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EC Declaration of Conformity

**according to EC Electromagnetic Compatibility Directive 89/336/EEC
and according to EC Low Voltage Directive 73/23/EEC**

We herewith declare, Labsphere, Inc.
P.O.Box 70, Shaker Street
North Sutton, NH 03260 USA

that the following product complies with the appropriate basic safety and health requirements of the EC Directive based on its design and type, as brought into circulation by us. In case of alteration of the product, not agreed upon by us, this declaration will lose its validity.

Product Description: Integrating Sphere System Control

Model Number: SC-5500

Applicable EC Directive(s): EC Electromagnetic Compatibility 89/336/EEC
EC Low Voltage Directive 73/23/EEC

Applicable Harmonized Standards: EN 61010-1:1993 EN 55022:1994, Class B
EN 50081-1:1992 IEC 801-2:1991
EN 50082-1:1992 IEC 801-3:1984
IEC 801-4:1988
IEC 1010-1: 1990 A1:1992

Authorized Signature: 

Title of Signatory: Vice President of Engineering Date: April 26, 2005



SC-5500 Integrating Sphere System Control

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Introduction

The SC-5500 Integrating Sphere System Control is the standard radiometer used by all single channel Labsphere detector systems, including uniform source and photopic lamp measurement systems. The radiometer is microprocessor-controlled, and accommodates either a silicon, germanium, or photomultiplier tube detector. The SC-5500 can function as a stand-alone component, or it can operate in conjunction with standard Labsphere Windows-based software.

Additional to its radiometer or photometer duties, the SC-5500 functions as an interface between your desktop computer and peripheral Labsphere components. Equipped with both RS-232C serial port and IEEE-488 bus interfaces, the SC-5500 communicates directly with the VAC-1000 Variable Attenuator Control, DM-1000 Detector Multiplexer and either the LPS-045-H or LPS-200-H Lamp Power Supply. The SC-5500 exercises control over these peripheral devices, at the same time, displaying the continuous output of your detector. The SC-5500 Integrating Sphere System Control is designed for either table top or rack mounted use.

Part No.	Calibration	Description	Typical Units
SCC-LU	Luminance of Source	Display luminance of a uniform source	Foot-Lamberts
SCC-RA	Radiance of Source	Display radiance of a source, integrated over specified bandwidth	W/m ² /sr
SCC-PS	Power Input	Display total input power at a specified wavelength	W
SCC-PM	Power Input	Display total input power at multiple wavelengths, from 300 to 1100 nm	W
SCC-LF	Luminous Flux Input	Display input luminous flux	lumens
SCC-AL	Alternate Units	Display luminance in different units	Lamberts, cd/m ²

Table 1. Standard integrating sphere calibrations offered by Labsphere.

Up to 100 different calibration constants can be programmed into the SC-5500 for direct read-out. All calibrations are performed at the Labsphere Optical Calibration Laboratory and are traceable to NIST. Your system may include a custom calibration, or one of the standard calibrations offered in Table 1.

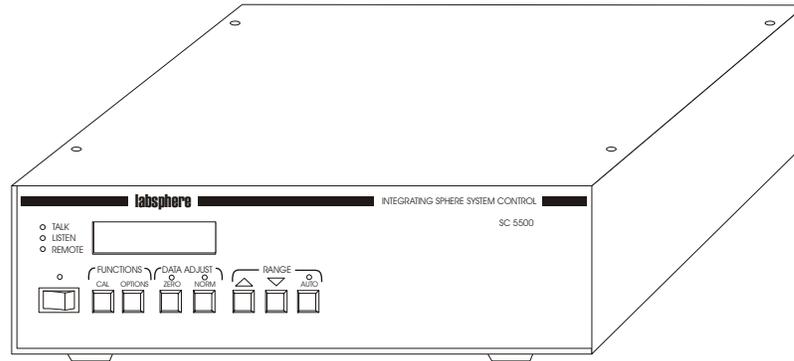


Figure 1. SC-5500 integrating Sphere System Control.

One of several standard Labsphere software packages may accompany your SC-5500, or you may want to write your own programming to control the SC-5500 and peripheral components. A discussion of the different software packages is provided in your system manual.

Special symbols are used in this manual. Triangular shaped symbols indicate a danger or warning.



Electrical Shock Hazard



Caution

Unpacking and Inspection

The SC-5500 Integrating Sphere System Control was thoroughly inspected and calibrated before shipping and should be ready to operate after completing the set-up instructions. All Labsphere instrumentation is packaged and shipped in reinforced shipping containers. Carefully check the components after unpacking for any damage that may have occurred during shipping. If there is any such damage, file a claim immediately with the freight carrier and contact the Labsphere Customer Service Department at

 **(603) 927-4266.**

The following standard items should accompany your SC-5500 shipment:

- SC-5500 instrument with instruction manual
- Power cord
- Rack mounting hardware (for rack mount option only)
- Foot pads (table mount option only)
- Calibration documentation

The following items either are provided with peripheral components or must be provided by the customer:

- Computer control cable (9-pin connector)
- Component control cable
- Detectors and detector cabling
- Software

Installation and Assembly

The primary assembly instructions for your Labsphere system is contained in your system instruction manual. The assembly information here covers the rack mounting procedure and SC-5500 setup for stand-alone operation. The triax detector cable connectors on the back panel of the SC-5500 instrument are specifically designed to accommodate standard Labsphere detector inputs. You should refer to the *Detectors* section of this manual before connecting a non-standard detector to the SC-5500.



CAUTION: Make all connections with the AC line power OFF.

Line Voltage Input Module

The AC line voltage input module, located on the rear panel, features a fuse holder and voltage cartridge that displays the factory-set line input voltage (115 or 230 VAC). The 115 volt setting has an effective range of 100-120 volts. The 230 volt setting has an effective range of 220-240 volts. Although the module should be configured for your power source at delivery, you should check the voltage setting before making the electrical hookup.



The appropriate line voltage for the SC-5500, either 115 or 230 VAC, was set prior to shipping, however it can be changed externally. Double check that the correct line voltage is set on the line voltage input module. Failure to operate the unit at the appropriate line voltage may cause serious damage. Refer to the Line Voltage Input section.

To check the voltage configuration of your instrument examine the text in the display window of the input module as shown in Figure 2. The text display visible in the window should read either 115V or 230V, depending on your power source. If the voltage setting does not agree with the power source you intend to use, proceed as follows to change the voltage configuration:

1. Remove the power cord from the back panel connector.
2. Using a slotted screwdriver, gently pry up the plastic tab on the left end of the module. Reach in with the screwdriver or your fingers and extract the voltage cartridge.
3. Flip the cartridge around so that the desired voltage text reading, either 115 or 230 VAC, is oriented in the manner shown in Figure 2.

4. Reinstall the cartridge in the module and replace the plastic tab.
5. Check the voltage reading in the display window.

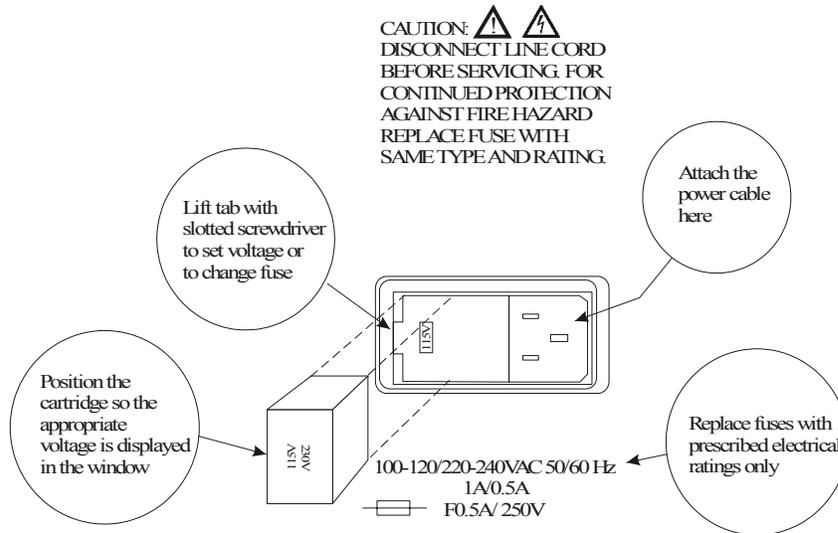


Figure 2. Checking the voltage configuration on your instrument. To operate the SC-5500 on 230VAC, two fuses are required.

Rack Mounting

The SC-5500 Integrating Sphere System Control is sold in two design configurations. The table top version features padded feet underneath the instrument enclosure for mounting on a flat surface. The rack-mount version is shipped without feet but with rack-mounting hardware. Labsphere rack-mounted instruments are constructed to fit standard ANSI/EIA-310D-1992 19" electronics racks. Proceed as follows to mount the SC-5500 in your rack:

1. Secure the two mounting brackets shown in Figure 3 to either side of the instrument enclosure.

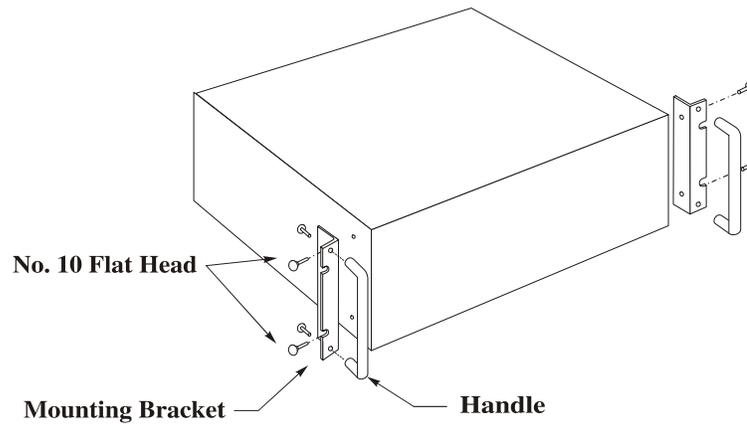


Figure 3. Installing rack-mounted instrument brackets on the instrument enclosure.

2. Locate the T-nuts provided with the electronics rack assembly and position them on the rack as shown in Figure 4 at the instrument locations desired. Since the SC-5500 has a display screen, you may want to mount the instrument in a top position

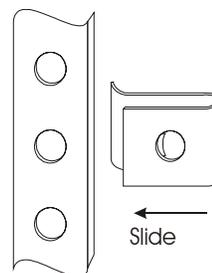


Figure 4. Install T-nuts into the rack on each side.

3. Install the chrome mounting screws through the brackets and into the T-nuts for each instrument. Secure the fastener with a Phillips screwdriver.

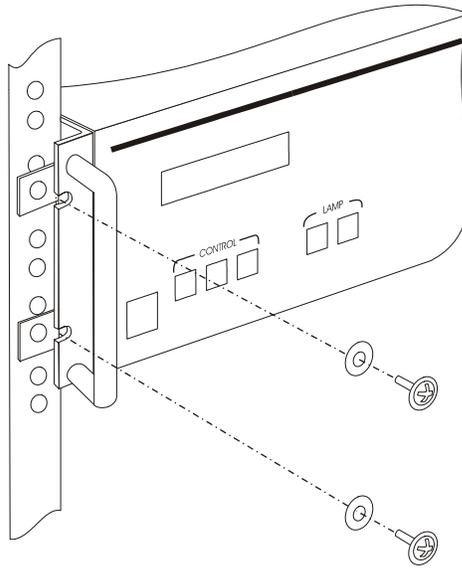


Figure 4. Mount the instrument and bracket into the electronics rack.

Electrical Cable Hookup

The SC-5500 instrument delivery includes only a single power cord. Cable connection to peripheral components depends on the configuration of the integrating sphere system. If you purchase a complete system from Labsphere, the necessary cabling may be packaged with other components.

1. The SC-5500 will operate by computer control, either RS232C or IEEE-488, or as a stand-alone unit. If you decide to use the RS-232C connector, you will need a null modem to reverse the RX and TX cable leads. Otherwise, you will need an IEEE-488 cable and control board.



CAUTION: Make all connections with the AC line power OFF.

2. Communications with the VAC-1000 Variable Attenuator Control, DM-1000 Detector Multiplexer or lamp power supply is maintained through the DB37 connector on the SC-5500 rear panel. Make the cable hookup between the SC-5500 connector and the individual connectors on your peripheral instrumentation.
3. Make the detector cable hookup between your detector and the corresponding input connector on the back panel of the SC-5500. The SC-5500 detector inputs require a TRIAX connector. You can connect up to two different detectors to the back panel of the SC-5500. You can monitor only one detector at a time.

4. Connect the power cord between the instrument and an available wall socket.
5. Turn the instrument on and check for proper operation.
6. Load the Labsphere software package on your computer and configure the communications link with the SC-5500 instrument.

System Description and Operation

There are two basic functions the SC-5500 provides for your integrating sphere system: the instrument displays the detector output, in either radiometric or photometric units, and exercises operating control over selected optical instruments. The instrument control function requires use of a host computer with either a standard Labsphere software package or your own software.

At the heart of the instrument is a Zilog Z180 8-bit microprocessor that performs all data collection and system control duties. The Z180 chip is an enhanced version of the time-tested Z80 MPU that featuring 1 Mb MMU, two DMA channels and 8 MHz on-chip oscillator. A functional block diagram of the instrument is provided in Appendix B. The radiometer features two detector inputs - one for current and one for voltage operation. Voltage signals from both detector channels are amplified and digitized before providing input to the microprocessor. Data processing commands for the microprocessor are held in system memory by a 8-bit 32K EPROM chip along with the necessary calibration data for displaying detector readings. The calibration data is embedded into the EPROM at Labsphere and provides accurate readings only when used in the configuration specified by the calibration documentation.

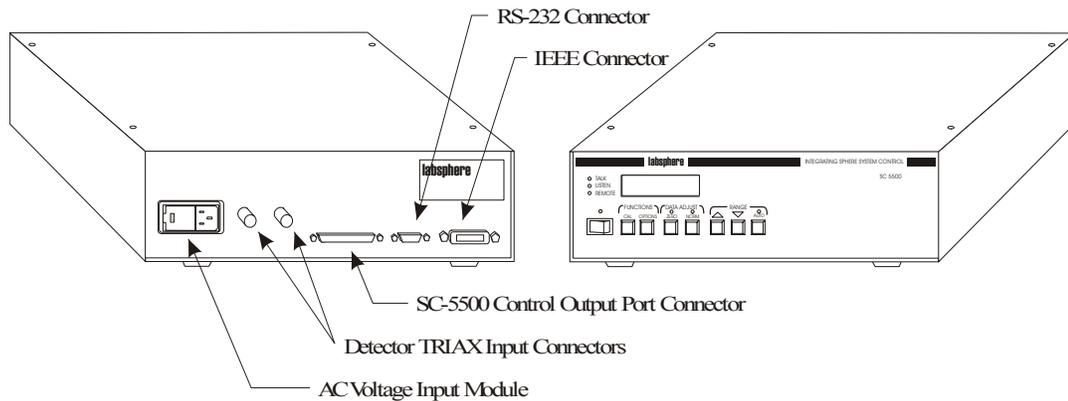


Figure 5. Front and back panels of the SC-5500 instrument.

Automatic or manually controlled ranging is provided for each detector channel over a control bus and three gain control networks. The gain network for the detector current channel consists

of a resistive bridge circuit operated by six low voltage relays. Seven decades of current amplification are available. The five decades of ranging for the detector voltage channel is accomplished in two stages. A resistive bridge network operated by a single relay pre-conditions the voltage signal before it reaches the multiplexer. The second stage of ranging for the voltage channel is accomplished in the JFET amplification circuit of the post amplifier.

The radiometer can be operated locally at the front panel of the instrument or from the host computer. Local operation is achieved through the use of seven control buttons that cycle the user through a sequence of menus. When connected to a detector and turned on, the SC-5500 takes continuous detector readings, displaying the results in the LCD display on the front panel or through the Windows software application on the host computer.

Detector Input

Triax connectors for two detector channels are provided on the back panel of the SC-5500. The connector labeled Silicon/Germanium should be used for current-based detectors such as the Labsphere SDA-050-U or the GDA-050-U photodiode assemblies. Current-based photodiodes are the most common form of light detection today - you will use the Silicon/Germanium connector for most of your applications. The SC-5500 and Labsphere photodiode detectors operate in photovoltaic mode. The connector labeled Thermopile/Lead Sulfide/PMT should be used for voltage-based detector systems such as the Labsphere PDA-050 photomultiplier tube. If you have both current and voltage based detectors, you can monitor the two detector inputs by cycling between the CAL0 and CAL1 options using the CAL function button on the SC-5500 front panel. If you need to monitor the signal input from more than one current-based detector, you will need to purchase a DM-1000 Detector Multiplexer.

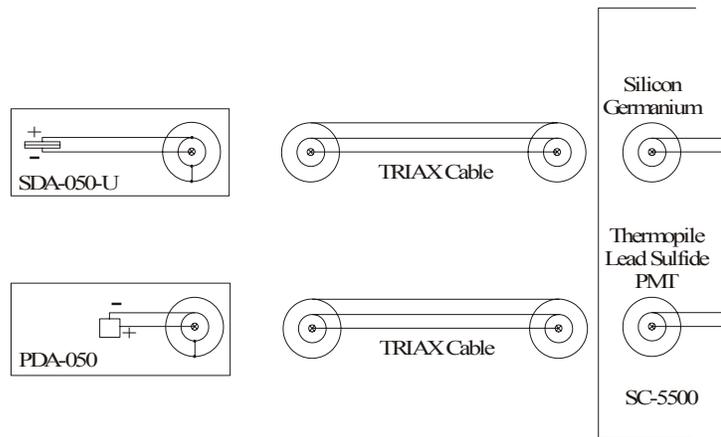


Figure 6. Wiring a custom detector to the SC-5500.

The SC-5500 detector input channels are configured to accommodate Labsphere detector assemblies. Labsphere photodiode detectors are wired in a manner opposite to most detectors. The positive detector signal output from the semiconductor is wired to the center ring of the detector

assembly TRIAX output connector - the negative lead is wired to the center pin. If you decide to connect your own photodiode detector to the SC-5500, you may need to reverse the detector leads. A simple electrical diagram is shown in Figure 6. The Thermopile/Lead Sulfide/PMT connector is wired in the normal fashion. Both connectors on the SC-5500 instrument are TRIAX configured. You may need an adapter if your detector uses a BNC cable.

SC-5500 Computer Interface

The rear panel of the SC-5500 provides standard RS-232C and IEEE-488 connectors for maintaining communications with the computer. You can elect to use either communications protocol. If your integrating sphere system includes one or more peripheral instruments, you must establish a computer link for control of these devices.

If you decide to use the IEEE-488 computer interface, you will need a GPIB board and IEEE-488 cable. Normally, these items are not provided by Labsphere. The default IEEE address for the SC-5500 and most Labsphere software applications is 10. Values between 1 and 15 are possible. To set the primary address on the radiometer, scroll to the IEEE ADDRESS menu option using the OPTIONS button and select your new address using the Up Δ and Down ∇ buttons on the front panel. Refer to your system manual when setting the IEEE address in your software application.

You will need a null modem if you decide to use the RS-232C communications interface. If your SC-5500 was purchased as part of an integrating sphere system, the null modem is provided. Refer to your system manual when configuring the serial port in your software application.

Lamp Power Supply, Detector Multiplexer and Variable Attenuator Operation

A custom designed cable connecting the SC-5500 with a lamp power supply, variable attenuator, detector multiplexer, or other peripheral accessory normally is supplied when your SC-5500 is part of an integrating sphere system. This cable connects to the DB37 connector on the rear panel of the radiometer and the input connectors of your peripheral equipment. A total of 32 output bits are provided on the DIGITAL OUTPUT CONTROL connector. The pinout for the connector is given in Table 2. There are no input bits.

Not all 32 bits over the DIGITAL OUTPUT CONTROL port are available for custom use. The DM-1000, VAC-1000 and lamp power supplies all utilize a certain number of the bits. The number and identification of the bits available to the user depends on system configuration. The lamp power supplies each use up a single bit, for example. The bits utilized by the VAC-1000 depend on the number of variable attenuator units attached. A map describing the utilization of SC-5500 output bits is provided in Appendix B.

Pin	Port No.	Bit No.	Pin	Port No.	Bit No.	Pin	Port No.	Bit No.
1	1	1	14	2	6	26	3	5
2	1	2	15	2	7	27	3	6
3	1	3	16	2	8	28	3	7
4	1	4	17	3	1	29	3	8
5	1	5	18	3	2	30	4	1
6	1	6	19	3	3	31	4	2
7	1	7	20	Gnd	NA	32	4	3
8	1	8	21	Gnd	NA	33	4	4
9	2	1	22	Gnd	NA	34	4	5
10	2	2	23	Gnd	NA	35	4	6
11	2	3	24	Gnd	NA	36	4	7
12	2	4	25	3	4	37	4	8
13	2	5						

Table 2. Pinout and port designation for the rear panel DB37 connector.

Operating Procedures

All SC-5500 hardware features except the control of peripheral equipment are duplicated in the standard Labsphere software applications. System operating procedures are provided in your system instruction manual. The following procedures pertain to stand-alone operation of the SC-5500.

Start Up

1. Press the POWER button on the front panel of the instrument. All LED indicators will light up briefly, and go out when the system has initialized. The Power indicator LED should remain on and the CAL1 default display will read detector current in the LCD display.
2. Toggle through the Calibration Menu using the CAL button and select the calibration display required.
3. Select the automatic range feature by pressing AUTO. The green LED above will light up.
4. To record a dark current reading, extinguish your light source and observe the detector reading on the LCD display. Press the ZERO button to store the dark current measurement into memory.
5. Turn on your light source and observe the readings on the LCD display. You can stabilize the detector readout by enabling the digital filter. To do this, invoke the DIGITAL FILTER menu option using the OPTIONS button and press the Up Δ or Down ∇ button.

Shutdown

When SC-5500 operation is no longer required, press the POWER button.

User Interface

In the stand-alone mode of operation, SC-5500 control is obtained through the buttons on the front panel of the instrument. A list of SC-5500 control features is provided here for user reference. The front panel of the SC-5500 is illustrated in Figure 1.

POWER

Power to the SC-5500 Integrating Sphere System Control is activated through the front-panel rocker switch. Pressing the switch to the ON **I** position activates instrument power, turns on the green light directly above the power switch, and enables the LCD display. Pressing the switch to the OFF **O** position deactivates the instrument.

LCD Display

The display panel consists of a two-row backlit LCD digital readout. It may be set for either analog or digital readings. The backlight may be turned off for dark room use. The LCD window displays a continuous detector readout during normal radiometer operation. When accessing SC-5500 control features, the window displays the menu options associated with each feature. To return to the detector readout display at any time, press the CAL button.

CAL

The CAL button provides operator access to the pre-programmed calibration coefficients embedded within the SC-5500 firmware. When the CAL button is selected, the LCD window displays the detector readout using the currently selected calibration coefficient. At startup, the CAL1 calibrated readout will be displayed. To switch the radiometer to an alternate calibration, press CAL repeatedly until the appropriate calibration coefficient is displayed.

OPTIONS

The OPTIONS button gives the operator access to the programmed features of the SC-5500 Integrating Sphere System Control. Repeated selection of this button scrolls the user through the Options Menu in the order displayed by Figure 7. The operator can scroll through the possible parameter options for each menu option through the Up Δ or Down ∇ buttons at the right. The selections from the Options Menu are not stored on EPROM - the next time you power up your SC-5500, the default parameters will be restored.

CAL		OPTIONS
CAL0	Detector Voltage	3½ - 4½ DIGIT DISPLAY
CAL1	Detector Current	ANALOG OR DIGITAL DISPLAY
CAL2	Luminance (ft-Lamberts)	DIGITAL FILTER
CAL3	Luminance (cd/m ²)	FRONT PANEL LIGHTS
CAL4	Custom Calibration	BACK LIGHT
CAL5	Custom Calibration	IEEE ADDRESS
CAL6	Custom Calibration	BAUD RATE
CAL7	Custom Calibration	PARITY
CAL8	Custom Calibration	DATA FORMAT
CAL9	Custom Calibration	RESPONSIVITY

Figure 7. Menu item sequence in the SC-5500 firmware.

If your SC-5500 is part of an integrating sphere system with Labsphere software, the software application can access the non-communications parameters on the Options Menu. When the SC-5500 powers up, the default parameters will always be restored. By applying the lock mode to the instrument during operation, you can disable the buttons on the front panel of the instrument. In the lock mode, only software configurations are effective. The lock mode is released automatically when you exit the software application. The lock mode feature may not be available on all Labsphere software applications.

3 1/2 and 4 1/2 Digit Display

The detector readout can be displayed in the LCD window using three or four decimals. Application of calibration coefficients may decrease this resolution. The default parameter is **3 1/2 DIGITS**.

Display Format

The LCD display format can be switched between **DIGITAL**, which shows the measurement along with the units, or **ANALOG**, which shows the measurement along with a proportional sliding-bar graph. The default setting at power up is **DIGITAL**.

Digital Filter

Enabling the digital filter reduces background fluctuations, thereby providing more stable readings. Disabling the filter provides quicker, continuous readings. The default setting at power up is **DISABLED**.

Front Panel Lights

The LED indicators on the front panel can be toggled on or off. The off position reduces ambient light in a dark room situation. The default setting at power up is **ENABLED**.

Back Light

The LCD display back light can be toggled on or off. The off position reduces ambient light in a

dark room situation. The default setting at power up is **ENABLED**.

IEEE Address

You can program the SC-5500 for a different IEEE address if the default address is already taken by another piece of equipment. The possible addresses include any number between 1 and 15, inclusive. Do not choose an address that conflicts with the address of another device in the system. This option is for computer interfacing with an IEEE-488 bus only and has no affect on stand-alone operation. The default address at power up is **10**. If you want a different permanent IEEE address, the custom firmware must be programmed into your SC-5500 EPROM.

Baud Rate, Parity and Data Formats Parameters

These parameters remain in the SC-5500 firmware for purposes of backwards RS-232C compatibility.

Responsivity

This menu option displays the calibration coefficients embedded in your SC-5500 EPROM firmware. The coefficients match the data in the calibration documentation accompanying your integrating sphere system.

ZERO

The ZERO button should be used for recording a dark current reading before taking measurement data. When the operator presses this button, the most recent detector reading is stored in memory and subtracted from all subsequent readings. The green LED above the ZERO button will be lit when the feature is enabled.

NORM

The NORM feature allows the operator to normalize detector readings to a previously saved value. When this button is pressed, all subsequent readings are divided by the current detector readout. If the total measured detector readout drops below the value that was present when the zero was initiated, the instrument will display negative numbers. These negative numbers are unreliable and should not be used. The green LED above the NORM button will be lit when the feature is enabled.

AUTO

The AUTO button enables the automatic detector amplification ranging feature of the SC-5500. When enabled, the detector readout is displayed using the most readable format in the LCD window. The operator can manually set the operating range for the detector by using the Up Δ and Down ∇ buttons. These buttons under the RANGE heading on the front panel allow detector sensitivity adjustment by changing the pre-amplifier gain of the SC-5500. Pushing these two buttons causes the running display to scroll through the ranges of the detector. For current-based detectors, seven decades of ranging are available; for voltage-based detectors, the operator can

scroll through five decades. A green light above the **AUTO** button indicates when the instrument is in the automatic ranging mode.

If the signal from the detector exceeds the set dynamic range, the display will read **OVERFLOW**. In this case, the sensitivity of SC-5500 Integrating Sphere System Control must be decreased or the radiant flux on the detector reduced before the display will function properly again.

TALK

A green light indicates when the SC-5500 Integrating Sphere System Control is sending information through the IEEE-488 or the RS-232C interface to a remote computer terminal.

LISTEN

A green light indicates when the SC-5500 Integrating Sphere System Control is receiving information through the IEEE-488 or the RS-232C interface from a remote computer terminal.

REMOTE

A green light indicates that the SC-5500 Integrating Sphere System Control is being operated by a remote computer in lock mode, and that the front-panel control buttons are deactivated.

Calibration

If your SC-5500 accompanies an integrating sphere system, the instrument will be calibrated to read out in the units of your choice when operated with the system. The calibration coefficients embedded in the SC-5500 firmware is not valid for other systems or with different detectors. The radiometer also can be used, however, to display the detector voltage or detector current. Calibration coefficients for CAL0 and CAL1 are installed on all SC-5500 radiometers to display detector voltage and current respectively. The CAL2, CAL3, ..., etc. calibrations are reserved for the standard part numbers listed in Table 1 or for custom calibrations. Up to 100 different calibrations are possible. The Calibration Certificate accompanying your system delivery describes the methods and equipment used for the specified calibrations. A sticker certifying the accuracy of the SC-5500 Integrating Sphere System Control calibration, the calibration date, and the suggested date to send the instrument back for recalibration is located on the rear panel. Labsphere maintains records of all calibrations completed. If you should wish to use new or different equipment with the SC-5500, contact the Labsphere Customer Service Department at (603) 927-4266. Your sales representative can arrange for you to send the equipment along with the SC-5500 Integrating Sphere System Control and the rest of the system to Labsphere for proper calibration.

During the calibration of your SC-5500, the luminance or radiance output from your sphere was measured along with detector voltage or current. The results of these measurements are available in the calibration documentation. A detector responsivity and correction multiplier is recorded along with each calibration in the documentation. The correction multiplier is the arithmetic inverse of detector responsivity and should be entered into the Labsphere software application

after installation on your computer. The same responsivities and correction multipliers discussed above are embedded into the EPROM in your SC-5500 so the instrument can be operated remotely or in stand-alone mode.

SC-5500 Programming

Labsphere provides several software packages that execute control over the SC-5500 instrument. If your application is very specialized, you may need to write your own software. This chapter provides some programming examples that may be helpful.

The SC-5500 instrument can be controlled through an IEEE-488 interface or using RS-232C format over a serial port. In either case, communications must be in text format. If you choose the IEEE-488 interface, you will need an IEEE board and cable. If you decide to use the 9-pin serial connector on the SC-5500, you need an RS-232C cable with the null modem.

SC-5500 Programming Commands

Commands given to the SC-5500 must be sent in capital letters and each command has to be followed with an X. For instance, to activate the AUTORANGE function via the terminal program, the following command must be sent, A0X. The “A0” is the actual command to instruct the SC-5500 to switch to the automatic ranging mode. The X tells the SC-5500 to execute the command. Complete strings of commands may be sent all at once as long as the final command is the X. A string of commands, up to 100 characters long, may be entered, followed by a single X. These commands will all be executed at once. For example, to instruct the SC-5500 to switch to 4-1/2 digit mode, toggle to AUTO RANGE, and also to use the voltage readout, the following string can be sent:

H1A0C0X.



Note: If an incorrect command is sent to the SC-5500 Integrating Sphere System Control from the computer, the LCD display on the instrument will read **INVALID MESSAGE** for approximately five seconds before it clears itself.

Automatic Ranging

An

A0X Sets the SC-5500 in the auto ranging mode.

A1X Turns off the auto ranging mode.

Calibrations **Cn**

CnX Typing **C** and the number that corresponds to a calibration stored in the SC-5500 sets the instrument for that specific calibration. (**n**) is the one or two digit decimal number of the calibration. Example: **C0X** sets the SC-5500 to Cal 0, **C1X** sets the SC-5500 to Cal 1. (C0 is factory set to display **volts**, C1 is factory set to display **amps**.)

Data Relay **On**

O0X Tells the SC-5500 to relay only one detector measurement to the computer for display. (This is not allowed for IEEE 488 operation, but is required for RS-232 operation.)

O1X Tells the SC-5500 to relay continuous detector measurements for display. (This is not allowed for IEEE 488 operation, but is required for RS-232 operation.)

Digit Display **Hn**

H0X Formats the detector readings for 3-1/2 digits on display and over computer interface.

H1X Formats the detector readings for 4-1/2 digits on display and over computer interface.

Digital Filter

F0X Enables digital filter

F1X Disables digital filter

Digital Output Control **Pn Jm (Km)**

Pn JmX Sends a +5 volt charge to the pin that corresponds with the bit (**Jm**) of the port (**Pn**). (**n**) is a decimal number from 1 to 4; (**m**) is a decimal number from 1 to 8.

Example: **P2 J3X** Sets bit 3 of port 2 high

Pn KnX Shuts down the voltage to the pin that corresponds with the bit (**Kn**) of the port (**Pn**).

Example: **P2 K3X** Sets bit 3 of port 2 low.

Normalizing Data **Nn**

N0X Sets the SC-5500 in the normalize mode.

N1X Turns off the normalize mode.

Manual Ranging **Rn**

RnX Sets the dynamic range of the SC-5500's detector measurements. When measuring cur-

rent, 7 decades of dynamic range are available. In terms of interface commands, **R0** corresponds with the most sensitive range and continues as such up through **R6**, which corresponds with least sensitive range. When measuring voltage, 5 decades of dynamic range are available. **R1** corresponds with the least sensitive range and continues as such up through **R5**, which corresponds with the most sensitive range.

Current Mode	Range	Resolution	Voltage Mode	Range	Resolution
R6X	E-3	1 mA	R4X	E+2	100 V
R5X	E-4	100 μ A	R3X	E+1	10 V
R4X	E-5	10 μ A	R2X	E00	1 V
R3X	E-6	1 μ A	R1X	E-1	1 mV
R2X	E-7	100 nA	R0X	E-2	10 mV
R1X	E-8	10 nA			
R0X	E-9	1 nA			

Table 3. Programming commands for detector ranging.

Remote Operation **Ln**

- L0X Sets the SC-5500 in the remote control mode. In this mode the front panel controls of the instrument are deactivated.
- L1X Turns the remote control mode off and reactivates the front panel controls.

Zeroing Data **Zn**

- Z0X Sets the SC-5500 in the zeroing mode.
- Z1X Turns off the zeroing mode.

IEEE-488 Programming

Most IEEE-488 interfaces that install on a computer come with a diagnostic software package allowing direct communications to the IEEE bus. You can use this software for command string characters to be sent to the SC-5500. Another mode would be via a communications program written in some form of intermediate language, such as QuickBasic.

When working with a user-designed terminal program in another language, such as C++ or QuickBasic, standard communication program design must be followed. For instance, when using Quick Basic, a Quick Library must be formed that has the various commands used for communication with the interface. Then, within the program, a reference has to be made to that particular library in order to use the interface supported commands. Once communications have been established, use the method of the current language to send strings to the communications

port.

All references to programming and structure will assume use of the National Instruments GPIB interface package, IBIC (the Interface Bus Interactive Control software provided with National Instruments GPIB boards to allow direct communications to the IEEE-488 bus). For other IEEE interfaces, use these examples to form the correct program structure to generate the same response.

When addressing the SC-5500 through the IEEE interface, common bus initialization, device clears and device finds are required. Then, using the IBIC command structure, My Talk Address and My Listen Address must be set for the communications board and the SC-5500. Then, when addressing the SC-5500 to perform an instruction, an IBCMD (Interface Bus Command) statement can be sent out to set up the nature of the communication occurring (i.e. SC-5500 as a TALKER and the interface board as a LISTENER). Once the communication parameter has been established, string commands as described in Appendix C can be sent to instruct the SC-5500 to perform the required actions.

RS-232C Programming

The SC-5500 can be controlled through the RS-232 by use of a standard terminal program. You will need to supply a NULL MODEM ADAPTER to use with a communications cable when attaching the SC-5500 to a communications port of a computer. Once connected, the proper communication parameters must be entered through the options panel of the SC-5500. The default setting for serial communications on the SC-5500 are a baud rate of 9600, 8 data bits, no parity and one stop bit. Once configured, simple commands may be sent across the serial line to the SC-5500. RS-232C programming examples are provided in Appendix C.

Maintenance

There is no user routine or corrective maintenance for the SC-5500 Integrating Sphere System Control. There are no serviceable components inside the SC-5500 enclosure.

The AC line voltage input module, located on the rear panel of the instrument, features a fuse holder and voltage cartridge which displays the factory-set line input voltage. The instrument is capable of operating on 115 or 230 VAC. The 115 volt setting has an effective range of 100-120 volts. The 230 volt setting has an effective range of 220-240 volts. The power and fuse ratings for the instrument are listed on the rear panel next to the input module.



DANGER: Incorrect fuse installation can cause a potential shock hazard or subject the SC-5500 instrument to electrical damage.

The voltage cartridge has been set at Labsphere prior to shipping and the correct power cord is provided at shipment to suit your power source. Should you ever need to change the configuration, make sure the desired setting of 115 or 230 VAC is prominently displayed in the window as shown in Figure 8.



CAUTION: Check the voltage setting on the AC line voltage input module before connecting the SC-5500 instrument to a new power source.

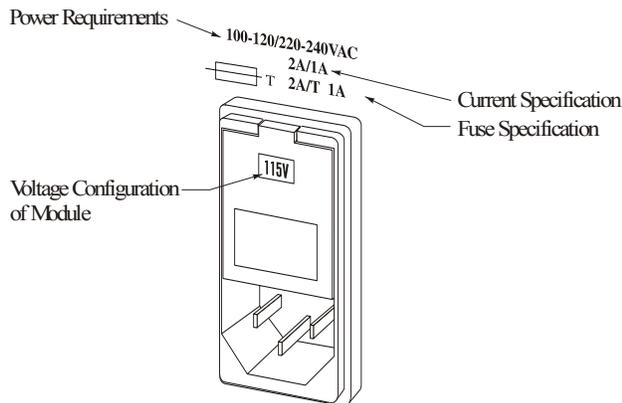


Figure 8. Reading the voltage setting from the rear panel.

To change the input voltage configuration, proceed as follows:

1. Remove the power cord and gently pry up the plastic tab on the top end of the module in Figure 8 using a slotted screwdriver.

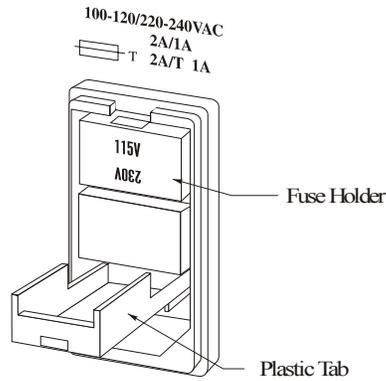


Figure 9. Pull down the plastic tab.

2. Remove the voltage cartridge from the module, as shown in Figures 9 and 10, and flip the cartridge around so that the alternate voltage reading will now be displayed.
3. Replace the existing fuses with the correct current rating. The fuse rating for each voltage configuration is printed on the rear panel of the instrument adjacent to the input module.

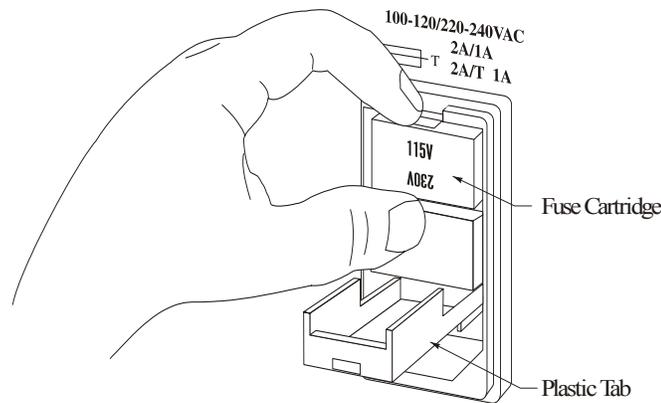


Figure 10. Removing the fuse cartridge.

4. Re-insert the cartridge and reassemble the input module as demonstrated in Figure 11.
5. Close the plastic tab and ensure the desired voltage (115 or 230 VAC) is displayed in the window.

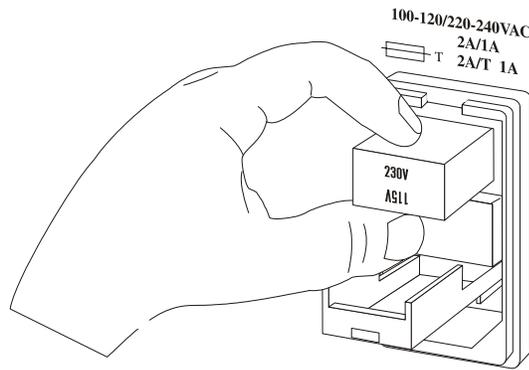


Figure 11. Re-installing the fuse cartridge.

To replace a fuse, remove the power cord and pry up the plastic tab on the top end of the module as discussed above. Remove the voltage cartridge from the module and remove the defective fuses. At the factory, Labsphere always installs two fuses of the same rating into the voltage cartridge, no matter what the intended voltage configuration. Install the appropriate replacement fuses into the cartridge, as shown in Figure 12, and load the cartridge into the input module in the correct orientation. Reassemble the line voltage input module, ensuring the desired voltage (115 or 230 VAC) is displayed in the window.

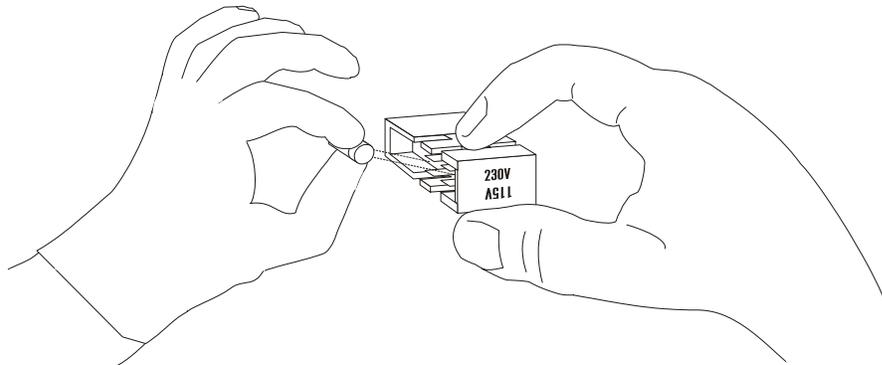


Figure 12. Labsphere always installs two fuses of the proper rating to correspond to your country's power configuration. If you are changing the power configuration, say from 115VAC to 230VAC, you must install fuses with the correct rating.

If a fuse blows, replace it with a fuse of the same rating. If a fuse blows a second time, contact the Labsphere Customer Service department at (603) 927-4266.

The SC-5500 uses a 1 amp, 250 volt, slow-blow GDA-type fuse. Two 1A fuses are required if operating the SC-5500 at 230 VAC. If a second fuse blows, contact the Labsphere Customer Service Department at (603) 927-4266.

Appendix A Specifications

Radiometer Performance

Current Input Characteristics at 25°C

Range	Resolution	Accuracy (% reading + counts) 24 hr period	Accuracy (% reading + counts) 1 yr period
1 nA	0.1 pA	0.05 + 2	0.1 + 5
10 nA	1 pA	0.05 + 1	0.1 + 2
100 nA	10 pA	0.05 + 1	0.1 + 2
1 μA	100 pA	0.05 + 1	0.1 + 2
10 μA	1 nA	0.05 + 1	0.1 + 2
100 μA	10 nA	0.05 + 1	0.1 + 2
1 mA	100 nA	0.05 + 1	0.1 + 2

Temperature Coefficient: $\pm(0.02\%$ of reading + 0.5 counts) per °C

Input Bias Current: 0.2 pA maximum

Voltage Input Characteristics at 25°C

Range	Resolution	Accuracy (% reading + counts) 24 hr period	Accuracy (% reading + counts) 1 yr period
10 mV	1 μV	0.05 + 2	0.1 + 5
100 mV	10 μV	0.05 + 1	0.1 + 2
1 V	100 μV	0.05 + 1	0.1 + 2
10 V	1 mV	0.05 + 1	0.1 + 2
50 V	5 mV	0.05 + 1	0.1 + 2

General Specifications

Temperature Coefficient	$\pm (0.02\% \text{ of reading} + 0.5 \text{ counts}) \text{ per } ^\circ\text{C}$
Noise Referred to Input	$100 \text{ nV RMS}/(\text{Hz})^{1/2}$
Input Bias Current	10 pA maximum
Input Impedance	100 Meg Ohm in parallel with 100 pF
Analog Input	Single Channel
Input Connector	twist-lock-type triaxial
Isolation	500 volts to ground
Common Mode Voltage	10 volts
CMRR	120 dB at DC to 60 Hz
Bandwidth	Detector dependent; 10 Hz at full bandwidth
Maximum Reading Rate	3 readings per second
Maximum Input	$\pm 70 \text{ volts}$ or 10 mA
ADC Resolution	20 bits
Nonlinearity	$\pm 1 \text{ count}$
Calibration	No trim pots. All calibrations done digitally and correction factors stored in the EPROM. Up to 100 calibration coefficients may be stored in the EPROM
Compatible Detectors	Si, Ge, PbS, InGaAs and PMT
Power	100-120/220-240 VAC; 50/60 Hz, 1/0.5 Amp
Operating Environment	0° to 50°C 0% to 70% relative humidity at 35°C Linearly derates 3% relative humidity per $^\circ\text{C}$ from 35° to 50°C
Dimensions	16.5" W x 16" D x 5" H
Weight	14 lbs. (4.75 kg.)
Sensitivity	0.1 pA/1.0 μV
Resolution	4.5 digits
Computer Interface	IEEE-488 RS-232C (Default settings: 8 data bits, 1 stop bit, no parity, 9600 baud)

Appendix B Schematics

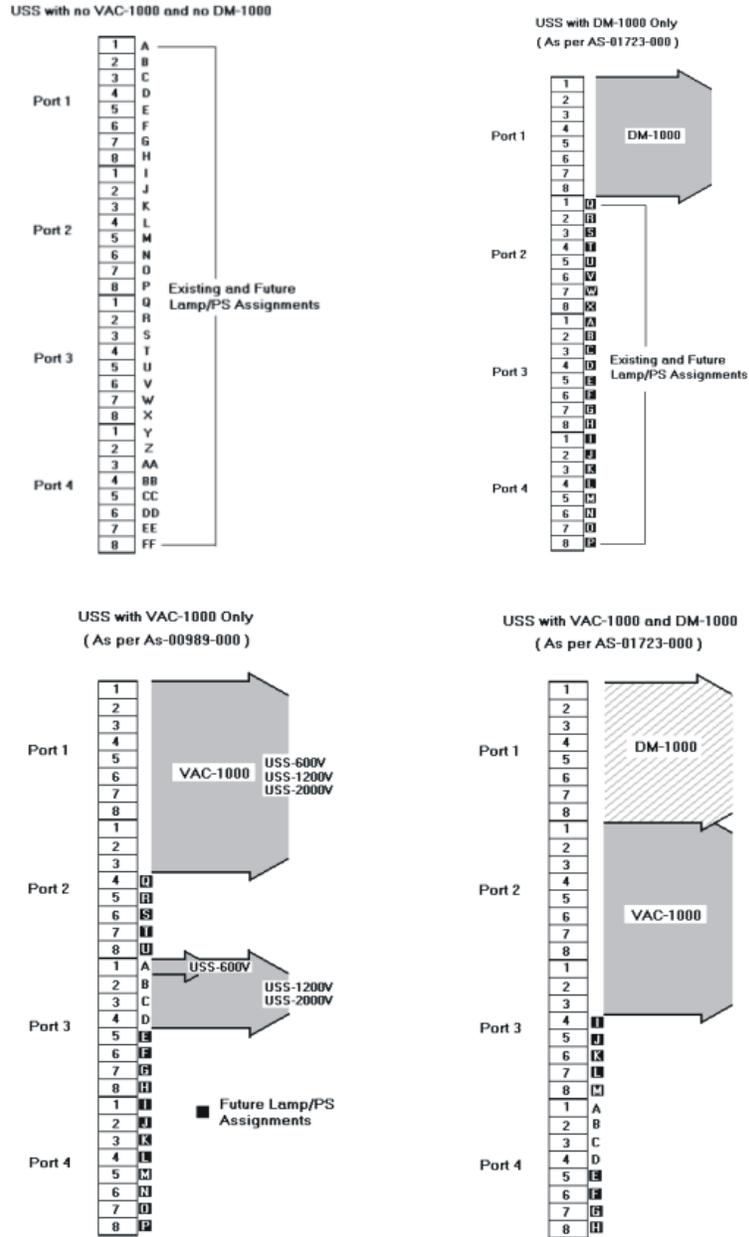


Figure 7. Typical DB37 setup for the SC-5500. The active pinout depends on your system configuration.

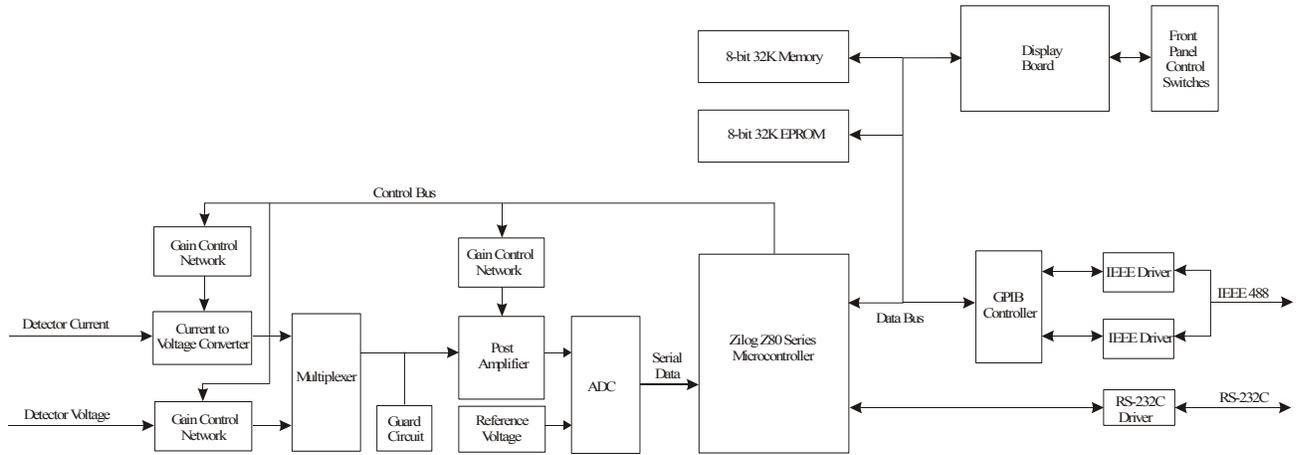


Figure 8. Functional block diagram of the SC-5500 radiometer.

Appendix C Sample Programming

SC-5500 programming examples are provided here for controlling the system through IEEE-488 and RS-232C interfaces. The IEEE-488 examples use functions referenced from the National Instruments NI-488.2M GPIB reference. In each case, one source code example is in C++, the other using QuickBasic.

IEEE-488 Programming in C++

```

int gpib_card=0;
int dm_port=1;
int sc_5500_address=10;
int port_1_status=0;
int port_2_status=0;
int port_3_status=0;
int port_4_status=0;

void zero_on (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"Z0X",3,0);
}

void zero_off (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"Z1X",3,0);
}

void norm_on (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"N0X",3,0);
}

void norm_off (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"N1X",3,0);
}

void auto_on (void)
{
    SendIFC(gpib_card);

```

```

        Send(gpib_card,sc_5500_address,"A0X",3,0);
    }

void auto_off (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"A1X",3,0);
}

void display_3_digits (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"H0X",3,0);
}

void display_4_digits (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"H1X",3,0);
}

void lock_front_panel (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"L0X",3,0);
}

void unlock_front_panel (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"L1X",3,0);
}

void filter_on (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"F0X",3,0);
}

void filter_off (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"F1X",3,0);
}

void go_to_range (int range)
{
    //range 0 is the most sensitive range (e-9)
    //range 6 is the least sensitive range (e-3)

    char tempstr[10],junk[10];
    memset(tempstr,'\0',10);
    memset(junk,'\0',10);
    strcpy(tempstr,"R");
    strcat(tempstr,itoa(range,junk,10));
}

```

```

        strcat(tempstr,"X");
        SendIFC(gpib_card);
        Send(gpib_card,sc_5500_address,tempstr,strlen(tempstr),0);
    }

void go_to_cal(int cal)
{
    //cal 0 is detector voltage, cal 1 is detector current, all other cals are setable only at the factory
    //the maximum number of calibrations is 99

    char tempstr[10],junk[10];
    memset(tempstr,'\0',10);
    memset(junk,'\0',10);
    strcpy(tempstr,"C");
    strcat(tempstr,ittoa(cal,junk,10));
    strcat(tempstr,"X");
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,tempstr,strlen(tempstr),0);
}

void SelectDetector_1()
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"P1J1K2K3K4K5K6K7K8X",19,0);
}

void SelectDetector_2()
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"P1J1K2J3K4K5K6K7K8X",19,0);
}

float get_sc_reading(void)
{
    void *buffer;
    float reading;
    char tempstr[25];
    memset(tempstr,'\0',25);
    buffer=&tempstr;
    SendIFC(gpib_card);

    //the Receive command will read up to 25 characteres until 0x0a (decimal 10) is
    //recieved. The SC-5500 sends back an 0x0d 0x0a after each reading.
    //Reading the data in this manner allows this function to work in both 3 1/2 and 4 1/2 digit mode

    Receive(gpib_card,sc_5500_address,buffer,25,10);
    reading=atof(tempstr);
    return reading;
}

void set_all_low(void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"P1K1K2K3K4K5K6K7K8X",19,0);
    Send(gpib_card,sc_5500_address,"P2K1K2K3K4K5K6K7K8X",19,0);
}

```

```

        Send(gpib_card,sc_5500_address,"P3K1K2K3K4K5K6K7K8X",19,0);
        Send(gpib_card,sc_5500_address,"P4K1K2K3K4K5K6K7K8X",19,0);
    }

void set_all_high (void)
{
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,"P1J1J2J3J4J5J6J7J8X",19,0);
    Send(gpib_card,sc_5500_address,"P2J1J2J3J4J5J6J7J8X",19,0);
    Send(gpib_card,sc_5500_address,"P3J1J2J3J4J5J6J7J8X",19,0);
    Send(gpib_card,sc_5500_address,"P4J1J2J3J4J5J6J7J8X",19,0);
}

void set_port (int port, int position)
{
    //This sequence sets up the SC-5500 control ports to control the VAC-1000. The second argument is the
    //attenuator position, 0 through 255, you want the attenuator to assume

    char bit_values[25],position_values[25],temptr[25],junk[25],attenuator_values[25];
    int i,j;
    memset(bit_values,'\0',25);
    memset(position_values,'\0',25);
    memset(attenuator_values,'\0',25);
    memset(temptr,'\0',25);
    memset(junk,'\0',25);

    strcpy(temptr,"P");
    strcat(temptr,itoa(port,junk,10));
    itoa(position, position_values, 2);
    j=strlen(position_values);
    for(i=1;i<=j;i++)
    {
        bit_values[i-1]=position_values[j-i];
    }
    for(i=j;i<8;i++)
    {
        bit_values[i]='0';
    }
    for(i=0;i<8;i++)
    {
        if(bit_values[i]=='0')
        {
            strcat(temptr,"K");
        }
        else
        {
            strcat(temptr,"J");
        }
        strcat(temptr,itoa(i+1,junk,10));
    }
    strcat(temptr,"X");
    SendIFC(gpib_card);
    Send(gpib_card,sc_5500_address,tempstr,strlen(tempstr),0);

    switch(port)

```

```

        {
            case 1:port_1_status=position;break;
            case 2:port_2_status=position;break;
            case 3:port_3_status=position;break;
            case 4:port_4_status=position;break;
            default:break;
        }
    }

void lamp_on(void)
{
    port_3_status=port_3_status|0x01;//set bit 1 high, and leave the rest alone
    set_port(3,port_3_status);
}

void lamp_off(void)
{
    port_3_status=port_3_status&0xfe;//set bit 1 low, and leave the rest alone
    set_port(3,port_3_status);
}

```

IEEE-488 Programming in QuickBasic

This programming example uses the IBIC command structure. When addressing the SC-5500 through the IEEE interface, common bus initializations, device clears and device finds are required. Then, using the IBIC command structure, My Talk Address and My Listen Address must be set for the communications board and the SC-5500. Then, when addressing the SC-5500 to perform an instruction, an IBCMD (Interface Bus Command) statement can be sent out to set up the nature of the communication occurring (i.e. SC-5500 as a TALKER and the interface board as a LISTENER). Once the communication parameter has been established, string commands can be sent to instruct the SC-5500 to perform the required actions.

If, during the process of sending commands to the SC-5500, a string or character is sent that the SC-5500 does not recognize, an **INVALID COMMAND ERROR** status message will be displayed on the front panel of the SC-5500. The duration of the display will be as long as required to clear the buffer of the characters. If there is a sufficient amount of unrecognizable characters in the buffer, it may become necessary to power off the SC-5500 and then power it back on.

```

'initialization
REM $INCLUDE: 'c:\at-gpib\qbasic\qbdecl.bas'           'INCLUDE file that points the program to
                                                       'the area where the IEEE-488 Quick Library
                                                       'of commands
scread$ = "?_J"                                     'Sets MyTalk address (MTA) to 10 and
                                                       'MyListen address (MLA) to 0
scwrite$ = "?_*@"                                   'Sets (MTA) to 0 and
                                                       '(MLA) to 10
CALL IBFIND("DEVA", 10)                             'Find SC-5500 at address 10
CALL SendIFC(0)                                     'Send InterFace Clear
CALL DevClear(0, 10)                                'Clear SC-5500 bus
CALL IBCMD(0, scwrite$)                             'Send MTA/MLA
CALL IBWRT(0, "P1C1K1H1L0X")                       'Set SC-5500 for 4 1/2 Digits, to Cal 0 and
                                                       'Remote ON operation

```

‘To get one display value back from the SC-5500, issue the following commands

```
r$ = SPACES(12)                                     ‘Set up display readback string for 12
                                                    ‘characters in 4 1/2 digit mode.Data format returned is
                                                    ‘terminated by <CR><LF>
Receive (0, 10, r$, NullEND)                       ‘Format is:0 = IEEE Interface board number
                                                    ‘10 = Default address of the SC-5500, r$ = String variable
                                                    ‘NullEND = Terminator
```

‘The SC-5500 will execute the Receive command by placing one display value into its buffer. The buffer is then swept and ‘the data sitting there is placed into the string variable. This one command will perform both tasks. The O0X command is ‘only an RS-232 command. It should never be used for the IEEE interface.

```
CLS
‘Now set up AutoRange:
CALL IBCMD(0, scwrite$)                             ‘Send MTA/MLA
CALL IBWRT(0, "A0X")                               ‘Turn on Autorange
SLEEP 5
CALL IBCMD(0, scwrite$)                             ‘Send MTA/MLA
CALL IBWRT(0, "A1X")                               ‘Turn off Autorange

‘Set up ReadBack:
CALL IBCMD(0, scread$)                              ‘Send MTA/MLA
CALL IBRD(0, r$)                                   ‘Receive into program the display value
```

RS-232C Programming in C++

```
int sc_idComDev;

int create_IdComDev(int comport)
// This routine checks creates the comport and
// sets it up for serial communications.
{
    int err;
    DCB dcb;      //Governing Data Control Block
    int idComDev;

    // initialize the serial communications parameters
    dcb.Id = 0;      //identify the Id number this is with
    dcb.BaudRate = CBR_9600; //set baud 9600
    dcb.Parity = NOPARITY; //set communications to no parity
    dcb.ByteSize = 8; //set to 8 data bits
    dcb.StopBits = ONESTOPBIT; //set to 1 stop bit
    dcb.fBinary = 0; //dont read in Binary!
    dcb.fParity = 0; //No parity checking
    dcb.fOutxCtsFlow = 0; //disable hardware handshaking
    dcb.fOutxDsrFlow = 0; //disable hardware handshaking
    dcb.fDtrDisable = 1; //disable hardware handshaking
    dcb.fOutX = 0; //disable Xon/Xoff outgoing // DSS 5/31/96 v1.1p
    dcb.fInX = 0; //disable Xon/Xoff incoming // DSS 5/31/96 v1.1p
    dcb.fDtrflow = 0; //disable hardware handshaking
    dcb.fRtsflow = 0; //disable hardware handshaking
```

```

char CommString[32];
char PortString[32];
const int RecvQueueSize=2048;
const int SendQueueSize=2048;

strcpy(&CommString[0],"COM"); //COM
itoa(comport,&PortString[0],10); //1
strcat(&CommString[0],&PortString[0]); //COM1

//Open a hailing frequency
idComDev = OpenComm(&CommString[0], RecvQueueSize, SendQueueSize);
if(idComDev<0)
{ //ReadHand the OpenComm Failure
    err = CloseComm(idComDev);
    return -1;
}

strcat(&CommString[0],":9600,n,8,1");
//Translates Device Definition String to DCB codes
err = BuildCommDCB(&CommString[0], &dcb);
if(err==-1)
{
    err = CloseComm(idComDev);
    return -1;
}

//Sets communication device to state defined in DCB
err = SetCommState(&dcb);
if (err < 0)
{
    err = CloseComm(idComDev);
    return -1;
}
return idComDev;
}

void zero_on_serial(void)
{
    WriteComm(sc_idComDev,"Z0X",strlen("Z0X"));
}

void zero_off_serial(void)
{
    WriteComm(sc_idComDev,"Z1X",strlen("Z1X"));
}

void norm_on_serial(void)
{
    WriteComm(sc_idComDev,"N0X",strlen("N0X"));
}

void norm_off_serial(void)
{
    WriteComm(sc_idComDev,"N1X",strlen("N1X"));
}

```

```

}

void auto_on_serial(void)
{
    WriteComm(sc_idComDev,"A0X",strlen("A0X"));
}

void auto_off_serial(void)
{
    WriteComm(sc_idComDev,"A1X",strlen("A1X"));
}

void display_3digits_serial(void)
{
    WriteComm(sc_idComDev,"H0X",strlen("H0X"));
}

void display_4digits_serial(void)
{
    WriteComm(sc_idComDev,"H1X",strlen("H1X"));
}

void lock_panel_serial(void)
{
    WriteComm(sc_idComDev,"L0X",strlen("L0X"));
}

void unlock_panel_serial(void)
{
    WriteComm(sc_idComDev,"L1X",strlen("L1X"));
}

void filter_on_serial(void)
{
    WriteComm(sc_idComDev,"F0X",strlen("F0X"));
}

void filter_off_serial(void)
{
    WriteComm(sc_idComDev,"F1X",strlen("F1X"));
}

void goto_range_serial(int range)
{
    char tempstr[10],junk[10];
    memset(tempstr,'\0',10);
    memset(junk,'\0',10);
    strcpy(tempstr,"R");
    strcat(tempstr,itoa(range,junk,10));
    strcat(tempstr,"X");
    WriteComm(sc_idComDev,tempstr,strlen(tempstr));
}

void goto_cal_serial(int cal)
{

```

```

char tempstr[10],junk[10];
memset(tempstr,'\0',10);
memset(junk,'\0',10);
strcpy(tempstr,"C");
strcat(tempstr,itoa(cal,junk,10));
strcat(tempstr,"X");
WriteComm(sc_idComDev,tempstr,strlen(tempstr));
}

void SerialSelectDetector_1()
{
    WriteComm(sc_idComDev,"P1J1K2K3K4K5K6K7K8X",strlen("P1J1K2K3K4K5K6K7K8X"));
}
void SerialSelectDetector_2()
{
    WriteComm(sc_idComDev,"P1J1K2J3K4K5K6K7K8X",strlen("P1J1K2J3K4K5K6K7K8X"));
}

/*****
float get_reading_serial(void)
{
    char data_read[25];
    float sc_reading;

    memset(data_read,'\0',24);
    WriteComm(sc_idComDev,"O0X",3);           //Ask the SC-5500 for a reading

    wait_n_mseconds(1000);

    //read the data back one character at a time until all characters have been read
    int BytesRead = 0;
    DWORD current_time;
    DWORD start_time = GetTickCount();
    start_time += 10000;
    while(BytesRead<12)
    {
        BytesRead+=ReadComm(sc_idComDev,&data_read[BytesRead],12);
        current_time = GetTickCount();
        if (start_time < current_time)
        {
            sc_reading = 0;
            return -1;
        }
    }
    char *end_point;
    sc_reading = strtod(data_read, &end_point);
    return sc_reading;
}

```

RS-232C Programming in QuickBasic

'initialization:

OPEN "com1:9600,N,8,1,ASC" FOR RANDOM AS #1

'Open comm port 1 at 9600 baud, no parity, 8 data bits, 1 stop
'bit, ASC formatted data and in RANDOM mode for

PRINT #1, "C1H1L1X"	'bi-directional communications
CLS	'Set SC-5500 for 4 1/2 Digits, to Cal 0 and to remote mode
SLEEP 1	'operation
	'Pause for command to be processed by SC-5500
'AutoRange setup:	
PRINT #1, "A0X"	'Turn on Autorange
SLEEP 5	'Pause for command to be processed by SC-5500
PRINT #1, "A1X"	'Turn off Autorange
'ReadBack a detector reading:	
PRINT #1, "00X"	'Send back one display value ie 1.0000E-3
	'<CR><LF>
INPUT #1, reading\$	'Receive into program the display value
CLOSE #1	



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