



A Quantum Switch for the Better

## Precision 4164

### High-Density Programmable 64 x 64 Switch Matrix System

The Precision 4164 is a reliable and robust solid-state switch matrix system in a compact, rack-mountable or benchtop package. The system provides computer-controlled connections between any input and any output. Connect any of the 64 inputs to any of the 64 outputs.

Save time and reduce errors on your switch system setups with the easy to use spreadsheet style Graphical User Interface. Save configurations and download them to your switch system over the network—and your tests are ready to go. Program the switch from your application via the high-level Ethernet interface. Edit configurations offline in Excel.

With system health monitoring, fault diagnostics, and exhaustive self-tests, you can have confidence in the integrity of the 4164 system. Option F provides Go/No-Go test feature and Factory Acceptance Tests (FAT) routines.



The built-in Go/No-Go test feature automatically verifies run-time setup by checking each programmed connection using a direct input-to-output measurement. The 4164 FAT routines measure switch system parametrics, including gain, crosstalk and open/short, in situ to verify performance and provides full test reports.

When power is applied to the system, the system provides unidirectional signal paths from input to output channels. When power is removed, switch settings are retained in nonvolatile memory and restored at power up. Balanced differential input buffers reduce noise susceptibility and correctly reference the signal inputs to their corresponding ground. Ground sensing output buffers reduce power-line hum when driving single-ended loads.

## Salient Features

### Switch Matrix Characteristics

- Solid-state switch matrix
- High density: 4,096 crosspoints

### Matrix Size

- 64 x 64, all in a compact 2U (3.5 in. high) mainframe

### System Control

- Spreadsheet-style graphical user interface (GUI) for host PC computer control
- Remote Ethernet interface command control
- Front-panel control
- Nonvolatile storage of switch configurations: Store up to eight setups in the system; store unlimited setups on the host computer

### System Integrity

- System health monitoring of power supply and internal temperatures
- Solid-state switches are more reliable than mechanical relay systems
- Optional self-tests, with reports, exhaustively test switch settings

### Signal Switching

- $\pm 10$  Vpk for each signal path

### Input Characteristics

- Balanced differential input

### Frequency Response

- DC to 350 kHz

### Output Characteristics

- Single-ended with manually selectable ground sense

## 4164 Solid State Switch Matrix System

### Switch System Specifications

#### Matrix Size

64 x 64, nonblocking solid-state switch

#### Input Characteristics

##### Type:

Balanced differential

##### Input Impedance:

2 M $\Omega$  Differential, 22.5 M $\Omega$  Common Mode

##### Common Mode Rejection Ratio:

70 dB, DC to 500 Hz

##### Max Level (AC + DC + Common Mode):

$\pm 10$  Vpk for  $f \leq 200$  kHz  
 $\pm 10$  Vpk x (200 kHz/f) for  $f > 200$  kHz

##### Protection:

$\pm 35$  V continuous  
 $\pm 100$  Vpk transient (1 ms pulse, 10% duty cycle)

#### Transfer Characteristics

##### Frequency Response:

0 dB  $\pm 0.01$  dB, DC to 16 kHz  
-0.1 dB  $\pm 0.05$  dB at 50 kHz  
-0.35 dB  $\pm 0.05$  dB at 100 kHz  
-3 dB  $\pm 0.35$  dB at 350 kHz

##### Phase Match:

1°, DC to 100 kHz

##### Group Delay:

750 nS typical

##### Total Harmonic Distortion:

$\pm 0.1\%$  at 7 Vrms and 10 kHz

##### Crosstalk:

70 dB to 100 kHz, all hostile

#### Output Characteristics

##### Type:

Single-ended with manual switch-selectable ground sense

##### Maximum Output:

$\pm 10$  Vpk,  $\pm 10$  mApk

##### Output Noise:

100  $\mu$ Vrms in 200 kHz BW

##### DC Offset:

$\pm 1$  mV, input shorted

##### Output Impedance:

10  $\Omega$

# 4164 Overview

## Description

The Precision 4164 solid-state switch matrix system provides 64 x 64 rectangular coordinate switching with 4,096 crosspoints.

The system is controlled by running a GUI on the host computer, remotely (using command line control) or from the front panel.

The 4164's internal test subsystem verifies system integrity. The FAT (factory acceptance test, Option F) exhaustively tests all possible switch connections and reports faults. The Go/No-Go test checks the current switch setup and may be run in place, with all input/output cables connected to the system.

The 4164 uses high impedance (2 MΩ) differential buffers for each of its inputs. The differential buffers properly reference each input signal to its point of origin while the high common mode rejection (CMR) rejects noise pick-up on long input wires. The differential buffers are especially important when both the input and output devices are single ended (grounded low) signals.

## Reliability and Dependability

Dependability and reliability are paramount as the switch system is a crucial link in the signal path of every measurement channel. Solid-state switches as opposed to electromechanical relays not only improves initial reliability but becomes an even greater advantage later in the service life of the switch. Over time, mechanical relay systems exhibit an increasing rate of contact and coil related failures.

## Prove It and Document It

The 4164 was designed with the philosophy that a switch matrix and its programmed configuration is of little use if you can't prove it and document it. If only one of the connections is faulty, it could corrupt the test data from a critical and expensive measurement test.

The extensive Option F self-test capabilities allow full parametric factory acceptance test "FAT" of the entire system including all switch paths, while the quicker "Go/No-Go" test verifies and documents only the active switch paths in the present configuration. Diagnostic test reports are saved as text documents and can be used to supplement quality and validity reports for the overall measurement system.

# Switch Matrix System Operation

Switch settings can be managed using the Graphical User Interface (GUI), the Ethernet remote interface or the front panel. The GUI is a convenient, ready to run solution that executes on a Windows based computer, providing an organized and efficient method to display and manage connections for a large number of switch system inputs and outputs.

## GUI Ease of Use

A simple and intuitive graphical user interface (GUI) controls the 4164 switch matrix. The main GUI selection screen presents a spreadsheet type matrix consisting of four columns and 16 rows with each switch output channel represented by one cell. Programming of the switch is as simple as clicking the mouse on one of the output cells and then selecting an input from a drop-down list.

Factory default names (In 1, In 2, Out 1, Out 2 etc.) are easily changed to any user defined name up to 32 characters long. Output channels color assignments provide an intuitive visual association of channel groupings similar to some manual patch panel configurations.

With frequent change-over of test articles in the test cells, it is important that an operator may quickly be able prepare for a subsequent test by programming the switch and name the input and output channels and save configurations to files and download the files the 4164 GUI as needed. The 4164 GUI accomplishes this by saving the current input and output setup and the color names groups files to the standard comma

separated variable (CSV) file format. These files are easily edited using Excel or any CSV file manager and imported back to the 4164 GUI as the active configuration.

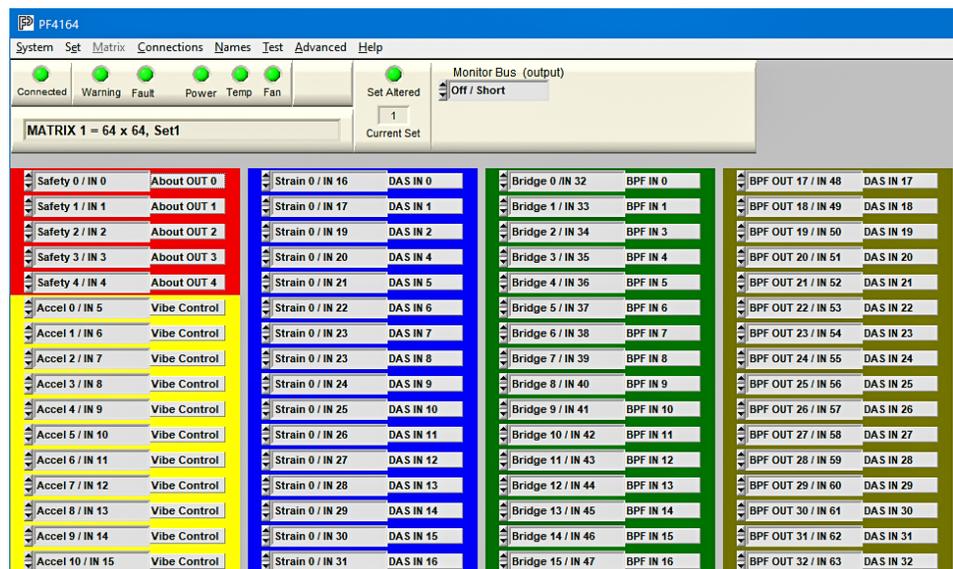
## System Health and Maintenance

The GUI displays the status of the power supply internal voltages, the cooling fans and the internal system temperature. If a failure condition is detected, the GUI warning LEDs indicators turn red. In addition, the system generates an audible warning and front-panel FAULT LED is activated.

The 4164 front-panel SOURCE connector is used to place an external test signal on the internal test bus that can be injected to a selected switch input. The front-panel SCOPE BNC is connected to the internal monitor bus and allows the user to monitor the output of any selected output.

The Monitor Bus menu is used to select the channel connected to the internal test bus or to select the channel connected to the internal monitor bus and output at the front-panel SCOPE connector.

Two types of test are available. FAT testing (Factory Acceptance Test, Option F) can be used to perform an exhaustive test of all switch settings, internal switch connections, and input/output connectors. The Go/No-Go test checks the integrity of the current setup and can be performed *in situ*, with all input and output cables connected.



The Main GUI Section Screen with User-Defined Colored Coded Groups and Descriptive Channel Names

# System Components

## Front Panel Controls, Indicators, and Connectors

### Power Switch and Indicator:

The on/off power switch, located on the front panel, includes a Power On LED that indicates when the system is powered up.

### Standby Power Indicator

The Standby LED indicates that the system has power and that the primary power switch, located on the rear of the frame, is in the *on* position.

### Ethernet Connector

The Ethernet interface 10/100BaseT connector (RJ45) provides the control link to a host PC computer.

### Menu Display and Programming Keys:

The front-panel menu display and keypad provide an alternative to the GUI or the remote interface to program the switch system and provide startup information.

### Monitor Hi and Low Jacks:

The monitor HI and LOW banana jacks provide connections to monitor a selected output with a digital multimeter.

### Source Connector:

The coaxial BNC external test source connector provides a connection for an external test signal from a programmable function generator.

### Scope Monitor Output Connector:

The coaxial BNC scope monitor output connector provides a means for viewing the output of a selected channel using a scope or other measurement device without disconnecting signal cables.

### Fault Indicator:

The warning LED indicates a system fault, such as if internal temperature or an internal power supply voltage is out of factory specifications.

## Rear Panel Components and Connectors

### Analog Input and Output Connectors:

Eight 26-pin D input connectors and eight 26-pin D output connectors with 8-channels on each connector.

### Power Supply

The field replaceable, low-noise AC power supply provides clean power to system. The 4164 system supports internal monitoring and reporting of power supply levels. Internal temperature and fan operations are also monitored, sounding an alarm if conditions are out of specified limits.

All 4164 systems are configured with the proper power supply input voltage and fuse(s) for your country when shipped from the factory, unless other requirements are specified.

### Power Entry Connector and Primary Power Switch:

The power connector provides the port for an AC power source and includes a power cord restraint. The primary power switch puts the system in standby mode.

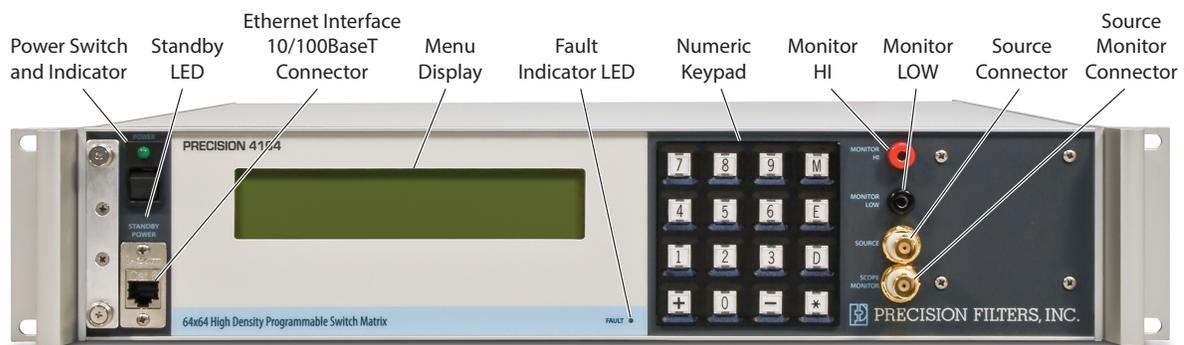
### Chassis Ground and Signal Ground Posts:

Signal and chassis ground posts are provided to provide the optimal grounding configuration for the test facility. The signal ground can be conveniently tied to the chassis using the included ground strap. If the chassis ground at the facility is noisy, the signal ground can be isolated from the chassis and tied to a more suitable low-noise ground connection.

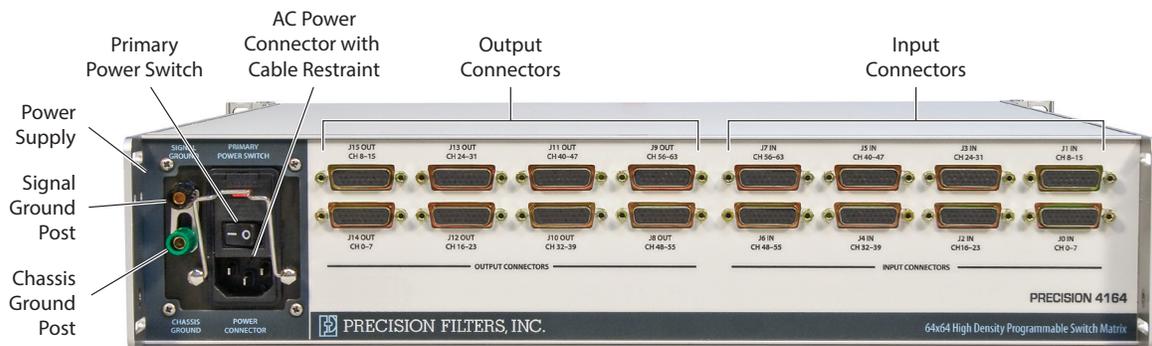
## Control Module

The 4164 switch matrix control module processes commands from the host computer via a 10/100 baseT Ethernet connection, as well as operates the front-panel display and reads input keys on the front panel.

The 4164 system operates as a single-connection server and may be programmed via a user application running on a host computer. Only one client can exercise control of the system at any point to protect the system from multiple origin control. Commands are easily interpreted high level ASCII keywords followed by an operator.



4164 Switch Matrix Front Panel



4164 Switch Matrix Rear Panel

# 4164 Switch Matrix Specifications

## Power Requirements

The standard power supply lets you select 120 or 240 VAC operation. The power frequency may range from 47 to 440 Hz.

**Connector:**  
IEC 320

**Voltage:**  
120 VAC, +10% -15%  
240 VAC, +10% -15%

**Power:**  
100 W

**Fuse:**  
2 amp Slo Blow @ 120V  
1 amp Slo Blow @ 240V

## 4164 Switch Matrix System General Characteristics

### Physical Characteristics

**Size:**  
19 x 19 x 2U (3.5 inches) (WDH)

**Weight:**  
16 lb. 2 oz.

### Environmental Requirements

**Operating Temperature:**  
0°C to 40°C

**Storage Temperature:**  
-20°C to 70°C

**Relative Humidity:**  
Less than 80%, noncondensing

## Accessories

### Mating Connectors

Precision Filters mating connectors accommodate up to 24-AWG wire and are supplied with high quality metal backshells with strain relief and gold plated screw machined contacts for high reliability connections and long service life.

#### CONN-OUT-26D

26-pin mating connector with crimp pins and strain relief, 20-24 gauge (PF part number A9405G1)

#### CONN-OUT-26D-SC

26-pin mating connector with solder cup pins and strain relief, 20-24 gauge (PF part number A9405G4)

### Cables and Panels

#### CB-HD26P/8BNCF-BH-L

High Density 26-Pin D-shell to 8-Channel BNC Female Cable for Bulkhead Panel Mount. L = Length in Feet.

#### PNL-64BNCBH-3U

Input or Output Panel for 64 Bulkhead Mounted BNC's, Standard 19-inch Rack Mount, 5.25-inch (3U). Labelled 0-63.

#### CB-HD26P/8BNCM-L

High Density 26-Pin D-shell to 8-Channel BNC Male Cable. L = Length in Feet.

#### CB-HD26P/HD26P-1.5

Spare 4164 test cable, one included with Option F (PF part number A10903G1)

## Mounting

### 2U-RM Rack

Mount Kit is pre-installed on each system and provides mounting at the front of a rack.

### PF4164-SM18 Slide Mount Kit

Accommodates cabinet depths of 18 to 23 inches. Provides addition support when needed such as when the system is mounted in a transit case. (PF part number B11618G1)

### Cable Tie Bar

The Cable Tie Bar provides a bar to secure input and output cables to the rear of the system. (PF part number B11247G1).

## Precision Product Solutions

For over 40 years Precision Filters has been a global provider of instrumentation for test measurements. You can rely on a single source for signal conditioning and switching—a *complete range of instrumentation*—products optimized to work together to provide high performance at a reasonable cost.

## Precision Products

### 28000 Analog Signal Conditioning System



**The new standard for the world's most discriminating test labs.**

The 28000 system makes it easy to manage a test, with up to 256 channels of fully programmable transducer conditioning. Choose a mix of bridge, charge, IEPE w/TEDS, voltage (filter/amplifier), strain, thermocouple, RTD/potentiometer, frequency, or other transducers.



### 464kC High-Density Programmable Switch Matrix

**Computer-controlled analog signal switching replaces tedious manual patch panels.**

The 464kC is a reliable solid-state switch matrix system that provides computer-controlled connection between 256 inputs and 256 outputs, all in a single mainframe. Save time and reduce errors on test system setup. Download switch configurations from the host computer over the network. Built-in self-test with fault diagnostics.

## Ordering Information

PF4164-<F>

Option F: Factory Acceptance Test and Test Cable