Installation and Operating Instructions

KSC-1

High-Performance Industrial Signal Conditioner for Kulite Sensor Products

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Rev. B

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Revision Record		
Rev Level	**Date**	**Description of Change**
-	1/10/2018	Initial release
A	10/9/2019	Added filter option BE4 cutoff frequencies
B	09/01/2020	Added Typical Pressure Transducer Color Code to Fig 6

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1 Safety Guidelines

This document describes how to use the KSC-1 Signal Conditioner and includes product information, installation, operation instructions, and contact information for support and service.

The safety guidelines and product information in this document are specific to the KSC-1 Signal Conditioner. The other components in your system might not meet the same safety rating and specifications. Please read and understand the documentation for each component in your system to determine the safety rating and specifications of the entire system.

CAUTION

A CAUTION statement describes a hazard. It calls attention to a procedure, practice, or condition that, if not correctly performed or adhered to, could result in damage to the product or loss of data. Do not proceed beyond a CAUTION statement until the conditions are fully understood and met.

WARNING

A WARNING statement describes a hazard. It calls attention to a procedure, practice or condition that if not correctly performed or adhered to could result in personal injury or death. Do not proceed beyond a WARNING statement until the conditions are fully understood and met.

1.1 Safety Information

General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in this document. Do not install substitute parts or perform any unauthorized modification to the product.

Return the product for service and repair to ensure that safety features are maintained. See the *Support and Service* section of this manual for information on how to contact Kulite Semiconductor Products, Inc.

Environmental Conditions

Unless otherwise noted in the specifications, this instrument or system is intended for indoor use in an installation category II, pollution degree 1 environment per IEC 61010-1 and 664 respectively. It is designed to operate at a maximum relative humidity of 5% to 95% (non-condensing). This instrument or system is designed to operate at altitudes up to 2000 meters, and at temperatures between 0 and 70° C.

Do not operate in an explosive atmosphere.

Do not operate the instrument in the presence of flammable gases or fumes.

Ground the Instrument

This product must be properly grounded before applying power. To minimize shock hazard, the instrument must be grounded though the DIN rail clip or the DIN rail clip screw, by mounting the unit to a grounded DIN rail or attaching a grounded wire to the DIN rail clip. Any interruption of the earth ground or disconnection of the ground will cause a potential shock hazard that could result in personal injury.

Safety Symbols


Chassis Ground


Signal Ground


Direct Current


Risk of Electric Shock


Refer to Manual for Additional Safety Information

Table of Contents

1 KSC-1 General Information

1.1 Introduction

This manual, *KSC-1 Signal Conditioner Installation and Operating Instructions*, contains information specific to the installation and configuration of the KSC-1 signal conditioner. Refer to this document and to the documentation supplied with each component in your system to understand how to operate your entire system safely and correctly.

The *KSC-1 Signal Conditioner Installation and Operating Instructions* manual comprises the following chapters:

KSC-1 General Information (this chapter) provides an overview and specifications of the KSC-1 system, along with environmental requirements.

KSC-1 Installation Instructions contains location and power requirements, installation instructions, grounding instructions and cable connections.

KSC-1 Operation and Configuration Instructions describes operating, programming and adjusting KSC-1 Signal Conditioner.

KSC-1 Troubleshooting offers steps to deal with common problems, such as when the unit does not turn on.

Support and Service tells you where to get technical support and how to obtain service or repair.

1.2 Description

The KSC-1 is part of the Kulite signal conditioning product family optimized specifically for Kulite sensor products. The KSC-1 is an industrial grade precision amplifier/filter with constant voltage excitation optimized for conditioning Kulite pressure sensors and microphone products in lab, test stands or industrial environments. Precise excitation with remote sense provides voltage for bridge type sensors. Excitation levels of 5 or 10 V are selectable via front panel switches. Manual balance/zero multi-turn potentiometers are provided for transducer balance and offset adjustment.

A low-noise, high common-mode rejection balanced differential input is supplied. Precision 4-pole Butterworth or Bessel low-pass filter options are available with four selectable cutoff frequency settings. Amplification is distributed as pre and postfilter gain, allowing for elimination of out-of-band energy such as transducer resonances that can cause non-linearities due to clipping of the amplifier. Overload detectors alert the user to output overloads as well as prefilter overloads that may be masked by the low-pass filter.

The KSC-1 may be mounted on a standard DIN rail with supplied clip. The module is powered using an external 10 to 32 VDC input (not supplied).

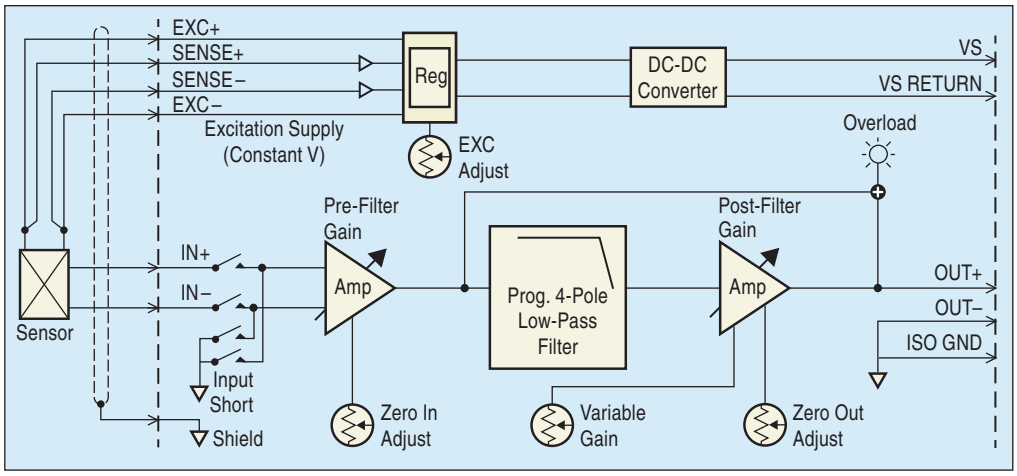

Figure 1 KSC-1 Channel Block Diagram

1.3 Features

- Single-channel module, DIN rail mountable
- 0.1% DC accuracy
- 4-pole low-pass filters with four selectable cutoffs
  (BU4: 100 Hz, 5 kHz, 25 kHz and 50 kHz)
  (BE4: 5 kHz, 25 kHz, 50 kHz and 100 kHz)
- Multi-turn potentiometers (with defeat mode) for precise bridge suppression, gain and amplifier offset
- Constant voltage excitation with remote sense
- Selectable excitation: 0, 5, 10 V with calibration potentiometer
- Manual bridge balance/suppress
- Balanced differential input
- 10 nV/$\sqrt{\text{Hz}}$ maximum input noise
- Pre-filter gain: x1, 2, 5, 10, 20, 50, 100
- Post-filter gain: x1, 2, 5, 10
- Variable gain for adjustment from 90 to 110% of output
- Input and output overload detection
- Input short via momentary switch or remote
- Zero excitation via momentary switch or remote
- 5th wire buffered output
- Compact, rugged design for industrial use
- DIN rail mounting
- 3.1 x 1.2 x 5.2 inches (LxWxH)
- 11.5 oz. net
- 0° C to 70° C (operating); –40° C to 105° C (storage)
- 1 ea. 9-pin female D-Sub for transducer interface and signal input
- 1 ea. 9-pin male D-Sub for power in and signal out
- 10 – 32 V DC power input, 3 W maximum

1.4 Specifications

1.4.1 KSC-1 Constant Voltage Excitation

Type:

Unipolar constant voltage excitation with selectable Local/Remote sense

Level:

5 or 10 V selected by front panel switches

Drive:

30 mA with 35 mA current limit indicated by front panel LED

Sense Boost:

Excitation boost limited to 3 V with passive protection in the sense leads.

EXC Off:

Momentary front-panel push button to set excitation to 0 VDC for sensor self-generated noise measurement.

Initial Accuracy:

Factory set to ±0.1% of setting ±5 mV

Calibration:

25T potentiometer for field calibration

Noise:

25 µVrms, 3 Hz to 25 kHz

Drift:

±0.0025%/° C of setting or ±150 µV/° C

Stability:

±0.005% of setting or ±250 µV for 8 hours

1.4.2 KSC-1 Input Characteristics

Type:

DC-Coupled balanced differential input

Common Mode Voltage:

±10 V operating

Input Level:

±10 Vpk

Input Protection:

24 VDC continuous

Input Impedance:

10 MΩ per side

Drift:

1 µV/° C, RTI

CMRR (input gain ≥x10):

90 dB, DC to 1000 Hz

Spectral Noise:

10 nV/$\sqrt{Hz}$ at 1 kHz RTI

Balance/Zero:

25T pot at front panel to provide Zero/Balance RTI (Z IN) adjustment up to ±20 mV of input voltage suppression for pre-filter gain settings of x10 or greater and up to ±200 mV of input voltage suppression for pre-filter gain settings of x5 or lower.

Input Short:

Momentary pushbutton input short for measuring amplifier offset and noise.

5th Wire Input:

Buffered, unity gain

1.4.3 KSC-1 Amplifier Characteristics

Pre-Filter Gain:

x1, 2, 5, 10, 20, 50, 100 with pre-filter overload detection

Post-Filter Gain:

x1, 2, 5, 10 with output overload detection

Overload Level:

10.2 V, ±2%

Variable Gain:

25T pot at front panel for continuous adjustments of
90 – 110% of full-scale output

Overall DC Accuracy:

±0.1 % at any gain setting. Includes filter.

Temperature Coefficient:

±0.004% / C

DC Linearity:

0.005% re: full scale output, best-fit straight line

1.4.4 KSC-1 Filter Characteristics

Type:

4-Pole Low-Pass Butterworth (BU4) or Bessel (BE4) selected at time of order

Cutoff Frequencies:

(BU4) 100 Hz, 5 kHz, 25 kHz and 50 kHz,
(BE4) 5 kHz, 25 kHz, 50 kHz and 100 kHz

Selectable via front panel switches. Custom cutoff frequencies available. Consult factory.

Cutoff Frequency Amplitude:

–3.01 dB

Pass-Band Accuracy:

±0.2 dB maximum to 0.8 Fc

Amplitude Match:

±0.2 dB maximum to 0.8 Fc

Phase Match:

±2° max to 0.8 Fc

1.4.5 KSC-1 Output Characteristics

Type:

DC coupled, single-ended output

Impedance:

10 Ω

Max Output:

±10 Vpk, ±10 mA pk

Offset:

50 µV RTI + 5 mV RTO adjustable to zero

Zero Out:

25T potentiometer at front panel to provide ±2.5 V of offset adjustment at the channel output

Offset Drift:

1 µV/°C, RTI + 150 µV /°C RTO, typical

Noise:

1.5 µV rms RTI + 30 µV rms RTO, 3 Hz to 25 kHz

1.4.6 General Characteristics

Size:

3.1 x 1.2 x 5.2 inches (L x W x H)

Weight:

11.5 oz. (326 grams) net

Temperature:

0°C to 70°C (operating); –40°C to 105°C (storage)

Humidity:

5% to 90% noncondensing

Input Connector:

9-pin D-sub female

Power In/Output Connector:

9-pin D-sub male

1.5 ISO/IEC Conformity

Product Category:

Electrical equipment for measurement, control, and laboratory use conforms to the directives and standards listed below.

Council Directive 2004/108/EC, Electromagnetic Compatibility,
IEC 61326-1:2005

Emission, group 1 equipment measured on a test site:

- CISPR 11:2010 Conducted emissions: Class B, 150 kHz to 30 MHz.
- CISPR 11:2010 Radiated emissions: Class B, 30 MHz to 1 GHz.
- 61000-3-2:2009 Harmonics
- 61000-3-3:2008 Flicker

Immunity, equipment intended for use in industrial locations:

- IEC 61000-4-2:2009 Electrostatic discharge: Performance Criteria B, 4 kV by contact, 8 kV by air discharge
- IEC 61000-4-3:2010 Radiated immunity: Performance Criteria B, 10 V/m, 80 MHz to 2.7 GHz, 80% AM with 1 kHz sine wave modulation, 200 Hz pulsed modulation
- IEC 61000-4-4:2011 Electrical fast transient/burst: Performance Criteria B, 1 kV to AC power line, Ethernet communication line, signal lines
- IEC 61000-4-5:2005 Surge: Performance Criteria B, 1 kV line to line/2 kV line to ground for AC power port, 1 kV for I/O signal/control lines, including functional earth lines
- IEC 61000-4-6:2008 Conducted immunity: Performance Criteria B, 10 V, 150 kHz to 80 MHz
- IEC 61000-4-11:2004 Voltage dips: Performance Criteria B, AC power port, 0% during half cycle, 0% during 1 cycle, 70% during 25 cycles for 50 Hz test, 70% during 30 cycles for 60 Hz test
- IEC 61000-4-11:2004 Voltage interrupts: Performance Criteria C, AC power port, 0% during 25 cycles for 50 Hz test, 0% during 30 cycles for 60 Hz test

Council Directive 2006/95/EC, Low-Voltage Safety

- IEC 61010-1:2010 Product meets the essential requirements for low-voltage safety.

Note: To meet the above directives and standards, the external power supply (not included with the KSC-1) must meet CE requirements, applicable EC directives and ISO/IEC standards.

1.6 Automotive Test Applications

The KSC-1 is also suitable for automotive test applications provided the 3W power input is derived from a source having an approved NRTL certification required by many automotive manufacturers. All of the internal power rails within the KSC-1 chassis are at low voltages derived from this 3W input. The KSC-1 would not exceed 3W if all internal components were operating at maximum current levels. No testing beyond input power certification is needed to achieve complete Underwriter's Lab listing for the KSC-1 electronics due to the low power and low voltage levels within the KSC-1 chassis.

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2 KSC-1 Installation Instructions

2.1 Introduction

This section contains instructions for installing and connecting the KSC-1 signal conditioner: unpacking, location, power requirements, grounding options, mounting options, and connecting cables.

Before installing the system, read the complete procedure to become familiar with the requirements and steps.

2.2 Site Preparation

This section describes the preparations that are necessary before you install the system.

2.2.1 Power Requirements

The KSC-1 requires input power of 10–32 VDC, 3 W maximum, applied at Power Input/Signal Output connector located on the bottom panel. See Section 2.6.7 *Power Input/Signal Output Connector* for the connector pin assignments.

2.2.2 Location Requirements

KSC-1 units must be installed and operated in an area that meets and can maintain the environmental specifications listed below:

- Maximum temperature: 70°C (158°F)
- Minimum temperature: 0°C (32°F)
- Relative humidity: 5% to 95% (noncondensing)

2.2.3 Physical Requirements

The KSC-1 unit weighs 11.5 oz. (326 grams) net. The unit is designed to be mounted on a grounded DIN rail but can mounted on a bench or other surface if the unit is properly grounded. The unit is approximatively 3.1 inches long by 1.2 inches wide by 5.2 inches high. Provide adequate room above and below the unit for connecting cables to the top and bottom and to provide airflow.

2.3 Unpacking

Before shipment, the KSC-1 unit was free of electrical and mechanical defects. It was fully tested and burned in.

2.3.1 Shipping Container

Inspect shipping containers immediately upon receipt for evidence of mishandling during transit. If a shipping container has been damaged in any way, have the carrier's agent present when the equipment is unpacked.

If the equipment is damaged, file a claim with the carrier and forward a copy to Kulite. Kulite will notify you of the disposition of the equipment and will arrange for repair or replacement without waiting for a settlement of the claim against the carrier. Retain the shipping container and packing material for the carrier's inspection or for reuse.

2.3.2 Chassis Inspection

Make a visual check of the unit's exterior to ensure that there are no broken controls or connectors and that the panel surfaces are free of dents and scratches.

2.4 Storage, Transport, and Shipment

The following environmental conditions must be maintained during storage, transport, or shipment of KSC-1 units:

- Maximum temperature: 105°C (221°F)
- Minimum temperature: −40°C (−40°F)
- Relative humidity: 5% to 95% (noncondensing)

2.4.1 Storage Requirements

The unit can be stored or remain in an equipment rack. For prolonged storage, protect the unit with a cover to prevent dust accumulation. The storage area should be free of dust and must meet the environmental conditions described in Section 2.4.

2.4.2 Transport Requirements

The unit may be transported without protective packaging if vibration and shock are held to a minimum. Before transport, remove cables. The environmental conditions described in Section 2.4 must be maintained.

2.4.3 Shipment Requirements

Always use the original packaging materials to ship the KSC-1. A new container can be purchased from Kulite. The environmental conditions described in Section 2.4 must be maintained.

2.5 Mounting the KSC-1

The KSC-1 is designed to be mounted vertically on a DIN rail and is supplied with an integrated DIN clip. The unit can also be set on a flat surface or mounted using pressure sensitive adhesive tape in environments with temperatures of 25° (77°F) or less.

For optimal performance, maintain airflow around the top and the bottom of KSC-1 to allow adequate cooling. In hotter environments, over 25°C (77°F), the unit requires vertical mounting with a minimum of 1 inch or more of clearance above and below the unit to allow for proper airflow through the unit.

2.5.1 Grounding Options

WARNING

The KCS-1 must be properly grounded before applying power. Any interruption of the earth ground or disconnection of the ground will cause a potential shock hazard that could result in personal injury.

The KCS-1 can be grounded using any of several methods:

- Mounting the unit to a grounded DIN rail using the attached DIN clip
- Attaching a grounded wire to one of the screws holding the DIN rail clip to the unit
- If the DIN clip is removed, attaching a grounded wire to the flat head screw near the center rear of the unit, see Section 2.5.3, *Removing the DIN Clip* below.

Note: The connector shells on both the Signal Input DB-9 connector and the Power Input/Signal Output DB-9 connector are tied to the KSC-1 chassis.

2.5.2 DIN Rail Mounting

The KSC-1 is shipped with a spring loaded DIN clip pre-attached. The KSC-1 attaches to a top hat style of rail. Figure 2 shows a side view and the dimensions of the top hat rail. Rack mounted DIN rails are an attractive hardware feature that allows adding or removing KSC-1 units as necessary.

To mount the unit to a DIN rail:

Step 1 Align the top of the DIN clip on the back of the unit to the top of the DIN rail and push down.

Step . While pushing down, swing the unit towards the rail until the lower tab on the clip snaps under the rail.

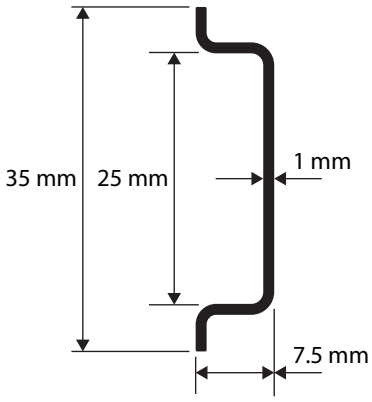

Figure 2 Top Hat DIN Rail Side View with Dimensions

2.5.3 Horizontally Mounting

Note: Vertical mounting is strongly recommended if the temperature around the unit(s) exceeds 25°C (77°F).

The KSC-1 can be set on either side of the unit on a flat surface. Pressure sensitive adhesive tape can be used to secure the unit(s) in place.

2.5.4 Removing the DIN Clip

The KSC-1 DIN clip is removeable if it is not needed. To remove the clip:

Step 1 Using a Phillips screw driver, remove the two flat head screws holding the DIN clip to the back of the unit. See Figure 3.

Step 2 Using one of the flat head screws that was just removed, insert and tighten the screw in the top DIN clip countersunk mounting hole to secure the two chassis sections. Save the unused screw and DIN clip for later use.

CAUTION

Use only the original flat-head Phillips screw that original held the DIN clip to the unit when securing the two chassis sections. Other screws may damage the system hardware.

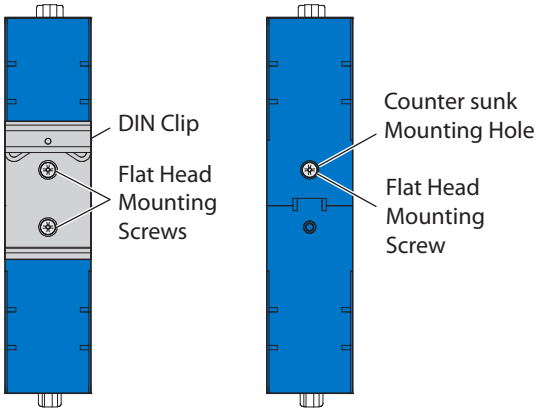

Figure 3 DIN Clip Location and Mounting Screws

2.6 Install Cables

2.6.1 KSC-1 Signal Input Connector

The KSC-1 Signal Input Connector is an industry-standard DB-9 female input connector, shown in Figure 4, located at the top of the unit.

Table 1 lists the input connector pin assignments.

Table 1 Signal Input Connector Pin Assignments

Pin	Description
1	Excitation +
2	In +
3	Sense –
4	ISO (Signal) Ground
5	5th Wire In
6	Sense +
7	In –
8	Excitation –
9	Shield

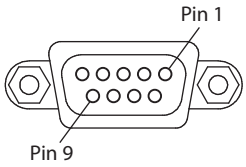

Figure 4 DB-9 Input Connector Pin Assignments

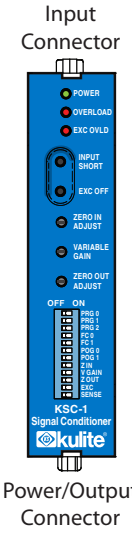

Figure 5 Connector Locations Viewed from the Front Panel

Input Cabling and Input Shielding

Twisted and shielded cable is recommend for signal inputs (In+, In−), especially in high-noise environments. The shield should be connected at one end only (i.e., either at the transducer or at the instrument) but not at both ends.

Avoid running signal leads near—or especially in parallel with—current-carrying power cables. In situations where twisted/shielded cable cannot be used, exercise care to avoid any large loop area (separation) in the input wiring pairs.

Twisted and shielded cable is preferred for + and – excitation and for + and – sense lines to minimize noise pickup. If the bridge configuration is physically unbalanced, noise pickup in the excitation or sense leads can degrade signal-to-noise ratio.

The Shield pin 9 may be used to terminate the twisted/shielded cable. The Shield pin is connected to the ISO (signal) ground internal to the KSC-1.

CAUTION

It is necessary to provide a high-quality instrument ground to the KSC-1 system. The KSC-1 input is rated for operation at a signal-plus-common-mode level of 10 V and is protected for a signal-plus-common-mode level of 24 V relative to signal ground (pin 4).

Note: The upcoming section "Channel Isolation" explains how to optimize signal ground quality.

2.6.2 KSC-1 Full-Bridge 4-Wire Connections

For full-bridge measurements using a 4-wire configuration, the KSC-1 connections should be made as shown in Figure 6. To set up the KSC-1 for 4-wire full bridge measurements, the excitation sense must be set to Local using the front panel DIP switch.

Note: The color code for the typical unamplified 4-wire Kulite pressure transducer is shown in Figure 6.

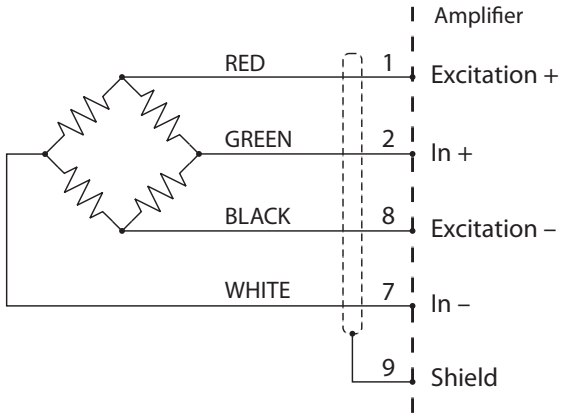

Figure 6 KSC-1 Full Bridge with Local Sense (4-Wire + Shield)
Shown with Typical Kulite Pressure Transducer Color Code

2.6.3 KSC-1 Full-Bridge 6-Wire Connections

Resistance in the excitation leads produces error in excitation delivered to the bridge. Remote excitation sense leads may be used to sense the excitation at the bridge in order to correct for the lead resistance drops.

Figure 7 shows the 6-wire configuration that uses the + and – Sense leads. To set up the KSC-1 for 6-wire full-bridge measurements, the excitation sense must be set to Remote using the front panel DIP switch.

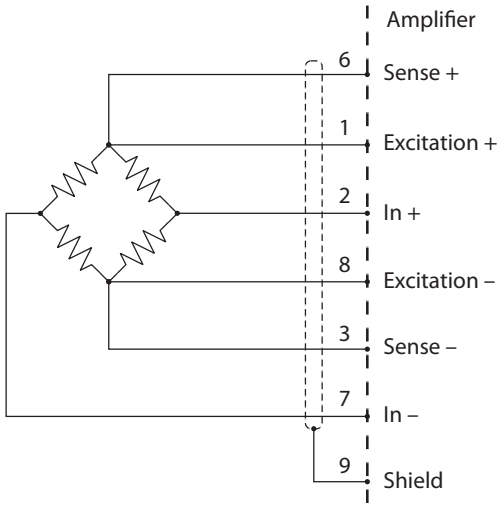

Figure 7 KSC-1 Full Bridge with Local Sense (6-Wire + Shield)

2.6.4 Other Bridge Input Configurations Using External Completion Resistors

The KSC-1 does not provide bridge completion; however, the user may wish to provide external completion resistors for quarter- and half-bridge configurations. The completion resistors should be located as close to the active gage as possible to keep the circuit physically balanced and minimize interfering noise sources. Figure 8 shows a typical configurations for a quarter bridge. Figure 9 shows a typical configuration for a half bridge.

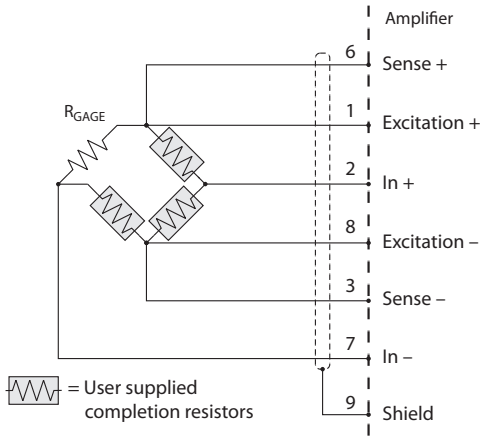

Figure 8 KSC-1 Quarter Bridge with Remote Sense & User-Supplied Completion Resistors

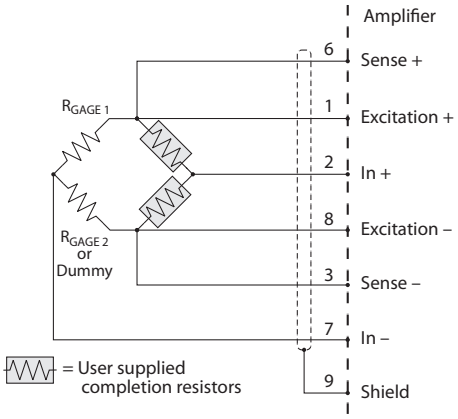

Figure 9 KSC-1 Half Bridge with Remote Sense & User-Supplied Completion Resistors

2.6.5 Voltage Input Configuration

The KSC-1 may be used as a low-noise voltage filter/amplifier by connecting a voltage output device to the In + and In − inputs.

2.6.6 5th Wire

The Kulite 5th wire transducer was developed to allow customers to obtain data about the bridge temperature of a 5th wire compatible pressure transducer in order to compensate the sensor for thermal errors. Using this temperature signal correctly can result in a very accurate pressure measurement—even over a wide temperature range.

The Kulite 5th wire voltage is proportional to the temperature of the silicon die. The output is approximately 5 V at room temperature and increases by 2 mV/°F nominal. Refer to Kulite application note *Kulite 5th Wire Combination Pressure and Temperature Transducers* for more details.

The KSC-1 features a buffered 5th wire output that allows measurement of the 5th wire voltage with an external acquisition device.

2.6.7 Power Input/Signal Output Connector

The KSC-1 Power Input/Signal Output Connector is an industry-standard DB-9 male output connector, shown in Figure 10, located at the bottom of the unit.

Table 2 lists the input connector pin assignments.

Table 2 Power Input/Signal Output Connector Pin Assignments

Pin	Description
1	VS (Voltage Supply)
2	VS Return
3	Short Control (CTRL)
4	ISO (Signal) Ground
5	5th Wire Out
6	Excitation Off Control (CTRL)
7	N/C
8	Out–
9	Out+

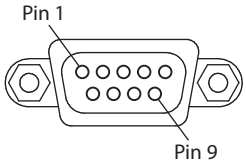

Figure 10 DB-9 Power Input/Signal Output Connector Pin Assignments

2.6.8 Channel Isolation

The KSC-1's built-in isolation can be used to reference the channel to a remote reference other than earth ground. This channel isolation can be useful if a distant ground causes the source to be at some potential beyond the ±10 V input range allowable by the KSC-1 amplifier.

If you are using channel isolation in this manner, follow these rules:

- The remote ground potential must not be more than 60 V from the chassis ground of the KSC-1.
- The input signals to the channel must not differ by more than ±10 V from the remote ground reference.
- Any recording device connected to the KSC-1 output must also have sufficient isolation capability.
- If input cabling connects the overall cable shield to the shell of the DB-9 input connector, this will connect the shield to the remote ground potential through the chassis connection. To prevent ground loop currents, do not terminate the cable shield at the sensor end.

2.6.9 Power Input

The KSC-1 requires input power of 10 – 32 VDC, 3 W maximum, applied at the Power Input/Signal Output Connector, pins 1 and 2.

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3 KSC-1 Operation and Configuration Instructions

3.1 Introduction

The KSC-1 Signal Conditioner provides LED indicators for power, excitation overload and input/output overloads as well as configuration setting for the following features:

- Constant voltage excitation with remote sense
- Input zero/bridge balance
- Pre-filter gain
- Filter cutoff frequencies
- Post-filter gain
- Output offset (RTO) adjustments

3.2 KSC-1 Front-Panel Operation

Figure 11 illustrates the front-panel indicators and switches used during KSC-1 operation.

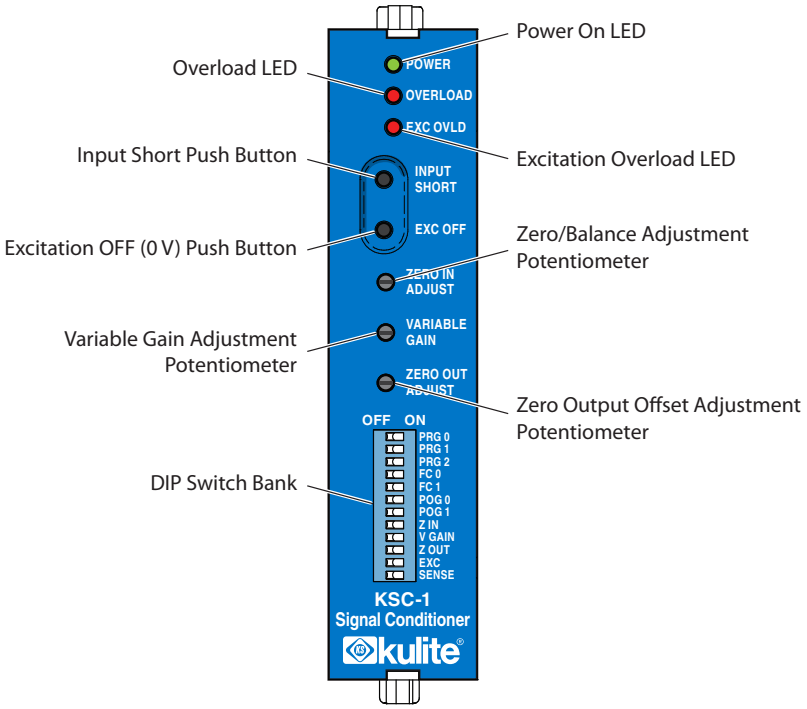

Figure 11 KSC-1 Front Panel Indicators, Buttons, Potentiometers and Switches

3.2.1 Front Panel LED Indicators

The KSC-1 has three LED indicators located on the front panel. Each indicator is described below:

- **Power On**

  The Power On green LED indicates the unit is receiving power and is ready to operate.

- **Overload**

  The Overload LED turns red if an overload condition is detected and stays red until the condition is eliminated.

  An overload condition occurs when either output from the pre-filter amplifier and/or the post filter amplifier is 10.2 V ±2% or higher.

  For more information, refer to Chapter 4, *KSC-1 Troubleshooting*, Section 4.3 *Overload LED Indicator is On*.

- **EXC OVLD**

  The Excitation Overload LED turns red if the excitation current draw exceeds 35 mA and stays on until the condition is corrected.

  Typically an excitation overload condition is caused by a faulty sensor or wiring that is shorting out.

  For more information, refer to Chapter 4, *KSC-1 Troubleshooting*, Section 4.4 *Excitation Overload LED Indicator is On*.

3.2.2 Push Buttons and Potentiometers

The KSC-1 front panel has two push buttons and three potentiometers.

Push Buttons

The push buttons are momentary buttons and are only active when the buttons are depressed. When the buttons are released, the unit settings are restored to the state before the buttons were activated.

- **Input Short**

  The Input Short push button is used for measuring amplifier offset and noise. When the button is activated the input from the sensor is temporarily disconnected and the input is terminated in the ISO (signal) ground.

  In addition, the input zero/bridge balance voltage is set to 0 volts when the button is depressed. See Section 3.4.3, *Input Short,* for more information about the input test mode.

- **EXC Off**

  The Excitation Off push button is used for measuring the sensor's self-generated noise. When the button is activated the excitation level is set to 0 VDC, temporarily removing the constant voltage excitation from the circuitry. See Section 3.3.1, *Setting Excitation Levels,* for more information.

Potentiometers

The multi-turn potentiometers on the front panel provide continuous adjustment for bridge balance/zero, gain and DC offset.

- **Zero In Adjust**

  The Zero In Adjust potentiometer is used to provide zero/balance RTI adjustments when Z In mode is enabled on the front panel DIP switch.

  The factory default is set to 0.00 millivolts.

  Refer to Section 3.4, *Input Amplifier with Bridge Balance/Zero,* for more information about setting and overriding the Balance/Zero mode.

- **Variable Gain**

  The Variable Gain potentiometer is used to provide continuously variable adjustments of gain when enabled on the front panel DIP switch.

  The factory setting is set to 0.0 dB. The variable post-filter gain is continuously adjustable from 90% to 110% of the full scale output.

  Refer to the Section 3.6, *Post-Filter Gain,* for information relating to post-filter gain, adjusting post-filter gain and overriding variable gain adjustments.

- **Zero Out Adjust**

  The Zero Out Adjust potentiometer is used to provide DC output offset (RTO) adjustments.

  The factory offset output setting is 0.0 mV and is adjustable to ±2.5 volts.

  Refer to Section 3.7, *Adjusting Output Offset (Zero Out),* more information about setting and overriding zero out adjustments.

3.2.3 DIP Switch Bank

The front panel DIP switch bank is used to select the following functions:

- **Pre-Filter Gain**

  Pre-Filter Gain has seven selectable settings: x1, x2, x5, x10, x20, x50, and x100.

  The factory pre-filter setting is x20.

  Refer to Section 3.4, *Input Amplifier with Bridge Balance/Zero,* for more information about pre-filter gain.

- **Filter Cutoff Frequencies**

  The BU4 4-pole low-pass filter has four selectable cutoff settings: 100 Hz, 5 kHz, 25 kHz, and 50 kHz. The factory cutoff setting is 50 kHz.

  The BE4 4-pole low-pass filter has four selectable cutoff settings: 5 kHz, 25 kHz, 50 kHz and 100 kHz. The factory cutoff setting is 100 kHz.

  Refer to Section 3.5, *Selecting Cutoff Frequencies,* for more information about the Fc settings.

- **Post-Filter Gain**

  Post-filter Gain has four selectable setting: x1, x2, x5, and x10.

  The factory post-filter setting is x5.

  Refer to Section 3.6, *Post-Filter Gain,* for more information about post-filter gain.

- **Zero In**

  The Zero In (Z IN) switch enables or disables the Zero In Adjust potentiometer.

  The factory Zero In setting is disabled.

  Refer to Section 3.4, *Input Amplifier with Bridge Balance/Zero,* for more information about the zero/balance RTI (Z IN) mode.

- **Variable Gain**

  The Variable Gain (V GAIN) switch enables or disables the Variable Gain potentiometer. When the V Gain is disabled, the post-filter gain reverts to the calibrated gains setting set with the Post-Filter Gain DIP switches.

  The factory Variable Gain setting is disabled.

  Refer to Section 3.6, *Post-Filter Gain,* for more information about the post-filter gain settings.

- **Zero Out**

  The Zero Out (Z OUT) switch enables or disables the setting of the Zero Out Adjust potentiometer.

  The factory Zero Out setting is disabled.

  Refer to Section 3.6, *Post-Filter Gain,* for more information about the Adjusting Output Offset settings.

- **EXC Level**

  The excitation level (EXC) switch has two selectable levels: 5 and 10 volts.

  The factory excitation level is 10 volts.

  Refer to Section , *Constant Voltage Excitation with Remote Sense,* for more information about using the excitation functions.

- **EXC Sense**

  The excitation sense switch sets how the excitation lines are set, either local or remote.

  The factory excitation sense setting is local.

  Refer to Section , *Constant Voltage Excitation with Remote Sense,* for more information about using the excitation functions.

DIP Switch Setting with BU4 Filter Option- Quick Reference

PRE-FILTER GAIN							
	x1	**x2**	**x5**	**x10**	**x20**	**x50**	**X100**
PRG 0	ON	OFF	ON	ON	OFF	ON	OFF
PRG 1	ON	ON	OFF	ON	ON	OFF	OFF
PRG 2	ON	ON	ON	OFF	OFF	OFF	OFF

FILTER Fc				
	100 Hz	**5 kHz**	**25 kHz**	**50 kHz**
FC 0	ON	OFF	ON	OFF
FC 1	ON	ON	OFF	OFF

POST-FILTER GAIN				
	x1	**x2**	**x5**	**x10**
POG 0	ON	OFF	ON	OFF
POG 1	ON	ON	OFF	OFF

ZERO IN	
ENABLE	**DISABLE**
OFF	ON

EXC LEVEL	
5 V	**10V**
OFF	ON

VARIABLE GAIN	
ENABLE	**DISABLE**
ON	OFF

EXC SENSE	
REMOTE	**LOCAL**
OFF	ON

ZERO OUT	
ENABLE	**DISABLE**
OFF	ON

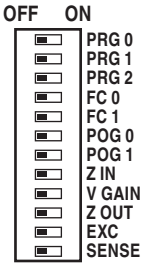

Figure 12 DIP Switch Bank with Designators

DIP Switch Setting with BE4 Filter Option- Quick Reference

PRE-FILTER GAIN							
	x1	**x2**	**x5**	**x10**	**x20**	**x50**	**X100**
PRG 0	ON	OFF	ON	ON	OFF	ON	OFF
PRG 1	ON	ON	OFF	ON	ON	OFF	OFF
PRG 2	ON	ON	ON	OFF	OFF	OFF	OFF

FILTER Fc				
	5 kHz	**25 kHz**	**50 kHz**	**100 kHz**
FC 0	ON	OFF	ON	OFF
FC 1	ON	ON	OFF	OFF

POST-FILTER GAIN				
	x1	**x2**	**x5**	**x10**
POG 0	ON	OFF	ON	OFF
POG 1	ON	ON	OFF	OFF

ZERO IN	
ENABLE	**DISABLE**
OFF	ON

EXC LEVEL	
5 V	**10V**
OFF	ON

VARIABLE GAIN	
ENABLE	**DISABLE**
ON	OFF

EXC SENSE	
REMOTE	**LOCAL**
OFF	ON

ZERO OUT	
ENABLE	**DISABLE**
OFF	ON

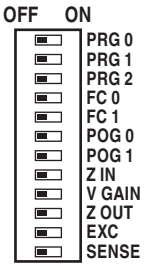

Figure 13 DIP Switch Bank with Designators

3.3 Constant Voltage Excitation with Remote Sense

This section contains instructions for using and controlling the unipolar constant voltage excitation with remote sense.

3.3.1 Setting Excitation Levels

The KCS-1 has two operating excitation voltage levels; 5 V and 10 V. The levels are set using the EXC switch on the DIP switch bank located the front panel. For 5 volts excitation set the switch to OFF, for 10 volts excitation set the switch to ON, see Table 3, EXC Switch Settings.

Table 3 EXC Switch Settings	
EXC LEVEL	
5 V	**10 V**
OFF	ON

Setting Excitation to Off

The excitation can be temporarily set to 0 volts either by using the front panel EXC OFF push button or remotely. Setting the excitation to 0 volts is useful for measuring the sensor's self-generated noise.

- **Front Panel EXC OFF Push Button**

  The front panel EXC OFF push button is a momentary button and sets the voltage to 0 volts when the button is depressed. When the button is released the excitation level is restored to the setting of the EXC DIP switch.

- **Remote EXC OFF Control**

  The excitation can be set to 0 volts remotely by tying the connection to the Power Input/Signal Output connector pin 6 (EXC OFF CTRL) to ISO (Signal) Ground.

3.3.2 Selecting Excitation Local/Remote Sense

The excitation sense has two settings, local and remote. The remote setting regulates the excitation voltage wherever the + and – sense leads are remotely connected. Local or remote sense is set using the SENSE switch on the front panel DIP switch bank. For local sense the switch is set to ON, for remote sense the switch is set OFF, see Table 4, Sense Switch Setting.

Table 4 Sense Switch Settings	
EXC SENSE	
REMOTE	**LOCAL**
OFF	ON

Note: Sense boost is limited to 3 V above the excitation level setting.

3.3.3 Excitation Overload

The Excitation Overload LED (labelled EXC OVLD) turns red if the excitation current draw exceeds 35 mA and stays red until the condition is corrected.

Typically an excitation overload condition is caused by a faulty sensor or wiring that is shorting out.

3.3.4 Excitation Calibration

The Excitation Adjust potentiometer on the bottom panel of the KSC-1 provides fine adjustment of the excitation levels and is used primarily for calibration. The excitation is factory calibrated for 10 V ±0.1% at the 10 V excitation setting.

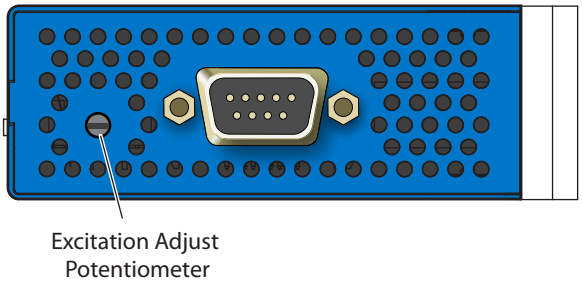

Figure 14 KSC-1 Bottom Panel with Excitation Adjust Potentiometer

To Calibrate the Excitation Levels

Step 1 Set the EXC DIP switch to 10 volts (ON).

Step 2 On the Signal Input connector, put a 1 kOhm load across the excitation + (pin 1) and the excitation – (pin 8).

Step 3 Adjust the Excitation Adjust potentiometer to 10.000 VDC across the load.

Step 4 Set the EXC DIP switch to 5 volts (OFF) and verify a 5 VDC across the load.

3.4 Input Amplifier with Bridge Balance/Zero

Gain is distributed both before and after the filter to provide protection from large out-of-band energy or transients that could cause clipping before the filter, distorting the data. The overload detector alerts the user to over-voltage conditions.

3.4.1 Selecting Pre-Filter Gain

The pre-filter gain has seven selectable gain settings: x1, x2, x5, x10, x20, x50, and x100. Pre-filter gain is selected using a combination of three DIP switches, PRG 0, PRG 1, and PRG 2 located on the front panel DIP switch bank. See Table 5, Pre-filter Gain Settings.

Table 5 Pre-Filter Gain Settings

PRE-FILTER GAIN							
	x1	**x2**	**x5**	**x10**	**x20**	**x50**	**x100**
PRG 0	ON	OFF	ON	ON	OFF	ON	OFF
PRG 1	ON	ON	OFF	ON	ON	OFF	OFF
PRG 2	ON	ON	ON	OFF	OFF	OFF	OFF

3.4.2 Setting Bridge Balance/Zero

Bridge balance provides capability to zero the amplifier with the transducer connected (by inserting an adjustable amount of voltage at the pre-filter amplifier stage) so that the condition of zero output for zero input (pressure, strain, etc.) can be achieved.

The insert voltage suppression range depending on the pre-filter gain settings:

- Gain settings of x5 or lower allows for up to ±200 mV of voltage suppression.
- Gain settings of x10 or greater allows for up to ±20 mV of voltage suppression.

Adjusting Bridge Balance/Zero

The Zero In Adjust potentiometer on the front panel is used to inject the bridge balance voltage when Z In mode is enabled, see *"Enabling/ Disabling Balance/Zero"* below for enabling and disabling bridge balance.

The factory default is set to 0.00 millivolts.

Enabling/ Disabling Balance/Zero

The Z IN switch on the front panel DIP switch bank is used to enable (OFF) or disable (ON) the bridge balance mode, see Table 6.

Table 6 Zero In Settings	
ZERO IN	
ENABLE	**DISABLE**
OFF	ON

3.4.3 Input Short

Input short is a test mode used to measure noise and DC offset by grounding the amplifier input. The input short test mode can be entered using the Input Short push button on the front panel or remotely.

- **Front Panel Input Short Push Button**

  The front panel Input Short push button is a momentary button and grounds the amplifier input when the button is depressed. In addition, the Z IN mode is temporarily disabled removing the balance/zero voltage. When the button is released the normal input is applied to the amplifier input and Z IN mode balance/zero voltage is restored.

- **Remote Input Short Control**

  The Input Short test mode can be activated remotely by tying the connection to the Power Input/Signal Output connector pin 3 (SHORT CTRL) to ISO (Signal) Ground.

3.5 Selecting Filter Cutoff Frequencies

The filter cutoff frequency is selected using a combination of two DIP switches, FC 0, and FC 1, located on the front panel DIP switch bank.

The 4-pole BU4 low-pass filter has four selectable cutoff frequencies: 100 Hz, 5 kHz, 25 kHz, and 50 kHz. See Table 7.

Table 7 BU4 Filter Cutoff Frequency Settings				
FILTER Fc				
	100 Hz	**5 kHz**	**25 kHz**	**50 kHz**
FC 0	ON	OFF	ON	OFF
FC 1	ON	ON	OFF	OFF

The 4-pole BE4 low-pass filter has four selectable cutoff frequencies: 5 kHz, 25 kHz, 50 kHz, and 100 kHz. See Table 8.

Table 8 BE4 Filter Cutoff Frequency Settings				
FILTER Fc				
	5 kHz	**25 kHz**	**50 kHz**	**100 kHz**
FC 0	ON	OFF	ON	OFF
FC 1	ON	ON	OFF	OFF

3.6 Post-Filter Gain

The post-filter gain is applied to the amplifier after the filter to allow the filter to remove any undesired out-band noise prior to application of all required gain.

3.6.1 Selecting Post-Filter Gain

Post-filter gain has four selectable settings: x1, x2, x5, and x10. Post-filter gain is selected using a combination of two DIP switches, POG 0 and POG 1, located on the front panel DIP switch bank, see Table 9.

Table 9 Post-Filter Gain Settings				
POST-FILTER GAIN				
	x1	**x2**	**x5**	**x10**
POG 0	ON	OFF	ON	OFF
POG 1	ON	ON	OFF	OFF

3.6.2 Adjusting Variable Gain

The V Gain potentiometer on the front panel is used to continuously adjust the overall gain from 90% to 110% of the full-scale output when the Variable Gain mode is enabled.

Enabling/Disabling Variable Gain

The V GAIN switch on the front panel DIP switch bank is used to enable (ON) or disable (OFF) the variable gain mode, see Table 10.

Table 10 Variable Gain Settings	
VARIABLE GAIN	
ENABLE	**DISABLE**
ON	OFF

3.7 Adjusting Output Offset (Zero Out)

The Zero Out Adjust potentiometer on the front panel is used to continuously adjust the output offset when the Zero Out mode is enabled. Adjustment range is ±2.5 V referred to the output (RTO).

3.7.1 Enabling/Disabling Output Offset

The Z OUT switch on the front panel DIP switch bank is used to enable (OFF) or disable (ON) the Zero Out mode, see Table 11.

Table 11 Zero Out Settings

Zero Out Settings	
ENABLE	**DISABLE**
OFF	ON

4 KSC-1 Troubleshooting

4.1 Introduction

This section contains troubleshooting tips for issues commonly encountered when using a KSC-1 unit.

4.2 Power LED Indicator Does Not Turn On

When power is applied to a KSC-1 unit, the POWER indicator light turns green. If the unit does not turn on check the following:

- The external power source is receiving power and is working correctly.
- The external power source is supplying 10 – 32 VDC at 0.3 A per module.
- The Power Input/Output Signal cable is properly wired.
- The Power Input/Output Signal cable is connected to Power Input/Signal Out connector on the bottom panel of the unit and is fully engaged.

4.3 Overload LED Indicator is On

The Overload LED indicator turns red when an overload fault condition occurs and stays red until the fault condition is cleared.

Overload conditions typically are solved by reducing the pre-filter gain and/or the post-filter gain. For more information, refer to *Selecting Pre-filter Gain*, Section 3.4.1 and *Selecting Post-Filter Gain*, Section 3.6.2.

4.4 Excitation Overload LED Indicator is On

The Excitation Overload (EXC OVLD) LED indicator turns red when an excitation overload fault condition occurs and stays red until the fault condition is cleared. Typical causes of an excitation fault are listed below:

- Faulty Sensor
- Grounded sensor wiring
- Excitation setting is too high for the sensor being used

4.5 Excitation Out of Specification

The excitation levels maybe recalibrated via adjustment of EXC Adjust potentiometer. Refer to Section 3.3.4, *Excitation Calibration,* for instructions on calibrating the excitation levels.

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5 Support and Service

5.1 Technical Support

Kulite provides full technical support from installing a new system to troubleshooting existing set-ups before or during a measurement test.

Technical support is available by phone, E-mail or by fax.

Technical Support Phone:

(201) 461-0900

Customer Service E-Mail:

KSCsupport@kulite.com

Fax:

(201) 461-0990

5.2 Service and Repair

If equipment is being returned to Kulite for service or repair, contact the factory for a Return Authorization Number.

To obtain a Return Authorization Number contact Kulite by one of these methods:

Phone:

(201) 461-0900

E-mail:

KSCsupport@kulite.com

Fax:

(201) 461-0990

Include the following information with the equipment:

- Owner's name, company, address and telephone number.
- A detailed description of the service or repair.
- The instrument model and serial numbers.
- The Return Authorization Number issued by Kulite clearly marked on the outside of the shipping container.

Equipment should be shipped in the best available packing materials. Factory packaging is available. Contact Kulite for more information.

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