
WATERS FREEDOM SERIES TEST SYSTEM (12840001)

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RACAL INSTRUMENTS

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RETURN of PRODUCT

Authorization is required from Racal Instruments before you send us your product for service or calibration. Call your nearest Racal Instruments support facility. A list is located on the last page of this manual. If you are unsure where to call, contact Racal Instruments, Inc. Customer Support Department in Irvine, California, USA at 1-800-722-3262 or 1-949-859-8999 or via fax at 1-949-859-7139. We can be reached at: helpdesk@racalinstruments.com.

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**WATERS
FREEDOM SERIES
TEST SYSTEM
(12840001)**

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General Information

Overview

This manual provides the information necessary to install, operate and maintain the Freedom Series Test System, (P/N 12840001).

Functional Description

The Freedom Series Test System provides an automatic testing capability through a combination of VXI-based and rack mounted instrumentation. The devices contained in the test system are listed below:

Model	Description	Mfr.	Location
	UPC1003-133		3-Phase Power Controller Racal 1U01
776564-01	NI-GPIB Bus Expander	National	1U03
TDS460A	Oscilloscope, Digital	Tek	1U07
K236	Source Measurement Unit	Keithley	1U11, 1U13
1261B	High Power VXIbus Chassis	Racal	1U21 VXIPCI-8015 VXI/MXI-2 Slot 0 controller Win NT National 1U21-Slot 0
4152	DMM, 6.5-Digit Module	Racal	1U21-Slot 1
2461CD	Universal Counter/Timer	Racal	1U21-Slot 2
3151	Waveform Generator	Racal	1U21-Slot 3
6065-8	Multi-Channel Serial Interface Module	Racal	1U21-Slot 4
1260-100	Adapta-Switch Carrier Module	Racal	1U21-Slots 5,6
1260-117	Hi-Density Switch/52SPDT	Racal	1U21-Slots 5-1
1260-118	Power Switch Module, 80 SPST	Racal	1U21-Slots 5-2
1260-120	Power Switch Module, 20 SPST	Racal	1U21-Slots 5-3
1260-138A	Hi-Density Multiplexer	Racal	1U21-Slots 5-4
1260-114	Hi-Density Digital I/O	Racal	1U21-Slots 5-5
1260-150	500MHz Multiplexer	Racal	1U21-Slots 5-6
921420-128	Computer, Waters	Dell	2U03
41-15326-94	Monitor, 17", Rackmount	MicTouch	2U07
6531-KB3M	Keyboard, Rackmount	ICS	2U17
MIC-C3099	Barcode Reader	Micro Biz	2U21
HP6050A	Electronic Load, Mainframe	Agilent	2U25

HP60502B	Load Module, 300W	Agilent	2U25-Slots 1-6
HP66000A	Power Supply, 8 Output	Agilent	2U27
HP66101A	DC Power Module, 8V/16A	Agilent	2U27-Slots 5,6
HP66103A	DC Power Module, 35V/4.5A	Agilent	2U27-Slots 0-4

Applicable Documents

This section lists the operating manuals for the various pieces of equipment contained in the test system. The following documents form a part of this operating manual.

Part Number	Description
777073-01	PCI-GPIB for Win95/NT Manuals & Software
777187-02	NI-VXI-MXI-2 for Win95/NT Manuals & Software
777560-01	PC-GPIB+ Controller/Analyzer
980831	Instruction Manual, Racal Instruments 4152A
980833-002	Instruction Manual, Racal Instruments 2461
980833	Instruction Manual, Racal Instruments 2460
980768	Instruction Manual, Racal Instruments 3151
980728	Instruction Manual, Racal Instruments 6065
980673-999	Instruction Manual, Racal Instruments 1260 Opt 01
980824-100	Instruction Manual, Racal Instruments 1260-100
980824-117	Instruction Manual, Racal Instruments 1260-117
980824-118	Instruction Manual, Racal Instruments 1260-118
980824-120	Instruction Manual, Racal Instruments 1260-120
980824-138A	Instruction Manual, Racal Instruments 1260-138A
980824-114	Instruction Manual, Racal Instruments 1260-114
980824-150	Instruction Manual, Racal Instruments 1260-150
980766	Manual, User, 1261B
236-904 D	Model 236/237 SMU Applications Manual
236-900-01 D	Model 236/237 SMU Operator's Manual
236-902-01 D	Model 236/237 SMU Service Manual
60502-90008	HP Model 60502B Module Operation Manual
5959-3386	HP Series 661XXA Module User's Guide
66000-900001	HP66000A MPS Mainframe Inst Guide
06060-90005	HP Electronic Load Family Programming Manual
5959-3368	HP Electronic Load Mainframe Program Manual
66001-90001	HP66001 MPS Keyboard Quick Reference Card
00431-003-2C	Model 6531-KB3 Product Manual
320390-01	GPIB 120A User's Manual
070-8567-01	TDS Option 13 RS232 Instruction Manual
070-9701-02	TDS420A Digital Oscilloscope User Manual
070-8521-04	TAS 200, TDS300 Rackmount Kit Instr

Installation

Installation Overview

This Installation section provides information on the installation of the Freedom Series Test System. This information may be necessary for the user to perform maintenance or calibration.

Unpacking and Setup

The Freedom Series Test System will be shipped from Racal Instruments in a reusable wooden crate. The following instructions detail the unpacking and set-up of the test system:

1. Before unpacking the test system, check the exterior of the shipping carton for any signs of damage. All irregularities should be noted on the shipping bill.
2. Remove the test system from the crate using a hoist or ramp and inspect for damage. If a forklift is to be used from the front, the front and rear decorative trimplates located at the bottom of the rack must be removed. If a forklift is to be used from the side, then both side panels must be removed. Remove the computer equipment (if applicable) from the separate containers and inspect for damage. Notify the carrier immediately if any damage is apparent. Save all packing material for use if the unit is to be re-shipped.
3. If your Freedom Series Test System came with a computer table: Attach the table legs to one side of the table and then attach the table to the side of the rack. Attachments are made using the large Allen wrench provided with the table. The fastening hardware will be attached to the table legs and to the side of the rack.
4. Set up the computer and or peripherals on the

5. a. The AC power cable will be wrapped and bundled at the rear of the rack. This cable is routed out the rear bottom of the rack. Remove the packaging which secures the cable.
- b. The computer cables will be wrapped and bundled at the side of the rack. Remove the packaging securing the cables.
6. Make connections from the computer to its peripherals (monitor, mouse, keyboard, printer, MXI and/or GPIB).

Rack Mount Equipment Installation/Removal

CAUTION

**THE FOLLOWING DEVICE(S) WEIGH IN EXCESS
OF 50 POUNDS AND REQUIRE TWO PERSONS
FOR REMOVAL OR INSTALLATION:**

1261B VXIbus CHASSIS (1U21)

The equipment within the test system is either supported by rack-mounted forward sliding assemblies or rests on horizontal angle brackets.

WARNING

**DISCONNECT ALL CABLES FROM THE DEVICE
BEFORE SLIDING THE EQUIPMENT OUT**

The slide assemblies, when installed on devices, are equipped with safety stop catches. As the device is slid forward the slide will catch and stop, preventing the unit from being removed. In order to remove the unit, the safety releases (one on each slide) must be depressed. These safety releases must also be depressed in order to install the unit.

System Interconnections

Interconnections between devices within the Freedom Series Test System are made in accordance with the system wire list (12840002). This drawing is provided in Section 7.

Equipment Configuration

Rack-mounted instrumentation within the test system is controlled from the system computer via an IEEE-488 bus (GPIB). **Table 2.1** identifies the IEEE-488 bus addresses for each device. VXIbus equipment contained within the Racal Instruments VXIbus chassis is controlled from the system computer via a MXI bus. Within the VXIbus chassis, the modules are controlled from a VXI/MXI Slot Zero controller. **Table 2.2** lists the logical addresses for the VXIbus modules within the VXIbus chassis. Any switches or jumpers not listed in **Table 2.2** are left in their factory default configuration. Please consult the individual instrument operating manuals for details regarding default switch and jumper settings.

The configuration of the MXI interface board and GPIB interface board installed in the computer is provided in **Table 2.3**.

Reference Designator	Device	IEEE-488 Address
1U05	TDS460A	1
1U11	K236	2
1U13	K236	3
2U25	HP6050A	4
2U29	HP66000A	5

TABLE 2.1, GPIB Configuration

Setting	MXI Interface Board	GPIB Interface Board
Base I/O Address	PCI	PCI
Master DMA Channel	N/A	N/A
Board Interrupt Level (IRQ)	N/A	N/A
Slave DMA Channel	N/A	N/A
Slave Interrupt Level	N/A	N/A
Master Window Base	N/A	N/A

TABLE 2.3 MXI/GPIB Interface Board Settings

AC Power Connection

Your Freedom Series system is configured to operate on one of the following voltages depending upon the region of the world where it was specified to operate:

120V	North America
------	---------------

The operating voltage will be marked on the part number/serial number ID label located at the upper, left, rear of the rack.

The power receptacle required for the system depends on the voltage and current requirements of the system.

For systems configured for operation on North American voltages of 120V/208V, the Freedom system will have one of the following National Electrical Manufacturers Association (NEMA) AC power plugs depending upon the current requirements of the system:

L21-30R	120/208V, 3-phase, 30 Amps/phase, twist-lock
---------	---

AC power is distributed to the instruments within the system using standard NEMA plugs and receptacles.

Power Up/Power Down Sequence

1. Ensure that all system equipment AC power switches are off.
2. Plug the main power plug from the Universal Power Controller into the appropriate power receptacle (See section: **AC Power Connections**). This controller is mounted at the top of the rack, (1U01).
3. Turn the Universal Power Controller circuit breaker on.
4. Depress the ON switch on the Universal Power Control panel (1U01). Ensure that the ON button is illuminated on the control panel (1U01).
5. Turn ON the AC power switches on all the system equipment.

For routine power-up/power-down of the Freedom system simply depress the ON or OFF button, as required, on the Universal Power Control Panel (1U01).

For Emergency shut down of the Freedom system press the red EMERGENCY OFF Mushroom Button on the Universal Control Panel (1U01). The RESET button must be depressed before power can be re-applied to the system.

Getting Started

Overview

This section provides information on getting started with your Freedom Series Test System. The material covered in this section is intended to provide introductory instructions in using the basic communications software utilities which are installed on the test system computer. This includes basic operational techniques for the use of National Instruments GPIB and VXI communications software (NI-VISA) and LabVIEW.

Software Overview

All instruments in your Freedom system, both GPIB and VXI, are controlled via the system computer. You may use a variety of software packages to control the instruments in your system. Usually a customer will select one software package to develop automated test programs for their system. Examples of some program development software packages are:

- Lab Windows CVI
- LabVIEW
- Visual Basic

Note: Instrument drivers are provided with your system for either Lab Windows or LabVIEW. Instrument drivers for other software packages may not exist. (See section **Using Instrument Drivers (VXI and GPIB)** for more information on instrument drivers).

In addition to automated test program development software, there are a number of software packages that allow the user to control the instruments in their Freedom system in a manual fashion by typing in individual commands or via a "soft front panel". These types of programs are useful for trouble-shooting system problems or for becoming acquainted with your Freedom system. Examples of this type of

software are:

VICTEXT
IBIC
VISA

Note: VISA allows interactive control of ALL the instruments (VXI, GPIB, RS232) in your freedom station.

Note: All Racal Instruments VXI modules come with interactive soft front panels.

Initializing Your System

After every station power up prior to using any VXI devices with any software, you must first initialize your freedom system using VXIINIT and RESMAN.

Using VXIINIT (VXI Initialize)

From Windows, launch VXIINIT by double clicking the VXIINIT (Windows) icon. Close the VXIINIT window.

Note: VXIINIT may have been automatically run when your computer was turned on or when you launched Windows with versions of VISA 2.0 or later. If you are not sure VXIINIT has been run, proceed with the above steps.

Using RESMAN (Resource Manager)

From Windows, launch RESMAN by double clicking on the RESMAN (Windows) icon. Verify the following message at the bottom of the RESMAN window: "Resource manager operations completed." Close the RESMAN window. Click on **T&M Explorer** icon to verify logical addresses and GPIB addresses of all equipment.

Manually Controlling VXI Devices

From Windows, launch VISA by double clicking on the VISA Interactive Control icon.

For our example we will read and write to a Racal Instruments 1261B EMS Monitor system. Most

Freedom systems contain EMS monitors. If your system does not contain a EMS card, or you desire to control other VXI devices, you must refer to the operation manual for the desired instrument for a list of valid commands. Operation manuals for each device in your freedom system are provided with each system.

Our VISA example will apply to message based devices ONLY. For information on communicating with register based devices using VISA, refer to the National Instruments VXI manual. If you are uncertain if an instrument is message or register based, refer the manual for that instrument.

In the VISA window, double click on the desired instrument. The VXI address for each device varies in each Freedom system. Refer to table 2.2 of this manual for a list of VXI addresses. If the address of the desired instrument is 19, for example, you would double click on the instrument descriptor that reads "VXI0::19::INSTR" (or "GPIB-VXI0::19::INSTR" if you are using a GPIB slot zero controller).

Select the "BASIC I/O" tab. Now select ViWrite. In the Buffer window, type "**IDN?". Press Execute.

The command "**IDN?" commands the EMS card to identify itself. We will now read back the response from the EMS card. Select the ViRead tab. Press Execute. VISA will now display the response. Close The VISA windows.

Manually Controlling GPIB Devices

From Windows, launch VISA by double clicking on the VISA Interactive Control icon.

For our example we will read from a Racal Instruments 1255 Chassis. If your system does not contain a model 1255 Chassis, or you desire to control other GPIB devices, you must refer to the operation manual for the desired instrument for a list of valid commands. Operation manuals for each device in your freedom system are provided with each system.

In the VISA window, double click on the desired instrument. The GPIB address for each device varies in each Freedom system. Refer to table 2.1 of this manual for a list of GPIB addresses. If the address of the desired instrument is 5, for example, you would double click on the instrument descriptor that reads "GPIB0::5::INSTR".

Select the "BASIC I/O" tab. Now select ViWrite. In the Buffer window, type "*IDN?". Press Execute.

The command "*IDN?" commands the 1255 Chassis to identify itself. We will now read back the response from the chassis. Select the ViRead tab. Press Execute. VISA will now display the response. Close The VISA windows.

Using Instrument Drivers (VXI and GPIB)

Note: Prior to using any VXI instruments, you must first initialize your system. See section: **Initializing Your System.**

Note: Instrument drivers for Lab Windows or LabVIEW are provided for each Freedom device of your Freedom system. Instrument drivers for non-Freedom instruments, if available from the instrument manufacturer, may also be provided with your system. The Instrument manufacturer assumes full responsibility for the integrity of non-Freedom drivers.

LabVIEW instrument drivers are specifically designed to be used in a LabVIEW automated test program diagram (see the LabVIEW manual for programming information). However, each instrument driver can be run manually as a stand alone program with a minimum of data manipulation.

For our example we will control Racal Instruments 1260 series switch cards using LabVIEW and LabVIEW 1260 instrument drivers as stand alone programs. Most Freedom systems contain 1260 series switch cards. If your system does not include 1260 series cards, or if you desire to control other

instruments, use the LabVIEW drivers for the specific instrument you desire to control. This **Getting Started** section will not cover Lab Windows CVI and Lab Windows drivers due to the programming experience of most Lab Windows users.

1. From windows, launch LabVIEW by double clicking on the LabVIEW icon in the LabVIEW program group.
2. All VXI instruments and some GPIB instruments (depending on the drivers supplied with the instrument) must first be initialized using their own initialize VI (driver) prior to operation. The initialize VI will output an INSTRUMENT HANDLE for that specific instrument. All communication with the instrument will be via the HANDLE assigned by the initialize VI rather than by the VXI address. In the LabVIEW window, select FILE and OPEN. Load the RI1260 INIT.VI usually located in c:\LabVIEW\vi.lib\drivers\RI1260.lib. This is the initialize VI for the 1260 series switch cards.
3. Change the VXI address in the INSTRUMENT DESCRIPTOR from 15 to the address of the 1260 Option 01 in your test system. See table 2.2 of this manual for a listing of VXI addresses. If, for example, the VXI address of your 1260 Option 01 is 21, the INSTRUMENT DESCRIPTOR would read "VXI::21::INSTR" (or "GPIB-VXI::21::INSTR" if you have a GPIB slot zero controller) . If you are controlling other instruments, the INSTRUMENT DESCRIPTOR format may vary. Use the HELP screen for information.
4. Run the VI by pressing the RUN arrow in the upper left corner of the LabVIEW window. Do not press the RUN arrow more than once as each time the VI is run, a new INSTRUMENT HANDLE is assigned. Verify that the ERROR OUT indicator indicates NO ERROR. Errors are usually caused by one of the following:
 - a. Wrong VXI address in the Instrument Descriptor.

- b. User failed to initialize the VXI instruments.
(See Section: **VXIINIT (VXI Initialize)**)
5. The initialize VI has now assigned an INSTRUMENT HANDLE for the 1260 series switch cards. Because we are running the drivers in a stand alone fashion, we must manually copy the INSTRUMENT HANDLE from the initialize VI to each new 1260 driver we use. To copy the INSTRUMENT HANDLE, locate the mouse over INSTRUMENT HANDLE OUT. Press and hold the right mouse button and select COPY DATA. Now load a new VI (Driver) named RI1260 RELAY CONFIDENCE TEST.VI, for example, usually located in c:\LabVIEW\vi.lib\drivers\RI1260.lib.
6. To complete the copy operation started in the last step, position the mouse over INSTRUMENT HANDLE IN, press and hold the right mouse button, and select PASTE DATA. The new VI is now ready to run. Press the RUN arrow in the upper left hand corner of the VI. The relay confidence test may take several minutes to execute depending on the number of switch cards in your system. Executing this VI will exercise every relay on each 1260 series card in your system. At the end of the test verify the FAILED? LED is extinguished. Also, verify the error out indicator indicates NO ERROR.
7. If an error exists in the ERROR OUT indicator, repeat steps 5 and 6. If the FAILED? LED is illuminated, see the HELP screen.
8. Before exiting LabVIEW you should close each instrument handle using the proper driver for each instrument (you may have more than one instrument handle open a time). To close the 1260 handle, load the VI titled RI1260 CLOSE.VI. Copy the instrument handle as described above. Press the RUN arrow. The handle is now closed. To communicate with the 1260 switch cards again, you will have to run RI1260 INIT.VI again (see step 2.) Close each open VI and exit LabVIEW.

Operation

Overview

This section provides information on the operation of the FreedomTest System and its individual instrumentation devices. The information provided in this manual for the various devices is limited to operational details relating to the system performance of each instrumentation device.

The operator should refer to the individual device operating manuals (listed in Section: **Applicable Documents**) for detailed operating information about each device.

This section also provides information which may have been omitted from the devices' operating manuals as well as pointing out operating details about the device which are crucial to the system performance.

System Devices Operation

This section provides information regarding each of the instrumentation devices contained in your Freedom Series Test System.

Racal Instruments 1261B, (1U21)

VXIbus devices within the Freedom Series Test System are contained in a Racal Instruments 1261B, high power VXIbus chassis. The chassis is equipped with the following options:

Enhanced Monitor System (EMS)

Refer to the Racal Instruments 1261B VXIbus Chassis operating manual for detailed information regarding the operation of the chassis.

National Instruments VXI-PCI8015 (MXI-2, Windows NT), (1U21-Slot 0)

Control of the devices within the VXIbus chassis is provided by a National Instruments VXI/MXI-2 Slot 0 controller. The Slot 0 provides the interface between the system controller and the VXI backplane via the system MXI-2 bus. The MXI-2 kit also contains the MXI-2 interface board installed in the external computer.

Refer to the National Instruments operating manual set for detailed information regarding the operation of the device.

Racal Instruments 1260 Option 01-T Switch Controller, (Installed in 1U21-Slot 5,6)

All switching in the Freedom Series Test System is based upon Racal Instruments 1260 series of switch modules. These modules provide for a common set of commands used to control the switches. A single 1260 Option 01-T smart card is installed in the left-most 1260 switch module of each contiguous group and serves as the VXIbus interface for all of the switch modules in that group.

Refer to the Racal Instruments 1260 Option 01-T instruction manual for detailed information regarding the operation and programming of this device.

Racal 4152A DMM Module, (1U21-Slot 1)

The Racal 4152A 6.5-Digit Multimeter is a C-size, 1-slot, message-based VXI module. This multimeter's wide product functionality includes volts, amps, ohms, and frequency with advanced tests including limit checks to drive a TTL output and dc voltage ratios. Standard measurements include ac/dc voltage, ac/dc current, 2- & 4-wire Ohm, plus frequency/period.

All I/O from the Racal 4152A is wired to the receiver interface by harness assembly 407464 (TTI Testron Interface).

Refer to the Racal Instruments 4152A instruction manual for detailed information regarding the operation and programming of this device. The 4152A instruction manual also contains the assembly drawings, parts list and wirelists for the 4152A Freedom Series harness assembly used in the system.

Racal Instruments 2461, (1U21-Slot 2)

The test system contains a Racal Instruments 2461 Universal Timer/Counter which provides both frequency and time interval measurement with both two or four channel capability in a 200 MHz range.

All I/O from the 2461 is wired to the receiver interface by harness assembly 407584 (TTI Interface).

Refer to the Racal Instruments 2461 instruction manual for detailed information regarding the operation and programming of this device. The 2461 instruction manual also contains the assembly drawings, parts list and wirelists for the 2461 Freedom Series harness assembly used in the system.

Racal Instruments 3151, (1U21-Slot 3)

The test system contains a Racal Instruments 3151 Waveform Generator. This module combines a function generator, pulse generator, sequencer and arb waveform generator in one instrument. Output ranges from 100Hz to 50Mhz.

All I/O from the 3151 is wired to the receiver interface by harness assembly 407434 (TTI Interface).

Refer to the Racal Instruments 3151 instruction manual for detailed information regarding the operation and programming of this device. The 3151 instruction manual also contains the assembly

drawings, parts list and wirelists for the 3151 Freedom Series harness assembly used in the system.

Racal Instruments 6065-8 w/512K, (1U21-Slot 4)

Serial I/O capability is provided by way of a Racal

Instruments 6065-8 Serial Communications VXIbus module. The 6065-8 provides eight serial I/O ports supporting both RS232 and RS422 at data rates from 300 to 38400 baud.

All I/O from the 6065-8 is wired to the receiver interface by harness assembly 407317 (TTI Testron Interface).

Refer to the Racal Instruments 6065 operating manual for detailed information regarding the operation and programming of this device. The 6065 instruction manual also contains the assembly drawings, parts list and wirelists for the 6065 Freedom Series harness assembly used in the system.

Racal Instruments 1260-100 Switch Carrier, (1U21-Slots 5,6)

The 1260-100 Switch Carrier accommodates up to six plug-in switch cards in a two-slot, C-size, VXIbus module.

The Option 01T interface, housed in the 1260-100, can control twelve Adapt-a-Switch plug-in cards. 1260-100 instruction manual also contains the assembly drawings, parts list and wirelists for the 1260-100 Freedom Series harness assembly used in the system.

Racal Instruments 1260-117, (1U21-Slots 5,6 -, module 1)

The Freedom Series Test System contains a Racal Instruments 1260-117 High Density Plug-in Switch module. It installs directly into the front panel of the Adapt-a-Switch VXIbus Carrier, 1260-100.

The 1260-117 is a 52-channel, SPDT module that is ideal for general purpose switching up to 60MHz. Each channel of the 1260-117 can switch up to 2A, 250VAC or 220VDC and can be used independently or linked to form custom switching networks.

All I/O from the 1260-117 is wired to the receiver interface by harness assembly 407552 (TTI Testron Interface). The assembly drawing, parts list and wirelists for the 1260-117 Freedom Series harness

assembly used in this system are included in **Section 10.**

Refer to the Racal Instruments 1260-117 instruction manual for detailed information regarding the operation and programming of this device.

Racal Instruments 1260-118, (1U21-Slots 5,6 -, module 2)

The Freedom Series Test System contains a Racal Instruments 1260-118 Plug-In Switch module. It installs directly into the front panel of the Adapt-a-Switch VXIbus Carrier, 1260-100. The 1260-118 contains 80 channels of SPST relay switching. Each switch is capable of switching up to 2 Amps.

All I/O from the 1260-118 is wired to the receiver interface by harness assembly 407562 (TTI Testron Interface). The assembly drawing, parts list and wirelists for the 1260-118 Freedom Series harness assembly used in this system are included in **Section 10.**

Refer to the Racal Instruments 1260-118 instruction manual for detailed information regarding the operation and programming of this device.

Racal Instruments 1260-120, (1U21-Slots 5,6- module 3)

The Freedom Series Test System contains a Racal Instruments 1260-120 Plug-In Switch module. It installs directly into the front panel of the Adapt-a-Switch VXIbus Carrier, 1260-100. The 1260-120 contains 20 channels of SPST relay switching. Each switch is capable of switching up to 13 Amps.

All I/O from the 1260-120 is wired to the receiver interface by harness assembly 407564 (TTI Testron Interface). The assembly drawing, parts list and wirelists for the 1260-120 Freedom Series harness assembly used in this system are included in **Section 10.**

Refer to the Racal Instruments 1260-120 instruction

manual for detailed information regarding the operation and programming of this device.

Racal Instruments 1260-138A, (1U18-Slots 5,6-module 4)

The Freedom Series Test System contains a Racal Instruments High-Density Multiplexer Plug-In module. It installs directly into the front panel of the Adapt-a-Switch VXIbus Carrier, 1260-100. The 1260-138A can be user-configured in many ways, from one 1x128 to sixteen 1x8 2-wire multiplexers, switching up to 250VDC or 2A per channel.

All I/O from the 1260-138A is wired to the receiver interface by harness assembly 407568 (TTI Testron Interface). The assembly drawing, parts list and wirelists for the 1260-138A Freedom Series harness assembly used in this system are included in **Section 10**.

Refer to the Racal Instruments 1260-138A instruction manual for detailed information regarding the operation and programming of this device.

Racal Instruments 1260-114OC, (1U21-Slots 5,6 - module 5)

The test system contains a Racal Instruments 1260-114 Plug-In Switch module. It installs directly into the front panel of the Adapt-a-Switch VXIbus Carrier, 1260-100. Each module features 96-channel digital I/O TTL operation which may be placed in a high-impedance, tri-state mode.

All I/O from the 1260-114OC is wired to the receiver interface by harness assembly 407560 (TTI Testron Interface). The assembly drawing, parts list and wirelists for the 1260-114OC Freedom Series harness assembly used in this system are included in **Section 10**.

Refer to the Racal Instruments 1260-114OC instruction manual for detailed information regarding the operation and programming of this device.

Racal Instruments 1260-150, (1U21-Slots 5,6 - module 6)

The test system contains a Racal Instruments 1260-150 10-channel High Frequency module. It installs directly into the front panel of the Adapt-a-Switch VXIbus Carrier, 1260-100.

All I/O from the 1260-150 is wired to the receiver interface by harness assembly 407570 (TTI Testron Interface). The assembly drawing, parts list and wirelists for the 1260-150 Freedom Series harness assembly used in this system are included in **Section 10**.

Refer to the Racal Instruments 1260-150 instruction manual for detailed information regarding the operation and programming of this device.

Tektronix TDS460, (1U05)

The Tektronix TDS 460 provides a Digitizing Oscilloscope capability for the test system. The oscilloscope's four channel inputs (A, B, C and D) are wired to the receiver interface using RG316 coaxial cable.

All I/O from the TDS460 is wired to the receiver interface by harness assembly 407343 (TTI Testron Interface). The assembly drawing, parts list and wirelists for the TDS460 Freedom Series harness assembly used in this system are included in **Section 10**.

Refer to the Tektronix TDS460 operating manual set for detailed information regarding the operation and programming of this device.

Keithley 236 SMU, (1U11, 1U13)

The 236, 237 and 238 Source-Measure Units (SMU) are fully programmable instruments, capable of sourcing and measuring very small amounts of voltage or current simultaneously. These systems are four instruments in one: voltage source, current source, voltage measure and current measure.

All I/O from the Keithley 236 is wired to the TTI receiver interface thru a 2U interface panel by a system harness assembly detailed in the Enclosure Assembly 12840002, along with the parts list.

Refer to the Keithley 236 operating manual set for detailed information regarding the operation and programming of this device.

HP6050A HP Load Mainframe, (2U25)

The Agilent 6050A electronic load mainframe accepts the user-installable Agilent load modules for system configuration and future reconfiguration. The 6050A holds up to six 60501B, 60502B, and 60503B load modules, or three 60504B and 60507B load modules, allowing up to 1,800 watts of total maximum power. One GPIB address is used to control and readback of all load modules within a single mainframe.

All I/O from the 6050A is wired to the TTI receiver by a system harness assembly detailed in the Enclosure Assembly 12840002, along with the parts list.

Refer to the 6050A operating manual set for detailed information regarding the operation and programming of this device.

HP60502B HP Load Module, (2U25-Slots 1-6)

The HP60502B carries a load capability from 0 to 60A, with a maximum power output of 300W. Each module includes programming inputs that allow control of load current via an analog control voltage.

HP66000 Programmable Supply, (2U29)

The 66000A mainframe can accommodate up to eight dc power modules. Provides high-accuracy read-back of voltage and current over HP-IB Standard Commands for Programmable Instruments (SCPI).

All I/O from the HP66000 is wired to the VP receiver interface by a system harness assembly detailed in the Enclosure Assembly 12840002, along with the parts list.

Refer to HP manual set for detailed information regarding the operation and programming of the device.

HP 66101A DC Power Module, (2U29, Slots 5,6)
Programmable module with ratings of 0-8 V, 0-16 A, 128 W.

HP 66103A DC Power Module, (2U29, Slots 0-4)
Programmable module with ratings of 0-35 V, 0-4.5 A, 150 W.

Power Distribution

RACAL UPC1003-133, (U01)

AC power to the test system is controlled by a Racal UPC-2003-133 3-phase AC power controller. This controller provides a front panel On/Off switch along with an Emergency Off (EMO) switch. When pressed, the EMO switch shuts down the entire test system. Power cannot be re-applied until the EMO switch is mechanically reset and the RESET button is pressed.

Selftest Software Operation

Each Freedom Series Test System is delivered with a menu-driven self-test program. The self-test program, also known as QBIT, verifies the proper communications configuration of the system and the operational status of each device within the system.

The selftest is executed from within Windows by double-clicking the *Freedom Selftest* icon located in the *Freedom Selftest* program group. When the selftest menu is displayed, the test is run by clicking the Run Test Toggle switch on the self-test menu display. Any device may be selected or de-selected for testing by clicking the checkbox next to the device. If an X appears in the checkbox then the device will be tested.

When the test is run, each piece of equipment with the capability to do so is commanded to perform its internal self test and the results are verified for

passing status. Also included in this test is verification from the 1261A Chassis Intelligent Front Panel (Option P, if present in your system) that the VXIbus chassis is operating within normal parameters.

During QBIT, the 1260 series switch modules are tested by placing each switch module in its confidence mode. Each relay is closed and opened in turn and the test reads back the proper opened or closed status of the relay.

Execution of the selftest is based upon a system configuration file. The file has the name *selftest.cfg* and is located in the *selftest* sub-directory on the computer. Three example entries from a configuration file are shown below:

1260-45C (1U18-SLOT 1)	VXI::17::INSTR	1
T 1260-45C 1		
1362 (1U18-SLOT 7)	VXI::22::INSTR	4
W ""TST?"		
D 12000		
R 80		
C "0"		
TDS460 (1U7)	GPIB::5::INSTR	7
W "DIAG:SEL:ALL ALL"		
W "DIAG:STATE EXEC"		
D 80000		
P		
W "DIAG:RESU:FLAG?"		
R 80		
C ":DIA:RESU:FLA PASS"		

There is an entry in the configuration file for each device in the system. Each entry has the following format:

Line 1, Column 1:	Device name as it will appear in the selftest menu
Line 1, column 31	Instrument type and address. This is of the form: XXXX::AD::INSTR, where XXXX is either VXI or GPIB, and AD is the Logical Address or GPIB address of the device.
Line 1, column 52	This entry is the number of

Line 2 thru n	command lines which follow. Instrument command lines. Each instrument command appears on a separate line. The following commands are allowed:
T 1260-xx n	Racal 1260 series switch module test. Where xx is the particular 1260 series switch module to be tested and n is its module address.
W "string"	Writes <i>string</i> to the device. <i>String</i> must be enclosed in quotes.
D n	Delay n milliseconds
R n	Reads n characters from the device.
C "string"	Compares <i>string</i> to data retrieved from the most recent read. <i>String</i> must be enclosed in quotes. Leading blanks and trailing characters in the retrieved data are ignored.
P	Perform a GPIB serial poll.

1

2

Maintenance

Overview

This section describes the maintenance and calibration procedures for the Freedom Series Test System and its constituent devices.

Routine Maintenance

The Freedom Series Test System, as a whole, requires very little routine maintenance for normal operation. The test system should be kept clean of dirt and grease, particularly in the areas around electrical connectors and the louvered top panel. A removable air filter is located behind the grill of the fan assembly located at the bottom, rear of the rack and should be removed and cleaned or replaced periodically depending on how dust free the environment is. It is recommended that the filter be checked at least once per month. Replacement filters may be ordered from Racal Instruments under Part Number 921390.

CAUTION

TURN OFF POWER TO THE TEST SYSTEM BEFORE PERFORMING ANY MAINTENANCE

Note the main AC power cord should be removed from its receptacle to insure that no power is present in the system.

Individual devices within the Freedom Series Test System should be maintained in accordance with the manufacturer's instructions. Refer to the devices' operating manuals for maintenance information

Calibration

Each instrumentation device within the Freedom

Specifications

Electrical Specifications

The complete performance specifications for each of the devices contained in the Freedom Series Test System may be found in each device's operating manual. The devices are listed in Section: **Functional Description** and the manuals are listed in Section: **Applicable Documents**.

Mechanical Specifications

The Freedom Series Test System is housed in a two-bay Knurr rack having a 19" panel opening for each bay.

Height: 72.0"
Width: 47.0"
Depth: 35.4"
Weight: approx. 1500 lbs.

Environmental Specifications

Temperature -
operating: +0 to +50 °C
Humidity - (non-condensing)
operating: 0 to 80%
storage : 0 to 95%

Reliability

This section provides MTTR, MTBF and Maintainability figures for the Freedom Series Test System.

MTTR is the mean time to repair the system once a failure has been isolated to the Lowest Replacable Unit (LRU). An LRU is defined as a VXibus module or piece of rack-mounted equipment. MTTR includes the time required to remove the failed unit, install a new unit and configure the new unit if required. MTBF is the mean time between failures for the system. This is the mean time between failures of the LRUs within the system. Average system maintainability is a figure of merit that indicates how much the system complexity affects the overall MTTR

Mean Time To Repair (MTTR)	XXX min.
Mean Time Between Failures (MTBF)	XXXX hrs.
Average System Maintainability:	XXX min.

System Power and Cooling

Table 6.1 gives the power dissipated within the Freedom Series Test System. Values are given for dissipated power within the equipment rack under normal test conditions and does not include power delivered to UUT loads by the power supplies.

VXIbus Chassis Power Dissipation

Table 6.2 gives the DC power dissipated within the Racal Instruments VXIbus chassis. Also shown is the total DC power available within the VXIbus chassis.

VXIbus Chassis Cooling

Table 6.3 provides a cooling analysis for the Racal Instruments VXIbus chassis.

DEVICE	CURRENT max. AMPS @ AC Line Voltage			BAY 1 POWER DISSIPATION (WATTS)	BAY 1 POWER DISSIPATION (WATTS)
	φA	φB	φC		
IPC1003					
GPIB-120	0.60			50.00	
TDS460A	2.10			240.00	
K236 (1U11)		0.90		120.00	
K236 (1U13)		0.90		120.00	
1261B Chassis			3.30	341.46	
Computer	2.50				250.00
Monitor	1.50				250.00
HP6050A		5.50			1000.00
HP66000A	12.50				425.00
Printer			2.50		
Fans			1.00	30.00	30.00
TOTAL ** USAGE	19.20	7.30	6.80	901.46	1955.00
TOTAL AVAILABLE	30.00	30.00	30.00	2670.00	2670.00

AC service is provided through the Racal Instruments UCP1003 located at U01

Two 294 cfm fans are mounted in the bottom rear of each rack bay.
This provides 2.67 KW of cooling capability for 10°C rise with a 1.25 factor of safety as shown below:

$$KW = (cfm) \times (\Delta t_c) / (1760) \times (1.25) = (2)(294)(10) / (1760)(1.25) = 2.67 \text{ KW}$$

** Expected current based on expected power supply usage is shown in (parentheses)

TABLE 6.1 System Power Distribution/Dissipation

SLOT	DEVICE	CURRENT, I_{pm} (Amps)						
		+5V	+12V	-12V	+24V	-24V	-5.2V	-2V
0	VXI-MXI-2	3.50						
1	4152A	0.20	0.70					
2	2461CD	1.81			0.45	0.27	0.76	0.02
3	3151A	3.00	0.10	0.10	0.25	0.25	2.00	
4	6065-8	2.00	0.10	0.10	0.20	0.20		
5	1260-117,-118,-120	4.00						
6	1260-138A,-114,-150	4.00						
7	BLANK							
8	BLANK							
9	BLANK							
10	BLANK							
11	BLANK							
12	BLANK							
TOTAL		18.51	0.90	0.20	0.90	0.72	2.76	0.02
CURRENT AVAILABLE		80.00	13.00	13.00	18.00	12.00	60.00	30.00

Total Power Dissipation = 341.46

TABLE 6.2 VXIbus Chassis Power Dissipation

SLOT	DEVICE	MODULE		CHASSIS	SUFFICIENT COOLING
		AIRFLOW (liters/sec)	BACK PRESSURE (mm of H ₂ O)	PRESSURE AVAILABLE @ SPEC'd AIR-FLOW (mm of H ₂ O)	
0	VXI-MXI-2	3.50	0.25	0.80	YES
1	4152A	0.80	0.05	1.60	YES
2	2461CD	4.00	0.14	0.80	YES
3	3151A	3.70	0.55	0.80	YES
4	6065-8	2.00	0.50	1.32	YES
5	1260-117,-118,-120	1.50	0.35	1.32	YES
6	1260-138A,-114,150	1.50	0.35	1.32	YES
7	BLANK			1.85	YES
8	BLANK			1.85	YES
9	BLANK			1.85	YES
10	BLANK			1.85	YES
11	BLANK			1.85	YES
12	BLANK			1.85	YES

TABLE 6.3 VXIbus Chassis Cooling

Drawings

This section contains the following drawings:

12840002, ENCLOSURE ASSEMBLY

Parts Lists

This section contains the following drawings:

12840001, SYSTEM ASSEMBLY
12840002, ENCLOSURE ASSEMBLY

Wire Lists

This section contains the following drawings:

12840002, ENCLOSURE ASSEMBLY WIRE LIST

Receiver Pin Out Mapping

This section contains the receiver pinout mapping for the Freedom Series Test System, 12840001.

Freedom Series Harnesses

Freedom series wiring harnesses for Racal instruments products are contained in the individual devices' operating manuals. This section contains Freedom series wiring harnesses for Other Equipment Manufacturer's (OEM) products. This section contains the following drawings:

407464, HARNESS ASSY, VXI DMM, TTI	11-3
407584, HARNESS ASSY, 2461, TTI.....	11-7
407434, HARNESS ASSY, 3151, TTI.....	11-11
407317, HARNESS ASSY, 6065, TTI.....	11-15
407343, HARNESS ASSY, TDS460A, TTI.....	11-22
407560, HARNESS ASSY, 1260-114, TTI	11-26
407552, HARNESS ASSY, 1260-117, TTI	11-36
407562, HARNESS ASSY, 1260-118, TTI	11-47
407564, HARNESS ASSY, 1260-120, TTI	11-57
407568, HARNESS ASSY, 1260-138A, TTI.....	11-63
407570, HARNESS ASSY, 1260-150, TTI	11-73

Product Support

Product Support

Racal Instruments has a complete Service and Parts Department. If you need technical assistance or should it be necessary to return your product for repair or calibration, call 1-800-722-3262. If parts are required to repair the product at your facility, call 949-859-8999 and ask for the Parts Department.

When sending your instrument in for repair, complete the form in the back of this manual.

Reshipment Instructions

For worldwide support, refer to the **Support Offices** section on the following page.

Use the original packing material when returning the Freedom Series Test System to Racal Instruments for calibration or servicing. The original shipping crate and associated packaging material will provide the necessary protection for safe reshipment.

If the original packing material is unavailable, contact Racal Instruments Customer Service for information.

Support Offices

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