

Operations Manual

FC200-000-02.3

FC200 Series Power Converters



ADAPTIVE Power Systems

Worldwide Supplier of Power Conversion Equipment

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FC200 Series Power Converters Limited Warranty

Adaptive Power Systems, Inc. (APS) warrants each unit to be free from defects in material and workmanship. For the period of one (1) year from the date of shipment to the purchaser, APS will either repair or replace, at its sole discretion, any unit returned to the APS factory in Irvine, California. It does not cover damage arising from misuse of the unit or attempted field modifications or repairs. This warranty specifically excludes damage to other equipment connected to this unit.

Upon notice from the purchaser within (30) days of shipment of units found to be defective in material or workmanship, APS will pay all shipping charges for the repair or replacement. If notice is received more than thirty (30) days from shipment, all shipping charges shall be paid by the purchaser. Units returned on debit memos will not be accepted and will be returned without repair.

This warranty is exclusive of all other warranties, expressed or implied.

FC200 Series Service and Spare Parts Limited Warranty

APS warrants repair work to be free from defects in material and workmanship for the period of ninety (90) days from the invoice date. This *Service and Spare Parts Limited Warranty* applies to replacement parts or to subassemblies only. All shipping and packaging charges are the sole responsibility of the buyer. APS will not accept debit memos for returned power sources or for subassemblies. Debit memos will cause return of power sources or assemblies without repair.

This warranty is exclusive of all other warranties, expressed or implied.

DECLARATION OF CONFORMITY

The manufacturer hereby declares that the product

Product Name FC205, FC205P, FC210, FC210P
Serial Number _____

Conforms to the following standards or other normative documents:

SAFETY:

Standard applied IEC 61010 - 1: 2010 (3rd Edition)

EMC:

Standard applied	30 MHz – 230 MHz	40 dB(μV/m) QP at 10m SAC
EN 61326-1:2006	230 MHz – 1000 MHz	47 dB(μV/m) QP at 10m SAC

ELECTROMAGNETIC EMISSIONS:

Radiated Emissions (at Enclosure) EN550111998/A2:2002 Class A	0,15 MHz – 0,5 MHz	79 dB(μV/m) QP 66 dB(μV/m) AV
	0,5 MHz – 5,0 MHz	73 dB(μV/m) QP 60 dB(μV/m) AV
	5 MHz – 30 MHz	73 dB(μV/m) QP
		60 dB(μV/m) AV

Conducted Emissions
(at Mains Terminals)
EN550111998/A2:2002 Class A

VOLTAGE FLUCTUATIONS:

EN 61000-3-3:1995/A1:2001/A2:2005

ELECTROMAGNETIC IMMUNITY:

Electrostatic Discharge (Enclosure Port)	IEC 61000-4-2:1995/A2:2000
RF Electromagnetic Field (Enclosure Port)	IEC 61000-4-3:2002
Electrical Fast Transient/Burst (Input AC Power port; Signal port)	IEC 61000-4-4:2004
Surge (Input AC Power port)	IEC 61000-4-5: 1995/A1:2000
Conducted RF Immunity (Input AC Power port; Signal port)	IEC 61000-4-6: 2003
Power frequency magnetic fields (Enclosure Port)	IEC 61000-4-8:1993/A1:2000
Voltage Dips and Interruptions (Input AC Power port)	IEC 61000-4-11: 2004

Supplemental Information:

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Mark of Compliance

Chapter 1

Introduction

Overview

Chapter 1 contains important information you should read **BEFORE** attempting to install and power-up your FC200 Series Power Converter. The information in this chapter is provided for use by experienced operators. Experienced operators understand the necessity of becoming familiar with, and then observing, life-critical safety and installation issues. Topics in this chapter include:

- Safety Notices
- Warnings
- Cautions
- Preparation for Installation
- Installation Instructions
- Transportation
- Storage



Introduction to the FC200 Power Converter

FC200 Series Power Converters have been designed for long-life trouble-free operation in the production floor or testing environment. The input to FC200 units is commercially available power at fixed voltage and frequency. The output from FC200 units is programmable power at user-controlled voltages and frequencies.

There are several operational modes: (1) front panel manual control; (2) manually programmed tests ; (3) external control of the manually programmed tests(optional).


The FC200 Series of Power Converters are linear technology devices designed to provide frequency and voltage conversion in a controlled environment. Both manually-adjustable and programmable settings are provided. All FC200 Series Power Converters provide 1-phase output power. Different models cover the power range from 500 VA to 1 kVA. All units provide user-controlled 1-phase output power within the frequency range of 45 – 500 Hz.


FC200 Series Power Converters are designed for long-term continuous operation in sheltered (no rain) environments. FC200 units operate reliably over a wide ambient temperature range.

Safety Notices

- Only experienced operators who have both read and understood the information in this manual should attempt to operate the unit.
- The following warnings and cautions herein must be observed at all times.

WARNINGS indicate potentially hazardous situations which, if not avoided, could result in death or serious injury. All warnings throughout this manual will appear as follows:

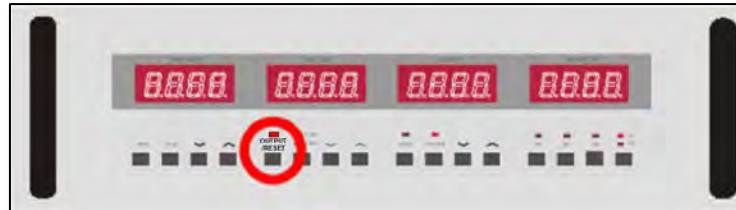
	WARNING
<p>THIS EQUIPMENT produces voltages and currents that can cause electrical shock resulting in serious injury or death. To prevent injury or death, these safety procedures must be strictly observed when operating this equipment</p>	

	WARNING
<p>ALWAYS turn off all AC Input power to the Frequency Converter (POWER DOWN) before connecting or disconnecting any load to the OUTPUT terminals of the unit.</p>	



WARNING

ANY TIME the POWER/RESET LED on the front panel is lit, potentially lethal voltage may be present at the Frequency Converter's Output Terminals.





WARNING

**THIS EQUIPMENT CONTAINS HIGH ENERGY, LOW IMPEDANCE CIRCUITS!!
LETHAL POTENTIALS ARE CONTAINED WITHIN THE CABINET.**

**CARE MUST BE EXERCISED WHEN OPERATING, CALIBRATING, OR SERVICING
THIS EQUIPMENT, IN ORDER TO PREVENT SERIOUS OPERATOR INJURY OR
EQUIPMENT DAMAGE.**

OBSERVE THE FOLLOWING WHEN SERVICE AND MAINTENANCE ARE REQUIRED:

- 1) REMOVE ALL JEWELRY FROM ARMS AND NECK WHEN SERVICING THIS
EQUIPMENT. THIS PREVENTS THE POSSIBILITY OF SHORTING THROUGH THE
JEWELRY AND CAUSING BURNS TO THE OPERATOR.**
- 2) WEAR SAFETY GLASSES WHEN SERVICING THIS EQUIPMENT TO PREVENT EYE
INJURY DUE TO FLYING PARTICLES CAUSED BY ACCIDENTAL SHORT CIRCUIT
CONDITIONS.**
- 3) DO NOT REMOVE ANY PANEL OR COVER WITHOUT FIRST REMOVING THE INPUT
POWER BY OPENING ALL CIRCUIT BREAKERS.**
- 4) SERVICE OTHER THAN REGULARLY SCHEDULED CALIBRATION OR EXTERNAL
CLEANING SHOULD BE REFERRED TO PERSONNEL AUTHORIZED BY THE
FACTORY TO SERVICE THIS EQUIPMENT.**



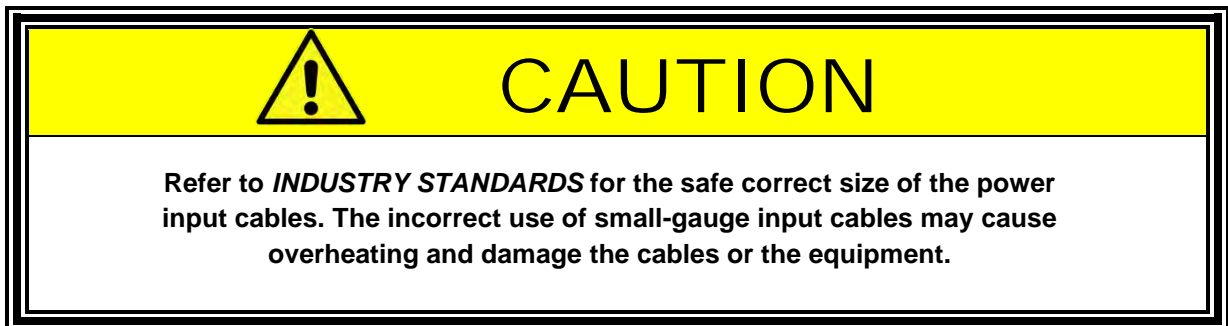
WARNING

**IF THIS EQUIPMENT IS NOT USED IN A MANNER SPECIFIED BY THE MANUFACTURER,
THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED**

CAUTIONS indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It also may be used to alert against unsafe practices. Cautions will appear as shown below. All cautions should be rigorously observed.



To protect the equipment from damage, caution statements are used as follows:



- Before using this AC converter, please read all the safety labels that are attached to this unit.
- Before turning on the input power source to this equipment, please check to make sure that the input voltage selection is correct.

Preparation for Installation

Important Information and Instructions

This section contains instructions for unpacking, inspecting, preparing and storing your FC200 Power Converter.

Unpacking and Inspection

FC200 Power Converters are well packed to provide protection in the normal shipping environment. If the shipping box appears damaged upon receiving, please inspect the power source for scratches or damage. If the product has been damaged, please alert the freight company and contact APS or the distributor. Please keep the original box and packing to assist in determining how the damage occurred.

What to do if Damage has Occurred

If your FC200 Power Converter was damaged in shipment, you must file a damage claim with the freight company. Do not return the product before contacting APS to receive a Returned Merchandise Authorization (RMA) number.

Please retain all the original packing materials. If the FC200 Power Converter must be returned for repair, use the original packing materials for packing.

Installation Instructions

Input Connections

FC200 Power Converter input connections are on the rear of the unit. Please check to make sure all wires are connected correctly and secured. Cooling fans, located at the rear of the unit, provide air circulation for cooling and heat removal. Please leave at least 6 to 8 inches of free space behind a unit to allow adequate airflow.

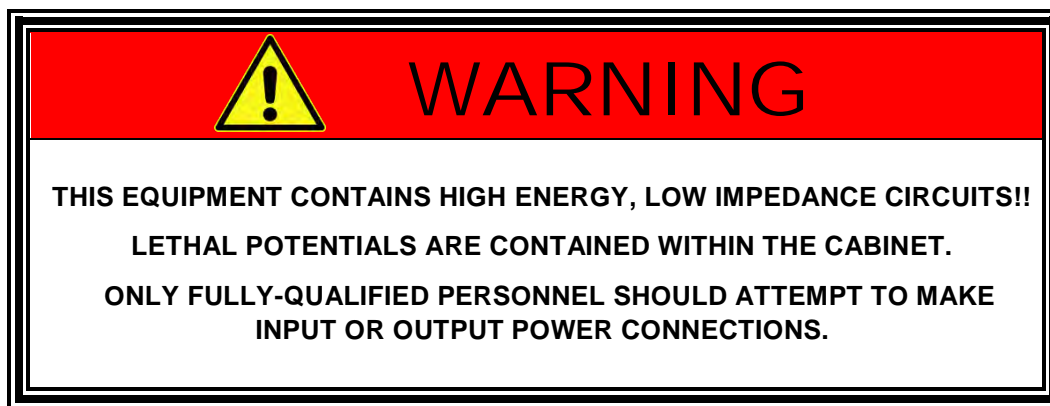
Input Voltage Requirement and Selection

FC200 Series Power Converters have input voltage selector switches on the rear of the unit. You will receive your unit factory set and tested at the voltage specified at the time of order. Please check the unit to verify the voltage is correct.

Operating Environment

FC200 Series Power Converters are designed to operate reliably over a wide range of environmental conditions. Please operate within the following limits:

- Temperature: 0 °C – 40 °C (32 °F – 104 °F)
- Humidity: 20% – 80% (Non-condensing)
- Altitude: Below 2,000 meters (6,500 feet) of elevation



Storage and Transportation

Packing Instructions

Please retain all the original packing materials. If the equipment must be sent back for repair, use the original packing materials for packing. Please contact the APS repair center or factory before returning equipment. Be sure to send all accessories and indicate the symptoms and cause of failure if known.

Other packing Material

If the original packing material is missing, please follow the instructions below:

- Wrap the equipment in PU (polyurethane) foam or Styrofoam.
- The equipment must be protected by shock-resistant material, about 70 to 100mm thick (3 to 4 inches).
- The front panel must be protected with cardboard.
- Secure packing tightly and insert unit into a wooden crate if possible.
- Label the box “fragile” and transport carefully.

Non-Operating Environment

The FC200 Series Frequency Converter can be stored and transported under the following environment:

- Temperature: -40°C - 55°C (-40°F - 131°F)
- Altitude: 7,620 meters (25,000 feet)

Avoid sudden temperature changes. Sudden changes in temperature may result in condensation inside the equipment.

Chapter 2

Specifications

Overview

Chapter 2 summarizes the capabilities and general features of the FC200 family of Power Converters. Functional capabilities are similar for all units. FC200 units convert fixed line voltage at a fixed frequency to user-selected 1-phase output voltages and frequencies. The primary differences between units are size, weight, options installed, and power handling capability.

The Displays and Controls Table in this section provides summary information about the programmable memories and external control. More detailed information about external interface control is found in Chapter 5.

This Chapter includes five summary tables and a surge-current performance graph. The tables summarize different capabilities and features of FC200 Power Converters. The graph illustrates over-current (start-up surge-current) capabilities.

Introduction

FC200 Power Converters are rugged versatile workhorses. They can be used production floor or a laboratory workbench.

Users can select from several modes of operation:

- full-manual operation
- manually programmed operation
- remote PLC operation (Optional)

In keeping with their workhorse nature, all FC200 units feature a 400% start-up surge-current capability. The ability to source initial surge currents prevents the programmed over-current protection from disabling a test.

FC200 Specifications

The following five tables and surge current graph provide detailed information about the entire family of FC200 Series of power converters.

- Input Electrical Specifications
- Output Electrical Specifications
- Displays and Controls
- Mechanical Specifications
- Environmental Specifications
- Surge-Current Rating Graph

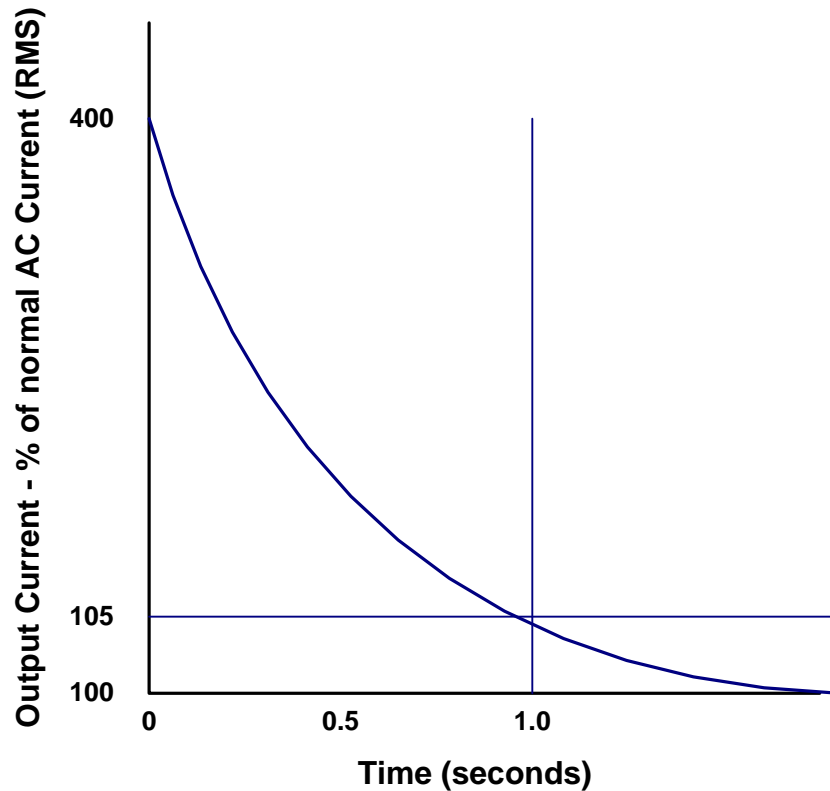
Input Electrical Specifications				
Model		FC205		FC210
Input Phase		1-phase / 2-wire + Ground		
Input Voltage		115/230Vac +/-15%		
Current (max. @ low line)		7.2A – 115V / 3.6A – 230V		14.4A – 115V / 7.2A – 230V
Input Frequency		47 – 63 Hz		
Output Electrical Specifications				
Total Power		500VA		1000VA
Maximum Amps	0 – 150 V		4.2A	8.4A
	0 – 300 V		2.1A	4.2A
Phase		1-phase / 2-wire + Ground		
Voltage (r.m.s.)	Low Range		0 – 150 V	
	High Range		0 – 300 V	
	Resolution		0.1 V	
	Accuracy		± (0.5% of setting+2 counts)	
Frequency	Range		45 – 500 Hz	
	Resolution		0.1 Hz at 45 – 99.9 Hz, 1 Hz at 100 – 500 Hz	
	Accuracy		± 0. 2%	
Current (r.m.s.)	Range	L	0.000 – 3.5 A	0.00 – 35.00 A
		H	3.00 – 35.00 A	30.00 – 350.0 A
	Resolution	L	0.001 A	0.01 A
		H	0.01 A	0.1 A
	Accuracy	L	± (0.5% of reading +5 counts)	± (0.5% of reading +5 counts)
		H	± (0.5% of reading +3 counts)	± (0.5% of reading +3 counts)
Power	Range	L	0.0 – 350.0 W	0.000 – 3.500 kW
		H	300 – 4000 W	3.00 – 40.00 kW
	Resolution	L	0.1 W	0.001 kW
		H	1 W	0.01 kW
	Accuracy	L	± (0.6% of reading + 5 counts)	± (0.6% of reading + 5 counts)
		H	± (0.6% of reading + 5 counts)	± (0.6% of reading + 5 counts)
Power Factor	Range		0.001 – 1.000	
	Resolution		W/VA, Calculated and displayed to three significant digits	
	Accuracy			
Total Harmonic Distortion		≤0.5% (Resistive Load)		
Crest Factor		≥ 4		
Load Regulation		± 0.5%(Resistive Load)		
Protection		Over-Current, Short-Circuit, Over-Temperature		

Displays and Controls	
4 Digital LED meters	Frequency, Voltage, Current, Power or Power Factor (simultaneously)
Memory	3 Memories, 3 Programmable Parameters per Memory for: Voltage, Frequency, Current. Note: Programmable memories can be manually programmed and used manually or in conjunction with the External PLC Interface option.
PLC External Interface optional	OUTPUT ON/OFF, Recall memory 1 through 7
Calibration	Front Panel Calibration (see Chapter 6)

Mechanical Specifications				
Model		FC205	FC210	
Power Rating		500VA	1000VA	
Dimensions mm (In.)	H	89 (3.504)	89 (3.504)	
	D	400 (15.748)	560 (22.047)	
	W	430 (16.929)	430 (16.929)	
Weight	Kg	22	37	
	lbs	48	81	

Environmental Specifications	
Operating Temperature	32 °F – 104 °F (0 °C – 40 °C)
Relative Humidity	< 80 % (Non-condensing)
Altitude	≤ 6,500 feet

Output Surge-Current Capability



Output Surge-Current Rating

Rated Short-Term Overload Current vs. Time

Peak instantaneous current to approximately 400% of nominal AC RMS current is allowed. The actual operating time before thermal shutdown, or before the circuit breaker trips, will always vary. The exact time depends upon the temperature and line conditions.

Chapter 3

Unit Description

Overview

Chapter 3 helps you locate controls and understand their functions. More importantly, the names used throughout this manual to identify controls and functions are defined. You need to know the vocabulary of the FC200 Series to take full advantage of the information in this manual. Information in this chapter is in three sections:

- Location and function of front panel displays and controls
- Cabinet controls and connectors
- Chassis features and details

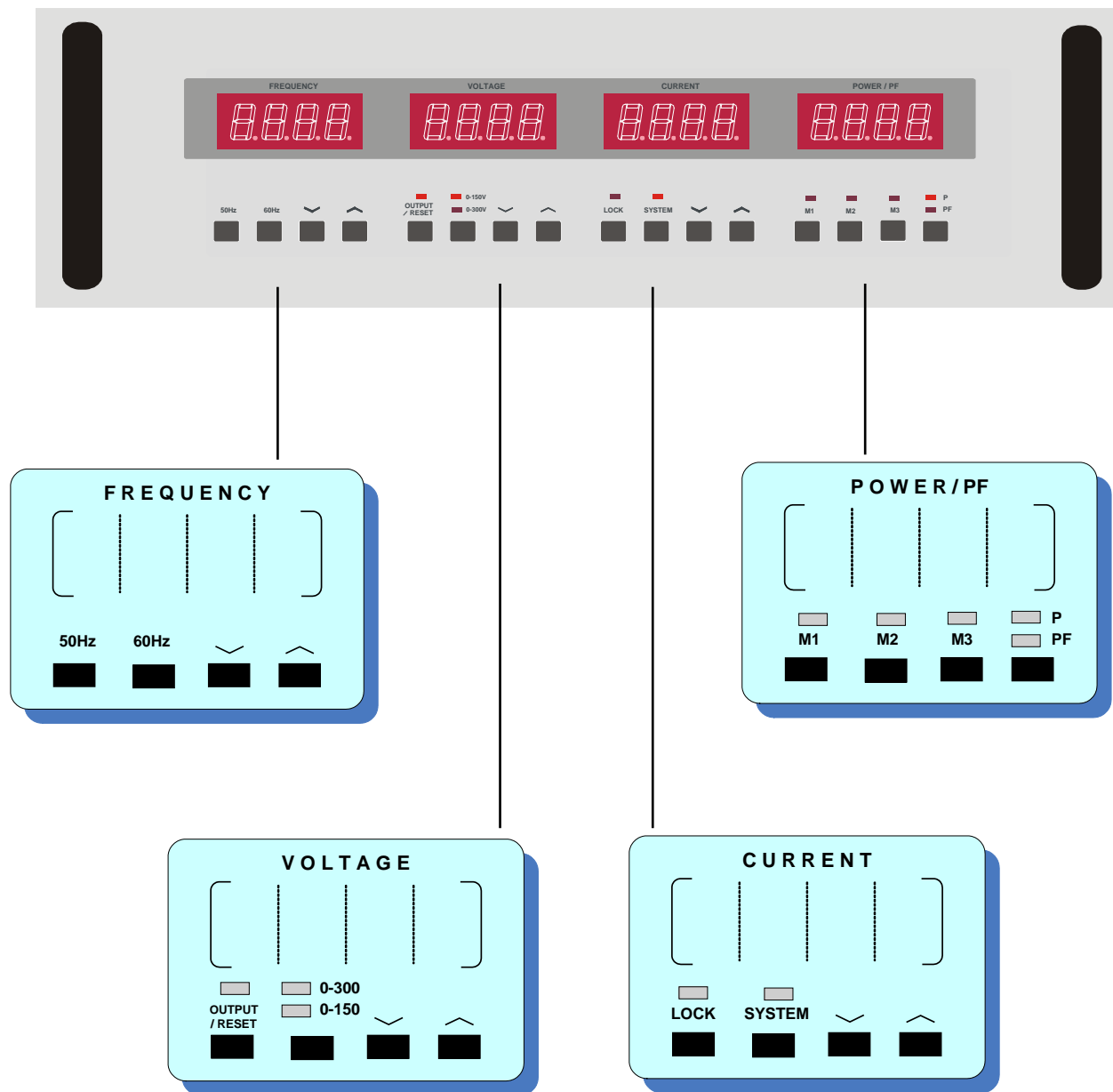
Use the information in this chapter to gain a general understanding of the locations and functionality of indicators, controls, connectors, and mechanical details of your FC200 unit.

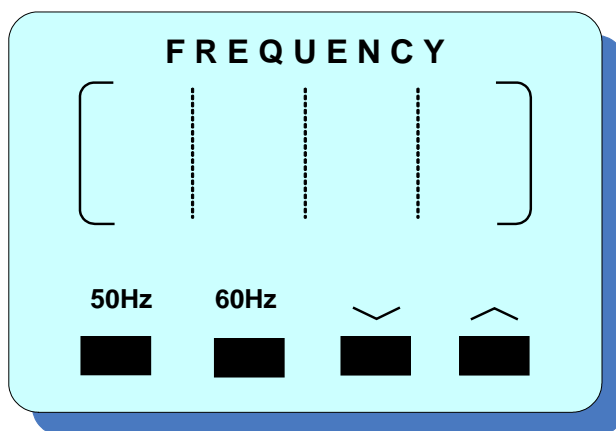
Front Panel Organization

The front panel of your FC200 unit is organized for efficiency of operation. It is laid out to simplify operation in a test environment. The layout features:

- 4 Display Groups
 - Frequency Display
 - Voltage Display
 - Current Display
 - Power / Power Factor Display
- 16 7-segment Display Indicators
- 16 Pushbutton Switches
- 10 LED Indicators

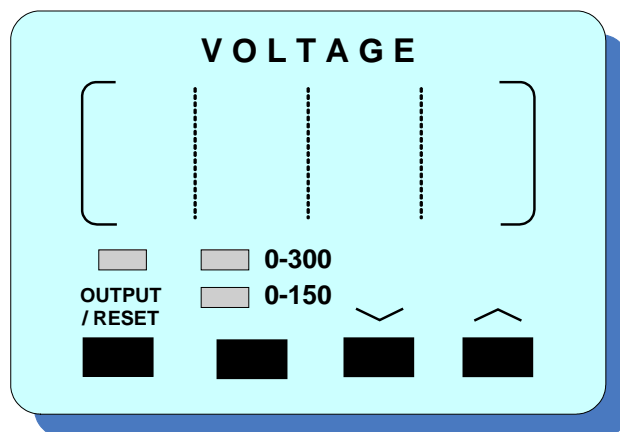
FC200 Front Panel Controls





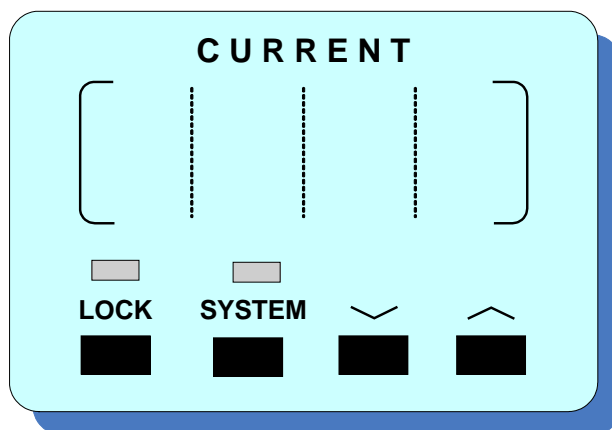
FC200 Frequency Display

Frequency Selection	
FREQUENCY display	Displays the: <ul style="list-style-type: none"> • Selected frequency value when output is OFF. • Frequency value during selection or adjustment. • Output frequency during normal operation. • System parameters during System set-up. • Error messages when an output error occurs.
50 Hz button	Sets the output frequency to 50 Hz.
60 Hz button	Sets the output frequency to 60 Hz.
⌵ button	Steps the output frequency down to a minimum of 45 Hz.
⌶ button	Steps the output frequency up to a maximum of 500 Hz.



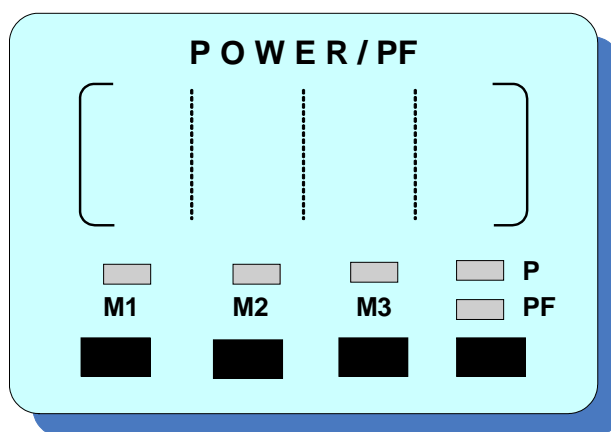
FC200 Voltage Display

Voltage Selection	
VOLTAGE display	Displays the: <ul style="list-style-type: none"> • Selected voltage value when Output is OFF. • Voltage value during voltage adjustment. • Output voltage during normal operation. • System parameters during SYSTEM / PROGRAM set-up.
150V indicator	When ON, the system is in low-voltage range (0 - 150 VAC).
300V indicator	When ON, the system is in high-voltage range (0 - 300 VAC).
OUTPUT / RESET indicator	<ul style="list-style-type: none"> • When ON, the system is in normal operation. • When BLINKING, the system has encountered an error.
RANGE button	Located below the two voltage range indicators; toggles voltage range.
OUTPUT / RESET button	<ul style="list-style-type: none"> • Toggles System Output ON/Off, under normal operation. • Resets the System after an Output error has occurred.
⌞ button	Steps the output voltage down; SYSTEM / PROGRAM parameter select.
⌞ button	Steps the output voltage up; SYSTEM / PROGRAM parameter select.



FC200 Current Display

Current Selection	
CURRENT display	Displays the: <ul style="list-style-type: none"> • Selected current value when Output is OFF. • Current value during current adjustment. • Output current during normal operation. • System parameters during System set-up.
LOCK indicator	When ON, the panel is in a locked state; all buttons except the P/PF buttons are deactivated.
SYSTEM indicator	When ON, the SYSTEM parameter setting mode is active.
LOCK button	Locks all panel controls, except the P/PF button.
SYSTEM button	Enters / exits SYSTEM parameter set-up.
⏏ button	Steps the current / SYSTEM / PROGRAM parameters value down; status select.
⏏ button	Steps the current / SYSTEM / PROGRAM parameters value up; status select.



FC200 Power / PF Display

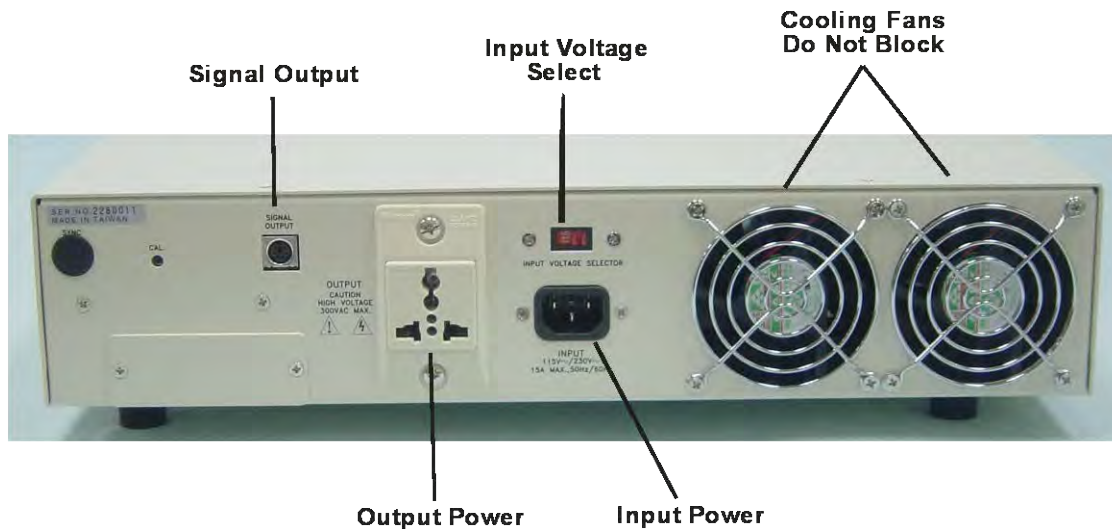
Power / PF Selection	
POWER / PF display	Displays the: <ul style="list-style-type: none"> • Power (in kW) • Power Factor
P indicator	When ON, displays output Power (kW).
PF indicator	When ON, displays Power Factor.
M1 indicator	When On, indicates Program Memory 1 is selected.
M2 indicator	When On, indicates Program Memory 2 is selected.
M3 indicator	When On, indicates Program Memory 3 is selected.
M1 button	Selects Program Memory 1, as the active parameter set.
M2 button	Selects Program Memory 2, as the active parameter set.
M3 button	Selects Program Memory 3, as the active parameter set.

Cabinet FC200 controls and connections are conveniently located for ease of use and accessibility. Included are:

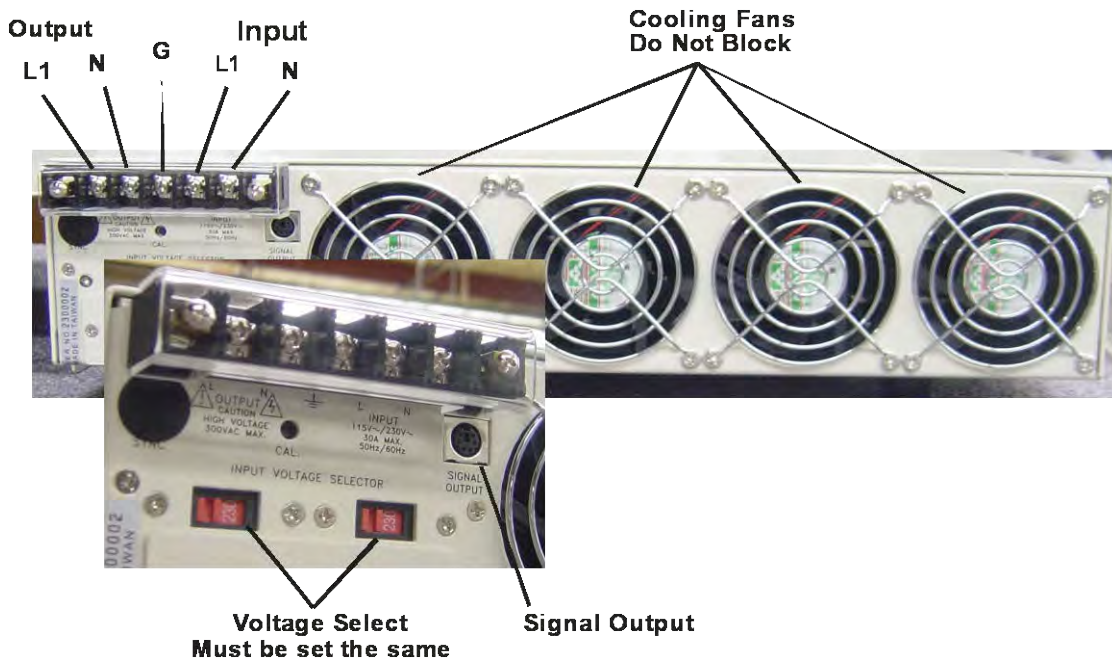
- Power ON/OFF
- PLC Control Port
- Input Power Connection
- Output Power Connection

See the following page for illustrations. The Cabinet Controls Table on page 3-9 provides additional information about each of these items.

FC205 Rear Panel



FC210 Rear Panel



Cabinet Features

CABINET CONTROLS	
Power ON / OFF	At the left side of the front of the unit. This is the main power switch that enables operation.
PLC Remote INPUT (Optional)	On the rear panel, DE-9 connector for external switchable selection and control of three stored programs; typically switched by a PLC.
Input Power Connection	The power input terminals are located on the rear panel. The terminals are labeled "N" neutral; "G" Chassis / Earth Ground; and "L" Line. The FC205 uses an IEC type line cord
PLC Remote Output	Connector for monitoring Output ON and Fail signals
Output Power Connection	The power output terminals are located on the rear panel and a universal socket on the front panel. The terminals are labeled "G" Chassis / Earth Ground; "N" neutral; and "L" Line. The FC205 uses universal sockets both front and rear

CHASSIS DETAILS	
Handles	Handles are provided with each unit and may be mounted to the unit if desired
Fans and Vents	The unit draws air from the sides near the front. Please keep the intake vents on the sides and the fan exhausts on the rear clear of obstructions. Adequate cooling airflow is essential in maintaining proper operation.

Chapter 4

Operating Instructions

Overview

This chapter provides the details to help you be successful in setting up your FC200 Power Converter. Familiarity with material in Chapters 2 and 3 is also necessary. Chapter 2 provides general information about the FC200 Series. Chapter 3 illustrates the locations and functions of the front panel displays.

There are many ways you can operate your unit. Consequently, you should begin getting acquainted with your FC200 Converter by NOT attaching a load. You can first learn to select simple parameters by observing the front panel status displays. After you are comfortable with your ability to enter safe and realistic operating parameters, you should power-down completely before connecting a test load.

The information in this chapter guides you through the process of first turning on the unit and then verifying the configuration.

How Chapter 4 is Organized

Chapter 4 is where you will return when you forget how to use a control or want to verify a command or parameter. This chapter includes many detailed sections. The information begins with an explanation of what to expect when you power-up the unit. The order of information in this chapter is intended to help you learn to operate your FC200. The sections are arranged by four major topics:

- Basic Operation
- System Parameters
- Program Parameters
- Error Messages

Basic Operation

System Information

When the power is turned ON, the front panel momentarily displays:

- The model number, in the VOLTAGE display.
- The installed firmware version number, in the CURRENT display.

Overview of Capabilities

System parameters are identified and explained in this chapter. This overview is provided to give you an idea of capabilities. You must read and study this chapter to understand how to effectively and safely use the FC200.

When the unit is turned ON, but the output power is OFF, you can manually set values for Voltage, Frequency, and Current. When you begin a test (output ON), the selected values will be output to the connected load.

During a test, you can make changes to the values being output. Alternatively, you can lock the front panel controls, so values will not accidentally be changed.

In addition, you can store up to three different sets of voltage, frequency and current parameters in memories M1, M2 or M3. You will be able to manually recall these stored values. Or, you can use an external interface controller (typically a PLC)(optional), to execute the stored programs. During a manual or PLC-managed test, you can switch between the stored programs using M1, M2, or M3.

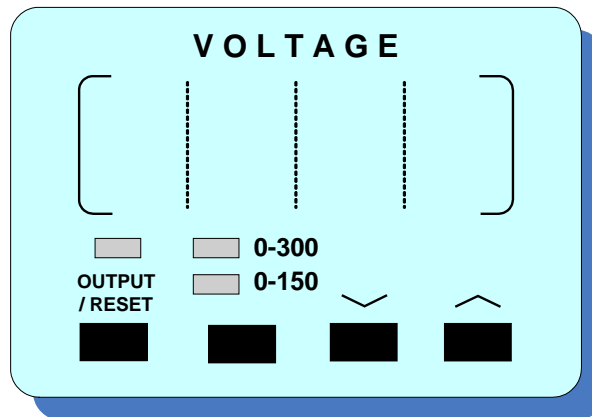
System Parameters: Displays and Controls

To operate the FC200, you should become thoroughly familiar with the front panel displays, controls, and indicators. Once you understand the basics, you will be able to concentrate on testing. Chapter 3 provided summary information about displays and controls. More in-depth information follows, about:

- Voltage (Display) Setting
- Frequency (Display) Setting
- Current (Display) Setting
- Power / PF (Display) Setting

Voltage (Display) Setting

When the system is in RESET (Standby) or the TEST (Output ON) mode, you can adjust the voltage value. There are two ranges: high and low. The low voltage range is 0 – 150V and the high range is 0 – 300V.



Voltage Display \wedge and \vee Buttons

Pressing the \wedge or \vee Voltage Display buttons causes the value to increase/decrease one step every 0.3 seconds. Holding a button "in" causes the rate of change to accelerate. After a voltage adjustment has been completed, and the voltage selection remains unchanged for 2 seconds, the voltage display will flash once. The unit will memorize the current voltage setting. The system then exits the voltage-setting mode.

NOTE: If you have a series of tests, and any of those tests requires a voltage in excess of 150V, you must start your test sequence in the high voltage mode. The unit does not automatically switch from the 150V to the 300V range. Although the unit's rated maximum power is available in either voltage range, the maximum current in the 300V range is one-half that in the 150V range.

Voltage Display High / Low Output Range Button

To switch between the high and low range, press the voltage range button (located beneath the 0 – 150V and 0 – 300V LEDs. In the low range, the voltage can be set between 0 – 150V. Available current capacity is higher, thus maintaining full power capacity. In the high voltage range, 0 – 300V, the current capacity is one-half (see Product Specifications, Chapter 2).

During TEST (Output ON), you can switch between high and low voltage modes. Switching between high/low voltage modes will not affect the voltage setting. However, there will be a brief interruption of the output (about 20 milliseconds), during the change.

If your test is unable to tolerate a 20 millisecond drop-out, you should not exercise this feature.

The system remembers your previously entered limit settings. Thus, the system will not accept a switching command which would direct operation outside the range limits. For example, if you have specified a 200V lower voltage limit, the system will not allow you to switch to the low voltage (150V max) range.

Voltage Display OUTPUT / RESET Button

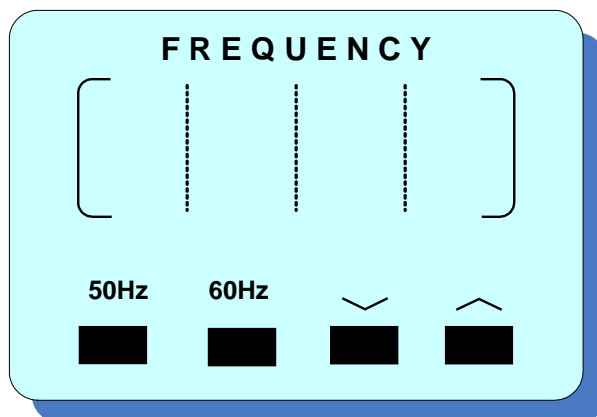
Use the OUTPUT / RESET button to turn the system output ON or OFF. The LED above the pushbutton switch will be illuminated when the system is ON.

CAUTION: Before turning the system output ON, please determine that the load is properly connected, the instrument leads are safely configured, and all personnel are in a safe location.

Note: Manual voltage adjustments will not automatically change the voltage values stored in memory locations M1, M2 or M3. To change stored voltage parameter values, please refer to the Section *Program Memory Setting Procedure*.

Frequency (Display) Setting

When the system is in RESET (Standby) or the TEST (Output ON) mode, you can adjust the output frequency.



Frequency Display ^ and v Buttons

Pressing the ^ or v frequency adjust buttons causes the value to increase/decrease one step every 0.3 seconds. Holding a button "in" forces the rate of change to accelerate. When the frequency selection remains unchanged for two seconds, the frequency display will flash once. The unit will memorize the current frequency setting. The system will then exit the frequency-setting mode. For frequencies between 45 – 99.9 Hz, the adjustment is 0.1 Hz per step. For frequencies between 100 Hz – 500 Hz, the adjustment is 1 Hz per step.

Frequency Display 50Hz and 60Hz Buttons

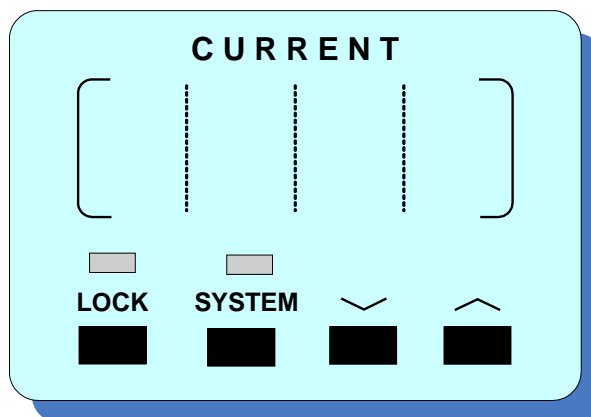
At any time you can press one of these buttons and the frequency will change from its present value to either 50 Hz or 60 Hz (depending on which button you press).

Note: Manual frequency adjustments will not automatically change the frequency values stored in memory locations M1, M2 or M3. To change stored frequency parameter values, please refer to the Section *Program Memory Procedures*.

Note: If your unit shuts down due to a detected Error condition, the FREQUENCY display shows an abbreviation for that error. For example, an over-current condition will result in OCP being displayed. For a listing and discussion of all displayed error conditions, see the Error Messages section of this chapter.

Current Limit (Display) Setting

When the system is in RESET (Standby) or the TEST (Output ON) mode, you can change the Current Limit value.



Current Display ^ and v Buttons

Press the ^ or v buttons to adjust the current limit. When unchanged for two seconds, the current limit adjustment terminates and the system returns to the previous setting interface. When the current limit value is OFF, the system will protect itself by limiting the current according to output capacity (see Specifications).

Current Display LOCK Button

This button locks the front panel control, except for the Power / PF. Use this button to eliminate the possibility of unexpected (accidental) changes.

Current Display SYSTEM Button

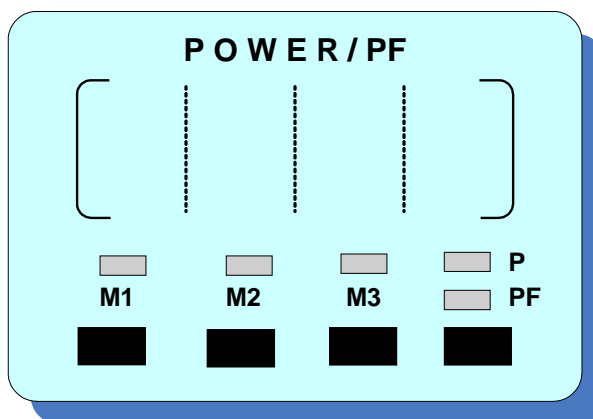
This button enables the setting of SYSTEM parameters. See the Section in this chapter called *System Parameter Settings*.

Note: Manual current adjustments will not automatically change the current limit values stored in memory locations M1, M2 or M3. To change stored parameter values, please refer to the Section *Program Memory Procedures*.

Note: If your unit shuts down due to a detected Over-Current condition, the FREQUENCY display shows OCP.

Power / PF (Display) Setting

When the system is in RESET (Standby) or the TEST (Output ON) mode, you can switch between Power and Power Factor (PF) mode. However, unless the system is in TEST (Output ON) you will not have a displayed value.



Power / PF Display P and PF Buttons

Use the button beneath the P / PF indicators to switch between modes.

Power / PF Display M1, M2, and M3 Buttons

These buttons are used to command the system to store (program) a set of values: voltage, frequency, and current limit. The buttons are also used to recall the stored set of values for output, during a test.

During RESET (Standby), press and holding "down" a button to command the system to store a set of values. When you first depress the button, The related indicator begins to flash. When the flashing stops, release the button and the values will be stored in that memory set.

During TEST (Output ON), press and release a button to command the system to output a set of stored values.

For more detailed information about the M-buttons, see the Section *Program Memory Procedures*.

Operations

Start Output

BEFORE pressing the OUTPUT button (on the Voltage display), check to ensure every setting is correct. Press the OUTPUT button to start the output. The LED (above the OUTPUT / RESET button) will light, indicating normal voltage output.

Stop Output

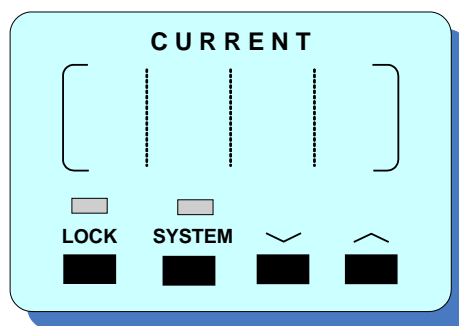
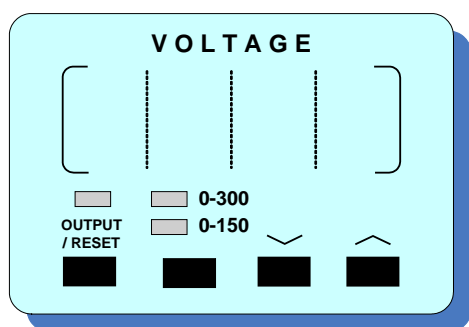
Press the RESET button to stop any test. When in the Output OFF (Standby) mode, the LED above the OUTPUT / RESET button will be OFF.

Stop Alarm

When the system encounters an overload, short-circuit, over-temperature, over-current, or power/power-factor beyond the preset limit, the unit will shut down. Output power will turn off, and an alarm will sound. The OUTPUT / RESET LED will flash.

When an error occurs, an error message will appear on either the Voltage or Current Display (see *Interpreting Error Messages*, page 4-17).

Pressing the OUTPUT / RESET button (on the Voltage display) once, will disable the alarm. Pressing it again, will reset the error message and return the unit to standby status. Pressing the OUTPUT / RESET button a third time will resume output (test).



NOTE: Please determine the cause (source) of any alarm and correct the problem — before pressing OUTPUT — to start the output again.

Lock Button

Pressing the LOCK/LOCAL button (on the CURRENT display) will light the LOCK LED (on the CURRENT display) and disable the other controls, except the P / PF button on the (on the POWER / PF display). Pressing the LOCK/LOCAL button again unlocks the front panel. This procedure is used to avoid accidental adjustments to the system.

External Switching Control(optional)

You can attach a simple external switches, relays, or a PLC, to the 9-pin D-sub connector on the rear panel. External switching can be used to control the output ON/OFF or to switch between any of seven pre-programmed control memories M1 through M7. Chapter 5, External Interface, describes the external switching operations.

System Parameter Settings

The FC200 front panel displays are used to present status, test data, and system parameters. This is the normal mode of display during operation. However, setting system parameters requires a special operator-selected mode (described below). System parameters are persistent. This means the system parameters are in effect regardless of whether you are operating the system manually, running from stored programs, or even powering up after the system has been shut down.

Entering the System Parameter Setting Mode

To enter the System Parameter Setting Mode, begin from the RESET (Standby) mode. Press the SYSTEM button (on the CURRENT display). The SYSTEM LED (above the SYSTEM switch) lights up. System Parameters are shown in the FREQUENCY and VOLTAGE displays. The present status and values are shown in the CURRENT display (see page 4-12 for details).

- Press the VOLTAGE \wedge or \vee buttons to select parameters for adjustment.
- Press the CURRENT \wedge or \vee buttons to set status and values for each item.

A table of parameters and values is shown in the next section. Following the table, you will find a set of detailed instructions for entering each system parameter.

Sequence of System Parameters

The System Parameter items are displayed in the following order:

- PLC Remote(optional)
- Alarm Volume
- Power-Up
- Frequency Hi-Limit
- Frequency Low-Limit
- Voltage Hi-Limit
- Voltage Low-Limit
- Over-Current Foldback

After the last item appears, the system cycles back to the first item on the list. When you have finished entering the System Parameters, press SYSTEM (on the CURRENT Display), to exit the System Parameter Setting mode.

System Parameter Table			
FREQUENCY DISPLAY	VOLTAGE DISPLAY	CURRENT DISPLAY	DESCRIPTION
	<i>PLC</i>	<i>OFF</i>	External Control / PLC Remote ON/OFF
	<i>PLC</i>	<i>On</i>	
<i>AL Ar</i>	<i>11_11</i>	<i>0-9</i>	Alarm Volume
	<i>P-UP</i>	<i>OFF</i>	Power-Up output status
	<i>P-UP</i>	<i>On</i>	
	<i>P-UP</i>	<i>LAST</i>	
<i>FREQ</i>	<i>HI</i>	<i>500.0</i>	Maximum frequency setting limit
<i>FREQ</i>	<i>LO</i>	<i>45.0</i>	Minimum frequency setting limit
<i>VOLT</i>	<i>HI</i>	<i>300.0</i>	Maximum voltage setting limit
<i>VOLT</i>	<i>LO</i>	<i>0.0</i>	Minimum voltage setting limit
<i>OC</i>	<i>FOLD</i>	<i>On</i>	Current Limit output mode, ON / OFF
<i>OC</i>	<i>FOLD</i>	<i>OFF</i>	

Setting System Parameters

Frequency Display	Voltage Display	Current Display
	<i>PLC</i>	<i>On / OFF</i>

PLC Remote(optional). Press the CURRENT \wedge or \vee buttons to toggle the PLC ON / OFF in the current display.

- **OFF** The system is controlled directly from the front panel.
- **ON** The system is controlled by an external controller that is connected to the 9-PIN D-sub PLC connector on the rear panel.

Pressing any button on the front panel will cause the display to show PLC-ON, the buzzer to beep twice, and the display to return to RESET (Standby) mode. The LOCK / LOCAL, SYSTEM, and P ? PF buttons are the only ones that will function when the PLC feature is ON.

NOTE: DO NOT use the PLC port for RS-232 serial or GPIB parallel data.

Frequency Display	Voltage Display	Current Display
<i>ALAr</i>	<i>11.11</i>	<i>0-9</i>

Alarm Volume. Press the CURRENT \wedge or \vee buttons to adjust the volume of the audible alarm

- 0 Minimum volume
- 9 Maximum volume

Frequency Display	Voltage Display	Current Display
	<i>P-UP</i>	<i>On / OFF / LAST</i>

Power Up. Press the CURRENT \wedge or \vee buttons to step the current display between OFF/ON/LAST.

- **OFF** The system will start in standby mode.
- **ON** The system will power up using default output settings.
- **LAST** The system will power up using the output settings that were active when it was last shut down.

Frequency Display	Voltage Display	Current Display
<i>FrEq</i>	<i>HI</i>	<i>500.0</i>

Frequency Hi Limit. Press the CURRENT \wedge or \vee buttons to adjust the frequency limit value in the current display within the available range: 45.0 – 500.0 Hz. This value sets the upper frequency limit that can be adjusted during normal operation. The FrEq HI value must be higher than the FrEq LO value.

Frequency Display	Voltage Display	Current Display
<i>FrEq</i>	<i>LO</i>	<i>45.0</i>

Frequency Lo Limit. Press the CURRENT \wedge or \vee buttons to adjust the frequency limit value in the current display within the available range: 45.0 – 500.0 Hz. This value sets the lower frequency limit that can be adjusted during normal operation. The FrEq LO value must be lower than the FrEq HI value.

Frequency Display	Voltage Display	Current Display
<i>Volt</i>	<i>HI</i>	<i>300.0</i>

Voltage Hi Limit. Press the CURRENT \wedge or \vee buttons to adjust the voltage limit value in the current display within the available range: 0.0 – 300.0 V. This value sets the upper voltage limit that can be adjusted during normal operation. The Volt HI value must be higher than the Volt LO value.

Frequency Display	Voltage Display	Current Display
<i>Volt</i>	<i>LO</i>	<i>0.0</i>

Voltage Lo Limit. Press the CURRENT \wedge or \vee buttons to adjust the voltage limit value in the current display within the available range: 0.0 – 300.0 V. This value sets the lower voltage limit that can be adjusted during normal operation. The Volt LO value must be lower than the Volt HI value.

Frequency Display	Voltage Display	Current Display
<i>OC</i>	<i>Fold</i>	<i>On / OFF</i>

Current Limit Enable. Press the CURRENT \wedge or \vee buttons to toggle between ON/OFF.

- **OFF** The system will operate as a constant voltage power source only. If the load current exceeds the current high limit (A-HI), the unit will shut down.
- **ON** The system will limit the output current to a maximum value set by the current high limit (A-HI). For loads requiring less current than the A-HI value, the unit maintains a steady voltage output as set. If the load impedance is low enough, this function is activated when the load current attempts to exceed the current high limit (A-HI). The output current will then remain constant at the A-HI value and the output voltage will decrease accordingly.

Program Memory Procedures (Programming)

Use the procedures in this section to program the three memories: M1, M2, and M3. Each program has three stored parameters: voltage, frequency, and current limit. Note: The System Parameters (described in the previous section) take precedence over any parameters stored in program memories.

- Output Voltage
- Output Frequency
- Current High Limit

Setting Memory Parameters

- Begin in the RESET (standby) mode. The indicator above the OUTPUT/RESET button on the Voltage Display should be OFF. To set the desired parameter values for voltage, frequency, and current limit, press the \wedge or \vee buttons on the respective displays.
- Check to make sure the values are what you want to store, then
- Press and hold the M-button (1, 2, or 3) for the memory in which you want to store the displayed parameters. The indicator above the selected M-button will flash. When the flashing stops, release the button. The parameter values are now stored and ready for recall. **Note:** Nothing will be stored if you release the button while the indicator is still flashing.
- NOTE: When the PLC External Interface Option is installed there are seven memories available M1~M7. Follow the instructions above using the buttons indicated in the table below for storing parameters in M1~M7.

	M1	M2	M3
M1	X		
M2		X	
M3			X
M4	X	X	
M5		X	X
M6	X		X
M7	X	X	X

Recalling Memory Parameters

- Recall a set of stored values by momentarily pressing and releasing the desired M-buttons.
- When in RESET (Standby), use this recall approach to verify you have stored the values you want; or, you can establish values before you turn the output on.
- Recall a set of stored values when the system is in OUTPUT (Power ON) mode by momentarily pressing and releasing the M-buttons.
- Recall a set of stored values when the system is in OUTPUT (Power ON) mode and PLC is ON, through the external interface (see Chapter 5).


Note: Switching between stored programs during OUTPUT (Power ON) mode will cause a brief interruption of the output. The system first turns OFF the power and then ramps-up to the new voltage value.

Error Messages

Why are there Errors?

Setup mistakes happen. Overloads occur. Systems under test fail. When the APS-1000 unit encounters a fault condition, an error has occurred. The result is:

- The front panel display presents a message.
- The output turns OFF.
- An alarm sounds.
- The “OUTPUT/RESET” LED flashes.



CAUTION

Any error message signifies a fault was detected in the system or in the operating environment. Please carefully record the error message. The error **MUST** be resolved before resuming operation. If you are unable to resolve the error, please contact APS or the distributor for service. Contact information is found on page "v" of this manual.

Clearing an Error

- Press RESET (once) to disable the alarm.
- Make a note of the error message.
- Re-read the CAUTION (above)
- Refer to following **Error Message Table**.
- Refer also to the more detailed explanation of error messages in the Error Message Section.
- Press RESET (again) to clear the error message and return to Standby status.
- If you are unable to resolve the difficulty, please see page "v" of this manual for APS contact information.

Error messages are displayed because of the following conditions:

- OCP Output current exceeded 105% of units maximum-rated value
- Hi-A Output current exceeded the set current high limit value
- OtP System's critical temperature was exceeded
- OVP Output voltage was high
- LVP Output voltage was low
- OPP Output power was high

Error Message Table			
FREQUENCY DISPLAY	VOLTAGE DISPLAY	CURRENT DISPLAY	DESCRIPTION
<i>OCP</i>			Output current exceeded 105% of maximum rated value
<i>HI - A</i>			Output current exceeded set current high-limit value
<i>OtP</i>			System's critical temperature was exceeded
<i>OVP</i>			Output voltage exceeded limit
<i>LVP</i>			Output voltage below limit
<i>OPP</i>			Output power exceeded limit

Interpreting Error Messages

Frequency Display	OCP
----------------------	------------

Output Current Exceeded 105%. If the output current exceeds 105% of the rated output, the FREQUENCY display will show OCP (Over Current Protect); an alarm will sound; the OUTPUT/RESET LED will flash; and the VOLTAGE and CURRENT displays will show the corresponding values at the time of overload.

Frequency Display	HI-A
----------------------	-------------

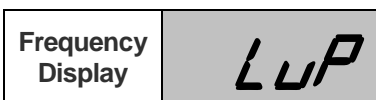
Output Current Exceeded Hi-A Limit. If the output current exceeds the set current high limit value, the FREQUENCY display will show HI-A; an alarm will sound; the OUTPUT/RESET LED will flash; and the VOLTAGE and CURRENT displays will show the corresponding values at the time of the over-current.

Frequency Display	OtP
----------------------	------------

System Critical Temperature Exceeded. If any of the system's critical temperatures are exceeded, the FREQUENCY display will show OtP (Over temperature Protect). This signifies overheating. An alarm will sound; the OUTPUT/RESET LED will flash; and the VOLTAGE and CURRENT displays will show their corresponding values at the time of the over-temperature.

Frequency Display	OVP
----------------------	------------

Output Voltage Limit Exceeded. If the output voltage exceeds the voltage setting by more than 5V on the 0-150V range or 10V on the 0-300V range, the FREQUENCY display will show OVP (Over Voltage Protect); an alarm will sound; the OUTPUT/RESET LED will flash; and the VOLTAGE and CURRENT displays will show the corresponding values at the time of over-voltage.



Output Voltage Below Limit. If the output voltage is lower than the voltage setting by more than 5V on the 0-150V range or 10V on the 0-300V range, the FREQUENCY display will show LVP (Underr Voltage Protect); an alarm will sound; the OUTPUT/RESET LED will flash; and the VOLTAGE and CURRENT displays will show the corresponding values at the time of under-voltage.



Output Power Limit Exceeded. If the output power exceeds 125% of the rated output for 0.3 seconds or 110% of the rated output for 1.0 seconds the FREQUENCY display will show OPP (Over Power Protect); an alarm will sound; the OUTPUT/RESET LED will flash; and the VOLTAGE and CURRENT displays will show the corresponding values at the time of over-power.

Chapter 5

External Interface

Output Signal

Signal Output

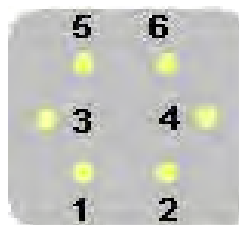
The rear panel connector provides output signals to remotely monitor FAIL, and OUTPUT ON conditions. Below is a listing that indicates what conditions activate each pin. When a terminal becomes active, the relay closes thereby allowing the external voltage to operate an external device.

FAIL	Connect between PIN 3 and PIN 4.
OUTPUT ON	Connect between PIN 5 and PIN 6.

The following describes how the relays operate for each test condition.

OUTPUT ON - The relay contact closes the connection between pin (5) and pin (6) while the output is on. The connection is open when the output is off.

FAIL - The relay contact closes the connection between pin (3) and pin (4) after detecting that the item under test failed any test. The connection is opened when the next test is initiated or the reset function activated.



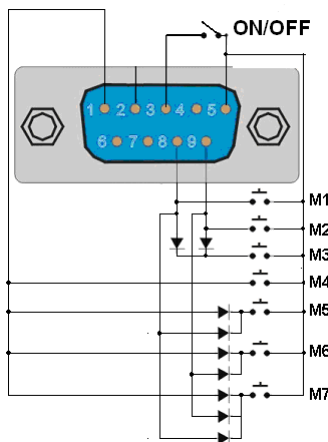
SIGNAL OUTPUT

PLC External Interface option

The PLC external interface option allows remotely located contact closures to select one of seven sets of pre-programmed test parameters. The test parameters are entered in memory sets M1~M7.

Operation of the PLC remote interface does not require a true PLC, as simple switch closures are effective at selecting, starting and stopping stored test programs. However, although simple switches can be used, they require manual operation. The use of a PLC permits external automatic control of the test programs in memories M1~M7.

The proper connections for the PLC external interface are shown below.



	PIN1	Pin9	Pin 8
M1	OFF	OFF	ON
M2	OFF	ON	OFF
M3	OFF	ON	ON
M4	ON	OFF	OFF
M5	ON	OFF	ON
M6	ON	ON	OFF
M7	ON	ON	ON

Signal Input (Option)

OUTPUT ON/OFF

Connect between PIN 3 and PIN5

Memories Input Control can be achieved by using Normally Open (N.O) Momentary Switches and the connections as shown in the table above.

For an example,

Memory 3 (M3) Connect PIN 8 and PIN 9 with a series diode (ex. 1N4148) at each pin and the common point is connected to PIN 5.

The procedure for storing parameters in memories M1~M7 is explained in Program Memory Procedures (Programming) chapter 4 page 4-14.

Chapter 6

System Calibration

Overview

Chapter 6 explains how to calibrate your FC200 Series Power Converter. Although each APS unit is carefully calibrated at the factory prior to shipment, periodic calibration is appropriate. Normal system maintenance requires calibration once a year (See Chapters 7).

Whether you perform calibration prior to a critical test or as a scheduled annual maintenance task, the procedures for calibration are identical.

Note, the values of some calibration parameters are different for different sizes of APS models. This chapter includes tables of all calibration parameters for all models. Please use the calibration values that are for your particular model.

FC200 Series Calibrations Modes

Six separate procedures are provided for the six calibration modes.

- Low-voltage mode ($V-L$) calibration:
- High-voltage mode ($V-H$) calibration:
- Low-current mode ($A-L$) calibration:
- High-current mode ($A-H$) calibration:
- Low-power mode ($P-L$) calibration:
- High-power mode ($P-H$) calibration:

Each of the six calibration modes is explained in a separate section. As necessary, sections contain calibration parameters relative to that calibration mode.

Calibration Setup

FC200 calibration is straightforward. However, you must use the appropriate calibration instrumentation and test fixtures. In addition to test cables and connectors, you will need:

- RMS Voltmeter, $\pm 0.2\%$, at least 300 VAC
- RMS Ammeter, $\pm 0.2\%$, (See Calibration Settings Table for your APS model)
- Restive Load Bank, Calculated for your APS model (See following Example)

How to Calculate the Size of the Test Load (Example)

For an example, suppose your system is an FC210.

The High Current Calibration Procedure (later in this chapter) specifies an output voltage of 100 VAC, for all models. From the Table of Calibration Settings, you see the A HI (A) calibration test current for the (example) FC210 is specified at 8.00 A.



CALIBRATION SETTINGS							
Parameter	FC205	FC210					
V LO (VAC)	150.0	150.0					
V HI (VAC)	300.0	300.0					
A LO (A)	3.000	3.000					
A HI (A)	4.00	8.00					
P LO (W)	300.0	300.0					
P HI (W)	500.0	1000					

For 100 VAC and 8.0 Amps, your load should have a resistance of 12.5 ohms.

$$R = \frac{V_{rms}}{I_{rms}} = \frac{100 \text{ Volts}}{8.0 \text{ Amps}} = 12.5 \text{ ohms.}$$

The power handling capability of the test load must be at least 0.8 KW.

$$P = \frac{(V_{rms})^2}{I_{rms}} = \frac{(100 \text{ volts})^2}{12.5 \text{ ohms}} = 800 \text{ Watts} = 0.8 \text{ KW.}$$



WARNING

**THIS EQUIPMENT CONTAINS HIGH ENERGY, LOW IMPEDANCE CIRCUITS!!
LETHAL POTENTIALS ARE CONTAINED WITHIN THE CABINET.**

**CARE MUST BE EXERCISED WHEN OPERATING, CALIBRATING, OR SERVICING
THIS EQUIPMENT, IN ORDER TO PREVENT SERIOUS OPERATOR INJURY OR
EQUIPMENT DAMAGE.**

OBSERVE THE FOLLOWING WHEN SERVICE AND MAINTENANCE ARE REQUIRED:

- 5) REMOVE ALL JEWELRY FROM ARMS AND NECK WHEN SERVICING THIS
EQUIPMENT. THIS PREVENTS THE POSSIBILITY OF SHORTING THROUGH THE
JEWELRY AND CAUSING BURNS TO THE OPERATOR.**
- 6) WEAR SAFETY GLASSES WHEN SERVICING THIS EQUIPMENT TO PREVENT EYE
INJURY DUE TO FLYING PARTICLES CAUSED BY ACCIDENTAL SHORT CIRCUIT
CONDITIONS.**
- 7) DO NOT REMOVE ANY PANEL OR COVER WITHOUT FIRST REMOVING THE INPUT
POWER BY OPENING ALL CIRCUIT BREAKERS.**
- 8) SERVICE OTHER THAN REGULARLY SCHEDULED CALIBRATION OR EXTERNAL
CLEANING SHOULD BE REFERRED TO PERSONNEL AUTHORIZED BY THE
FACTORY TO SERVICE THIS EQUIPMENT.**

Calibration Instructions

General Information about Calibration

- At the VOLTAGE Display, pressing the RESET button aborts the calibration process.
- The system must be restarted after all calibration operations have been completed.

Entering the Calibration Mode

- At the rear of the unit, press and continue to hold the CAL switch (recessed) while turning the power on.
- After about 2 seconds, the unit will execute the calibration program that is appropriate for your particular unit, based on the FC200 model number. The panel will display CAL 2XY.
- 2XY corresponds to the model number and nominal power rating of your unit.

Frequency Display	Voltage Display
CAL	2XY



OUTPUT ELECTRICAL SPECIFICATIONS							
Model		FC205	FC210				
Total Power		500 VA	1 KVA				
Maximum Amps	0 – 150 V	4.2 A	8.4 A				
	0 – 300 V	2.1 A	4.2 A				

- Confirm the displayed model number agrees with your unit's external model number. The internal calibration program uses this model number in its activities .
- If there is disagreement between the displayed model number and unit's external model number, you should stop the process, turn off the unit, and contact your distributor or the factory. Please refer to page "v" of this manual for factory contact information.

Selecting Calibration Parameters

- Following the power-up into the Calibration Mode, the FC200 unit enters the Low Voltage ($V-L$) calibration mode.
- Press the FREQUENCY \vee or \wedge buttons to select the system parameter you are going to calibrate.
- Pressing FREQUENCY \vee proceeds to the next calibration mode. Pressing FREQUENCY \wedge returns to the previous step.
- Low-voltage mode ($V-L$) calibration
- High-voltage mode ($V-H$) calibration
- Low-current mode ($A-L$) calibration
- High-current mode ($A-H$) calibration
- Low-power mode ($P-L$) calibration
- High-power mode ($P-H$) calibration

Calibration Frequency

Please note, the calibration frequency is internally selected to be 60 Hz. Consequently, there is no user-selectable calibration frequency setting. Please use resistive loads for all of your load-calibration procedures. Resistive loads are not sensitive to frequency.

Low-Voltage Mode (U-LO) Calibration

1. At the FREQUENCY Display, press the \wedge or \vee buttons to select **U-LO** (V-LO). The low-voltage parameter is calibrated (first) at the beginning of calibration.
2. At the OUTPUT Terminals, with no load attached, carefully connect a certified, calibrated RMS voltmeter, of at least 0.2% accuracy, to the output.
3. At the VOLTAGE Display, press the OUTPUT button. The FC200 unit will automatically perform a low-voltage output reading and will output approximately 150 VAC. The external RMS voltmeter will display the actual voltage output, and the current display will show the calibration value (see Calibration Table below).

Frequency Display	Voltage Display	Current Display
U-LO	150.0	150.0

Calibration Settings							
Parameter	FC205	FC210					
V LO (VAC)	150.0	150.0					
V HI (VAC)	300.0	300.0					
A LO (A)	3.000	3.000					
A HI (A)	4.00	8.00					
P LO (W)	300.0	300.0					
P HI (W)	500.0	1000					

4. At the CURRENT Display Adjust the voltage using the CURRENT \wedge or \vee buttons until the metered values match.
5. At the CURRENT Display, press the LOCK button to finish low-voltage calibration.
6. Proceed to the next calibration function, unless this completes system calibration.
7. Note, to exit the Calibration Mode, your FC200 unit must be restarted after you have completed ALL calibration operations.

High-Voltage Mode (U-HI) Calibration

1. At the FREQUENCY Display, press the \vee buttons to select *U-HI* (V-HI). The high-voltage parameter is calibrated after you calibrate the low voltage.
2. At the OUTPUT Terminals, with no load attached, carefully connect a certified, calibrated RMS voltmeter, of at least 0.2% accuracy, to the output.
3. At the VOLTAGE Display, press the OUTPUT button. The FC200 unit will automatically perform a high-voltage output reading and will output approximately 300 VAC. The external RMS voltmeter will display the actual voltage output. The CURRENT Display shows the calibration value (See Calibration Table, below).

Frequency Display	Voltage Display	Current Display
<i>U-HI</i>	<i>300.0</i>	<i>300.0</i>



Calibration Settings							
Parameter	FC205	FC210					
V LO (VAC)	150.0	150.0					
V HI (VAC)	300.0	300.0					
A LO (A)	3.000	3.000					
A HI (A)	4.00	8.00					
P LO (W)	300.0	300.0					
P HI (W)	500.0	1000					

4. At the CURRENT Display, adjust the voltage using the CURRENT \wedge or \vee buttons until the metered values match.
5. At the CURRENT Display, press the LOCK button to finish high-voltage calibration.
6. Proceed to the next calibration function, unless this completes system calibration.
7. Note, to exit the Calibration Mode, your FC200 unit must be restarted after you have completed ALL calibration operations.

Low-Current (A-LO) Mode Calibration

1. At the FREQUENCY Display, press the \sim button to select **A-LO** (A LO).
2. At the OUTPUT Terminals, carefully connect a resistive load and connect a certified, calibrated RMS ammeter, of at least 0.2% accuracy.
3. The size of the resistive load should be calculated based on the low-current parameter for your particular FC200 unit, as shown in the following Calibration Settings Table. Use 100 VAC for the voltage.
4. An example calculation is shown on page 6-2 in the Section *Calculation Setup*, subsection *How to Calculate the Size of the Load*.

Calibration Settings							
Parameter	FC205	FC210					
V LO (VAC)	150.0	150.0					
V HI (VAC)	300.0	300.0					
A LO (A)	3.000	3.000					
A HI (A)	4.00	8.00					
P LO (W)	300.0	300.0					
P HI (W)	500.0	1000					

5. At the VOLTAGE Display, press the OUTPUT button. The FC200 unit will automatically perform a low-current output reading and will output approximately 100 VAC.
6. The external RMS ammeter will display the actual current output. The CURRENT Display shows the calibration value (see Calibration Table, above).

Frequency Display	Voltage Display	Current Display
A-LO	100.0	XX.XX

7. Adjust the load or the output voltage until the RMS ammeter displays the value shown in the Calibration Table (above). Please note, the value for your unit will depend on the model.
8. At the CURRENT Display, adjust the metered current using the \wedge or \vee buttons until the metered values match.

9. At the CURRENT Display, press the LOCK button to complete low-current calibration.
10. Proceed to the next calibration function, unless this completes system calibration.
11. Note, to exit the Calibration Mode, your FC200 unit must be restarted after you have completed ALL calibration operations.

High Current (A-HI) Mode Calibration

1. At the FREQUENCY Display, press the \sim button to select **A-HI** (A HI).
2. At the OUTPUT Terminals, carefully connect a resistive load and connect a certified, calibrated RMS ammeter, of at least 0.2% accuracy.
3. The size of the resistive load should be calculated based on the high-current parameter for your particular FC200 unit, as shown in the following Calibration Table. Use 100 VAC for the voltage.
4. An example calculation is shown on page 6-2 in the Section *Calculation Setup*, subsection *How to Calculate the Size of the Load*.

Calibration Settings							
Parameter	FC205	FC210					
V LO (VAC)	150.0	150.0					
V HI (VAC)	300.0	300.0					
A LO (A)	3.000	3.000					
A HI (A)	4.00	8.00					
P LO (W)	300.0	300.0					
P HI (W)	500.0	1000					

5. At the VOLTAGE Display, press the OUTPUT button. The FC200 unit will automatically perform a high-current output reading and will output approximately 100 VAC.
6. The external RMS ammeter will display the actual current output. The CURRENT Display shows the calibration value (see Calibration Table, above).

Frequency Display	Voltage Display	Current Display
A-HI	100.0	XX.XX

7. Adjust the load or the output voltage until the RMS ammeter displays the value shown in the Calibration Table (above). Please note, the value for your unit will depend on the model.
8. At the CURRENT Display, adjust the metered current using the \wedge or \vee buttons until the metered values match.

9. At the CURRENT Display, press the LOCK button to complete high-current calibration.
10. Proceed to the next calibration function, unless this completes system calibration.
11. Note, to exit the Calibration Mode, your FC200 unit must be restarted after you have completed ALL calibration operations.

Low-Power (P-LO) Mode Calibration

1. At the FREQUENCY Display, press the \sim button to select **P-LO** (P LO).
2. At the OUTPUT Terminals, carefully connect a resistive load and connect a certified, calibrated RMS power meter, of at least 0.2% accuracy.
3. The size of the load should be calculated based on the low-current parameter for your particular FC200 unit, as shown in the following Calibration Table. Use 100 VAC for the voltage.
4. An example calculation is shown on page 6-2 in the Section *Calculation Setup*, subsection *How to Calculate the Size of the Load*.

Calibration Settings							
Parameter	FC205	FC210					
V LO (VAC)	150.0	150.0					
V HI (VAC)	300.0	300.0					
A LO (A)	3.000	3.000					
A HI (A)	4.00	8.00					
P LO (W)	300.0	300.0					
P HI (W)	500.0	1000					

5. At the VOLTAGE Display, press the OUTPUT button. The FC200 unit will automatically perform a low-power output reading and will output approximately 100 VAC.
6. The external RMS power meter will display the actual power output. The CURRENT Display shows the calibration value (see Calibration Table, above).

Frequency Display	Voltage Display	Current Display
P-LO	100.0	X.XX

7. Adjust the load or the output voltage until the RMS power meter displays the value shown in the Calibration Table (above). Please note, the value for your unit will depend on the model.
8. At the CURRENT Display, adjust the metered power using the \wedge or \vee buttons until the metered values match.

9. At the CURRENT Display, press the LOCK button to complete low-power calibration.
10. Proceed to the next calibration function, unless this completes system calibration.
11. Note, to exit the Calibration Mode, your FC200 unit must be restarted after you have completed ALL calibration operations.

High-Power (P-HI) Mode Calibration

1. At the FREQUENCY Display, press the \sim button to select **P-HI** (P HI).
2. At the OUTPUT Terminals, carefully connect a resistive load and connect a certified, calibrated RMS power meter, of at least 0.2% accuracy.
3. The size the load should be calculated based on the high-current parameter for your particular FC200 unit, as shown in the following Calibration Table. Use 120 VAC for the voltage.
4. An example calculation is shown on page 6-2 in the Section *Calculation Setup*, subsection *How to Calculate the Size of the Load*.

Calibration Settings							
Parameter	FC205	FC210					
V LO (VAC)	150.0	150.0					
V HI (VAC)	300.0	300.0					
A LO (A)	3.000	3.000					
A HI (A)	4.00	8.00					
P LO (W)	300.0	300.0					
P HI (W)	500.0	1000					

5. At the VOLTAGE Display, press the OUTPUT button. The FC200 unit will automatically perform a high-power output reading and will output approximately 100 VAC.
6. Using the VOLTAGE \curvearrowright or \sim buttons adjust the voltage to approximately 120 VAC.
7. The external RMS power meter will display the actual power output. The CURRENT Display shows the calibration value (see Calibration Table, above).

Frequency Display	Voltage Display	Current Display
P-HI	100.0	X.XX

8. Adjust the load or the output voltage until the RMS power meter displays the value shown in the Calibration Table (above). Please note, the value for your unit will depend on the model.

9. At the CURRENT Display, adjust the metered power using the \wedge or \vee buttons until the metered values match.
10. At the CURRENT Display, press the LOCK button to complete high-power calibration.
11. Proceed to the next calibration function, unless this completes system calibration.
12. Note, to exit the Calibration Mode, your FC200 unit must be restarted after you have completed ALL calibration operations.

Chapter 7

System Maintenance

Overview

Chapter 7 describes the maintenance procedures you should perform. This is a very short chapter because, other than keeping air filters clean, there is almost no user maintenance required.

Introduction

No internal parts require user maintenance. If the equipment appears to have a malfunction, please contact APS or the distributor for service (see page "v"). The wiring and block diagram are for reference only.

Scheduled Maintenance

The FC200 Series Frequency Converters should be inspected and calibrated once per year to ensure safety and accuracy of the equipment. Air vents must be kept clear of obstructions. If the equipment is used on a regular basis in a dusty environment, more frequent cleaning may be necessary.

Modification

Do not modify this equipment. Any modifications void the warranty automatically, and violate the tested safety standards of the unit. APS does not take responsibility for such equipment. Parts or accessories not certified by APS will not be covered under the warranty. If any modification is detected in equipment returned for service, the equipment will be returned immediately by APS and the customer will be charged for this inspection / service.

System Design

FC200 Series power converters are high power linear technology amplifiers.. The all-digital control circuitry meters and displays system outputs, in addition to generating control signals. The system is microprocessor-based. Firmware in a proprietary EEPROM allows configuration upgrades.



WARNING

**THIS EQUIPMENT CONTAINS HIGH ENERGY, LOW IMPEDANCE CIRCUITS!!
LETHAL POTENTIALS ARE CONTAINED WITHIN THE CABINET.**

**CARE MUST BE EXERCISED WHEN SERVICING THIS EQUIPMENT
IN ORDER TO PREVENT SERIOUS OPERATOR INJURY OR EQUIPMENT DAMAGE.**

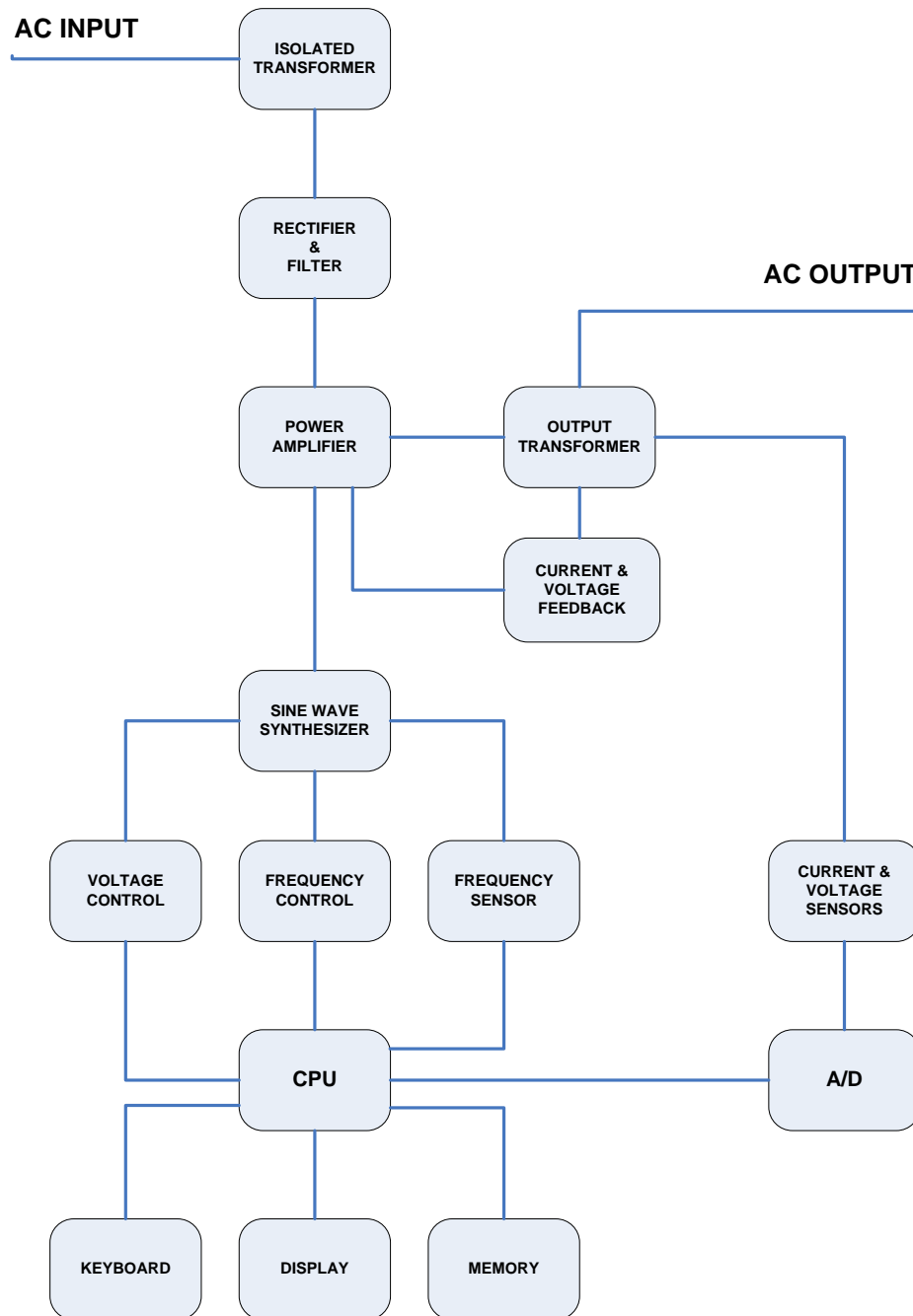
OBSERVE THE FOLLOWING --- WHEN SERVICE AND MAINTENANCE ARE REQUIRED:

- **REMOVE ALL JEWELRY FROM ARMS AND NECK WHEN SERVICING THIS EQUIPMENT. THIS PREVENTS THE POSSIBILITY OF SHORTING THROUGH THE JEWELRY AND CAUSING BURNS TO THE OPERATOR.**
- **WEAR SAFETY GLASSES WHEN SERVICING THIS EQUIPMENT TO PREVENT EYE INJURY DUE TO FLYING PARTICLES CAUSED BY ACCIDENTAL SHORT CIRCUIT CONDITIONS.**
- **DO NOT REMOVE ANY PANEL OR COVER WITHOUT FIRST REMOVING THE INPUT POWER BY OPENING ALL CIRCUIT BREAKERS.**
- **SERVICE OTHER THAN EXTERNAL CLEANING SHOULD BE REFERRED TO PERSONNEL AUTHORIZED BY THE FACTORY TO SERVICE THIS EQUIPMENT. THERE ARE NO USER-SERVICABLE INTERNAL PARTS.**

System Block Diagram

If you are interested in how the FC200 works, you can learn more by reviewing the System Block Diagram on the following page. Please note, the block diagram is supplied for information purposes only. There are no serviceable components available to the user.

7.1 Block Diagram of the AC Power Source



7.2 THEORY OF OPERATION

The FC 200 Series AC sources use isolated transformers and rectify the AC input voltage to create the DC supply for the power amplifier.

The control circuit of the AC source is microprocessor controlled and is fully digital. The CPU regulates the frequency and amplitude of the sine wave via the digital synthesizer. When the CPU receives a voltage setting, the CPU will generate a sine wave and send a signal to the power amplifier for amplification. The CPU will read back from the digital feedback loop to fine-tune the output voltage to within the specification.

Two feedback loops are used to regulate the stability of the output voltage. One is an analog feedback for quick response, typically within 100 μ s. Regulation of $\pm 0.5\%$ of the set voltage is reached. The other feedback loop uses digital feedback. The CPU reads the output voltage and compares it with the setting and adjusts the amplitude of the synthesized voltage accordingly. The accuracy of the output voltage will be within ± 0.1 V of the setting.

The output metering circuits read true RMS values of voltage and current. The LED display shows true RMS readings. The power and power factor readings are derived from the voltage and current measurements.

The accuracy of the metered displays and of the digital feedback loop depends on proper calibration. The calibration data is stored in the EEPROM. The calibration is accomplished by using the built-in software, and the front panel key. Using the external standard Voltmeter, Ammeter, Wattmeter and following the instructions described in this manual, the AC source can be easily calibrated. The EPROM is also used for storing the instrument settings. The last used settings remain in the AC source when the power is turn off. When the unit is turned on again, the AC source will return to the last setting.