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RACAL INSTRUMENTS™

1260-21

12 CHANNEL, 10A HIGH POWER SWITCH MODULE

Publication No. 980673-065 Rev. A

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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

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DOCUMENT CHANGE HISTORY

Revision	Date	Description of Change
	08/25/2005	Publication
A	8/14/2014	Initial Release

Chapter 1
SPECIFICATIONS

Introduction

The 1260-21 is a High Power VXI Switch Module developed for the 1260 Series of switch modules.

The 1260-21 is available configured from the factory and can be ordered with the Option-01T Message Based Interface.

The following features are included in the 1260-21

- Message Based Interface Option available.
- Supports coil voltage Read Back to test coils are driven.
- Data-Driven embedded descriptor, allowing immediate use with any Option-01T switch controller, regardless of firmware revision level.

The 1260-21 is a high power, single-wire switching module that consists of twelve 1x2 switches. Each switch can handle current up to 10 Amps. The 1260-21 plug-in fits into a standard VXI chassis.

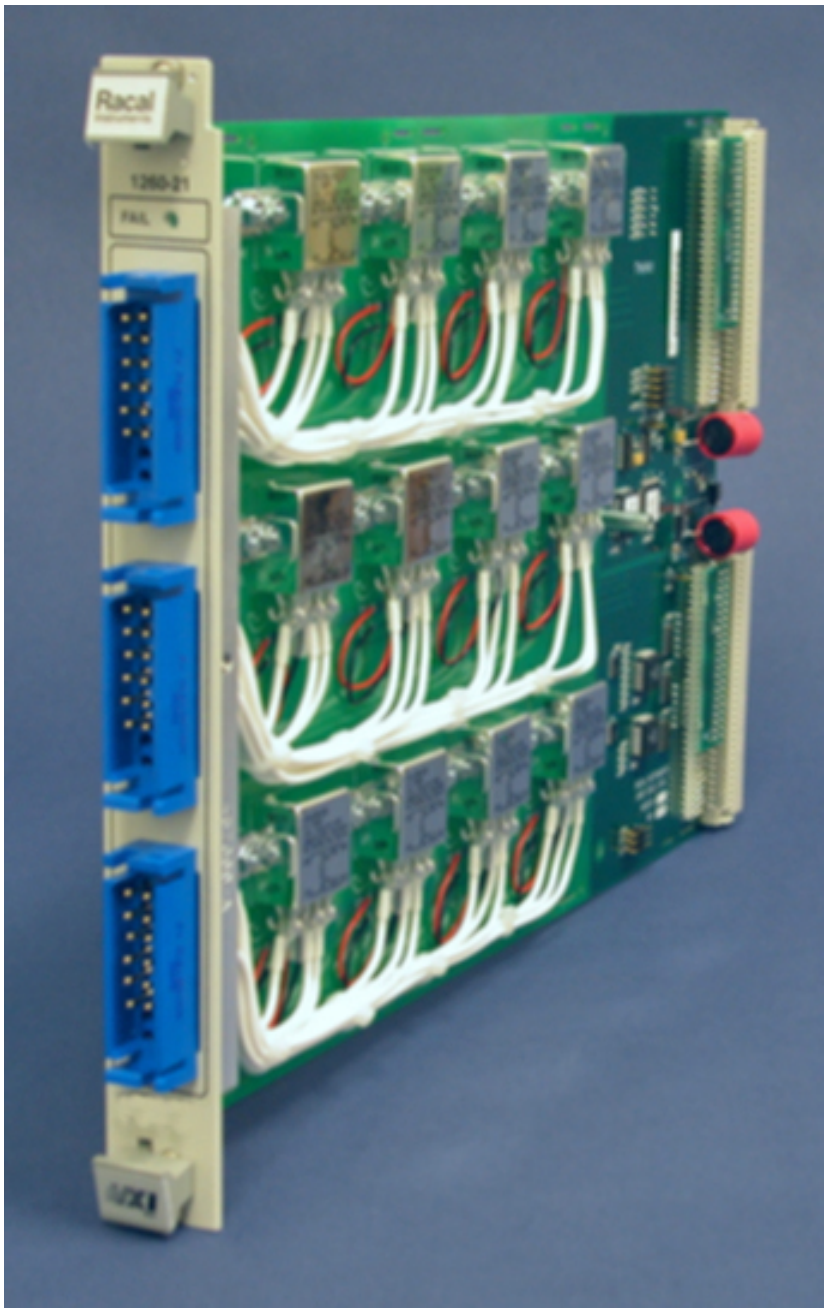


Figure 1-1, The 1260-21

Specifications

Bandwidth (-3dB)	300 KHz
Crosstalk Isolation	
DC to 100 KHz	> 60 dB
100 KHz to 300 KHz	> 50 dB
Channel Crosstalk	
DC to 100 KHz	< -60 dB
100 KHz to 300 KHz	< -50 dB
Switching Voltage	
AC	130 V, Max
DC	32 V, Max
Switching Current	
AC	10 A, Max
DC	10 A, Max
Switching Power	
AC	1150 VA, Max
DC	280 W, Max
Path resistance	< 20 mΩ @ 9 A
	< 100 mΩ @ 1 mA
Capacitance	
Channel-Chassis	< 40 pF
Open-Channel	< 40 pF
Insulation resistance	> 10^9 Ω
Relay Settling Time	< 25 ms
Breakdown Voltage	> 1000 V DC
Shock	30g, 11 ms, ½ sine wave
Vibration	0.013 in. P-P, 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 +75°C
Relative Humidity	95%, non-condensing at < 30°C

Altitude

Operating	10,000 feet
Non-operating	15,000 feet

Power Requirements (with Option-01T)

+5V	0.541 A dynamic current
	1.805 A peak current
+12V	3.000 A dynamic current
	3.000 A peak current

Cooling (25% Relays energized operating at full rated current)
1.69 Liters/sec @ 0.113 mmH_2O

Weight

with Option-01T	3.0 lbs. (1.361 kg)
w/o Option-01T	3.0 lbs. (1.361 kg)

MTBF (MIL-HDBK-217-FN2 method)

Excluding relays	1,500,000 hours
Including relays	280,000 hours

Relay Life Expectancy

Mechanical	5,000,000 operations
Electrical	10,000 operations at full load

Dimensions (Module) C-Size, Single Slot VXI bus Module

Power Dissipation

While the cooling of the 1260-21 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, power to the coils, the ambient temperature, and the number of relays closed at any one time.

For example, if a 1260-21 module (containing 12 relays) has 3 relays closed, passing a current of 10 A, then:

Total power dissipation =
$[(\text{current})^2 * (\text{path resistance}) * 3] + (\text{coil power} * 3) + (\text{quiescent power})$

By substituting the actual values:

Total power dissipation =
$[(10\ A)^2 * (.020\ \Omega) * 3] + [(12\ V)^2 / 80\ \Omega * 3] + (9.0\ W)$

= 20.4 W at 55°C

This is acceptable power dissipation for an individual plug-in module. The overall module power dissipation is approximately 20.4 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 typical power dissipation for each module should be no more than 10.2 W.

Most users of a signal-type switch, such as the 1260-21, 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 1261B, almost any configuration may be realized.

About MTBF

The 1260-21 MTBF is 1,500,000 hours, calculated in accordance with MIL-HDBK-217-FN2, 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

For example, under a given condition of 10 A switched current, 10 cycles/hour switch rate, and 30°C ambient temperature, MTBF is calculated to be 280,000 hours.

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 1260-21 plug-in is Astronics part no. 310314-001. The relay manufacturer's specifications for this relay are:

Life Expectancy

Mechanical	5,000,000 operations
Electrical	10,000 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 the 1260-21 switch module. The 1260-21 uses a single type of mating connector.

ITEM	DESCRIPTION	PART #
1260-21 Switch Module w/o – 01T	12 Channel, 10 A SPDT Power Switch Consists of: 405233 PCB Assy. 1260-21 manual	408004 405233 980673-065
Option-01T	Option-01T (installed) Option-01T (spare) Instruction Manual for Option-01T (Must be added w/ Option-01T installed)	OPT-405108-001 407531-001 980806-999
1260-21 Connector Mating Kit	Consists of: 3 16-pin mating connector shells 54 female connector pins	407917
Additional Manual		980673-065

Chapter 2
INSTALLATION INSTRUCTIONS

Unpacking and Inspection

1. Remove the 1260-21 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 1260-21 module option and the 1260-21 Users Manual. Notify Customer Service if the module appears damaged in any way. Do not attempt to install a damaged module into a VXI chassis.

3. The 1260-21 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.

Option 01T Installation

Installation of the Option 01T is described in the Installation and Setup section of the 1260A-Option 01T Users Manual, Publication No. 980806-999.

Module Installation

Installation of the 1260-21 Switching Module into a VXI mainframe, including the setting of switches SW1-1 through SW1-4, SW2, and SW3, is described in the Setup Section of the 1260A Option 01T Users Manual, Publication No. 980806-999.

Module Configuration

The 1260-21 is a 12-channel module consisting of 12 individual DPDT relay switches. The relay architecture consists of 12 1x2 switches.

For a block diagram of the switches used on the 1260-21, refer to **Figure 2-1**.

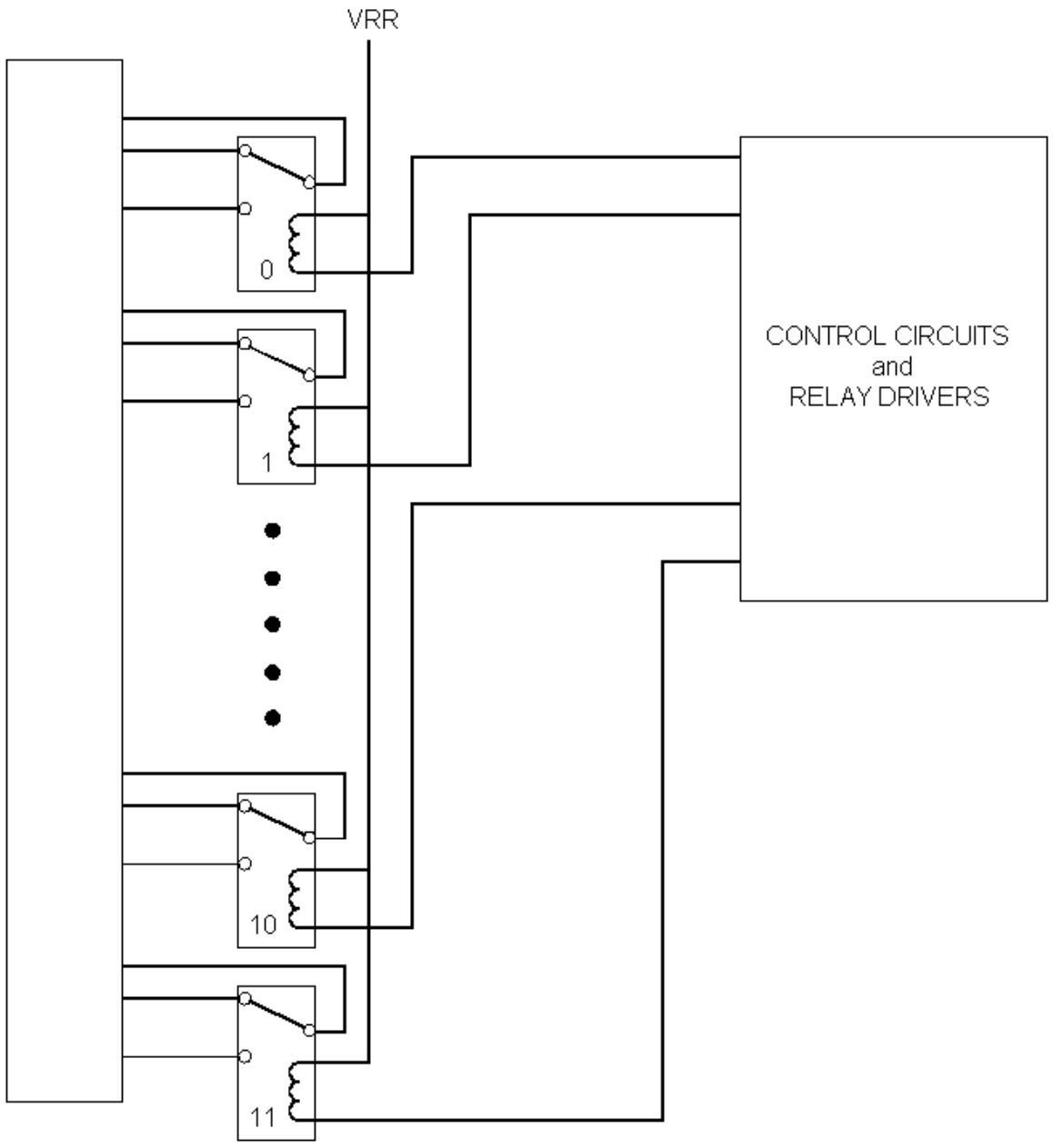


Figure 2-1, 1260-21, Switch Block Diagram

Front Panel Connectors

The 1260-21 has three 16-pin front-panel connectors, labeled J200, J201 and J202. It has one pin for each input and one for each output. See **Figure 2-2** for pin numbering. **Table 2-1** shows the mapping of channel numbers to connector pins. Information about available mating connectors is provided in **Table 2-2**.

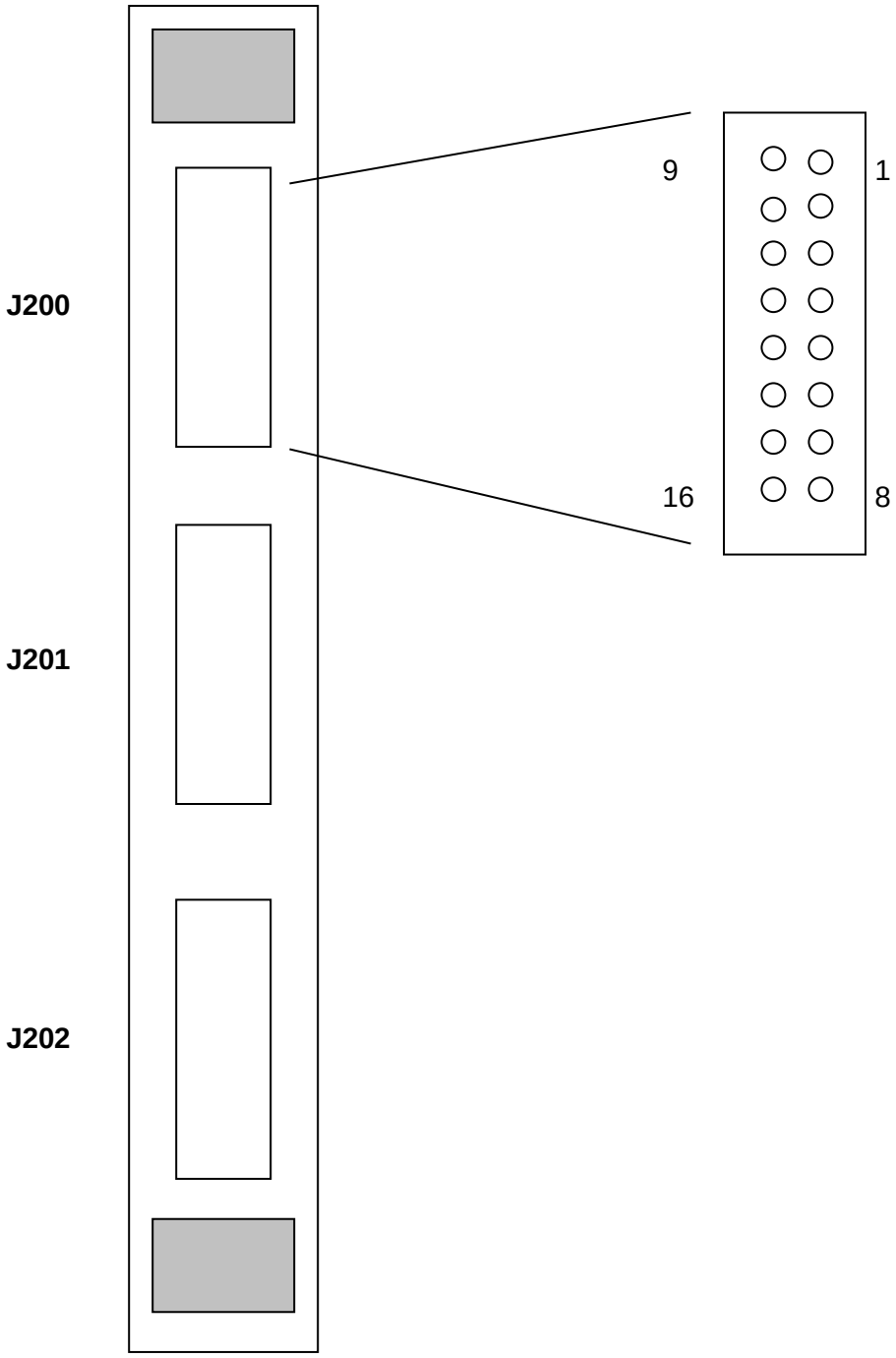


Figure 2-2, Front Panel Connector Pin Numbering

Table 2-1, 1260-21 Front-Panel Connections & Commands

SW	Function	Connector	SW	Function	Connector	
0	COM 0	J200-9	**1**	COM 1	J200-1	C
	CH0-1	J200-10		CH1-1	J200-2	NC
	CH0-2	J200-11		CH1-2	J200-3	NO
2	COM 2	J200-12	**3**	COM 3	J200-4	C
	CH2-1	J200-13		CH3-1	J200-5	NC
	CH2-2	J200-14		CH3-2	J200-6	NO
4	COM 4	J201-9	**5**	COM 5	J201-1	C
	CH4-1	J201-10		CH5-1	J201-2	NC
	CH4-2	J201-11		CH5-2	J201-3	NO
6	COM 6	J201-12	**7**	COM 7	J201-4	C
	CH6-1	J201-13		CH7-1	J201-5	NC
	CH6-2	J201-14		CH7-2	J201-6	NO
8	COM 8	J202-9	**9**	COM 9	J202-1	C
	CH8-1	J202-10		CH9-1	J202-2	NC
	CH8-2	J202-11		CH9-2	J202-3	NO
10	COM 10	J202-12	**11**	COM 11	J202-4	C
	CH10-1	J202-13		CH11-1	J202-5	NC
	CH10-2	J202-14		CH11-2	J202-6	NO

Mating Connectors

Mating connector accessories are available from Positronic:

The cable assembly should be made from at least 12 - 14 AWG wire. The mating contacts are crimp style and can handle wire up to 12 AWG.

After wire attachment, the pin is inserted in the housing and will snap into place, providing positive retention. To ensure that the pin is locked into place, the assembler should pull on the wire after insertion.

Refer to **Table 2-1** for channel-to-pin mapping information. **Table 2-2** contains manufacture's part numbers for the connector housing and contacts.

Table 2-2, Mating Connectors and Pins

Manufacturer	Mfr. P/N	Description
Astronics	407917	1260-21 Connector Mating Kit
Positronic	PLB16F0000	Connector block, 16-position. Mates with front-panel connector. Pins sold separately.
Positronic	FC112N2S	Female contact, crimp type, for up to 12 AWG wire. Mates with front-panel connector pins. Low resistance contacts

More About Maximum Current Ratings

The front panel connector and pins are rated for 10 A per pin, with all channels conducting full-rated current. The relays are rated at 10 A. This keeps the temperature rise within 10°C. It should be noted that with all electromechanical relays, the higher the switched power (voltage times current), the shorter the useful life of the relays.

Definitions:

- *Max current carrying capacity*

  The maximum current that the relay can conduct if the relay is not switched while voltage is applied. The maximum current carrying capacity is affected by the size of the conducting section of the contact at its smallest area. The listed values are obtained from several tests in laboratories under room-temperature conditions (21°C). The contact is considered to be in free air. The maximum current carrying for the 1260-21 is 10 A.

- *Max operating current*

  The current the contacts can switch while conducting, without deteriorating. This depends on working conditions, such as dissipated heat, cooling provisions, ambient temperature, insulation material, etc. The maximum operating current for the 1260-21 is 10 A.

- *Recommended continuous current*

The maximum current recommended for indefinitely-long time periods. The primary concern here is the heat generated in the relay. This specification can be applied for normal working conditions. The specification includes a safety margin. However, there are restrictions in the application of the given values. The most important restriction is the cross-sectional area of the connecting wire, insulation temperature range, and wire bundling. The recommended continuous current for the 1260-21 is 10 A.

Installation

To install the 1260-21 Switching Module into a VXI mainframe chassis, engage the printed circuit board into the grooves of the desired chassis slot. Slide the 1260-21 into the chassis until its connector mates with the connector on the chassis backplane. Push firmly to fully seat the connector. Tighten the two retaining screws at the top and bottom of the 1260-21 module.

Chapter 3
MODULE OPERATION

Operating Modes

The 1260-21 may be operated either in *message-based* mode or in *register-based* mode.

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 1260-21 module.

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

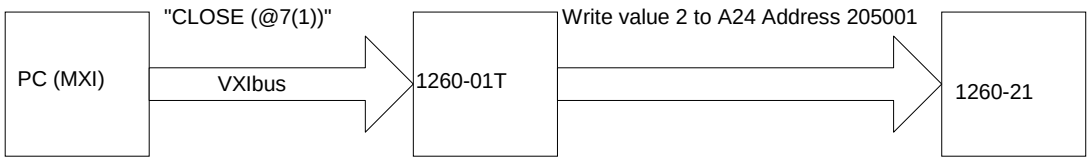


Figure 3-1, Message-Based Mode of Operation

In the *register-based* mode, the user writes directly to the control registers on the 1260-21 module. The 1260-01T command module does not monitor these operations, and does not keep track of the relay states on the 1260-21 module in this mode.

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

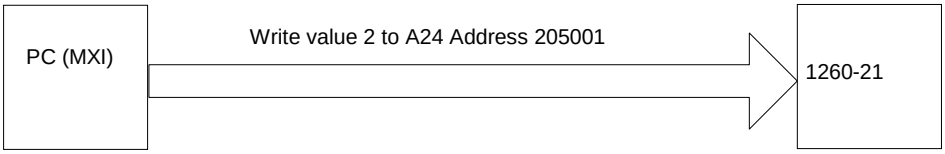


Figure 3-2, Register-Based Mode of Operation

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 Message-Based Mode

Channel Descriptors For The 1260-21

The standard 1260-01T commands are used to operate the 1260-21 module. These commands are described in the 1260-01T User's Manual. **Table 2-1** shows the channel commands for the 1260-21.

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> ) )
```

Where:

<module address> is the address of the 1260-21 module, as set by the logical address DIP switch SW1 on the 1260-21.

The module address is a number from 1 through 12, inclusive.

Set the module addresses for the 1260-21 and other 1260-Series modules so that no address is used by more than one 1260-Series module. For instructions on setting module addresses for a 1260-Series module, see the label on the side panel of the module.

<channel range> ::= <channel number>:<channel number>|
<channel number>,<channel number>|
<channel number>

<Channel number> ::= <Mux><channel>

<Mux> ::= 0 to 11 for 1x2 switches

<channel> ::= 0 or 1 (open or closed) for 1x2 switches

The default state of each 1x2 multiplexer with no relays energized is for channel 0 (of each multiplexer) to be connected to the common.

The following examples illustrate the use of the channel descriptors for 1x2 switches on the 1260-21:

`OPEN (@10(5))`	Open channel 5 on the 1260-21 that has module address 10.
`CLOSE (@10(5,7))`	Close channels 5 and 7 on the 1260-21 that has module address 10.
`CLOSE (@5(5:7))`	Close channels 5 through 7, inclusive, on the 1260-21 that has module address 5.

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 1260-21 is:

```
1260-21 12-CHANNEL SPDT 10A SWITCH
```

So, for a 1260-21 whose <module address> is set to 6, the reply to this query would be:

```
6 : 1260-21 12-CHANNEL SPDT 10A SWITCH
```

Operating The 1260-21 in Register-Based Mode

In register-based mode, the 1260-21 is operated by directly writing to control registers and reading from status registers on the 1260-21 module. There are two control registers and two status registers on the 1260-21 module. Relay Control Registers 0 control 8 1x2 switches. Relay Control Registers 1 control another four 1x2 switches. When a control register is written to, all channels controlled by that register are operated simultaneously. Writing a ‘1’ to the register bit will activate the relay coil and put it into the NO position. Writing a ‘0’ to the register bit will deactivate the relay coil and put it back into the NC position. Default value for all control registers is hex ‘00’ after reset.

The status registers contain the Read Back bits from the coil voltage. The 1x2 switches require only one status bit each. Refer to **Figure 3-3** for the relay order that comprises 1x2 switches.

The Read Back status reads the coil value for each relay inverted. When the relay coil is deactivated by setting the relay control bit to '0' (switch is in the Normally Closed position) the Read Back bit is '1'. When the relay coil is activated by setting the relay control bit to '1' (switch is in the Normally Open position) the Read Back bit is '0'.

The control registers are located in the VXI bus 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 VXI bus 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 1260-21 module. This is a value in the range 1 through 12.

3. Each control register/status register on the 1260-21 has a unique address.

The base A24 address for the 1260-21 module may be calculated by:

(A24 Offset of Option-01T) + (1024 x Module Address of 1260-21).

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

A 1260-21 with a module address of 6 would have the base A24 address computed as follows:

Base A24 Address of 1260-21 = 204000_{16} + (400_{16} x 6_{10})
= 205800_{16}

The control registers for 1260-Series VXI modules are always on odd-numbered A24 addresses. The two control registers for the 1260-21 reside at the first two odd-numbered A24 addresses for the module:

(Base A24 Address of 1260-21) + 1 = Control Reg. 0

(Base A24 Address of 1260-21) + 3 = Control Reg. 1

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

205801 Control Register 0

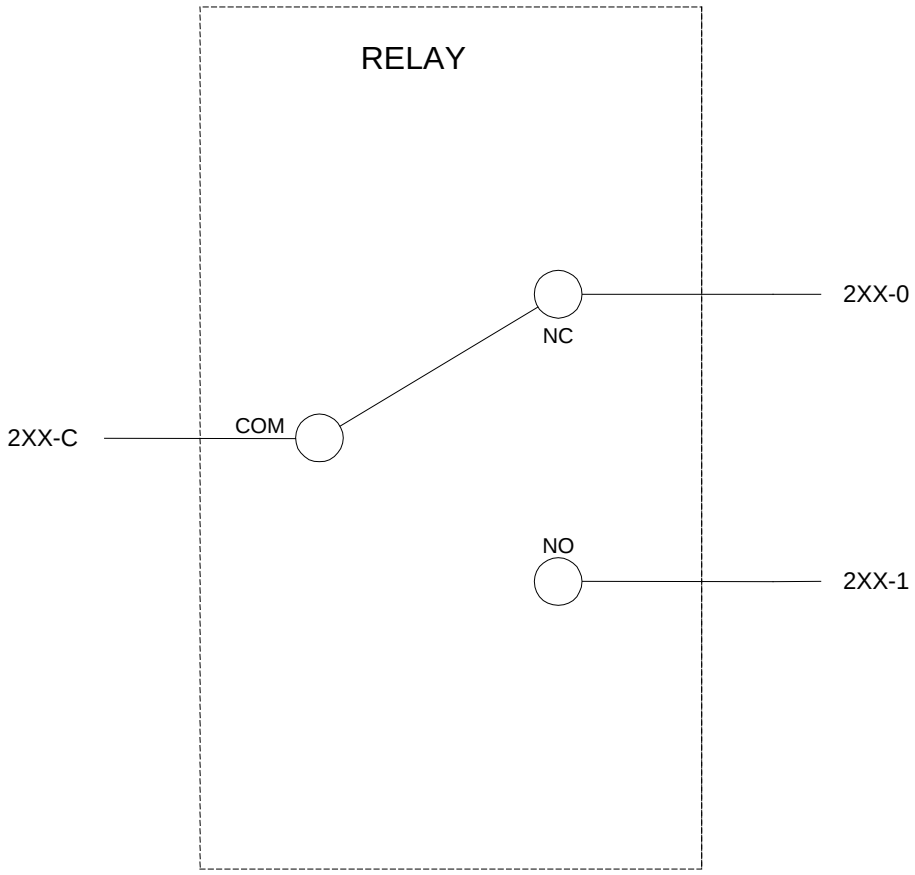
205803 Control Register 1

Refer to **Figure 3-3** for 1x2 channel nomenclature when determining channel assignments.

Table 3-1 shows the channel assignments for each control register while **Table 3-2** shows the channel assignments for each status register. **Table 3-3** shows the register values for programming the 1260-21 module.

Relay Nodes for Path Reference

2XX-Y Where:
2 = 1x2 Mux
XX = Switch
Y = Relay Node (C for COM)



Relay Nomenclature for Command Writes

2XXRY Where:
2 = 1x2 Mux
XX = Switch
R = Relay
Y = Relay # within Switch

Relay Nomenclature for Status Reads

2XXRY-ZZ Where:
2 = 1x2 Mux
XX = Switch
R = Relay
Y = Relay # within Switch
ZZ = NC or NO

Figure 3-3, 1X2 Switch

Table 3-1, Control Register Channel Assignments

Control Register	Channels							
	Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
0	Switch 7 Relay 0 (207R0)	Switch 6 Relay 0 (206R0)	Switch 5 Relay 0 (205R0)	Switch 4 Relay 0 (204R0)	Switch 3 Relay 0 (203R0)	Switch 2 Relay 0 (202R0)	Switch 1 Relay 0 (201R0)	Switch 0 Relay 0 (200R0)
1	X	X	X	X	Switch 11 Relay 0 (211R0)	Switch 10 Relay 0 (210R0)	Switch 9 Relay 0 (209R0)	Switch 8 Relay 0 (208R0)

Table 3-2, Status Register Channel Assignments

Control Register	Channels							
	Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
0	Switch 7 Relay 0 (207R0)	Switch 6 Relay 0 (206R0)	Switch 5 Relay 0 (205R0)	Switch 4 Relay 0 (204R0)	Switch 3 Relay 0 (203R0)	Switch 2 Relay 0 (202R0)	Switch 1 Relay 0 (201R0)	Switch 0 Relay 0 (200R0)
1	X	X	X	X	Switch 11 Relay 0 (211R0)	Switch 10 Relay 0 (210R0)	Switch 9 Relay 0 (209R0)	Switch 8 Relay 0 (208R0)

Table 3-3, Registers Values

Channel #	Switch #	Channel Path		Write (Command)		Read (Status)		Refer to Figure
		From	To	Reg. #	Value (Hex)	Reg. #	Value (Binary)	
0	0	200-C	200-0	0	xxxxxxx0	0	xxxxxxx1	3-3
0	0	200-C	200-1	0	xxxxxxx1	0	xxxxxxx0	3-3
1	1	201-C	201-0	0	xxxxxx0x	0	xxxxxx1x	3-3
1	1	201-C	201-1	0	xxxxxx1x	0	xxxxxx0x	3-3
2	2	202-C	202-0	0	xxxxx0xx	0	xxxxx1xx	3-3
2	2	202-C	202-1	0	xxxxx1xx	0	xxxxx0xx	3-3
3	3	203-C	203-0	0	xxxx0xxx	0	xxxx1xxx	3-3
3	3	203-C	203-1	0	xxxx1xxx	0	xxxx0xxx	3-3
4	4	204-C	204-0	0	xxx0xxxx	0	xxx1xxxx	3-3
4	4	204-C	204-1	0	xxx1xxxx	0	xxx0xxxx	3-3
5	5	205-C	205-0	0	xx0xxxxx	0	xx1xxxxx	3-3
5	5	205-C	205-1	0	xx1xxxxx	0	xx0xxxxx	3-3
6	6	206-C	206-0	0	x0xxxxxx	0	x1xxxxxx	3-3
6	6	206-C	206-1	0	x1xxxxxx	0	x0xxxxxx	3-3
7	7	207-C	207-0	0	0xxxxxxx	0	1xxxxxxx	3-3
7	7	207-C	207-1	0	1xxxxxxx	0	0xxxxxxx	3-3
8	8	208-C	208-0	1	xxxxxxx0	1	xxxxxxx1	3-3
8	8	208-C	208-1	1	xxxxxxx1	1	xxxxxxx0	3-3
9	9	209-C	209-0	1	xxxxxx0x	1	xxxxxx1x	3-3
9	9	209-C	209-1	1	xxxxxx1x	1	xxxxxx0x	3-3
10	10	210-C	210-0	1	xxxxx0xx	1	xxxxx1xx	3-3
10	10	210-C	210-1	1	xxxxx1xx	1	xxxxx0xx	3-3
11	11	211-C	211-0	1	xxxx0xxx	1	xxxx1xxx	3-3
11	11	211-C	211-1	1	xxxx1xxx	1	xxxx0xxx	3-3

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