BOOK0895-N
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ACX SERIES
AC MOTOR CONTROLLERS

TECHNICAL MANUAL

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ILLUSTRATIONS

STORAGE INSTRUCTIONS

If the ACX controller is not to be installed immediately, it should be stored in a clean, dry location at an ambient temperature between -20°C and +55°C (-4°F and +131°F). The surrounding air must be free of corrosive fumes and electrically conductive contaminants. Care must be taken to prevent condensation from forming within the equipment enclosures during storage. A space heater may have to be installed if condensation or excessive moisture is expected.

Motors, transformers and other electrical equipment may also have storage limitations. Refer to the manuals supplied with this equipment for specific recommendations.

If long term storage or conditions other than covered above are expected, contact the factory.

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NOTICE

Due to periodic engineering design changes to the drive equipment, this manual is provided as a guide only. All drawings contained herein, unless certified, are for reference only. The factory reserves the right to make changes on all products. As a result, this manual is subject to change without notice.

SECTION I

GENERAL DESCRIPTION

The ACX is a general purpose, low cost, AC micro-controller which provides adjustable speed control of conventional AC motors in applications exhibiting a variety of load characteristics. The controller converts the fixed frequency and voltage of the AC line supply to a sine-coded pulse-width-modulated adjustable voltage and frequency output. The power section utilizes Insulated-Gate-Bipolar-Transistors (IGBT's) operating at a fixed carrier frequency, thereby providing high starting torque and cool motor operation.

The design features and programming functions of the ACX, along with its available options, enable the controller to be applied to numerous industrial applications.

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SECTION II

INSTALLATION INSTRUCTIONS

MOUNTING DIMENSIONS

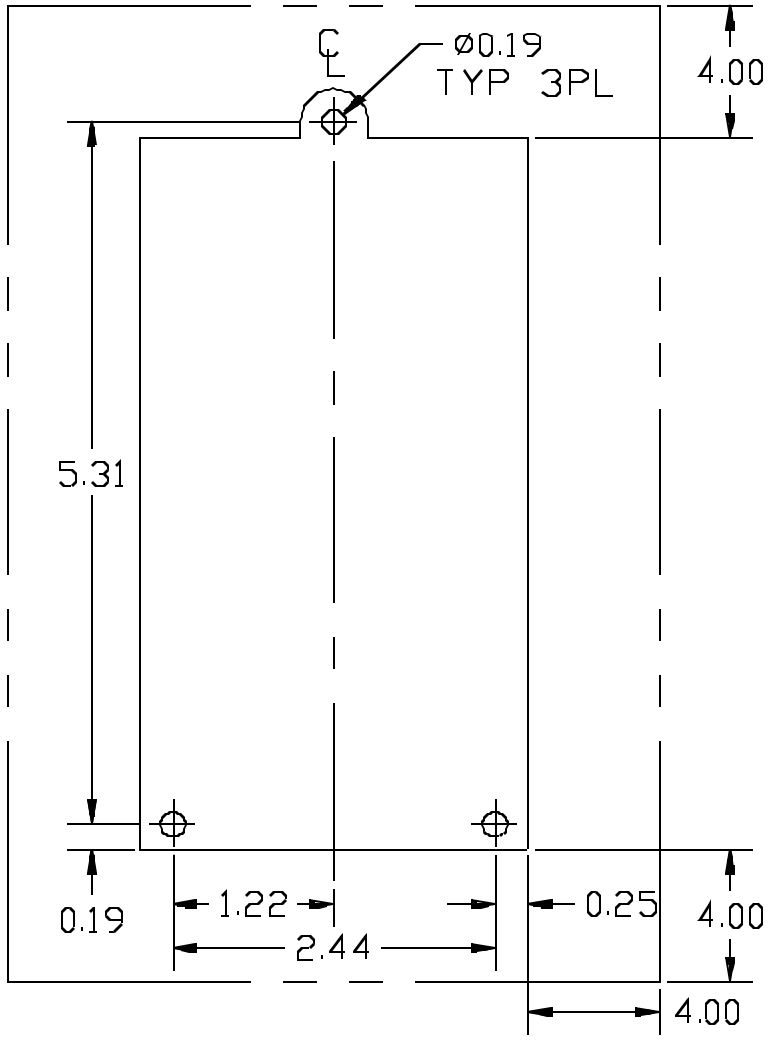
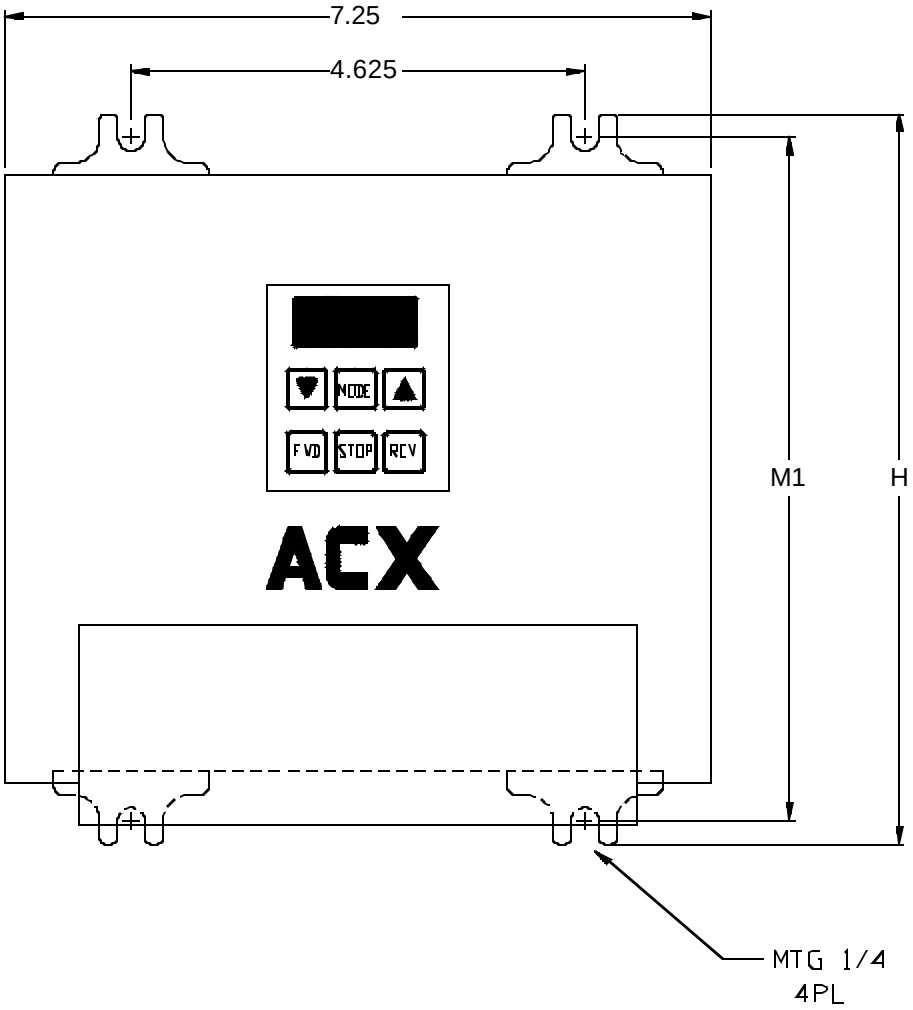
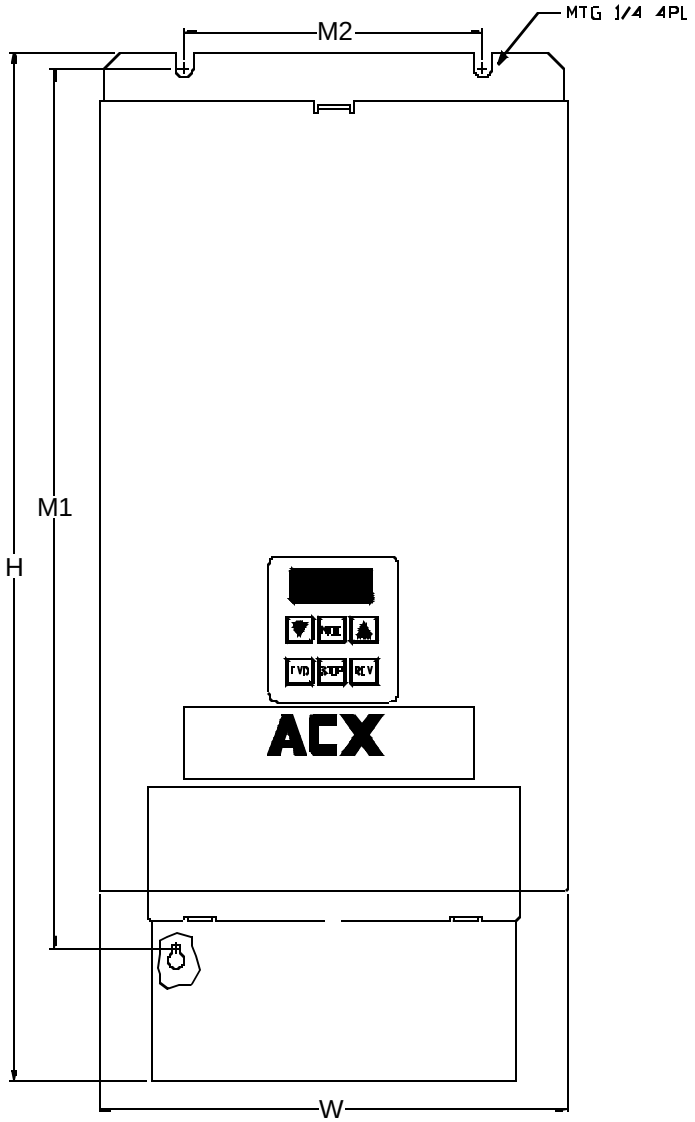


FIGURE 2-1. MOUNTING DIMENSIONS, 1/6 - 1HP, 230V CONTROLLERS



CONTROLLER RATING	DIMENSIONS (Inches)	
	H	M1
1-1/2 - 5HP, 230V 1 - 10HP, 460V	7.50	7.00
7-1/2 - 10HP, 230V 15HP, 460V	12.00	11.50

FIGURE 2-2. MOUNTING DIMENSIONS, 1-1/2 - 10HP, 230V CONTROLLERS AND 1 - 15HP, 460V CONTROLLERS



CONTROLLER RATING	DIMENSIONS (Inches)			
	H	W	M1	M2
15 - 20HP, 230V 20 - 30HP, 460V	15.94	7.25	13.63	4.625
25 - 30HP, 230V	25.31		21.875	
40HP, 460V	22.13		19.63	
50HP, 460V	25.13		22.63	
60 - 75HP, 460V	27.00	14.375	26.25	11.75

FIGURE 2-3. MOUNTING DIMENSIONS, 15 - 30HP, 230V CONTROLLERS AND 20 - 75HP, 460V CONTROLLERS

ACX DIMENSIONS

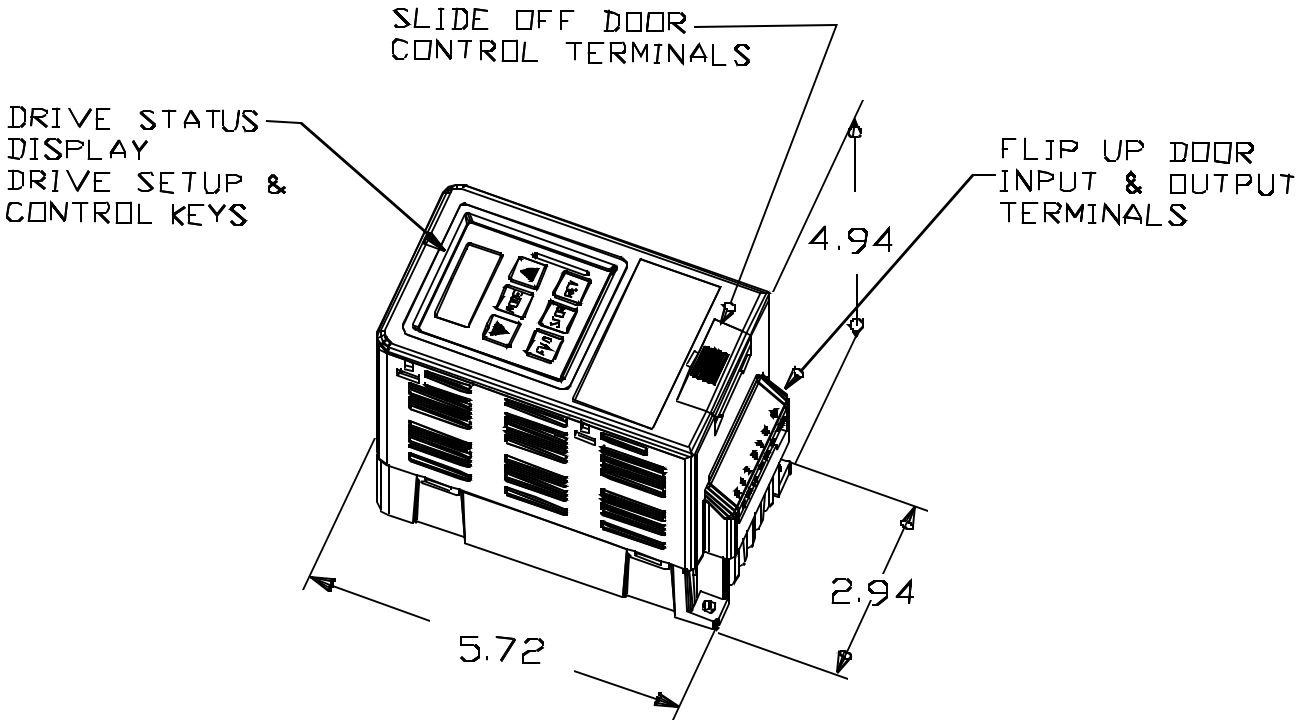
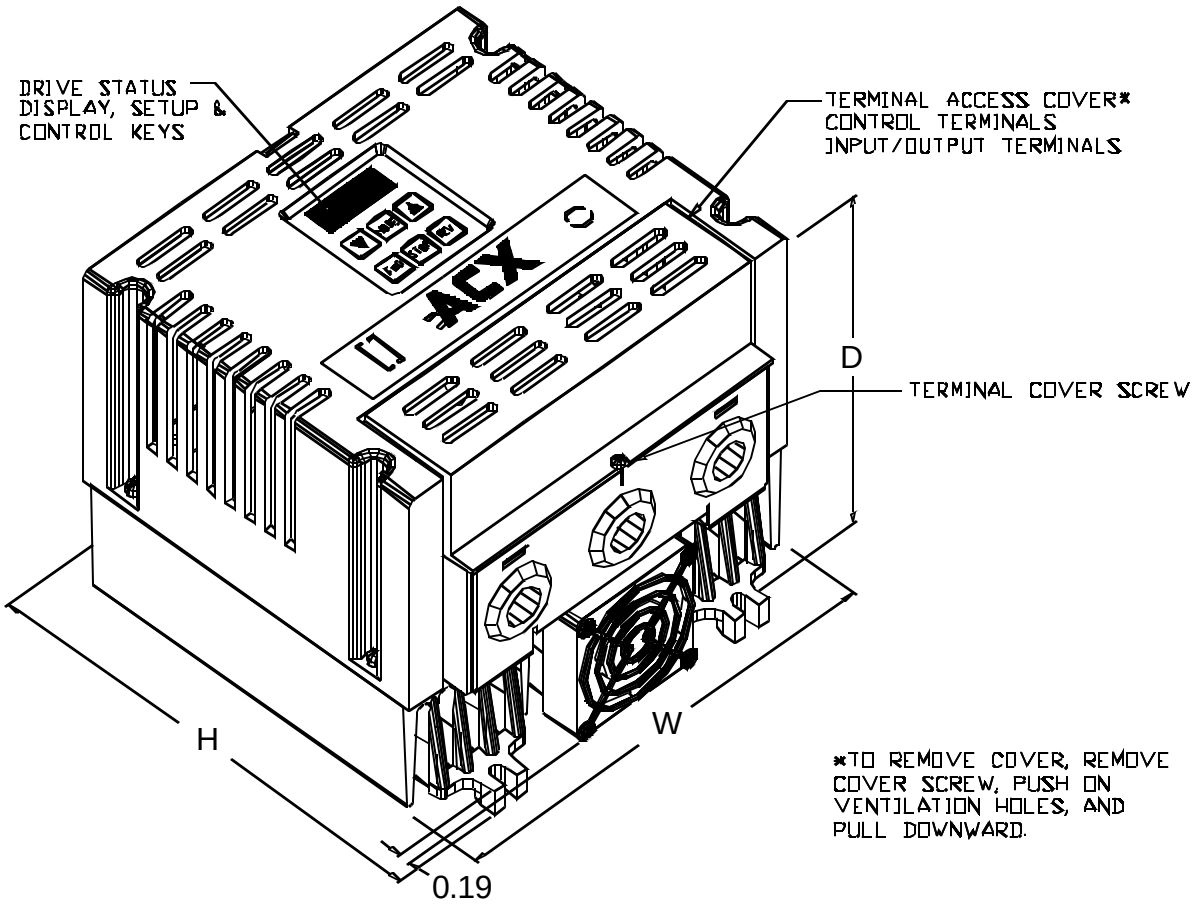
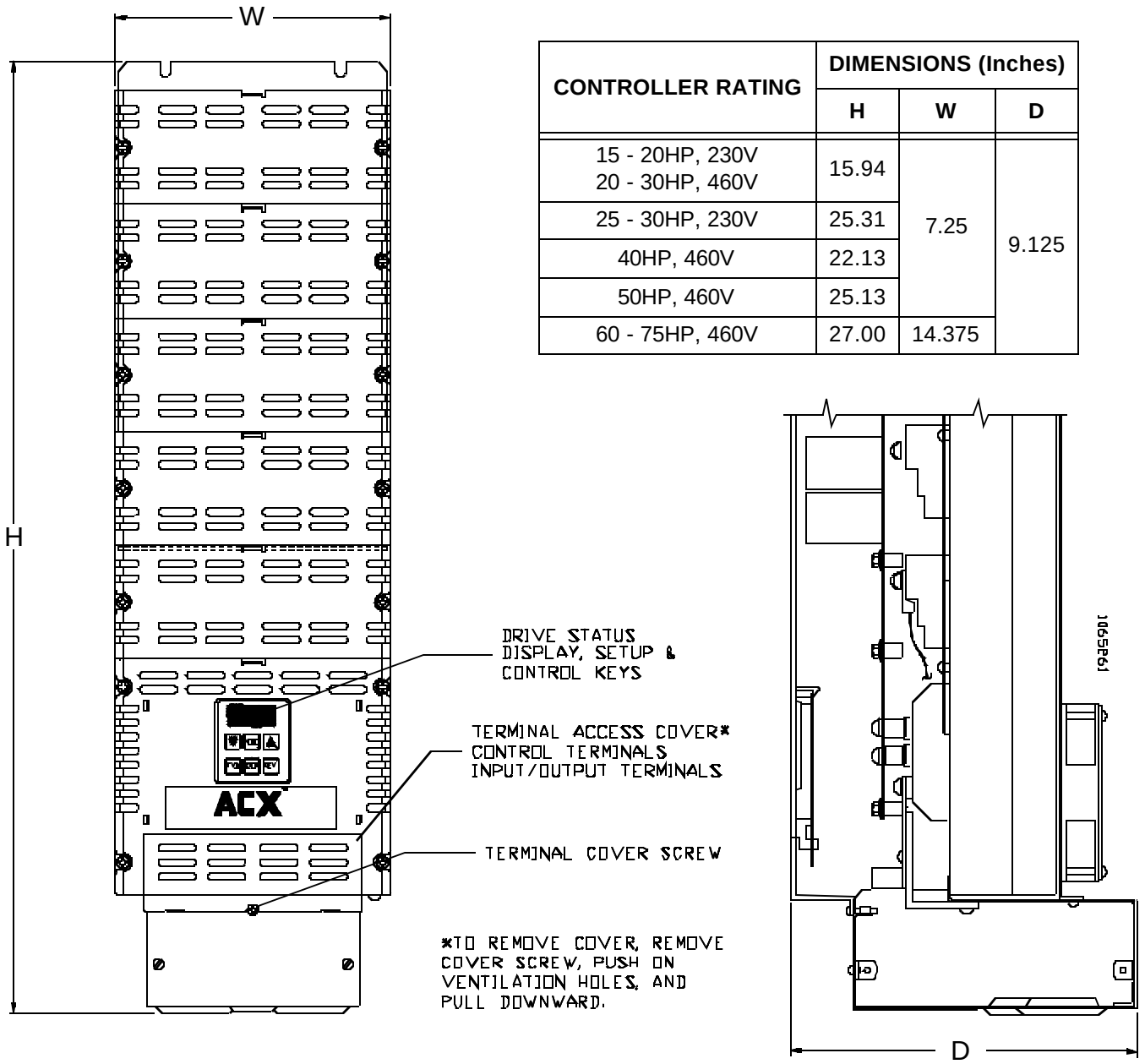


FIGURE 2-4. DIMENSIONS, 1/6 - 1HP, 230V CONTROLLERS



CONTROLLER RATING	DIMENSIONS (Inches)		
	H	W	D
1-1/2 - 5HP, 230V 1 - 10HP, 460V	7.50	7.25	6.25
7-1/2 - 10HP, 230V 15HP, 460V	12.00		

FIGURE 2-5. DIMENSIONS, 1-1/2 - 10HP, 230V CONTROLLERS AND 1 - 15HP, 460V CONTROLLERS



CONTROLLER RATING	DIMENSIONS (Inches)		
	H	W	D
15 - 20HP, 230V 20 - 30HP, 460V	15.94	7.25	9.125
25 - 30HP, 230V	25.31		
40HP, 460V	22.13		
50HP, 460V	25.13		
60 - 75HP, 460V	27.00	14.375	

FIGURE 2-6. DIMENSIONS, 15 - 30HP, 230V CONTROLLERS AND 20 - 75HP, 460V CONTROLLERS

MOUNTING SPECIFICATIONS

Location	Indoor (Protected from Corrosive Gas and Dust)	
Ambient Temperature	32°F to 104°F (0°C to 40°C)	
Humidity	0 - 95% (noncondensing)	
Altitude	3300 feet (1000 meters) above sea level	
Size	1/6 - 1HP, 230V	5.72" (14.53 cm)H x 2.94" (7.47 cm)W x 4.94" (12.55 cm)D
	1-1/2 - 5HP, 230V & 1 - 10HP, 460V	7.50" (19.05 cm)H x 7.25" (18.42 cm)W x 6.25" (15.88cm)D
	7-1/2 - 10HP, 230V & 15HP, 460V	12.00" (30.48 cm)H x 7.25" (18.42 cm)W x 6.25" (15.88cm)D
	15 - 20HP, 230V & 20 - 30HP, 460V	15.94" (40.49 cm)H x 7.25" (18.42 cm)W x 9.125" (23.18 cm)D
	25 - 30HP, 230V	25.31" (64.29 cm)H x 7.25" (18.42 cm)W x 9.125" (23.18 cm)D
	40HP, 460V	22.13" (56.21 cm)H x 7.25" (18.42 cm)W x 9.125" (23.18 cm)D
	50HP, 460V	25.13" (63.83 cm)H x 7.25" (18.42 cm)W x 9.125" (23.18 cm)D
	60 - 75HP, 460V	27.00" (68.58 cm)H x 14.375" (36.51 cm)W x 9.125" (23.18 cm)D
Weight	1/6 - 1HP, 230V	1.75 lbs (0.79 Kg)
	1-1/2 - 5HP, 230V & 1 - 10HP, 460V	5.60 lbs (2.54 Kg)
	7-1/2 - 10HP, 230V	7.20 lbs (3.27 Kg)
	15HP, 460V	12.70 lbs (5.76 Kg)
	15 - 20HP, 230V & 20 - 30HP, 460V	27.00 lbs (12.25 Kg)
	25 - 30HP, 230V	37.00 lbs (16.78 Kg)
	40 - 50HP, 460V	30.00 lbs (13.61 Kg)
	60HP, 460V	60.00 lbs (27.22 Kg)
	75HP, 460V	65.00 lbs (29.48 Kg)
Enclosure	NEMA 1	
Clearance	4" (10.2 cm) around the heat sink	
Orientation	Heat-sink fins vertical	

SAFETY WARNINGS AND CAUTIONS

- You, as the owner or operator of this controller, have the responsibility to have the users of this equipment trained in its operation and warned of any potential hazards which can cause personal injury or loss of life.

- Wait at least 5 minutes before accessing the controller after AC power has been disconnected from the controller. Failure to do this can cause electric shock which can result in personal injury or loss of life.

- Follow all local electrical and safety codes including the National Electrical Code (NEC) and when applicable, the Occupational Safety and Health Act (OSHA). The controller should be installed, adapted and serviced by qualified electrical maintenance personnel familiar with the installation and operation of the equipment and the hazards involved.

- Do not mount the controller on a wall or surface that is combustible. A metal surface is recommended.

- Be sure the AC power source conforms to the requirements of the equipment.

- **CAUTION: Do not wire the AC power leads to the motor connection terminals. This will damage the controller.**

- All wiring should be rated for at least 600 volts. For 1/6 - 2HP, 230V controllers only, leads should be tinned, or UL recognized ferrules similar to Altech Type H2.5/7 Catalog Number 2223.0 should be used. Also for 1/6 - 2HP, 230V controllers, solid wire, maximum wire size 14AWG, 600 volts, may be used. For 3 - 30HP, 230V controllers and 1 - 75HP, 460V controllers, use stranded wire. Maximum wire size and terminal tightening torque for all ACX controller power wiring are shown in the table on page 2-9.

- The motor and controller must be securely and adequately grounded. Connect the green or bare (ground) wire of the line supply to the controller ground connection terminal. For 1/6 - 1HP, 230V controllers, a green ground connection terminal is located beside the power terminals. For 1-1/2 - 30HP, 230V controllers and 1 - 75HP, 460V controllers, two ground connection terminals are located on the conduit entry bracket. For 1/6 - 1HP, 230V controllers, use a lug similar to AMP Part Number 35432 or 324955. For 1-1/2 - 30HP, 230V controllers and 1 - 75HP, 460V controllers, use a lug similar to AMP Part Number 34162 for 16 - 14 AWG wire size or AMP Part Number 322455 for 12 - 10 AWG wire size.

- AC power, motor and control wiring should be run separately from each other.

- The controller should not be connected to a line supply capable of supplying more that 10,000 rms symmetrical amperes.

- If the AC line impedance is low (i.e., the KVA rating of the AC supply is greater than three times the KVA rating of the controller), the optional input line chokes (see page 13-2) should be used.

CONTROLLER RATING		MAXIMUM WIRE SIZE (AWG)	TERMINAL TIGHTENING TORQUE (IN-LBS)
1/6 - 1HP, 230V		14	3.5
1 - 10HP, 460V		14	12
1-1/2 - 2HP, 230V		14	[a]
3HP, 230V		12	3.5
5HP, 230V		10	4.4
7-1/2 - 10HP, 230V	Input	2	16
	Output	8	16
15 & 20HP, 230V	Input	2	50
	Output	2	50
15 & 20HP, 460V		8	16
25 & 30HP, 230V		2	50
25 & 30HP, 460V	Input	2	150[b]
	Output	6	20
40 & 50HP, 460V	Input	1/0	180[b]
	Output	2	50
60 & 75HP, 460V	Input	250MCM	325[b]
	Output	1/0	26.1

a. Spring clamp wire terminals are used instead of screw terminals.
b. Rating based on the use of an external drive wrench.

- Do not operate the controller in an explosive atmosphere or near high capacitive discharge electrical equipment (e.g., electrical welders).
- Keep the controller dry and free of dust, dirt and debris.

CAUTION FOR BYPASS APPLICATIONS

If the ACX is to be used in a Bypass application, never change from the VFD mode to the Bypass mode or from the Bypass mode to the VFD mode while the motor is rotating. Allow at least 4 seconds for the motor to stop before changing modes.

FAILURE TO USE A DELAY BETWEEN MODE CHANGES WILL DAMAGE THE CONTROLLER AND/OR MOTOR.

CE COMPLIANCE REQUIREMENTS

Controllers Rated 1/6 - 5HP @ 230V And 1 - 10HP @ 460V Only

- The environment must comply with Pollution Degree 2. If the environment contains conductive pollution, adequate countermeasures shall be taken. For example, the use of an appropriate enclosure, air ducts, filters, ion exchanger, etc.

- If the controller is to be mounted in a user supplied enclosure, the enclosure must be fitted to provide adequate ventilation, protection from live parts, and it must maintain a minimum of Pollution Degree 2.

- All wiring must comply with Standard EN50178.

POWER WIRING

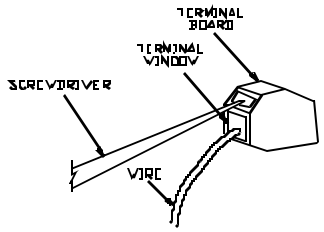
- For 1/6 - 1HP, 230V controllers, terminals are located under the flip-up door (see Figure 2-4 on page 2-4). Terminal legends are located on the door.

- For 1-1/2 - 30HP, 230V controllers and 1 - 75HP, 460V controllers, terminals are located beneath the terminal access cover (see Figure 2-5 (page 2-5) or Figure 2-6 (page 2-6), as applicable). Terminal legends are located on the printed wiring board. Two ground connection terminals are provided on the conduit entry bracket.

- For 208/230 VAC single-phase operation, connect the AC line input to any two of the three input terminals (R [L1] - S [L2] - T [L3]). Refer to "Single-Phase Operation," Section VIII.

- **Review the safety warnings and cautions on pages 2-8 and 2-9.**

- Controllers rated 1-1/2 - 3HP, 230V use screwless input and output terminals. To secure or release a wire, insert a screwdriver into the appropriate slot as shown. Then turn the screwdriver slightly to open the terminal window



- Insulated-Gate-Bipolar-Transistor (IGBT) based Pulse Width Modulation (PWM) drives have better performance than earlier designed AC drives, but also have more high frequency components in the input and output waveforms. As a result, the following power wiring recommendations should be observed to prevent or help minimize problems caused by electrical noise:

  1. Run the line supply and motor wiring in separate conduits.

  2. For installations with multiple controllers, use individual conduit runs for each controller.

  3. For installations with multiple motors, use individual conduit runs for each motor.

  4. Separate the line supply and motor wiring as much as possible within an enclosure.

  5. If the length of wire between the controller and motor exceeds 150 feet, consult the factory.

- The controller uses high speed PWM (Pulse Width Modulation) for efficient motor control at all output frequencies. PWM techniques expose the motor to higher spike voltages than it would experience when operated from commercial power at a fixed speed. These higher spike voltages can cause the motor insulation to break down. The motor's ability to tolerate these voltage peaks is a function of the motor design, including the type of magnet wire, method of winding, and other insulation material characteristics. This phenomenon may be a concern on a 460VAC motor, but is typically less of a concern at 230VAC or below. The voltage spikes tend to be larger for longer length of cable between the controller and motor.

The following guidelines will help minimize or eliminate motor insulation problems:

1. For new installations, specify PWM inverter duty rated motors. These motors have superior insulation systems which will tolerate modest voltage spikes.

2. For retrofit applications where motor leads are less than 150 feet, use optional motor filters connected between the inverter and motor.

3. For all applications where motor leads exceed 150 feet, consult the factory.

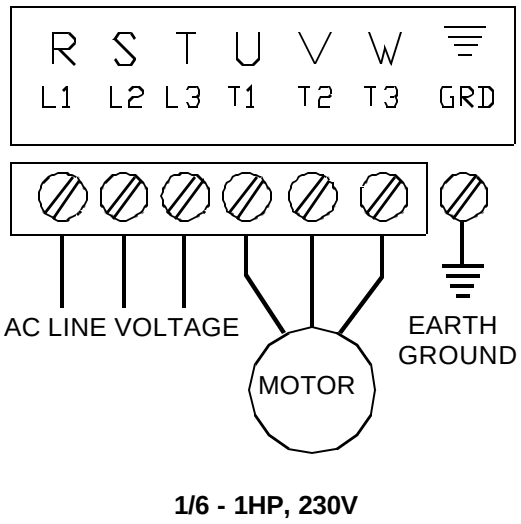
- **CAUTION: Before applying power to the controller for the first time, check the following:**

1. Be sure the AC line supply does not connect to the motor terminals.

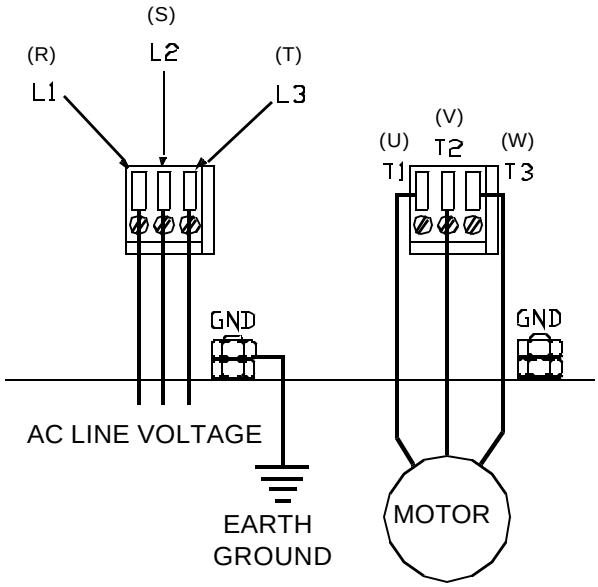
2. Be sure the motor wiring is not grounded. Isolate the motor wiring from the controller and check from each wire to ground with an ohmmeter.

INCORRECT CONNECTIONS OR GROUNDED MOTOR WIRING WILL DAMAGE THE CONTROLLER.

- Connect the power wiring to the controller as shown in Figure 2-7 (below) through Figure 2-10 (page 2-15), as applicable.

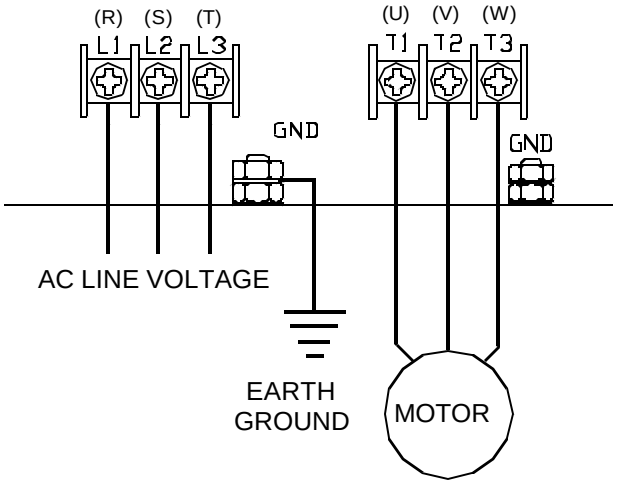


1/6 - 1HP, 230V

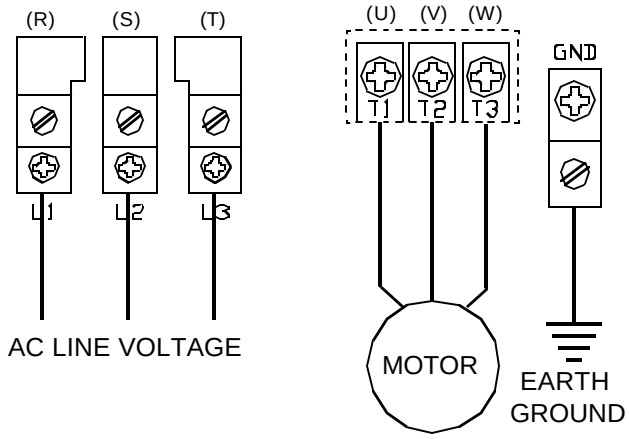


1-1/2 - 3HP, 230V

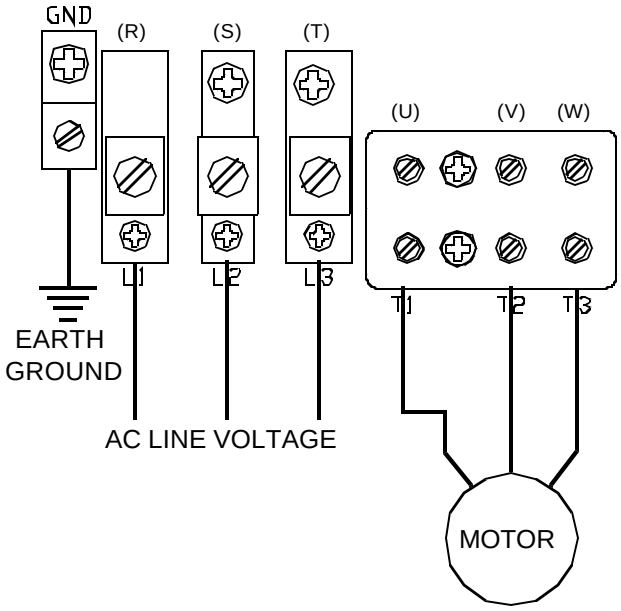
FIGURE 2-7. POWER CONNECTIONS, 1/6 - 3HP, 230V CONTROLLERS



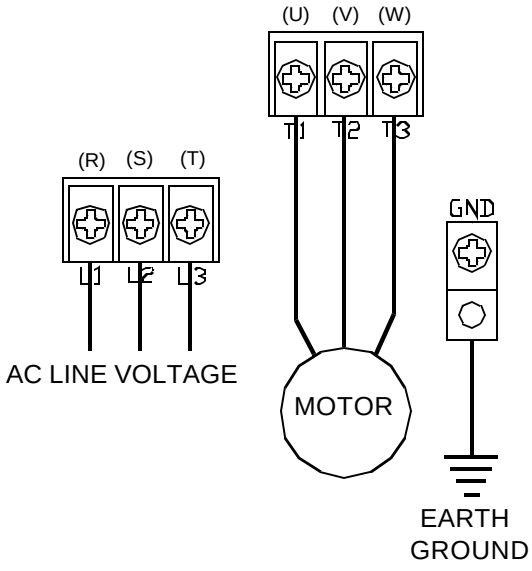
5HP, 230V
1 - 10HP, 460V



7-1/2 - 10HP, 230V

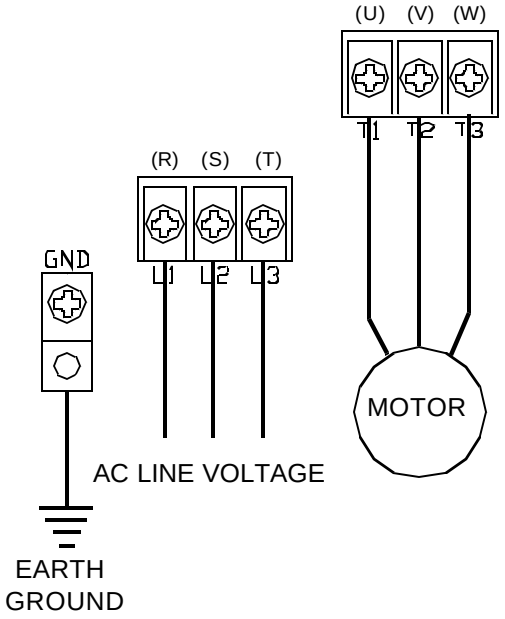


15 - 20HP, 230V

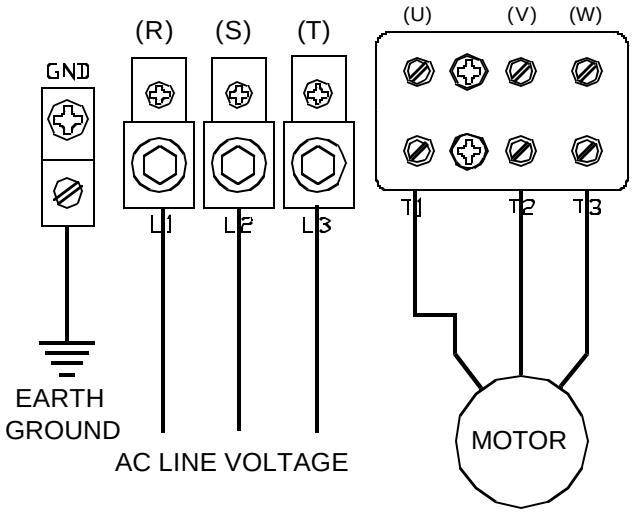


15HP, 460V

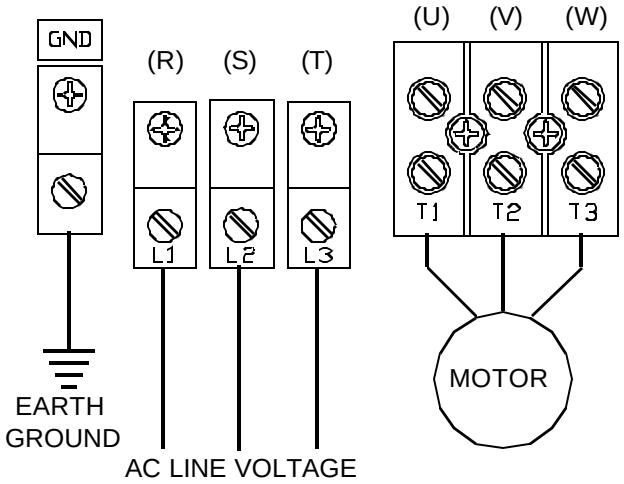
FIGURE 2-8. POWER CONNECTIONS, 5 - 20HP, 230V & 1 - 15HP, 460V CONTROLLERS



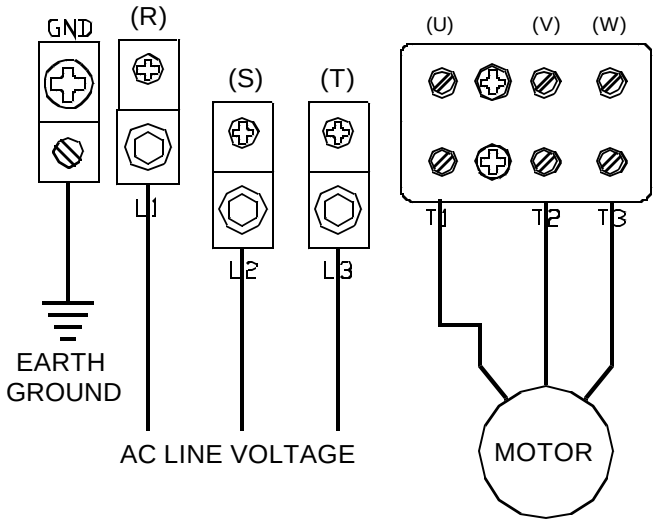
20HP, 460V



25 - 30HP, 230V

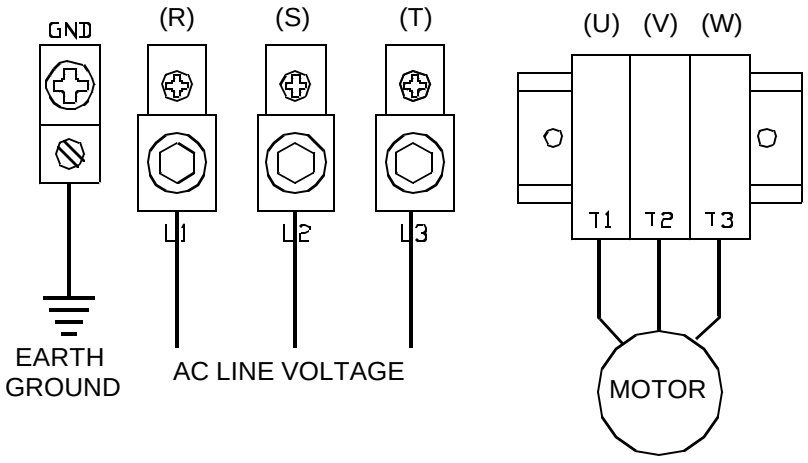


25 - 30HP, 460V



40 - 50HP, 460V

FIGURE 2-9. POWER CONNECTIONS, 25 - 30HP, 230V & 20 - 50HP, 460V CONTROLLERS



60 - 75HP, 460V

FIGURE 2-10. POWER CONNECTIONS, 60 - 75HP, 460V CONTROLLERS

- If the motor rotates in the wrong direction, interchange any two motor leads at the controller.
- For most applications, operation is performed from the controller keypad (see Keypad in Section III). If external connections are required for operation, refer to Control Wiring in Section VII.

CE COMPLIANCE REQUIREMENTS

Controllers Rated 1/6 - 5HP @ 230V And 1 - 10HP @ 460V Only

- Filters must be provided by the user and connected in the input line supply to the controller. The filters must be rated to carry the input amperage rating of the controller. Recommended filters: Schaffner Series FN258 or equivalent. Refer to the following table for Schaffner filter part numbers.

CONTROLLER MODEL	SCHAFFNER FILTER PART NUMBER
ACX2003	FN258-7-29
ACX2010	
ACX4010	
ACX4015	
ACX4020	
ACX4030	
ACX2015	FN258-16-29
ACX2020	
ACX2030	
ACX4050	
ACX2050	FN258-30-33
ACX4075	
ACX4100	

SECTION III

KEYPAD

The membrane keypad consists of six keys and a three-digit, seven-segment LED display. The keys are used for changing operating modes and parameter values[1], and for running the motor.

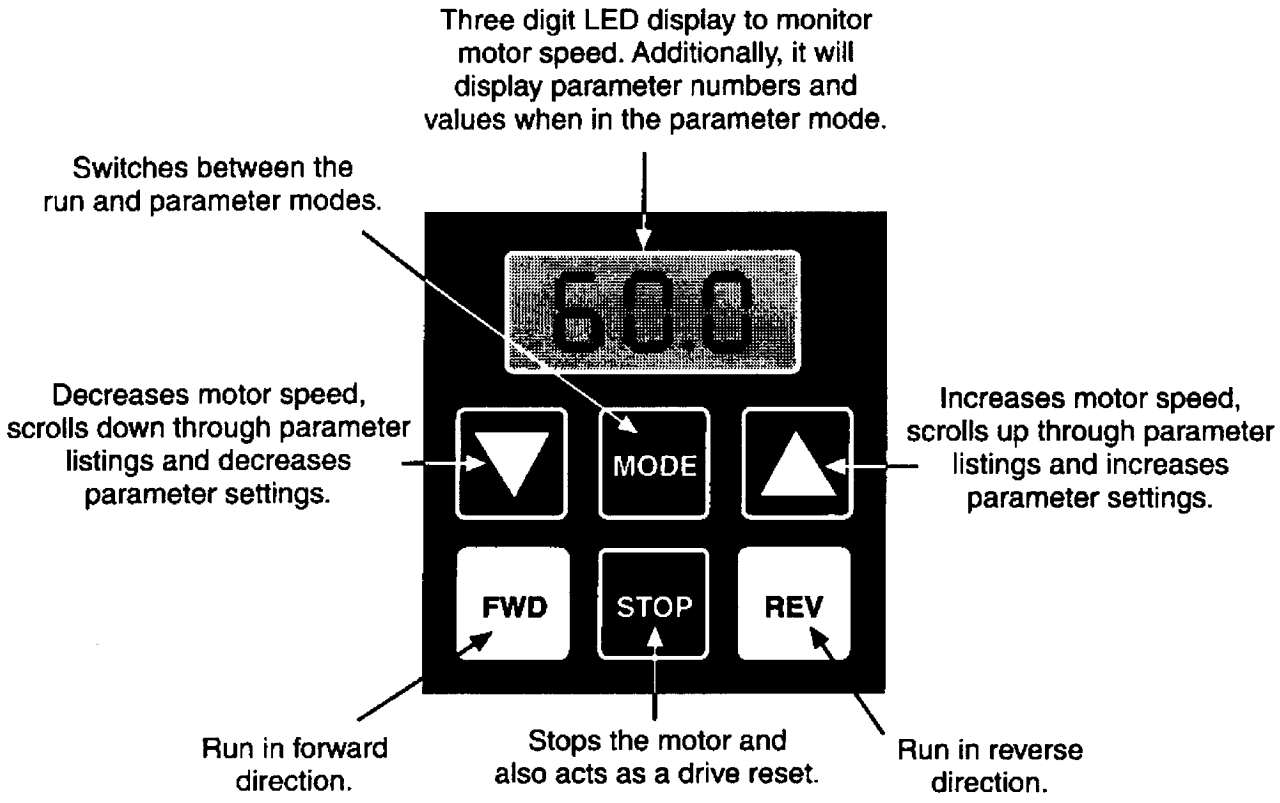


FIGURE 3-1. KEYPAD

On power up, the controller will perform a display lamp test (all LED segments and all decimal points will turn on). After the lamp test, the display will blank momentarily and then display the version number of the software (e.g., 1.10). After the version number is displayed, the Monitor display will appear.

1. Parameter values should only be changed when the controller is in a Stop Mode. Changing parameter values when the controller is in a Run Mode can cause the controller to malfunction.

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SECTION IV

EXPRESS START-UP

Express start-up instructions are for those applications where:

- The user wishes to get the drive running quickly.
- The factory preset parameter values are suitable for the application.

The factory presets will be suitable for most applications, and are shown on page 6-1.

The controller is configured to operate a NEMA design B induction motor for constant torque applications at 60 Hertz (base speed).

1. Mounting the controller
   a. Install in a clean, dry location.
   b. Allow a clearance of 4 inches (10.2 cm) from top, bottom, sides, and front of the controller.
   c. The ambient temperature should not exceed 0°C to 40°C (32°F to 104°F).
2. Wiring the controller
   a. AC power should be turned off.
   b. Observe all national and local electrical codes.
3. Connect the power wiring to the controller terminal strip as shown in Figure 2-7 on page 2-11.
4. Apply power to the controller.
5. The controller factory setting for motor amps should be compared with the motor nameplate amps. The factory setting is based on the maximum capacity of the controller. If a motor is used with a current rating lower than the controller rating, Parameter P06 should be changed to match the motor nameplate current rating. The functional flow chart on page 5-4 shows how to change Parameter P06. **Refer to the CAUTIONS on page 6-1.**
6. After the motor current value has been changed, it must be saved. This is done by changing Parameter P08 from 0. to 1.

7. Press the FWD key on the keypad.

   a. Hold the Up arrow key until the motor begins to rotate.

   b. Check motor rotation for the correct direction.

   c. If motor rotation is not correct, press the STOP key, and remove all power to the controller. Wait five minutes to ensure that the controller capacitors have fully discharged, and then interchange any two motor leads on the controller terminal strip.

   d. Reapply power to the controller, and press the FWD key. Motor rotation should now be correct, and the start-up should be complete.

Note: The factory settings provide for forward operation only. To run reverse, enable the Reverse Mode by setting Parameter P28 to 1.

8. DC injection braking is a standard feature of the ACX controller. However, it must be enabled for activation on start, stop, or start and stop by setting Parameter P17 (on start) and/or Parameter P18 (on stop) to 1. The braking level is set by Parameter P19 and the braking time is set by Parameter P20. Refer to Parameters P17 through P20 on page 6-10.

SECTION V

ACX PROGRAMMING PANEL OPERATION

BASIC CONCEPTS

The ACX programming panel consists of six keys and a three-digit, seven-segment LED display. The six keys are labeled Up, Down, (depicted by arrows in the appropriate direction), MODE, FWD, REV, and STOP. Only the Up, Down, and MODE keys are used to change parameter values.

POWER UP

On power up, the ACX will perform a display lamp test (all LED segments and all decimal points will turn on). After the lamp test, the display will blank momentarily and then display the version number of the software. After the version number is displayed, the ACX will display the Monitor display. The Monitor display can be set by the user to monitor any of the parameters of the ACX drive. The default parameter monitored is motor speed in percent.

OPERATING MODES

The ACX has three operating modes which are selected by pressing the MODE key:

- **Monitor Mode**: Displays a parameter value only (no editing is allowed in this mode).
- **Parameter Selection Mode**: Allows the user to select a parameter to edit.
- **Data Entry Mode**: Allows the user to edit parameter values.

Monitor Mode

The Monitor Mode allows the user to monitor all of the drive parameters and conditions. The Up/ Down arrow keys will function as a digital speed potentiometer, if enabled. The rate at which the run speed command is changed in this mode is controlled by the Acceleration and Deceleration Time parameters.

Parameter Selection Mode

The Parameter Selection Mode is entered from the Monitor Mode by pressing the MODE key once. The LED display will display a “P” followed by a two digit number. The Up/Down arrow keys allow the parameter number to be indexed up or down.

Data Entry Mode

The Data Entry Mode allows parameter values to be edited (i.e., changed by the Up/Down arrow keys). If the parameter can be edited, the decimal point will flash at approximately a one pulse/ second rate. However, editing should be done only when the controller is in a Stop Mode. Editing when the controller is in a Run Mode can cause the controller to malfunction. Editing data is always terminated by pressing the MODE key, which returns the controller to the Monitor Mode. However, if "rSt" appears when the MODE key is pressed, the STOP key should be pressed.

There are four cases where data may not be edited. One is, if the data is Read Only. In this case, the parameter can never be adjusted by the user. The Read Only (RO) parameters are shown in the parameter list table on pages 6-3 and 6-4.

The second case is where operating conditions are such that it is not safe (or technically possible) to allow certain adjustments. For example, changing the maximum output frequency will not be possible (or advisable) while the drive is in a Run Mode. The Run Protected (RP) parameters are shown in the parameter list table on pages 6-2 and 6-3.

The third case when parameter editing may be prohibited is during a fault condition. Certain parameters cannot be changed when the drive is in a fault condition because doing so may destroy information about the state of the drive at the time of the fault. Once the fault condition has been reset (by pressing the STOP key), the parameter may be changed again. The Fault Protected (FP) parameters are shown in the parameter list table on pages 6-2 and 6-3.

The fourth case when parameter editing is not allowed is when password protection is active. The user may, if desired, enter a three digit password in Parameter P99. Once this password is entered in Parameter P99, a matching number must be entered in Parameter P00 before a password protected parameter can be changed. If Parameter P00 does not equal the value in Parameter P99, P99 cannot be viewed on the LED display, thus keeping the password secret. Not all parameters are password protected. For example, the Run Speed (Parameter P01) is not password protected. However, if password protection is desired for all parameters, Parameter P98 can be set to 1. When Parameter P98 is equal to 1 and the password in Parameter P00 does not equal Parameter P99, the only parameter that can be changed is the Password (Parameter P00). To retain the password when line power is removed from the ACX controller, set Parameter P08 to 1. The normal Password Protected (PP) parameters are shown in the parameter list table on pages 6-2, 6-3, and 6-4.

The user will know that editing certain data is not allowed by the function of the keypad panel. When the parameter can be adjusted by the user, the decimal point will flash. For integer or bit parameters, the rightmost decimal point will flash. If the decimal point does not flash, then the drive is either faulted, or the password has not been entered.

RETURNING TO THE MONITOR DISPLAY

When editing is complete, the user will most likely want to return to the monitor display to continue to monitor the selected parameter. To do this, press the MODE key.

PARAMETERS REQUIRING RESET

Certain parameters (such as Maximum Output Frequency) require that the drive be reset before the change in parameter data takes effect. When one of these parameters is edited and the MODE key is pressed to accept the change, the display LEDs will flash "rSt" indicating the drive must be reset (see Drive Reset, below).

SAVING PARAMETER DATA

Any changed parameter value will be valid only as long as power is applied to the ACX controller and the controller is not faulted. To retain parameter values permanently, the values must be saved. To save parameter values permanently, perform the following steps:

1. Change Save Parameters Parameter P08 to 1.

2. Press the MODE key to save parameters.

SPECIAL KEY FUNCTION

One special key function exists in the ACX operating system. If AC power is applied to the controller when the Up/Down arrow keys are pressed, the controller parameters will reset to factory settings.

DRIVE RESET

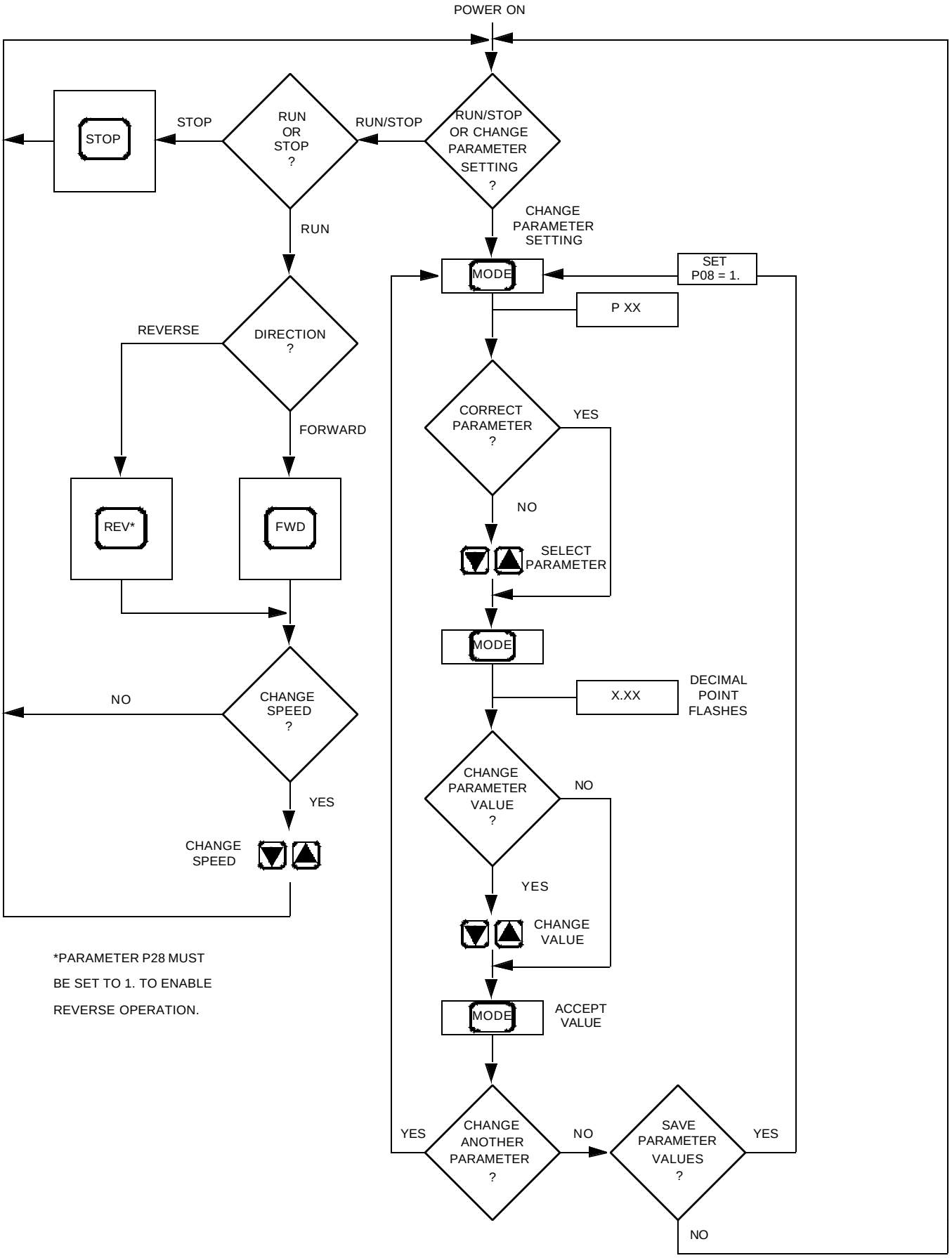
Resetting the ACX drive is required to allow certain parameter changes to take effect (see the ACX Parameter Descriptions for a list of these parameters). Any parameter value changes must be saved to memory (see Saving Parameter Data, above) before performing the reset. The following two methods may be used to reset the drive:

- Remove and reapply AC power to the ACX controller.

- Press the STOP key on the ACX keypad.

  Note: If the drive is in a Run Mode when the STOP key is pressed, wait until the motor stops rotating, and then press the STOP key again. When the STOP key is pressed the second time, the keypad display may either flash "rSt" or go blank for several seconds while the drive resets.

FUNCTIONAL FLOW CHART



SECTION VI

PARAMETERS

SET-UP PARAMETERS

PARAMETER		UNIT	RANGE		FACTORY SETTING	USER SETTING
NO	NAME		MINIMUM	MAXIMUM		
P00	Password Entry	---	000.	999.	000.	
P01	Run Speed Command	%	0.00	100.	0.00	
P02	Minimum Speed	%	0.00	75.0	0.00	
P03	Maximum Speed	%	50.0	100.	100.	
P04	Acceleration Time	Seconds	00.1	999.	10.0	
P05	Deceleration Time	Seconds	00.1	999.	10.0	
P06	Motor Full Load Amps[a]	Amps	[b]	[b]	[b]	
P07	Nominal Line Voltage	Volts	[c]	[c]	[c]	
P08	Save Parameters	---	0.	1.	0.	
P15	Run Speed Source	---	0.	1.	0.	
P28	Reverse Enable	---	0.	1.	0.	
P29	Remote Stop	---	0.	1.	0.	
P30	Remote Maintained Run	---	0.	1.	0.	
P31	Keypad Speed Adjust	---	0.	1.	1.	
P33	Line Starting	---	0.	1.	0.	
P49	Keypad Run Enable[d]	---	0.	1.	1.	
P96	Factory Preset	---	0.	1.	0.	
P99	User Password	---	000.	999.	000.	

a. Parameter P06 is factory preset to the output current rating of the controller (i.e., the motor nameplate current rating). The output current rating is listed on the controller nameplate and in the tables on pages 9-1 and 9-2. If a motor is used with a current rating lower than the output current rating of the controller, Parameter P06 should be changed to match the motor nameplate current rating.

• CAUTION: PARAMETER P06 MUST BE SET TO THE MOTOR NAMEPLATE CURRENT RATING TO ENSURE CORRECT MOTOR PROTECTION AND DRIVE OPERATION. IF P06 IS CHANGED TO A VALUE OUTSIDE THE ACCEPTABLE RANGE FOR A PARTICULAR HORSEPOWER AND VOLTAGE CONTROLLER (SEE THE TABLE ON PAGE 6-6), THE DRIVE WILL MALFUNCTION.

• CAUTION: IF THE CONTROLLER PARAMETERS ARE RESET TO THE FACTORY PRE-SET VALUES BY SETTING PARAMETER P96 TO 1., PARAMETER P06 WILL ALSO RESET TO ITS FACTORY PRESET VALUE.

b. See page 6-6 for Minimum and Maximum Range, and Factory Setting.
c. See page 6-7 for Minimum and Maximum Range, and Factory Setting.
d. Only available in controllers with software version 1.30 or higher.

COMPLETE PARAMETER LIST

SECTION	PARAMETER NUMBER	NAME	RANGE	UNITS	FACTORY SETTING	USER SETTING	REFERENCE PAGE	TYPE
Express Start-Up	P00	Password Entry	0.-999.	No Units	0.		6-5	W
	P01	Run Speed Command	0.00-100.	%	0.00		6-5	FP
	P02	Minimum Speed	0.00-75.0	%	0.00		6-5	FP, PP
	P03	Maximum Speed	50.0-100.	%	100.		6-5	FP, PP
	P04	Acceleration Time	00.1-999.	Seconds	10.0		6-5	FP
	P05	Deceleration Time	00.1-999.	Seconds	10.0		6-5	FP
	P06	Motor Full Load Amps	[a]	Amps	[a]		6-6	W, RR, PP
	P07	Nominal Line Voltage	[b]	Volts	.[b]		6-7	W, RR, PP
	P08	Save Parameters	0.-1.	No Units	0.		6-7	W
High Level Prog.	P09	Current Limit	50.0-200.	%	150.		6-8	FP
	P10	Boost Level	[c]	%	[c]		6-8	FP, PP
	P11	Slip Compensation	0.-100.	%	0.		6-8	FP, PP
	P12	Ramp Type	0.-1.	No Units	0.		6-8	FP
	P13	Analog Input Mode	0.-1.	No Units	0.		6-9	FP, PP
	P14	Analog Input Invert	0.-1.	No Units	0.		6-9	FP, PP
	P15	Run Speed Source	0.-1.	No Units	0.		6-9	RP, PP
	P16	Current Limit Source	0.-1.	No Units	0.		6-9	RP, PP
	P17	DC Injection Braking On Start	0.-1.	No Units	0.		6-10	FP, PP
	P18	DC Injection Braking On Stop	0.-1.	No Units	0.		6-10	FP, PP
	P19	DC Injection Braking Level	[d]	%	[d]		6-10	FP, PP
	P20	DC Injection Braking Time	0.0-25.5	Seconds	0.0		6-10	FP, PP
	P21	Speed Avoidance Band #1	0.00-100.	%	0.00		6-11	FP, PP
	P22	Speed Avoidance Band #1 Width	0.0-20.0	%	0.0		6-11	FP, PP
	P23	Speed Avoidance Band #2	0.00-100.	%	0.00		6-11	FP, PP
	P24	Speed Avoidance Band #2 Width	0.0-20.	%	0.0		6-11	FP, PP
	P25	Speed Avoidance Band #3	0.00-100.	%	0.00		6-11	FP, PP
	P26	Speed Avoidance Band #3 Width	0.0-20.0	%	0.0		6-11	FP, PP
	P27	Forward Enable	0.-1.	No Units	1.		6-11	RP, PP
	P28	Reverse Enable	0.-1.	No Units	0.		6-12	RP, PP
	P29	Remote Stop	0.-1.	No Units	0.		6-12	RP, PP
	P30	Remote Maintained Run	0.-1.	No Units	0.		6-12	RP, PP
	P31	Keypad Speed Adjust	0.-1.	No Units	1.		6-13	W, PP
	P32	Stopping Mode	0.-1.	No Units	0.		6-13	RR, PP
	P33	Line Starting	0.-1.	No Units	0.		6-13	W, RR, PP
	P34	Rotating Motor starting	0.-1.	No Units	0.		6-13	W, RR, PP
	P35	Overload Threshold	50.0-115.[e]	%	115.[f]		6-14	W, RR, PP
	P36	Overload Time	1.-60.	Seconds	60.		6-14	W, RR, PP
(Contd on next page)	P37	Restart Tries	0.-5.	No Units	0.		6-15	FP, RR, PP
	P38	Restart Window	300.-999.	Seconds	300.		6-16	FP, RR, PP

SECTION	PARAMETER NUMBER	NAME	RANGE	UNITS	FACTORY SETTING	USER SETTING	REFERENCE PAGE	TYPE
High Level Prog. (Contd)	P39	Restart Delay	3.-60.[g]	Seconds	5.		6-16	FP, RR, PP
	P40	V/F Profile List	0.-20.	No Units	1.		6-16	W, RR, PP
	P41	Volts Per Hertz	80.0-120.	%	100.		6-17	FP
	P42	Preset Speed Enable	0.-1.	No Units	0.		6-17	RP, PP
	P43	Preset Speed #1	0.00-100.	%	0.00		6-17	FP, PP
	P44	Preset Speed #2	0.00-100.	%	0.00		6-17	FP, PP
	P45	Preset Speed #3	0.00-100.	%	0.00		6-17	FP, PP
	P46[h]	Electronic Braking Enable	0.-1.	No Units	0.		6-18	RP, PP
	P47[i]	Analog Input Offset	(-100.)-(100.)	No Units	0.		6-18	FP, PP
	P48[j]	Analog Input Trim	(-100.)-(100.)	No Units	0.		6-18	FP, PP
	P49[j]	Keypad Run Enable	0.-1.	No Units	1.		6-20	RP, PP
Read Only	P50	Frequency Output	0.00-400.	Hertz			6-20	RO
	P51	Analog Input	0.00-200.	%			6-20	RO
	P52	Speed Command	0.00-100.	%			6-20	RO
	P53	Speed Operator Control	(-100.)-(100.)	%			6-20	RO
	P54	Final Speed Reference	(-100.)-(100.)	%			6-21	RO
	P55	Speed Acceleration/Deceleration	(-100.)-(100.)	%			6-21	RO
	P56	Speed Current Limit Input	(-100.)-(100.)	%			6-21	RO
	P57	Speed Correction	(-100.)-(100.)	%			6-21	RO
	P58	Final Speed Output	(-100.)-(100.)	%			6-21	RO
	P59	Voltage Volts/Hertz Profile	0.00-100.	%			6-21	RO
	P60	Current Error	(-199.)-(199.)	%			6-21	RO
	P61	Motor Voltage	00.0-460.[k]	Volts			6-22	RO
	P62	Bus Voltage	00.0-900.[l]	Volts			6-22	RO
	P63	Filtered Bus Voltage	00.0-815.[m]	Volts			6-22	RO
	P64	Bus Voltage Integrator	(-100.)-(100.)	%			6-22	RO
	P65	Motor Amps	0.00-180.	Amps			6-22	RO
	P66	Filtered Motor Amps	0.00-180.[n]	Amps			6-22	RO
	P67	Current Setpoint	0.00-200.	%			6-22	RO
	P68	Current Limit Integrator	(-199.)-(300.)	%			6-22	RO
	P69	Slip Comp Torque	0.00-100.	%			6-23	RO
	P70	Overload tegrator	0.00-300.	%			6-23	RO
	P71	Overload Trip	0.00-300.	%			6-23	RO
	P72	DC Injection Braking Timer	0.00-327.	%			6-23	RO
	P73	Disable Timer	0.00-327.	%			6-23	RO
	P74	Frequency Scale	0.00-100.	%			6-19	RO
	P75	PWM Frequency	0.00-100.	%			6-23	RO
	P76	PWM Voltage	0.-219.	No Units			6-23	RO
	P77	Speed Search Volts/Hertz	0.00-100.	%			6-24	RO
(Contd on next page)	P78	Speed Search Timer	0.00-327.	%			6-24	RO
	P79	Match Speed	(-100.)-(100.)	%			6-24	RO

SECTION	PARAMETER NUMBER	NAME	RANGE	UNITS	FACTORY SETTING	USER SETTING	REFERENCE PAGE	TYPE
Read Only (Contd)	P80	Fault Code	0.-99.	No Units			6-24	RO
	P81	Start Again Timer	0.00-100.	%			6-24	RO
	P82	Digital Inputs	0.-255.	No Units			6-25	RO
	P83	Digital Input Flags	0.-255.	No Units			6-25	RO
	P84	Logic State	0.-255.	No Units			6-26	RO
	P85	Status 1	0.-255.	No Units			6-26	RO
	P86	Status 2	0.-255.	No Units			6-27	RO
	P87	Flags	0.-255.	No Units			6-27	RO
	P88							FUO
Utility	P94[h]	Starting Delay	0.-1.	No Units	0.		6-28	W
	P95	Monitor Parameter	0.-99.	No Units	58.		6-28	W
	P96	Load Factory Settings	0.-1.	No Units	0.		6-28	W
	P97	Reset Drive	0.-1.	No Units	0.		6-28	W
	P98	Global Password	0.-1.	No Units	0.		6-28	PP
	P99	Set Password	0.-999.	No Units	0.		6-29	W

a. See pages 6-1 and 6-6 for Parameter P06 range and factory setting.
b. See page 6-7 for Parameter P07 range and factory setting.
c. See page 6-8 for Parameter P10 range and factory setting.
d. See page 6-10 for Parameter P19 range and factory setting.
e. With software version 1.35 or lower, the range is 50.0-150.
f. With software version 1.10 through 1.35, the factory setting is 125.
g. With software version 1.30 or lower, the minimum value is 2.
h. Not available with software version 1.00.
i. Available only with software version 1.12 or higher.
j. Available only with software version 1.21 or higher.
k. With software version 1.00, the range is 0.0-230.
l. With software version 1.00, the range is 00.0-500., and with software version 1.11 through 1.35, the range is 00.0-815.
m. With software version 1.00, the range is 0.0-500.
n. With software version 1.00, the range is 0.00-12.8.

W - Write
FP - Fault Protected
RR - Reset Required
RP - Run Protected
PP - Password Protected
FUO - Factory Use Only

PARAMETER DESCRIPTIONS

P00: PASSWORD ENTRY
(No Units, Write)
Minimum Value: 0. Factory Preset Value: 0. Maximum Value: 999.
Used to enter the password which allows Password Protected Parameters to be changed. The Set Password (Parameter P99) allows setting a custom password. Parameter P99 is factory set to 0 (no password required for parameter changes). The password must be 3 digits in length.

P01: RUN SPEED CMD
Run Speed Command
(Percent, Fault Protected)
Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 100.
Sets the Digital Speed Command when the drive is in the Run Mode. The controller is factory set to use the Run Speed Cmd (Parameter P01) as the speed command source.

P02: MINIMUM SPEED[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 75.0
Sets Minimum Speed.

P03: MAXIMUM SPEED[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 50.0 Factory Preset Value: 100. Maximum Value: 100.
Sets Maximum Speed.

P04: ACCELERATION TIME
(Seconds, Fault Protected)
Minimum Value: 00.1 Factory Preset Value: 10.0 Maximum Value: 999.
Sets the amount of time it takes the motor to accelerate from zero speed to 100 percent speed. Parameter P04 also controls the rate at which the speed will change when the keypad is used to increase motor speed.

P05: DECELERATION TIME
(Seconds, Fault Protected)
Minimum Value: 00.1 Factory Preset Value: 10.0 Maximum Value: 999.
Sets the amount of time it takes the motor to decelerate from 100 percent speed to zero speed. Parameter P05 also controls the rate at which the speed will change when the keypad is used to decrease motor speed.

1. If Maximum Speed (Parameter P03) is set lower than Minimum Speed (Parameter P02), maximum speed will override minimum speed.

P06: MOTOR FULL LOAD AMPS

(Amps, Write, Reset Required, Password Protected)

LINE VOLTAGE	HORSEPOWER RANGE	FACTORY PRESET VALUE[a]	MINIMUM VALUE[b]	MAXIMUM VALUE[c]
208/230 VAC	1/3 - 3	3.60	0.60	10.6
	5 - 10	15.2	10.7	30.8
	15 - 25	42.0	30.9	75.2
	30	80.0	75.3	144
460 VAC	1 - 3	1.80	0.60	4.80
	5 - 10	7.60	4.81	14.0
	15 - 25	21.0	14.1	34.0
	30 - 75	40.0	34.1	156

a. With software version 1.35 or lower, Factory Preset Value is 3.60.
b. With software version 1.35 or lower, Minimum Value is 0.60.
c. With software version 1.00, Maximum Value is 3.98, with software version 1.10, Maximum Value is 59.4, with software version 1.11, Maximum Value is 144.9, and with software version 1.12 through 1.35, Maximum Value is 156.

Motor Nameplate Current in Amps. Used to determine how the current feedback will be scaled, and to define the motor full load current. For controllers with software version 1.10 or higher, Parameter P06 also defines the shunt resistors installed for current feedback as shown in the following table. **Parameter P06 must be set to the motor nameplate current rating to ensure correct motor protection and drive operation. If P06 is changed to a value outside the acceptable range for a particular horsepower and voltage controller (see the following table), the drive will malfunction.**

208/230 VAC CONTROLLERS			460 VAC CONTROLLERS		
HORSEPOWER	PARAMETER P06 ACCEPTABLE RANGE	SHUNT RESISTORS	HORSEPOWER	PARAMETER P06 ACCEPTABLE RANGE	SHUNT RESISTORS
0 - 1/3	0.60 - 2.00[a]	(1) 0.10 ohm (R25)	1	0.60 - 1.80	(1) 0.10 ohm (R25)
1/2 - 1	2.01 - 4.00[b]	(2) 0.10 ohm (R25 - R26)	1-1/2	1.81 - 2.60	(1) 0.06 ohm (R25)
1-1/2	4.01 - 5.70	(3) 0.10 ohm (R25 - R27)	2	2.61 - 3.40	(1) 0.06 ohm (R25), (1) 0.20 ohm (R26)
2	5.71 - 7.50	(4) 0.10 ohm (R25 - R28)	3	3.41 - 4.80	(3) 0.10 ohm (R25 - R27)
3	7.51 - 10.6	(3) 0.05 ohm (R26 - R28)[c]	5	4.81 - 7.60	(2) 0.05 ohm (R25 - R26)
3	7.51 - 10.6	(6) 0.10 ohm (R25 - R30)[c]	7-1/2	7.61 - 11.0	(3) 0.05 ohm (R25 - R27)
5	10.7 - 16.8	(4) 0.05 ohm (R25 - R28)	10	11.1 - 14.0	(4) 0.05 ohm (R25 - R28)
7-1/2	16.9 - 24.2	(4) 0.03 ohm (R25 - R28)	15	14.1 - 21.0	(4) 0.03 ohm (R25 - R28)
10	24.3 - 30.8	(5) 0.03 ohm (R25 - R28)	20	21.1 - 27.0	(5) 0.03 ohm (R25 - R29)
15	30.9 - 46.2	(6) 0.02 ohm (R24 - R28, R68)[c]			
15	30.9 - 46.2	(6) 0.02 ohm (R25 - R30)[c]	25	27.1 - 34.0	(6) 0.03 ohm (R24 - R28, R68)
20	46.3 - 59.4	(8) 0.02 ohm (R24 - R28, R68 - R70)[c]	30	34.1 - 40.0	(6) 0.03 ohm (R24 - R28, R68)

208/230 VAC CONTROLLERS			460 VAC CONTROLLERS		
HORSEPOWER	PARAMETER P06 ACCEPTABLE RANGE	SHUNT RESISTORS	HORSEPOWER	PARAMETER P06 ACCEPTABLE RANGE	SHUNT RESISTORS
20	46.3 - 59.4	(8) 0.02 ohm (R25 - R32)[c]	40	40.1 - 52.0	(7) 0.02 ohm (R24 - R28, R68, R108)
25	59.5 - 75.2	(10) 0.02 ohm (R24 - R28, R68 - R72)	50	52.1 - 65.0	(8) 0.02 ohm (R24 - R28, R68, R108, R109)
30	75.3 - 88.5	(12) 0.02 ohm (R24 - R28, R68 - R74)	60	65.1 - 77.0	(10) 0.02 ohm (R24 - R28, R68, R108 - R112)
			75	77.1 - 96.0	(12) 0.02 ohm (R24 - R28, R68, R108 - R114)

a. With software version 1.00, P06 acceptable range is 0.60 - 1.99.
b. With software version 1.00, P06 acceptable range is 2.00 - 3.98.
c. The quantity, value and designations of the shunt resistors in the 3, 15 and 20HP, 230V controllers may vary depending on the version of the controller power board.
d. With software version 1.00, the maximum value is 3.98. With software version 1.10, the maximum value is 59.4, with software v ersion 1.11, the maximum value is 144.9, and with software version 1.12, the maximum value is 156.

For controllers with software version 1.00, if the value of Parameter P06 is less than or equal to 1.99, the current feedback shunt resistor will be assumed to be 0.10 ohm, and if the P06 value is greater than 1.99, the current feedback shunt resistor will be assumed to be 0.05 ohm. Also with software version 1.00, for the controller to be calibrated correctly for currents less than or equal to 1.99 Amps RMS, the R25 resistor must be removed from the controller.

If the controller parameters are reset to the factory preset values by setting Parameter P96 to 1., Parameter P06 will also reset to the factory preset value.

P07: NOMINAL LINE VOLTAGE

(Volts, Write, Reset Required, Password Protected)

LINE VOLTAGE	HORSEPOWER RANGE	FACTORY PRESET VALUE[a]	MINIMUM VALUE[b]	MAXIMUM VALUE[c]
208/230 VAC	1/3 - 30	230	190	253
460 VAC	1 - 75	460	254	506

a. With software version 1.35 or lower, Factory Preset Value is 230.
b. With software version 1.35 or lower, Minimum Value is 190.
c. With software version 1.00, Maximum Value is 230, and with software version 1.10 through 1.35, Maximum Value is 506.

Calibrates the controller to the Nominal Line Voltage and Volts per Hertz. For controllers with software version 1.10, when Parameter P07 is set to a value less than 254., the controller will be calibrated for a 208/230VAC line, and when Parameter P07 is set to a value greater than 254., the controller will be calibrated for a 460VAC line.

P08: SAVE PARAMETERS

(No units, Write)
Factory Preset Value: 0.
Setting Parameter P08 to 1., saves all parameter settings. If P08 is set to 0., changed parameter values will be lost when AC input power is removed from the controller.

P09: CURRENT LIMIT
(Percent, Fault Protected)
Minimum Value: 50.0 Factory Preset Value: 150. Maximum Value: 200.
Sets the maximum motor current allowed in percent of Motor Full Load Amps (Parameter P06). Parameter P09 sets the maximum current allowed. For single-phase operation, set Parameter P09 at 75.0 or lower.

P10: BOOST LEVEL
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.00 Factory Preset Value: 0.00

CONTROLLER RATING	MAXIMUM VALUE OF P10[a]
Up To 3HP	7.00
5 To 10HP	5.00
15 To 25HP	4.00
30 To 75HP	2.50

a. With software version 1.35 or lower, Maximum Value is 30.0.

Increases starting torque by applying proportionally higher voltage to the motor at slow speeds. Adjust Parameter P10 only in applications where the motor will not start the load. First try a setting of 0.50. Then try increases in increments of no more than 0.50 until the motor starts the load. However, never set P10 higher than the maximum values shown in the above table.
CAUTION: If P10 is set too high, controller damage may occur.

P11: SLIP COMPENSATION
(Percent, Fault Protected, Password Protected)
Minimum Value: 0. Factory Preset Value: 0. Maximum Value: 100.
Sets the percentage of slip speed added to the output frequency at 100 percent motor load. The standard factory setting is 0 percent, which means that slip compensation is disabled. To provide minimum speed droop as motor load increases, try a value of 75 for Parameter P11. If the Slip Compensation is set too high, motor speed instability may occur.

P12: RAMP TYPE
(No Units, Fault Protected)
Factory Preset Value: 0.
0. Linear (0.1 to 999.0 seconds linear acceleration/deceleration)
1. S Curve (6.0 to 150.0 seconds S Curve acceleration/deceleration)

With software version 1.00, the S Curve range is 2.0 to 120.0 seconds. If P12=1. for S Curve and P32=0 for Controlled Stop, be aware of the following stopping characteristics:

Notes:
- If the motor is accelerating when a Stop command is given, the motor will continue accelerating up to twice the speed it was running when the Stop command was given before it decelerates to a stop.
- If a Reversing command is given and immediately thereafter a Stop command is given, the motor will reverse direction and accelerate before it decelerates to a stop.

If the above stopping characteristics are undesirable, either change P32 to 1. for Coast-To-Stop, or install an emergency stop circuit by using an AC contactor to open the AC line supply to the controller.

P13: ANALOG INPUT MODE
(No Units, Fault Protected, Password Protected)
Factory Preset Value: 0.
0. 0-10VDC
1. 4-20mA

Selects the type of Analog Input used. The Analog Input must be unipolar (positive voltage only). When 4-20mA (Parameter P13=1.) is selected, the controller will automatically offset the speed reference to allow for 4mA of deadband.

P14: ANALOG INPUT INVERT
(No Units, Fault Protected, Password Protected)
Factory Preset Value: 0.
0. Normal
1. Invert

Determines if the Analog Input will be inverted. When the Analog Input is inverted (Parameter P14=1.), zero reference voltage will produce maximum speed or current limit and 10VDC will produce minimum speed or current limit.

P15: RUN SPEED SOURCE[1]
(No Units, Run Protected, Password Protected)
Factory Preset Value: 0.
0. Digital Input (Parameter P01)
1. Analog Input (Parameter P51)

Selects either Digital or Analog Speed Reference input. When Parameter P15 is set to 1., Keypad Speed Adjust Parameter P31 should be set to 0. (disable).

Note: If both Parameters P15 and P31 are set to 1., pushing the Up/Down arrow keys will increase or decrease the speed reference only while the key is held. When the key is released, the speed reference will return to the analog input setting.

P16: CURRENT LIMIT SOURCE[1]
(No Units, Run Protected, Password Protected)
Factory Preset Value: 0.
0. Digital Input (Parameter P09)
1. Analog Input (Parameter P51)

Selects either Digital or Analog Current Limit Setpoint.

1. If both Parameters P15 and P16 are set to 1, both the speed reference and the current limit will be controlled by the analog input.

P17: DC INJECTION BRAKING ON START
(No Units, Fault Protected, Password Protected)
Factory Preset Value: 0.

0. No DC Injection Braking on Start
1. DC Injection Braking on Start (DC Injection Braking activates when the drive is started)

P18: DC INJECTION BRAKING ON STOP
(No Units, Fault Protected, Password Protected)
Factory Preset Value: 0.

0. No DC Injection Braking on Stop
1. DC Injection Braking on Stop (DC Injection Braking activates three seconds after a drive stop command is given at any speed)

P19: DC INJECTION BRAKING LEVEL
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.0 Factory Preset Value: 0.0

CONTROLLER RATING	MAXIMUM VALUE OF P19[a]
Up To 3HP	7.00
5 To 10HP	5.00
15 To 25HP	4.00
30 To 75HP	2.50

a. With software version 1.35 or lower, Maximum Value is 10.0.

Establishes the DC Injection Braking Voltage in percent of Maximum Voltage that will be applied to the motor during DC Injection Braking.

CAUTION: Never set P19 higher than the Maximum Value shown in the above table. If P19 is set too high, controller damage may occur.

P20: DC INJECTION BRAKING TIME
(Seconds, Fault Protected, Password Protected)
Minimum Value: 0.0 Factory Preset Value: 0.0 Maximum Value: 25.5
Sets the time period in seconds that DC Injection Braking is active.

P21: SPEED AVOIDANCE BAND #1[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 100.
Sets the center (in percentage of Maximum Speed) of a band of speeds to be avoided.

P22: SPEED AVOIDANCE BAND #1 WIDTH[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.0 Factory Preset Value: 0.0 Maximum Value: 20.0
Sets the width (in percentage of Maximum Speed) of a band of speeds to be avoided. Example: A value of 20.0 yields ±10% of Maximum Speed above and below Parameter P21. Setting Parameter P22 to 0.0 disables speed avoidance for Band #1.

P23: SPEED AVOIDANCE BAND #2[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 100.
Sets the center (in percentage of Maximum Speed) of a band of speeds to be avoided.

P24: SPEED AVOIDANCE BAND #2 WIDTH[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.0 Factory Preset Value: 0.0 Maximum Value: 20.0
Sets the width (in percentage of Maximum Speed) of a band of speeds to be avoided. Setting Parameter P24 to 0.0 disables speed avoidance for Band #2. See Parameter P22 for an example.

P25: SPEED AVOIDANCE BAND #3[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 100.
Sets the center (in percentage of Maximum Speed) of a band of speeds to be avoided.

P26: SPEED AVOIDANCE BAND #3 WIDTH[1]
(Percent, Fault Protected, Password Protected)
Minimum Value: 0.0 Factory Preset Value: 0.0 Maximum Value: 20.0
Sets the width (in percentage of Maximum Speed) of a band of speeds to be avoided. Setting Parameter P26 to 0.0 disables speed avoidance for Band #3. See Parameter P22 for an example.

P27: FORWARD ENABLE
(No Units, Run Protected, Password Protected)
Factory Preset Value: 1.
0. Disabled (Forward motoring operation disabled)
1. Enabled (Forward motoring operation enabled)

Enables the drive to operate in the forward direction.

1. Care must be taken to ensure that the width parameters are set so the speed avoidance bands do not overlap. If, for example, Band #1 Setpoint=25.0%, Band #1 Width=20.0%, Band #2 Setpoint=30.0%, and Band #2 Width=20.0%, the bands will overlap. Instead of preventing operation from 15.0% speed to 40.0% speed as intended, the motor can run at both 35.0% speed and at 20.0% speed.

P28: REVERSE ENABLE
(No Units, Run Protected, Password Protected)
Factory Preset Value: 0.

0. Disabled (Reverse motoring operation disabled)
1. Enabled (Reverse motoring operation enabled)

Enables the drive to operate in the reverse direction.

P29: REMOTE STOP
(No Units, Run Protected, Password Protected)
Factory Preset Value: 0.

0. Disabled (Digital Input #2 disables remote stop and enables remote reverse)
1. Enabled (Digital Input #2 enables remote stop and disables remote reverse)

Programs Digital Input #2 (Terminal 5) for a remote normally-closed Stop button. When Parameter P29 is set to 1., Digital Input #1 (Terminal 4) will start the drive when the input is energized momentarily. Digital Input #2 will stop the drive when it is de-energized momentarily. Reverse operation is prohibited in this mode.

Notes:
- Refer to the notes in Parameter P30, below.
- Parameter P29 must be set to 0. if Line Starting (Parameter P33=1.) is enabled.

P30: REMOTE MAINTAINED RUN
(No Units, Run Protected, Password Protected)
Factory Preset Value: 0.

0. Disabled (Remote Maintained Run function disabled)
1. Enabled (Remote Maintained Run function enabled)

Enables Digital Input #1 (Terminal 4) and Digital Input #2 (Terminal 5) to start the drive when energized, and stop the drive when de-energized. Parameter P30 must be set to 1. to use the preset speed function (see Parameters P42, P43, P44, and P45). Parameter P30 can also be used to provide a jog function (drive will only run while a pushbutton is held closed).

Notes:
- If both Parameters P29 and P30 are set to 0. and Digital Input #1 (Terminal 4) is energized, the drive will start, but will not stop when power is removed from Terminal 4. The STOP key must be pushed on the controller keypad to stop the drive. This is also true for Digital Input #2 (Terminal 5) if Parameter P28 is set to 1.
- If Keypad Run Enable Parameter P49 is set to 1., the FWD and REV keys on the controller keypad will also start the drive. Setting Parameter P49 to 0. will disable keypad starts. However, the keypad STOP key will remain enabled.
- If Parameter P30 is set to 1, Parameter P29 must be set to 0.
- Parameter P30 must be set to 1. if Line Starting (Parameter P33=1.) is enabled.

P31: KEYPAD SPEED ADJUST
(No Units, Write, Password Protected)
Factory Preset Value: 1.

0. Keypad Speed Adjust disabled
1. Keypad Speed Adjust enabled

Allows the Up and Down arrow keys on the keypad to adjust the speed of the motor when operating in the Monitor Mode. Parameter P31 should be set to 0. if the Run Speed Source (Parameter P15) is set to 1.

P32: STOPPING MODE
(No Units, Password Protected)
Factory Preset Value: 0.

0. Controlled Stop
1. Coast-to-Stop

If Parameter P32 is set to 0. when a Stop command occurs, the drive will decelerate to zero speed following the deceleration time set in Deceleration Time Parameter P05. If Parameter P32 is set to 1. when a Stop command occurs, the motor will coast-to-stop. If P32=0. and P12=1. for S Curve acceleration/deceleration, refer to P12: Ramp Type (page 6-8) for stopping characteristics.

P33: LINE STARTING
(No Units, Write, Reset Required, Password Protected)
Factory Preset Value: 0.

0. Normal (No Line Starting)
1. Line Starting (Line Starting Enabled, Remote Stop P29 Disabled)

Determines if the drive can be started when AC line power is applied to the controller. Setting Parameter P33 to 1. allows the drive to start if Digital Input #1 (Terminal 4 - Forward) or Digital Input #2 (Terminal 5 - Reverse) is jumpered to +24VDC (Terminal 1). Parameter P33 must equal 1. for Auto Restart on fault operation (see Parameters P37 - P39).

Note: For line starting to function correctly, Remote Stop (Parameter P29) must be set to 0., and Remote Maintained Run (Parameter P30) must be set to 1.

CAUTION: Frequent restarting can damage the controller. A one minute delay is recommended between starts.

P34: ROTATING MOTOR STARTING
(No Units, Write, Reset Required, Password Protected)
Factory Preset Value: 0.

0. Normal (No Rotating Motor Starting)
1. Rotating Motor Starting (Rotating Motor Starting Enabled)

When set to 1., Parameter P34 enables the controller to start a rotating motor. The controller will attempt to match the speed of a rotating motor every time a Start command occurs.

Notes for Rotating Motor Starting Mode:

- If Rotating Motor Starting Mode is selected, the controller will start the motor at a reduced Volts Per Hertz setting and a reduced Current Limit setting. If the speed command is greater than 30 percent of

the Maximum Constant Torque Speed, the controller will try to match the speed of the motor and accelerate the motor to the commanded speed (Speed Search Mode 1). Once a speed match is found (current limit no longer active), or if a speed match is not found in 10 seconds, the Volts Per Hertz ratio and Current Limit will ramp to the user setting.

- If the speed command is less than 30 percent of the Maximum Constant Torque Speed, the controller will attempt to stop or slow the motor before accelerating the motor to speed (Speed Search Mode 2). The motor stops or is slowed because attempting to match the motor speed could cause the motor to accelerate to a speed higher than the speed command. Once a speed match is found, or if a speed match is not found in 10 seconds, the Volts Per Hertz ratio and Current Limit setpoint will ramp to the user setting.

- Rotating Motor starting only works if a single motor is connected to the controller output terminals. If multiple motors are connected to the controller and rotating motor starting is still desirable, configure the drive for DC Injection Braking on Start (see Parameters P17, P19, and P20). This will cause the motors to stop before restarting.

P35: OVERLOAD THRESHOLD

(Percent, Write, Reset Required, Password Protected)

Minimum Value: 50.0 Factory Preset Value: 115. Maximum Value: 115.

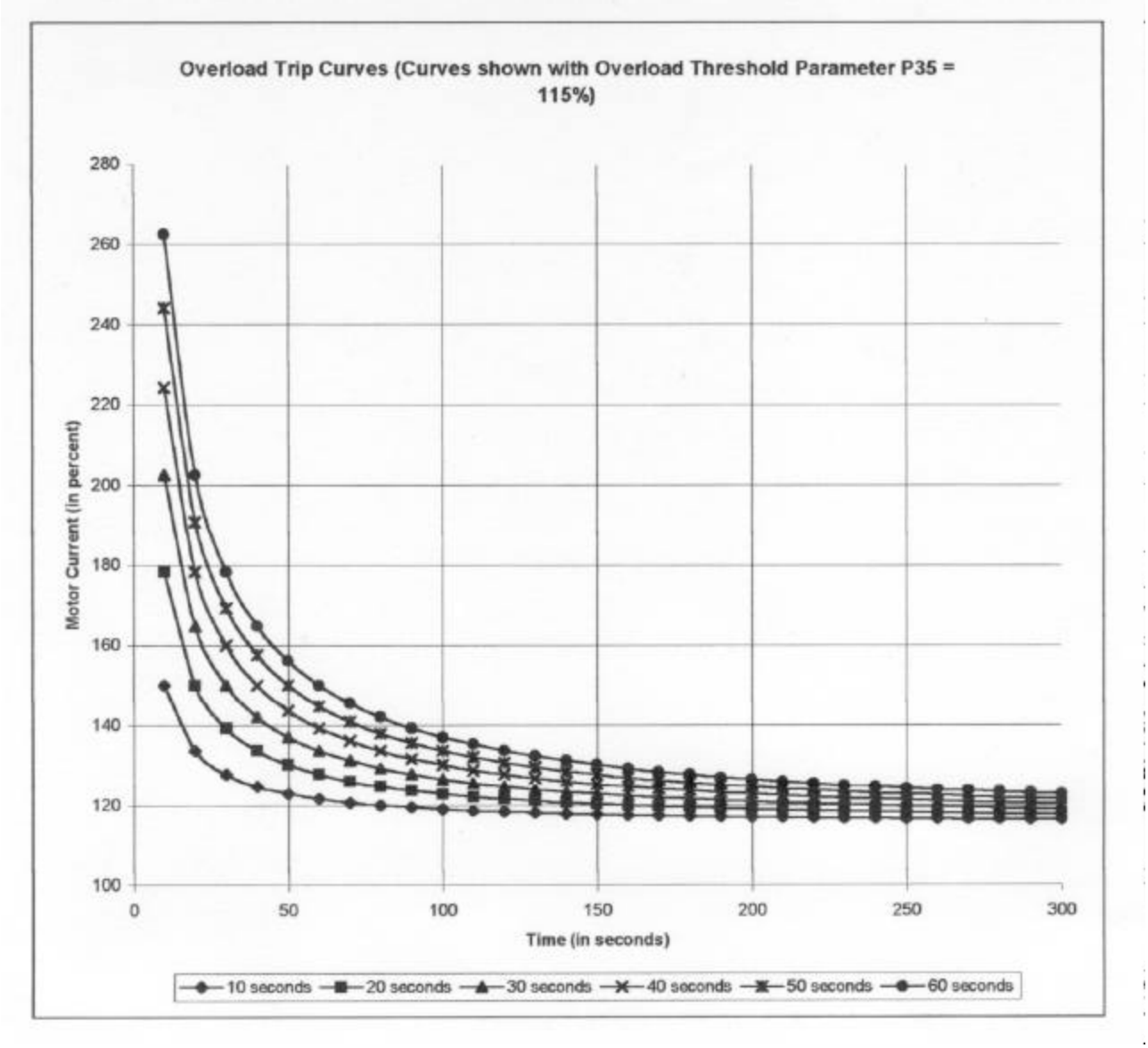
Sets the motor current (in percent of Motor Full Load Amps Parameter P06) above which a motor overload trip will occur if the overload is present for the required time (see Overload Time Parameter P36). With software version 1.10 through 1.35, the Factory Preset Value is 125. With software version 1.35 or lower, the Maximum Value is 150.

P36: OVERLOAD TIME

(Seconds, Write, Reset Required, Password Protected)

Minimum Value: 1. Factory Preset: 60. Maximum Value: 60.

Determines the amount of time (in seconds) that 150 percent of Motor Full Load Amps (Parameter P06) must be present before an Overload Trip occurs. The curves in the following graph (page 6-15) show the effect of changing the Overload Time Parameter P36 from 10 seconds to 60 seconds:



*Changing Parameter P35 moves the convergent point vertically on the graph.

P37: RESTART TRIES

(No Units, Fault Protected, Reset Required, Password Protected)

Minimum Value: 0. Factory Preset Value: 0. Maximum Value: 5.

Number of times the drive will try to restart automatically after a fault. Set Parameter P37 to 0. to disable this feature.

Note: The drive must be configured for Line Starting to enable this feature to start the controller after a fault. If Line Starting is not enabled and Restart Tries is non zero, the controller will automatically reset faults, but the drive will not restart (see Line Starting Parameter P33).

P38: RESTART WINDOW
(Seconds, Fault Protected, Reset Required, Password Protected)
Minimum Value: 300. Factory Preset Value: 300. Maximum Value: 999.
Maximum time period in seconds from the first restart until the maximum number of restarts (see Parameter P37) occurs. If the maximum number of restarts occurs within this time window, no more restarts will be allowed and the controller will be faulted, requiring a manual reset. A manual reset must be initiated by pushing the STOP key on the controller keypad or by removing power from the controller. If the time difference between the present time and the time of the first restart exceeds the time entered in Parameter P38, and the maximum number of restarts has not occurred, the restart count and the window timer will reset to zero. This effectively clears the restart memory and allows the selected number of restarts (Parameter P37) to occur after the next fault.

Note: The drive must be configured for Line Starting to enable this feature to restart the drive after a fault occurs (see Line Starting Parameter P33).

P39: RESTART DELAY
(Seconds, Fault Protected, Reset Required, Password Protected)
Minimum Value: 3. Factory Preset Value: 5. Maximum Value: 60.
Sets the time delay from the time a fault occurs until a restart of the drive is attempted. With software version 1.30 or lower, the minimum value is 2.

Note: The drive must be configured for Line Starting to enable this feature to restart the drive after a fault occurs (see Line Starting Parameter P33).

P40: V/F PROFILE LIST
(No Units, Write, Reset Required, Password Protected)
Allows the V/F (Volts per Frequency (Hertz)) profile to be changed.
Factory Preset Value: 1. 60 Hz CT

0.	50 Hz CT	(0-50 Hertz Constant Torque)
1.	60 Hz CT	(0-60 Hertz Constant Torque)
2.	90 Hz CT	(0-90 Hertz Constant Torque)
3.	120 Hz CT	(0-120 Hertz Constant Torque)
4.	180 Hz CT	(0-180 Hertz Constant Torque)
5.	240 Hz CT	(0-240 Hertz Constant Torque)
6.	400 Hz CT	(0-400 Hertz Constant Torque)
7.	50-55 Hz CHP	(0-50 Hertz Constant Torque, 50-55 Hertz Constant HP)
8.	60-66 Hz CHP	(0-60 Hertz Constant Torque, 60-66 Hertz Constant HP)
9.	60-90 Hz CHP	(0-60 Hertz Constant Torque, 60-90 Hertz Constant HP)
10.	60-120 Hz CHP	(0-60 Hertz Constant Torque, 60-120 Hertz Constant HP)
11.	60-180 Hz CHP	(0-60 Hertz Constant Torque, 60-180 Hertz Constant HP)
12.	60-240 Hz CHP	(0-60 Hertz Constant Torque, 60-240 Hertz Constant HP)
13.	60-400 Hz CHP	(0-60 Hertz Constant Torque, 60-400 Hertz Constant HP)
14.	90-120 Hz CHP	(0-90 Hertz Constant Torque, 90-120 Hertz Constant HP)
15.	90-180 Hz CHP	(0-90 Hertz Constant Torque, 90-180 Hertz Constant HP)
16.	90-240 Hz CHP	(0-90 Hertz Constant Torque, 90-240 Hertz Constant HP)
17.	90-400 Hz CHP	(0-90 Hertz Constant Torque, 90-400 Hertz Constant HP)

18. 120-180 Hz CHP (0-120 Hertz Constant Torque, 120-180 Hertz Constant HP)
19. 120-240 Hz CHP (0-120 Hertz Constant Torque, 120-240 Hertz Constant HP)
20. 120-400 Hz CHP (0-120 Hertz Constant Torque, 120-400 Hertz Constant HP)

P41: VOLTS PER HERTZ

(Percent, Fault Protected)

Minimum Value: 80. Factory Preset Value: 100. Maximum Value: 120.

Trims the nominal Volts per Hertz +/- 20% from 80% to 120%. The Nominal Volts per Hertz is set by the V/F Profile (Parameter P40). To adjust Volts Per Hertz, run the motor at half speed. Connect an AC clamp-on ammeter to one of the motor leads. Adjust Parameter P41 for minimum current on the AC ammeter. If the motor speed decreases while adjusting Parameter P41, increase the value of the P41 until the motor speed returns to the command speed.

P42: PRESET SPEED ENABLE

(No Units, Run Protected, Password Protected)

Factory Preset Value: 0.

0. Preset Speeds Disabled
1. Preset Speeds Enabled (Parameters P43, P44, and P45)

Enables Preset Speeds #1, #2, and #3 (Parameters P43, P44, and P45, respectively), provided Remote Maintained Run Parameter P30 is also set to 1. (Enable). When Parameter P42 is set to 1., the preset speed selection contact also starts the drive. When this contact opens, the drive stops. When Reverse Enable Parameter P28 is set to 1. (Enable) and Line Starting Parameter P33 is set to 1. (Enable), Preset Speeds #2 and #3 will select speeds in the Reverse direction. When Parameter P33 is set to 0. (Disable), and Parameter P28 is set to either 0. or 1., Preset Speeds #2 and #3 will select speeds in the Forward direction.

P43: PRESET SPEED #1

(Percent, Fault Protected, Password Protected)

Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 100.

Sets Preset Speed #1, which becomes the speed reference when +24VDC is applied to Digital Input #1 (Terminal 4). Preset Speeds are enabled by setting Preset Speed Enable Parameter P42 to 1.

P44: PRESET SPEED #2

(Percent, Fault Protected, Password Protected)

Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 100.

Sets Preset Speed #2, which becomes the speed reference when +24VDC is applied to Digital Input #2 (Terminal 5). Preset Speeds are enabled by setting Preset Speed Enable Parameter P42 to 1.

P45: PRESET SPEED #3

(Percent, Fault Protected, Password Protected)

Minimum Value: 0.00 Factory Preset Value: 0.00 Maximum Value: 100.

Sets Preset Speed #3, which becomes the speed reference when +24VDC is applied to both Digital Input #1 (Terminal 4) and Digital Input #2 (Terminal 5). Preset Speeds are enabled by setting Preset Speed Enable Parameter P42 to 1.

P46: ELECTRONIC BRAKING ENABLE
(No Units, Run Protected, Password Protected)
Factory Preset Value: 0.

0. Electronic Braking Disabled
1. Electronic Braking Enabled

Enables the Electronic Braking Option to function by disabling the Bus Voltage Limiting feature of the controller. Parameter P46 is not available with software version 1.00.

Note: If Electronic Braking is enabled, but the Electronic Braking Option is not installed, Bus Overvoltage faults may occur during deceleration.

P47: ANALOG INPUT OFFSET[1]
(No Units, Fault Protected, Password Protected)
Minimum Value: -100. Factory Preset Value: 0.00 Maximum Value: 100.
Allows adjusting the input voltage level that will produce an analog input of 0.00%. Increasing Parameter P47 will lower the input voltage that will produce a 0.00% analog input. Lowering or making Parameter P47 negative will raise the input voltage that will produce an analog input of 0.00%.

P48: ANALOG INPUT TRIM[1]
(No Units, Fault Protected, Password Protected)
Minimum Value: -100. Factory Preset Value: 0.00 Maximum Value: 100.
Allows adjusting the input voltage level that will produce an analog input of 100% for analog speed input, or 200% for analog current limit input. Increasing Parameter P48 will lower the input voltage that will produce a 100% (or 200%) analog input. Lowering or making Parameter P48 negative will raise the input voltage that will produce a 100% (or 200%) analog input.

Analog Input Calibration

The factory preset settings of Parameters P47 and P48 provide acceptable operation for most applications. However, for applications that require accurate setting of the motor speed by the analog input, the following procedure may be used:

1. Connect a speed control potentiometer, external 0-10VDC, or external 4-20mA speed reference to Terminals TB1-6, TB1-7, and TB1-8 as shown in Section VI of this manual.
2. Connect a DC voltmeter to Terminals TB1-7 and TB1-8 (common).
3. Select Analog Speed Input by setting Parameter P15 to 1.
4. Set Parameter P13 to 0. for 0-10VDC input, or to 1. for 4-20mA input, as applicable.
5. Set Parameters P47 and P48 to 0.
6. Set the controller to display Parameter P51 (Analog Input).
7. Set the input speed control at 0VDC (or to 2VDC for a 4-20mA signal) as measured by the voltmeter connected to Terminals TB1-7 and TB1-8.
8. Increase the input speed control signal slowly until the value displayed for Parameter P51 starts to increase from 0.00.

1. Available only with software version 1.12 or higher.

9. Record the voltage displayed on the DC voltmeter.
10. Continue to increase the input speed control signal until the Parameter P51 value reaches 100.
11. Record the voltage displayed on the DC voltmeter.
12. If a speed control potentiometer is used to set the speed, turn it fully clockwise and then record the voltage displayed on the DC voltmeter.
13. Use one of the following formulas, as applicable, to calculate the Analog Trim (Parameter P48) setting.

    For 0-10VDC Analog Input (Parameter P13=0.):

$$P48 = \left[\left(\frac{100\%\text{Voltage} - 0\%\text{Voltage}}{\text{ReferenceVoltage}} \times 100\right) - 100\right] \times \frac{100}{16}$$

    For 4-20mA Analog Input (Parameter P13=1.):

$$P48 = \left[\left(\frac{100\%\text{Voltage} - 0\%\text{Voltage}}{\text{ReferenceVoltage}} \times 129.76\right) - 100\right] \times \frac{100}{16}$$

    Where:

    100% Voltage = The voltage recorded in step 11.
    0% Voltage = The voltage recorded in step 9.
    Reference Voltage = The voltage recorded in step 12 (or 10VDC)

14. Enter the number that was calculated in step 13 into Parameter P48.
15. Return the speed control signal to 0VDC (2VDC for 4-20mA input) as measured by the DC voltmeter connected to Terminals TB1-7 and TB1-8.
16. Set the controller to display Parameter P51 (Analog Input).
17. Increase the input speed control signal slowly until the value displayed for Parameter P51 starts to increase from 0.00.
18. Record the voltage displayed on the DC voltmeter.
19. Use one of the following formulas, as applicable, to calculate the Analog Offset (Parameter P47) setting.

    For 0-10VDC Analog Input (Parameter P13=0.):

$$P47 = \frac{0\%\text{Voltage}}{10} \times \frac{5192}{100} \times \frac{100}{16}$$

    For 4-20mA Analog Input (Parameter P13=1.):

$$P47 = \frac{0\%\text{Voltage}}{10} \times \frac{5192}{129.76} \times \frac{100}{16}$$

    Where: 0% Voltage = Voltage recorded in step 18.

20. Enter the number that was calculated in step 19 into Parameter P47.
21. Set Parameter P08 to 1. to save the parameter values.

P49: KEYPAD RUN ENABLE
(No Units, Run Protected, Password Protected)
Factory Preset Value: 1. Keypad Run enabled
0. Keypad Run disabled
1. Keypad Run enabled
Enables and disables the FWD and REV keys on the controller keypad. Setting Parameter P49 to 0. will disable the FWD and REV keys, and allow the drive to be started only from Digital Input #1 (Terminal 4) and Digital Input #2 (Terminal 5). Setting Parameter P49 to 1. allows the FWD and REV keys and both digital inputs to start the drive. See Parameters P29 and P30. Regardless of the setting of Parameter P49, the STOP key is always enabled. Parameter P49 is available only with software version 1.21 or higher.

READ ONLY PARAMETERS

P50: FREQUENCY
(Hertz, Read Only)
Minimum Value: 0.00 Maximum Value: 400.
Output Frequency in Hertz.

P51: ANALOG INPUT
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 200.
Displays the Analog Input used for either Run Speed or Current Limit (see Parameters P15 and P16). Parameter P13 determines if the Analog Input is scaled for 4-20 mA or 0-10VDC. Parameter P14 determines if the Analog Input is inverted. When Parameter P51 is selected for Run Speed by Parameter P15, the maximum value of P51 will be 100. When Parameter P51 is selected for Current Limit by Parameter P16, the maximum value of P51 will be 200.

Note: The value of Parameter P51 will be 0.00 if both Parameters P15 and P16 are set to 0.

P52: SPEED COMMAND
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 100.
Displays the speed reference selected by Run Speed Source Parameter P15.

P53: SPEED OPERATOR CONTROL
(Percent, Read Only)
Minimum Value: -100. Maximum Value: 100.
Displays the speed reference as determined by the Run/Stop logic. When running forward, Parameter P53 will equal Speed Command Parameter P52. When running in reverse, Parameter P53 will equal the negative of Parameter P52.

P54: FINAL SPEED REFERENCE
(Percent, Read Only)
Minimum Value: -100. Maximum Value: 100.
Displays the speed reference input to the Acceleration/Deceleration Ramp Control. The value of Parameter P54 is limited by Minimum Speed Parameter P02 and Maximum Speed Parameter P03. When the drive is stopped, Parameter P54 will equal zero.

P55: SPEED ACCEL/DECEL
(Percent, Read Only)
Minimum Value: -100. Maximum Value: 100.
The output of the Acceleration/Deceleration Ramp Control.

P56: SPEED CURRENT LIMIT INPUT
(Percent, Read Only)
Minimum Value: -100. Maximum Value: 100.
The output of the Acceleration/Deceleration Ramp Control after Slip Compensation has been added (see Slip Compsensation Parameter P11). Parameter P56 is the speed command input to the Current and Bus Voltage Limit functions.

P57: SPEED CORRECTION
(Percent, Read Only)
Minimum value: -100. Maximum Value: 100.
The change in the speed command as a result of the Current Limit function.

P58: FINAL SPEED OUTPUT
(Percent, Read Only)
Minimum Value: -100. Maximum Value: 100.
The speed command output of the Current Limit function, and reflects the actual speed the motor is running.

P59: VOLTAGE (VOLTS PER HERTZ) PROFILE
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 100.
The calculated voltage output in percent as determined by Volts Per Hertz Parameter P41 and Boost Level Parameter P10.

P60: CURRENT ERROR
(Percent, Read Only)
Minimum Value: -199. Maximum Value: 199.
Displays the percentage of current error between Motor Amps Parameter P65 and Current Setpoint Parameter P67.

P61: MOTOR VOLTAGE
(Volts, Read Only)
Minimum Value: 0.0 Maximum Value: 460.
Displays the RMS Line to Line output voltage to the motor. With software version 1.00, the Maximum Value is 230.

P62: BUS VOLTAGE
(Volts, Read Only)
Minimum Value: 0.0 Maximum Value: 900.
Displays the DC Bus Voltage. With software version 1.00, the Maximum Value is 500, and with software version 1.11 through 1.35, the Maximum Value is 815.

P63: FILTERED BUS VOLTAGE
(Volts, Read Only)
Minimum Value: 00.0 Maximum Value: 815.
Displays the DC Bus Voltage after filtering by a low pass filter. With software version 1.00, the Maximum Value is 500.

P64: BUS VOLTAGE INTEGRATOR
(Percent, Read Only)
Minimum Value: -100. Maximum Value: 100.
Displays the integrated value of Bus Voltage Error when the Bus Limiting function is active.

P65: MOTOR AMPS
(Amps, Read Only)
Minimum Value: 0.00 Maximum Value: 180.
Displays the Motor RMS Current in Amps.

P66: FILTERED MOTOR AMPS
(Amps, Read Only)
Minimum Value: 0.00 Maximum Value: 180.
Shows the Motor Amps (Parameter P65) after filtering by a low pass filter. With software version 1.00, the Maximum Value is 12.8.

P67: CURRENT SETPOINT
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 200.
Displays the Current Limit Setpoint from either the Digital Current Limit (Parameter P09) or the Analog Input (Parameter P51), as determined by the Current Limit Source (Parameter P16). When the controller is performing a rotating motor start, Parameter P67 will display the current limit setpoint used for rotating motor starts.

P68: CURRENT LIMIT INTEGRATOR
(Percent, Read Only)
Minimum Value: -199. Maximum Value: 300.
Displays the integrated value of Current Error when the Current Limit function is active.

P69: SLIP COMP TORQUE
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 100.
Displays the percent torque which is calculated by taking the percent motor current and subtracting 60.00. This value is used for the Slip Compensation function.

P70: OVERLOAD INTEGRATOR
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 300.
Displays the Overload Integrator Value. When Parameter P70 exceeds Overload Trip Parameter P71, a Motor Overload Fault will occur.

P71: OVERLOAD TRIP
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 300.
Displays the value of Overload Integrator Parameter P70 that will generate a Motor Overload Trip.

P72: DC INJECTION BRAKING TIMER
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 327.
Displays the timer that is used to determine how long DC Injection Barking will be active.

P73: DISABLE TIMER
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 327.
Displays the timer that is used to determine how long DC Injection Barking will be inactive when a DC Injection Braking On Stop command is given.

P74: FREQUENCY SCALE
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 100.
Displays a Scaling Constant used to calculate the phase angle for PWM generation.

P75: PWM FREQUENCY
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 100.
Displays the percent frequency output of the controller.

P76: PWM VOLTAGE
(No Units, Read Only)
Minimum Value: 0. Maximum Value: 219.
Displays the duty cycle of the PWM output of the controller.

P77: SPEED SEARCH VOLTS PER HERTZ
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 100.
Displays the Volts Per Hertz Ratio during rotating motor starts.

P78: SPEED SEARCH TIMER
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 327.
Displays the timer that is used to determine how long the Speed Search function will be active when a Rotating Motor Start is initiated.

P79: MATCH SPEED
(Percent, Read Only)
Minimum Value: -100. Maximum Value: 100.
Displays the speed that the Rotating Motor Starting function determines the motor is running when Rotating Motor Starts are enabled by setting Parameter P34 equal to 1.

P80: FAULT CODE
(No Units, Read Only)
Minimum Value: 0. Maximum Value: 99.0
Displays the Fault Code if the drive is faulted. Fault Codes are listed below:

0. No Fault
1. DC Bus Overcurrent Fault
2. DC Bus Overvoltage Fault
3. Motor Overload Fault
4. Not Used
5. EEPROM Read Failure
6. EEPROM Write Failure
7. Low Bus Voltage Fault (Power Loss Ride Through failed or wrong line voltage applied)
8. Drive Enable Fault (Gate Pulse Enable never generated)
9. EEPROM Acknowledge Fault
10. EEPROM Not Responding Fault
11. PWM Generator Fault
12. Bad Opcode Fault (Illegal Software Code Executed or Watchdog Timer Fault)
13. Trap Fault (Trap Instruction Executed)
14. Not used.
15. ADC Fault (Analog-To-Digital Converter failure)

P81: START AGAIN TIMER
(Percent, Read Only)
Minimum Value: 0.00 Maximum Value: 100.
Displays the time delay between starts. There is a minimum three seconds off time each time the PWM output is disabled.

P82: DIGITAL INPUTS
(No Units, Read Only)
Minimum Value: 0. Maximum Value: 255.
Shows the state of all the digital inputs to the controller. The following table shows the bit locations of each input. Value displayed will be the sum of the total Binary Weights.

BIT POSITION	BINARY WEIGHT	DIGITAL INPUT
0	1	Digital Input #2
1	2	Digital Input #1
2	4	Forward Key
3	8	Reverse Key
4	16	Stop Key
5	32	Down Arrow Key
6	64	Up Arrow Key
7	128	Mode Key

P83: DIGITAL INPUT FLAGS
(No Units, 1 byte, Read Only)
Minimum Value: 0.00 Maximum Value: 255.
Shows the previous state of various control inputs listed in the following table. Value displayed will be the sum of the total Binary Weights.

BIT POSITION	BINARY WEIGHT	DIGITAL INPUT
0	1	Previous state of the Forward key or Digital Input #1
1	2	Previous state of the Reverse key or Digital Input #2
2	4	Previous state of the Stop bit in Logic State Parameter P84
3	8	Previous state of the Stop bit in Logic State Parameter P84. Used for DC braking
4	16	Force restart: This bit is a 1 when the Stop key is pressed while Digital Input #1 or Digital Input #2 is high (1). The Stop key must be pressed a second time before restarting. Digital Inputs #1 and #2 must both open and either input must close to restart.
5	32	Test mode active
6	64	Keypad test active
7	128	Remote Fault Reset

P84: LOGIC STATE
(No Units, Read Only)
Minimum Value: 0.00 Maximum Value: 255.
Shows the status of the Run/Stop logic listed in the following table. Value displayed will be the sum of the total Binary Weights.

BIT POSITION	BINARY WEIGHT	BIT DESCRIPTION
0	1	Forward Run Command
1	2	Reverse Run Command
2	4	Drive Enabled
3	8	Stop Command
4	16	Start Inhibit
5	32	PWM Output Inhibit
6	64	Acceleration Enable
7	128	Minimum Frequency Inhibit

P85: STATUS 1
(No Units, Read Only)
Minimum Value: 0. Maximum Value: 255.
Shows the various status indications listed in the following table. Value displayed will be the sum of the total Binary Weights.

BIT POSITION	BINARY WEIGHT	BIT DESCRIPTION
0	1	Off-line Mode
1	2	DC Braking Enable
2	4	Power Loss Ride Through
3	8	Speed Search
4	16	Forward Motor Rotation
5	32	Reverse Motor Rotation
6	64	Speed Search Mode 1 Active
7	128	DC Braking Active

P86: STATUS 2
(No Units, Read Only)
Minimum Value: 0. Maximum Value: 255.
Shows the various status indications listed in the following table. Value displayed will be the sum of the total Binary Weights.

BIT POSITION	BINARY WEIGHTS	BIT DESCRIPTION
0	1	Speed Match
1	2	Short Circuit Test Active
2	4	Speed Avoidance Active
3	8	At Speed
4	16	Overload Warning
5	32	Speed Search Mode 2 Active
6	64	High DC Bus Voltage
7	128	Current Limit Active

P87: FLAGS
(No Units, Read Only)
Minimum Value: 0. Maximum Value: 255.
Shows the various control indications listed in the following table.

BIT POSTION	BIT DESCRIPTION
0	Odd Loop Active
1	Operating System Monitor Mode Active
2	Operating System Parameter Entry Mode Active
3	Operating System Data Entry Mode Active
4	Display Update Required
5	Flash LED's on Display
6	Faster/Slower Control Active
7	Analog Input Available

UTILITY FUNCTIONS

P94: STARTING DELAY

(No Units, Write)
Factory Preset Value: 0.
Available only with software version 1.3 or higher. Used with the Bypass option. Prevents the controller from starting the motor too soon when the operating mode is switched from Bypass to VFD. Setting Parameter P94 to 1. causes a 3-second starting delay. If no Bypass option is installed and Line Starting is not enabled (Parameter P33=0.), Parameter P94 can be set to 0., thereby improving drive response to Run commands. However, when Parameter P94 is set to 0., and a Run command is given within 3 seconds after a Stop command, a 3-second start delay will occur.

P95: MONITOR PARAMETER

(No Units, Write)
Minimum Value: 0. Factory Preset Value: 58. Maximum Value: 99.
Allows the user to define which parameter to display when the Monitor Mode is selected. The Factory Preset value of 58. will display speed in percent (Parameter P58).

P96: LOAD FACTORY

(No Units, Write)
Factory Preset Value: 0.
Setting Parameter P96 to 1. loads all parameters with the factory preset values. Note that Parameter P06 (Motor Full Load Amps) may need to be set again to the motor nameplate current rating. If Parameter P96 is set to 1. while the drive is running, the keypad display will flash **rSt** indicating that the STOP key must be pressed to stop the motor before the factory preset values will be loaded. When the motor stops, the controller will pause 3 seconds, load the factory preset values, save the factory preset values, and then reset the controller.

P97: RESET DRIVE

(No Units, Write)
Factory Preset Value: 0.
Setting Parameter P97 to 1. initiates a drive reset. A drive reset can also be initiated by removing and reapplying AC line power to the controller. If Parameter P97 is set to 1. while the drive is running, the keypad display will flash **rSt** indicating that the STOP key must be pressed to stop the motor before the controller will reset. When the motor stops, the controller will pause 3 seconds, and then reset the controller.

P98: GLOBAL PASSWORD

(No Units, Password Protected)
Factory Preset Value: 0.
Setting Parameter P98 to 1. will require that a password be entered in Parameter P00 to gain access to any parameter. If the correct password is not entered in Parameter P00, all parameters other than P00 will be password protected.

P99: USER PASSWORD
(No Units, Write)
Minimum Value: 0. Factory Preset Value: 0. Maximum Value: 999.
Allows the user to define a value that must be entered in Password Parameter P00 before access is allowed to the password protected parameters. If the correct password is not entered in Parameter P00, the user may only access the non password protected parameters. Setting Parameter P99 to 0. will disable password protection.

Note: The keypad display will not display P99 unless Password Parameter P00 equals the value in Parameter P99.

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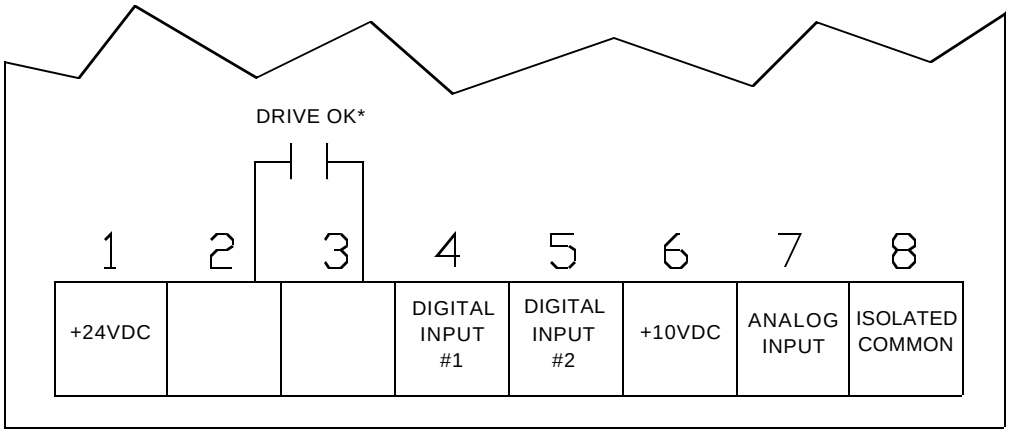
SECTION VII

CONTROL WIRING

Normal drive operation is controlled from the controller keypad. The following diagrams illustrate the external connections required to start and stop the motor as well as vary motor speed from a remote location. Control wiring should utilize multiconductor twisted cable. Some of the connection diagrams require parameter changes to provide the remote functions. The parameter settings required are listed with each diagram. When remote control is used, the FWD, REV, and UP/Down arrow keys should be disabled (see Parameters P31 and P49). For the location of the control wiring terminals, see Figure 2-4 (page 2-4), Figure 2-5 (page 2-5) or Figure 2-6 (page 2-6), as applicable.



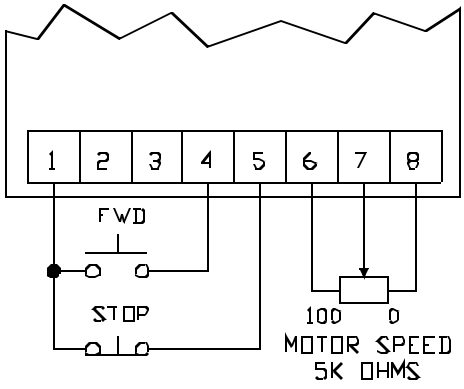
*The contact closes when the controller is powered up, provided it is not faulted. Contact is rated for 0.5A at 125VAC and 2.0A at 30VDC.

RUN FORWARD AND STOP BY MOMENTARY (three wire control) PUSHBUTTONS AND EXTERNAL SPEED REFERENCE

If motor rotation is incorrect, interchange two motor leads at the controller.

PARAMETER SETTINGS

P15 Run Speed Source	= 1.
P29 Remote Stop	= 1.
P31 Keypad Speed Adjust	= 0.
P49 Keypad Run Enable	= 0.
P08 Save Parameters	= 1.

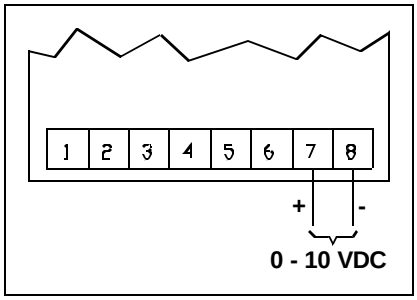


EXTERNAL 0-10VDC SPEED REFERENCE

Input Signal May Be Isolated Or Non-isolated

Parameter Settings

P15 Run Speed Source = 1.
P31 Keypad Speed Adjust = 0.
P08 Save Parameters = 1.
(Also See Parameters P47 and P48)

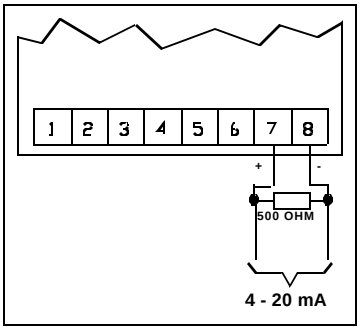


EXTERNAL 4-20MA SPEED REFERENCE

Input Signal May Be Isolated Or Non-Isolated

Parameter Settings

P13 Analog Input Mode = 1.
P15 Run Speed Source = 1.
P31 Keypad Speed Adjust = 0.
P08 Save Parameters = 1.
(Also See Parameters P47 and P48)

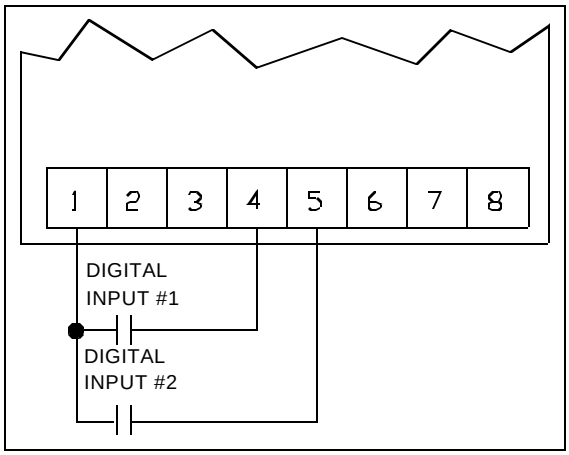


PRESET SPEEDS (FOR FORWARD DIRECTION ONLY)

This setup allows a maximum of three preset speeds by the use of two external (normally open) relay or switch contacts. When Digital Input #1 (Terminal 4) is connected to the +24VDC supply (Terminal 1), Preset Speed #1 will be activated and the motor will run at this speed. When Digital Input #2 (Terminal 5) is connected to the +24VDC supply (Terminal 1), Preset Speed #2 will be activated and the motor will run at this speed. When both Digital Input #1 (Terminal 4) and Digital Input #2 (Terminal 5) are connected to the +24VDC supply (Terminal 1), Preset Speed #3 will be activated and the motor will run at this speed.

Parameter Settings

P42 Preset Speed Enable = 1.
P43 Preset Speed #1 = XXX
P44 Preset Speed #2 = XXX
P45 Preset Speed #3 = XXX



DIGITAL INPUT #1 (Terminal 4)	DIGITAL INPUT #2 (Terminal 5)	PRESET SPEED
OFF (Open)	OFF (Open)	NONE
ON (Closed)	OFF (Open)	#1
OFF (Open)	ON (Closed)	#2
ON (Closed)	ON (Closed)	#3

EXTERNAL 0-10VDC CURRENT LIMIT

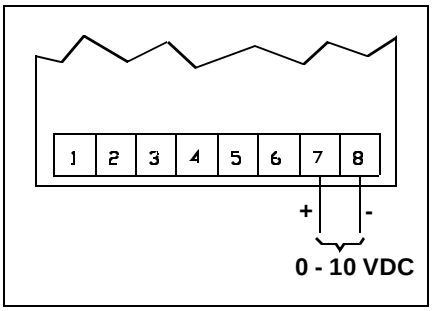
(Adjustment Range is 20-200% With A 0-10VDC Input Signal)

INPUT SIGNAL MAY BE ISOLATED OR NON-ISOLATED

Parameter Settings

P15 Run Speed Source	= 0.
P16 Current Limit Source	= 1.
P31 Keypad Speed Adjust	= 0.
P08 Save Parameters	= 1.

(Also See Parameters P47 and P48)

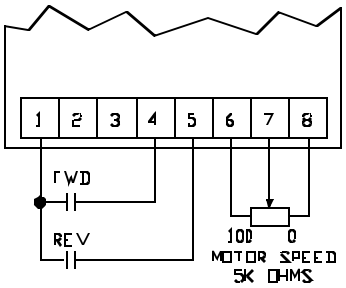


This setup allows remote adjustment of Current Limit (Parameter P09). In the Run Mode, the motor will run at the command speed unless the current demand (loosely proportional to motor loading) is greater than the value in Parameter P09. When this occurs, the motor will slow down until the load is reduced.

RUN FORWARD AND RUN REVERSE BY MAINTAINED (two wire control) CONTACTS AND EXTERNAL OR KEYPAD SPEED REFERENCE

If motor rotation is incorrect, interchange any two motor leads at the controller.

PARAMETER	SETTINGS	
	EXTERNAL SPEED REF	KEYPAD SPEED REF
P15 Run Speed Source	1.	0.
P28 Reverse Enable	1.	1.
P29 Remote Stop	0.	0.
P30 Maintained Run Mode	1.	1.
P31 Keypad Speed Adjust	0.	1.
P49 Keypad Run Enable	0.	0.
P08 Save Parameters	1.	1.



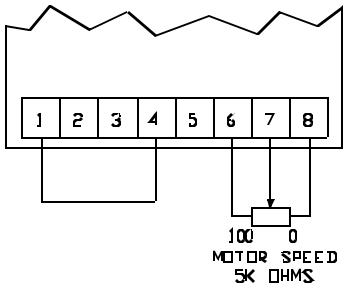
Notes:
- When a Stop command is given, be sure both FWD and REV contacts remain open until the motor stops rotating.
- The selected direction contact (FWD or REV) must be opened before a change of direction command is given.
- Do not set Parameter P30=0. for a Jog function. When either the FWD or REV contact is closed momentarily and P30=0., the motor will accelerate to the speed reference setting and keep running until the STOP key is pressed on the keypad.

LINE STARTING AND EXTERNAL OR KEYPAD SPEED REFERENCE

The motor will start rotating as soon as AC line power is applied. This setup is required if the Auto Restart function is desired.

CAUTION: Frequent restarting can damage the controller. A one minute delay is recommended between starts.

PARAMETER	SETTINGS	
	EXTERNAL SPEED REF	KEYPAD SPEED REF
P15 Run Speed Source	1.	0.
P29 Remote Stop	0.	0.
P30 Maintained Run Mode	1.	1.
P31 Keypad Speed Adjust	0.	1.
P33 Line Starting	1.	1.
P49 Keypad Run Enable	0.	0.
P08 Save Parameters	1.	1.



Notes: 1 If the drive won't restart after a power outage, but no fault code is indicated on the keypad display, turn-off the AC line power to the controller, wait until the keypad display turns-off, and then turn-on the AC line power.

2. A maintained normally-closed contact may be connected to Terminals 1 and 4 instead of a jumper. Opening the contact stops the motor.

3. Before changing parameter values, be sure Terminals 1 and 4 are open.

LINE STARTING WITH EXTERNAL RUN CONTACT

Some applications require a run contact to start/stop the drive along with line starting. However, some drives may fail to restart when the run contact is re-closed after the AC line power is interrupted. For this to occur, the following conditions must exist:

- The ACX controller must have Software Version V1.32 through V1.36.
- The controller must be configured for line starting (Line Starting Parameter P33 = 1.).
- An external run contact must be connected between Terminals 1 and 4 on the control board and be used to start and stop the drive.
- The external run contact must open during the period from shortly after the AC line power is interrupted until the controller keypad display goes blank.

If the drive does not restart when the run contact closes, it will not restart unless the drive is reset by setting Reset Drive Parameter P97 = 1., or by removing the AC line power long enough for the keypad display to go blank.

To eliminate this condition, first configure the controller for normal starting (Line Starting Parameter P33 = 0.). Then, be sure the external run contact remains open when AC line power is reapplied to the controller. The drive should now start when the run contact closes.

If Auto Restart is required, the following two methods are provided:

- The supervisory logic can monitor the ACX Drive OK relay contact, and then open and re-close the run contact to clear a fault.

- If the controller has Software Version V1.35 or higher, the run contact can be connected in series with the Drive OK contact. Since the Drive OK contact is always open at power up, this method will ensure that the Run command is open at power up, thereby allowing line starting and Auto Reset functions without enabling line starting. This method is also a solution for supervisory logic that does not consistently open the run contact after AC line power is reapplied.

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SECTION VIII

SINGLE-PHASE OPERATION

ACX controllers rated 10HP or less can be operated from a 208/230 VAC single-phase power source. Controllers rated 1HP or less can be operated from a 115 VAC single-phase power source, provided the optional voltage doubler (Option 2XV) is used.

Single-phase operation requires the controller to be derated by 50%. For example, if a controller is rated 10HP with a three-phase input, it must be derated to 5HP with a single-phase input. Likewise, if the application requires a 5HP motor, a 10HP controller must be used for single-phase operation. For single-phase ratings, refer to the table on page 9-2.

POWER WIRING

Connect the AC lines to any two of the three controller input Terminals (R [L1] - S [L2] - T [L3]).

SET-UP INSTRUCTIONS

The following parameters must be set as described below. If these parameters are not set correctly, controller and/or motor failure can occur.

1. Parameter P06 (MOTOR FULL LOAD AMPS): Set Parameter P06 at the maximum setting of the acceptable range for the horsepower rating of the controller. For the Parameter P06 Acceptable Range, refer to the table on page 6-6. As an example, if the application requires a 5HP motor with a 10HP controller, set Parameter P06 at 30.8 (see page 6-6).

2. Parameter P09 (CURRENT LIMIT): Set Parameter P09 at 75.0. This setting limits motor current to 150% of rated for single-phase operation.

3. Parameter P35 (OVERLOAD THRESHOLD): Set Parameter P35 at 62.0. This setting provides an overload threshold of 125% of rated motor current for single-phase operation.

4. Parameter P36 (OVERLOAD TIME): Set Parameter P36 using the following equation:

$$P36 = \frac{(DesiredTripTime) \times (P09^2 - P35^2) \times 0.3}{P09^2}$$

where:

Desired Trip Time = The time (in seconds) that the drive takes to trip when it is operating under current limit. This time is normally set at 60 seconds.

P09 = Current limit parameter setting.

P35 = Overload threshold parameter setting.

Example: Assume an application requires a 10HP, 230V controller with a 5HP motor to operate with a single-phase input.

10HP current rating = 30.8 amps (see page 6-6).
5HP current rating = 16.8 amps (see page 6-6).

a. Set Parameter P06 = 30.8 (amps)
b. Set Parameter P09 = 75 (%). This setting limits motor current to 150% of rated for single-phase operation.
c. Set Parameter P35 = 62 (%). This setting provides an overload threshold of 125% of rated motor current for single-phase operation.
d.

$$P36 = \frac{(60) \times (75^2 - 62^2) \times 0.3}{75^2} = 5.69 \approx 6.$$

In this example, set P36 at 6.

5. Parameter P08 (SAVE PARAMETERS): Set Parameter P08 at 1. This setting saves parameter values that were changed for single-phase operation.

SECTION IX

RATINGS AND FUNCTIONAL SPECIFICATIONS

RATINGS

ACX RATINGS, 3-PHASE

MOTOR		CONTROLLER									
HP	KW	208/230/460 VAC 50/60 HZ INPUT VOLTAGE						OUTPUT (AMPS)			MODEL NUMBER
		208V 3-PHASE		230V 3-PHASE		460V 3-PHASE					
		KVA	INPUT AMPS	KVA	INPUT AMPS	KVA	INPUT AMPS	208V 3-PHASE	230V 3-PHASE	460V 3-PHASE	
1/6	0.12	0.50	1.4	0.56	1.4	NA	NA	0.94	0.85	NA	ACX2003
1/4	0.19	0.58	1.6	0.64	1.6	NA	NA	1.50	1.40	NA	
1/3	0.25	0.79	2.2	0.88	2.2	NA	NA	1.99	1.80	NA	
1/2	0.37	1.01	2.8	1.12	2.8	NA	NA	2.20	2.00	NA	ACX2010
3/4	0.56	1.44	4.0	1.59	4.0	NA	NA	3.10	2.80	NA	
1	0.75	1.73	4.8	1.83	4.6	NA	NA	3.98	3.60	NA	
		NA	NA	NA	NA	1.91	2.4	NA	NA	1.80	ACX4010
1-1/2	1.12	2.77	7.7	2.79	7.0	NA	NA	5.70	5.20	NA	ACX2015
		NA	NA	NA	NA	2.79	3.5	NA	NA	2.60	ACX4015
2	1.50	3.39	9.4	3.39	8.5	NA	NA	7.50	6.80	NA	ACX2020
		NA	NA	NA	NA	3.43	4.3	NA	NA	3.40	ACX4020
3	2.24	5.12	14.2	5.10	12.8	NA	NA	10.60	9.60	NA	ACX2030
		NA	NA	NA	NA	5.10	6.4	NA	NA	4.80	ACX4030
5	3.73	8.50	23.6	8.49	21.3	NA	NA	16.70	15.20	NA	ACX2050
		NA	NA	NA	NA	8.53	10.7	NA	NA	7.60	ACX4050
7-1/2	5.60	12.6	35.0	12.6	31.6	NA	NA	24.20	22.00	NA	ACX2075
		NA	NA	NA	NA	12.7	16.0	NA	NA	11.00	ACX4075
10	7.46	16.6	46.1	16.6	41.7	NA	NA	30.80	28.00	NA	ACX2100
		NA	NA	NA	NA	16.6	20.9	NA	NA	14.00	ACX4100
15	11.2	24.1	67.2	24.2	60.8	NA	NA	46.2	42.0	NA	ACX2150
		NA	NA	NA	NA	24.9	31.3	NA	NA	21.0	ACX4150
20	14.9	32.3	89.6	32.3	81.1	NA	NA	59.4	54.0	NA	ACX2200
		NA	NA	NA	NA	31.6	39.7	NA	NA	27.0	ACX4200

Continued on next page.

ACX RATINGS, 3-PHASE

MOTOR		CONTROLLER									
HP	KW	208/230/460 VAC 50/60 HZ INPUT VOLTAGE						OUTPUT (AMPS)			MODEL NUMBER
		208V 3-PHASE		230V 3-PHASE		460V 3-PHASE					
		KVA	INPUT AMPS	KVA	INPUT AMPS	KVA	INPUT AMPS	208V 3-PHASE	230V 3-PHASE	460V 3-PHASE	
25	18.6	39.9	111.0	39.9	100.0	NA	NA	74.8	68.0	NA	ACX2250
		NA	NA	NA	NA	39.7	49.8	NA	NA	34.0	ACX4250
30	22.4	47.9	133.0	47.9	120.0	NA	NA	88.0	80.0	NA	ACX2300
		NA	NA	NA	NA	47.6	59.7	NA	NA	40.0	ACX4300
40	29.8	NA	NA	NA	NA	63.5	79.6	NA	NA	52.0	ACX4400
50	37.3	NA	NA	NA	NA	79.0	99.1	NA	NA	65.0	ACX4500
60	44.8	NA	NA	NA	NA	94.8	119	NA	NA	77.0	ACX4600
75	56.0	NA	NA	NA	NA	118	149	NA	NA	96.0	ACX4750

ACX RATINGS, 1-PHASE[a]

MOTOR		CONTROLLER								
HP	KW	115/208/230 VAC 50/60 HZ INPUT VOLTAGE						OUTPUT (AMPS)		MODEL NUMBER
		115V 1-PHASE		208V 1-PHASE		230V 1-PHASE				
		KVA	INPUT AMPS	KVA	INPUT AMPS	KVA	INPUT AMPS	208V 3-PHASE	230V 3-PHASE	
1/6	0.12	Model ACX2003 With Option 2XV-03		0.42	2.0	0.44	1.9	0.94	0.85	ACX2003
1/4	0.19			0.52	2.5	0.55	2.4	1.50	1.40	
1/3	0.25			0.71	3.4	0.76	3.3	1.99	1.80	
1/2	0.37	Model ACX2010 With Option 2XV-10		0.99	4.8	1.10	4.8	2.20	2.00	ACX2010
3/4	0.56			1.54	7.4	1.54	6.7	3.10	2.80	ACX2015
1	0.75			2.00	9.6	2.00	8.7	3.98	3.60	ACX2020
1-1/2	1.12	NA	NA	2.91	14.0	2.92	12.7	5.70	5.20	ACX2030
2	1.50	NA	NA	3.58	17.2	3.57	15.5	7.50	6.80	ACX2050
3	2.24	NA	NA	5.35	25.7	5.36	23.3	10.60	9.60	ACX2075
5	3.73	NA	NA	8.92	42.9	8.92	38.8	16.70	15.20	ACX2100

a. Single-phase operation requires that the controller be derated by 50%. Refer to Section VIII, “Single-Phase Operation,” for information.

FUNCTIONAL SPECIFICATIONS

FUNCTION/FEATURE		SPECIFICATION
Control Characteristics	Line Voltage Variation	±10% of Rated
	Output Voltage	0-208/230/460VAC, 3-Phase
	Carrier Frequency	2.3 KHz Fixed
	Output Frequency Range	0 to 400Hz
	Frequency Resolution	Digital Input 0.01% of Maximum Frequency Analog Input 0.03% of Maximum Frequency
	Analog Reference	0-10VDC 4-20mA (Requires External 500 Ohm Resistor)
	Accel/Decel Time	Separate 0.1-999 Seconds (6.0-150 Seconds S-Curve[a])
	Braking Torque	Approximately 10%. Adjustable Level and Time Period
	V/F Pattern	21 Preprogrammed Patterns
	Efficiency (At Rated Speed, Rated Frequency)	Controller 95%
	Control Terminals	8 Terminals Isolated From Line Potential
Protection	Overload	150% for 1 Minute
	Overvoltage	DC Bus Exceeds 400VDC @ 230VAC Line, 775VDC @ 460VAC Line
	Undervoltage	DC Bus Below 184VDC @ 230VAC Line, 368VDC @ 460VAC Line
	Momentary Power Loss	0.1 Second Minimum
Operation	Digital Input Signals	2 Provided. Programmable Forward, Reverse, Stop
	Control Voltage	Supplied +24VDC (Isolated)
	Output Signal	1 Provided. Drive OK/Fault
	Built-in Features	Reverse Enable, Line Start
	Digital Keypad	Combined Digital Programming and Operator Panel
Environmental Conditions	Location	Indoor (Protected from Corrosive Gas and Dust)
	Ambient Temperature	32°F to 104°F (0°C to 40°C)
	Humidity	0-95% (Noncondensing)
	Altitude	3300 Feet (1000M) Maximum Above Sea Level
Enclosure		NEMA 1
Codes		UL, cUL Listed

a. With software version 1.00, the S-Curve accel/decel time is 2.0-120 seconds.

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SECTION X

FAULT CODES

If a fault occurs, the fault code will flash on the keypad display. The value of all parameters will be at their last value before the fault occurred. These values can be examined until the fault is cleared.

If Auto Restart has been enabled, the controller will flash "**ArX**" on the display (where **X** equals the number of the restart being performed). After the Restart Delay, the controller will reset and if the fault has cleared, the drive will restart.

Note: The controller must be configured for Line Starting (see Parameter P33) to enable Auto Restart. If Line Starting is not enabled, the controller will automatically clear the fault and the drive must be restarted manually. If the maximum number of restarts (entered in Restart Tries Parameter P37) is reached, the display will flash the last fault that occurred and a manual reset, or removing and reapplying power, will be required to allow further operation.

The controller contains a Drive OK/Fault contact which is closed whenever power is applied to the controller and the drive is not faulted. This contact (Terminals 2 and 3) will open if a fault occurs. The contact is rated 0.5A at 125VAC and 2.0A at 30VDC.

The fault can be cleared by one of the following methods:

- Pressing the STOP key on the ACX keypad panel.
- Pressing the Stop button on a remote operator control station.
- Opening and closing the Run contact if in the Line Starting Mode.
- Removing and reapplying AC power.

The chart in Section XI (page 11-1) describes the various fault codes, their possible causes, and recommended actions.

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SECTION XI

TROUBLESHOOTING

FAULT CODE	DESCRIPTION	POSSIBLE CAUSE	RECOMMENDED SOLUTIONS
F01	DC Bus Overcurrent	Drive is trying to accelerate the load too quickly	Extend Acceleration Time (Parameter P04). Note: It may be necessary to extend Deceleration Time (Parameter P05) as well.
		Phase to phase short in motor or motor leads	Check motor leads and wiring.
F02	DC Bus Overvoltage	Line voltage is too high	Check that the line voltage is not higher than the controller rating.
		Drive deceleration time is shorter than the load can be stopped.	The load may be decelerating too quickly. Extend the Deceleration Time (Parameter P05) to accommodate the high inertia load.
F03	Motor Overload	Excessive motor current	Check for mechanical problems that may be causing the overload.
			If the overload is continuous, a higher rated controller and motor may be required.
			Disconnect the motor from the controller, and check that the resistance between motor leads is within 5%. If motor windings are shorted, repair or replace the motor.
			Check that Motor Rated Amps Parameter P06 is set correctly.
		If DC injection braking is selected (Parameter P17 or P18=1), Parameter P19 and/or Parameter P20 may be set too high	Reduce the value of P19 and/or P20.
F05	EEPROM Read Failure	Internal controller fault	Shut off the AC line power, wait 5 minutes and reapply power. If problem persists, replace the controller.
F06	EEPROM Write Failure		
F07	Low Bus Voltage	Low line voltage	Check that the line voltage meets controller rating.

(Continued on next page)

FAULT CODE	DESCRIPTION	POSSIBLE CAUSE	RECOMMENDED SOLUTIONS
F08	Drive Enable Fault	Internal controller fault	Shut off the AC line power, wait 5 minutes and reapply power. If problem persists, replace the controller.
F09	EEPROM Acknowledge Fault		
F10	EEPROM Not Responding		
F11	PWM Generator Fault		
F12	Bad Opcode		
F13	Trap		
F15	ADC (Analog-To-Digital) Fault	Microprocessor failure	Drive reset required. See page 12-1. If the fault repeats, replace the controller.
rSt	Drive Reset	Programming error	Drive reset required. See page 12-1.

If the keypad display goes blank, reset the drive by removing the AC supply to the controller, waiting 5 minutes, and then reapplying the AC supply.

If the blank display condition recurs, or if the drive resets unexpectedly, check for electrical noise being induced into the control or signal wiring connected to the controller. To minimize electrical noise induction, use shielded cables. If shielded cables are used, connect the shields to the controller ground terminal, and tape the opposite ends of the shields. Do not connect the shields at both ends.

SECTION XII

DRIVE RESET

Resetting the drive is required to allow certain parameter changes to take effect (the keypad display will flash "rSt"). Any parameter changes must be saved to memory (Parameter P08) before resetting the drive. When the display flashes "rSt" or a fault code "FXX" occurs, perform the following:

1. Press the STOP key on the controller keypad while the display is flashing.

   Note: If the drive is in a Run Mode when the STOP key is pressed, wait until the motor stops rotating, and then press the STOP key again. When the STOP key is pressed the second time, the keypad display may either flash "rSt" or go blank for several seconds while the drive resets.

2. If the display flashes an "FXX" fault code, the drive may also be reset by opening and closing a maintained external run contact or by pressing an external Stop button (if used).

Either of these following methods will reset the drive when the display is not flashing:

1. Remove AC line power, wait 5 minutes, and then reapply power to the controller.

2. Change Parameter P97 to 1.

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SECTION XIII

OPTIONS (FIELD INSTALLED KITS)

FOR 1/6 - 1HP, 230V CONTROLLERS

DIN DIN RAIL MOUNTING
Provides a bracket that attaches to the bottom of the ACX Controller and enables the ACX to be mounted on a standard 35mm DIN rail.

DMK DOOR MOUNTING KIT
Provides a bracket and gasket to expose the keypad through an enclosure or panel door.

LSP POTENTIOMETER (MOTOR SPEED)
For local mounting in the Conduit Box Option (WBX). The potentiometer is 1/2W, 5K Ohms, Single Turn.

WBX CONDUIT BOX
Provides a bracket for attaching two conduit connectors to the basic ACX Controller. This bracket will partially cover the opening to the power and control wiring.

WD WASHDOWN DUTY
Provides the ACX Controller in a rugged NEMA 4/12 enclosure with an analog speed pot and a Run/Stop switch or with a blank front panel.

2XV 115VAC SINGLE PHASE VOLTAGE DOUBLER
Allows the use of 115VAC single phase power to the ACX Controller. Two models are available: 2XV-03 for up to 1/3HP and 2XV-10 for up to 1HP.

FOR 1-1/2 - 30HP, 230V CONTROLLERS AND 1 - 75HP, 460V CONTROLLERS

CBH AC LINE CIRCUIT BREAKER WITH HANDLE

Provides a three-pole magnetic only, fast-trip circuit breaker for manually disconnecting the drive from the AC line. The handle is cover mounted.

EB ELECTRONIC BRAKING

Provided in a ventilated enclosure designed for separate mounting. The braking circuit is rated for stopping a typical load a maximum number of two stops per minute from motor base speed. A typical load is defined as:

- Not exceeding rated load torque.
- External load inertia (beyond the motor shaft) not exceeding that of the motor rotor.

Braking time should not exceed four seconds per stop. High inertia loads may extend braking times beyond the wattage rating of the power dissipation resistor(s). The braking circuit is not rated for continuous regeneration and should be used only where intermittent control of overhauling loads is required. The braking circuit is not a holding brake; it will not prevent a motor at rest from rotating.

HOA HAND-OFF-AUTO SWITCH

Provides a three-position switch and legend plate to select between a user supplied manual speed control potentiometer and an automatic speed reference. Option HOA can be used with Magnetic Bypass (MB) or as a stand alone option.

LC AC LINE CONTACTOR

Provides an AC line disconnect for the ACX Controller.

LCE INPUT LINES CHOKES (ENCLOSED)

This is Option LCO mounted in a NEMA 1 enclosure.

LCO INPUT LINE CHOKES (OPEN)

Includes an assembly with three AC line reactors (chokes rated 3% impedance) connected in series with the AC supply lines. They are furnished for separate mounting. These reactors oppose rapid line current changes and surges and help protect the controller from transients.

This option is not normally needed when a controller is connected to the AC supply through an isolation transformer. However, this option is suggested whenever:

- The KVA of the AC power supply is greater than three times the KVA rating of the controller.
- Additional transient voltage surge protection is desirable.
- It is desirable to isolate inverter ripple currents from the AC line.

- Harmonic distortion must be reduced.

This option should not normally be used in combination with Option LFO (Output Line Filter).

LFE OUTPUT LINE FILTER (ENCLOSED)
This is Option LFO in a NEMA 1 enclosure.

LFO OUTPUT LINE FILTER (OPEN)
This option filters the AC output to provide the following benefits:

- Quiet motor operation at low carrier frequencies.
- Elimination of ground fault due to DV/DT.
- Reduced DV/DT stress on motor windings at higher carrier frequencies.
- Reduced electrical interference.

Since this option represents a 3% output impedance, it may not be acceptable in applications characterized by low line voltage, heavy loading, and high speeds, or in combination with Input Line Chokes.

LSP LOCAL SPEED POTENTIOMETER
Provides a speed control potentiometer for local mounting on the cover of the ACX Controller. This potentiometer is 1/2W, 5K ohms, single turn.

MB COMPLETE MAGNETIC BYPASS
Bypasses the ACX Controller and connects the motor directly to the AC line. Three contactors are included, and the ACX is isolated in the Bypass mode. AC line disconnect with fuses and motor overload are included.

MC MOTOR CONTACTOR
Provides an AC output contactor that is coordinated with the ACX electronics to ensure a safe, reliable shut-down and a positive disconnection of the motor from the ACX Controller.

OR OVERLOAD RELAY
Includes a three-pole overload relay. Motor full-load current must match listed adjustment range.

WD WASHDOWN DUTY
Provides the ACX Controller in a rugged NEMA 4/12 enclosure with an analog speed control potentiometer and a Run/Stop switch or with a blank front panel.

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