



*A Quantum Switch for the Better*

## Precision 4164 Switch Matrix High Density Programmable 64x64 Switch Matrix System

The Precision 4164 Switch Matrix System is a reliable solid-state switch matrix system in a compact rack mountable or bench top package providing computer-controlled connections between any input and any output.



Connect between 64 input and 64 output channels with 4,096 cross points.

Save time and reduce errors on your switch system setups. Program your switch configurations on a host computer, download them to your switch system over the network and your tests are ready to go. With system health monitoring, fault diagnostics and exhaustive self-tests, you can be confident of the integrity of your switch system.

### Salient Features

#### Switch Matrix Characteristics

- Solid state switch matrix
- High density: 4,096 cross points

#### Matrix Size

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

#### System Control

- Front panel control or remote host PC control via Ethernet
- Spreadsheet style graphical user interface for host PC control
- Non-volatile storage of switch configurations: store up to 8 setups in the system, store unlimited setups on host PC

#### System Integrity

- System health monitoring of power supply and internal temperatures
- Built-in self-test, with reports, exhaustively test switch settings

#### Signal Switching

- $\pm 10$  Vpk for each signal path

#### Input Characteristics

- Differential Input

#### Frequency Response

- DC to 1 MHz

#### Output Characteristics

- Single-ended with manually selectable ground sense

### 4164 Switch Matrix System Description

The Precision 4164 Solid State Switch Matrix System provides 64 x 64 rectangular coordinate switching with 4,096 cross points.

The 4164 Switch Matrix is a robust switching system. When power is applied to the system it provides uni-directional signal paths from the input to the output channels. When power is removed, switch settings are maintained in non-volatile memory and restored at power up.

The system is controlled from the front panel, remotely using command line control or by running a graphical user interface on the host computer.

The 4164's Internal Test Subsystem provides verification of the system integrity. The FAT (Factory Acceptance Test) 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.

### Switch System Specifications

#### Input Characteristics

**Differential Input:**  
 $\pm 10$  Vpk, linear

**Common Mode Input:**  
 $\pm 10$  Vpk, linear

**Common Mode Rejection Ratio:**  
78.0 dB  $\pm 25.5$  dB @ 15.36 kHz  
64.9 dB  $\pm 36.5$  dB @ 100 kHz  
59.9 dB  $\pm 37.6$  dB @ 300 kHz

**Protection:**  
 $\pm 35$  Vpk maximum, without damage

**Input Z:**  
2 M $\Omega$  differential  $\pm 1\%$ ,  
22.5 M $\Omega$  Common Mode

#### Transfer Characteristics

**Frequency Response:**  
0 dB  $\pm 0.01$  dB @ DC  
-0.008 dB  $\pm 0.01$  dB @ 15.36 kHz  
-0.350 dB  $\pm 0.05$  dB @ 100 kHz  
-2.390 dB  $\pm 0.27$  dB @ 300 kHz

**Level vs. Frequency:**  
 $\pm 10$  Vpk for  $f \leq 200$  kHz  
 $\pm 10$  Vpk (200 kHz/f) for  $f > 200$  kHz

**Recovery Time:**  
<1  $\mu$ s w/50% overload

**Total Harmonic Distortion:**  
 $\pm 0.1\%$  at 7 Vrms and 10 kHz

**Noise:**  
38.8  $\mu$ Vrms, maximum 100  $\mu$ Vrms,  
200 kHz BW

**All Hostile Crosstalk:**  
-81.4 dB  $\pm 4.0$  dB @ 15.36 kHz  
-66.5 dB  $\pm 3.1$  dB @ 100 kHz

**Phase Match:**  
 $\pm 1^\circ$  maximum, DC to 100 kHz

**DC Offset:**  
16.7  $\mu$ V  $\pm 860$   $\mu$ V

**Delay:**  
750 ns typical

#### Output Characteristics

**Output Type:**  
Single-ended with manual switch  
selectable ground sense

**Maximum Output:**  
 $\pm 10$  Vpk at 10 mA pk

**Output Z:**  
10  $\Omega$

Performance data is from tests performed with external instruments on nine units. A detailed uncertainty analysis report of our tests is available upon request.

# 4164 Switch Matrix System Operation

Switch settings can be entered or verified using the graphical user interface, front panel or remote interface. Running the built-in Go/No-Go self-test will verify that the unit has made the expected connections. Tests can be run unattended and diagnostics will isolate problems.

## Setting Up Your Switch Matrix System

The IN x OUT columns indicate a current input-to-output connection. The number on the left side is the input. The number on the right side is the output. The 64 x 64 matrix has 64 inputs (0 through 63) and 64 outputs (0 through 63). In the menu below, six pairs of inputs and outputs are shown. Connections are entered at the keypad using the up and down arrow keys.

```
IN * OUT SETUP 4 |Remote:
60*60      61*61      62*62 |CONNECT
63*63  open * 00      01*01 |Status:
Enter Inlet | OK
```

A switch setup can be constructed easily by listing inputs and outputs and identifying the desired cross points. It's easy to enter the cross points into memory. With the list, use the IN/OUT key to switch between the IN and OUT fields, enter the input or output using the arrow keys, then press the ENTER key to save the setting. Step to the next output and enter the input. You can quickly enter the cross points for a large matrix. Up to eight setups can be stored in the 4164 system.

The front panel menu and controls provide a convenient way to set up the switch system. There's computer control available, of course, via the remote interface. Setups can be uploaded and downloaded in text format through the remote interface so you can do your programming off-line and download to your switch system. Unlimited setups can be stored in the host computer using the graphical user interface.

The menu also displays system status information. The Remote field indicates whether the system is operating under front panel control or via the remote interface. The Status field is updated to indicate system faults. To review switch settings, step through the outputs by pressing the plus and minus keys in the keypad, and note the displayed input connections.

The SET: field indicates which of eight setups is selected as the active set for the matrix. The eight setups, Set 1 through Set 8, are stored locally on the switch in non-volatile memory. The system always powers up with the programmed settings for the Active Set when power was removed.

The MENU key provides access to the menus used to perform other system functions such as setting the network address or switching sets.

## Remote Operation

Programming the switch system from a host computer is as easy as operating it at the front panel. System setups programmed at the front panel can be up loaded to the host computer and stored. A stored setup can be downloaded from the host computer, eliminating programming effort altogether. Remote commands are in plain English and are similar to the front panel menu. This command sequence defines two switch closures for Set 1 of matrix 1.

### Command Description

SET:1;	Select Set 1 for configuration.
reset;	Reset (open) all switches in Set 1.
15*0;	Connect input 15 to output 0.
12*2;	Connect input 12 to output 2.

## Verifying Setups

You can read and verify from the front panel that the switch settings are in memory. Or you can call for status via the host computer.

### Command Description

SET:?	Report the active setup.
?*0;	Report the input connection for output 0.
?*2;	Report the input connection for output 2.

System status information can also be accessed via the remote interface using the "temp" and "ps" commands.

## System Health and Maintenance

The system control monitors the status of the power supply and internal temperature. If a failure is detected, an audible warning and front panel FAULT LED are activated and fault reports can be displayed using the Status key or read by the host computer.

The System 4164 front panel SOURCE connector is used to place an external test signal on the internal Test Bus which 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 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 tests are available. FAT tests (Factory Acceptance Test) 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.

# System Components

## Controls, Indicators and Connectors

### Front Panel

#### Menu Display and Programming Keys:

The front panel menu display and keypad provide a convenient way to set up the switch system.

#### 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.

#### Monitor Hi and Low Jacks:

The Monitor HI and LOW Banana jacks provide connections to a high performance multimeter.

#### Fault Indicator:

The Warning LED indicates a system fault such as over temperature or a power voltage out of factory specifications.

#### Ethernet Connector:

RJ45 Ethernet connector provides the control link for a host computer.

#### Power Switch and Indicator:

The On/Off Power Switch is located on the front panel and includes a Power On LED indicating when the system is powered up.

#### Standby Indicator

The Standby LED indicates that the system has power and the Primary Power Switch, located on the rear of the frame, is in the on position.

### Rear Panel

#### Analog Input and Output Connectors:

Eight 26-pin D input connectors.  
Eight 26-pin D output connectors.

#### Power Connector and Primary Power Switch:

The Power Connector provides a connection for an AC power source and includes a power cord restraint. The Primary Power Switch applies power to the system and puts the the system in standby mode.

#### Chassis Ground and Signal Ground Posts:

The Chassis Ground post and the Signal Ground post provide a means for connecting chassis ground to the signal ground.

## Control Module

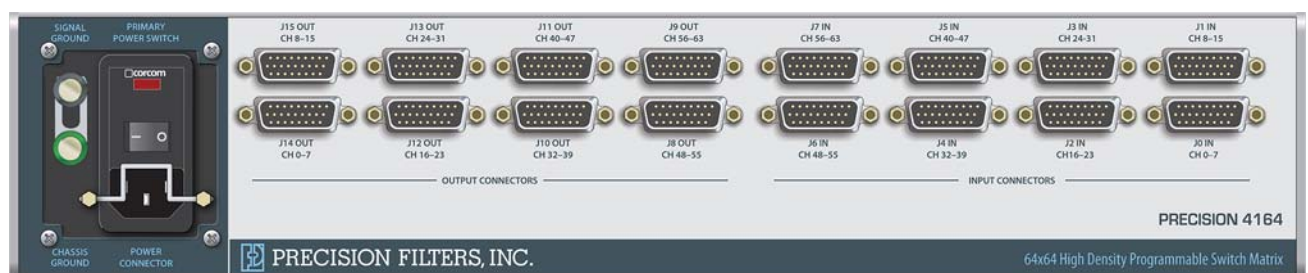
The 4164 Switch Matrix control module provides programming commands to the I/O stages. The control module operates the front panel display, reads input keys and processes commands from the remote interface(s).

The control module also provides 10/100 baseT Ethernet interface. IP address and port configurations are set using a front panel menu sequence. The IP assignment is static.

The control module also monitors the status of the power supply and internal temperature. If a failure is detected, a front panel FAULT LED is activated.



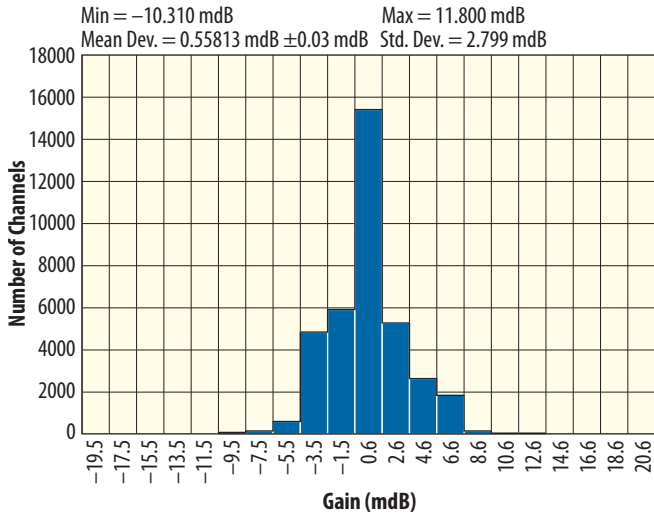
4164 Switch Matrix Front Panel



4164 Switch Matrix Rear Panel

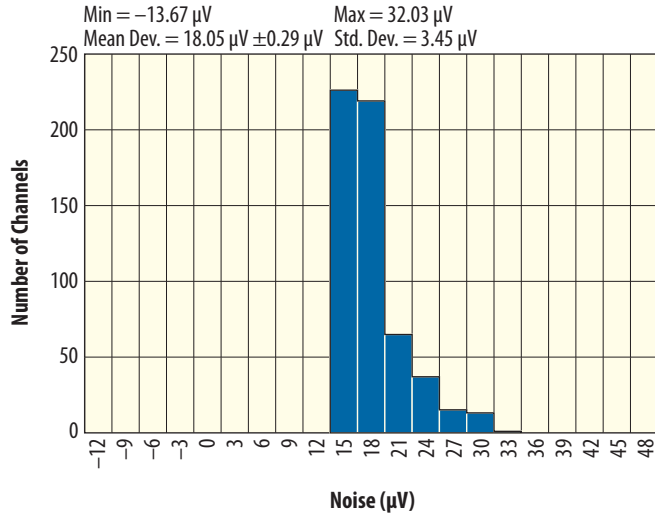
# Typical Performance Characteristics (with Built-in Self-Tests)

## Gain



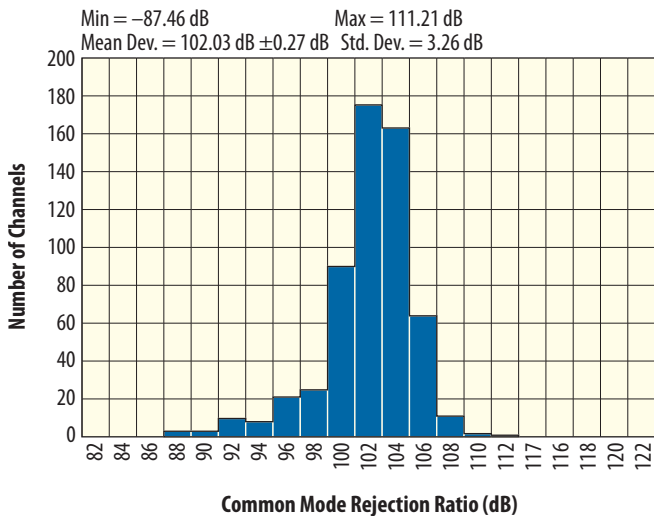
Nine systems tested, 4,096 channels tested per unit

## Noise



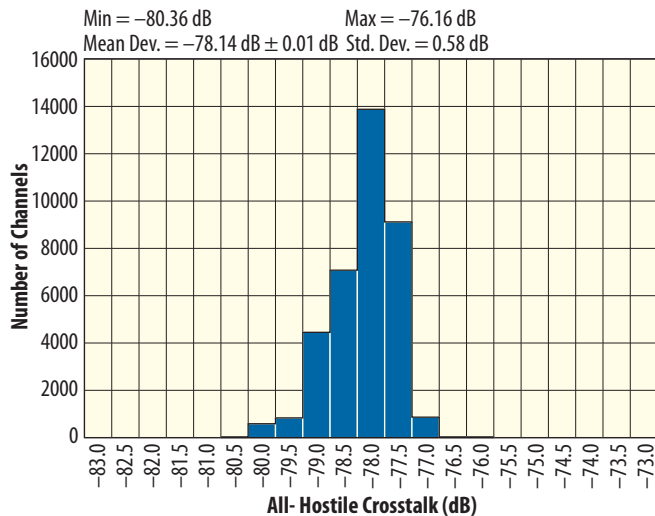
Nine systems tested, 64 channels tested per unit

## Common Mode Rejection Ratio



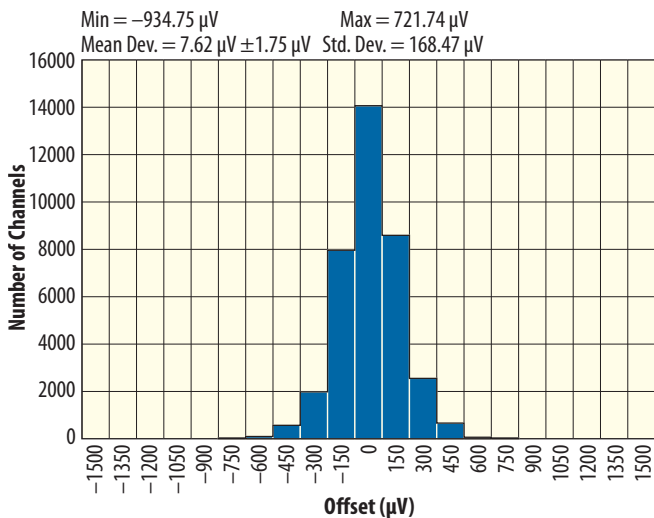
Nine systems tested, 64 channels tested per unit

## All-Hostile Crosstalk



Nine systems tested, 4,096 channels tested per unit

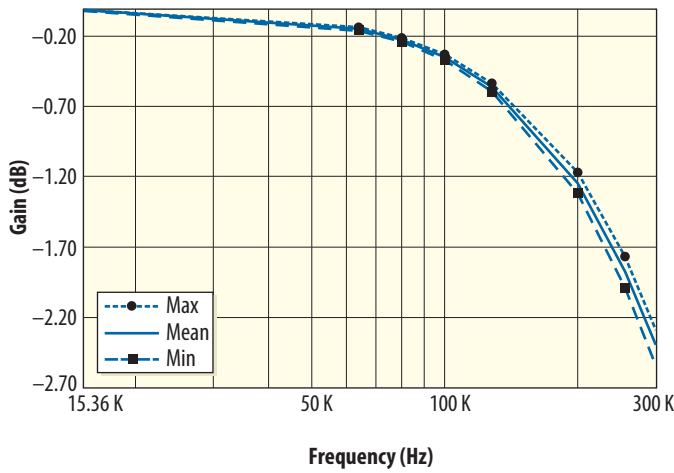
## DC Offset



Nine systems tested, 4,096 channels tested per unit

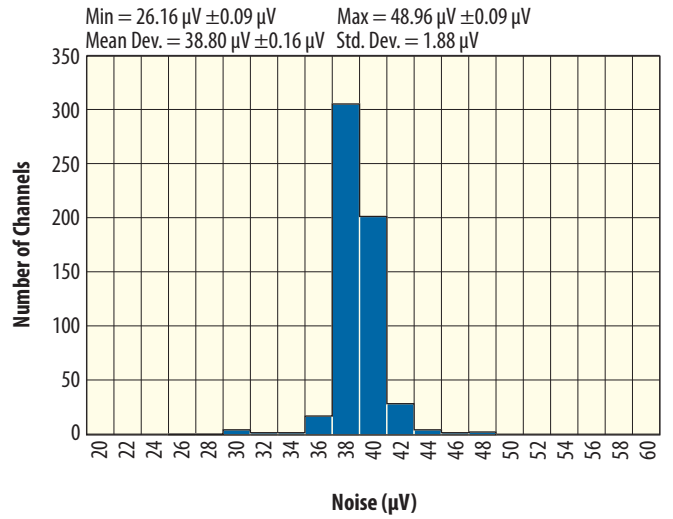
# Typical Performance Characteristics (with External Instruments)

## Gain vs. Frequency



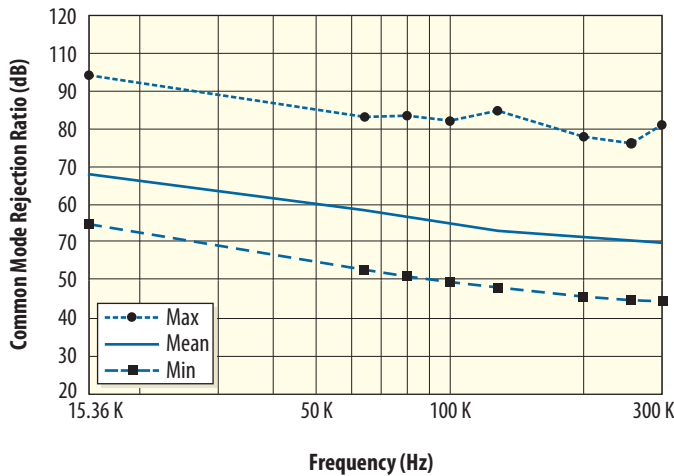
Nine systems tested, 4,096 channels tested per unit

## Noise



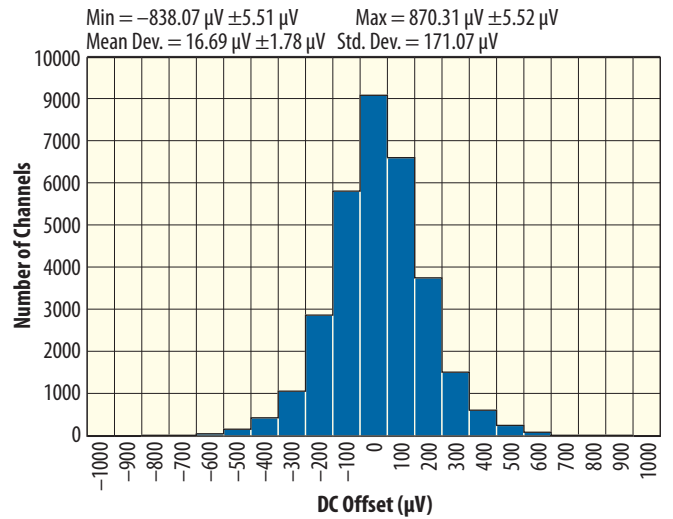
Nine systems tested, 64 channels tested per unit

## Common Mode Rejection Ratio vs. Frequency



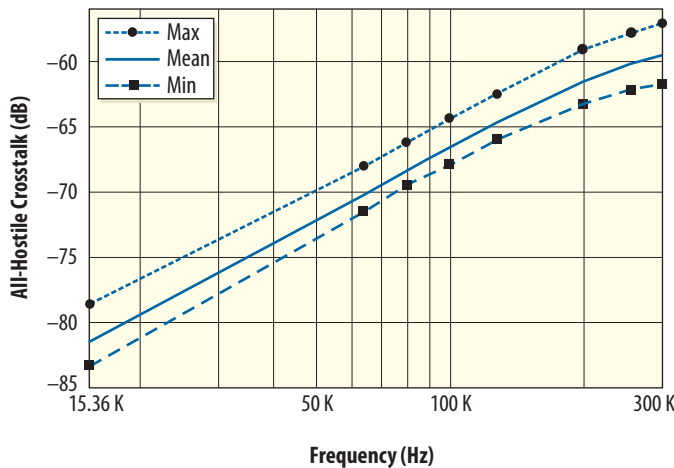
Nine systems tested, 64 channels tested per unit

## DC Offset



Nine systems tested, 4,096 channels tested per unit

## All-Hostile Crosstalk vs. Frequency



Nine systems tested, 4,096 channels tested per unit

# 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 Temp:

0° C to 40° C

#### Storage Temp:

-20° C to 70° C

#### Relative Humidity:

Less than 80%, non-condensing

## Mating Connectors, Cables, and Test Accessories

### CONN-OUT-26D-MTL

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

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

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

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

Cable set for bulkhead panels; 26-pin D-shell with eight BNC connectors

### 4164-I/O-TEST

4164 Test Cable, 1 required (PF part number A10903G1)

## Accessories

### Mounting

#### 2U-RM 19-inch Rack Mount Kit:

Rack Mount Kit provides standard 2U height RETMA rack installation (included with system)

#### 4164-Rear Mount Bracket Kit

Rear Mount Bracket Kit Provides additional support in a RETMA rack installation (PF part number B11248)

## Precision Product Solutions

For over 30 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 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.

### 464kB High Density Programmable Switch Matrix



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

The 464kB 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.