7722-SV

AC Vector Control Manual

Control Model: 71X-XXX-175X
(Bipolar)

Installation and Operation Manual

Software Version 2.02

April 26, 1993 Rev A

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Introduction

Purpose

The purpose of this manual is to provide installation, setup, operation, reference and troubleshooting information for the 71X series Encoder Feedback Vector Controllers.

NOTE: If you are experienced with the installation and set-up of drives, motors and control equipment you may wish to skip ahead to the flowchart at the beginning of Chapter 2. Each block of the flowchart represents the title of appropriate sections of this manual, including elevator applications.

About This Manual

This manual uses the following icons to highlight points of interest:

Indicates a note of interest.

Indicates a safety warning; read the comments before continuing.

Indicates possible high voltage present. Always insure that AC line voltage is off and that DC Bus Voltage is below 10 volts by measuring with a voltage meter before proceeding.

Indicates instructions for factory support.

NOTE: The words Controller and Drive are used interchangeably throughout this manual.

For Additional Information or Assistance

If you require assistance or information please contact Baldor=Sweodrive at:

4330 150th Ave NE
Redmond, WA 98052-5301

(206) 867-9677 (7:00AM - 5:00PM Pacific Standard Time)
Fax: (206) 867-9719

Please have drive and motor information available when you call.

Chapter 1
General Information

Factory Assistance

Should it become necessary to contact the factory for assistance, please have the following information and Control Nameplate Data on hand when you call:

Control Model Number: _____

Control Serial Number: _____

The Application of the Control: _____

Safety Notice

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

- USE EXTREME CAUTION, DO NOT TOUCH ANY CIRCUIT BOARD, POWER DEVICE OR ELECTRICAL CONNECTION WITHOUT INSURING THAT HIGH VOLTAGE IS NOT PRESENT.
- THE UNIT MUST BE PROPERLY GROUNDED. DO NOT APPLY AC POWER BEFORE FOLLOWING GROUNDING INSTRUCTIONS.
- DO NOT OPEN COVER FOR 2 MINUTES AFTER REMOVING AC POWER, TO ALLOW CAPACITORS TO DISCHARGE.
- IMPROPER CONTROL OPERATION MAY CAUSE VIOLENT MOTION OF MOTOR SHAFT AND DRIVEN EQUIPMENT. BE CERTAIN THAT UNEXPECTED MOTOR SHAFT MOVEMENT WILL NOT CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT. PEAK TORQUES OF SEVERAL TIMES RATED MOTOR TORQUE CAN OCCUR DURING A CONTROL FAILURE.
- MOTOR CIRCUIT MAY HAVE HIGH VOLTAGE PRESENT WHENEVER AC POWER IS APPLIED, EVEN WHEN MOTOR IS NOT ROTATING.

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 two (2) years 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. (Use shall be defined as installation and application of power.) The liability of Seller hereunder shall be limited to replacing or repairing, at its option, any defective units or parts thereof which are returned F.O.B. Seller's plant, Redmond, 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.

Control Description

The 700 Series AC flux vector controls are especially adapted for high performance industrial drive systems. They operate directly from three phase 230, 400 or 460 VAC power. They can control 5 to 75 HP AC induction motors with encoder feedback. Operation on a single phase power source with a 40% reduction in output current is also possible. Outline and mounting dimensions of the control enclosure are specified on drawing B-0022 at the end of this manual.

Figure 1-1 700 Series Drive

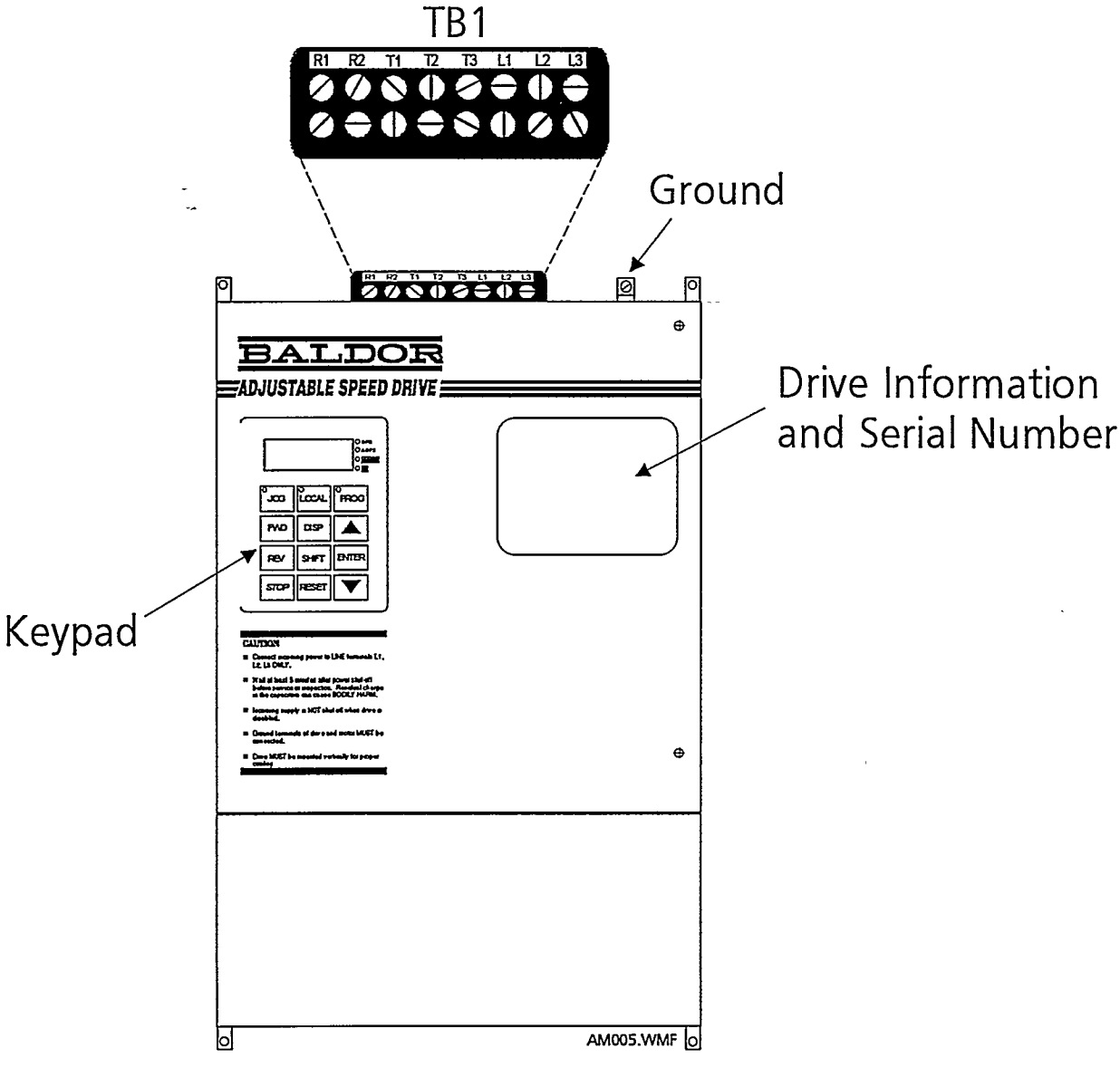
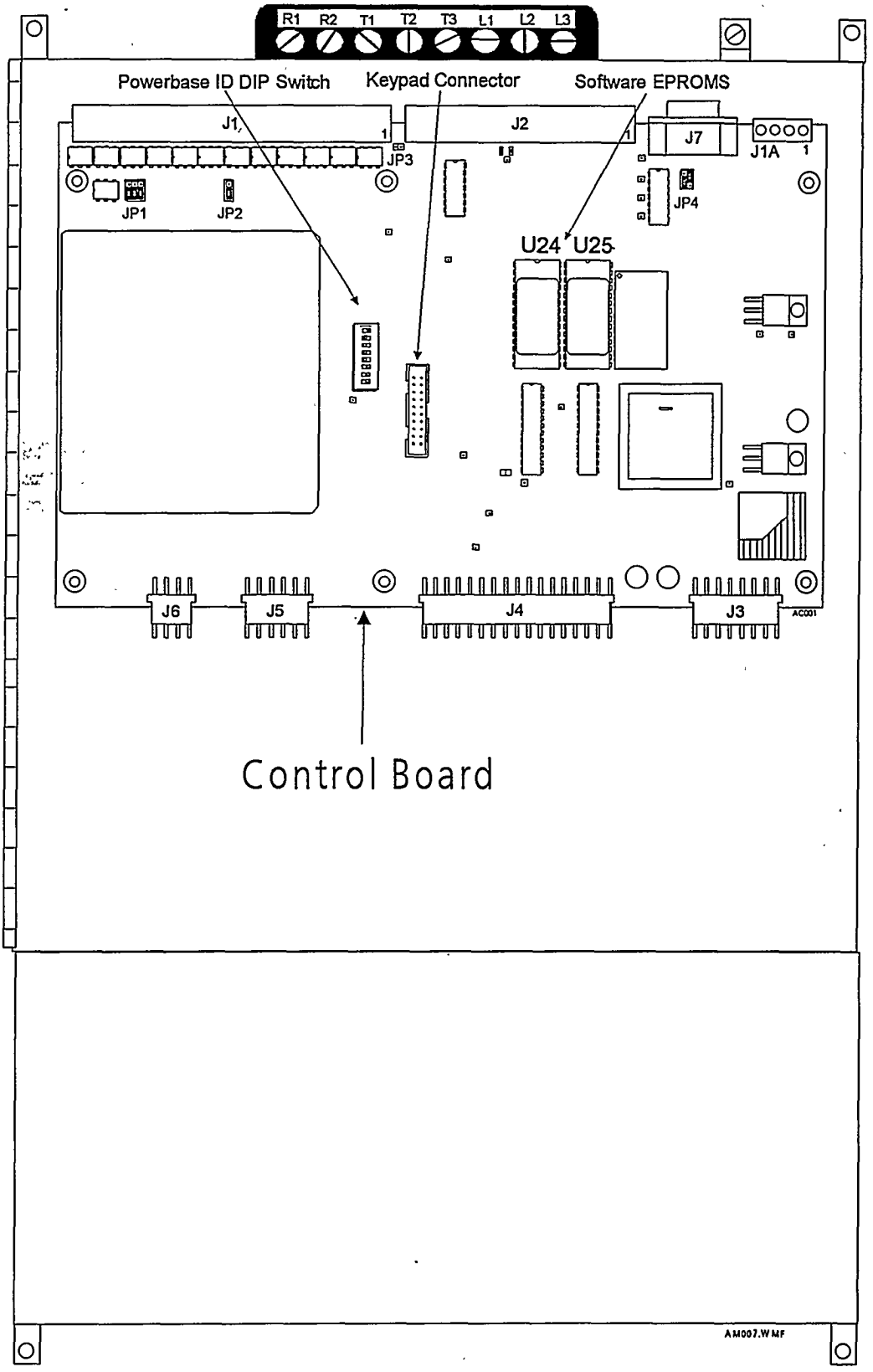


Figure 1-2 700 Series Drive With Cover Open



Components

Controls consist of the following major elements in a compact enclosed assembly:

1. Mounting base with grounded heat sink, on which are mounted: bus capacitors, main power transistor pair modules, output current sensing devices, three phase rectifying circuits, input filter inductor, soft start resistor, soft start bypass SCR, regenerated energy regulator transistor, and the power terminal block. Units rated over 20 amps rms have a fan or blower for circulation of cooling air.

2. Base drivers mounted over the main power transistor modules.

3. Power supply assembly mounted on inside surface of the swing out door.

4. Control board mounted inside the control board cover.

5. Keypad-display mounted on control board cover.

6. For controls rated from 5 to 25 HP @ 230 VAC, from 3 to 35 HP @ 400 VAC, and from 5 to 40 HP @ 460 VAC, a current feedback mod-demod assembly is mounted on the inside surface of the swing out door.

Specifications

Output Voltage	230, 400, 460 VAC
Constant HP range	Above base speed
Output Current	Per Rating Table
Velocity loop bandwidth	Adjustable to 60 Hz
Current loop bandwidth	Adjustable to 400 Hz
Maximum output frequency	500 Hz standard
Current ripple frequency	5 KHz standard Adjustable 2 to10Khz
UL listing	File No. 6J32

SERVICE CONDITIONS

Rated Input Voltages	3 phase 50/60 Hz single phase 50/60 Hz with 40% derate
230 VAC Models	190 to 253 VAC
400 VAC Models	330 to 440 VAC
460 VAC Models	380 to 506 VAC
Ambient temperature	Operating: 0 to +40°C Storage: -30 to +65°C
Humidity	10% to 90% non-condensing
Altitude	Sea level to 3,300 feet without derating
Enclosure	NEMA 1 with conduit entry knockout plate

MOTOR AND ENCODER REQUIREMENT

Motor poles	2, 4, 6, or 8
Incremental encoder	Mounted on motor
Pulses/rev	60 to 15,000 adjustable
Voltage outputs	2 channel quadrature, 5 VDC, differential
Marker pulse	Required for position orientation
Power output	+5 VDC, 300 ma Max.
Maximum frequency	1 MHz

DIAGNOSTIC INDICATIONS

Current Sense fault
Following Error
Instantaneous over current or ground fault (each phase)
Invalid Power Base ID
Line power loss
Microprocessor failure
Over speed
Overload
Overtemperature (motor or control)
Overvoltage
Parameter Loss
Ready
Regen Overload (dynamic braking)
Soft Start Fault
Torque Proving fault
Undervoltage

ANALOG AND CONTROL I/O

Buffered speed/torque input	
Common mode rejection	40 db
Full scale range	± 5 VDC, ± 10 VDC, 4-20 mA
Auto-adjusted resolutions	12 bits + sign below ±1V 9 bits + sign above ±1V
Update rate	2.0 ms in speed mode 1.0 ms in torque mode
Other analog input	1 assignable
Full scale range	± 10 V
Resolution	9 bits + sign
Update rate	2.0 ms
Analog outputs	2 assignable
Full scale range	0 to + 5 VDC
Resolution	8 bits
Update rate	2.0 ms
Opto-isolated logic inputs	9 total, 6 assignable
Rated voltage	10 to 30 VDC (closed contacts standard)
Input impedance	6.8K ohms
Update rate	8 ms
Opto-isolated logic outputs	4 assignable
ON current sink	60 mA Max
ON voltage drop	2VDC Max
Update rate	8 ms

RS232C / 422 / 485 SERIAL PORT

Functions	Parameter load / display Digital control Auto tuning Positioning Commands
Addressable	Up to 31 drives
Baud Rate	1200-19.2K Baud

SELECTABLE OPERATING MODES

Standard run
PLC interface with 16 preset speeds
Analog speed or torque control
Serial control

KEYPAD DISPLAY

Keys	12
Display	4 character LED
Functions	Motor Output Monitoring Diagnostic display Digital speed control Motor Jog Parameter load/display Auto-tuning

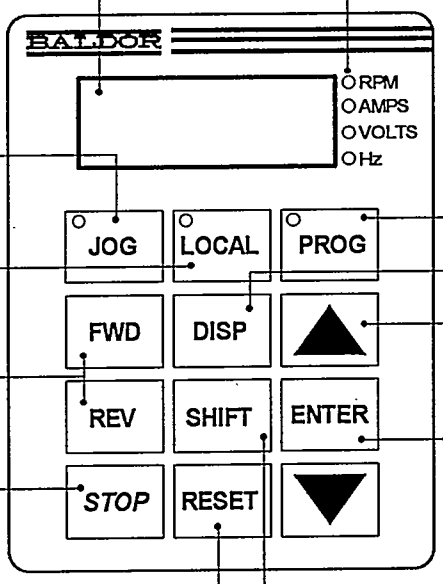
Ratings

Table 1.1 Drive Ratings

VAC	CONSTANT TORQUE RATINGS				MODEL NO.	SIZE	VARIABLE TORQUE RATINGS	
	MAX HP	AMPS CONT	AMPS 1 MIN	AMPS 3 SEC			MAX HP	AMPS CONT
230	5	18	27	35	712-24-175	A	7.5	25
	7.5	25	37	50	712-35-175	A	10	35
	10	35	52	70	712-47-175	A	15	45
	15	50	75	100	712-510-175	A	20	55
	25	68	102	135	712-714-175	A	25	70
	40	104	156	200	712-1020-175	C	50	130
	50	135	202	270	712-1427-175	C	60	145
400	3	10	15	20	713-12-175	A	5	15
	7.5	18	27	35	713-24-175	A	10	25
	10	25	37	50	713-35-175	A	20	35
	22	35	52	70	713-47-175	B	26	45
	35	52	78	100	713-510-175	B	35	55
	40	70	135	102	713-714-175	C	50	80
	60	100	150	200	713-1020-175	C	78	125
460	5	10	15	20	714-12-175	A	7.5	15
	10	18	27	35	714-24-175	A	15	25
	15	25	37	50	714-35-175	A	25	35
	25	35	52	70	714-47-175	B	30	45
	30	45	68	100	714-510-175	B	40	55
	50	70	102	135	714-714-175	C	60	80
	75	100	150	200	714-1020-175	C	100	125

Using The Keypad

Keypad Overview



FOUR CHARACTER DISPLAY
Displays motor speed, load, voltage or frequency during motor operation.

During setup the parameter number and value are displayed.

Displays drive status under trip condition.

JOG KEY
Used to switch between RUN and JOG mode. Lights when JOG is active.

LOCAL KEY
Used to switch between LOCAL keypad and "Terminal strip" (remote) control.

FORWARD AND REVERSE KEYS
Used to control motor direction in RUN and JOG modes.

STOP KEY
Used to stop the motor in LOCAL mode, and as an emergency stop in "Terminal strip" mode.

RESET / CANCEL KEY
Used to reset the drive from a fault condition.
Used to cancel out of parameter entry modes.

DISPLAY INDICATORS
Indicate units of display or parameter entry.

PROGRAM KEY
Used to toggle in and out of parameter setup mode. Lights when PROG is active.

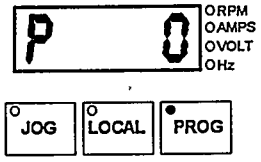
DISPLAY KEY
Used to switch between the monitor display modes, the fault log, and parameter view.

ARROW KEYS
Used to adjust operating speeds, parameter numbers, and parameter values.

ENTER KEYS
Used to enter parameter numbers and values.

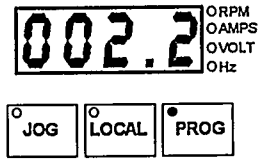
SHIFT KEY
Used to select a single character for faster entry. (Character will flash).

Changing Parameters

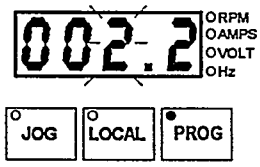


To change parameters the keypad must be in *Program Mode*. Pressing the PROG key enters and exits the program mode. A lit LED in the PROG key will indicate that the drive can be programmed.

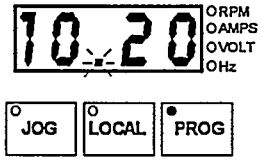
If security system is being used, the display will alternately flash SEC and CODE. Press the ENTER key and use the up and down arrow keys with the shift key to select the security code. Press enter. When the code is correct, the controller will switch to the program mode and the LED will be lit. Prog LED flashing (allows user to enter SEC code once, remember to "Reset" to secure the drive.



Use the UP and DOWN arrow keys to select the desired parameter number and press ENTER. The parameter *value* will now be displayed. If the value is in units that can be indicated (i.e. RPM, AMPS, VOLTS or Hz) then the appropriate LED will be lit. Use the UP and DOWN arrow keys to scroll to the desired value. (NOTE pressing RESET will cancel changes and return to displaying the parameter number).



Pressing the SHIFT key allows a single character to be changed at a time for faster entry. The character selected for adjustment will flash. Repeated presses of the SHIFT key will move the active character from right to left across the display and then return the display to normal adjustment.



NOTE: When numbers larger than 9999 are entered the display will switch to displaying "extended" numbers. The display will then show "thousands" of units with the decimal point flashing. This allows for motor operation above 9999 RPM as well as parameter entry.

Press ENTER to enter the new parameter value. Press RESET to cancel and return to displaying parameter *numbers*. To exit the program mode press the PROG or DISP keys.

LOCAL Keypad Control

Running the Motor

To operate the motor from the keypad the drive must be in LOCAL mode. This is done by pressing the **LOCAL** key. The local LED will be lit when the drive is in LOCAL keypad control. The drive will ignore all input connections on the J1 terminal strip except the external motor temp input.

The motor can now be controlled by the FWD, REV, STOP, JOG and arrow keys. Make sure the PROG LED is not lit. The FWD and REV keys control the direction of motor rotation while the arrow keys are used to adjust the speed.

There are three ways to control the motor in local keypad control. They are Increment, Entered Speed and Preset speed. Parameter P38 KEYPAD SPEED CONTROL determines which one is active. The factory preset is Increment. (Refer to Chapter 3 for more information on setting P38).

Increment Mode (P38 = 0 or 1) (Factory Preset)

Use the arrow keys to ramp the motor speed at the defined ACC / DEC rate.

EXAMPLE: Press FWD. Power will be applied to the motor and a small amount of audible noise may be heard. Press the UP arrow momentarily, the drive will accelerate toward the defined max speed. Press the DOWN arrow momentarily, the drive will decelerate toward zero speed. Press STOP to disable the drive.

To adjust motor speed more precisely, press the ENTER key after pressing the FWD and before using the arrow keys. The RPM LED will flash and you can use the arrow keys and shift key to adjust motor speed. Press Enter again and the RPM LED will adjust motor speed. Press Enter again and the RPM LED will stop flashing and the arrow keys will work as described above.

EXAMPLE: Press FWD to enable the drive. Press ENTER. The RPM LED will now flash. Press the SHIFT key until the "tens" position flashes. Now repeatedly press the UP arrow key, the drive speed will advance in increments of 10 RPM. Press the SHIFT key again, the "hundreds" position will now flash. Repeated presses of the UP arrow key will now advance the speed by 100 RPM. Press STOP to disable the drive.

Entered Speed Keypad Control (P38 = 2 or 3)

Use the arrow and shift keys to enter an exact digital speed command. NOTE: This differs from the Increment control described above in that the desired command is not acted upon until the ENTER key is pressed.

EXAMPLE: Press FWD to enable the drive. Press ENTER, UP, or DOWN; the display will change to RPM will the RPM LED flashing. Use the arrow and shift keys to select the desired speed. Press ENTER, the drive will now command the entered speed and return to viewing the selected output condition (the RPM LED will stop flashing). Press STOP to disable the drive.

Preset Speed Keypad Control (P38 = 4 or 5)

Operate the motor at from the defined preset speeds (Parameters P11 - P25).

EXAMPLE: Press FWD to enable the drive. Press ENTER, UP or DOWN, the display will change to RPM will the RPM LED flashing. Use the arrow and shift keys to select the desired preset speed number (1-15). Press ENTER, the drive will now command the preset speed and return to viewing the selected output condition (the RPM LED will stop flashing). Press STOP to disable the drive.

Jog Keypad Control

When the JOG and LOCAL LED's are Lit, the motor will run at a predetermined speed as long as the FWD or REV key is held. When the key is released the motor decelerates to a stop and holds zero speed.

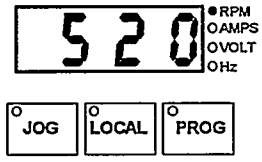
This is useful in applications such as a machine tool, where the drive is used to control an axis of the table. The drive can be used to "jog" the table around manually before returning it to automatic control.

Four Jog parameters (P0 - P3) are available to control the jog speed, accel rate, decel rate, and "s-curve".

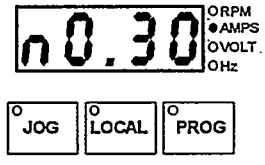
EXAMPLE: While in LOCAL mode: Press JOG to place the drive in JOG mode, (the JOG LED will be lit). The FWD and REV keys are used to jog the motor in the appropriate direction: Press and hold the FWD key. The motor will rotate in the forward direction at the Jog speed (P0). Release the FWD key, the motor will decelerate to zero speed. Press JOG to exit JOG mode and disable the drive.

Changing the Display

While the motor is in operation seven different output conditions can be monitored by pressing the display key. NOTE: The decimal point is not displayed for whole numbers. For numbers larger than 9999, the display will switch to extended numbers, showing 'thousands' of units with the decimal point flashing. Pressing the DISP key will toggle through the following display modes:

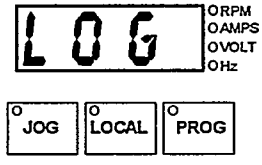


Motor Speed in RPM
Motor Current in amps
% of Rated Load
Output Voltage in volts
Output Frequency in Hertz
Fault Log
Parameter View



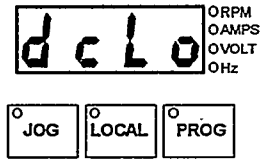
When motor data is displayed an indicating LED will be lit to show the appropriate units. In the case of % Rated load; the display will be normalized so that 1.00 = 100% motor rated amps. The Amps LED will be lit and the display will begin with an "n". (i.e. n0.30 = 30% rated load).

Fault Log



The drive retains up to 15 of the most recent faults for display. To view the fault log, press the DISP key until LOG is displayed. Press the ENTER key and the present drive status will be displayed. Use the arrow keys to scroll through the previous faults. While scrolling, the display will momentarily show the log position (1-15) before displaying the fault code.

Refer to Chapter 6 for a complete list of faults.



Pressing the SHIFT key will momentarily display the elapsed time in minutes between the selected fault and the previous fault. (If pressed while viewing the current status the elapsed run time in hours will be displayed).

To exit the fault log press either the DISP key of the RESET key.

Parameter View

The drive can display any parameter during operation. Press the display key until the display reads PXXX where XXX is the parameter number. Press ENTER to see the value for the selected parameter. The PROG LED will not be lit since the user cannot change parameter values while in this mode.

Fault Condition Mode

If a fault condition exists, the display will show one of the fault codes automatically. Pressing RESET will clear the fault as long as the condition that caused the fault no longer exists.

Refer to Chapter 6 for a complete list of fault codes and troubleshooting flowcharts.

Software Revisions

This manual has been prepared for software version 2.02 but can be used on prior versions with the following exceptions.

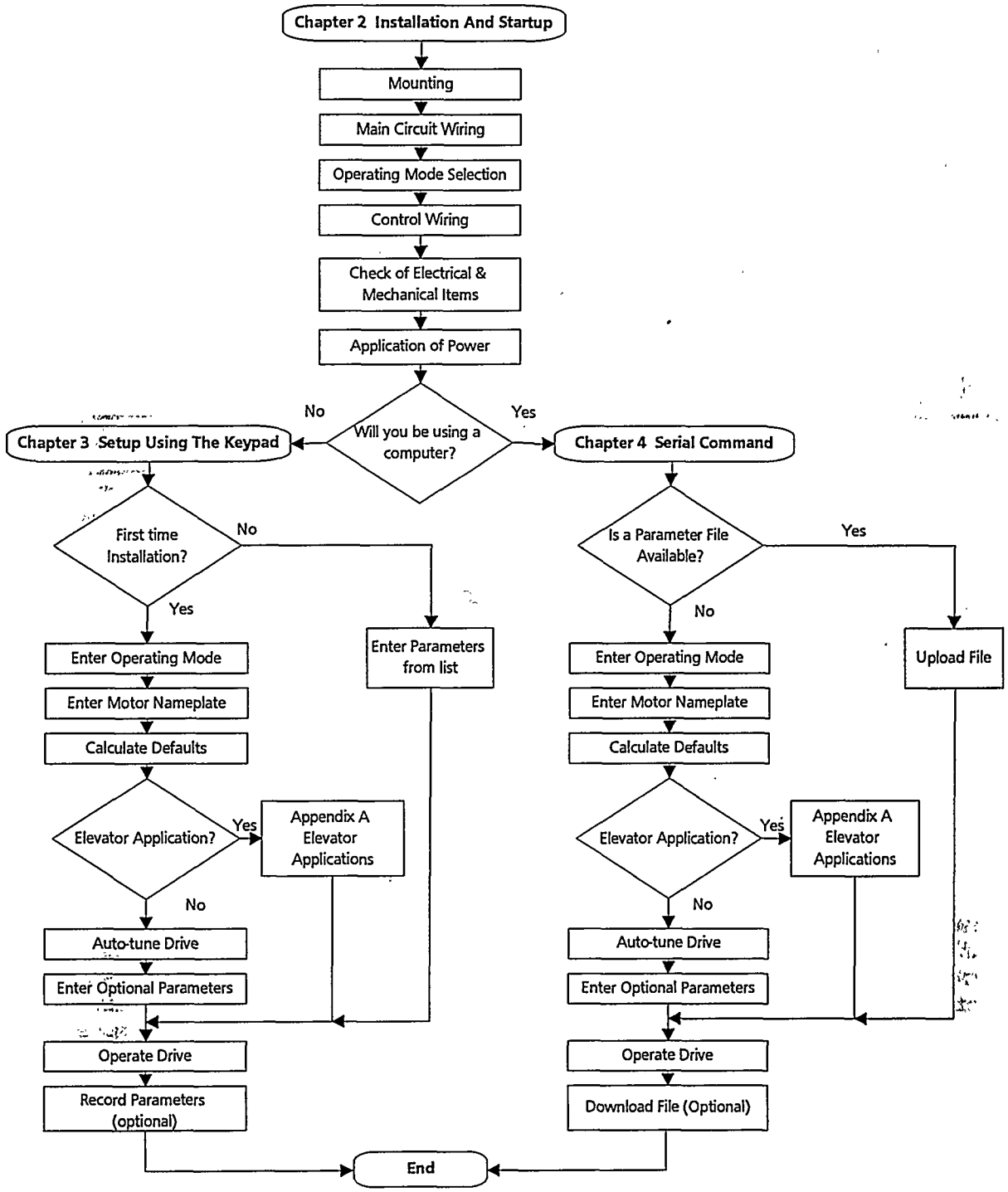
Ver 2.01	Fault log recorded power loss and undervoltage faults on turn off. After fault reset dcLo, dcHi or REG sometimes remained on the display. Regen still active during an ID, SSF, or CUr fault. During a fault condition the keypad does not allow programming. RPM display not consistent with digital speed command. The serial commands "O6" and "O7" are not supported. Drive allows upload of incompatible software versions Serial command "B" deleted.

Chapter 2
Installation and Setup

Introduction

The flowchart (figure 2-1) outlines the sections in this manual that should be followed to install and setup the drive. Each block represents the appropriate section of this manual to follow. It is strongly recommended that the flowchart be followed and each section of the manual referenced during the installation, setup, and operation of the drive.

Figure 2-1 Installation and setup flow diagram:



Mounting

(Refer to Chapter 10 for appropriate mounting drawings)

The drive is designed for panel mounting. Mount in a clean dry enclosure with an ambient temperature less than +40° C. Contact factory for derating to be used at higher ambient temperatures. DO NOT mount control above transformer or other heat source. DO provide 2" minimum clear area above and below the control to allow free flow of air over heat sink on the back of the enclosure.

Mounting dimensions are shown on the appropriate drawing given in Chapter 10. Provide access to the front of the enclosure to adjust parameters and to observe the keypad display. Allow room to remove the top cover (if applicable) to gain access to the power components.

Main Circuit Wiring

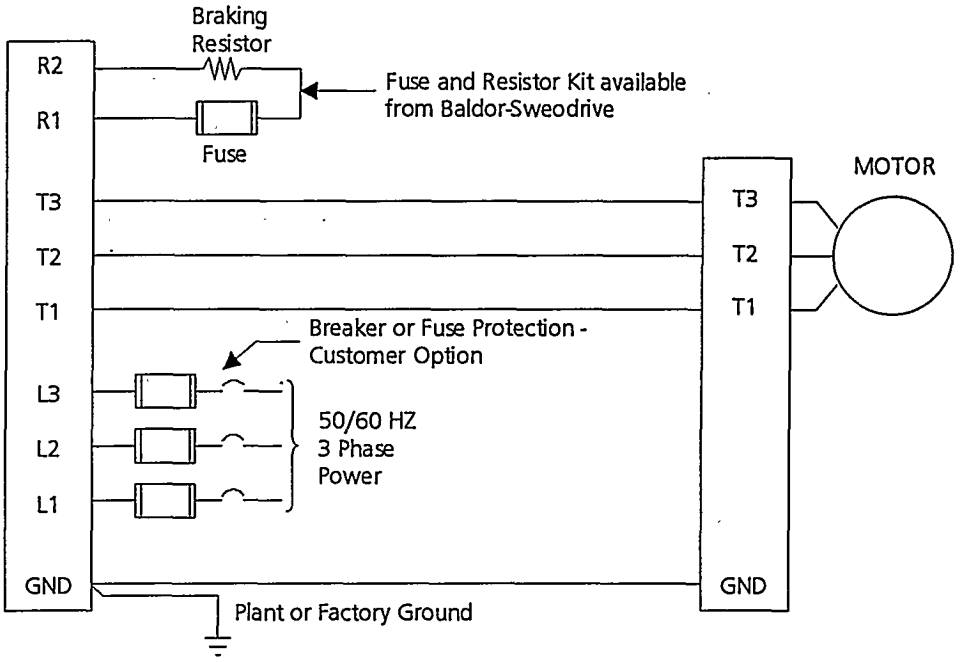
CAUTION: Check the motor nameplate and power source voltage to be sure they match the drive nameplate ratings. **DO NOT USE THIS DRIVE ON ANY OTHER VOLTAGES WITHOUT FACTORY APPROVAL.**

All wiring shall be in accordance with the National Electric Code and applicable local codes. Install wiring as shown in Figure 2-2A. External or remote motor overload protection must be provided in accordance with the National Electrical Code or equivalent. Use the appropriate wire gauge per Chapter 7 and terminal block tightening torques as called out in Appendix F.

The drive requires input power protection in the form of either a circuit breaker or fuses. Required sizes and types of circuit breakers and fuses for this particular drive are given in chapter 7 entitled PROTECTIVE DEVICES. Circuit breakers are recommended.

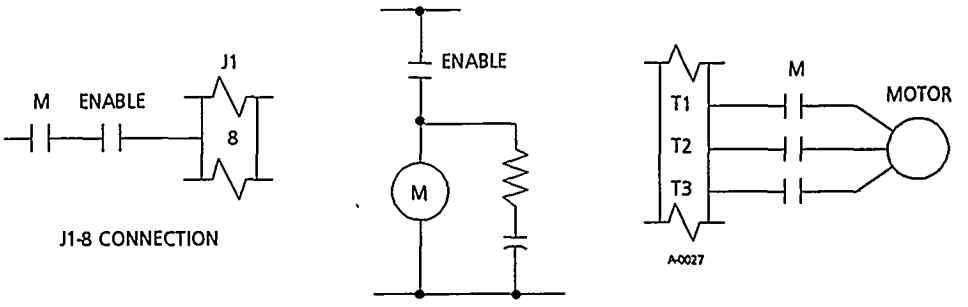
Connect control terminals L1, L2 and L3 to the load side of the customer supplied protective device. The control may be powered with AC three phase power or single phase power. NOTE: Apply only line voltage for which the controller is rated. Phase sequence of incoming power is not important. If single phase power is to be used, connect power to drive terminals L1 and L2. Place a jumper between control input terminals L2 and L3. Size this wire the same as the incoming line to L1. Note that drive capacity is restricted to 60% of normal when operated on single phase power.

Figure 2-2 Main Circuit Wiring



Wire the three phase motor stator to control terminals T1, T2 and T3 using appropriately sized wire per table, Chapter 7. Connect the control to the motor either directly (Figure 2-2) or through a contactor as shown in Figure 2-3. Connection of motor temperature sensor / switch is optional (refer to Appendix B). A motor circuit contactor is recommended whenever a positive disconnection must prevent motor motion which could pose a safety hazard to personnel or equipment.

Figure 2-3 Typical Connections for Output Contactor



Open the Enable input to J1 at least 20 msec before main M contacts open to prevent arcing at contacts. This greatly increases contactor life and allows use of IEC rated contactors.

Ground **both** the drive chassis ground lug and motor frame to machine or plant ground. Use the same size wire used for the AC connections. Refer to Figure 2-2.

Dynamic Braking

If your controller requires dynamic braking capability (optional) an external braking assembly or braking resistor with suitable fuse or breaker protection will be required.

Minimum resistance of the braking resistor is limited by the regeneration capacity of the drive. Dissipation rating of the resistor must be selected to suit the average regeneration of an overhauling load or dynamic braking deceleration. The protective fuse or breaker for the braking resistor must be rated at 400 VDC minimum for 230 VAC drives and 800 VDC minimum for 460 VAC drives. It must be of sufficient capacity to interrupt a continuous connection of the resistor across the DC bus, should a control failure occur. Chapter 8 lists several kits for regeneration resistors. Connect regeneration resistor and associated fuse or breaker between control terminals R1 and R2.

Operating Mode Selection

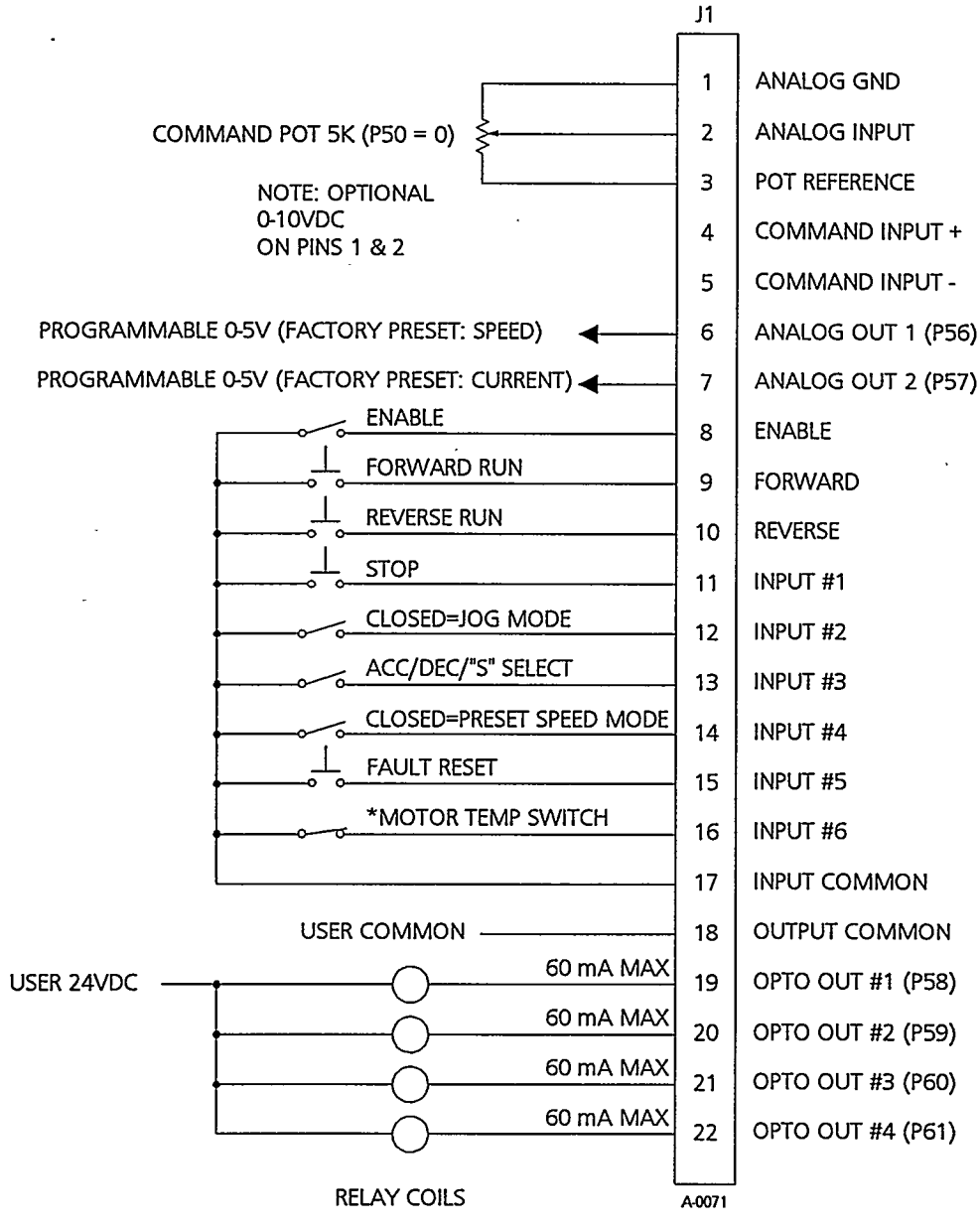
The controller has four interface modes of operation. Select the operating mode that best suits your application. Refer to Figures 2-4 through 2-7 for typical terminal strip connections for each mode. Refer to Figure 2-3 for use of contactor to provide positive disconnection of power to the motor. During the setup procedure, parameter (P 90) will be set to the value defined below to match the desired mode of operation.

NOTE: The keypad may be used with any of the operating modes below. When the drive is placed in LOCAL keypad control (by pressing the LOCAL key) it bypasses all the terminal strip connections except the external motor temp input J1-16, (if active) to allow front - panel operation.

P90	OPERATING MODE
0	**STANDARD RUN** - The Drive operates from Speed potentiometer or a 0-10 VDC signal (P50=0). This mode includes logic inputs for Enable, Forward/Reverse selection, Stop, Jog, Fault Reset, and a Motor temp switch. Also included are an input to select between two separate Accel / Decel / "S" curve ramps and an input to command a preset speed (selected with parameter P11, preset speed 1). See Figure 2-4.
1	**PLC INTERFACE** - Drive operates from logic inputs (analog speed input and command input are not used). This mode includes inputs for Enable, Forward / Reverse selection, 15 preset speeds and 2 Accel /Decel / "S" curve ramps. See Figure 2-5.
2	**ANALOG INPUT SPEED OR TORQUE CONTROLLER** - The drive follows an analog command from selected input source, some of these options include a differential ±5VDC, ±10VDC, or 4-20mA (see parameter P 50). (See Appendix B for more information on Analog input options). Logic inputs are provided for Enable, Forward and Reverse Limit (provides simple travel limit protection), Home, Fault Reset, Speed or Torque Control, 4 selectable parameter tables, and a motor temp switch. See Figure 2-6 and Appendix B (Selectable parameter tables).
3	**SERIAL CONTROL** - Control is exclusive through the RS232 / 422 / 485 port. Inputs to the ENABLE, FORWARD LIMIT SWITCH, and REVERSE LIMIT SWITCH (1-8,9,10) are still required for safety considerations. Opening the Enable input will cause the motor to coast to a stop. Opening the FORWARD/REVERSE LIMIT SWITCHES will cause the motor to brake to zero speed, and hold zero speed with full torque. All speed and control commands are given digitally via the Serial Command Language (See chapter 4). This mode should be used if serial control is the ONLY mode of operation. See Figure 2-7.

NOTE: It is not necessary to select this mode to use the Serial Command Language. The drive can be placed in SERIAL LOCAL CONTROL, which is the equivalent of the Keypad LOCAL mode, effectively bypassing all terminal strip connections except ENABLE (J1-8), FORWARD LIMIT SWITCH (J1-9), and REVERSE LIMIT SWITCH (J1-10), and MOTOR TEMP SWITCH (if active) (J1-16) which are still required.

Figure 2-4 Mode 0 Standard Run (P90=0)



J1-8 OPEN disables the drive & motor coasts to a stop, Closed allows current to flow in the motor and produce torque. Parameter P55 controls Enable polarity.

J1 -9 Momentary CLOSED starts motor operation in the Forward direction. In Jog mode (J1-12 CLOSED), continuous CLOSED jogs motor in the Forward direction.

J1-10 Momentary CLOSED starts motor operation in the reverse direction. In Jog mode (J1-12 CLOSED), continuous CLOSED jogs motor in the Reverse direction.

J1-11 When CLOSED drive brakes to a Stop and disables.

J1-12 CLOSED places drive in JOG mode, Forward and Reverse run are used to Jog the motor.

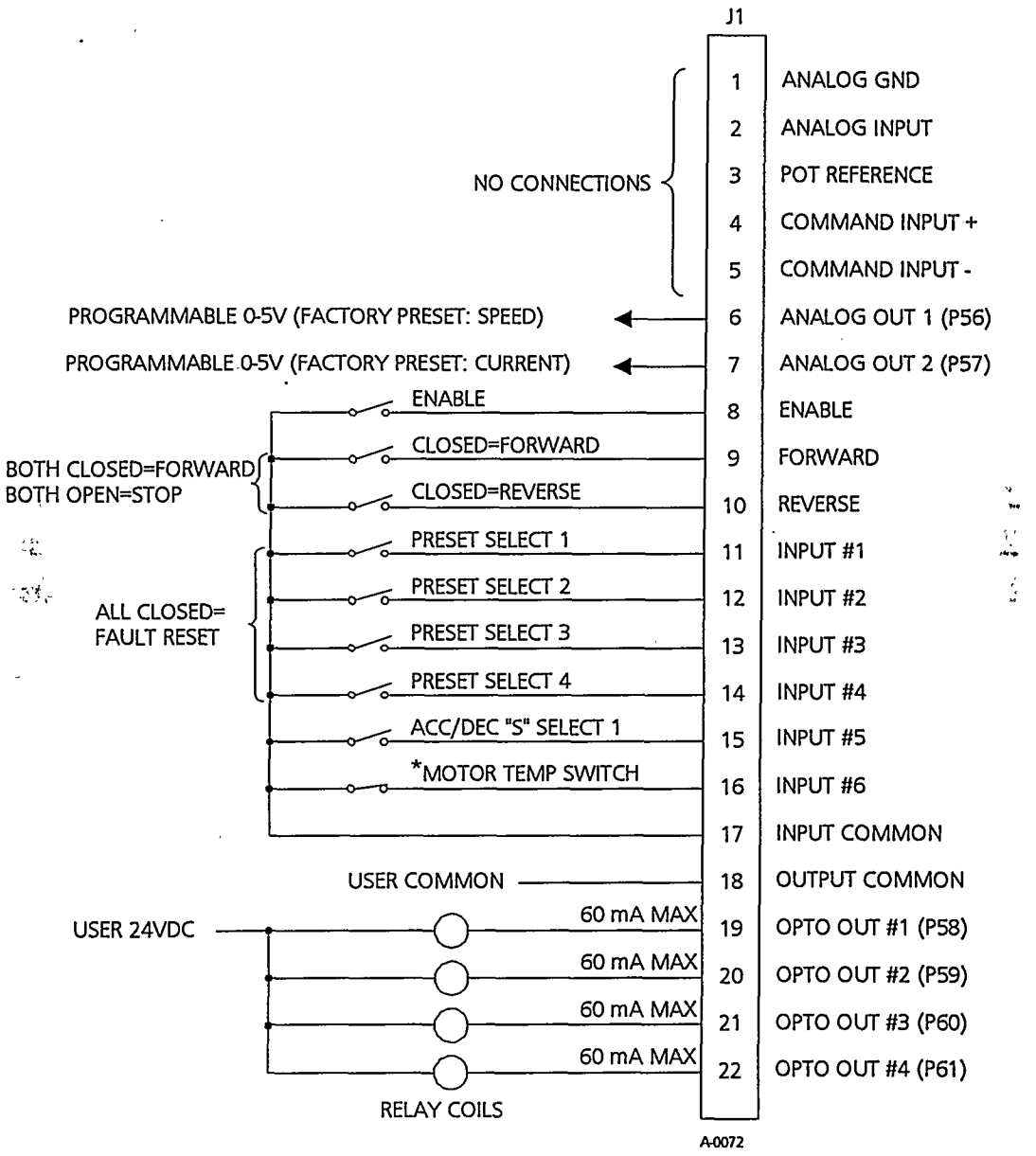
J1-13 OPEN selects ACC / DEC / "S" Curve group #1, CLOSED selects group #2.

J1-14 CLOSED selects preset speed #1 Parameter P11, OPEN allows speed command from Pot input. Jog mode (J1-12) will override this preset speed.

J1-15 OPEN to run, CLOSED to reset fault condition.

J1-16 OPEN causes a motor overtemp to be received by the drive. The drive will disable and display the fault. *This input is optional and is controlled by P80.

Figure 2-5 Mode 1 PLC Interface (P90=1)



J1-14	J1-13	J1-12	J1-11	FUNCTION
Open	Open	Open	Open	Preset 1: P11
Open	Open	Open	Closed	Preset 2: P12
Open	Open	Closed	Open	Preset 3: P13
Open	Open	Closed	Closed	Preset 4: P14
Open	Closed	Open	Open	Preset 5: P15
Open	Closed	Open	Closed	Preset 6: P16
Open	Closed	Closed	Open	Preset 7: P17
Open	Closed	Closed	Closed	Preset 8: P18
Closed	Open	Open	Open	Preset 9: P19
Closed	Open	Open	Closed	Preset 10: P20
Closed	Open	Closed	Open	Preset 11: P21
Closed	Open	Closed	Closed	Preset 12: P22
Closed	Closed	Open	Open	Preset 13: P23
Closed	Closed	Open	Closed	Preset 14: P24
Closed	Closed	Closed	Open	Preset 15: P25
Closed	Closed	Closed	Closed	Fault Reset

J1-8 OPEN disables the drive & motor coasts to a stop, Closed allows current to flow in the motor and produce torque. Parameter P55 controls enable polarity.

J1 -9 CLOSED operates motor in the Forward direction (with J1-10 OPEN).

J1-10 CLOSED operates motor in the Reverse direction (with J1-9 OPEN).

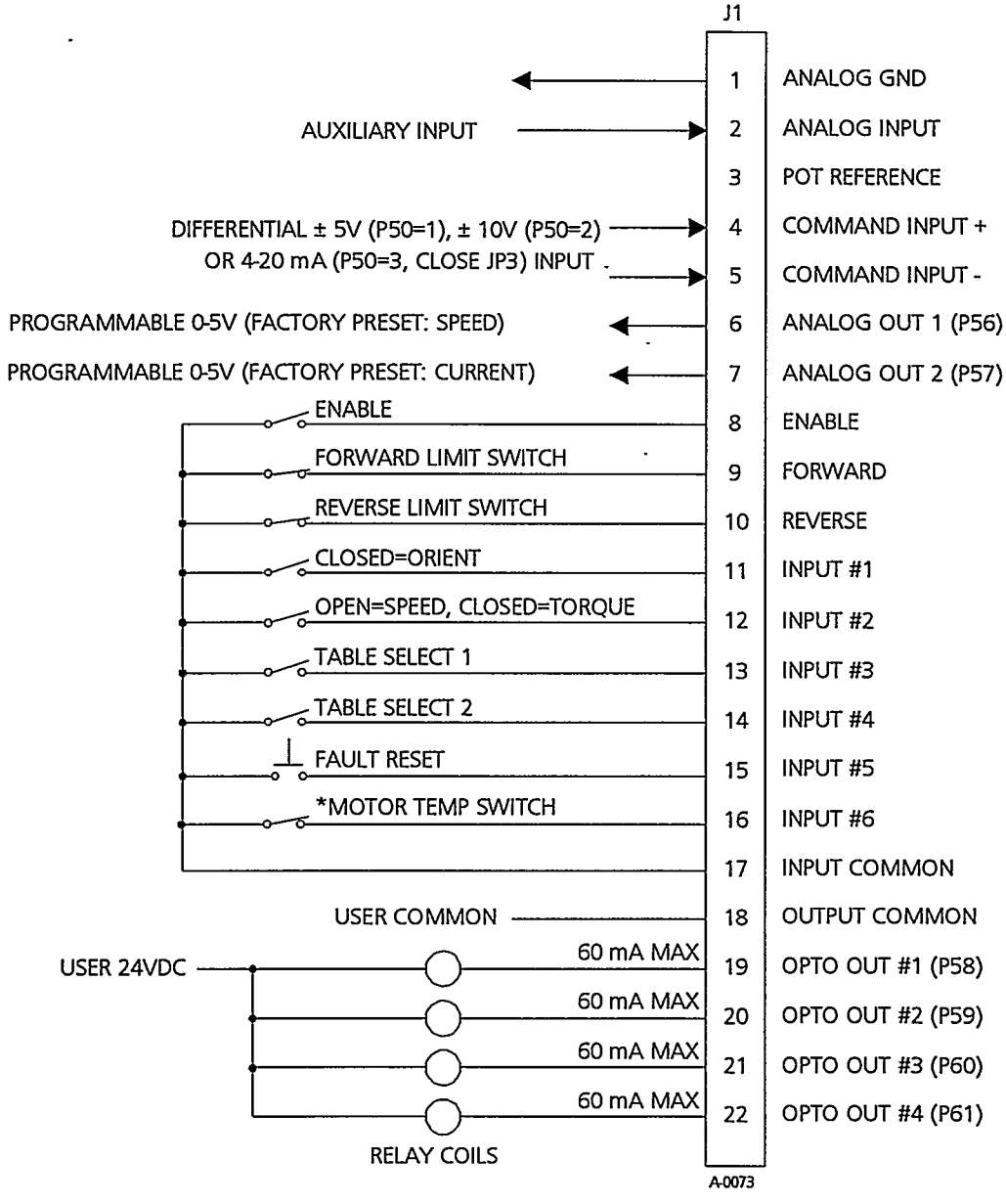
J1-11-14 Selects preset speeds, (see table left).

J1-15 Selects ACC / DEC. group. (see table below).

J1-15	FUNCTION
OPEN	ACC/DEC GROUP 1
CLOSED	ACC/DEC GROUP 2

J1-16 OPEN causes a motor overtemp to be received by the drive. The drive will disable and display the fault. *This input is optional and is controlled by P80.

Figure 2-6 Mode 2 Analog Input Speed or Torque Controller (P90=2)



J1-8 OPEN disables the drive & motor coasts to a stop, CLOSED allows current to flow in the motor and produce torque. Parameter P55 controls enable polarity.

J1-9 CLOSED to enable operation in the Forward direction. OPEN to disable Forward operation (drive will brake to a stop if a Forward command is still present).

J1-10 CLOSED to enable operation in the Reverse direction. OPEN to disable Reverse operation (drive will brake to a stop if a Reverse command is still present).
NOTE: OPENING both J1-9 and J1-10 causes the drive to brake to a stop.

J1-11 CLOSED commands the drive to stop the motor at a predefined home / orient position. OPEN for normal control.

J1-12 OPEN for Speed control, CLOSED for Torque Control.

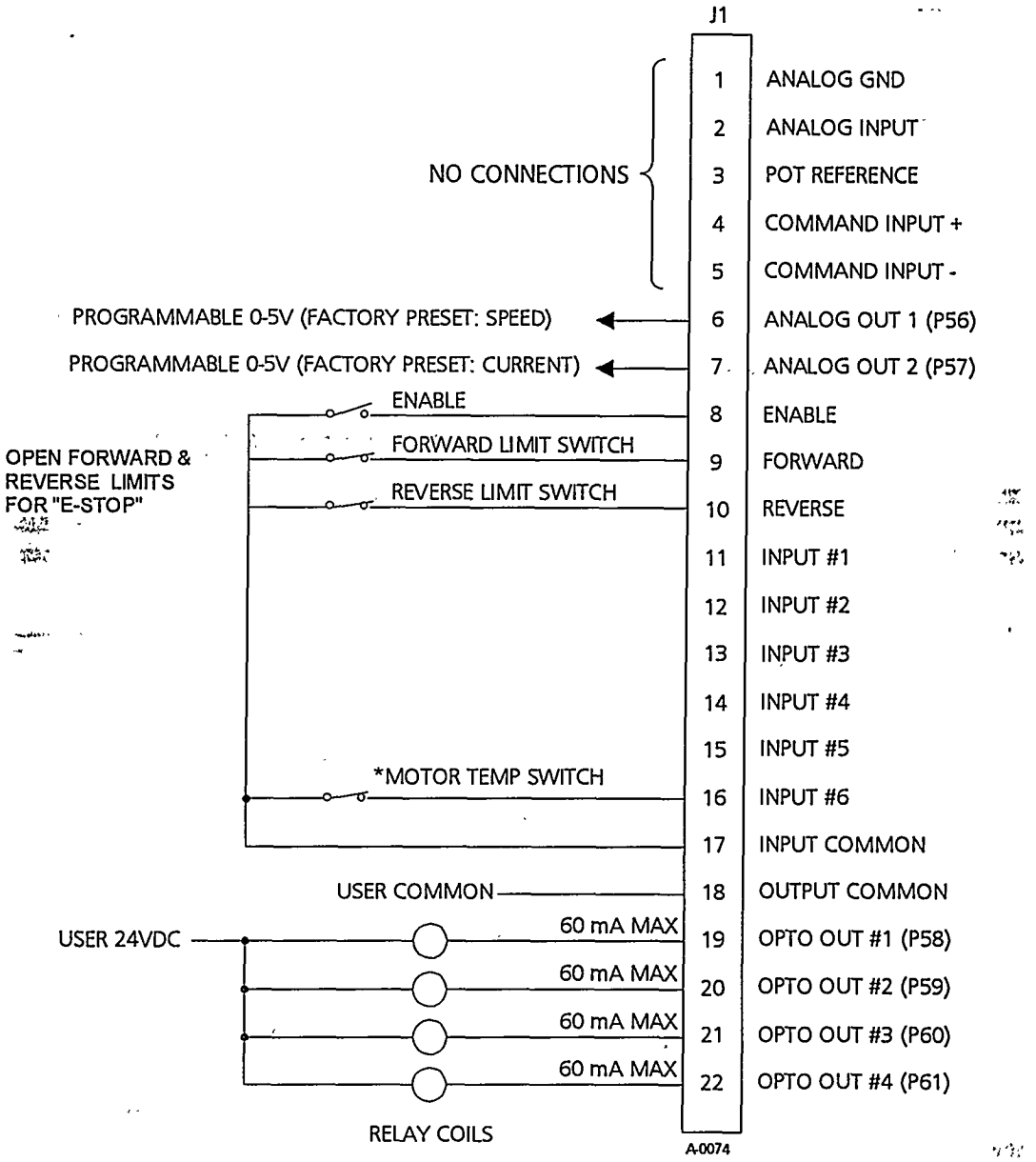
J1-13&14 Select from four Parameter tables (see table below). For more information refer to Appendix B.

J1-14	J1-13	FUNCTION
OPEN	OPEN	Parameter table #0
OPEN	CLOSED	Parameter table #1
CLOSED	OPEN	Parameter table #2
CLOSED	CLOSED	Parameter table #3

J1-15 OPEN to run, CLOSED to reset fault condition.

J1-16 OPEN causes a motor overtemp to be received by the drive. The drive will disable and display the fault. *This input is optional and is controlled by P80.

Figure 2-7 Mode 3 Serial Control (P90=3)



J1-8 CLOSED allows serial control of the motor current. (Drive is not enabled until a serial enable command is given). OPEN prevents the drive from operation, (if the motor is in operation it will coast to a stop). Parameter P55 controls enable polarity.

J1-9 CLOSED to enable operation in the Forward direction. OPEN to disable Forward operation (drive will brake to a stop if a Forward command is still present).

J1-10 CLOSED to enable operation in the Reverse direction. OPEN to disable Reverse operation (drive will brake to a stop if a Reverse command is still present). NOTE: OPENING both J1-9 and J1-10 causes the drive to regen to a stop.

J1-16 OPEN causes a motor overtemp to be received by the drive. The drive will disable and display the fault. *This input is optional and is controlled by P80.

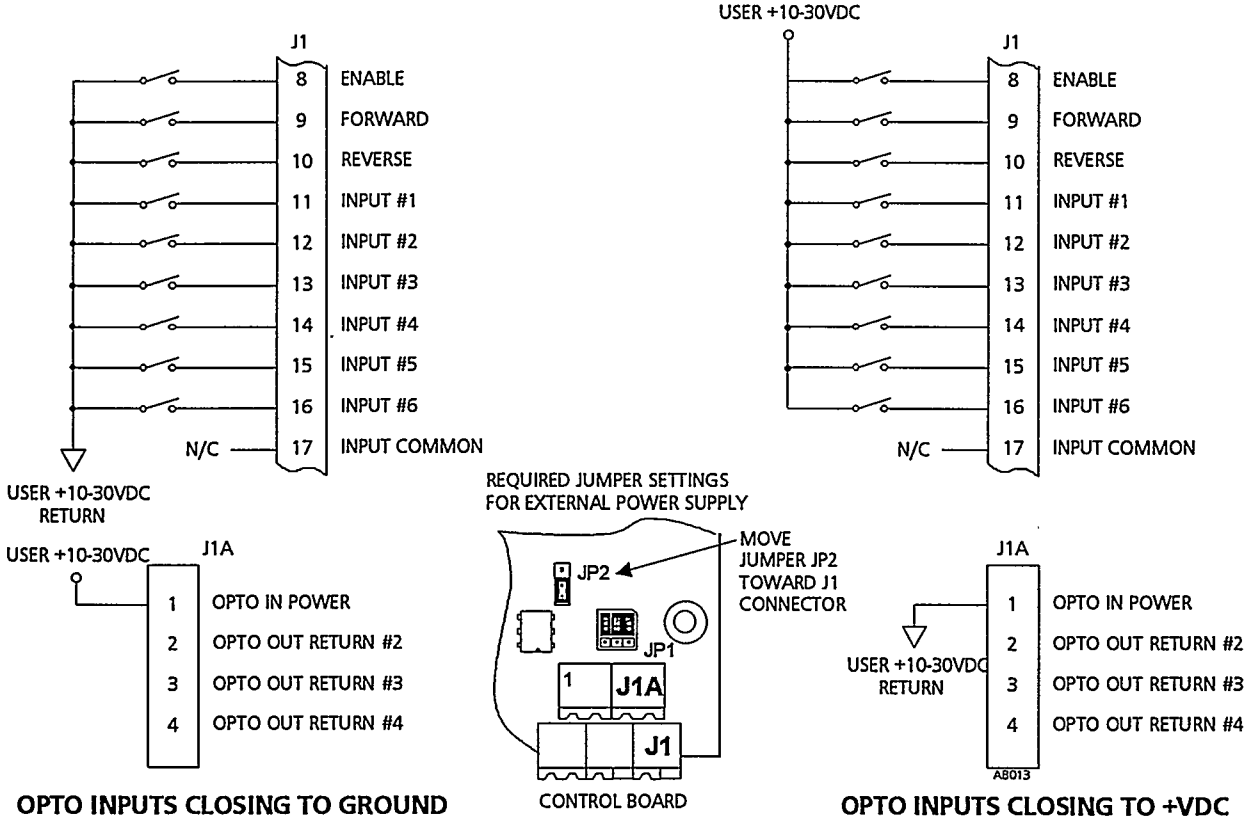
Control Wiring (J1)

All control connections are made to terminal strip J1 located on the edge of the control board, above the power connections. This terminal strip contains chassis ground referenced analog I/O circuits, and opto isolated discrete I/O circuits. The front panel cover (if supplied) will need to be removed to access these connections. Make control connections per the appropriate Figure 2-4 thru 2-7 for your selected operating mode.

Opto-Isolated Inputs

The opto-isolated inputs (J1-8 to J1-16) are normally operated by closing contacts or switches between them and the Input Common J1-17. All switches shown in Figures 2-4 through 2-7 may be replaced by static logic outputs from a PLC, CNC or computer if the outputs of such devices are open collector and the ground is connected to Input Common (J1-17). Jumper JP2 is factory preset on 1 and 2 for use with the internal supply. When using an external supply (10-30 VDC) with the opto-isolated inputs the JP2 jumper must be moved to pins 2&3 (refer to Figure 2-8). The inputs can be configured to close to common or to positive DC voltage.

Figure 2-8 Using an external power supply with the opto inputs



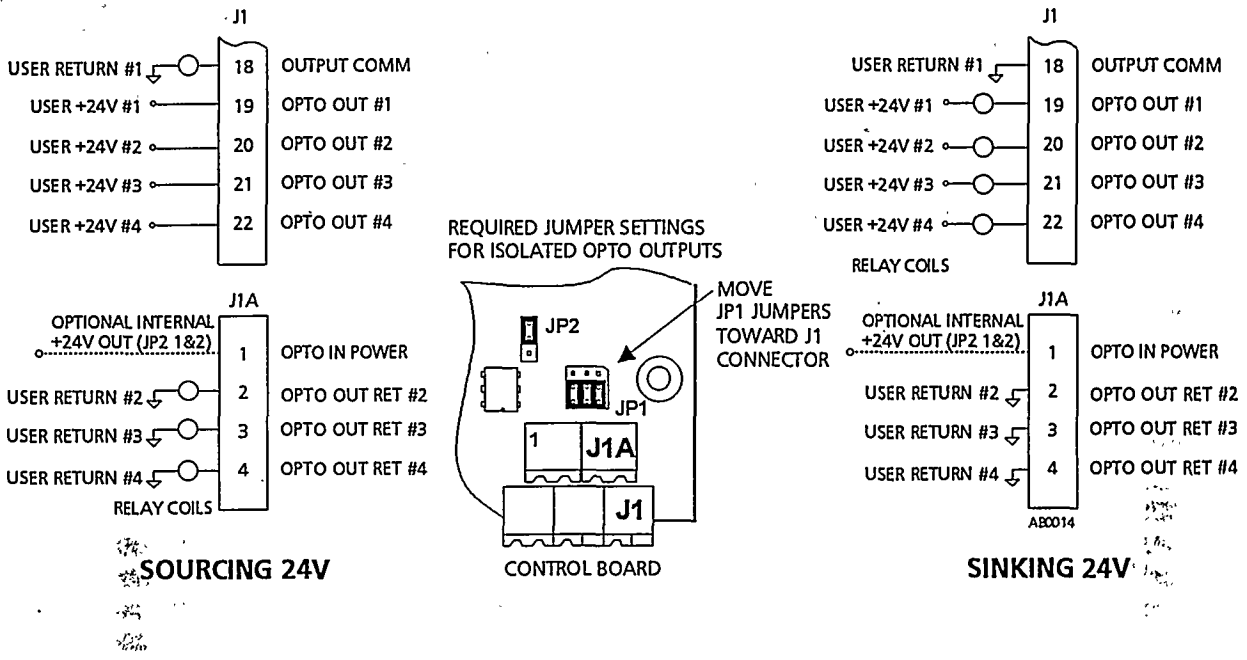
Opto-Isolated Outputs

Four programmable opto-isolated outputs are provided on J1 (J1-19 to J1-22). These outputs can be used to provide indications of various drive conditions. The source of these outputs is programmed with parameters P58 - P61. The opto-isolated outputs will sink up to 60 mA of current. The minimum voltage from opto output to common, when active, is 2.5 VDC (this is not TTL compatible). Their factory preset connection with common emmiters (Jumpers on JP1 set towards J1) is shown in the appropriate connection diagram (Figures 2-4 thru 2-7). See appendix B for complete schematic diagram.

NOTE: An internal +24V supply is available on J1A pin 1 when the jumper JP2 is connected across pins 1 & 2. This supply is normally connected to the opto inputs.

The four opto-isolated outputs can be diconnected from each other by moving the jumpers on JP1 toward the J1 connector. Each output can then be used to switch an external 10 - 30 VDC supply in either a sourcing or sinking mode. Connections are shown in Figure 2-9. The complete schematic diagram of the output circuits is shown in Appendix B.

Figure 2-9 Using isolated supplies with the opto outputs



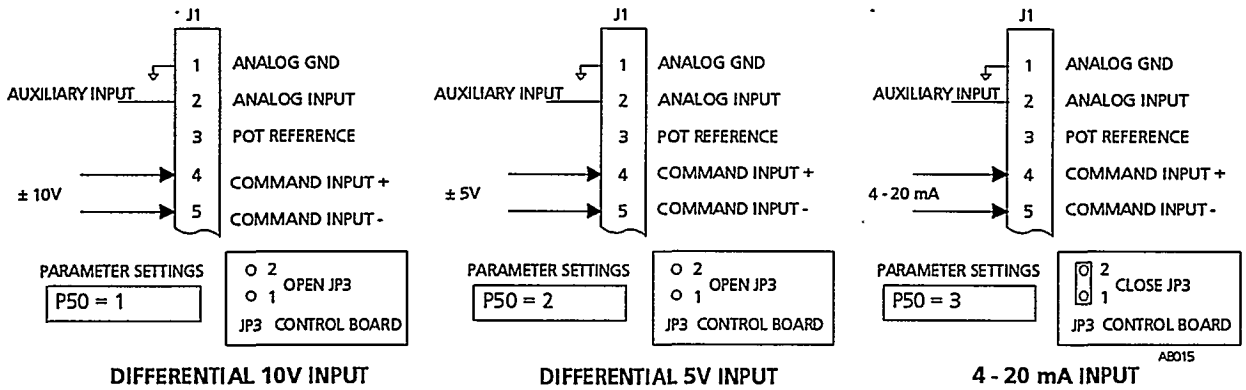
Analog Inputs

Two analog speed inputs are available on J1, the auxiliary or pot input (J1-1 to J1-3), and the command input (J1-4 and J1-5).

The auxiliary input is used when Parameter P50 is set to 0 (speed pot). The reference comes from a 5K pot connected as shown in Figure 2-4, or a 0-10V signal on J1-1 and J1-2.

The command input (J1-4 to J1-5) accepts a differential ±5V, ±10V or 4-20mA as selected in Parameter P50 (refer to Figure 2-10). This input is buffered to provide 40 db common mode isolation with up to ±15 Volts common mode relative to common. Either analog input may be grounded provided the common mode range is not exceeded.

Figure 2-10 Analog Input Options for Mode 2



Analog Outputs

Two programmable analog outputs are provided on J1, (J1-6 & J1-7). These outputs are scaled 0-5VDC and can be used to provide real-time status of various drive conditions. The type of output is selected by parameters P56 and P57 (see Appendix D). Additional information on the Analog Outputs is available in Appendix B.

Encoder Wiring (J2)

The controller requires the use of an encoder mounted on the shaft of the motor. The encoder power and input connections are made to terminal strip J2. A 5VDC supply is provided, on J2-7, to power the encoder (350 mA max).

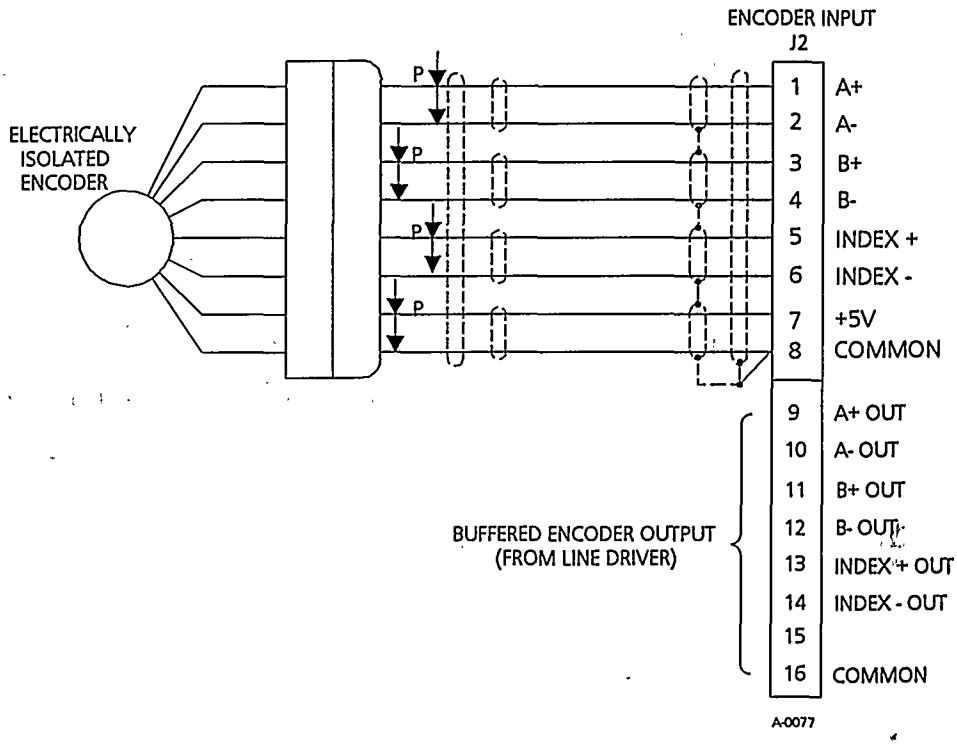
NOTE: When installing the encoder take note of the number of counts per revolution, this number will be used later in Chapter 3 to set parameter P95.

Encoder wiring must be in twisted shielded pairs per Figure 2-11, #22 AWG minimum size, 150' maximum, with an insulated overall shield. Connect all shields to J2-8. DO NOT CONNECT ANY SHIELDS TO THE ENCODER CASE OR MOTOR FRAME. Maximum wire-wire or wire-shield capacity shall not exceed 7500 picofarads per pair (50 pf/foot at 150'). Baldor=Sweodrive stocks encoder cable as an optional accessory. Electrical isolation of the encoder case and shaft from the motor is highly recommended to prevent capacitively coupled motor noise from influencing the encoder signal.

The encoder +5 VDC power supply output provided by the drive at J2-7 is referenced to circuit board common. DO NOT CONNECT THIS OUTPUT TO GROUND OR ANOTHER POWER SUPPLY or damage to the drive may result.

NOTE: Encoder wiring must be separated from power wiring. Separate parallel runs of encoder cable by at least 3" from power wires, cross power wires at right angles only. Insulate or tape off ungrounded end of shields to prevent contact with other conductors or ground.

Figure 2-11 Encoder Connections



Differential inputs from 5VDC encoder as shown in Figure 2-10 are highly recommended for best noise immunity. If only non-differential encoder signals are available, connect these to +A, +B and +INDEX on the plug-in terminal strip J2. NOTE: The encoder signals can be open collector, however this is not recommended.

NOTE: Contact factory if encoder output has any connections to voltage higher than +5VDC (eg, a pull-up resistor or high voltage line driver). Special connections are required to prevent damage to the encoder input circuit when this type of encoder is used.

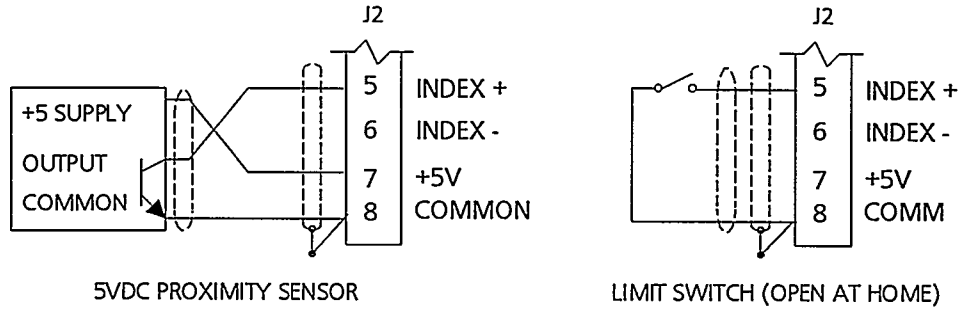
Buffered Encoder Output

The controller provides a buffered encoder output, (from line drivers), on terminal strip J2 pins 9 - 16 (Refer to figure 2-11). This output can be used by external hardware which needs to monitor the encoder signals. Splitting the encoder output is not recommended.

Home or Orient Switch Input (J2)

A machine mounted switch may be used to define the Home or Orient position in place of the encoder index channel. A differential line driver output from a solid state switch is preferred for best noise immunity. Connect this input to J2-5 and J2-6 replacing the encoder INDEX channel. Wire the non-differential solid state switch or limit switch per Figure 2-12.

Figure 2-12 Typical home or orient switch connections



The logic input defining Home is a rising edge at J2-5. Regardless of the type of switch used, clean rising and falling edges at J2-5 are required or erroneous positioning will occur.

Check of Electrical Items

CAUTION: After completing all the installation steps outlined in this Chapter, and before applying line power to the system, double check the following items:

Verify AC line voltage at source matches rating control.

Inspect all power terminations for workmanship and tightness.

Verify control and motor are grounded to each other and the control is connected to supply ground.

Check incoming signal and encoder wiring for accuracy.

Be certain all brake coils, contactors, and relay coils have noise suppression. This should be R-C filters for AC coils and reverse polarity diodes for DC coils. MOV type transient suppression is not adequate.

WARNING: Make sure that unexpected operation of the motor shaft during start-up will not cause injury to personnel or damage to equipment.

Check of Motors / Couplings

Verify freedom of motion for all motor shafts and that all motor couplings are tight without backlash.

Check that the encoder shaft coupling and encoder body mounting have no backlash or looseness.

Verify the holding brakes, if any, are properly adjusted to fully release and set to the desired torque value.

Momentary Application of Power

Double check electrical and mechanical connections before applying power to the control.

Verify that Enable input to J1-8 is off.

Temporarily apply power and observe that the display indicates a 0 (zero). If this indication doesn't occur, double check all connections and verify input voltage and refer to Chapter 6 "Troubleshooting". If fault indication occurs, refer to Chapter 6.

Chapter 3
Setup Using the Keypad

This Chapter describes the setup and tuning of the controller from the keypad. If you are not yet familiar with the operation of the keypad please refer to the section entitled USING THE KEYPAD in Chapter 1.

The flow diagram at the beginning of Chapter 2 outlines the setup procedure.

NOTE: If you have a completed Parameter list available for your application, enter all the parameters from that list (refer to USING THE KEYPAD in Chapter 1) and skip ahead to the section entitled: OPERATE THE DRIVE.

The following procedure assumes that you have successfully completed the installation of the control and have momentarily applied power as outlined in Chapter 2.

Drive Setup From Motor Nameplate Data

Verify that the Enable input to J1 is off. Apply power to the controller and verify that the keypad display does not indicate a fault condition.

To enter the parameters that follow, the keypad must be in program mode. This is accomplished by pressing the PROG key on the keypad to light the PROG indicator. If this is not a first-time setup you may be prompted for a security code. To exit the program mode at any time press the PROG or DISP keys.

Setup Parameters

The first step of the setup procedure is to enter the desired operating mode, the motor nameplate data, and the encoder counts per revolution in the parameters that follow.

PARAMETER	DESCRIPTION AND PROCEDURE
P90	**OPERATING MODE** Enter the mode number chosen in Chapter 2 (Figures 2-4 thru 2-7).
P91	**MOTOR RATED VOLTAGE** Enter the rated voltage of the motor in RMS volts from the motor nameplate.
P92	**MOTOR RATED CURRENT** Enter the rated full load current of the motor in RMS amps from the motor nameplate.
P93	**MOTOR RATED SPEED** Enter the rated or base speed of the motor in RPM exactly as shown on the motor nameplate. **NOTE: DO NOT ENTER DESIRED OR RATED MAXIMUM SPEED OR ROUND OFF THE RATED NAMEPLATE SPEED**

P94 **MOTOR "RATED" OR "BASE" FREQUENCY**
Enter the rated or base frequency in Hertz from the motor nameplate.

P95 **ENCODER LINES PER MOTOR REVOLUTION**
Enter directly from encoder nameplate or data sheet for direct coupled encoder. Geared or belt coupled encoders are not recommended, if used they must have positive ratio with no slippage and encoder lines per motor revolution must be entered here.

Calculate Control Parameters

This procedure uses the nameplate data to compute initial values for various remaining parameters.

NOTE: Parameters with their factory preset marked as CALC or referenced to another parameter in the parameter list (Appendix D) will be overwritten by this procedure.

P99 **CALCULATE AND LOAD FACTORY PRESET DATA.** Set P99 to 1 to automatically calculate flux vector control parameter and load other parameters with factory preset data. This procedure also clears all recorded fault conditions in the fault log. When the procedure is finished, it will reset P99 to zero. MANUALLY CALCULATED PARAMETERS THAT YOU WISH TO RETAIN MUST BE RE-ENTERED AFTER THIS STEP.

Auto-Tuning the Drive

CAUTION: The auto-tuning tests are not recommended for elevator applications, with the exception of test AU1 & AU2. Please refer to appendix A for elevator setup procedures.

Automatic tuning of the controller to the motor is accomplished by running a six step tuning procedure activated through Parameter P100. The resulting parameters P71 through P78 selected by the microprocessor may be manually changed if required to suit the application.

WARNING: THESE PROCEDURES MAY ROTATE THE MOTOR UP TO MAXIMUM SPEED. DO NOT PERFORM AUTO TUNING UNLESS IT IS SAFE TO ROTATE THE MOTOR UNDER AUTOMATIC CONTROL OF THE DRIVE.

These procedures require the motor and encoder to be properly wired, shielded, and grounded per Figures 2-2 through 2-12. They also require that the motor rotor be free to rotate with no external load or source of significant windage or friction. The tests must be run in sequence from Au01 to Au06.

To run each auto-tuning procedure, first disable the drive and select Parameter P100 (Press Enter) to gain access to the tests (ALL, AU01,..., Au06). Use the arrow keys to select the desired test, enable the drive (except for AU01), and press Enter again to start. **NOTE:** Selecting "ALL" will automatically advance through all tests (AU01 through AU06, and provided they all pass will display "DonE" when completed. If running each test individually, the display will indicate either "PASS" or "Err" to announce the individual test result. Press Enter, and the next test number will be displayed. Repeat the procedure until all tests have been run successfully.

Enabling the Drive

All of the tuning tests except AU01 require the drive to be enabled. The drive may be enabled by closing J1-8 on the J1 terminal strip (some operation modes require J1-9 & 10 to be closed also), or from the keypad by entering LOCAL mode (press LOCAL, the led will be lit) then pressing FWD. Once enabled, current will flow in the motor.

Running the Tests

During the operation of the tests, tuning variables will be displayed on the keypad. If you are having trouble getting a test to pass, take note of the final value on the display before consulting the factory for assistance.

ALL **RUN ALL TESTS**

Running this test will sequence through all tests (AU01 - AU06) automatically. If a test fails the procedure will stop. Select "ALL", enable the drive, and press Enter to run the procedure.

AU01 **COMMAND OFFSET TRIM**

Trims out any voltage offsets on the differential command input (J1-4 & J1-5). It does not trim the Analog (POT) input (J1-1, 2, 3). This test is required only if the controller is to be used in mode 2; you can skip this procedure for other modes. Apply input command to J1-4 and J1-5 corresponding to zero speed, disable the drive (open the Enable input J1-8 or press STOP on the keypad), select AU01, and press Enter to run the procedure. IF THE PROCEDURE FAILS, J1-4 to J1-5 input is too high to trim out. Measure voltage J1-4 to J1-5 and command voltage near zero before re-running.

AU02 **CURRENT LOOP COMPENSATION**

Enable the drive, select AU02 and press Enter to run the procedure. This procedure measures current response to commanded pulses of 1/2 rated motor current. The test sets the values for Parameters P73 - Current Controller Proportional Gain, and P74 - Current Controller Integral Gain. If this procedure fails, retry once before consulting factory for assistance.

AU03 **FLUX (EXCITATION) CURRENT SETTING**

Enable the drive, select AU03 and press Enter to run procedure. This procedure runs the motor near rated speed for up to several minutes and sets flux current (P72) based on line voltage and motor nameplate data. IF PROCEDURE FAILS, remove the Enable (OPEN J1-8) and check P90 through P95 entries, motor grounding, and proper voltage at L1, L2, L3.

AU04 **ENCODER TESTS**

Enable the drive, select AU04 and press Enter to run the procedure. This procedure checks the values entered in Parameters P95 - Encoder lines per revolution, and P71 Encoder alignment direction. This is accomplished by accelerating the motor "open loop", detecting the phasing of encoder feedback and counting the number of encoder pulses per revolution of the motor. The test will automatically switch the value of P71 to match motor rotational direction. IF THE PROCEDURE FAILS OR THE CONTROLLER APPEARS UNSTABLE, check motor and drive grounding, encoder coupling, P95 encoder lines selection, wiring and shielding, and then repeat the test. If the test still fails, Open the Enable input (J1-8) to disable the controller, put the keypad in Display RPM mode (Press the DISP key until the RPM indicator is lit) and

observe RPM on the display while rotating motor rotor by hand. Zero RPM or erratic display indicates malfunctioning encoder, power supply, encoder wiring error or damaged encoder line receiver on the control board. If display seems OK, manually change P71 from 1 to zero or vice-versa and retry.

AU05 **SLIP FREQUENCY TEST**

Enable the drive, select AU05 and press Enter to run the procedure. This procedure repeatedly accelerates motor to test Parameter P78 and will yield errant results if there are significant windage or friction loads on the motor. IF THE PROCEDURE FAILS, manually reset P78 to the value calculated from the CALCULATE DEFAULT PARAMETERS section above.

AU06 **SPEED CONTROLLER COMPENSATION**

Enable the drive, select AU06 and press Enter to run the procedure. This procedure accelerates the motor to measure the current to acceleration ratio (P75). It also adjusts Parameters P76 - Speed Controller Integral Gain and P77 Speed Controller Differential Gain. Because the auto-tune is usually done at no load, it will generally set P76 too high for high inertia motors and loads if current limit P33 is set too low. If the controller is too responsive when the drive is loaded, set current limit to the proper value and rerun this procedure. NOTE: This auto-tune procedure can be run with the drive loaded. IF THIS PROCEDURE FAILS or drive is still too responsive, adjust P75 manually as discussed in Appendix C.

After the tuning tests are complete, disable the drive and exit the auto tuning mode by pressing RESET on the keypad.

NOTE: The following section is optional. If your application does not require any of the parameters described below you can skip ahead to the section entitled OPERATE THE DRIVE.

Selection of Optional Parameters (P0 - P65)

These parameters are not required to set up the control to match the motor; they are used to specify analog and digital inputs, outputs, and other functions to suit the application.

System Control Parameters

PARAMETER	DESCRIPTION AND PROCEDURE
P0	**JOG SPEED** (RPM) This is the speed that the drive uses when a Jog command is given from J1-12 in mode 0, the keypad, or the serial port.

NOTE: Although the Accel / Decel ramps are defined as having a maximum value of 999.9, this is dependent on the max speed of the motor. The slowest profile the drive can apply to a command is 3.25 RPM per second. For example, if 1000 RPM is max speed, then maximum Acc / Dec would be: 307 sec; 2000 RPM = 615 sec; and 3000 RPM = 923 sec.

P1	**JOG ACCEL** (0 TO MAX SPEED) (SEC) Sets the time in seconds for the Jog command to rise linearly from zero to the maximum speed (set with P30) Adjustable from zero to 999.9 seconds with resolution of 0.1 seconds.
P2	**JOG DECEL** (MAX SPEED TO 0) (SEC) Sets the time in seconds for the jog

command to fall linearly from the maximum speed (set with P30) to zero. Adjustable from zero to 999.9 seconds with resolution of 0.1 seconds. The drive will follow this rate if a braking option is used, otherwise the drive will take longer to decelerate.

P3 **JOG "S" CURVE** (TIME TO MAX ACCEL) (SEC) Sets the time in seconds for the acceleration or deceleration to rise from zero to the maximum speed set with P30 or fall from the maximum speed to zero. Adjustable from zero to 99.99 seconds with a resolution of 0.01 seconds. Increasing the S-Curve time softens the acceleration transient the drive will apply to the driven equipment and lengthens the time required to change speed. Refer to Figure 3-1.

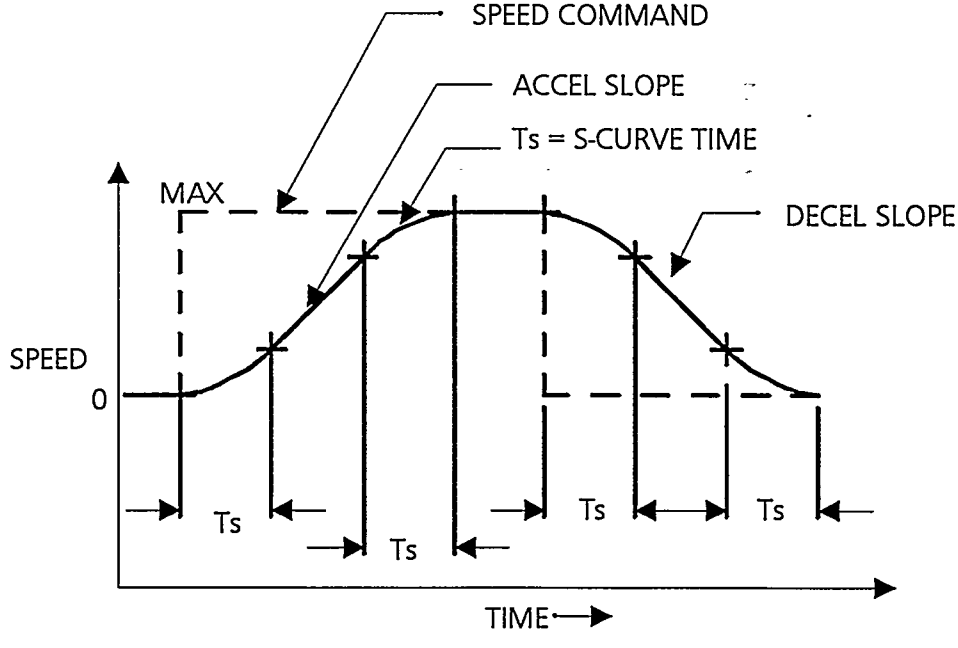
P4 & P7 **ACCEL #1 and #2** (0 TO MAX SPEED) SEC Sets the time in seconds for the speed command to rise linearly from zero to the maximum speed (P30) Adjustable from zero to 999.9 seconds with resolution of 0.1 seconds. Two independent Acc / Dec / S-curve groups are available.

P5 & P8 **DECEL #1 and #2** (MAX SPEED TO 0) (SEC) Sets the time in seconds for the speed command to fall linearly from the maximum speed (P30) to zero. Adjustable from zero to 999.9 seconds with resolution of 0.1 seconds. Two independent Acc / Dec / S-curve groups are available. The drive will follow this decel rate if a braking option is used, otherwise the drive will take longer to decelerate.

P6 & P9 **"S" CURVE #1 and #2** (TIME TO MAX ACCEL) (SEC) Sets the time in seconds for the acceleration or deceleration to rise from zero to the maximum value set with P30 or fall from the maximum to zero. Adjustable from zero to 99.99 seconds with a resolution of 0.01 seconds. Increasing the S-Curve time softens the acceleration transient the drive will apply to the driven equipment and lengthens the time required to change speed. Two independent Acc / Dec / S-curve groups are available. Refer to Figure 3-1.

P11 - P25 **PRESET SPEEDS #1 - #15** (RPM) These parameters select the preset speeds to be used in Mode 1 (Mode 0 uses preset #1). These speeds are selected from logic inputs J1-11 - J1-14 (in mode 1). All preset speeds are factory preset to 0.

Figure 3-1 Typical S-Curve Limited Velocity Profile



P26 **HOMING / ORIENT SPEED** (RPM) Sets the command speed in RPM for the motor when Home / Orient logic input is applied. Upon a Home / Orient input the drive will accelerate or decelerate to this speed in the forward direction. The drive will rotate at this speed until the Home (or Orient) marker input is received, then it will position as described below.

NOTE: Homing is always done in the FORWARD direction. If the drive orients in the wrong direction for your system you must change the phasing of the motor so that "drive" forward matches the desired homing direction. This is done by swapping any two output phases (T1 - T3), and changing the encoder alignment direction (P71) from a 1 to a 0 or vise versa.

P27 **HOME OFFSET (IN ENCODER COUNTS AFTER X4 MULTIPLICATION)** Sets the distance past the Home marker input at which the motor will decelerate and hold position. Resolution is four times the number of encoder lines per revolution. Home position will be the rising edge of the marker input plus this offset. It is recommended that this distance be set at least 100 counts to provide deceleration distance and avoid an abrupt stop.

Misc Operating Parameters

P30 **DESIRED MAXIMUM MOTOR SPEED** (RPM) Enter desired maximum motor speed in RPM. **THIS MUST NOT EXCEED MOTOR NAMEPLATE MAXIMUM SPEED.**

P31 **MINIMUM SPEED (RPM)** This parameter sets the offset applied to analog speed commands in Mode 0 only. This sets the minimum speed command in RPM which will occur with zero volts input. P51, - Analog Input Deadband, should be set to zero whenever P31 is non-zero.

P32 **CONSTANT POWER SPEED (RPM)** This parameter defines the speed in RPM below which the flux current is constant (the constant torque region). Above this speed the flux current is reduced inversely with increasing speed for constant HP operation. This setting is made automatically during the setup procedure. Lowering the setting operates the motor at lower voltage in the constant HP region to provide better dynamic response. Raising the setting results in maximum voltage supplied to the motor and provides maximum output torque in the constant HP region speeds.

P33 **CURRENT LIMIT (AMPS)** Sets maximum current in amps the control will supply to the motor. This parameter is automatically set to 2 times the motor rated current (P92) when the motor parameters are entered. This parameter may be set to any current within the peak rating of the control. Settings below the peak control current rating will allow higher continuous current for variable torque applications with maximum continuous capability equal to the variable torque current rating when the current limit is set to this value.

P34 **REGEN RESISTANCE (OHMS)** This parameter sets the value of the external regen resistor (if one is used) in ohms. From this parameter and P35 the controller calculates the maximum obtainable value of regenerative energy. NOTE: if no regen resistor is used, set this value to 0. Set this value to 1 for a Multi-Axis System.

P35 **REGEN RESISTOR POWER (WATTS)** This parameter sets the wattage rating of the external regen resistor (if one is used).

P36 **TORQUE RATE LIMIT (mSEC)** This parameter is used to limit the rate of change of a torque command. The parameter sets the time in milliseconds for the torque command to rise linearly from 0 to the maximum value.

P37 **KEYPAD CONTROL** (0-9) This parameter sets the control functions which are active from the keypad. Appendix D gives a matrix of possible choices for this parameter. The default setting is 0, which allows forward and reverse jog, forward and reverse run, and stop to be controlled from the keypad.

P38 **KEYPAD SPEED** (0-5) This parameter controls the method of running (speed control) and stopping the motor from the keypad. Appendix D gives a matrix of possible choices for this parameter. There are 3 ways to control speed: Increment (@ACC / DEC rate), Entered speed, and Preset speed. Each of these can be set for Coast to stop or brake to Stop in conjunction with decel time (P5).

Increment Control: (P38 = 0 or 1)

Described in Chapter 1, Using the Keypad.

Entered Speed Control: (P38 = 2 or 3)

Allows entry of an exact digital speed command. To use this mode the drive must be in LOCAL keypad control, viewing an output condition (not in PROGram mode). Press ENTER, UP or DOWN, the display will change to RPM with the RPM indicator flashing. Use the arrow and shift keys to select the desired speed. Press ENTER, the drive will now command the speed and return to viewing the selected output condition.

Preset Speed Control: (P38 = 4 or 5)

Allows speed selection from the 15 preset speeds, Parameters P11 - P25. To do this, the drive must be in LOCAL keypad control, viewing an output condition, and not in PROGram mode. Press ENTER, UP or DOWN key and the display will change to RPM with the RPM indicator flashing. Use the arrow and shift keys to select the preset speed number (1 thru 15). Press ENTER, the drive will now command the preset speed and return to viewing the selected output condition.

P39 **SECURITY CONTROL** (0-3) Sets the level of security applied to the changing of parameters. Valid choices are 0 - 3.

P39 = 0

No security code is required from the keypad or the serial port.

P39 = 1

A security code must be entered to change parameters from BOTH the keypad and the serial port.

P39 = 2

A security code is required from keypad only.

P39 = 3

A security code is required from serial port only.

P40 **BAUD RATE** (0-4) Sets the baud rate of the serial port for serial commands. Possible values range from 0 for 1200, 2 for 4800, 3 for 9600 (factory preset) and 4 for 19,200 baud. NOTE: parity = None, Data Bits = 8, and Stop Bits = 1 for all selections.

P41 **DRIVE ADDRESS** (0, 1-31) The serial command language supports from 1 to 32 drives on a common serial line. This parameter sets the address of this controller. The default value is 0 for single system and the drive acts upon all valid serial commands. With a setting of 1 or higher the drive will wait to be addressed before accepting a command. See Chapter 4 and Appendix E for more information on Serial Command.

NOTE: Setting this to a nonzero value will automatically turn echo off for serial commands.

P42 **AUTO FAULT RESET** (FAULTS/HOUR) This parameter allows the user to select automatic reset of up to 5 faults per hour. The factor preset value of 0 selects no auto reset, a value of 1 selects 1 auto reset/hour, etc. All faults are stored in the fault log (up to 15 total) for retrieval during troubleshooting.

P43 **AUTO RESET DELAY TIME** (SEC) This parameter sets the time delay in seconds before the controller will auto reset a fault. The adjustable range is 0 to 120 seconds. The factory preset value is 0.

P44 **POWER LOSS RESET** (0,1) A value of 1 turns on the power loss reset, the factory preset of 0 turns it off. When power loss reset is on, the controller will automatically reset from a momentary loss of input power using the values set in P42 and P43. When power loss reset is off a momentary loss of input power will cause a power loss fault.

I/O Parameters

P50 **ANALOG INPUT** (0-4) This parameter controls the type of analog input used for speed commands in mode 2 (in mode 0 the input is 0-10VDC, or a speed pot on J1-1 to J1-2). 0 selects a 0-10 VDC signal on J1-1 and J1-2 (see Figure 2-4). 1 = a ±10 V signal on J1-4 and J1-5, 2 = a ±5 V signal on J1-4 and J1-5, 3 = a 4-20 ma signal on J1-4 and J1-5, 4 = ±10 V signal on J1-4 and J1-5 with a 0-5 V torque limit on J1-1 and J1-2 (5 V = FULL TORQUE). Appendix B has schematic.

P51 **ANALOG DEADBAND FOR ZERO SPEED COMMAND (RPM)** This parameter sets the input threshold below which the analog input signal will result in zero speed command to the drive in mode 2. This "dead zone" allows the drive to hold zero speed for small offsets or drifts in the speed command input. (Example - P51 = 30 RPM will cause the drive to hold zero speed for analog inputs commanding less than 30 RPM.) Set P31 = 0 whenever P51 is non-zero.

P55 **ENABLE POLARITY** (0,1) Controls the polarity of the enable input (J1-8). The factory preset is 0 and requires an open on J1-8 to disable the motor. A setting of 1 requires a closed connection. This defeats the open wire protection!

P56 & P57 **SELECTION FOR ANALOG OUTPUTS #1,2** (0-20) This parameter selects the output at J1-6 & J1-7. Valid choices are given in Appendix D and an explanation of each is given in Appendix B.

P58 - P61 **SELECTION FOR OPTO OUTPUT #1 - #4** (J1-19 - J1-22) Valid choices are given in Appendix D and an explanation of each of is given in Appendix B.

I/O Threshold Parameters (For Opto Outputs)

P62 **ZERO SPEED TOLERANCE (RPM)** This threshold sets the dead zone for the zero speed logic output in RPM. Speeds equal to or less than this setting will cause the zero speed output to be closed, speeds greater than this setting will cause the zero speed output to be open. See Opto-Isolated Outputs in Appendix B.

P63 **AT SPEED TOLERANCE (%)** This parameter sets the width of the band about the commanded speed which will cause the At-Speed logic output to be closed. The setting defines the tolerance band in percent of base speed for speeds below base speed and percent of commanded speed above base speed. See Opto-Isolated Outputs in Appendix B.

P64 **POSITION TOLERANCE** (ENCODER COUNTS) This parameter sets the number of encoder counts a serial positioning command is allow to be off before it tries to correct.

P65 **SET SPEED (RPM)** This parameter defines the speed in RPM below which the Set Speed logic output is open. At or above this speed, the Set Speed logic output is closed. See Opto-Isolated Outputs in Appendix B.

Flux Control Parameters

P70 **ENCODER FILTER** (0 - 7) This is the number of servo cycles the encoder counts are accumulated over to provide the RPM feedback. It is automatically set to suit the encoder resolution. The preset filter frequency may be reduced to obtain smoother low speed operation. The higher the number, the more filtered the signal but less bandwidth is available. Valid frequencies are 0 - 7 Hz.

P71 **ENCODER ALIGNMENT DIRECTION** (0 OR 1) This parameter sets the encoder's electrical direction of rotation to match that of the motor. This parameter is normally set during the auto-tuning procedure.

NOTE: Parameters P72 through P78 are set during the tuning procedure. Appendix C covers these parameters in greater detail.

P79 **POSITION GAIN** This value sets the gain for serial positioning commands, it is automatically calculated by the controller.

P80 **PROTECTIVE FEATURE** Refer to Appendix B for descriptions and method of selection.

P81 **NUMBER OF PARALLEL CONTROLS**
No entry normally required. If multiple controls are connected, this number needs to be entered before Auto-Tuning the Drive. Normally P81 = 1, unless multiple control modules are connected in parallel to drive motors requiring more current than is available from a single control module. Enter number of parallel controls for those systems which include the necessary equipment to parallel control modules.

P82 **PWM RIPPLE FREQUENCY** (KHz) Sets the ripple frequency of the controller in .1 KHz increments. Valid selections are from 2 KHz - 20 KHz for the IGBT high frequency version, 2 KHz - 5 KHz for the IGBT low frequency version, and 2 KHz - 10 KHz for the Bipolar version. NOTE: Operation of the drive above its factory preset ripple frequency will reduce its output capability.

Operate the Drive

Now that the controller is setup it should be run to verify correct operation. The controller should be enabled, and given speed commands to verify that the motor response is adequate for the application. (The motor can be run from the terminal strip as defined in the appropriate Figure 2-4 through 2-7, or from the keypad as outlined in Chapter 1).

If the motor rotates in the wrong direction for your application (i.e. drive forward does not match system forward), remove power from the drive and exchange any two motor leads (T1, T2, or T3) and change the encoder alignment direction parameter P71.

If the drive trips (indicates a fault condition on the display) refer to Chapter 6 for troubleshooting information.

Adjust Control Parameters to Suit the Application

The factory preset parameters or auto-tuned parameters set up the controller to operate properly with only the motor rotor as a load. When the actual load to be driven is connected, it may be necessary to adjust some of the parameters to optimize performance. Other parameters should not be changed as they are difficult to adjust to obtain increased performance.

1. After initial setup, DO NOT ADJUST P72, P73, P74 or P78. These are normally automatically set near-ideal. See Appendix C for methods of calculating flux vector parameters if auto-tuning cannot be used.

2. The speed loop parameters P75, P76 and P77 can often be manually adjusted to better suit the application. See Appendix C for PI (proportional plus integral) controller background and setup procedures. The P70 encoder filter may also be used to smooth the speed loop response.

3. The constant power speed P32 may need adjustment for ideal high speed performance.

4. If homing is used, the homing speed and offset may require adjustment to suit the application.

5. Preset speeds and accel, decel and S-curves should be adjusted to suit the application.

6. Current limit P33 can be adjusted to limit maximum torque the motor will apply to the load.

Select Security Code

The security code (P101) is an optional entry. It works with parameter P39 to prevent keypad or serial users from entering the Program mode where parameter variables may be altered but does allow users to view any variable. The factory preset value is 9999.

The security code value may be set by changing parameter P101 to the desired value (see Chapter 1 for information on how to use the keypad). Once the number is selected, record it in a safe place. Next P39 will need to be changed to select the

desired security mode (see P39 earlier in this chapter or Appendix D for more information).

After a security code is entered and P39 is set for keypad security code, when pressing PROG to enter the program mode for the first time you will be prompted to enter the security code. Press Enter and use the shift and arrow keys to select the code, Press Enter again and the program mode will be active (PROG LED lit). Once the security code has been entered you can toggle in and out of program mode without re-entering the code, (the program led will flash when out of program mode to indicate that the security code is still entered). To clear (and re-activate) the entered security code press Reset while in Program mode or when the PROG led is flashing. The next time the PROG key is pressed you will be prompted for the security code again.

Record Parameters

Record the parameters values from the display for future reference. The vector drive parameter sheet in Appendix D provides a convenient form for the data. Parameter data may also be stored in a computer file by the procedure given in Chapter 4.

Chapter 4
Serial Command

A computer or CNC that provides an RS232 / 422 / 485 serial interface may be used to set up and operate the drive. A Serial Command Language is built into the drive for this purpose. The Serial Command Language accepts commands in the form of ASCII characters, and can control any aspect of the drive including running the motor, changing parameters, and viewing output conditions. Some control features are unique to serial control such as positioning and file transfer commands.

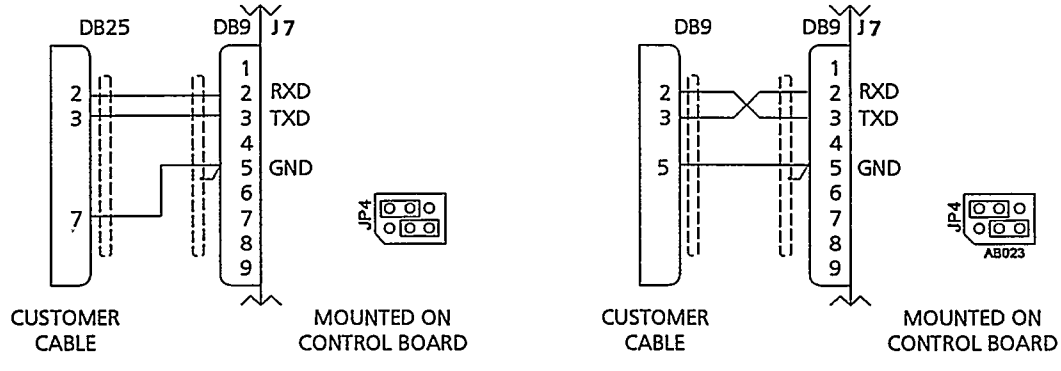
Serial Connections

To use the serial commands requires the use of a computer or terminal capable of serial communications using the standard ASCII character set. (A typical system consists of an MS-DOS compatible laptop running communications software). The drive supports RS-232, RS-422 (2 wire), and RS-485 (2 wire) multi-drop. The factory preset communications settings are RS-232, 9600 baud, no parity, 8 data bits, 1 stop bit. If your system requires a different baud rate you must change Parameter P40 - from the **keypad** before continuing. Refer to Chapter 1 for information on using the keypad.

RS-232 Operation

The serial cable (customer supplied) must be wired as shown in Figure 4-1 and should be connected to the control board on the drive and the host computer before applying power. **Shielded wire MUST be used, with the shield connected to ground at the control board.** Plug one end of the communications cable into the DB9 connector on the drive (J7) and the opposite end into the DB9 or DB25 RS-232 serial port on the computer or terminal. Make sure the JP4 jumpers on the control board match the settings in Figure 4-1.

Figure 4-1 RS-232 Serial Connections



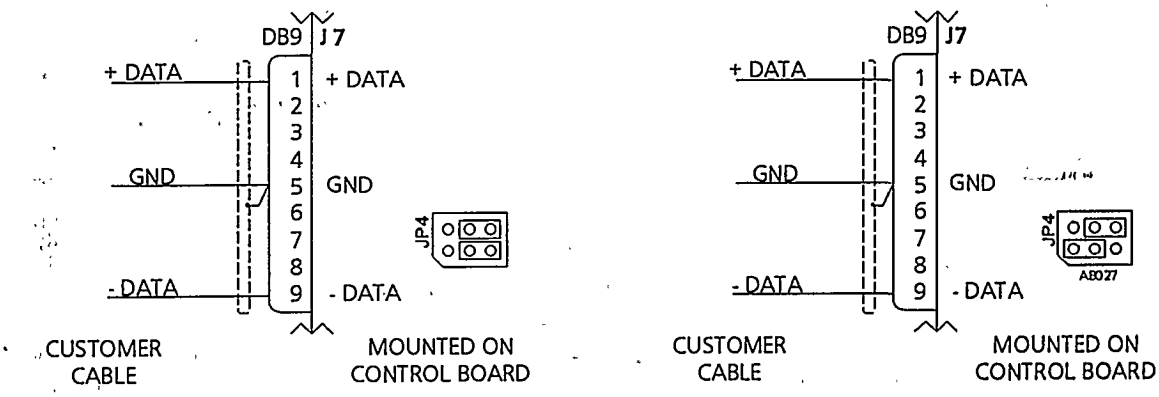
RS232 DB25 TO DB9 CONNECTIONS

RS232 DB9 TO DB9 CONNECTIONS

RS-422 / RS-485 Operation

The RS-422 and RS-485 interfaces use differential signals, providing increased noise immunity. The connections are shown in Figure 4-2. The cable should be connected to the control board on the drive and the host computer before applying power. **Shielded wire MUST be used, with the shield connected to ground at the control board.** Make sure the JP4 jumpers on the control board match the appropriate settings in Figure 4-2.

Figure 4-2 RS-422 / RS-485 Connections

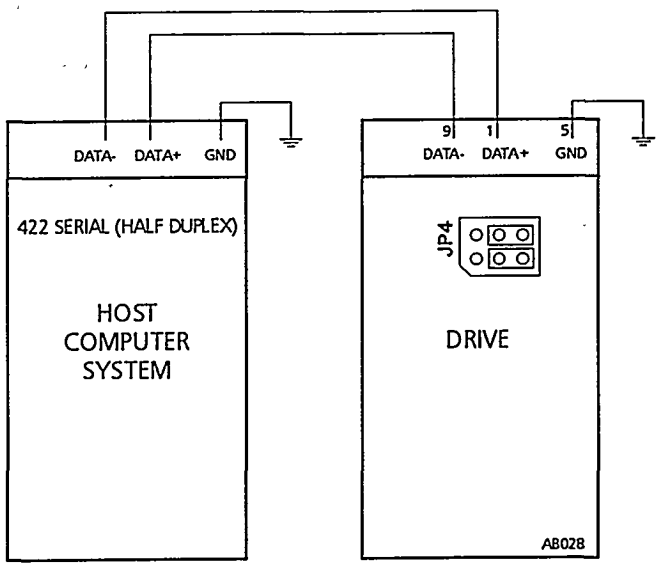


RS422 / 485 (NOT TERMINATED) 2 WIRE CONNECTIONS **485 (TERMINATED) 2 WIRE CONNECTIONS**

RS-422 2 Wire Point To Point

A typical RS-422 system is shown in Figure 4-3. RS-422 allows half duplex (2-wire) operation between one host computer and one drive.

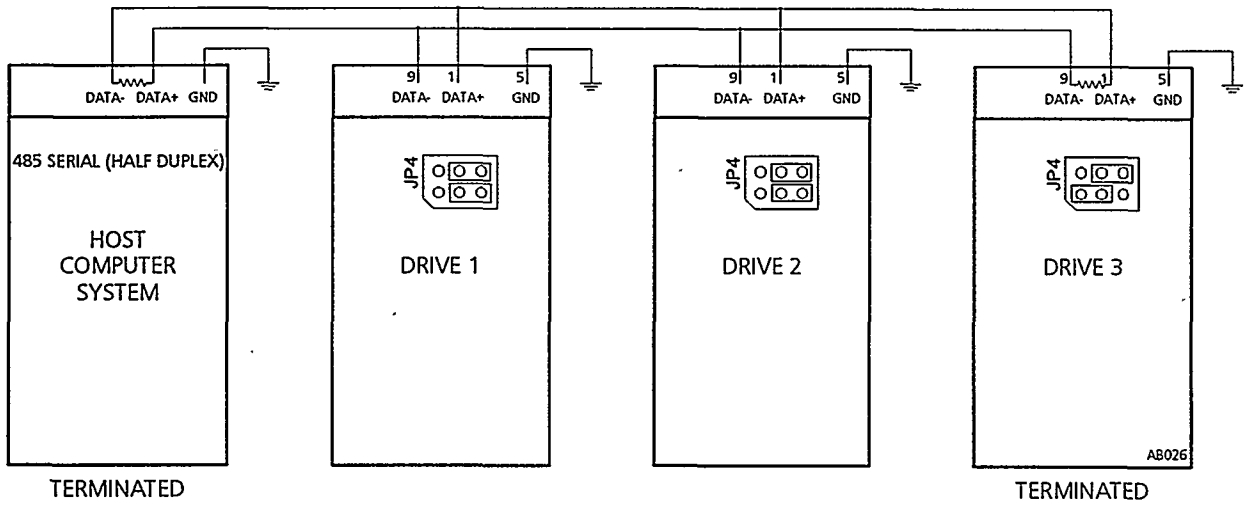
Figure 4-3 RS-422 Point to Point System



RS-485 2-Wire Multi-Drop

RS-485 2-wire allows up to 31 drives to be connected (half duplex) to a host computer through a multi-drop or "party lined" cable. A typical RS-485 2 wire system is shown in Figure 4-4. Note: the last drive in a multi-drop system MUST be terminated by setting the JP4 jumpers accordingly, refer to Figures 4-4 and 4-2. The host computer must also be configured with a RS-485 terminated connection. In multi drop operation each drive must be configured with a different drive address (P41). Note in this configuration the host computer **MUST** disable its transmitter after **each** transmission.

Figure 4-4 RS-485 2-Wire Multi Drop System



Drive Setup from Serial Command

After completing all wiring and safety checks per Chapter 2, and connecting the serial cable, apply power to the drive.

NOTE: If you have a correct Parameter file available for your application and you are familiar with entering serial commands, you may skip ahead to the section entitled: FILES TRANSFER COMMANDS to upload your file to the controller. After your file has been uploaded you should proceed to the section entitled: OPERATE THE DRIVE.

Using the Serial Command Language

This section describes the setup and tuning of the controller from serial commands. The Sweodrive serial command language provides a comprehensive set of instructions for configuration and operation that are listed later in this chapter. A brief list of the commands required for setup will be given below.

The serial command language can be used with any of the operating modes described in Chapter 2 as long as the user can assert control over the Enable line (J1-8), Forward Limit (J1-9), and Reverse Limit (J1-10). These inputs function as emergency stop lines and must be maintained closed to allow control serial operation. Once under serial local control, the drive will ignore all J1 logic inputs except the enable and forward/reverse limit inputs (J1-8,9,10 and the motor temp input J1-16 if active).

Once the proper cable has been installed, power has been applied to the controller, and the computer or terminal is configured and operational; type **STATUS** and press Enter (Return on some keyboards). A few lines of text should appear on your screen.

Commands Required for Setup

(Commands are case sensitive)

L_ON	Places the drive in Serial Local Control (bypasses Terminal Strip J1 connections except J1-8,9,10).
L_OFF	Exits Serial Local Control (returns control to Terminal Strip J1).
E	Enables the drive to produce torque (J1-8 must be closed. J1- 9 must be closed for forward operation, J1-10 for reverse).
D	Disables the drive.
Pxxx or **Pxxx nnnn**	Change or view parameters where xxx is the parameter number and nnnn is desired value for the parameter. Typing Pxxx alone displays the current value. Typing P will display all parameters.
AUx	Runs an auto tuning test, where x is the test number.
STATUS	Returns the current status of the drive.
Vxxxx	Gives the drive a velocity command. xxxx is the desired velocity (signed) in RPM.

The following procedure assumes that the controller has no security code defined (factory preset). If your controller has already been programmed with a security code you will need to enter that number. To enter the security code: Type **SCxxxx** (press ENTER). Where xxxx is your four digit security code. For example if your security code is 1234 you would type: **SC1234** and press the ENTER key.

The following procedure also assumes that you have successfully completed the installation of the controller as outlined in Chapter 2 and have successfully established serial communications between the controller and your system.

To enter the parameters that follow, you must use the change / view parameters command: **Pxxx** or **Pxxx nnnn**. For example, to change P0 to 3 you would type: **P0 3** (press ENTER). NOTE: the space between "P0" and "3" is required.

Setup Parameters

PARAMETER	DESCRIPTION AND PROCEDURE
P90	**OPERATING MODE** Enter the mode number chosen in Chapter 2 (Figures 3 -6).
P91	**MOTOR RATED VOLTAGE** Enter the rated voltage of the motor in RMS volts from the motor nameplate.
P92	**MOTOR RATED CURRENT** Enter the rated full load current of the motor in RMS amps from the motor nameplate.
P93	**MOTOR RATED SPEED** Enter the rated or base speed of the motor in RPM exactly as shown on the motor nameplate. **NOTE: DO NOT ENTER DESIRED OR RATED MAXIMUM SPEED OR ROUND OFF THE RATED NAMEPLATE SPEED**
P94	**MOTOR "RATED" OR "BASE" FREQUENCY** Enter the rated or base frequency in Hertz from the motor nameplate.
P95	**ENCODER LINES PER MOTOR REVOLUTION** Enter directly from encoder nameplate or data sheet for direct coupled encoder. Geared or belt coupled encoders are not recommended, if used they must have positive ratio with no slippage and encoder lines per motor revolution must be entered here.

Calculate Default Parameters

This procedure uses the nameplate data to compute default values for various remaining parameters. NOTE: Parameters with their factory preset marked as CALC or referenced to another parameter in the parameter list (Appendix D) will be overwritten by this procedure.

P99 CALCULATE AND LOAD FACTORY PRESET DATA. Enter **1** to calculate flux vector parameters and load parameters with factory preset data. NOTE: MANUALLY CALCULATED PARAMETERS THAT YOU WISH TO RETAIN MUST BE RE-ENTERED AFTER THIS STEP. The drive will reset the P99 value to 0 after it has completed calculations and entered parameters.

Auto-Tuning the Drive

CAUTION: The auto-tuning tests are not recommended for elevator applications, with the exception of test AU1. Please refer to appendix A for elevator setup procedures.

Automatic tuning of the controller to the motor is accomplished by running a six step tuning procedure activated through **AUx** auto-tuning commands. The resulting parameters P72 through P78 selected by the microprocessor may be manually changed if required to suit the application. Refer to Appendix C for more information on manually adjusting gain parameters.

WARNING: These procedures may rotate the motor up to maximum speed. Do not perform auto tuning unless it is safe to rotate the motor under automatic control of the drive.

These procedures require the motor and encoder (if used) to be properly wired, shielded, and grounded per Figures 2-2 through 2-12. They also require that the motor rotor be free to rotate with no external load or source of significant windage or friction. The tests must be run in sequence from AU1 to AU6.

To run each procedure, first put the drive in Serial Local mode by typing **L_ON** (press ENTER). Next activate the enable inputs (J1- 8, 9 & 10) but do not enable the drive with an **"E"** command. Type **AUx** where x is the desired test number, press ENTER to start the test. When complete, the drive will echo back either "PASS" or "Fail" to announce whether or not the procedure has run successfully. Repeat the procedure for the next test number until all tests have been run. NOTE AU_ALL will automatically advance through all tests (provided they all pass), and display a "PASS" when finished.

During the operation of the tests, tuning variables will be displayed on the keypad. If you are having trouble getting a test to pass, take note of the final value on the display before consulting the factory for assistance.

AU_ALL **RUN ALL TESTS**
Running this test will sequence through all tests (AU1 - AU6) automatically. If a test fails the procedure will stop.

AU1 **COMMAND OFFSET TRIM**
Trims out any offsets on the differential command input (J1-4 & J1-5). It does not trim the Analog (POT) input (J1-1,2,3). This test is required only if the controller is to be used in mode 2; you can skip this procedure for other modes. Apply input command to J1-4 and J1-5 corresponding to zero speed, select AU01, and run the procedure as described above. IF THE PROCEDURE FAILS, J1-4 to J1-5 input is too high to trim out. Measure voltage J1-4 to J1-5 and command voltage near zero before re-running.

AU2 **CURRENT LOOP COMPENSATION**
This procedure measures current response to pulses of 1/2 rated motor current. The test sets the values for Parameters P73 - Current Controller Proportional Gain, and P74 - Current Controller Integral Gain. If this procedure fails, retry once before consulting factory for assistance.

AU3 **FLUX (EXCITATION) CURRENT SETTING**
This procedure runs the motor near rated speed for up to several minutes and sets flux current (P72) based on line voltage and motor nameplate data. IF PROCEDURE

FAILS, remove the Enable (OPEN J1-8) and check P90 through P95 entries, motor grounding and proper voltage at L1, L2, L3.

AU4 **ENCODER TESTS**

This procedure checks the values entered in Parameters P95 - Encoder lines per revolution, and P71 Encoder alignment direction. This is accomplished by accelerating the motor "open loop", detecting the phasing of encoder feedback and counting the number of encoder pulses per revolution of the motor. The test will automatically switch the phasing of P82 to match motor rotational direction. IF THE PROCEDURE FAILS OR THE CONTROLLER APPEARS UNSTABLE, check motor and drive grounding, encoder coupling, P95 encoder lines selection, wiring and shielding and then repeat the test. If the test still fails, Open the Enable input (J1-8) to disable the controller, put the keypad in Display RPM mode (Press the DISP key until the RPM indicator is lit) and observe RPM on the display while rotating motor rotor by hand. Zero RPM or erratic display indicates malfunctioning encoder, power supply, encoder wiring error or damaged control board encoder line receiver. If the display seems OK, manually change P71 from 1 to zero or vice-versa and retry.

AU5 **SLIP FREQUENCY TEST**

This procedure repeatedly accelerates motor to test Parameter P78 and will yield erratic results if there are significant windage or friction loads on the motor. IF THE PROCEDURE FAILS, manually reset P78 to the value calculated from the CALCULATE DEFAULT PARAMETERS section above.

AU6 **SPEED CONTROLLER CALCULATION**

This procedure accelerates the motor to measure the current to acceleration ratio (P75). It also adjusts Parameters P76 - Speed Controller Integral Gain and P77 Speed Controller Differential Gain. Because the auto-tune is usually done at no load, it will generally set P76 too high for high inertia motors and loads if current limit P33 is set too low. If the controller is too responsive when the drive is loaded, set current limit to the proper value and rerun this procedure. NOTE: This auto-tune procedure can be run with the drive loaded. IF THIS PROCEDURE FAILS or drive is still too responsive, adjust P75 manually as discussed in Appendix C.

Enter Optional Parameters

NOTE: Entering the optional parameters is not required for the initial setup of the controller. If your application does not require any of the parameters described below you can skip ahead to the section entitled OPERATE THE DRIVE.

Parameters P0 through P65 are used to specify analog and digital inputs, outputs, and other functions to suit the application. A complete list of the optional parameters with descriptions exists in Chapter 3. If your application requires some of these parameters to be changed please refer to the section entitled SELECTION OF OPTIONAL PARAMETERS in Chapter 3 and use the "Pxxx nnn" command to change parameters.

Operate the Drive

Now that the controller is setup it should be run to verify correct operation. The controller should be enabled, and given speed commands to verify that the motor response is adequate for the application. (The motor can be run from the terminal strip as defined in the appropriate Figure 2-4 through 2-7 or from the keypad as outlined in Chapter 1). To run the drive from the serial port:

Make sure the drive is in Serial Local Mode: type **L_ON** (press ENTER)

Close the enable and forward/reverse limit inputs (J1- 8, 9 & 10).

Enable the drive: type **E** (press ENTER)

Current should now be flowing in the motor (you may hear some audible noise).

Enter a Velocity command: **Vxxxx** (press ENTER) (use the desired speed instead of xxxx).

The motor should now run at the desired speed.

Disable the drive: type **D** (press ENTER)

Return control to the J1 terminal strip: type **L_OFF** (press ENTER)

Adjust Control Parameters to Suit the Application

The factory preset parameters or auto-tuned parameters set up the controller to operate properly with only the motor rotor as a load. When the actual load to be driven is connected, it may be necessary to adjust some of the parameters to optimize performance. Other parameters should not be changed as they are difficult to adjust to obtain increased performance.

1. After initial setup, DO NOT ADJUST P72, P73, P74 or P78. These are normally automatically set near-ideal. See Appendix C for methods of calculating flux vector parameters if auto-tuning cannot be used.

2. The speed loop parameters P75, P76 and P77 can often be manually adjusted to better suit the application. See Appendix C for PI (proportional plus integral) controller background and setup procedures. The P70 encoder filter may also be used to smooth the speed loop response.

3. The constant power speed P32 may need adjustment for ideal high speed performance.

4. If homing is used, the homing speed and offset may require adjustment to suit the application.

5. Preset speeds and accel, decel and S-curves should be adjusted to suit the application.

6. Current limit P33 is adjusted to limit maximum torque the motor will apply to the load.

Select Security Code

The security code (P101) is an optional entry. It works with Parameter P39 to prevent keypad or serial users from entering the Program mode where Parameter variables may be altered but does allow users to view any variable. The factory preset value is 9999.

The security code value may be set by changing parameter P101 to the desired value. Once the number is selected, record it in a safe place. Next P39 will need to

be changed to select the desired security mode (see discussion of P39 in chapter 3 or Appendix D for more information).

After a security code is entered and P39 is set for serial security code, you must first enter the security code to access security lockable commands (described later in this chapter):

type: **SCxxxx** (press ENTER) (Use the desired code instead of xxxx).

You can now access the security lockable and local mode commands. The STATUS command can be used to determine the present state of the security code.

Record Parameters

If you wish to save the parameters you have entered you may copy down parameters from the keypad display for future reference. The vector drive parameter sheet in Appendix D provides a convenient form for the data. Parameter data may also be stored in a computer file by the procedure given below.

File Transfer Commands

The serial command language supports the transfer of parameter files using the standard XMODEM protocol.

To UPLOAD a file FROM a remote computer TO the drive:

Type: **UL** (press ENTER)
Then start your remote UPLOAD procedure using XMODEM. To cancel type CTRL-X.

To DOWNLOAD a file FROM the drive TO a computer:

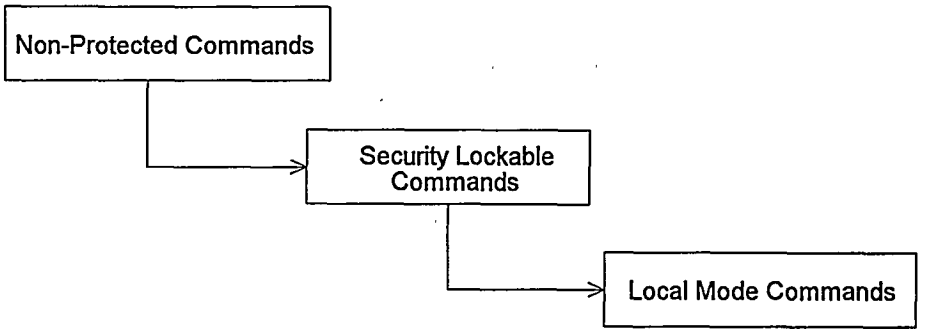
Type: **DL** (press ENTER)
Then start your remote DOWNLOAD procedure using XMODEM. To cancel type CTRL-X.

Serial Command Language Reference

The following instruction set has been incorporated in into the drive software. The use of the command set is optional for operation and set up of the drive, but allows enhanced computer digital control through the Serial communications port running from 1200 - 19.2K baud.

All commands consist of ASCII characters followed by a CR (carriage return, hex 0D). The CR is used as the "End of Line" character, and prompts the controller to process the command. The BACKSPACE character (hex 08 or control-H) cancels the previous character. The Control-X keystroke(hex 18) cancels the current line.

The commands are organized in nested levels:



To access commands in a lower level you proceed through the level above it.

Non-Protected Commands:

These commands do not require a security code. The only requirement to access these commands is that in a multi-drop system; the drive must be addressed. (In a non-multi-drop system addressing is not required).

Ax (Address) — (used in multi-drop systems) where x = 1 to 32

The Address command is used to select the drive identified by x, for communication. Commands will be received and processed by the drive with x address until another address is called for, or a global Address All (**AA**) command is given. The drive address is set (if used) in the DRIVE address parameter P41. The drive defaults to an address of 0 until another is selected. The drive with the address of 0 defaults to receiving and processing commands until another address is called for. This command is used in multi-drop systems where many drives share a common serial connection.

When the drive receives an address command it echoes back its drive address to acknowledge that it is now online.

AA (Address All) — (used in multi-drop systems)

This is the Address All command, it is used to direct the following command to ALL drives on a multi-drop system, regardless of their individual DRIVE ID. The Address All is active for only ONE command, after that the address returns to its previous selection.

ECHO_ON — Turns on the echo character function. (Default when not in multi-drop).

ECHO_OFF — Turns off the echo character function. (Default when in multi-drop).

L (Log) — Sends a report of the last 15 faults with time stamps with the most recent first. The fault numbers displayed correspond to the following fault codes found in the troubleshooting chapter.

ST (Status) — This returns the current drive status in the form of:
0 = DISABLED
1 = ENABLED
2 = FAULT

STATUS (Full Status)

This returns a listing of serial mode variables and their status.

TP (Test points)

This command prints out a list of captured test points. The test point recorder is made up of two channels. When the drive is enabled the recorder continuously captures data, when the drive becomes disabled or faults, the data capture stops and the drive retains the last 32 points of data per channel. The channels can be set to record internal variables by setting P105 (ch1) and P106 (ch2) according to the following list:

0 = Velocity
1 = Electrical Angle
2 = Absolute Value Command
3 = Voltage magnitude for PWM
4 = Direct Current
5 = Direct Current Command
6 = Quad Current
7 = Quad Current Command
8 = Voltage Regulator
9 = Speed Following Error
10 = Quad Controller
11 = Direct Controller
12 = AC Voltage Out
13 = Bus Voltage
14 = Voltage Vector Out
15 = Power
16 = Speed Command
17 = Overload Accumulator
18 = I Phase 2
19 = I Phase 3
20 = Position counter

ID (Power base ID)

This returns a listing of power base settings and the drive Line volts.

IO (IO Status)

This returns the current state of all J1 connections, this is useful for troubleshooting. The output is as follows: Pins 2, 4, and 5 give the status of the analog inputs. A value of 512 represents 0 V, 1024 = 10 V, 0 = -10 V. Pins 6 & 7 are the analog outputs, they are scaled 0-256, where 256 = the maximum value.

PIN 2 505
PIN 4,5 505
PIN 6 88
PIN 7 34
PIN 8 On
PIN 9 Off
PIN 10 Off
PIN 11 Off
PIN 12 Off
PIN 13 Off
PIN 14 Off
PIN 15 Off
PIN 16 Off
PIN 19 On
PIN 20 Off
PIN 21 On
PIN 22 Off

F (Fault)

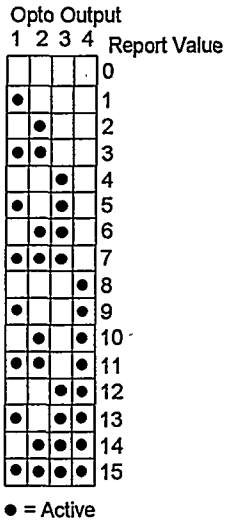
This returns the current FAULT code. Returns 0 if no fault condition exits.

Oxx (Report)

If entered without arguments it returns a report of the current output RPM, Hz, Vrms and Arms. Arguments are used to return a specific operating value according to the following table.

1 = RPM	5 = % Rated Load
2 = Hz	6 = Analog Input (± 4096)
3 = Motor Vrms	7 = Opto Outputs (0-15)
4 = Motor Arms	

Note: the Opto Output report represents a 4 bit word:



TAR Xxxx (target register)

where Xxxx is any serial command in its normal format.

Stores the command after the space in a target register. This command is stored and processed when a **GO** command is given. This is useful when synchronizing multiple drives on a common mark. For example on a 3 axis system each drive could be given a "target" position, and all three could be started at the same time with a global **GO**.

GO (process target command)

The command stored in the target register will be processed. Note: although **TAR** and **GO** are non - protected commands, the command stored in the target register is still subject to its appropriate access level.

SCxxxx (Security Code)

Locks and unlocks serial commands, where xxxx is the Security Code (parameter 101)

If entered with xxxx this command unlocks the serial commands that follow. This is only active if serial locking is turned on by parameter #39. Entering **SC** alone locks up the serial commands again.

Security Lockable Commands

These commands require the entry of the Security Code if this option is turned on in the parameter list (P39). They also require an address command in a multi-drop

system.

File Transfer Commands:

UL (Upload) — Begins the Upload procedure

The drive will then receive a parameter file uploaded using the standard XMODEM protocol. Control-X can be used to cancel. If the XMODEM procedure is not started within 60 seconds the command aborts.

DL (Download) — Begins the Download procedure.

The drive will then send a parameter file to be downloaded using the standard XMODEM protocol. Control-x can be used to cancel. If the XMODEM procedure is not started within 60 seconds the command aborts.

Control Commands:

C (Clear) — This command clears and existing fault, returning the drive to operation if an enable is still present.

Pxxx or **Pxxx nnnn** (Parameter) — where xxx is a value from 0 - 999, and nnnn is a value from 0 - 9999.

When the command is **Pxxx** the current value of parameter xxx is returned. When the command is followed by a space & nnnn, parameter xxx is changed to the value of nnnn. **P** entered with no arguments lists all parameters.

L_ON (Local on) — This command switches the drive control to local mode. This has the effect of locking out, or ignoring input from external I/O or the Keypad. This effects only the commands that follow, which control the actual movement of the motor. It does not effect the previously listed commands which with the exception of AU (Auto Tune), do not control the motor. NOTE: the STOP button on the keypad still acts as an E-STOP.

L_OFF (Local off) — This command switches the drive from local_mode back to the preexisting control mode. Note this only effects commands which control the movement of the motor.

Local Mode Commands

These commands require the drive to be in Serial Local Mode. When in this mode the drive locks out the external I/O (except enable) and the keypad.
NOTE: When the Operating Mode is set to 3, Serial Control, (Serial Local Mode) is automatically turned on. The drive must be addressed in multi-drop systems. If the security code has been turned on for serial control it must be entered.

AUx (Tune) — This command starts the motor tuning procedure. The drive must be externally enabled by either the keypad or external I/O If **AU_ALL** is entered the drive will sequence through all tuning procedures. The drive will return a status word as follows:
Passed (test passed)

1 Failed (test #1 failed)
2 Failed (test #2 failed)
etc...
If a test fails, the procedure is stopped.

H (Home) — Commands the drive to go the predefined home position at the predefined homing speed. NOTE: this is not the same as the **W** (Position to zero command) and is not meant to be used in conjunction with positioning commands.

V or **Vnnnn** (Velocity command) — where nnnn is a numeric value.

When the **V** command is alone it enters velocity control and returns the last velocity command. When followed by a numeric value it commands that value. Note negative velocities are denoted by -nnnn (positive values may be entered by +nnnn but this is optional). **V+** or **V-** (depending on the current direction) will cause the drive to reverse direction using the last commanded velocity value.

T or **Tnnnn** (Torque command) — where nnnn is a numeric value.

When the command is alone it enters torque control and returns the last torque command. When followed a numeric value it commands that value. Note: negative torques are denoted by a -nnnn (positive values may be entered by +nnnn but this is optional). **T+** or **T-** will (depending on the present torque direction) will cause the drive to reverse direction using the last commanded torque value.

E (Enable) — Enables the drive. Note: the current status of the drive can be retrieved by using the **ST** (STATUS) command.

D (Disable) — Disables the drive. Note: the current status of the drive can be retrieved by using the **ST** (STATUS) command.

Jx (Jog) — arguments: + - S (stop)

Jogs the drive at the rate set by the JOG SPEED parameter, (P0). The argument determines the direction or stops the jog.

S (Stop) — Issues an ALL STOP to the drive. The KEYPAD SPEED CONTROL parameter determines whether the drive coasts to a stop, or decels to a stop

Positioning Commands

NOTE: Position commands can only be used with a braking option installed. Refer to Chapter 8 for information on braking options.

M or **Mxxxxx** (Absolute move) — where xxxxx is an absolute position (signed) in encoder counts X 4.

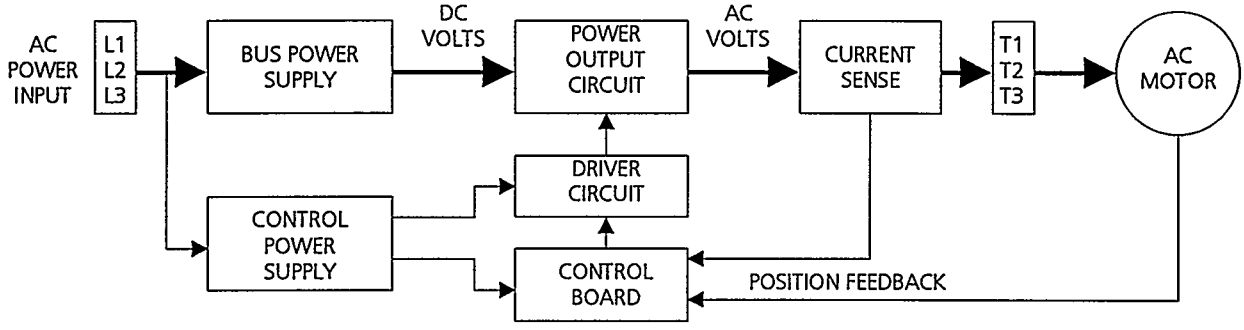
When M is passed followed by a carriage return (without xxxxx) it returns the absolute position of the motor, in encoder counts from

	the **Z** (zero) position . When followed by xxxxx, the drive will move to absolute position of xxxxx encoder counts relative to the **Z** position at the rate defined with the **v** (Positioning Speed) command. Note: positions negative to the ZERO position must be entered using -xxxxx.
m or **mxxxxx** (Relative Position)	where xxxxx is a (signed) position relative to the current position in encoder counts X 4. When passed with xxxxx the drive will then move xxxxx encoder counts relative to the current position at the rate defined with the **v** (Positioning Speed) command. (note: negative direction is denoted by -xxxx).
vxxxx (Positioning Speed)	where xxxx is a velocity value. This command changes the maximum of speed used to achieve positioning commands.
W (Position to Zero)	This command positions the drive to the absolute ZERO position as defined with the **Z** command. The command moves at the defined positioning "speed" as set be **v**. NOTE: this is not the same as the **H** (HOME) command.
Z (Set current position to Zero)	This command sets the current position to zero. (To be used only with positioning commands).

See Appendix E for a Quick list of the Serial commands.

Chapter 5
Theory of Operation

Figure 5-1 Simplified AC Vector Block Diagram



Drive Overview

An AC Vector drive system consists of a 3 phase induction motor and a Flux Vector controller. The Flux Vector controller converts the incoming AC line power to the appropriate motor voltage, current and frequency necessary to achieve the desired motor speed and torque.

In an AC vector controller the incoming AC power is first converted to DC by the bus power supply. This DC voltage is converted (pulse width modulation) back to AC by power output circuit. The control board microprocessor uses feedback from the current sensors, the bus voltage, and the motor position (optional) to generate the driver control signals. The driver circuit uses these signals to turn on the appropriate transistors in the power output stage. The control power supply converts the incoming line voltage into operating voltages used by various circuits through-out the controller.

Bus Power Supply

(Refer to Drawing No. 7143 for 230 VAC/ No. 7148 for 460 VAC)

The bus power supply converts the incoming AC voltage to a DC voltage used by the Output Power section. The drawings show the interconnection of the power components. The incoming AC power, at terminals L1 through L3, is full-wave rectified by a diode bridge. It is then filtered by inductor L1 and the bus capacitors. The capacitors store DC bus energy to provide a safe operating voltage for the power transistors by absorbing a limited amount of regenerated energy. Motor regeneration will increase the DC bus voltage causing operation of the shunt regulator which limits the DC bus voltage to predetermined level. See Table 5.1 for the appropriate bus voltage thresholds.

Table 5.1 Bus Voltage Thresholds

NOMINAL LINE VOLTAGE	230 VAC	400 VAC	460 VAC
NOMINAL BUS VOLTAGE	275 - 350 VDC	510 - 625 VDC	550 - 695 VDC
BUS OVERVOLTAGE	386 VDC	645 VDC	772 VDC
SHUNT REGULATOR ON	372 VDC	620 VDC	748 VDC
SHUNT REGULATOR OFF	362 VDC	607 VDC	732 VDC
BUS UNDERVOLTAGE	224 VDC	400 VDC	460 VDC

Excessive current inrush upon power application is prevented by the soft start circuit. This circuit is composed of a starting resistor, fuses F1-F2 and an SCR. Operation of the soft start function is supervised by the power supply. The SCR is fired to bypass the charging resistor only after its voltage drop is less than 30 VDC. The power supply is interlocked with the control board to prevent operation of the main output transistors until the capacitors are charged and the soft start SCR is turned on.

The DC bus voltage is continuously monitored by the power supply which controls the shunt regulator transistor. When the bus voltage approaches its peak level, the shunt transistor is turned on to draw current through the external regeneration resistor to dissipate excess regenerated energy. The peak energy that can be absorbed is limited by the maximum resistor current that can be controlled by the transistor. See section 6 for minimum allowable resistance for each controller rating.

Control Power Supply

The control power supply assembly operates directly from the main DC bus derived from the full wave rectified 208-230/460 VAC line and accomplishes the following:

1) Supplies a 27 kHz, 100 volts peak to peak regulated square-wave for base drive and auxiliary loads. This supply is nominally rated at 100 Watts.

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

3) Supplies a regulated + 24 VDC for auxiliary relay and DC fan use. This is nominally rated at 25 watts total.

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

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

6) Provides the gate signal to the soft start bypass SCR. This signal is coordinated with AC line voltage presence, bus to line differential voltage, and bus undervoltage.

7) Generates the base drive current to the shunt regulator power transistor to regulate the DC bus voltage during motor drive regeneration.

8) Provides independent opto-isolated status signals for bus undervoltage, bus over voltage and shunt regulator transistor drive.

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

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

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

2) DC Bus Voltage under 225/450 VDC, which inhibits turn-on of the soft start circuit and the power output circuit.

3) DC Bus Voltage over 375/750 VDC, which turns on the shunt regulator transistor Q4.

4) DC Bus Voltage over 385/770 VDC, which inhibits operation of the power output circuit.

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

Control Board

The functions of the control board are:

1) To provide either a speed or torque controller which responds to the user's input.

2) To provide separate flux and load current loops which respond to the flux vector supplied current commands.

3) To provide pulse width modulated outputs to the driver circuit in response to current loop errors.

4) To provide current limiting.

5) To provide latching and indication of control power failure, overload, bus under- and over-voltages, amplifier fault, and drive or motor overtemp conditions.

6) To provide a selection of drive and motion enables.

7) To provide two programmable analog inputs, two analog outputs, nine opto isolated inputs, and four opto isolated outputs.

8) To provide simple entry, storage, and retrieval of control parameters.

9) To provide a controller which automatically calculates servo parameters from simple nameplate data.

All control boards with the same part number have identical hardware. However, the motor parameters stored in the battery backed RAM may be different. The control boards may also have different revisions of software (noted on IC's U25 and U26). See Software Revisions, Chapter 1.

The control board saves all motor and control parameters in nonvolatile RAM. The contents of this ram are checked upon each power up sequence for possible corruption. The RS232 / RS422 / RS485 serial interface allows the user to change

parameters, store and retrieve file data, monitor drive status, or fully control the motor operation. The keypad display provides metering of speed, voltage, current, or frequency as well as parameter adjustment and monitoring. The keypad also allows the user to operate the motor in several configurations.

Encoder Signals

The Encoder Feedback Flux Vector control board operates with position feedback from a shaft mounted encoder.

The flux vector board provides a separate 5V power supply for the encoder. Quadrature A and B phases are necessary for the control board to determine the direction of rotation. A once per rev index pulse is optional (may be used to orient the rotor). The signal lines can be received differentially.

The control board also provides a buffered (via line drivers) encoder output. This output can be used by external hardware which needs to share the encoder signals.

Outputs to Base Drivers

The base signal outputs are PWM waveforms, one for each of the six power output transistors. These signals are developed by three independent circuits, one per output phase. The voltage command for each phase is generated in software and converted to an analog signal by DAC's 3 and 4. This analog signal is compared to a triangle wave to produce a pulse width modulated (PWM) waveform. Changes in the PWM pulse widths control the three main power transistor pairs to regulate motor voltage as required by the control system.

Flux Control

The flux control includes the direct current loop which regulates the direct component of motor voltage to maintain the desired motor excitation current. The flux controller develops the direct current command from the flux current parameter and speed feedback. Proportional and integral gains in the flux current controller provide high gain and rapid current loop response, typically less than 2 milliseconds rise time.

Load Current (Torque) Controller

The load current controller controls the torque producing (load) component of motor current by regulating the quadrature component of motor voltage. Proportional and integral gain in the load current controller provide rapid torque response, typically less than 2 milliseconds rise time.

When the drive is selected to be a speed controller, the speed controller output commands load current. When the drive is selected to be a torque controller, the input directly commands load current.

Speed Controller

The speed controller sums the speed command and the digital speed feedback to command load current. Proportional and integral gain in the speed controller

provide accurate regulation and rapid response. Typically the speed loop bandwidth can be set as high as 40 to 50 Hertz when the current controller gains are set near maximum.

Current Limiter

Amplifier current is limited by restricting the current command to the current limit value. The maximum current value is normally set to twice the rated motor current. The controller will not allow a value above the capacity of the amplifier. The smaller of the continuous current rating of the motor or amplifier is used for current overload protection. The overload protection of the controller will allow the drive to operate at or below this current indefinitely, at 150% of the drive rating for 80 seconds, and at 200% of the drive rating for 3 seconds.

Flux Vector Theory

The "Flux Vector" control is an algorithm for running an AC induction motor. The induction motor has a 3 phase wye or delta connected stator. Instead of permanent magnets, the rotor has a group of shorted bars commonly referred to as a squirrel cage. This makes the induction motor very rugged requiring low maintenance. The goal of the control scheme is to achieve the same high performance of the more costly, less robust permanent magnet motors.

A standard in induction motor control has been the voltage source invertor which allows the induction motor to operate at variable speeds by controlling the voltage and frequency to the motor. This type of control yields very poor performance at low speeds and under dynamic conditions.

The modern approach to this problem is the "Vector" control. This control scheme regulates the flux and torque producing components (or vectors) of current. There are several methods of achieving this but one approach is to use the known electrical frequency of the motor to strip off the rotating portion of the sensed motor currents, leaving magnitude and phase information. This magnitude and phase is then used to produce a direct component (flux) and a quadrature component (torque) of current which are DC values. (These currents are in fact analogous to the field and armature currents in a permanent magnet DC motor.) The direct and quadrature components are then compared to the commanded components and used to create two compensating DC voltage components which in turn yield a voltage magnitude and phase. Once again, using the known electrical frequency of the motor, a three phase AC voltage pattern is created and sent to the motor.

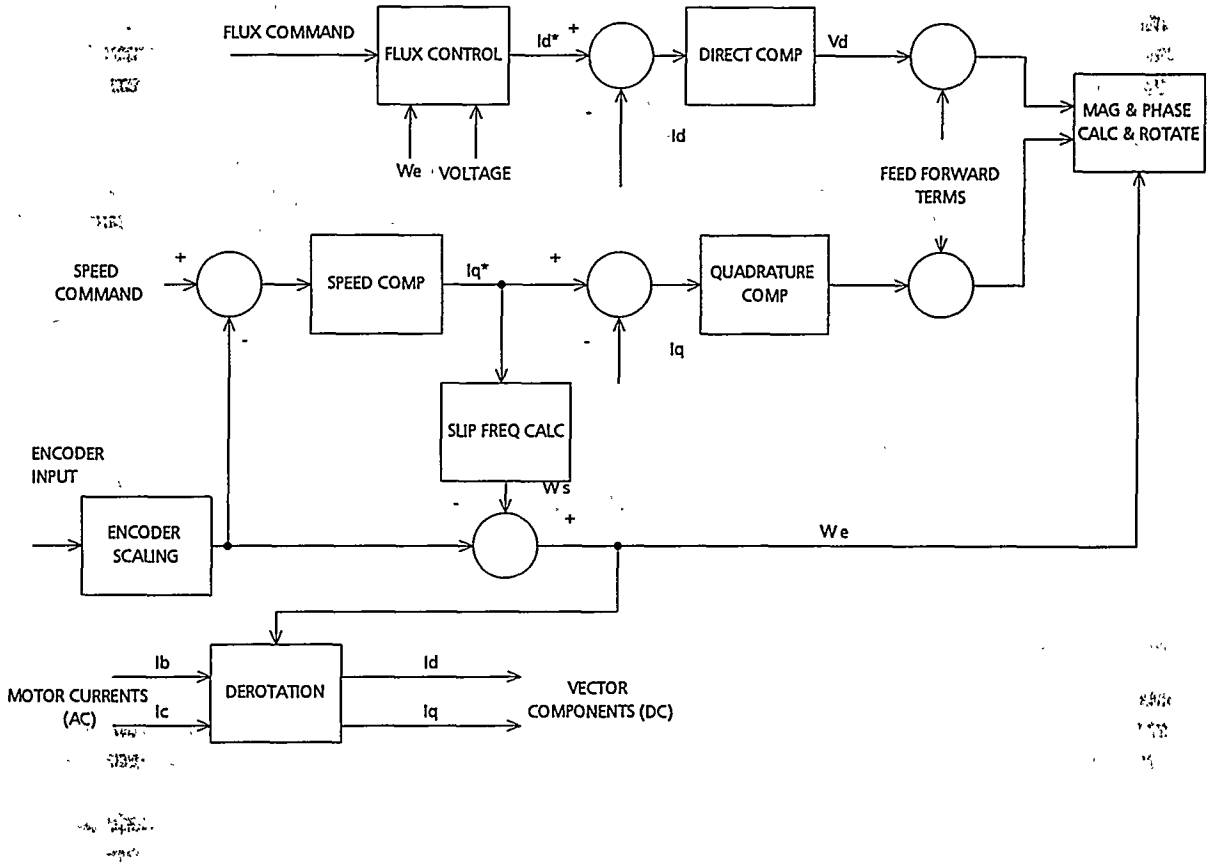
In addition to the motor current the electrical frequency must be calculated. The electrical frequency is equal to the sum of the rotating frequency and the slip frequency. The slip frequency is calculated by dividing the torque producing current by the flux current times an appropriate scale factor. This means that when the torque producing current is zero, the slip frequency is zero and the electrical frequency equals the rotating frequency. When the torque producing current is positive the electrical frequency is slightly higher than the rotating frequency. Up until this point, the position feedback version is identical to the sensorless version.

The motor control system has a constant torque (below base speed) and a constant power (extended speed) region. The flux producing current is the main contributor in setting the motor voltage. With the flux current held constant the motor voltage will increase proportionally with speed. When the motor voltage equals the line

voltage, the flux current must be reduced as the speed increases. This is known as field weakening. Because the torque constant (that is, the amount of torque per torque producing amp) of the motor is proportion to flux, the region where the flux is held constant is known as the constant torque region. Since power is torque times speed, the region where the flux (or torque) is reduced as the speed increases is known as the constant power region.

By using a shaft position transducer (resolver, optical or magnetic encoder) the rotating frequency is measured directly. This term plus the calculated slip frequency give the electrical frequency. The position transducer is also used to provide speed regulation and/or positioning depending upon the operating mode. By supplying the controller with a marker input, positioning to an index is also possible.

Figure 5-1 Simplified Position Feedback Block Diagram



Power Output Circuit

The power output circuit consists of six Darlington power transistors connected in a three phase bridge configuration. Clamping diodes are included on each transistor to provide a path for load current to return to the DC bus. The transistors and their associated clamp diodes are contained in isolated mounting type power modules. Output currents are sensed with two current shunt resistors (R2 and R3) or Hall effect feedback sensors. The output transistors are driven and monitored by the base drivers (A5, A6 and A7). Control board A1 generates pulse width modulation (PWM) base signals for control of the transistors. One transistor in each pair must always be off at any given time to avoid shorting out the bus supply and damaging the output transistors.

Mod-Demod Current Sensor

(230VAC drives 5-25 Hp & 460VAC drives 5-40 Hp)

The mod-demod assembly consists of two independent and identical modulator-demodulator circuits for isolating the current feedback signals from the power circuitry. A carrier frequency of approximately 500 kHz modulates the voltage developed across a current sensing resistor. The resulting ac signal is transformer coupled to a demodulator which recovers the original signal. The offset of the amplified and isolated output is trimmed with R14 for the T3 channel and R30 for the T2 channel. Gain adjustment is provided to compensate for component tolerances, (including the sensing resistor) using R15 for the T3 channel and R29 for the T2 channel. These adjustments are set at the factory and do not need to be changed. The mod-demod is operated from ±15 VDC supplied by the power supply A3.

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

Hall Current Feedback board

(230VAC drives 40-50Hp & 460 VAC drives 50-75 Hp)

On models with a Hall Effect Current Sensor, the current is passed though a gaped toroid and a flux proportional to current is measured using a Hall effect sensing device located in the gap of the toroid. Current variation through the toroid causes a corresponding change in the flux in the gap. The flux in the gap is sensed by the Hall sensor and scaled to the appropriate Amps of phase current per volt of signal. The resulting signal is then passed to the control board for use in the Flux Vector algorithm and for over-current detection. The drive uses a dual current sensor that is capable of sensing two independent phase currents.

Base Drivers

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

The isolated ±8 VDC power supply is obtained from the 27kHz 100 volt square-wave source provided by power supply A3. The supply furnishes the current required for turning on and off the power transistors. The opto-isolated base driver circuit includes base current limiting which forces the Darlington transistor to pull out of saturation when its collector current exceeds the transistor's capacity. The base driver circuit also provides a high current reverse base drive for fast turn off of the power transistor. The desaturation detector monitors the power transistor's collector-emitter voltage and shuts it off when this voltage exceeds a safe level. This happens when an overload current begins to pull the transistor out of saturation. This shutdown creates an output fault signal which is opto-isolated and sent to the control board A1. Fault monitoring circuits on the control board shut down the drive, latch the fault and turn on the fault indication.

Chapter 6
Troubleshooting

This chapter is divided into three sections, they are: **No Display, Fault Code Present,** and **Improper Motor Operation.**

No Display describes typical problems related to a "dead" drive, one which does not appear to respond when AC power is applied.

The section entitled Fault Code Present contains a list of possible fault indications with a description of each, as well as flow charts and detailed testing procedures.

Improper Motor Operation covers topics related to the operation of the motor and response to speed commands.

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

- USE EXTREME CAUTION, DO NOT TOUCH ANY CIRCUIT BOARD, POWER DEVICE OR ELECTRICAL CONNECTION WITHOUT INSURING THAT HIGH VOLTAGE IS NOT PRESENT.
- THE UNIT MUST BE PROPERLY GROUNDED. DO NOT APPLY AC POWER BEFORE FOLLOWING GROUNDING INSTRUCTIONS.
- DO NOT OPEN COVER FOR 2 MINUTES AFTER REMOVING AC POWER, TO ALLOW CAPACITORS TO DISCHARGE.
- IMPROPER CONTROL OPERATION MAY CAUSE VIOLENT MOTION OF MOTOR SHAFT AND DRIVEN EQUIPMENT. BE CERTAIN THAT UNEXPECTED MOTOR SHAFT MOVEMENT WILL NOT CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT. PEAK TORQUES OF SEVERAL TIMES RATED MOTOR TORQUE CAN OCCUR DURING A CONTROL FAILURE.
- MOTOR CIRCUIT MAY HAVE HIGH VOLTAGE PRESENT WHENEVER AC POWER IS APPLIED, EVEN WHEN MOTOR IS NOT ROTATING.

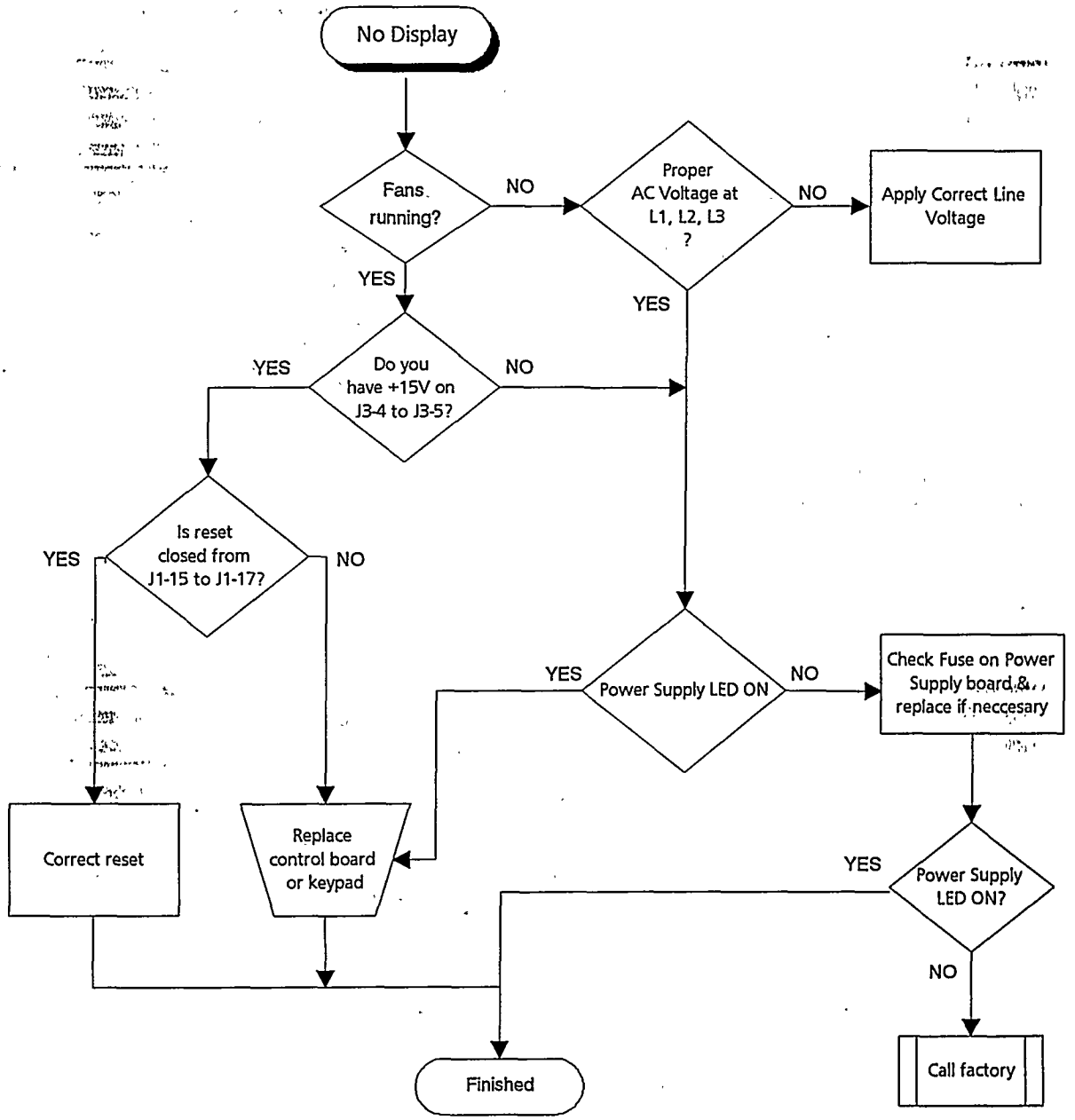
Most troubleshooting can be performed using only a digital voltmeter (DVM) having an input impedance exceeding 1 megohm. In some cases however, an oscilloscope with 5 mhz minimum bandwidth may be useful.

Before consulting the factory double check that all power and control wiring is correct and installed per the recommendations given in this manual.

No Display

When AC power is applied to the drive the keypad should display 0 (zero), or some other indication depending on the active display mode. Also the fans should be running (on convection cooled models). See the flow chart of figure 6-1 for common causes and solutions.

Figure 6-1 No Display With Power Applied



Fault Code Present

When a fault condition occurs, motor operation halts and a fault code is displayed on the keypad. Table 6-1 gives a list of possible fault codes with a description and possible cause. Detailed information and flow charts for each fault are given in the remainder of this section.

Table 6-1 Explanation of fault codes

INDICATION	FAULT #	DESCRIPTION	POSSIBLE CAUSE
PH	1-7	Phase fault	A phase fault has been detected by an individual transistor drive circuit. This indicates an instantaneous phase over-current condition or drive supply failure. See flowchart.
OC	11	Over-current fault	An instantaneous over current condition has been detected from either an output phase or bus current sensor (where applicable). See flowchart.
OC.P	12	Over-current and phase fault	A simultaneous over-current and phase fault has occurred. See flowchart.
oc	13	Undetermined fault	A fault condition has occurred but was not sustained long enough for the control board to determine the source. See flowchart.
OL	16	Overload fault	Drive output current has exceeded capacity. This is generally caused by excessive load on the motor. (The drive current can be set to foldback instead of faulting out with P80). See flowchart.
OSP	17	Overspeed fault	The motor speed has exceeded 110% of the set maximum RPM (P30). See flowchart.
OH-E	18	External (Motor) over temp fault	An external over temperature or open circuit has occurred on J1-16. This fault is only active when turned on in P80. See flowchart.
OH-C	19	Controller over temp fault	The controller heatsink temperature has exceeded safe levels. See flowchart.
PAr	21	Parameter loss fault	The battery backed-up RAM parameters have either been lost or corrupted. When this fault is cleared the drive will reset itself to default parameter values. See flowchart.
uP	22	Microprocessor fault	A watchdog timer error has occurred in the software. This can sometimes occur if power is cycled before the bus has bled down completely. Call factory for assistance.
Prog	23	ROM fault	An EPROM error has occurred. Call factory for assistance.
dcLo	24	Undervoltage fault	A bus undervoltage condition has occurred. This can result from low line voltage, a soft line, or a problem with the soft start circuit. See flowchart.

dcHI	25	Overvoltage fault	A bus overvoltage condition has occurred. (The bus voltage has risen above safe levels). This can be caused by excessive regen current during a decel, an improperly sized regen resistor or a problem with the regen circuit. See flowchart.
FEr	26	Following error fault	An excessive following error has occurred. This fault can be turned on and off with P80. See flowchart.
I LO	27	Torque proving fault	The torque proving test has failed to measure adequate current in all 3 motor windings upon an enable. This may indicate an open wire connection or motor winding. (This feature is controlled with P80). See flowchart.
Cur	28	Current sense fault	A phase current or bus current sensor is defective or an open wire condition exists between the control board and the sensor. See flowchart.
Id	31	Power base ID fault	An invalid power base ID code has been read by the control board. See flowchart.

Phase Fault

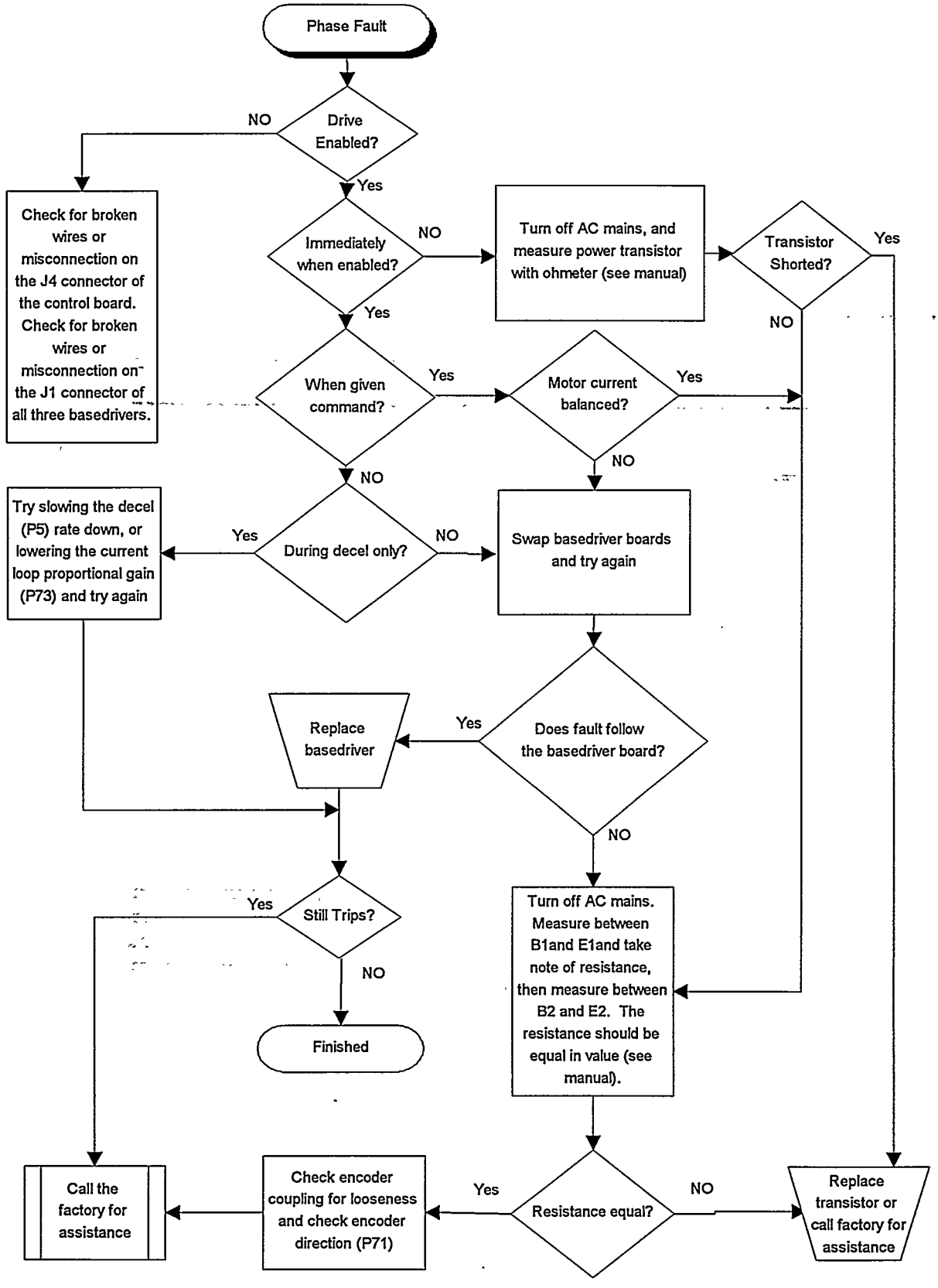
PH-1, PH-2, PH-3, PH1.2, PH1.3, PH2.3, PH

These faults are usually a result of an excessive load on the drive output. The fault condition can be permanent, occurring when the drive is enabled, or, intermittent, occurring randomly during otherwise normal operation. See figure 6-2.

Testing for Shorted Transistors

If it is suspected that a power transistor is shorted: Remove AC power, wait 2 minutes, open enclosure observing CAUTION warnings, bleed capacitor DC voltage to 10 volts maximum with resistor and then shunt the transistor bus bars. Inspect power transistors and base drivers for burned components and other obvious signs of damage. To test transistors remove shunt between bus bars. Measure resistance from each bus bar to output terminals T1, T2 and T3 using ohmmeter polarity to back bias power transistor diodes. Any resistance less than 500K ohms indicates fault in transistor or internal wiring. Replace power transistor and its associated base driver for any outputs showing less than 500K resistance (power transistor failure usually damages its base driver).

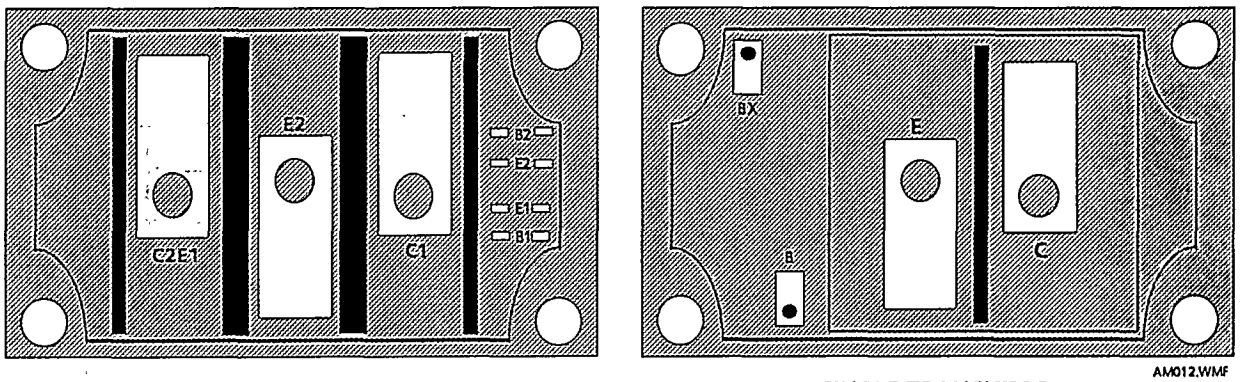
Figure 6-2 Phase Fault Flow Chart



Measuring Transistor Base Resistance

When you experience consistent phase faults it is advisable to measure (with a DVM set on Ohms) the resistance between the base drive connections on the transistor. This is where the basedriver board's wires connect to the transistor. They should always be equal in resistance for both transistors in a phase. Measure between B1 and E1 of a dual type transistor (see figure 6-3) and compare with B2 / E2 of the same device. For a single transistor (figure 6-3) measure between B and E and compare to the other single in the same phase.

Figure 6-3 Single and Dual Transistor Configurations



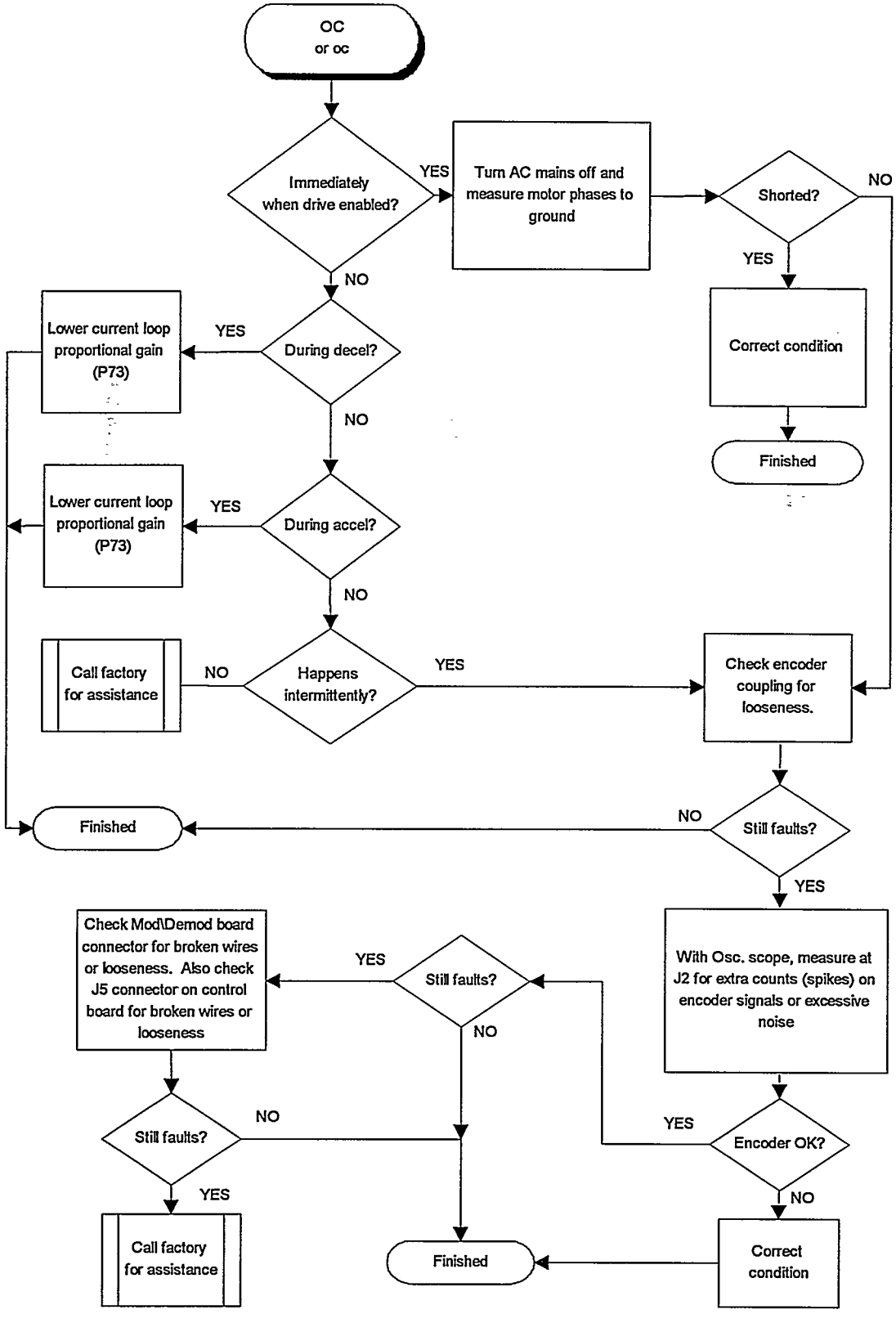
DUAL TRANSISTOR SINGLE TRANSISTOR

Over-current Fault

OC or **oc**

This fault indicates that an instantaneous over current condition has been detected from either an output phase or bus current sensor. This is usually caused by an excessive load condition. Figure 6-4 gives a flow chart for common problems that can produce an over-current fault.

Figure 6-4 Over-current Fault Flow Chart

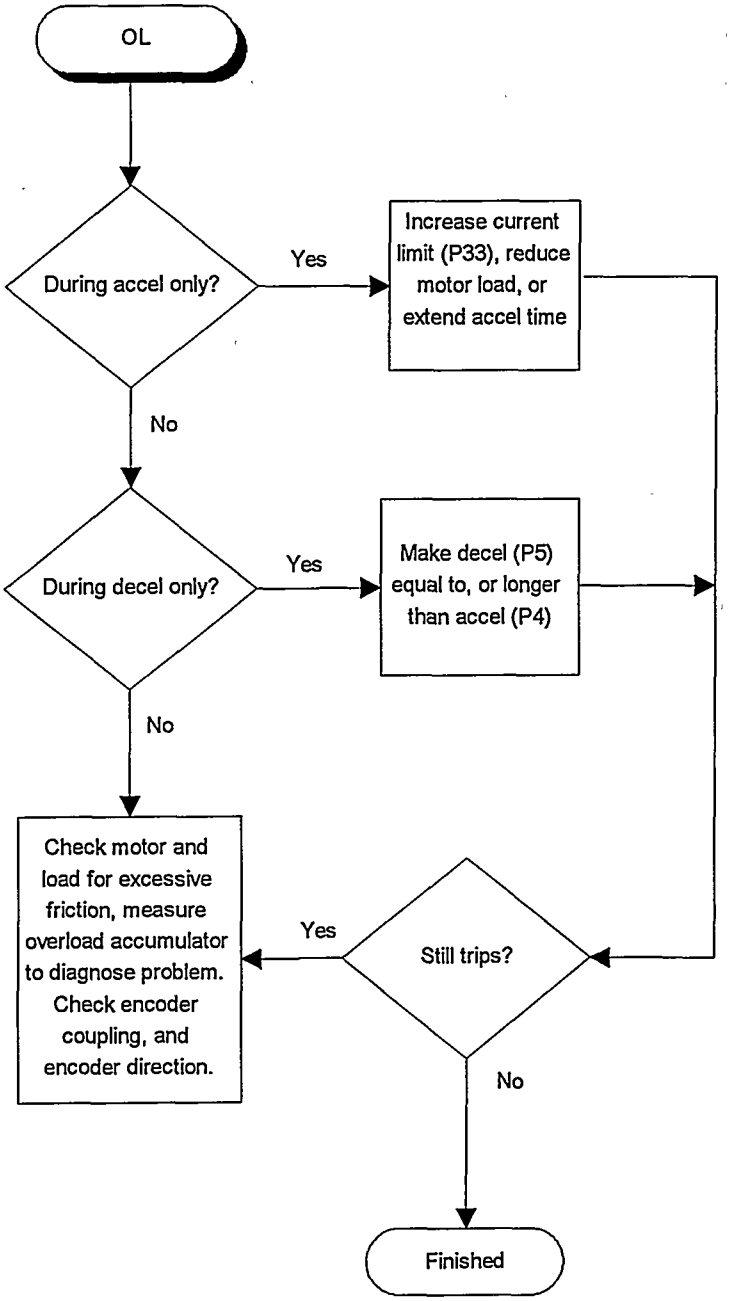


Overload Fault

OL

An overload condition is caused by load current which exceeds the rating of the drive or motor. This fault may also occur from a loss of encoder signal. The drive may be set to fold back current rather than trip with parameter P80. Figure 6-5 gives a flow chart for common problems that can produce an over-current fault.

Figure 6-5 Overload Fault Flow Chart

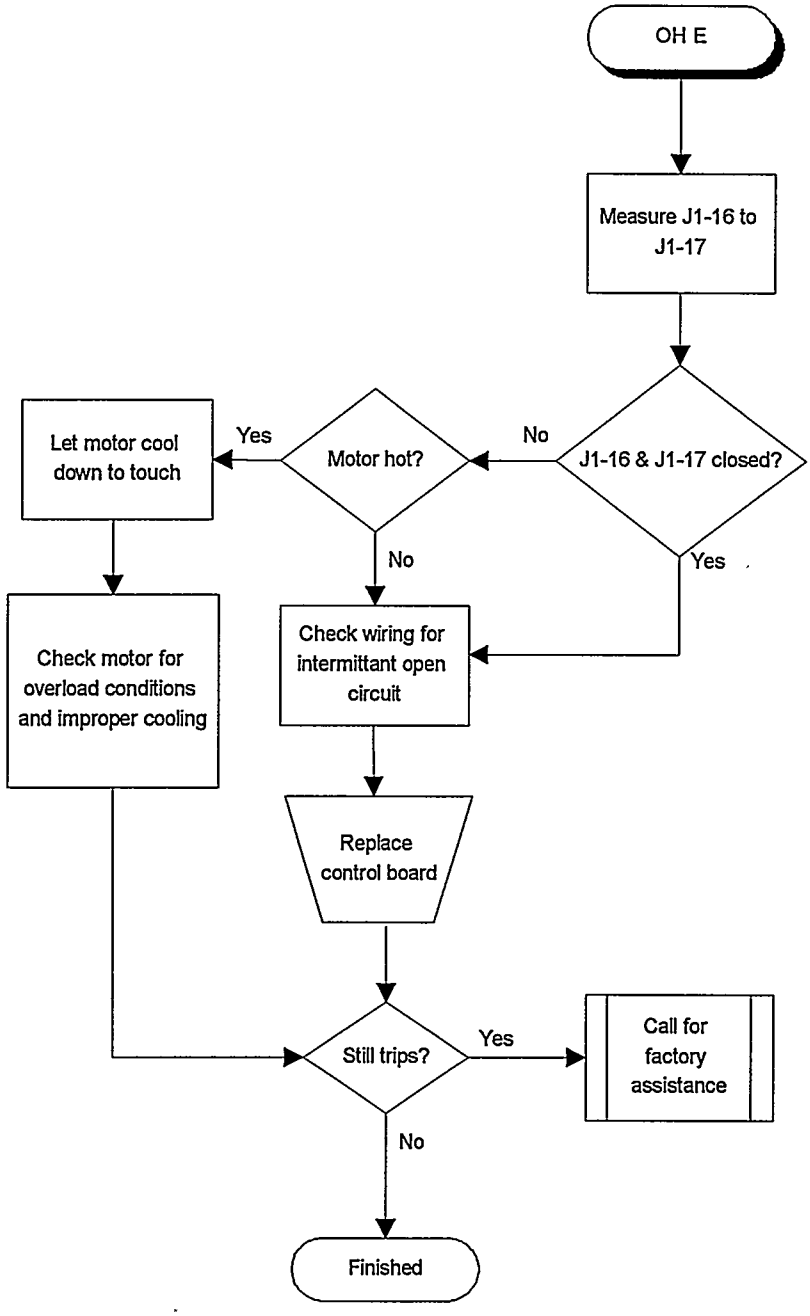


External Over Temp Fault

OH-E

This fault occurs when the input J1-16 opens indicating that an overtemp condition exists. External temperature protection is enabled by parameter P80. Figure 6-6 gives a flow chart for common problems that can produce an external over temp fault.

Figure 6-6 External Over Temp Fault Flow Chart

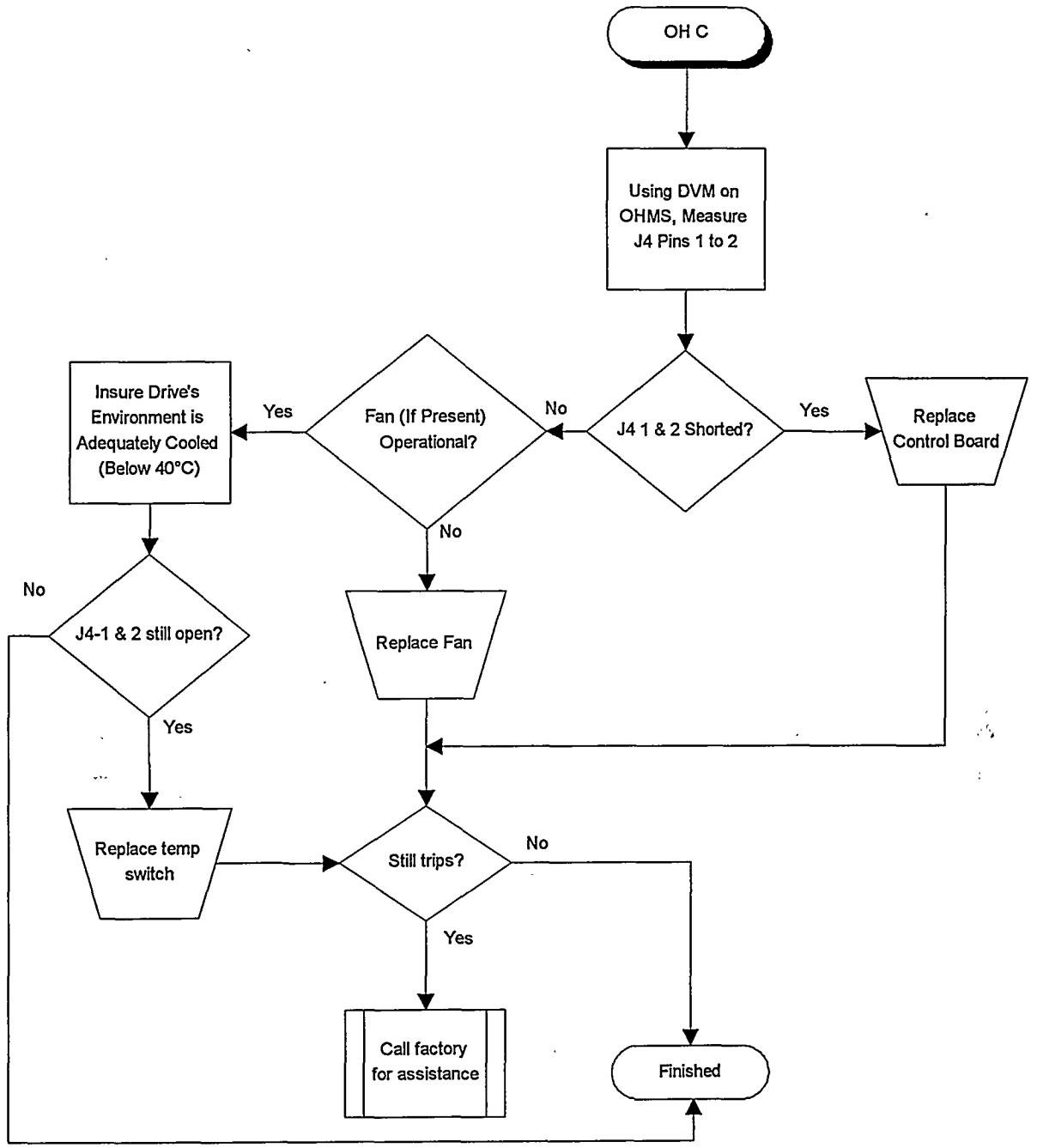


Controller Over Temp Fault

OH-C

This fault occurs when the internal temperature switch opens indicating an over temp condition. Figure 6-7 gives a flow chart for common problems that can produce a controller over temp fault.

Figure 6-7 Controller Over Temp Fault Flow Chart

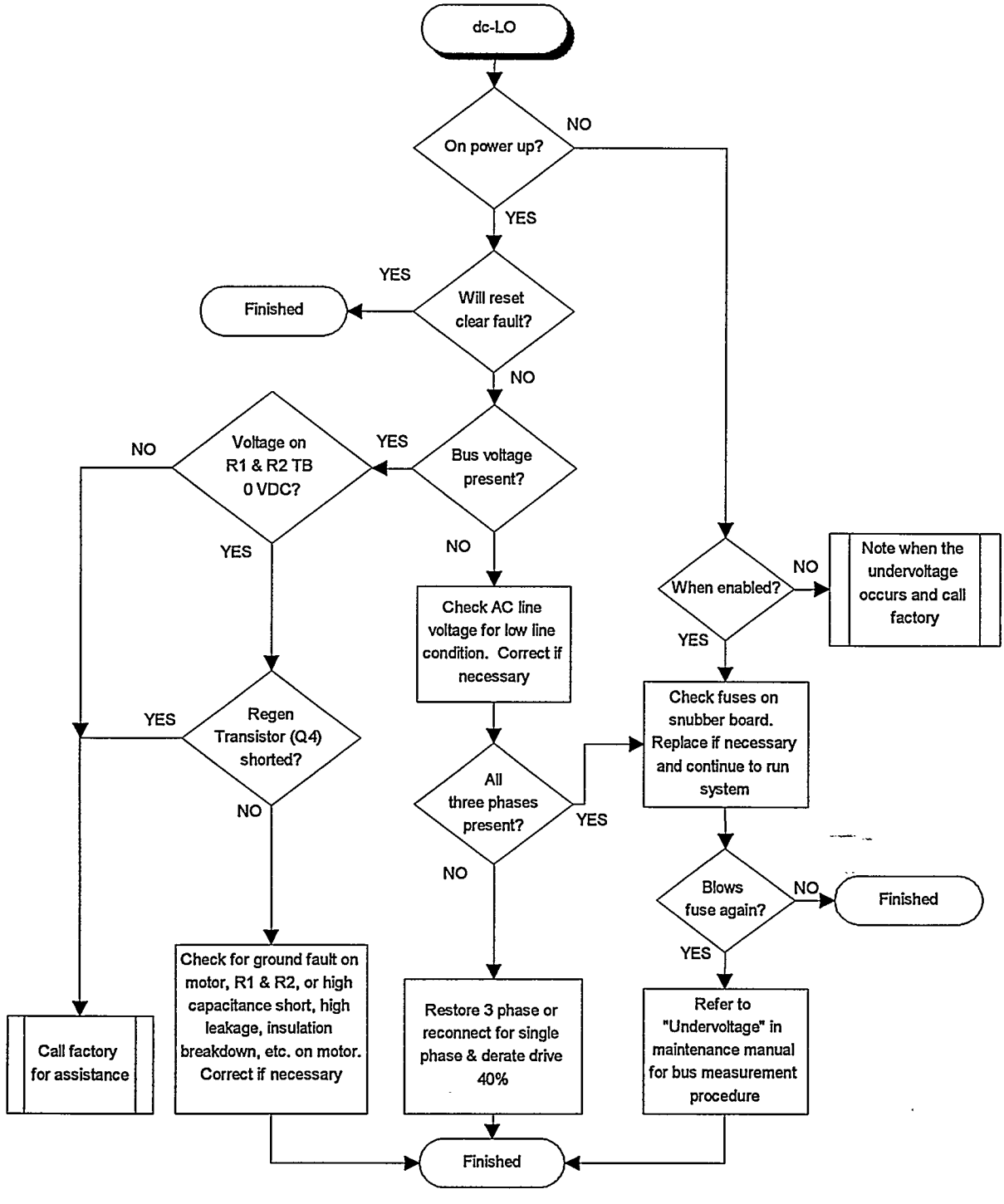


Undervoltage Fault

dcLo

Figure 6-8 gives a flow chart for common problems that can produce an undervoltage fault.

Figure 6-8 Undervoltage Fault Flow Chart

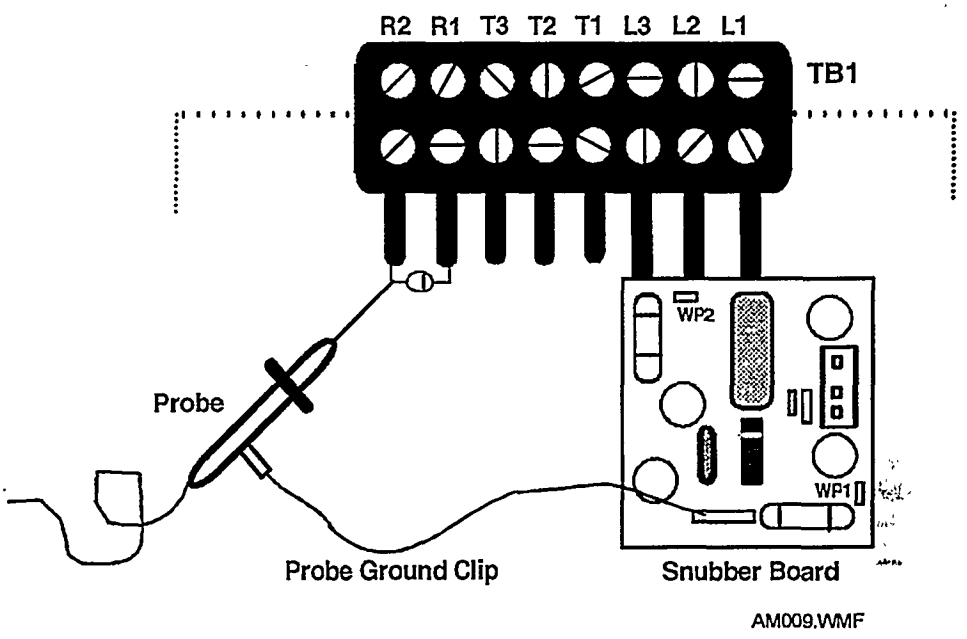


Under voltage faults are caused when the bus voltage dips below a predefined value. This condition shuts down the drive and latches the fault indication. Under voltage faults while the drive is enabled are usually symptoms of AC ripple problems on the DC bus supply. This AC ripple can be caused by various problems with the DC bus capacitors, soft-start scr, soft-start resistor, switching power supply and snubber fuses. To determine whether or not you have a high AC ripple problem you should use an isolated scope capable of measuring up to 1000 volts DC/AC (high voltage probe).

WARNING: When measuring high voltage on an oscilloscope an isolation transformer MUST be used or damage to scope and personal injury may occur. Always use caution when working around high voltage. If properly trained personnel are not available do not attempt the following procedure.

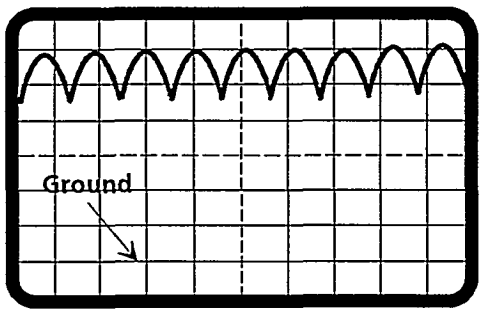
Connect the ground clip of the scope probe to the negative bridge connection on the snubber board. Connect the probe to the R2 connection on the drive terminal block. (See figure 6-9).

Figure 6-9 700 Series Ac Ripple Testing



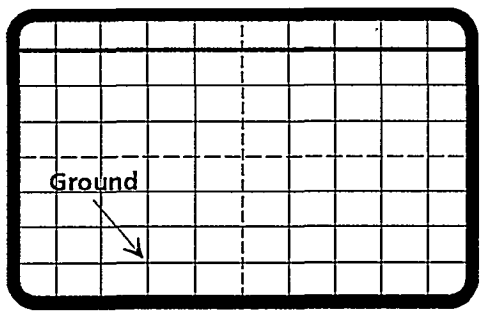
With the scope set to 50VDC for a 230V drive (100VDC for a 460V drive) and 2mS per division, apply power to the drive. You should momentarily see a AC ripple as the bus begins to charge (figure 6-10). After a few seconds the SCR should turn on and the waveform on the scope should be DC or a straight line (figure 6-11).

Figure 6-10 Normal DC Bus AC Ripple Before SCR Turn ON



DC Coupled-50V 2ms

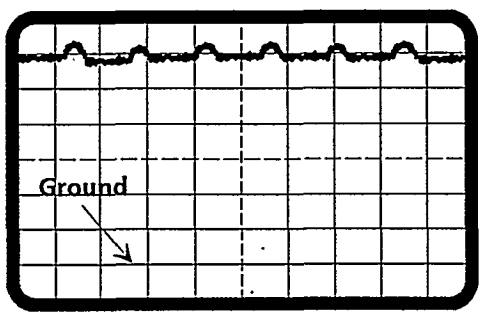
Figure 6-11 DC Bus After SCR Turn ON (Normal Operation)



DC Coupled-50V 2ms

Figure 6-12 shows AC ripple remaining on the DC bus after the SCR has had time to turn on. This indicates a problem with the soft-start circuit and can cause under voltage faults.

Figure 6-12 DC Bus problem after SCR Turn ON



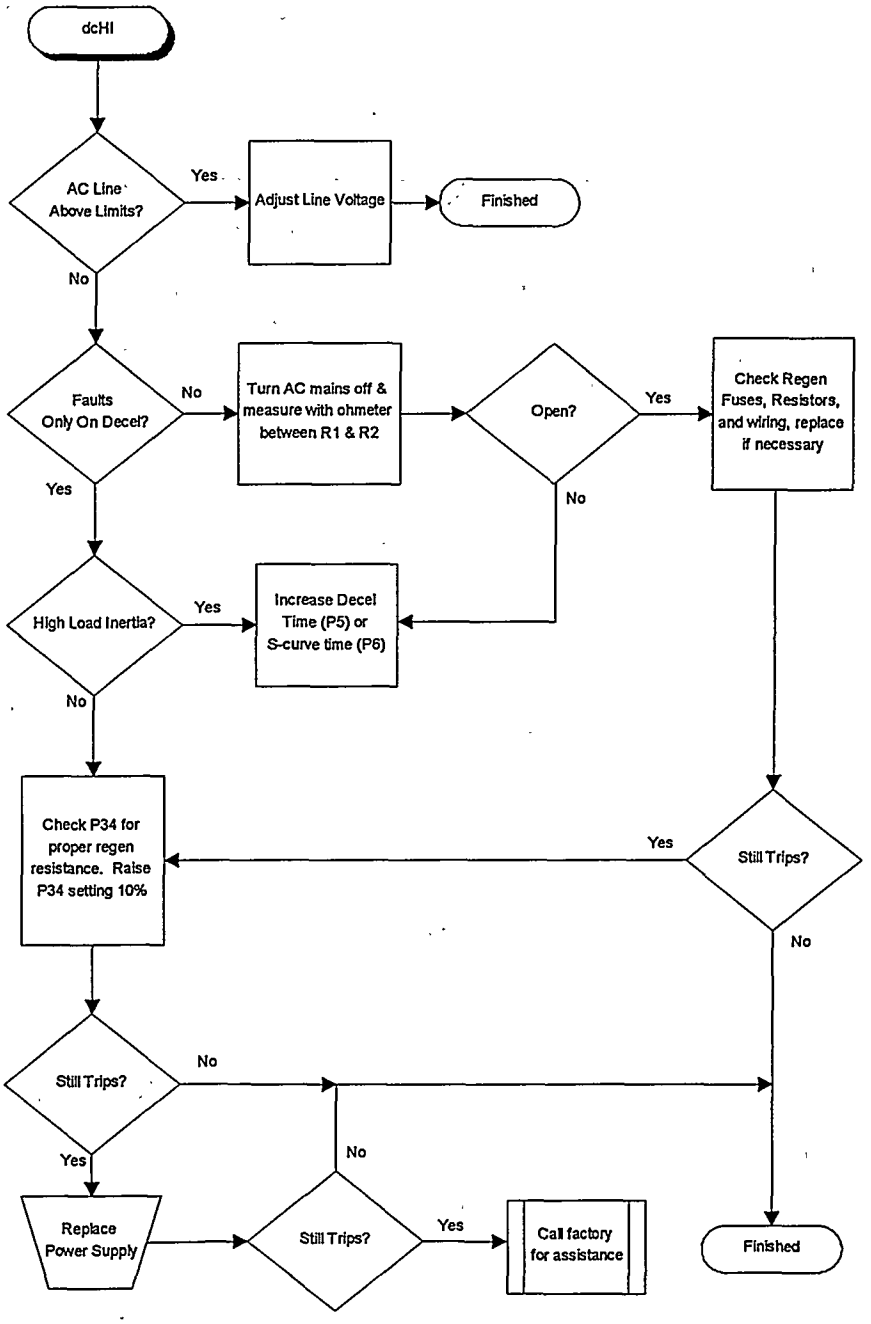
DC Coupled-50V 2ms

Overvoltage Fault

dcHI

This fault occurs when the bus supply voltage has gone to high. Figure 6-13 gives a flow chart for common problems that can produce an over-voltage fault.

Figure 6-13 Overvoltage Fault Flow Chart

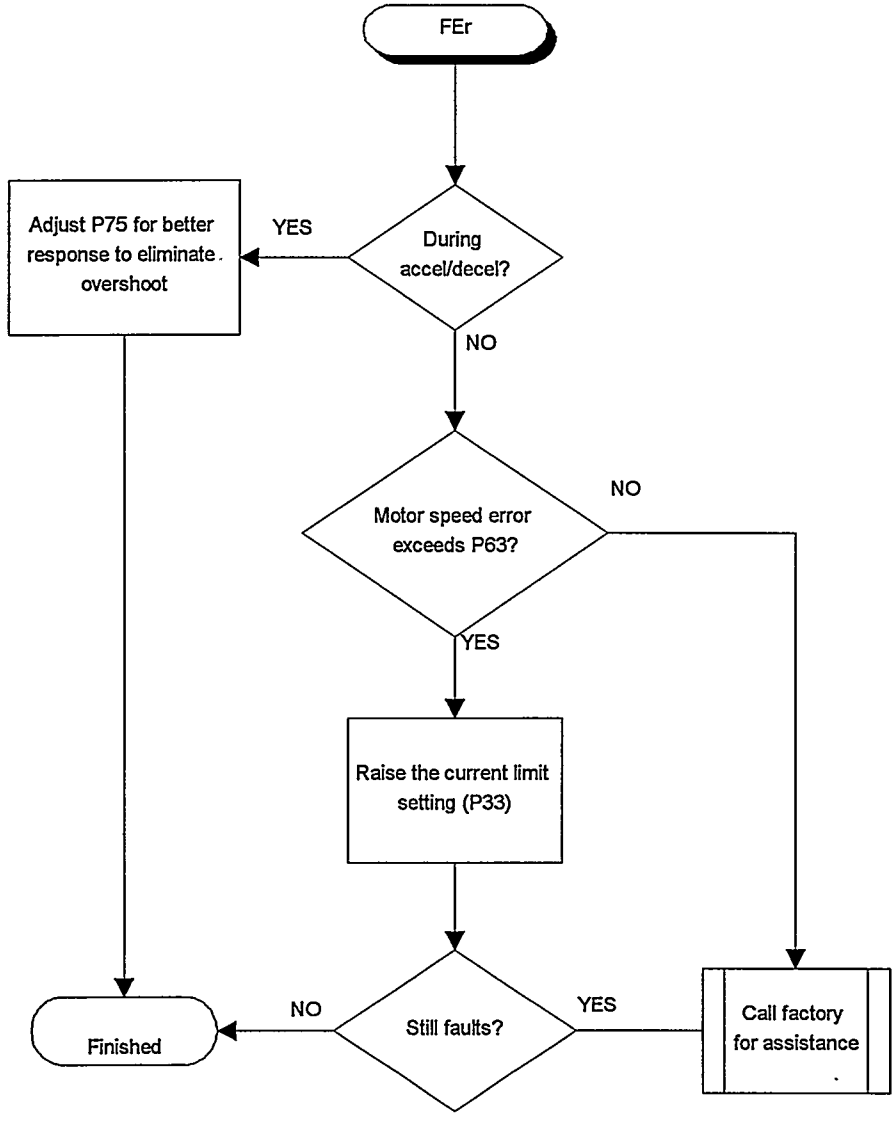


Following Error Fault

FEr

This fault indicates that the drive cannot follow the speed command within the error bandset with the "at speed' parameter (P63). This fault is enabled with parameter P80. Figure 6-14 gives a flow chart for common problems that can produce a following error fault.

Figure 6-14 Following Error Fault Flow Chart

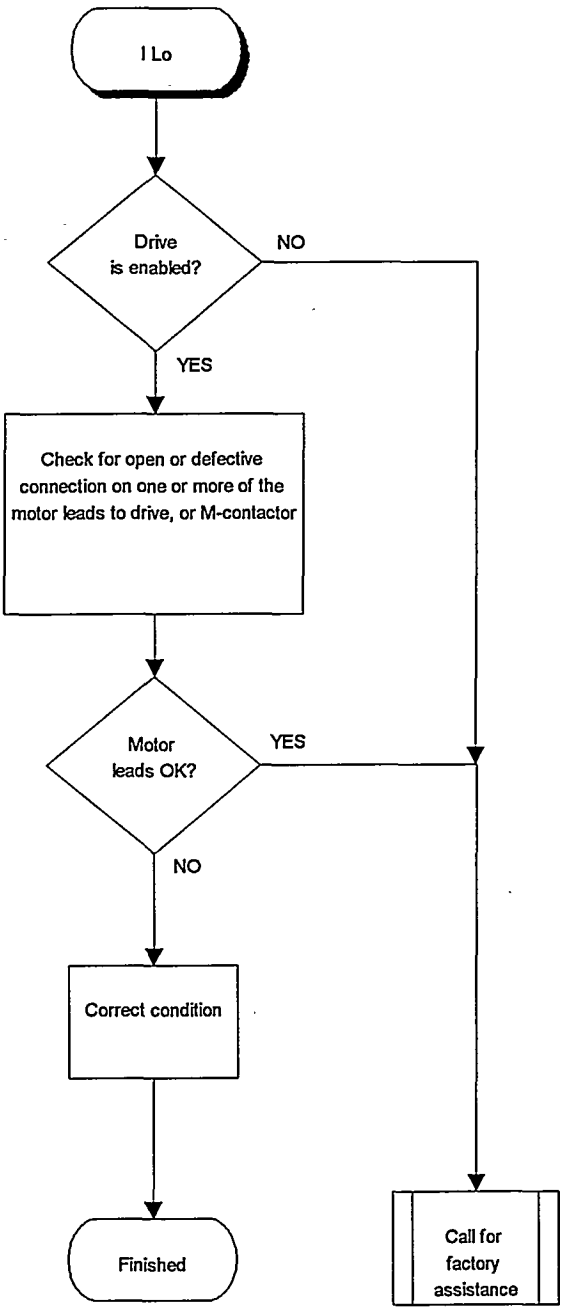


Torque Proving Fault

I Lo

This fault indicates that the drive has failed to measure adequate current in all 3 motor windings upon and enable. This fault is activated with P80. Figure 6-15 gives a flow chart for common problems that can produce a torque proving fault.

Figure 6-15 Torque Proving Fault Flow Chart

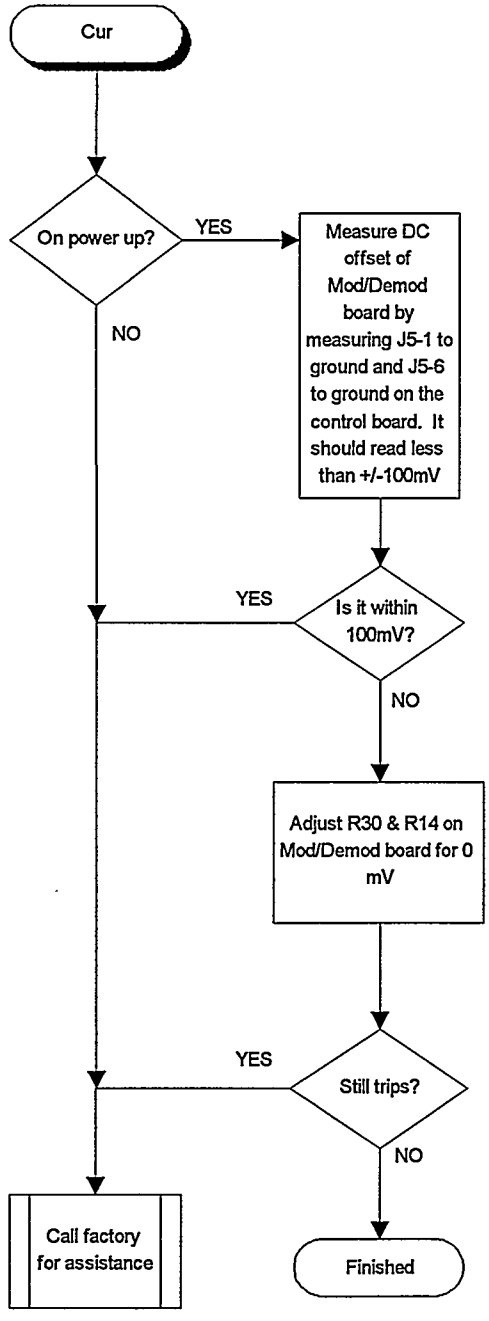


Current Sense Fault

Cur

A phase or Bus current sensor has a DC offset or an open wire condition exists. Figure 6-16 gives a flow chart for common problems that can produce a current sense fault.

Figure 6-16 Current Sense Fault Flow Chart

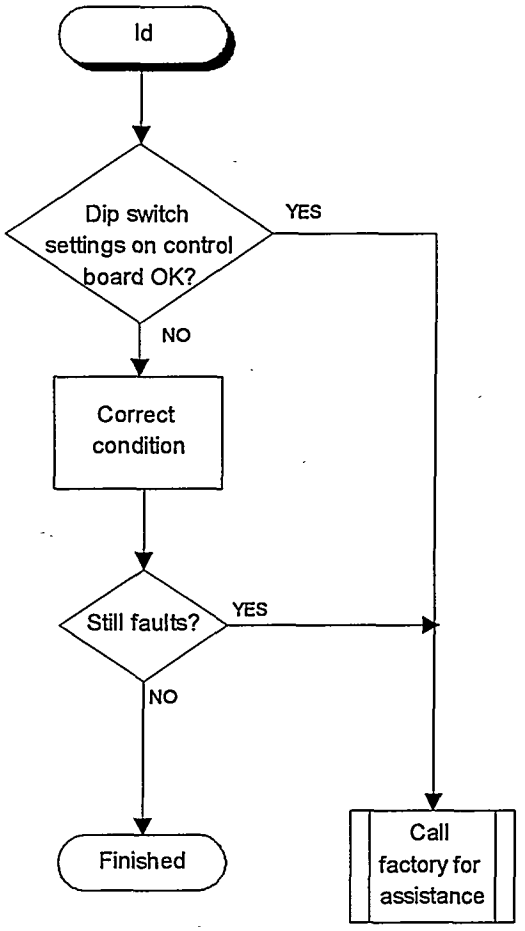


Power Base ID Fault

Id

The control board has read an invalid ID number on the dip switches. Figure 6-17 gives a flow chart for common problems that can produce a power base ID fault.

Figure 6-17 Power Base ID Fault Flow Chart



Improper Motor Operation

No Motor Shaft Rotation

Figure 6-18 gives a flow chart for common problems that prevent motor rotation. Figure 6-19 is a continuation that covers cases when the drive will not enable.

Figure 6-18 No Motor Shaft Rotation Flow Chart

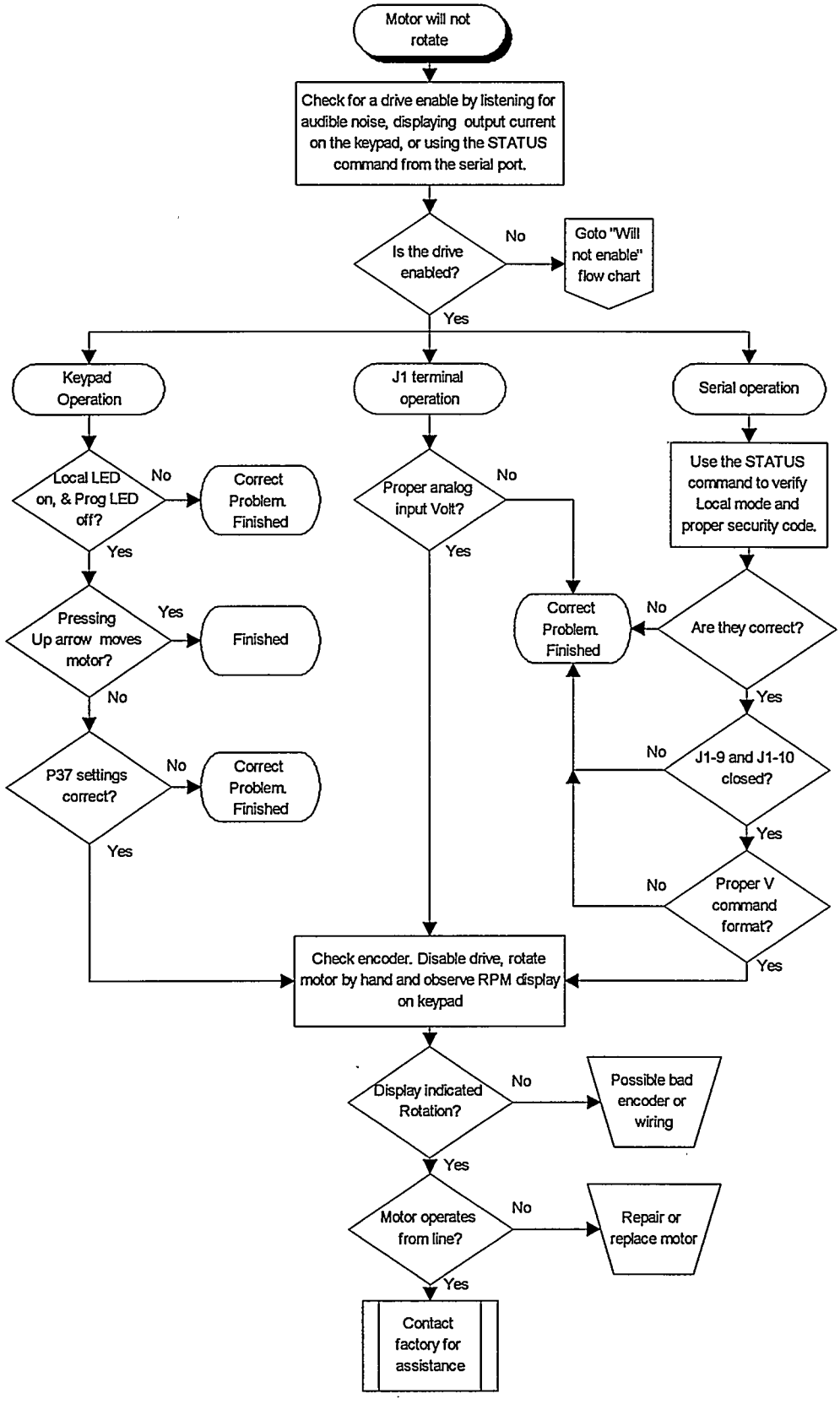
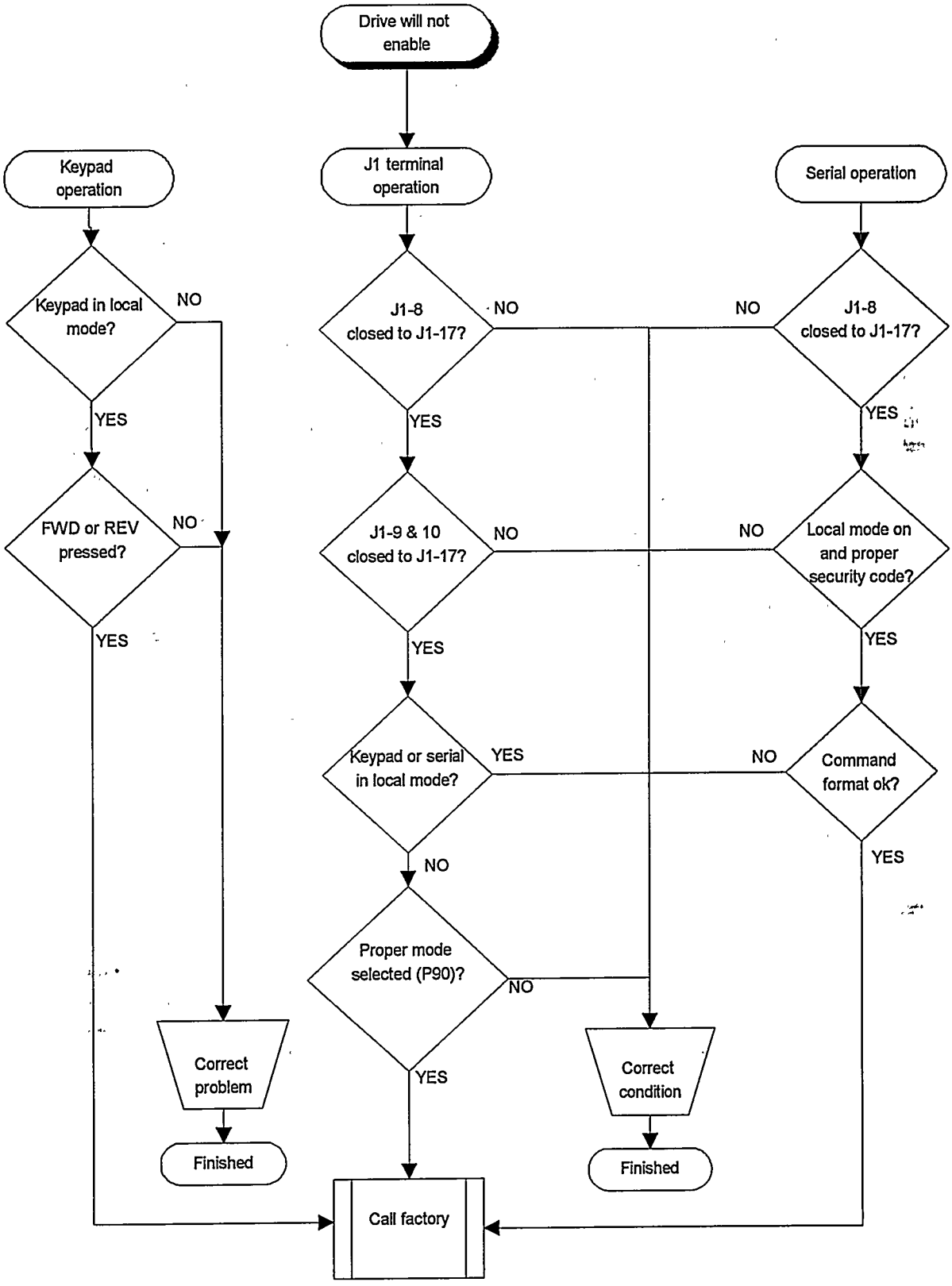


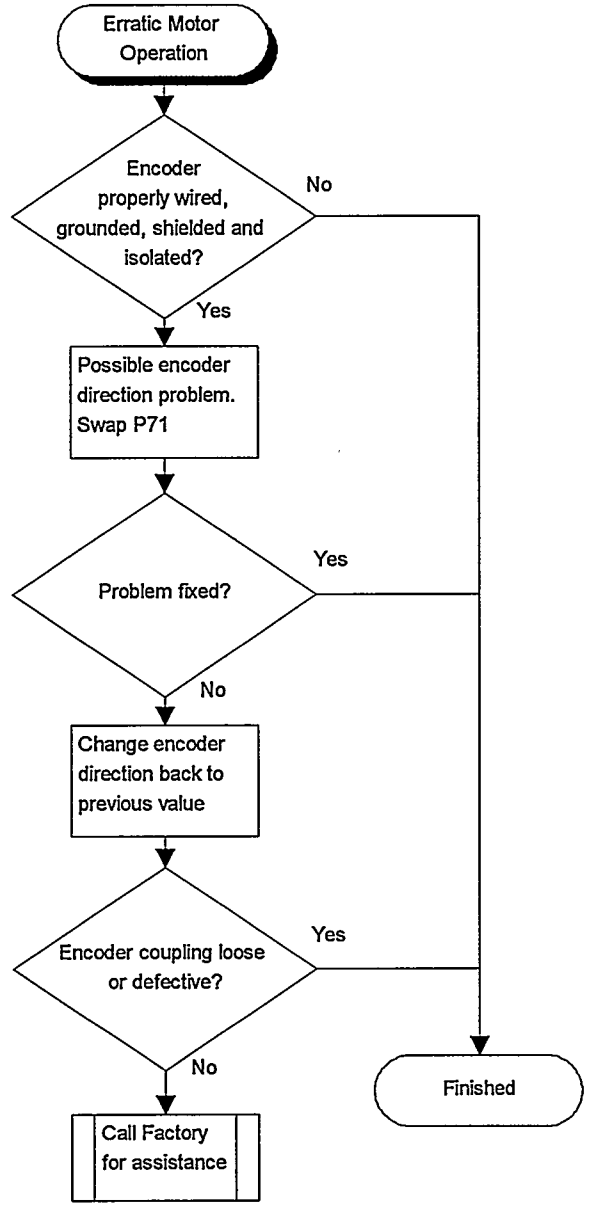
Figure 6-19 Drive will not enable Flow Chart



Erratic or Jittery Shaft Rotation

This condition is usually caused by problems with the encoder. Figure 6-20 gives flow chart for typical problems.

Figure 6-20 Erratic Shaft rotation Flow Chart



Wrong Response to Speed Commands

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

2. Encoder polarity may be wrong. Reverse the encoder direction P71.

Chapter 7
Wiring and Protective Devices

Constant Torque Applications

This control must be provided with a suitable input power protective device. Use the recommended fuses or circuit breaker from the tables below. Input and output wire size is based on use of 75° C rated copper conductor wire.

Circuit Breaker - 3 phase, thermal magnetic. Equal to GE type THQ or TEB for 230 VAC or GE type TED for 460 VAC

Fast Acting Fuses - Buss KTN on 230 VAC or Buss KTS on 460 VAC, or equal.

Time Delay Fuses - Buss FRN on 230 VAC or Buss FRS on 460 VAC, or equal.

Table 7.1 Constant Torque Protection

CATALOG NO.	MAX. HP	INPUT WIRE (AWG)	INPUT BREAKER	INPUT FUSES		OUTPUT WIRE (AWG)
				FAST ACTING	TIME DELAY	
712-24-175	5	10	230V/30A	250V/40A	250V/30A	10
712-35-175	7.5	8	230V/40A	250V/60A	250V/40A	8
712-47-175	10	8	230V/50A	250V/70A	250V/50A	8
712-510-175	15	4	230V/70A	250V/90A	250V/70A	4
712-714-175	25	3	230V/100A	250V/125A	250V/100A	3
712-1020-175	40	1	230V/150A	250V/200A	250V/150A	1
712-1427-175	50	3/0	230V/200A	250V/250A	250V/200A	3/0
714-12-175	5	12	460V/20A	600V/30A	600V/20A	12
714-24-175	10	10	460V/30A	600V/40A	600V/30A	10
714-35-175	15	8	460V/40A	600V/60A	600V/40A	8
714-47-175	25	8	460V/50A	600V/70A	600V/50A	8
714-510-175	30	6	460V/70A	600V/90A	600V/70A	6
714-710-175	40	4	460V/70A	600V/90A	600V/70A	4
714-714-175	50	3	460V/100A	600V/125A	600V/100A	3
714-1020-175	75	1/0	460V/150A	600V/200A	600V/150A	1/0

Variable Torque Applications

(FANS AND CENTRIFUGAL PUMPS)

This control must be provided with a suitable input power protective device. Use the recommended fuses or circuit breaker from the tables below. Input and output wire size is based on use of 75° C copper conductor wire.

Circuit Breaker - 3 phase, thermal magnetic. Equal to GE type THQ or TEB for 230 VAC or GE type TED for 460 VAC

Fast Acting Fuses - Buss KTN on 230 VAC or Buss KTS on 460 VAC, or equal.

Time Delay Fuses - Buss FRN on 230 VAC or Buss FRS on 460 VAC, or equal.

Table 7.2 Variable Torque Protection

CATALOG NO.	MAX. HP	INPUT WIRE (AWG)	INPUT BREAKER	INPUT FUSES		OUTPUT WIRE (AWG)
				FAST ACTING	TIME DELAY	
712-24-175	7.5	8	230V/40A	250V/40A	250V/30A	8
712-35-175	10	8	230V/50A	250V/70A	250V/50A	8
712-47-175	15	6	230V/70A	250V/70A	250V/70A	6
712-510-175	20	4	230V/80A	250V/100A	250V/80A	4
712-714-175	25	3	230V/100A	250V/125A	250V/100A	3
712-1020-175	50	2/0	250V/225A	250V/225A	250V/175A	2/0
712-1427-175	60	3/0	230V/200A	250V/250A	250V/200A	3/0
714-12-175	7.5	12	460V/20A	600V/30A	600V/20A	12
714-24-175	15	8	460V/40A	600V/60A	600V/40A	8
714-35-175	25	8	460V/50A	600V/70A	600V/50A	8
714-47-175	30	6	460V/70A	600V/90A	600V/70A	6
714-510-175	40	4	460V/80A	600V/100A	600V/80A	4
714-710-175	50	3	460V/90A	600V/125A	600V/90A	3
714-714-175	60	2	460V/110A	600V/150A	600V/110A	2
714-1020-175	100	2/0	460V/175A	600V/225A	600V/175A	2/0

Internal Fuse Lists

Table 7.3 Internal Fuse List - Model 712-XXXX-175 (230 VAC)

QTY	RATING	SWEODRIVE P/N	COMMERCIAL EQUIV.	REF. DES.
2	2A, 250VAC	4392000	Buss FNM 2	A8F1, A8F2
1	1 1/2A, 600VAC	4331500	Buss KTK 1 1/2 Littlefuse KLK 1 1/2	A3F1

Table 7.4 Internal Fuse List - Model 714-XXXX-175 (460 VAC)

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

Chapter 8
Braking Options Information

Table 8.1 Braking Resistor Assemblies

BRAKING RESISTOR ASSEMBLIES

P/N MATRIX: R XX (X OR XX) XX

- XX — EQUIVALENT RESISTANCE IN OHMS
- X OR XX — WATTS/100
- XX — G=KIT, without NEMA 1 enclosure
- XX — GA=assembly in NEMA 1 enclosure
- R — BRAKING RESISTOR DESIGNATOR

WATTS	600	1200	2400	4800
MODEL NO.				
712-24-175	RG610\RGA610	RG1210\RGA1210	RG2410\RGA2410	RG4810\RGA4810
712-35-175	RG610\RGA610	RG1210\RGA1210	RG2410\RGA2410	RG4810\RGA4810
712-47-175	RG610\RGA610	RG1210\RGA1210	RG2410\RGA2410	RG4810\RGA4810
712-510-175	RG606\RGA606	RG1206\RGA1206	RG2406\RGA2406	RG4806\RGA4806
712-714-175	RG606\RGA606	RG1206\RGA1206	RG2406\RGA2406	RG4806\RGA4806
712-1020-175	-	RG1203\RGA1203	RG2403\RGA2403	RG4803\RGA4803
712-1427-175	-	RG1202\RGA1202	RG2402\RGA2402	RG4802\RGA4802
714-12-175	RG620\RGA620	RG1220\RGA1220	RG2420\RGA2420	RG4820\RGA4820
714-24-175	RG620\RGA620	RG1220\RGA1220	RG2420\RGA2420	RG4820\RGA4820
714-35-175	RG620\RGA620	RG1220\RGA1220	RG2420\RGA2420	RG4820\RGA4820
714-47-175	RG620\RGA620	RG1220\RGA1220	RG2420\RGA2420	RG4820\RGA4820
714-510-175	-	RG1212\RGA1212	RG2412\RGA2412	RG4812\RGA4812
714-714-175	-	RG1210\RGA1210	RG2410\RGA2410	RG4810\RGA4810
714-1020-175	-	-	RG2406\RGA2406	RG4806\RGA4806

Chapter 9
Renewal Parts

Table 9.1 Renewal Parts Model No. 712-XXXX-175 (Part 1)

Model No.	712-24-175		712-35-175		712-47-175		712-510-175	
	QTY	PART #	QTY	PART #	QTY	PART #	QTY	PART #
Power Supply	1ea	0070871	1ea	0070871	1ea	0070871	1ea	0070871
Fans/Blowers		N/A	1ea	6950010	1ea	6950010	1ea	6950010
Elect. Caps	1ea	7417825	2ea	7417825	2ea	7417825	2ea	7417825
Diode Bridge	1ea	3710608	1ea	3710608	1ea	3710608	1ea	3710608
DC Link Ind.	1ea	2050020	1ea	2050019	1ea	2050019	1ea	2050019
Base Drivers	3ea	0070086	3ea	0070087	3ea	0070088	3ea	0070085
Power Trans.	3ea	3605005	3ea	3607505	3ea	3610005	3ea	3615005
SCR	1ea	3750608	1ea	3750608	1ea	3750608	1ea	3750608
Snubber Brd.	1ea	0070841	1ea	0070841	1ea	0070841	1ea	0070841
Hall Sensor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sense Resistors	2ea	8387!10	2ea	8387!10	2ea	8387!05	2ea	8387!05
MOD/DEMOD	1ea	0072001	1ea	0072001	1ea	0072001	1ea	0072001
R1	1ea	8344027	1ea	8344027	1ea	8344027	1ea	8344027
R5	1ea	8364224	1ea	8364224	1ea	8364224	1ea	8364224
Control Board	1ea	0078543	1ea	0078543	1ea	0078543	1ea	0078543
Connector P1	1ea	6020122	1ea	6020122	1ea	6020122	1ea	6020122
Connector P2	1ea	6020116	1ea	6020116	1ea	6020116	1ea	6020116
Regen Trans.	1ea	3505005	1ea	3505005	1ea	3505005	1ea	3510005
Membrane Keypad	1ea	1080931	1ea	1080931	1ea	1080931	1ea	1080931
Keypad Cir. Bd.	1ea	1080906	1ea	1080906	1ea	1080906	1ea	1080906
Cable, display	1ea	1076921	1ea	1076921	1ea	1076921	1ea	1076921

Table 9.1 Renewal Parts Model No. 712-XXXX-175 (Part 2)

Model No.	712-714-175		712-1020-175		712-1427-175			
	QTY	PART #	QTY	PART #	QTY	PART #		
Power Supply	1ea	0070871	1ea	0070875	1ea	0070875		
Fans/Blowers	2ea	6950010	1ea	1003035	1ea	1003035		
Elect. Caps	3ea	7417825	4ea	7417825	4ea	7417825		
Diode Bridge	1ea	3711008	3ea	3701008	3ea	3701608		
DC Link Ind.	1ea	2050019	1ea	2050024	1ea	2050024		
Base Drivers	3ea	0070089	3ea	0070090	3ea	0070093		
Power Trans.	3ea	3620005	6ea	3530005	6ea	3540005		
SCR	1ea	3750908	1ea	3751608	1ea	3752512		
Snubber Brd	1ea	0070841	1ea	0076351	1ea	0076351		
Hall Sensor	N/A	N/A	1ea	0076508	1ea	0076509		
Sense Resistors	2ea	8387105	N/A	N/A	N/A	N/A		
MOD/DEMOD	1ea	0072001	N/A	N/A	N/A	N/A		
R1	1ea	8344027	2ea	8344050	2ea	8344050		
R5	1ea	8364224	1ea	8364224	1ea	8364224		
Control Board	1ea	0078543	1ea	0078543	1ea	0078543		
Connector P1	1ea	6020122	1ea	6020122	1ea	6020122		
Connector P2	1ea	6020116	1ea	6020116	1ea	6020116		
Regen Trans.	1ea	3510005	1ea	3520005	1ea	3520005		
Membrane Keypad	1ea	1080931	1ea	1080931	1ea	1080931		
Keypad Cir. Bd.	1ea	1080906	1ea	1080906	1ea	1080906		
Cable, Display	1ea	1076921	1ea	1076921	1ea	1076921		

Table 9.1 Renewal Parts Model No. 714-XXXX-175 & 713-XXXX-175 (Part 1)

Model No.	714-12-175		714-24-175		714-35-175		714-47-175	
	QTY	PART #	QTY	PART #	QTY	PART #	QTY	PART #
Power Supply (460 VAC)	1ea	0070872	1ea	0070872	1ea	0070872	1ea	0070872
Power Supply (400 VAC)	1ea	0070873 (713-XXXX)	1ea	0070873 (713-XXXX)	1ea	0070873 (713-XXXX)	1ea	0070873 (713-XXXX)
Fans/Blowers	N/A	N/A	N/A	N/A	1ea	6950010	1ea	6950010
Elect. Caps	2ea	7417825	2ea	7417825	2ea	7417825	4ea	7417825
Diode Bridge	1ea	3710616	1ea	3710616	1ea	3710616	1ea	3710616
DC Link Ind.	1ea	2050017	1ea	2050017	1ea	2050017	1ea	2050013
Base Drivers	3ea	0725221	3ea	0725222	3ea	0725223	3ea	0725216
Power Trans.	3ea	3603112	3ea	3605112	3ea	3607612	3ea	3610112
SCR	1ea	3750612	1ea	3750612	1ea	3750612	1ea	3750612
Snubber Brd.	1ea	0070842	1ea	0070842	1ea	0070842	1ea	0070842
Hall Sensor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sense Resistors	2ea	8398003	2ea	8387!10	2ea	8387!10	2ea	8387!05
MOD/DEMOD	1ea	0072001	1ea	0072001	1ea	0072001	1ea	0072001
R1	1ea	8344047	1ea	8344047	1ea	8344047	1ea	8344047
R5	1ea	8364236	1ea	8364236	1ea	8364236	1ea	8364236
Control Board	1ea	0078543	1ea	0078543	1ea	0078543	1ea	0078543
Connector P1	1ea	6020122	1ea	6020122	1ea	6020122	1ea	6020122
Connector P2	1ea	6020116	1ea	6020116	1ea	6020116	1ea	6020116
Regen Trans.	1ea	3505010	1ea	3505010	1ea	3505010	1ea	3505010
Membrane Keypad	1ea	1080931	1ea	1080931	1ea	1080931	1ea	1080931
Keypad Cir. Bd.	1ea	1080906	1ea	1080906	1ea	1080906	1ea	1080906
Cable, Display	1ea	1076921	1ea	1076921	1ea	1076921	1ea	1076921

Table 9.2 Renewal Parts Model No. 714-XXXX-175 & 713-XXXX-175 (Part 2)

Model No.	714-510-175		714-714-175		714-1020-175			
	QTY	PART #	QTY	PART #	QTY	PART #		
Power Supply (460 VAC)	1ea	0070872	1ea	0070877	1ea	0070877		
Power Supply (400 VAC)	1ea	0070873 (713-XXXX)	1ea	0070873 1 (713-XXXX)	1ea	00708731 (713-XXXX)		
Fans/Blowers	1ea	6950010	1ea	1003035	1ea	1003035		
Elect. Caps	4ea	7417825	8ea	7417825	8ea	7417825		
Bridge	1ea	3710616	3ea	3700816	3ea	3700816		
DC Lnk Ind.	1ea	2050013	1ea	2050025	1ea	2050025		
Base Drivers	3ea	0725216	3ea	0725219	3ea	0725219		
Power Trans.	3ea	3615112	6ea	3520112	6ea	3530112		
SCR	1ea	3750612	1ea	3750912	1ea	3751612		
Snubber Brd.	1ea	0070842	1ea	0076351	1ea	0076351		
Hall Sensor	N/A	N/A	1ea	0076507	1ea	0076508		
Sense Resistor	2ea	8387!05	N/A	N/A	N/A	N/A		
MOD/DEMOD	1ea	0072001	N/A	N/A	N/A	N/A		
R1	1ea	8344047	2ea	8344050	2ea	8344050		
R5	1ea	8364236	1ea	8364236	1ea	8364236		
Control Board	1ea	0078543	1ea	0078543	1ea	0078543		
Connector P1	1ea	6020122	1ea	6020122	1ea	6020122		
Connector P2	1ea	6020116	1ea	6020116	1ea	6020116		
Regen Trans.	1ea	3510010	1ea	3520112	1ea	3520112		
Membrane Keypad	1ea	1080931	1ea	1080931	1ea	1080931		
Keypad Cir. Bd.	1ea	1080906	1ea	1080906	1ea	1080906		
Cable, Display	1ea	1076921	1ea	1076921	1ea	1076921		

Chapter 10
Drawing List

B-0022	Outline and Mounting
7143	Connection Diagram 230 VAC. Motor Controller, Size A, B
7148	Connection Diagram 400/460 VAC. Motor Controller, Size A, B
7633	Connection Diagram 230 VAC Motor Controller Size C
7634	Connection Diagram 400/460 VAC Motor Controller Size C

Appendix A
Elevator Applications

Elevator Setup Procedure

1) Follow the entire installation and startup procedure as outlined in the flowchart in chapter 2.

2) After entering the setup (nameplate) parameters and calculating the defaults, run auto tuning test AU1 (command offset trim) and AU2 (current loop compensation) as described in chapter 3 (keypad) or chapter 4 (serial). **DO NOT RUN ANY AUTO TUNING TEST OTHER THAN AU1 & AU2.**

3) Setup the optional parameters in chapter 3 to match the specific application. (e.g. Accel / Decel and S-curve ramps, current limit, max speed etc.).

   It is recommended that the optically isolated outputs be used to indicate correct or fault conditions. A possible combination could be: 'READY' on output #1, 'DRIVE ON' on #2, and 'DIRECTION FLAG' on #3. It is also recommended that the following protective features be enabled (P80): following error, torque proving, and external motor temp.

4) Calculate the "slip frequency" (P78) using the formula given in Appendix C. This value is typically between 1 and 3 Hz. Compare the value calculated with the value set in P78 during the "calculate presets - P99" procedure and change if necessary.

5) Set the encoder direction with parameter P71.

   Parameter P71 aligns the direction of the encoder quadrature signal with the direction of motor rotation. The value of P71 can either be a one or a zero.

NOTE: NOTE: The following procedure may cause erratic motor operation, precautions must be taken to prevent injury to personnel or damage to equipment.

   Enable the drive with a zero speed command.

   Observe the shaft of the motor. The motor should be at zero speed.

   If the shaft is moving erratically: the encoder direction is backwards. Swap P71 (if it is set to 0 enter a 1, if it is set to 1 enter a 0).

   If the shaft is holding zero speed: give the drive a small speed command (around 50 RPM). If the motor does not rotate smoothly, swap the encoder direction.

6) Run the elevator at contract speed and adjust the speed controller gains (P75 & P76), and Accel, Decel, S-Curve ramps for best response. See appendix C for a discussion on adjusting gain values.

Recommended Sequencing for Elevators or Cranes

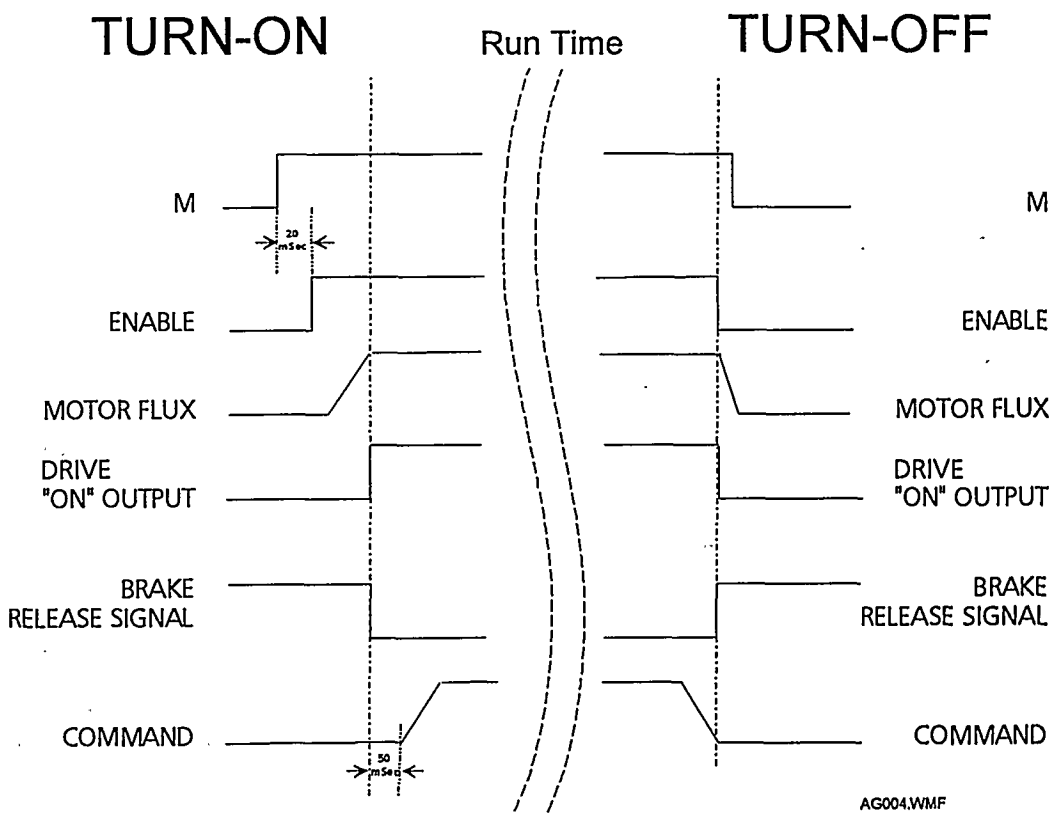
The following is a recommended sequence for turning on and off the drive system. (See chapter 2 for a wiring connections for an output "M" contactor).

1. Select the "Torque Proving" fault active (P80).
2. Select "DRIVE ON" output as one of the opto-isolated outputs on J1 (P58-P61).
3. Pull in the M-contactor.
4. Close the drive "ENABLE".
5. Use the "DRIVE ON" output to energize an external coil for a relay to perform the following:

   Signal the PLC or equivalent controller to engage or disengage the brake and feed the speed command reference (pattern generator) signal into the drive. There should be a 50 mseconds delay between the brake release signal and the speed command signal.

   The time between "DRIVE ON" output and the "ENABLE" signal allows flux build up in the AC motor. This delay should be no less than 20 mseconds. The "Torque Proving" fault will prevent a "DRIVE ON" output if the drive is not applying current to the motor due to an open contactor, broken motor lead, or open motor winding. If during operations a fault occurs, then "DRIVE ON" and "READY" both go inactive and engage the brake and open motor contactor.

Figure A-1 Elevator run sequence



Appendix B
Interface I/O and Protective Features

This appendix contains a discussion on the available interface methods and additional protective features of the controller. A schematic diagram for each type of I/O is given as a reference.

Analog Outputs

There are two programmable 0 to +5 Vdc full scale analog outputs available on pins J1-6 and J1-7. They can be used to monitor various internal digital flux vector variables. Assignment is controlled with parameters P56 and P57. The schematic is shown in Figure B-1 followed by the selection number and description.

Figure B-1 Analog Outputs

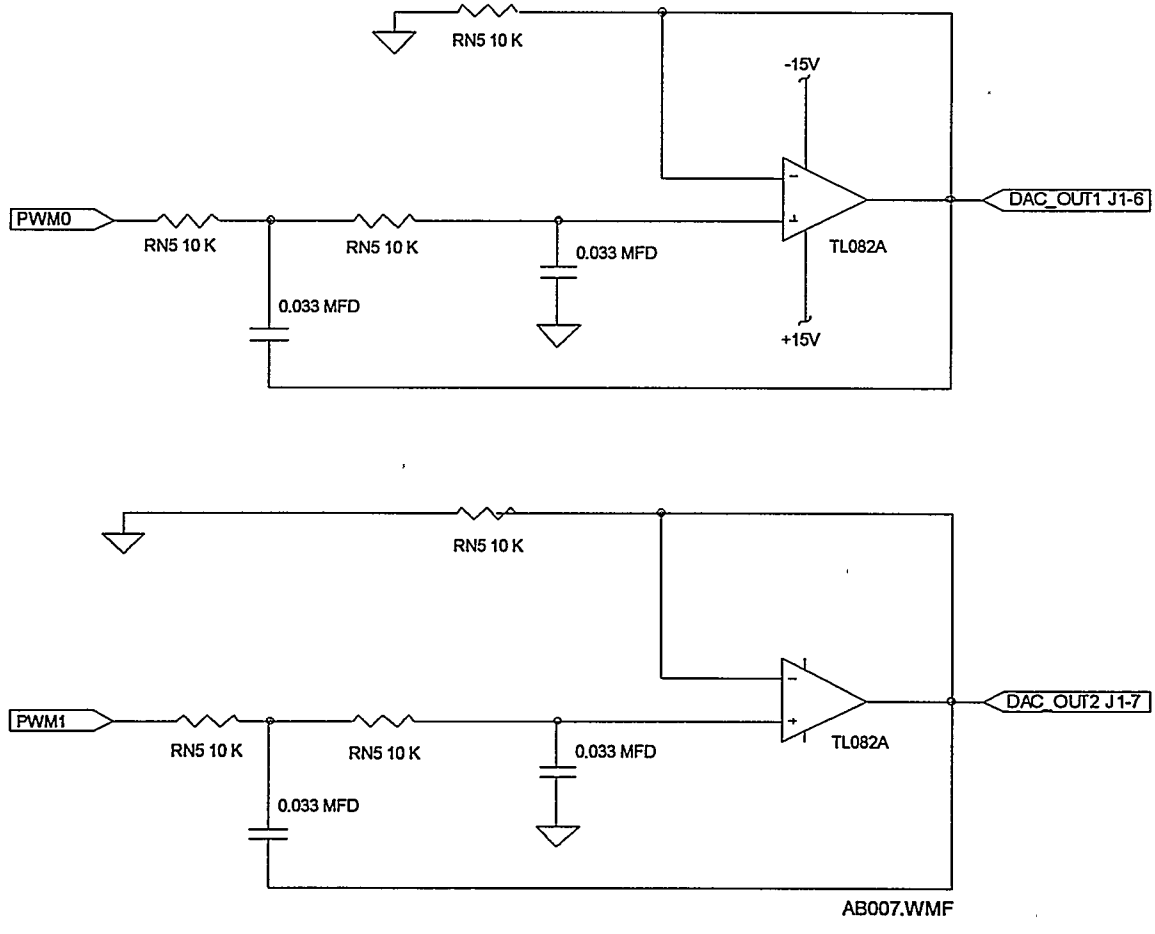


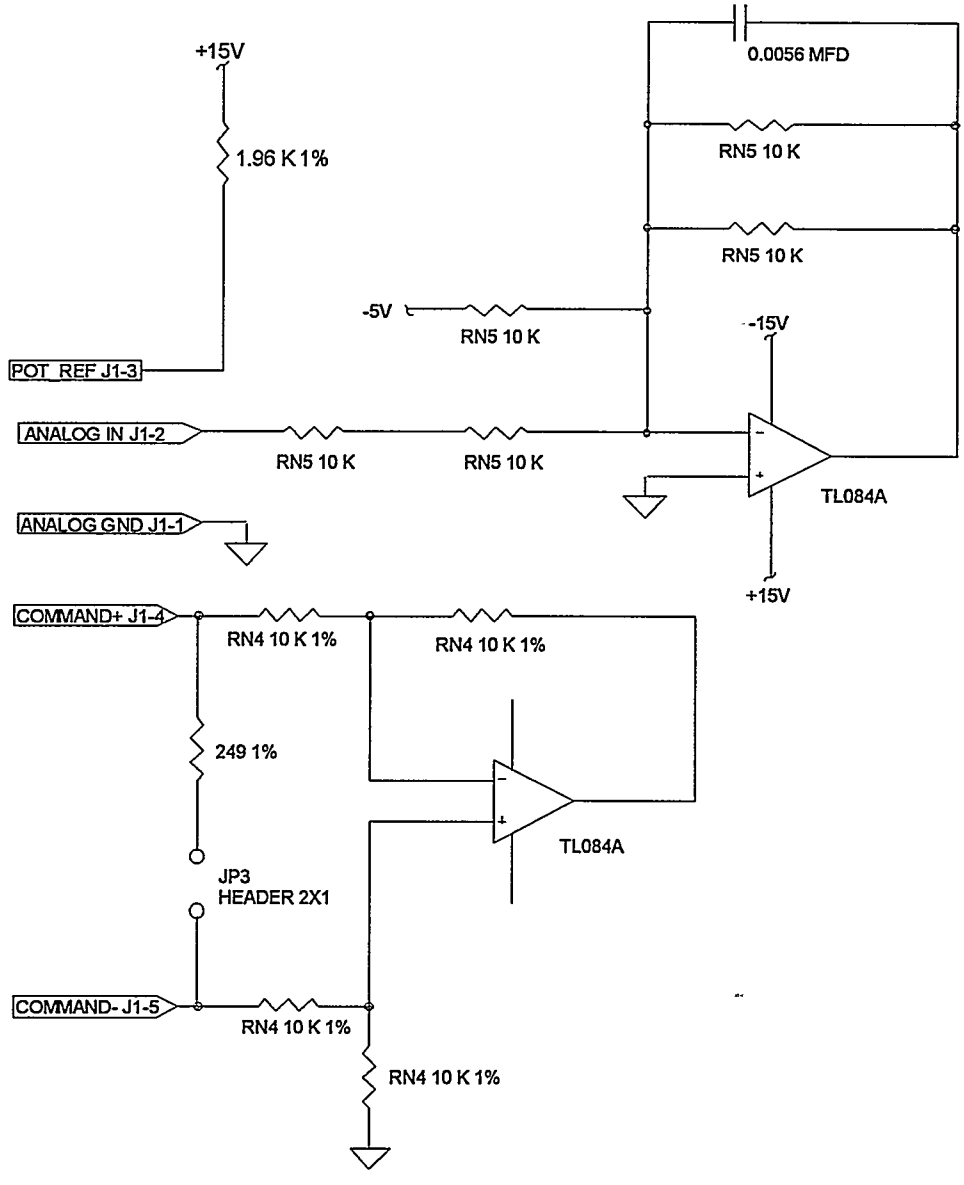
Table B-1 Analog Output Parameter Settings

Number	Name	Description
0)	SPEED	Absolute value of speed with +5 Vdc = MAX RPM (P30). Useful as speed meter output. Factory preset for J1-6.
1)	ABS VALUE TORQUE	Absolute value of torque with +5 Vdc = torque at CURRENT LIMIT (P33). Useful as load meter output.
2)	SPEED COMMAND	Absolute value of the commanded speed with +5 Vdc = MAXIMUM RPM (P30).
3)	VOLTS DC	Amplitude of PWM voltage. 0 - max AC voltage.
4)	FLUX	Flux current feedback. Useful with #5 FLUX COMMAND
5)	FLUX COMMAND	Commanded flux current.
6)	LOAD	Load current feedback. Useful with #7 LOAD COMMAND to determine torque loop response.
7)	LOAD COMMAND	Commanded load current.
8)	CURRENT	Magnitude of motor current, scaled + 2.5V = rated motor current (P92). Factory preset for J1-7.
9)	LOAD CURRENT	Load (torque producing) component of rated motor current (P92): +2.5V = rated current.
10)	VOLTS QUADRATURE	Load controller output. Useful in diagnosing controller problems and manual setting of feed forward.
11)	VOLTS DIRECT	Flux controller output.
12)	VOLTS AC	PWM control voltage which is proportional to AC line to line motor terminal voltage. 2.5V centered.
13)	VOLTS BUS	5V = 800 VDC. (900 Series Drives only)
14)	TORQUE	Bipolar torque output. 2.5V centered, 5V = max pos torque, 0 Vdc = max negative torque.
15)	POWER	Bipolar power output. +2.5V = zero power, 0 V = - rated peak power, +5V = + rated peak power.
16)	VELOCITY	Motor speed scaled +2.5V = zero speed, 0 V = negative Maximum Speed (P30), +5V = positive Maximum Speed.
17)	OVERLOAD	Accumulated current squared X time, OL occurs at +5V.
18)	CURRENT PHASE 2	Sampled AC motor current. +2.5V = Zero
19)	CURRENT PHASE 3	current, 0 V = negative rated peak current, +5V = positive rated peak current.
20)	POSITION	Position within a single revolution. 5V = 1 complete revolution. (The counter will reset to 0 once every rev.)

Analog Inputs

Two analog inputs are available on pins J1-4 and J1-5. Assignments of these inputs may be made through parameter P50. They accept signals in the form of ±5V, ±10 VDC and 4 - 20 mA. The schematic is shown in figure B-2.

Figure B-2 Analog inputs



Selectable Parameter Tables

Selectable parameter tables allow the drive to maintain four separate tables of values for each parameter and switch between them. A typical application might be a motor with windings that are automatically switched between wye and delta configurations. A separate parameter table could be used for each configuration of the motor.

Mode 2 is the only mode which allows different parameter tables to be selected. Do not change the operating mode (P90) to anything other than 2.
As shown in Figure 2-6, pins J1-13&14 select from four parameter tables. Initially when setting up the drive, parameter values are entered either manually by the user (such as nameplate data) or automatically by the drive (e.g. calculate defaults). Unless otherwise selected by pins J1-13&14 in mode 2, all parameter values will be stored in parameter table #0 by default.

When setting up parameter tables that have only slight variations, the following sequence is recommended:

1. Set up parameter table #0 for correct operation first.
2. Download the parameter file to a computer disk.
3. Select a different parameter table using pins J1-13&14.
4. Upload the file back into the drive.
5. Make changes as desired.

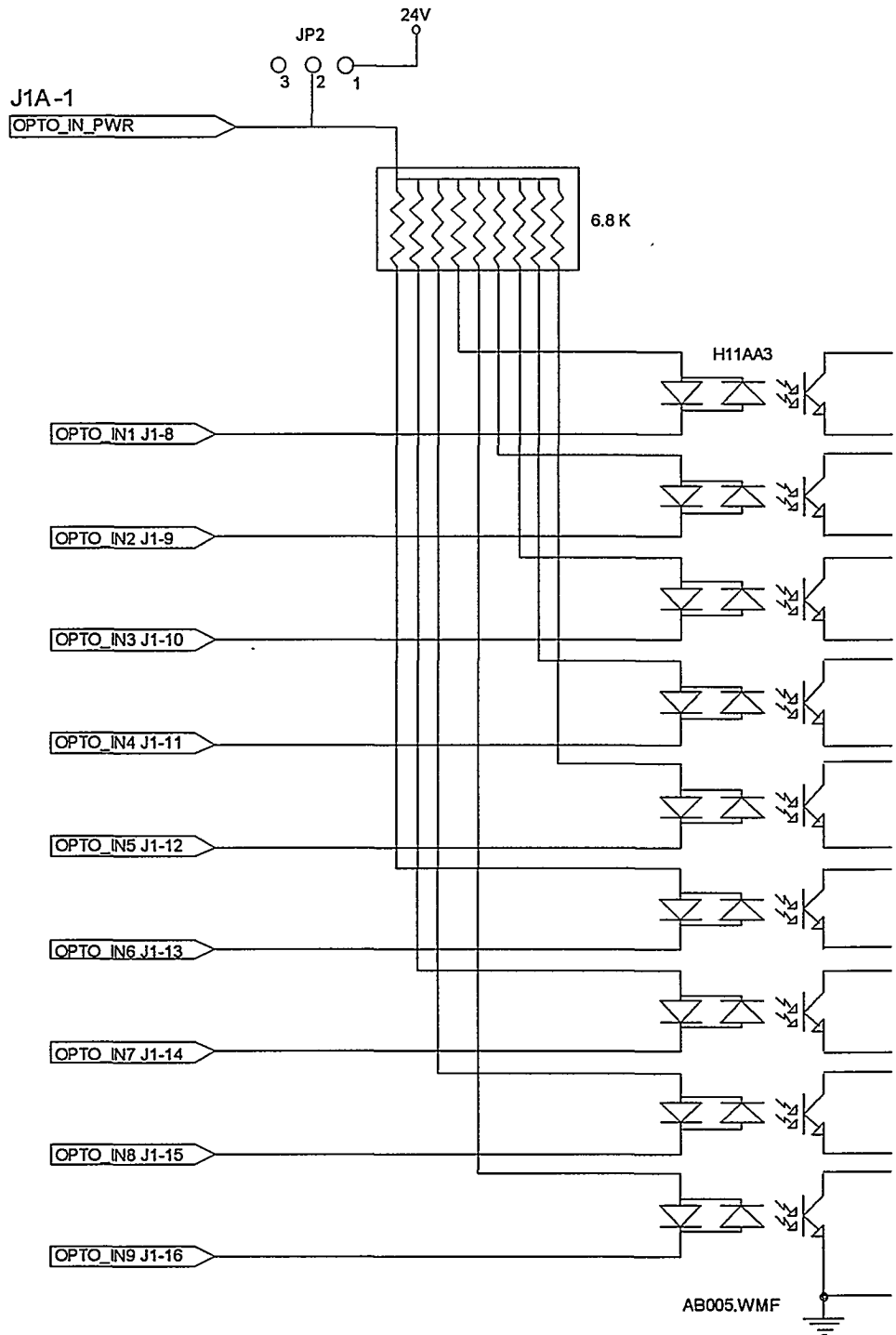
Unless otherwise specified, parameter tables #1 through #3 will contain factory preset values.

The active parameter table can be determined using the "P" serial command (type: P, and press enter).

Opto Isolated Inputs

There are nine optically isolated inputs located on J1-8 to J1-16. Three of these inputs are dedicated for specific use (J1-8 - J1-10), while the functions of the remaining six can vary depending on the selected operating mode (P90). As discussed in Chapter 2; these inputs are normally powered by an internal 24 VDC supply, but can optionally be powered externally be changing the jumper position of JP2, and applying a 10-30 VDC voltage to J1A-1.

Figure B-3 Optically Isolated Inputs



Opto Isolated Outputs

There are four opto isolated outputs on connector J1 pins 19 through 22. Assignment of these outputs to available drive variables may be made through the keypad as parameters P58, P59, P60 and P61. The interface schematic is shown below followed by the parameter selection number and description.

Figure B-4 Optically Isolated Outputs

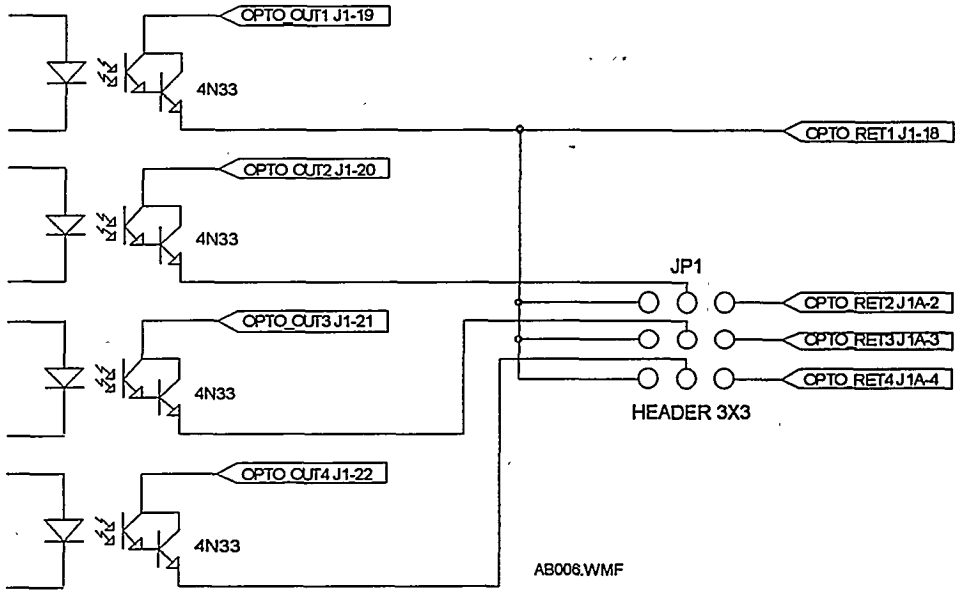


Table B-2 Opto-isolated Output Parameter Settings

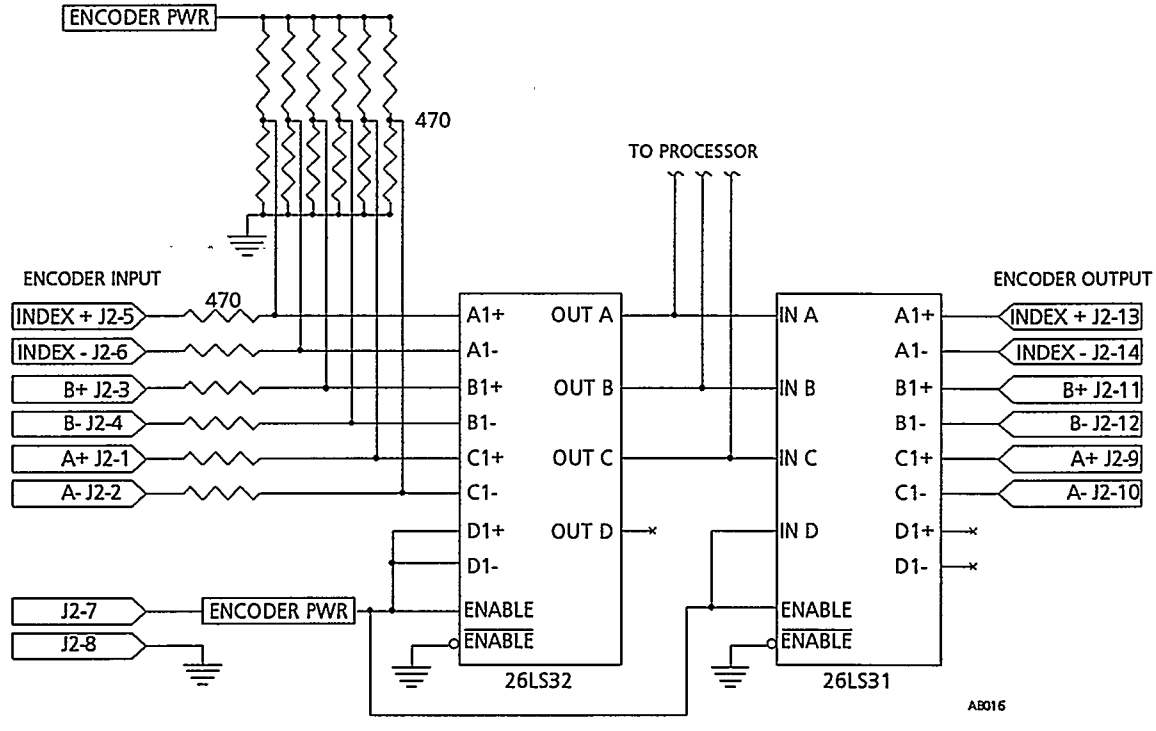
Number	Name	Description
0)	READY	Closed when no faults are present. Open if fault exists or AC power not applied.
1)	ZERO SPEED	Closed when the motor speed is less than the user specified (P62) speed threshold, otherwise open. If 'orient' is enabled, this output is active when the motor speed is less than the specified (P62) speed threshold AND the motor shaft is within .5 degrees of the predetermined position.
2)	AT SPEED	Closed whenever the motor speed is within the user specified (P63) tolerance band of the commanded speed, open outside tolerance band.
3)	OVERLOAD	Closed when an RMS current overload has not occurred, open upon overload.
4)	KEYPAD CONTROL	Closed when the drive is under local keypad control.
5)	SET SPEED	Closed whenever the motor speed is above the user specified (P65) "set speed", open below set speed.

6)	FAULT	Closes when a FAULT is present, open at Ready.
7)	FOLLOWING ERROR	Closed when the motor speed is outside the user specified (P63) tolerance band of the Acc-Dec and S-Curve Conditioned commanded speed. Open when motor speed is within tolerance band of conditioned speed command.
8)	LOW BUS VOLTS	Closed whenever a DC Bus undervoltage fault has occurred.
9)	DRIVE ON	Closed when drive is capable of producing torque. (Motor current has reached excitation level, P72).
10)	INPUT DIRECTION	Closed when reverse input direction command is received, open for forward.
11)	AT POSITION	Closed during a positioning command when the drive is within the tolerance band set by P64.

Encoder Interface

The encoder interface is located on the J2 (16 pin) connector. The schematic is given in Figure B-5. The input (J2 1-6) accepts an incremental quadrature encoder with a "once per revolution" index pulse. A differential encoder signal is recommended however an open collector or other non-differential signal can be used by connecting to the A+, B+ and INDEX+ inputs. The retransmitted encoder output is from a 26LS31 line driver.

Figure B-5 Encoder Interface



Additional Protective Features

Additional protective features are set with parameter P80, protective feature. The Factory preset is all additional faults not active.

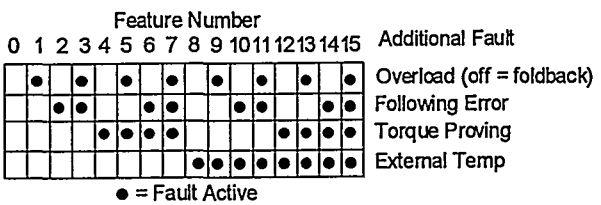
By factory preset the Overload Foldback prevents the drive from tripping off on an overload condition by automatically reducing the internal current limit (P33) to 90% of the motor rating (P92) until the overload accumulator drops below 90%. The internal current limit is then automatically restored to its original setting (equal to P33 current limit). When the overload fault is active the drive will indicate an OC (over-current fault) when the current capability of the drive is exceeded.

When active, the Following Error protective feature shuts down the drive and displays FEr whenever the actual speed (as sensed by the encoder) differs from the commanded speed by more than the P63 value (At Speed Tolerance).

When active, the Torque Proving protective feature quickly detects an open motor winding, broken motor lead or open contactor upon startup, shuts down the drive and displays I LO. When the drive is switched to "ENABLE" with torque proving fault active, the flux current is oriented to cause current to flow in all three motor phases. Each phase current is monitored and an I LO (torque proving) fault occurs if all three phases do not provide adequate current. After approximately 0.5 seconds, the monitoring is completed, and receiving a torque proviing fault is no longer possible. Any open wire/lead to the motor will cause a "Cur" fault (current sense fault).

When active the External Temp protective feature will detect an overtemperature condition from an external source and shut down the drive. The input comes from a normally closed thermal switch on J1-6. This switch can be located on the motor or other device in the system. When the switch opens an OH-E fault is indicated. **Note:** This feature must be activated before the drive can detect a motor overtemp condition. During setup, this feature should be tested by opening J1-6 to assure that the motor protection is in operation.

Figure B-6 Additional Protective Features (P80) Settings



Appendix C
Discussion on Gain Parameters

Flux Current P72

The flux current is normally preset, entered from nameplate data or auto-tuned. If no other data is available, set flux current to about 40% of the motor nameplate rated current.

The following procedure should be used for setting the Flux Current with the motor coupled to the load:

1. Adjust P72 to 40% of the motor nameplate full load current rating.
2. Give the drive a speed command input of 80% of the Base Speed on motor nameplate.
3. Select motor voltage on keypad display by pressing the DISP key until the VOLTS indicator is lit.
4. Observe the motor voltage. Ideally, it should read 80% of motor nameplate voltage.

   By raising P72, you will notice the motor voltage will raise proportionally. Continuing to raise P72 will eventually saturate the motor voltage. By lowering P72, the motor voltage will lower proportionally.

5. While the motor is running adjust P72 until the display indicates the proper voltage (80% of motor rated).

Slip Frequency P78

The slip frequency is calculated from nameplate data or auto tuned.

$$F_{slip} = \text{Rated Freq} - \left(\text{Rated RPM} \times \frac{\text{No. POLES}}{120}\right)$$

Current Controller Gains - P73 & P74

The current controller proportional gain P73 is normally preset for pre-tuned systems or auto-tuned where motor parameters aren't known. Where auto-tuning can't be used, the proper manual setting for the proportional gain can be calculated by:

$$P73 = K_p = \frac{[740 \times L \times (A/V)]}{VAC}$$

L = line to neutral leakage inductance of the motor in mH
VAC = nominal line volts
A/V = the amps/volt scaling of the current feedback

Note: Motor line to neutral leakage inductance can be obtained either from the motor manufacturer or by measuring the line to line inductance and dividing by two.

For most applications a value of P73 = 20 will yield adequate performance.

The current controller integral gain P74 is factory preset at 50 Hz. This setting is suitable for essentially all systems, **DO NOT CHANGE WITHOUT FACTORY APPROVAL.**

Speed Controller gains - P75 - P77

The speed controller proportional gain P75 is normally preset or auto-tuned. This gain may be increased or decreased to suit the application. Increasing P75 will result in faster response, excessive proportional gain will cause overshoot and ringing. Decreasing P75 will cause slower response and decrease overshoot and ringing caused by excessive proportional gain. If P75 & P76 are set too close together an overshoot condition can also occur.

The speed controller integral gain parameter P76 in Hertz as discussed under PI controller later in this chapter may be set at any value from zero to 10 Hertz. Setting P76 = 0 removes integral compensation, resulting in a proportional rate loop. This selection is ideal for systems where overshoot must be avoided and substantial stiffness" (ability of the drive to maintain commanded speed despite torque loads) isn't required. Increasing values of P76 increase the low frequency gain and stiffness of the drive, an excessive integral gain setting will cause overshoot for transient speed commands and may lead to oscillation. Typical setting is 4 Hertz, DO NOT SET ABOVE 10 HERTZ OR SUBSTANTIAL OVERSHOOT WILL OCCUR.

To manually tune the speed controller:

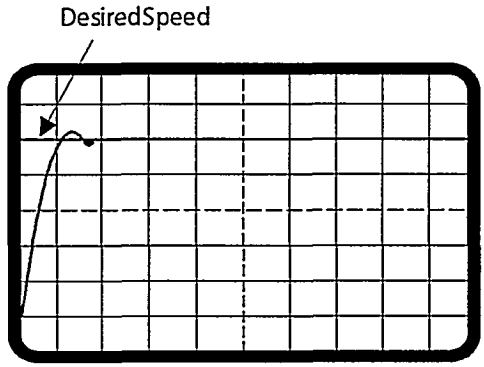
1. Set P76 = 0 (remove integral gain).
2. increase the P75 setting until adequate response to step speed commands is attained.
3. Increase P76 setting to increase the stiffness of the drive.

It is convenient to monitor speed step response with a strip chart recorder or storage oscilloscope connected to J1-6 or -7 with P56 or 57 set to 16 (bipolar speed, 2.5 VDC = zero speed). See Appendix B discussion of analog outputs.

Examples

Figures C-1 through C-4 illustrate what the speed response would look like on an oscilloscope for various gain settings. The examples show waveforms from the analog output J1-6 with "VELOCITY" selected during a stepped speed command from zero to 100 RPM.

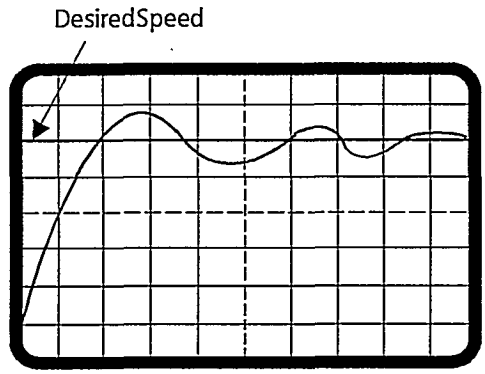
Figure C-1 Oscilloscope Response No. 1



With P75 at 40 & P76 at 1

Figure C-1 shows the optimum response for this particular system. (Proportional gain = 40 and integral = 1).

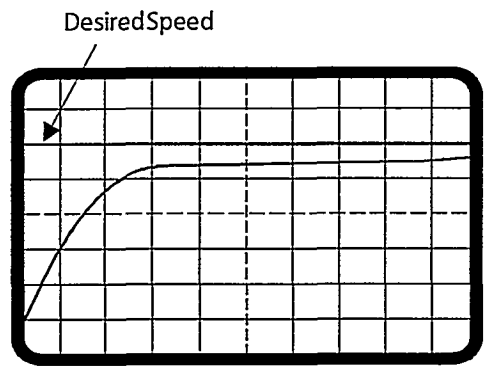
Figure C-2 Oscilloscope Response No. 2



With P75 at 10 & P76 at 1

In Figure C-2 the integral gain is set too high (1) for the value of proportional gain (10). The result is an excessive overshoot and ringing. Therefore raise P75 or lower P76 integral gain.

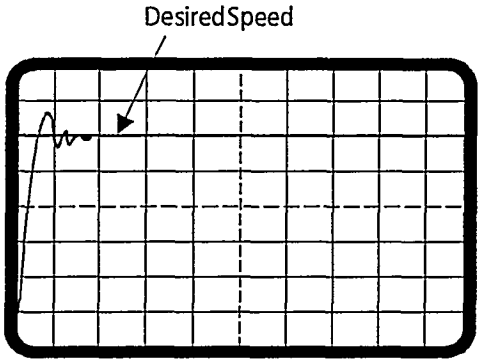
Figure C-3 Oscilloscope Response No. 3



With P75 at 10 & P76 at 0

Figure C-3 shows the response of a proportional rate loop with the integral gain has been set to 0 Hz. However, the value of proportional gain is too low.

Figure C-4 Oscilloscope Response No. 4



With P75 at 100 & P76 at 1

Figure C-4 is an example of excessive proportional gain, note the ringing in the speed response.

PI Controller

Both the current and rate control loops are of the Proportional plus Integral type. If 'E' is defined to be the error signal,

E = Command - Feedback

then the PI controller operates on 'E' as

Output = (Kp * E) + (Ki $\int$E dt)

where Kp is the proportional gain of the system and Ki is the integral gain of the system.

The transfer function (Output /E) of the controller using 1/s (Laplace Operator) to denote the integral

Output/E = Kp + Ki / s = Kp (s + Ki/Kp) / s .

The second equation shows that the ratio of Ki/Kp is a frequency in radians/sec. In the SWEODRIVE flux vector drive the integral gain has been redefined to be

SWEODRIVE KI = (Ki / Kp) / (2 Π) Hz,

and the transfer function is

Output/E = Kp (s + 2 Π KI) / s.

This sets the integral gain as a frequency in Hertz. As a rule of thumb, set this frequency about 1/10 of the bandwidth of the control loop.

The proportional gain sets the open loop gain of the system - the bandwidth (speed of response) of the system. If the system is excessively noisy, it is most likely due to the proportional gain being set too high.

Appendix D
AC Vector Drive Parameter List

FLUX VECTOR PARAMETER LIST (VER 2.02) 4/15/93

P #	DESCRIPTION	RANGE	FACTORY PRESET	SETTINGS
	SYSTEM CONTROL PARAMETERS			
	JOG			
0	JOG SPEED (RPM)	0-MAX SPEED	0	
1	JOG ACCEL (0 TO MAX SPEED) SEC	0 - 999.9	2.0	
2	JOG DECEL (MAX SPEED TO 0) SEC	0 - 999.9	2.0	
3	JOG TIME TO MAX ACCEL ("S" CURVE) SEC	0 - 99.99	0.00	
	ACC / DEC			
4	ACCEL #1 (0 TO MAX SPEED) SEC	0 - 999.9	2.0	
5	DECEL #1 (MAX SPEED TO 0) SEC	0 - 999.9	2.0	
6	"S" CURVE #1 (TIME TO MAX ACCEL) SEC	0 - 99.99	0.00	
7	ACCEL #2 (0 TO MAX SPEED) SEC	0 - 999.9	2.0	
8	DECEL #2 (MAX SPEED TO 0) SEC	0 - 999.9	2.0	
9	"S" CURVE # 2 (TIME TO MAX ACCEL) SEC	0 - 99.99	0.00	
	PRESET SPEEDS			
11	PRESET SPEED #1 (RPM)	0-MAX SPEED	0	
12	PRESET SPEED #2 (RPM)	0-MAX SPEED	0	
13	PRESET SPEED #3 (RPM)	0-MAX SPEED	0	
14	PRESET SPEED #4 (RPM)	0-MAX SPEED	0	
15	PRESET SPEED #5 (RPM)	0-MAX SPEED	0	
16	PRESET SPEED #6 (RPM)	0-MAX SPEED	0	
17	PRESET SPEED #7 (RPM)	0-MAX SPEED	0	
18	PRESET SPEED #8 (RPM)	0-MAX SPEED	0	
19	PRESET SPEED #9 (RPM)	0-MAX SPEED	0	
20	PRESET SPEED #10 (RPM)	0-MAX SPEED	0	
21	PRESET SPEED #11 (RPM)	0-MAX SPEED	0	
22	PRESET SPEED #12 (RPM)	0-MAX SPEED	0	
23	PRESET SPEED #13 (RPM)	0-MAX SPEED	0	
24	PRESET SPEED #14 (RPM)	0-MAX SPEED	0	
25	PRESET SPEED #15 (RPM)	0-MAX SPEED	0	

P #	DESCRIPTION	RANGE	FACTORY PRESET	SETTINGS
	HOMING / ORIENT			
26	HOMING SPEED (RPM)	0-MAX SPEED	100	
27	HOMING OFFSET FROM INDEX MARK (ENCODER COUNTS X 4)	0-9999	P95	
	MISC OPERATING PARAMETERS			
	MOTOR SPEED LIMITS			
30	DESIRED MAXIMUM MOTOR SPEED (RPM)	0-32767	P93	
31	DESIRED MINIMUM MOTOR SPEED (RPM)	0-MAX SPEED	0	
32	CONSTANT POWER SPEED (RPM)	0-MAX SPEED	CALC	
	CURRENT CONTROL			
33	CURRENT LIMIT	0-RATING	2X P92	
34	REGEN RESISTANCE (OHMS) 0 = NO REGEN, 1 = FULL REGEN (MULTI-AXIS)	0-127	0	
35	REGEN RESISTOR POWER (WATTS)	0-9999	300	
36	TORQUE RATE LIMIT (mSEC)	0-9999	0	
	KEYPAD			
37	KEYPAD CONTROL Control Modes 0 1 2 3 4 5 6 7 8 9 Control Functions ● ● ● ● ● ● Jog Forward ● ● ● ● Jog Reverse ● ● ● ● ● Run Forward ● ● Run Reverse ● ● ● ● ● ● ● ● Stop ● = Active		0	
38	KEYPAD SPEED CONTROL Speed Modes 0 1 2 3 4 5 Active Function ● ● Increment (@ Acc / Dec) ● ● Entered Speed ● ● Preset Speed ● ● ● Regen to Stop (off = Coast) ● = Active		0	
	SECURITY CONTROL SETTINGS			
39	SECURITY CONTROL 0 = NO SECURITY CODE 1 = SECURITY CODE -- KEYPAD & SERIAL 2 = SECURITY CODE -- KEYPAD ONLY 3 = SECURITY CODE -- SERIAL ONLY		0	
	SERIAL PORT			
40	BAUD RATE (FOR SERIAL COMMAND) 0 = 1200 4 = 19,200 1 = 2400 2 = 4800 3 = 9600		3	
41	DRIVE ADDRESS (1 - 31 FOR MULTI-DROP SYSTEMS)		0	

P #	DESCRIPTION	RANGE	FACTORY PRESET	SETTINGS
	FAULT RESET			
42	AUTO FAULT RESET (FAULTS / HR)	0-5	0	
43	AUTO RESET DELAY TIME (SECONDS)	0-120	0	
44	POWER LOSS RESET 0 = OFF, 1 = ON		0	
	I/O PARAMETERS			
50	SPEED INPUT SELECTION 0 = SPEED POT OR 0 - 10V (J1-1 TO J1-2) 1 = ±10V 2 = ±5V 3 = 4-20mA 4 = ±10V w/ 0-5V Aux torque limit		0	
51	ANALOG INPUT DEADBAND FOR ZERO SPEED COMMAND (RPM)	0-127	0	
53	AUXILIARY ANALOG INPUT PROPORTIONAL GAIN	0-200	CALC	
54	AUXILIARY ANALOG INPUT INTEGRAL GAIN	0-9999	0	
55	ENABLE POLARITY 0 = OPEN TO STOP, 1 = CLOSE TO STOP		0	
56 57	SELECTION FOR USER D/A #1 (J1-6) SELECTION FOR USER D/A #2 (J1-7) 0 = SPEED 1 = ABS TORQUE 2 = SPEED COMMAND 3 = VOLTS DC 4 = FLUX 5 = FLUX COMMAND 6 = LOAD 7 = LOAD COMMAND 8 = CURRENT 9 = LOAD I 10 = VOLTS QUADRATURE 11 = VOLTS DIRECT 12 = VOLTS AC 13 = VOLTS BUS (900 series only) 14 = TORQUE 15 = POWER 16 = VELOCITY 17 = OVERLOAD 18 = CURRENT PHASE 2 19 = CURRENT PHASE 3 20 = POSITION		0 8	
58 59 60 61	SELECTION FOR OPTO OUTPUT #1 (J1-19) SELECTION FOR OPTO OUTPUT #2 (J1-20) SELECTION FOR OPTO OUTPUT #3 (J1-21) SELECTION FOR OPTO OUTPUT #4 (J1-22) 0 = READY 1 = ZERO SPEED 2 = AT SPEED 3 = OVERLOAD 4 = KEYPAD CONTROL 5 = SET SPEED 6 = FAULT 7 = FOLLOWING ERROR 8 = N/A 9 = DRIVE ON 10 = DIRECTION FLAG 11 = AT POSITION		0 1 2 11	
	I/O THRESHOLD PARAMETERS (FOR OPTO OUTPUTS)			
62	ZERO SPEED TOLERANCE (RPM)	0-127		
63	AT SPEED TOLERANCE (%)	0-100		
64	POSITION TOLERANCE (ENCODER COUNTS)	0-9999	CALC	
65	SET SPEED (RPM)	0-9999	P93	

P #	DESCRIPTION	RANGE	FACTORY PRESET	SETTINGS
	FLUX VECTOR CONTROL PARAMETERS			
70	ENCODER FILTER 0 = NO FILTER, 7 = MAX FILTER	0-7	CALC	
71	ENCODER ALIGNMENT DIRECTION (0 OR 1)		1	
72	FLUX (NO LOAD, IDLE) CURRENT (AMPS RMS)	0-CUR. LIMIT	CALC	
73	CURRENT CONTROLLER PROPORTIONAL GAIN	0-200	20	
74	CURRENT CONTROLLER INTEGRAL GAIN (Hz)	0-99	50	
75	SPEED CONTROLLER PROPORTIONAL GAIN	0-200	10	
76	SPEED CONTROLLER INTEGRAL GAIN (Hz)	0-999	1	
77	SPEED CONTROLLER DIFFERENTIAL GAIN	0-100	0	
78	SLIP FREQUENCY (Hz)	0-10	CALC	
79	POSITION LOOP GAIN	0-9999	CALC	
80	PROTECTIVE FEATURE Feature Number 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 Additional Fault Overload (off = foldback) Following Error Torque Proving External Temp ● = Fault Active		0	
81	NUMBER OF PARALLEL CONTROLLERS (1 STANDARD)	1-5	1	
82	PWM RIPPLE FREQUENCY (KHZ) (.1 KHZ INCREMENTS) (REFER TO SPECIFICATIONS, CH 1, FOR MAX RATING)	2.0 - RATING	RATED PWM	
	SETUP			
90	OPERATING MODE (See Manual) 0 = STANDARD RUN 1 = PLC INTERFACE 2 = ANALOG INPUT SPEED OR TORQUE CONTROLLER 3 = SERIAL CONTROL 4 = APPLICATION SPECIFIC		0	
91	MOTOR RATED VOLTAGE (VOLTS RMS)	0-9999		
92	MOTOR RATED CURRENT (AMPS RMS)	0-9999		
93	MOTOR "RATED" OR "BASE" SPEED (RPM)	0-32767		
94	MOTOR "RATED" OR "BASE" FREQUENCY (Hz)	0-9999		
95	ENCODER LINES PER REVOLUTION	0-32767	1024	
99	CALCULATE DEFAULTS & CLEAR FAULT LOG (ENTER 1)			
100	AUTO TUNING (DRIVE DISABLED TO ENTER) ALL = RUN ALL TESTS AU01 = COMMAND OFFSET TRIM AU02 = CURRENT LOOP COMPENSATION AU03 = FLUX (EXCITATION) CURRENT SETTING AU04 = ENCODER TESTS AU05 = SLIP FREQUENCY TEST AU06 = SPEED CONTROLER CALCULATION			
101	SECURITY CODE	0-9999	9999	

P #	DESCRIPTION	RANGE	FACTORY PRESET	SETTINGS
103	VIEW SOFTWARE VERSION			
105	TEST POINT VARIABLE CHANNEL 1	0-20		
106	TEST POINT VARIABLE CHANNEL 2	0-20		

Appendix E
Serial Command Quick List

COMMAND (CASE SENSITIVE)	DESCRIPTION	RANGE
	NON-PROTECTED COMMANDS	
Ax	ADDRESS (MULTI-DROP SYSTEMS ONLY)	x = 0 - 32
AA	ADDRESS ALL (MULTI-DROP SYSTEMS ONLY)	
ECHO_ON	TURN ON CHARACTER ECHO	
ECHO_OFF	TURN OFF CHARACTER ECHO	
L	FAULT LOG (LAST 15 FAULT CODES)	
ST	DRIVE STATUS (0 = DISABLED, 1 = ENABLED, 2 = FAULT)	
STATUS	FULL DRIVE STATUS	
ID	POWER BASE ID	
IO	J1 CONNECTION STATUS	
F	RETURN CURRENT FAULT CODE (0 = NO FAULT EXISTS)	
Ox	REPORT OUTPUT VARIABLES (x IS OPTIONAL)	x = 1 - 7
TP	RETURN CAPTURED TEST POINTS	
SCxxxx	SECURITY CODE	x = 0 - 9999
	SECURITY PROTECTED COMMANDS (ALL COMMANDS AFTER THIS LEVEL ARE AFFECTED)	
UL	UPLOAD PARAMETER FILE (DISK TO CONTROL BOARD)	
DL	DOWNLOAD PARAMETER FILE (CONTROL BOARD TO DISK)	
C	CLEAR FAULT (RESET)	
Pxxx or Pxxx nnnn	CHANGE / VIEW PARAMETER (P WILL SHOW ALL PARAMETERS)	xxx = 0 - 999 nnnn = 0 - 9999
L_ON	SERIAL LOCAL CONTROL ON	
L_OFF	SERIAL LOCAL CONTROL OFF	
	LOCAL MODE COMMANDS (ALL COMMANDS AFTER THIS LEVEL ARE AFFECTED)	
AUx	AUTO TUNE	x = 1 - 6
AU_ALL	RUN ALL TUNING TESTS	
H	HOME (NOT TO BE USED WITH POSITIONING COMMANDS)	
V OR Vxxxx	VELOCITY COMMAND (V+ OR V- CHANGES DIRECTION ONLY)	xxxx = 0 - MAX SPEED (RPM)
T OR Txxxx	TORQUE COMMAND (T+ OR T- CHANGES DIRECTION ONLY)	xxxx = 0 - 2048
E	ENABLE	
D	DISABLE	
Jx	JOG COMMAND	x = +, -, S

COMMAND (CASE SENSITIVE)	DESCRIPTION	RANGE
S	ALL STOP	
TAR Xxxxx	TARGET REGISTER	Xxxxx IS ANY COMMAND
GO	EXECUTE TARGET COMMAND	
	POSITIONING COMMANDS	
M OR Mxxxxx	ABSOLUTE POSITION COMMAND (ENCODER COUNTS X 4)	
m OR mxxxxx	RELATIVE POSITION COMMAND (ENCODER COUNTS X 4)	
vxxxx	POSITIONING SPEED (RPM)	xxxx = 0 - 9999
W	POSITION COMMAND TO ZERO	
Z	SET CURRENT POSITION TO ZERO	

Appendix F
Recommended Tightening Torques

RECOMMENDED TIGHTENING TORQUES FOR TERMINAL BLOCKS

FOR A & B SIZE, AC SINGLE AXIS POWER BASES
(Use copper or aluminum conductors rated 75C or higher. External or remote overload protection must be provided in accordance with the "National Electrical Code" or the like.)

POWER BASE	TERM. BLOCK	CUSTOMER SELECTED AWG WIRE SIZE			
PART NO.	COLOR	UP TO #10 AWG	UP TO #8 AWG	UP TO #4 AWG	UP TO 2/0 AWG
0712016-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0712026-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0712033-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0712036-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0712043-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0712046-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0713006-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0713016-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0713026-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0713036-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0713046-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0714006-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0714016-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0714026-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0714036-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0714046-XXXX	BLACK	20 IN/lb 2.3NM	25 IN/lb 2.8NM	35 IN/lb 4.0NM	
0712060-XXXX	WHITE		20 IN/lb 2.3NM	35 IN/lb 4.0NM	50 IN/lb 5.7NM
0712063-XXXX	WHITE		20 IN/lb 2.3NM	35 IN/lb 4.0NM	50 IN/lb 5.7NM
0713056-XXXX	WHITE		20 IN/lb 2.3NM	35 IN/lb 4.0NM	50 IN/lb 5.7NM
0714056-XXXX	WHITE		20 IN/lb 2.3NM	35 IN/lb 4.0NM	50 IN/lb 5.7NM

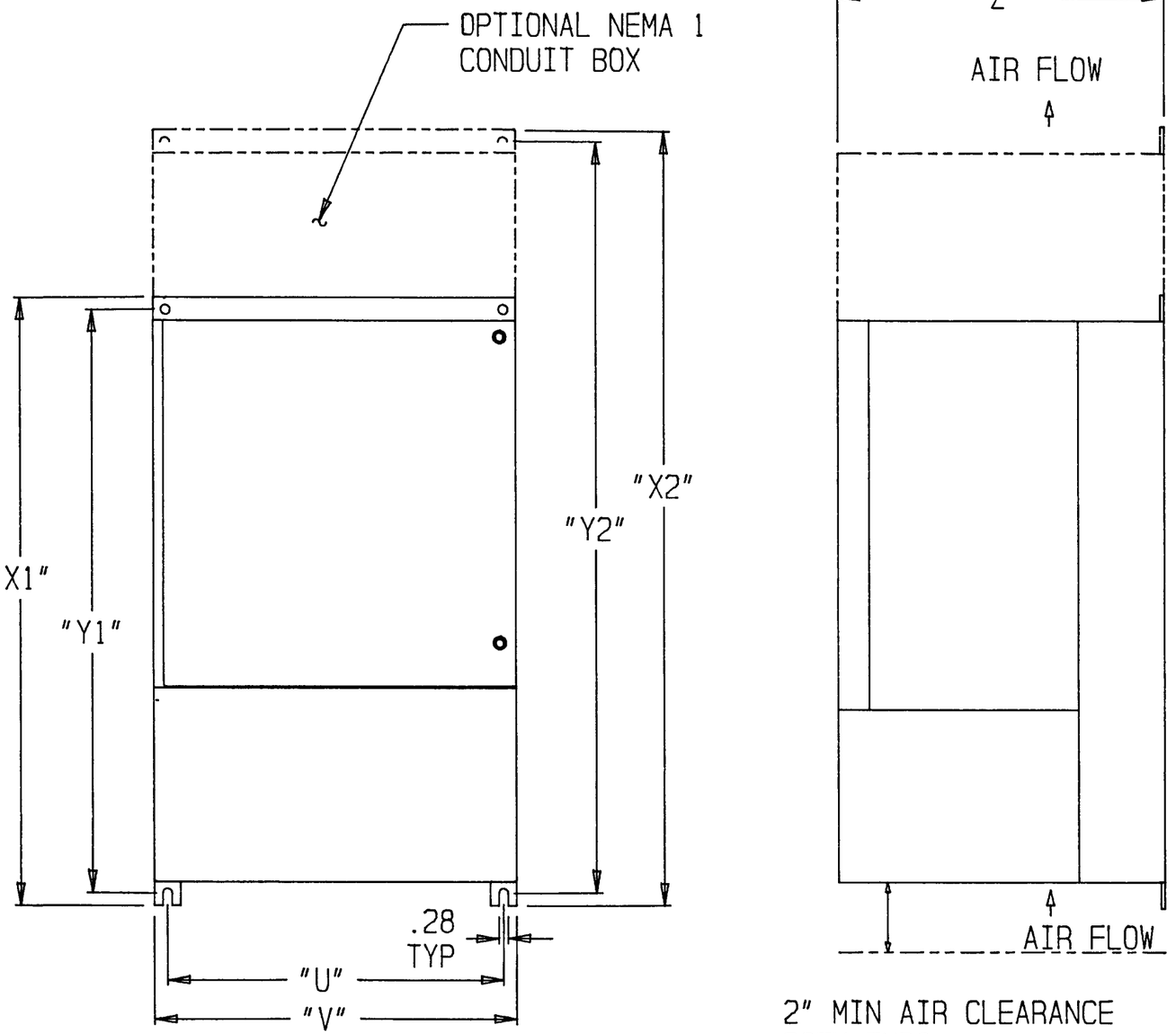
RECOMMENDED TIGHTENING TORQUES FOR TERMINAL BLOCKS

FOR C SIZE, AC SINGLE AXIS POWER BASES

(Use copper or aluminum conductors rated 75C or higher. External or remote overload protection must be provided in accordance with the "National Electrical Code" or the like.)

POWER BASE	TERM. BLOCK	DRIVE TERMINALS AND MAXIMUM WIRE SIZE PER TERMINAL	
PART NO.	COLOR	R1, R2 UP TO 2 AWG	L1-L3, T1-T3 UP TO 3/0 AWG
0712076-XXXX	GRAY	39 IN/lb 4.5NM	52 IN/lb 6NM
0712086-XXXX	GRAY	39 IN/lb 4.5NM	52 IN/lb 6NM
0713066-XXXX	GRAY	39 IN/lb 4.5NM	52 IN/lb 6NM
0713076-XXXX	GRAY	39 IN/lb 4.5NM	52 IN/lb 6NM
0714066-XXXX	GRAY	39 IN/lb 4.5NM	52 IN/lb 6NM
0714075-XXXX	GRAY	39 IN/lb 4.5NM	52 IN/lb 6NM
0714076-XXXX	GRAY	39 IN/lb 4.5NM	52 IN/lb 6NM

REVISIONS				
LTR.	DESCRIPTION	DR.	CHK.	DATE



2" MIN AIR CLEARANCE
BOTH ENDS

SIZE	"U"	"V"	"Z"	"X1"	"Y1"	"X2"	"Y2"
A	10.25 (26,0)	11.00 (28,0)	10.00 (25,4)	18.50 (47,0)	17.75 (45,1)	23.50 (59,7)	22.75 (57,8)
B	10.25 (26,0)	11.00 (28,0)	10.00 (25,4)	22.50 (51,2)	21.75 (55,2)	27.50 (69,9)	26.75 (69,8)
C	13.00 (33,0)	14.50 (36,8)	11.00 (28,0)	41.00 (104,2)	40.00 (101,6)	50.50 (128,3)	49.50 (125,7)

B-0022

DIMENSIONS IN INCHES (CM)

APPLICATION / NEXT ASSEMBLY	DASH NO.	CONTRACT NO.	
PREPARED D. ROUSSEAU	DATE	BALDOR SWEODRIVE	
CHECKED	DATE	OUTLINE AND MOUNTING BALDOR/SWEO SERIES 700 CONTROLLER WITH AND WITHOUT NEMA 1 CONDUIT BOX	
APPD.	DATE	SIZE D	PROJ NO. 4S586
APPD.	DWG	B-0022	
		SCALE 1X	SHEET 1 OF 1

REVISIONS					
LTR	DESCRIPTION	DOC. CONT.	DR.	CHK	DATE
H	ADDED CHASSIS GROUND SYMBOL.	JK	MB	SLB	12 MAY 92

REVISIONS					
LTR	DESCRIPTION	DOC. CONT.	DR.	CHK.	DATE
A	DELETED J6 & J2 ON A1 CONTROL BOARD CONNECTED PINS 11 & 13 ON A3 PWR SUPPLY		BJ		2 -
B	A4J2-2 WAS BLU		DK		MAR 8
C	DWG CLARIFICATION OF CONNECTORS ON A3		AK	RLD	5/10/88
D	ADDED J2 TO A1 CONTRL BOARD; ADDED WHT WIRE FROM A1J3-1 TO A3J3-14; ADDED FLAG NOTE 1 AND CALLOUT.		AK	TL	5/3/89
E	R1 WAS 13.7Ω 55W		DR	WG	13 FEB 91
F	REVISED LOGO		DR	WG	9 MAY 6/27/91
G	REVISED TWISTED TRIPLE WIRE COLORS FROM GRN,RED,WHT TO GRA,ORN, VIO. ADDED WIRES FROM A3J3-3 & A3J3-4 TO FAN 2. DELETED WIRES FROM FAN 1 TO A3J2-7 & A3J2-10	JK	MB	SLB	8APR92

TB1
D1/1N5626
REGENERATIVE LOAD RESISTOR
R1
R2
BLK
RED
230VAC 1 PHASE OR 3 PHASE 60 Hz
L1
L2
L3
R5 2.43K 60W
GND
CHASSIS
BR+
BR-
BR1
L1
A6 SNUBBER
FNM2 TYP
F1
F2
WP2
RV1
J1
R2 68
C2 .1
R1 47 2W
C1 .068 800V
WP1
2400uf 450V 3 PLCS
C1
C2
C3
RED R1 GRA 27.4Ω 110W
VIO
ORN
Q4
R4 22 2W
GRA
BLK
Q5
G
FAN 1
FAN 2 (OPTION)
(+)BUS
(-)BUS
A5 BASE DRIVE #1
A6 BASE DRIVE #2
A7 BASE DRIVE #3
P
RED
BLU
J2
J1
ORN
YEL
BLU
BLK
RED
C1
B1
E1/C2
B2
E2
WHT
Q1 UPPER
Q1 LOWER
Q2 UPPER
Q2 LOWER
Q3 UPPER
Q3 LOWER
TS1
GRA
BRN
HEAT SINK TEMP SWITCH
R3
R2
TB1
T3
T2
T1
BLU
BLK
BRN
ORN
YEL
GRA
VIO
WHT
T
P
1 4 7 10 13
J2
1 2 3 6 9
J1
A3
POWER SUPPLY
J3
1 RED
2 BLU
3 BLK
4 RED
5 RED
6 ORN
7 YEL
8 BLU
9 VIO
10 BLK
12 BRN
11 YEL
13
14 WHT
J4
1 2
AUX 50 VAC
50 VAC
27KHz
ORN WHT BLK BRN RED YEL
1 2 3 4 5 6
J5
GRA BRN ORN RED BLK YEL BLU ORN RED BLK YEL BLU ORN RED BLK YEL BLU
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
J4
TO A5
TO A6
TO A7
A1
CONTROL BOARD
J2
J1
CUSTOMER INTERFACE
1
J3
8 7 6 5 4 3 2 1
RED ORN YEL BLU VIO BLK BRN WHT
RED BLK
BLU
N.C.
A4
MOD/DEMOD
J3
1 2 3 4 5 6
ORN WHT BLK BRN RED YEL

1 J2 MOTOR FEEDBACK CONNECTOR ONLY EXISTS ON SERVO MODELS

APPLICATION		CONTRACT NO.
NEXT ASSEMBLY	DASH NO	

PREPARED	B. J.	DATE 9/10/87
CHECKED	D. W.	DATE 10/15/87
APPD		DATE
DOC CONT.		DATE 4/8/92

BALDOR SWEODRIVE

CONNECTION DIAGRAM 230V A.C. MOTOR CONTROLLER

SIZE	CODE IDENT. NO.		
D	4S586	7143	H

SCALE NONE SHEET 1 OF 1

REVISIONS					
LTR	DESCRIPTION	DOC. CONT.	DR	CHK	DATE
A	A4J2-2 WAS BLU; DWG CLARIFICATION OF CONNECTORS ON A3		BR	RLD	5/10/88
B	ADDED J2 TO A1 CONTROL BOARD; ADDED WHT WIRE FROM A1J3-1 TO A3J3-14; ADDED FLAG NOTE 1 AND CALLOUT.		BJ	TL	5/3/89
C	MOVED POSITION OF C9.		BJ	RLD	10/4/89
D	R1 WAS 27.4Ω 55W		DR	MH	12/20/91
E	REVISED LOGO		DR	CJP	6/27/91
F	REVISED WIRE COLORS: TWISTED TRIPLE FROM GRN, RED, WHT TO GRA, ORN, VIO; ALL OTHER ORG & GRY TO ORN & GRA.	SLB	MB	SLB	2/24/92

REGENERATIVE LOAD RESISTOR

TB1 R1 R2

D1 1N5626 (2 PL) D2

BLK

RED

460VAC 1 OR 3 PHASE 60 Hz

L1 L2 L3

R5 3.65K 60W

GND

CHASSIS

BR1

BR+ L1

BR-

A5 SNUBBER

FNQ2 TYP F1 F2

RV2 RV1

WP2 WP1

R2 68

C2 .1

R1 47 2W

C1 .047 1200V

WHT

G Q5

RED R1 GRY

VIO ORN 47Ω 110W

BLU

Q4

R4 22 2W

GRA BLK

FAN 1

FAN 2 (OPTION)

P

BLK RED

C1 C2 C3 C4 C5 C6

FOR 3 FILTER CAPACITORS IN SERIES

(+)BUS

(-)BUS

A5 BASE DRIVE #1

A6 BASE DRIVE #2

A7 BASE DRIVE #3

J1 J2

C1 B1 B2 E1/C2 E2

WHT RED BLK BLU ORN YEL

Q1 UPPER Q1 LOWER

Q2 UPPER Q2 LOWER

Q3 UPPER Q3 LOWER

R6 1Ω 3W C7.047 1200V

C9

C8 .047 1200V

R7 1Ω 3W

TS1 GRA BRN

HEAT SINK TEMP SWITCH

R3

R2

TB1 T3 T2 T1

BLU BLK BRN ORN YEL

1 4 7 10 13

J2

T GRA ORN VIO BLU RED

1 2 3 6 9

J1

50VAC RMS 27 KHz

A3 POWER SUPPLY

J3

1 RED
2 BLU
3 BLK
4 RED
5 RED
6 ORN
7 YEL
8 BLU
9 VIO
10 BLK
12 BRN
11 YEL
13
14 WHT

J4 1 2

AUX 50VAC

ORN WHT BLK BRN RED YEL

1 2 3 4 5 6

J5

GRA BRN ORN RED BLK YEL BLU ORN RED BLK YEL BLU ORN RED BLK YEL BLU

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

J4

TO A5 TO A6 TO A7

A1 CONTROL BOARD

J2 ⚠1

J1 CUSTOMER INTERFACE

J3

8 7 6 5 4 3 2 1

RED ORN YEL BLU VIO BLK BRN WHT

RED BLK P BLU N.C. RED P

1 2 J2 1 2 3 J1

A4 MOD/DEMOD

J3

1 2 3 4 5 6

ORN WHT BLK BRN RED YEL

⚠1 J2 MOTOR FEEDBACK CONNECTOR ONLY EXISTS ON SERVO MODELS

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

BALDOR SWEODRIVE

CONNECTION DIAGRAM 460V A.C. MOTOR CONTROLLER

SIZE	CODE IDENT NO.		
D	4S586	7148	F

SCALE

SHEET 1 OF 1

REVISIONS					
LTR.	DESCRIPTION	DOC. CONTR.	CHK.	DATE	
A	REVISED DRAWING TO SHOW AS BUILT		DCB	DET	2AUG91
B	UPDATED LOGO		DR	DET	31OCT91
C	ZN (7) ADDED FUSE BLOCK AND FUSES; A3J2-4 WAS CONNECTED TO J3-12,		DR	DET	31OCT91
D	Q7 BASE WIRE COLOR REVISED FROM GRY TO RED. ADDED BREAK LINES TO J1 BLOWER CONNECTION DIAGRAM. ALL BRN WIRES WERE ORG. ALL GRA WIRES WERE GRY.		JRB	SLB	13APR92
E	ADDED CHASSIS GROUND SYMBOL. DELETED ALL BUS BAR DESIGNATIONS.	KL	JRB	WEB	6/4/92

REGENERATIVE LOAD RESISTOR

TB1 R2 R1 D4 #6 #6 #2 L1

208/230VAC 3 PHASE 50/60 Hz

L3 L2 L1 RED RV1 RV2 RV3 D1 D2 D3

R5 2.43K 65W

WHT BLK FU3 FU4 WHT BLK TB BLOWER

GND CHASSIS

TO FUSES 208/230 VAC WHT BLK BLU BRN BLK RED

BLOWER CONNECTION DIAGRAM

FB1 FU1 FU2

A8 SNUBBER J1 WHT RED BLU R1 68 C1 .1 R2 47 2W C2 .068 800V WP1

2900uf 450V 4 PLCS C1 C2 C3 C4

RED R1 R2 GRA 50 Ω 110W 2 PLCS

Q7 Q8

RED BLK WHT

A9 TRANSISTOR RE-GEN BOARD J1

SEE 7626 FOR DETAIL

GRA

T

BLU BLK BRN ORN YEL 1 4 7 10 13 J2

GRA RED WHT BLU RED 1 2 3 6 9 J1

A3 POWER SUPPLY

J3 1 RED 2 BLU 3 4 5 RED 6 ORN 7 YEL 8 BLU 9 VIO 10 BLK 12 BRN 11 YEL 13 14 WHT

J4 1 2 AUX 50 VAC

A5 NEAREST TERMINAL BLOCK BASE DRIVE #1 J2 2 1 P RED BLU

J1 5 4 3 2 1 DRN YEL BLU BLK RED 5

C1 WHT B1 RED E1/C2 BLK B2 RED E2 BLU

(+)BUS (-)BUS

Q2 Q1 CLAMP (+) CLAMP (-)

A6 MIDDLE BASE DRIVE #2 J2 2 1 P RED BLU

J1 5 4 3 2 1 DRN YEL BLU BLK RED 5

C1 WHT B1 RED E1/C2 BLK B2 RED E2 BLU

Q4 Q3 CLAMP (+) CLAMP (-)

A7 NEAREST BLOWER BASE DRIVE #3 J2 2 1 P RED BLU

J1 5 4 3 2 1 DRN YEL BLU BLK RED 5

C1 WHT B1 RED E1/C2 BLK B2 RED E2 BLU

Q6 Q5 CLAMP (+) CLAMP (-)

TS1 GRA BRN HEAT SINK TEMP SWITCH

WHT BRN BLK VIO BLU YEL ORN RED J3 1 2 3 4 5 6 7 8

GRA BRN ORN RED BLK YEL BLU ORN RED BLK YEL BLU ORN RED BLK YEL BLU J4 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 .5 .5 .5

TO A5 TO A6 TO A7

ORN WHT BLK BRN RED YEL J5 1 2 3 4 5 6

A1 CONTROL BOARD

J1 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

TB1 T3 T2 T1 U3 U1

A4 CURRENT SENSOR

J3 1 2 3 4 5 6 DRN WHT YEL BRN RED BLK

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS .xx ±.03 .xxx ±.010 ANGLES ±1/2° MACHINE FINISH DO NOT SCALE DRAWING MATERIAL:

APPLICATION NEXT ASSEMBLY DASH NO.

CONTRACT NO.

PREPARED D. ROUSSEAU DATE 9/10/90

CHECKED 10/N/T DATE 9/15/90

APPD. D. TENINTY DATE 9/15/90

DOC. CONT. K. LONGTHORPE DATE 4/13/92

BALDOR SWEDRIVE

CONNECTION DIAGRAM 230V A.C. MOTOR CONTROLLER EXPANDED HORSEPOWER

SIZE D PSCH NO. 4S586 7633 E

SCALE NONE 7633E SHEET 1 OF 1

REVISIONS					
LTR.	DESCRIPTION	DOC.CONT.	DR.	CHK.	DATE
F	ADDED CHASSIS GROUND SYMBOL. DELETED ALL BUS BAR DESIGNATIONS.	KL	JRB	HEB	6/24/92
G	MIDPOINT CONNECTION BETWEEN CAPS C1-C8 BUSSED TOGETHER. ADDED + TO C1-C8.	KL	JB.	DR	11/18/92

REVISIONS					
LTR	DESCRIPTION	DOC.CONT.	DR.	CHK.	DATE
A	REVISED DRAWING TO SHOW AS BUILT		DCB	DET	2APR91
B	UPDATED LOGO		DR	DET	1JUN91
C	ZN D6,D7: RELOCATED J2-1,R5,D4; DELETED R4; REVISED 2 WIRE COLORS.		JRB	JM	31JULY91
D	ZN C7 ADDED FUSE BLOCK FOR U.L.; A3J2-4 BLK WIRE WAS MOVED FROM D3 - TO TERM ON 7660 BUS BAR		DR	DET	31OCT91
E	ADDED BREAK LINES TO TB1-T1,-T2,-T3. ADDED BLOWER CONNECTION DIAGRAM. ALL BRN WIRES WERE ORG. ALL GRA WIRES WERE GRY.	K L	JRB	SLB	13APR92

TB1
REGENERATIVE LOAD RESISTOR
R2
R1
#6
#6
#2
L1
460VAC 3 PHASE 50/60 Hz
L3
L2
L1
RV1
RV2
RV3
D1
D2
D3
FB1
FU1
FU2
2900uf 450V 8 PLCS
C1
C2
C3
C4
C5
C6
C7
C8
(+)BUS
A8 SNUBBER
R1 68
C1 .1
R2 47 2W
C2 .068 800V
J1
WHT
RED
BLU
4
5
1
WP1
RED
R1
R2
GRA
50 Ω 110W 2 PLCS
D4
D7
D8
G
GND
CHASSIS
WHT
BLK
FU3
FU4
TO FUSES 460 VAC
WHT
BLK
BLU
ORN
BLK
RED
TB
BLOWER
BLOWER CONNECTION DIAGRAM
R5
3.45K 65W
RED
NEAREST TERMINAL BLOCK
A5 BASE DRIVE #1
P
RED
BLU
2
1
J1
C1
B1
WHT
RED
BLK
E1/C2
J2
ORN
YEL
BLU
BLK
RED
5
4
3
2
1
B2
E2
S
Q2
Q1
CLAMP (+)
CLAMP (-)
A6 MIDDLE BASE DRIVE #2
A7 NEAREST BLOWER BASE DRIVE #3
Q4
Q3
Q6
Q5
(-)BUS
TS1
GRA
BRN
HEAT SINK TEMP SWITCH
RED
BLK
WHT
B
E
C
A9 TRANSISTOR RE-GEN BOARD
J1
GRA
SEE 7626 FOR DETAIL
T
TB1
T3
T2
T1
U3
U1
A4 CURRENT SENSOR
J3
1 2 3 4 5 6
ORN
WHT
YEL
BRN
RED
BLK
BLU
BLK
BRN
DRN
YEL
J2
1 4 7 10 13
GRA
RED
WHT
BLU
RED
J1
1 2 3 6 9
P
RED
BLU
1
2
3
4
5
6
7
8
9
10
11
12
13
14
RED
ORN
YEL
BLU
VIO
BLK
BRN
YEL
WHT
A3 POWER SUPPLY
J3
J4
1 2
AUX 50 VAC
WHT BRN BLK VIO BLU YEL ORN RED
1 2 3 4 5 6 7 8
J3
GRA BRN ORN RED BLK YEL BLU DRN RED BLK YEL BLU DRN RED BLK YEL BLU ORN
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
J4
TO A5
TO A6
TO A7
ORN WHT BLK BRN RED YEL
1 2 3 4 5 6
J5
A1 CONTROL BOARD
J1
20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

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

APPLICATION
NEXT ASSEMBLY
DASH NO

CONTRACT NO.

BALDOR SWEODRIVE

PREPARED	D. ROUSSEAU	9/10/90
CHECKED	10-N-T	9/15/90
APPD.	D. TENINTY	9/15/90
DOC CONT	K. LONGTHORPE	4/13/92

CONNECTION DIAGRAM 460V
A.C. MOTOR CONTROLLER
EXPANDED HORSEPOWER

SIZE	PIECE NO.		
D	4S586	7634	G
SCALE NONE	7634G	SHEET 1 OF 1	