SENSOTEC

Additional Channels for SC Instrumentation

Temperature (RTD) Input, Frequency Input

Pressure Transducers

Load & Torque Cells

Accelerometers

Displacement Transducers

Instrumentation

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Additional Channels for SC Series Instrumentation

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IMPORTANT It is recommended that you read the “SC Series Instruction Manual”, Sensotec document 008-0608-00 before using the channels described herein.

CAUTION: The operator of this instrument is advised that if the equipment is not used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

CAUTION: Only qualified, service-trained personnel who are aware of the hazards involved should remove the cover from the instrument or connect external wiring to the instrument.

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Sensotec continually improves its products, and thus the information herein is subject to change without notice.

Contents

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Chapter 1 Introduction

1.1 About This Manual

1.1.1 Scope

This manual will explain the setup, features and operation of additional Input and Output channels that may be installed into Sensotec's 3rd generation SC SEries instruments. This series includes the models SC1000, SC2000, SC2001 and SC3004.

1.1.2 Conventions

This manual uses the following conventions to present information:

[TEXT IN BRACKETS]	The label of a front panel button.
DISPLAY	Text that appears on the display, such as error messages or menu items.
->	Indicates that what follows is an item from a sub-menu, such as SYSTEM MENU -> DIAGNOSTICS.
DATA	Serial communications commands sent to (or replies from) the instrument
↵	The carriage-return character, ASCII code decimal 13
Note	Notes contain important information set off from the text.
	A stop sign highlights procedures or information necessary to avoid damage to equipment, damage to software, loss of data, loss of calibration, or invalid test results.
	The caution symbol alerts that a specific procedure or practice which, is not followed correctly, could cause serious personal injury.

1.1.3 Organization

Chapter 1, "Introduction", offers general information about this instruction manual.

Chapter 2, "RTD Input Channel", explains how to wire, configure, operate and calibrate the RTD Input channel.

Chapter 3, "Frequency Input Channel", explains how to wire, configure, operate and calibrate the Frequency Input channel.

Chapter 4, "Setup Menu Reference", is a list of all SETUP menus and a cross-reference to related information in this instruction manual.

1.2 Related Documents

SC Series Instruction Manual

The “SC Series Instruction Manual”, Sensotec p/n 008-0608-00, describes the wiring, setup and operation of the chassis and channels of SC Series Instruments. The channels described in this document are:

- Strain-Gage Input channel
- AC/AC-LVDT Input channel
- High-Level Input channel
- Relay Output channel
- DAC Output channel
- Split-Display Virtual channel
- Mathematics Virtual channel

A printed copy of this document is available for order, or you may download it for free Sensotec’s web site, www.sensotec.com.

Customer Information Sheet

Every instrument is shipped with a Customer Information Sheet which documents the configuration of the instrument when it left the factory. Such information includes:

- Sensotec part number,
- date of manufacture,
- list of all installed channels and their setup information,
- customer specific SensoCode programming of Mathematics Virtual channels and operation notes.

Communications Guide

The “SC Series Communications Guide”, Sensotec p/n 008-0610-00, describes in detail how to communicate with an SC Series instrument using RS-232 and RS-485. Wiring diagrams, sample programs, and command descriptions are included.

A printed copy of this document is available for order, or you may download it for free Sensotec’s web site, www.sensotec.com.

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Chapter 2
RTD Input Channel

2.1 Features

The RTD Input channel provides a DC excitation current to and accepts millivolt signals from a standard platinum, 100Ω Resistance Temperature Detector (RTD). These signals are digitized, converted into engineering units, and placed into the track, peak and valley data values of the channel.

Setup and calibration of the channel is made at the factory for operation with a customer-supplied Pt-100 RTD with a DIN-43760 standard calibration curve. Re-calibration can be made manually through the SETUP mode with the known-load calibration method and a customer-supplied RTD calibrator.

The engineering units used to display the temperature readings are field select-able from a built-in conversion table. In addition, the engineering units used for calibration can be independently selected.

Two rear panel control inputs can be field-configured for such functions as remote track/hold, disabling peak/valley detection and clearing the peak/valley values. A voltage or current digital-to-analog output is also provided.

2.2 Getting Started Quickly

As shipped from the factory, the RTD Input channel is calibrated for a standard Pt100 (platinum, 100Ω @ 100ºC) RTD that conforms to the DIN-43760 / IEC751 standards ($\propto$=0.00385). No further calibration is required prior to use.

Connect the RTD to the RTD Input channel according to “Wiring” on page 10.

2.3 Wiring

2.3.1 Channel Connector

The pin-out for the channel's connector is shown in the following table.

Table 2-1: RTD Input Channel Pin Connections

Pin	Label	Function	NOTES
1 (top)	+EXC	(+)Excitation	referenced to pin 10
2	N/C	N/C	**DO NOT CONNECT!**
3	N/C	N/C	**DO NOT CONNECT!**
4	-EXC	(-)Excitation	referenced to pin 10
5	+SIG	(+)Signal	referenced to pin 10
6	-SIG	(-)Signal	referenced to pin 10
7	+OUT	Analog Output	referenced to pin 8
8	-OUT	Analog Return	-
9	N/C	N/C	**DO NOT CONNECT!**
10	DGND	Digital Ground	-
11	AUX1	Auxiliary Function 1 (connect to pin 10 to activate)	referenced to pin 10
12 (bottom)	AUX2	Auxiliary Function 2 (connect to pin 10 to activate)	referenced to pin 10

The Analog Output and Analog Return pins are electrically isolated from all other pins on the instrument.

Do not connect anything to the pins labeled as "N/C". Damage to the instrument or loss of accuracy may result.

2.3.2 4-Wire RTD Connection

Use a 4-wire RTD connection when the highest possible accuracy is desired. The excitation current from the instrument will be carried by two wires and the voltage drop across the RTD will be sensed with the other two wires. Since the (+)Signal and (-)Signal pins are high impedance inputs, there is little current flow through these wires therefore the resistance of the wires doesn't add to the resistance of the RTD.

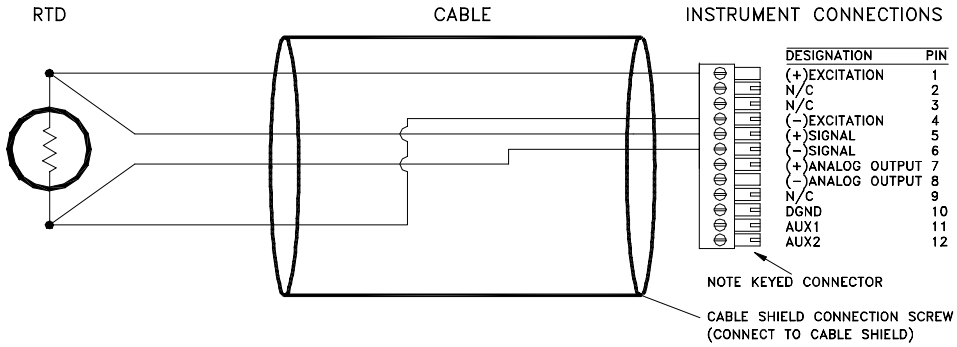

Figure 2-1: "4-wire RTD Connection" to RTD Input Channel

2.3.3 3-Wire RTD Connection

If the cost of 4-wire cable is an issue, it is possible to use a 3-wire RTD connection that shares many of the benefits of the 4-wire connection. The wire lengths should be equal and the wire type should be identical. This will equalize wire resistance and thus obtain the best accuracy.

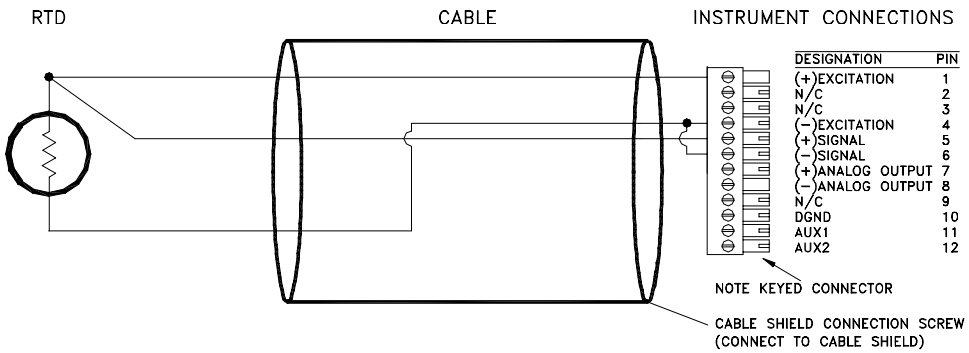

Figure 2-2: "3-Wire RTD" Connection to RTD Input Channel

2.3.4 2-Wire RTD Connection

The 2-wire connection scheme is not recommended unless the cable length is short. The wire's resistance will add to the resistance of the RTD and result in reduced accuracy.

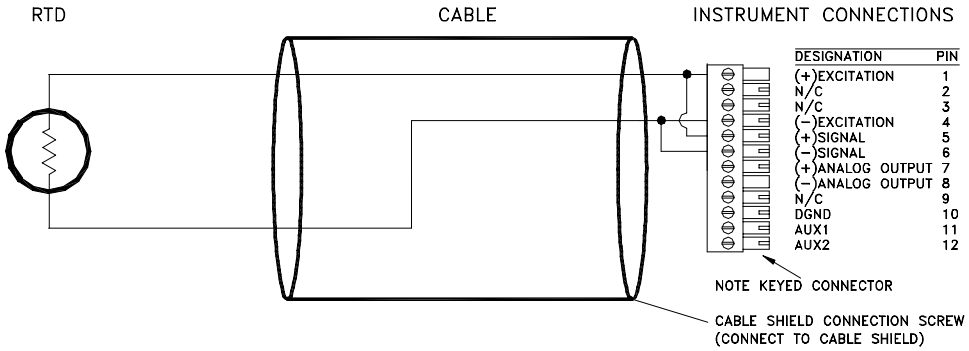

Figure 2-3: "2-Wire RTD Connection" to RTD Input Channel

2.4 Calibration

A listing of all menu items for this channel is given in “Setup Menu Reference” on page 55.

A customer-supplied RTD simulator/calibrator is required for re-calibration.

Although not recommended, field re-calibration of the channel for operation with RTDs with outputs other than the Pt100 DIN-43760 / IEC751 standards can be made; this may result in reduced accuracy and resolution.

Step 1: Wire the RTD simulator/calibrator to the channel’s connector.
See “Wiring” on page 10.

Step 2: Enter the CALIBRATION DATA.
See “CALIBRATION DATA Sub-Menu” on page17.

If you wish to re-calibrate the instrument using a unit-of-measure other than degrees Celsius, you can use the CALIBRATION UNITS menu item to change the units-of-measure that the instrument uses for calibration.

Step 3: Perform the calibration.
See “CALIBRATE Menu Item” on page 17.

Using the CALIBRATE menu item starts the calibration process. You will be prompted to use your RTD simulator/calibrator to apply simulated RTD signals to the channel as required.

2.5 Channel Specifications

RTD INPUT	
Excitation Current	0.25mA
Factory Calibration	For use with Pt100 RTD that use DIN-43760 / IEC751 standard (α=0.00385)
Absolute Accuracy of Factory Calibration	±0.5ºC max. from -200ºC to +200ºC
Resolution	±0.2ºC
A/D Converter	24-bit Sigma-Delta
Low-pass filter	digital, 24-tap FIR
Frequency Response	16 Hz
Step Response	55 ms (typical)
Maximum Input Resistance	~250Ω

AUXILLIARY INPUTS	
Quantity	2
Type	momentary contact closure
Response Time	< 5ms
Field-Selectable Functions	peak/valley clear, peak/valley hold, track hold

ANALOG OUTPUT	
Output voltage range	5, ±5, 10 or ±10 VDC (field selectable)
Output current range (optional current output channels)	4-20 mA
Source	any channel's track, peak or valley value
Isolation	500V
Resolution	13 bits
Frequency Response	same as input when driven by the same channel's tracking data

2.6 Channel Menu

The RTD Input channel is configured and calibrated via its channel menu. Detailed instructions on operating the instrument in the SETUP Menu mode can be found in the “SC Series Instruction Manual”, Sensotec p/n 008-0608-00.

2.6.1 OPERATION Sub-Menu

This menu controls the operation of this channel when the instrument is in the RUN mode.

POWER-ON SOURCE Menu Item

This menu selects which value is displayed by the channel when first entering the RUN mode.

The choices are:

- “TRACK” means the live tracking value of the channel.
- “PEAK” means the highest value of the channel.
- “VALLEY” means the lowest value of the channel.

2.6.2 DISPLAY UNITS Menu Item

This menu item controls how data values are scaled into engineering units, displayed by the channel, and transmitted via serial communications. The RTD Input channel has conversion factors for degrees Celsius, degrees Fahrenheit and Kelvin. Note that if the CALIBRATION UNIT is set to something other than "degC", then the choices available in the DISPLAY UNITS and the associated conversion factors will change accordingly. For example, if the CALIBRATION UNIT is set to "degF" then choices available for the DISPLAY UNITS will be "degF to degC"," degF to degF" and "degF to K".

Table 2-1: Temperature Conversion

Unit of Measure	DISPLAY UNITS Menu Item (when CALIBRATION UNIT is set to degC)
degrees Celsius	degC to degC
degrees Fahrenheit	degC to degF
Kelvin	degC to K

The decimal point position is set to one decimal place with a resolution of 0.2 ºC, ºF or K; it cannot be changed manually.

When the DISPLAY UNITS setting is changed, all LIMIT. SETPOINTs, LIMIT. RETURN PNTs, tare values, DAC. ZERO-SCALE and DAC. FULL-SCALE values in the entire instrument that refer to this channel will also be converted to the new DISPLAY UNITS setting.

2.6.3 AUXn FUNCTION Menu Items

The AUX1 FUNCTION and AUX2 FUNCTION menu items determine what happens when the Auxiliary Function pins (labeled as "AUX1" and "AUX2") on the channel's connector are activated. These pins are "activated" when they are connected to the Digital Ground (labeled as "DGND") pin. The choices are:

- "DISABLED" means that activating the pin does nothing.
- "TRACK HOLD" means that the tracking, peak and valley values will not be updated.
- "HIGH/LOW HOLD" means that the peak and valley values will not be updated.
- "HIGH/LOW CLEAR" means that the peak and valley values are reset.

As the Auxiliary Function pins are not isolated, it is recommended that a push-button switch or relay is used to connect these pins to the Digital Ground pin.

2.6.4 CALIBRATION TYPE Menu Item

The only choice is:

- "TYPE= 5 POINT CAL" means 5-Point Known Load Calibration. You are prompted to use your RTD simulator/calibrator to simulate the RTD output at the temperatures entered in the "KNOWN POINT 1/5", "KNOWN POINT 2/5", "KNOWN POINT 3/5", "KNOWN POINT 4/5" and "KNOWN POINT 5/5" registers. This technique is used to compensate for the non-linearity inherent in RTDs.

The calibration points used for factory calibration are -200ºC, -100ºC, +0ºC, +100ºC and +200ºC. Using these temperatures for calibration is recommended for most applications. If desired, accuracy may be improved by calibrating over a narrower temperature range which decreases the difference between the points.

Choosing calibration points where the difference between points is larger than 100ºC will result in greatly reduced accuracy.

2.6.5 CALIBRATION DATA Sub-Menu

CALIBRATION UNIT Menu Item

This menu item controls what units of measure are used for the known-load calibration points.

Table 2-2: Temperature Conversion

Unit of Measure	CALIBRATION UNIT Menu Item
degrees Celsius	degC
degrees Fahrenheit	degF
Kelvin	K

KNOWN POINT x/y Menu Items

This enters the engineering unit values for the known-load calibration points. These points must match the actual temperatures that you will apply to the instrument during calibration. The following menu items are available:

- "KNOWN POINT 1/5": point 1 of 5, usually -200ºC.
- "KNOWN POINT 2/5": point 2 of 5, usually -100ºC.
- "KNOWN POINT 3/5": point 3 of 5, usually 0 ºC.
- "KNOWN POINT 4/5": point 4 of 5, usually +100ºC.
- "KNOWN POINT 5/5": point 5 of 5, usually +200ºC.

The instrument expects the input signal applied at each known-load point to be increasing. For example, the load applied at Known-Load Point 2/5 must cause the transducer to produce a more positive output than at Known-Load Point 1/5.

2.6.6 CALIBRATE Menu Item

This menu item performs a calibration according to what was entered in the CALIBRATION TYPE and CALIBRATION DATA menu items.

Before performing a calibration, the CALIBRATION DATA must be entered (see "CALIBRATION DATA Sub-Menu" on page 17).

For maximum accuracy, allow at least five minutes of warm-up before calibration.

The CALIBRATION TYPE is **5-Point Known Load Calibration**.

- The display will read DOING 5POINT CAL, and prompt you to APPLY -200.00 degC (or whatever the settings of KNOWN POINT 1/5 and CALIBRATION UNIT are). When you have applied this simulated temperature, press [ENTER].
- The display will read WORKING, then APPLY -100.00 degC (or whatever the settings of KNOWN POINT 2/5 and CALIBRATION UNIT are). When you have applied this simu-

lated temperature, press [ENTER].

- The display will read WORKING, then APPLY 000.00 degC (or whatever the settings of KNOWN POINT 3/5 and CALIBRATION UNIT are). When you have applied this simulated temperature, press [ENTER].
- The display will read WORKING, then APPLY 100.00 degC (or whatever the settings of KNOWN POINT 4/5 and CALIBRATION UNIT are). When you have applied this simulated temperature, press [ENTER].
- The display will read WORKING, then APPLY 200.000 degC (or whatever the settings of KNOWN POINT 5/5 and CALIBRATION UNIT are). When you have applied this simulated temperature, press [ENTER].
- The display will indicate DONE and the instrument will return to the RUN mode.

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2.6.7 DAC SETUP Sub-Menu

This sub-menu contains four items that control the Digital-to-Analog Converter (DAC) output of the channel.

DAC. CHANNEL Menu Item

This chooses which channel will drive the DAC output. Normally, the DAC located on a particular channel will be driven by that channel, but that need not be the case. For example, if a Mathematics Virtual channel is installed on the instrument, the output of this Virtual channel could be used to drive this channel's DAC output.

If the DAC is set-up to be driven by its own channel's tracking value, the Analog Output will have the frequency response specified by "Channel Specifications" on page 13. Otherwise, the Analog Output will operate more slowly.

DAC. SOURCE Menu Item

This designates the data source of the channel monitored by the analog output. Each channel has three data sources: the live tracking value (TRACK), its highest value (PEAK), and its lowest value (VALLEY).

The options for this menu item are:

- "TRACK" means the live tracking value of the channel.
- "PEAK" means the highest value of the channel since the peak/valley detector was last cleared.
- "VALLEY" means the lowest value of the channel since the peak/valley detector was last cleared.

If the DAC is set-up to be driven by its own channel's tracking value, the Analog Output will have the frequency response specified by "Channel Specifications" on page 13. Otherwise, the Analog Output will operate more slowly.

DAC. ZERO-SCALE Menu Item

This specifies what value, in engineering units, corresponds to zero output on the Analog Output.

"Zero output" might be 0 Volts, 2.5 Volts, 5 Volts, 4 mA or 12 mA depending on if the channel has a voltage or current output and how it is configured. See the "Digital-to-Analog Output" section of this chapter for details.

DAC. FULL-SCALE Menu Item

Specifies what value, in engineering units, corresponds to full output on the Analog Output.

"Full output" might be 5 Volts, 10 Volts or 20 mA depending on if the channel has a voltage or current output and how it is configured. See the "Digital-to-Analog Output" section of this chapter for details.

2.6.8 DIAGNOSTICS Sub-Menu

DAC FULL SCALE Menu Item When this menu item is selected, the Analog Output of the channel is forced to its full-scale output, then DAC UPDATED is displayed. This is useful when calibrating or trimming the readout connected to the Analog Output.

DAC ZERO SCALE Menu Item When this menu item is selected, the Analog Output of the channel is forced to its zero-scale output, then DAC UPDATED is displayed. This is useful when calibrating or trimming the readout connected to the Analog Output.

VERSION INFO Menu Item This menu item displays the part number and revision level of the firmware used by this channels microprocessor.

DISPLAY ADC Menu Item The options for this menu item are:

- "OFF" will allow the [VALUE] button to cycle through "TK" (tracking value), "HI" (peak value) and "LO" (valley value). This is the recommended option.
- "ON" will allow the "AD" (percentage of the Analog-to-Digital converter's full-scale digitizing capability) display source to be available along with "TK" (tracking value), "HI" (peak value) and "LO" (valley value) when the [VALUE] button is pressed on the front panel.

The Analog-to-Digital converter counts are displayed as a percentage from -100.00% to 100.00%.

This can be used to verify the correct operation of the input circuitry of the channel.

LINEARIZATION Menu Item The options for this menu item are:

- "ON" will allow the linearization data obtained from the 5-Point Known Load Calibration to affect a channel's scaled values. This is the recommended option.
- "OFF" will not allow linearization data to effect the channel's scaled values. This is useful when diagnosing problems in a calibration procedure.

DISABLE CHANNEL Menu Item The options for this menu item are:

- "ON" will bypass the INITIALIZE and RUN modes of the channel. The track, peak and valley values of the channel are forced to 0. This option is helpful when a channel is installed but not being used.
- "OFF" will allow normal operation of the channel.

2.7 Analog Output Configuration

2.7.1 Identifying the Output Type

A RTD Input channel is available with one of two types of digital-to-analog (DAC) outputs: voltage or current. You can determine which type of output a channel has by one of three ways:

- Consulting the instrument's Customer Information Sheet
- Examining the SYSTEM MENU -> CONFIGURATION -> CHANNEL nn TYPE menu item where nn is the number of the channel. If the channel's type is RTD Vout, it has a voltage output. If the channel's type is RTD Iout, it has a current output.
- Examining the channel's circuit board as shown in the figure below.

2.7.2 Channel Menu Items

The Analog Output can be driven by any channel's track, peak or valley value.

See the "Channel Menu" section earlier in this chapter for a complete listing of SETUP menu items available on the DAC. SETUP sub-menu.

2.7.3 Output Selection

Jumpers located on the channel's circuit board determine what outputs are generated when the value selected to drive the Analog Output (from the DAC. CHANNEL and DAC. SOURCE menu items) equals the DAC. FULL SCALE and DAC. ZERO SCALE settings.

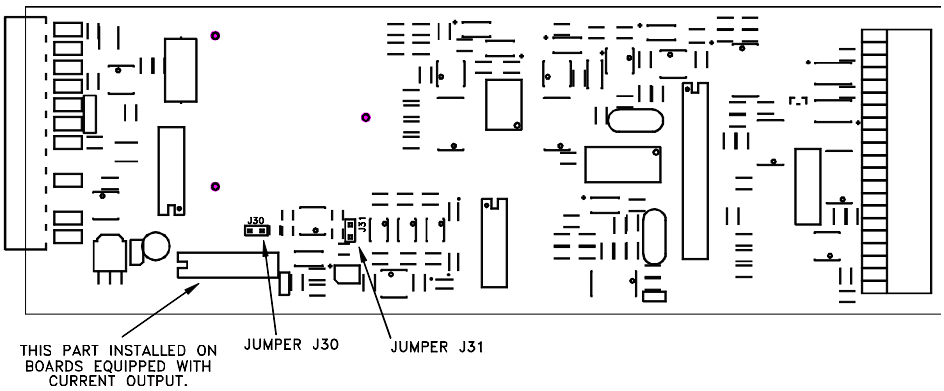

Figure 2-4: Digital-to-Analog Output Jumper Locations

DAC. ZERO SCALE Output	DAC. FULL SCALE Output	J30 jumper	J31 jumper
CHANNELS WITH VOLTAGE OUPUT			
0-5V	2.5 Volts	5 Volts	open	closed
±5V	0 Volts	5 Volts	open	open
0-10V	5 Volts	10 Volts	closed	closed
±10V	0 Volts	10 Volts	closed	open
CHANNELS WITH CURRENT OUTPUT			
4-20mA	4 mA	20 mA	open	open
4-20mA	12 mA	20 mA	open	closed

2.8 Troubleshooting

2.8.1 Error Messages

See the “Error Messages” chapter of the “SC Series Instruction Manual”, Sensotec p/n 008-0608-00, for information relating to error messages.

2.8.2 Common Problems and Solutions

Erratic Display

Make sure that the temperature on the RTD is constant. A RTD simulator/calibrator may be used.

The RTD Input channel is calibrated at the factory for Pt100 RTD’s with the DIN standard output curve. See “Channel Specifications” on pag e13.

It is recommended that the RTD Input channel be calibrated at -200ºC, -100ºC, 0ºC, +100ºC and +200ºC for rated accuracy.

+OVLD or -OVLD on Display

Check “Wiring” on page 10 and make certain that nothing is connected to the pins labeled as “N/C”.

The RTD Input channel is calibrated at the factory for Pt100 RTD’s with the DIN standard output curve. See “Channel Specifications” on pag e13.

Analog Output Incorrect

Make certain of the type of Analog Output (voltage or current) that the channel is equipped with; see “Identifying the Output Type” on page21.

Use the DIAGNOSTICS -> DAC FULL SCALE and DIAGNOSTICS -> DAC ZERO SCALE menu items to force the Analog Output to a known output. Then, adjust your readout device, panel meter, PLC or data acquisition system to match.

Check the output selection jumpers; see “Output Selection” on page 21.

Auxiliary Function Pins Not Operating

Make sure that the AUX1 FUNCTION or AUX2 FUNCTION SETUP menu items are set correctly; if they are set to DISABLED then they will not operate.

The Auxiliary Function (“AUX1” and “AUX2”) pins must be connected to pin 10, not pin 8, to activate them.

2.9 Communication Commands

2.9.1 Introduction

This section only documents the communication commands that affect the operation of the RTD Input channel. Refer to document p/n 008-0610-00, “SC Series Communications Guide” for details regarding serial communications. This document can be downloaded from Sensotec’s web site, www.sensotec.com.

2.9.2 Descriptions

F0	Transmit Track Data
Purpose	To transmit the channel’s tracking data value
Usage	"#*aacc*F0↵" *#* is the ‘pound’ or ‘hash’ character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the ‘carriage return’ character (ASCII decimal 13).
Example	"#0001F0↵"
Reply	" 0037.5” (typical)
Remarks	The input channel continuously reads the RTD. This function transmits the most recent reading.

F9	Transmit Peak Data
Purpose	To transmit the channel’s peak data value
Usage	"#*aacc*F9↵" *#* is the ‘pound’ or ‘hash’ character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the ‘carriage return’ character (ASCII decimal 13).
Example	"#0001F9↵"
Reply	" 0162.5” (typical) or "N/A”

FA	Transmit Valley Data
Purpose	To transmit the channel's valley data value
Usage	"#*aacc*FA↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001FA↵"
Reply	"-0012.5" (typical) or "N/A"

FB	Clear Peak and Valley Data
Purpose	To reset the channel's peak and valley data values to the track value.
Usage	"#*aacc*FB↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001FB↵"
Reply	"OK" or "N/A"
Remarks	This command is not available on the Model SC1000.

FF	Transmit Analog-to-Digital Converter Reading
Purpose	To transmit the Analog-to-Digital converter reading as a percentage from -100% to +100% of the A/D converters's full scale.
Usage	"#*aacc*FF↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001FF↵"
Reply	" 50.000" (typical)
Remarks	none

FH	Write DAC Control Value
Purpose	To control the channel's Digital-to-Analog Converter (DAC) manually or automatically.
Usage	"#*aacc*FH*n*↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *n* is the argument defined below. ↵ is the 'carriage return' character (ASCII decimal 13).
Argument	"AUTO" returns the DAC to its normal automatic operation (power-on default). That is, it is controlled by the "DAC. CHANNEL", "DAC. SOURCE", "DAC. ZERO-SCALE" and "DAC. FULL-SCALE" menu items. If the argument is a numeric value between -1 and +1, the DAC is forced to manual control and the value is used to drive the DAC from -100% to +100% of its output.
Example	"#0001FH.5↵" will force channel 01's DAC to +50% of full-scale.
Reply	"OK" or "ERROR"
Remarks	You might wish to force a channel's DAC to a certain output to help calibrate the attached data acquisition system or other device.

R6	Read Display Units
Purpose	Reads the channel's "DISPLAY UNITS" menu item
Usage	"#*aacc*R6↵" to read. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001R6↵"
Reply	When reading: a four-character string.

RK/WK	Read/Write Known-Load Calibration Point
Purpose	Reads or writes the channel's "KNOWN POINT x/y" menu items
Usage	"#*aacc*RK*pp*↵" to read, "#*aacc*WK*ppn*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *pp* is the parameter defined below. *n* is the known-load calibration point in engineering units. ↵ is the 'carriage return' character (ASCII decimal 13).
Parameter	"00" accesses the "KNOWN POINT 1/5" menu item. "01" accesses the "KNOWN POINT 2/5" menu item. "02" accesses the "KNOWN POINT 3/5" menu item. "03" accesses the "KNOWN POINT 4/5" menu item. "04" accesses the "KNOWN POINT 5/5" menu item.
Example	"#0001RK01↵"
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value. Changing this value has no effect until the channel is re-calibrated to the RTD with the Known-Load Calibration method.

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RM/WM	Read/Write DAC Channel & Value
Purpose	Reads or writes the channel's "DAC. CHANNEL" and "DAC. SOURCE" menu items
Usage	"#*aacc*RM↵" to read, "#*aacc*WM*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number. *n* is the argument defined below. ↵ is the 'carriage return' character (ASCII decimal 13).
Argument	A number which selects a channel's value. This number is created by adding together the values of the desired options as shown. Channel / Value: 01 1., 02 2., 03 3., 04 4., 05 5., 06 6., 07 7., 08 8., 09 9., 10 10., 11 11., 12 12., 13 13., 14 14., 15 15., 16 64., 17 65., 18 66., 19 67., 20 68., 21 69., 22 70., 23 71. Source / Value: TRACK 0., PEAK 16., VALLEY 32.
Example	"#0001RM33↵" will cause the channel 01's DAC to monitor channel 01's valley value.
Reply	When writing: "OK", "ERROR" or "N/A". When reading: a number corresponding to a channel number and data value as shown above.
Remarks	none

RN/WN	Read/Write DAC Zero-Scale Value
Purpose	Reads or writes the channel's "DAC. ZERO-SCALE" menu item
Usage	"#*aacc*RN↵" to read, "#*aacc*WN*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *n* is the zero Analog Output value in engineering units. ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001WN-8000↵"
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value.

RO/WO	Read/Write DAC Full-Scale Value
Purpose	Reads or writes the channel's "DAC. FULL-SCALE" menu item
Usage	"#*aacc*RO↵" to read, "#*aacc*WO*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *n* is the full Analog Output value in engineering units. ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001WO8000↵"
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value.

RP/WP	Read/Write Operation
Purpose	Read or write the operation settings of the channel
Usage	"#*aacc*RP*pp*↵" to read, "#*aacc*WP*ppn*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number. *pp* is one of the two-character parameters given below. *n* is the argument. ↵ is the 'carriage return' character (ASCII decimal 13).
Parameters & Arguments	Using *pp*="00" accesses the "AUTO-ZERO" and "LINEARIZATION" menu items. When writing this parameter, the argument *n* is a number which selects different operating features. This number is created by adding together the values of the desired options as shown. Linearization: OFF 0., ON 16. Using *pp*="01" accesses the "CALIBRATION TYPE" menu item. When reading this parameter: *n*=5 means 5-Point Known-Load Calibration. Using *pp*="02" accesses the "AUX1 FUNCTION" menu item. Using *pp*="03" accesses the "AUX2 FUNCTION" menu item. When writing these parameters: *n*=0 means the Auxiliary Function pin is disabled. *n*=1 means track hold. *n*=2 means peak & valley hold. *n*=4 means peak & valley clear (edge triggered). Using *pp*="04" accesses the "CALIBRATION UNIT" menu item. This parameter can be read from, not written to.
Example	Sending "#0001WP0216↵" will allow the assertion of channel 01's Auxiliary 1 Function pin to activate the Tare function. The instrument will reply with "OK".
Reply	When writing: "OK" or "ERROR" When reading: a numeric value or text string according to the information above.

RR	Read Version Info
Purpose	Read version information found on the "VERSION INFO" menu item.
Usage	"#*aacc*RR↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001RR↵"
Reply	A text string such as 084-1169-01 04
Remarks	This is the part number and version of the firmware used by the channel's microprocessor.

RT/WT	Read/Write Front Panel Switch Operation
Purpose	Reads or writes the operation of the front panel switches when the Protection jumper is installed.
Usage	"#*aacc*RT↵" to read, "#*aacc*WT*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number. *n* is the argument defined below. ↵ is the 'carriage return' character (ASCII decimal 13).
Argument	The argument is created by adding together the values of the desired options as shown. [VALUE] Value — [CLEAR] Value ENABLED 0. — ENABLED 0. DISABLED 8. — DISABLED 4. [CHANNEL] Value — [TARE] Value ENABLED 0. — ENABLED 0. DISABLED 2. — DISABLED 1.
Example	It is desired to disable the [TARE] button for channel 02 when the Protection jumper is installed. Sending "#0002WT1↵" will accomplish this.
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value described above.
Remarks	If a disabled front panel button is pressed, the message "PROTECTED" will appear on the display.

Chapter 3
Frequency Input Channel

3.1 Features

The Frequency Input channel accepts square wave or sine wave input signals from such transducers as magnetic pickups, devices with TTL outputs, or devices with PNP or NPN transistor outputs. These signals are AC coupled into a zero-crossing detector, digitized, converted into engineering units, and placed into the track, peak and valley data values of the channel. A 5V excitation is available in case it is required by the device.

Setup and calibration of the channel is made at the factory. Re-calibration can be made manually through the SETUP mode with the known-load calibration method and a customer-supplied frequency calibrator.

The engineering units used to display the frequency are Hz. A Mathematics Virtual channel can be factory programmed for specific applications that required conversion into units of RPM or horsepower.

Two rear panel control inputs can be field-configured for such functions as remote track/hold, disabling peak/valley detection and clearing the peak/valley values. A voltage or current digital-to-analog output is also provided.

3.2 Getting Started Quickly

As shipped from the factory, the Frequency Input channel is calibrated and ready for use.

Connect the output of your transdcuer to the Frequency Input channel according to “Wiring” on pag e34.

3.3 Wiring

3.3.1 Channel Connector

The pin-out for the channel's connector is shown in the following table.

Table 3-1: Frequency Input Channel Pin Connections

Pin	Label	Function	NOTES
1 (top)	+EXC	(+)Excitation	referenced to pin 10
2	N/C	N/C	**DO NOT CONNECT!**
3	N/C	N/C	**DO NOT CONNECT!**
4	-EXC	(-)Excitation	referenced to pin 10
5	+SIG	(+)Signal	referenced to pin 10
6	-SIG	(-)Signal	referenced to pin 10
7	+OUT	Analog Output	referenced to pin 8
8	-OUT	Analog Return	-
9	N/C	N/C	**DO NOT CONNECT!**
10	DGND	Digital Ground	-
11	AUX1	Auxiliary Function 1 (connect to pin 10 to activate)	referenced to pin 10
12 (bottom)	AUX2	Auxiliary Function 2 (connect to pin 10 to activate)	referenced to pin 10

The Analog Output and Analog Return pins are electrically isolated from all other pins on the instrument.

Do not connect anything to the pins labeled as "N/C". Damage to the instrument or loss of accuracy may result.

3.3.2 NPN Open-Collector Connection

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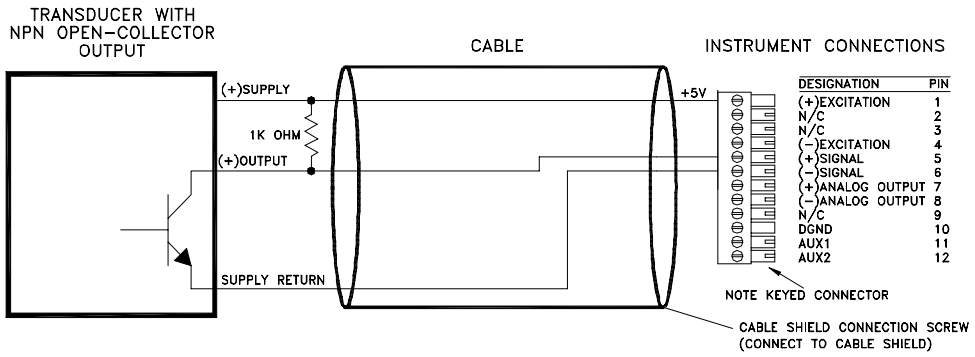

Figure 3-1: NPN Open-Collector Connection to Frequency Input Channel

3.3.3 PNP Open-Collector

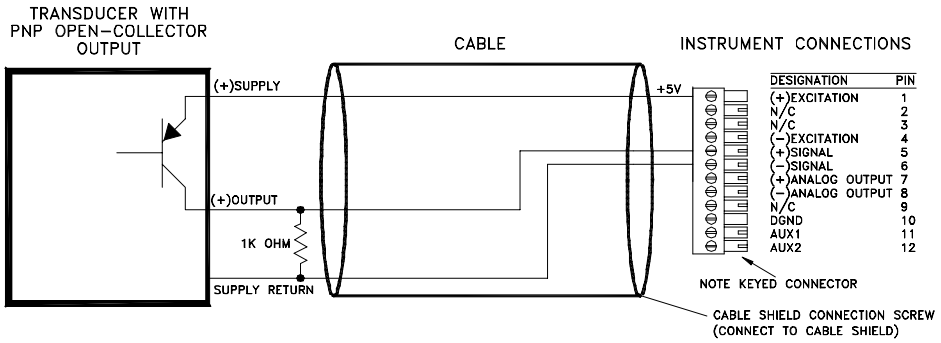

Figure 3-2: PNP Open-Collector Connection to Frequency Input Channel

3.3.4 TTL/CMOS Logic Connection

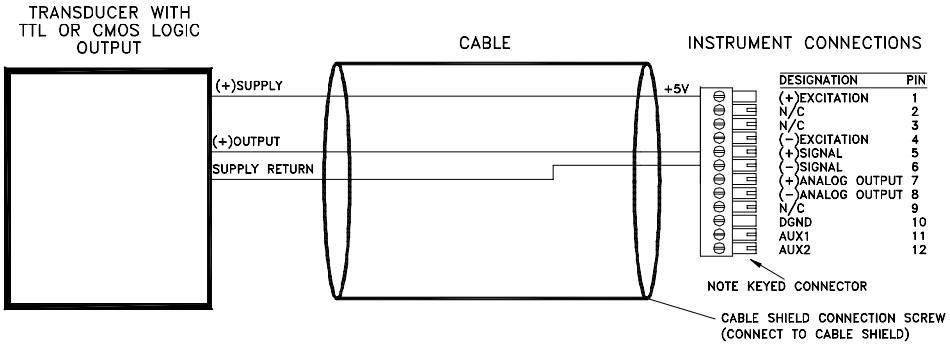

Figure 3-3: TTL or CMOS Logic Connection to Frequency Input Channel

3.3.5 Magnetic Pickup Connection

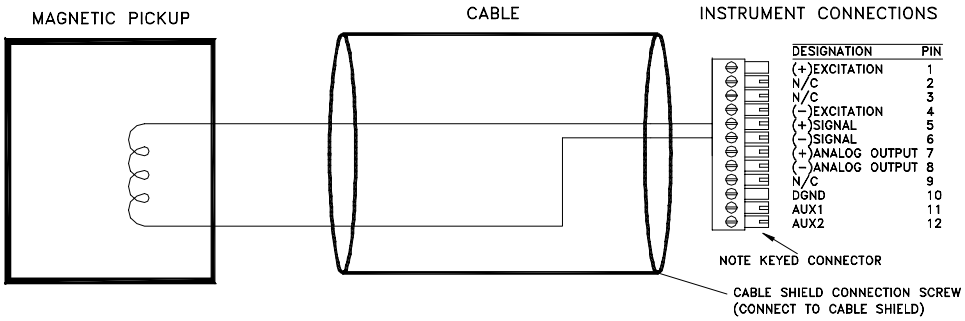

Figure 3-4: Magnetic Pickup Connection to Frequency Input Channel

3.4 Calibration

A listing of all menu items for this channel is given in “Setup Menu Reference” on page 55.

A customer-supplied signal generator is required for re-calibration. It should be set up to produce a square wave output at 1V peak-to-peak amplitude.

Step 1: Wire the signal generator to the channel’s connector.
See “Wiring” on page 34.

Step 2: Enter the CALIBRATION DATA.
See “CALIBRATION DATA Sub-Menu” on page40.

Step 3: Perform the calibration.
See “CALIBRATE Menu Item” on page 40.

Using the CALIBRATE menu item starts the calibration process. You will be prompted to use your signal generator to apply signals at various frequencies to the channel as required.

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3.5 Channel Specifications

FREQUENCY INPUT	
Frequency Range	15 Hz to 40kHz (square wave) 200Hz to 40kHz (sine wave)
Threshold	Zero Crossing (AC coupled)
Level	0.2Vpp to 30Vpp
Minimum Pulse Width	20us
Non-linearity	0.05% ful-scale
Temperature Effect	150 ppm/ºC
Frequency Response	2 Hz
Step Response	40 ms (typical)

EXCITATION OUTPUT	
Output	5V @ 100mA max.

AUXILLIARY INPUTS	
Quantity	2
Type	momentary contact closure
Response Time	< 5ms
Field-Selectable Functions	peak/valley clear, peak/valley hold, track hold

ANALOG OUTPUT	
Output voltage range	5, ±5, 10 or ±10 VDC (field selectable)
Output current range (optional current output channels)	4-20 mA
Source	any channel's track, peak or valley value
Isolation	500V
Resolution	13 bits
Frequency Response	same as input when driven by the same channel's tracking data

3.6 Channel Menu

The Frequency Input channel is configured and calibrated via its channel menu. Detailed instructions on operating the instrument in the SETUP Menu mode can be found in the "SC Series Instruction Manual", Sensotec p/n 008-0608-00.

3.6.1 OPERATION Sub-Menu

This menu controls the operation of this channel when the instrument is in the RUN mode.

POWER-ON SOURCE Menu Item

This menu selects which value is displayed by the channel when first entering the RUN mode.

The choices are:

- "TRACK" means the live tracking value of the channel.
- "PEAK" means the highest value of the channel.
- "VALLEY" means the lowest value of the channel.

3.6.2 AUXn FUNCTION Menu Items

The AUX1 FUNCTION and AUX2 FUNCTION menu items determine what happens when the Auxiliary Function pins (labeled as "AUX1" and "AUX2") on the channel's connector are activated. These pins are "activated" when they are connected to the Digital Ground (labeled as "DGND") pin. The choices are:

- "DISABLED" means that activating the pin does nothing.
- "TRACK HOLD" means that the tracking, peak and valley values will not be updated.
- "HIGH/LOW HOLD" means that the peak and valley values will not be updated.
- "HIGH/LOW CLEAR" means that the peak and valley values are reset.

As the Auxiliary Function pins are not isolated, it is recommended that a push-button switch or relay is used to connect these pins to the Digital Ground pin.

3.6.3 CALIBRATION TYPE Menu Item

The only choice is:

- "TYPE= 5 POINT CAL" means 5-Point Known Load Calibration. You are prompted to use your singal generator to apply the frequencies that were entered in the "KNOWN POINT 1/5", "KNOWN POINT 2/5", "KNOWN POINT 3/5", "KNOWN POINT 4/5" and "KNOWN POINT 5/5" registers. This technique is used to compensate for the non-linearity inherent in the channel's frequency-to-voltage converter.

The calibration points used for factory calibration are 0 Hz, 35kHz, 45kHz, 47.5kHz and 50kHz.

Choosing calibration points other than these will result in greatly reduced accuracy.

3.6.4 CALIBRATION DATA Sub-Menu

KNOWN POINT x/y Menu Items

This enters the engineering unit values for the known-load calibration points. These points must match the actual frequencies that you will apply to the instrument during calibration. The following menu items are available:

- "KNOWN POINT 1/5": point 1 of 5, must be 0Hz.
- "KNOWN POINT 2/5": point 2 of 5, must be 35kHz.
- "KNOWN POINT 3/5": point 3 of 5, must be 45kHz.
- "KNOWN POINT 4/5": point 4 of 5, must be 47.5kHz.
- "KNOWN POINT 5/5": point 5 of 5, must be 50kHz.

The instrument expects the frequency applied at each known-load point to be increasing. For example, the frequency applied at Known-Load Point 2/5 must be greater than the frequency applied at Known-Load Point 1/5.

3.6.5 CALIBRATE Menu Item

This menu item performs a calibration according to what was entered in the CALIBRATION TYPE and CALIBRATION DATA menu items.

Before performing a calibration, the CALIBRATION DATA must be entered (see "CALIBRATION DATA Sub-Menu" on page40).

For maximum accuracy, allow at least five minutes of warm-up before calibration.

The CALIBRATION TYPE is **5-Point Known Load Calibration**.

- The display will read DOING 5POINT CAL, and prompt you to APPLY 00000. Hz . When you have applied this frequency, press [ENTER].
- The display will read WORKING, then APPLY 37500. Hz. When you have applied this frequency, press [ENTER].
- The display will read WORKING, then APPLY 45000. Hz. When you have applied this frequency, press [ENTER].
- The display will read WORKING, then APPLY 47500. Hz. When you have applied this frequency, press [ENTER].
- The display will read WORKING, then APPLY 50000. Hz. When you have applied this frequency, press [ENTER].
- The display will indicate DONE and the instrument will return to the RUN mode.

3.6.6 DAC SETUP Sub-Menu

This sub-menu contains four items that control the Digital-to-Analog Converter (DAC) output of the channel.

DAC. CHANNEL Menu Item

This chooses which channel will drive the DAC output. Normally, the DAC located on a particular channel will be driven by that channel, but that need not be the case. For example, if a Mathematics Virtual channel is installed on the instrument, the output of this Virtual channel could be used to drive this channel's DAC output.

If the DAC is set-up to be driven by its own channel's tracking value, the Analog Output will have the frequency response specified by "Channel Specifications" on page 37. Otherwise, the Analog Output will operate more slowly.

DAC. SOURCE Menu Item

This designates the data source of the channel monitored by the analog output. Each channel has three data sources: the live tracking value (TRACK), its highest value (PEAK), and its lowest value (VALLEY).

The options for this menu item are:

- "TRACK" means the live tracking value of the channel.
- "PEAK" means the highest value of the channel since the peak/valley detector was last cleared.
- "VALLEY" means the lowest value of the channel since the peak/valley detector was last cleared.

If the DAC is set-up to be driven by its own channel's tracking value, the Analog Output will have the frequency response specified by "Channel Specifications" on page 37. Otherwise, the Analog Output will operate more slowly.

DAC. ZERO-SCALE Menu Item

This specifies what value, in engineering units, corresponds to zero output on the Analog Output.

"Zero output" might be 0 Volts, 2.5 Volts, 5 Volts, 4 mA or 12 mA depending on if the channel has a voltage or current output and how it is configured. See the "Digital-to-Analog Output" section of this chapter for details.

DAC. FULL-SCALE Menu Item

Specifies what value, in engineering units, corresponds to full output on the Analog Output.

"Full output" might be 5 Volts, 10 Volts or 20 mA depending on if the channel has a voltage or current output and how it is configured. See the "Digital-to-Analog Output" section of this chapter for details.

3.6.7 DIAGNOSTICS Sub-Menu

DAC FULL SCALE Menu Item When this menu item is selected, the Analog Output of the channel is forced to its full-scale output, then DAC UPDATED is displayed. This is useful when calibrating or trimming the readout connected to the Analog Output.

DAC ZERO SCALE Menu Item When this menu item is selected, the Analog Output of the channel is forced to its zero-scale output, then DAC UPDATED is displayed. This is useful when calibrating or trimming the readout connected to the Analog Output.

VERSION INFO Menu Item This menu item displays the part number and revision level of the firmware used by this channels microprocessor.

DISPLAY ADC Menu Item The options for this menu item are:

- "OFF" will allow the [VALUE] button to cycle through "TK" (tracking value), "HI" (peak value) and "LO" (valley value). This is the recommended option.
- "ON" will allow the "AD" (percentage of the Analog-to-Digital converter's full-scale digitizing capability) display source to be available along with "TK" (tracking value), "HI" (peak value) and "LO" (valley value) when the [VALUE] button is pressed on the front panel.

The Analog-to-Digital converter counts are displayed as a percentage from -100.00% to 100.00%.

This can be used to verify the correct operation of the input circuitry of the channel.

LINEARIZATION Menu Item The options for this menu item are:

- "ON" will allow the linearization data obtained from the 5-Point Known Load Calibration to affect a channel's scaled values. This is the recommended option.
- "OFF" will not allow linearization data to effect the channel's scaled values. This is useful when diagnosing problems in a calibration procedure.

DISABLE CHANNEL Menu Item The options for this menu item are:

- "ON" will bypass the INITIALIZE and RUN modes of the channel. The track, peak and valley values of the channel are forced to 0. This option is helpful when a channel is installed but not being used.
- "OFF" will allow normal operation of the channel.

3.7 Analog Output Configuration

3.7.1 Identifying the Output Type

A Frequency Input channel is available with one of two types of digital-to-analog (DAC) outputs: voltage or current. You can determine which type of output a channel has by one of three ways:

- Consulting the instrument's Customer Information Sheet
- Examining the SYSTEM MENU -> CONFIGURATION -> CHANNEL nn TYPE menu item where nn is the number of the channel. If the channel's type is FREQUENCY Vout, it has a voltage output. If the channel's type is FREQUENCY Iout, it has a current output.
- Examining the channel's circuit board as shown in the figure below.

3.7.2 Channel Menu Items

The Analog Output can be driven by any channel's track, peak or valley value.

See the "Channel Menu" section earlier in this chapter for a complete listing of SETUP menu items available on the DAC. SETUP sub-menu.

3.7.3 Output Selection

Jumpers located on the channel's circuit board determine what outputs are generated when the value selected to drive the Analog Output (from the DAC. CHANNEL and DAC. SOURCE menu items) equals the DAC. FULL SCALE and DAC. ZERO SCALE settings.

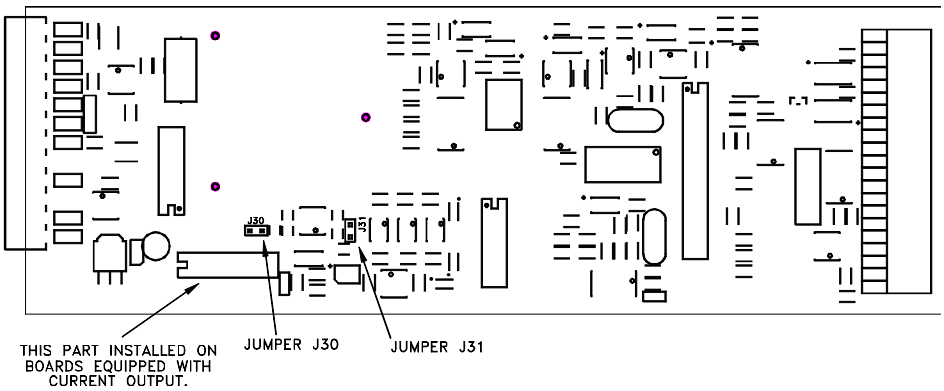

Figure 3-5: Digital-to-Analog Output Jumper Locations

DAC. ZERO SCALE Output	DAC. FULL SCALE Output	J30 jumper	J31 jumper
CHANNELS WITH VOLTAGE OUPUT			
0-5V	2.5 Volts	5 Volts	open	closed
±5V	0 Volts	5 Volts	open	open
0-10V	5 Volts	10 Volts	closed	closed
±10V	0 Volts	10 Volts	closed	open
CHANNELS WITH CURRENT OUTPUT			
4-20mA	4 mA	20 mA	open	open
4-20mA	12 mA	20 mA	open	closed

3.8 Troubleshooting

3.8.1 Error Messages

See the “Error Messages” chapter of the “SC Series Instruction Manual”, Sensotec p/n 008-0608-00, for information relating to error messages.

3.8.2 Common Problems and Solutions

Erratic Display

Check “Wiring” on page 34 and make certain that nothing is connected to the pins labeled as “N/C”.

Incorrect display readings over 50kHz

The Frequency Input channel can only digitize signals with the minimum pulse specified in “Channel Specifications” on pag e37.

Analog Output Incorrect

Make certain of the type of Analog Output (voltage or current) that the channel is equipped with; see “Identifying the Output Type” on page43.

Use the DIAGNOSTICS -> DAC FULL SCALE and DIAGNOSTICS -> DAC ZERO SCALE menu items to force the Analog Output to a known output. Then, adjust your readout device, panel meter, PLC or data acquisition system to match.

Check the output selection jumpers; see “Output Selection” on page 43.

Auxiliary Function Pins Not Operating

Make sure that the AUX1 FUNCTION or AUX2 FUNCTION SETUP menu items are set correctly; if they are set to DISABLED then they will not operate.

The Auxiliary Function (“AUX1” and “AUX2”) pins must be connected to pin 10, not pin 8, to activate them.

3.9 Communication Commands

3.9.1 Introduction

This section only documents the communication commands that affect the operation of the Frequency Input channel. Refer to document p/n 008-0610-00, “SC Series Communications Guide” for details regarding serial communications. This document can be downloaded from Sensotec’s web site, www.sensotec.com.

3.9.2 Descriptions

F0	**Transmit Track Data**
Purpose	To transmit the channel’s tracking data value
Usage	"#*aacc*F0↵" *#* is the ‘pound’ or ‘hash’ character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the ‘carriage return’ character (ASCII decimal 13).
Example	"#0001F0↵"
Reply	" 0037.5” (typical)
Remarks	The input channel continuously reads the RTD. This function transmits the most recent reading.

F9	**Transmit Peak Data**
Purpose	To transmit the channel’s peak data value
Usage	"#*aacc*F9↵" *#* is the ‘pound’ or ‘hash’ character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the ‘carriage return’ character (ASCII decimal 13).
Example	"#0001F9↵"
Reply	" 0162.5” (typical) or "N/A”

FA	Transmit Valley Data
Purpose	To transmit the channel's valley data value
Usage	"#*aacc*FA↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001FA↵"
Reply	"-0012.5" (typical) or "N/A"

FB	Clear Peak and Valley Data
Purpose	To reset the channel's peak and valley data values to the track value.
Usage	"#*aacc*FB↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001FB↵"
Reply	"OK" or "N/A"
Remarks	This command is not available on the Model SC1000.

FF	Transmit Analog-to-Digital Converter Reading
Purpose	To transmit the Analog-to-Digital converter reading as a percentage from -100% to +100% of the A/D converters's full scale.
Usage	"#*aacc*FF↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001FF↵"
Reply	" 50.000" (typical)
Remarks	none

FH	Write DAC Control Value
Purpose	To control the channel's Digital-to-Analog Converter (DAC) manually or automatically.
Usage	"#*aacc*FH*n*↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *n* is the argument defined below. ↵ is the 'carriage return' character (ASCII decimal 13).
Argument	"AUTO" returns the DAC to its normal automatic operation (power-on default). That is, it is controlled by the "DAC. CHANNEL", "DAC. SOURCE", "DAC. ZERO-SCALE" and "DAC. FULL-SCALE" menu items. If the argument is a numeric value between -1 and +1, the DAC is forced to manual control and the value is used to drive the DAC from -100% to +100% of its output.
Example	"#0001FH.5↵" will force channel 01's DAC to +50% of full-scale.
Reply	"OK" or "ERROR"
Remarks	You might wish to force a channel's DAC to a certain output to help calibrate the attached data acquisition system or other device.

R6	Read Display Units
Purpose	Reads the channel's "DISPLAY UNITS" menu item
Usage	"#*aacc*R6↵" to read. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001R6↵"
Reply	When reading: a four-character string.

RK/WK	Read/Write Known-Load Calibration Point
Purpose	Reads or writes the channel's "KNOWN POINT x/y" menu items
Usage	"#*aacc*RK*pp*↵" to read, "#*aacc*WK*ppn*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *pp* is the parameter defined below. *n* is the known-load calibration point in engineering units. ↵ is the 'carriage return' character (ASCII decimal 13).
Parameter	"00" accesses the "KNOWN POINT 1/5" menu item. "01" accesses the "KNOWN POINT 2/5" menu item. "02" accesses the "KNOWN POINT 3/5" menu item. "03" accesses the "KNOWN POINT 4/5" menu item. "04" accesses the "KNOWN POINT 5/5" menu item.
Example	"#0001RK01↵"
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value. Changing this value has no effect until the channel is re-calibrated to the RTD with the Known-Load Calibration method.

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RM/WM	Read/Write DAC Channel & Value
Purpose	Reads or writes the channel's "DAC. CHANNEL" and "DAC. SOURCE" menu items
Usage	"#*aacc*RM↵" to read, "#*aacc*WM*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number. *n* is the argument defined below. ↵ is the 'carriage return' character (ASCII decimal 13).
Argument	A number which selects a channel's value. This number is created by adding together the values of the desired options as shown. Channel / Value: 01 1., 02 2., 03 3., 04 4., 05 5., 06 6., 07 7., 08 8., 09 9., 10 10., 11 11., 12 12., 13 13., 14 14., 15 15., 16 64., 17 65., 18 66., 19 67., 20 68., 21 69., 22 70., 23 71. Source / Value: TRACK 0., PEAK 16., VALLEY 32.
Example	"#0001RM33↵" will cause the channel 01's DAC to monitor channel 01's valley value.
Reply	When writing: "OK", "ERROR" or "N/A". When reading: a number corresponding to a channel number and data value as shown above.
Remarks	none

RN/WN	Read/Write DAC Zero-Scale Value
Purpose	Reads or writes the channel's "DAC. ZERO-SCALE" menu item
Usage	"#*aacc*RN↵" to read, "#*aacc*WN*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *n* is the zero Analog Output value in engineering units. ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001WN-8000↵"
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value.

RO/WO	Read/Write DAC Full-Scale Value
Purpose	Reads or writes the channel's "DAC. FULL-SCALE" menu item
Usage	"#*aacc*RO↵" to read, "#*aacc*WO*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number *n* is the full Analog Output value in engineering units. ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001WO8000↵"
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value.

RP/WP	Read/Write Operation
Purpose	Read or write the operation settings of the channel
Usage	"#*aacc*RP*pp*↵" to read, "#*aacc*WP*ppn*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number. *pp* is one of the two-character parameters given below. *n* is the argument. ↵ is the 'carriage return' character (ASCII decimal 13).
Parameters & Arguments	Using *pp*="00" accesses the "AUTO-ZERO" and "LINEARIZATION" menu items. When writing this parameter, the argument *n* is a number which selects different operating features. This number is created by adding together the values of the desired options as shown. Linearization: OFF 0., ON 16. Using *pp*="01" accesses the "CALIBRATION TYPE" menu item. When reading this parameter: *n*=5 means 5-Point Known-Load Calibration. Using *pp*="02" accesses the "AUX1 FUNCTION" menu item. Using *pp*="03" accesses the "AUX2 FUNCTION" menu item. When writing these parameters: *n*=0 means the Auxiliary Function pin is disabled. *n*=1 means track hold. *n*=2 means peak & valley hold. *n*=4 means peak & valley clear (edge triggered). Using *pp*="04" accesses the "CALIBRATION UNIT" menu item. This parameter can be read from, not written to.
Example	Sending "#0001WP0216↵" will allow the assertion of channel 01's Auxiliary 1 Function pin to activate the Tare function. The instrument will reply with "OK".
Reply	When writing: "OK" or "ERROR" When reading: a numeric value or text string according to the information above.

RR	Read Version Info
Purpose	Read version information found on the "VERSION INFO" menu item.
Usage	"#*aacc*RR↵" *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number ↵ is the 'carriage return' character (ASCII decimal 13).
Example	"#0001RR↵"
Reply	A text string such as 084-1169-01 04
Remarks	This is the part number and version of the firmware used by the channel's microprocessor.

RT/WT	Read/Write Front Panel Switch Operation
Purpose	Reads or writes the operation of the front panel switches when the Protection jumper is installed.
Usage	"#*aacc*RT↵" to read, "#*aacc*WT*n*↵" to write. *#* is the 'pound' or 'hash' character (ASCII decimal 35). *aa* is the two-character instrument address. *cc* is the two-character channel number. *n* is the argument defined below. ↵ is the 'carriage return' character (ASCII decimal 13).
Argument	The argument is created by adding together the values of the desired options as shown. [VALUE] Value — [CLEAR] Value ENABLED 0. — ENABLED 0. DISABLED 8. — DISABLED 4. [CHANNEL] Value — [TARE] Value ENABLED 0. — ENABLED 0. DISABLED 2. — DISABLED 1.
Example	It is desired to disable the [TARE] button for channel 02 when the Protection jumper is installed. Sending "#0002WT1↵" will accomplish this.
Reply	When writing: "OK" or "ERROR". When reading: an ASCII-floating-point value described above.
Remarks	If a disabled front panel button is pressed, the message "PROTECTED" will appear on the display.

Chapter 4
Setup Menu Reference

4.1 Navigation instructions

- Press [UP]+[DOWN] to enter the SETUP menu mode.
- Press [UP] to move up.
- Press [DOWN] to move down.
- Press [ENTER] to select an item.
- Press [EXIT] to re-start the instrument.

Table 4-1: RTD Input Channel Men u

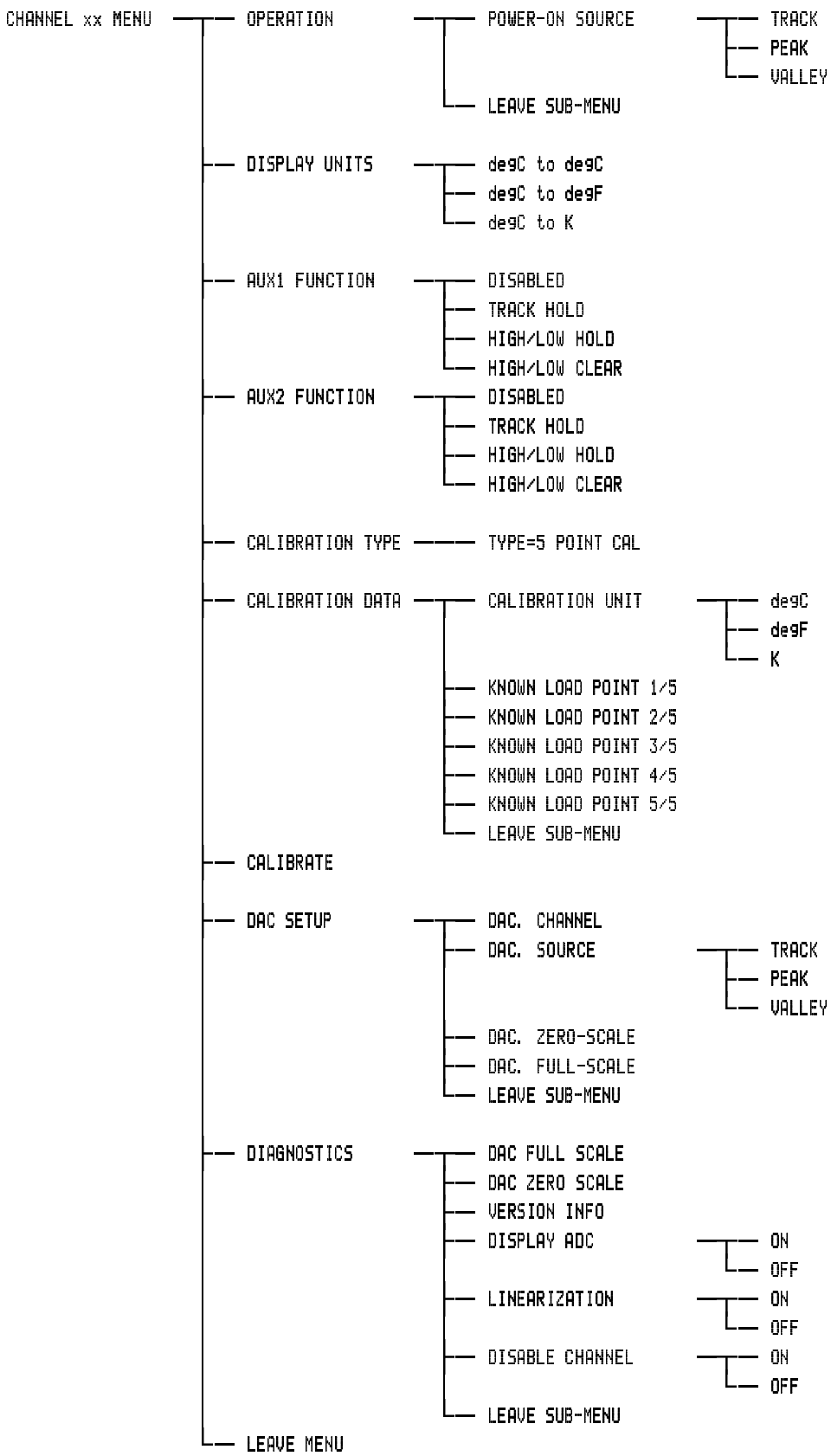
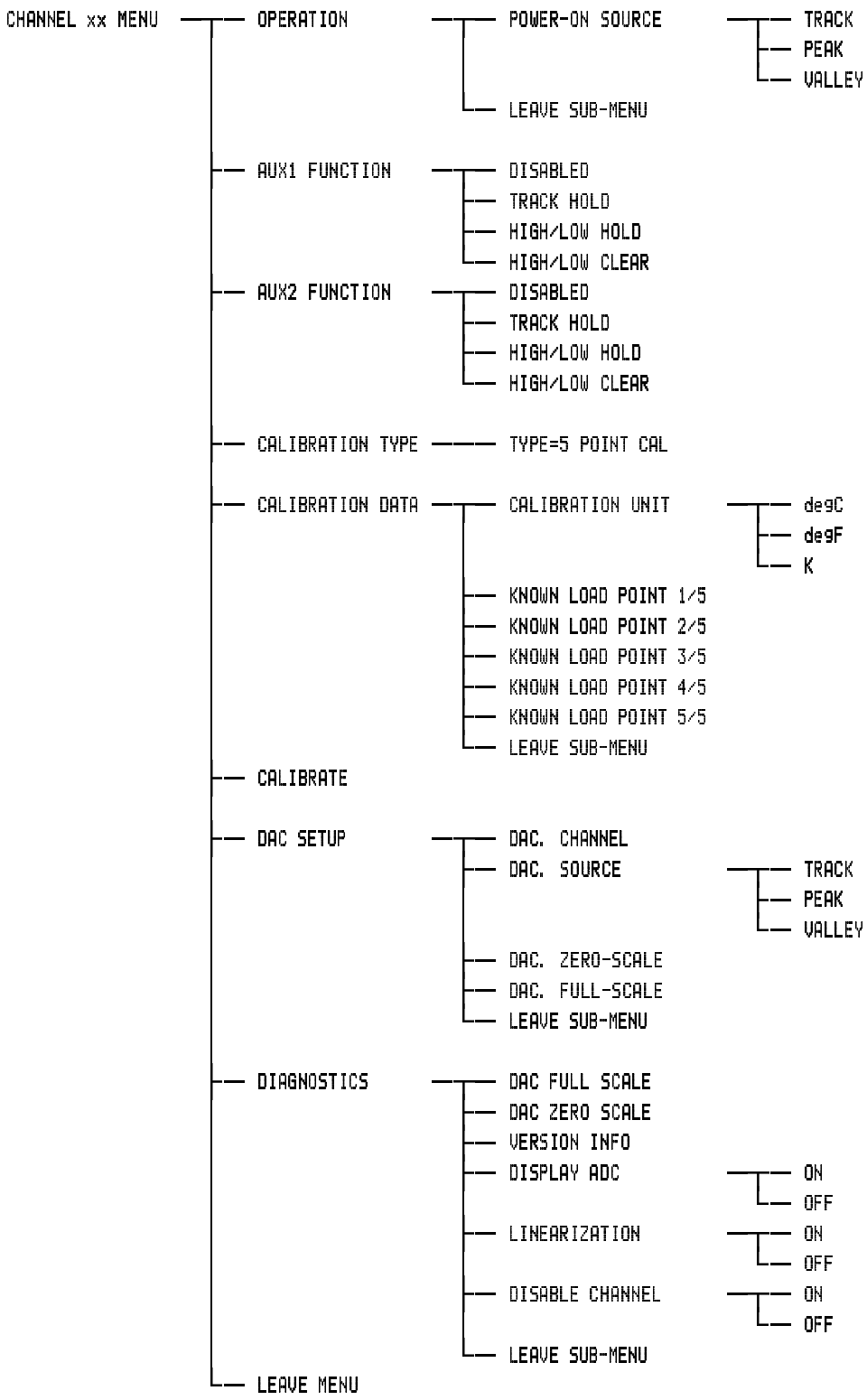


Table 4-2: Frequency Input Channel Menu



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Warranty/Repair Policy

Limitation of Remedy and Disclaimer of Warranty

Any of our products which, under normal operating conditions, proves defective in material or in workmanship within one year from the date of shipment by Sensotec, Inc., will be repaired or replaced free of charge, provided that the buyer (1) promptly notifies Sensotec, Inc. of any such defect; (2) provides Sensotec, Inc. with satisfactory proof of the defect and that the product was properly installed, maintained, and operated within the limits of rated and normal usage; and (3) obtains from Sensotec, Inc. authorization to return the product. Any such product shall be returned with transportation charges prepaid. The replacement product will be shipped F.O.B. our plant.

The remedy set forth herein does not extend to any product or part thereof which, under normal usage, has an inherently shorter useful life than one year. The remedy set forth herein does not apply to damage or to defects in any product caused by the buyer's misuse or neglect, nor does it apply to any product which has been repaired or disassembled which, in the sole judgement of Sensotec, Inc. affects the performance of the product.

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Advanced authorization is required prior to the return to Sensotec, Inc. Before returning the items, either write to the Repair Department c/o Sensotec, Inc., 2080 Arlingate Lane, Columbus, Ohio 43228, or call (800) 848-6564 with: 1) a part number; 2) a serial number of the defective product; 3) a technical description* of the defect; 4) a no-charge purchase order number (so products can be returned to you correctly); and 5) ship and bill addresses. Shipment to Sensotec, Inc. shall be at Buyer's expense and repaired or replacement items will be shipped F.O.B. our plant in Columbus, Ohio. Non-verified problems or defects may be subject to an evaluation charge. Please return the original calibration data with the unit.

Obtaining Non-warranty Service

Advance authorization is required prior to the return to Sensotec, Inc. Before returning the item, either write to the Repair Department c/o Sensotec, Inc., 2080 Arlingate Lane, Columbus, Ohio 43228, or call (800) 848-6564 with: 1) a part number; 2) a serial number of the defective product; 3) a technical description* of the malfunction; 4) a purchase order number to cover Sensotec, Inc.'s repair cost; and 5) ship and bill addresses. After the product is evaluated by Sensotec, Inc., we will contact you to provide the estimated repair costs before proceeding. The minimum evaluation charge is $95. Shipment to Sensotec, Inc. shall be at Buyer's expense and repaired items will be shipped to you F.O.B., our plant in Columbus, Ohio. Please return the original calibration data with the unit.

Repair Warranty

All repairs of Sensotec, Inc. products are warranted for a period of 90 days from date of shipment. This warranty applies only to those items which were found defective and repaired. It does not apply to products in which no defect was found and returned as is or merely re-calibrated. Out of warranty products may not be capable of being returned to the exact original specifications or dimensions.

*Technical description of the defect: In order to properly repair a product, it is necessary for Sensotec, Inc. to receive information specifying the reason the product is being returned. Specific test data, written observations on the failure and specific corrective action you require is needed.

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