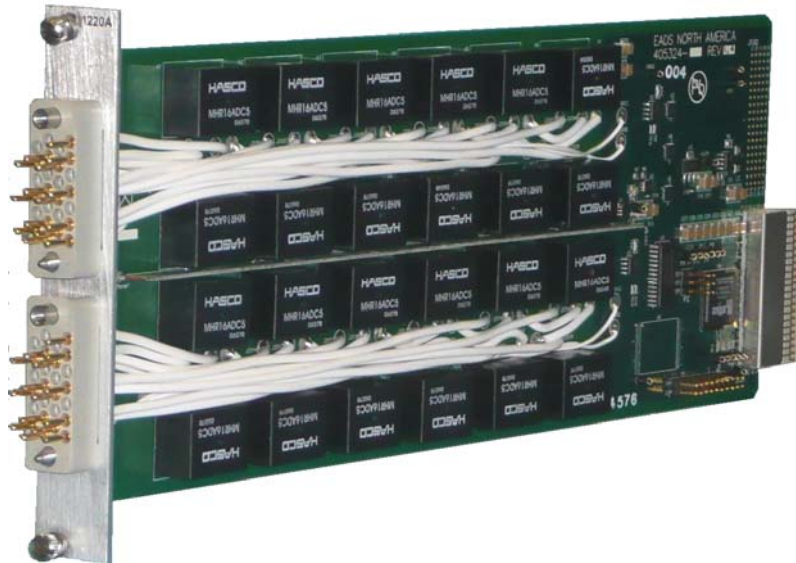


Racal Instruments™

1220 24-Channel 16 Amp, SPST Plug-in Switch Card User Manual

Publication No. 980937-1220 Rev. B



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Publication Date: August 7, 2009

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FOR YOUR SAFETY

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



CAUTION
RISK OF ELECTRICAL SHOCK
DO NOT OPEN



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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Document Change History

Revision	Date	Description of Change
A	4/6/09	Document Control release
B	8/7/09	Revised per EO 29765. Revised DC and AC performance; updated web page and ActivATE screen shots; added icon to ESD caution; updated CE declaration with current version; and updated environmental data specifications.

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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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Chapter 1

Overview and Specifications

Overview

The Racal Instruments™ 1220 is a family of 24-channel, SPST (Form A) plug-in switch cards for the 1800 series Source/Measure Switch platform that are available in four different configurations (A to D). They quickly and easily plug into a switching system like the Model 1830 Source/Measure Switch for LXI™/GPIB/USB interfaces.

Feature highlights include:

- 24 channels of SPST switching available in 4 configurations (see below)
- Ideal for general purpose switching to 8 MHz
- Switches up to 16 A
- Hard-wired emergency reset feature for safety

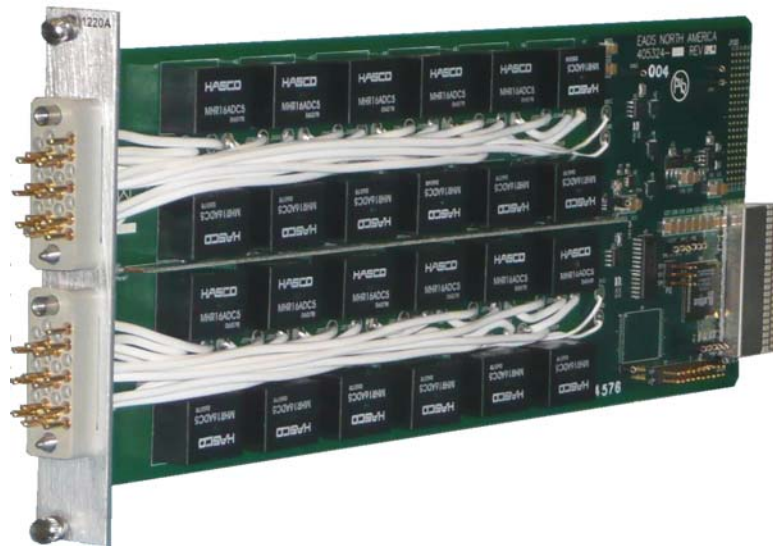


Figure 1-1: 1220 Plug-in Switch Card

The four 1220 models include:

- 1220A: 24 channels of SPST, with space for parallel components
- 1220B: 12 channels of 1x2, with space for parallel components
- 1220C: 6 channels of 1x4, with space for parallel components
- 1220D: 2 channels of 1x12, with space for parallel components

All 1220 models feature a hard-wired emergency reset feature which immediately opens all closed channels when activated. Refer to **Emergency Reset Feature** in **Chapter 3, Operation** for additional information.

The 1220A/B/C/D 16 Amp switch card 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 1220 can be programmed in the optional ActivATE™ test platform software.

Specifications

Input

Maximum Switching Voltage	125 VDC or 250 VAC
Maximum Switching Current	16 A DC/AC
Maximum Switching Power	300 W, 4000 VA

DC Performance

Path Resistance	< 50 mΩ (Initial)
Insulation Resistance	> 5x10 ⁸ Ω
Thermal EMF	< 10 μV

AC Performance (50 Ω): 1220A

Bandwidth (-3 dB) *	50 MHz
Insertion Loss	1 KHz: < -0.1 dB 1 MHz: < -0.1 dB 10 MHz: < -0.1 dB 50 MHz: < -3 db
Isolation	1 KHz: > 60 dB 1 MHz: > 45 dB 10 MHz: > 25 dB 50 MHz: > 10 dB
Crosstalk	1 KHz: < -70 dB 1 MHz: < -50 dB 10 MHz: < -30 dB 50 MHz: < -10 dB
Capacitance	Channel-Chassis: < 50 pF Open Channel: < 20 pF

AC Performance (50 Ω): 1220B

Bandwidth (-3 dB) *	40 MHz
Insertion Loss	1 KHz: < -0.1 dB 1 MHz: < -0.1 dB 10 MHz: < -0.1 dB 40 MHz: < -3 db
Isolation	1 KHz: > 60 dB 1 MHz: > 45 dB 10 MHz: > 25 dB 40 MHz: > 15 dB
Crosstalk	1 KHz: < -70 dB 1 MHz: < -50 dB 10 MHz: < -30 dB 40 MHz: < -10 dB
Capacitance	Channel-Chassis: < 70 pF Open Channel: < 20 pF

AC Performance (50 Ω): 1220C

Bandwidth (-3 dB) *	30 MHz
Insertion Loss	1 KHz: < -0.1 dB 1 MHz: < -0.1 dB 10 MHz: < -0.1 dB 30 MHz: < -3 db
Isolation	1 KHz: > 60 dB 1 MHz: > 45 dB 10 MHz: > 25 dB 30 MHz: > 15 dB
Crosstalk	1 KHz: < -70 dB 1 MHz: < -50 dB 10 MHz: < -30 dB 30 MHz: < -10 dB
Capacitance	Channel-Chassis: < 100 pF Open Channel: < 20 pF

AC Performance (50 Ω): 1220D

Bandwidth (-3 dB) *	8 MHz
Insertion Loss	100 KHz: < -0.1 dB 1 MHz: < -0.1 dB 8 MHz: < -1.5 dB
Isolation	100 KHz: > 60 dB 1 MHz: > 45 dB 8 MHz: > 25 dB

Crosstalk	100 KHz: < -70 dB 1 MHz: < -50 dB 8 MHz: < -30 dB
Capacitance	Channel-Chassis: < 200 pF Open Channel: < 20 pF

Interface Data

Power Requirements	+5 VDC at 100 mA +3.3 VDC at 1 A +5 VDC at 40 mA per energized relay
--------------------	--

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: 250 V Pollution degree 2: 250 V Not for connection directly to mains power
Material Handling	RoHS

Reliability

Switching Time	< 15 ms (includes settling time)
Rated Switch Operations	Mechanical: 1 X 10 ⁸ Electrical: 100,000 @ 125 Vrms/16 A/2 kVA
Relay Operations Counter	Running total of operations stored in on-board non-volatile memory

Mean Time Between Failure (MTBF)

The 1220 MTBF is 439,072 hours at 25° calculated in accordance with MIL-STD-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	21.0 oz. (0.6 kg)
Dimensions	4.26" H x 0.75" W x 11.82" D
Front Panel I/O Interface Connector	26 pin rack and panel connector

Ordering Information

Listed below are part numbers for the 1220 switch card and available mating connector accessories. Each 1220 can use two mating connectors.

For additional information regarding the 26-pin cable assembly, see **Chapter 2, Installation Instructions**.

Model/Description	Part No.
Racal Instruments™ 1220A 24-Channel SPST, 16A Switch Card	405324-001
Racal Instruments 1220B 12-Channel 1x2, 16A Switch Card	405324-002
Racal Instruments 1220C 6-Channel 1x4, 16A Switch Card	405324-003
Racal Instruments 1220D Dual Channel 1x12, 16A Switch Card	405324-004
Card shield	408190

Model/Description	Part No.
26-pin cable assembly, 6 ft.	408200
26-pin connector kit	408201
Crimp hand tool	991020
Crimp pin-insertion tool	990898
Pin-removal tool	990899

Chapter 2

Installation Instructions

Unpacking and Inspection



CAUTION

Use standard ESD procedures including ground straps and static-safe work surfaces whenever handling the 1220 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 you 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 1220 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 1220 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.

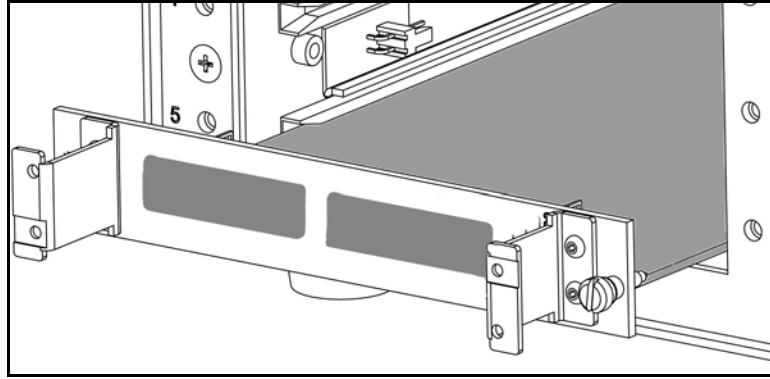


Figure 2-1: Inserting a Plug-In Card

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.

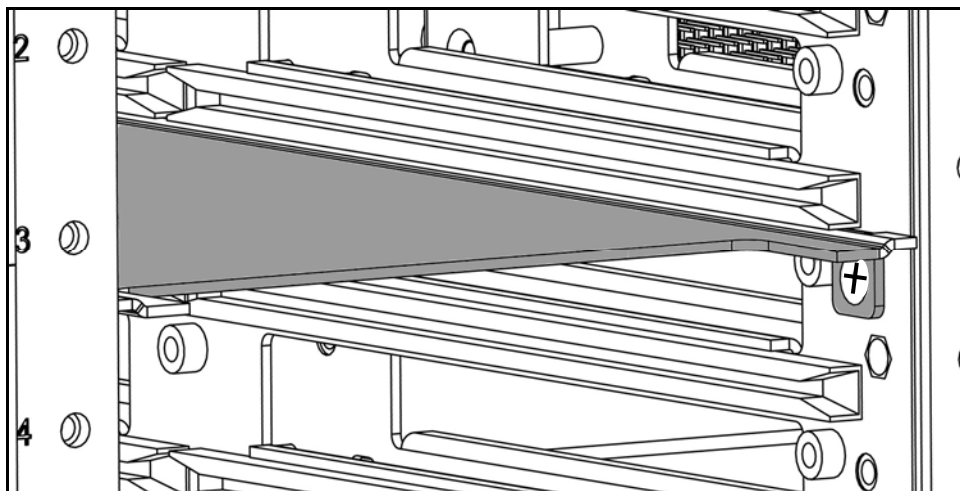


Figure 2-2: Installing a Card Shield

Parallel Component Installation

Parallel components such as MOVs, diodes, or capacitors may be installed on the 1220 in the location next to each relay. See Figure 2-3.

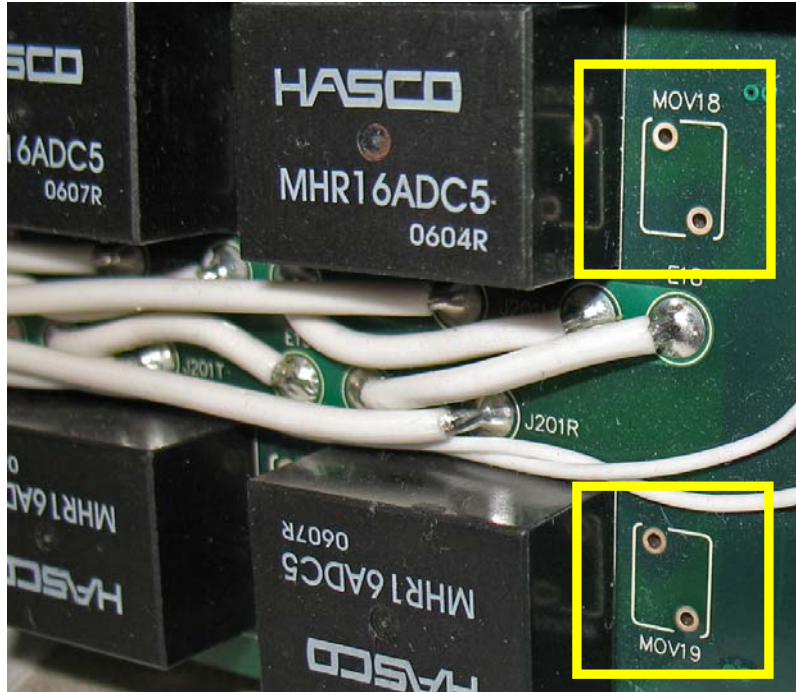


Figure 2-3: Parallel Component Installation



CAUTION:

The 1220 card was built to RoHS standards. If you perform any work on this board (such as installing new components), you must use RoHS-compliant components and lead-free solder.

Front Panel Connector Pin Assignment

When the 1220 card is installed into the 1830 chassis, the dual 26-pin connector side is called the front panel. Tables 2-1 through 2-4 list the pin assignments for the four different 1220 card models. Figure 2-4 shows the connector numbering and pin locations.

Table 2-1: 1220A Front Panel Connector Pin Assignment

Channel #	Relay #	IN (COM)	OUT (NO)
0	1	200-A	200-E
1	2	200-C	200-H
2	3	200-B	200-F
3	4	200-D	200-J
4	5	200-K	200-P
5	6	200-M	200-S
6	7	200-L	200-R
7	8	200-N	200-T
8	9	200-U	200-Y
9	10	200-W	200-AA
10	11	200-V	200-Z
11	12	200-X	200-BB
12	13	201-A	201-E
13	14	201-C	201-H
14	15	201-B	201-F
15	16	201-D	201-J
16	17	201-K	201-P
17	18	201-M	201-S
18	19	201-L	201-R
19	20	201-N	201-T
20	21	201-U	201-Y
21	22	201-W	201-AA
22	23	201-V	201-Z
23	24	201-X	201-BB

		SW	GND
EM RST1		200-CC	200-DD
EM RST2		201-CC	201-DD

Table 2-2: 1220B Front Panel Connector Pin Assignment

Channel #	Relay #	IN (COM)	OUT (NO)
0	1	200-A	200-E
1	2		200-H
2	3	200-B	200-F
3	4		200-J
4	5	200-K	200-P
5	6		200-S
6	7	200-L	200-R
7	8		200-T
8	9	200-U	200-Y
9	10		200-AA
10	11	200-V	200-Z
11	12		200-BB
12	13	201-A	201-E
13	14		201-H
14	15	201-B	201-F
15	16		201-J
16	17	201-K	201-P
17	18		201-S
18	19	201-L	201-R
19	20		201-T
20	21	201-U	201-Y
21	22		201-AA
22	23	201-V	201-Z
23	24		201-BB

		SW	GND
EM RST1		200-CC	200-DD
EM RST2		201-CC	201-DD

Table 2-3: 1220C Front Panel Connector Pin Assignment

Channel #	Relay #	IN (COM)	OUT (NO)
0	1	200-A	200-E
1	2		200-H
2	3		200-F
3	4		200-J
4	5	200-K	200-P
5	6		200-S
6	7		200-R
7	8		200-T
8	9	200-U	200-Y
9	10		200-AA
10	11		200-Z
11	12		200-BB
12	13	201-A	201-E
13	14		201-H
14	15		201-F
15	16		201-J
16	17	201-K	201-P
17	18		201-S
18	19		201-R
19	20		201-T
20	21	201-U	201-Y
21	22		201-AA
22	23		201-Z
23	24		201-BB

		SW	GND
EM RST1		200-CC	200-DD
EM RST2		201-CC	201-DD

Table 2-4: 1220D Front Panel Connector Pin Assignment

Channel #	Relay #	IN (COM)	OUT (NO)
0	1	200-A	200-E
1	2		200-H
2	3		200-F
3	4		200-J
4	5		200-P
5	6		200-S
6	7		200-R
7	8		200-T
8	9		200-Y
9	10		200-AA
10	11		200-Z
11	12		200-BB
12	13	201-A	201-E
13	14		201-H
14	15		201-F
15	16		201-J
16	17		201-P
17	18		201-S
18	19		201-R
19	20		201-T
20	21		201-Y
21	22		201-AA
22	23		201-Z
23	24		201-BB

		SW	GND
EM RST1		200-CC	200-DD
EM RST2		201-CC	201-DD

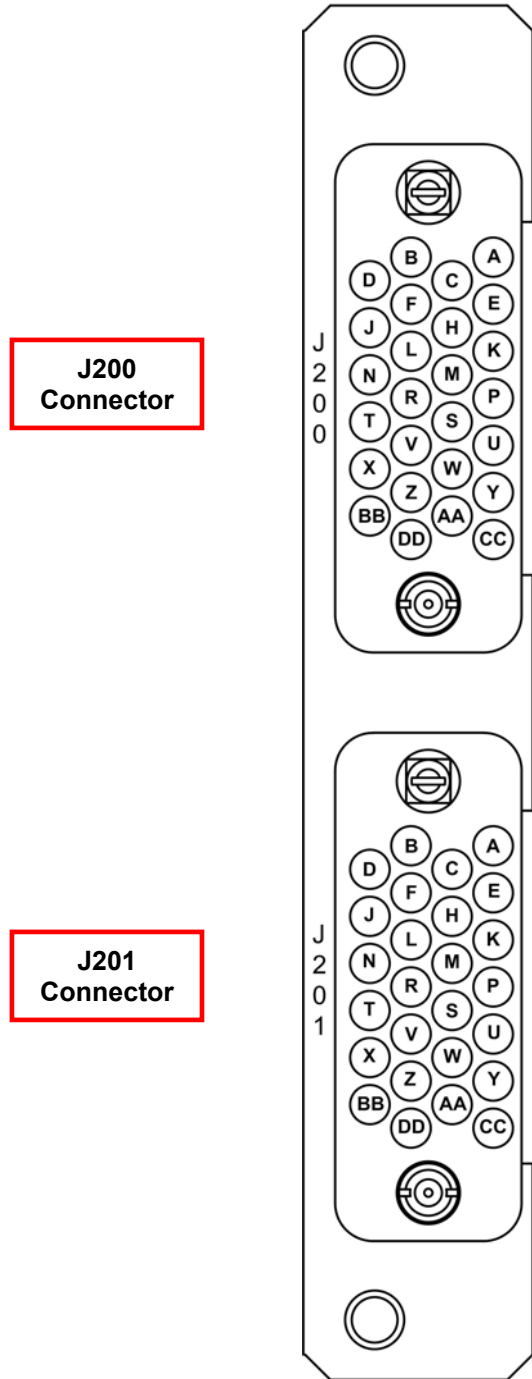


Figure 2-4: Front Panel Connector Layout

Chapter 3 Operation

Block Diagram

Figure 3-1 shows the relay block diagram of the 1220 card.

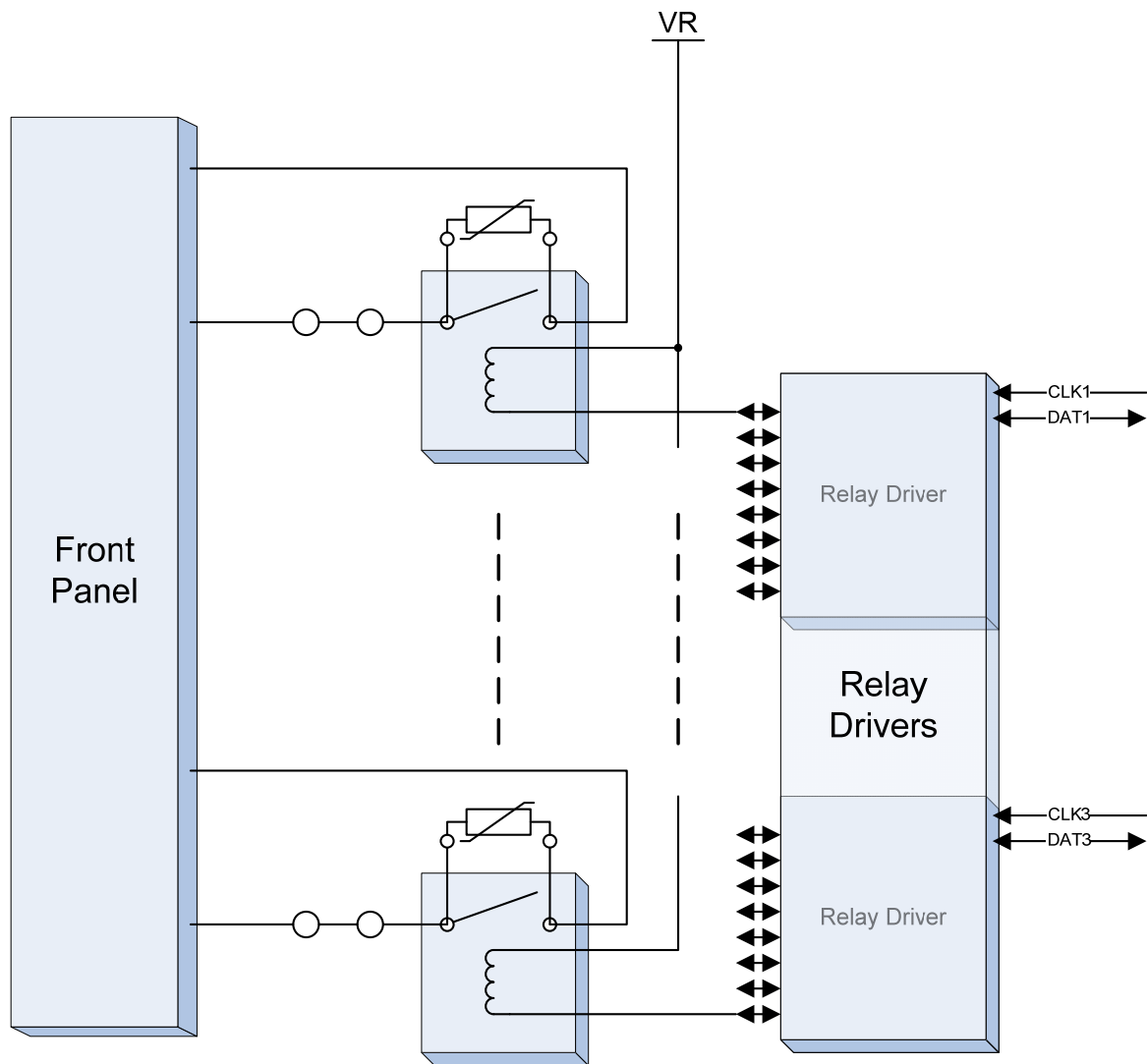


Figure 3-1: Relay Block Diagram

Emergency Reset Feature

The Emergency Reset feature provides a simple and automatic mechanism to open all relays quickly in case of a problem. This helps you maximize safety in a system that performs high-current switching.

The 1220 card comes with a zero ohm resistor set as a jumper across two pads marked R4 on the 1220 printed circuit board. This creates a global reset circuit within the entire 1830 system. When a condition activates the reset circuit, the global reset circuit triggers the 1830 system to open the relays on all of the cards in the chassis.

Refer to the 1830 user manual, PN 980938, for additional information on the screen warnings that will appear when an emergency reset occurs.

After an emergency reset occurs, you can resume normal test conditions with your 1830 system by:

1. First removing the condition causing the emergency reset.
2. Then either toggle the system power off/on OR send a ***RST** SCPI command.

You will need to rerun the program or software commands to return to the test state you were in when the system reset.

Figure 3-2 features a board diagram of the emergency reset circuit and shows the location of the R4 and R8 jumpers and where Q1 could be installed. The photos in Figure 3-3 show the location of the components on the 1220 circuit board.

Removing R4 and adding a zero-ohm resistor R8 and a field-effect transistor Q1 (such as Si9936DY) to the circuit board changes the reset function from a global mode to a local mode (see Table 3-1). In local mode, only relays on the affected 1220 board will be opened.



CAUTION:

The 1220 card was built to RoHS standards. If you perform any work on this board (such as installing new components), you must use RoHS-compliant components and lead-free solder.

Table 3-1: Component Configuration for Emergency Reset

Configuration	Feature
R4 installed, R8 and Q1 not installed (Factory default)	Global Reset
R4 removed, R8 and Q1 installed	Local Reset

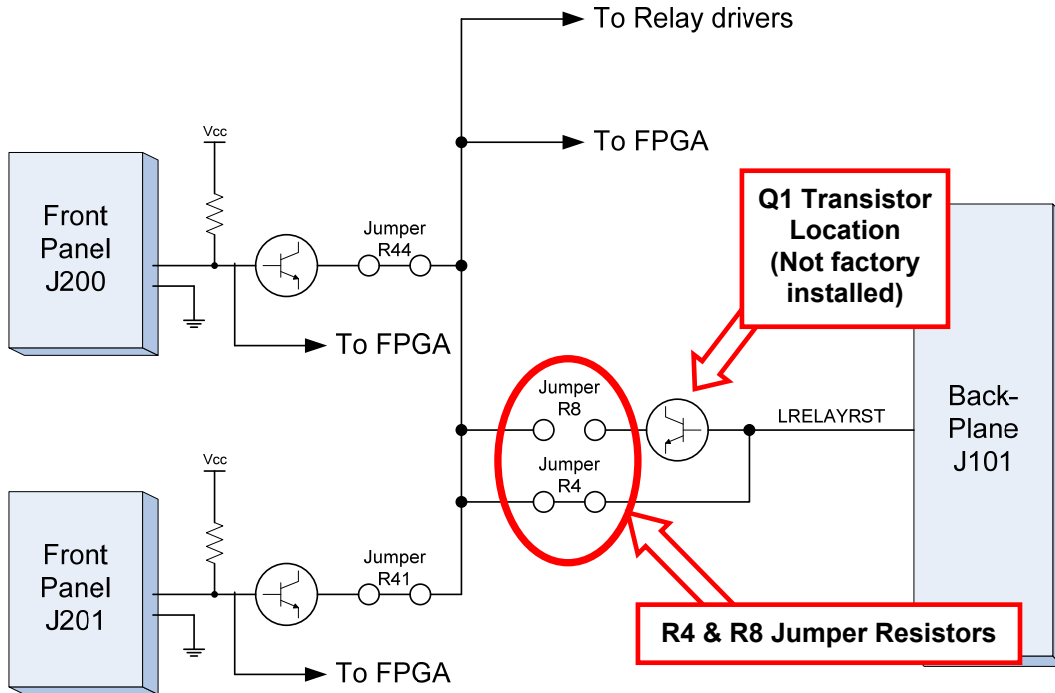


Figure 3-2: Emergency Reset Circuit Diagram (Factory Default)

You can determine which emergency shutdown input initiated the shutdown by viewing the web page interface or by sending the SCPI command `SHUTDOWN:STATUS? <slot>`.

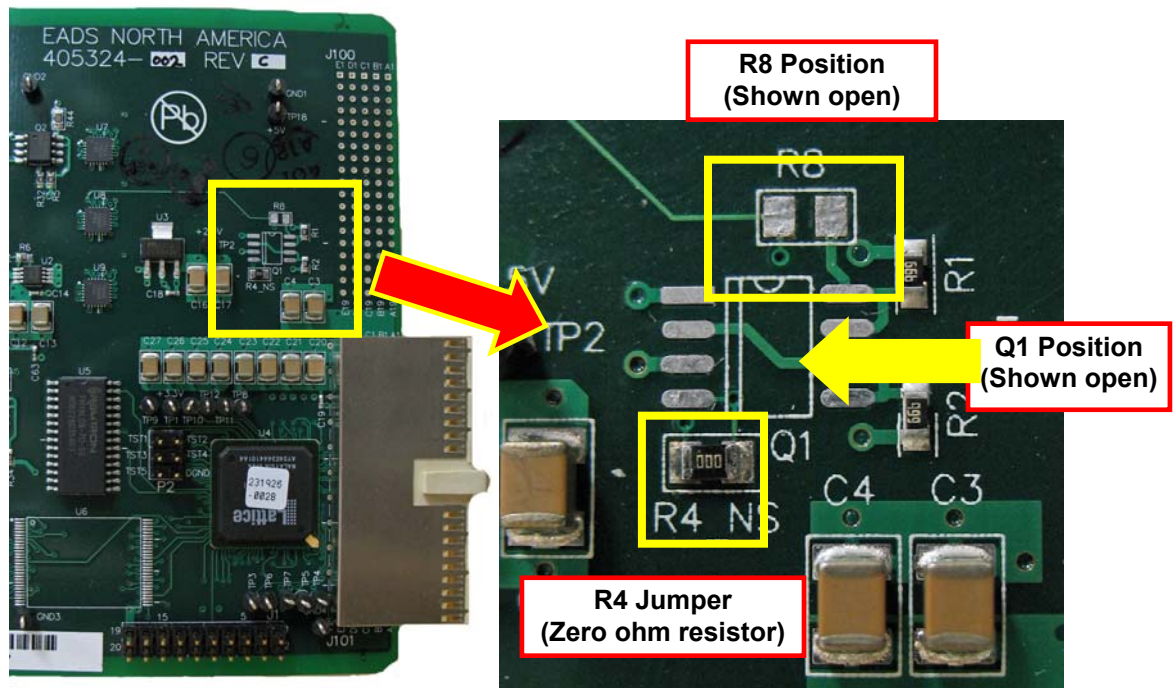


Figure 3-3: Resistors R4 & R8 and Transistor Q1 Locations

Operating the 1220 Switch Card

The 1220 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 1220 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 1220 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 1220 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>

The <model code> can be “XI1220A”, “XI1220B”, “XI1220C” or “XI1220D”. A typical reply is

XI1220A,EADS NORTH AMERICA,093008377495,1.0-0.0-2.1

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

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

LXI Web Page Controls

Figures 3-4 through 3-7 show the LXI web pages that allow you to control the 1220 card through manual setting or through SCPI commands.

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

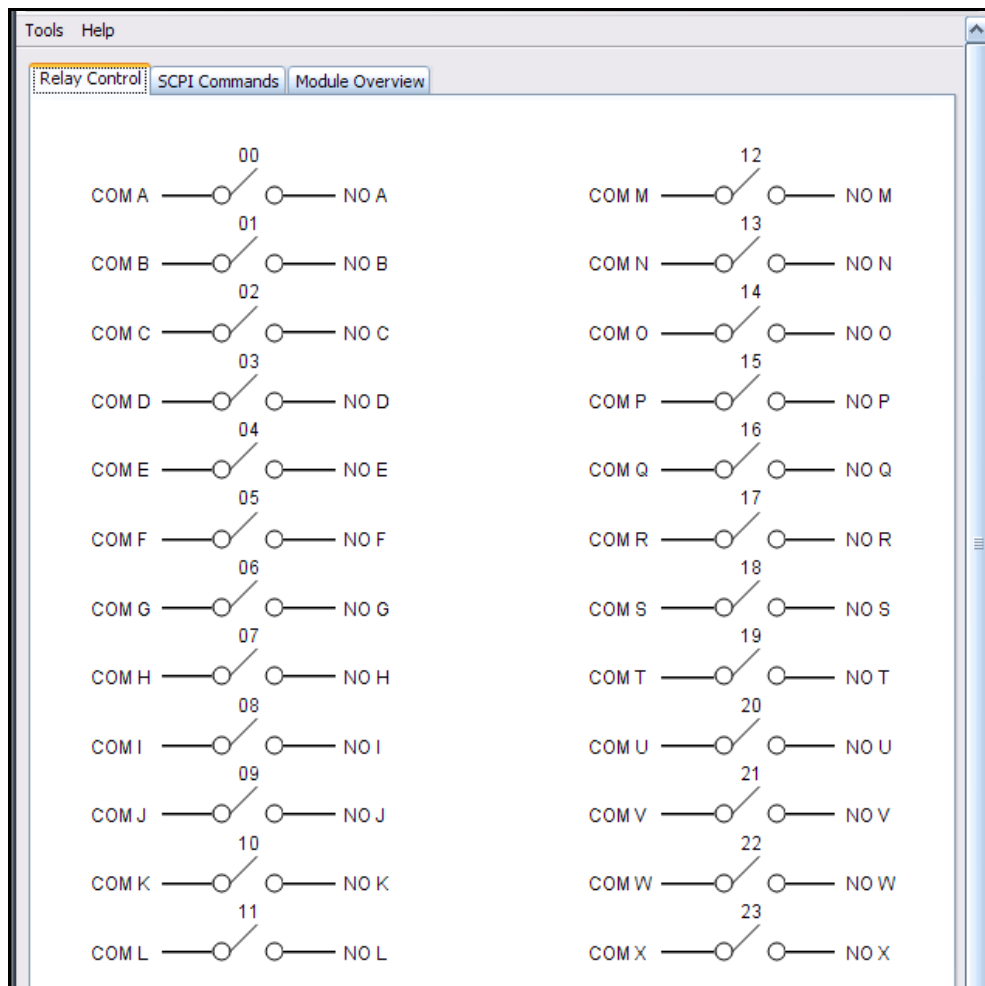


Figure 3-4: Relay Control Page

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

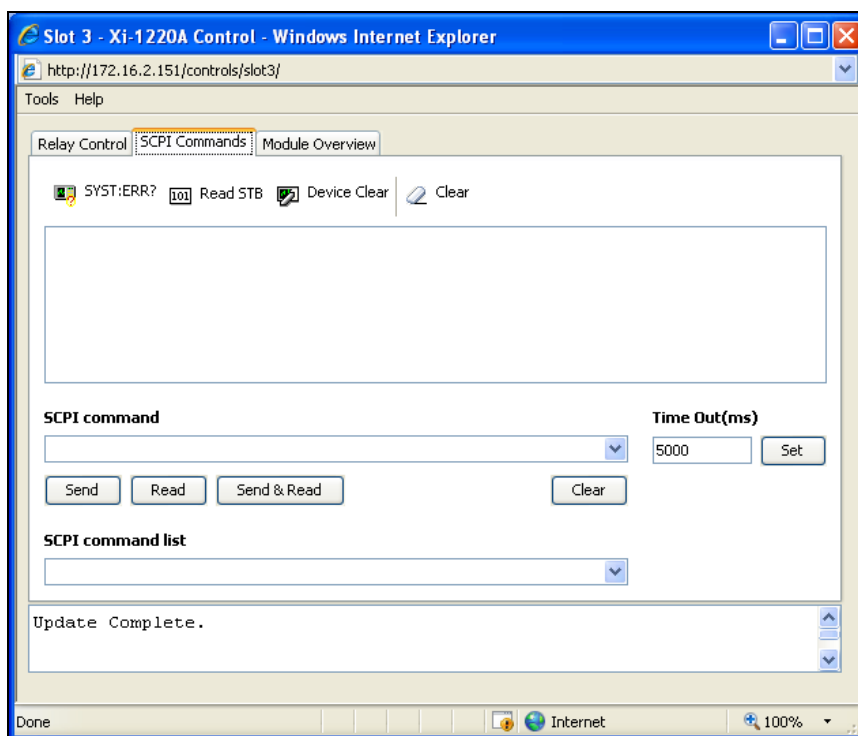


Figure 3-5: SCPI Commands Tab

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.

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.

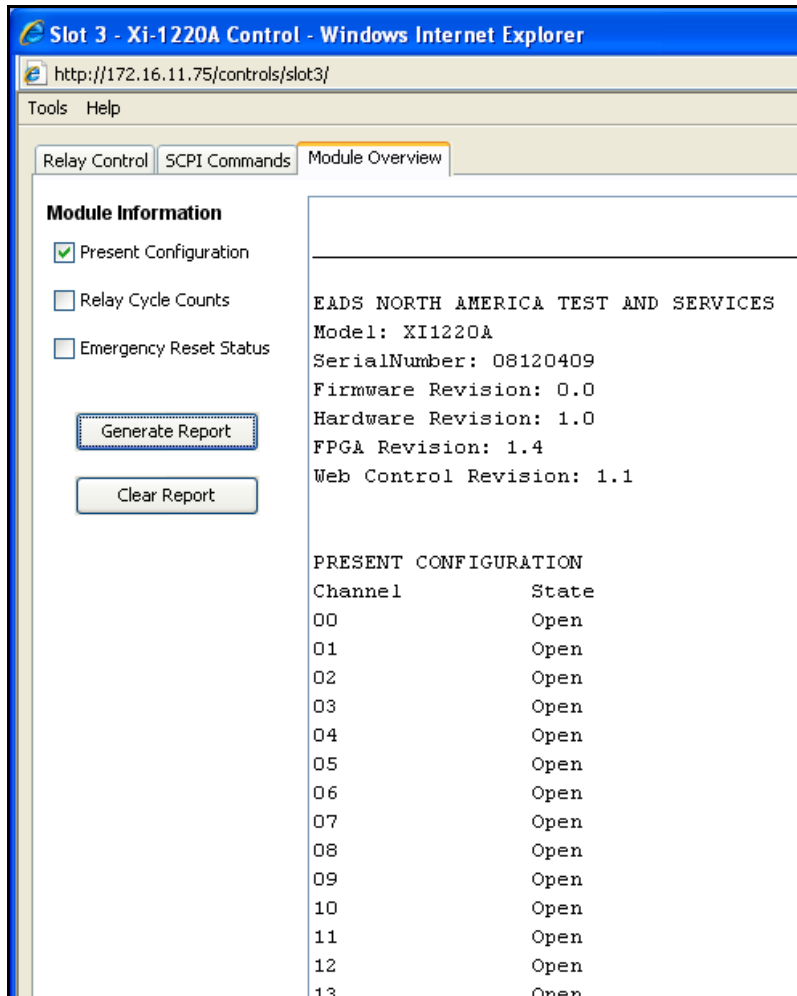


Figure 3-6: Module Overview Tab

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.

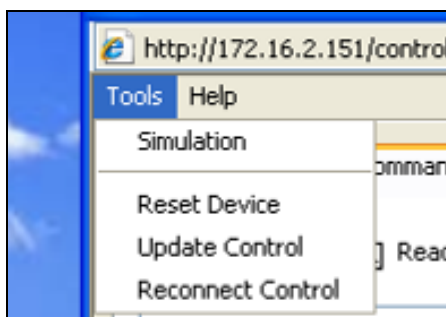


Figure 3-7: Web Page Tools Menu

IVI Driver Operation

The 1220 card is supplied with an IVI (Interchangeable Virtual Instruments) driver. This driver is IVISwch class compliant. For more information on IVI and IVISwch 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.

The channel names used for the IVI driver depend on the model of 1220 card used. Because the 1220 card topologies vary by model number, unique channel names have been assigned for each model.

The IVI driver channel names corresponding to the SCPI channel numbers is shown in Tables 3-2 through 3-5.

Table 3-2: IVI Driver Channel Names for the 1220A

Channel	Channel Name 1	Channel Name 2
0	COM A	NO A
1	COM B	NO B
2	COM C	NO C
...
23	COM X	NO X

Table 3-3: IVI Driver Channel Names for the 1220B

Channel	Channel Name 1	Channel Name 2
0	COM A	NO A1
1		NO A2
2	COM B	NO B1
3		NO B2
...
22	COM L	NO L1
23		NO L2

Table 3-4: IVI Driver Channel Names for the 1220C

Channel	Channel Name 1	Channel Name 2
0	COM A	NO A1
1		NO A2
2		NO A3
3		NO A4
...
20	COM F	NO F1
21		NO F2
22		NO F3
23		NO F4

Table 3-5: IVI Driver Channel Names for the 1220D

Channel	Channel Name 1	Channel Name 2
0	COM A	NO A1
1		NO A2
2		NO A3
3		NO A4
...
11		NO A12

Channel	Channel Name 1	Channel Name 2
12	COM B	NO B1
13		NO B2
14		NO B3
...
23		NO B12

So, to close relay 3 on a 1220A, you would use the “Connect” API as follows

```
sp_driver->Path->Connect("COM D", "NO D");
```

But to close relay 3 on a 1220D, you would use the “Connect” API as follows

```
sp_driver->Path->Connect("COM A", "NO A4");
```

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

```
sp_driver->Path->Disconnect("COM D", "NO D");
```

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 1220 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 1220.

You must create a new session for **each** 1220 you want to control. That is, if there are 3 1220 switch cards plugged into your 1800-series platform, then you will need to create 3 sessions to control them.

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 1220.

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 for a model 1220B driver named “RIXI1220B_S1”.

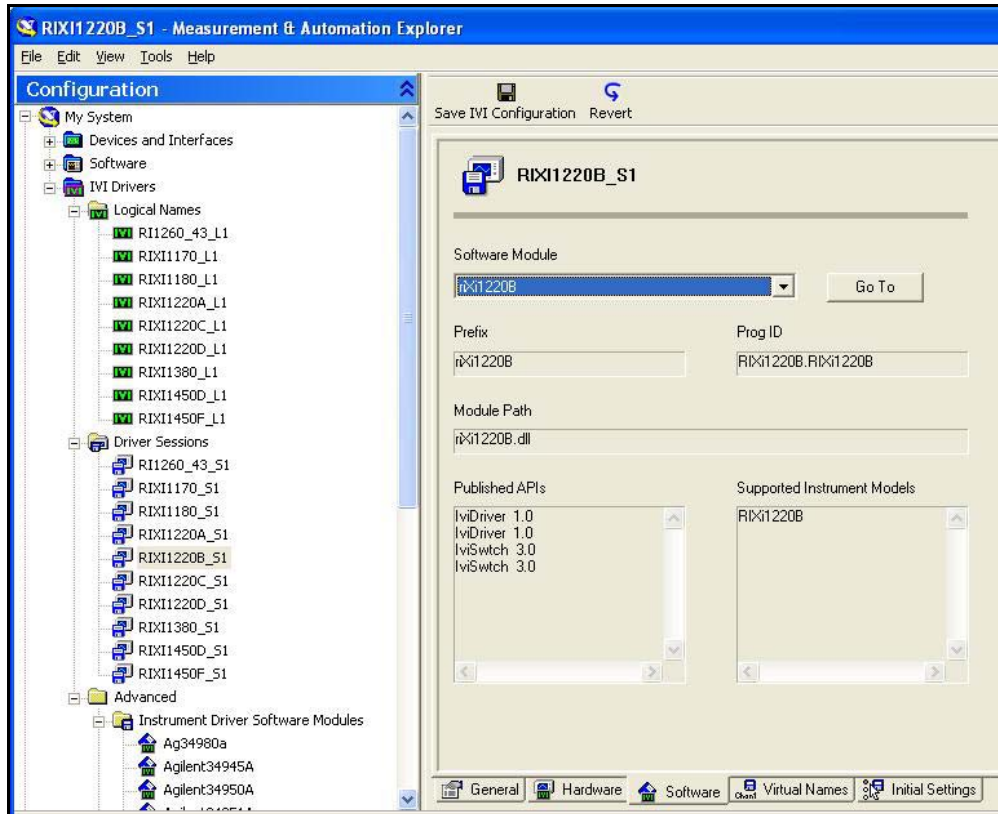


Figure 3-8: Creating New IVI Driver Session

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 “riX1220B” software module that was installed with the IVI driver installation. This is shown in Figure 3-9.

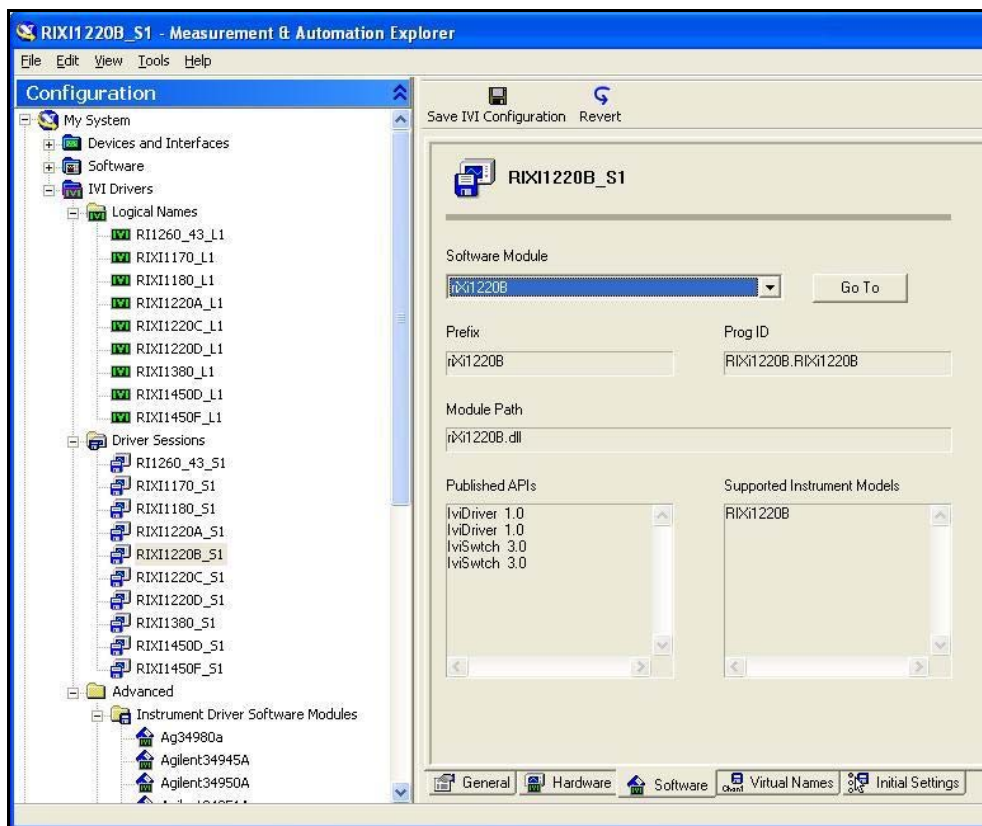


Figure 3-9: Associating Software Module with IVI Driver Session

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 1220 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 1220 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.

After the hardware asset has been created, the module address must be updated to match the plug-in slot of the 1220. Select the “Initial Settings” tab and modify the “Module Address” entry to match the plug-in slot of the 1220 card. In the example shown in Figure 3-11, the module address is set to 7.

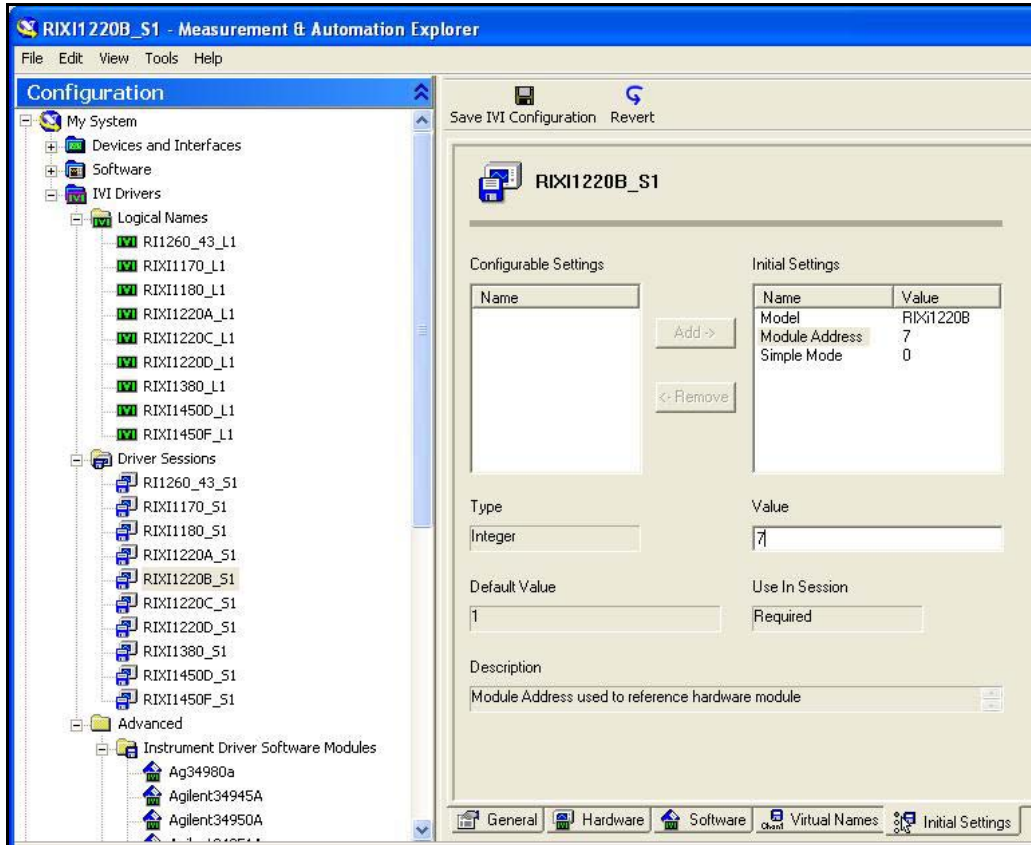


Figure 3-11: Modifying the Module Address for the IVI Driver Session

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 “RIXI1220B_L1”) and then select the driver session created previously (“RIXI1220B_S1”).

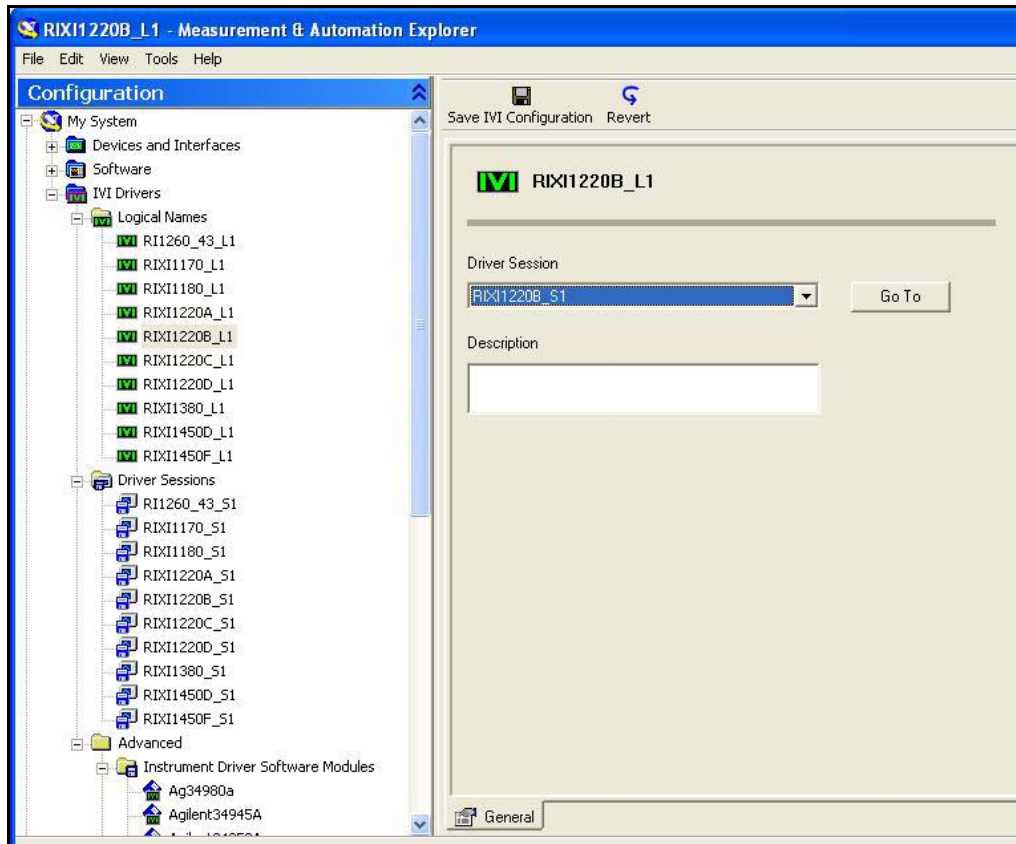


Figure 3-12: Creating a Logical Name for the IVI Driver Session

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 3). 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 1220B IVI driver
//

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

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

    try
    {
        IIVIvDriverPtr spDriver(__uuidof(RIXI1220B));
        IIVIvSwTchPtr spSwitch;

        try
        {

            // IIVIvDriverIdentity 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 = "RIXI1220B_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=RIXI1220B, Trace=false";

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

```

        strDriverSetupOptions;

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

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

    // close channel 0
    _bstr_t channel1 = _bstr_t("COM A");
    _bstr_t channel2 = _bstr_t("NO A1");

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

    channel1 = _bstr_t("COM B");
    channel2 = _bstr_t("NO B2");

    // close channel 79
    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 3). 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.RIXI1220B.Interop.dll
```

The interoperability DLLs are installed when the IVI shared components are installed (first two items above) and when the 1220B 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.RIXi1220B.Interop.RIXi1220B riDriver =
                new EADS.RIXi1220B.Interop.RIXi1220Class();

            Ivi.Swtch.Interop.IIviSwtch switchDriver;

            // Use resource string from IVI configuration store
            string strResourceDesc = "RIXI1220B_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=RIXi1220B, Trace=false";
```


The sample function in Figure 3-15 illustrates a series of function calls to operate various channels on the 1220 card. Note that the test program reference “xi1220_1” has been assigned as the interface to the 1220 card.

```
Function Sample_Test()  
  
    Dim nErr  
  
    'initialize test node as a failure  
    Sample_Test = false  
  
    ' close channel 14  
    nErr = xi1220B_1.Close(14)  
    if nErr <> 0 then exit function  
  
    'close channels 0, 11, 17, and 22  
    nErr = xi1220B_1.CloseList("0,11,17,22")  
    if nErr <> 0 then exit function  
  
    'close channels 21 to 23  
    nErr = xi1220B_1.CloseRange(21,23)  
    if nErr <> 0 then exit function  
  
    ' open channel 0  
    nErr = xi1220B_1.Open( 0 )  
    if nErr <> 0 then exit function  
  
    'open a channels 0, 21, 23  
    nErr = xi1220B_1.OpenList("0, 21, 23")  
    if nErr <> 0 then exit function  
  
    'open channels 0 to 23  
    nErr = xi1220B_1.OpenRange(0,23)  
  
    ' indicate test has passed  
    Sample_Test = true  
  
End Function
```

Figure 3-15: Example ActivATE Test Script for the 1220

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 1220. 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 ActivATE GUI (Figure 3-16) displays the present status for the channels of the 1170. By clicking on any of the relays, the state of the relay can be changed from closed to open or from open to closed.

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.

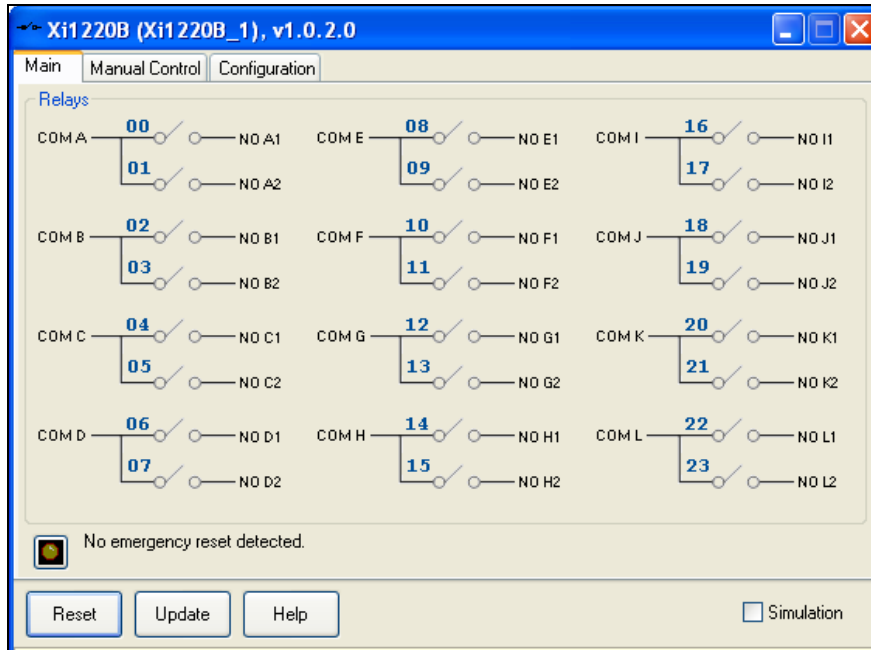


Figure 3-16: ActivATE GUI for the 1220B Card

Main Control Tab

The **Manual Control** tab (Figure 3-17) acts very similar to the web page version. It allows you to send SCPI commands to and read replies from the system.

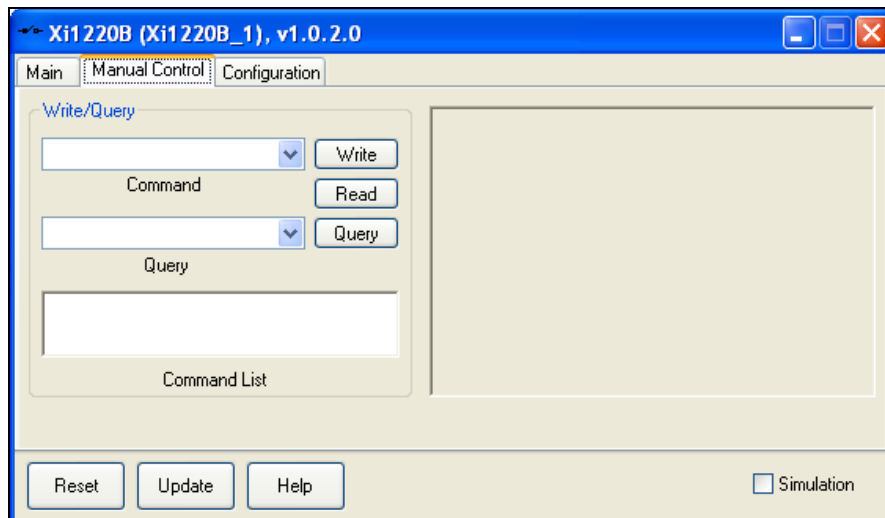


Figure 3-17: ActivATE Manual Control Tab

Configuration Tab

The **Configuration** tab (Figure 3-18) provides the means to locate and load 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.

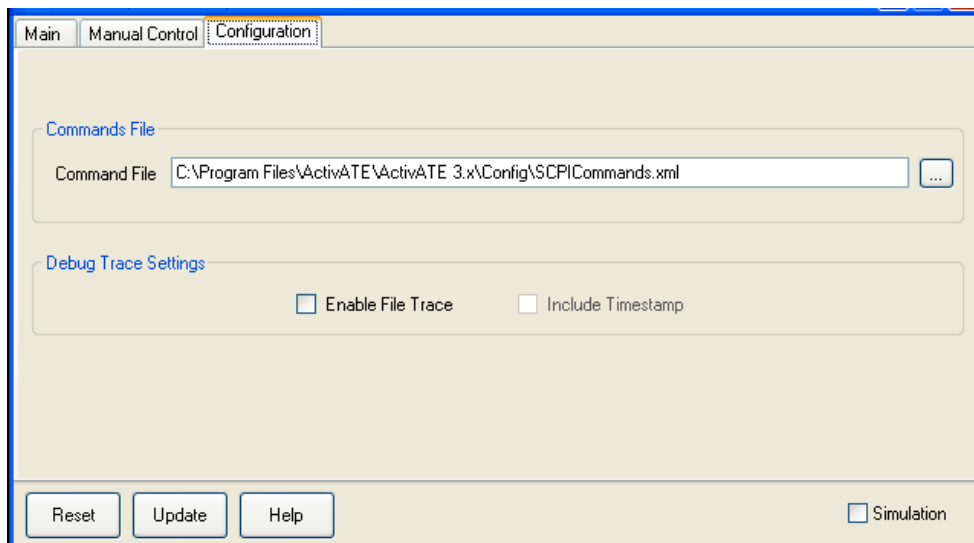


Figure 3-18: ActivATE Configuration Tab

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 1220.

The most commonly used commands used with the 1220 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 an 1220 range from 0 to 23. The correspondence between channel numbers and front panel connection is shown in Figures 2-3 and 2-4 of this manual.

The following would be valid channel descriptors for an 1220 switch card plugged into slot 7:

```
(@7(0))
```

```
(@7(14))
```

```
(@7(23))
```

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

```
(@7(0,14,23))
```

specifies each channel 0, 14, and 23 on the switch card in slot 7. Also, a range of relays may be specified by using the colon character (':'):

```
(@7(11:15,23:20))
```

specifies that each channel from 11 to 15 and from 20 to 23 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, (@9(11,22))
```

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 (@7(0,11:15,23:16))
```

This example shows that the scan list will cycle through the following sequence of channels on the plug-in module in slot 7:

```
0,11,12,13,14,15,23,22,21,20,19,18,17,16
```

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 "SEQunce: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.

STATus:SHUTdown? Query

The “STATus:SHUTdown?” query may be used to read back the present state of the local and global emergency reset condition for the module. The reply to this query is an integer value in the range 0 to 7. This value is a bit-weighted numeric value:

Bit 0	Global (backplane) emergency reset asserted
Bit 1	Front Panel 1 emergency reset asserted
Bit 2	Front Panel 2 emergency reset asserted

So, if this query returns a value of “5”, this indicates that both the Front Panel 2 and Global Reset are asserted.

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