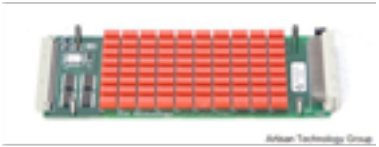
VXI Technology SM5001

SPST General Purpose Relay SMIP Module



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Switch Modularity & Interface Platform (SMIP™) Reduces the Size and Cost of ATE

Overview

There are many different types of Automated Test Equipment (ATE) systems available to help manufacturers improve production quality and throughput. Although these test stations are used in different applications, they all share one common denominator - a signal switching system - that directs the 'input/output traffic' between the test stand instrumentation and the devices being tested.

The budget allocated to ATE for manufacturing test, or even for service and repair, is considered part of the overhead in bringing the final product to market. Reducing this cost, therefore, is an important consideration. The goal of meeting the budget can be achieved by decreasing the purchase price of the ATE station, or increasing its throughput (i.e., increase the number of units being tested per day).

With advancements in technology and competitive constraints increasing, the need to drive overhead costs down has intensified. Modular high-density VXIbus instruments such as the VMIP™ family have helped improve the size, cost and throughput of VXIbus systems with virtually every new test station being designed today utilizing modular VXIbus instruments. The SMIP™ family switching system has leveraged off this trend in modular instruments continuing to improve the cost/benefit ratio of the production test cycle.

The Advantages of "Next Generation" Signal Switching (SMIP™ Series)

Reduced System Size and Cost - Density and Modularity

There are numerous standards and platforms for ATE equipment, and price and performance are key factors in determining the correct platform for the application. Whenever a large amount of signal switching is required in an ATE system, VXIbus always makes cost-effective sense, and in many cases helps justify the decision to select a VXIbus system. While first generation VXI products had made very real and measurable improvements in ATE signal switching, the "next generation" of signal switching systems driven by the SMIP™ series is vaulting the VXIbus to a higher level in terms of performance, density and value.

First generation VXIbus switch cards contain one switch configuration per card slot (e.g., 32 SPDT, 64x1 2-wire scanner, 4x64 matrix), very similar to first generation VXIbus instruments. These switch systems are typically GPIB/VME-based products converted over to the VXIbus. The SMIP™ series is designed exclusively for the VXIbus, and takes advantage of the recent advancements in relay and driver technology, providing higher performing switches in a smaller footprint.

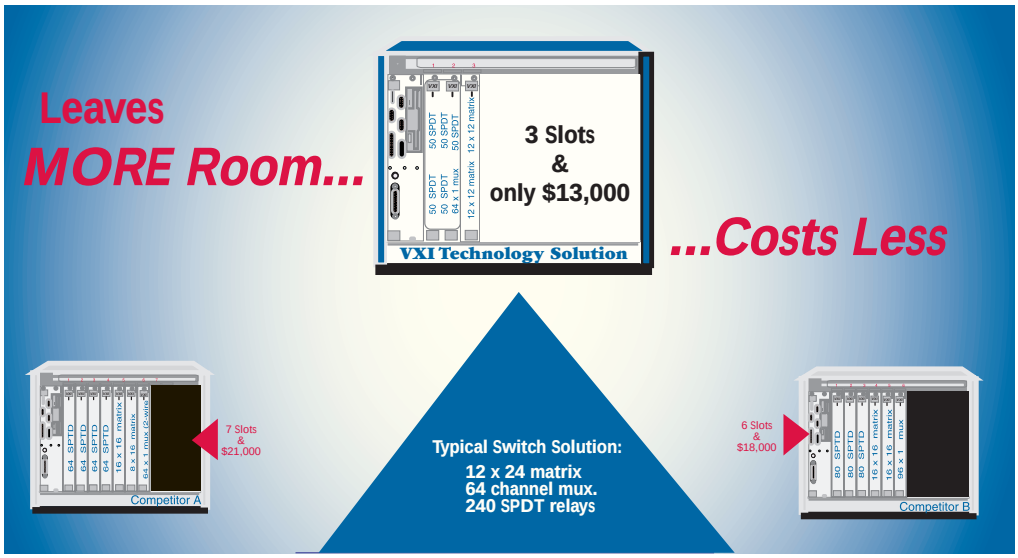

Figure 1

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The SMIP™ family provides a level of modularity and density that is unfamiliar in first generation VXIbus cards, and reduces the number of slots used in a VXIbus mainframe.

A recent application testing engine control modules called for the following switch requirements and demonstrates the size and cost advantages of the SMIP™ family, compared to first generation VXIbus switch systems from other manufacturers:

- **12x24 matrix to connect engine control module I/O to test station**
- **64-channel multiplexer connecting DMM to multiple measurement points**
- **240 Form C Relays for high-density general purpose switching**

The three VXIbus switch systems proposed are detailed in Figure 1. The 'first generation' system occupies seven slots, whereas the modular switch system (SMIP™) occupies only three.

The SMIP™ was selected because an additional four slots were freed up for instrumentation purposes, and also because the switches are rated for 2A as opposed to 1A for the switches in the first generation system. Additionally, this system could have been reduced to a six-slot mainframe, had portability been an issue. Subsequent hardware costs are considerably reduced (30-40%) because the modular system utilizes shared resources (i.e., connectors, VXIbus interface, sheet metal, etc.).

Improved Throughput and Performance

The VXIbus offers tremendous advantages in reducing test cycle times because the instruments and switches share a common backplane. The VXI specification reserves eight lines dedicated to triggering back and forth between instruments. VXI switch cards that utilize scan lists (a sequence of relay states) can then be triggered to advance through this list by an instrument on the bus.

For example, test specifications of a device often require the verification of continuity or isolation between connector pins. A DMM is most often the instrument used to verify the results. The continuity/isolation test can involve a large number of pins. Thus, the DMM needs to be switched to a connector pair and take its measurement before moving to the next pair. This sequence of events can take a significant amount of time, due to the overhead in handshaking between the DMM and the switch card, particularly if pre-programmed scan lists are not utilized. By utilizing a VXI-based card with a scan list, all handshaking can be done across the backplane, and since the scan list is stored in memory, no software overhead is incurred. Large channel counts can be scanned in a fraction of the time through the use of on-board scan lists.

GPIB and first generation VXI-based switch cards implement scan list capabilities in a couple of different ways. A GPIB switch or message-based switch card requires an 'intelligent interpreter' that usually takes the form of a plug-in card. Scan lists are stored on this card and message-based commands are parsed by the interpreter. Traditional register-based switch cards must have a driver downloaded to the slot 0 controller and this driver acts as the interpreter. In both cases, ASCII strings (messages) are sent via the host controller to set up the switch card and scan list. There is also a relatively substantial amount of latency between the time a trigger is received by the switch card and the time that the card issues a trigger to the backplane indicating that the relays have settled (10-40ms).

The SMIP™ series builds the intelligence (scan lists) into the hardware registers. The time delta between TTL trigger in (command to close the relays) and TTL trigger out (indicating relays have settled) is effectively reduced to the settling time of the relay itself (about 3-5 ms). An excellent example highlighting the effectiveness of this technique was demonstrated by a defense contractor exercising a missile simulator (See Figure 2). Stimulus is applied to the launch sequencer via a Form C switch. The launch sequencer replies with an 'initiate fire ready' command and the stimulus must be removed to ground within 10 ms. The only viable solution was to use a switch card with its scan list and control built into the hardware, as the latency times were well within the window of acceptance. The switch card selected in this case was

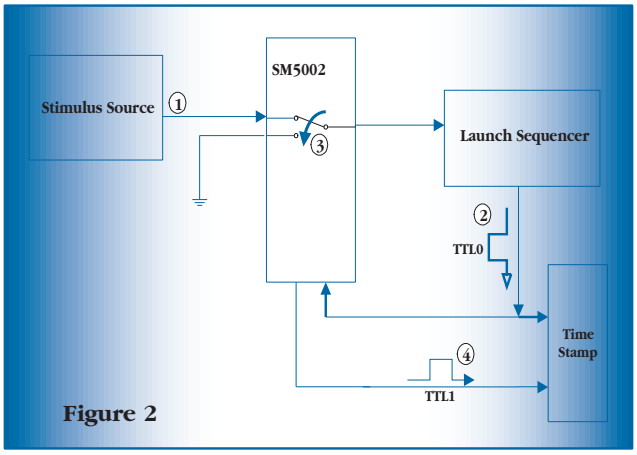

Figure 2

VXI Technology's SM5002.
(1) Stimulus is applied to the sequencer via the normally closed contact of a Form C relay on an SM5002 card.
(2) The sequencer processes the data and issues an 'initiate fire' command, sending out a pulse on TTL0 of the VXI backplane. The Time Stamp module records TTL0 pulse as t0.
(3) The SM5002 also detects the pulse on TTL0 and the relay changes state.
(4) The SM5002 issues a 'relay settled' pulse on TTL1, which the Time Stamp records at t1. Dt (t1-t0) needed to be less than 10 ms to meet specification for this application (verified to be under 3ms).

This was compared to a Dt of over 40ms from a switch module that used an intelligent interpreter plug-on card.

Conclusion

In the past decade, VXIbus switching systems have grown to become a significant part of Automated Test Equipment because of the ability to fit a large number of switches on a card. But test instrumentation consumers are continually demanding product that is faster, smaller and less expensive. Innovative hardware designs greatly ease the burden placed on production engineers by cutting down on test cycle time, and further reducing hardware costs. The SMIP™ series is leading the way to meet the expectations of customers by taking advantage of the latest relay technology yielding higher performing switches in a smaller footprint. Modular switch cards provide the systems engineer the flexibility to design a system that optimizes space while keeping down the overall price.

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SMIP™ Contents

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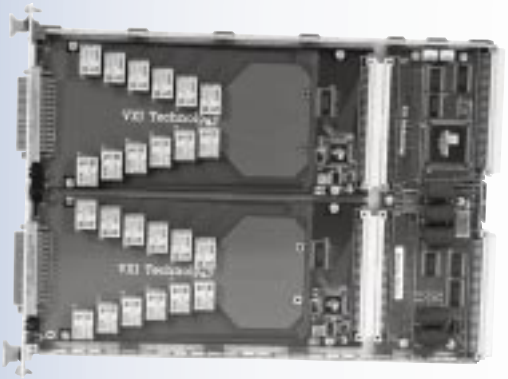
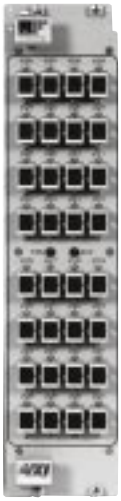
Switch Modularity & Interface Platform (SMIP™)

SM1000B shown with 6 high density switch modules

SM7000 shown with microwave building blocks



SM1000A shown with 2 power modules



SM8000 shown with optical switches

- **The only switch family on the market offering signal switching "From DC to Light"!**
- **Modular building blocks in each frequency range allow flexibility and increased density**
- **Designed to offer the switching features of VXI message-based systems, with the throughput of register-based systems**
- **Extensive non-volatile memory allows storage of data such as module serial numbers, maintenance dates, plus more**
- **VXI*plug&play* drivers and logical relay mapping ease programming**
- **Built-in scan lists with 1Mbyte deep pattern memory, make-before-break (MBB) and break-before-make (BBM) features, extensive triggering and failure interrupts as well as other features are all implemented in hardware, significantly improving overall system throughput**
- **Designed to reduce the size by at least 30%, and the cost by at least 20% from previously available switching solutions**

Overview

The SMIP™ is designed with modularity, density and cost in mind. Unlike "first generation" VXIbus switching solutions, the SMIP™ family consists of switch modules that can be mixed and combined within a VXIbus card to form flexible and high-density switch configurations. The SMIP™ family reduces the size of switching solutions by at least 30%, and the overall cost by at least 20% compared to solutions from other manufacturers - regardless of their platform (GPIB, VME, VXI or PC).

Each SMIP™ base unit includes a switch control interface board, which has one of the most advanced switch control designs on the market. The interface has been designed to provide all the features of an intelligent message-based switching system, but with the speed and flexibility of a register-based device. These features are achieved in hardware on the control interface board, rather than in a driver or via on-board microprocessor based firmware. This approach to the interface design guarantees the user that all communications to the switch occur in microseconds, as opposed to several milliseconds, considerably improving system throughput.

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Switch Modularity & Interface Platform (SMIP™)

The advanced register-based interface design allows new switching modules to be introduced into the product family without the need to reprogram EEPROMs or exchange control modules, as is common with other switching systems.

The SMIP™ interface supports direct register control of all relays, the ability to download scan lists with backplane trigger advance, and hardware implemented break-before-make and make-before-break switching. By using direct register access, switching speeds are maximized while keeping VXIbus backplane traffic to a minimum. By using the trigger feature, large switching systems across multiple mainframes can be controlled with a single command.

The supplied VXI*plug&play* drivers provide support for higher level commands and a unified switch interface.

Signal Integrity

All SMIP™ switch modules have been designed with over a decade of experience in signal switch design and are optimized to preserve signal integrity. All switch modules employ multi-layer PCB designs with extensive ground planes and shielding where appropriate, with relays also being selected to maximize signal integrity. Signal ground planes are isolated from the control circuit grounds, and signal paths are designed to minimize crosstalk between channels. To further minimize any digital noise, the control circuitry goes into a quiescent state when not processing commands, making it possible to switch low-level signals. Mating connector shrouds are also available to permit cable harnesses to be crimped, soldered or connected via terminal blocks, so the user can select the best method of cabling for the application.

Programming

The SMIP™ family of switch modules is programmed using direct register access for fast data throughput and boasts the following features for easy programming and integrating of the SMIP™ family:

Automatic Scanning: A predefined sequence of channels or set-ups can be programmed into 1 Mbyte of RAM, and can be incremented by software or hardware trigger sources. This approach relieves the host controller from having to tie up the VXIbus backplane when scanning.

Programmable Timing Delays: A delay can be programmed between relay closures to allow for settling times of other system resources. When used with triggers and automatic scanning, a controlled synchronous switching system can easily be configured.

Confidence Checking: Internal feedback provides confidence of relay closures.

Extensive Triggering: Triggers can be generated when a relay closes and settles, and programmed relays can be actuated upon receipt of a trigger to allow for synchronization between other devices. Since trigger management is performed in hardware, triggers command a relay to open or close within microseconds, as opposed to several milliseconds from other competing systems that support triggers.

Make-Before-Break and Break-Before-Make: Relay control implemented in hardware eases software burden, and considerably improves system throughput.

Safety Interrupt: This is a programmable fail-safe feature that allows all relays to open based upon external or TTL backplane triggers. Signals can be removed from the unit under test if a system fail-safe occurs, such as inadvertent removal of a test adapter.

Non-volatile Memory: Allows users to store pertinent information such as maintenance records, relay specs, installation dates, serial numbers and last user's id.

The SMIP™ family is comprised of three distinct switching groups divided by frequency range. Each switching group has its own base units designed to maximize the modularity and flexibility of switching within that frequency range. Switch control and programming features remain consistent with the overall SMIP™ family.

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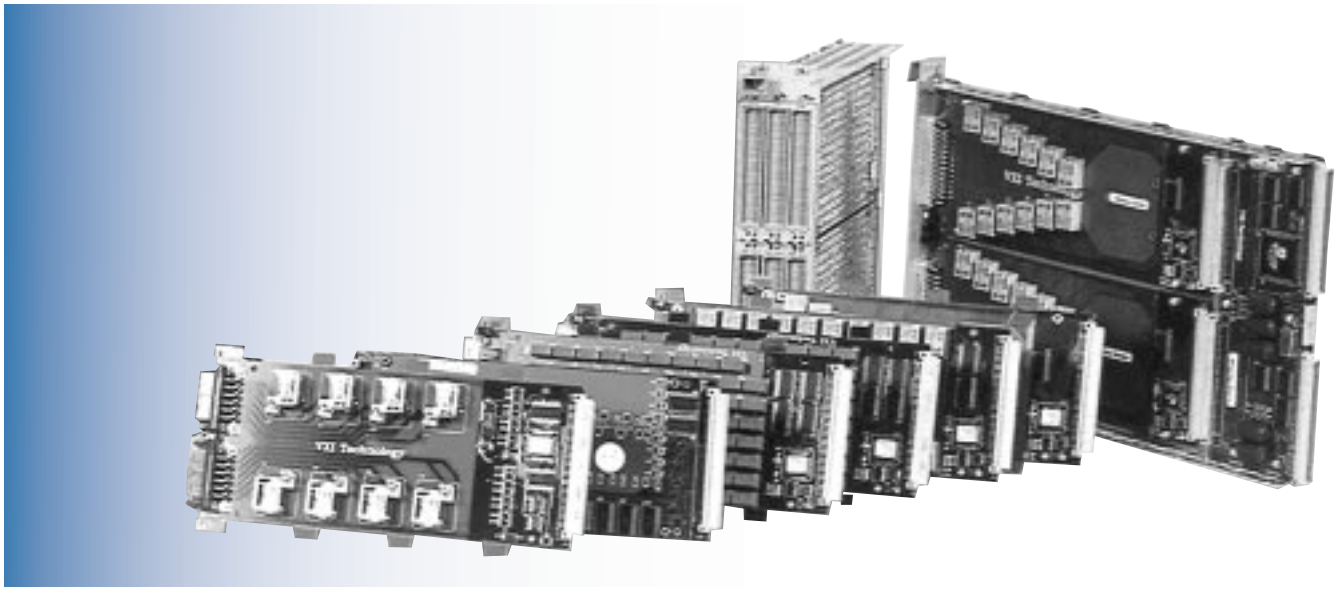
Signal Switching DC to RF



Step 1: Start with the SM1000A single-wide or SM1000B double-wide base unit.

Step 2: Select up to two switch modules for the SM1000A, or up to six for the SM1000B. Different switch modules can be mixed and matched within the SM1000A and SM1000B, i.e., RF, matrices, power, multiplexers and general purpose switches can all be mixed together.

Step 3: Select the appropriate mating connectors.

Step 4: Contact VXI Technology for price and delivery.

Overview

The base units for signal switching in frequency ranges under 1GHz consist of the SM1000A single-slot base unit and the SM1000B double-slot base unit. The SM1000A can house up to two high-density switch modules, and the SM1000B can house up to six high-density switch modules.

Switch modules can be mixed and matched for flexibility and density. For example, scanners, multiplexers, power, general-purpose switches and RF cards can all be housed in a double-slot VXIbus card. Also a 1 x 768 one-wire multiplexer can be accommodated in a double-slot VXIbus card (SM1000B).

The switch modules for this SMIP™ group are further broken down into:

- **Power (switching greater than 2A)**
- **Matrices**
- **Multiplexers/scanners**
- **General purpose**
- **RF**

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VXI Technology™

Product Brief

SM2001A 20 SPST 16 Amp Power Switch or 10 DPST 16 Amp Power Switch and SM2002A 12 SPDT 16 Amp Power Switch

- **Large Switching Capacity in a Small Footprint**
- **High Breakdown Voltage (1,000 Vrms between open contacts)**
- **Ideal for Switching AC or DC Power Supplies and Current Sources**
- **Fail-safe Interrupt Input on Front Panels for Emergency Safety Conditions**

SM2001A
1 of 20 SPST

SM2002A
1 of 12 SPDT

Overview

The SM2001A and SM2002A 16A switch modules are the first to break the 13A switching barrier found on other VXI power switching cards. Up to 120 16A SPST or 72 SPDT relays can be accommodated in two VXIbus card slots for maximum density, or mixed and matched with other SMIP™ cards for flexibility. Some applications include: AC line power switching, switching of DC or AC power supplies, control or driving relays for industrial machines (robotics, numerical control machines), automotive engine control, and solenoid switching.

All relays are driven from the VXIbus +5V supply line since VXIbus mainframes always have ample current capability on this supply line, as opposed to the +24 or +12V supply lines. Since these modules typically switch power to the UUT or interface, a fail-safe interrupt input line is provided on the front panel that can open all relays automatically if a safety condition occurs. This approach instantly removes all power to the UUT or interface.

Specifications

Maximum Switching Voltage: 250VAC 125VDC

Maximum Switching Current: 16A

Maximum Switching Power: 300WDC, 2000 VA per channel
25K Watts per switch module

Path Resistance: <100mΩ

Insulation Resistance: >10e9Ω

Maximum Thermal Offset Per Channel (HI-LO): <50µV

Capacitance:

Open Channel:	<20pF
Channel-Mainframe:	<20pF
High-Low:	<50pF

Bandwidth (-3dB): >20MHz bandwidth

Insertion Loss:

100kHz:	<0.2dB
1MHz:	<0.5dB
10MHz:	<1.0dB

Crosstalk:

100kHz:	<-75dB
1MHz:	<-50dB
10MHz:	<-40dB

Rated Switch Operations:

Mechanical:	1×10^7
Electrical:	1×10^5 at full load

Switching Time: <10mS

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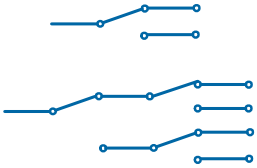
SM2003 8 SPDT 20 Amp Power Switch and SM2004 12 SPST 20 Amp Power Switch SM2005 3 SPDT and 3 SP4T Power Switch

- **High Switching Capacity**
- **High Breakdown Voltage (1,500 Vrms between open contacts)**
- **Ideal for Switching AC or DC Power Supplies and High Current Sources**

SM2004
1 of 12 SPST

SM2003
1 of 8 SPDT



SM2005
1 of 3 SPDT
1 of 3 SP4T

Overview

The SM2003, SM2004 and SM2005 20A switch modules are designed for heavy-duty power switching requirements. These modules are ideal for automating the signal switching and testing of motors, ballasts, or simple high-power AC or DC signal devices. Some useful applications for the SM2003, SM2004 and SM2005 include automotive, home appliance, and large ATE systems. Since large power relays are used, these modules can only be configured in the SM1000A, but they may be mixed and matched with other modules. All SMIP™ family modules can utilize the VXIbus TTL trigger lines to provide a fail-safe interrupt feature.

Specifications

Maximum Switching Voltage:	270VAC, 220VDC
Maximum Switching Current:	20A
Maximum Switching Power:	600WDC, 5400 VA
Path Resistance:	<100mΩ
Insulation Resistance:	>10e7Ω

Capacitance:

Open Channel:	<20pF
Channel-Mainframe:	<20pF
High-Low:	<50pF

Bandwidth (-3dB):	>20MHz bandwidth

Insertion Loss:

100kHz:	<0.2dB
1MHz:	<0.5dB
10MHz:	<1.0dB

Crosstalk:

100kHz:	<-75dB
1MHz:	<-50dB
10MHz:	<-40dB

Rated Switch Operations:

Mechanical:	1×10^7
Electrical:	1×10^5 at full load

Switching Time:	<15mS
Power, Cooling and Weight:	See page 6

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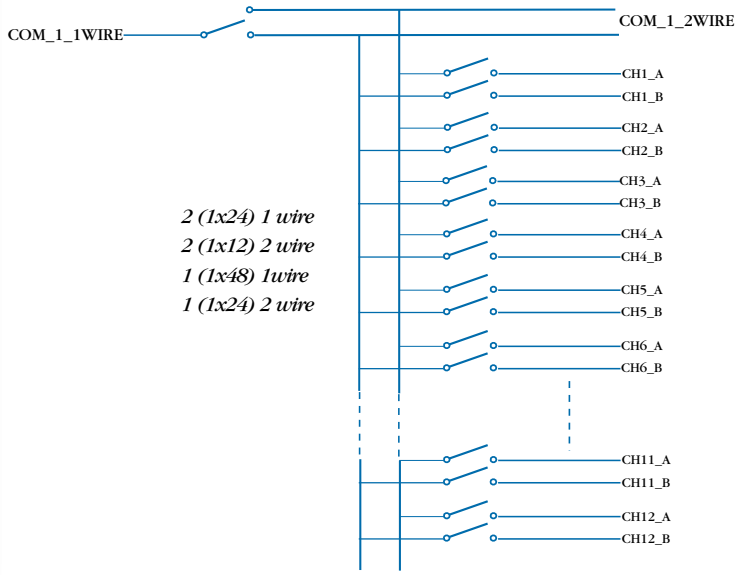
VXI Technology™

Product Brief

SM2007 1x48 High-voltage Multiplexer

- **High-density, High-voltage Multiplexer/Scanner (1x288 in a VXI Double-slot)**
- **Built-in Configuration Relays Expand the 1x24 Multiplexer Building Blocks**
- **Ideal for Hipot, Cable Breakdown, Source-Measure-Unit and Power Supply Switching**
- **Extensive Signal Shielding Employed on PCBs for Excellent Signal Fidelity**
- **Break-Before-Make (BBM) and Make-Before-Break (MBB) Accomplished in Hardware, Considerably Improving Scanning Time**



Overview

The SM2007 is designed for scanning high-voltage multiple points to a common bus in either 1- or 2-wire configurations, either synchronously with an instrument (i.e., using triggers), or asynchronously with individual relay control. Up to 144 2-wire (or 288 1-wire) channels can be accommodated in a double-slot VXIbus card (SM1000B) for maximum density, or mixed and matched with other SMIP™ cards for flexibility. Applications include Hipot or cable breakdown testing.

When switching high voltages, the need for signal shielding becomes critical. The SM2007 has been designed to include large shield planes to improve crosstalk and voltage spikes to adjacent channels.

For ATE applications, such as switching high-voltage source measure units or power supplies, a fail-safe interrupt line is provided on the front panel. This can open all relays automatically if a safety condition occurs. This approach instantly removes all high voltages to the UUT or interface.

The SM2007 consists of 2 individual (1x12) 2-wire multiplexers, or 2 (1x24) 1-wire multiplexers that can be interconnected under program control (via the bussing relays) to configure larger multiplexers as required. This eliminates external wiring and helps reduce unterminated stubs. All relays are also driven from the VXIbus +5V supply line, since VXIbus mainframes always have ample current capacity on this supply line, as opposed to the +24 or +12V supply lines.

Specifications

Maximum Switching Voltage: 500 VDC

Maximum Switching Current: 1A

Maximum Carry Current: 2A

Maximum Switching Power: 25 WDC

Path Resistance: < 1Ω (Resistive Load)

Insulation Resistance: >10e7Ω

Bandwidth (-3dB): >20MHz bandwidth

Rated Switch Operations:

Mechanical:	100×10^6
Electrical:	1×10^6 at full load

Switching Time: <1mS

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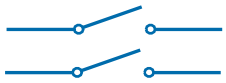
VXI Technology™

Product Brief

SM2008 16 DPST 500V High-voltage Switch and SM2009 16 SPDT 500V High-voltage Switch

- **Large Switching Capacity in a Small Footprint**
- **High Breakdown Voltage (2,000 Vrms between open contacts)**
- **Shielded Coaxial Signal Paths Improve Signal Integrity**
- **75 Ohm Impedance for Communications Applications**
- **Fail-safe Interrupt Input on Front Panels for Emergency Safety Conditions**



SM2008
1 of 16 DPST

SM2009
1 of 16 SPDT

Overview

The SM2008 and SM2009 have been designed for applications requiring high-voltage signal switching. These modules have also been designed with controlled 75 ohm shielded signal paths. This approach improves signal shielding, while making these modules ideal for switching CATV and other communication signals.

Up to 96 500V DPST or SPDT relays can be accommodated in two VXIbus card slots for maximum density, or mixed and matched with other SMIP™ cards for flexibility.

All relays are driven from the VXIbus +5V supply line since VXIbus mainframes always have ample current capability on this supply line, as opposed to the +24 or +12V supply lines. Since these modules typically switch high voltage to the UUT or interface, a fail-safe interrupt input line is provided on the front panel that can open all relays automatically if a safety condition occurs. This approach instantly removes all power to the UUT or interface.

Specifications

Maximum Switching Voltage: 500VDC

Maximum Switching Current: 1A

Maximum Carry Current: 2A

Maximum Switching Power: 25W (Resistive Load)

Path Resistance: <1Ω

Bandwidth (-3dB): >50 MHz bandwidth

Rated Switch Operations:

Mechanical:	100×10^6
Electrical:	1×10^6 at full load

Switching Time: <1mS

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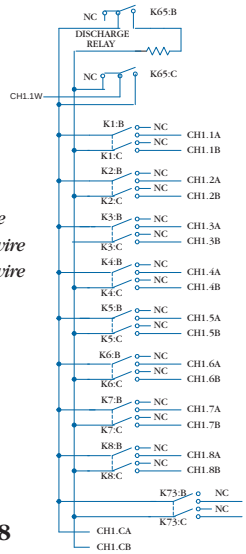
SM3001 Multiplexer

- **High-density Multiplexing/Scanning (1x768 in a VXI Double-slot)**
- **Built-in Configuration Relays Expand the 1x16 Multiplexer Building Blocks**
- **Internal Capacitive Discharge Relays keep High Voltages from Disturbing Sensitive Measurement Points**
- **Extensive Signal Shielding Employed on PCBs for Excellent Signal Fidelity**
- **Break-Before-Make (BBM) and Make-Before-Break (MBB) Accomplished in Hardware, Considerably Improving Scanning Time**

4 (1x8) 4 wire; 8 (1x8) 2 wire; 8 (1x16) 1 wire
2 (1x16) 4 wire; 4 (1x16) 2 wire; 4 (1x32) 1 wire
1 (1x32) 4 wire; 2 (1x32) 2 wire; 2 (1x64) 1 wire
1 (1x64) 2 wire; 1(1x128) 1 wire



1 of 8

SM3001

Overview

The SM3001 high-density multiplexer module is designed for scanning of multiple points to a common bus, in either 1- 2- or 4-wire configurations, either synchronously with an instrument (i.e., using triggers), or asynchronously with individual relay control. Up to 384 2-wire (or 768 1-wire) channels can be accommodated in a double-slot VXIbus card (SM1000B) for maximum density, or mixed and matched with other SMIP™ cards for flexibility. Applications include cable harness testing, semiconductor and PCB testing, or applications where multiple points need to be switched to a common resource. All relays also have individual relay control, and each path allows for 2A switching. The SM3001 consists of 8 individual (1x8) 2-wire multiplexers, or 8 (1x16) 1-wire multiplexers that can be interconnected under program control (via the bussing relays) to configure larger multiplexers as required. This eliminates external wiring and helps reduce unterminated stubs. All relays are also driven from the VXIbus +5V supply line, since VXIbus mainframes always have ample current capacity on this supply line, as opposed to the +24 or +12V supply lines.

Internal residual voltage discharge relays can be enabled to momentarily short out the measurement path when changing from one input channel to the next. This dissipates any voltage held by the wiring and instrument input capacitance. These relays protect sensitive devices, such as CMOS circuits, from residual voltages caused by previous high-voltage measurements. This feature can also be disabled in low-voltage applications where maximum throughput speed is important.

Specifications

Maximum Switching Voltage: 300VAC, 300VDC
Maximum Switching Current: 2A

Maximum Switching Power: 60WDC, 125 VA
Path Resistance: < 500mΩ
Insulation Resistance: >10e9Ω
Maximum Thermal Offset Per Channel (HI-LO): <7µV
Capacitance:

Open Channel:	<50pF
Channel-Mainframe:	<20pF
High-Low:	<50pF

Bandwidth (-3dB): >40MHz bandwidth

Insertion Loss:

100kHz:	<0.1dB
1MHz:	<0.2dB
10MHz:	<1.0dB

Crosstalk:

100kHz:	<-90dB
1MHz:	<-70dB
10MHz:	<-50dB

Isolation:

100kHz:	<-90dB
1MHz:	<-70dB
10MHz:	<-60dB

Rated Switch Operations:

Mechanical:	1×10^7
Electrical:	5×10^5 at full load

Switching Time: <3mS

Power, Cooling and Weight: See page 6

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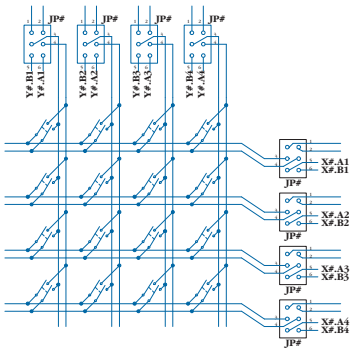
Matrix Switching
SM4001/SM4002/SM4003/SM4004
SM4005/SM4006/SM4007/SM4001-S-xxxx

- **Highest Density 2-wire Matrix Available on the Market (4x216 in 2 VXIbus Slots)**
- **Extensive Signal Shielding Employed on PCBs for Excellent Signal Fidelity**
- **Matrices Built up Using 4x4 Building Blocks for Configuration Flexibility**
- **2A Switching per Path**



SM4001	9 (4x4) 2-Wire Matrices, 2A per Channel
SM4002	1 (4x36) 2-Wire Matrix, 2A per Channel
SM4003	2 (4x16) 2-Wire and 1 (4x4) 2-Wire Matrices, 2A per Channel
SM4004	1 (8x16) 2-Wire and 1 (4x4) 2-Wire Matrices, 2A per Channel
SM4005	1 (12x12) 2-Wire Matrix, 2A per Channel
SM4006	3 (4x12) 2-Wire Matrices, 2A per Channel
SM4007	2 (8x8) 2-Wire Matrices, 2A per Channel
SM4001-S-xxxx	User-defined Matrix, Built from 9 (4x4) Matrices

Overview

The SM4000 series high-density matrix modules are designed for applications that require a true non-blocking matrix, where the user has the ability to connect any row to any column. The smallest building block is a (4x4) 2-wire matrix, and rows and columns can easily be expanded to form larger matrices. A (4x216) 2-wire matrix can be accommodated in a double-slot VXIbus card (SM1000B) for maximum density or mixed and matched with other SMIP™ cards for flexibility. All relays also have individual relay control allowing multiple inputs to be connected to multiple outputs, with each path allowing for 2A switching.

Various configurations are shipped from the factory, and the user also has the capability to define a custom configuration using the available 9 (4x4) building blocks.

Complete block diagrams for each configuration can be found in the SMIP™ manual.

Specifications

Maximum Switching Voltage:	300VAC, 300VDC
Maximum Switching Current:	2A
Maximum Switching Power:	60WDC, 125 VA
Path Resistance:	<500mΩ
Insulation Resistance:	>10e9Ω
Maximum Thermal Offset per Channel (HI-LO):	<7µV
Capacitance:	
Open Channel:	<50pF
Channel-Mainframe:	<80pF
High-Low:	<50pF
Bandwidth (-3dB):	>40MHz bandwidth
Insertion Loss:	
100kHz:	<0.1dB
1MHz:	<0.2dB
10MHz:	<1.0dB
Crosstalk:	
100kHz:	<-80dB
1MHz:	<-50dB
10MHz:	<-30dB
Isolation:	
100kHz:	<-80dB
1MHz:	<-60dB
10MHz:	<-30dB
Rated Switch Operations:	
Mechanical:	1×10^7
Electrical:	5×10^5 at full load
Switching Time:	<3mS
Power, Cooling and Weight:	See page 6

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General Purpose Relays
SM5001 80 SPST Relays 2A per Channel
SM5002 50 SPDT Relays 2A per Channel
SM5003 26 SP4T Relays 2A per Channel

- **High Channel Counts - up to 480 SPST Relays in Two VXIbus Card Slots**
- **Can be Mixed and Matched to Create Application Specific Configurations**
- **Ideal for General Purpose Switching**
- **SPST Relays can be Paired to Configure 40 DPST Relays per SM5001**
- **SPDT Relays can be Paired to Configure 25 DPDT Relays per SM5002**

SM5001
1 of 80 SPST

SM5002
1 of 50 SPDT

SM5003
1 of 26 SP4T

Overview

These high-density basic switch modules are designed for general purpose switching where individual relays can be used to route signals to/from the units under test (UUT), or combined externally to form user-defined configurations. The latter approach allows the same switch module to be used for testing multiple UUTs by simply changing the configuration within a UUT-specific external adapter. Up to 480 individual SPST relays, 300 individual SPDT, or 156 SP4T relays can be accommodated in a double-slot VXIbus card (SM1000B) for maximum density, or mixed and matched with other SMIP™ cards for flexibility.

All relays are driven from the VXIbus +5V supply line, since VXIbus mainframes always have ample current capability on this supply line, as opposed to the +24 or +12V supply lines.

Specifications

Maximum Switching Voltage:	300VAC, 300VDC
Maximum Switching Current:	2A
Maximum Switching Power:	60WDC, 125 VA
Path Resistance:	<300mΩ
Insulation Resistance:	>10e9Ω
Maximum Thermal Offset per Channel (HI-LO):	<7µV
Capacitance:	
Open Channel:	<50pF
Channel-Mainframe:	<80pF
High-Low:	<50pF
Bandwidth (-3dB):	> 50MHz bandwidth
Insertion Loss:	
100kHz:	<0.1dB
1MHz:	<0.2dB
10MHz:	<1.0dB
Crosstalk:	
100kHz:	<-80dB
1MHz:	<-60dB
10MHz:	<-40dB
Isolation:	
100kHz:	<-50dB
1MHz:	<-45dB
10MHz:	<-40dB
Rated Switch Operations:	
Mechanical:	1×10^7
Electrical:	5×10^5 at full load
Switching Time:	<3mS
Power, Cooling & Weight:	See page 6

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VXI Technology™

Product Brief

5A General Purpose Relays
SM5004 30 SPDT Relays 5A per Channel
SM5005 48 SPST Relays 5A per Channel

- **Fail-safe Interrupt Input on Front Panels for Emergency Safety Conditions**
- **All Cards have Built-in Shield Planes to Improve Signal Integrity**
- **Ideal for 5A General Purpose Switching**
- **SPST Relays can be Paired to Configure 24 DPST Relays per SM5005**
- **SPDT Relays can be Paired to Configure 15 DPDT Relays per SM5004**

SM5005
1 of 48 5A SPST

SM5004
1 of 30 5A SPDT

Overview

These high-density 5A switch modules are designed for switching applications such as process control, appliance pass/fail testing, and on/off control. Up to 288 individual SPST relays, or 180 individual SPDT relays can be accommodated in a double-slot VXIbus card (SM1000B) for maximum density, or mixed and matched with other SMIP™ cards for flexibility.

All relays are driven from the VXIbus +5V supply line, since VXIbus mainframes always have ample current capability on this supply line, as opposed to the +24 or +12V supply lines. Since these modules typically switch power to the UUT or interface, a fail-safe interrupt input line is provided on the front panel that can open all relays automatically if a safety condition occurs. This approach instantly removes all power to the UUT or interface.

Specifications

Maximum Switching Voltage:	250VAC, 110VDC
Maximum Switching Current:	5A
Maximum Switching Power:	150WDC, 1250 VA per channel 18K Watts per switch module
Path Resistance:	<150mΩ
Insulation Resistance:	>10e9Ω
Maximum Thermal Offset per Channel (HI-LO):	<7µV
Capacitance:	
Open Channel:	<50pF
Channel-Mainframe:	<80pF
Bandwidth (-3dB):	> 50MHz bandwidth
Insertion Loss:	
100kHz:	<0.1dB
1MHz:	<0.2dB
10MHz:	<1.0dB
Crosstalk:	
100kHz:	<-80dB
1MHz:	<-60dB
10MHz:	<-40dB
Isolation:	
100kHz:	<-50dB
1MHz:	<-45dB
10MHz:	<-40dB
Rated Switch Operations:	
Mechanical:	1×10^7
Electrical:	5×10^5 at full load
Switching Time:	<3mS

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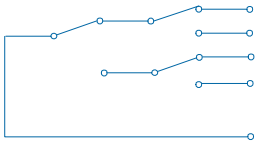
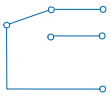
Coaxial Switching
SM6001 10 (4x1) Coaxial Trees
SM6002 17 (1x2) Coaxial Switches

- Greater than 900MHz Bandwidths with Excellent Crosstalk and Isolation
- 10W Maximum Switching Power
- Can be Mixed and Matched to Create Application Specific Configurations
- Ideal for General Purpose RF Switching with High Signal Fidelity
- No Unterminated Stub Effects



Model SM6001
1 of 10 (1x4) Coaxial Trees



Model SM6002
1 of 17 (1x2) Coaxial Switches

Overview

The SM6001 high-density 4:1 coaxial tree and SM6002 high-density coaxial switch modules are designed for general purpose RF switching. The front panel contains two high-density, 26-pin connectors. Excellent crosstalk and isolation is maintained by using RF relays with bandwidths in excess of 1.5GHz, along with short low loss coaxial runs from the connector directly to the relays. Both modules are also configured to avoid any unterminated stub effects.

The SM6001 and SM6002 are part of the SMIP™ family and can be mixed and matched with other SMIP™ modules to configure high-density switching systems.

Specifications

Maximum Switching Voltage: 100V

Maximum Switching Current: 0.5A

Maximum Switching Power: 10W

Path Resistance: <1Ω

Bandwidth (-3dB): > 900MHz

Insertion Loss:

100MHz:	<0.2dB
500MHz:	<0.5dB

Crosstalk:

10MHz:	<-70dB
100MHz:	<-65dB
500MHz:	<-60dB

Isolation:

10MHz:	<-80dB
100MHz:	<-70dB
500MHz:	<-65dB

VSWR: <1.2:1 at 100MHz
<1.5:1 at 900 MHz

Rated Switch Operations:

Mechanical:	5×10^6
Electrical:	1×10^5 at full load

Switching Time: <5mS

Power, Cooling and Weight: See page 6

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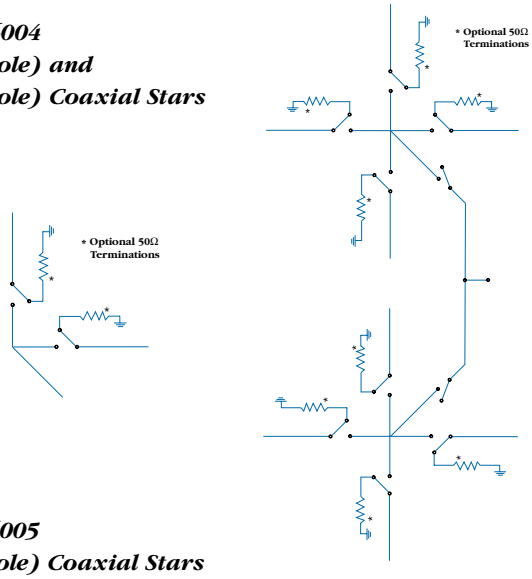
VXI Technology™

Product Brief

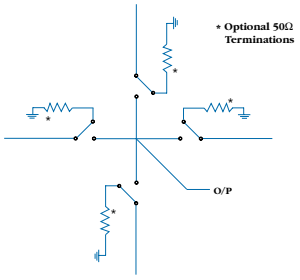
Coaxial Switching
SM6004 3 (8-pole) and 3 (2-pole)Coaxial Stars
SM6005 8 (4-pole) Coaxial Stars

- **Greater than 500MHz Bandwidths with Excellent Crosstalk and Isolation**
- **10W Maximum Switching Power**
- **Star Configurations Allow any Channel to be Connected to any other Channel**
- **Ideal for General Purpose RF Switching with High Signal Fidelity**
- **Optional 50 ohm Terminations (1/2 Watt)**

Model SM6004
1 of 3 (2-pole) and
1 of 3 (8-pole) Coaxial Stars



Model SM6005
1 of 8 (4-pole) Coaxial Stars



Overview

The SM6004 and SM6005 are RF switch modules designed as star configurations. A star switch allows any channel to be connected to any other channel.This configuration approach also allows for the creation of simple matrices (i.e. 4 x 1 x 4).

For applications that require unswitched signal sources to be terminated into 50 ohms, optional 1/2 watt 50 ohm terminations can be provided. Both modules are configured to avoid any unterminated stub effects, and utilize high bandwidth RF relays.

The SM6004 and SM6005 are part of the SMIP™ family and can be mixed and matched with other SMIP™ modules to configure high-density switching systems.

Specifications

Maximum Switching Voltage:	100V
Maximum Switching Current:	0.5A
Maximum Switching Power:	10W (1/2 watt into terminations)
Path Resistance:	<1Ω
Bandwidth (-3dB)	> 500MHz
Switching Time:	<5mS

Insertion Loss:

100MHz:	<0.2dB
500MHz:	<0.5dB

Crosstalk:

10MHz:	<-70dB
100MHz:	<-65dB
500MHz:	<-60dB

Isolation:

10MHz:	<-80dB
100MHz:	<-70dB
500MHz:	<-65dB

VSWR:

<1.2:1 at 100MHz
<1.5:1 at 500 MHz

Rated Switch Operations:

Mechanical:	5×10^6
Electrical:	1×10^5 at full load

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VXI Technology™

Product Brief

Microwave Switch Module SM7000

- **DC to 18GHz**
- **The First Modular VXI Microwave Switch on the Market**
- **Up to 6 (1x6) in Only One C-size Slot**
- **Building Blocks Range from Dual SPDT Relays to SP6T Relays, Transfer Switches and Relay Drivers**
- **Microwave Building Blocks are "Pluggable" from the Front of the VXIbus Card**
- **18GHz Building Blocks Priced to Satisfy Lower Frequency Cellular Switching Markets**

SM7000

Step 1: Start with the SM7000 base unit. It holds up to six microwave building blocks in one C-size slot.

Step 2: Select up to six microwave building blocks

Step 3: Contact VXI Technology for price and delivery

Overview

The SM7000 is part of the SMIP™ family, offering the extensive control and interfacing features provided by SMIP™. Microwave relay technology has been pioneered to offer density, modularity and cost benefits not available from other VXI suppliers.

Using the SMIP™ family for microwave switching, the user obtains the following benefits over other VXI microwave switch solutions:

Density: Up to 6 (1x6) microwave relays can be housed in a single VXIbus slot (SM7000).

Modularity: Each SM7000 switch module can house up to 6 building blocks, which can be mixed and matched for the final configuration. There are 7 different building blocks to choose from.

Cost: The SM7000 has been priced to help reduce the cost of microwave switching by at least 20% from existing solutions.

The following building blocks have been selected to allow the majority of microwave switch applications to be accommodated within 1 VXIbus card slot. Each building block is also "pluggable" from the front allowing for easy configurations and repair.

Specifications

Maximum Power per Channel: 20W @ 18 GHz

Switching Time: <15mS

RF Impedance: 50 ohms

Frequency (GHz)	DC-3GHz	3-8GHz	8.1-2.4GHz	12.4-18GHz
Isolation (dB min)	80	70	60	60
Insertion Loss (dB max)	0.2	0.3	0.4	0.5
VSWR min	1.2:1	1.3:1	1.4:1	1.5:1

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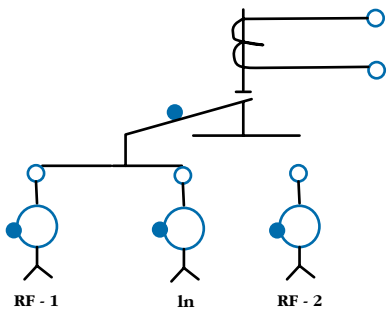
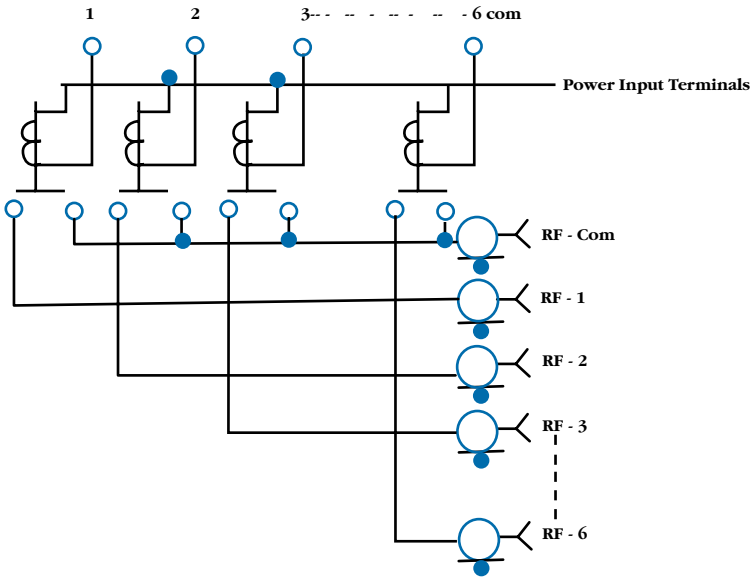
Microwave Switch Module SM7000

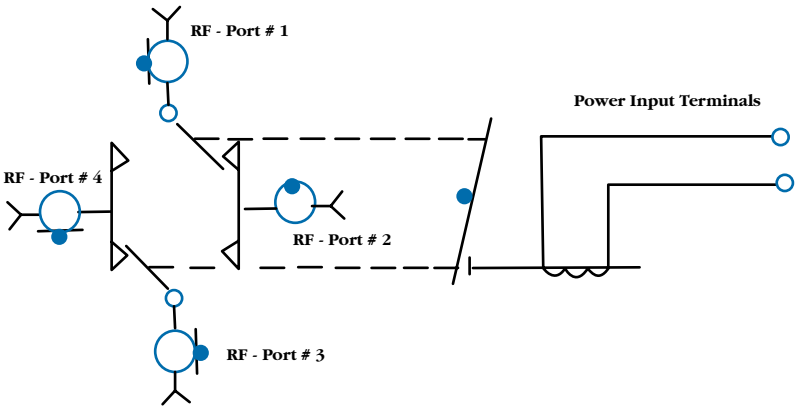
SPDT



MULTI-POSITION



TRANSFER SWITCH



Ordering Information

SM7000	Single-slot Base unit	7274	SP6T 18GHz relay
7270	2 (SPDT) 18GHz relays	7275	18GHz transfer switch
7272	SP4T 18GHz relay	7276	6 relay driver lines

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VXI Technology™

Product Brief

Microwave Switch Module SM7001A

- **DC to 40GHz**
- **The First Modular VXI Microwave Switch on the Market**
- **Up to 4 Building Blocks per SM7001A**
- **Building Blocks Range from Terminated 18 GHz SP6T to 26.5 GHz and 40 GHz Relays.**
- **Microwave Building Blocks are "Pluggable" from the Front of the VXIbus Card**
- **An Addittional 32 SPST Relays are Provided to Drive External Devices**

Step 1: Start with the SM7001A base unit. It holds up to four microwave building blocks.

Step 2: Select up to four microwave building blocks

Step 3: Contact VXI Technology for price and delivery

Overview

The SM7001A is part of the SMIP™ family, offering the extensive control and interfacing features provided by SMIP™. Microwave relay technology has been pioneered to offer density, modularity and cost benefits.

The SM7001A base unit can house up to 4 microwave building blocks. These microwave building blocks can be:

18 GHz self-terminated multi-position relays
26.5 GHz multi-position relays
40 GHz multi-position relays

In order to drive additional RF/Microwave components such as attenuators or splitters, 32 SPST relays are also provided per SM7001A.

VXI Technology can also house other RF/microwave components in single or double slot enclosures and drive them using the same instrument drivers and control logic found throughout the SMIP™ family.

Specifications

Model 7374 18 GHz self-terminated

Maximum Power per Channel: 5W @ 18 GHz

Switching Time: <15mS

RF Impedance: 50 ohms

Frequency (GHz)	DC-3GHz	3-8GHz	8-12.4GHz	12.4-18GHz
Isolation (dB min)	80	70	60	60
Insertion Loss (dB max)	0.2	0.3	0.4	0.5
VSWR min	1.2:1	1.3:1	1.4:1	1.5:1

Model 7474 26.5 GHz

Maximum Power per Channel: 30W @ 18 GHz

Switching Time: <15mS

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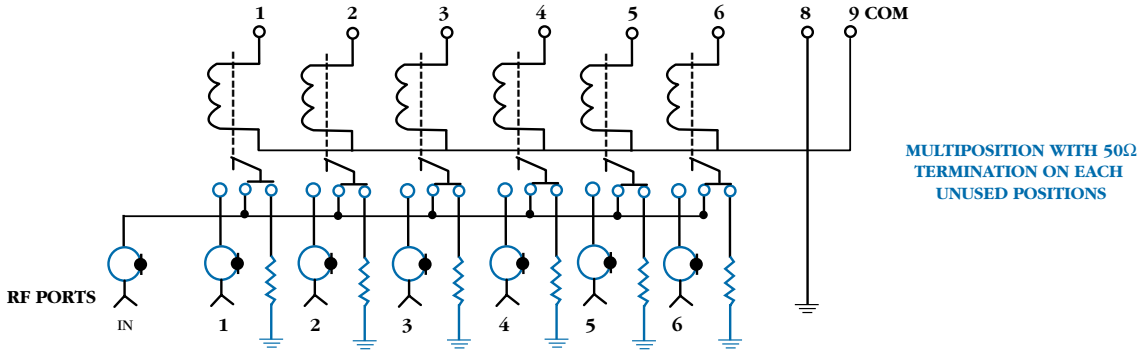
Microwave Switch Module SM7001A



RF Impedance: 50 ohms

Connector: APC 3.5

Frequency (GHz)	DC-3GHz	3-8GHz	8-12.4GHz	12.4-18GHz	18-26.5 GHz
Isolation (dB min)	80	70	60	60	50
Insertion Loss (dB max)	0.2	0.3	0.4	0.5	0.8
VSWR min	1.2:1	1.3:1	1.4:1	1.5:1	1.8:1

Model 7574 40 GHz

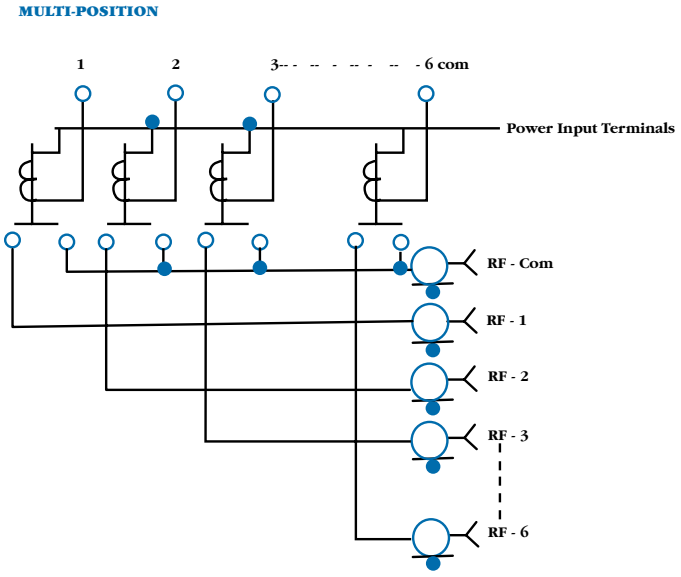
Maximum Power per Channel: 3W @ 40 GHz

Switching Time: <15mS

RF Impedance: 50 ohms

Connector: K

Frequency (GHz)	DC-6GHz	6-12GHz	12-18GHz	18-26.5GHz	26.5-40GHz
Isolation (dB min)	70	60	60	55	50
Insertion Loss (dB max)	0.2	0.4	0.5	0.7	0.9
VSWR min	1.3:1	1.4:1	1.5:1	1.7:1	2.0:1



Ordering Information:

SM7001A	Double-slot Base unit
7374	SP6T 18 GHz self-terminated relay
7474	SP6T 26.5 GHz relay
7574	SP6T 40 GHz relay

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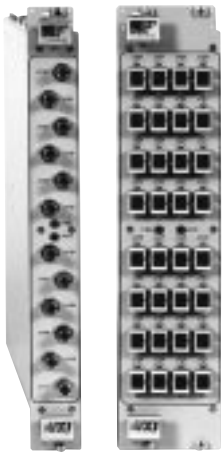
Optical Switch Modules SM8001, SM8002 and SM8003

- First Modular Optical Switch Family for VXI
- Building Blocks Include 1xN, 2xN, SPST and SPDT Switches
- Mix and Match Optical Building Blocks for Final Configuration
- Includes all the Features of the SMIP™ Family



Step 1: Start with the SM8001, SM8002 or SM8003 Base Unit. The SM8001 and SM8002 house the 1xN and 2xN multi-channel switches. The SM8003 houses the SPST and SPDT prism switches. Up to two 1xN or 2xN multi-channel switches can be housed in either an SM8001 single-slot or SM8002 double slot VXIbus card. The SM8002 has more connector space on the front panel and can accommodate a larger number of N channels.

Step 2: Select the combination of 1xN and 2xN switches for the SM8001/SM8002, or select a combination of SPST and SPDT switches for the SM8003.

Step 3: Contact VXI Technology for price and delivery

Overview

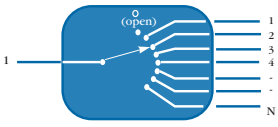
The SM8000 optical switch modules are part of the SMIP™ family, offering the extensive control and interfacing features provided by SMIP™. The latest optical relay technology, combined with the modular approach of VXI and SMIP™, finally provides optical switching solutions that are open architecture and modular in design. Combined with other SMIP™ switch products, a complete switching solution "From DC to Light" can now be configured in a single VXIbus mainframe, with a consistent driver interface.

Precise switching of optical channels is achieved in the SM8001 and SM8002 multi-channel switch modules using diffraction limited collimating lenses, which enhance both thermal stability and repeatability. The SM8003 single-mode prism switches provide channel selection from one input fiber to either one or two output fibers using a moving prism between fixed collimator pairs.

SM8001 and SM8002

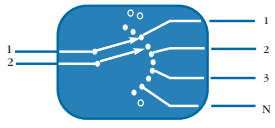
The SM8001 and SM8002 can each hold up to 2 optical switch modules. Each switch module can be either a 1xN (where N ranges from 2 to 17) or a 2xN (where N ranges from 2 to 8). Selecting between the SM8001 and SM8002 is dependent on the required number of front panel I/O connectors for the desired configuration.

Configurations:

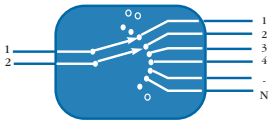


1 x N

Duplex 1 x N



2 x N Blocking



2 x N Non-Blocking

The total numbers of available connectors per base unit are:

SM8001 Single-slot, Multi-channel Base Unit:
12 ST connectors
16 SC connectors
12 FC connectors

SM8002 Double-slot, Multi-channel Base Unit:
24 ST connectors
32 SC connectors
24 FC connectors

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Optical Switch Modules SM8001, SM8002 and SM8003

Some examples of typical configurations are:

SM8001 with dual (1 x 5) switches using FC connectors (12 total)
SM8002 with 1x12 using ST connectors (13 total)
SM8002 with 1 x 17 switches using SC connectors (18 total)
SM8002 with dual (1 x 8) switches using FC connectors (18 total)
SM8001 with dual (1 x 4) switches using ST connectors (10 total)

Specifications[1] for SM8001 and SM8002

Insertion Loss:[2]	0.5 dB typ., 1.2 dB max.
Back-reflection:[3]	-60 dB typ.,-55 dB max. (Singlemode) -20 dB typ. (Mult-mode)
Switching Time:	100 msec. +16 msec. per channel
Isolation:	-80 dB max.
Durability:	10 million cycles min.
Repeatability:[4]	±0.01 dB max. sequential ±0.03 dB max. random
PDL:[5]	0.05 dB max. (single-mode)
Wavelength Range:	780 – 1650 nm
Operating Temperature:	0˚C to 50˚C max.
Storage Temperature:	-20˚C to +70˚C max.
Humidity:	40˚C /90% RH /5 days

1. All specifications referenced without connectors.
2. Measured at 23 ±5˚C.
3. Based on standard 1 meter pigtail length. –60 dB max. by request.
4. 100 cycles measured at constant temperature after warm-up.
5. Measured at 1550 nm. Lower PDL available by request.

Ordering Information for SM8001 and SM8002

SM800 -- [ ] - [ ] - [ ] - [ ] - [ ] - [ ]

VXIbus Module

1	SM8001 Single slot
2	SM8002 Double slot

Switch Configuration 1

1xN	1xN (specify N)
1xN/DS	Synchronous Duplex 1xN
2xN/LB	Low-loss 2xN Blocking
2xN/LN	Low-loss 2xN Non-blocking

Switch Configuration 2

1xN	1xN (specify N)
1xN/DS	Synchronous Duplex 1xN
2xN/LB	Low-loss 2xN Blocking
2xN/LN	Low-loss 2xN Non-blocking
Ø	None

Fiber Type

9	9/125
50	50/125
62	62.5/125
100	100/140
X	Specify

Wavelength Range (nm)

8	780-950 (MM only)
13	1290-1360
8/13	780-1360 (MM only)
15	1480-1570
13/15	1290-1570
16	1600-1650
13/16	1290-1650
X	Specify

Connector Type

FC	FC
SC	SC
ST	ST

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Optical Switch Modules SM8001, SM8002 and SM8003

SM8003

The SM8003 can house up to 4 SPST and/or SPDT switches. SPST and SPDT switches can be mixed and matched within the same unit.

Configurations

SPST

SPDT

The total numbers of available connectors per base unit are:

SM8003 Single-slot Prism switch Base Unit:

12 ST connectors
16 SC connectors
12 FC connectors

Some examples of typical configurations are:

SM8003 with 4 SPDT prism switches using SC connectors
SM8003 with 2 SPDT and 2 SPST prism switches using FC connectors

Specifications[1]

Wavelength Range:	1290 - 1650 nm
Insertion Loss:[2]	0.5 dB typ., 1.2 dB max.
Back-reflection:[2]	-55 dB max.
Switching Time:	25 msec. max.
Isolation:	-80 dB max.
Crosstalk:	-80dB max.
Durability:	10 million cycles/min.
Repeatability:[3]	±0.015 dB max. (Latching)
PDL:[4]	0.05 dB max.
Switching Voltage:	4.3 VDC min., 6.0 VDC max.
Switching Current:	120 mA @ 5.0 VDC to switch
Coil Resistance:	40 ohm min., 44 ohm max.
Operating Temperature:	0˚C to 50˚C max.
Storage Temperature:	-20˚C to +70˚C max.
Humidity:	40˚C /90% RH /5 days

1. All specifications referenced without connectors.
2. Measured at 1310 and 1550nm at 23 ±5˚C.
3. Short-term repeatability for 100 cycles at constant temperature.
4. Measured at 1550 nm. Lower PDL available by request.

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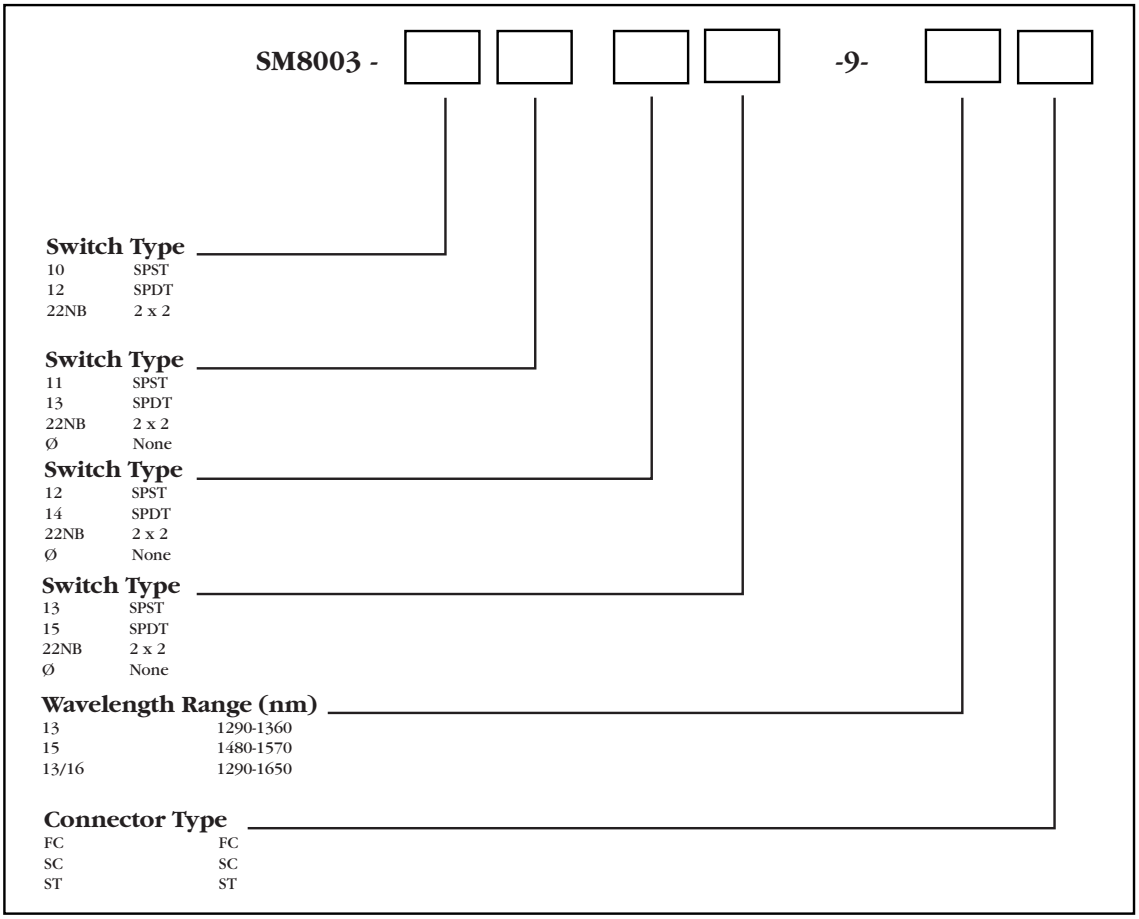
Optical Switch Modules SM8001, SM8002 and SM8003

Ordering Information for SM8003



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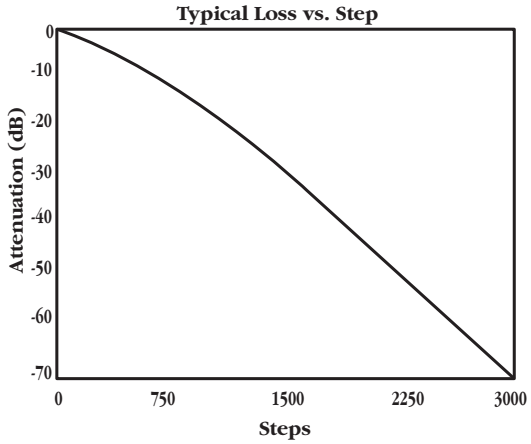
Optical Switch Modules
SM8101 and SM8102 Optical Attenuators

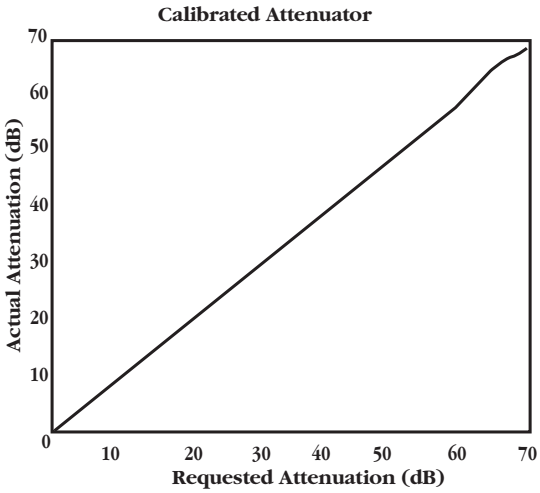
- Wide Attenuation Range (60dB min.)
- Low Back-reflection (-50dB max.)
- Precise Resolution (0.05 dB)
- Low Insertion Loss (1.5 dB max.)
- Up to 2 Optical Attenuators per Single VXIbus Slot

Overview

The SM8101 and SM8102 are single-slot VXIbus modules. The SM8101 is a single-channel variable attenuator, whereas the SM8102 is a two-channel variable attenuator. Both modules are used to automatically adjust optical power level in test systems with a range 0 to 60 dB, with better than 0.05 dB resolution. Applications include setting power levels to optimize receiver sensitivity in single wavelength systems, as well as active gain equalization in dense WDM systems. Factory test applications include bit error rate performance and dynamic range testing.

Optical Performance





Specifications

Range:	0 - 20 dB	21- 40 dB	41 -70 dB
Resolution	0.01 dB	0.05 dB	0.2 dB
Repeatability:	0.1 dB	0.2 dB	0.2 dB
Polarization Dep.loss:[1]	0.08 dB	0.1 dB	0.3 dB
Absolute Accuracy:[1]	±0.1 dB	±0.25 dB	±0.25 dB
Insertion Loss:[2]	0.6 dB typical, 1.5 dB max.		

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Optical Switch Modules
SM8101 and SM8102 Optical Attenuators

Specifications Continued

Back Reflection:[2] -50 dB max.

Tuning Speed: 50 msec/min. 1400 msec max.

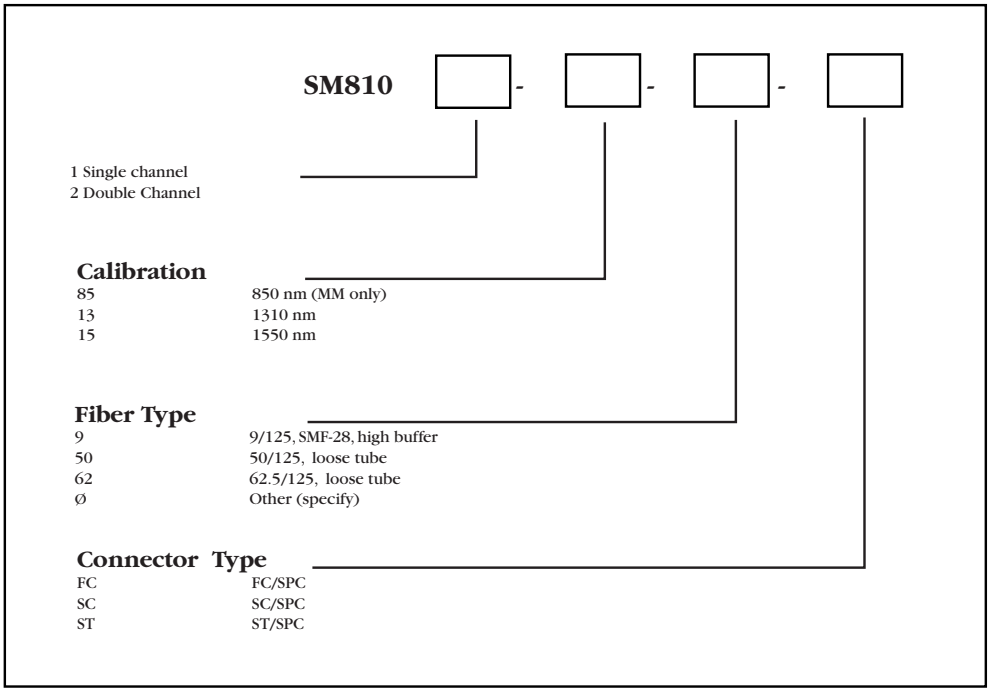
Operating Temp: 0˚C to +50˚C

Storage Temp: -20˚C to +70˚C

Humidity: 40˚C/ 90% RH / 5 days

1. Single mode only measured at 1550 nm.
2. Excluding connectors.

Ordering Information



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