

# SIEMENS

## SED2 VFD Electronic Bypass Option

### *Operating Instructions*





**SIEMENS**

**SED2 VFD Electronic  
Bypass Option  
Operating Instructions**



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#### WARNING

*The Siemens Building Technologies SED2 Variable Frequency Drives are shipped without EMC line filters. (The EMC filter is most commonly used in Europe.) Where local codes or customer/installation requirements dictate, separately orderable Class A line filters are available. More stringent Class B line filters are also available for most models. Installation of these filters satisfies the requirements for the EU's EMC directive.*

#### SERVICE STATEMENT

*Control devices are combined to make a system. Each control device is mechanical in nature and all mechanical components must be regularly serviced to optimize their operation. All Siemens Building Technologies, Inc. branch offices and authorized distributors offer Technical Support Programs that will ensure your continuous, trouble-free system performance.*

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#### TO THE READER

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# How to Use this Manual

## Manual Organization

This manual contains the following sections:

- *How to Use this Manual*, describes the organization of this manual and the symbols used throughout this manual.
- *Safety Instructions*, provides general guidelines for your safety and to prevent equipment damage.
- *SED2 VFD Electronic Bypass Option Overview*, describes the Electronic Bypass Option Controller board, inputs, outputs, contactors, and keypad.
- *Installation Instructions*, provides mounting information and details on electrical connections.
- *Startup Procedures*, provides step-by-step procedures to start up the Electronic Bypass Option.
- *Application Feature Setup*, describes application features and provides the necessary parameter settings.
- *Technical Specifications*, lists Electronic Bypass Option specification data.
- *Troubleshooting*, provides guidelines for troubleshooting the Electronic Bypass Option.

## Manual Notations

Notation	Symbol	Meaning
<b>WARNING:</b>		Indicates that personal injury/loss of life may occur if you do not perform a procedure as specified.
<b>CAUTION:</b>		Indicates that equipment damage, or loss of data may occur if you do not perform a procedure as specified.
<b>NOTES:</b>	(no symbol)	Provides other important information or helpful hints.

## Where To Send Comments

Your feedback is important to us. If you have comments about this manual, please submit them to [technical.editor@siemens.com](mailto:technical.editor@siemens.com).

## Reference Documents

The following SED2 VFD documentation is available from your local Siemens Building Technologies representative:

- *SED2 VFD Operation & Maintenance Manual (125-3202)*, operating instructions and procedures for the SED2 VFD.
- *SED2 VFD Startup Guide (125-3201)*, a brief guide to operation offers fast access to all basic information necessary to set up, commission, and operate a SED2 VFD or SED2 VFD with Bypass Option.
- *SED2 VFD Submittal Sheet (154-042)*, a synopsis of the SED2 VFD product line, accessories and technical data.

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# Safety Instructions

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The following general guidelines are provided for your safety, to prevent damage, and to extend the service life of the SED2 product and any connected equipment. *Read this information carefully.* Specific Warnings, Cautions, and Notes are provided in the relevant sections of this manual.

**WARNINGS:**

- The SED2 uses hazardous voltages and controls potentially dangerous rotating mechanical parts. Non-compliance with warnings or failure to follow the instructions contained in this manual can result in loss of life, severe personal injury, or serious damage to property/equipment.
- Only authorized personnel should work on this equipment, and only after becoming familiar with all local regulations and ordinances; safety notices; and installation, operation, and maintenance procedures in this manual. Successful and safe operation of this equipment depends upon its proper handling, installation, operation, and maintenance.
- Before carrying out any installation and commissioning procedures, you must read all safety instructions and warnings, including all warning labels attached to the equipment. Make sure that the warning labels are kept in a legible condition and ensure missing or damaged labels are replaced.
- Observe the regulations of Safety Code VBG 4.0 (in particular, “Permissible Deviations when Working with Live Parts”) whenever measuring or testing is performed on live equipment. Also, use suitable electronic tools.
- Only use this equipment for the purpose specified by the manufacturer. Unauthorized modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the equipment can cause fires, electric shocks, and injuries.
- Prevent the general public from accessing or approaching this equipment.

**NOTE:** Keep these Operating Instructions near the equipment and available to all users.

# Electronic Bypass Option Overview

## General Description

During normal operation in a typical application, the input and output contactors close and the VFD operates the motor (Figure 1). The bypass contactor provides the ability to operate the motor on utility power and eliminate the VFD from the motor control circuit. The SED2 VFD Electronic Bypass Option also allows the user to select features that enhance the control of the contactors and the outputs that report operation.

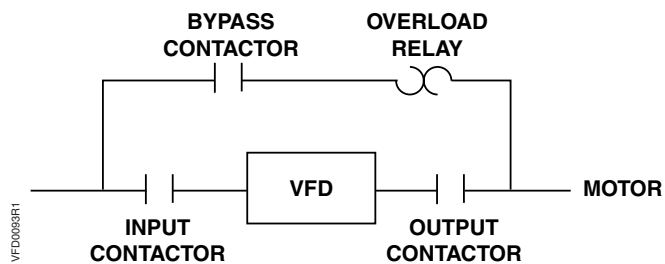


Figure 1. Functional Block Diagram of Typical Electronic Bypass Option.

The SED2 VFD Electronic Bypass Option consists of a SED2 VFD, and a bypass enclosure with electronic controls (Figure 2). The electronic controls include:

- Controller board
- Keypad
- Step-down power transformer
- Contactors:
  - Bypass
  - Output
  - Input (optional)
- Overload (current) relay
- Reactor (optional)
- Disconnect switch (or optional circuit breaker)
- Fuses (optional)
- Cable harnesses

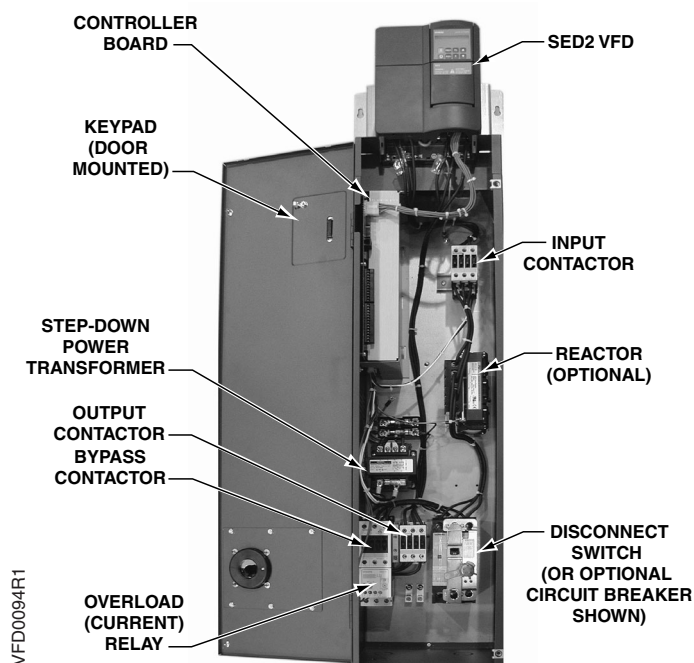


Figure 2. Typical SED2 VFD Electronic Bypass Option Components.

# Controller Board

The Controller board is the foundation of the SED2 VFD Electronic Bypass Option. It controls communications to and from the SED2 VFD, keypad, isolated digital inputs, relay/digital outputs, and contactors (Figure 3).

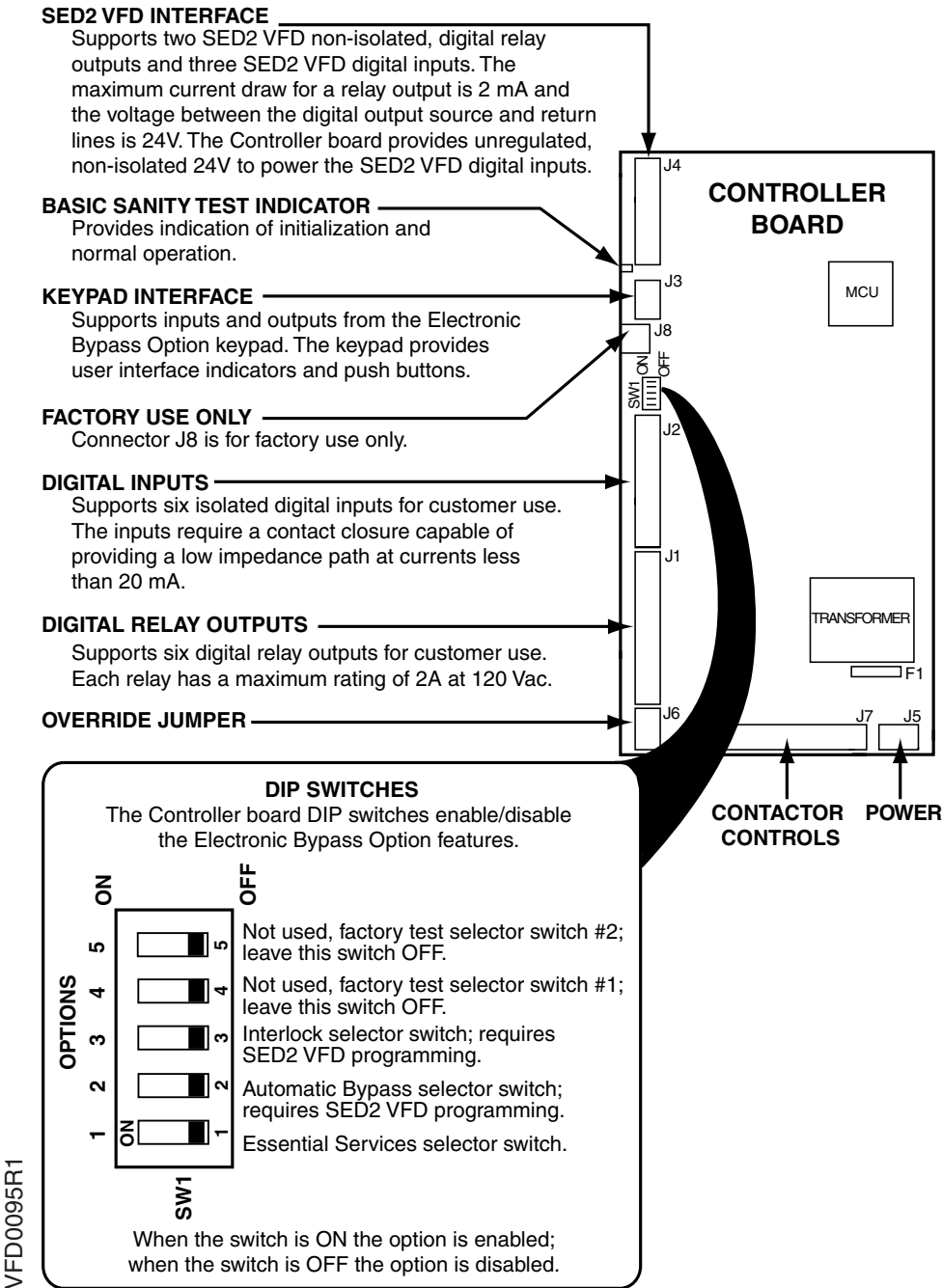


Figure 3. Controller Board Inputs and Outputs.

## Contactors

The Controller board provides two or three relay contact circuits controlled by the Electronic Bypass Option: bypass, input, and output contactors. Each circuit includes a NO relay. Controller board connector J7 enables circuit connections. The relay circuits route power to the SED2 VFD and the motor via the contactors. Controlling the contactors through the relay circuits is the main function of the Controller board.

**Bypass Contactor** – The bypass relay on the Controller board controls the bypass contactor. The output and bypass relays are interconnected to 120 Vac Hot. This enables a safety circuit that prevents the bypass and output contactors from simultaneously being energized.

**Output Contactor** – The output relay on the Controller board controls the output contactor.

**Input Contactor** – The input relay on the Controller board controls the optional input contactor.

## Keypad Functions

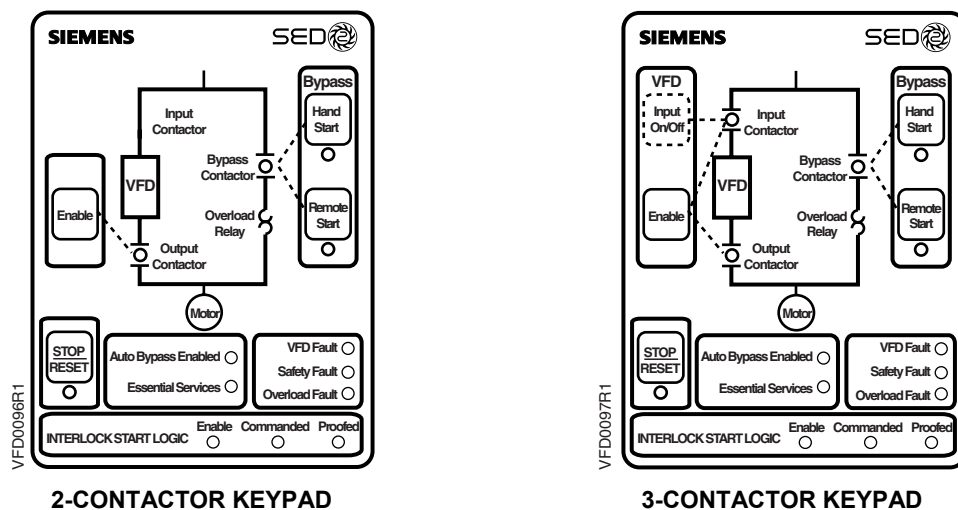





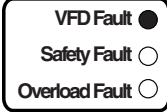
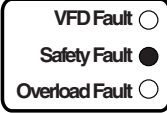
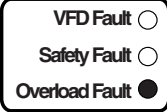
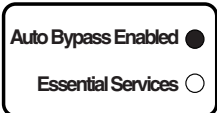
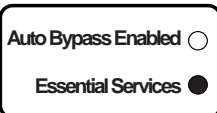
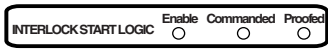


Figure 4. Electronic Bypass Option Keypad Indicators and Push Buttons.

The keypad provides user interface indicators and push buttons. The following table describes specific push button and indicator functions:

Push Button/Indicator	Description
	The Input On/Off push button is supplied with the optional drive input contactor. In VFD mode, this switch does nothing. In bypass mode, this switch closes/opens the input contactor, switching the SED2 VFD power on/off.
	Enables SED2 VFD operation by closing the input and output contactors.
	Manually enables bypass mode operation by ensuring that the output contactor is open and then closing the bypass contactor.

Push Button/Indicator	Description
	<p>Activates the bypass mode and operates the bypass contactor according to the status of the Remote Start input on the Controller board.</p>
	<p>Opens the output and bypass contactors, disconnecting the motor.</p>
	<p>When a VFD Fault is indicated, the VFD Fault indicator lights and the VFD Fault Relay output on the Controller Board is triggered.</p>
	<p>The Safety Fault indicator lights when either of the Remote Safety inputs on the Controller board opens. The motor is prohibited from operating in either the VFD or bypass modes while either of these contacts is open.</p> <p><b>EXCEPTION:</b> Essential Services ignores a Safety Fault.</p> <p><b>NOTE:</b> If not using the Remote Safety feature, hard wire the two Remote Safety inputs.</p>
	<p>If the Electronic Bypass Option current overload relay trips, the Overload Fault indicator lights and the motor will not run in bypass mode.</p>
	<p>When the Auto Bypass DIP switch is enabled, the Auto Bypass Enabled indicator is on steady. Bypass operation is automatically initiated by the SED2 VFD.</p> <p>When Auto Bypass is active, the Auto Bypass Enabled indicator flashes.</p>
	<p>When the Essential Services DIP switch is enabled, the Essential Services indicator is on steady.</p> <p>When the Essential Services input is open, normal operation is indicated as the output contactor remains closed to keep the motor running and the Essential Services indicator is on steady.</p> <p>When the Essential Services input is closed, the bypass contactor closes and the Essential Services indicator flashes.</p> <p><b>NOTE:</b> Nothing can interrupt the Essential Services mode except for the Essential Services input opening.</p>
	<p>When the Interlock DIP switch is enabled, the Interlock Start Logic Enable indicator is on steady. Any call to start the motor in either VFD or bypass modes will not start the motor but instead closes the Programmable Output relay on the Controller board.</p> <p>The Programmable Output can be used to actuate another device. When this occurs, the Interlock Start Logic Commanded indicator also lights, and the Interlock Start Logic Proofed indicator flashes.</p> <p>A contact closure from this other device is wired to the Interlock Start on the Controller Board which then starts the motor and turns the Interlock Start Logic Proofed indicator on steady. This feature is also called damper end switch relay logic.</p>

# Installation Instructions

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## Environmental Conditions

Install the Electronic Bypass Option in a heated, indoor controlled environment that is free of moisture and conductive contaminants such as condensation and dust. The air entering the unit for ventilation/cooling must be clean and free from corrosive gases.

The ambient temperature must be between 32°F and 104°F (0°C to 40°C) and the relative humidity must be 0% to 95% noncondensing. Do not mount unit in direct sunlight.

## Mechanical Installation

### Inspection

1. As you unpack the Electronic Bypass Option, check for shipping damage. In the event of damage, contact the transport company.
2. Locate the Electronic Bypass Option nameplate and confirm that the unit is configured to the installation requirements.
3. Verify the delivery is complete. If not, contact the supplier.

### Dimensions and Weights

Figure 5 shows overall and mounting dimensions for the Electronic Bypass Option.

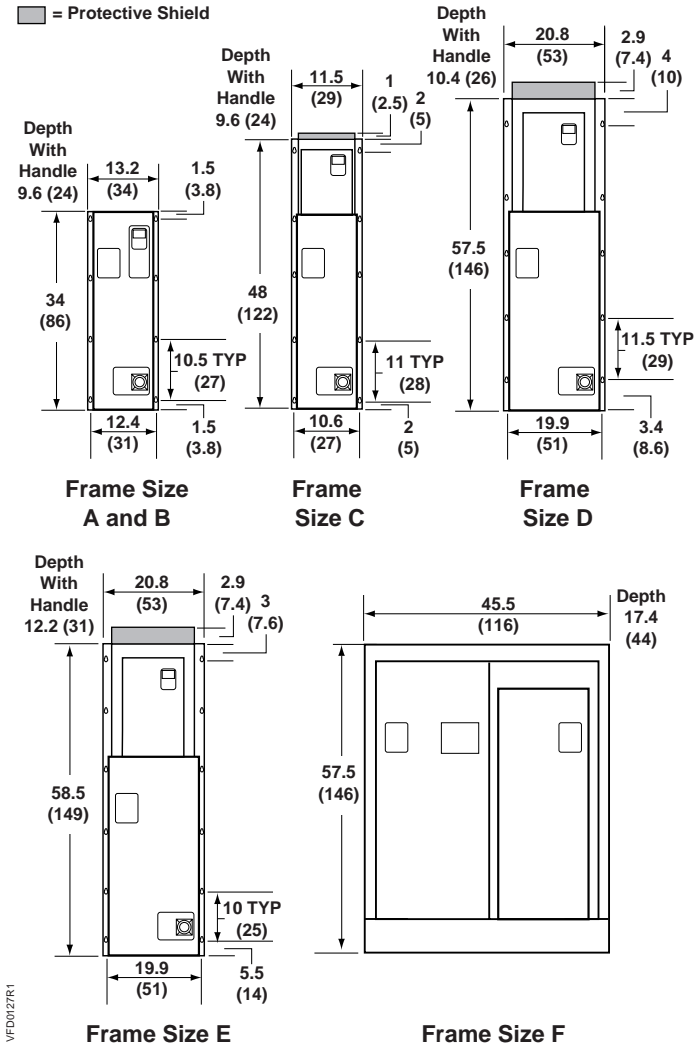
Approximate weights are as follows.

<b>Bypass Frame Size</b>	<b>Δ Weight lb (kg)</b>
A	45 (20)
B	55 (25)
C	75 (34)
D	150 (68)
E	180 (82)
F	500 (227)

**NOTE:** Actual weight will be affected by actual HP voltage and selected power options.

## Mounting

1. To ensure safe installation, verify that the surface of the mounting location is level.
2. Mount the Electronic Bypass Option vertically with the SED2 VFD operator panel, Electronic Bypass Option keypad, and disconnect accessible.



**NOTE:** It is recommended to leave 6 inches (15 cm) around the top and sides of the unit.

**Figure 5. Electronic Bypass Option Dimensions in Inches (Centimeters).**

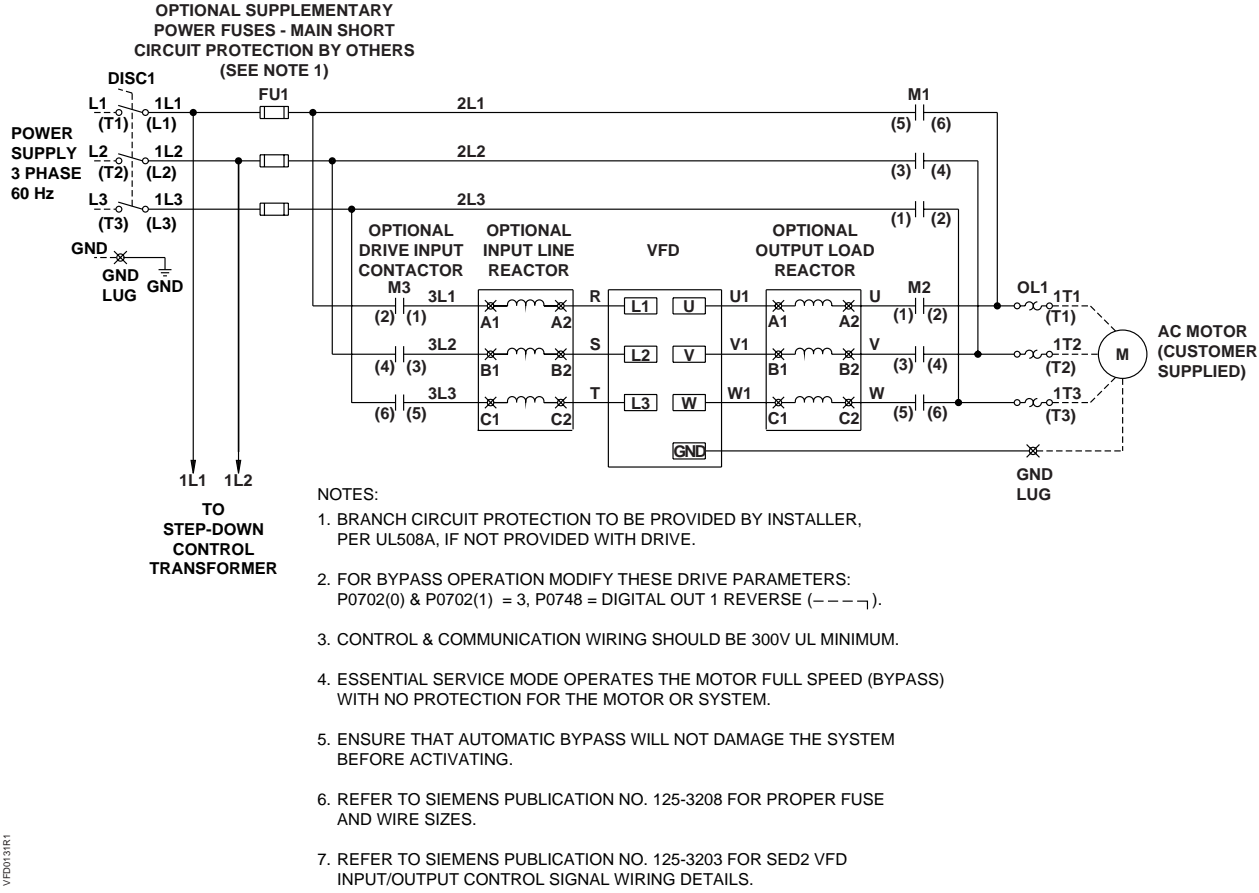
## Electrical Installation

See Figure 6 for all Electronic Bypass Option wiring.

1. Route shielded twisted pair (recommended wire type) cable, 24 gauge minimum *control wiring* in conduit through knockout and into housing (Figures 7 through 9). Connect control wiring per job-specific drawings.

### NOTES:

- Terminate shield at control device.
  - Control wiring is 12 to 26 AWG and tightening torque is 5 lb-in.
2. If applicable, route *communications wiring (P1)* in conduit through knockout and into housing (Figures 7 through 9). Continue to route communications wiring to VFD and terminate per *SED2 VFD Operation & Maintenance Manual*.
  3. Route motor wiring in conduit through knockout and into housing (Figures 7 through 9). Connect motor wiring to motor overload and ground lug. See Tables 1 through 4 for wire sizes and tightening torques.
  4. Route input power wiring in conduit through knockout and into housing (Figures 7 through 9). Connect input power wiring to disconnect switch and ground lug or to circuit breaker and ground lug. See Tables 1 through 4 for wire sizes and tightening torques.



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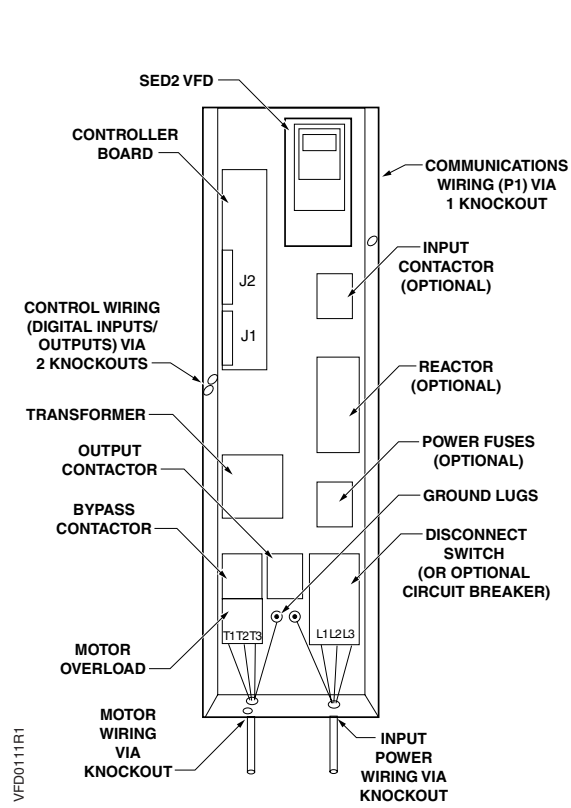


Figure 7. Routing of Power and Control Wiring for Frame Sizes A and B.

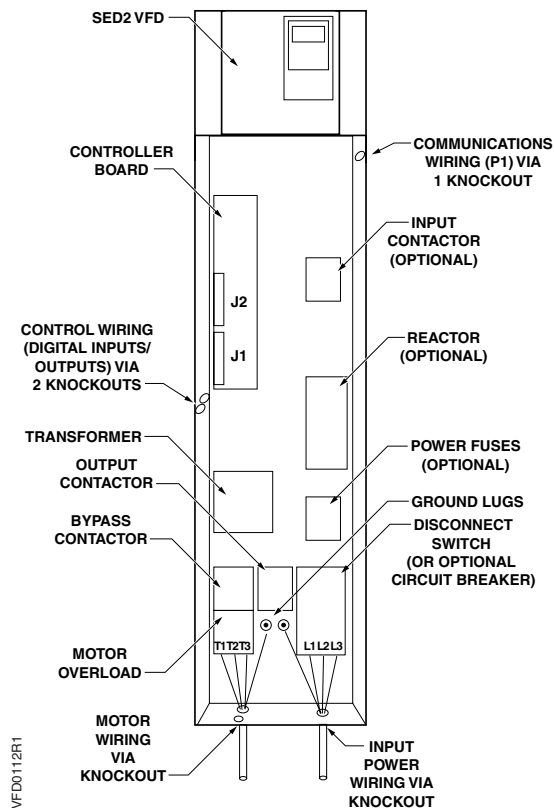


Figure 8. Routing of Power and Control Wiring for Frame Sizes C, D, and E.

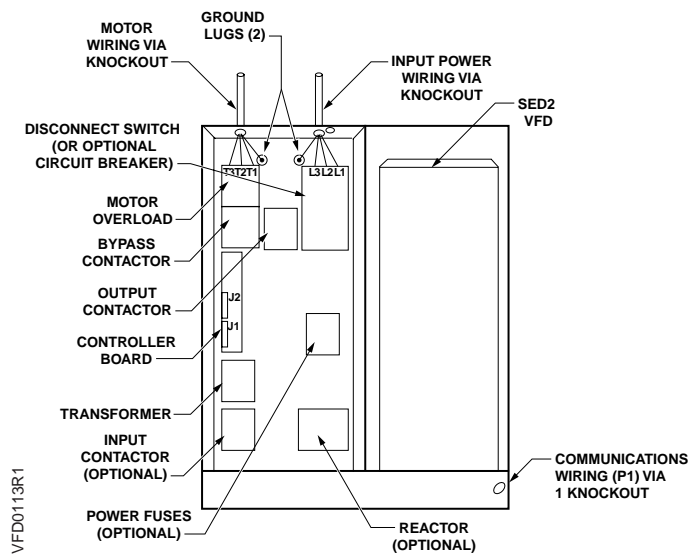


Figure 9. Routing of Power and Control Wiring for Frame Size F.

**Table 1. Wire Sizes and Tightening Torques for Electronic Bypass Option with 208V Drive.**

Part Number	Bypass Frame Size	HP	kW	Amps	Circuit Breaker		Disconnect Switch		Overload			Ground Lug		
					Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Range, Amps	Max Backup Fuse, Amps	Wire Size *	Torque, lb-in (Nm)
VBE10.5----	A	0.5	0.37	2.3	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	1.8 - 2.5	10	14-2	35 (4)
VBE10.7----	A	0.7	0.55	3.0	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.2 - 3.2	12	14-2	35 (4)
VBE11.0----	A	1.0	0.75	3.9	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.8 - 4	16	14-2	35 (4)
VBE11.5----	B	1.5	1.1	5.5	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	4.5 - 6.3	25	14-2	35 (4)
VBE12.0----	B	2.0	1.5	7.4	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	5.5 - 8.0	30	14-2	35 (4)
VBE13.0----	B	3.0	2.2	10.4	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	7 - 10	40	14-2	35 (4)
VBE15.0----	C	5.0	4.0	16.7	14-10 Cu	32 (3.6)	14-8	17 - 22 (1.9 - 2.5)	14-10	18 - 22 (2 - 2.5)	14 - 20	80	14-2	35 (4)
VBE17.5----	C	7.5	5.5	22.0	14-10 Cu	20 - 60 (2.2 - 6.8)	14-8	17 - 22 (1.9 - 2.5)	14-10	18 - 22 (2 - 2.5)	20 - 25	100	14-2	35 (4)
VBE110.----	C	10	7.5	28	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-8	17 - 22 (1.9 - 2.5)	18-3	27 - 40 (3.1 - 4.5)	22 - 32	125	14-2	35 (4)
VBE115.----	D	15	11.0	42	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	40 - 50	200	14-2	35 (4)
VBE120.----	D	20	15.0	54	10-1/0 Cu	20 - 60 (2.2 - 6.8)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	45 - 63	250	14-2	35 (4)
VBE125.----	D	25	18.5	68	3-3/0-3 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	57 - 75	300	14-2	35 (4)
VBE130.----	E	30	22.0	80	3-3/0-3 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	70 - 90	350	14-2	35 (4)
VBE140.----	F	40	30.0	104	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	12-1	22 - 27 (2.5 - 3.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)
VBE150.----	F	50	37.0	130	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (13.5 - 31.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)
VBE160.----	F	60	45.0	154	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (13.5 - 31.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)

\*Wire size in AWG unless noted otherwise. use Copper (Cu) wire that is rated 167°F (75°C) minimum, 600 Vac.

**Table 2. Wire Sizes and Tightening Torques for Electronic Bypass System with 230V - 240V Drive.**

Part Number	Bypass Frame Size	HP	kW	Amps	Circuit Breaker		Disconnect Switch		Overload				Ground Lug	
					Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Range, Amps	Max Backup Fuse, Amps	Wire Size *	Torque, lb-in (Nm)
VBE20.5----	A	0.5	0.37	2.2	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	1.8 - 2.5	10	14-2	35 (4)
VBE20.7----	A	0.7	0.55	3.0	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.2 - 3.2	12	14-2	35 (4)
VBE21.0----	A	1.0	0.75	3.9	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.8 - 4	16	14-2	35 (4)
VBE21.5----	B	1.5	1.1	5.5	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	4.5 - 6.3	25	14-2	35 (4)
VBE22.0----	B	2.0	1.5	6.8	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	5.5 - 8.0	30	14-2	35 (4)
VBE23.0----	B	3.0	2.2	9.6	14-10 Cu	32 (3.6)	18-10	13 - (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	7 - 10	40	14-2	35 (4)
VBE25.0----	C	5.0	4.0	15.2	14-10 Cu	32 (3.6)	14-8	17 - 22 (1.9 - 2.5)	14-10	18 - 22 (2 - 25)	14 - 20	80	14-2	35 (4)
VBE27.5----	C	7.5	5.5	22	14-10 Cu	20 - 60 (2.2 - 6.8)	14-8	17 - 22 (1.9 - 2.5)	14-10	18 - 22 (2 - 25)	20 - 25	100	14-2	35 (4)
VBE210----	C	10	7.5	28	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-8	17 - 22 (1.9 - 2.5)	18-3	27 - 40 (3.1 - 4.5)	22 - 32	125	14-2	35 (4)
VBE215----	D	15	11.0	42	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	40 - 50	200	14-2	35 (4)
VBE220----	D	20	15.0	54	10-1/0 Cu	20 - 60 (2.2 - 6.8)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	45 - 63	250	14-2	35 (4)
VBE225----	D	25	18.5	68	3-3/0-3 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	57 - 75	300	14-2	35 (4)
VBE230----	E	30	22.0	80	3-3/0-3 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	70 - 90	350	14-2	35 (4)
VBE240----	F	40	30.0	104	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	12-1	22 - 27 (2.5 - 3.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)
VBE250----	F	50	37.0	130	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (13.5 - 31.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)
VBE260----	F	60	45.0	154	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (13.5 - 31.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)

\* Wire size is AWG unless noted otherwise. Use Copper (Cu) wire that is rated 167°F (75°C) minimum 600 Vac.

**Table 3. Wire Sizes and Tightening Torques for Electronic Bypass System with 380V - 480V Drive.**

Part Number	Bypass Frame Size	HP	kW	Amps	Circuit Breaker		Disconnect Switch		Overload				Ground Lug	
					Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Range, Amps	Max Backup Fuse, Amps	Wire Size*	Torque, lb-in (Nm)
VBE30.5----	A	0.5	0.37	1.1	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	.7 - 1.0	4	14-2	35 (4)
VBE30.7----	A	0.7	0.55	1.6	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	1.1 - 1.6	6	14-2	35 (4)
VBE31.0----	A	1.0	0.75	2.1	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	1.4 - 2.0	8	14-2	35 (4)
VBE31.5----	A	1.5	1.1	3.0	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.2 - 3.2	12	14-2	35 (4)
VBE32.0----	A	2.0	1.5	3.4	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.8 - 4	16	14-2	35 (4)
VBE33.0----	B	3.0	2.2	4.8	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	3.5 - 5	20	14-2	35 (4)
VBE35.0----	B	5.0	4.0	7.6	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (.8 - 1.2)	7 - 10	40	14-2	35 (4)
VBE37.5----	C	7.5	5.5	11	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	9 - 12	45	14-2	35 (4)
VBE310----	C	10	7.5	14	14-10 Cu	32 (3.6)	18-10	13 to 17 (1.5 - 1.7)	14-10	18 - 22 (2 - 2.5)	11 - 16	60	14-2	35 (4)
VBE315----	C	15	11.0	21	14-10 Cu	20 - 60 (2.2 - 6.8)	14-8	17 - 22 (1.9 - 2.5)	14-10	18 - 22 (2 - 2.5)	17 - 22	80	14-2	35 (4)
VBE320----	C	20	15.0	27	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-8	17 - 22 (1.9 - 2.5)	18-3	27 - 40 (3.1 - 4.5)	22 - 32	125	14-2	35 (4)
VBE325----	D	25	18.5	34	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	28 - 40	150	14-2	35 (4)
VBE330----	D	30	22.0	40	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	28 - 40	150	14-2	35 (4)
VBE340----	D	40	30.0	52	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	40 - 50	200	14-2	35 (4)
VBE350----	E	50	37.0	65	10-1/0 Cu	20 - 60 (2.2 - 6.8)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	57 - 75	300	14-2	35 (4)
VBE360----	E	60	45.0	77	3-3/0 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	70 - 90	350	14-2	35 (4)
VBE375----	F	75	55.0	96	3-3/0 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	80 - 100	400	14-2/0	50 (5.6)
VBE3100----	F	100	75.0	124	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (13.5 - 31.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	148-2/0	50 (5.6)
VBE3125----	F	125	90.0	156	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (13.5 - 31.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)
VBE3125--HA	F	—	90.0	178	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (13.5 - 31.1)	6-3/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)

\* Wire size is AWG unless noted otherwise. Use Copper (Cu) wire that is rated 167°F (75°C) minimum 600 Vac.

Table 4. Wire Sizes and Tightening Torques for Electronic Bypass System with 500V - 600V Drive.

Part Number	Bypass Frame Size	HP	kW	Amps	Circuit Breaker		Disconnect Switch		Overload				Ground Lug	
					Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Wire Size *	Torque, lb-in (Nm)	Range, Amps	Max Backup Fuse, Amps	Wire Size *	Torque, lb-in (Nm)
VBE40.5----	C	0.5	0.37	.9	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	.7 - 1.0	4	14-2	35 (4)
VBE40.7----	C	0.7	0.55	1.3	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	.9 - 1.25	5	14-2	35 (4)
VBE41.0----	C	1.0	0.75	1.4	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	1.1 - 1.6	6	14-2	35 (4)
VBE41.5----	C	1.5	1.1	2.4	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	1.8 - 2.5	10	14-2	35 (4)
VBE42.0----	C	2.0	1.5	2.7	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.2 - 3.2	12	14-2	35 (4)
VBE43.0----	C	3.0	2.2	3.9	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	2.8 - 4	16	14-2	35 (4)
VBE45.0----	C	5.0	4.0	6.1	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	4.5 - 6.3	25	14-2	35 (4)
VBE47.5----	C	7.5	5.5	9	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	7 - 10	40	14-2	35 (4)
VBE410.----	C	10	7.5	11	14-10 Cu	32 (3.6)	18-10	13 - 17 (1.5 - 1.7)	18-14	7 - 10.3 (8 - 1.2)	9 - 2	45	14-2	35 (4)
VBE415.----	C	15	11.0	17	14-10 Cu	32 (3.6)	14-8	17 - 22 (1.9 - 2.5)	14-10	18 - 22 (2 - 2.5)	14 - 20	80	14-2	35 (4)
VBE420.----	C	20	15.0	22	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-8	17 - 22 (1.9 - 2.5)	14-10	18 - 22 (2 - 2.5)	17 - 22	80	14-2	35 (4)
VBE425.----	C	25	18.5	27	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	22 - 32	125	14-2	35 (4)
VBE430.----	D	30	22.0	32	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	28 - 40	150	14-2	35 (4)
VBE440.----	D	40	30.0	41	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	36 - 45	175	14-2	35 (4)
VBE450.----	E	50	37.0	52	10-1/0 Cu	20 - 60 (2.2 - 6.8)	14-6	22 - 27 (2.5 - 3.1)	18-3	27 - 40 (3.1 - 4.5)	40 - 50	200	14-2	35 (4)
VBE460.----	E	60	45.0	62	10-1/0 Cu	20 - 60 (2.2 - 6.8)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	45 - 63	250	14-2	35 (4)
VBE475.----	F	75	55.0	77	3-3/0 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	70 - 90	350	14-2/0	50 (5.6)
VBE4100----	F	100	75.0	99	3-3/0 Cu	80 (9)	12-1	22 - 27 (2.5 - 3.1)	10-1/0	36 - 53 (4.1 - 6)	80 - 100	400	14-2/0	50 (5.6)
VBE4125----	F	125	90.0	125	6 - 350 kcmil Cu	120 - 275 (14 - 31.1)	6 - 350 kcmil	120 - 275 (14 - 31.1)	10-1/0	124 - 210 (14 - 23.7)	50 - 200	800	14-2/0	50 (5.6)

\* Wire Size in AWG unless noted otherwise. Use Copper (Cu) wire that is rated 167°F (75°C) minimum, 600 Vac.

# Startup Procedures

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## Safety Precautions



### WARNING:

When you connect input power to the Electronic Bypass Option, the motor terminals are energized even if the motor is not running. Do not make any connections with input power connected to the Electronic Bypass Option. Disconnect and lock out power to the drive before servicing it. Failure to disconnect input power may cause serious injury or death.



### CAUTION:

After you disconnect input power, the DC bus capacitors must be allowed to discharge to a safe voltage. This will take about 5 minutes.

## Installation Inspection

Inspect the mechanical and electrical installation for compliance with local electrical codes and regulations. After installation, verify that:

- Electronic Bypass Option and motor are properly grounded.
- Input power and motor wire sizes are correct and connections are secure.
- Control wiring is correct, connections are secure, and wire shield is properly grounded.
- Control wiring is not routed with power wiring.
- Electronic Bypass Option has proper ventilation.
- Internal Bypass connections are secure.

## Power-On

1. Turn on Electronic Bypass Option power.

Power-on initialization performs a basic sanity test (approximately 7 seconds) to initialize the Controller board. Also, the Stop/Reset indicator will flash.

A unit fault condition occurs if the Electronic Bypass Option did not pass the basic sanity test. See the *Troubleshooting* section in this manual for more details.

After the basic sanity test, if the DIP switches have not changed and there is no operator intervention, the most recent bypass function is restored. If the DIP switches have changed, the Electronic Bypass Option activates the Stop/Reset function.

2. Press the **Enable** key on the Electronic Bypass Option keypad to place the unit in VFD mode.

3. Perform VFD commissioning per the *SED2 VFD Operation & Maintenance Manual* (Document No. 125-3202). If using the Quick Commissioning mode, end this mode with P3900=3 to run a motor calculation without resetting the SED2 to factory defaults.
4. After basic VFD operation is established and verified, turn VFD power off via the Electronic Bypass Option input power device and verify that no dangerous voltages are present in the enclosure.
5. Select Electronic Bypass Option application features using the DIP switches.

**DIP Switch Settings for Electronic Bypass Option Features.**

Switch Position	Description
1	Essential Services selector switch.
2	Automatic Bypass selector switch; requires SED2 VFD programming.
3	Interlock selector switch; requires SED2 VFD programming.
4	Factory test #1 selector switch. Not used; leave this switch OFF.
5	Factory test #2 selector switch. Not used; leave this switch OFF.

**NOTE:** When the switch is ON, the feature is enabled; when the switch is OFF, the feature is disabled. For details on the Electronic Bypass Option features, see the *Application Feature Setup* section in this manual.

6. Re-apply power to the Electronic Bypass Option. On units with three contactors, energize the SED2 by pressing the Input push button on the Electronic Bypass Option keypad.
7. Program the SED2 per the *Application Feature Setup* section in this manual.
8. Test all VFD and bypass features.
9. If motor rotation is incorrect in either VFD, bypass, or both modes, have the appropriate site personnel take corrective action as follows:
  - **Wrong Rotation in Bypass, Right in VFD Mode** – Swap two input leads on the main input device of the Electronic Bypass Option.
  - **Wrong Rotation in VFD, Right in Bypass Mode** – Swap two input leads on the main input device of the Electronic Bypass Option and swap two motor leads at the motor overload in the Electronic Bypass Option.
  - **Wrong Rotation in both VFD and Bypass Modes** – Swap two motor leads at the motor overload in the Electronic Bypass Option.

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# Required SED2 VFD Parameter Settings

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The following SED2 parameters are programmed by the factory before shipping. If these parameters are changed or if the SED2 VFD is ever reset to factory default, you must reset these parameters as follows:

Parameter	Setting
P0748	----
P0702 in000	3
P0702 in001	3
P0731	52.3

**NOTES:**

1. The Interlock Start on the Controller board is simply a follower that can be used to tell the drive to do anything by closing the SED2 Interlock Start and programming P0704.
2. The Programmable Output on the Controller board is simply a follower of the SED2 Relay.
3. The SED2 Fault must always be programmed as a fault. Do not change the SED2 relay fault for other uses via P0731.
4. Changing P0700 resets all digital inputs and P0702 will require programming.

# Application Feature Setup

## Overview

The Controller board supports six isolated digital inputs and six digital relay outputs for customer use (Figure 10). The digital inputs include: Remote Start Input, Remote Safety #1 and #2, Interlock Start, Essential Services, and Overload Trigger. The digital outputs include:

- VFD Fault
- Programmable Output
- Drive Select
- Bypass Select
- Bypass Running
- Overload Fault

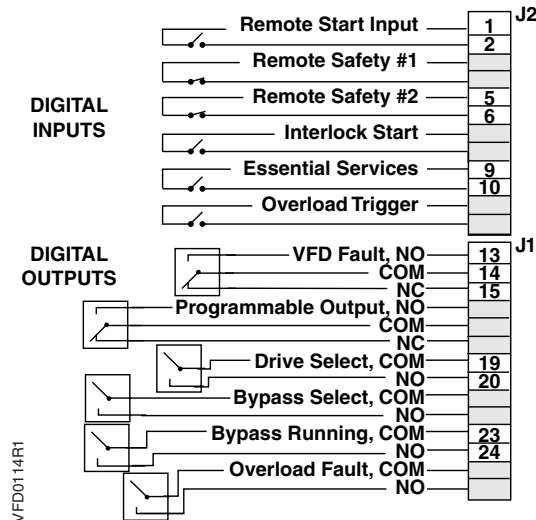


Figure 10. Controller Board Digital Inputs and Outputs.

## Auto Bypass without Interlock

### Description

The Auto Bypass feature enables the SED2 to initiate automatic bypass mode operation. Closing of the SED2 Relay sends the motor to hand bypass mode. See the *SED2 VFD Operation & Maintenance Manual* (Document No. 125-3202) for programming of this relay and for its desired action.

When the SED2 VFD initiates bypass mode operation, the following occurs:

- The VFD stops delivering power
- The output contactor opens.
- The bypass contactor closes and the Programmable Output on the Controller board closes.

### NOTES:

1. All safety conditions must be met for bypass mode operation.
2. The input contactor remains energized.

The Electronic Bypass Option will return to VFD mode operation as soon as the SED2 Relay in control opens. When the Electronic Bypass Option returns to VFD mode operation, the following occurs:

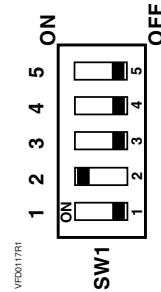
- The SED2 Relay opens, the Programmable Output on the Controller board opens, and the bypass contactor opens.
- The output contactor closes.

**NOTE:** All safety conditions must be met for VFD mode operation.

## Settings

The Auto Bypass feature requires that Controller board DIP Switch 2 is set ON.

**NOTE:** During operation, the Auto Bypass Enabled indicator is on steady.



## Example VFD Settings

Set parameters P0732 and P0748 for Auto Bypass on Drive Fault. Programming of the SED2 Relay is required for proper Auto Bypass activation. Set P0732 and P0748 as follows:

Parameter	Setting
P0732 in000	52.3
P0732 in001	52.3
P0748	— — — □

## Interlock

### Description

The Interlock feature (also called damper end switch logic) enables the SED2 VFD outputs to inhibit motor start until a safety condition (proofing sequence) is confirmed. Any call to start the motor from the SED2 VFD or bypass does not directly start the motor, but instead initiates the following Interlock procedure:

- The Interlock Start Logic Enable indicator is ON. Proofing is required to start in VFD or bypass mode.
- The Interlock Start Logic Command indicator turns ON and the Proofing indicator flashes.
- *When in VFD mode*, the SED2 Relay closes and the Controller board Programmable Output closes to initiate the proofing sequence. The Programmable Output relay is used to supply power to an external device such as a damper actuator.

When not in VFD mode, the Controller board ignores the SED2 Relay.

- *When in bypass mode*, any call to start the motor in bypass (in either hand bypass or auto bypass) initiates the proofing sequence. The Programmable Output closes and is used to supply power to an external device such as a damper actuator.
- When control of the external device (such as a damper actuator) is satisfied, it must supply a contact closure to the Controller board Interlock Start. The Interlock Start Logic Command indicator turns OFF and the Proofing indicator turns ON. The motor then starts in the selected mode.
- Any call for the motor not to be running requires a new proofing sequence to be initiated.

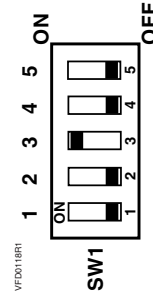
**NOTE:** This feature can only be used with a hardwired start/stop command.

## Settings

The Interlock feature requires that Controller board DIP Switch 3 is set ON.

**NOTES:**

1. The Interlock Start Logic Enabled indicator is on steady.
2. Example assumes hardwired start is in auto. If other, modify P0732 as appropriate.

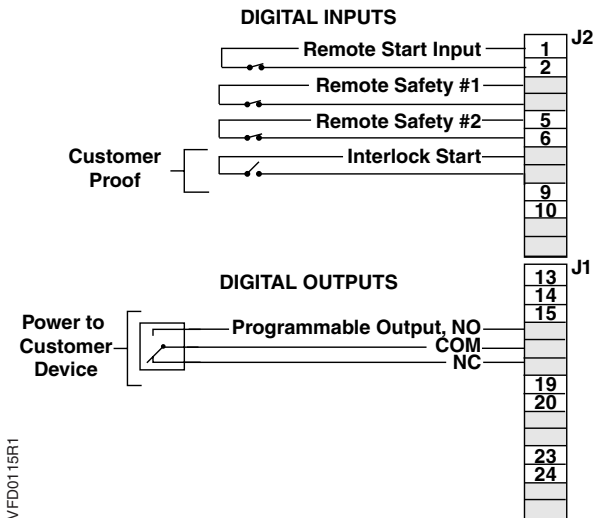


For proper Interlock operation, set the following VFD parameters:

- P0700 in000 = 2  
Digital input that is the start command in the *auto* mode (from the damper end switch)
- P0700 in001 = 2  
Digital input that is the start command in the *hand* mode (from the damper end switch)
- P0701 in000 = 99 and P0701 in001 = 99  
Initiate BiCo
- P0702 in000 = 3 and P0702 in001 = 3
- P0732 in000 = 722.0  
Tells the drive through BiCo that instead of starting the drive in auto mode when the Remote Start input closes, it should close the SED2 Relay.
- P0732 in001 = 19.0  
Tells the drive through BiCo that instead of starting the drive in hand mode when the green Start button is selected, it should close the SED2 Relay.
- P0704 in000 = 1 and P0704 in001 = 1

**NOTE:** For a complete description of BiCo, see the *SED2 VFD Operation & Maintenance Manual* (Document No. 125-3202).

## Wiring Example for Interlock



# Essential Services

## Description

The Essential Services feature allows full-power bypass mode control of the motor during an emergency scenario. Activation of Essential Services overrides any other selected operation. Essential Services ensures that the bypass contactor will not open when a safety input or overload opens. Power goes directly to the motor.

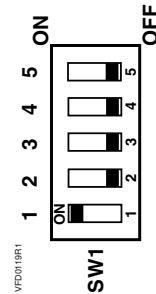
### NOTES:

1. If using both the Interlock and Essential Services features, Essential Services waits 10 seconds for the Interlock to confirm the safety condition (such as opening a damper). After the 10-second delay, Essential Services controls the motor regardless of the Interlock safety condition status.
2. Use extreme care when using the Essential Services mode. All safety circuits are no longer active (including motor overload and safety inputs to the Controller board).

## Settings

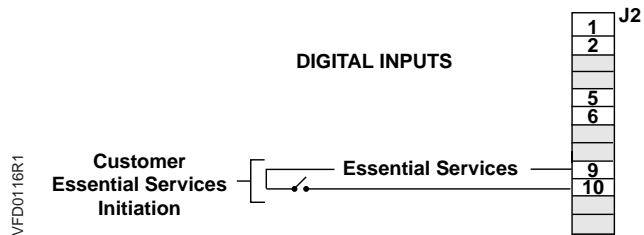
The Essential Services feature requires that Controller board DIP Switch 1 is set ON.

**NOTE:** The Essential Services indicator is on steady.



Essential Services does not require SED2 VFD parameter settings. The Essential Services feature simply puts the Electronic Bypass Option into override bypass mode no matter what operation is selected.

## Wiring Example for Essential Services



# Interlock and Auto Bypass on VFD Fault

## Description

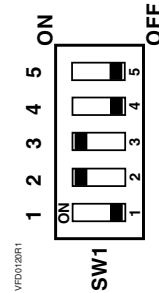
Interlock and Auto Bypass features are both active. Auto bypass now becomes auto bypass on a VFD fault only (bypass is initiated by the SED2 Fault and this digital output must always be programmed to VFD fault).

- All set-up is the same as with Interlock (see the *Interlock* section in *Application Feature Setup*).
- Hand bypass is now initiated by SED2 Fault.
- The Programmable Output is still used to initiate the proofing sequence.

## Settings

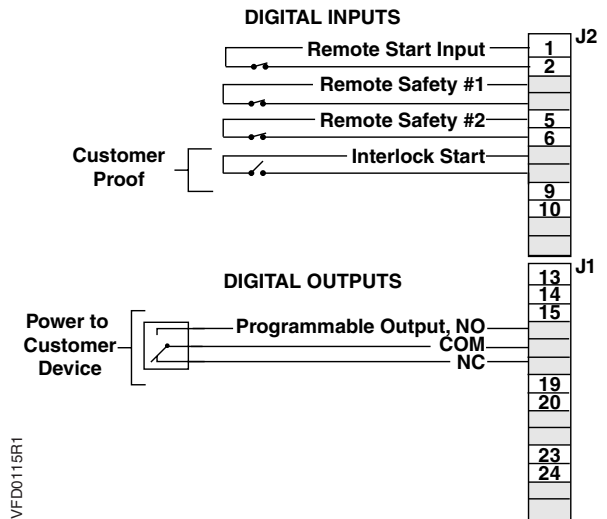
Interlock and Auto Bypass requires that Controller board DIP Switches 2 and 3 are set ON.

**NOTE:** During operation, the Auto Bypass Enabled indicator is on steady. Also, the Interlock Start Logic Enabled indicator is on steady.



See the *Auto Bypass without Interlock on VFD Relay Output* and *Interlock* sections for parameter settings.

## Wiring Example for Interlock and Auto Bypass on VFD Fault



# Technical Specifications

**Table 1. Electronic Bypass Specifications.**

Specifications	Description
Input Voltage (3 phase)	208V, 3AC±10%
	230V, 3AC±10%
	460V, 3AC ±10%
	575V, 3 AC ±10%
Digital Inputs	<p>Six Digital Inputs as follows:</p> <ul style="list-style-type: none"> <li>• Remote start input</li> <li>• Remote safety 1</li> <li>• Remote safety 2</li> <li>• Interlock start</li> <li>• Essential services</li> <li>• Overload trigger</li> </ul> <p>Inputs require a contact closure capable of providing a low impedance path at currents less than 20 mA.</p>
Relay/Digital Outputs	<p>Six Relay/Digital Outputs as follows:</p> <ul style="list-style-type: none"> <li>• VFD fault</li> <li>• Programmable output</li> <li>• Drive select</li> <li>• Bypass select</li> <li>• Running on bypass</li> <li>• Overload fault</li> </ul> <p>Each relay has a maximum rating of 2A at 120V ac.</p>
Temperature	Operating: 32°F to 104°F (0°C to 40°C)
	Storage: -40°F to 158°F (-40°C to 70°C)
Humidity	0 to 95% rh, noncondensing

**NOTE:** For technical specifications on the SED2 VFD, see the *SED2 VFD Operation & Maintenance Manual*, Document No. 125-3202.

**Table 2. Drive Specifications.**

<b>Drive Specifications</b>	<b>Description</b>
Input voltage and power ranges (3 phase) Amps	200V to 240V, 3 AC ± 10%. 1/2 hp to 60 hp (2.3 Amps to 154 Amps)
	380V to 480V, 3 AC ± 10% 1/2 hp to 125 hp (1.2 Amps to 178 Amps)
	500V to 600V, 3 AC ± 10% 1 hp to 125 hp (2.3 Amps to 125 Amps)
Input frequency	47 Hz to 63 Hz
Output frequency	0 Hz to 150 Hz
Power factor	≥0.9
VFD degree of efficiency	96% to 97%
Switch-on current	Less than nominal input current
Auxiliary supply 24V	Galvanically separated, unregulated auxiliary supply (18V to 32V) 100 mA
Overload capacity	110% for 60 seconds, 150% for 3 seconds
Control method	Linear, parabolic and programmable V/f; and flux current control low-power mode
PWM frequency	2k Hz to 16k Hz (adjustable in 2k Hz increments)
Fixed frequencies	15 programmable
Skip frequency bands	4 programmable
Setpoint resolution	0.01 Hz digital
	0.01 Hz serial
	10 bit analog
Digital inputs (sink/source)	6: fully programmable and scalable isolated digital inputs, switchable
Analog inputs	2: 0 to 10 Vdc, 0/4 to 20 mA, can also be configured as digital inputs or Ni 1000 input
Relay outputs	2: configurable 30 Vdc/5A (resistive), 250 Vac 2A (inductive)
Analog outputs	2: programmable (0/4 to 20 mA)
Serial interface	RS-485; Protocols: Siemens, P1 and Johnson, N2; Transmission rate: Up to 38.4k Baud
Protection level	IP20: NEMA Type 1 with protective shield and gland plate installed
	IP54: NEMA Type 12 (400V and 500V series only)
Temperature ranges	Operating: 14°F to 104°F (–10°C to 40°C)
	Storage: –40°F to 158°F (–40°C to 70°C)
Humidity	95% rh, non-condensing
Operational altitudes	Up to 3280 ft (1000m) above sea level without derating
Protection features	<ul style="list-style-type: none"> <li>• Under-voltage</li> <li>• Over-voltage</li> <li>• Overload</li> <li>• Ground fault</li> <li>• Short circuit</li> <li>• Stall prevention</li> <li>• Locked motor</li> <li>• Motor overtemperature I<sup>2</sup>t, PTC</li> <li>• Over-temperature</li> <li>• Parameter PIN protection</li> </ul>
Standards	UL, cUL

# Troubleshooting



**WARNING:**

Always disconnect all power sources before opening the SED2 VFD Electronic Bypass Option.

## Power-on Initialization Failure (Unit Fault Condition)

During power-on initialization, a unit fault condition occurs if the Electronic Bypass Option did not pass the basic sanity test. Rather than flash normally, the basic sanity test indicator pauses, flashes a fault code, and then repeats.

Table 5 shows the fault codes. For example, if the basic sanity test indicator flashes three times rapidly, pauses, and then repeats, this means that there is a keypad failure.

**Table 5. Basic Sanity Test Fault Codes.**

Basic Sanity Test Fault Code/Flashes	Description
1	Non-Volatile Memory Failure
2	Flash Memory Failure (CRC – cyclic redundancy check)
3	Keypad Failure
4	RAM Memory Failure (not used)
5	EEPROM Read error
6	EEPROM Write Failure
7	Runtime Flash Failure (CRC – cyclic redundancy check)
8	Main Program Failed (or hangs)

It may be possible to recover from the unit fault condition by simply attempting a power down/up of the Electronic Bypass Option. If the unit fault condition still exists, replace the Controller board.



**CAUTION:**

When powering down/up the Electronic Bypass Option, power down the unit, wait 5 minutes, and then power up the unit.

## Override Jumper

An Override Jumper (J8) is supplied on the Controller board. Moving this jumper to the override position removes the Controller board and its keypad from the control and closes the drive output contactor (and the input contactor if supplied).

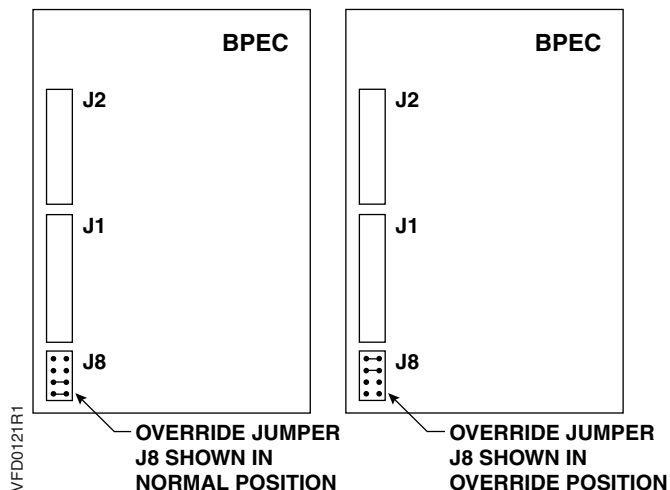


Figure 11. Override Jumper J8 Location and Positions.

## Fuses

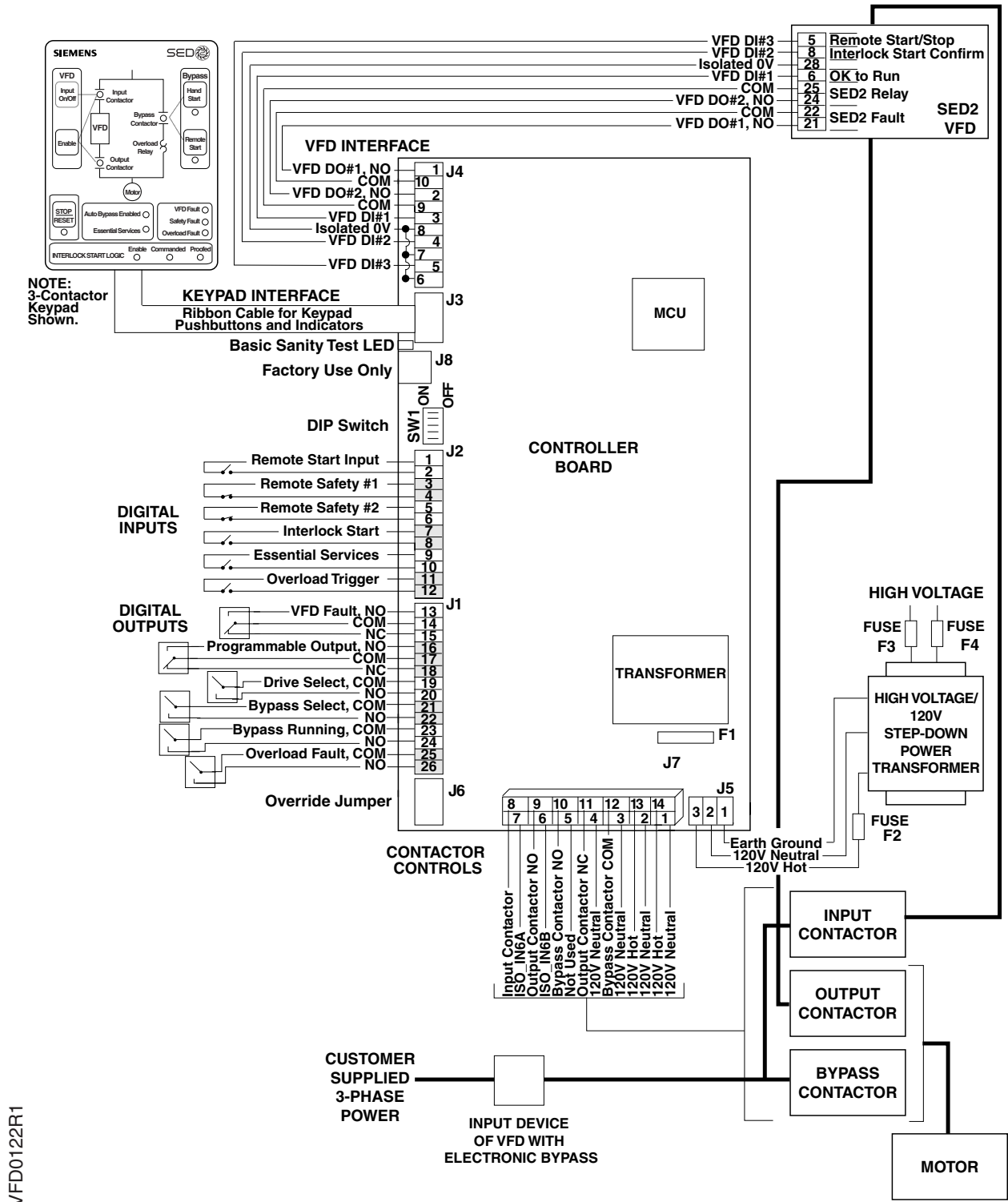
The Controller board contains a fuse (F1) under its cover (Figure 12). Determine if the fuse F1 needs replacement as follows:

1. If the basic sanity test indicator (Figure 12) is flashing, fuse F1 is okay and no action is required.
2. Verify that 120 Vac power is available on the secondary side of the Electronic Bypass Option power transformer (Figure 12). If power is not proper, check the Electronic Bypass Option components such as:
  - Power transformer
  - Power transformer fuses (F2, F3, and F4). Table 6 provides fuse replacement information.
3. If power is proper, check fuse F1 as follows:
  - Power down the Electronic Bypass Option.
  - Remove the Controller board cover.
  - Remove fuse F1.
  - Use an ohm meter to check the fuse.
  - Replace fuse F1 if necessary.

**NOTE:** Replace fuse F1 with an 8 AG, 1/2 amp, 250V, fast-acting instrument fuse such as a Bussmann AGX1/2 or Littlefuse 361.500.

**Table 6. Fuse Replacement Information.**

<b>Bypass Option Part Number</b>	<b>Primary Fuse (F3 and F4)</b>	<b>Secondary Fuse (F2)</b>
VBE10.5... to VBE17.5...	Bussmann/Littlefuse LP-CC-1	Bussmann/Littlefuse LP-CC-6/10
VBE110... to VBE110...	Bussmann/Littlefuse LP-CC-2	Bussmann/Littlefuse LP-CC-1 1/4
VBE115... to VBE160...	Bussmann/Littlefuse LP-CC-3	Bussmann/Littlefuse LP-CC-2
VBE20.5... to VBE27.5...	Bussmann/Littlefuse LP-CC-1	Bussmann/Littlefuse LP-CC-6/10
VBE210... to VBE210...	Bussmann/Littlefuse LP-CC-2	Bussmann/Littlefuse LP-CC-1 1/4
VBE215... to VBE260...	Bussmann/Littlefuse LP-CC-3	Bussmann/Littlefuse LP-CC-2
VBE30... to VBE315...	Bussmann/Littlefuse LP-CC-1/2	Bussmann/Littlefuse LP-CC-6/10
VBE320... to VBE320...	Bussmann/Littlefuse LP-CC-1	Bussmann/Littlefuse LP-CC-1 1/4
VBE325... to VBE3125...	Bussmann/Littlefuse LP-CC-1 1/2	Bussmann/Littlefuse LP-CC-2
VBE40... to VBE420...	Bussmann/Littlefuse FNQ-R-4/10	Bussmann/Littlefuse LP-CC-6/10
VBE425... to VBE425...	Bussmann/Littlefuse LP-CC-8/10	Bussmann/Littlefuse LP-CC-1 1/4
VBE430... to VBE4125...	Bussmann/Littlefuse LP-CC-1 1/4	Bussmann/Littlefuse LP-CC-2



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Figure 12. Controller Board Inputs and Outputs.



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