RACAL INSTRUMENTS
1260-155
HIGH FREQUENCY
PLUG-IN

PUBLICATION NO. 980824-155

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FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.

2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until, performance is checked by qualified personnel.

Racal Instruments

EC Declaration of Conformity

We

Racal Instruments Inc.
4 Goodyear Street
Irvine, CA 92718

declare under sole responsibility that the

1260-155 Dual 1x4 RF Switching Mux
P/N 407815-001, -002, -003,-004

They conform to the following Product Specifications:

Safety: EN61010-1:1993+A2:1995

EMC: EN61326:1997+A1:1998, Class A

Supplementary Information:

The above specifications are met when the product is installed in a Racal Instruments certified mainframe with faceplates installed over all unused slots, as applicable

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (modified by 93/68/EEC).

Irvine, CA, July 31, 2003 Karen L Evensen

Karen L Evensen
Engineering Director

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Table of Contents

List of Figures

List of Tables

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Chapter 1
SPECIFICATIONS

Introduction

The 1260-155 is a plug-in switch module developed for the Racal Instruments 1260-100 Adapt-a-Switch Carrier and the 1256 Switch Controller. The 1260-155 includes the following features:

- Standard plug-in design, providing for ease of replacement.
- Data-Driven embedded descriptor, allowing immediate use with any Option-01T or 1256 switch controller, regardless of firmware revision level.
- Dual 1x4 RF Multiplexers.
- 1.5 GHz and 3.0 GHz Bandwidth versions.
- Terminated and unterminated versions.
- 75Ω impedance and 1x8 multiplexer configurations available (contact factory).
- Low VSWR 1.5 GHz versions available (contact factory).

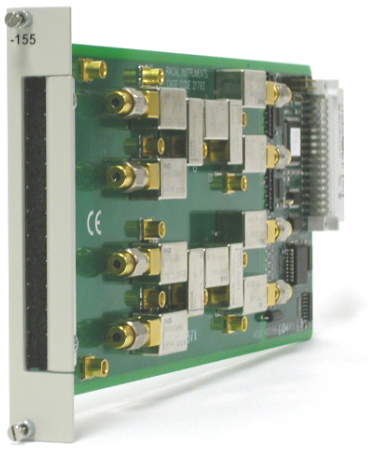

Figure 1-1, 1260-155

Specifications

Characteristic Impedance
50Ω

Bandwidth (-3dB)

1260-155/155T	> 1.5GHz
1260-155A/155AT	> 3.0GHz

Insertion Loss

1260-155	≤ 0.4 dB to .5GHz ≤ 0.6 dB to 1.0GHz ≤ 0.8 dB to 1.5GHz
1260-155T	≤ 0.6 dB to .5GHz ≤ 0.8 dB to 1.0GHz ≤ 1.2 dB to 1.5GHz
1260-155A	≤ 0.5 dB to 1.0GHz ≤ 0.75 dB to 2.0GHz ≤ 1.25 dB to 3.0GHz
1260-155AT	≤ 0.75 dB to 1.0GHz ≤ 1.25 dB to 2.0GHz ≤ 1.75 dB to 3.0GHz

Isolation

1260-155	≥ 70 dB to 1.0 GHz ≥ 50 dB to 1.5 GHz
1260-155T	≥ 55 dB to 1.0 GHz ≥ 50 dB to 1.5 GHz
1260-155A	≥ 70 dB to 1.0 GHz ≥ 50 dB to 3.0 GHz
1260-155AT	≥ 70 dB to 1.0 GHz ≥ 45 dB to 3.0 GHz

Crosstalk

1260-155	≥ 80 dB to 1.0 GHz
1260-155T	≥ 75 dB to 1.0 GHz
1260-155A	≥ 80 dB to 1.0 GHz
1260-155AT	≥ 80 dB to 1.0 GHz

VSWR		
	1260-155	≤ 1.2 dB to .1GHz ≤ 1.5 dB to .5GHz ≤ 1.6 dB to 1.5GHz
	1260-155T	≤ 1.2 dB to .1GHz ≤ 1.6 dB to .5GHz ≤ 1.7 dB to 1.5GHz
	1260-155A	≤ 1.2 dB to 1.0GHz ≤ 1.3 dB to 2.0GHz ≤ 1.5 dB to 3.0GHz
	1260-155AT	≤ 1.2 dB to 1.0GHz ≤ 1.3 dB to 2.0GHz ≤ 1.5 dB to 3.0GHz
Maximum Switching Voltage		
	1260-155/155A	30 VDC or VAC peak
	1260-155T/155AT	6 VDC or VAC RMS (with standard 1W terminators)
Max Switching Current		
	0.50 ADC or RMS	
Max Switching Power		
	1260-155/155A	≤ 10 VA, 10W
	1260-155T/155AT	≤ 1.0 W at 25°C derate linearly to 0.5 W at 55°C
Initial Path Resistance		≤ 250mΩ
Capacitance		
	Channel-Ground	≤ 15 pF
	Open-Channel	≤ 1.0 pF
Insulation resistance		≥ 10^9 Ω
Relay Settling Time		≤ 10 ms
Shock		30g, 11 ms, ½ sine wave
Vibration		0.013 in. P_k-P_k, 5-55 Hz
Bench Handling		4 in., 45°
Cooling		See 1260-100 cooling data
Temperature		
	Operating	0°C to +55°C
	Non-operating	-40°C to +60°C

Relative Humidity	85% ± 5% non-condensing at < 35°C	
Altitude		
Operating	10,000 feet	
Non-operating	15,000 feet	
Power Requirements		
+5 VDC	≤300mA + 44mA per energized relay (0.8 Max.)	
Weight	1260-155/155A	5.5 oz (.16Kg)
	1260-155T/155AT	8.5 oz (.24Kg)
MTBF	>300,000 hours (MIL-HDBK-217E)	
Dimensions	4.5”H X 0.75”W X 9.5”D	

Power Dissipation

While the cooling of the Adapt-a-Switch carrier is dependent upon the chassis into which it is installed, the carrier can normally dissipate approximately 100 W. Care must be taken, then, in the selection and loading of the plug-in modules used in the carrier. It is not possible to fully load the carrier, energize every relay, and run full power through every set of contacts, all at the same time. In practice this situation would never occur.

To properly evaluate the power dissipation of the plug-in modules, examine the path resistance, the current passing through the relay contacts, the ambient temperature, and the number of relays closed at any one time.

For example, if a 1260-155T module (containing 14 relays) has all relays closed, passing a current of 0.5A, then:

Total power dissipation =
$[(\text{current})^2 * (\text{path resistance}) * (\text{total number of paths})] +$
(quiescent power) + (total termination power)

By substituting the actual values:

Total power dissipation =
$[(0.5\ A)^2 * (.25\ \Omega) * 2] + (4\ W) + (7\ W) = 11.12\ W$ at 55°C

This is acceptable power dissipation for an individual plug-in module. If five additional modules are likewise loaded, then the overall carrier dissipation is approximately 66 W, which is well within the cooling available in any commercial VXIbus chassis. In practice, rarely are more than 25% of the module’s relays energized simultaneously, and rarely is full rated current run through every path. In addition, the actual contact resistance is typically one-half to one-fourth the specified maximum, and

temperatures are normally not at the rated maximum. The power dissipated by each plug-in should be no more than 15 W if all six slots are used simultaneously. Consult the Power Dissipation Section of any other 1260 Adapt-a-Switch card manuals for additional information.

Most users of a signal-type switch, such as the 1260-155, switch no more than a few hundred milliamperes and are able to energize all relays simultaneously, should they so desire.

Additionally, if fewer plug-in modules are used, more power may be dissipated by the remaining cards. By using a chassis with high cooling capacity, such as the Racal Instruments 1261B, almost any configuration may be realized.

About MTBF

The 1260-155 MTBF is >300,000 hours, calculated in accordance with MIL-HDBK-217E, with the exception of the electromechanical relays. Relays are excluded from this calculation because relay life is strongly dependent upon operating conditions. Factors affecting relay life expectancy are:

1. Switched voltage
2. Switched current
3. Switched power
4. Maximum switching capacity
5. Maximum rated carrying current
6. Load type (resistive, inductive, capacitive)
7. Switching repetition rate
8. Ambient temperature

The most important factor is the maximum switching capacity, which is an interrelationship of maximum switching power, maximum switching voltage and maximum switching current. When a relay operates at a lower percentage of its maximum switching capacity, its life expectancy is longer. The maximum switching capacity specification is based on a resistive load, and must be further de-rated for inductive and capacitive loads.

For more details about the above life expectancy factors, refer to the data sheet for the switch plug-in module.

The relay used on the 1260-155 and 1260-155T plug-in is Racal P/N 310257-001. The relay used on the 1260-155A and 1260-155AT plug-in is Racal P/N 310305. The manufacturer's specifications for these relays are:

Life Expectancy

Mechanical	5,000,000 operations
Electrical	100,000 operations at full rated load (resistive)

For additional relay specifications, refer to the relay manufacturer's data sheet.

Ordering Information

Listed below are part numbers for both the 1260-155 switch modules and available mating cable accessories. The 1260-155 uses up to 10 standard MCX Right Angle Plug connectors.

ITEM	DESCRIPTION	PART #
1260-155	Dual 1x4 Rf Switch Card, 1.5GHz	407815-001
1260-155T	Dual 1x4 Terminated Switch Card, 1.5GHz	407815-002
1260-155A	Dual 1x4 Rf Switch Card, 3.0GHz	407815-003
1260-155AT	Dual 1x4 Terminated Switch Card, 3.0GHz	407815-004
Shipping Kit	Cable ties and manual	407653-155
Cable Assy. 2ft, 50Ω	Single Coax Cable w/ (2) MCX R/A Plugs (can be cut and used as 2 cables)	407828-001
Cable Assy. 6ft, 50Ω	Single Coax Cable w/ (2) MCX R/A Plugs (can be cut and used as 2 cables)	407828-003
Cable Assy. 12ft, 50Ω	Single Coax Cable w/ (2) MCX R/A Plugs (can be cut and used as 2 cables)	407828-006
Additional Manual	User Manual	980824-155

Chapter 2

INSTALLATION INSTRUCTIONS

Unpacking and Inspection

1. Remove the 1260-155 module and inspect it for damage. If any damage is apparent, inform the carrier immediately. Retain shipping carton and packing material for the carrier's inspection.

2. Verify that the pieces in the package you received contain the correct 1260-155 module option and the 1260-155 Users Manual. Notify EADS North America Defense Test and Services, Inc. if the module appears damaged in any way. Do not attempt to install a damaged module into a VXI chassis.

3. The 1260-155 module is shipped in an anti-static bag to prevent electrostatic damage to the module. Do not remove the module from the anti-static bag unless it is in a static-controlled area.

Reshipment Instructions

1. Use the original packing when returning the switching module to EADS North America Defense Test and Services, Inc. for calibration or servicing. The original shipping carton and the instrument's plastic foam will provide the necessary support for safe reshipment.

2. If the original packing material is unavailable, wrap the switching module in an ESD Shielding bag and use plastic spray foam to surround and protect the instrument.

3. Reship in either the original or a new shipping carton.

Installation

Installation of the 1260-155 Switching Module into a 1260-100 Carrier assembly is described in the Installation section of the 1260-100 Adapt-a-Switch Carrier Manual.

Module Configurations

The 1260-155 series are high frequency coaxial switch modules each containing two 1x4 RF multiplexers. The 1260-155 and 1260-155A are simple RF trees, where channel 0 in each multiplexer is normally connected to the COM output. The 1260-155 has a rated bandwidth of greater than 1.5 GHz where the 1260-155A has a bandwidth greater than 3 GHz. Otherwise the configurations are identical. See **Figure 2-1** for a Relay Diagram.

The 1260-155T and 1260-155AT are terminated multiplexer modules where the non-selected inputs are terminated into 1 Watt, 50 ohms SMA terminators.

If higher power terminators are needed, the installed SMA terminators can be removed and replaced with user supplied terminations, though the user is responsible for location mounting and fit issues.

The 1260-155T has a rated bandwidth in excess of 1.5 GHz and the 1260-155AT has a bandwidth above 3 GHz. See **Figure 2-2** for a Relay Diagram.

Front Panel Cable Clamp and PCB Connectors

The 1260-155 Series uses ten MCX PCB mounted jack connectors as the module interface. The channel designations are silk screened on the PCB, next to the connectors, as shown in **Figures 2-3 and 2-4**. **Table 2-1** shows the mapping of I/O connections to channel numbers and **Figure 2-5** shows a block diagram of the1260-155.

The 1260-155 uses a cable clamp at the Front Panel to secure the coax cables which route the signals to the 1260-155 as shown in **Figure 2-6**. The three screws that hold down the cable clamp must be removed prior to connecting to the 1260-155. The interfacing connectors are attached to the 1260-155 and the cables are routed out through the Front Panel. After all the connections are made and the cables routed through the Front Panel. The cable clamp can be attached with the three screws that were removed previously. In addition, cable ties and adhesive clamps are provided as part of the 1260-155 Shipping Kit to help hold the interface cables in place.

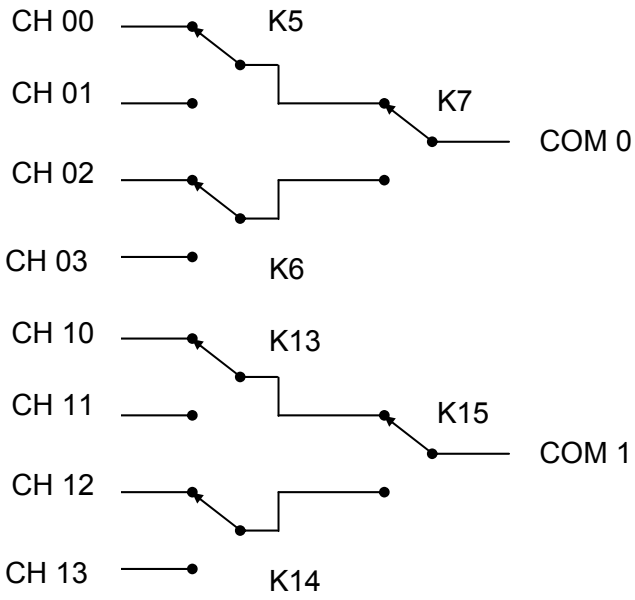

Figure 2-1, 1260-155 and 1260-155A

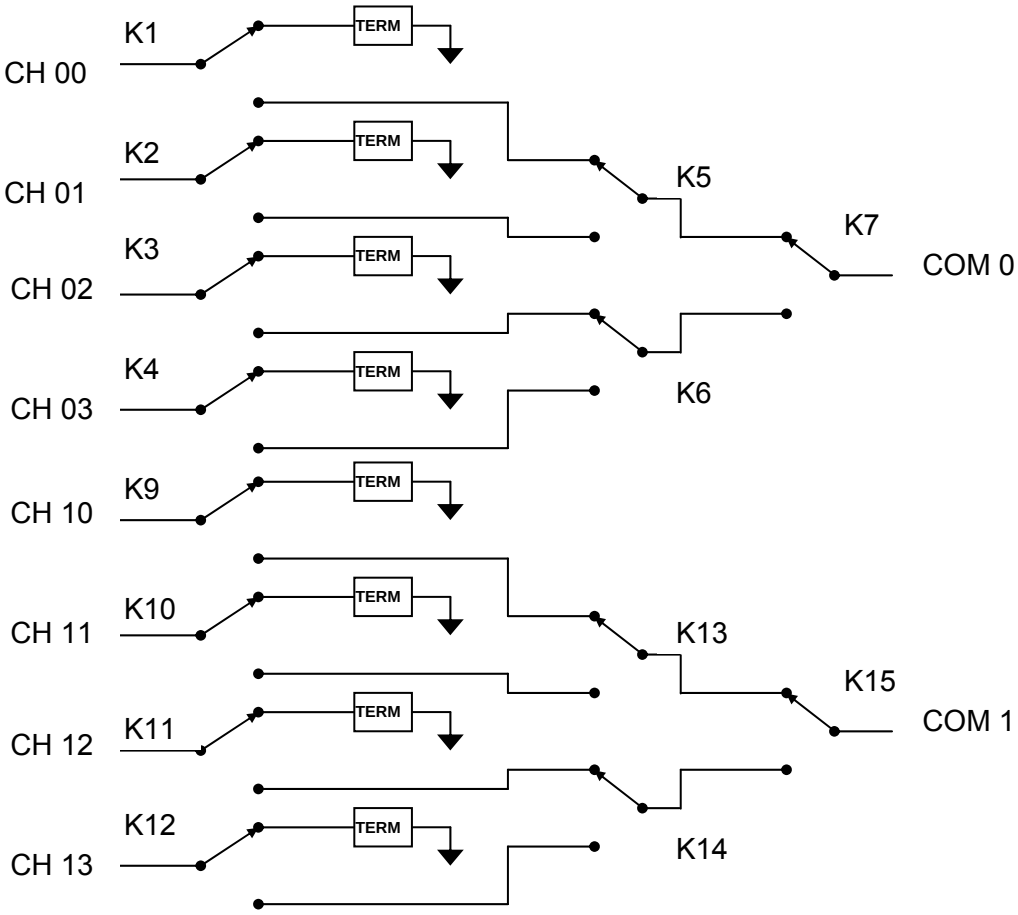

Figure 2-2, 1260-155T and 1260-155AT

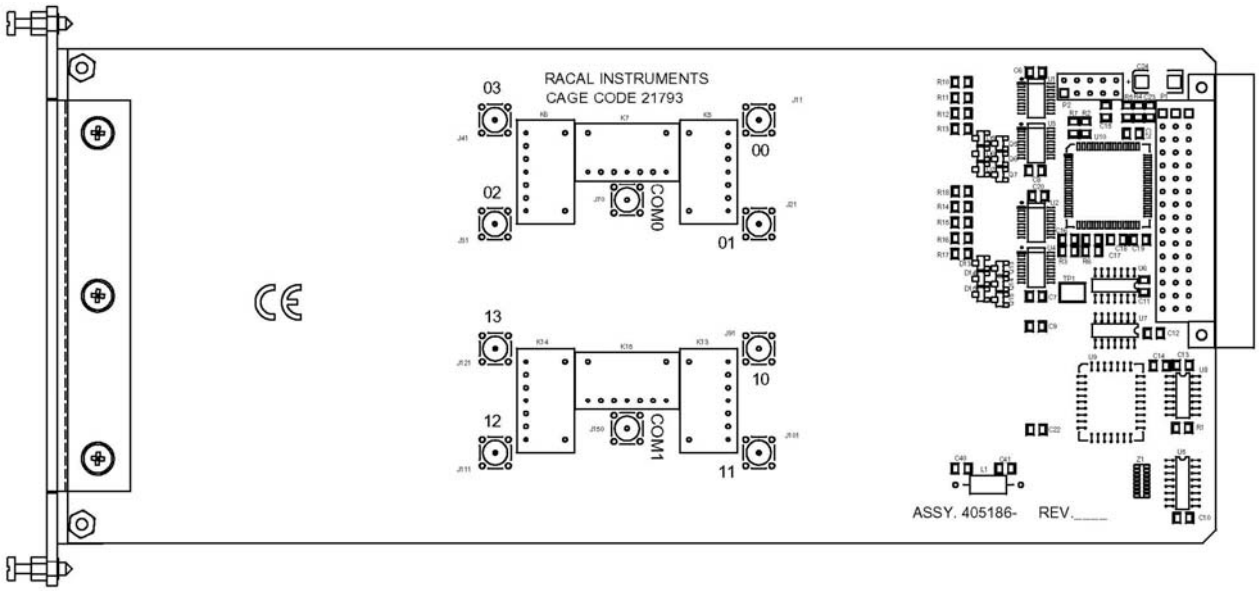

Figure 2-3, 1260-155, -155A-Channel Designations

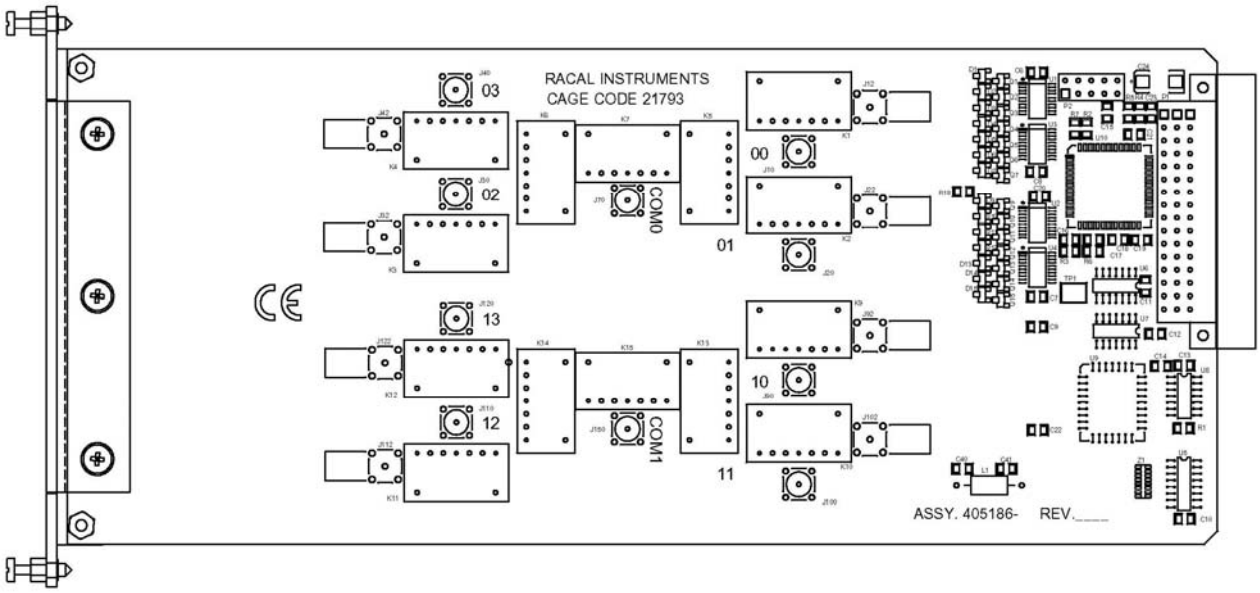

Figure 2-4, 1260-155T, -155AT,Channel Designations

Table 2-1, 1260-155 I/O Connections

Channel Number	In	Out
00	00	COM0
01	01	COM0
02	02	COM0
03	03	COM0
10	10	COM1
11	11	COM1
12	12	COM1
13	13	COM1

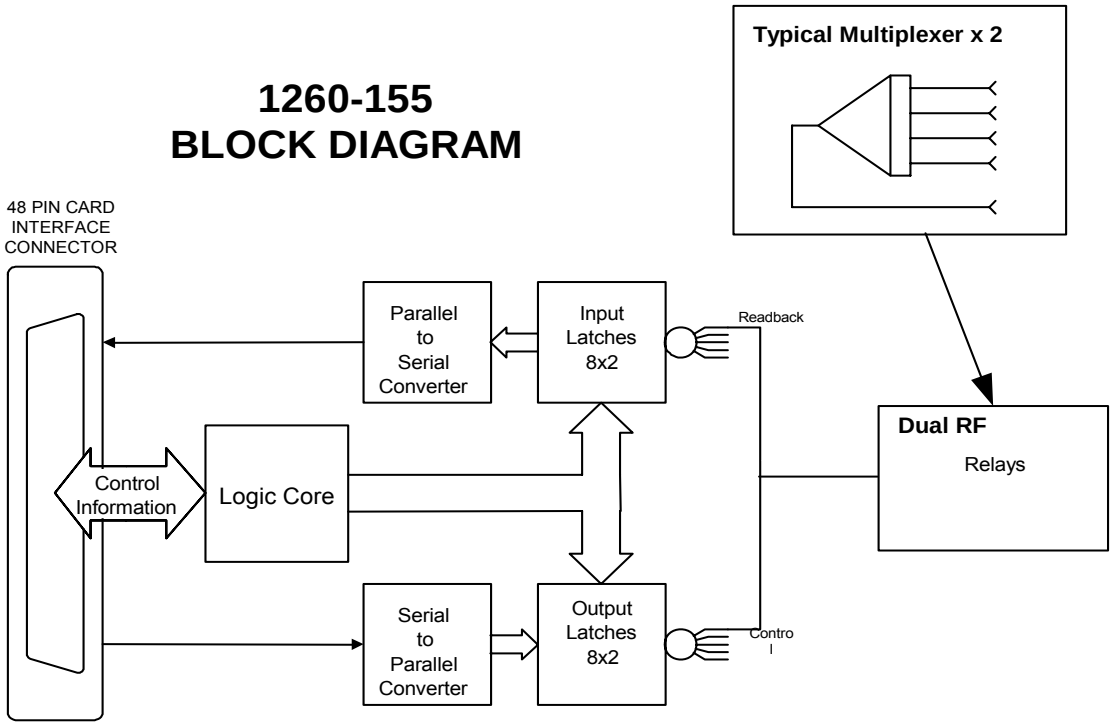

Figure 2-5, Block Diagram

Figure 2-6, Front Panel Cable Clamp

Mating Connectors

The 1260-155 uses standard MCX right angle plugs for mating connectors.

Mating connectors and cables are not provided as part of the 1260-155 Shipping Kit. Mating Cable assemblies must be ordered separately. Refer to the Ordering Information section of this manual.

If the user chooses to build his own cables, Standard MCX right angle plug mating connectors for coax cable may be used.

Chapter 3
MODULE OPERATION

Setting the Module Address

Both the Racal Instruments Option-01T and 1256 switch controllers identify each Adapt-a-Switch plug-in by a *module address* that is unique to that module.

For setting the module address of the 1260-155 refer to one of the following manuals.

- 1260-100 Adapt-a-Switch Manual – Publication No. 980824-100
- 1256 User Manual – Publication No. 980855

1256 Operation

For a detailed description of the use of the 1260-155 when they are being used in a 1256 Switch Controller, refer to the 1256 User Manual (P/N 980855).

VXI Operating Modes

The 1260-155 may be operated either in *message-based* mode or in *register-based* mode when used with an Adapt-a-switch Carrier in a VXI chassis.

In the *message-based* mode, the 1260-01T switch controller interprets commands sent by the slot 0 controller, and determines the appropriate data to send to the control registers of the 1260-155 module.

A conceptual view of the message-based mode of operation is shown in **Figure 3-1** below.

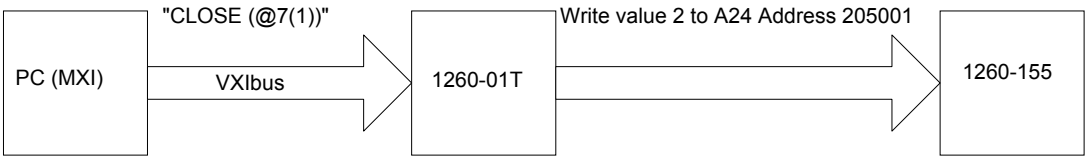

Figure 3-1, Message-Based Mode of Operation

In the *register-based* mode, the user writes directly to the control registers on the 1260-155 module. The 1260-01T command module does not monitor these operations, and does not keep track of the relay states on the 1260-155 module in this mode.

A conceptual view of the register-based mode is shown in **Figure 3-2** below.

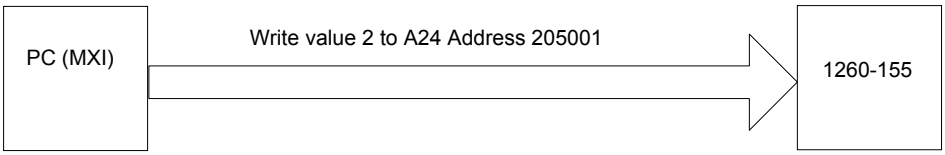

Figure 3-2, Register-Based Mode of Operation

Since the 1260-01T switch controller does not keep track of relay states during the register-based mode, it is advisable to use **either** the message-based or the register-based mode, and continue to use the same mode throughout the application program.

In general, the message-based mode of operation is easier to use with utility software such as the National Instruments VXI Interactive Control (VIC) program. The message-based mode allows the user to send ASCII text commands to the 1260-01T and to read replies from the 1260-01T. In addition, some features, such as the SCAN list, are available only in the message-based mode of operation.

The register-based mode provides faster control of relay channels. In this mode, relay operations are processed in less than 9 microseconds, not counting relay settling time or software overhead inherent in I/O libraries such as VISA. To determine the relay settling time, refer to Relay Settling Time in the Specifications

section.

Consult the 1260-01T User's Manual for a comparison of the message-based and register-based modes of operation.

Operating In VXI Message-Based Mode

Channel Descriptors For The 1260-155

The standard 1260-01T commands are used to operate the 1260-155 module. These commands are described in the 1260-01T User's Manual.

Each 1260-01T relay command uses a *channel descriptor* to select the channel(s) of interest. The syntax for a channel descriptor is the same for all 1260 series modules. In general, the following syntax is used to select a single channel:

```
(@ <module address> ( <channel range> ) )
```

Where:

- <module address> is the address of the 1260-155 module. This is a number is in the range from 1 through 12, inclusive.
- <channel range> is a list of <channels> to operate.

  When listing multiple channels, separate the channels with a comma (,). To select a contiguous range of channels, specify the first and last channels, and separate them by a colon (:)
- <channels> are defined by <mux> <sel>. Each channel is a two digit number specifying the multiplexer <mux> and the selected channel <sel> of the mux.
- <mux> valid designations are:

  0 or 1
- <sel> there are four valid selected inputs designated:

  0, 1, 2, or 3

The following examples illustrate the use of the channel

descriptors for the 1260-155, with a module address of 8.

`OPEN (@8(00))`	Open channel 0 on the 1260-155.
`OPEN (@8(10))`	Open channel 10 on the 1260-155.
`CLOSE (@8(02))`	Close channel 02 on the 1260-155.
`CLOSE (@8(01,13))`	Close channels 01 and 13 on the 1260-155.

NOTE:

There can only be one selected input for each multiplexer. For example, if channel 01 is closed and channel 02 is commanded to close channel 01 will open by default.

Reply To The MOD:LIST? Command

The 1260-01T returns a reply to the MOD:LIST? command. This reply is unique for each different 1260 series switch module. The syntax for the reply is:

<module address> : <module-specific identification string>

The <module-specific identification string> for the 1260-155 are:

```
1260-155 DUAL 1X4 RF MUX

or

1260-155A DUAL 1X4 UHF MUX

or

1260-155T DUAL 1X4 RF MUX WITH
TERMINATION

or

1260-155AT DUAL 1X4 UHF MUX WITH
TERMINATION
```

So, for a 1260-155 whose <module address> is set to 8, the reply

to this query would be:

```
8 : 1260-155 DUAL 1X4 RF MUX
```

Operating in VXI Register-Based Mode

In register-based mode, the 1260-155 is operated by directly writing and reading control registers on the 1260-155 module. The first control register on the module operates control bits 0 through 7. The second control register operates control bits 8 through 15. When a control register is written to, all channels controlled by that register are operated simultaneously.

The control registers are located in the VXIbus A24 Address Space. The A24 address for a control register depends on:

1. The A24 Address Offset assigned to the 1260-01T module by the Resource Manager program. The Resource Manager program is provided by the VXIbus slot-0 controller vendor. The A24 Address Offset is placed into the “Offset Register” of the 1260-01T by the Resource Manager.

2. The <module address> of the 1260-155 module. This is a value in the range from 1 and 12 inclusive.

3. The 1260-155 control register to be written to or read from. Each control register on the 1260-155 has a unique address.

The base A24 address for the 1260-155 module may be calculated by:

> (A24 Offset of the 1260-01T) + (1024 x Module Address of 1260-155).

The A24 address offset is usually expressed in hexadecimal. A typical value of 204000_{16} is used in the examples that follow.

A 1260-155 with a module address of 7 would have the base A24 address computed as follows:

> Base A24 Address of 1260-155 = 204000_{16} + (400_{16} x 7_{10}) = $205C00_{16}$

The control registers for Adapt-a-Switch plug-ins and conventional 1260-Series modules are always on odd-numbered A24 addresses. The three control registers for the 1260-155 reside at the first three odd-numbered A24 addresses for the module:

> (Base A24 Address of 1260-155) + 1 = Control Register 0

(Base A24 Address of 1260-155) + 3 = Control Register 1

So, for our example, the three control registers are located at:

205C01 Control Register 0, controls bits 0 through 7.

205C03 Control Register 1, controls bits 8 through 15.

Table 3-1 shows the bit and relay assignments for each control register.

Table 3-1, Control Register/Relay Assignments

Control Register	Relays							
	Bit 7 (MSB)	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0 (LSB)**
0	Note 1	7	6	5	4	3	2	1
1	Not used	15	14	13	12	11	10	9

Note 1: Bit used to control relay K16 in a 1x8 configuration.

Setting a control bit to 1 closes the corresponding relay, and clearing the bit to zero opens the corresponding relay. Thus, if you write the value 1000 0101 binary = 133 decimal = 85 hexadecimal to Control Register 0, relays 0, 2, and 7 will close, while channels 1, 3, 4, 5, and 6 will open.

The present control register value may be read back by reading an 8-bit value from the control register address. **The value is inverted**. In other words, the eight-bit value read back is the one's complement of the value written.

If you want to change the state of a single relay without affecting the present state of the other relays controlled by the control register, you must:

1. Read the control register.

2. Invert the bits (perform a one's complement on the register data).

3. Perform a bit-wise AND operation, leaving all but the specific control register bit for the relay to change.

4. **To open**: continue to step 5. **To close**: OR in the bit for the relay to close.

5. Write the modified value back to the control register.

For example, to close channel 13:

1. Read Control Register 1 (this register controls channels 8 through 15, with channel 8 represented by the LSB).

2. Invert the bits in the value read in step 1.

3. AND with 1101 1111 binary (the zero is in the position corresponding to channel 13).

4. OR with 0010 0000 binary.

5. Write the value to Control Register 1.

In order to control the relays the user should consult the relay diagrams **Figures 2-1 and 2-2** in chapter 2 which shows the relationship between the connected paths and the associated relays.

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Chapter 4
PRODUCT SUPPORT

Product Support

EADS North America Defense Test and Services, Inc. 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 1-949-859-8999 and ask for the Parts Department.

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

For worldwide support and the office closest to your facility, refer to the website for the most complete information http://www.eads-nadefense.com.

Reshipment Instructions

Use the original packing material when returning the 1260-155 to EADS North America Defense Test and Services, Inc. for calibration or servicing. The original shipping container and associated packaging material will provide the necessary protection for safe reshipment.

If the original packing material is unavailable, contact EADS North America Defense Test and Services, Inc. Customer Service at 1-800-722-3262 for information.

REPAIR AND CALIBRATION REQUEST FORM

To allow us to better understand your repair requests, we suggest you use the following outline when calling and include a copy with your instrument to be sent to the EADS North America Defense Test and Service, Inc. Repair Facility.

Model_____ Serial No._____ Date_____

Company Name_____ Purchase Order #_____

Billing Address_____

City

State/Province Zip/Postal Code Country

Shipping Address_____

City

State/Province Zip/Postal Code Country

Technical Contact_____ Phone Number ( )_____
Purchasing Contact_____ Phone Number ( )_____

1. Describe, in detail, the problem and symptoms you are having. Please include all set up details, such as input/output levels, frequencies, waveform details, etc.

2. If problem is occurring when unit is in remote, please list the program strings used and the controller type.

3. Please give any additional information you feel would be beneficial in facilitating a faster repair time (i.e., modifications, etc.)

4. Is calibration data required? Yes No (please circle one)

Call before shipping
Note: We do not accept "collect" shipments.

Ship instruments to nearest support office.