



EX7000-OEM

SCALABLE OPEN-ARCHITECTURE MICROWAVE INTERFACE

USER'S MANUAL

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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.

RESTRICTED RIGHTS LEGEND

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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.

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-OEM family is the first scalable series of microwave subsystems built on an open-architecture Ethernet/LXI platform. It provides a common hardware platform and software communications interface that is designed to simplify the development of custom radio frequency interface unit (RFIU) requirements, while maintaining the look and feel of a standard product. The EX7000-OEM is designed for the end users who want to design and build their own RFIU, while minimizing development time of software and relay control.

The EX7000-OEM consists of an LXI Class A compliant digital controller interface and a 72-channel relay driver board. Optional driver expansion boards are available for designs that require additional drive control (up to eight per interface).



FIGURE 1-1: EX7000-OEM-2 (SHOWN WITH OPTION PWD STACKING)

INTERACTIVE CONTROL

As an LXI-compliant device, the EX7000-OEM has 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. Configurations are stored on the EX7000-OEM's non-volatile memory to simplify the software development cycle.

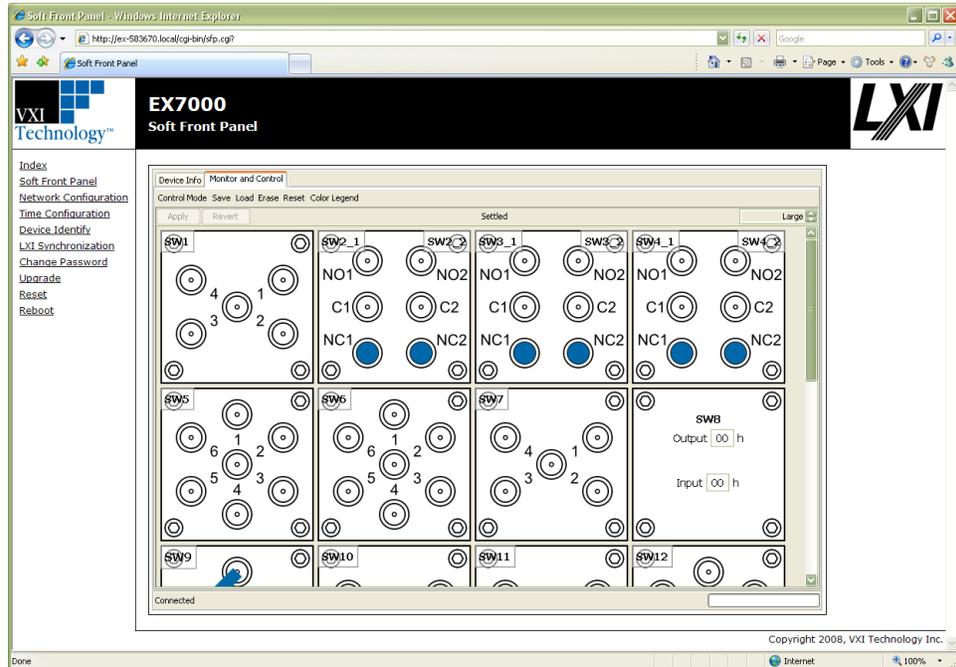


FIGURE 1-2: JAVA-BASED GRAPHICAL USER INTERFACE

RELAY DRIVE CONTROL

The EX7000-OEM has been designed to provide maximum flexibility for controlling virtually any type of RF/microwave relay or component. The 72 high-current drivers 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

Each driver board is capable of recognizing and controlling either latching or non-latching relays. 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 FET dictating whether or not the FET will sink current and energize the relay coil. There is an optionally populated pull-up resistor from the FET drain to +5 V for connection to devices which require TTL control. This is detailed in the section below.

Each relay section can support identification of one relay if the relay has ID bits (optional on some types of relays) and the IDs are tied to the communications bus and the main interface board will report the data back to the application code. If indicator contacts are present, the status of the relay will also be reported back.

INTERFACING WITH OTHER COMPONENTS

The EX7000-OEM 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. Consecutive channels can be grouped and allocated to a particular component and assigned a logical name which can be used in application code or through the graphical interactive utility.

Additionally, optional versions of the EX7000-OEM are available to convert the 72 drive lines such that they are capable of driving TTL inputs. Options are available for 24, 48, or 72 TTL capable drive lines. This is in addition to the 32-bit parallel I/O bus.

Channels are grouped and assigned to a logical name through the an intuitive graphical utility. As an example, eight consecutive channels on a driver board can provide the logic that controls an 8-bit attenuator. The command to set the attenuator is called as follows:

```
driver->Attenuator->Item[0].Data = 16;  
<writes the value of 16 to the first attenuator in the list>
```

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 called 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 Configuration File allows the user to establish a complete signal route by indicating only the end points in an IVISwitch compliant Connect statement, thus simplifying the programming task.

Programmable MBB and BBM

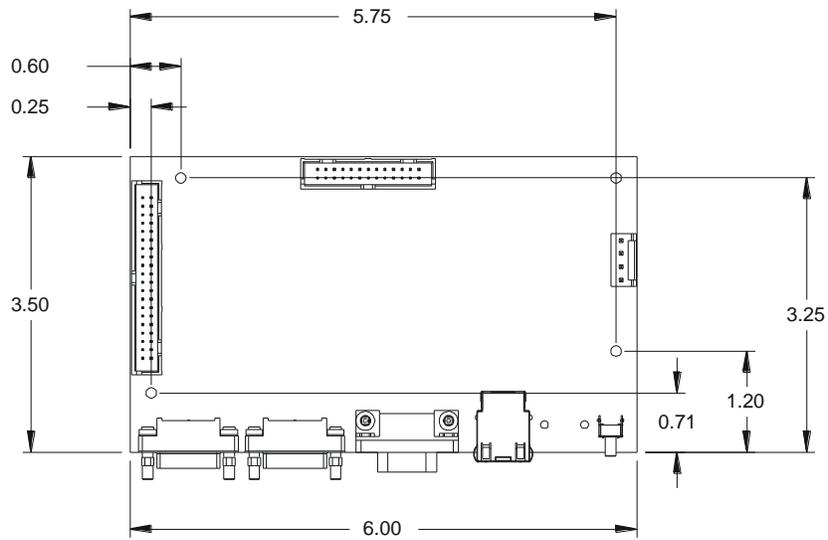
The application code can globally define whether or not the relays ‘break-before-make’ or ‘make-before-break’ when sequencing through relay setups.

EX7000-OEM SPECIFICATIONS

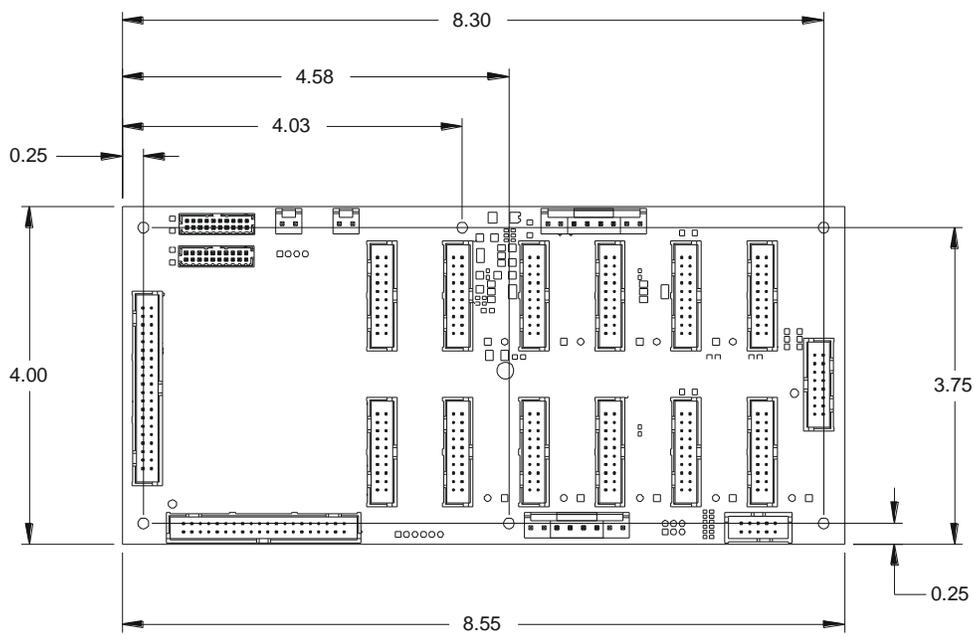
| DIGITAL INTERFACE BOARD | |
|-------------------------------------|---|
| PHYSICAL DIMENSIONS | |
| | 15.2 cm (width) x 8.8 cm (depth) x 2.2 cm (height) |
| CONNECTORS | |
| Host interface | RJ-45 (CAT 5e) Ethernet (10/100T) |
| Trigger bus | Dual 25-pin mini D-Sub 8 LVDS in/out, LXI Class A |
| GP Digital I/O | 9-pin D-Sub 8 TTL I/O |
| Power | 4-pin power header, 5 V |
| Reset | Momentary push-button LAN reset |
| Communication Bus | 40-pin IDC (to relay driver board) |
| PROCESSOR | |
| | MCF5272 |
| SDRAM | |
| | 32 MB |
| Flash ROM | |
| | 8 MB |
| Single-command Response Time | |
| | < 3 ms |
| RELAY DRIVER BOARD | |
| DIMENSIONS | |
| | 18.4 cm (width) x 10.1 cm (depth) x 1.6 cm (height) |
| MAXIMUM DISTANCE | |
| Interface Board to RDB | 12 in – 16 in (first to last) |
| CONNECTORS | |
| Communications bus | 40-pin IDC |
| Relay drivers | 20-pin IDC |
| Module ID | Rotary switch |
| Power | 6-pin power header (1) 5 V (3) Ground (2) EXT_SOURCE (5 V to 48 V) |
| DIGITAL CONTROL LINES | |
| | Dual 20-pin, 2 mm connectors |
| INDICATOR | |
| | Header for LXI compliant LEDs |
| RELAY POWER | |
| | +5 V to +48 V *Three power pins, each connected to four relay driver connections |
| RELAY DRIVERS | |
| | 72 per board open-collector, expandable to 576 |
| MAXIMUM CURRENT SINK | |
| | 200 mA (all channels ON) 410 mA (individual channels) |
| TTL I/O | |
| | 32 channels per board, expandable to 256 |
| MODULE ID | |
| | Rotary switch (0 through 7 identifies driver board in chain) |

*Relay coil voltage is supplied to the relay driver board through three isolated power pins. Each pin is routed to a group of four driver connectors (6 drive lines per connector). The three coil voltage pins can be connected to the same supply voltage or to three different voltages. This provides the flexibility to use, for instance, 24 V, 12 V, and 5 V relays all with one driver board.

| SOFTWARE | | | |
|--|---|----------------|----------------|
| PROGRAMMATIC CONTROL | | | |
| | IVI-COM and IVI-C API IVI similar API for Linux DOS-based interactive command set Low-level command set (EXP protocol) | | |
| DIRECT CONTROL | | | |
| | Embedded Java applet | | |
| CONFIGURATION TABLE | | | |
| | 128 elements (power-on, last known, user-defined) | | |
| SCAN LIST | | | |
| | 16k set-ups | | |
| LXI REQUIRED SPECIFICATIONS | | | |
| TRIGGER RESPONSE TIMES | Minimum | Typical | Maximum |
| Trigger Source | | | |
| LXI WTB | 948 μ s | 1 ms | 1.4 ms |
| DIO port | 948 μ s | 1 ms | 1.4 ms |
| LAN event | 3.8 ms | 4 ms | 4.2 ms |
| Alarm | 700 μ s | 1 ms | 1.8 ms |
| EVENT RESPONSE TIMES | Minimum | Typical | Maximum |
| Event Source \rightarrow Trigger Destination | | | |
| LXI WTB \rightarrow LXI WTB | 37.5 ns | 40 ns | 50 ns |
| LXI WTB \rightarrow DIO port | 54 ns | 60 ns | 65 ns |
| LXI WTB \rightarrow LAN event | 1.26 ms | 1.4 ms | 1.5 ms |
| DIO port \rightarrow LXI WTB | 56 ns | 60 ns | 66 ns |
| DIO port \rightarrow DIO port | 26 ns | 30 ns | 39 ns |
| DIO port \rightarrow LAN event | 1.19 ms | 2.0 ms | 2.2 ms |
| LAN event \rightarrow LXI WTB | 3.7 ms | 4 ms | 4.8 ms |
| LAN event \rightarrow DIO port | 3.7 ms | 4 ms | 4.8 ms |
| LAN event \rightarrow LAN event | 14.8 ms | 16 ms | 25 ms |
| Alarm \rightarrow LXI WTB | 36 ns | 36 ns | 36 ns |
| Alarm \rightarrow DIO port | 36 ns | 36 ns | 36 ns |
| Alarm \rightarrow LAN event | 1.2 ms | 1.35 ms | 1.45 ms |
| Operation Complete \rightarrow LXI WTB | 320 μ s | 500 μ s | 600 μ s |
| Operation Complete \rightarrow DIO port | 320 μ s | 500 μ s | 600 μ s |
| Operation Complete \rightarrow LAN event | 1.8 ms | 1.9 ms | 2.0 ms |
| TIMESTAMP ACCURACY | | | |
| | 200 μ s | | |



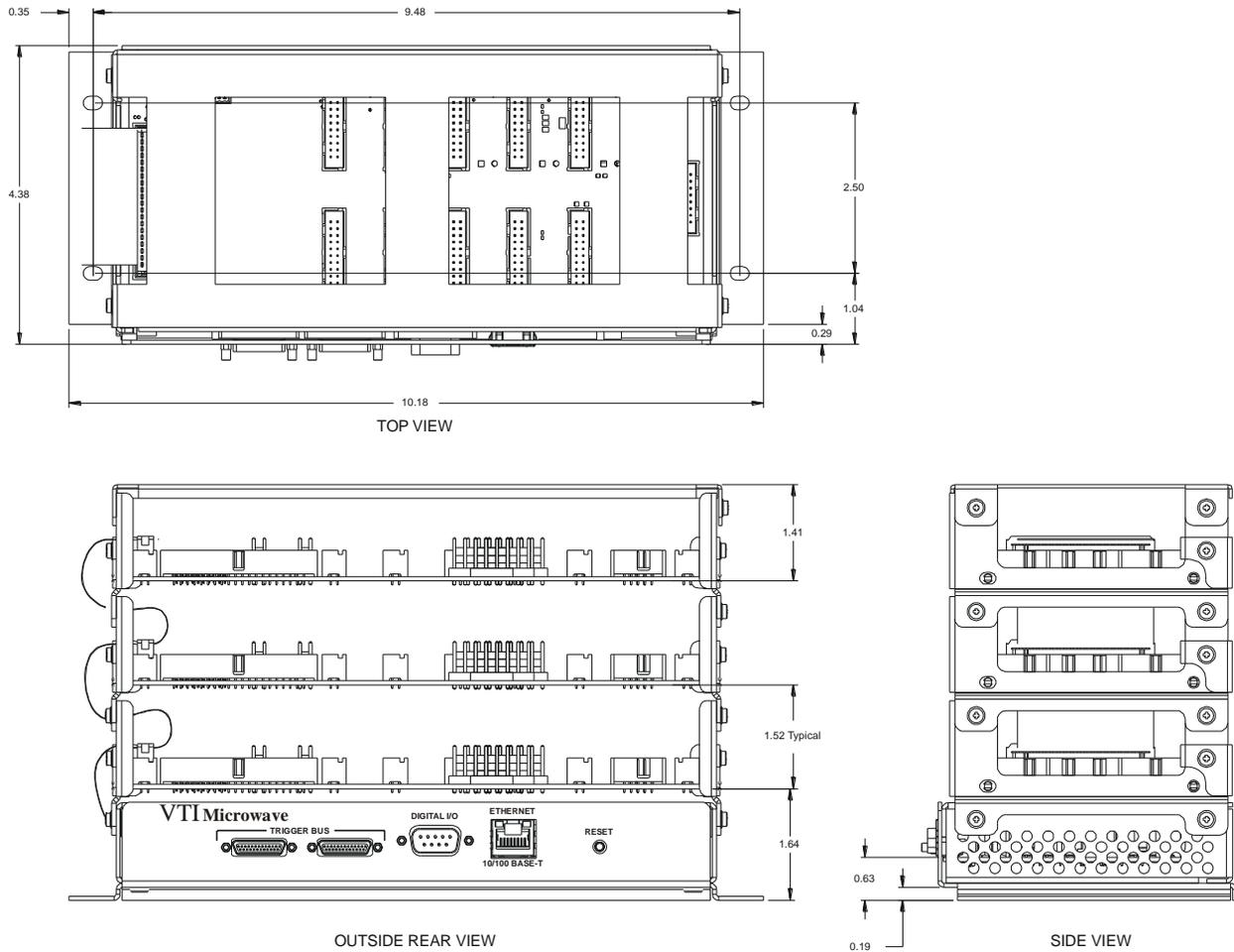
Digital Control Board (DCB)



Relay Driver Board (RDB)

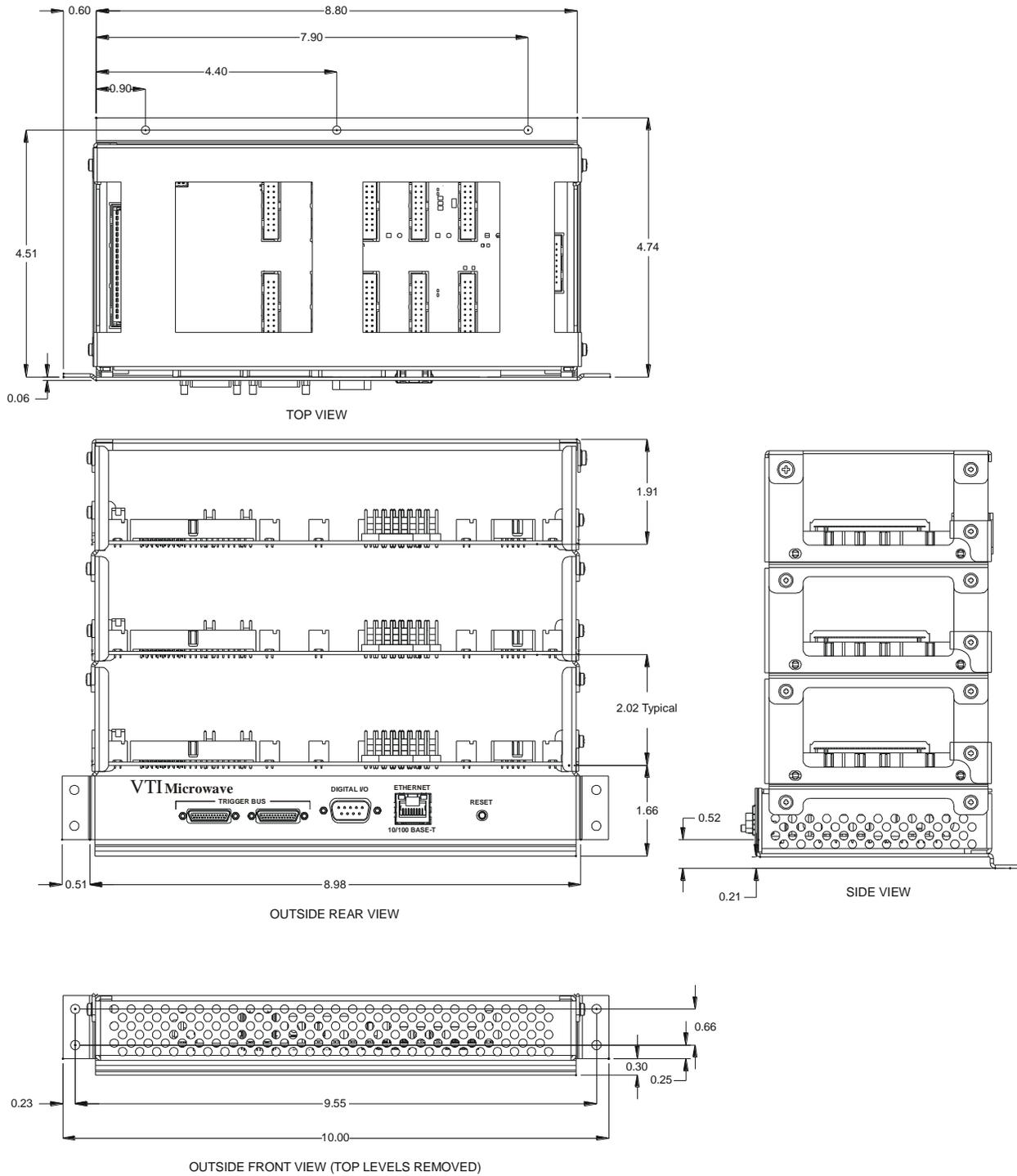
Note: Dimensions are provided in inches.

FIGURE 1-3: EX7000-OEM DIMENSIONAL DIAGRAM (TOP VIEWS)



Note: Dimensions are provided in inches.

FIGURE 1-4: EX7000-OEM WITH OPTION PWD-03



Note: Dimensions are provided in inches.

FIGURE 1-5: EX7000-OEM WITH OPTION PWD-13

SECTION 2

PREPARATION FOR USE

OVERVIEW

This section provides a step-by-step process for setting up the EX7000-OEM for use. It covers hardware installation, input connections, and software installation.

UNPACKING

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

- EX7000-OEM (plus options, if applicable)
- *LXI Quick Start Guide*
- *EX7000-OEM Series User's Manual* (this manual)
- *VTEX Switch Driver Programmer's Manual*
- *VTI Instruments Corp. Drivers and Product Manuals CD*
- Digital Interface Cable (VTI P/N: 52-0497-003)

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

INSTALLATION LOCATION

The EX7000-OEM 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 EX7000-OEM employs active cooling for maximum product reliability. When the EX7000-OEM is installed into a test fixture, the user must ensure that adequate air flow is provided to all components.

EX7000-OEM HARDWARE SETUP

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

- The DCB must be connected to the RDB via the Digital Interface Cable provided with the EX7000-OEM. This cable should connect J1 on the DCB to either J1 or J1A on the RDB. The selection of RDB connector is made by positioning the jumper at J20. For more information on J1, J1A, and J20, please refer to the *Digital Interface Controller Connectors* section.
- A connection from the user-provided power supply must be made to J7 on the Digital Controller Board (DCB) and to J14 or J14A of the Relay Driver Board (RDB). If multiple RDBs exist, power must be supplied to each RDB. A cable can be made using the information provided in the *Reset Button*

The reset button, accessible through a hole in the rear panel of the EX7000-OEM, 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-OEM, 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-OEM 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-OEM, 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-OEM 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-OEM 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.

- Power Connector section, as well as information provided by the power supply manufacturer.
- A connection to the relays, attenuators, and filters must be made from the appropriate device to the RDB. Information in the *Relay Drive Connectors* section provide the user with the information needed to create an appropriate cable.
- A connection between the Host PC and the DCBs LAN port must be made. A CAT-5e cable may be used to make this connection. Note, this cable is not provided with the EX7000-OEM.

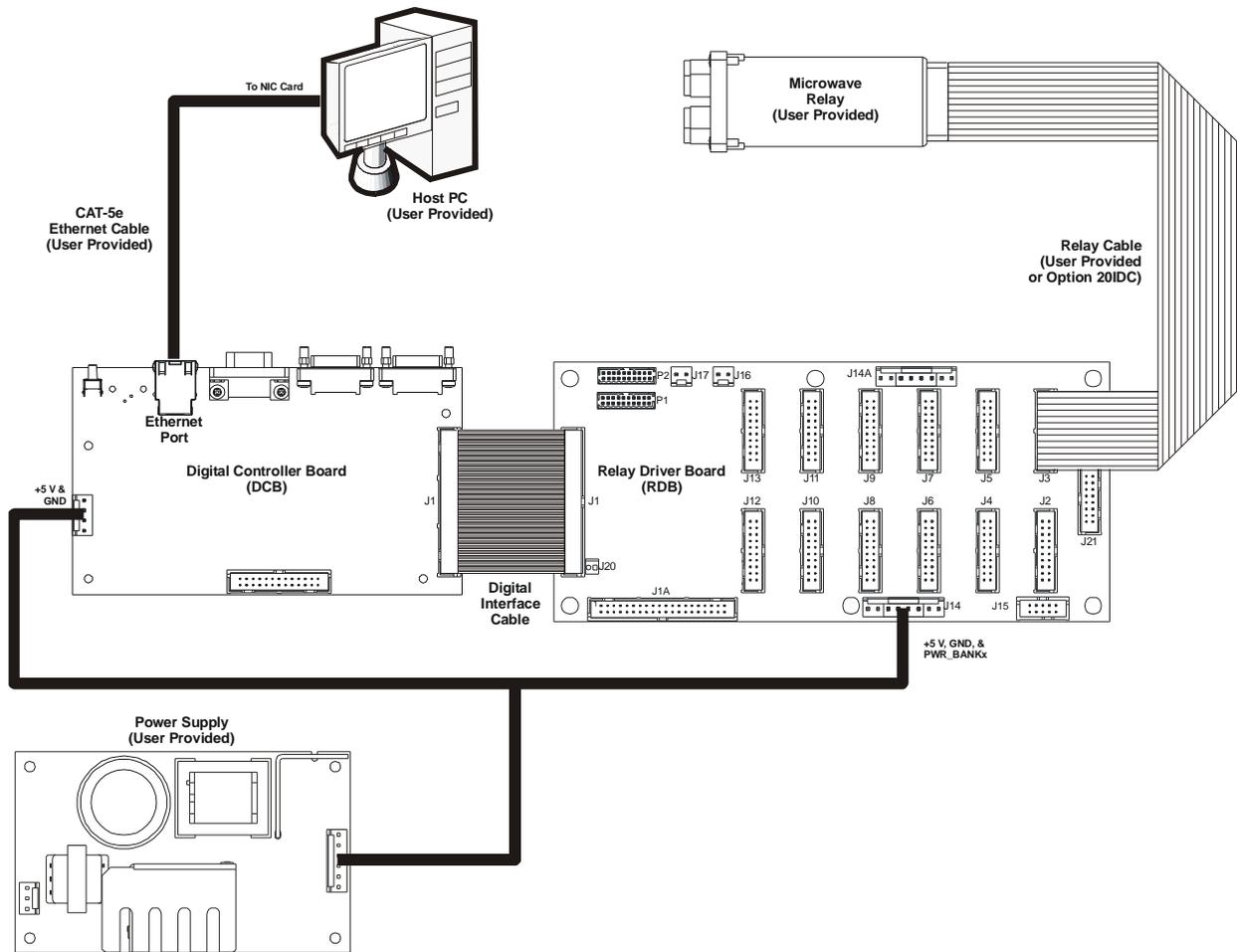


FIGURE 2-1: EX7000-OEM CABLING DIAGRAM

OPEN-COLLECTOR VS. TTL DRIVE LINES

The RDBs of the EX7000-OEM 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 3-3. 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.

SOFTWARE INSTALLATION

The fastest way to begin controlling an EX7000-OEM is to discover the unit using VTI's LAN Instrument Connection and Upgrade (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-OEM. 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-OEM 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-OEM'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-OEM, please refer to *Web Page Operation* in *Section 4*.

LInC-U Installation

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

NETWORK CONFIGURATION

With its default network configuration, the EX7000-OEM 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-OEM can be returned to a known, default network configuration by using the LCI (LAN Configuration Initialize) mechanism. See *Error! Reference source not found.* 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-OEM (see the *Web Page Operation Introduction* in Section 4 for more information on discovery), it may be necessary to change the network settings for the EX7000-OEM and the host PC. By using the following methodology, most network-related issues can be resolved:

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

Restore the EX7000-OEM's Default Network Settings

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

- 1) Power off the EX7000-OEM.
- 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-OEM. 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-OEM, 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-OEM 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.

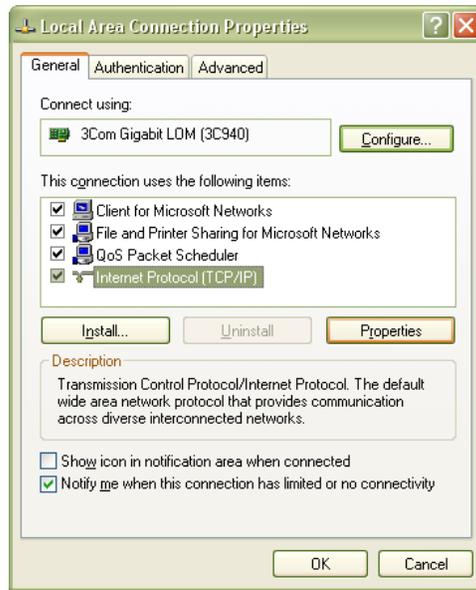


FIGURE 2-3: LOCAL AREA CONNECTION PROPERTIES DIALOG BOX

- 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.

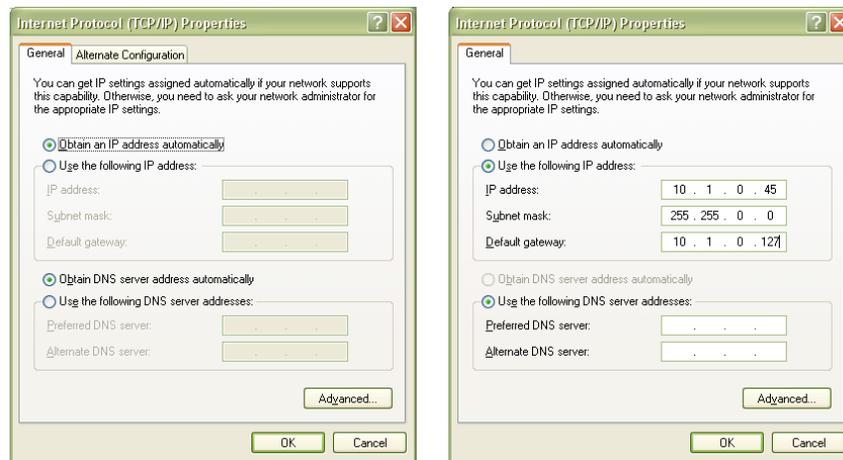


FIGURE 2-4: DYNAMIC (LEFT) AND STATIC (RIGHT) IP ADDRESS CONFIGURATIONS

- 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-OEM. Click the **OK** button and proceed to *Set the EX7000-OEM to Static IP*. If set to use a dynamic IP, click the **OK** button and proceed to *Set the EX7000-OEM to Auto IP*.

Set the EX7000-OEM to Auto IP

- 1) Remove all network connections from the PC except for the connection to the EX7000-OEM. Wireless adapters should be disabled as well.
- 2) Apply power to the EX7000-OEM and wait for the LAN LED to turn green.
- 3) Discover EX7000-OEM 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-OEM, 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.

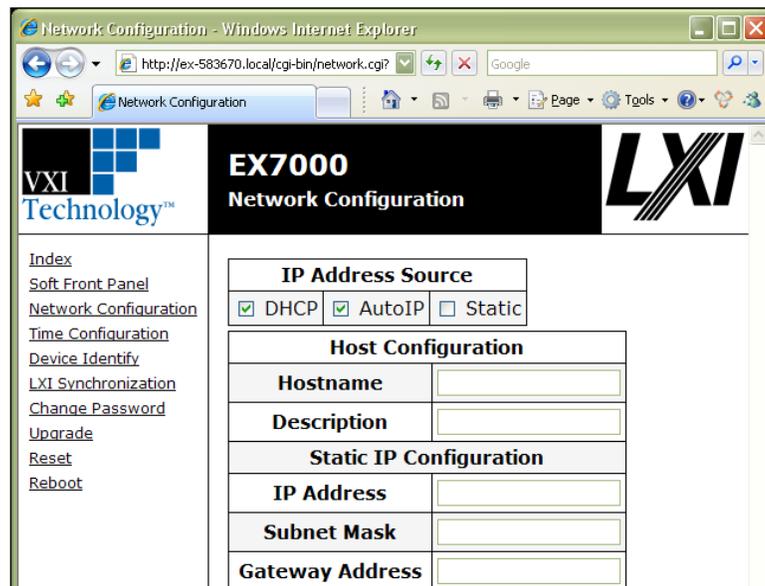


FIGURE 2-5: EX7000-OEM SET TO USE AUTO IP

Set the EX7000-OEM to Static IP

- 1) Disconnect all network connections from the PC except for the connection between the PC and the EX7000-OEM.
- 2) Apply power to the EX7000-OEM and wait for the LAN LED to turn green.
- 3) Discover EX7000-OEM 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-OEM. 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-OEM 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.

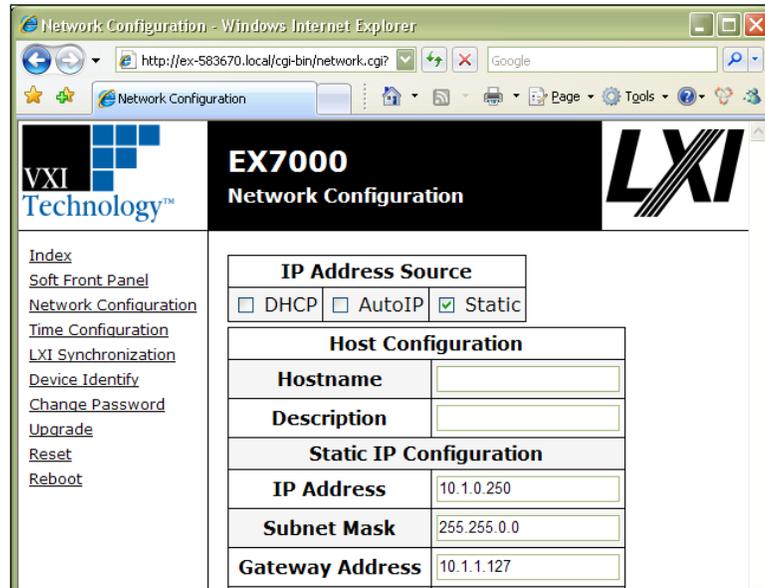


FIGURE 2-6: EX7000-OEM SET TO USE STATIC IP

Restore the Host PCs Network Settings

- 1) Power down the EX7000-OEM 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 its original state.
- 3) Power on the EX7000-OEM and wait for the LAN LED to turn solid green.
- 4) Discover the EX7000-OEM using Bonjour as described in *Section 4, Web Page Operation*.

DRIVER INSTALLATION

To monitor and/or control the EX7000-OEM'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 Platforms 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-OEM 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>.

SECTION 3

HARDWARE DESCRIPTION

OVERVIEW

An EX7000-OEM consists of the following, constituent parts:

- Digital Controller Board, or DCB
- Relay Driver Board, or RDB (may be one to eight boards depending on the model)
- A ribbon cable to connect the DCB to the RDB
- If multiple RDBs are used, a special ribbon cable with multiple connectors is required

The DCB provides the user interface to the host PC, via a LAN connection, and controls the action of the associated RDB cards. It is connected to the RDB cards via ribbon cables which run from the J1 connector to the J1 or J1A connector of the RDB. Also available on the DCB are the LXI trigger bus connectors, the Digital I/O connectors, and the LXI LAN Reset button.

The RDB is primarily responsible for providing control for the relays attached to the EX7000-OEM. The board contains connectors for relays, communication to the DCB, power supply inputs, optional LEDs, and parallel I/Os. The remainder of this section will discuss, in detail, the constituent parts of the EX7000-OEM.

NOTE User must follow the specification listed below to make mating connectors. Deviation from these specification may result in incorrect operation, or damage to the system.

DIGITAL CONTROLLER BOARD DETAIL

Five connectors are located on the digital controller board (DCB) that are user accessible. Additionally, a reset button is provided for LCI functionality. The connectors provide access to the EX7000-OEM's DCB. The location of the connectors are provided below. Note, the power connector is not visible in the figure below.

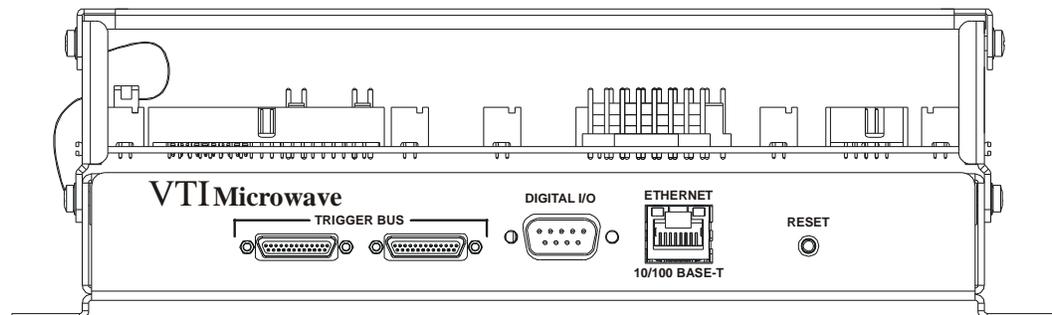


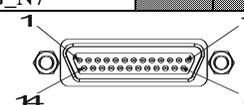
FIGURE 3-1: EX7000-OEM REAR PANEL CONNECTORS (WITH OPTIONAL STACKING FRAME)

Please note that Figure 3-1 depicts the EX7000-OEM mounted in an optional, single-high stacking frame. Additional sections can be added for up to eight relay driver boards stacked on top of the digital controller board.

Trigger Bus Connectors

The EX7000-OEM provides an LXI compatible trigger bus connector. For more information on the LXI Trigger Bus and creating an appropriate cable, please visit www.lxistandard.org and refer to *LXI Standard Revision 1.1* and *LXI Trigger Bus Cable and Terminator Specifications Rev 1.1*.

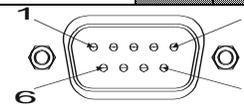
| Trigger Bus Connectors | | | |
|------------------------|------------|-----|------------|
| Pin | Signal | Pin | Signal |
| 1 | +3.3 V | 14 | RP_TRIG_P0 |
| 2 | GND | 15 | RP_TRIG_N0 |
| 3 | RP_TRIG_P1 | 16 | RESERVED |
| 4 | RP_TRIG_N1 | 17 | RP_TRIG_P2 |
| 5 | GND | 18 | RP_TRIG_N2 |
| 6 | RP_TRIG_P3 | 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-OEM features an 8-channel digital I/O port on the rear panel of the instrument. This port can be used as an arm/trigger source, for presentation of limit evaluation information, and as a general purpose output device. The digital I/O connector is a standard DB-9 with the following pin assignment:

| 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. Unless linked to a limit condition, as discussed below, its operation is completely autonomous.

When enabled as an output, each channel also has the ability to generate a 1 μ s pulse upon command. An example application of this pulse is to use the EX7000-OEM 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.

For expanded and more automated operation, each DIO channel can be independently linked to one or multiple limit conditions on one or more input channels. This is termed a DIO Limit Event. For example, DIO channel 0 can be programmed to go high when the upper limit of set 0 for channel 2 or the lower limit of set 1 for channel 1 is exceeded. When linked as a limit event, a DIO channel will be cleared at the beginning of a new acquisition. Its state will then be updated with each scan according to the programmed limit evaluations. By default, the cleared state is low, but can be set on a per channel basis to be high through the use of the Invert setting. Similarly, the default operation of each channel is non-latch mode, but can be set on a per channel basis to be latch mode. In latch mode, a transition out of the cleared state would remain, regardless of future limit evaluations, until it is cleared at the beginning of a new acquisition.

It is important to note that the control of the DIO channels through DIO Limit Event assignment does not lock out control through the direct output mechanism. For example, even if a DIO channel has been set high by a DIO Limit Event, it could be asynchronously set low through direct output control. Because limits can only be evaluated as fast as data is being acquired, there could be an application that employs a slow sampling rate but requires the DIO channel to be reset sooner than the normal limit evaluation mechanism would do it. The direct DIO control provides this capability. Use of that control does not alter or disable the limit event mechanism controls; it simply asynchronously alters the level of the DIO channel output. Upon the next scan (and subsequent limit evaluation), the DIO channel will be updated normally per its DIO Limit Event configuration. In general, however, an application will employ only one control mechanism. For that reason, if a DIO channel is linked as a DIO Limit Event, this is noted in the direct control mechanism as a pseudo-warning to guard against accidental use.

The default selections for each DIO channel are:

- output enable is off
- output level is 0

The default selections for DIO Limit Events are:

- all channels are disabled
- invert is off
- latch is off

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-OEM.

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

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

Reset Button

The reset button, accessible through a hole in the rear panel of the EX7000-OEM, 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-OEM, 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-OEM 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.

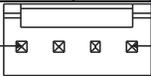
Device Reboot/LCI Reset Mode

To perform an LCI reset and an immediate reboot of the EX7000-OEM, 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-OEM 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-OEM 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.

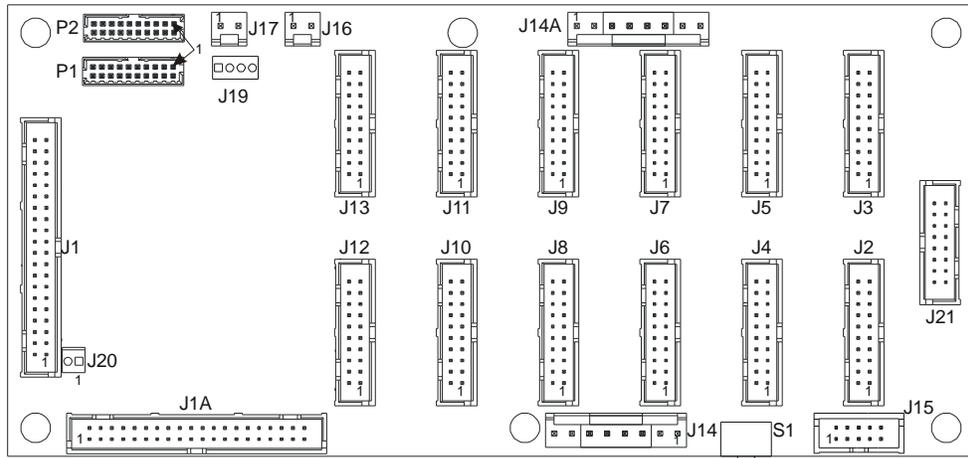
Power Connector

The connector located at J7 is used to supply dc power to the DCB.

| Power Connectors | | | |
|---|---------------|------------|---------------|
| Pin | Signal | Pin | Signal |
| 1 | GND | 2 | +5 V |
| 3 | +5 V | 4 | GND |
|  | | | |
| Mating Connector: AMP 640250-4 | | | |
| Crimp Pins: AMP 640706-1 | | | |

RELAY DRIVER BOARD DETAIL

The relay driver board (RDB) has several connector interfaces which are made available to the user. A description of the connectors and their function follows.



NOTE: J19 and J21 are reserved for future use.

FIGURE 3-2: EX7000-OEM RDB CONNECTOR LOCATIONS

Digital Interface Controller Connectors

The J1 and J1A connectors are used to connect the relay driver board to the controller board. J1 and J1A are interchangeable for ease of usage. When J20 is jumpered, J1A will be utilized, otherwise, J1 is used.

Relay Drive Connectors

Connectors J2 through J13 are Relay Drive connectors. On each connector, there will be:

- 1) 6 relay drive outputs capable of 200 mA (410 mA for three or fewer channels)
- 2) 6 relay indicator inputs which will provide the relay coil status, if applicable
- 3) 4 relay ID inputs
- 4) 1 relay reset output, capable of sinking up to 800 mA to reset all relay coils

| Relay Drive Connectors | | | | |
|-------------------------|--------------------------------|------------------|-----|------------------|
| Designator | Pin | Signal | Pin | Signal |
| J2 through J13 | 1 | PWR_BANKx | 2 | RELAY_DRIVE0 |
| | 3 | RELAY_DRIVE1 | 4 | RELAY_DRIVE2 |
| | 5 | RELAY_DRIVE3 | 6 | RELAY_DRIVE4 |
| | 7 | RELAY_DRIVE5 | 8 | RELAY_INDICATOR0 |
| | 9 | RELAY_INDICATOR1 | 10 | RELAY_INDICATOR2 |
| | 11 | RELAY_INDICATOR3 | 12 | RELAY_INDICATOR4 |
| | 13 | RELAY_INDICATOR5 | 14 | RELAY_ID0 |
| | 15 | RELAY_ID1 | 16 | RELAY_ID2 |
| | 17 | RELAY_ID3 | 18 | RELAY_RST_DRV |
| | 19 | GND | 20 | +5V |
| Connector Pin Locations | | | | |
| Mating Connector | 3M P/N: 3421-7600 (or similar) | | | |

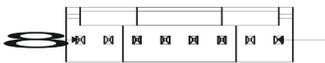


CAUTION

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.

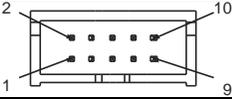
Power Connectors

Either J14 or J14A can be used to supply dc power to the relay driver board. PWR_BANKx voltage can range from 5 V to 45 V.

| Power Connectors | | | | |
|--------------------------------|--|-----------|----------|--------|
| Designator | Pin | Signal | Pin | Signal |
| J14 & J14A | 1 | PWR_BANK0 | 2 | GND |
| | 3 | PWR_BANK1 | 4 | GND |
| | 5 | PWR_BANK2 | 6 | GND |
| | 7 | +5 V | 8 | +5 V |
| Connector Pin Locations |  | | | |
| Mating Connector | AMP P/N: 640250-8 (connector) AMP P/N: 640706-1 (crimp pins) | | | |

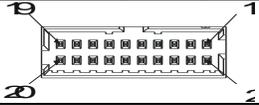
LED Connectors

A header is provided here for compliance with the LXI Standard. For more information, please visit www.lxistandard.org and refer to *LXI Standard Revision 1.1* for LED function. Note that, in order to use the FP_OPENn signal, pins 8 must be connected to ground (pin 10). This function is further described in the *FP Open Signal* section of the *Theory of Operation*.

| LED Connectors | | | | |
|--------------------------------|--|----------|-----------|----------|
| Designator | Pin | Signal | Pin | Signal |
| J15 | 1 | GND | 2 | PWR_GRN |
| | 3 | PWR_RED | 4 | LAN_GRN |
| | 5 | LAN_RED | 6 | 1588_GRN |
| | 7 | 1588_RED | 8 | FP_OPENn |
| | 9 | N/C | 10 | GND |
| Connector Pin Locations |  | | | |
| Mating Connector | AMP P/N: 746288-1 | | | |

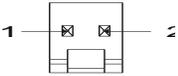
Parallel TTL IO Ports

The PIO port signals are bi-directional, +5 V TTL input/output ports. They can write to and be written from an external device.

| Parallel TTL IO Ports | | | | |
|-------------------------|---|------------|-----|------------|
| Designator | Pin | Signal | Pin | Signal |
| P1 | 1 | GND | 2 | GND |
| | 3 | PIO_PORT0 | 4 | PIO_PORT1 |
| | 5 | PIO_PORT2 | 6 | PIO_PORT3 |
| | 7 | PIO_PORT4 | 8 | PIO_PORT5 |
| | 9 | PIO_PORT6 | 10 | PIO_PORT7 |
| | 11 | PIO_PORT8 | 12 | PIO_PORT9 |
| | 13 | PIO_PORT10 | 14 | PIO_PORT11 |
| | 15 | PIO_PORT12 | 16 | PIO_PORT13 |
| | 17 | PIO_PORT14 | 18 | PIO_PORT15 |
| | | 19 | +5V | 20 |
| P2 | 1 | GND | 2 | GND |
| | 3 | PIO_PORT16 | 4 | PIO_PORT17 |
| | 5 | PIO_PORT18 | 6 | PIO_PORT19 |
| | 7 | PIO_PORT20 | 8 | PIO_PORT21 |
| | 9 | PIO_PORT22 | 10 | PIO_PORT23 |
| | 11 | PIO_PORT24 | 12 | PIO_PORT25 |
| | 13 | PIO_PORT26 | 14 | PIO_PORT27 |
| | 15 | PIO_PORT28 | 16 | PIO_PORT29 |
| | 17 | PIO_PORT30 | 18 | PIO_PORT31 |
| | | 19 | +5V | 20 |
| Connector Pin Locations |  | | | |
| Mating Connector | Molex P/N: 87568-2093 | | | |

Fan Power Connectors

J16 and J17 provide the power to the fan. Note, the voltage at J16/J17 come from PWR_BANK2.

| Fan Power Connectors | | | | |
|-------------------------|---|-----------|-----|--------|
| Designator | Pin | Signal | Pin | Signal |
| J16 & J17 | 1 | PWR_BANK2 | 2 | GND |
| Connector Pin Locations |  | | | |
| Mating Connector | Tyco P/N: 3-640441-2 | | | |

Address Switch

The rotary switch located at S1 sets an RDB's address. The 16 position is only valid in the 0 through 7 range. Setting an RDB to addresses 8 through F is not defined and should not be used.

| | |
|--------------|---|
| NOTES | In EX7000-OEM systems that include multiple RDBs, it is imperative that each RDB be set to a unique address. The address does not have to be in sequential order. |
|--------------|---|

Relay Banks

The EX7000-OEMs relay drive connectors on the RDB 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.

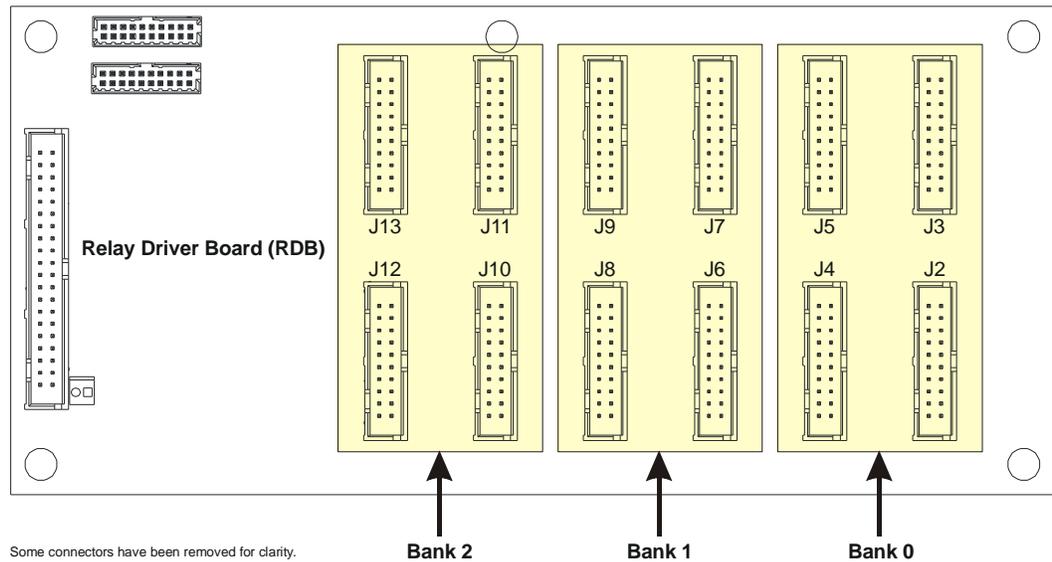


FIGURE 3-3: RELAY DRIVE CONNECTOR BANKS

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 in the **Discover Devices** tab. The IP address of the EX7000-OEM can also be viewed from this window as well as its firmware version.

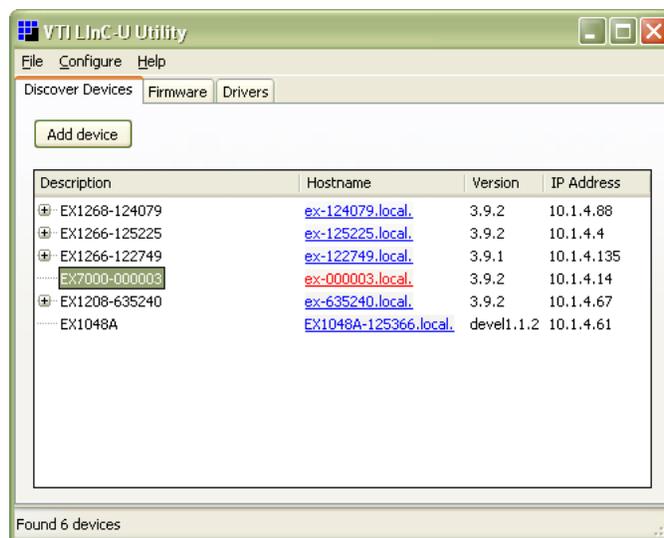


FIGURE 4-1: LINC-U DISCOVERY TAB WITH EX7000 SELECTED

Alternatively, the EX7000-OEM may also be discovered using Internet Explorer's Bonjour for Windows plug-in. The IP address of the EX7000-OEM can also be entered into the address bar of any web browser to view the embedded web page. By default, the EX7000-OEM 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.

GENERAL WEB PAGE OPERATION

When initial connection is made to the EX7000-OEM, the instrument home page, **Index**, appears (see Figure 4-2). 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

The **Index** is accessible from any other instrument page by clicking on the EX7000-OEM web page header. The EX7000-OEM 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.

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.

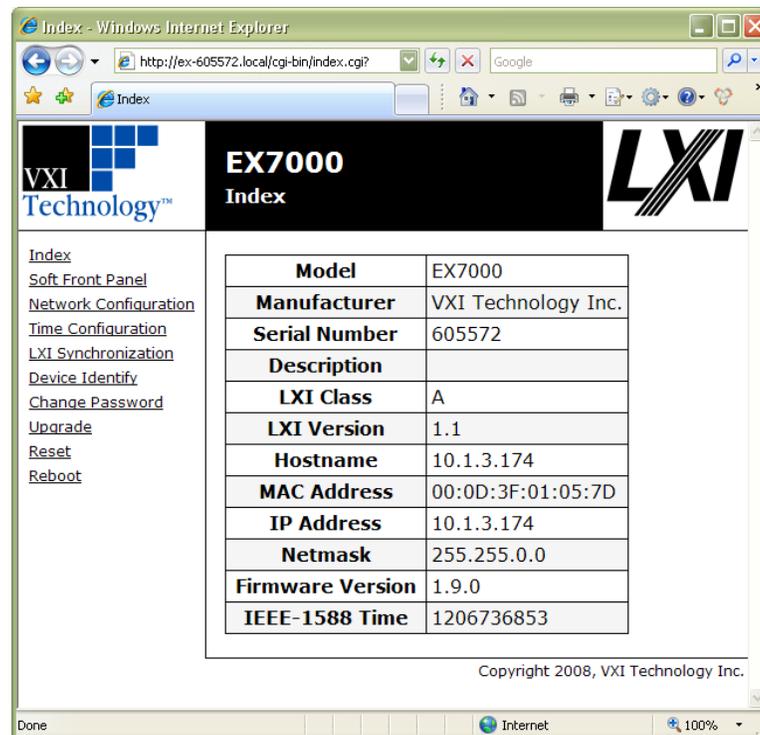


FIGURE 4-2: EX7000-OEM MAIN WEB PAGE

Use of the entry-type web pages in the EX7000-OEM 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-OEM, 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.

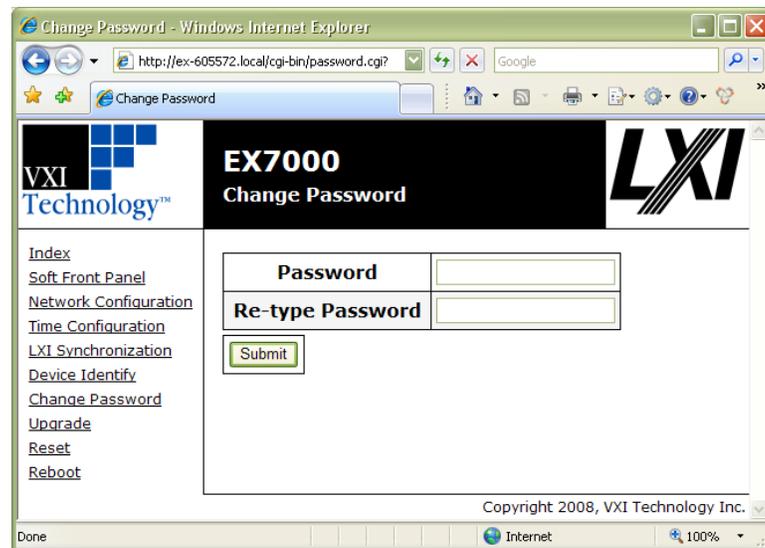


FIGURE 4-3: EX7000-OEM PASSWORD PAGE

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-OEM web pages is a link to the VTI Instruments Corp. corporate website: <http://www.vtiinstruments.com>.

EX7000 Title Block

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

SOFT FRONT PANEL

An example of the EX7000-OEM 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-OEM 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-OEM. 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.

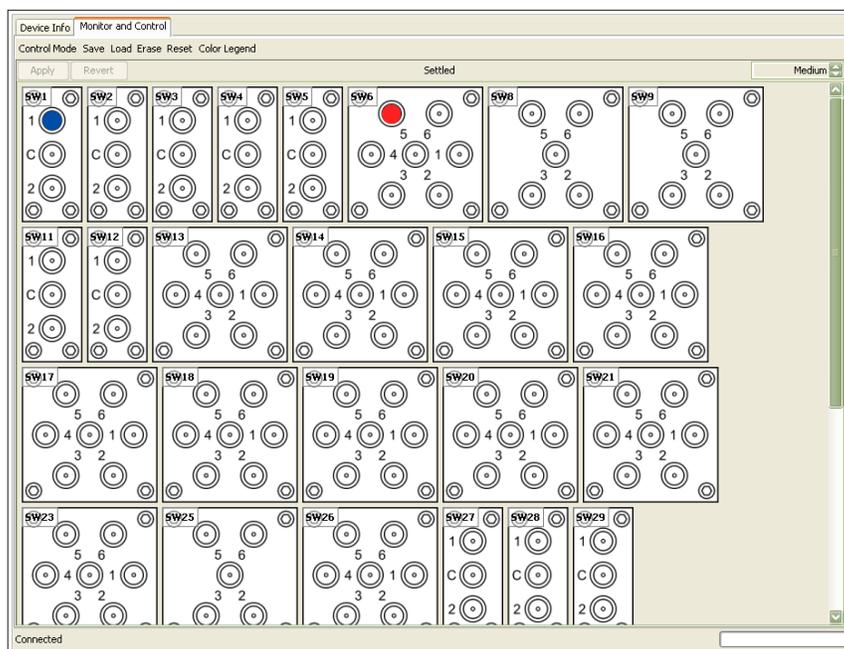


FIGURE 4-4: EX7000-OEM SOFT FRONT PANEL PAGE

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-OEM modules.
 - **Monitor Only:** In this mode, the user can view the actions the various EX7000-OEM 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 established a session with the EX7000-OEM, 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-OEM in real time. As the user clicks a port or sets a value and it affects the EX7000-OEM 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/Erse:** 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 **Erse** 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.

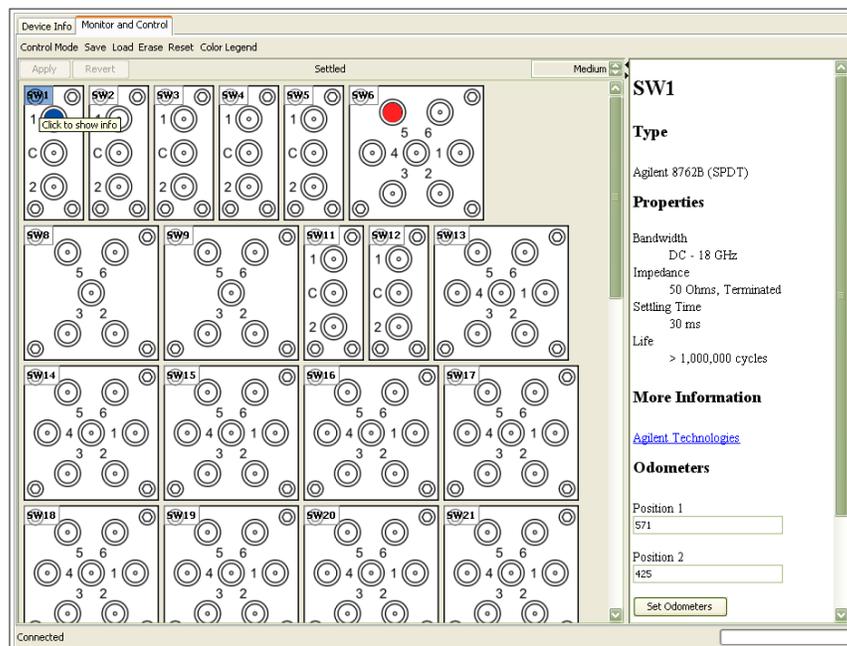


FIGURE 4-5: SWITCH INFORMATION MENU (RIGHT)

Device Info Tab

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

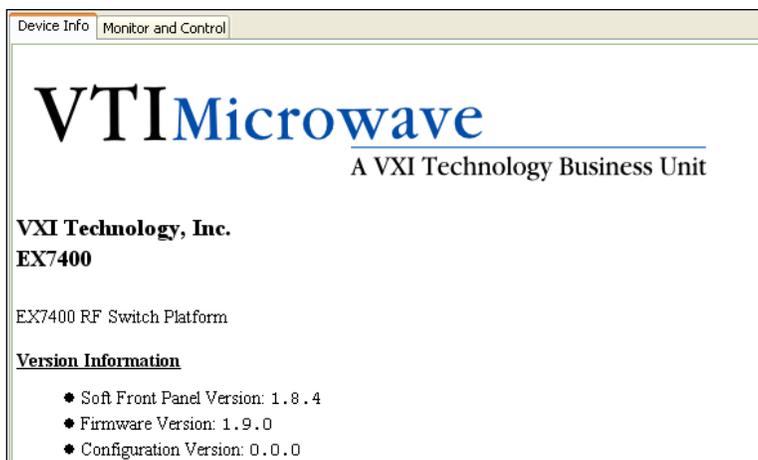


FIGURE 4-6: DEVICE INFORMATION WEB PAGE

NETWORK CONFIGURATION

The EX7000-OEM **Network Configuration** page can be seen in Figure 4-7. By default, the EX7000-OEM 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-OEM can be returned to a known, default network configuration by using the LCI (LAN Configuration Initialize) Mechanism. See *Error! Reference source not found.* 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

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-OEM's MAC address on the DHCP server, would be assigned to the EX7000-OEM at power up initialization without having to manually set it on the EX7000-OEM. 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-OEM. This allows all EX7000-OEMs on a local network to be found without knowledge of their MAC address or IP address with the use of a broadcast message.

The screenshot shows the 'EX7000 Network Configuration' web page. The browser address bar shows 'http://ex-605572.local/cgi-bin/network.cgi?'. The page has a navigation menu on the left with links like 'Index', 'Soft Front Panel', 'Network Configuration', 'Time Configuration', 'LXI Synchronization', 'Device Identify', 'Change Password', 'Upgrade', 'Reset', and 'Reboot'. The main content area is divided into several sections:

- IP Address Source:** Three checkboxes: DHCP, AutoIP, and Static.
- Host Configuration:** Two text input fields for 'Hostname' and 'Description'.
- Static IP Configuration:** Four text input fields for 'IP Address', 'Subnet Mask', 'Gateway Address', and 'DNS Servers'.
- Network Status:** A table showing current network settings:

| | |
|-----------------|-------------------|
| IP Address | 10.1.3.174 |
| Subnet Mask | 255.255.0.0 |
| Gateway Address | vtigate127.vxit |
| MAC Address | 00:0D:3F:01:05:7D |

A 'Submit' button is located at the bottom of the configuration section. The footer of the page reads 'Copyright 2008, VXI Technology Inc.' and the browser status bar shows 'Internet' and '100%' zoom.

FIGURE 4-7: EX7000-OEM NETWORK CONFIGURATION

NOTE If problems are experienced connecting to the EX7000-OEM, 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-OEM. As the EX7000-OEM 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).

The screenshot shows a web browser window titled "Time Configuration - Windows Internet Explorer". The address bar shows "http://ex-605572.local/cgi-bin/time.cgi". The page content includes the VTI Technology and LXI logos, a navigation menu with links like "Index", "Soft Front Panel", "Network Configuration", "Time Configuration", "LXI Synchronization", "Device Identif", "Change Password", "Upgrade", "Reset", and "Reboot". The main content area is titled "EX7000 Time Configuration" and contains two tables. The first table, "Time Configuration", has fields for "Time Zone" (set to "(GMT -08:00) PST (Pacific Sta)", "Time Source" (set to "PTP"), and "Set Time" (checkbox). The second table, "Time Status", shows "Current Time" as "Fri Mar 28 13:42:05 2008" and "PTP Status" as "Master". A "Submit" button is located below the tables. The footer of the page reads "Copyright 2008, VTI Technology Inc.".

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

- **Time Zone:** allows the user to select an appropriate time zone.
- **Time Source:** allows the user to set the EX7000-OEMs date by entering the month (MM), day (DD), and year (YYYY), respectively.
- **Set Time:** allows the user to set the EX7000-OEMs time by entering the hour (HH), minute (MM), and second (SS), respectively. If the EX7000-OEM 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-OEM can be 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 effect.

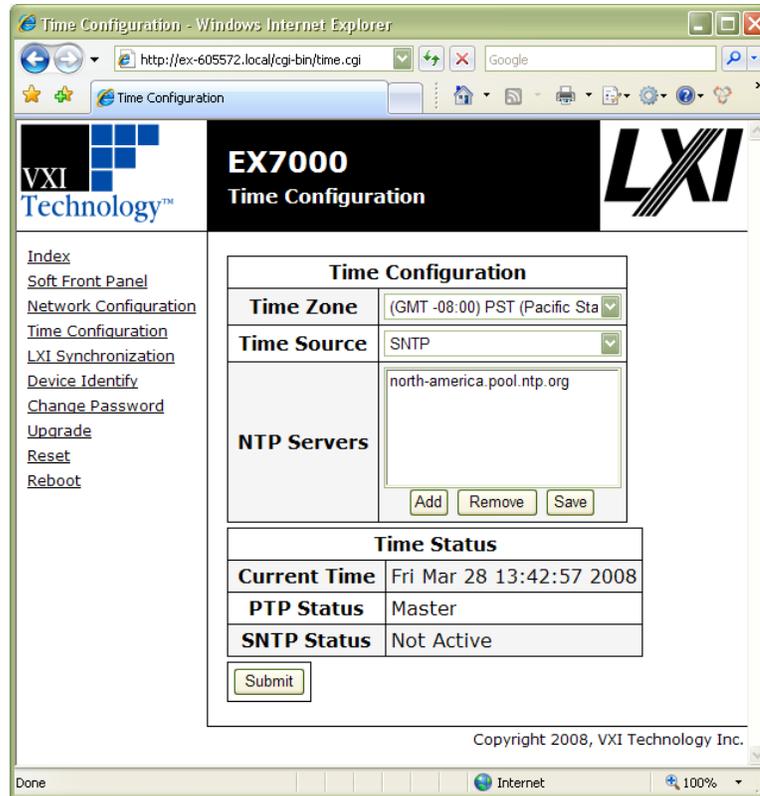


FIGURE 4-9: SNTP CONFIGURATION PAGE

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 EX7000-OEMs 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.*

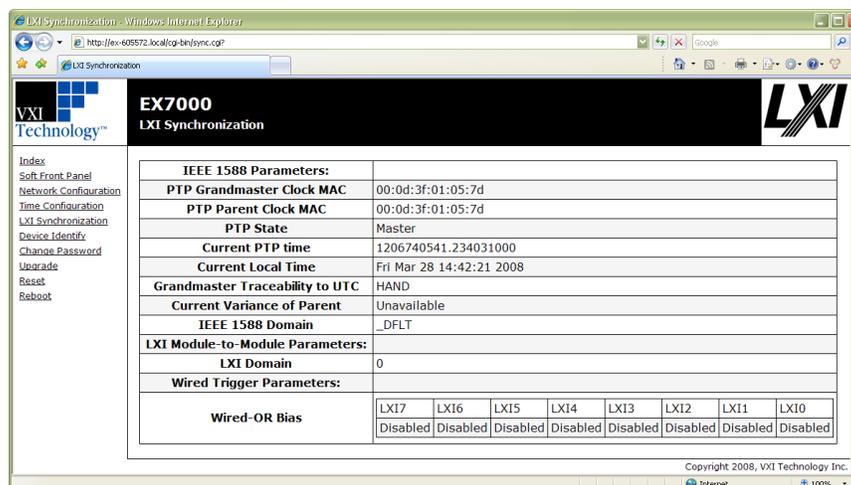


FIGURE 4-10: LXI SYNCHRONIZATION WEB PAGE

- **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-OEM 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-OEM 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-OEM.
- **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-OEM 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.

DEVICE IDENTIFY

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

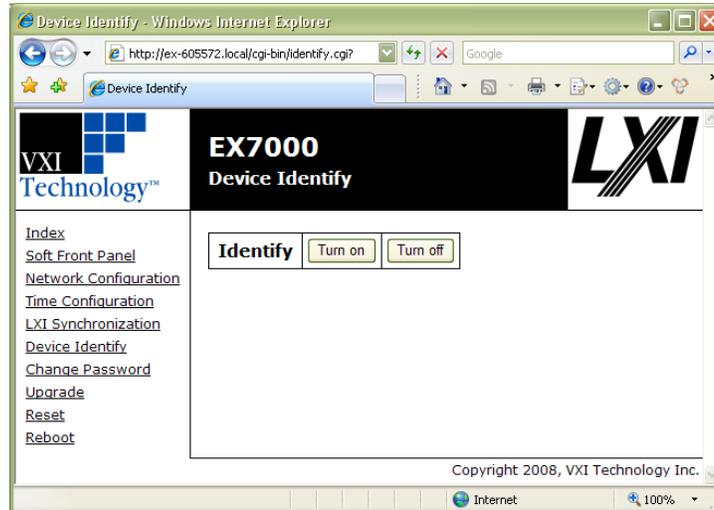


FIGURE 4-11: DEVICE IDENTIFY WEB PAGE

UPGRADE

This action page is used to upgrade the embedded firmware of the EX7000-OEM. 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-OEM. Unless specifically noted, firmware upgrades do not alter the non-volatile configuration settings (network configuration, time configuration) of the EX7000-OEM.

NOTE Do not power cycle the EX7000-OEM 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.

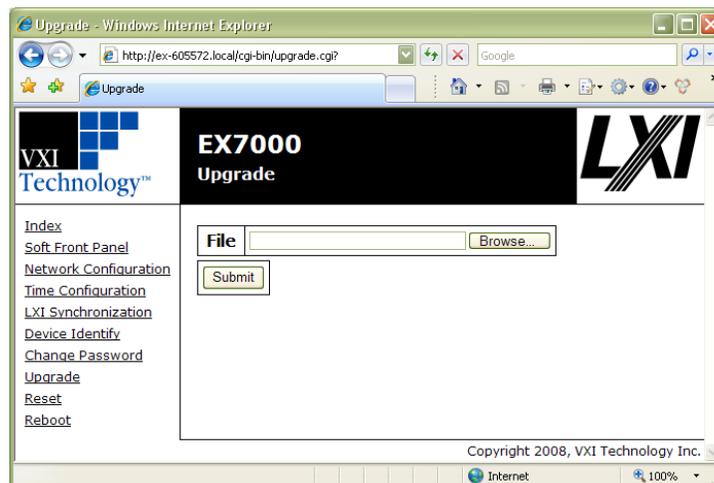


FIGURE 4-12: UPGRADE WEB PAGE

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.

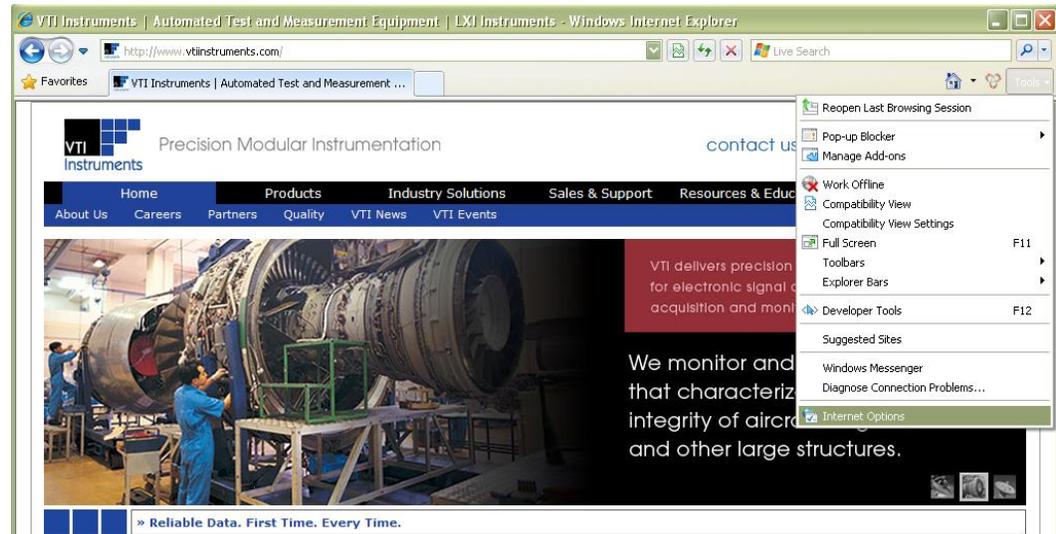
Removing Temporary Internet Files

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 on-line help documentation):

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



- 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.



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**).

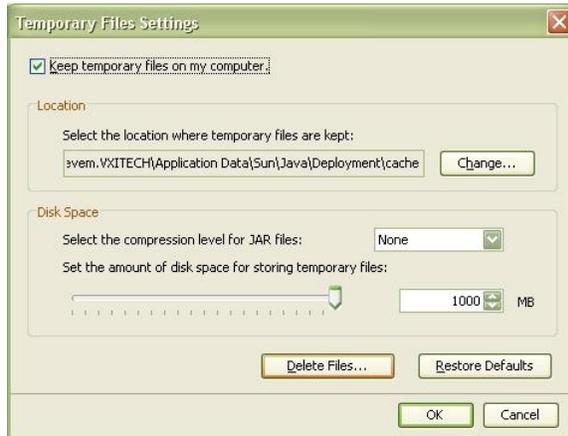
- 2) Double click the **Java** icon in the Control Panel.



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



- 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

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

SECTION 5

THEORY OF OPERATION

INTRODUCTION

This section expands on the description of the EX7000-OEMs features and explains how to best use them. A functional block diagram is provided below.

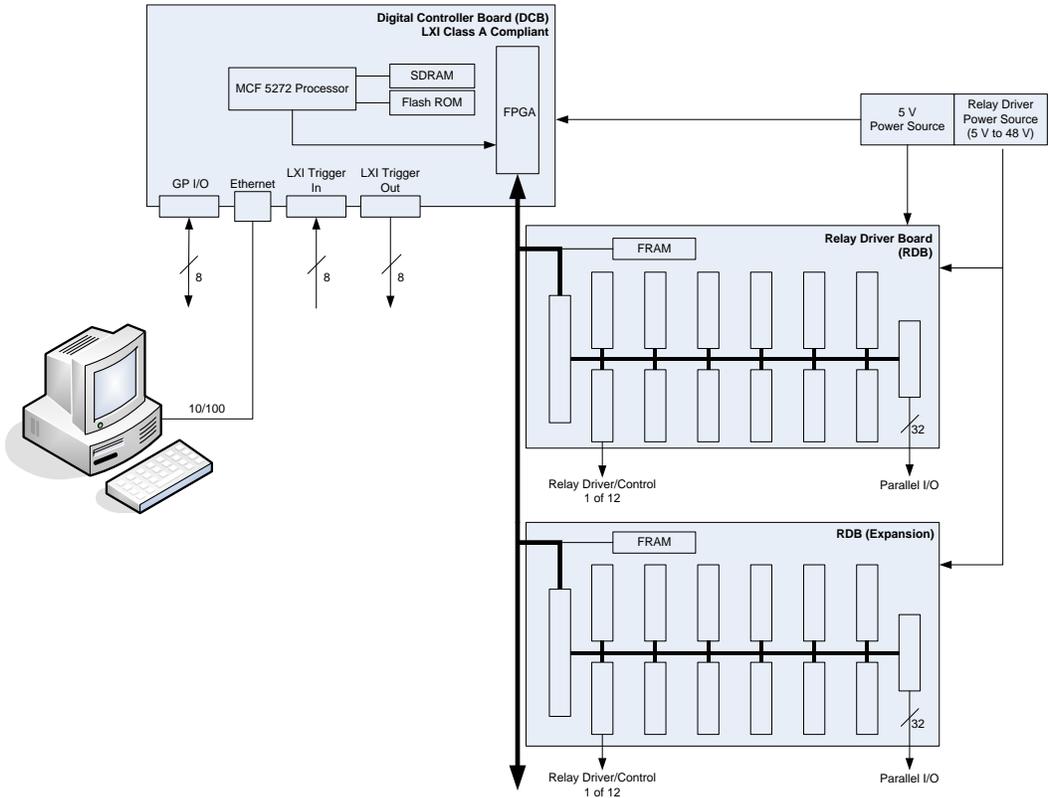


FIGURE 5-1: FUNCTIONAL BLOCK DIAGRAM

SYSTEM OVERVIEW

Using the drivers provided with the EX7000-OEM, commands are issued from the host PC to the Digital Controller Board (DCB). The DCB, in turn, controls the operation of the Relay Driver Boards (RDBs). Up to eight RDBs can be controlled by one DCB, making the EX7000-OEM capable of providing up to 576 relay control driver, 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-OEM system, a rotary switch on the RDB is used to set a unique address for each RDB.

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 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 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 different types may result in erratic behavior and damage to overall system.

OPEN-COLLECTOR VS. TTL DRIVE LINES

The EX7000-OEM relay drive connectors reside on RDBs that are partitioned into three banks: J2 through J5 constitute bank 0, J6 through J10 bank 1, and J11 through J14 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.

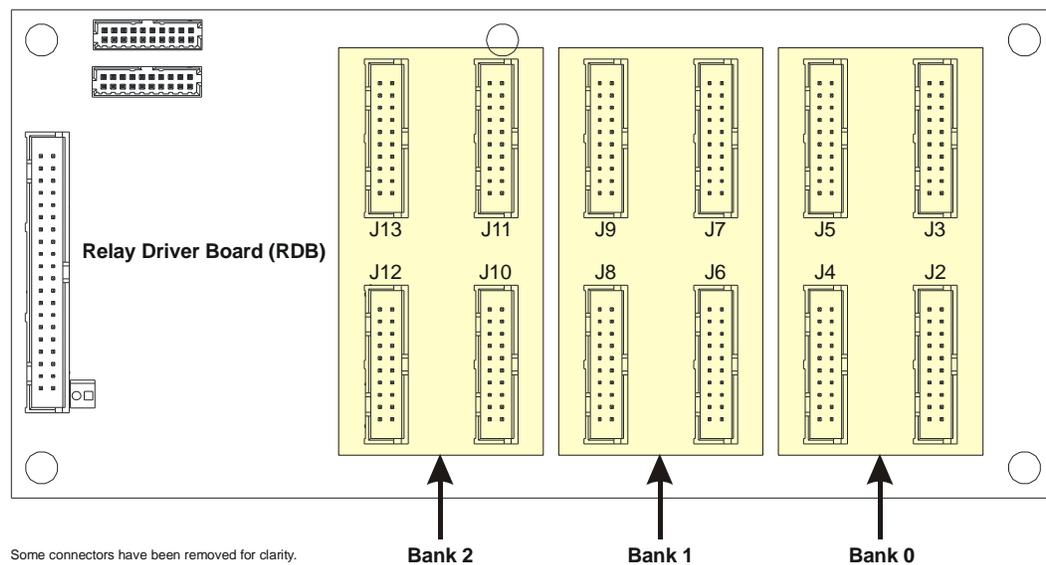


FIGURE 5-2: RELAY DRIVE CONNECTOR BANKS

Additionally, the RDB of the EX7000-OEM 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 to 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

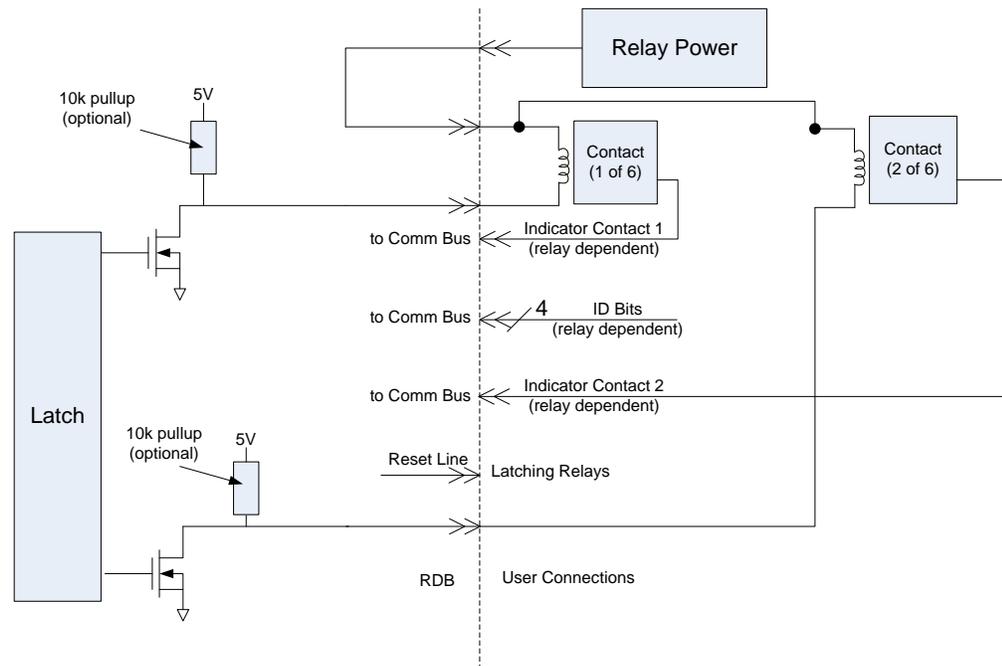


FIGURE 5-3: RELAY DRIVER BLOCK DIAGRAM

The following connections should be made:

- 1) The Relay Power line (PWR_BANKx) to the positive sides of all relay coils.
- 2) The Relay Drive line (RELAY_DRIVEEx) to the negative sides of the coils.

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 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.

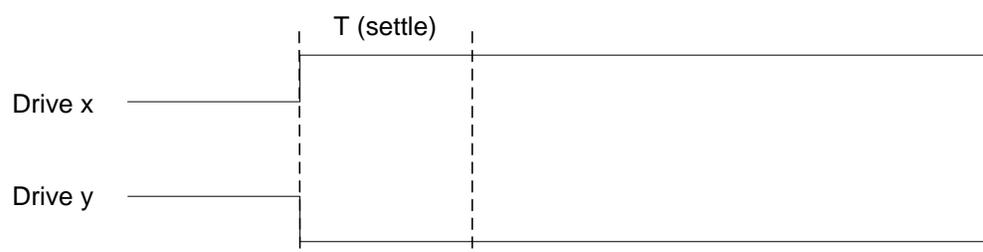


FIGURE 5-4: CONTINUOUS OPERATION MODE

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.

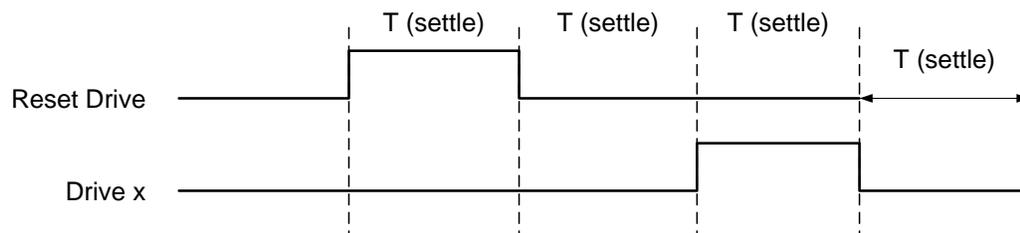


FIGURE 5-5: PULSE OPERATION MODE

NOTE There is no current monitoring capability on the EX7000-OEM. 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 a 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.

FP Open Signal

Front panel open (FP_OPEN n) is an active low signal that allows the user to open all relays with a single event. To activate the front panel open signal, connect pins 8 and 10 together on the J15 connector (see *LED Connectors* for more information). When these pins are connected for a minimum of 5 ms, the relays on all open-collector RDBs that share the same DCB will open. As long as the FP_OPEN n signal is active, RDBs will not respond to commands. In order to return to normal operation, the connection between the pins 8 and 10 must be removed *and* a software reset must be performed. Figure 5-6 shows the soft front panel of an EX7000-OEM where the FP_OPEN n signal has been asserted and is currently active, as indicated by the monitor error that appears in the lower left corner.

NOTE

In a system a where a DCB is connected to multiple RDBs, only one (1) RDB needs to be configured to accept the FP_OPEN n signal. When FP_OPEN n is asserted on this RDB, it will cause all RDBs in the system to open their relays as well.

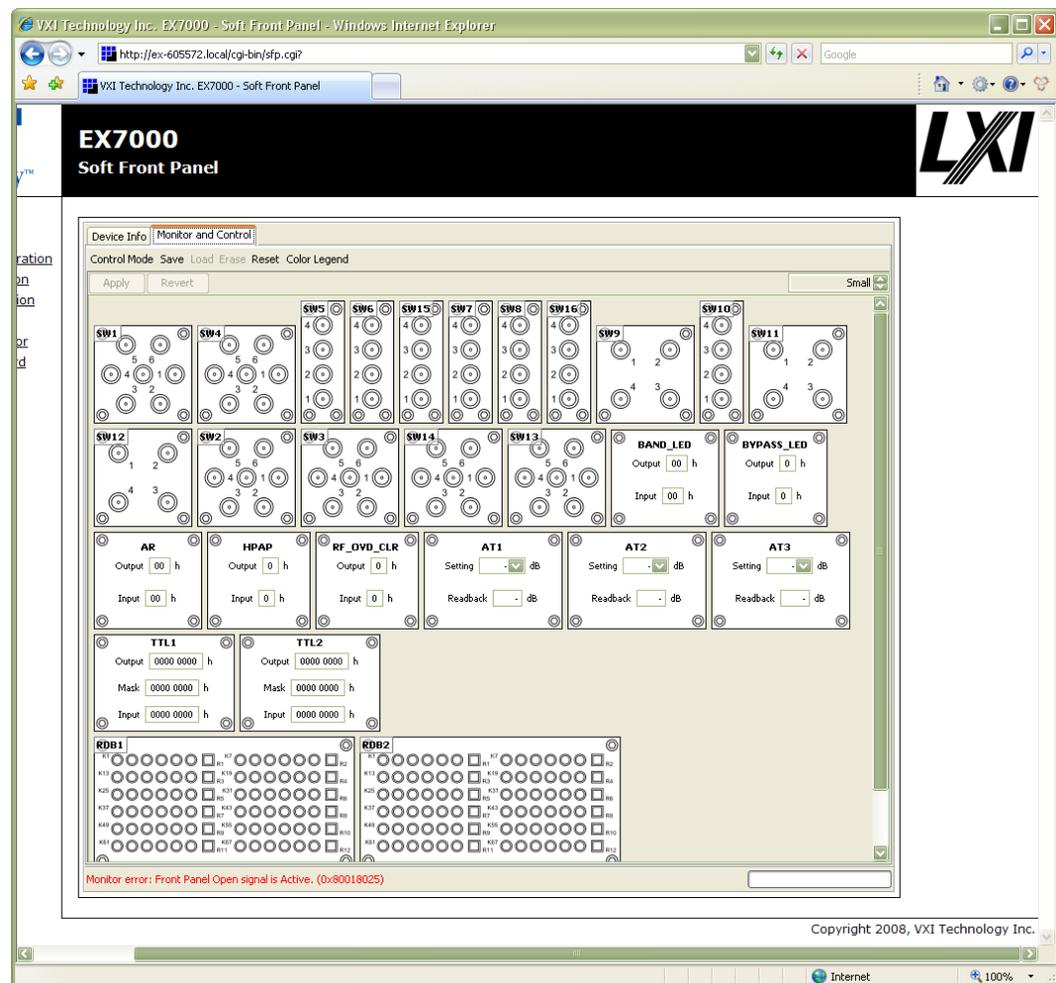


FIGURE 5-6: FP OPEN ERROR MESSAGE

NOTE

This feature is only available to RDBs (P/N: 52-0646-00x) of revision B or later with a firmware version of 1.9.4 or later.

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\EX7000-OEMSystemConfigurator_Rnpr.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.

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-OEM , 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-OEM 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 System Configurator 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.

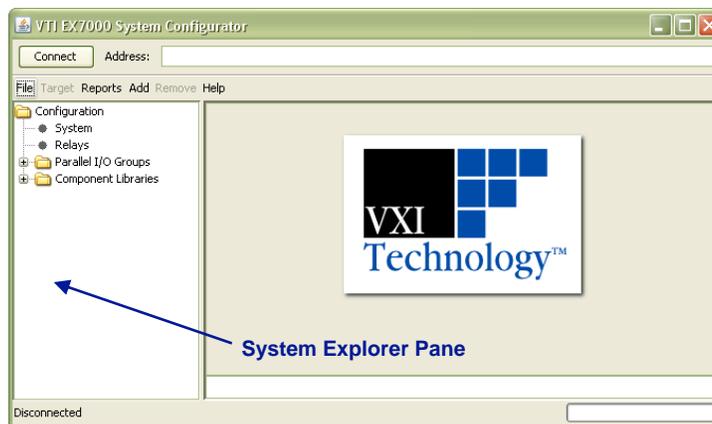


FIGURE A-3: CREATING A NEW DFC FILE

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, 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-OEM system. This is done by entering the IP address of the target EX7000-OEM 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-OEM

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-OEM system.

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

Relays

To add a relay to an EX7000-OEM 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-OEM 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.

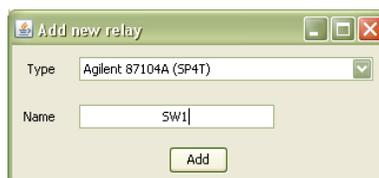


FIGURE A-6: ADDING AN AGILENT 87104A RELAY AS “SW1”

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.

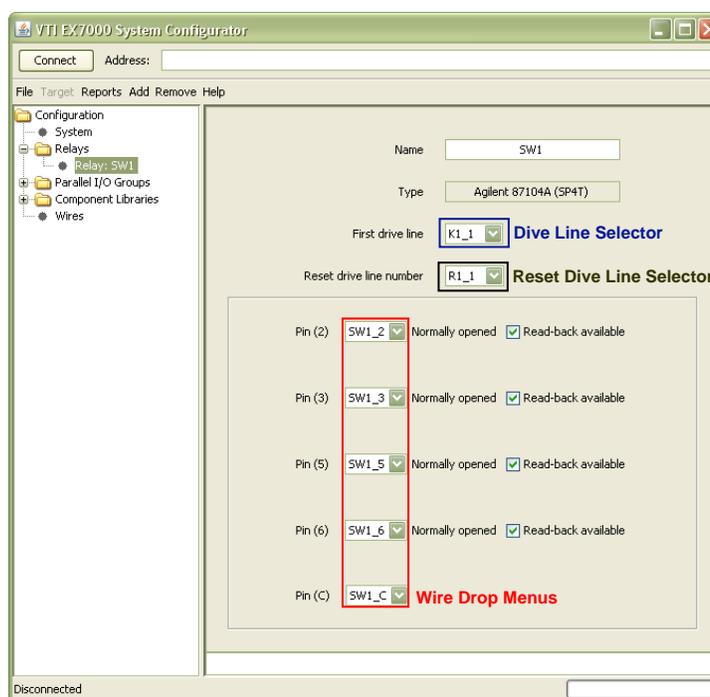


FIGURE A-7: RELAY PROPERTIES WINDOW

NOTE

Latching and non-latching relays cannot be tied to the same RDB bank of relay drive lines (bank 0: Kn_1 to Kn_{24} , bank 1: Kn_{25} to Kn_{48} , and bank 2: Kn_{49} to Kn_{72}). For more information, please refer to the *Open-Collector vs. TTL Drive Lines* section in *Section 2*.

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

This function is specific to the EX71HD. It should not be used with an EX7000-OEM.

Attenuators

To add an attenuator to an EX7000-OEM 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-OEM 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.

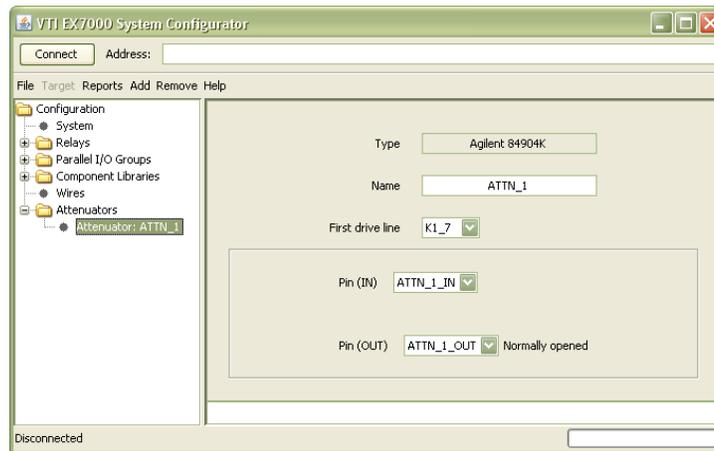


FIGURE A-8: ATTENUATOR PROPERTIES WINDOW

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.

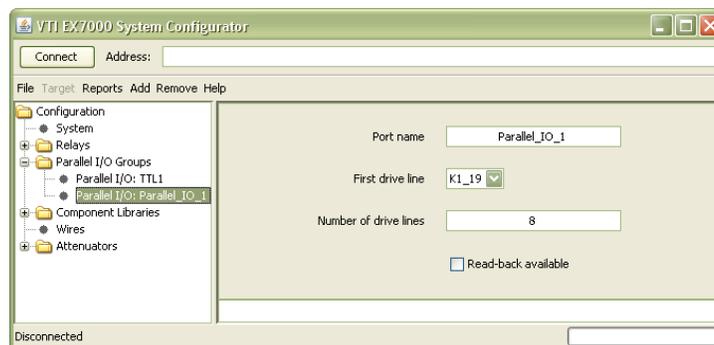


FIGURE A-9: PARALLEL I/O PROPERTIES WINDOW

Wire Types and Wires

A wire is created to define a connection between two components in an EX7000-OEM 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.

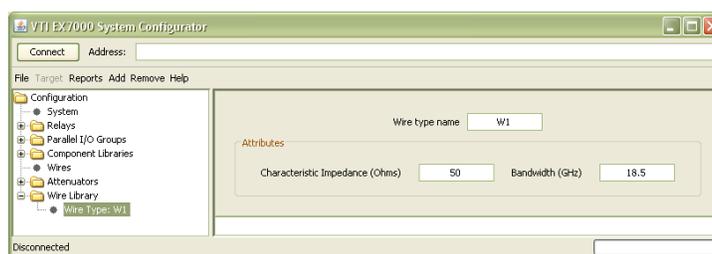


FIGURE A-10: WIRE TYPE PROPERTIES WINDOW

Once a wire type has been defined, a wire can be 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.

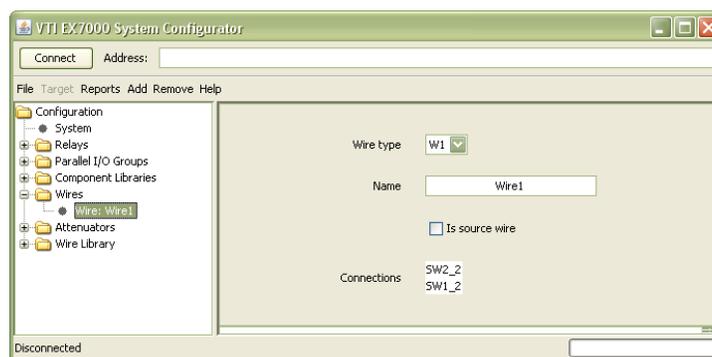


FIGURE A-11: WIRE PROPERTIES WINDOW

Passive Devices

In addition to the active system components, various passive components can be added to an EX7000-OEM 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 appears, 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.

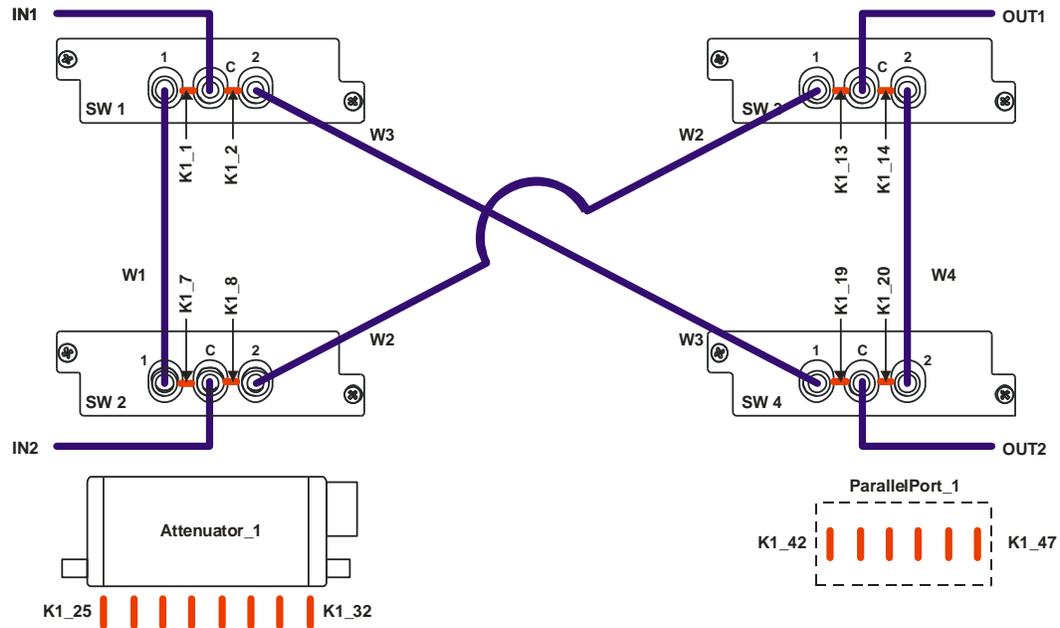


FIGURE A-12: CONFIGURATION EXAMPLE

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.

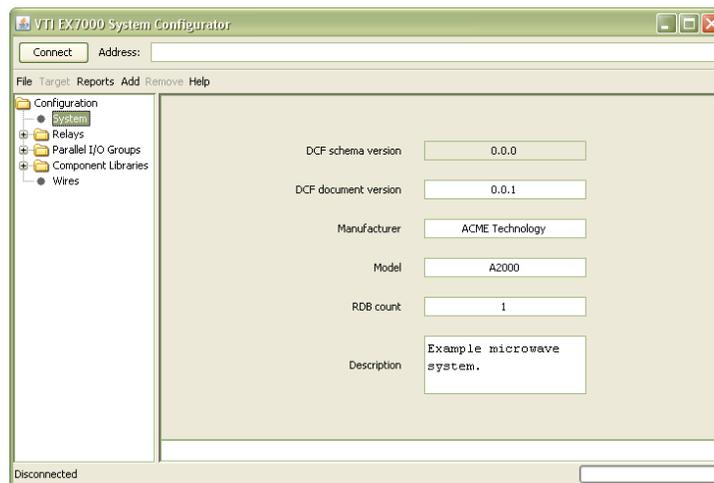


FIGURE A-13: SYSTEM PROPERTIES WINDOW

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.



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.

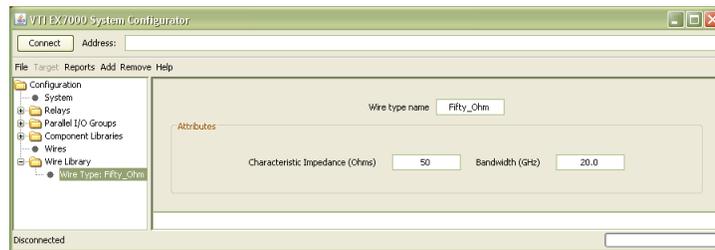


FIGURE A-15: WIRE TYPE DETAIL PANE

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.

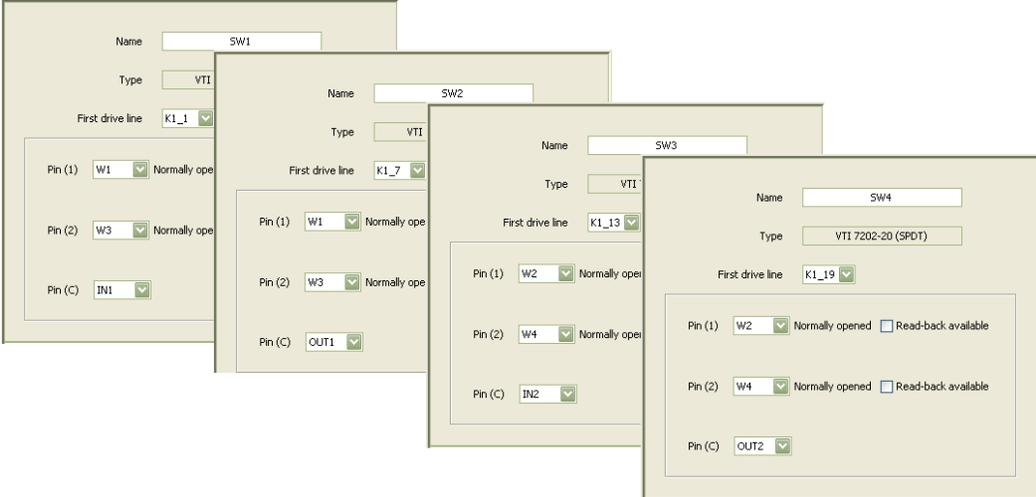


FIGURE A-17: CONFIGURED RELAYS — SW1 THROUGH SW4

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.

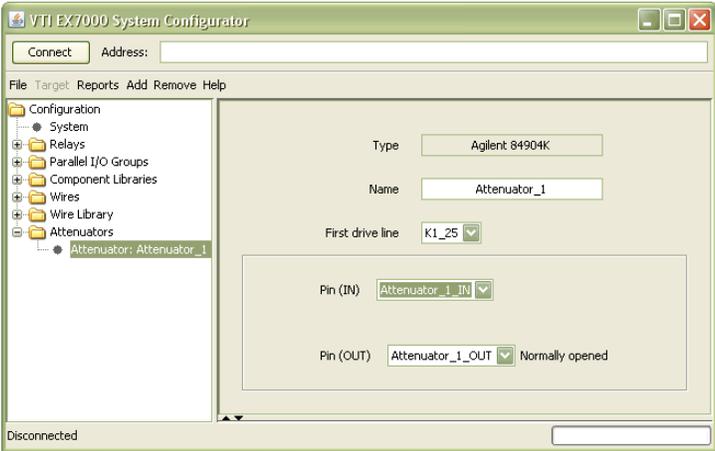


FIGURE A-18: ATTENUATOR DETAIL PANE

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.

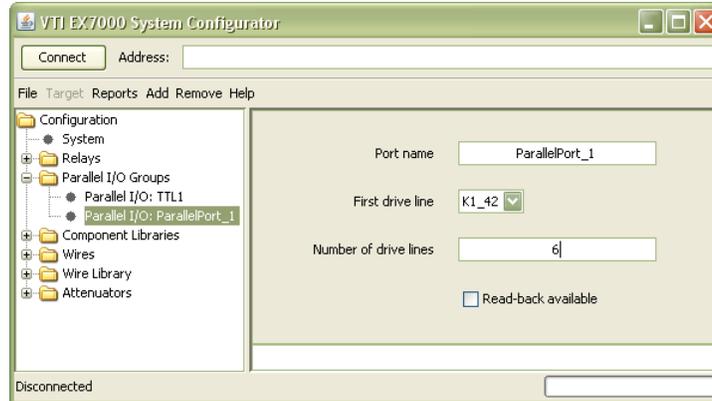


FIGURE A-19: PARALLEL PORT DETAIL PANE

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-OEM’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.

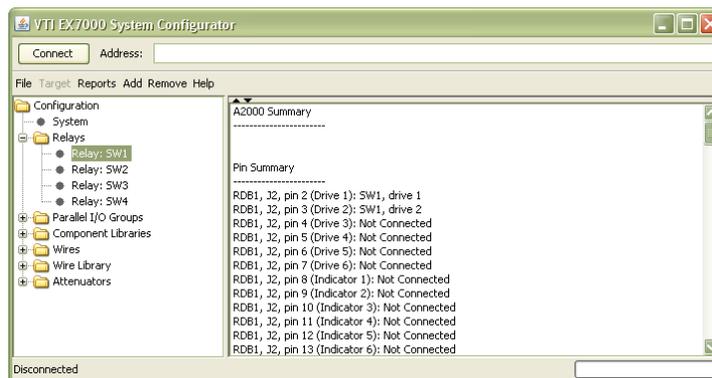


FIGURE A-20: CONFIGURATION SUMMARY REPORT

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 |
| 2x32 MB DRAM (Micron Tech, MT48LC8M16A2TG-7E) | Yes | Runtime Data | Yes | Power cycle machine |
| 1 Mb EEPROM (1 per RDB) (Xilinx, XCF01SVIG020) | 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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