

SCM10 Cryogenic Temperature Monitor

User's Manual



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 SCIENTIFIC
INSTRUMENTS

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Printing History
Initial Issue

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The Model SCM10 does not contain any user serviceable parts. Do not open the enclosure. Do not install substitute parts or perform any unauthorized modification to the product. For service or repair, return the product to SII or an authorized service center.



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1. INTRODUCTION

PRODUCT DESCRIPTION

The SCM10 single channel monitor provides the accuracy, resolution and interface features of a bench top temperature monitor in an easy to use, compact and easily integrated instrument. With appropriate sensors, the SCM10 measures temperature from 1.4K to 800K and in difficult sensing conditions, including high vacuum and magnetic fields. SCM10 has two programmable alarms, two relays and a user configurable analog voltage or current output. Serial interface and Ethernet interface are provided for remote operation.

A PC-compatible utility software is provided with the SCM10. This graphical user interface provides an easy way to set all instrument parameters and evaluate the performance of the instrument. The SCM10 also has an embedded web server that can be used to connect to the instrument from anywhere within the LAN using an internet browser. The instrument web page shows the current temperature reading and shows the status of all alarms and relays.

The SCM10 Temperature Monitor supports diode and RTD sensors. The instrument can be configured for the appropriate sensor type using the front panel or the utility software. Two convenient sensor excitation currents are provided to choose from. The SCM10 provides a 4 -leaded differential measurement for accurate temperature measurements. Measurements are available in temperature units K, °C or °F , or sensor units V or Ω.

The SCM10 has 9 standard sensor curves that are programmed into the instrument from the factory. It also provides room for one 200 point user curve, which may be loaded into the instrument using the utility software.

With a serial, Ethernet, and convenient graphical user interface, as well as an ASCII command set and LabVIEW™ drivers, the SCM10 can be used as a stand-alone temperature monitor or can be easily integrated into other systems.

PRODUCT SPECIFICATIONS

Input Specifications

- Number of Inputs: 1
- Measurement Type: 4-leaded differential
- Excitation Current: Constant Current (10 μ A or 1mA)
- Isolation: Measurement not isolated from chassis ground
- A/D Resolution: 24 bit
- Input Accuracy: Sensor Dependent
- Measurement Resolution: Sensor Dependent
- Measurement Rate: 5 rdgs/s
- Supported Sensors:

Diodes	Silicon, Gallium Arsenide (25K & above)
RTDs	RuO 1k Ω , RuO 100k Ω , Pt 1000 Ω , Pt 1000 Ω , Cernox™, Carbon-Glass (4K & above)

- Standard Curves: Si410, Si430, DT470, DT670, CTI, Pt100, Pt1000, RO600, RO105
- User Curve: One user curve in non-volatile memory (up to 200 points)
- Settings: Sensor Type, Sensor Curve
- Input Connector: DB15

Sensor Performance Specifications

Sensor Type	Silicon Diode	Ruthenium Oxide	Platinum
Model Number	Si410	RO105	Pt100
Temperature Range	1 to 450K	2.0 to 273K	30 to 800K
Sensor Units	Volts	Ohms	Ohms
Input Range	0 to 5V DC	0 to 500 k Ω	0 to 500 Ω
Sensor Excitation	10 μ A	10 μ A	1mA
Electronic Resolution	10 μ V	1 Ohm	1 mOhm
Sensor Sensitivity	-36.36mV/K at 4K -1.701mV/K at 77K -2.293mV/K at 300K	12.652k Ω /K at 4K 174.55 Ω /K at 77K 19.52 Ω /K at 270K	0.231 Ω /K at 36K 0.422 Ω /K at 77K 0.386 Ω /K at 300K
Electronic Accuracy Sensor Units:	\pm 150 μ V	\pm 60 Ω	\pm 0.05 Ω
Temperature:	\pm 3.7mK at 4K \pm 87mK at 77K \pm 66mK at 273K	\pm 4.5mK at 4K \pm 0.31K at 77K \pm 2.8K at 273K	\pm 0.21K at 36K \pm 0.12K at 77K \pm 0.13K at 273K

Analog Output Specifications

- Isolation: Output not isolated from chassis ground
- Update Rate: 2 rdg/s

	<i>Voltage</i>	<i>Current</i>
Range:	0-10 V	4-20mA
Resolution:	0.15 mV	0.3 µA
Accuracy:	±1.25 mV	±2.5 µA
Min. Load Resistance	500 Ω (short-circuit protected)	N/A
Compliance Voltage	N/A	10 V
Load Regulation	N/A	±0.02% rdg (0 to 500Ω)

- Settings: Scale Voltage or Current with Temperature, Sensor Units or Natural Logarithm of Sensor Units
- Connector: DB15

Front Panel

- Display Type: 6 digit LED
- Display Units: K, °C, °F, V, Ω
- Display Update Rate: 2 rdg/s
- Temperature Display Resolution: 0.001° between 0-99.999°, 0.01° between 100-999.99°, 0.1° above 1000°
- Sensor Units Display Resolution: 100µV (for diode type), Sensor Dependent (for RTD type)
- Keys: Menu, ▼(Down), ▲(Up), Enter
- Front Panel Features: Alarm LEDs, View & Edit Configuration, Instrument Reset

Relays and Alarms

Alarms:

- Number: 2
- Settings: Enabled or Disabled, High or Low Setpoint, Deadband, Latching or Non-Latching
- Actuators: Front Panel LEDs, Relays

Relays:

- Number: 2
- Contacts: Normally Open (NO), Normally Closed (NC) and Common (COM)
- Contact Rating: 24VDC @ 1A
- Settings: Manually ON, Manually OFF, Follow Alarms
- Connector: DB15

Interface

Serial Interface:

- Format: RS232
- Baud Rate: 9600, 19200, 57600, 115200
- Functionality: Graphical User Interface, LabVIEW™ Drivers (Version 8.0)
- Connector: DB9 (DCE)

Ethernet Interface:

- Format: 10 Base T
- Speed: 10 Mbps
- Functionality: Graphical User Interface, LabVIEW™ Drivers, Embedded Web Server
- Connector: RJ-45

Input Power Specifications

- Power Requirement: Regulated 9-24V DC @ 300mA
- Connector: Barrel Plug 5.5mm OD x 2.5 mm ID x 9.9 mm L, Center Positive
- Internal Fuse Specifications: 1.5A, 250V, Fast Acting, 5 X 20mm

General

- Ambient Temperature Range: 15-35°C at rated accuracy, 10-40°C at reduced accuracy
- Size: 96mm W X 48mm H X 166mm D (3.8 in x 1.9 in x 6.5 in)
- Mounting: Panel mount into 91mm W X 44mm H (3.6 in x 1.7 in) cutout
- Weight: 1 lb
- Approval: CE, RoHS compliant

Power Supply (#490-060)- supplied with the SCM10

- Input Power Requirements: 90-264VAC, 47-63Hz, 0.25A rms @ 120Vac, 0.15A rms@ 240Vac
- Output Voltage: +12V DC
- Output Power: 12W (1A)

SAFETY SUMMARY

Observe these general safety requirements with the instrument at all times. Failure to comply with these precautions or with specific warnings elsewhere in the manual violates safety standards of design, manufacture and intended instrument use. Scientific Instruments assumes no liability for customer failure to comply with these requirements.

The SCM10 has been designed and tested to protect the user from electric shock, burn, mechanical hazards and spread of fire from the instrument, under normal working conditions. The SCM10 is designed for indoor use only. Improper use of the instrument may pose a hazard to the operator and surrounding area.

The power supply included with the SCM10 meets or exceeds the European Union standard, EN-60950-1.

Scientific Instruments assumes no liability for damage caused by controlling or switching any safety equipment or high integrity equipment with the SCM10's relays and alarms.

Do not operate the instrument in an explosive atmosphere. Operation of any instrument in the presence of flammable gases and fumes that is not rated for such use constitutes a safety hazard.

Do not install substitute parts in the SCM10 or perform any unauthorized modification to the instrument. Return the instrument to Scientific Instruments for service and repair to ensure that safety features are maintained.

Operating personnel must not remove instrument covers or replace components while the instrument is still energized. To avoid injuries, always disconnect power and discharge circuits before touching them.

RELATED SAFETY SYMBOLS

 Direct Current (power line)

ABSOLUTE MAXIMUM RATINGS

The following table lists the absolute maximum ratings of the power input and other analog input/output connections. This information is useful when selecting the appropriate wiring conductor for these connections.

<i>Input/Output Pin</i>	<i>Maximum Voltage/Current Ratings</i>
Sensor input (I+ to I-, E+ to E-)	6V, 1mA
Analog Output (with respect to COM)	11V, 20mA
Relay Pins (with respect to COM)	24VDC, 1A
Input Power	9-24VDC, 1A

2. INSTRUMENT SUMMARY

GENERAL

This chapter describes the general installation instructions for the SCM10.

INSPECTION AND UNPACKING

Inspect shipping boxes for external damage before opening. Photograph any box that has significant damage before opening. If there is visible damage to the contents of the container, please contact the shipping company and Scientific Instruments immediately.

Items included with the SCM10 Temperature Monitor:

1. SCM10 Temperature Monitor
2. SCM10 Users Manual
3. SCM10 Utility Software CD
4. DB15 Mating Connector and Shell
5. DC Adapter
6. DC Fuse (spare)

REAR PANEL DEFINITION

This section describes the connections on the rear panel of the SCM10. It contains references to the sections that describe these connector pin outs in detail. Figure 2.1 shows the rear panel of the SCM10.



Figure 2.1

INPUT POWER CONNECTOR

Power is supplied to the SCM10 through the coaxial connector. There is no power switch on the instrument. Hence, the SCM10 is turned ON simply by plugging in the power cable from the wall wart or power source. The SCM10 requires regulated 9-24VDC @ 300mA.

The wall wart that is supplied with the SCM10 provides 12VDC. However, any other regulated voltage source (within the specification limits) may be used to power the SCM10.

The dimensions for the barrel plug are as follows:

- 2.5mm I.D. x 5.5mm O.D. Female, Positive Center



Figure 2.2

I/O CONNECTOR



Figure 2.3

Pin #	Signal Description	Pin #	Signal Description
1	I+	9	I-
2	E+	10	E-
3	Shield	11	Shield
4	Analog Output +	12	Analog Output – (COM)
5	Shield	13	Relay 1 NC
6	Relay 1 Common	14	Relay 1 NO
7	Relay 2 NC	15	Relay 2 COM
8	Relay 2 NO		

The DB15 Female connector on the rear panel is used for I/O signals. This connector has the sensor input, analog output and relay output connections. The pin out for this connector is shown in Figure 2.3.

Shielded cables are highly recommended for the I/O connections, since these signals are very sensitive to radiated and conducted noise. In particular, screened and shielded twisted pair cables are very effective as they have a foil shield around each twisted pair as well as an overall braided metal sheath around all the pairs, thereby shielding wires from external Electromagnetic Interference and crosstalk between the wire pairs.

It is also recommended to pair up the following wires as twisted pairs in order to minimize noise pickup:

- I+ and I-
- E+ and E-
- Analog Output + and Analog Output –

SERIAL CONNECTOR

The pin-out of the DB9 connector for SCM10 is given below: (DCE)



Figure 2.4

<i>Pin #</i>	<i>Pin Description</i>	<i>Pin #</i>	<i>Pin Description</i>
1	No Connection	6	No Connection
2	Transmit data (Out)	7	No Connection
3	Receive Data (In)	8	No Connection
4	No Connection	9	No Connection
5	Ground		

The DB9 connector on the rear panel is used for Serial communication (RS232). The SCM10 is a DCE (Data Communications Equipment) device for RS232 communication. Most PCs are DTE type. Hence, a straight DB9 cable is recommended for setting up an RS232 connection from the SCM10 to the PC.

ETHERNET CONNECTOR

<i>Pin #</i>	<i>Pin Description</i>	<i>Pin #</i>	<i>Pin Description</i>
1	+ Transmit Data	5	No Connection
2	- Transmit Data	6	- Receive Data
3	+ Receive Data	7	No Connection
4	No Connection	8	No Connection

The RJ45 connector on the rear panel is used for Ethernet communication. If the SCM10 is going to be connected directly to the PC with an Ethernet cable, a crossover cable is required! If the SCM10 is to be connected directly to the network, a straight Ethernet cable is sufficient.



Figure 2.5

SENSOR INPUT

Sensors are typically connected to the SCM10 using 4 wires; I+, I-, E+, E-.

I+ and I- wires carry a constant current for exciting the sensors. This constant current can be programmed to be 10 μ A or 1mA.

E+ and E- wires measure the voltage across the sensor leads and this data is used to calculate the temperature of the sensor.

Sensors connected using just 2 wires (by connecting I+ to V+ and I- to V- at the connector) have the voltage drop along the wires added to the sensor measurement. Hence, 4-leaded sensor connections are recommended for the best measurements.

Sensor Input connections are done through the DB15 connector on the rear panel. Refer to Figure 2.3 for the pin out of the I/O connector.

ANALOG OUTPUT

Analog Output, available on the rear panel, generates a voltage or current output proportional to the temperature or sensor data, as measured by the SCM10.

When the voltage type output is selected, the range of the output is from 0-10V with a resolution of 0.15mV. The output impedance of the analog output (voltage type) is 500 Ohms and this protects the SCM10 circuitry from damage due to a short between the analog output leads.

For the current type output, the range of the output is from 4mA to 20mA with a resolution of 2.5 μ A. The compliance voltage for the current output circuitry is 10V, so that the maximum load resistance that the 4-20mA output can support is 500 Ohms.

Analog Output can be programmed to scale with temperature, sensor data or the natural logarithm of sensor data.

Analog Output scaling is completely customizable by editing the Low Limit and High Limit values. If the data is less than or equal to the Low Limit value, the analog output would be 0V or 4mA. Similarly, if the data is greater than or equal to the High Limit, then the output would be 10V or 20mA.

Analog output connections are done through the DB15 connector on the rear panel. Refer to [Sensor Performance Specifications Table](#) on page 6 for the pin out of the I/O connector.

ALARMS AND RELAYS

Alarms:

The SCM10 has 2 programmable Alarms that can be used to flag Low or High Temperature conditions. Each of the alarms has its own set point. The alarm set point is entered in Kelvin. If the Alarm is set to be a High Alarm, then the Alarm turns ON when the temperature measured by SCM10 is greater than or equal to the set point. Similarly, if the Alarm is set to be a Low Alarm, then the Alarm turns ON when the temperature measured by SCM10 is less than or equal to the set point.

Alarms are annunciated through Front Panel LEDs and the Utility Software (when in use). Additionally, relays can also be configured to be activated when the Alarm(s) is (are) ON.

Latching is a feature provided to leave Alarm ON upon entering an Alarm Condition. This is useful to detect faults in the system. The latched alarm can be turned OFF by pressing the **[Enter]** key on the front panel. If latching is disabled, the alarm turns OFF when the alarm condition no longer exists.

When the latching feature is disabled, the deadband parameter can be used to prevent the alarm from toggling ON and OFF when temperature varies around the set point. For example, if the high alarm set point is 300K and the deadband is 2K, the alarm will turn on, when the temperature goes above 300K, but will remain ON as long as the temperature is above $300K - 2K = 298K$. The alarm will turn OFF, only when the temperature drops below 298K.

Relays:

The SCM10 has 2 SPDT relays available through the I/O connector in the rear panel. The relay contacts are rated for 24VDC and 1A.

Each of the relays can be set up to be manually ON or OFF. Alternatively, they can also be set up to follow alarms, i.e., the relay activates when the alarm is ON.

When the relays are set up to follow alarms, Relay 1 is always tied to Alarm 1 and Relay 2 is tied to Alarm 2.

The Normally Open, Normally Closed and Common contacts for each relay are available through the I/O connector in the rear panel. Refer to [Sensor Performance Specifications Table](#) on page 6 for the pin out of the I/O connector.

3. FRONT PANEL OPERATION

INSTRUMENT POWER UP

The SCM10 is turned ON simply by plugging in the power supply. When the instrument is powered ON, it will display "HELLO" and after a brief amount of time, the front panel will begin displaying the temperature reading along with the corresponding units. Alarm LEDs on the front panel display the status of the alarms.

DISPLAY DEFINITION

The front panel display consists of the six digit LEDs capable of showing numeric and character data. In normal operation, the display shows the temperature or sensor data depending on the display units selected. It also displays menus and parameters, when the menu is activated.

To the bottom right hand side of the display are annunciators to show the units of the displayed data and the alarm status.



Figure 3.1

DISPLAY UNITS AND ALARM STATUS ANNUNCIATORS

The SCM10 displays sensor data in four different units:

- Kelvin(K)
- Celcius (°C)
- Fahrenheit ('F)
- Volts/Ohms (V/Ω)

The user can toggle through the display units using the up and down arrow buttons on the keypad. The SCM10 saves the display units that were selected prior to power down and will display the same units when it is powered ON again.

Alarm LEDs A1 and A2 indicate the status of the alarms. The alarm LED is ON, if the alarm is ON.

KEYPAD OPERATION

The SCM10 has 4 keys - **[Menu]**, **▲**(Up Arrow), **▼** (Down Arrow) and **[Enter]**. When the SCM10 is displaying sensor data, **▲** and **▼** keys are used to toggle through the various display units. When in this mode, **[Enter]** is pressed in order to turn off any latched alarms.

[Menu] is used to activate the menu display. It is also used to get back a level in the menu hierarchy and eventually to get out of the menu mode.

In the menu display mode, **▲** and **▼** keys are used to go up and down the menu structure. The **▲** and **▼** keys are also used to increment or decrement numeric configuration parameters (e.g., set point, scaling). Holding either key for a few seconds would make the numbers increment or decrement at a faster rate.

[Enter] is used to select a particular option and go a level deeper in the menu hierarchy. It is also used to save the selected options.

INSTRUMENT RESET

In order to reset/restart the SCM10, hold **[Menu]** down for 2 seconds. This is equivalent to toggling the input power off and on again as it resets the processor and displays the “*HELLo*” message briefly before displaying the current measurement.

MENU STRUCTURE

The following table shows the front panel menu for accessing the SCM10 configuration:

<i>Top Menu</i>	<i>Description</i>	<i>Sub Menu</i>	<i>Description</i>
“ <i>InPut</i> ”	Sensor Curve Selection	<i>nonE/S i4 I0/..../USEr</i>	Sensor Selection
“ <i>ALA 1</i> ”	Alarm 1 Settings	<i>R1 OFF / R1 On</i>	Alarm Disable/ Enable
		<i>R1 HI / R1 Lo</i>	High/Low Alarm
		<i>Pxxx.xx</i>	Alarm Setpoint
		<i>Lch Y /Lch n</i>	Latching/ Non Latching
		<i>d xx.x</i>	Deadband Limit

Top Menu	Description	Sub Menu	Description
"ALA 2"	Alarm 2 Settings	R2 OFF / R2 On	Alarm Disable/Enable
		R2 HI / R2 LO	High/Low Alarm
		Pxxx.xx	Alarm Setpoint
		Latch Y / Latch n	Latching/Non Latching
		d XX.X	Deadband Limit
"rLy 1"	Relay 1 Settings	r1 OPn / r1 CLo / r1 RL1	Manual Control/Follow Alarm
"rLy 2"	Relay 2 Settings	r2 OPn / r2 CLo / r2 RL2	Manual Control/Follow Alarm
"OutPut"	Analog Output Settings	Uout / Cur	Voltage/Current Type
		LEPr / SEN5 / LN5EN5	Scale with Temperature/Sensor Data
		- XXX.XX	Low Scale
		+ XXX.XX	High Scale
"SyS"	System Configuration	FI L XX	Temperature Calculation Filter
		rESn X	Temperature Display resolution
		brightX	Display Brightness
		bd 96 /.../ bd 1152	Serial Baud Rate
		Fxx.XX	Firmware Revision
"nEt"	Network Settings	IP 1.xxx	IP Address
		IP2.xxx	IP Address
		IP3.xxx	IP Address
		IP4.xxx	IP Address
		IP dEF	Default IP Address

INPUT SETUP

SCM10 supports a variety of sensors including diodes and RTDs. It has 9 standard curves loaded at the factory and room for one user curve. The table below shows the various sensor curve options available. A suitable sensor must be selected for sensor input.

Curve No.	Sensor Display Name	Sensor Description	Exec Current	Temperature Range
1	Si410	Silicon Diode	10µA	1 – 450K
2	Si430	Silicon Diode	10µA	1 – 500K
3	dE470	Silicon Diode	10µA	1.4 – 450K
4	dE670	Silicon Diode	10µA	1.4 – 500K
5	Pt100	100 Ω Platinum RTD	1mA	30 – 800K
6	Pt1000	1000 Ω Platinum RTD	1mA	30 – 800K
7	r0600	Ruthenium Oxide RTD	10µA	0.05 – 20K
8	r0105	Ruthenium Oxide RTD	10µA	2 – 273K
9	CE1	Silicon Diode	10µA	0 – 460K
10	USER	-	-	-

To View Active Sensor Curve: Press **Menu** and press **▲** or **▼** keys until the word “*i nPUt*” appears on the display. Press **Enter** to step into level 2 of this option. This will display the sensor that is currently active.

To Activate a different sensor curve: Perform the steps from the above paragraph to get to level 2 of the menu and then , press **Enter** again to step into Level 3 of the menu. Press **▲** or **▼** keys until the desired sensor name appears on the display. Press **Enter** again to activate this.

The SCM10 has 9 standard curves loaded from factory and space for one user curve. The user curve can have a maximum of 200 points and can be loaded through the Utility Software.

ALARM SETUP

The SCM10 has 2 programmable alarms each of which can be set to High/Low and can be Latching/Non-latching type.

To access the Alarm settings, press **Menu** and press **▲** or **▼** keys until the word “**ALR 1**” (or “**ALR 2**” to access Alarm 2 settings) appears on the display. Press **Enter** to select this option. This displays the Alarm submenu. Use **▲** or **▼** keys to go through the various Alarm settings. Press **Enter** to edit any of these settings. Use **▲** or **▼** keys until the desired option is displayed. Press **Enter** to save the change or press **Menu** to get out of the edit menu without saving changes.

The rest of this section describes the Alarm submenu for Alarm 1 settings. Alarm 2 settings are accessed similarly by selecting the “**ALR 2**” option.

Alarm Enable/Disable: This is displayed as “**Al on**” (or “**Al off**”) and is used to disable or enable the Alarm 1 feature.

Alarm Low/High: Displayed as “**Al Lo**” (or “**Al Hi**”), this parameter is used to configure the alarm for Low/High setting.

Alarm Setpoint: “**Pxxx.xx**” defines the numeric setpoint for the alarm (in Kelvin). To edit the number, use **▲** or **▼** keys. Holding the arrow keys for a few seconds changes the number at a faster rate. The minimum and maximum values for the set point are 0 K and 9999.9 K.

Latching/Non-Latching: “**Lech y**” enables latching feature in the Alarm. “**Lech n**” disables latching.

Deadband: Displayed as “**d xx.x**”, this numeric parameter defines the deadband region when the alarm is set up to be the non-latching type. When the temperature goes beyond the setpoint , the alarm turns ON and continuous to remain ON even if the temperature falls outside of the setpoint, but within deadband limits.

RELAY SETUP

The SCM10 has 2 programmable relays each of which can be manually controlled or set up to follow the alarm(s).

To access the relay setting, press **Menu** and press **▲** or **▼** keys until the word “*rLY 1*” (or “*rLY 2*” to access relay 2 setting) appears on the display.

Press **Enter** to select this option. This displays the current relay setting. To set a different option, press **Enter** to go into edit mode. Use **▲** or **▼** keys to go to the desired option and press **Enter** to save this.

Below are the various relay configuration options:

- “*r 1 oPn*” stands for Relay Manually Open. This is the power off state of the relay. In this state Normally Closed contact is connected to COM.
- “*r 1 cLo*” stands for Relay Manually Closed/Activated. In this state, Normally Open contact is connected to COM.
- “*r 1 RL 1*” is the option where relay follows alarm. When this option is chosen, Relay 1 is activated when Alarm 1 is ON and relay deactivates when alarm is OFF. “*r2 RL2*” is similar to where Relay 2 follows the status of Alarm 2.

ANALOG OUTPUT SETUP

The SCM10 has 2 types of Analog Output - Voltage and Current. The analog output functions as a temperature indicator in itself since it displays a voltage or current signal proportional to the temperature or sensor data. Voltage output ranges from 0-10V and the current output ranges from 4mA to 20mA. Low Limit and High limit values set the scaling relationship between the data and the analog output. Low and High limit values are in Kelvin (for temperature data), kOhms or V (for sensor data) and in (Ohms) for logarithm data.

To access the Analog output settings, press **Menu** key and press **▲** or **▼** keys until the word “*aLgOpUt*” appears on the display. Press **Enter** to select this option. This displays the Analog Output submenu. Use **▲** or **▼** keys to go through the various settings. Press **Enter** key to edit any of these settings. Use **▲** or **▼** keys until the desired option is displayed. Press **Enter** to save the change or press **Menu** to get out of the edit mode without saving changes.

Below are the various settings for the Analog Output:

- **Output Type:** “*UoLt*” stands for Voltage type and “*CUr*” stands for Current type output
- **Output Data:** The Analog output can be configured to represent temperature, sensor data or the natural logarithm of the sensor data. “*TEPr*” represents temperature, “*SEnS*” represents the sensor data and “*LnSEnS*” represents the natural logarithm of sensor data.

- *Low Limit:* “_xxx.xx” represents the temperature, sensor data (in kOhms) or natural logarithm of sensor data (in Ohms) that corresponds to the zero of analog output (0V or 4mA).
- *High Limit:* “~xxx.xx” represents the temperature, sensor data (in kOhms) or logarithm of sensor data (in Ohms) that corresponds to the maximum analog output (10V or 20mA).

SYSTEM SETTINGS

This section explains how to access the various system settings pertaining to display, serial communication and firmware details.

To access the System settings, press **Menu** key and press **▲** or **▼** keys until the word “**SYS**” appears on the display. Press **Enter** to select this option. This displays the System settings submenu. Use **▲** or **▼** keys to go through the various settings. Press **Enter** to edit any of these settings. Use **▲** or **▼** keys until the desired option is displayed. Press **Enter** to save the change or press **Menu** to get out of the edit mode without saving changes.

Below are the various system settings for SCM10:

- *Temperature Filter:* “**Fl L xx**” represents the temperature filter setting. When the filter is set to 10 (the highest filter setting), there is maximum noise filtering performed on the temperature data. A filter setting of 0 would turn noise filtering off.
- *Display Resolution:* “**rE5n x**” represents the number of digits of precision for temperature data. The resolution ranges from 1 to 3.
- *Display Brightness:* “**br9hlx**” represents the brightness of the front panel display. Brightness setting ranges from 0-9.
- *Serial Baud Rate:* “**bd xxx**” represents the baud rate of serial communication (RS232). The available options are :
 - “**bd 96**” = 9600 bps
 - “**bd 192**” = 19200 bps
 - “**bd 576**” = 57600 bps
 - “**bd 1152**” = 115200 bps
- *Firmware Revision:* ” **Fxx.xx**” displays the firmware revision installed in the SCM10, xx.xx indicating the revision level.

NETWORK SETTINGS

This menu option lets the user assign an IP address for the unit for TCP/IP communication.

To access the Network settings, press **Menu** and press **▲** or **▼** keys until the word “**nEt**” appears on the display. Press **Enter** to select this option. This displays the Network settings submenu. Use **▲** or **▼** keys to go through the various settings. Press **Enter** to edit any of these settings. Use **▲** or **▼** keys until the desired option is displayed. Press **Enter** to save the change or press **Menu** to get out of the edit mode without saving changes.

The IP address has been split into to four items on the submenu to denote the four octets. They are called IP1, IP2, IP3 and IP4.

I P 1.xxx, I P2.xxx, I P3.xxx, I P4.xxx are used to display the entire IP address.

“**i P dEF**” option sets the unit’s IP address to the factory default which is 192.168.0.4

4. REMOTE INTERFACE

GENERAL

The SCM10 can be accessed remotely using serial or Ethernet connection. The remote interface can be used to monitor temperature and alarm status, access configuration settings, load sensor curves and perform calibration. The SCM10 Utility Software and the Embedded Web server that come with the instrument can be used to access nearly every feature. In addition, an ASCII command list has also been provided to help the user write custom software to communicate with the instrument.

Configuration of remote interfaces is done through the instrument's front panel (refer to [Analog Output Setup](#) on page 20 & [System Settings](#) on page 21). All configuration parameters are stored in non-volatile memory and once setup, will not change when power is turned off or when a remote interface is reset.

ETHERNET(LAN) CONNECTION

The SCM10 uses 10BaseT Ethernet (RJ45) connectivity. The 10Mbps Ethernet communication operates over two pairs of twisted wires, one for transmitting and the other one for receiving.

When connecting the SCM10 to a hub or switch, a standard 'patch' cable or straight through cable is used. This will connect the instrument's transmit lines to the hub's receive lines. When connecting the SCM10 directly to the computer, the transmit lines from the instrument should be connected to the receive lines of the computer, hence a crossover cable must be used.

The RJ45 LAN connector on the rear panel has two LEDs. The left green LED indicates that a valid connection has been made to the computer. The right orange LED indicates the activity of the LAN. It should blink periodically during normal operation.

ETHERNET CONFIGURATION

Protocols Supported

- **TCP/IP:** Transmission Control Protocol/Internet protocol provides reliable, flow controlled transfer of data between any two machines. TCP/IP uses port numbers to identify the many application protocols that can run over it. In the SCM10, a TCP/IP port is available for communication using ASCII commands (similar to the ones used for serial communication). This is how the instrument interfaces with the GUI, LabVIEW™ programs, etc.

- **HTTP:** HyperText transfer protocol is the TCP/IP application layer protocol that implements the Web by enabling the transfer of hypertext documents and other files between a client and server. Web browsers such as Internet Explorer™, Firefox™ and Chrome™ are HTTP Client software programs that run on TCP/IP client computers to access web documents on web servers.

The SCM10 has an embedded HTTP server that manages multiple connections simultaneously. The web browser issues HTTP requests to access status information from the SCM10 instrument.

IP Configuration

Each device on the Ethernet LAN must have a unique IP address. Further, the address assigned to the SCM10 must be within the range of computers with which you want it to communicate. The SCM10 is shipped with a default IP address of 192.168.0.4 and subnet mask of 255.255.255.0. The SCM10 can be configured to use any IP address from the front panel interface by going to the “net” menu.

Alternatively, the PC’s network configuration can also be modified to have an IP address that is in the same range as the SCM10 (192.168.0.x) and connect to the instrument using a crossover cable between the PC and SCM10. When a connection is made with the SCM10, a web browser window may be opened and SCM10’s IP address may be typed in the address bar to view the SCM10’s Webpage which looks like Figure 4.1 below.

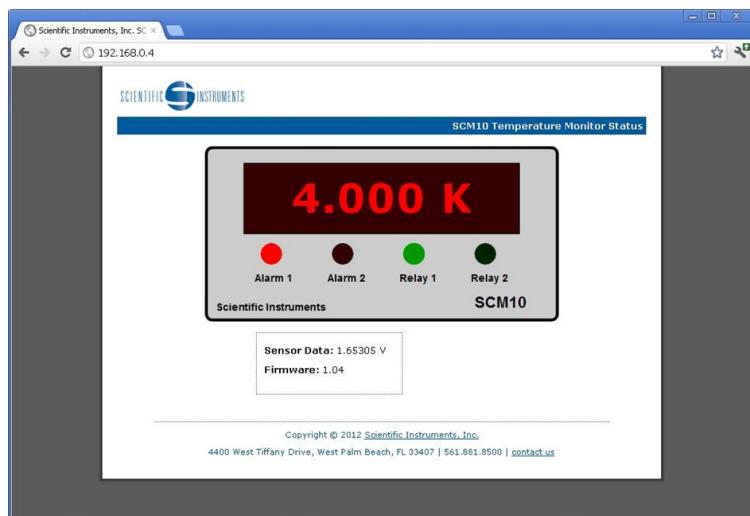


Figure 4.1
SCM10's Embedded Web Page

The SCM10 does not support DHCP addressing since it could possibly relocate the unit on the LAN with each power up.

TCP Data Socket Configuration

In order to communicate with the SCM10 using the same ASCII command set as the RS232 serial port, a TCP data socket application must be configured in the PC using remote port 9760.

Ethernet Interface Specifications

Connector Type:	RJ45
Protocols Supported:	TCP/IP, HTTP
DHCP Enabled:	No
Default IP Address:	192.168.0.4
Subnet Mask:	255.255.255.0
TCP Data Socket:	9760

SERIAL RS232 PHYSICAL CONNECTION

The SCM10 can be connected to the PC for remote interface using RS232 serial communication. The SCM10 has a 9-pin D-Subminiature connector on the rear panel for serial communication. It is a DCE device for RS232 communication and the pin out is detailed in the [Rear Panel Definition](#) on page 10. Since the PC is a DTE device in serial communication, a DB9 straight-through cable is required for connecting PC to the instrument.

The SCM10's serial connector is the socket half of a mating pair and must be matched with a plug on the cable. If the cable has the correct wiring configuration, but also has a socket end, a "gender changer" can be used to mate the two socket ends together.

SERIAL RS232 CONNECTION – HARDWARE SUPPORT AND DATA FORMAT

The SCM10 interface hardware supports the following features:

- Asynchronous timing is used for individual bit data within a character. This timing requires start and stop bits as part of each character so the transmitter and receiver can resynchronize between each character. Half duplex transmission enables the instrument to be a transmitter or receiver, but not both at the same time.
- Hardware handshaking is not supported by the instrument. The serial output supports four different baud rates for communication: 9600, 19200, 57600 and 115200. The desired baud rate may be selected through the instrument front panel interface (refer to [Analog Output Setup](#) on page 20).

The SCM10 uses a 3-wire serial communication link – transmit data, receive data and signal ground. Hence there is no hardware flow control associated with the link.

Each character that is transmitted (and received) is 10 bits long – 1 start bit, 8 data bits and 1 stop bit. Please note that there is no parity bit sent with the data.

Data is sent in ASCII strings comprised of an array of characters. Each string is terminated by a Carriage Return ('\r') or a line feed ('\n').

Serial Interface Specifications

Connector Type:	DB9 Socket
Connector Wiring:	DCE
Voltage Levels:	Standard RS232
Timing Format:	Asynchronous
Baud Rate:	9600,19200,57600, 115200
Character Bits:	1 start bit,8 data bits, 1 stop bit
Parity:	None
Hardware Flow Control:	None

ASCII MESSAGE STRING FORMAT

A message string is a string of characters assembled to perform an interface function.

Query strings are enquiries sent from the PC to the instrument about the status or configuration parameters. The format for the query string is as follows:
<Query string><?><space><parameters> <terminators>. Terminators such as Line feed ('\n') or a carriage return ('\r') must be sent with each query. Parameters are usually not necessary for a query.

In response to the query string, a response string is generated by the SCM10 and sent to the PC. The format for the response string, in general, is as follows: <Response string><space><data><comma><data>...<terminators>. SCM10 sends a carriage return ('\r') for a response string terminator through the serial port and sends a carriage return ('\r') followed by a line feed ('\n') for the response string terminator through TCP data socket. The response string is usually a response to a query only, except while communicating via TCP Data Socket. In this case, in addition to query responses, an "OK" response string is also sent by the SCM10 to acknowledge every command string received.

Command strings are sent from the PC to instruct the instrument to perform a certain function or change a configuration setting. The format for a command string is as follows:

<Command string><space><data><comma><data>...<terminators>

ASCII COMMAND SUMMARY

The following table provides the list of ASCII message strings. This is followed by a detailed description of each ASCII message with the corresponding parameter list.

Command	Function	Query(Q)/ Command(C)
*IDN	Instrument Identification Query	Q
T	Current Temperature Reading(in Kelvin)	Q
SDAT	Current Sensor Data Reading(in Volts/Ohms)	Q
ERSTA	Error Status	Q
ALAST	Alarm Status	Q
RELST	Relay Status	Q
ALA	Basic Alarm Settings	Q, C
ALSP	Alarm Setpoint	Q, C
ALDB	Alarm Deadband	Q, C
RELY	Relay Settings	Q, C
ANAST	Basic Analog Output Settings	Q, C
ANAT	Analog Output Scaling	Q, C
SSEL	Sensor Curve Selection	Q, C
SHDR	Sensor Header	Q, C
CDAT	Sensor Curve Data	Q, C
VER	Firmware Version	Q
IPA	Instrument IP Address	Q, C
FILT	Noise Filter Setting	Q, C
FDEF	Restore Factory Default Cal	C
DOM	Serial Number & Date of Mfr	Q
ANAM	Analog Output Manual Mode	Q, C
AOUT	Analog Output Percentage	Q, C

DETAILED MESSAGE SYNTAX

*IDN	Instrument Identification Query
Query String:	*IDN?<terminator>
Response String:	Scientific Instruments, SCM10,xxx, y.yy<terminator> xxx = Serial Number of Instrument y.yy = Firmware version
T	Current Temperature Reading Query
Query String:	T?<terminator>
Response String:	T xxx.xxx<terminator> xxx.xxx = Temperature reading in Kelvin
SDAT	Current Sensor Data Reading Query
Query String:	SDAT?<terminator>
Response String:	SDAT x.xxxxx<terminator> x.xxxxx = sensor voltage in volts (if sensor type is diode) x.xxxxx = sensor resistance in Ω (if sensor type is RTD)
ERSTA	Error Status Query
Query String:	ERSTA? <terminator>
Response String:	ERSTA x<terminator> x = error value 0 = No Error 1 = ADC Error 2 = Open Sensor 3 = Sensor Input too high 4 = Sensor input too low 5 = No Active Curve loaded 6 = Sensor Data outside Curve
ALAST	Alarm Status Query
Query String:	ALAST? x<terminator>
Response String:	ALAST x,y<terminator> x = Alarm Number (1 or 2) y = Off(0)/On(1)
RELST	Relay Status Query
Query String:	RELST? x<terminator>
Response String:	RELST x,y<terminator> x = Relay Number (1 or 2) y = De-energized (0)/Energized (1)

ALA		Basic Alarm Settings Query & Command
Query String:	ALA? x<terminator>	
Response String:	ALA x,y,z,w<terminator>	
Command String:	ALA x,y,z,w<terminator> x = Alarm Number (1 or 2) y = Disabled (0)/Enabled (1) z = Low Alarm (0)/High Alarm (1) w = Latched Alarm (0)/Non-Latched Alarm (1)	
ALSP		Alarm Setpoint Query & Command
Query String:	ALSP? x<terminator>	
Response String:	ALSP x,yyy.yy<terminator>	
Command String:	ALSP x,yyy.yy<terminator> x = Alarm Number (1 or 2) yyy.yy = Temperature Setpoint in Kelvin for alarm to activate. Range(0 - 9999.99)	
ALDB		Alarm Deadband Setting Query & Command
Query String:	ALDB? x<terminator>	
Response String:	ALDB x,yyy.yy<terminator>	
Command String:	ALDB x,yyy.yy<terminator> x = Alarm Number (1 or 2) yyy.yy = Temperature Deadband Limit in Kelvin for alarm. Range(0 - 9.99)	
RELY		Relay Settings Query & Command
Query String:	RELY? x<terminator>	
Response String:	RELY x,y<terminator>	
Command String:	RELY x,y<terminator> x = Relay Number (1 or 2) y = Relay Mode	
ANAST		Basic Analog Output Settings Query & Command
Query String:	ANAST?<terminator>	
Response String:	ANAST x,y<terminator>	
Command String:	ANAST x,y<terminator> x = Analog Output Type 0 = Voltage 1 = Current y = Data to scale for Analog Output 0 = Temperature Reading 1 = Current Sensor Data 2 = Logarithm of Sensor Data	

ANAT	Analog Output Scaling Query & Command
Query String:	ANAT?<terminator>
Response String:	ANAT xxx.xx,yyy.yy<terminator>
Command String:	ANAT xxx.xx, yyy.yy<terminator> xxx.xx = Low Limit – Value of Analog Data corresponding to 0V / 4mA. yyy.yy = High Limit – Value of Analog Data corresponding to 10V / 20mA.
SSEL	Active Sensor Curve Query & Command
Query String:	SSEL?<terminator>
Response String:	SSEL x <terminator>
Command String:	SSEL x <terminator> x = Sensor curve number 0 = none 1 = Si410 2 = Si430 3 = Dt470 4 = Dt670 5 = Pt100 6 = Pt1000 7 = RO600 8 = RO105 9 = CTI 10 = User Curves 1 through 9 are standard curves and come with the SCM10 from the factory.
SHDR	Sensor Curve Header Query & Command
Query String:	SHDR? x<terminator>
Response String:	SHDR x,y,z,ww, aaaaa,bbbb <terminator>
Command String:	SHDR x,y,z,ww, aaaaa,bbbb <terminator> x = Sensor Curve Number (1-10). See SSEL command for list of curves. y = Sensor Type (1= Diode, 2=RTD) z = Sensor Excitation Current (1= 10µA, 2= 1mA) ww = Number of points in the curve (3-200) aaaa = Model number of the curve (up to 12 characters) bbbb = Serial number of the sensor (up to 12 characters)
Remarks:	Curve # 10 is the only curve that can be edited. The other curves can only be viewed. So, the legal value for sensor curve number field(x) in the SHDR command is only 10 (user curve).

CDAT		Sensor Data point Query & Command
Query String:		CDAT? x,y<terminator>
Response String:		CDAT x,y,zzz.zz,w.ww <terminator>
Command String:		CDAT x,y,zzz.zz,w.ww <terminator> x = Sensor Curve Number (1-10). See SSEL command for list of curves. y = Data point Number/Row Number of curve data (1-200) zzz.zz = Temperature data in Kelvin (0-9999.99) w.ww = Sensor Data in volts(if diode type) or Ω (if RTD type)
Remarks:		Curve # 10 is the only curve that can be edited. The other curves can only be viewed. So, the legal value for sensor curve number field(x) in the CDAT command is only 10 (user curve). Also, curve data should always be in ascending order by temperature. i.e., Data point #2's temperature must be higher than data point #1's temperature and so on.
VER		Firmware Version Number Query
Query String:		VER?<terminator>
Response String:		VER x.xx <terminator> x.xx = Firmware version number.
IPA		Ethernet IP Address Query & Command
Query String:		IPA?<terminator>
Response String:		IPA xxx.yyy.zzz.www <terminator>
Command String:		IPA xxx.yyy.zzz.www <terminator> xxx.yyy.zzz.www = IP address of the instrument
FILT		Noise Filter Query & Command
Query String:		FILT?<terminator>
Response String:		FILT x <terminator>
Command String:		FILT x <terminator> x = Noise filter setting (0-9)
Remarks:		Filter setting of 9 is for maximum filtering and a filter setting of 0 is to turn off filtering.

FDEF	Factory Default calibration setting Command
Command String:	FDEF<terminator>
Remarks:	Restores all calibration values to the custom factory defaults. Please note that these factory default calibration values are not constant and they have been derived by calibrating the individual unit at our calibration setup.
DOM	Serial Number & Date of Manufacture Query
Query String:	DOM?<terminator>
Response String:	DOM xx/yy/zzzz,www <terminator> xx/yy/zzzz = Instrument's Data of Manufacture (MM/DD/YYYY) www = Serial Number of Instrument
ANAM	Analog Output Manual Mode Query & Command
Query String:	ANAM?<terminator>
Response String:	ANAM x <terminator>
Command String:	ANAM x <terminator> x = Analog Output Manual mode Enable (0=Not in manual mode 1=Manual mode)
Remarks:	Analog Output is normally a scaled output of temperature or sensor data. But, it can also be put under manual control for diagnostic purposes. Once Analog output is in manual mode, the output is controlled in percentage of maximum output. Refer to AOUT command.
AOUT	Analog Output Percentage Query & Command
Query String:	AOUT?<terminator>
Response String:	AOUT x.xx<terminator>
Command String:	AOUT x.xx<terminator> x.xx = Analog Output Percentage (0 to 100)
Remarks:	When Analog output is in manual mode, the output is controlled in percentage of maximum output. For example, if Analog output is set to voltage type, "AOUT 100" would make analog output to be @ maximum voltage = 10V. AOUT command and query is to be used, only when analog output is in manual mode.

5. GRAPHICAL USER INTERFACE (GUI)

The LabVIEW™-based Graphical User Interface (GUI) is a valuable extension to the SCM10, providing an easy way to collect data, change instrument parameters, transfer sensor curves, and perform calibrations. Please take a moment to review the following system requirements:

Minimum System Requirements:

- Windows 98/2000/MA/XP/Vista/7
- CD-ROM Drive
- 120 MB free hard disk space

INSTALLATION

Insert the CD into the PC's CD-ROM drive; the setup should launch automatically. If it does not start automatically, go to Start > Run > and type the name of your CD ROM Drive, followed by setup.exe. (For example: D:\setup.exe) Follow the prompts to install the SCM10 GUI to its default directory, or choose a custom directory for installation.

OPERATION

Before using the SCM10, please first refer to the [Instruments Summary](#) for the guide to making rear panel connections and applying power. You may choose to connect the SCM10 by one of three methods:

- Directly to your computer using a straight-through RS-232 cable
- Directly to your computer using a crossover Ethernet cable
- To your network via network switch using a standard RJ-45 Ethernet cable

Starting the GUI for the First Time (First Time Initialization, FTI)

Launch the program either from the desktop shortcut created during installation, or from the Windows Start Menu. The FTI dialog will assist you in establishing communication with the SCM10 (Figure 5.1). Follow the on-screen prompts to choose your connection mode and parameters. Once communication has been established, a small read-only configuration file is generated and the FTI dialog will not appear the next time you launch the GUI.

Status Page

The Status Page (see Figure 5.2) is your home base for interacting with the SCM10. From here, you can monitor your system via the real-time strip chart, read temperature or sensor data directly, observe alarm and relay status, enable/disable data logging, see your activated sensor type, and check the instrument's firmware version. A full complement of interactive plot tools is provided for navigating and manipulating the data area and axes of the strip chart.

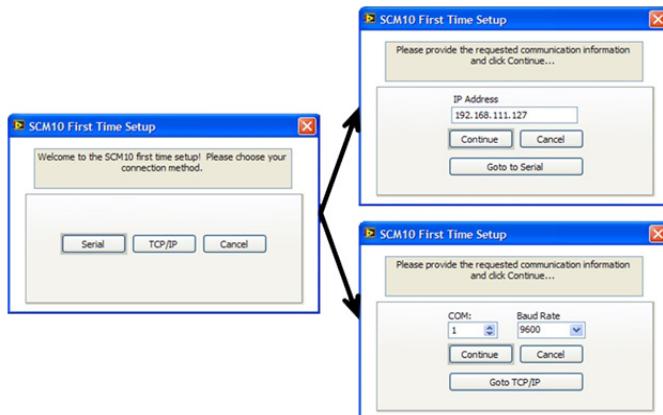


Figure 5.1
First Time Initialization Procedure

Alarm and Relay LED Status Indicators

Alarm 1 (A1), Alarm 2 (A2), Relay 1 (R1), and Relay 2 (R2) statuses are shown in the LED quadrant below the strip chart. When either alarm or relay is engaged, the LED will light either red or green, respectively. Recall that the SCM10's relays are normally open.

Data Logging

You can begin logging real-time data by selecting the appropriate sample rate followed by clicking on the Data Log button. You will be asked to choose a location and a name for your data log file. The default sample rate is 1/min. The output log is a simple text file that can be opened directly in any text editor or imported into your spreadsheet program of choice.

The data is separated into five tab-delimited columns:

Timestamp	Temp [K]	Sensor (V or Ω)	ALA1	ALA2
-----------	----------	-----------------	------	------

Note that the Alarm value is represented as a Boolean value, either 0 (off) or 1 (on). You can turn off data logging at any time by clicking the data logging button again. It will read "OFF" when not active. You will be prompted to choose a new file name the next time you enable data logging. If you choose a filename that already exists, the new data will be appended to that file.

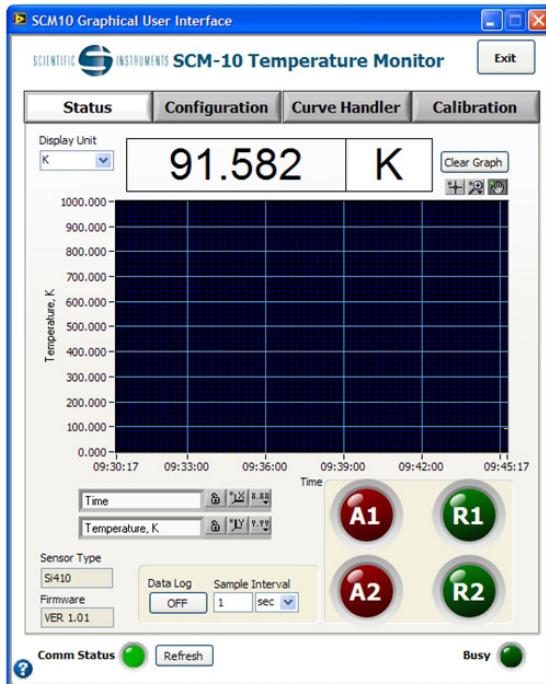
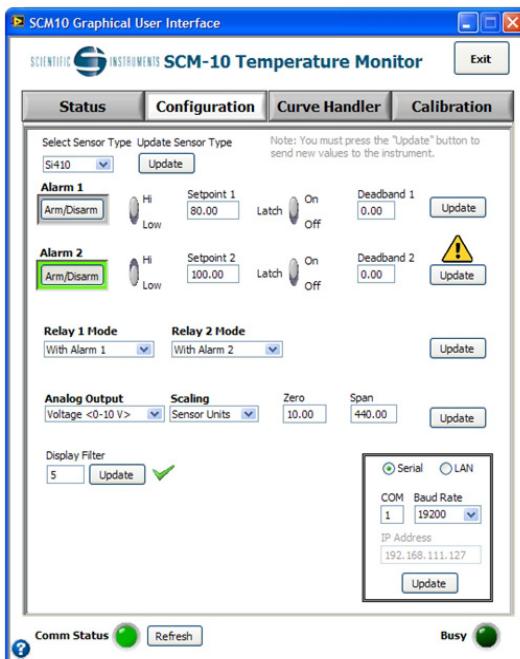


Figure 5.2

The Status Page is your SCM10 GUI home base

Configuration Page

Clicking on the Configuration tab in the gray navigation bar changes the GUI display to show all the instrument parameters that are user-configurable. When entering the Configuration Page, values are initialized to those currently stored in the SCM10. **Note: Any changes that you make will not take effect until you click the “Update” button for the respective parameter.** A warning icon above the button will appear to indicate that a change has been made but not yet applied. The icon will change to a green checkmark only after the button is pressed and the command is passed successfully to the instrument (see Figure 5.3). A dismissal notification will appear if you attempt to navigate away from the Configuration Page if parameters have been edited but not updated. Please note that disconnecting the SCM10 or a loss of communication (indicated by a RED status LED at the bottom left of the GUI) while entering the Configuration Page will result in default program values being applied to the controls. You must ensure connectivity, leave and re-enter the Configuration page in order to read the current configuration from the SCM10. Do not disconnect the SCM10 while updating settings. This may result in a failure to apply the desired settings.

**Figure 5.3**

The Configuration Page provides quick and easy access to all of the SCM10's user programmable settings

Selecting your sensor type

From the Select Sensor Type dropdown menu, you can choose to activate the appropriate curve for your sensor. Take care to select the right sensor type, otherwise the SCM10 will not display the proper temperature data, or may display an out-of-range error. Click the update button adjacent to the sensor type selector to update the SCM10.

Setting the Alarms

Alarms 1 and 2 are updated independently of each other. To enable an alarm, press the “Arm/Disarm” button until its border turns green. This indicates that the alarm is “armed.” Adjust the other alarm parameters as desired and click the respective “Update” to pass the new settings to the instrument. To disable the alarm, simply click the “Arm/Disarm” button again until its border turns grey and click the “Update” button.

Setting the Relays

You may manually set Relay 1 and/or Relay 2 to be either “manually closed” or “manually open” by choosing the desired option from the Relay Mode dropdown menus and then by clicking the update button. Likewise, you can also choose to have Relay 1 and Relay 2 track with Alarm 1 and Alarm 2, respectively. Since the normal state of the SCM10 relays is open, the relay will close when its respective alarm is tripped.

Adjusting the Analog Output

The GUI provides a direct means to set the SCM10’s analog output mode (voltage or current), scaling (helpful for logarithmic RTDs), and its zero and span values. Remember to click the update button to pass any new settings to the SCM10.

Changing the Display Filter

The display filter can be set to an integer value between 0 and 9. This parameter determines the amount of filtering done on the real time temperature data before displaying it. A filter value of 0 stands for no filtering at all and 9 stands for the highest filtering option.

Switching Communication Modes

Depending upon the needs of your system, you may desire to toggle from RS-232 to Ethernet or vice versa. This can be achieved by selecting the mode and by setting the respective parameter(s). Clicking the update button will immediately change the communication mode and will update the configuration file originally generated by the FTI procedure. It is strongly recommended that you check all physical connections to the SCM10 before proceeding with the update to ensure no lapse in communication.

Curve Handler: Downloading a Calibration Curve to the SCM10

If you acquire a calibrated sensor, the Curve Handler page provides a unique and simple interface for downloading the calibration curve to the user memory block in the SCM10. The Curve Handler can accept most major curve formats utilized in the industry and will attempt to parse header information and prepare it for download. For best results, a proper curve file should be in the *.txt format and should include two major sections: 1) Header and 2) Temperature vs. Sensor Data. These two sections are discussed in the following section.

Curve Header and Data Format

The preferred header format consists of seven lines, the first five each with a parameter (see below) and value separated by a tab and terminated by a carriage return. The sixth line is left blank and the seventh line denotes the column titles for data beginning on the eighth line:

Sensor Type	Diode←
Model Number	Si410←
Serial Number	12345←
Current	10←
Number of Data Points	60←
←	
Temperature	Data←
1.0	1.7191←
2.0	1.7086←
3.0	1.6852←

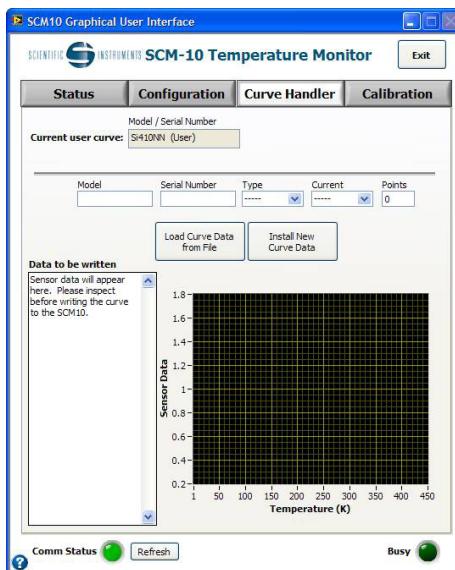


Figure 5.4
Download calibration curves directly to
the SCM10 using the Curve Handler

Note that for clarification, the carriage returns are shown here as the symbol ↵. Temperature and sensor data are tab-separated floating point values. The data points should be arranged in ascending order by temperature. See the table for parameter definitions. If only some or none of the header information is present or if the data is in an unrecognized format, the GUI will attempt to parse the file for the header and temperature data.

Preparing a Curve for Download

To load a curve, click the button, “Load Curve Data from File.” A dialog will appear where you can navigate to and select the curve file. Upon clicking “OK” you will see the curve data appear in both the text field and in the graph. (Note that you cannot edit data points in the GUI. If you need to edit data points, this must be done in the curve file directly using a text editor.) Once the data appears but before installing the curve, you must inspect the “Model,” “Serial Number,” “Type,” Current,” and “Points” fields and make any necessary changes for the proper heading information. These fields will be populated automatically if the GUI was able to successfully parse the information from your curve file. You will not be able to proceed if any field is left blank. Note that incorrect header data may result in unpredictable behavior of either the GUI or the instrument.

Downloading the Curve

Once you are satisfied with the sensor data and the header information, you can install the curve by clicking, “Install New Curve Data.” The GUI will proceed to install the header and then each data point sequentially.

Do not disconnect or turn off the SCM10 or attempt to exit the GUI while downloading curve data! Doing so will result in incomplete or corrupted curve data in the SCM10.

To verify that your curve has been loaded, you can leave and re-enter the Curve Handler page; the newly installed curve model and serial number will be displayed in the Current User Curve field.

Hardware Calibration

The Calibration Page allows the user to perform calibrations of the current source, ADC, and DAC outputs (both current and voltage). While a calibration interface is provided in this GUI with prompted instructions, it is not recommended for the end user to perform calibration tasks. ***Your SCM10 has been designed and calibrated to exacting specifications by trained and qualified technical experts at the factory and re-calibration is rarely necessary.*** There is no password protection on any of the calibration routines. Should you choose to perform a calibration, please note that any change you make may result in unpredictable behavior of either the GUI or the instrument, and may render the instrument inoperable. Please refer to [Instrument Calibration](#) on page 42 for the calibration process outline and for a list of minimum requirement equipment needed to perform the calibrations. Failure to utilize the proper test equipment may result in diminished accuracy or may render the instrument inoperable. Proceed at your own risk.

Table 5.2.4. Curve Parameter Definitions

Line Parameter	Value (NOT case sensitive)
Sensor Type	Diode, RTD
Model Number	Text string up to 15 characters
Serial Number	Text string up to 15 characters
Current	10, 1000 (1000 μ A = 1 mA)
Number of Data Points	Up to 200

6. SERVICE

This chapter provides basic service information on the SCM10 Single channel temperature monitor. Please note that these are only guidelines for troubleshooting or calibration and in case of any persistent problems, the instrument should be sent to the factory for repair or recalibration.

TROUBLESHOOTING

The following error messages are displayed on the SCM10 front panel, when there is a problem during operation. The first message is related to a hardware problem and if it doesn't go away with a reset to the SCM10, then the instrument should be sent to the factory for repair. The remaining messages are all related to sensor input status and will typically go away by connecting sensor leads properly or by choosing the correct curve.

Error Message	Description
<i>Err Ad</i>	Analog to Digital Converter not communicating with the processor. This is a hardware error and is not correctable by the user. Unit should be sent to factory for repair.
<i>Err So</i>	Sensor inputs are open. To correct this, check the wiring from sensor to connector (all four wires) to make sure there is no break in wiring. If the wiring is good, then verify that the voltage across the sensor leads (especially between I+ and I-) does not exceed 6V.
<i>Err IH</i>	This indicates that the sensor input voltage (between E+ and E-) is over the full scale. Full scale is 5V and this error appears when voltage exceeds 5.1V.
<i>Err IL</i>	This indicates that the sensor input voltage (between E+ and E-) is below the zero scale. Zero scale is 0V and this error appears when voltage goes under -0.1V.
<i>Err nC</i>	This indicates that there is no active curve. Curve may be activated either through the front panel or through the Utility software. If error still persists after activating curve, contact factory.
<i>Err to</i>	Temperature conversion is outside of the curve limits.

REPLACING INTERNAL FUSE

If there is no display (no LEDs or digits lit up) on the SCM10 front panel when the SCM10 is being powered, it could mean that the internal fuse is blown. This could be a result of powering the SCM10 with an input power that is beyond the rated voltage of 9-24V, 0.5A or it could be due to an electronic failure internal to the instrument. If the fuse blew because of providing incorrect input power to the SCM10, the following is the sequence of tasks to replace the internal fuse.

1. Disconnect power plug from the rear of the unit.
2. Use a Phillips screw driver and remove the four screws from the corners of the rear panel.
3. Slide out the PC board assembly. The rear panel is attached to the PC board.
4. Disconnect the serial cable from the board, so that the fuse location is accessible.
5. If the fuse is blown, remove the fuse from the fuse holder.
6. Install the new fuse (supplied as part of the accessory kit). The fuse specifications are 1.5A, 250V, Fast Acting and its dimensions are 5 X 20mm.
7. Connect the serial cable connector to the PC board.
8. Slide the PC board assembly in from the rear of the chassis making sure the keypad aligns with holes in the front panel.
9. Use a Phillips screw driver to install four screws in the corners of the rear panel.
10. Check the voltage of input power source and make sure it is within the requirements for powering up the SCM10.
11. Connect the power cord to rear of the unit.

If the problem persists, the SCM10 should be sent to the factory for repair.

INSTRUMENT CALIBRATION

The SCM10 requires calibration of both sensor input and analog output to function within specifications. The instrument comes calibrated from the factory. If for some reason, the instrument seems to be operating out of specification, the user may calibrate the instrument by him/herself at his/her own risk. This section describes the procedure to calibrate the SCM10. If the user doesn't have the recommended hardware or better for calibration, then it is strongly recommended to send the unit to the factory for recalibration.

Hardware Requirements for Calibration:

1. PC with the SCM10 utility software installed.
2. Serial Cable or Ethernet cable to connect PC to the SCM10
3. Digital Multimeter (DMM) capable of measuring Voltage and Current (at least 6 digits resolution)
4. Resistance Standards: 1k Ω and 100 k Ω
5. Voltage Standard (accurate to within 10 μ V in 5V range)

Getting Ready for Calibration

1. Make sure that the SCM10 sensor input is connected to a resistance load around $1\text{k}\Omega$ and the analog output (Analog output set to Current type) is connected to a load of 100Ω to 500Ω . Let the instrument warm up for at least one hour. Resistive loads must be attached to the sensor and analog output circuits to allow them warm up properly.
2. Connect the SCM10 to the PC using a standard RS232 cable/Ethernet cable.
3. Open the SCM10 Utility software and ensure that the GUI is connected to the SCM10 (A green light next to Communication on the bottom of the GUI screen means that the communication is OK).
4. Click the “Calibration” tab on the GUI. This opens up a window like shown in Figure 6.1.

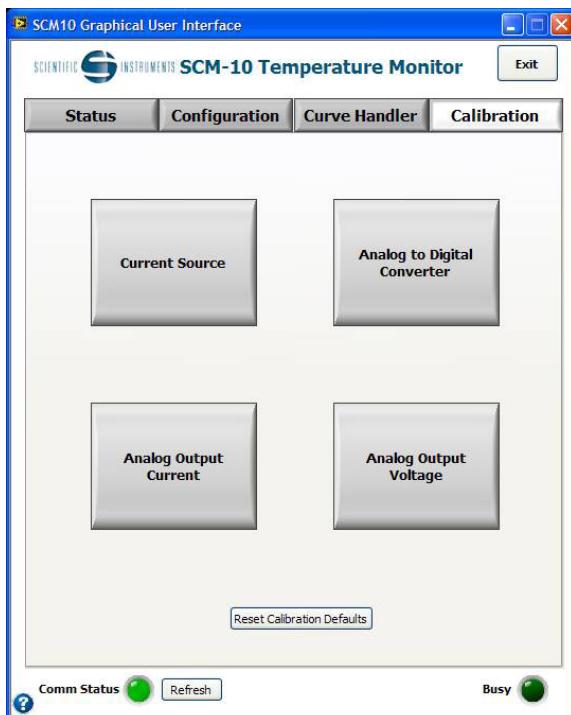


Figure 6.1
Calibration tab of the GUI

Sensor Input Calibration

The sensor input calibration consists of 2 parts: Current Source calibration and the ADC Calibration.

Current Source Calibration

The SCM10 provides a constant current of $10\mu A$ or $1mA$ to excite the sensor for measurement. The $10\mu A$ and $1mA$ sources need to be individually calibrated to be within specified tolerances.

10 μA Current Source Calibration:

1. Connect the sensor input leads from the DB15 connector (I_+ , I_- , E_+ and E_-) to the $100k\Omega$ resistance standard.
2. Connect the DMM across the resistance standard to measure the DC voltage across it.
3. Click on the “Current Source” button of the Utility Software Calibration window. This opens up a warning window. Click on “Proceed” to continue. The next screen is shown in figure 6.2.

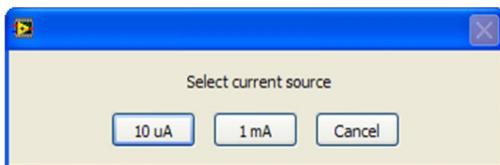


Figure 6.2
Current Source
calibration options

4. Click on the $10\mu A$ option. This opens up an instruction window. Click “Proceed” to continue.
5. The next screen is similar to Figure 6.3 . Adjust the DAC value by clicking on the up or down keys on the screen, until the voltage reading on the DMM = $(Value \text{ of } the \text{ resistance } standard / 100000) \text{ V} \pm 0.0001\text{V}$. Click on “Yes” to save these calibration values.

For example, if the actual value of the resistance standard is 100001Ω , then voltage on the DMM should be $1.00001 \pm 0.0001\text{V}$.



Figure 6.3
Current source
DAC settings

1mA Current source calibration:

1. Connect the sensor input leads from the DB15 connector (I+, I-, E+ and E-) to a $1\text{k}\Omega$ resistance standard.
2. Connect the DMM across the resistance standard to measure the DC voltage across it.
3. Click on the “Current Source” button of the GUI Calibration window. This opens up a warning window. Click “Proceed” to continue. The next screen is shown in Figure 6.2.
4. Click on the 1mA option. This opens up an instruction window. Click “Proceed” to continue.
5. The next screen is similar to Figure 6.3. Adjust the DAC value by clicking on the up or down keys on the screen, until the voltage reading on the DMM = (Value of the resistance standard/1000) V $\pm 0.0001\text{V}$. Click on “Yes” to save these calibration values.
For example, if the actual value of the resistor standard is 999.98Ω , then voltage on the DMM should be $0.99998 \pm 0.0001\text{V}$.

ADC Offset & Gain Calibration

The SCM10’s voltage measurement circuitry should be calibrated for the appropriate offset and gain in order to meet the performance specifications. There are 2 internal gains – gain of 1 and a gain of 10, both of which should be calibrated individually for optimum performance.

Gain x1 Calibration:

1. Connect the sensor input leads (E+ and E-) from the DB15 connector to the voltage standard and set the voltage standard to $0\text{V} \pm 0.00001\text{V}$.
2. Connect the DMM to the voltage standard to measure DC voltage across it.
3. Click on the “Analog to Digital Converter” button of the GUI Calibration window. This opens up a window as shown in Figure 6.4.

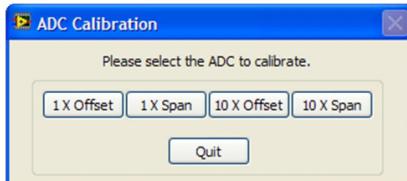


Figure 6.4
ADC Calibration options

4. Click on “1 X Offset” button. This displays an instruction window. Click “Continue” to go to the next screen.
5. Next, the calibration software determines if the zero reading is within desired limits or not. If zero reading is within desired limits, then the software displays a message saying that calibration is already within specifications. If the zero reading is not within the desired limits, it displays a message as shown in Figure 6.5.

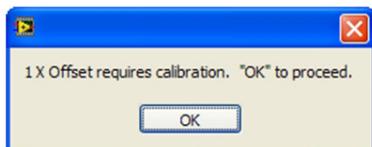


Figure 6.5
Offset Calibration prompt

6. Click “OK” to let the software perform calibration. Upon completion, the software displays the screen as shown in Figure 6.6. Click “OK” to go to the ADC calibration screen, as shown in Figure 6.4.

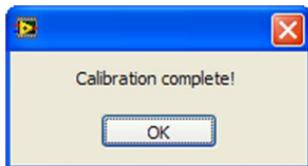


Figure 6.6
Calibration
Confirmation message

7. Next, set the voltage standard to $5V \pm 0.00001V$ and let the SCM10 readings settle down for a minute. After this, click the “1 X Span” button. This displays an instruction window. Click “Continue” to go to the next screen.
8. Next, the calibration software determines if the Span reading is within desired limits or not. If the Span reading is within desired limits, the software displays a message saying that the calibration is already within specifications. If the reading is not within the desired limits, then it displays a message as shown in Figure 6.7.

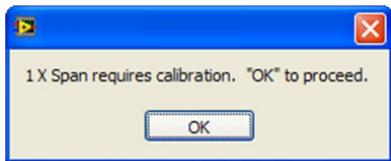


Figure 6.7
Span Calibration
prompt

9. Click “OK” to let the software perform calibration. Upon completion, the software displays the screen as shown in Figure 6.6. Click “OK” to go to ADC calibration screen, as shown in Figure 6.4.

Gain x10 Calibration:

1. Connect the sensor input leads (E+ and E-) from the DB15 to the voltage standard and set the output to $0V \pm 0.00001V$.
2. Connect the DMM to the voltage standard to measure DC voltage across it.
3. Click on the “Analog to Digital Converter” button of the GUI Calibration window. This opens up a window as shown in Figure 6.4.
4. Click on “10 X Offset” button. This displays an instruction window. Click “Continue” to go to the next screen.
5. Next, the calibration software determines if the zero reading is within desired limits or not. If zero reading is within desired limits, the software displays a message saying that calibration is already within specifications. If zero reading is not within the desired limits, it displays a message similar to that in Figure 6.5.
6. Click “OK” to let the software perform calibration. Upon completion, the software displays the screen as shown in Figure 6.6. Click “OK” to go to ADC calibration screen, as shown in Figure 6.4.

7. Next, set the voltage standard to 0.5V and let the SCM10 reading settle for a minute. After this, click the “10 X Span” button. This displays an instruction window. Click “Continue” to go to the next screen.
8. The calibration software determines if the Span reading is within desired limits or not. If the Span reading is within desired limits, the software displays a message saying that calibration is already within specifications. If the reading is not within the desired limits, it displays message similar to that in Figure 6.7.
9. Click “OK” to let the software perform calibration. Upon completion, software displays the screen as shown in Figure 6.6. Click “OK” to go to ADC calibration screen, as shown in Figure 6.4.

Analog Output Calibration

The SCM10's analog output should be calibrated for Voltage mode and Current mode separately for optimum performance. In each of these modes, the offset and span values have to be adjusted so that the analog output is within performance specifications.

Analog Output Current Mode Calibration

1. Connect the analog output leads (+ and -) from the DB15 connector to the current measuring inputs of the DMM.
2. Click on the “Analog Output Current” button of the GUI Calibration window. This opens up an instruction window. Click “OK” to continue to the next screen, which is similar to Figure 6.8.

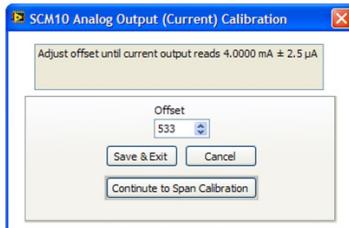


Figure 6.8
Offset DAC adjustment
for Analog Op (I)

3. Adjust the value of the Offset DAC until the reading on the DMM is 4mA $\pm 2.5\mu\text{A}$. Click “Continue to Span Calibration”. This displays a screen similar to Figure 6.9.

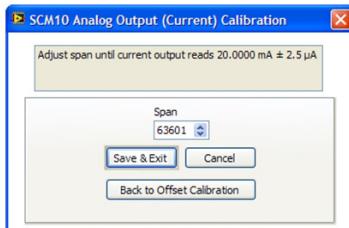


Figure 6.9
Span DAC adjustment
for Analog Op (I)

4. Adjust the value of the Span DAC until the reading on the DMM is 20mA $\pm 2.5\mu\text{A}$. Click “Save & Exit” button to save all these calibration values.

Analog Output Voltage Mode Calibration

1. Connect the analog output leads (+ and -) from the DB15 connector to the voltage measuring inputs of the DMM.
2. Click on the “Analog Output Voltage” button of the GUI Calibration window. This opens up an instruction window. Click “OK” to continue to the next screen, which is similar to Figure 6.10.

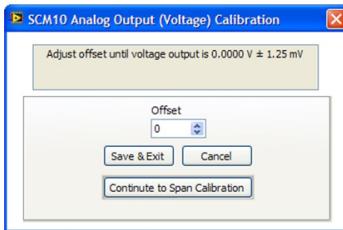


Figure 6.10
Offset DAC adjustment
for Analog Op (V)

3. Adjust the value of the Offset DAC until the reading on the DMM is 0V ±1.25mV. Click “Continue to Span Calibration”. This displays a screen similar to Figure 6.11.

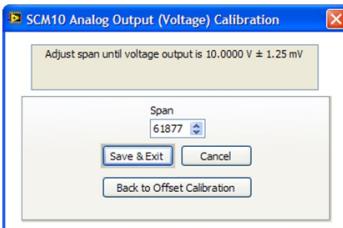


Figure 6.11
Span DAC adjustment
for Analog Op (V)

4. Adjust the value of the Span DAC until the reading on the DMM is 10V ±1.25mV. Click “Save & Exit” button to save all calibration values.