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User Manual

Tektronix

VX4342
Dual Resistance Programming (DRP) Module

070-9149-02

This document supports firmware version 1.00 and above.

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to the Safety Summary prior to performing service.

CE

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EC Declaration of Conformity

We

Tektronix Holland N.V.
Marktweg 73A
8444 AB Heerenveen
The Netherlands

declare under sole responsibility that the

VX4342 and all options

meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 55011 Class A Radiated and Conducted Emissions

EN 50081-1 Emissions:

EN 60555-2 AC Power Line Harmonic Emissions

EN 50082-1 Immunity:

IEC 801-2 Electrostatic Discharge Immunity
IEC 801-3 RF Electromagnetic Field Immunity
IEC 801-4 Electrical Fast Transient/Burst Immunity
IEC 801-5 Power Line Surge Immunity

To ensure compliance with EMC requirements only high quality shielded cables having a reliable, continuous outer shield (braid & foil) which has low impedance connections to shielded connector housings at both ends should be connected to this product.

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VX4342 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 VX4342 Module after the completion of power-up self test is as follows:

- o both outputs disconnected from the module output connector,
- o both outputs programmed to the maximum resistance,
- o generation of VXIbus Request True interrupt, if not disabled.

LEDs

When lit, the LEDs indicate the following:

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

COMMAND SYNTAX

Command protocol and syntax for the VX4342 Module is as follows: (3 - 3)

1) Each command consists of a single line of characters. Parameters may not be "wrapped around". Every command must be terminated with a <LF> or semicolon. <CR> are optional before line feeds or semicolons.

2) If a character is not enclosed by brackets, that character itself is sent, otherwise:

[ ]	encloses the symbol for the actual argument to be sent.
< >	a binary value
<CR>	a carriage return.
<LF>	a line feed.
<SP>	space character.
<TM>	terminator: <LF> or semicolon.

3) Any character may be sent in either upper or lower case form.

4) Any of the following white space characters:
   00 hex
   01 hex through 08 hex
   09 hex (TAB character)
   0B hex through 19 hex (including carriage return)
   20 hex (SPACE character)

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are allowed before any comma, semicolon, or <LF>; after any comma; in place of any space character. Any number of white space characters may be used together.

SYSTEM COMMANDS

These low-level commands are typically sent by the module's commander, transparent to the user, except for the Read Status command. See Page 3 - 1 for details.

Clear	Asynchronous Mode Control	
Begin Normal Operation	Abort Normal Operation	
Read Protocol	End Normal Operation	
Read Status	Control Event	
Set Lock	Read Protocol Error	
Clear Lock	Byte Available	
Read Interrupters	Byte Request	
Read Interrupt Line	Control Response	Trigger

MODULE COMMANDS

All commands must be terminated with a line feed or semicolon.

CLS z_1,z_2 connects the specified channel(s)' programmable resistor to the module's output connector. (3 - 5)

DINT disables generation of the VXIbus Request True interrupt when an error condition is detected by the DRP Module. (3 - 6)

ERR? return the error status the next time input is requested from the module. (3 - 7)

INT enables generation of a VXIbus Request True interrupt when an error condition is detected by the DRP Module. (3 - 10)

IST initiates an internal self test of the DRP Module. (3 - 11)

OPN z_1,z_2 disconnects the specified channel(s)' programmable resistor from the DRP Module's output connector. (3 - 12)

Rz_1 z_2 programs a single channel to a specified output resistance. (3 - 13)

REV? returns the revision level of the onboard microprocessor firmware. (3 - 15)

RST resets the module to its power-up state. (3 - 16)

Sz_1 z_2 programs a single channel to an output resistance specified in integer multiples of the channel's minimum step size. (3 - 17)

PROGRAMMING

The programming examples in the manual are written in Microsoft GW BASIC. For programming examples, see page 4 - 2.

CALL ENTER (R$, LENGTH%, ADDRESS%, STATUS%)
Inputs data into the string R$ from the IEEE-488 instrument whose decimal primary address is contained in the variable ADDRESS%. LENGTH% = the number of bytes read from the instrument. STATUS% = '0' if the transfer was successful; '8' if an operating system timeout occurred in the PC. To use 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 module.

CALL SEND (ADDRESS%, WRT$, STATUS%)
Outputs the contents of the string variable WRT$ to the IEEE-488 instrument whose decimal primary address is in the variable ADDRESS%. The variable STATUS% = '0' if the transfer was successful and an '8' if an operating timeout occurred in the PC.

END Terminates the program.

FOR/NEXT Repeats the instructions between the FOR and NEXT statements for a defined number of iterations.

GOSUB n Runs the subroutine beginning with line n. The end of the subroutine is delineated with a RETURN statement. When the subroutine reaches the RETURN statement, execution will resume on the line following the GOSUB command.

GOTO n Program branches to line n.

IF/THEN Sets up a conditional IF/THEN statement. Used with other commands, so that IF the stated condition is met, THEN the command following is effective.

REM All characters following the REM command are not executed.

RETURN Ends a subroutine and returns operation to the line after the last executed GOSUB command.

<CR> Carriage return character, decimal 13.

<LF> Line feed character, decimal 10.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and marking on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

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

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:



WARNING
High Voltage



Protective Ground
(Earth) Terminal



CAUTION
Refer to Manual



Double
Insulated

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Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, disconnect the main power by means of the power cord or, if provided, the power switch.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

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VX4342
Dual Resistance Programming (DRP) Module

Section 1
General Information and Specifications

Introduction

The VX4342 Dual Resistance Programming (DRP) Module is a printed circuit board assembly for use in a mainframe conforming to the VXIbus Specification, such as the VX1400 "C" size mainframe used in the Tek/CDS IAC System. The DRP Module provides two sets of programmable resistors, channel A and channel B. Each set can be programmed in 4096 resistance steps. The minimum step size of each channel can be individually set during module calibration to any value from 10 ohms to 100 ohms. The maximum resistance output of either channel is:

4095 X Minimum Resistance Step Size

The output of the module can be programmed directly in resistance or as an integer multiple of the minimum resistance step size. When the module is programmed directly in resistance, the resulting output value will be the nearest integer multiple of the minimum resistance step size.

The DRP Module includes Built-In Test Equipment (BITE) which allows each programmable resistor channel to be tested under program control, using a resistance meter built into the DRP Module. During self test, the output resistance of the module is relay isolated from the module's output connector to provide a completely isolated self test of the DRP Module. While the self test is being performed, the module automatically switches either an open, short, or user-selected resistance value across the terminals of the module's output connector.

Hardware controls (switches) are provided to allow either a fixed offset resistor and/or a variable offset potentiometer to be placed in series with each channel's programmable output resistor. The offset resistors are useful in those applications requiring either a constant fixed resistance offset or when the resistance value of interconnect cabling between the DRP and the Unit Under Test (UUT) needs to be trimmed to a cardinal value for ease of programming overall module-to-UUT resistance values.

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When Option 1M to the VX4342 Module is ordered, the module is provided with a built-in Test Module Adapter (TMA) and isolated self test software that allow the DRP to meet the requirements of the United States Air Force's Modular Automatic Test Equipment (MATE) guidelines.

The standard module is supplied with potentiometers for setting the minimum resistance step size (10 ohms to 100 ohms) and the corresponding full scale output resistance of the module. Other potentiometer values or fixed resistor values can be ordered. Consult the factory for available resistor values and option numbers.

Note that certain terms used in this manual have very specific meanings in the context of a VXIbus System. A list of these terms is presented in the VXIbus Glossary (Appendix C).

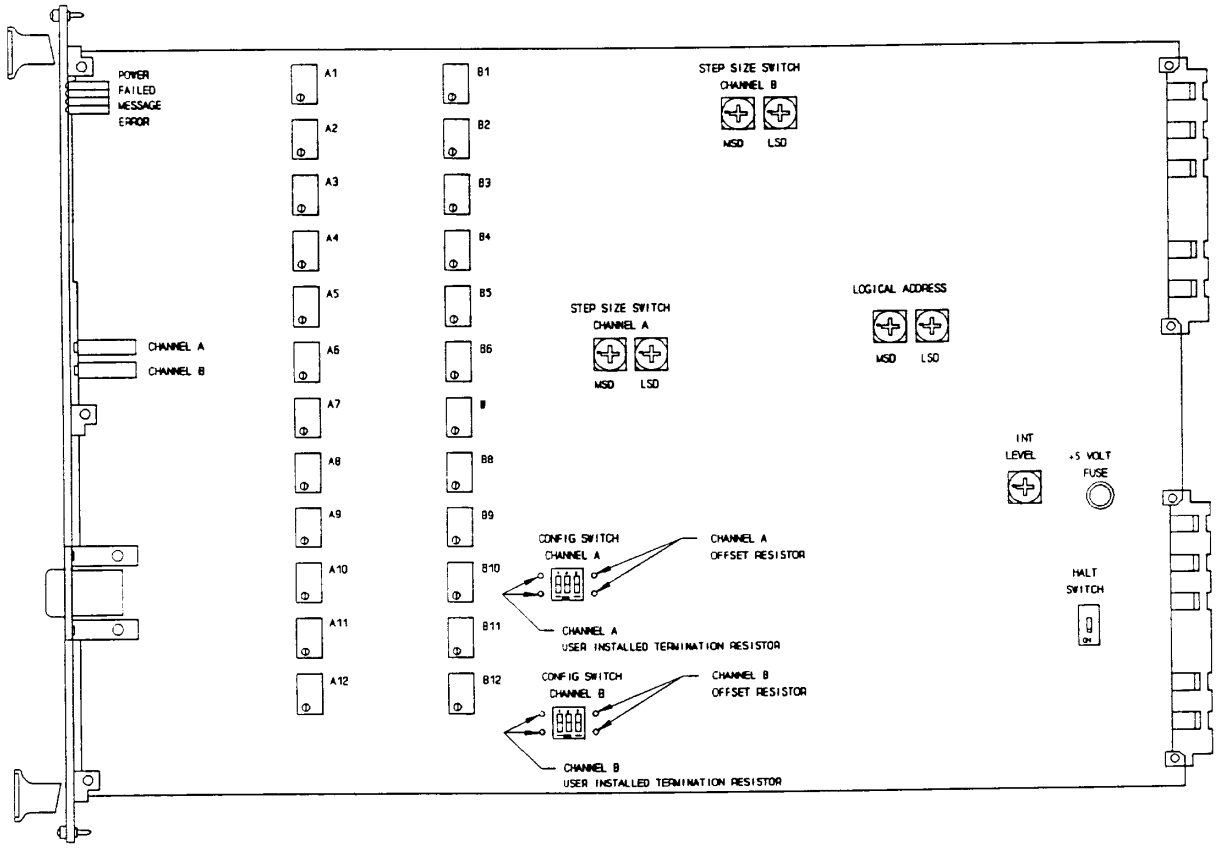


Figure 1: VX4342 Controls and Indicators

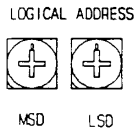
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Controls And Indicators

The following controls and indicators are provided to select and display the functions of the VX4342 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 254 decimal. The base VMEbus address of the VX4342 is set to a value between 1 and FEh (254d) by two hexadecimal rotary switches. Align the desired switch position with the arrow on the module shield.

The actual physical address of the DRP 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 VX4342 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

IEEE-488 Address

Using the VX4342 Module in an IEEE-488 environment requires knowing the module's IEEE-488 address in order to program it. Different manufacturers of IEEE-488 interface devices may have different algorithms for equating a logical address with an IEEE-488 address.

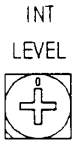
If the VX4342 is being used in a Tek/CDS IEEE-488 interface module, consult the operating manual of the Tek/CDS Resource Manager/IEEE-488 Interface Module being used.

If the VX4342 is being used in a MATE system, VXIbus logical addresses are converted to IEEE-488 addresses using the algorithm specified in the MATE IAC standard (MATE-STD-IAC). This algorithm is described in detail in the 73A-156 Operating Manual.

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If the VX4342 is not being used with a Tek/CDS Resource Manager/IEEE-488 Interface Module, consult the operating manual of the IEEE-488 interface device being used for recommendations on setting the logical address.

VMEbus Interrupt Level Select Switch

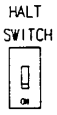


Each function module in a VXIbus System can generate an interrupt on the VMEbus to request service from the interrupt handler located on its commander (for example, a Tek/CDS VX4521 Enhanced Slot 0/Resource Manager/IEEE-488 Module or VX4544 embedded PC-386 compatible system controller). The VMEbus interrupt level on which the VX4342 Module generates interrupts is set by a BCD rotary switch. Align the desired switch position with the arrow on the module shield.

Valid Interrupt Level Select switch settings are 1 through 7, with setting 1 equivalent to level 1, etc. The level chosen should be the same as the level set on the VX4342's interrupt handler, typically the module's commander. Setting the switch to an invalid interrupt level (0, 8, or 9) will disable the module's interrupts.

Interrupts are used by the module to return VXIbus Protocol Events to the module's commander. Refer to the Operation section for information on interrupts. The VXIbus Protocol Events supported by the module are listed in the Specifications section.

Halt Switch



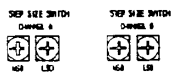
This two-position slide switch selects the response of the VX4342 Module when the Reset bit in the module's VXIbus Control register is set. Control of the Reset bit depends on the capabilities of the VX4342's commander.

If the Halt switch is in the ON position, then the VX4342 Module is reset to its power-up state and all programmed module parameters are reset to their default values.

If the Halt switch is in the OFF position, the module will ignore the Reset bit and no action will take place.

Note that the module is not in strict compliance with the VXIbus specification when the Halt switch is OFF.

Step Size Switch



For each DRP channel, a two digit rotary switch is used to inform the DRP software of the minimum resistance step size that the channel has been calibrated for. Align the desired switch position to the arrow on the module shield.

The most significant switch digit (MSD) is used to set a mantissa value (0.0 through 0.9) and the least significant digit (LSD) is used to set an exponent value (0 through 9).

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The following table shows several examples of how the Step Size switch for each channel is set.

Minimum Resistance Step Size (Ohms)	Step Size Switch MSD	LSD
10	1	2
50	5	2
100	1	3

Channel Configuration Switch





For each DRP channel, a three-position rocker switch is used to set up the isolation and offset configuration of the channel. The Configuration switch for each channel controls setup for three separate module functions:

(1) Rocker 1: During self test, the programmed output resistance of the module is relay isolated from the module's output connector to provide an isolated self test of the module. While the module's resistance output is isolated from the module output connector, the module automatically switches either an open or a user selected termination resistor (see Figure 1) across the terminals of the output connector.

If rocker 1 of the Channel Configuration switch is CLOSED, the user-installed resistor is switched across the channel's output terminals during self test or when the OPN command is issued to the channel. If the rocker is OPEN, an open circuit is switched across the channel's output terminals during self test or when the OPN command is issued to the channel.

(2) Rocker 2 places a twenty ohm, ¾ watt trim potentiometer in series with the resistance value programmed for a given channel. The potentiometer associated with each channel is accessible through the front panel of the DRP Module, to allow selection of the resistance needed. If rocker 2 of the Channel Configuration switch is OPEN, the potentiometer is placed in series with the programmed output resistance value. If rocker 2 is CLOSED, the potentiometer is removed from the circuit. Refer to the section on the trim potentiometer.

(3) Rocker 3 allows a user-defined offset resistor to be placed in series with the resistance value programmed for a given channel. The offset resistor provides a simple means of providing a fixed offset resistance in a given output channel. If rocker 3 of the Channel Configuration switch is OPEN, the user-installed offset resistor is placed in series with the programmed output resistance value. If rocker 3 is CLOSED, the user-installed offset resistor is removed from the circuit.

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Trim Potentiometer

Each DRP output channel has a twenty turn, twenty ohm, ¾ watt trim potentiometer which is accessible through the front panel of the module. This feature provides a convenient means of trimming the cable resistance between the DRP Module and the UUT to a cardinal value for ease in programming an overall resistance value to be presented to the UUT. The variable resistor is placed in series with the programmed output resistance value when rocker 2 of the channel's Configuration switch is CLOSED.

LEDs

The following LEDs are visible at the top of the VX4342 Module's front panel to indicate the status of the module's operation:

Power LED
This green LED is normally lit and is extinguished if the +5V bus fails or the +5V fuse opens.

Failed LED
This red LED is normally off. It is lit whenever SYSFAIL* is asserted, indicating a module failure. Module failures include failure to correctly complete a self test, loss of a power rail, or failure of the module's central processor.

If the module loses any of its power voltages, the Failed LED will be lit and SYSFAIL* asserted. A module power failure is indicated when the module's Power LED is extinguished.

MSG LED
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.

Error LED
This green LED indicates that an error was detected while attempting to execute a command sent to the DRP Module. The complete set of errors that cause this LED to light are listed under the ERR? (Error Query) command.

Fuses

The VX4342 Module has a 5V fuse. The fuse protects the module in case of an accidental shorting of the power bus or any other situation where excessive current might be drawn.

If the +5V fuse opens, the VXIbus Resource Manager will be unable to assert SYSFAIL INHIBIT on this module to disable SYSFAIL*.

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If the +5V fuse opens, remove the fault before replacing the fuse. Replacement fuse information is given in the Specifications section of this manual.

BITE (Built-In Test Equipment)

The VX4342 DRP Module includes built-in self test capability that allows each resistor channel to be tested under program control, using a resistance meter built into the DRP Module. During self test, the output resistance of the module is relay isolated from the module's output connector to provide an isolated self test of the DRP Module. While the module's resistance output is isolated from the module's output connector, the module automatically switches either an open, short, or user-selected resistance value across the terminals of the output connector.

The DRP's built-in self test is initiated at power-up or when the IST (Internal Self Test) command is issued to the module. The module's built-in resistance meter performs a test to insure that the cardinal resistance steps of each channel are within their proper step range and that no shorts or opens exist.

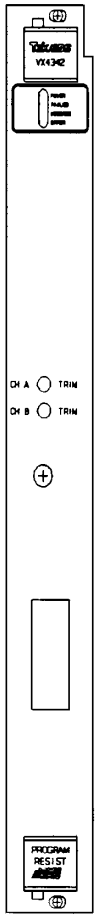


Figure 2: VX4342 Front Panel

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Specifications

Number of Resistance Channels:	Two.
Type Resistors:	Two sets of programmable resistors, each set consisting of twelve (12) ¾ watt, twenty turn cermet potentiometers.*
Minimum Resistance Step:	Variable from 10 ohms to 100 ohms.*
Maximum Resistance Output:	Adjustable from 40,950 to 409,500 ohms.*
Maximum Input Voltage:	30 V_{RMS}, 42.2 V_{p-p}, 60 V DC.
Resistance Resolution:	Variable for 10 ohms to 100 ohms.*
Standard Step Size:	100 ohm minimum step size, factory calibration.
Resistance Accuracy:**	Variable resistors: ±0.3 ohms ±1% of programmed value, 10 ohms steps. ±0.3 ohms ±0.3% of programmed value, 100 ohm steps.
Resistance Differential Linearity:	Variable resistors, ±0.015 ohms ±2% of programmed value, 10 ohms steps. ±0.015 ohms ±0.6% of programmed value, 100 ohm steps.
Resistance Temperature Coefficient:	±0.01% of programmed value per degree C.
VXIbus Compatibility:	Fully compatible with the VXIbus Specification 1.3 for message-based instruments with the Halt switch in the ON position. The module meets or exceeds all VXIbus power, cooling, emissions and susceptibility specifications.
VXI Device Type:	VXI message based instrument.
VXI Protocol:	Word serial.
VXI Card Size:	C size, one slot wide.

* Standard values. Fixed or variable resistors of the user's choice may be substituted.

** Resistance accuracies assume a known offset resistance value and compensation for that offset value in programming. If no programming compensation is performed, add ±2.5 ohms to the accuracy specification.

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Module-Specific Commands:	All module-specific commands and data are sent via the VXIbus Byte-Available command. All module-specific commands are made up of ASCII characters. Module-specific data may be in either ASCII or binary format.
VMEbus Interface:	Data transfer bus (DTB) slave - A16, D16 only.
Interrupt Level:	Switch selectable, levels 1 (highest priority) through 7 (lowest).
Interrupt Acknowledge:	D16; lower 8 bits returned are the logical address of the module.
VXIbus Protocol Events Supported:	VXIbus events are returned via VME interrupts. The following events are supported and returned to the VX4342 Module's commander: REQUEST TRUE (In an IEEE-488 system, this interrupt will cause a Service Request (SRQ) to be generated on the IEEE-488 bus.)
VXIbus Registers:	ID Device Type Status Control Protocol Response Data Low See Appendix A for definition of register contents.
ID Register Contents:	FFFC (Colorado Data Systems' manufacturer's ID)
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.
Current (Peak Module, I_{PM}):	+5 Volt supply: 2.1A
Current (Dynamic Module, I_{DM}):	+5 Volt supply: 1.79 APP
Fuses:	Replacement fuse: Littlefuse P/N 273004
Cooling:	Provided by the fan in the VXIbus mainframe. The module will have a temperature rise of 10°C with 1.5 liters/sec of air and a pressure drop of 0.03 mm of H_2O.

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Temperature, Ambient:	0°C to +50°C, operating. -40°C to +85°C, storage.
Humidity:	Less than 95% R.H. non-condensing, 0°C to +30°C. Less than 75% R.H. non-condensing, +30°C to +40°C. Less than 45% R.H. non-condensing, +40°C to +50°C.
VXI Bus Radiated Emissions:	Complies with the VXIbus Specification.
VXI Bus Conducted Emissions:	Complies with the VXIbus Specification.
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)
Dimensions, Shipping:	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 kg (2.2 lb).
Weight, Shipping:	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: 3.13 kg (3.5 lb).
Mounting Position:	Any orientation.
Mounting Location:	Installs in an instrument module slot (slots 1-12) of a C or D size VXIbus mainframe. (Refer to D size mainframe manual for information on required adapters.)
Front Panel Signal Connectors:	9 pin DE-9P connector (pins). Refer to Appendix B for connector pinouts.
Recommended Cable:	73A-719S Data Cable.
Equipment Supplied:	1 - VX4342 Module.
Optional:	73A-719S Analog Cable or 73A-784S Hooded Connector. Option 1M - MATE TMA.
Software Version:	V3.4

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Section 2
Preparation For Use

Installation Requirements And Cautions

The VX4342 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 manual 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 on selecting and setting the VX4342 Module's logical address. To avoid confusion, it is recommended that the slot number and the logical address be the same.

Tools Required

The following tools are required for proper installation:

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 "VX4342" 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 VX4342 is used in a VX1X Series Mainframe, all VX4342 cooling requirements will be met.

CAUTION

If the VX4342 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 VX4342 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 VX4342 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 VX4342), and switch settings on the Installation Checklist on the next page. Only qualified personnel should install the module.

2) Verify that the Logical Address and Interrupt Level switches are switched to the correct value. The Halt switch should be in the ON position unless it is required to not allow the resource manager to reset this module.

   Note that with either Halt switch position, a "hard" reset will occur at power-up and when SYSRST* is set true on the VXIbus backplane. If the module's commander is a Tek/CDS Resource Manager/IEEE-488 Interface Module, SYSRST* will be set true whenever the Reset switch on the front panel of that module is depressed. Also note that when the Halt switch is in the OFF position, the operation of this module is not VXIbus compatible.

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3) Unless special resistance step size options have been ordered, the module has been calibrated at the factory with a minimum resistance step size of 100 ohms. Recalibration is required at this stage if a different minimum resistance step size is required. Calibration procedures are given in the Service Manual.

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

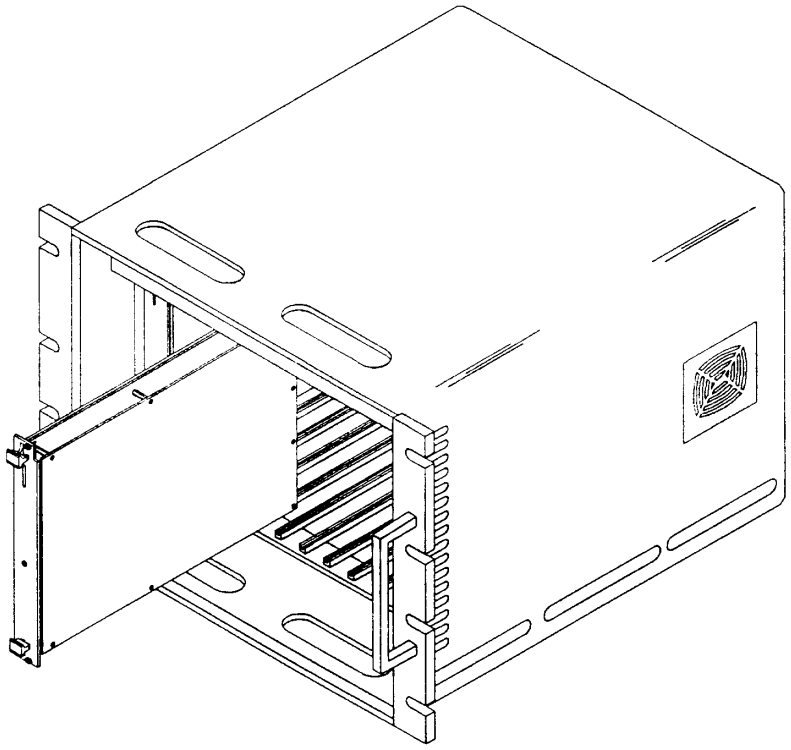


Figure 3: Module Installation

5) **Installation of cables -**
Use either a 73A-719S Analog Cable or 73A-784S Hooded Connector to interface between the DRP output connector and the UUT. If the module is being installed in a Tek/CDS VX1400 or VX1401 Mainframe, route the cable from the front panel of the module down through the cable tray at the bottom of the mainframe and out the rear of the mainframe.

The mainframe is interfaced to the system controller using a standard IEEE-488 cable to connect the IEEE-488 connector on the rear panel of the VX1400 Mainframe to the IEEE-488 interface connector at the system controller.

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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 VX4342 Module.

Revision Level: _____

Serial No.: _____

Mainframe Slot Number: _____

Switch Settings:

VXIbus Logical Address Switch: _____

Interrupt Level Switch: _____

Halt Switch: _____

Channel A Configuration Switch:

Rocker 1 (Self-test/Termination resistor) :__ OPEN __ CLOSED
Value of Termination Resistor _____

Rocker 2 (Trim Potentiometer) : __ OPEN __ CLOSED

Rocker 3 (User series Offset Resistor) : __ OPEN __ CLOSED
Value of offset resistor _____

Channel A Step Size Switch: MSD _____ LSD _____

Channel B Configuration Switch:

Rocker 1 (Self-test/Termination resistor) :__ OPEN __ CLOSED
Value of Termination Resistor _____

Rocker 2 (Trim Potentiometer) : __ OPEN __ CLOSED

Rocker 3 (User series Offset Resistor) : __ OPEN __ CLOSED
Value of offset resistor _____

Channel B Step Size Switch: MSD _____ LSD _____

Cable Hooded Connector Installed:
73A-719S Analog Cable _____
73A-784S Hooded Connector _____

Performed by: _____ Date: _____

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Section 3
Operation

Overview

The VX4342 Module is programmed by ASCII characters issued from the system controller to the VX4342 Module via the module's VXIbus commander and the VXIbus mainframe backplane. The module is a VXIbus Message Based instrument and communicates using the VXIbus Word Serial Protocol. Refer to the manual for the VXIbus device that will be the VX4342 Module's commander for details on the operation of that device.

The VX4342 Module provides two sets of programmable resistors, channel A and channel B. Each set can be programmed in 4096 resistance steps. The output of the module can be programmed directly in resistance or as an integer multiple of the minimum resistance step size. When the module is programmed directly in resistance, the resulting output value will be the nearest integer multiple of the minimum resistance step size.

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.

Power-up

The VX4342 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. The Power LED will be on, and all other LEDs off. The MSG LED will blink during the power-up sequence as the VXIbus Resource Manager addresses all modules in the mainframe.

After power-up, both resistance output channels of the DRP will be programmed to maximum resistance and isolated from the module's output connector by the module's output isolation relays. The resistance value presented at the module's output connector for each output channel will depend on the setting of rocker 1 of the respective channel's Configuration switch. The generation of Request True interrupts will be disabled.

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

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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 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 operation per VXI Specification.
Read Protocol	The module will return its protocol to its commander.
Read Status	The module will return its VXI Status byte to its commander.
Set Lock	Set the LOCKED* bit of the Response register.
Clear Lock	Clears the LOCKED* bit of the Response register.
Read Interrupters	Returns the value FFF9, indicating there is one interrupter on this module.
Read Interrupt Line	Returns the interrupt line per VXI Specification.
Asynchronous Mode Control	Returns information that events are being sent as interrupts per VXI Specification.
Abort Normal Operation	Causes this device to cease normal operation per VXI Specification.
End Normal Operation	Causes this device to cease normal operation per VXI Specification.
Control Event	Used by a commander to selectively enable the generation of events by a servant.
Read Protocol Error	Returns the module's most recent error code, which includes multiple query errors, unsupported commands, and DOR violations.
Byte Available	Transfers module commands to this module.
Byte Request	Requests data be returned form the module.
Control Response	Returns information indicating response interrupts are not supported.
Trigger	This module will accept the Trigger command, although no part of this instrument will be affected by it.

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Module Commands

A summary of the VX4342 Module's commands is listed below. This is followed by detailed descriptions of each of the commands. Sample BASIC programs using these commands are given in the Programming Examples section.

NOTE:

If Option 1M (MATE TMA) has been ordered with this module, see Appendix M for information on ATLAS/CIIL programming syntax. The commands listed in this section are not effective with the MATE option installed.

Command protocol and syntax for the VX4342 Module are as follows:

1) Each command consists of a single line of characters. Parameters may not be "wrapped around" (continued on the next line). Every command must be terminated with a line feed <LF> or semicolon, indicated by <TM> in the command descriptions. Carriage returns <CR> are optional before line feeds or semicolons.

2) If a character is not enclosed by brackets, that character itself is sent, otherwise:

[]	encloses the symbol for the actual argument to be sent. These argument symbols are defined under each command heading.
< >	indicates a binary value; ie: <0Ah> is a line feed.
<CR>	indicates a carriage return.
<LF>	indicates a line feed.
<SP>	indicates a space character.
<TM>	terminator: indicates a line feed or a semicolon.

3) Any character may be sent in either upper or lower case form.

4) Any of the following white space characters:

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

are allowed in any of the following places:

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- before any comma, semicolon, or <LF>.
- after any comma.
- in place of any SPACE character listed in the following command formats.

Any number of white space characters may be used together.

Command Summary

Detailed descriptions of each command (in alphabetical order) are given following the summary. An overview of the commands, in the order they typically would be programmed, is as follows:

Command	Action
CLS	Closes the module's output isolation relay(s), connecting the A and/or B channel programmable resistor(s) to the module's output connector.
R	Programs the specified output channel to the specified output resistance in ohms.
S	Programs the specified output channel to an output resistance equal to the specified integer multiple of the channel's minimum step size.
OPN	Opens the module's output isolation relay(s), disconnecting the A and/or B channel programmable resistor(s) from the module's output connector.
ERR?	Returns the error status of the module.
INT	Enables Request True interrupt generation.
IST	Initiates module's internal self test.
DINT	Disables Request True interrupt generation.
REV?	Returns the Module's firmware revision level.
RST	Resets the VX4342 to its power-up state.

A detailed description of each command, in alphabetical order, is given on the following pages.

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- **Command Descriptions**

Command: CLS (Close Isolation Relays)

Syntax: CLS z_1,z_2<TM>

Purpose: The Close command connects the specified channel(s)' programmable resistor to the module's output connector.

Description: z represents the channel whose isolation relays are to be closed.

If no channel is specified, both channels' programmable resistors are connected to the module's output connector.

Examples: CLS A,B<TM>

CLS B<TM>

The first example closes the isolation relay for both channels A and B, while the second example closes only the B channel isolation relay.

Errors: If the command contains syntax errors, such as CLS C<TM> (close the isolation relay of an undefined channel), then the module's Error LED will be lit and a VXIbus Request True interrupt will be generated if interrupts have been enabled with the INT command. In an IEEE-488 system, the Request True interrupt will cause the Service Request (SRQ) line on the IEEE-488 bus to be set true. The ERR? command can then be used to determine the cause of the error condition.

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Command: DINT (Disable Interrupts)

Syntax: DINT<TM>

Purpose: This command disables generation of the VXIbus Request True interrupt when an error condition is detected by the DRP Module.

Description: The DINT command stops the VX4342 from generating any external interrupts on the VXIbus that could be caused by a module error condition. If the VX4342 detects a programming error or self-test error, it has the capability to generate a VXIbus Request True event to its interrupt handler (typically its commander).

For further information on VX4342 programming errors, refer to the ERR? command.

Example: DINT<TM>

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Command: ERR? (Error Query)

Syntax: ERR?<TM>

Purpose: The ERR? command instructs the DRP Module to return its error status the next time input is requested from the module.

Description: This command is typically issued to the DRP Module in response to a VXIbus Request True interrupt (in an IEEE-488 system, the Request True interrupt generates an SRQ true condition on the IEEE-488 bus). Errors reported by this command include those detected during self-test.

All errors listed in this section cause a Request True interrupt to be generated (if interrupts are enabled via the INT command).

All errors occurring since the last ERR? command or reset condition will be returned, beginning with the first error that occurred. After issuing the ERR? command to the DRP Module, the system controller should continue to request input from the module until the "No additional errors to report" message is returned from the module.

Response Syntax: The format of data returned by the ERR? command is:

[channel ID],[error],[ASCII message]<CR><LF>
[channel ID],[error],[ASCII message]<CR><LF>
.
.
0,0,NO ADDITIONAL ERRORS TO REPORT<CR><LF>

where [channel ID] is one of the following ASCII characters:

A or B	- channel the error occurred on
Z	- error is a channel-independent error
0	- no additional errors to report

[error] is a 1 digit ASCII error code.

[ASCII message] is an English message describing the error.

The meaning of [error] depends upon the [channel ID]. If the error message [channel ID] is a 0, either all errors have been reported or no errors have occurred since last ERR? command or reset.

All possible values for [error] and [ASCII message] are listed below. [error] is listed first, with [ASCII message] below it, and below this the description of the error.

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[channel ID] = 0

0

NO ADDITIONAL ERRORS TO REPORT

There are no more errors to report. [error] is always 0 for [channel ID] = 0.

[channel ID] = A or B

1

SELF TEST ERROR: RESISTOR [R] READS TOO LOW

A cardinal resistance step was found that had a resistance which was too low. [R] is a 2- or 3-character mnemonic specifying the resistor. The first character is either A or B, for the channel. The remaining characters are the cardinal resistor number which failed with this channel. Refer to Figure 1 for the resistors' physical location. This error will occur if the Step Size switches are in the wrong position.

2

SELF TEST ERROR: RESISTOR [R] READS TOO HIGH

A cardinal resistance step was found that had a resistance which was too high. [R] is a 2- or 3-character mnemonic specifying the resistor. The first character is either A or B, for the channel. The remaining characters are the cardinal resistor number which failed with this channel. Refer to Figure 1 for the resistors' physical location. This error will occur if the Step Size switches are in the wrong position.

3

SELF TEST ERROR: FAILURE OF ONBOARD OHMMETER

The on-board ohmmeter has been determined to be non-operational. No determination as to the accuracy or operation of either channel can be made.

4

SELF TEST UNIMPLEMENTED
FOR BASE RESISTOR = [RESISTANCE]

This error occurs on the execution of a self test when the Step Size switch of one or both channels is at a setting indicating a base resistor of 10,000 ohms or larger. [RESISTANCE] is the base resistor as read from the Step Size switch in ohms.

5

RESISTANCE OUT OF RANGE

The data value sent in conjunction with the R or S command was out of range. For the R command, this error occurs if the programmed resistance value is greater than 4095 times the value set in the Step Size switch for this channel. For the S command, this error occurs if the data value was greater than 4095.

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6
NEGATIVE RESISTANCE NOT ALLOWED

An R or S command was received with a negative data value.

7
SET RESISTANCE COMMAND WITH VALUE OMITTED

An R or S command was received without a data value.

[channel ID] = Z

1
RECEIVED UNEXPECTED <CHR> WHILE <REASON>

Where: <CHR> = <single quote><character><single quote> for printable characters (20 hex through 7F hex), for example, 'G'.
or
<CHR> = <space><hex digit><hex digit> for nonprintable characters (00 hex through 19 hex and 80 hex through FF hex), for example, OA .

<REASON> = one of the following:
- EXPECTING A LINE FEED, SEMICOLON OR COMMA
- EXPECTING A NUMERIC
- PARSING MANTISSA
- PARSING EXPONENT

2
UNRECOGNIZED COMMAND

This error occurs if a command not listed in this document is received by the module.

Examples: ERR?<TM>

Example Responses:

no errors:
0,0,NO ADDITIONAL ERRORS TO REPORT<CR><LF>

multiple errors:
A,2,SELF TEST ERROR: RESISTOR A5 READS TOO HIGH <CR><LF>
B,1,SELF TEST ERROR: RESISTOR B12 READS TOO LOW<CR><LF>
Z,2,UNRECOGNIZED COMMAND<CR><LF>
0,0,NO ADDITIONAL ERRORS TO REPORT<CR><LF>

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Command: INT (Interrupt Enable)

Syntax: INT<TM>

Purpose: The INT command enables generation of a VXIbus Request True interrupt when an error condition is detected by the DRP Module.

Description: The INT command instructs the module to generate a VXIbus Request True interrupt whenever any of the error conditions listed under the ERR? command occur. If the DRP Module is installed in an IEEE-488 system, the occurrence of a VXIbus Request True interrupt condition will cause a Service Request (SRQ) true condition to be generated on the IEEE-488 bus.

Example: INT<TM>

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Command: IST (Internal Self Test)

Syntax: IST<TM>

Purpose: The IST command initiates an internal self test of the DRP Module.

Description: The self test initiated by the IST command is the same as the power-up self test described in the SYSFAIL, Self Test and Initialization subsection. Following completion of the self test, the connected/disconnected state and output resistance of each channel is restored to the same condition as before execution of the IST command.

If a failure occurs, the ERR LED will be lit and the reason for the failure will be stored for later interrogation by the ERR? command. If interrupts have been enabled by the INT command, a VXIbus Request True interrupt will be generated.

Example: IST<TM>

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Command: OPN (Open)

Syntax: OPN z_1,z_2<TM>

Purpose: The Open command disconnects the specified channel(s)' programmable resistor from the DRP Module's output connector.

Description: z represents the channel whose isolation relays are to be opened.

If no channel is specified, both channels' programmable resistors are disconnected from the module's output connector. Note that a space is required between the 'OPN' and any arguments.

Examples: OPN A,B<TM>

OPN B<TM>

The first example opens the isolation relay for both channels A and B, while the second example opens only the B channel isolation relay.

Errors: If the command contains syntax errors, such as OPN C<TM> (open the isolation relay of an undefined channel), then the module's Error LED will be lit and a VXIbus Request True interrupt will be generated if interrupts have been enabled with the INT command. In an IEEE-488 system, the Request True interrupt will cause the Service Request (SRQ) line on the IEEE-488 bus to be set true. The ERR? command can then be used to find the cause of the error condition.

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Command: R (Set Resistance in Ohms)

Syntax: $Rz_1\ z_2$<TM>

Purpose: The R (Resistance) command programs a single channel to a specified output resistance. The resistance output is rounded to the nearest integer multiple of the channel's minimum step size.

Description: z_1 represents the channel, A or B, whose output resistance is to be set.

z_2 represents the resistance (in ohms) that the specified channel is to be set to.

Note that there is no space between the R and z_1, and that a space is required between z_1 and z_2.

The value of z_2 can range from 0 to the maximum resistance value of the channel. The channel's maximum resistance value is equal to 4095 times the channel's minimum step size. The numeric value of z_2 can be formatted in either integer or scientific notation. For example, 6780 ohms could be expressed as any of the following:

6780	+6780	6.78E+3
67800E-1	+6.78e+03	

Examples: If a channel's minimum step size was 10 ohms, and 197 ohms was programmed, the output resistance would be rounded and then set to 200 ohms.

The command

RA 3450;RB +1.23E3<TM>

sets the output resistance of the A channel to 3,450 ohms and the resistance of the B channel to 1,230 ohms. Note that the two command strings have been placed on the same programming line by using a semicolon to separate them.

To use the offset trim potentiometer to achieve the published accuracy specifications, program RA0;RB0<TM> and calibrate the offset trim value such that a 4-wire ohms measurement of the channel (including measurement of the cable to the load) is equivalent to one step size, 10 ohms, for example. A more accurate 340 ohm and 1230 ohm value for the example shown may now be achieved by programming 10 ohms less than the desired value.

The command RA3440;RB1.22E3<TM>

sets the desired values of 3,450 and 1,230 ohms for channels A and B.

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Errors: If the command contains syntax errors, such as specifying a resistance value that exceeds the maximum resistance value of a channel, the module's Error LED will be lit and a VXIbus Request True interrupt will be generated. In an IEEE-488 system, the Request True interrupt will cause the Service Request (SRQ) line on the IEEE-488 bus to be set true. The ERR? command can then be used to determine the cause of the error condition.

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Command: REV? (Revision Level)

Syntax: REV?<TM>

Purpose: The REV? command instructs the module to return the revision level of the onboard microprocessor firmware.

Description: This command returns the revision level of the onboard firmware as an alphanumeric string representing the revision level.

Example: REV?<TM>

Response Syntax: An example of a typical response is:

REVISION 1.0<CR><LF>

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Command: RST (Reset)

Syntax: RST<TM>

Purpose: The RST command resets the module to its power-up state.

Description: On receipt of the RST command, the module is returned to its power-up state. Both channels are set to their maximum resistance, both isolation relays are opened, and all pending error messages are cleared.

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Command: S (Set Resistance)

Syntax: $Sz_1\ z_2$<TM>

Purpose: The S command programs a single channel to an output resistance specified in integer multiples of the channel's minimum step size.

Description: z_1 represents the channel whose output resistance is to be set.

Note that there is no space between the S and z_1 and that a space is required between z_1 and z_2.

z_2 represents the number of integer multiples of the channels minimum step size that the output resistance is to be set to. The value of z_2 can range from 0 to 4095. The numeric value of z_2 can be formatted in either integer or scientific notation. For example, the integer 678 could be expressed as any of the following:

678	+678	6.78E+2
6780E-1	+6.78e+02	

Example: SA 345;SB +1.3E1<TM>

This command sets the output resistance of the A channel to 345 times the channel's minimum step size and the resistance of the B channel to 13 times its minimum step size. Notice that the two command strings have been placed on the same programming line by using a semicolon to separate them.

Errors: If the command contains syntax errors, such as specifying a step size increment greater than 4095, the module's Error LED will be lit and a VXIbus Request True interrupt will be generated if interrupts have been enabled with the INT command. In an IEEE-488 system, the Request True interrupt will cause the Service Request (SRQ) line on the IEEE-488 bus to be set true. The ERR? command can then be used to determine the cause of the error condition.

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SYSFAIL, Self Test, and Initialization

The VX4342 Module will execute a self test at power-up, or on detection of a VXIbus hard or soft reset condition, or on command. 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 VX4342's commander, sets the Reset bit in the VX4342's Control register.

At power-up, as well as during self test, all module outputs remain isolated from the module's front panel connector.

During a power-up, or hard 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.

2) Both channels are disconnected from the module's output connector. One channel at a time, each of the twelve resistors making up a channel's variable resistor are multiplexed to a resistance measuring device on the module to verify their value.

3) If the self test detects a problem with the VXI interface, the SYSFAIL* line remains active, the Failed LED remains on, and the module enters the VXIbus FAILED state. If the self test detects a problem in the programmable resistance section, the ERR LED will be lit, and a message describing the failure will be queued up to be returned to the module's commander by using the ERR? command. In this state the module is still operational.

If the self test completes successfully, the SYSFAIL* line is released, and the module enters the VXIbus PASSED state (ready for normal operation). SYSFAIL* will be released within five seconds in normal operation.

The default condition of the VX4342 Module after the completion of power-up self test is as follows:

- o both outputs disconnected from the module output connector,
- o both outputs programmed to the maximum resistance,
- o generation of VXIbus Request True interrupt, if not disabled.

Self test can also be run at any time during normal operation by using the IST command. At the end of a self test initiated by the IST command, the module is restored to its pre-test state.

During a commanded self test:

1) SYSFAIL* will not be asserted.
2) The module executes the same self test as described for power-up self test.

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3) On completion of the self test, the module restores itself to its pre-test state. If the test fails, the ERR LED will be lit and pertinent error messages will be queued by the module for later reporting with the ERR? command.

SYSFAIL* Operation

SYSFAIL* becomes active on a software failure, during power-up, a hard or soft reset, self test, or if the module loses +5 volt power. When the mainframe Resource Manager detects SYSFAIL* set, it will attempt to inhibit the line. This will cause the VX4342 Module to deactivate SYSFAIL* in all cases except when +5 volt power is lost.

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Section 4
Programming Examples

This section contains example programs which demonstrate how the various programmable features of the VX4342 are used. The examples are written in BASIC using an IBM PC or equivalent computer as the system 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 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 VX4342.
CALL SEND (ADDRESS%, OUT$, STATUS%)	The CALL SEND statement outputs the contents of the string variable OUT$ 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.
END	Terminates the program.
FOR/NEXT	Repeats the instructions between the FOR and NEXT statements for a defined number of iterations.
GOSUB n	Runs the subroutine beginning with line n. EX: GOSUB 750 - runs the subroutine beginning on line 750. The end of the subroutine is delineated with a RETURN statement. When the subroutine reaches the RETURN statement, execution will resume on the line following the GOSUB command.

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GOTO n — Program branches to line n. EX: GOTO 320 - directs execution to continue at line 320.

IF/THEN — Sets up a conditional IF/THEN statement. Used with other commands, such as PRINT or GOTO, so that IF the stated condition is met, THEN the command following is effective. EX: IF I = 3, GOTO 450 - will continue operation at line 450 when the value of variable I is 3.

REM — All characters following the REM command are not executed. REM statements are used for documentation and user instructions. EX: REM **CLOSE ISOLATION RELAYS**

RETURN — Ends a subroutine and returns operation to the line after the last executed GOSUB command.

<CR> — Carriage Return character, decimal 13.

<LF> — Line Feed character, decimal 10.

Programming Examples In BASIC

The following sample BASIC programs show how commands for the VX4342 might be used. These examples assume that the VX4342 has logical address 24 and is installed in a VXIbus mainframe that is controlled via an IEEE-488 interface from an external system controller, such as an IBM PC or equivalent, using a Capital Equipment Corporation 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 VX4342 Module's logical address to an IEEE-488 primary address of decimal 24.

The command sequence terminator character <TM> used in the example programs is a line feed character, which is appended to output data strings using the BASIC command CHR$(10). That is, DATA$ = "....." + CHR$(10).

Example 1:

The following program causes the VX4342 to connect the A and B channel variable resistors to the module's output connector, and programs their respective output resistances to 500 and 9,870 ohms.

Lines 10 through 40 initialize the PC's IEEE-488 interface card as a system controller with an IEEE-488 address of decimal 21.
Line 50 assigns the decimal 24 IEEE-488 address of the VX4342 to the variable ADDRESS%.
Lines 60 through 70 connect the A and B channel variable resistors to the modules' output connector.
Lines 80 through 90 set the channel A and B outputs to 500 and 9,870 ohms respectively.

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```
10    GOSUB 1000
20    SEND = 9 : INIT = 0
30    PC.ADDRESS% = 0 : CONTROL% = 0
40    CALL INIT (PC.ADDRESS%, CONTROL%)
50    ADDRESS% = 24
60    WRT$ = "CLS A,B" + CHR$(10)
70    CALL SEND(ADDRESS%,WRT$,STATUS%)
80    WRT$ = "RA 500;RB 9870" + CHR$(10)
90    CALL SEND(ADDRESS%,WRT$,STATUS%)
100   END

1000 'Sub-routine identifies the memory location of 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
```

Shown below are the commands and data sent to the VX4342 Module:

```
CLS A,B<LF>
RA 500;RB 9870<LF>
```

Example 2:

The example program below causes the VX4342 to execute a self test and print the results on the system controller display.

Lines 10 through 40 initialize the PC's IEEE-488 interface card as a system controller with an IEEE-488 address of decimal 21.
Line 50 assigns the decimal 24 IEEE-488 address of the VX4342 to the variable ADDRESS%.
Lines 60 through 70 initiate the VX4342 self test.
Lines 80 through 90 issue an error reporting command to the module and print the results on the PC display.
Lines 100 through 170 input the results of the self test and print then on the PC display.

```
10    GOSUB 1000
20    SEND = 9 : INIT = 0 : TRANSMIT = 3: ENTER = 21
30    PC.ADDRESS% = 0 : CONTROL% = 0
40    CALL INIT (PC.ADDRESS%, CONTROL%)
```


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```
50   ADDRESS% = 24
60   WRT$ = "IST"
70   CALL SEND(ADDRESS%,WRT$,STATUS%)
80   WRT$ = "ERR?"
90   CALL SEND(ADDRESS%,WRT$,STATUS%)
100  PRINT "RESULTS OF SELF TEST"
110  RECV$ = SPACE$(100)
120  CALL ENTER(RECV$,LENGTH%,ADDRESS%,STATUS%)
130  PRINT RECV$
140  IF MID$(RECV$,1,1) = "0" THEN GOTO 160
150  GOTO 200
160  PRINT "ALL ERRORS REPORTED"
170  END

1000 'Sub-routine identifies the memory location of 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
```

Shown below are the commands and data sent to the VX4342 Module and the response data returned. Response data is underlined.

IST<LF>
ERR?<LF>
<u>0,0,NO ADDITIONAL ERRORS TO REPORT<CR><LF></u>

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Appendix A
VXIbus Operation

CAUTION

If the user's mainframe has other manufacturer's computer boards operating in the role of VXIbus foreign devices, the assertion of BERR (as defined by the VXIbus Specification) may cause operating problems on these boards.*

The VX4342 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 VX4342 Module is neither a VXIbus commander nor a VMEbus master, and therefore it does not have a VXIbus signal register. The VX4342 is a VXIbus message based servant.

The module supports the Normal Transfer Mode of the VXIbus, using the Write Ready and Read Ready bits of the module's Response register.

A Normal Transfer Mode Read of the VX4342 Module proceeds as follows:

1. The commander reads the VX4342's Response register and checks if the Write Ready bit is true. If it is, the commander proceeds to the next step. If not, the commander continues to poll the Write Ready bit until it becomes true.

2. The commander writes the Byte Request command (0DEFFh) to the VX4342's Data Low register.

3. The commander reads the VX4342's Response register and checks if the Read Ready bit is true. If it is, the commander proceeds to the next step. If not, the commander continues to poll the Read Ready bit until it becomes true.

4. The commander reads the VX4342's Data Low register.

A Normal Transfer Mode Write to the VX4342 Module proceeds as follows:

1. The commander reads the VX4342's Response register and checks if the Write Ready bit is true. If it is, the commander proceeds to the next step. If not, the commander continues to poll the Write Ready bit until it becomes true.

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2. The commander writes the Byte Available command which contains the data (0BCXX or 0BDXX depending on the state of the End bit) to the VX4342's Data Low register.

The VX4342 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 VX4342's address space may cause incorrect operation of the module.

As with all VXIbus devices, the VX4342 Module has registers located within a 64 byte block in the A16 address space. The base address of the VX4342 device's registers is determined by the device's unique logical address and can be calculated as follows:

$$\text{Base Address} = V * 40H + C000H$$

where V is the device's logical address as set in the logical address switches.

VX4342 Configuration Registers

Below is a list of the VX4342 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	1X11 1111 1111 1111 (BFFFh or FFFFh)
Control	0004H	W	0111 1111 1111 110X (7FFCh or 7FFDh)
Offset	0006H	WO	Not used
Protocol	0008H	RO	1111 1111 1111 1111 (FFFFh)
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

BIT DEFINITIONS

Register	Bit Location	Bit Usage	VX4342 Value	VX4342 Usage
ID	15-14	Device Class	10	Message Based
	13-12	Address Space	11	A16 only
	11-0	Manufact. ID	1111 1111 1100	Colorado Data Systems

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BIT DEFINITIONS (continued)

Register	Bit Location	Bit Usage	VX4342 Value	VX4342 Usage
Device Type	15-0	Device Type	1111 0110 1010 1001	Ones comp. of 4342
Status	15	A24/32 Active	x	Not used
	14	MODID*	1	MODID line not active
			0	MODID line active
	13-4	Device dependent	xxx xxxx xxxx	Not used
	3	Ready	0 or 1	Per VXI Spec.
	2	Passed	1	Passed
			0	VXI Interface failure
	1-0	Device dependent	xx	Not used
Control	15	A24/32 Enable	x	No effect
	14-2	Device dependent	xx xxxx xxxx xx	Not used
	1	SYSFAIL Inhibit	1	Disables module from driving Sysfail
			0	Enables module to drive Sysfail
	0	Reset	1	Reset
			0	Not reset
Protocol	15	CMDR*	1	Servant only
	14	Signal Reg.*	1	No Signal Reg.
	13	Master*	1	Slave only
	12	Interrupter	1	Interrupter
	11	FHS*	0	Fast Handshake capability
	10	Shared Memory*	1	No Shared Memory capability
	9-4	Reserved	11 1111	Not used
	3-0	Device dependent	1111	Not used
Response	15	Defined value of 0	0	Per VXI
	14	Reserved	1	Per VXI
	13	DOR	1 or 0	1 indicates that instrument data may be read at this time.
	12	DIR	1 or 0	1 indicates that instrument data may be sent to this module.
	11	ERR*	1	No VXI error has occurred
			0	VXI error has occurred.

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Register	Bit Location	Bit Usage	VX4342 Value	VX4342 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 or 0	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 some of the 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	VX4342 Value	VX4342 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.
	5-4	not used	0	not used
	3-0	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

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Register	Bit Location	Bit Usage	VX4342 Value	VX4342 Usage
	2	Event En*	0 or 1	if bits 15-12 are 1111, echoes bit 2 of the command
	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

VX4342 Interrupts

The VX4342 will interrupt its commander with the following "event" if it does not recognize a VXIbus Word Serial command:

Unrecognized Command Event:

```
15 14 13 12 11 10  9  8  7  6  5  4  3  2  1  0
 1  1  1  0  1  1  1  1  <--Logical Address--->
```

This event is generated by this module in response to any command sent to the data low register other than the following:

Byte Available Command
Byte Request Command
Begin Normal Operation Command
Trigger
Identify Commander
Read Status
Clear Command
Read Protocol Command
Grant Device
Set Lock
Clear Lock

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Appendix B
Input/Output Connections

	VX4342 Front Panel Connector Signal Pin No.
Contact 1, A Resistor	2
Contact 2, A Resistor	3
Contact 1, B Resistor	4
Contact 2, B Resistor	5

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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 mainframe 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 mainframe 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 mainframe. 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 mainframe or several mainframes. 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 Mainframe, 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 mainframe.
P2	The bottom backplane connector for a given module slot in a vertical C-size mainframe such as the VX1400; or the middle backplane connector for a given module slot in a vertical D-size mainframe such as the VX1500.
P3	The bottom backplane connector for a given module slot in a vertical D-size mainframe 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 mainframe. 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 mainframe. 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 mainframe 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
MATE Programming

This appendix defines the programming commands to be used with the VX4342 when the module has been ordered with Option 1M (MATE TMA). With Option 1M installed, the VX4342 includes an embedded TMA (Test Module Adapter) that fulfills the United States Air Force MATE system IAC (Instrument-on-A-Card) requirements for isolated self test and remote programming via MATE CIIL (Control Interface Intermediate Language) commands.

The following subjects are covered in this manual section:

CIIL / Commercial Differences (A - 17)
CIIL Command Mnemonics and Definitions (A - 18)
CIIL Command Structures and Formats (A - 20)
CIIL Syntax Expansions (A - 21)
ATLAS and CIIL Syntax (A - 22)

The user is assumed to be familiar with the ATLAS (Abbreviated Test Language for All Systems) programming language as it is applied to MATE systems.

CIIL / Commercial Differences

The CIIL implementation of this module differs from operations described in this manual in some respects.

CIIL does not allow interrupts to be enabled for IEEE-488 Service Requests.

Because the self test takes under five seconds, the confidence and self test are identical on this module.

On completion of a self test, the isolation relays will be open, and both channels will be programmed to maximum resistance.

The following specifications differ with the CIIL option installed:

VXI Data Rate:	400 bytes/sec minimum
VXIbus Protocol Events Supported:	VXIbus events are returned by this module via VME interrupts. This module supports the following event:

UNRECOGNIZED COMMAND

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Conversion Rate: Throughput is the maximum number of conversions per second which can be accomplished by the DAC on a continuous basis. This module is capable of a conversion rate in excess of 500 conversions per second per channel.

CIIL Command Mnemonics and Definitions

The VX4342 DRP Module is controlled by CIIL commands issued to the module by the module's VXIbus commander over the VXIbus mainframe backplane. For example, in a Tek/CDS 73A-MCX MATE Compatible Instrument mainframe, the DRP Module's commander is the 73A-156 IAC Control Module (ICM). The 73A-156 Module is interfaced to the MATE station computer via an IEEE-488 interface bus. A typical control sequence for the DRP Module is shown below:

1) Set up the resistance output value of a given DRP channel.

2) Connect the output pins of the DRP Module to the UUT via the MATE ICA (Interface Control Assembly).

3) Close the channel's isolation relay, connecting the channel's variable resistor to the module's front panel connector.

4) Open the channel's isolation relay, disconnecting the channel's variable resistor from the module's front panel connector.

Each CIIL command consists of a verb and up to three different types of operands. The operands are nouns, modifiers, and modifier values. Depending on the verb, a given operand may or may not be required.

If the DRP Module detects syntax errors in a transmission, the entire transmission and all future transmissions are ignored until a STA (Status) command is received.

Following an STA command, the station computer requests input from the DRP Module and receives an ASCII message, identifying the module status as error or no error.

Verbs

Mnemonic	Definition
CIIL	Return from Alternate Language: This command returns the system to the CIIL environment after a GAL command. Any pending errors are discarded and Request True interrupts are disabled.
CLS	CLOSE: commands the DRP Module to close the specified isolation relay.
CNF	Confidence Test: commands the DRP Module to perform a confidence test. An error message is queued if hardware malfunctions are encountered during the test. The queued error message is returned to the station computer when the module receives an

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STA command. The confidence test takes approximately two seconds to execute. The test performed is described under the IST command in the Operation section of the standard instrument manual. The same test is performed for both the CIIL CNF and IST commands.

FNC — Function: identifies a DRP resistance channel to be set up and indicates the start of a setup sequence.

GAL — Go to alternate language: allows any command listed in the Operation section of this manual to be executed. Any pending errors are discarded.

IST — Internal Self Test: commands the DRP Module to perform a self test. An error message is queued if hardware malfunctions are encountered during the self test. The queued error message is returned to the station computer when the module receives an STA command. The internal self test takes approximately two seconds to execute. The test performed is described under the IST command in the Operation section of this manual. The same test is performed for both the CIIL CNF and IST commands.

OPN — Open: commands the DRP Module to open a specified channel's isolation relay.

RST — Reset: opens the specified DRP channel's isolation relay and sets its resistance to maximum value.

SET — Setup: indicates the beginning of the setup of a module channel.

SID — Self Identification: commands the module to return an identification string in the following format:

<SP>COLORADO DATA SYSTEMS;VX4342;0;<REV>; <STATUS RESPONSE> <CR><LF>

where:

<SP> = space
<REV> = revision level (e.g. 1.0)
<STATUS RESPONSE> = the ASCII message that would normally be returned in response to a STA command, in accordance with MATE-STD-2806763, paragraphs 5.3.4 and 5.3.4.2.
<CR> = carriage return
<LF> = line feed

STA — Status: commands the DRP Module to report its current status and/or any error that has been queued to the station computer.

Nouns

IMP — Impedance: the CIIL noun defining the general class of the DRP Module output.

Modifiers

RESI — Resistance: indicates the programmable parameter to be set.

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CIIL Command Structures and Formats

This sub-section defines the ordering of commands that are accepted by the DRP Module. Except for the "FNC ..." command, each command is transmitted separately and terminated with a <CR><LF>. The "FNC ..." command appears as the first command in a sequence, followed by all other commands (ie: "SET ...") in the same transmission. One <CR><LF> is sent at the end of the transmission. The symbols used in the syntax expansions are defined below.

Symbol	Definition
< >	Item referenced later (enclosed between symbols).
[ ]	Optional item or structure (enclosed between symbols).
"---"	No operand required or expected.
"y"	Decimal value is in signed scientific notation with no embedded blanks (sign may be + or - ; no sign means +). The mantissa is 10 characters; the exponent is two characters with a mandatory sign. All numbers are rounded to the nearest three significant digits. Valid syntaxes are: +.9000000000E+01 +.2559000000E+01 +.2559000000E+04 (rounded to +2560 ohms) Values may be programmed from 0 to 4095 times the minimum resistance step size value of a given channel. See the R command in the Operation Section of this manual.
z	Single digit integer value. For the DRP Module, the acceptable values are 0 or 1. 0 is the DRP A output channel and 1 is the DRP B output channel.

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CIIL Syntax Expansions

<resistance value set up> :: [FNC IMP :CH<z> SET RESI<y><CR/LF>]

<channel isolation relay-close> :: [CLS :CH<z><CR/LF>]

<channel isolation relay-open> :: [OPN :CH<z><CR/LF>]

<module self test> :: [IST<CR/LF>]

<module confidence test> :: [CNF<CR/LF>]

<reset channel to default value> :: [RST IMP :CH<z><CR/LF>]

<request status read back> :: [STA<CR/LF>]

<module normal response to STA> :: ASCII SPACE<CR/LF>

<module abnormal response to STA> :: [F07IMP(MOD):<SP><error description> <CR/LF>]

The following error descriptions are supported:

CHAN(S) <z>[,<z>]OUT OF TOLERANCE: <CARDINAL RESISTANCES>

A cardinal resistance step was found that had a resistance which was out of tolerance. <CARDINAL RESISTANCES> is an ASCII description of which cardinal resistors were found out of tolerance. Dashes and commas are used to delineate the resistors listed. For example, if resistors A2, A3, A4, A5, A6, A8, A12, B1, and B9 were all out of tolerance, the error message would be:

F07IMP (MOD): CHAN(S) 0,1 OUT OF TOLERANCE: A2-A6,A8,A12,B1,B9<CR><LF>

If only resistor B3 was out of tolerance, the message would be:
F07IMP (MOD): CHAN(S) 1 OUT OF TOLERANCE: B3<CR><LF>

Refer to Figure 1 for the resistors' physical locations. The error will occur if the Step Size switches are in the wrong position.

SELF TEST ERROR: FAILURE OF ONBOARD OHMMETER

The on-board ohmmeter has been determined to be non-operational. No determination as to the accuracy or operation of either channel can be made.

SELF TEST UNIMPLEMENTED FOR BASE RESISTOR = [RESISTANCE]

The step size switch of one or both channels is at a setting indicating a base resistor of 10,000 ohms or larger. [RESISTANCE] is the base resistor as read from the Step Size switch.

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RESISTANCE OUT OF RANGE

The resistance sent in conjunction with the SET RESI command was out of range. This error occurs if the programmed resistance value is greater than the maximum resistance value of this module.

NEGATIVE RESISTANCE NOT ALLOWED

A SET RESI command was received with a negative resistance.

SET RESISTANCE COMMAND WITH VALUE OMITTED

A SET RESI command was received without a data value.

RECEIVED UNEXPECTED <CHR> WHILE <REASON>

Where:

<CHR> = <single quote><character><single quote> for printable characters (20 hex through 7F hex), for example, 'G'.

or

<CHR> = <space><hex digit><hex digit> for nonprintable characters (00 hex through 19 hex and 80 hex through FF hex), for example, 0A.

<REASON> = one of the following:

- EXPECTING A LINE FEED, SEMICOLON OR COMMA
- EXPECTING A NUMERIC
- PARSING MANTISSA
- PARSING EXPONENT

UNRECOGNIZED COMMAND

This error occurs if a command not listed in this document is received by the module.

ATLAS and CIIL Syntax

This sub-section provides examples of the ATLAS syntax that can be used to control the DRP Module. The ATLAS syntax is shown, followed by the corresponding CIIL command expansions. The symbol definitions used in the syntax expansions are as follows:

Symbol	Definition
< >	Item reference defined later (enclosed between symbols).
[ ]	Optional item or structure (enclosed between symbols).
::	Is defined to be.
{ }	Set of choices or boundaries of a structure of inseparable items (enclosed between symbols).
:	Exclusive OR.
...	Optional repetition.

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Term Definitions:

<integer-val>	Integer
<integer-list>	A list of integers
<real-val>	Decimal number
<real-list>	A list of decimal numbers
<connection>	Connection field as defined in ATLAS program.
<chan-num>	Channel number
<statno>	Statement number
<CR>	Carriage return
<LF>	Line feed
<SP>	Space
<units>	Units of measure of specified value.

NOTE: <chan-num> is a value of 0 or 1 allocated by the ATLAS compiler during its allocate phase, derived from the connection field of the ATLAS statement. The <chan-num> directly corresponds to DRP resistance channels A and B respectively.

Examples:

The examples that follow use single-action verbs. It is also possible to use multi-action verbs which will issue combinations of CIIL strings for each ATLAS statement. For further details, consult the ATLAS Compiler manual.

Set up a resistance output value.

<statno> SETUP,IMPEDANCE,RESISTANCE <real-val> <units>,CNX <connect field> $

CIIL Expansion

FNC IMP :CH<chan-num> SET RESI <real-val><CR><LF>

Connect the output pins of the DRP Module to the UUT via the MATE ICA.

<statno> CONNECT,IMPEDANCE, RESISTANCE <real-val> <units>, CNX <connection field> $

CIIL Expansion

CON <connection data><CR><LF>

The above CIIL message is sent to the MATE ICA and not to the DRP Module.

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Connect the output pins of the DRP Module to the UUT (Unit Under Test) via the MATE ICA.

<statno> CLOSE,IMPEDANCE, RESISTANCE <real-val> <units>, CNX <connection field> $

CIIL Expansion

CLS :CH<chan-num><CR/LF>

Open the channel's isolation relay, disconnecting the channel's variable resistor from the module's front panel connector.

<statno> OPEN,IMPEDANCE, RESISTANCE <real-val> <units>, CNX <connection field> $

CIIL Expansions

OPN :CH<chan-num><CR><LF>

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Appendix E
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	Part Number
User Manual	070-9149-XX
Label, Tek CDS	950-0703-00
Label, VXI	950-0958-00
Fuse, Micro 4 Amp 125 V Fast	159-0374-00
Collar Screw, Metric 2.5 × 11 Slotted	950-0952-00
Shield, Front	950-3734-00
Screw, Phillips Metric 2.5 × 4 FLHD SS	211-0867-00

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Appendix F
Options

Option 1M

Option 1M adds programming per CIIL Specification (MATE-STD-IAC).

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OPTION 01

Option 01 to the VX4342 Module substitutes fixed resistors for the standard variable potentiometers. The values selected allow both Channels A and B to be programmed from 1 ohms to 4095 ohms in 1 ohm steps.

SPECIFICATION CHANGES

Minimum/Maximum Resistance Step:	1 ohm, fixed.
Maximum Programmable Resistance:	4095 ohms.
Minimum Programmable Resistance:	0 ohm (see programming changes).
Maximum Power Dissipation:	1 watt, each channel.
Resistance Accuracy:	±0.5 ohms ±.13% of programmed resistance. (The above accuracy assumes null compensation through programming.)
Resistance Differential Linearity:	±0.26% of programmed resistance.

PROGRAMMING CHANGES

With a 1 ohm range, the contact resistance of the relays plus user cable resistance becomes significant when trying to achieve the published accuracy specification.

The nominal module resistance when 0 ohms is programmed is 0.6 ohms.

This, together with customer cable resistance, can be measured and compensated for by programming. For example, if the customer cable resistance is 0.4 ohms, giving a total null resistance of 1 ohm, the actual resistance when 0 through 999 ohms is programmed will be 1 through 1000 ohms.

REQUIRED SWITCH SETTINGS

Step Size Switch:

The Step Size switch for both the A and B channels must be set for 1 ohm, as shown:

Step Size Switch	
MSD	LSD
1	1

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CALIBRATION CHANGES

Since the variable potentiometers have been replaced with fixed resistors, no module calibration is required.

SERVICE MANUAL CHANGES

See Option 01 parts list.

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OPTION 02

Option 02 to the VX4342 Module substitutes fixed resistors for the standard variable potentiometers. The values selected allow both Channels A and B to be programmed from 100 ohms to 409,500 ohms in 100 ohm steps.

SPECIFICATION CHANGES

Minimum/Maximum Resistance Step:	100 ohms, fixed.
Maximum Programmable Resistance:	409,500 ohms.
Minimum Programmable Resistance:	100 ohms.
Maximum Power Dissipation:	1 watt, each channel.
Resistance Accuracy:	±0.5 ohms ±.13% of programmed resistance.
Resistance Differential Linearity:	±0.26% of programmed resistance.

REQUIRED SWITCH SETTINGS

Step Size Switch:

The Step Size switch for both the A and B channels must be set for 100 ohms, as shown:

Step Size Switch	
MSD	LSD
1	3

CALIBRATION CHANGES

Since the variable potentiometers have been replaced with fixed resistors, no module calibration is required.

SERVICE MANUAL CHANGES

See Option 02 parts list.

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OPTION 10

Option 10 to the VX4342 Module substitutes fixed resistors for the standard variable potentiometers. The values selected allow both Channels A and B to be programmed from 10 ohms to 40,950 ohms in 10 ohm steps.

SPECIFICATION CHANGES

Minimum/Maximum Resistance Step:	10 ohms, fixed.
Maximum Programmable Resistance:	40,950 ohms.
Minimum Programmable Resistance:	10 ohms.
Maximum Power Dissipation:	1 watt, each channel.
Resistance Accuracy:	±0.5 ohms ±.13% of programmed resistance.
Resistance Differential Linearity:	±0.26% of programmed resistance.

REQUIRED SWITCH SETTINGS

Step Size Switch:

The Step Size switch for both the A and B channels must be set for 10 ohms, as shown:

Step Size Switch	
MSD	LSD
1	2

CALIBRATION CHANGES

Since the variable potentiometers have been replaced with fixed resistors, no module calibration is required.

SERVICE MANUAL CHANGES

See Option 10 parts list.

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WARNING

The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all Safety Summaries before performing any service.

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Appendix G
Adjustment and Calibration

Calibrate the VX4342 Module at the temperature at which it will be operating. If this is not feasible, or the module will be operating under a wide temperature variation, consult the temperature drift specifications. Allow a ten minute warm-up period before performing the calibration.

NOTE: If the module has been ordered with a special option that replaces the module's potentiometers with fixed resistors, then no calibration is required.

Test Equipment Required

- 73A-850 Extender Card or equivalent
- 4½ Digit DMM with a resistance accuracy of 0.05% or better

Calibration Procedure

The A and B channels of the DRP Module must each be individually calibrated. Each channel contains twelve potentiometers which are switched in and out by relays to provide the programmed output resistance. Each of the twelve resistors will be individually calibrated using the procedure detailed below:

1) Select a minimum step size. If the channel has been previously calibrated, this will be the value set in the channel's Minimum Step Size switch. (See the paragraph entitled Minimum Step Size Switch in the Switches sub-section). Both channels of the DRP module have been calibrated with a minimum step size of 100 ohms when shipped from the factory, unless special step size options were ordered.

2) For each channel to be calibrated, close rockers 2 and 3 of the channel's Configuration switch (see the Switches subsection in the Manual) to remove the trim potentiometer and offset resistor from the output signal path.

3) Connect the resistance input of the DMM to the output connector pins associated with the channel to be calibrated (See Appendix B for output connector pin definitions).

The system accuracy requirements may require attaching the DMM to the UUT end of the cable used to connect the DRP to the UUT to calibrate out the effects of system cabling. This can only be done if the minimum step size is greater than the system resistance.

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4) Use the CLS<LF> command to connect both variable resistors to the module's output connector. If the module has been ordered with Option 1M (MATE TMA), use the CIIL command CLS :CH0<CR><LF> to connect the A channel and CLS :CH1<CR><LF> to connect the B channel to the module's output connector.

5) Use the SA 0; SB 0<LF> command to program the module to 0 ohms. If the module has been ordered with Option 1M (MATE TMA), use the following CIIL command to set both channels to zero ohms:

```
FNC IMP :CH0 SET RESI 0 <CR><LF>
FNC IMP :CH1 SET RESI 0 <CR><LF>
```

Record the resistance as read by the DMM for each channel. This resistance reading is the offset resistance of the DMM cabling plus onboard resistance.

6) a) VX4342 Without Option 1M

Using the commands shown in the table below, program the channel to be calibrated to each of the indicated number of multiples of the minimum step size. For each minimum step size multiple, adjust the channel's indicated potentiometer until the DMM reads the indicated number of multiples of the minimum step size plus the resistance reading from Step 5 ±0.05% (±0.5% for 10 ohm step size). The potentiometers are accessible through holes in the module shield, and are labeled A1 through A12 and B1 through B12.

Minimum Step Size Multiples	S Command To Program A Chan	S Command To Program B Chan	DMM Reading: Multiples of Min Step Size *	Pot. Number A or B
1	SA 1<LF>	SB 1<LF>	1	1
2	SA 2<LF>	SB 2<LF>	2	2
4	SA 4<LF>	SB 4<LF>	4	3
8	SA 8<LF>	SB 8<LF>	8	4
16	SA 16<LF>	SB 16<LF>	16	5
32	SA 32<LF>	SB 32<LF>	32	6
64	SA 64<LF>	SB 64<LF>	64	7
128	SA 128<LF>	SB 128<LF>	128	8
256	SA 256<LF>	SB 256<LF>	256	9
512	SA 512<LF>	SB 512<LF>	512	10
1024	SA 1024<LF>	SB 1024<LF>	1024	11
2048	SA 2048<LF>	SB 2048<LF>	2048	12

* cabling and onboard resistance from Step 5 is added to the multiple of the minimum step size.

NOTE: <LF> is a line feed character, decimal 10.

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6. b) VX4342 With Option 1M

Enter the command:

FNC IMP :CH<chan-num> SET RESI <real-val><CR><LF>

where <chan-num> is 0 or 1 for the A and B channels respectively and <real-val> is as defined in the table below. <CR> is a carriage return character, decimal 13 and <LF> is a line feed character, decimal 10. For additional details on programming in CIIL, refer to Appendix M of the Operating Manual.

Minimum Step Size Multiples	DMM Reading: Pot. <real-value> MSS = Minimum Step Size	Multiples of Min Step Size *	Number A or B
1	MSS times 1	1	1
2	MSS times 2	2	2
4	MSS times 4	4	3
8	MSS times 8	8	4
16	MSS times 16	16	5
32	MSS times 32	32	6
64	MSS times 64	64	7
128	MSS times 128	128	8
256	MSS times 256	256	9
512	MSS times 512	512	10
1024	MSS times 1024	1024	11
2048	MSS times 2048	2048	12

* cabling and onboard resistance from Step 5 is added to the multiple of the minimum step size.

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