Reliance SS4437

Regenerative Converter with PWM Technique

Limited Availability
Used and in Excellent Condition

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SS4000 Bidirectional Converter Hardware and Software Reference, Installation, Start-up, and Troubleshooting

460 V class: 15 kW (30 kW, 45 kW)
37 kW (75 kW, 110 kW)
125 kW (250 kW, 375 kW)
230 V Class: 7.5 kW (15 kW, 22.5 kW)
18.5 kW (37 kW, 55 kW)
22 kW (44 kW, 66 kW)
65 kW (130 kW, 195 kW)

Instruction Manual 35001-6E

Rockwell Automation
Reliance Electric

March 2000

The information in this instruction manual is subject to change without notice.

Throughout this manual, the following notes are used to alert you to safety considerations:

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: Do not install or remove any parts with power applied to this equipment. Disconnect and lock out incoming power before attempting such installation or removal. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: DC bus capacitor retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait for a while for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: The user is responsible for conforming with all applicable local, national and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

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CHAPTER 1
Introduction

The products described in this instruction manual are manufactured and distributed by Reliance Electric Limited.

The SS4000 Bidirectional Converter is a sinusoidal PWM converter which can control increase of DC bus voltage and perform continuous power regeneration. The SS4000 units, therefore, can be used as power supply unit for various drives and inverter units.

This instruction manual covers the SS4000 units for 380-460 VAC and 200-230 VAC, and describes the hardware and the start-up and programming procedure for the SS4000 units. Read and understand this manual before proceeding.

The following units are UL/C-UL listed:

SS4000 units for 460 V: SS4437 and SS4437P units
SS4000 units for 230 V: SS4218, SS4218P, SS4222 and SS4222P units

For the remaining units, application for securing UL/C-UL listing was already filed to Underwriters Laboratories.

Also, the Declaration of Conformity with the requirements for CE Mark was already issued for the following units:

SS4000 units for 460 V: SS4415, SS4415P, SS4437 and SS4437P units
SS4000 units for 230 V: SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units

1.1 Finding Information

The SS4000 unit is a bidirectional converter with the following features:

- Use of chopper type voltage increasing method with sinusoidal pulse-width-modulated (PWM) waveform control.
- Increasing DC bus voltage and controlling it at a selected value.
- Continuous power regeneration.
- Restraint of higher harmonic of input current.
- Safety and environmental consideration.

This instruction manual describes the detail of the SS4000 unit for the user's full understanding. As an aid in finding information in this manual, each chapter is briefly described below:

- Chapter 1 : Introduction

  Provides situation for acquiring UL Marks and CE Marks for the SS4000 units and information on how this instruction manual is organized and where to find additional information.

- Chapter 2 : About the SS4000 Unit

  Identifies components of the SS4000 unit, shows their locations, and describes the main components.

- Chapter 3 : Installing the SS4000 Unit

  Describes how to mount the SS4000 units properly.

- Chapter 4 : Wiring the SS4000 Unit

  Describes how to properly wire and connect the SS4000 units.

- Chapter 5 : Starting and Adjusting the SS4000 Unit

  Provides information on how to perform a final check before power is applied, and instructions on basic operation.

- Chapter 6 : Using the Operation Panel to Set Parameters, Monitor Operation, and Reset Error

  Describes the composition and contents of the operation panel.

- Chapter 7 : Setting Parameters

  Provides detailed description of each parameter.

- Chapter 8 : Displaying Error Codes

  Describes contents of error codes and how to correct problems.

- Chapter 9 : Troubleshooting the SS4000 Unit

  Describes how to inspect and troubleshoot the SS4000 unit.

- Chapter 10 : Replacement Part List

  Provides a list of required replacement parts.

- Chapter 11 : Dimensional Outline Drawings for the Peripheral Devices

  Provides outline dimensions of reactors, varistors, harmonic filters, and line filters out of the peripheral devices to be connected to the SS4000 unit.

- Appendix A: Technical Specifications

  Lists specifications of the SS4000 unit in table form.

- Appendix B: Default Values of Parameters

  Provides the default values of the parameters in table form.

- Appendix C: Control Block Diagram

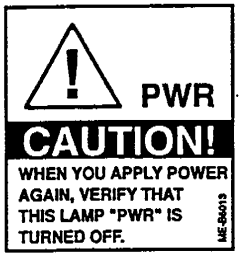
  Provides a control block diagram.

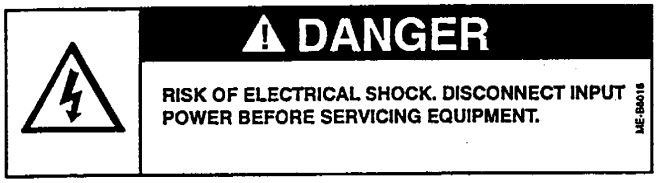
1.2 Assumptions About the Audience

This instruction manual is intended for qualified electrical personnel.

1.3 Notes on Handling the SS4000 Unit

The following three labels are put on the SS4000 unit, advising the user of the notes on handling the unit. Read and understand the contents before using the unit





CAUTION !

THIS EQUIPMENT MUST BE MOUNTED IN A SUITABLE UL RECOGNIZED ENCLOSURE OR NEMA ENCLOSURE.

USE COPPER 60/75 DEGREE C WIRE ONLY.

CHAPTER 2

About the SS4000 Unit

This chapter describes how to identify the SS4000 units using the model number matrix. Major components, their locations, and terminal blocks are also shown.

2.1 Receive and Accept the Shipment

Reliance Electric's terms of sale, in all instances, are F.O.B. point of origin. The user is responsible for thoroughly inspecting the equipment before accepting shipment from the transportation company.

If all the items called for the bill of lading or on the express receipt are not included or if any items are obviously damaged, do not accept the shipment until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight or express agent within 15 days of receipt and request that he make an inspection of the shipment. Keep the entire shipment intact in its original shipping container.

The user is responsible for making claim against the Carrier for any shortage or damage occurring in transit. Claims for loss or damage in shipment must not be deducted from the Reliance Electric invoice, nor should payment of the invoice be withheld while awaiting adjustment of such claims since the Carrier guarantees safe delivery.

2.2 Identify the SS4000 Unit by Model Number

Power rating of each SS4000 unit can be identified by its model number. See Figure 2.1. This number appears on the shipping label and on the unit's nameplate.

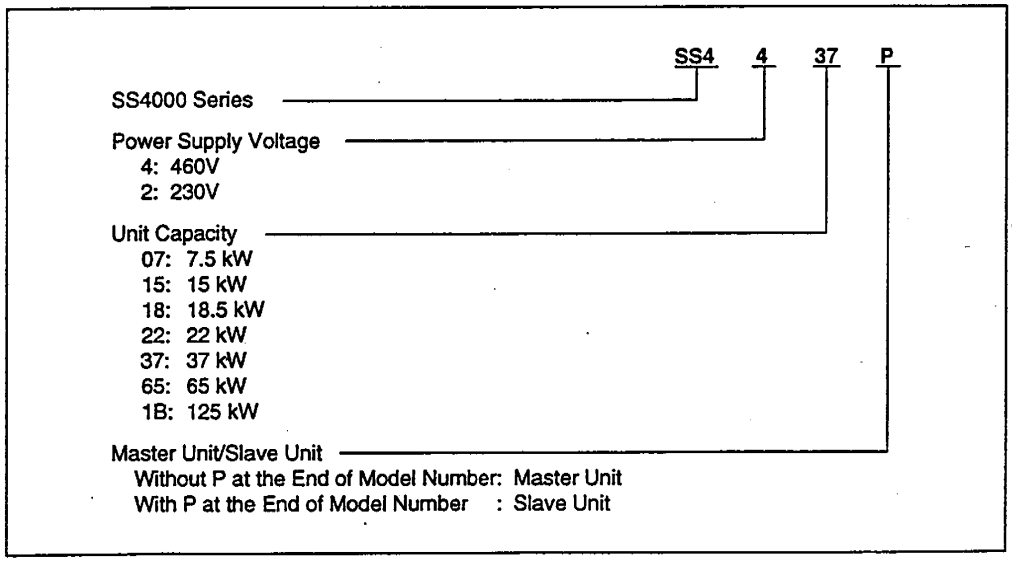


Figure 2.1 – Unit Model Number

Up to three SS4000 units can be connected in parallel depending on the required capacity as shown in Table 2.1.

Table 2.1 – Kind, Connection and Power Ratings

Kind of Unit	Connection	Model Number	Power Rating
15 kW for 460 V	Single Unit	SS4415 x 1	15 kW
	Two paralleled units	SS4415 x 1 + SS4415P x 1	30 kW
	Three paralleled units	SS4415 x 1 + SS4415P x 2	45 kW
37 kW for 460 V	Single Unit	SS4437 x 1	37 kW
	Two paralleled units	SS4437 x 1 + SS4437P x 1	75 kW
	Three paralleled units	SS4437 x 1 + SS4437P x 2	110 kW
125 kW for 460 V	Single Unit	SS441B x 1	125 kW
	Two paralleled units	SS441B x 1 + SS441BP x 1	250 kW
	Three paralleled units	SS441B x 1 + SS441BP x 2	375 kW
7.5 kW for 230 V	Single Unit	SS4207 x 1	7.5 kW
	Two paralleled units	SS4207 x 1 + SS4207P x 1	15 kW
	Three paralleled units	SS4207 x 1 + SS4207P x 2	22.5 kW
18.5 kW for 230	Single Unit	SS4218 x 1	18.5 kW
	Two paralleled units	SS4218 x 1 + SS4218P x 1	37 kW
	Three paralleled units	SS4218 x 1 + SS4218P x 2	55 kW
22 kW for 230 V	Single Unit	SS4222 x 1	22 kW
	Two paralleled units	SS4222 x 1 + SS4222P x 1	44 kW
	Three paralleled units	SS4222 x 1 + SS4222P x 2	66 kW
65 kW for 230 V	Single Unit	SS4265 x 1	65 kW
	Two paralleled units	SS4265 x 1 + SS4265P x 1	130 kW
	Three paralleled units	SS4265 x 1 + SS4265P x 2	195 kW

2.3 Appearance of the SS4000 Unit

2.3.1 Appearance of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

The appearance of Model SS4415, SS4437, SS4207, SS4218 and SS4222 units is illustrated in Figures 2.2 to 2.4.

Figure 2.2 shows the front view of the unit covered by the front cover. The operation panel (only for master unit) and the power lamp can be seen through the front cover. All the terminals blocks to connect wiring are covered by the front cover.

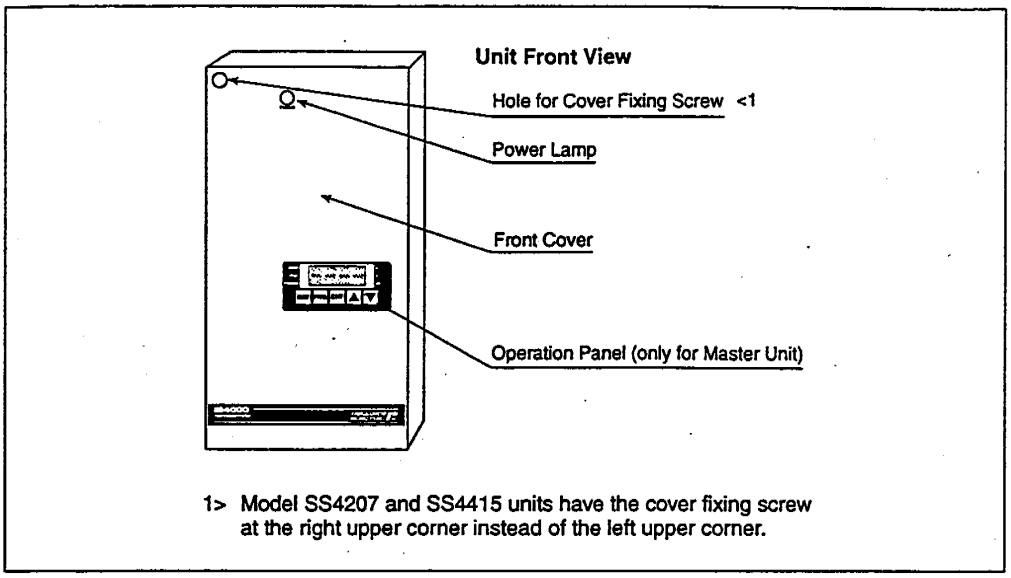


Figure 2.2 – Front View of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

When the front cover is removed from the SS4000 unit, the main power terminal block (TB1) and the Regulator Board (only for master unit) will appear as shown in Figure 2.3. To remove the front cover, first remove the screw (one piece only) at the upper left corner of the unit, and then lift up the cover. Note, however, that Model SS4207 and SS4415 units have the cover fixing screw at the upper right corner instead of the upper left corner. Do not drop the screw from the cover.

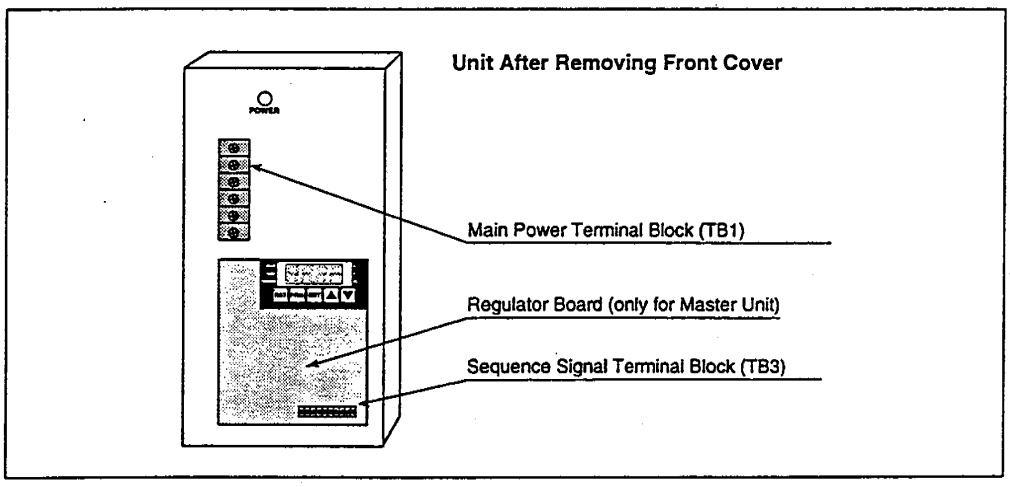


Figure 2.3 – Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units After Removing the Front Cover

The control power terminal block (TB2) will be disclosed as shown in Figure 2.4, when the Regulator Board is opened to the left hand side by removing the two fixing screws on the right hand side of the bracket supporting the Regulator Board.

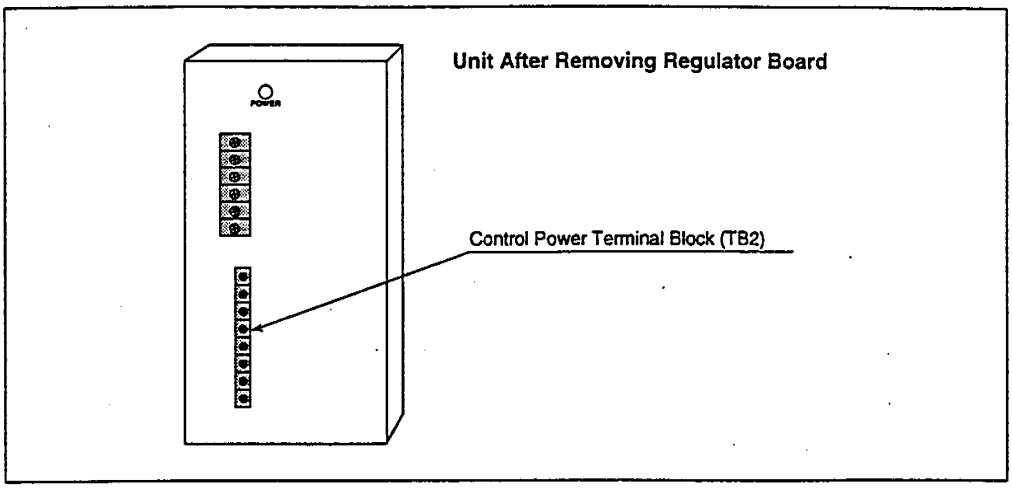


Figure 2.4 – Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units After Removing the Regulator Board

2.3.2 Appearance of Model SS441B and SS4265 Units

The appearance of Model SS441B and SS4265 units is shown in Figures 2.5 and 2.6. Figure 2.5 illustrates the front view of these units and Figure 2.6 shows the units after removing the front cover.

These units have the main power terminals L1 to L3 at the top of the unit, and the DC bus terminals N and P at the bottom of the unit.

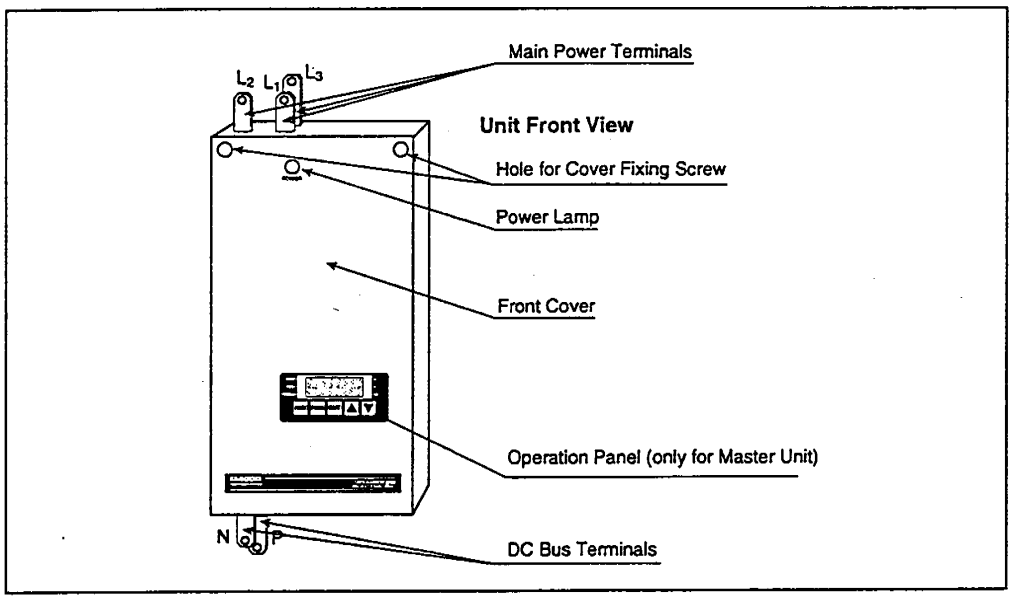


Figure 2.5 – Front View of Model SS441B and SS4265 Units

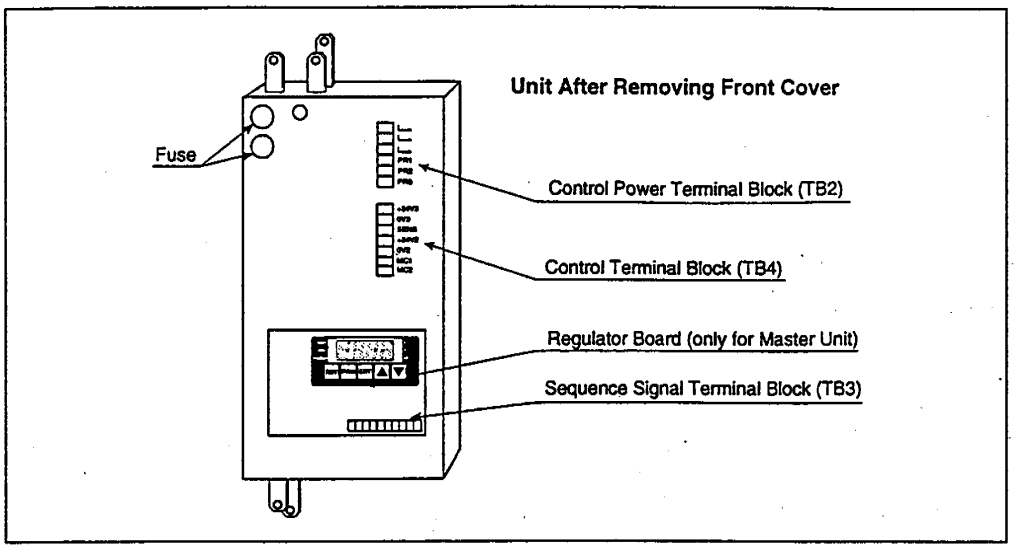


Figure 2.6 – Model SS441B and SS4265 Units after Removing the Front Cover

2.4 Main Components and Locations

The SS4000 unit has the following main components. The identification numbers provided correspond to the numbers used in Figure 2.7. These main components are included in the replacement part list shown in Chapter 10.

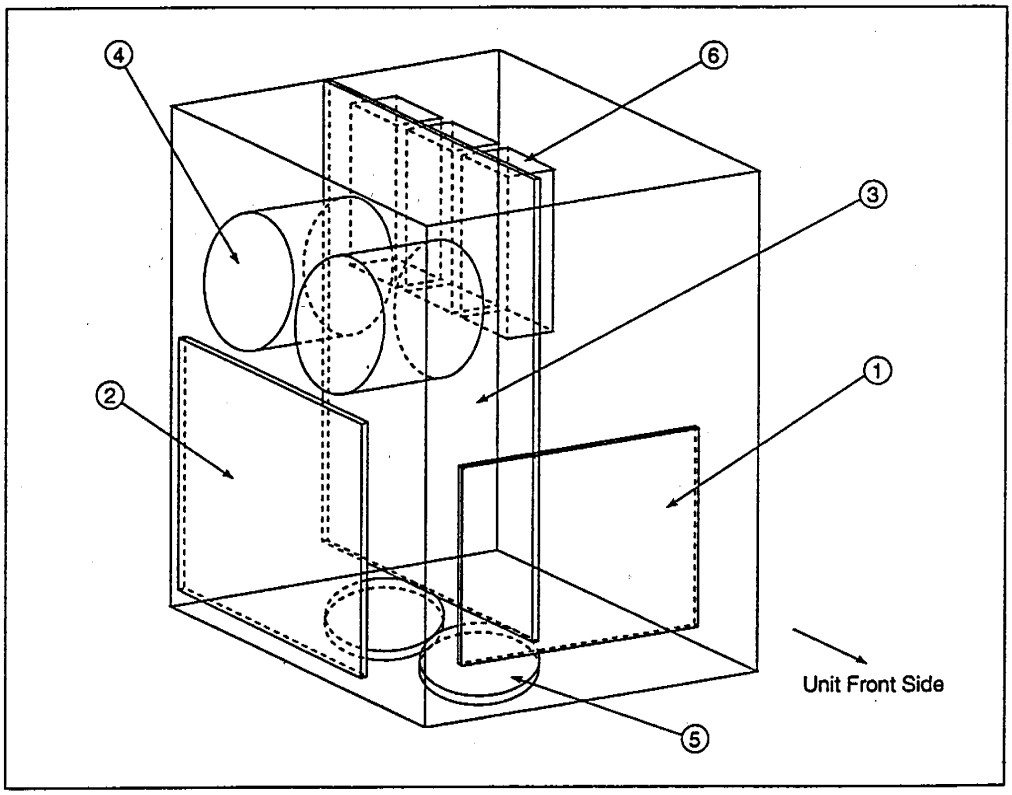


Figure 2.7 – Main Components and their Locations

1. Regulator Board (BDSR) (only master unit has a Regulator Board, not on slave unit)
2. Power Interface Board (PIFS)
3. Driver Board (RCPB or BDI)
4. Bus Capacitors
5. Cooling Fan
6. Power Modules

To organize a system using the SS4000 unit, the following peripheral devices to be provided by the user are required as shown in Figures 4.1 to 4.3 and 4.6 to 4.8.

1. Disconnect (breaker)
2. Main magnetic contactor *
3. Reactor
4. Line filter for AC input power
5. Line filter for power supply for main magnetic contactor *
6. Harmonic filter *
7. Varistor *
8. Fuse (UL-listed)

* It is not necessary to provide these peripheral devices for Model SS441B and SS4265 units.

For more information, refer to Chapter 4 of this instruction manual.

2.5 Knowing the Terminal Blocks on the Main Circuit

This section provides the main circuit block diagram and the description of the main power terminal block (TB1) and the control power terminal block (TB2). Figure 2.8 shows the main circuit block diagram for Model SS4415, SS4437, SS4207, SS4218 and SS4222 units and their slave units. The main circuit block diagram for Model SS441B and SS4265 units and their slave units is shown in Figure 2.9.

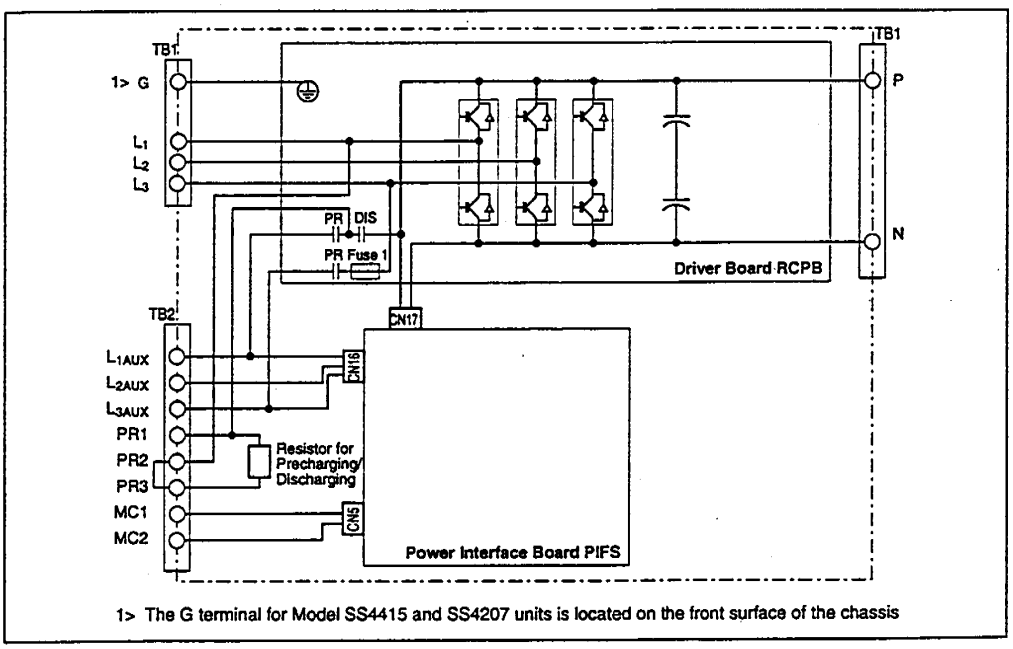


Figure 2.8 – Main Circuit Block Diagram for Model SS4415, SS4437, SS4207, SS4218 and SS4222 and their Slave Units

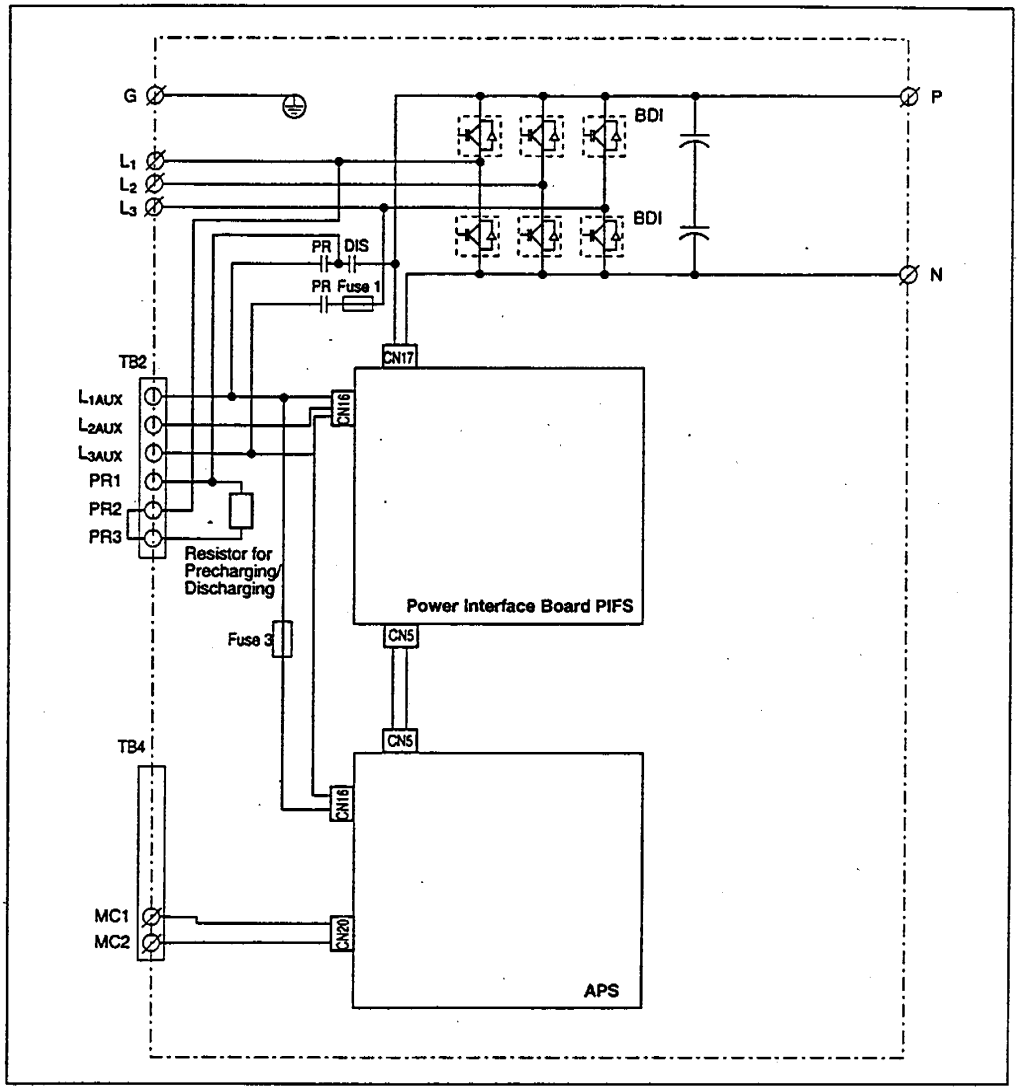


Figure 2.9 – Main Circuit Block Diagram for Model SS441B and SS4265 and their Slave Units

2.5.1 Main Power Terminal Block (TB1) and the Main Power Terminal Bars

Table 2.2 provides the information on use of the terminals on the main power terminal block (TB1) for Model SS4415, SS4437, SS4207, SS4218 and SS4222 units and the main power terminal bars for Model SS441B and SS4265 units.

Table 2.2 – Terminals on the Main Power Terminal Block (TB1) for Model SS4415, SS4437, SS4207, SS4218 and SS4222 units and Main Power Terminal Bars for Model SS441B and SS4265 units

Terminal Name	Symbol	Description
Main Power Terminals	L_1, L_2, L_3	To connect three-phase AC input power to the main circuit. For 460 V unit: 380 to 460 VAC +10%, –15%, 50/60 Hz +/– 5% For 230 V unit: 200 to 230 VAC +10%, –15%, 50/60 Hz +/– 5%
DC Bus Terminals	P, N	To connect the SS4000 unit to load equipment.
Grounding Terminal	G	To ground the SS4000 unit.

2.5.2 Control Power Terminal Block (TB2) for Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

Table 2.3 describes the terminals on the control power terminal block (TB2) for Model SS4207, SS4218, SS4222, SS4415 and SS4437 units.

Table 2.3 – Terminals on the Control Power Terminal Block (TB2) for Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

Terminal Name	Symbol	Description
Control Power Terminals	L_{1AUX}, L_{2AUX}, L_{3AUX}	To connect three-phase AC input power to the control circuit. For 460 V unit: 380 to 460 VAC +10%, –15%, 50/60 Hz +/– 5% For 230 V unit: 200 to 230 VAC +10%, –15%, 50/60 Hz +/– 5%
Terminals to Connect Precharge/Discharge Resistor	PR1, PR2, PR3	To connect precharge/discharge resistor. When the built-in resistor is used: Jumper between PR2 and PR3, and open PR1. When an external resistor is used: Connect the resistor between PR1 and PR2, and open PR3. When the unit is connected for power regeneration mode only: Open all the terminals PR1, PR2 and PR3.
Control Terminals for Main Magnetic Contactor	MC1, MC2	To be used as the control terminals for the main magnetic contactor (rated for 250 VAC/1 A or 30 VDC/1 A).

2.5.3 Control Power Terminal Block (TB2) for Model SS441B and SS4265 Units

Table 2.4 describes the terminals on the control power terminal block (TB2) for Model SS441B and SS4265 units.

Table 2.4 – Terminals on the Control Power Terminal Block (TB2) for Model SS441B and SS4265 Units

Terminal Name	Symbol	Description
Control Power Terminals	L_{1AUX}, L_{2AUX}, L_{3AUX}	To connect three-phase AC input power to the control circuit. For 460 V unit: 380 to 460 VAC +10%, –15%, 50/60 Hz +/– 5% For 230 V unit: 200 to 230 VAC +10%, –15%, 50/60 Hz +/– 5%
Terminals to Connect Precharge/Discharge Resistor	PR1, PR2, PR3	To connect precharge/discharge resistor. When the built-in resistor is used: Jumper between PR2 and PR3, and open PR1. When an external resistor is used: Connect the resistor between PR1 and PR2, and open PR3. When the unit is connected for power regeneration mode only: Open all the terminals PR1, PR2 and PR3.

2.5.4 Control Terminal Block (TB4) for Model SS441B and SS4265 Units

Table 2.5 describes the terminals on the control terminal block (TB4) for Model SS441B and SS4265 units.

Table 2.5 – Terminals on the Control Terminal Block (TB4) for Model SS441B and SS4265 Units

Terminal Name	Symbol	Description
AC Reactor Fan Power Terminals	+24V3 0V3	To supply AC power to the fan for the AC reactor unit through the EM4000 EMC filter unit.
Terminal for Fan Fault Signal	SENS	To enter fault signal of the fan for the AC reactor unit.
Power Terminals for Main Magnetic Contactor MC and Optional Fan	+24V2 0V2	To supply power to the main magnetic contactor and the fan for the cabinet fan through the EM4000 EMC filter unit.
Control Terminals for Main Magnetic Contactor	MC1 MC2	To be used as the control terminals for the main magnetic contactor.

2.6 Regulator Board

The Regulator Board exists only on master unit. The slave unit for parallel connection has no Regulator Board and is controlled by the microprocessor of the Regulator Board on the master unit.

The SS4000 unit regulation is performed by the microprocessor on the Regulator Board. Figure 2.10 shows the locations of the main components on the Regulator Board. The operation of the SS4000 unit is adjusted by the parameters set by the keypad.

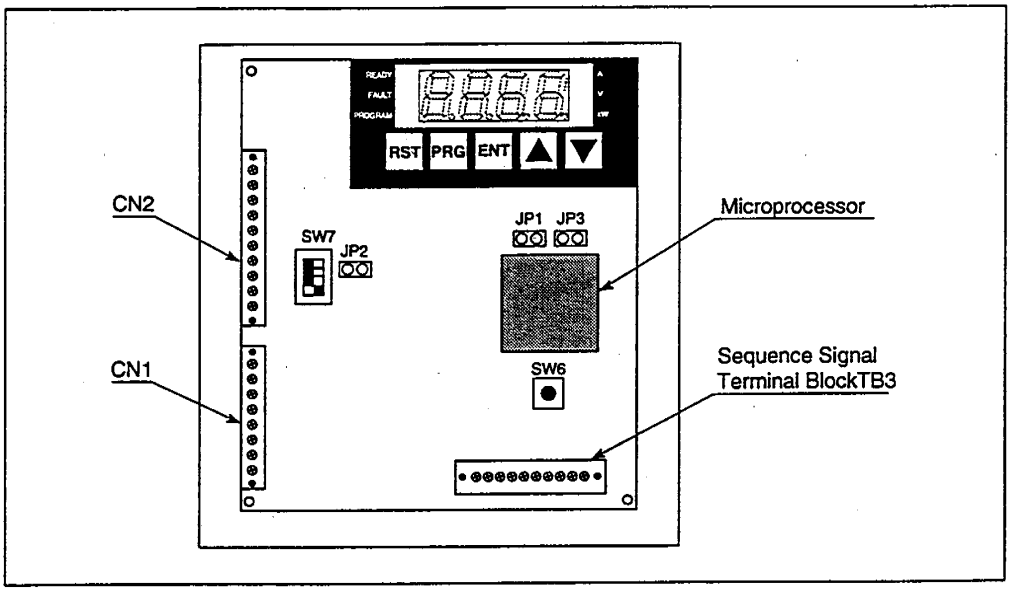


Figure 2.10 – Regulator Board and Locations of Main Components

- PWM Gating Signals

  Based on the output of the current/voltage control loop, the Regulator Board sends PWM gating signals through the Power Interface Board to the Power Modules (transistors), producing a pulse-width-modulated (PWM) waveform.

- Sequence Output Signals

  Sequence output signals are provided from the sequence signal terminal block (TB3) of the Regulator Board to indicate the unit status .

- Four-character Display and Six LEDs

  A four-character seven-segment LED display is used to monitor values, parameter numbers, parameter values, and error codes. Six LEDs show the display mode of the operation panel and the units of the monitored values.

2.6.1 Jumpers and Switches

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should set jumpers and switches. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Do not press the reset button switch (SW6) during operation. Also, do not alter the setting of any jumpers and switches during operation. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: Do not alter the settings of any jumpers not described in this instruction manual. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

The jumpers JP1 to JP3 and the switches SW6 and SW7 are set before shipment from factory. If you need to change the jumpers and/or switch settings, read and understand the following description of these jumpers and switches before proceeding.

- Jumper JP1 to Enable Operation

  Short this jumper to start switching operation of transistors of the SS4000 unit when the RUN sequence input is enabled. This jumper should always be kept closed.

- Jumper JP2 to Enable Inspection Mode

  Keep this jumper open always.

- Jumper JP3 to Reserve the System

  Keep this jumper open always.

- Reset Switch SW6

  Pressing this switch resets the CPU.

  Important: Do not press the reset switch SW6 during operation.

- Switch SW7 to Enable Base Block

  This switch is used to stop switching of transistors that produce PWM waveform by interrupting the base signal from the Power Modules. To interrupt the base signal, turn the switch to the OFF side.

  As shown in Figure 2.11, SW7 consists of four switches, and SW7-1 to SW7-3 can be allocated to the master unit and slave units 1 and 2. In the case of a master with paralleled slave units, it is possible to interrupt the base signal of each unit by turning the corresponding switch to the OFF side. SW7-4 must always be kept to the OFF side.

  When two units are connected in parallel, turn the switches SW7-1 and SW7-2 to the ON side, and when three units are connected in parallel, turn the switches SW7-1 through SW7-3 to the ON side.

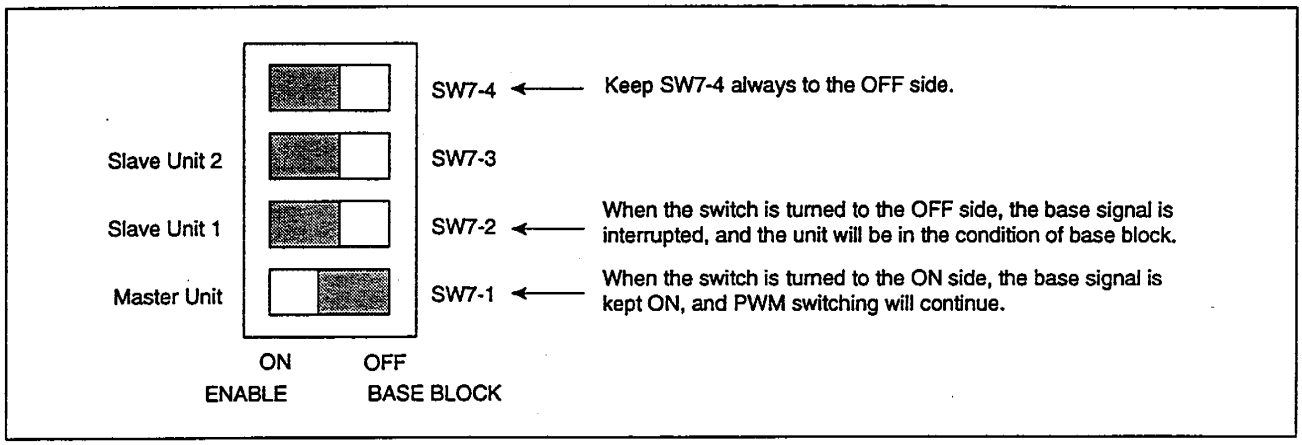
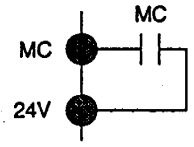
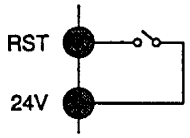
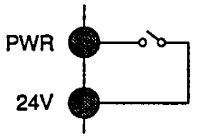
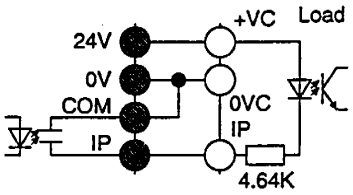
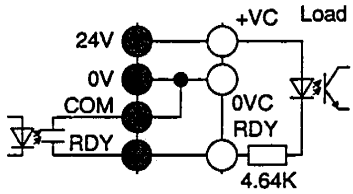
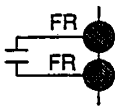


Figure 2.11 – Switches to Enable Base Block

2.6.2 Sequence Signal Terminal Block (TB3)

As shown in Figure 2.10, there is a sequence signal terminal block (TB3) on the Regulator Board. Table 2.6 provides the information on each terminal of TB3.

Table 2.6 – Sequence Signal Terminals

Name of Terminal	Symbol	Description
Sequence Input Signals	MC	Enter the supplemental contact signal (normally open contact) of the main magnetic contactor. 
	RST	The reset signal (+24 VDC) is used to reset fault. Close this reset signal as required. 
	PWR	Enter the RUN signal (+24 VDC). 
Power for Sequence Signals	0 V	0 V of +24 VDC power.
	24 V	+24 VDC power (rated for 24 VDC/0.2 A).
Sequence Output Signals	COM	Common for IP and RDY signals.
	IP	This is a contact signal that is turned ON during instantaneous power loss (rated for 24 VDC/50 mA). 
	RDY	This is a contact signal that is turned ON while the unit is ready for operation (rated for 24 VDC/50 mA). 
	FR, FR	This is a contact signal that opens while fault occurs (rated for 250 VAC/1 A or 30 VDC/1 A). 

CHAPTER 3

Installing the SS4000 Unit

This chapter shows how to mount the SS4000 units properly, and provides information on the items to be checked.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury, or loss of life.

ATTENTION: The user is responsible for conforming with all applicable local, national and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

3.1 Installation Site

It is important to properly plan before installing the SS4000 units to ensure that the environment and operating conditions of the units are satisfactory. Read this section before continuing with the unit installation.

3.1.1 Making Sure Environment Conditions are Met

The Declaration of Conformity with the requirements for CE Mark was issued for the following SS4000 units, and these units must be used in cabinet.

SS4000 units for 460 V: SS4415, SS4415P, SS4437 and SS4437P units
SS4000 units for 230 V: SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units

Also, before deciding on an installation site, consider the following guidelines:

- Verify that the units can be kept clean, cool and dry.
- Be sure that the units are always away from oil, metal powder, other airborne contaminants, and direct sunlight.
- Check that the units will not be exposed to excessive vibration and noise, and that they will not be close to instruments sensitive to electrical noise.
- The area chosen should allow the space required for proper air flow as defined in Section 3.1.3.
- Check that the temperatures within the vicinity of the units are between –10 to 50 degree C (14 to 122 degree F).

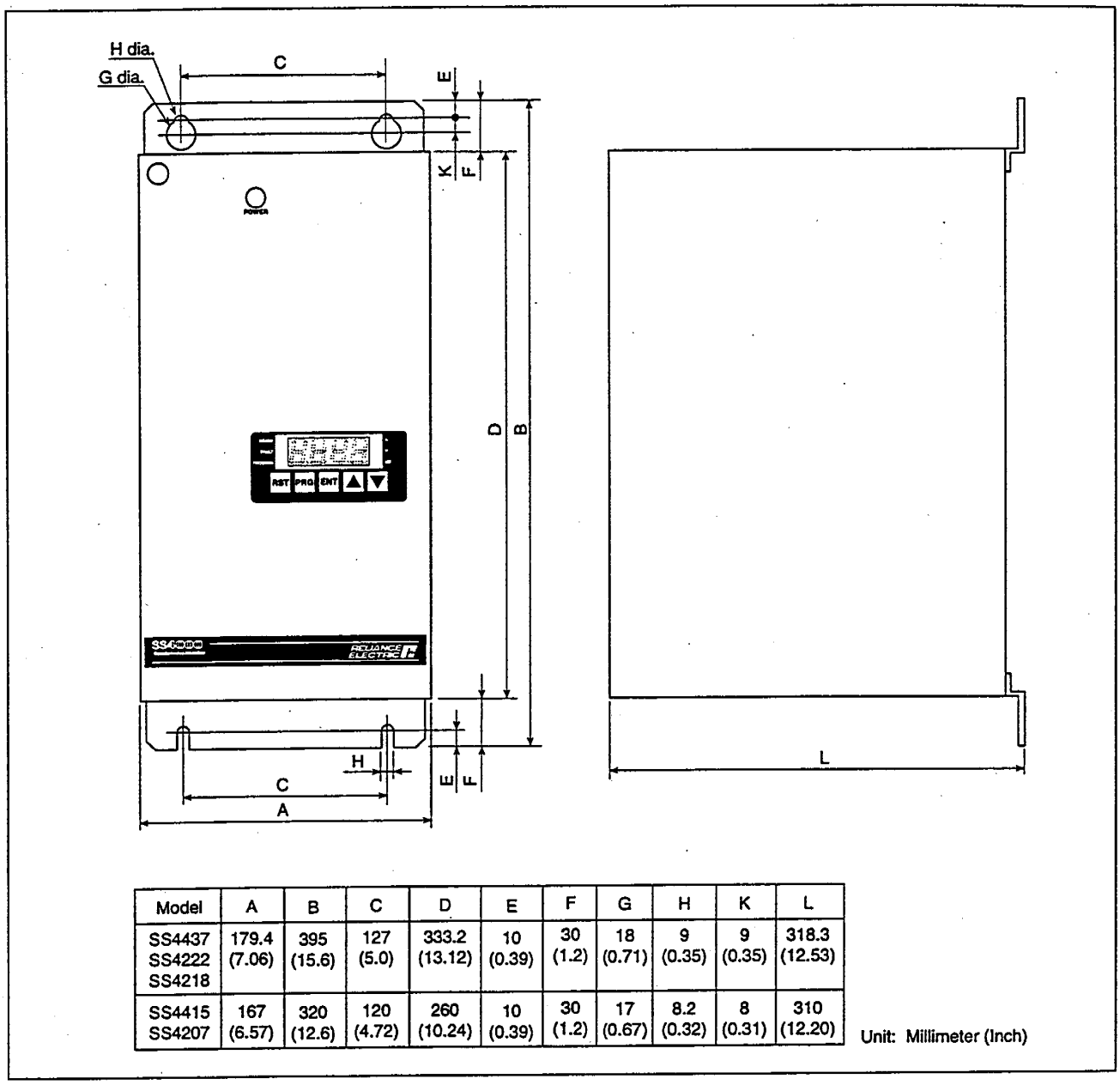
- Check that the relative humidity is between 5 and 95% without condensation.
- Do not install the units above 1,000 meters (3,300 feet) without derating output power. For every 300 meters (1,000 feet) above 1,000 meters (3,300 feet), derate the output power 4%. When you need to install the units above 1,500 meters (5,000 feet), contact Reliance Electric.

In case of Model SS441B, SS441BP, SS4265 and SS4265P units, it is possible to ship the units from factory after mounting each of these units in a cabinet together with the required peripheral devices and installing wiring in the cabinet. Model S241B Cabinet is used for Model SS441B and SS441BP units, and Model S2265 Cabinet for Model SS4265 and SS4265P units. When the user purchases from Reliance Electric the units mounted in the cabinets, the above-mentioned guidelines should also be considered for selection of the installation site. But in this case, the ambient temperature must be between –10 to 40 degree C (14 to 104 degree F).

3.1.2 Determining Total Area Required Based on Unit Dimensions

Overall unit dimensions are shown in Figures 3.1 and 3.2. Figure 3.1 illustrates the outline dimensions of Model SS4415, SS4437, SS4207, SS4218 and SS4222 units, and Figure 3.2 shows the outline dimensions of Model SS441B and SS4265 units. Also as an aid in calculating the required total area, Figures 3.3 and 3.4 show the minimum required distance between two adjacent units in case of two and three paralleled units of Model SS4415, SS4437, SS4207, SS4218 and SS4222 units, and Figures 3.5 and 3.6 show the minimum required distance between two adjacent units in case of two and three paralleled units of Model SS441B and SS4265 units installed in a cabinet provided by the user.

For the dimensions of Model S241B and S2265 Cabinets, refer to Section 11.6 of this manual.



Model	A	B	C	D	E	F	G	H	K	L
SS4437 SS4222 SS4218	179.4 (7.06)	395 (15.6)	127 (5.0)	333.2 (13.12)	10 (0.39)	30 (1.2)	18 (0.71)	9 (0.35)	9 (0.35)	318.3 (12.53)
SS4415 SS4207	167 (6.57)	320 (12.6)	120 (4.72)	260 (10.24)	10 (0.39)	30 (1.2)	17 (0.67)	8.2 (0.32)	8 (0.31)	310 (12.20)

Unit: Millimeter (Inch)

Figure 3.1 – Overall Dimensions of a Single Unit of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

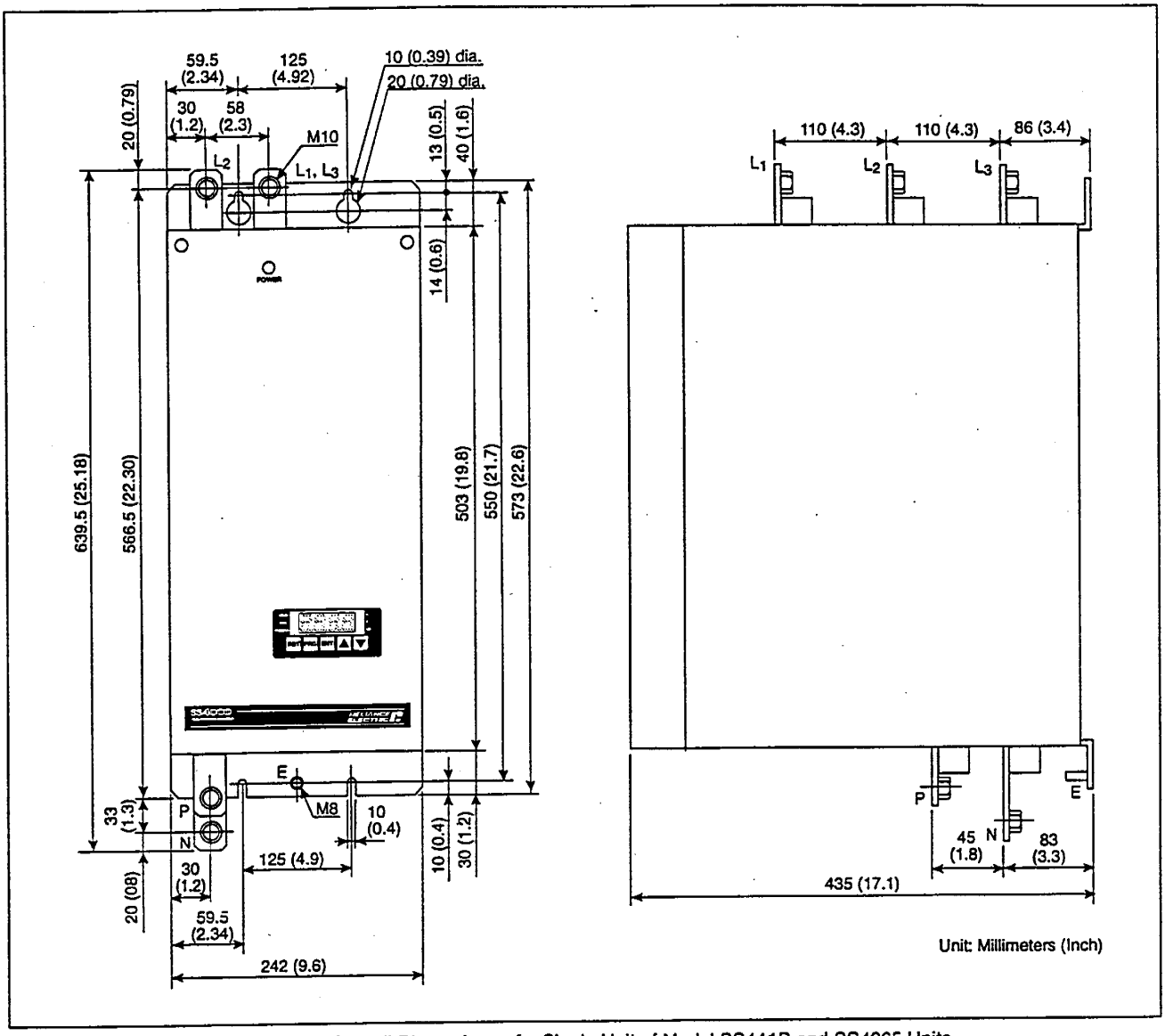


Figure 3.2 – Overall Dimensions of a Single Unit of Model SS441B and SS4265 Units

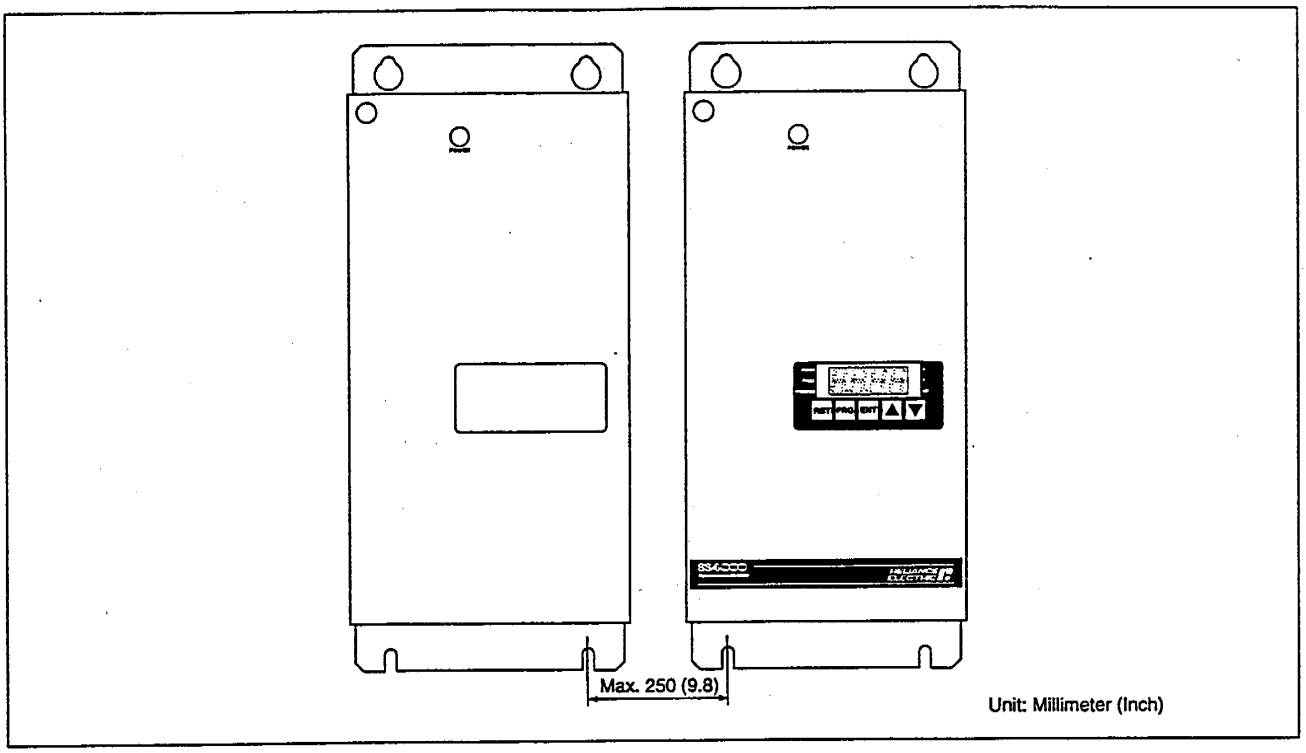


Figure 3.3 – Required Distance between Units in Case of Two Paralleled Units of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

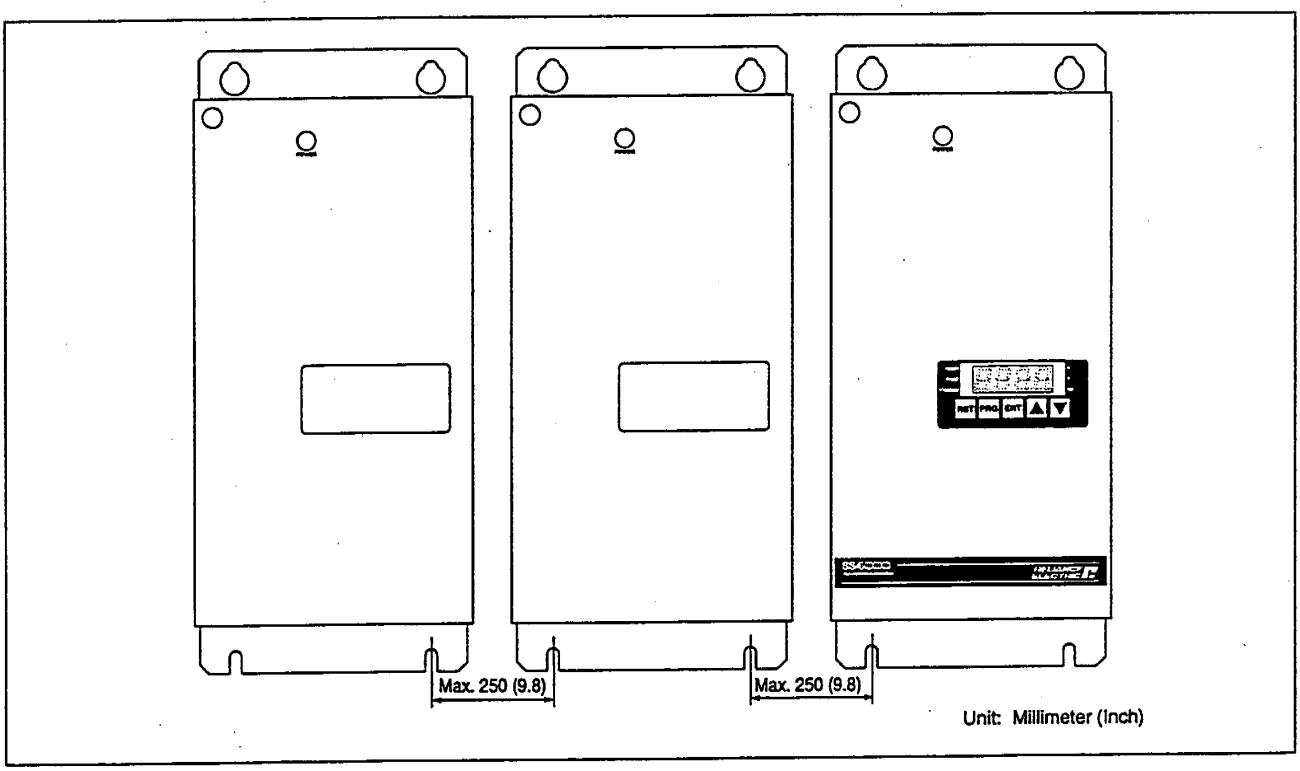


Figure 3.4 – Required Distance between Units in Case of Three Paralleled Units of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

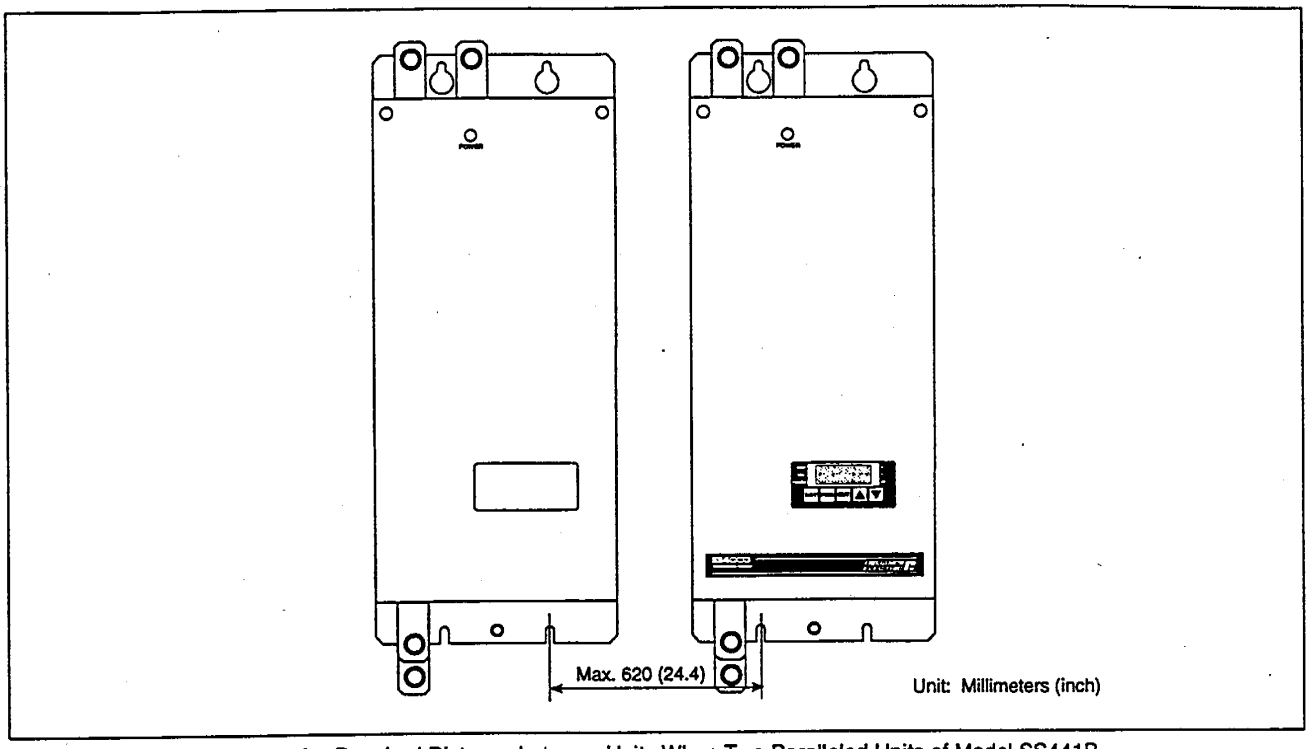


Figure 3.5 – Required Distance between Units When Two Paralleled Units of Model SS441B and SS4265 Units are Installed in a Cabinet Provided by the User Himself

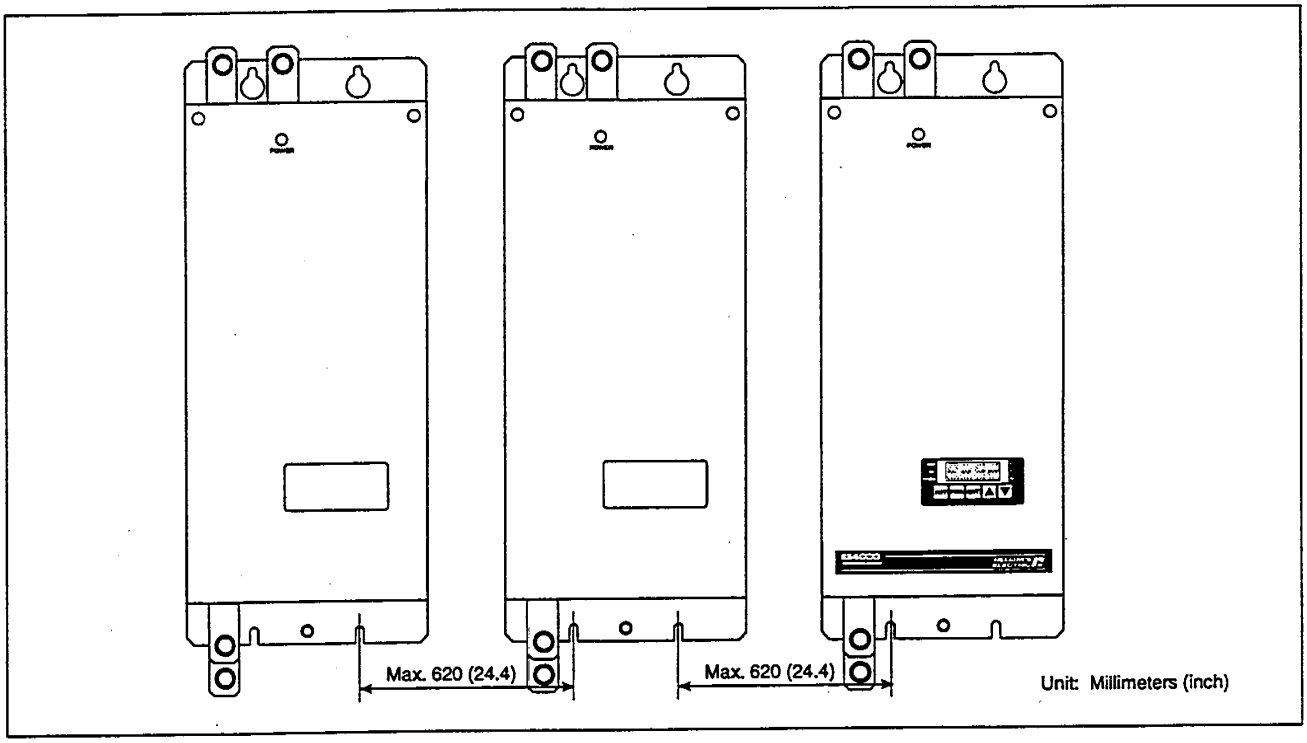


Figure 3.6 – Required Distance between Units When Three Paralleled Units of Model SS441B and SS4265 Units are Installed in a Cabinet Provided by the User Himself

3.1.3 Verifying the Site Provides for Recommended Air Flow Clearances

Be sure that there is adequate clearance for air ventilation around the SS4000 units. Cooling air flows from the bottom to the top of the units. For best cooling effect, do not mount the SS4000 units directly above each other. Figure 3.7 shows recommended air flow clearance.

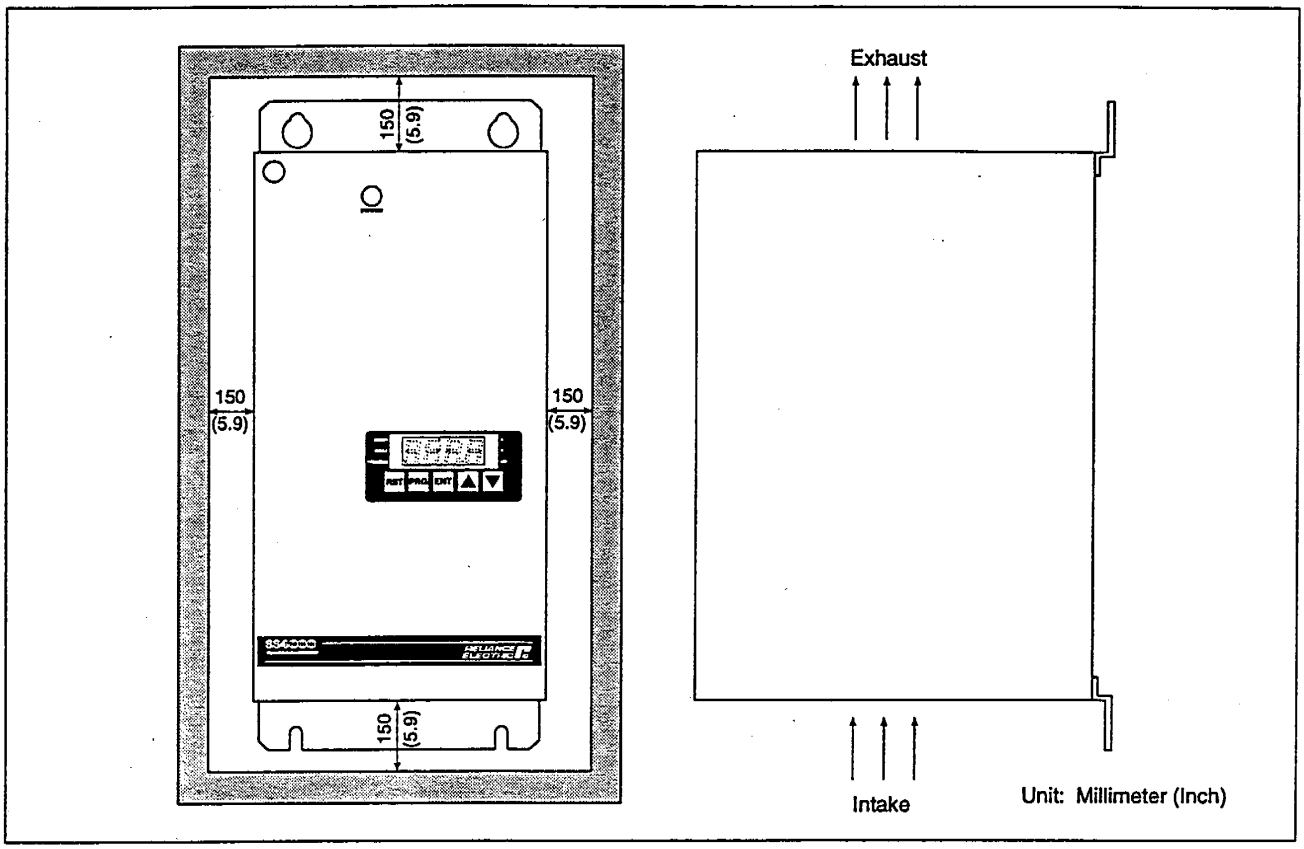


Figure 3.7 – Recommended Air Flow Clearance

3.2 Notes on Installation

When mounting the SS4000 units, pay attention to the following:

- Mount the units vertically.
- Be sure that the ambient temperature surrounding the units is between –10 to 50 degree C (14 to 122 degree F). In case of Model SS441B, SS441BP, SS4265 and SS4265P units, the ambinet temperature is between –10 to 40 degree C (14 to 104 degree F). To cool down the temperature in the cabinet, provide sufficient space to allow adequate air flow over the components. If necessary, add circulating fans to ensure good convective heat transfer.
- Do not mount any devices behind the units. This area must be kept clear of all power wiring (control power wiring, main power supply wiring and DC bus power wiring).

- Do not expose the units to excessive electrical noise. If it is not avoidable to install the SS4000 units close to a noise source or to use the units in environment where noise trouble is expected, take sufficient noise suppressing measures.

CHAPTER 4
Wiring the SS4000 Unit

This chapter provides instructions on how to properly wire the SS4000 units. It also provides information on the selection of the circuit breaker, the main magnetic contactor, the reactor, and the harmonic filter, etc.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: The user is responsible for conforming with all the applicable codes. Wiring practices, grounding, disconnects, and overcurrent protection are of particular importance. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Do not use a megger to perform continuity checks in the equipment. Use higher range of a circuit tester for this purpose. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: The user is responsible for conforming with all applicable local, national and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

4.1 Recommended Wire Sizes

This section shows the recommended wire sizes for the wires to be used in cabinet. Select the wire sizes in consideration of the following:

- Applicable local, national and international codes.
- Temperature increase and voltage drop due to type of wires, wiring method, wiring distance, etc.

4.1.1 Recommended Wire Sizes for Power Wiring to the Main Power Terminal Block (TB1) and the Main Power Terminal Bars

Tables 4.1 to 4.3 show the recommended wire sizes for power wiring to the main power terminal block (TB1) and the main power terminal bars. Table 4.1 shows the wire sizes for Model SS4415 and SS4207 units, Table 4.2 shows the wire sizes for Model SS4437, SS4218 and SS4222 units, and Table 4.3 shows the wire sizes for Model SS441B and SS4265 units.

Table 4.1 – Recommended Power Wire Sizes for Model SS4415 and SS4207 Units

Terminal Name	Symbol	Screw Size	Wire Size
Main Terminals (Input)	L_1, L_2, L_3	M5	5.5 mm² (AWG #10)
Main Terminals (Output)	P, N	M5	5.5 mm² (AWG #10)
Grounding Terminal (Earth)	G	M5	5.5 mm² (AWG #10)

Table 4.2 – Recommended Power Wire Sizes for Model SS4437, SS4218 and SS4222 Units

Terminal Name	Symbol	Screw Size	Wire Size
Main Terminals (Input)	L_1, L_2, L_3	M6	22 mm² (AWG #4)
Main Terminals (Output)	P, N	M6	22 mm² (AWG #4)
Grounding Terminal (Earth)	G	M6	16 mm² (AWG #5)

Table 4.3 – Recommended Power Wire Sizes for Model SS441B and SS4265 Units

Terminal Name	Symbol	Screw Size	Wire Size	Attached Lugs (1)
Main Terminals (Input)	L_1, L_2, L_3	M10	Larger than 33.6 mm² - 2 in parallel (AWG #2 - 2 in parallel)	JST, R38-10 (M10) (6 Pieces)
Main Terminals (Output)	P, N	M10	Larger than 107 mm² (AWG #4/0)	JST, R100-10 (M10) (2 Pieces)
Grounding Terminal (Earth)	G	M8	Larger than 33.6 mm² (AWG #2)	JST, R38-8 (M8) (1 Piece)

(1) UL-listed wires must be lugged by attached lugs.
JST is Japan Soldeerless Terminal Co.

4.1.2 Recommended Wire Sizes for Power Wiring to the Control Power Terminal Block (TB2) and Control Terminal Block (TB4)

Table 4.4 shows the recommended wire sizes for power wiring to the control power terminal block (TB2) and the control terminal block (TB4).

Table 4.4 – Recommended Wire Sizes for Power Wiring to the Control Power Terminals and Control Terminals

Name of Terminal	Symbol	Size of Wire
Control Power Terminals	L_{1AUX}, L_{2AUX}, L_{3AUX}	3.5 mm²
Terminals to Connect Precharge/ Discharge Resistor	PR1, PR2, PR3	3.5 mm²
Control Terminals for Main Magnetic Contactor	MC1, MC2	2.0 mm²

4.2 Installing AC Input Power Wiring for Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

ATTENTION: Equipment as the SS4000 units using high speed switching elements generates noise regarding both of emission and immunity due to noise generated during switching. To avoid influence of such noise, it is very important to use as thick and short grounding wire as possible.

ATTENTION: It is required to install a power disconnecting device, a main magnetic contactor, an AC reactor and a line filter in the AC input power line. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

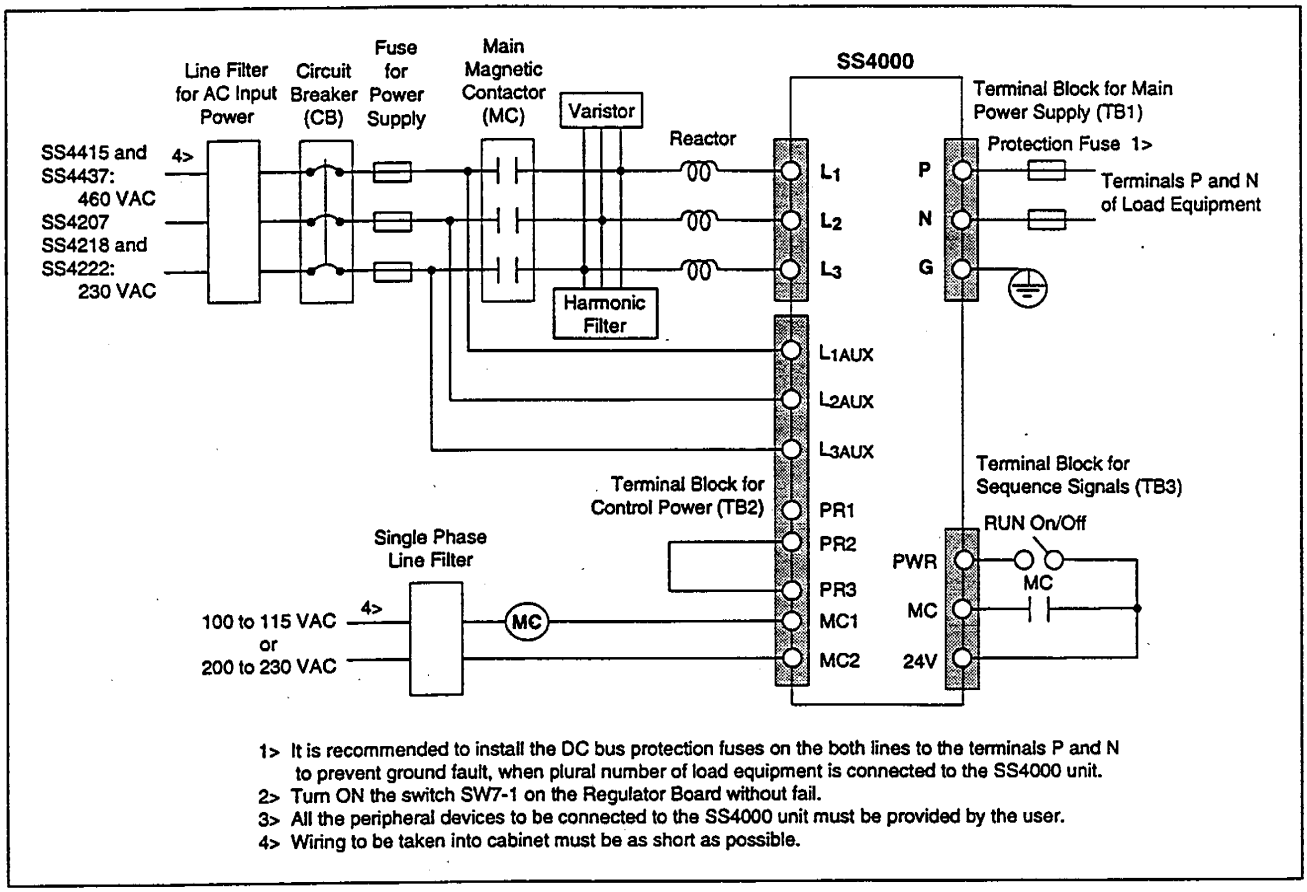
ATTENTION: When a thyristor or similar equipment is connected to AC input power line of SS4000 unit, large distortion may be produced in the AC input power voltage and the SS4000 unit may not operate normally. Remove such large distortion from the AC input power voltage.

The capacity (rating) of the SS4000 unit depends on the number of units connected in parallel, i.e, single unit, two paralleled units, or three paralleled units. The relation between the number of paralleled units and the unit capacity is shown in Table 2.1.

Figures 4.1 to 4.3 show typical connection of AC input power wiring for Model SS4415, SS4437, SS4207, SS4218 and SS4222 units. Figure 4.1 shows AC input power wiring for the single unit, and Figures 4.2 and 4.3 show AC input power wiring for parallel connection of two units and three units respectively. Install appropriate reactors, magnetic contactors, disconnects, line filters, etc. at the positions shown in these figures.

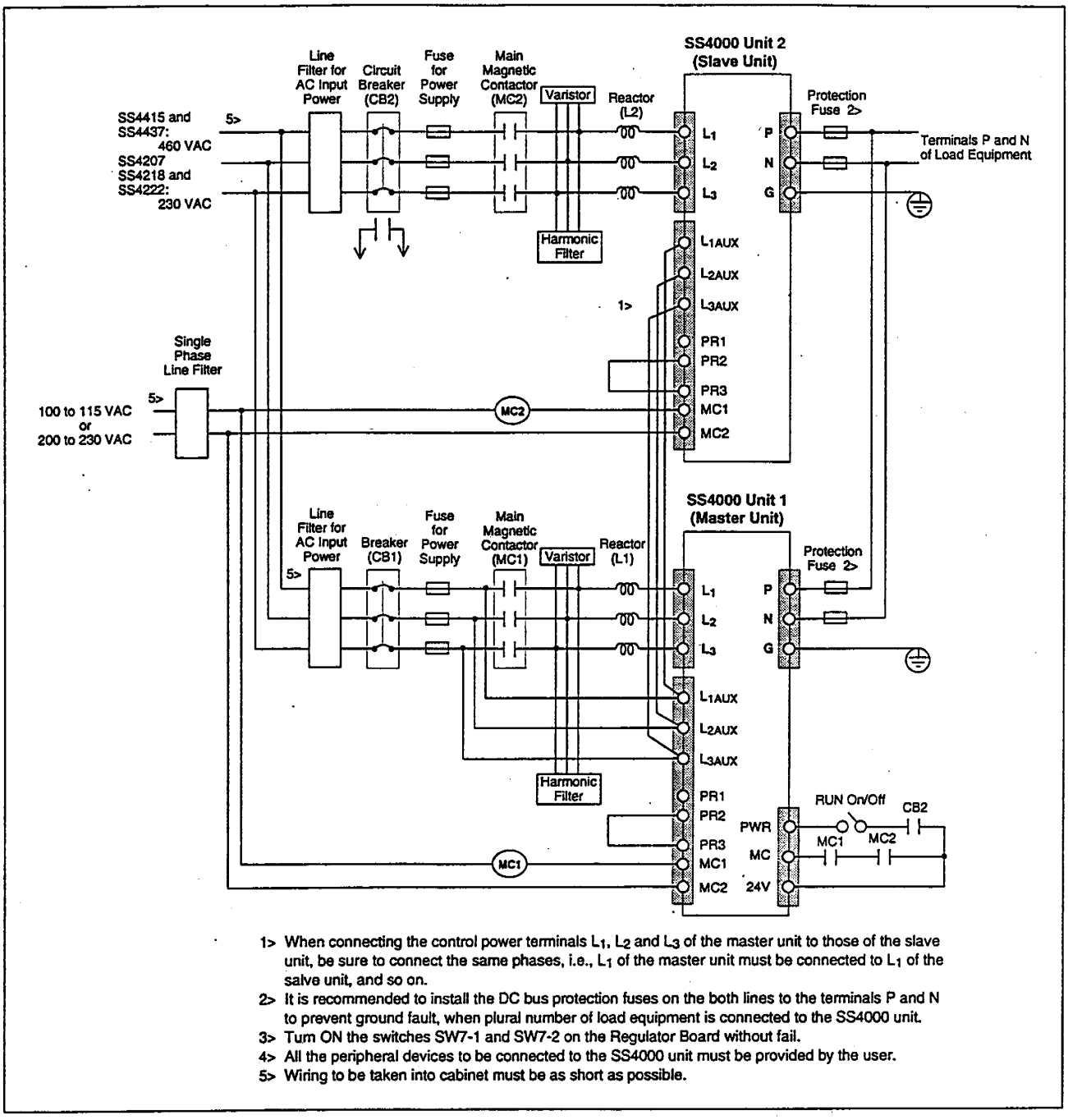
The phases of the AC input power to the main power supply terminals L_1, L_2 and L_3 must be same as the phases of the control power to the control power terminals L_{1AUX}, L_{2AUX}, and L_{3AUX}. In case of paralleled units, the phases of the control power L_{1AUX}, L_{2AUX}, and L_{3AUX} for the slave unit(s) must also be same as those for the master unit.

ATTENTION: Special caution must be paid to wiring to the SS4000 units when connecting multiple units in parallel. The phases of AC input power to the main power supply terminals (L_1, L_2 and L_3) and to the control power terminals (L_{1AUX}, L_{2AUX}, and L_{3AUX}) and the polarity of DC bus output (P and N) of all the connected units must be the same. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.



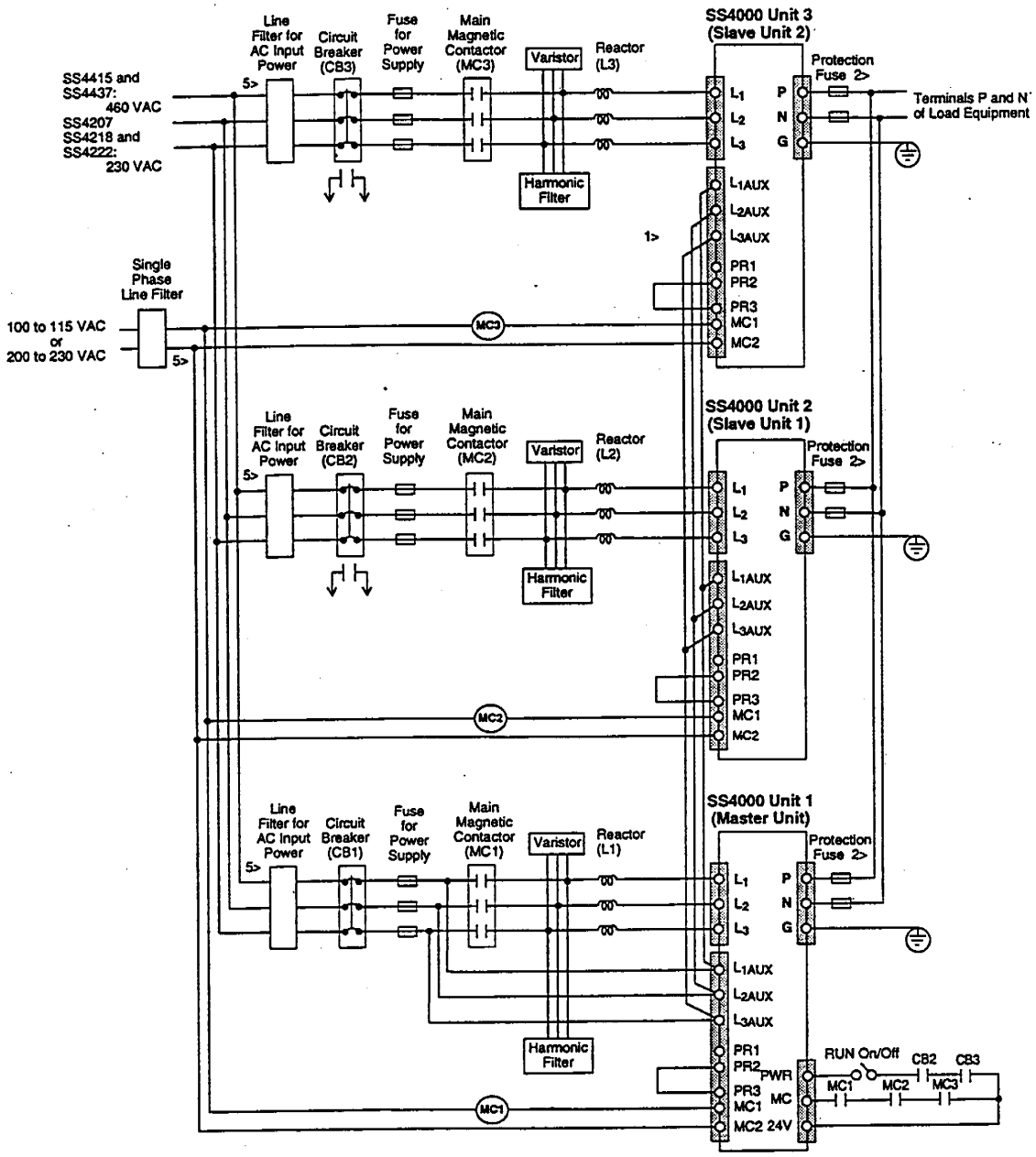
1> It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when plural number of load equipment is connected to the SS4000 unit.
2> Turn ON the switch SW7-1 on the Regulator Board without fail.
3> All the peripheral devices to be connected to the SS4000 unit must be provided by the user.
4> Wiring to be taken into cabinet must be as short as possible.

Figure 4.1 – Typical Connection of AC Input Power Wiring for Single Unit of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units



1> When connecting the control power terminals L_1, L_2 and L_3 of the master unit to those of the slave unit, be sure to connect the same phases, i.e., L_1 of the master unit must be connected to L_1 of the salve unit, and so on.
2> It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when plural number of load equipment is connected to the SS4000 unit.
3> Turn ON the switches SW7-1 and SW7-2 on the Regulator Board without fail.
4> All the peripheral devices to be connected to the SS4000 unit must be provided by the user.
5> Wiring to be taken into cabinet must be as short as possible.

Figure 4.2 – Typical Connection of AC Input Power Wiring for Two Paralleled Units of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units



1> When connecting the control power terminals L_1, L_2 and L_3 of the master unit to those of the slave unit, be sure to connect the same phases, i.e., L_1 of the master unit must be connected to L_1 of the salve unit, and so on.

2> It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when plurql number of load equipment is connected to the SS4000 unit.

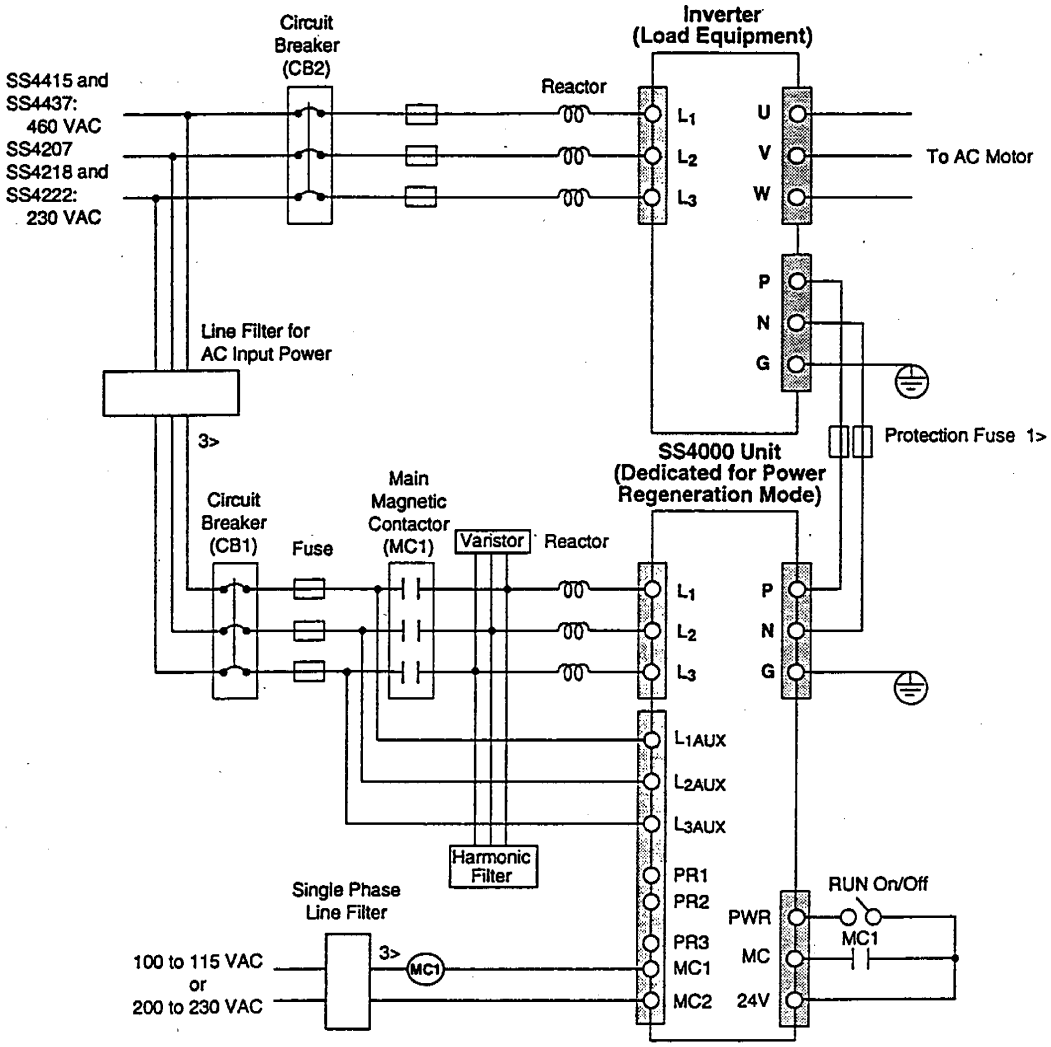
3> Turn ON the switches SW7-1, SW7-2 and SW7-3 on the Regulator Board without fail.

4> All the peripheral devices to be connected to the SS4000 unit must be provided by the user.

5> Wiring to be taken into cabinet must be as short as possible.

Figure 4.3 – Typical Connection of AC Input Power Wiring for Three Paralleled Units of Model SS4415, SS4437, SS4207, SS4218 and SS4222 Units

The SS4000 unit operates in two modes, power supply mode and power regeneration mode. Figure 4.4 shows wiring of Model SS4415, SS4437, SS4207, SS4218 or SS4222 unit used as a converter for the power regeneration mode only, by using the power regeneration function of the unit.



1> It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when plural number of load equipment is connected to the SS4000 unit.
2> All the peripheral devices to be connected to the SS4000 unit must be provided by the user.
3> Wiring to be taken into cabinet must be as short as possible.

Figure 4.4 – Wiring Model SS4415, SS4437, SS4207, SS4218 and SS4222 Unit Used as a Converter for the Power Regeneration Mode Only

To connect Model SS4415, SS4437, SS4207, SS4218 or SS4222 unit as a dedicated converter for the power regeneration mode only, open all the terminals PR1, PR2 and PR3 for connecting precharge/discharge resistor. Because these terminals are open, the unit does not perform precharge and discharge operations. Enter the RUN signal (PWR) after precharge on inverter side is completed. Discharge must also be performed on inverter side. Carefully check the specifications of the inverter to be used.

When an SS4000 unit is operated in the power regeneration mode only, set the parameter of the FWD Current Limit (U.001) to zero (0). Also, set the DC bus voltage to start power regeneration to the parameter of the DC Bus Voltage Reference (U.000).

Be careful that when the magnetic contactor MC1 of the SS4000 unit is closed, charging current will flow also from the SS4000 to DC bus of inverter. The charging current value from the SS4000 roughly depends on the impedance ratio of reactances of the inverter side and the SS4000 side.

4.2.1 Installing Circuit Breaker

To protect AC input power, install a circuit breaker with supplemental contact (CB) in the AC input power line. Refer to Figures 4.1 to 4.3 for the wiring. The rated ampacities of the circuit breakers are as follows:

For Model SS4415, SS4415P, SS4207 and SS4207P units:	50 Amps
For Model SS4437, SS4437P, SS4218 and SS4218P units:	100 Amps
For Model SS4222 and SS4222P units:	125 Amps

The following are the recommended circuit breakers with supplemental contact.

For Model SS4415, SS4415P, SS4207 and SS4207P units:

Fuji Electric – SA100BA/50W
BU3ESB-50 W (UL-listed)
Westinghouse – FDB3050
or equivalent

For Model SS4437, SS4437P, SS4218 and SS4218P units:

Fuji Electric – SA100BA/100W
BU3ESB-100 W (UL-listed)
Westinghouse – FDB3100
or equivalent

For Model SS4222 and SS4222P units:

Fuji Electric – SA203BA/125W
BU3ESB-125 W (UL-listed)
Westinghouse – FDB3125
or equivalent

Be sure to provide required quantity of circuit breakers (CB) with supplemental contact for all units connected in parallel (see Figure 4.2 or 4.3).

4.2.2 Installing Main Magnetic Contactor

The SS4000 unit uses a magnetic contactor for turning the main power supply ON/OFF. Install and wire the main magnetic contactors as shown in Figures 4.1 to 4.4.

After the RUN sequence signal entered and the precharge operation is completed, the main magnetic contactor will be turned ON. On the contrary, when the RUN sequence signal is turned OFF, or when a fault occurs, the main magnetic contactor will be turned OFF and the discharge operation will begin.

The following are the recommended main magnetic contactors.

For Model SS4415, SS4415P, SS4207 and SS4207P units:

Allen-Bradley – 100-A24x3 or 100-A30x3 (CE marked)
(where x is voltage suffix code of operating coil)
Fuji Electric – SC-1N (UL listed component)

For Model SS4437, SS4437P, SS4218, SS4218P, SS4222 and SS4222P units:

Allen-Bradley – 100-A45x3 (CE marked)
(where x is voltage suffix code of operating coil)
Fuji Electric – SC-2SN (UL listed component)

(Select an adequate operating coil for the magnetic contactor within the range of 100 to 230 VAC depending on the used voltage.)

Be sure to provide required quantity of magnetic contactors (MC) for all units connected in parallel (see Figure 4.2 or 4.3).

4.2.3 Installing Reactor

ATTENTION: During operation of the SS4000 unit, reactor is at a high temperature. Do not touch reactor during operation or immediately after the unit has been turned OFF. Failure to observe this precaution could result in bodily injury.

ATTENTION: During operation of the SS4000 unit, the reactor operates at a high temperature. Install the reactor in a location where high temperature does not present a problem.

The SS4000 unit boosts up and controls the DC bus voltage, by utilizing the magnetic characteristics of reactor. Therefore, reactors are required for the SS4000 unit.

Install a single-phase type reactor to each of L_1-phase, L_2-phase and L_3-phase. Do not use three-phase AC reactors, since this will cause unwanted coupling between the phases.

The following inductance of the reactor must be maintained in a high frequency as 10 to 20 KHz. Note that use of a reactor for commercial power supply may not maintain the required inductance, resulting in increased heat generation or saturation due to iron loss.

When multiple units are connected in parallel, a current unbalance between the units is produced due to vibration of reactor inductance. To make the current difference between the connected units as small as possible, use reactors having a vibration of no more than +/–2.5%.

The following are the recommended reactors. When selected reactors are installed, set their capacity to the parameter F.013.

Model MT-B0013 (1200 micro-henry):
For 460 V units (SS4437 and SS4437P) that are used at 80 Amps or less (capacity of applicable motor is 37 KW or less), or
for 230 V units (SS4218, SS4218P, SS4222 and SS4222P) that are used at 80 Amps or less (capacity of applicable motor is 22 KW or less)

Model MT-B0014 (1100 micro-henry):
For 460 V units (SS4437 and SS4437P) that are used at 60 Amps or less (capacity of applicable motor is 30 KW or less), or
for 230 V units (SS4218, SS4218P, SS4222 and SS4222P) that are used at 60 Amps or less (capacity of applicable motor is 15 KW or less)

Model MT-B0015 (800 micro-henry):
For 460 V units (SS4437 and SS4437P) that are used at 48 Amps or less (capacity of applicable motor is 22 KW or less), or
for 230 V units (SS4218, SS4218P, SS4222 and SS4222P) that are used at 48 Amps or less (capacity of applicable motor is 11 KW or less)

Model MT-B0016 (850 micro-henry):
For 460 V units (SS4415, SS4415P, SS4437 and SS4437P) that are used at 32 Amps or less (capacity of applicable motor is 15 KW or less), or
for 230 V units (SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P) that are used at 32 Amps or less (capacity of applicable motor is 7.5 KW or less)

It is recommended to use a reactor integrated for three phases consisting of three single phase reactors. Each SS4000 unit can use such an integrated type reactor.

The reactor should operate in an ambient temperature of 50 degree C or lower. If it is not avoidable to use a reactor above 50 degree C, decrease current 1% for every 1 degree C above 50 degree C.

Select temperature rating of wire to connect a reactor as follows.

For Model MT-B0013 reactor used with current of 60 Amps or lower, and for Model MT-B0014, MT-B0015 and MT-B0016 reactors, select a temperature rating of 105 degree C or higher.

For Model MT-B0013 reactor used with a current between 60 and 80 Amps, select a temperature rating of 130 degree C or higher.

Be sure to provide required quantity of reactors for all units connected in parallel (see Figure 4.2 or 4.3).

4.2.4 Installing Varistor

Install a varistor to absorb serge voltage between AC input power wires. The following is the recommended varistor.

For 460 V units (SS4415, SS4415P, SS4437 and SS4437P):
Marcon 23SAD102 or UL-listed equivalent varistor

For 230 V units (SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P):
Marcon 23SAD431 or UL-listed equivalent varistor

Be sure to provide required quantity of varistors for all units connected in parallel (see Figure 4.2 or 4.3).

4.2.5 Installing Harmonic Filter

Install an adequate harmonic filter as shown in Figures 4.1 to 4.5 to remove higher order harmonics generated by switching operation of Power Modules, from AC input power. The following are the recommended harmonic filter and wire size.

Nichicon EM601450 T1UA4HR or UL-listed equivalent harmonic filter

Wire size: 3.5 square millimeters

Be sure to provide required quantity of harmonic filters for all units connected in parallel (see Figure 4.2 or 4.3).

4.2.6 Installing Fuses

Install a fuse on the AC incoming power line. The following is the recommended fuse for the single unit.

For 460 V units: Gould A4J or equivalent (Class J Fuse)

For 230 V units: Gould A4J or equivalent (Class J Fuse)

Table 4.5 – Rated Current of Fuses for Various Reactors

Reactor		MT-B0013	MT-B0014 to MT-B0016	MT-B0016 (Rating 30 Amps)
Rated Current	460 V	100 Amps	100 Amps	50 Amps
	230 V	125 Amps/22 kW		
		100 Amps/18 kW		

Also, as a measure against ground fault, install a fuse to protect the DC bus. The recommended fuses are as follows.

For Model SS4437 and SS4437P units for 460 V: Gould A1-100C100 or equivalent
For Model SS4415 and SS4415P units for 460 V: Gould A100P50 or equivalent
For Model SS4222 and SS4222P units for 230 V: Gould A1-70C125 or equivalent
For Model SS4218 and SS4218P units for 230 V: Gould A1-70C100 or equivalent
For Model SS4207 and SS4207P units for 230 V: Gould A70P50 or equivalent

When two or three units are connected in parallel, use fuses having rated current twice or three times the above depending on the number of units connected in parallel (see Figure 4.2 or 4.3).

4.2.7 Installing Line Filters

If an SS4000 unit is used as a unit conforming with the requirements of CE Mark, install a line filter for AC input power on each AC incoming power line. Table 4.6 shows the recommended line filters for AC input power. The SS4000 units listed in Table 4.6 have CE marks.

Table 4.6 – Recommended Line Filters for AC Input Power

SS4000 Unit	SS4437/SS4437P SS4218/SS4218P	SS4222/SS4222P	SS4415/SS4415P SS4207/SS4207P
When units are used for the power supply mode only	Schaffner: FN258-75-34 Soshin Electric: HF3080C-TOA	Schaffner: FN258-100-35 Soshin Electric: HF3080C-TOA	Schaffner: FN258-42-07 or FN258-30-07 Soshin Electric: HF3030C-TMA
When units are used for both of the power supply mode and power regeneration mode	Schaffner: FN3100-80-35 Soshin Electric: HF3080C-TOA	Schaffner: FN3100-80-35 Soshin Electric: HF3080C-TOA	Schaffner: FN3100-35-33 Soshin Electric: HF3030C-TMA

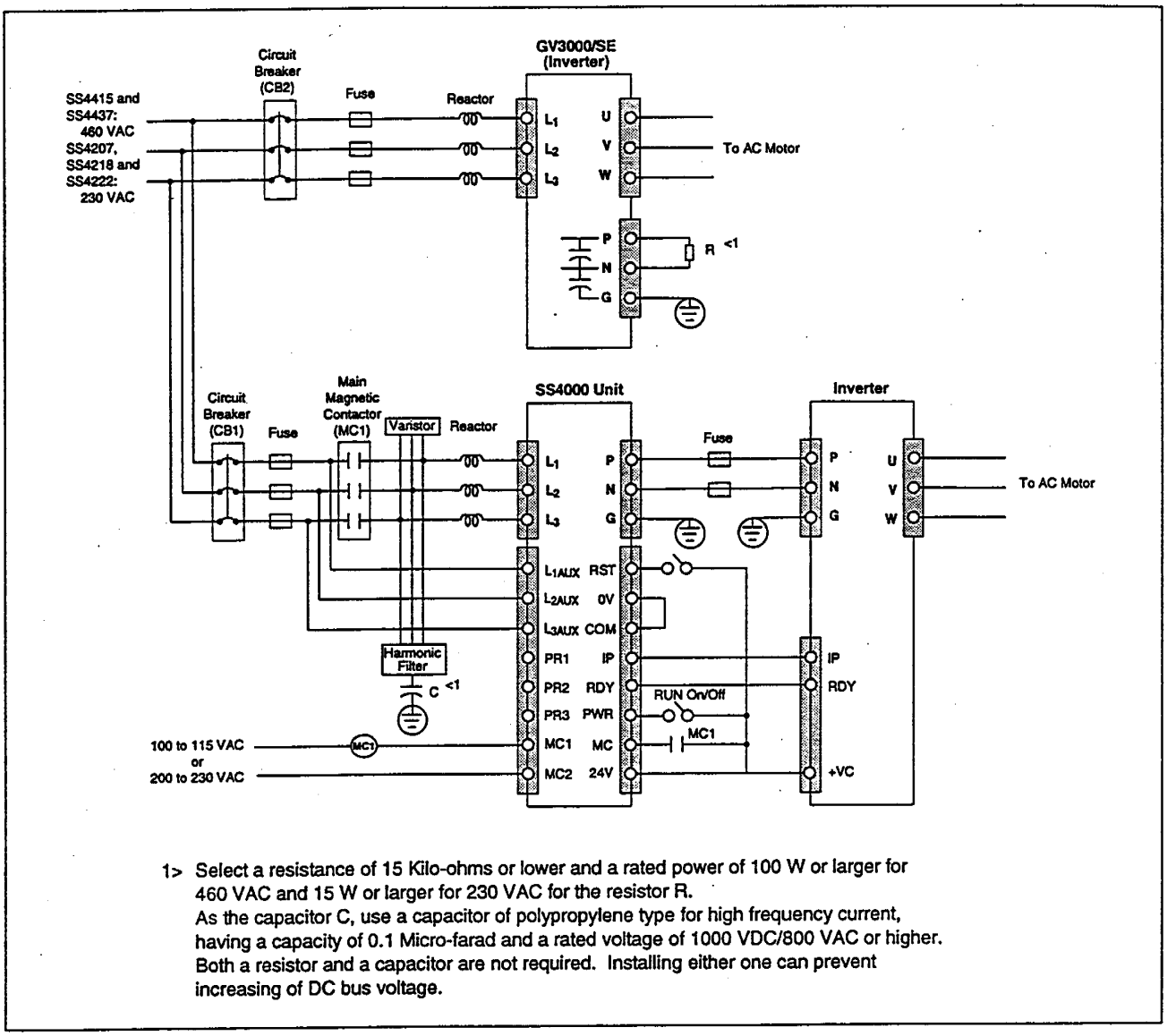
Install also a line filter on single phase AC incoming power line for a main magnetic contactor. The following are typical single phase line filters:

For Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units:

Schaffner FN2010-6-06 or
Soshin Electric NF2005A-YX

4.2.8 Notes on Connecting GV3000/SE Unit to the Same AC Input Power Line as Model SS4415, SS4437, SS4207, SS4218 or SS4222 Unit

When a GV3000/SE drive is connected to the same AC input power line as Model SS4415, SS4437, SS4207, SS4218 or SS4222 unit, stopping the GV3000/SE drive may increase DC bus voltage and may cause AC input overvoltage alarm or Bus overvoltage error. In such a case, install a resistor R or capacitor C as shown in Figure 4.5.



1> Select a resistance of 15 Kilo-ohms or lower and a rated power of 100 W or larger for 460 VAC and 15 W or larger for 230 VAC for the resistor R.
As the capacitor C, use a capacitor of polypropylene type for high frequency current, having a capacity of 0.1 Micro-farad and a rated voltage of 1000 VDC/800 VAC or higher.
Both a resistor and a capacitor are not required. Installing either one can prevent increasing of DC bus voltage.

Figure 4.5 – Wiring When GV3000/SE Drive is Connected to the Same AC Input Power Line as Model SS4415, SS4437, SS4207, SS4218 or SS4222 Unit

4.3 Installing AC Input Power Wiring for Model SS441B and SS4265 Units

ATTENTION: Equipment as the SS4000 units using high speed switching elements generates noise regarding both of emission and immunity due to noise generated during switching. To avoid influence of such noise, it is very important to use as thick and short grounding wire as possible.

ATTENTION: It is required to install a power disconnecting device, a main magnetic contactor, an AC reactor and a line filter in the AC input power line. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

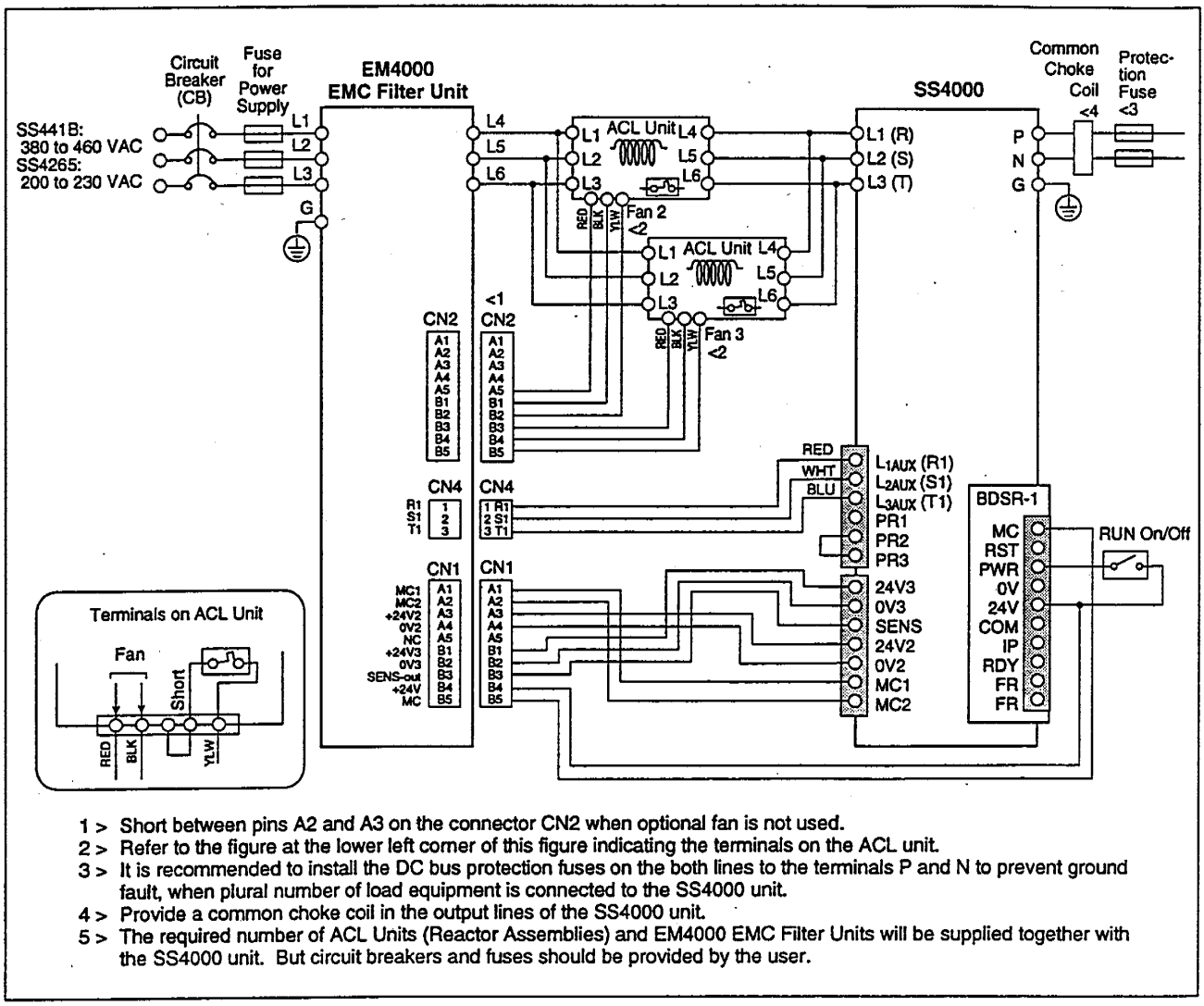
ATTENTION: When a thyristor or similar equipment is connected to AC input power line of SS4000 unit, large distortion may be produced in the AC input power voltage and the SS4000 unit may not operate normally. Remove such large distortion from the AC input power voltage.

The capacity (rating) of the SS4000 unit depends on the number of units connected in parallel, i.e, single unit, two paralleled units, or three paralleled units. The relation between the number of paralleled units and the unit capacity is shown in Table 2.1.

Figures 4.6 to 4.8 show typical connection of AC input power wiring for Model SS441B and SS4265 units. Figure 4.6 shows AC input power wiring for the single unit, and Figures 4.7 and 4.8 show AC input power wiring for parallel connection of two units and three units respectively. Select appropriate ACL units (reactor assemblies), EM4000 EMC filter units, disconnects, etc. and installed them at the positions shown in these figures.

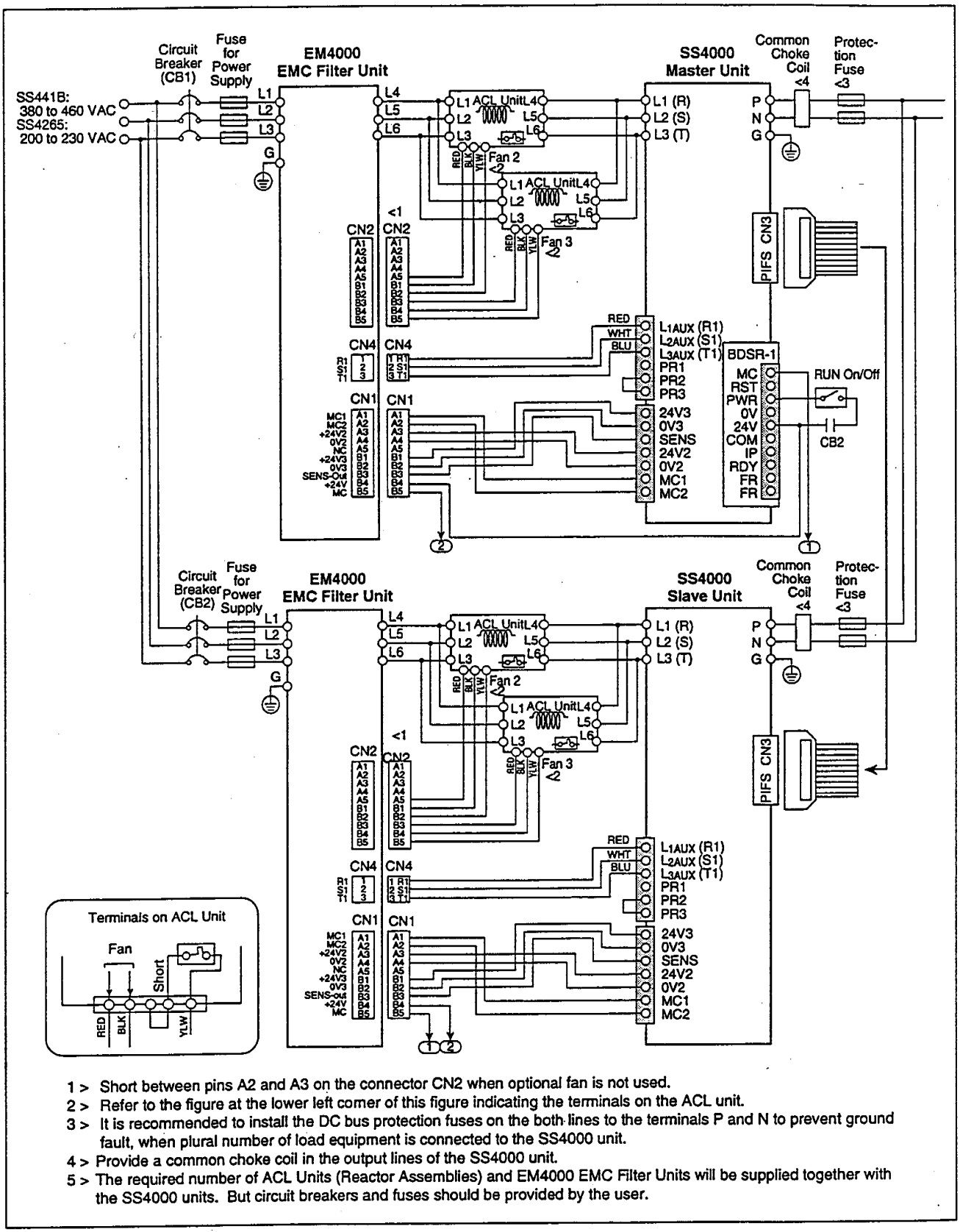
ATTENTION: When two or three paralleled units of Model SS441B or SS4265 unit are operated, special care should be paid to the counter-measures against noise generated by each of the paralleled units during switching operation. If each of the paralleled units is installed in a separate cabinet, be careful for selection of cabinet and installation of the units.

ATTENTION: The temperature inside the cabinet must be kept below 50 degree C (122 degree F). Because Model SS441B and SS4265 units generate large amount of heat, exercise special caution for exhausting air. Also, be careful for selection of installation location of the EM4000 EMC filter units.



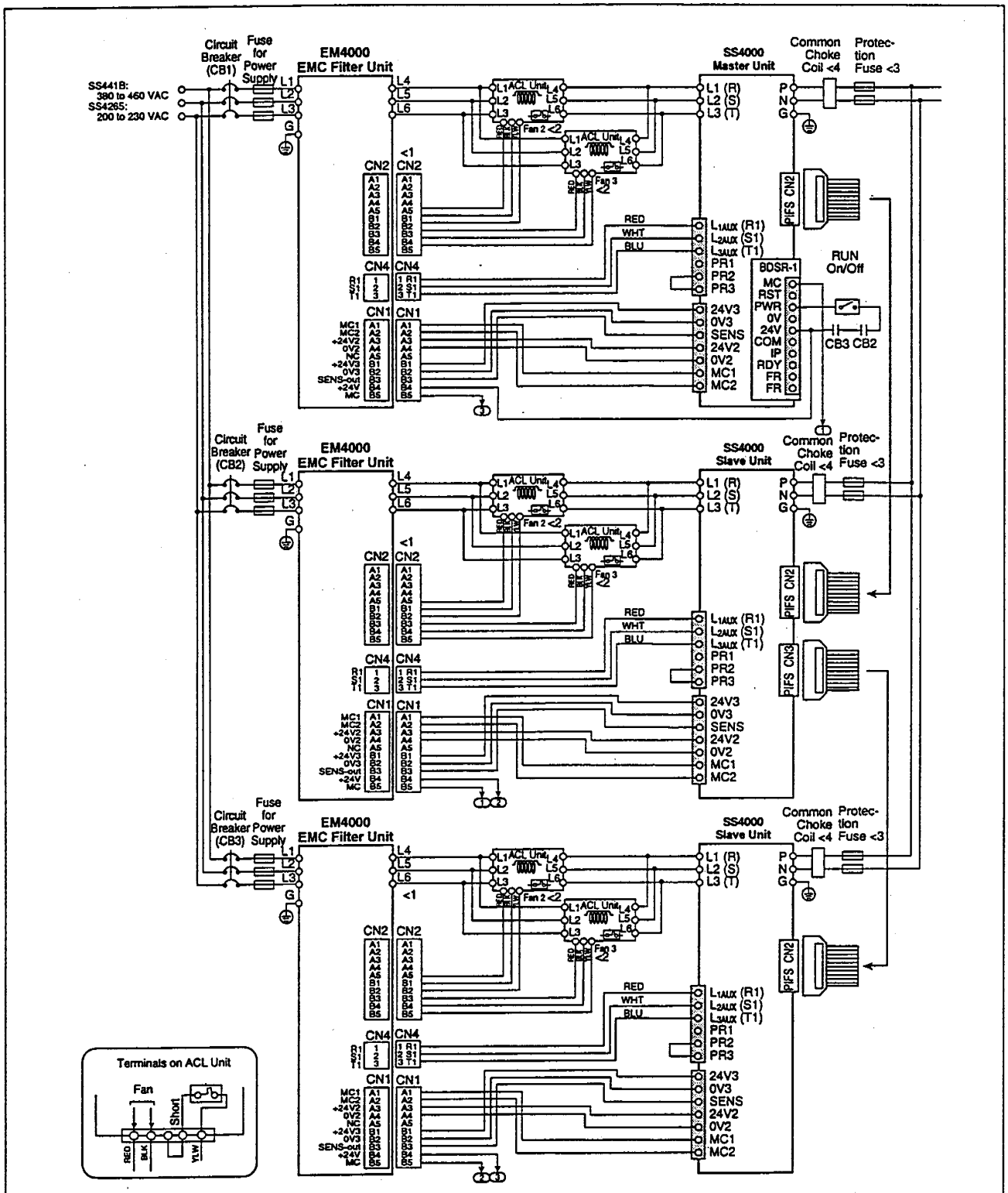
1 > Short between pins A2 and A3 on the connector CN2 when optional fan is not used.
2 > Refer to the figure at the lower left corner of this figure indicating the terminals on the ACL unit.
3 > It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when plural number of load equipment is connected to the SS4000 unit.
4 > Provide a common choke coil in the output lines of the SS4000 unit.
5 > The required number of ACL Units (Reactor Assemblies) and EM4000 EMC Filter Units will be supplied together with the SS4000 unit. But circuit breakers and fuses should be provided by the user.

Figure 4.6 – Typical Connection of AC Input Power Wiring for Single Unit of Model SS441B and SS4265 Units



1 > Short between pins A2 and A3 on the connector CN2 when optional fan is not used.
2 > Refer to the figure at the lower left corner of this figure indicating the terminals on the ACL unit.
3 > It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when plural number of load equipment is connected to the SS4000 unit.
4 > Provide a common choke coil in the output lines of the SS4000 unit.
5 > The required number of ACL Units (Reactor Assemblies) and EM4000 EMC Filter Units will be supplied together with the SS4000 units. But circuit breakers and fuses should be provided by the user.

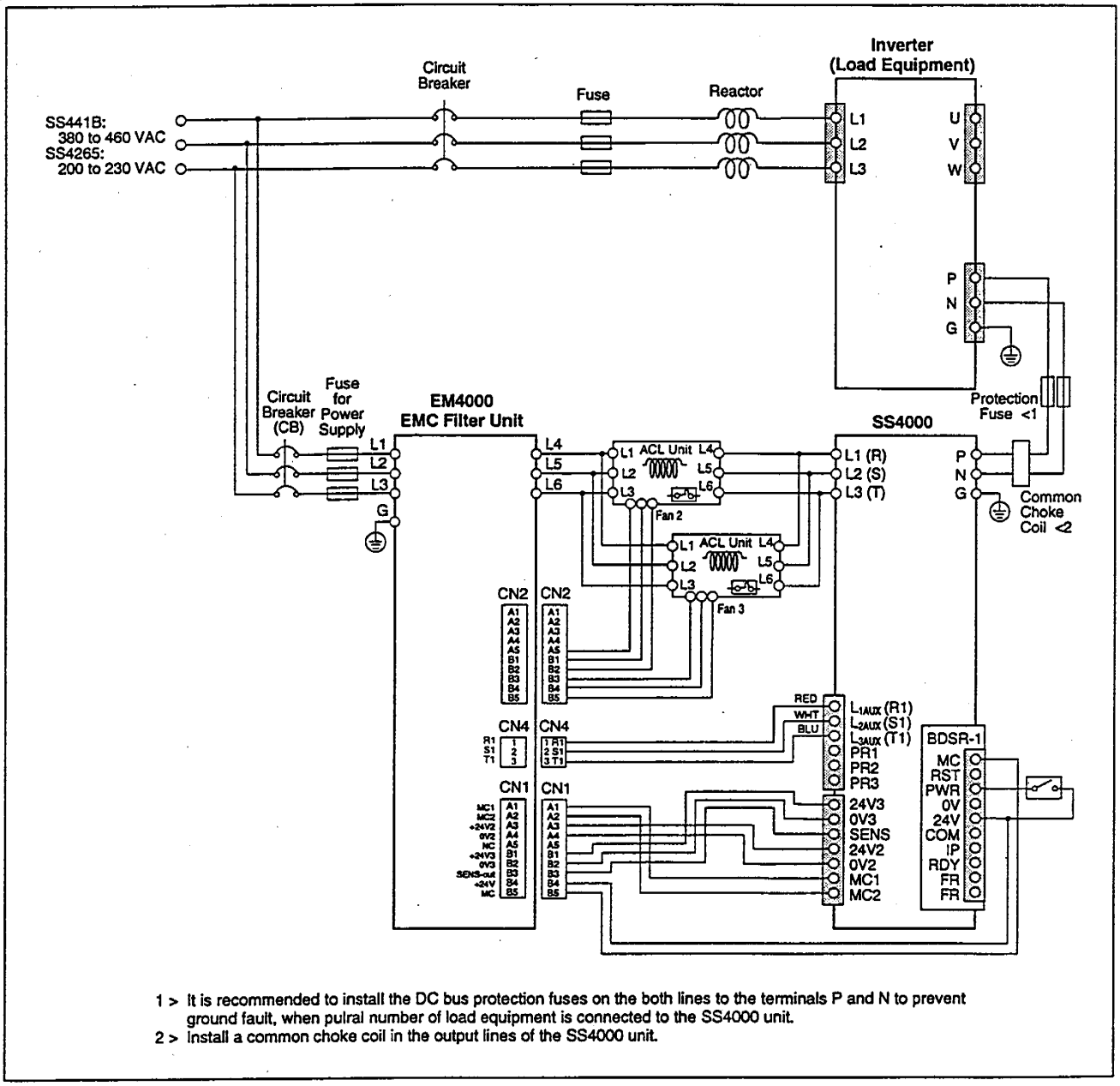
Figure 4.7 – Typical Connection of AC Input Power Wiring for Two Paralleled Units of Model SS441B and SS4265 Units



1 > Short between pins A2 and A3 on the connector CN2 when optional fan is not used.
2 > Refer to the figure at the lower left corner of this figure indicating the terminals on the ACL unit.
3 > It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when plural number of load equipment is connected to the SS4000 unit.
4 > Provide a common choke coil in the output lines of the SS4000 unit.
5 > The required number of ACL Units (Reactor Assemblies) and EM4000 EMC Filter Units will be supplied together with the SS4000 units. Bus circuit breakers and fuses should be provided by the user.

Figure 4.8 – Typical Connection of AC Input Power Wiring for Three Paralleled Units of Model SS441B and SS4265 Units

The SS4000 unit operates in two modes, power supply mode and power regeneration mode. Figure 4.9 shows wiring of Model SS441B or SS4265 unit used as a converter for the power regeneration mode only, by using the power regeneration function of the unit.



1 > It is recommended to install the DC bus protection fuses on the both lines to the terminals P and N to prevent ground fault, when pulral number of load equipment is connected to the SS4000 unit.
2 > Install a common choke coil in the output lines of the SS4000 unit.

Figure 4.9 – Wiring Model SS441B or SS4265 Unit Used as a Converter for the Power Regeneration Mode Only

To connect Model SS441B and SS4265 units as a dedicated converter for the power regeneration mode only, open all the terminals PR1, PR2 and PR3 for connecting precharge/discharge resistor. Because these terminals are open, the unit does not perform precharge and discharge operations. Enter the RUN signal (PWR) after precharge on inverter side is completed. Discharge must also be performed on inverter side. Carefully check the specifications of the inverter to be used.

When an SS4000 unit is operated in the power regeneration mode only, set the parameter of the FWD Current Limit (U.001) to zero (0). Also, set the DC bus voltage to start power regeneration to the parameter of the DC Bus Voltage Reference (U.000).

Be careful that when the magnetic contactor MC1 of the SS4000 unit is closed, charging current will flow also from the SS4000 to DC bus of the inverter. The charging current value from the SS4000 roughly depends on the impedance ratio of reactances of the inverter side and the SS4000 side.

4.3.1 Installing Circuit Breaker

To protect AC input power, install a circuit breaker with supplemental contact (CB) in the AC input power line. Refer to Figures 4.6 to 4.8 for wiring. The rated ampacities of the circuit breakers are as follows:

For Mode SS441B, SS441BP, SS4265 and SS4265P units: 350 Amps

The following are the recommended circuit breakers with supplemental contact.

For Mode SS441B, SS441BP, SS4265 and SS4265P units:

Fuji Electric	– BU-KSB350
Westinghouse or equivalent	– KDB3350

Be sure to provide required quantity of circuit breakers (CB) with supplemental contact for all units connected in parallel (see Figures 4.7 and 4.8)

4.3.2 Installing ACL Unit (Reactor Assembly)

ATTENTION: During operation of the SS4000 unit, reactor is at a high temperature. Do not touch reactor during operation or immediately after the unit has been turned OFF. Failure to observe this precaution could result in bodily injury.

ATTENTION: During operation of the SS4000 unit, the reactor operates at a high temperature. Install the reactor in a location where high temperature does not present a problem.

The SS4000 unit boosts up and controls the DC bus voltage, by utilizing the magnetic characteristics of reactor. Therefore, reactors are required for the SS4000 unit.

Install a single-phase type reactor to each of L_1-phase, L_2-phase and L_3-phase. Do not use three-phase AC reactors, since this will cause unwanted coupling between the phases.

The following inductance of the reactor must be maintained in a high frequency as 10 to 20 kHz. Note that use of a reactor for commercial power supply may not maintain the required inductance, resulting in increased heat generation or saturation due to iron loss.

When multiple units are connected in parallel, a current unbalance between the units is produced due to vibration of reactor inductance. To make the current difference between the connected units as small as possible, use reactors having a vibration of no more than +/–2.5%.

The following are the recommended reactors. Depending on the motor capacity, single unit of the recommended reactor is used or two units of the reactors connected in parallel are used as shown below. When selected reactors are installed, set their capacity to the parameter F.013.

One (1) Model MB-B0025 (800 micro-henry):
For 460 V units (SS441B) that are used at 100 Amps or less (capacity of applicable motor is 65 kW or less), or
for 230 V units (SS4265) that are used at 100 Amps or less (capacity of applicable motor is 33 kW or less)

Two (2) Model MB-B0025 (800 micro-henry) connected in parallel:
For 460 V units (SS441B and SS441BP) that are used at 190 Amps or less (capacity of applicable motor is 125 kW or less), or
for 230 V units (SS4265 and SS4265P) that are used at 190 Amps or less (capacity of applicable motor is 75 kW or less)

Cooling fan and thermo switch are mounted on the ACL unit. The thermo switch opens at about 150 degree C (302 degree F) and produces a reactor fan fault signal.

It is recommended to use a reactor integrated for three phases consisting of three single phase reactors. Each SS4000 unit can use such an integrated type reactor.

The reactor should operate in an ambient temperature of 50 degree C or lower. If it is not avoidable to use a reactor above 50 degree C, decrease current 1% for every 1 degree C above 50 degree C.

Select temperature rating of 105 degree C or higher for the wire to connect Model MB-B0025 reactors.

Usually, the required number of the ACL Units will be supplied together with the SS4000 units. Be sure to instasll the ACL Units for all units connected in parallel (see Figure 4.7 or 4.8).

4.3.3 Installing Fuses

Install a fuse on the AC incoming line. The following is the recommended fuse for the single unit.

For 460 V units: Gould A4J or equivalent (Class J Fuse)
For 230 V units: Gould A4J or equivalent (Class J Fuse)

Rated current of the fuse for Model MT-B0025 reactor is 350 Amps.

Also, as a measure against ground fault, install a fuse to protect the DC bus. The recommended fuses are as follows:

For Model SS441B and SS441BP units for 460 V: A1-100C 350
For Model SS4265 and SS4265P units for 230 V: A1-70C 350

When two or three units are connected in parallel, use fuses having rated current twice or three times the above depending on the number of units connected in parallel (see Figure 4.7 or 4.8). The required number of fuses should be provided by the user.

4.3.4 Installing EM4000 EMC Filter Unit

The EM4000 EMC filter unit contains line filter, magnetic contactor, varistor and harmonic filter, and are used for Model SS441B, SS441BP, SS4265 and SS4265P units (Model EM441B EMC filter unit is used for SS441B and SS441BP unit, and Model EM4265 EMC filter unit for Model SS4265 and SS4265P units). Because the EM4000 unit is completely assembled, wiring can be simplified in combination with Model MB-B0025 reactor, and also the space to be required can be reduced considerably.

The recommended wire sizes for power wiring to the main power terminals of the EM4000 unit are shown in Table 4.7.

Table 4.7 – Recommended Power Wire Sizes for the EM4000 Unit

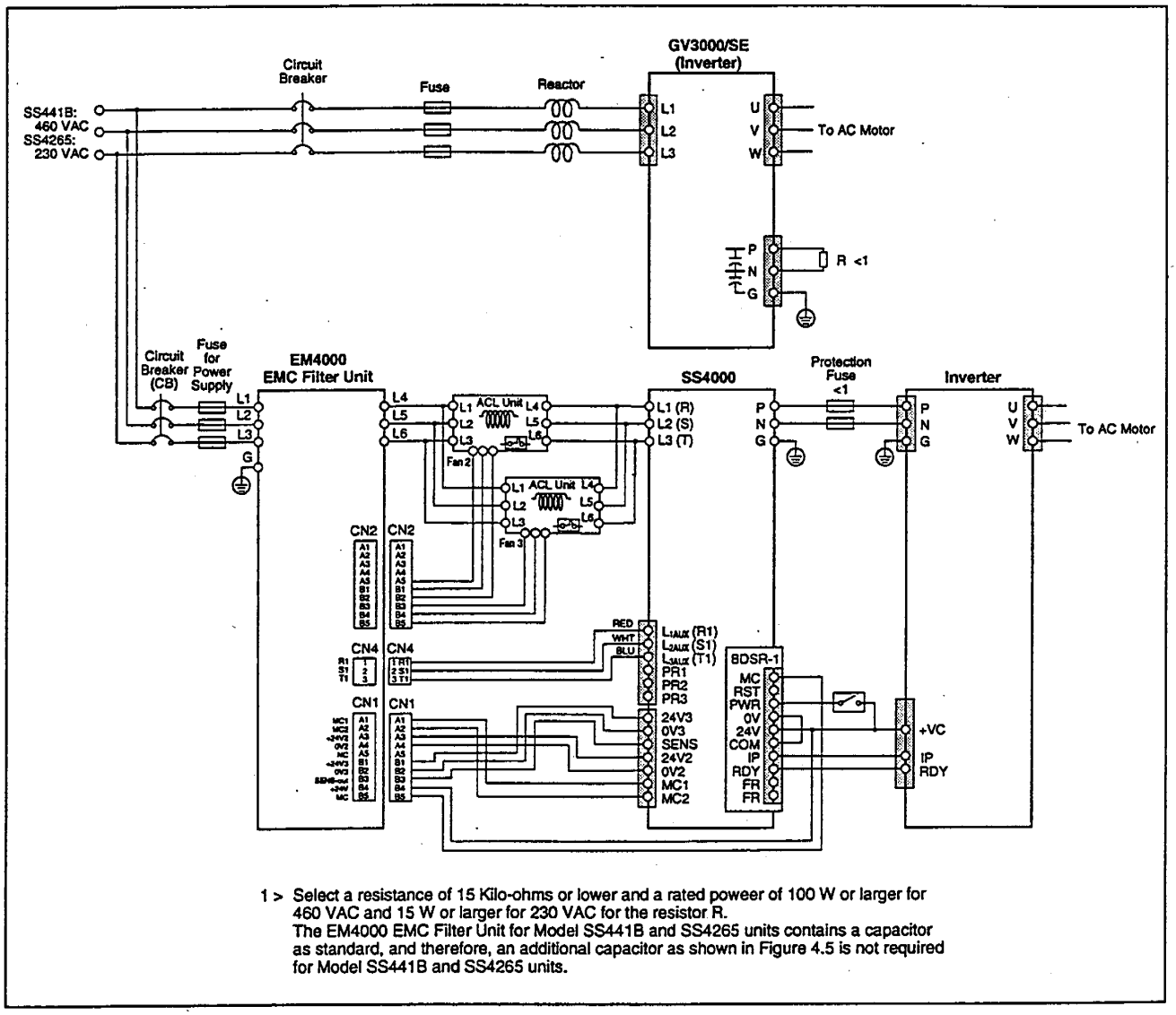
Terminal Name	Symbol	Screw Size	Wire Size	Attached Lug (1)
Main Terminals (Input)	L1, L2, L3	M8	Larger than 33.6 mm^2 - 2 Para (AWG #2 - 2 Para)	JST, R38-8 (M8) (6 Pieces)
Main Terminals (Output)	L4, L5, L6	M10	Larger than 33.6 mm^2 - 2 Para (AWG #2 - 2 Para)	JST, R38-10 (M108) (6 Pieces)
Grounding Terminal (Earth)	G	M8	Larger than 33.6 mm^2 (AWG #2)	JST, R38-8 (M8) (1 Pieces)

(1) UL-listed wires must be lugged by attached lugs.
JST is Japan Solderless Terminal Co.

For wiring the EM4000 units, refer to Figures 4.6 to 4.8.

4.3.5 Notes on Connecting GV3000/SE Unit to the Same AC Input Power Line as Model SS441B or SS4265 Unit

When a GV3000/SE drive is connected to the same AC input power line as Model SS441B or SS4265 unit, stopping the GV3000/SE drive may increase DC bus voltage and may cause AC input overvoltage alarm or Bus overvoltage error. In such a case, install a resistor R as shown in Figure 4.10.



1 > Select a resistance of 15 Kilo-ohms or lower and a rated poweer of 100 W or larger for 460 VAC and 15 W or larger for 230 VAC for the resistor R.
The EM4000 EMC Filter Unit for Model SS441B and SS4265 units contains a capacitor as standard, and therefore, an additional capacitor as shown in Figure 4.5 is not required for Model SS441B and SS4265 units.

Figure 4.10 – Wiring When GV3000/SE Drive is Connected to the Same AC Input Power Line as Model SS441B or SS4265 Unit

4.4 Installing DC Bus Power Output Wiring

ATTENTION: When connecting the DC bus to plural number of external load equipment, the user is responsible for installing fuses to protect the DC bus from shorting, if no fuse is provided in the load equipment. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: Exercise extreme caution for polarity of wiring when wiring DC bus. Failure to observe this precaution could result in damage to, or destruction of, the SS4000 unit and the connected load equipment.

The DC bus output terminals on the main power terminal block (TB1) or the DC bus terminal bars of the SS4000 unit are used for connecting to load equipment such as inverter. Use the recommended wire size shown in Tables 4.1 to 4.3 for wiring between the SS4000 unit and the load equipment. Connect the terminal P on the main power terminal block (TB1) or the terminal bar P of the SS4000 unit to the positive (plus) DC bus terminal of the load equipment, and the terminal N on the terminal block TB1 or the terminal bar N to the negative (minus) DC bus terminal of the load equipment. Do not connect the positive (plus) side with the wiring of the negative (minus) side. Such miswiring will damage the SS4000 unit and the connected load equipment.

When multiple drives are connected to the SS4000 unit, always install output fuses before each drive to protect the wiring and the drive. Select adequate fuse(s) for the drives.

4.5 Grounding the SS4000 Unit

Connect an adequate equipment grounding conductor to ground terminal of load equipment, motor's frame, remote control station (if used), input transformer (if used), and ground terminal of the SS4000 unit. Run earth conductor to earth ground after confirming that the conductors are unbroken.

4.6 Wiring Precharge/Discharge Resistor

When load equipment is connected to high capacity capacitors, large current flows will occur when precharging and discharging the capacitors. If the load equipment (including external capacitors) capacitance is larger than the following, connect an external resistor for precharge/discharge .

- For the SS4000 units for 460 V: 8,000 micro-farad or more
- For the SS4000 units for 230 V: 39,000 micro-farad or more

The resistance of the external resistors is as shown in Table 4.8. Select the rated wattage of the resistor adequately for the connected capacitance.

Table 4.8 – Resistance of the External Resistors for the SS4000 Units

Unit	SS4207, SS4207P SS4415, SS4415P	SS4218, SS4218P SS4222, SS4222P SS4437, SS4437P	SS4265, SS4265P SS441B, SS441BP
Resistance of External Resistor (Ohms)	33	22	10

Connect an external resistor between the terminals PR1 and PR2 of the control power terminal block (TB2) and open the terminal PR3.

When an external resistor is connected, change the setting of the following parameters:

- Precharge/Discharge Time (F.014)
- Wattage of Precharge/Discharge Resistor (F.015).

4.7 Installing Sequence Signal Wiring

Figure 4.11 shows a typical connection of sequence control signals.

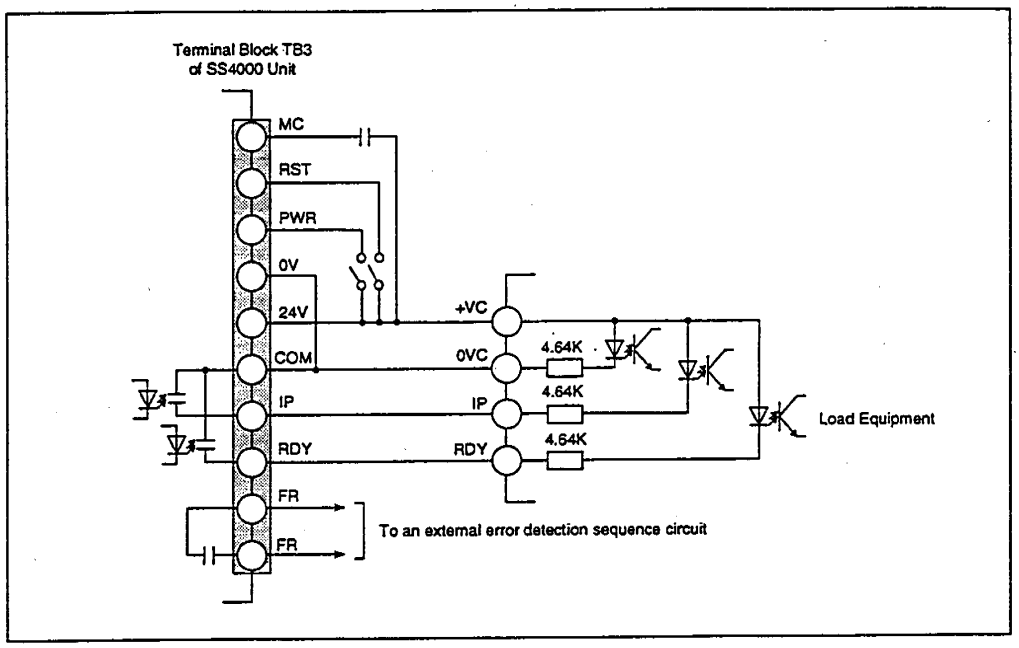


Figure 4.11 – Typical Connection of Sequence Control Signals

4.7.1 Installing Sequence Signal Wiring

Verify the following when installing sequence signal wiring:

- Twisted pair wires of 0.2 to 0.5 mm^2 should be used for the signal line.
- Verify that the sequence signal wiring is separated from the power wiring (main power supply wiring, control power wiring and DC bus power wiring). Malfunction of the SS4000 unit is possible if the control wires are separated from the AC and DC power wires.
- Use a separate duct for the sequence signal wiring. It is recommended to use a dedicated duct for the sequence signal wiring.
- Do not route the sequence signal wiring near any equipment which is producing electromagnetic interference.

4.7.2 Operation Timing of Sequence Control Signals

Figures 4.12 through 4.17 show timing of various sequence control signal operations.

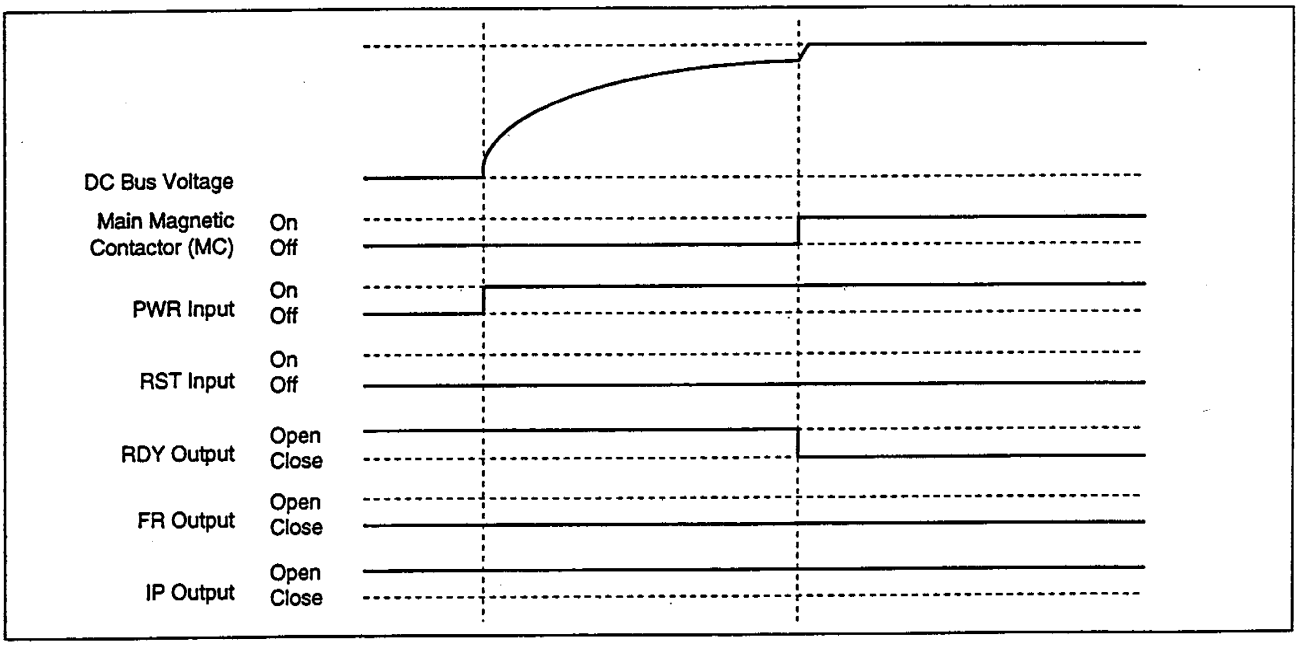


Figure 4.12 – Sequence Operation of Precharging

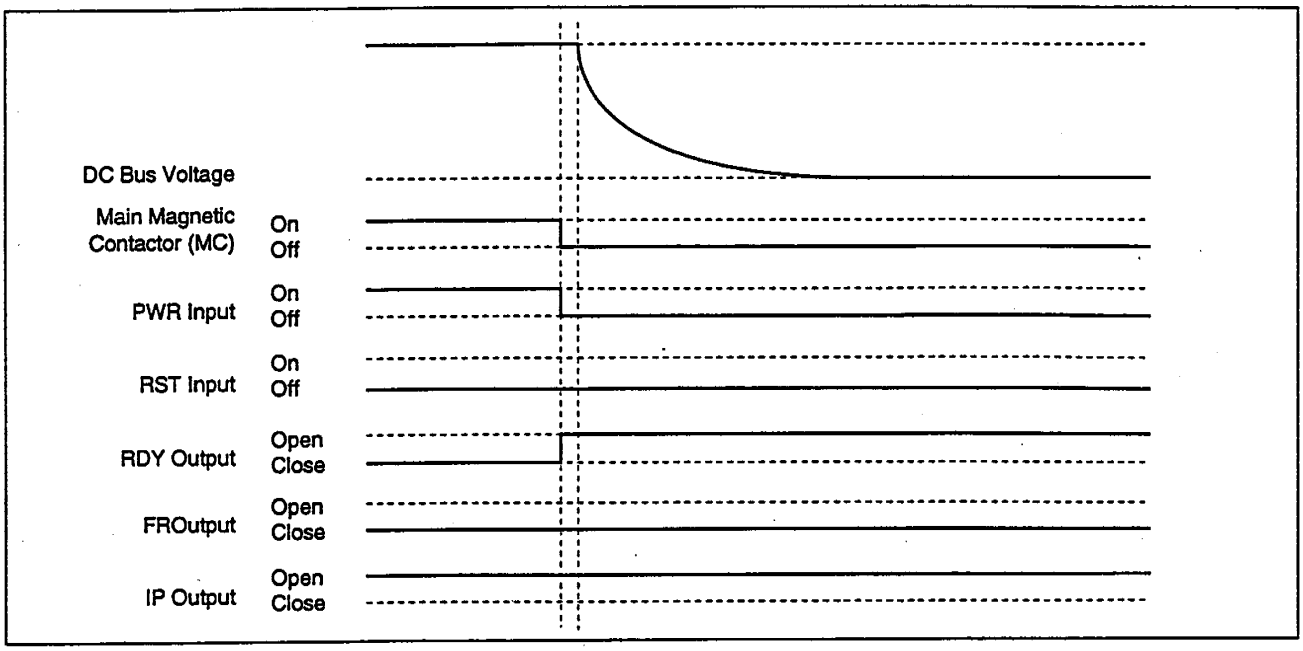


Figure 4.13 – Sequence Operation of Discharging

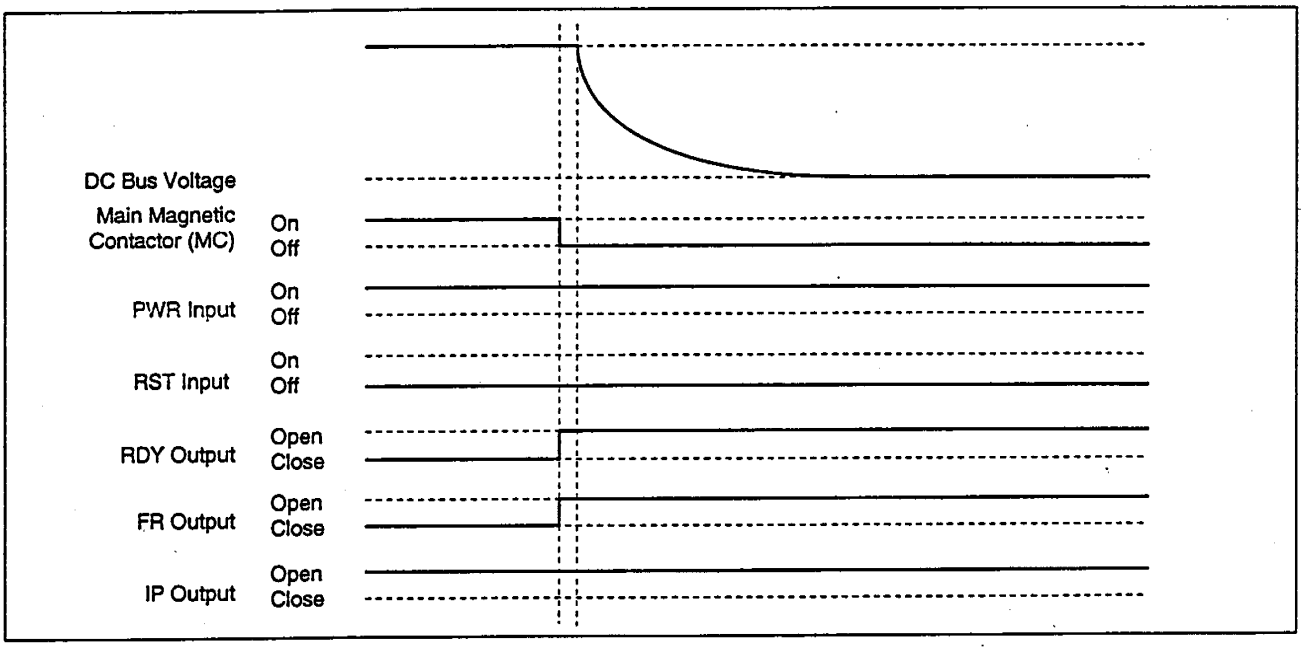


Figure 4.14 – Sequence Operation of Error Detection

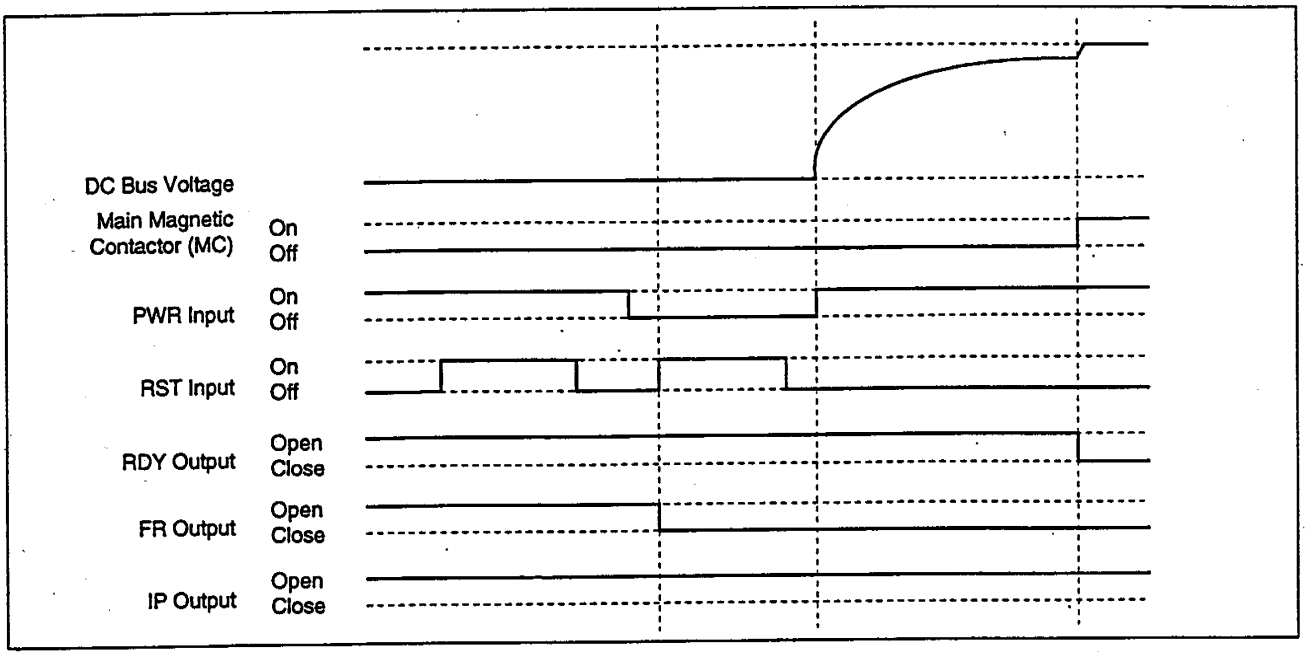


Figure 4.15 – Sequence Operation of Resetting Error

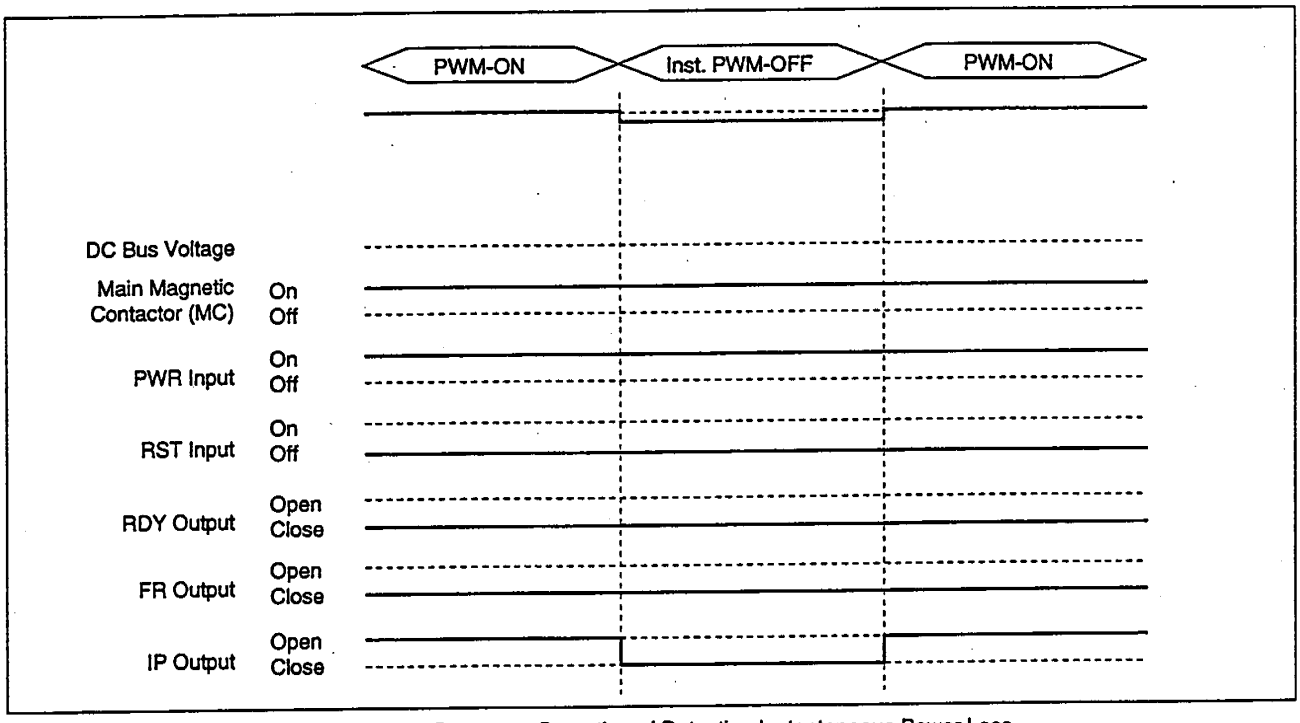


Figure 4.16 – Sequence Operation of Detecting Instantaneous Power Loss
(When Main Magnetic Contactor is not Turned OFF)

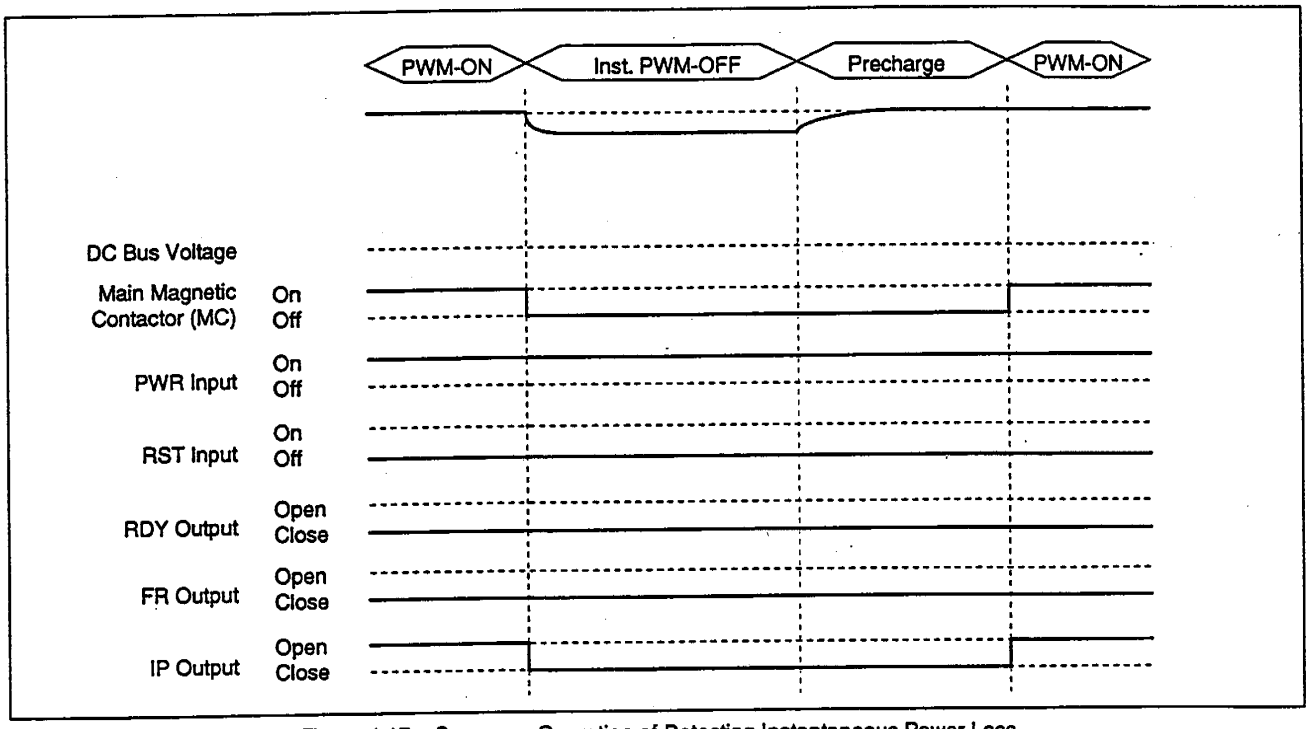


Figure 4.17 – Sequence Operation of Detecting Instantaneous Power Loss (When Main Magnetic Contactor is Turned OFF)

4.8 Installing Ribbon Cables

Ribbon cables are used for connecting:

- Between Regulator Board (BDSR) and Power Interface Board (PIFS),
- Between Power Interface Boards (PIFS).

For a single unit or for master unit of multiple units connected in parallel, the Regulator Board is connected to the Power Interface Board with a ribbon cable. Also, ribbon cable is used for connection between the Power Interface Boards of the master unit and the slave unit, and between the Power Interface Boards of the slave units.

Figure 4.18 shows typical connection with ribbon cables.

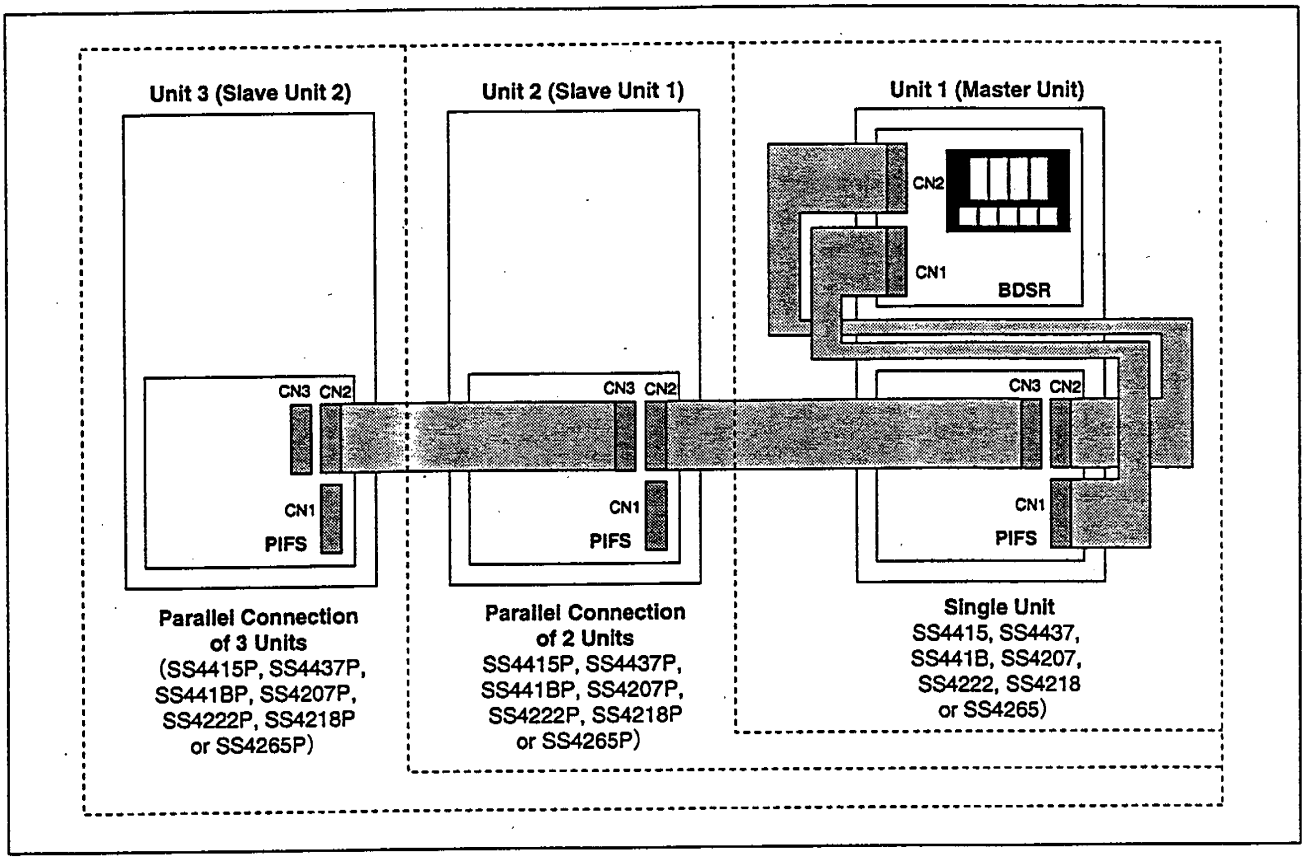


Figure 4.18 – Wiring with Ribbon Cables

4.9 Notes on Wiring

Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units comply with the requirements of CE Mark and the Declaration of Conformity was issued for these units. Insert the specified line filter into the power supply line if these units are used as the units conforming to the requirement of CE Mark.
Caution must be paid to the following when performing wiring:

- Because instantaneous large power is required at overload, provide sufficient AC power supply facility having a smaller voltage fluctuation to prevent the input voltage from dropping below the minimum specified requirement.
- The SS4000 unit does not contain a circuit breaker. Install an adequate circuit breaker on the AC input power line (see Section 4.2.1). When an earth leakage breaker is used, select a breaker equipped with harmonic suppressor.
- The phases of the main power terminals L_1, L_2 and L_3 must be same as the phases of the control power terminals L_{1AUX}, L_{2AUX} and L_{3AUX}. Failure to keep the phase relationship the same will cause malfunction of the SS4000 unit.
- Completely separate the sequence control signal wiring from the power wiring, and do not put the both into a same duct. Also, do not route the both wires in parallel.
- To prevent noise problems, peripherals of the SS4000 unit such as magnetic contactors and relays must be provided with adequate surge suppressor, such as CR filter for AC circuit and inverse-parallel diodes for DC operation circuit.

- Install a varistor for absorbing surge between AC input wires and a specified harmonic filter for reducing higher order harmonics generated by fast switching.
- When wiring is finished, check that all the wiring has been connected correctly before supplying power.
- When the load equipment uses both DC bus power and AC input power to ensure control power, high voltage might be applied to the load equipment due to wraparound. In such a case, change the circuit structure to allow only DC bus power or AC input power to enter to the load equipment in order to prevent wraparound.

CHAPTER 5

Starting and Adjusting the SS4000 Unit

This chapter provides instructions on how to perform a final check before power is applied to the SS4000 unit, how to turn power to the unit ON and how to operate the unit.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this instruction manual in its entirely before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting power, wait for a while for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Be sure that the input disconnect (breaker) is in the correct position either ON or OFF depending on the work to be performed. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: A back up technician must be in line of sight when this work is performed, to assist in case of emergency. Failure to observe this precaution could result in severe bodily injury or loss of life.

5.1 Checking before Powering up the SS4000 Unit

This section describes the procedure to perform a final check before powering up the SS4000 unit.

5.1.1 Verifying the Installation

Confirm the following points of the installation before powering up the SS4000 unit:

- Check that no foreign materials such as wire fragments and screws are left inside the unit.
- Verify that there is no debris such as metal shavings around the unit.
- Check that there is adequate clearances around the unit.

5.1.2 Verifying the Rating of the SS4000 Unit

Before powering up the SS4000 unit, check the following:

- Check the unit's nameplate and confirm that the installed SS4000 unit has an enough rating for the load.
- Check that the incoming power is rated correctly for the rating of the SS4000 unit.
- Check that the disconnect (breaker) and the fuses provided for the branch circuit protection are rated correctly.
- Check that the AC reactor is rated correctly.

5.1.3 Verifying Wiring

Check the following before powering up the SS4000 unit:

- Verify that the SS4000 unit was installed rigidly.
- Check that there is no miswiring.
- Check that no terminals and connections are loose.
- Verify that there is no short circuit with regard to the terminals L_1, L_2, L_3, P, N and G, or no ground fault with regard to these terminals except the terminal G.
- Check that the terminals L_{1AUX}, L_{2AUX} and L_{3AUX} are not shorted.
- Verify that the electronic size is within the specification range and the wire is tightened correctly.
- Verify that the operations of the sequence control signals are normal.

5.2 Powering up the SS4000 Unit

Use the following procedure to turn power to the SS4000 unit ON:

Step 1. Turn the RUN sequence signal OFF.

Step 2. Turn the input power breaker to the ON position.

Step 3. Apply power to the SS4000 unit.

Step 4. Verify that the unit powers up properly without incident such as abnormal sound or nasty smell.

Step 5. Verify that there is no input power voltage drop or short circuit.

Step 6. Verify that the rating of the SS4000 unit matches with the parameter setting of the Unit Selection (F.001).

For Step 6, more information will be given in Section 5.3.

5.3 Operating the SS4000 Unit

This section describes the following basic start-up and operation procedure:

- Powering up
- Precharging
- Verifying the parameter of the Unit Selection
- Checking the DC bus voltage
- Changing the DC bus voltage reference value
- Discharging
- Disconnecting power

This start-up procedure describes how to set the minimum set of parameters. Your application may require programming other parameters in addition to those described in this start-up procedure. Refer to Chapter 8 for the description of all parameters to verify whether you need to program any additional parameters as well.

In this manual, you will see references to parameter names and the numbers that identify them for the SS4000 unit. This manual uses the same format that will be shown on the display to refer to parameters:

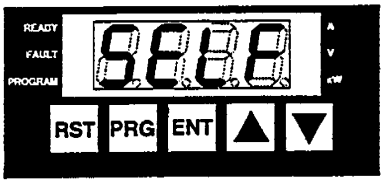
U.nnn
F.nnn

where: nnn is a number
U designates User parameters
F designates Factory parameters.

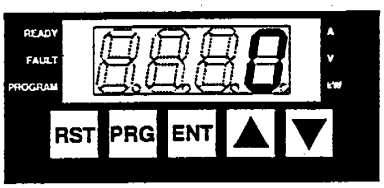
Step 1. Power Up the SS4000 Unit

This step verifies that the SS4000 unit powers up and passes the power-up self-diagnostics. After the unit passes the diagnostics, the operation panel automatically enters monitor mode, with input current displayed.

Step 1.1 Turn power ON.



The initial display shows SELF, with all six status LEDs ON, indicating the unit is performing power-up self-diagnostics.

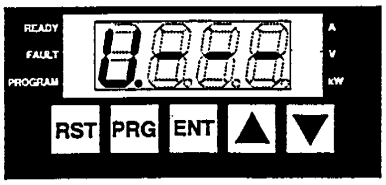


After the diagnostics are complete (approx. 0.5 seconds), the operation panel is in monitor mode. The display shows input current value, and the "A" status LED turns ON. This display shows that the input current is 0 Amp.

Step 2. Verifying the Parameter of the Unit Selection

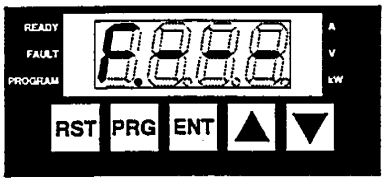
In this step, you will verify that the unit rating matches with the parameter setting of the Unit Selection.

Step 2.1 Press the PRG key.



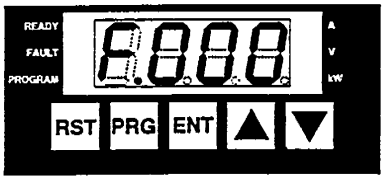
The operation panel changes to program mode and the "PROGRAM" status LED turns ON. The display shows "U.---" indicating that you can access the User parameters.

Step 2.2 Press the ▼ key.



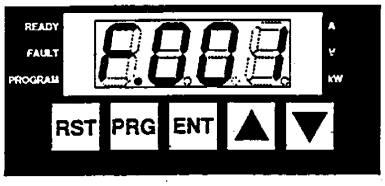
The display shows "F.---" indicating that the Factory parameters can be accessed.

Step 2.3 Press the ENT key.



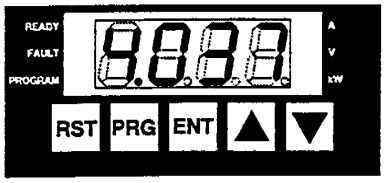
The display shows the first Factory parameter (F.000).

Step 2.4 Press the ▼ key.



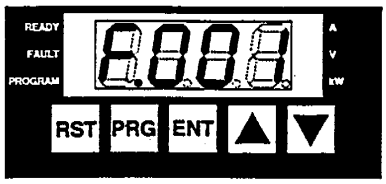
The display indicates the second Factory parameter.

Step 2.5 Press the ENT key.



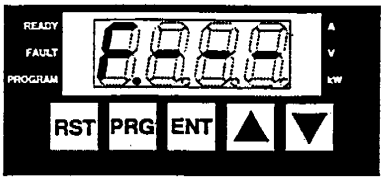
The display shows that 37 kW unit for 460 V is selected. If the display does not match with the actual unit rating, first set the Password (F.000), and then set again the Unit Selection conforming to the unit rating (refer to Section 7.5).

Step 2.6 Press the PRG key.



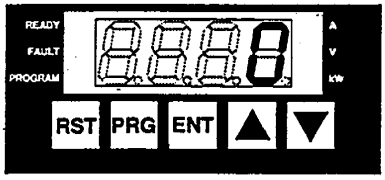
The display indicates the second Factory parameter (F.001).

Step 2.7 Press the PRG key.



The display shows "F.---" indicating that you can access the Factory parameters.

Step 2.8 Press the PRG key.

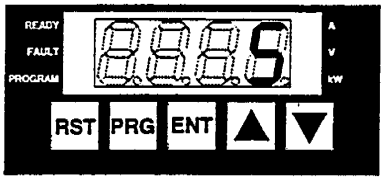


The operation panel returns to monitor mode again. The display indicates the input current and the "A" status LED turns ON. This display shows the input current is 0 Amp.

Step 3. Precharging

In this step, you will turn the RUN sequence control signal ON. When the RUN sequence signal is enabled, the SS4000 unit will start the precharge operation. When the precharge operation is completed, the main magnetic contactor will be turned ON and the PWM switching will begin.

Step 3.1 Turn the RUN sequence signal ON.

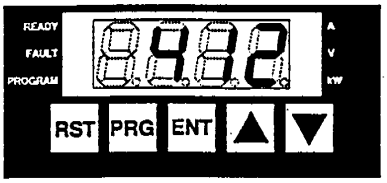


The precharge operation starts. When the precharge operation is completed, the main magnetic contactor is turned ON and the PWM switching starts. When the precharge operation is finished, the DC bus voltage goes up to the reference value. This displays the input current is 5 Amps.

Step 4. Verifying DC Bus Voltage

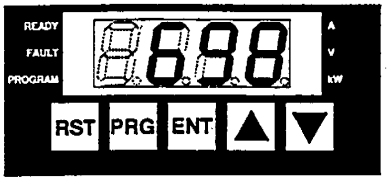
When the PWM switching begins and controlling the DC bus voltage starts, the DC bus voltage will be maintained at the reference value (U.000). Then, you will verify that the DC bus voltage value is same as the reference value.

Step 4.1 Press the ▼ key.



The display shows AC input power voltage, with the "V" status LED turned ON. This display indicates that the input power voltage is 412 V.

Step 4.2 Press the ▼ key.

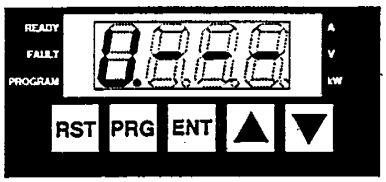


The display indicates the DC bus voltage and the "V" status LED turns ON. This display shows that the DC bus voltage is 698 V.

Step 5. Changing the DC Bus Voltage Reference Value

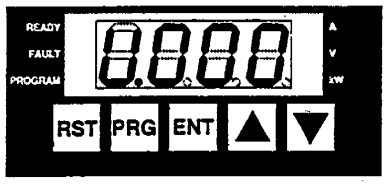
The default value of the DC Bus Voltage Reference (U.000) is 700 V for 460 V unit and 350 V for 230 V unit. This procedure assumes that the DC Bus Voltage Reference value is to be changed to 650 V. In the actual procedure, use the value of your application.

Step 5.1 Press the PRG key.



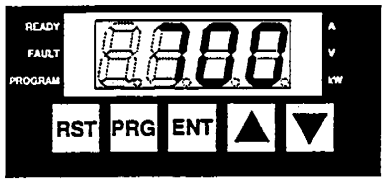
The operation panel is now in program mode, and the "PROGRAM" status LED is ON. The display shows "U.---" indicating that the User parameters can be accessed.

Step 5.2 Press the ENT key.



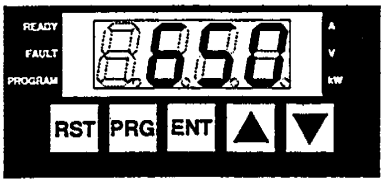
The display shows the first User parameter, U.000.

Step 5.3 Press the ENT key.



The display indicates the value of the DC Bus Voltage Reference (U.000). The default value is 700 V for 460 V unit and 350 V for 230 V unit.

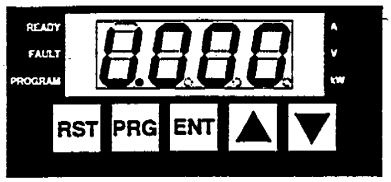
Step 5.4 Press the ▼ key until the display shows 650.



Pressing the ▼ key decrements the value on the display. Holding down the ▼ key will increase the scroll speed.

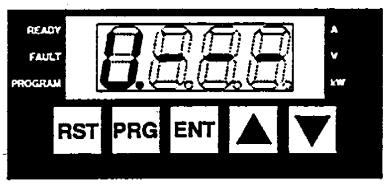
When the display shows 650, stop pressing the ▼ key. If you desire to increase the set value, press the ▲ key.

Step 5.5 Press the ENT key.



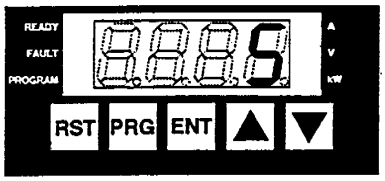
The set value is decided and is written to the EEPROM. After pressing the ENT key, the display returns to the first User parameter (U.000), indicating that the set value has been decided.

Step 5.6 Press the PRG key.



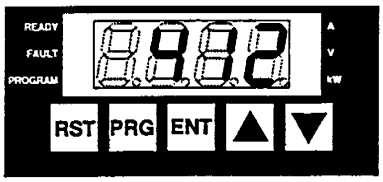
The display shows "U.---" indicating that the User parameters can be accessed.

Step 5.7 Press the PRG key.



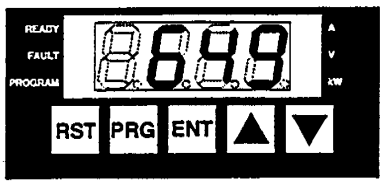
The operation panel returns to monitor mode, and the display indicates the input current, with the "A" status LED turned ON. This display shows that the input current is 5 Amps.

Step 5.8 Press the ▼ key.



The display shows the AC input power voltage and the "V" status LED turns ON. This display shows that the input power voltage is 412 V.

Step 5.9 Press the ▼ key.

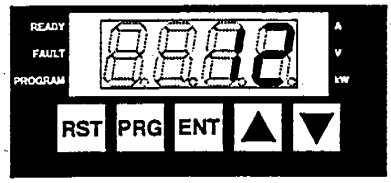


The display indicates the DC bus voltage and the "V" status LED turns ON. Verify that the DC bus voltage is almost same as the reference value (U.000).

Step 6. Discharging

In this step, you will turn the RUN sequence signal OFF. When the RUN sequence signal is turned OFF, the SS4000 unit starts the discharge operation, stops the PWM switching and turns the main magnetic contactor OFF.

Step 6.1 Turn the RUN sequence control signal OFF.

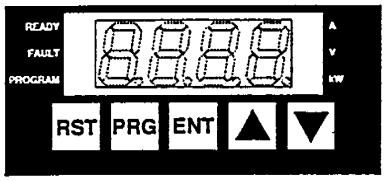


The discharge operation starts, and the PWM switching stops. Turn the main magnetic contactor OFF. When the discharge operation is completed, the DC bus voltage drops to 50 V or lower. The display shows the DC bus voltage is 12 V.

Step 7. Disconnecting Power to the SS4000 Unit

As the final step, disconnect power to the SS4000 unit.

Step 7.1 Disconnect input power.



Power to the Regulator Board is turned OFF, and the display and the LEDs are turned OFF. But when you desire to touch the internal portion of the SS4000 unit, pay extreme caution to the DC bus voltage which might be retained.

CHAPTER 6

Using the Operation Panel To Set Parameters, Monitor Operation, and Reset Errors

This chapter describes the configuration of operation panel and the operation modes.

6.1 Configuration of the Operation Panel

The operation panel is used for setting parameters, monitoring operating conditions and resetting faults. Figure 6.1 shows the configuration of the operation panel and the names of the components.

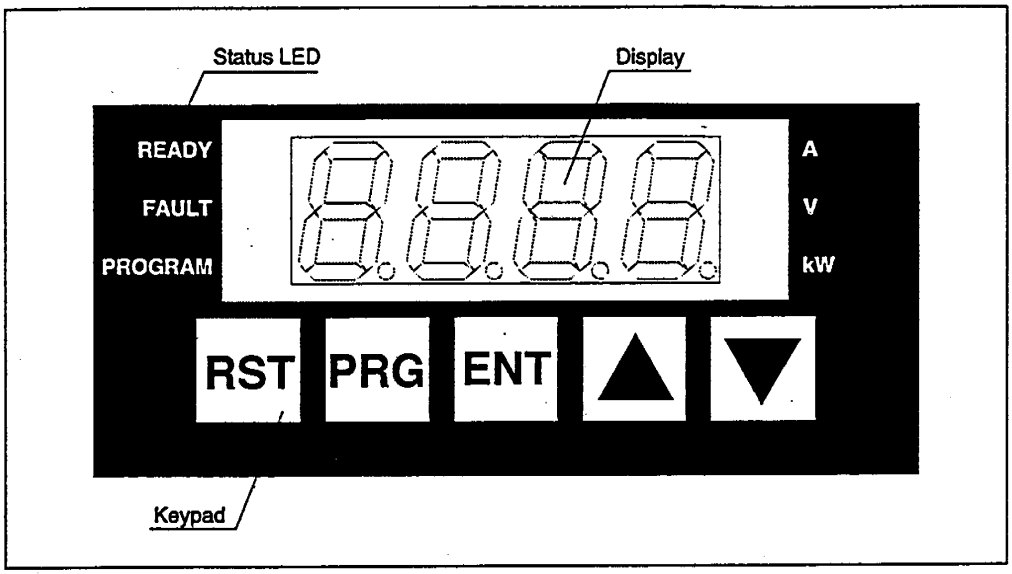


Figure 6.1 – Configuration of the Operation Panel

On the keypad of the operation panel, there are five push-button switches, to be used for selecting monitoring information, setting parameters and resetting faults.

The display on the operation panel consists of four seven-segment LEDs that display monitored values, parameter numbers, parameter values and error codes.

Six status LEDs on the operation panel are used to display the operation status and the units of the monitored values.

6.2 Operation Modes

The operation panel operates in the two modes:

1) Monitor mode

2) Program mode

In monitor mode, you can monitor various operating conditions including input current of the SS4000 unit, DC bus voltage, etc.

In program mode, you can view and change parameter values, and examine the error log.

6.2.1 Monitor Mode

Monitor mode is the operation mode to display operating conditions. The following data can be displayed in this mode:

- Input current *
- AC input power voltage
- DC bus voltage
- Power
- Load ratio.

* The displayed value of input current is only an approximate value and no accuracy can be guaranteed. If you need an accurate input current, measure it by using a dedicated measuring device.

To select a value to monitor, press the ▲ key or the ▼ key until the desired value is displayed. Pressing the ▲ key or the ▼ key will move you through the each of the displays.

The unit of the displayed value is shown by turning ON the status LEDs as follows:

- "A" : Shows the unit when the input current is displayed.
- "V" : Shows the unit when monitoring the AC input power voltage or the DC bus voltage.
- "kW" : Shows the unit when monitoring the power.
- Turning OFF all LEDs : Shows the unit when the load ratio is displayed.

In both cases of monitoring the AC input power voltage and the DC bus voltage, the "V" status LED is ON. You can judge which item is being monitored, by the display order. The unit of the load ratio is percent (%). But in this case, no status LED is ON.

In case of monitoring the power, the "kW" status LED is ON continuously when the operation is in power running, and the "kW" status LED flashes when the operation is regenerative.

In monitor mode, the "PROGRAM" status LED is turned OFF, indicating that the operation panel is not in program mode.

When any fault occurs, the operation panel cannot be changed to monitor mode.

Figure 6.2 shows an example of display in monitor mode.

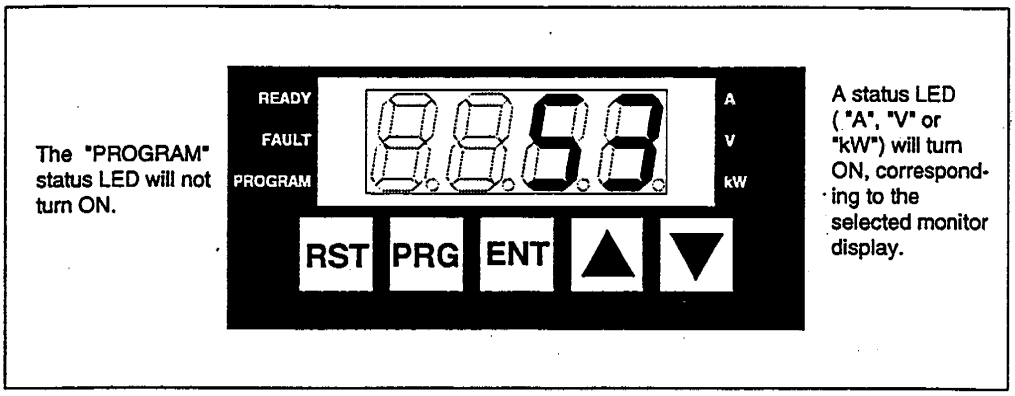


Figure 6.2 – Example of Monitor Mode Display (Displaying Load Ratio of 53%)

6.2.2 Program Mode

Program mode allows you to display and modify set parameter values, and to display the error log. The following can be displayed in program mode:

- Types of parameters
- Parameter numbers
- Parameter values
- Selection of error log
- Error log number
- Error codes.

In program mode, the "PROGRAM" status LED is ON, indicating that the operation panel is in the program mode.

Figure 6.3 shows an example of display in the program mode.

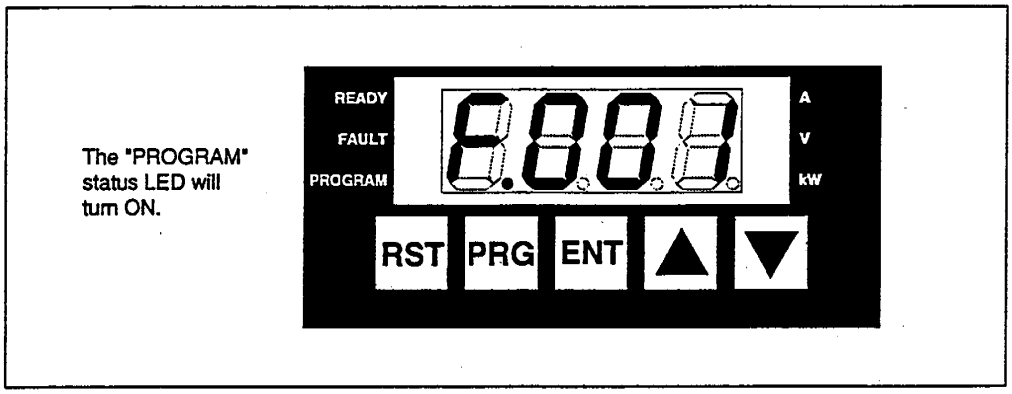


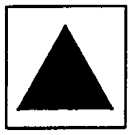
Figure 6.3 – Example of Program Mode Display (Displaying F.001 Unit Selection)

6.3 The Display

The display portion of the operation panel is a four-character, seven-segment LED. When the unit is powered up, SELF is displayed as the SS4000 unit performs the power-up self-diagnostics. When the diagnostics are completed, the display indicates various monitor values, parameter numbers, parameter values and error codes. Figures 6.2 and 6.3 show examples of displays.

6.4 The Keypad

The keypad portion of the operation panel has five push-button switches that are used to select monitoring items, to set parameters and to reset faults.



The UP (▲) and DOWN (▼) arrow keys are used to:

- Select monitoring items in monitor mode.
- Select parameters, and move through the error log in case of program mode.
- Increase or decrease a numeric value when a parameter value is displayed.

Holding down these keys will increase the scroll speed.

ENT

The ENT key is used to:

- Display a selected parameter value and the contents of the error log in program mode.
- Save a parameter value when the parameter value is displayed.

PRG

The PRG key is used to:

- Move between program and monitor modes. The "PROGRAM" status LED will turn OFF when the operation panel is in the monitor mode and turn ON when the operation panel is in the program mode.
- Return to the display of parameter number without saving a parameter value when a parameter value is displayed.

RST

The RST key is used to:

- Reset fault when fault occurred and the display shows the error code.

Before resetting fault, remove the reasons of the fault. Note that when the RUN sequence signal has entered, fault cannot be reset.

6.5 Status LEDs

The operation panel contains six LEDs that show the present status of the SS4000 unit. Table 6.1 describes what each status LED means.

Table 6.1 -- Meaning of Status LEDs

LED	Status	Meaning
READY	On	PWM switching is being performed.
	Off	PWM switching is not performed.
FAULT	On	Fault occurred, or the error log is being displayed.
	Off	Operation is normal.
PROGRAM	On	The operation panel is in program mode.
	Off	The operation panel is in monitor mode.
A	On	The root mean square value of the monitored input current is displayed in the unit of ampere. (1)
V	On	The root mean square value of the monitored AC input power voltage or DC bus voltage is displayed in the unit of volt.
KW	On	The monitored power (power running) is displayed in the unit of kilowatt.
	Flashing	The monitored power (regenerated) is displayed in the unit of kilowatt.
A, V, and KW	Off	The load ratio (2) is displayed in the unit of % when A, V and kW are turned OFF in monitor mode.

(1) The displayed value of input current is only an approximate value and no accuracy can be guarantied. If you need an accurate value, measure it by using a dedicated measuring device.

(2) The load ratio is a ratio of the input current to the rated current.

CHAPTER 7

Setting Parameters

The parameters are used to define characteristics of the SS4000 unit. To program the unit for a specific application, you display the appropriate parameter and adjust it as required. This chapter provides information on parameter types as well as detailed descriptions of each parameter. This chapter also describes how to access, display, and modify parameters.

7.1 Parameter Types

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should adjust and operate this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

There are the following two types of parameters.

1) User Parameters

   These parameters can be adjusted or modified at any time.

2) Factory Parameters

   These parameters are initially set before shipping out from the factory. Usually, these parameters are not required to be adjusted or modified.

   The Factory parameters are protected by password, and the adequate password must be set to access these parameters. Note, however, that some of these parameters cannot be modified during operation even though the password has been set.

Each parameter is described in detail in this chapter. The following information is provided for each parameter.

- **Parameter Number**

  A unique number is assigned to each parameter. The number is preceded by either U or F to identify it as a User or Factory parameter, respectively. The parameter number is shown on the display of the operation panel.

- **Parameter Name**

  A name is assigned to a parameter. The parameter name is not displayed when programming the SS4000 unit using the operation panel.

- **Parameter Description**

  This is a description of the parameter's function.

- **Parameter Range**

  This shows the predefined upper and lower limits of the parameter value.

- **Default Setting**

  The parameters are initially set before shipping from the factory, and the default setting is such factory setting.

- **Parameter Type**

  The parameter type identifies whether the parameter can be modified at any time, is protected by password, or cannot be modified during operation.

- **Refer also to Parameters**

  This shows a list of associated parameters that may provide additional or related information.

Figure 7.1 shows the parameter structure.

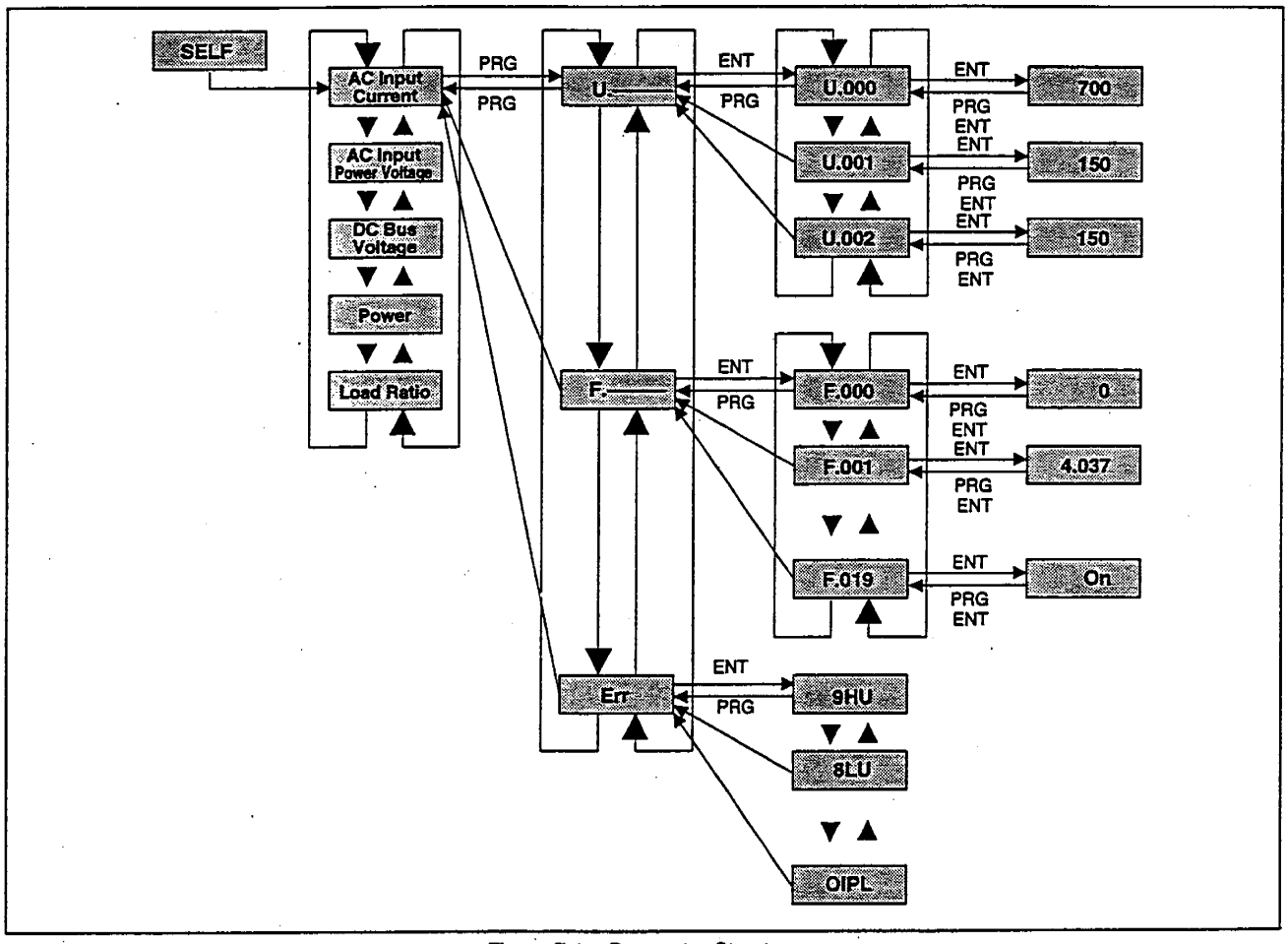


Figure 7.1 – Parameter Structure

7.2 Protecting Parameters with Password

Factory parameter values are password protected using Parameter F.000 (Setting Password). But even after the password has been set, some Factory parameters cannot be modified. Such parameters must be set after operation stopped.

Note that Parameter F.018 (Version Information) is a read-only parameter, and therefore, cannot be modified.

ATTENTION: It is the user's responsibility to determine how to distribute the password. Reliance Electric is not responsible for unauthorized access violations within the user's organization.

7.3 Displaying and Changing Parameter Values

To display or change parameter values, the operation panel must be in the program mode. Use the procedure described in the following sections to change parameters in the program mode. For calling out the error log and resetting faults, refer to Chapter 9.

7.4 User Parameters

The User parameters contain basic parameters that are modified depending on applications of the SS4000 unit. Use the following procedure to modify the User parameters.

Step 1. Press the PRG key until the "PROGRAM" status LED turns ON and the display shows "U.---". You can access the User parameters. If "U.---" is not shown on the display, press the ▲ key or the ▼ key until "U.---" appears on the display.

Step 2. Press the ENT key. The first User parameter number (U.000) will be displayed.

Step 3. Use the ▲ key or the ▼ key to move through the User parameters.

Step 4. When the desired parameter appears, press the ENT key. The parameter will be called out, and the parameter value will be displayed.

Step 5. Use the ▲ key to increment the value and the ▼ key to decrement the value.

Step 6. Press the ENT key to save changed value. Pressing the ENT key will display the same parameter number again, indicating that the value was saved.

Note 1: Value is not written to the memory until the ENT key has been pressed.

Note 2: Pressing the PRG key will also return to the same parameter number, without saving the value.

Parameter values are retained through a line dip or power shutdown.

U.000 DC Bus Voltage Reference

This parameter sets the DC bus voltage reference value. The SS4000 unit controls to maintain the DC bus voltage at the set value.

Parameter Range:	275 to 750 V (for 460 V units) 275 to 375 V (for 230 V units)
Default Setting:	700 V (for 460 V units) 350 V (for 230 V units)
Parameter Type:	Configurable only when the unit is normal
Refer also to Parameters:	U.001 FWD Current Limit U.002 REV Current Limit F.005 Voltage Control Proportional Gain F.007 Bus Overvoltage Detection Level F.008 Bus Low Voltage Detection Level

Set the DC bus voltage (V) desired to maintain, to this parameter. When the actual DC bus voltage is lower than the set value, current flows to the direction of power running, resulting in increase of voltage. On the contrary, if the actual DC bus voltage is higher than the set value, current flows to the regenerative direction, and the voltage will drop. But when the current limits (U.001 and U.002) are set to low values, the DC bus voltage might fluctuate because the current to be used for controlling the DC bus voltage is limited.

When the DC bus voltage is set too low, control will become impossible, and the DC bus voltage will swing widely. Set the DC bus voltage to a value equal to or higher than the peak value of AC input power voltage plus 30 V.

When regenerated power enters rapidly due to rapid deceleration of load equipment or other reasons, the DC bus voltage might go up instantaneously. To prevent such rapid change of the DC bus voltage, adjust the Voltage Control Proportional Gain (F.005).

If the difference between the set values of the DC Bus Voltage Reference and the Bus Overvoltage Detection Level (F.007) is small, bus overvoltage fault may be caused.

When a fault occurred, the DC Bus Voltage Reference cannot be set until the fault has been reset.

U.001 FWD Current Limit

This parameter limits current flowing from the AC input power to the SS4000 unit during operation.

Parameter Range:	0 to 150%
Default Setting:	150%
Parameter Type:	Configurable only when the unit is normal
Refer also to Parameters:	U.000 DC Bus Voltage Reference U.002 REV Side Current Limit F.002 Rated Current

Set the FWD current value (flowing in the direction to power running) to be limited as a ratio (%) of the Rated Current (F.002). What is to be limited is the current value flowing by the PWM switching. It is impossible to limit the current flowing through diodes.

When the set value of the FWD Current Limit is too small, the DC bus voltage might not go up to the set value of the DC Bus Voltage Reference (U.000).

If the SS4000 unit operates in the power regeneration mode only, set this parameter to 0%. The DC bus voltage to start power regeneration is the set value of the DC Bus Voltage Reference (U.000).

When an error occurred, the FWD Current Limit cannot be set until the error has been reset.

U.002 REV Current Limit

This parameter limits current flowing from the SS4000 unit to the AC input power during operation.

Parameter Range:	0 to 150%
Default Setting:	150%
Parameter Type:	Configurable only when the unit is normal
Refer also to Parameters:	U.000 DC Bus Voltage Reference U.001 FWD Current Limit F.002 Rated Current

Set the REV current value (flowing in the direction to power regeneration) to be limited as a ratio (%) of the Rated Current (F.002). What is to be limited is the current value flowing by the PWM switching.

When the set value of the REV Current Limit is too small, the DC bus voltage might not go down to the set value of the DC Bus Voltage Reference (U.000), and DC bus overvoltage error might be detected.

When an error occurred, the REV Current Limit cannot be set until the error has been reset.

7.5 Factory Parameters

F.000 Password

A password must be set to this parameter to change the Factory parameters.

Parameter Range:	0 to 999
Default Setting:	0
Parameter Type:	Configurable
Refer also to Parameters:	F.001 Unit Selection

ATTENTION: It is the user's responsibility to determine how to distribute the password. Reliance Electric is not responsible for unauthorized access violations within the user's organization.

Once a password is set, it will be retained until power to the SS4000 unit is disconnected. Note, therefore, that once a password is set to this parameter, the Factory parameters can be changed at any time until the power to the unit is disconnected.

Even though a password has been set to this parameter, the password can be cancelled by setting other value than the password to this parameter.

Password can be set at any time while the SS4000 unit is operating or stopping, or fault occurred.

Use the following procedure to set a password:

Step 1. Press the PRG key. "U.---" will be displayed, and the "PROGRAM" status LED will turn ON.

Step 2. Press the ▲ key or the ▼ key until "F.---" is displayed.

Step 3. Press the ENT key. "F.000" will be displayed.

Step 4. Press the ENT key. "0" will be displayed.

Step 5. Press the ▲ key until "55" is displayed. (Holding down the ▲ key will increase the scroll speed.)

Step 6. Press the ENT key to enter the value.

F.001 Unit Selection (Note 1)

As the type of the SS4000 unit, this parameter sets a character code representing the input power supply voltage and the unit capacity.

For most applications, it is recommended that this parameter not be adjusted.

Note 1: This parameter is available from software version No. 3.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	4.015	(15 kW unit for 460 V, single 15 kW unit)
	4.030	(30 kW unit for 460 V, 2 paralleled 15 kW units)
	4.045	(45 kW unit for 460 V, 3 paralleled 15 kW units)
	4.037	(37 kW unit for 460 V, single 37 kW unit)
	4.075	(75 kW unit for 460 V, 2 paralleled 37 kW units)
	4.110	(110 kW unit for 460 V, 3 paralleled 37 kW units)
	4.125	(125 kW unit for 460 V, single 125 kW unit)
	4.250	(250 kW unit for 460 V, 2 paralleled 125 kW units)
	4.375	(375 kW unit for 460 V, 3 paralleled 125 kW units)
	2.007	(7.5 kW unit for 230 V, single 7.5 kW unit)
	2.015	(15 kW unit for 230 V, 2 paralleled 7.5 kW units)
	2.023	(22.5 kW unit for 230 V, 3 paralleled 7.5 kW units)
	2.018	(18.5 kW unit for 230 V, single 18.5 kW unit)
	2.037	(37 kW unit for 230 V, 2 paralleled 18.5 kW units)
	2.055	(55 kW unit for 230 V, 3 paralleled 18.5 kW units)
	2.022	(22 kW unit for 230 V, single 22 kW unit)
	2.044	(44 kW unit for 230 V, 2 paralleled 22 kW units)
	2.066	(66 kW unit for 230 V, 3 paralleled 22 kW units)
	2.065	(65 KW unit for 230 V, single 65 KW unit)
	2.130	(130 KW unit for 230 V, 2 paralleled 65 KW units)
	2.195	(195 KW unit for 230 V, 3 paralleled 65 KW units)
Default Setting:	Unit-dependent	
Parameter Type:	Requiring the password, configurable only while the unit stops	
Refer also to Parameters:	F.002	Rated Current

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should change this parameter. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

As shown in Figure 7.2, the unit type is represented by the numbers showing the AC input power voltage and the unit capacity.

F.001 Unit Selection *(continued)*

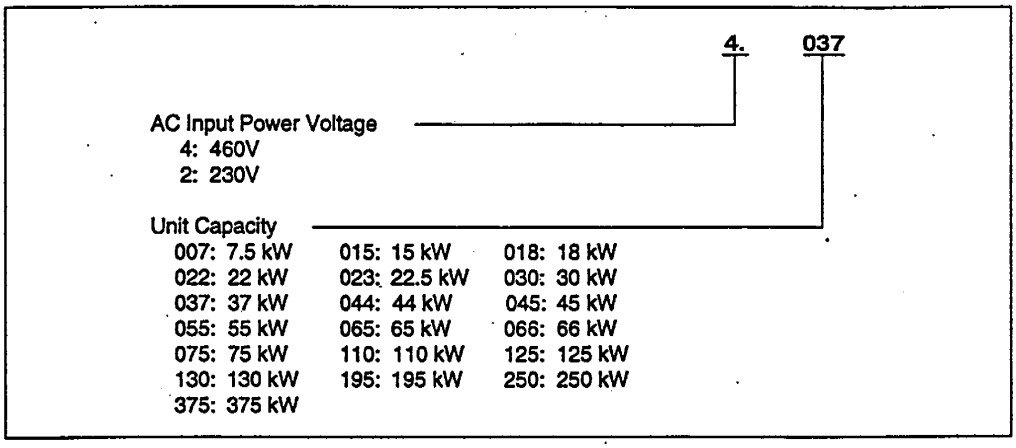


Figure 7.2 – Character Code to Show the Unit Type

Be careful that setting a unit type to this parameter resets all the parameters to factory default settings, and cancels the password.

When the password has not been set, or during operation even though the password has been set, the unit capacity cannot be changed.

F.002 Rated Current (Note 1)

This parameter sets the rated current of the SS4000 unit. In case of multiple units connected in parallel, the total current of the connected units must be set.

For most applications, it is recommended that this parameter not be adjusted.

Note 1: This parameter is available from software version No. 3.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	
10 to 35 Amps	15 kW unit for 460 V (single 15 kW unit)
10 to 70 Amps	37 KW unit for 460 V (single 37 KW unit)
30 to 215 Amps	125 kW unit for 460 V (single 125 kW unit)
10 to 35 Amps	7.5 kW unit for 230 V (single 7.5 kW unit)
10 to 70 Amps	18.5 kW unit for 230 V (single 18.5 kW unit)
10 to 80 Amps	22 kW unit for 230 V (single 22 kW unit)
30 to 250 Amps	65 kW unit for 230 V (single 65 kW unit)
20 to 70 Amps	30 kW unit for 460 V (2 paralleled 15 kW units)
20 to 140 Amps	75 kW unit for 460 V (2 paralleled 37 kW units)
60 to 430 Amps	250 kW unit for 460 V (2 paralleled 125 kW units)
20 to 70 Amps	15 kW unit for 230 V (2 paralleled 7.5 kW units)
20 to 140 Amps	37 kW unit for 230 V (2 paralleled 18.5 kW units)
20 to 160 Amps	44 KW unit for 230 V (2 paralleled 22 kW units)
60 to 500 Amps	130 kW unit for 230 V (2 paralleled 65 kW units)
30 to 105 Amps	45 kW units for 460 V (3 paralleled 15 kW units)
30 to 210 Amps	110 KW unit for 460 V (3 paralleled 37 kW units)
90 to 645 Amps	375 kW unit for 460 V (3 paralleled 125 kW units)
30 to 105 Amps	23 kW units for 230 V (3 paralleled 7.5 kW units)
30 to 210 Amps	55 kW unit for 230 V (3 paralleled 18.5 kW units)
30 to 240 Amps	66 kW unit for 230 V (3 paralleled 22 kW units)
90 to 750 Amps	195 kW unit for 230 V (3 paralleled 65 kW units)

F.002 Rated Current *(continued)*

Default Setting:	28 Amps 15 kW unit for 460 V (single 15 kW unit) 65 Amps 37 KW unit for 460 V (single 37 KW unit) 190 Amps 125 kW unit for 460 V (single 125 kW unit) 28 Amps 7.5 kW unit for 230 V (single 7.5 kW unit) 65 Amps 18.5 kW unit for 230 V (single 18.5 kW unit) 79 Amps 22 kW unit for 230 V (single 22 kW unit) 190 Amps 65 kW unit for 230 V (single 65 kW unit) 56 Amps 30 kW unit for 460 V (2 paralleled 15 kW units) 130 Amps 75 kW unit for 460 V (2 paralleled 37 kW units) 380 Amps 250 kW unit for 460 V (2 paralleled 125 kW units) 56 Amps 15 kW unit for 230 V (2 paralleled 7.5 kW units) 130 Amps 37 kW unit for 230 V (2 paralleled 18.5 kW units) 158 Amps 44 KW unit for 230 V (2 paralleled 22 kW units) 380 Amps 130 kW unit for 230 V (2 paralleled 65 kW units) 84 Amps 45 kW units for 460 V (3 paralleled 15 kW units) 195 Amps 110 KW unit for 460 V (3 paralleled 37 kW units) 570 Amps 375 kW unit for 460 V (3 paralleled 125 kW units) 84 Amps 23 kW units for 230 V (3 paralleled 7.5 kW units) 195 Amps 55 kW unit for 230 V (3 paralleled 18.5 kW units) 237 Amps 66 kW unit for 230 V (3 paralleled 22 kW units) 570 Amps 195 kW unit for 230 V (3 paralleled 65 kW units)
Parameter Type:	Requiring the password, configurable only while the unit stops
Refer also to Parameters:	U.001 FWD Current Limit U.002 REV Current Limit F.001 Unit Selection

This parameter sets the rated current of the unit in the unit of amperes. The set value affects the FWD and REV Current Limits (U.001 and U.002), overload detection, etc.

In case of paralleled units, the total current value of the connected units must be set to this parameter. When pressing the ▲ key or the ▼ key, the displayed value changes 1 Amp per stroke in case of single unit, 2 Amps per stroke in case of two paralleled units, and 3 Amps per stroke in case of three paralleled units.

The Rated Current cannot been changed, when the password has not been set, while operating even if the password has already been set, or when an error occurred.

F.003 Current Control Proportional Gain

This parameter determines the response of the current control.

For most applications, it is recommended that this parameter not be adjusted.

Parameter Range:	0.01 to 10.00 times
Default Setting:	1.00 times
Parameter Type:	Requiring the password, configurable only when the unit is normal
Refer also to Parameters:	F.004 Current Control Integral Gain

Larger values of the Current Control Proportional Gain set in this parameter result in faster response of the current control loop. But if the gain is set to a too large value, the unit becomes more susceptible to overcurrent detection and unstable by starting vibration of input current. Decreasing the gain value will help increase stability, but result in less respondence.

F.004 Current Control Integral Gain

This parameter determines the dynamic characteristics of the current control.

For most applications, it is recommended that this parameter not be adjusted.

Parameter Range:	1 to 3,000 rad/sec
Default Setting:	64 rad/sec
Parameter Type:	Requiring the password, configurable only when the unit is normal
Refer also to Parameters:	F.003 Current Control Proportional Gain

Larger values of the Current Control Integral Gain set in this parameter result in shorter arrival time to the reference current value. If the gain is set too large, the current vibrates and becomes unstable. Decreasing the gain will help increase stability, but the arrival time to the reference current value becomes longer to a change of input current.

F.005 Voltage Control Proportional Gain

This parameter determines the response of the voltage control.

Parameter Range:	0.01 to 30.00 times
Default Setting:	5.00 times
Parameter Type:	Requiring the password, configurable only when the unit is normal
Refer also to Parameters:	F.006 Voltage Control Integral Gain

Larger values of the Voltage Control Proportional Gain set in this parameter result in faster response to change of DC bus voltage. But if the gain is set too large, the unit becomes unstable. Decreasing the gain value will help increase stability, but may result in less respondence to a change of DC bus voltage.

If capacity of load equipment capacitors is large, increase the set value of the Voltage Control Proportional Gain.

F.006 Voltage Control Integral Gain

This parameter determines the dynamic characteristics of the voltage control.

For most applications, it is recommended that this parameter not be adjusted.

Parameter Range:	1 to 3,000 rad/sec
Default Setting:	128 rad/sec
Parameter Type:	Requiring the password, configurable only when the unit is normal
Refer also to Parameters:	F.005 Voltage Control Proportional Gain

Larger values of the Voltage Control Integral Gain set in this parameter result in shorter arrival time to the set value. But if the gain is set too large, the voltage vibrates and becomes unstable. Decreasing the gain will help increase stability, but the arrival time to the set value becomes longer to a change of DC bus voltage.

When capacity of load equipment capacitors is large, increase the set value of the Voltage Control Integral Gain.

F.007 Bus Overvoltage Detection Level

This parameter sets the voltage level to detect the DC bus overvoltage error.

Parameter Range:	325 to 900 V (for 460 V units) 325 to 450 V (for 230 V units)
Default Setting:	800 V (for 460 V units) 400 V (for 230 V units)
Parameter Type:	Requiring the password, configurable only while the unit stops
Refer also to Parameters:	U.000 DC Bus Voltage Reference F.001 Unit Selection F.008 Bus Low Voltage Detection Level

When the DC bus voltage reaches the set value of the Bus Overvoltage Detection Level, the DC bus overvoltage error will be detected. When the error is detected, the PWM switching will stop, the discharge operation will start, and operation will stop.

When load changes largely due to rapid deceleration of load equipment or other reasons, the DC bus voltage might be increased instantaneously. If the voltage difference between the set values of the DC Bus Voltage Reference (U.000) and the Bus Overvoltage Detection Level is not large enough, the bus overvoltage error might be detected.

Set the Bus Overvoltage Detection Level to the same value as the detection level of the load equipment.

F.008 Bus Low Voltage Detection Level

This parameter sets the voltage level to detect the DC bus low voltage error.

Parameter Range:	200 to 600 V (for 460 V units) 200 to 300 V (for 230 V units)
Default Setting:	400 V (for 460 V units) 200 V (for 230 V units)
Parameter Type:	Requiring the password, configurable only while the unit stops
Refer also to Parameters:	U.000 DC Bus Voltage Reference F.001 Unit Selection F.007 Bus Overvoltage Detection Level

When the DC bus voltage reaches the set value of the Bus Low Voltage Detection Level, the DC bus low voltage error will be detected. Detection of the error will stop the PWM switching, start the discharge operation, and stop operation.

F.009 AC Overvoltage Detection Level

This parameter sets the voltage level to detect the AC input power overvoltage error.

Parameter Range:	200 to 550 V (for 460 V units) 200 to 275 V (for 230 V units)
Default Setting:	550 V (for 460 V units) 275 V (for 230 V units)
Parameter Type:	Requiring the password, configurable only while the unit stops
Refer also to Parameters:	F.001 Unit Selection

When the AC input power voltage reaches the set value of the AC Overvoltage Detection Level, the AC overvoltage error will be detected. Detection of the error will stop the PWM switching, start the discharge operation, and stop operation.

When the AC Overvoltage Detection Level is carelessly set lower than the AC input power voltage, the AC overvoltage error cannot be reset. In such a case, use the following steps to reset the AC overvoltage error.

Step 1. Press the PRG key while the "AC" error is shown on the display. The operation panel will be in program mode, and the display will show "U.---".

Step 2. Press the ▲ key or the ▼ key until "F.---" will be shown in the display.

Step 3. Press the ENT key. The display will show "F.000".

Step 4. Press the ENT key. The display will show "0".

Step 5. Set the password (55), and press the ENT key. The display will show "F.000".

Step 6. Press the ▲ key or the ▼ key until "F.009" will be shown in the display.

Step 7. Press the ENT key. The display will show the AC Overvoltage Detection Level.

Step 8. Press the ▲ key to increment the set value to an adequate value.

Step 9. Press the ENT key to decide the set value. The display will show "F.009".

Step 10. Press the PRG key. The display will show "AC".

Step 11. Press the RST key or enter the RST sequence signal. Resetting "AC" will return to monitor mode.

F.010 Carrier Frequency (Note 1)

This parameter sets the carrier frequency of the PWM switching.

Note 1: This parameter is available from software version No. 3.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	5 kHz, 10 kHz, or 15 kHz
Default Setting:	10 kHz: For Model SS4207, SS4218, SS4222 SS4415 and SS4437 5 kHZ: For SS4265 and SS441B (See Note 1.)
Parameter Type:	Requiring the password, configurable only when the unit is normal
Refer also to Parameters:	F.002 Rated Current

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should change this parameter. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

The carrier frequency is largely concerned with heat generation of the SS4000 unit and the reactor. When the carrier frequency is increased from 10 kHz to 15 kHz, use the unit by derating the Rated Current (F.002) by 20%.

F.011 Deadtime

This parameter sets the deadtime of PWM.

For most applications, it is recommended that this parameter not be adjusted.

Parameter Range:	1.5 to 15.0 microseconds
Default Setting:	6.0 microseconds
Parameter Type:	Requiring the password, configurable only while the unit is normal and stops
Refer also to Parameters:	N/A

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should change this parameter. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

The deadtime is the time provided for protecting the Power Modules from shorting. Therefore, the set value depends on the transistor modules to be used for the Power Modules. Careless change of the deadtime might damage the unit. If you need to change the setting of this parameter, contact Reliance Electric.

F.012 Allowable Time for Instantaneous Power Loss

This parameter sets the time period within which the SS4000 unit can return to operation automatically, when the input power voltage dropped (lower than 200 VAC for 460 V units, and 100 VAC for 230 V unit) instantaneously, or when instantaneous phase loss occurred.

When the power dip or phase loss continued longer than the set value, a phase loss error will be detected.

Parameter Range:	0.05 to 3.00 seconds
Default Setting:	0.50 seconds
Parameter Type:	Requiring the password, configurable only while the unit is normal and stops
Refer also to Parameters:	N/A

If an instantaneous power loss or phase loss is detected, the PWM switching will stop. When the unit returns from the instantaneous power loss or phase loss, the PWM switching will restart.

When the power to the main magnetic contactor was turned OFF due to an instantaneous power loss or phase loss and the main power supply was turned OFF, returning from the instantaneous power loss or phase loss will start precharge operation. After the precharge operation is completed, the PWM switching will restart.

When an instantaneous power loss or phase loss continued longer than the value set to this parameter, it is considered as a power loss, and a phase loss error will be detected. Detecting a phase loss error will start discharge operation.

F.013 AC Reactor Capacity (Note 1)

This parameter sets the capacity of the AC reactor installed in the main power wiring.

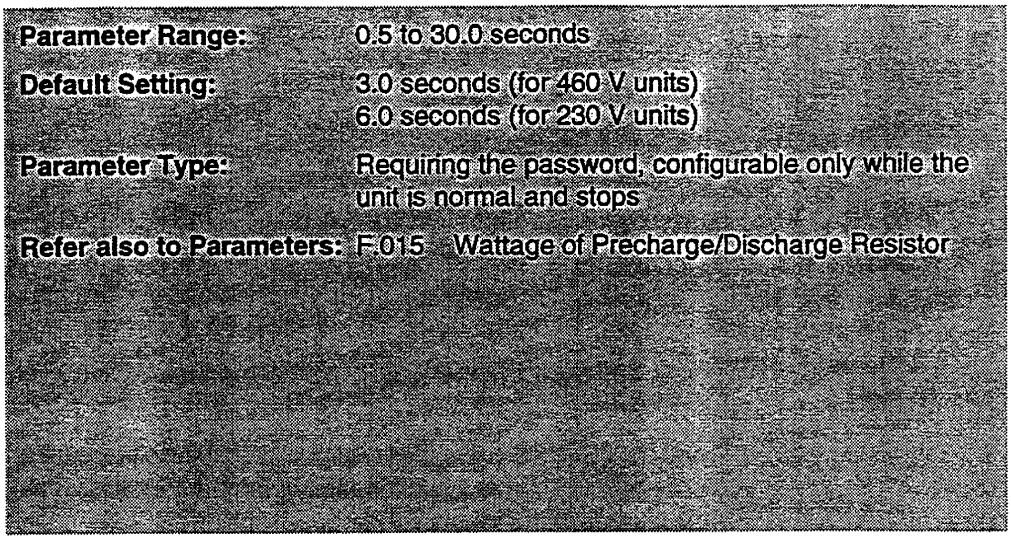
Note 1: This parameter is available from software version No. 3.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	100 to 8,000 micro-henry (for 460 V units) 100 to 4,000 micro-henry (for 230 V units)	
Default Setting:	1,200 micro-henry:	For Model SS4437, SS4437P, SS4218, SS4218P, SS4222 and SS4222P units
	850 micro-henry:	For Model SS4207, SS4207P, SS4415 and SS4415P units
	400 micro-henry:	For Model SS4265, SS4265P, SS441B and SS441BP units
Parameter Type:	Requiring the password, configurable only while the unit is normal and stops	
Refer also to Parameters:	F.003	Current Control Proportional Gain
	F.004	Current Control Integral Gain
	F.010	Carrier Frequency

This parameter sets the capacity of the AC reactor in the unit of micro-henry. Note that the AC reactor capacity set to the parameter is not the total capacity for three phases but the capacity for one phase only. This is also applicable to multiple units connected in parallel.

F.014 Precharge/Discharge Time

This parameter sets the precharge/ discharge time. If the DC bus voltage did not go up in precharge even if the set time period has elapsed, a precharge error will be detected. In case of discharge, the discharge operation will continue for the time period set to this parameter.



Larger capacity of capacitors connected to the DC bus requires a longer precharge time. In such a case, set a large value to this parameter.

When the DC bus voltage does not reach the precharge voltage even if the time period set to this parameter has already elapsed, a precharge error will be detected. Set a larger value. (Remarks: The precharge time is the time in which 90% of the peak value of the AC input power voltage or higher reaches.)

In case of precharge, the precharge operation will be finished when the DC bus voltage arrives at a certain value, even though the set Precharge/Discharge Time has not elapsed yet. But in case of discharge, the discharge operation continues for the set value of this parameter, regardless of the DC bus voltage.

When capacitors (including external capacitors) of load equipment connected to the SS4000 unit have a larger capacity than the following, connect an external precharge/discharge resistor:

- 460 V units: 8,000 micro-farad or larger
- 230 V units: 39,000 micro-farad or larger

When built-in precharge/discharge resistor is replaced with an external resistor, set again the Precharge/Discharge Time. For connection of an external resistor, refer to Section 4.5.

F.015 Wattage of Precharge/Discharge Resistor (Note 1)

This parameter sets the rated wattage of the precharge/ discharge resistor.

Note 1: This parameter is available from software version No. 3.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	50 to 2,000 W
Default Setting:	120 W: For Model SS4437, SS4437P, SS4218, SS4218P, SS4222 and SS4222P units 80 W: For Model SS4207, SS4207P, SS4415 and SS4415P units 400 W: For Model SS4265, SS4265P, SS441B and SS441BP units
Parameter Type:	Requiring the password, configurable only while the unit is normal and stops
Refer also to Parameters:	F.014 Precharge/Discharge Time

When capacitors (including external capacitors) of load equipment connected to the SS4000 unit have a larger capacity than the following, connect an external precharge/discharge resistor:

- 460 V units: 8,000 micro-farad or larger
- 230 V units: 39,000 micro-farad or larger

When built-in precharge/discharge resistor is replaced with an external resistor, set again the Wattage of Precharge/Discharge Resistor. For connection of an external resistor, refer to Section 4.6.

The SS4000 unit has an overload protection function for precharge/discharge resistor. When the resistor becomes overload condition as a result of repeated precharge and discharge, an overload error of the precharge/discharge resistor will be detected.

The standard indication of overload of the precharge/discharge resistor is as follows:

Temperature increase of resistor:

$$\text{Temp. Increase of Resistor (deg. C)} = \frac{500 \times \text{Precharge/Discharge Time (F.014)}}{\text{Wattage of Precharge/Discharge Resistor}}$$

Temp. of Resistor to Detect Overload = 120 degree C (248 degree F)

When the temperature of the precharge/discharge resistor reaches 120 degree C (248 degree F), an overload error of the resistor will be detected. But if precharge/discharge operation is not performed for 10 minutes, the integrated values will be cleared.

F.016 DC Bus Voltage Offset (Note 1)

This parameter is used to compensate error of monitored DC bus voltage from actual value, by multiplying feedback value of DC bus voltage by offset (gain).

Note 1: This parameter is available from software version No. 2.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	0.900 to 1.100
Default Setting:	1.000
Parameter Type:	Requiring the password, configurable only while the unit is normal
Refer also to Parameters:	U.000 DC Bus Voltage Reference

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should change this parameter. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

An error of monitored value of DC bus voltage shown on the display (usually almost same as the set value of the DC Bus Voltage Reference (U.000) from actually measured DC bus voltage can be compensated by setting an adequate value to this parameter.

The value to be set to the DC Bus Voltage Offset (F.016) is determined by using the following formula:

DC Bus Voltage Offset (F.016)
= Measured DC Bus Voltage (*) / DC Bus Voltage Reference (U.000)

* Measured DC Bus Voltage is value actually measured by a voltmeter.

After setting this parameter, confirm that the error was reduced.

F.017 Discharging Function Enable (Note 1)

This parameter selects whether the discharging function of DC bus voltage is performed or not, when the SS4000 unit is stopped or aborted. When "On" is selected, DC bus voltage will be discharged at stopping the unit. If "OFF" is set, DC bus voltage will not be discharged.

Note 1: This parameter is available from software version No. 2.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	OFF, On
Default Setting:	On
Parameter Type:	Requiring the password, configurable only while the unit is normal
Refer also to Parameters:	N/A

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should change this parameter. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting power, wait for a while for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

Setting this parameter to "OFF" will not discharge the DC bus voltage when the SS4000 unit is stopped or aborted, resulting in retaining an almost same voltage as the set value of the DC Bus Voltage Reference (U.000) in the DC bus capacitors. Exercise extreme care when this parameter is set to "OFF".

When a GV3000/SE unit is connected to the SS4000 unit as load equipment, set this parameter to "OFF", and perform discharging on the GV3000/SE unit side. In this case, the discharging time is determined by the GV3000/SE unit.

F.018 Version Information

This parameter displays the software version number.

Parameter Range:	N/A
Default Setting:	N/A
Parameter Type:	Read only
Refer also to Parameters:	N/A

F.019 Selection of Wiring Error (LE) Detecting Function (Note 1)

This parameter selects whether detecting function of wiring error (LE) during operation is used or not. When "On" is selected, existence of wiring error will be verified when operation is started. If "OFF" is selected, verification of existence of wiring error will no be performed.

Note 1: This parameter is available from software version No. 3.00 (to be shown on the parameter F.018) or later only.

Parameter Range:	OFF, On
Default Setting:	On
Parameter Type:	Requiring the password, configurable only while the unit is normal and stops.
Refer also to Parameters:	N/A

CHAPTER 8

Displaying Error Codes and Description of Warning Buzzer

This chapter describes contents of error codes, warning buzzer and how to correct problems.

When an error occurs in the SS4000 unit, an error code corresponding to the error is shown on the display. The error codes are two- or three-letter codes flashing on the display.

When an error occurs while the unit stops, the precharge operation and the PWM switching cannot be started by entering the RUN sequence signal, and thus, operation cannot be started, until the error has been reset.

When an error occurs during operation, the PWM switching will stop and the discharge operation will start, and the unit will stop. In this case, the unit cannot be started until the error has been reset.

For resetting an error, press the RST key or enter the RESET sequence signal after removing the cause of the error. In either case, the error cannot be reset when the RUN sequence signal has been entered.

If multiple errors occurred at a time, the corresponding error codes will be scrolled flashing one by one.

It is possible to view all the parameters, while an error occurred and the error code is being displayed. But in such a case, any parameters except some special ones cannot be changed. To view a parameter, press the PRG key while an error code is displayed. Pressing the PRG key will display "U.---", indicating the operation panel is changed to program mode.

A maximum of ten error codes can be stored in the error log. The last error that occurred is the first one to appear on the display when accessing the error log. The last error will be identified with the highest number (up to 9).

The first error that occurred will appear as the last one in the error log. The first error will be identified by the number 0.

When viewing the error log, pressing the ▲ key or the ▼ key will scroll the error codes.

The error log will be retained even if power to the unit is lost. If the error log is full, more entries can be added by clearing older entries. If you desire to clear the error log, press the RST key while the error log is displayed.

8.1 Contents of Error Codes and Recovering

The error codes are shown in Tables 8.1 through 8.4. Table 8.1 shows the error codes common to all units regardless of single unit connection or parallel connection of multiple units. Table 8.2 shows the error codes caused by master unit (unit having Regulator Board) regardless of single unit connection or parallel connection of multiple units. Table 8.3 shows the error codes caused by slave unit 1 (slave unit adjacently connected to master unit) in case of parallel connection of multiple units. Table 8.4 shows the error codes caused by slave unit 2 (slave unit adjacently connected to slave unit 1) in case of parallel connection of multiple units.

To reset error codes, first remove the causes of the errors, and then press the RST key or enter the RESET sequence signal. In either case, resetting cannot be performed when the RUN sequence signal has been entered.

Table 8.1 – List of Error Codes Common to All SS4000 Units

Error Code	Error Description	Error Cause	Corrective Action
PrC	Precharge Error	The DC bus voltage did not reach a certain level in precharge even if the precharge/discharge time has elapsed.	Check that the set value of the Precharge/ Discharge Time (F.014) is correct. If no other problem is found, increase the set value.
			Precharge/discharge resistor or its wiring is faulty. Check the resistor and wiring, and remove the cause.
CHr	Precharge/Discharge Overload Error	The precharge/discharge resistor is in overload condition.	Do not perform precharge and discharge for a while.
			Replace the precharge/discharge resistor with one having a larger wattage, and set again the Wattage of Precharge/Discharge Resistor (F.015).
oL	Overload Error	Output current is excessive.	Check that the power rating of the unit is adequate for the input of the load.
			Decrease the input of the load.
AC	AC Input Frequency or High Voltage Error	The AC input power frequency exceeds the base frequency (50 Hz or 60 Hz) by +/–3% or more.	Check the AC input power supply.
		There is large distortion (notches) in AC input power voltage.	
		The AC input power is too high.	Check that the set value of the AC Overvoltage Detection Level (F.009) is adequate. If no other problem is found, increase the set value.

Table 8.1 – List of Error Codes Common to All SS4000 Units (continued)

Error Code	Error Description	Error Cause	Corrective Action
HU	High Bus Voltage	The DC bus voltage is too high.	Check the AC input power voltage.
			Check that the set value of the Voltage Control Proportional Gain (F.005) is adequate.
			Check that the set value of the Bus Overvoltage Detection Level (F.007) is adequate. If no other problem is found, increase the set value.
			The capacity of the AC reactor is too large. Replace it with a reactor having a smaller capacity.
			The load change is too fast. Reduce the load change speed.
LU	Low Bus Voltage Error	The DC bus voltage is too low.	Check the AC input power voltage and the line fuse.
			Check that the set value of the Allowable Time for Instantaneous Power Loss (F.012) is adequate. If no other problem is found, increase the set value.
IPL	Input Phase Loss Error	Phase loss occurred for the AC input power.	Check the AC input power voltage and the line fuse.
		Power loss occurred (The allowable time for instantaneous power loss was exceeded.)	Check that the set value of the Allowable Time for Instantaneous Power Loss (F.012) is adequate. If no other problem is found, increase the set value.
Con	Magnetic Contactor Error	No answer-back signal was received from the main magnetic contactor.	Check the operation of the main magnetic contactor.
			Verify that the answer-back signal of the main magnetic contactor is correctly wired to the sequence input signal terminal.
Fr	Faulty Relay Signal	An error was received from the Power Interface Board (PIFS).	Verify that the connecter to connect the Regulator Board and the Power Interface Board is correctly inserted.

Table 8.2 – List of Error Codes Relating to Mater Units

Error Code	Error Description	Error Cause	Corrective Action
P.U1	Power Module Phase L_1 Error	The Phase L_1 Power Module of the master unit is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
PU.1	Power Module Phase L_2 Error	The Phase L_2 Power Module of the master unit is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
PU1.	Power Module Phase L_3 Error	The Phase L_3 Power Module of the master unit is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
FA1	Fan Error	The cooling fan(s) of the master unit and/or the AC reactor is (are) defective. The AC reactor is overheated. (1)	Check the wiring of the cooling fans for the master unit and the AC reactor.
			Verify that no foreign material is caught in the cooling fans for the master unit and the AC reactor.
			If the error occurs intermittently, contact Reliance Electric or replace the cooling fan or the Power Interface Board (PIFS).
LE1	Line Connect Error	The phases (L_1, L_2 and L_3) of the AC input power of the master unit do not match with those of the control power.	Make the phases (L_1, L_2 and L_3) of the AC main power same as those of the control power.
PS1	Power Supply Board Error	The Power Interface Board (PIFS) of the master unit is faulty.	If the error occurs intermittently, contact Reliance Electric or replace the Power Interface Board (PIFS).

(1) This is applicable only to Model SS441B, SS441BP, SS4265 and SS4265P units.

Table 8.3 – List of Error Codes Relating to Slave Units 1

Error Code	Error Description	Error Cause	Corrective Action
P.U2	Power Module Phase L_1 Error	The Phase L_1 Power Module of the slave unit 1 is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
PU.2	Power Module Phase L_2 Error	The Phase L_2 Power Module of the slave unit 1 is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
PU2.	Power Module Phase L_3 Error	The Phase L_3 Power Module of the slave unit 1 is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
FA2	Fan Error	The cooling fan(s) of the slave unit 1 and/or the AC reactor is (are) defective. The AC reactor is overheated. (1)	Check the wiring of the cooling fans for the slave unit 1 and the AC reactor.
			Verify that no foreign material is caught in the cooling fans for the slave unit 1 and the AC reactor.
			If the error occurs intermittently, contact Reliance Electric or replace the cooling fan or the Power Interface Board (PIFS).
LE2	Line Connect Error	The phases (L_1, L_2 and L_3) of the AC input power of the slave unit 1 do not match with those of the control power.	Make the phases (L_1, L_2 and L_3) of the AC main power same as those of the control power.
PS2	Power Supply Board Error	The Power Interface Board (PIFS) of the slave unit 1 is faulty.	If the error occurs intermittently, contact Reliance Electric or replace the Power Interface Board (PIFS).

(1) This is applicable only to Model SS441B, SS441BP, SS4265 and SS4265P units.

Table 8.4 – List of Error Codes Relating to Slave Units 2

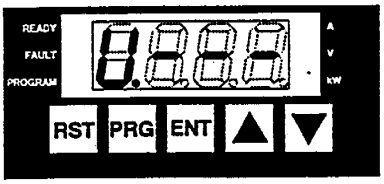
Error Code	Error Description	Error Cause	Corrective Action
P.U3	Power Module Phase L_1 Error	The Phase L_1 Power Module of the slave unit 2 is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
PU.3	Power Module Phase L_2 Error	The Phase L_2 Power Module of the slave unit 2 is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
PU3.	Power Module Phase L_3 Error	The Phase L_3 Power Module of the slave unit 2 is faulty.	Check the wiring of the AC input power.
			Check the ambient temperature, the cooling fan, and the clearances around the unit.
			If the error occurs intermittently, contact Reliance Electric or replace the unit.
FA3	Fan Error	The cooling fan(s) of the slave unit 2 and/or the AC reactor is (are) defective. The AC reactor is overheated. (1)	Check the wiring of the cooling fans for the slave unit 2 and the AC reactor.
			Verify that no foreign material is caught in the cooling fans for the slave unit 2 and the AC reactor.
			If the error occurs intermittently, contact Reliance Electric or replace the cooling fan or the Power Interface Board (PIFS).
LE3	Line Connect Error	The phases (L_1, L_2 and L_3) of the AC input power of the slave unit 2 do not match with those of the control power.	Make the phases (L_1, L_2 and L_3) of the AC main power same as those of the control power.
PS3	Power Supply Board Error	The Power Interface Board (PIFS) of the slave unit 2 is faulty.	If the error occurs intermittently, contact Reliance Electric or replace the Power Interface Board (PIFS).

(1) This is applicable only to Model SS441B, SS441BP, SS4265 and SS4265P units.

8.2 Accessing and Clearing the Entries in the Error Log

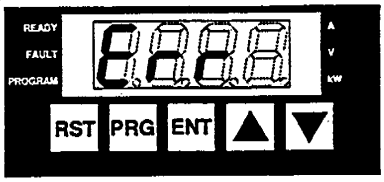
The following procedure shows how to access and clear the error log. Note that you cannot clear a single entry from the error log. The entire log will be cleared simultaneously using this procedure.

Step 1. Press the PRG key.

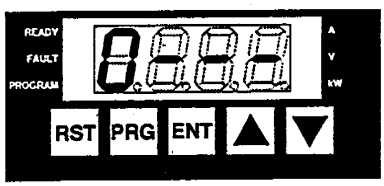


When the operation panel becomes program mode, the User parameter will be displayed and the "PROGRAM" status LED turn ON.

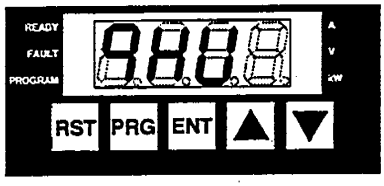
Step 2. Press the ▼ key until the "Err" is displayed.



Step 3. Press the ENT key.

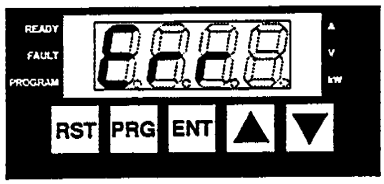


If there is no error that occurred, "0---" will be displayed.



If there is any error that occurred, the last error that occurred will be displayed.

Step 4. When the RST key is pressed while the error log is being displayed, all the entries of the error log will be cleared, and "Err" will be displayed again, indicating that the error log became empty.



8.3 Recovering from Fatal Error

Fatal error codes normally indicate a malfunction of the Regulator Board. In some cases, fatal error codes can be reset by once disconnecting the power supply and reapplying power. But in order to prevent any problem, the Regulator Board must be replaced.

Table 8.5 lists the fatal error codes.

Table 8.5 – List of Fatal Error Codes

Error Code	Error Description	Error Cause	Corrective Action
SCx	Self Check Error	Error was detected during self-diagnostics. "x" in the error code shows an integer value of 1 to 7.	Contact Reliance Electric or replace the Regulator Board.
CHS	Checksum Error	Writing parameter value to EEPROM was not successful.	Set again the Unit Selection (F.001), and restore all the parameters to the default values.
			If this error occurs intermittently, contact Reliance Electric or replace the Regulator Board.
CPU	CPU Error	Unexpected error occurred during CPU internal calculation.	Contact Reliance Electric or replace the Regulator Board.
SYS	System Error	Unexpected error occurred.	Contact Reliance Electric or replace the Regulator Board.

8.4 Warning Buzzer

Model SS441B, SS441BP, SS4265 and SS4265P units are provided with thermo switch so that warning buzzer will alert operators when intake air temperature to the SS4000 unit exeeds about 50 degree C (122 degree F). In such a case, check the ambient temperature and the cooling fans.

CHAPTER 9

Inspecting Trouble and Recovering

This chapter describes how to inspect troubles and take recovery actions.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate or service this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: Do not install or remove any components with power applied to the SS4000 unit. Disconnect and lock out incoming power before attempting such installation or removal. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait for a while for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in destruction of the equipment, severe bodily injury or loss of life.

9.1 Safety Precautions

1. Be sure that the input disconnect is in the correct position, either ON or OFF, depending on the work to be performed.
2. A backup technician must be in line of sight when the work is being performed, to assist in case of emergency.

ATTENTION: Do not use a megger to perform continuity checks in the SS4000 unit. Use high resistance range of a circuit tester for this purpose. Failure to observe these precautions could result in damage to, or destruction of, the unit.

3. Use one hand to hold and connect test probes of multimeter and others.

9.2 Preliminary Review

1. Turn OFF the input power to the SS4000 unit and wait until "POWER" lamp will go OFF.
2. Verify that the DC bus voltage is zero and the DC bus capacitors are completely discharged.

3. Check the following:

   - Check that no terminal is loose and that termination to the connectors is correct.
   - Check that the incoming power voltage is correct.
   - Check that the unit was installed correctly.
   - Verify that all the coils possibly generating electrical noise around the unit, such as relays, solenoid-valves, and magnetic brakes are provided with surge suppressors.

9.3 Troubleshooting Flow Charts

9.3.1 SS4000 Unit Does Not Run

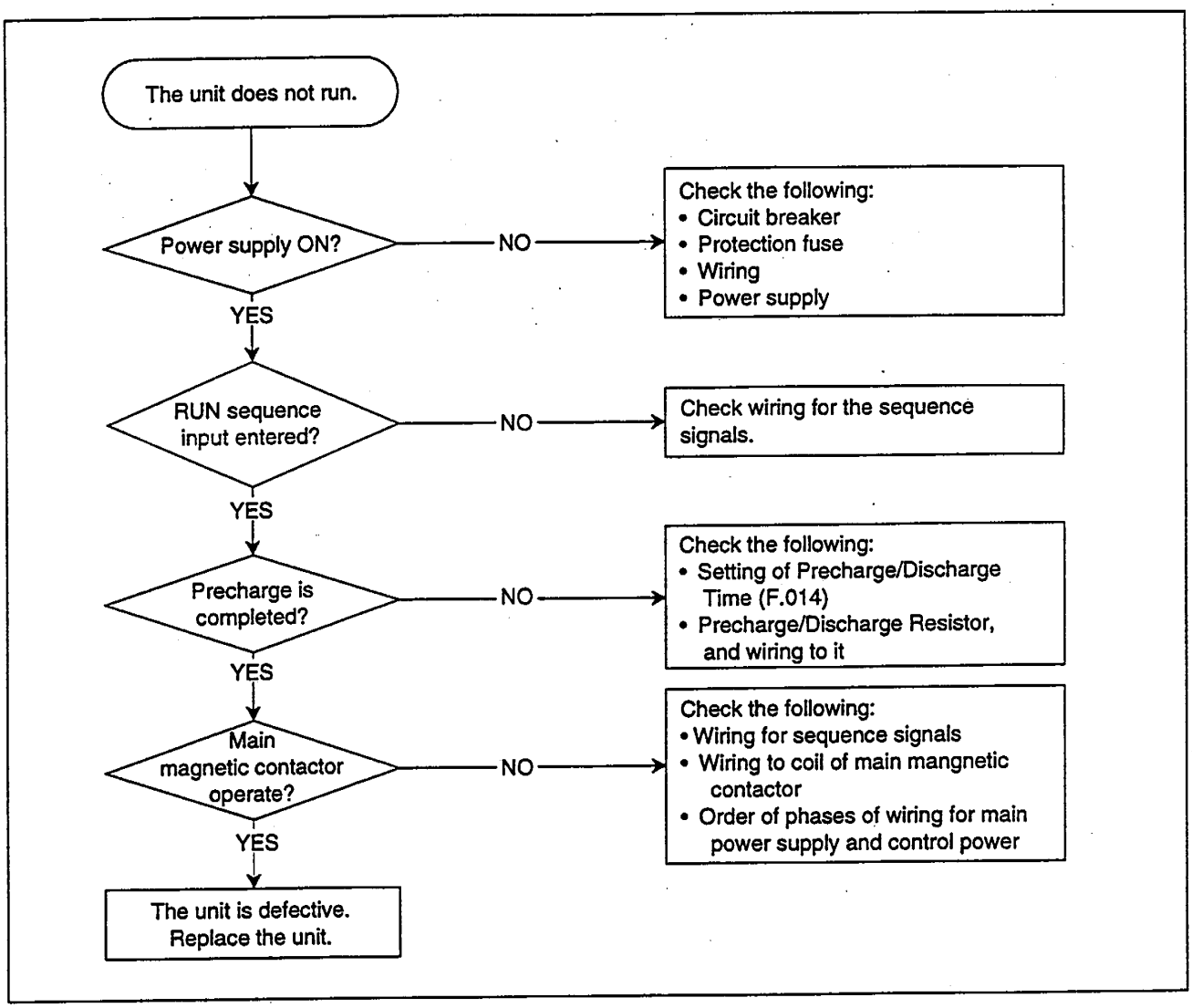


Figure 9.1 – SS4000 Unit Does Not Run

9.3.2 DC Bus Voltage Does Not Go Up

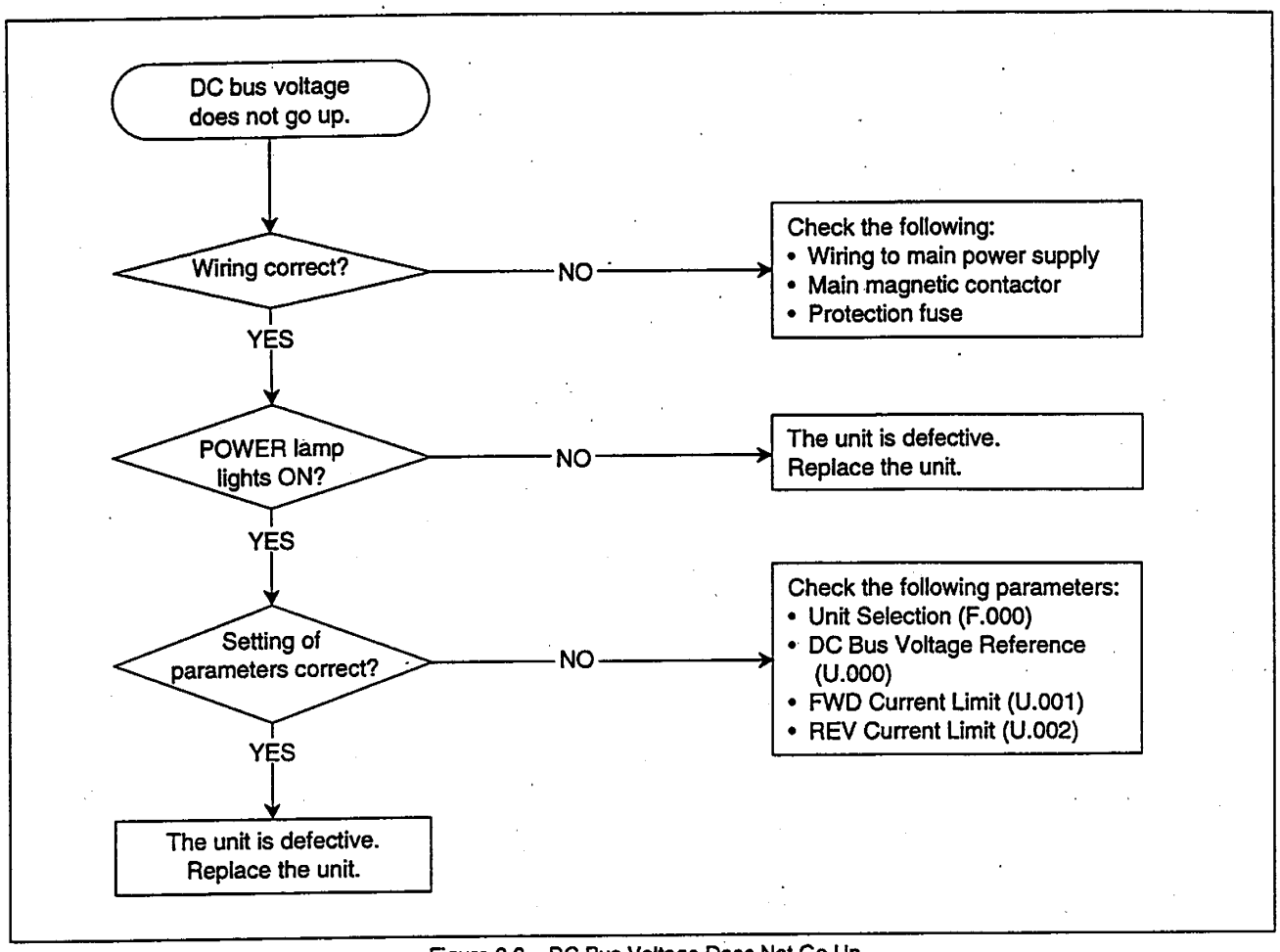


Figure 9.2 – DC Bus Voltage Does Not Go Up

CHAPTER 10
Replacement Parts

This chapter describes the required replacement parts.

Table 10.1 lists the replacement parts for SS4000 units for 460 V, and Table 10.2 shows the replacement parts for the SS4000 units for 230 V. The figures shown in the tables show required quantities of the corresponding parts.

The standards or specifications of the parts in the table might be changed by integration or abolition of parts. If you need spare parts, contact Reliance Electric.

Table 10.1 – Replacement Parts for the SS4000 Unit for 460 V

Part Name	Standards and Specifications	Part Number	Required Quantities					
			SS4415	SS4415P	SS4437	SS4437P	SS441B	SS441BP
Regulator Board BDSR-1	S-B0001	826751	1	0	1	0	1	0
Power Interface Board PIFS-11	S-B0002-1	826752	1	1	1	1	1	1
Driver Board RCPB-1	S-B0003	826754	0	0	1	1	0	0
Driver Board RCPB-2	S-B0008	826755	1	1	0	0	0	0
Base Driver Board BDI-091	S-B5081	826739	0	0	0	0	6	6
Fan Power Supply APS-011	05-03162-52	–	0	0	0	0	1	1
Fuse	500V FA16A 6x32	286040	1	1	1	1	0	0
	500V 50A	–	0	0	0	0	2	2
	500V 3 A	–	0	0	0	0	1	1
Power Module	PM75DSA120	–	3	3	0	0	0	0
	PM150DSA120	536603	0	0	3	3	0	0
	PM600HSA120-18	–	0	0	0	0	6	6
Capacitor	HU42W331MRZ	–	12	12	0	0	0	0
	450LGSN3800M	453783	0	0	2	2	8	8
Cooling Fan	MB-B0041	926024	2	2	0	0	0	0
	MB-B0012	926504	0	0	2	2	0	0
	MADC24Z4SQ	–	0	0	0	0	2	2
Resistor for Precharging and Discharging	MB-B0040	926023	1	1	0	0	0	0
	MB-B0011	926503	0	0	1	1	0	0
Cable for Parallel Connection	MB-B0013	352311	0	1	0	1	0	0
	65-03204-00	–	0	0	0	0	0	1

Table 10.2 – Replacement Parts for the SS4000 Unit for 230 V

Part Name	Standards and Specifications	Part Number	Required Quantities					
			SS4207	SS4207P	SS4218 SS4222	SS4218P SS4222P	SS4265	SS4265P
Regulator Board BDSR-1	S-B0001	826751	1	0	1	0	1	0
Power Interface Board PIFS-12	S-B0002-1	826752	1	1	1	1	1	1
Driver Board RCPB-1	S-B0003	826754	0	0	1	1	0	0
Driver Board RCPB-2	S-B0008	–	1	1	0	0	0	0
Base Driver Board BDI-091	S-B5081	826739	0	0	0	0	6	6
Fan Power Supply APS-012	05-03162-53	–	0	0	0	0	1	1
Fuse	500V FA16A 6x32	286040	1	1	1	1	0	0
	500V 50A	–	0	0	0	0	2	2
	500V 3 A	–	0	0	0	0	1	1
Power Module	PM75DSA120	–	3	3	0	0	0	0
	PM150DSA120	536603	0	0	3	3	0	0
	PM600HSA120-18	–	0	0	0	0	6	6
Capacitor	HU42W331MRZ	–	12	12	0	0	0	0
	450LGSN3800M	453783	0	0	2	2	8	8
Cooling Fan	MB-B0041	926024	2	2	0	0	0	0
	MB-B0012	926504	0	0	2	2	0	0
	MADC24Z4SQ	–	0	0	0	0	2	2
Resistor for Precharging and Discharging	MB-B0040	926023	1	1	0	0	0	0
	MB-B0011	926503	0	0	1	1	0	0
Cable for Parallel Connection	MB-B0013	352311	0	1	0	1	0	0
	65-03204-00	–	0	0	0	0	0	1

Decide the quantities of spare parts in consideration of the number of the connected units.

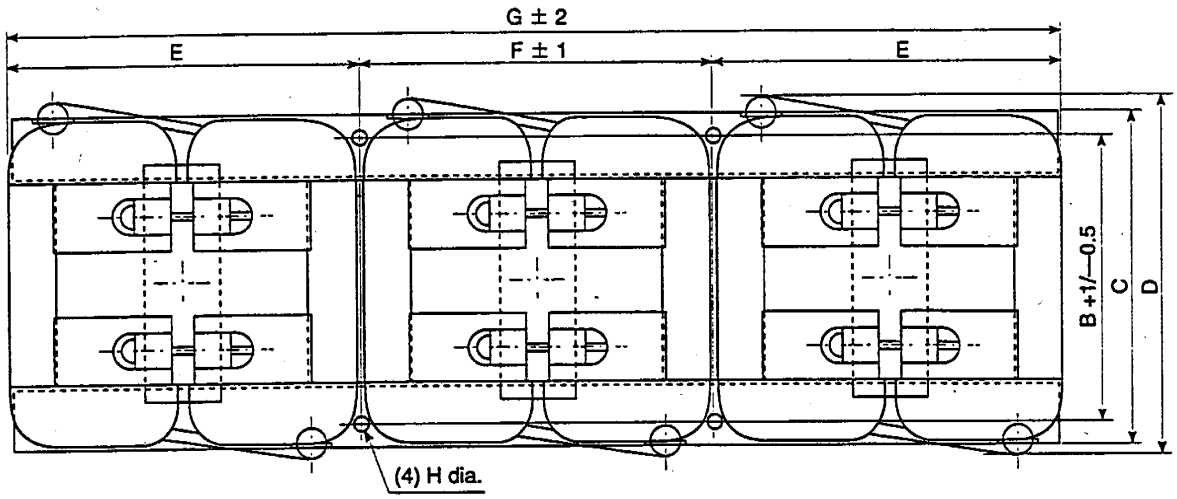
CHAPTER 11

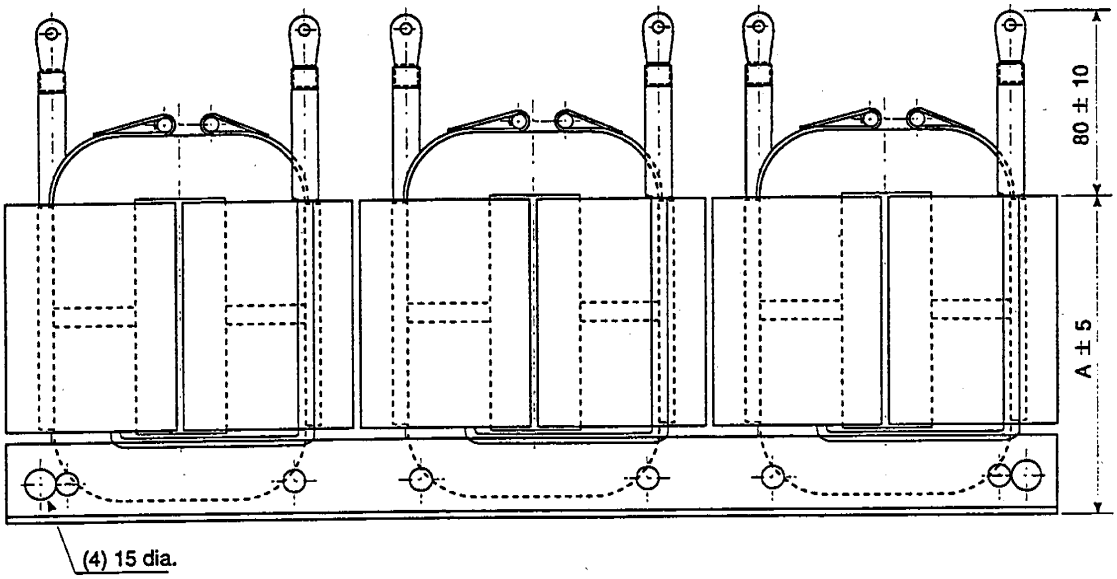
Dimensional Outline Drawings for the Peripheral Devices

This chapter provides dimensional outline drawings of reactors, varistors, harmonic filters and line filters out of the peripheral devices to be connected to the SS4000 unit.

11.1 Outline Drawing of the Reactors

Figure 11.1 shows the dimensional outline drawing of the recommended reactors to be used for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units. The dimensional outline drawing of the ACL units (AC reactor assemblies) for Model SS441B, SS441BP, SS4265 and SS4265P units is illustrated in Figure 11.2.





Model	Part Number	A	B	C	D	E	F	G	H
MT-B0013	261301	140	125	145	Max. 180	155	150	460	9.5
MT-B0014	261302	125	110	130	Max. 160	145	150	440	9.5
MT-B0015	261303	125	105	125	Max. 155	132.5	135	400	7
MT-B0016	261304	127	100	120	Max. 140	112.5	120	345	7

(Unit: Millimeters)

Figure 11.1 – Dimensional Outline Drawing of the Recommended Reactors for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P Units

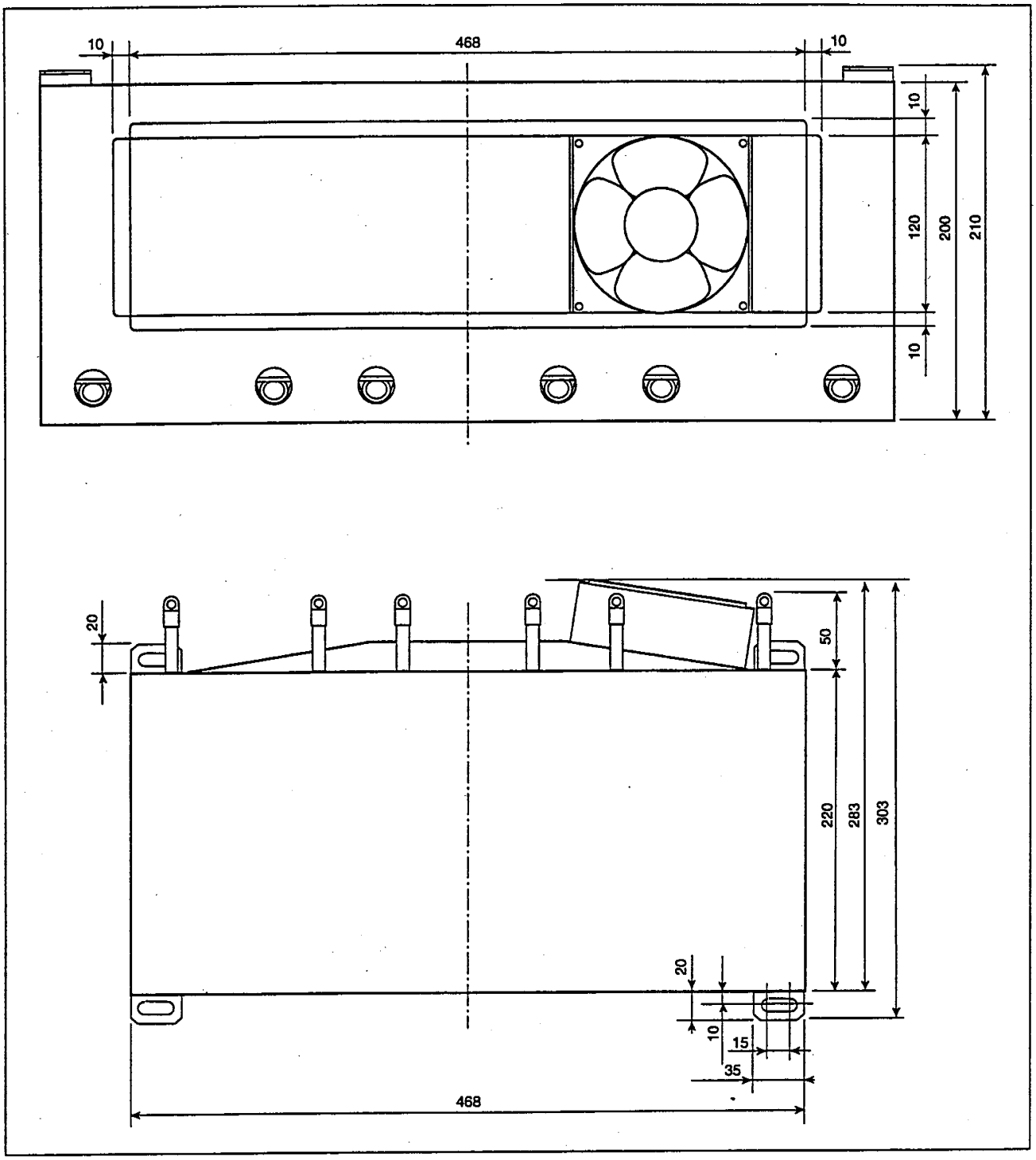
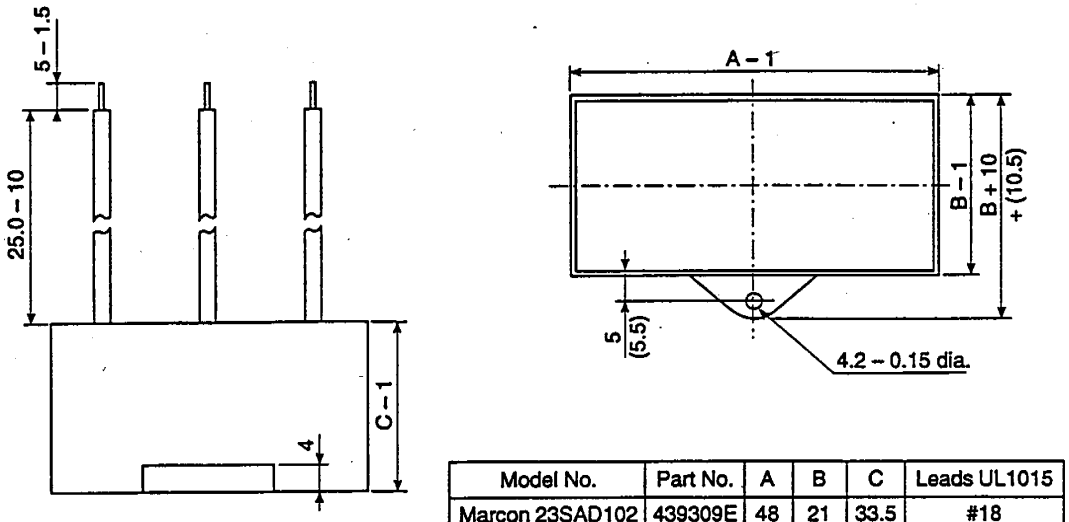


Figure 11.2 – Dimensional Outline Drawing of the Recommended ACL Units (AC Reactor Assemblies) for Model SS441B, SS441BP, SS4265 and SS4265P Units

11.2 Outline Drawing of the Varistors

Figure 11.3 shows the dimensional outline drawing of the recommended varistors to be used for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units. The varistors for Model SS441B, SS441BP, SS4265 and SS4265P units are included in the EM441B EMC filter unit whose dimensions are shown in Figure 11.7.



Model No.	Part No.	A	B	C	Leads UL1015
Marcon 23SAD102	439309E	48	21	33.5	#18
Marcon 23SAD431	439400	48	17.5	29.5	#18

Unit: Millimeters

Figure 11.3 – Dimensional Outline Drawing of the Recommended Varistors for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P Units

11.3 Outline Drawing of the Harmonic Filters

Figure 11.4 shows the dimensional outline drawing of the recommended harmonic filters to be used for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units. The harmonic filters for Model SS441B, SS441BP, SS4265 and SS4265P units are included in the EM4000 EMC filter unit whose dimensions are shown in Figure 11.7.

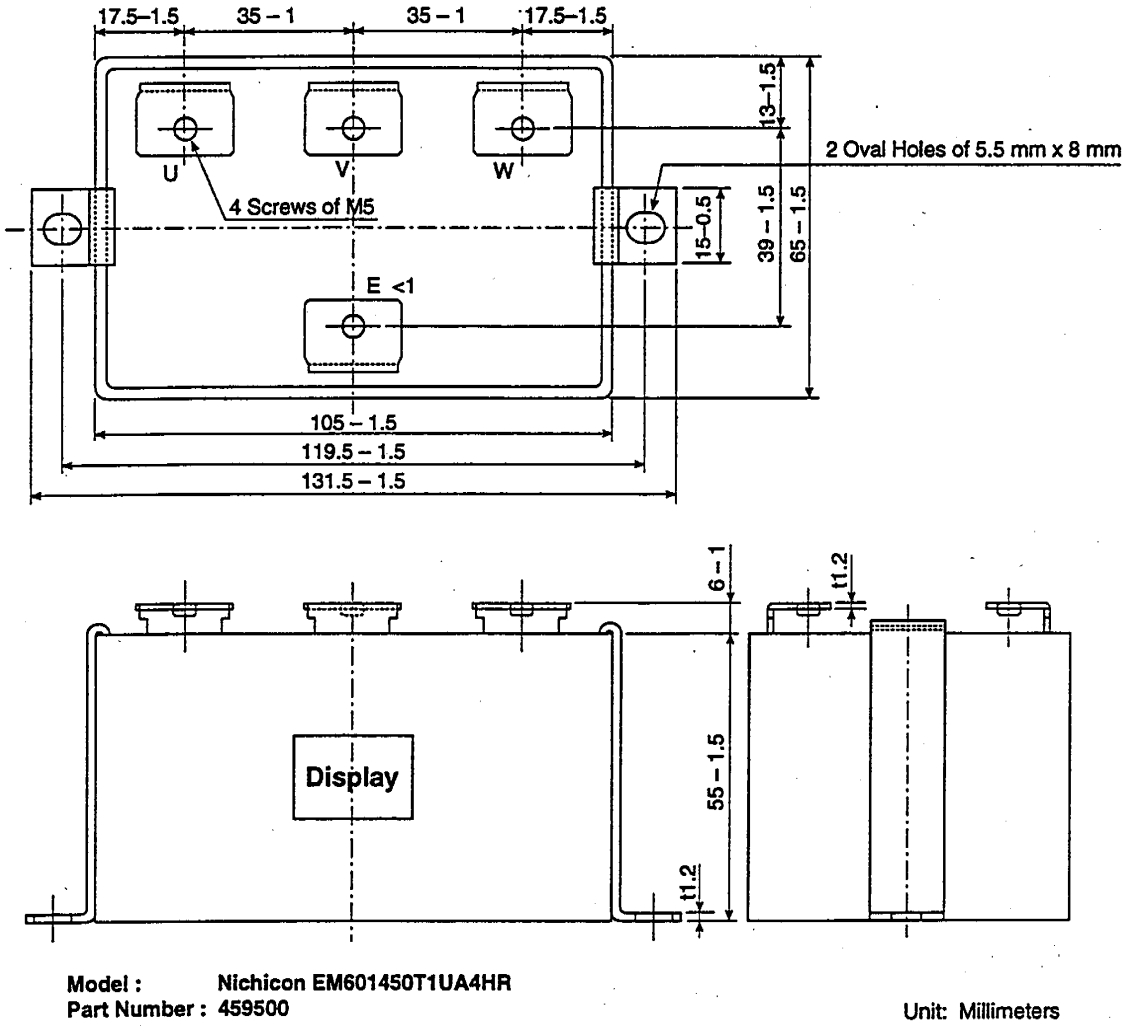
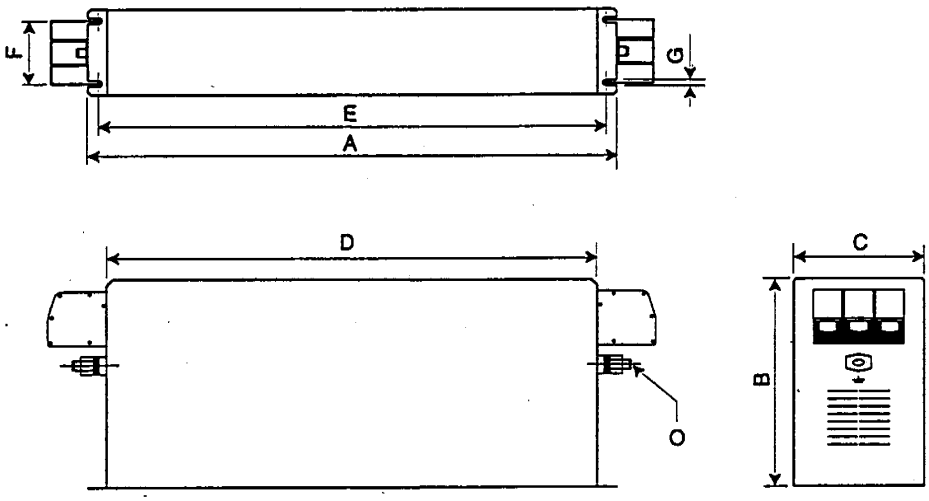


Figure 11.4 – Dimensional Outline Drawing of the Recommended Harmonic Filters for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P Units

11.4 Outline Drawing of the Line Filters

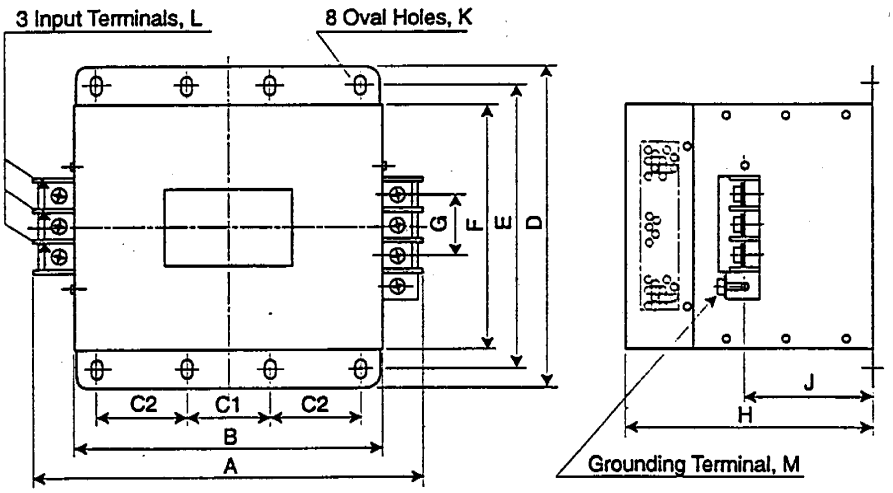
Figures 11.5 and 11.6 show the dimensional outline drawing of the recommended line filters for AC input power to be used for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P units. Figure 11.5 shows Schaffner's products and Figure 11.6 shows Soshin Electric's product. The line filters for Model SS441B, SS441BP, SS4265 and SS4265P units are included in the EM4000 EMC filter unit whose dimensions are shown in Figure 11.7.



Model	A	B	C	D	E	F	G	O
FN258-30-07	335	150+/-1	60	305	320	35	6.5	M5
FN258-42-07	329	185+/-1	70	300	314	45	6.5	M6
FN258-75-34	329	220	80	300	314	55	6.5	M6
FN258-100-35	379+/-1.5	220	90+/-0.8	350+/-1.2	364	65	6.5	M10
FN3100-35-33	335+/-1	150+/-1	60+/-0.6	305+/-1	320	35	6.5	M5
FN3100-80-35	379	220	90	350	364	65	6.5	M10

(Unit: Millimeters)

Figure 11.5 – Dimensional Outline Drawing of the Recommended Line Filters of Schaffner for AC Input Power for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P Units



Model	A	B	C1	C2	D	E	F
HF3080C-TOA	405+/-5	350+/-2	100+/-1	100+/1	220+/-2	200+/-1	180+/-2
HF3030C-TMA	260	210	85	-	155	140	125

Model	G	H	J	K	L	M
HF3080C-TOA	56+/-1	210+/-2	135+/-2	4.25 mm R x 12 mm long	M8	M6
HF3030C-TMA	44	140	70	3.25 mm R x 8 mm long	M5	M4

(Unit: Millimeters)

Figure 11.6 – Dimensional Outline Drawing of the Recommended Line Filter of Soshin Electric for AC Input Power for Model SS4415, SS4415P, SS4437, SS4437P, SS4207, SS4207P, SS4218, SS4218P, SS4222 and SS4222P Units

11.5 EM4000 EMC Filter Unit for Model SS441B, SS441BP, SS4265 and SS4265P Units

Figure 11.7 shows the outline dimensions of the EM4000 EMC filter units for Model SS441B, SS441BP, SS4265 and SS4265P units. The following two models of EM4000 EMC filter units are available: Model EM441B for Model SS441B and SS441BP units and Model EM4265 for Model SS4265 and SS4265P units. The EM4000 unit include the varistor, magnetic contactor, harmonic filter, line filter, grounding capacitor, fan and MC interface card and cable assembly for these SS4000 units. The connection diagram of the EM4000 EMC filter unit is shown in Figure 11.7.

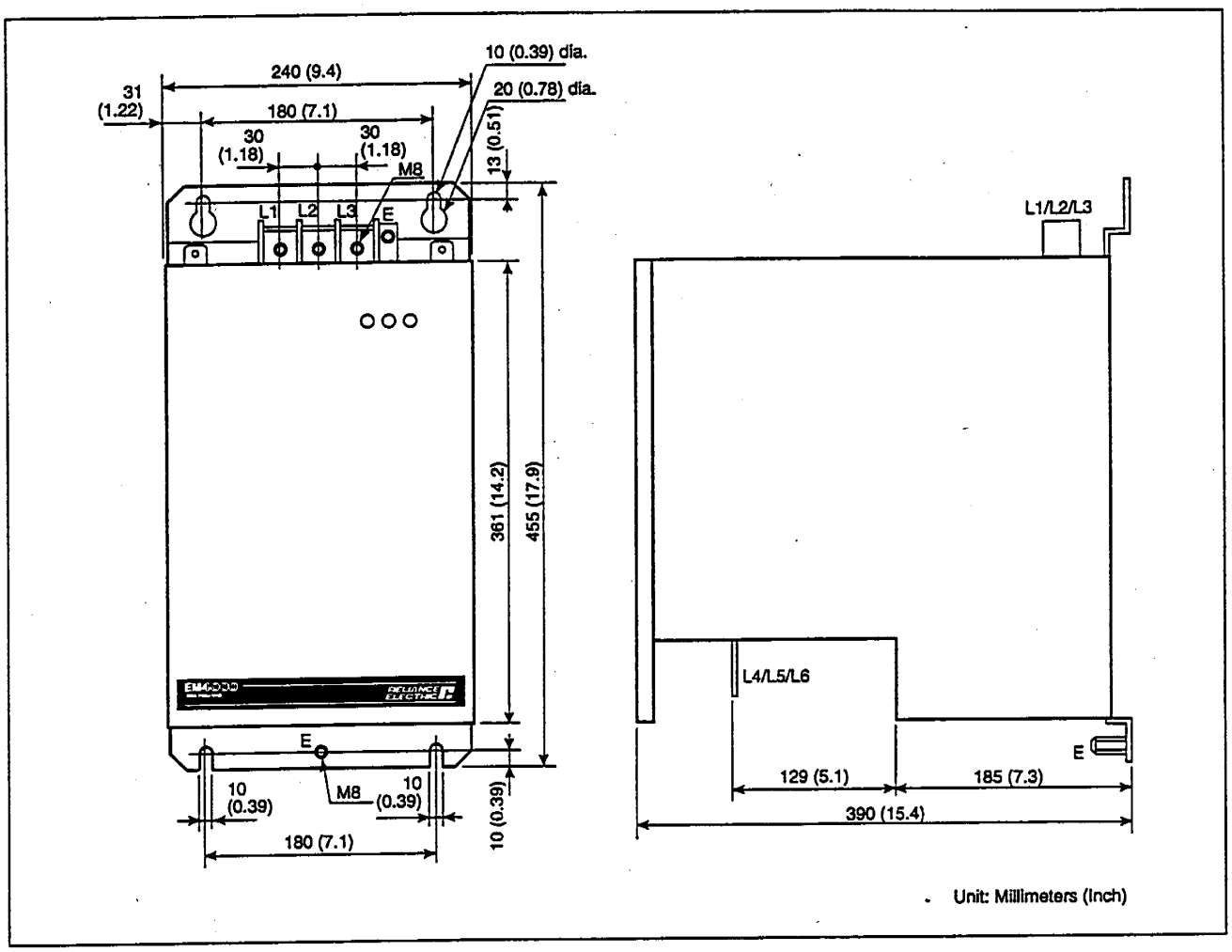


Figure 11.7 – Dimensional Outline Drawing of Model EM441B and EM4265 EMC Filter Units

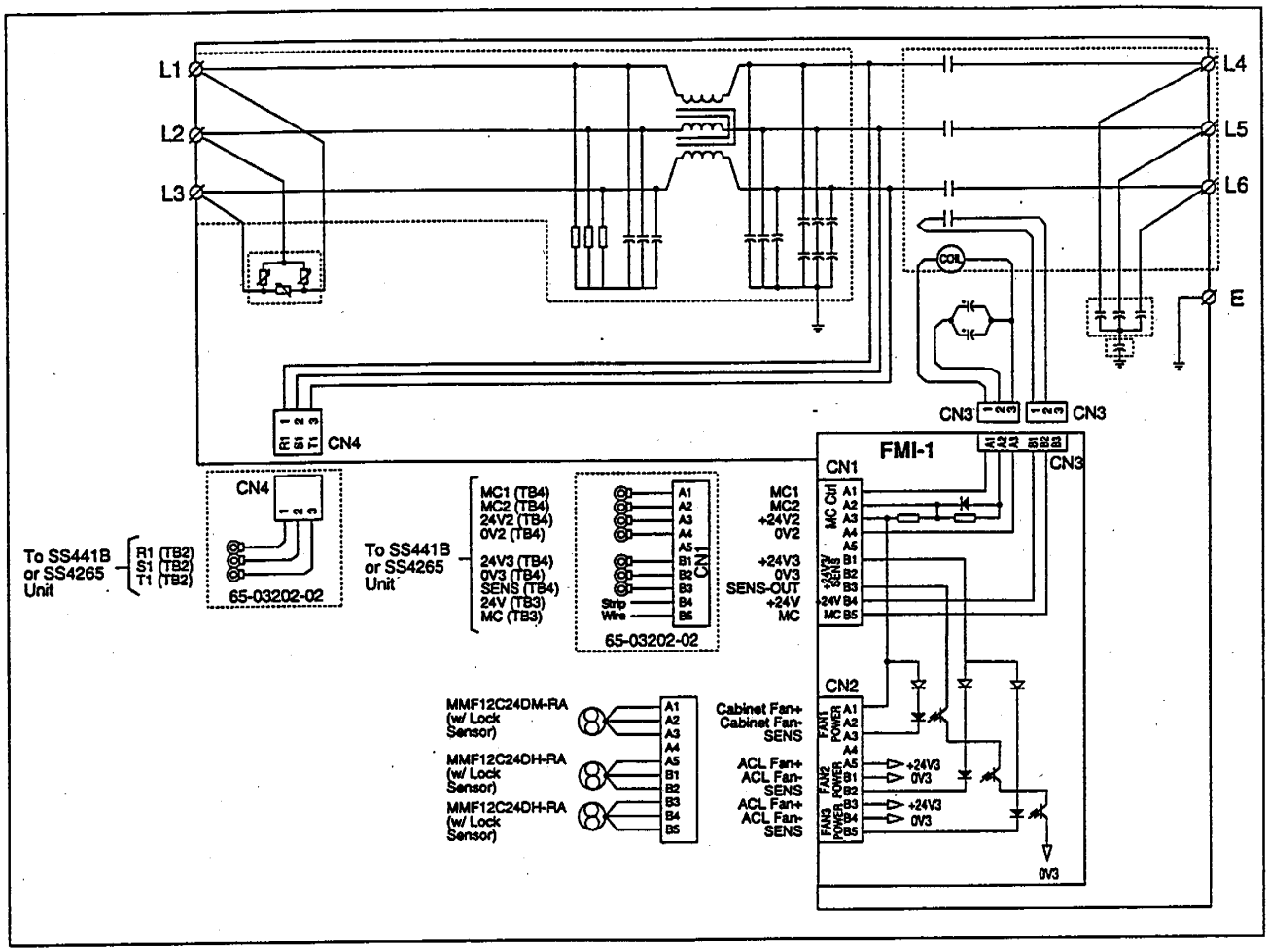


Figure 11.8 – Connection Diagram of the Model EM441B and EM4265 EMC Filter Units

11.6 S241B and S2265 Cabinets to Install Model SS441B, SS441BP, SS4265 and SS4265P Units

Model S241B Cabinet is a standard cabinet to install one unit of Model SS441B and SS441BP units, and Model S2265 Cabinet is a standard cabinet to install one unit of Model SS4265 and SS4265P units. The required EM4000 EMC filter unit and ACL unit(s) are also installed in the cabinets. In addition, the main circuit breaker and UL-listed fuses can be included. The following are main specifications of Model S241B and S2265 Cabinets.

- Size: 600 millimeters (23.6 inches) width x 630 millimeters (24.8 inches) depth x 2200 millimeters (86.6 inches) height (See Figure 11.9.)
- Standards: NEMA1 and JIS (UL-listed)
- Power:

Type 1:	For 460 V:	125 kW
	For 230 V:	65 kW
Type 2:	For 460 V:	55 kW
	For 230 V:	30 kW

- Environment Conditions:
  - Ambient Temperature: In use: –10 to 40 degree C (14 to 104 degree F)
    Storing: –40 to 65 degree C (-40 to 149 degree F)
  - Humidity: 5 to 95% (non-condensation)
  - Elevation: Lower than 1000 meters (3300 feet) above see level
  - Vibration: Less than 1 G (25 Hz)
  - Shock : Less than 2 G

Figure 11.9 shows the outline dimensions of Model S241B and S2265 Cabinets.

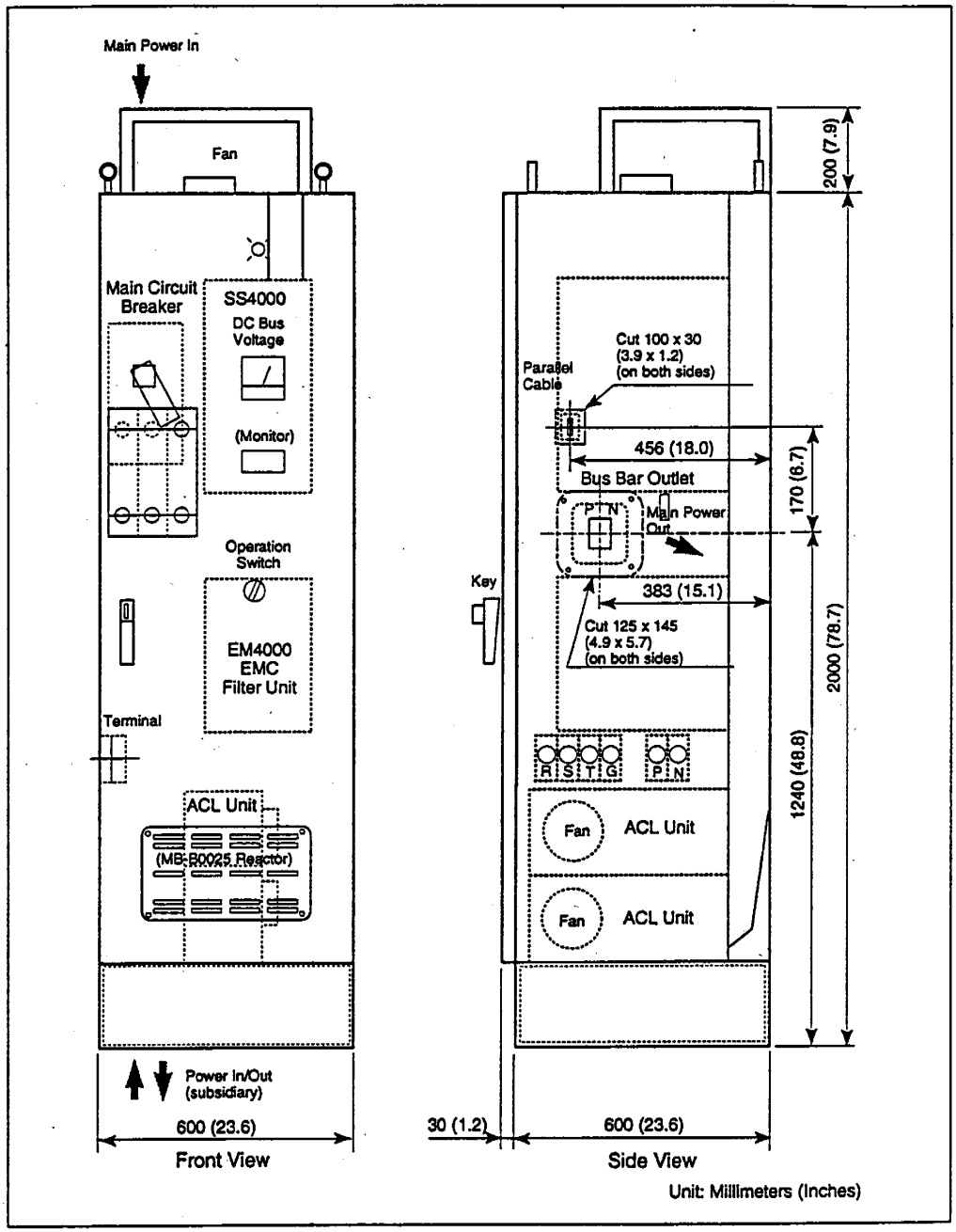


Figure 11.9 – Dimensional Outline Drawing of Model S241B and S2265 Cabinets

APPENDIX A

Techanical Specifications

A.1 Specifications of the SS4000 Units for 460 V

Voltage Class		15 KW Unit for 460 V			37 KW Unit for 460 V			125 KW Unit for 460 V		
Number of Units Connected in Parallel		Single Unit	2 Units in Parallel	3 Units in Parallel	Single Unit	2 Units in Parallel	3 Units in Parallel	Single Unit	2 Units in Parallel	3 Units in Parallel
Model Number		SS4415	SS4415 SS4415P	SS4415 SS4415P SS4415P	SS4437	SS4437 SS4437P	SS4437 SS4437P SS4437P	SS441B	SS441B SS441BP	SS441B SS441BP SS441BP
Capacity of Motor to be Applied (KW)		15	30	45	37	75	110	125	250	375
Input	Rated Capacity of Power Supply (KVA)	20	40	60	45	90	135	152	304	457
	Input Power Factor	0.95 or higher								
	Power Supply	380 to 460 VAC +10/-15%, 50/60 Hz +/- 5%								
	Rated Current (Arms)	28	56	84	65	130	195	190	380	570
	Maximum Current (1 min.) (Arms)	42	84	126	98	196	294	285	570	855
	PWM Carrier Frequency (KHz)	5, 10 (standard), and 15						5 (standard), 10 and 15		
Output	Rated Output Capacity (KVA)	19	38	57	45	90	135	143	286	430
	Voltage (V)	700 (standard)								
	Rated Current (A)	27	54	81	64	128	192	190	380	570
	Maximum Current (1 min.) (A)	40.5	81	121.5	96	192	288	285	570	855
Protection Functions		Overcurrent, overload, overvoltage, low voltage, and phase loss								
Output Signals		RDY signal, FR signal, instantaneous power loss signal, and main magnetic contactor reference contact								
Monitor Display (WITH four character seven-segment LED)		Input current, input power supply voltage, DC bus voltage, power and load ratio								
Input Signals		RUN signal, RESET signal, and answer-back signal of main magnetic contactor								
Environment	Place of Installation	In a control cabinet (kept away from corrosive and dagerous gas)								
	Ambient Temp.	In use: -10 to 50 deg. C (14 to 122 deg. F), Stored: -40 to 65 deg. C (-40 to 149 deg. F)								
	Ambient Himidity	5 to 95% (non-condensation)								
	Elevation	Lower than 1,000 meters (3,300 feet) above sea level								
	Vibration	Less than 1 G (25 Hz)								
	Shock	Less than 2 G								
Weight (kg (lbs))		11.0 (24.3)	11.0 x 2 (24.3 x 2)	110. x 3 (24.3 x 3)	13.5 (29.7)	13.5 x 2 (29.7 x 2)	13.5 x 3 (29.7 x 3)	48.5 (108)	48.5 x 2 (108 x 2)	48.5 x 3 (108 x 3)

Note 1: The above specifications are those for the power supply of 400 Vrms AC (or 200 Vrms AC). If you continuously use the unit under a lower voltage than those stated, derating is required.

2: In case of units connected in parallel, derating is required proportionally to the fluctuation (disperation) of inductances of AC reactors connected to phases.

3: The values of the input power factor are those at the rated current of the units.

4: When you desire to install a unit above 1,000 meters (3,300 feet), derate 4% for every 300 meters (1,000 feet) above 1,000 meters (3,300 feet). If you install a unit above 1,500 meters (5,000 feet), contact Reliance Electric.

A.2 Specifications of the SS4000 Units for 230 V

Voltage Class		7.5 KW Unit for 230 V			18.5 KW Unit for 230 V			22 KW Unit for 230 V			65 KW Unit for 230 V		
Number of Units Connected in Parallel		Single Unit	2 Units in Para.	3 Units in Para.	Single Unit	2 Units in Para.	3 Units in Para.	Single Unit	2 Units in Para.	3 Units in Para.	Single Unit	2 Units in Para.	3 Units in Para.
Model Number		SS4207	SS4207 SS4207P	SS4207 SS4207P SS4207P	SS4218	SS4218 SS4218P	SS4218 SS4218P SS4218P	SS4222	SS4222 SS4222P	SS4222 SS4222P SS4222P	SS4265	SS4265 SS4265P	SS4265 SS4265P SS4265P
Capacity of Motor to be Applied (KW)		7.5	15	22	18.5	37	55	22	44	66	65	130	195
Input	Rated Capacity of Power Supply (KVA)	10	20	30	22.5	45	67.5	29	58	87	76	152	228
	Input Power Factor	0.95 or higher											
	Power Supply	200 to 230 VAC +10/-15%, 50/60 Hz +/- 5%											
	Rated Current (Arms)	28	56	84	65	130	195	79	158	237	190	380	570
	Maximum Current (1 min.) (Arms)	42	84	126	98	196	294	119	238	357	285	570	855
	PWM Carrier Frequency (KHz)	5, 10 (standard), and 15									5 (standard), 10 and 15		
Output	Rated Output Capacity (KVA)	10	20	30	22.5	45	67.5	27	54	81	72	143	215
	Voltage (V)	350 (standard)											
	Rated Current (A)	27	54	81	64	128	192	76	152	228	190	380	570
	Maximum Current (1 min.) (A)	40.5	81	121.5	96	192	288	114	228	342	285	570	855
Protection Functions		Overcurrent, overload, overvoltage, low voltage, and phase loss											
Output Signals		RDY signal, FR signal, instantaneous power loss signal, and main magnetic contactor reference contact											
Monitor Display (with four character seven-segment LED)		Input current, input power supply voltage, DC bus voltage, power and load ratio											
Input Signals		RUN signal, RESET signal, and answer-back signal of main magnetic contactor											
Environment	Place of Installation	In a control cabinet (kept away from corrosive and dagerous gas)											
	Ambient Temp.	In use: -10 to 50 deg. C (14 to 122 deg. F), Stored: -40 to 65 deg. C (-40 to 149 deg. F)											
	Ambient Himidity	5 to 95% (non-condensation)											
	Elevation	Lower than 1,000 meters (3,300 feet) above sea level											
	Vibration	Less than 1 G (25 Hz)											
	Shock	Less than 2 G											
Weight (kg (lbs))		11.0 (24.3)	11.0x2 (24.3x2)	11.0x3 (24.3x3)	13.5 (29.7)	13.5x2 (29.7x2)	13.5x3 (29.7x3)	13.5 (29.7)	13.5x2 (29.7x2)	13.5x3 (29.7x3)	48.5 (108)	48.5x2 (108x2)	48.5x3 (108x3)

Note 1: The above specifications are those for the power supply of 400 Vrms AC (or 200 Vrms AC). If you continuously use the unit under a lower voltage than those stated, derating is required.

2: In case of units connected in parallel, derating is required proportionally to the fluctuation (disperation) of inductances of AC reactors connected to phases.

3: The values of the input power factor are those at the rated current of the units.

4: When you desire to install a unit above 1,000 meters (3,300 feet), derate 4% for every 300 meters (1,000 feet) above 1,000 meters (3,300 feet). If you install a unit above 1,500 meters (5,000 feet), contact Reliance Electric.

APPENDIX B

Default Parameter Settings

B.1 Default Parameter Settings of the SS4000 Units for 460 V Depending on Number of Units Connected in Parallel

Parameter Number	Parameter Name	Unit	Unit Capacity								
			15 KW Unit for 460 V			37 KW Unit for 460 V			125 KW Unit for 460 V		
			Single Unit	2 Units in Parallel	3 Units in Parallel	Single Unit	2 Units in Parallel	3 Units in Parallel	Single Unit	2 Units in Parallel	3 Units in Parallel
U.000	DC Bus Voltage Reference	V	700			700			700		
F.001	Unit Selection		4.015	4.030	4.045	4.037	4.075	4.110	4.125	4.250	4.375
F.002	Rated Current	Amp	28	56	84	65	130	195	190	380	570
F.007	Bus Overvoltage Detection Level	V	800			800			800		
F.008	Bus Low Voltage Detection Level	V	400			400			400		
F.009	AC Overvoltage Detection Level	V	550			550			550		
F.013	AC Reactor Capacity	µH	850			1200			400		
F.014	Precharge/Discharge Time	sec	3.0			3.0			3.0		
F.015	Wattage of Precharge/Discharge Resistor	W	80			120			400		

B.2 Default Parameter Settings of the SS4000 Units for 230 V Depending on Number of Units Connected in Parallel

Parameter Number	Parameter Name	Unit	Unit Capacity											
			7.5 KW Unit for 230 V			18.5 KW Unit for 230 V			22 KW Unit for 230 V			65 KW Unit for 230 V		
			Single Unit	2 Units in Para.	3 Units in Para.	Single Unit	2 Units in Para.	3 Units in Para.	Single Unit	2 Units in Para.	3 Units in Para.	Single Unit	2 Units in Para.	3 Units in Para.
U.000	DC Bus Voltage Reference	V	350			350			350			350		
F.001	Unit Selection		2.007	2.015	2.023	2.018	2.037	2.055	2.022	2.044	2.066	2.065	2.130	2.195
F.002	Rated Current	Amp	28	56	84	65	130	195	79	158	237	190	380	570
F.007	Bus Overvoltage Detection Level	V	400			400			400			400		
F.008	Bus Low Voltage Detection Level	V	200			200			200			200		
F.009	AC Overvoltage Detection Level	V	275			275			275			275		
F.013	AC Reactor Capacity	µH	850			1200			1200			400		
F.014	Precharge/ Discharge Time	sec	6.0			6.0			6.0			6.0		
F.015	Wattage of Precharge/ Discharge Resistor	W	80			120			120			400		

B.3 Default Settings of All Parameters

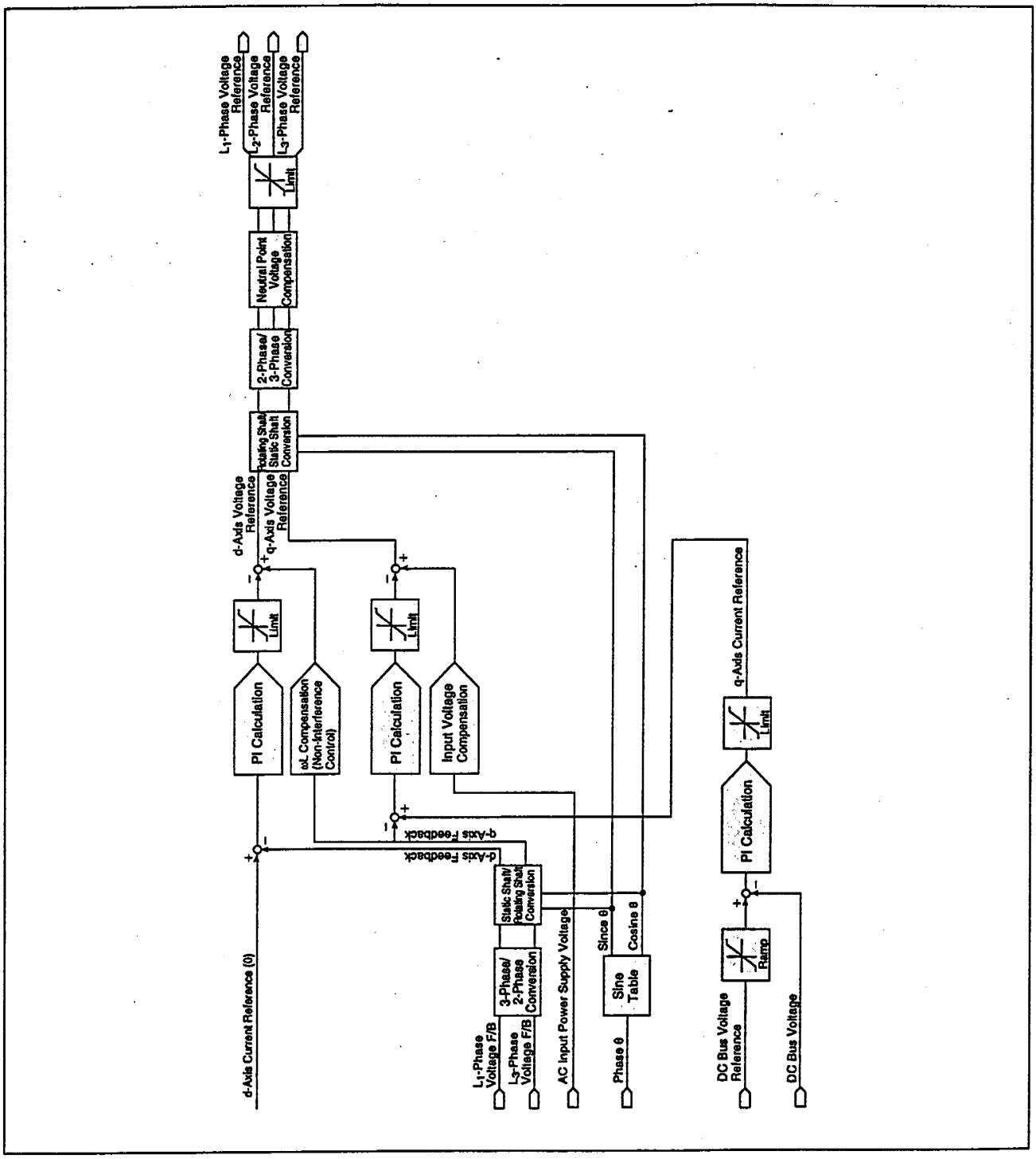
Parameter Number		Parameter Name	Setting Range	Unit	Default Value	User's Setting	
						Setting	Date
User Parameters	U.000	DC Bus Voltage Reference	460 V: 275 to 750 230 V: 275 to 375	V	See Sect. B.1 and B.2.		
	U.001	FWD Current Limit	0 to 150	%	150		
	U.002	REV Current Limit	0 to 150	%	150		
Factory Parameters	F.000	Password	0 to 999		0		
	F.001	Unit Selection	4.015, 4.030, 4.045, 4.037, 4.075, 4.110, 4.125, 4.250, 4.375, 2.007, 2.015, 2.023, 2.018, 2.037, 2.055, 2.022, 2.044, 2.066, 2.065, 2.130, 2.195		See Sect. B.1 and B.2.		
	F.002	Rated Current	4.015: 10 to 35 4.030: 20 to 70 4.045: 30 to 105 4.037: 10 to 70 4.075: 20 to 140 4.110: 30 to 210 4.125: 30 to 215 4.250: 60 to 430 4.375: 90 to 645 2.007: 10 to 35 2.015: 20 to 70 2.023: 30 to 105 2.018: 10 to 70 2.037: 20 to 140 2.055: 30 to 210 2.022: 10 to 80 2.044: 20 to 160 2.066: 30 to 240 2.065: 30 to 250 2.130: 60 to 500 2.195: 90 to 750	A	See Sect. B.1 and B.2.		
	F.003	Current Control Proportional Gain	0.01 to 10.00	Times	1.00		
	F.004	Current Control Integral Gain	1 to 3,000	rad/sec	64		
	F.005	Voltage Control Proportional Gain	0.01 to 30.00	Times	5.00		
	F.006	Voltage Control Integral Gain	1 to 3,000	rad/sec	128		
	F.007	Bus Overvoltage Detection Level	460 V: 325 to 900 230 V: 325 to 450	V	See Sect. B.1 and B.2.		
	F.008	Bus Low Voltage Detection Level	460 V: 200 to 600 230 V: 200 to 300	V	See Sect. B.1 and B.2.		
	F.009	AC Overvoltage Detection Level	460 V: 200 to 550 230 V: 200 to 275	V	See Sect. B.1 and B.2.		
	F.010	Carrier Frequency	5, 10 and 15	kHz	See Sect. A.1 and A.2.		
	F.011	Deadtime	1.5 to 15.0	µsec	6.0		
	F.012	Allowable Time for Instantaneous Power Loss	0.05 to 3.00	sec	0.50		

Parameter Number		Parameter Name	Setting Range	Unit	Default Value	User's Setting	
						Setting	Date
Factory Parameters (continued)	F.013	AC Reactor Capacity	460 V: 100 to 8,000 230 V: 100 to 4,000	µH	See Sect. B.1 and B.2.		
	F.014	Precharge/Discharge Time	0.5 to 30.0	sec	See Sect. B.1 and B.2.		
	F.015	Wattage of Precharge/Discharge Resistor	50 to 2,000	W	See Sect. B.1 and B.2.		
	F.016	DC Bus Voltage Offset (1)	0.900 to 1.100		1.000		
	F.017	Discharge Function Enable (1)	OFF, On		On		
	F.018	Version Information					
	F.019	Selection of Wiring Error (LE) Detecting Function	OFF, On		On		

(1) These parameters are availalbe from software version No. 2.00 or later only.

APPENDIX C

Control Block Diagram



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