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User Manual

Tektronix

VX4385
Matrix Switch Module

070-9131-01

This document applies for firmware version 1.00 and above.

Please check for change information at the rear of this manual.

Second Edition: September, 1994

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LIMit n — Sets the maximum number of matrix relays that can be closed at one time. (3 - 41)

LIMit? — Returns the maximum number of matrix relays that can be closed at one time. (3 - 42)

MBUFfer ON | OFF
Enables or disables buffer mode when running macros in non-buffered mode. (3 - 43)

MBUFfer? — Returns the state of the MBUFfer mode. (3 - 44)

OPEN [:ALL] | [:ABSolute] x,y[,m]
Opens switches relative to the configured matrix. (3 - 45)

OPEN? [:ABSolute] x,y[,m]
Returns the state of the relay indicated by the parameters. (3 - 47)

UPDate [ON | OFF]
Disables or enables display updates after an OPEN or CLOSE command. Forces an update if no parameters are given. (3 - 48)

UPDate? — Returns the state of the automatic updating feature. (3 - 49)

VERBose ON | OFF
Disables or enables full error messages to the four digit display. (3 - 50)

VERBose? — Returns the state of full error message generation to the four digit display. (3 - 51)

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VX4385 Matrix Switch Module
QUICK REFERENCE GUIDE

Numbers in parentheses refer to the page(s) in the Operating Manual.

SETUP

Be sure all switches are correctly set. (p. 1 - 3)
Follow Installation guidelines. (p. 2 - 1)

The default condition of the VX4385 Module after the completion of power-up self test is as follows:

All configuration relays open (Dual 4 X 16).
All matrix relays open.
Error messages cleared.
BUFFer OFF.
MBUFfer OFF.
VERBose ON.
UPDate ON.
DWELl ON.

LEDs

When lit, the LEDs indicate the following:

Power	power supplies functioning
Failed	module failure
ERR	an error has been found in self test or programming
MSG	module is processing a VMEbus cycle

SYSTEM COMMANDS

These non-data commands are initiated by the VX4385's commander. The following VXIbus Instrument Protocol commands will affect the VX4385:

ABORT NORMAL OPERATION	ERROR QUERY
ASYNCHRONOUS MODE CONTROL	GRANT DEVICE
BEGIN NORMAL OPERATION	IDENTIFY COMMANDER
BYTE AVAILABLE	READ INTERRUPTERS
BYTE REQUEST	READ PROTOCOL
CLEAR	READ STATUS
CLEAR LOCK	RESPONSE ENABLE
CONTROL EVENT	SET LOCK
END NORMAL OPERATION	TRIGGER

COMMAND SYNTAX

Command protocol and syntax for the VX4385 Module is as follows: (3 - 3)

1) Commands consist of 3-12 ASCII characters, and require a terminator.
<CR> indicates a carriage-return. <LF> indicates a line-feed.
<TM> indicates a line feed or semicolon terminator.

2) Any character may be sent in either upper or lower case form. Upper case shows the short form; lower case shows additional characters needed for the long form.

3) Any of the following are white space characters:
00 hex (NULL character) 01 hex through 08 hex
09 hex (TAB character) 0B hex through 19 hex (including <CR>
20 hex (SPACE character)
A space must separate commands from parameters beginning with an letter. If a parameter begins with a number, ("), or ($), the space is optional. Any number of spaces may be used together, and leading or trailing spaces are ignored.

4) The numerical parameters for the OPEN or CLOSe functions may only be simple unsigned integers.

5) The quoted strings used in the DISPlay and DEFine functions must be formatted correctly. See the Command Syntax section for details.

6) Commands beginning with an asterisk (*) require the (*).

7) A vertical bar | separates parameter options.

MODULE COMMANDS

Commands with an * are part of the set defined by IEEE-488 Specification. The * is required.

*CLS Clears the status registers. (3 - 8)

*ESE n Sets the mask for the Standard Event Status register. (3 - 9)

*ESE? Returns the mask for the Standard Event Status register. (3 - 10)

*ESR? Returns the Standard Event Status register. (3 - 11)

*IDN? Returns the module identification and software revision. (3 - 12)

*OPC Sets the Operation Complete bit in the Standard Event Status register to a 1 when pending operations have been completed. (3 - 13)

*OPC? Delays execution of a program until the completion of an operation. (3 - 14)

*RST Resets the module to the power-up state. (3 - 15)

*SRE n Set the Status Request Enable Mask register. (3 - 16)

*SRE? Return the status mask register. (3 - 17)

*STB? Return the status byte. (3 - 18)

*TST? Return the results of the RAM test. (3 - 19)

*WAI Stops operation until pending operations have completed (provided for compatibility with IEEE 488.2 Specifications). (3 - 20)

BUFFer ON | OFF Enables or disables the input buffer. (3 - 21)

BUFFer? Returns the state of the buffer mode. (3 - 22)

CATalog? Returns a list of the user defined labels. (3 - 23)

CLOSe [:ABSolute] x,y[,m] | $I
Closes relays indicated by x, y, and m. (3 - 24)

CLOSe? [:ABSolute] x,y[,m]
Returns the state of the relay indicated by the parameters. (3 - 26)

CONFigure m Defines the matrix configuration. (3 - 27)

CONFigure? Returns the matrix configuration. (3 - 28)

DATE? Returns the date of the last software revision. (3 - 29)

DEFine l,s Defines an ASCII character or characters to be executed when the user defined label is received. (3 - 30)

DEFine? l Returns the user definition of a macro label. (3 - 32)

DELete l Deletes the user definition of a macro label. (3 - 33)

DISPlay s Enable/disable display, display a string on the front panel display. (3 - 34)

DISPlay? Returns the current display string. (3 - 35)

DWELl ON | OFF Turns the break-before-make feature on or off. (3 - 36)

DWELl? Returns the state of the break-before-make feature. (3 - 37)

ERRor? The next readback will be the next error message in the queue. (3 - 38)

HALT [r] Halts execution until a readback. (3 - 40)

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Safety Summary

The general safety information in this summary is for both operating and servicing personnel. Additional specific warnings and cautions are found throughout the manual where they apply, and may not appear in this summary.

TERMS

In This Manual

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the module or other property.

Marked on the Module

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property, including the module itself.

SYMBOLS

In This Manual



This symbol indicates where applicable cautionary or other information is to be found.



This symbol indicates where special explanatory information is included in the manual. There is no caution or danger associated with the information.

Marked on the Module



DANGER — High Voltage.



Protective ground (earth) terminal.



ATTENTION — Refer to the manual.



Refer to manual before using.

Power Source

This module is intended to operate in a mainframe whose power source does not apply more than 250V rms between the supply conductors or between either supply conductor and ground. A protective ground connection through the grounding conductor in the power cord(s) is essential for safe operation.

Grounding the Module

This module is grounded through the grounding conductor of the mainframe power cord(s). To avoid electrical shock, plug the mainframe power cord(s) into a properly wired receptacle before connecting to the module connectors. A protective ground connection through the mainframe is essential for safe operation.

Danger Arising from Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts can render an electric shock.

Use the Proper Fuse

To avoid fire hazard, use only fuses specified in the module parts list. A replacement fuse must meet the type, voltage rating, and current rating specifications required for the fuse that it replaces.

Do Not Operate in Explosive Atmosphere

To avoid explosion, do not operate the module in an explosive atmosphere.

Do Not Remove Covers or Panels

To avoid personal injury, the module covers should be removed only by qualified service personnel. Do not operate the module without covers and panels properly installed.

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VX4385
Matrix Switch Module

Section 1
General Information and Specifications

Introduction

The VX4385 Matrix Switch Module is a printed circuit board assembly for use in a mainframe conforming to the VXIbus Specification. The module provides 128 independently controlled double-pole single-throw DPST relays which can be configured as either a 2-wire or 4-wire switch. Software control insures break-before-make operation.

The matrix can be arranged into the following configurations by using software commands:

2-Wire	4-Wire
Two 4 x 16	Two 2 x 8
One 4 x 32	One 2 x 16
One 8 x 16	One 4 x 8

Two front panel DD50 connectors provide signal I/O. An additional front panel 16-pin header connector allows multiple modules to be connected for larger matrices. Some of the expansion possibilities are shown below:

	2-Wire	4-Wire
TWO MODULE SET	One 4 x 64	One 2 x 32
	One 8 x 32	One 4 x 16
THREE MODULE SET	One 4 x 96	One 2 x 80
	One 8 x 48	One 4 x 24
FIVE MODULE SET	One 4 x 160	One 2 x 80
	One 8 x 80	One 4 x 40

A maximum of twelve VX4385 Modules can be combined into a single matrix using a full size VXI mainframe.

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The VX4385 has an extensive macro capability. Macros are sequences of commands or groups of relays that are defined by the user using the DEFine command. Each macro is referenced by a label that is specified when the macro is defined. Macros are especially useful when a series of commands or a particular group of relays is going to be used frequently. Once the macro is defined, its contents do not need to be re-entered each time it is used. There are 20 Kbytes of memory available for macros.

BITE (Built-In Test Equipment)

The module will perform an extensive RAM test on power-up, and the *TST? command can return the results of this test at any time. A four-character alphanumeric front panel display can display the module's status, error messages, and indicate the closed relays.

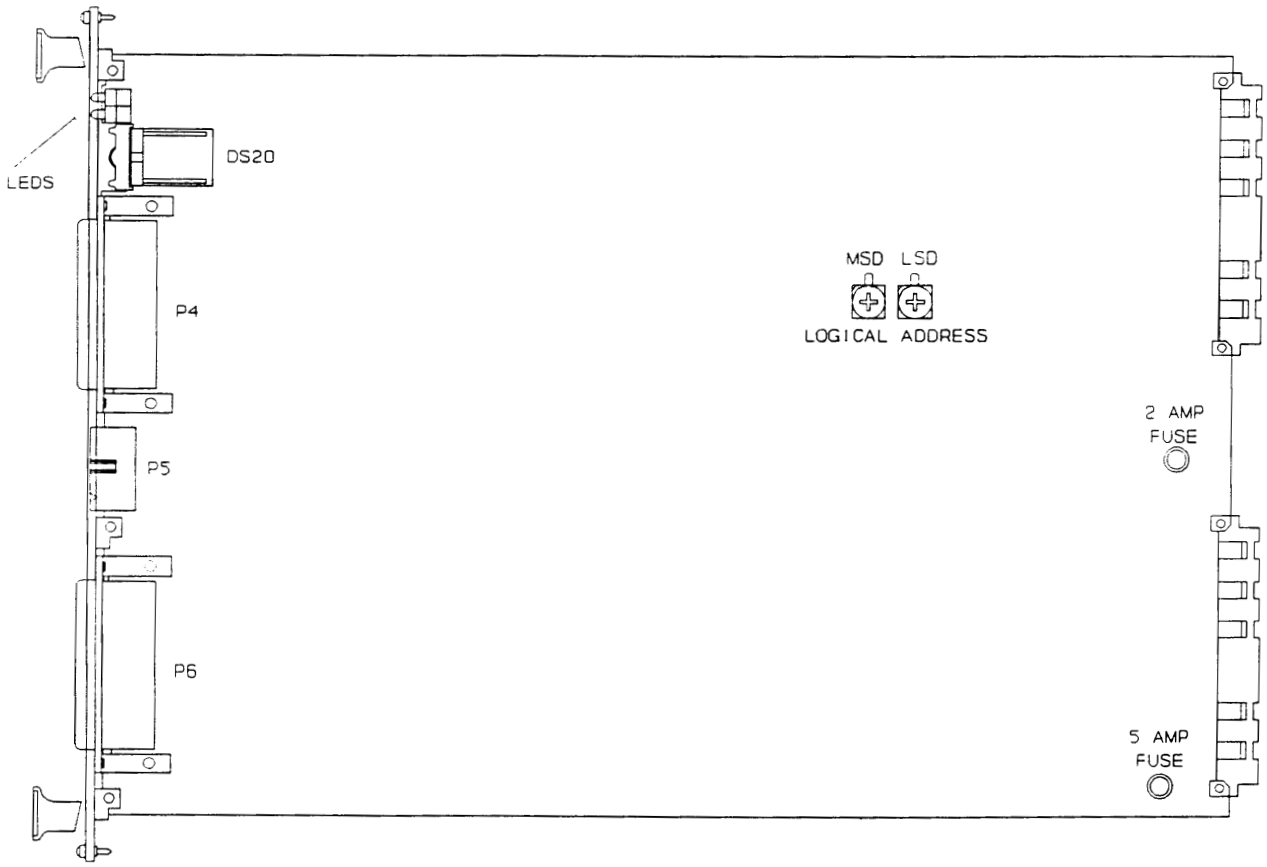


Figure 1: VX4385 Controls and Indicators

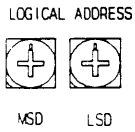
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Controls And Indicators

The following controls and indicators are provided to select and display the functions of the VX4385 Module's operating environment. See Figures 1 and 2 for their physical locations.

Switches

Logical Address Switches



Each function module in a VXIbus System must be assigned a unique logical address, from 1 to 255 decimal. The base VMEbus address of the VX4385 is set to a value between 1 and FFh (255d) by two hexadecimal rotary switches. Align the desired switch position with the arrow on the module shield.

The actual physical address of the VX4385 Module is on a 64 byte boundary. If the switch representing the most significant digit (MSD) of the logical address is set to position X and the switch representing the least significant digit (LSD) of the logical address is set to position Y, then the base physical address of the VX4385 will be [(64d * XYh) + 49152d]. For example:

L.A.	MSD	LSD	Base Physical Addr. (d)
Ah	0	A	(64*10)+49152 = 49792d
15h	1	5	(64*21)+49152 = 50496d

where: L.A. = Logical Address
MSD = Most Significant Digit
LSD = Least Significant Digit

LEDs

The following LEDs are visible at the top of the VX4385 Module's front panel to indicate the status of the module's operation:

POWER
This green LED is normally lit. If the +5V power supply fails or if the +5V fuse blows, the LED goes off.

FAILED
This normally off red LED is lit whenever SYSFAIL* is asserted, indicating a module failure. Module failures include loss of power or failure of the module's central processor.

MSG
This green LED is normally off. When lit, it indicates that the module is processing a VMEbus cycle. The LED is controlled by circuitry that appears to stretch the length of the VMEbus cycle. For example, a five microsecond cycle will light the LED for approximately 0.2 seconds. The LED will remain lit if the module is being constantly addressed.

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ERROR

This LED when lit indicates that the module has detected an error condition (usually a syntax error).

Front Panel Display

The front panel display is a four digit alpha-numeric readout which can display the module's status, error messages, and indicate the closed relays. If no errors have been generated after power-up or when all matrix relays are open, the message "RDY" will be displayed. If matrix relays are closed and there are no errors, the coordinates of the closed relays will be scrolled through the display. If errors have been generated, an "E" followed by the error number and error message of the last error generated will be scrolled through the display. The error message will be cleared from the display when the last error message is read back from the module.

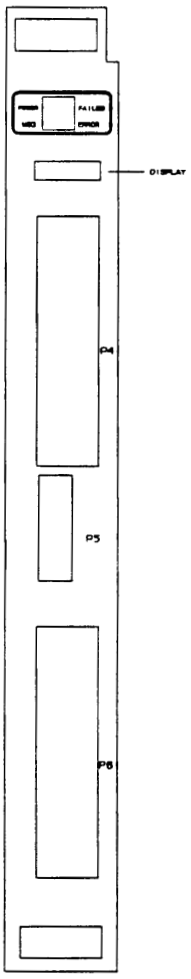


Figure 2: VX4385 Front Panel

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Specifications

Relays:	128 DPST relays - 128 point switch matrix. 20 DPST relays - configuration.
Contact Ratings:	Maximum Resistive: 1.0 amperes at 30V dc. Maximum Resistive: 0.3 amperes at 110V dc. Maximum Resistive: 0.5 amperes at 120V ac. Initial contact resistance: 50 mΩ @ 1A. (Not counting circuit board traces, connectors, or wire leads).
Total path resistance:	Maximum 1Ω.
Sealing:	Hermetic.
Operational Life:	100,000,000 mechanical operations. 200,000 operations at 1A 30V dc. 100,000 operations at 0.5A 125V ac.
Duty:	Continuous.
Switching Rate:	50 Hz.
Signal Path Specifications:	Single line thermal offset less than 150 microvolts. Initial signal path resistance less than 1 Ω. Signal path resistance at end of full load life less than 1.2 Ω. Insulation resistance greater than 10^9 Ω.

Crosstalk Between Channels:

Freq.	Crosstalk
1 KHz	less than -106 dB.
10 KHz	less than -86 dB.
100 KHz	less than -66 dB.
1 MHz	less than -42 dB.

Measurement made with a signal applied through a closed relay into 50 Ω, each open relay loaded with 50 Ω, and the measuring instrument connected to the open relays.

Power Up: When power is turned on, the module will go to the following known states:

- All switches open.
- Two 4x16 2-wire matrix configuration.
- Macro definitions cleared.
- Module in nonbuffered mode.
- DWELl ON.
- MBUFfer OFF.
- VERBose ON.
- UPDate ON.

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Power Down:	When the power is turned off all the switches will open.
VXIbus Compatibility:	Fully compatible with the VXIbus Specification for message based instruments.
VXI Device Type:	VXI Message based instrument, Revision 1.3.
VXI Protocol:	Word serial.
VXI Module Size:	C size, one slot wide.
Module Specific Commands:	All module-specific commands are sent via the VXIbus Byte Available command. All module-specific commands are made up of ASCII characters.
VMEbus Interface:	Data transfer bus (DTB) slave - A16, D16 only.
VXIbus Data Rate:	Buffered mode write: 200K bytes/sec maximum. Nonbuffered mode write: 20 K bytes/sec maximum.
VXIbus Commands Supported:	All VXIbus commands are accepted (e.g. DTACK* will be returned). The following commands have effect on this module; all other commands will cause an Unrecognized Command event:

ABORT NORMAL OPERATION
ASYNCHRONOUS MODE CONTROL
BEGIN NORMAL OPERATION
BYTE AVAILABLE (with or without END bit set)
BYTE REQUEST
CLEAR
CLEAR LOCK
CONTROL EVENT
END NORMAL OPERATION
ERROR QUERY
GRANT DEVICE
IDENTIFY COMMANDER
READ INTERRUPTERS
READ PROTOCOL
READ STATUS
RESPONSE ENABLE
SET LOCK
TRIGGER

VXIbus Protocol Events Supported:	None.
Device Type Register Contents:	F67E
ID Register Contents:	BFFC

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Protocol Register:	**E7FF**
Power Requirements:	All required dc power is provided by the Power Supply in the VXIbus mainframe.
Voltage:	+5 Volt Supply: 4.75 V dc to 5.25 V dc.
Peak Current:	+5 Volt Supply: 1.25 A, 4x16 and 2x8 1.36 A, 4x32 and 2x16 1.70 A, 8x16 and 4x8 plus 28 mA per closed switch. 2.15 A, normal usage. Normal usage, for VXI Specification purposes, is defined as an 8 x 16 configuration with 16 relays closed. Typical usage will be less.
Dynamic Current:	+5 Volt Supply: 70 mA quiescent. plus 28 mA per switch as they are cycled.
Replacement Fuses:	Littlefuse P/N 273002 Littlefuse P/N 273005
Cooling:	Provided by the fan in the VXIbus mainframe. Less than 10 °C temperature rise with 0.86 liters/sec of air at a pressure drop of 0.02 mm H_2O.
Temperature:	0°C to +50°C operating. -40°C to +85°C storage.
Humidity:	Less than 95% R.H. non-condensing, -10°C to +30°C. Less than 75% R.H. non-condensing, +31°C to +40°C. Less than 45% R.H. non-condensing, -41°C to +55°C.
Radiated Emissions:	Complies with VXIbus Specifications.
Conducted Emissions:	Complies with VXIbus Specifications.
Module Envelope Dimensions:	VXI C size. 262 mm x 353 mm x 30.5 mm. (10.3 in x 13.9 in x 1.2 in)
Shipping Dimensions:	When ordered with a Tek/CDS Mainframe, this module will be installed and secured in one of the instrument module slots (slots 1 - 12). When ordered alone, the module's shipping dimensions are: 406 mm x 305 mm x 102 mm. (16 in x 12 in x 4 in)
Weight:	1.47 kg (3.25 lb).

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Shipping Weight:	When ordered with a Tek/CDS Mainframe, this module will be installed and secured in one of the instrument module slots (slots 1 - 12). When ordered alone the module's shipping weight is: 1.93 kg (4.25 lb).
Mounting Position:	Any orientation.
Mounting Location:	Installs in an instrument module slot (slots 1-12) of a C or D size VXIbus mainframe.
Front Panel Signal Connectors:	Two DD50 50 pin connectors and one 16 pin header connector.
Recommended Cable or Connector:	VX1770, VX1771, or VX1772; or VX1780S.
Equipment Supplied:	1 - VX4385 Module.
Software Revision:	V2.1

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Section 2
Preparation For Use

Installation Requirements And Cautions

The VX4385 Module is a C size VXIbus instrument module and therefore may be installed in any C or D size VXIbus mainframe slot other than slot 0. If the module is being installed in a D size mainframe, consult the operating for the mainframe to determine how to install the module in that particular mainframe. Setting the module's Logical Address switch defines the module's programming address. Refer to the Controls and Indicators subsection for information in selecting and setting the module's logical address.

Tools Required

The following tools are required for proper installation:

A slotted screwdriver set.

CAUTION

Note that there are two printed ejector handles on the card. To avoid installing the card incorrectly, make sure the ejector marked "VX4385" is at the top.

In order to maintain proper mainframe cooling, unused mainframe slots must be covered with the blank front panels supplied with the mainframe.

Based on the number of instrument modules ordered with the mainframe, blank front panels are supplied to cover all unused slots. Additional VXIbus C size single-slot and C size double-slot blank front panels can be ordered from your Tektronix supplier.

CAUTION

Verify that the mainframe is able to provide adequate cooling and power with this module installed. Refer to the mainframe Operating Manual for instructions.

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If the VX4385 is used in a VX1X Series Mainframe, all VX4385 cooling requirements will be met.

CAUTION

If the VX4385 Module is inserted in a slot with any empty slots to the left of the module, the VME daisy-chain jumpers must be installed on the backplane in order for the VX4385 Module to operate properly. Check the manual of the mainframe being used for jumpering instructions.

If a Tek/CDS VX1400 or VX1401 mainframe is being used, the jumper points may be reached through the front of the mainframe. There are five (5) jumpers that must be installed for each empty slot. The five jumpers are the pins to the left of the empty slot.

Installation Procedure

CAUTION

The VX4385 Module is a piece of electronic equipment and therefore has some susceptibility to electrostatic damage (ESD). ESD precautions must be taken whenever the module is handled.

1) Record the module's revision level, serial number (located on the label on the top shield of the VX4385), and switch setting on the Installation Checklist following these installation procedures. Only qualified personnel should install the VX4385 Module.

2) Verify that the Logical Address switches are switched to the correct value.

3) The module can be inserted into any slot of the chassis other than slot 0.

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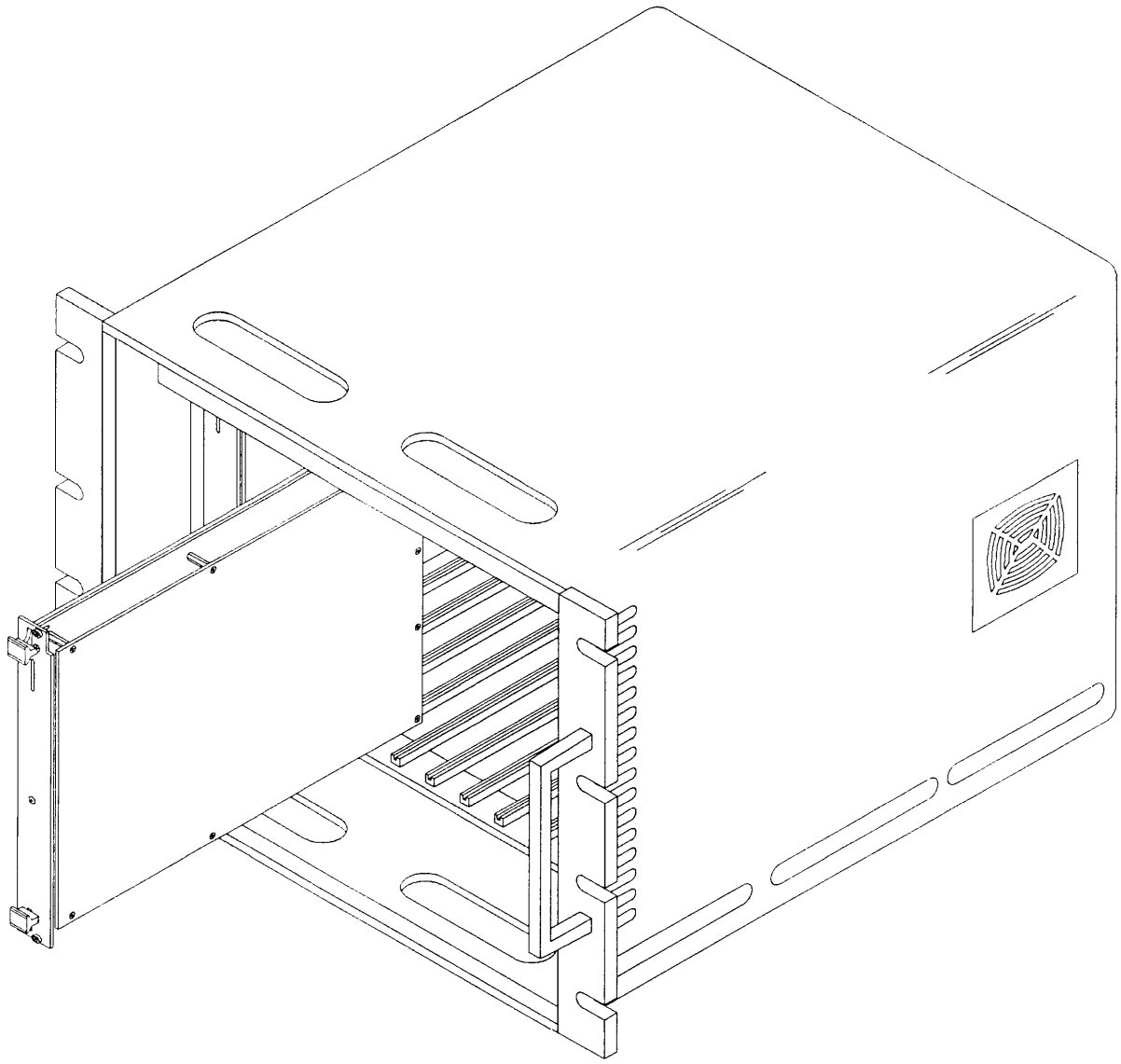


Figure 3: Module Installation

4) Installation of Cables (VX16xx)

If a module is being installed in a Tek/CDS mainframe, route the cables from the DD50 connectors on the front panel of the module down through the cable tray at the bottom of the mainframe and out the rear of the mainframe.

If the matrix is being expanded via the front panel header connector, connect a 16 pin header connector between the modules.

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Installation Checklist

Installation parameters may vary depending on the mainframe being used. Be sure to consult the mainframe Operating Manual before installing and operating the VX4385 Module.

Revision Level: _____

Serial No.: _____

Mainframe Slot Number: _____

Switch Settings:

VXIbus Logical Address Switch: _____

Cables Installed:

_____

_____

Performed by: _____ Date: _____

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Section 3
Operation

Overview

The VX4385 Module is programmed by ASCII characters issued from the system controller to the VX4385 Module via the module's VXIbus mainframe backplane. The module is a VXIbus Message Based Device and communicates using the VXIbus Word Serial Protocol. Refer to the manual for the VXIbus device that will be the VX4385 Module's commander for details on the operation of that device.

If the module commander is a Tek/CDS Resource Manager/IEEE-488 Interface Module, refer to that Operating Manual and the programming examples in the Operation section of this manual for information on how the system controller communicates with the commander being used.

The module provides 128 independently controlled DPST switches which can be configured as either a 2-wire or 4-wire switch. Software control insures break-before-make operation. A maximum of twelve VX4385 Modules can be combined into a single matrix using a full size VXI mainframe.

The VX4385 also has extensive macro capability. Macros are sequences of commands or groups of relays that are defined by the user using the DEFine command. Each macro is referenced by a label that is specified when the macro is defined. They are especially useful when a series of commands or particular group of relays is going to be used frequently. It can be defined as a macro, and then does not need to be re-entered each time it is used. There are 20 Kbytes of memory available for macros.

Power-up

The VX4385 Module will complete its self test and be ready for programming five seconds after power-up. The VXIbus Resource Manager may add an additional one or two second delay to this time. The Power LED will be on and RDY will appear in the display. All other LEDs will be off. The MSG LED will blink during the power-up sequence as the VXIbus Resource Manager addresses all modules in the mainframe.

System Commands

These low-level commands are typically sent by the module's commander, transparent to the user of the module. An exception is the Read Status command, which is sent whenever a Serial Poll on an IEEE-488 system is performed. Most commanders or Slot 0 devices have specific ASCII commands which will cause them to send one of these

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low-level commands to a specified instrument. Refer to the Operating Manual of the commander or Slot 0 device for information on these commands.

Command	Effect
Clear	The module clears its VXIbus interface and any pending commands. Current module operations are unaffected.
Begin Normal Operation	The module will begin normal operation if has not already done so.
Read Protocol	The module will return its protocol to its commander.
Read Status	The module will return its status to its commander.
Abort Normal Operation	The module clears its VXIbus interface and pending commands.
End Normal Operation	After the completion of any command which has already begun, the module clears its VXIbus interface.
Response Enable	This command enables or disables response interrupts. Response Interrupts may be used in place of the normal polling that takes place between a commander and this module. This module supports no response interrupts.
Control Event	Selectively enables or disables different types of VXIbus interrupts. The module will return a 16-bit message confirming completion.
Byte Available	Transfers module commands to this module.
Byte Request	Requests data to be returned from the module.
Asynchronous Mode Control	Generates a response indicating that no interrupts are supported.
Read Protocol Error	Returns the module's most recent error code, which includes Multiple Query error, Unsupported Command, and DOR Violation.
Grant Device	No action taken.
Identify Commander	No action taken.
Set Lock	Resets the LOCKED* bit of the Response register. No other action is taken.

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Clear Lock	Sets the LOCKED* bit of the Response register. No other action is taken.
Read Interrupters	Returns a word signifying that this module has no interrupter.
Trigger	No action taken.

Module Commands

A summary of the VX4385 Module's commands is listed below. This is followed by detailed descriptions of each of the commands. A sample BASIC program using these commands is shown in the Programming Examples section.

Command Syntax

Command protocol and syntax for the VX4385 Module are as follows:

1) Commands consist of three to twelve ASCII characters. Parameters affecting the command are in the form of ASCII alpha-numeric characters following the command. A command must be terminated by a semicolon or line feed which would follow any parameters.

   <CR> indicates a carriage return.
   <LF> indicates a line feed.
   <TM> indicates a line feed or semicolon terminator.

2) Any character may be sent in either upper or lower case form. In the command descriptions, upper case represents the short form of the command. Lower case shows the additional characters needed for the long form (BUFFer for example).

3) Any of the following are white space characters:

   00 hex (NULL character)
   01 hex through 08 hex
   09 hex (TAB character)
   0B hex through 19 hex (including carriage return)
   20 hex (SPACE character)

   These white space characters must be used to separate commands from parameters that begin with an alpha (A-Z or a-z) character. If a parameter begins with a numeric character (0-9), a quote, or a dollar sign, the white space is optional. Any number of white space characters may be used together. Leading or trailing white space characters are ignored.

4) The numerical parameters for the OPEN or CLOSe functions must be simple unsigned integers. Floating point and exponentiation is not supported for these parameters.

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5) The quoted strings used in the DISPlay and DEFine functions must be enclosed in either single or double quotes. Whichever type of quote is used as the opening quote must also be used as the closing quote. To use the opening quote character within the string, the string must contain two consecutive quote characters, only one of which will be part of the resulting string. The quoted strings for this module will also be terminated on a <LF> terminator and may not contain a <LF> character.

6) Commands beginning with an asterisk (*) are part of the set of Standard commands as described in the IEEE-488.2 Specification. The * is required.

7) A vertical bar | separates parameter options. For example, ON | OFF .

8) Queries should be read back before additional commands are sent to the module.

Macros

Macros are sequences of commands or groups of relays that are defined using the DEFine command. Each macro is referenced by a label that is specified when the macro is defined. Macros are especially useful when a series of commands or a particular group of relays is going to be used frequently. Once the macro is defined, its contents do not need to be re-entered each time it is used.

There are 20 Kbytes of memory available for macros. Each macro requires the length of the label plus the length of the macro plus 8 bytes of memory. There is no limit on either the length or number of macros other than they must all fit into the 20 Kbytes of memory. The CATalog? query can be used to determine the amount of memory used by each macro and the amount of free memory. The macro contents can be queried using the DEFine? query.

When using a macro, a dollar sign ($) must be prefixed to the macro label so that it will be recognized as a macro label. The dollar sign is optional when defining, querying, or cataloging the macro. Macro labels can be used either as commands or as parameters for the OPEN and CLOSe commands. The macro can also be displayed in the front panel display using the DISPlay command.

Macros can be nested ten deep. However, care must be taken not to allow recursion (a macro calling its own label or the label of a macro that called it). Recursion will cause the module to exceed the nesting limit and generate an error.

Queries or HALT commands can be placed in any position within a macro. A query or HALT will halt the execution of the macro until the query is read back. If macros containing queries or HALT commands are used, the queries should be read back before additional commands are sent to the module. If additional commands are sent to the module while macro execution is halted, macro processing will be terminated and the command will be executed. On some systems it may be necessary to turn MBUFfer ON in order for this to work properly. See the MBUFfer command for details. If it is necessary to place a macro containing queries ahead of other commands, it can be

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nested within another macro in any position. However, other commands cannot be sent after the macro containing the nest until the queries have been read back.

Speed Optimization

The command execution of the module can be optimized by using the following procedures:

1. When opening or closing more than one switch, group the switches in a list and use a single OPEN or CLOSe command. See the OPEN or CLOSe commands for examples.

2. Set the BUFFer mode to ON. In this mode, the module will read up to 512 bytes ahead while processing commands. Care must be used with this mode, however, since the card will finish reading commands before it finishes processing them. See the BUFFer command for examples.

3. Set UPDate to OFF. In this mode, the module will not update the front panel display after OPEN or CLOSe commands. The display is normally updated after the switch or group of switches in an OPEN or CLOSe command is processed and can take about 50 milliseconds. If the first two suggestions are followed this will probably will not be noticeable. If several OPEN or CLOSe commands are given in succession, a noticeable decrease in processing time can be observed, since the display is updated after each OPEN or CLOSe command. See the UPDate command for examples.

Command Summaries

Detailed descriptions of each command (in alphabetical order) are given following the summaries. The summary lists all commands in alphabetical order. The commands beginning with an asterisk (*) are part of the set of Standard commands as described in the IEEE-488.2 Specification. The * is the first character of the command, and is required.

Command	Description
*CLS	Clears the status registers.
*ESE n	Sets the mask for the Standard Event Status Register.
*ESE?	Returns the mask for the Standard Event Status Register.
*ESR?	Returns the Standard Event Status Register.
*IDN?	Returns the module identification and software revision.
*OPC	Forces operation complete.
*OPC?	Returns a '1' when an operation is complete.

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*RST	Resets the module.
*SRE n	Set the Status Byte Mask register.
*SRE?	Return the Status Mask register.
*STB?	Return the status byte.
*TST?	Return the results of the RAM test.
*WAI	Wait for pending operations to complete.
BUFFer ON | OFF	Enables or disables the input buffer.
BUFFer?	Returns the state of the buffer mode.
CATalog?	Returns a list of the user-defined labels.
CLOSe [:ABSolute] x,y[,m]	Closes relays indicated by x, y, and m.
CLOSe? [:ABSolute] x,y[,m]	Returns the state of the relay indicated by the parameters.
CONFigure m	Defines the matrix configuration.
CONFigure?	Returns the matrix configuration.
DATE?	Returns the date of the last software revision.
DEFine l, t	Defines an ASCII character or characters [t] to be executed when the user defined label [l] is received.
DEFine? l	Returns the user definition.
DELete l	Deletes the user definition.
DISPlay s	Enable, disable display, display a string on the front panel display.
DISPlay?	Returns the current display string.
DWELl ON | OFF	Turns the break-before-make feature on or off.
DWELl?	Returns the state of the break-before-make feature.
ERRor?	Causes the next readback to be the next error message in the queue.

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HALT [s]	Halts execution until a readback.
LIMit n	Sets the maximum number of matrix relays that can be closed at one time.
LIMit?	Returns the maximum number of matrix relays that can be closed at one time.
MBUFfer ON ¦ OFF	Enables or disables buffer mode when running macros in non-buffered mode.
MBUFfer?	Returns the state of the MBUFfer mode.
OPEN [:ALL] ¦ [:ABSolute] x,y[,m]	Opens the relays indicated by x, y, and m.
OPEN? [:ABSolute] x,y[,m]	Returns the state of the relay indicated by the parameters.
UPDate [ON ¦ OFF]	Disables or enables display updates after an OPEN or CLOSE command. Forces an update if no parameters are given.
UPDate?	Returns the state of the automatic updating feature.
VERBose ON ¦ OFF	Disables or enables full error messages to the four digit display.
VERBose?	Returns the state of full error message generation to the four digit display.

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Command Descriptions

Command: *CLS

Syntax: *CLS

Purpose: Clears the Status registers.

Description: This command clears the Standard Event Status register and the Status Byte register. The masks set with *ESE and *SRE commands remain unchanged.

Example: *CLS<CR><LF>

The Standard Event Status register and the Status Byte register are cleared.

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Command: *ESE

Syntax: *ESE n

Purpose: Sets the Standard Event Status Enable register.

Description: n A decimal or hexadecimal format number which specifies the mask to be placed in the Standard Event Status Enable register. The format #Hxx must be used when sending hexadecimal format.

This command sets the value in the Standard Event Status Enable register. This register is a mask register which determines which events cause the ESB bit in the Status Byte Register to be set.

The format #Hxx must be used must be used for hexadecimal numbers. Whichever format is used, subsequent queries to *ESE?, *ESR?, *SRE?, and *STB? will be returned in like format. See the *ESR? command for a description of each bit.

Example: *ESE 48<CR><LF>

or *ESE #H30<CR><LF>

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Command: *ESE?

Syntax: *ESE?

Purpose: Returns the value in the Standard Event Status Enable register.

Description: This command causes the module to return the value in the Standard Event Status Enable register. By default, the returned value is in decimal format. However, if the *ESE or *SRE commands last used the hexadecimal format to set the mask registers, the value will be returned in hexadecimal format (#Hxx).

Example: *ESE?<CR><LF>

Response: 16<CR><LF>

or #H10<CR><LF>

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Command: *ESR?

Syntax: *ESR?

Purpose: Returns the value in the Standard Event Status register.

Description: This command causes the module to return the value in the Standard Event Status register. By default, the returned value is in decimal format. However, if the *ESE or *SRE command last used the hexadecimal format to set the mask register, the value will be returned in hexadecimal format (#Hxx). Reading this value clears the Standard Event Status register.

Bits 0, 2, 4, and 7 are supported in this module and have the following meanings:

Bit 0	set to a 1 20ms after opening or closing a relay.
Bit 4	set to a '1' if a command is given an out-of-range number.
Bit 5	set to a '1' on a syntax error.
Bit 7	set to a '1' on power-up and subsequent resets until this register has been read. It is not set on resets if this register has been read since power-up.

Example: *ESR?<CR><LF>

The response after power-up would be:

128<CR><LF>

or #H80<CR><LF>

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Command: *IDN?

Syntax: *IDN?

Purpose: Returns the module identification and the software revision used in the module.

Description: The first readback after sending *IDN? to the VX4385 will be the module identification and revision of the software used in the module.

The returned string consists of four fields separated by commas:

1. The manufacturer.
2. The model number.
3. The serial number (returns a zero).
4. The software revision.

Example: *IDN?<CR><LF>

Response: Tek/CDS, VX4385, 0, 1.0<CR><LF>

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Command: *OPC

Syntax: *OPC

Purpose: Sets the Operation Complete bit in the Standard Event Status register to a '1' when pending operations have been completed.

Description: Under most circumstances, the VX4385 Module processes commands serially and the OPEN and CLOSe commands set the Operation Complete bit by default, so this command would have no effect since pending operations would have already been completed. The exception is when user-defined macros are being processed from memory. In that case, this command can be used to abort the user program if it is halted with a HALT or query, since sending the module a command will cause the macro to terminate.

Example: *OPC<CR><LF>

When any pending operations have been completed, the Operation Complete bit in the Standard Event Status register will be set.

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Command: *OPC?

Syntax: *OPC?

Purpose: Delays execution of a program until the completion of an operation.

Description: This function is a query which returns a '1' 20 ms after an OPEN or CLOSe command has been executed. This insures that the switches have closed and settled before continuing.

Example: OPEN:ALL ; CLOSE 1,2 ; OPC?<CR><LF>

If this command is followed by a readback, it would cause switch 1,2 to close and a '1' to be returned 20ms later.

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Command: *RST

Syntax: *RST

Purpose: Resets the board to the power-up configuration.

Description: This function resets the board to the following:

All configuration relays open (Dual 4 X 16).
All matrix relays open.
Error messages cleared.
BUFFer OFF.
MBUFfer OFF.
VERBose ON.
UPDate ON.
DWELl ON.
Display ON.

The following are unaffected:

Status registers
User definitions

Example: *RST<CR><LF>

The board is reset to its power-up state.

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Command: *SRE

Syntax: *SRE n

Purpose: Sets the Status Request Enable Mask register.

Description: n A decimal or hexadecimal format number which specifies the mask to be placed in the Status Request Enable Mask register. The format #Hxx must be used when sending hexadecimal format.

This command sets the value in the Status Enable Register. This register is a mask register which determines which events cause bit 6 in the Status Byte Register to be set. Whichever format is used, subsequent queries to *ESE?, *ESR?, *SRE?, and *STB? will be returned in like format. See the *STB? command for a description of each bit.

Example: *SRE 16<CR><LF>

or *SRE #H10<CR><LF>

These commands would set bit 4 of the SRE register, which will cause bit 6 of the Status Byte register to be set whenever future error messages are placed in the Output Queue.

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Command: *SRE?

Syntax: *SRE?

Purpose: Returns the value in the Status Request Enable register.

Description: This command causes the module to return the value in the Status Request Enable register. By default, the returned value is in decimal format. However, if the *ESE or *SRE commands last used the hexadecimal format to set the mask registers, the value will be returned in hexadecimal format (#Hxx).

Example: *SRE?<CR><LF>
Response: 16<CR><LF> or #H10<CR><LF>

This response assumes that the register has been set with the example given in the *SRE command description.

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Command: *STB?

Syntax: *STB?

Purpose: Returns the contents of the Status Byte register.

Description: The module will return the value in the Status Byte Register the next time it is read. By default, the returned value is in decimal format. However, if the *ESE or *SRE command last used the hexadecimal format to set the mask registers, the value will be returned in hexadecimal format (#Hxx). Bits 0 and 6 will be cleared after the execution of this command.

Bits 0, 4, 5, and 6 are supported in this module and have the following meanings:

Bit 0 — set to a '1' when the module is reset and the bit is reset after the execution of this command.

Bit 4 — set to a '1' whenever there are error messages to be read in the Output Queue. This bit is cleared after the error messages in the Output Queue have been read.

Bit 5 — set to a '1' whenever an unmasked bit (see *ESE) in the Standard Event Status register is set. The bit is reset when the Standard Event Status register is cleared.

Bit 6 — set to a '1' when any other unmasked bit (see *ESR) in this register is set. This bit is reset after the execution of this command.

Example: *STB<CR><LF>

Response: 1<CR><LF>

or #H1<CR><LF>

This response is generated on the first reading of this register after a hardware reset.

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Command: *TST?

Syntax: *TST?

Purpose: Returns the results of the RAM test that is done at power-up or module reset.

Description: Issuing this command causes the module to return the results of the RAM test that is done at power-up or at module reset. Since the RAM test is quite extensive, it would destroy the current contents of RAM. As a result, the test is not repeated when this command is issued. If a re-test of RAM is desired, then either re-cycle power or issue a hardware reset from the controller.

Example: *TST?<CR><LF>

Response: 0,"Passed RAM Test"<CR><LF>

or

-311,"Failed RAM test"<CR><LF>

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Command: *WAI

Syntax: *WAI

Purpose: Stops operation until pending operations have completed.

Description: Since the VX4385 Module processes commands serially, previous operations will have completed by the time this command is processed. The command is provided for compatibility with IEEE 488.2 Specifications.

Example: *WAI<CR><LF>

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Command: BUFFer

Syntax: BUFFER ON | OFF
or BUFF ON | OFF

Purpose: Enables or disables the buffered mode.

Description: Sending BUFFER ON enables the module's 512-byte input buffer. The command allows the system controller to send commands to the VX4385 at optimum speed, independent of the parsing and execution speed of the module. Sending BUFFER OFF disables this mode. BUFFER OFF is the default.

A white space must be placed between the command and the parameter.

NOTE: If the BUFFER ON command is used, noise levels on relay connections may exceed 200 mV p-p.

Example: BUFF ON<CR><LF>
or
BUFFER OFF<CR><LF>

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Command: BUFFer?

Syntax: BUFFER?
or BUFF?

Purpose: Determines whether or not the module is in buffer mode.

Description: The BUFFer? query causes the module to return an ON if the module is in buffer mode or an OFF if it is not.

Example: BUFFER?<CR><LF>

Response: OFF<CR><LF>

or ON<CR><LF>

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Command: CATalog?

Syntax: CATALOG[:FREE]? | [I]
or CAT[:FREE]? | [I]

Purpose: Returns a list of the user-defined labels.

Description:

[:FREE] returns a listing of the number of bytes used in the defined macros, and the remaining space available.

[I] returns information on the macro specified by this label.

The CATalog? query causes the VX4385 to return a list of the currently defined macro labels (see the DEFine command). If macros are defined, the module will have to be read three or more times to read out the catalog of labels. The first response tells how many macro labels are defined. The next responses are the catalog of the defined macro labels. The final response tells the total memory usage of the defined macros. The first and final response both have leading spaces; the macro labels do not. If no macros are defined, only the memory usage line will be returned.

The response for each macro label consists of four fields separated by commas.

- The first field is the label name. This field is 12 characters long. If the label has fewer than 12 characters then the rest of the field will contain spaces.
- The second field contains the type of memory usage. In this module only macros can be defined.
- The third field is a 13-byte field and contains the size of the macro in bytes.
- The fourth field is an 8-byte field which indicates the number of the macro. Macros are numbered in the order in which they are defined.

Examples:

CAT?
Response if no macros are defined:

<SP>0 bytes used in 0 macros, 20000 bytes free<CR><LF>

Responses if macros are defined:

```
 2 Macros<CR><LF>
LABEL1      , MACRO,     25 bytes, No.    1<CR><LF>
LABEL2      , MACRO,     32 bytes, No.    2<CR><LF>
 57 bytes used in 2 macros, 19943 bytes free<CR><LF>
```

CAT:FREE?<CR><LF> or CAT?:FREE<CR><LF>
Response:

60 bytes used in 2 macros, 19940 bytes free<CR><LF>

CAT? LABEL1<CR><LF>
Response:

LABEL1 , MACRO, 25 bytes, No. 1<CR><LF>

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Command: CLOSe

Syntax: CLOSE [:ABSolute] x,y[,m] | $I
or CLOS [:ABS] x,y[,m] | $I

Purpose: Closes switches relative to the configured matrix.

Description:

[:ABSolute] An optional parameter which causes the x and y parameters to close the switches that would be closed in the 4x32 configuration, regardless of how the matrix is actually configured.

x A number from 1 - 8 which indicates the X co-ordinate of the switch to be closed. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. A comma must follow the number to separate the x and y parameters.

y A number from 1 - 32 which indicates the Y co-ordinate of the switch to be closed. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. A comma must follow the y parameter if the optional m parameter is used.

[m] A or B. An optional parameter used when the switch is divided into two matrices to select either the A or B matrix. If [m] is not specified, A is used. If a letter other than A or B is given, an error will be generated. If the matrix is not divided, an A or B will be ignored.

$I A macro label containing the above parameters which has been defined with the DEFine command. The $ is required to identify it as a macro label.

NOTE: In the 4-wire configurations, two switches will be closed for each X and Y co-ordinate.

More than one switch can be closed with a single command by chaining parameters with an ampersand (&) and optionally enclosing the list in parentheses. The maximum length of the list (not including white spaces) cannot exceed 200 characters.

Examples: CLOSE (1,3,A & 4,2,A & 3,10,A)<CR><LF>
or
CLOSE 1,3,A & 4,2,A & 3,10,A<CR><LF>

The above commands would close the three switches at the indicated coordinates on matrix A.

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CLOSE:ABS 1,24<CR><LF>

This example closes the switch that would be closed at coordinates 1,24 in the 4 x 32 configuration regardless of the actual configuration.

CLOSE $LABEL1<CR><LF>

This example assumes a macro label named LABEL1 has been defined with the DEFine command. The macro could contain any of the parameters given in the previous examples.

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Command: CLOSe?

Syntax: CLOSE? [:ABSolute] x,y[,m]
or CLOS? [:ABS] x,y[,m]

Purpose: Reads back the state of a switch relative to the configured matrix.

Description: CLOSe? causes the module to return an ASCII '1' if the queried switch is closed and an ASCII '0' if it is open.

[:ABSolute] An optional parameter which causes the x and y parameters to reference the switches that would be referenced in the 4x32 configuration, regardless of how the matrix is actually configured.

x A number from 1 - 8 which indicates the X co-ordinate of the switch to be queried. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. A comma must follow the number to separate the x and y parameters.

y A number from 1 - 32 which indicates the Y co-ordinate of the switch to be queried. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. A comma must follow the y parameter if the optional m parameter is used.

[m] A or B. An optional parameter used when the switch is divided into two matrices to select either the A or B matrix. If [m] is not specified, A is used. If a letter other than A or B is given, an error will be generated. If the matrix is not divided, an A or B will be ignored.

NOTE: In the 4-wire configurations, the returned value will represent the two switches which would be affected by the CLOSE command. If both switches are closed, a '2' will be returned.

Switches can only be queried with one X,Y co-ordinate set at a time. The entire list of closed switches can be queried by updating the display, then reading back the display buffer: UPDATE;DISP?<CR><LF>

Example: CLOSE? 1,1<CR><LF>
or
CLOSE?:ABS 1,1<CR><LF>

Response: 1<CR><LF> if the switch is closed.

0<CR><LF> if the switch is open.

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Command: CONFigure

Syntax: CONFIGURE m
or CONF m

Purpose: Configures the module's matrix.

Description: The CONFigure command is used to change the module's matrix configuration.

m	Description
4X16	Opens all matrix configuration switches, placing the module in the dual 2-wire 4x16 configuration (power-up default).
4X32	Places the module in the single 2-wire 4x32 configuration.
8X16	Places the module in the single 2-wire 8x16 configuration.
2X8	Places the module in the dual 4-wire 2x8 configuration.
2X16	Places the module in the single 4-wire 2x16 configuration.
4X8	Places the module in the single 4-wire 4x8 configuration.
DEFault	Places the module in the default (4X16) configuration.

See the diagrams in Appendix B for clarification.

NOTE: All matrix switches are opened prior to changes in the configuration settings and are left open after this command is executed.

Example: CONF 2X16<CR><LF>

Places the module in the single 4-wire 2x16 configuration. All switches are open.

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Command: CONFigure?

Syntax: CONFIGURE?
or CONF?

Purpose: Returns the current configuration.

Description: The VX4385 Module will return the current configuration the next time it is read.

Example: CONF?<CR><LF>

Responses:

Dual 4 x 16 -- Two Wire<CR><LF>
4 x 32 -- Two Wire<CR><LF>
8 x 16 -- Two Wire<CR><LF>
Dual 2 x 8 -- Four Wire<CR><LF>
2 x 16 -- Four Wire<CR><LF>
4 x 8 -- Four Wire<CR><LF>

Only one of the above responses will be generated to indicate the current configuration of the module.

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Command: DATE?

Syntax: DATE?

Purpose: Returns the date of the software revision.

Description: The VX4385 Module will return the date of the software revision installed in the module the next time it is read.

Example: DATE?<CR><LF>

Response: PROGRAM 24 CREATION DATE SEP 18, 1991<CR><LF>

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Command: DEFine

Syntax: DEFINE l,s
or DEF l,s

Purpose: Defines a macro.

Description: The DEFine command defines a macro label which can be used as a command in subsequent communications with the module.

l The macro label of up to twelve ASCII characters long which will become a user command or a parameter (for OPEN or CLOSe) in subsequent communications with the module.

If the label has already been defined, an error will be generated. If white spaces are used in the label, they will be removed. The label will be truncated at twelve characters. A white space character must be placed between the DEFine command and the label.

s This is the ASCII string which will be executed when the macro label is received.

The string must be enclosed in either single or double quotes and can contain pre-defined module commands, white spaces, semicolon terminators, and other user defined macro labels. A terminator will automatically be placed at the end of the string. The quoted string will be stored exactly as sent, so less memory will be used if optional white spaces are left out.

This string can also denote parameters to be used with the OPEN or CLOSe commands.

The string will be truncated on receipt of a <LF> terminator. The <LF> terminator cannot be used within the string. Commands within the macro must be separated by semicolons. It is also best not to include carriage returns <CR> within the string. While these are allowed, they can cause erratic results when querying or displaying the macro.

When using the defined macro, the label must have a '$' (ASCII 36) prefix. The '$' is optional when defining or deleting the macro. Upper or lower case is ignored, thus Measure, measure, or MEASURE will be equivalent. White spaces within the label will be removed.

The macro will not be parsed until it is used, therefore, potential errors will not be generated for the macro until it is used.

The DEFine or BUFFer commands cannot be used within the macro. Attempting to do so will generate an error when the macro is used.

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Macros can be nested (a macro calling another macro) ten deep.

Recursion (the macro calling itself or a macro from which it was called) will cause nesting to exceed the limit of ten and an error will be generated.

Example:

DEFINE MEASURE1, "OPEN 1,4; CLOSE 2,12 & 1,8"<CR><LF>
or
DEFINE $measure1, "OPEN 1,4; CLOSE 2,12 & 1,8"<CR><LF>

Upon the receipt of $MEASURE1, the module will execute the following:

```
OPEN 1,4; CLOSE 2,12 & 1,8
```


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Command: DEFine?

Syntax: DEFINE? I
or DEF? I

Purpose: Returns the user definition of a macro label.

Description: This command will return the user definition of the label specified by I the next time the module is read. A white space character must be placed between the DEFine command and the label.

Example: DEF? MEASURE1 <CR> <LF>

If the macro label MEASURE1 had been defined as in the example shown in the DEFine command, then the response would be:

OPEN 1,4; CLOSE 2,12 & 1,8 <CR> <LF>

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Command: DELete

Syntax: DELETE [:ALL] | l
or DEL [:ALL] | l

Purpose: Deletes a macro from memory.

Description: The DELete command deletes a macro which has been defined with the DEFine command. The memory used by the macro will be freed for re-use.

[:ALL] If this parameter is used, all macros will be deleted and the associated memory freed. No additional parameters are required for this option, and an error will be generated if one is given.

l The label of the macro which is to be deleted.

If the user label has not been defined, an error will be generated. White spaces within the label will be removed. The label will be truncated at twelve characters. A white space character must be placed between the DELete command and the label. Optionally a '$' (ASCII 36) may be prefixed to the label.

Examples: DEL MEASURE2<CR><LF>

The macro 'MEASURE2' will be deleted.

DEL :ALL<CR><LF>

All macros will be deleted.

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Command: DISPlay

Syntax: DISPLAY s
or DISP s

Purpose: Enables or disables the front panel display and puts a user message on the four character front panel display.

Description: s The message to be displayed, consisting of up to 1000 ASCII characters. The message must be enclosed in either single or double quotes. Line feeds <LF> are not allowed within the quotes. If a line feed is encountered, the message will be truncated at that point.
ON: will enable the display. This is the power-on default.
OFF: will disable the display. The display will show "DOFF" when disabled.

NOTE: When the display is enabled, noise levels on relay connections may exceed 200 mV p-p.

If the message is greater than four characters then it will be scrolled horizontally through the display. For messages of more than four characters, it may be desirable to add extra spaces at the beginning or end of the message since the end of the message will be wrapped around to the beginning and would otherwise run together. Only one continuous line can be displayed. Carriage returns or line feeds will cause the message to wrap back to the beginning.

Messages to be displayed should be placed after OPEN or CLOSe statements, since these statements will place their own messages in the display. Even if UPDate is OFF, the OPEN or CLOSe statements will place the characters 'RDY' in the display.

Defined macros can also be displayed by using the macro label with a leading '$' (ASCII 36) in place of the quoted string. When macros are displayed, two spaces will be appended to the end to separate the beginning and end during wrap-around. If a macro is over 1000 characters, only the first 1000 will be displayed.

NOTE: A display user can not be specified when enabling or disabling the display. They must have separate DRSP commands.

Examples: DISPLAY 'Running TEST2. '<CR><LF>
The message 'Running TEST2. ' will be scrolled horizontally through the display.

DISPLAY $LABEL1<CR><LF>
The contents of the macro defined as LABEL1 will be displayed with two spaces at the end.

DISPLAY OFF<CR><LF>
The message "DOFF" will be displayed and no other messages will appear until the display is re-enabled.

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Command: DISPlay?

Syntax: DISPLAY?
or DISP?

Purpose: Returns the contents of the Display buffer.

Description: The contents of the Display buffer will be returned on the next read.

Example: DISP?<CR><LF>
Response: 1,1,A - 2,5,B <4X16><CR><LF>

This response assumes that the module is in the 4X16 configuration, that the switches shown have been closed, and that no other messages have been placed in the display. The actual returned string will be whatever is currently being displayed. If the display has been disabled, a "DOFF" message will be returned.

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Command: DWELL

Syntax: DWELL ON | OFF
or DWEL ON | OFF

Purpose: Turns the break-before-make feature on and off.

Description: The DWELI command turns on and off a 5 ms timer which is set at each switch opening and must timeout before a switch is closed.

A white space must be placed between the command and the parameter.

The break-before-make feature is on after power-up or a *RST command is issued. Setting DWELI to OFF will have no effect if UPDate is ON (default) since updating the display after an OPEN command will take longer than 5 ms.

Example: DWELL OFF<CR><LF>

The break-before-make feature is turned off.

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Command: DWELI?

Syntax: DWELL?
or DWEL?

Purpose: Determines whether or not the break-before-make feature is on.

Description: The DWELI? query causes the module to return an ON if the break-before-make feature is on, or an OFF if it is not.

Example: DWELL?<CR><LF>

Response: OFF<CR><LF>

or ON<CR><LF>

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Command: ERRor?

Syntax: ERROR?
or ERR?

Purpose: Direct the module to return any error messages in the error queue.

Description: The module will return any error messages in the error queue on subsequent reads. If no error messages are left in the queue a 0,'no error' message will be returned. The error queue is 2048 bytes long and will hold approximately 50 - 60 error messages. The error query mode is the default query mode. The ERROR? query causes any other queries to be terminated.

Error Messages

0,"No error"
-101,"Invalid OPEN or CLOSE parameter"
-101,"Invalid hex format"
-101,"Syntax error setting display update"
-101,"Syntax error setting delay"
-101,"Syntax error setting verbose"
-101,"Syntax error setting buffer mode"
-102,"String length exceeded display buffer"
-102,"String length exceeded remaining macro buffer"
-102,"Unrecognized command"
-103,"Too many commas"
-103,"Comma missing before A or B"
-103,"Too many commas"
-108,"Illegal Parameter after :ALL"
-109,"& without XY co-ordinates"
-109,"A or B without XY co-ordinates"
-109,"Both X and Y co-ordinates not given"
-109,"Missing X co-ordinate"
-141,"Invalid character in open or close"
-148,"Additional character after closing quotes"
-171,"Right parenthesis without Left"
-171,"Right parenthesis missing"
-178,"Invalid left parenthesis"
-178,"Attempting a list on readback"
-222,"Co-ordinates out of range"
-222,"Value out of range"
-222,"Limit value out of range"
-223,"Extra characters"
-223,"Parameter exceeded 200 characters"
-224,"Incorrect matrix parameter"
-240,"Exceeded allowed simultaneous switch closures"
-270,"Cannot define inside macro"
-270,"Cannot delete inside macro"
-270,"Cannot set buffer mode inside macro"

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-270,"Cannot set mbuff mode inside macro"
-277,"Macro label already defined"
-278,"Macro label not found"
-278,"Macro label to Catalog not found"
-278,"Macro label to delete not found"
-278,"Macro label to display not found"
-278,"Macro label to query not found"
-278,"Macro nesting exceeded ten"
-281,"Out of macro memory"

Example: ERR?<CR><LF>

Any errors queued will be returned until all errors are reported.

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Command: HALT

Syntax: HALT [r]

Purpose: Halts the operation of a macro and waits for a readback.

Description: [r] an optional parameter that will be returned on readback. This parameter can be any ASCII character or string of characters up to 200. White spaces will be removed.

When used within a macro, the HALT command halts the operation of the module until a readback occurs. If the optional parameter is supplied, the parameter will be returned when the card is read, otherwise a single space with a <CR><LF> will be returned. If operating in real time, this command will have little effect except to return the parameter if this command is the last command sent. This command can be used within a macro to get the module to sequence through a series of commands.

Example: DEFINE, LABEL1, "OPEN:ALL;CLOSE 1,1; HALT 1; OPEN 1,1; CLOSE 1,2"<CR><LF>
$LABEL1<CR><LF>

In this example, the module would first open all switches, close 1,1 and halt waiting for a readback. When the module is read back it will return the '1', open 1,1 and close 1,2.

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Command: LIMit

Syntax: LIMIT n
or LIM n

Purpose: Sets the maximum number of matrix switches that can be energized.

Description: The Limit command sets the maximum number of switches that can be energized. The default is 64. This number does not include the configuration switches.

n a number from 0 to 128 which sets the maximum number of matrix switches that can be energized.

The coil for each relay draws 28 mA of current from the 5V supply when energized. This function is provided as a means of controlling the maximum current use of the card. If an attempt is made to close more switches than the limit setting, an error will be generated and the switch will not be closed.

Example: Limit 55<CR><LF>

This command sets the maximum number of switches that can be closed to 55.

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Command: LIMit?

Syntax: LIMIT?
or LIM?

Purpose: Returns the current limit setting.

Description: The LIMit? query returns a decimal number from 0 to 128 which indicates the current limit setting. (The LIMit command sets the maximum number of switches that can be energized.)

Example: LIM?

A response of 55 would indicate that a maximum of 55 switches can be energized.

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Command: MBUFfer

Syntax: MBUFFER ON | OFF
or MBUF ON | OFF

Purpose: Places the module into buffer mode when running macros.

Description: The MBUFfer command determines whether the module is placed into buffer mode when running macros in unbuffered mode. On some systems, queries or HALT commands placed within macros may not work correctly because the system sends additional characters after the macro label terminator, causing the macro to terminate after the first query. If MBUFfer is ON, the module will be placed into buffer mode during macro processing, and the additional characters will be placed into the buffer during initial macro processing, where they will not cause the macro to be terminated while halted. The MBUFfer command must be issued prior to executing a macro and cannot be placed within a macro.

Be aware that if MBUFfer is ON the module will operate asynchronously while macros are being processed.

The default is MBUFfer OFF.

Example: MBUF ON<CR><LF>

or MBUFFER OFF<CR><LF>

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Command: MBUFfer?

Syntax: MBUFFER?
or MBUF?

Purpose: Determines whether or not the module places itself into buffer mode during macro execution.

Description: The MBUFfer? query causes the module to return an ON if the MBUFfer switch is on, or an OFF if it is not.

Example: MBUFFER?<CR><LF>

Response: OFF<CR><LF>

or ON<CR><LF>

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Command: OPEN

Syntax: OPEN [:ALL] | [:ABSolute] x,y[,m] | $I

Purpose: Opens switches relative to the configured matrix.

Description: OPEN opens switches indicated by parameters as follows:

[:ALL] Opens all the matrix switches. The configuration switches and macro definitions are unchanged. No parameters are necessary with this option, and an error will be generated if one is given.

[:ABSolute] An optional parameter which causes the x and y parameters to open the switches that would be opened in the 4x32 configuration, regardless of how the matrix is actually configured.

x A number from 1 - 8 which indicates the X co-ordinate of the switch to be opened. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. A comma must follow the number to separate the x and y parameters.

y A number from 1 - 32 which indicates the Y co-ordinate of the switch to be opened. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. If the optional m parameter is used, a comma must follow the y parameter to separate it from the x parameter.

[m] A or B. An optional parameter used when the switch is divided into two matrices to select either the A or B matrix. If [m] is not specified, A is used. If a letter other than A or B is given, an error will be generated. If the matrix is not divided, an A or B will be ignored.

I A macro label containing the above parameters which has been defined with the DEFine command.

NOTE: In the 4-wire configurations, two switches will be opened for each X and Y co-ordinate.

More than one switch can be opened with a single command by chaining the parameters with an ampersand (&) sign. The parameters may be enclosed in parentheses for clarity. The maximum length of the list (not including white spaces) cannot exceed 200 characters.

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Examples:

```
OPEN:ALL<CR><LF>
OPEN:ABSOLUTE 3,23<CR><LF>
OPEN 2,5<CR><LF>
OPEN 1,3,A & 4,2,A & 3,10,A<CR><LF>
OPEN (1,3,A & 4,2,A & 3,10,A)<CR><LF>
OPEN $LABEL1<CR><LF>
```

These commands open the switches at the indicated co-ordinates. The last example assumes that a macro with the name 'LABEL1' has been defined containing the required parameters.

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Command: OPEN?

Syntax: OPEN? [:ABSolute] x,y[,m]

Purpose: Reads back the state of a switch relative to the configured matrix.

Description: OPEN? causes the module to return an ASCII '1' if the queried switch is open and an ASCII '0' if it is closed.

[:ABSolute] An optional parameter which causes the x and y parameters to reference the switch that would be referenced in the 4x32 configuration, regardless of how the matrix is actually configured.

x A number from 1 - 8 which indicates the X co-ordinate of the switch to be queried. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. A comma must follow the number to separate the x and y parameters.

y A number from 1 - 32 which indicates the Y co-ordinate of the switch to be queried. The maximum number allowed will depend on the matrix configuration. If this number is exceeded, an error will be generated. If the optional m parameter is used, a comma must follow the y parameter to separate it from the x parameter.

[m] A or B. An optional parameter used when the switch is divided into two matrices to select either the A or B matrix. If [m] is not specified, A is used. If a letter other than A or B is given, an error will be generated. If the matrix is not divided, an A or B will be ignored.

NOTE: In the 4-wire configurations, the returned value will represent the two switches which would be affected by the OPEN command. If both relays are closed an ASCII '2' will be returned.

Switches can only be queried with one X,Y co-ordinate set at a time. The entire list of closed switches can be queried by updating the display, then reading back the display buffer: UPDATE;DISP?<CR><LF>

Examples: OPEN? 1,4,A<CR><LF>
OPEN?:ABS 2,5<CR><LF>

Response:

1<CR><LF>	The queried switch is open.
0<CR><LF>	The queried switch is closed.
2<CR><LF>	4-wire mode with both switches associated with the queried co-ordinates closed.

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Command: **UPDate**

Syntax: UPDATE [ON | OFF]
or UPD [ON | OFF]

Purpose: Causes the display to be updated to the current switch closures, or determines whether or not the display is updated after each OPEN or CLOSe command.

Description: A white space must be placed between the command and the parameter.

If used without any parameters, the UPDate command causes the display to be updated to the current list of closed switches. Giving the ON or OFF parameter determines whether future OPEN or CLOSE commands update the display. If the ON or OFF parameters are given, the current display will be unaffected. The default is ON.

This command can be useful for speeding up switch operations by not generating the display listing each time an OPEN or CLOSe operation is executed.

Examples: UPDATE<CR><LF>
UPDATE ON<CR><LF>
UPDATE OFF<CR><LF>

If UPDate is ON, the first of the following examples would execute more slowly than the second, even though the result would be the same, since in the second example the display listing would only be generated after the group was processed. If UPDate is OFF there would be little difference in the processing speed of the two examples.

OPEN:ALL; CLOSE 1,2; CLOSE 4,12; CLOSE 3,9; CLOSE 2,14<CR><LF>
OPEN:ALL; CLOSE 1,2 & 4,12 & 3,9 & 2,14<CR><LF>

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Command: UPDate?

Syntax: UPDATE? or UPD?

Purpose: Returns the state of the automatic updating feature.

Description: The UPDate? query causes the module to return an ON if the update feature is in effect, or an OFF if it is not.

Example: UPDATE?<CR><LF>

A response of OFF indicates that the update feature is not enabled.

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Command: VERBose

Syntax: VERBOSE ON ¦ OFF
or VERB ON ¦ OFF

Purpose: Turns the display of full scrolling error messages in the module's display on or off.

Description: The VERBose function allows the generation of 4-digit non-scrolling error messages in the module's display if the longer scrolling messages are undesirable

If VERBose is OFF, only a non-scrolling 4-digit error message starting with 'E' and then the error number will be displayed when an error is generated. The full error message will always be returned by the card when errors are queried. The default is ON.

Example: VERB OFF<CR><LF>

VERBOSE ON<CR><LF>

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Command: VERBose?

Syntax: VERBose? or VERB?

Purpose: Determines whether long or short error message display is in effect.

Description: The VERBose? query causes the module to return an ON if the longer error messages are being displayed, or an OFF if they are not.

Example: VERBOSE?<CR><LF>

A response of ON<CR><LF> indicates that the longer error messages are being displayed.

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SYSFAIL, Self Test, and Initialization

The VX4385 Module will execute a self test of RAM at power-up or upon direction of a VXIbus hard or soft reset condition. A VXIbus hard reset occurs when another device, such as the VXIbus Resource Manager, asserts the backplane line SYSRST*. A VXIbus soft reset occurs when another device, such as the VX4385's commander, sets the Reset bit in the VX4385's Control register. The result of this self test can be obtained with the *TST? query.

During a power-up, hard reset, or soft reset, the following actions take place:

1) The SYSFAIL* (VME system-failure) line is set active, indicating that the module is executing a self test, and the Failed LED is lit. In the case of a soft reset, SYSFAIL* is set. However, all Tek/CDS commanders, such as the VX4520, will simultaneously set SYSFAIL INHIBIT. This is done to prevent the Resource Manager from prematurely reporting the failure of a module.

2) Once the self test is complete, the SYSFAIL* line is released, and the module enters the VXIbus PASSED state (ready for normal operation). SYSFAIL* will be released with five seconds in normal operation.

The default condition of the VX4385 Module after the completion of a power-up self test is as follows:

All relays open
Dual 4 x 16 matrix configuration
User definitions cleared
Nonbuffered mode
DWELL ON

SYSFAIL* Operation

SYSFAIL* becomes active during power-up, hard or soft reset, power-up self test, or if the module loses any of its power voltages. When the mainframe Resource Manager detects SYSFAIL* set, it will attempt to inhibit the line. This will cause an operational VX4385 Module to deactivate SYSFAIL*.

SCPI Compatibility

To provide compatibility with systems which generate SCPI code the following strings can be prefixed to any command:

DISPlay:
MEMory:
PROGram:
ROUTe:
SYSTem:

None of the above strings will have any effect on command execution.

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Section 4
Programming Examples

This section contains an example program which demonstrates how the programmable features of the VX4385 are used. The example is written in BASIC using an IBM PC or equivalent computer with a Capital Equipment Corp. IEEE-488 interface as the controller.

Definition of BASIC Commands

The programming examples in this manual are written in Microsoft GW BASIC. These examples use the GW BASIC commands described below. If the programming language that you are using does not conform exactly to these definitions, use the command in that language that will give the same result.

Command	Result

CALL ENTER(R$, LENGTH%, ADDRESS%, STATUS%)

The CALL ENTER statement inputs data into the string R$ from the IEEE-488 instrument whose decimal primary address is contained in the variable ADDRESS%. Following the input, the variable LENGTH% contains the number of bytes read from the instrument. The variable STATUS% contains the number '0' if the transfer was successful or an '8' if an operating system timeout occurred in the PC. Prior to using the CALL ENTER statement, the string R$ must be set to a string of spaces whose length is greater than or equal to the maximum number of bytes expected from the VX4385.

CALL SEND(ADDRESS%, WRT$, STATUS%)

The CALL SEND statement outputs the contents of the string variable WRT$ to the IEEE-488 instrument whose decimal primary address is contained in the variable ADDRESS%. Following the output of data, the variable STATUS% contains a '0' if the transfer was successful and an '8' if an operating timeout occurred in the PC.

CLS — Clear the screen.

END — Terminates the program.

PRINT — Prints a line of text on the screen.

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Programming Example In BASIC

The sample BASIC program shows how commands for the VX4385 might be used. This example assumes that the VX4385 has logical address 24 and is installed in a VXIbus mainframe that is controlled through an IEEE-488 interface from an external system controller, such as an IBM PC or equivalent using a Capital Equipment Corp. IEEE-488 interface. The VXIbus IEEE-488 interface is assumed to have an IEEE-488 primary address of decimal 21 and to have converted the VX4385 Module's logical address to an IEEE-488 primary address of decimal 24.

The following program configures the VX4385 to a single 4 x 32 matrix, connects the DVM (wired to the two wires of 1X) to two devices in turn (wired to 3Y and 5Y), takes measurements, and displays the measurements on the screen.

Lines 10 through 70 initialize the Capital Equipment interface installed in the PC.

```
10 REM INITIALIZE SYSTEM
20 GOSUB 1000          ' DETERMINE MEMORY LOCATION OF CEC CARD
30 INIT = 0            ' CALL INIT ( GPIB%,LEVEL% )
40 SEND = 9            ' CALL SEND ( PCX%, WRT$, STATUS% )
50 SPOLL = 12          ' CALL SPOLL ( PCX%, POLL%, STATUS% )
60 ENTER = 21          ' CALL ENTER ( RD$, LENGTH%, PCX%, STATUS% )
70                     '  ENTER MUST BE PRECEDED BY
80                     '  "RD$ = SPACE$( N ) AND FOLLOWED
90                     '   BY RD$ = LEFT$ ( RD$, LENGTH% )
100 ADDRESS% = 21      ' ADDRESS OF GPIB CARD IN THE PC
110 CONTROL% = 0       ' DEFINES THE PC'S INTERFACE AS BUS CONTROLLER
120 CALL INIT(ADDRESS%,CONTROL%) ' INITIALIZE THE PC'S INTERFACE CARD
130 TM$ = CHR$(10)     ' DEFINE THE LINE FEED TERMINATOR
140 CLS                ' CLEAR CRT SCREEN
150 ADDRESS4385% = 3     ' GPIB ADDRESS OF VX4385 CARD
160 ADDRESSDVM% = 2      ' GPIB ADDRESS OF DMM CARD
170 WRT$ = "DELETE:ALL;configure 4x32" + TM$
180 CALL SEND(ADDRESS4385%,WRT$,STATUS%)
190                    ' CLEAR PREVIOUS PROGRAMMING AND SET MODULE
200                    ' FOR 4 X 32 MATRIX
210 WRT$ = "DEFINE MEASURE1,'OPEN:ALL;CLOSE 1,3'" + TM$
220 CALL SEND(ADDRESS4385%,WRT$,STATUS%)
230                    ' DESIGNATES A USER DEFINED FUNCTION (MACRO)
240                    ' TO OPEN ALL RELAYS THEN CLOSE RELAY 1,3
250 WRT$ = "DEFINE MEASURE2,'OPEN:ALL;CLOSE 1,5'" + TM$
260 CALL SEND(ADDRESS4385%,WRT$,STATUS%)
270                    ' DESIGNATES A USER DEFINED FUNCTION (MACRO)
280                    ' TO OPEN ALL RELAYS THEN CLOSE RELAY 1,5
290 WRT$ = "$MEASURE1" + TM$
300 CALL SEND(ADDRESS4385%,WRT$,STATUS%)
310                    ' CLOSE RELAY FOR FIRST MEASUREMENT
320 WRT$ = "input ch_a,x?" + TM$
```


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```
330 CALL SEND(ADDRESSDVM%,WRT$,STATUS%)
340                     ' INITIALIZE AND TRIGGER DVM FOR MEASUREMENT
350 RD$ = SPACE$(20)
360 CALL ENTER(RD$,LENGTH%,ADDRESSDVM%,STATUS%)
370 PRINT"Y3 Measured ";RD$;"VDC":PRINT:PRINT
380                     ' READ DVM AND PRINT READING
390 'WRT$ = "$MEASURE2" + TM$
400 'CALL SEND(ADDRESS4385%,WRT$,STATUS%)
410                     ' CLOSE RELAY FOR FIRST MEASUREMENT
420 WRT$ = "input ch_a,x?" + TM$
430 CALL SEND(ADDRESSDVM%,WRT$,STATUS%)
440 CALL ENTER(RD$,LENGTH%,ADDRESSDVM%,STATUS%)
450                     ' INITIALIZE AND TRIGGER DVM FOR MEASUREMENT
460 PRINT"Y5 Measured ";RD$;"VDC":PRINT:PRINT
470                     ' READ DVM AND PRINT READING
480 WRT$ = "open:all" + TM$
490 CALL SEND(ADDRESS4385%,WRT$,STATUS%)
500                     ' OPEN ALL RELAYS
510 PRINT"End Of Test ":PRINT:PRINT
520 WRT$ = "ERR?" + TM$
530 CALL SEND(ADDRESS4385%,WRT$,STATUS%)
540 CALL ENTER(RD$,LENGTH%,ADDRESS4385%,STATUS%)
550 PRINT  RD$:PRINT:PRINT
560                     ' READ RELAY MODULE ERROR REGISTER
570                     ' AND PRINT RESULTS
580 END
590 '
600 '
610 '
620 '
1000 '  SUB ROUTINE IDENTIFIES THE MEMORY LOCATION OF
1010 '  CEC IEEE-488 INTERFACE CARD ROM
1020 '
1030 FOR I = &H40 TO &HEC STEP &H4
1040 FAILED =0: DEF SEG = (I * &H100)
1050 IF CHR$ ( PEEK (50) ) <> "C" THEN FAILED =1
1060 IF CHR$ ( PEEK (51) ) <> "E" THEN FAILED =1
1070 IF CHR$ ( PEEK (52) ) <> "C" THEN FAILED =1
1080 IF FAILED = 0 THEN CECLOC = (I * &H100 ): I = &HEC
1090 NEXT I
1100 RETURN
```


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Appendix A
VXIbus Operation

The VX4385 Module is a C size single slot VXIbus Message-Based Word Serial instrument. It uses the A16, D16 VME interface available on the backplane P1 connector and does not require any A24 or A32 address space. The module is a D16 interrupter.

The VX4385 Module is neither a VXIbus commander or VMEbus master, and therefore it does not have a VXIbus Signal register. The VX4385 is a VXIbus message based servant.

The module supports the Normal Transfer Mode of the VXIbus, using the Write Ready, Read Ready, Data In Ready (DIR), and Data Out Ready (DOR) bits of the module's Response register.

A Normal Transfer Mode read of the VX4385 Module proceeds as follows:

1. The commander reads the VX4385's Response register and checks if the Write Ready and DOR bits are true. IF they are, the commander proceeds to the next step. If not, the commander continues to poll these bits until they become true.

2. The commander writes the Byte Request command (0DEFFh) to the VX4385's Data Low register.

3. The commander reads the VX4385's Response register and checks if the Read Ready and DOR bits are true. If they are, the commander proceeds to the next step. If not, the commander continues to poll these bits until they become true.

4. The commander reads the VX4385's Data Low register.

A Normal Transfer Mode Write to the VX4385 Module proceeds as follows:

1. The commander reads the VX4385's Response register and checks if the Write Ready and DIR bits are true. If they are, the commander proceeds to the next step. If not, the commander continues to poll the Write Ready and DIR bits until they are true.

2. The commander writes the Byte Available command which contains the data (0BCXX or 0BDXX, depending on the End bit) to the VX4385's Data Low register.

The VX4385 Module also supports the Fast Handshake Mode during readback. In this mode, the module is capable of transferring data at optimal backplane speed without the need of the commander's testing any of the handshake bits. The VX4385 Module asserts BERR* to switch from Fast Handshake Mode to Normal Transfer Mode, per VXI

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Specification. The VX4385's Read Ready, Write Ready, DIR and DOR bits react properly, in case the commander does not support the Fast Handshake Mode.

A Fast Handshake Transfer Mode Read of the VX4385 Module proceeds as follows:

1. The commander writes the Byte Request command (0DEFFh) to the VX4385's Data Low register.

2. The commander reads the VX4385's Data Low register.

The VX4385 Module has no registers beyond those defined for VXIbus message based devices. All communications with the module are through the Data Low register, the Response register or the VXIbus interrupt cycle. Any attempt by another module to read or write to any undefined location of the VX4385's address space may cause incorrect operation of the module.

As with all VXIbus devices, the VX4385 module has registers located within a 64 byte block in the A16 address space.

The base address of the VX4385 device's registers is determined by the device's unique logical address and can be calculated as follows:

Base Address = V * 40H + C000H

where V is the device's logical address as set by the Logical Address switches.

Configuration Registers

Below is a list of the VX4385 Configuration registers with a complete description of each. In this list, RO = Read Only, WO = Write Only, R = Read, and W = Write. The offset is relative to the module's base address:

REGISTER DEFINITIONS

Register	Address	Type	Value (Bits 15-0)
ID Register	0000H	RO	1011 1111 1111 1100 (BFFCh)
Device Type	0002H	RO	See Device Type definition below
Status	0004H	R	Defined by state of interface
Control	0004H	W	Defined by state of interface
Offset	0006H	WO	Not used
Protocol	0008H	RO	1110 0111 1111 1111 (E7FFh)
Response	000AH	RO	Defined by state of the interface
Data High	000CH		Not used
Data Low	000EH	W	See Data Low definition below
Data Low	000EH	R	See Data Low definition below

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REGISTER BIT DEFINITIONS

ID:	BFFCh
Device:	F67Eh
Protocol:	E7FFh

Word Serial Commands

A write to the Data Low register causes this module to execute some action based on the data written. This section describes the device specific Word Serial commands this module responds to and the results of these commands.

Read Protocol command response: FE6Bh

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BIT DEFINITIONS

Register	Bit Location	Bit Usage	VX4385 Value	VX4385 Usage
Response	10	Read Ready	1 or 0	Indicates that data may be read from this module at this time. Set by the instrument following a "Byte Request" or any other VXI command requiring readback. Cleared on reset or when no data is left to send.
	9	Write Ready	1 or 0	Indicates that VXI commands or instrument data may be written at this time.
	8	FHS Active*	1	Indicates that this module is capable of supporting fast handshake (not requiring handshake) at this point in time.
	7	Locked*	1 or 0	Follows the state of the Clear Lock and Set Lock VXIbus commands.
	6-0	Device dependant	xxx xxxx	Not used

Data High - not implemented.

Data Low (read/write)

Word Serial Commands

A write to the Data Low register causes this module to execute some action based on the data written. This section describes the device specific Word Serial commands this module responds to and the results of these commands.

Read Protocol Command:

```
15 14 13 12 11 10  9  8  7  6  5  4  3  2  1  0
 1  1  0  1  1  1  1  1  1  1  1  1  1  1  1  1
```

If the Data Low register is read after this command, the contents are as follows:

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BIT DEFINITIONS

Register	Bit Location	Bit Usage	VX4385 Value	VX4385 Usage
Read Protocol	15	VXI Rev.	1	VXI Revision 1.3
	14-11	Device Dependant	1111	not used
	10	Reserved	1	Reserved
	9	RG*	1	response generation not supported
	8	EG*	0	event generation supported
	7	Zero	0	must be 0, per VXI specification.
	6	PI*	1	programmable interrupts not supported
	5	PH*	1	programmable interrupt handlers not supported
	4	TRG*	0	Word Serial Trigger command supported
	3	I4*	1	488.2 protocol not supported
	2	I*	0	VXIbus Instrument Protocol supported
	1	ELW*	1	Extended Long Word protocol not supported
	0	LW*	1	Long Word protocol not supported
Read STB	15-8	Upper byte	1111 1111	not used
	7	not used	0	not used
	6	RQS	1 or 0	set when a request true interrupt has been generated. Cleared upon the execution of this command.
	5-0	not used	0	not used
Async Mode Control	15-12	Status	1111	command successful
			0111	command unsuccessful. this occurs if bits 0 or 1 of this command are 1 indicating that a request is being made to have responses and/or events sent as signals. This module supports interrupts rather than signals.
	11-4	not used	1111 1111	not used
	3	Resp En*	0 or 1	if bits 15-12 are 1111, echoes bit 3 of the command
	2	Event En*	0 or 1	if bits 15-12 are 1111, echoes bit 2 of the command

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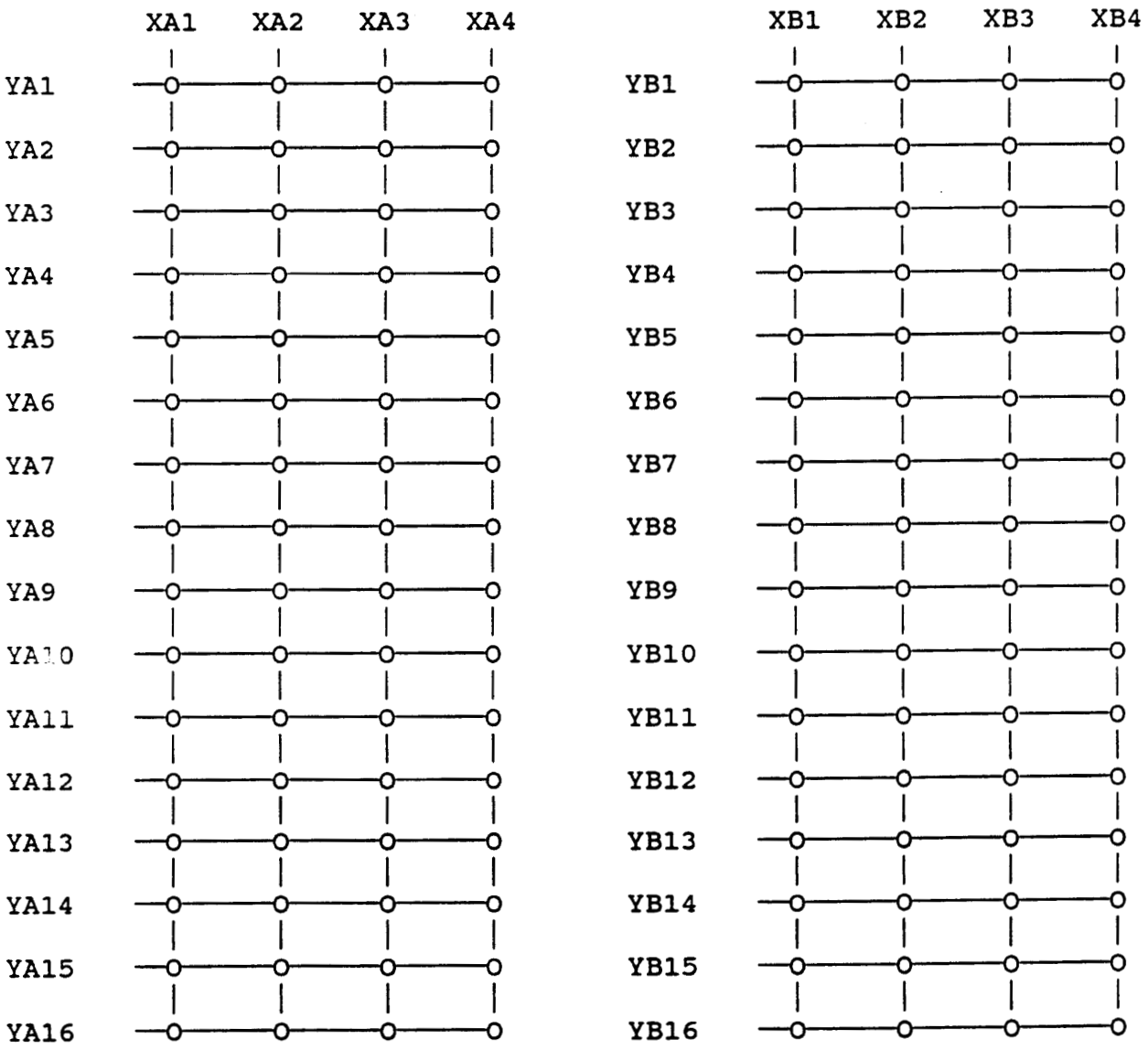
Register	Bit Location	Bit Usage	VX4385 Value	VX4385 Usage
	1	Resp Mode	0	interrupts are supported
	0	Event Mode	0	interrupts are supported
Control Response	15-12		1111	command passed
	11-7	not used	11111	not used
	6-0		1111111	no responses supported

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Appendix B
Input/Output Connections

TWO WIRE

DUAL 4 X 16 MATRIX



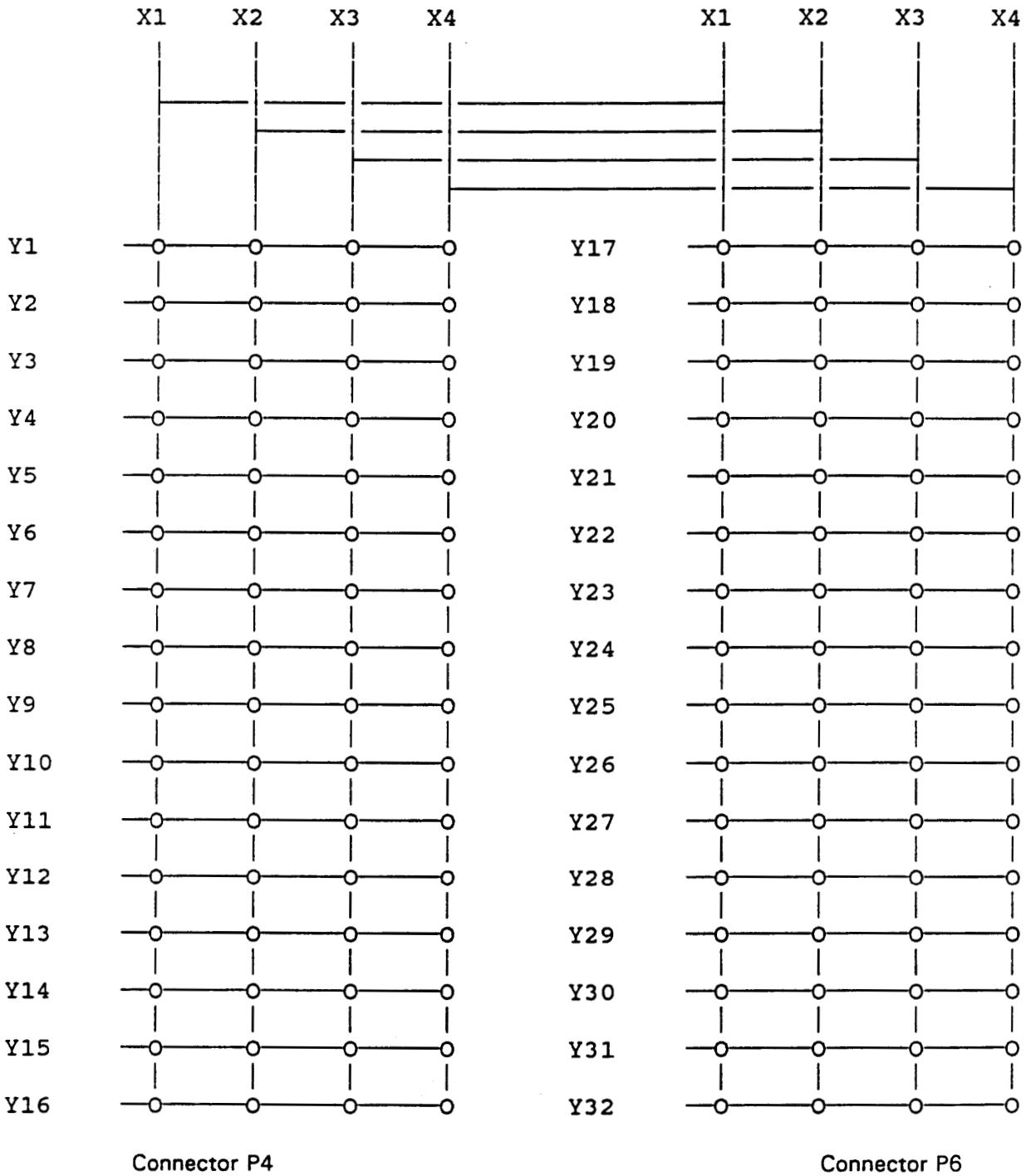
Connector P4

Connector P6

Each line represents a wire pair.

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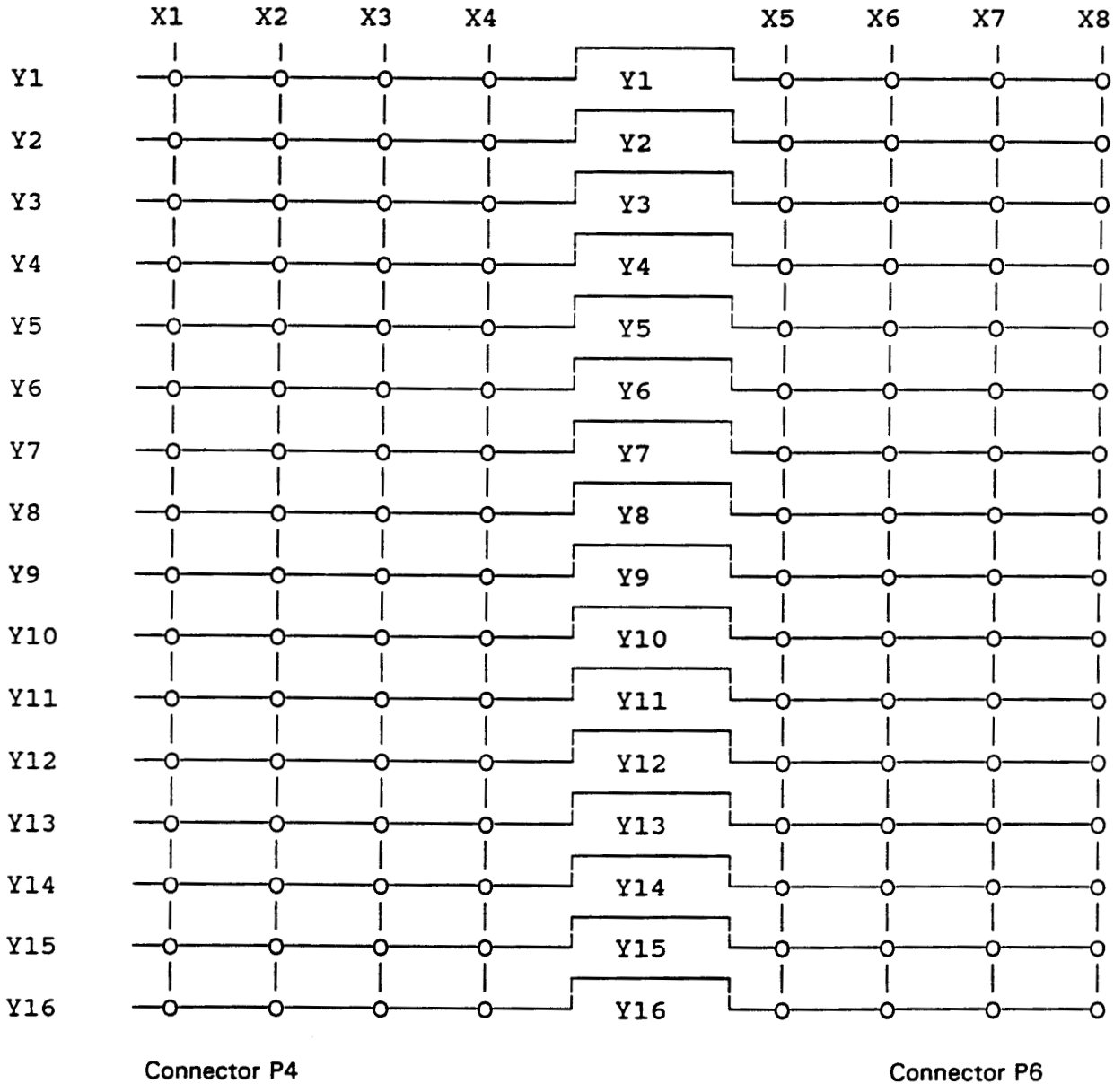
TWO WIRE
SINGLE 4 X 32 MATRIX



Each line represents a wire pair.

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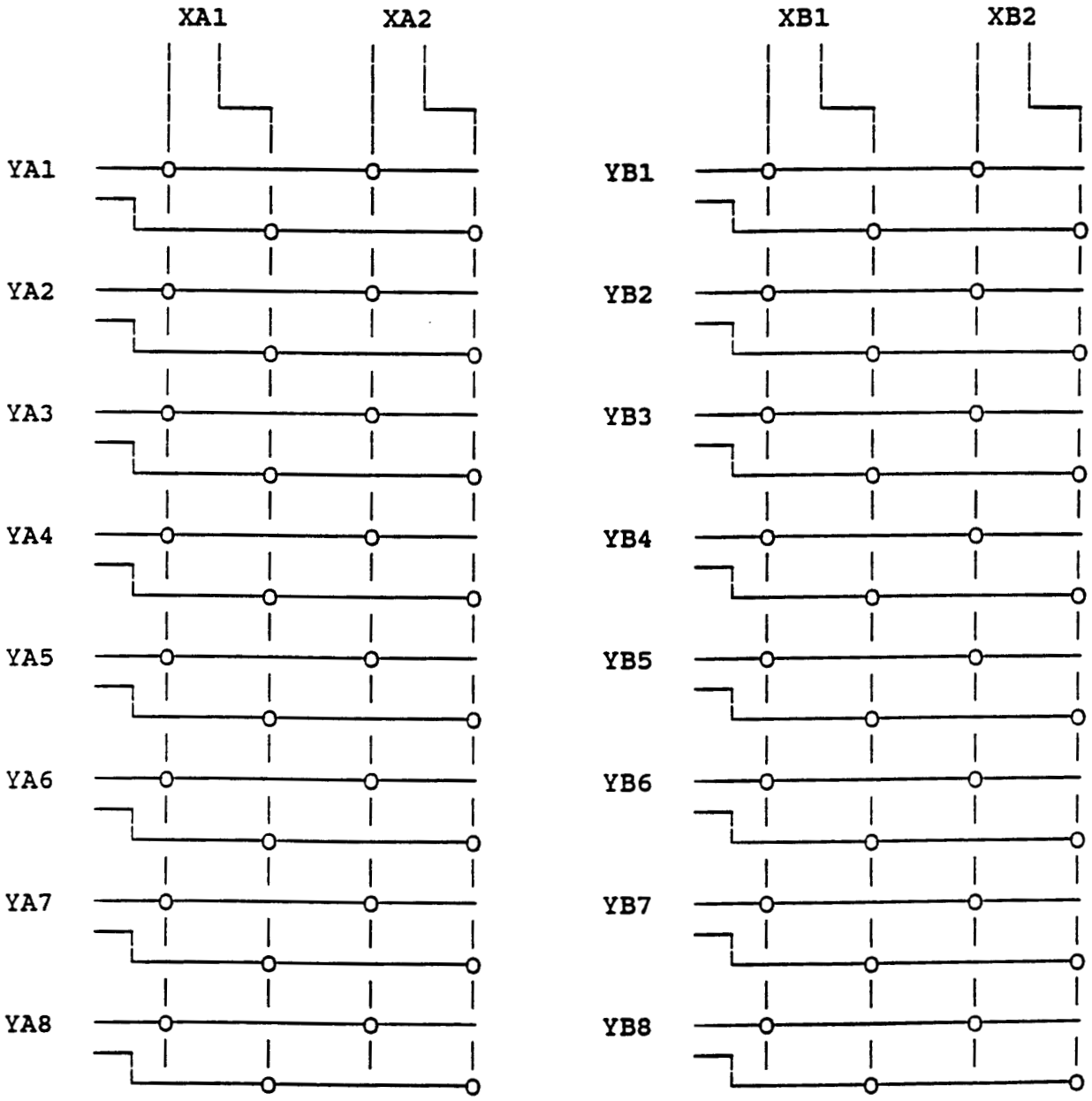
TWO WIRE
SINGLE 8 X 16 MATRIX



Each line represents a wire pair.

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FOUR WIRE
DUAL 2 X 8 MATRIX



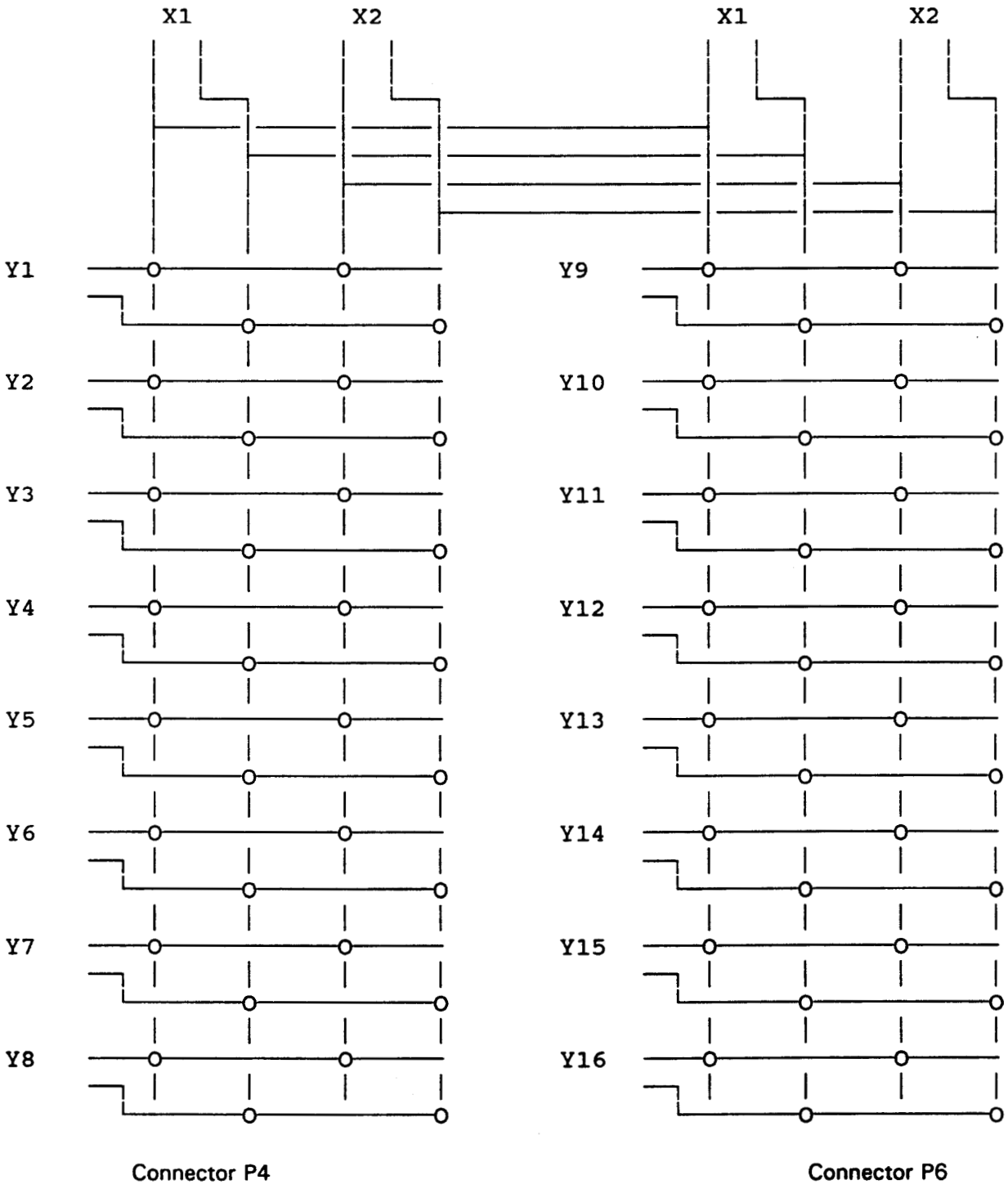
Connector P4

Connector P6

Each line represents a wire pair.

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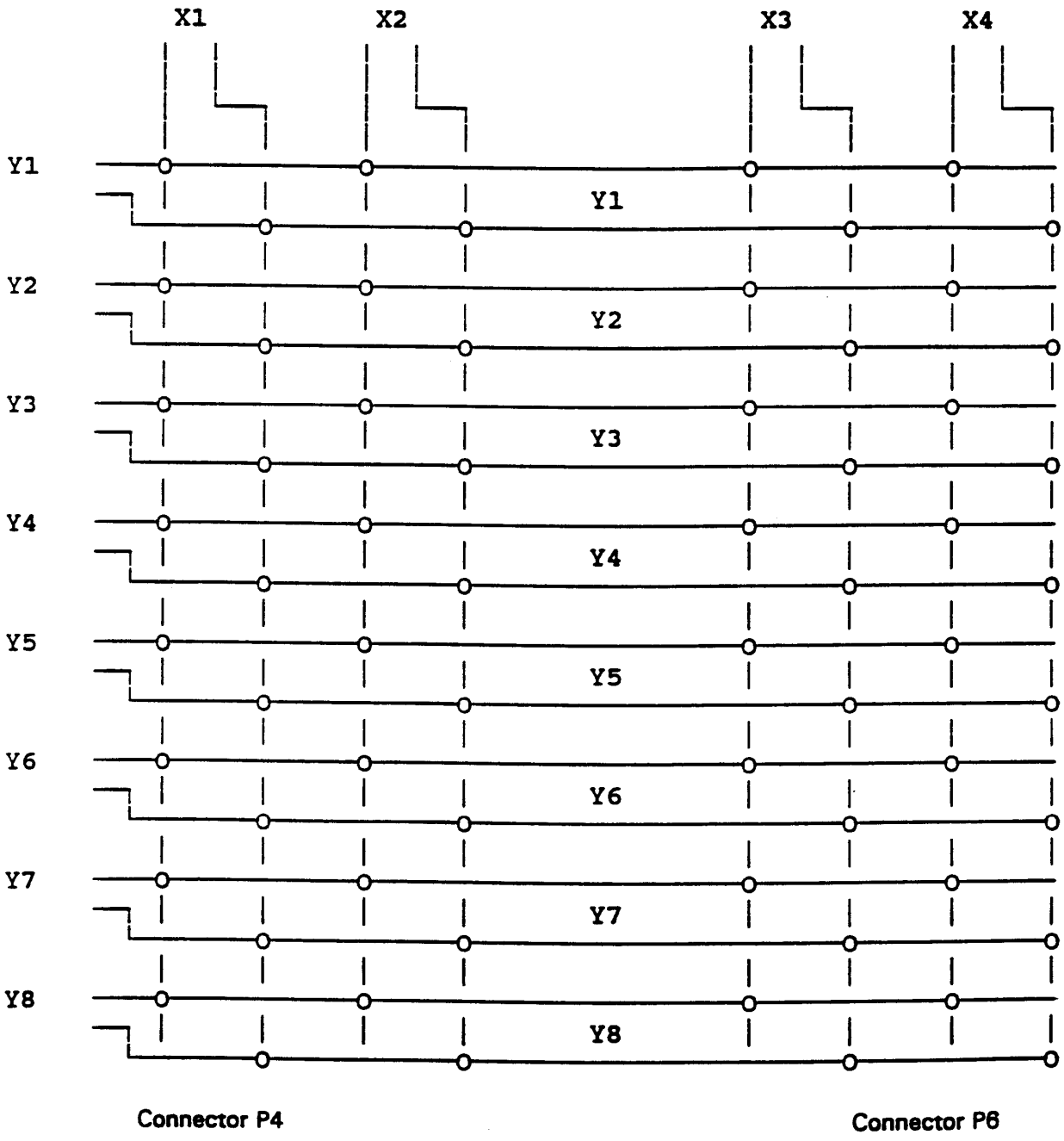
FOUR WIRE
SINGLE 2 X 16 MATRIX



Each line represents a wire pair.

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FOUR WIRE
SINGLE 4 X 8 MATRIX



Each line represents a wire pair.

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TWO WIRE P4 - DUAL 4 X 16 MATRIX A				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H		GND	1
35	XA1 L	18	H - YA1 - L	2
36	H	19	H - YA2 - L	3
37	XA2 L	20	H - YA3 - L	4
38	H	21	H - YA4 - L	5
39	XA3 L	22	H - YA5 - L	6
40	H	23	H - YA6 - L	7
41	XA4 L	24	H - YA7 - L	8
42	GND	25	H - YA8 - L	9
43	L	26	H - YA9 - L	10
44	XB1 H	27	H - YA10 - L	11
45	L	28	H - YA11 - L	12
46	XB2 H	29	H - YA12 - L	13
47	L	30	H - YA13 - L	14
48	XB3 H	31	H - YA14 - L	15
49	L	32	H - YA15 - L	16
50	XB4 H	33	H - YA16 - L	17

The signals in the shaded areas are duplicates of signals appearing on page A-10 and would normally be found on that connector.

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TWO WIRE P6 - DUAL 4 X 16 MATRIX B				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H XB1 L		GND	1
35		18	H - YB1 - L	2
36	H XB2 L	19	H - YB2 - L	3
37		20	H - YB3 - L	4
38	H XB3 L	21	H - YB4 - L	5
39		22	H - YB5 - L	6
40	H XB4 L	23	H - YB6 - L	7
41		24	H - YB7 - L	8
42	GND	25	H - YB8 - L	9
43	L XA1 H	26	H - YB9 - L	10
44		27	H - YB10 - L	11
45	L XA2 H	28	H - YB11 - L	12
46		29	H - YB12 - L	13
47	L XA3 H	30	H - YB13 - L	14
48		31	H - YB14 - L	15
49	L XA4 H	32	H - YB15 - L	16
50		33	H - YB16 - L	17

The signals in the shaded areas are duplicates of signals appearing on page A-8 and would normally be found on that connector.

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TWO WIRE P4 - SINGLE 4 X 32 Y1 - Y16				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H X1 L		GND	1
35		18	H - Y1 - L	2
36	H X2 L	19	H - Y2 - L	3
37		20	H - Y3 - L	4
38	H X3 L	21	H - Y4 - L	5
39		22	H - Y5 - L	6
40	H X4 L	23	H - Y6 - L	7
41		24	H - Y7 - L	8
42	GND	25	H - Y8 - L	9
43	L X1 H	26	H - Y9 - L	10
44		27	H - Y10 - L	11
45	L X2 H	28	H - Y11 - L	12
46		29	H - Y12 - L	13
47	L X3 H	30	H - Y13 - L	14
48		31	H - Y14 - L	15
49	L X4 H	32	H - Y15 - L	16
50		33	H - Y16 - L	17

The signals in the shaded areas are duplicates of signals appearing on page A-10 and would normally be found on that connector.

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TWO WIRE P6 - SINGLE 4 X 32 Y17 - Y32				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H X1 L		GND	1
35		18	H - Y17 - L	2
36	H X2 L	19	H - Y18 - L	3
37		20	H - Y19 - L	4
38	H X3 L	21	H - Y20 - L	5
39		22	H - Y21 - L	6
40	H X4 L	23	H - Y22 - L	7
41		24	H - Y23 - L	8
42	GND	25	H - Y24 - L	9
43	L X1 H	26	H - Y25 - L	10
44		27	H - Y26 - L	11
45	L X2 H	28	H - Y27 - L	12
46		29	H - Y28 - L	13
47	L X3 H	30	H - Y29 - L	14
48		31	H - Y30 - L	15
49	L X4 H	32	H - Y31 - L	16
50		33	H - Y32 - L	17

The signals in the shaded areas are duplicates of signals appearing on page A-8 and would normally be found on that connector.

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TWO WIRE P4 - SINGLE 8 X 16				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H X1 L		GND	1
35		18	H - Y1 - L	2
36	H X2 L	19	H - Y2 - L	3
37		20	H - Y3 - L	4
38	H X3 L	21	H - Y4 - L	5
39		22	H - Y5 - L	6
40	H X4 L	23	H - Y6 - L	7
41		24	H - Y7 - L	8
42	GND	25	H - Y8 - L	9
43	L X5 H	26	H - Y9 - L	10
44		27	H - Y10 - L	11
45	L X6 H	28	H - Y11 - L	12
46		29	H - Y12 - L	13
47	L X7 H	30	H - Y13 - L	14
48		31	H - Y14 - L	15
49	L X8 H	32	H - Y15 - L	16
50		33	H - Y16 - L	17

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TWO WIRE P6 - SINGLE 8 X 16				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H X5 L		GND	1
35		18	H - Y1 - L	2
36	H X6 L	19	H - Y2 - L	3
37		20	H - Y3 - L	4
38	H X7 L	21	H - Y4 - L	5
39		22	H - Y5 - L	6
40	H X8 L	23	H - Y6 - L	7
41		24	H - Y7 - L	8
42	GND	25	H - Y8 - L	9
43	L X1 H	26	H - Y9 - L	10
44		27	H - Y10 - L	11
45	L X2 H	28	H - Y11 - L	12
46		29	H - Y12 - L	13
47	L X3 H	30	H - Y13 - L	14
48		31	H - Y14 - L	15
49	L X4 H	32	H - Y15 - L	16
50		33	H - Y16 - L	17

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FOUR WIRE P4 - DUAL 2 X 8 MATRIX A				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H		GND	1
35	L	18	H L	2
36	XA1 G	19	YA1 G S	3
37	S	20	H L	4
38	H	21	YA2 G S	5
39	L	22	H L	6
40	XA2 G	23	YA3 G S	7
41	S	24	H L	8
42	GND	25	YA4 G S	9
43	L	26	H L	10
44	H	27	YA5 G S	11
45	XB1 S	28	H L	12
46	G	29	YA6 G S	13
47	L	30	H L	14
48	H	31	YA7 G S	15
49	XB2 S	32	H L	16
50	G	33	YA8 G S	17

The signals in the shaded areas are duplicates of signals appearing on page A-10 and would normally be found on that connector.

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FOUR WIRE P6 - DUAL 2 X 8 MATRIX B				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H		GND	1
35	L	18	H L	2
36	XB1 G	19	YB1 G S	3
37	S	20	H L	4
38	H	21	YB2 G S	5
39	L	22	H L	6
40	XB2 G	23	YB3 G S	7
41	S	24	H L	8
42	GND	25	YB4 G S	9
43	L	26	H L	10
44	H	27	YB5 G S	11
45	XA1 S	28	H L	12
46	G	29	YB6 G S	13
47	L	30	H L	14
48	H	31	YB7 G S	15
49	XA2 S	32	H L	16
50	G	33	YB8 G S	17

The signals in the shaded areas are duplicates of signals appearing on page A-8 and would normally be found on that connector.

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FOUR WIRE P4 - SINGLE 2 X 16 Y1 - Y8				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H		GND	1
35	L X1	18	H L Y1	2
36	G	19	G S	3
37	S	20	H L Y2	4
38	H	21	G S	5
39	L X2	22	H L Y3	6
40	G	23	G S	7
41	S	24	H L Y4	8
42	GND	25	G S	9
43	L	26	H L Y5	10
44	H X1	27	G S	11
45	S	28	H L Y6	12
46	G	29	G S	13
47	L	30	H L Y7	14
48	H X2	31	G S	15
49	S	32	H L Y8	16
50	G	33	G S	17

The signals in the shaded areas are duplicates.

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FOUR WIRE P6 - SINGLE 2 X 16 Y9 - Y16				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H		GND	1
35	L	18	H L	2
36	X1 G	19	Y9 G S	3
37	S	20	H L	4
38	H	21	Y10 G S	5
39	L	22	H L	6
40	X2 G	23	Y11 G S	7
41	S	24	H L	8
42	GND	25	Y12 G S	9
43	L	26	H L	10
44	H	27	Y13 G S	11
45	X1 S	28	H L	12
46	G	29	Y14 G S	13
47	L	30	H L	14
48	H	31	Y15 G S	15
49	X2 S	32	H L	16
50	G	33	Y16 G S	17

The signals in the shaded areas are duplicates.

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FOUR WIRE P4 - SINGLE 4 X 8				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H		GND	1
35	L	18	H L	2
36	X1 G	19	Y1 G S	3
37	S	20	H L	4
38	H	21	Y2 G S	5
39	L	22	H L	6
40	X2 G	23	Y3 G S	7
41	S	24	H L	8
42	GND	25	Y4 G S	9
43	L	26	H L	10
44	H	27	Y5 G S	11
45	X3 S	28	H L	12
46	G	29	Y6 G S	13
47	L	30	H L	14
48	H	31	Y7 G S	15
49	X4 S	32	H L	16
50	G	33	Y8 G S	17

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FOUR WIRE P6 - SINGLE 4 X 8				
PIN	SIGNAL	PIN	SIGNAL	PIN
34	H		GND	1
35	L	18	H L	2
36	X3 G	19	Y1 G S	3
37	S	20	H L	4
38	H	21	Y2 G S	5
39	L	22	H L	6
40	X4 G	23	Y3 G S	7
41	S	24	H L	8
42	GND	25	Y4 G S	9
43	L	26	H L	10
44	H	27	Y5 G S	11
45	X1 S	28	H L	12
46	G	29	Y6 G S	13
47	L	30	H L	14
48	H	31	Y7 G S	15
49	X2 S	32	H L	16
50	G	33	Y8 G S	17

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TWO WIRE P5 - DUAL 4 X 16			
PIN	SIGNAL	PIN	SIGNAL
16	XA4 H	15	XA4 L
14	XA3 H	13	XA3 L
12	XA2 H	11	XA2 L
10	XA1 H	9	XA1 L
8	XB4 H	7	XB4 L
6	XB3 H	5	XB3 L
4	XB2 H	3	XB2 L
2	XB1 H	1	XB1 L

TWO WIRE P5 - SINGLE 4 X 32			
PIN	SIGNAL	PIN	SIGNAL
16	X4 H	15	X4 L
14	X3 H	13	X3 L
12	X2 H	11	X2 L
10	X1 H	9	X1 L
8	X4 H	7	X4 L
6	X3 H	5	X3 L
4	X2 H	3	X2 L
2	X1 H	1	X1 L

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TWO WIRE P5 - SINGLE 8 X 16			
PIN	SIGNAL	PIN	SIGNAL
16	X4 H	15	X4 L
14	X3 H	13	X3 L
12	X2 H	11	X2 L
10	X1 H	9	X1 L
8	X8 H	7	X8 L
6	X7 H	5	X7 L
4	X6 H	3	X6 L
2	X5 H	1	X5 L

FOUR WIRE P5 - DUAL 2 X 8			
PIN	SIGNAL	PIN	SIGNAL
16	XA2 G	15	XA2 S
14	XA2 H	13	XA2 L
12	XA1 G	11	XA1 S
10	XA1 H	9	XA1 L
8	XB2 G	7	XB2 S
6	XB2 H	5	XB2 L
4	XB1 G	3	XB1 S
2	XB1 H	1	XB1 L

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FOUR WIRE P5 - SINGLE 2 X 16			
PIN	SIGNAL	PIN	SIGNAL
16	X2 G	15	X2 S
14	X2 H	13	X2 L
12	X1 G	11	X1 S
10	X1 H	9	X1 L
8	X2 G	7	X2 S
6	X2 H	5	X2 L
4	X1 G	3	X1 S
2	X1 H	1	X1 L

FOUR WIRE P5 - SINGLE 4 X 8			
PIN	SIGNAL	PIN	SIGNAL
16	X2 G	15	X2 S
14	X2 H	13	X2 L
12	X1 G	11	X1 S
10	X1 H	9	X1 L
8	X4 G	7	X4 S
6	X4 H	5	X4 L
4	X3 G	3	X3 S
2	X3 H	1	X3 L

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Appendix C
VXI Glossary

The terms in this glossary are defined as used in the VXIbus System. Although some of these terms may have different meanings in other systems, it is important to use these definitions in VXIbus applications. Terms which apply only to a particular instrument module are noted. Not all terms appear in every manual.

Term	Definition
Accessed Indicator	An amber LED indicator that lights when the module identity is selected by the Resource Manager module, and flashes during any I/O operation for the module.
ACFAIL*	A VMEbus backplane line that is asserted under these conditions: 1) by the card cage Power Supply when a power failure has occurred (either ac line source or power supply malfunction), or 2) by the front panel ON/STANDBY switch when switched to STANDBY.
A-Size Card	A VXIbus instrument module that is 100.0 by 160 mm by 20.32 mm (3.9 by 6.3 in by 0.8 in), the same size as a VMEbus single-height short module.
Asynchronous Communication	Communications that occur outside the normal "command-response" cycle. Such communications have higher priority than synchronous communication.
Backplane	The printed circuit board that is mounted in a VXIbus card cage to provide the interface between VXIbus modules and between those modules and the external system.
B-Size Card	A VXIbus instrument module that is 233.4 by 160 mm by 20.32 mm (9.2 by 6.3 in by 0.8 in), the same size as a VMEbus double-height short module.
Bus Arbitration	In the VMEbus interface, a system for resolving contention for service among VMEbus Master devices on the VMEbus.
Bus Timer	A functional module that measures the duration of each data transfer on the Data Transfer Bus (DTB) and terminates the DTB cycle if the duration is excessive. Without the termination capability of this module, a Bus Master attempt to transfer data to or from a non-existent Slave location could result in an infinitely long wait for the Slave response.

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Client — In shared memory protocol (SMP), that half of an SMP channel that does not control the shared memory buffers.

CLK10 — A 10-MHz, ±100 ppm, individually buffered (to each module slot), differential ECL system clock that is sourced from Slot 0 and distributed to Slots 1-12 on P2. It is distributed to each module slot as a single source, single destination signal with a matched delay of under 8 ns.

CLK100 — A 100-MHz, ±100 ppm, individually buffered (to each module slot), differential ECL system clock that is sourced from Slot 0 and distributed to Slots 1-12 on P3. It is distributed to each module slot in synchronous with CLK10 as a single source, single destination signal with a maximum system timing skew of 2 ns, and a maximum total delay of 8 ns.

Commander — In the VXIbus interface, a device that controls another device (a servant). A commander may be a servant of another commander.

Command — A directive to a device. There are three types of commands:

In Word Serial Protocol, a 16-bit imperative to a servant from its commander.

In Shared Memory Protocol, a 16-bit imperative from a client to a server, or vice versa.

In a Message, an ASCII-coded, multi-byte directive to any receiving device.

Communication Registers — In word serial protocol, a set of device registers that are accessible to the commander of the device. Such registers are used for inter-device communications, and are required on all VXIbus message-based devices.

Configuration Registers — A set of registers that allow the system to identify a (module) device type, model, manufacturer, address space, and memory requirements. In order to support automatic system and memory configuration, the VXIbus standard specifies that all VXIbus devices have a set of such registers, all accessible from P1 on the VMEbus.

C-Size Card — A VXIbus instrument module that is 340.0 by 233.4 mm by 30.48 mm (13.4 by 9.2 in by 1.2 in).

Custom Device — A special-purpose VXIbus device that has configuration registers so as to be identified by the system and to allow for definition of future device types to support further levels of compatibility.

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Data Transfer Bus — One of four buses on the VMEbus backplane. The Data Transfer Bus allows Bus Masters to direct the transfer of binary data between Masters and Slaves.

DC SUPPLIES Indicator — A red LED indicator that illuminates when a DC power fault is detected on the backplane.

Device Specific Protocol — A protocol for communication with a device that is not defined in the VXIbus specification.

D-Size Card — A VXIbus instrument module that is 340.0 by 366.7 mm by 30.48 mm (13.4 x 14.4 in x 1.2 in).

DTB — See Data Transfer Bus.

DTB Arbiter — A functional module that accepts bus requests from Requester modules and grants control of the DTB to one Requester at a time.

DUT — Device Under Test.

ECLTRG — Six single-ended ECL trigger lines (two on P2 and four on P3) that function as inter-module timing resources, and that are bussed across the VXIbus subsystem backplane. Any module, including the Slot 0 module, may drive and receive information from these lines. These lines have an impedance of 50 ohms; the asserted state is logical High.

Embedded Address — An address in a communications protocol in which the destination of the message is included in the message.

ESTST — Extended STart/STop protocol; used to synchronize VXIbus modules.

Extended Self Test — Any self test or diagnostic power-up routine that executes after the initial kernel self test program.

External System Controller — The host computer or other external controller that exerts overall control over VXIbus operations.

FAILED Indicator — A red LED indicator that lights when a device on the VXIbus has detected an internal fault. This might result in the assertion of the SYSFAIL* line.

IACK Daisy Chain Driver — The circuit that drives the VMEbus Interrupt Acknowledge daisy chain line that runs continuously through all installed modules or through jumpers across the backplane.

ID-ROM — An NVRAM storage area that provides for non-volatile storage of diagnostic data.

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Instrument Module	A plug-in printed circuit board, with associated components and shields, that may be installed in a VXIbus card cage. An instrument module may contain more than one device. Also, one device may require more than one instrument module.
Interface Device	A VXIbus device that provides one or more interfaces to external equipment.
Interrupt Handler	A functional module that detects interrupt requests generated by Interrupters and responds to those requests by requesting status and identity information.
Interrupter	A device capable of asserting VMEbus interrupts and performing the interrupt acknowledge sequence.
IRQ	The Interrupt ReQuest signal, which is the VMEbus interrupt line that is asserted by an Interrupter to signify to the controller that a device on the bus requires service by the controller.
Local Bus	A daisy-chained bus that connects adjacent VXIbus slots.
Local Controller	The instrument module that performs system control and external interface functions for the instrument modules in a VXIbus card cage or several card cages. See Resource Manager.
Local Processor	The processor on an instrument module.
Logical Address	The smallest functional unit recognized by a VXIbus system. It is often used to identify a particular module.
Mainframe	**Card Cage** For example, the Tektronix VX1400 Card Cage, an operable housing that includes 13 C-size VXIbus instrument module slots.
Memory Device	A storage element (such as bubble memory, RAM, and ROM) that has configuration registers and memory attributes (such as type and access time).
Message	A series of data bytes that are treated as a single communication, with a well defined terminator and message body.
Message Based Device	A VXIbus device that supports VXI configuration and communication registers. Such devices support the word serial protocol, and possibly other message-based protocols.
MODID Lines	Module/system identity lines.

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Physical Address	The address assigned to a backplane slot during an access.
Power Monitor	A device that monitors backplane power and reports fault conditions.
P1	The top-most backplane connector for a given module slot in a vertical mainframe such as the Tektronix VX1400. The left-most backplane connector for a given slot in a horizontal card cage.
P2	The bottom backplane connector for a given module slot in a vertical C-size card cage such as the VX1400; or the middle backplane connector for a given module slot in a vertical D-size card cage such as the VX1500.
P3	The bottom backplane connector for a given module slot in a vertical D-size card cage such as the Tektronix VX1500.
Query	A form of command that allows for inquiry to obtain status or data.
READY Indicator	A green LED indicator that lights when the power-up diagnostic routines have been completed successfully. An internal failure or failure of +5 Volt power will extinguish this indicator.
Register Based Device	A VXIbus device that supports VXI register maps, but not high level VXIbus communication protocols; includes devices that are register-based servant elements.
Requester	A functional module that resides on the same module as a Master or Interrupt Handler and requests use of the DTB whenever its Master or Interrupt Handler requires it.
Resource Manager	A VXIbus device that provides configuration management services such as address map configuration, determining system hierarchy, allocating shared system resources, performing system self test diagnostics, and initializing system commanders.
Self Calibration	A routine that verifies the basic calibration of the instrument module circuits, and adjusts this calibration to compensate for short- and long-term variables.
Self Test	A set of routines that determine if the instrument module circuits will perform according to a given set of standards. A self test routine is performed upon power-up.
Servant	A VXIbus message-based device that is controlled by a commander.
Server	A shared memory device that controls the shared memory buffers used in a given Shared Memory Protocol channel.

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Shared Memory Protocol — A communications protocol that uses a block of memory that is accessible to both client and server. The memory block operates as a message buffer for communications.

Slot 0 Controller — See Slot 0 Module. Also see Resource Manager.

Slot 0 Module — A VXIbus device that provides the minimum VXIbus slot 0 services to slots 1 through 12 (CLK10 and the module identity lines), but that may provide other services such as CLK100, SYNC100, STARBUS, and trigger control.

SMP — See Shared Memory Protocol.

STARX — Two (2) bi-directional, 50 ohm, differential ECL lines that provide for inter-module asynchronous communication. These pairs of timed and matched delay lines connect slot 0 and each of slots 1 through 12 in a card cage. The delay between slots is less than 5 nanoseconds, and the lines are well matched for timing skew.

STARY — Two (2) bi-directional, 50 ohm, differential ECL lines that provide for inter-module asynchronous communication. These pairs of timed and matched delay lines connect slot 0 and each of slots 1 through 12 in a card cage. The delay between slots is less than 5 nanoseconds, and the lines are well matched for timing skew.

STST — STart/STop protocol; used to synchronize modules.

SYNC100 — A Slot 0 signal that is used to synchronize multiple devices with respect to a given rising edge of CLK100. These signals are individually buffered and matched to less than 2ns of skew.

Synchronous Communications — A communications system that follows the "command-response" cycle model. In this model, a device issues a command to another device; the second device executes the command; then returns a response. Synchronous commands are executed in the order received.

SYSFAIL* — A signal line on the VMEbus that is used to indicate a failure by a device. The device that fails asserts this line.

System Clock Driver — A functional module that provides a 16 MHz timing signal on the Utility Bus.

System Hierarchy — The tree structure of the commander/servant relationships of all devices in the system at a given time. In the VXIbus structure, each servant has a commander. A commander may also have a commander.

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Test Monitor	An executive routine that is responsible for executing the self tests, storing any errors in the ID-ROM, and reporting such errors to the Resource Manager.
Test Program	A program, executed on the system controller, that controls the execution of tests within the test system.
Test System	A collection of hardware and software modules that operate in concert to test a target DUT.
TTLTRG	Open collector TTL lines used for inter-module timing and communication.
VXIbus Subsystem	One card cage with modules installed. The installed modules include one module that performs slot 0 functions and a given complement of instrument modules. The subsystem may also include a Resource Manager.
Word Serial Protocol	A VXIbus word oriented, bi-directional, serial protocol for communications between message-based devices (that is, devices that include communication registers in addition to configuration registers).
Word Serial Communications	Inter-device communications using the Word Serial Protocol.
WSP	See Word Serial Protocol.
10 MHz Clock	A 10 MHz, ±100 ppm timing reference. Also see CLK10.
100 MHz Clock	A 100 MHz, ±100 ppm clock synchronized with CLK10. Also see CLK100.
488-To-VXIbus Interface	A message based device that provides for communication between the IEEE-488 bus and VXIbus instrument modules.

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Appendix D
User Service

This appendix contains service-related information that covers the following topics:

- Preventive maintenance
- User-replaceable Parts

Preventive Maintenance

You should perform inspection and cleaning as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunction and enhance reliability. inspect and clean the module as often as conditions require by following these steps:

1. Turn off power and remove the module from the VXIbus mainframe.
2. Remove loose dust on the outside of the instrument with a lint-free cloth.
3. Remove any remaining dirt with lint-free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.

User-Replaceable Parts

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable.

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User-Replaceable Parts

Part Description	Part Number
User Manual	070-9131-01
Label, Tek CDS	950-0924-00
Label, VXI	950-1002-00
Fuse, Micro 2 Amp 125 V Fast	159-0128-00
Fuse, Micro 5 Amp 125 V Fast	159-0207-00
Collar Screw, Metric 2.5 × 11 Slotted	950-0952-00
Shield, Front	950-1323-00
Screw, Phillips Metric 2.5 × 4 FLHD SS	211-0867-00

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Appendix E
Performance Verification Procedure

The performance verification for the VX4385 Matrix Switch Module checks that the module is operating within specification.

Conventions Used In This Procedure

All control of the VX4385 Module will be accomplished through a VXI Slot 0 device. ASCII characters will form the commands sent to control the module and ASCII characters will be read from the module.

Throughout this document writes to the VX4385 Module will be shown as:

Send “ERR?lf”

where “ERR?lf” is the command (Error Query) terminated with a linefeed character (lf). Commands must be sent exactly as shown.

Reads from the module are shown as:

Read “0,”No Error” crlf”

Where 0,“No Error” crlf is the ASCII string returned from the VX4385 Module, terminated with a carriage return and linefeed (crlf). The ASCII string returned from the module will be exactly as shown.

Unless otherwise noted, all commands are sent to the VX4385 Module, and all ASCII strings read are read from the VX4385 Module.

Two characters are used throughout the communication sequences: “cr” is the carriage return character (character 13) and “lf” is the line feed character (character 10). These characters are the terminating characters for communication. They are shown throughout this document in the font shown here. Most reads from the VX4385 Module are terminated with both characters and are shown as “crlf”. Writes to the module require only a “lf”, but both characters may be used.

An ASCII upper case letter “O” will be shown as “O”, and an ASCII zero will be shown as “0”.

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Equipment Required

Table 1–1 lists the equipment required for the performance and verification procedure.

Table 1–1: Equipment Required

Required tools and equipment	Part number
VXI Mainframe (such as the Tektronix VX1410)	n/a
VXI Slot 0 with resource Manager (Tektronix VX4521) and appropriate cables and interface cards.	n/a
Digital Multi Meter (DMM) with 4-wire Ohm capability, and the ability to read more then 10 Gigohms.	standard lab equipment
Connector for VXI 1780S	n/a
Talker/Listerner (Send/Read)	n/a

Connector Wiring

1. Using the VX1780S connector wire pins 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, and 17 together, leaving a “pig tail” to connect to the DMM. This is the “Y” axis low side of the relays.

2. Wire pins 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, and 33 together, leaving a “pig tail” to connect to the DMM. This is the “Y” axis High side of the relays.

3. Wire pins 35, 37, 39, and 41 together, leaving a “pig tail” to connect to the DMM. This is the “X” axis low side of the relays.

4. Wire pins 34, 36, 38, and 40 together, leaving a “pig tail” to connect to the DMM. This is the “X” axis high side of the relays.

5. Plug the connector into P4 on the VX4385.

Performance Verification Procedure

6. Apply power to the VXI system and wait 10 seconds.

   a. Only the green PWR LED will be lit.

   b. Verify that the 4 segment Display shows RDY

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Digital Multi-Meter Set Up

1. Connect the DMM signal high and input + side to the “pig tail” that is connected to the VX1780S connector pin-18 (“Y” axis high side).

2. Connect the DMM signal low and input – side to the “pig tail” that is connected to the VX1780S connector pin-34 (“X” axis high side).

3. Set the DMM into 4-wire Ohms mode and autorange.

Testing The Relay Resistance

The commands CLOSE x,y,m and OPEN x,y,m are used for the following steps. The x is for the “X” axis, the y is for the “Y” axis, and the m is for the Matrix to use either A or B.

1. Send “CLOSE 1,1,Alf” (Set relay 1,1) to the VX4385.

2. The display on the VX4385 will scroll and show <4x16> 1,1,A.

3. Read the DMM and verify the resistance is less than 1 ohm.

4. Send “OPEN 1,1,Alf” (open relay 1,1) to the VX4385.

5. The display on the VX4385 will show RDY.

6. Read the DMM and verify the resistance is greater than 10 gigohms.

7. Send “CLOSE 1,2,Alf” (Set relay 1,2) to the VX4385.

8. The display on the VX4385 will scroll and show <4x16> 1,2,A.

9. Read the DMM and verify the resistance is less than 1 ohm.

10. Send “OPEN 1,2,Alf” (open relay 1,2) to the VX4385.

11. The display on the VX4385 will show RDY.

12. Read the DMM and verify the resistance is greater than 10 gigohms.

    a. Send “CLOSE 1,3,Alf” (Set relay 1,3) to the VX4385.

13. The display on the VX4385 will scroll and show <4x16> 1,3,A.

14. Read the DMM and verify the resistance is less than 1 ohm.

15. Send “OPEN 1,3,Alf” (open relay 1,3) to the VX4385.

16. The display on the VX4385 will show RDY.

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17. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,4,Aıf” (Set relay 1,4) to the VX4385.

18. The display on the VX4385 will scroll and show <4x16> 1,4,A.

19. Read the DMM and verify the resistance is less than 1 ohm.

20. Send “OPEN 1,4,Aıf” (open relay 1,4) to the VX4385.

21. The display on the VX4385 will show RDY.

22. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,5,Aıf” (Set relay 1,5) to the VX4385.

23. The display on the VX4385 will scroll and show <4x16> 1,5,A.

24. Read the DMM and verify the resistance is less than 1 ohm.

25. Send “OPEN 1,5,Aıf” (open relay 1,5) to the VX4385.

26. The display on the VX4385 will show RDY.

27. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,6,Aıf” (Set relay 1,6) to the VX4385.

28. The display on the VX4385 will scroll and show <4x16> 1,6,A.

29. Read the DMM and verify the resistance is less than 1 ohm.

30. Send “OPEN 1,6,Aıf” (open relay 1,6) to the VX4385.

31. The display on the VX4385 will show RDY.

32. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,7,Aıf” (Set relay 1,7) to the VX4385.

33. The display on the VX4385 will scroll and show <4x16> 1,7,A.

34. Read the DMM and verify the resistance is less than 1 ohm.

35. Send “OPEN 1,7,Aıf” (open relay 1,7) to the VX4385.

36. The display on the VX4385 will show RDY.

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37. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,8,A\lf” (Set relay 1,8) to the VX4385.

38. The display on the VX4385 will scroll and show <4x16> 1,8,A.

39. Read the DMM and verify the resistance is less than 1 ohm.

40. Send “OPEN 1,8,A\lf” (open relay 1,8) to the VX4385.

41. The display on the VX4385 will show RDY.

42. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,9,A\lf” (Set relay 1,9) to the VX4385.

43. The display on the VX4385 will scroll and show <4x16> 1,9,A.

44. Read the DMM and verify the resistance is less than 1 ohm.

45. Send “OPEN 1,9,A\lf” (open relay 1,9) to the VX4385.

46. The display on the VX4385 will show RDY.

47. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,10,A\lf” (Set relay 1,10) to the VX4385.

48. The display on the VX4385 will scroll and show <4x16> 1,10,A.

49. Read the DMM and verify the resistance is less than 1 ohm.

50. Send “OPEN 1,10,A\lf” (open relay 1,10) to the VX4385.

51. The display on the VX4385 will show RDY.

52. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,11,A\lf” (Set relay 1,11) to the VX4385.

53. The display on the VX4385 will scroll and show <4x16> 1,11,A.

54. Read the DMM and verify the resistance is less than 1 ohm.

55. Send “OPEN 1,11,A\lf” (open relay 1,11) to the VX4385.

56. The display on the VX4385 will show RDY.

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57. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,12,Aıf” (Set relay 1,12) to the VX4385.

58. The display on the VX4385 will scroll and show <4x16> 1,12,A.

59. Read the DMM and verify the resistance is less than 1 ohm.

60. Send “OPEN 1,12,Aıf” (open relay 1,12) to the VX4385.

61. The display on the VX4385 will show RDY.

62. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,13,Aıf” (Set relay 1,13) to the VX4385.

63. The display on the VX4385 will scroll and show <4x16> 1,13,A.

64. Read the DMM and verify the resistance is less than 1 ohm.

65. Send “OPEN 1,13,Aıf” (open relay 1,13) to the VX4385.

66. The display on the VX4385 will show RDY.

67. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,14,Aıf” (Set relay 1,14) to the VX4385.

68. The display on the VX4385 will scroll and show <4x16> 1,14,A.

69. Read the DMM and verify the resistance is less than 1 ohm.

70. Send “OPEN 1,14,Aıf” (open relay 1,14) to the VX4385.

71. The display on the VX4385 will show RDY.

72. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,15,Aıf” (Set relay 1,15) to the VX4385.

73. The display on the VX4385 will scroll and show <4x16> 1,15,A.

74. Read the DMM and verify the resistance is less than 1 ohm.

75. Send “OPEN 1,15,Aıf” (open relay 1,15) to the VX4385.

76. The display on the VX4385 will show RDY.

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77. Read the DMM and verify the resistance is greater than 10 gigohms.

a. Send “CLOSE 1,16,Aif” (Set relay 1,16) to the VX4385.

78. The display on the VX4385 will scroll and show <4x16> 1,16,A.

79. Read the DMM and verify the resistance is less than 1 ohm.

80. Send “OPEN 1,16,Aif” (open relay 1,16) to the VX4385.

81. The display on the VX4385 will show RDY.

a. Read the DMM and verify the resistance is greater than 10 gigohms.

Repeat steps 1 through 81 three more times substituting the x axis with 2, 3, 4.

82. Connect the DMM signal high and input + side to the “pig tail” from pin-2 (“Y” axis low side)

83. Connect the DMM signal low and input – side to the “pig tail” from pin-35 (“X” axis low side).

84. Set the DMM to 4-wire Ohms mode and select autorange.

Repeat steps 1 through 81 four more times substituting the x axis with 1, 2, 3, 4.

85. Remove the connector from P4 and plug connector into P6.

86. Connect the DMM signal high and input + side to the pigtail from pin-18 (“Y” axis high side).

87. Connect the DMM signal low and input – side to the pigtail from pin-34 (“X” axis high side).

88. Set the DMM to 4-wire Ohms mode and select autorange.

89. Repeat steps 1 through 81 four more times, substituting the m matrix option with B and the x axis option with 1, 2, 3, 4.

90. Connect the DMM signal high and input + side to the “pig tail” from pin-2 (“Y” axis low side)

91. Connect the DMM signal low and input – side to the “pig tail” from pin-35 (“X” axis low side).

92. Set the DMM into 4-wire Ohms mode and select autorange.

93. Repeat steps 1 through 81 four more times substituting the m matrix option with B and the x axis option with 1, 2, 3, 4.

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