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24-Channel Low-Voltage Multiplexer/Matrix

NI PXI-2501, NI PXI-2503

- Configuration determined by terminal block
- 48x1 (1-wire), 24x1 (2-wire), and 12x1 (4-wire) configurations
- 4x6 2-wire matrix
- 1,024-step scanlist for deterministic scanning
- Fully software programmable

NI PXI-2501
- NI FET switches
- Up to +10 VDC capacity
- 250,000 operations/s max

NI PXI-2503
- Electromechanical relay
- Up to ±60 VDC/30 V_{rms}
- Up to 1A switching
- 100 operations/s

Operating Systems
- Windows 2000/NT/XP

Recommended Software
- LabVIEW
- LabVIEW Real-Time Module
- LabWindows/CVI
- Measurement Studio
- NI Switch Executive

Other Compatible Software
- Visual Basic
- C/C++

Driver Software (included)
- NI-SWITCH

Compliance
- CE



Overview

The National Instruments PXI-2501 and PXI-2503 are multiplexer and matrix switch modules for use in automated measurements. The NI PXI-2501 is ideal for applications that require high-speed scanning of short voltage signals (±10 V) because it uses FET switches with very short settling times (30 µs). Its fast scanning speeds also make it a highly effective solution for expanding the number of channels for a DAQ device. The PXI-2503 routes signals up to 60 VDC or 30 V_{rms}. For low-voltage sources, such as thermocouples, the PXI-2503 relays have very low thermal offset (less than 2 µV) to ensure accurate measurements. For low resistance measurements, use the PXI-2503 with its very low-contact resistance. For automotive-level voltage measurements, the PXI-2503 handles up to 1 A at 30 VDC.

These switch modules deliver maximum flexibility in managing a wide variety of test signals. Through software configuration, the uses of these modules range from a 48-channel, 1-wire mode for making a large number of common-reference measurements to a 12-channel, 4-wire mode for precision resistive and temperature measurements using thermistors or RTDs. Finally, with the use of the TB-2606 terminal block, you can instantly configure either of the switch modules as a 4x6, 2-wire matrix. All of these configurations are outlined in Table 1.

Module	Topology	Configuration	Terminal Block
PXI-2503, PXI-2501	Multiplexer	48x1 1-wire 24x1 2-wire 12x1 4-wire	TB-2605
PXI-2503, PXI-2501	Matrix	4x6 2-wire	TB-2606

Table 1. PXI-2501 and PXI-2503 Configurations

Analog Signal Routing

An external analog bus routes the output of a module to adjacent switch modules in order to expand the multiplexer architecture to include two or more modules. Connection is made with the analog plug that is shipped with every TB-2605 terminal block, see Figure 3. The analog bus consists of 4 wires for easy expansion of 4-wire, 2-wire, and 1-wire configurations. With this flexibility, you can create large switching solutions and keep the wiring of the modules to a minimum.

For example, if you have two PXI multiplexers in two adjacent slots, you can connect their analog bus via the analog plug and create either a 48-channel, 2-wire multiplexer or a 96-channel 1-wire multiplexer. In the same way, with five switching modules and the analog plugs, you can create a 240-channel, 1-wire multiplexer. If you need to connect the common terminal of the resulting multiplexer to a DMM, use the LV6-to-BAN4 cable for direct connectivity between the analog bus plug and the banana connectors of a DMM. If you have space restrictions in front of your terminal blocks, use the P-3 Probe set, which connects to screw terminals on one side and to banana plugs on the other.

Extended Features and Specifications

National Instruments switch modules are built with a number of core features that are covered in detail in the Switch Overview section.

For additional information about the PXI-2501 and PXI-2503, including software, certifications and compliance, relay control, etc., please see page 20. For detailed specifications, please see page 502.

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24-Channel Low-Voltage Multiplexer/Matrix

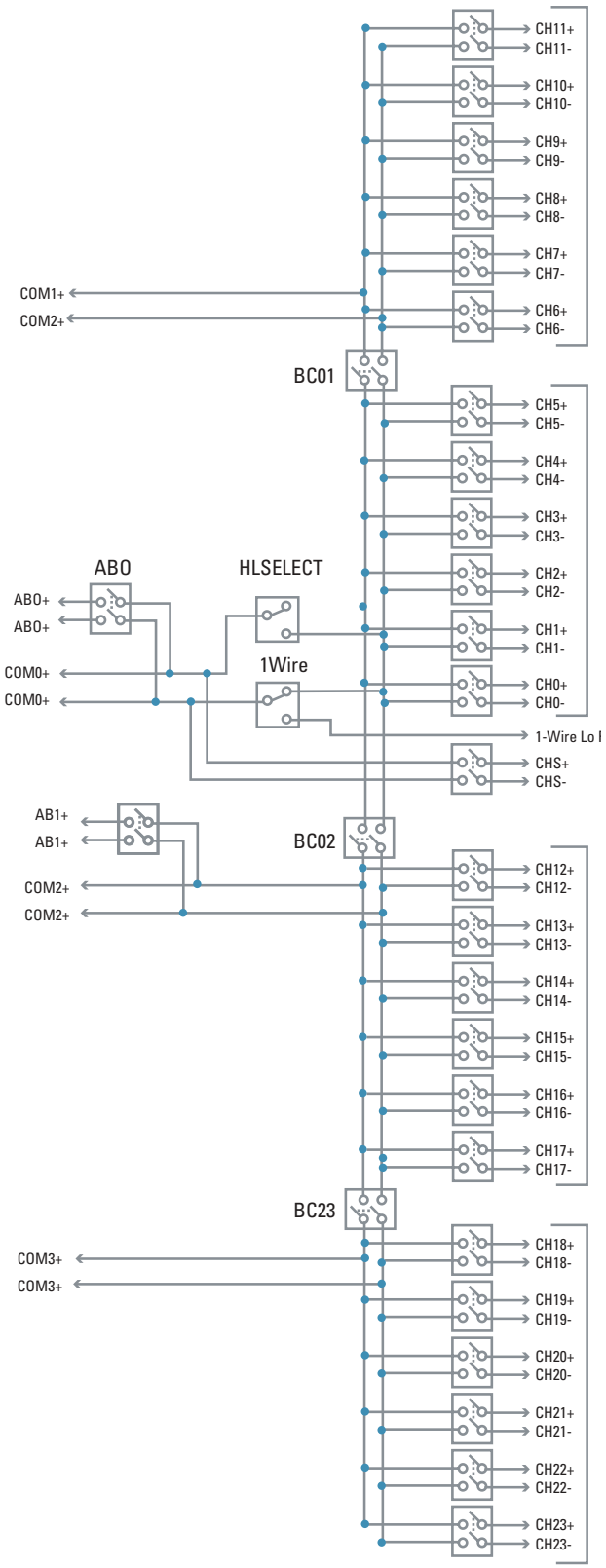


Figure 1. NI PXI-2501 and NI PXI-2503 Hardware Diagram



Figure 2. Analog plugs used with the TB-2605.

Ordering Information

NI PXI-2501 777696-01
NI PXI-2503 777697-01
Includes the switch module and NI-SWITCH driver software.

Accessories

TB-2605 multiplexing terminal block 777878-01
TB-2606 matrix terminal block.....777879-01

For information on extended warranty and value added services, see page 20.
See page 499 for accessory and cable information.

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Switch Specifications

Specifications

SCXI-1129

Input Characteristics

Input voltage, node to node ..... 150 V_{rms} or 150 VDC
Maximum switching voltage
  AC ..... 150 V_{rms}
  DC ..... 150 VDC
Maximum current switching capacity
  AC (resistive load) ..... 250 mA
  DC (resistive load) ..... 1 A
Maximum relay switching power ..... 37.5 VA, 30 W
Maximum combined channel current ..... 5 A
Path resistance (HVAB) ..... 1 Ω
Contact material ..... Gold-clad AgPd

Transfer Characteristics

Thermal emf (differential) ..... 9 µV (worst case)

Bandwidth (-3 dB)

1 row – 1 column ..... 10 MHz

Crosstalk[1] (Adjacent Rows and Columns)

Frequency	Crosstalk (dB)
10 KHz	-80
100 KHz	-66
1 MHz	-50

[1]50 Ω termination
Dynamic Characteristics
Maximum operating speed ..... Between 22 and 250 operations/s depending on the number of relays operated
Relay operate time (at 20 ºC)
  Set/release ..... 4 ms max
Expected life
  Mechanical (at 3 operations/s) ..... $5x10^7$ operations

Stability

Recommended warm-up time ..... 5 minutes

Physical

Dimensions ..... 3.0 by 17.2 by 20.3 cm (1.18 by 6.9 by 8.0 in.)
I/O connector ..... 180-pin HDI

Environment

Operating temperature ..... 0 to 50 °C
Storage temperature ..... -20 to 70 °C
Relative humidity ..... 5% to 85% noncondensing
IEC-1010, voltage insulation category I double insulation, EMI, CE

SCXI-1127, SCXI-1128

Input Characteristics

Input voltage
  Channel-to-channel ..... 250 VDC/V_{rms}
  Channel-to-earth ..... 250 VDC/V_{rms}
Maximum switching voltage
  differential or single ended ..... 250 VDC/V_{rms}
Maximum switching capacity – differential mode or single ended
  AC
    SCXI-1127 (resistive load) ..... 200 mA at 250 V_{rms}, 500 mA at 125 V_{rms}
    SCXI-1128 (resistive load) ..... 30 mA at 10 V_{rms}, 1 mA at 250 V_{rms}
  DC
    SCXI-1127 (resistive load) ..... 1 A at 30 VDC
    SCXI-1128 (resistive load) ..... 30 mA at 10 VDC 1 mA at 300 VDC
Maximum switching power per differential channel or single ended
  SCXI-1127 ..... 60 VA, 30 W
  SCXI-1128 ..... 300 mW
Path resistance
  SCXI-1127 ..... <1 Ω
  SCXI-1128 ..... <1.2 kΩ
Contact material (SCXI-1127) ..... Gold-clad silver alloy

Transfer Characteristics

Thermal emf (differential) (SCXI-1127) ..... ≤3 µV
Thermal offset voltage (SCXI-1128) ..... <100 µV

Maximum Bandwidth

SCXI-1127 ..... 11 MHz

Channel-to-Channel Isolation

SCXI-1127 (50 Ω termination)

Frequency	Isolation (dB)
10 KHz	> 70
100 KHz	> 55
1 MHz	> 50
5 MHz	> 40
11 MHZ	> 25

SCXI-1128 (50 Ω termination)

Frequency	Isolation (dB)
100 Hz	> 80
1 KHz	> 70
10 KHz	> 55
100 KHz	> 35
1 MHZ	> 20

Dynamic Characteristics

Maximum operating speed
  SCXI-1127 ..... 100 operations/s
  SCXI-1128 ..... 1200 operations/s
Relay operate time (at 20 °C)
  SCXI-1127 ..... 3 ms typical, 5 ms maximum
  SCXI-1128 ..... 0.25 ms typical, 0.5 ms maximum
Relay release time (at 20 °C)
  SCXI-1127 ..... 1.5 ms typical, 5 ms maximum
  SCXI-1128 ..... 0.08 ms typical, 0.2 ms maximum
Mechanical (at 3 operations/s)
SCXI-1127 ..... $5x10^7$ operations
SCXI-1128 ..... unlimited
SCXI-1127 relay lifetime ..... (operating life varies with switching conditions)
Expected Life

Voltage	Current	Expected Operations
30 VDC	1 A	200,000
250 V_{rms}	200 mA	50,000
250 V_{rms}	250 µA	100,000

Stability

Recommended warm-up time ..... 5 minutes

Physical

Dimensions ..... 3.0 by 17.2 by 20.3 cm
(1.18 by 6.9 by 8.0 in.)
I/O connector ..... 96-pin HDI

Environment

Operating temperature ..... 0 to 50 °C
Storage temperature ..... -20 to 70 °C
Relative humidity ..... 5% to 85% noncondensing
IEC-1010, voltage insulation category I double insulation, EMI, CE

PXI-2501

Input Characteristics

Maximum working voltage ..... ±10 VDC from chassis ground
Overvoltage protection (signals CH<0:23>, COM<0:3>)
  Powered on or off ..... ±25 VDC from ground
Overvoltage protection (signals AB<0:1>)
  Powered on ..... ±25 VDC from ground
  Powered off ..... ±15 VDC from ground
FET switch on-resistance
  At 25 °C ..... 50 Ω typical; 85 Ω maximum
  At 85 °C ..... 100 Ω
Total signal path resistance
  (channel x to analog bus x) ..... 1,650 Ω typical; 1,900 Ω maximum
Total signal path resistance
  (channel x to common x) ..... 1,900 Ω typical; 2,150 Ω maximum

Transfer Characteristics

Channel amplifier (unity gain)
  Offset voltage (differential) ..... 1.2 mV, maximum
Cold-junction sensor channel buffer
  Offset voltage ..... 60 µV, maximum

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Switch Specifications

Specifications (continued)

Frequency bandwidth (50 Ω source, 1 MΩ, 25 pF load)
- -3 dB ..... 400 kHz
- -10 dB ..... 1 MHz

Dynamic Characteristics

Operating speed ..... 25,000 operation/s typical, 250,000 operation/s max
Settling time* (+5 to -5 V step) using a 6 in. cable to measurement device
- 0.012% accuracy
  - With output buffer selected ..... 8.5 µs
  - Without output buffer ..... 9.0 µs
- 0.006% accuracy
  - With output buffer selected ..... 10 µs
  - Without output buffer ..... 11.5 µs
- 0.0015% accuracy
  - With output buffer selected ..... 16 µs
  - Without output buffer ..... 18 µs

Settling time* (+5 to -5 V step) using a 3 m cable to measurement device
- 0.012% accuracy
  - With output buffer selected ..... 21 µs
  - Without output buffer ..... 45 µs
- 0.006% accuracy
  - With output buffer selected ..... 30 µs
  - Without output buffer ..... 60 µs
- 0.0015% accuracy
  - With output buffer selected ..... 80 µs
  - Without output buffer ..... 160 µs

*Minimizing wiring from the analog bus connection to the measurement device improves settling time.

PXI Trigger Bus

Interface ..... Slave
Trigger lines 8
Star trigger 1

Power Requirements

+5 VDC ..... 300 mA, typical
+12 VDC ..... 30 mA, typical
-12 VDC ..... 30 mA, typical

Physical

Dimensions ..... 10 by 16 cm (3.9 by 6.3 in.)
I/O connector ..... 68-pin male SCSI

Environment

Operating temperature ..... 0 to 50 °C
Storage temperature ..... -20 to 70 °C
Relative humidity ..... 5 to 85% noncondensing

PXI-2503

Input Characteristics

Input voltage
- Channel-to-channel ..... 30 V_{rms}/60 VDC
- Channel-to-earth ..... 30 V_{rms}/60 VDC

Maximum switching voltage – differential or single ended
- AC ..... 30 V_{rms}
- DC ..... 60 VDC

Maximum switching capacity – differential or single ended
- 30 VDC (resistive load) ..... 1 A

Maximum switching power per
- differential or single ended channel ..... 30 W

Path resistance ..... < 1 Ω
Contact material ..... Gold-clad silver alloy

Transfer Characteristics

Thermal EMF (differential) ..... < 2 µV
Maximum frequency, 3 dB bandwidth, 50 Ω termination
- Worst case channel ..... 10 MHz minimum

Channel-to-channel isolation (2-wire) ..... 50 Ω termination

Frequency	Isolation
10 kHz	> 100 dB
100 kHz	> 80 dB
1 MHz	> 55 dB
10 MHz	> 30 dB

Dynamic Characteristics

Operating speed ..... 100 operation/s
Relay operate time (20 °C) ..... 3 ms typical, 5 ms maximum
Relay release time (20 °C) ..... 1.5 ms typical, 5 ms maximum
Expected life (at 120 cpm)
- Mechanical (3 Hz rate) ..... $5x10^7$ operations
- Electrical at maximum load ..... $2x10^6$ operations

PXI Trigger Bus

Interface ..... Slave
Trigger lines 8
Star trigger 1

Power Requirement

+5 VDC ..... 370 mA, typical 700 mA, maximum

Physical

Dimensions ..... 10 by 16 cm (3.9 by 6.3 in.)
I/O connector ..... 68 pin male SCSI

Environment

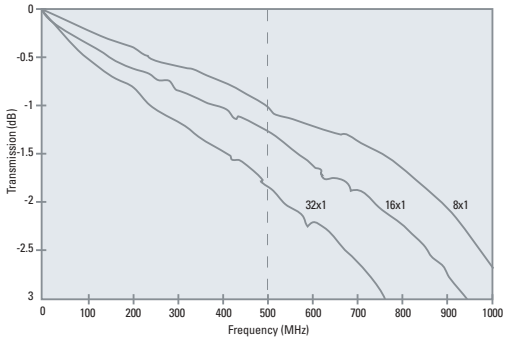
Operating temperature ..... 0 to 50 °C
Storage temperature ..... -20 to 70 °C
Relative humidity ..... 5 to 85% noncondensing

PXI-2593, PXI-1193

RF Performance Characteristics

Characteristic impedance (Z_0) ..... 50 Ω nominal
Insertion loss
- 8x1
  - DC to 200 MHz ..... <0.9 dB
  - 200 to 500 MHz ..... <1.6 dB
- 16x1
  - DC to 200 MHz ..... <1.2 dB
  - 200 to 500 MHz ..... <1.9 dB
- 32x1 (SCXI-1193 only)
  - DC to 200 MHz ..... <1.4 dB
  - 200 to 500 MHz ..... <2.4 dB

Typical bandwidth (3 dB)
- 8x1 ..... >900 MHz
- 16x1 ..... >750 MHz
- 32x1 (SCXI-1193 only) ..... >600 MHz



VSWR
- 8x1
  - DC to 200 MHz ..... <1.4
  - 200 to 500 MHz ..... <1.8
- 16x1
  - DC to 200 MHz ..... <1.4
  - 00 to 500 MHz ..... <1.8
- 32x1 (SCXI-1193 only)
  - DC to 200 MHz ..... <1.4
  - 200 to 500 MHz ..... <1.8

Maximum RF carry power ..... 10 W up to 500 MHz (per channel)

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