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EX7000 SERIES

MICROWAVE SWITCH ASSEMBLIES WITH LXI-COMPLIANT LAN INTERFACE

USER'S MANUAL

P/N: 82-0121-000
Release June 10th, 2013

VTI Instruments Corp.

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Irvine, CA 92614-6509
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CERTIFICATION

VTI Microwave, a business unit of VTI Instruments Corp. (VTI) certifies that this product met its published specifications at the time of shipment from the factory. VTI Microwave further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

The product referred to herein is warranted against defects in material and workmanship for a period of one year from the receipt date of the product at customer's facility. The sole and exclusive remedy for breach of any warranty concerning these goods shall be repair or replacement of defective parts, or a refund of the purchase price, to be determined at the option of VTI Microwave.

For warranty service or repair, this product must be returned to a VTI Instruments authorized service center. The product shall be shipped prepaid to VTI and VTI shall prepay all returns of the product to the buyer. However, the buyer shall pay all shipping charges, duties, and taxes for products returned to VTI from another country.

VTI Microwave warrants that its software and firmware designated by VTI Microwave for use with a product will execute its programming when properly installed on that product. VTI Microwave does not however warrant that the operation of the product, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The warranty shall not apply to defects resulting from improper or inadequate maintenance by the buyer, buyer-supplied products or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

VTI Microwave and VTI Instruments Corp. shall not be liable for injury to property other than the goods themselves. Other than the limited warranty stated above, VTI Instruments Corp. makes no other warranties, express or implied, with respect to the quality of product beyond the description of the goods on the face of the contract. VTI Microwave specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

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DECLARATION OF CONFORMITY

Declaration of Conformity According to ISO/IEC Guide 22 and EN 45014

MANUFACTURER'S NAME	VTI Instruments Corp.
MANUFACTURER'S ADDRESS	2031 Main Street Irvine, California 92614-6509
PRODUCT NAME	Microwave Switch Assembly with LAN Interface
MODEL NUMBER(S)	EX7000 Series Microwave Switch Assemblies
PRODUCT OPTIONS	All
PRODUCT CONFIGURATIONS	All

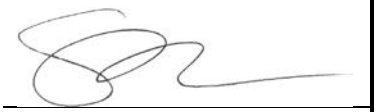
VTI Instruments Corp. declares that the aforementioned product conforms to the requirements of the Low Voltage Directive 73/23/EEC *and the* EMC Directive 89/366/EEC *(inclusive* 93/68/EEC*) and carries the "CE" mark accordingly. The product has been designed and manufactured according to the following specifications:*

SAFETY	EN61010 (2001)
EMC	EN61326 (1997 w/A1:98) Class A CISPR 22 (1997) Class A VCCI (April 2000) Class A ICES-003 Class A (ANSI C63.4 1992) AS/NZS 3548 (w/A1 & A2:97) Class A FCC Part 15 Subpart B Class A EN 61010-1:2001

I hereby declare that the aforementioned product has been designed to be in compliance with the relevant sections of the specifications listed above as well as complying with all essential requirements of the Low Voltage Directive.

August 2008

CE



Steve Mauga, QA Manager

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GENERAL SAFETY INSTRUCTIONS

Review the following safety precautions to avoid bodily injury and/or damage to the product. These precautions must be observed during all phases of operation or service of this product. Failure to comply with these precautions, or with specific warnings elsewhere in this manual, violates safety standards of design, manufacture, and intended use of the product.

Service should only be performed by qualified personnel.

TERMS AND SYMBOLS

These terms may appear in this manual:

WARNING Indicates that a procedure or condition may cause bodily injury or death.

CAUTION Indicates that a procedure or condition could possibly cause damage to equipment or loss of data.

These symbols may appear on the product:



ATTENTION - Important safety instructions



Frame or chassis ground



Indicates that the product was manufactured after August 13, 2005. This mark is placed in accordance with *EN 50419, Marking of electrical and electronic equipment in accordance with Article 11(2) of Directive 2002/96/EC (WEEE).* End-of-life product can be returned to VTI by obtaining an RMA number. Fees for take-back and recycling will apply if not prohibited by national law.

WARNINGS

Follow these precautions to avoid injury or damage to the product:

Use Proper Power Source

To avoid electrical overload, electric shock, or fire hazard, do not use a power source that applies other than the specified voltage.

Operating Conditions

To avoid injury, electric shock or fire hazard:

- Do not operate in wet or damp conditions.
- Do not operate in an explosive atmosphere.
- Operate or store only in specified temperature range.
- Provide proper clearance for product ventilation to prevent overheating.
- DO NOT operate if any damage to this product is suspected. ***Product should be inspected or serviced only by qualified personnel.***



Improper Use

The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.
Conformity is checked by inspection.

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SUPPORT RESOURCES

Support resources for this product are available on the Internet and at VTI Instruments customer support centers.

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SECTION 1

INTRODUCTION

INTRODUCTION

The EX7000 series of modular microwave switch assemblies consist of standard products as well as custom factory configured enclosures. All are rack mountable and range in size from 1U to 4U. The standard products include the EX71HD, a 1U high-density, 26 GHz non-latching microwave switch mainframe; the EX72SF, a 2U high-density, 26 GHz latching microwave switch mainframe; the EX72CC, a 2U high-density switch mainframe optimized for 12V non-latching relays such as the Teledyne CR/CT series; and the EX7400, a 4U switching platform that is custom built per customer specifications, but contains the same LAN interface, relay driver boards, and power supply (unless otherwise required or specified) as the EX71HD and EX72SF. The EX7400 can contain an assortment of electromechanical relays, plus any additional active or passive components that may be required. Every member of the EX7000 series comes with an LXI compliant LAN interface.

EX71HD: High-Density 26 GHz Modular Microwave Switching, Non-Latching

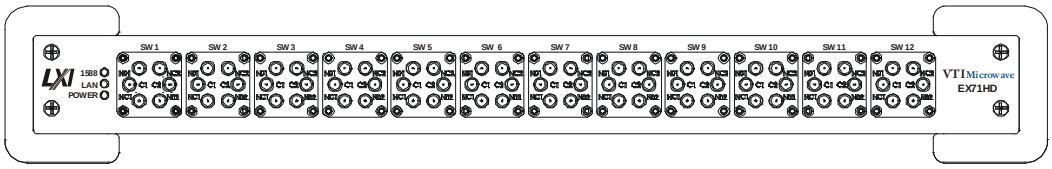


FIGURE 1-1: EX71HD (SHOWN WITH A FULL COMPLIMENT OF HIGH-DENSITY SWITCHES)

The EX71HD measures only 1U (1.75”) in height yet can be configured with up to twelve miniature microwave switches. Any combination of the following switches may be installed:

7100 Six line pass-through adapter
7102 Dual SPDT
7104 SP4T
7106 SP6T
7122 Transfer

The unit can be delivered preconfigured with any combination of switches. Any slot that remains empty may be populated later as required. The EX71HD is a totally self-contained unit with an EX7000 and ac power supply built in to the assembly.

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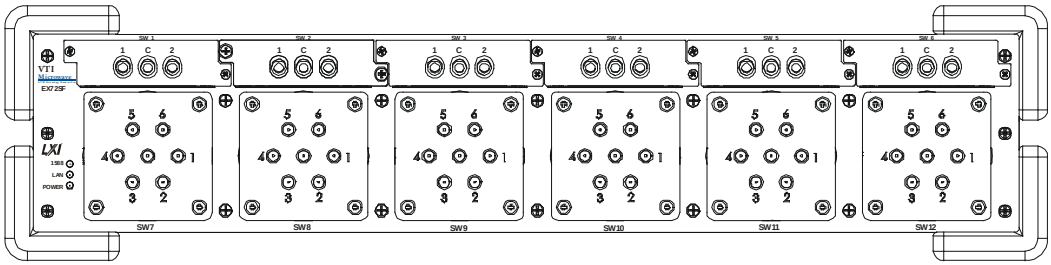


FIGURE 1-2: EX72SF (SHOWN WITH A FULL COMPLIMENT OF AGILENT SWITCHES)

The EX72SF is a 2U (3.5”) enclosure that can house up to six Agilent SPDT switches as well as up to six full-size Agilent multi-pole, single throw, terminated or unterminated, latching switches (see Table 3-2 for available switch modules). As with the EX71HD, it can be delivered preconfigured with any combination of switches with the capability of populating empty slots on-site as required. The EX72SF is a self-contained unit that uses the EX7000 and an AC power supply built into the assembly. Also provided on the EX72SF is a 32-channel, general purpose I/O bus. Access to this bus is through a front panel-mounted 37-pin D-sub connector. Further details on this bus can be found in *Section 3*.

EX72CC: LXI Based Custom RF Interface Platform

The EX72CC is a 2U(3.5”) enclosure that can house up to six SPDT switches as well as up to six full size(2.25” square) multi-pole, terminated or unterminated 12V switches. Contact the VTI sales team for the full list of possible switch choices. As with the EX71HD and the EX72SF, it can be delivered preconfigured. The EX72CC is a self-contained unit that uses the EX7000 and an AC power supply built into the assembly. Also provided on the EX72CC is a 32-channel, general purpose I/O bus.

EX7400: LXI Based Custom RF Interface Platform

The EX7400 is built around the same internal components as the EX71HD and EX72SF. It starts life as a 4U high and 24” deep rack mountable enclosure. It can be purchased in this configuration allowing a customer to add their own RF and microwave components to the front and rear panels as well as the removable mezzanine that is located at approximately the mid way point between the top and bottom covers. It may also be supplied as a custom or special unit which is preconfigured at the factory with all of the components and inter-connect cabling specified by the customer.

COMMON FEATURES

Preconfigured units, whether an EX71HD, EX72SF, EX72CC, or the EX7400, are delivered with a complete device configuration file (DCF) that contains all the pertinent details about each programmable device mounted inside. In the case of the EX7400, which may contain internal inter-connect path cabling, the DCF also contains all of the point-to-point signal path information. The information included in the DCF allows the user to establish a complete signal route by indicating only the end points in a compliant IVI-Switch Connect statement, thus simplifying the programming task.

All EX7000s consists of an LXI Class A compliant digital controller interface, one or more 72-channel relay driver boards, an integrated ac power supply, and a selectable assortment of electromechanical microwave switches. More than one relay driver board is used in custom applications where the internal number of coils exceed the 72 coil capacity of a single relay driver board. As many as four total relay driver boards can be used in large designs. Extremely large designs, that require five to eight relay driver boards, can be accommodated with special hardware and software updates. Please consult the factory for details.

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INTERACTIVE CONTROL

As LXI-compliant devices, EX7000s have an embedded web server running which provides a Java applet for interactively configuring the box for its specific configuration as well as allowing for the direct control of components.

A functional list of the actual components within the enclosure is stored on-board in non-volatile memory. Opening of the Soft Front Panel (SFP) results in a graphical depiction of the various switching components along with an indication of the current state of their contacts. Simple mouse clicks on the web browser can easily and quickly open and close any contact.

The DCF can be edited using a simple software tool called the EX7000 System Configurator. This is especially convenient when additional microwave switches are added in the field. Use of the System Configurator is detailed in *Appendix A*.

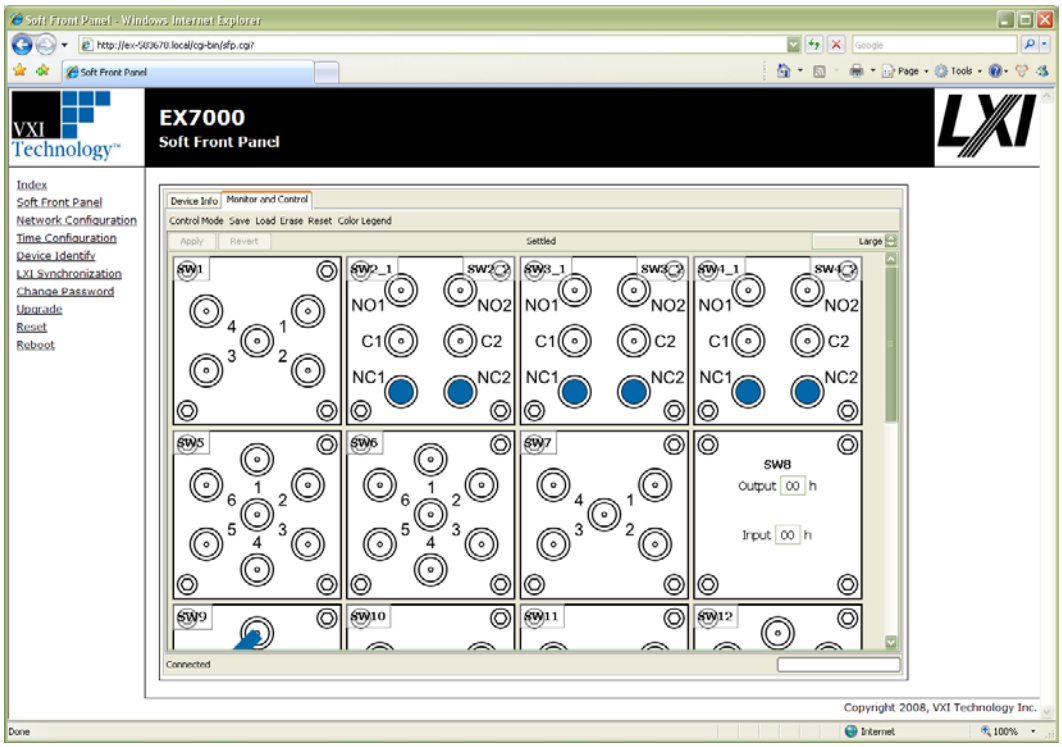


FIGURE 1-3: JAVA-BASED GRAPHICAL USER INTERFACE

RELAY DRIVE CONTROL

The EX7000 contains a proprietary circuit board set consisting of a Relay Driver Board (RDB) and a Digital Controller Board (DCB), which is known as the EX7000 when supplied as a set without an enclosure. They have been designed to provide maximum flexibility for controlling virtually any type of RF/microwave relay or component. Each RDB provides 72 high-current drivers, which are divided into twelve sections of six lines. Each section consists of:

- six high-current drive lines
- six indicator/status bits
- one reset line
- four relay ID bits
- one relay power input
- one 5 V input
- one ground

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Each driver board is capable of recognizing and controlling either latching or non-latching switch modules. A programmable delay (per driver board) dictates the amount of time allocated to relay settling times and current cutoffs (for latching relays). Each driver board has a single programmable delay parameter. The programmable delay for any board should be set to the maximum value required by any component connected to that board.

Data is latched to the gate of the output coil drive FET dictating whether or not the FET will sink current and energize the relay coil. See the *EX7000 Manual* (P/N: 82-0118-000) for more details.

INTERFACING WITH OTHER COMPONENTS

The EX7000 board set is capable of controlling other programmable components, such as filters and attenuators, through either the high-current channels or the 32-bit parallel I/O. Access to the control lines can be achieved in various ways. The high-current channels are available from the EX71HD, EX72SF, and EX72CC via pass-through switches that mount on the front panel in place of one or more switches. These switches consist of a flat mounting plate with mounting holes to match the multi-throw switch it replaces. A multi-pin connector is mounted to the plate and the connector is wired directly to one of the relay driving connectors, allowing external use by the user.

In addition to the high-current control lines, the EX72SF and the EX72CC also has a rear panel mounted, 32-channel, TTL-level, general purpose IO bus available. Refer to *Section 3* for details or obtain a copy of the *EX7000 Manual* for more information on this bus. Contact the factor or visit the VTI Instruments Corp. website for a copy of this document.

FEATURES

Relay Odometer

Each relay drive line has an associated “odometer” which tracks the number of times a relay coil has been actuated. This data is written to non-volatile memory and can be queried from application code or the web interface. This assists preventative maintenance programs as relays can be closely monitored as they near end-of-life.

Exclude Lists

The supplied API supports the implementation of exclude lists. Undesirable combinations of relay closures can be stored and warnings or errors will be generated any time an excluded combination is attempted. This helps prevent unsafe conditions such as shorting sources to ground or coupling one source to another.

Scan Lists

Up to 16,000 scan list elements can be stored to help reduce overhead that can be accrued when relying on the host controller to manage the sequencing of switch states. A predefined list of switch states can be stored on-board and advanced through hardware control/handshaking with external system devices via the LXI Trigger Bus or the GP digital I/O port. Use of scan lists can considerably speed up test execution times.

Configuration Table

The information included in the DCF allows the user to establish a complete signal route by indicating only the end points in a compliant IVI-Switch Connect statement, thus simplifying the programming task.

Programmable MBB and BBM

The application code can globally define whether or not the relays ‘break-before-make’ or ‘make-before-break’ when sequencing through relay setups in a scan list.

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EX7000 SPECIFICATIONS

GENERAL SPECIFICATIONS	
PHYSICAL DIMENSIONS	
EX71HD	17.28” (48.2 cm) width x 14.24” (61.6 cm) depth* x 1.72” (4.5 cm) height
EX72SF	17.25” (48.2 cm) width x 14.09” (61.6 cm) depth* x 3.28” (8.9 cm) height
EX7400	17.25” (48.2 cm) width x 14.09” (61.6 cm) depth* x 6.56” (17.8 cm) height
	* excludes coaxial connector protrusion from face of front and/or rear panels
CONNECTORS	
Host interface	RJ-45 (CAT 5e) Ethernet (10/100T)
Trigger bus	Dual 25-pin mini D-sub 8 LVDS in/out, LXI Class A
GP digital I/O	9-pin D-sub 8 TTL I/O
AC power	IEC EN 60320 C13
RESET	
	Momentary push-button LAN reset, available through rear panel access hole
POWER	
Voltage	90 V ac to 264 V ac, 47 Hz to 63 Hz
Power	110 VA max (EX71HD), 20 VA max (EX72SF)

DIGITAL CONTROLLER BOARD (DCB)	
PROCESSOR	MCF5272
SDRAM	32 MB
Flash ROM	8 MB
Single-command response time	< 3 ms

RELAY DRIVER BOARD (RDB)	
RELAY POWER	
	+5 V to +48 V *Three power pins, each connected to four relay driver connections
RELAY DRIVERS	
	72 open-drain high-current sink on a standard board. Options available to replace some or all of the open drain outputs with TTL drivers. Expandable to 576. Twelve open-drain very high-current sink drivers for reset. Arranged as one drive line per relay driver connector as well as 12 lines together on one connector on J21.
MAXIMUM CURRENT SINK	
	200 mA (all channels ON) for 72 channels 410 mA (individual channels) for 72 channels 800 mA for 12 reset lines
TTL I/O	
	32 channels per board, expandable to 256
MODULE ID	
	Rotary switch (0 through 7 identifies driver board in chain)

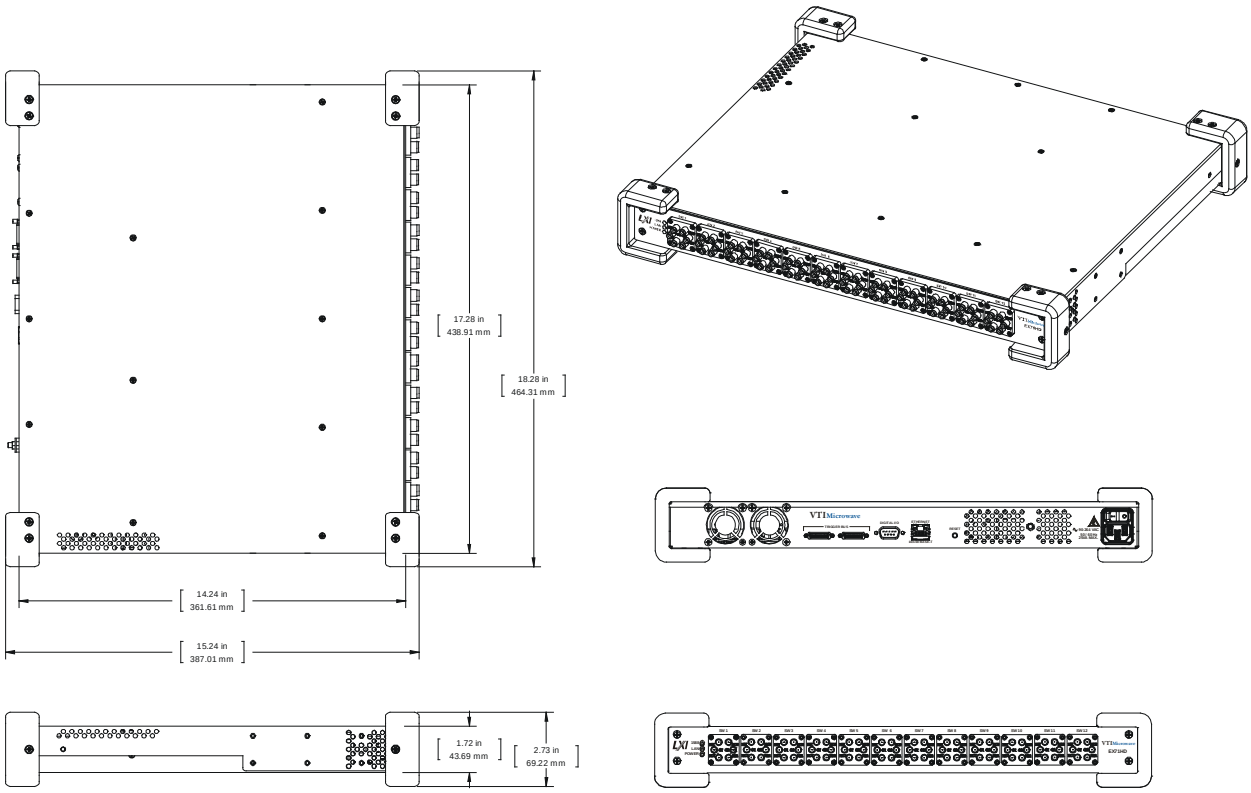
SOFTWARE	
PROGRAMMATIC CONTROL	
	IVI-COM and IVI-C API IVI similar API for Linux DOS-based interactive command set
INTERACTIVE CONTROL	
	Embedded Java applet
CONFIGURATION TABLE	
	128 elements (power-on, last known, user-defined)
SCAN LIST	
	16k set-ups

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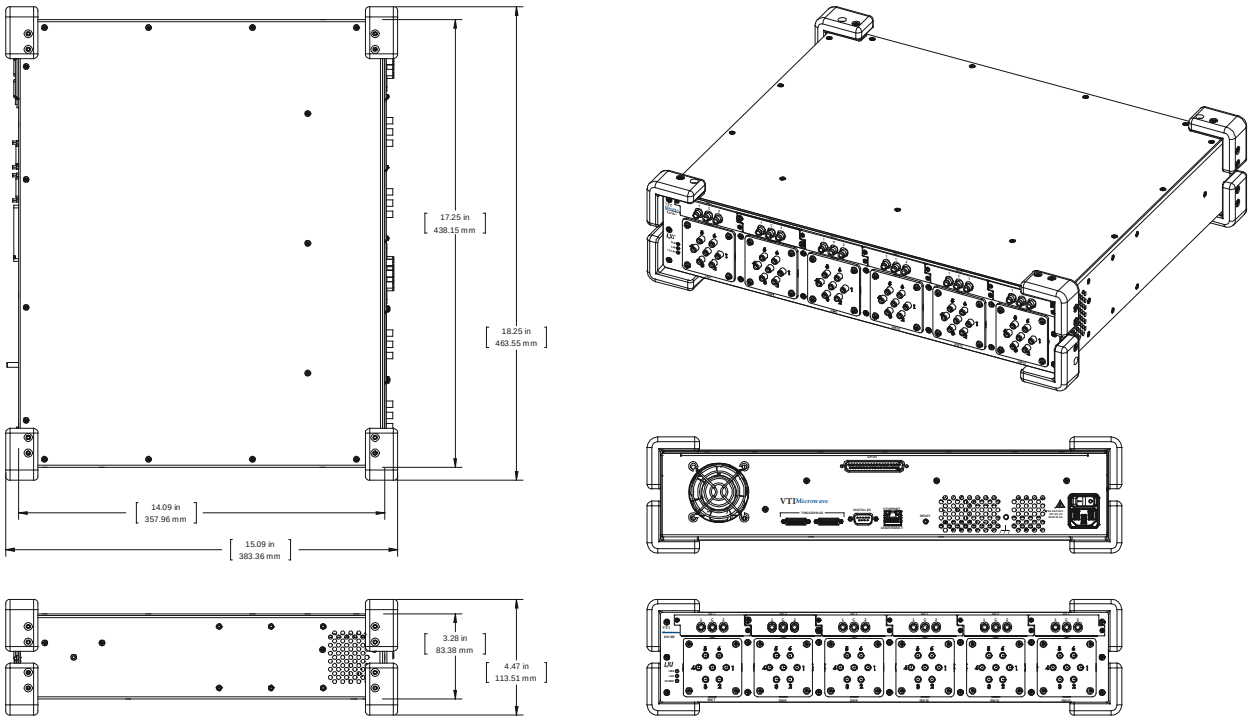
LXI REQUIRED SPECIFICATIONS			
TRIGGER RESPONSE TIMES	**Minimum**	**Typical**	**Maximum**
Trigger Source			
LXI WTB	948 µs	1 ms	1.4 ms
DIO port	948 µs	1 ms	1.4 ms
LAN event	3.8 ms	4 ms	4.2 ms
Alarm	700 µs	1 ms	1.8 ms
EVENT RESPONSE TIMES	**Minimum**	**Typical**	**Maximum**
Event Source → Trigger Destination			
LXI WTB → LXI WTB	37.5 ns	40 ns	50 ns
LXI WTB → DIO port	54 ns	60 ns	65 ns
LXI WTB → LAN event	1.26 ms	1.4 ms	1.5 ms
DIO port → LXI WTB	56 ns	60 ns	66 ns
DIO port → DIO port	26 ns	30 ns	39 ns
DIO port → LAN event	1.19 ms	2.0 ms	2.2 ms
LAN event → LXI WTB	3.7 ms	4 ms	4.8 ms
LAN event → DIO port	3.7 ms	4 ms	4.8 ms
LAN event → LAN event	14.8 ms	16 ms	25 ms
Alarm → LXI WTB	36 ns	36 ns	36 ns
Alarm → DIO port	36 ns	36 ns	36 ns
Alarm → LAN event	1.2 ms	1.35 ms	1.45 ms
Operation Complete → LXI WTB	320 µs	500 µs	600 µs
Operation Complete → DIO port	320 µs	500 µs	600 µs
Operation Complete → LAN event	1.8 ms	1.9 ms	2.0 ms
TIMESTAMP ACCURACY			
	200 µs		

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EX71HD DIMENSIONAL DIAGRAM

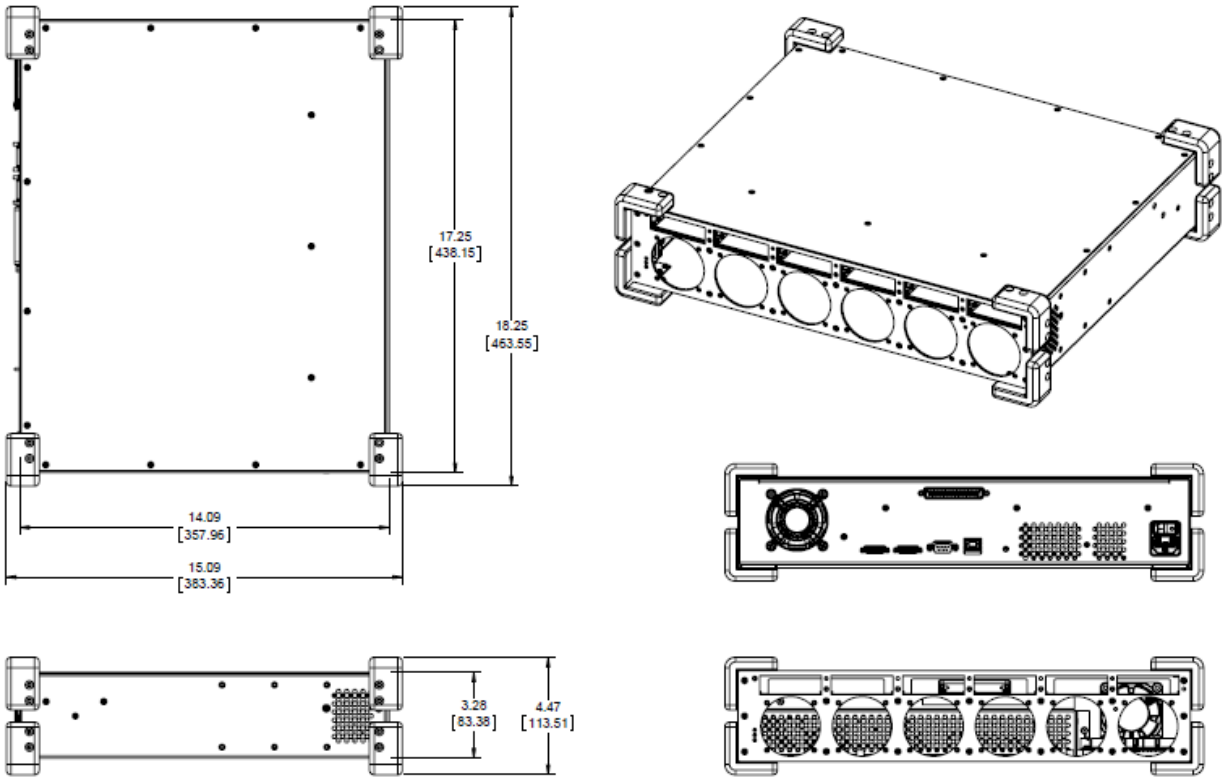


EX72SF DIMENSIONAL DIAGRAM



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EX72CC DIMENSIONAL DIAGRAM



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SECTION 2

PREPARATION FOR USE

OVERVIEW

This section provides a step-by-step process for setting up the EX7000 series assemblies for use. For simplicity, the EX7000 series assemblies, including the EX71HD, EX72SF, EX72CC, and EX7400 will be referred to as EX7000 in this section. It covers hardware installation, input connections, and software installation.

UNPACKING

When the EX7000 is unpacked from its shipping carton, the contents should include the following items:

- EX7000 series instrument
- *LXI Quick Start Guide*
- *EX7000 Series User's Manual* (this manual)
- *VTEX Switch Driver Programmer's Manual*
- *VTI Instruments Corp. Drivers and Product Manuals* CD
- Power line cord

All components should be immediately inspected for damage upon receipt of the unit.

INSTALLATION LOCATION

The EX7000 is designed to be largely insensitive to external electrical, magnetic, and thermal disturbances. However, as with all precision instrumentation, certain precautions, if taken into consideration, can help achieve maximum performance.

1) The unit should be located away from sources of extreme high or low temperatures.
2) The unit should be located away from sources of high magnetic fields such as motors, generators, and power transformers.

The EX71HD, EX72SF, and EX72CC employ active cooling for maximum product reliability. The EX7400 may or may not employ such cooling, depending on the expected power consumption. When any of the EX7000 family of products is installed into a test fixture, the user must ensure that adequate air flow is provided to all components.

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EX7000 HARDWARE SETUP

To properly set up the EX7000 for use, the following cabling connections must be made:

- The ac power cord, supplied with the EX7000 must be plugged into any standard ac outlet providing 90 V ac to 264 V ac at 47 Hz to 63 Hz.
- A connection between the Host PC/LAN Switch and the EX7000 LAN port must be made. An unshielded Cat 5e Ethernet cable of less than 100 m in length should be used to make this connection. The EX7000 is auto-MDIX capable, making crossover cables unnecessary. Note, this cable is not provided with the EX7000.

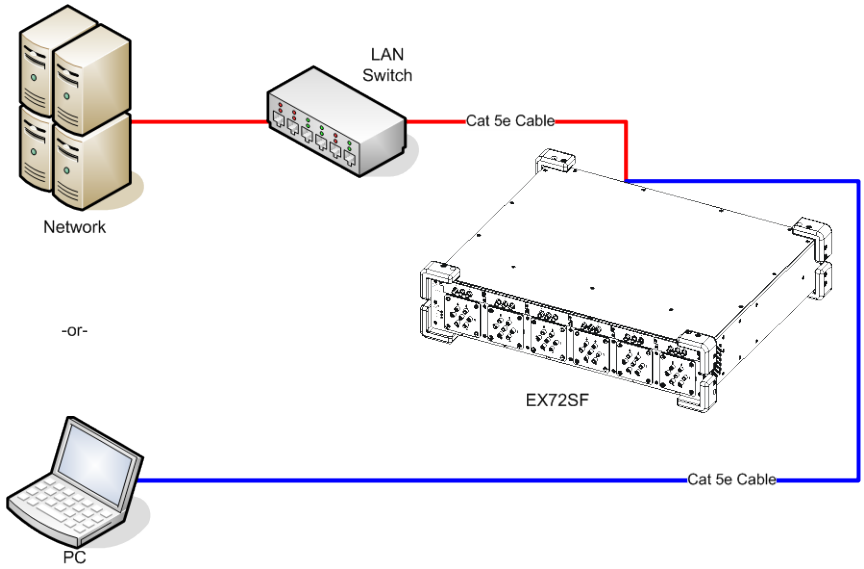


FIGURE 2-1: EX7000 CABLING DIAGRAM

SOFTWARE INSTALLATION

The fastest way to begin controlling an EX7000 is to discover the unit using VTI's **L**AN **In**strument **C**onnection and **U**pgrade (or **LInC-U**) utility and then manipulate the instrument's Java-based SFP. To do this, the following is required:

- A PC or laptop computer
- Microsoft™ Windows™ XP OS with Service Pack 2 (SP2) and Internet Explorer™ (IE)
- An internet connection
- Java™ Runtime Environment (JRE) version 6.0 (or later)
- VTI's LInC-U utility

An executable for installing JRE is available on the *VTI Instruments Corp. Drivers and Product Manuals* CD provided with the EX7000. If JRE is currently installed on the host PC, the software installation instruction for this software can be skipped.

The **LInC-U Utility** searches for all LAN-based VTI devices on the network and can be found on the *VTI Instruments Corp. Drivers and Product Manuals* CD that shipped with the EX7000 or may be downloaded from the VTI Instruments corporate website. This utility leverages Apple's Bonjour plug-in if it is installed on the host PC, but, in its absence, uses the VXI-11 discovery protocol. This utility can also be used to upgrade the EX7000's driver and firmware. For more information on using the LInC-U utility, please refer to its online Help file. For more information on discovering the EX7000, please refer to *Web Page Operation* in *Section 4*.

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LInC-U Installation

To install **LInC-U** as a discovery tool for the EX7000's embedded webpage, insert the *VTI Instruments Corp. Drivers and Product Manuals* CD into the host PCs CD-ROM and, using Windows Explorer, navigate to the *<CD-ROM Drive>:\EX Platforms Requisites* directory. Next, run the **VTI_LInC-U_setup.exe** program. Once installation begins, simply follow the on-screen instructions.

Java Installation

Java Runtime Environment (JRE) is required to access the SFP page of the EX7000. Prior to installing JRE, ensure that all IE sessions have been closed. To install JRE, insert the *VTI Instruments Corp. Drivers and Product Manuals* CD into the host PCs CD-ROM and, using Windows Explorer, navigate to the *<CD-ROM Drive>:\EX Platforms Requisites* directory. Then run the **JRESetup.exe** program. Once installation begins, simply follow the on-screen instructions.

NETWORK CONFIGURATION

With its default network configuration, the EX7000 will attempt to locate a DHCP server. If one is found, the IP address assigned by the DHCP server will be used. Otherwise, after a timeout of 20 seconds, the unit will attempt to obtain an IP address by using Auto IP.

NOTE	At any time, the EX7000 can be returned to a known, default network configuration by using the LCI (LAN Configuration Initialize) mechanism. See *Reset Button* for more information.

Auto IP is a mechanism for finding an unused IP address in the range 169.254.X.Y, where X is in the range 1 through 254 and Y is in the range 0 through 255. The device will first attempt to obtain the specific address 169.254.X.Y, where X and Y are the second-to-last and last octets (bytes) of the device's MAC address. However, X will be set to 1 if it is 0 in the MAC address, and to 254 if it is 255 in the MAC address. This is in accordance with the Auto IP standard (RFC 3927). If this address is already in use, the unit will attempt to obtain other IP addresses in a pseudorandom fashion until it finds one that is available.

To illustrate the Auto IP mechanism, Table 2-1 lists the Auto IP default address for some example MAC addresses.

MAC Address	Auto IP Default Address
00:0D:3F:01:00:01	169.254.1.1
00:0D:3F:01:01:01	169.254.1.1
00:0D:3F:01:A3:28	169.254.163.40
00:0D:3F:01:FE:FE	169.254.254.254
00:0D:3F:01:FF:FE	169.254.254.254

TABLE 2-1: AUTO IP DEFAULT ADDRESS ASSIGNMENT

If a static IP address assignment is preferred, one can be optionally assigned via the embedded web page interface. This is done by clicking the **Network Configuration** link, disabling DHCP and Auto IP, enabling Static, and then assigning a static IP address, subnet mask, and gateway address, and, optionally up to three DNS servers. For more information, see *Network Configuration* in *Section 4*.

NETWORK TROUBLESHOOTING

If an error occurs when trying to discover the EX7000 (see *Web Page Operation Introduction* in *Section 4* for more information on discovery), it may be necessary to change the network settings for the EX7000 and the host PC. By using the following methodology, most network-related issues can be resolved:

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1) *Restore the EX7000's Default Network Settings*
2) *Determine PCs Network Settings*
3) *Set the EX7000 to Auto IP* or *Set theEX7000 to Static IP*
4) *Restore the Host PCs Network Settings*

Restore the EX7000's Default Network Settings

It may be the case that the EX7000 is in an unknown network configuration. The EX7000 can be returned to its default state by pressing the *Reset Button* located at the rear of the chassis.

1) Power off the EX7000.
2) Press and hold the reset button until the LAN LED flashes green (approximately 5 s).
3) Release the reset button.

Determine PCs Network Settings

1) Ensure that all host PC Ethernet connections are made that will be used while controlling the EX7000. If the PC will be connected to a LAN, ensure that the LAN connection is made.
2) From Windows , navigate to **Start**-> **Settings**->**Network Connections**.
3) Right click on the connection that will be used to communicate with the EX7000, then select **Properties** (see Figure 2-2). Some PCs have multiple network connections, so it is important to make certain that the connection used to communicate with the EX7000 is selected.

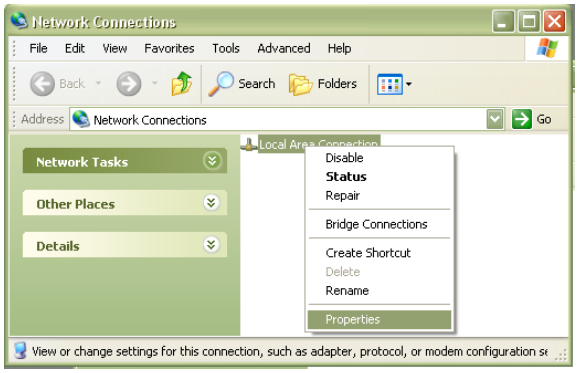


FIGURE 2-2: NETWORK CONNECTION PROPERTIES

4) Select **Internet Protocol (TCP/IP)**, then click the **Properties** button as shown in Figure 2-3.

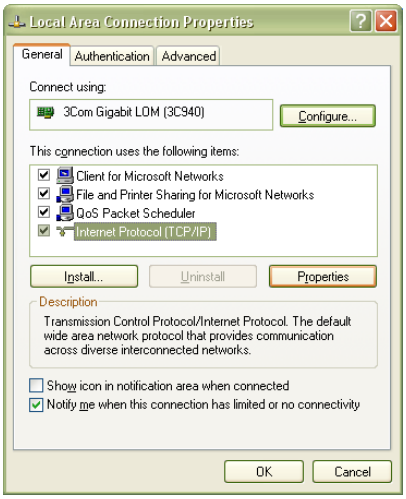


FIGURE 2-3: LOCAL AREA CONNECTION PROPERTIES DIALOG BOX

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5) Determine if the PC is set to use auto or static IP. Figure 2-4 shows examples of both auto and static IP address configurations.

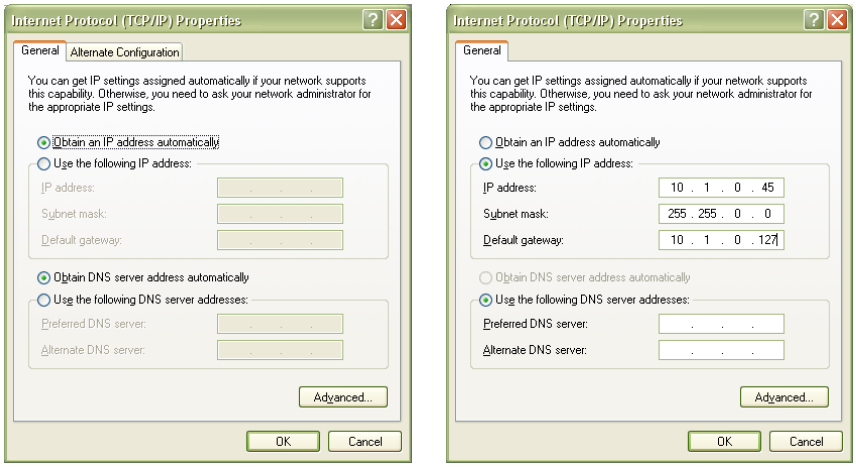


FIGURE 2-4: DYNAMIC (LEFT) AND STATIC (RIGHT) IP ADDRESS CONFIGURATIONS

6) If set to use a static IP, record the IP address, subnet mask, and default gateway for use later. Select **Obtain an IP address automatically** to establish a connection to the EX7000. Click the **OK** button and proceed to *Set theEX7000 to Static IP*. If set to use a dynamic IP, click the **OK** button and proceed to *Set the EX7000 to Auto IP*.

Set the EX7000 to Auto IP

1) Remove all network connections from the PC except for the connection to the EX7000. Wireless adapters should be disabled as well.
2) Apply power to the EX7000 and wait for the LAN LED to turn green.
3) Discover EX7000 using Bonjour as described in the *Web Page Operation Introduction* in *Section 4*. The steps taken previously should ensure that discovery works.
4) Once connected to the EX7000, click on **Network Configuration** in the command menu.
5) Select **DHCP** and **AutoIP** in the **IP Address Source** field and ensure that **Static IP** is not selected. Figure 2-5 shows the proper configuration. Click the **Submit** button to save all changes.

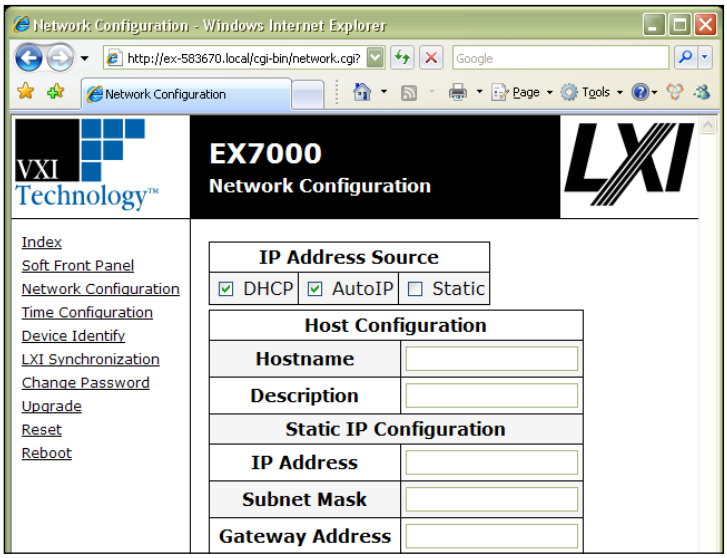


FIGURE 2-5: EX7000 SET TO USE AUTO IP

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Set theEX7000 to Static IP

1) Disconnect all network connections from the PC except for the connection between the PC and the EX7000.
2) Apply power to the EX7000 and wait for the LAN LED to turn green.
3) Discover EX7000 using Bonjour as described in the *Section 4, Web Page Operation*. The steps taken previously should ensure that discovery works.
4) Once connected to the embedded web interface, click on the **Network Configuration** link in the command menu.
5) Select the **Static** checkbox in the **IP Address Source** field and ensure that **DHCP** and **AutoIP** are not selected.
6) In the **IP Address** field, enter an appropriate IP address for the EX7000. Use the IP address obtained the *Determine PCs Network Settings* step to determine the network address. The network address is the first three digits of the IP address (10.1.0 in the example provided). The last digit of the IP address (the node), is a number, 0 through 255, that is not currently assigned to any other device on the network. Ensure that a unique IP address is assigned to the EX7000 by consulting a network administrator.
7) In the **Subnet Mask** field, enter the subnet mask in the *Determine PCs Network Settings* step.
8) In the **Gateway Address** field, enter the same gateway address in the *Determine PCs Network Settings* step.
9) Click **Submit** to save all changes made to the **Network Configuration** page.

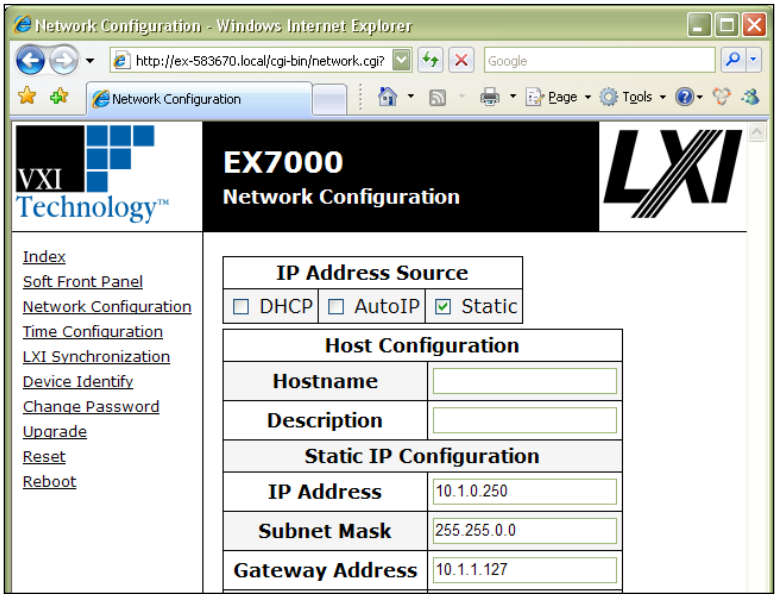


FIGURE 2-6: EX7000 SET TO USE STATIC IP

Restore the Host PCs Network Settings

1) Power down the EX7000 and reconnect it to the LAN in its desired location.
2) If the PC was originally set to use a static IP address, use the procedure in *Determine PCs Network Settings* to change the PCs IP address back to it original state.
3) Power on the EX7000 and wait for the LAN LED to turn solid green.
4) Discover the EX7000 using Bonjour as described in *Section 4, Web Page Operation*.

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DRIVER INSTALLATION

To monitor and/or control the EX7000's instruments programmatically (via a user generated program or through tools such as HP VEE, National Instrument's Switch Executive, etc.), two additional components must be installed: the IVI Shared Components library and the provided VTI Instruments instrument driver. Follow these steps:

IVI Shared Components Installation

If this component was installed during a previous LXI instrument installation, please proceed to *Switch Instrument Driver Installation*. First, close all other open programs, leaving only Windows Explorer open. Navigate to the *<CD-ROM Drive>:\EX Platform Requisites* directory on the CD and run the **IVISharedComponents1.5.0.exe** program. Next, follow the on-screen instructions. Do not proceed to the next step until this installation completes successfully. If instructed to reboot the PC, it will be necessary to do so at that time.

Switch Instrument Driver Installation

If the VTEXSwitch instrument driver was installed previously on the host PC, proceed to *System/LXISync Instrument Driver Installation*. To install the VTEXSwitch instrument driver, navigate to *<CD-ROM Drive>:\LXI Drivers\EX Switch Driver, IVI* on the CD and run the .msi installer located in this directory.

System/LXISync Instrument Driver Installation

NOTE	Complete this step only if the LXISync capabilities of the EX7000 platform are required. Also, if this driver was installed previously on the host PC, software installation is now complete.

To install the System/LXISync Instrument driver, navigate to *<CD-ROM Drive>:\LXI Drivers\EX System Driver, IVI* on the CD and run the .msi installer located in this directory.

Please refer to *VTEX Switch Driver Programmer's Manual* for programming guidelines. Additional information about IVI drivers can be found on the web at http://ivifoundation.org. Information about the LXI standard and LXI technology can be found at http://www.lxistandard.org.

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SECTION 3

BASIC OPERATION

INTRODUCTION

The EX7000 Series modular microwave switch assemblies require only ac power and a LAN connection to a PC or network. The PC must have an Internet browser, such as Internet Explorer or Firefox, installed. The embedded web page in each EX7000 allows easy access and control of the internal microwave components.

REAR PANEL VIEW

The rear panel of the EX7000 contains an ac power entry module, an ac power switch, an Ethernet 10/100 Base-T connection, a general purpose digital IO connections (on the EX72SF), LXI Trigger Bus connectors, and access to the reset button. Figure 3-1 shows a typical rear panel, in this case, of an EX72SF.

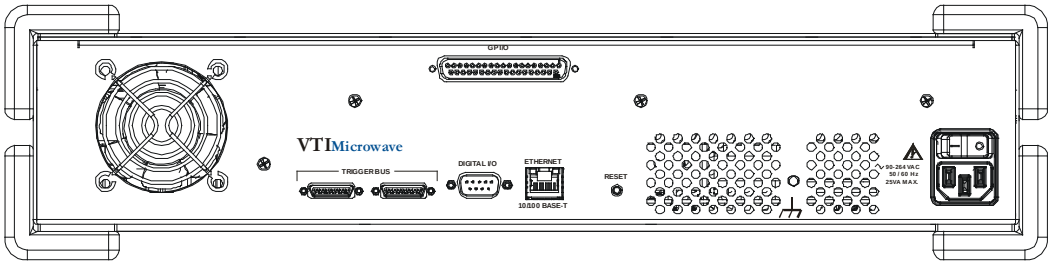


FIGURE 3-1: EX72SF REAR PANEL VIEW

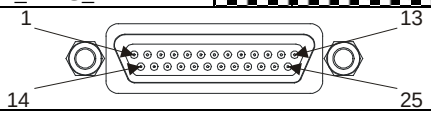
The rear panel of the EX7400 may have coaxial connectors. Their type, quantity, and location are a function of the customer's requirements.

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Trigger Bus Connectors

The EX7000 provides an LXI compatible trigger bus connector set on the rear panel of the instrument. Both connectors have the same pin assignments and are wired in parallel. For more information on the LXI Trigger Bus and creating an appropriate cable, please visit *www.lxistandard.org* and refer to *LXI Standard Revision 1.2* and *LXI Trigger Bus Cable and Terminator Specifications Rev 1.1*.

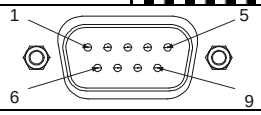
Trigger Bus Connectors			
Pin	**Signal**	**Pin**	**Signal**
1	+3.3 V	**14**	RP_TRIG_P0
2	GND	**15**	RP_TRIG_N0
3	RP_TRIG_P1	**16**	RESERVED
4	RP_TRIG_N1	**17**	RP_TRIG_P2
5	GND	**18**	RP_TRIG_N2
6	RP_TRIG_P3	**19**	GND
7	RP_TRIG_N3	**20**	RP_TRIG_P4
8	GND	**21**	RP_TRIG_N4
9	RP_TRIG_P5	**22**	GND
10	RP_TRIG_N5	**23**	RP_TRIG_P6
11	RESERVED	**24**	RP_TRIG_N6
12	RP_TRIG_P7	**25**	RESERVED
13	RP_TRIG_N7		



Digital I/O Connector

The EX7000 features an 8-channel digital I/O port on the rear panel of the instrument. This port can be used as a trigger source and as a general purpose output device. The digital I/O connector is a standard DB-9 with the following pin assignments:

Digital IO Connector			
Pin	**Signal**	**Pin**	**Signal**
1	DIO Channel 0	**2**	DIO Channel 1
3	DIO Channel 2	**4**	DIO Channel 3
5	DIO Channel 4	**6**	DIO Channel 5
7	DIO Channel 6	**8**	DIO Channel 7
9	GND		



Mating Connector: Tyco 5-747904-2

As a general purpose output device, each DIO channel can be independently programmed with regards to its output functionality and its static level to assume when enabled as an output. When not enabled as an output, a channel becomes tri-stated, preventing conflict with other potential voltage drivers. Reference the port's electrical specifications in Table 3-1 for voltage tolerance limits and output drive capabilities. Regardless of output functionality, each channel provides constant input functionality. That is, the input level on each channel can be accessed without a specific enable command. Moreover, the base functionality of the DIO channels is not affected by triggering, scanning, or any other instrument process.

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When enabled as an output, each channel also has the ability to generate a 1 µs pulse upon command. An example application of this pulse is to use the EX7000 to externally trigger another piece of test equipment. The specific operation of the pulse depends on the static level programmed for that channel. When a channel is programmed with a static level of high, the pulse will be low-going. When a channel is programmed with a static level of low, the pulse will be high-going. Each pulse generation requires a separate command.

The electrical specifications for the digital I/O port are provided in Table 3-1. Particular note should be given to the V_{INPUT} specification of -0.5 V to 5.5 V. Exceeding that value with an external voltage source, even through a resistance, could permanently damage the EX7000.

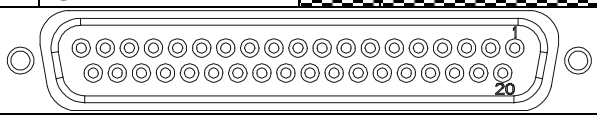
Characteristic	Value
V_{INPUT}	-0.5 V to 5.5 V
V_{IH}	2 V min
V_{IL}	0.8 V max
V_{OH} (I_{OH} = -32 mA)	2 V min
V_{OL} (I_{OL} = 64 mA)	0.55 V max

TABLE 3-1: DIGITAL I/O PORT ELECTRICAL SPECIFICATIONS

General Purpose I/O

The EX72SF features an additional 32-bit general purpose TTL I/O port. This is in additional to the internal 72-channel relay drivers and the 8-bit digital I/O described above. The following are the pin assignments for the rear-mounted 37-pin D-sub connector:

Pin	Signal	Pin	Signal
1	GND	20	PIO-PORT0
2	PIO-PORT1	21	PIO-PORT2
3	PIO-PORT3	22	PIO-PORT4
4	PIO-PORT5	23	PIO-PORT6
5	PIO-PORT7	24	PIO-PORT8
6	PIO-PORT9	25	PIO-PORT10
7	PIO-PORT11	26	PIO-PORT12
8	PIO-PORT13	27	PIO-PORT14
9	PIO-PORT15	28	GND
10	+5 V	29	GND
11	PIO-PORT16	30	PIO-PORT17
12	PIO-PORT18	31	PIO-PORT19
13	PIO-PORT20	32	PIO-PORT21
14	PIO-PORT22	33	PIO-PORT23
15	PIO-PORT24	34	PIO-PORT25
16	PIO-PORT26	35	PIO-PORT27
17	PIO-PORT28	36	PIO-PORT29
18	PIO-PORT30	37	PIO-PORT31
19	GND		



A current limited supply of +5 V is provided on pin 10. An internal, resettable fuse is provided to protect 200 mA against excessive current flow and short circuits.

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Reset Button

The reset button, accessible through a hole in the rear panel of the EX7000, implemented according to the LXI LAN Configuration Initialize (LCI) Mechanism specification, can be used to restore default network settings. This is useful for recovery from an incorrect or unknown network configuration. There are three modes of operation for this button which are based on the time the reset button has been depressed.

Debounce Protection Mode

To prevent unintentional resets of the EX7000, there is a short (< 1 s) debounce protection mechanism. If the reset switch is depressed for less 1 s, the activation of the reset button is treated as unintentional and no action is taken.

Device Reset Mode

Depressing the switch for a longer time (greater than 1 s but less than or equal to 10 s) causes the EX7000 to reset in the same manner as clicking the Reset button on the webpage. All switch modules, for instance, will move their switches to the predefined "reset" state. There is no visual indicator for this reset.

Device Reboot/LCI Reset Mode

To perform an LCI reset and an immediate reboot of the EX7000, depress the reset button for longer than 10 s, wait for the LAN LED to flash red, then release the button. This will return the EX7000 to the power-on default state. The network configuration will be restored to factory defaults in accordance with the LCI reset procedure described in the LXI Specification.

The EX7000 will now revert back to the default network configuration (DHCP and Auto IP enabled) instead of its previous settings. VXI-11 Discovery (supported by the VISA IO-Libraries) can be used to determine the IP address of the instrument.

FRONT PANEL VIEW

The front panel of each EX7000 model is different. The EX71HD front panel is configured with twelve identical mounting locations for miniature microwave switch modules. The EX72SF front panel is configured with twelve locations for latching microwave switches. The twelve locations are divided into six locations for SPDT switches and six locations for SP*n*T and/or transfer switches. The EX7400 will be configured to satisfy its unique customer specified requirements. Details for each EX7400 are supplied as supplements to this manual.

EX71HD

The EX71HD enclosure, shown in Figure 1-1, and switch modules are fitted with blind mating connectors to simplify switch module removal and installation. The mounting plate on the switches contains two rear facing alignment pins that fit into holes on the front panel. These pins only allow full insertion of the switch into the EX71HD enclosure opening when properly aligned.

NOTE	Before proceeding with the removal and/or installation of any microwave switch modules in any of the EX7000 Series assemblies, turn the ac power switch to the OFF position and remove the ac power cord.

To remove a switch from the enclosure, simply remove the four miniature hex head cap screws from the four corners of the switch using a 5/64" hex key wrench and pull the switch forward. There will be some slight resistance until the blind mate connectors disengage.

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Installation is in the reverse order. Carefully insert the multi-pin connector end of the switch into the opening, turning the switch module to arrange the two alignment pins to be on the top side of the switch. Insert straight back until the blind mating connector alignment pins engage. Once these alignment pins are engaged, press firmly until the switch slides in flush with the EX71HD front panel. Insert and tighten the four 2-56 hex head cap screws.

Following the mechanical installation, the EX72HD needs to have its DCF updated. This will not be necessary for cases where a switch is simply replaced with another of the same model. The DCF tells the internal control and drive circuitry exactly what is connected to each port of the unit. Updating the DCF is accomplished by running the System Configurator and following the intuitive prompts. See *Appendix A* for more details on using the System Configurator. Alternatively, the new DCF can be generated by the factory and downloaded over the Internet. Consult the factory for details.

EX72SF

The EX7SF enclosure , shown in Figure 1-2,can accommodate a large number and various types of Agilent latching switch modules. The upper six switch mounting locations, designated SW1 to SW6, are designed for SPDT switches. The lower six switch mounting locations, designated SW7 to SW12, are designed for SP4T, SP6T, and transfer switches.

The following table provides the switch model choices for these sections:

VTI MODEL	DESCRIPTION	AGILENT MODEL NUMBER
SPDT (SW 1 – 6)		
7200-2P	6 line, SPDT, pass- through adapter	N/A
7202-20	SPDT, 20 GHz	8765B
7202-26	SPDT, 26 GHz	8765C
7202-20T	SPDT, T, 20 GHz	8762B
7202-26T	SPDT, T, 26 GHz	8762C
7202-20EL	SPDT, EL, 20 GHz	N1810UL-020
7202-26EL	SPDT, EL, 26 GHz	N1810UL-026
7202-20TEL	SPDT, T, EL, 20 GHz	N1810TL-020
7202-26TEL	SPDT, T, EL, 26 GHz	N1810TL-026
SP4T (SW7-12)		
7200-6P	6 line, SP*n*T, pass-through adapter	N/A
7204-20	SP4T, 20 GHz	L7204B
7204-26	SP4T, 26 GHz	L7204C
7204-20T	SP4T, T, 20 GHz	L7104B
7204-26T	SP4T, T, 26 GHz	L7104C
7204-20TEL	SP4T, T, EL, 20 GHz	87104B
7204-26TEL	SP4T, T, EL, 26 GHz	87104C
SP6T (SW7-12)		
7206-20	SP6T, 20 GHz	L7206B
7206-26	SP6T, 26 GHz	L7206C
7206-20T	SP6T, T, 20 GHz	L7106B
7206-26T	SP6T, T, 26 GHz	L7106C
7206-20TEL	SP6T, T, EL, 20 GHz	87106B
7206-26TEL	SP6T, T, EL, 26 GHz	87106C
Transfer (SW7-12)		
7222-26	Transfer, 26 GHz	L7222C
87222-26	Transfer, EL, 26 GHz	87222C

TABLE 3-2: EX72SF SWITCH MODULES

The SPDT switches are mounted on special carriers for installation into the EX72SF and are delivered this way if ordered separately from the factory. The SP4T and SP6T switches mount directly in the lower openings and do not require any special carriers. The transfer switches do not

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have the same square mounting plate as the multi-throw switches so they require a special carrier for mounting in the lower round openings.

NOTE	Before proceeding with the removal and/or installation of any microwave switch modules in an EX7000, turn the ac power switch to the OFF position and remove the ac power cord.

To remove a SPDT switch from the enclosure, simply remove the two pan head Philips screws from each side of the individual switch faceplate. Remove the faceplate and slide the switch forward until it is away from the enclosure and far enough out to expose the white plastic 8-pin in-line connector. Firmly grasp each end of the white plastic body, squeezing the release tab on the enclosure side and pull until the two parts separate.

NOTE	The new switch modules must have the cable assembly with the white plastic multi-pin connector installed in order for it to interface with the internal control circuitry. All replacement or add-on relays supplied by VTI Microwave will have this cable in place. Contact VTI Microwave immediately if your switch module arrives without this cable assembly as well as the universal mounting carrier installed.

Installation is in the reverse order. Carefully insert the multi-pin white plastic connector, at the end of the switch module cable, into the mating cable extending from the EX72SF enclosure opening. Press the two plastic connectors firmly together until you can feel slight clicking action as the release tab on the enclosure side connector drops into place, locking the two connectors together. Next, align the sides of the carrier with the dark plastic card guides on each side of the rectangular opening. Slide the switch and carrier all the way in until it reaches the rear stop which should place the front body of the connector approximately flush with the front panel of the enclosure. Place the faceplate back in position and secure with the two pan head Philips screws.

To remove a SP4T or SP6T switches from the enclosure, simply remove the four flat head Philips screws from each corner of the switch. Slide the switch forward until it is away from the enclosure and far enough out to access the 16 pin ribbon cable connector plugged into the rear of the switch. Pull the release tab on the rear of the switch away from the connector and pull the ribbon cable connector out of the switch.

Installation is in the reverse order. Carefully insert the ribbon cable connector into the mating connector on the switch module. Align the ribbon cable connector tab with the release tab on the switch's connector. Press the ribbon cable connector firmly in until the release tab on the switch clicks into place locking the connector in place. Slide the switch all the way in until it the mounting flange is flush with the front panel of the enclosure. The switch can operate in any orientation but the standard configuration is for the #1 port to be closest to the right side of the enclosure which puts port 5 and 6 at the top. Align the four holes and secure with the four flat head Philips head screws.

Following the mechanical installation, the EX72SF needs to have its DFC updated. This will not be necessary for cases where a switch is simply replaced with another of the same model. The DCF tells the internal control and drive circuitry exactly what is connected to each port of the unit. Updating the DCF is accomplished by running the System Configurator and following the intuitive prompts (see *Appendix A* for more details). Alternatively, the new DCF can be generated by the factory and downloaded over the Internet. Consult the factory for details.

EX72CC

The EX72CC can be configured in many different ways much like the EX72SF. However, the EX72CC can accommodate a much wider range of SPDT and SPnT switches from various manufacturers. Please contact your local VTI sales rep to discuss the options available. The only restrictions to be considered are size (SPnT limited to 2.25" square face plates), an operating voltage of 12V and non-latching operation.

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EX7400

Generally speaking, most EX7400 models will have their switches mounted internally and are not intended for easy field upgrades or repairs. Please contact the VTI Microwave in the event of a failure.

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SECTION 4

WEB PAGE OPERATION

INTRODUCTION

To open the embedded web page, start the **LInC-U** utility by navigating to **Start → Programs → VTI Instruments Corporation → LInC-U Utility → LInC-U Utility**. Once the utility is run, LInC-U will scan the network to discover all LAN-based VTI instruments. Once the scan is complete, the **Discovery Devices** tab will appear and show the instruments that were discovered, as shown in Figure 4-1. To open the web page, click on the hostname hyperlink on the **Discover Devices** tab. The IP address of the EX7000 can also be viewed from this window as well as its firmware version.

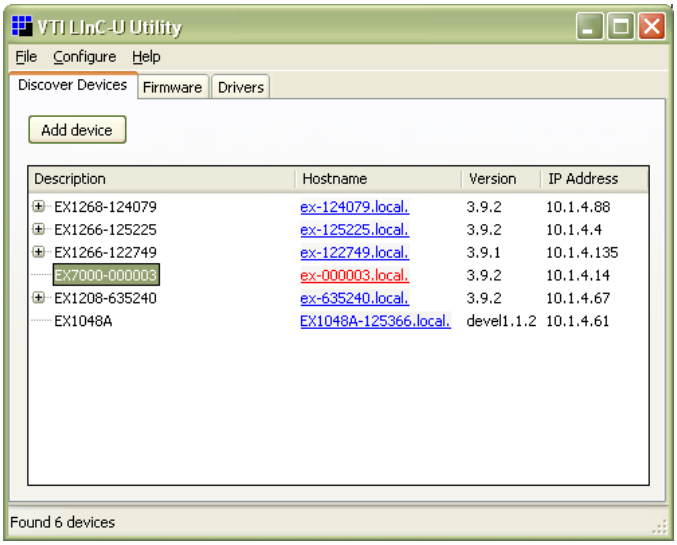


FIGURE 4-1: LINC-U DISCOVERY TAB WITH EX7000 SELECTED

Alternatively, the EX7000 may also be discovered using Internet Explorer's Bonjour for Windows plug-in. The IP address of the EX7000 can also be entered into the address bar of any web browser to view the embedded web page. By default, the EX7000 will first attempt to use DHCP to set its IP Address. If DHCP is not available on the network it is connected to, it will instead use Auto IP. Determining the Auto IP address is discussed in the *Network Configuration* discussion in *Section 2*. Other discovery methods, such as VXI-11, can be used as well

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GENERAL WEB PAGE OPERATION

When initial connection is made to the EX7000, the instrument home page, **Index**, appears (see **Error! Reference source not found.**). This page displays instrument-specific information including:

- Model
- Manufacturer
- Serial Number
- Description
- LXI Class
- LXI Version
- Hostname
- MAC Address
- IP Address
- Netmask
- Firmware Version
- IEEE-1588 Time

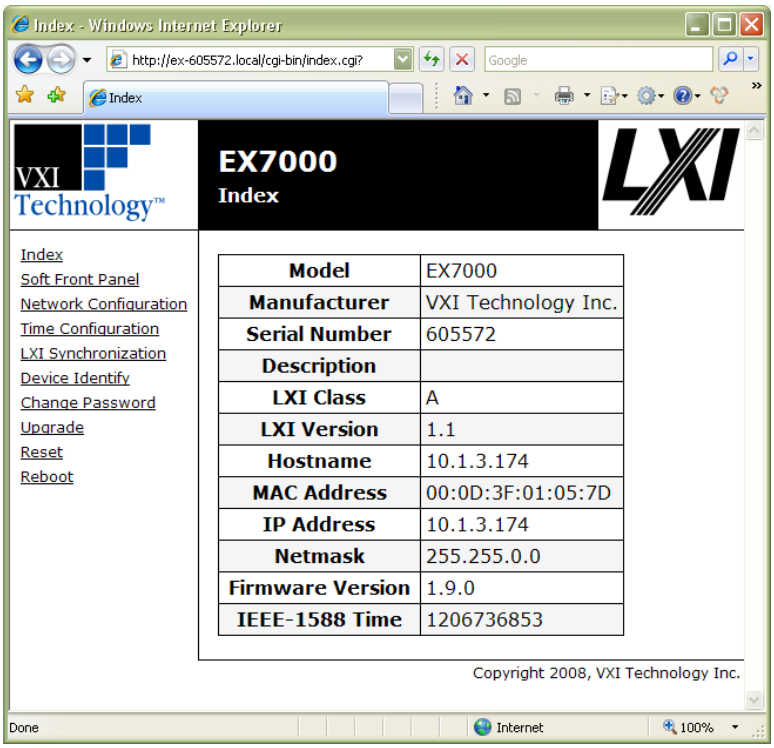


FIGURE 4-2: EX7000 MAIN WEB PAGE

The **Index** is accessible from any other instrument page by clicking on the EX7000 web page header. The EX7000 command menu is displayed on the left-hand side of every internal web page. The entries on the command menu represent three types of pages:

Status This type of page performs no action and accepts no entries. It provides operational status and information only. The **Index** page is an example of a status page.

Action This type of page initiates a command on the instrument, but does not involve parameter entry. The **Reboot** page is an example of an action page.

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Entry This type of page displays and accepts changes to the configuration of the instrument. The **Time Configuration** page is an example of an entry page.

Use of the entry-type web pages in the EX7000 are governed by a common set of operational characteristics:

- Pages initially load with the currently-entered selections displayed.
- Each page contains a **Submit** button to accept newly entered changes. Leaving a page before submitting any changes has the effect of canceling the changes, leaving the instrument in its original state.
- Navigation through a parameter screen is done with the Tab key. The Enter key has the same function as clicking the **Submit** button and cannot be used for navigation.

Password Protection

Once connected to the EX7000, the user should define a password. No password is defined by default. To create a password, click on the **Change Password** link in the command menu, then enter the desired password in both text fields. From this point forward, pages that modify instrument configuration (e.g., SFP) require this password to initially login. It is only necessary to enter a password once per session.

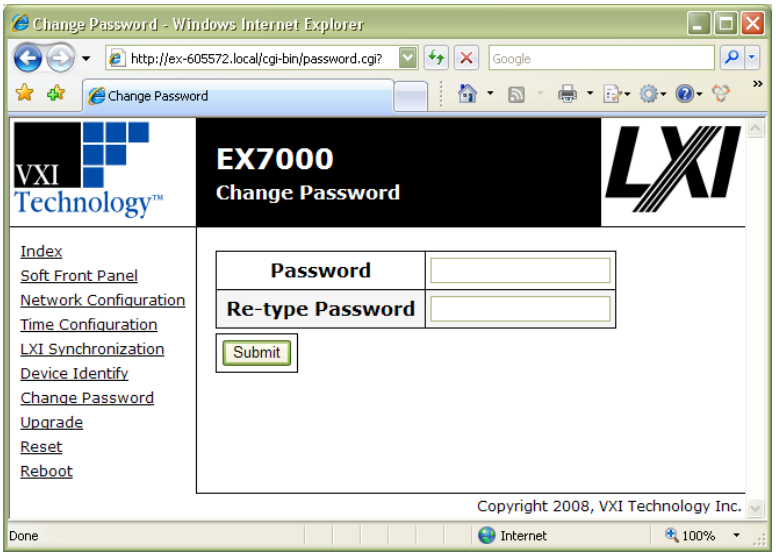


FIGURE 4-3: EX7000 PASSWORD PAGE

NOTES	1) The instrument password uses lower-case letters. 2) This password mechanism provides only the most basic security. Applications requiring additional security should consider using private, dedicated subnets, firewalls, etc. to limit access to the instrument on the network.

VTI Instruments Logo

The VTI Instruments logo that appears on the upper left of all EX7000 web pages is a link to the VTI Instruments Corp. corporate website: http://www.vxitech.com.

EX7000 Title Block

The title block (“EX7000” on a black background at the top of the page) of all EX7000 web pages is a link to the Main Web Page.

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SOFT FRONT PANEL

An example of the EX7000 SFP page can be seen in Figure 4-4. By accessing this page, the various switch modules, attenuators, and other devices connected to the EX7000 can be viewed, identified, and commanded.

Monitor and Control Tab

By default, the SFP opens to the **Monitor and Control** view. From this view, the user can see the RF devices installed in the EX7000. To control a switch, for example, simply click on the pin that needs to be activated to cause the internal relay to actuate and connect to the pin indicated. For other RF devices, certain values may need to be entered or selected in order for them to perform as required. Horizontal and vertical scroll bars allow the user to navigate larger systems by scrolling. The user may also change the size of the schematic. Near the upper right corner of the web page is a size selection menu. By clicking on either the up or down arrow, the size of the schematic can be changed from to any of the following sizes: Tiny, Small, Medium (default), and Large.

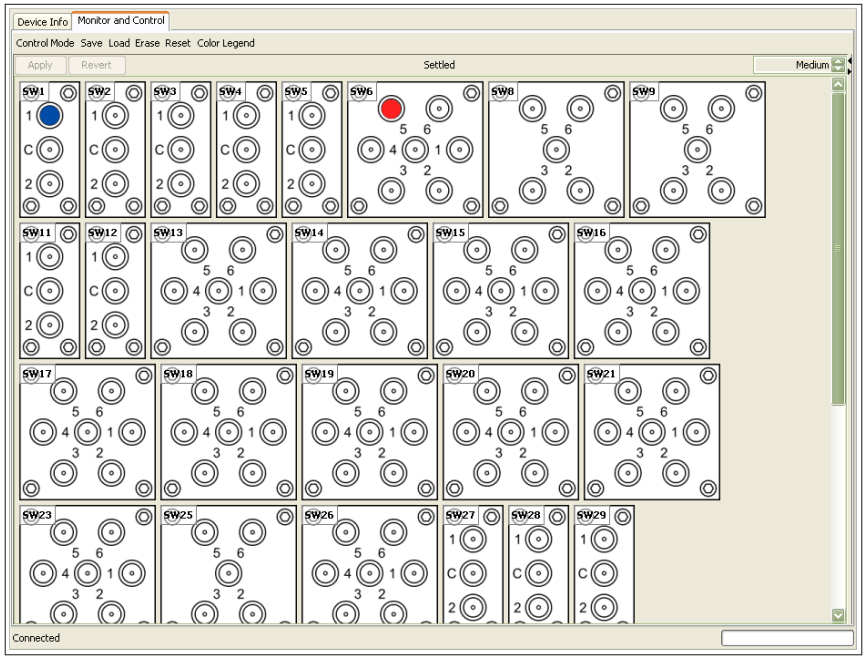


FIGURE 4-4: EX7000 SOFT FRONT PANEL PAGE

For switches that support read-back, the ports are color coded to provide the user an indication of the relay states. The **Color Legend** provides the meaning of each color. **Dark blue** ports have been commanded closed. This color should appear each time a port is selected and working properly. A **light blue** port may be found on a latching relay. It indicates that, although the port has not been commanded closed, read-back indicates that it is closed. If a port turns **red** after being commanded, this indicates that the switch has failed to close and may require repair. For switches that do not read-back, ports will appear dark blue for all states.

The main toolbar of the SFP provides the following functionality:

- **Control Mode**: Three control modes are available for EX7000 modules.
  - **Monitor Only**: In this mode, the user can view the actions the various EX7000 components while the module is actively performing automated test. The image is refreshed every 3 s. In this mode, no modifications can be made. If a another user has

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established a session with the EX7000, all other sessions established after that will be "Monitor Only" sessions until the previous session has ended.

- **Synchronous Mode**: In this mode, the user can manipulate the RF components in the EX7000 in real time. As the user clicks a port or sets a value and it affects the EX7000 at that time.
- **Asynchronous Mode**: In this mode, the user may manipulate all RF components, but the actions do not occur until after the **Apply** button is clicked. Clicking on the **Revert** button will cause the RF components to revert to the state they were in the last time **Apply** was clicked.

- **Save/Load/Erase**: These functions allow the user to either save, load, or erase a switch configuration. Saving a state allows the user to use the same switch set up at a later time. When the **Save** button is clicked, a prompt will appear. The user selects a number, 0 through 127, from this field. Click **OK** to save the current state as the state number entered. To load or erase a saved state, simply click on the **Load** or **Erase** button, select the desired state number from the dialog box that appears, and then click **OK**.

Switches are typically identified with an "SW" number located in the upper-left corner (and upper-right corner for dual SPDT switches). If this indicator is clicked, a switch information menu appears. From this menu, the user can determine the switch type, view specifications, and monitor switch life using the odometer feature. Odometer information is stored on the controller card, so, if a switch is moved from one slot to another, it is necessary to enter the correct odometer information initially. This is done by entering the correct number of actuations into the **Position** entry field and then clicking on the **Set Odometers** button.

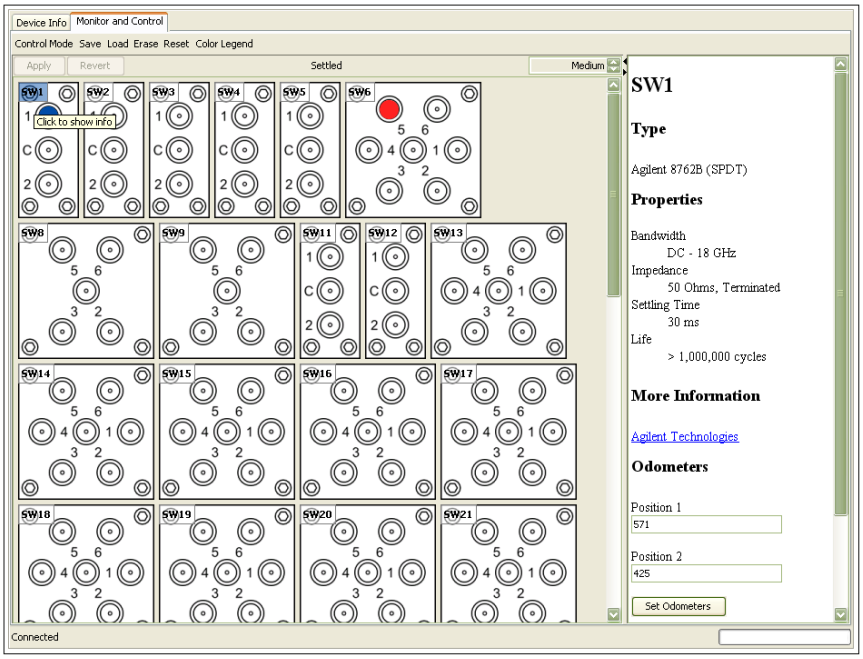


FIGURE 4-5: SWITCH INFORMATION MENU (RIGHT)

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Device Info Tab

If the **Device Info** tab is clicked, information regarding the EX7000 mainframe is available as well as the version of the SFP, firmware, and configuration.

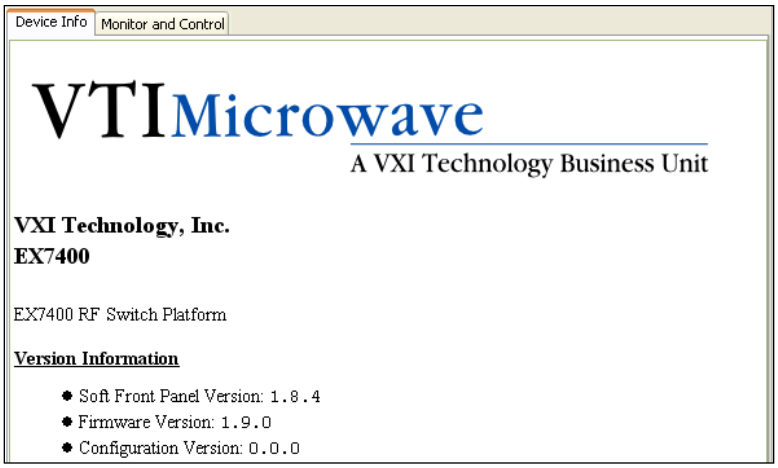


FIGURE 4-6: DEVICE INFORMATION WEB PAGE

NETWORK CONFIGURATION

The EX7000 **Network Configuration** page can be seen in Figure 4-7. By default, the EX7000 will attempt to locate a DHCP server. If one is found, the IP address assigned by the DHCP server will be assumed, along with subnet masks, gateway, etc. Otherwise, after a timeout of 20 seconds, the unit will attempt to obtain an IP address by using Auto IP (IPv4 Dynamic Link Local Addressing).

NOTE	The EX7000 can be returned to a known, default network configuration by using the LCI (LAN Configuration Initialize) Mechanism. See *Reset Button* for more information.

Auto IP is a mechanism for finding an unused IP address in the IANA assigned range 169.254.X.Y (169.254/16) where X is in the range 1 to 254 and Y is in the range 0 to 255. The device will first attempt to obtain the specific address 169.254.X.Y, where X and Y are the second-to-last and last octets of the device's MAC address. However, X will be set to 1 if it is 0 in the MAC address, and to 254 if it is 255 in the MAC address for conformance with the Auto IP specifications. If this address is already in use, the unit will attempt to obtain other IP addresses in the 169.254/16 range in a pseudorandom fashion until it finds one that is available.

To illustrate the Auto IP mechanism, Table 4-1 lists the Auto IP default address for some example MAC addresses.

MAC Address	Auto IP Default Address
00:0D:3F:01:00:01	169.254.1.1
00:0D:3F:01:01:01	169.254.1.1
00:0D:3F:01:A3:28	169.254.163.40
00:0D:3F:01:FE:FE	169.254.254.254
00:0D:3F:01:FF:FE	169.254.254.254

TABLE 4-1: AUTO IP DEFAULT ADDRESS ASSIGNMENT

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If a static IP address assignment is preferred, one can be optionally assigned via the embedded web page interface. This is done by clicking the **Network Configuration** link, disabling DHCP and Auto IP, enabling Static, and then assigning a static IP address, subnet mask, and gateway address, and, optionally, up to three DNS servers (see Figure 4-7).

NOTE	The 169.254/16 subnet is reserved by the IANA for Auto IP usage. It should not be used for either DHCP or static IP configurations.

However, a much more convenient and recommended way to obtain the benefits of a static IP address is to employ DHCP, but assign the instrument a reserved IP address in your company's DHCP server configuration. This reserved address, linked to the EX7000's MAC address on the DHCP server, would be assigned to the EX7000 at power up initialization without having to manually set it on the EX7000. The DHCP server configuration provides a centralized, controlled database of assigned IP addresses, preventing accidental assignment of the same IP address to multiple instruments. Consult your company's Information Technology department for assistance.

VXI-11 Device Discovery is also supported by the EX7000. This allows all EX7000s on a local network to be found without knowledge of their MAC address or IP address with the use of a broadcast message.

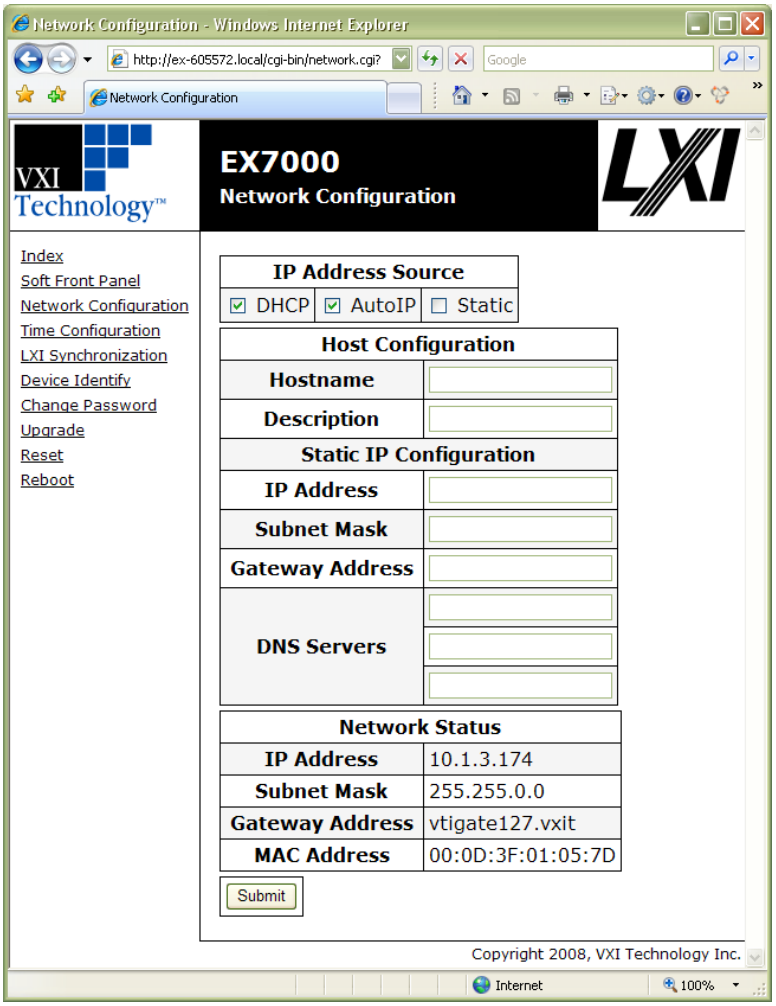


FIGURE 4-7: EX7000 NETWORK CONFIGURATION

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NOTE	If problems are experienced connecting to the EX7000, please refer to the *Network Troubleshooting* process in Section 2.

TIME CONFIGURATION

This entry page is used to change the time configuration of the EX7000. As the EX7000 has no notion of "wall clock" or calendar time and no battery-backed clock or any other mechanism to retain time between reboots and power-cycles, the time must be set by the user. By default, the instrument's time and date at power-up are midnight, January 1, 1970 (the beginning of the "epoch"). Three time source options are provided: PTP (Precision Time Protocol or IEEE 1588 synchronization), SNTP (simple network time protocol), or manual. The default time source is PTP (see Figure 4-8).

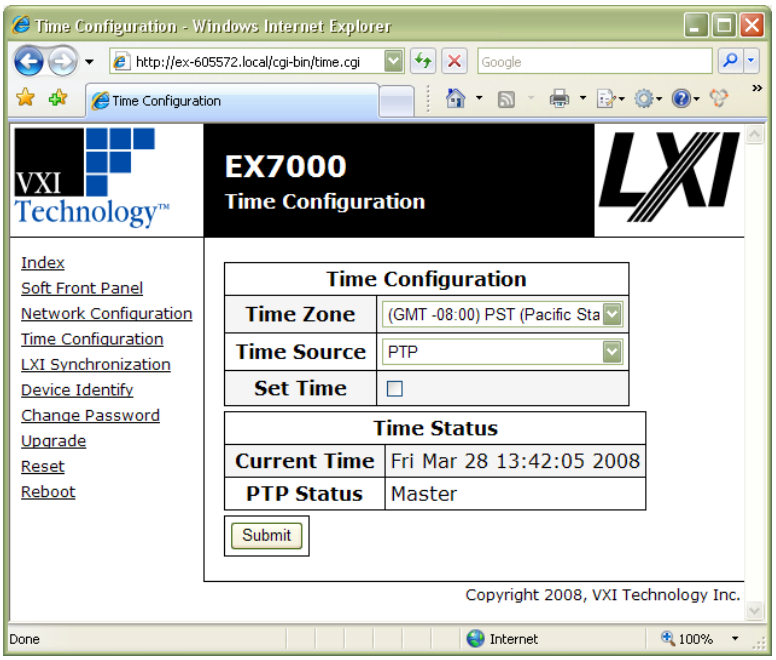


FIGURE 4-8: EX7000 TIME CONFIGURATION WEB PAGE – DEFAULT

- **Time Zone**: allows the user to select an appropriate time zone.
- **Time Source**: allows the user to set the EX7000s date by entering the month (MM), day (DD), and year (YYYY), respectively.
- **Set Time**: allows the user to set the EX7000s time by entering the hour (HH), minute (MM), and second (SS), respectively. If the EX7000 is set as an IEEE 1588 Master, the hour should be entered using the 24-hour format.
- **Time Status**: this section of the web page provides the mainframe's current time configuration settings.

Selecting **SNTP** from the **Time Source** menu, the EX7000 can synchronized with an SNTP server. The **Time Zone** drop menu allows the user to select the local time zone. SNTP or NTP (Network Time Protocol) servers are specified in the **NTP Servers** field, by IP address or hostname. Once configured, the user must click **Submit** in order for the changes to take affect.

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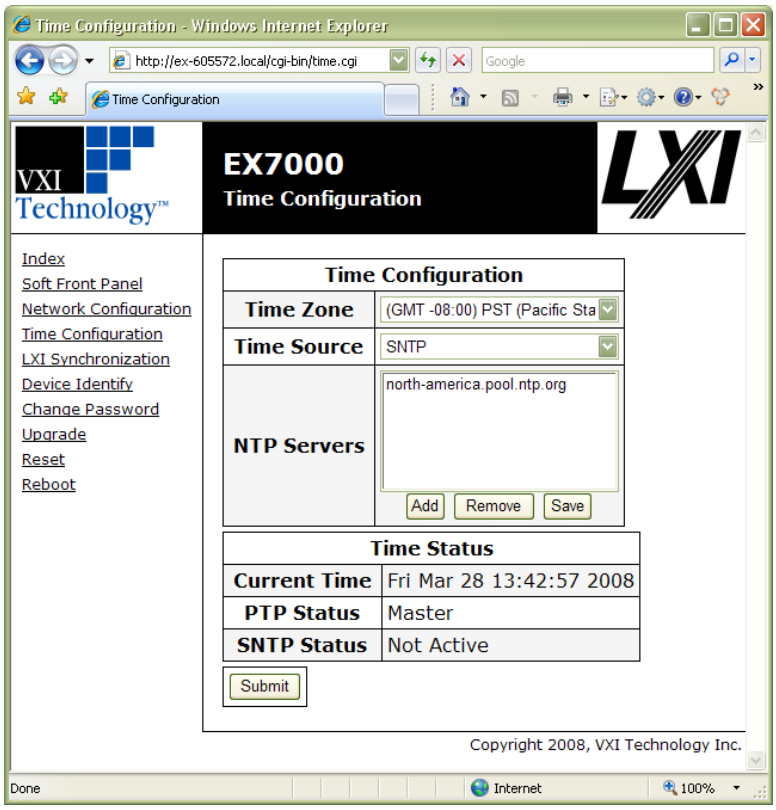


FIGURE 4-9: SNTP CONFIGURATION PAGE

NOTE	Specifying SNTP or NTP servers by hostname requires that the instrument be set to DNS, either by DHCP or Static IP.

If a PTP master or an SNTP server is not available, time can be configured manually by the user by selecting **Manual** in the **Time Source** drop menu, clicking the **Set Time** checkbox, and then entering the time appropriately. Once the time information has been entered, click the **Submit** button. An instrument reboot is then required to activate the new selection.

LXI SYNCHRONIZATION

The **LXI Synchronization** status page provides information about the EX7000s synchronization characteristics. Note that PTP must be selected in the **Time Configuration** web page in order for this page to be populated as see in Figure 4-10.

For more information, please refer to *LXI Standard Revision 1.2, Section 9, Rule 9.6.* and *IEEE 1588-2002, Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.*

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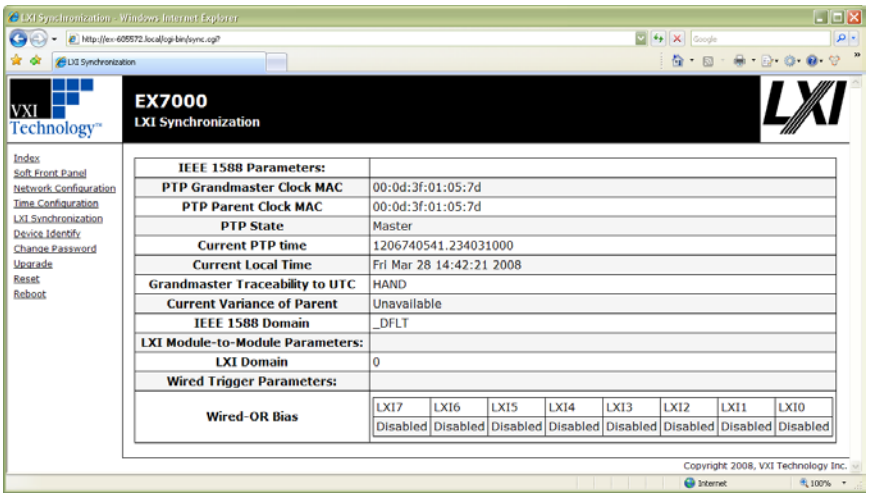


FIGURE 4-10: LXI SYNCHRONIZATION WEB PAGE

- **IEEE 1588 Parameters**
  - **PTP Grandmaster Clock MAC**: indicates the MAC address of the device on the network to which all other IEEE 1588 compliant devices are synchronized.
  - **PTP Parent Clock MAC**: indicates the MAC address of the device to which the EX7000 is synchronized. On a LAN that consists of multiple subnets, this indicates the MAC address of the parent clock on that particular subnet.
  - **PTP State**: indicates whether the EX7000 is a master, slave, faulty, disabled, passive, or unlocked.
  - **Current PTP Time**: indicates the number of seconds since midnight January 1, 1970 UTC (coordinated universal time).
  - **Current Local Time**: indicates the date and time (in 24-hour format).
  - **Grandmaster Traceability to UTC**: indicates how the grandmaster is synchronized to the UTC. The values provide an indicator of how closely synchronized the grandmaster is to UTC time.

Value	Clock Source	UTC Synchronization
ATOM	UTC Atomic Clock	Less than 100 ns
GPS	GPS Receiver	Less than 100 ns
NTP	Network Time Protocol	Less than 50 ms
HAND	Manually/Automatically Set	Less than 10 s
INIT	User Defined	Not specified
DFLT	None	None

TABLE 4-2: UTC GRANDMASTER CLOCK IDENTIFIERS

  - **Current Variance of Parent**: this function not currently supported by the EX7000.
  - **IEEE 1588 Domain**: indicates the instrument's PTP subdomain. Typically, this indicator is _DFLT.
- **LXI Module to Module Parameters**
  - **LXI Domain**: an 8-bit number, 0 to 255, that indicates the domain the EX7000 is using for LAN events. All events sent by this device will include this data. Likewise, the device will only accept events that include the same LXI Domain data.
- **Wired Trigger Parameters**
  - **Wired-OR Bias**: indicates whether the Wired-OR bias for each Trigger Bus channel (LXI0 through LXI7) is enabled or disabled.

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DEVICE IDENTIFY

This action page is used to identify the EX7000 that is being commanded in the current session. When the **Turn on** button is pressed, the LAN LED located on the front panel of the EX7000 will blink. When the **Turn off** button is pressed, the LAN LED returns to its normal operation.

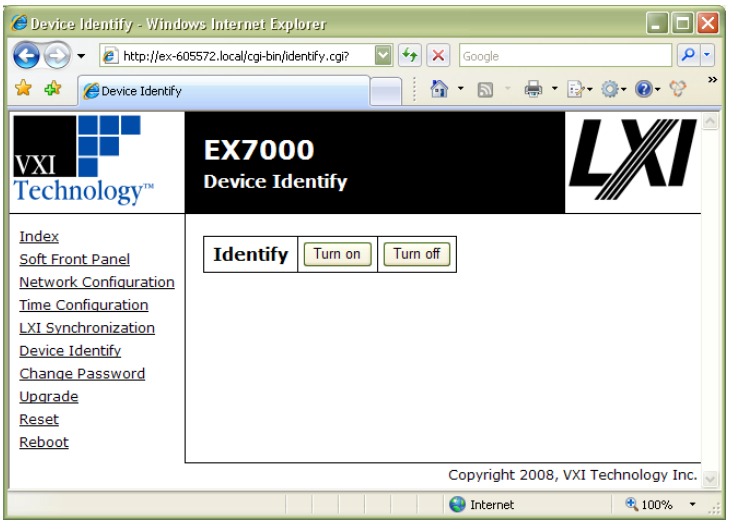


FIGURE 4-11: DEVICE IDENTIFY WEB PAGE

UPGRADE

This action page is used to upgrade the embedded firmware of the EX7000. Prior to initiating the firmware upgrade process, a new, uncompressed firmware image must be obtained from VTI Instruments and be accessible from the computer that is connected to the EX7000. Unless specifically noted by VTI Instruments, firmware upgrades do not alter the non-volatile configuration settings (network configuration, time configuration) of the EX7000.

NOTE	Do not power cycle the EX7000 during the firmware upgrade process. If power is lost during the upgrade, the instrument may be put into an inoperable state, requiring return to the factory. An uninterruptible power supply may be used to avoid this risk.

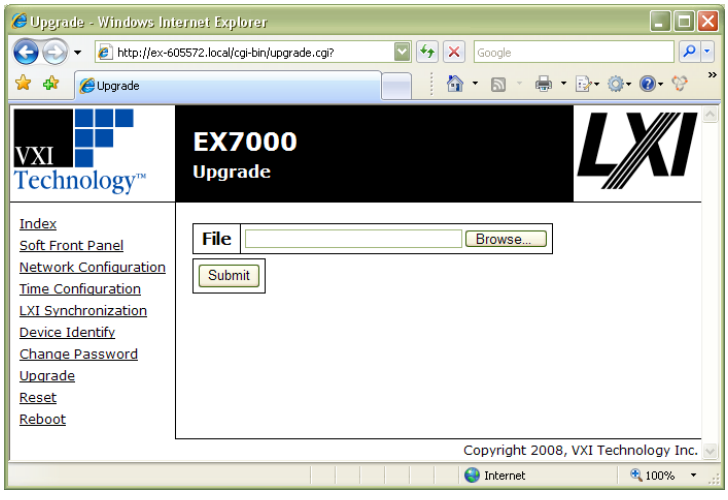


FIGURE 4-12: UPGRADE WEB PAGE

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Perform the following steps to conduct a firmware upgrade:

1) Delete cookies from Internet browser.
2) Delete Java cache on host PC.
3) Perform a **Reboot** or a power cycle.
4) Connect to the EX7000 via the embedded web page.
5) Click on the **Upgrade** link.
6) Click on the **Browse** button and select the firmware image file to be uploaded to the instrument.
7) Click the **Submit** button to initiate the upgrade process.

The upgrade process takes approximately 5 minutes to complete and will be followed by a prompt to reboot the instrument. Once the reboot is complete, reconnect and confirm on the **Index** page that the firmware revision level has been properly updated.

Removing Temporary Internet Files

The initial steps of firmware upgrade involve preparing the host PC. The instructions that follow provide guidance for removing cookies from IE and clearing the cache retained by Java.

Clearing Cookies from Internet Explorer 7

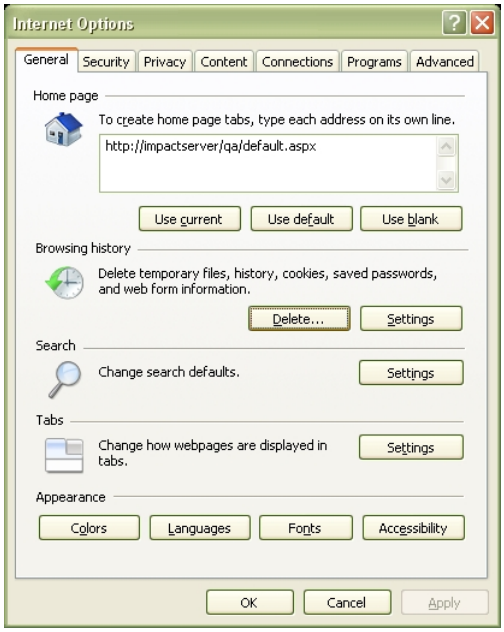
For Internet Explorer 7, the following steps can be taken to delete existing cookies (for other browsers, please refer to the browser's online help documentation):

1) Open Internet Explorer.
2) Click on the **Tools** icon and select **Internet Options** from the drop menu.



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3) When the **Internet Options** window appears, click on the **Delete** button in the **Browsing history** section.



4) When the **Delete Browsing History** window appears, click on the **Delete cookies…** button. A confirmation dialog box will appear. Click the **Yes** button to remove the cookies present on the host PC.

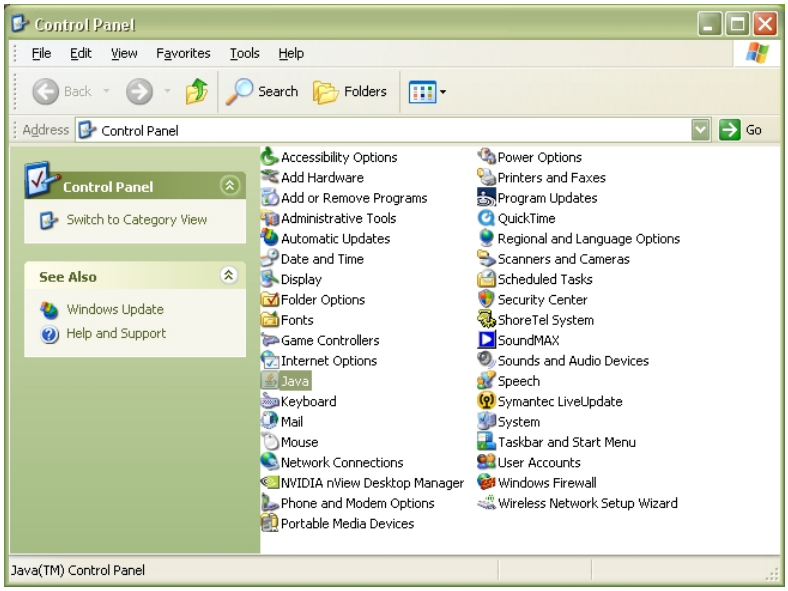


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Clearing Java Cache

Once the cookies have been deleted from the host PC, the Java cache should be deleted next. For Java version 6, the cache can be removed by performing the following steps:

1) Navigate to the **Control Panel** (**Start → Settings → Control Panel**).
2) Double click the **Java** icon in the Control Panel.

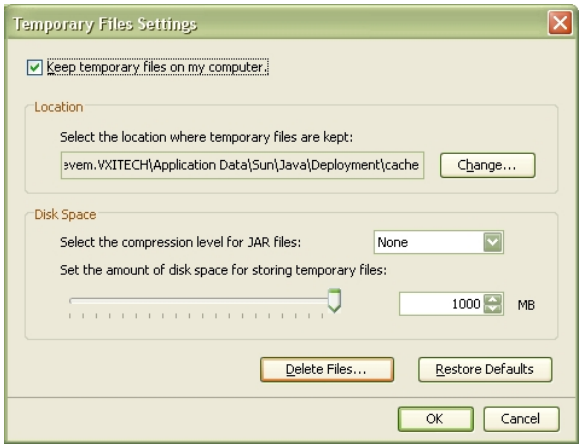


3) <u>When the **Java Control Panel** opens, click on the **Settings** button in the **Temporary Internet Files** section of the window.</u>



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4) When the **Temporary Internet Files** window opens, click the **Delete Files…** button. A confirmation dialog box will appear. Click to **OK** button delete the cache.



RESET/REBOOT

The **Reset** action page is used to return the EX7000 to a known communication state. Pressing the **Reset** button will cause the EX7000 to terminate all active sessions, leaving only the current session viable.

The **Reboot** action page is used to perform a complete instrument reboot, equivalent to that which occurs when the instrument is power cycled. It is most commonly used to accept changes that are made to the network configuration or time configuration settings. In addition, it is suggested that a reboot be performed before conducting a firmware upgrade.

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SECTION 5

THEORY OF OPERATION

INTRODUCTION

This section expands on the description of the internal operation of the EX7000 and explains how to best use them. A full understanding of this operation is not required to operate and use the EX7000. A functional block diagram is provided below.

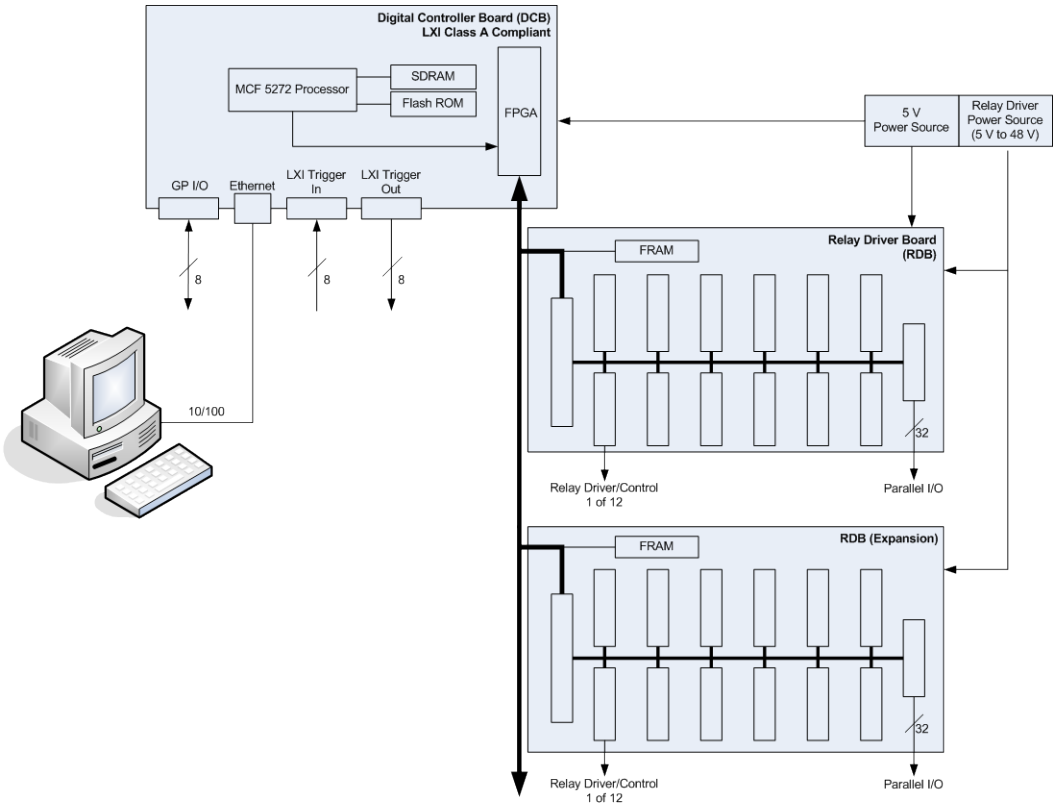


FIGURE 5-1: FUNCTIONAL BLOCK DIAGRAM

SYSTEM OVERVIEW

Using the drivers provided with the EX7000, commands are issued from the host PC to the DCB. The DCB, in turn, controls the operation of the RDBs. Up to eight RDBs can be controlled by one DCB, making the EX7000 capable of providing up to 576 high-current relay control drivers, 96 very high-current drivers, and 256 parallel I/O ports. This is illustrated in Figure 5-1.When multiple RDBs exist in an EX7000 system, a rotary switch on the RDB is used to set a unique address for each RDB.

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RDBs can either be commanded one board at a time or several RDBs may be commanded simultaneously. The RDB has 72 relay control drive lines capable of sinking 200 mA and twelve very high-current reset lines capable of sinking 800 mA. They are divided into three banks, each can be powered separately. Each bank consists of four 20-pin connectors. Each connectors consists of:

- six high-current drive lines
- six indicator/status bits
- one very high-current reset line
- four relay ID bits
- one relay power input
- one 5 V input
- one ground

NOTE	All devices connected to a particular bank (i.e. group of four connectors) must be of the same type: continuous or latching. Mixing of different type may result in erratic behavior and damage to overall system.

OPEN-COLLECTOR VS. TTL DRIVE LINES

The EX7300 and EX7400 relay drive connectors reside on RDBs that are partitioned into three banks: J2 through J5 constitute bank 0, J6 through J9 bank 1, and J10 through J13 bank 2. Although a single RDB may contain both latching and non-latching devices, the banks may only contain one type of device. For example, if J2, J3, and J4 are connected to non-latching devices, J5 may only contain a non-latching relay. A latching relay could, however, be installed in J6.

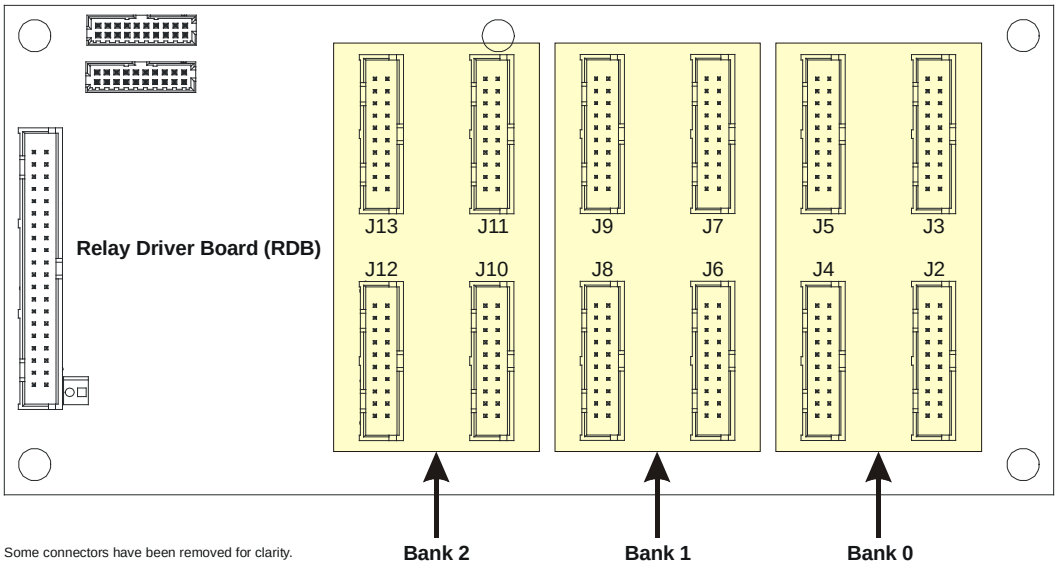


FIGURE 5-2: RELAY DRIVE CONNECTOR BANKS

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Additionally, the RDB of the EX7300 and EX7400 may have varying quantities of open-collector and TTL drive lines, depending on the model ordered. This property is linked to the relay drive connector banks, as illustrated in Figure 5-2. The following table indicates how banks are used according the part number assigned.

Part Number	Bank 0	Bank 1	Bank 2
-000	Open-collector	Open-collector	Open-collector
-001	TTL	Open-collector	Open-collector
-002	TTL	TTL	Open-collector
-003	TTL	TTL	TTL

CAUTION

It is imperative that TTL banks only have TTL devices connected to them. Connecting an open-collector device to a TTL port will result in damage to the RDB and, potentially, to other equipment in the test system. Failure to comply with this warning will result in voiding the manufacturer's warranty.

RELAY ACCESS & CONTROL

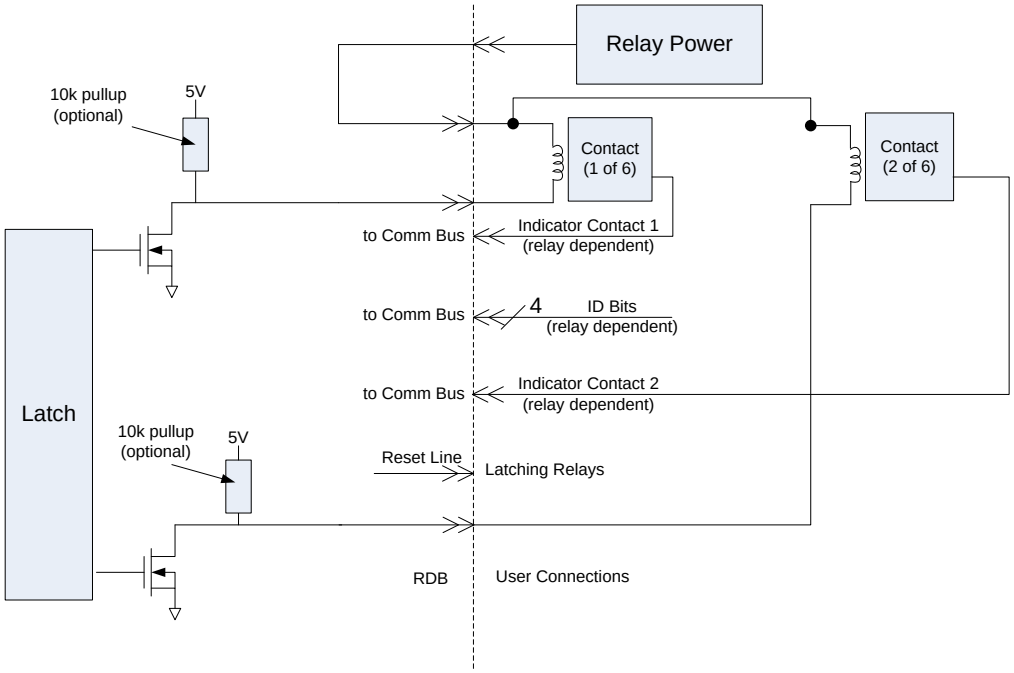


FIGURE 5-3: RELAY DRIVER BLOCK DIAGRAM

When asserted, the relay drive lines will sink the necessary current through the coils, effectively switching the relay. The user can program the relay settling time for each RDB.

The relay control can be operated in two modes: Pulse and Continuous

Continuous Mode

Connecting non-latching devices to any bank of the RDB will dictate that bank must be operating in continuous mode. Commanded by software, the latch signal driving the FET will change state to activate/deactivate FETs and continuously stay in that state until the next command. All Relay Control Drive bits within a bank will change state at the same time. Continuous mode requires a

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power supply capable of sustaining the high-current requirement. The user must allow an appropriate amount of time after the Relay Control Drive bit changes state for the relay to settle. This is typically between 10 ms to 30 ms.

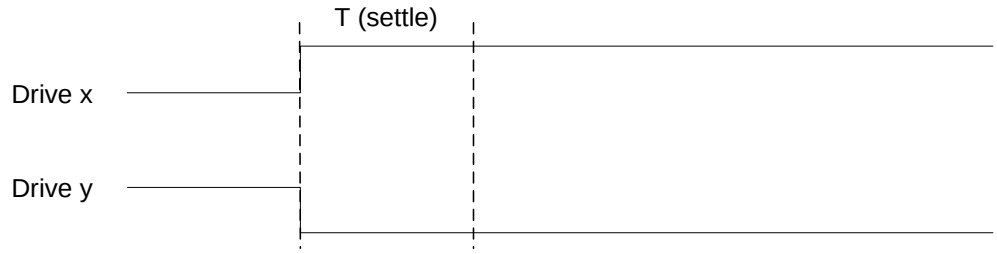


FIGURE 5-4: CONTINUOUS OPERATION MODE

Pulse Mode

Connecting latching devices to any bank of the RDB will dictate that bank must be operating in pulse mode. Commanded by software, the latch signal driving the FET will change state to activate FETs and then change state back when the settling time is reached. All Relay Control Drive bits within a bank will change state at the same time. Certain latching devices will require a reset signal to move all latches to a known state prior to a new state is applied. The Reset signal will be a pulse with the same duration as the Relay Control Drive. The pulse width should exceed the settling time specification for the relays being used. This value will be used as both pulse width and settling time.

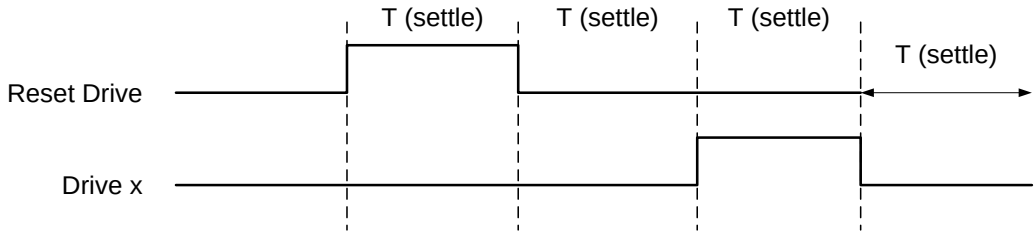


FIGURE 5-5: PULSE OPERATION MODE

NOTE	There is no current monitoring capability on the EX7000. It is the user's responsibility to estimate the total current requirement and provide sufficient power supply current.

The user can mix and match non-latching and latching devices among the banks. For instance, bank 1 and 3 can be all latching, bank 2 can be non-latching. The RDB, if set up properly, will be able to control all of the devices.

In case of multiple RDBs, all devices in different boards can be controlled in parallel as long as the current requirement is met. The user does not have to wait for one RDB to finish its operation before moving to the next. On the contrary, the user can also control one RDB at time. The settling time in case of multiple RDB will be the longest between the boards, multiply with the aggregate number of banks connecting to latching devices.

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APPENDIX A

EX7000 SYSTEM CONFIGURATOR

INTRODUCTION

All products in the EX7000 series share common programmatic characteristics. Each can be controlled using an IVISwitch class-compliant driver, the VTEXSwitch driver, which universally controls all VTI Instruments switch product family models. To achieve this architecture, each switch product carries its own device configuration file (DCF) which fully describes an instrument's components and their interconnectivity. Once created, the DCF resides in the EX7000 system. The System Configurator can be used to manipulate a DCF from either a system or from a local drive. The user can modify and save multiple versions of a DCF, as needed, to configure multiple systems. Note, however, that, at any single point in time, an EX7000 system can contain only one DCF.

STARTING THE CONFIGURATOR

The System Configurator is located at <CD-ROM Drive>:\LXI Software\EX7000 Config Editor\ EX7000SystemConfigurator_R*npn*.jar on the Distribution CD provided with all EX7000 series products. Copy and save this applet to a local hard drive. After double clicking on the .jar file, the EX7000 System Configurator will open.

NOTE	In order to use the System Configurator, Java Runtime Environment (JRE) version 6.0 (or later) must be installed the host PC.



FIGURE A-1: EX7000 SYSTEM CONFIGURATOR

Once opened, the user can choose to either create a new DCF or can open and modify an existing DCF. This is done by selecting either **Open** or **New** in the **File** menu.

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Opening an Existing Configuration

To open an existing DCF, select **Open** from the **File** menu, then navigate to the location of the DCF to open. The System Configurator will then populate the System Explorer pane with various inherent items. If the DCF exists on an EX7000, enter the IP address of the device in the address bar, as shown in Figure A-2, then click on the **Connect** button. Once the configurator opens, select **Get current configuration** from the **Target** menu. This will import the DCF of the EX7000 into the System Configurator.



FIGURE A-2: OPENING AN EXISTING DCF AT IP ADDRESS 10.1.3.55

NOTE	If a DCF references a component library, and the VTEXSwitch driver has not been installed on the host PC, the library must exist in the same directory as the EX7000SystemConfigurator_R*npn*.jar applet.

Create a New Configuration

To create a new DCF, select **New** from the **File** menu. A prompt will appear asking for the number of RDBs that the system will contain. Enter a number in this field between 1 to 8, inclusive. After entering a valid RDB count, the System Configurator will populate the System Explorer pane as shown in Figure A-3.

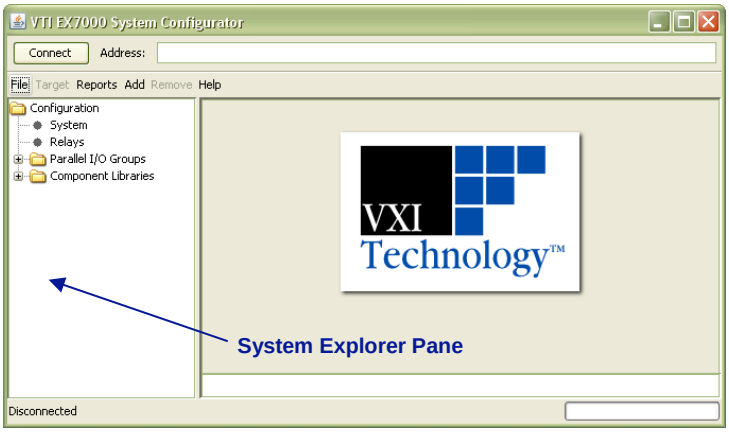


FIGURE A-3: CREATING A NEW DFC FILE

If the VTEXSwitch driver has been installed on the Host PC, the System Configurator will attempt to load the default component library. If a component library was not added to the configuration,

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then it must be added manually by selecting **Add Component Library** under the **Add** menu. Use the browser to navigate to and select the “EX7000_library” file.



FIGURE A-4: ADD MENU OPTIONS

Saving a Configuration

To save changes made to a DCF, select **Save** from the **File** menu. An explorer window will appear allowing the user to specify where the file will be saved. The DCF will be saved with a “.dcf” file extension. This should not be changed. It is convenient to save the DCF in the same directory as the component library (EX7000_library.dcf).

Export a Configuration

If a new DCF is created, it must be exported to the EX7000 system. This is done by entering the IP address of the target EX7000 into the configurator’s Address and then pressing the **Connect** button. Once connected, click on the **Target** menu and select **Set as current configuration**.



FIGURE A-5: EXPORTING A DCF TO AN EX7000

ADDING COMPONENTS

When creating or modifying a DCF, the user has the ability to add or remove components from the system. Relays, wires, attenuators, parallel IO ports, and some passive devices are defined in the System Configurator and can be used when creating an EX7000 system.

NOTE	When using the System Configurator, only devices that appear in that component’s drop menu can be used.

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Relays

To add a relay to an EX7000 system, select **Add Relay** from the **Add** menu. The **Add new relay** prompt will appear. Select the relay type that will be used and provide a name for this component, then click the **Add** button to add this component to the EX7000 system. Continue to add relays in this manner until all relay have been defined, then close the prompt. Once the **Add new relay** prompt is closed, the added relays will appear in the **Relays** folder in the System Explorer.

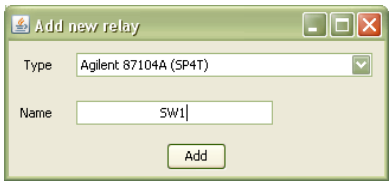


FIGURE A-6: ADDING AN AGILENT 87104A RELAY AS "SW1"

When a relay is selected in the System Explorer, various properties can be viewed and edited. By default, the relay will be added to the lowest available drive line. This can be modified to fit the user's setup by changing the value in the **First drive line** drop menu. In addition to changing the relay drive line, user's can change the name of the relay, the reset drive line, and the wire connectivity as well.

NOTE	The EX72SF and the EX72CC are supplied from the factory prewired for the connections between the front panel switches and the RDB drive lines. Thus, SW1 must be configured to use drive line K1-1; SW2 must be configured to use drive K1-7, etc. Table 6-1 provides the required starting drive lines associated with each front panel switch position.

Switch	Drive
SW1	K1-1
SW2	K1-7
SW3	K1-13
SW4	K1-19
SW5	K1-25
SW6	K1-31
SW7	K1-37
SW8	K1-43
SW9	K1-49
SW10	K1-55
SW11	K1-61
SW12	K1-67

TABLE 6-1: SWITCH CONFIGURATIONS AND RDB DRIVE LINES

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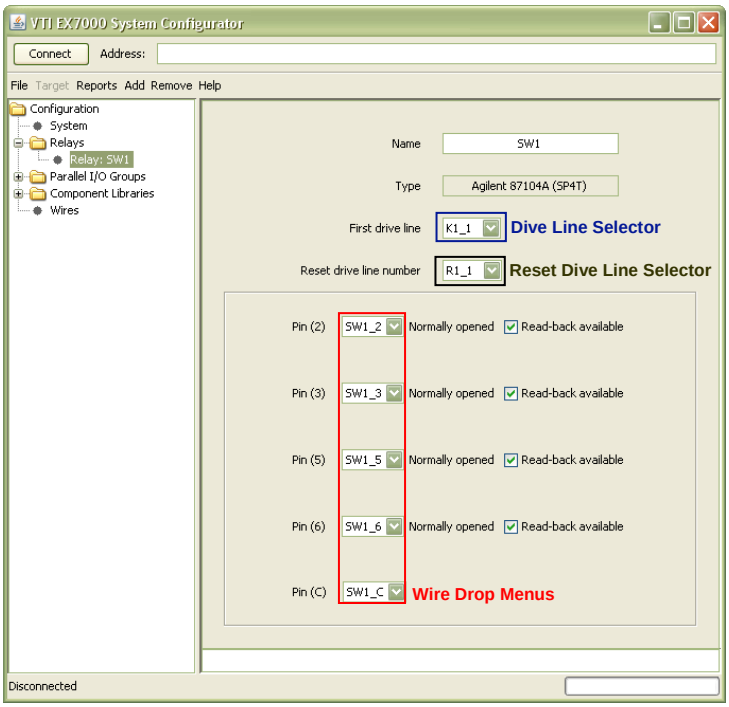


FIGURE A-7: RELAY PROPERTIES WINDOW

NOTE	Latching and non-latching relays cannot be tied to the same RDB bank of relay drive lines (bank 0: K*n*_1 to K*n*_24, bank 1: K*n*_25 to K*n*_48, and bank 2: K*n*_49 to K*n*_72). For more information, please refer to the *Open-Collector vs. TTL Drive Lines* section in Section 5.

Circuits can be created using the system components defined in the DCF by defining routing wires (see the *Wire Types and Wires* section for more information). Once a "wire" has been added to the configuration, it can be tied to existing relay pins via the wire drop menus shown in Figure A-7.

Query 4-Bit Relay ID

If configuring an EX71HD, it is possible to automatically discover the relays by using the **Query 4-Bit Relay ID** command. In order to perform this query, enter the IP address of the EX71HD in the **Address Bar** and then click on the **Connect** button. Next, import the EX71HD_template.dcf file (see *Opening an Existing Configuration*). The default location of this file is C:\Program Files\IVI Foundation\IVI\Drivers\VTEXLibs. Once the DCF file has been installed, click on the **Target** menu and select **Query 4-Bit Relay ID**. The configurator will then use the miniature relay's ID bits and populate the **Relays** directory.

Note, this function only works for the EX71HD.

Attenuators

To add an attenuator to an EX7000 system, select **Add Attenuator** from the **Add** menu. The **Add new attenuator** prompt will appear. Select the type of attenuator that will be used and provide a name for this component, then click the **Add** button to add this component to the EX7000 system. Continue to add attenuators in this manner until all attenuators have been defined, then close the prompt. Once the **Add new attenuator** prompt is closed, the added attenuators will appear in the **Attenuators** folder in the System Explorer. For attenuators, the name and drive lines can be defined as well as the IN and OUT pins.

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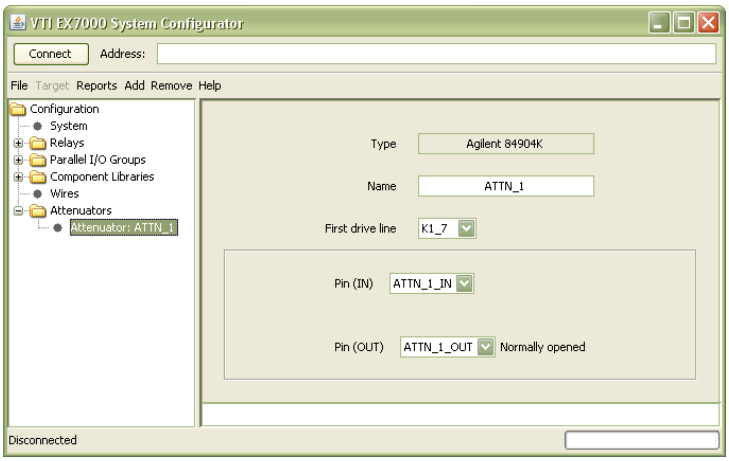


FIGURE A-8: ATTENUATOR PROPERTIES WINDOW

Parallel I/O Ports

To add a parallel IO port to the system, select **Add Parallel IO Port** under the **Add** menu. The parallel I/O properties window will appear as in Figure A-9. From here, the user can assign the port a reference designator (i.e. name) in the **Port name** text input box, the first drive line where the port begins by using the **First drive line** drop menu, and the number of the drive lines that the port contains by using the **Number of drive lines** text input box.

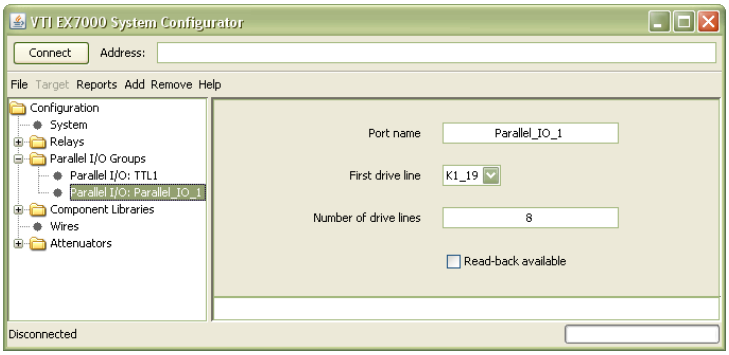


FIGURE A-9: PARALLEL I/O PROPERTIES WINDOW

Wire Types and Wires

A wire is created to define a connection between two components in an EX7000 system. Before creating a wire, however, a *wire type* must be defined. The wire type is used to describe the physical characteristics (impedance, bandwidth) of a wire that will be used.

To do this, select **Add Wire Type** from the **Add** menu. The **Add new wire type** prompt will appear. Enter a name for the wire type being created, then click the **Add** button to add this component to the system. Continue to add wire types in this manner until all wire types that will be used have been defined, then close the prompt. Once the **Add new wire type** prompt is closed, the added wire types will appear in the **Wire Library** folder in the System Explorer. When a wire type is selected in the **Wire Library**, the user can define the wire's characteristic impedance (in ohms) and bandwidth (in GHz) as shown in Figure A-10.

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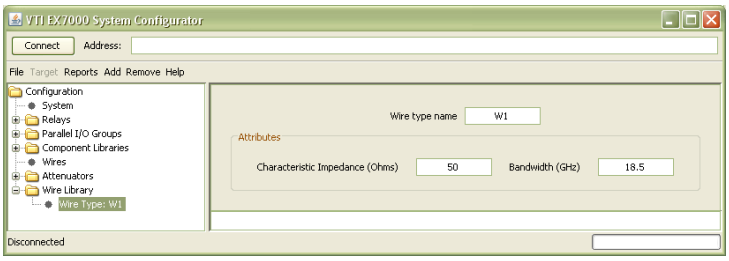


FIGURE A-10: WIRE TYPE PROPERTIES WINDOW

Once a wire type has been defined, a wire can added to the system. This is done by selecting **Add Wire** from the **Add** menu to bring up the **Add new wire** prompt. From here, select the wire type that will be used for the new wire and enter a name for the wire. Once this information has been provided, click on the **Add** button to add the wire to the system. When a wire is selected in the System Explorer, the user can define whether the wire is connected to a source, which will prevent its connection to other sources.

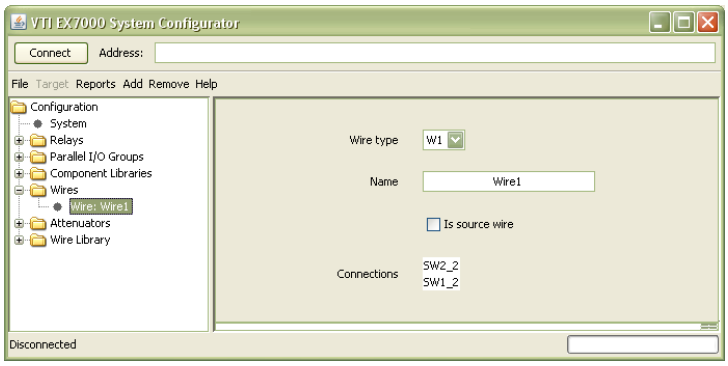


FIGURE A-11: WIRE PROPERTIES WINDOW

Passive Devices

In addition to the active system components, various passive components can be added to an EX7000 system as well. For the purposes of this applet, a "passive device" is one that is not connected to a drive line and, therefore, cannot be controlled by software. To add a passive device, select **Add Passive Device** from the **Add** menu, select the desired passive device from the drop menu when the **Add New Passive Device** prompt appear, enter a name for the device, then press the **Add** button. The passive device will now be added to the System Explorer. When selected, a detail pane appears with detail appropriate for that device. Wires can be selected from the wire drop menus to establish the required connectivity.

SYSTEM CONFIGURATION EXAMPLE

As an example, a 2 x 2 RF matrix will be created as shown in Figure A-12 using one RDB, four 7202-20 SPDT switch modules, an Agilent 84904 attenuator, and a user-defined parallel port. In Figure A-12, blue lines indicate wires in the system (such as W1), while red lines indicate drive line allocations (such as K1_1). To begin, open the System Configurator, then click on **New** in the **File** menu. When the **RDB Count** prompt appears, ensure that a "1" is entered in the text box (note, this is the default value). Click on the **OK** button to begin configuration.

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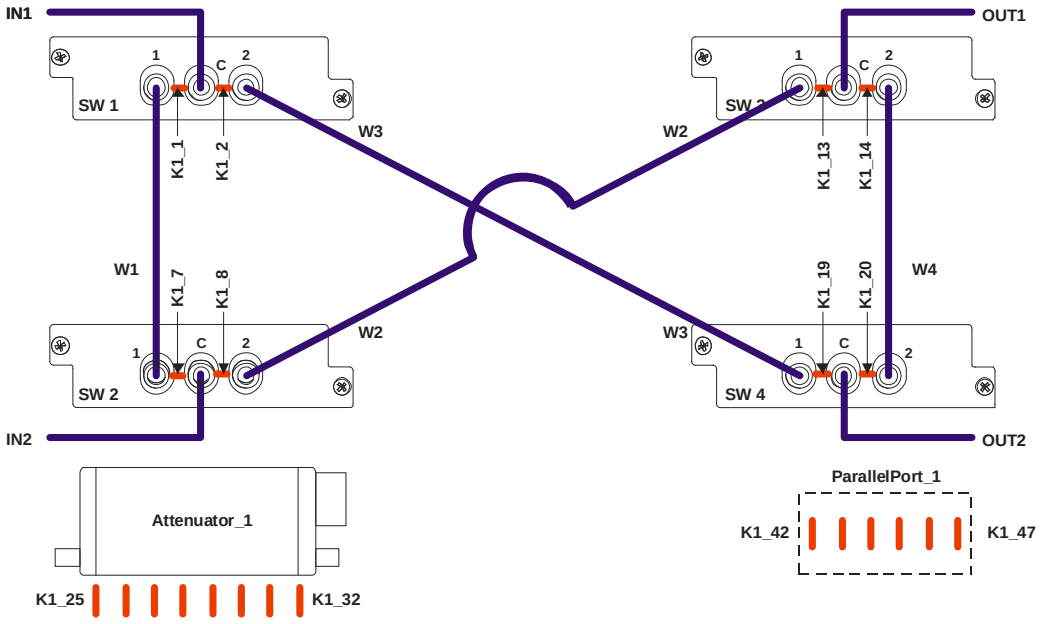


FIGURE A-12: CONFIGURATION EXAMPLE

When a new system is created, it contains "TTL1" in the **Parallel I/O Groups** folder and references the default component library. If desired, the user can click on **System** in the System Explorer pane and can use the fields provided to differentiate one system from another, although this is not required to configure a system.

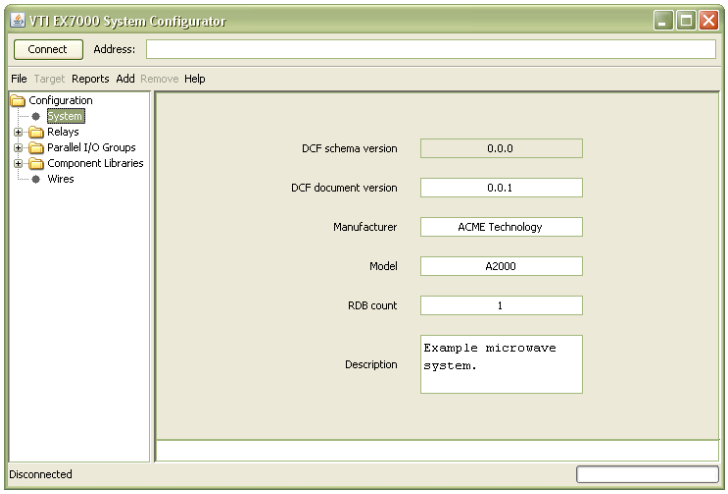


FIGURE A-13: SYSTEM PROPERTIES WINDOW

To add the relays, select **Add Relay** from the **Add** menu. Here, we will select the "VTI 7202-20 (SPDT)" from the drop menu. Per Figure A-12, "SW1" is entered as the relay name. Once this is completed, the **Add** button is clicked. These steps are repeated for SW2, SW3, and SW4. Once all relays have been added, the **Add new relay** prompt can be closed.

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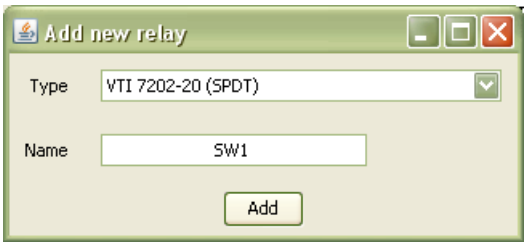


FIGURE A-14: ADDING A 7202-20 RELAY AS "SW1"

Next, a wire type will be defined followed by the creation of wire connections to relays. To define a wire type, select **Add wire type** from the **Add** menu. In this example, the wire type will be called "Fifty_Ohm". After entering the name, the **Add** button is clicked and the prompt is closed. When selected in the System Explorer, the impedance and bandwidth of the wire appears. In the example, the bandwidth has been changed to 20 GHz to match the bandwidth of the relay.

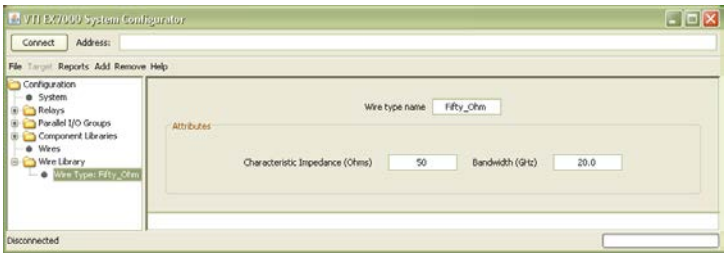


FIGURE A-15: WIRE TYPE DETAIL PANE

Once a wire type has been defined, define the wires in the system. This done by selecting **Add wire** from the **Add** menu. When the **Add new wire** prompt appears, the wire designators are entered into the **Name** text field, one at a time, and then the **Add** button is clicked to add the wire to the System Explorer.

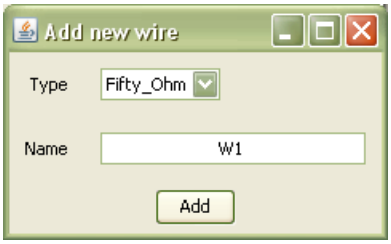


FIGURE A-16: ADDING A NEW WIRE AS "W1"

With the wires defined, switch connectivity can now be set. To set the pin connections for relay SW1, select SW1 in the relay folder. Next, change the Pin (1) setting to "W1" to match the connectivity in Figure A-12 by using the wire drop menu. Then change Pin (2) to "W3" and Pin (C) to IN1 using the same method. Once all of the relays have been configured, their detail panes should appear as in Figure A-17.

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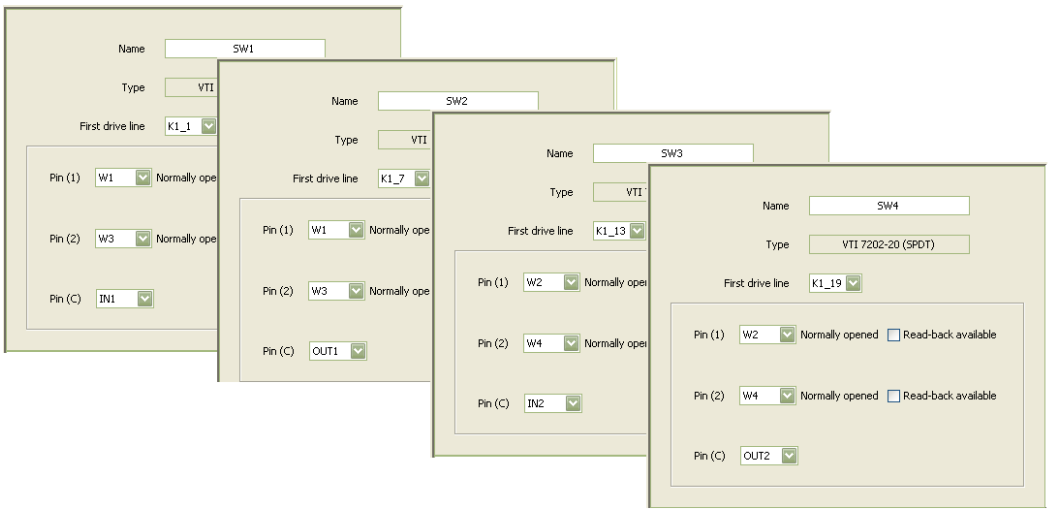


FIGURE A-17: CONFIGURED RELAYS — SW1 THROUGH SW4

Note that the **First drive line** for each switch already matches the example circuit. As the relays were added, the System Configurator determined the ports available and automatically added the relays to the available drive lines. If necessary, the relays can be tied to other drive lines by changing the value in the **First drive line** drop menu.

At this point, the relays have been fully configured. They have been successfully connected to RDB drive lines as well as interconnected via wires. Next, the attenuator will be added to the system. To add an attenuator, select selecting **Add Attenuator** from the **Add** menu. In the example, an "Agilent 84904" is used. Select this component from the **Add new attenuator** prompt drop menu. Name the component "Attenuator_1" and click the **Add** button to add it to the system.

The attenuator has now been added to the configuration. Again, the System Configurator successfully placed the component in the correct location by placing the attenuator at drive line K1_25. Complete the attenuator's set up by setting the Pin (IN) and Pin (OUT) to the appropriate wire using the drop menus provided.

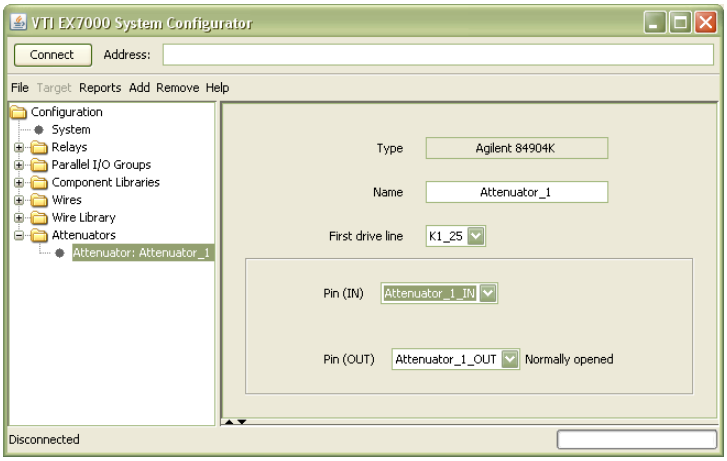


FIGURE A-18: ATTENUATOR DETAIL PANE

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The parallel port, the final component in the example system, can now be added. Add the port by selecting **Add Parallel IO Port** in the **Add** menu. Enter “ParallelPort_1” for the name, then enter “6” in the **Number of drive lines** text field. Note that, when selected, the System Configurator did not assign the component to the desired drive line (K1_37 rather than K1_42). Change this by selecting “K1_42” from the **First drive line** drop menu.

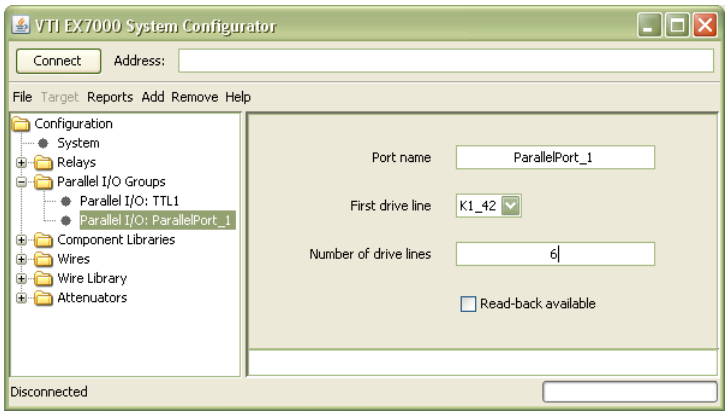


FIGURE A-19: PARALLEL PORT DETAIL PANE

This completes the example system. Save the configuration by selecting **Save** from the **File** menu to save, then save the file to a local computer. To export the configuration to the instrument, enter the EX7000’s IP address in the **Address** bar and click the **Connect** button. Once connected, select **Set as current configuration** from the **Target** menu.

A text report of the configuration can be viewed by clicking on the **Reports** menu and selecting **Configuration Summary**. The report will appear below the detail pane of the selected component. The viewing area of the report can be modified by clicking on the separator bar and increasing or decreasing the size of the report pane.

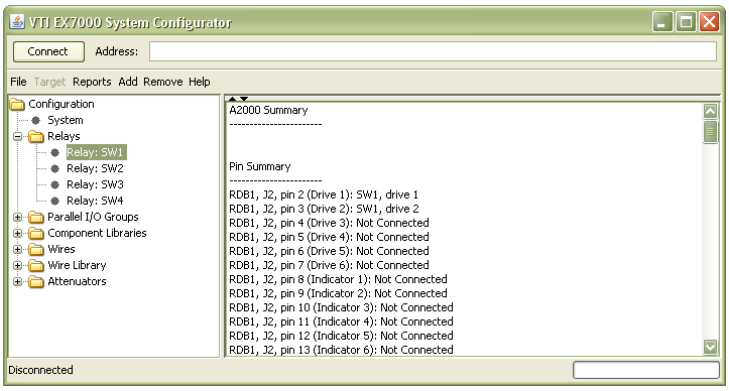


FIGURE A-20: CONFIGURATION SUMMARY REPORT

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APPENDIX B

ONBOARD MEMORY

MEMORY LISTINGS AND CLEARING PROCEDURES

The following table provides information regarding memory contained in the EX7000. Protocol for clearing the memory is also included.

Component	Volatile?	Contains	User Writeable?	Clear Procedure
8MB Flash (Intel, TE28F640J3D-75)	No	Firmware	No	None
		Time Config	Yes	Go to webpage, change values
		Network Config	Yes	Go to webpage, change values
		DCF	Yes	Go to webpage, upgrade using Erase.DCP
2x16 MB DRAM (Micron Tech, MT48LC8M16A2TG-7E)	Yes	Runtime Data	Yes	Power cycle machine
1 Mb EEPROM (1 per RDB) (Xilinx, XCF01SVO20C)	No	FPGA	No	None
8 KB Serial FRAM (1 per RDB) (Ramtron, FM25CL64-G)	No	Latching Config	Yes	Go to webpage, upgrade using Erase.DCP

The 'Erase.DCP' Device Configuration Package file (P/N: 61-0042-000) can be loaded via the browser.

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