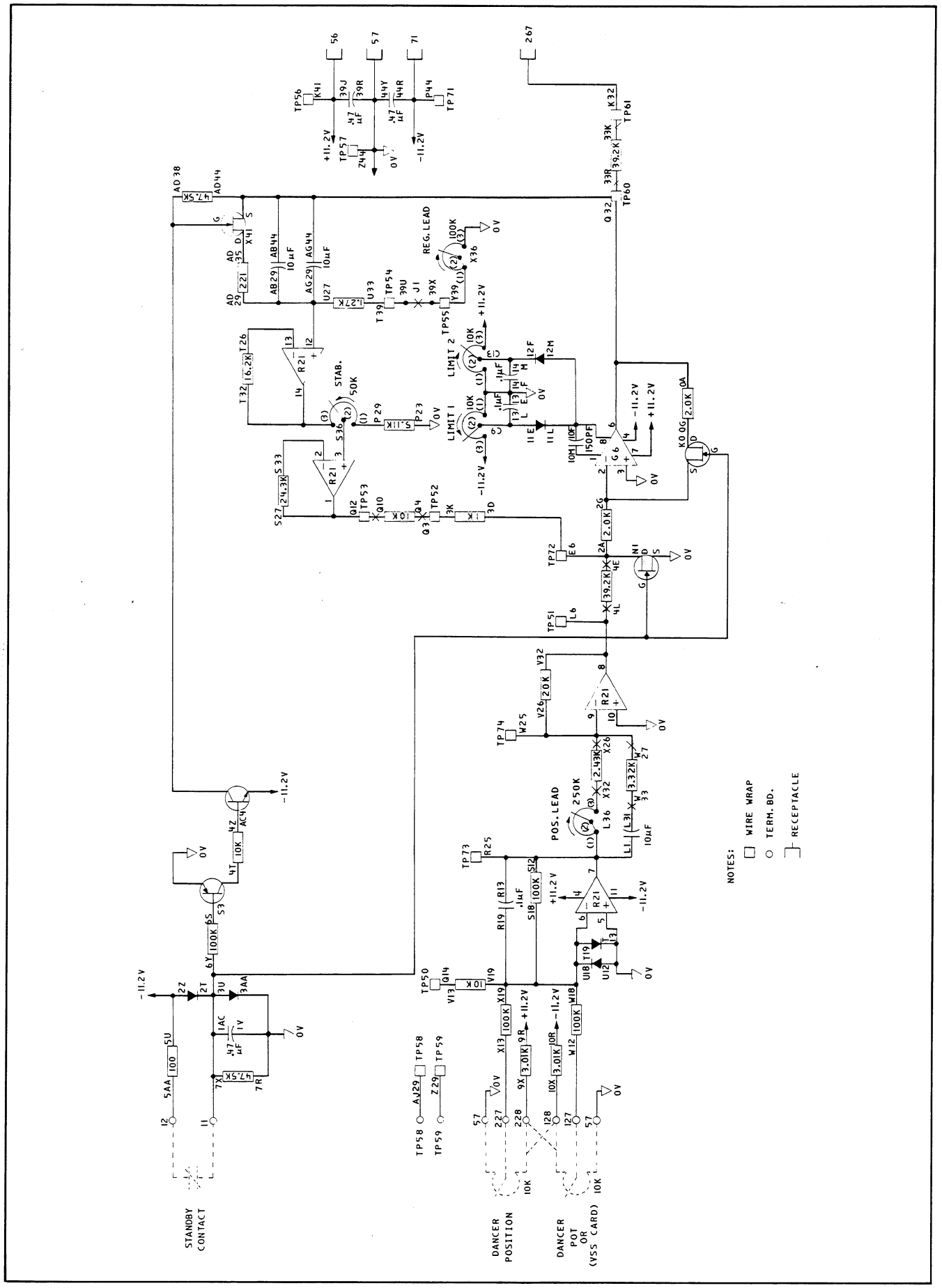
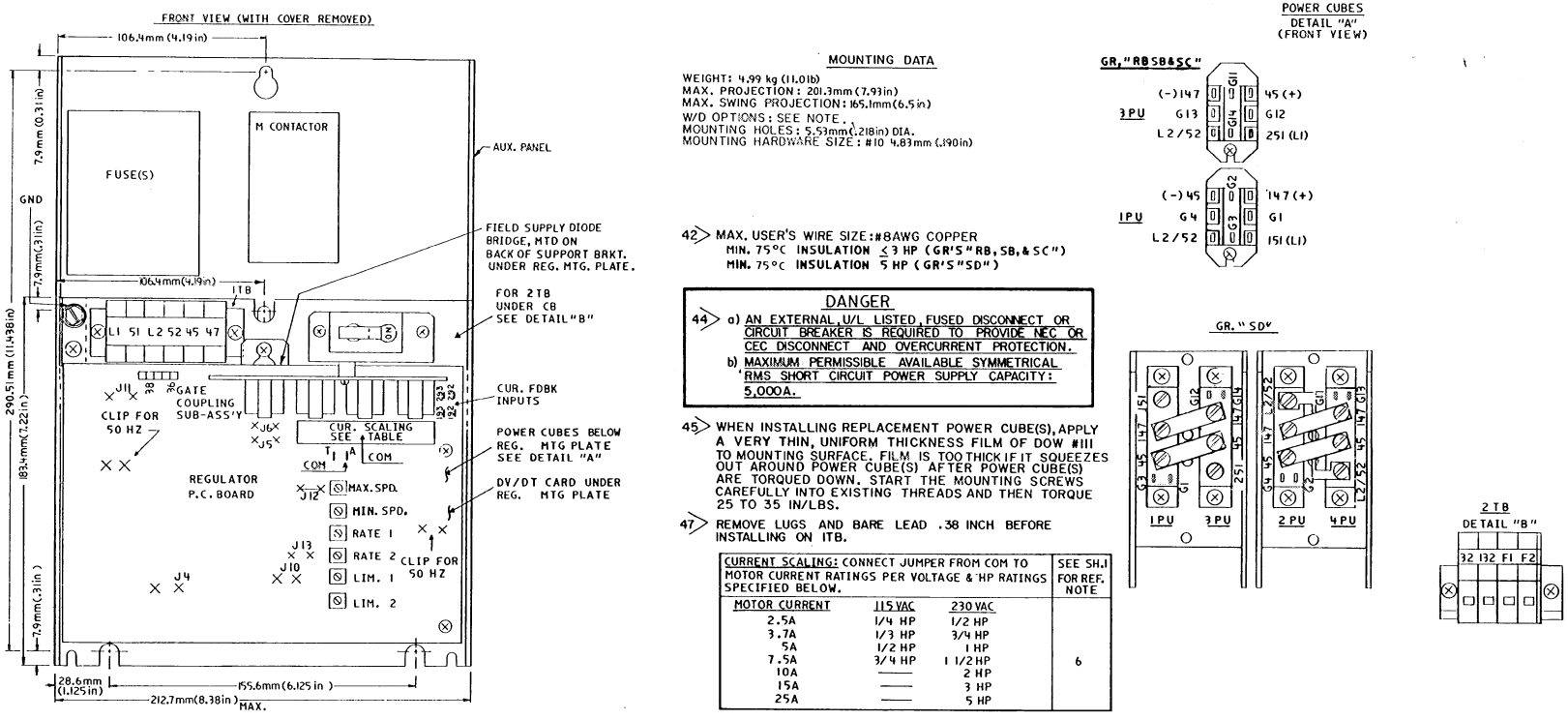


Figure 6.6. Position Loop schematic.



MOUNTING DATA

WEIGHT: 4.99 kg (11.0lb)
MAX. PROJECTION: 201.3mm (7.93in)
MAX. SWING PROJECTION: 165.1mm (6.5in)
W/D OPTIONS: SEE NOTE .
MOUNTING HOLES: 5.53mm (.218in) DIA.
MOUNTING HARDWARE SIZE: #10 4.83mm (.190in)

42> MAX. USER'S WIRE SIZE: #8AWG COPPER
MIN. 75°C INSULATION ≤ 3 HP (GR'S "RB, SB, & SC")
MIN. 75°C INSULATION 5 HP (GR'S "SD")

DANGER

44> a) AN EXTERNAL, U/L LISTED, FUSED DISCONNECT OR CIRCUIT BREAKER IS REQUIRED TO PROVIDE NEC OR CEC DISCONNECT AND OVERCURRENT PROTECTION.
b) MAXIMUM PERMISSIBLE AVAILABLE SYMMETRICAL RMS SHORT CIRCUIT POWER SUPPLY CAPACITY: 5,000A.

45> WHEN INSTALLING REPLACEMENT POWER CUBE(S), APPLY A VERY THIN, UNIFORM THICKNESS FILM OF DOW #111 TO MOUNTING SURFACE. FILM IS TOO THICK IF IT SQUEEZES OUT AROUND POWER CUBE(S) AFTER POWER CUBE(S) ARE TORQUED DOWN. START THE MOUNTING SCREWS CAREFULLY INTO EXISTING THREADS AND THEN TORQUE 25 TO 35 IN/LBS.

47> REMOVE LUGS AND BARE LEAD .38 INCH BEFORE INSTALLING ON 1TB.

POWER CUBES DETAIL "A" (FRONT VIEW)

GR, "RB SB & SC"

GR. "SD"

2TB DETAIL "B"

CURRENT SCALING: CONNECT JUMPER FROM COM TO MOTOR CURRENT RATINGS PER VOLTAGE & HP RATINGS SPECIFIED BELOW.			SEE SH.1 FOR REF. NOTE
MOTOR CURRENT	115 VAC	230 VAC	
2.5A	1/4 HP	1/2 HP	
3.7A	1/3 HP	3/4 HP	
5A	1/2 HP	1 HP	
7.5A	3/4 HP	1 1/2 HP	6
10A	——	2 HP	
15A	——	3 HP	
25A	——	5 HP	

42>

WIRING DIA. 30046	REF. ASS'Y 80154	PANEL RATING <44 MAX. RATED HP	AC INPUT VOLTS	AC INPUT AMPS	DC OUTPUT VOLTS	DC OUTPUT AMPS	REPLACEMENT PARTS TABLE: CURRENT TRANSFORMER 1CT	CURRENT TRANSFORMER 2CT	POWER CUBE <45	CIRCUIT BREAKER DC (CB)	CONTROL TRANSF. (1T)	REGULATOR P.C. BOARD	FIELD DIODE (1D)	SUPPRESSOR (1SSR) 47>	DV/DT CARD	GATE COUPLING SUB-ASS'Y	AUX. PANEL
RB	RB	3/4	115	10.5	90	7.5	64670-19R	64670-19V	701819-303AC (2 REQ'D)	65241-37H	411027-61R	0-57140 <43 <5	——	411026-4X	0-55300	608870-48R	801592-71RB
SB	SB	1 1/2	230	10.5	180	7.5	64670-19R	64670-19V	701819-303AC (2 REQ'D)	65241-37H	411027-61S		——	411026-4AC		608870-48R	801592-71SB
SC	SC	3	230	21	180	15	64670-19R	64670-19V	701819-303AC (2 REQ'D)	65241-54D			701819-12AD			608870-48S	801592-71SC
SD	SD	5	230	35	180	25	64670-19T	64670-19X	701819-19AC (4 REQ'D)				701819-12AD			608870-48T	801592-71SD

GO TO FIG. 6.4 FOR SH.1 REFERENCE.

JUMPER	FUNCTION	SEE SH.1 FOR REF. NOTE
J4	ALWAYS PRESENT ON W/D 30046.	——
J5, J6	JUMPERS ARE REMOVED ON 230V UNITS.	3
J10, J13	JUMPER MAY BE REMOVED FOR SYSTEMS APPLICATION ONLY.	4
J11, J12	NOT INSTALLED ON W/D 30046.	——

VOLTAGE FEEDBACK		SEE SH.1 FOR REF. NOTE
JUMPER	FUNCTION	
A - COM	CONNECTION FOR ARMATURE FEEDBACK.	1
T - COM	CONNECTION FOR TACH FEEDBACK WHEN TACH FEEDBACK IS USED.	

Figure 6.7. Controller technical data.

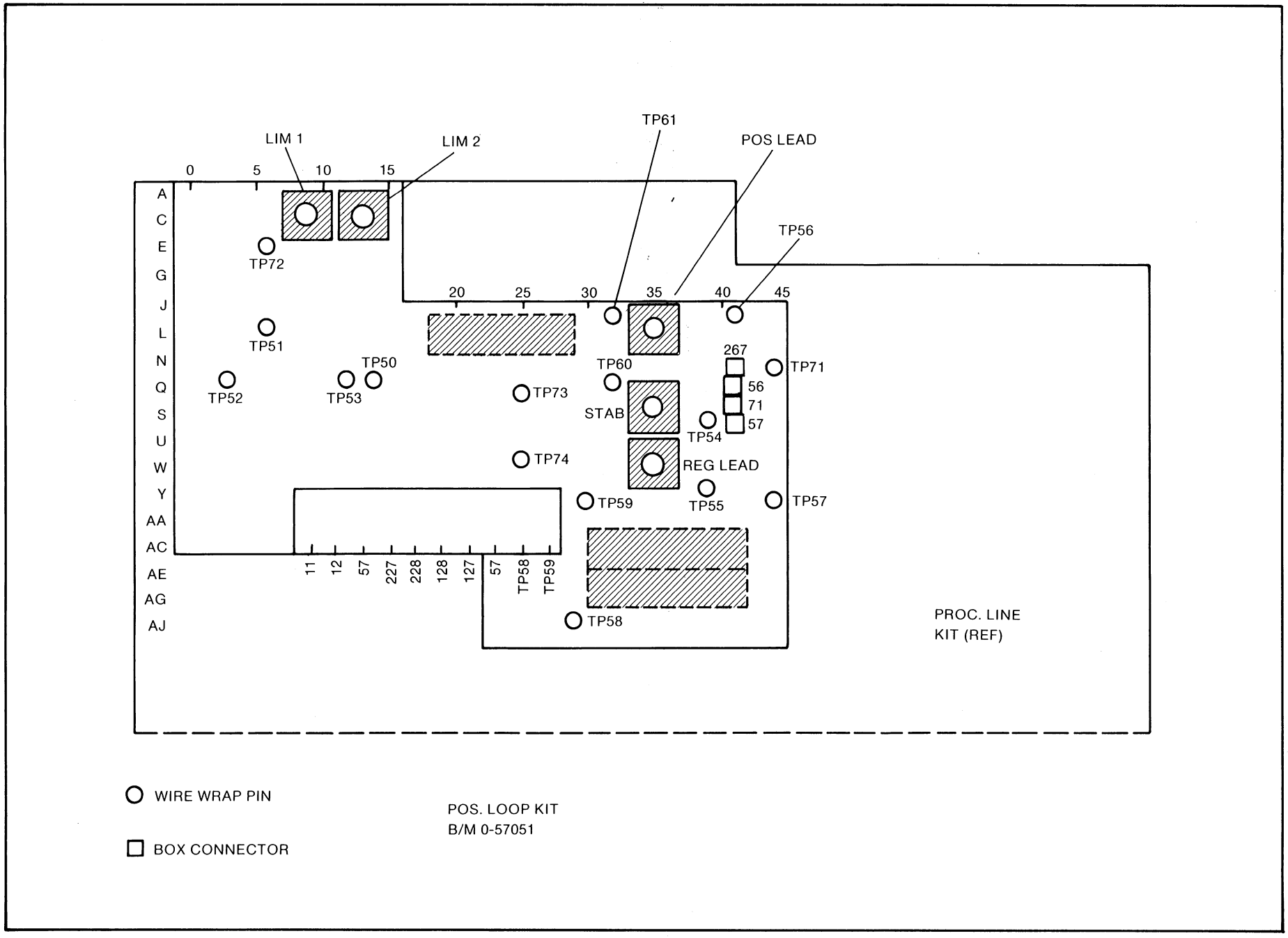


Figure 6.8. Position Loop Kit Module Screen.

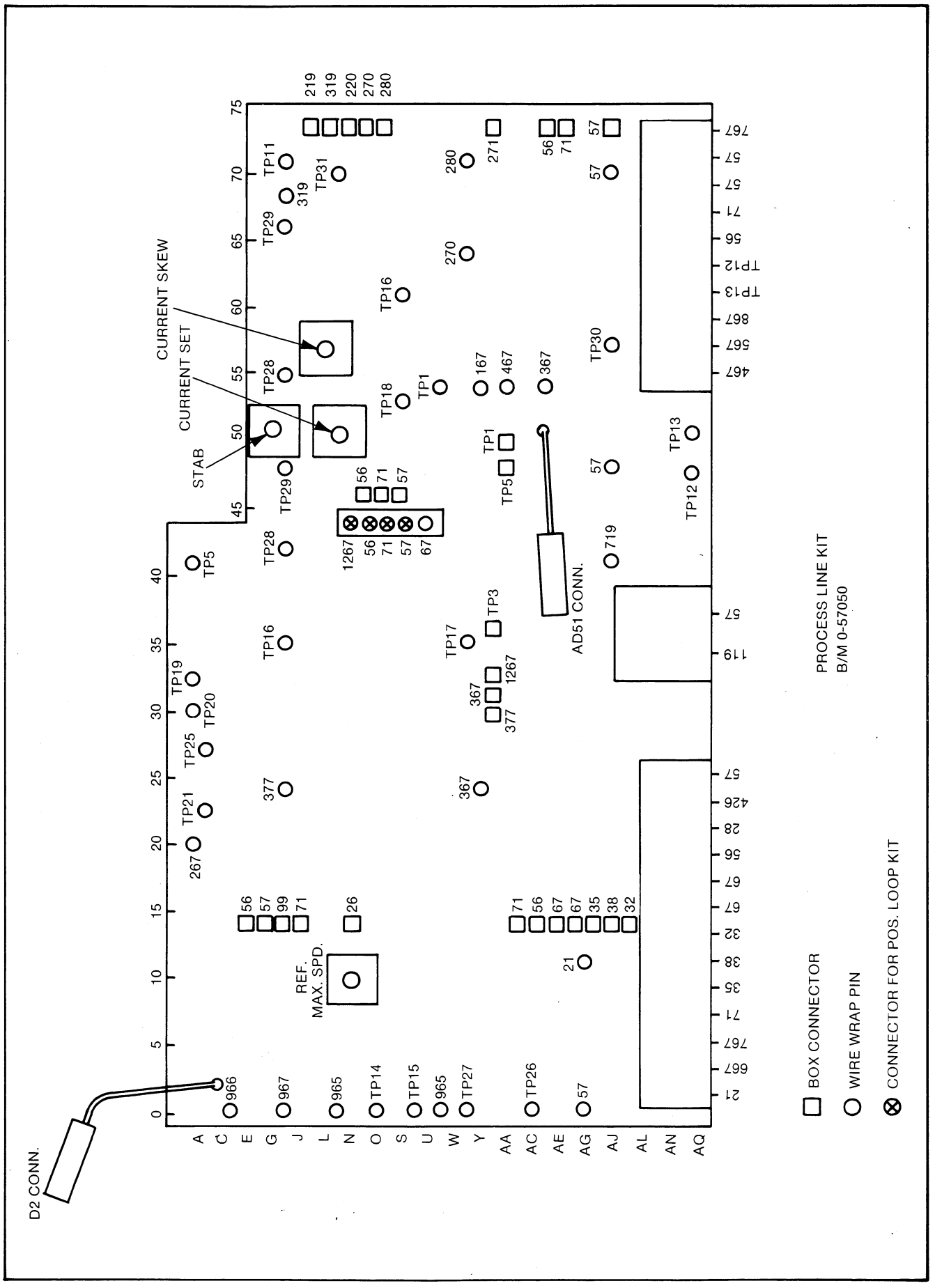


Figure 6.9. Process Line Kit Module Screen

SECTION 7
REPLACEMENT PARTS

7.0 General — Users should consider maintaining a stock of spare parts. Table 7.A lists the more common parts along with part numbers and quantities actually used in the controller.

Table 7.A. Replacement Modules.

Part Description	Quantity Per Controller	Part Number
Regulator Module	1	0-57140
Gate Coupling Module		
¼ to 2 hp	1	608870-48S
3 hp	1	608870-48S
5 hp	1	608870-48T
Power Cube		
¼ to ¾ hp 115 VAC	2	701819-303AC
½ to 1½ hp 230 VAC	2	701819-303AC
2 and 3 hp 230 VAC	2	701819-303AC
5 hp 230 VAC	4	701819-19AC
M Contactor	1	69326-30R
Fuse, Class K5 or RK5		
¼ to ¾ hp 115 VAC	1	64676-1W
½ to 1½ hp 230 VAC	2	64676-1W
2 and 3 hp 230 VAC	2	64676-1Y
5 hp 230 VAC	2	64676-1AC
MOV Surge Suppressor		
115-volt drives	1	411026-4X
230-volt drives	1	411026-4AC
Control Transformer		
115-volt drives	1	411027-61R
230-volt drives	1	411027-61S
DV/DT Module	1	0-55300
Dynamic Braking		
¼ to ½ hp 115 VAC	1	705385-61R
2 to 3 hp 230 VAC	1	705385-61R
¾ hp 115 VAC	1	705385-61S
½ to 1½ and 5 hp 230 VAC	1	705385-61T
Field Supply	1	701819-12AD

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