

E-Flex™

Adjustable Speed Drive Controllers for HVAC and Pumping Applications

Instruction Bulletin

30072-451-51D

Retain for future use.



TABLE OF CONTENTS

	Hazard Categories and Special Symbols	8
	Product Support	8
	Qualified Personnel	9
SECTION 1:	INTRODUCTION AND TECHNICAL CHARACTERISTICS	11
	Introduction	11
	Related Documentation	11
	Terminology	11
	Before You Begin	12
	Catalog Numbers	14
	Nameplate Identification	15
	Component Locations	16
	Technical Characteristics	19
	Drive Ratings	19
	Input Current Ratings	21
	Specifications	25
	Short Circuit Ratings	26
	Standard Features	26
	Factory Modifications	27
	Control Options	27
	Light Options	28
	Misc. Options	29
	Dimensions and Weight for Wall Mounting	30
	Total Dissipated Watts Loss	34
SECTION 2:	RECEIVING, INSTALLATION, AND START-UP	35
	Preliminary Inspection	35
	Handling the Drive	36
	Installation	37
	Mechanical Installation	37
	Seismic Qualification Mounting Criteria	37
	Electrical Installation	38
	General Wiring Practices	38
	Input Power	38
	Branch Circuit Connections	38
	Input Wiring	39
	Grounding	39
	Wiring and Electromagnetic Compatibility	40
	Output Wiring	41
	Output Cable	41
	DC Bus Voltage Measurement Procedure	42
	Wire Routing and Interconnection	44
	Wire Class	44
	Noise Class	44
	Voltage Class	44
	Wiring Methods	45
	Component Identification and Terminal Strip Locations	46
	Power Wiring	51

Control Wiring	54
Initial Start-up Procedure	56
Circuit Breaker Trip Adjustment Procedure	61
SECTION 3: CIRCUIT DESCRIPTIONS AND OPTIONS	63
Introduction	63
Terminal Versus Keypad Command Operation.....	63
Graphic Display Terminal Operation	63
Type 3R Operation	63
Reset After Clearing a Fault	64
Power Circuit W (Without Bypass)	64
Operator Controls—General Arrangement and Operation	64
Controller Operation	64
Fire/Freezestat Interlocks	64
MOD A07	
Hand-Off-Auto Selector and Manual Speed Potentiometer	65
MOD B07	
Hand-Off-Auto Selector, Start/Stop Push Buttons, and Manual Speed Potentiometer	65
MOD C07	
Start/Stop Push Buttons and Manual Speed Potentiometer	66
MOD D07	
Hand-Off-Comm Selector and Manual Speed Potentiometer	66
MOD E07	
Hand-Off-Comm Selector, Start/Stop Push Buttons, and Manual Speed Potentiometer	66
MOD N07	
No Operators; Wired for Remote Operation	67
MOD A08	
Pilot Light Option #1 Cluster	67
MOD C08	
Pilot Light Option #3 Cluster	67
MOD A09	
5% Line Reactor	67
MOD C09	
3–15 PSI Transducer with Digital Display Option	67
MOD D09	
Omit Graphic Display Terminal	67
MOD E09	
Smoke Purge Option (Fireman’s Override)	68
MOD F09	
Profibus	68
MOD H09	
I/O Extension Card	68
MOD J09	
0–10 V Auto Speed Reference	68
MOD K09	
cUL Listing	68
MOD L09	
LonWorks®	68
MOD M09	
Modbus®	68
MOD O09	
Apogee™ P1	68

MOD P09	
Metasys® N2	68
MOD Q09 Ethernet	68
MOD R09 BACnet	68
MOD S09	
End Damper Control	68
MOD T09	
Service Entrance Rating	68
MOD U09	
Seismic Qualified	68
MOD X09	
3% Line Reactor	69
Power Circuit Y	
(Bypass)	69
Operator Controls—General Arrangement and Operation	69
Test-Normal Operation (Bypass only)	69
Bypass Operation	70
Fire/Freeze Stat Interlocks	71
MOD AO7	
Hand-Off-Auto Selector and Manual Speed Potentiometer	71
MOD BO7	
Hand-Off-Auto Selector, Start/Stop Push Buttons, and Manual Speed Potentiometer	72
MOD D07	
Hand-Off-Comm Selector and Manual Speed Potentiometer	73
MOD E07	
Hand-Off-Comm Selector, Start/Stop Push Buttons, and Manual Speed Potentiometer	73
MOD N07	
No Operators; Wired for Remote Operation	74
MOD A08	
Pilot Light Option #1 Cluster	74
MOD B08	
Pilot Light Option #2 Cluster	74
MOD A09	
Line Reactor	74
MOD B09	
Line Contactor	74
MOD C09	
3–15 PSI Transducer with Digital Display Option	74
MOD D09	
Omit Graphic Display Terminal	74
MOD E09	
Smoke Purge Option (Fireman’s Override)	75
MOD F09	
Profibus	75
MOD H09	
I/O Extension Card	75
MOD J09	
0–10 V Auto Speed Reference	75
MOD K09	
cUL Listing	75
MOD L09	
LonWorks®	75
MOD M09	
Modbus®	75




MOD O09	
Apogee™ P1	75
MOD P09	
Metasys® N2	75
MOD Q09	
Ethernet	75
MOD R09	
BACnet	75
MOD S09	
End Damper Control	75
MOD T09	
Service Entrance Rating	76
MOD U09	
Seismic Qualified	76
MOD X09	
3% Line Reactor	76
SECTION 4: PROPORTIONAL–INTEGRAL–DERIVATIVE CONTROL	77
Introduction	78
Scaling of PID Parameters	79
PID Tuning	79
Setting PID control	81
Drive Configuration	82
Control Wiring Modifications	83
Hand-Off-Auto SELECTOR SWITCH WIRING	84
SECTION 5: TROUBLESHOOTING AND MAINTENANCE	87
Introduction	89
External Signs of Damage.....	89
Preventive Maintenance	89
Product Support.....	90
Service (On-Site)	90
Customer Training	90
E-FLEX TROUBLESHOOTING SHEET	91
DRIVE CONFIGURATION	91
MOTOR NAMEPLATE DATA	91
POWER SOURCE AND ENVIRONMENT	91
DRIVE DETECTED FAULT CODES	91
DETAILED DESCRIPTION OF PROBLEM	91
Field Replacement Procedures.....	92
Field Replacement of the Power Converter	92
Removing the Power Converter Assembly	92
Installing the Power Converter Assembly	94
Field Replacement of Heatsink Fan Assembly	95
Removing the Heatsink Fan Assembly	95
Installing the Heatsink Fan Assembly	96
Field Replacement of the Stirring Fans	96
Field Replacement of the Ventilation Fan on Type 3R	97
Field Replacement of the Space Heater on Type 3R	97
Field Maintenance and Replacement of Hood Filters on Type 3R	97
SECTION 6: POWER AND CONTROL CIRCUIT ELEMENTARY DIAGRAMS	99
APPENDIX A: RENEWABLE PARTS	119

HAZARD CATEGORIES AND SPECIAL SYMBOLS

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of the lightning bolt or ANSI man symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exist which, as indicated below, can or will result in personal injury if the instructions are not followed.

The exclamation point symbol is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Symbol	Name
	Lightning Bolt
	ANSI Man
	Exclamation Point

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** property damage.

PRODUCT SUPPORT

For support and assistance, contact the Product Support Group. The Product Support Group is staffed from Monday through Friday, 8:00 am until 6:00 pm Eastern time, to assist with product selection, start-up, and diagnosis of product or application problems. Emergency phone support is available 24 hours a day, 365 days a year.

Toll free: 888-SquareD (888-778-2733)

E-Mail: drive.products.support@us.schneider-electric.com

Fax: 919-217-6508

QUALIFIED PERSONNEL

For the protection of personnel and equipment, a qualified person must perform the procedures detailed in this instruction bulletin.

A qualified person is one who has skills and knowledge related to the construction and operation of this electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved. Refer to the most current release of NFPA 70E®, “Standard for Electrical Safety in the Workplace,” for safety training requirements.

In addition, the person must be:

- Able to read, interpret, and follow the instructions and precautions in this instruction bulletin and the other documentation referenced.
- Able to use the required tools listed in this instruction bulletin in a safe and correct manner.

SECTION 1— INTRODUCTION AND TECHNICAL CHARACTERISTICS

INTRODUCTION

The E-Flex enclosed drives are tailored for commercial market specifications in wall-mounted Type 1, Type 12K, or Type 3R enclosures. With a circuit breaker disconnect, these drives can be configured with or without bypass.

This instruction bulletin covers receiving, installation, start-up, configuration, and troubleshooting of the 1 to 100 hp, 460 V and 1 to 50 hp, 208/230 V variable torque E-Flex drives.

RELATED DOCUMENTATION

For further information, refer to the latest revision of the following instruction bulletins which ship with the drive when the corresponding option is selected and are available from the Technical Library at www.Schneider-Electric.us.

Table 1: Instruction Bulletins

Bulletin No.	Title
1760643 (VT)	<i>Installation Manual, 0.5–60 hp, 230 V and 0–100 hp, 460 V</i>
1760649 (VT)	<i>Programming Manual</i>
1755861	<i>Communication Parameters</i>
W817574030111	<i>Altivar 61 CD-ROM</i>
30072-200-50	<i>Handling, Installation, Operation, and Maintenance of Electrical Control Equipment</i>
1755867 30072-451-27	<i>Modbus/Unitelway™ Card, VW3A3303 Supplementary Instructions for ATV71 Option Cards</i>
AAV33578	<i>Option Card (Metasys® N2 Card, VW3A3313)</i>
1755879	<i>Ethernet Modbus TCP/IP Card, VW3A3310D</i>
1765273	<i>Option Card (LonWorks® Card, VW3A3312)</i>
1755877 30072-451-27 30072-451-44	<i>DeviceNet™ Card, VW3A3309 Supplementary Instructions for ATV71 Option Cards Addendum to ATV71 DeviceNet™ Card</i>
1755873 30072-451-27 30072-451-45	<i>Profibus DP Card, VW3A3307 Supplementary Instructions for ATV71 Option Cards Addendum to ATV71 Profibus™ DP VW3A3307</i>
—	<i>I/O Extension Card, VW3A3202: Refer to the Installation Manual.</i>
BBV10543	<i>Option Card (Apogee P1 Card, VW3A3314)</i>
1765274	<i>Option Card (BACnet Card, VW3A3315)</i>
1754480	<i>Option Card (Ethernet IP, VW3A3316)</i>

TERMINOLOGY

The following terminology is used throughout this instruction bulletin in reference to the E-Flex drives. These terminology distinctions are made to minimize confusion when discussing installation and adjustment practices.

When used as a component of the E-Flex drive, devices with part numbers beginning in ATV61 are referred to as *power converters*.

The combination of the power converter, the enclosure, and the power and control circuits that constitute the E-Flex product is referred to as the *drive*, the *controller*, or the *adjustable frequency controller (AFC)*.

BEFORE YOU BEGIN

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand this bulletin in its entirety before installing or operating E-Flex drives. Installation, adjustment, repair, and maintenance of the drives must be performed by qualified personnel.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive, including printed wiring boards, operate at line voltage. **DO NOT TOUCH.** Use only electrically insulated tools.
- **DO NOT** short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Before servicing the drive:
 - Disconnect all power including external control power that may be present before servicing the drive.
 - Place a “DO NOT TURN ON” label on the drive disconnect.
 - Lock disconnect in the open position.
 - **WAIT 15 MINUTES** for the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure on page 42 to verify that the DC voltage is less than 42 V. The drive LEDs are not indicators of the absence of DC bus voltage.
- Install and close all covers before applying power or starting and stopping the drive.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

For 460 V units:

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Never operate energized switch with door open.
- Turn off switch before removing or installing fuses or making load side connections.
- Always use a properly rated voltage sensing device at all line and load fuse clips to confirm switch is off.
- Turn off power supplying switch before doing any other work on or inside switch.
- Do not use renewable link fuses in fused switches.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

For 208 and 230 V units:

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside the equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

UNINTENDED EQUIPMENT OPERATION

Before turning on the drive or upon exiting the configuration menus, ensure that the inputs assigned to the Run command are in a state that will not cause the drive to run. Otherwise, the motor can start immediately.

Failure to follow these instructions will result in death, or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of anticipated transmission delays or failures of the link¹.
- Each implementation of an E-Flex enclosed drive must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

¹ For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems."

⚠ CAUTION

INCOMPATIBLE LINE VOLTAGE

Before turning on and configuring the drive, ensure that the line voltage is compatible with the line voltage range specified on the drive nameplate. The drive can be damaged if the line voltage is not compatible.

Failure to follow these instructions can result in injury or equipment damage.

Follow these precautions before installing the E-Flex drive:

- The Type 1 or Type 3R controller is suitable for installation in a Pollution Degree 2 environment as defined in NEMA ICS1 and IEC 90664-1. The Type 12K controller is suitable for installation in a Pollution Degree 3 environment as defined in NEMA ICS1 and IEC 90664-1. The expected environment must be compatible with this rating.
- When attaching wall-mountable controllers to their mounting surfaces, use fasteners rated for the weight of the apparatus, the expected shock and vibration of the installation, and the expected environment.
- Provide sufficient cooling for the expected heat load. Refer to Tables 15–17 on page 34.

CATALOG NUMBERS

The controller catalog number, located on the nameplate on the inside of the door, is coded to describe the configuration and options present. Use the following grid to translate the catalog number into a description of the drive.

Class Type

8839	EFD	•	•	•	V	•
	①	②	③	④	⑤	⑥

Modifications

Control	Light	Misc.
•	•	•
⑦	⑧	⑨

① Product

Code	Drive Type
EFD	E-Flex Controller

② Horsepower Code

Code	hp Rating	Code	hp Rating
C	1 hp	L	25 hp
D	2 hp	M	30 hp
E	3 hp	N	40 hp
F	5 hp	P	50 hp
G	7.5 hp	Q	60 hp (460 V only)
H	10 hp	R	75 hp (460 V only)
J	15 hp	S	100 hp (460 V only)
K	20 hp		

③ Enclosure Type

Code	Environment Rating
A	Type 12K
G	Type 1
H ^[5]	Type 3R

④ Voltage Rating

Code	Voltage
2	208 V
3	230 V
4	460 V

⑤ Application Type

Code	Applied Rating
V	Variable Torque

⑥ Device Type

Code	Power Circuit
W ^[5]	Without Bypass
Y ^[8]	Bypass

- [1] Control option C07 (Start/Stop, Speed Potentiometer) is not compatible with Power Circuit Y (Bypass) or light cluster A08 or B08.
- [2] Light cluster A08, B08, and C08 cannot be selected together. Select only one.
- [3] Light cluster B08 is not compatible with Power Circuit W (Without Bypass).
- [4] Light cluster C08 is not compatible with A07 (Hand/Off/Auto, Speed Potentiometer), or B07 (Hand/Off/Auto, Start/Stop, Speed Potentiometer).
- [5] Line contactor B09 is not compatible with this option.
- [6] Smoke purge E09 permits the motor to run at full speed.
- [7] Place the Hand-Off-Auto switch in the Off position for AFC reset after detected fault is cleared.
- [8] Includes AFC/Off/Bypass switch and Test/Normal switch.
- [9] E07 or D07 must be selected for control. A07 or B07 may be used for monitoring only.
- [10] 3–15 PSI Transducer C09 is not compatible with Start/Stop, Speed Potentiometer C07, 0–10 V Auto Speed Reference J09, or Analog Card H09.

⑦ Control Option

Code	AFC Controls
A07 ^[7]	Hand/Off/Auto, Speed Potentiometer
B07 ^[7]	Hand/Off/Auto, Start/Stop, Speed Potentiometer
C07 ^[11]	Start/Stop, Speed Potentiometer
D07 ^[15]	Hand/Off/Comm, Speed Potentiometer
E07 ^[15]	Hand/Off/Comm, Start/Stop, Speed Potentiometer
N07	No operators; wired for remote operation

⑧ Light Option

Code	Light Cluster
A08 ^[2]	Red Power On
	Green AFC Run
	Yellow AFC Fault
B08 ^{[2], [3]}	Yellow Auto
	Red Power On
	Green AFC Run
	Yellow AFC Fault
C08 ^{[2], [4]}	Yellow Bypass
	Red Power On
	Green AFC Run
	Yellow AFC Fault

⑨ Misc. Options

Code	Feature
A09	Line Reactor, 5%
B09	Line Contactor
C09 ^[10]	3–15 PSI Transducer
D09 ^[13]	Omit Door-Mounted Graphic Display Terminal
E09 ^[6]	Smoke Purge (Fireman's Override)
F09 ^{[9], [14]}	Profibus
H09 ^[11]	I/O Extension: 4 logic inputs, 2 logic outputs, 2 analog inputs, 1 differential analog output
J09 ^[12]	0–10 Vdc Auto Speed Reference
K09	cUL Listing
L09 ^{[14], [9]}	LonWorks
M09 ^{[14], [9]}	Modbus [®] / Unitelway
O09 ^{[9], [14]}	Apogee™ P1
P09 ^{[14], [9]}	Metasys [®] N2
Q09 ^{[9], [14]}	Ethernet
R09 ^{[9], [14]}	BACnet
S09	End Damper Control
T09 ^[16]	Service Entrance Rating
U09	Seismic Qualified
V09	Ethernet IP
X09	Line Reactor, 3%

- [11] I/O Extension Card H09 is not compatible with 3–15 PSI Transducer C09.
- [12] 0–10 V Auto Speed Reference J09 is not compatible with C07 Start/Stop Potentiometer or C09 3–15 PSI Transducer.
- [13] Omit the keypad D09. User must buy separate device to program the controller.
- [14] Serial communication F09, L09, M09, O09, P09, Q09, and R09 cannot be selected together. Select only one. Serial communication cannot be selected with H09.
- [15] 3–15 PSI Transducer C09 and 0–10 Vdc Auto Speed Reference J09 are not available with D07 and E07.
- [16] Available only with NEMA Type 3R configurations.

NAMEPLATE IDENTIFICATION

The nameplate for the E-Flex drive is located on the inside of the door. This nameplate, shown in Figure 1, identifies the controller class, type, and modification (options) listing. When identifying or describing E-Flex drives, use the data from this nameplate.

Figure 1: E-Flex Nameplate

The nameplate is a black rectangular plate with white text and boxes. It features the Square D logo, E-Flex™ logo, and UL logo. The main title is 'ALTIVAR MOTOR CONTROLLER'. Below this, it lists various technical specifications in a grid-like format, including input and output ratings, current ratings, and wiring information. Callouts on the left and right sides point to specific fields on the nameplate.

Options (MOD) Code	[]		SQUARE D	E-FLEX™	UL	LISTED IND. CONT. EQ.
Class Number	CLASS 8839		SER B	POWER CONVERTER ATV61HD18N4		
Controller Type Code	TYPE EFDMG4VY		MOD A07			
Permissible Input Voltage	INPUT VOLTS 460 ± 10 %		PH 3	Hz 60		
Maximum Input Current Ratings	33.7 AMPS AT 100 KA 460 volts SHORT-CIRCUIT RATING with 3% DC Choke					
	AMPS AT 100 KA 460 volts SHORT-CIRCUIT RATING with 5% Line Reactor					
	OUTPUT AT 8 KHz SWITCHING FREQUENCY					
	VOLTS 0-460 ±10 %		PH 3	Hz 0-60		AMPS 40.0
Power (Line) Circuit Breaker	OVERLOAD CAPACITY 0		AMPS FOR 60 S		HP / KW 30/22	
Control Transformer Primary Fuses	CIRCUIT BREAKER HLL36100LV		TRANSFORMER FUSES PRIMARY 1.0		CLASS CC, 600 V, TIME-DELAY SECONDARY 1.4	
Line Terminations	ENCLOSURE TYPE 1		OVERLOAD RELAY CLASS 20		WIRE TYPE / TEMPERATURE 75° C CU	
	POWER WIRING AWG #14 - #10 TORQUE lb-in 50		LINE AWG #8 - 3/0 TORQUE lb-in 120		LOAD AWG #14 - 1/0 TORQUE lb-in 50	
Factory Order Number (Q2C and item number)	REFERENCE MANUALS 30072-451-51 Instruction Bulletin					
	MADE IN USA		46	50015325003	6010	80461 - 035 - 01

Callouts on the right side of the nameplate include: Power Converter Part Number, Input Frequency, Max. Continuous Output Current, Motor Rating, Control Transformer Secondary Fuse, Load Terminations, and Date Code.

COMPONENT LOCATIONS

Figure 2: Typical Type 1/12K Front Component Locations for Controller: 1–100 hp @ 460 V and 1–50 hp @ 208/230 V (Class 8839 Type EFDG4VY, Mods: B07, B08, A09, C09, E09, and P09 shown)

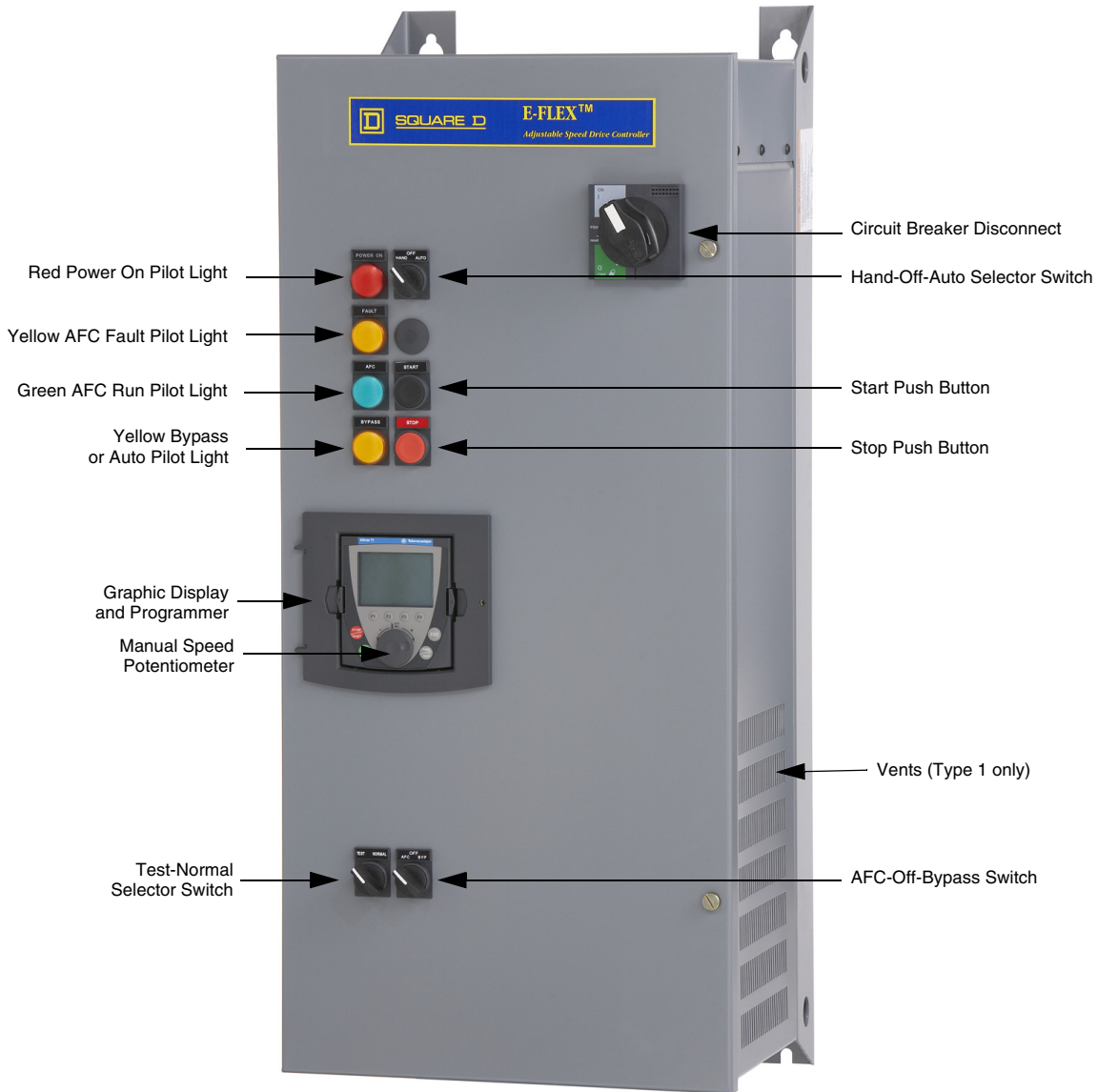


Figure 3: Typical Type 3R Front Component Locations for Controller: 1–100 hp @ 460 V and 1–50 hp @ 208/230 V (Class 8839 Type EFDKH2VY, Mods: B07, B08, A09, E09, J09, and F09 shown)

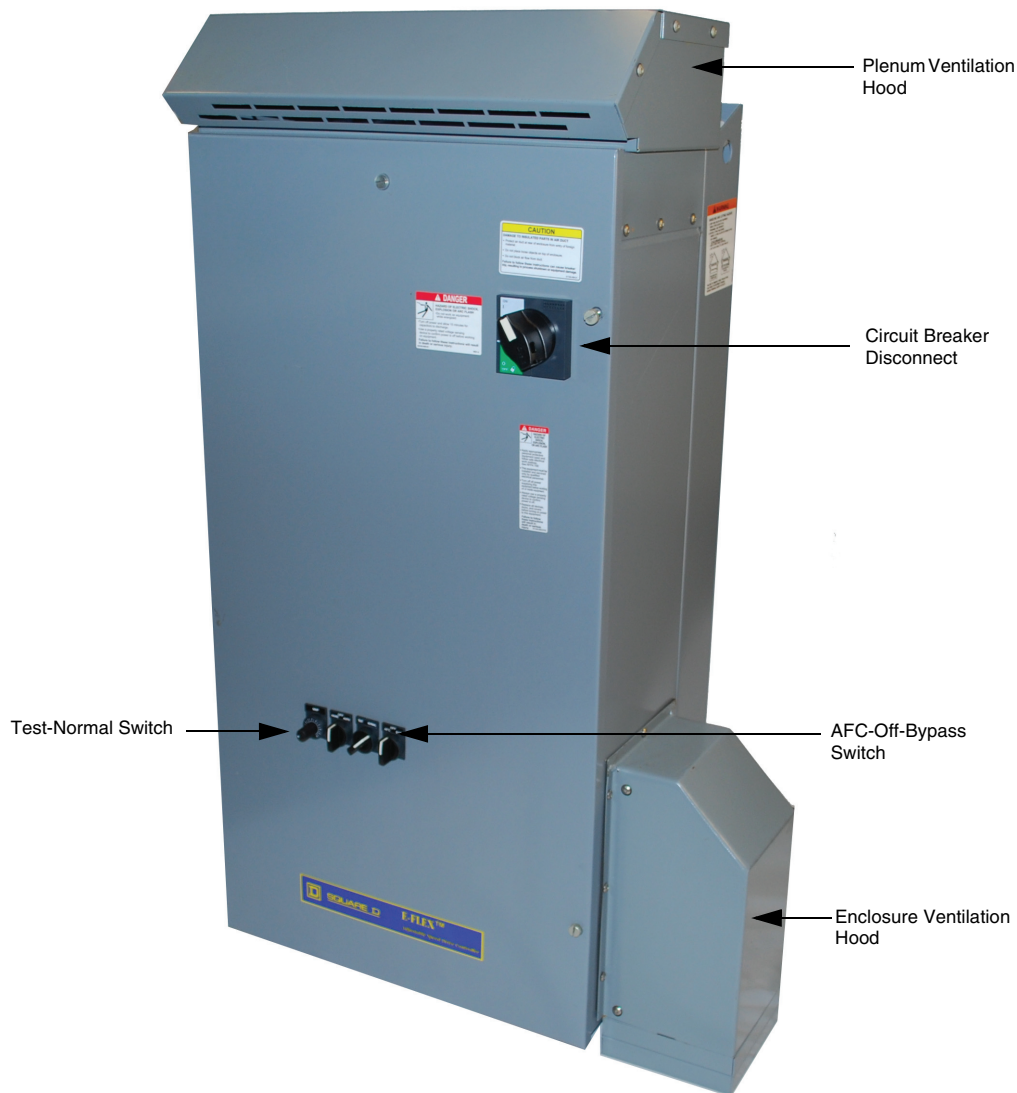
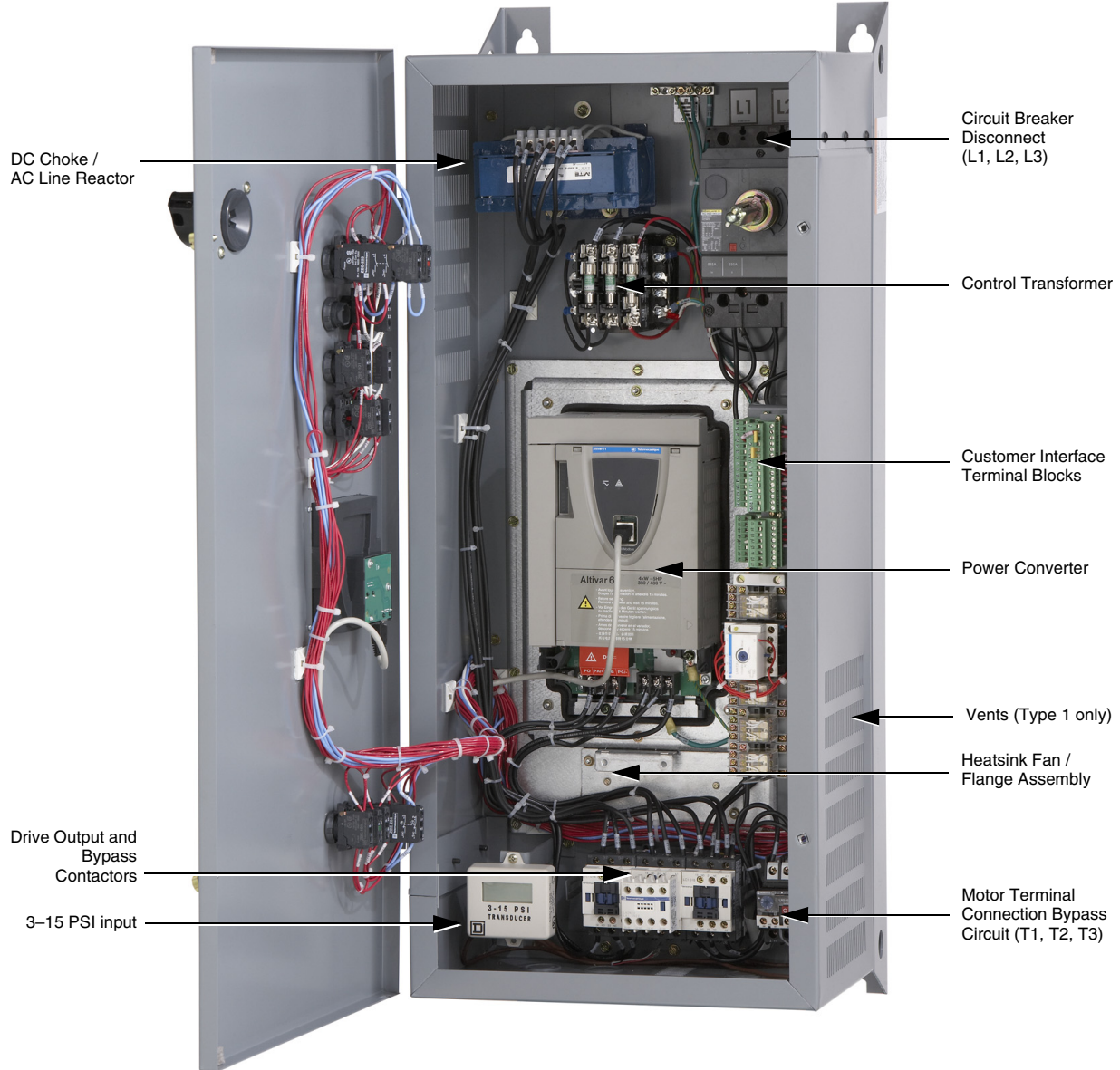


Figure 4: Typical Inside Component Locations for Controller: 1–100 hp @ 460 V and 1–50 hp @ 208/230 V (Class 8839 Type EFDG4VY, Mods: B07, B08, A09, C09, E09, P09, and X09 shown)



TECHNICAL CHARACTERISTICS

DRIVE RATINGS

Table 2: E-Flex Drive Ratings, 460 V

Drive Catalog Number ¹	Motor Power ² 460 V 60 Hz (hp)	Max. Continuous Output Current ³ (A)	Max. Transient Output Current (60 s) (A)	Power Converter Part Number ⁴
EFDC•4V_	1	2.1	2.3	ATV61H075N4
EFDD•4V_	2	3.4	3.7	ATV61H015N4
EFDE•4V_	3	4.8	5.3	ATV61HU15N4
EFDF•4V_	5	7.6	8.4	ATV61HU30N4
EFDG•4V_	7.5	11	12.1	ATV61HU40N4
EFDH•4V_	10	14	15.4	ATV61HU55N4
EFDJ•4V_	15	21	23.1	ATV61HU75N4
EFDK•4V_	20	27	29.7	ATV61HD11N4
EFDL•4V_	25	34	37.4	ATV61HD15N4
EFDM•4V_	30	40	44.0	ATV61HD18N4
EFDN•4V_	40	52	57.2	ATV61HD22N4
EFDP•4V_	50	65	71.5	ATV61HD30N4
EFDQ•4V_	60	77	84.7	ATV61HD37N4
EFDR•4V_	75	96	105.6	ATV61HD45N4
EFDS•4V_	100	124	136.4	ATV61HD55N4

¹ "•" can be "A", "G", or "H". "A" denotes a Type 12K enclosure; "G" denotes a Type 1 enclosure; "H" denotes a Type 3R enclosure. "_" indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.

² Power shown is for a carrier switching frequency of 8 kHz. For a switching frequency between 12 and 16 kHz, select the next largest size drive. If the duty cycle does not exceed 60% (36 s maximum for a 60 s cycle) this is not necessary.

³ Continuous output current is based on NEC 2005 table 430.250. The E-Flex controller nameplate rating conforms to the NEC table, not the current value listed in the graphic display lookup table.

⁴ All E-Flex adjustable speed drives use the ATV61 (or HTV61) power converter in a customized hardware and software configuration in which the product gains a horsepower rating for devices configured in IP00 with a DC choke (or 3% line reactor). 3% impedance may be internal or external to the power converter or a combination of internal and external impedances to total 3%. The power converter is programmed by quality assurance personnel so that these settings match NEC2005 Table 430.250 for 460 V and 230 V configurations only. The hp/kW sticker (or imprint) on the cover of the power converter component may not reflect the marking of the enclosed device. However, the graphic display terminal reflects the correct rating and matches the enclosed drive nameplate. Use the graphic display terminal to observe the horsepower rating for the application.

Table 3: E-Flex Drive Ratings, 230 V

Drive Catalog Number ¹	Motor Power ² 230 V 60 Hz (hp)	Max. Continuous Output Current ³ (A)	Max. Transient Output Current (60 s) (A)	Power Converter Part Number ⁴
EFDC•3V_	1	4.2	4.6	ATV61H075M3
EFDD•3V_	2	6.8	7.5	ATV61HU15M3
EFDE•3V_	3	9.6	10.5	ATV61HU15M3
EFDF•3V_	5	15.2	16.7	ATV61HU30M3
EFDG•3V_	7.5	22	24.2	ATV61HU40M3
EFDH•3V_	10	28	30.8	ATV61HU55M3
EFDJ•3V_	15	42	46.2	ATV61HU75M3
EFDK•3V_	20	54	59.4	ATV61HD11M3X
EFDL•3V_	25	68	74.8	ATV61HD15M3X
EFDM•3V_	30	80	88	ATV61HD18M3X
EFDN•3V_	40	104	114.4	ATV61HD22M3X
EFDP•3V_	50	130	143	ATV61HD30M3X

¹ “•” can be “A”, “G”, or “H”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure; “H” denotes a Type 3R enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.

² Power shown is for a carrier switching frequency of 8 kHz. For a switching frequency between 12 and 16 kHz, select the next largest size drive. If the duty cycle does not exceed 60% (36 s maximum for a 60 s cycle) this is not necessary.

³ Continuous output current is based on NEC 2005 table 430.250. The E-Flex controller nameplate rating conforms to the NEC table, not the current value listed in the graphic display lookup table.

⁴ All E-Flex adjustable speed drives use the ATV61 (or HTV61) power converter in a customized hardware and software configuration in which the product gains a horsepower rating for devices configured in IP00 with a DC Choke (or 3% line reactor). 3% impedance may be internal or external to the power converter or a combination of internal and external impedances to total 3%. The power converter is programmed by quality assurance personnel so that these settings match NEC2005 Table 430.250 for 460 V and 230 V configurations only. The hp/kW sticker (or imprint) on the cover of the power converter component may not reflect the marking of the enclosed device. However, the graphic display terminal reflects the correct rating and matches the enclosed drive nameplate. Use the graphic display terminal to observe the horsepower rating for the application.

Table 4: E-Flex Drive Ratings, 208V

Drive Catalog Number ¹	Motor Power ² 208 V 60 Hz (hp)	Max. Continuous Output Current ³ (A)	Max. Transient Output Current (60 s) (A)	Power Converter Part Number ⁴
EFDC•2V_	1	4.6	5.1	ATV61HU15M3
EFDD•2V_	2	7.5	8.3	ATV61HU30M3
EFDE•2V_	3	10.6	11.7	ATV61HU30M3
EFDF•2V_	5	16.7	18.4	ATV61HU40M3
EFDG•2V_	7.5	24.2	26.6	ATV61HU55M3
EFDH•2V_	10	30.8	33.9	ATV61HU75M3
EFDJ•2V_	15	46.2	50.8	ATV61HD11M3X
EFDK•2V_	20	59.4	65.3	ATV61HD15M3X
EFDL•2V_	25	74.8	82.3	ATV61HD18M3X
EFDM•2V_	30	88	96.8	ATV61HD22M3X
EFDN•2V_	40	114	125.4	ATV61HD30M3X
EFDP•2V_	50	143	157.3	ATV61HD37M3X

- ¹ “•” can be “A”, “G”, or “H”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure; “H” denotes a Type 3R enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.
- ² Power shown is for a carrier switching frequency of 8 kHz. For a switching frequency between 12 and 16 kHz, select the next largest size drive. If the duty cycle does not exceed 60% (36 s maximum for a 60 s cycle) this is not necessary.
- ³ Continuous output current is based on NEC 2005 table 430.250. The E-Flex controller nameplate rating conforms to the NEC table, not the current value listed in the graphic display lookup table.
- ⁴ The first five characters of the power converter part number may be “ATV61,” indicating an IP20 device, or “HTV61,” indicating an IP00 device.

INPUT CURRENT RATINGS

All branch circuit components and equipment such as feeder cables, disconnect devices, and protective devices must be rated for the higher of the following two currents: the input current of the drive, or the motor full load current (MFLC). The input current and MFLC are printed on the nameplate (see Figure 1 on page 15). The branch circuit feeder protection must be sized according to the NEC.

DC link chokes and AC line reactors are used to add reactance to the branch circuit, minimize drive input line current, reduce controller nuisance tripping due to transient overvoltage, reduce harmonic distortion, and help improve controller immunity to voltage imbalance. The supplied DC chokes have an impedance of 3%. Impedance may be internal or external to the power converter or a combination of internal and external impedance to total 3%. A 5% line reactor is available as Mod A09.

In systems that use bypass contactors, the line reactor must only be connected between the breaker load terminals in the controller and the power converter. A line reactor in a bypass motor-starting circuit will reduce the motor’s ability to produce starting torque.

Table 5: Short-Circuit Current Ratings (SCCR)

Range (hp)	Minimum UL (kA)	High Fault UL (kA)
1–50	5	100
51–200	10	100
201–400	18	100
450–500	30	100

Table 6: Input Line Currents for Selection of Branch Circuit Feeders, 460 V¹

Drive Catalog Number ²	Motor Power 460 V 60Hz (hp)	Input Current Ratings					
		Standard 3% DC Choke/ 3% Line Reactor MOD X09 ³			Factory Mounted 5% Line Reactor ⁴ MOD A09		
		5 kA (A)	22 kA (A)	100 kA (A)	5 kA (A)	22 kA (A)	100 kA (A)
EFDC•4V_	1	1.5	1.5	1.5	1.5	1.4	1.4
EFDD•4V_	2	2.9	2.9	2.9	2.7	2.7	2.7
EFDE•4V_	3	4.0	4.0	4.0	3.8	3.8	3.8
EFDF•4V_	5	6.9	6.9	6.9	6.6	6.6	6.6
EFDG•4V_	7.5	9.2	9.2	9.2	8.8	8.8	8.8
EFDH•4V_	10	12.5	12.5	12.5	11.8	11.8	11.8
EFDJ•4V_	15	17.5	17.6	17.6	16.8	16.8	16.8
EFDK•4V_	20	23.5	23.6	23.7	22.4	22.4	22.4
EFDL•4V_	25	28.8	29.0	29.1	27.9	27.9	27.8
EFDM•4V_	30	33.5	33.7	33.7	33.1	33.1	33.1
EFDN•4V_	40	45.1	45.3	45.3	44.7	44.7	44.6
EFDP•4V_	50	55.5	55.6	55.7	54.7	54.7	54.6
EFDQ•4V_	60	67.4 ⁵	67.4	67.4	66.9 ⁵	66.9	66.8
EFDR•4V_	75	82.3 ⁵	82.4	82.6	81.5 ⁵	81.5	81.4
EFDS•4V_	100	111.1 ⁵	111.2	111.3	109.9 ⁵	109.9	109.8

¹ Select conductor based on the input line current or motor FLA, whichever is greater.

² “•” can be “A”, “G”, or “H”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure; “H” denotes a Type 3R enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.

³ Factory modification X09 is an optional 3% line reactor available for drives of all hp ratings.

⁴ Factory modification A09 is an optional 5% line reactor available for drives of all hp ratings.

⁵ 10 kA.

Table 7: Input Line Currents for Selection of Branch Circuit Feeders, 230 V¹

Drive Catalog Number ²	Motor Power 230 V 60Hz (hp)	Input Current Ratings					
		Standard 3% DC Choke/ 3% Line Reactor MOD X09 ³			Factory Mounted 5% Line Reactor ⁴ MOD A09		
		5 kA (A)	22 kA (A)	100 kA (A)	5 kA (A)	22 kA (A)	100 kA (A)
EFDC•3V_	1	3.2	3.2	3.2	3.0	3.0	3.0
EFDD•3V_	2	6.0	6.0	6.0	5.6	5.6	5.6
EFDE•3V_	3	8.3	8.4	8.4	8.0	8.0	8.0
EFDF•3V_	5	14.3	14.3	14.3	13.7	13.8	13.8
EFDG•3V_	7.5	19.5	19.5	19.5	18.4	18.4	18.4
EFDH•3V_	10	25.6	25.8	25.8	24.4	24.6	24.6
EFDJ•3V_	15	36.4	36.5	36.6	35.0	35.0	35.0
EFDK•3V_	20	47.4	47.5	47.6	46.2	46.4	46.3
EFDL•3V_	25	59.6	59.7	59.7	58.0	58.0	57.9
EFDM•3V_	30	69.7	69.7	69.7	68.8	68.9	68.9
EFDN•3V_	40	94.2	94.2	93.9	93.5	93.6	93.4
EFDP•3V_	50	116.4	116.5	116.2	116.0	116.0	115.8

¹ Select conductor based on the input line current or motor FLA, whichever is greater.
² “•” can be “A”, “G”, or “H”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure; “H” denotes a Type 3R enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.
³ Factory modification X09 is an optional 3% line reactor available for drives of all hp ratings.
⁴ Factory modification A09 is an optional 5% line reactor available for drives of all hp ratings.

Table 8: Input Line Currents for Selection of Branch Circuit Feeders, 208 V¹

Drive Catalog Number ²	Motor Power 208 V 60Hz (hp)	Input Current Ratings					
		Standard 3% DC Choke/ 3% Line Reactor MOD X09 ³			Factory Mounted 5% Line Reactor ⁴ MOD A09		
		5 kA (A)	22 kA (A)	100 kA (A)	5 kA (A)	22 kA (A)	100 kA (A)
EFDC•2V_	1	3.3	3.3	3.3	3.3	3.3	3.3
EFDD•2V_	2	6.3	6.3	6.2	6.2	6.2	6.2
EFDE•2V_	3	8.5	8.6	8.7	8.8	8.8	8.8
EFDF•2V_	5	15.3	15.3	15.3	15.1	15.2	15.2
EFDG•2V_	7.5	20.3	20.3	20.3	20.3	20.3	20.3
EFDH•2V_	10	27.1	27.3	27.3	27.0	27.1	27.1
EFDJ•2V_	15	38.7	38.8	38.8	38.7	38.7	38.7
EFDK•2V_	20	50.9	50.9	51.0	51.4	51.4	51.3
EFDL•2V_	25	63.5	63.6	63.6	64.1	64.2	64.1
EFDM•2V_	30	75.2	75.2	76.1	76.1	76.1	76.1
EFDN•2V_	40	103.5	103.5	103.6	102.5	102.5	103.5
EFDP•2V_	50	127.3	127.4	127.7	127.4	127.5	127.0

¹ Select conductor based on the input line current or motor FLA, whichever is greater.
² “•” can be “A”, “G”, or “H”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure; “H” denotes a Type 3R enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.
³ Factory modification X09 is an optional 3% line reactor available for drives of all hp ratings.
⁴ Factory modification A09 is an optional 5% line reactor available for drives of all hp ratings.

Table 9: 3% DC Choke Reactance Distribution¹

Drive Catalog Number ²	Motor Power (hp)	208 V		230 V		460 V	
		Power Converter Impedance	External Impedance	Power Converter Impedance	External Impedance	Power Converter Impedance	External Impedance
		(mH)	(mH)	(mH)	(mH)	(mH)	(mH)
EFDC***_	1	—	4.000	—	7.500	—	15.000
EFDD***_	2	—	4.000	—	4.000	—	15.000
EFDE***_	3	—	1.275	—	4.000	—	7.500
EFDF***_	5	—	0.750	—	1.275	—	3.750
EFDG***_	7.5	—	0.750	—	0.750	—	3.750
EFDH***_	10	—	0.625	—	0.750	—	1.780
EFDJ***_	15	0.120	0.400	—	0.625	—	1.750
EFDK***_	20	0.080	0.300	0.120	0.400	—	1.620
EFDL***_	25	0.170	0.220	0.080	0.300	—	1.000
EFDM***_	30	0.170	0.220	0.170	0.220	0.300	0.625
EFDN***_	40	0.100	0.220	0.170	0.220	0.500	0.320
EFDP***_	50	0.100	0.120	0.100	0.220	0.380	0.310
EFDQ***_	60	—	—	—	—	0.270	0.250
EFDR***_	75	—	—	—	—	0.180	0.220
EFDS***_	100	—	—	—	—	0.180	0.120

¹ 3% impedance may be internal or external to the power converter (ATV61_ or HTV61_) or a combination of internal and external impedances to total 3% as shown in this table.

² "*" can be "A", "G", or "H". "A" denotes a Type 12K enclosure; "G" denotes a Type 1 enclosure; "H" denotes a Type 3R enclosure. "_" indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.

SPECIFICATIONS

Table 10: Specifications for Drives

Input voltage	460 V \pm 10%, 230 V \pm 10%, 208 V \pm 10%
Displacement power factor	98% through speed range
Input frequency	60 Hz \pm 5%
Output voltage	Three-phase output Maximum voltage equal to input voltage
Galvanic isolation	Galvanic isolation between power and control (inputs, outputs, and power supplies)
Frequency range of power converter	0.1 to 500 Hz (factory setting of 60 Hz)
Torque/overtorque	VT: 110% of nominal motor torque for 60 s
Current (transient)	VT: 110% of controller rated current for 60 s
Switching frequency	Selectable from 0.5 to 16 kHz. ^[1] Factory setting: VT: 8 kHz for 208 V, 230 V, and 1–100 hp @460 V 2 kHz for 125–500 hp @ 460 V The drive reduces the switching frequency automatically in the event of excessive heatsink temperature.
Speed reference	AI1: 0 to +10 V, Impedance = 30 k Ω . Can be used for speed potentiometer, 1–10 k Ω . AI2: Factory setting: 4 to 20 mA. Impedance = 242 Ω (reassignable, X–Y range with graphic display terminal). Factory modification J10 allows 0–10 Vdc reference signal to AI2, Z= 30 k Ω .
Frequency resolution in analog reference	0.1 for 100 Hz (11 bits)
Speed regulation	V/f control: equal to the motor's rated slip. SFVC: 10% of the motor's rate slip from 20% to 100% of nominal motor torque.
Efficiency	97% at full load typical
Reference sample time	2 ms \pm 0.5 ms
Acceleration and deceleration ramps	0.1 to 999.9 s (definition in 0.1 s increments)
Drive protection	<ul style="list-style-type: none"> • Thermal protection of power converter • Phase loss of AC mains • Circuit breaker rated at 100 kAIC
Motor protection	Class 10 electronic overload protection Class 20 electromechanical overload protection with bypass ^[2]
Graphic display terminal	Self diagnostics with messages in three languages; also refer to the <i>Programming Manual</i> , supplied on CD-ROM W817574030111 with the power converter. ^[3]
Temperature	Storage for all enclosures: -13 to +149 °F (-25 to +65 °C). Operation: NEMA Type 1, 12, 12K: +14 to +104 °F (-10 to 40 °C); NEMA Type 3R: +14 to +122 °F (-10 to 50 °C). For 1–100 hp drives (208, 230 & 460 V) operating between 40 and 50 °C, derate the current 2% per °C above 40°C.
Humidity	95% with no condensation or dripping water, conforming to IEC 60068-2-78.
Altitude	3,300 ft (1000 m) maximum without derating; derating of the current by 1% for each additional 330 ft (100 m)
Enclosure	Type 1: all controllers Type 3R: all controllers Type 12/12K: all controllers
Pollution degree	Type 1, Type 3R: Pollution degree 2 per NEMA ICS-1 Annex A and IEC 60664-1 Type 12: Pollution degree 3 per NEMA ICS-1 and IEC17.560664-1
Operational test vibration	Conforming to IEC 60721-3-3-3M3 amplitude 1.5 mm peak to peak from 3 to 13 Hz 1 g from 13 to 200 Hz
Transit test to shock	Conforming to National Safe Transit Association and International Safe Transit Association test for packages.
Operational shock	15 g, 11 ms
Seismic qualification	2003 IBC, NFPA 5000, and ASCE 7 ICC ES AC156 acceptance criteria test protocol with an importance factor of 1.5.
Codes and standards	UL Listed per UL 508C under category NMMS. Conforms to applicable NEMA ICS, NFPA, and IEC standards. Manufactured under ISO 9001 standards. Factory modification G10 provides Canadian cUL certification per C22.2 No. 14.

1. On 1–100 hp VT controllers, above 8 kHz, select the next largest size drive.
If the duty cycle does not exceed 60% (36 s maximum for a 60 s cycle), this is not necessary.
2. Class 10 electromechanical for 1 hp at 460 V.
3. Refer to Table 1 for the instruction bulletin number.
4. Plenum rated; suitable for placement in a compartment handling conditioned air.

SHORT CIRCUIT RATINGS

All E-Flex devices include a PowerPact® H- or J-frame circuit breaker as the overcurrent protective device (OCPD). All configurations have a coordinated short circuit current rating of 100,000 A symmetrical.

- 460 Volt, 1–100 hp, VT, 100,000 A
- 230 Volt, 1–50 hp, VT, 100,000 A
- 208 Volt, 1–50 hp, VT, 100,000 A

STANDARD FEATURES

The E-Flex drive includes the following standard features:

With or Without Bypass

- Circuit breaker disconnect
- Form C AFC fault contact wired to customer terminal block
- Form C AFC run contact wired to customer terminal block
- Fire/freezestat interlock location provided to customer terminal block
- Graphic display terminal
- Factory-mounted link choke (see Table 14 on page 29)
- Modbus and CANopen

Bypass Only

- Drive output and bypass contactors
- AFC-Off-Bypass selector switch
- Test-Normal selector switch
- Class 20 overload protection (Class 10 for 1 hp @ 460 V)

Table 11: Parts List for Bypass Circuit Selector Switches and Circuit Breaker Handle

Selector Switch or Handle	Part No.	Description
Test-Normal Selector Switch	ZB5AD2	Two-position selector switch
	ZB5AZ009	Mounting collar with contact block (1 N.O.)
	ZBE204	Additional contact block (2 N.C.)
	ZBE101	Additional contact block (1 N.O.)
	65170-166-72	Engraved legend plate, "Test-Normal"
	ZBZ32	Legend plate holder
AFC-Off-Bypass Selector Switch	ZB5AD3	Three-position selector switch
	ZB5AZ103	Mounting collar with contact block (2 N.O.)
	65170-166-43	Engraved legend plate "AFC-Off-Bypass"
Circuit Breaker Handle	ZBZ32	Legend plate holder
	29338C	Disconnect switch handle, black

NOTE: Legend plate part numbers beginning with 65170 are not available as an ordered part. Please contact your local field sales office.

FACTORY MODIFICATIONS

CONTROL OPTIONS

Table 12: Control Options (Required Selection)

Control Option	Description	Parts List
A07	Hand-Off-Auto Selector Switch	ZB5AD3 Three-position selector switch ZB5AZ009 mounting collar ZBE205 Additional contact block (1 N.O., 1 N.C.) (2) ZBE102 Additional contact block (1 N.C.) ZBE203 Additional contact block (2 N.O.) ZBZ32 Legend plate holder
	Speed Potentiometer ¹	ATVPOT25K Speed potentiometer assembly
B07	Hand-Off-Auto Selector Switch	ZB5AD3 Three-position selector switch ZB5AZ009 mounting collar ZBE205 Additional contact block (1 N.O., 1 N.C.) (2) ZBE102 Additional contact block (1 N.C.) ZBE203 Additional contact block (2 N.O.) ZBZ32 Legend plate holder
	Stop/Start Push Buttons	ZB5AA2 Black push button w/ mounting base ZB5AA4 Red push button w/ mounting base ZB5AZ101 Mounting collar w/ additional contact block (1 N.O.) ZB5AZ102 Mounting collar w/ additional contact block (1 N.C.) (2) ZBZ32 Legend plate holder
	Speed Potentiometer ¹	ATVPOT25K Speed potentiometer assembly
C07	Stop/Start Push Buttons	ZB5AA2 Black push button w/ mounting base ZB5AA4 Red push button w/ mounting base ZB5AZ101 Mounting collar w/ additional contact block (1 N.O.) ZB5AZ102 Mounting collar w/ additional contact block (1 N.C.) (2) ZBZ32 Legend plate holder
	Speed Potentiometer ¹	ATVPOT25K Speed potentiometer assembly
D07	Hand-Off-Comm Selector Switch	ZB5AD3 Three-position selector switch ZB5AZ009 mounting collar ZBE205 Additional contact block (1 N.O., 1 N.C.) (2) ZBE102 Additional contact block (1 N.C.) ZBE203 Additional contact block (2 N.O.) ZBZ32 Legend plate holder
	Speed Potentiometer ¹	ATVPOT25K Speed potentiometer assembly
E07	Hand-Off-Comm Selector Switch	ZB5AD3 Three-position selector switch ZB5AZ009 Mounting collar ZBE205 Additional contact block (1 N.O., 1 N.C.) (2) ZBE102 Additional contact block (1 N.C.) ZBE203 Additional contact block (2 N.O.) ZBZ32 Legend plate holder
	Stop/Start Push Buttons	ZB5AA2 Black push button w/ mounting base ZB5AA4 Red push button w/ mounting base ZB5AZ101 Mounting collar w/ additional contact block (1 N.O.) ZB5AZ102 Mounting collar w/ additional contact block (1 N.C.) (2) ZBZ32 Legend plate holder
	Speed Potentiometer ¹	ATVPOT25K Speed potentiometer assembly
N07	No operators; wired for remote operation	No drive control options are supplied on the front door of the drive. For use in remote-mounted operator applications. Refer to Section 3, Power Circuit Descriptions, for remote mounting information.

¹ For Type 3R controllers and if the graphic display is deleted (MOD D09). In all other cases, the speed potentiometer is the control on the graphic display terminal.

LIGHT OPTIONS

Table 13: Light Options (Optional Selection)

Light Option	Description	Parts List
A08 Pilot Light Option #1 Cluster	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Yellow Detected Fault	ZB5AV05 Amber pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Yellow Auto	ZB5AV05 Amber pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
B08 Pilot Light Option #2 Cluster	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Yellow Detected Fault	ZB5AV05 Amber pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Yellow Bypass	ZB5AV05 Amber pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
C08 Pilot Light Option # 3 Cluster	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder
	Yellow Detected Fault	ZB5AV05 Amber pilot light head ZB5AV6 Mounting collar with light module ZBZ32 Legend plate holder

MISC. OPTIONS

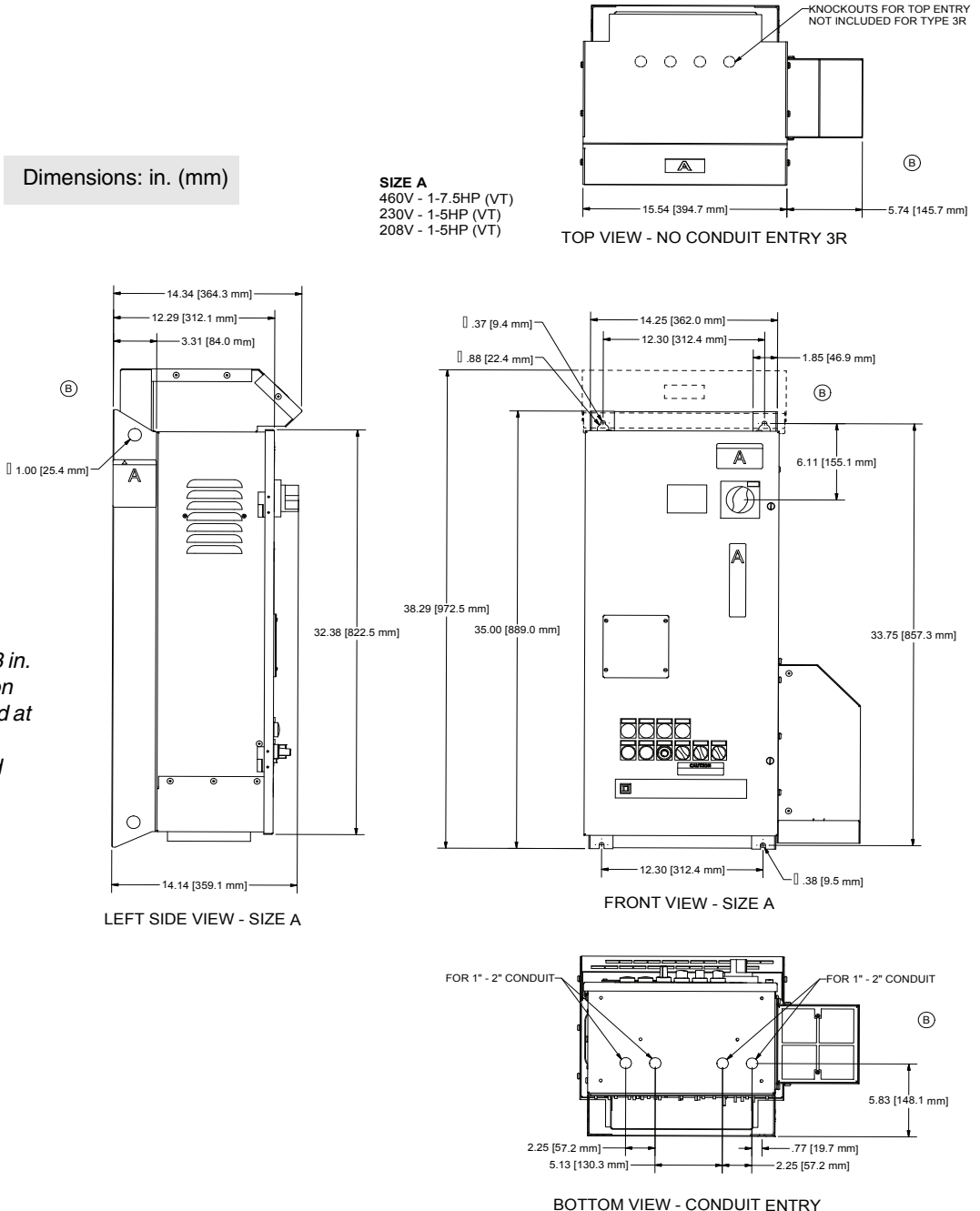
Table 14: Miscellaneous Options (Optional Selection)

Misc. Option	Name	Description
A09	Line Reactor	Factory-mounted line reactor within enclosure. Standard = 3% DC Choke Mod A09 = 5% Line Reactor
B09	Line Contactor	A line contactor can be added between the circuit breaker and the drive (Type 1 and 12K only).
C09	3–15 PSI Transducer	Allows the controller to follow a user-supplied 3–15 PSI input.
D09	Omit Door-Mounted Graphic Display Terminal	The graphic display terminal is not supplied. The user must buy the terminal as a separate device to program the drive.
E09	Smoke Purge	Provides a smoke purge operating mode controlled by a user-supplied 120 Vac signal wired to customer's terminal block.
F09	Profibus Serial Communication	Provides a factory-installed plug-in Profibus card, VW3A3307.
H09	I/O Extension	0–20 mA analog output for customer use. Factory programmed for motor frequency. Includes I/O extension card VW3A3202. Reassignable x–y range with keypad display. Also includes logic inputs, logic outputs, analog inputs, analog outputs, configurable relay outputs, PTC probe input, and frequency control input.
J09	0–10 Vdc Auto Speed Reference	Provides for a 0–10 Vdc user-supplied auto speed reference signal to the AI2 input.
K09	cUL Listing	Provides Canadian cUL certification when required by local code requirements.
L09	LonWorks® Serial Communication	Provides a factory installed LonWorks card, VW3A3312.
M09	Modbus® Serial Communication ¹	Provides a factory installed plug-in Modbus card VW3A3303.
P09	Metasys® N2 Serial Communication	Provides a factory installed plug-in Metasys N2 card VW3A3313.
O09	P1 Serial Communication	Provides a factory installed plug-in Apogee™ P1 card VW3A3314.
Q09	Ethernet Serial Communication	Provides a factory installed plug-in Ethernet card VW3A3310D.
R09	BACnet Serial Communication	Provides a factory installed plug-in BACnet card VW3A3315.
S09	End Damper Control	Provides a circuit to delay drive operation until the damper is fully open.
T09	Service Entrance Rating	Provides a factory-installed insulated ground neutral assembly with ground wire and label for use as service entrance rated equipment.
U09	Seismic Qualified	Provides a certification label and hardware qualified to seismic rating ICC ES AC156 acceptance criteria test protocol with an importance factor of 1.5.
V09	Ethernet IP	Provides a factory installed plug-in Ethernet IP card VW3A3316.
X09	Line Reactor	Factory-mounted line reactor within enclosure Standard = 3% DC Choke Mod X09 = 3% Line Reactor

¹ The 9-pin to 15-pin connector cable that ships with the Modbus card when ordered from the distributor does not ship with an E-Flex unit.

DIMENSIONS AND WEIGHT FOR WALL MOUNTING

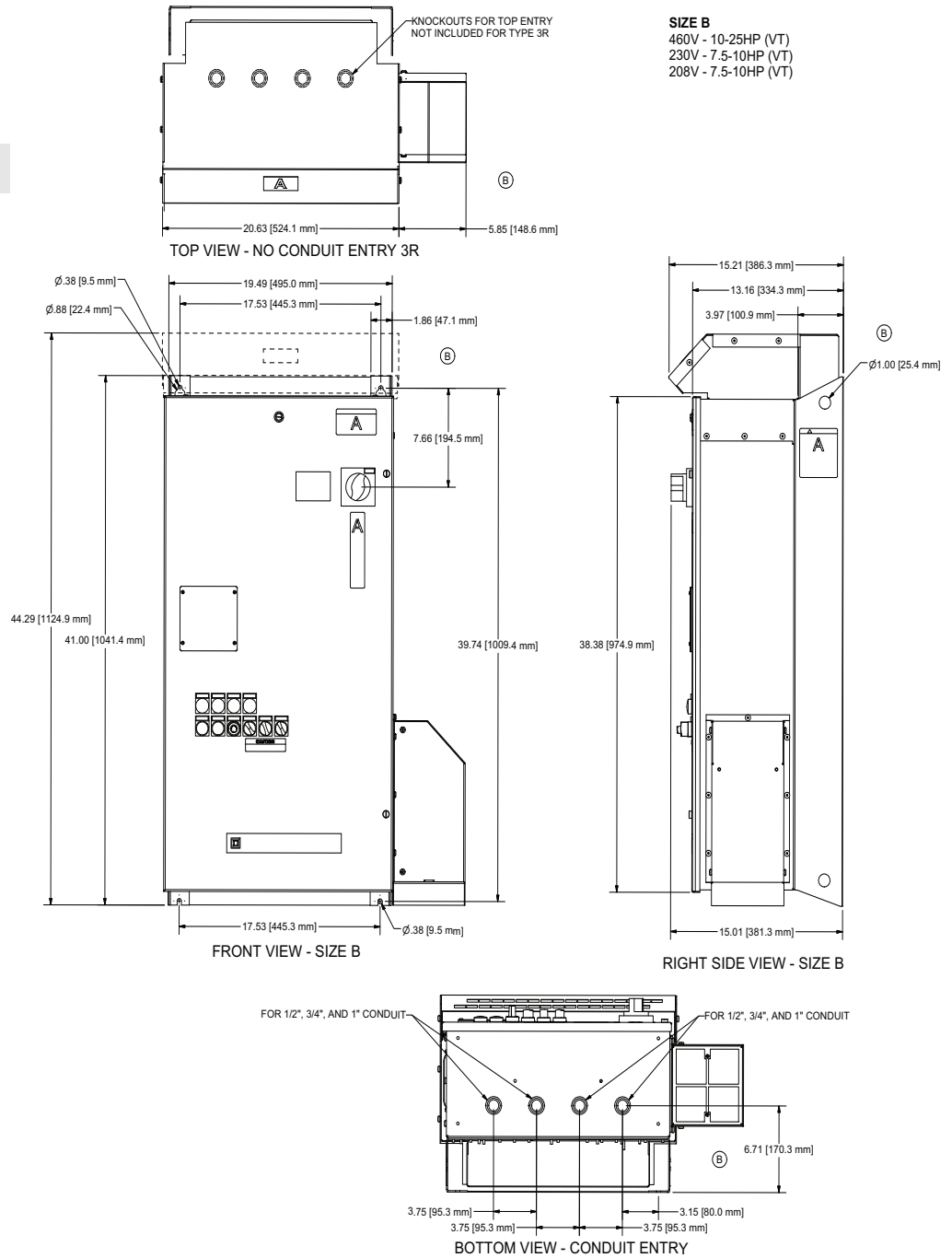
Figure 5: Mounting Information for 1–7.5 hp Controllers @ 480 V and 1–5 hp Controllers @ 208/230 V, with or without Bypass



hp		Weight	
460 V	208/ 230 V	lb	kg
1–7.5	1–5	83	37.7
10–25	7.5–10	126	57.2

Figure 6: Mounting Information for 10–25 hp Controllers @ 480 V and 7.5–10 hp Controllers @ 208/230 V, with or without Bypass

Dimensions: in. (mm)

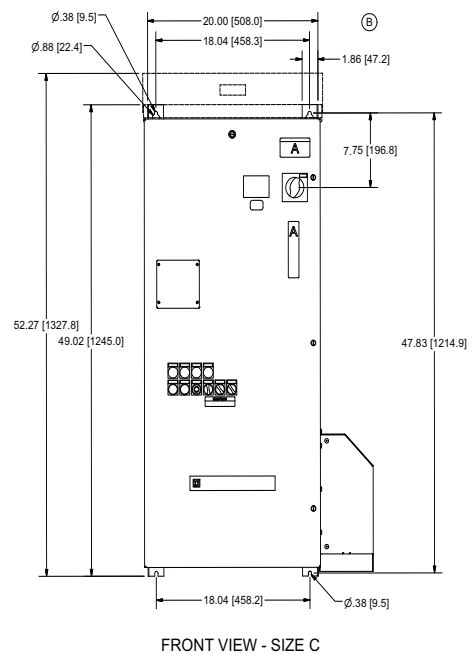
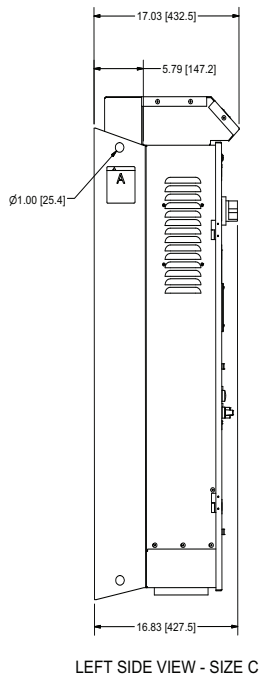
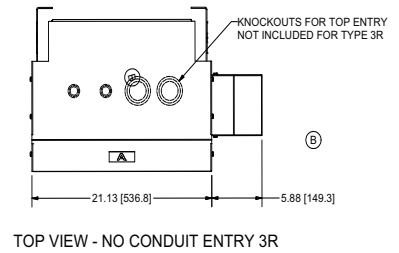


NOTE: Provide at least 3 in. of mounting clearance on each side of the drive and at least 6 in. of mounting clearance at the top and bottom of the drive.

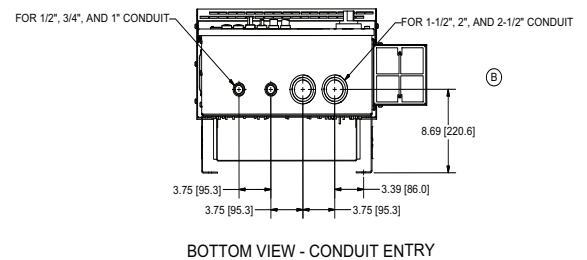
hp		Weight	
460 V	208/230V	lb	kg
30–50	15–25	177	80.5
60–100	30–50	211	95.9

Figure 7: Mounting Information for 30–100 hp Controllers @ 480 V and 15–25 hp Controllers @ 208/230 V, with or without Bypass

Dimensions: in. (mm)



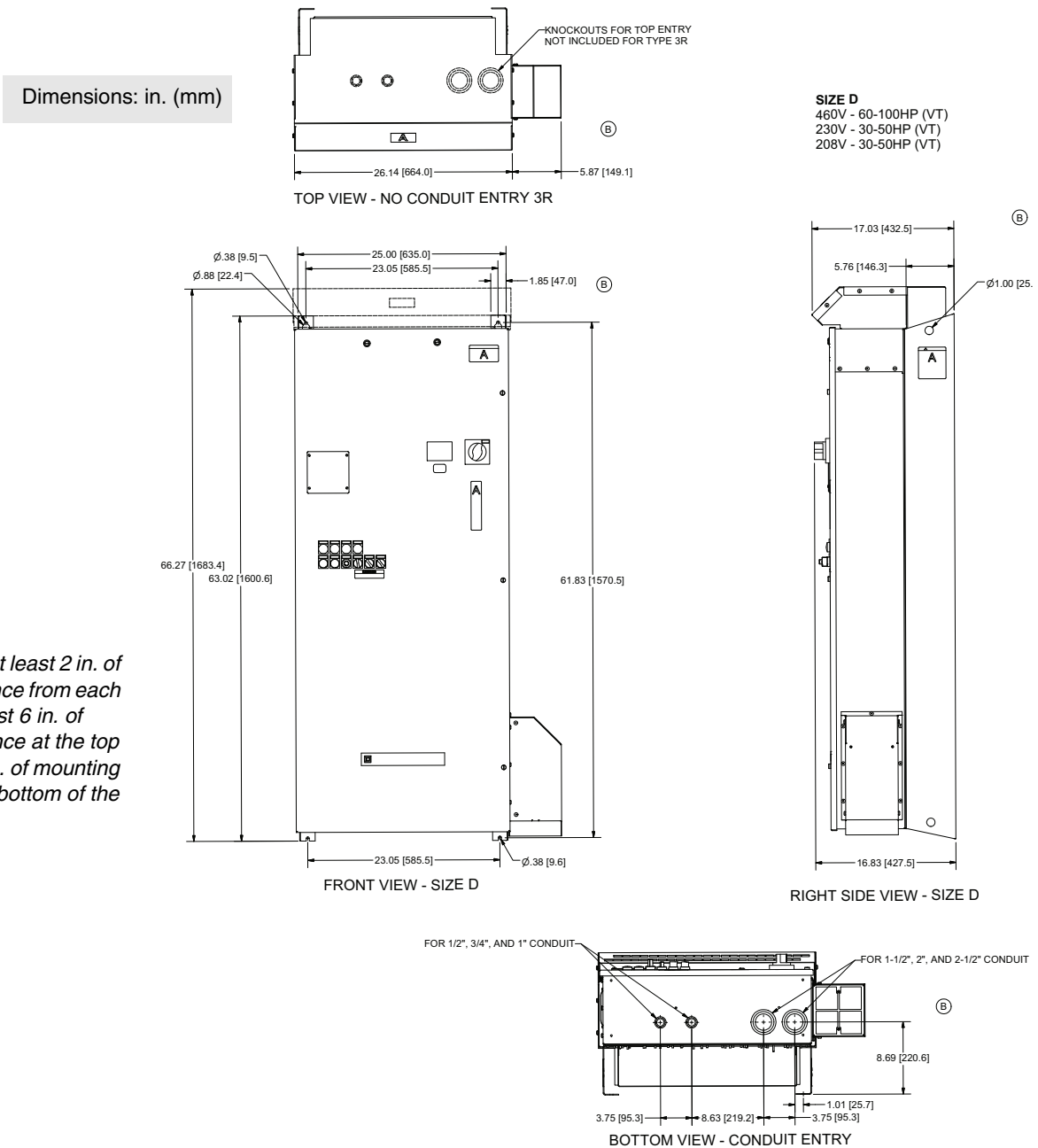
NOTE: Provide at least 2 in. of mounting clearance from each side hood, at least 6 in. of mounting clearance at the top and at least 12 in. of mounting clearance at the bottom of the drive.



SIZE C
460V - 30-50HP (VT)
230V - 15-25HP (VT)
208V - 15-25HP (VT)

hp		Weight		Maximum Enclosure Dimensions					
				Height		Width		Depth	
460 V	208/ 230V	lb	kg	in	mm	in	mm	in	mm
1–7.5	1–5	115	52.3	35	889	24.43	620.52	13.69	347.73
10–25	7.5–10	163	74.1	41	1041.4	30.19	766.83	13.69	347.73
30–50	15–25	213	96.8	52.22	1326.39	30.32	770.13	16.34	415.04
60–100	30–50	247	112.3	66.22	1681.99	35.32	897.13	16.34	415.04

Figure 8: Mounting Information for 60–100 hp Controllers @ 480 V and 30–50 hp Controllers @ 208/230 V, with or without Bypass



hp		Weight		Maximum Enclosure Dimensions					
460 V	208/ 230V	lb	kg	Height		Width		Depth	
				in	mm	in	mm	in	mm
1–7.5	1–5	115	52.3	38.3	973	21.3	541	14.3	364
10–25	7.5–10	163	74.1	44.3	1125	26.5	673	15.2	386
30–50	15–25	213	96.8	52.3	1328	27.0	686	17.0	433
60–100	30–50	247	112.3	66.3	1683	32.0	813	17.0	433

TOTAL DISSIPATED WATTS LOSS

The total dissipated watts loss in Tables 15–17 is provided for sizing the environment HVAC cooling requirements based upon worst-case operating conditions for Type 1 and Type 12K enclosures.

Notes to Table 15:

- ¹ “•” can be “A” or “G”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.
- ² To convert to BTU/hr, multiply Watts Loss by 3.41.

Table 15: Total Dissipated Watts Loss, 460 V

Drive Catalog No. 1	hp	Total Dissipated Watts Loss ²
EFDC•4V_	1	174
EFDD•4V_	2	193
EFDE•4V_	3	194
EFDF•4V_	5	249
EFDG•4V_	7.5	287
EFDH•4V_	10	317
EFDJ•4V_	15	367
EFDK•4V_	20	474
EFDL•4V_	25	559
EFDM•4V_	30	664
EFDN•4V_	40	913
EFDP•4V_	50	1203
EFDQ•4V_	60	1392
EFDR•4V_	75	1603
EFDS•4V_	100	1833

Notes to Table 16:

- ¹ “•” can be “A” or “G”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.
- ² To convert to BTU/hr, multiply Watts Loss by 3.41.

Table 16: Total Dissipated Watts Loss, 230 V

Drive Catalog No. 1	hp	Total Dissipated Watts Loss ²
EFDC•3V_	1	195
EFDD•3V_	2	236
EFDE•3V_	3	236
EFDF•3V_	5	294
EFDG•3V_	7.5	347
EFDH•3V_	10	454
EFDJ•3V_	15	546
EFDK•3V_	20	771
EFDL•3V_	25	848
EFDM•3V_	30	1014
EFDN•3V_	40	1110
EFDP•3V_	50	1426

Notes to Table 17:

- ¹ “•” can be “A” or “G”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.
- ² To convert to BTU/hr, multiply Watts Loss by 3.41.

Table 17: Total Dissipated Watts Loss, 208 V

Drive Catalog No. 1	hp	Total Dissipated Watts Loss ²
EFDC•2V_	1	234
EFDD•2V_	2	293
EFDE•2V_	3	293
EFDF•2V_	5	337
EFDG•2V_	7.5	454
EFDH•2V_	10	544
EFDJ•2V_	15	769
EFDK•2V_	20	838
EFDL•2V_	25	1055
EFDM•2V_	30	1099
EFDN•2V_	40	1409
EFDP•2V_	50	1668

SECTION 2— RECEIVING, INSTALLATION, AND START-UP

PRELIMINARY INSPECTION

▲ CAUTION

DAMAGED CONTROLLER EQUIPMENT

Do not operate any drive that appears damaged.

Failure to follow these instructions can result in injury or equipment damage.

The drive must be thoroughly inspected before it is stored or installed. Upon receipt:

- A. Remove the drive from its packaging and visually inspect the exterior for shipping damage.
- B. Ensure that the Class, Type, and MOD specified on the drive nameplate agree with the packing slip and corresponding purchase order. See Figure 1 on page 15.
- C. If you find any shipping damage, notify the carrier and your sales representative.
- D. If you plan to store the drive after receipt, replace it in its original packaging material and store it at the temperature specified in Table 10 on page 25.

▲ CAUTION

DAMAGE TO INSULATED PARTS IN AIR DUCT

- Protect the air duct at the rear of the enclosure from entry of foreign material.
- Do not place loose objects on top of the enclosure.
- Do not block air flow from the duct.

Failure to follow these instructions can cause breaker trip, resulting in process shutdown or equipment damage.

Before installation:

1. Open the door of the drive. To open the door, turn the circuit breaker and handle assembly to the Off position.
2. Visually verify that all internal mounting and terminal connection hardware is properly seated, securely fastened, and undamaged.
3. Visually verify that the control board on the power converter is properly seated, securely fastened, and undamaged. Verify that the internal wiring connections are tight. Inspect all connections for damage.
4. Close and secure the drive door.

HANDLING THE DRIVE

⚠ WARNING

HANDLING AND LIFTING HAZARD

Keep the area below any equipment being lifted clear of all personnel and property. Use the lifting method shown in Figure 9.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

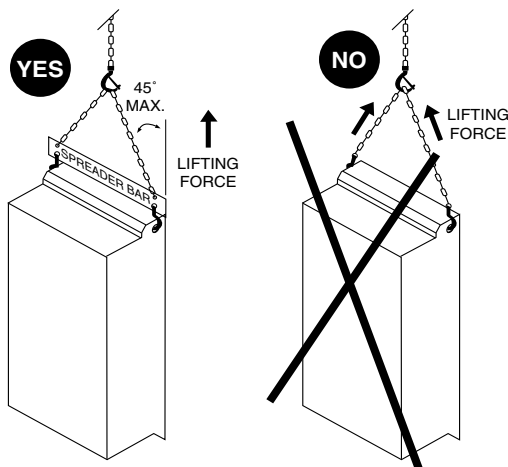
Drives are shipped on a pallet on their back. To avoid damage, do not stack drives on top of each other. Store the drive in its original packaging until it is at the final installation site. The packaging protects the drive and prevents damage to its exterior.

Handle the drive carefully to avoid damage to the internal components, frame, or exterior. When handling a drive, balance it carefully to keep it from tipping. After removing packaging materials, drives require some type of mechanical lifting.

When handling drives:

- Always work with another person. The weight, size, and shape of the drive is such that two people are required to handle it.
- Use gloves.
- Attach a spreader bar to the two top lifting holes on the drive back panel (see Figures 5–7 on pages 30–32 for location of lifting holes) and hoist the controller with chains or straps. See Figure 9 for the proper hoisting method.
- Raise the drive from a horizontal position (that is, the back of the controller resting on a pallet).
- Place the drive in an upright position.
NOTE: The bottom of the drive is on an angle.
- Mount the drive on a flat, solid, noncombustible vertical surface, capable of supporting the controller weight.
- Secure all four corners of the controller with hardware of a sufficient size and type capable of supporting the controller weight.

Figure 9: Hoisting E-Flex Drives



⚠ WARNING

IMPROPER MOUNTING

Before removing the lifting mechanism:

- Ensure that all hardware is of sufficient size and type for the controller weight.
- Secure and tighten all hardware.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

INSTALLATION

MECHANICAL INSTALLATION

Refer to Table 10 on page 25 for Specifications.

- The Type 1 or 12K controller must be mounted vertically against a solid, flat surface to allow for proper ventilation.
- If drilling for conduit entry, exercise care to prevent metal chips from falling on parts and electronic printed wiring boards.
- See Figure 5 on page 30, Figure 6 on page 31, or Figure 7 on page 32 for mounting dimensions, mounting clearances, conduit entry areas, and controller weights.
- Do not mount the drive on hot surfaces.
- Do not mount the Type 1 or 12K drives in direct sunlight.
- Use water-tight rated conduit hubs to make connections between the conduit and Type 3R drives.

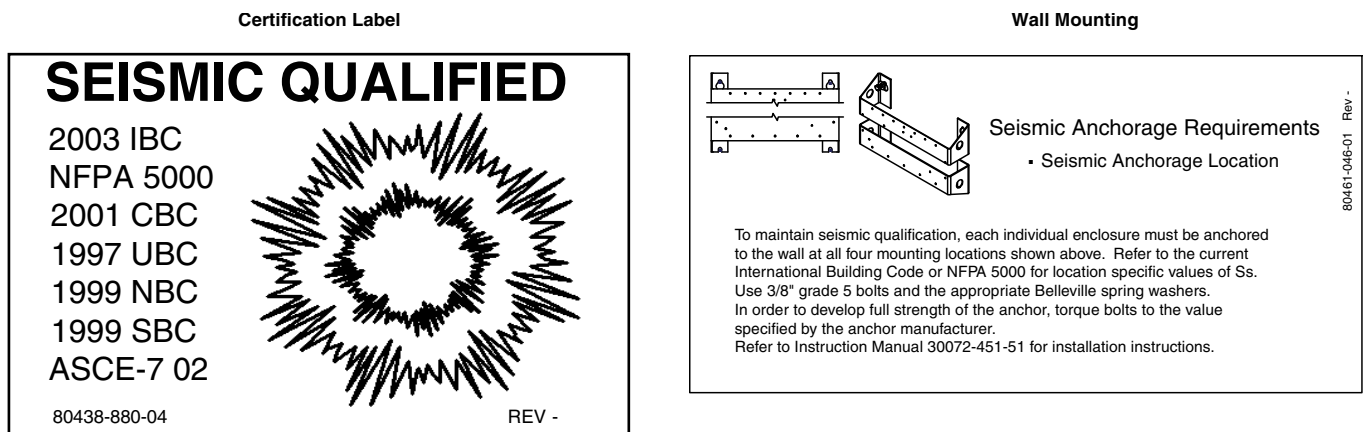
SEISMIC QUALIFICATION MOUNTING CRITERIA

Seismic qualification (MOD U09) harmonizes the following standards in compliance to ICC ES AC156 acceptance criteria test protocol with an importance factor of 1.5:

- 2003 IBC (International Building Code)
- NFPA 5000 (Building Code – National Fire Protection Agency)
- 2001 CBC (Canadian Building Code)
- 1997 UBC (Uniform Building Code)
- 1999 NBC (BOCA National Building Code)
- 1999 SBC (Standard Building Code)
- ASCE 7 (American Society of Civil Engineers)

For seismic rating installation compliance, follow the specific labels attached to the drive (see Figure 10) for anchorage, lateral and mounting guidelines using **SAE Grade 5 hardware bolts and washers**. These guidelines apply for all wall mounted Type 1, 12K and 3R construction.

Figure 10: Seismic Qualification Labels



ELECTRICAL INSTALLATION

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Turn off all power (main and remote) before installing the equipment.

Failure to follow these instructions will result in death or serious injury.

General Wiring Practices

Before wiring the drive, perform the bus voltage measurement procedure on page 42. Good wiring practice requires the separation of control circuit wiring from all power wiring. Power wiring to the motor must have the maximum possible separation from all other power wiring, whether from the same drive or other drives. **Do not run power and/or control or multiple power wiring in the same conduit.** This separation reduces the possibility of coupling electrical transients from power circuits into control circuits or from motor power wiring into other power circuits.

⚠ CAUTION

IMPROPER WIRING HAZARD

Follow the wiring practices described in this document in addition to those already required by the National Electrical Code and local codes.

Failure to follow these instructions can result in injury or equipment damage.

Follow the practices below when wiring the E-Flex drive:

- Before applying power assure that the wiring termination points have been checked of proper torque. See Tables 22–24 on pages 51–53 for torque values.
- Use the supplied knockouts to feed control wiring into the cabinet. Do not run control wires through the drive vents or through the rear air intake.
- Use metallic conduit for all drive wiring. Do not run control and power wiring in the same conduit.
- Separate metallic conduits carrying power wiring or low-level control wiring by at least 3 inches (76 mm).
- Separate existing, non-metallic conduits or cable trays used to carry power wiring from metallic conduit carrying low-level control wiring by at least 12 inches (305 mm).
- Whenever power and control wiring cross, the metallic conduits and non-metallic conduits or trays must cross at right angles.
- Equip all inductive circuits near the controller (relays, contactors, solenoid valves) with noise suppressors.

INPUT POWER

The E-Flex drive operates from a three-phase, 460 Vac \pm 10%, 230 Vac \pm 10%, or 208 Vac \pm 10%, 60 Hz \pm 5% supply connected to the input circuit breaker disconnect. The circuit breaker disconnect is coordinated and tested with the controller power circuit for a short circuit current rating of 100,000 A.

BRANCH CIRCUIT CONNECTIONS

All branch circuit components and equipment (such as feeder cables, disconnect devices, and protective devices) must be rated for the maximum input current of the E-Flex drive, or the FLA of the motor, whichever is

greater. The drive input current and motor full load current is stamped on the nameplate. Refer to Tables 23, 24, or 25 on pages 22–23 for drive input currents.

Connect input power leads L1, L2, and L3 to the input of the circuit breaker. Refer to Figures 12–16 (pages 46–50) for location. Refer to Tables 22, 23, or 24 (pages 51–53) for lug data and wire size range for drive input terminals L1, L2, and L3.

⚠ WARNING

IMPROPER OVERCURRENT COORDINATION

- Protective devices must be properly coordinated.
- Do not connect the drive to a power feeder whose short circuit capacity exceeds the short circuit rating listed on the drive nameplate.

Failure to follow these instructions can result in death or serious injury.

⚠ CAUTION

EQUIPMENT DAMAGE FROM IMPROPER WIRING

- Do not connect input power leads to the drive output terminals (T1, T2, T3 or U, V, W). This damages the controller and voids the warranty.
- Check the power connections before energizing the controller.

Failure to follow these instructions can result in injury or equipment damage.

INPUT WIRING

The ampacity of the input power conductors should be sized according to the National Electrical Code, and applicable local codes, based on:

- A. Drive input current when controller has no bypass.
- B. Drive input current or motor full load current (whichever is greater) when controller has a bypass circuit.

GROUNDING

Ground the drive according to the National Electrical Code and all local codes. To ground the drive:

- Connect a copper wire from the ground bar terminal to the power system ground.
- Verify that the resistance to ground is 1 Ω or less. Improper grounding causes intermittent and unreliable operation.

⚠ DANGER

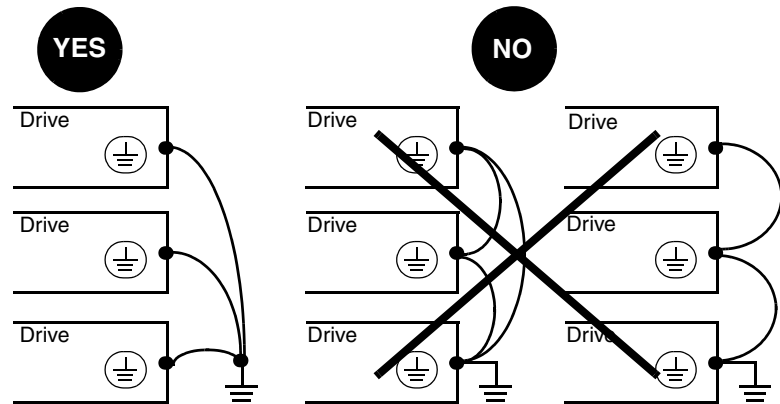
HAZARD OF ELECTRIC SHOCK FROM IMPROPER GROUNDING

- Ground equipment using the provided ground connection point as shown in Figures 12–16 starting on page 46. The drive panel must be properly grounded before power is applied.
- Do not use metallic conduit as a ground conductor.

Failure to follow these instructions will result in death or serious injury.

Ground multiple drives as shown in Figure 11 on page 40. Use one grounding conductor per device. Do not loop ground conductors or install them in series.

Figure 11: Grounding Multiple Drives



Wiring and Electromagnetic Compatibility

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and over travel stop.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of anticipated transmission delays or failures of the link¹.
- Each implementation of a E-Flex enclosed drive must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

¹ For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems."

The high frequency equipotential ground connection between the drive, motor, and cable shielding does not eliminate the need to connect the ground (PE) conductors (green-yellow) to the appropriate terminals on each unit. To help accomplish this, follow these guidelines:

- To avoid communication interference, grounds between the drive, motor and cable shields must have high frequency equipotentiality.
- When using shielded cable for the motor, use a 4-conductor cable so that one wire will be the ground connection between the motor and the drive. Size of the ground conductor must be selected in compliance with local and national codes. The shield can then be grounded at both ends.

Metal ducting or conduit can be used for part or all of the shielding length, provided there is no break in continuity.

- When using shielded cable for control signals, if the cable is connecting equipment that is close together and the grounds are bonded together, then both ends of the shield can be grounded. If the cable is connected to equipment that may have a different ground potential, then ground the shield at one end only to prevent large currents from flowing in the shield. The shield on the ungrounded end may be tied to ground with a capacitor (for example: 10 nF, 100V or higher) in order to provide a path for the higher frequency noise.
- Ensure maximum separation between the power supply cable (line supply) and the motor cable and also ensure maximum separation between the control cables and any power cables.

OUTPUT WIRING

The ampacity of motor power conductors should be sized according to the motor full load current, National Electrical Code, and applicable local codes.

Connect motor conductors to the lugs provided and connect the motor ground to the ground bar provided. Connect motor conductors to T1, T2, and T3 on the overload relay when the controller is supplied with a bypass circuit. Connect motor conductors to T1/U, T2/V, and T3/W on the power converter, or T1, T2, and T3 on the distribution block (if supplied) when the controller is supplied without a bypass circuit. See Figures 12–16 starting on page 46 for location. See Tables 22, 23, and 24 (pages 51–53) for lug data and wire size range. Refer to the nameplate for torque requirements.

The drive is sensitive to the amount of capacitance (either phase-to-phase or phase-to-ground) present on the output power conductors. If excessive capacitance is present, the drive may trip on overcurrent.

Output Cable

Follow the guidelines below when selecting output cable:

- Cable type: the cable selected must have a low capacitance phase-to-phase and to ground. Do not use mineral-impregnated cable because it has a very high capacitance. Immersion of cables in water increases capacitance.
- Cable length: the longer the cable, the greater the capacitance. Cable lengths greater than 150 ft (50 m) may cause ground faults. For installation where cable capacitances may be a problem, a reactor or motor protection filter can be installed between the drive and the motor.

The following guidelines are designed to address maximum cable length for typical drive/motor applications:

These limits are based on the maximum recommended peak voltage that can be allowed at the motor terminals, which is due to the reflected wave phenomenon. This increase in voltage is primarily determined by the degree of impedance mismatch between the power conductor and the motor in combination of the dV/dt of the specific semiconductors used in the inverter section of the drive feeding the motor, both of which vary depending on the horsepower involved. Many variables can affect the performance of the drive, the motor, and the cables in long lead applications. Motor protection filters can provide substantial benefits when you are using:

- 460 V or higher rated AC drives
- Existing inverter duty motors subject to retrofit to an AC drive
- Shielded cables

NEMA MG-1 Part 31 compliant motors are recommended but not required. However, it is prudent to consult the motor manufacturer or vendor literature to address any specific limitations governing the application.

- Proximity to other output cables: because of high frequency switching and increased capacitance, the drive may trip under some conditions.
- **Do not use lightning arrestors or power factor correction capacitors on the output of the drive.**

For proper drive short circuit protection, certain values of inductance may be required in the output power wiring. Inductance can be supplied by the power wiring or auxiliary inductors.

⚠ CAUTION

INSUFFICIENT OUTPUT INDUCTANCE

A minimum inductance is needed to protect the drive output from short circuits. Provide at least 20 in. (500 mm) of cable at the drive outputs, T1/U, T2/V, and T3/W, and on distribution block terminals T1, T2, and T3 (for a controller without bypass) or overload relay terminals T1, T2, and T3 (for a controller with bypass).

Failure to follow these instructions can result in injury or equipment damage.

Table 18: Maximum Cable Length for Inverter Duty Motors

Drive Rating hp @ 480 V	Type of cable	Approximate length of motor cables								
		20 in. to 164 ft. (0.5 to 50 m)	164 to 328 ft. (50–100 m)	328 to 492 ft. (100–150 m)	492 to 656 ft. (150–200 m)	656 to 984 ft. (200–300 m)	984 to 1,312 ft. (300–400 m)	1,312 to 1,968 ft. (400–600 m)	1,968 to 3,280 ft. (600–1000 m)	
1 to 20 hp CT 1 to 25 hp VT	Shielded		3% Load Reactor		Motor Protection Filter					Consult Factory
	Unshielded			3% Load Reactor			Motor Protection Filter			
25 to 100 hp CT 30 to 125 hp VT	Shielded			3% Load Reactor	Motor Protection Filter					
	Unshielded				3% Load Reactor		Motor Protection Filter			
125 to 450hp CT 150 to 500 hp VT	Shielded			3% Load Reactor		Motor Protection Filter				
	Unshielded			3% Load Reactor			Motor Protection Filter			

**DC BUS VOLTAGE MEASUREMENT
PROCEDURE**

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand the DC Bus Voltage Measurement Procedure before performing the procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- DO NOT short across capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Failure to follow these instructions will result in death or serious injury.

The DC bus voltage level is determined by monitoring the PA/+ and PC/- terminals. The location of these terminals varies by power converter model number. Read the model number of the power converter from the nameplate, and identify the corresponding PA/+ and PC/- terminals. The power converter model number is listed on the nameplate. Refer to ATV61 installation manual for location of drive terminals.

To measure the DC bus capacitor voltage:

1. Observe the lockout/tagout procedures as identified in OSHA Standard 29 CFR, Subpart J covering:
 - 1910.147: The control of hazardous energy (lockout/tagout)
 - 1910.147: App A, Typical minimal lockout procedures.
2. Be sure to remove all external control power that may be present such as on the control board and the option board terminals.
3. Wait fifteen minutes for the DC bus capacitors to discharge.
4. Open the door of the drive.
5. Set the voltmeter to the 1000 Vdc scale. Measure the voltage between the PA/+ and PC/- terminals.
6. Verify that the DC bus voltage has discharged below 42 V before servicing the drive. If the DC bus capacitors will not discharge below 42 V, contact your local Schneider Electric representative. **Do not operate the drive.**
7. After servicing the drive, close and secure door.

WIRE ROUTING AND INTERCONNECTION

Wire Class

The Wire Class describes the compatibility of the field wiring terminal with the conductor material and insulation system. When used in conjunction with the required conductor current rating and controller ambient temperature rating, the Wire Class forms the basis for selecting a conductor size that limits the temperature on the conductor insulation at the field wiring terminal to acceptable limits. Although it is permissible to use conductors with operating temperatures exceeding those given by the Wire Class, conductor **size** must fall within the Wire Class limits.

Noise Class

The Noise Class categorizes the electromagnetic properties of the voltages and currents present. The Noise Class comprises of the six categories shown in Table 19.

Table 19: Noise Class Categories

Noise Class	Definition
Quiet Wiring 1 (QW1)	High susceptibility analog and digital control signals. Signals falling under this classification include digital communication/network circuits, controller analog I/O and analog process signals.
Quiet Wiring 2 (QW2)	Medium susceptibility, analog and digital control signals. Signals falling under this classification include 24 Vdc and Vac control circuits.
Standard Wiring 1 (SW1)	Low susceptibility control or power circuits rated less than 600 Vac (250 Vdc) and less than 15 A (voltage and current spectra are generally contained within 0.05–9 kHz). Signals falling under this classification include 120 Vac control circuits.
Standard Wiring 2 (SW2)	Power circuits rated greater than 15 A (voltage and current spectra are generally contained within 0.05–9 kHz). Signals falling under this classification include line power to controllers.
Standard Wiring 3 (SW3)	Reserved.
Pulse Wiring 1 (PW1)	Control or power circuits whose voltage or current spectra significantly exceed 9 kHz. Signals falling under this classification include motor and dynamic braking circuits fed from pulse width modulated (PWM) power converters.

Voltage Class

The Voltage Class categorizes the voltages present into recognized conductor insulation categories (30, 150, 300, and 600 V) for selection of the conductor voltage rating and physical segregation purposes.

Wiring Methods

Based upon the Noise Class and Voltage Class of the conductors, apply the wiring methods in Table 20 to the drive system.

Table 20: Wire Routing and Interconnection

Wiring Methods and Considerations	Noise Class of Conductors				
	QW1	QW2	SW1	SW2	PW1
Conductor Grouping in Wireways/Conduits					
1. All conductors of 1 or 3 phase AC power circuits must be bundled to minimize stray magnetic fields.			X	X	X
2. All conductors of a DC power circuit must be bundled to minimize stray magnetic fields.			X	X	X
3. When parallel conductors must be run in separate wireways or conduit, bundle conductors into groups that minimize stray magnetic fields.				X	X
4. Maintain conductor runs as short and direct as practical.	X	X	X	X	X
Separation of Circuits					
1. DO NOT run different Noise Class conductors in the same conduit.	X	X	X	X	X
2. DO NOT run different Voltage Class conductors in the same conduit unless all conductors are insulated for the maximum Voltage Class present.	X	X	X	X	X
3. All pulse wiring (PW) conductor groups must be individually segregated using metallic conduit.					X
4. Segregate all conductors by Noise Class. Use the following circuit separation when conductors can run parallel for more than 12 in.					
• Metallic conduit: 3 in. between quiet wiring (QW) to standard wiring (SW) / pulse wiring (PW)	X	X	X	X	X
• Metallic tray: 3 in. between SW to PW			X	X	X
• Metallic tray: 6 in. between QW to SW/PW	X	X	X	X	X
• Against continuous metal surface: 3 in. between SW to PW			X	X	X
• Against continuous metal surface: 6 in. between QW to SW/PW	X	X	X	X	X
• Metallic conduit housing QW: 12 in. to non-metallic conduit SW/PW	X	X	X	X	X
• Non-metallic conduit: 3 in. between SW to PW			X	X	X
• Non-metallic conduit: 24 in. between QW to SW/ PW	X	X	X	X	X
5. If QW and SW1 wiring must cross SW2 or PW1 wiring, the bundles must cross at right angles.	X	X	X	X	X
Common Mode Noise Issues					
1. Provide adjacent signal returns using twisted pair cable.	X	X			
2. Galvanically isolate signal and associated signal return path when possible.	X	X			
Shielding					
1. Use metallic conduit for all power and control circuits external to the controller enclosure.	X	X	X	X	X
2. Shields should be continuous and equipped with a drain wire.	X	X	X		
3. DO NOT group different Noise Class conductors within the same shield.	X	X	X	X	X
4. Minimize the non-shielded portion of conductor at the ends of shielded cable.	X	X	X	X	X
5. When shielding AC or DC power conductors, group conductors to minimize magnetic field in shield.			X	X	X
Grounding					
1. Ground shields only at the controller end.	X	X	X	X	X
2. Use separate ground wire for each shield ground.	X	X	X	X	X
3. Provide a ground wire with all conductor groups whether in tray or conduit.			X	X	X
4. When multiple grounds must be made to a shielded power cable, the shield must have the same short circuit withstand capability as the ground conductor in the power cable.			X	X	X
5. Terminate all power grounds and power shield grounds to the controller grounding point or bar.			X	X	X
6. Terminate all signal shield grounds to the terminals provided.	X	X			
7. Always supply a separate equipment grounding conductor with the controller power feed. DO NOT depend upon metallic conduit for ground connection.			X	X	X

**COMPONENT IDENTIFICATION AND
 TERMINAL STRIP LOCATIONS**

Figure 12 shows component identification and terminal strip locations for E-Flex drives 1–7.5 hp at 460 V and 1–5 hp at 208/230 V.

Tables 22, 23, and 24 (pages 51–53) list wire size range and terminal torque requirements.

NOTE: A typical device is shown with options. The Type 3R ventilation fan and space heater are not shown.

Figure 12: Typical Component Identification and Terminal Strip Locations for 1–7.5 hp @ 460 V and 1–5 hp @ 208/230 V

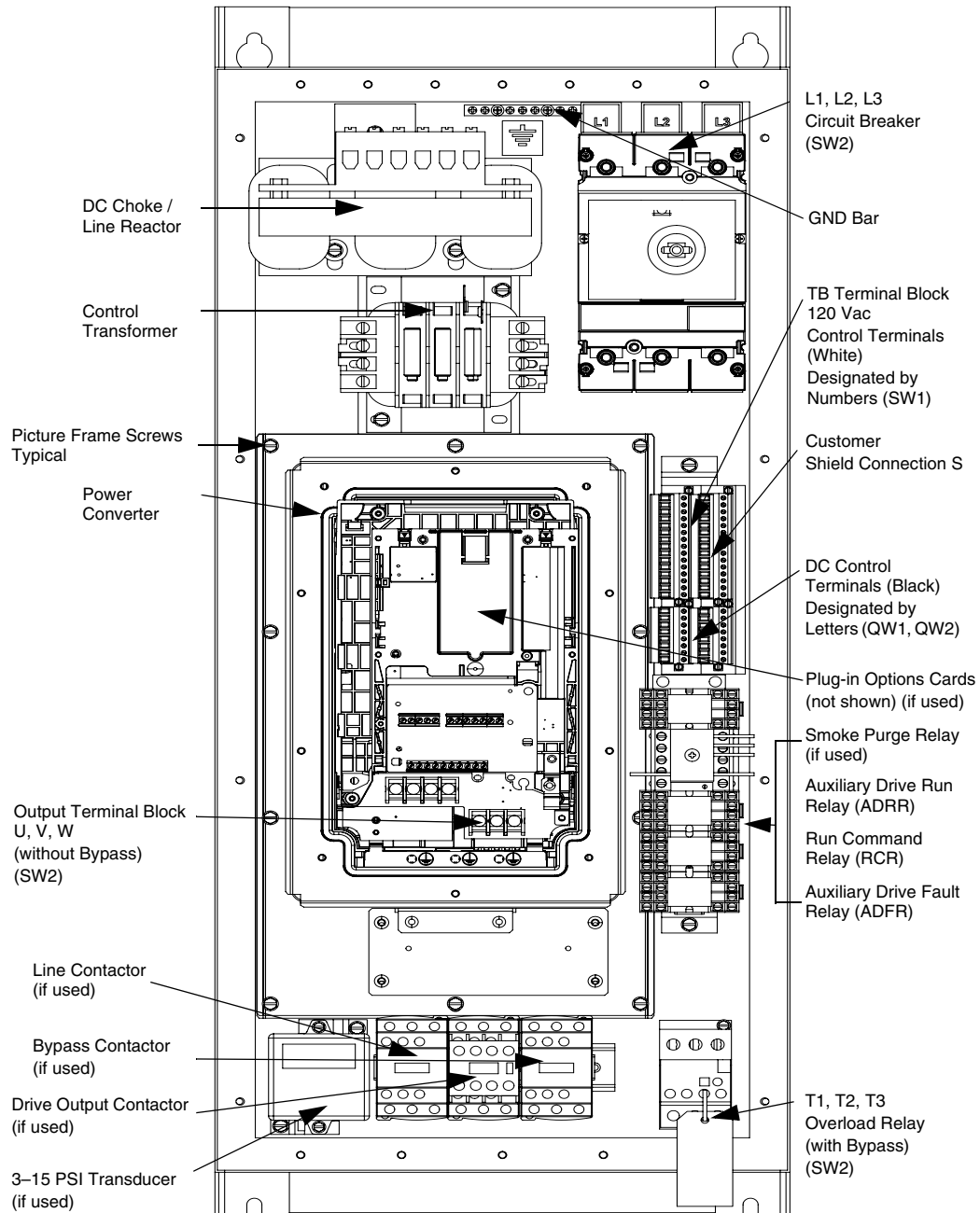


Figure 13 shows component identification and terminal strip locations for E-Flex drives 10–25 hp at 460 V and 7.5–10 hp at 208/230 V. Tables 22, 23, and 24 (pages 51–53) list wire size range and terminal torque requirements.

NOTE: A typical device is shown with options. The Type 3R ventilation fan and space heater are not shown.

Figure 13: Typical Component Identification and Terminal Strip Locations for 10–25 hp @ 460 V and 7.5–10 hp @ 208/230 V

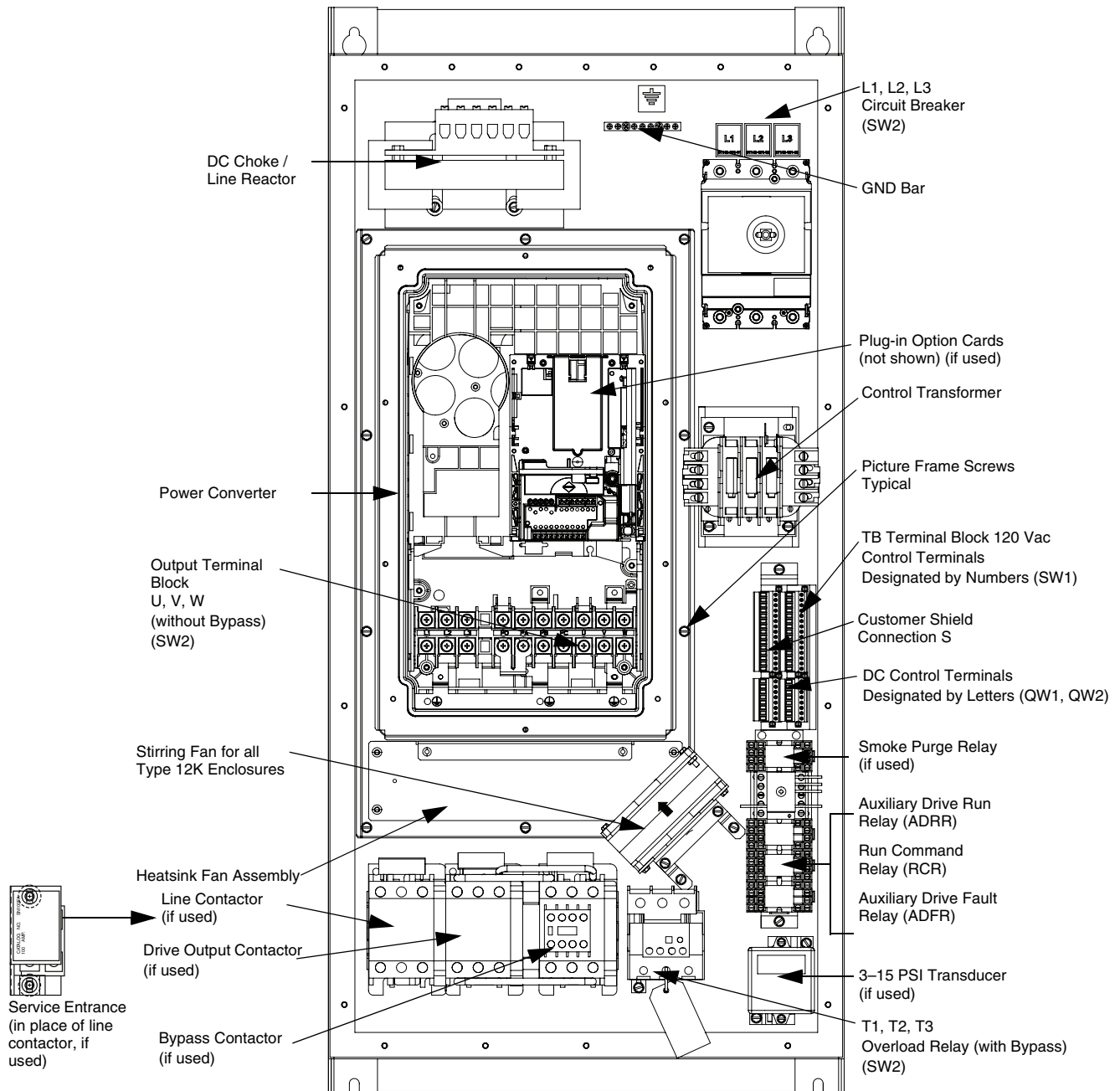


Figure 14 shows component identification and terminal strip locations for E-Flex drives 30–50 hp at 460 V and 15–25 hp at 208/230 V. Tables 22, 23, and 24 (pages 51–53) list wire size range and terminal torque requirements.

NOTE: A typical device is shown with options. The Type 3R ventilation fan and space heater are not shown.

Figure 14: Typical Component Identification and Terminal Strip Locations for 30–50 hp @ 460 V and 15–25 hp @ 208/230 V

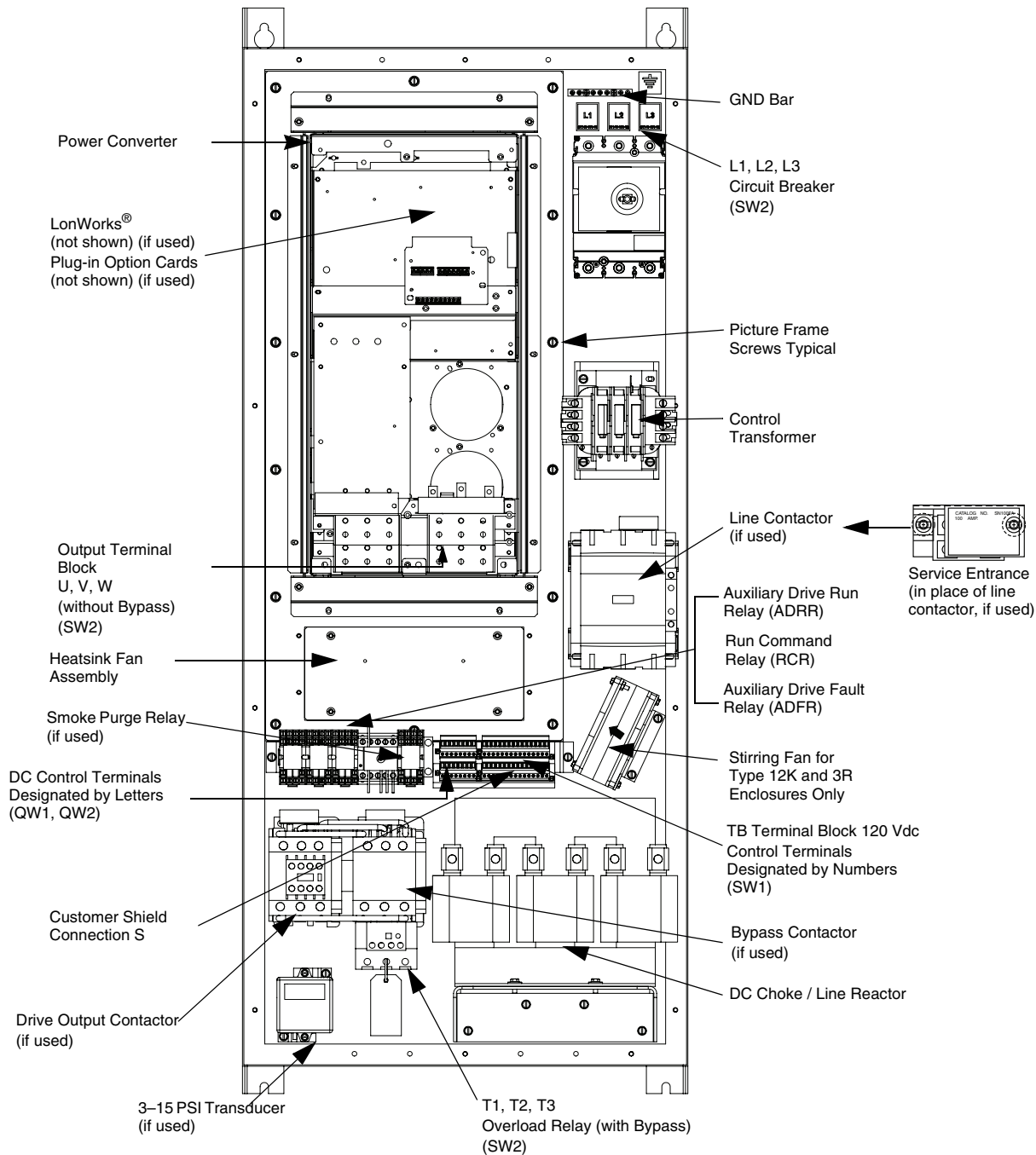


Figure 15 shows component identification and terminal strip locations for E-Flex drives 60–100 hp at 460 V and 30–50 hp at 208/230 V. Tables 22,

23, and 24 (pages 51–53) list wire size range and terminal torque requirements.

NOTE: A typical device is shown with options. The Type 3R ventilation fan and space heater are not shown.

Figure 15: Typical Component Identification and Terminal Strip Locations for 60–100 hp With Bypass @ 460 V and 30–50 hp @ 208/230 V

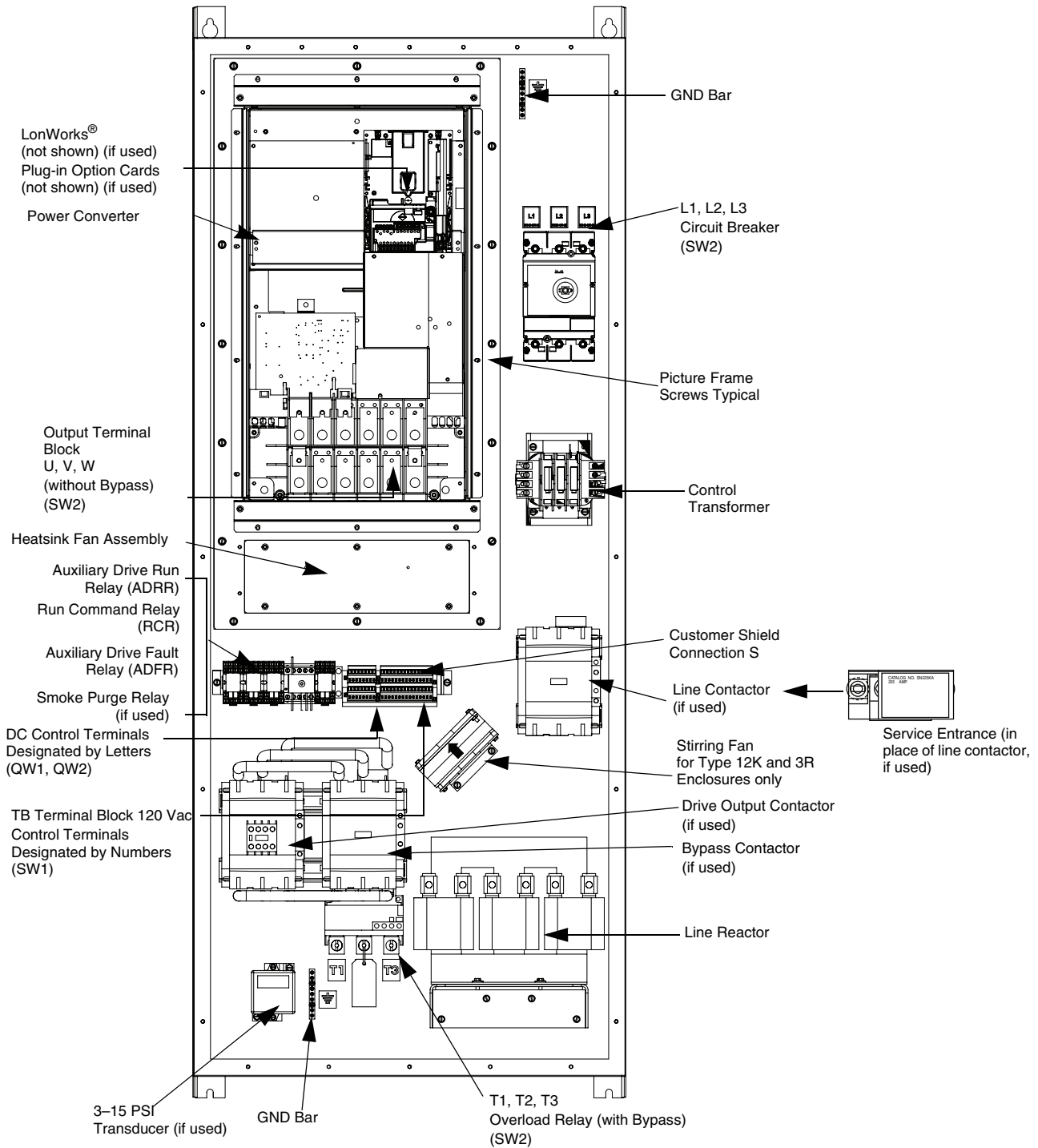
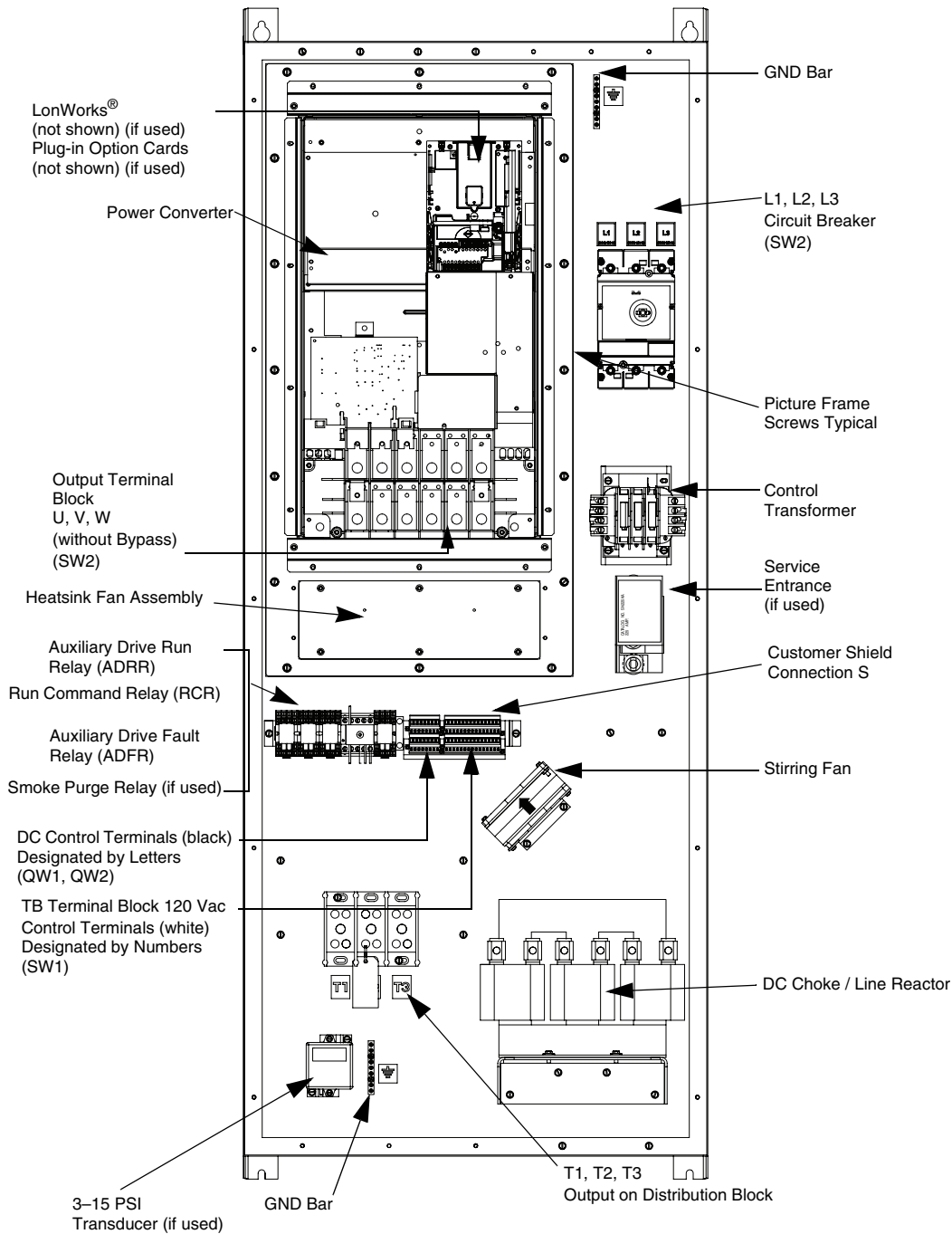


Figure 16: Typical Component Identification and Terminal Strip Locations Without Bypass for 60–100 hp @ 460 V and 30–50 hp @ 208/230 V



POWER WIRING

Table 21: Power Terminal Functions

Terminal	Function
GND	Ground Bar
L1 L2 L3	3-phase input power supply (at top of circuit breaker)
T1 T2 T3	Output connections to motor for controller with bypass (at bottom of overload relay), or distribution block for controller without bypass
T1/U T2/V T3/W	Output connections to motor for controller without bypass (power converter output terminal)

Table 22: Power Terminal Wire Range, 460 V

VT	Terminals									
	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)
hp	L1, L2, L3 (Line)		T1/U, T2/V, T3/W (Load)		Distribution Block Terminals (Non-Bypass) T1, T2, T3 (load)		Overload Relay Output Terminals (Bypass) T1, T2, T3 (Load)		GND Bar	
1	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
2	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
3	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
5	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
7.5	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
10	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	8 (6)	26.5 (3)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
15	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	8 (6)	26.5 (3)	2/0 (67.4)	40 (4.5)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
20	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	4 (16)	26.5 (3)	2/0 (67.4)	40 (4.5)	6 (13.3)	15 (1.69)	4 (21.15)	20 (2.26)
25	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	2 (35)	47.7 (5.4)	2/0 (67.4)	40 (4.5)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
30	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	2 (35)	47.7 (5.4)	2/0 (67.4)	120 (3.6)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
40	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	1/0 (50)	106.2 (12)	2/0 (67.4)	120 (3.6)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
50	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	1/0 (50)	106.2 (12)	350 (177)	250 (28.3)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
60	1/0–4/0 (50–95)	225 (25)	1/0 (50)	106.2 (12)	350 (177)	250 (28.3)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
75	3/0–350 (120–185)	225 (25)	300 (150)	360 (41)	350 (177)	250 (28.3)	250 (127)	300 (33.9)	4 (21.15)	20 (2.26)
100	3/0–350 (120–185)	225 (25)	300 (150)	360 (41)	350 (177)	250 (28.3)	250 (127)	300 (33.9)	4 (21.15)	20 (2.26)

Table 23: Power Terminal Wire Range, 230 V

VT	Terminals									
	Maximum Wire Size	Terminal Torque	Maximum Wire Size	Terminal Torque	Maximum Wire Size	Terminal Torque	Maximum Wire Size	Terminal Torque	Maximum Wire Size	Terminal Torque
	AWG (mm ²)	lb-in (N•m)	AWG (mm ²)	lb-in (N•m)	AWG (mm ²)	lb-in (N•m)	AWG (mm ²)	lb-in (N•m)	AWG (mm ²)	lb-in (N•m)
hp	L1, L2, L3 (Line)		T1/U, T2/V, T3/W (Load)		Distribution Block Terminals (Non-Bypass) T1, T2, T3 (load)		Overload Relay Output Terminals (Bypass) T1, T2, T3 (Load)		GND Bar	
1	14–10 (2.5–6)	50 (5)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
2	14–10 (2.5–6)	50 (5)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
3	14–10 (2.5–6)	50 (5)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
5	14–10 (2.5–6)	50 (5)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
7.5	14–10 (2.5–6)	50 (5)	10 (4)	12.3 (1.4)	2/0 (67.4)	40 (4.5)	6 (13.3)	15 (1.69)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
10	14–10 (2.5–6)	50 (5)	8 (6)	26.5 (3)	2/0 (67.4)	40 (4.5)	6 (13.3)	15 (1.69)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
15	14–10 (2.5–6)	50 (5)	4 (16)	26.5 (3)	2/0 (67.4)	120 (13.5)	6 (13.3)	75 (8.47)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
20	14–10 (2.5–6)	50 (5)	2 (35)	47.7 (5.4)	400 (203)	250 (28.3)	6 (13.3)	75 (8.47)	4 (21.15)	20 (2.26)
	8–3/0 (10–95)	120 (14)								
25	1/0–4/0 (50–95)	225 (25)	2 (35)	47.7 (5.4)	400 (203)	250 (28.3)	6 (13.3)	75 (8.47)	4 (21.15)	20 (2.26)
30	3/0–350 (120–185)	225 (25)	1/0 (50)	106.2 (12)	350 (177)	250 (28.3)	3/0 (85)	200 (22.6)	4 (21.15)	20 (2.26)
40	3/0–350 (120–185)	225 (25)	1/0 (50)	106.2 (12)	350 (177)	250 (28.3)	3/0 (85)	200 (22.6)	4 (21.15)	20 (2.26)
50	3/0–350 (120–185)	225 (25)	300 (150)	360 (41)	350 (177)	250 (28.3)	3/0 (85)	200 (22.6)	4 (21.15)	20 (2.26)

Table 24: Power Terminal Wire Range, 208 V

VT	Terminals									
	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)
hp	L1, L2, L3 (Line)		T1/U, T2/V, T3/W (Load)		Distribution Block Terminals (Non-Bypass) T1, T2, T3 (load)		Overload Relay Output Terminals (Bypass) T1, T2, T3 (Load)		GND Bar	
1	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
2	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
3	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
5	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	35 (4.0)	10 (5.26)	15 (1.69)	4 (21.15)	20 (2.26)
7.5	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	10 (4)	12.3 (1.4)	2/0 (67.4)	40 (4.5)	6 (13.3)	15 (1.69)	4 (21.15)	20 (2.26)
10	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	8 (6)	26.5 (3)	2/0 (67.4)	40 (4.5)	6 (13.3)	15 (1.69)	4 (21.15)	20 (2.26)
15	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	4 (16)	26.5 (3)	2/0 (67.4)	120 (13.5)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
20	14–10 (2.5–6) 8–3/0 (10–95)	50 (5) 120 (14)	2 (35)	47.7 (5.4)	400 (203)	250 (28.3)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
25	1/0–4/0 (50–95)	225 (25)	2 (35)	47.7 (5.4)	400 (203)	250 (28.3)	1/0 (53.5)	75 (8.47)	4 (21.15)	20 (2.26)
30	3/0–350 (120–185)	225 (25)	1/0 (50)	106.2 (12)	350 (177)	250 (28.3)	3/0 (85)	200 (22.6)	4 (21.15)	20 (2.26)
40	3/0–350 (120–185)	225 (25)	1/0 (50)	106.2 (12)	350 (177)	250 (28.3)	3/0 (85)	200 (22.6)	4 (21.15)	20 (2.26)
50	3/0–350 (120–185)	225 (25)	300 (150)	360 (41)	350 (177)	250 (28.3)	3/0 (85)	200 (22.6)	4 (21.15)	20 (2.26)

Table 25: Service Entrance Ground Wire Range

VT	Terminals			
	208/230 V		460 V	
hp	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)	Maximum Wire Size AWG (mm ²)	Terminal Torque lb-in (N•m)
1	Service Entrance Ground Lug			
1	—	—	—	—
2	—	—	—	—
3	—	—	—	—
7.5	14–1/0 (2–54) ¹	75 (8.47) ¹	—	—
10	14–1/0 (2–54) ¹	75 (8.47) ¹	14–1/0 (2–54) ¹	75 (8.47) ¹
15	14–1/0 (2–54) ¹	75 (8.47) ¹	14–1/0 (2–54) ¹	75 (8.47) ¹
20	14–1/0 (2–54) ¹	75 (8.47) ¹	14–1/0 (2–54) ¹	75 (8.47) ¹
25	14–1/0 (2–54) ¹	75 (8.47) ¹	14–1/0 (2–54) ¹	75 (8.47) ¹
30	3–300 (27–150) ¹	250 (28.2) ²	14–1/0 (2–54) ¹	75 (8.47) ¹
40	3–300 (27–150) ²	250 (28.2) ²	14–1/0 (2–54) ¹	75 (8.47) ¹
50	3–300 (27–150) ²	250 (28.2) ²	3–300 (27–150) ²	250 (28.2) ²
60	—	—	3–300 (27–150) ²	250 (28.2) ²
75	—	—	3–300 (27–150) ²	250 (28.2) ²
100	—	—	3–300 (27–150) ²	250 (28.2) ²

¹ Specifications are for the mail lug only. See the component label for wire and torque specifications for other grounding terminals.

CONTROL WIRING

Table 26: I/O Extension (MOD H09)

Terminal ^{1,2}	Function	Characteristics
AO2, AO3 ³	Analog output programmed for motor frequency	0–20 mA Z = 500 Ω Reassignable x–y range with keypad
COM	Common for analog output	0 V

- ¹ See the Control Circuit Elementary Diagrams in Section 5.
- ² The green Phoenix terminals are rated 250 V, 12 A.
Max. wire size for the Phoenix terminals:
12 AWG (2.5 mm²)–1 wire
16 AWG (1.5 mm²)–2 wire
Tightening torque: 4.5 lb-in (0.5 N•m) min.
- ³ Analog output “AO1” is standard on the terminal block

Table 27: 0–10 V Auto Speed Reference (MOD J09)

Terminal ^{1,2}	Function	Characteristics
G1, S2+	AI2 Input	0–10 V, Z = 30 kΩ
J/S3	COM	

- ¹ See the Control Circuit Elementary Diagrams in Section 5.
- ² The green Phoenix terminals are rated 250 V, 12 A.
Max. wire size for the Phoenix terminals:
12 AWG (2.5 mm²)–1 wire
16 AWG (1.5 mm²)–2 wire
Tightening torque: 4.5 lb-in (0.5 N•m) min.

NOTE: Refer to Table 26 for characteristics of the analog output available with MOD H09.

Table 28: Terminal Block Characteristics

Terminal ^{[1][2]}	Function	Characteristics
A, A1	+24 V (+24 V control supply)	Minimum: 21 V; Maximum: 27 V; I = 200 mA maximum ^[5]
B	LI3 (Logic Input 3) programmed for Reference Switching Auto/Manual	24 Vdc, 10 mA State 0: V<5 V; State 1: V>11 V; Z = 3.5 kΩ
C	LI4 (Logic Input 4) programmed for Fault Reset. Communication option programmed for Forced Local.	24 Vdc, 10 mA State 0: V<5 V; State 1: V>11 V; Z = 3.5 kΩ
D	LI2 (Logic Input 2) programmed for Freewheel Stop on bypass. Also programmed for Freewheel Stop on Hand-Off-Comm. Without bypass, not assigned.	24 Vdc, 10 mA State 0: V<5 V; State 1: V>11 V; Z = 3.5 kΩ
E F	Line contactor auxiliary contact or jumper LI1 (Logic Input 1) programmed for Run Forward	24 Vdc, 10 mA State 0: V<5 V; State 1: V>11 V; Z = 3.5 kΩ
G1, S2+ +10 ^[10]	AI2 (Analog Input 2 programmed for Speed Reference Current or Voltage) +10 V Reference Supply	4–20 mA ^[6] , Z = 250 Ω, 0–10 V, 30 kΩ 10 V, I = 10 mA maximum
AI1+ ^[10]	AI1 (Analog Input 1) programmed for Speed Reference Voltage	0–10 V, Z = 30 kΩ (bipolar differential)
J/S3	COM (Speed Reference Common)	0 V
S1	Shield	
1 2	Fire/Freezestat Interlocks	Provision for user-supplied, N.C. fire/freezestat contact.
2	Control Transformer (Ungrounded)	115 Vac, 60 Hz [100 VA Type 1 and 12K, ^[8] 350 VA Type 3R ^[9]]
2 3	Smoke Purge Relay Contact ^[7]	Normally-jumpered or N.C. SPR contact when option is supplied.
3 4	AFC Select ^[7]	Supplied with bypass circuit

Notes to Table 28:

- ¹ See the Control Circuit Elementary Diagrams in Section 5.
- ² All green Phoenix terminals are rated 250 V, 12 A.
Max. wire size for all Phoenix terminals: 12 AWG (2.5 mm²)–1 wire; 16 AWG (1.5 mm²)–2 wire; Tightening torque: 4.5 lb-in (0.5 N•m) min.
- ³ Relay coil deenergizes on detected fault. Contacts are shown in detected fault mode.
- ⁴ Contact state with drive deenergized.
- ⁵ Total current of +24 V internal supply is 200 mA. If more current is required, an external supply must be used.
- ⁶ 0–20 mA, X–Y programmable with keypad display.
- ⁷ Available only when option is provided.
- ⁸ Approximately 45 VA available when all mods are selected.
- ⁹ Approximately 58 VA available when all mods are selected.
- ¹⁰ Terminal located on power converter.

Table 28: Terminal Block Characteristics (continued)

Terminal ^{[1][2]}	Function	Characteristics	Notes to Table 28:
3 5	Bypass Select ^[7]	Supplied with bypass circuit	¹ See the Control Circuit Elementary Diagrams in Section 5.
6 7	Auto Enabled	User-supplied auto start contact (run permissive)	² All green Phoenix terminals are rated 250 V, 12 A. Max. wire size for all Phoenix terminals: 12 AWG (2.5 mm ²)–1 wire; 16 AWG (1.5 mm ²)–2 wire; Tightening torque: 4.5 lb-in (0.5 N•m) min.
6A 8	Stop Push Button ^[7]		³ Relay coil deenergizes on detected fault. Contacts are shown in detected fault mode.
6 8	Start Push Button and Interlock ^[7]		⁴ Contact state with drive deenergized.
9	AFC Fault Pilot Light ^[7]		⁵ Total current of +24 V internal supply is 200 mA. If more current is required, an external supply must be used.
10A	Auto Pilot Light ^[7]		⁶ 0–20 mA, X–Y programmable with keypad display.
10	AFC Run Pilot Light ^[7]		⁷ Available only when option is provided.
11	Line Contactor Coil ^[7]		⁸ Approximately 45 VA available when all mods are selected.
12 13	Normal Contact of Test-Normal Switch ^[7]		⁹ Approximately 58 VA available when all mods are selected.
14 -15	Bypass Pilot Light ^[7]		¹⁰ Terminal located on power converter.
16 17 18	AFC Run Contacts ^[4] Auxiliary N.C. Contact (AFC Run) COM Auxiliary N.O. Contact (AFC Run)	Minimum: 10 mA, 24 Vdc; Maximum: Inductive load of: <ul style="list-style-type: none"> • 2.0 A @ 120 Vac; maximum 0.10 J/operation, 80 operations/minute • 1.0 A @ 220 Vac; maximum 0.25 J/operation, 25 operations/minute • 2.0 A @ 24 Vac; maximum 0.10 J/operation, 80 operations/minute 	
19 20 21	AFC Fault Contacts ^[3] Auxiliary N.C. Contact (AFC Fault) COM Auxiliary N.O. Contact (AFC Fault)	Minimum: 10 mA, 24 Vdc; Maximum: Inductive load of: <ul style="list-style-type: none"> • 2.0 A @ 120 Vac; maximum 0.10 J/operation, 80 operations/minute • 1.0 A @ 220 Vac; maximum 0.25 J/operation, 25 operations/minute • 2.0 A @ 24 Vac; maximum 0.10 J/operation, 80 operations/minute 	
22 23	120 Vac Smoke Purge Relay coil ^[7]	115–120 Vac/60 Hz supply (user supplied)	
24	Control Transformer (Grounded), End Damper Solenoid (–)	115 Vac, 60 Hz	
25	End Damper Solenoid (+) ^[7]	User supplied	
25, 26	Customer Damper End Switch	User supplied	
3, 3A	Fire/Freezestat Interlock for H-O-C with bypass	Provision for user supplied with N.C. contact	
A, D	Fire/Freezestat Interlock for H-O-C without bypass	Provision for user supplied with N.C. contact	
A01	Analog output configurable for voltage or current (programmed for Motor Frequency)	0–10 V, min., Z = 470 Ω 0–20 mA, max., Z = 500 Ω ^[6]	
COM	Common, Analog I/O Common	0 V	
A, A1	Smoke Purge Relay Contact ^[7]	Normally jumpered; N.C. SPR contact when option is supplied.	

INITIAL START-UP PROCEDURE

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Before working on this equipment, turn off all power supplying it and perform the bus voltage measurement procedure on page 42.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

UNQUALIFIED PERSONNEL

- This equipment must be installed and serviced only by qualified personnel.
- Qualified personnel performing diagnostics or troubleshooting requiring electrical conductors to be energized must comply with NFPA 70 E - Standard for Electrical Safety Requirements for Employee Workplaces and OSHA Standards – 29 CFR Part 1910 Subpart S Electrical.

Failure to follow these instructions will result in death or serious injury.

The E-Flex drive has been configured for the installed options and tested at the factory. Minor adjustments to complete the field installation may be required based upon the application requirements. This initial start-up procedure should be followed step by step. In case of difficulty, refer to Section 4, Troubleshooting and Maintenance, beginning on page 87.

A door-mounted or remote-mounted graphic display must be used to perform the initial start-up procedure. Type 3R enclosures include a graphic display terminal cable and graphic display terminal located inside the enclosure.

To perform any programming on the Type 3R enclosure:

1. **Remove all power**, then test for the absence of voltage.
NOTE: Verify the voltage tester is functioning properly before and after testing for the absence of voltage.
2. Open the door of the drive. To open the door, turn the circuit breaker and handle assembly to the Off position.
3. Remove the graphic display terminal and cable from inside the enclosure.
4. Connect the graphic display terminal cable to the power converter and graphic display terminal.
5. Place the graphic display terminal cable outside the enclosure by positioning the cable in the bottom left corner between the hinge and bottom of the door.
6. Close and secure the enclosure door.
7. Close the equipment disconnect means.
8. Perform programming on keypad.
9. When programming is completed, **remove all power**, then test for the absence of voltage.
10. Open the enclosure door.
11. Remove the graphic display terminal cable from the power converter.
12. Place the graphic display terminal and cable inside the enclosure.
Ensure that the graphic display terminal is not left in the bottom of the enclosure.
13. Close and secure the enclosure door.

After replacing the power converter or installing any plug-in option card, the programming parameters must be set as listed in the elementary diagram that corresponds to the options ordered. See pages 100–114.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

- Properly ground the controller panel before applying power.
- Close and secure the enclosure door before applying power.
- Certain adjustments and test procedures require that power be applied to this controller. Extreme caution must be exercised as hazardous voltages exist. The enclosure door must be closed and secured while turning on power or starting and stopping this controller.

Failure to follow these instructions will result in death or serious injury.

In addition, after installing any plug-in option card for the first time, previously-saved parameters downloaded from the graphic display terminal or PC software will not be correct because they do not include the additional parameters available with the card. The I/O extension card parameters must be set as listed in the elementary diagram that corresponds to the options ordered. See pages 100–114.

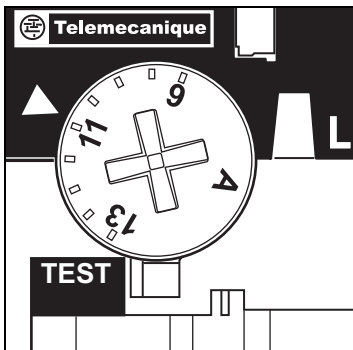
With all incoming power removed, make the following equipment checks:

- A. Verify that all equipment disconnects are open.
- B. Set the Hand-Off-Auto or Hand-Off-Comm selector switch (controller mounted or remotely mounted) to Off and the AFC-Off-Bypass switch (if used) to Off.
- C. Set the speed potentiometer (controller mounted or remotely mounted) to its minimum setting (full counterclockwise position).
- D. Open the enclosure door. To open the door, turn the circuit breaker and handle assembly to the Off position.
- E. Check the wiring of the input power ground, motor ground, speed potentiometer (if remotely mounted), and Hand-Off-Auto or Hand-Off-Comm circuit connections (if remotely mounted). See the control circuit elementary diagrams in Section 5 beginning on page 99 for the wiring of the remote control operators.
- F. When using the bypass circuit, check that the motor conductors are wired to the T1, T2, and T3 terminals of the overload relay. When using the power circuit *without* bypass, check the motor conductors wired to T1/U, T2/V, and T3/W of the controller, or T1, T2, and T3 of the distribution block.
- G. If the controller includes a bypass option for running the motor across the line, set the overload relay dial (on the load side of the bypass contactor) to the full load ampere rating on the nameplate of the connected motor. See the example at left.
- H. Using a voltmeter set at the 1000 Vac scale, verify that the incoming line voltage at the line side of the disconnecting means is within $\pm 10\%$ of the input voltage rating on the controller nameplate.
- I. Close and secure the enclosure door. Close the equipment disconnect means. The Power On pilot light (if used) illuminates.

This drive does not provide direct thermal protection for the motor. Consult the motor manufacturer for the thermal capability of the motor when operated over the desired speed range.

Figure 17: Overload Relay Dial

NOTE: The LR2D1516 overload relay is shown. Your dial setting range may be different.



▲ CAUTION

MOTOR OVERHEATING HAZARD

Use a thermal sensor in the motor as required by the motor manufacturer to help facilitate motor overheating protection at all speeds and load conditions.

Failure to follow these instructions can result in injury or equipment damage.

- J. Press the ESC key on the graphic keypad until “MAIN MENU” is displayed and “DRIVE MENU” is highlighted. Press the keypad knob (ENT) twice. The “SIMPLY START” menu is displayed. Rotate the keypad knob clockwise until “Mot. therm. current” is highlighted. Press ENT. Rotate the keypad knob until the display indicates the correct motor nameplate full load amperes. Press ENT. The controller is now

calibrated to provide motor overload protection. Press ESC three times to return to the monitor screen.

NOTE: The settings listed in this procedure are suitable for most applications. If your application requires different operating characteristics, refer to the Programming Manual, on CD-ROM W817574030111 for more information.

▲ WARNING

HAZARDOUS MOVING PARTS

Before starting the drive, ensure that the motor and its connected load are clear from personnel and are ready to run.

Failure to follow these instructions can result in death or serious injury.

- K. Set the AFC-Off-Bypass selector switch (if used) to AFC; the Normal-Test selector switch (if used) to Normal; and the Hand-Off-Auto or Hand-Off-Comm selector switch to Hand (push Start if the Start/Stop push buttons are used). If using a manual speed potentiometer, slowly turn it clockwise to accelerate the motor. If using the graphic keypad knob for potentiometer mode, rotate the keypad knob clockwise until “HMI frequency ref.” is highlighted. Press ENT. Slowly rotate the keypad knob clockwise to accelerate the motor. Check the direction of motor rotation. If correct, proceed to step P. If incorrect, stop the drive. **Remove all power!**

▲ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Turn off all power supplying this equipment and perform the bus voltage measurement procedure on page 42 before proceeding.

Failure to follow these instructions will result in death or serious injury.

- L. Correct the direction of motor rotation by reversing any two motor leads connected to the controller output (see Step F, page 57).
- M. Reset the speed potentiometer to minimum speed (counterclockwise) or until graphic display terminal motor frequency reads zero. Close and secure the enclosure door, then reapply power and restart the controller.
- N. If using a manual speed potentiometer, slowly turn it clockwise to accelerate the motor. If using the graphic keypad knob for potentiometer mode, rotate the keypad knob clockwise until “HMI frequency ref.” is highlighted. Press ENT. Slowly rotate the keypad knob clockwise to accelerate the motor. Check the direction of motor rotation. If correct, this completes the controller mode, motor rotation check.

CAUTION

RISK OF CONTROLLER DAMAGE

- Move the Hand-Off-Auto switch to the Off position before moving the AFC-Off-Bypass switch from AFC to the Off position.
- Avoid repeated opening of the drive output contactor while under load.

Failure to follow these instructions can result in equipment damage.

- O. Set the AFC-Off-Bypass selector switch (if used) to Off, leaving the Hand-Off-Auto or Hand-Off-Comm selector switch in the Hand position.

NOTE: If the controller circuit breaker trips during this test, a higher trip setting may be required. Refer to "Circuit Breaker Trip Adjustment Procedure" on page 56.

- P. Momentarily set the AFC-Off-Bypass selector switch to Bypass to check the direction of motor rotation, then return it immediately to the Off position. If the direction of motor rotation is correct, proceed to Step S. If incorrect, stop the drive. **Remove all power!**

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Turn off all power supplying this equipment and perform the bus voltage measurement procedure on page 42 before proceeding.

Failure to follow these instructions will result in death or serious injury.

- Q. Correct the direction of motor rotation by reversing any two incoming leads to the circuit breaker disconnect means marked L1, L2, or L3.
- R. Momentarily set the AFC-Off-Bypass selector switch to Bypass to check the direction of motor rotation, then return it immediately to the Off position. If correct, this completes the bypass mode motor rotation check.
- S. Check the High Speed (HSP) setting (maximum motor speed setting). Press the ESC key on the graphic keypad until “MAIN MENU” is displayed and “DRIVE MENU” is highlighted. Press the keypad knob (ENT) twice. The “SIMPLY START” menu is displayed. Rotate the keypad knob clockwise until “High Speed” is highlighted. Press ENT. Rotate the keypad knob until the display indicates the maximum output frequency required for the application (factory default is 60 Hz), then press ENT. The controller HSP setting is now complete.
Refer to the *Programming Manual, W817574030111 (CD-ROM)*.¹
- T. Check the Low Speed (LSP) setting (minimum motor speed setting). Continuing from step S above, rotate the keypad knob counter-clockwise until “Low Speed” is highlighted. Press ENT. Rotate the keypad knob until the display indicates the minimum output frequency required for the application (preset value is 3 Hz; factory default is 0 Hz), then press ENT. The controller LSP setting is now complete. Press ESC three times to return to the monitor screen.
Refer to the *Programming Manual, W817574030111 (CD-ROM)*.¹
- U. The application may require changing the setting of acceleration (ACC) and deceleration (dEC) times. Preset value is 10 seconds. If the power converter has been replaced or reset to factory default, the value will be 3 seconds. To change the setting, press the ESC key on the graphic keypad until “MAIN MENU” is displayed and “DRIVE MENU” is highlighted. Press the keypad knob (ENT) twice. The “SIMPLY START” menu is displayed. Rotate the keypad knob clockwise until “Acceleration” is highlighted. Press ENT. Rotate the keypad knob until the display indicates the acceleration time required for the application, then press ENT. Rotate the keypad knob counter-clockwise until “Deceleration” is highlighted. Press ENT. Rotate the keypad knob until the display indicates the deceleration time required for the application, then press ENT. The controller acceleration and deceleration time setting is now complete. Press ESC three times to return to the monitor screen.

¹ See the ATV61 Installation Manual and the ATV61 Programming Manual. These manuals are available from the Technical Library at www.Schneider-electric.us.

**CIRCUIT BREAKER TRIP ADJUSTMENT
PROCEDURE**

All circuit breakers with an “H” prefix have no adjustment; they have fixed trip units. All circuit breakers with a “J” prefix have adjustable trip settings, and should be set as shown in the tables for the controller selected.

Table 29: Circuit Breaker Trip Adjustment, 460 V

hp-VT	Circuit Breaker	Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short-Circuit Protection			
		Hold (A)	Trip (A)	Low (A)	High (A)	Drive only Set (A)	Drive w/ Bypass Set (A)
1	HLL36015	350	750	–	–	–	–
2	HLL36015	350	750	–	–	–	–
3	HLL36015	350	750	–	–	–	–
5	HLL36015	350	750	–	–	–	–
7.5	HLL36025	350	750	–	–	–	–
10	HLL36025	400	850	–	–	–	–
15	HLL36050	400	850	–	–	–	–
20	HLL36060	800	1450	–	–	–	–
25	HLL36080	800	1450	–	–	–	–
30	HLL36100	900	1700	–	–	–	–
40	HLL36125	900	1700	–	–	–	–
50	HLL36150	900	1700	–	–	–	–
60	JLL36175	–	–	875	1750	876	1001
75	JLL36225	–	–	1125	2250	1125	1248
100	JLL36250	–	–	1250	2500	1447	1612

Table 30: Circuit Breaker Trip Adjustment, 230 V

hp-VT	Circuit Breaker	Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short-Circuit Protection			
		Hold (A)	Trip (A)	Low (A)	High (A)	Drive only Set (A)	Drive w/ Bypass Set (A)
1	HLL36015	350	750	–	–	–	–
2	HLL36015	350	750	–	–	–	–
3	HLL36025	350	750	–	–	–	–
5	HLL36040	400	850	–	–	–	–
7.5	HLL36060	800	1450	–	–	–	–
10	HLL36070	800	1450	–	–	–	–
15	HLL36110	900	1700	–	–	–	–
20	HLL36125	900	1700	–	–	–	–
25	JLL36175	–	–	875	1750	875	884
30	JLL36200	–	–	1000	2000	1000	1040
40	JLL36250	–	–	1250	2500	1250	1352
50	JLL36250	–	–	1250	2500	1511	1690

Table 31: Circuit Breaker Trip Adjustment, 208 V

hp-VT	Circuit Breaker	Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short-Circuit Protection			
		Hold (A)	Trip (A)	Low (A)	High (A)	Drive only Set (A)	Drive w/ Bypass Set (A)
1	HLL36015	350	750	—	—	—	—
2	HLL36015	350	750	—	—	—	—
3	HLL36025	350	750	—	—	—	—
5	HLL36040	400	850	—	—	—	—
7.5	HLL36060	800	1450	—	—	—	—
10	HLL36070	800	1450	—	—	—	—
15	HLL36110	900	1700	—	—	—	—
20	HLL36125	900	1700	—	—	—	—
25	JLL36175	—	—	875	1750	875	973
30	JLL36200	—	—	1000	2000	1000	1144
40	JLL36250	—	—	1250	2500	1347	1482
50	JLL36250	—	—	1250	2500	1660	1860

Table 32: PowerPact Circuit Breaker Derating for Temperature and Altitude¹, 480 V/100 kA and 240 V/125 kA

Circuit Breaker	Circuit Breaker (A)			Altitude Current Derating Value		
	≤ 40° C	≤ 50° C	≤ 60° C	≤ 2000 m	2600 m	3900 m
	≤ 104° F	≤ 122° F	≤ 140° F	≤ 6600 ft	8500 ft	13000 ft
HLL36015	15	12	9	1	0.99	0.96
HLL36020	20	17	14	1	0.99	0.96
HLL36025	25	21	17	1	0.99	0.96
HLL36030	30	25	20	1	0.99	0.96
HLL36035	35	30	24	1	0.99	0.96
HLL36040	40	34	28	1	0.99	0.96
HLL36045	45	38	31	1	0.99	0.96
HLL36050	50	43	35	1	0.99	0.96
HLL36060	60	53	46	1	0.99	0.96
HLL36070	70	62	53	1	0.99	0.96
HLL36080	80	72	63	1	0.99	0.96
HLL36090	90	80	70	1	0.99	0.96
HLL36100	100	86	72	1	0.99	0.96
HLL36110	110	95	80	1	0.99	0.96
HLL36125	125	109	93	1	0.99	0.96
HLL36150	150	131	111	1	0.99	0.96
JLL36150	150	131	111	1	0.99	0.96
JLL36175	175	150	124	1	0.99	0.96
JLL36200	200	176	151	1	0.99	0.96
JLL36250	225	193	160	1	0.99	0.96
JLL36250	250	214	177	1	0.99	0.96

¹ Derating applies to the thermal magnetic circuit breaker, not the overall drive.

SECTION 3— CIRCUIT DESCRIPTIONS AND OPTIONS

INTRODUCTION

This section describes basic sequences of operation for the two pre-engineered power circuit configurations and available options. The options are:

- Power Circuit W: Without Bypass (see page 64)
- Power Circuit Y: Bypass (see page 69)

TERMINAL VERSUS KEYPAD COMMAND OPERATION

For factory and user-supplied pilot devices and controls to be recognized, the E-Flex drive is factory-configured to operate from the terminal strip. Changing settings in Menu 1.6 COMMAND disables certain power converter logic inputs. Factory and user-provided control devices are ignored. For this reason, do not operate the drive with Menu 1.6 settings different than those shown in the ATV61 Factory Configuration tables (see Figures 29–35 on pages 100–114).

Changing certain factory settings will affect the performance of the E-Flex drive.

▲ WARNING

UNINTENDED EQUIPMENT OPERATION

- The controller has been factory-programmed. Alteration of factory programming may create incompatibilities with the supplied controller configuration.
- Read and understand the *Programming Manual*, on CD-ROM W817574030111 supplied with the power converter, as well as the programming information found in the applicable control circuit elementary diagrams provided with each controller.
- If the power converter unit or the main control board of the power converter is replaced, or if any option cards are field installed, the power converter must be re-programmed according to the programming instructions found in the applicable control circuit elementary diagrams provided with each controller.

Failure to follow these instructions can result in death or serious injury.

NOTE: The factory program can be saved in the graphic display terminal. Refer to the ATV61 Programming Manual for saving and retrieving factory settings.¹

GRAPHIC DISPLAY TERMINAL OPERATION

The graphic display terminal is for programming and display. The FWD/REV, Run, and Stop/Reset buttons are not for controller primary operation. The 22 mm operators located on the front of the controller door are used to command the AFC and Bypass modes of operation.

TYPE 3R OPERATION

To prevent condensation on the inside of the cabinet, leave the mains energized when the motor is not running.

¹ See the ATV61 Installation Manual and the ATV61 Programming Manual. These manuals are available from the Technical Library at www.Schneider-electric.us.

RESET AFTER CLEARING A FAULT

When a communication option is selected, the drive fault reset feature will be removed. Instead:

- LI4 is programmed for forced local

The user may choose to remove the forced local function if start/stop commands are not commanded over the communication system network. To activate the fault reset function:

- Assign fault reset to LI4

POWER CIRCUIT W (WITHOUT BYPASS)

This power circuit consists of a fused control transformer, circuit breaker disconnect with means for locking in the open position, power converter, and optional equipment as specified.

OPERATOR CONTROLS—GENERAL ARRANGEMENT AND OPERATION

The operator controls are located on the front door of the drive unless no control options are specified. The drive is factory configured to operate in terminal command mode.

MOD D09 omits the graphic display terminal. If D09 is selected, a separate graphic display terminal or PowerSuite software must be ordered to program the power converter.

CONTROLLER OPERATION

To operate the controller, the circuit breaker disconnect located on the front of the drive must be in the closed position. There are several modes of operation depending upon the control method used.

- Two-wire control functionality: Hand-Off-Auto or Hand-Off-Comm selector switch. The controller will automatically restart when power is restored after a power loss or upon clearing a fault condition, if the Auto contact is closed.
- Three-wire control functionality: Start/Stop push buttons. The controller will not restart when power is restored after a power loss or upon clearing a fault. The start push button must be pressed to restart the controller.

FIRE/FREEZESTAT INTERLOCKS

Table 33 describes the dedicated terminals for accepting a normally-closed user-supplied fire/freezestat interlock, for the controller configurations shown. The controller will stop operation if the connection between these terminals is opened.

Table 33: Fire/Freezestat Interlock Terminals

Terminals	Product Configuration	Control Circuit Voltage
1 and 2	Controllers (Power Circuit W or Y) without a communication card. The Run Command Relay is dropped out if the connection between terminals 1 and 2 is opened, stopping the motor.	120 VAC
A and D	Controllers without Bypass (Power Circuit W) with a communication card. The signal to LI2 (Freewheel Stop) is removed if the connection between terminals A and D is opened, stopping the motor.	24 VDC
3 and 3A	Controllers with Bypass (Power Circuit Y) with a communication card. The drive output contactor and bypass contactor open if the connection between terminals 3 and 3A is opened, stopping the motor.	120 VAC

Always remove the factory-installed jumper from these terminals before installing the interlock.

**MOD A07
HAND-OFF-AUTO SELECTOR AND
MANUAL SPEED POTENTIOMETER**

This control option provides a door-mounted Hand-Off-Auto (H-O-A) selector switch and manual speed potentiometer to operate the power converter.

Hand mode is for local control. As soon as Hand mode is selected, the power converter starts the motor. In Hand mode, the speed potentiometer is used to control the speed of the drive.¹

Off mode commands the power converter to stop the motor by either following the programmed deceleration ramp (factory setting) or by a freewheel stop.

Set the H-O-A switch to Off for fault reset.

Auto mode is for remote control. In Auto mode, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7. Motor speed is varied by adjusting the user-supplied auto speed reference signal (4–20 mA or 0–10 Vdc if J09 is selected) supplied to terminals G1/S2+ and J1/S3 in the drive.

When using a communication card in the Auto mode, forced local is inactive, therefore the communications network can change the power converter programming.

When MOD J09 is selected, the motor speed is varied by adjusting the user-supplied auto speed reference signal (0–10 V) supplied to terminals G1/S2+ and J1/S3. The converter is programmed to allow 0–10 V on AI2 input.

**MOD B07
HAND-OFF-AUTO SELECTOR,
START/STOP PUSH BUTTONS, AND
MANUAL SPEED POTENTIOMETER**

This control option provides a door-mounted Hand-Off-Auto (H-O-A) selector switch, a Start push button, a Stop push button, and a manual speed potentiometer to operate the power converter.

Hand mode is for local control. The power converter will not start the motor until the Start push button is pushed. In Hand mode, the manual speed potentiometer (graphic keypad knob or remotely mounted potentiometer) is used to control the speed of the controller.¹

Off mode commands the power converter to stop the motor by either following the programmed deceleration ramp (factory setting) or by a freewheel stop.

Set the H-O-A switch to Off for fault reset.

⚠ WARNING

INABILITY TO INITIATE A STOP

The Stop push button is only active in the Hand mode.

- To stop the drive, open the disconnect switch or set the Hand-Off-Auto switch to Off.
- Use appropriate guarding or interlocking.

Failure to follow these instructions can result in death or serious injury.

Auto mode is for remote control. In Auto mode, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7. Motor speed is varied by adjusting the user supplied auto speed reference signal (4–20 mA or 0–10 Vdc if J09 is selected) supplied to terminals G1/S2+ and J1/S3. in the drive.

¹ The graphic keypad serves as the manual speed potentiometer function unless mod D09 or Type 3R configurations are used.

When using a communication card in the Auto mode, forced local is inactive, therefore the communications network can change the power converter programming.

When MOD J09 is selected, the motor speed is varied by adjusting the user-supplied auto speed reference signal (0–10 V) supplied to terminals G1/S2+ and J1/S3. The converter is programmed to allow 0–10 V on AI2 input.

The **Start** push button commands the power converter to start the motor for local control. The manual speed potentiometer is used to control the speed of the controller.

The **Stop** push button commands the power converter to stop the motor for local control by either following the programmed deceleration ramp (factory setting) or by freewheel stopping. If the Hand-Off-Auto switch is in the Auto mode, the switch must be set to Off to stop the power converter. The Stop push button is only active for local control (Hand), not for remote control (Auto).

MOD C07 START/STOP PUSH BUTTONS AND MANUAL SPEED POTENTIOMETER

This control option provides door-mounted Start and Stop push buttons and a manual speed potentiometer to operate the power converter locally.

The **Start** push button commands the power converter to start the motor. The manual speed potentiometer mounted on the drive is used to control the speed of the controller.

The **Stop** push button commands the power converter to stop the motor by either following the programmed deceleration ramp (factory setting) or by a freewheel stop.

MOD D07 HAND-OFF-COMM SELECTOR AND MANUAL SPEED POTENTIOMETER

This control option provides a door-mounted Hand-Off-Comm (H-O-C) selector switch and manual speed potentiometer (graphic keypad knob or remotely mounted potentiometer) to operate the power converter.

Hand mode is for local control. As soon as Hand mode is selected, the power converter starts the motor. In Hand mode, the speed potentiometer is used to control the speed of the drive.¹

Off mode commands the power converter to stop the motor either by following the programmed deceleration ramp (factory setting) or by a freewheel stop.

Comm mode is for communication card control. In Communication mode, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7 and a control signal from a communication card is sent to the converter.

MOD E07 HAND-OFF-COMM SELECTOR, START/STOP PUSH BUTTONS, AND MANUAL SPEED POTENTIOMETER

This control option provides a door-mounted Hand-Off-Comm (H-O-C) selector switch, a Start push button, a Stop push button, and a manual speed potentiometer (graphic keypad knob or remotely mounted potentiometer) to operate the power converter.

Hand mode is for local control. The power converter will not start the motor until the Start push button is pushed. In Hand mode, the manual speed potentiometer is used to control the speed of the controller.¹

Off mode commands the power converter to stop the motor either by following the programmed deceleration ramp (factory setting) or by a freewheel stop.

¹ The graphic keypad serves as the manual speed potentiometer function unless mod D09 or Type 3R configurations are used.

▲ WARNING

INABILITY TO INITIATE A STOP

The Stop push button is only active in the Hand mode.

- To stop the drive, open the disconnect switch or set the Hand-Off-Comm switch to Off.
- Use appropriate guarding or interlocking.

Failure to follow these instructions can result in death or serious injury.

Comm mode is for communication card control. In Communication mode, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7, and a control signal from a communication card is sent to the converter.

The **Start** push button commands the power converter to start the motor in local control. The manual speed potentiometer is used to control the speed of the controller.

The **Stop** push button commands the power converter to stop the motor in local control by either following the programmed deceleration ramp (factory setting) or by freewheel stopping. If the Hand-Off-Comm switch is in Communication mode, the switch must be set to Off to stop the power converter. The Stop push button is only active for local control (Hand), not for communication control (Comm).

MOD N07 NO OPERATORS; WIRED FOR REMOTE OPERATION

Control option N07 omits control operator functions. It is for use with customer-supplied external control devices.

MOD A08 PILOT LIGHT OPTION #1 CLUSTER

This pilot light option provides visual indication of protective functions and circuit status.

Power On (red): illuminates when mains power is applied to the controller. The pilot light device is rated 120 Vac.

AFC Run (green): illuminates to annunciate an AFC run condition. The pilot light device is rated 120 Vac.

Auto (yellow): illuminates when the Hand-Off-Auto or Hand-Off-Comm selector switch is set to Auto or Comm. The pilot light device is rated 120 Vac.

Fault (yellow): illuminates to annunciate an AFC fault (trip) condition. The pilot light device is rated 120 Vac.

MOD C08 PILOT LIGHT OPTION #3 CLUSTER

This pilot light option provides visual indication of protective functions and circuit status.

Power On (red): illuminates when mains power is applied to the controller. The pilot light device is rated 120 Vac.

AFC (green): illuminates to annunciate an AFC run condition. The pilot light device is rated 120 Vac.

Fault (yellow): illuminates to annunciate an AFC fault (trip) condition. The pilot light device is rated 120 Vac.

MOD A09 5% LINE REACTOR

This option includes an integrally-mounted 5% AC line reactor factory-installed and wired between the circuit breaker disconnect means and the power converter for harmonic mitigation. It replaces the standard 3% DC choke.

MOD C09 3–15 PSI TRANSDUCER WITH DIGITAL DISPLAY OPTION

This option provides the controller with the capability to follow a user-supplied 3–15 PSI follower signal with digital display. The module is calibrated to operate as a 4–20 mA DC follower for the power converter.

MOD D09 OMIT GRAPHIC DISPLAY TERMINAL

This option omits the graphic display terminal. If MOD D09 is selected, a separate graphic display must be ordered to program the drive.

**MOD E09
SMOKE PURGE OPTION (FIREMAN'S
OVERRIDE)**

This option provides a smoke purge operating mode controlled by a user-supplied 120 Vac signal applied between terminals 22 and 23. When 120 Vac power is supplied to 22 and 23, the drive runs the motor at 60 Hz.

When using End damper control (MOD S09) with the Smoke purge option, there will be a delay on initiation of the drive.

NOTE: Delayed Start:

- End damper control is installed.
- Motor start will be delayed until the damper is fully open.
- Wait a sufficient time for the damper to open after start-up.

A supplied Delayed Operation Notice should be placed by the Fireman's Override Key Switch.

**MOD F09
PROFIBUS**

This option provides a factory-installed Profibus Communication card, VW3A3307.

**MOD H09
I/O EXTENSION CARD**

This option provides an additional 0–20 mA analog output for customer use. It includes a plug-in analog card, VW3A3202, with AO2, AO3, and COM. The output is factory-programmed for motor frequency. Selectable x–y range with graphic display.

**MOD J09
0–10 V AUTO SPEED REFERENCE**

This option provides for a 0–10 V user-supplied auto speed reference signal into the AI2 input, terminals G1/S2+ and J/S3 on terminal block 2. Not available with MOD C07 (page 66) or with MOD C09 (page 67).

**MOD K09
cUL Listing**

This option provides Canadian cUL certification when required by local code requirements.

**MOD L09
LONWORKS®**

This option provides a factory-installed LonWorks card, VW3A3312.

**MOD M09
MODBUS®**

This option provides, in addition to a standard Modbus port, a factory-installed plug-in Modbus card, VW3A3303.

**MOD O09
APOGEE™ P1**

This option provides a factory-installed PI card, VW3A3314.

**MOD P09
METASYS® N2**

This option provides a factory-installed plug-in Metasys® N2 card, VW3A3313.

MOD Q09 ETHERNET

This option provides a factory-installed Ethernet card, VW3A3310D.

MOD R09 BACNET

This option provides a factory-installed BACnet card, VW3A3315.

**MOD S09
END DAMPER CONTROL**

This option provides a factory-installed circuit to inhibit converter operation until the damper is fully open.

**MOD T09
SERVICE ENTRANCE RATING**

This option provides a UL869A approved insulated ground neutral lug assembly and mounting bracket with bonded enclosure ground wire suitable for use as service entrance rated equipment.

**MOD U09
SEISMIC QUALIFIED**

This option supplies a certification label and hardware qualified to seismic rating AC156 acceptance criteria test protocol with an importance factor of 1.5. Refer to "Seismic Qualification Mounting Criteria" on page 37.

**MOD X09
3% LINE REACTOR**

This option includes an integrally-mounted 3% AC line reactor factory installed and wired between the circuit breaker disconnect means and the power converter for harmonic mitigation. It replaces the standard 3% DC choke.

**POWER CIRCUIT Y
(BYPASS)**

This power circuit operates the motor from the power converter or from full voltage line power (bypass mode). The motor can be run in the bypass mode in the unlikely event that the power converter becomes inoperative. The Bypass Package consists of:

- Drive output and bypass contactors (electrically interlocked) with Class 20 overloads (Class 10 for 1 hp @ 460 V)
- Control transformer
- Circuit breaker disconnect with means for locking in the open position
- AFC-Off-Bypass switch
- Test-Normal switch
- Power converter
- Optional equipment as specified

**OPERATOR CONTROLS—GENERAL
ARRANGEMENT AND OPERATION**

CAUTION

RISK OF CONTROLLER DAMAGE

- Move the Hand-Off-Auto switch to the Off position before moving the AFC-Off-Bypass switch from AFC to the Off position.
- Avoid repeated opening of the drive output contactor while under load.

Failure to follow these instructions can result in equipment damage.

Drive output contactors are rated to carry full load motor current; however, these contactors are not intended to break motor current except in the event of an emergency. Always ensure that the motor has come to a complete stop and that the drive is stopped and its output frequency is zero before switching the drive off. Failure to follow these guidelines can reduce the life of the device.

Operator controls are located on the front door of the drive unless no control options are specified. The drive is factory configured to operate in terminal command mode. MOD D09 omits the graphic display terminal. If D09 is selected, a separate graphic display or PowerSuite software must be ordered to program the power converter.

The AFC-Off-Bypass switch allows selection of either adjustable speed operation of the motor through the power converter (AFC position) or line power operation of the motor (Bypass position). Both AFC and Bypass operation can be started in the Hand mode for immediate start, or in the Auto or Communication mode for remote contactor start.

**TEST-NORMAL OPERATION (BYPASS
ONLY)**

The Test-Normal switch is used to test the power converter while the drive is operating the motor in bypass. To use this function and maintain motor operation, place the following switches in these positions:

- AFC-Off-Bypass: Set the switch to bypass to run the motor at full speed across the line.
- Test-Normal: Set the switch to Test.

- Hand-Off-Auto or Hand-Off-Comm: Set the switch to Hand. Use the manual speed potentiometer to change the speed reference and observe power converter operation.

BYPASS OPERATION

To control the operation of the motor with line power, the circuit breaker disconnect located on the front of the drive must be in the closed position and the AFC-Off-Bypass switch must be in the Bypass position. When the AFC-Off-Bypass selector switch is set to Bypass, motor operation is transferred to line power. In Hand mode the motor will immediately start. In Hand mode with a start/stop push button, the motor will start when the start push button is pressed. In Auto mode, the motor will start when the user-supplied contact is closed. In Communication mode, the motor will start when the Comm board Comm signal commands a run. When the selector switch is moved to the Off position, the bypass contactor opens and the motor stops. When in Bypass and Communication modes, the Comm board has no control over when the motor runs. If terminals 6 and 7 are connected, then the motor will run immediately.

FIRE/FREEZE STAT INTERLOCKS

Table 34 describes the dedicated terminals for accepting a normally-closed user-supplied fire/freezestat interlock, for the controller configurations shown. The controller will stop operation if the connection between these terminals is opened.

Table 34: Fire/Freezestat Interlock Terminals

Terminals	Product Configuration	Control Circuit Voltage
1 and 2	Controllers (Power Circuit W or Y) without a communication card. The Run Command Relay drops out if the connection between terminals 1 and 2 is opened, stopping the motor.	120 Vac
A and D	Controllers without Bypass (Power Circuit W) with a communication card. The signal to LI2 (Freewheel Stop) is removed if the connection between terminals A and D is opened, stopping the motor.	24 Vdc
3 and 3A	Controllers with Bypass (Power Circuit Y) with a communication card. The drive output contactor and bypass contactor open if the connection between terminals 3 and 3A is opened, stopping the motor.	120 Vac

Always remove the factory-installed jumper from these terminals before installing the interlock.

**MOD A07
HAND-OFF-AUTO SELECTOR AND
MANUAL SPEED POTENTIOMETER**

This control option provides a door-mounted Hand-Off-Auto (H-O-A) selector switch and manual speed potentiometer to operate the power converter.

Hand mode is for local control. In Bypass operation, as soon as Hand mode is selected, a full-voltage across-the-line start will occur. In AFC operation, as soon as Hand mode is selected, the power converter starts the motor. The manual speed potentiometer is used to control the speed of the controller.¹

Off mode commands the power converter to stop the motor by either following the programmed deceleration ramp (factory setting) or by a freewheel stop.

Set the H-O-A switch to Off for fault reset.

Auto mode is for remote control. In Bypass operation, a full-voltage across-the-line start will occur when the user-supplied run contact is closed between controller terminals 6 and 7. In AFC operation, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7. Motor speed is varied by adjusting the user-supplied auto speed reference signal (4-20 mA or 0–10 Vdc if J09 is selected) supplied to terminals G1/S2+ and J1/S3 in the drive.

When using a communication card in the Auto mode, forced local is inactive, therefore the communications network can change the power converter programming.

When MOD J09 is selected, the motor speed is varied by adjusting the user-supplied auto speed reference signal (0–10 V) supplied to terminals G1/S2+ and J1/S3. The converter is programmed to allow 0–10 V on AI2 input.

¹ The graphic keypad serves as the manual speed potentiometer function unless mod D09 or Type 3R configurations are used.

**MOD B07
HAND-OFF-AUTO SELECTOR,
START/STOP PUSH BUTTONS, AND
MANUAL SPEED POTENTIOMETER**

This control option provides a door-mounted Hand-Off-Auto (H-O-A) selector switch, a Start push button, a Stop push button, and a manual speed potentiometer to operate the power converter.

⚠ WARNING

INABILITY TO INITIATE A STOP

The Stop push button is only active in the Hand mode.

- To stop the drive, open the disconnect switch or set the Hand-Off-Auto switch to Off.
- Use appropriate guarding or interlocking.

Failure to follow these instructions can result in death or serious injury.

Hand mode is for local control. In Bypass operation, when Hand mode is selected, a full-voltage across-the-line start will occur when the start push button is pushed. In AFC operation, the power converter will not start the motor until the Start push button is pressed. The manual speed potentiometer is used to control the speed of the controller.¹

Off mode commands the power converter to stop the motor by either following the programmed deceleration ramp (factory setting) or by a freewheel stop.

Set the H-O-A switch to Off for fault reset.

Auto mode is for remote control. In Bypass operation, a full-voltage across-the-line start will occur when the user-supplied run contact is closed between controller terminals 6 and 7. In AFC operation, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7. Motor speed is varied by adjusting the user-supplied auto speed reference signal (4–20 mA or 0–10 Vdc if J09 is selected) supplied to terminals G1/S2+ and J1/S3 in the drive.

When using a communication card in the Auto mode, forced local is inactive, therefore the communications network can change the power converter programming.

When MOD J09 is selected, the motor speed is varied by adjusting the user-supplied auto speed reference signal (0–10 V) supplied to terminals G1/S2+ and J1/S3. The converter is programmed to allow 0–10 V on AI2 input.

The **Start** push button commands the power converter to start the motor in Hand mode for local control. The manual speed potentiometer is used to control the speed of the controller.

The **Stop** push button commands the power converter to stop the motor for local control by either following the programmed deceleration ramp (factory setting) or by a freewheel stop. If the Hand-Off-Auto Switch is in Auto mode, it must be set to Off to stop the power converter. The Stop push button is only active for local control (Hand), not for remote control (Auto).

¹ The graphic keypad serves as the manual speed potentiometer function unless mod D09 or Type 3R configurations are used.

**MOD D07
HAND-OFF-COMM SELECTOR AND
MANUAL SPEED POTENTIOMETER**

This control option provides a door-mounted Hand-Off-Comm (H-O-C) selector switch and manual speed potentiometer to operate the power converter.

Hand mode is for local control. As soon as Hand mode is selected, the power converter starts the motor. In Hand mode, the speed potentiometer is used to control the speed of the drive.

Off mode commands the power converter to stop the motor by either following the programmed deceleration ramp (factory setting) or by a freewheel stop.

Comm mode is for communication card control. In Communication mode, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7 and a control signal from a communication card is sent to the converter.

**MOD E07
HAND-OFF-COMM SELECTOR,
START/STOP PUSH BUTTONS, AND
MANUAL SPEED POTENTIOMETER**

This control option provides a door-mounted Hand-Off-Comm (H-O-C) selector switch, a Start push button, a Stop push button, and a manual speed potentiometer to operate the power converter.

Hand mode is for local control. The power converter will not start the motor until the Start push button is pushed. In Hand mode, the manual speed potentiometer is used to control the speed of the controller. When using the knob on the graphic display to change the speed in hand mode, go to Menu 1.2, Monitoring, and select HMI Frequency Ref.

Off mode commands the power converter to stop the motor by either following the programmed deceleration ramp (factory setting) or by a freewheel stop.

⚠ WARNING

INABILITY TO INITIATE A STOP

The Stop push button is only active in the Hand mode.

- To stop the drive, open the disconnect switch or set the Hand-Off-Comm switch to Off.
- Use appropriate guarding or interlocking.

Failure to follow these instructions can result in death or serious injury.

Comm mode is for communication card control. In Communication mode, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 6 and 7 and a control signal from a communication card is sent to the converter.

The **Start** push button commands the power converter to start the motor for local control. The manual speed potentiometer is used to control the speed of the controller.

The **Stop** push button commands the power converter to stop the motor for local control by either following the programmed deceleration ramp (factory setting) or by freewheel stopping. If the Hand-Off-Comm switch is in Communication mode, the switch must be set to Off to stop the power converter. The Stop push button is only active for local control (Hand), not for communication control (Comm).

**MOD N07
NO OPERATORS; WIRED FOR REMOTE
OPERATION**

Control option N07 omits control operator functions. It is for use with customer-supplied external control devices.

**MOD A08
PILOT LIGHT OPTION #1 CLUSTER**

This pilot light option provides visual indication of protective functions and circuit status.

Power On (red): illuminates when mains power is applied to the controller. The pilot light device is rated 120 Vac.

AFC (green): illuminates to announce an AFC run condition. The pilot light device is rated 120 Vac.

Fault (yellow): illuminates to announce an AFC fault (trip) condition. When MOD B09 (line contactor) is selected, the light illuminates when the AFC-Off-Bypass selector switch is in the Off or Bypass position to indicate that the power converter is not running. The pilot light device is rated 120 Vac.

Auto (yellow): illuminates when the Hand-Off-Auto or Hand-Off-Comm selector switch is set to Auto or Comm. The pilot light device is rated 120 Vac.

**MOD B08
PILOT LIGHT OPTION #2 CLUSTER**

This pilot light option provides visual indication of protective functions and circuit status.

Power On (red): illuminates when mains power is applied to the controller. The pilot light device is rated 120 Vac.

AFC (green): illuminates to announce an AFC run condition. The pilot light device is rated 120 Vac.

Fault (yellow): illuminates to announce an AFC fault (trip) condition. When MOD B09 (line contactor) is selected, the light illuminates when the AFC-Off-Bypass selector switch is in the Off or Bypass position to indicate that the power converter is not running. The pilot light device is rated 120 Vac.

Bypass (yellow): illuminates when the motor is started across the line. The pilot light device is sequenced by the Hand-Off-Auto selector switch and is rated 120 Vac.

**MOD A09
LINE REACTOR**

This option includes an integrally-mounted 5% AC line reactor, factory-installed and wired between the circuit breaker disconnect means and the power converter, for harmonic mitigation. It replaces the standard 3% DC choke.

**MOD B09
LINE CONTACTOR**

This option provides a line contactor factory-wired between the circuit breaker disconnect (or line reactor when provided) and the power converter. Not available with Type 3R.

NOTE: With line contactor MOD B09, the AFC Fault light will illuminate when the AFC-Off-Bypass selector switch is in the Off or Bypass position to indicate that the power converter is not running.

**MOD C09
3–15 PSI TRANSDUCER WITH DIGITAL
DISPLAY OPTION**

This option provides the controller with the capability to follow a user-supplied 3–15 PSI follower signal with digital display. The module is calibrated to operate as a 4–20 mA DC follower for the power converter.

**MOD D09
OMIT GRAPHIC DISPLAY TERMINAL**

This option omits the graphic display terminal. If MOD D09 is selected, a separate graphic display must be ordered to program the drive.

**MOD E09
SMOKE PURGE OPTION (FIREMAN'S
OVERRIDE)**

This option provides a smoke purge operating mode controlled by a user-supplied 120 Vac signal applied between terminals 22 and 23. When 120 Vac power is supplied to 22 and 23, motor operation is transferred to bypass (if not operating in this mode already).

The jumper between terminals 2 and 3 must be removed before using this mode.

When using End damper control (MOD S09) with the Smoke purge option, there will be a delay on initiation of the drive.

NOTE: Delayed Start:

- End damper control is installed.
- Motor start will be delayed until the damper is fully open.
- Wait a sufficient time for the damper to open after start-up.

A supplied Delayed Operation Notice should be placed by the Fireman's Override Key Switch.

**MOD F09
PROFIBUS**

This option provides a factory-installed Profibus Communication card, VW3A3307.

**MOD H09
I/O EXTENSION CARD**

This option provides a 0–20 mA analog output for customer use. It includes a plug-in analog card, VW3A3202, with AO and COM. The output is factory-programmed for motor frequency. Selectable x–y range with graphic display¹.

**MOD J09
0–10 V AUTO SPEED REFERENCE**

This option provides for a 0–10 V user-supplied auto speed reference signal into the AI2 input, terminals G1/S2+ and S3 (J) on terminal block 2. Not available with MOD C09 (page 74).

**MOD K09
cUL Listing**

This option provides Canadian cUL certification when required by local code requirements.

**MOD L09
LONWORKS®**

This option provides a factory-installed LonWorks card, VW3A3312.

**MOD M09
MODBUS®**

This option provides a factory-installed plug-in Modbus card, VW3A3303.

**MOD O09
APOGEE™ P1**

This option provides a factory-installed Apogee P1 card, VW3A3314.

**MOD P09
METASYS® N2**

This option provides a factory-installed plug-in Metasys N2 card, VW3A3313.

**MOD Q09
ETHERNET**

This option provides a factory-installed Ethernet card, VW3A3310D.

**MOD R09
BACNET**

This option provides a factory-installed BACnet card, VW3A3315.

**MOD S09
END DAMPER CONTROL**

This option provides a factory-installed circuit to inhibit converter operation until the damper is fully open.

¹ See the ATV61 Installation Manual and the ATV61 Programming Manual. These manuals are available from the Technical Library at www.us.SquareD.com.

MOD T09
SERVICE ENTRANCE RATING

This option provides a UL869A approved insulated ground neutral lug assembly and mounting bracket with bonded enclosure ground wire suitable for use as service entrance rated equipment.

MOD U09
SEISMIC QUALIFIED

This option supplies a certification label and hardware qualified to seismic rating AC156 acceptance criteria test protocol with an importance factor of 1.5. Refer to “Seismic Qualification Mounting Criteria” on page 37.

MOD X09
3% LINE REACTOR

This option includes an integrally-mounted 3% AC line reactor factory installed and wired between the circuit breaker disconnect means and the power converter for harmonic mitigation. It replaces the standard 3% DC choke.

SECTION 4— PROPORTIONAL–INTEGRAL–DERIVATIVE CONTROL

DANGER

HAZARD OF ELECTRICAL SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand “Before You Begin” on page 12 before installing or operating the E-Flex drive.
- Properly ground the controller panel before applying power.
- Close and secure the enclosure door before applying power.
- Certain adjustments and test procedures require that power be applied to this controller. Extreme caution must be exercised as hazardous voltages exist. The enclosure door must be closed and secured while turning on power or starting and stopping this controller.

Failure to follow these instructions will result in death or serious injury.

DANGER

UNINTENDED EQUIPMENT OPERATION

Test and ensure that any changes made to the parameter settings do not present any danger to personnel and equipment during the drive operation.

Each control scheme must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions will result in death or serious injury.

INTRODUCTION

This section provides programming instructions for using Proportional-Integral-Derivative (PID) control on the E-Flex adjustable speed drive.

PID control provides a method for controlling a process variable using a closed loop feedback system. The error between the desired setpoint and feedback process variable provides continuous corrective action to control the process output. From an application standpoint, the drive output adjusts the speed of the motor to reduce the error to zero. Closed loop control eliminates the cycling normally associated with open loop on-off control methods. PID control aims to regulate the process consistently under changing conditions at a maximum rate with minimum waste and minimum cost of operation.

Process variables such as temperature, pressure and level can be monitored by the drive as a current or voltage analog feedback signal. The PID regulator calculates the error between the setpoint and feedback for a closed loop, then applies an appropriate reference to adjust the motor speed.

There are three functions for control:

1. Proportional (P): The Proportional function determines the responsiveness of control or how quickly the output reacts to the error.
2. Integral (I): The Integral function determines the reaction based on the sum of recent errors and its absence may prevent the system from reaching its target value.
3. Derivative (D): The Derivative function determines the reaction to the rate at which the error has been changing and is very sensitive to measurement noise.

The weighted sum of P, I, and D functions is used to correct the process variable.

By tuning these three functions, the system performance including responsiveness (time to correct the error), overshoot (overage from the reference setpoint) and oscillations (cycling between the highest and lowest point until signal stabilization) can be controlled.

With PID control the relationship between speed and process variable (pressure, level, or temperature) is often misunderstood. For example, users may expect a certain motor speed at a given system variable. This is not correct because the speed is not directly related to the system variable. Instead the PID calculations adjust the speed as needed to maintain the setpoint. As system dynamics change (valves, dampers, ambient temperature, flow rate, and other processes), the speed required to maintain the setpoint will differ. Base PID performance on its ability to maintain the setpoint, not on motor speed.

Figure 18: PID Control Concept

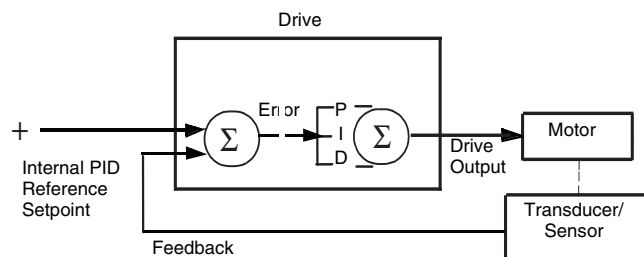
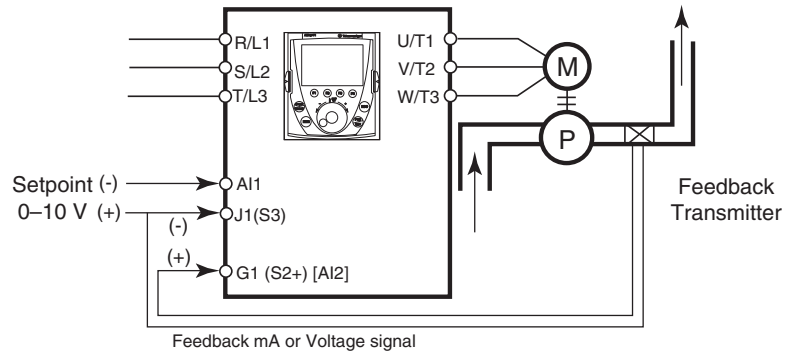


Figure 19: PID Setup for Drive



SCALING OF PID PARAMETERS

Scaling of PID parameters is required to suit a customer's application or range of the sensor input device providing the feedback signal or both. Some examples of PID parameters and their ranges are pressure (0 to 20 psi), flow (0 to 500 gpm), and temperature (-100 °F to 300 °F).

PID REFERENCE (Min., Max.) parameters must be within the sensor range, for example, PID FEEDBACK (Min., Max.) parameters. Parameter INTERNAL PID REF Setpoint is entered as a percentage of the PID FEEDBACK range demonstrated in the following examples. The scaling parameters cannot exceed a value of 32767. To simplify the setup, use the values as close as possible to this maximum limit, but remain within powers of 10 with respect to the actual values.

For example:

- To maintain a pressure of 40 psi for a pressure transducer with 0-100 psi range with an input signal of 4 to 20 mA, enter the MIN PID FEEDBACK as 0 (corresponding to 0 psi) and the MAX PID FEEDBACK as 1000 (corresponding to 100PSI). As 40 psi equals 40% of the sensor range with 0-100 psi, therefore set the INTERNAL PID REF Setpoint to 400.
- If a temperature device is scaled at -100 to +300 °F, enter the Minimum PID Feedback as 0 (corresponding to -100 °F) and the Maximum PID Feedback as 1000 (corresponding to +300 °F). An 80 °F setpoint is 45% of the range from -100 to 300°F; therefore set the INTERNAL PID REF Setpoint to 450.

PID TUNING

Tuning of the P, I, and D control functions is required to optimize the process performance based on application needs. There are several methods for tuning including manual, Ziegler-Nichols, and by using several software tools available in the market. The PID proportional gain (rPG), Integral gain (rIG) and derivative gain (rdG) parameters can be adjusted to allow the PID regulator to be tuned for a specific application.

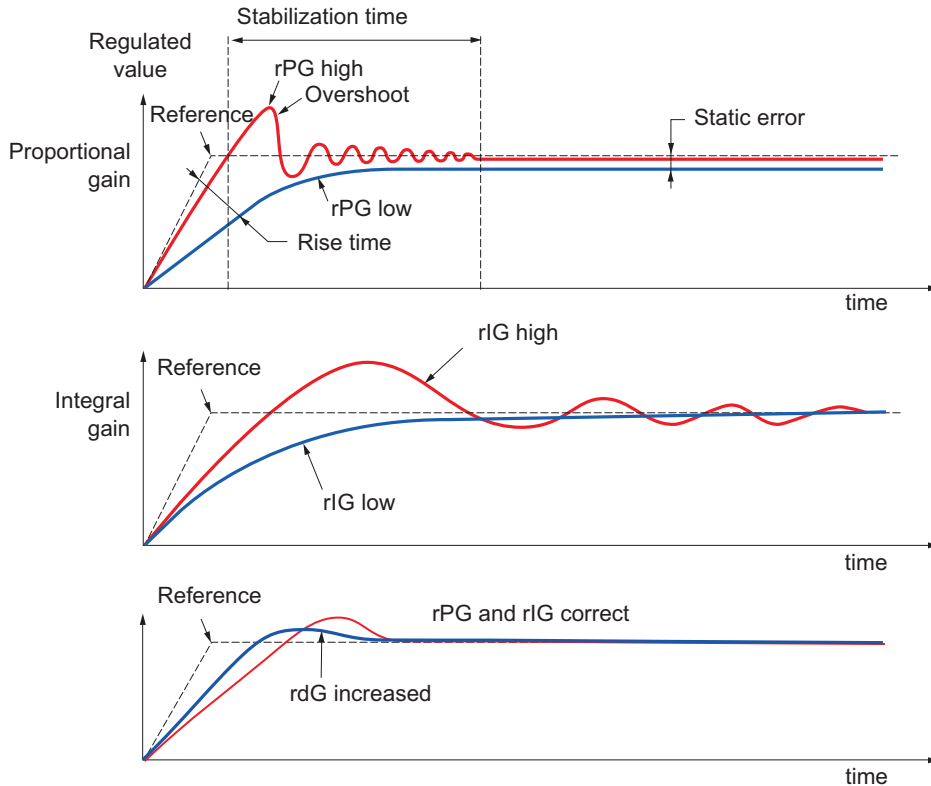
NOTE: Follow the instructions in the "Drive Configuration" on page 82 to set-up the P, I, and D control functions and access the parameters for gains adjustment.

In many cases the factory settings for these parameters will be sufficient. However, if necessary, adjustments should be gradual and independent. If the system is unstable with the factory settings or the PID reference (setpoint) is not achieved, use the manual method described below:

- Set the integral gain (rlG) to minimum.
- Leave the derivative gain (rdG) at 0.
- Vary the load or PID reference setpoint a number of times and observe the PID regulator response.
- Set the proportional gain (rPG) in order to obtain the best compromise between response time and stability.
- Once stable if the steady state response varies from the preset value (setpoint), gradually increase the integral gain (rlG), reduce the proportional gain (rPG) in the event of instability (pump applications) and find a compromise between response time and precision.
- Typically, the derivative gain (rdG) is not required, but may permit the reduction of overshoot and the improvement of response time. This can make it more difficult to obtain a compromise in terms of stability since this depends on 3 gains. If rdG is adjusted then the rPg and rlg may require re-adjustment.

Figure 20 on page 81 illustrates the system performance with adjustments in P, I, and D gains.

Figure 20: System Performance With Adjustments in P, I, and D Gains



The oscillation frequency depends on the system kinematics.

Parameter	Rise time	Overshoot	Stabilization time	Static error
rPG ↗	↘ ↘	↗	=	↘
rIG ↗	↘	↗ ↗	↗	↘ ↘
rdG ↗	=	↘	↘	=

SETTING PID CONTROL

The PID control with a Hand-Off-Auto selector switch can be set using the following positions:

- In the Auto position the drive speed reference follows the PID regulator
- In the Hand position the drive speed reference follows the graphic display terminal (HMI)

PID control for analog inputs with voltage (0–10 V) or current (4–20 mA) signal is possible.

If the E-Flex is a Type 3R Enclosure or has option D09 to omit the HMI, in the Hand position the drive speed reference is a door mounted speed potentiometer in place of the HMI.

Drive Configuration

Ensure that the Factory settings for the enclosed drive and motor parameters are set. For more information, refer to the Altivar 61 programming manual shipped with the drive.

NOTE: When making programming changes, if a warning message appears indicating that an input is already assigned to another function, press Enter to acknowledge this warning and continue programming the drive.

Use the graphic display terminal (HMI) attached to the E-Flex drive to change the following settings:

Table 35: Programmable Settings

Parameters	Description
SET ACCESS LEVEL	From the MAIN menu, select ACCESS LEVEL > ADVANCED.
SET THE ANALOG FEEDBACK SIGNAL	Configure the customer supplied analog feedback signal using the following rules: AI1 is a voltage only input (integral to the power converter ATV-61) AI2 is configured for voltage or current [AI2 is wired to GI (S2+) on the E-Flex terminal block]
DRIVE CONFIGURATION	From the MAIN menu, select DRIVE > INPUTS/OUTPUTS CFG > AI1 OR AI2 CONFIGURATION.
SET TYPE OF SIGNAL	Set AI1 or AI2 used to supply the analog feedback signal: From MAIN menu select DRIVE > 1.5 Inputs/ Outputs > AI2 Type as voltage or current.
SET THE MIN-MAX VALUES	Continue with the AI1 OR AI2 CONFIGURATION described above and configure the drive based on the type of feedback transducer used. Set AI2 min. value and AI2 max. value. For example, if the device has a 4–20 mA input, set AI2 Min. Value to 4 and AI2 Max. Value to 20. Also, if the device has a 0–10 Vdc input, set AI1 OR AI2 Min. Value to 0 and AI1 OR AI2 Max. Value to 10.
SET REFERENCE CHANNEL	From the MAIN menu select DRIVE > 1.6 COMMAND and assign REF. 2 CHANNEL to HMI. <i>NOTE:</i> If the E-Flex drive is a Type 3R Enclosure or has option D09 to omit the HMI, program the Ref. 2 channel to AI1 instead of HMI. From the MAIN menu select DRIVE > 1.6 COMMAND, then assign the REF. 2 channel to AI1. Additional programming for logic inputs (LI3/LI4) is described in “Hand-Off-Auto SELECTOR SWITCH WIRING” on page 84.
SET PID REGULATOR PARAMETERS	From the MAIN menu select DRIVE > 1.7 APPLICATION FUNCT > PID REGULATOR.
1.7 APPLICATION FUNCT> PID FEEDBACK ASS.	Specify the analog input to which the customer feedback signal is applied: AI1 OR AI2
1.7 APPLICATION FUNCT> ACT. INTERNAL PID REF.	Enables customers to enter a desired setpoint/reference value in the INTERNAL PID REF parameter.
MIN PID FEEDBACK	
MAX PID FEEDBACK	
MIN PID REFERENCE	
MAX PID REFERENCE	
INTERNAL PID REF	
PID PROPORTIONAL GAIN	
PID INTEGRAL GAIN	
PID DERIVATIVE GAIN	
PID RAMP	PID acceleration/deceleration ramp time can be adjusted from 0–99.95 s.
MIN PID OUTPUT	Min value of regulator output in Hz. Factory setting is 0 Hz.
MAX PID OUTPUT	Max value of regulator output in Hz. Factory setting is 60 Hz.
PID CORRECT REVERSE	Setting this value to No, increases the motor speed when the error is positive (for example, pressure control with a pump). Setting this value to Yes, decreases the motor speed when the error is positive (for example, temperature controls using a cooling tower fan). Error = Setpoint (PID Reference)–Process Variable (PID Feedback). A positive error occurs when the process variable is below the setpoint. <i>NOTE: Most applications work best with this value set to No.</i>

CONTROL WIRING MODIFICATIONS

In Figure 21, the analog PID feedback signal is wired to the control rail terminals G1 (S2+), A, and COM. Connect the transducer based on the type of feedback signal (see Figure 21 for a 2-wire loop powered transducer and Figure 22 for a separately powered transducer). In Figure 23 on page 84, the setpoint can be applied externally using the wiring to the terminals on the power converter ATV61.

As an optional means for setpoint and wiring modifications, use a speed potentiometer (see Figure 24 on page 84). Programming changes for this option include:

MAIN > DRIVE > 1.6 COMMAND > Ref. 1 Channel to AI1.

Another option is to use the keypad to program the Internal setpoint. Activate the Internal PID ref. using the Menu option:

From the MAIN menu select DRIVE > 1.7 APPLICATION FUNCT > PID REGULATOR > ACT. INT PID REF., then select Yes.

⚠ CAUTION

UNINTENDED MOTOR SPEED

Ensure adequate current for the transducer. The 24 Vdc power supply is current limited to 200 mA for all components powered.

A load greater than the limit will cause the control voltage to dip and may result in erroneous behavior of the drive or components powered by 24 Vdc power supply. See Figure 22 for recommended wiring.

Failure to follow these instructions can result in injury or equipment damage.

Figure 21: 2-Wire Loop Powered 24 Vdc Transducer

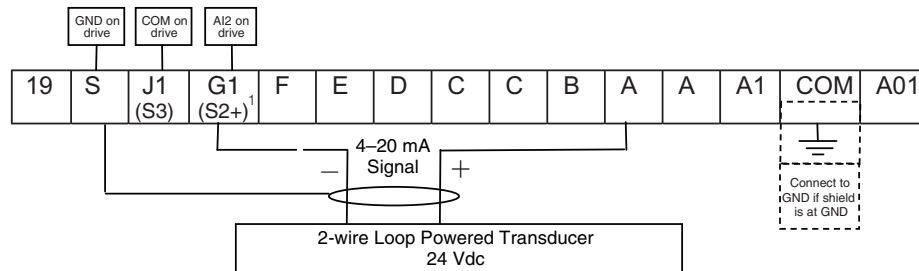
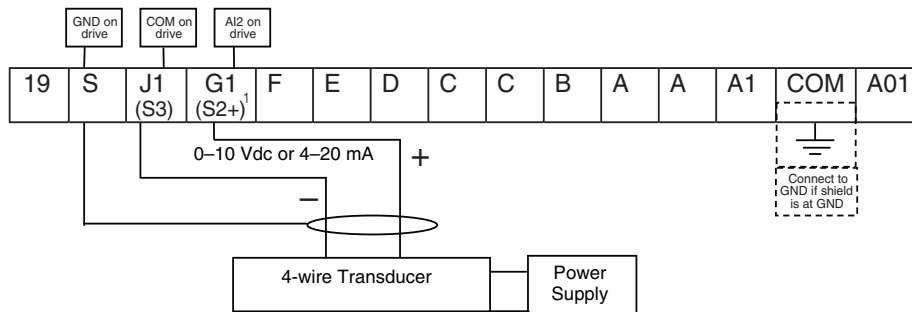


Figure 22: Separately Powered Transducer



1

¹ Terminal S2+ is not always wired to the drive and may need to be wired directly to the drive or as illustrated, a wire must be added from the drive to the terminal block.

Figure 23: Optional Setpoint Wiring (Using an External Source)

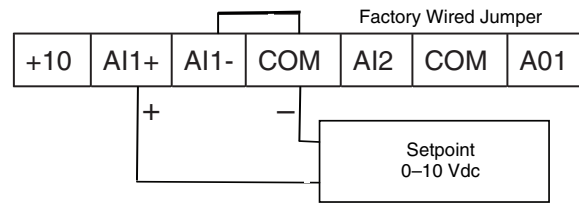
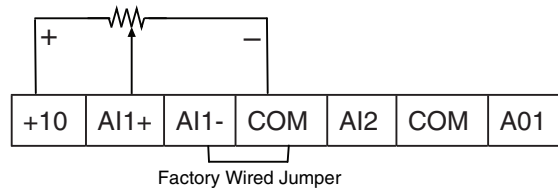


Figure 24: Optional Setpoint Wiring (Using a Speed Potentiometer)



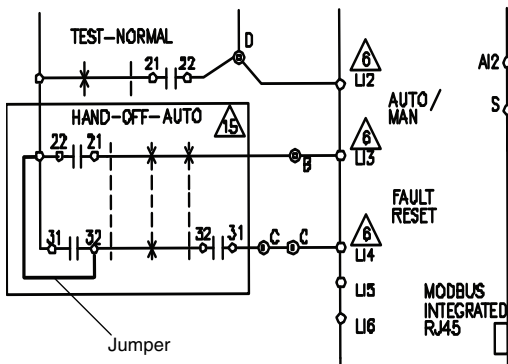
NOTE: Ground the shield at one end only to prevent large currents from flowing through the shield. The shield on the ungrounded end may be tied to ground through a capacitor (for example, 10 nF, 100 V or higher) in order to provide a path for the higher frequency noise.

HAND-OFF-AUTO SELECTOR SWITCH WIRING

The E-Flex standard Hand-Off-Auto (HOA) switch contact wired to LI3 is opened when in Hand mode and closed when in Auto mode. To allow PI control in Auto mode and HMI control in Hand mode, the logic for this circuit must be reversed so that the contact is closed in Hand mode and opened in Auto mode. Use one of the following methods to wire the HOA selector switch wiring:

Method 1

Figure 25: Wiring Change Using a Jumper



CAUTION

UNINTENDED MOTOR SPEED

Ensure adequate current for the auxiliary relay. The 24 Vdc power supply is current limited to 200 mA for all components powered. A load greater than the limit will cause the control voltage to dip and may result in erroneous behavior of the drive or components powered by 24 Vdc power supply.

Failure to follow these instructions can result in injury or equipment damage.

- Using the HMI, select LI4 as Auto Manual:
MAIN > DRIVE > 1.6 COMMAND MENU> REF. 2 SWITCHING, then select LI4.
- Ensure that REF. 2 CHANNEL is set to HMI or AI1 as described in “Drive Configuration” on page 82.
- Connect a jumper wire across H22 and H32 to change. See Figure 25.
Access these wires from the contact block located at the back side of the door mounted HOA switch. The wires are labeled at the terminations.

NOTE: When making this modification, reset the drive in Hand mode by turning the HOA switch from Hand to Auto and then Off.

SECTION 5— TROUBLESHOOTING AND MAINTENANCE

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

For 460 V units:

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Never operate energized switch with door open.
- Turn off switch before removing or installing fuses or making load side connections.
- Always use a properly rated voltage sensing device at all line and load fuse clips to confirm switch is off.
- Turn off power supplying switch before doing any other work on or inside switch.
- Do not use renewable link fuses in fused switches.

Failure to follow these instructions will result in death or serious injury.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

For 208 and 230 V units:

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside the equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand this bulletin in its entirety before installing or operating E-Flex drives. Installation, adjustment, repair, and maintenance of the drives must be performed by qualified personnel.
- Disconnect all power including external control power that may be present before servicing the drive. WAIT 15 MINUTES for the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure on page 42 to verify that the DC voltage is less than 42 V. The drive LEDs are not accurate indicators of the absence of DC bus voltage.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Install and close all covers before applying power or starting and stopping the drive.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Before servicing the drive:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive disconnect.
- Lock disconnect in open position.

Failure to follow these instructions will result in death or serious injury.

INTRODUCTION

A number of diagnostic and status codes are included on the power converter. The graphic display terminal provides visual indication of controller operating and protective circuit functions and indicator lights to assist in maintenance and troubleshooting. If the controller trips while operating, the codes must be viewed before power is removed because removing power resets the fault code.

NOTE: For controllers equipped with optional line contactor (MOD B09) the power is removed via the line contactor upon power converter trips.

EXTERNAL SIGNS OF DAMAGE

The following are examples of external signs of damage:

- Cracked, charred, or damaged covers or enclosure parts
- Damage to the graphic display terminal such as scratches, punctures, burn marks, chemical burns, or moisture in the screen
- Oil or electrolyte on the bottom of the drive which might have leaked from the capacitors inside
- Excessive surface temperatures of enclosures and conduits
- Damage to power or control conductors
- Unusual noise or odors from any of the equipment
- Abnormal temperature, humidity, or vibration

If any of the above signs are found while the equipment is powered up, immediately inform operating personnel and assess the risk of leaving the drive system powered up. Before removing power from the equipment, always consult with the operating personnel responsible for the machinery and process.

If troubleshooting indicates the need for component replacement, refer to “Field Replacement of the Power Converter” on page 92.

PREVENTIVE MAINTENANCE

All Type 1 controllers use convection cooling. All Type 12K controllers for 10 hp and above at 460 V and 7.5 hp and above at 208/230 V use forced air cooling. All Type 3R controllers use ventilation cooling. Inspect the interior fans (if used) and exterior fans of the controller for blockage and impeded rotation. To prevent overheating and to allow proper air flow, maintain the clearances shown on the enclosure outline drawings in this instruction bulletin.

To maintain the environmental rating of Type 12K or 3R enclosures, periodically inspect the enclosure gaskets for damage.

The graphic display terminal is an integral part of the enclosure and must be installed on the door to maintain the environmental integrity of a Type 12K enclosure. It can be omitted when MOD D09 is selected and in that case a closing plate must be installed to maintain the Type 12K environmental rating.

PRODUCT SUPPORT

When troubleshooting the E-Flex™ drive, discuss with operating personnel the symptoms of the reported problems. Ask them to describe the problem, when they first observed the problem, and where the problem was seen. Observe directly the drive system and process.

For more information, call, fax, or write:

Drives Product Support Group
P.O. Box 27446
Raleigh, NC 27611-7446

The Product Support Group is staffed from 8 am to 6 pm Eastern time for product selection, start-up assistance, or diagnosis of product problems and advice for the correct course of action. **Emergency phone support** is available 24 hours a day, 365 days a year.

Toll Free	1-888-778-2733 (888-Square D)
E-mail	drive.products.support@us.schneider-electric.com
Fax	919-217-6508

SERVICE (ON-SITE)

The Services division is committed to providing quality on-site service that consistently meets customer expectations. Services responds to your requests, seven days a week, 24 hours a day.

Toll Free	1-888-778-2733 (888-Square D)
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CUSTOMER TRAINING

Schneider Electric offers a variety of instructor-led, skill enhancing and technical product training programs for customers. For a complete list of drives/soft start training with dates, locations, and pricing, please call:

Phone	978-975-9306
Fax	978-975-2821

E-FLEX TROUBLESHOOTING SHEET

When requesting after-sales service, it is important to disclose all conditions under which the Square D equipment currently operates. This will help in diagnosing the system quickly.

Call the Product Support Group at 888-SQUARED (778-2733)

DATE: _____
 CONTACT NAME: _____
 COMPANY: _____
 ADDRESS: _____
 CITY: _____
 STATE: _____
 PHONE: _____
 FAX: _____

DRIVE CONFIGURATION

CATALOG NUMBER: CLASS **8839** TYPE **EFD**: _____
 APPLICATION/EQUIPMENT DESIGNATION: _____

MOTOR NAMEPLATE DATA

HORSEPOWER: _____ VOLTAGE (3 PHASE): _____ FREQUENCY: _____ POLES: _____ FLA: _____
 SERVICE FACTOR: _____ MOTOR INSULATION: NEW OR EXISTING
 MOTOR CABLE TYPE: _____ LENGTH IN FEET: _____
 IS MOTOR DESIGNED TO COMPLY WITH NEMA MG-1 PART 31 GUIDELINES? YES NO

POWER SOURCE AND ENVIRONMENT

VOLTAGE BETWEEN: L1 AND L2: _____ L2 AND L3: _____ L3 AND L1: _____
 SERVICE TRANSFORMER RATING: _____ KVA _____ % Z FREQUENCY: 60 HZ OR 50 HZ
 AMBIENT TEMPERATURES: MIN °C (°F) _____ MAX °C (°F) _____ HUMIDITY: _____
 ALTITUDE IF GREATER THAN 3300 FEET ABOVE SEA LEVEL, SPECIFY: _____ FT

DRIVE DETECTED FAULT CODES

Refer to ATV61 Programming Manual for possible causes and corrective action

- | | | | | |
|---|---|--|---|--|
| <input type="checkbox"/> Ai2F Ai2 input | <input type="checkbox"/> FCF1 Output contactor stuck | <input type="checkbox"/> InFb Internal-thermal sensor | <input type="checkbox"/> OPF2 3 motor phase loss | <input type="checkbox"/> SCF4 IGBT short circuit |
| <input type="checkbox"/> APF Application fault | <input type="checkbox"/> FCF2 Output contactor open | <input type="checkbox"/> InFC Internal-time measurement | <input type="checkbox"/> OSF Mains overvoltage | <input type="checkbox"/> SCF5 Motor short circuit |
| <input type="checkbox"/> bOF DB resistor overload | <input type="checkbox"/> HCF Cards pairing | <input type="checkbox"/> InFE Internal-CPU | <input type="checkbox"/> OtF1 PTC1 overheat | <input type="checkbox"/> SLF1 Modbus comm. |
| <input type="checkbox"/> bUF DB unit short circuit | <input type="checkbox"/> HdF IGBT desaturation | <input type="checkbox"/> LCF Input contactor | <input type="checkbox"/> OtF2 PTC2 overheat | <input type="checkbox"/> SLF2 Powersuite comm. |
| <input type="checkbox"/> CFF Incorrect config. | <input type="checkbox"/> ILF Internal comm. link | <input type="checkbox"/> LFF2 Ai2 4-20mA loss | <input type="checkbox"/> OtFL LI6 = PTC overheat | <input type="checkbox"/> SLF3 HMI communication |
| <input type="checkbox"/> CFI Invalid configuration | <input type="checkbox"/> InF1 Rating error | <input type="checkbox"/> LFF3 Ai3 4-20mA loss | <input type="checkbox"/> PHF Input phase loss | <input type="checkbox"/> SOF Overspeed |
| <input type="checkbox"/> CnF Comm. network | <input type="checkbox"/> InF2 Incompatible power board | <input type="checkbox"/> LFF4 Ai4 4-20mA loss | <input type="checkbox"/> PrF Phase removal | <input type="checkbox"/> SPIF PI Feedback |
| <input type="checkbox"/> COF CAN comm. | <input type="checkbox"/> InF3 Internal serial link | <input type="checkbox"/> nFF External flow sensor | <input type="checkbox"/> PrtF Power identification | <input type="checkbox"/> SSF Torque/current limit |
| <input type="checkbox"/> CrF1 Precharge | <input type="checkbox"/> InF4 Internal MFG area | <input type="checkbox"/> ObF Overbraking | <input type="checkbox"/> PtF1 PTC1 probe | <input type="checkbox"/> tJF IGBT overheat |
| <input type="checkbox"/> CrF2 Thyristor soft charge | <input type="checkbox"/> InF6 Internal-option | <input type="checkbox"/> OCF Overcurrent | <input type="checkbox"/> PtF2 PTC2 probe | <input type="checkbox"/> tnF Auto tuning |
| <input type="checkbox"/> EEF1 Control Eeprom | <input type="checkbox"/> InF7 Internal-hard initialization | <input type="checkbox"/> OHF Drive overheat | <input type="checkbox"/> PtFL LI6 = PTC probe | <input type="checkbox"/> ULF Process underload |
| <input type="checkbox"/> EEF2 Power Eeprom | <input type="checkbox"/> InF8 Internal-control supply | <input type="checkbox"/> OLC Process overload | <input type="checkbox"/> SCF1 Motor short circuit | <input type="checkbox"/> USF Undervoltage |
| <input type="checkbox"/> EPF1 External fault via logic input | <input type="checkbox"/> InF9 Internal-current measure | <input type="checkbox"/> OLF Motor overload | <input type="checkbox"/> SCF2 Impedant short circuit | |
| <input type="checkbox"/> EPF2 External fault via comm. link | <input type="checkbox"/> InFA Internal-mains circuit | <input type="checkbox"/> OPF1 1 motor phase loss | <input type="checkbox"/> SCF3 Ground short circuit | |

DETAILED DESCRIPTION OF PROBLEM

FIELD REPLACEMENT PROCEDURES

Refer to Appendix A beginning on page 103 for the part numbers of the equipment required for the following field replacement procedures. For component locations, refer to Figures 2–4 on pages 16–18.

FIELD REPLACEMENT OF THE POWER CONVERTER

If the power converter becomes inoperable in the E-Flex controllers, it must be replaced. Refer to Table 36 for power converter weights.

Table 36: Power Converter Weights

460 V	230/208 V	Converter		Converter w/ Flange	
		lb	kg	lb	kg
VT					
1–5	1–3	6.6	3	12.54	5.7
7.5	5–7.5	8.8	4	15.62	7.1
10–15	10	12.1	5.5	20.24	9.2
20	15	15.4	7	25.52	11.6
25–30	20–25	19.8	9	30.58	13.9
40	30–40	41.8	19	50.38	22.9
	50	85.8	39	96.58	43.9
50–60		57.2	26	66.44	30.2
75–100		96.8	44	108.24	49.2

Observe the lockout/tagout procedures as identified in OSHA Standard 29 CFR, Subpart J covering:

- 1910.147: The control of hazardous energy (lockout/tagout).
- 1910.147: App A, Typical minimal lockout procedures.

Removing the Power Converter Assembly

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power.
- Place a “Do Not Turn On” label on the drive disconnect.
- Lock the disconnect in the open position.
- Read and understand the bus voltage measurement procedure on page 42 before performing the procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connectors with voltage present.
- Many parts in the drive, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

ELECTROSTATIC DISCHARGE

Do not subject this device to electrostatic discharge. This controller contains electronic components that are very susceptible to damage from electrostatic discharge.

Failure to follow these instructions can result in injury or equipment damage.

Observe the following precautions when handling static sensitive components:

- Keep static producing material (plastic, upholstery, carpeting) out of the immediate work area.
- Store the power converter assembly in its protective packaging when it is not installed in the drive.
- When handling the power converter assembly, wear a conductive wrist strap connected to the power converter assembly through a minimum of one megaohm resistance.
- Avoid touching exposed conductors and component leads with skin or clothing.

To replace the power converter, follow these steps:

1. Open the door of the drive. To open the door, turn the circuit breaker and handle assembly to the Off position.
2. Measure the DC bus voltage as described on page 42 of this instruction bulletin.
3. Disconnect all power and control wiring from the power converter assembly. Identify each wire for ease of re-assembling the new power converter.
4. Remove the heatsink fan assembly before removing the power converter. Refer to the “Field Replacement of Heatsink Fan Assembly” on page 95 for directions.
5. Remove the outside flange screws that secure the power converter to the enclosure back pan. Refer to Figures 12–16 starting on page 46 for screw locations. Refer to Table 37 for the number of screws on your controller. Keep the screws for the new power converter.

Table 37: Number of Flange Screws

460 V	No. of Screws	208/230 V	No. of Screws
1–7.5	10	1–5	10
10–25	10	7.5–10	10
30 40 50	10 12 14	15–25	10
60 75–100	14 16	30–40 50	12 14

6. Remove the power converter assembly from the enclosure.

Installing the Power Converter Assembly

Before installing, remove the side panels from the new drive.

To install the new power converter, follow these steps:

1. Install the new power converter assembly in the enclosure.
2. Secure the power converter picture frame to the enclosure back pan using the picture frame screws from the removed power converter. Torque the screws to 15 ± 2 lb-in. (1.7 ± 0.2 N·m).
3. Install all power and control wiring to the power converter assembly terminal blocks. Install all other removed equipment. Tighten the hardware to the torque values given in Table 38. Check all wiring connections for correct terminations and check the power wiring for grounds with an ohmmeter.

Table 38: Terminal Torques

Terminal		Torque	
		lb-in	N·m
Power Terminal Strip:			
460 V	EFDC•4V_ to EFDG•4V_ (1–7.5 hp)	12.3	1.4
	EFDH•4V_ to EFDK•4V_ (10–20 hp)	26.5	3
	EFDL•4V_ to EFDN•4V_ (25–30 hp)	47.7	5.4
	EFDN•4V_ to EFDQ•4V_ (40–60 hp)	106.2	12
	EFDR•4V_ to EFDS•4V_ (75–100 hp)	360	41
230 V	EFDC•3V_ to EFDG•3V_ (1–7.5 hp)	12.3	1.4
	EFDH•3V_ to EFDJ•3V_ (10–15 hp)	26.5	3
	EFDK•3V_ to EFDL•3V_ (20–25 hp)	47.7	5.4
	EFDN•3V_ to EFDN•3V_ (30–40 hp)	106.2	12
	EFDP•3V_ (50 hp)	360	41
208 V	EFDC•2V_ to EFDG•2V_ (1–7.5 hp)	12.3	1.4
	EFDH•2V_ to EFDJ•2V_ (10–15 hp)	26.5	3
	EFDK•2V_ to EFDL•2V_ (20–25 hp)	47.7	5.4
	EFDN•2V_ to EFDN•2V_ (30–40 hp)	106.2	12
	EFDP•2V_ (50 hp)	360	41
S Shield Connection (power converter)		3.5	0.34

4. Shut the enclosure door, secure the door with door fasteners, and close the circuit breaker disconnect.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- This equipment must be installed and serviced only by qualified personnel.
- Qualified personnel performing diagnostics or troubleshooting requiring electrical conductors to be energized must comply with NFPA 70 E - Standard for Electrical Safety Requirements for Employee Workplaces and OSHA Standards – 29 CFR Part 1910 Subpart S Electrical.

Failure to follow these instructions will result in death or serious injury.

5. To set the drive to allow increase in horsepower, do the following:
 - Make sure the Hand off Auto selector switch is in the Off position, and the Test Normal switch (if present) is in the Test position, then apply power to the drive.
 - Go to menu 2 (Access Level) and select Expert.
 - Go to Menu 1.4 (Motor Control) and change the Power Ident (Prt) from IP20 to IP00.
6. Program the drive according to the control circuit elementary diagrams in Section 5 beginning on page 99. Follow the initial start-up procedure on page 56.

The drive is now ready to operate.

Refer to Appendix A beginning on page 103 for the part numbers of the equipment required for the following field replacement procedures. For component locations, refer to Figures 2–4 on pages 16–18.

FIELD REPLACEMENT OF HEATSINK FAN ASSEMBLY

If a heatsink fan becomes inoperable the fan assembly must be replaced. Observe the lockout / tagout procedures as identified in OSHA Standard 29 CFR, Subpart J covering:

- 1910.147: The control of hazardous energy (lockout/tagout).
- 1910.147: App A, Typical minimal lockout procedures.

Removing the Heatsink Fan Assembly

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power.
- Place a “Do Not Turn On” label on the drive disconnect.
- Lock the disconnect in the open position.
- Read and understand the bus voltage measurement procedure on page 42 before performing procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connectors with voltage present.
- Many parts in the drive, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

ELECTROSTATIC DISCHARGE

Do not subject this device to electrostatic discharge. This controller contains electronic components that are very susceptible to damage from electrostatic discharge.

Failure to follow these instructions can result in injury or equipment damage.

Observe the following precautions when handling static sensitive components:

- Keep static producing material (plastic, upholstery, carpeting) out of the immediate work area.
- Store the heatsink fan assembly in its protective packaging when it is not installed in the drive.
- When handling the heatsink fan assembly, wear a conductive wrist strap connected to the heatsink fan assembly through a minimum of one megaohm resistance.
- Avoid touching exposed conductors and component leads with skin or clothing.

To replace the heatsink fan assembly, follow these steps:

1. Open the door of the drive. To open the door, turn the circuit breaker and handle assembly to the Off position.
2. Measure the DC bus voltage as described on page 42.
3. Locate the heatsink fan assembly below the power converter.
4. Remove the four screws securing the heatsink fan assembly. Keep the four screws.
5. Lift the fan assembly above the flange opening.
6. Disconnect the fan cable from the converter.
7. Remove the fan assembly from the enclosure.

Installing the Heatsink Fan Assembly

To install the new heatsink fan assembly, follow these steps:

1. Place the fan assembly near the flange opening.
2. Connect the fan assembly wiring plug to the converter cable, below the flange.
3. Install the heatsink fan assembly. Secure the assembly with the four screws saved from step 4 above. Torque the screws to 15 lb-in (1.7 N•m).
4. Shut the enclosure door and secure it with door fasteners. Then close the circuit breaker disconnect.
5. Fully test the drive before placing into service.

FIELD REPLACEMENT OF THE STIRRING FANS

If a stirring fan inside the enclosure becomes inoperable, the fan must be replaced.

Before removing the inoperable stirring fan, mark and note airflow direction to ensure proper installation of the replacement fan.

FIELD REPLACEMENT OF THE VENTILATION FAN ON TYPE 3R

Figure 27: Removing Mounting Screws

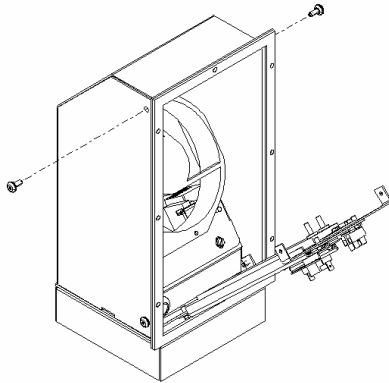
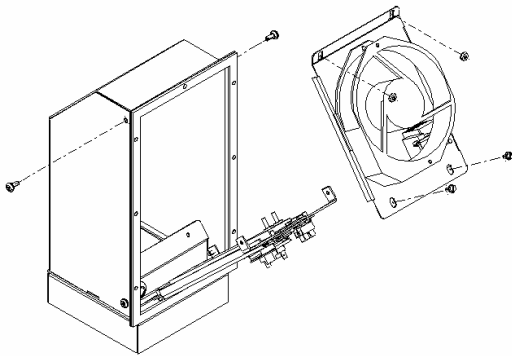


Figure 28: Removing Bracket Mounting Screws



FIELD REPLACEMENT OF THE SPACE HEATER ON TYPE 3R

FIELD MAINTENANCE AND REPLACEMENT OF HOOD FILTERS ON TYPE 3R

If a Type 3R ventilation fan becomes inoperable, the fan must be replaced. Before removing the inoperable ventilation fan, mark and note airflow direction to ensure proper installation of the replacement fan.

To replace the enclosure ventilation fan:

1. Observe the lockout/tagout procedures as identified in OSHA Standard 29 CFR, Subpart J covering:
 - 1910.147: The control of hazardous energy (lockout/tagout)
 - 1910.147: App A, Typical minimal lockout procedures
2. Open the disconnect between the input line and the drive, then lock and tag the disconnect between the input line and the drive in the Off position.
3. Remove all external control power that may be present.
4. Wait 15 minutes before opening the door of the drive.
5. Using a T20 Torx driver, remove the 7 screws used to hold the enclosure ventilation hood to the side of the enclosure.
6. Remove the control power wires and ground bonding jumper, then mark the location of these terminals.
7. Remove the bracket mounting screws and rotate the bracket forward. See Figure 27.
8. Using a 3/8 in. hex-head socket, remove the screws holding the fan bracket to the ventilation hood. See Figure 28.
9. Remove and replace the two screws that attaches the fan to the fan bracket.
10. Reassemble the ventilation hood. Make sure not to pinch the wires or allow the wires to come into contact with the heater surface.

CAUTION

EQUIPMENT DAMAGE

The surface of the heater is potentially hot.

- Prevent contact with the wires and the heater guard.
- Ensure that the wires do not contact the heater surface.

Failure to follow these instructions can result in equipment damage.

11. Reattach the control wires and the ground bonding jumper.
12. Mount the ventilation hood back to the side of the enclosure and secure with the 7 screws that were removed in step 4.

NOTE: To prevent displacement of the rubber washers, do not over tighten the screws.
13. After servicing the drive, close and secure the door.
14. Fully test the drive before placing into service.

If a Type 3R strip heater becomes inoperable, the strip heater must be replaced. The thermostat is factory set at 60 °F (15 °C).

The Type 3R E-Flex filter material located on the bottom of the side hoods is washable. Remove, wash, and install it as required to maintain airflow.

SECTION 6— POWER AND CONTROL CIRCUIT ELEMENTARY DIAGRAMS

Figure 29: Power Circuit Y (With Bypass): Hand-Off-Auto, Speed Potentiometer and Start-Stop
(Drawing No. 80461-071-01)

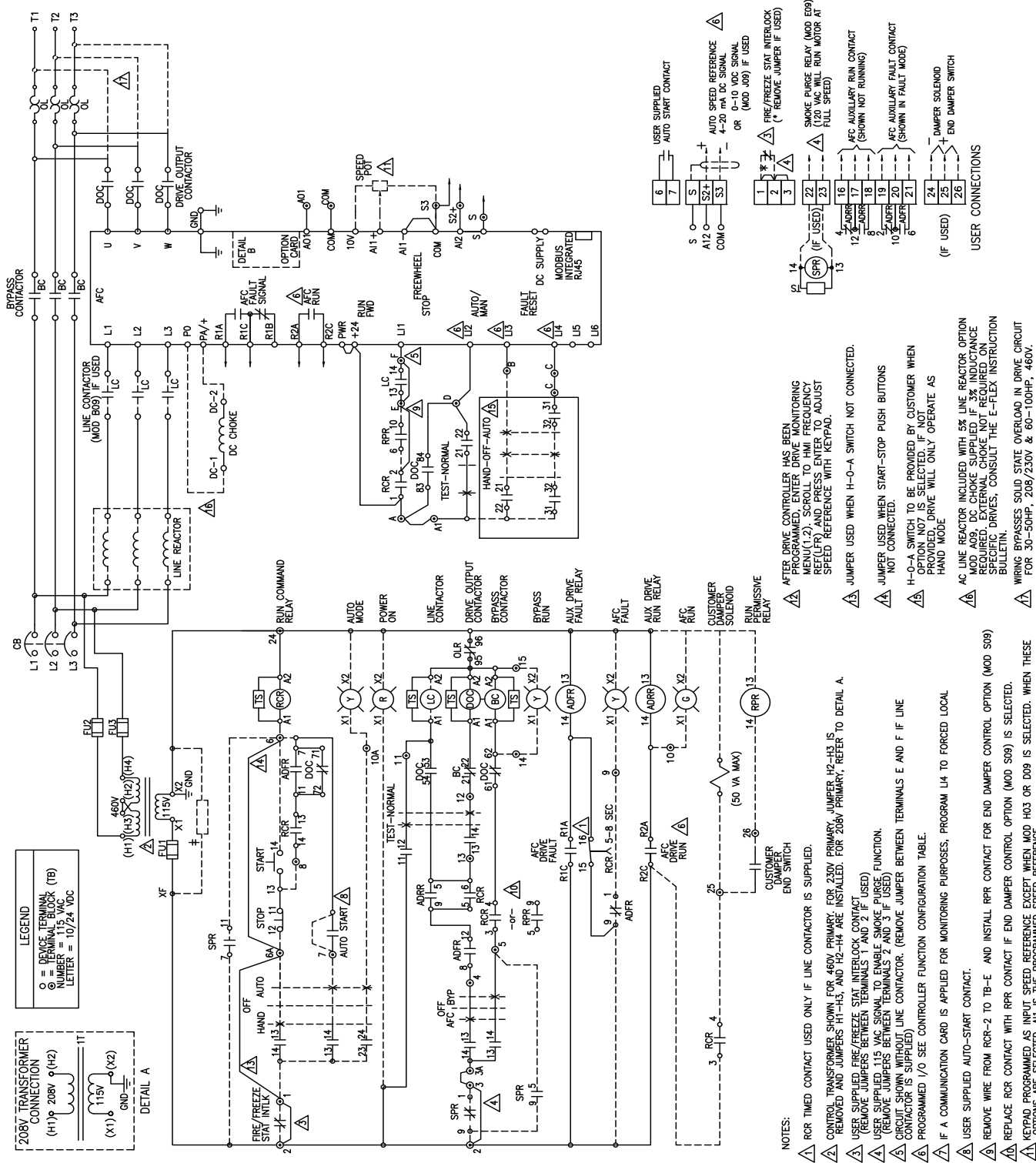


Figure 29: Power Circuit Y (With Bypass): Hand-Off-Auto, Speed Potentiometer and Start-Stop
(Drawing No. 80461-071-01) (continued)

ATV61 FACTORY CONFIGURATION						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
SIM	1.1	-----	2/3 WIRE CONTROL	tCC	2C	
SIM	1.1	-----	PUMPS/FANS	CFG	PnF	
SIM	1.1	-----	STANDARD MOT. FREQ. (HZ)	bFr	60	
SIM	1.1	-----	ACCELERATION (SEC)	ACC	10	
SIM	1.1	-----	DECELERATION (SEC)	dEC	10	
SIM	1.1	-----	LOW SPEED (HZ)	LSP	3	
SEt	1.3	-----	SWITCHING FREQ. (HZ)	SFr	8	
I-O	1.5	-----	2 WIRE TYPE	tCt	LEL	
I-O	1.5	AI2 CONFIG.	AI2 MIN. VALUE (mA)(W/O MOD J09)	CrL2	4	
I-O	1.5	R2 CONFIG.	R2 ASSIGN - DRIVE RUNNING	r2	rUn	
△	CtL	1.6	-----	REF. 1 CHAN	FR1	HMI
△	CtL	1.6	-----	REF. 1 CHAN(MOD H03 OR D09 ONLY)	FR1	AI1
CtL	1.6	-----	PROFILE(W/O MOD H03 OR D09 ONLY)	CHCF	SEP	
FUn	1.7	STOP CONFIG.	FREEWHEEL STOP ASSIGN	nST	LI2	
FUn	1.7	REFERENCE SWITCH.	REF. 1B SWITCHING	rCb	LI3	
FUn	1.7	REFERENCE SWITCH.	REF. 1B CHAN	Fr1b	AI2	
FLT	1.8	FAULT RESET	FAULT RESET	rSF	LI4	
FLT	1.8	CATCH ON THE FLY	CATCH ON THE FLY	FLR	YES	
FLT	1.8	OUTPUT PHASE LOSS	OUTPHASE LOSS	OPL	NO	
△	COM	1.9	FORCED LOCAL	FLO	LI4	
WHEN MOD H09 SELECTED - EXTENDED I/O CARD						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	A02	A02 ASSIGNMENT (MOTOR FREQ, mA)	A02	OFR	
WHEN MOD J09 SELECTED - 0-10V DC SPEED REF.						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	AI2 CONFIG.	AI2 TYPE	AI2t	10U	

DESCRIPTION	TYPE 1	TYPE 12K	TYPE 3R
‡ STIRRING FAN	NA	10-100HP 460V, 7.5-50HP 208/230V	NA
‡ VENTILATION FAN	NA	NA	ALL HP
‡ SPACE HEATER	NA	NA	ALL HP

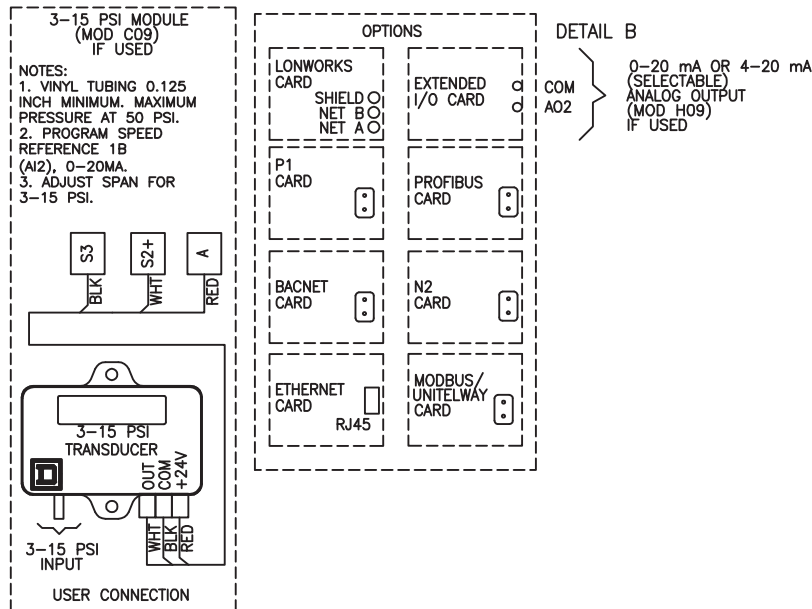
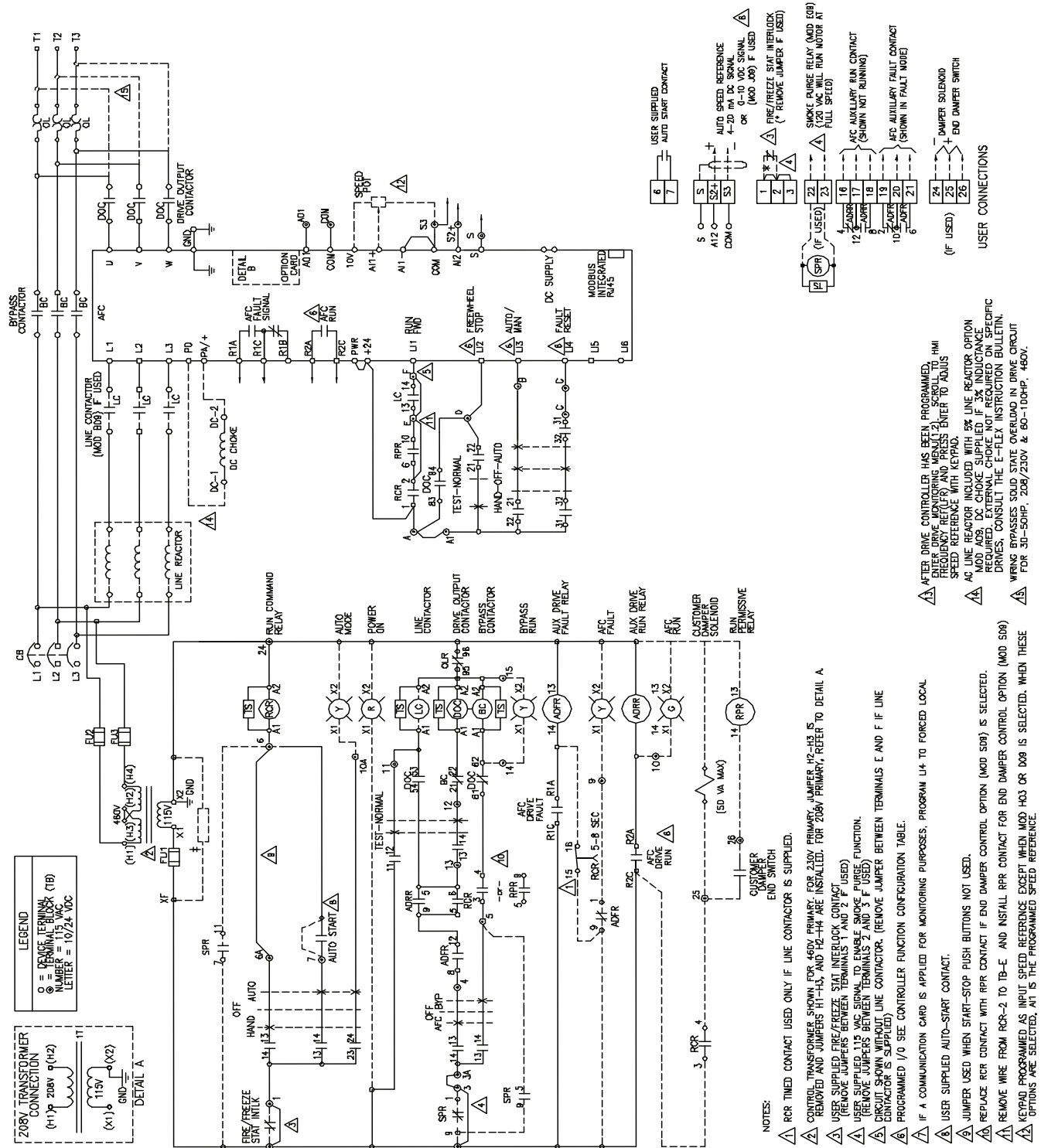


Figure 30: Power Circuit Y (With Bypass): Hand-Off-Auto and Speed Potentiometer
(Drawing No. 80461-072-01)



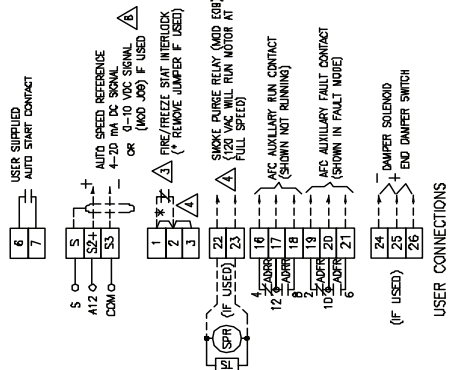
LEGEND
 ○ = TERMINAL BLOCK (TB)
 NUMBER = 115 VAC
 LETTER = 10/24 VDC

208V TRANSFORMER CONNECTION
 (H1) 208V (H2)
 (X1) 115V (X2)
 GND
 DETAIL A

NOTES:
 △ RCR TIMED CONTACT USED ONLY IF LINE CONTACTOR IS SUPPLIED.
 △ CONTROL TRANSFORMER SHOWN FOR 480V PRIMARY. FOR 208V PRIMARY, JUMPER 17-14 IS REMOVED AND JUMBERS 11-14, AND 12-14 ARE INSTALLED. FOR 208V PRIMARY, REFER TO DETAIL A.
 △ USER SUPPLIED FIRE/FREEZE START INTERLOCK CONTACT USED.
 △ USER SUPPLIED 115 VDC SIGNAL TO ENABLE SMOKE PULSE FUNCTION. (REMOVE JUMPERS BETWEEN TERMINALS 7 AND 3 IF USED)
 △ CIRCUIT SHOWN WITHOUT LINE CONTACTOR. (REMOVE JUMPER BETWEEN TERMINALS E AND F IF LINE CONTACTOR IS SUPPLIED)
 △ PROGRAMMED 1/9 SEE CONTROLLER FUNCTION CONFIGURATION TABLE.

△ IF A COMMUNICATION CARD IS APPLIED FOR MONITORING PURPOSES, PROGRAM L14 TO FORCED LOCAL
 △ USER SUPPLIED AUTO-START CONTACT.
 △ JUMPER USED WHEN START WITH RPR CONTACT IF END DAMPER CONTROL OPTION (MOD 509) IS SELECTED.
 △ REPLACE RCR CONTACT WITH RPR CONTACT IF END DAMPER CONTROL OPTION (MOD 509) IS SELECTED.
 △ REMOVE WIRE FROM RCR-2 TO TB-E AND INSTALL RPR CONTACT FOR END DAMPER CONTROL OPTION (MOD 509)
 △ KEYPAD PROGRAMMED AS INPUT SPEED REFERENCE EXCEPT WHEN MOD H03 OR X08 IS SELECTED. WHEN THESE OPTIONS ARE SELECTED, A11 IS THE PROGRAMMED SPEED REFERENCE

△ AFTER DRIVE CONTROLLER HAS BEEN PROGRAMMED, EITHER DRIVE MOTOR OR RAMPING WINDS UP SCROLLING SPEED REFERENCE WITH KEYPAD.
 △ AC LINE REACTOR INCLUDED WITH 6% LINE REACTOR OPTION. NOT A09. DC CHOKES SUPPLIED IF 3% INDUCTANCE REQUIRED. EXTERNAL CHOKES NOT REQUIRED ON SPECIFIC DRIVES. CONSULT THE E-FLEX INSTRUCTION BULLETIN. WIRING BYPASSES SOLID STATE OVERLOAD IN DRIVE CIRCUIT FOR 30-50HP, 208/230V & 60-100HP, 460V.



USER CONNECTIONS
 (IF USED)
 24 DAMPER SOLENOID
 25 END DAMPER SWITCH

Figure 30: Power Circuit Y (With Bypass): Hand-Off-Auto and Speed Potentiometer
(Drawing No. 80461-072-01) (continued)

ATV61 FACTORY CONFIGURATION					
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.
SIM	1.1	-----	2/3 WIRE CONTROL	tCC	2C
SIM	1.1	-----	PUMPS/FANS	CFG	PnF
SIM	1.1	-----	STANDARD MOT. FREQ (HZ)	bFr	60
SIM	1.1	-----	ACCELERATION (SEC)	ACC	10
SIM	1.1	-----	DECELERATION (SEC)	dEC	10
SIM	1.1	-----	LOW SPEED (HZ)	LSP	3
SEt	1.3	-----	SWITCHING FREQ. (HZ)	SFr	8
I-O	1.5	-----	2 WIRE TYPE	tct	LEL
I-O	1.5	A12 CONFIG.	A12 MIN. VALUE (mA)(W/O MOD J09)	rL2	4
I-O	1.5	R2 CONFIG.	R2 ASSIGN - DRIVE RUNNING	r2	rUn
CtL	1.6	-----	REF. 1 CHAN	FR1	HMI
		-----	REF. 1 CHAN(MOD H03 OR D09 ONLY)	FR1	A1
CtL	1.6	-----	PROFILE(W/O MOD H03 OR D09 ONLY)	CHCF	SEP
FUn	1.7	STOP CONFG.	FREEWHEEL STOP ASSIGN	nST	U2
FUn	1.7	REFERENCE SWITCH.	REF. 1B SWITCHING	rCb	U3
FUn	1.7	REFERENCE SWITCH.	REF. 1B CHAN	Fr1b	A12
FLT	1.8	FAULT RESET	FAULT RESET	rSF	U4
FLT	1.8	CATCH ON THE FLY	CATCH ON THE FLY	FLR	YES
FLT	1.8	OUTPUT PHASE LOSS	OUTPHASE LOSS	OPL	NO
COM	1.9	FORCED LOCAL	FORCED LOCAL ASSIGN.	FLO	U4
WHEN MOD H09 SELECTED - EXTENDED I/O CARD					
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.
I-O	1.5	A02	A02 ASSIGNMENT (MOTOR FREQ, mA)	A02	QFr
WHEN MOD J09 SELECTED - 0-10V DC SPEED REF.					
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.
I-O	1.5	A12 CONFIG.	A12 TYPE	A12	10U

DESCRIPTION	TYPE 1	TYPE 12K	TYPE 3R
± STIRRING FANS	NA	10-100HP 460V, 7.5-50HP 208/230V	NA
± VENTILATION FAN	NA	NA	ALL HP
± SPACE HEATER	NA	NA	ALL HP

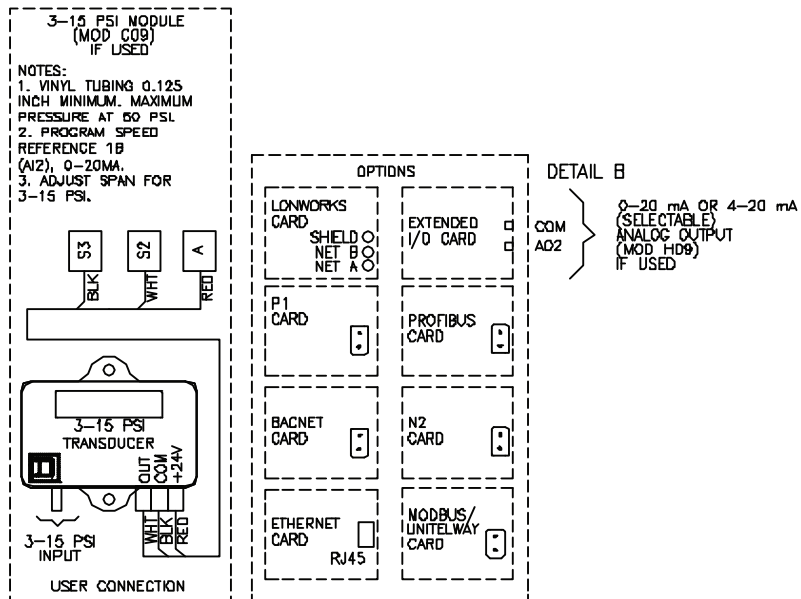


Figure 31: Power Circuit W (Without Bypass): Hand-Off-Auto, Start-Stop, and Speed Potentiometer
(Drawing No. 80461-073-01)

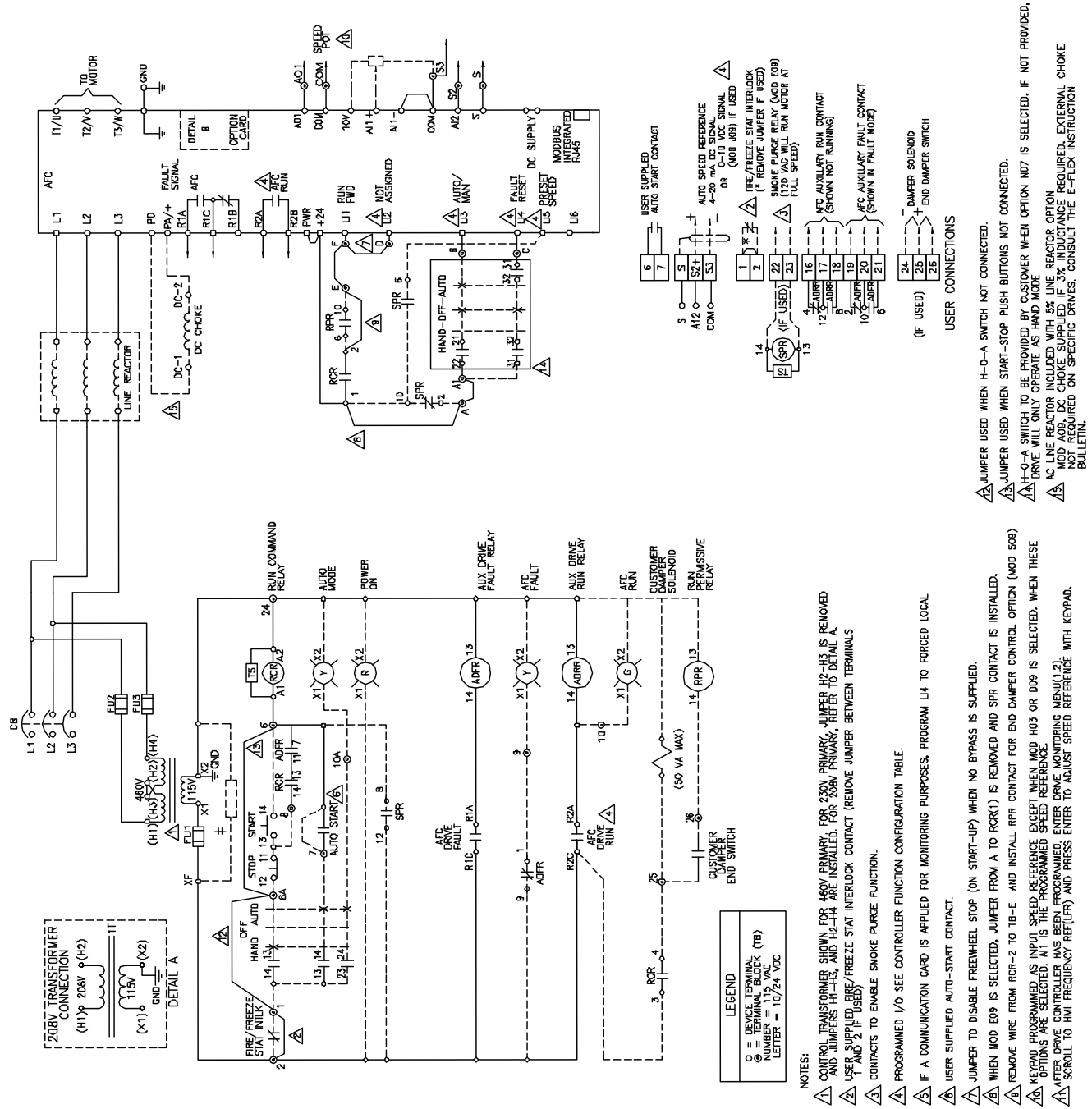


Figure 31: Power Circuit W (Without Bypass): Hand-Off-Auto, Start-Stop, and Speed Potentiometer (Drawing No. 80461-073-01) (continued)

ATV61 FACTORY CONFIGURATION						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
SIM	1.1	-----	2/3 WIRE CONTROL	tCC	2C	
SIM	1.1	-----	PUMPS/FANS	CFG	PnF	
SIM	1.1	-----	STANDARD MOT. FREQ (HZ)	bFr	60	
SIM	1.1	-----	ACCELERATION (SEC)	ACC	10	
SIM	1.1	-----	DECELERATION (SEC)	dEC	10	
SIM	1.1	-----	LOW SPEED (HZ)	LSP	3	
SET	1.3	-----	SWITCHING FREQ. (HZ)	SFr	8	
I-O	1.5	-----	2 WIRE TYPE	tCt	LEL	
I-O	1.5	A12 CONFIG.	A12 MIN. VALLIE (mA)(W/O MOD J09)	CrL2	4	
I-O	1.5	R2 CONFIG.	R2 ASSIGN - DRIVE RUNNING	r2	rUn	
△	CtL	1.6	-----	REF. 1 CHAN	FR1	HMI
	CtL	1.6	-----	REF. 1 CHAN(MOD H03 OR D09 ONLY)	FR1	A11
	CtL	1.6	-----	PROFILE(W/O MOD H03 OR D09 ONLY)	CHCF	SEP
FUn	1.7	REFERENCE SWITCH.	REF. 1B SWITCHING	rCb	U3	
FUn	1.7	REFERENCE SWITCH.	REF. 1B CHAN	Fr1b	A12	
FUn	1.7	PRESET SPEEDS	2 PRESET SPEEDS	PS2	U5	
FUn	1.7	PRESET SPEEDS	PRESET SPEED 2	SP2	60	
FLT	1.8	FAULT RESET	FAULT RESET	rSF	U4	
FLT	1.8	CATCH ON THE FLY	CATCH ON THE FLY	FLR	YES	
COM	1.9	FORCED LOCAL	FORCED LOCAL ASSIGN.	FLO	U4	
WHEN MOD H09 SELECTED - EXTENDED I/O CARD						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	A02	A02 ASSIGNMENT (MOTOR FREQ, mA)	A02	0Fr	
WHEN MOD J09 SELECTED - 0-10V DC SPEED REF.						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	A12 CONFIG.	A12 TYPE	A12t	10U	

DESCRIPTION	TYPE 1	TYPE 12K	TYPE 3R
‡ STIRRING FANS	NA	10-100HP 480V, 7.5-50HP 208/230V	NA
‡ VENTILATION FAN	NA	NA	ALL HP
‡ SPACE HEATER	NA	NA	ALL HP

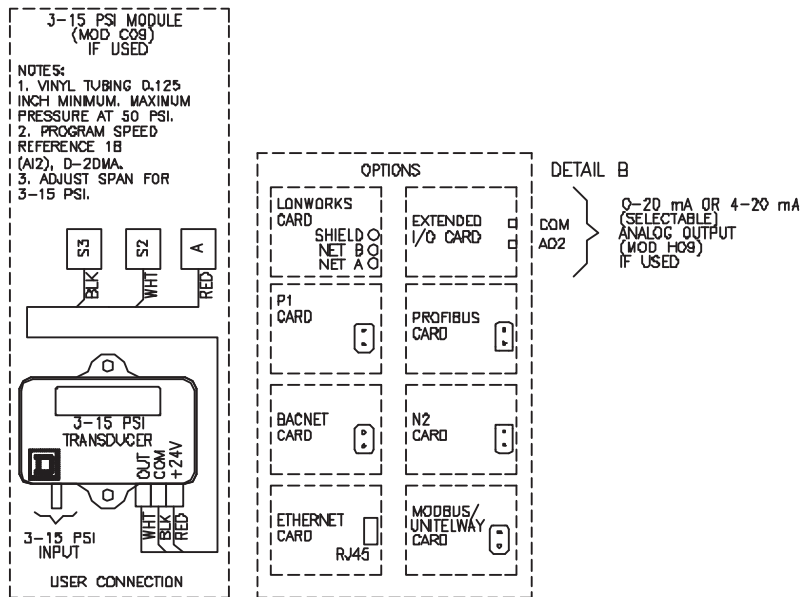


Figure 32: Power Circuit W (Without Bypass): Start-Stop and Speed Potentiometer
(Drawing No. 80461-074-01)

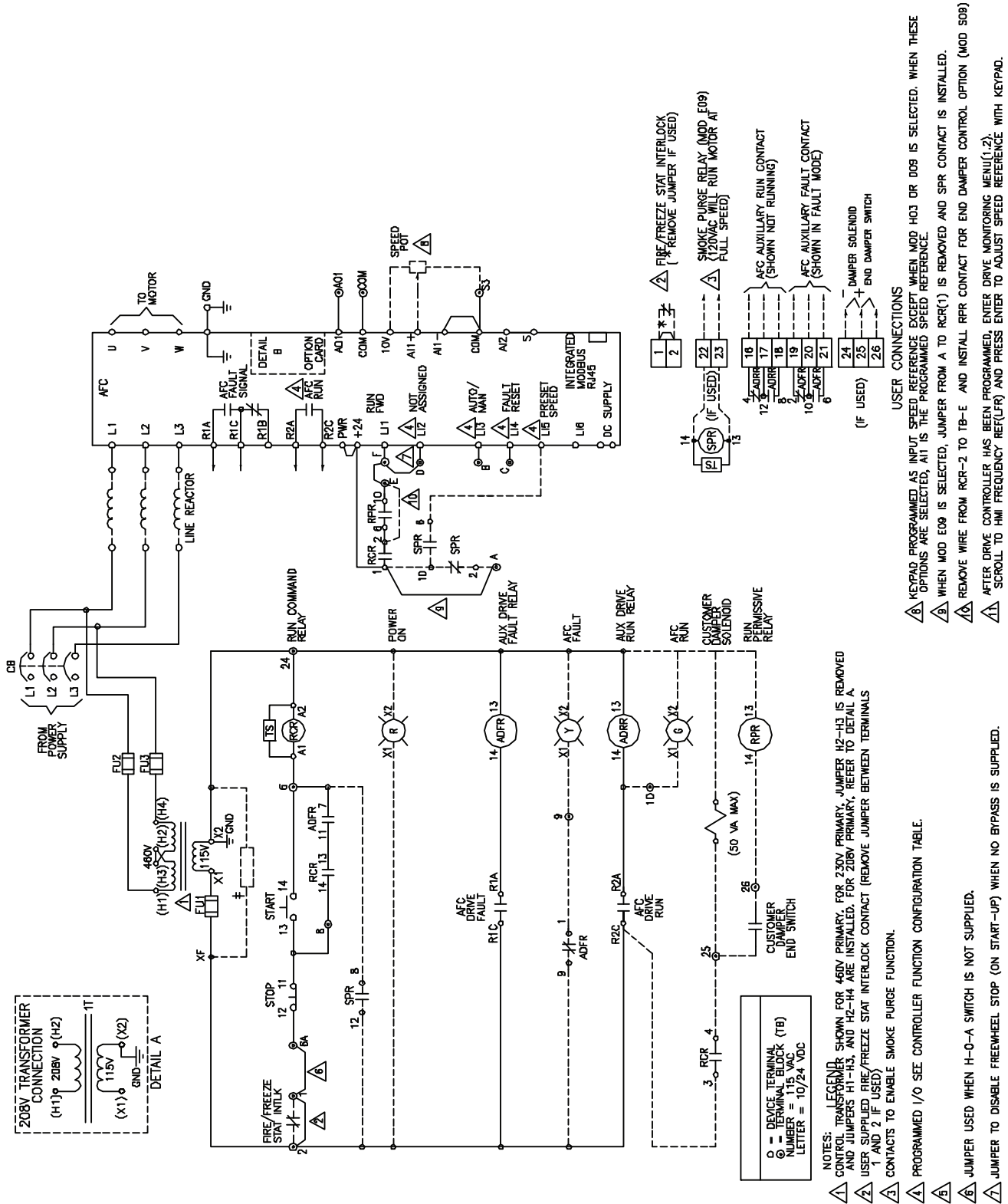


Figure 32: Power Circuit W (Without Bypass): Start-Stop and Speed Potentiometer
(Drawing No. 80461-074-01) (continued)

ATV61 FACTORY CONFIGURATION						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
SIM	1.1	----	2/3 WIRE CONTROL	tCC	2C	
SIM	1.1	----	PUMPS/FANS	CFG	PnF	
SIM	1.1	----	STANDARD MOT. FREQ (HZ)	bFr	60	
SIM	1.1	----	ACCELERATION (SEC)	ACC	10	
SIM	1.1	----	DECELERATION (SEC)	dEC	10	
SIM	1.1	----	LOW SPEED (HZ)	LSP	3	
SEt	1.3	----	SWITCHING FREQ. (HZ)	SFr	8	
I-O	1.5	----	2 WIRE TYPE	tCt	LEL	
I-O	1.5	A12 CONFIG.	A12 MIN. VALUE (mA)(W/O MOD J09)	CrL2	4	
I-O	1.5	R2 CONFIG.	R2 ASSIGN - DRIVE RUNNING	r2	rUn	
△	CtL	1.6	----	REF. 1 CHAN	FR1	HMI
	CtL	1.6	----	REF. 1 CHAN(MOD H03 OR D09 ONLY)	FR1	AI1
	CtL	1.6	----	PROFILE(W/O MOD H03 OR D09 ONLY)	CHCF	SEP
	FUn	1.7	REFERENCE SWITCH.	REF. 1B SWITCHING	rCb	LI3
	FUn	1.7	REFERENCE SWITCH.	REF. 1B CHAN	Fr1b	AI2
	FUn	1.7	PRESET SPEEDS	2 PRESET SPEEDS	PS2	LI5
	FUn	1.7	PRESET SPEEDS	PRESET SPEED 2	SP2	60
	FLT	1.8	FAULT RESET	FAULT RESET	rSF	LI4
	FLT	1.8	CATCH ON THE FLY	CATCH ON THE FLY	FLR	YES
WHEN MOD H09 SELECTED - EXTENDED I/O CARD						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	A02	A02 ASSIGNMENT (MOTOR FREQ, mA)	A02	Ofr	
WHEN MOD J09 SELECTED - 0-10V DC SPEED REF.						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	A12 CONFIG.	A12 TYPE	A12t	10U	

DESCRIPTION	TYPE 1	TYPE 12K	TYPE 3R
‡STIRRING FANS	10-100HP 460V, 7.5-50HP 208/230V	10-100HP 460V, 7.5-50HP 208/230V	NA
‡VENTILATION FAN	NA	NA	ALL HP
‡SPACE HEATER	NA	NA	ALL HP

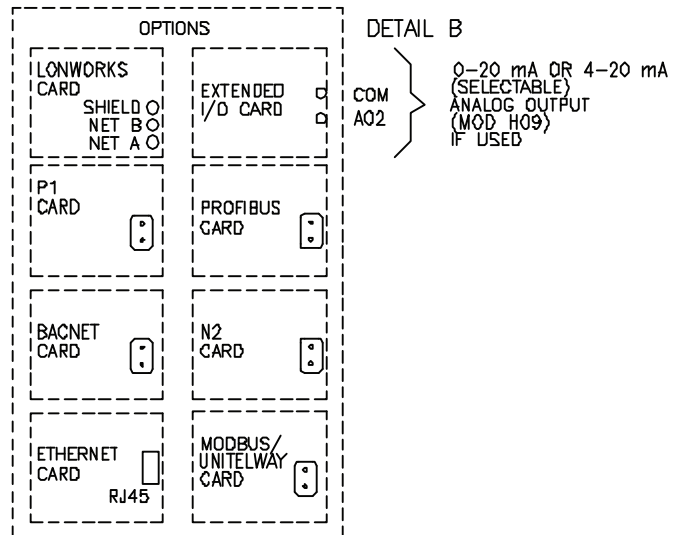


Figure 33: Power Circuit W (Without Bypass): Hand-Off-Auto and Speed Potentiometer
(Drawing No. 80461-075-01)

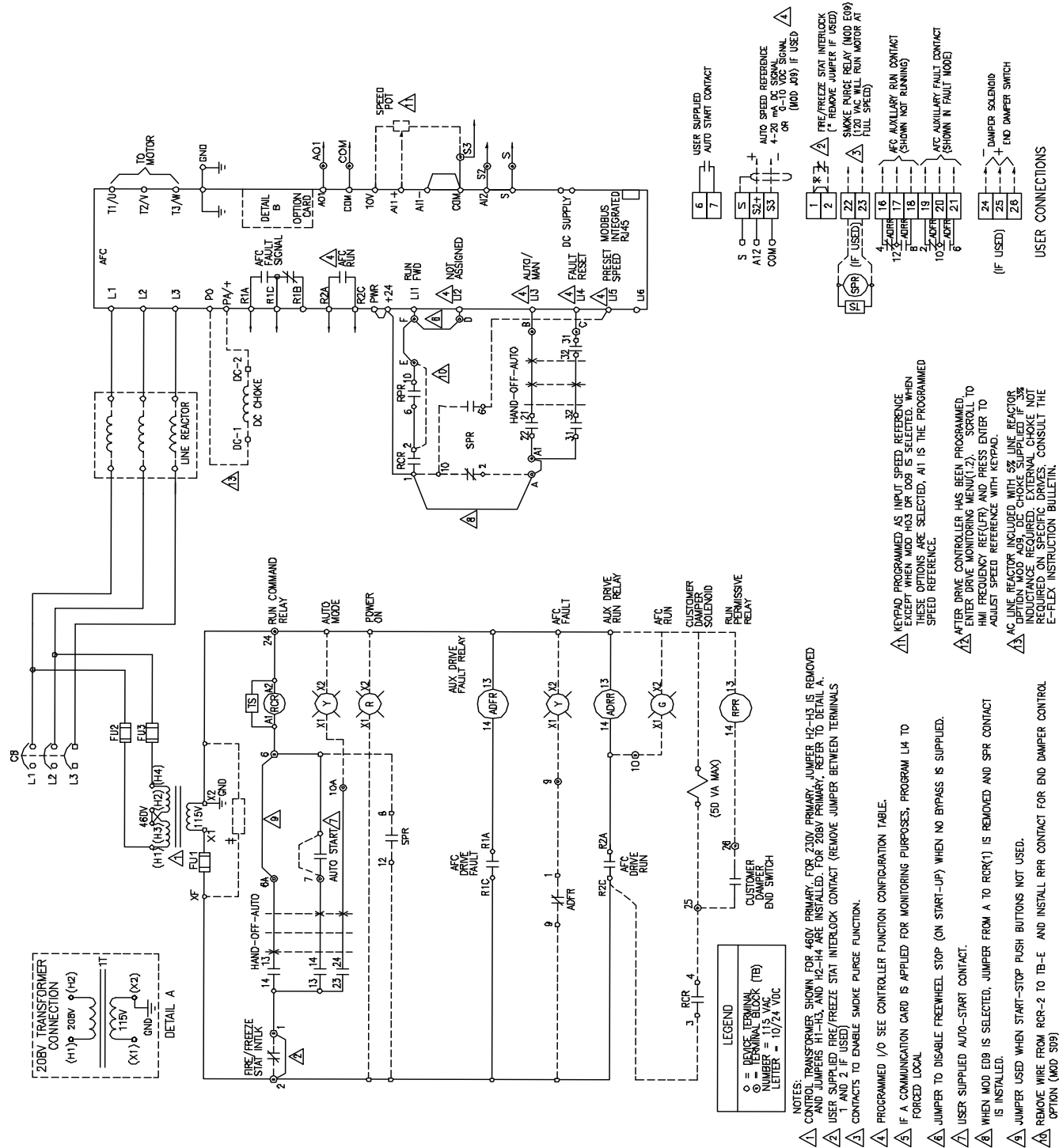


Figure 33: Power Circuit W (Without Bypass): Hand-Off-Auto and Speed Potentiometer
(Drawing No. 80461-075-01) (continued)

ATV61 FACTORY CONFIGURATION						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
SIM	1.1	----	2/3 WIRE CONTROL	tCC	2C	
SIM	1.1	----	PUMPS/FANS	CFG	PnF	
SIM	1.1	----	STANDARD MOT. FREQ (HZ)	bFr	60	
SIM	1.1	----	ACCELERATION (SEC)	ACC	10	
SIM	1.1	----	DECELERATION (SEC)	dEC	10	
SIM	1.1	----	LOW SPEED (HZ)	LSP	3	
SEt	1.3	----	SWITCHING FREQ. (HZ)	SFr	8	
I-O	1.5	----	2 WIRE TYPE	tCt	LEL	
I-O	1.5	A12 CONFIG.	A12 MIN. VALUE (mA)(W/O MOD J09)	CrL2	4	
I-O	1.5	R2 CONFIG.	R2 ASSIGN - DRIVE RUNNING	r2	rUn	
△1	CtL	1.6	----	REF. 1 CHAN	FR1	HMI
	CtL	1.6	----	REF. 1 CHAN(MOD H03 OR D09 ONLY)	FR1	AI1
	CtL	1.6	----	PROFILE(W/O MOD H03 OR D09 ONLY)	CHCF	SEP
	FUn	1.7	REFERENCE SWITCH.	REF. 1B SWITCHING	rCb	LI3
	FUn	1.7	REFERENCE SWITCH.	REF. 1B CHAN	Fr1b	AI2
	FUn	1.7	PRESET SPEEDS	2 PRESET SPEEDS	PS2	LI5
	FUn	1.7	PRESET SPEEDS	PRESET SPEED 2	SP2	60
	FLT	1.8	FAULT RESET	FAULT RESET	rSF	LI4
	FLT	1.8	CATCH ON THE FLY	CATCH ON THE FLY	FLR	YES
△5	COM	1.9	FORCED LOCAL	FORCED LOCAL ASSIGN.	FLO	LI4
WHEN MOD H09 SELECTED - EXTENDED I/O CARD						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	A02	A02 ASSIGNMENT (MOTOR FREQ, mA)	A02	OFr	
WHEN MOD J09 SELECTED - 0-10V DC SPEED REF.						
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.	
I-O	1.5	AI2 CONFIG.	AI2 TYPE	AI2t	10U	

DESCRIPTION	TYPE 1	TYPE 12K	TYPE 3R
± STIRRING FANS	NA	10-100HP 460V, 7.5-50HP 208/230V	NA
± VENTILATION FAN	NA	NA	ALL HP
± SPACE HEATER	NA	NA	ALL HP

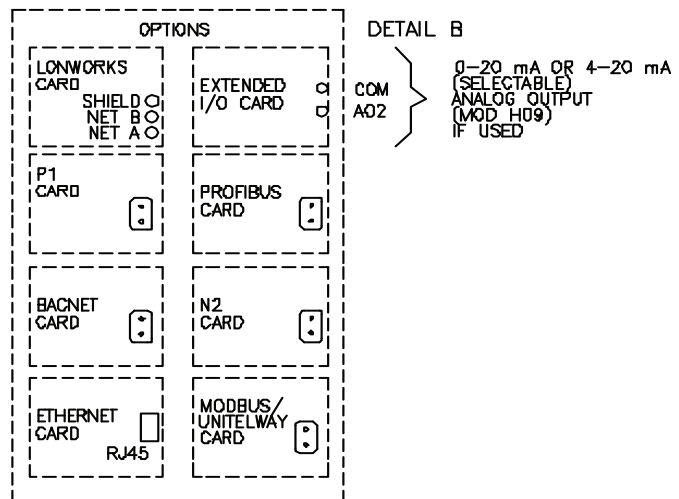
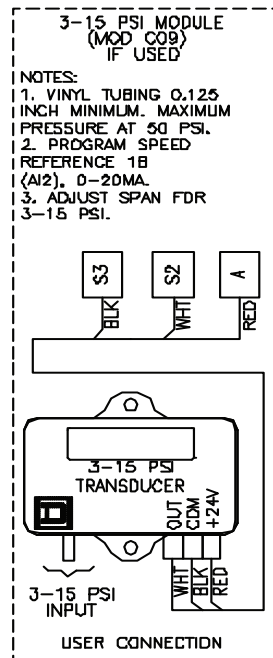


Figure 34: Power Circuit Y (With Bypass): Hand-Off-Comm, Start-Stop, and Speed Potentiometer
(Drawing No. 80461-078-01)

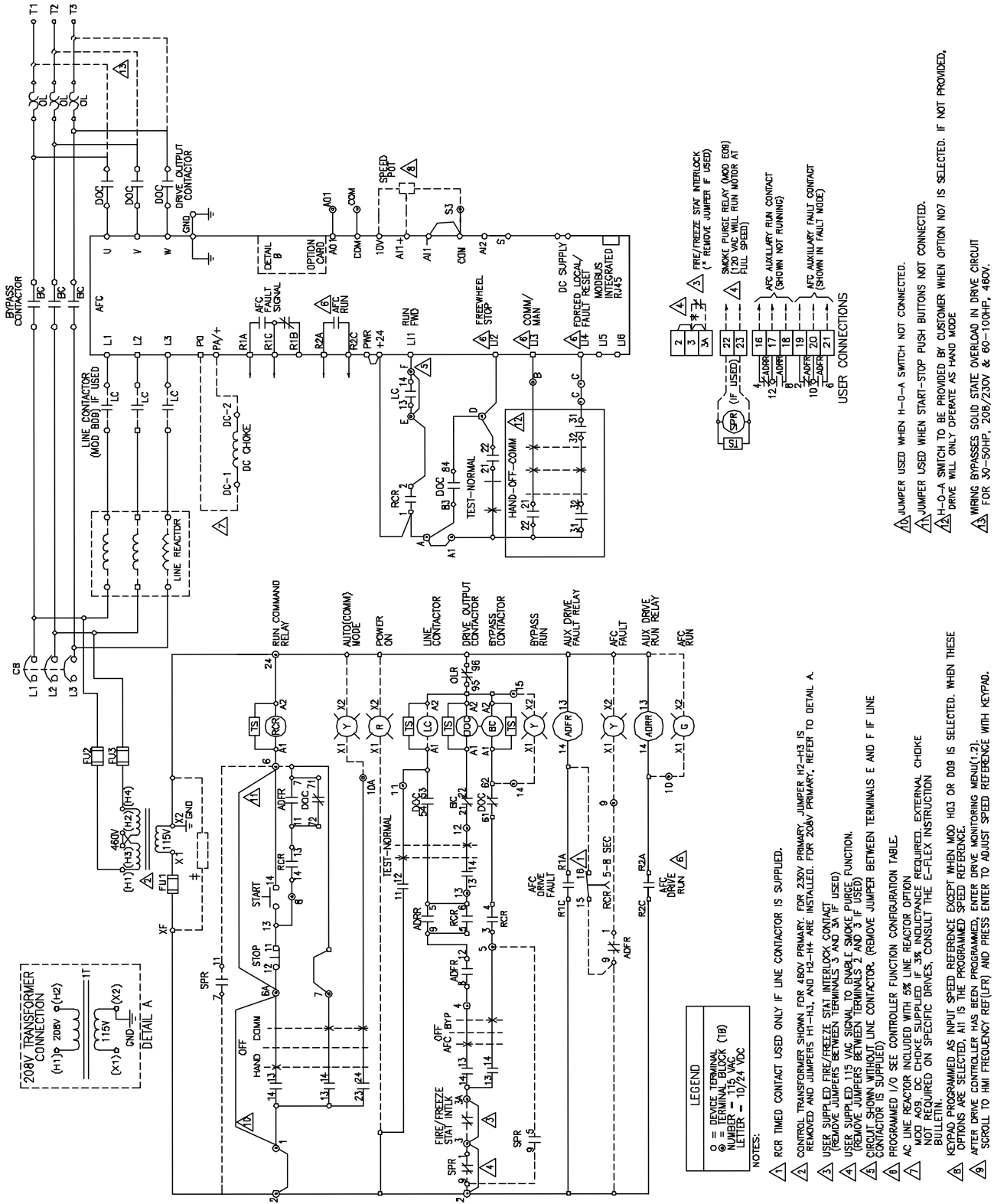


Figure 34: Power Circuit Y (With Bypass): Hand-Off-Comm, Start-Stop, and Speed Potentiometer
(Drawing No. 80461-078-01) (continued)

ATV61 FACTORY CONFIGURATION					
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.
SIM	1.1	-----	2/3 WIRE CONTROL	tCC	2C
SIM	1.1	-----	PUMPS/FANS	CFG	PnF
SIM	1.1	-----	STANDARD MOT. FREQ (HZ)	bFr	60
SIM	1.1	-----	ACCELERATION (SEC)	ACC	10
SIM	1.1	-----	DECELERATION (SEC)	dEC	10
SIM	1.1	-----	LOW SPEED (HZ)	LSP	3
SEt	1.3	-----	SWITCHING FREQ. (HZ)	SFr	8
I-O	1.5	-----	2 WIRE TYPE	tCt	LEL
I-O	1.5	R2 CONFIG.	R2 ASSIGN - DRIVE RUNNING	r2	rUn
CtL	1.6	-----	REF. 1 CHAN(W/O HO3 OR DO9 ONLY)	FR1	HMI
CtL	1.6	-----	REF. 1 CHAN(MOD HO3 OR DO9 ONLY)	FR1	AI1
CtL	1.6	-----	PROFILE	CHCF	SEP
CtL	1.6	-----	CMD SWITCHING	CCS	LI3
CtL	1.6	-----	CMD CHANNEL 2	Cd2	COM.CARD
FUn	1.7	REFERENCE SWITCH.	REF. 1B SWITCHING	rCb	LI3
FUn	1.7	REFERENCE SWITCH.	REF. 1B CHANNEL	Fr1b	COM.CARD
FUn	1.7	STOP CONFIG.	FREEWHEEL STOP ASSIGN.	nST	LI2
FLT	1.8	FAULT RESET	FAULT RESET	rSF	LI4
FLT	1.8	CATCH ON THE FLY	CATCH ON THE FLY	FLR	YES
FLT	1.8	OUTPUT PHASE LOSS	OUTPHASE LOSS	OPL	NO
COM	1.9	FORCED LOCAL	FORCED LOCAL ASSIGN.	FLO	LI4
WHEN MOD HO9 SELECTED - EXTENDED I/O CARD					
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.
I-O	1.5	A02	A02 ASSIGNMENT (MOTOR FREQ, mA)	A02	QFr

DESCRIPTION	TYPE 1	TYPE 12K	TYPE 3R
± STIRRING FANS	NA	10-100HP 460V, 7.5-50HP 208/230V	NA
± VENTILATION FAN	NA	NA	ALL HP
± SPACE HEATER	NA	NA	ALL HP

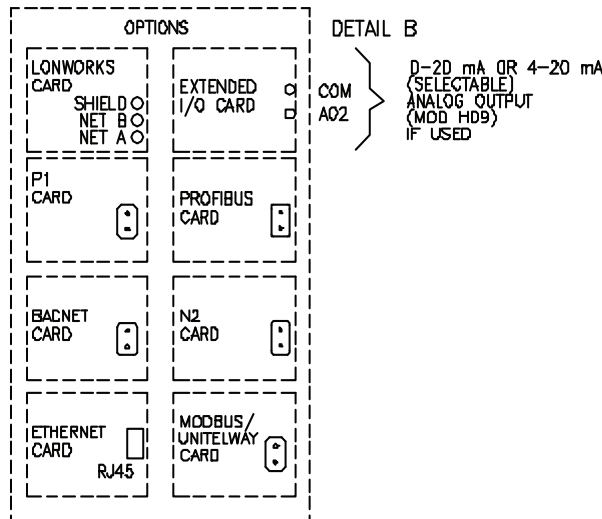


Figure 35: Power Circuit W (Without Bypass): Hand-Off-Comm, Start-Stop, and Speed Potentiometer (Drawing No. 80461-079-01)

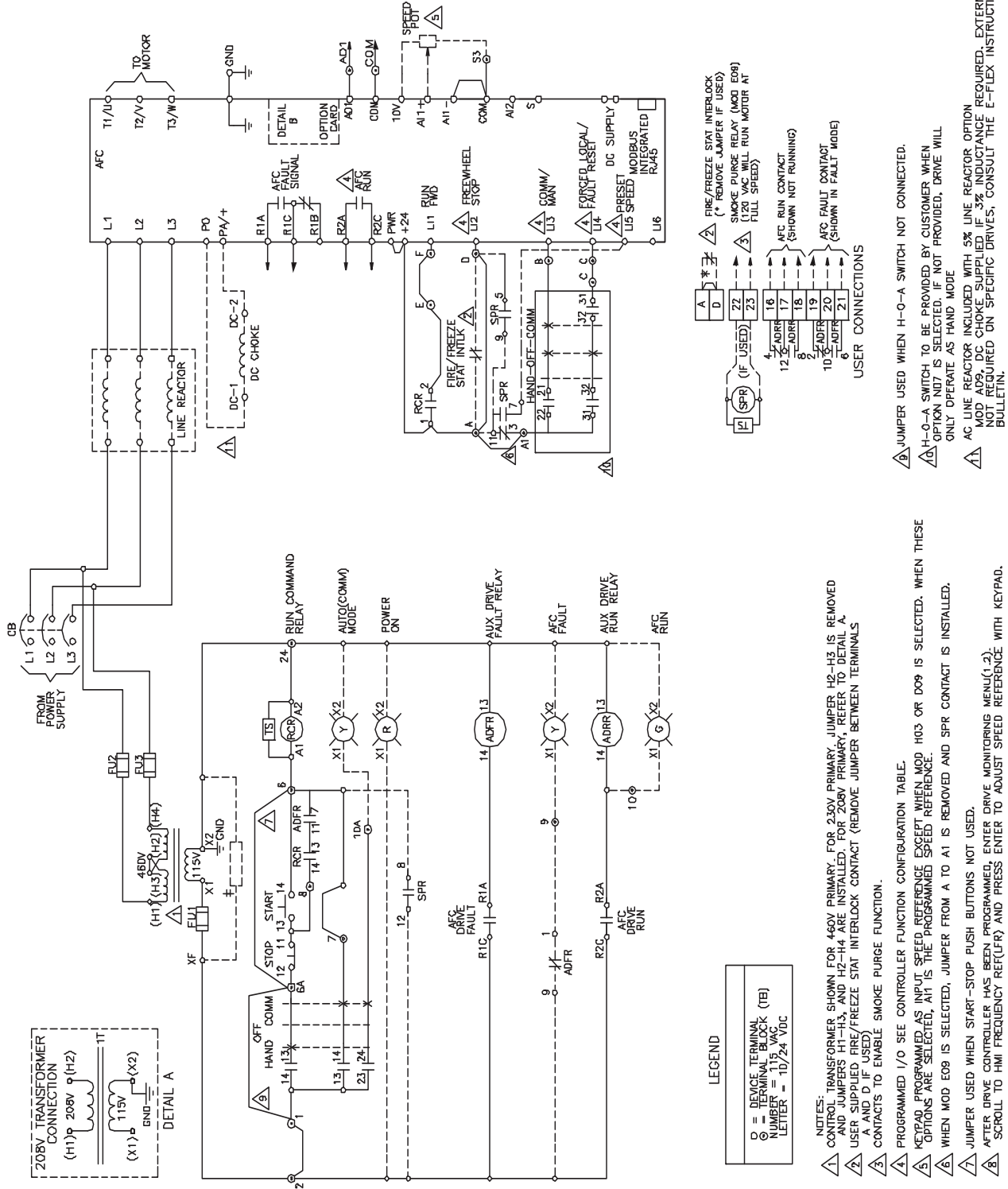
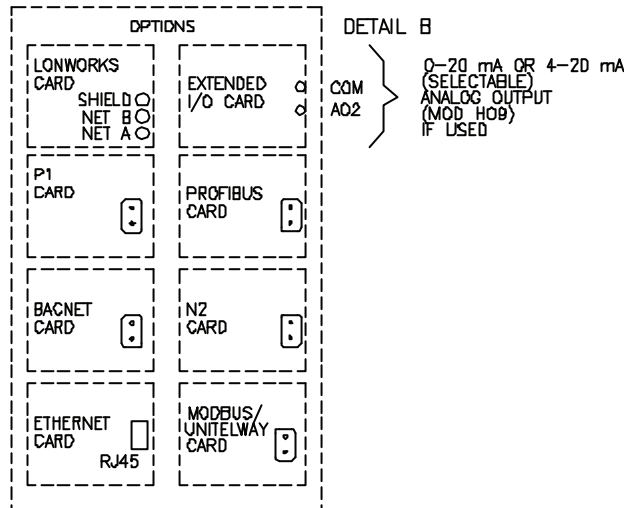


Figure 35: Power Circuit W (Without Bypass): Hand-Off-Comm, Start-Stop, and Speed Potentiometer (Drawing No. 80461-079-01) (continued)

ATV61 FACTORY CONFIGURATION					
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.
SIM	1.1	-----	2/3 WIRE CONTROL	tCC	2C
SIM	1.1	-----	PUMPS/FANS	CFG	PnF
SIM	1.1	-----	STANDARD MOT. FREQ (HZ)	bFr	60
SIM	1.1	-----	ACCELERATION (SEC)	ACC	10
SIM	1.1	-----	DECELERATION (SEC)	dEC	10
SIM	1.1	-----	LOW SPEED (HZ)	LSP	3
SEt	1.3	-----	SWITCHING FREQ. (HZ)	SFr	8
I-O	1.5	-----	2 WIRE TYPE	tCt	LEL
I-O	1.5	R2 CONFIG.	R2 ASSIGN - DRIVE RUNNING	r2	rUn
△	CtL	1.6	REF. 1 CHAN(W/O H03 OR D09 ONLY)	FR1	HMI
	CtL	1.6	REF. 1 CHAN(MOD H03 OR D09 ONLY)	FR1	AI1
	CtL	1.6	PROFILE	CHCF	SEP
	CtL	1.6	CMD SWITCHING	CCS	LI3
	CtL	1.6	CMD CHANNEL 2	cd2	COM.CARD
	FUn	1.7	REFERENCE SWITCH. REF. 1B SWITCHING	rCb	LI3
	FUn	1.7	REFERENCE SWITCH REF. 1B CHANNEL	Fr1b	COM.CARD
	FUn	1.7	STOP CONFIG. FREEWHEEL STOP ASSIGN.	nST	LI2
	FUn	1.7	PRESET SPEEDS 2 PRESET SPEEDS	PS2	LI5
	FUn	1.7	PRESET SPEEDS PRESET SPEED 2	SP2	60
	FLT	1.8	FAULT RESET FAULT RESET	rSF	LI4
	FLT	1.8	CATCH ON THE FLY CATCH ON THE FLY	FLR	YES
	COM	1.9	FORCED LOCAL FORCED LOCAL ASSIGN.	FLO	LI4
WHEN MOD H09 SELECTED - EXTENDED I/O CARD					
MENU	No	SUB-MENU	DESCRIPTION	CODE	ADJ.
I-O	1.5	A02	A02 ASSIGNMENT (MOTOR FREQ, mA)	A02	OFr

DESCRIPTION	TYPE 1	TYPE 12K	TYPE 3R
±STIRRING FANS	NA	10-100HP 460V, 7.5-50HP 208/230V	NA
±VENTILATION FAN	NA	NA	ALL HP
±SPACE HEATER	NA	NA	ALL HP



Numerics

- 24 Vdc supply 119–120
- 3 to 15 PSI input 18
- 3R
 - hood filter 97, 119–120
 - space heater 119–120
 - ventilation fan 119–120

A

- AC line reactor
 - location 18
- acceleration ramp range 25
- AFC-off-bypass selector switch 63, 69, 74
 - location 16–17
- altitude 25
- Apogee P1 14, 29, 68, 75
 - replacement card 119–120
- auto speed ref. 14, 29, 68, 75

B

- BACnet 14, 29, 68, 75
 - replacement card 119–120
- branch circuit
 - components 21, 38
 - feeder protection 21

C

- cable
 - input 51–53
 - output 41, 51–53
- capacitance 41
- capacitors 42
- catalog number 14
- certifications
 - cUL 14, 25, 29, 68, 75
 - IEC 25
 - ISO 25
 - NEMA 25
 - NFPA 25
 - UL 25
- circuit breaker 26
 - disconnect
 - description 38
 - location 16–18, 46–50
 - handle 26
- circuit diagrams
 - power circuit w 104, 106, 108, 112
 - power circuit y 100, 102, 110
- clearances 30–33
- codes 25
- communication options 29, 68
- component locations 46–48
- conductor
 - choosing 44
 - grounding 40
 - grouping 45
 - motor power 41
- conduit
 - choosing 38–39
 - entry 37
- contactor
 - bypass
 - location 18
 - drive output

- location 18
- control options 14, 27, 65–67, 71, 73–74
- control transformer 46, 48–50
 - location 18
- cooling 34
- cUL 14, 25, 29, 68, 75
- current 22–23, 25
 - input line 22–23
 - output 19–21
- customer interface terminal block
 - location 18, 46–48

D

- deceleration ramp range 25
- diagnostic tools 89
- dimensions 30, 32–33
- displacement power factor 25
- documentation 11

E

- efficiency 25
- enclosure 14, 25
- end damper control 14, 29, 68, 75
- Ethernet 14, 29, 68, 75

F

- factory modifications
 - control options 14, 27, 65–67, 71, 73–74
 - light options 14, 28, 67, 74
 - miscellaneous options 14, 29, 67, 74
- factory settings 63
- fans
 - 3R ventilation 119–120
 - heatsink 119–120
 - stirring 119–120
- fasteners 36
- fault
 - reset 14, 54, 64–65, 71–72
- fire/freezestat interlocks 64, 71
- forced local 54, 64
- frequency specifications 25
- fuses
 - replacement 119–120

G

- galvanic isolation 25
- graphic display terminal 25
 - location 16
 - option to omit 14, 29, 67, 74
 - replacement 119–120
- grounding 39, 45

H

- handling 36
- hand-off-auto selector switch 27
 - location 16
 - operation in MOD A07 65, 71
 - operation in MOD B07 65, 72
- hand-off-comm selector switch 27
 - operation in MOD D07 66, 73
 - operation in MOD E07 66, 73
- harmonic distortion 21, 67, 74
- heater 119–120

- heatsink fan assembly 47–50, 119–120
 - installing 96
 - removing 95
- heatsink flange assembly
 - location 18
- hoisting 36
- hood filter 97, 119–120
- humidity 25

I

- I/O extension 14, 29, 75
 - replacement card 119–120
- ICC ES 29
- IEC 25
- input
 - cable 39, 51–53
 - frequency 25
 - power 38
 - voltage 25
 - wiring 39
- installation
 - electrical 38
 - mechanical 37
- ISO 25

K

- keypad command operation 63

L

- light options 14, 28, 67, 74
- lightning arrestors 42
- line
 - contactor 14, 29, 74, 89
 - location 46–49
 - reactor 14, 21, 29, 46–47, 67, 74
 - location 18
 - voltage. See voltage
- LonWorks 14, 29, 68, 75
 - replacement card 119–120

M

- manual speed potentiometer
 - location 16
- Metasys N2 14, 29, 68, 75
 - replacement card 119–120
- miscellaneous options 14, 29, 67, 74
- MOD
 - A07 14, 27, 65, 71
 - A08 14, 28, 67, 74
 - A09 14, 29, 67, 74
 - B07 14, 27, 65, 72
 - B08 14, 28, 74
 - B09 14, 29, 74, 89
 - C07 14, 27, 66
 - C08 14, 28, 67
 - C09 14, 29, 67, 74
 - D07 14, 27, 66, 73
 - D09 14, 29, 67, 74
 - E07 14, 27, 66, 73
 - E09 14, 29, 68, 75
 - F09 14, 29, 68, 75
 - H09 14, 29, 75
 - J09 14, 29, 68, 75
 - K09 14, 29, 68, 75

L09 14, 29, 68, 75
M09 14, 29, 68, 75
N07 14, 27, 67, 74
O09 14, 29, 68, 75
P09 14, 29, 68, 75
Q09 14, 29, 68, 75
R09 14, 29, 68, 75
S09 14, 29, 68, 75
T09 14, 29, 68, 76
U09 14, 29, 68, 76
Modbus 14, 29, 68, 75
replacement card 119–120
motor
power conductors 41
protection 25
rotation
correcting direction of 58
terminal connection 46–48
mounting
clearance 30–33
dimensions and weights 30, 32–33
fasteners 36
suitable surface 36–37

N

nameplate
description 15
NEMA 25
NFPA 25
noise
class 44
suppressors 38
nuisance tripping 21, 41

O

OCPD 26
operators
option to omit 27, 67
option card 57
options
control 14, 27, 65–67, 71, 73–74
light 14, 28, 67, 74
misc. 29
miscellaneous 14, 29, 67, 74
selection rules 14
output
cable 41, 51–53
inductance 42
current 19–21
voltage 25
wiring 38, 41
overcurrent protective devices 39
overload
relay dial 57
overload protection 25

P

parts
208/230 V 120
460 V 119
phase loss protection 25
pilot lights
green 28, 67, 74
locations 16
red 28, 67, 74

replacement 119–120
yellow 28, 67, 74
pollution degree 25
power circuit w (without bypass) 64–68
2-wire control functionality 64
3-wire control functionality 64
control options 65–67
controller operation 64
fire/freezestat interlocks 64
light options 67
misc. options 67–68
operator controls 64
power circuit y (bypass) 69–76
bypass operation 70
control options 71–74
fire/freezestat interlocks 71
light options 74
misc. options 74–76
operator controls 69
test-normal operation 69
power converter
location 18, 46–50
replacement 119–120
replacing 56, 92–95
power factor correction capacitors 42
PowerPact 26
precautions 36
Profibus 14, 29, 68, 75
replacement card 119–120
protection
drive controller 25
motor 25
overcurrent protection device 26
overload 25
phase loss 25
thermal 25
PSI transducer 14, 29, 67, 74

R

ratings 22–23
208 V 21
230 V 20
460 V 19
SCCR 21–23
short-circuit current 21–23, 26
RCR relay
location 46–50
receiving 35
reference sample time 25
renewable parts 119
208/230 V 120
460 V 119

S

seismic qualification 25
seismic qualified label 14, 29, 68, 76
selector switches
AFC-off-bypass 63, 69, 74
hand-off-auto 27
hand-off-comm 27
test-normal 69
serial communication 29, 68
service entrance
location 47–49
service entrance rating 14, 29, 68, 76

shielding 45
shipping damage 35
shock 25
short circuit ratings 26
side air
intake
location 17
smoke purge 14, 29, 68, 75
space heater 97
specifications 25
speed 25
speed potentiometer 27
operation in MOD A07 65, 71
operation in MOD B07 65, 72
operation in MOD C07 66
operation in MOD D07 66, 73
operation in MOD E07 66, 73
standards 25
start pushbutton 27
location 16
operation in MOD B07 65, 72
operation in MOD C07 66
operation in MOD E07 66, 73
start-up 56
stirring fans 119–120
location 47–48
replacing 96
stop pushbutton 27
location 16
operation in MOD B07 65, 72
operation in MOD C07 66
operation in MOD E07 66, 73
supply voltage. See voltage
switching frequency 19–21, 25

T

technical support 90
temperature
operation 25
storage 25
terminal command operation 63
terminals
control 54
locations 18, 46–48
power 51
terminology 11
test-normal selector switch 14, 69
location 16–17
thermal protection 25
three-wire control functionality 64
transient overvoltage 21
two-wire control functionality 64
type 3R
hood filter 97
space heater 97
ventilation fans 97

U

UL 25

V

vent (type 1)
location 16, 18
ventilation
fans 97

vibration 25

voltage

class 44

imbalance 21

input 25

line voltage

compatibility with supply voltage 13

output 25

W

weights 30, 32–33

wire class 44

wiring

general 38

general practices 45

grounding 39, 45

methods 45

noise class 44

output 41

separation of circuits 45

shielding 45

terminal locations 46

voltage class 44

wire class 44

APPENDIX A—RENEWABLE PARTS

Table 1: 460 V Renewable Parts

Description	Qty	1-7.5 hp	Qty	10-25 hp	Qty	30-50 hp	Qty	60-100 hp
Power Converter ¹	1	ATV61H075N4 (1 hp) ATV61H075N4 (2 hp) ATV61HU15N4 (3 hp) ATV61HU30N4 (5 hp) ATV61HU40N4 (7.5 hp)	1	ATV61HU55N4 (10 hp) ATV61HU75N4 (15 hp) ATV61HD11N4 (20 hp) ATV61HD15N4 (25 hp)	1	ATV61HD18N4 (30 hp) ATV61HD22N4 (40 hp) ATV61HD30N4 (50 hp)	1	ATV61HD37N4 (60 hp) ATV61HD45N4 (75 hp) ATV61HD55N4 (100 hp)
Graphic Display	1	VW3A1101	1	VW3A1101	1	VW3A1101	1	VW3A1101
Control Fuses Primary	2	25430-20100 (1A, 100 VA) 25430-20161 (1-6/10 A, 150 VA) 25430-20350 (3-1/2 A, 350 VA)	2	25430-20100 (1A, 100 VA) 25430-20161 (1-6/10 A, 150 VA) 25430-20350 (3-1/2 A, 350 VA)	2	25430-20100 (1A, 100 VA) 25430-20161 (1-6/10 A, 150 VA) 25430-20350 (3-1/2 A, 350 VA)	2	25430-20100 (1A, 100 VA) 25430-20161 (1-6/10 A, 150 VA) 25430-20350 (3-1/2 A, 350 VA)
Control Fuses Secondary	1	25430-20140 (1-4/10 A, 100 VA) 25430-20200 (2 A, 150 VA) 25430-20500 (5 A, 350 VA)	1	25430-20140 (1-4/10 A, 100 VA) 25430-20200 (2 A, 150 VA) 25430-20500 (5 A, 350 VA)	1	25430-20140 (1-4/10 A, 100 VA) 25430-20200 (2 A, 150 VA) 25430-20500 (5 A, 350 VA)	1	25430-20140 (1-4/10 A, 100 VA) 25430-20200 (2 A, 150 VA) 25430-20500 (5 A, 350 VA)
Pilot Light Red ²	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04
Pilot Light Yellow ²	1	LED 25501-00004 Head ZB5AV05	1	LED 25501-00004 Head ZB5AV05	1	LED 25501-00004 Head ZB5AV05	1	LED 25501-00004 Head ZB5AV05
Pilot Light Green ²	1	LED 25501-00005 Head ZB5AV03	1	LED 25501-00005 Head ZB5AV03	1	LED 25501-00005 Head ZB5AV03	1	LED 25501-00005 Head ZB5AV03
Pilot Light Mounting Collar w/ Light Module	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6
I/O Extension Card ³	1	VW3A3202	1	VW3A3202	1	VW3A3202	1	VW3A3202
LonWorks® Card ³	1	VW3A3312	1	VW3A3312	1	VW3A3312	1	VW3A3312
Modbus® ³	1	VW3A3303	1	VW3A3303	1	VW3A3303	1	VW3A3303
Metasys® N2 ³	1	VW3A3313	1	VW3A3313	1	VW3A3313	1	VW3A3313
24 Vdc supply	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003
3R Hood Filter Material	2	31158-441-01	2	31158-441-01	2	31158-441-01	2	31158-441-01
3R Space Heater	1	29904-00027	1	29904-00027	1	29904-00027	1	29904-00027
3R Ventilation Fan	1	26016-00006 29904-09300	1	26016-00006	1	26016-00006	1	26016-00006
Stirring Fan Assembly	1	N/A	1 2	31158-065-50	1	31158-065-50	2	31158-065-50
Heatsink Fans	1	VZ3V1203 (1-3 hp) VZ3V1209 (5, 7.5 hp)	1	VZ3V1204 (10, 15 hp) VZ3V1210 (20 hp) VZ3V1205 (25 hp)	1	VZ3V1205 (30 hp) VZ3V1211 (40 hp) VZ3V1206 (50 hp)	1	VZ3V1206 (60 hp) VZ3V1208 (70, 105 hp)
Profibus Card ³	1	VW3A3307	1	VW3A3307	1	VW3A3307	1	VW3A3307
Ethernet Card ³	1	VW3A3310D	1	VW3A3310D	1	VW3A3310D	1	VW3A3310D
Apogee™ P1 Card ³	1	VW3A3314	1	VW3A3314	1	VW3A3314	1	VW3A3314
BACnet Card ³	1	VW3A3315	1	VW3A3315	1	VW3A3315	1	VW3A3315

¹ The first five characters of the power converter part number may be "ATV61," indicating an IP20 device, or "HTV61," indicating an IP00 device.

² Long life 120 V LED type bulbs (100,000 hours) are provided as standard hardware from the factory. An alternative to the LEDs are incandescent bulbs (2,000 hours). Part number DL1CE130, Type BA9 rated 120–130 V, 2.4 W, is available as an interchangeable part.

³ Field replacement of the option board will reset the power converter to the factory default settings. The user must configure the controller per the elementary diagram with or without bypass starting on page 46.

Table 2: 208/230 V Renewable Parts

Description	Qty	1-3 hp	Qty	5-10 hp	Qty	15-25 hp	Qty	30-50 hp
Power Converter ¹	1	ATV61H075M3 (1 hp) ATV61HU15M3 (2 hp) ATV61HU15M3 (3 hp)	1	ATV61HU30M3 (5 hp) ATV61HU40M3 (7.5 hp) ATV61HU55M3 (10 hp)	1	ATV61HU75M3 (15 hp) ATV61HD11M3X (20 hp) ATV61HD15M3X (25 hp)	1	ATV61HD18M3X (30 hp) ATV61HD22M3X (40 hp) ATV61HD30M3X (50 hp)
Graphic Display	1	VW3A1101	1	VW3A1101	1	VW3A1101	1	VW3A1101
Control Fuses Primary 208 V	2	25430-20225 (100 VA, 2-1/4 A) 25430-20350 (150 VA, 3-1/2 A) 25430-20800 (350 VA, 8 A)	2	25430-20225 (100 VA, 2-1/4 A) 25430-20350 (150 VA, 3-1/2 A) 25430-20800 (350 VA, 8 A)	2	25430-20225 (100 VA, 2-1/4 A) 25430-20350 (150 VA, 3-1/2 A) 25430-20800 (350 VA, 8 A)	2	25430-20225 (100 VA, 2-1/4 A) 25430-20350 (150 VA, 3-1/2 A) 25430-20800 (350 VA, 8 A)
230 V	2	25430-20200 (100 VA, 2 A) 25430-20321 (150 VA, 3-2/10 A) 25430-20750 (350 VA, 7-1/2 A)	2	25430-20200 (100 VA, 2 A) 25430-20321 (150 VA, 3-2/10 A) 25430-20750 (350 VA, 7-1/2 A)	2	25430-20200 (100 VA, 2 A) 25430-20321 (150 VA, 3-2/10 A) 25430-20750 (350 VA, 7-1/2 A)	2	25430-20200 (100 VA, 2 A) 25430-20321 (150 VA, 3-2/10 A) 25430-20750 (350 VA, 7-1/2 A)
Control Fuses Secondary 208 V	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5 A)	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5 A)	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5 A)	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5 A)
230 V	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5A)	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5A)	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5A)	1	25430-20140 (100 VA, 1-4/10 A) 25430-20200 (150 VA, 2 A) 25430-20500 (350 VA, 5A)
Pilot Light Red ²	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04
Pilot Light Yellow ²	1	LED 25501-00004 Head ZB5AV05	1	LED 25501-00004 Head ZB5AV05	1	LED 25501-00004 Head ZB5AV05	1	LED 25501-00004 Head ZB5AV05
Pilot Light Green ²	1	LED 25501-00005 Head ZB5AV03	1	LED 25501-00005 Head ZB5AV03	1	LED 25501-00005 Head ZB5AV03	1	LED 25501-00005 Head ZB5AV03
Pilot Light Mounting Collar w/ Light Module	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6
I/O Extension Board ³	1	VW3A3202	1	VW3A3202	1	VW3A3202	1	VW3A3202
LonWorks® Card ³	1	VW3A3312	1	VW3A3312	1	VW3A3312	1	VW3A3312
Modbus® ³	1	VW3A3303	1	VW3A3303	1	VW3A3303	1	VW3A3303
Metasys® N2 ³	1	VW3A3313	1	VW3A3313	1	VW3A3313	1	VW3A3313
24 Vdc supply	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003
3R Hood Filter Material	2	31158-441-01	2	31158-441-01	2	31158-441-01	2	31158-441-01
3R Space Heater	1	29904-00027	1	29904-00027	1	29904-00027	1	29904-00027
3R Ventilation Fan	1	26016-00006	1	26016-00006	1	26016-00006	1	26016-00006
Stirring Fan Assembly	1	N/A	1	31158-065-50	1	31158-065-50 31158-295-50	2	31158-065-50
Heatsink Fans	1	VZ3V1203	1	VZ3V1209 (5, 7.5 hp) VZ3V1204 (10 hp)	1	VZ3V1210 (15 hp) VZ3V1205 (20, 25 hp)	1	VZ3V1211 (30, 40 hp) VZ3V1207 (50 hp)
Profibus Card ³	1	VW3A3307	1	VW3A3307	1	VW3A3307	1	VW3A3307
Ethernet Card ³	1	VW3A3310D	1	VW3A3310D	1	VW3A3310D	1	VW3A3310D
Apogee™ P1 Card ³	1	VW3A3314	1	VW3A3314	1	VW3A3314	1	VW3A3314
BACnet Card ³	1	VW3A3315	1	VW3A3315	1	VW3A3315	1	VW3A3315

¹ The first five characters of the power converter part number may be "ATV61," indicating an IP20 device, or "HTV61," indicating an IP00 device.

² Long life 120 V LED type bulbs (100,000 hours) are provided as standard hardware from the factory. An alternative to the LEDs are incandescent bulbs (2,000 hours). Part number DL1CE130, Type BA9 rated 120–130 V, 2.4 W, is available as an interchangeable part.

³ Field replacement of the option board will reset the power converter to the factory default settings. The user must configure the controller per the elementary diagram with or without bypass starting on page 46.

Table 3: Circuit Breaker OCPD–Fuse List

8839 Controller ¹	hp-VT	Circuit Breaker	Class J T-D Fuses ²		
			No Bypass	Bypass	
				150%	175%
460 V					
EFDC•4V_	1	HLL36015	2-1/4	4	4-1/2
EFDD•4V_	2	HLL36015	5	6	7
EFDE•4V_	3	HLL36015	6	9	10
EFDF•4V_	5	HLL36015	12	15	15
EFDG•4V_	7.5	HLL36025	15	20	20
EFDH•4V_	10	HLL36035	20	25	30
EFDJ•4V_	15	HLL36050	30	40	45
EFDK•4V_	20	HLL36060	40	50	60
EFDL•4V_	25	HLL36080	45	60	70
EFDM•4V_	30	HLL36100	60	70	90
EFDN•4V_	40	HLL36125	70	100	110
EFDP•4V_	50	HLL36150	90	125	125
EFDQ•4V_	60	JLL36175	110	150	150
EFD R•4V_	75	JLL36225	125	175	200
EFD S•4V_	100	JLL36250	175	225	250
230 V					
EFDC•3V_	1	HLL36015	5	8	9
EFDD•3V_	2	HLL36015	9	12	15
EFDE•3V_	3	HLL36025	15	17 1/2	20
EFDF•3V_	5	HLL36040	25	30	30
EFDG•3V_	7.5	HLL36060	30	40	45
EFDH•3V_	10	HLL36070	40	50	60
EFDJ•3V_	15	HLL36110	60	80	90
EFDK•3V_	20	HLL36125	80	100	110
EFDL•3V_	25	JLL36175	90	125	150
EFDM•3V_	30	JLL36225	110	150	175
EFDN•3V_	40	JLL36250	150	200	225
EFD P•3V_	50	JLL36250	175	250	250
208 V					
EFDC•2V_	1	HLL36015	5-6/10	9	10
EFDD•2V_	2	HLL36015	10	15	15
EFDE•2V_	3	HLL36025	15	20	20
EFDF•2V_	5	HLL36040	25	30	35
EFDG•2V_	7.5	HLL36060	35	45	50
EFDH•2V_	10	HLL36070	45	60	60
EFDJ•2V_	15	HLL36110	60	90	100
EFDK•2V_	20	HLL36125	80	110	125
EFDL•2V_	25	JLL36175	100	150	150
EFDM•2V_	30	JLL36225	125	175	175
EFDN•2V_	40	JLL36250	175	200	250
EFD P•2V_	50	JLL36250	200	250	300

¹ “•” can be “A”, “G” or “H”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure. “H” denotes a Type 3R enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.

² Standard product is configured with circuit breakers. Fuse data is provided as an alternative to customized product from the factory.

Table 4: Replacement Power Converter Part Numbers

8839 Controller ¹	hp	Power Converter ²
460 V		
EFDC•4V_	1	ATV61K075N4U
EFDD•4V_	2	ATV61K075N4U
EFDE•4V_	3	ATV61KU15N4U
EFDF•4V_	5	ATV61KU30N4U
FDG•4V_	7.5	ATV61KU40N4U
FDH•4V_	10	ATV61KU55N4U
FDJ•4V_	15	ATV61KU75N4U
FDK•4V_	20	ATV61KD11N4U
FDL•4V_	25	ATV61KD15N4U
FD•4V_	30	ATV61KD18N4U
FDN•4V_	40	ATV61KD22N4U
FD•4V_	50	ATV61KD30N4U
FDQ•4V_	60	ATV61KD37N4U
FD•4V_	75	ATV61KD45N4U
FD•4V_	100	ATV61KD55N4U
230 V		
EFDC•3V_	1	ATV61K075M3U
EFDD•3V_	2	ATV61KU15M3U
EFDE•3V_	3	ATV61KU15M3U
EFDF•3V_	5	ATV61KU30M3U
FDG•3V_	7.5	ATV61KU40M3U
FDH•3V_	10	ATV61KU55M3U
FDJ•3V_	15	ATV61KU75M3U
FDK•3V_	20	ATV61KD11M3U
FDL•3V_	25	ATV61KD15M3U
FD•3V_	30	ATV61KD18M3U
FDN•3V_	40	ATV61KD22M3U
FD•3V_	50	ATV61KD30M3U
208 V		
EFDC•2V_	1	ATV61KU15M3U
EFDD•2V_	2	ATV61KU30M3U
EFDE•2V_	3	ATV61KU30M3U
EFDF•2V_	5	ATV61KU40M3U
FDG•2V_	7.5	ATV61KU55M3U
FDH•2V_	10	ATV61KU75M3U
FDJ•2V_	15	ATV61KD11M3U
FDK•2V_	20	ATV61KD15M3U
FDL•2V_	25	ATV61KD18M3U
FD•2V_	30	ATV61KD22M3U
FDN•2V_	40	ATV61KD30M3U
FD•2V_	50	ATV61KD37M3U

¹ “•” can be “A”, “G” or “H”. “A” denotes a Type 12K enclosure; “G” denotes a Type 1 enclosure. “H” denotes a Type 3R enclosure. “_” indicates that the catalog number continues. See page 14 for a detailed description of catalog numbers.

² Standard product is configured with circuit breakers. Fuse data is provided as an alternative to customized product from the factory.

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