XANTREX
The Power To Rely On

Technical Manual for

Internal M9B-HFS Serial Interface for XFR Series Power Supply

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ABOUT THIS MANUAL

This technical manual is for the M9B-HFS Interface, a microprocessor-controlled option card for all models of 1200 Watt and 2800 Watt DC output power supplies. This manual provides you with specifications, user options, and configuration instructions for the interface, along with a command set which will enable you to control your power supply from a computer console. Error messages, calibration procedures, schematics, and parts lists are also included.

This manual is designed for the user who is familiar with basic electrical laws especially as they apply to the operation of power supplies. This implies a recognition of Constant Voltage and Constant Current operation modes and the control of input and output power, as well as the observance of safe techniques while effecting supply or pin connections and any changes in switch settings. The user should also have experience with a computer-based communications software package.

Refer to the 1200 Watt and 2800 Watt DC power supply technical manual for installation, configuration, and operating procedures for the power supply.

The six major sections in this manual are:

Section 1. Features	Describes the interface and lists its features.
Section 2. Inspection and Configuration	Details the inspection of the interface card and basic setup procedures.
Section 3. M9B-HFS Operation	Lists the complete command set, status registers, and error codes.
Section 4. Calibration	Provides procedures for voltage and current mode calibration as well as Over Voltage Protection (OVP) calibration.
Section 5. Maintenance	Covers troubleshooting and lists replacement parts.
Appendix A: Specifications	Contains specifications on the 2800 Watt and 1200 Watt DC output power supply with M9B-HFS interface installed .
Appendix B: Schematics	Contains M9B-HFS interface printed circuit board schematic.

Manual Revisions

The current release of this manual is listed below. Insert pages will update already printed manuals. Reprinted manuals may note any minor corrections and additions on the Manual Changes list (page ii). A new release of the manual is identified by a new release number and printing date and will include all of the additional or corrected information since the last release.

Release 1.0 (97/10/14)

Warnings, Cautions, and Notes

Warnings, cautions, and notes are defined and formatted as presented below.

WARNING
Describes a potential hazard which could result in injury or death, or a procedure which, if not performed correctly, could result in injury or death.

CAUTION
Describes a procedure which, if not performed correctly, could result in damage to data, equipment, or systems.

Note: Describes additional operating information which may affect the performance of the equipment.

MANUAL CHANGES

There are no changes at this time.

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1. FEATURES

1.1 Introduction to the Interface

The M9B-HFS Interface is a microprocessor-controlled option card for the 1200 Watt or 2800 Watt model power supply. Installed internally, the M9B-HFS gives you remote digital control of simple test systems. It has 16-bit resolution for programming and readback and uses bit serial protocol for sending data between the computer and the interface. The fiber optic link provides electrical isolation between the host computer and the power supply. Electrical isolation reduces the impact of noise on communications to the power supply and improves signal quality.

The M9B-HFS features an extensive command set and several user-programmable features. In addition to fiber optic cable and a computer interface, this remote control application requires a computer-based communications software package such as PROCOMM, XTALK, Windows Terminal Program or equivalent communications software. You can also use low level or high level language programs to control your system. The M9B-HFS is an ideal tool for reliable, remote power supply control of research and development applications.

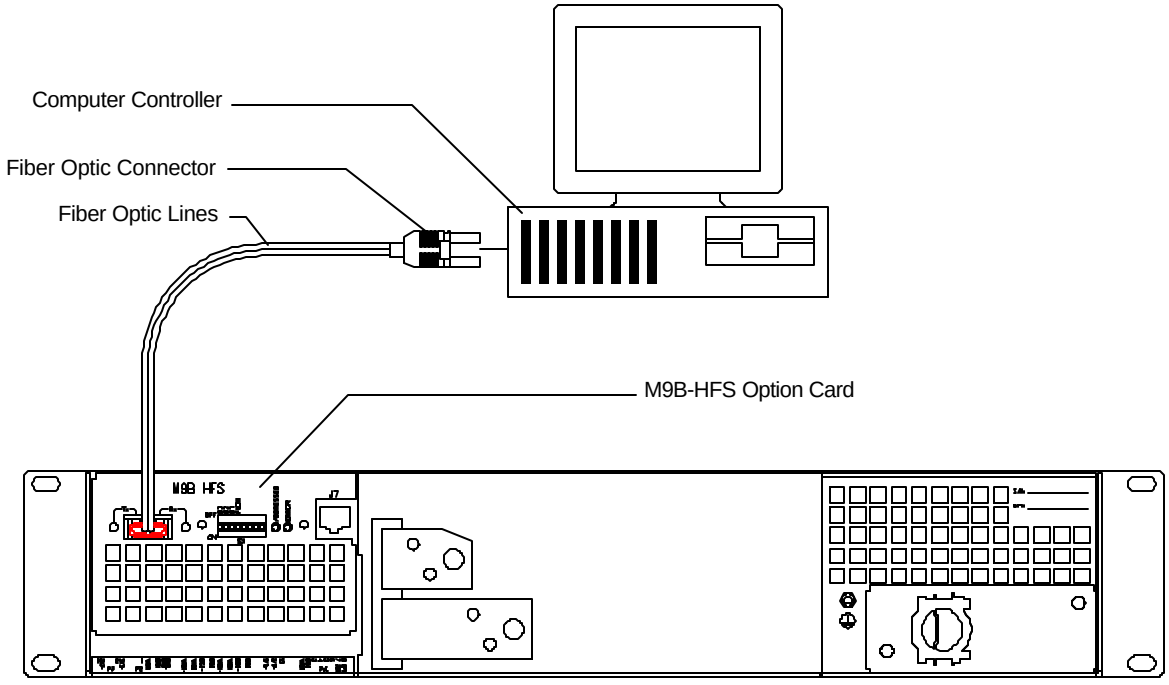


Figure 1.1-1 Sample Configuration using HFS-M9B Interface
(2800 Watt Power Supply Rear Panel Shown)

1.2 Features and Functions

1.2.1 Features

- Fiber optic receiver/transmitter pair
- 16-bit programming and readback of voltage and current
- Programmable soft limits for voltage and current
- Programmable over voltage protection with reset
- Easy-to-use, self-documenting command set
- Standardized commands for complete communication with any of the supplies in the system
- User-programmable isolated fault, polarity, isolation, and auxiliary, user-defined output signals
- LED status signals: error, address, remote/local operation, and over voltage protection
- Foldback in CV or CC mode with reset
- Software calibration
- Software communications flow control
- Asynchronous full duplex data rate of 9600 baud

1.2.2 Programmable Functions

- Output voltage and current
- Soft limits for voltage and current
- Over voltage protection
- Output enable/disable
- Maskable fault interrupt
- Hold and trigger
- Output relay signals

1.2.3 Readback Functions

- Actual voltage and current
- Voltage and current settings
- Soft voltage and current limits
- Over voltage protection setting
- Present and accumulated power supply status
- Programming error codes
- Fault codes
- Power supply model and software version identification

2. INSPECTION AND CONFIGURATION

2.1 Initial Inspection

CAUTION
If you remove the unit's cover, use proper static control techniques to avoid damage to static-sensitive components on the printed circuit board.

The M9B-HFS interface card typically comes pre-installed if you have ordered the interface with a power supply. If you have ordered the interface separately, your sales/service representative can ensure it is correctly installed in your previously -purchased power supply.

On first receiving your unit, perform a quick physical check.

1. Ensure each package contains a power supply with its M9B-HFS Interface board installed and manuals for the power supply and the M9B-HFS Interface. Any additional parts shipped with the power supply will be identified in the supply's documentation.
2. Inspect the unit for any signs of physical damage such as scratches, cracks, or broken switches, connectors, and displays.
3. Check the printed circuit board and components if you suspect internal damage.

If the unit is damaged, save all packing materials and notify the carrier immediately.

To configure your M9B-HFS interface card for remote operation, refer to the setup procedure in Section 2.2 M9B-HFS Setup Procedure .

2.2 M9B-HFS Setup Procedure

To use this product, you must have the following equipment:

- Two fiber optic cables, or one duplex fiber optic cable (for receiving and transmitting)
- Computer with a fiber optic serial interface
- Computer-based communications software package
- 1200W or 2800W variable DC output power supply with M9B-HFS interface installed

You can configure the M9B-HFS option for operation in four simple steps. Follow all steps in Table 2.2-1 M9B-HFS Setup Procedure in the order provided.

Table 2.2-1 M9B-HFS Setup Procedure

Step #	Procedure	References
1	Set the back panel S1 Communication Switch for operation.	See Section 2.3 S1 Switch Communication Settings for information on setting the Baud Rate and Flow control for the interface.
2	Install the fiber optic lines between the computer and the interface.	See Section 2.4 Connecting the Fiber Optic Line for information on the fiber optic connector.
3	Power ON the power supply.	See Section 2.5 Power ON Conditions for information on power supply default settings and remote operation.
4	Set the command protocol for the computer.	See Section 2.6 Computer Settings. The computer and the interface must share the same serial settings to ensure proper communication.

For additional interface functions, see Section 2.8 J7 User Signal Connector and Section 2.7 Internal Jumper Selections .

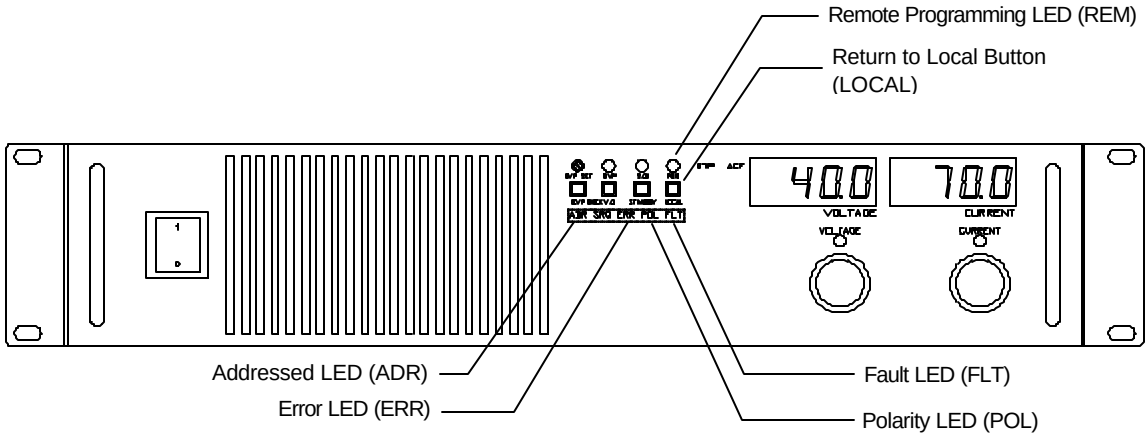


Figure 2.2-1 Front Panel
(2800 Watt DC Power Supply shown)

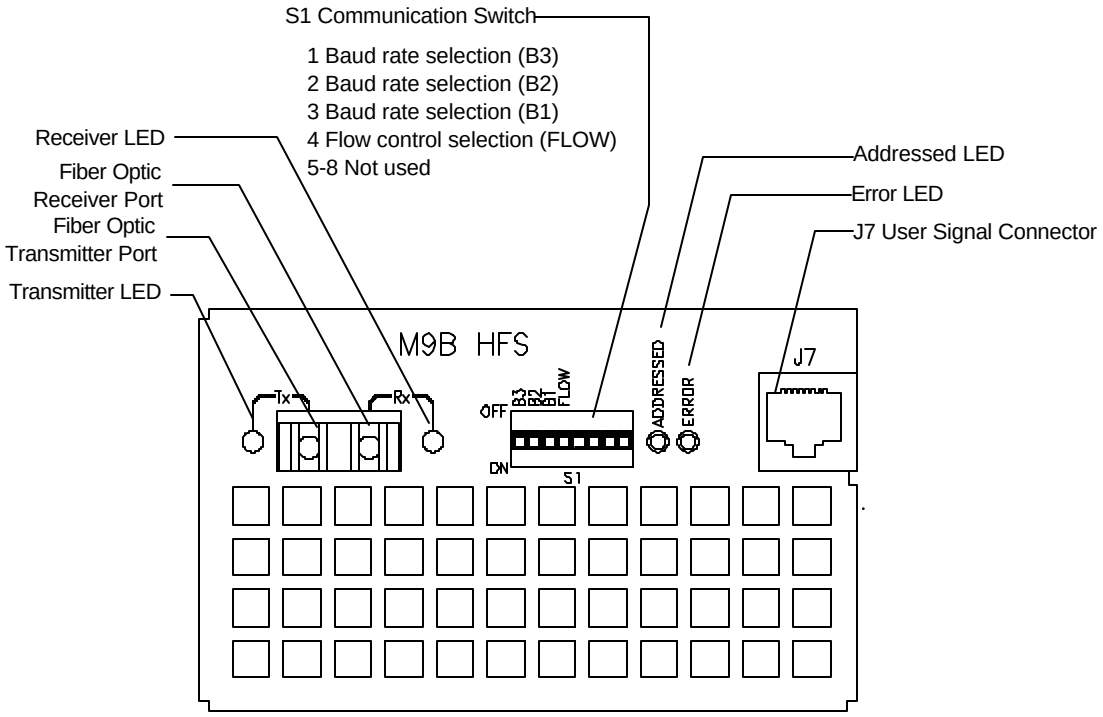


Figure 2.2-2 M9B- HFS Interface Subplate
(Located on the Power Supply Rear Panel)

2.3 S1 Switch Communication Settings

2.3.1 Baud Rate Selection

Serial transmission sends and receives data in bit streams at fixed bit rates. Both the computer and the interface must have the same bit rate setting for proper communication. Use switches B3, B2, and B1 on the rear panel S1 switch to select the power supply's rate of transmission in bits per second. Switch settings are summarized in Table 2.3-1. Refer to Figure 2.2-2 for a drawing of the rear panel subplate.

Note: When resetting switches B3, B2, and B1 during a working session, turn the power supply OFF and then ON again to ensure that the new settings are put into effect.

Switch OPEN=0 (OFF) Switch CLOSED=1 (ON)

Table 2.3-1 S1 Switch Settings for Baud Rate Selection

BAUD Rate	B3	B2	B1
9600	1	1	1
4800	0	1	1
2400	1	0	1
1200	0	0	1
600	1	1	0
300	0	1	0
150	1	0	0
75	0	0	0

2.3.2 Flow Control

Flow control signals regulate data flow for proper communication. The M9B-HFS Interface card uses XON/XOFF protocol to monitor and report on the status of the transmission between devices. You can select flow control using the back panel S1 switch. Set the S1-FLOW switch to ON to invoke flow control. Set S1-FLOW to OFF to disable flow control.

Table 2.3-2 S1 FLOW Switch Setting for Flow Control

S1-4 Setting	Flow Control Setting
ON	Software Flow Control enabled
OFF	Flow Control disabled

XON/XOFF

This software protocol uses special characters that synchronize device communications. The device sends the control code XOFF (ASCII value 13 hex) when it is not ready to receive data. The device sends the control code XON (ASCII value 11 hex) when it is ready to resume receiving data.

2.4 Connecting the Fiber Optic Line

To connect the option card to a computer, you need:

- two fiber optic cables, or one duplex fiber optic cable (for receiving and transmitting)
- a computer with a fiber optic serial port

2.4.1 Fiber Optic Cable

The maximum fiber optic cable length for connecting the M9B-HFS option card to a computer is 20 meters. This length is dependent on the type of fiber optic cable used. The M9B-HFS uses a Hewlett Packard (HP) receiver/transmitter pair with HP part numbers shown in Table 2.4-1. Select the fiber optic cable best suited for use with these parts.

Table 2.4-1 Receiver/Transmitter Pair

Description	HP Part #
Fiber optic receiver	HFBR-1521
Fiber optic transmitter	HFBR-2521

You need two fiber optic lines: one for transmitting and one for receiving. These cables connect to the interface at the Rx and Tx ports on the rear panel subplate.

2.4.2 Fiber Optic Serial Interface

You will need a fiber optic serial port to connect the fiber optic line to your computer. The fiber optic serial port must have both receiver and transmitter connections for the fiber optic cable. You can use an RS232 interface with the M9B-HFS by using a fiber-to-RS232 serial adapter. See Section 5.3.4 for more information on obtaining parts for fiber optic connections.

Standard fiber optic cable assembly and fiber to serial adapters are available from your electronics/computer equipment supplier.

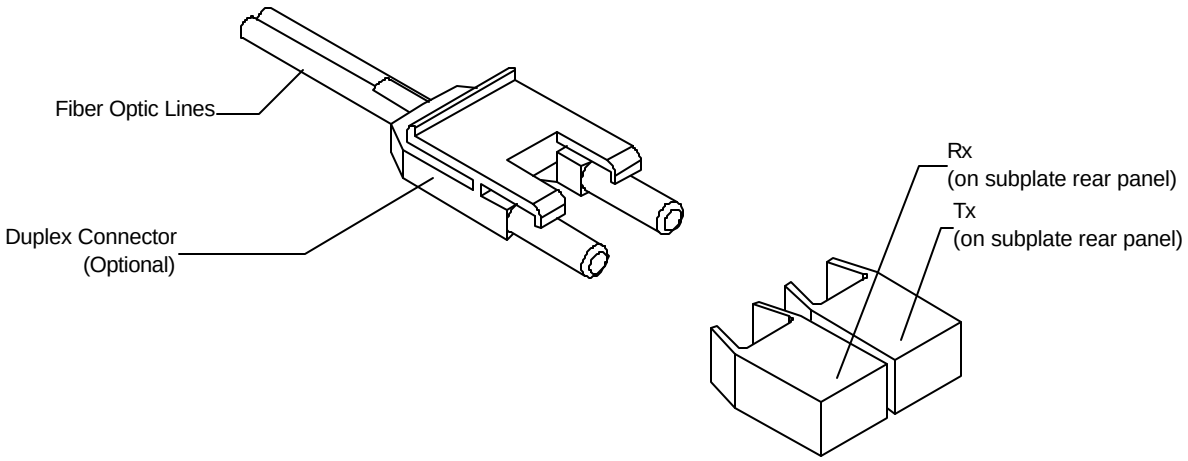


Figure 2.4-1 Sample Configuration of a Fiber Optic Connector
(Duplex connector shown)

2.5 Power ON Conditions

2.5.1 Default Conditions

The M9B-HFS Interface is configured to operate in remote mode when powered on. The default command setting Remote Enable (REN) ON enables remote digital control of the supply. With REN ON, the supply will respond to any command you send from the computer.

To select local mode, either press the front panel LOCAL button or send the Go To Local (GTL) command from the computer. The power supply will return to remote mode if a programming command is sent to it from the computer.

The default power ON settings are shown in Table 2.5-1. You can change these settings using the software commands shown in Section 3.3.

Table 2.5-1 Remote Mode Power On Default Settings

Condition	Default	Software Command Setting
Remote Enable	ON	REN ON
Voltage	0 Volts	VSET 0
Current	0 Amps	ISET 0
Soft Voltage Limit	VMAX (see models)	VMAX (supply's voltage limit)
Soft Current Limit	IMAX (see models)	IMAX (supply's current limit)
OVP Trip Voltage	Model VMAX + 10%	OVSET (voltage limit + 10%)
Delay	0.5 seconds	DLY 0.5S
Foldback Protection	OFF	FOLD OFF
Output	ON	OUT ON
Hold	OFF	HOLD OFF
Unmask	NONE	UNMASK NONE
AUXA	OFF	AUXA OFF
AUXB	OFF	AUXB OFF

2.5.2 Remote Enable (REN)

The remote enable command REN controls the remote mode switching of the power supply. The default setting is REN ON. REN ON enables remote digital mode, returning the power supply to remote digital control whenever a command is sent from the computer. REN OFF disables remote digital operation. When set at REN OFF, power supply control is at the front panel or at the back panel J2 connector. To check the state of remote enable, use the REN? query command.

Table 2.5-2 Remote Enable (REN) Command

Condition	Power Supply Control
REN OFF	Local control only
REN ON	Responds to software commands

2.5.3 Local Lockout (LLO)

The local lockout (LLO) command disables the front panel LOCAL button. With LLO in effect, you cannot return to local control using the front panel LOCAL button. To return to local mode, use the GTL command. The command REN OFF turns off the LLO condition and returns the power supply to local mode.

2.6 Computer Settings

For serial communication, the computer and the power supply must share the same communication settings. Make sure that the settings of the computer and of the power supply agree with those shown in Table 2.6-1.

Table 2.6-1 Power Supply Settings

Parameter	Setting
Transmission	Asynchronous
Mode	Full duplex
Baud rates	75, 150, 300, 600, 1200, 2400, 4800, 9600
Parity	None
Start Bit	1
Stop Bit	1
Data Bits	8
Flow Control	XON/XOFF, None

2.7 Internal Jumper Selections

CAUTION
If you remove the unit's cover, use proper static control techniques to avoid damage to static-sensitive components on the printed circuit board.

Remote operation options OVP control, TTL Shutdown, and Local Mode Disable are selected by changing jumper positions on the M9B-HFS PCB. Refer to the operating manual for information on how to use over voltage protection and TTL shutdown.

2.7.1 OVP Control Selection

Over voltage protection (OVP) on the M9B-HFS Interface is set at the factory for remote software operation. When operating the power supply in remote mode, you control the OVP trip level using the OVSET software command. If you return the power supply to local operation by using the REN software command or the front panel LOCAL button, control of the OVP trip level switches to the front panel OVP potentiometer. The default OVP trip level is set as 110% of the power supply's rated output voltage. See Table 2.5-1 for a complete list of remote power ON default settings.

You can change the location of OVP control by changing the positions of the OVP Control jumper J66 and the Local Mode Disable jumper J104, both on the M9B-HFS PCB. The default jumper settings allow control of OVP to depend on the operating state of the power supply. By physically changing the jumper settings, you can isolate the location of OVP control to just software control or just front panel control. Table 2.8-1 shows a table of jumper settings and OVP programming selection. Refer to Figure 2.7-1 for the positions of the jumpers on the M9B-HFS PCB.

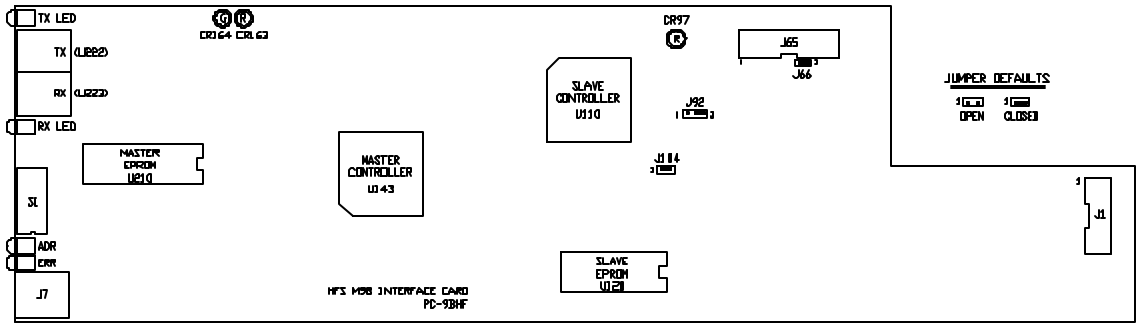
Note: Jumper J104 affects more than just the location of OVP control. See Section 2.7.3 Local Mode Disable before applying changes to jumper J104.

Table 2.7-1 OVP Control Mode Selection

PCB Jumper J66 Position	PCB Jumper J104 Position	OVP Programming Selection
Closed (default)	Closed (default)	Software or Front Panel OVP control (dependent on the power supply operating state)
Closed	Open	Software OVP control only
Open	Closed	Front Panel OVP control only
Open	Open	Front Panel OVP control only

CAUTION

Use proper static control techniques to avoid damage to static-sensitive components on the printed circuit board.



JUMPER SELECTION

J66	OVP Control Selection	[closed] (default) See Table 2.7-1 [open] Front panel OVP control
J92	User TTL Shutdown (S/D) Selection	[1-2] User TTL S/D line active low [2-3] User TTL S/D line active high [default]
J104	Local Mode Disable Selection	[closed] (default) See Section 2.7.3 [open] See Section 2.7.3

Note: All other jumpers are not user-selectable.

LED INDICATORS

CR97	Red Diagnostic LED	Bus error or soft restart on Slave circuitry
CR163	Red Diagnostic LED	Soft restart on Master circuitry
CR164	Green Diagnostic LED	Bus error on Master circuitry

EPROMS

U120	Slave EPROM	See revision number stamped on EPROM.
U210	Master EPROM	See revision number stamped on EPROM.

CONNECTORS

J1	Front Panel A1 PCB Interconnect
J7	User Signals Connector
J65	A2 Control PCB Interconnect
U222	Fiber Optic Transmit Connector
U223	Fiber Optic Receive Connector

Figure 2.7-1 M9B-HFS Interface PCB

2.7.2 TTL Shutdown

You can use the Shutdown function to disable or enable the supply's output. Disabling the supply using TTL shutdown allows you to make adjustments to the load or the power supply without shutting down the power supply. With the M9B-HFS interface installed, TTL shutdown is activated by a TTL signal to Pin 1 of the J7 connector on the interface subplate.

You can select the logic level of the TTL input by changing the J92 connector on the M9B-HFS PCB. Table 2.7-2 shows the TTL signal levels for the J92 jumper settings. See Figure 2.7-1 for the location of the J92 jumper on the printed circuit board.

Table 2.7-2 Switch Settings for TTL Shutdown Circuit Logic

PCB Jumper J92 Position	TTL Signal Level	Supply Output Condition
Pin 2 to Pin 3	HIGH	OFF
	LOW	ON
Pin 1 to Pin 2	HIGH	ON
	LOW	OFF

2.7.3 Local Mode Disable

You can disable local control of the power supply by removing jumper J104 on the option card PCB. We recommend that you remove jumper J104 only if you never plan to control the power supply from the front panel. Otherwise, the software commands and the front panel return to local (LOCAL) button will offer you greater flexibility in controlling your supply.

When the Local Mode Disable jumper J104 is closed, you can select between operating the power supply in either local mode or remote mode by using the software commands and the front panel return to local (LOCAL) button. With jumper J104 open, you can only operate the power supply in remote mode. Opening the J104 jumper disables the front panel LOCAL button and the front panel voltage and current limit potentiometers. You cannot return to local mode using software commands without closing jumper J104. Table 2.7-3 gives a quick reference to how the jumper affects the operating state of the power supply. Figure 2.7-1 shows the position of jumper J104 on the M9B-HFS PCB.

Table 2.7-3 Local Mode Disable Jumper J104 Selection

Jumper J104 Position	Operating State
Closed	Remote or Local Control of Power Supply
Open	Software Control Only

Note: The location of over voltage protection control is dependent on the positions of jumper J104 and OVP control jumper J66. Table 2.7-1 shows how the jumper positions affect the location of OVP control.

2.8 J7 User Signal Connector

Auxiliary connector J7, located on the HFS-M9B Interface rear panel, provides several signals to increase your operating control of the supply. These signals are dependent on the operator's design and uses. The operation of the J7 signal requires that you provide external Vcc and ground connection. Use a standard 8-position telephone jack and data cable to connect to J7. To locate the connector, refer to the M9B-HFS interface rear panel drawing in Figure 2.2-2. Pin 1 is located in the top right position of connector J7 when you face the rear panel. See also Section 3.2 Command Summary for more information about the device dependent commands.

J7-1 External TTL shutdown input signal
J7-2 Polarity signal, open collector
(asserted by VSET -x)
J7-3 Isolation signal, open collector
(asserted by OUT OFF)
J7-4 Fault signal, open collector
(asserted when bit set in fault register)
J7-5 External Vcc, 18V maximum
(supplied by connecting and operating an external source)
J7-6 External ground and shutdown return
(supplied by connecting and operating an external source)
J7-7 Open collector user signal
(asserted by AUXA ON)
J7-8 Open collector user signal
(asserted by AUXB ON)

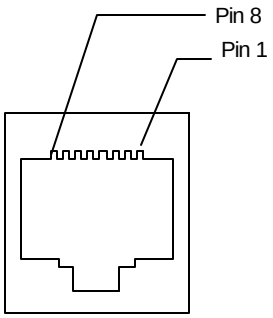


Figure 2.8-1 J7 Connector and Pin Settings
(2800 Watt Model Orientation)

2.8.1 J7 Cable Connection

Use a standard 8-position telephone jack and data cable to connect to J7. Add a ferrite block to reduce radiated emission. The one inch square ferrite block with built-in housing clip is packaged and shipped with the power supply interface card.

To install the ferrite block:

1. Position the block no more than 5 cm (2") from the power supply end of the J7 user cable.
2. Open the ferrite block housing.
3. Loop the cable through the ferrite block. See Figure 2.8-2.
4. Close the housing clip.

The ferrite block ensures that the power supply system meets radiated emission requirement 89/336/EEC for CE mark approval. See the power supply's operating manual for noise specifications.

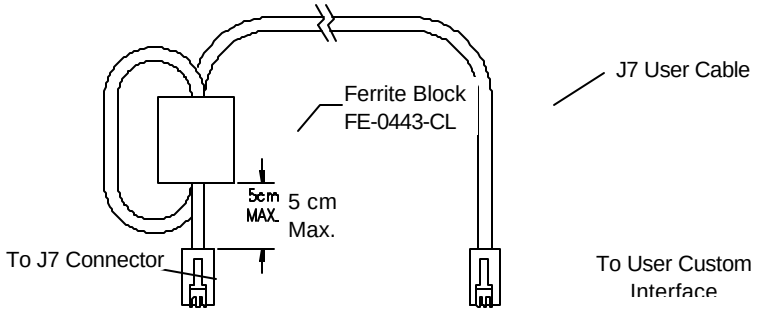


Figure 2.8-2 J7 User Cable with Ferrite Block

3. M9B-HFS OPERATION

The M9B-HFS interface controller card enables you to send and receive data via the fiber optic communication line which connects your supply to a computer. You can use the computer controller to issue commands to the power supply for programming, queries, calibration, or status. The power supply responds to the complete set of device dependent software commands shown in Section 3.3 Command Reference.

3.1 Command Syntax

3.1.1 Manual Conventions

The manual uses these conventions when displaying command information. These characters are not part of the command but are used to denote parameters used with the command.

< > (angle brackets) Angle brackets enclose a parameter. Do not include the angle brackets in the command line you send to the computer.

/ (slash) Separates two alternative parameters. When a slash separates two parameters, you can use either parameter to achieve the same result.

Example: <1/ON>

Entering 1 or ON will achieve the same result.

COMPUTER ENTRY Words typed on the computer are shown in Arial text, full capitals.

3.1.2 Command Format and Parameters

The device-dependent language for the M9B-HFS Interface consists of commands and parameters. A command is a one word code which either gives instructions to the interface or asks for information from the interface. A command may be followed by one or more parameters, a short code that changes the state of the power supply or the state of the bit register. Table 3.1-1 lists the parameters that affect the command set.

Format:

COMMAND or COMMAND <parameter> or COMMAND <parameter>,<parameter>

- You can enter commands in upper or lower case lettering.

  Example: MASK FOLD = mask fold

- Do not further abbreviate command names or parameters.

  Example: MASK FOLD ≠ MK FOLD
  MASK FOLD ≠ MASK FD

- Use a space between the command and the first parameter. Any number of consecutive spaces is treated as one space. Numeric data may contain leading spaces. Embedded spaces between digits or between a digit and a decimal point are not accepted.

  Example: MASK FOLD = MASK FOLD
  VOUT 3.4 = VOUT 3.4
  VOUT 3.4 ≠ VOUT 3. 4

- Use commas between parameters in those commands with more than one parameter, and between mnemonic parameters as in the MASK and UNMASK commands. Only one comma is allowed and it may be preceded or followed by any number of spaces.

  Example: MASK CV, OV, FOLD

3.1.2 Command Format and Parameters (continued)

Table 3.1-1 Command Parameters		
Parameter	**Description**	**Form**
<current>, <Ihi>, <Ilo>	The current in amps or milliamps. If no unit is given, the default unit is amps.	<float> <float>A <float>mA
<time>	The time in seconds or milliseconds. If no unit is given, the default unit is seconds.	<float> <float>s <float>ms
<voltage>, <Vlo>, <Vhi>	The voltage in volts or millivolts. If no unit is given, the default unit is volts.	<float> <float>V <float>mV
<mnemonics>	A combination of CV, CC, CV, OV, SD, FOLD, ERR, and REM. See MASK and UNMASK commands in the command reference for use of the ALL and NONE parameters.	See registers in Section 3.4.
<state>	The state of a binary condition.	<1/ON, 0/OFF>

Floating Point Number <float>

Variables sent with command parameters are floating point numbers. Table 3.1-2 Floating Point Numbers defines the structure of floating point numbers for use with the software commands.

Table 3.1-2 Floating Point Numbers	
Floating Number Definition	**Example**
The floating point number has four significant figures. It can be of either sign, positive or negative.	1.234 -1.234 +1.234
A floating point number can have one decimal point.	0.123 1.2 123.4
Scientific Notation Use E or e after the number for a base ten exponent. An integer of either sign must follow an exponent.	123.0E-1 1.2E-1 10.00E+1

3.1.3 Command Strings

If you send more than one command line, separate the commands with a semicolon. The semicolon may be preceded or followed by spaces.

Example: ISET 2.0A; VSET 5V
ISET 2.0A ; VSET 5V

3.1.4 Command Terminators

Terminators indicate the end of a command string and tell the power supply to execute the command. The termination character is CR (Carriage Return).

Format: COMMAND <parameter>; COMMAND <parameter> , <parameter><CR>

Most computer controllers automatically send CR with output statements.

3.1.5 Order

You may send commands in any order, keeping in mind that only those commands received after a HOLD and before a TRG (trigger) will be released by the TRG command. In addition, only these commands received after a supply disable and before a RST (reset) or OUT ON command will be released by the RST command or the OUT command. Commands are executed in the order they are received.

3.2 Command Summary

Table 3.2-1 to Table 3.2-4 list the commands that control the operation of the power supply. The four command function types are programming, query, calibration, and status. See Section 3.3 Command Reference for more detailed information about each command and its use.

Table 3.2-1 Programming Commands

Command	Description
AUXA	Selects the state of the AUXA output signal on the J7-7 connector.
AUXB	Selects the state of the AUXB output signal on the J7-8 connector.
CLR	Initializes the power supply to its Power ON (PON) state.
DLY	Sets a programmable time delay which is executed by the supply before reporting fault conditions after a new output voltage or current is specified.
FOLD	Sets foldback mode for the supply.
GTL	Sends the supply to local mode.
HOLD	Enables or disables voltage/current setting hold mode for the supply.
IMAX	Sets an upper soft limit on the programmed output current for the supply.
ISET	Sets the output current of the supply in amps (default) or in milliamps.
LLO	Local lockout. Disables the front panel LOCAL button.
OUT	Enables or disables voltage/current output for the supply.
OVSET	Sets the over voltage protection trip point for the supply in volts (default) or in millivolts.
REN	Enables or disables remote mode.
RST	Resets the supply to present voltage and current settings if the output is disabled by OVP or foldback protection.
TRG	Implements programmed voltage and current settings which had been in hold mode.
VMAX	Sets an upper soft limit on the supply's programmed output voltage.
VSET	Sets the output voltage of the power supply in volts (default) or in millivolts.

Table 3.2-2 Query Commands	
Command	**Description**
AUXA?	Asks for the state of the set value for the AUXA command.
AUXB?	Asks for the state of the set value for the AUXB command.
CMODE?	Asks for the power supply's calibration mode status.
DLY?	Asks for the programmable time delay setting before the supply reports fault conditions.
ERR?	Asks for the most recent remote programming error which occurred in the supply since the last time the error query command (ERR?) was used.
FOLD?	Asks for the supply's present foldback setting.
HOLD?	Asks for the present hold mode setting.
ID?	Asks for the power supply's model name and master EPROM version.
IMAX?	Asks for the supply's soft current limit setting.
IOUT?	Measures the actual current output for the supply.
ISET?	Asks for the supply's present output current setting.
OUT?	Asks for the present enabled/disabled status of the supply's output.
OVSET?	Asks for the supply's present over voltage protection limit.
REN?	Asks for the state of the remote enable control.
ROM?	Asks for the version number of the master and slave EPROMs on the interface PCB.
VMAX?	Asks for the supply's soft voltage limit setting.
VOUT?	Measures the supply's actual voltage output.
VSET?	Asks for the supply's present output voltage setting.

Table 3.2-3 Calibration Commands	
Command	**Description**
CMODE	Places the supply into calibration mode.
IDATA	Calculates the slope and intercept for current programming.
IHI	Sets the current output to the high calibration point.
ILO	Sets the current output to the low calibration point.
IRDAT	Calculates the slope and intercept for current readback.
IRHI	Sets the current output to the high readback point.
IRLO	Sets the current output to the low readback point.
OVCAL	Calibrates the over voltage protection (OVP).
VDATA	Calculates the slope and intercept for voltage programming.
VHI	Sets the voltage output to the high calibration point.
VLO	Sets the voltage output to the low calibration point.
VRDAT	Calculates the slope and intercept for voltage readback.
VRHI	Sets the voltage output to the high readback point.
VRLO	Sets the voltage output to the low readback point.

Table 3.2-4 Status Commands	
Command	**Description**
ASTS?	Asks for the supply's accumulated status register.
FAULT?	Asks for the supply's fault register for the status of preset operating conditions.
MASK	Disables the supply's previously unmasked operating conditions from setting bits in the fault register.
STS?	Asks for the supply's present status register.
UNMASK	Enables you to select those supply's operating conditions that you are most interested in monitoring for fault occurrence.
UNMASK?	Asks for the supply's fault conditions which are currently enabled (unmasked).

3.3 Command Reference

ASTS?	Asks for the supply's accumulated status register. The accumulated status register stores any bit that was entered in the status register since the accumulated status query command (ASTS?) was last used, regardless of whether the condition still exists. The accumulated status register has the same bits, weights, and conditions as the status register. A bit in the accumulated status register will be set at 1 if the corresponding bit in the status register has been 1 (TRUE) at any time since the register was last read. See Section 3.4 Accumulated Status, Status, and Fault Registers. The query clears the accumulated status register. **Response:** ASTS <status mask> where status mask is the decimal equivalent of the total bit weights for the operating conditions as listed in the status register.
AUXA <state >	**Parameters:** 1/ON, 0/OFF Controls the AUXA output signal level at rear panel connector J7 -7. Active low. **Initial value:** AUXA 0
AUXA?	Asks for the present set value of the AUXA output signal. **Response:** AUXA 0 (OFF) AUXA 1 (ON)
AUXB <state >	**Parameters:** 1/ON, 0/OFF Controls the AUXB output signal level at rear panel connector J7 -8. Active low. **Initial value:** AUXB 0
AUXB?	Asks for the present set value of the AUXB output signal. **Response:** AUXB 0 (OFF) AUXB 1 (ON)
CLR	Initializes the power supply to its power ON condition. If issued while in local mode, CLR will force power supply settings to register default values as in Table 2.5-1 Remote Mode Power On Default Settings. These default settings will not come into effect until the power supply is switched to remote mode operation. **CLR will not reset AUXA, AUXB, or CMODE.**
CMODE <state>	**Parameters:** 1/ON, 0/OFF CMODE ON places the power supply into calibration mode for processing calibration commands. **Initial value:** CMODE 0 (OFF)

CMODE?	Asks for the power supply's calibration mode status. **Response:** CMODE 0 (disabled) CMODE 1 (enabled)
DLY < time>	**Parameter:** seconds Sets a programmable time delay employed by the power supply before reporting fault conditions. The power supply uses the time delay after receiving a new output voltage or current setting via VSET or ISET, or after receiving RST, TRG, or OUT ON commands. During the time delay, the power supply disables CV, CC, and FOLD conditions from generating faults, preventing possible nuisance foldback if the supply momentarily switches modes while changing an output setting. **Range:** 0 to 32 seconds, with 32ms resolution **Initial value:** 0.5 seconds
DLY?	Asks for the setting of the programmable time delay before the power supply reports fault conditions. **Response:** DLY <seconds>
ERR?	Asks for the most recent remote programming error. When the power supply detects a programming error, it lights the ERR LED and sets the ERR bit in the accumulated status and fault registers. If the ERR bit has been masked using the MASK command, then the ERR bit in the registers will not be set. Once an error is detected, the remaining portion of the command line is discarded. An error query clears the ERR bit in the status register. See Section 3.5 Error Codes. **Response:** ERR <error number> **Example:** ERR 0 (if no error)
FAULT?	Asks for the state of the fault register. A bit is set in the fault register when a fault arises for that condition. Table 3.4-1 lists the conditions which activate a fault bit. You can use the MASK command to disable bits from being set in the fault register. When a bit is set in the fault register it also asserts a signal on the J7-4 user signal line. You can tie the J7-4 fault line signal to the power supply's own External Shutdown user line, J7-1, so that the shutdown signal goes low (active) in the case of a user-defined fault. The FAULT? query clears bits in the supply's fault register and fault line. **Response:** FAULT <fault mask> where fault mask is the decimal equivalent of the total bit weights for the operating conditions as listed in the fault register. See Section 3.6 Accumulated Status, Status, and Fault Registers .

FOLD <mnemonics>	**Parameters:** 0/OFF, 1/CV, 2/CC Sets foldback mode for the supply. Foldback protection disables the power supply output when the output enters the fold condition. Reset with the RST command. **Example:** Specify FOLD 1 or FOLD CV (Constant Voltage) when you want the supply to operate in Constant Current mode and have foldback protection disable the output if the supply switches to Constant Voltage mode. **Initial value:** FOLD 0 (OFF)
FOLD?	Asks for the supply's present foldback setting. **Response:** FOLD 0/OFF 1/CV 2/CC
GTL	Go to local. Returns the power supply to local control. See LLO (local lockout).
HOLD <state >	**Parameters:** 1/ON, 0/OFF Enables or disables voltage/current setting hold mode for the supply. When HOLD ON is specified, hold mode is enabled so that all voltage and current settings which would normally be implemented by the supply are held until a TRG (trigger) command is received. **Initial value:** HOLD 0 (OFF)
HOLD?	Asks for the present hold mode setting. **Response:** HOLD 0/OFF (disabled) 1/ON (enabled)
ID?	Asks for the power supply model and the master EPROM version. **Response:** ID <model name><version>
IDATA <Ilo>, <Ihi>	**Parameters:** <Ilo>, <Ihi> Calculates and records the slope and offset for programmed current using ILO and IHI data. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
IHI	In response to this command, the power supply sends a programmed current value to the output terminal. This value is at the high end of the power supply's current range and is read by an external device connected as part of the calibration procedure. Refer to this value as IHI and record it to use as input with the IDATA command. Set CMODE ON before using this command. See also the calibration procedures in Section 4

ILO	In response to this command, the power supply sends a programmed current value to the output terminal. This value is at the low end of the power supply's current range and is read by an external device connected as part of the calibration procedure. Refer to this value as ILO and record it to use as input with the IDATA command. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
IMAX <current>	**Parameter:** current Sets an upper soft limit on the supply's programmed output current. If the soft limit is exceeded, or if the soft limit value is lower than the present output current setting, the supply will ignore the command, turn on the ERR LED, and set the ERR bit in the status registers. **Range:** 0 to model maximum output current (IMAX) **Initial value:** IMAX
IMAX?	Asks for the supply's soft current limit setting. **Response:** IMAX <current>
IOUT?	Measures the supply's actual current output using the built -in current readback circuitry. **Response:** IOUT <current>
IRDAT<Ilo>, <Ihi>	**Parameters:** <Ilo>, <Ihi> Calculates and records the slope and offset for readback voltage using IRLO and IRHI data. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
IRHI	The power supply outputs a current value to an external device connected as part of the calibration procedure and records a current readback value internally. These values are at the high end of the programmed current range. Refer to the output value as IRHI and record it to use as input with the IRDAT command. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
IRLO	The power supply outputs a current value to an external device connected as part of the calibration procedure and records a current readback value internally. These values are at the low end of the programmed current range. Refer to the output value as IRLO and record it to use as input with the IRDAT command. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
ISET <current>	**Parameter:** current Sets the power supply's output current in amps (default) or in milliamps. This programmed current is the actual output in CC mode or the current limit in CV mode. **Range:** 0 to model maximum output current (IMAX) **Initial value:** 0 amps

ISET?	Asks for the supply's present output current setting. Does not apply to current settings which are being held. See HOLD command. **Response:** ISET <current>
LLO	Disables the front panel LOCAL switch. When LLO is in effect you can only return to local mode using the GTL command.
MASK <mnemonics>	**Parameters:** CV, CC, OV, SD, FOLD, ERR, OT, ACF, OPF,SNSP, ALL, NONE Disables the supply's previously unmasked operating conditions from setting bits in the fault and status registers. See Section 3.4. Mnemonics are separated from each other by commas and may be sent in any order. **Initial value:** MASK ALL **Note:** UNMASK NONE = MASK ALL; MASK NONE = UNMASK ALL
OUT <state>	**Parameters:** <1/ON, 0/OFF> Enables or disables the supply's voltage/current output. The supply will continue to accept new commands while the output is disabled but these will not be implemented until OUT ON or OUT 1 is received. OUT OFF (or OUT 0) also asserts the isolation signal on the rear panel J7 connector, line 3. You can use the J7-3 user signal to trip external relays to isolate the power supply from the load. **Initial value:** OUT 1 (output enabled)
OUT?	Asks for the present enabled/disabled status of the supply's output voltage/current. **Response:** OUT 1 output enabled OUT 0 output disabled
OVCAL	Causes the master controller to perform automatic calibration of the supply's over voltage protection circuitry. Set CMODE ON before using this command. Ensure jumper J66 and jumper J104 on the M9B-HFS Interface PCB are connected for remote operation.
OVSET <volts>	Sets the supply's over voltage protection trip point in volts (default) or in millivolts. If the trip point is exceeded, or if the trip point value is lower than the present output voltage setting, the supply will ignore the command and set the ERR bit in the accumulated status register. **Range:** 0 to 110% of model maximum output voltage (VMAX) **Initial value:** 110% of model VMAX
OVSET?	Asks for the supply's present over voltage protection limit. **Response:** OVSET <voltage>

REN <state>	**Parameters:** <0/OFF,1/ON> Remote Enable. With the REN 0, the power supply is in local mode. If a command is sent from the computer, the power supply does not respond but remains in local mode. With REN 1, the power supply will enter remote mode when a command is sent from the computer.
REN?	Asks for the state of remote enable. **Response:** REN <state>
ROM?	Asks for the version number of the master and slave EPROMs located on the interface PCB. **Response:** ROM M:<version> S:<version>
RST	Resets the supply to present voltage and current settings if the output is disabled by over voltage or foldback protection. Output values changed via software commands while the unit is disabled will not take effect until RST is used.
STS?	Asks for the supply's present status register. Status conditions are stored in the status register. Each bit represents a separate condition. When the condition is true, the corresponding bit is 1. Bits remain set in the status register as long as the condition is true. See Section 3.4 Accumulated Status, Status, and Fault Registers. **Response:** STS <status mask> where status mask is the decimal equivalent of the total bit weights for the operating conditions as listed in the status register.
TRG	Implements programmed voltage and current settings which had been in hold mode. The supply operates with previous values until the TRG (trigger) command is sent.
UNMASK <mnemonics>	**Parameters:** CV, CC, OV, SD, FOLD, ERR, OT, ACF, OPF,SNSP**,** ALL, NONE Enables you to select the supply operating conditions that you are most interested in monitoring for fault occurrence. Mnemonics describing the conditions are separated from each other by commas, and may be sent in any order. Specifying one or more mnemonics which describe the conditions (or the decimal equivalent of their total bit weight) enables the selected conditions to set bits in the supply's fault and status registers during operation. A bit is set in the fault register when the corresponding bit in the status register changes from 0 to 1 and the corresponding bit in the mask register is 1. See Section 3.4 Accumulated Status, Status, and Fault Registers . **Initial value:** UNMASK NONE **Note:** UNMASK NONE = MASK ALL; MASK NONE = UNMASK ALL
UNMASK?	Asks for the supply's fault conditions which are currently enabled (unmasked). **Response:** UNMASK <fault mask> where fault mask is the decimal equivalent of the total bit weights for the operating conditions as listed in the status and fault registers See Section 3.4 Accumulated Status, Status, and Fault Registers .

VDATA <Vlo>, <Vhi>	**Parameters:** <Vlo>, <Vhi> Calculates and records the slope and offset for programmed voltage using VLO and VHI data. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
VHI	In response to this command, the power supply sends a programmed voltage value to the output terminal. This value is at the high end of the power supply's voltage range and is read by an external device connected as part of the calibration procedure. Refer to this value as VHI and record it to use as input with the VDATA command. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
VLO	In response to this command, the power supply sends a programmed voltage value to the output terminal. This value is at the low end of the power supply's voltage range and is read by an external voltmeter connected as part of the calibration procedure. Refer to this value as VLO and record it to use as input with the VDATA command. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
VMAX <volt>	Sets an upper soft limit on the supply's programmed output voltage. If the soft limit is exceeded, or if the soft limit value is lower than the present output voltage setting, the supply will ignore the command, turn on the ERR LED, and set the ERR bit in the accumulated status register. **Range:** 0 to model maximum output voltage (VMAX) **Initial value:** VMAX
VMAX?	Asks for the supply's soft voltage limit setting. **Response:** VMAX <voltage>
VOUT?	Measures the supply's actual voltage output using the built-in voltage readback circuitry. **Response:** VOUT <voltage>
VRDAT <Vlo>, <Vhi>	**Parameters:** <Vlo>, <Vhi> Calculates and records the slope and offset for readback voltage using VRLO and VRHI data. Set CMODE ON before using this command. See also the calibration procedures in Section 4. <Vlo> and <Vhi> are in <voltage> format.
VRHI	The power supply outputs a voltage value to an external voltmeter connected as part of the calibration procedure and records a voltage readback value internally. These values are at the high end of the programmed voltage range. Refer to the output value as VRHI and record it to use as input with the VRDAT command. Set CMODE ON before using this command. See also the calibration procedures in Section 4.

VRLO	The power supply outputs a voltage value to an external voltmeter connected as part of the calibration procedure and records a voltage readback value internally. These values are at the low end of the programmed voltage range. Refer to the output value as VRLO and record it to use as input with the VRDAT command. Set CMODE ON before using this command. See also the calibration procedures in Section 4.
VSET <volt>	**Parameter:** voltage Sets the power supply's output voltage in volts (default) or in millivolts. This programmed voltage is the actual output in CV (constant voltage) mode or the voltage limit in CC (constant current) mode. If you enter a negative voltage value, the power supply will assert a signal on the J7-4 user signal line. You can use the user signal to trip external relays to switch the output polarity. **Range:** 0 to model maximum output voltage (VMAX) **Initial value:** 0 volts
VSET?	Asks for the power supply's present output voltage setting. Does not apply to voltage settings which are being held by the HOLD command. See HOLD command. **Response:** VSET <voltage>

3.4 Accumulated Status, Status, and Fault Registers

The HFS-M9B option card uses three separate registers which are always active. They are the accumulated status, status, and fault registers. You can use the status commands shown in Table 3.2-4 to activate the registers. The bit register has twelve conditions, each assigned a bit weight. When querying a register, the controller returns a response which is the sum of the weights of all relevant conditions.

Example:

ASTS? Queries the accumulated status register.

ASTS 771 Controller Response

771 = 512 + 256 + 2 + 1 = PON + REM + CC + CV

The accumulated status register shows that PON, REM, CC, and CV have all been active since the last accumulated register query.

Table 3.4-1 shows the mnemonics and bit weights which correspond to each register condition. You can select conditions you want to monitor in the fault and status register by using the MASK and UNMASK commands.

Table 3.4-1 Accumulated Status, Status, and Fault Registers

Condition	Mnemonic	Bit Position	Bit Weight
Constant voltage operation	**CV**	0	1
Constant current operation	**CC**	1	2
Not used	**–**	2	4
Over voltage protection tripped	**OV**	3	8
Over temperature protection tripped	**OTP**	4	16
Supply external shutdown active (J7-1)	**SD**	5	32
Foldback mode operation	**FOLD**	6	64
Remote programming error	**ERR**	7	128
Power ON (accumulated status, status registers only)	**PON**	8	256
Remote mode (accumulated status, status registers only)	**REM**	9	512
AC fail condition	**ACF**	10	1024
Output fail condition	**OPF**	11	2048
Sense protection tripped	**SNSP**	12	4096

Notes:

1. All mnemonics can be masked or unmasked.
2. The error (ERR) bit is reset in the status registers with an error query (ERR?).
3. The accumulated status register is cleared with an accumulated status query (ASTS?).
4. A fault is cleared with a fault query (FAULT?).

3.5 Error Codes

If the ERR flag in the accumulated status or fault registers has been activated, an ERR? query will return an error number which corresponds to an event described in Table 3.5-1. The ERR? query will also clear the ERR bit in the status register.

Table 3.5-1 Error Codes

Error #	Error Identification	Explanation
0	No Errors	
4	Unrecognized Character Improper Number Unrecognized String Syntax Error	A character such as @,*,$ was received. A numeric character was received but the characters were not a proper number. **Example:** VSET ,±10.3 V An invalid command was received. An incorrectly placed word, number, separator, or terminator was received. **Example:** OFF, VOUT 6V, MASK, ERR
5	Number Out of Range	The numerical value for the command was outside of the allowed range.
6	Attempt to Exceed Soft Limits	An attempt was made to program a voltage or current **greater than** the soft limit. **Example:** VMAX 500V ; VSET 550V CR
7	Improper Soft Limit	An attempt was made to program a soft limit **less than** the output value.
8	Data Requested without a Query Being Sent	The controller requested data from the power supply without first sending a query command.
9	OVP Set Below Output	An OVSET command was sent with a trip value lower than the output voltage.
10	Slave Processor Not Responding	The interface PCB slave processor did not respond.
12	Illegal Calibration	Calibration was attempted when the supply was not in calibration mode. See CMODE command.

4. CALIBRATION

4.1 Introduction

WARNING

Exercise caution when using and servicing power supplies. High energy levels can be stored at the output voltage terminals on all power supplies in normal operation. In addition, potentially lethal voltages exist in the power circuit and the output connector of power supplies which are rated at 40V and over. Filter capacitors store potentially dangerous energy for some time after power is removed.

You calibrate the M9B-HFS interface so that signal levels on the interface card correspond to the expected signal levels on the power supply's main assembly. You may need to recalibrate the interface whenever you install a new interface board, or, if the unit falls out of specification due to component aging drifts.

You can calibrate the M9B-HFS interface for:

- voltage program
- voltage readback
- current program
- current readback
- over voltage protection.

For reading accuracy, perform the calibration procedures in this section at an ambient temperature of 25°C ± 5°C.

4.2 Voltage Mode Calibration

Follow all procedures in the sequence given. Make sure that you are set up as in Section 4.2.1 Voltage Calibration Setup Procedure prior to any voltage calibration.

4.2.1 Voltage Calibration Setup Procedure

1. Disconnect any load from the power supply which is to be calibrated.
2. Connect a voltmeter across the power supply's output terminals.

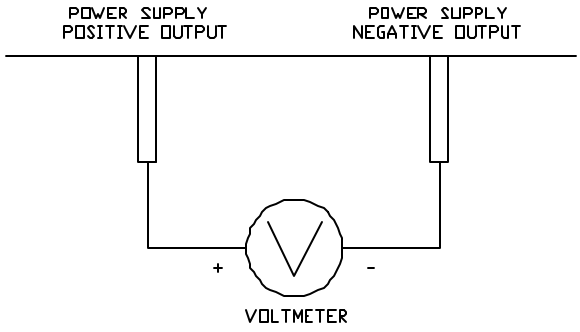


Figure 4.2-1 Voltage Calibration Setup

4.2.2 Voltage Program Calibration Procedure

1. Set up for calibration as in Section 4.2.1 Voltage Calibration Setup.
2. Activate calibration mode by sending command CMODE ON.
3. Send commands VLO; ILO to the power supply. Measure and record the output voltage shown on the external voltmeter.
4. Send commands VHI; IHI to the supply. Measure and record the output voltage shown on the external voltmeter.
5. Send the command VDATA <vlo>,<vhi> to the power supply. <vlo> and <vhi> are the voltage values taken from the voltmeter when the VLO and VHI commands were sent. When the power supply is calibrated, the <vlo> and <vhi> voltage values are stored as constants.
6. Program the supply at various levels using the VSET command to confirm that the calibration was successful and that linearity is observed. See the voltage program accuracy specification in Appendix A.
7. Turn off calibration mode by sending the command CMODE OFF to the supply.

4.2.3 Voltage Readback Calibration Procedure

1. Set up for calibration as in Section 4.2.1 Voltage Calibration Setup.
2. Send the software command CMODE ON to activate calibration mode.
3. Send command VRLO; IRLO to the power supply. Wait for supply to settle. Measure and record the output shown on the external voltmeter. Send VRLO again.
4. Send command VRHI; IRHI to the supply. Wait for the supply to settle. Measure and record the output voltage shown on the external voltmeter. Send VRHI again.
5. Send the command VRDAT <vlo>,<vhi> to the power supply. <vlo> and <vhi> are the voltage values obtained from the voltmeter by sending the VRLO and VRHI commands. The processor calculates the offset value required to calibrate the power supply. When the power supply is calibrated, the low to high voltage readback calibration values (offsets) are stored as constants.
6. Use commands VSET and VOUT? to confirm that the calibration was successful and that linearity is observed. Refer to the voltage readback accuracy specification in Appendix A.
7. Turn off calibration mode by sending the CMODE OFF command to the supply.

4.3 Current Mode Calibration

Follow all procedures in the sequence given. Make sure that you are set up as in Section 4.3.1 Current Calibration Setup before doing current calibration.

4.3.1 Current Calibration Setup

1. Disconnect any load from the power supply to be calibrated.
2. Connect a current shunt across the supply's output terminals.
3. Connect a voltmeter across the current shunt.

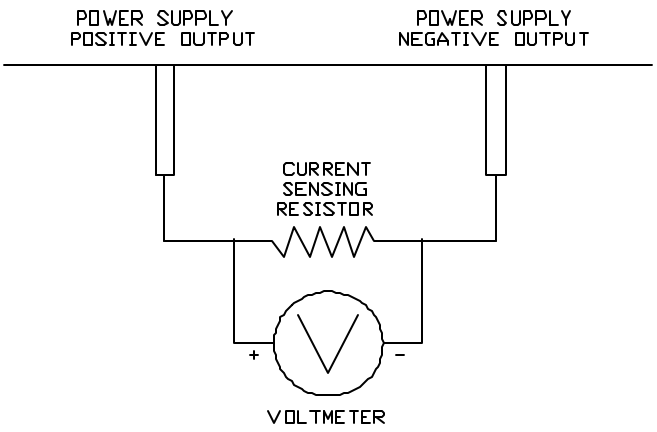


Figure 4.3-1 Current Calibration Setup

4.3.2 Current Program Calibration Procedure

1. Connect the current shunt to the power supply as shown in Section 4.3.1 Current Calibration Setup.
2. Activate calibration mode by sending command CMODE ON to the power supply.
3. Send commands ILO; VLO to the power supply. Measure and record the output voltage shown on the external voltmeter.
4. Send commands IHI; VHI to the supply, then measure and record the output voltage shown on the external voltmeter.
5. Calculate ILO and IHI from the voltages measured and the shunt resistance. I =V/R.
6. Send the command IDATA <ilo>,<ihi> to the power supply. <ilo> and <ihi> are the current values obtained from sending the ILO and IHI commands to the supply. When the power supply is calibrated, the low to high current program calibration values are stored as constants.
7. Program the supply at various levels using the ISET command to confirm that the calibration was successful and that linearity is observed. Refer to the current program accuracy specification in Appendix A.
8. Turn off calibration mode by sending the command CMODE OFF to the supply.

4.3.3 Current Readback Calibration Procedure

1. Connect the current shunt to the power supply as shown in Section 4.3.1 Current Calibration Setup. Connecting a DVM is optional.
2. Activate calibration mode by sending software command CMODE ON to the power supply.
3. Send command IRLO; VRLO to the power supply. Wait for the supply to settle. Measure and record the voltage output shown on the external meter. Send IRLO again.
4. Send command IRHI; VRHI to the supply. Wait for the supply to settle. Measure and record the output voltage as shown on the external meter. Send IRHI again.
5. Calculate IRLO and IRHI from the voltages taken from the external meter and the shunt resistance. I=V/R.
6. Send the command IRDAT <ilo>,<ihi> where <ilo> and <ihi> are the current values obtained by sending the commands IRLO and IRHI to the supply. When the power supply is calibrated, the low to high current readback calibration values are stored as constants. Refer to the current readback accuracy specification in Appendix A.
7. Use commands ISET and IOUT? to confirm that the calibration was successful and that linearity is observed. Refer to the voltage readback accuracy specification in Appendix A.
8. Turn off calibration mode by sending the command CMODE OFF to the power supply.

4.4 Over Voltage Protection (OVP) Calibration

We recommend that you perform OVP calibration every six months. Connecting a digital voltmeter as in Section 4.2.1 Voltage Calibration Setup is optional.

1. Disconnect any load from the supply.
2. Ensure that jumper J66 on the interface PCB is installed to enable remote OVP calibration. (Jumper J66 is installed at the factory). See Figure 2.7-1 for the location of jumper J66.
3. Activate calibration mode by sending command CMODE ON to the supply.
4. Send the command OVCAL to the supply. The ADDR LED will light during OVP calibration. Calibration is complete when the ADDR LED turns off. This may take a few minutes.
5. Use the OVSET, OVSET?, and VSET commands to trip the OVP level, confirming that the calibration was successful. When you trip the OVP level, the red OVP LED will light and the voltage will drop to zero. Send the command RST to clear the OVP condition. Refer to the OVP program accuracy specification in Appendix A.
6. Turn off calibration mode by sending the command CMODE OFF to the supply.

5. MAINTENANCE

5.1 Introduction

This section describes the diagnostic LEDs located on the M9B-HFS interface printed circuit board (PCB) and provides a list of replacement parts for the interface. The schematic for the M9B-HFS interface is in Appendix B.

5.2 Troubleshooting

5.2.1 Diagnostic LEDs

Computer Operating Properly (COP) LEDs

There are three diagnostic LEDs, located at CR164, CR163, and CR97 on the M9B-HFS interface PCB. Refer to Figure 2.7-1 for their locations. Issue a RST (reset) command to clear diagnostic LEDs.

When it lights up, the green COP LED at circuit designation CR164 indicates that the M9B-HFS interface microprocessor successfully recovered from a timeout error due to a communications bus error. The event is transparent to the M9B-HFS line. The M9B-HFS interface continues to function normally.

A lighted, red COP LED at CR163 indicates that noise in the master processor circuitry caused a transparent restart. An internal bus error will also attempt a transparent restart.

A lighted, red COP LED at CR97 indicates that noise in the slave processor circuitry caused a transparent restart. An internal bus error will also attempt a transparent restart.

5.3 Replaceable Parts

WARNING

Exercise caution when using and servicing power supplies. High energy levels can be stored at the output voltage terminals on all power supplies in normal operation. In addition, potentially lethal voltages exist in the power circuit and the output connector of power supplies which are rated at 40V and over. Filter capacitors store potentially dangerous energy for some time after power is removed.

CAUTION

Use proper static control techniques to avoid damage to static-sensitive components on the printed circuit board.

In this section, you will find parts lists for the M9B-HFS Interface assembly. Each of the parts and options listed can be ordered separately.

5.3.1 Parts Replacement and Modifications

Do not use substitute parts or make any unauthorized modifications to the interface to ensure that its safety features are not degraded.

5.3.2 Ordering Parts

Order parts from the factory using the parts numbers given in this section. When ordering parts, please include the model number and serial numbers. Since microprocessor and EPROM revisions occur frequently, check the revision number stamped on these parts if you should need to order a replacement.

5.3.3 M9B-HFS PCB Replaceable Parts

Table 5.3-1 M9B-HFS Interface PCB Replaceable Parts

Designation	Description	Part #
C4,5,6	0.33µF 50V Metalized Polypropylene Axial Capacitor	CD-334A-09
C10,12-14,16,21,26,30, 31,34,41,42,51,59, 62 78-80,101,103,107,113, 115,122,129,139,145, 149,157,159,172, 176-181,192,197,198, 201,203, 204, 207,209, 219,220	0.33µF Axial Lead By-Pass Capacitor	CC-334A-09
C15,23	1µF 35V Tantalum 10% 2.5mm Capacitor	CJ-1U0D-35
C17	1nF 100V X7R 10% 5.0mm Ceramic Radial Capacitor	CB-102F-16
C22,29	220pF 100V X7R 10% 5.00mm Ceramic Radial Capacitor	CB-221F-16
C25,55,75,76,82,84,85, 112,144,148,151,193, 214,218	10µF 25V 2.5mm 20% Tantalum Capacitor	CJ-100D-25
C43,44,52,121,153	4.7µF 2.5mm 25V Tantalum Capacitor	CJ-4U7D-25
C50,57,83	10nF 100V X7R 10% 5.00mm Ceramic Radial Capacitor	CB-103F-16
C61	47nF 50V X7R 10% 5.0mm Ceramic Radial Capacitor	CB-473F-06
C182-188,189	3.3nF 1KV Z5U +80% to -20% 6.5mm Cer. Rad. Capacitor	CC-332G-67
CR9,24,36,45-47,56,60, 90,90,111,147	1N4148 UR D035 75V 300mA	CR-4148
CR97,163	T1-3/4 2mcd @2mA Red LED	DS-4700-R2
CR164	T1-3/4 1.8mcd @2mA Green LED	DS-4740-G2
CR221,224,227	3mm D. Right Angle Housed Green LED	DS-1503-G8
CR228	3mm D. Right Angle Housed Red LED	DS-1301-R8
J1	14 Pin Dual Row 0.1" Shrouded PCB Header	MC-1408-MC
J65	20 Pin Dual Row 0.1" Shrouded PCB Header	MC-2008-MC
J66,104	2x1 0.25"Sq, 0.1" Spacing Header	MC-0201-MC
J92	3x1 0.25"Sq, 0.1" Spacing Header	MC-0301-MC
J92,66,104	2 PIN Female 0.1" Header Jumper	MC-0201-JMP
J229	RJ45 8 Position Filtered Modular Phonejack	MC-458B-MJ
L86,87,88	0.25" 3.5Ω 130mA 33µH Axial Inductor	L-0330
PCB	M9B-HFS Printed Circuit Board, Rev. C	PC-9BHF-C
Q53,73,74	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q54,211,212	XX2907A PB 60V 0.5mA 400mW TO92	QN-2907-A
Q217	2N7000 N-FET 60V 500mA TO226AA	MC-TRNS-HP
R2,3	221Ω 1% 1/4W MF	R-2210-41
R7	100Ω Isolated SIP, 10 pin, 2%	RY-1000-02
R8	1.50M 1/4W 1%	R-1504-41
R18	6.34k 1/4W 1% MF	R-6341-41
R20,98,99,100,156,161, 162,215	100Ω 1% 1/4W MF	R-1000-41
R33,64	20.0k 1/4W 1%	R-2002-41
R37,38,40,117,125,126, 140,141,200,206	1.00k 1% 1/4W MF	R-1001-41
R39,63,71,77,124,160	10k 1% 1/4W	R-1002-41
R48,49	100k 1% 1/4W MF	R-1003-41

Continued on next page.

5.3.3 M9B-HFS Replaceable Parts (continued)

Table 5.3-1 M9B-HFS Interface PCB Replaceable Parts (continued)

Designation	Description	Part #
R67,69,72,106,119,142, 152,169	4.75k 1/4W 1%	R-4751-41
R68,70	27.4k 1/4W 1%	R-2742-41
R89,166,167	2k 1/4W 1% MF	R-2001-41
R93	665k 1/4W 1%	R-6653-41
R108,114,173,226	4.7k x 9, 10 pin SIP 2%	RX-4701-02
R118,130	330Ω Isolated SIP, 10 pin 2%	RY-3300-02
R127,128,137,138,175	511Ω 1/4W 1%	R-4751-41
R165,190,191,195,196	475Ω 1% 1/4W MF	R-4750-41
R174	10k bussed sip 10 pin 2%	RX-1002-02
R199,205	1M 1/4W 1%	R-1004-41
R213	4.7k Isolated SIP, 10 pin 2%	RY-4701-02
R216	121Ω 1/4W 1%	R-1210-41
SW225	8PST 5V 0.1A Piano DIP Switch	SW-8156-KA3
U11,32	Quad SPST CMOS Analog Switch Logic	UI-D445-DJ
For U11, 32	16 pin Machined Socket, 0.3"	MC-M316-IC
U19	Quad OP Amp Rail-Rail	UA-2274-CN
For U19,94,171	14 pin Machined Socket, 0.3"	MC-M314-IC
U28	TLC372 Dual Differential Comparators	UA-C372-N
U35	Unity Gain, Precision, Diff. Amplifier 8 DIP	UA-AMP3-GP
U58	LF353 Dual Amp FET Input 8 pin DIP	UA-0353-N
For U28,35,58,131,132, 134,135,194,202	8 pin Machined Socket, 0.3"	MC-M308-IC
U81	16 bit Resolution DAC	UD-1600-JP
For U81	24 pin Machined Socket 0.6"	MC-M624-IC
U94,171	Quad Pos NAND Gates with Schmitt Trig	UH-C132
U95,96,116	20 pin DIP 74HCT574 Octal Latch	UH-T574-N
For U95,96,116	20 pin Machined IC Socket 0.3"	MC-M320-IC
U102,155	8.0 MHz TTL Clock Osc Metal Pkg	YM-0008-5
U110,143	68 pin PLCC 68HC11F1 µController	US-11F1-FN
For U110,143	68 pin PLCC Socket	MC-PL68-IC
U120	M9B HFS Slave HC11 EPROM Firmware V1.01	UM-XF3B-S101
For U120,210	28 pin Machined Socket, 0.6"	MC-M628-IC
U123,158	MC34064P Power Reset IC TO92	US-3406-4P
U131,132	High Speed Dual Opto-Coupler 8 pin DIP	UP-2630
U133,136	6 pin DIP 4N35 Opto-Coupler 3550V Isolation	UP-4N35
For U133,136	6 pin Machined Socket, 0.3"	MC-M306-IC
U134,135	Min 8 pin DIP MCT6 Dual PhotoQ O/C 20% Ctr	UP-MCT6
U150	3 turn LM2940CT 5V Low Sat Reg TO220	UR-2940-CT
For U150	Black Heatsink TO-220 0.71"L x 0.5"H	HS-6107-B
For U150	#4-40 x 1/4" Kep Nut, Stainless Steel	MN-440Z-08
For U150	#4-40 x 5/16" Phillips Pan Screw, Stainless Steel	MS-4P28-05
U210	M9B HFS Master HC11 EPROM Firmware V1.01	UM-XF3C-M101
U194,202	7555 CMOS Timer 8 pin DIP	UC-1600-JP
U208	Empty Location	U-EMPT
U222	HP Fiber-Optic Transmitter	MC-TRNS-HP
U223	HP Fiber-Optic Receiver	MC-RECV-HP

5.3.4 Fiber Optic Cable Assembly Parts

To use the M9B-HFS interface, you will need to supply fiber optic cable and a computer with a fiber optic serial port. The M9B-HFS uses a HP receiver/transmitter pair with HP part numbers shown in Table 5.3-2. Choose fiber optic cable which is compatible with this receiver/transmitter pair.

If you have an RS232 serial port, you can connect fiber optic line to it using a fiber-to-RS232 serial data converter. Table 5.3-2 shows the part number and supplier of a fiber optic-to-RS232 serial data converter.

Standard fiber optic cable assembly and fiber to serial adapters are available from your electronics/computer equipment supplier.

Table 5.3-2 Fiber Optic Connection Parts

Description	Part #	Vendor
fiber optic receiver fiber optic transmitter	HFBR-1521 HFBR-2521	Hewlett Packard (contact nearest HP office)
fiber optic to RS232 serial data converter	FTR	Group 3 Technology Ltd. P.O. Box 71-111 Rosebank, Auckland, New Zealand. ph: 64 9 828 3358 fax: 64 9 828 3357

A. SPECIFICATIONS

A.1 XFR 1200 Watt Series Supplies with M9B-HFS Interface Installed

All specifications are subject to change without notice. Specifications are warranted from 25°C ±5°C unless otherwise specified.

Table A-1 Electrical Specifications for XFR 1200 Watt Series
7.5 Volt to 60 Volt Models

Models	7.5-140	12-100	20-60	40-30	60-20
Program Resolution					
Voltage	0.2mV	0.3mV	0.4mV	0.8mV	1.3mV
Current	4.8mA	3.4mA	2.1mA	1.0mA	0.7mA
OVP	0.2mV	0.3mV	0.4mV	0.8mV	1.3mV
Program Accuracy[1]					
Voltage	10mV	75mV	75mV	75mV	150mV
	±0.12%	±0.12%	±0.2%	±0.3%	±0.25%
Current	500mA	250mA	165mA	140mA	120mA
	0.1%	0.1%	0.15%	0.15%	0.1%
OVP	80mV	200mV	330mV	400mV	600mV
Readback Resolution					
Voltage	0.2mV	0.3mV	0.4mV	0.8mV	1.3mV
Current	4.8mA	3.4mA	2.1mA	1.0mA	0.7mA
Readback Accuracy[1]					
Voltage	30mV	75mV	75mV	75mV	150mV
	±0.12%	±0.12%	±0.2%	±0.3%	±0.25%
Current	500mA	250mA	165mA	140mA	120mA
	0.1%	0.1%	0.15%	0.15%	0.1%

Table A-2 Electrical Specifications for XFR 1200 Watt Series
100 Volt to 600 Volt Models

Models	100-12	150-8	300-4	600-2
Program Resolution				
Voltage	2.1mV	3.2mV	6.3mV	12.6mV
Current	0.4mA	0.6mA	0.1mA	0.1mA
OVP	2.1mV	3.2mV	6.3mV	12.6mV
Program Accuracy[1]				
Voltage	150mV	225mV	225mV	300mV
	±0.35%	±0.35%	±0.35%	±0.35%
Current	80mA	80mA	80mA	75mA
	0.1%	0.1%	0.1%	0.1%
OVP	1.0V	3.0V	3.0V	6V
Readback Resolution				
Voltage	2.1mV	3.2mV	6.3mV	12.6mV
Current	0.4mA	0.6mA	0.1mA	0.1mA
Readback Accuracy[1]				
Voltage	150mV	225mV	225mV	300mV
	±0.35%	±0.35%	±0.35%	±0.35%
Current	80mA	80mA	80mA	75mA
	0.1%	0.1%	0.1%	0.1%

[1]Apply accuracy specifications according to the following voltage program accuracy example:
Set a model XFR 20-60 power supply to ten volts.
The expected result will be within the range of 10 volts ±75mV ±0.2% of the set voltage of 10 volts.

A.2 XFR 2800 Watt Series Supplies with M9B-HFS Interface Installed

All specifications are subject to change without notice. Specifications are warranted from 25°C ±5°C unless otherwise specified.

Table A-3 Electrical Specifications for 2800 Watt Supplies
7.5 Volt to 60 Volt Models (HFS Installed)

Models	7.5-300	12-220	20-130	40-70	60-46
Program Resolution					
Voltage	0.2mV	0.3mV	0.4mV	0.8mV	1.3mV
Current	10.3mA	7.5mA	4.4mA	2.4mA	1.6mA
OVP	0.2mV	0.3mV	0.4mV	0.8mV	1.3mV
Program Accuracy[1]					
Voltage	10mV	75mV	75mV	75mV	150mV
	0.12%	0.12%	0.2%	0.3%	0.3%
Current	300mA	165mA	120mA	110mA	80mA
	0.15%	0.15%	0.15%	0.15%	0.1%
OVP	75mV	200mV	330mV	400mV	600mV
Readback Resolution					
Voltage	0.2mV	0.3mV	0.4mV	0.8mV	1.3mV
Current	10.3mA	7.5mA	4.4mA	2.4mA	1.6mA
Readback Accuracy[1]					
Voltage	10mV	75mV	75mV	75mV	150mV
	0.12%	0.12%	0.2%	0.3%	0.3%
Current	300mA	165mA	120mA	110mA	80mA
	0.15%	0.15%	0.15%	0.15%	0.1%

Table A-4 Electrical Specifications for 2800 Watt Supplies
100 Volt to 600 Volt Models (HFS Installed)

Models	100-28	150-18	300-9	600-4
Program Resolution				
Voltage	2.1mV	3.2mV	6.3mV	12.6mV
Current	1.0mA	0.6mA	0.3mA	0.1mA
OVP	2.1mV	3.2mV	6.3mV	12.6mV
Program Accuracy[1]				
Voltage	150mV	225mV	225mV	300mV
	0.35%	0.35%	0.35%	0.35%
Current	80mA	80mA	75mA	75mA
	0.1%	0.1%	0.1%	0.1%
OVP	1.0V	1.5V	3.0V	6V
Readback Resolution				
Voltage	2.1mV	3.2mV	6.3mV	12.6mV
Current	1.0mA	0.6mA	0.3mA	0.1mA
Readback Accuracy[1]				
Voltage	150mV	225mV	225mV	300mV
	0.35%	0.35%	0.35%	0.35%
Current	80mA	80mA	75mA	75mA
	0.1%	0.1%	0.1%	0.1%

[1]Apply accuracy specifications according to the following voltage program accuracy example:
Set a model XFR 20-130 power supply to ten volts.
The expected result will be within the range of 10 volts ±75mV ±0.2% of the set voltage of 10 volts.

B. ASSEMBLY SCHEMATIC

M9B-HFS OPTION BOARD
XS-9BHF

Xantrex Technology Inc.
8999 Nelson Way
Burnaby, B.C.
Canada V5A 4B5

Tel: 604-422-8595
Fax: 604-420-1591

Toll Free North America
1-800-667-8422

e-mail: info@xantrex.com
http://www.xantrex.com

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