Racal Instruments™

1450 144 Crosspoint 2A, Two-Wire Matrix Plug-in Switch Card

User Manual

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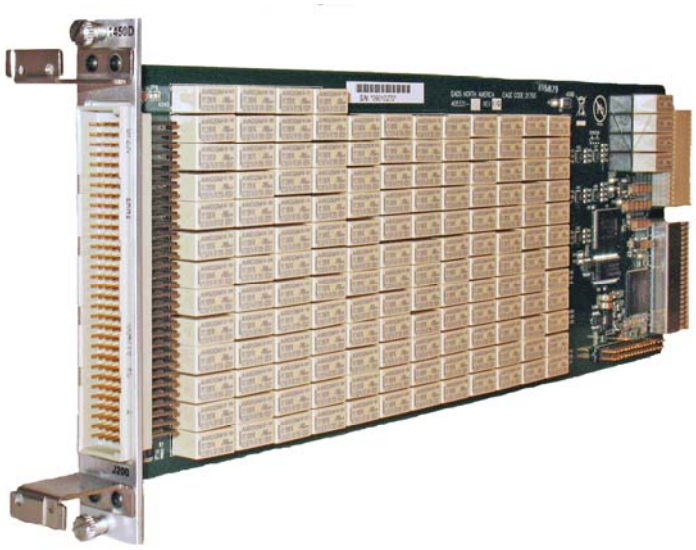

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FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.
2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

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EADS North America Test and Services

CE Declaration of Conformity

We

EADS North America Test and Services
4 Goodyear St.
Irvine, CA 92618

declare under sole responsibility that the

1830 Source/ Measure switch, P/N 1830-0102YYZZ
LXI 1170, 52ch SPDT, P/N 408161
LXI 1180, 80ch SPST, P/N 408162
LXI 1220, 16A, P/N 408163-001,-002,-003,-004
LXI 1380, 2W 8 1x8 Mux, P/N 408164
LXI 1450, Matrix, P/N 408175, 408176
DMM, 7.5 Digit, 1830, LXI, 408186

conforms to the following Product Specifications:

Safety: **EN 61010-1:2001**

EMC: **EN61326:2006 CLASS B**

Supplementary Information:

The above specifications are met when the product is installed in an EADS North America Test and Services certified enclosure, with faceplates installed over all unused slots, as applicable.

The product herewith complies with the requirements of EN 61010-1:2001 and EN61326:2006 CLASS B

Irvine, CA, July 6, 2009

David Johnston, Engineering Manager

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Document Change History

Revision	Date	Description of Change
A	8/11/09	Document Control release

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Chapter 1
Overview and Specifications

Overview

The Racal Instruments™ 1450D and 1450F cards are expandable, high-density switch matrices for the 1800 Series Source/Measure Switch platform. The cards quickly and easily plug into a switching system like the Model 1830 Source/Measure Switch using LXI/GPIB/USB interfaces and easily expand with the internal Signal Raceway analog bus.

Feature highlights include:

- Two standard versions with 144 crosspoints
- Specifications provided for all configurations
- Ideal for connecting test signals to/from multiple instruments
- Plug-in design for rapid expansion and replacement
- Internal analog bus for construction of large matrices up to 4x324 or 8x162 (with Model 1830 Source/Measure Switch)

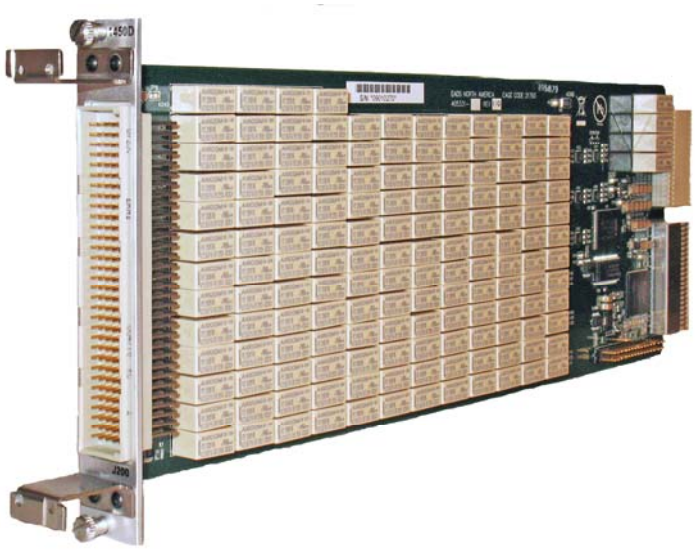

Figure 1-1: 1450 Plug-in Switch Card

This plug-in provides the flexibility of a high-density matrix while maintaining excellent bandwidth and signal integrity. Two different versions are available. Each version is separately characterized for performance, eliminating the guesswork involved in using matrix families with “up to…” style specifications.

Careful consideration has been given to board layout to provide superior performance in demanding differential communications applications. Electromechanical relays support bi-directional operation. 1450 Series plug-in cards are available in the following two-wire configurations:

- 1450D (4x36): Using the analog bus of the Model 1830 Source/Measure Switch, matrix dimensions can be expanded up to 4x324
- 1450F (8x18): Using the analog bus of the Model 1830 Source/Measure Switch, matrix dimensions can be expanded up to 8x162

The 1450 cards can be programmed using industry-standard SCPI commands or with an included IVI COM or C driver. If LAN communication is used, the card may be programmed directly using a web-page. If test-executive, data acquisition, and database capabilities are needed, the 1450 can be programmed in the optional ActivATE™ test software platform, which is available as an option at a bundled price when purchased with an 1800-series switching system.

All 1450 models can be used to construct large matrices from multiple plug-ins without using external loop-back connections. Each plug-in includes provisions for expansion to “4xN” (up to 4x324) or “8xN” (up to 8x162) using the analog bus with no external wiring necessary. The analog bus is easily controlled using software command of on-board configuration relays.

The 1450 switch card takes advantage of the Signal Raceway analog bus which provides a high-quality route for the connection of instruments to the unit or system under test. The tight integration between the instruments and switching simplifies connectivity and reduces external cabling.

Specifications

Input

Maximum Switching Voltage	300 VDC or 300 VAC
Maximum Switching Current	2 A DC/AC
Maximum Switching Power	60 W, 125 VA

DC Performance: 1450D/F (2-wire)

Path Resistance	< 900 mΩ (Initial)
Insulation Resistance	> 10^9 Ω
Thermal EMF	< 1 µV
Analog Bus	1450D: Connection to Differential Bus 1450F: Connection to Single-ended and Differential Buses Thermal EMF + 2 µV Path Resistance + 1.0 Ω

AC Performance (50Ω): 1450D (4x36)

Bandwidth (-3 dB)	> 65 MHz
Insertion Loss	100 KHz: < 0.1 dB 1 MHz: < 0.2 dB 10 MHz: < 0.3 dB 65 MHz: < 3.0 dB
Isolation	100 KHz: > 80 dB 1 MHz: > 70 dB 10 MHz: > 50 dB 65 MHz: > 25 dB
Crosstalk	100 KHz: < -85 dB 1 MHz: < -75 dB 10 MHz: < -50 dB 65 MHz: < -30 dB
Capacitance	Channel-Chassis: < 100 pF Hi to Lo: < 100 pF Open Channel: < 20 pF

AC Performance (50Ω): 1450F (4x36)

Bandwidth (-3 dB)	> 80 MHz
Insertion Loss (1x8)	100 KHz: < 0.2 dB 1 MHz: < 0.2 dB 10 MHz: < 0.3 dB 80 MHz: < 3.0 dB
Isolation (1x8)	100 KHz: > 80 dB 1 MHz: > 70 dB 10 MHz: > 50 dB 80 MHz: > 20 dB
Crosstalk (1x8)	100 KHz: < -85 dB 1 MHz: < -85 dB 10 MHz: < -55 dB 80 MHz: < -30 dB
Capacitance	Channel-Chassis: < 100 pF Hi to Lo: < 100 pF Open Channel: < 20 pF

Interface Data

Power Requirements	+5 VDC at 100 mA +3.3 VDC at 1 A 5 VDC at 30 mA per energized relay (Analog Bus) +5 VDC at 30 mA per energized latching relay, momentary (Matrix)

Software

Native Language	SCPI & SCPI scripting
Driver Support	IVI (C and Com), LabVIEW
Test Executive	ActivATE™ software (optional)
Web Page	LXI control only

Environmental Data

Temperature	Operating: 0° C to 50° C Storage: -40° C to 71° C
Relative Humidity	80% RH at 40° C

Conformance Testing

Emissions/Immunity	EN61326: 2006, Class B
Safety	EN61010-1:2001 Pollution degree 1: 300 V Pollution degree 2: 250 V Analog Bus safety interlock Not for connection directly to mains power
Material Handling	RoHS

Reliability

Switching Time	< 10 ms (includes settling time)
Rated Switch Operations	Mechanical: 1 X 10^8 Electrical: 200,000 @ 300 Vrms/0.2 A/ 125 VA
Relay Operations Counter	Running total of operations stored in on-board non-volatile memory

Mean Time Between Failure (MTBF)

The 1450D MTBF is 34,939 hours at 25° C and the 1450F MTBF is 33,910 hours at 25° C, calculated in accordance with MIL-HDBK-217FN2. Factors affecting relay life expectancy are:

1. Switched voltage
2. Switched current
3. Switched power
4. Maximum switching capacity
5. Maximum rated carrying current

6. Load type (resistive, inductive, capacitive)
7. Switching repetition rate
8. Ambient temperature

The most important factor is the maximum switching capacity, which is an interrelationship of maximum switching power, maximum switching voltage and maximum switching current. When a relay operates at a lower percentage of its maximum switching capacity, its life expectancy is longer. The maximum switching capacity specification is based on a resistive load, and must be further de-rated for inductive and capacitive loads.

Mechanical

Weight	1.25 lb. (0.57 kg)
Dimensions	4.26” H x 0.75” W x 11.82” D
Front Panel I/O Interface Connector	160 pin DIN connector

Ordering Information

Listed below are part numbers for the 1450 switch card and available mating connector accessories. Each 1450 uses a single mating connector.

For additional information regarding the 160-pin cable assembly, see **Chapter 2, Installation Instructions.**

Model/Description	Part No.
Racal Instruments™ 1450D, 4x36, 2-wire, 2A Matrix Switch Card	405331
Racal Instruments 1450F, 8x18, 2-wire, 2A Matrix Switch Card	405330
160-pin cable assembly, 6 ft	408191
160-pin connector kit with backshell and pins	408192
Crimp hand tool	991020
Crimp pin-insertion tool	990898
Pin-removal tool	990899

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Chapter 2
Installation Instructions

Unpacking and Inspection

CAUTION

Use standard ESD procedures including ground straps and static-safe work surfaces whenever handling the 1450 card.

1. Upon receipt, remove the card from its packaging and inspect for damages. If any damage is apparent, inform the carrier immediately. Retain shipping carton and packing material for the carrier's inspection.
2. Verify that the pieces in the package your received contain the correct card. Notify EADS North America Test and Services Product Support if the card appears damaged in any way.

   Do not attempt to install a damaged card into the Model 1830 Source/Measure Switch System chassis.
3. The 1450 is shipped in an anti-static bag to prevent electrostatic damage to the card. Do not remove the card from the anti-static bag unless it is in a static-controlled area.

Installation

CAUTION

Make sure the power to the Model 1830 system is turned OFF before installing or removing any plug-in card. The 1450 card is NOT Hot-Swappable.

1. With the system power off, slide the card into the card guides of the 1830 chassis. When inserting the card, place the card edges into the card guides of the 1830. (See Figure 2-1.)
2. Carefully slide the card into the chassis until it stops.
3. Firmly push the card to engage its rear connectors with the 1830 backplane. When the plug-in card is fully seated, its panel is flush with the rear panel of the 1830 chassis.
4. Carefully turn the card retainer screws and tighten securely.

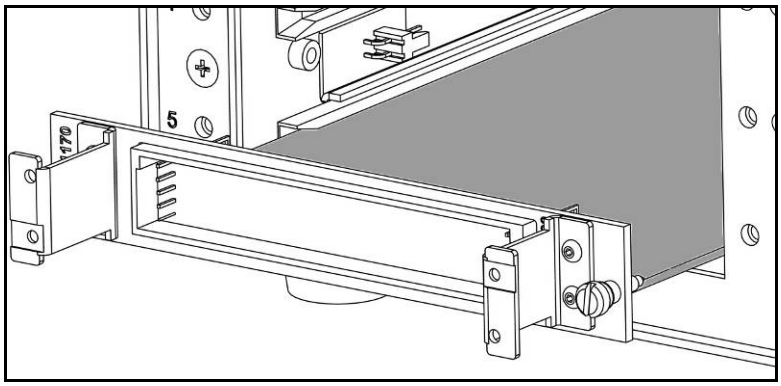

Figure 2-1: Inserting a Plug-In Card

Plug-in Card Shield

If you wish to reduce the electromagnetic interference (EMI) between cards, install an optional card shield (PN 408190) immediately above the cards. Refer to the Figure 2-2.

1. If already installed, remove the plug-in card you wish to cover.
2. Slide the card shield into the slot above the card slot.
3. Use the supplied flat-head screw to attach the shield to the chassis frame.
4. Install the card below the shield.

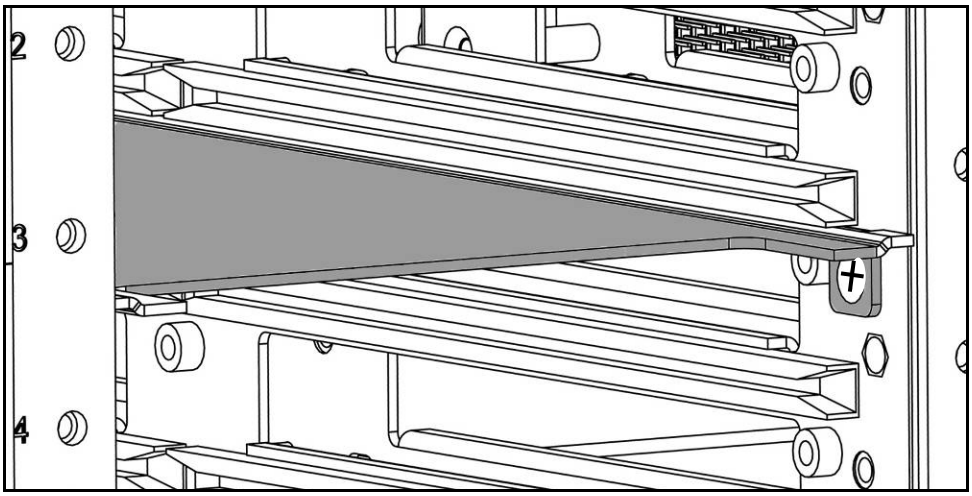

Figure 2-2: Installing a Card Shield

Front Panel Connector Pin Assignment

The 160-pin connector end of the 1450 card is referred to as the front panel. The connector, labeled J200, is a modified DIN style with 0.025” square posts. See Figure 2-3 for a diagram of the front panel connector pin numbering. See Tables 2-1 and 2-2 for the pin assignment of the 1450D card and Tables 2-3 and 2-4 for the pin assignment of the 1450F card.

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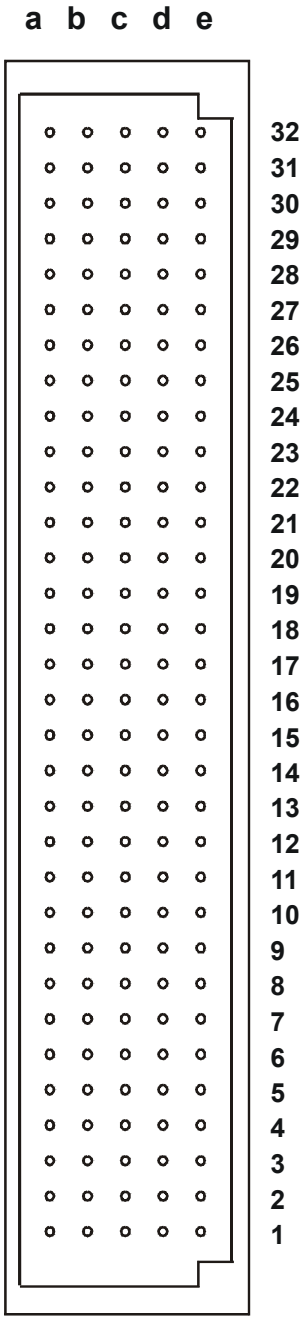

Figure 2-3: Front Panel Connector Layout

Table 2-1: 1450D Front Panel Pin Assignment (Columns E, D)

PIN	SIGNAL
E32	-
E31	COL_L_22
E30	COL_L_34
E29	-
E28	COL_L_21
E27	COL_L_33
E26	-
E25	COL_L_20
E24	COL_L_32
E23	-
E22	COL_L_19
E21	COL_L_31
E20	-
E19	COL_L_18
E18	COL_L_30
E17	-
E16	COL_L_17
E15	COL_L_29
E14	-
E13	COL_L_16
E12	COL_L_28
E11	-
E10	COL_L_15
E9	COL_L_27
E8	ROW_L_3
E7	COL_L_14
E6	COL_L_26
E5	ROW_L_2
E4	COL_L_13
E3	COL_L_25
E2	ROW_L_1
E1	COL_L_24

PIN	SIGNAL
D32	-
D31	COL_H_22
D30	COL_H_34
D29	-
D28	COL_H_21
D27	COL_H_33
D26	-
D25	COL_H_20
D24	COL_H_32
D23	-
D22	COL_H_19
D21	COL_H_31
D20	-
D19	COL_H_18
D18	COL_H_30
D17	-
D16	COL_H_17
D15	COL_H_29
D14	-
D13	COL_H_16
D12	COL_H_28
D11	-
D10	COL_H_15
D9	COL_H_27
D8	ROW_H_3
D7	COL_H_14
D6	COL_H_26
D5	ROW_H_2
D4	COL_H_13
D3	COL_H_25
D2	ROW_H_1
D1	COL_H_24

Table 2-2: 1450D Front Panel Pin Assignment (Columns C, B, A)

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
C32	COL_L_23	B32	COL_H_23	A32	-
C31	COL_L_35	B31	COL_H_35	A31	-
C30	COL_L_11	B30	COL_H_11	A30	SGND
C29	-	B29	-	A29	-
C28	COL_L_10	B28	COL_H_10	A28	-
C27	-	B27	-	A27	SGND
C26	COL_L_9	B26	COL_H_9	A26	SGND
C25	-	B25	-	A25	-
C24	COL_L_8	B24	COL_H_8	A24	-
C23	-	B23	-	A23	SGND
C22	-	B22	-	A22	SGND
C21	COL_L_7	B21	COL_H_7	A21	-
C20	-	B20	-	A20	-
C19	-	B19	-	A19	SGND
C18	COL_L_6	B18	COL_H_6	A18	SGND
C17	-	B17	-	A17	SGND
C16	-	B16	-	A16	SGND
C15	COL_L_5	B15	COL_H_5	A15	SGND
C14	-	B14	-	A14	SGND
C13	-	B13	-	A13	-
C12	COL_L_4	B12	COL_H_4	A12	-
C11	-	B11	-	A11	-
C10	-	B10	-	A10	-
C9	COL_L_3	B9	COL_H_3	A9	CGND
C8	-	B8	-	A8	-
C7	COL_L_2	B7	COL_H_2	A7	-
C6	-	B6	-	A6	SGND
C5	COL_L_1	B5	COL_H_1	A5	-
C4	-	B4	-	A4	-
C3	COL_L_0	B3	COL_H_0	A3	CGND
C2	COL_L_12	B2	COL_H_12	A2	INTLK_N
C1	ROW_L_0	B1	ROW_H_0	A1	DGND

Note: A common ground plane, SGND, is provided for RF applications.

Table 2-3: 1450F Front Panel Pin Assignment (Columns E, D)

PIN	SIGNAL
E32	-
E31	-
E30	-
E29	-
E28	-
E27	-
E26	-
E25	-
E24	-
E23	-
E22	-
E21	-
E20	ROW_L_7
E19	-
E18	-
E17	ROW_L_6
E16	COL_L_17
E15	-
E14	ROW_L_5
E13	COL_L_16
E12	-
E11	ROW_L_4
E10	COL_L_15
E9	-
E8	ROW_L_3
E7	COL_L_14
E6	-
E5	ROW_L_2
E4	COL_L_13
E3	-
E2	ROW_L_1
E1	-

PIN	SIGNAL
D32	-
D31	-
D30	-
D29	-
D28	-
D27	-
D26	-
D25	-
D24	-
D23	-
D22	-
D21	-
D20	ROW_H_7
D19	-
D18	-
D17	ROW_H_6
D16	COL_H_17
D15	-
D14	ROW_H_5
D13	COL_H_16
D12	-
D11	ROW_H_4
D10	COL_H_15
D9	-
D8	ROW_H_3
D7	COL_H_14
D6	-
D5	ROW_H_2
D4	COL_H_13
D3	-
D2	ROW_H_1
D1	-

Table 2-4: 1450F Front Panel Pin Assignment (Columns C, B, A)

PIN	SIGNAL
C32	-
C31	-
C30	COL_L_11
C29	-
C28	COL_L_10
C27	-
C26	COL_L_9
C25	-
C24	COL_L_8
C23	-
C22	-
C21	COL_L_7
C20	-
C19	-
C18	COL_L_6
C17	-
C16	-
C15	COL_L_5
C14	-
C13	-
C12	COL_L_4
C11	-
C10	-
C9	COL_L_3
C8	-
C7	COL_L_2
C6	-
C5	COL_L_1
C4	-
C3	COL_L_0
C2	COL_L_12
C1	ROW_L_0

PIN	SIGNAL
B32	-
B31	-
B30	COL_H_11
B29	-
B28	COL_H_10
B27	-
B26	COL_H_9
B25	-
B24	COL_H_8
B23	-
B22	-
B21	COL_H_7
B20	-
B19	-
B18	COL_H_6
B17	-
B16	-
B15	COL_H_5
B14	-
B13	-
B12	COL_H_4
B11	-
B10	-
B9	COL_H_3
B8	-
B7	COL_H_2
B6	-
B5	COL_H_1
B4	-
B3	COL_H_0
B2	COL_H_12
B1	ROW_H_0

PIN	SIGNAL
A32	-
A31	-
A30	SGND
A29	-
A28	-
A27	SGND
A26	SGND
A25	-
A24	-
A23	SGND
A22	SGND
A21	-
A20	-
A19	SGND
A18	SGND
A17	SGND
A16	SGND
A15	SGND
A14	SGND
A13	-
A12	-
A11	-
A10	-
A9	CGND
A8	-
A7	-
A6	SGND
A5	-
A4	-
A3	CGND
A2	INTLK_N
A1	DGND

Note: A common ground plane, SGND, is provided for RF applications.

Mating Connectors

The following 1450 mating connector accessories are available from your EADS North America Test and Services representative or through our main sales contact numbers.

160-Pin Connector Kit with backshell and pins, P/N 408192

The 160-Pin Connector Kit consists of a connector housing, plastic backshell, and 160 crimp pins. After wire attachment, the pin is inserted into the housing and will snap into place, providing positive retention.

160-Pin Cable Assembly, 6 Ft., 24 AWG, P/N 408191

The 160-Pin Cable Assembly uses 24 AWG cable with crimp pins to mate with the 1170. The other cable end is unterminated. Refer to Figure 2-4 and Table 2-5 for channel, pin mapping, and wire reference information. Refer to the figure to identify Cable 1 and Cable 2.

The last two columns of Table 2-5 repeat the signal information from Tables 2-1 through 2-4 to make it easier for you to configure your cables. The **Card** column indicates if a certain card (D or F or both) connects to that signal.

The suggested crimp hand tool is PN991020. The crimp pin-insertion tool is P/N 990898. The corresponding pin-removal tool is P/N 990899.

Included with both the connector and cable assembly is a set of hardware to code your connector to specific plug-in cards. See the section **Installing Coding Keys on Cards and Connectors** later in this chapter for more information.

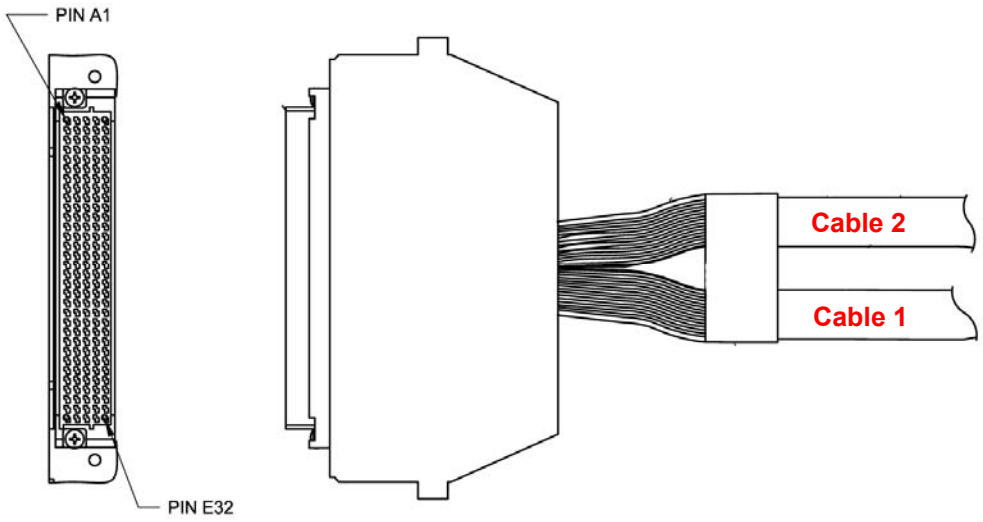

Figure 2-4: Cable Assembly (P/N 408191) Connector End

Table 2-5: Cable Assembly Pin, Signal, and Wire Reference

Wire No.	Pin No.	Cable No.	Wire Color Reference	Card	Signal
1	PIN - A32	Cable 1	WHT_BLK_YEL_GRY	D,F	NC
2	PIN - A31	Cable 1	WHT_BLK_ORG_VIO	D,F	NC
3	PIN - A30	Cable 1	WHT_BLK_RED_VIO	D,F	SGND
4	PIN - A29	Cable 1	WHT_BLK_BRN_VIO	D,F	NC
5	PIN - A28	Cable 1	WHT_BLK_BRN_RED	D,F	NC
6	PIN - A27	Cable 1	WHT_GRN_VIO	D,F	SGND
7	PIN - A26	Cable 1	WHT_YEL_GRN	D,F	SGND
8	PIN - A25	Cable 1	WHT_ORG_YEL	D,F	NC
9	PIN - A24	Cable 1	WHT_RED_YEL	D,F	NC
10	PIN - A23	Cable 1	WHT_BRN_GRN	D,F	SGND
11	PIN - A22	Cable 1	WHT_BLK_VIO	D,F	SGND
12	PIN - A21	Cable 1	WHT_BLK_RED	D,F	NC
13	PIN - A20	Cable 1	WHT_GRN	D,F	NC
14	PIN - A19	Cable 1	WHT_BLK	D,F	SGND
15	PIN - A18	Cable 1	GRN	D,F	SGND
16	PIN - A17	Cable 1	BLK	D,F	SGND
17	PIN - A16	Cable 2	WHT_BLK_YEL_GRY	D,F	SGND
18	PIN - A15	Cable 2	WHT_BLK_ORG_VIO	D,F	SGND
19	PIN - A14	Cable 2	WHT_BLK_RED_VIO	D,F	SGND
20	PIN - A13	Cable 2	WHT_BLK_BRN_VIO	D,F	NC
21	PIN - A12	Cable 2	WHT_BLK_BRN_RED	D,F	NC
22	PIN - A11	Cable 2	WHT_GRN_VIO	D,F	NC
23	PIN - A10	Cable 2	WHT_YEL_GRN	D,F	NC
24	PIN - A9	Cable 2	WHT_ORG_YEL	D,F	CGND
25	PIN - A8	Cable 2	WHT_RED_YEL	D,F	NC
26	PIN - A7	Cable 2	WHT_BRN_GRN	D,F	NC
27	PIN - A6	Cable 2	WHT_BLK_VIO	D,F	SGND
28	PIN - A5	Cable 2	WHT_BLK_RED	D,F	NC
29	PIN - A4	Cable 2	WHT_GRN	D,F	NC
30	PIN - A3	Cable 2	WHT_BLK	D,F	CGND
31	PIN - A2	Cable 2	GRN	D,F	INTLK_N
32	PIN - A1	Cable 2	BLK	D,F	DGND
33	PIN - B32	Cable 1	WHT_BLK_GRN_BLU	D	COL_H_23
34	PIN - B31	Cable 1	WHT_BLK_ORG_GRY	D	COL_H_35
35	PIN - B30	Cable 1	WHT_BLK_RED_GRY	D.F	COL_H_11
36	PIN - B29	Cable 1	WHT_BLK_BRN_GRY	D.F	NC
37	PIN - B28	Cable 1	WHT_BLK_BRN_ORG	D.F	COL_H_10
38	PIN - B27	Cable 1	WHT_GRN_GRY	D.F	NC
39	PIN - B26	Cable 1	WHT_YEL_BLU	D.F	COL_H_9
40	PIN - B25	Cable 1	WHT_ORG_GRN	D.F	NC
41	PIN - B24	Cable 1	WHT_RED_GRN	D.F	COL_H_8
42	PIN - B23	Cable 1	WHT_BRN_BLU	D.F	NC

Wire No.	Pin No.	Cable No.	Wire Color Reference	Card	Signal
43	PIN - B22	Cable 1	WHT_BLK_GRY	D.F	NC
44	PIN - B21	Cable 1	WHT_BLK_ORG	D.F	COL_H_7
45	PIN - B20	Cable 1	WHT_BLU	D.F	NC
46	PIN - B19	Cable 1	WHT_BRN	D.F	NC
47	PIN - B18	Cable 1	BLU	D.F	COL_H_6
48	PIN - B17	Cable 1	BRN	D.F	NC
49	PIN - B16	Cable 2	WHT_BLK_GRN_BLU	D.F	NC
50	PIN - B15	Cable 2	WHT_BLK_ORG_GRY	D.F	COL_H_5
51	PIN - B14	Cable 2	WHT_BLK_RED_GRY	D.F	NC
52	PIN - B13	Cable 2	WHT_BLK_BRN_GRY	D.F	NC
53	PIN - B12	Cable 2	WHT_BLK_BRN_ORG	D.F	COL_H_4
54	PIN - B11	Cable 2	WHT_GRN_GRY	D.F	NC
55	PIN - B10	Cable 2	WHT_YEL_BLU	D.F	NC
56	PIN - B9	Cable 2	WHT_ORG_GRN	D.F	COL_H_3
57	PIN - B8	Cable 2	WHT_RED_GRN	D.F	NC
58	PIN - B7	Cable 2	WHT_BRN_BLU	D.F	COL_H_2
59	PIN - B6	Cable 2	WHT_BLK_GRY	D.F	NC
60	PIN - B5	Cable 2	WHT_BLK_ORG	D.F	COL_H_1
61	PIN - B4	Cable 2	WHT_BLU	D.F	NC
62	PIN - B3	Cable 2	WHT_BRN	D.F	COL_H_0
63	PIN - B2	Cable 2	BLU	D.F	COL_H_12
64	PIN - B1	Cable 2	BRN	D.F	ROW_H_0
65	PIN - C32	Cable 1	WHT_BLK_GRN_VIO	D	COL_L_23
66	PIN - C31	Cable 1	WHT_BLK_YEL_GRN	D	COL_L_35
67	PIN - C30	Cable 1	WHT_BLK_ORG_YEL	D.F	COL_L_11
68	PIN - C29	Cable 1	WHT_BLK_RED_YEL	D.F	NC
69	PIN - C28	Cable 1	WHT_BLK_BRN_YEL	D.F	COL_L_10
70	PIN - C27	Cable 1	WHT_BLU_VIO	D.F	NC
71	PIN - C26	Cable 1	WHT_YEL_VIO	D.F	COL_L_9
72	PIN - C25	Cable 1	WHT_ORG_BLU	D.F	NC
73	PIN - C24	Cable 1	WHT_RED_BLU	D.F	COL_L_8
74	PIN - C23	Cable 1	WHT_BRN_VIO	D.F	NC
75	PIN - C22	Cable 1	WHT_BRN_RED	D.F	NC
76	PIN - C21	Cable 1	WHT_BLK_YEL	D.F	COL_L_7
77	PIN - C20	Cable 1	WHT_VIO	D.F	NC
78	PIN - C19	Cable 1	WHT_RED	D.F	NC
79	PIN - C18	Cable 1	VIO	D.F	COL_L_6
80	PIN - C17	Cable 1	RED	D.F	NC
81	PIN - C16	Cable 2	WHT_BLK_GRN_VIO	D.F	NC
82	PIN - C15	Cable 2	WHT_BLK_YEL_GRN	D.F	COL_L_5
83	PIN - C14	Cable 2	WHT_BLK_ORG_YEL	D.F	NC
84	PIN - C13	Cable 2	WHT_BLK_RED_YEL	D.F	NC
85	PIN - C12	Cable 2	WHT_BLK_BRN_YEL	D.F	COL_L_4

Wire No.	Pin No.	Cable No.	Wire Color Reference	Card	Signal
86	PIN - C11	Cable 2	WHT_BLU_VIO	D.F	NC
87	PIN - C10	Cable 2	WHT_YEL_VIO	D.F	NC
88	PIN - C9	Cable 2	WHT_ORG_BLU	D.F	COL_L_3
89	PIN - C8	Cable 2	WHT_RED_BLU	D.F	NC
90	PIN - C7	Cable 2	WHT_BRN_VIO	D.F	COL_L_2
91	PIN - C6	Cable 2	WHT_BRN_RED	D.F	NC
92	PIN - C5	Cable 2	WHT_BLK_YEL	D.F	COL_L_1
93	PIN - C4	Cable 2	WHT_VIO	D.F	NC
94	PIN - C3	Cable 2	WHT_RED	D.F	COL_L_0
95	PIN - C2	Cable 2	VIO	D.F	COL_L_12
96	PIN - C1	Cable 2	RED	D.F	ROW_L_0
97	PIN - D32	Cable 1	WHT_BLK_GRN_GRY	D.F	NC
98	PIN - D31	Cable 1	WHT_BLK_YEL_BLU	D	COL_H_22
99	PIN - D30	Cable 1	WHT_BLK_ORG_GRN	D	COL_H_34
100	PIN - D29	Cable 1	WHT_BLK_RED_GRN	D.F	NC
101	PIN - D28	Cable 1	WHT_BLK_BRN_GRN	D	COL_H_21
102	PIN - D27	Cable 1	WHT_BLU_GRY	D	COL_H_33
103	PIN - D26	Cable 1	WHT_YEL_GRY	D.F	NC
104	PIN - D25	Cable 1	WHT_ORG_VIO	D	COL_H_20
105	PIN - D24	Cable 1	WHT_RED_VIO	D	COL_H_32
106	PIN - D23	Cable 1	WHT_BRN_GRY	D.F	NC
107	PIN - D22	Cable 1	WHT_BRN_ORG	D	COL_H_19
108	PIN - D21	Cable 1	WHT_BLK_GRN	D	COL_H_31
109	PIN - D20	Cable 1	WHT_GRY	F	ROW_H_7
110	PIN - D19	Cable 1	WHT_ORG	D	COL_H_18
111	PIN - D18	Cable 1	GRY	D	COL_H_30
112	PIN - D17	Cable 1	ORG	F	ROW_H_6
113	PIN - D16	Cable 2	WHT_BLK_GRN_GRY	D.F	COL_H_17
114	PIN - D15	Cable 2	WHT_BLK_YEL_BLU	D	COL_H_29
115	PIN - D14	Cable 2	WHT_BLK_ORG_GRN	F	ROW_H_5
116	PIN - D13	Cable 2	WHT_BLK_RED_GRN	D.F	COL_H_16
117	PIN - D12	Cable 2	WHT_BLK_BRN_GRN	D	COL_H_28
118	PIN - D11	Cable 2	WHT_BLU_GRY	F	ROW_H_4-
119	PIN - D10	Cable 2	WHT_YEL_GRY	D.F	COL_H_15
120	PIN - D9	Cable 2	WHT_ORG_VIO	D	COL_H_27
121	PIN - D8	Cable 2	WHT_RED_VIO	D.F	ROW_H_3
122	PIN - D7	Cable 2	WHT_BRN_GRY	D.F	COL_H_14
123	PIN - D6	Cable 2	WHT_BRN_ORG	D	COL_H_26
124	PIN - D5	Cable 2	WHT_BLK_GRN	D.F	ROW_H_2
125	PIN - D4	Cable 2	WHT_GRY	D.F	COL_H_13
126	PIN - D3	Cable 2	WHT_ORG	D	COL_H_25
127	PIN - D2	Cable 2	GRY	D.F	ROW_H_1
128	PIN - D1	Cable 2	ORG	D	COL_H_24

Wire No.	Pin No.	Cable No.	Wire Color Reference	Card	Signal
129	PIN - E32	Cable 1	WHT_BLK_BLU_VIO	D.F	NC
130	PIN - E31	Cable 1	WHT_BLK_YEL_VIO	D	COL_L_22
131	PIN - E30	Cable 1	WHT_BLK_ORG_BLU	D	COL_L_34
132	PIN - E29	Cable 1	WHT_BLK_RED_BLU	D.F	NC
133	PIN - E28	Cable 1	WHT_BLK_BRN_BLU	D	COL_L_21
134	PIN - E27	Cable 1	WHT_VIO_GRY	D	COL_L_33
135	PIN - E26	Cable 1	WHT_GRN_BLU	D.F	NC
136	PIN - E25	Cable 1	WHT_ORG_GRY	D	COL_L_20
137	PIN - E24	Cable 1	WHT_RED_GRY	D	COL_L_32
138	PIN - E23	Cable 1	WHT_RED_ORG	D.F	NC
139	PIN - E22	Cable 1	WHT_BRN_YEL	D	COL_L_19
140	PIN - E21	Cable 1	WHT_BLK_BLU	D	COL_L_31
141	PIN - E20	Cable 1	WHT_BLK_BRN	F	ROW_L_7-
142	PIN - E19	Cable 1	WHT_YEL	D	COL_L_18
143	PIN - E18	Cable 1	WHT	D	COL_L_30
144	PIN - E17	Cable 1	YEL	F	ROW_L_6-
145	PIN - E16	Cable 2	WHT_BLK_BLU_VIO	D.F	COL_L_17
146	PIN - E15	Cable 2	WHT_BLK_YEL_VIO	D	COL_L_29
147	PIN - E14	Cable 2	WHT_BLK_ORG_BLU	F	ROW_L_5-
148	PIN - E13	Cable 2	WHT_BLK_RED_BLU	D.F	COL_L_16
149	PIN - E12	Cable 2	WHT_BLK_BRN_BLU	D	COL_L_28
150	PIN - E11	Cable 2	WHT_VIO_GRY	F	ROW_L_4-
151	PIN - E10	Cable 2	WHT_GRN_BLU	D.F	COL_L_15
152	PIN - E9	Cable 2	WHT_ORG_GRY	D	COL_L_27
153	PIN - E8	Cable 2	WHT_RED_GRY	D.F	ROW_L_3
154	PIN - E7	Cable 2	WHT_RED_ORG	D.F	COL_L_14
155	PIN - E6	Cable 2	WHT_BRN_YEL	D	COL_L_26
156	PIN - E5	Cable 2	WHT_BLK_BLU	D.F	ROW_L_2
157	PIN - E4	Cable 2	WHT_BLK_BRN	D.F	COL_L_13
158	PIN - E3	Cable 2	WHT_YEL	D	COL_L_25
159	PIN - E2	Cable 2	WHT	D.F	ROW_L_1
160	PIN - E1	Cable 2	YEL	D	COL_L_24

Note: “NC” in the **Signal** column means there is no connection to any signal.

Installing Coding Keys on Cards and Connectors

Included with each connector kit or cable assembly is a set of hardware (Figure 2-5) which you can use to key code your connector to specific plug-in cards to prevent cables from being misconnected to the wrong card. You may want to install the key for specific card types or to match module operating conditions.

The kit comes with two sets of male and female mating bushings along with appropriate mounting hardware. When installed in pairs, you can mount the bushings in up to 16 different coded configurations.

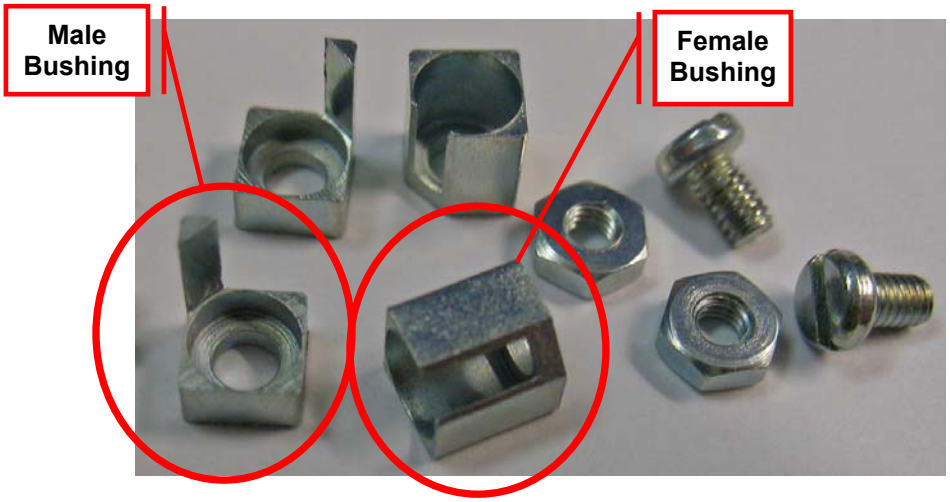

Figure 2-5: Coding Key Hardware

Prior to installing the keys, determine the “code” you wish to use and then carefully install the bushings onto the connector and card guide in the proper position so that the prong fits into the open slot when the connector is mated to the card.

Figure 2-6: Installed Keys

The left photo in Figure 2-6 shows the male key installed in the connector shell. The right photo shows the female key installed onto the card guide.

Repeat the installation for the both ends of the connector shell and card guide.

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Chapter 3
Operation

Block Diagram

Figure 3-1 shows simplified block diagrams of the 1450D and 1450F cards where row and column intersections represent matrix crosspoints.

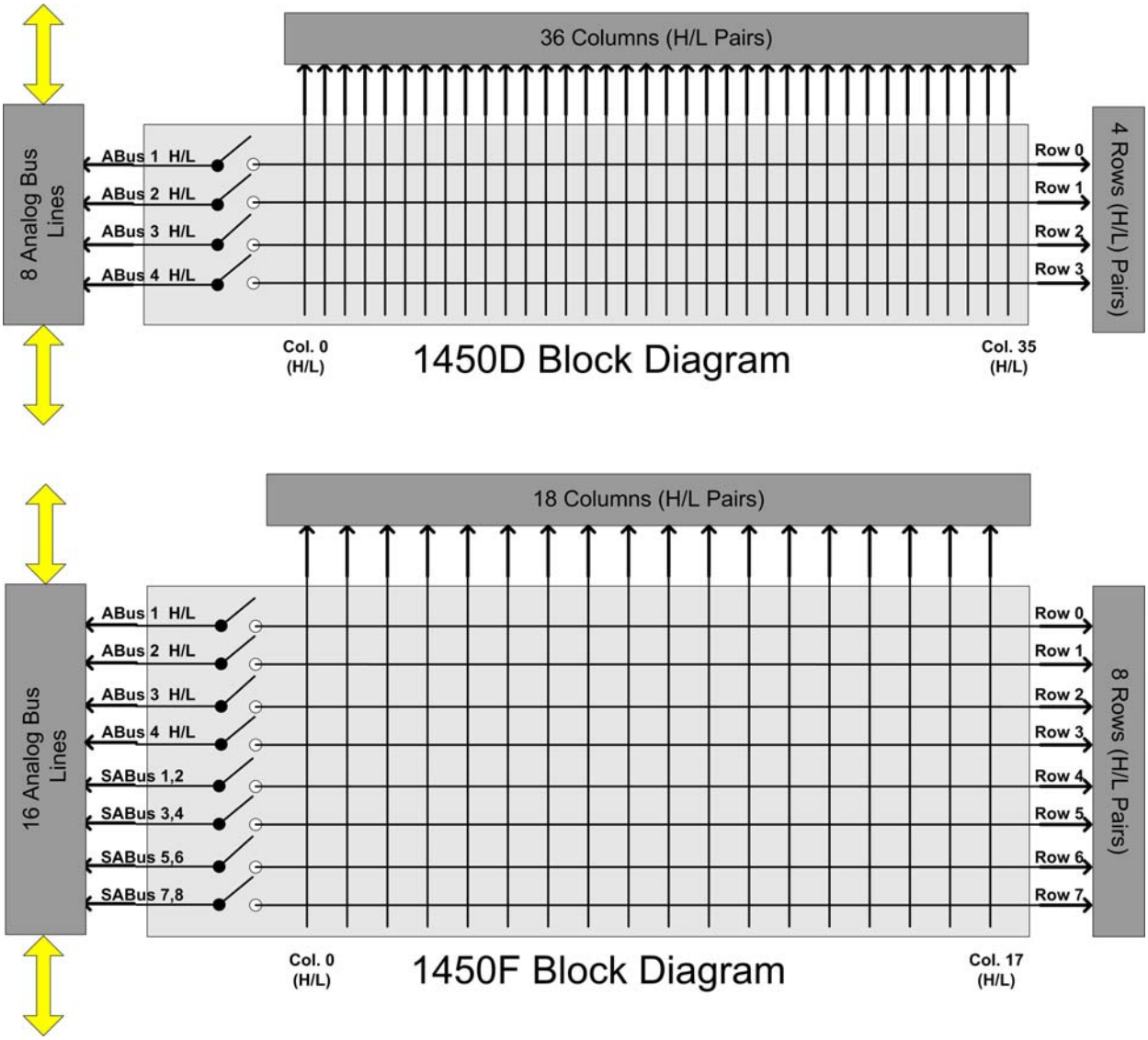


Figure 3-1: 1450 Block Diagram

Note: all wires shown are 2-wire pairs.

Operating the 1450 Switch Card

The 1450 switch card is controlled by the firmware in the 1800-series Source/Measure Switch platform into which it is installed. There are several ways to operate the 1450 switch card. These include:

- Using the web page to interactively control the relays.
- Using the web page to interactively send SCPI commands to operate the relays.
- Using SCPI commands in a test program to directly communicate with the 1830.
- Using the IVI™ driver to control the relays from any COM-compatible programming language, such as Visual C++, Visual BASIC, .Net languages, LabVIEW™, and so on.
- Using the ActivATE™ driver to control the relays from within an ActivATE test program.
- Using the GUI of the ActivATE driver to control the relays interactively.

The first two methods above communicate exclusively via the Ethernet interface. The remaining methods can use the VISA I/O library to communicate via Ethernet, GPIB, or USB.

Command Set

The 1800-series platform uses the SCPI command language to provide for set-up and control of all of the instrument functions, including operating the 1450 switch card.

Commands such as CLOSE, OPEN, SCAN, INCLude, and EXCLude all use channel descriptors to select one or more relays on one or more plug-in modules.

Consult your 1800-series system user manual for a more detailed description of the SCPI command language supported by the platform.

Identifying the 1450 Card in the Chassis

The main web page is recommended for identifying which cards are located in the system chassis. As an alternative, a SCPI command can be used to read the type of cards installed in the 1800-series platform.

The “SYSTem:CTYPE?” query can be used to read the type of card, the serial number, and the firmware/FPGA/hardware revision of the card in the chassis:

```
SYST:CTYPE? 9
```

Reads the type of card installed in slot 9. The response to this command uses the format:

```
<model code>,<manufacturer>,<serial number>,<revision info>
```

A typical response for the 1450 card is:

```
XI1450,EADS NORTH AMERICA,112508363942,1.0-0.0-2.1
```

If no card is recognized in the slot 9, the reply would be

```
NONE,EADS NORTH AMERICA,0,0.0-0.0-0.0
```

Analog Bus Safety Interlock Circuit

CAUTION

The 1830 Analog Bus is rated for 300 VAC/VDC on ABus and 150 VAC/VDC on SABus. Depending on use, the potential exists for high voltages to be present on these internal buses which could be routed to the outside connector.

The 1450 board has a built-in safety interlock circuit which prevents the module connection to the 1830 Analog Bus and potential high voltage exposure on the outside connector **unless external interlock jumpers are installed**.

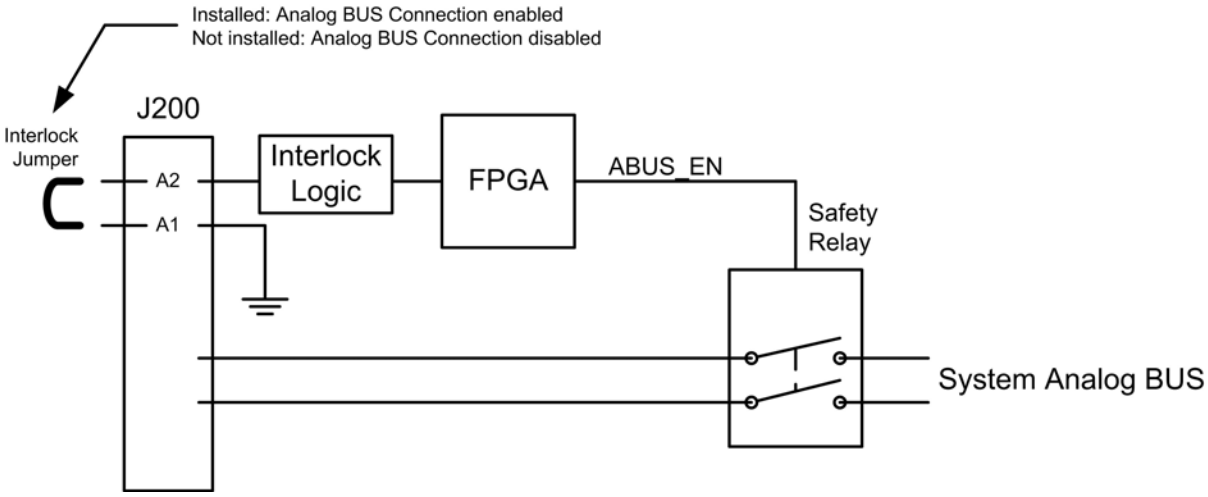


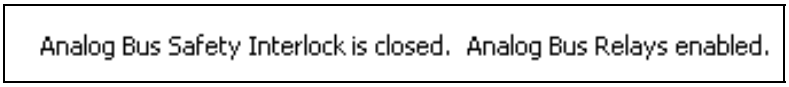
Figure 3-2: Analog Bus Safety Interlock

CAUTION

When utilizing high voltage or hazardous signals, the cable signals should be insulated from user exposure with a connector shell.

To allow access to the analog bus, you must install a jumper or connecting loop (Figure 3-2) between pins A1 and A2 on the outside connector of the card. One method, for instance, would be to connect these pins together at the connector end when you build your cable harness.

A message appears on the **Relay Control** tab of the web page indicating the status of the interlock and your access to the 1830 analog bus. The following illustrations show the message when the interlock is closed (and the relays are enabled for use) or open (the relays are disabled).



CAUTION

Pin A1 is referenced through digital ground to earth ground, should only be connected to Pin A2 when required, and must not used for any other signal connection. Pin A2 is TTL signal compatible only, and must not be used for any purpose other than the safety interlock.

DO NOT connect any high voltage signals to these two pins. Non-compliance may cause damage to the instrument or electrical shock hazard.

LXI Web Page Controls

Figures 3-3 through 3-7 show the LXI web pages that allow you to control the 1450 card through manual setting or by using SCPI commands.

Relay Control Tab

The **Relay Control** tab (Figures 3-3 and 3-4) allows you to change the conditions on the various relays on the 1450 card. Simply click the appropriate relay to change the state of the relay on the card. The relay change is immediate.

Figure 3-3 shows the **Relay Control** web page for the 1450D card. Figure 3-4 shows the web page for the 1450F card.

Note the message on the top of the screen in those figures regarding the Analog Bus Safety Interlock. When the jumper between connector pins A1 and A2 is installed, the message indicates that the interlock is closed, the bus relays are enabled, and you are connected to the analog bus. Figure 3-3 shows this message.

When the jumper is not connected, the message indicates that the interlock is open, the bus relays are not enabled, and you are not connected to the analog bus. Figure 3-4 shows this message.

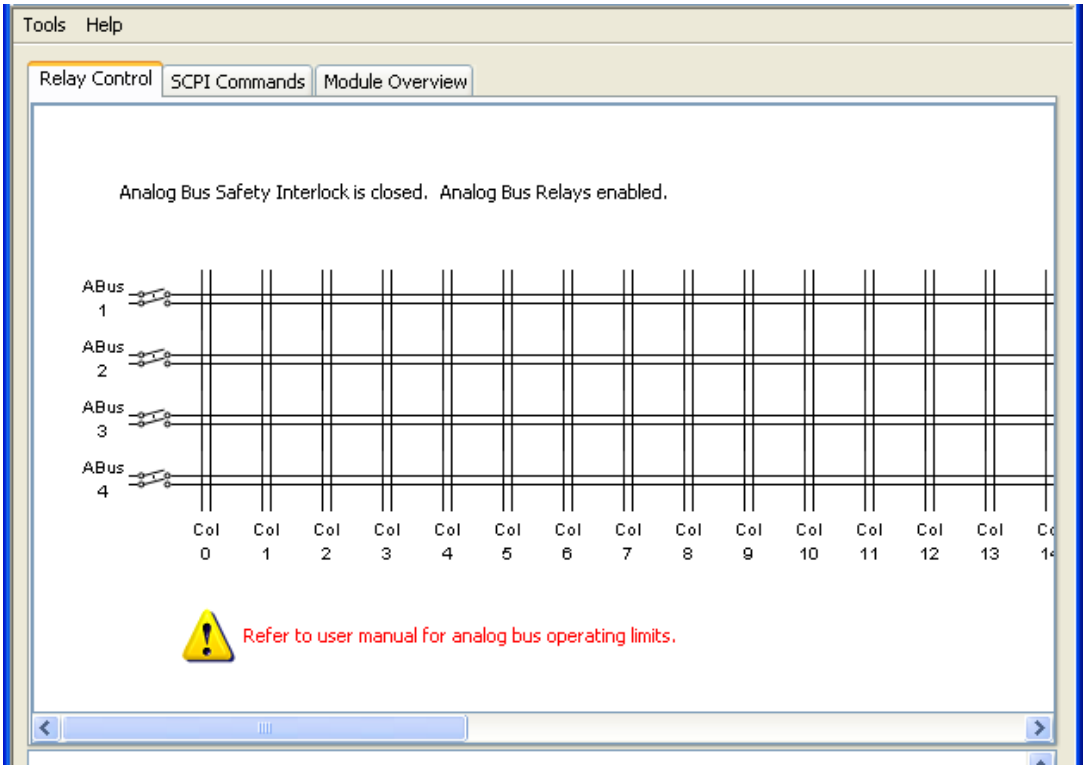


Figure 3-3: 1450D Relay Control Tab

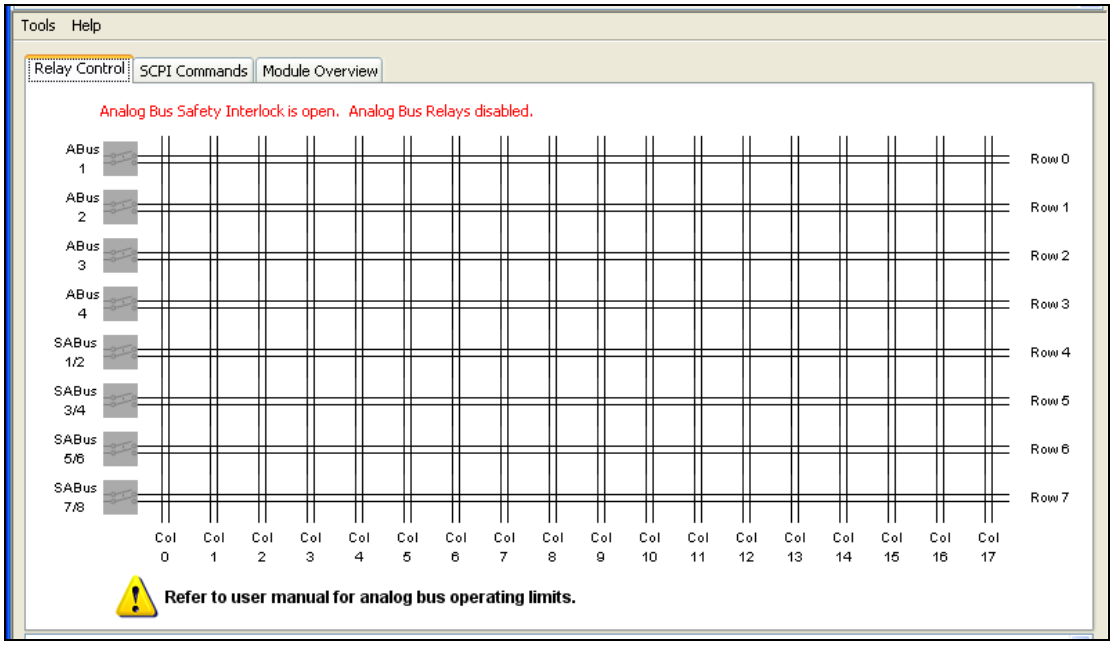


Figure 3-4: 1450F Relay Control Tab

SCPI Commands Tab

The **SCPI Commands** tab (Figure 3-5) allows you to send SCPI commands to the card. A few common SCPI commands have clickable icons along the top of the tab including:

- **SYST:ERR?:** Checks on and reports if there are any errors
- **Read STB:** Reads the value of the Status Byte Register
- **Device Clear:** Clears error queue and flushes all input and output buffers
- **Clear:** Clears any text in the text message box below the icons

Use the **SCPI Command** input box to enter SCPI commands. The command and any replies will be shown in the text message box.

- Clicking **Send** sends the command.
- Clicking **Read** receives the reply.
- Clicking **Send/Read** both sends and then receives the reply.
- Clicking **Clear** clears the commands history in the **SCPI command** input box

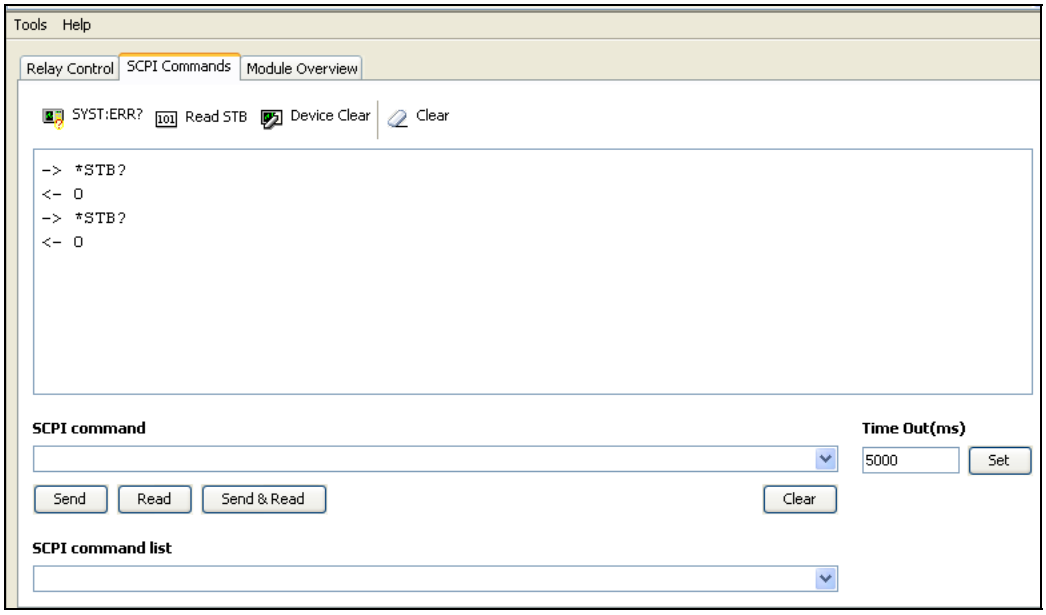


Figure 3-5: SCPI Commands Tab

The **Time Out** box allows you to set different values as needed.

The **SCPI command list** drop-down box includes a list of commonly used commands and queries that you can choose to automatically appear in the **SCPI command** input box.

Additional information on and a listing of SCPI commands can be found in the **Model 1830 Source/Measure Switch System User Manual**, part number 980937.

Module Overview Tab

The **Module Overview** tab (Figure 3-6) allows you to review current card information including model and serial number, revision levels, channel/state configuration, relay cycle counts, and emergency reset status.

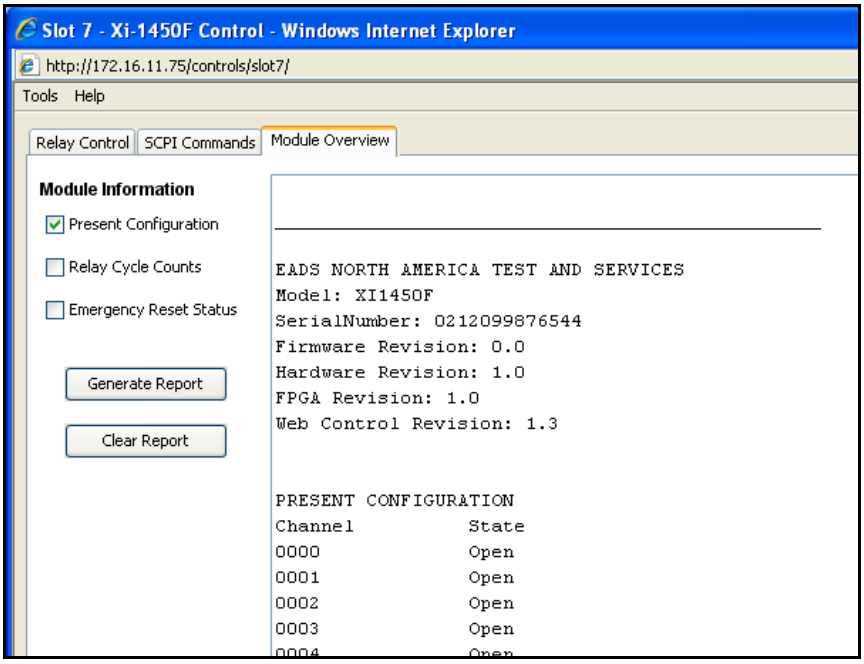


Figure 3-6: Module Overview Tab

Clicking **Generate Report** generates a status report and shows the results on the information screen to the right of the button. Clicking **Clear Report** removes the information from the screen. Clicking any of the checkboxes on the left side before you click **Generate Report** adds this additional information to the generated report.

Tools Menu

Each web page has a **Tools** menu (Figure 3-7) with a drop-down menu that expands when you click it.

The selections include:

- **Simulation** – Puts the control into a simulation mode where no commands for this card are sent to the 1830 system
- **Reset Device** – Resets the card to its default state
- **Update Control** – Updates the control to reflect the current state of the card on the 1830
- **Reconnect Control** – Re-establishes communication between the control and the 1830 system. Useful when the 1830 has been power cycled and the control is left open.

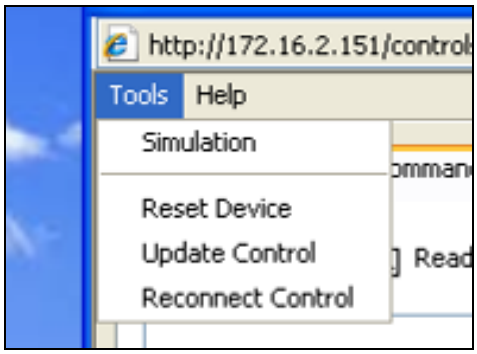


Figure 3-7: Web Page Tools Menu

IVI Driver Operation

The 1450 card is supplied with an IVI (Interchangeable Virtual Instruments) driver. This driver is IVISwtch class compliant. Each model of 1450 card has its own IVI driver. For more information on IVI and IVISwtch class drivers, consult the IVI website

http://www.ivifoundation.org

Unlike SCPI commands, the IVI driver does not specifically select channel numbers to operate one or more relays. The IVI driver operates on channel names, which identify the two points to connect together.

Channel numbers are used for SCPI commands. The channel numbers for the 1450 matrix cards consist of a 4-digit number. The first 2 digits identify the row and the last 2 digits identify the column. For example:

0000 = row 0, column 0

0 = row 0, column 0

1 = row 0, column 1

100 = row 1, column 0

417 = row 4, column 17

The 1450D card has 4 rows and 36 columns, so the valid matrix channel numbers range from 0 to 335. The 1450F card has 8 rows and 18 columns, so the valid matrix channel numbers for this card are 0 to 717.

The 1450 cards also support connecting to the Analog Bus. Row “99” is used to identify that the analog bus relays are being controlled.

9901 = connect row 0 to analog bus 1

9902 = connect row 1 to analog bus 2

9903 = connect row 2 to analog bus 3

9904 = connect row 3 to analog bus 4

9905 = connect row 4 to single-ended analog bus (SABUS) 1 & 2

9906 = connect row 5 to single-ended analog bus (SABUS) 3 & 4

9907 = connect row 6 to single-ended analog bus (SABUS) 5 & 6

9908 = connect row 7 to single-ended analog bus (SABUS) 7 & 8

Since the 1450D has only 4 rows, channels 9905 through 9908 are not supported by this module.

The IVI driver channel names select row and column (or row and analog bus). The IVI driver channel names corresponding to the SCPI channel numbers is shown in Table 3-1 below. Note that either the "high" channel pair or the "low" channel pair may be specified in the IVI driver Connect() method.

Table 3-1: IVI Driver Channel Names

Channel	Channel Name 1 (H)	Channel Name 2 (H)	Channel Name 1 (L)	Channel Name 2 (L)
0	ROW00_H	COL00_H	ROW00_L	COL00_L
1	ROW00_H	COL01_H	ROW00_L	COL01_L
2	ROW00_H	COL02_H	ROW00_L	COL02_L
…	…	…	…	…
17	ROW00_H	COL17_H	ROW00_L	COL17_L
100	ROW01_H	COL00_H	ROW01_L	COL00_L
…	…	…	…	…
117	ROW01_H	COL17_H	ROW01_L	COL17_L
700	ROW07_H	COL00_H	ROW07_L	COL00_L
…	…	…	…	…
717	ROW07_H	COL17_H	ROW07_L	COL17_L
9901	ROW00_H	ABUS1_H	ROW00_L	ABUS1_L
9902	ROW01_H	ABUS2_H	ROW01_L	ABUS2_L
9903	ROW02_H	ABUS3_H	ROW02_L	ABUS3_L
9904	ROW03_H	ABUS4_H	ROW03_L	ABUS4_L
9905	ROW04_H	ABUS5_H	ROW04_L	ABUS5_L
9906	ROW05_H	ABUS6_H	ROW05_L	ABUS6_L
9907	ROW06_H	ABUS7_H	ROW06_L	ABUS7_L
9908	ROW07_H	ABUS8_H	ROW07_L	ABUS8_L

So, to connect row 3 to column 11, you would use the "Connect" API as follows

```
sp_driver->Path->Connect("ROW03_H","COL11_H");
```

Once the channel is closed, it may be opened with the "Disconnect()" method:

```
sp_driver->Path->Disconnect("ROW03_H","COL11_H");
```

To disconnect all channels, the DisconnectAll() method may be used:

```
sp_driver->Path->DisconnectAll();
```

In order to install and operate properly, the IVI shared components must first be installed on your computer. To download the IVI shared components, visit the IVI foundation website:

http://www.ivifoundation.org/shared_components/Default.aspx

Once the shared components have been installed, the IVI driver for the 1450 may be installed. The IVI driver can be installed from the manual and software installation CD provided with the 1800 series platform. The driver may also be downloaded from EADS's website:

http://www.eads-nadefense.com/downloads/1830.dl.htm

IVI Configuration Store

Once the driver is installed, the IVI Configuration Store must be edited to create a "session". The session is used to associate the VISA resource descriptor and the module address (plug-in slot) with the 1450 card.

You must create a new session for **each** 1450 you want to control. That is, if there are three 1450 switch cards plugged into your 1800-series platform, then you will need to create three sessions to control them.

The examples in this section demonstrate how to add a 1450D model switch card to the IVI configuration store. To add a 1450F model, follow the example but replace "1450F" for each instance of "1450D" in the example.

The most effective way to edit the IVI configuration store is with an IVI-aware tool, such as National Instruments™ Measurement and Automation Explorer (NI-MAX). The following example shows how to use this tool to make the entries in the IVI configuration store to allow operation of the IVI driver for the 1450.

The first step is to create a driver session. This can be done by right-clicking on the **Driver Sessions** element in the IVI Drivers portion of the NI-MAX tool.

In the example shown in Figure 3-8, we have created a new session named "RIXI1450D_S1".

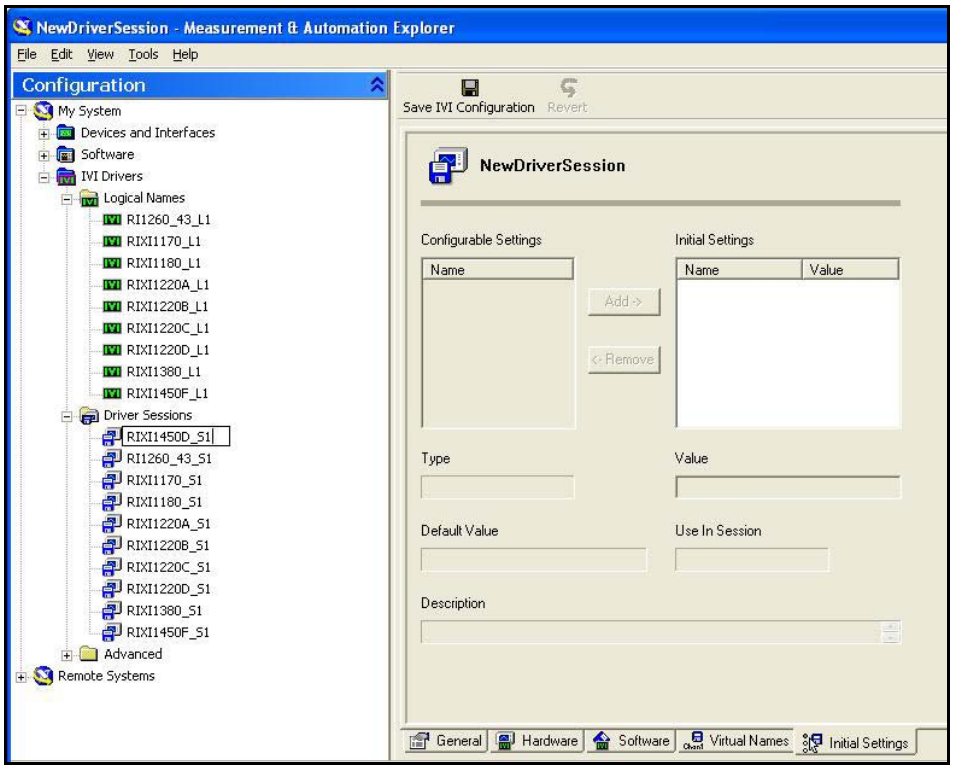


Figure 3-8: Creating a New IVI Driver Session

Once the driver session has been created, it must be associated with a software module. To do this, select the **Software** tab of the session. Then select the "riXi1450D" software module that was installed with the IVI driver installation. This is shown in Figure 3-9.

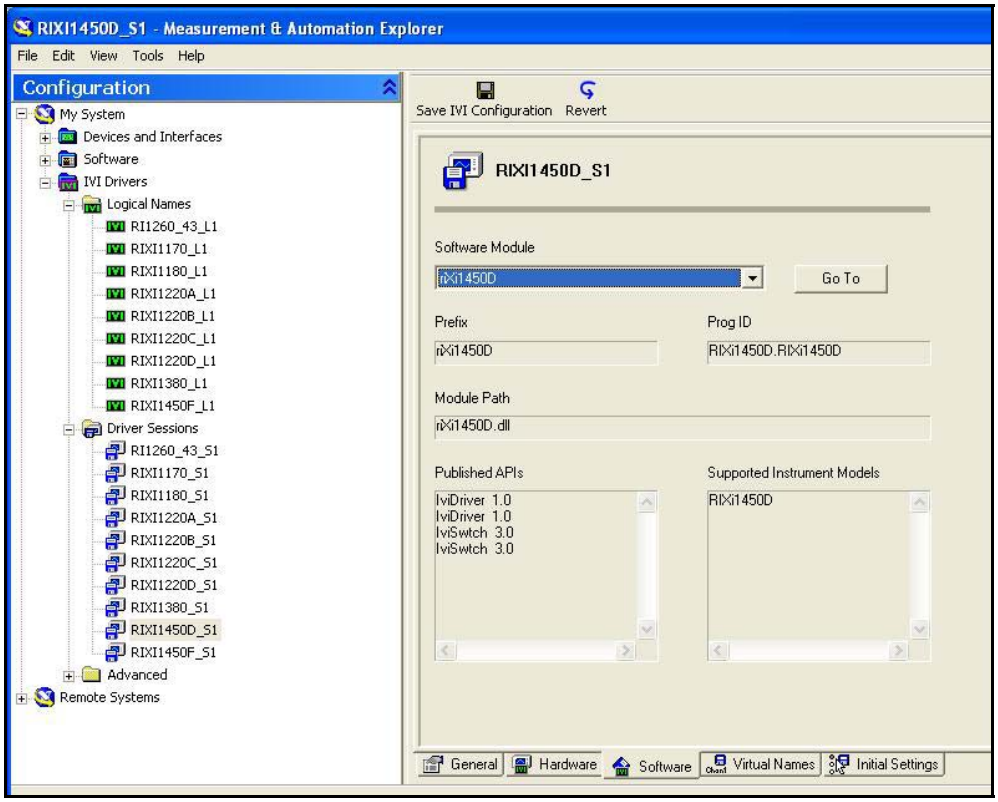


Figure 3-9: Associating Software Module with IVI Driver Session

The next step in the process is to create a hardware asset to associate with the driver. This is basically a VISA resource descriptor that can be used to communicate with the 1800-series system that contains the 1450D module (in this case via the Ethernet interface). This is shown in Figure 3-10.

Note that the "Resource Descriptor" is the VISA resource descriptor for the 1800 series platform into which the 1450D module is plugged. VISA supports the Ethernet interface (as shown), the USB interface, or the GPIB interface. The main web page for the 1800 series platform displays the Ethernet and USB VISA descriptors, and the GPIB address, for the platform.

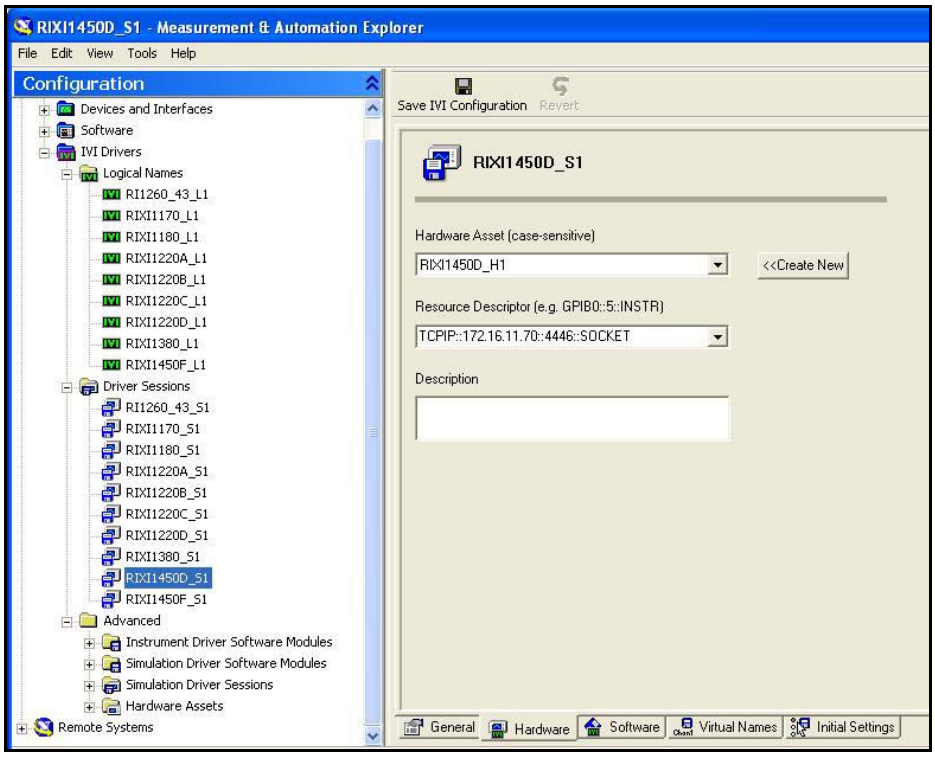


Figure 3-10: Creating a Hardware Asset for the IVI Driver Session

After the hardware asset has been created, the module address must be updated to match the plug-in slot of the 1450D. Select the **Initial Settings** tab and modify the "Module Address" entry to match the plug-in slot of the 1450D card. In the example shown in Figure 3-11, the module address is set to 5.

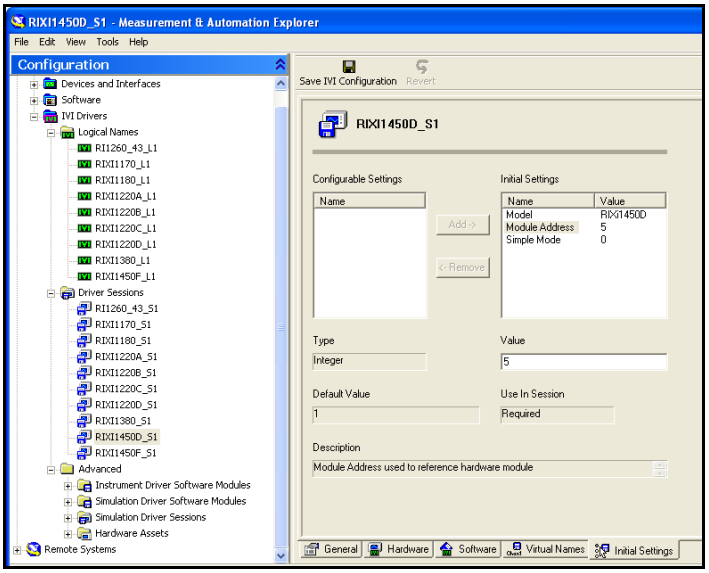


Figure 3-11: Modifying the Module Address for the IVI Driver Session

The final step in the configuration process is to create a logical name. To do this, right mouse click on the **Logical Names** tree element and select the **Create new (case sensitive**) item. Enter the name of the new logical session (shown in Figure 3-12 as "RIXI1450D_L1") and then select the driver session created previously ("RIXI1450D_S1").

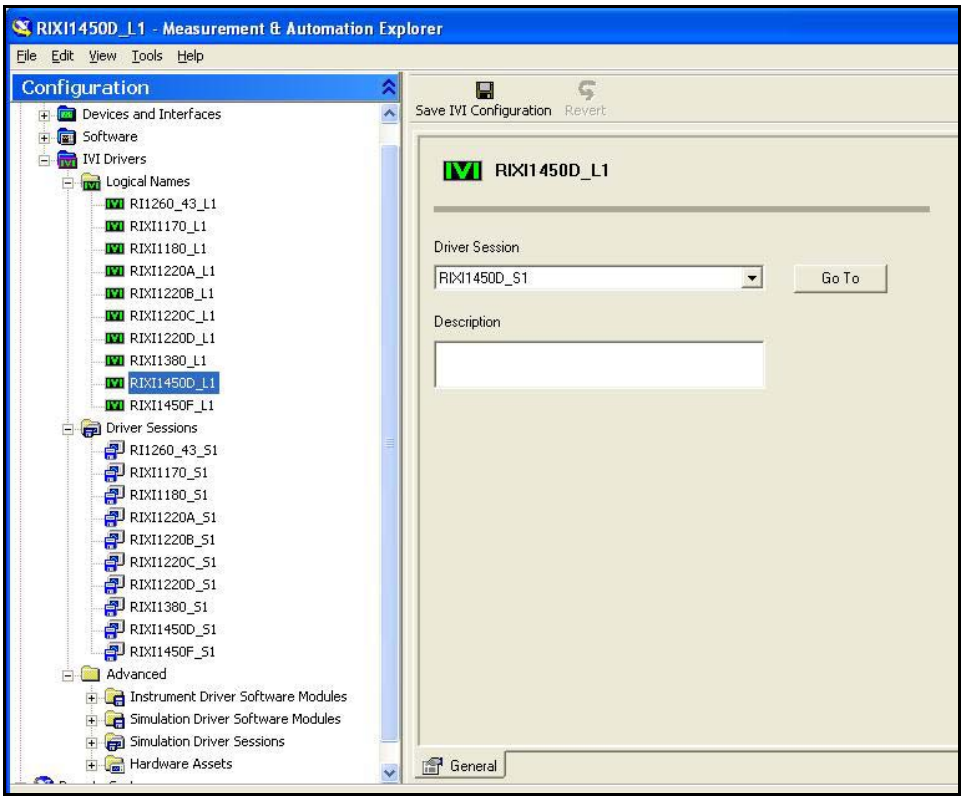


Figure 3-12: Creating a Logical Name for the IVI Driver Session

After all of the editing has completed, click the **Save IVI Configuration** button to save the configuration in the IVI configuration store.

Visual C++ Example

An example showing how to use the IVI driver with Microsoft Visual C++ is shown in Figure 3-13. This example instantiates an instance of the driver, initiates the driver, and closes two channels (channels 0 and 9901). It then waits for the channel debounce to occur, and finally opens all channels.

```
// Example console test program showing how to use the
// basic methods of the 1450D IVI driver
//

#include "stdafx.h"
#include <atlstr.h>

int _tmain(int argc, _TCHAR* argv[])
{
      ::CoInitialize(NULL);

      try
      {
            IIviDriverPtr spDriver(__uuidof(RIXi1450D));
            IIviSwtchPtr spSwitch;

            try
            {

                  // IIviDriverIdentity properties
                  // Initialize not required
                  _bstr_t bstrIdentifier = spDriver->Identity->Identifier;
                  wprintf(L"Identifier: %s\n", bstrIdentifier.GetBSTR());

                  _bstr_t bstrRevision = spDriver->Identity->Revision;
                  wprintf(L"Revision: %s\n", bstrRevision.GetBSTR());

                  _bstr_t bstrVendor = spDriver->Identity->Vendor;
                  wprintf(L"Vendor: %s\n", bstrVendor.GetBSTR());

                  _bstr_t bstrDescription;
                  bstrDescription = spDriver->Identity->Description;
                  wprintf(L"Description: %s\n", bstrDescription.GetBSTR());

                  // Setup resource descriptor.
                  // this is the IVI configuration store logical name
                  CString strResourceDesc = "RIXI1450D_L1";

                  // Setup IVI-defined initialization options
                  CString strStandardInitOptions =
                        "Cache=true, InterchangeCheck=false,
                        QueryInstrStatus=true, RangeCheck=true,
                        RecordCoercions=false, Simulate=false";

                  // Setup driver-specific initialization options
                  CString strDriverSetupOptions =
                        "DriverSetup= Model=RIXi1450D, Trace=false";

                  CString strOptions = strStandardInitOptions + "," +
```

```
                                        strDriverSetupOptions;

                    spDriver->Initialize(LPCTSTR(strResourceDesc),
                                        VARIANT_FALSE, VARIANT_FALSE,
                                        LPCTSTR(strOptions));

                    // cast the specific driver to an
                    // IVISwtch class compliant one
                    spSwitch = spDriver;

                    // close channel 0
                    _bstr_t channel1 = _bstr_t("ROW00_H");
                    _bstr_t channel2 = _bstr_t("COL00_H");

                    spSwitch->Path->Connect(channel1, channel2);

                    channel1 = _bstr_t("ROW00_H");
                    channel2 = _bstr_t("ABUS1_H");

                    // close channel 9901
                    spSwitch->Path->Connect(channel1, channel2);


                    // wait until the channels have settled (up to 10 msec)
                    spSwitch->Path->WaitForDebounce( 10 );

                    // Disconnect all channels
                    spSwitch->Path->DisconnectAll();

              }
              catch (_com_error& e)
              {
                    ::MessageBox(NULL, e.Description(), e.ErrorMessage(),
                                                      MB_ICONERROR);
              }

              if (spSwitch != NULL && spSwitch->Initialized)
              {
                    // Close driver
                    spSwitch->Close();
              }
        }
        catch (_com_error& e)
        {
              ::MessageBox(NULL, e.Description(), e.ErrorMessage(),
                                                MB_ICONERROR);
        }

        ::CoUninitialize();

        printf("\nDone - Press Enter to Exit");
        getchar();

        return 0;
}
```

Figure 3-13: Example Visual C++ Program Using the IVI Driver

Visual C# Example

An example showing how to use the IVI driver with Microsoft Visual C# is shown in Figure 3-14. This example instantiates an instance of the driver, initiates the driver, and closes two channels (channels 0 and 9901). It then waits for the channel debounce to occur, and finally opens all channels.

Note that for the C# program to link, the following interoperability references must be added to the C# project:

Ivi.Driver.Interop.dll

Ivi.Swtch.Interop.dll

EADS.RiXI1450D.Interop.dll

The interoperability DLLs are installed when the IVI shared components are installed (first two items above) and when the 1450D IVI driver is installed. These are typically installed into the following directory, but your system may have a different IVI installation directory:

C:\Program Files\IVI\Bin\Primary Interop Assemblies

```
using System;

namespace ClientCS
{
	/// <summary>
	/// Example test program to operate the IVI driver using C#.
	/// </summary>
	class ClientCS
	{
		/// <summary>
		/// The main entry point for the application.
		/// </summary>
		[STAThread]
		static void Main(string[] args)
		{
			EADS.RIXi1450D.Interop.RIXi1450D riDriver =
				new EADS.RIXi1450D.Interop.RIXi1450DClass();

			Ivi.Swtch.Interop.IIviSwtch switchDriver;

			// Use resource string from IVI configuration store
			string strResourceDesc = "RIXI1450D_L1";

			// Setup IVI-defined initialization options
			string strStandardInitOptions =
				"Cache=true, InterchangeCheck=false,
				QueryInstrStatus=true, RangeCheck=true,
				RecordCoercions=false, Simulate=false";

			// Setup driver-specific initialization options
			string strDriverSetupOptions =
				"DriverSetup= Model=RIXi1450D, Trace=false";
```

```
                string strOptions = strStandardInitOptions + "," +
                                        strDriverSetupOptions;

                riDriver.Initialize(strResourceDesc, false, false,
                                                        strOptions);


                // cast the RIXI1450D driver as an IVISwtch class driver
                switchDriver = riDriver as Ivi.Swtch.Interop.IIviSwtch;


                if (switchDriver != null)
                {
                      // connect channel 0
                      switchDriver.Path.Connect("ROW00_H", "COL00_H");

                      // connect channel 9901
                      switchDriver.Path.Connect("ROW00_H", "ABUS1_H");

                      // wait for debounce (up to 10 msec)
                      switchDriver.Path.WaitForDebounce( 10 );

                      // disconnect all channels
                      switchDriver.Path.DisconnectAll();
                }
          }
     }
}
```

Figure 3-14: Example Visual C++ Program Using the IVI Driver

ActivATE Operation

The 1450D and 1450F cards may also be used within the ActivATE™ test platform environment.

Consult the 1800-series manual for a description of how to configure your system for use with the 1800-series plug-in cards. That section will instruct you how you may add the 1800-series driver to the list of devices available to your test program, and also how to configure the 1800-series driver to provide access to the drivers for the various plug-in modules.

Once the ActivATE environment is configured, the driver for the 1450D/F will be available for your test program. The following methods are the most commonly used to operate the relays on the 1450D/F card:

Close()	closes a single channel
CloseList()	closes a list of channels
CloseRange()	closes a range of channels
Open()	opens a single channel
OpenList()	opens a list of channels
OpenRange()	opens a range of channels.

The sample function in Figure 3-15 illustrates a series of function calls to operate various channels on the 1450D card. Note that the test program reference “xi1450D_1” has been assigned as the interface to the 1450D card.

```
Function Sample_Test()

      Dim nErr

      'initialize test node as a failure
      Sample_Test = false

      ' close channel 9901
      nErr = xi1450D_1.Close(9901)
      if nErr <> 0 then exit function

      'close channels 0, 11, 107, 317
      nErr = xi1450D_1.CloseList("0,11,107,317")
      if nErr <> 0 then exit function

      'close channels 205 to 211
      nErr = xi1450D_1.CloseRange(205,211)
      if nErr <> 0 then exit function

      ' open channel 0
      nErr = xi1450D_1.Open( 0 )
      if nErr <> 0 then exit function

      'open a channels 0, 222, 315
      nErr = xi1450D_1.OpenList("0, 222, 315")
      if nErr <> 0 then exit function

      'open channels 0 to 9904 (all relays on 1450D)
      nErr = xi1450D_1.OpenRange(0,9904)

      ' indicate test has passed
      Sample_Test = true

End Function
```

Figure 3-15: Example ActivATE Test Script for the 1450D

The ActivATE environment also has a graphical user interface that can be used both as a control and to display the current status of the relays on the 1450 card. This graphical user interface is “live” in that it remains synced up with the current state of the instrument if it is controlled via the ActivATE driver.

Main Tab

The **Main** tab of the graphical user interface displays the present status for the channels of the 1450 card. By clicking on any of the relays, the state of the relay can be changed from closed to open or from open to closed. An open check box means that relay is open.

Figures 3-16 and 3-17 show the **Main** tab of the ActivATE GUI for the 1450D

and 1450F cards.

The current status of the channels shows on this tab but if you have a question about status, click **Update** to confirm.

Click **Reset** to open all the relays. Click **Simulation** to put the screen into simulation mode where no commands for this card are sent to the 1830 system.

The **Main** tab features a message regarding the Analog Bus Safety Interlock. **Analog Bus Safety Interlock is closed** means that a jumper is installed, the analog bus relays are enabled, and the 1450 card is electrically connected to the analog bus. If the message states that the Interlock is open, the relays are disabled and the card is not connected to the analog bus.

Figure 3-18 shows the various messages and variations on the Main tab depending on the current situation. For more information, refer to the **Analog Bus Safety Interlock Circuit** section earlier in this chapter.

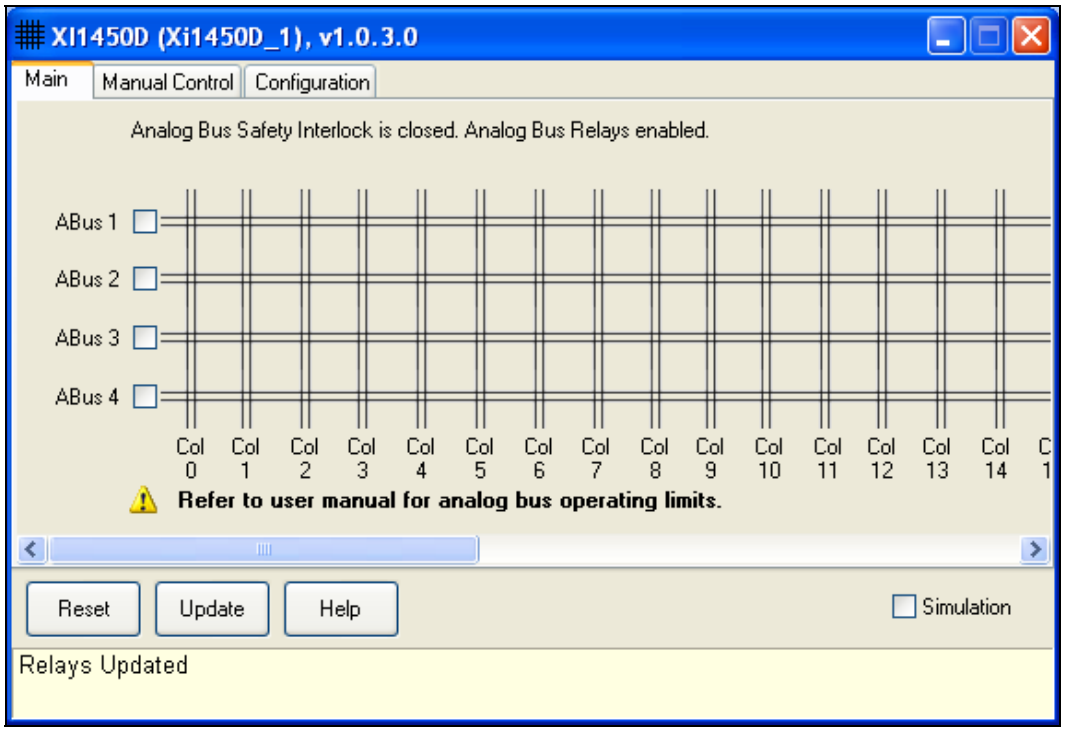


Figure 3-16: ActivATE Main Tab for the 1450D Card

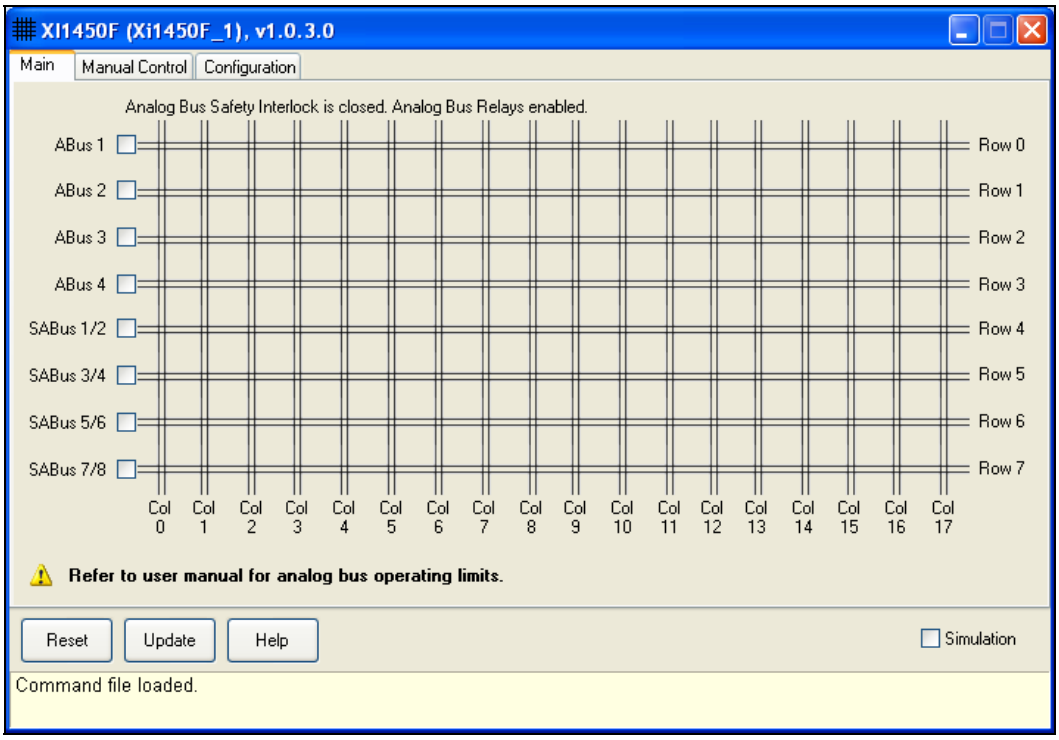


Figure 3-17: ActivATE Main Tab for the 1450F Card

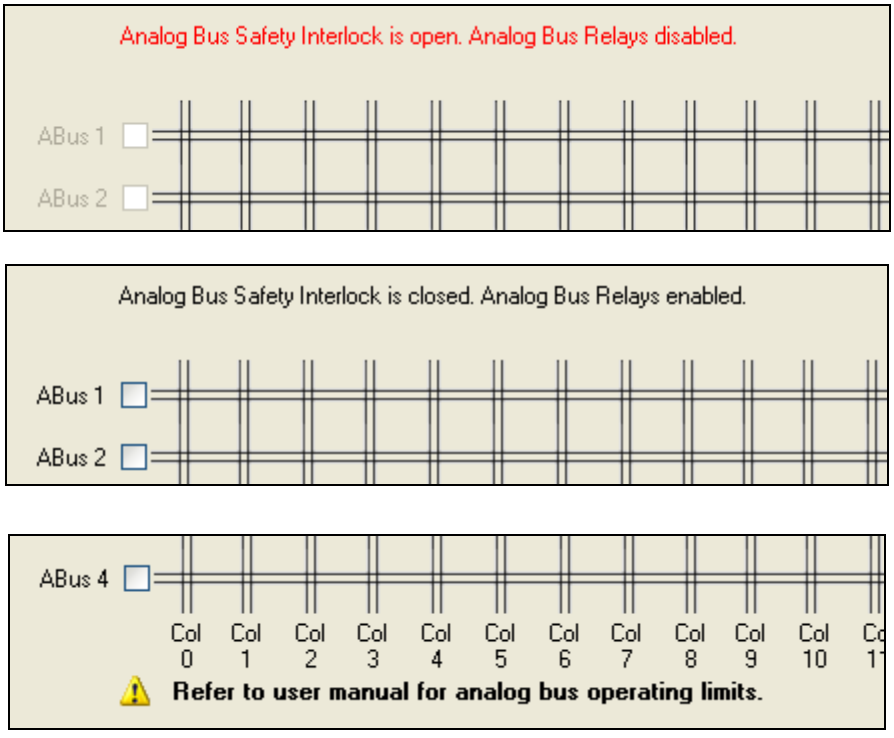


Figure 3-18: Analog Bus Safety Interlock Information on ActivATE Screen.

Main Control Tab

The **Manual Control** tab (Figure 3-19) acts very similar to the web page version. It allows you to send commands to and read replies from the system.

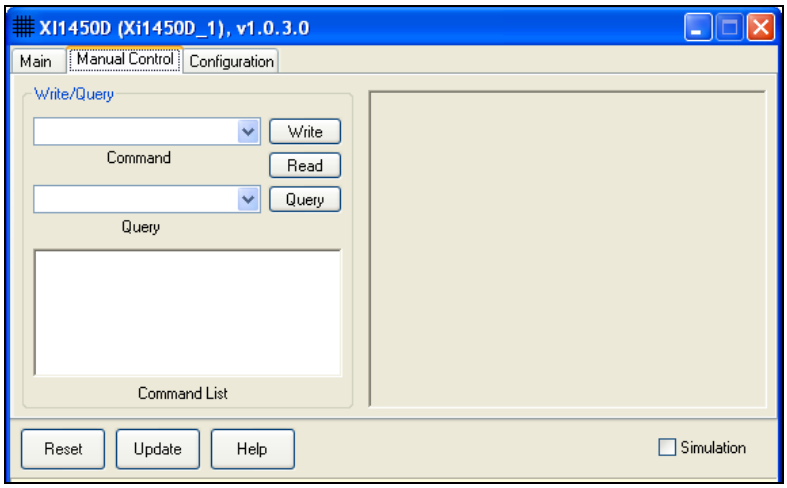


Figure 3-19: ActivATE Manual Control Tab

Configuration Tab

The **Configuration** tab (Figure 3-20) provides the means to locate the XML command file that contains all of the relevant SCPI commands for this card. The tab also allows you to enable a file trace to store all the commands sent to the hardware (through the driver). This is helpful for debugging purposes.

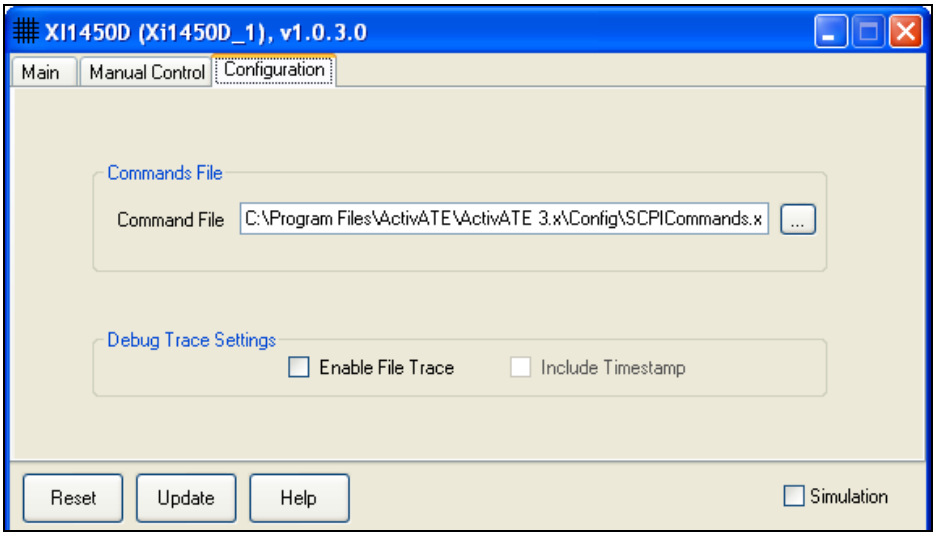


Figure 3-20: ActivATE Configuration Tab

Commonly Used SCPI Commands

The full command set supported by the 1800-series system is documented in its user manual. This section describes a few of the most commonly used commands that apply specifically to the 1450.

The most commonly used commands used with the 1450 card are:

CLOSe	close one or more channels on one or more cards
OPEN	open one or more channels on one or more cards
SCAN	operate a list of relay channels, closing one and opening the previous one with each trigger received
PATH	define a set of relays to operate and associate a name to them
EXCLude	prevent more than one in a group of relays from being closed simultaneously
INCLude	cause two or more relays to always stay in the same state as the others so that they are all opened or all closed
CHANnel:DELay	sets the channel close and open settling times for each channel

Channel Descriptors

Many SCPI commands require one or more relays to be selected. These commands take a *channel descriptor* as one of the command parameters. The most basic form of a channel descriptor uses the form:

```
(@ <module address> ( <channel> ) )
```

Where:

`<module address>`	identifies the slot of the plug-in (1 to 9)
`<channel>`	identifies the relay channel being controlled.

The valid <channel> numbers for a 1450D are as follows:

0 to 35	(row 0, columns 0 to 35)
100 to 135	(row 1, columns 0 to 35)
200 to 235	(row 2, columns 0 to 35)
300 to 335	(row 3, columns 0 to 35)
9901 to 9904	(analog bus relays to row connections)

The valid <channel> numbers for a 1450F are as follows:

0 to 17	(row 0, columns 0 to 17)
100 to 117	(row 1, columns 0 to 17)

200 to 217	(row 2, columns 0 to 17)
300 to 317	(row 3, columns 0 to 17)
400 to 417	(row 4, columns 0 to 17)
500 to 517	(row 5, columns 0 to 17)
600 to 617	(row 6, columns 0 to 17)
700 to 717	(row 7, columns 0 to 17)
9901 to 9904	(analog bus relays to row 0 to 3)
9905 to 9908	(SABUS relays to row 4 to 7)

The correspondence between channel numbers and front panel connection is shown in Tables 2-1 and 2-2 and Figure 2-3 of this manual.

The following would be valid channel descriptors for a 1450D switch card plugged into slot 5:

```
(@5(0))
(@5(335))
(@5(9904))
```

In addition to single channels, multiple channels on the same card can be separated by commas. For example:

```
(@5(0,335,9904))
```

specifies each channel 0, 335, and 9904 on the switch card in slot 5. Also, a range of relays may be specified by using the colon character (':'):

```
(@9(11:15,320:335))
```

specifies that each channel from 11 through 15 and from 320 through 335 should be selected for the command.

Note that the channel descriptors can include channels from multiple modules as well:

```
(@9(16,22),7(14:21),5(0,19))
```

The previous example selects two channels from the plug-in card in slot 9, all channels between 14 and 21 for the plug-in in slot 7, and channels 0 and 19 for the plug-in in slot 5.

PATH Command

The PATH command can be used to associate a set of relays with a name. The name can then be used in lieu of channel numbers in the commands that support a channel list.

For example, a path named "TURN_OFF_POWER" can be associated with several channels on one or more switch cards:

```
PATH:DEFINE TURN_OFF_POWER,(@5(110,222))
```

Now, when the command

```
CLOSE (@TURN_OFF_POWER)
```

is received, it will close all of the channels defined for the path named TURN_OFF_POWER.

SCAN Command

The SCAN command is used to instruct the 1800-series system to scan across a set of relay channels. The relay channels can occur in any order, across any number of plug-in modules.

The SCAN list is defined by using the SCAN command:

```
SCAN (@5(0,11:15,123:116,200,305)
```

This example shows that the scan list will cycle through the following sequence of channels on the plug-in module in slot 5:

0,11,12,13,14,15,123,122,121,120,119,118,117,116,200,305

After the scan has been initiated (with an “INITiate:IMMediate” command), the 1800 series platform will wait for a trigger to be received, at which point scanning will begin. The trigger source used for scanning is determined by the “TRIGger:SOURce” command.

Once the trigger source has been received, the system will wait for a “scan advance source”. The scan advance source is selected by the “SCAN:ADVance:SOURce” command. For each trigger received on the scan advance source, the system will open the previous switch in the scan list, wait for it to settle, and then close the next switch in the scan list.

At each step of the scan list, a set of SCPI commands can be executed. The set of SCPI commands to execute are defined by the “SEQunce:DEFine” command. For example, if you want to configure a DMM in slot 14 to use the 2-wire resistance function in the 10KOhm range and make 2 readings, you could issue the following commands:

```
SEQUENCE:DEF      READ_2_WIRE
SEQUENCE:STEP     “SENSE:RES 10000,(@14(0))”
SEQUENCE:STEP     “READ? (@14(0))”
SEQUENCE:STEP     “READ? (@14(0))”
SEQUENCE:END
```

Now, the series of 3 SCPI commands can be used by specifying the sequence name “READ_2_WIRE”. In order to execute the sequence whenever one of the channels on the scan list is closed, the sequence must be associated with the channel(s) by using the “SEQuence:SELect” command:

```
SEQ:SEL READ_2_WIRE,(@9(0:16))
```

With this association, the scan list will make two 2-wire measurements in the 10K Ohm range after each channel 0 through 16 is closed. Since there is no association for any channel above 16, no action will be taken for those channels when they are closed during the execution of the scan list.

The sequence association can be unique for each channel on the scan list.

That is, if the scan list consists of 50 channels, each of those channels could have a unique sequence defined and then associated with it.

For more information on the SCAN and SEQUENCE commands, consult the SCPI section of your 1800-series system user manual.

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