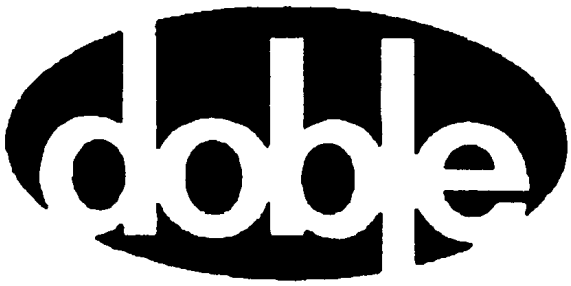
F6300 Power System Simulator User Guide



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Contents

1. Introducing the F6300

The 6300 High Power Current Module (Figure 1.1), used in conjunction with the F6150 Power System Simulator, provides you with realistic power system simulation for protection schemes. The F6300 has two groups of three current sources, six in total. Each source is rated at 150 VA of continuous power or 225 VA of power for 1.5 seconds. Also, each group can be configured as one source at 450 VA of continuous power or 675 VA of power for 1.5 seconds. The F6300 provides:

- Six 150 VA current sources

or

- Two 450 VA current sources

Figure 1.1 F6300

Configuration of the sources is internal and independently controlled by a computer to meet diverse requirements for various relay tests. By configuring the current sources in series or in parallel, the F6300 yields more power for testing high burden relays or protection schemes.

Hardware Architecture

The F6300 High Power Current Amplifier (Figure 1.2) is designed to work in conjunction with the F6150 Power System Simulator. The F6150 is responsible for the waveform generation. The F6300 makes the control of the amplifiers available to the F6150 via the Ethernet link and the low level input connection.

The components of the F6300 Instrument are:

- Front Panel
- CPU Board
- Analog Multiplexer board
- Six Current Amplifiers
- Power Supply
- Four Cooling Fans

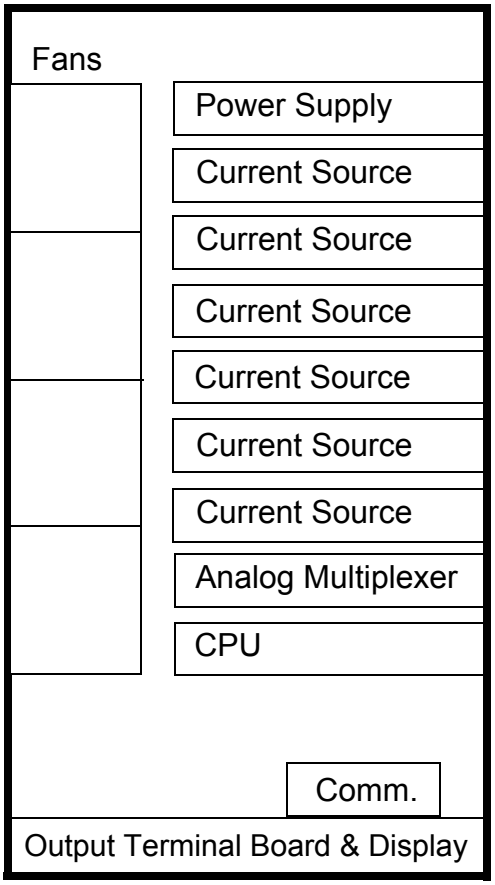

Figure 1.2 F6300 Components

Control Panel Version 2

The F6000 Control Panel Version 2 (Figure 1.3) controls the power system simulator from a computer connected to the instrument's front panel. It configures and controls the instrument's voltage sources, current sources, logic inputs, logic outputs, and timers. The F6000 Control Panel Version 2 emulates front panel controls. It also employs flexible data entry procedures to accommodate the wide range of test configurations possible. The Control Panel's (Version 2) intuitive controls can check a relay without an elaborate test plan.

A stand alone version of the Control Panel (Version 2) is shipped with each F6000 instrument.

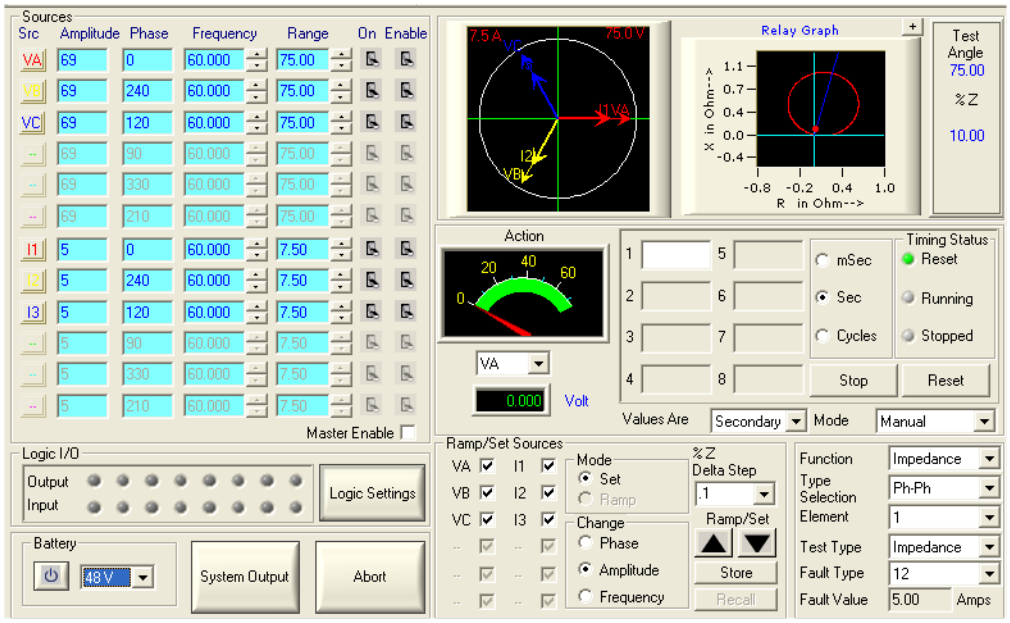

Figure 1.3 F6000 Control Panel Version 2

What is ProTesT™

ProTesT is a software system for protective relay testing and equipment maintenance. It includes the F6000 Control Panel (Version 2) for manual control of the instrument. It also combines automatic control of the F6300 instrument with the functions of a client server database.

ProTesT uses test templates called macros to automate tests on protection scheme relays. The ProTesT database also documents relay settings, test conditions, and test history. Figure 1.4 illustrates how the ProTesT software interacts with the F6150, F6300, and with the relay under test.

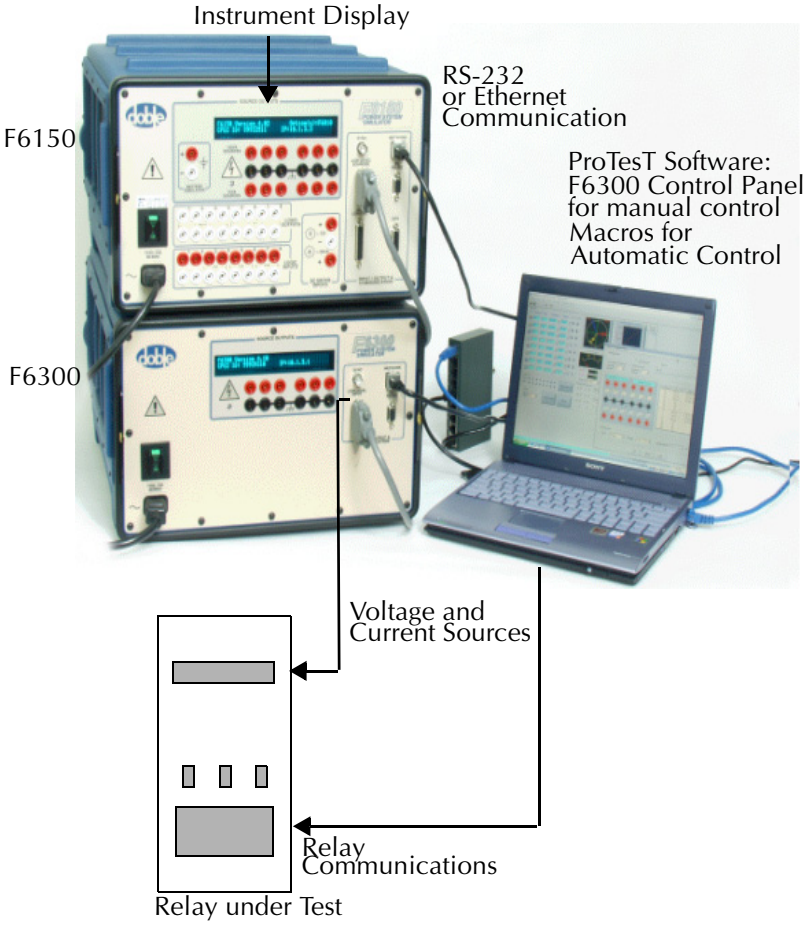

Figure 1.4 ProTesT Architecture

ProTesT has three testing methods:

- Steady state relay calibration
- Dynamic state testing
- Transient testing

Steady state relay calibration uses macros to automate tests on protection relays and schemes. These macros test individual relay functions, such as reach, instantaneous overcurrent, reverse current response, pick up and dropout, and operation and reset timing.

Dynamic state testing uses a special state simulation macro. The state simulation macro simultaneously applies sinusoidal components of voltage and current phasors that represent power system states. For example, these states can be pre-fault, fault, and post-fault.

Transient testing uses the optional ProTesT TPlan. Transient simulation tests can simultaneously apply sinusoidal and non-sinusoidal waveforms of voltage and current that represent power system conditions obtained from Disturbance Fault Recorders (DFR) or system modeling tools such as EMTP or ATP. The DFR and system modeling tool data are typically stored in a COMTRADE file. ProTesT TPlan can work with COMTRADE files and *.pl4 files.

To enhance the capabilities of the F6300 instruments, ProTesT:

- Automates protective relay tests to reduce testing time and increase accuracy
- Tests complete protection schemes under realistic power system conditions
- Creates standardized test plans with repeatable results
- Stores test plans and test results for later retrieval and analysis

2. F6300 Front Panel

Located on the instrument front panel (Figure 2.1) are:

- Outputs for six 150 VA current sources
- Communication ports
- Low level input connection
- On/Off switch and AC power connection
- Sync port (for future use)

Control of all test functions is accomplished from a computer.

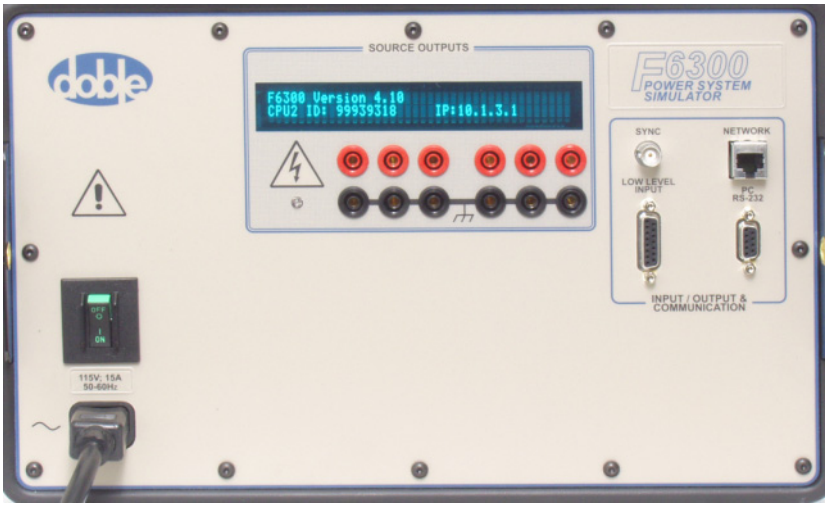

Figure 2.1 Front Panel

NOTE

Figure 2.1 shows an instrument that contains the CPU2 CPU board. The CPU2 F6300 contains a RJ45 CAT5 network connector and the CPU1 F6300 contains a 10 Base 2 network connector.

Source Outputs

The Source Outputs section of the relay F6300 front panel contains outputs for AC/DC current sources.

Instrument Display

The Instrument Display shows key information about the operation of the instrument. On bootup, the messages in the Instrument Display cycle in a predictable and recognizable pattern. This pattern is disrupted if the F6300 Instrument fails its internal diagnostic test. The F6300 performs a set of internal diagnostics to check the integrity of the system's memory, data, and communication paths. It also checks the integrity of all the system modules. After a successful bootup, the F6300 Instrument Display shows the following information:

- CPU serial number
- Firmware revision currently installed
- Instrument's IP address for purposes of network communications

During normal operation, the Instrument Display shows source names and the layout of the sources. When any source is on or enabled, it shows the amplitude and phase angle of the source for up to six sources.

NOTE

When a source is enabled, the source label uses a lower case identifier (i.e., i1, i2, and i3). When any source is on, the source label uses an upper case identifier (i.e., I1, I2, and I3.)

Current Sources

The F6300 provides six 150 VA current sources, which can be combined to achieve more power. Also, three 150 VA current sources can be combined to form a 450 VA source.

For source selection rules and examples of different test setups, see Appendix C "Source Configurations".

WARNING

The high intensity yellow LED flashes when or any output source is on or enabled to indicate the potential for dangerous or fatal voltages.

Auxiliary Functions

Other functions on the F6300 front panel include:

- ″Communications″
- Power Connection and Switch

Communications

The computer is connected and communicates to an F6150 via a RS232 serial port or an Ethernet communications link. The F6300 does not directly communicate with the computer, only through a F6150.

If the control PC is configured for Ethernet communications, it can communicate with the F6300 on a private network using the TCP/IP protocol. When it initiates two-way communication, the PC sends its IP address to the instrument. The F6150, the F6300, and your PC must each have a different IP address assigned.

CAUTION

Use the Ethernet communications link only with a discrete PC on a private network. Connecting the instruments to a local-area or a wide-area network permits unauthorized control of the test instrument.

NOTE

To configure ProTesT to communicate using either the serial port or an Ethernet connection, see Chapter 3 ″Setup and Configuration″.

″Connecting the F6300 and F6150″ contains:

- Illustrations showing the possible Ethernet and serial wiring configurations of your PC, F6300, and F6150.
- Tables summarizing the communications setup requirements for both Ethernet and serial connections.

Connecting the F6300 and F6150

This section contains procedures and step-by-step examples for connecting the F6300 and F6150 to the system, including:

- ″Ethernet 10Base 2 Communications with a “T” Connector″
- ″Ethernet 10Base 2 Communication using Terminators″ on page 2-5
- ″Ethernet Communication to F6000 Instruments″ on page 2-5

Ethernet 10Base 2 Communications with a “T” Connector

To connect your F6150 and F6300 for Ethernet 10Base 2 communication with a *T* connector (Figure 2.2):

1. Connect one of the 50 Ohm terminators to the F6150 network BNC connector.
2. Connect the second 50 Ohm terminator to the computer network BNC connector.
3. Connect a BNC *T* connector to the F6300 Network BNC connector.
4. Connect the one RG-58 coax cable between the F6150 and the F6300 and one more RG-58 coax cable between the F6300 and the computer.

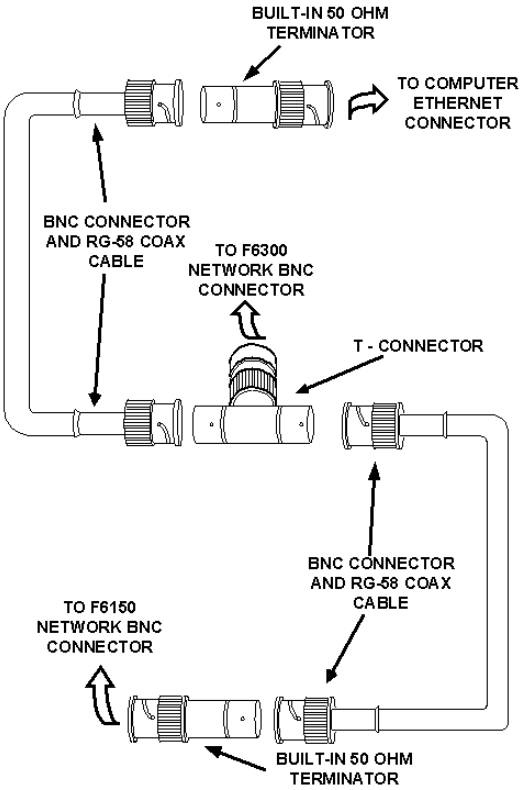

Figure 2.2 Connection Using a 10Base2 Connector

Ethernet 10Base 2 Communication using Terminators

To connect your F6150 and F6300 for serial communication (Figure 2.3):

1. Connect one of the 50 Ohm terminator to the F6150 network BNC connector.
2. Connect the second 50 Ohm terminator to the F6300 network BNC connector.
3. Connect the supplied RG-58 coax cable to both the F6150 and the F6300.

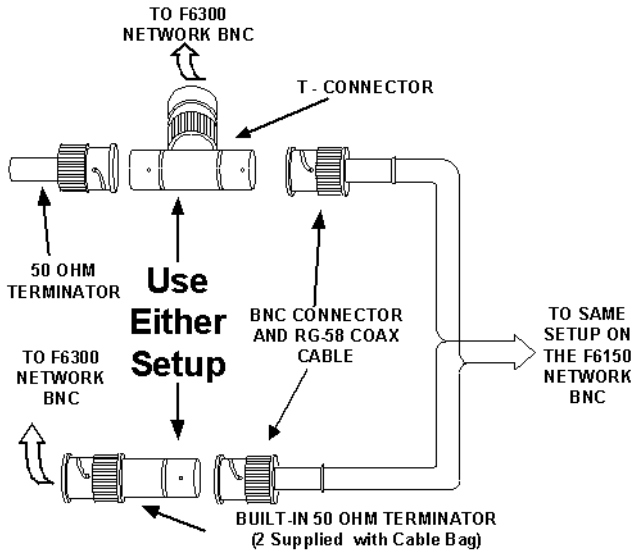

Figure 2.3 A Terminating 10Base2 Connection

Ethernet Communication to F6000 Instruments

The configurations for Ethernet communication include:

- Computer to CPU1 F6150
- Computer to CPU2 F6150 with Switch/Hub
- Computer to CPU2 F6150 with CAT5 Crossover Cable
- Computer to CPU1 F6150/CPU1 F6300
- Computer to CPU2 F6150/CPU2 F6300
- Computer to CPU1 F6150/CPU2 F6300
- Computer to CPU2 F6150/CPU1 F6300

NOTE

F6150 to F6300 Low voltage cable connections are not shown.

Table 2.1 lists the Ethernet communications setup parameters. Figure 2.4 through Figure 2.10 on page 2-9 shows the configurations.

Table 2.1 Ethernet Communications Setup

	Instrument Connection	**Cable Type**
Comm Port	Not Applicable	
Baud Rate	Not Applicable	
IP Address	Enter the F6150 IP address	Default is 10.1.3.1
Slave Addr	Enter the F6300 IP address	Default is 10.1.3.2
Connect with	Ethernet	

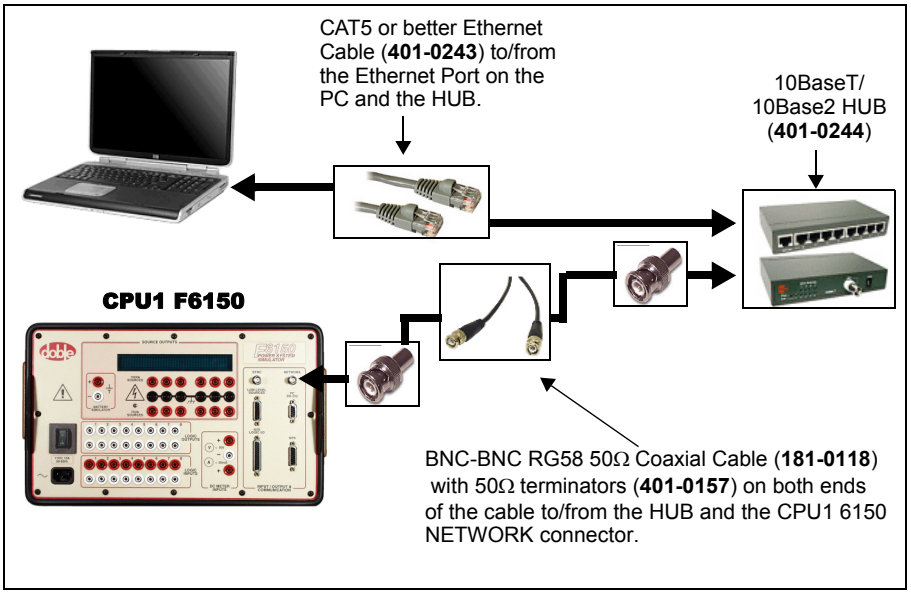

Figure 2.4 Computer to CPU1 F6150

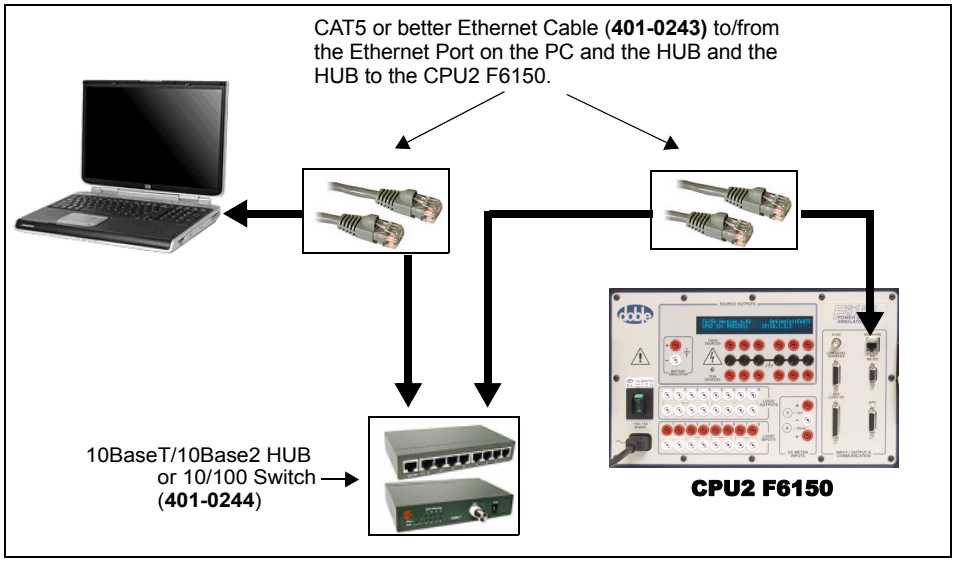

Figure 2.5 Computer to CPU2 F6150 with Switch/Hub

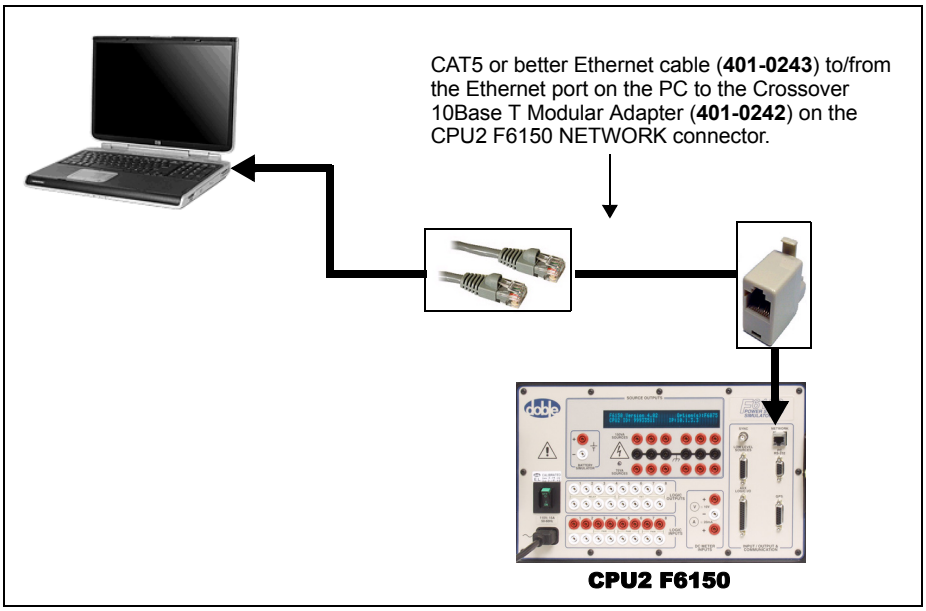

Figure 2.6 Computer to CPU2 F6150 with a CAT5 Crossover Cable

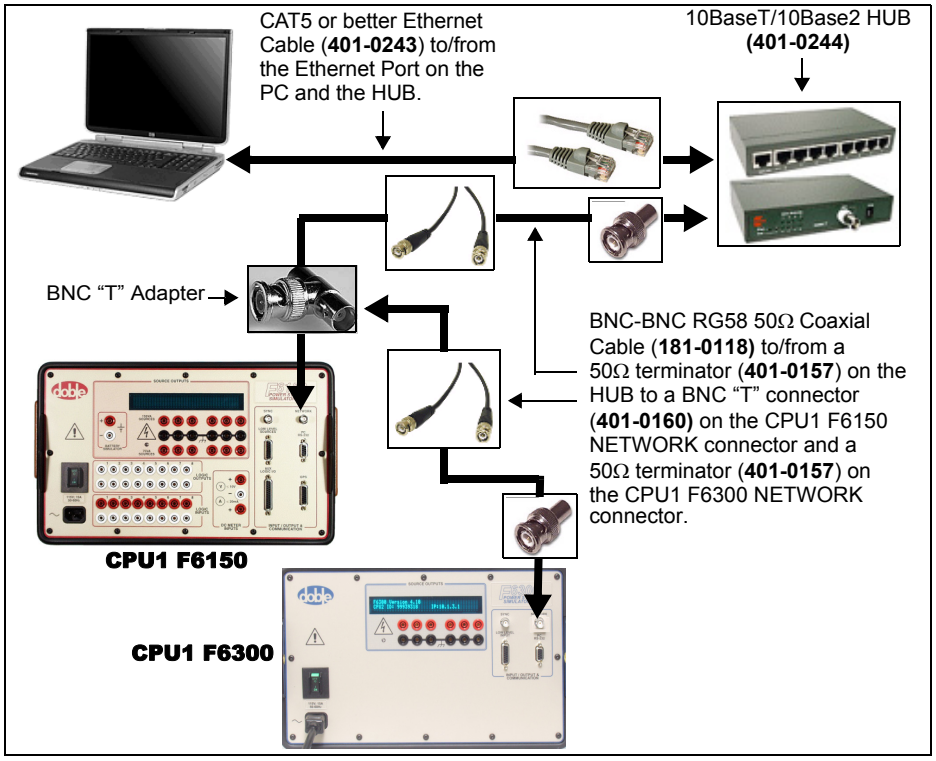

Figure 2.7 Computer to CPU1 F6150/CPU1 F6300

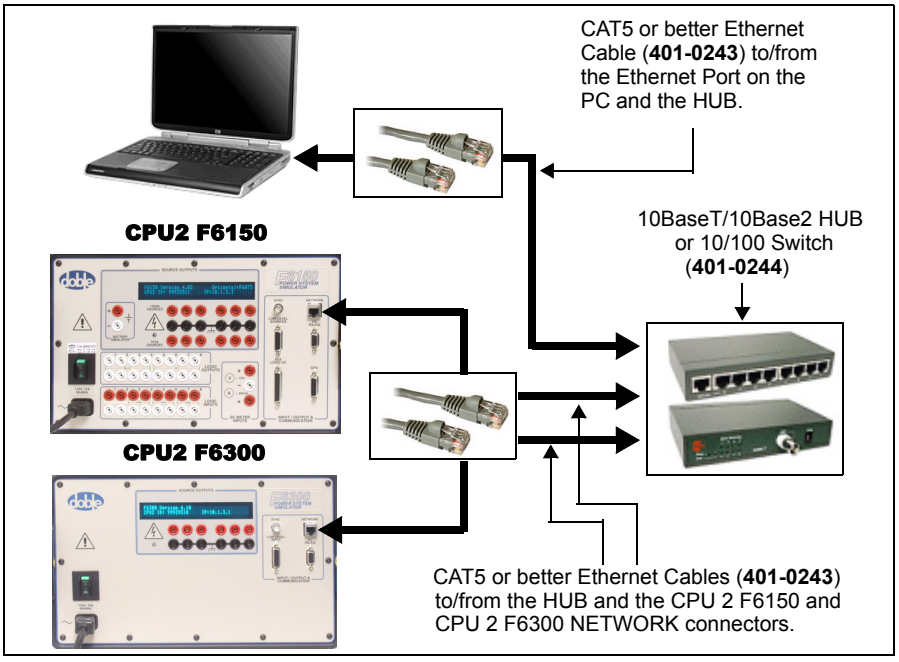

Figure 2.8 Computer to CPU2 F6150/CPU2 F6300

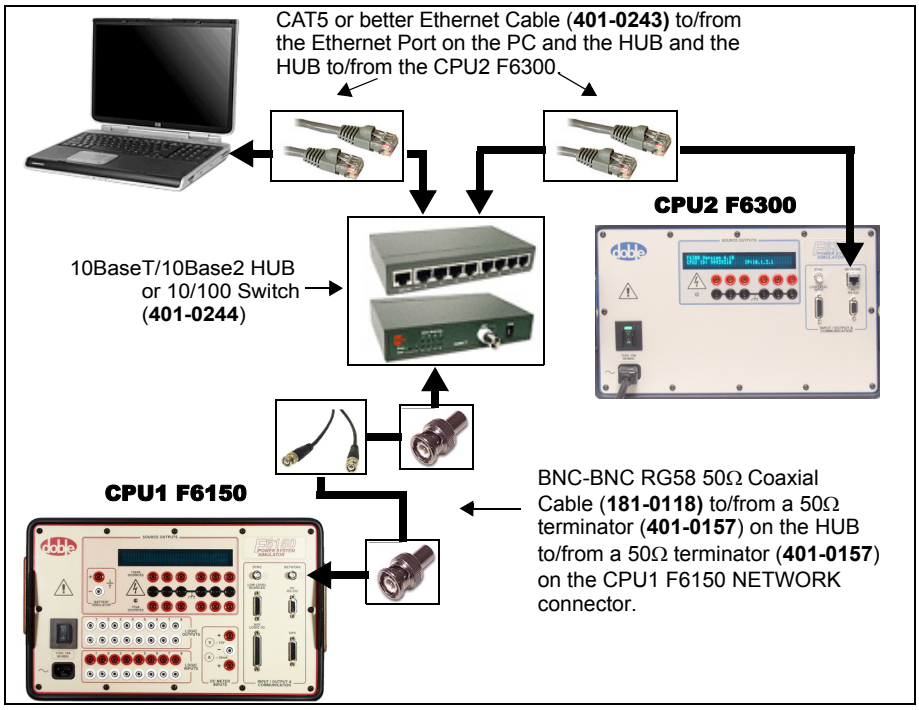

Figure 2.9 Computer to CPU1 F6150/CPU2 F6300

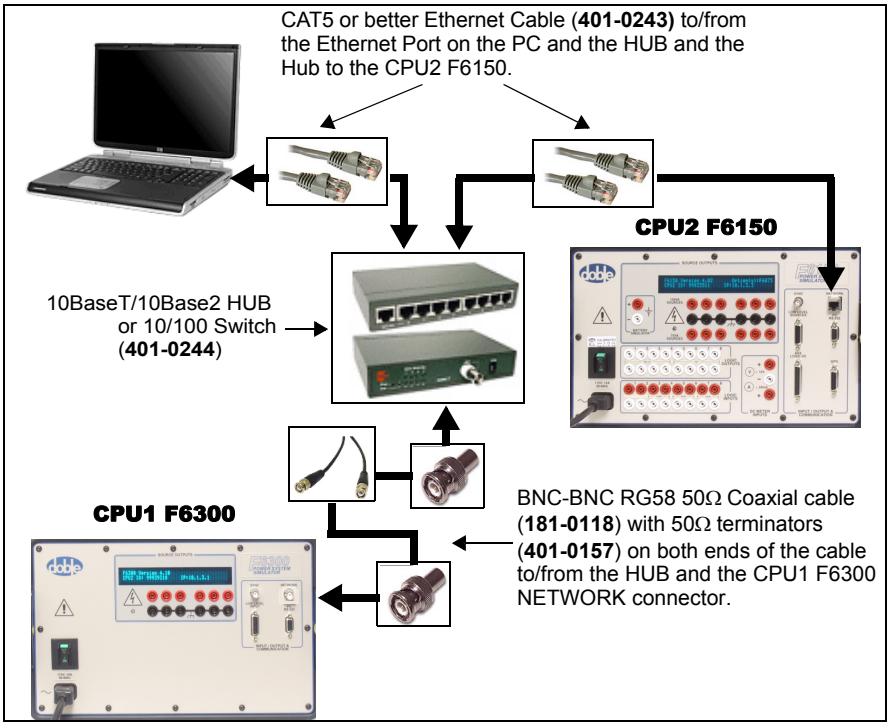

Figure 2.10 Computer to CPU2 F6150/CPU1 F6300

Serial Communication to F6000 Instruments

The configurations for serial communications include:

- Computer to CPU1 or CPU2 F6150
- Computer to CPU1 F6150/CPU1 F6300
- Computer to CPU2 F6150/CPU2 F6300 with CAT5 Crossover Cable
- Computer to CPU2 F6150/CPU2 F6300 with Switch/Hub
- Computer to CPU2 F6150/CPU1F6300
- Computer to CPU1 F6150/CPU2 F6300

Table 2.2 lists the Serial communications setup parameters. Figure 2.11 through Figure 2.16 on page 2-13 shows the configurations.

Table 2.2 Serial Communications Setup

	Instrument Connection	Cable Type
Comm Port	Select desired communication port	Comm Port 1 through 32
Baud Rate	57600	Not user changeable.
IP Address	Not Applicable	
Slave Addr	Not Applicable	
Connect with	Serial	

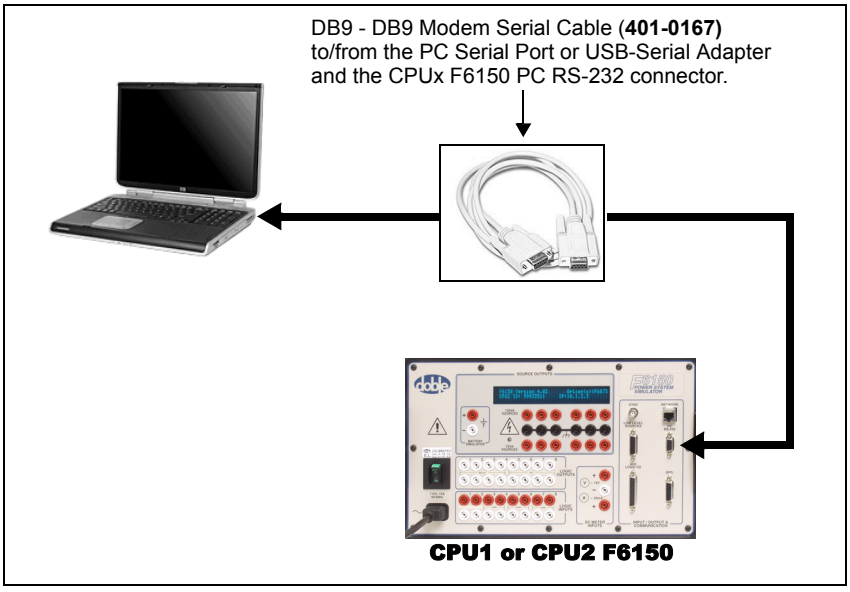

Figure 2.11 Computer to CPU1 or CPU2 F6150

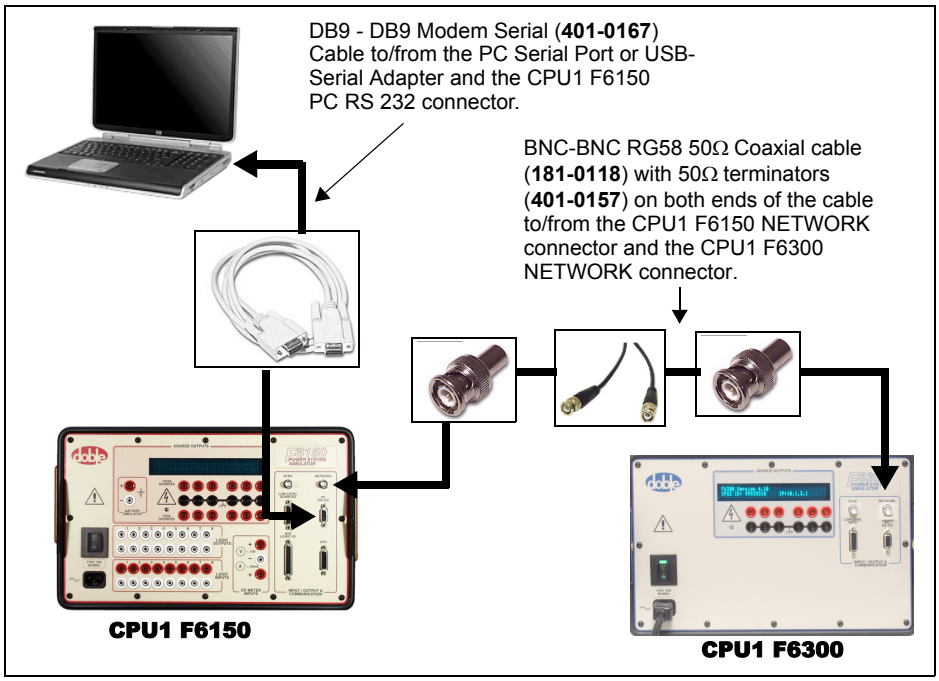

Figure 2.12 Computer to CPU1 F6150/CPU1 F6300

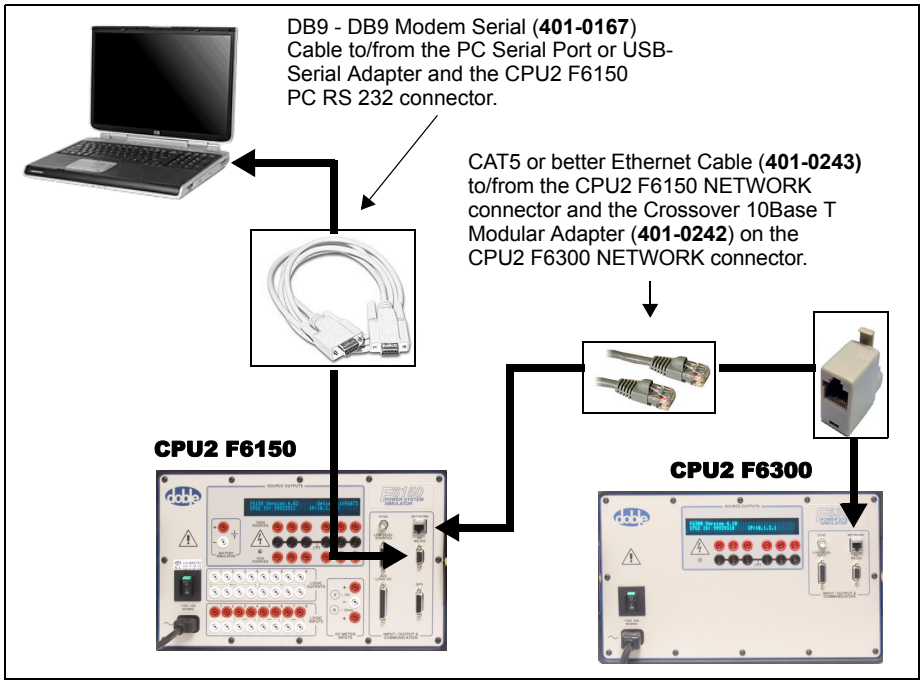

Figure 2.13 Computer to CPU2 F6150/CPU2 F6300

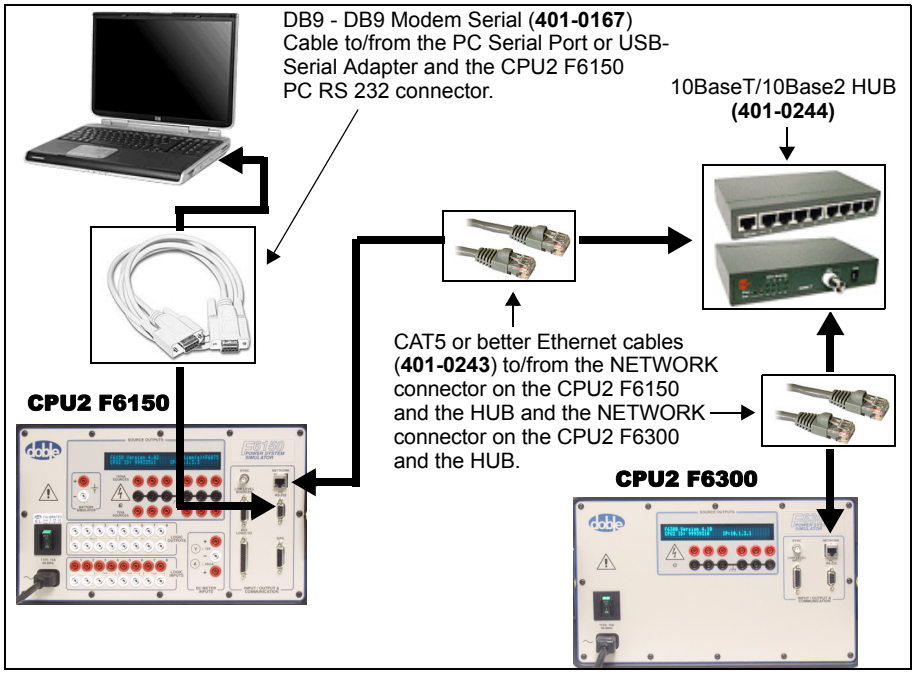

Figure 2.14 Computer to CPU2 F6150/CPU2 F6300 with Hub/Switch

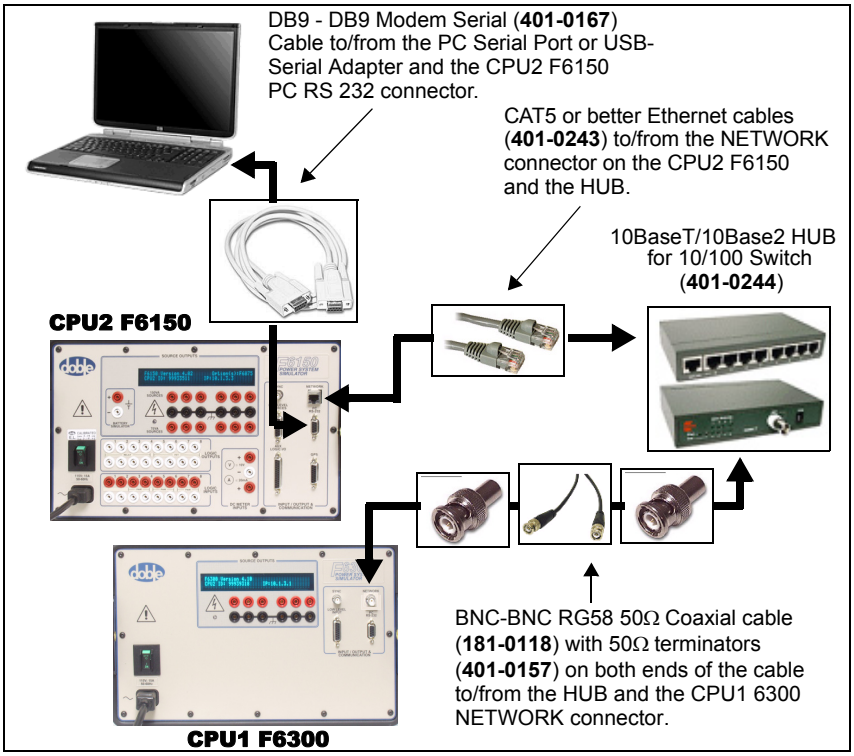

Figure 2.15 Computer to CPU2 F6150/CPU1 F6300

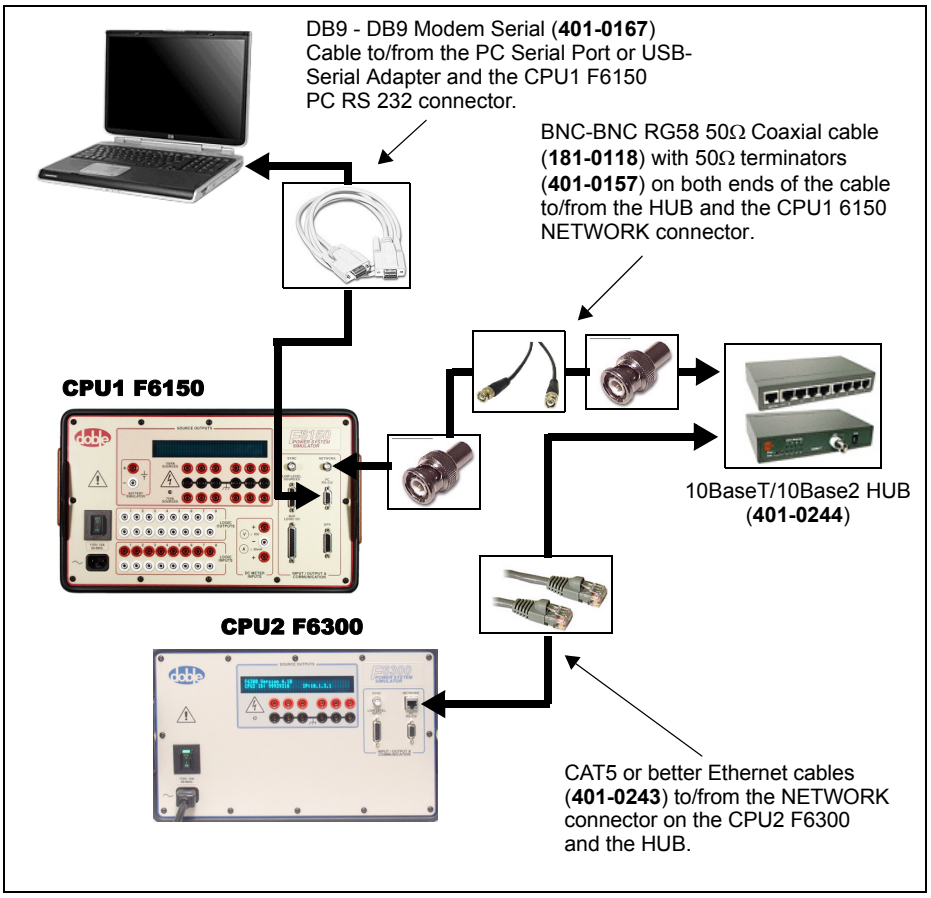

Figure 2.16 Computer to CPU1 F6150/CPU2 F6300

Low Level Source Connections

The F6150 and F6300 each come equipped with a low level source connector.

NOTE

The male/male DB15 cable supplied with the F6300 MUST BE connected between the LOW LEVEL SOURCES connectors of both instruments. This cable connection is required for the proper operation of the F6300.

To connect the F6150 and F6300 for Ethernet serial communication for:

- Three voltages and nine currents
- Three voltages and three currents

1. Connect a RG-58 coax cable with 50 Ohm terminators at each end or CAT5 or better crossover cable at the NETWORK 10Base2 Ethernet connector of each instrument (Figure 2.17).
2. Connect a DB15 cable with male connectors on each end at the LOW LEVEL SOURCES connector of each instrument.

3. Connect a DB9 RS232 cable with male and female ends to the comm port of your PC RS 232 connector on the F6150.

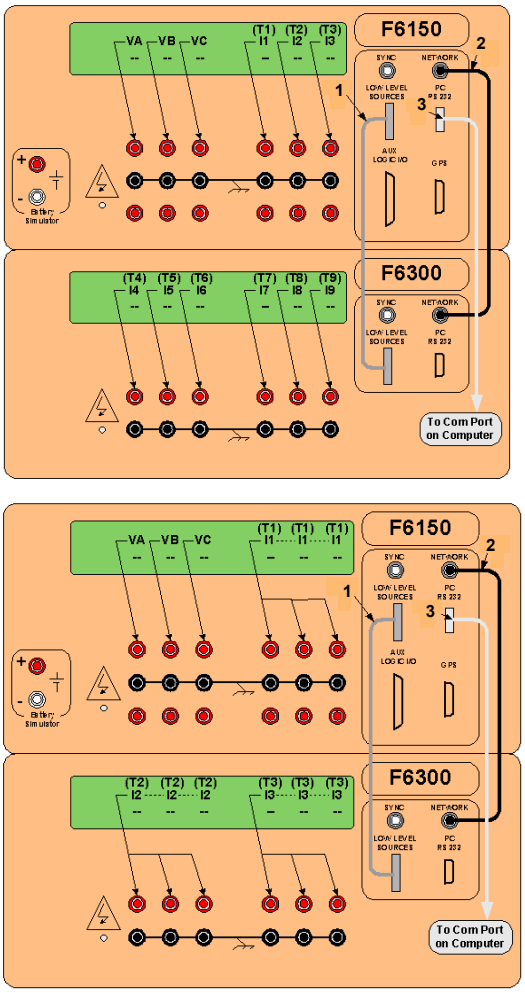

Figure 2.17 Low Level Source Connections

Power

The connection for the electrical cord is in the lower left-hand corner of the front panel. The On/Off switch for the unit is directly above the power connection. The F6300 is factory configured to use either 115 V or 230 V 50/60 Hz power as specified when ordering. The instrument front panel is labeled at the power entry receptacle with the selected power option.

3. Setup and Configuration

This chapter explains how to set up the F6300 Instrument and how to establish communications between the instrument and the software used to control it. It also explains briefly how to configure the current sources on the front panel of the instrument.

Setup and configuration consists of:

Getting Started

Perform the following steps to set up the F6300 power system simulator.

1. Unpack the instrument and inspect it for completeness and transportation damage. Verify that all system components are present according to the supplied check list.
2. Connect the power cord to the power connection socket in the lower left-hand corner of each instrument's (F6150 and F6300) front panel and plug it into a standard wall outlet.
3. Connect the Ethernet and low level input cables.
4. Turn the instrument on with the On/Off switch located above the power connection socket.

   On bootup, the messages in the Instrument Display cycle in a predictable and recognizable pattern. This pattern is disrupted if the F6300 Instrument fails its internal diagnostic test. The F6300 performs a set of internal diagnostics to check the integrity of the system's memory, data, and communication paths. It also checks the integrity of all the system modules.

WARNING **When an instrument is on the possibility of hazardous voltages or currents at the sources exists.**

A series of messages appear in the display on the instrument front panel as the F6300 firmware boots up. These messages track the sequence of steps in a successful bootup. At the end of this series of messages, the information in Figure 3.1 appears in the display.

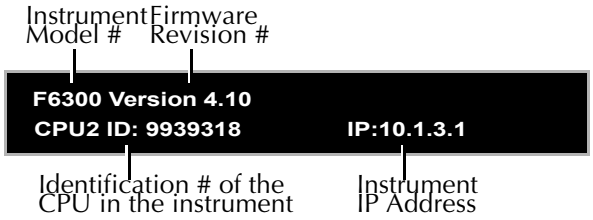

Figure 3.1 Display Information

NOTE **If an error message appears in the VFD at the end of the bootup sequence, refer to Chapter 4 ″Troubleshooting the F6300″.**

The F6300 Instrument is controlled via the F6300 Control Panel Version 2 installed with ProTesT 2.02 software. ProTesT 2.02 or later requires the following hardware and software:

- **Personal computer with a Pentium class processor.**
- **Windows 95/98/2000/XP/NT 4.0 SP6 operating systems.**
- **ProTesT 2.02 or later installed on the hard drive of the computer (for installation instructions, see the ProTesT User Guide.)**
- RS232 serial cable or Ethernet cable.
- At least the minimum amount of RAM (Random Access Memory) required by your operating system.

5. Connect one end of the RS232 cable to the serial port on the computer, or connect the Ethernet cable to the network card on the computer.
6. Connect the other end of the RS232 cable to the serial port on the F6150 instrument front panel. Alternately, connect the Ethernet cable to the network connection on the instrument front panel. Both connections are on the right-hand side of the front panel.
7. Turn the computer on.
8. Select *Start > Programs > ProTesT > Tools > F6000 Control Panel* to access the F6000 Control Panel Version 2 (Figure 3.2).

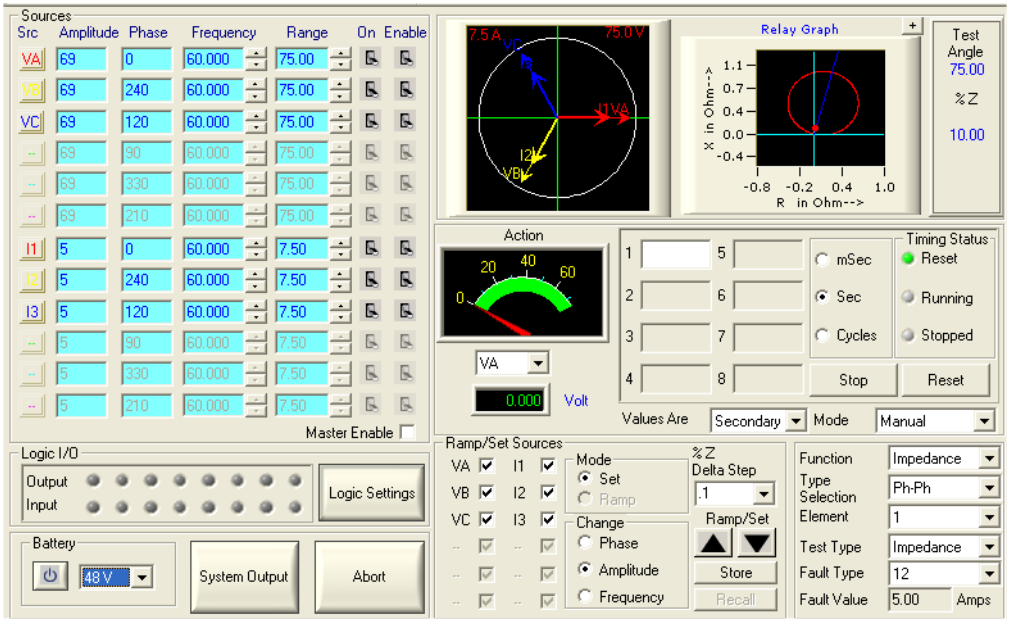

Figure 3.2 F6000 Control Panel Version 2

Using the Setup Preferences

Use the *Preferences* window (Figure 3.3) to configure the ProTesT software to communicate with the F6300 instrument. To open the *Preferences* window:

1. Select *Setup* in the ProTesT menu bar.

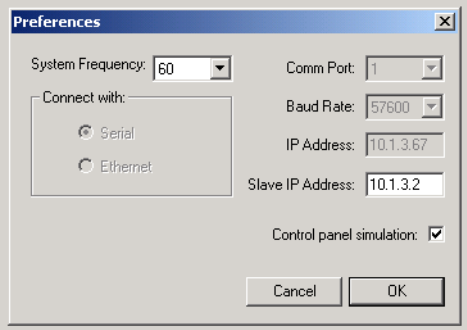

Figure 3.3 Preferences

2. Select either 50 or 60 for the *System Frequency*, as applicable.
3. Enter the *Slave IP Address* of the F6300.
4. Check *Control panel simulation* if the computer is not connected to an instrument, or if the instrument is switched off, operate the Control Panel in simulator mode. Simulator mode is useful for training and for configuring tests that will be conducted at a later time.

NOTE

If the computer is not connected to an instrument or if the instrument is switched off when the F6300 Control Panel Version 2 is opened, an error message appears. Acknowledge the error message, then specify Control panel simulation in the Setup display or switch the instrument on.

5. Click **OK**.

Using the F6300 Configuration Window

The F6300 sources can be placed in a number of configurations to suit test requirements. Configure these sources via the *F6300 Configuration* window.

This window has a graphic display which represents the current source output terminals on the F6150/F6300 front panel. When a preset configuration is selected, the source names and layout appear.

To configure this window:

1. Select *Tools > F6000 Configuration* and the *F6000 Configuration* window appears (Figure 3.4).

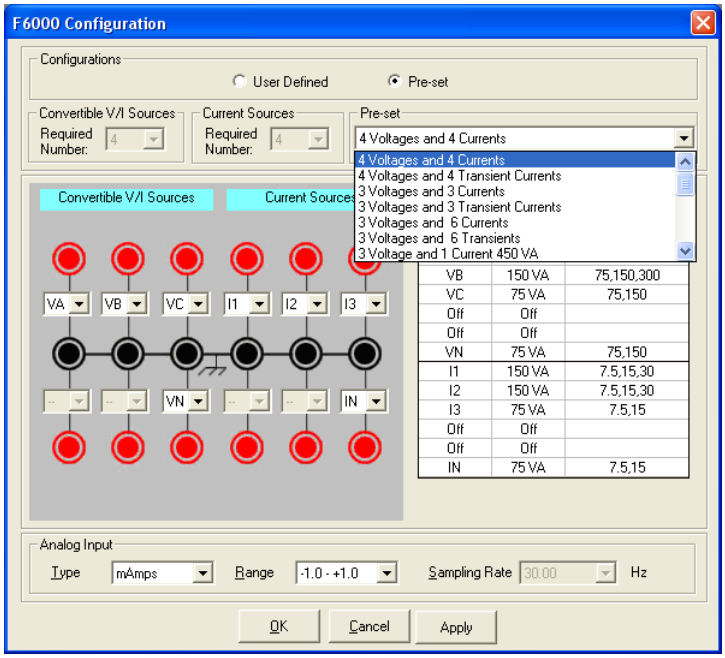

Figure 3.4 F6000 Configuration Window

2. Configure the F6150/F6300 sources using the *Pre-set Configurations* dropdown box (*User Defined* source configurations work with F6150 source configurations).

The F6150/F6300 Pre-set source configuration selections end with *...F6300 Required*. The connection graphics change to reflect F6150 and F6300 source configurations whenever a F6150/F6300 source configuration is selected. The F6150/F6300 source configuration selections are:

- 3 Voltages and 3 450 VA Currents
- 3 Voltages and 3 675 VA Transient Currents
- 3 Voltages and 9 150 VA Currents
- 3 Voltages and 9 225 VA Transient Currents

The F6300 Current Ranges (Resolution) are:

- 2 x 675 VA 1.5 Second Transient Source 15, 45, 90, 180 (0.01) A-rms
- 2 x 675 VA 1.5 Second Transient Source 10 (0.001), 30, 60, 120 (0.01) A-dc
- 2 x 450 VA Continuous Source 7.5, 22.5 (0.001), 45, 90 (0.01) A-rms
- 2 x 450 VA Continuous Source 5 (0.001), 15, 30, 60 (0.01) A-dc
- 6 x 225 VA 1.5 Second Transient Source 15, 30 (0.001), 60 (0.01) A-rms
- 6 x 225 VA 1.5 Second Transient Source 10, 20, 40 (0.01) A-dc
- 6 x 150 VA Continuous Source 7.5, 15 (0.001), 30 (0.01) A-rms
- 6 x 150 VA Continuous Source 5 (0.001), 10, 20 (0.01) A-dc

NOTE

User defined source selections are not available for F6150/F6300 instrument selection. Moreover, the source names can be chosen from the available options for each source shown in the graphic.

3. Assign a name to each source. Name the sources by choosing from active pick lists in the middle of the display:
   - Current sources start with the letter *I*: i.e., I1, I2, and I3.
   - Voltage sources start with a *V*, i.e.: VA, VB, VC
   - Current sources start with an *I*, i.e.: I1, I2, I3
   - Transient current sources start with a *T*, i.e.: T1, T2, T3
4. Configure the *Analog Input* fields:
   - *Type* - mAmps or Volts
   - *Range*: - Ranges are dictated by Pre-set selection.
   - *Sampling Rate* - Non-editable
5. Click:
   - **OK** to configure the sources on the F6150/F6300 Instruments.
   - **Cancel** to ignore changes to the source configuration.
   - **Apply** to configure the sources on the F6150/F6300 Instruments without closing the window.

4. Troubleshooting the F6300

This chapter contains diagnostic information and troubleshooting tools for the F6000 Instrument designed to pinpoint problems based on symptoms. Topics include:

If the solutions discussed in this guide do not resolve the problem, obtain further assistance by contacting Doble customer service:

Web Site:	www.doble.com/support/support.htm
Email:	customerservice@doble.com
Telephone:	617-926-4900

Troubleshooting Flow Charts

Figure 4.1 on page 4-2 and Figure 4.2 on page 4-3 are diagnostic flow charts for use in identifying and isolating problems in F6300 operations.

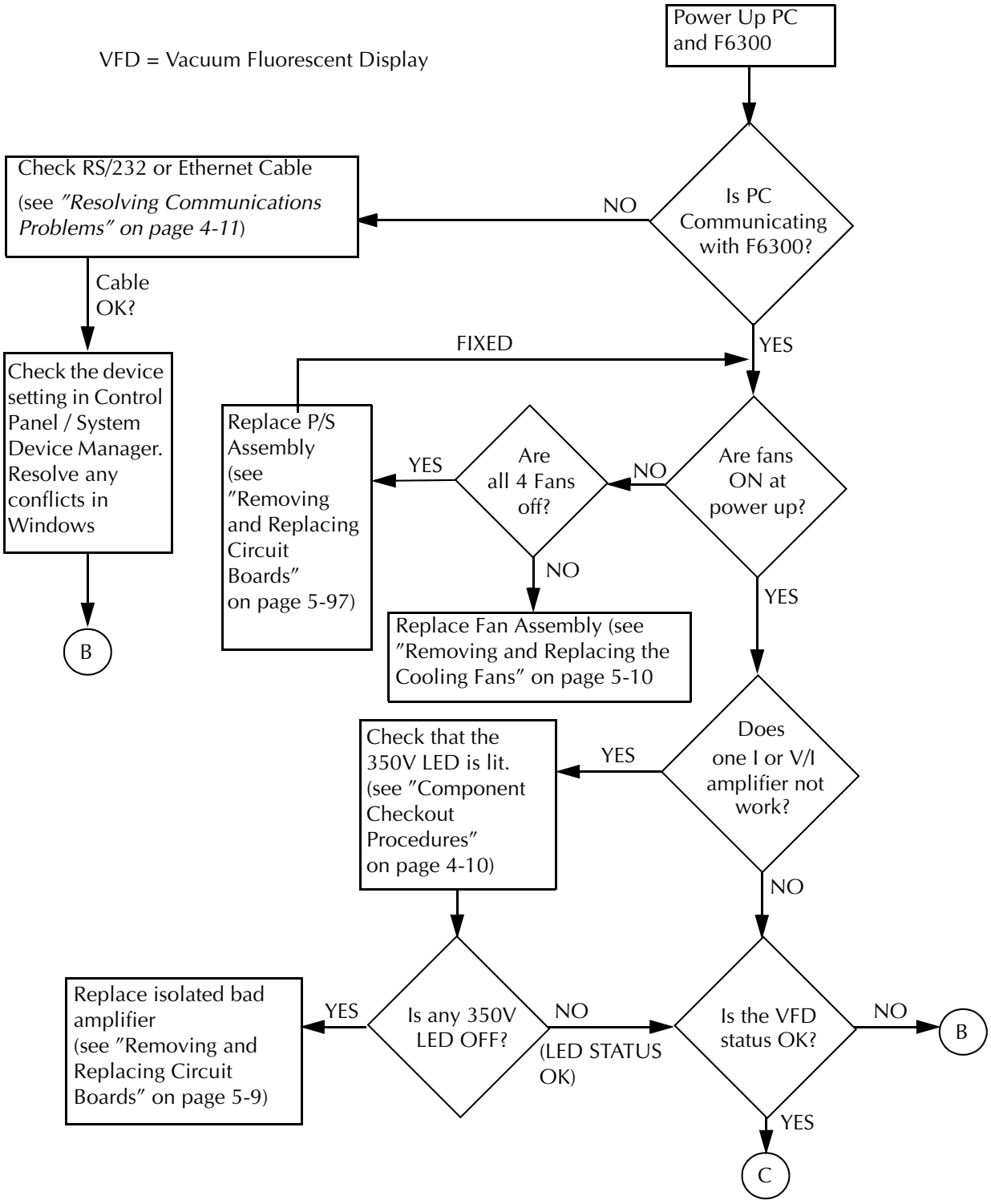

Figure 4.1 Troubleshooting Flowchart Part 1

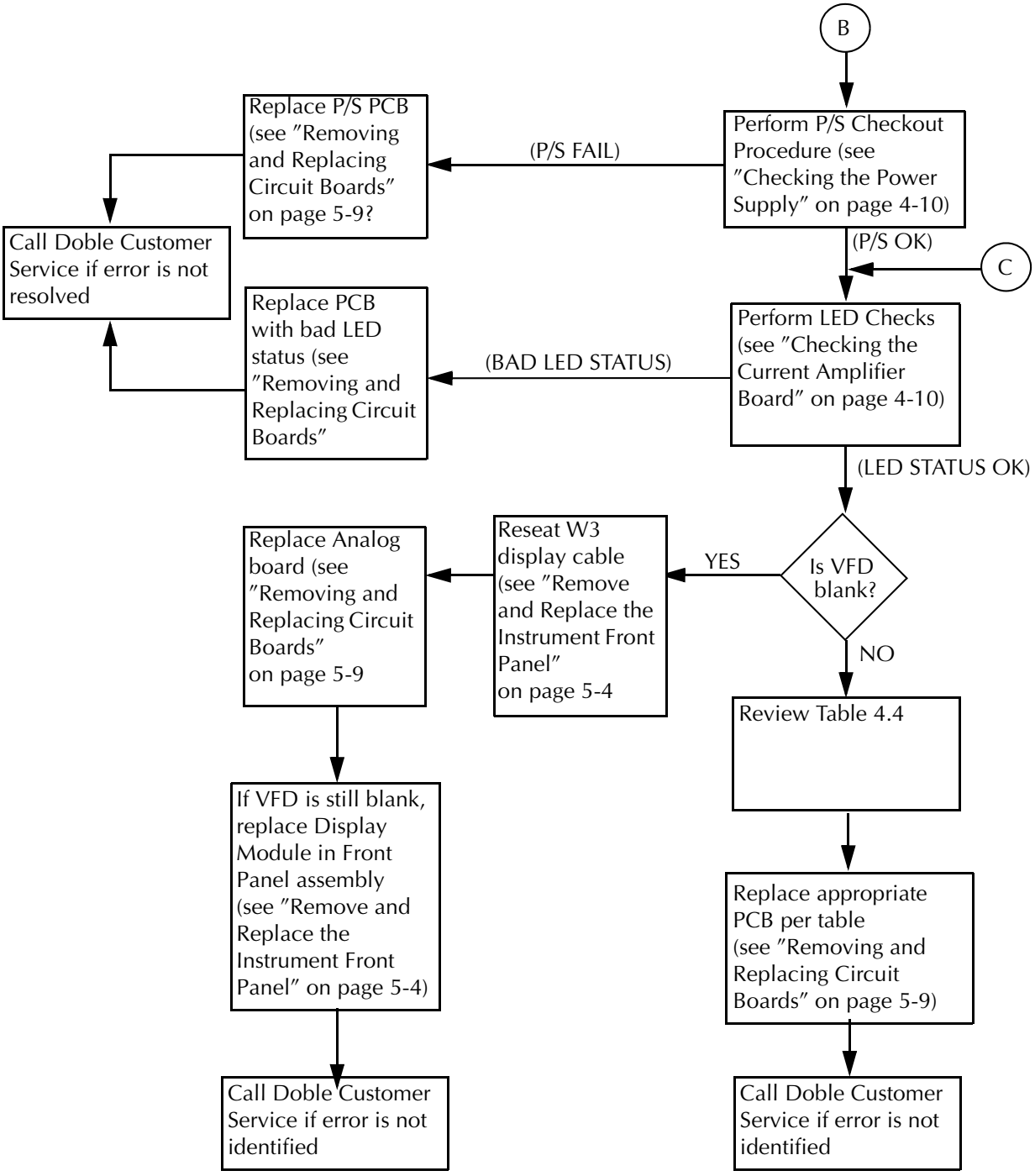

Figure 4.2 Troubleshooting Flowchart Part 2

General Troubleshooting Techniques

If the F6300 experiences difficulties, perform the following external checks to isolate the problem before removing the cover.

NOTE

Many of the major problems encountered in the F6300 are corrected by replacing a board in the unit. Chapter 5 "Field Replacement Procedures" explains how to remove a defective board and replace it.

1. Check for boot-up errors.
2. Power up the F6300 and watch the boot sequence displayed in the VFD (Vacuum Fluorescent Display).
3. Check for source errors in the Source Table of the Control Panel (Version 2).
4. Verify the configuration of current sources.
5. Select *Tools > F6000 Configuration* in the ProTesT menu bar.
6. Check for open circuits (current sources).
7. Remove all connections and check the source outputs with an ammeter, or short the output terminals.
8. Verify that the Ethernet connection is functioning properly.
9. Ping the F6300 from a DOS window (see Appendix B, *Ethernet Communications*.)

If the preliminary external checks do not identify the problem, remove the cover and check the LED status of internal components for proper operation. Refer to *"LED Status Indicators"*.

LED Status Indicators

The following circuit boards have status LEDs:

- Current amplifier circuit boards
- CPU board
- Analog multiplexer board
- High Voltage Power Supply Board

VOLTAGE

Lethal voltages are exposed with the cover removed. Follow safe procedures designed to protect against electrical shock. Always turn the unit off before making contact with any of the internal components.

Current Amplifier Circuit Boards

Six current amplifier boards are installed in slots 5-10. Each current amplifier circuit board has two LEDs that are visible when looking at the front of the board (Figure 4.3).

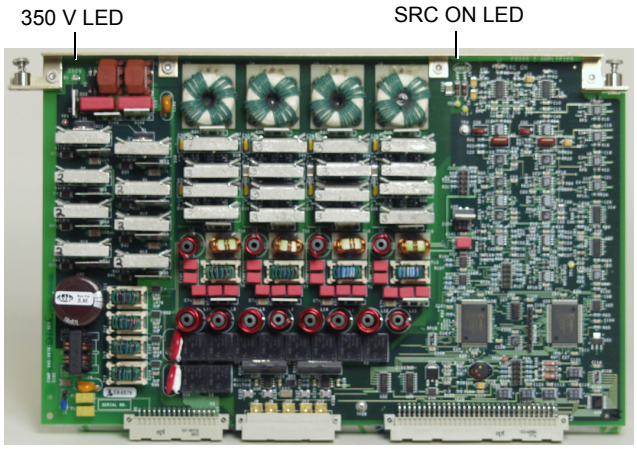

Figure 4.3 Current Amplifier Circuit Boards

Table 4.1 defines the function of the LEDs.

Table 4.1 Current Amplifier Circuit Boards LEDs

Amplifier Board LED	Indication
350V	Illuminates steady green after the Power up diagnostics pass, indicating a healthy status. This LED is located on the left side of the board, close to the top edge, as viewed with the front panel oriented towards the front.
SRC ON (right side *)	Illuminates steady green when the amplifier is enabled or turned on by ProTesT software, indicating an active source. This LED is located on the right side of the board, close to the top edge, as viewed with the front panel oriented towards the front.

* If the 350V LED is not illuminating green, replace the amplifier circuit board. Refer to *Chapter 5 "Field Replacement Procedures"*.

If all 6 350V LEDs are off, check the power supply. Refer to "Checking the Power Supply" on page 4-10.

CPU1 and CPU2 Circuit Boards

Either the CPU1 (Figure 4.4) or the CPU2 (Figure 4.5) circuit boards are installed in slot 3. Both boards have twelve LEDs located at the top and one push button.

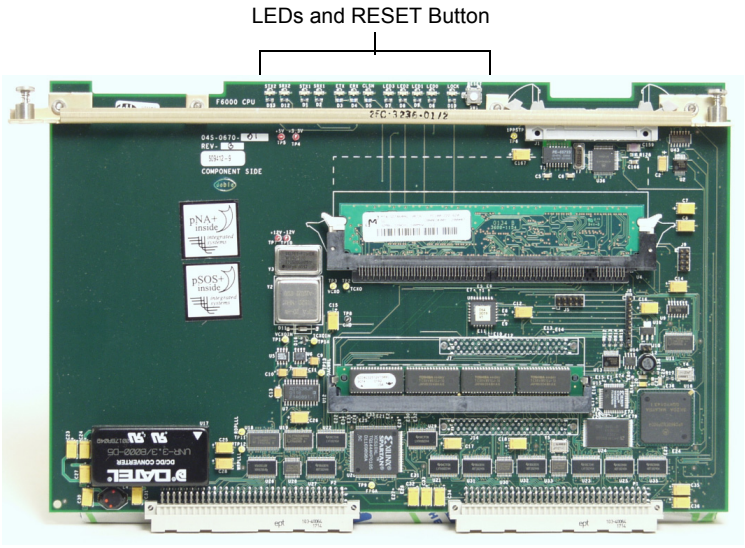

Figure 4.4 CPU1 Circuit Board

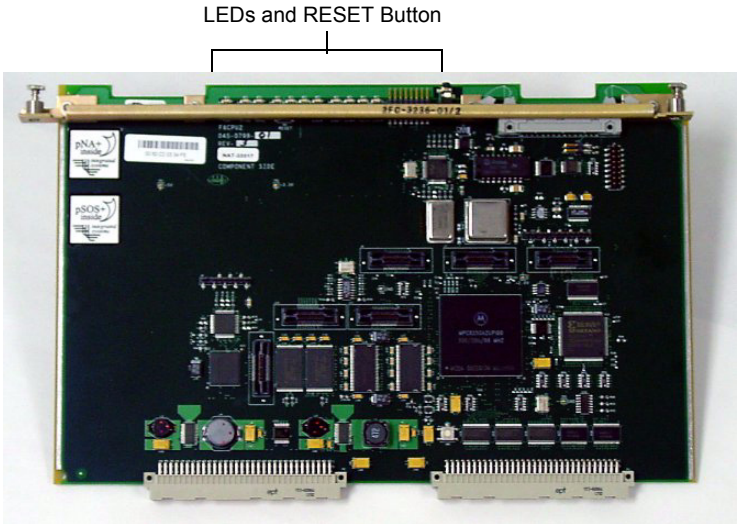

Figure 4.5 CPU2 Circuit Board

The LEDs indicate communication status (either RS-232 or Ethernet) and are described in Table 4.2. The *RESET* push button activates a new power diagnostic cycle when pressed.

Table 4.2 CPU Board 1 and 2 Communications Status Indications

CPU Board LEDs	Indication
	
STX2 [D13]	RS-422 GPS transmit active. Illuminates green during power up only, otherwise it is OFF.
SRX2	RS-422 GPS receive active.
STX1 [D1]	RS-232 serial port transmit active. Blinks red during RS-232 communication with the controlling computer.
SRX1 [D2]	RS-232 serial port receive active. Blinks red during RS-232 communication with the controlling computer.
ETX [D3]	Ethernet transmit active. Blinks during Ethernet communication. This LED is always OFF if no Ethernet cable is attached.
ERX [D4]	Ethernet receive active. Blinks during Ethernet communication. This LED is always OFF if no Ethernet cable is attached.
CLSN [D5]	Ethernet collision. Blinks red during power up, and when no Ethernet cable is attached.
LED3	General purpose lights used for CPU/RAM status and power-on self-test.
LED2	
LED1	
LED0	
LOCK	1 PPS lock for GPS communications ((not supported in this release

Analog Multiplexer Circuit Board

The Analog Multiplexer circuit board (Figure 4.6) is installed in slot 4 and has three LEDs. When the F6300 is powered up, but idle, all LEDs should be OFF. The Analog Multiplexer board LEDs are defined in Table 4.3.

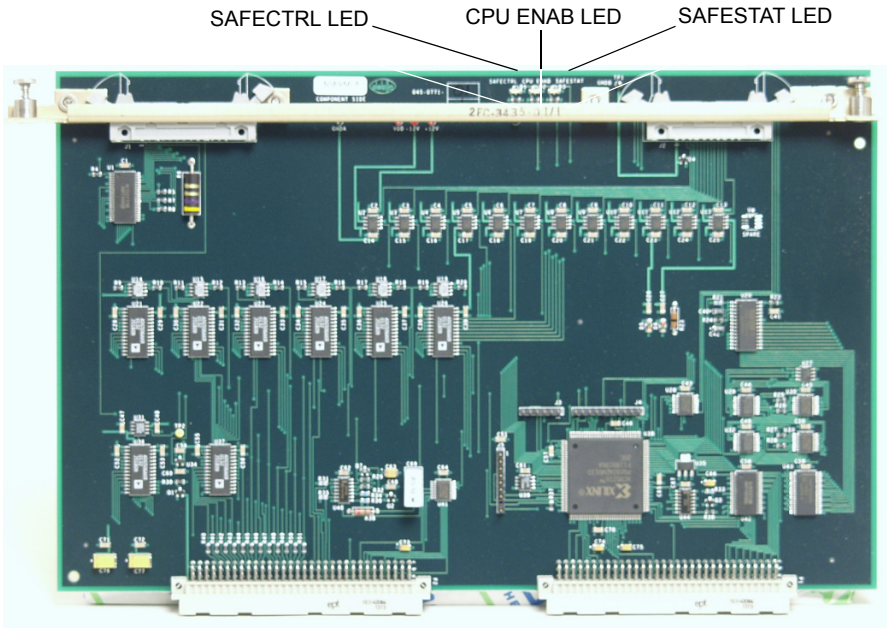

Figure 4.6 Analog Multiplexer Circuit Board

Table 4.3 Analog Multiplexer Circuit Board LEDs

Analog Multiplexer Board LED	Indication
SAFECTRL [D1]	Illuminates green when any source is turned ON. Does not illuminate during power up or when idle.
CPU ENAB [D2]	Illuminates green during power up only, then OFF.
SAFESTAT [D3]	Should never illuminate green during power up.

High Voltage Power Supply Circuit Board

F6300 instruments has a power supply board (04S-0794-01) that has an integrated Variable Output Battery Simulator. This board is located in slot 11 (Figure 4.6).

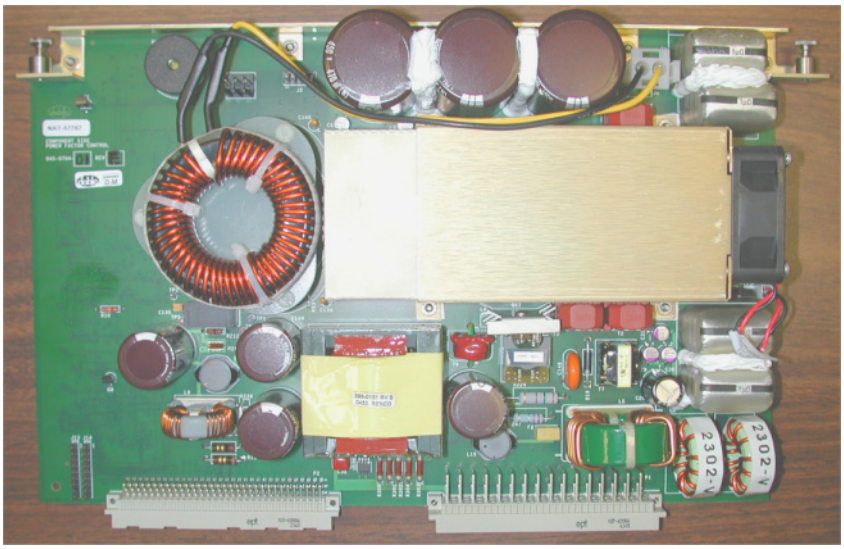

Figure 4.7 High Voltage Power Supply Circuit Board

If the board is diagnosed to be defective, just remove it in the same manner as the other circuit boards.

NOTE **This unit supplies the + 350 VDC to amplifiers and the variable output battery simulator power.**

Fuses

The 3 A fuse is located on the power supply board at F1.

Component Checkout Procedures

This section lists procedures for troubleshooting the following components:

- ″Checking the Power Supply″
- ″Checking the Current Amplifier Board″ on page 4-10
- ″Checking the Cooling Fans″ on page 4-10

Checking the Power Supply

To verify proper operation of the power supply:

1. Connect a multimeter to a ground point on the chassis, for example Test Point 8.
2. Measure each of the following test points on the F6300 CPU circuit board, located in slot 3 of the backplane:
   - Test Point #8 - Ground: Any point on the Instrument chassis can be used as a reference.
   - Test Point #5 - +5 V DC ±0.25 V
   - Test Point #7 - +12 V DC ±0.25 V
   - Test Point #7 - –12 V DC ±0.25 V

NOTE

These test points are not on the edge of the printed circuit board. They are located near the middle of the circuit board.

3. Replace the Power Supply Assembly circuit board (04S-0794-01) in slot 11 if any of the test point voltages are not present.

Checking the Current Amplifier Board

To verify proper operation of the amplifier circuit boards:

1. Select six i's from the ProTesT software.
2. Verify that the *350V* and *SRC ON* LEDs illuminate when enabled.
3. If any LED fails to illuminate when enabled, replace the circuit board for that amplifier.

Checking the Cooling Fans

To verify cooling fan operation, power up the F6150 and listen for the audible sound of the fans spinning. This sound is the only indication that the fans are functioning. No LEDs or error messages appear to indicate a problem until an over-temperature condition occurs.

CAUTION

It is very important to verify fan operation at power up. Equipment damage can result during operation with one or more broken fans.

If one or more of the cooling fans is not operating:

1. Power down the F6300.
2. Remove the cover. Refer to ″Remove and Replace the Instrument Front Panel″ on page 5-4.

3. Check that the large inductor (L1) located in the middle of the power supply circuit board has not broken loose:
   - If the L1 inductor has broken loose, replace the power supply board (04S-0676-01 or 04S-0676-02.)
   - If the L1 inductor has not broken loose, replace the fan. Refer to "Removing and Replacing the Cooling Fans" on page 5-10.

Resolving Communications Problems

If communication fails or cannot be established between the F6300 and the F6150:

1. Check the Ethernet cable.
2. Verify that the CPU circuit board LEDs (D1 & D2) are blinking.
3. If the communication cable is functioning and no conflicts are found, replace either the CPU circuit board, Analog I/O circuit board, or the Communications circuit board. Refer to Chapter 5 "Field Replacement Procedures" when replacing these boards.

Error Types

Three types of errors can occur while using the F6000 Instrument:

- "Hardware Errors"
- "Source Errors" on page 4-13
- "System Errors" on page 4-14

Hardware Errors

Hardware error messages display on the VFD on the Instrument front panel. They are often the first sign that something is not functioning properly in the Instrument.

NOTE

Hardware errors must be resolved before further testing can proceed. Check and ensure that the IP address is set correctly on the F6150 and F6300.

Table 4.4 describes hardware errors and possible solutions.

Table 4.4 Hardware Error Resolution

Error Message	Description	Action (Refer to Chapter 5 "Field Replacement Procedures" when replacing boards)
Cal A/D Hardware failure	The calibration analog to digital conversion hardware failed.	Replace the Analog Multiplexer board.
Analog GND sense failed	The analog GND sense failed.	Check the power supply with a voltmeter (discussed earlier in this chapter.) If the voltages are not correct replace the power supply board. If the voltages are ok replace the analog I/O board.
Missing/bad Analog Multiplexer board	The Analog Multiplexer board is either missing or bad.	Replace the analog Multiplexer board.
Missing/bad (I AMP#1) SLOT 5	The amplifier in slot 5 is either missing or bad.	Replace the amplifier board in slot 5.
Missing/bad (V AMP#2) SLOT 6	The amplifier in slot 6 is either missing or bad.	Replace the amplifier board in slot 6.
Missing/bad (V AMP#1) SLOT 7	The amplifier in slot 7 is either missing or bad.	Replace the amplifier board in slot 7.
Missing/bad (V AMP#2) SLOT 8	The amplifier in slot 8 is either missing or bad.	Replace the amplifier board in slot 8.
Missing/bad (I AMP#1) SLOT 9	The amplifier in slot 9 is either missing or bad.	Replace the amplifier board in slot 9.
Missing/bad (I AMP#2) SLOT 10	The amplifier in slot 10 is either missing or bad.	Replace the amplifier board in slot 10.
Missing/bad HVPS	The high-voltage power supply is either missing or bad.	Check the power supply with a voltmeter (discussed earlier in this chapter.) Replace the board if necessary.
Bad/Blank CPU EEPROM	The CPU board is either bad or the EEPROM has no data.	Replace the CPU board.

Source Errors

Source errors display in the Source Table of the ProTesT Control Panel Version 2 (see the F6150 User Guide.) A Source error is typically due to problems with the load. For example:

- Current is driven into an open circuit or high impedance.
- Power requirements of the relay under test exceed the capacity of the source.

If a source error occurs:

- The name of the affected source displays as *ER* and blinks in the Source Table.
- The Amplitude and Phase fields for the affected source blink in the Source Table.
- An audible alarm sounds from the speakers of the control PC.

Common source errors are defined in Table 4.5.

Table 4.5 Source Errors

Error	Description	Action
Transient over 1.5 seconds	Hardware disables the source.	Turn off the source.
Peak current	Hardware disables the source. Normally, this error does not occur for a current source. It typically means a voltage source is overloaded (as, for example, when a short circuit occurs at high amplitude.)	Reduce the current on the F6150.
Clip Fast	A current source cannot drive a load.	
Clip Slow	A current source cannot drive a load.	
Battery Power Limit	Battery simulator load has exceeded maximum power output of 60 W.	Reduce the battery simulator load.
Battery Current Limit	Battery simulator load has exceeded maximum current limit of 1.25 A at 48 volts.	Reduce the battery simulator load.

System Errors

System errors are indicated on the Source Table of the ProTesT Control Panel Version 2. A System error occurs when an Instrument component controlled by ProTesT is functioning improperly. For example, a current amplifier overheats and ProTesT shows a system error message (Figure 4.8).

System errors display in a ProTesT dialog box. Figure 4.8 shows the first message that appears.

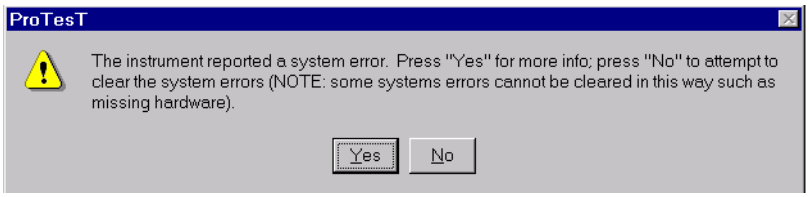

Figure 4.8 System Error

Click **Yes** for more information about the system error, as in Figure 4.9.

Figure 4.9 System Error Explanation

Click **OK** to close the dialog box and clear the system error. As the note in the dialog box indicates, the system error does not clear if the problem is related to a bad amplifier or missing hardware.

Use Table 4.6 to diagnose and correct system errors.

Table 4.6 System Error Resolution

Error	Description	Action
Current monitor (Power supply high amps)	Input line current is too large. Hardware detects that the Instrument is drawing too much current from the wall. The total of all amplifier outputs exceeds system specifications.	Reduce the source amplitude or reduce the load.
Voltage monitor (Power supply high volts)	Either the AC input line voltage is too high, or power is being fed back into the F6300 through the amplifier outputs.	Reduce the input line voltage.

Table 4.6 System Error Resolution (Continued)

Open ground detector (Power supply)	Hardware detects an open ground detector.	This hardware problem must be addressed before it is safe to operate the F6300. When the F6300 clears the error, it occurs again if the hardware problem has not been fixed.
+12 Volt fail monitor (DC power supply)	Hardware disables amplifiers to prevent damage to relays on the amplifier assemblies if System +12 V falls below a threshold of approximately +5 volts.	Check the DC power supply.
Fan flow monitor error	Fans are blocked or inoperative.	Verify fan operation (discussed earlier in this chapter.) Replace the fan assembly if required. If the fans are functioning, replace the power supply circuit board.*
Source Disabled	One or more sources were disabled by the hardware.	Verify the status of the amplifier circuit boards (discussed earlier in this chapter.) Replace the board if necessary. *
Over Temperature or fuse blown (I AMP #4)	Amplifier in slot 5 is overheated or has a blown fuse.	Replace the amplifier board in slot 5.*
Over Temperature or fuse blown (I AMP #5)	Amplifier in slot 6 is overheated or has a blown fuse.	Replace the amplifier board in slot 6.*
Over Temperature or fuse blown (I AMP #6)	Amplifier in slot 7 is overheated or has a blown fuse.	Replace the amplifier board in slot 7.*
Over Temperature or fuse blown (I AMP #7)	Amplifier in slot 8 is overheated or has a blown fuse.	Replace the amplifier board in slot 8.*

Table 4.6 System Error Resolution (Continued)

Over Temperature or fuse blown (I AMP #8)	Amplifier in slot 9 is overheated or has a blown fuse.	Replace the amplifier board in slot 9.*
Over Temperature or fuse blown (I AMP #9)	Amplifier in slot 10 is overheated or has a blown fuse.	Replace the amplifier board in slot 10.*
Missing analog multiplexer board	Hardware is missing or not communicating properly with the CPU.	Check the communication cable. If OK, replace the analog multiplexer board in slot 4.*
Control Panel Mode	Option F6909 required.	Call Doble Customer Service.
Macro Mode	Option F6910 required.	Call Doble Customer Service.

* Refer to Chapter 5 ″Field Replacement Procedures″ when replacing any boards.

NOTE1

Some system errors cannot be cleared. For example, if the Instrument has no Analog Multiplexer board, the error condition remains until the board is supplied. If any of the fuses on any of the Amplifier boards are blown, the F6300 will not be operational. Visually inspect the Amplifier fuses to ensure that the fuses are functional.

5. Field Replacement Procedures

This chapter explains how to replace a major component in the field. The procedures apply to the replacement of a failed component or to the installation of a new upgrade. To replace a component in the field, follow these basic steps:

1. Turn the instrument off.
2. "Remove the Instrument Cover" on page 5-2.
3. "Perform a Power Up and a Visual Check to Identify a Faulty Component" on page 5-4)
4. Turn the instrument off and remove the power cord.
5. Replace the component.
6. Replace the cover, plug in the power cord and turn the instrument on.
7. Verify that the replacement solves the problem.

The replaceable components in the F6300 are:

- Instrument front panel
- Communications board
- Circuit boards in slots 1 through 11
- Cooling fans

Preparatory Steps

The replacement of any component in the F6300 requires removal of the cover first. If the cause of a problem is undetermined at the time the cover is removed, turn the instrument on and check the components visually. When the faulty component is identified, follow the replacement procedures in this chapter.

VOLTAGE

When replacing internal components, follow safe procedures designed to protect against electrical shock. Always turn the unit off before making contact with any of the internal components.

CAUTION

The F6300 contains electrostatic-sensitive components. Practice safe handling methods to protect components against electrostatic discharge.

Remove the Instrument Cover

Remove the cover to access the replaceable components in the Instrument. Figure 5.1 illustrates the location of these components.

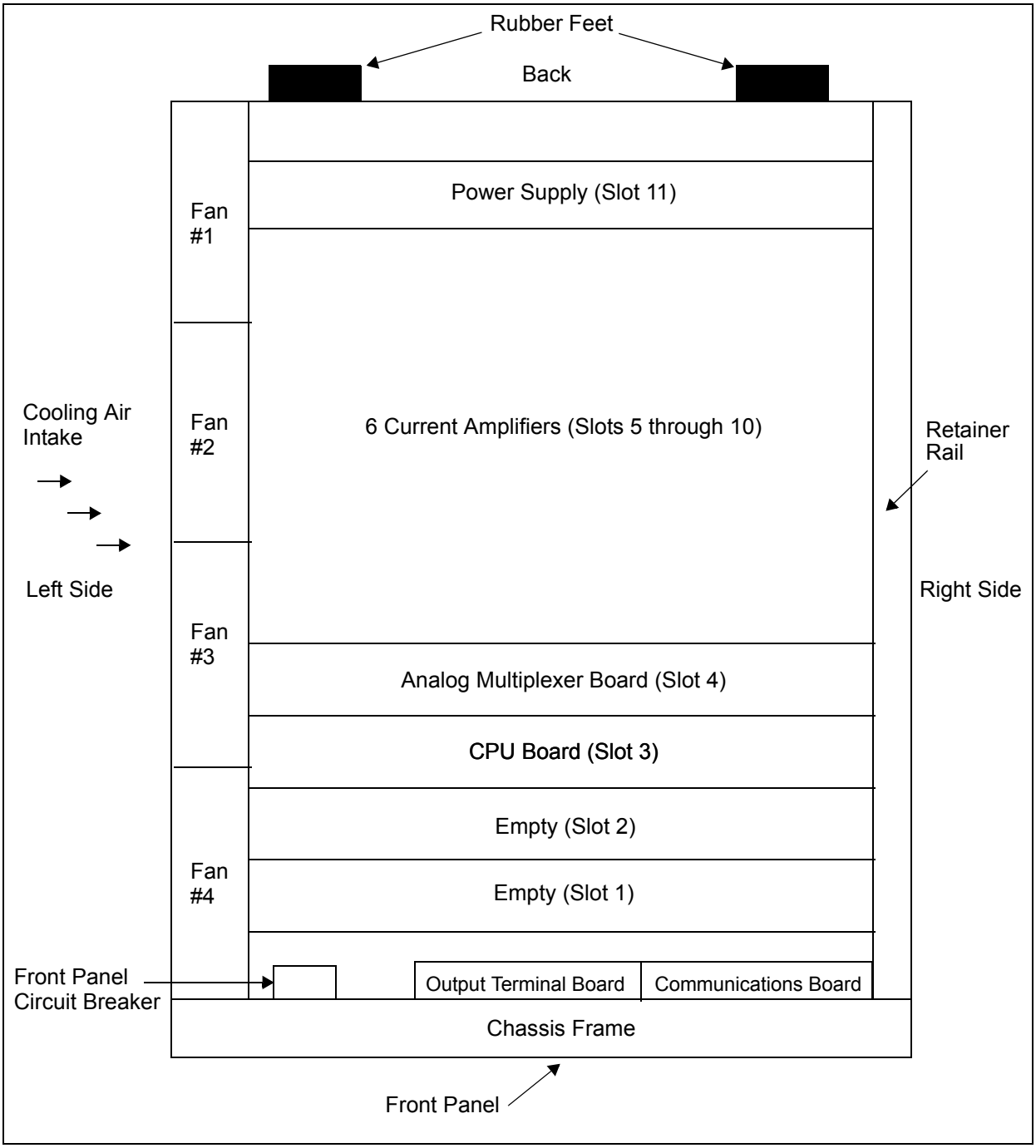

Figure 5.1 F6300 Components

To remove the instrument cover:

1. Turn the instrument off.
2. Remove the power cord.
3. Use a flat head screwdriver to remove the top two rubber feet from the back of the instrument (Figure 5.2).

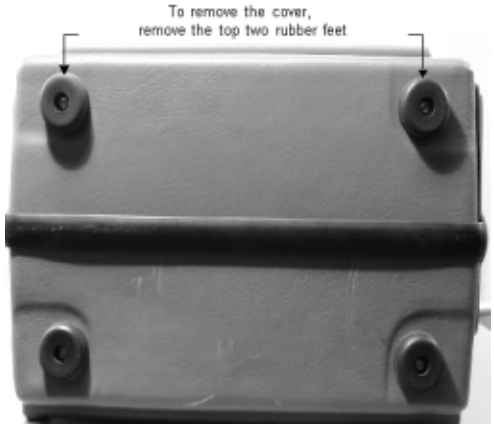

Figure 5.2 Remove Rubber Feet

4. Remove the cover to expose the circuit boards and other components inside the instrument (Figure 5.3).

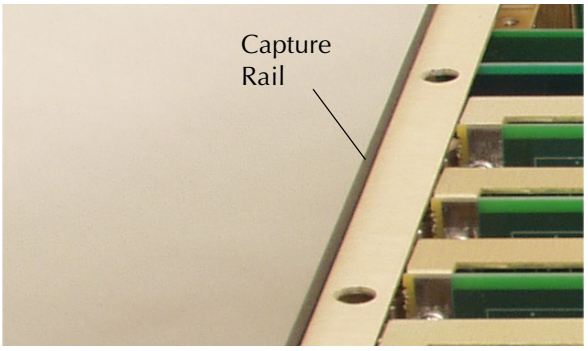

Figure 5.3 F6300 Circuit Boards

5. Use a Phillips head screwdriver to remove the screw on the side of the capture rail.
6. Use a flat head screwdriver to remove the four screws on top of the capture rail and remove the capture rail.

Perform a Power Up and a Visual Check to Identify a Faulty Component

Perform a power up and a visual check:

1. Attach the power cord to the instrument and turn it on.
2. Observe the LEDs on the left side of each amplifier board:
   - A green light indicates that the board is working properly.
     When the sources are active, the green LED on the right side of an amplifier board illuminates when that particular amplifier is supplying power.
   - No light indicates a faulty amplifier board.
3. Verify, through the audible sound, that the four cooling fans are operating.

Remove and Replace the Instrument Front Panel

Remove the front panel of the instrument:

1. Remove the 12 hex-head screws from the front panel (Figure 5.4).
2. Disconnect W6, W7, and W20, from the CPU board and the Analog Multiplexer board.
3. Rest your fingers on the inside surface of the front panel and grasp the top of the black instrument frame.
4. Push the panel forward and swing the panel to the side.

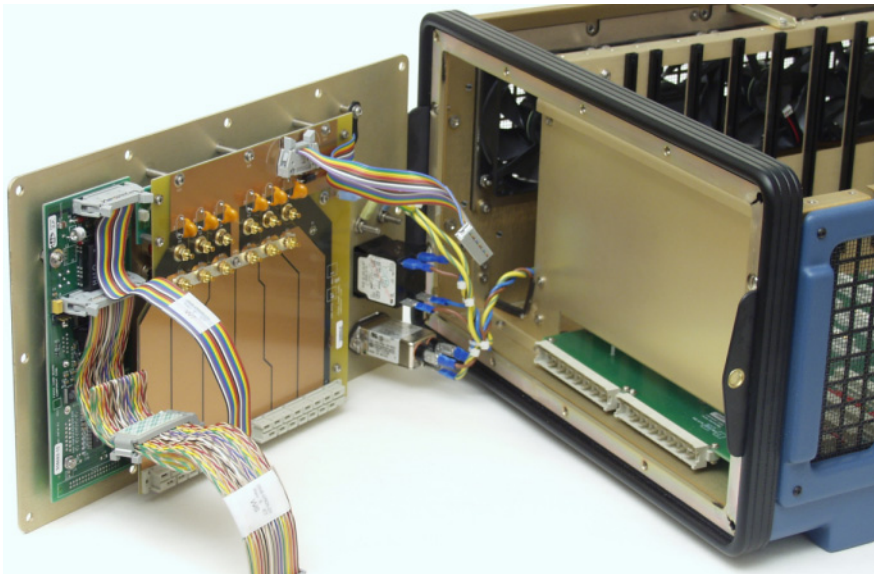

Figure 5.4 F6300 with Front Panel Swung to Side

5. Gently lift the front panel away from the instrument and lay the front panel face down on the table in front of the instrument. A High Current Interface connects the lower part of the Output Terminal board to the motherboard. Carefully work this connection loose as the front panel tilts away from the chassis frame

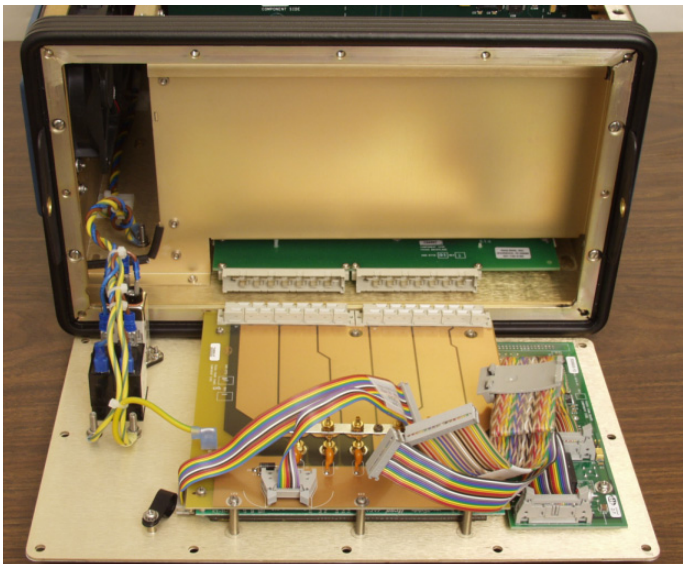

Figure 5.5 F6300 with Front Panel Removed

6. Disconnect wires W20 from the Output Terminal board.
7. Disconnect wires W6 and W7 from the communications board and set them aside for use with the new front panel.

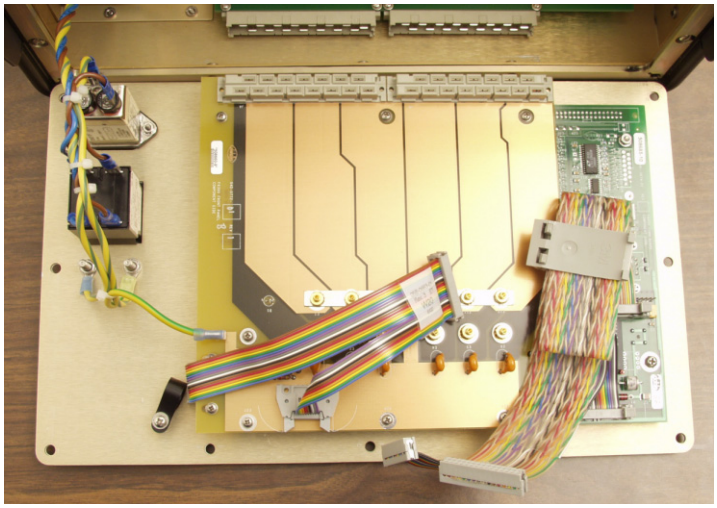

Figure 5.6 W6 and W7 Wires Disconnected

8. Disconnect the blue and brown AC wires that lead from the circuit breaker back to the instrument.
   - Grasp the blue insulation.
   - Pull hard and work the connectors loose.
9. Use an open-ended wrench to remove the hex nut that secures the chassis ground wire to the circuit breaker.

10. Disconnect the ground wire (Figure 5.7).

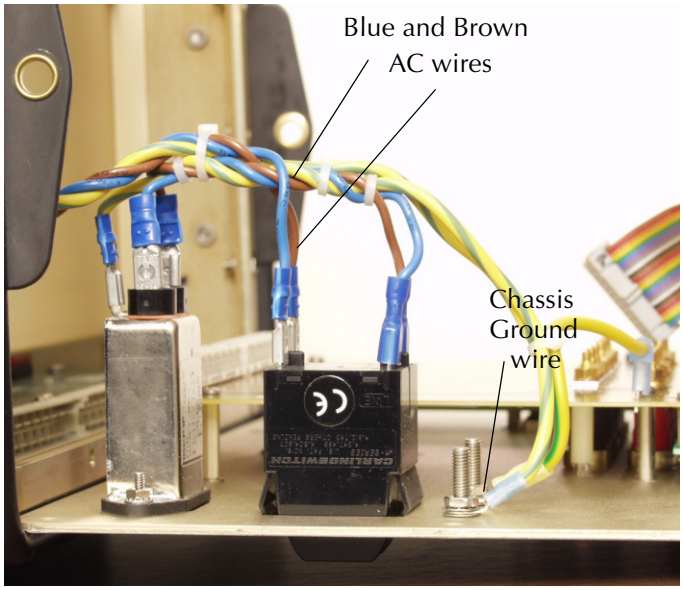

Figure 5.7 Location of the AC Leads and the Ground Wire

Figure 5.8 shows the circuit breaker after the blue AC lead, the brown AC lead, and the chassis ground wire disconnected.

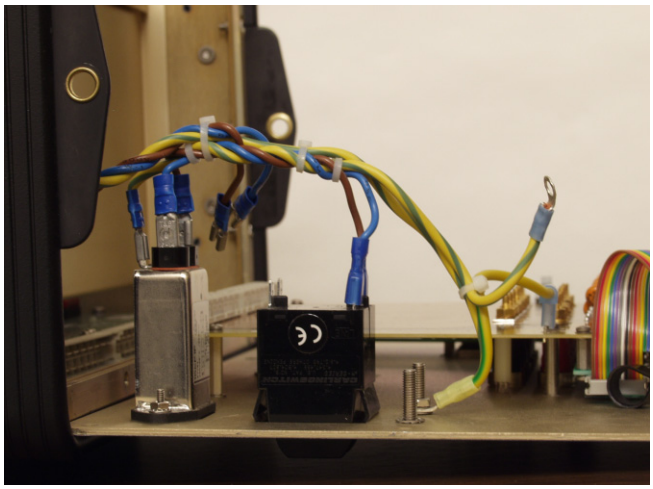

Figure 5.8 AC Leads and Chassis Ground Disconnected

The front panel is now completely disconnected from the instrument.

Replace the front instrument panel:

1. Lay the new front panel face down in front of the instrument, with the communications board on the right.
2. Reconnect the ground wire in front of the circuit breaker.
3. Reconnect the blue and brown AC leads to the circuit breaker.
   - Connect the blue lead opposite the blue wire at the front of the circuit breaker.
   - Connect the brown lead opposite the brown wire at the front of the circuit breaker.
4. Reconnect wire W8 to the Output Terminal board.
5. Tilt the front panel up and rest the bottom of the front panel inside the bottom of the black instrument frame.
6. Line up the connector at the bottom of the High Current Interface board with its mate on the motherboard.
7. Tilt the front panel into a vertical position and press the bottom of the panel until the High Current Interface connector mates.
8. Secure the front panel with 12 hex-head screws.
9. Reconnect W6, W7, and W20.

NOTE

All the wires in the F6300 (Table 5.1) connect to the communications board or the output terminal board on the instrument front panel.

Table 5.1 F6300 Connections to the Front Panel

Wire	Connects From	Connects To
W6	Communications board	CPU board
W7	Communications board	Analog I/O board
W20	Analog Multiplexer board	Output Terminal board

10. Replace the instrument cover.

Removing and Replacing the Communications Board

The communications board supports the input and output terminals on the right side of the front panel. To replace the communications board, first remove the instrument front panel, but *do not disconnect the leads from the circuit breaker* on the left side of the panel.

1. Remove the front panel using the procedure in "Remove and Replace the Instrument Front Panel" on page 5-4 to access the Communications board.
2. Remove the two Phillips head screws that secure the communications board to the front panel (Figure 5.9).

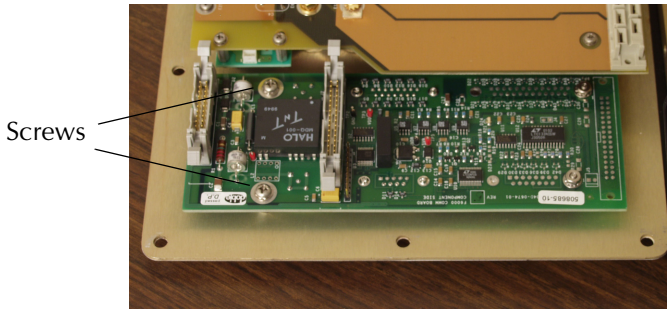

Figure 5.9 Communications Board Screws

3. Tilt the front panel up until it leans against the instrument.
4. Use an open-ended wrench or pliers to remove the eight nuts on the right side of the front panel (two for each of the four connectors).
5. Tilt the front panel back down until it lies face down on the table.
6. Lift the communications board off the front panel.
7. Place the new communications board in its position on the right side of the front panel.
8. Secure the communications board to the front panel with the two Phillips head screws.
9. Use an open-ended wrench or pliers to turn the 8 nuts on the front of the front panel.
10. Tilt the front panel back into place. Be sure the High Current Interface at the bottom of the front panel mates properly with the connector on the motherboard.
11. Secure the front panel to the instrument chassis with the 12 hex-head screws.
12. Reconnect wires W2, W3, W4, W5, W6, and W7 (Table 5.2).

Table 5.2 W2, W3, W4, W5, W6, and W7 Connections

Wire	Connects From	Connects To
W6	Communications board	CPU board
W7	Communications board	Analog I/O board
W20	Analog Multiplexer board	Output Terminal board

13. Replace the instrument cover.

Removing and Replacing Circuit Boards

Doble Customer Service may recommend that a circuit board be replaced to remedy an operating problem. None of the solid-state circuit boards requires user calibration or adjustment. Table 5.3 contains a list of slot numbers and circuit boards in the F6300

Table 5.3 Circuit Board Slot Numbers

Slot Number	Circuit Board
Slot 1	Spare slot (**Front**)
Slot 2	Spare slot
Slot 3	CPU board
Slot 4	Analog Multiplexer board
Slot 5	Current amplifier #1
Slot 6	Current amplifier #2
Slot 7	Current amplifier #3
Slot 8	Current amplifier #4
Slot 9	Current amplifier #5
Slot 10	Current amplifier #6
Slot 11	Power supply (**Back**)

NOTE

Remove or insert printed circuit assemblies carefully to avoid damage to their mating connectors. To ensure that new boards go into their correct locations, replace them individually.

Contact Doble for a replacement circuit board, or obtain one from your company inventory of replacement parts, if available.

To replace a circuit board:

1. Turn the instrument off.
2. Remove the power cord.
3. Disconnect all external cables from the instrument.
4. Remove the instrument cover.
5. Remove the capture rail.
6. Disconnect any circuit board ribbon cables required to perform the replacement.
7. Unscrew the captive fasteners on the circuit board.
8. Firmly grasp the defective board and pull it straight up.
9. Place the new board firmly in the slot and make sure it is squarely seated.
10. Re-attach ribbon cables if necessary.

11. Replace the capture rail.
12. Attach the power cord and turn the instrument on.If the new board is a current amplifier, verify that the healthy status indicator light on the left side of the board is ON.

Removing and Replacing the Cooling Fans

The fan assembly has an integral power supply with two power modules; one provides - 12 Vdc and another provides +5 and +12 Vdc. They are located at the bottom of this unit (Figure 5.10).

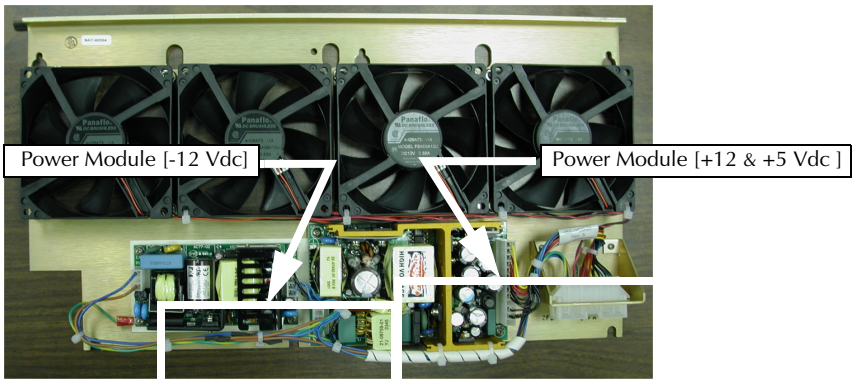

Figure 5.10 Fan Assembly with Integral Power Supply

Unlike the initial style fan assembly, all the steps in the removal procedure for the new style are performed inside the enclosure. Use these steps:

1. Turn the instrument off.
2. Remove the power cord.
3. Remove the instrument cover.
4. Remove the two Phillips head screws that hold the top retaining bracket (Figure 5.11)

NOTE

The two screws that secure the retaining bracket are of different length. When the bracket is replaced during reassembly, put each screw in its original position.

Figure 5.11 Retaining Bracket for Cooling Fan Assembly

5. Loosen the Phillips head screws that secure each end of the assembly. These screws fit inside oblong shaped holes on the assembly rail (Figure 5.12).

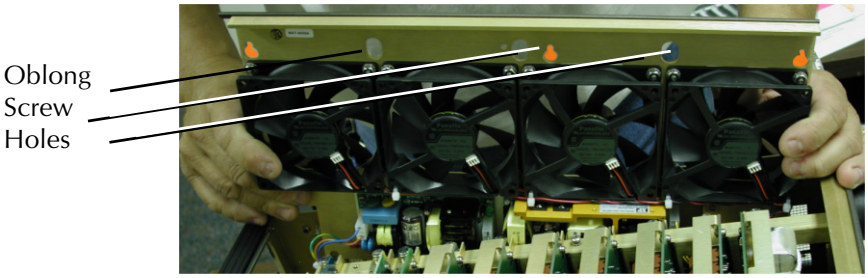

Figure 5.12 Screw Holes on Fan Assembly Rail

6. Slide the board upward; tilt it forward; pull the board up and out of the chassis.

7. Ensure that you do not snag or nick any wires on the assembly.

Study the instrument chassis with the Fan Assembly removed (Figure 5.13). Prior to replacing this style fan assembly, locate the electrical connector, the various standoffs, and screws.

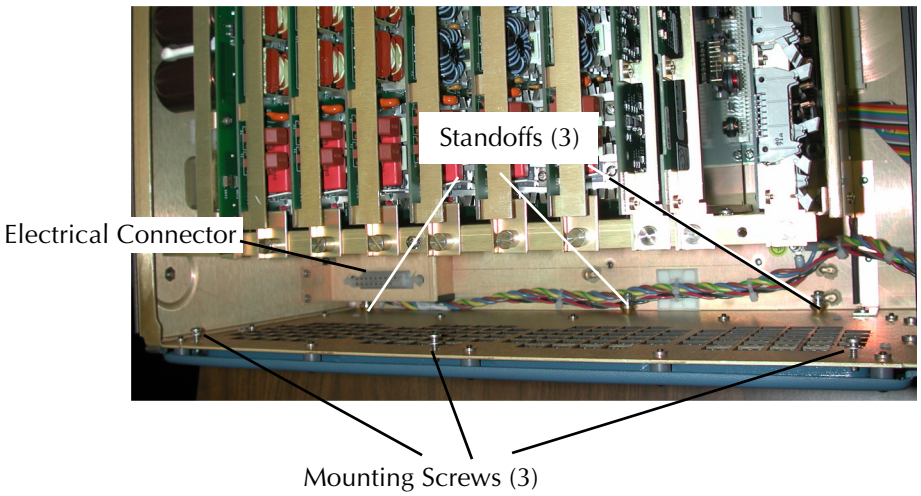

Figure 5.13 Instrument Chassis with Fan Assembly Removed

Procedure for installing the fan assembly:

1. Ensure that the three Phillips head screws are backed out of their holes, but not removed.
2. Carefully lower and align the fan assembly over the connector, the three standoffs, and the three mounting screws.
3. Press the assembly into place, ensuring that the male connector (on the fan assembly) is seated with the connector socket.
4. Tighten the two end screws to secure the fan assembly rail.
5. Install the center bracket with the appropriate screws.

Verify the Replacement

To determine whether the replacement procedure is successful:

1. Turn the instrument on.
2. Monitor the messages on the front panel as the instrument goes through its startup sequence.
3. Check the status indicator light on the left side of each amplifier board.If the replacement is successful, the status indicator lights are green and the error message on the front panel is cleared.
4. Repeat the test sequence that led to the error.
5. Check the instrument front panel for error messages.
6. Check the Control Panel Version 2 in ProTesT for source errors.

Replaceable Components and Cables

Table 5.4 provides you with the part numbers of field replaceable items

Table 5.4 Field Replaceable Items

Part Number	Field Replaceable Part
04S-0670-01	F6CPU1 board
04S-0799-01	F6CPU2 board
04S-0771-01	Analog Multiplexer board
04S-0674-02	F6 Communications board
04S-0801-02	F6 Communications II board
04D-0772-01	Output Terminal board
04S-07946-01	High Voltage Power Supply board
04S-0678-01	Current Amplifier board
03D-1356-01	Front Panel Assembly
384-0167	3 A Fuse for High Voltage Power Supply board
384-0169	5 A Fuses (for the Current Amplifier board)
2Fd-3189-01	Carrying Strap

Table 5.5 lists all the cables and cable components used with the F6300.

NOTE

If a system failure is traced to a particular cable, ensure that the cable is properly seated and connected before replacing it. Contact Doble Customer Service to order replacement cables.

Table 5.5 Replacement Components and Cables

Part Number	Description
05B-0531-01	Cable, 90A, 5 FT, Black, F2250
05B-0616-01	Assy, Cable, I Output
05B-0619-02	Cable, Adapt #4 R LUG-3x4 mm, F
05B-0662-01	Assy, Cable I PWR Amp Out
181-0088	Cord, Power, 14AWGX3, USA Plug
181-0118	Cable, RG58C/U, 500 HM 20 A M/M
401-0042	Cable, Molded, 5 FT, 15 P, SYNC
401-0157	Terminator, In-line 50 Ohm BNC
401-0160	Adapter, BNC, T, F/M/F
401-0167	Cable, RS-232, INSTR-PC 10 Ft/3.05 Meter
401-0242	Adapter, 10BaseT
401-0243	Cable. ethernet, RJ45/RJ45, 10’

6. Safety and Maintenance

This chapter discusses rules for the safe operation of the F6300, and several topics related to maintenance of the unit.

F6300 Rules for Safe Operation

Safe operation of the system requires adherence to the following guidelines:

- *Do not*, for any reason, cut or remove the grounding prong from the power cord.
- **Do not** defeat the AC power input source ground connection, and verify that the power connections have proper hot and neutral polarity.
- Use the correct electrical line voltage to avoid an electrical short circuit, overheating and shocks. If in doubt, check the electrical rating label attached to each unit.
- Always turn the power **OFF** and disconnect the F6300 from line power before reaching into the instrument.

WARNING

The F6300 contains capacitors capable of storing hazardous voltages even after the instrument is turned off and the power cord is removed. Always proceed with caution when reaching into the instrument.

- Never insert metal objects, such as screwdrivers or paper clips, inside the instrument while power is ON.
- Unplug the instrument if it is not to be used for an extended period of time, or before cleaning.
- If the instrument is dropped, have it checked by a qualified service technician before placing it back in service. Dropping the instrument can disturb the insulation system.
- Do not place the instrument in excessively warm or humid locations.
- If the instrument is dropped or physically damaged, or if spilled liquid penetrates the instrument case, return the instrument to Doble for repair.

The F6300 output and measurement terminals are intended for Installation Category I usage. The F6300 power input is intended for connection to an Installation Category II (overvoltage category) AC main supply. The F6300 is intended for indoor use only.

Cleaning the F6300

To clean the instrument, sponge the instrument covers and panels with a mild soap solution. Observe the following precautions whenever the instrument is cleaned:

- Disconnect the instrument's power cord and all other external cables before cleaning or removing the instrument cover.
- *Do not* use household cleaners containing chlorinated or abrasive compounds.
- *Do not* spray liquids directly onto the instrument.
- Do not use flammable liquids, such as gasoline or lighter fluid, for cleaning electrodes, electrical components or moving parts.

Customer Service

To request assistance with any question or problem, call Doble Engineering Customer Service at 617-926-4900 or send e-mail to customerservice@doble.com. Before contacting Customer Service for help, please take the following preliminary steps:

- Review the pertinent portions of this user guide.
- Check all cable connections.
- Work through the diagnostic flow charts shown in Chapter 5 to identify and isolate problems in F6300 operations.
- Perform the *Component Checkout Procedures* in Chapter 5 to verify component operations.
- If the instrument fails during a relay test and another instrument is available, try the test using the second instrument.
- If the instrument fails during a relay test, compare the requirements in the test plan to your test setup and source configuration.

If possible, have the instrument set up near a telephone to facilitate telephone assistance. Please have the following available when calling Customer Service:

- The instrument serial number, which is found on the bottom outer case of the F6300.
- The hardware configuration and software revision, which are displayed on the instrument front panel during the bootup sequence.
- A precise description of the problem. Include any error messages that have appeared, and the sequence of events leading to the messages.
- The solutions that have been tried.
- Electronics tool kit and digital multimeter, in case Customer Service suggests that a board or subassembly be removed.

Write down the name of the Customer Service representative, and ask to speak to the same person during subsequent calls. Write down any instructions the representative gives during a service call.

Returning the F6300

If troubleshooting checks and the replacement of defective parts in the field fails to correct a problem with the instrument, the F6300 may need to be returned to Doble for servicing. Contact Doble Engineering Customer Service at 617-926-4900 before shipping the instrument.

To prepare the F6300 for shipping, disconnect all external cables and attach the cover that protects the front panel of the instrument. Use the original packing materials if they are available. If the original packing materials are not available, pack the instrument for shipment as for any fragile electronic equipment.

Triple-wall shipping containers can be ordered from Customer Service for a nominal charge (Doble Part # 903-0045). Alternately, the instrument may be packed using either of the following methods:

- Double-wall cardboard box with a minimum of 2-inch thick poly foam padding all around.
- Wooden crate with a minimum of 2-inch thick poly foam padding all around.

NOTE

Doble Engineering is not responsible for shipping damage. Carefully protect each instrument from shipping and handling hazards. Ensure that protective covers are securely in place.

Send the instrument to Doble Engineering, freight pre-paid, unless other arrangements have been authorized in advance by Doble Customer Service. The shipping address is:

Customer Service Manager

Doble Engineering Company
85 Walnut Street
Watertown, MA 02472-4037

Before returning the instrument to Doble Engineering, contact Customer Service to obtain a **Return Material Authorization** (RMA) number. The RMA number must be attached to the instrument, as it is used to track the instrument through the repair cycle.

Do not return instruction manuals and cables with the instrument, unless Doble Customer Service requests these items.

Appendix A. Firmware Maintenance

Use the utilities available in ProTesT to accomplish routine maintenance of the software:

- The *F6000 Flash Loader* installs revised firmware.

Open both utilities from the *Tools* pull-down menu in the ProTesT menu bar.

NOTE

When the F6300 Instrument boots up, the current firmware revision number appears in the display on the instrument front panel.

Flash Loader

The Flash Loader installs revised firmware in the F6300 Instrument:

- Select *Tools > F6000 Flash Loader* in the ProTesT menu bar to open the program and the *Flash Loader* window appears (Figure A.1).

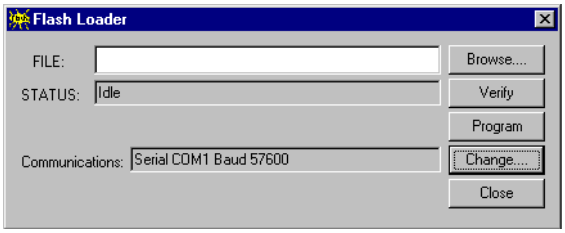

Figure A.1 Flash Loader

Table A.1 explains the fields and buttons in the Flash Loader window.

Table A.1 Flash Loader Buttons and Fields

Fields and Buttons	Description
File	Displays the name of the package file to load.
Status	Shows the progress of the last action.
Communication	Displays the current settings for communication between the computer and the F6300 Instrument.
Browse	Browses for the location of the package file to load.
Verify	Verifies whether or not the current firmware version in the instrument matches the selected version.
Program	Downloads the selected package file to the F6300 Instrument.
Change	Changes the communication settings.
Close	Closes the Flash Loader and aborts any actions in progress.

About F6XXX Firmware

The operation of the for F6150 and F6300 in conjunction requires the same version of F6xxx firmware be loaded in both instruments:

- 2.11 (or higher) for CPU1 instruments
- 4.11 (or higher) for CPU2 instruments

The F6150 and F6300 instruments require different firmware package files, *.pkg. The package file with:

- F6150 in the name is for the F6150 instrument.
- F6300 in the name is for the F6300 instrument.

Use the F6 Flash Load to load the correct firmware to the instruments.

Down-loading the F6150/F6300 Firmware

Loading new firmware into an existing F6150 is all that's required to use the F6150 Power System Simulator with the F6300 High Current Module. To download the F6150 firmware:

1. Open ProTesT and ensure that the communications are setup correctly. The communication cable must connected directly to the F6150.
2. Select *Tools > F6000 Flash Loader* from the menu bar.
3. Click on the Browse button and browse to the firmware package file. Click **Open** to select the file (Figure A.2).

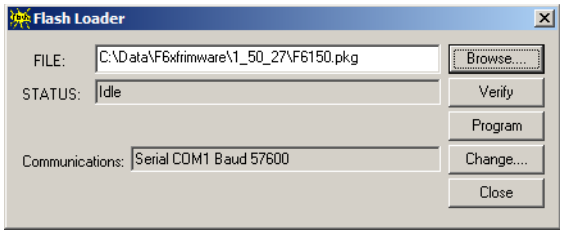

Figure A.2 Flash Loader Browsing

4. Click **Program**.

   The Flash Loader *Status* field shows the status of the download.

NOTE

DO NOT power cycle the or disconnect the computer until the Flash Loader download is complete.

A Flash load successful message appear on a successful flash download (Figure A.3).

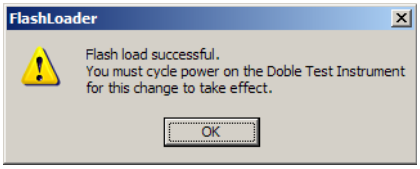

Figure A.3 Flash Load Success

5. Click **OK** to close the dialog windows and power cycle the instrument.

Communications Parameters

If the revised firmware does not load successfully, check the setup for communication between the computer and the F6150/F6300 Instrument. To verify or change the communications settings:

1. Click **Change** in the *Flash Loader* window and the *Set Communications Parameters* window appears (Figure A.4).

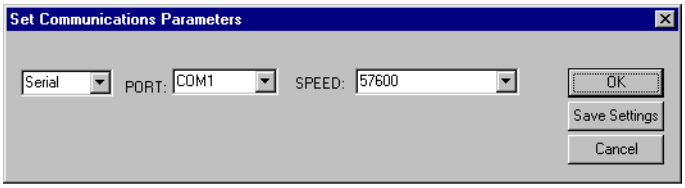

Figure A.4 Set Communications Parameters

2. Select the correct setting from each of the three pick lists in the display:
   - *Connection type* - Serial or EthernetPort
   - *Port* - COM1 through COM32
   - *Speed* - The connection speed must be 57,600 baud per second

3. Click **OK**.

To make the settings in the *Set Communications Parameters* window the default settings for future firmware updates, save them in the ProTest INI file:

1. Click **Save Settings** and the **FlashLoader** dialog box appears (Figure A.5).

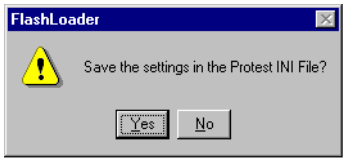

Figure A.5 Flash Loader Save Settings

2. Click **Yes** to save the settings in the INI file.

NOTE

The Flash Loader normally updates the FLASH by communicating with the application that is already in the FLASH. The link is made using either serial or Ethernet communication. If there is no valid application in the FLASH, the loader updates the FLASH by communicating with the boot loader that is already in the FLASH. In this case, the update can only be done using serial communication.

Appendix B. Configuring Windows for Ethernet Communications

Configuring the Control PC

To configure Windows 98/2000/NT/XP for communication with the F6300 on a private network:

1. Right-click the *Network* icon on the desktop and select *Properties* for all supported Windows systems and the *Network* window appears (Figure B.1).

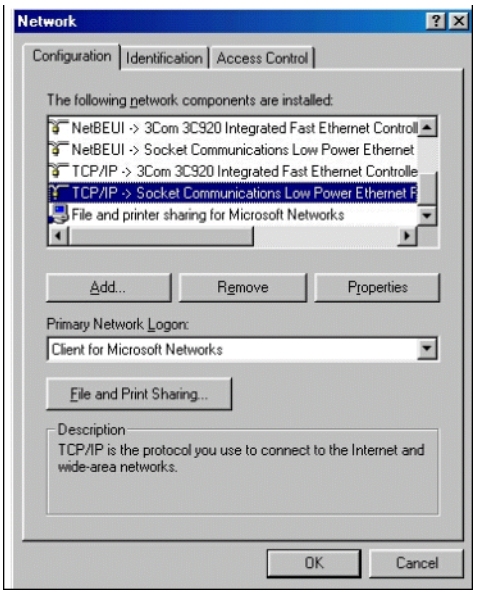

Figure B.1 Network

2. Scroll down the list of network components in the *Configuration* tab and select the component that corresponds to the Ethernet card in the control PC.
3. Click **Properties** underneath the list of network components. The TCP/IP dialog box opens (Figure B.2).

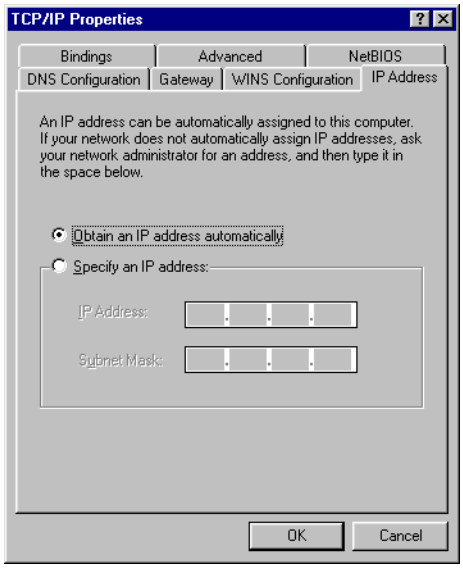

Figure B.2 TCP/IP Properties

4. Select the *IP Address t*ab in the *TCP/IP Properties* dialog box.
5. Select the radio button for *Specify an IP address*.The *IP Address* and *Subnet Mask* fields become available.
6. Enter an IP address in the *IP Address* field, close to, but different from the IP address that is displayed on the F6150 after it is turned on.
7. Enter the subnet mask in the *Subnet Mask* field (Figure B.3).

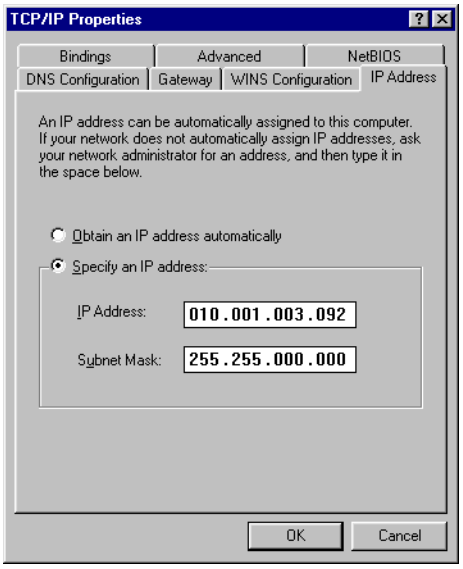

Figure B.3 TCP/IP Properties

8. Reboot the computer to effect these changes if required.

9. Double-click the MS-DOS icon on the desktop to open an MS-DOS window.

10. Type *ping* after the prompt, followed by a space and the IP address of the F6300:

- If the connection is working, four replies from the F6300 appear (Figure B.4).

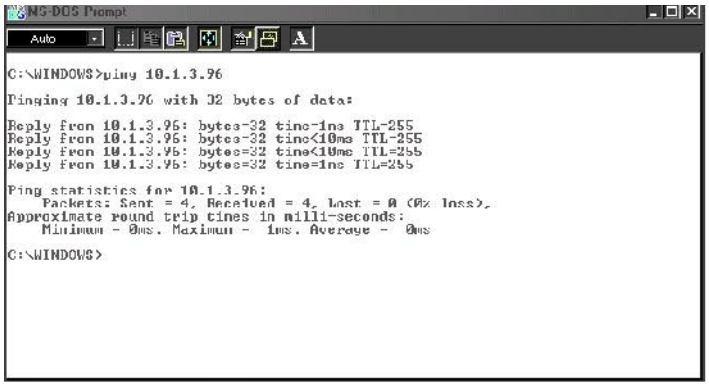

Figure B.4 Working F6300 Replies

- If the connection is not working, four time outs appear (Figure B.5).

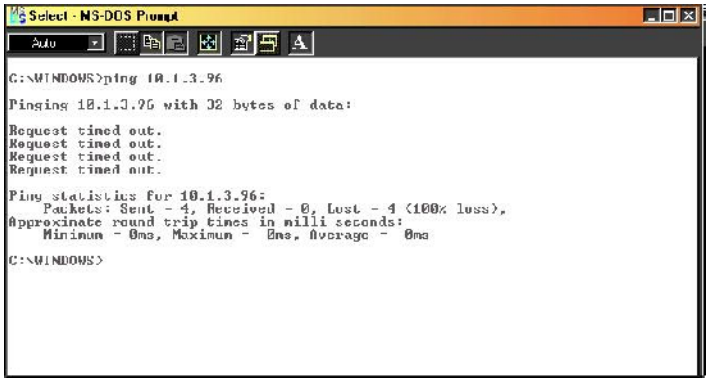

Figure B.5 Non-working F6300 Replies

If the ping is unsuccessful, check the network connections, terminators, connecting cable, and network properties. Then try again.

Setting the F6300 IP Address

The Set IP Address utility sets or changes the IP address that the instrument uses for Ethernet communications. The current IP address of the instrument, if assigned, appears in the display on the instrument front panel after a successful boot-up.

NOTE

Before setting the F6300 IP address, ensure that the computer is directly connected via a Serial, (RS232), cable to the F6300.

To set the F6300 instrument's IP address:

1. Select *Tools > F6000 IP Set* in the ProTesT menu bar and the *Set F6000 IP Address* dialog box appears (Figure B.6).

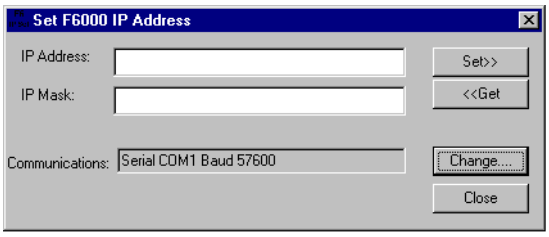

Figure B.6 Set F6000 IP Address

2. Enter the IP Address in the ***IP Address*** field.
3. Click **Set**.
4. Click **Get** to obtain the IP Mask that corresponds to the IP Address entered in Step 2. The mask name appears in the *IP Mask* field.

   If necessary, click **Change** to enter new communications parameters. Refer to *"Communications Parameters" on page A-3*.

Appendix C. Source Configurations

This appendix explains the configuration of power sources for the F6300 Instrument. Source configuration is set from ProTesT to meet protection scheme test requirements.

Current Sources

The F6300 has two banks of three current sources, each rated at 150 VA. The current ranges for the 150 VA sources are 7.5, 15, and 30 A. The three current sources on a bank can be paralleled to create a 450 VA source. The current ranges for the 450 VA sources are 7.5, 22.5, 40 and 90 A.

The current sources can be placed in transient current mode to increase the output power by 50% and the current range by 100% for 1.5 seconds. When in transient current mode, the 150 VA sources supply 225 VA for 1.5 seconds.

Rules for Source Selection

The F6300 software supports a maximum of six 150 V sources and two 450 VA sources at a time.

NOTE

When using paralleled current sources, it is recommended to parallel the wiring in order to reduce cable heating and voltage drop.

Compliance Voltage and Current Range

The compliance voltage of a current source is the highest voltage into which the current source can inject current. The formula for calculating the compliance voltage of a current source is:

$$V = P \div I$$

where:

- *P* is the VA rating of the current source
- *I* is the current range.

For example, if a source is rated at 150 VA and the current range is set at 7.5 A, the compliance voltage for the source is 20 V.

NOTE

For maximum power, use the lowest current range that can produce the desired test current. For example, if the test requires 5 A, set the range at 7.5 A, not 15 A.

Table C.1 and Table C.2 show range settings and compliance voltages for all common source configurations. See Appendix E "F6300 Specifications" for more information on range settings.

Table C.1 Maximum Compliance Voltage for Current Source Combinations

Current Range	150 VA Source	450 VA Source
7.5 A	20 V	60 V
15 A	10 V	—
22.5 A	—	20 V
30 A	5 V	—
45 A	—	10 V
90 A	—	5 V

Table C.2 Maximum Compliance Voltage for Transient Current Source Combinations

Current Range	225 VA Source	675 VA Source
15 A	15 V	45 V
30 A	7.5 V	—
45 A	—	15 V
60 A	3.75 V	—
90 A	—	7.5 V
180 A	—	3.75 V

User Defined Configurations

To configure the sources on the instrument front panel independently of the pre-set options:

- Select *User Defined* from the *Configurations* field (Figure C.1).

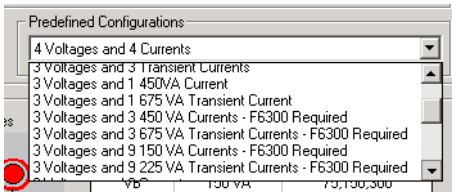

Figure C.1 Pre-set Configurations

The list of user-defined configurations contains two options (Figure C.2):

- 6 Currents 150 VA
- 2 Currents 450 VA

Top Row of Sources (Red): **150 VA**
Bottom Row (Black): **Return Lines**

6 Currents **2 Currents**

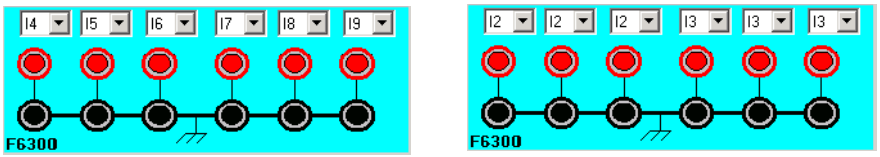

Figure C.2 User Defined Configuration Topology

Appendix D. Field Calibration Verification

This appendix defines testing specifications and procedures for performing Amplitude and Distortion tests, and Phase Shift tests on configured current and voltage sources.

Testing Specifications

Test specifications for following are provided in this section.

- "Ambient Accuracy"
- "Test Setup"
- "Test Equipment"

Ambient Accuracy

F6300 Test Instruments are normally used in areas where the temperature is between 68 and 86°F (20-30°C) and the AC power is within ±10% of 115 (or 230) V. Under these conditions, and when connected to a load that does not exceed the source's range limits, F6300 AC test signals are warranted to meet the following accuracy specifications.

Amplitude	±0.03% of range from 0 to 10% of range, and within ±0.3% of setting from 10 to 100% of range for High Current.
Phase Angle	±0.25° at 50 or 60 Hz.
Distortion	2% maximum at 50 or 60 Hz., 0.1% typical

Test Setup

All Current Sources are measured with either a shunt or ammeter connected across the output.

Test Equipment

All test equipment must be more accurate than the signal being measured, and have a valid calibration sticker tracing the calibration to the Nation Bureau of Standard references. As a reference, the instruments used by Doble Engineering for factory calibration of the F6300 are listed in Table D.1

Table D.1 Test Equipment

Equipment	Manufacturer	Model Number
Voltmeter	Hewlett Packard	Model 3458A
Phase Meter	Arbiter	Model 931A
Distortion Analyzer	Krohn-Hite	Model 6880A
100 A Shunt	Julie	CS-1R-100-2-05A
20 A Shunt	Julie	CS-1R-20-1-01A

NOTE **All current measurements are made with the Julie shunts. A differential amplifier with a gain of 10 is used to boost the shunt output for distortion measurements.**

Testing a 150 VA High Current Source

To perform the Amplitude and Distortion check on a 150 VA High Current source:

1. Click **User Defined** on the F6300 Configuration display in ProTesT to configure the F6300 for three 150 VA Currents.
2. Set the number of *Current Sources* to *3*.
3. Set the range to 7.5 A and amplitude to 7.5 A. Connect an ammeter or appropriate shunt across the Source I1 output terminals, and turn the source ON.
4. Verify that the amplitude is within limits and the total harmonic distortion (THD) is <2%.
5. Change the amplitude as shown in Table D.2 and verify that the amplitude and distortion are within the limits.
6. Repeat step 5 for the 15 and 30 A range.
7. Repeat steps 3, 4, 5, and 6 for Source I2 and I3.

NOTE **The load including wire and connections must not exceed the Max. Load in Table D.2.**

Table D.2 lists the specifications for the 150 VA High Current Source measurements. Minimum and maximum amplitudes are given in amperes. When using a four-terminal shunt, convert the values to the appropriate voltages.

Table D.2 150 VA High Current Source Measurements Specifications

Max. Load	Range	Value	Minimum	Maximum	Max. THD
2.67 Ohm	7.5 A	7.5 A	7.48 A	7.523 A	2%
		0.75 A	0.748 A	0.7523 A	2%
0.67 Ohm	15 A	15.0 A	14.96 A	15.05 A	2%
		1.5 A	1.496 A	1.505 A	2%
0.167 Ohm	30 A	30.0 A	29.91 A	30.09 A	2%
		3.0 A	2.991 A	3.009 A	2%

Figure D.1 shows a typical setup for 150 VA (right bank) High Current and Distortion measurements

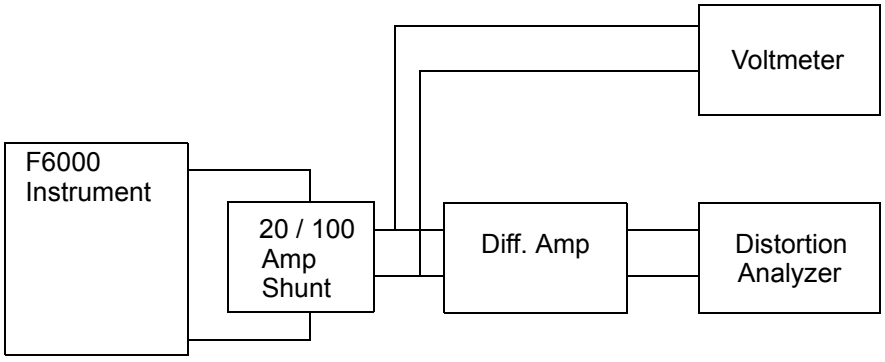

Figure D.1 Typical Setup 150 VA (right bank) High Current and Distortion Measurements

Testing a 450 VA High Current Source

To perform the Amplitude and Distortion check on a 450 VA High Current source:

1. Click **User Defined** on the F6300 Configuration display in ProTesT to configure the F6300 for two 450 VA Current Sources:
   - Set the number of Current Sources to *2*.
   - Set the *Current Sources Reference Designations* so that all three sources are named I1.
   - Set the range to 7.5 A and amplitude to 7.5 A, connect an ammeter or appropriate shunt across the Source I1 output terminals, *all three I1 terminals must be connected to the ammeter or shunt,* and turn the source ON.
2. Verify that the amplitude is within limits and that the total harmonic distortion (THD) is <2%.
3. Change the amplitude as shown in Table D.3. Verify that the amplitude and distortion are within the limits.
4. Repeat step 3 for the 90 A range.
5. Repeat steps 2 through 4 for I2.

NOTE

The load including wire and connections must not exceed the Max. Load in Table D.3.

Table D.3 lists the specifications for the 450 VA High Current Source measurements. Minimum and maximum amplitudes are given in amperes.When using a four-terminal shunt, convert the values to the appropriate voltages.

Table D.3 450 VA High Current Source Measurements Specifications

Range	Max. Load	Value	Minimum	Maximum	Max. THD
7.5 A	8 Ohm	7.5 A	7.48 A	7.523 A	2%
		0.75 A	0.748 A	0.7523 A	2%
90 A	0.0555 Ohm	90.0 A	59.82 A	60.18 A	2%
		9.0 A	5.982 A	6.018 A	2%

Figure D.2 shows a typical setup for 450 VA High Current and Distortion measurements.

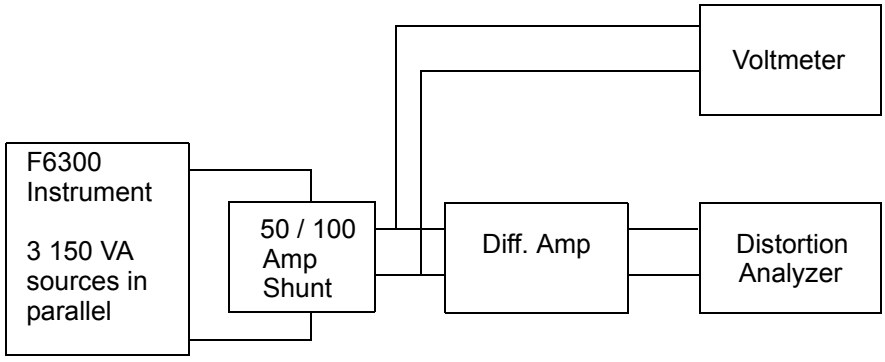

Figure D.2 Typical Setup 450 VA High Current and Distortion Measurements

Phase Shift Testing

To perform the Phase Shift test on a 150 VA High Current source at 50 or 60 Hz:

1. Configure the F6300 for six currents using the Pre-set Configurations on the F6300 Configuration display in ProTesT.
2. Set all six ranges to 7.5 A and all amplitudes to 5 A.
3. Set all six phase angles to 0°.
4. Connect source I1 to the reference input of the phase meter.
5. Connect source I1 to the signal input of the phase meter.
6. Turn both sources **ON**.
7. Verify that the phase angle is within ± 0.25°.
8. Turn **OFF** the signal source.
9. Repeat steps 5 through 8 for sources I3, IR, IS, and IT as signal sources.

Figure D.3 shows a typical setup for phase testing six Current Sources. The phase meter shown is an Arbiter model 931 A.

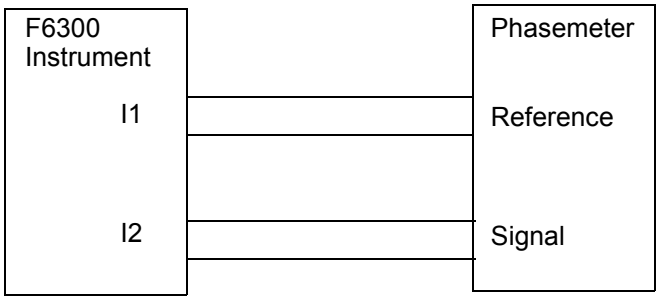

Figure D.3 Typical Setup Phase Testing Six Current Sources

Appendix E. F6300 Specifications

Current Sources

Table E.1 Source Configurations

Output Power Continuous	Output Power Transient for 1.5 Sec.
6*150 VA sources	6*225 VA sources
2*450 VA sources	2*675 VA sources

Ranges and Resolution

Table E.2 150 VA Sources

Current	Range (Resolution)
AC 1.5 Seconds Transient Continuous	 15, 30 A (0.001 A), 60 A rms (0.01 A) 7.5, 15 A (0.001 A), 30 A rms (0.01 A)
DC 1.5 Seconds Transient Continuous	 10, 20, 40, ADC (0.01 A) 5A (0.001 A), 10, 20 ADC (0.01 A)

NOTE **Three 150 VA current sources can be combined into one 450 VA current source.**

Table E.3 450 VA Sources

Current	Range (Resolution)
AC 1.5 Seconds Transient	15, 45, 90, 180 A rms (0.01 A)
Continuous	7.5, 22.5 A (0.001 A), 45 A, 90 A rms (0.01 A)
DC 1.5 Seconds Transient	10 A (0.001 A), 30, 60, 120 ADC (0.01 A)
Continuous	5 A (0.001 A), 15, 30, 60 ADC (0.01 A)

General Specifications

Table E.4 provides you with general specifications for the F6300.

Table E.4 General Specifications

Specification	Description
Source Operation	Worst-case accuracy specifications *simultaneously* include all errors contributed by variations in power line voltage, load regulation, stability, and temperature, up to full output power. Includes stable source operation in four quadrants while delivering power — load power factor from nearly 1 to 0, leading or lagging. Each F6000 Instrument is supplied with a Certificate of Calibration traceable to the National Institute of Standards and Technology.
Electrostatic Discharge Immunity	IEC 801-2 I.E.C. performance level 1 @ 10 kV: normal performance within specifications. IEC 801-2 I.E.C. performance level 2 @ 20 kV: no permanent damage.
Surge Withstand Capability	ANSI/IEEE C37.90. The F6000 Instrument functions as a source during surge withstand capability tests, when the ANSI/IEEE-specified isolating circuit is interposed between the instrument and the relay under test.
AC Amplitude Accuracy at 50/60 Hz	From 20° to 30° C: < 0.02% typical or < 0.09 % Guaranteed Typical of 0.02% of reading.
Distortion and Noise at 50/60 Hz Output (10 Hz - 2 KHz Bandwidth)	Current Source: Total Harmonic Distortion (THD) < 0.02 % typical; <0.1% guaranteed.

Table E.4 General Specifications (Continued)

Specification	Description
Phase Angle	• Range: 0^{o} to $+359.9^{o}$ (Lead)/0 to -359.9^{o} (Lag) • Accuracy: $\pm 0.25^{o}$ at 50/60 Hz • Resolution: $\pm 0.1^{o}$ at 50/60 Hz
Frequency	Bandwidth: DC to 3 kHz at full power for transient playback. Range: DC, AC from 0.1 Hz to 2 kHz at full power, continuous load. Resolution: 0.001 Hz Accuracy: • 0.05 PPM:Typical • 1.5 PPM: 20° to 30° C • 10 PPM: 0° to 50° C
Ramp/Set	Ramp: Increments/decrements voltage, current, phase angle, and frequency at user defined ramp rates. Ensures smooth, linear changes in value.
Input Power Supply	• 115 V nominal at 15 A maximum (50 or 60 Hz) • 230 V nominal at 10 A maximum (50 or 60 Hz)
Temperature	• Operating temperature: 0° to 50° C (32° to 122° F) • Storage temperature: -25° to +70° C (13° to 117° F)
Humidity	Up to 95% relative humidity, non-condensing
Interfaces	RS-232 or Ethernet remote control to computer
Safety	European Standard: • EN61010-1:1993/A1+A2 • EN61010-2-031:1994
Electromagnetic Compatibility (EMC)	European Standard: • EN61326:1997/A1:1998 • US Standard: • FCC 47CFR Part 15 Class A
Enclosure	High impact, molded, flame retardant ABS. Meets National Safe Transit Association testing specification No. 1A for immunity to severe shock and vibration.
Dimensions and Weight	• Dimensions: 15 x 9.5 x 18 in or 38 x 24 x 45.7 cm • Weight: 35.4 lbs/16.1 kgs

NOTE

All specifications are subject to change without notice.

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