

# SCB-2U-16FA-UNV

## 16-Channel Universal Signal Conditioner for Voltage, RTD, and 4-20 mA Sensors



### Description

The SCB-2U-16FA-UNV Signal Conditioner is a programmable 16-channel universal signal conditioner for RTD's, silicon diodes, 4-20 mA output sensors, or any voltage output device up to 60 V. The balanced differential input, low-noise gain stages, and programmable 4-pole filter remove aliases and maximize dynamic range for an attached A/D converter system. The dual-mode excitation supply provides either +24 V to power external pre-amplifiers, or a precision 100  $\mu$ A constant current source to excite RTD's or silicon diodes.

Programmable channel gain and optional 4-pole FLAT/PULSE low-pass filters provide clean, amplified "data acquisition ready" output signals. The AC-coupled amplifier stage provides programmable gain settings up to x1000 in a x1, 2, 5, 10 sequence with 0.1% accuracy. The standard unit includes a 4-pole dual-mode LP4FP low-pass filter available in two standard ranges, each with five programmable cutoff frequencies. The FLAT mode (LP4F) provides a maximally flat pass-band response; the PULSE mode (LP4P) provides linear phase with optimized pulse response. A wideband mode (filter bypass) is also standard.

Packaged in a 2U rack-mounted enclosure, the SCB-2U-16FA front panel features 6-pin 38999 type circular connectors as inputs for each of the 16 channels. Test and Monitor BNCs allow for testing, monitoring, troubleshooting, and other diagnostics. Analog channel outputs are mass terminated to industry standard 37-pin D-shell connectors for easy connection to ADC inputs. An Ethernet connector with IP reset switch, a signal ground connector with ground source selection switch, and a power connector and power switch with status indicators are also located on the rear panel

The settings on the SCB-2U-16FA are fully programmable via high-level, English-language readable remote commands or by a stand-alone spreadsheet style graphical user interface that runs on a Windows PC. Channel overload and current limit fault of the 24 V excitation supply are continuously monitored and indicated on the GUI panel or remote interface. Chassis temperature, voltage, current, and loop resistance of RTD measurements are available on command without disruption of the RTD measurement.

Option F together with the SCB-7-TEST third-party test instruments and required adapters and cables adds Factory Acceptance Test (FAT) capability. The SCB FAT, initiated from the SCB GUI, is a fully automated, NIST traceable series of tests that measure and report the unit's performance against published specifications.

The SCB-2U-16FA is powered by 10.8 to 30 V DC and is supplied with a tension clamp power entry connector. An external AC-to-DC universal supply is available from Precision Filters.

### Specifications

**Number of Channels:** 16

**Input Connectors:**

16 isolated 6-pin circular 38999 type connectors at the front panel

**Input Characteristics:**

**Type:** DC coupled, balanced differential input w/ shield

**Input Operating Modes:**  $\pm 10$  V,  $\pm 60$  V, 4-20 mA (100  $\Omega$  sense)

**$\pm 10$  V Input Mode:**

**Input Impedance:** 10 M $\Omega$ //50 pF per side

**Input Protection:** 32 VDC continuous

**Common-Mode Level:**  $\pm 10$  V

**CMRR:** 100 dB, DC to 440 Hz, input gain  $\geq 10$

**Max Level at Diff Amp Input:**  $\pm 10$  Vpk for  $f \leq 100$  kHz;  $\pm 10$  Vpk x (100 kHz/f) for  $f > 100$  kHz

**DC Offset Drift:** 1  $\mu$ V/ $^{\circ}$ C, typical

**Noise:** 15 nV/ $\sqrt{\text{Hz}}$  at 1 kHz and gain  $\geq 100$  (max)

**$\pm 60$  V Input Mode:**

**Fixed Input Attenuator:** 1/10,  $\pm 0.2\%$  DC accuracy

**Input Impedance:** 100 k $\Omega$  per side

**CMRR:** 50 dB, DC to 440 Hz

**Max Input:**  $\pm 60$  Vpk for  $f \leq 100$  kHz;  $\pm 60$  Vpk x (100 kHz/f) for  $f > 100$  kHz

**4-20 mA Sense Mode:**

**Resistance:** 100  $\Omega$ , 0.02% sense resistor with fixed channel gain of 5x (equivalent to 500  $\Omega$  resistor)

**Total Input Impedance:** 600  $\Omega$

**Voltage on Input Terminals:** Input current (4-20 mA) x 600  $\Omega$

**Drift:** 17  $\mu$ V/ $^{\circ}$ C, typical

## Specifications (Continued)

### Test Input:

A switch at the channel input allows for injection of external test signal via an external front panel BNC connector.

### Input Short:

Amplifier inputs may be programmed to ground to measure amplifier noise and DC offset.

### MUTE Mode:

When the Mute button is ON, the channel is placed in a quiescent state, minimizing the possibility of coupling noise on properly functioning channels from a faulty or failed sensor. Mute Mode is also useful for terminating unused channels in a safe and quiet state.

### Excitation:

#### 24 VDC Sensor Excitation:

**Accuracy:**  $\pm 5\%$  of setting

**Current:** 40 mA

**Short Circuit Protection:** 50 mA (excitation and signal out protected)

**Current Limit Indicator:** Warning LED (illuminated red) when in current limit

#### 100 $\mu$ A Constant Current Sensor Excitation:

**Type:** Single-ended, 2, 3, or 4-wire modes supported via wiring to input connector

**Level:** 100  $\mu$ A  $\pm 0.03\%$

**Drift:** 10 PPM/ $^{\circ}$ C

**Compliance:** 10 V ( $R_{load} = 100$  k $\Omega$  max)

**Spectral Noise:** 1.2 pA/ $\sqrt{\text{Hz}}$  @ 1 kHz  
0.1-10 Hz Pk-Pk Noise: 400 pA

### Amplifier and Filter:

**Gain Settings:** x1, x2, x5, x10, x20, x50, x100, x200, x500 and x1000

**Overload Detection:**  $\pm 10.2$  Vpk threshold (pre-filter)

**Overall Gain Accuracy:** 0.1% (includes gain stages and filter; excludes attenuator accuracy)

#### Low-Pass Filter:

##### Type:

4-pole, 4-zero FLAT/PULSE low-pass filter w/ programmable bypass for wideband operation. Programmable for maximally flat (LP4F) or linear phase with optimized pulse response (LP4P).

The LP4F is specified to have excellent pass-band flatness and sharp roll-off characteristics. The pass-band characteristic is nearly identical to a 4-pole Butterworth yet the LP4F has a much sharper roll-off. The LP4F is a good choice for applications that require spectral analysis and anti-aliasing. The LP4P has excellent transient response and

phase linearity making it a good filter for time domain applications including transient (shock) measurements and waveform analysis. The LP4P's frequency and time domain characteristics are superior to a 4-pole Bessel filter.

#### Cutoff Frequencies:

##### FX01 Range:

100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz

##### FX02 Range:

300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz

#### Pass-Band Accuracy:

$\pm 0.1$  dB, DC to  $F_{-0.1\text{dB}}$

$\pm 0.15$  dB to  $F_{-0.5\text{dB}}$

$\pm 0.25$  dB to  $F_{-3.01\text{dB}}$

**Wideband (Bypass) Mode:** 140 kHz -3dB bandwidth (typical)

LP4FP Filter Specifications		
Spec	LP4F 4-Pole Maximally Flat Low-Pass Filter	LP4P 4-Pole Constant Time Delay Low-Pass Filter
Number of Poles	4	4
Amplitude @ Cutoff ( $F_c$ )	-3.01 dB	-3.01 dB
DC Gain	0.00 dB	0.00 dB
Stop-Band Frequency (-80 dB)	5.9465 $F_c$	11.863 $F_c$
Phase @ $F_c$	-180.0 $^{\circ}$	-101.5 $^{\circ}$
Phase Distortion (DC to $F_c$ )	<31.8 $^{\circ}$	<3.7 $^{\circ}$
Zero Frequency Group Delay	0.4117/ $F_c$	0.2920/ $F_c$
Percent Overshoot	11.1%	0.5%
1% Settling Time	1.65/ $F_c$	0.66/ $F_c$
0.1% Settling Time	2.72/ $F_c$	0.77/ $F_c$
-0.1 dB Frequency	0.635 $F_c$	0.182 $F_c$
-0.5 dB Frequency	0.775 $F_c$	0.406 $F_c$
-1 dB Frequency	0.849 $F_c$	0.574 $F_c$
-2 dB Frequency	0.937 $F_c$	0.813 $F_c$
-3.01 dB Frequency	1.000 $F_c$	1.000 $F_c$
-20 dB Frequency	1.741 $F_c$	3.025 $F_c$
-40 dB Frequency	2.956 $F_c$	5.693 $F_c$
-60 dB Frequency	4.599 $F_c$	9.098 $F_c$
-80 dB Frequency	5.947 $F_c$	11.86 $F_c$

## Specifications (Continued)

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### Output Characteristics:

**Type:** DC coupled, single-ended

**Output Connector:** 37-pin connector at rear panel

**Impedance:**  $10\ \Omega // 100\ \text{pF}$

**Max Output:**  $\pm 10\ \text{V pk}$ ,  $\pm 4\ \text{mA pk}$

**Offset:**  $\leq 5\ \text{mV}$  at any gain setting after auto-adjust

**Offset Drift:**  $1\ \mu\text{V}/^\circ\text{C}$ , RTI +  $100\ \mu\text{V}/^\circ\text{C}$  RTO, typical ( $17\ \mu\text{V}/^\circ\text{C}$  RTO in 4-20 mA mode)

**Noise:**  $5\ \mu\text{V rms RTI}$  +  $100\ \mu\text{V rms RTO}$ ; 3 Hz to 100 kHz

**Output Protection:** Short circuit protection (excitation and signal out)

### Output Monitor:

A switch at the output of each channel allows for multiplexed connection to the chassis output monitor bus BNC connector for viewing any channel output with an external device.

### NIST Traceable Self-Test (Option F):

All test and measurement systems require periodic calibration. Typically, this means dismantling systems and shipping components to an in-house cal lab or back to the manufacturer. Precision Filters' built-in test hardware and software enables NIST traceable calibration tests on site without removing the system from the rack.

The test subsystem consists of the SCB graphical user interface (GUI), the SCB-2U-16FA with Option F installed, and the SCB-7-TEST third-party test instrument package. For traceability, a high-performance digital multimeter (DMM) is kept in calibration by a third-party metrology test lab.

Test software within the SCB GUI verifies calibration and traceability information of the DMM and then proceeds, step by step, through an extensive test routine. Every system function is executed, and all data-critical performance characteristics are accurately measured and compared to published specifications. These calibration tests are the same rigorous measurement routines performed in the factory before shipment, and they serve as a robust Factory Acceptance Test (FAT) to be used by a customer upon receipt of new equipment.

The SCB FAT verifies all key performance characteristics, including: Filter and amplifier frequency response, gain accuracy, AC coupling, noise, common-mode rejection ratio (CMRR), excitation levels and max signal level.

### Control:

For local control, the SCB-2U-16FA system is controlled via the rear panel 10/100 Base T Ethernet interface using the supplied spreadsheet-style GUI application

running on a Windows PC. The GUI supports control of all channel and system features and allows for group control of channels. Up to 8 systems in the SCB-2U family can be controlled by a single GUI.

Alternatively, the system may be controlled remotely via a high-level command line interface over the Ethernet connection. All features and functions in the GUI are available over the remote interface.

The settings are retained when the computer is disconnected even after a power cycle, allowing the unit to be pre-configured for an application in which a computer may not be available for control. A front panel reset button restores the IP address to factory default.

### Physical:

**Size:** 19" rack mount, 10" Depth, 2U

**Weight:** 6.6 lb. (net)

**Operating Temp:** 0 to 55°C

**Storage Temp:** -25 to 85°C

**Humidity:** 10% to 90% noncondensing

### Power:

Power is supplied to the SCB-2U-16FA from either a direct DC power source or via an AC/DC power converter. A power supply mating connector is supplied with each SCB system.

**Input:** 10.8-30V DC @ 70W Max

**Connector:** Rear-panel with on-off switch

**Power Entry Connector:** 3-pin Weidmuller Omnimate tension clamp connector

### Ground:

A signal ground post is located on the rear panel. A slider switch can connect signal ground to chassis ground for normal, ground-referenced operation. Alternatively, the switch can be set to isolated mode to reference the SCB circuitry to an external ground connected to the signal ground post.

**Isolation:** External ground reference can be up to 60 V from the SCB-2U-16FA chassis ground.

### Certifications:

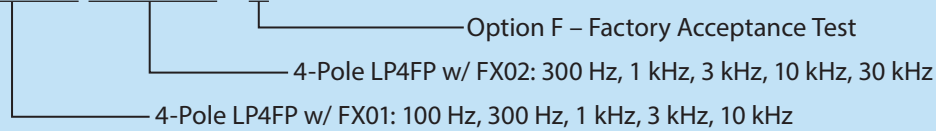
CE, RoHS

Safety Standards: EN 61010-1

EMC Standards: EN 61326-1

## Ordering Information

SCB-2U-16FA<FX01-LP4FP|FX02-LP4FP><F>



## SCB-7-TEST Subsystem Components

**Keysight 33509B Waveform Generator:** Used as the source of test signals in the SCB test subsystem

**Keysight 3458A Digital Multimeter:** Used as the measuring device in the SCB test subsystem

**NI GPIB-USB-HS+:** Allows for PC control of the digital multimeter via USB connection to host PC and NI GPIB configuration software

**Keysight 34191A Flange Kit:** Provides mounting hardware for the 3458A multimeter

**Keysight 34190A Flange Kit:** Provides mounting hardware for the 33509B waveform generator

## Accessories

**CB-SCB-32CC-Test:** 4 ft DE9 to banana plug (4 connectors) FAT test cable

**CB-BNC-48:** 4 ft coaxial BNC cable that connects the waveform generator to the SCB Test input

**SCB-2U-UNV-TEST-ADAPTER:** FAT test adapter (16 required, one per channel)

**SCB-ACDC-130W:** Optional external power AC to DC supply with 3-position tension clamp connector

**CONN-IN-38999-6P:** Mating 38999 nickel plated input connector w/ strain relief and gold plated machined pin contacts (accommodates 22-28 AWG wire)

**CONN-IN-TCP3:** Tension clamp mating power entry connector (one included with system)

**CB-DC37P/16BNM-SCB-4:** 4 ft 37-pin D to 16 male BNC output cable

**CB-DC37P/16BNM-SCB-L:** Custom length (L) 37-pin D to 16 male BNC output cable

## SCB-2U-16FA-FX?-LP4FP Block Diagram

