M-Flex™ Adjustable Speed Controllers

1–450 hp CT & 1–500 hp VT, 460 Vac;
1–40 hp CT & 1–50 hp VT, 208/230 Vac

Instruction Bulletin

30072-451-52
Rev. 02, 07/2014

Retain for future use.

Schneider Electric™

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 hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol is not used with this signal word.

NOTE: Provides additional information to clarify or simplify a procedure.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

Before You Begin

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- 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.
- Turn off all power supplying this equipment before working on or inside 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 M-Flex controllers. Installation, adjustment, repair, and maintenance of the controllers must be performed by qualified personnel.
- User is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this controller, 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 controller:
  - — Disconnect all power including external control power that may be present before servicing the controller.
  - — Place a “DO NOT TURN ON” label on the controller disconnect.
  - — Lock the disconnect in open position.
  - — WAIT 15 MINUTES for the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure on page 61 to verify that the DC voltage is less than 42 V. The controller LEDs are not accurate indicators of the absence of DC bus voltage.
- Install and close all covers before applying power or starting and stopping the controller.

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

Section 1—Introduction and Technical Characteristics

Introduction

The M-Flex™ enclosed controller is targeted for industrial, municipal, and high end commercial applications. See Table 1 for available enclosures and short-circuit current ratings. All controllers are UL 508C Listed with selectable control and power configurations.

This instruction bulletin covers receiving, installation, start-up, configuration, operation, and troubleshooting of the M-Flex AC controllers listed in Table 1.

Table 1: M-Flex AC Controller Enclosures and Short-Circuit Current Ratings

Controllers		Enclosure Type(s)	Short-Circuit Current Rating	
			Standard	Optional (with Option 610)
Constant torque (CT)	1–40 hp, 208/230 V	1, 12/12K	100 kA	—
	1–75 hp, 460 V	1, 12/12K	100 kA	—
	100–250 hp, 460 V	1, 1G	100 kA	—
	300–450 hp, 460 V	1, 1G	65 kA	100 kA
Variable torque (VT)	1–50 hp, 208/230 V	1, 12/12K	100 kA	—
	1–100 hp, 460 V	1, 12/12K	100 kA	—
	125–500 hp, 460 V	1, 1G	100 kA	—
	300–500 hp, 460 V	1, 1G	65 kA	100 kA

NOTE: 1G = Type 1 enclosure with gaskets and fan filters

Related Documentation

For further information, refer to the latest revision of the instruction bulletins listed in Tables 2 and 3. These documents ship with the controller when the corresponding option is selected and are available from the Technical Library at www.schneider-electric.com.

Table 2: Instruction Bulletins

Bulletin No.	Title
1755843 (CT) or 1760643 (VT)	*Installation Manual*, 0.5–60 hp, 230 V and 0–100 hp, 460 V
1755849 (CT) or 1760655 (VT)	*Installation Manual*, 75–100 hp, 230 V and 125–700 hp, 460 V
1755855 (CT) or 1760649 (VT)	*Programming Manual*
1755861 (CT) or 1760661 (VT)	*Communication Parameters*
W817574030111 (CD)	*Altivar™ 61*
W817555430114 (CD)	*Altivar 71*
30072-200-50	*Handling, Installation, Operation, and Maintenance of Electrical Control Equipment*

Table 3: Option Card Bulletins

Bulletin No.	Title	Option
1755869 30072-451-27 30072-451-43	*Modbus Plus Card, VW3A3302* *Supplementary Instructions for ATV71 Option Cards* *Addendum to ATV71 Modbus Plus Card VW3A3302*	A09
1755867 30072-451-27	*Modbus/Uni-Telway™ Card, VW3A3303* *Supplementary Instructions for ATV71 Option Cards*	B09
1754480	*Option Card* (Metasys® N2 Card, VW3A3318)	C09
AAV69931	*Ethernet Modbus TCP/IP Card, VW3A3310D*	D09
1765273	*Option Card* (LonWorks® Card, VW3A3312)	E09
1755877 30072-451-27 30072-451-44	*DeviceNet™ Card, VW3A3309* *Supplementary Instructions for ATV71 Option Cards* *Addendum to ATV71 DeviceNet™ Card*	F09
1755873 30072-451-27 30072-451-45	*Profibus DP Card, VW3A3307* *Supplementary Instructions for ATV71 Option Cards* *Addendum to ATV71 Profibus™ DP VW3A3307*	G09
—	I/O Extension Card, VW3A3202: Refer to the Installation Manual. See Table 2 on page 9.	H09
BBV10543	*Option Card* (Apogee P1 Card, VW3A3314)	J09
1765274	*Option Card* (BACnet Card, VW3A3319)	K09
1755871 30072-451-27	*Interbus Card, VW3A3304* *Supplementary Instructions for ATV71 Option Cards*	L09
1755883 30072-451-27	*Standard Fipio Card, VW3A3311* *Supplementary Instructions for ATV71 Option Cards*	M09
1629225	*Bluetooth® USB, VW3A8115*	O09 or Q09
30072-451-39	*Modbus® Bluetooth®, VW3A8114*	P09 or Q09

All controllers include factory-supplied user drawings and are identified by a factory order number. The factory order number for the controller is referenced in Figure 1 on page 11. This same number appears as part of the number sequence in the title block of the factory-supplied user drawings. The drawing set includes:

- an enclosure outline drawing
- a power elementary drawing
- a control elementary drawing
- an interconnection drawing
- a component layout drawing (1–100 hp VT / 1–75 hp CT @ 460 V; 1–50 hp VT / 1–40 hp CT @ 208/230 V)

Terminology

The following terminology is used throughout this instruction bulletin in reference to the M-Flex controller family.

- **Enclosed drive, or controller** refers to the combination of the power converter, enclosure, and the power and control circuits that constitute the M-Flex Adjustable Speed Enclosed Drive.
- **Drive**, as used in this manual, refers to the controller portion of the adjustable speed drive as per the NEC.
- **Power converter** refers to the ATV61 or ATV71 series controllers when used as a component in the M-Flex enclosed drive.

Precautions

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Turn off all power supplying this equipment before working on it.

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

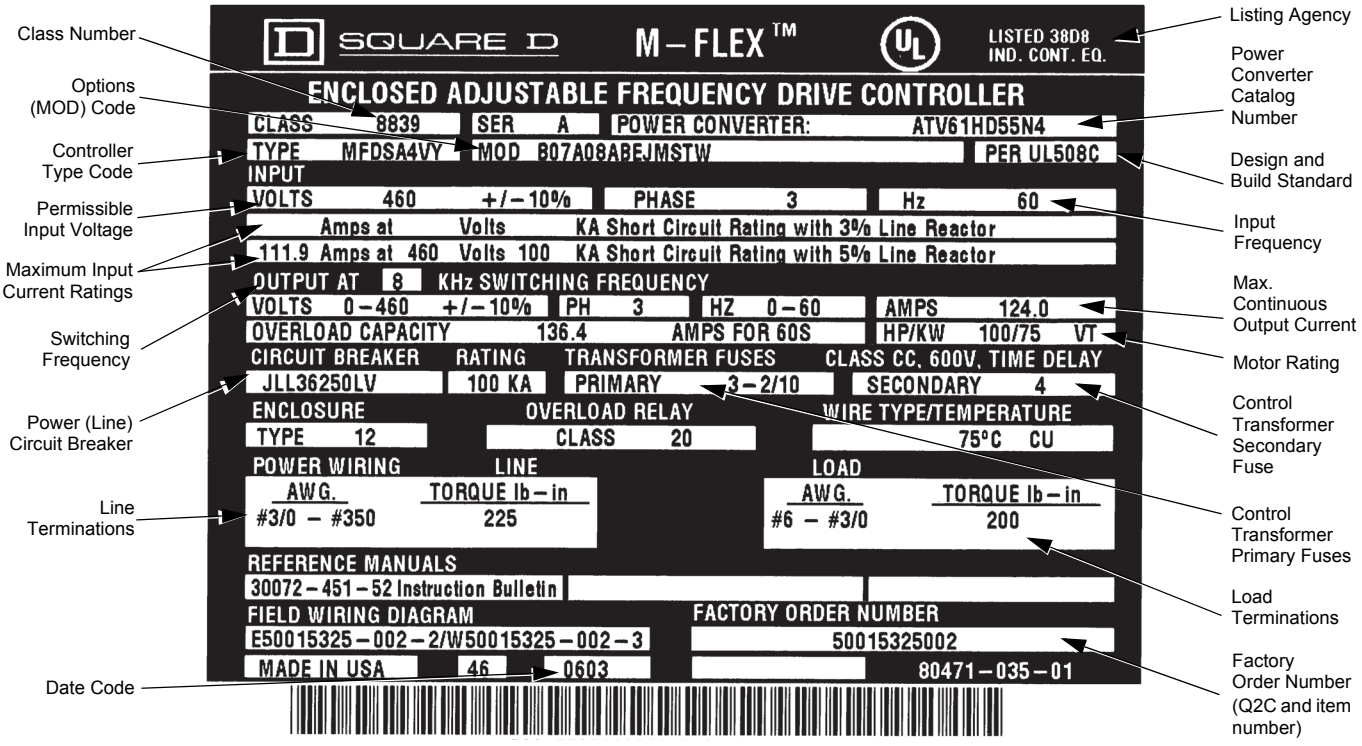
Follow these precautions when installing M-Flex controllers:

- The Type 1 and 1G controllers are suitable for installation in a Pollution Degree 2 environment as defined in NEMA ICS1 and IEC 60664-1. The Type 12/12K controller is suitable for installation in a Pollution Degree 3 environment as defined in NEMA ICS1 and IEC 60664-1. The expected environment must be compatible with this rating.
- When attaching wall- and floor-mounted 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 to maintain a maximum 40 °C (104 °F) ambient temperature in accordance with the total dissipated power specified in Tables 25–27 on pages 30–31.
- For seismic qualified products (Mod H10), follow the mounting precautions stated on the safety labels attached to the device.

Controller Nameplate Identification

The nameplate for the M-Flex controller is located on the inside of the door. This nameplate, described in Figure 1, identifies the controller Class, Type, and modification (options) listing. When identifying or describing M-Flex controllers, use the data from this nameplate.

Figure 1: Information Provided by the Controller Nameplate



Controller 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 grid on pages 12–13 to translate the catalog number into a description of the controller.

Class	Type						Modifications			
							Control	Light	Card	Misc.
8839	MFD	•	•	•	•	•	•	•	•	•
		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Product

Code	Drive Type
MFD	M-Flex Controller

② Horsepower Code

Code	Rating, hp	Code	Rating, hp
C	1	Q	60 (460 V only)
D	2	R	75 (460 V only)
E	3	S	100 (460 V only)
F	5	T	125 (460 V only)
G	7.5	U	150 (460 V only)
H	10	W	200 (460 V only)
J	15	X	250 (460 V only)
K	20	Y	300 (460 V only)
L	25	Z	350 (460 V only)
M	30	4	400 (460 V only)
N	40	5	450 (460 V only)
P	50	6	500 (460 V only, VT only)

③ Enclosure Type

Code	Environment Rating
A	Type 12/12K: 1–100 hp VT; 1–75 hp CT
G	Type 1
B	Type 1G: 125–500 hp VT; 100–450 hp CT

④ Voltage Rating

Code	Voltage
2	208 V
3	230 V
4	460 V

⑤ Application Type

Code	Applied Rating
V	Variable Torque
C	Constant Torque

⑥ Device Type

Code	Power Circuit
R [31]	Barriered Bypass—RVAT
S [31]	Barriered Bypass—SSRVS
T [31]	Isolation and Transfer
W [1]	Drive Only
Y [2]	Integrated Bypass
Z [2]	Barriered Bypass—Full Voltage
Refer to Power Circuits—General beginning on page 92 for definitions.	

[1] Barriered bypass is not compatible with this option.

[2] Includes AFC/Off/Bypass switch and Test/Normal switch.

[3] All controls are mutually exclusive. Select only one.

[4] The Hand-Off-Auto switch can be set to the Off position for AFC trip reset.

[5] Supplied as the default.

[6] Control option C07 is not compatible with bypass or any light cluster except C08.

[7] Only available without bypass.

[8] Only available with a communication card. This option is the default control option supplied when a communication option is selected.

[9] Light clusters are mutually exclusive. Select only one.

[10] Not available with option C07 or D07.

[11] Only available with bypass.

[12] Light cluster B08 is not compatible without bypass.

[13] Only available with option C07 and non-bypass.

[14] Only available with option D07 and non-bypass.

[15] Only available with option A07, B07, or E07.

[16] Only available with option F07.

[17] Select only one option card.

[18] Must use option F07 for control.

[19] Line contactor is not standard with bypass. It can be selected if bypass is also selected. Without bypass option B10, requires order engineering.

[20] C10 is not compatible with C07, D07, or J10.

[21] User must buy separate device to program the controller.

[22] Smoke purge relay E10 permits the motor to run at full speed.

[23] J10 is not compatible with C07, D07, or C10.

[24] Available only when pilot lights are selected.

[25] Not available on power on light.

[26] Not available without bypass.

[27] Not available with option B07, C07, or D07.

[28] With options U10 and V10 you must select option F10.

[29] Supplied with illuminated reset push button.

[30] Not available with 1, 2, or 3 hp controllers.

[31] Requires Order Engineering.

⑦ Control Option [3]

Code	AFC Controls	Code	AFC Controls
A07 [4], [5]	Hand/Off/Auto, Speed Potentiometer	D07 [7]	Stop/Start, Forward/Reverse, Speed Potentiometer
B07 [4]	Hand/Off/Auto, Start/Stop, Speed Potentiometer	E07 [4]	Hand/Off/Auto, Local/Remote, Speed Potentiometer
C07 [6], [7]	Start/Stop, Speed Potentiometer	F07 [8]	Communication/Auto/Off/Hand, Speed Potentiometer
		N07 [31]	Wired for Remote Operation

⑧ Light Option [9]

Code	Light Cluster	Code	Light Cluster	Code	Light Cluster
A08 [10]	Red Power On	C08 [7], [13]	Red Power On	E08 [15]	Red Power On
	Green AFC Run		Green AFC Run		Green AFC Run
	Yellow AFC Trip				Yellow AFC Trip
	Yellow Auto		Yellow AFC Trip		Blue Hand
					Yellow Auto
B08 [11], [12], [10]	Red Power On	D08 [7], [14]	Red Power On	F08 [16]	Red Power On
	Green AFC Run		Yellow AFC Trip		Green AFC Run
	Yellow AFC Trip		Green Run Forward		Yellow AFC Trip
	Yellow Bypass		Green Run Reverse		Yellow Communication

⑨ Option Cards [17]

Code	Feature	Code	Feature
A09 [18]	Modbus™ Plus	J09 [18]	Apogee P1 (ATV61 only)
B09 [18]	Modbus / Uni-Telway	K09 [18]	BACnet (ATV61 only)
C09 [18]	Metasys N2 (ATV61 only)	L09 [18]	Interbus
D09 [18]	Ethernet TCP/IP	M09 [18]	Fipio™
E09 [18]	LONWORKS (ATV61 only)	O09	Bluetooth USB
F09 [18]	DeviceNet™	P09	Bluetooth Modbus
G09 [18]	Profibus	Q09	Bluetooth USB and Modbus
H09	I/O extension card: adds 2 analog output, 4 logic inputs, 2 logic output, and 1 differential analog input		

⑩ Miscellaneous Options

Code	Feature	Code	Feature
A10	Line Reactor nominal 5% impedance	P10 [13]	AFC Trip Reset
B10 [1], [19]	Line Contactor	Q10 [24], [25]	Push-To-Test Pilot Lights
C10 [20]	3–15 psi Transducer	R10 [26], [27]	Auto Transfer to Bypass
D10 [21]	Omit Graphic Display Terminal	S10	Motor Elapsed Time Meter
E10 [22]	Smoke Purge Relay	T10 [10]	Emergency Stop
F10 [28]	Additional Control Power VA	U10 [28]	Motor Space Heater Sequencing
G10	cUL Listing	V10 [28]	Seal Water Solenoid
H10	Seismic Qualified	W10 [29]	Check Valve Sequencing
I10	Permanent Wire Marker Sleeves	X10	I.D. Engraved Nameplate
J10 [23]	0–10 Vdc Auto Speed Reference	Y10 [30]	Harmonic Filter Provisions
K10	Additional N.O. Auxiliary Drive Run Contact	Z10	24 Vdc Power Supply
L10	Additional N.C. Auxiliary Drive Trip Contact	310	Order Engineered (internal use only)
M10 11]	1 N.O. Auxiliary Bypass Run Contact	410	RFI Suppressor
O10 [10], [15]	1 N.O. Auxiliary Auto Mode Contact	610	100 AIC Option for VT 300–450 hp and CT 300–500 hp

Technical Characteristics

M-Flex Controller Ratings

NOTE: The drive reduces the switching frequency automatically in the event of excessive heatsink temperature.

Notes to Tables 4 and 5:

1. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
   "▼" can be "G" or "B". "G" denotes a Type 1 enclosure; "B" denotes a Type 1G enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.
2. Power shown is for the carrier switching frequency shown. For a switching frequency above factory settings, select the next largest size controller. 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 NEC2005 table 430.250. The M-Flex controller nameplate rating conforms to the NEC table, **not** the current value listed in the ATV61 or ATV71 instruction manual.
4. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Table 4: Constant Torque, 460 V (Switching Frequency: 1–75 hp @ 4 kHz; 100–450 hp @ 2 kHz)

Controller Catalog Number [1]	Motor Power [2] 460 V, 60 Hz (hp)	Max. Continuous Output Current (A) [3]	Max. Transient Output Current, 60 s (A)	Power Converter Catalog Number [4]
MFDC•4C_	1	2.1	3.2	ATV71H075N4
MFDD•4C_	2	3.4	5.1	ATV71HU15N4
MFDE•4C_	3	4.8	7.2	ATV71HU22N4
MFDF•4C_	5	7.6	11.4	ATV71HU40N4
MFDG•4C_	7.5	11	16.5	ATV71HU55N4
MFDH•4C_	10	14	21	ATV71HU75N4
MFDJ•4C_	15	21	31.5	ATV71HD11N4
MFDK•4C_	20	27	40.5	ATV71HD15N4
MFDL•4C_	25	34	51	ATV71HD18N4
MFDM•4C_	30	40	60	ATV71HD22N4
MFDN•4C_	40	52	78	ATV71HD30N4
MFDP•4C_	50	65	97.5	ATV71HD37N4
MFDQ•4C_	60	77	115.5	ATV71HD45N4
MFDR•4C_	75	96	144	ATV71HD55N4
MFDS▼4C_	100	124	186	ATV71HD75N4
MFDT▼4C_	125	156	234	ATV71HD90N4
MFDU▼4C_	150	180	270	ATV71HC11N4
MFDW▼4C_	200	240	360	ATV71HC13N4
MFDX▼4C_	250	302	453	ATV71HC16N4
MFDY▼4C_	300	361	541.5	ATV71HC20N4
MFDZ▼4C_	350	414	621	ATV71HC25N4
MFD4▼4C_	400	477	715.5	ATV71HC25N4
MFD5▼4C_	450	515	772.5	ATV71HC28N4

Table 5: Variable Torque, 460 V (Switching Frequency: 1–100 hp @ 8 kHz; 125–500 hp @ 2 kHz)

Controller Catalog Number [1]	Motor Power [2] 460 V, 60 Hz (hp)	Max. Continuous Output Current (A) [3]	Max. Transient Output Current, 60 s (A)	Power Converter Catalog Number [4]
MFDC•4V_	1	2.1	2.3	ATV61H075N4
MFDD•4V_	2	3.4	3.7	ATV61HU15N4
MFDE•4V_	3	4.8	5.3	ATV61HU15N4
MFDF•4V_	5	7.6	8.4	ATV61HU30N4
MFDG•4V_	7.5	11	12.1	ATV61HU40N4
MFDH•4V_	10	14	15.4	ATV61HU55N4
MFDJ•4V_	15	21	23.1	ATV61HU75N4
MFDK•4V_	20	27	29.7	ATV61HD11N4
MFDL•4V_	25	34	37.4	ATV61HD15N4
MFDM•4V_	30	40	44.0	ATV61HD18N4
MFDN•4V_	40	52	57.2	ATV61HD22N4
MFDP•4V_	50	65	71.5	ATV61HD30N4
MFDQ•4V_	60	77	84.7	ATV61HD37N4
MFDR•4V_	75	96	105.6	ATV61HD45N4

Table 5: Variable Torque, 460 V *(continued)*
(Switching Frequency: 1–100 hp @ 8 kHz; 125–500 hp @ 2 kHz)

Controller Catalog Number [1]	Motor Power [2] 460 V, 60 Hz (hp)	Max. Continuous Output Current (A) [3]	Max. Transient Output Current, 60 s (A)	Power Converter Catalog Number [4]
MFDS•4V_	100	124	136.4	ATV61HD55N4
MFDT▼4V_	125	156	172	ATV61HD75N4
MFDU▼4V_	150	180	198	ATV61HC11N4
MFDW▼4V_	200	240	264	ATV61HC13N4
MFDX▼4V_	250	302	332	ATV61HC16N4
MFDY▼4V_	300	361	397	ATV61HC22N4
MFDZ▼4V_	350	414	455	ATV61HC22N4
MFD4▼4V_	400	477	525	ATV61HC25N4
MFD5▼4V_	450	515	567	ATV61HC31N4
MFD6▼4V_	500	590	649	ATV61HC31N4

Table 6: Constant Torque 230 V (Switching Frequency: 4 kHz)

Controller Catalog Number [1]	Motor Power [2] 230 V, 60 Hz (hp)	Max. Continuous Output Current (A) [3]	Max. Transient Output Current, 60 s (A)	Power Converter Catalog Number [4]
MFDC•3C_	1	4.2	6.3	ATV71H075M3
MFDD•3C_	2	6.8	10.2	ATV71HU15M3
MFDE•3C_	3	9.6	14.4	ATV71HU22M3
MFDF•3C_	5	15.2	22.8	ATV71HU40M3
MFDG•3C_	7.5	22	33	ATV71HU55M3
MFDH•3C_	10	28	42	ATV71HU75M3
MFDJ•3C_	15	42	63	ATV71HD11M3X
MFDK•3C_	20	54	81	ATV71HD15M3X
MFDL•3C_	25	68	102	ATV71HD18M3X
MFDM•3C_	30	80	120	ATV71HD22M3X
MFDN•3C_	40	104	156	ATV71HD30M3X

Table 7: Variable Torque 230 V (Switching Frequency: 8 kHz)

Controller Catalog Number [1]	Motor Power [2] 230 V, 60 Hz (hp)	Max. Continuous Output Current (A) [3]	Max. Transient Output Current, 60 s (A)	Power Converter Catalog Number [4]
MFDC•3V_	1	4.2	4.6	ATV61H075M3
MFDD•3V_	2	6.8	7.5	ATV61HU15M3
MFDE•3V_	3	9.6	10.5	ATV61HU15M3
MFDF•3V_	5	15.2	16.7	ATV61HU30M3
MFDG•3V_	7.5	22	24.2	ATV61HU40M3
MFDH•3V_	10	28	30.8	ATV61HU55M3
MFDJ•3V_	15	42	46.2	ATV61HU75M3
MFDK•3V_	20	54	59.4	ATV61HD11M3X
MFDL•3V_	25	68	74.8	ATV61HD15M3X
MFDM•3V_	30	80	88	ATV61HD18M3X
MFDN•3V_	40	104	114.4	ATV61HD22M3X
MFDP•3V_	50	130	143	ATV61HD30M3X

Notes to Tables 6 and 7:

1. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.
2. Power shown is for the carrier switching frequency shown. For a switching frequency above factory settings, select the next largest size controller. 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 NEC2005 table 430.250. The M-Flex controller nameplate rating conforms to the NEC table, **not** the current value listed in the ATV61 or ATV71 instruction manual.
4. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Notes to Tables 8 and 9:

1. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.
2. Power shown is for the carrier switching frequency shown. For a switching frequency above factory settings, select the next largest size controller. 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 table 430.250. The M-Flex controller nameplate rating conforms to the NEC table, **not** the current value listed in the ATV61 or ATV71 instruction manual.
4. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Table 8: Constant Torque 208 V (Switching Frequency: 4 kHz)

Controller Catalog Number [1]	Motor Power [2] 208 V, 60 Hz (hp)	Max. Continuous Output Current (A) [3]	Max. Transient Output Current, 60 s (A)	Power Converter Catalog Number [4]
MFDC•2C_	1	4.6	6.9	ATV71H075M3
MFDD•2C_	2	7.5	11.3	ATV71HU15M3
MFDE•2C_	3	10.6	15.9	ATV71HU22M3
MFDF•2C_	5	16.7	25.1	ATV71HU40M3
MFDG•2C_	7.5	24.2	36.3	ATV71HU55M3
MFDH•2C_	10	30.8	46.2	ATV71HU75M3
MFDJ•2C_	15	46.2	69.3	ATV71HD11M3X
MFDK•2C_	20	59.4	89.1	ATV71HD15M3X
MFDL•2C_	25	74.8	112.2	ATV71HD18M3X
MFDM•2C_	30	88.0	132	ATV71HD22M3X
MFDN•2C_	40	114	171	ATV71HD30M3X

Table 9: Variable Torque 208 V (Switching Frequency: 8 kHz)

Controller Catalog Number [1]	Motor Power [2] 208 V, 60 Hz (hp)	Max. Continuous Output Current (A) [3]	Max. Transient Output Current, 60 s (A)	Power Converter Catalog Number [4]
MFDC•2V_	1	4.6	5.1	ATV61H075M3
MFDD•2V_	2	7.5	8.3	ATV61HU15M3
MFDE•2V_	3	10.6	11.7	ATV61HU15M3
MFDF•2V_	5	16.7	18.4	ATV61HU30M3
MFDG•2V_	7.5	24.2	26.6	ATV61HU40M3
MFDH•2V_	10	30.8	33.9	ATV61HU55M3
MFDJ•2V_	15	46.2	50.8	ATV61HU75M3
MFDK•2V_	20	59.4	65.3	ATV61HD11M3X
MFDL•2V_	25	74.8	82.3	ATV61HD15M3X
MFDM•2V_	30	88	96.8	ATV61HD18M3X
MFDN•2V_	40	114	125.4	ATV61HD22M3X
MFDP•2V_	50	143	157.3	ATV61HD30M3X

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 controller, or the motor full load current (MFLC). The input current and MFLC are printed on the nameplate (see Figure 1 on page 11). The branch circuit feeder protection must be sized according to the NEC.

Line reactors are used to add reactance to the branch circuit, minimize controller input line current, reduce controller nuisance tripping due to transient overvoltage, reduce harmonic distortion, and help improve controller immunity to voltage imbalance. The supplied line reactors have an impedance of 3%. A 5% line reactor is available as Mod A10.

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 10: Short-Circuit Current Ratings

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

Table 11: Input Line Currents for Selection of Branch Circuit Feeders for 1–75 hp, 460 V, CT [1]

Controller Catalog Number [2]	Motor Power 460 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating							
			5,000 A		10,000 A		22,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDC•4C_	1	2.1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
MFDD•4C_	2	3.4	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
MFDE•4C_	3	4.8	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
MFDF•4C_	5	7.6	6.8	6.9	6.8	6.8	6.9	6.9	6.9	6.9
MFDG•4C_	7.5	11	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
MFDH•4C_	10	14	12.5	12.5	12.5	12.4	12.5	12.4	12.5	12.4
MFDJ•4C_	15	21	17.5	17.5	17.5	17.5	17.5	17.5	17.6	17.5
MFDK•4C_	20	27	23.6	23.5	23.6	23.5	23.6	23.5	23.6	23.4
MFDL•4C_	25	34	28.5	28.4	28.4	28.4	28.5	28.4	28.5	28.4
MFDM•4C_	30	40	33.5	33.4	33.4	33.4	33.4	33.4	33.4	33.4
MFDN•4C_	40	52	45.5	45.4	45.4	45.4	45.4	45.3	45.4	45.2
MFDP•4C_	50	65	55.7	55.7	55.8	55.7	55.8	55.7	55.9	55.7
MFDQ•4C_	60	77	67.5	67.5	67.6	67.5	67.6	67.5	67.6	67.4
MFDR•4C_	75	96	82.1	82.1	82.2	82.1	82.2	82.1	82.3	82.1

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 12: Input Line Currents for Selection of Branch Circuit Feeders for 100–450 hp, 460 V, CT [1]

Controller Catalog Number [2]	Motor Power 460 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating			
			65,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDS▼4C_	100	124	111.8	111.7	111.9	111.8
MFDT▼4C_	125	156	131.9	131.7	132.0	131.8
MFDU▼4C_	150	180	161.3	161.1	161.4	161.2
MFDW▼4C_	200	240	192.7	192.6	192.8	192.7
MFDX▼4C_	250	302	233.5	233.5	232.8	233.7
MFDY▼4C_	300	361	288.9	288.7	289.1	288.9
MFDZ▼4C_	350	414	317.2	317.1	317.2	317.1
MFD4▼4C_	400	477	360.6	360.5	360.6	360.5
MFD5▼4C_	450	515	402.7	402.6	403.1	402.8

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "▼" can be "G" or "B". "G" denotes a Type 1 enclosure; "B" denotes a Type 1G enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 13: Input Line Currents for Selection of Branch Circuit Feeders for 1–100 hp, 460 V, VT [1]

Controller Catalog Number [2]	Motor Power 460 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating							
			5,000 A		10,000 A		22,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDC•4V_	1	2.1	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.4
MFDD•4V_	2	3.4	2.9	2.7	2.9	2.7	2.9	2.7	2.9	2.7
MFDE•4V_	3	4.8	4.0	3.8	4.0	3.8	4.0	3.8	4.8	3.8
MFDF•4V_	5	7.6	6.9	6.6	6.9	6.6	6.9	6.6	6.9	6.6
MFDG•4V_	7.5	11	9.2	8.8	9.2	8.8	9.2	8.8	9.2	8.8
MFDH•4V_	10	14	12.5	11.8	12.5	11.8	12.5	11.8	12.5	11.8
MFDJ•4V_	15	21	17.5	16.8	17.5	16.8	17.6	16.8	17.6	16.8
MFDK•4V_	20	27	23.5	22.4	23.5	22.4	23.6	22.4	23.7	22.4
MFDL•4V_	25	34	28.8	27.9	28.9	27.9	29.0	27.9	29.1	27.8
MFDM•4V_	30	40	33.5	33.1	33.6	33.1	33.7	33.1	33.7	33.1
MFDN•4V_	40	52	45.1	44.7	45.2	44.7	45.3	44.7	45.3	44.6
MFDP•4V_	50	65	55.5	54.7	55.5	54.7	55.6	54.7	55.7	54.6
MFDQ•4V_	60	77	67.3	66.8	67.4	66.9	67.4	66.9	67.4	66.8
MFDR•4V_	75	96	82.1	81.4	82.3	81.5	82.4	81.5	82.6	81.4
MFDS•4V_	100	124	111.0	109.8	111.1	109.9	111.2	109.9	111.3	109.8

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 14: Input Line Currents for Selection of Branch Circuit Feeders for 125–500 hp, 460 V, VT [1]

Controller Catalog Number [2]	Motor Power 460 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating			
			65,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDT▼4V_	125	156	134.2	132.5	134.2	132.4
MFDU▼4V_	150	180	160.4	160.4	160.3	160.3
MFDW▼4V_	200	240	192.1	192.1	192.1	192.1
MFDX▼4V_	250	302	231.9	231.9	231.7	231.7
MFDY▼4V_	300	361	309.3	309.3	309.0	309.0
MFDZ▼4V_	350	414	316.7	316.7	317.1	317.1
MFD4▼4V_	400	477	359.2	359.2	358.6	358.6
MFD5▼4V_	450	515	402.2	402.2	401.6	401.6
MFD6▼4V_	500	590	451.1	451.1	450.5	450.5

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "▼" can be "G" or "B". "G" denotes a Type 1 enclosure; "B" denotes a Type 1G enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 15: Input Line Currents for Selection of Branch Circuit Feeders for 230 V, CT [1]

Controller Catalog Number [2]	Motor Power 230 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating							
			5,000 A		10,000 A		22,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDC•3C_	1	4.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
MFDD•3C_	2	6.8	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
MFDE•3C_	3	9.6	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
MFDF•3C_	5	15.2	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
MFDG•3C_	7.5	22	19.5	19.4	19.5	19.4	19.4	19.4	19.5	19.5
MFDH•3C_	10	28	25.6	25.5	25.6	25.5	25.7	25.5	25.8	25.6
MFDJ•3C_	15	42	35.4	35.2	35.4	35.2	35.8	35.5	35.9	35.7
MFDK•3C_	20	54	47.4	47.3	47.4	47.3	47.8	47.6	47.8	47.7
MFDL•3C_	25	68	58.6	58.4	58.6	58.4	58.9	58.8	59.0	58.9
MFDM•3C_	30	80	69.4	69.2	69.4	69.2	69.5	69.4	69.5	69.5
MFDN•3C_	40	104	94.5	94.2	94.5	94.2	94.6	94.6	94.6	94.6

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 16: Input Line Currents for Selection of Branch Circuit Feeders for 230 V, VT [1]

Controller Catalog Number [2]	Motor Power 230 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating							
			5,000 A		10,000 A		22,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDC•3V_	1	4.2	3.2	3.0	3.2	3.0	3.2	3.0	3.2	3.0
MFDD•3V_	2	6.8	6.0	5.6	6.0	5.6	6.0	5.6	6.0	5.6
MFDE•3V_	3	9.6	8.3	8.0	8.3	8.0	8.4	8.0	8.4	8.0
MFDF•3V_	5	15.2	14.3	13.7	14.3	13.8	14.3	13.8	14.3	13.8
MFDG•3V_	7.5	22	19.5	18.4	19.5	18.4	19.5	18.4	19.5	18.4
MFDH•3V_	10	28	25.6	24.4	25.6	24.6	25.8	24.6	25.8	24.6
MFDJ•3V_	15	42	36.4	35.0	36.4	35.0	36.5	35.0	36.6	35.0
MFDK•3V_	20	54	47.4	46.2	47.4	46.4	47.5	46.4	47.6	46.3
MFDL•3V_	25	68	59.6	58.0	59.7	58.0	59.7	58.0	59.7	57.9
MFDM•3V_	30	80	69.7	68.8	69.7	68.9	69.7	68.9	69.7	68.9
MFDN•3V_	40	104	94.2	93.5	94.2	93.6	94.2	93.6	93.9	93.4
MFDP•3V_	50	130	116.4	116.0	116.5	116.0	116.5	116.0	116.2	115.8

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
   "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 17: Input Line Currents for Selection of Branch Circuit Feeders for 208 V, CT [1]

Controller Catalog Number [2]	Motor Power 208 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating							
			5,000 A		10,000 A		22,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDC•2C_	1	4.6	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
MFDD•2C_	2	7.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
MFDE•2C_	3	10.6	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
MFDF•2C_	5	16.7	15.7	15.7	15.7	15.7	15.7	15.6	15.7	15.6
MFDG•2C_	7.5	24.2	21.1	21.1	21.2	21.2	21.2	21.2	21.2	21.2
MFDH•2C_	10	30.8	28.0	28.0	28.1	28.1	28.1	28.1	28.1	28.1
MFDJ•2C_	15	46.2	39.3	39.3	39.4	39.3	39.4	39.3	39.4	39.3
MFDK•2C_	20	59.4	52.5	52.5	52.6	52.5	52.6	52.5	52.6	52.5
MFDL•2C_	25	74.8	65.0	65.0	65.1	65.0	65.1	65.0	65.0	65.0
MFDM•2C_	30	88	76.7	76.7	76.9	76.6	76.9	76.6	76.8	76.6
MFDN•2C_	40	114	104.3	104.3	104.5	104.5	104.5	104.5	104.6	104.5

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
"_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 18: Input Line Currents for Selection of Branch Circuit Feeders for 208 V, VT [1]

Controller Catalog Number [2]	Motor Power 208 V 60 Hz (hp)	Rated Output Current	Short-Circuit Current Rating							
			5,000 A		10,000 A		22,000 A		100,000 A	
			3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option	3% reactor standard	5% reactor option
MFDC•2V_	1	4.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
MFDD•2V_	2	7.5	6.3	6.2	6.3	6.2	6.3	6.2	6.2	6.2
MFDE•2V_	3	10.6	8.5	8.8	8.5	8.8	8.6	8.8	8.7	8.8
MFDF•2V_	5	16.7	15.3	15.1	15.3	15.2	15.3	15.2	15.3	15.2
MFDG•2V_	7.5	24.2	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3
MFDH•2V_	10	30.8	27.1	27.0	27.2	27.1	27.3	27.1	27.3	27.1
MFDJ•2V_	15	46.2	38.7	38.7	38.7	38.7	38.8	38.7	38.8	38.7
MFDK•2V_	20	59.4	50.9	51.4	50.9	51.4	50.9	51.4	51.0	51.3
MFDL•2V_	25	74.8	63.5	64.1	63.5	64.2	63.6	64.2	63.6	64.1
MFDM•2V_	30	88	75.2	76.1	75.2	76.1	75.2	76.1	76.1	76.1
MFDN•2V_	40	114	103.5	102.5	103.5	102.5	103.5	102.5	103.6	103.5
MFDP•2V_	50	143	127.3	127.4	127.3	127.4	127.4	127.5	127.7	127.0

1. Input line currents are based on the source impedance capable of providing the listed amperage levels.
2. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
"_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Specifications

Table 19: Specifications for Controllers

Input voltage	460 V ±10%, 230 V ±10%, 208 V ±10%, three-phase
Displacement power factor	98% through speed range
Input frequency	60 Hz ± 5%
Output voltage	Three-phase output Maximum voltage (RMS) is ~97% of input voltage (RMS), ~95% if option A10 is selected.
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 **CT:** 150% of nominal motor torque for 60 s
Current (transient)	**VT:** 110% of controller rated current for 60 s **CT:** 150% 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 **CT:**4 kHz (2 kHz for 100–450 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 kΩ. Can be used for speed potentiometer, 1–10 kΩ. **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 kΩ.
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 ±0.5 ms
Acceleration and deceleration ramps	0.1 to 999.9 s (definition in 0.1 s increments)
Controller protection	• 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 trip messages in three languages; also refer to the *Programming Manual* on the CD supplied with the power converter. [3]
Temperature	**Storage** for all enclosures: -13 to +149 °F (-25 to +65 °C). **Operation**: +14 to +104 °F (-10 to 40 °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. For **125–500 hp** (460 V) operating between 40 and 50 °C, derate the current 3.3% per °C above 40 °C.
Humidity	95% with no condensation or dripping water, conforming to IEC 60068-2-3.
Altitude	3,300 ft (1000 m) maximum without derating; derating of the current by 1% for each additional 330 ft (100 m), not to exceed 9,900 ft (3000 m)
Enclosure	Type 1: all controllers Type 1G: 125–500 hp VT or 100–450 hp CT @ 460 V only Type 12/12K: all except 125–500 hp VT and 100–450 hp CT @ 460 V
Pollution degree	Type 1, 1G: 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 standards. Manufactured under ISO 9001 standards. Factory modification G10 provides Canadian cUL certification.

1. On 1–75 hp CT and 1–100 hp VT controllers, above 4 kHz CT/8 kHz VT, select the next largest size controller. 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 @ 460 V.
3. Refer to Table 2 for the instruction bulletin number.

Standard Features

Drive Only

Controllers without bypass are available up to 450 hp CT / 500 hp VT @ 460 V; or 40 hp CT / 50 hp VT @ 208/230 V.

The following are standard for controllers without bypass when no options are ordered:

- Circuit breaker disconnect
- UL Listed per UL 508C
- 65,000 or 100,000 A short-circuit current rating
- Heavy duty industrial disconnect handle with lockout/tag-out provisions
- Hand-Off-Auto selector switch and manual speed potentiometer
- Door-mounted graphic display terminal
- Auto start relay (115-volt control)
- One Form C AFC run mode contact
- One Form C AFC trip contact
- Remote trip condition reset in Auto mode with transition of auto start contact
- Manual trip condition reset in Off position of H-O-A selector switch
- Safety interlock/run permissive wired to user terminal block TB1
- Permanent wire markers
- White component mounting plate
- Conduit knockouts on wall mounted enclosures
- Removable conduit entry plates on floor mount enclosures
- ANSI 49 dark gray enclosure
- Class 10 electronic overload protection

With Bypass

Controllers with bypass are available up to 150 hp CT / 200 hp VT @ 460 V; or 40 hp CT / 50 hp VT @ 208/230 V.

The following are standard for controllers with bypass when no options are ordered:

- Circuit breaker disconnect
- UL Listed per UL 508C
- 65,000 or 100,000 A short-circuit current rating
- Heavy duty industrial disconnect handle with lockout/tag-out provisions
- Hand-Off-Auto selector switch and manual speed potentiometer
- Door-mounted graphic display terminal
- Auto start relay (115-volt control)
- One Form C AFC run mode contact
- One Form C AFC trip contact
- Remote trip condition reset in Auto mode with transition of auto start contact
- Manual trip condition reset in Off position of H-O-A selector switch
- Safety interlock/run permissive wired to user terminal block TB1
- Permanent wire markers
- White component mounting plate
- Conduit knockouts on wall mounted enclosures

Continued on next page

- Removable conduit entry plates on floor mount enclosures
- ANSI 49 dark gray enclosure
- Class 20 overload protection with door mounted reset
- AFC-Off-Bypass selector switch
- Test-Normal selector switch
- Isolation and bypass contactors (with mechanical and electrical interlocking)
- Bypass and isolation contactor sequencing for true motor isolation
- Remote automatic bypass operation using Auto Start relay

Factory Modifications

Refer to Tables 20–24 for the list of parts included with each factory modification.

NOTE: Legend plate part numbers beginning with 65170 are not available as a separately-ordered part. Contact your local field sales office.

Power Options

Table 20: Parts List for Bypass Circuit Selector Switches

Selector Switch	Part No.	Description
Test-Normal Selector Switch	ZB5AD2	Two-position selector switch
	ZB5AZ009	Mounting collar
	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”
	ZBZ32	Legend plate holder

Control Options

NOTE: Refer to the notes on pages 12 and 13 for rules governing component selection.

Table 21: Control Options (Required Selection)

Control Option	Description	Parts List
A07	Hand-Off-Auto Selector Switch	ZB5AD3 Three-position selector switch ZB5AZ009 Mounting collar (2) ZBE205 Contact blocks (1 N.C. and 1 N.O.) 65170-166-17 Hand-Off-Auto legend plate ZBZ32 Legend plate holder
	Speed Potentiometer	ATVPOT25K Speed potentiometer assembly
B07	Hand-Off-Auto Selector Switch	ZB5AD3 Three-position selector switch ZB5AZ009 Mounting collar (2) ZBE205 Contact blocks (1 N.C. and 1 N.O.) 65170-166-17 Hand-Off-Auto legend plate ZBZ32 Legend plate holder
	Stop/Start Push Buttons	ZB5AA2 Black push button ZB5AA4 Red push button ZB5AZ101 Mounting collar w/ contact block (1 N.O.) ZB5AZ102 Mounting collar w/ contact block (1 N.C.) 65170-166-31 Start legend plate 65170-166-09 Stop legend plate (2) ZBZ32 Legend plate holders
	Speed Potentiometer	ATVPOT25K Speed potentiometer assembly
C07	Stop/Start Push Buttons	ZB5AA2 Black push button ZB5AA4 Red push button ZB5AZ101 Mounting collar w/ contact block (1 N.O.) ZB5AZ102 Mounting collar w/ contact block (1 N.C.) 65170-166-31 Start legend plate 65170-166-09 Stop legend plate (2) ZBZ32 Legend plate holders
	Speed Potentiometer	ATVPOT25K Speed potentiometer assembly
D07	Stop/Start Push Buttons	ZB5AA2 Black push button ZB5AA4 Red push button ZB5AZ101 Mounting collar w/ contact block (1 N.O.) ZB5AZ102 Mounting collar w/ contact block (1 N.C.) 65170-166-31 Start legend plate 65170-166-09 Stop legend plate (2) ZBZ32 Legend plate holders
	Forward/Reverse Selector Switch	ZB5AD2 Two-position selector switch ZBE203 Contact block (2 N.O.) ZBE204 Contact block (2 N.C.) ZB5AZ009 Mounting collar 65170-166-45 Forward/Reverse legend plate ZBZ32 Legend plate holder
	Speed Potentiometer	ATVPOT25K Speed potentiometer assembly
E07	Hand-Off-Auto Selector Switch	ZB5AD3 Three-position selector switch ZB5AZ009 Mounting collar (2) ZBE205 Contact blocks (1 N.C. and 1 N.O.) 65170-166-17 Hand-Off-Auto legend plate ZBZ32 Legend plate holder
	Local/Remote Selector Switch	ZB5AD2 Two-position selector switch ZB5AZ101 Mounting collar w/ contact block (1 N.O.) 65170-166-80 Local/Remote legend plate ZBZ32 Legend plate holder
	Speed Potentiometer	ATVPOT25K Speed potentiometer assembly
F07	Communication-Auto-Off-Hand Selector Switch	KAXZ1M12 Operator handle 9003K2H0285USX Contact block assembly 65170-170-41 A-O-H legend plate 31164-098-01 Comms label ZBZ32 Legend plate holder
	Speed Potentiometer	ATVPOT25K Speed potentiometer assembly

Light Options

NOTE: Refer to the notes on pages 12 and 13 for rules governing component selection.

Notes for Table 22:

1. For the push-to-test feature, the following pilot light operators are used:
   ZB5AW35 replaces ZB5AV05
   ZB5AW33 replaces ZB5AV03
   ZB5AW36 replaces ZB5AV06
2. For the push-to-test feature, ZB5AW065 (mounting collar w/ light module and 1 N.O. and 1 N.C. contact) replaces ZB5AV6 (mounting collar w/ light module).

Table 22: Light Options (Optional Selection)

Light Option	Description	Parts List
A08 Pilot Light Cluster Option #1	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module 25501-00003 LED 65170-166-24 Power On legend plate ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00005 LED 65170-166-42 AFC Run legend plate ZBZ32 Legend plate holder
	Yellow Trip	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-39 Trip legend plate ZBZ32 Legend plate holder
	Yellow Auto	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-08 Auto legend plate ZBZ32 Legend plate holder
B08 Pilot Light Cluster Option #2	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module 25501-00003 LED 65170-166-24 Power On legend plate ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00005 LED 65170-166-42 AFC Run legend plate ZBZ32 Legend plate holder
	Yellow Trip	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-39 Trip legend plate ZBZ32 Legend plate holder
	Yellow Bypass	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-37 Bypass legend plate ZBZ32 Legend plate holder
C08 Pilot Light Cluster Option # 3	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module 25501-00003 LED 65170-166-24 Power On legend plate ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00005 LED 65170-166-42 AFC Run legend plate ZBZ32 Legend plate holder
	Yellow Trip	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-39 Trip legend plate ZBZ32 Legend plate holder

NOTE: Refer to the notes on pages 12 and 13 for rules governing component selection.

Notes for Table 22:

1. For the push-to-test feature, the following pilot light operators are used:
   ZB5AW35 replaces ZB5AV05
   ZB5AW33 replaces ZB5AV03
   ZB5AW36 replaces ZB5AV06
2. For the push-to-test feature, ZB5AW065 (mounting collar w/ light module and 1 N.O. and 1 N.C. contact) replaces ZB5AV6 (mounting collar w/ light module).

Table 22: Light Options (Optional Selection) *(continued)*

Light Option	Description	Parts List
D08 Pilot Light Cluster Option #4	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module 25501-00003 LED 65170-166-24 Power On legend plate ZBZ32 Legend plate holder
	Yellow Trip	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-39 Trip legend plate ZBZ32 Legend plate holder
	Green AFC Forward	ZB5AV03 Green pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00005 LED 65170-166-15 Forward legend plate ZBZ32 Legend plate holder
	Green AFC Reverse	ZB5AV03 Green pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00005 LED 65170-166-27 Reverse legend plate ZBZ32 Legend plate holder
E08 Pilot Light Cluster Option #5	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module 25501-00003 LED 65170-166-24 Power On legend plate ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00005 LED 65170-166-42 AFC legend plate ZBZ32 Legend plate holder
	Yellow Trip	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-39 Trip legend plate ZBZ32 Legend plate holder
	Blue Hand	ZB5AV06 blue pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00006 LED 65170-166-16 Hand legend plate ZBZ32 Legend plate holder
	Yellow Auto	ZB5AV05 Amber pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00004 LED 65170-166-08 Auto legend plate ZBZ32 Legend plate holder
F08 Pilot Light Cluster Option #6	Red Power On	ZB5AV04 Red pilot light head ZB5AV6 Mounting collar with light module 25501-00003 LED 65170-166-24 Power On legend plate ZBZ32 Legend plate holder
	Green AFC Run	ZB5AV03 Green pilot light head [1] ZB5AV6 Mounting collar with light module [2] 25501-00005 LED 65170-166-42 AFC Run legend plate ZBZ32 Legend plate holder
	Yellow Trip	ZB5AV05 Amber pilot light head ZB5AV6 Mounting collar with light module 25501-00004 LED 65170-166-39 Trip legend plate ZBZ32 Legend plate holder
	Yellow Communication	ZB5AV05 Amber pilot light head ZB5AV6 Mounting collar with light module 25501-00004 LED 65170-170-39 Communication legend plate ZBZ32 Legend plate holder

Option Cards

These cards must be programmed by the customer.

NOTE: Refer to the notes on pages 12 and 13 for rules governing component selection.

Notes for Table 23:

1. PowerSuite™ software is required for configuring the power converter. Options pending availability.

Table 23: Option Cards (Optional Selection)

Card Option	Name	Description	Connector
A09	Modbus Plus	Factory-installed plug-in Modbus Plus card VW3A3302.	Equipped with one 9-pin female SUB-D connector
B09	Modbus/Uni-Telway Serial Communication	Factory-installed plug-in Modbus card VW3A3303.	Equipped with one 9-pin female SUB-D connector
C09	Metasys® N2 Serial Communication	Factory-installed plug-in Metasys N2 card VW3A3318.	Equipped with one 9-pin female SUB-D connector
D09	Ethernet	Factory-installed plug-in Ethernet card VW3A3310D with RJ45 connector port.	Equipped with one RJ45 connector
E09	LonWorks Serial Communication	Factory-installed LonWorks card VW3A3312.	Equipped with one removable 3-way screw connector
F09	DeviceNet	Factory-installed plug-in DeviceNet card VW3A3309 and user terminal block TB5.	Equipped with one removable screw connector
G09	Profibus	Factory-installed Profibus card VW3A3307.	Equipped with one 9-pin female SUB-D connector
H09	I/O Extension Card	Factory-installed I/O extension card VW3A3202. Adds 2 analog output, 4 logic inputs, 2 logic output, and 1 differential analog input.	—
J09	Apogee P1	Factory-installed P1 card VW3A3314.	Equipped with one 9-pin female SUB-D connector
K09	BACnet	Factory-installed BACnet card VW3A3319.	Equipped with one 9-pin female SUB-D connector
L09	Interbus	Factory-installed Interbus card VW3A3304.	Equipped with one 9-pin male SUB-D connector and one 9-pin female SUB-D connector
M09	Fipio	Factory-installed Fipio card VW3A3311.	Equipped with one 9-pin male SUB-D connector
O09 [1]	Bluetooth USB	Factory-supplied Bluetooth USB device VW3A8115.	—
P09 [1]	Bluetooth Modbus	Factory-supplied Bluetooth Modbus adapter VW3A8114.	—
Q09 [1]	Bluetooth USB and Modbus	Factory-supplied Bluetooth USB device VW3A8115 and Modbus adapter VW3A8114.	—

Miscellaneous Options

NOTE: Refer to the notes on pages 12 and 13 for rules governing component selection.

Notes for Table 24:

1. One N.O. and one N.C. Form C Drive Run contact is provided as standard on the user terminal block.
2. One N.O. and one N.C. Form C Drive Trip contact is provided as standard on the user terminal block.
3. If the motor space heater (U10) and seal water solenoid (V10) are both required, additional control power VA (F10) is also supplied.
4. See pages 64–67 to locate terminal blocks TB1 and TB2.

Table 24: Miscellaneous Options (Optional Selection)

Misc. Option	Name	Description
A10	5% Line Reactor	Optional, 5% impedance, factory-mounted line reactor within the enclosure.
B10	Line Contactor	A line contactor is added between the circuit breaker and the controller when bypass is also selected.
C10	3–15 psi Transducer	Allows the controller to follow a user-supplied 3–15 psi input.
D10	Omit Door-Mounted Graphic Display Terminal	The graphic display terminal is not supplied. The user must buy a graphic display terminal as a separate device to program the controller.
E10	Smoke Purge Relay	Provides a smoke purge operating mode controlled by a user-supplied 120 Vac signal wired to terminal block TB1 [4], terminals 48 and 49.
F10 [3]	Additional Control Power VA	Provides a 50 VA larger control transformer for use with 120 Vac connected to terminal block TB1 [4], terminals 1 to 50.
G10	cUL Listing	Provides Canadian cUL certification when required by local code requirements.
H10	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.
I10	Permanent Wire Marker Sleeves	Provides permanent wire-sleeve markers.
J10	0–10 Vdc Auto Speed Reference	Provides for a 0–10 Vdc user-supplied auto-speed reference signal to the AI2 input.
K10	Additional N.O. Aux. Drive Run Contact [1]	Adds 1 N.O. controller run contact on terminal block TB1 [4], terminals 57 and 58.
L10	Additional N.C. Aux. Drive Trip Contact [2]	Adds 1 N.C. controller trip contact on terminal block TB1 [4], terminals 59 and 60.
M10	1 N.O. Aux. Bypass Run Contact	Provides 1 N.O. bypass run contact on terminal block TB1 [4], terminals 61 and 62.
O10	1 N.O. Aux. Auto Mode Contact	Provides 1 N.O. auto mode contact on terminal block TB1 [4], terminals 63 and 64.
P10	AFC Trip Reset	Factory-installed door mounted push button to reset the controller trip when hand-off-auto is not used.
Q10	Push-To-Test Pilot Lights	Provides push-to-test function on all pilot lights except Power On.
R10	Auto Transfer to Bypass	Provides an automatic transfer to the bypass in the event that the controller trips. A selector switch is provided to enable or disable this function.
S10	Motor Elapsed Time Meter	Provides elapsed time meter to record the motor run time. Runs whenever the motor is running.
T10	Emergency Stop	Provides door mounted maintained off emergency stop red mushroom push button with turn-to-reset feature.
U10 [3]	Motor Space Heater Sequencing	Provides 50 VA/120 V to terminal block TB1 [4], terminals 45 to 50, for motor space heater whenever the motor is not running.
V10 [3]	Seal Water Solenoid	Provides 50 VA/120 V to terminal block TB1 [4], terminals 43 to 50, whenever the motor is running.
W10	Check Valve Sequencing	Provides an automatic shutdown of the controller when the user supplied N.C. contact from the check valve limit switch does not open within 5 s after the motor starts. The user limit switch contact connects to terminal block TB1 [4], terminals 46 and 47.
X10	I.D. Engraved Nameplates	Provides an engraved lamacoid nameplate attached to the front door of the enclosure (engraved per user request at time of order).
Y10	Harmonic Filter Provisions	Provides fused output terminals with return terminals for connection of an externally mounted harmonic filter. Class J fuses are provided.
Z10	24 Vdc Power Supply	Provides 24 Vdc, 300 mA power supply at terminal block TB2 [4], terminals 0 (+) to N (–).
310	Order Engineered (Internal Use Only)	Order Engineered. For internal use only.

Table 24: Miscellaneous Options (Optional Selection) *(continued)*

Misc. Option	Name	Description
410	RFI Suppressor	Provides radio frequency interference suppression with ferrites on the power leads to the controller input.
610	100 kAIC	Increase the AIC rating from 65 kA to 100 kA for VT 300–450 hp and CT 300–500 hp

Total Dissipated Watts Loss

The total dissipated watts loss in Tables 25–27 is provided for sizing the environment HVAC cooling requirements based upon worst-case operating conditions for Type 1 and Type 12/12K enclosures.

Table 25: Maximum Total Dissipated Watts Loss, 460 V

Controller Catalog No. [1]	Constant Torque		Variable Torque	
	hp	Total Dissipated Watts Loss	hp	Total Dissipated Watts Loss
MFDC•4◊ _	1	307	1	285
MFDD•4◊_	2	337	2	317
MFDE•4◊_	3	367	3	345
MFDF•4◊_	5	450	5	420
MFDG•4◊_	7.5	546	7.5	510
MFDH•4◊_	10	541	10	498
MFDJ•4◊_	15	708	15	606
MFDK•4◊_	20	827	20	743
MFDL•4◊_	25	960	25	872
MFDM•4◊_	30	1187	30	955
MFDN•4◊_	40	1529	40	1232
MFDP•4◊_	50	1751	50	1562
MFDQ•4◊_	60	2048	60	1841
MFDR•4◊_	75	2230	75	2022
MFDS•4◊_	100	2434	100	2375
MFDT▼4◊_	125	3029	125	3026
MFDU▼4◊_	150	3056	150	3103
MFDW▼4◊_	200	3745	200	3756
MFDX▼4◊_	250	5081	250	5107
MFDY▼4◊_	300	5554	300	5560
MFDZ▼4◊_	350	7005	350	7006
MFD4▼4◊_	400	8103	400	8103
MFD5▼4◊_	450	8248	450	8251
MFD6▼4◊_	—	—	500	8628

Note for Table 25:

1. "•" can be "A", or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure.
"▼" can be "G" or "B". "G" denotes a Type 1 enclosure; "B" denotes a Type 1G enclosure.
"◊" can be "C" or "V". "C" denotes a constant torque controller; "V" denotes a variable torque controller. "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Table 26: Maximum Total Dissipated Watts Loss, 230 V

Controller Catalog No. [1]	Constant Torque		Variable Torque	
	hp	Total Dissipated Watts Loss	hp	Total Dissipated Watts Loss
MFDC•3◊_	1	338	1	305
MFDD•3◊_	2	386	2	351
MFDE•3◊_	3	424	3	403
MFDF•3◊_	5	503	5	466
MFDG•3◊_	7.5	627	7.5	525
MFDH•3◊_	10	742	10	671
MFDJ•3◊_	15	1026	15	821
MFDK•3◊_	20	1113	20	1053
MFDL•3◊_	25	1346	25	1186
MFDM•3◊_	30	1388	30	1307
MFDN•3◊_	40	1784	40	1500
MFDP•3◊_	—	—	50	1899

Table 27: Maximum Total Dissipated Watts Loss, 208 V

Controller Catalog No. [1]	Constant Torque		Variable Torque	
	hp	Total Dissipated Watts Loss	hp	Total Dissipated Watts Loss
MFDC•2◊_	1	342	1	309
MFDD•2◊_	2	388	2	353
MFDE•2◊_	3	429	3	408
MFDF•2◊_	5	511	5	473
MFDG•2◊_	7.5	640	7.5	538
MFDH•2◊_	10	761	10	690
MFDJ•2◊_	15	1052	15	847
MFDK•2◊_	20	1144	20	1085
MFDL•2◊_	25	1397	25	1230
MFDM•2◊_	30	1424	30	1344
MFDN•2◊_	40	1849	40	1566
MFDP•2◊_	—	—	50	1930

Note for Tables 26 and 27:

1. "•" can be "A" or "G". "A" denotes a Type 12/12K enclosure; "G" denotes a Type 1 enclosure. "◊" can be "C" or "V". "C" denotes a constant torque controller; "V" denotes a variable torque controller. "_" indicates that the catalog number continues. See pages 12 and 13 for a detailed description of catalog numbers.

Mounting Dimensions

Dimensions provided are for devices with or without bypass, unless otherwise specified.

Figure 2: Size C Enclosure: 1–5 hp CT/VT Controllers @ 208/230 V; 1–20 hp CT and 1–25 hp VT Controllers @ 460 V (Drawing 80471-215-00)

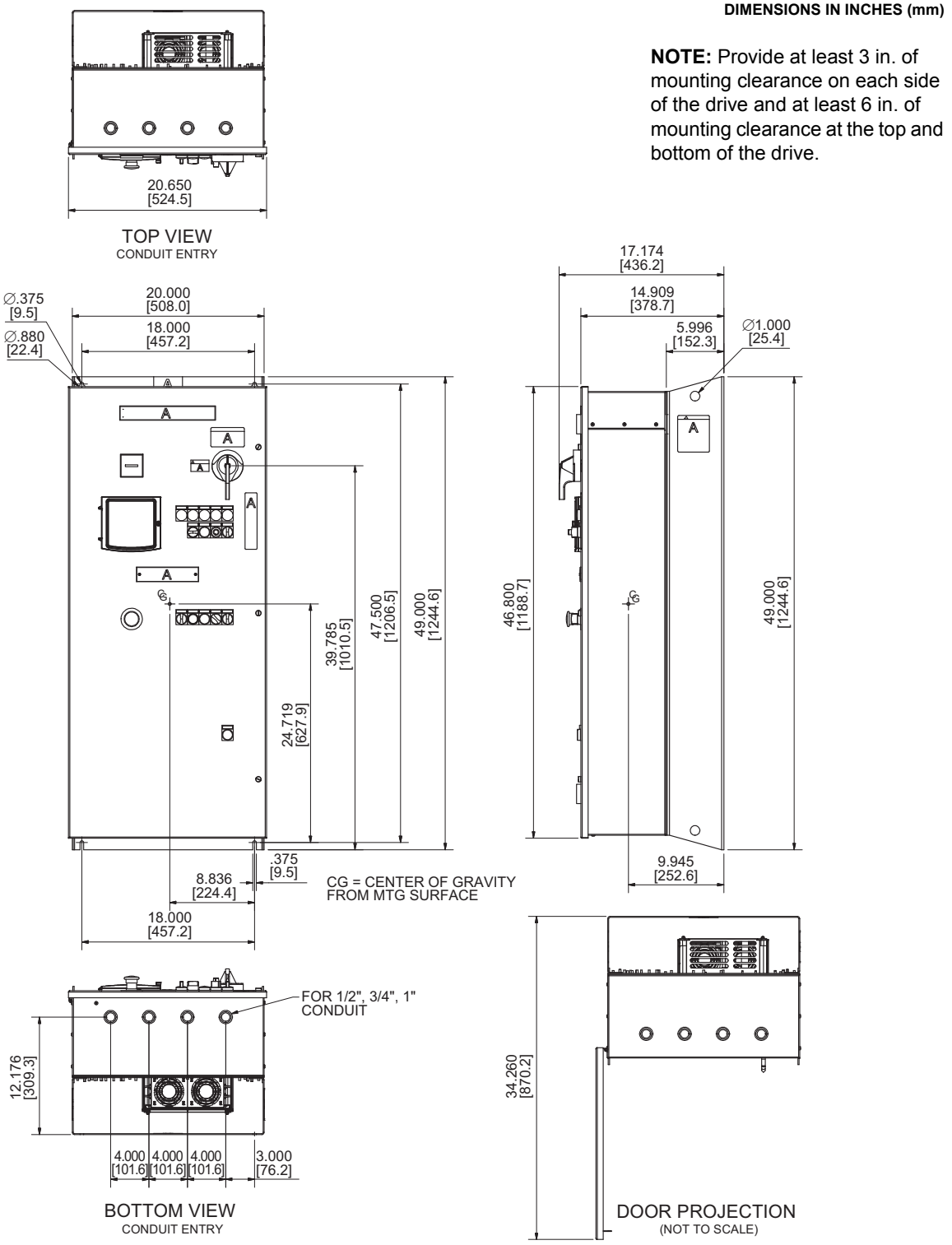


Figure 3: Size D Enclosure: 7.5–10 hp CT/VT Controllers @ 208/230 V (Drawing 80471-215-00)

DIMENSIONS IN INCHES (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.

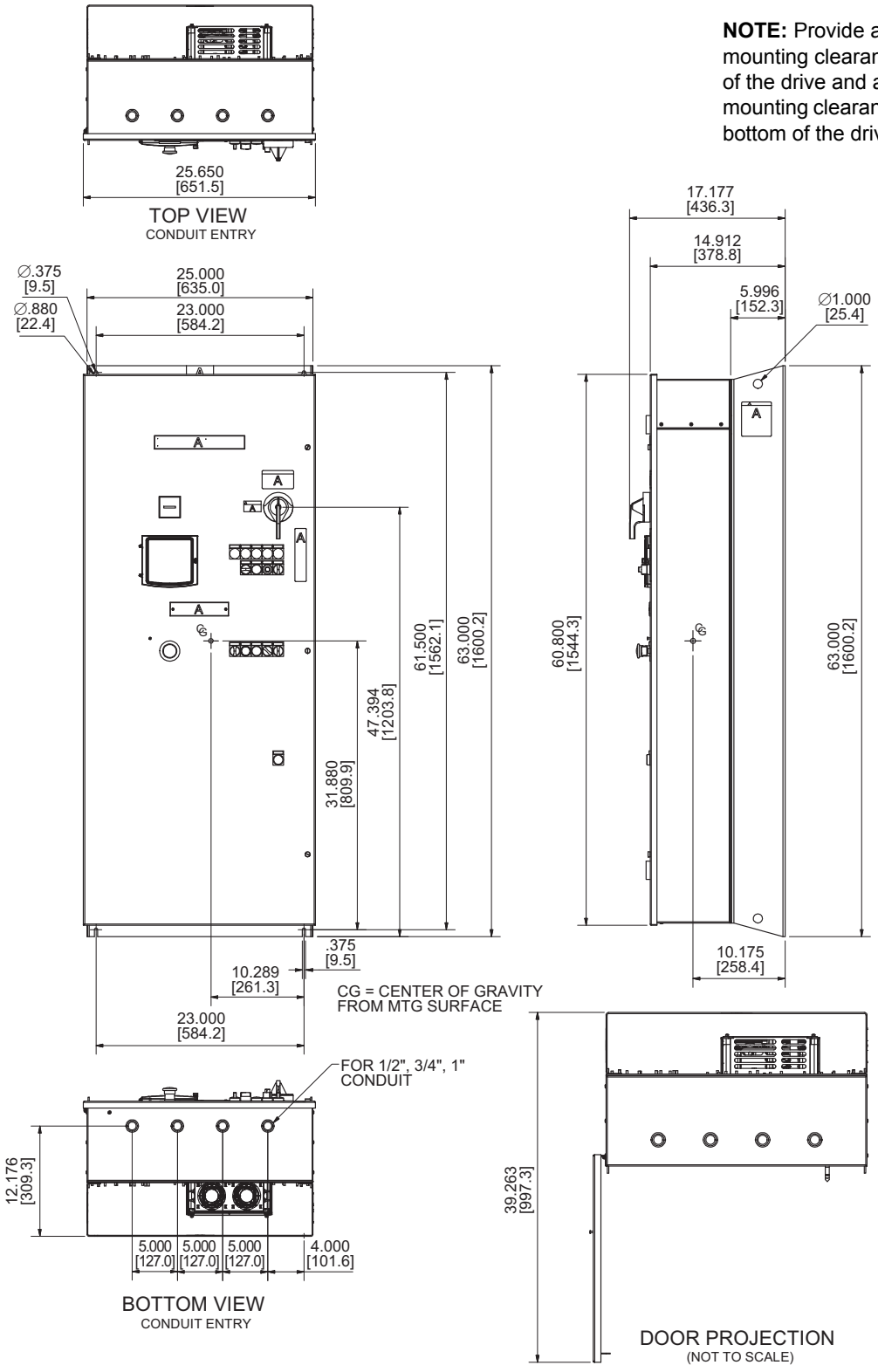
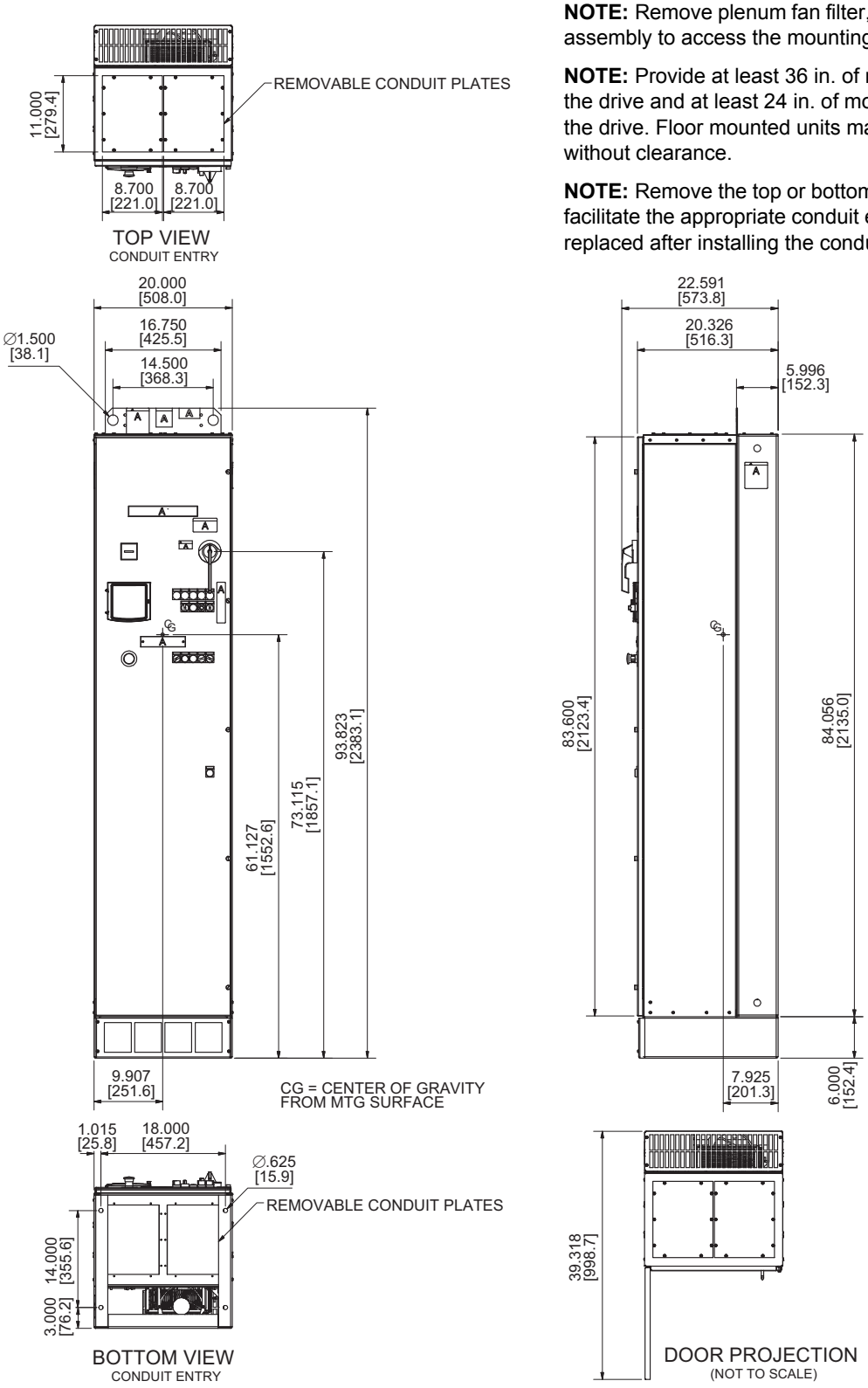


Figure 4: Size E Enclosure: 15–20 hp CT and 15–25 hp VT Controllers @ 208/230 V; 25–40 hp CT and 30–50 hp VT Controllers @ 460 V (Drawing 80471-216-00)

DIMENSIONS IN INCHES (mm)

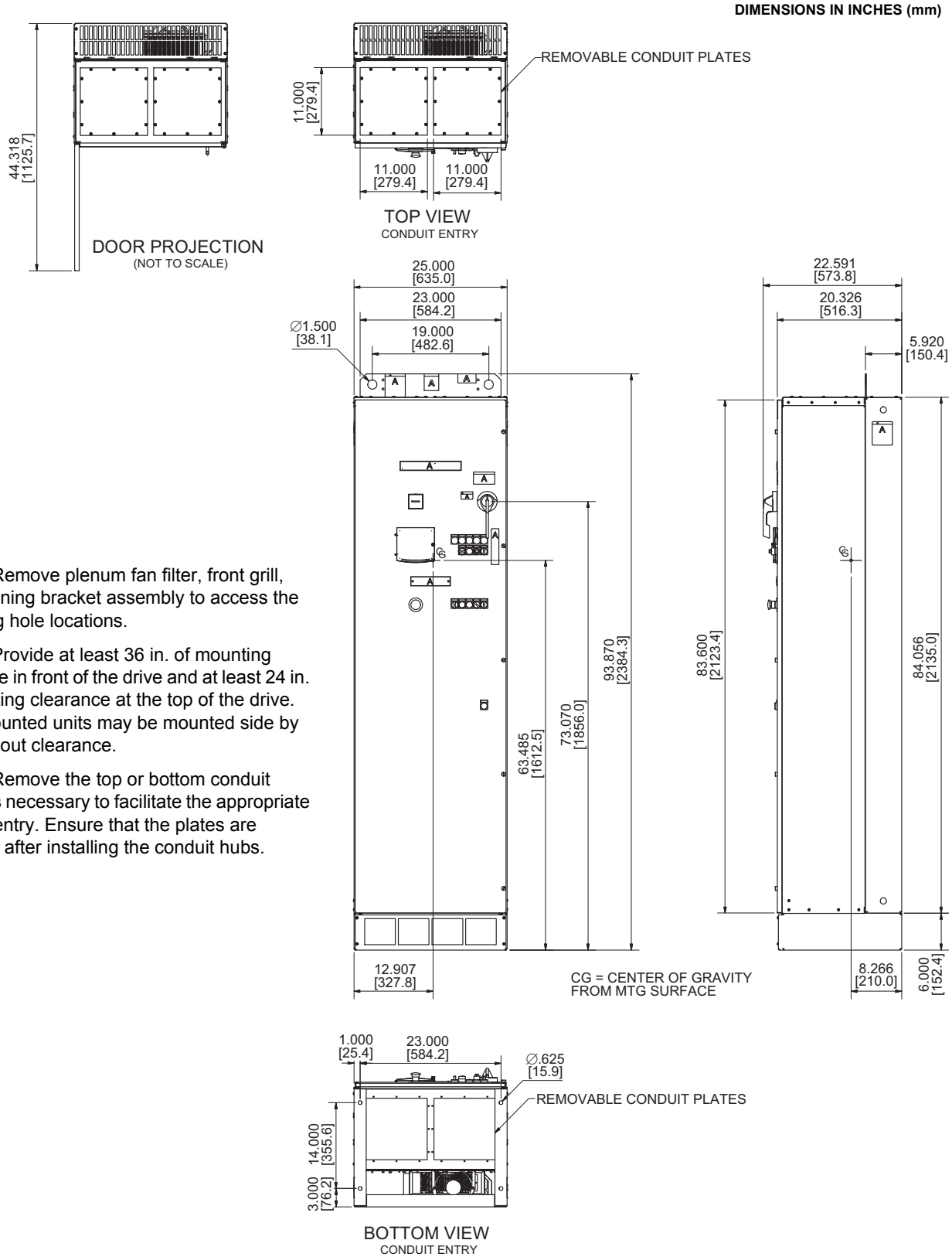


NOTE: Remove plenum fan filter, front grill, and retaining bracket assembly to access the mounting hole locations.

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

Figure 5: Size F Enclosure: 25–40 hp CT and 30–50 hp VT Controllers @ 208/230 V; 50–75 hp CT and 60–100 hp VT Controllers @ 460 V (Drawing 80471-219-00)



NOTE: Remove plenum fan filter, front grill, and retaining bracket assembly to access the mounting hole locations.

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

Figure 6: Size C/D Barriered Enclosure: 1–10 hp CT/VT Controllers @ 208/230 V; 1–20 hp CT and 1–25 hp VT Controllers @ 460 V (Drawing 80471-217-00)

NOTE: Remove plenum fan filter, front grill, and retaining bracket assembly to access the mounting hole locations.

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

DIMENSIONS IN INCHES (mm)

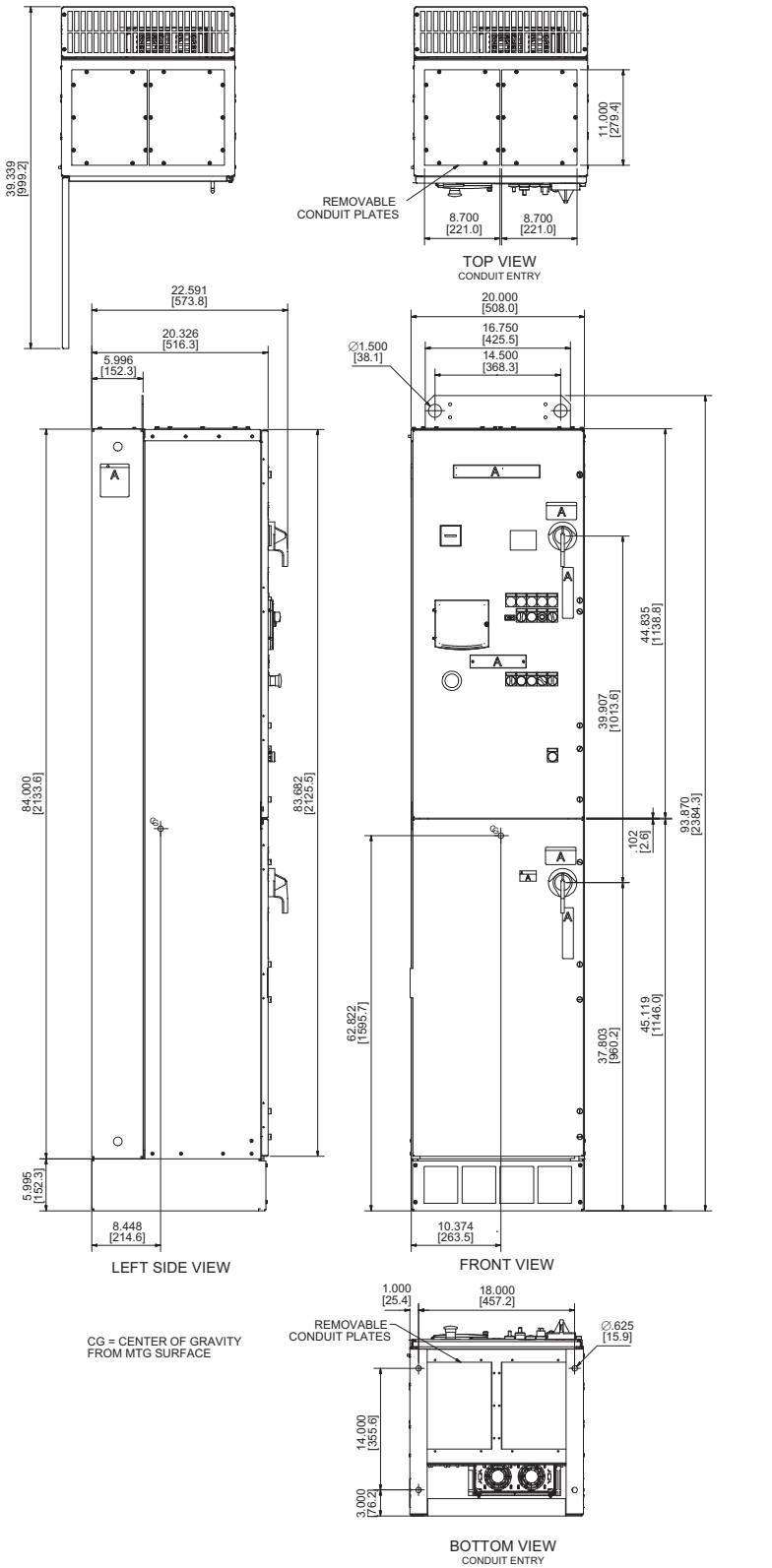


Figure 7: Size E Barriered Enclosure: 15–20 hp CT and 15–25 hp VT Controllers @ 208/230 V; 25–40 hp CT and 30–50 hp VT Controllers @ 460 V (Drawing 80471-217-00)

DIMENSIONS IN INCHES (mm)

NOTE: Remove plenum fan filter, front grill, and retaining bracket assembly to access the mounting hole locations.

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

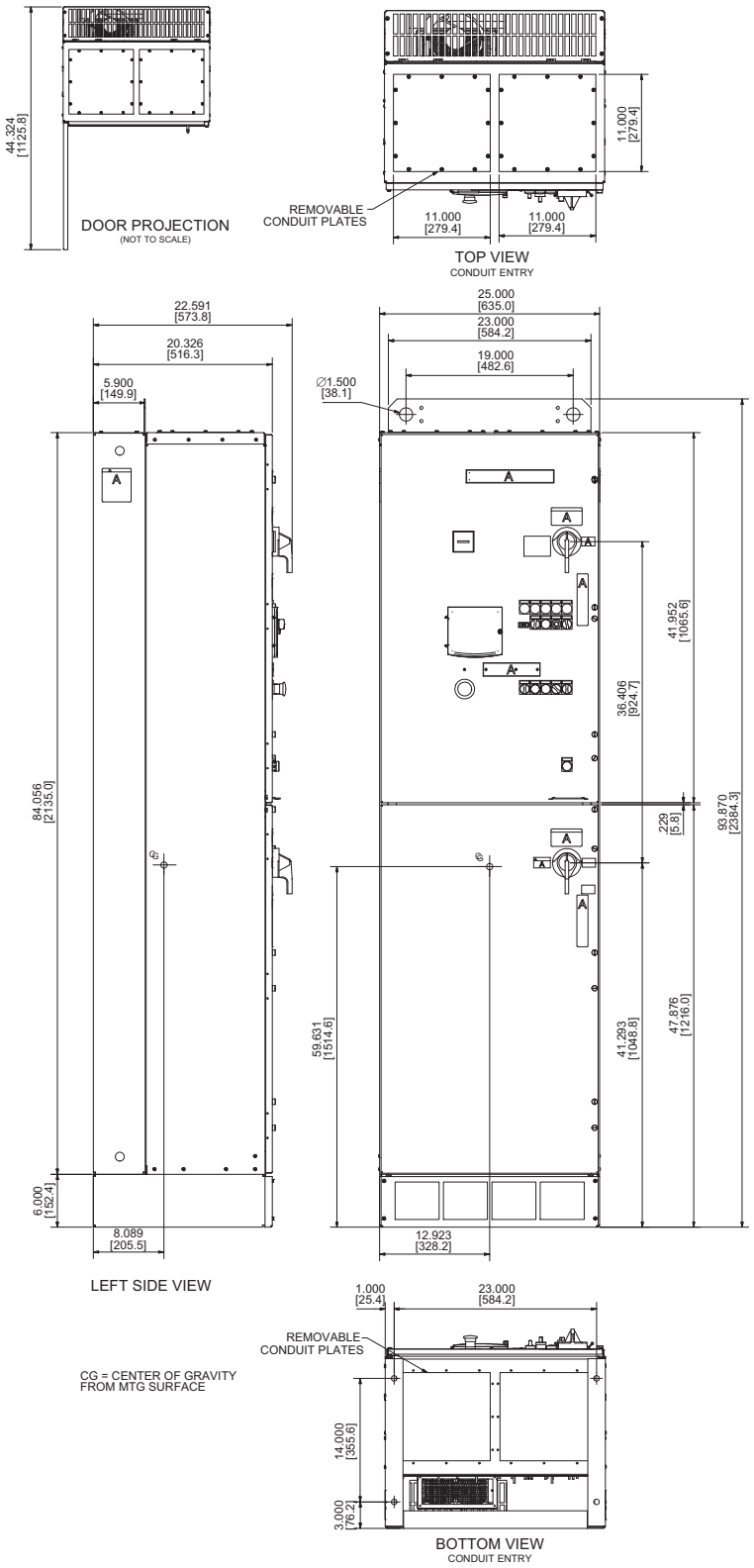


Figure 8: Size F Barriered Enclosure: 25–40 hp CT and 30–50 hp VT Controllers @ 208/230 V; 50–75 hp CT and 60–100 hp VT Controllers @ 460 V (Drawing 80471-218-00)

DIMENSIONS IN INCHES (mm)

NOTE: Remove plenum fan filter, front grill, and retaining bracket assembly to access the mounting hole locations.

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

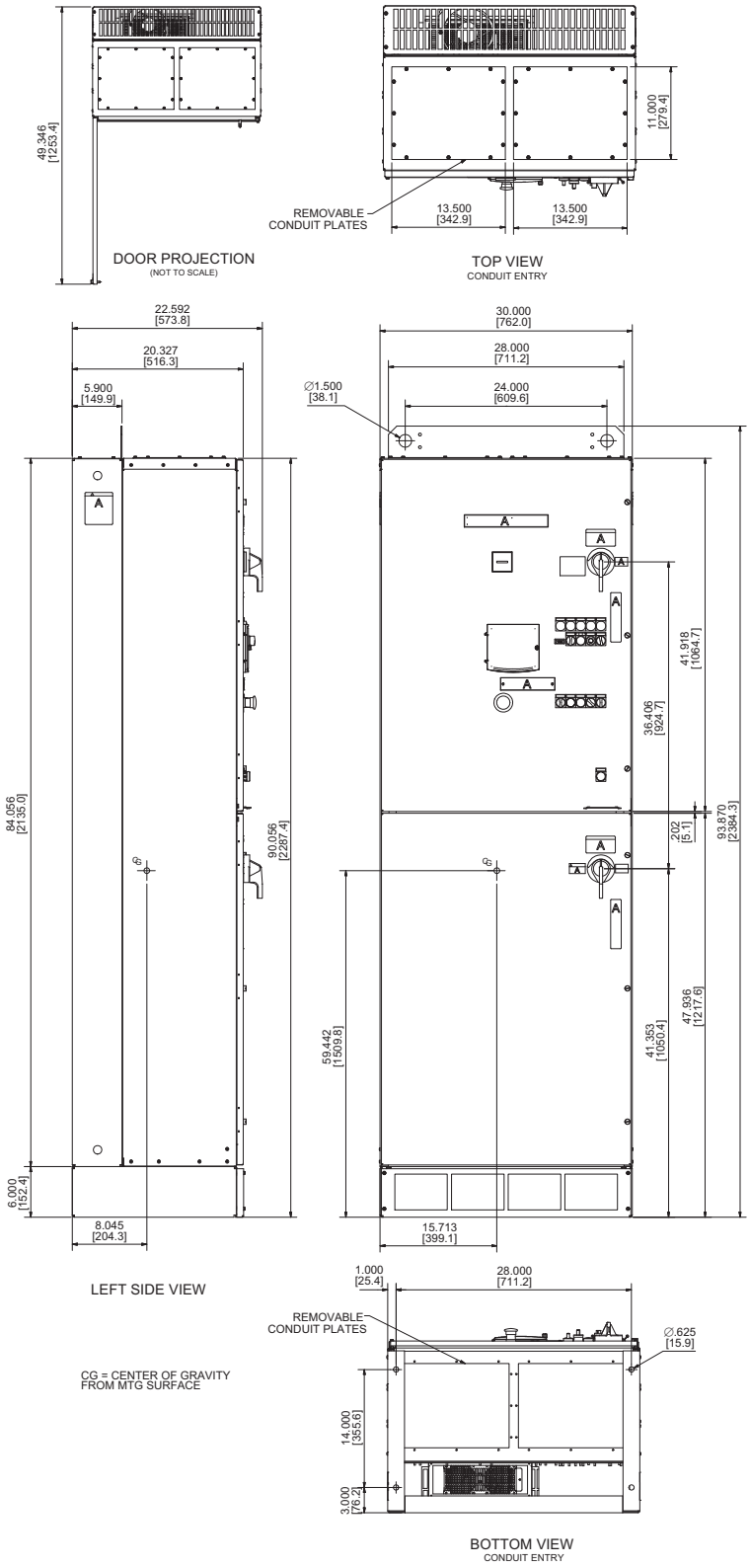


Figure 9: Size H Enclosure: 100 hp CT and 125 hp VT Controllers @ 460 V with Drive Only (Drawing 80444-870-00)

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

DIMENSIONS IN INCHES (mm)

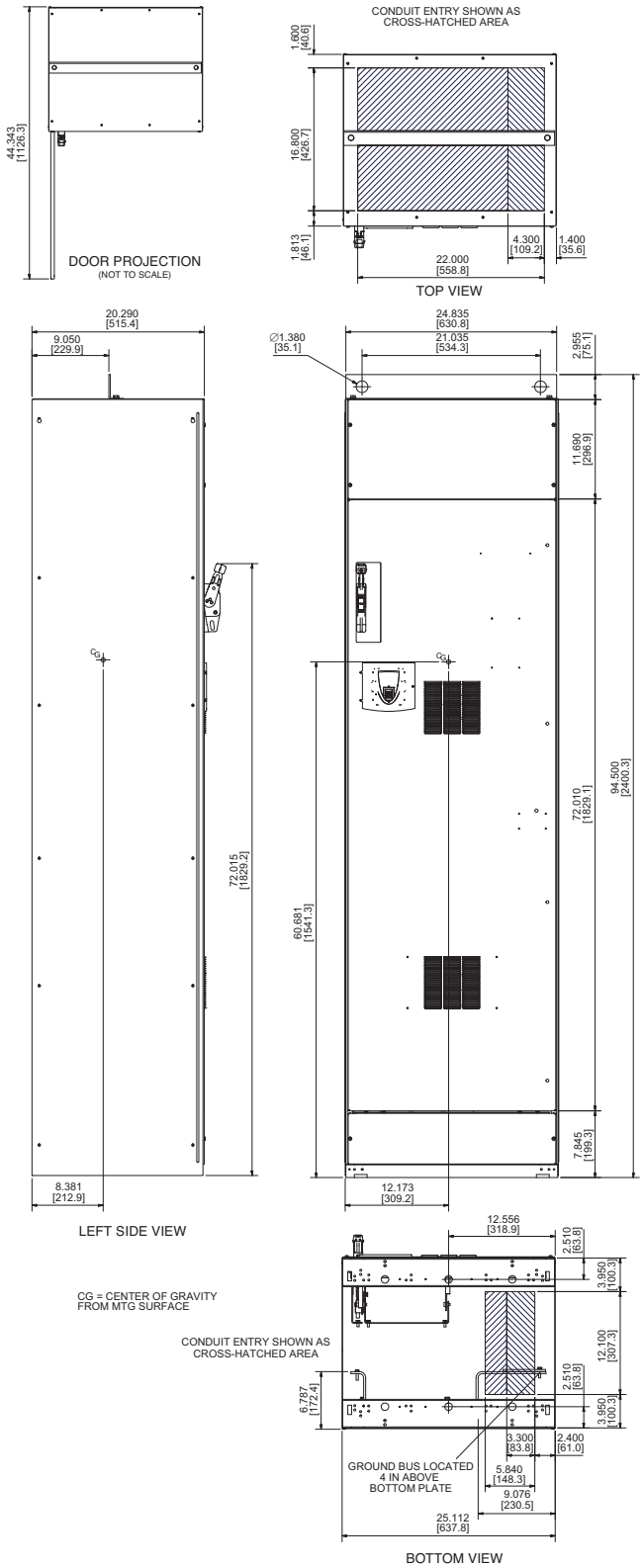


Figure 10: Size I Enclosure: 125–200 hp CT and 150–250 hp VT Controllers @ 460 V with Drive Only (Drawing 80444-871-00)

DIMENSIONS IN INCHES (mm)

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

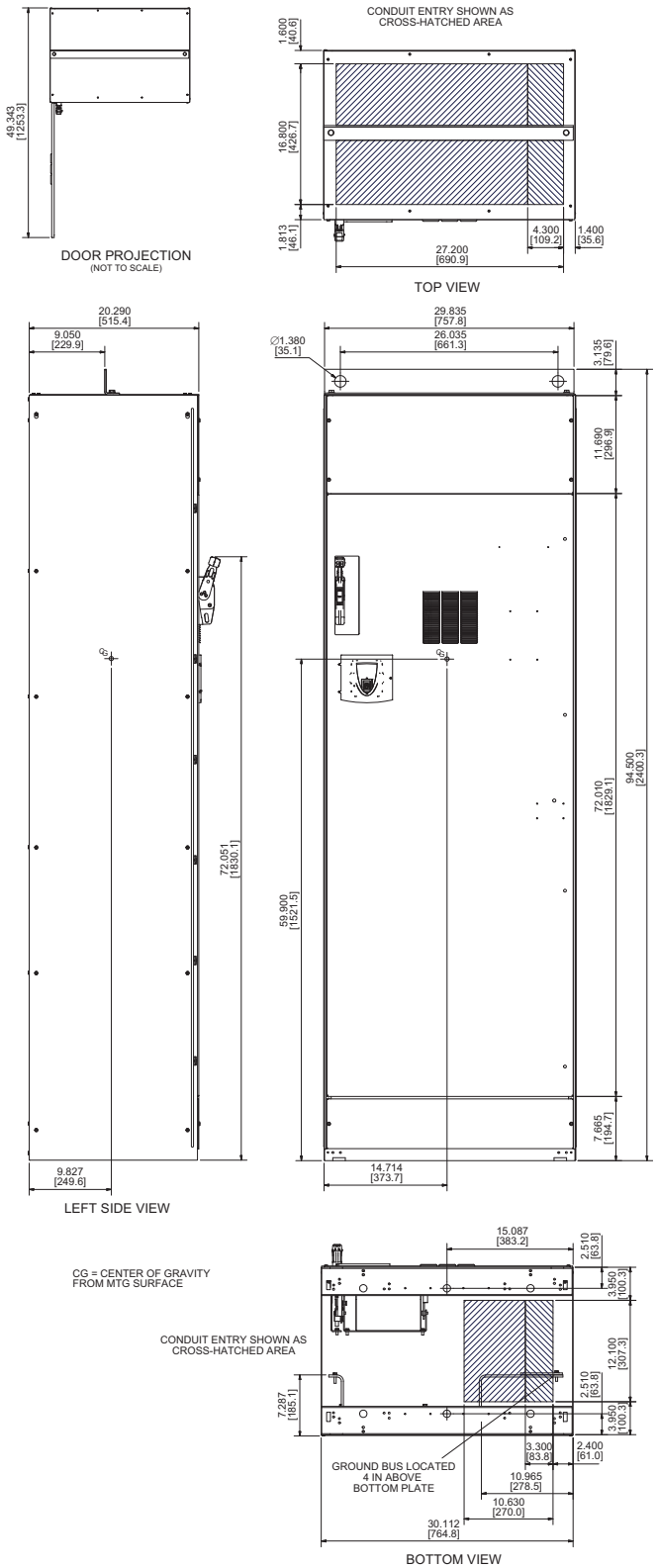


Figure 11: Size J Enclosure: 250–450 hp CT and 300–500 hp VT Controllers @ 460 V with Drive Only (Drawing 80444-872-00)

DIMENSIONS IN INCHES (mm)

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

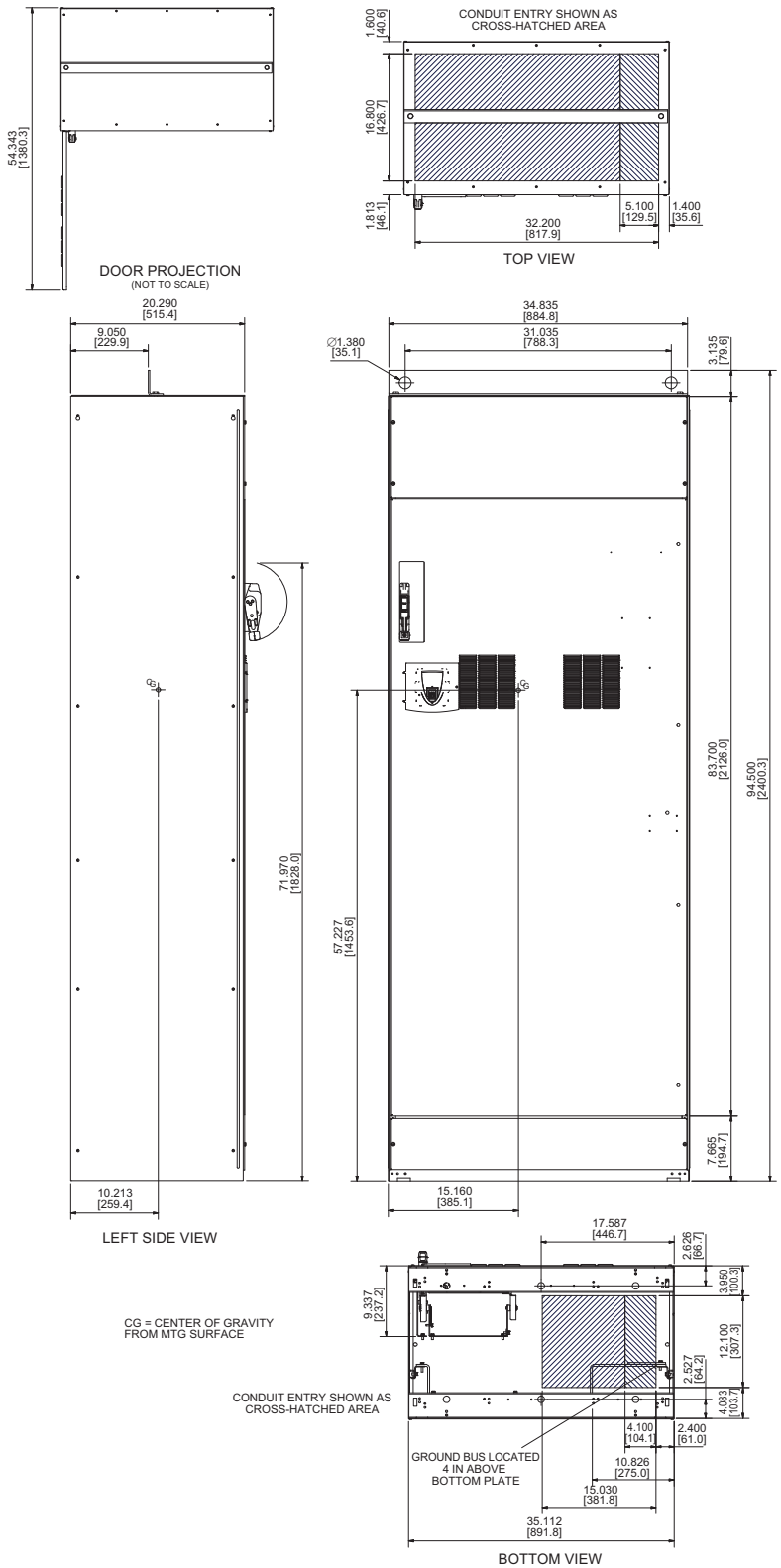


Figure 12: Size H Integrated Enclosure: 100 hp CT and 125 hp VT Controllers @ 460 V with Integrated Bypass Option (Drawing 80444-870-00)

DIMENSIONS IN INCHES (mm)

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

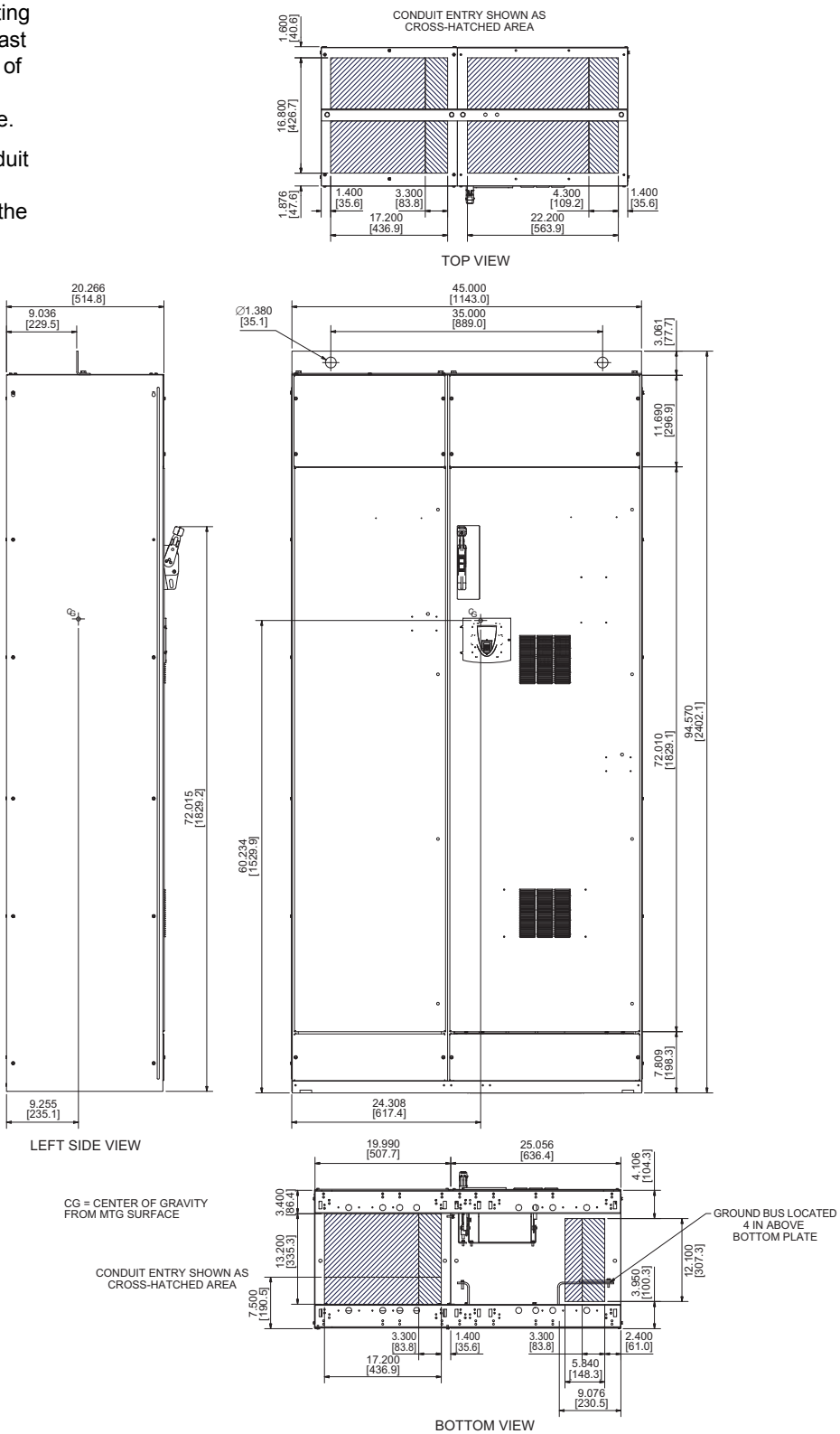


Figure 13: Size I Integrated Enclosure: 125–200 hp CT and 150–250 hp VT Controllers @ 460 V with Integrated Bypass Option (Drawing 80444-871-00)

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

DIMENSIONS IN INCHES (mm)

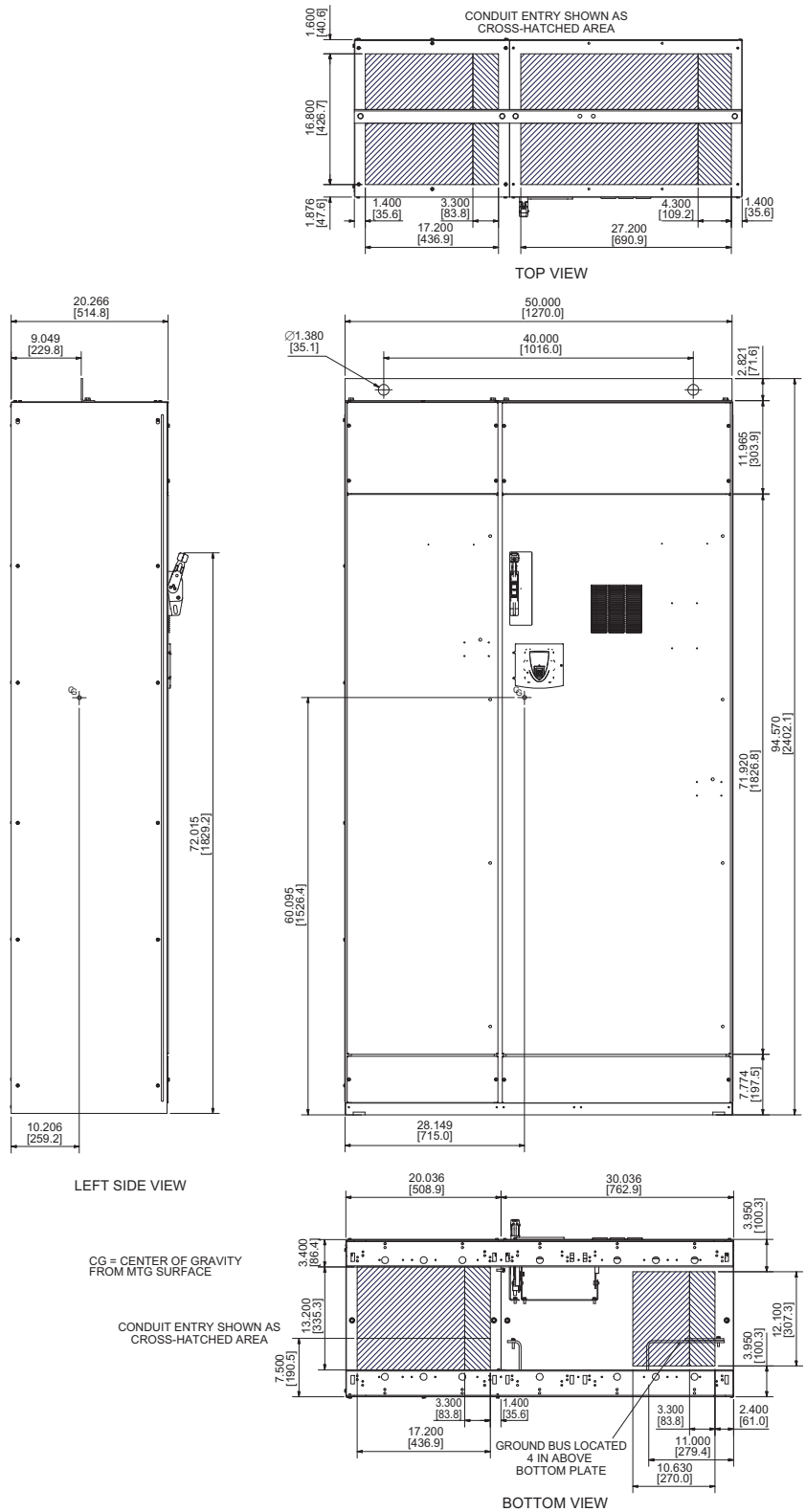


Figure 14: Size H Barriered Enclosure: 100 hp CT and 125 hp VT Controllers @ 460 V with Barriered Bypass Option (Drawing 80444-870-00)

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

DIMENSIONS IN INCHES (mm)

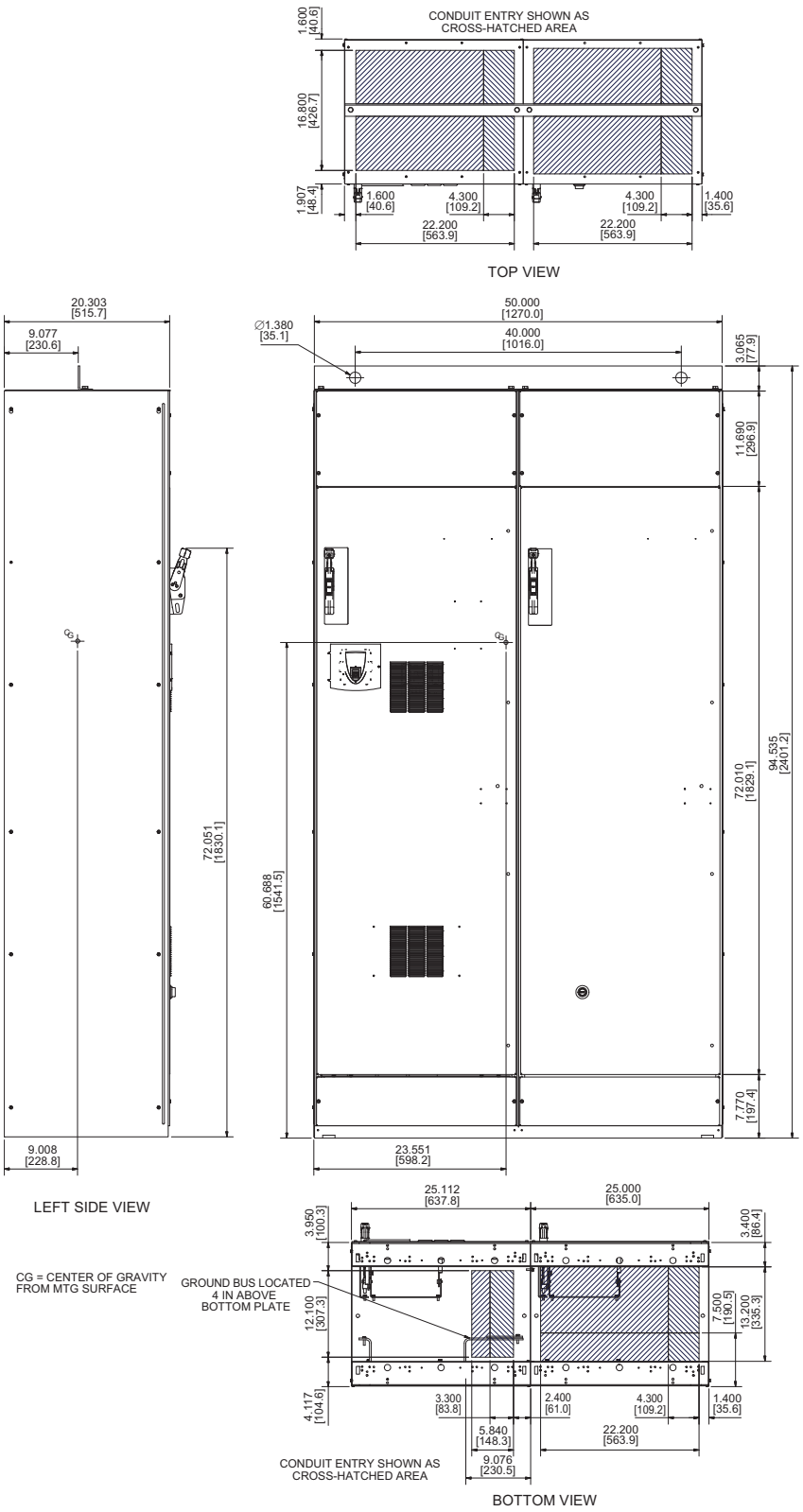


Figure 15: Size I Barriered Enclosure: 125–150 hp CT and 150–200 hp VT Controllers @ 460 V with Barriered Bypass Option (Drawing 80444-871-00)

DIMENSIONS IN INCHES (mm)

NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

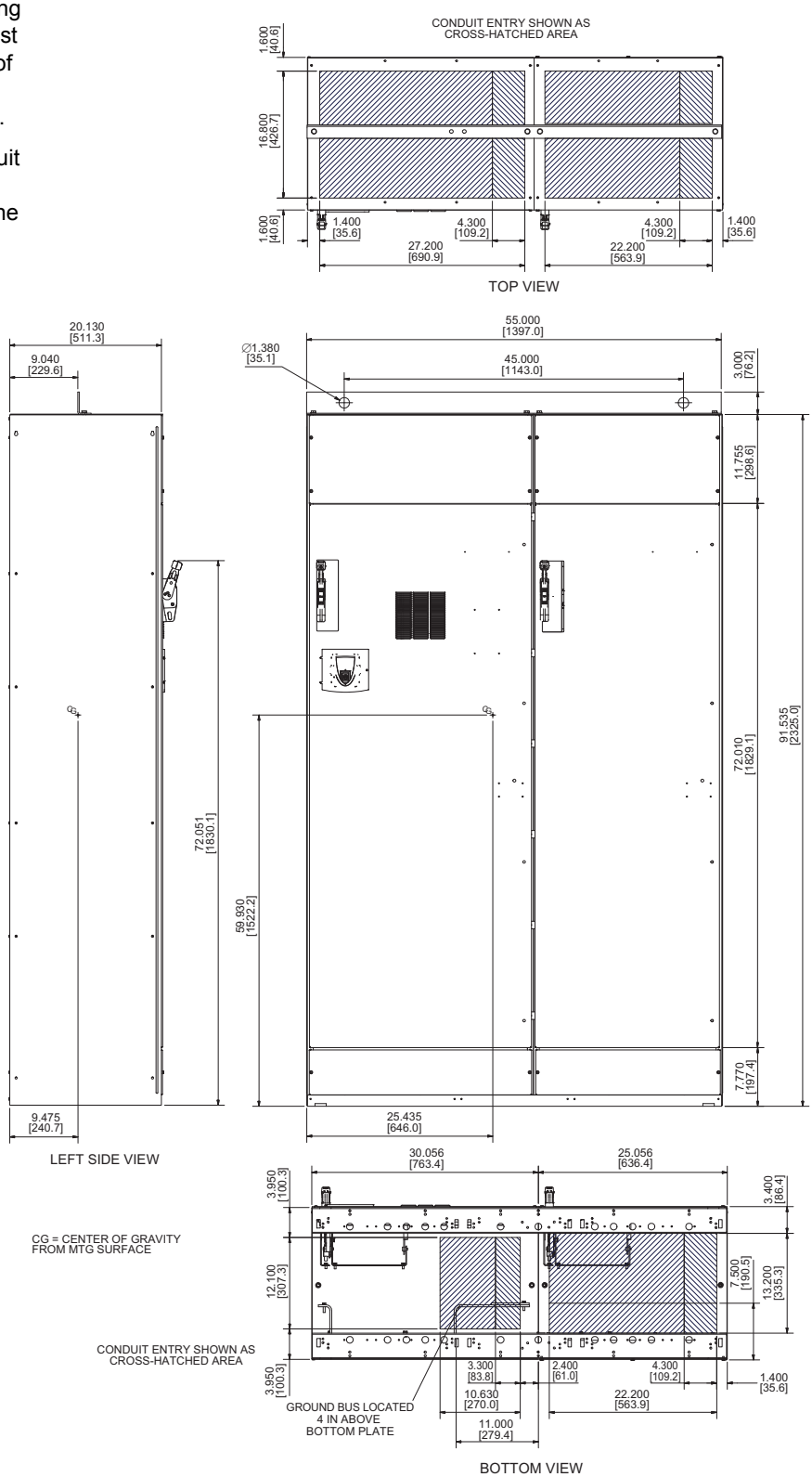


Figure 16: 125–200 hp VT and 100–150 hp CT Controllers @ 460 V with Integrated or Barriered Bypass (Conduit Views)

hp	**460 V**	**CT**	100	125–150	100	125–150
		VT	125	150–200	125	150–200
Weight		**lb**	1025	1175	1150	1300
		kg	464.9	532.9	521.6	589.6
Enclosure Dimensions	**C**	**in.**	5.84	10.63	5.84	10.63
		mm	148.3	270.0	148.3	270.0
	D	**in.**	25	30	25	30
		mm	635	762	635	762
	E	**in.**	22.2	27.2	22.2	27.2
		mm	563.8	690.8	563.8	690.8
	F	**in.**	22.5	25.0	25.0	27.5
		mm	571.5	635	635	698.5
	G	**in.**	12.5	15.0	12.5	12.5
		mm	317.5	381.0	317.5	317.5
Enclosure Size			integrated		barriered	
			H	I	H	I

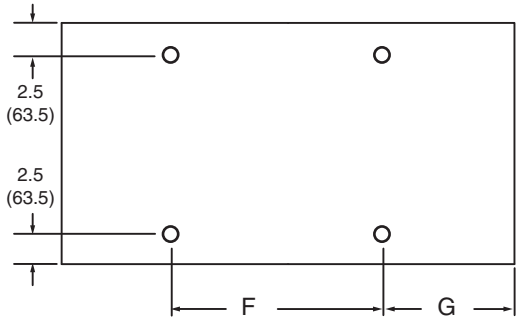
NOTE: Provide at least 36 in. of mounting clearance in front of the drive and at least 24 in. of mounting clearance at the top of the drive. Floor mounted units may be mounted side by side without clearance.

NOTE: Remove the top or bottom conduit plates as necessary to facilitate the appropriate conduit entry. Ensure that the plates are replaced after installing the conduit hubs.

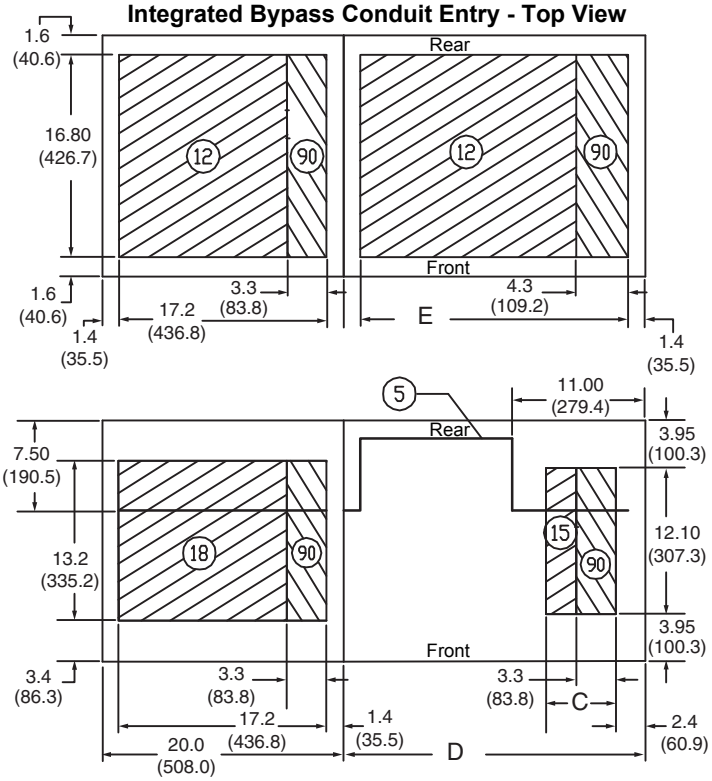
Dimensions: in. (mm)

NOTE: Circled numbers indicate depth in inches.

Anchor Mounting Holes

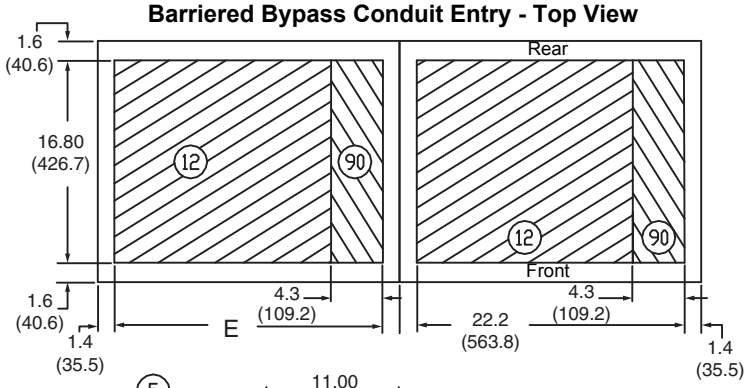


Integrated Bypass Conduit Entry - Top View

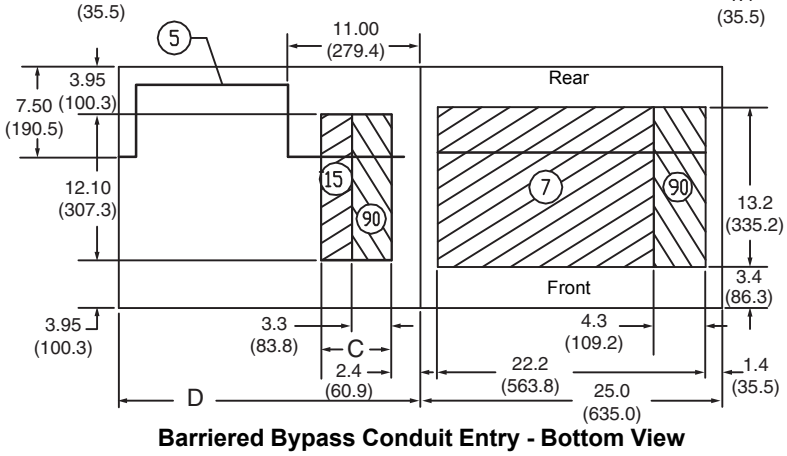


Integrated Bypass Conduit Entry - Bottom View

Barriered Bypass Conduit Entry - Top View



Barriered Bypass Conduit Entry - Bottom View



Weights

Table 28: M-Flex Controller Weights

Controller Rating				Weight lb (kg)[1]	Enclosure Size Reference
208/230 V CT	208/230 V VT	460 V CT	460 V VT		
1–5	1–5	1–20	1–25	175 (79.4)	Size C
7.5–10	7.5–10	—	—	243 (110.2)	Size D
1–10	1–10	1–20	1–25	379 (310.3)	Size C/D BB [2]
15–20	15–20	25–40	30–50	375 (170.1)	Size E
				512 (232.2)	Size E BB [2]
25–40	30–50	50–75	60–100	548 (248.6)	Size F
				684 (171.9)	Size F BB [2]
—	—	100	125	489 (221.8)	Size H
—	—			1014 (459.9)	Size H w/ integrated bypass.
—	—			1139 (516.6)	Size H BB [2]
—	—	125–200	150–250	657 (298.0)	Size I
—	—			1182 (536.1)	Size I w/ integrated bypass.
—	—			1307 (592.8)	Size I w/ BB [2]
—	—	250–450	300–500	969 (439.5)	Size J

1 The weight supplied is for a typical configuration and may differ for different power options and miscellaneous options selected.

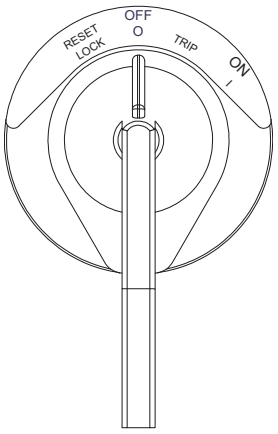
2 BB is an abbreviation for barriered bypass power circuit.

Section 2—Receiving, Installation, and Start-Up

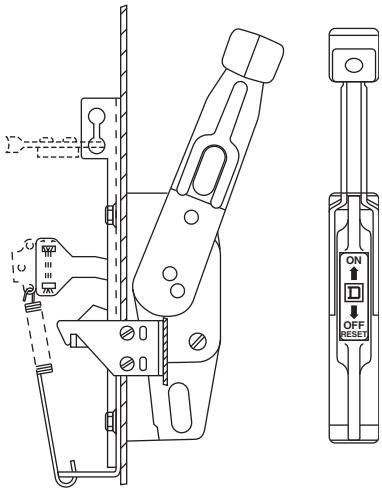
Preliminary Inspection

Figure 17: Circuit Breaker Handle Assembly

208/230 V; and 1–75 hp CT / 1–100 hp VT @ 460 V



100–450 hp CT / 125–500 hp VT @ 460 V



⚠ CAUTION

DAMAGED EQUIPMENT

Do not operate any controller that appears damaged.

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

Thoroughly inspect the controller before storing or installing it. Upon receipt:

A. Remove the controller from its packaging and visually inspect the exterior for shipping damage.
B. Ensure that the Class, Type, and option specified on the controller nameplate agree with the packaging slip and corresponding purchase order. Refer to page 11.
C. If you find any shipping damage, notify the carrier and your sales representative.
D. If you plan to store the controller after receipt, replace it in its original packaging material and observe storage temperature and humidity specifications in Table 19 on page 22.

⚠ 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.

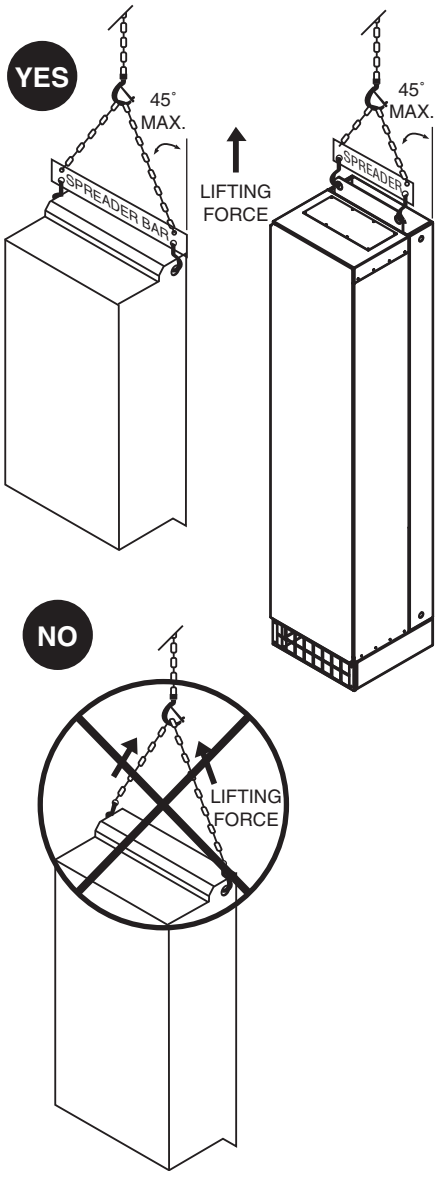
Failure to follow these instructions can cause breaker trip, resulting in process shutdown or equipment damage.

Before installation:

1. Open the controller door by moving the circuit breaker handle assembly to the Off position. Refer to Figure 17.
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 and any communication boards on the power converter are properly seated, securely fastened, and undamaged. Verify that the internal plugs and wiring connections are tight. Inspect all connections for damage.
4. Verify that all relays and fuses are installed and fully seated.
5. Close and secure the controller door, by fully closing all latching means.

Handling the Controller

Figure 18: Hoisting M-Flex Controllers



⚠ 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 18.

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

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

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

When handling controllers:

- Always work with another person. The weight, size, and shape of the controller is such that two people are required to handle it.
- Use gloves.
- Attach a spreader bar to the two top lifting holes on the controller back panel or lifting bracket (see Figures 2–15 on pages 32–45 for location of lifting holes) and hoist the controller with chains or straps. See Figure 18 for the proper hoisting method.
- Raise the controller from a horizontal position (i.e., the back of the controller resting on a pallet).
- Place the controller in an upright position.

  NOTE: Wall mounted enclosures will not sit upright without support. The bottom of the wall mounting controller is on an angle.

⚠ 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 19 beginning on page 22 for specifications.

- Secure all four corners of the controller with hardware of a sufficient size and type for the controller weight.
  - — For floor-mounted enclosures, these corners are on the base support of the enclosure. For locations see pages 34–46.
  - — For wall-mounted enclosures, these corners are at the back of the enclosure. For locations see pages 32–33.
- Mount the wall-mounted controller on a flat, noncombustible vertical surface capable of supporting the controller weight.
- Mount the floor-mounted controller on a flat, solid surface capable of supporting the controller weight.
- The floor-mounted controller must be mounted in a location which provides air access into the lower front of the controller.
- For seismic qualified products (Mod H10), follow the mounting precautions stated on the safety labels attached to the device.
- If drilling for conduit entry, exercise care to prevent metal chips from falling on parts and electronic printed wiring boards.
- See Figures 2–16 on pages 32–46 for mounting dimensions, mounting clearances, and conduit entry areas. See Table 28 on page 47 for controller weights.
- Do not mount the controller on hot surfaces.
- Do not mount the controller in direct sunlight.

Seismic Qualification Mounting Criteria

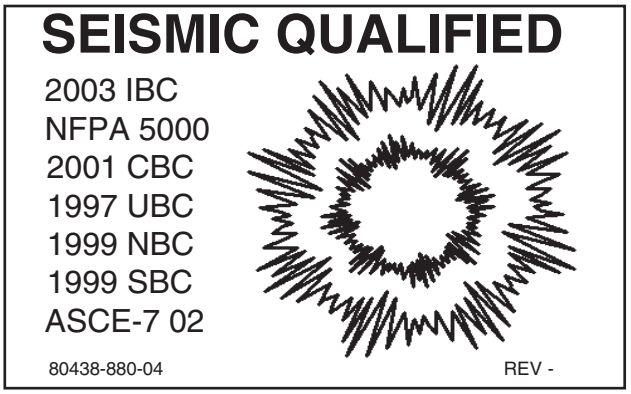
Seismic qualification (MOD H10) harmonizes the following standards in compliance with ICC ES AC156 acceptance criteria test protocol with an importance factor of 1.5.

- 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 installation compliance, follow the specific labels attached to the controller and refer to Figures 19–24 on pages 52–55 for anchorage, lateral bracing, and mounting guidelines using SAE Grade 5 hardware bolts and washers. These guidelines apply for all wall- and floor-mounted, Type 1, 1G, and 12/12K constructions.

Figure 19: Seismic Qualification Labels

Certification Label



Danger Label

Figure 20: Seismic Qualification Label: Wall Mounting
1–25 hp VT, 1–20 hp CT @ 460 V; 1–10 hp VT, 1–10 hp CT @ 208/230 V

Wall Mounting

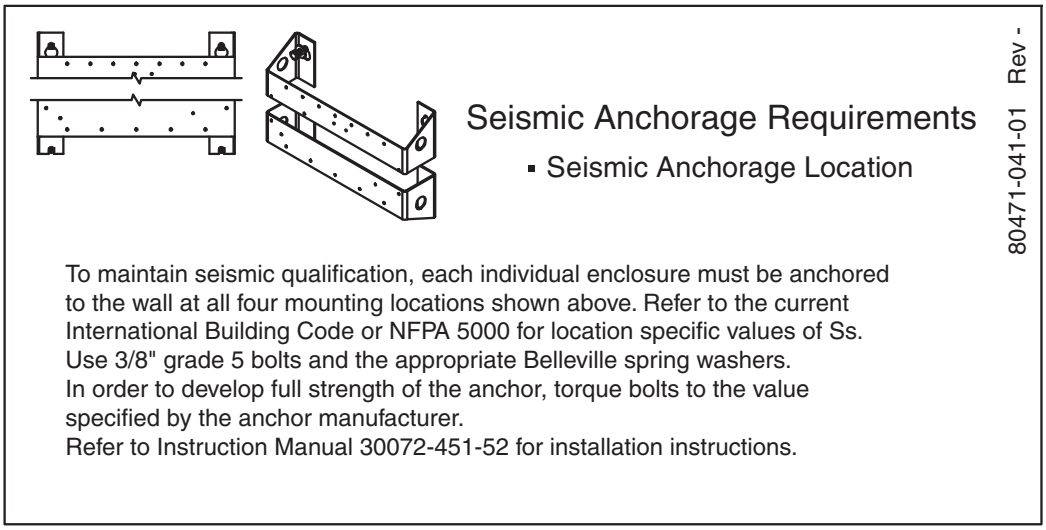


Figure 21: Seismic Qualification Label: Base Mounting for Floor-Mounted Units 1–100 hp VT, 1–75 hp CT @ 460 V; 1–50 hp VT, 1–40 hp CT @ 208/230 V

Base Mounting Label

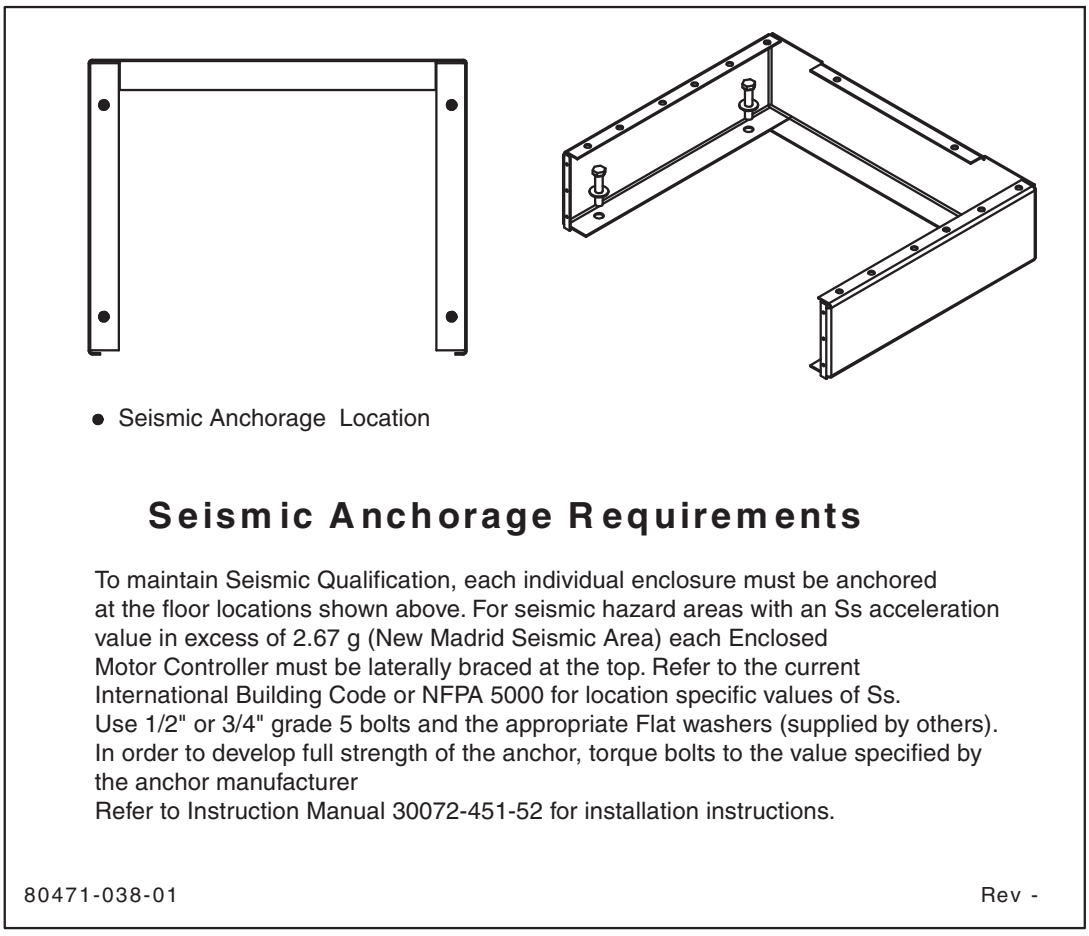


Figure 22: Seismic Qualification Label: Lateral Bracing for Floor-Mounted Units 1–100 hp VT, 1–75 hp CT @ 460 V; 1–50 hp VT, 1–40 hp CT @ 208/230 V

Lateral Bracing

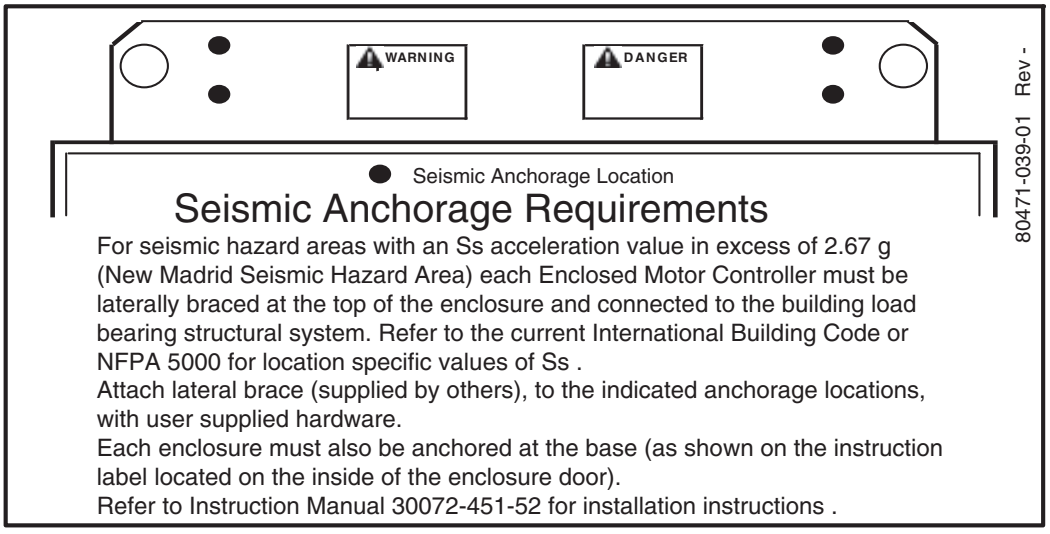
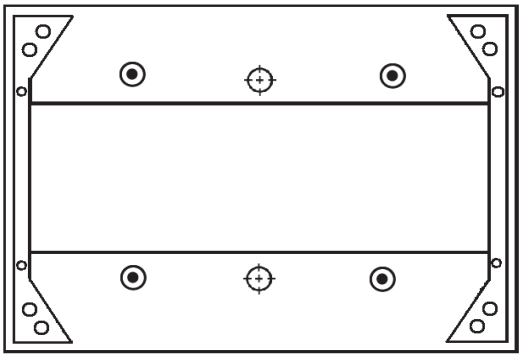
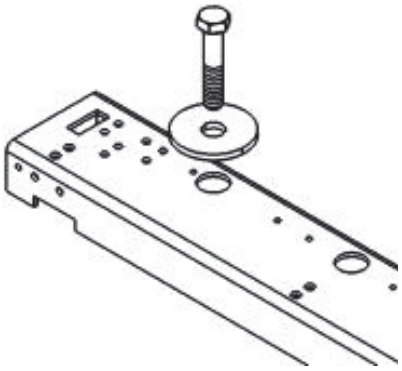


Figure 23: Seismic Qualification Label: Base Mounting for Floor-Mounted Units 125–500 hp VT, 100–450 hp CT @ 460 V

Base Mounting



Seismic Anchorage Location



Seismic Anchorage Requirements

To maintain seismic qualification, each individual section must be anchored at the floor locations shown above.

For seismic hazard areas with an Ss acceleration value in excess of 2.67g (New Madrid Seismic Area) each individual section must be laterally braced at the top. Refer to the current International Building Code or NFPA 5000 for location-specific values of Ss.

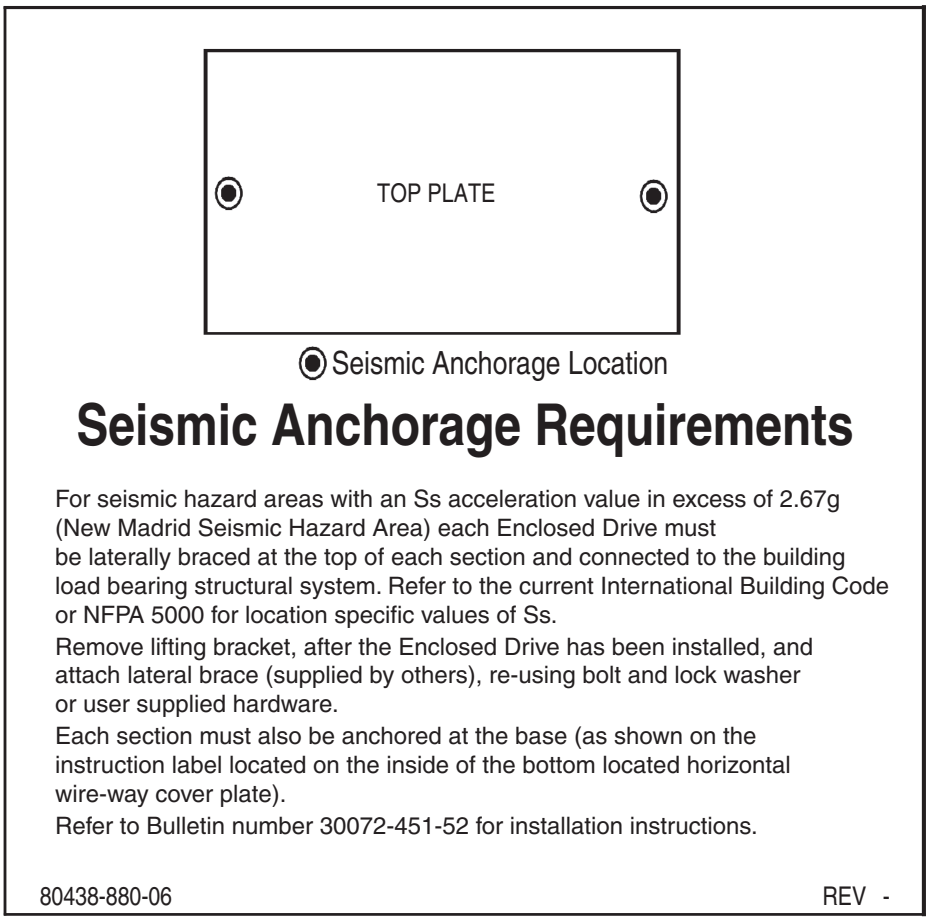
Use 1/2" or 3/4" grade 5 bolts (supplied by others) and the appropriate Belleville spring washers (supplied with equipment). In order to develop full strength of the anchor, torque bolts to the value specified by the anchor manufacturer.

Refer to Bulletin number 30072-451-52 for installation instructions.

80438-880-07 REV -

Figure 24: Seismic Qualification Label: Lateral Bracing for Floor-Mounted Units 125–500 hp VT, 100–450 hp CT @ 460 V

Lateral Bracing



Electrical Installation

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off all power (main and remote) before installing the equipment.
- Read the hazard statements on page 9 of this manual.

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

General Wiring Practices

Before wiring, perform the bus voltage measurement procedure on page 61. 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 controller or other controllers. **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

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 M-Flex controller:

- Use metallic conduit for all controller 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, or connect them to a separate circuit.

Input Power

The M-Flex controller operates from a three-phase, 460 Vac ± 10%, 230 Vac ±10%, or 208 Vac ± 10% 60 Hz ± 5% supply connected to the input of the controller.

Branch Circuit Connections

All branch circuit components and equipment such as feeder cables, disconnect devices, and protective devices must be rated for highest current, either the input current of the controller or the MFLC. The input current and MFLC are printed on the nameplate (see Figure 1 on page 11). Refer to Tables 11–18 on pages 18–21 for controller input currents. Refer to Tables 33–39 (pages 69–74) for lug data and wire range for controller input terminals L1, L2, and L3.

- For barriered bypass products, connect input power leads L1, L2, and L3:
  - — to the labeled distribution block (1–75 hp CT and 1–100 hp VT)
  - — to the disconnect switch in the bypass section (100–150 hp CT and 125–200 hp VT).
- For all other products, connect input power leads L1, L2, and L3 to the input of the circuit breaker.

⚠ WARNING

IMPROPER OVERCURRENT COORDINATION

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

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

CAUTION

IMPROPER WIRING

The controller will be damaged and the warranty voided if input line voltage is applied to the output terminals (T1, T2, T3). Check the power connections before energizing the controller.

Failure to follow these instructions can result in equipment damage.

Grounding

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

- 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.
- Do not remove any internal ground wires or connections.

⚠ DANGER

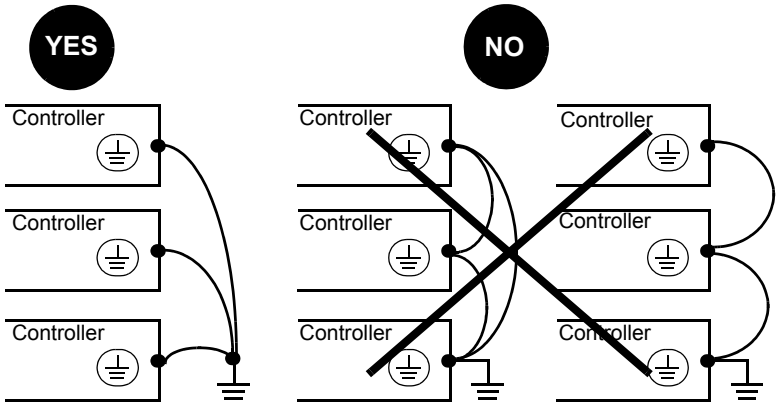
HAZARD OF ELECTRIC SHOCK

- Ground equipment using the provided ground connection point as shown in Figures 26–29 starting on page 64. The controller 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 controllers as shown in Figure 25. Use one grounding conductor per device. Do not loop ground conductors or install them in series.

Figure 25: Grounding Multiple Controllers



⚠ 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 link[1].
- Each implementation of an M-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 grounding connection between the drive, motor, and cable shielding does not eliminate the need to connect the grounding (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 grounding connection between the motor and the drive. Size the grounding conductor 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, 100 V 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.

If the controller is supplied with a bypass circuit, connect the motor conductors to T1, T2, and T3 on the overload relay. If the controller is supplied without a bypass circuit, connect the motor conductors to T1, T2, and T3 on the power converter distribution block or the converter output terminals U, V, and W. See Figures 26–29 (pages 64–67) for location. Refer to Tables 33–39 (pages 69–74) for lug data and wire range. Refer to the nameplate for torque requirements.

The controller 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 controller 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 trips. For installation where cable capacitances may be a problem, a reactor or motor protection filter can be installed between the controller and the motor.

  Refer to the guidelines in Table 29 on page 60 for the 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, 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 by horsepower.

Many variables affect the performance of the drive, motor, and cables in long lead applications. Motor protection filters can provide substantial benefits for:

— 460 V or higher rated AC drives

— Existing general-purpose motors subject to retrofit with an AC drive

— Shielded cables

NEMA MG-1 Part 31 compliant motors are recommended but not required. 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 controller may trip under some conditions.
- **Do not use lightning arrestors or power factor correction capacitors on the output of the controller.**

⚠ CAUTION

INSUFFICIENT OUTPUT INDUCTANCE

For proper controller 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.

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

A minimum inductance is needed to protect the controller output from short circuits. Provide at least 20 in. (508 mm) of cable at the controller output (T1, T2, and T3).

Table 29: Maximum Cable Length for Standard Duty Motors

Controller Rating hp @ 480 V	Type of Cable	Approximate length of motor cables, ft (m)							
		20 in. to 164 ft (0.5 to 50 m)	164–328 (50–100)	328–492 (100–150)	492–656 (150–200)	656–984 (200–300)	984–1,312 (300–400)	1,312–1,968 (400–600)	1,968–3,280 (600–1000)
1–20 CT	Shielded	—	3% Load Reactor		Motor Protection Filter				Consult your Schneider Electric representative.
1–25 VT	Unshielded	—		3% Load Reactor			Motor Protection Filter		
25–100 CT 30–125 VT	Shielded	—		3% Load Reactor	Motor Protection Filter				
	Unshielded	—			3% Load Reactor		Motor Protection Filter		
125–450 CT	Shielded	—		3% Load Reactor		Motor Protection Filter			
150–500 VT	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 bus voltage measurement procedure before performing the procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- Many parts in this controller, 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.

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

Refer to Before You Begin on page 8 for additional safety information.

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. Open the disconnect between the input line and the controller. Lock the disconnect in the open position and install a “Do Not Turn On” sign. Open the circuit breaker disconnect located on the front of the controller. Also, 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 controller.
5. Set a properly rated voltmeter to the 1000 Vdc scale. Measure the voltage between the PA/+ and PC/– terminals. The physical location of these terminals varies by the power converter model number, which is listed on the power converter nameplate.
6. Verify that the DC bus voltage has discharged below 45 V before servicing the controller. If the DC bus capacitors will not discharge below 42 V, contact your local Schneider Electric representative. **Do not operate the controller.**
7. After servicing the controller, close and secure the 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 is comprised of the six categories shown in Table 30.

Table 30: Noise Class Categories

Noise Class	Definition
Quiet Wiring 1 (QW1)	High susceptibility to 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 to analog and digital control signals. Signals falling under this classification include 24 Vdc and Vac control circuits.
Standard Wiring 1 (SW1)	Low susceptibility to 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 modulation (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 31 to the controller system.

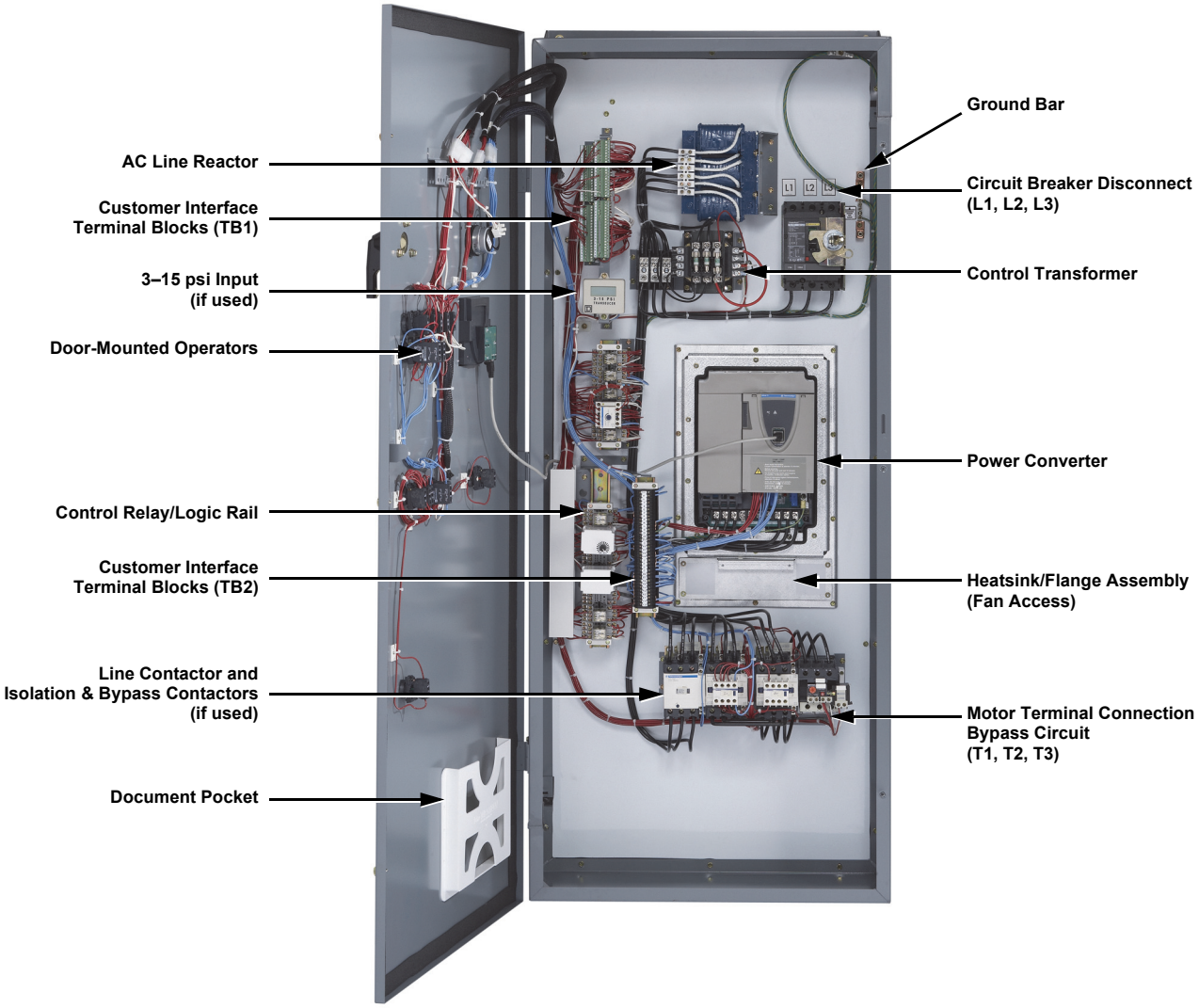
Table 31: Wire Routing and Interconnection

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 paralleled 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 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. (305 mm)					
• Metallic conduit: 3 in. (76 mm) between QW to SW/PW	X	X	X	X	X
• Metallic tray: 3 in. (76 mm) between SW to PW			X	X	X
• Metallic tray: 6 in. (152 mm) between QW to SW/PW	X	X	X	X	X
• Against continuous metal surface: 3 in. (76 mm) between SW to PW			X	X	X
• Against continuous metal surface: 6 in. (152 mm) between QW to SW/PW	X	X	X	X	X
• Metallic conduit housing QW: 12 in. (305 mm) to non-metallic conduit SW/PW	X	X	X	X	X
• Non-metallic conduit: 3 in. (76 mm) between SW to PW			X	X	X
• Non-metallic conduit: 24 in. (610 mm) 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 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

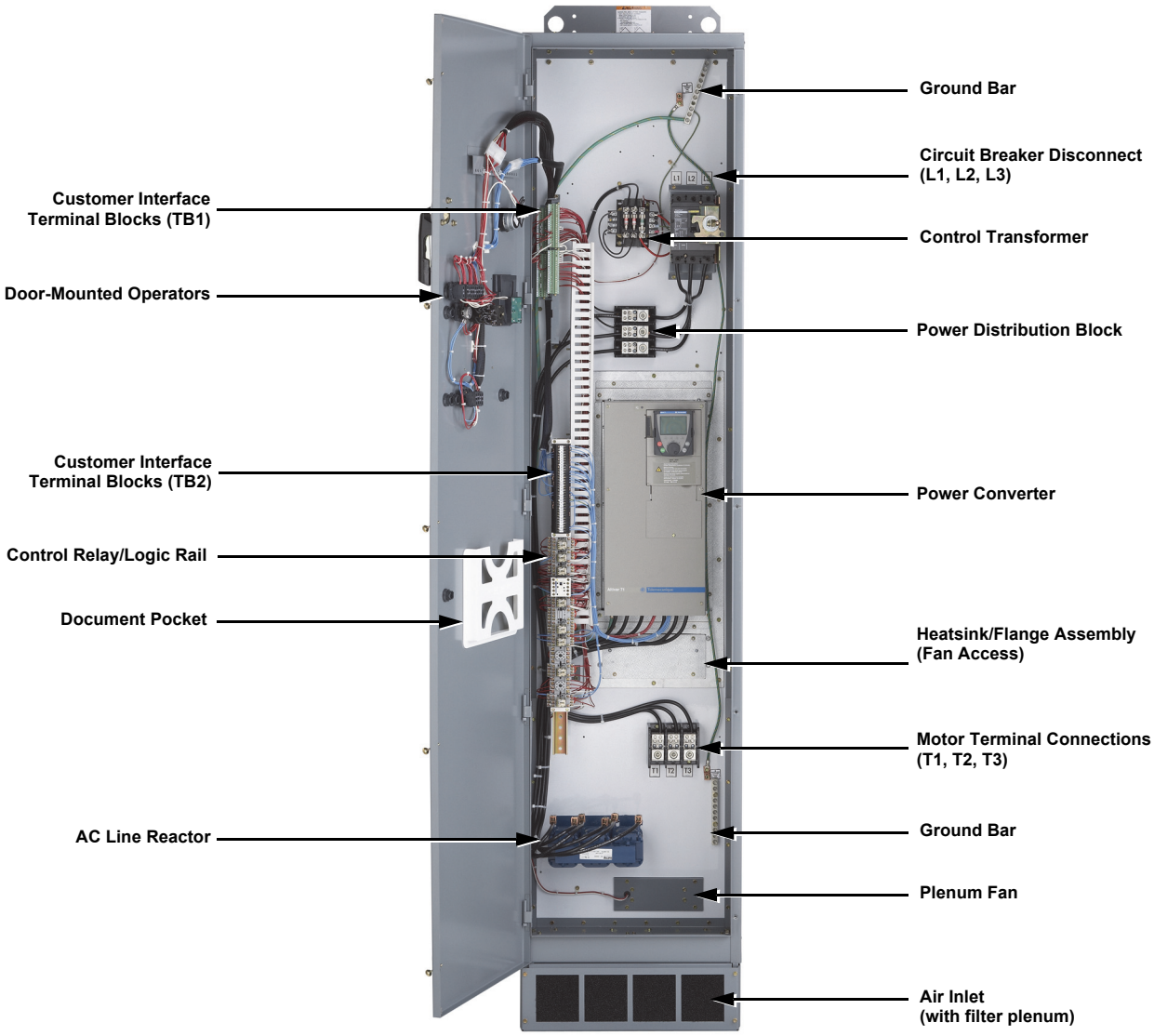
Figures 26–29 show component identification and terminal strip locations for M-Flex controllers. Refer to Tables 33–39 (pages 69–74) for wire range and terminal torque requirements.

Figure 26: Typical Component Locations for Wall-Mount Enclosures: 1–20 hp CT and 1–25 hp VT @ 460 V; 1–10 hp CT/VT @ 208/230 V



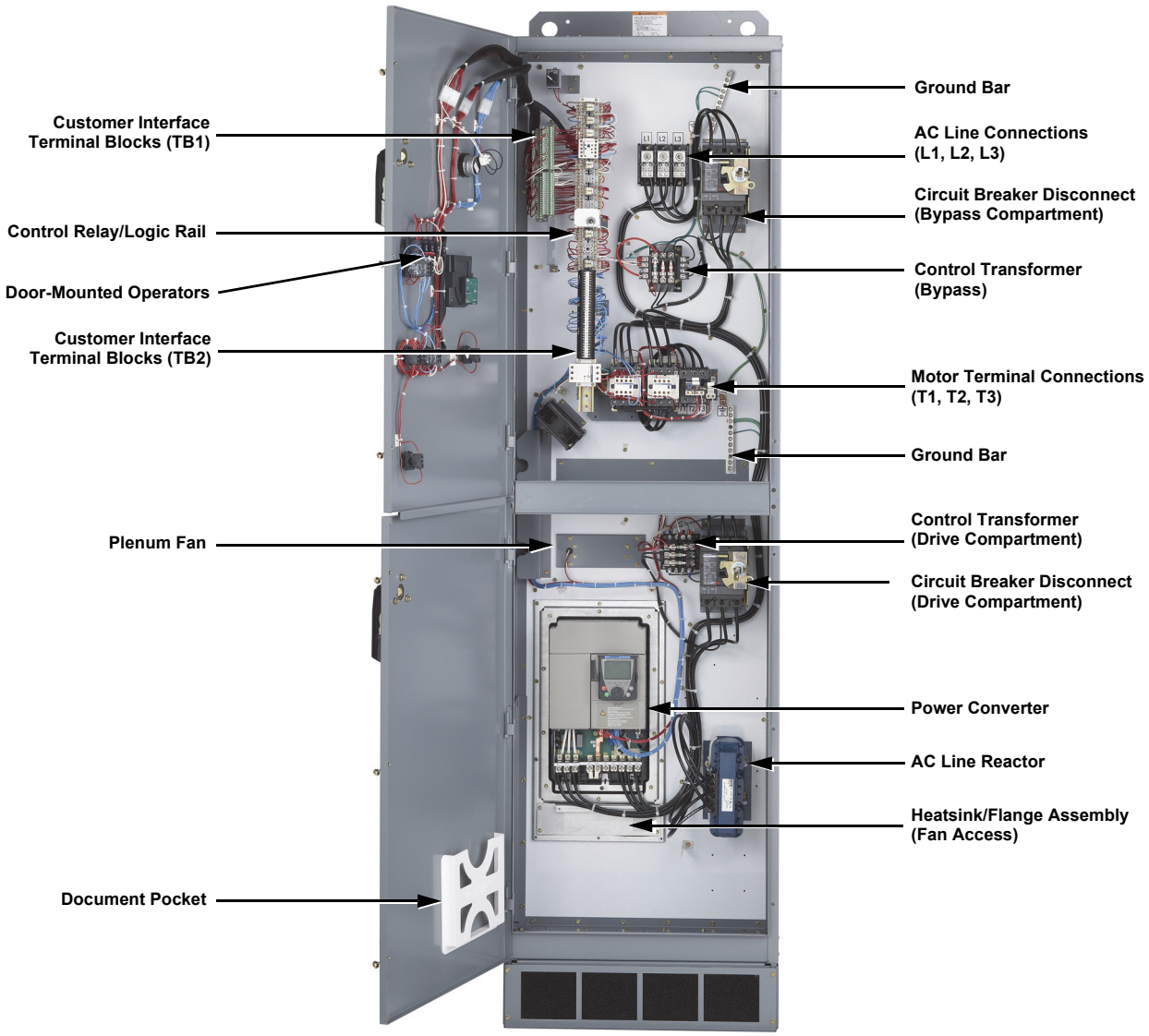
Shown: Class 8839 Type MFDHA2CY, Mods F07, F08, F09, A10, B10, C10, E10, F10, L10, S10, T10, U10, W10

Figure 27: Typical Component Locations for Floor-Mount Integrated Enclosures: 25–75 hp CT and 30–100 hp VT @ 460 V; 15–40 hp CT and 15–50 hp VT @ 208/230 V



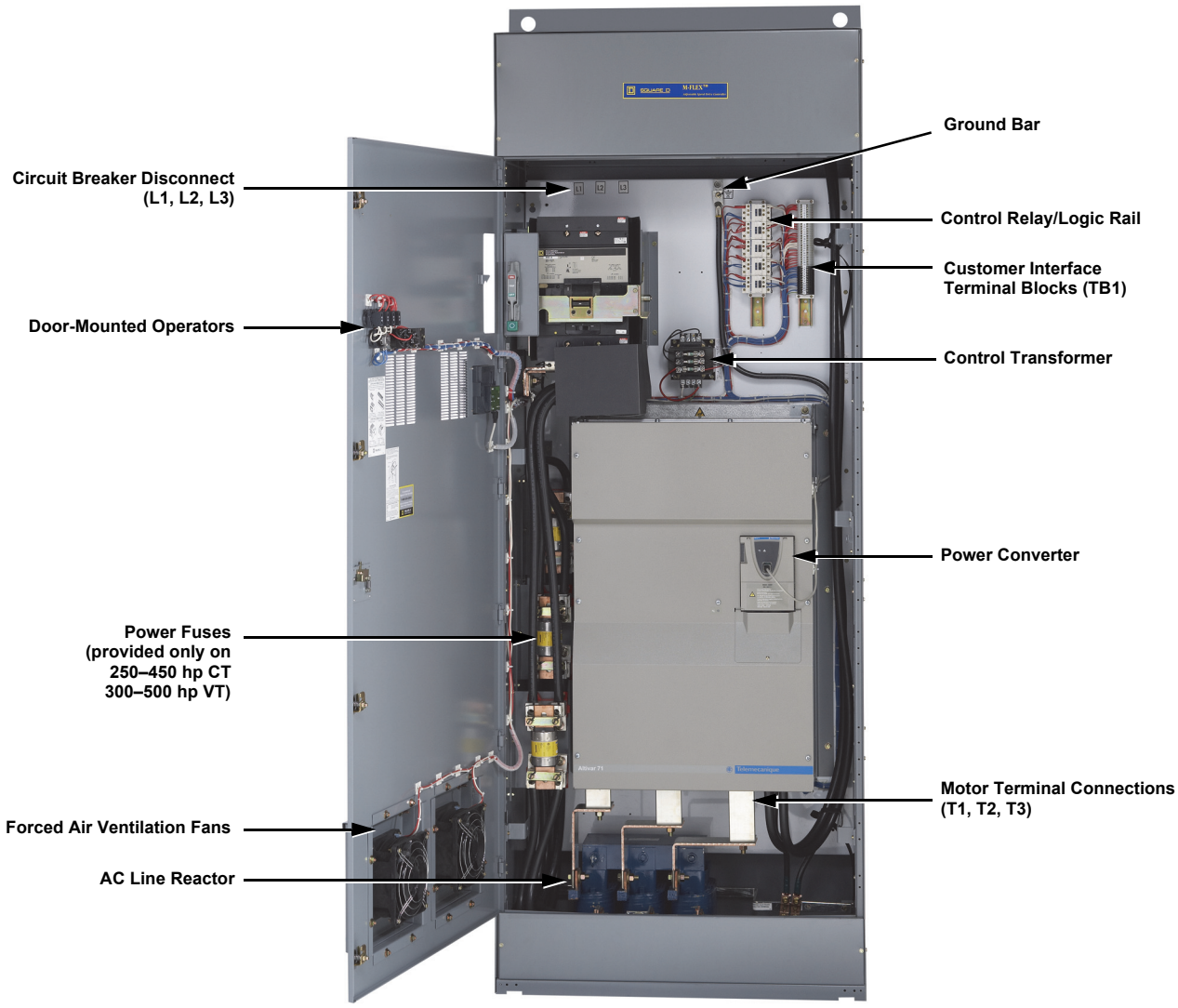
Shown: Class 8839 Type MFDPG4VW, Mods F07, F08, N09, A10, E10, F10, J10, K10, Q10, S10, W10

Figure 28: Typical Component Locations for Floor-Mount Barriered Enclosures: 25–75 hp CT and 30–100 hp VT @ 460 V; 15–40 hp CT and 15–50 hp VT @ 208/230 V



Shown: Class 8839 Type MFDLG4CZ, Mods A07, E08, A10, C10, E10, O10, Q10, R10, S10, T10, W10

Figure 29: Typical Component Locations for Floor-Mount Enclosures: 100–450 hp CT and 125–500 hp VT @ 480 V



Shown: Class 8839 Type MFD6G4VW, Mods F07, A08, F09

Power Wiring

Table 32: Power Terminal Functions [1]

Terminal		Function
GND		Ground bar and ground lugs
L1, L2, L3	with and without integrated bypass	3-phase input power (at top of circuit breaker)
	with barriered bypass	1–75 hp CT and 1–100 hp VT: 3-phase input power at distribution block DB1
		100 hp CT and 125 hp VT: 3-phase input power at disconnect switch
T1, T2, T3	with bypass	Output connections to motor (at bottom of overload relay)
	without bypass	Output connections to motor (power distribution block DB3), 1–100 hp VT / 1–75 hp CT
	without bypass	Output connections to motor (converter terminals), 100–450 hp CT, 125–500 hp VT
Output 1, Output 2, Output 3 [2]		Output from fuses to externally mounted harmonic filter.
Input 1, Input 2, Input 3 [2]		Input from externally mounted harmonic filter to controller.

1. For terminal locations refer to Figures 26–29 on pages 64–67.
2. Only applicable with option 710, harmonic filter provision.

Wire Range and Power Terminal Torque Requirements

- **Controller:** For the wire range and power terminal torque requirements of the controller, refer to Tables 33–39 beginning on page 69.
- **Power converter:** For the power terminal torque requirements of the power converter, refer to Tables 57–59 beginning on page 107.

Table 33: Drive Converter Terminal Wire Size and Torque

Constant Torque Converter	hp	Max. Wire Size		Terminal Torque	
		AWG	mm²	lb-in	N•m
208/230 V					
ATV71H037M3	0.5	10	4	12.3	1.4
ATV71H075M3	1	10	4	12.3	1.4
ATV71HU15M3	2	10	4	12.3	1.4
ATV71HU22M3	3	10	4	12.3	1.4
ATV71HU30M3	4	10	4	12.3	1.4
ATV71HU40M3	5	10	4	12.3	1.4
ATV71HU55M3	7.5	8	6	26.5	3
ATV71HU75M3	10	4	16	26.5	3
ATV71HD11M3X	15	2	35	47.7	5.4
ATV71HD15M3X	20	2	35	47.7	5.4
ATV71HD18M3X	25	1/0	50	106.2	12
ATV71HD22M3X	30	1/0	50	106.2	12
ATV71HD30M3X	40	300	150	360	41
460 V					
ATV71H075N4	1	10	4	12.3	1.4
ATV71HU15N4	2	10	4	12.3	1.4
ATV71HU22N4	3	10	4	12.3	1.4
ATV71HU30N4	4	10	4	12.3	1.4
ATV71HU40N4	5	10	4	12.3	1.4
ATV71HU55N4	7.5	8	6	26.5	3
ATV71HU75N4	10	8	6	26.5	3
ATV71HD11N4	15	4	16	26.5	3
ATV71HD15N4	20	2	35	47.7	5.4
ATV71HD18N4	25	2	35	47.7	5.4
ATV71HD22N4	30	1/0	50	106.2	12
ATV71HD30N4	40	1/0	50	106.2	12
ATV71HD37N4	50	1/0	50	106.2	12
ATV71HD45N4	60	300	150	360	41
ATV71HD55N4	75	300	150	360	41
ATV71HD75N4	100	300	150	360	41
ATV71HD90N4D	125	2–250	2–100	212	24
ATV71HC11N4D	150	2–250	2–100	212	24
ATV71HC13N4D	200	2–250	2–120	212	24
ATV71HC16N4D	250	2–350	2–150	360	41
ATV71HC20N4D	300	3–350	4–185	360	41
ATV71HC25N4D	350	3–350	4–185	360	41
ATV71HC25N4D	400	3–350	4–185	360	41
ATV71HC28N4D	450	3–350	4–185	360	41

Variable Torque Converter	hp	Max. Wire Size		Terminal Torque	
		AWG	mm²	lb-in	N•m
208/230 V					
ATV61H075M3	1–1.5	10	4	12.3	1.4
ATV61HU15M3	2–3	10	4	12.3	1.4
ATV61HU30M3	5	10	4	12.3	1.4
ATV61HU40M3	7.5	10	4	12.3	1.4
ATV61HU55M3	10	8	6	26.5	3
ATV61HU75M3	15	4	16	26.5	3
ATV61HD11M3X	20	2	35	47.7	5.4
ATV61HD15M3X	25	2	35	47.7	5.4
ATV61HD18M3X	30	1/0	50	106.2	12
ATV61HD22M3X	40	1/0	50	106.2	12
ATV61HD30M3X	50	300	150	360	41
460 V					
ATV61H075N4	1	10	4	12.3	1.4
ATV61HU15N4	2–3	10	4	12.3	1.4
ATV61HU30N4	5	10	4	12.3	1.4
ATV61HU40N4	7.5	10	4	12.3	1.4
ATV61HU55N4	10	8	6	26.5	3
ATV61HU75N4	15	8	6	26.5	3
ATV61HD11N4	20	4	16	26.5	3
ATV61HD15N4	25	2	35	47.7	5.4
ATV61HD18N4	30	2	35	47.7	5.4
ATV61HD22N4	40	1/0	50	106.2	12
ATV61HD30N4	50	1/0	50	106.2	12
ATV61HD37N4	60	1/0	50	106.2	12
ATV61HD45N4	75	300	150	360	41
ATV61HD55N4	100	300	150	360	41
ATV61HD75N4	125	300	150	360	41
ATV61HD90N4D	125	2–250	2–100	212	24
ATV61HC11N4D	150	2–250	2–100	212	24
ATV61HC13N4D	200	2–250	2–100	212	24
ATV61HC16N4D	250	2–250	2–120	212	24
ATV61HC22N4D	300–350	2–350	2–150	360	41
ATV61HC25N4D	400	3–350	4–185	360	41
ATV61HC31N4D	450–500	3–350	4–185	360	41

Table 34: Circuit Breaker Terminal Wire Size and Torque—Constant Torque Controller

CT	Circuit Breaker		Wire Range, AWG (mm²)			Terminal Torque, lb-in (N•m)		
hp	460 V	230/208 V	460 V	230 V	208 V	460 V	230 V	208 V
1	HLL36015	HLL36015	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
2	HLL36015	HLL36025	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
3	HLL36015	HLL36035	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
5	HLL36025	HLL36060	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
7.5	HLL36040	HLL36080	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
10	HLL36050	HLL36110	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
15	HLL36070	HLL36110	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
20	HLL36100	HLL36150	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
25	HLL36090	JLL36175	14–10 (2.5–6)	3/0–350 (120–185)	3/0–350 (120–185)	50 (5)	225 (25)	225 (25)
			8–3/0 (10–95)			120 (14)		
30	HLL36100	JLL36200	14–10 (2.5–6)	3/0–350 (120–185)	3/0–350 (120–185)	50 (5)	225 (25)	225 (25)
			8–3/0 (10–95)			120 (14)		
40	HLL36125	JLL36250	14–10 (2.5–6)	3/0–350 (120–185)	3/0–350 (120–185)	50 (5)	225 (25)	225 (25)
			8–3/0 (10–95)			120 (14)		
50	HLL36150	—	14–10 (2.5–6)	—	—	50 (5)	—	—
		—	8–3/0 (10–95)	—	—	120 (14)	—	—
60	JLL36200	—	3/0–350 (120–185)	—	—	225 (25)	—	—
75	JLL36225	—	3/0–350 (120–185)	—	—	225 (25)	—	—
100	JLL36250	—	3/0–350 (120–185)	—	—	225 (25)	—	—
125	LIL36300	—	[2] 4/0–500 (95–253)	—	—	300 (34)	—	—
	LLL36400U31X	—	[2] 2/0–500 (70-240)	—	—	442 (50)	—	—
150	LIL36300	—	[2] 4/0–500 (95–253)	—	—	300 (34)	—	—
	LLL36400U31X	—	[2] 2/0–500 (70-240)	—	—	442 (50)	—	—
200	LIL36400	—	[2] 4/0–500 (95–253)	—	—	300 (34)	—	—
	LLL36400U31X	—	[2] 2/0–500 (70-240)	—	—	442 (50)	—	—
250	LIL36400 [1] LPJ400SP	—	[2] 4/0–500 (95–253)	—	—	300 (34)	—	—
	LLL36400U31X	—	[2] 2/0–500 (70-240)	—	—	442 (50)	—	—
300	MJL36600LW [1] LPJ500SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34060LW [1] LPJ500SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
350	MJL36600LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34060LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
400	MJL36800LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34080LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
450	MJL36800LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34080LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—

1 Circuit breaker with Class J time-delay fuses.

Table 35: Circuit Breaker Terminal Wire Size and Torque—Variable Torque Controller

VT	Circuit Breaker		Wire Range, AWG (mm²)			Terminal Torque, lb-in (N•m)		
hp	460 V	230/208 V	460 V	230 V	208 V	460 V	230 V	208 V
1	HLL36015	HLL36015	14–10 (2.5 - 6)	14 - 10 (2.5 - 6)	14 - 10 (2.5 - 6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
2	HLL36015	HLL36015	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
3	HLL36015	HLL36025	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
5	HLL36015	HLL36040	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
7.5	HLL36025	HLL36060	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
10	HLL36035	HLL36070	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
15	HLL36050	HLL36110	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
20	HLL36060	HLL36125	14–10 (2.5–6)	14–10 (2.5–6)	14–10 (2.5–6)	50 (5)	50 (5)	50 (5)
			8–3/0 (10–95)	8–3/0 (10–95)	8–3/0 (10–95)	120 (14)	120 (14)	120 (14)
25	HLL36080	JLL36175	14–10 (2.5–6)	1/0–4/0 (50–95)	1/0–4/0 (50–95)	50 (5)	225 (25)	225 (25)
			8–3/0 (10–95)			120 (14)		
30	HLL36100	JLL36200	14–10 (2.5–6)	3/0–350 (120–185)	3/0–350 (120–185)	50 (5)	225 (25)	225 (25)
			8–3/0 (10–95)			120 (14)		
40	HLL36125	JLL36250	14–10 (2.5–6)	3/0–350 (120–185)	3/0–350 (120–185)	50 (5)	225 (25)	225 (25)
			8–3/0 (10–95)			120 (14)		
50	HLL36150	JLL36250	14–10 (2.5–6)	3/0–350 (120–185)	3/0–350 (120–185)	50 (5)	225 (25)	225 (25)
			8–3/0 (10–95)			120 (14)		
60	JLL36175	—	1/0–4/0 (50–95)	—	—	225 (25)	—	—
75	JLL36225	—	3/0–350 (120–185)	—	—	225 (25)	—	—
100	JLL36250	—	3/0–350 (120–185)	—	—	225 (25)	—	—
125	JLL36250	—	3/0–350 (120–185)	—	—	225 (25)	—	—
150	LIL36300	—	[2] 4/0–500 (95–253)	—	—	300 (34)	—	—
	LLL36400U31X	—	[2] 2/0–500 (70-240)	—	—	442 (50)	—	—
200	LIL36400	—	[2] 4/0–500 (95–253)	—	—	300 (34)	—	—
	LLL36400U31X	—	[2] 2/0–500 (70-240)	—	—	442 (50)	—	—
250	LIL36400	—	[2] 4/0–500 (95–253)	—	—	300 (34)	—	—
	LLL36400U31X	—	[2] 2/0–500 (70-240)	—	—	442 (50)	—	—
300	MJL36600LW [1] LPJ500SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34060LW [1] LPJ500SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
350	MJL36600LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34060LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
400	MJL36800LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34080LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
450	MJL36800LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
	PLL34080LW [1] LPJ600SP	—	[3] 3/0–500 (95–253)	—	—	450 (51)	—	—
500	PLL34100LW [1] LPL600SP	—	[3] 3/0–500 (95 - 253)	—	—	450 (51)	—	—

1 Circuit breaker with Class J time-delay fuses.

Table 36: Variable Torque Controllers
Power Terminal Wire Range: Distribution Block Terminals and Overload Relay Output Terminals

hp	Distribution Block Terminals T1, T2, T3 (Load)						Overload Relay Output Terminals T1, T2, T3 (Load)					
	Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)			Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)		
	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V
1	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
2	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
3	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
5	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
7.5	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	35 (4.0)	40 (4.5)	40 (4.5)	10 (5.26)	6 (13.3)	6 (13.3)	15 (1.69)	15 (1.69)	15 (1.69)
10	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	35 (4.0)	40 (4.5)	40 (4.5)	10 (5.26)	6 (13.3)	6 (13.3)	15 (1.69)	15 (1.69)	15 (1.69)
15	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	40 (4.5)	120 (13.5)	120 (13.5)	10 (5.26)	6 (13.3)	1/0 (53.5)	15 (1.69)	75 (8.47)	75 (8.47)
20	2/0 (67.4)	400 (203)	400 (203)	40 (4.5)	250 (28.3)	250 (28.3)	6 (13.3)	6 (13.3)	1/0 (53.5)	15 (1.69)	75 (8.47)	75 (8.47)
25	2/0 (67.4)	400 (203)	400 (203)	40 (4.5)	250 (28.3)	250 (28.3)	1/0 (53.5)	6 (13.3)	1/0 (53.5)	75 (8.47)	75 (8.47)	75 (8.47)
30	2/0 (67.4)	350 (177)	350 (177)	120 (3.6)	250 (28.3)	250 (28.3)	1/0 (53.5)	3/0 (85)	3/0 (85)	75 (8.47)	200 (22.6)	200 (22.6)
40	2/0 (67.4)	350 (177)	350 (177)	120 (3.6)	250 (28.3)	250 (28.3)	1/0 (53.5)	3/0 (85)	3/0 (85)	75 (8.47)	200 (22.6)	200 (22.6)
50	350 (177)	350 (177)	350 (177)	250 (28.3)	250 (28.3)	250 (28.3)	1/0 (53.5)	3/0 (85)	3/0 (85)	75 (8.47)	200 (22.6)	200 (22.6)
60	350 (177)	—	—	250 (28.3)	—	—	1/0 (53.5)	—	—	75 (8.47)	—	—
75	350 (177)	—	—	250 (28.3)	—	—	250 (127)	—	—	300 (33.9)	—	—
100	350 (177)	—	—	250 (28.3)	—	—	250 (127)	—	—	300 (33.9)	—	—
125	500 (253)	—	—	375 (42.4)	—	—	3/0 (85)	—	—	—	—	—
150	500 (253)	—	—	375 (42.4)	—	—	3/0 (85)	—	—	—	—	—
200	500 (253)	—	—	375 (42.4)	—	—	300 (152)	—	—	—	—	—
250	500 (253)	—	—	375 (42.4)	—	—	500 (253)	—	—	—	—	—
300	2-600 (304)	—	—	375 (42.4)	—	—	500 (253)	—	—	—	—	—
350	2-600 (304)	—	—	375 (42.4)	—	—	2-500 (253)	—	—	—	—	—
400	2-600 (304)	—	—	375 (42.4)	—	—	2-500 (253)	—	—	—	—	—
450	2-600 (304)	—	—	375 (42.4)	—	—	2-500 (253)	—	—	—	—	—
500	2-600 (304)	—	—	375 (42.4)	—	—	2-500 (253)	—	—	—	—	—

Table 37: Constant Torque Controllers
Power Terminal Wire Range: Distribution Block Terminals and Overload Relay Output Terminals

hp	Distribution Block Terminals T1, T2, T3 (Load)						Overload Relay Output Terminals T1, T2, T3 (Load)					
	Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)			Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)		
	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V
1	2/0 (67.4)	2/0 (67.4)	2/0 (67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
2	2/0(67.4)	2/0(67.4)	2/0(67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
3	2/0(67.4)	2/0(67.4)	2/0(67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
5	2/0(67.4)	2/0(67.4)	2/0(67.4)	35 (4.0)	35 (4.0)	35 (4.0)	10 (5.26)	10 (5.26)	10 (5.26)	15 (1.69)	15 (1.69)	15 (1.69)
7.5	2/0(67.4)	2/0(67.4)	2/0(67.4)	35 (4.0)	40 (4.5)	40 (4.5)	10 (5.26)	6 (13.3)	6 (13.3)	15 (1.69)	15 (1.69)	15 (1.69)
10	2/0(67.4)	2/0(67.4)	2/0(67.4)	35 (4.0)	40 (4.5)	40 (4.5)	10 (5.26)	6 (13.3)	6 (13.3)	15 (1.69)	15 (1.69)	15 (1.69)
15	2/0(67.4)	2/0(67.4)	2/0(67.4)	40 (4.5)	120 (13.5)	120 (13.5)	10 (5.26)	6 (13.3)	1/0 (53.5)	15 (1.69)	75 (8.47)	75 (8.47)
20	2/0(67.4)	400 (203)	400 (203)	40 (4.5)	250 (28.3)	250 (28.3)	6 (13.3)	6 (13.3)	1/0 (53.5)	15 (1.69)	75 (8.47)	75 (8.47)
25	2/0(67.4)	400 (203)	400 (203)	40 (4.5)	250 (28.3)	250 (28.3)	1/0 (53.5)	6 (13.3)	1/0 (53.5)	75 (8.47)	75 (8.47)	75 (8.47)
30	2/0(67.4)	350 (177)	350 (177)	120 (3.6)	250 (28.3)	250 (28.3)	1/0 (53.5)	3/0 (85)	3/0 (85)	75 (8.47)	200 (22.6)	200 (22.6)
40	2/0(67.4)	350 (177)	350 (177)	120 (3.6)	250 (28.3)	250 (28.3)	1/0 (53.5)	3/0 (85)	3/0 (85)	75 (8.47)	200 (22.6)	200 (22.6)
50	350 (177)	—	—	250 (28.3)	—	—	1/0 (53.5)	—	—	75 (8.47)	—	—
60	350 (177)	—	—	250 (28.3)	—	—	1/0 (53.5)	—	—	75 (8.47)	—	—
75	350 (177)	—	—	250 (28.3)	—	—	250 (127)	—	—	300 (33.9)	—	—
100	350 (177)	—	—	250 (28.3)	—	—	250 (127)	—	—	300 (33.9)	—	—
125	500 (253)	—	—	375 (42.4)	—	—	3/0 (85)	—	—	—	—	—
150	500 (253)	—	—	375 (42.4)	—	—	3/0 (85)	—	—	—	—	—
200	500 (253)	—	—	375 (42.4)	—	—	300 (152)	—	—	—	—	—
250	500 (253)	—	—	375 (42.4)	—	—	500 (253)	—	—	—	—	—
300	2-600 (304)	—	—	375 (42.4)	—	—	500 (253)	—	—	—	—	—
350	2-600 (304)	—	—	375 (42.4)	—	—	2-500 (253)	—	—	—	—	—
400	2-600 (304)	—	—	375 (42.4)	—	—	2-500 (253)	—	—	—	—	—
450	2-600 (304)	—	—	375 (42.4)	—	—	2-500 (253)	—	—	—	—	—

Table 38: Variable Torque Controllers, Power Terminal Wire Range: Ground Bar and Ground Lugs

hp	Ground Bar						Ground Lugs					
	Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)			Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)		
	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V
1	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
2	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
3	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
5	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
7.5	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
10	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
15	4 (21.15)	1/0 (53.5)	1/0 (53.5)	20 (2.26)	45 (5.1)	45 (5.1)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
20	4 (21.15)	1/0 (53.5)	1/0 (53.5)	20 (2.26)	45 (5.1)	45 (5.1)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
25	4 (21.15)	1/0 (53.5)	1/0 (53.5)	20 (2.26)	45 (5.1)	45 (5.1)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
30	1/0 (53.5)	1/0 (53.5)	1/0 (53.5)	45 (5.1)	45 (5.1)	45 (5.1)	4/0 (107)	350 (177)	350 (177)	110 (12.43)	250 (28.3)	250 (28.3)
40	1/0 (53.5)	1/0 (53.5)	1/0 (53.5)	45 (5.1)	45 (5.1)	45 (5.1)	4/0 (107)	350 (177)	350 (177)	110 (12.43)	250 (28.3)	250 (28.3)
50	1/0 (53.5)	1/0 (53.5)	1/0 (53.5)	45 (5.1)	45 (5.1)	45 (5.1)	4/0 (107)	350 (177)	350 (177)	110 (12.43)	250 (28.3)	250 (28.3)
60	1/0 (53.5)	—	—	45 (5.1)	—	—	350 (177)	—	—	250 (28.3)	—	—
75	1/0 (53.5)	—	—	45 (5.1)	—	—	350 (177)	—	—	250 (28.3)	—	—
100	1/0 (53.5)	—	—	45 (5.1)	—	—	350 (177)	—	—	250 (28.3)	—	—
125	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
150	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
200	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
250	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
300	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
350	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
400	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
450	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
500	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—

Table 39: Constant Torque Controllers, Power Terminal Wire Range: Ground Bar and Ground Lugs

hp	Ground Bar						Ground Lugs					
	Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)			Max Wire Size, AWG (mm²)			Terminal Torque, lb-in (N•m)		
	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V	460 V	230 V	208 V
1	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
2	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
3	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
5	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
7.5	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
10	4 (21.15)	4 (21.15)	4 (21.15)	20 (2.26)	20 (2.26)	20 (2.26)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
15	4 (21.15)	1/0 (53.5)	1/0 (53.5)	20 (2.26)	45 (5.1)	45 (5.1)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
20	4 (21.15)	1/0 (53.5)	1/0 (53.5)	20 (2.26)	45 (5.1)	45 (5.1)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
25	4 (21.15)	1/0 (53.5)	1/0 (53.5)	20 (2.26)	45 (5.1)	45 (5.1)	4/0 (107)	4/0 (107)	4/0 (107)	110 (12.43)	110 (12.43)	110 (12.43)
30	1/0 (53.5)	1/0 (53.5)	1/0 (53.5)	45 (5.1)	45 (5.1)	45 (5.1)	4/0 (107)	350 (177)	350 (177)	110 (12.43)	250 (28.3)	250 (28.3)
40	1/0 (53.5)	1/0 (53.5)	1/0 (53.5)	45 (5.1)	45 (5.1)	45 (5.1)	4/0 (107)	350 (177)	350 (177)	110 (12.43)	250 (28.3)	250 (28.3)
50	1/0 (53.5)	—	—	45 (5.1)	—	—	4/0 (107)	—	—	110 (12.43)	—	—
60	1/0 (53.5)	—	—	45 (5.1)	—	—	350 (177)	—	—	250 (28.3)	—	—
75	1/0 (53.5)	—	—	45 (5.1)	—	—	350 (177)	—	—	250 (28.3)	—	—
100	1/0 (53.5)	—	—	45 (5.1)	—	—	350 (177)	—	—	250 (28.3)	—	—
125	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
150	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
200	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
250	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
300	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
350	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
400	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—
450	250 (127)	—	—	200 (22.6)	—	—	300 (152)	—	—	275 (31.1)	—	—

Control Wiring

Table 40: TB1 Terminal Block Characteristics, 120 Vac Control

Terminal	Function	Characteristics
1	Control power [2]	115 Vac (line side) 60 Hz [1]
1 to 2	Fire/Freezestat interlocks	Provision for user supplied, N.C. fire/freeezestat contact
2 to 3	User emergency stop	Provision for user supplied, N.C. emergency freewheel stop contact
3 to 4	Jumper for customer use	Provision for user supplied, N.C. safety interlock contact
4 to 5	Jumper for customer use	Provision for user supplied, N.C. safety interlock contact
5 to 6	Check valve sequence contact	N.C. timed open contact from check valve sequence relay
7 to 11	Stop push button [3]	—
8 to 11	Start push button (and holding circuit) [3]	—
9A to 8	User-supplied auto start contact	—
10 to 50	Auto mode pilot light	—
18 to 32	Test contact of Test-Normal switch [3]	—
25 to 26	Normal contact of Test-Normal switch [3]	—
26 to 31	Isolation contactor coil and bypass contactor N.C. interlock [3]	—
30 to 31	Bypass pilot light and bypass contactor coil [3]	—
31 to 32	Line contactor coil [3]	—
33 to 1	Controller internal relay (AFC trip) N.O. contact	—
35 to 50	AFC trip pilot light	—
36 to 1	Controller internal relay (AFC run) N.O. contact	—
36 to 50	AFC run pilot light and run relay coils (ADRR1, ADRR2)	—
37 to 1	Controller internal relay (AFC trip) N.C. contact	—
39 thru 42	Reserved	—
43 to 50	User-connected seal water solenoid [3]	—
44 to 50	Factory connection for elapsed time meter [3]	—
45 to 50	User-connected motor space heater [3]	—
46 to 47	User-supplied N.C contact from check valve limit switch [3]	—
48 to 49	Smoke purge relay coil connection (user supplied 115 Vac control)	—
50	Control power, ground side	—
50 to 1	Power On pilot light	—
50 to 10	Auto mode pilot light	—
50 to 12	Hand mode pilot light	—
50 to 36	AFC run pilot light	—
50 to 35	Trip pilot light	—
51 to 53	ADRR1 N.C. contact for customer use	Standard controller run
52 to 53	ADRR1 N.O. contact for customer use	Standard controller run
54 to 56	ADFR1 N.C. contact for customer use	Standard controller trip
55 to 56	ADFR1 N.O. contact for customer use	Standard controller trip
57 to 58	ADRR1 N.O. contact for customer use [3]	Optional controller run
59 to 60	ADFR2 N.C. contact for customer use [3]	Optional controller trip
61 to 62	Bypass relay N.O. contact for customer use [3]	Optional bypass run
63 to 64	Auto mode N.O. contact for customer use [3]	Optional auto mode

1. Wall mount, with standard transformer: 50 VA available. 460 V: 1–25 hp VT, 1–20 hp CT. 208/230 V: 1–10 hp VT/CT.
   Floor mount, up to 100 hp: 20 VA available. 460 V: 30–100 hp VT, 25–75 hp CT. 208/230 V: 15–50 hp VT, 15–40 hp CT.
   Floor mount, 125–500 hp: 20–50 VA for customer use
2. Approximately 50 VA additional to standard is available with option F10 (additional VA transformer).
3. Available only when this option is provided.

Table 41: Terminal Block Characteristics, 24 Vdc Control (1–100 hp: TB2; 100–500 hp: Black Terminals)

Terminal [1, 2]	Function	Characteristics
O [5]	+24 V (+24 V control supply)	Minimum: 19 V; Maximum: 30 V; I = 200 mA maximum [3]
N [5]	+24 V (common)	
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 trip 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) is programmed for Freewheel Stop on bypass. Without bypass it is not assigned.	24 Vdc, 10 mA State 0: V<5 V; State 1: V>11 V; Z = 3.5 kΩ
E	LI1 (Logic Input 1) Run Forward	24 Vdc, 10 mA State 0: V<5 V; State 1: V>11 V; Z = 3.5 kΩ
F	Line contactor auxiliary contact or jumper (if used)	24 Vdc, 10 mA State 0: V<5 V; State 1: V>11 V; Z = 3.5 kΩ
G1 (S2+)	AI2 (Analog Input 2: Speed Reference Current or Voltage)	4–20 mA [4], Z = 250 Ω 0–10 Vdc, Z = 30 kΩ
H	+10 V Reference Supply.	10 Vdc, I = 10 mA maximum
I or W	AI1+ (Analog Input 1: Speed Reference Voltage)	0–10 Vdc, Z = 30 kΩ AI1– (jumpered to J3)
J (S3)	COM (Speed Reference Common)	0 V
S1	Shield	

Notes to Table 41:

1. See the drawings provided separately.
2. All green Phoenix terminals are rated 250 V, 12 A.
   Max. wire size for all green Phoenix terminals:
   1 wire:12 AWG (2.5 mm^2)
   2 wires:16 AWG (1.5 mm^2).
   Min. tightening torque:
   4.5 lb-in (0.5 N•m)

   All Class 9080 Type GM6 terminals are rated 600 V, 30A.
   Max. wire size for all Type GM6 terminals:
   10 AWG (2.5 mm^2)
   Tightening torque:
   7–8 lb-in (0.8–0.9 N•m)
3. Total current of +24 V internal supply is 200 mA. If more current is required, an external supply must be used.
4. 0–20 mA, X–Y programmable with graphic display terminal, or 0–10 Vdc
5. Provided only with MOD Z10.

Table 42: M-Flex User Terminal Connections

NOTE: Terminal connections are enabled only when the corresponding option is selected.

TB1	Option	User Terminals	
120 Vac (for additional VA use)	F10	1	50
Safety Interlocks	standard	1	2
Emergency Stop (door)	T10	2	3
Emergency Stop (user)	standard	3	4
Open	standard	4	5
AUTO Start Contacts	A07,B07,E07,F07	8	9
Seal Water Solenoid	V10	43	50
Motor Space Heater	U10	45	50
Check Valve N.C. Contact	W10	46	47
N.C. AFC Trip Contact	standard	54	56
N.O. AFC Trip Contact	standard	55	56
N.C. AFC Run Contact	standard	51	53
N.O. AFC Run Contact	standard	52	53
SPR Coil	E10	48	49
N.O. Bypass Run Contact	M10	61	62
N.O. Auto Mode Contact	O10	63	64
N.C. AFC Trip Contact	L10	59	60
N.O. AFC Run Contact	K10	57	58

TB2	Option	User Terminals		
24 Vdc	Z10	O (+)	N (–)	
Speed Potentiometer Input	standard	H (+10V)	I (IN)	J (S3) Com
4-20 mA Input	standard	G1 (S2+) IN	J (S3) Com	
0–10 V Input	J10	G1 (S2+) IN	J (S3) Com	
Analog Output # 1	standard	AO1	J (S3) Com	

Extended I/O Card	Option	User Terminals		
Analog Output # 2	H09	AO2 (or AO3)	Com	

Initial Startup 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 61.

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 that requires 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.

Electric shock will result in death or serious injury.

The M-Flex controller 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, Maintenance and Support, beginning on 103.

A door-mounted or remote-mounted graphic display terminal, or a computer loaded with SoMove™ software, must be used to perform the initial start-up procedure.

⚠ 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.

⚠ WARNING

UNINTENDED CONFIGURATION CHANGES

- Changing the macro configurations or installing a new option card reconfigures the controller to factory settings.
- The controller configuration must be reinstalled.

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

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 the diagrams provided with the controller.

In addition, after installing any plug-in option card for the first time, previously-saved parameters downloaded from the keypad or PC software will not be correct because they do not include the additional parameters available with the card. The analog card parameters must be set as listed in the elementary diagram that corresponds to the options ordered. See the diagrams provided with the controller.

Start-Up Procedure

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

- ❑ Step 1: Check the enclosure components and connections (see page 78).
- ❑ Step 2: Provide motor overload protection and thermal protection (see page 79).
- ❑ Step 3: Test motor rotation (see page 80).
- ❑ Step 4: If your controller has a bypass, test the motor rotation in bypass mode (see page 81).
- ❑ Step 5: Check the graphic display terminal high speed, low speed, acceleration, and deceleration settings (see page 81).

Step 1: Checking the Enclosure Components and Connections

A. Verify that all equipment disconnects are open.

B. Set the Hand-Off-Auto selector switch (controller mounted or remote mounted) to Off and the AFC-Off-Bypass switch (if used) to Off.

C. Set the speed potentiometer (controller mounted or remote mounted) to its minimum setting (full counterclockwise position).

D. Open the enclosure door. Turn the circuit breaker and handle assembly to the Off position as shown in Figure 17 on page 49, and unscrew the door thumbscrews or quarter-turn fasteners.

E. Check the wiring of the input power ground, motor ground, speed potentiometer (if remote mounted), and Hand-Off-Auto circuit connections (if remote mounted). See the control circuit elementary diagrams provided separately, and the power circuit descriptions starting on page 92, for wiring diagrams of the remote control operators.

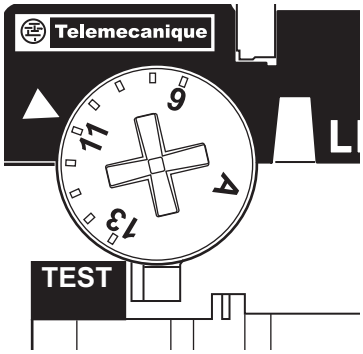
F. When using the bypass circuit, check that the motor conductors are wired to the T1, T2, and T3 terminals of the overload relay. When using the power circuit *without* bypass, ensure that the motor conductors are wired either to T1/U, T2/V, and T3/W of the power converter, or to the T1, T2, and T3 distribution block below the power converter.

G. Follow the “Circuit Breaker Trip Adjustment Procedure” on page 83.

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 ± 10% of the input voltage rating on the controller nameplate.

Step 2: Providing Motor Overload Protection and Thermal Protection

Figure 30: Overload Relay Dial



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

Overload Relay Adjustment

A. 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 Figure 30.

B. Close and secure the enclosure door by tightening the thumbscrews. Close the equipment disconnect means. The Power On pilot light (if used) illuminates.

C. Provide power by closing the disconnect.

D. Press ESC on the graphic display terminal until the Main menu is displayed and the Drive menu is highlighted. Press the keypad knob (ENT) twice. The Simply Start menu is displayed.

E. Rotate the keypad knob clockwise until Mot. Therm Current is highlighted. Press ENT.

F. Rotate the keypad knob until the display indicates the correct MFLC. Press ENT.

The controller is now calibrated to provide motor overload protection. To return to the monitor screen, press ESC three times.

Refer to the *Programming Manual* on the CD supplied with the power converter.

Always verify that the overload relay setting does not exceed the motor full load current or rated controller current found on the M-Flex nameplate, whichever is less.

Table 43 provides the range of adjustment for overload relays according to horsepower rating and voltage. Contact your Schneider Electric representative if the overload range or adjustment does not meet the intended application.

Table 43: Overload Relay Adjustment Range For Full Voltage Bypass Operation

HP	208 V	230 V	460 V
1	4–6	4–6	1.6–2.5
2	7–10	5.5–8	2.5–4
3	9–13	9–13	4–6
5	12–18	12–18	5.5–8
7.5	23–32	16–24	9–13
10	23–32	23–32	12–18
15	37–50	37–50	16–24
20	48–65	48–65	23–32
25	63–80	63–80	30–40
30	60–100	60–100	37–50
40	90–150	90–150	48–65
50	90–150	90–150	55–70
60	—	—	60–100
75	—	—	90–150
100	—	—	90–150 [1]
125	—	—	132–220 [1]
150	—	—	132–220 [1]
200	—	—	200–330 [1]

1 When barriered bypass (Z06) is selected, a class 8536 Type S NEMA size 5 starter is provided. Select melting alloy overload thermal units (not included) appropriate for the current and application.

> **⚠ CAUTION**
>
> **OVERHEATED MOTOR**
>
> - This controller does not provide direct thermal protection for the motor.
> - Use of a thermal sensor in the motor may be required for protection at all speeds or load conditions.
> - Consult the motor manufacturer for the thermal capability of the motor when it is operated over the desired speed range.
>
> **Failure to follow these instructions can result in injury or equipment damage.**

Step 3: Testing Motor Rotation

> **⚠ WARNING**
>
> **HAZARDOUS MOVING PARTS**
>
> Before starting the controller, ensure that personnel are clear of the motor and its connected load and that the motor and load are ready to run.
>
> **Failure to follow these instructions can result in death or serious injury.**

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 the CD supplied with the power converter, for more information.

A. Set the AFC-Off-Bypass selector switch (if used) to AFC, the Normal-Test selector switch (if used) to Normal, and Hand-Off-Auto selector switch to Hand (push Start if the Start/Stop push buttons are used).
B. Slowly turn the speed potentiometer clockwise to accelerate the motor. Check the direction of motor rotation.
   — If correct, proceed to Step 4: Testing Motor Rotation in Bypass Mode below.
   — If incorrect, stop the controller. **Remove all power!** Correct the motor rotation.

Correcting Motor Rotation

> **⚠ 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 61 before proceeding.
>
> **Failure to follow these instructions will result in death or serious injury.**

To correct the direction of motor rotation:

A. Reverse any two motor leads located on the device terminals marked T1, T2, or T3.
B. Reset the speed potentiometer to minimum speed (fully counterclockwise). Close and secure the enclosure door, then reapply power and restart the controller.

C. Slowly turn the speed potentiometer clockwise to accelerate the motor. Check the direction of motor rotation.

   — If correct, this completes the controller mode motor rotation check.

   — If incorrect, repeat Steps A–C until correct.

Step 4: Testing Motor Rotation in Bypass Mode

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

B. 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 5: Checking the Graphic Display Settings below.

   — If incorrect, stop the controller. **Remove all power!** Correct the motor rotation.

   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 83.

Correcting Motor Rotation in Bypass Mode

⚠ 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 61 before proceeding.

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

To correct the direction of motor rotation:

C. Reverse any two incoming leads to the controller input marked L1, L2, or L3.

D. 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.

   — If incorrect, repeat Steps C and D until correct.

Step 5: Checking the Graphic Display Settings

A. Check the **High Speed (HSP)** setting (maximum motor speed setting).

   a. Press ESC on the graphic display terminal until Main Menu is displayed and Drive Menu is highlighted. Press the keypad knob (ENT) twice. The Simply Start menu is displayed.

   b. Rotate the keypad knob clockwise until High Speed is highlighted. Press ENT.

   c. Rotate the keypad knob until the display indicates the maximum output frequency required for the application (factory default is 60 Hz). Press ENT.

      The controller HSP setting is now complete.

      Refer to the *Programming Manual* on the CD supplied with the power converter.

B. Check the **Low Speed (LSP)** setting (minimum motor speed setting).

   a. Continuing from Step A above, rotate the keypad knob counter-clockwise until Low Speed is highlighted. Press ENT.

   b. 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). Press ENT.

      The controller LSP setting is now complete. To return to the monitor screen, press ESC three times.

      Refer to the *Programming Manual* on the CD supplied with the power converter.

C. The application may require changing the setting of **Acceleration (ACC)** and **Deceleration (dEC)** times. Preset value is 10 s. If the power converter has been replaced or reset to factory defaults, the value will be 3 s. To change the setting:

   a. Press ESC on the graphic display terminal until Main Menu is displayed and Drive Menu is highlighted. Press the keypad knob (ENT) twice. The Simply Start menu is displayed.

   b. Rotate the keypad knob clockwise until Acceleration is highlighted. Press ENT.

   c. Rotate the keypad knob until the display indicates the acceleration time required for the application. Press ENT.

   d. Rotate the keypad knob counter-clockwise until Deceleration is highlighted. Press ENT.

   e. Rotate the keypad knob until the display indicates the deceleration time required for the application. Press ENT.

      The controller acceleration and deceleration time settings are now complete. To return to the monitor screen, press ESC three times.

Circuit Breaker Trip Adjustment Procedure

For Type HLL, PLL, and MJL circuit breakers, no adjustments are required. For Type JLL, KCL, LIL, LLL, or MHL circuit breakers, set the breaker dial to the magnetic trip setting shown in Tables 44–49. Circuit breakers including electronic trip units may require additional adjustment. Refer to the circuit breaker instruction bulletin for making adjustments to circuit breaker trip unit settings.

Table 44: Short-Circuit Protection—460 V, Variable Torque

460 V, VT		Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short-Circuit Protection			
hp	Circuit Breaker	Hold (A)	Trip (A)	Low (A)	High (A)	Controller Only Set (A)	Controller with 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	HLL36035	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
125	JLL36250	—	—	1250	2500	1745	2028
125	KCL34250	—	—	1250	2500	1745	2028
150	LIL36300	—	—	1500	3200	2084	2340
	LLL36400U31X	—	—	600	4800	2084	2340
200	LIL36400	—	—	2000	3200	2498	3120
	LLL36400U31X	—	—	600	4800	2498	3120
250	LIL36400	—	—	2000	3200	3012	3200
	LLL36400U31X	—	—	600	4800	3012	3926
300	MHL36600 [1]	—	—	3000	6000	4017	4693
350	MHL36600 [1]	—	—	3000	6000	4122	5382
400	MHL36700 [1]	—	—	3500	7000	4662	6201
450	MHL36700 [1]	—	—	3500	7000	5221	6695
500	MHL36800 [1]	—	—	4000	8000	5857	7670

1 Fused with Class J time-delay fuses. Refer to Table 61 on page 112 for details.

Table 45: Short-Circuit Protection—230 V, Variable Torque

230 V, VT		Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short—Circuit Protection			
hp	Circuit Breaker	Hold (A)	Trip (A)	Low (A)	High (A)	Controller Only Set (A)	Controller with 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 46: Short-Circuit Protection—208 V, Variable Torque

208 V, VT		Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short-Circuit Protection			
hp	Circuit Breaker	Hold (A)	Trip (A)	Low (A)	High (A)	Controller Only Set (A)	Controller with 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 47: Short-Circuit Protection—460 V, Constant Torque

460 V, CT		Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short—Circuit Protection			
hp	Circuit Breaker	Hold (A)	Trip (A)	Low (A)	High (A)	Controller Only Set (A)	Controller with Bypass Set (A)
1	HLL36015	350	750	—	—	—	—
2	HLL36015	350	750	—	—	—	—
3	HLL36015	350	750	—	—	—	—
5	HLL36025	350	750	—	—	—	—
7.5	HLL36040	400	850	—	—	—	—
10	HLL36050	400	850	—	—	—	—
15	HLL36070	800	1450	—	—	—	—
20	HLL36100	900	1700	—	—	—	—
25	HLL36090	800	1450	—	—	—	—
30	HLL36100	900	1700	—	—	—	—
40	HLL36125	900	1700	—	—	—	—
50	HLL36150	900	1700	—	—	—	—
60	JLL36200	—	—	1000	2000	1000	1001
75	JLL36225	—	—	1125	2250	1125	1248
100	JLL36250	—	—	1250	2500	1455	1612
100	KCL34250	—	—	1250	2500	1455	1612
125	LIL36300	—	—	1500	3200	1716	2028
	LLL36400U31X	—	—	600	4800	1716	2028
150	LIL36300	—	—	1500	3200	2098	2340
	LLL36400U31X	—	—	600	4800	2098	2340
200	LIL36400	—	—	2000	3200	2506	3120
	LLL36400U31X	—	—	600	4800	2506	3120
250	LIL36400 [1]	—	—	2000	3200	3026	3926
	LLL36400U31X	—	—	600	4800	3026	3926
300	MHL36600 [1]	—	—	3000	6000	3758	4693
350	MHL36600 [1]	—	—	3000	6000	4124	5382
400	MHL36700 [1]	—	—	3500	7000	4688	6201
450	MHL36800 [1]	—	—	4000	8000	5240	6695

[1] Fused with Class J time-delay fuses. Refer to Table 61 on page 112 for details.

Table 48: Short-Circuit Protection—230 V, Constant Torque

230 V, CT		Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short—Circuit Protection			
hp	Circuit Breaker	Hold (A)	Trip (A)	Low (A)	High (A)	Controller Only Set (A)	Controller with Bypass Set (A)
1	HLL36015	350	750	—	—	—	—
2	HLL36025	350	750	—	—	—	—
3	HLL36035	400	850	—	—	—	—
5	HLL36060	800	1450	—	—	—	—
7.5	HLL36080	800	1450	—	—	—	—
10	HLL36110	900	1700	—	—	—	—
15	HLL36110	900	1700	—	—	—	—
20	HLL36150	900	1700	—	—	—	—
25	JLL36175	—	—	875	1750	875	884
30	JLL36200	—	—	1000	2000	1000	1040
40	JLL36250	—	—	1250	2500	1250	1352

Table 49: Short-Circuit Protection—208 V, Constant Torque

208 V, CT		Fixed Trip Unit Short-Circuit Protection		Adjustable Trip Unit Short—Circuit Protection			
hp	Circuit Breaker	Hold (A)	Trip (A)	Low (A)	High (A)	Controller Only Set (A)	Controller with Bypass Set (A)
1	HLL36015	350	750	—	—	—	—
2	HLL36025	350	750	—	—	—	—
3	HLL36035	400	850	—	—	—	—
5	HLL36060	800	1450	—	—	—	—
7.5	HLL36080	800	1450	—	—	—	—
10	HLL36110	900	1700	—	—	—	—
15	HLL36110	900	1700	—	—	—	—
20	HLL36150	900	1700	—	—	—	—
25	JLL36175	—	—	875	1750	875	973
30	JLL36200	—	—	1000	2000	1000	1144
40	JLL36250	—	—	1250	2500	1360	1482

Start-Up Checklist

Table 50 on page 87 is an initial start-up checklist for customer use. It is recommended that you store this information with the controller.

Table 50: Controller Start-Up Checklist

	Yes	No	N/A
Equipment Location			
1. Is (Are) the drive(s) mounted in its (their) permanent location(s)?			
2. Is the work area around the drive(s) accessible?			
3. Does the work facility have safety provisions such as first aid, fire extinguishers, etc.?			
Power Connections (Line Side)			
1. Is (Are) the proper sized incoming power connection(s) installed, completely terminated, and properly tightened?			
2. Are the incoming power leads in the standard (A-B-C) rotation pattern?			
3. Have proper grounding practices per NEC codes been followed?			
Motor Connections (Load Side)			
1. Is (Are) the proper motor(s) installed for each controller?			
2. Is (Are) the motor lead(s) completely terminated and properly tightened to the output of each controller?			
3. If an iso/bypass application is part of the installation, are the contactors mounted, wired, and properly tightened?			
4. Is each AFC output power cable in an independent conduit with respect to other AFC output cables?			
5. Can the motor be run at **full** speed in Bypass mode?			
Motor Load Device			
1. Is the proper load device installed and ready?			
2. Is the desired motor rotation known?			
3. Is the load properly coupled to the motor shaft?			
4. At time of start-up, can the application provide maximum motor loading?			
Control Circuit Wiring			
1. Is all local and remote control wiring properly identified, securely terminated, and properly tightened?			
2. Are the low level analog signals separated from control and power wiring?			
3. Was shielded cable used for all analog signals, and is the shield wire grounded at the AFC end **only**?			
4. Is control wiring separated from the power wiring?			
Other User Interfaces			
1. Is (Are) any remote commissioning terminal(s) with any interconnect cable(s) operational and available?			
2. Are any of your serial communication links ready for AFC operational use?			
3. Are accurate control and power wiring diagrams available at the start-up location?			
4. Are specific drive settings known for each controller (e.g., Min/Max speed, Acc/Dec Time, etc.)?			
Availability Of Equipment			
1. Will the equipment be available to be energized and de-energized on the date of start-up?			
2. Will the **process/load** be available to be exercised?			
Authorized Personnel			
1. Will the person(s) responsible for the entire process be available to verify final operation?			
2. Will all necessary **union** trade personnel be ready and available if they need to be present when Schneider Electric Company personnel are working on the equipment?			
Special Requirements: Please list any **specific** concerns/comments			
For enclosed controllers with bypass, are the bypass fuses installed?			
For bypass controllers with NEMA contactors, are the overload elements properly selected to the motor nameplate information and installed?			

Customer Readiness Acknowledgment

I/We have verified that all checklist questions have been answered. All questions with a Yes response indicate a ready state for the start-up to be efficient and successful. Explanation(s) for any question with a No response is listed in the Special Requirements section above.

CUSTOMER NAME: _____

COMPANY NAME: _____

PHONE: (_____) _____ FAX: (_____) _____

SIGNATURE: _____ DATE: _____

Section 3—Circuit Descriptions and Options

Introduction

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

- Power Circuit W: Drive Only (see page 92)
- Power Circuit Y: Integrated Bypass (see page 93)
- Power Circuit Z: Barriered Bypass (see page 93)

Terminal Command Versus Keypad Command Operation

For factory and/or user-supplied pilot devices and controls to be recognized, the M-Flex controller 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 controller with Menu 1.6 settings different from those shown in the ATV61 or ATV71 Factory Configuration tables.

Before re-programming inputs, outputs, torque types, or control types:

- Consult the factory configuration listing on the applicable control circuit diagram provided separately.
- Refer to the *Programming Manual* supplied with the power converter.
- Refer to the instruction bulletin for the selected option, as specified in Table 51.

Table 51: Option Card Bulletins

Bulletin No.	Title	Option
1755869 30072-451-27 30072-451-43	*Modbus Plus Card, VW3A3302* *Supplementary Instructions for ATV71 Option Cards* *Addendum to ATV71 Modbus Plus Card VW3A3302*	A09
1755867 30072-451-27	*Modbus/Uni-Telway™ Card, VW3A3303* *Supplementary Instructions for ATV71 Option Cards*	B09
1754480	*Option Card* (Metasys® N2 Card, VW3A3318)	C09
AAV69931	*Ethernet Modbus TCP/IP Card, VW3A3310D*	D09
1765273	*Option Card* (LonWorks® Card, VW3A3312)	E09
1755877 30072-451-27 30072-451-44	*DeviceNet™ Card, VW3A3309* *Supplementary Instructions for ATV71 Option Cards* *Addendum to ATV71 DeviceNet™ Card*	F09
1755873 30072-451-27 30072-451-45	*Profibus DP Card, VW3A3307* *Supplementary Instructions for ATV71 Option Cards* *Addendum to ATV71 Profibus™ DP VW3A3307*	G09
—	I/O Extension Card, VW3A3202: Refer to the Installation Manual. See Table 2 on page 9.	H09
BBV10543	*Option Card* (Apogee P1 Card, VW3A3314)	J09
1765274	*Option Card* (BACnet Card, VW3A3319)	K09
1755871 30072-451-27	*Interbus Card, VW3A3304* *Supplementary Instructions for ATV71 Option Cards*	L09
1755883 30072-451-27	*Standard Fipio Card, VW3A3311* *Supplementary Instructions for ATV71 Option Cards*	M09
1629225	*Bluetooth USB Adapter, VW3A8115*	O09 or Q09
30072-451-39	*Modbus Bluetooth Adapter, VW3A8114*	P09 or Q09

NOTE: Changing certain factory settings will affect the performance of the M-Flex controller.

⚠ 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 the CD 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 Programming Manual for information on 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. Use the operators located on the front of the controller door to command the AFC and Bypass modes of operation.

Trip Reset

When a communication option is selected, the controller trip reset feature is removed. If Start/Stop commands are not sent over the communication system network, you may choose to activate the trip reset function by assigning trip reset to LI4.

Control Circuit Sequencing and Operation

The following descriptions **do not** represent all possible combinations of standard control options. Order engineered (OE) options are available for other possible combinations.

Run Command Relay (RCR)

The RCR closes if all safety interlocks are closed and the controller has been commanded to run. A run command initiates when:

- The HOA selector switch is in the Hand position.
- The HOA selector switch is in the Hand position and the Start push button has been pressed.
- The H-O-A selector switch is in the Auto position and a user-supplied start contact is closed.
- The C-A-O-H selector switch is in the Communication position, allowing the communication relay to close, and a start command has been transmitted over a digital communication link.
- The start push button has been pushed.

[1] User documentation for Altivar 61 and Altivar 71 controllers is available electronically from the Technical Library at www.schneider-electric.com.

Auxiliary Run Command Relay (ARCR)

ARCR is in parallel with the RCR and provides additional contacts to prevent transfer to bypass when the controller has power applied and is in a trip state, if not commanded to run. If a line contactor is used and the customer-supplied interlock circuits are not closed, the ARCR disconnects line power from the controller via control of the line contactor and isolation contactor.

Auxiliary Drive Run Relay (ADRR1)

If the power converter is running, ADRR1 provides run contacts, and when bypass is supplied, circuit operation of the power converter isolation contactor. This relay is controlled by a programmable relay (R2), internal to the controller, programmed for Drive Run. One N.O. and one N.C. run contact from ADRR1 are provided as standard for customer use. If option K10 is supplied, one additional N.O. contact is wired to the user terminal block TB1.

Auxiliary Drive Run Relay (ADRR2)

ADRR2 is in parallel with ADRR1 and provides additional contacts for operation of the motor elapsed time meter (option S10) and seal water solenoid (option V10), when the controller is operating. ADRR2 contacts provide operation of the motor space heater relays (option U10) when the controller is not running but power to the controller is on. If the contact from the check valve limit switch is closed and the controller is running the motor, ADRR2 contacts also provide actuation of the check valve sequence timer (option W10).

Auxiliary Drive Trip Relay (ADFR1)

ADFR1 provides trip contacts for initiating controller shutdown. If the controller detects a trip condition, it illuminates the drive trip pilot light. This relay is controlled by a programmable relay (R1), internal to the controller, when a line contactor is supplied. A timing head mounted on the RCR holds in the ADFR1 for five seconds. This provides time for the input line contactor (if used) to close and eliminates a momentary false power loss trip indication. ADFR1 provides one N.O. and one N.C. trip contacts as standard for customer use.

Auxiliary Drive Trip Relay (ADFR2)

ADFR2 (option L10) supplies one additional N.C. contact wired to user terminal block TB1.

Auxiliary Transfer Bypass Relay (ATB)

The ATB relay (option R10) is an adjustable timing relay, factory set for 5 seconds. If the automatic transfer to bypass is enabled (using the selector switch mounted inside the enclosure), the relay provides a time delay before automatically transferring to bypass after a controller trip condition.

NOTE: You must confirm that application **ductwork and piping** can handle the pressure resulting from a rapid transfer to full speed operation.

Communication Mode Relay (CMR)

The CMR is provided when control option F07 is supplied. The CMR provides contacts to control the RCR circuit. If the line contactor is used, contacts from the CMR keep power applied to the controller by keeping the line contactor closed when the motor is not running and removing control to LI1. CMR contacts are also used to remove the forced local from LI4. Forced local is a logic input assignment used to force start/stop and speed control command away from communication systems using local control operators such as Hand-Off-Auto.

Check Valve Sequence (CVS) Relay

The CVS relay is a timing relay providing indication of a properly sequenced check valve. If the check valve does not open within the specified time, the CVS relay times out and shuts down the controller. If the valve does not open after the controller starts, the CVS relay circuit illuminates a blue pilot light. Pressing the blue push-to-reset pilot light resets this circuit.

Trip Reset

The M-Flex controllers have remote trip reset capability when H-O-A or H-O-A with Local/Remote control is used. In Auto mode, trips can be remotely reset by cycling the user's auto start contact. If automatic trip reset is not desired, the user's auto start contacts must remain in the closed state. To manually reset trip conditions, select the Off position of the H-O-A selector switch. To disable automatic trip reset, remove the wire connected between terminals TB2-C and ARCR-11.

When a trip reset occurs, the display trip is cleared and stored in the controller. The last eight trips are stored in the controller and can be viewed using the graphic display terminal.

When Start-Stop control option C07 or D07 is provided, a separate trip reset push button (option P10) must be used. When the trip reset push button is pressed the drive trip is reset.

When C-A-O-H control option F07 is provided, trip reset can be performed over the communication link or by cycling power using the disconnect handle at the controller.

Power Circuits—General

Controller Operation

To operate the controller, the circuit breaker disconnect located on the front of the controller 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 selector switch.
  - — In **Hand** mode, the controller automatically restarts when power is restored after a power loss or upon resetting a trip condition
  - — In **Auto** mode, restart depends on the auto-start contact position.
- Three-wire control functionality: Start/Stop push buttons. The controller will not restart when power is restored after a power loss or upon resetting an AFC trip. In Hand mode, the Start push button must be pressed to restart the controller. In Auto mode, restart is dependent on the auto start contact position.

Interlocks

The interlock terminals on terminal block TB1, noted below, are dedicated for accepting a user-supplied N.C. interlock. The power converter will stop operation if the connection between the two terminals is opened. Remove the factory jumper wire located on these terminals before installing the interlock.

- The fire/freezestat interlock connects to terminals TB1-1 to TB1-2.
- The external emergency stop interlock connects to terminals TB1-3 to TB1-4.
- Additional user interlocks connect at terminals TB1-3 to TB1-4 and TB1-5 to TB1-6.

Power Circuit W (Drive Only)

This power circuit operates the motor from the power converter only (without bypass). It consists of:

- a fused control transformer
- circuit breaker disconnect with means for locking in the open position
- power converter
- optional equipment as specified

Operator Controls—General Arrangement and Operation (Drive Only)

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

Option D10 omits the graphic display terminal. If D10 is selected, to alter the programming of the power converter, you must order either a separate graphic display terminal or PowerSuite software.

Power Circuit Y (Integrated Bypass)

This power circuit operates the motor either 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:

- Isolation and bypass contactors with Class 20 overloads (Class 10 for 1 hp @ 460 V)
- Fused control transformer
- Circuit breaker disconnect with means for locking in the open position
- AFC-Off-Bypass switch
- Test-Normal switch
- Overload relay reset push button
- Power converter
- Optional equipment as specified

Power Circuit Z (Barriered Bypass)

This power circuit operates the motor either from the power converter or from full voltage line power (bypass mode). This option consists of one floor mounted enclosure with two doors, two disconnects, and a barrier separating the power converter from the bypass circuit. Refer to Table 52. The bypass circuit consists of an across-the-line full-voltage starter, comprising a contactor (NEMA or IEC) and an overload relay. Each section is supplied by its own circuit breaker disconnect.

Table 52: Power Circuit Z: Enclosure Description

Controller Rating	Power Converter Location	Enclosure Width
1–25 hp, VT and 1–20 hp CT @ 460 V and 1–10 hp VT, CT @ 208/230 V	Below the bypass circuit	20 in. (508 mm)
30–50 hp VT and 25–40 hp CT @ 460 V and 15–25 hp VT, 15–20 hp CT @ 208/230 V	Below the bypass circuit	25 in. (635 mm)
60–100 hp VT and 50–75 hp CT @ 460 V and 30–50 hp VT, 25–40 hp CT @ 208/230 V	Below the bypass circuit	30 in. (762 mm)
125–200 hp VT and 100–150 hp CT @ 460 V	To the left of the bypass circuit	Bypass section: 25 in. (635 mm)

Barriered bypass provides two separate compartments, one for the controller and one for the bypass. This provides maximum maintenance flexibility if emergency full speed operation is required while servicing or replacing the controller. Each compartment is provided with its own circuit breaker disconnect with a door mounted operating handle to ensure the removal of power within the drive compartment when service is required. The circuit breaker disconnect for the bypass provides control power for the contactors and must remain on for drive operation. Line contactor option (B10) is not available as standard with a barriered bypass.

The bypass compartment door cannot be opened unless the power converter compartment door is open.

Operator Controls—General Arrangement and Operation (Bypass)

Operator controls are located on the front door of the controller unless no control options are specified. The controller is factory configured to operate in terminal command mode. Option D10 omits the graphic display terminal. If D10 is selected, to alter the programming of the power converter, you must order either a separate graphic display terminal or PowerSuite software.

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 may be started in the Hand mode for immediate start or in the Auto mode for remote start with an external contact, when an HOA switch is used.

Test-Normal Operation

The test-normal switch can be used to test the power converter while 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: Set the switch to Hand. Use the manual speed potentiometer to change the speed reference and observe power converter operation. Refer to the *Programming Manual* on the CD supplied with the power converter, for trip definitions.

Bypass Operation

To control the operation of the motor with line power, the circuit breaker disconnect located on the front of the controller 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 stop/start 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.
- When the selector switch is moved to the Off position, the bypass contactor opens and the motor stops.

Engineered Power Circuits

Other engineered power-circuit modifications are available to provide backup and redundant control if the power converter becomes inoperable. Refer to the factory-supplied documentation for information on applying these configurations to address your specific requirements.

For units supplied with full-voltage starters, full-speed operation is provided at the end of the acceleration ramp.

Power Circuit R (Isolation And Transfer—RVAT)

This power circuit consists of isolation and transfer contactors integrated with a reduced-voltage autotransformer starter (RVAT) as the emergency bypass.

Power Circuit S (Barriered Bypass—SSRVS)

This power circuit consists of a barriered, compartmentalized enclosure design integrating a solid-state reduced-voltage starter (electronic soft start) as the emergency bypass.

Power Circuit T (Isolation and Transfer)

This power circuit consists of isolation and transfer contactors to coordinate and connect an external electromechanical combination starter, reduced-voltage starter, or solid-state reduced-voltage starter as the emergency bypass.

Modifications

Control Function Descriptions (A07–F07)

Table 53 shows the door-mounted power converter control functions supplied with the available control options. Selector switches are provided for Hand-Off-Auto (H-O-A), Communication-Auto-Off-Hand (C-A-O-H), Forward/Reverse, and Local/Remote control. Push buttons are provided for Start and Stop functions and reset functions.

Table 53: Modification Control Circuits

Control Option (Modifications)	Hand	Off	Auto	Speed Potentiometer	Start/ Stop	Forward/ Reverse	Local/ Remote	Communication
A07	X	X	X	X				
B07	X	X	X	X	X			
C07 [1]				X	X			
D07 [1]				X	X	X		
E07	X	X	X	X			X	
F07	X	X	X	X				X

1. This option is only available for power circuit W (drive only).

Hand Mode (2-Wire Control—Without Start/Stop)

Hand mode is for local control. In Bypass operation, as soon as Hand mode is selected, a full-voltage across-the-line start occurs. In AFC operation, as soon as Hand mode is selected, the power converter starts the motor.

Hand Mode (3-Wire Control—With Start/Stop)

Hand mode is for local control. When used with start/stop buttons, the power converter does not start the motor until the Start button is pressed. In Bypass operation, a full-voltage across-the-line start occurs. In AFC operation, the power converter starts the motor.

Off Mode

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 trip reset.

Auto Mode

Auto mode is for remote control. In Bypass operation, a full-voltage or reduced-voltage start occurs when the user-supplied run contact is closed between controller terminals 8 and 9A on terminal block TB1. In Auto mode and AFC operation, the power converter starts the motor when the user-supplied run contact is closed between controller terminals 8 and 9A on terminal block TB1. Motor speed is varied by adjusting the user-supplied auto speed reference signal (4–20 mA) supplied to terminals G1 (S2+) and J (S3) on terminal block TB2 in the controller. Refer to the *Programming Manual* on the CD supplied with the power converter, for scaling of this signal.

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

When option J10 is selected, the motor speed is varied by adjusting the user-supplied auto speed reference signal (0–10 Vdc) supplied to terminals G1 (S2+) and J (S3) on terminal block TB2.

Start Push Button

The Start push button commands the controller to start the motor (in Hand mode) for local control.

Stop Push Button

⚠ WARNING

INABILITY TO INITIATE A STOP

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

- To stop the controller, 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.

The Stop push button commands the controller 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).

Manual Speed Potentiometer

The manual speed potentiometer is used to control the speed of the controller in Hand mode.

Forward/Reverse

The Forward/Reverse switch selects the input to the power converter, which is programmed for LI1= forward and LI2= reverse.

Local/Remote

The Local/Remote switch selects whether speed control is sent by signal into terminal AI1 (local) or AI2 (remote) on terminal block TB2, when the Hand-Off-Auto switch is in Auto mode.

Communication Mode

Communication mode is for communication option card control of the controller. When Communication mode is selected the RCR is picked up, input to LI1 opens, and forced local releases. In Communication mode, the controller receives start, stop, and speed commands from a serial communication protocol.

Pilot Light Option Clusters (A08–F08)

The pilot light options listed in Table 54 provide visual indication of protective functions and circuit status. All pilot light bulbs are LEDs, which can be removed from the front with the enclosure door closed. All pilot lights are rated for 120 Vac.

Table 54: Pilot Light Cluster Identification

Cluster/Option	Power On	AFC Run	Auto	Trip	Bypass	Forward	Reverse	Hand	Comm
A08, #1 Cluster	X	X	X	X					
B08, #2 Cluster [1]	X	X		X	X				
C08, #3 Cluster [2]	X	X		X					
D08, #4 Cluster [2]	X			X		X	X		
E08, #5 Cluster	X	X	X	X				X	
F08, #6 Cluster	X	X		X					X

1. This option is only available for power circuit Y (integrated bypass) or power circuit Z (barriered bypass).
2. This option is only available for power circuit W (drive only).

Power On (red)

This pilot light illuminates when mains power is applied to the controller.

AFC Run (green)

This pilot light illuminates to annunciate an AFC run condition.

Auto (yellow)

This pilot light illuminates to annunciate that speed control is via the remote contact closure and the 4–20 mA (or 0–10 Vdc) signal into AI2 with the Hand-Off-Auto switch set to Auto.

Trip (yellow)

- For power circuit W (drive only): the pilot light illuminates to annunciate an AFC trip condition.
- For power circuit Y (bypass) or power circuit Z (barriered bypass): the pilot light illuminates to annunciate an AFC trip condition. When option B10 (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.

Bypass (yellow)

This pilot light illuminates when the motor is started across the line. The pilot light device is sequenced by initiation of the bypass contactor.

Forward (green)

This pilot light illuminates to annunciate that the power converter is set to run in the forward direction with input to LI1.

Reverse (green)

This pilot light illuminates to annunciate that the power converter is set to run in the reverse direction with input to LI2.

Hand (blue)

This pilot light illuminates to annunciate that speed control is by the speed potentiometer on AI1 and the Hand-Off-Auto switch is set to Hand.

Comm (yellow)

This pilot light illuminates to annunciate that the Communication-Auto-Off-Hand switch is set to Comm and control is via a communication card with LI4 set to forced local.

Communication Options

All communication cards are provided without factory programming. Refer to the communication card manual for a description of forced local operation.

A09: Modbus Plus

This option card provides a factory-installed plug-in Modbus Plus card, VW3A3302. This interface device connects to a Modbus Plus tap.

B09: Modbus/Uni-Telway

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

C09: Metasys N2

This option provides a factory-installed plug-in. Metasys N2 card, VW3A3318.

D09: Ethernet

This option provides a factory-installed plug-in Ethernet card, VW3A3310D, with user termination to RJ45 plug-in interface connector.

E09: LONWORKS

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

F09: DeviceNet

This option provides a factory-installed plug-in DeviceNet card, VW3A3309, with user termination to a terminal block.

G09: Profibus

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

H09: I/O Extension Card

This option provides a 0–20 mA analog output for customer use. It includes a plug-in I/O extension card, VW3A3202. The output is factory-programmed for motor frequency. Refer to the *Programming Manual* on the CD supplied with the power converter, for other programming choices. Selectable x–y range with graphic display terminal.

J09: Apogee P1

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

K09: BACnet

This option provides a factory-installed BACnet card, VW3A3319.

L09: Interbus

This option provides a factory-installed Interbus card, VW3A3304.

M09: Fipio

This option provides a factory-installed Fipio card, VW3A3311.

O09: Bluetooth USB

This option provides a Bluetooth USB device, VW3A8115, pending availability.

P09: Bluetooth Modbus

This option provides a Bluetooth Modbus adapter, VW3A8114, pending availability.

Q09: Bluetooth USB and Modbus

This option provides both a Bluetooth USB device, VW3A8115, and a Bluetooth Modbus adapter, VW3A8114, pending availability.

Miscellaneous Options

A10: 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 (in place of the factory-installed 3% AC line reactor) for harmonic mitigation.

B10: Line Contactor

This option is only available for power circuit Y (bypass). It provides a line contactor factory-wired between the circuit breaker disconnect (or line reactor or harmonic filter when provided) and the power converter.

NOTE: With line contactor option B10, the AFC Trip 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.

When the line contactor is open, serial communication is disabled.

C10: 3–15 psi Transducer with Digital Display (TB2-G1/S2+ to TB2-J/S3)

This option provides the controller with the capability to follow a 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. User connection to the module is made at terminals G1 (S2+) and J (S3) on terminal block TB2. Not available with control options C07, start-stop, D07, forward-reverse, or if option J10, 0–10 V auto speed reference, is used.

D10: Omit Graphic Display Terminal

This option omits the graphic display terminal. If option D10 is selected, to alter the programming of the power converter, you must order a separate graphic display terminal, PowerSuite software, or wireless bluetooth device.

E10: Smoke Purge Relay (TB1-48 to TB1-49)

This option provides a smoke purge operating mode controlled by a user-supplied 120 Vac signal applied between terminals 48 and 49 on terminal block TB1.

- For power circuit W (drive only): When 120 Vac power is supplied to 48 and 49, the controller runs the motor at 60 Hz.
- For power circuit Y (integrated bypass) or power circuit Z (barriered bypass): When 120 Vac power is supplied to 48 and 49, motor operation is transferred to bypass (if not operating in this mode already), and runs at full speed.

F10: Additional Control Power VA (TB1-1 to TB1-50)

This option provides an additional 50 VA increase in the transformer at terminals 1 and 50 on terminal block TB1. It must be selected if options U10 and V10 are both selected.

G10: cUL Listing

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

H10: 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 51.

I10: Permanent Wire Marker Sleeves

This option provides permanent wire marking on the control wires with marker sleeves.

J10: 0–10 V Auto Speed Reference (TB2-G1/S2+ to J-S3)

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 TB2. The 0–10 V analog input is not optically isolated, but it does contain noise suppression circuitry and a programmable electronic filter. Not available with C07 or D07 controls, or with 3–15 psi transducer, C10.

K10: Additional N.O. Auxiliary Drive Run Contact (TB1-57 to TB1-58)

This option provides one N.O. drive run contact at terminals 57 and 58 on terminal block TB1 in addition to the Form C drive run contacts provided as standard. This contact indicates when the power converter is running.

L10: Additional N.C. Auxiliary Drive Trip Contact (TB1-59 to TB1-60)

This option supplies one N.C. drive trip contact at terminals 59 and 60 on terminal block TB1 in addition to the standard Form C drive trip contacts. This contact indicates a power converter trip.

M10: N.O. Auxiliary Bypass Run Contact (TB1-61 to TB1-62)

This option is only available for power circuit Y (bypass). It supplies one N.O. bypass run contact at terminals 61 and 62 on terminal block TB1 to indicate that the controller is running in bypass mode.

O10: N.O. Auxiliary Auto Mode Contact (TB1-63 to TB1-64)

This option supplies one N.O. auto mode contact at terminals 63 and 64 on terminal block TB1 to indicate that the controller is set to run in Auto mode with a signal into AI2 and operation by remote operating contact. Not available with C07 or D07 controls.

P10: AFC Trip Reset (TB2-A to TB2-C)

This option is only available with control options C07 and D07 and for power circuit W (drive only). It provides trip reset to LI4 on the power converter at terminals A and C on terminal block TB2 when an H-O-A switch is not supplied.

Q10: Push-to-Test Pilot Lights

This option provides a push-to-test feature on all pilot lights except Power On. Not available on a trip light unless P10 is selected.

R10: Auto Transfer to Bypass (TB1-23 to TB1-27 and TB1-22 to TB1-23)

This option is only available for power circuit Y (integrated bypass) or power circuit Z (barriered bypass). It is not available with control options B07, C07, or D07. This option provides an automatic transfer to bypass at terminals 23 to 27 and 22 to 23 on terminal block TB1. Whenever the power converter trips, this function transfers to bypass within 5 seconds of the trip. An enable/disable (off) switch is provided internally.

S10: Motor Elapsed Time Meter (TB1-44 to TB1-50)

This option provides an elapsed time meter, connected at terminals 44 and 50 on terminal block TB1, which operates whenever the motor runs. The motor elapsed time meter is non-resettable

T10: Emergency Stop (TB1-2 to TB1-3)

⚠ WARNING

POWER IS MAINTAINED ON MOTOR AND CONTROLLER

- Emergency Stop, option T10, does not remove all power for the motor or the controller.
- Automatic restart may occur when the mushroom head operator is rotated to reclose the contact.
- Emergency Stop is a normal ramp-to-stop function using power from the controller, and it will force a controlled ramp-to-stop in all control modes, including Communication mode.
- Always open the controller disconnect or remove power to the controller after an emergency stop is initiated.

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

This option provides an emergency stop mushroom-operator push button mounted on the enclosure door. The push button is maintained in the open position until the operator is rotated to reclose the contact. This option is not available with control options C07 or D07.

U10: Motor Space Heater Sequencing (TB1-45 to TB1-50)	This option provides contact closure and terminals on terminal block TB1 with 120 V / 50 VA available. This voltage will be available at terminals 45 and 50 whenever the motor is not running.
V10: Seal Water Solenoid (TB1-43 to TB1-50)	This option provides contact closure and terminals on terminal block TB1 with 120 V / 50 VA available. This voltage will be available at terminals 43 and 50 whenever the motor is energized.
W10: Check Valve Sequencing (TB1-46 to TB1-47)	This option provides a timed safety contact at terminals 46 and 47 on terminal block TB1, available for an N.C. limit switch contact that shuts down the controller whenever the user-supplied limit switch contact does not open within a specified time. This option also supplies an illuminated blue reset push button on the enclosure door.
X10: I.D. Engraved Nameplates	This option provides a lamacoid nameplate which is engraved per user request and attached to the front door of the enclosure.
Y10: Harmonic Filter Provisions	This option provides fuses in a fuseblock for connection to an externally mounted harmonic filter input, and a distribution block for return wires from the harmonic filter to the controller. Not available for 1, 2, or 3 hp controllers.
Z10: 24 Vdc Power Supply [TB2-O (+) to TB2-N (COM)]	This option provides a 24 Vdc / 300 mA power supply to terminals O (+) and N (COM) on terminal block TB2.
310: Order Engineered (Internal Use Only)	Order Engineered. For internal use only.
410: RFI Suppressor	This option provides RFI suppression with ferrite cores which are factory attached on the power wires ahead of the power converter.
610: 100 kAIC	This option increases the short circuit current rating from 65 kA to 100 kA. It is available with controllers using the PowerPact P circuit breakers, 300 hp to 450 hp CT or 300 hp to 500 hp VT.

Section 4—Maintenance and Support

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- 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.
- Turn off all power supplying this equipment before working on or inside 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 M-Flex controllers. Installation, adjustment, repair, and maintenance of the controllers must be performed by qualified personnel.
- User is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this controller, 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 controller:
  - — Disconnect all power including external control power that may be present before servicing the controller.
  - — Place a “DO NOT TURN ON” label on the controller disconnect.
  - — Lock the disconnect in open position.
  - — WAIT 15 MINUTES for the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure on page 61 to verify that the DC voltage is less than 42 V. The controller LEDs are not accurate indicators of the absence of DC bus voltage.
- Install and close all covers before applying power or starting and stopping the controller.

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 operation 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 trip code.

NOTE: For controllers equipped with optional line contactor (option B10) the power is removed via the line contactor in the event that the 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 controller 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 that component replacement is necessary, refer to “Field Replacement of Power Converters” on page 105.

Preventive Maintenance

Type 1 controllers in the 1–7.5 hp range at 460 V and 1–5 hp range at 208/230 V use convection cooling. All converters use forced air cooling. Inspect the interior fans 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 on pages 32–46.

To maintain the environmental rating of Type 12/12K 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 12/12K enclosure. It can be omitted when option D10 is selected and in that case a closing plate must be installed to maintain the Type 12/12K environmental rating.

On 100–450 hp CT and 125–500 hp VT, 460 V controller with 1G enclosures, clean the filters at least once every 6 months. See Appendix B on page 115.

Field Replacement of Power Converters

1–75 hp CT and 1–100 hp VT

Power converters cannot be replaced in the field on 100-450 hp CT or 125-500 hp VT 460 V controllers. For replacement of power converters on drives in the range, contact:

Schneider Electric
Drives Product Support Group

Toll free: 1-888-778-2733
Fax: 919-217-6508

E-mail: drive.products.support@schneider-electric.com

If the power converter becomes inoperable in the M-Flex controllers, it must be replaced. Refer to Table 55 for power converter weight before handling this component.

Table 55: Power Converter Weights

Horsepower				Weight			
Variable Torque (VT)		Constant Torque (CT)		Maximum, Converter		Max., Converter with Flange	
460 V	208/230 V	460 V	208/230 V	lb	kg	lb	kg
1–25	1–5	1–20	1–5	19.8	9.0	30.6	13.9
—	7.5–10	—	7.5–10	19.8	9.0	30.6	13.9
30–50	15–25	25–40	15–20	57.2	26.0	66.4	30.2
60–100	30–50	50–75	25–40	96.8	44.0	108.2	49.2
125 [1]	—	100 [1]	—	96.8	44.0	—	—
150–250 [1]	—	125–200 [1]	—	176.0	80.0	—	—
300–500 [1]	—	250–450 [1]	—	308.0	140.0	—	—

1. For replacement of any 100–450 hp CT or 125–500 hp VT power converters, contact Schneider Electric AC Drives Technical Support.

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

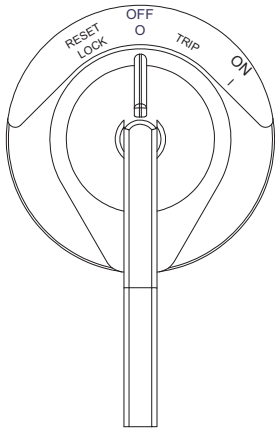
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power.
- Place a “Do Not Turn On” label on the controller disconnect.
- Lock the disconnect in the open position.
- Read and understand the bus voltage measurement procedure on page 61 before performing the procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- Many parts in the controller, 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 connectors with voltage present.

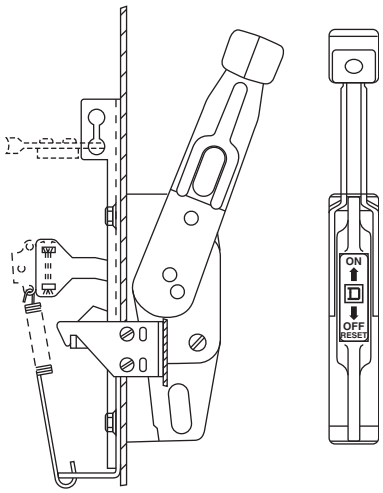
Failure to follow these instructions will result in death or serious injury.

Figure 31: Circuit Breaker Handle Assembly

208/230 V; and 1–75 hp CT / 1–100 hp VT @ 460 V



100–450 hp CT / 125–500 hp VT @ 460 V



Installing the Power Converter Assembly

⚠ 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.

To replace the power converter:

1. Open the controller door by moving the circuit breaker handle assembly to the Off position. Refer to Figure 31.
2. Measure the DC bus voltage as described on page 61 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. For the 60–100 hp VT, 50–75 hp CT 460 V and 30–50 hp VT, 25–40 hp CT 208/230 V, it is necessary to remove the heatsink fan assembly before removing the power converter. Refer to the “Field Replacement of the Heatsink Fan Assembly” on page 108 for directions.
5. Remove the outside hex-slot flange screws that secure the power converter to the enclosure back pan. Refer to Figures 26–29 starting on page 64 for screw locations. Refer to Table 56 for the number of screws on your controller. Keep the screws for the new power converter.
6. Remove the power converter assembly from the enclosure.

Table 56: Number of Flange Screws

Constant Torque (CT) hp		Variable Torque (VT) hp		No. of Screws
460 V	208/230 V	460 V	208/230 V	
1–5	1–5	1–7.5	1–5	10
7.5–20	7.5–10	10–25	7.5–10	10
25	10–20	30	15–25	10
30	—	40	—	12
40	—	50	—	14
—	25–30	—	30–40	12
50	40	60	50	14
60–75	—	75–100	—	16

To install the new power converter:

1. Install the new power converter assembly in the enclosure.
2. Secure the power converter frame to the enclosure back pan with the flange 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 Tables 57–59 on page 107. Check all wiring connections for correct terminations and check the power wiring for grounds with an ohmmeter.
4. Shut the enclosure door, secure the door with door fasteners, and close the circuit breaker disconnect.

⚠ 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.

5. Program the controller according to the control circuit elementary diagrams provided with each controller. Follow the initial start-up procedure on page 77.

The controller is now ready to operate.

Table 57: Converter Power Terminal Torque—460 V

VT		CT		Torque	
Catalog Number	hp	Catalog Number	hp	lb-in	N•m
MFDC•4V_ to MFDG•4V_	1–7.5	MFDC•4C_ to MFDF•4C_	1–5	12.3	1.4
MFDH•4V_ to MFDJ•4V_	10–15	MFDG•4C_ to MFDH•4C_	7.5–10	26.5	3
MFDK•4V_	20	MFDJ•4C_	15	26.5	3
MFDL•4V_ to MFDM•4V_	25–30	MFDK•4C_ to MFDL•4C_	20–25	47.7	5.4
MFDN•4V_ to MFDQ•4V_	40–60	MFDM•4C_ to MFDP•4C_	30–50	106.2	12
MFDR•4V_ to MFDT•4V_	75–125	MFDQ•4C_ to MFDS•4C_	60–100	360	41
MFDU•4V_	150	MFDT•4C	125	212	24
MFDW•4V_	200	MFDU•4C	150	212	24
MFDX•4V_	250	MFDW•4C	200	212	24
MFDY•4V_	300	MFDX•4C	250	360	41
MFDZ•4V_	350	MFDY•4C	300	360	41
MFD4•4V_	400	MFDZ•4C	350	360	41
MFD5•4V_	450	MFD4•4C	400	360	41
MFD6•4V_	500	MFD5•4C	450	360	41

Table 58: Converter Power Terminal Torque—230 V

VT		CT		Torque	
Catalog Number	hp	Catalog Number	hp	lb-in	N•m
MFDC•3V_ to MFDG•3V_	1–7.5	MFDC•3C_ to MFDF•3C_	1–5	12.3	1.4
MFDH•3V_ to MFDJ•3V_	10–15	MFDG•3C_ to MFDH•3C_	7.5–10	26.5	3
MFDK•3V_ to MFDL•3V_	20–25	MFDJ•3C_ to MFDK•3C_	15–20	47.7	5.4
MFDM•3V_ to MFDN•3V_	30–40	MFDL•3C_ to MFDM•3C_	25–30	106.2	12
MFDP•3V_	50	MFDN•3C_	40	360	41

Table 59: Converter Power Terminal Torque—208 V

VT		CT		Torque	
Catalog Number	hp	Catalog Number	hp	lb-in	N•m
MFDC•2V_ to MFDG•2V_	1–7.5	MFDC•2C_ to MFDF•2C_	1–5	12.3	1.4
MFDH•2V_ to MFDJ•2V_	10–15	MFDG•2C_ to MFDH•2C_	7.5–10	26.5	3
MFDK•2V_ to MFDL•2V_	20–25	MFDJ•2C_ to MFDK•2C_	15–20	47.7	5.4
MFDM•2V_ to MFDN•2V_	30–40	MFDL•2C_ to MFDM•2C_	25–30	106.2	12
MFDP•2V_	50	MFDN•2C_	40	360	41

Field Replacement of the Heatsink Fan Assembly

All converters use forced air cooling. If a heatsink fan becomes inoperable in the 10–100 hp 460 V or 7.5–50 hp 208/230 V controllers, 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

NOTE: A heatsink fan assembly is required for this procedure. Refer to the Renewable Parts tables in Appendix A for the catalog number.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power.
- Place a “Do Not Turn On” label on the controller disconnect.
- Lock the disconnect in open position.
- Read and understand the bus voltage measurement procedure on page 61 before performing the procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- Many parts in the controller, 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 connectors with voltage present.

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.

To replace the heatsink fan assembly, follow these steps:

1. Open the controller door by moving the circuit breaker handle assembly to the Off position. Refer to Figure 31 on page 106.
2. Measure the DC bus voltage as described on page 61.

3. Locate the heatsink fan assembly.
4. Remove the four screws securing the heatsink fan assembly. Keep the four screws.
5. Lift the heatsink fan assembly above the flange opening.
6. Disconnect the heatsink fan cable from the converter.
7. Remove the heatsink fan assembly from the enclosure.

Installing the Heatsink Fan Assembly

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

1. Place the heatsink fan assembly near the flange opening.
2. Connect the heatsink 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. The controller is now ready to operate.

Field Replacement of the Stirring Fans

If a stirring fan inside the enclosure becomes inoperable in the M-Flex controllers, the fan must be replaced.

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

Field Replacement of the Plenum Fans

Floor mount units (460 V, 30–100 hp VT / 25–75 hp CT and 208/230 V 15–50 hp VT / 15–40 hp CT) use a plenum fan to assist in air movement over the controller heatsink. If the plenum fan becomes inoperable in the M-Flex controller, the fan must be replaced.

Before removing the inoperable plenum fan, mark the airflow direction on the plenum fan mounting bracket to ensure proper installation of the replacement fan.

Technical Support

When troubleshooting the M-Flex controller, 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 e-mail:

Schneider Electric
Drives Product Support Group

Toll free:	1-888-778-2733
E-mail:	drive.products.support@schneider-electric.com
Fax:	919-217-6508

The Drive Products Support Group is staffed from 8 am to 8 pm Eastern time for diagnosis of product problems and advice for the correct course of action. Emergency startup or breakdown phone support is available seven days a week, 24 hours a day, 365 days a year.

Schneider Electric Services (On-Site)

The Schneider Electric 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

Schneider Electric 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:	866-507-0894
Fax:	859-372-1565

Appendix A—Renewable Parts

Table 60: 460 V Renewable Parts, 1–100 hp VT / 1–75 hp CT

Description	Qty	1–7.5 hp	Qty	10–25 hp	Qty	30–50 hp	Qty	60–-100 hp
Power Converter: Variable Torque (VT) [3]	1	ATV61H075N4 (1 hp) ATV61HU15N4 (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)
Power Converter: Constant Torque (CT) [3]	1	ATV71H075N4 (1 hp) ATV71HU15N4 (2 hp) ATV71HU22N4 (3 hp) ATV71HU40N4 (5 hp) ATV71HU55N4 (7.5 hp)	1	ATV71HU75N4 (10 hp) ATV71HD11N4 (15 hp) ATV71HD15N4 (20 hp) ATV71HD18N4 (25 hp)	1	ATV71HD22N4 (30 hp) ATV71HD30N4 (40 hp) ATV71HD37N4 (50 hp)	1	ATV71HD45N4 (60 hp) ATV71HD55N4 (75 hp)
Graphic Display Terminal	1	VW3A1101	1	VW3A1101	1	VW3A1101	1	VW3A1101
Primary Control Fuses								
Standard 300 VA	2	25430-20320	2	25430-20320	2	25430-20320	2	25430-20320
Barriered bypass additional 150 VA	2	25430-20150	2	25430-20150	2	25430-20150	2	25430-20150
Option F10 350 VA	2	25430-20351	2	25430-20351	2	25430-20351	2	25430-20351
Secondary Control Fuses								
Standard	1	25430-20400	1	25430-20400	1	25430-20400	1	25430-20400
Barriered bypass	1	25430-20200	1	25430-20200	1	25430-20200	1	25430-20200
Option F10	1	25430-20500	1	25430-20500	1	25430-20500	1	25430-20500
Pilot Light, Red	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	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]
Pilot Light, Green	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]
Pilot Light, Blue	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]
Pilot Light Mounting Collar w/ Light Module	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6
Pilot Light Mounting Collar w/ Light Module, and 1 N.O. and 1 N.C. Contact for p-t-t [1]	1	ZB5AW065	1	ZB5AW065	1	ZB5AW065	1	ZB5AW065
I/O Extension [2]	1	VW3A3202	1	VW3A3202	1	VW3A3202	1	VW3A3202
LONWORKS [2]	1	VW3A3312	1	VW3A3312	1	VW3A3312	1	VW3A3312
Modbus [2]	1	VW3A3303	1	VW3A3303	1	VW3A3303	1	VW3A3303
Metasys N2 [2]	1	VW3A3318	1	VW3A3318	1	VW3A3318	1	VW3A3318
24 Vdc Supply	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003
Stirring Fan Assembly	1	N/A	1	31158-065-50	2	31158-065-50	2	31158-065-50

1. p-t-t: Push-to-test operator.
2. Field replacement of the option board resets the power converter to the factory defaults. The user must configure the controller per the elementary diagram provided.
3. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Table 60: 460 V Renewable Parts, 1–100 hp VT / 1–75 hp CT *(continued)*

Description	Qty	1–7.5 hp	Qty	10–25 hp	Qty	30–50 hp	Qty	60–-100 hp
Heatsink Fans	1	VZ3V1203 (1–3 hp) VZ3V1209 (5–7.5 hp)	1	VZ3V1204 (10–15 hp VT, 10 hp CT) VZ3V1210 (20 hp VT, 15 hp CT) VZ3V1205 (25 hp VT, 20 hp CT)	1	VZ3V1205 (30 hp VT, 25 hp CT) VZ3V1211 (40 hp VT, 30 hp CT) VZ3V1206 (50 hp VT, 40 hp CT)	1	VZ3V1206 (60 hp VT, 50 hp CT) VZ3V1208 (75–100 hp VT, 60–75 hp CT)
Plenum Fan Assembly	—	N/A	—	N/A	1	31164-215-50	1	31164-215-50
Filter for Input Plenum	—	N/A	—	N/A	1	31164-152-01	1	31164-153-01
Barriered Enclosure	1	31164-152-01	1	31164-152-01	1	31164-153-01	1	31164-174-01
Circuit Breaker Handle	1	3 in. handle for wall mount and barriered floor mount enclosure: 9421LH3	1	3 in. handle for wall mount and barriered floor mount enclosure: 9421LH3	1	6 in. handle for floor mount enclosure: 9421LH6	1	6 in. handle for floor mount enclosure: 9421LH6

1. p-t-t: Push-to-test operator.
2. Field replacement of the option board resets the power converter to the factory defaults. The user must configure the controller per the elementary diagram provided.
3. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Table 61: 460 V, Renewable Parts 125–500 hp VT / 100–450 hp CT

Description	Qty	125–200 hp	Qty	250 hp	Qty	300–500 hp
Power Converter: Variable Torque (VT) [4]	1	ATV61HD75N4 (125 hp) ATV61HC11N4 (150 hp) ATV61HC13N4 (200 hp)	1	ATV61HC16N4 (250 hp)	1	ATV61HC22N4 (300 hp) ATV61HC22N4 (350 hp) ATV61HC25N4 (400 hp) ATV61HC31N4 (450 hp) ATV61HC31N4 (500 hp)
Power Converter: Constant Torque (CT) [4]	1	ATV71HD75N4 (100 hp) ATV71HD90N4 (125 hp) ATV71HC11N4 (150 hp) ATV71HC13N4 (200 hp)	1	—	—	ATV71HC16N4 (250 hp) ATV71HC20N4 (300 hp) ATV71HC25N4 (350 hp) ATV71HC25N4 (400 hp) ATV71HC28N4 (450 hp)
Graphic Display Terminal	1	VW3A1101	1	VW3A1101	1	VW3A1101
Power Fuses	—	—	3	Bussmann LPJ400SP (CT)	3	Bussmann LPJ500SP (300 hp CT) Bussmann LPJ600SP (350–400 hp CT) Bussmann LPJ600SP (300–500 hp VT)
Primary Control Fuses Standard	2	25430-20161 (no bypass) 25430-20281 (w/ bypass)	2	25430-20161 (no bypass)	2	25430-20281 (no bypass)
Secondary Control Fuses Standard	1	25430-20250 (no bypass) 25430-20400 (w/ bypass)	1	25430-20250 (no bypass)	1	25430-20400 (no bypass)
Pilot Light Red	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04
Pilot Light Yellow	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]
Pilot Light Green	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]
Pilot Light Blue	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]
Pilot Light Mounting Collar w/ Light Module	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6
Pilot Light Mounting Collar w/ Light Module and 1 N.O. and 1 N.C. Contact for p-t-t [1]	1	ZB5AW065	1	ZB5AW065	1	ZB5AW065

1. p-t-t: Push-to-test operator.
2. Field replacement of the option board resets the power converter to the factory defaults. The user must configure the controller per the elementary diagram provided.
3. See Appendix B on page 115 for maintenance instructions.
4. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Table 61: 460 V, Renewable Parts 125–500 hp VT / 100–450 hp CT *(continued)*

Description	Qty	125–200 hp	Qty	250 hp	Qty	300–500 hp
I/O Extension [2]	1	VW3A3202	1	VW3A3202	1	VW3A3202
LONWORKS [2]	1	VW3A3312	1	VW3A3312	1	VW3A3312
Modbus [2]	1	VW3A3303	1	VW3A3303	1	VW3A3303
Metasys N2 [2]	1	VW3A3318	1	VW3A3318	1	VW3A3318
24 Vdc Supply	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003
Stirring Fan Kit	1	26016-31100	1	26016-31100	2	26016-31100
Heatsink Fan Assembly	1	VZ3V1208 (125 hp VT, 100 hp CT) VZ3V1215 (150 hp VT, 125 hp CT) VZ3V1212 (200 hp VT, 150–200 hp CT)	1	VZ3V1212 (250 hp VT, CT)	1	VZ3V1212 (300–500 hp VT, 300–450 hp CT)
Internal Fan Kit	1	VZ3V1214 (150–200 hp VT, 125–150 hp CT) VZ3V1213 (200 hp CT) Note: 125 hp VT, 100 hp CT internal fan not required)	1	VZ3V1213 (250 hp VT, CT)	1	VZ3V1213 (300–500 hp VT, 300–450 hp CT)
Foam Filter Element for 1G Enclosures [3]	1	80444-134-01	1	80444-134-01	1	80444-134-02
Circuit Breaker Operating Mechanism	1	80418-841-50 (125 hp, no bypass) 80439-801-51 (150–200 hp, no bypass) 80444-669-50 (w/ bypass)	1	80439-801-51 (no bypass)	1	80439-805-51 (no bypass)

1. p-t-t: Push-to-test operator.
2. Field replacement of the option board resets the power converter to the factory defaults. The user must configure the controller per the elementary diagram provided.
3. See Appendix B on page 115 for maintenance instructions.
4. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Table 62: 208/230 V Renewable Parts, 1–50 hp VT / 1–40 hp CT

Description	Qty	1–5 hp	Qty	7.5–10 hp	Qty	15–25 hp	Qty	30–50 hp
Power Converter: Variable Torque (VT) [3]	1	ATV61H075M3 (1 hp) ATV61HU15M3 (2 hp) ATV61HU15M3 (3 hp) ATV61HU30M3 (5 hp)	1	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)
Power Converter: Constant Torque (CT) [3]	1	ATV71H075M3 (1 hp) ATV71HU15M3 (2 hp) ATV71HU22M3 (3 hp) ATV71HU40M3 (5 hp)	1	ATV71HU55M3 (7.5 hp) ATV71HU75M3 (10 hp)	1	ATV71HD11M3X (15 hp) ATV71HD15M3X (20 hp) ATV71HD18M3X (25 hp)	1	ATV71HD22M3X (30 hp) ATV71HD30M3X (40 hp)
Graphic Display Terminal	1	VW3A1101	1	VW3A1101	1	VW3A1101	1	VW3A1101
Control Fuses Primary								
Standard		25430-20625		25430-20625		25430-20625		25430-20625
Barriered bypass additional 150 VA	2	25430-20350 (208 V) 25430-20300 (230 V)	2	25430-20350 (208 V) 25430-20300 (230 V)	2	25430-20350 (208 V) 25430-20300 (230 V)	2	25430-20350 (208 V) 25430-20300 (230 V)
Option F10		25430-20800 (208 V) 25430-20750 (230 V)		25430-20800 (208 V) 25430-20750 (230 V)		25430-20800 (208 V) 25430-20750 (230 V)		25430-20800 (208 V) 25430-20750 (230 V)
Control Fuses Secondary								
Standard		25430-20400		25430-20400		25430-20400		25430-20400
Barriered bypass additional 150 VA	1	25430-20200	1	25430-20200	1	25430-20200	1	25430-20200
Option F10		25430-20500		25430-20500		25430-20500		25430-20500
Pilot Light, Red	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04	1	LED 25501-00003 Head ZB5AV04

1. p-t-t: Push-to-test operator.
2. Field replacement of the option board resets the power converter to the factory defaults. The user must configure the controller according to the elementary diagram provided.
3. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Table 62: 208/230 V Renewable Parts, 1–50 hp VT / 1–40 hp CT *(continued)*

Description	Qty	1–5 hp	Qty	7.5–10 hp	Qty	15–25 hp	Qty	30–50 hp
Pilot Light, Yellow	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]	2	LED 25501-00004 Head ZB5AV05 w/o p-t-t [1] Head ZB5AW35 w/ p-t-t [1]
Pilot Light, Green	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]	1	LED 25501-00005 Head ZB5AV03 w/o p-t-t [1] Head ZB5AW33 w/ p-t-t [1]
Pilot Light, Blue	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]	1	LED 25501-00006 Head ZB5AV06 w/o p-t-t [1] Head ZB5AW36 w/ p-t-t [1]
Pilot Light Mounting Collar w/ Light Module	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6	1	ZB5AV6
Pilot Light Mounting Collar w/ Light Module and 1 N.O. and 1 N.C. Contact for p-t-t [1]	1	ZB5AW065	1	ZB5AW065	1	ZB5AW065	1	ZB5AW065
I/O Extension [2]	1	VW3A3202	1	VW3A3202	1	VW3A3202	1	VW3A3202
LONWORKS [2]	1	VW3A3312	1	VW3A3312	1	VW3A3312	1	VW3A3312
Modbus [2]	1	VW3A3303	1	VW3A3303	1	VW3A3303	1	VW3A3303
Metasys N2 [2]	1	VW3A3318	1	VW3A3318	1	VW3A3318	1	VW3A3318
24 Vdc Supply	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003	1	ABL7CEM24003
Stirring Fan Assembly	1	N/A	1	31158-065-50	1	31158-065-50	1	31158-065-50
Heatsink Fans	1	VZ3V1203 (1–3 hp VT, 1–2 hp CT) VZ3V1209 (5 hp VT, 3–5 hp CT)	1	VZ3V1209 (7.5 hp VT) VZ3V1204 (10 hp VT, 7.5 hp CT) VZ3V1210 (10 hp CT)	1	VZ3V1210 (15 hp VT) VZ3V1205 (20–25 hp VT, 15–20 hp CT) VZ3V1211 (25 hp CT)	1	VZ3V1211 (30–40 hp VT, 30 hp CT) VZ3V1207 (50 hp VT, 40 hp CT)
Plenum Fan Assembly	—	N/A	—	N/A	1	31164-214-50	1	31164-214-50
Filter for Input Plenum	—	N/A	—	N/A	1	31164-152-01	1	31164-153-01
Barriered Enclosure	1	31164-152-01	1	31164-152-01	1	31164-153-01	1	31164-174-01
Circuit Breaker Handle	1	3 in. handle for wall mount and barriered floor mount enclosure: 9421LH3	1	3 in. handle for wall mount and barriered floor mount enclosure: 9421LH3	1	6 in. handle for floor mount enclosure: 9421LH6	1	6 in. handle for floor mount enclosure: 9421LH6

1. p-t-t: Push-to-test operator.
2. Field replacement of the option board resets the power converter to the factory defaults. The user must configure the controller according to the elementary diagram provided.
3. The first three characters of the power converter catalog number may be ATV, signifying an IP20 rating, or HTV, signifying an IP00 rating.

Appendix B—Field Installation of Inlet Vent Filter Assembly

Overview

This appendix contains installation instructions for a foam filter assembly. The assembly is installed onto the enclosure door over the bottom inlet ventilation louvers of the M-Flex adjustable speed controller unit. The assembly is available only for 100–450 hp CT and 125–500 hp VT M-Flex drives.

When installed correctly, the filter will capture some contaminants in a foam filter media rated at 10 pores per inch. The factory installs the foam filter assembly as standard for 1G gasketed enclosures. The foam filter assembly is available only as a field installed option on Type 1 enclosures.

This filter reduces the amount of contaminants pulled through the cooling vents of the controller unit. Filters are not required to maintain the UL Listing of the unit for Type 1 integrity.

The assembly contains the parts listed in Table 63.

Figure 32: M-Flex Controller with Inlet Vent Filter Assembly Installed

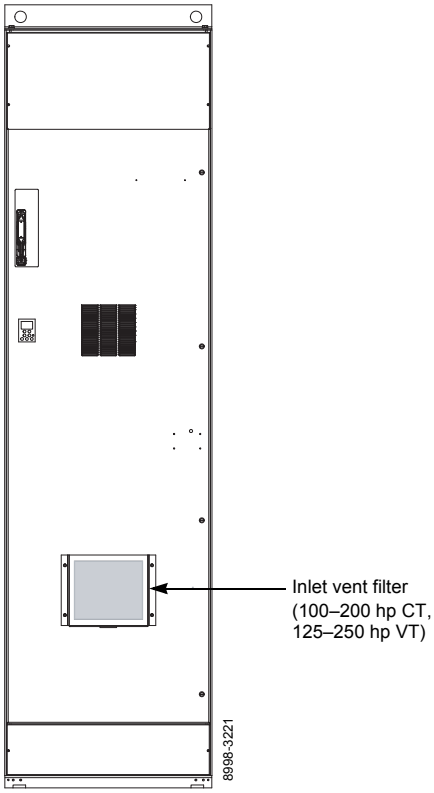


Table 63: Inlet Vent Filter Assembly Parts

Controller Rating (hp)		Description	Part Number	Quantity
100–200 CT	125–250 VT	Outer filter bracket	80444-132-02	1
		Inner filter bracket	80444-133-02	1
		Foam filter element	80444-134-01	1
250–450 CT	300–500 VT	Filter	80444-134-02	1

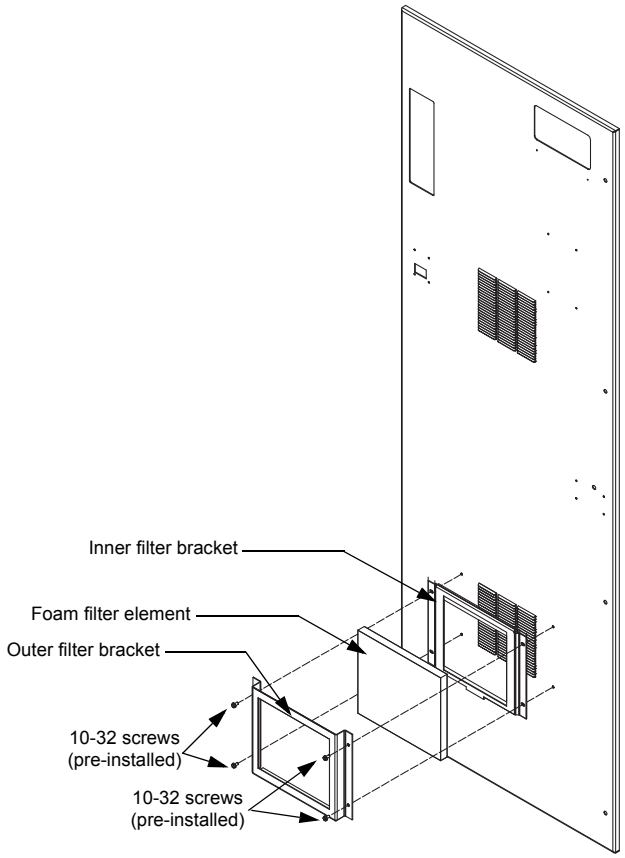
Each filter media is pre-cut to fit the inlet vent of a particular drive horsepower size.

Installation

To install the inlet vent filter assembly:

1. With the door closed, install the filter brackets (outer and inner) over the louvers as shown in Figure 33 on page 116 using the hardware provided in the pre-drilled holes around the louvers.
2. Insert the foam filter element into the opening at the top of the filter bracket. The element should be completely inside the filter brackets.

Figure 33: Inlet Vent Filter Assembly Hardware Locations



Maintenance

Enclosure sizes H–J controllers in 1G (gasketed) enclosures include a filter over the lower door vents. The maintenance procedures for the controller require that the filter element be inspected and cleaned every six months, or more frequently if indicated by service conditions and your established maintenance schedule.

To clean the filter element:

1. Remove the filter element from the front door bracket by pushing the filter element up from the bottom of the filter bracket, using the access slots in the bottom of the bracket. Once the filter element is partially above the bracket, remove it by pulling it out of the top of the bracket.
2. Vacuum and wash the filter thoroughly.
3. Dry the filter completely and re-install it.

NOTE: Replace the filter element if it becomes damaged or deteriorates. See Table 63 on page 115 for a list of filter part numbers.

Higher Horsepower Controllers (250–450 hp CT, 300–500 hp VT)

To prevent overheating and to allow proper air flow, maintain the clearances shown in Figures 11 to 16 on pages 41 to 46. Every six months, inspect and clean the filters if needed. Vacuum and wash the filters thoroughly, then dry and reinstall them.

NOTE: Replace the filter element if it becomes damaged or deteriorates. See Table 63 on page 115 for the filter part number.

Appendix C—Field Replacement of Power Fuses

Overview

This appendix contains instructions for replacing the power fuses in controllers with the following ratings:

- 250–450 hp CT
- 300–500 hp VT

Power Fuse Replacement

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- 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.
- Turn off all power supplying this equipment before working on or inside 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.

When replacing the power fuses, refer to Figure 34 on page 118.

1. Turn off all power supplying this equipment before working on or inside the equipment. Always use a properly rated voltage sensing device to confirm that power is off.
2. Loosen the bolts holding the clamps on each end of the Phase A fuse.
3. Push the fuse down until clear of the top clamp, then pull the fuse toward the front of the enclosure while lifting it clear of the bottom clamp.

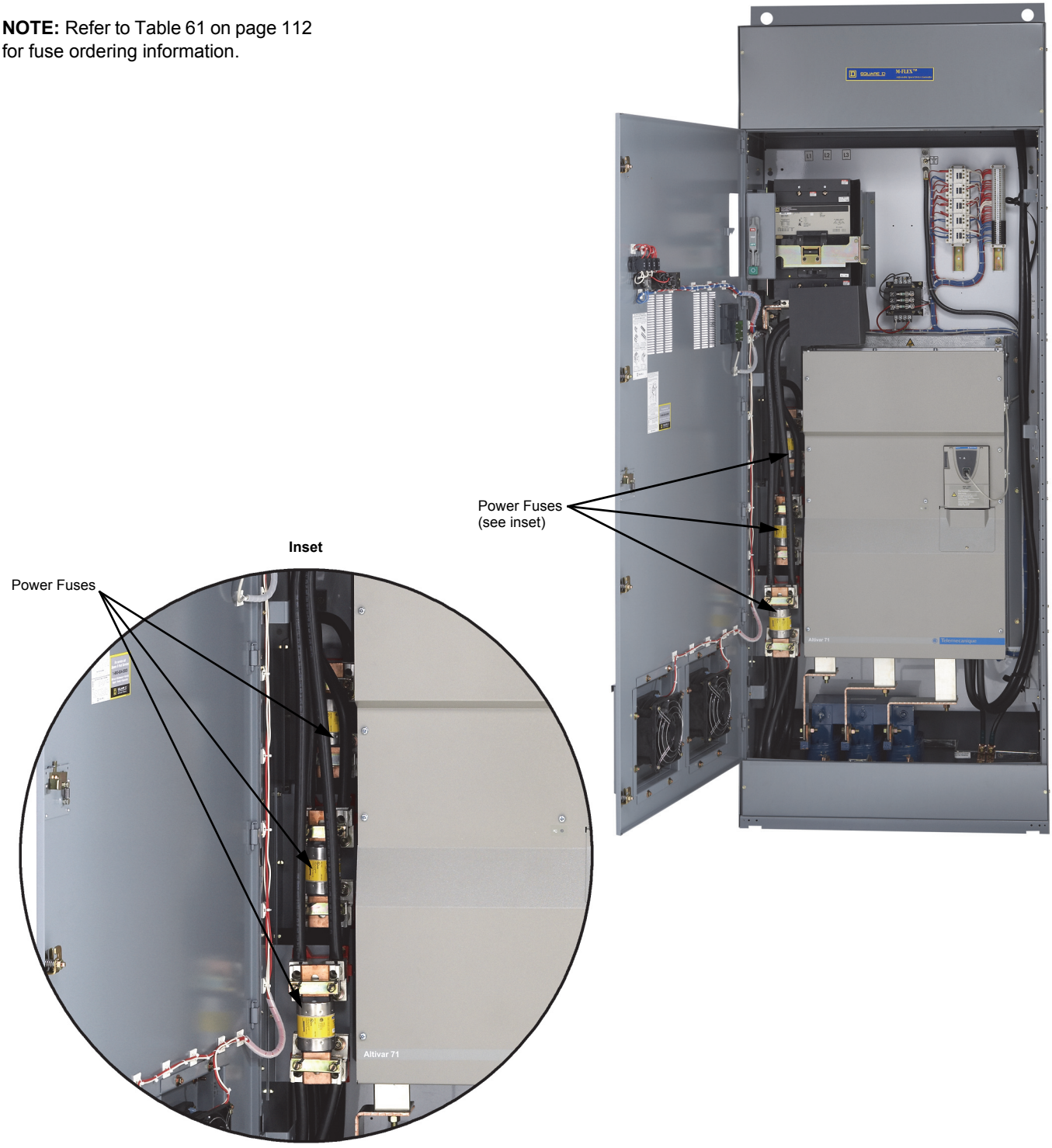
   NOTE: If the power wires block removal of the fuse:
   Loosen the wire-connector lug of the wire in front of the fuse, then pull the wire free of the lug.
4. Using a new fuse of the same class and size as the one removed, repeat Step 3 in reverse order.
5. Using the torque values specified in Table 64 on page 118:
   a. Tighten the two bolts of the top clamp holding the fuse.
   b. Tighten the two bolts of the bottom clamp.
6. If you removed the power wire, reinstall it into the lug. Tighten it to the torque value specified in Table 64 on page 118.
7. Repeat steps 1–5 for Phases B and C.
8. Close and latch the door before turning on power to the equipment.

Table 64: Recommended Fuse Tightening Torques

Description	lb-ft	N•m
Wire	25–32	34–43
Clamp	11–13	15–17

Figure 34: Power Fuse Locations

NOTE: Refer to Table 61 on page 112 for fuse ordering information.



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