MOORE INDUSTRIES

SCM

Sensor-to-Computer Module

USER'S MANUAL

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Introduction

Moore Industries' Sensor-to-Computer Module (SCM) is a compact, electronic device, used to establish a communications link between a personal computer (PC) or a computer-based host, and process instrumentation such as sensors or transmitters.

The unit features user-set operating parameters, and housing options to accommodate installation under a wide variety of field conditions.

This is the user's manual for both the standard and the Programmable SCM. It consists of:

- A description of the SCM's physical and operational characteristics;
- An overview of Moore Industries' SCM software, and the unit operational commands and options;
- A list of SCM performance and functional specifications, and an overview of Moore Industries' product serial number/model number unit data tracking system;
- A set of instructions for unit calibration;
- Information pertaining to unit installation;
- A description of SCM operation, including a summary of the unit's Operational Commands, and briefs covering the capabilities available through use of Moore Industries' Scanning software and Accessory Programs;
- A list of items for which to check when troubleshooting the SCM;
- Four appendixes, with information pertaining specifically to the configuration of SCM's equipped with PRG Option, quick-reference tables of SCM Commands, and a Hex-to-Binary-to-ASCII conversion table, and information on SCM's with the Radio Modem Option.

User's Manual Conventions

The text of this manual includes special NOTES and CAUTIONS. NOTES assist the user in avoiding inconveniences in the setup and use of the SCM. CAUTIONS warn against practices that might result in damage to the unit.

The format used in this manual to represent user input from the PC or Host, i.e. an SCM command, will be shown in a larger type size, in bold, and typically set off from the accompanying texts, as in the following:

$1SU+12345.67M↵

which is an example of a command entered by the user, and:

***1RS31Ø7Ø14292↵**

which is a typical SCM long form response (including an echo of the command) and a checksum.

Note that in the examples above, a carriage return ("ENTER" or "RETURN" on most computer keyboards) will be represented by the symbol "↵". Also, where the numeral zero and the capital letter O might be confused, the numeral is represented by the symbol "Ø".

The data acquisition system Host device, "Host" for the purposes of this manual, is assumed to be an IBM PC or an IBM-compatible PC clone. Any microprocessor-based device capable of sending and receiving ASCII via an asynchronous (serial) communications port can also be used. For more Host specifications, refer to table 2 in the Calibration Section.

References to "DOS", as in "DOS commands" and "DOS operations", in this manual are to facilities available in an IBM or IBM-compatible version of the PC Disk Operating System software package, such as Microsoft's MS-DOS.

Description

The SCM performs three, distinct operations. It receives an Operational Command from a system Host, retrieves the requested data from connected sensing or discrete devices, and transmits data from those devices back to the Host in ASCII. SCM data output can be displayed at the Host terminal, routed to log files, or sent to a system printer for hard-copy.

Except for units that process frequency input, the SCM also provides discrete output logic signals when prompted by the Host, useful for controlling external relays or switches.

The Host commands and the SCM data are sent over the same twisted wire pair, in either RS-232C or RS-485 communications standards (factory-set according to customer specification).

External Characteristics

The SCM is available in two housing styles; a thermoplastic version of Moore Industries' DIN-style housing, and an aluminum Hockey-puck (HP) housing style.

The DIN Housing Style. These units mount on 35 mm, H- or hat-rails (DIN EN50022). When ordered with the GR Option, DIN-style units can also be mounted on 32 mm G-rails (DIN EN50035).

The DIN housing is ideal for use in high-density installations.

The HP Housing Style. This SCM comes equipped with either spring clips or flange mount hardware, according to customer specification.

Spring clips are used to secure the SCM in multi-hub, high-cover, explosion-proof enclosures. They eliminate any requirement for drilling and tapping holes in the enclosure to accommodate mounting hardware.

With the flange mount option, HP-style SCM's can be surface-mounted, or slid into place on relay track.

The SCM Front Panel. Connections for power, sensor input/output, and data are made using labeled, removeable, compression-screw terminal blocks located on the unit front panel. In all but Thermocouple and Discrete SCM's, which have terminals along both the top and bottom edge of the front panel, units' terminals for DIN-style SCM's are along the top edge of the front panel. HP-style units have all terminals in a block at the center of the front panel.

There are no external or internal controls for the SCM. All settings and operational trimming adjustments are made using ASCII commands from a Host. Configuration and operating parameter settings are stored in the unit's non-volatile memory; saved even in the event of a power interruption or loss.

Operational Characteristics

The SCM can be ordered in any of six standard configurations. Units are referenced according to which of the six types of signal that they process.

The standard SCM configurations are:

- Voltage Input,
- Current Input,
- Thermocouple (T/C) Input,
- Resistance Bulb, or Resistance Temperature Detector (RTD) Input,
- Frequency Input,
- Discrete Input/Output.

Additional Input/Output Connections. With the exception of the RTD SCM, all standard configurations provide for connection of at least one discrete input. This capability can be put to use as an event counter, or in sensing the state of a remote limiting or safety relay.

All SCM's, except for RTD and Frequency units, also provide at least two discrete output connections. These function as open collector, transistor switches controlled by the Host.

The Operation Section of this manual has more on the uses and functioning of the available discrete terminals of the SCM.

SCM Communications. Each unit receives commands from, and transmits data to the Host via a single wire pair, factory-set for either RS-485 or RS-232C. RS-485 communications are well suited to multi-drop installations. RS-232C lends itself to "daisy-chained" arrays. Either type of unit functions equally well in either single- or multiple-unit settings.

In a system of RS-232C units, it is possible to connect up to ten "daisy-chained" modules over distances of two-hundred feet.

In units configured to use RS-485 communications, multi-drop schemes may be used to connect as many as thirty-two SCM's, at distances to the Host as great as ten-thousand feet.

Several types of repeaters, converters, and modems are available from Moore Industries. These compliment the use of SCM's in simple data acquisition systems by making it possible for as many as one-hundred-twenty-four units and a single Host to exchange data and commands over a single communications link at virtually unlimited distances (using telephone lines and modems).

NOTE

The number of units, and the distance separating them in your application, will depend upon several operational and environmental factors. These include the number of units installed, the baud rate selected, ambient electronic noise, etc.

Refer to the Installation Section and the SCM Specifications listed in table 1 for details, or consult your Moore Industries Sales Representative.

Moore Industries' SCM Software

The SCM is designed so that its operating parameters may be set or changed, and that the unit itself may be operated using any hardware/software combination that is capable of sending it appropriately formatted ASCII commands.

Two PC diskettes are shipped with each SCM order. These contain the Utility, Scanning, and several Auxiliary programs that can be used to set up and operate the SCM, using nothing more than a PC and DOS. Moore Industries' software is intended to provide an easy-to-use, alternative means of configuring and operating units in those installations where more elaborate systems are not required or available.

The diskettes are available on either 3.5- or 5.25-inch media, and are in low-density, non-protected format.

Utility is used to set units' basic operating parameters. Scan is a simple program that can be used to perform basic operations with installed SCM's. The Auxiliary package contains sample programs with suggestions for setting up "dumb" terminal emulation, effecting Host baud rate increases, and logging SCM data to your Host.

More information on these programs is provided in the Calibration and Operation Sections of this manual.

The SCM Commands

Though for some users the Utility and Scanning programs may prove the most convenient means of working with the SCM, neither is required to set up or to operate the unit. The SCM can be directly configured and controlled by commands from the Host. Refer to the Operation Section, and appendix B, for more information on the SCM commands.

Custom Applications. The use of "straight" ASCII in configuring and operating the SCM makes the generation of custom programs, macros and program drivers for the SCM a relatively simple matter. Ready-made drivers for several third-party acquisition and control software packages are available from several software manufacturers.

The SCM Programmer's Guide, a companion manual also available from the factory, provides additional command-level information on the SCM.

<u>*NOTE*</u>
Technical support related to the operation of the SCM in any custom programs or applications is limited to the material covered in the User's Manual and the Programmer's Guide only.

Options

The User-Programmable Transfer Function (PRG)
This enables the SCM to be programmed to work with non-linear sensor data, such as square root, nth root, nth power, and high-order polynomials. With RTD and T/C SCM's automatic linearization is provided as part of the standard unit; the PRG Option is not necessary.

PRG-equipped units can also scale and convert data to user-set engineering units, and can be programmed using real-time input from sensors.

PRG-equipped units are compatible with standard SCM's. Both PRG- and non-PRG-equipped units may be configured in any combination in your application.

Appendix A of this manual consists of a more detailed description of the PRG-equipped SCM, and provides information on its configuration and operation.

Radio Modem Operation
This option is required for applications that call for the connection of a single SCM to a radio modem, leased line, or dial-up modem with no auto-answer capability. The option enables the SCM to generate a Request to Send (RTS) signal, used by these devices as a prompt. Appendix D contains intructions for the use of the Radio Modem Operation Option.

Continuous Mode Capability
With standard SCM configurations, each unit requires a prompting command from the Host in order to transmit any data or operational response. If an application calls for a unit to provide data without having to be prompted by the Host, the Continuous Mode Operations Option, "C", should be ordered.

With the "C" Option, units begin to send data as soon as the appropriate triggering input is detected. This setup is particularly useful in applications calling for continuous module-to-module communications, such as when a C-equipped SCM is connected to a Continuous Mode configured Computer-to-Analog Module (Moore Industries' CAM with PRG Option).

Discrete SCM's have Continuous Mode Operations capability offered as part of the standard unit. To enable Continuous Mode Operations, the user selects one of four Continuous Mode types which control the circumstances under which Discrete units are triggered.

Serial Number. A complete history of every product Moore Industries sells and services is kept at the factory, filed according to unit serial number.

If service information is required for a Moore Industries' product, provide the factory with the serial number of the unit, and our skilled technicians will be happy to help you.

The serial number of the SCM is printed on an adhesive label, and affixed to the side panel of DIN-style units, and to the back panel of HP-style units.

Model Number. Moore Industries' model numbers identify the type of instrument, its primary functional characteristics and operating parameters, any options ordered, and its housing type.

If all documentation for a unit is missing, the model number can be used to reconstruct the configuration information for the unit.

The model number for SCM's is located on the same label as the serial number.

The example below depicts a typical model number, and is provided as an aid in deciphering the various fields.

The specifications for all types of SCM are listed in table 1 on the following pages.

EXAMPLE

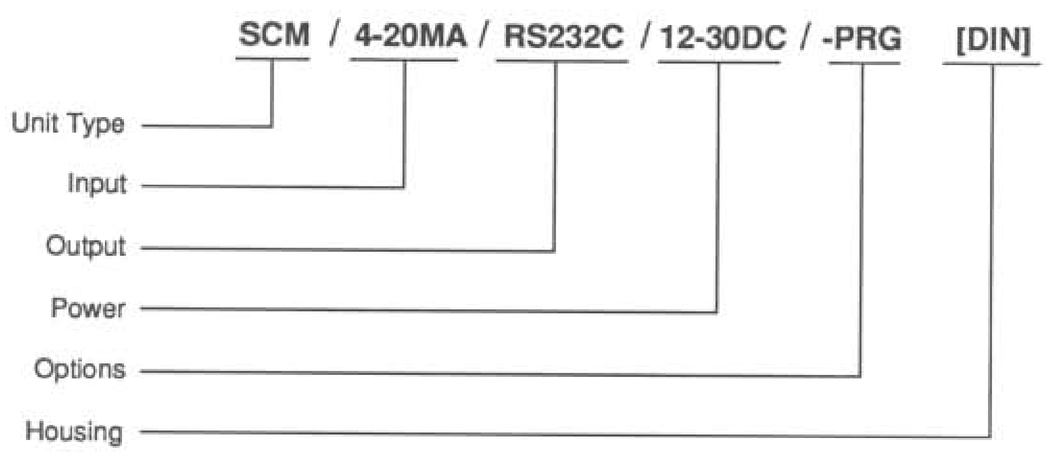


Table 1. SCM Performance and Operational Specifications

Characteristic	Unit Type	Specifications
Input	Voltage	**Factory-set range:** –100 to 100 mV, –1 to 1 V, –5 to 5 V, –10 to 10 V, and –100 to 100 V, dc. **Protection:** to 250 Vac. Two additional discrete outputs and one additional discrete input connection available.
	Current	**Factory-set range:** –1 to 1 mA into 100Ω, –10 to 10 mA into 10Ω, –100 to 100 mA into 1Ω, and 4 to 20 mA into 5Ω. **Voltage Drop** ±0.1 V, maximum. Two additional discrete outputs and one additional discrete input connection available.
	T/C	**Factory-set T/C Type:** J, K, T, E, R, S, B, or C. Any span within the following ranges is user-programmable (Note accuracy specification, under Performance): For J-type: –200 to 760 °C (–328 to 1400 °F), For K-type: –150 to 1250 °C (–238 to 2282 °F), For T-type: –200 to 400 °C (–328 to 752 °F), For E-type: –100 to 1000 °C (–148 to 1832 °F), For R- and S-types: 0 to 1750 °C (32 to 3182 °F), For B-type: 0 to 1820 °C (32 to 3308 °F), For C-type: 0 to 2315 °C (32 to 4199 °F). °C or °F is user-programmable. All units incorporate automatic cold-junction compensation and automatic linearization. Two additional discrete input and three additional discrete output connections available. **Protection:** to 250 Vac.
	RTD	**RTD Type:** Factory-set as two-, three-, or four-wire, 100Ω platinum. $\alpha = 0.00385\ \Omega/\Omega/°C$. Any span within –200 to 850 °C (–328 to 1562 °F) range is programmable, as is °C or °F. **Protection:** to 120 Vac. One additional discrete output connection available.
	Freq.	**Customer-specified range.** Any span from 1 Hz to 20 kHz. **Protection:** to 250 Vac. One additional discrete input connection available.
	All Units	**Analog Input:** Single Channel, auto-zero (±1 count drift, maximum), auto-calibrating. **Maximum CMV:** 500 V rms, input to output @ 60 Hz. **Discrete Inputs:** 8-bit CMOS. User-selectable scaling and calibration. **Voltage Limit:** ±30 V @ 1 A without damage. Saturation voltage @ 200 mA is 1.2 V. Up to 15 connections available with Discrete SCM.
Output	Alarm Signals	HI/LO Trip Point values user-programmable; stored in unit non-volatile memory. User-programmable for Latching or Momentary operation.
	Discrete Terminals	Open-collector transistor capable of sinking 200 mA. Maximum output voltage: 30 V, 30 mA maximum load. **Switching:** High @ 3.5 V, minimum; Low 1.0 V, maximum.
	T/C	Open T/C and over range indication.
	All Units	**Factory-set** for RS-232C or RS-485 communications. Up to 32 SCM's may be connected in a multi-drop, RS-485 System.

NOTE: Table continued next page.

Table 1. SCM Performance and Operational Specifications (continued)

Characteristic	Unit Type	Specifications
Power	All Units	12 to 30 Vdc; 1 Watt, maximum. Internal switching regulator protects against power supply reversals.
Communication	All Units	ASCII command/response protocol; User-programmable unit address. Software scans up to 250 channels per second from host. **Range:** Up to 10,000 feet, depending upon selected communications standard, baud rate, and number of units in system. Greater distances possible with modems and converters (refer to Installation and Operation Sections). **Baud Rate:** User-programmable; 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400 baud. **Parity:** User-programmable; odd, even, or none.
Event Counting	All Units*	Records 10, 000, 000 positive transitions @ 60 Hz, maximum. Filtered to prevent switch contact bounce. * NOT AVAILABLE with RTD SCM's.
Performance	Analog Input	**Resolution:** 15-bit measurement, with 8 conversions per second. **Leakage Current:** < 2 µA rms, input to output, @ 115 V rms, 60 Hz.
	Discrete Inputs/ Outputs	**Switch Points:** High - 3.5 V, minimum; Low - 1.0 V, maximum. **Filtering:** User-programmable time constants from 0 to 16 seconds.
	Voltage & Current Inputs	**Resolution:** 0.01% of full-scale (4 digits). **Accuracy:** ±0.02% of full-scale, maximum. **Common Mode Rejection:** 100 dB @ 50/60 Hz. **Impedance (Voltage):** For inputs of –1 to 1 V or less, 100 MΩ. For inputs of –5 to 5 V or more, 1 MΩ.
	T/C Inputs	**Resolution:** 1 °C or °F. **Accuracy (error from all sources @ 0 to 40 °C, ambient):** ±1 °C, maximum (J, K, T, E); ±2.5 °C, maximum (R, S, B, C). **Impedance:** 100 MΩ, minimum. **Lead Resistance Effect:** Less than 20 µV per 350Ω.
	RTD Inputs	**Resolution:** 0.1°C or °F. **Accuracy:** ±0.3 °C. **Excitation Current:** 0.25 mA. **Lead Resistance Effect:** For three-wire units, 2.5 °C per Ω of unbalance. For four-wire units, negligible.
	Freq. Inputs	**Resolution:** 0.01 Hz. **Accuracy:** 0.005% of reading, ±0.01 Hz. **Impedance:** 1 MΩ. **Switching Level:** User-programmable for 0 or 2.5 V. **Hysteresis:** User-programmable for from 10 mV to 1 V.
Environmental Ratings	Voltage	**Effect of Temperature:** ±0.005% of span per °C change, maximum.
	Current	**Effect of Temperature:** ±0.005% of span per °C change, maximum.
	RTD	**Effect of Temperature:** ±0.002% of span per °C change, maximum.
	Freq.	**Effect of Temperature:** ±0.002% of span per °C change, maximum.
	All Units	**Ambient Operating Range:** –25 to 70 °C (–58 to 158 °F). **Ambient Storage Range:** –25 to 85 °C (–58 to 185 °F). **Relative Humidity:** 0 to 95%, noncondensing.
NOTE: Refer to Installation Section of this manual for mounting dimensions of the SCM.		

Calibration

Every SCM manufactured or serviced by Moore Industries is calibrated and tested for compliance with our strict quality control guidelines. Each unit is guaranteed to perform according to specification without requiring any undue adjustment.

A bench check of unit settings and basic operation is suggested, however, prior to the unit's being placed into service, so that the existence of any damage to the unit resulting from mishandling during shipment may be uncovered.

A bench check also provides the user with the opportunity to become familiar with or change the factory's default SCM settings in an environment isolated from the application.

The calibration of the SCM consists of:

- Connecting the unit in its Default Mode,
- Conducting a basic operations Bench Check,
- Using the Utility program to view or change the unit communications and operating parameters,
- Checking or changing the Host's communications parameters.

<u>NOTE</u>

A brief explanation of the Setup command, $1SU, is included in this manual in appendix B. This is for those users who may find it more desirable or efficient to program the SCM "directly", bypassing the Utility program. Additional command-level information also is provided in the SCM Programmer's Guide.

Calibration Setup

It is recommended that the SCM be calibrated at a technician's bench or in a similar lab-type, controlled environment. In addition to basic terms and concepts of electronics calibration, persons carrying out these procedures should be familiar with some of the basic disk operations of an IBM PC or PC clone, and the DOS or MS-DOS environment.

Users of Moore Industries' SCM software will need to know enough about both their Host device and DOS to enable them to activate a drive/change to a different drive, copy/"backup" files from the Moore Industries' source diskettes, and to locate and run batch and other executable files under DOS.

The equipment listed in table 2 will be needed to perform the SCM Calibration/Bench check. These items are not supplied by Moore Industries, but should be available in most labs, maintenance sections, or service centers.

DOS Considerations. If your Host does not use a CONFIG.SYS file, one must be installed for the SCM to operate properly. Use the DOS command "COPY CON:" to install CONFIG.SYS from the DOS directory or the manufacturer's source diskette.

If using DOS or MS-DOS version 4.0, modify the CONFIG.SYS file (using an ASCII text editor such as DOS's EDLIN) to include the following driver:

DEVICE=ANSI.SYS /K

After saving the file, reboot to install the new/modified driver.

Refer to the DOS Reference and User's Manuals for more information on EDLIN, COPY CON:, ANSI.SYS, and the CONFIG.SYS file.

Table 2. SCM Calibration Equipment

Equipment	Specification
Host Device	IBM PC XT, AT, PS2; 100% compatible clone; or compatible "dumb terminal" running IBM or MS DOS version 2.0 or higher. Unit should also include, a **minimum** of: 384K of RAM; monochrome, text-capable monitor (color also supported); and one asynchronous (serial) communications port (COM1: or COM2). Microsoft, or compatible mouse is supported, but not required. Ensure that device is capable of ASCII output to its COM port, either through BASIC or some comparable application or environment. For communications with SCM's in the Default Mode, the Host should be set for 300 baud, no parity, no echo. Refer to the manufacturer's specifications for the device being used for instructions in configuring the unit as required. If the Utility software is to be used, Host must include one low-density (360K) or high-density (720K) floppy drive (5.25 or 3.5 inch, as appropriate).
Interface Cable	Standard PC communications cabling with one end terminating in a 9- or 25-pin connector that is compatible with the port of the Host being used. The other cable end should terminate in stripped wires that will be inserted into the SCM connection terminals, or that otherwise can be used with the compression-screw terminals of the SCM being checked.
Power Supply	Calibrated, and capable of stable output between 12 and 30 Vdc.
Screwdriver	Slotted type; head width no greater than 2.54 mm (0.1 inch).
Signal Source (Optional*)	Calibrated, adjustable source compatible with the configuration of the SCM to be checked. For example, a source of 4-20 mA for Current SCM rated for 4-20 mA input, or a calibrated thermocouple simulator of appropriate type and range for a T/C SCM. Accuracy of the Signal Source must exceed the rated accuracy of the SCM, which is approximately ±0.02% of span. ***Required** for trimming span or zero.

<u>*NOTE*</u>

Consult your Moore Industries Sales Representative for information on the availability of Moore Industries' Utility and Scanning programs compatible with DOS version 5.0.

Hookups. Figures 1, 2, and 3 show the hookups for the bench check/calibration of each type of SCM. Table 3 lists the abbreviations used on the terminal labeling. When completing the hookups, match the terminal numbers from the figures to the corresponding terminal numbers in the table.

Figure 1 shows the hookup for SCM's factory-configured for RS-232C communications, Figure 2 shows the hookup for RS-485 units to a Host PC, and Figure 3 shows the hookup required for RS-485 units to a non-PC Host device (a "dumb terminal" using a break-out box, for example). The HP-style SCM is not depicted in the hookup diagrams, but the terminal numbers are the same for either type unit.

Before beginning the bench check of the SCM, determine which of the hookups depicted in the figures applies to the units in your application, and complete the connections. Apply power to the hookup, and allow 5 minutes for stabilization/warm-up.

Table 3. SCM Terminal Labeling

Type of SCM ↓	Top Terminals										Bottom Terminals	
	1	2	3	4	5	6	7	8	9	10	11	12
VOLTAGE & CURRENT	+IN	–IN	DO1/HI	DIØ/ EV	DOØ/ LO	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	Not Used	Not Used
T/C	DO2	DI1	DO1/HI	DIØ/ EV	DOØ/ LO	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	–IN	+IN
RTD	C	B	A	D	DOØ/ LO	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	Not Used	Not Used
FREQ.	IN	+2.5V	SIG GND	HYSTR	DIØ/ EV	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	Not Used	Not Used
DISCRETE	BØ4	BØ3	BØ2	BØ1	BØØ/EV	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	BØ5	BØ6 See Note 2

NOTES:
1. For RS-485 SCM's these terminals are labeled with a wire color code and the word "DATA", as in "(Y)DATA" and "(G)DATA". RS-485 communications are in parallel, and thus do no require specific Transmit and Receive connections.
2. Discrete SCM's have an additional 10 terminals. Terminals 13 thru 20 are labeled "BØ7, BØ8, BØ9, BØA, BØB, BØC, BØD," and "BØD".

Key to Abbreviations:

DATA – Receive or Transmit to system host. Used on RS-485 SCM's, these terminal designators are accompanied by abbreviations for the wire colors commonly used in making this type of connection, i.e. standard 4-wire telephone line. The abbreviations used for the colors are (B) for black, (G) for green, (R) for red, and (Y) for yellow.

DEF – Default. This terminal may be connected to ground to place the unit in its Default Mode of operation.

DI – Discrete Input.

DIØ/EV – Discrete Input/Event Counter

DO – Discrete Output.

DOØ/LO – Discrete Output/Low Alarm.

DO1/HI – Discrete Output/High Alarm.

GND – Power Supply or Discrete Output Ground.

HYSTR – Hysteresis

+IN – Positive Signal Input.

–IN – Negative Signal Input.

RCV – Data Receive. RS-232C hookups.

SIG GND – Signal Ground.

A, B, etc. – RTD Sensor Input.

+VS – Positive Voltage Source Input.

XMT – Data Transmit. RS-232C hookups.

+2.5V – Excitation Voltage.

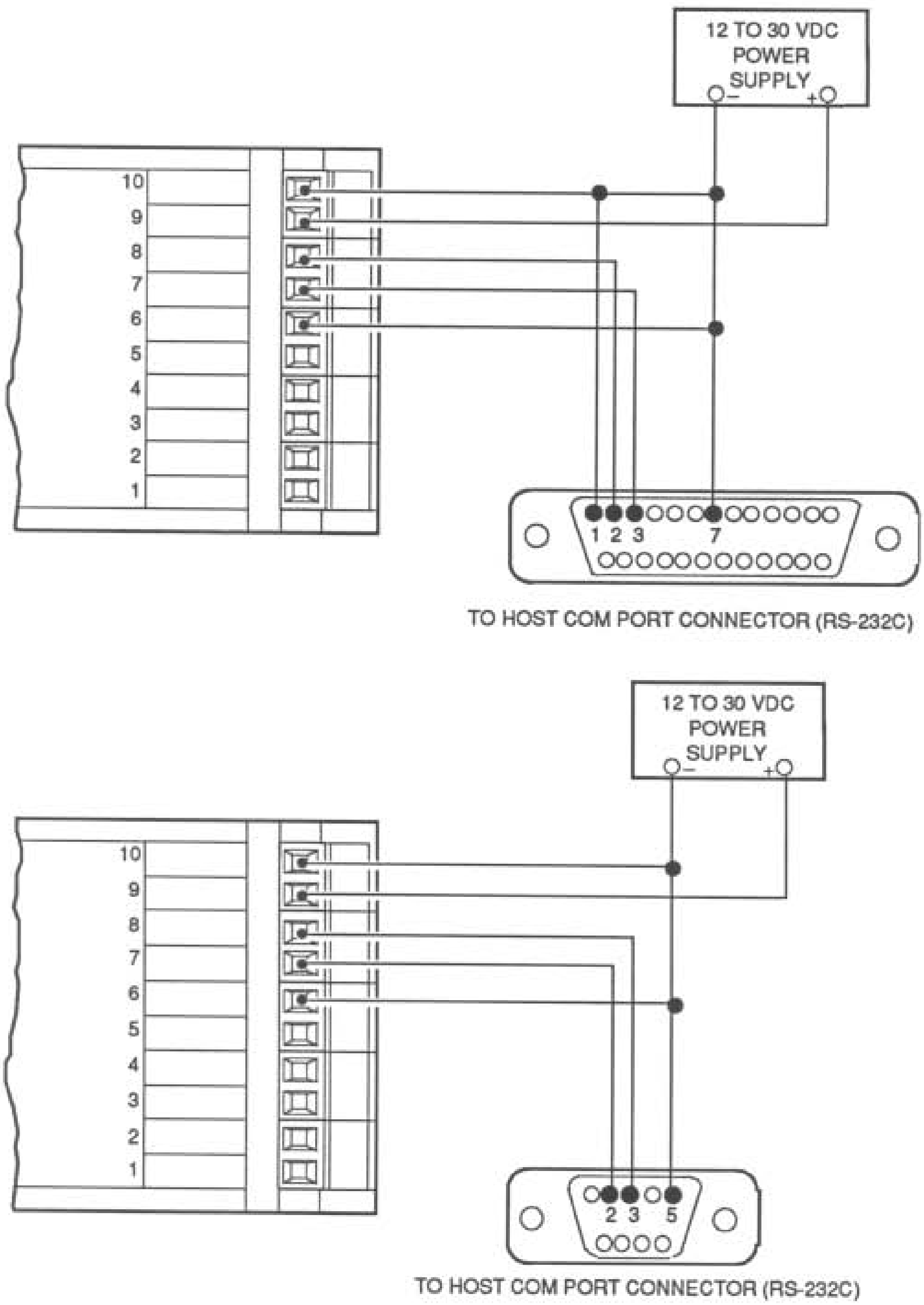


***Figure 1.** RS-232C SCM-to-PC Calibration Hookup*

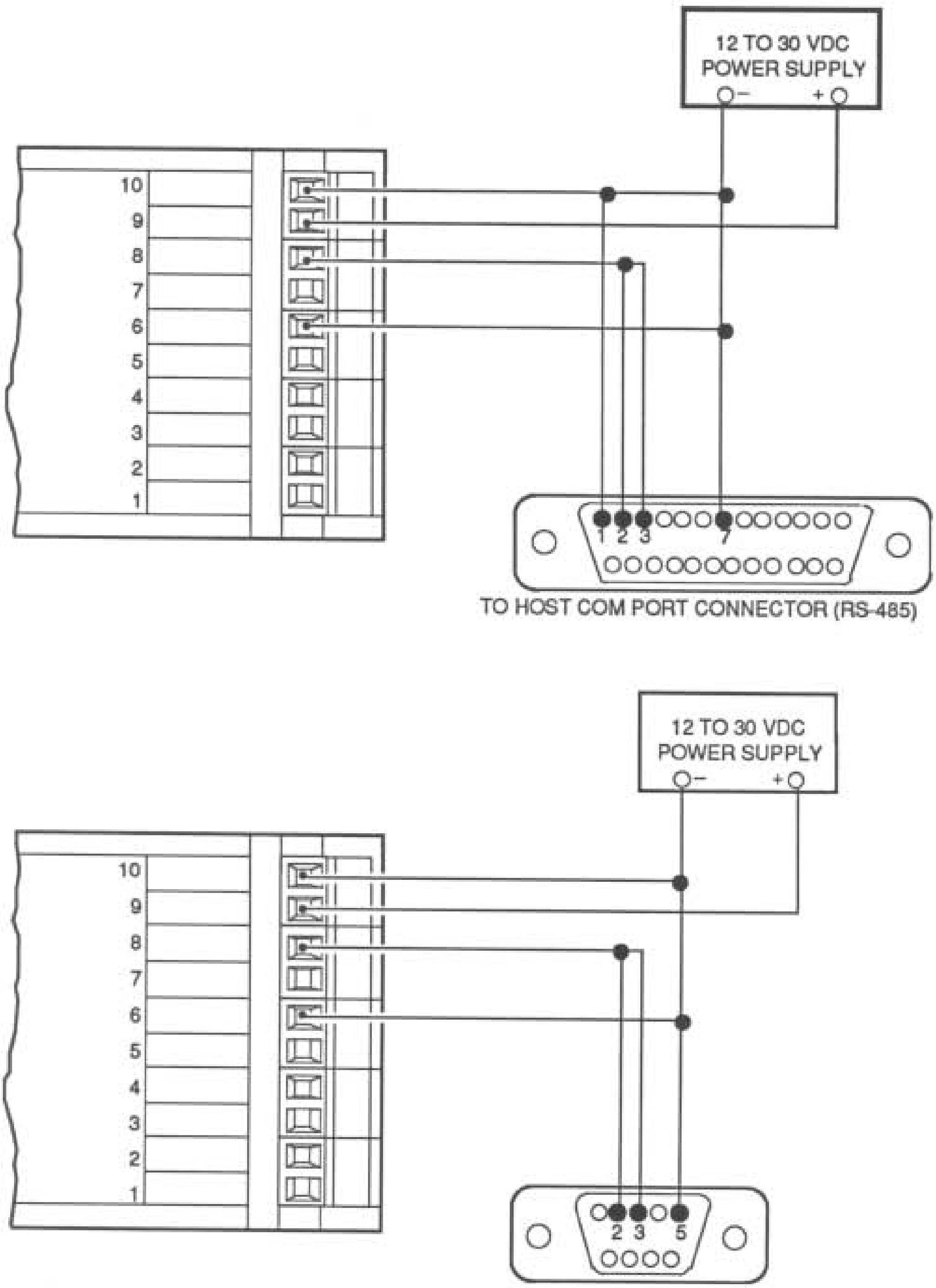


Figure 2. *RS-485 SCM-to-PC Calibration Hookup*

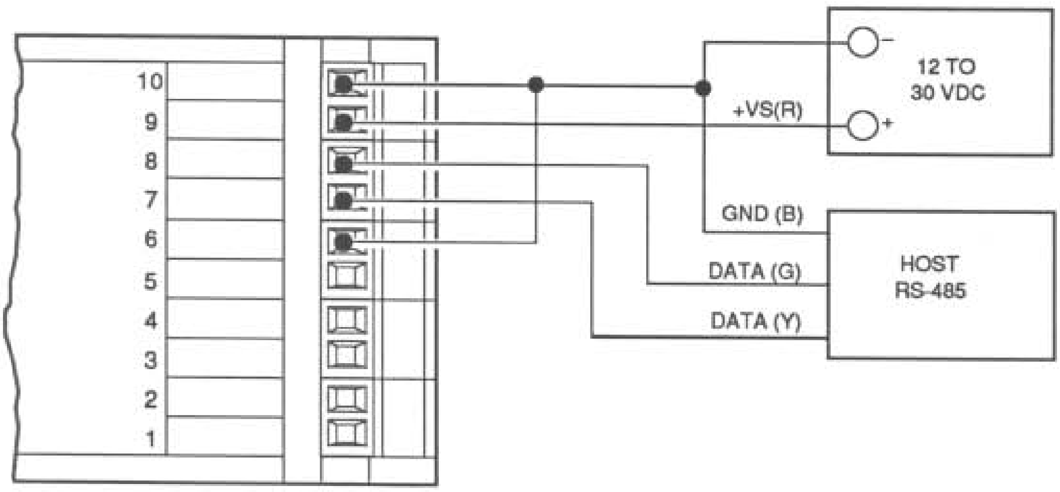


Figure 3. *RS-485 SCM-to-Non-PC Calibration Hookup*

The SCM Default Mode. The hookups shown in figures 1 through 3 depict the SCM in what is referred to as its "DEFAULT Mode".

Whenever the DEFAULT terminal of the SCM is connected to ground in the manner shown in the figures, the unit will enter DEFAULT Mode, which over-rides any communication settings stored in the unit's memory. This allows the user to communicate with the unit via a predetermined COM port, at a preset baud rate and parity setting,.

Also when in Default Mode, SCM's respond to any "legal" address (explained later in this manual).

Normally, when the address, baud rate, and parity settings are not known and not compatible with the settings of the Host, the unit will not communicate. The Default Mode feature is ideal for use with SCM's when record of configuration data has been lost.

When in DEFAULT Mode, every standard SCM will communicate with the Host using the following parameters:

- Host's COM1 Port Active
- 300 Baud
- No Parity
- Echo OFF
- Responding to any "legal" address

The only requirements for communicating with an SCM in Default Mode are that the appropriate communications format be used (RS-232C or RS-485), and that the Host's communications parameters be compatible (300 baud, COM1, etc.) with the Default Mode parameters listed above.

Calibration Procedure – Basic Operations Bench Check

1. Place Host keyboard in "Caps Lock".
2. With Calibration Setup complete, enter SCM "Read Settings" command on Host:

   $1RS↵

   Unit will respond with readout of its Module Settings Code. The Module Settings Code portrays the current settings of all the SCM user-modifiable operating parameters accessible in the Utility program. Table 4 lists acceptable Module Settings Codes for standard SCM's as they are set when shipped from the factory.

   For purposes of this bench check, the meaning of the codes used in the SCM "Read Settings" command, and the response to $1RS is not significant. The Operation Section of this manual provides more information on the SCM Command/Response format. For now:
3. Note response to the "Read Settings" command for future reference.
4. Verify that the first character of response is an asterisk(*).

   If it is, skip to step 5 of this procedure. If response begins with question mark ("?"), an error has occurred. Perform the following:

   a. Check all connections. Ensure that correct hookup was used.

   b. Make sure Host is using COM1 port at 300 baud, with no parity, and no echo. Set these Host operating parameters using the DOS command "MODE", or refer to the section in this manual on starting the Utility program.

   c. Ensure that power supply is operating within specified range (refer to table 2).

   d. Repeat steps 1 and 2 of this procedure.

   If problems persist, note the unit model and serial numbers, and contact Moore Industries' Customer Service Department.

Table 4. *Factory Settings – Responses to $1RS*

Unit Type	Input Range	SCM Response
Voltage	–100 to 100 mV	310701C2
	–1 to 1 V	31070182
	–5 to 5 V	31070142
	–10 to 10 V	31070142
	–100 to 100 V	310701C2
Current	–1 to 1 mA	31070182
	–10 to 10 mA	31070142
	–100 to 100 mA	310701C2
	4 to 20 mA	310701C2
T/C	All Types	31070142
RTD	All Types	31070182
Freq	All Types	310701C0
Discrete	All Types	31070102

5. Verify that unit is correctly configured according to the specifications of your order. Match SCM response noted in step 3 to number in column 3 of table 4. Check the unit's model number against the data derived from the table. If response does not match any of the numbers in table 4, contact the factory.

When steps 1 through 5 of the Basic Operations Bench Check have been successfully completed, it may be assumed that the SCM being checked is in good working order. Optionally, the input/output terminals may be checked using the following procedure, or if desired, the user may skip to the section entitled "Setup for SCM & Host Configuration" for instruction on setting initial SCM and Host communications and operating parameters.

Optional Input Terminals Bench Check. The following steps check for proper SCM communications between the Host and the input terminals of the unit.

1. Without disconnecting DEFAULT terminal of SCM from ground, simulate appropriate signal source. Refer to table 2 for input signal specifications.
2. Enter "Read Data" command:

   $1RD↵

   Unit will respond with appropriate readout of signal input, ±0.02% of rated span.
3. Change level of signal source, keeping within specified limits.
4. Repeat step 2. Unit again responds with appropriate readout of signal input.
5. Disconnect signal input and re-enter "Read Data" command.
6. Verify that unit responds with over-range readout; all zeroes or all nines.
7. If the SCM does not function as described in this procedure, e.g. it returns a communications error, refer to the Troubleshooting Section of this manual.

Refer to the Operation Section of this manual for information on zero offset, deviation output setpoints, and trimming span.

<u>*NOTE*</u>
Do not dismantle the hookup used in this portion of the calibration. The same equipment and hookup can be used to perform the next phase of SCM calibration.

SCM Configuration – The Utility Program

The next step in the calibration of the SCM is setting the unit's basic operating parameters. This is accomplished in three steps. First, the Utility program is loaded. Next the Host communications parameters are checked and set. Then the SCM parameters are viewed and changed.

If desired, the Utility program can also be used to execute SCM Operational Commands, or to verify that the settings changes made in the Setup portion of the program have been down-loaded to unit memory.

If already familiar with the SCM Module Designator, the basic Command/Response Format, and the SCM "Setup" command, skip the following phase of SCM calibration, and execute/verify changes to unit operating parameters using the information in appendix B.

<u>*NOTE*</u>
To perform the Configuration phase of SCM Calibration, use the same equipment and hookup from the Basic Operations Bench Check. See figures 1, 2, or 3.

Installing Utility

SCM basic operating parameters are set using the Utility program included with each shipment. The floppy diskette labeled "Utility Software" comprises the Utility batch file, the executable files invoked by that batch program when it is run, and additional Auxiliary programs, discussed later.

Make a "working copy" of both the Utility and the Scanning software before loading and using them. Use the copies to complete the procedures in this section. A hard disk, if available, is the preferred location for storing and running the programs. The original diskettes should be stored as backup copies in a cool, dry place.

CAUTION

Exposing floppy diskettes to electrical or magnetic fields may result in the loss of data. Stored diskettes should be kept away from extremes in heat and moisture, and should be protected against static discharge and magnetic fields.

Use the DOS command "DISKCOPY" to perform the backup. Refer to the Reference or User's manuals of the DOS version being used for more information on DISKCOPY and other methods of backup.

NOTE

The remainder of the Calibration Section pertains to non-PRG SCM's exclusively. For setup instructions pertaining to SCM's equipped with the PRG Option, refer to appendix A.

Once the source diskettes have been backed up, and with the proper Bench Check/Calibration hookup in place, switch to the drive (or drive partition) where the working copy of the file "Utility.bat" is stored, or insert the appropriate working diskette.

Enter:

UTILITY.BAT↵

After briefly displaying a "logo screen" with the program title and "Moore Industries", the program's Main Menu window will appear. The program is now loaded into the Host's RAM.

NOTES

The Utility program is supported by most color monitors, graphics adapters, and drivers. A color monitor is not required to run the program, but some adjustment to the contrast and brightness setting of monochrome screens, particularly if running the program on a laptop, may be necessary.

If no other batch programs named "Utility" are stored on the drive/partition, it is not necessary to enter the ".BAT" extension.

Once loaded, the Utility program activates the Host device COM1 port, and sets it to 300 baud with no parity and no echo. This over-rides any setting effected by the Host's boot program (autoexec.bat or config.sys), and any setting initiated by use of the DOS command "MODE".

Getting Around in Utility

With the program's Main Menu window on the Host's monitor screen, the version number of the program is shown in the upper left corner. A bar with the five available Actions is across the top, and along the bottom edge, the Help (<F1>) and Navigation Keys are shown.

NOTE

If your display does not appear as described here, refer to the Trouble-shooting Section of this manual.

Making Selections – Pop-ups. There are three ways to get around in the Utility program; by Mouse, by mnemonic, or by moving the Selection Highlight cursor.

If using a mouse, move the pointer, usually a diamond shape on the screen, to the desired Action, and "click". The appropriate "pop-up" screen will come up.

NOTE
A mouse is not required to run the Utility program. Support for most Microsoft-compatible mouse drivers is incorporated into Utility.

An alternative to mouse-based selection is the mnemonic. Press the highlighted first letter of the desired Action to access it.

"S", for example, accesses the Address and Model entry pop-up, which is the security level of the unit Setup. "M" accesses the Miscellaneous pop-up, where the Terminal Simulation and the Rx/Tx Facilities are found. "F" brings up the File functions; and "Q" is for Quit.

As an alternative to either of these methods, an Action can be selected by moving the Selection Highlight cursor, the selection box that appears over one of the items in the Actions bar when the program first comes up.

To use the Selection Highlight, press the "number lock" ("Num. Lock" on some keyboards), then use the cursor control keys on the number keypad. Or use the dedicated cursor keys in the manner described in the Navigation Bar at the bottom of the screen (no "Num.Lock" required).

On number keypads, 4=←, 6=→, 8=↑, and 2=↓.

When the Selector is highlighting the desired Action, press ↵ to access the desired pop-up (start the selected "Action").

NOTE
On the Main Menu window, the UP and DOWN cursor keys serve the same function as ↵
(refer to the preceding paragraph).

Cancelling Selections – Escape. To cancel a pop-up selection, or to escape from any window to the Main Menu window, press the Escape key ("Esc." on most keyboards), or press the right-most mouse button.

Context-Sensitive Help

The first item at the left of the Navigation Bar at the bottom of the screen is "<F1> Help". This is the Utility program's "on-line" reference aid. It consists of brief explanations keyed to the item or action underway (highlighted) at the time the <F1> (<PF1> on some terminals) key is pressed.

To use Help, select an item/action as described above, and press the <F1> function key. A brief explanation of the selected item will appear. If using a mouse, click the item, then click on "Help" in the navigation bar.

When a pop-up is active, press <F1> again, and a "Table of Contents" for the Help system will pop-up. Highlight (click) a topic to select it, and press ↵ to access the help text.

Some Help screens contain more information than can be fit into a single window. Use the Page Down and Page Up keys to access the other screens of information.

Quitting Help. Escape from the Help pop-ups at any time by pressing Escape, or the right-most mouse button.

"Host" – Configuring the Host in Utility

The first Action to access when configuring the SCM is "Host". If the connected SCM and the system Host cannot communicate with each other, settings will not be downloaded to the unit. Remember, when the SCM's are installed in multi-unit applications, unless the communications parameters for both the Host and all connected SCM's are the same, particularly in daisy-chained systems, as soon as a single unit's Default Mode is disconnected, all communications will be lost.

In a multi-drop system it is possible to configure each SCM with a different baud rate. Although it may seem to provide organizational advantages (one unit or a group of units configured to respond at one baud rate, and another unit or group configured to respond at another) this technique requires careful documentation for all units.

To access the communications parameter settings for the Host, select "Host" at the Main Menu window. The Host Communications Parameters pop-up will appear.

Inputting Data/Getting Around in Host. The menu bar at the bottom of the pop-up has the instructions for making changes to the data in the various input fields in the pop-up. Note that the context-sensitive Help system is available.

To move from field to field, use the Tab key, ↵, the down/up cursor controls, or select the desired field with the mouse.

If the connected SCM is in its Default Mode, choose 300 Baud, No Parity, and No Echo. These settings should be selected when the pop-up first appears.

If the connected SCM is not in its Default, pick the baud rate for the Host that is compatible. The navigation bar at the bottom of the pop-up describes how to select the baud rate options.

When all of the Host's parameters have been set, press Escape (Esc.) to load the input and return to the Main Menu window.

"Setup" – Configuring the SCM in Utility

When the Host parameters are set to be compatible with the connected unit, the next step in calibrating the SCM is to bring up its basic operating settings in the "Setup" window of Utility. To access Setup, select the Setup Action from the Main Menu.

The first pop-up to appear is a security window for entering the Address and Model Designator of the connected unit. If the connected SCM is in its Default Mode, the first input field, the address, is irrelevant since units in Default Mode respond to any address. If calibrating the connected module in its actual operations mode, however, the correct unit address is required, and if omitted, will result in a TIME-OUT or COMMUNICATIONS ERROR.

<u>NOTE</u>

If the address of an SCM is unknown, place the unit in its Default Mode and access "Setup" in the Utility program.

With the appropriate address showing in the input field, press ↵.

The next field is for the Module Designator Code. Table 5 lists all Module Designator Codes according to SCM type. Refer to the data on the unit(s) you ordered, use table 5 to determine the correct Module Designator, and enter the code in the appropriate field of the pop-up.

With the correct data shown in the input fields, press ↵.

If the unit is not connected properly, if the correct Module Designator Code is not entered, if the unit is not in Default Mode and an incorrect address was used, a pop-up with an error message will come up. Before going on, press Escape (Esc.) to return to the Main Menu window. Take steps to isolate and correct the problem before attempting to establish a Setup session with the unit.

If there are no Error Messages, the program displays a status pop-up while it reads the basic operational settings of the connected unit. The next pop-up is the full screen edit session of those settings.

<u>NOTE</u>

It is possible to enter a Setup session after encountering an error at this point in the procedure. Any changes made to the operating parameters in the session WILL NOT be down-loaded to the memory of the unit.

Table 5. SCM Model Designator Codes

Input Type	Input Range	Model Designator
Voltage	–100 to 100 mV in RS-232C –100 to 100 mV in RS-485	1111 1112
	–1 V to 1 V in RS-232C –1 V to 1 V in RS-485	1121 1122
	–5 to 5 V in RS-232C –5 to 5 V in Rs-485	1131 1132
	–10 to 10 V in RS-232C –10 to 10 v in Rs-485	1141 1142
	–100 to 100 V in RS-232C –100 to 100 v in RS-485	1151 1152
	–100 to 100 mV w/PRG Option in RS-232C –100 to 100 mV w/PRG Option in RS-485	2111 2112
	–1 to 1 V w/PRG Option in RS-232C –1 to 1 V w/PRG Option in RS-485	2121 2122
	–5 to 5 V w/PRG Option in RS-232C –5 to 5 V w/PRG Option in RS-485	2131 2132
	–10 to 10 V w/PRG Option in RS-232C –10 to 10 V w/PRG Option in RS-485	2141 2142
	–100 to 100 V w/PRG Option in RS-232C –100 to 100 V w/PRG Option in RS-485	2151 2152
Current	–10 to 10 mA in RS-232C –10 to 10 mA in RS-485	1211 1212
	–1 to 1 mA in RS-232C –1 to 1 mA in RS-485	1221 1222
	–100 to 100 mA in RS-232C –100 to 100 mA in RS-485	1231 1232
	–1 to 1 A in RS-232C –1 to 1 A in RS-485	1241 1242
	4 to 20 mA in RS-232C 4 to 20 mA in RS-485	1251 1252
	–1 to 1 mA w/PRG Option in RS-232C –1 to 1 mA w/PRG Option in RS-485	2211 2212
	–10 to 10 mA w/PRG Option in RS-232C –10 to 10 mA w/PRG Option in RS-485	2221 2222
	–100 to 100 mA w/PRG Option in RS-232C –100 to 100 mA w/PRG Option in RS-485	2231 2232
	–1 to 1 A w/PRG Option in RS-232C –1 to 1 A w/PRG Option in RS-485	2241 2242
	4 to 20 mA w/PRG Option in RS-232C 4 to 20 mA w/PRG Option in RS-485	2251 2252

NOTE: Table continued next page.

Table 5. SCM Model Designator Codes (continued)

Input Type	Input Range	Model Designator
T/C	J-type in RS-232C J-type in RS-485	1311 1312
	K-type in RS-232C K-type in RS-485	1321 1322
	T-type in RS-232C T-type in RS-485	1331 1332
	E-type in RS-232C E-type in RS-485	1341 1342
	R-type in RS-232C R-type in RS-485	1351 1352
	S-type in RS-232C S-type in RS-485	1361 1362
	B-type in RS-232C B-type in RS-485	1371 1372
	C-type in RS-232C C-type in RS-485	1381 1382
RTD	All input types and ranges in RS-232C All input types and ranges in RS-485	1411 1412
Frequency	1 Hz to 20 kHz in RS-232C 1 Hz to 20 kHz in RS-485	1601 1602
	1 Hz to 20 kHz w/PRG Option in RS-232C 1 Hz to 20 kHz w/PRG Option in RS-485	2601 2602
Discrete	In RS-232C In RS-485	1711 1712

Inputting Data/Getting Around in Setup. The menu bar at the bottom of the pop-up tells how to enter new parameters in the input fields of the settings edit session. The Utility program's on-line Help system is active here too. Any questions on the input fields in the session can be answered by placing the selector on the field and pressing <F1>.

To move from field to field, use the Tab key, ø, the down/up cursor controls, or click the desired field with the mouse.

When all input fields reflect the desired operating parameters, press <F10>. This sends the new setup data to the connected module, and brings up the pop-up prompting for a Module Reset.

A Module Reset, the "RR" command, sets the new baud rate into module memory. When the SCM is removed from its Default Mode, the new baud rate will be placed into effect.

NOTE

If performing the Setup routine with the SCM's installed, (i.e., not connected in their Default Mode) do not reset any modules until all of the connected units, including the Host have the same baud rate setting. In a daisy-chain installation (RS-232C), if the baud rate is different for any unit in the chain, communications with ALL units will be lost.

After the Module Reset selection is made, either "Y↵" or "N↵", the program returns to the full screen settings edit session window. Another SCM can now be connected, and its parameters viewed and changed.

Quitting Setup. When all units have been set, press the Escape key (Esc.) to return to the Main Menu window.

"Misc." – Terminal Emulation in Utility

The Misc Action from the Main Menu window, when selected, brings up the Terminal Simulator and the Rx/Tx Facility. These can be used to send SCM Operational Commands to the connected unit(s) to verify the settings of SCM's being calibrated, to check the status of installed units, or to operate the SCM's in the system when third party software, or the Scanning program are not used.

Clear To Send (CTS) and Ready to Send (RTS) support, required for some applications where SCM's are used with certain types of modem, disabled when the Terminal Simulation facility under Misc., the "dumb terminal", is active. If CTS support is required for a radio modem application, use the Rx/Tx facility only.

"Quit" – Quitting Utility

To quit the Utility program at any time, press Escape (Esc.) until the Main Menu window comes up, then select "Quit". A Yes/No pop-up will ask for confirmation of your request, and if "Y↵" is entered, the Host will return to the last DOS prompt. A "N↵" response returns the program to the Main Menu window.

Installation

In most cases, it is more efficient to physically mount the unit(s) in the application, and then to effect the electrical and data connections.

Mounting

Figure 4 provides the outline dimensions of the DIN-style SCM, figure 5 shows the dimensions of the HP-housed version.

Always ensure that the SCM is mounted in an area that is relatively free of dust, excessive moisture, and corrosives. Consult your Moore Industries Sales Representative for information on protective enclosures if called for in your application.

When mounting the unit, consider connecting wire routing and terminal access. Try to ensure that all pertinent labeling will be conveniently visible for future reference.

DIN-Housed Units. To mount the DIN-style SCM in the standard thermoplastic housing, set the top lip on the back panel over the top edge of the hat-rail, and press down, pivoting on the unit's lip, until it snaps into place.

To mount SCM's equipped with the GR option place the metal clip on the back of the unit under the top edge of the G-rail, and press downward, pivoting on the clip, until the unit snaps into position.

HP-Housed Units. This version of the SCM comes with spring clips or with flange mount hardware.

To install units with spring clips in an explosion-proof enclosure, press the clips inward and hold them while placing the unit into position inside the enclosure. Once the unit is oriented properly, release the clips. They will secure the unit adequately for most applications; no drilling or tapping of the enclosure is required.

If surface mount of the HP unit is required, use the dimensions in figure 5 for drilling holes.

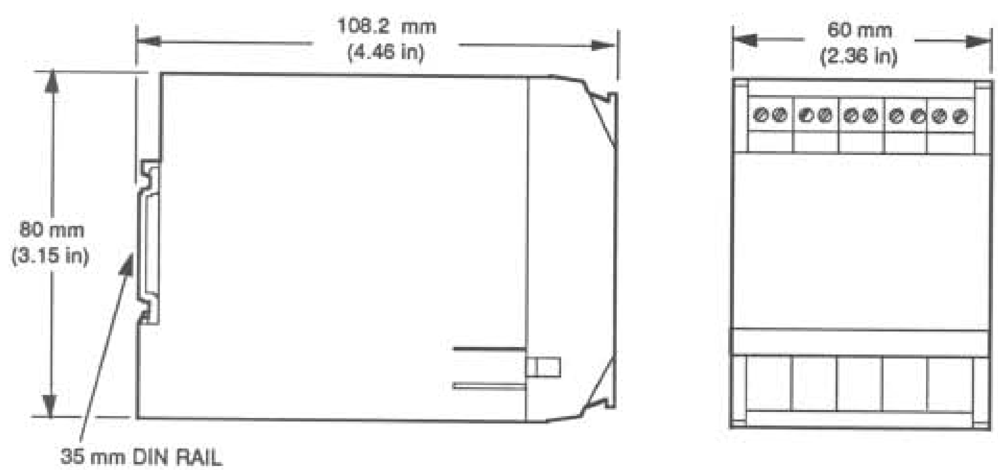


Figure 4. *DIN-style SCM Outline Dimensions*

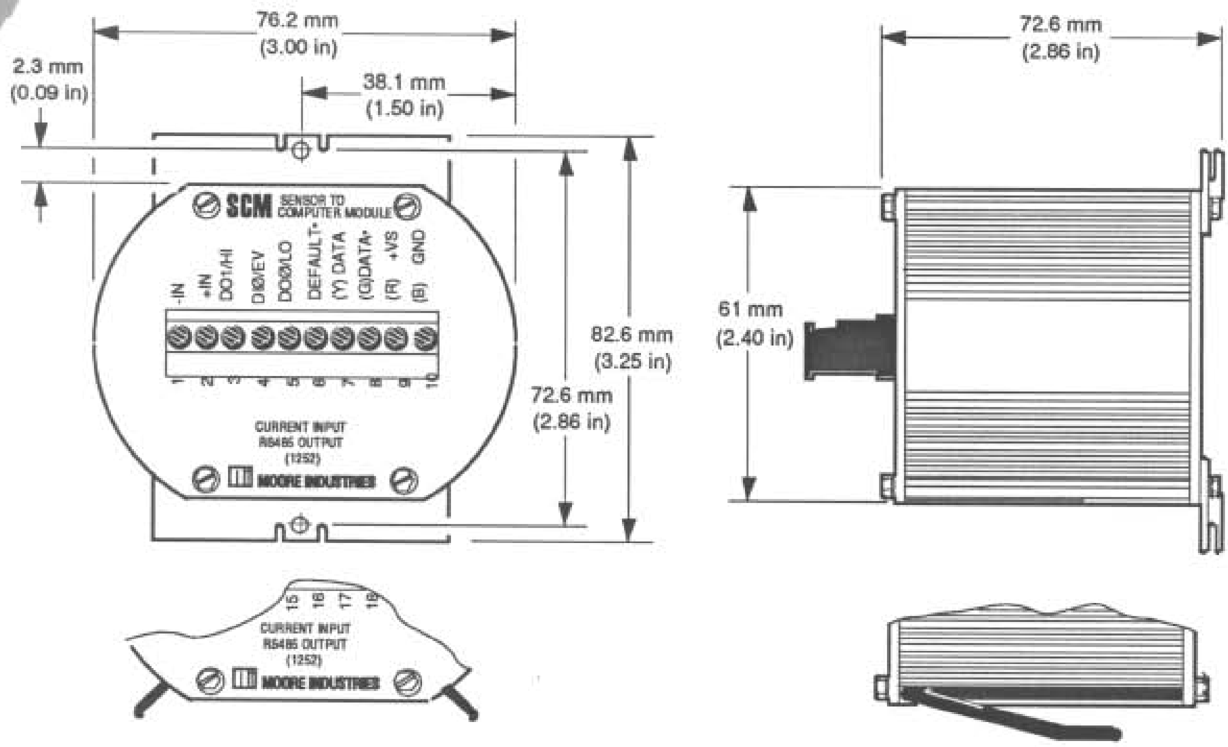


Figure 5. *HP-style SCM Outline Dimensions*

Electrical Connections

Table 3, the break-out for the SCM labeling, is repeated in this section for convenience. When making power, data, and input/output connections to and from the SCM, use the terminal numbers called out in the table. The labeling on the unit is explained in the key.

Figures 6 and 7, on the following pages, illustrate the hookups for power and data in RS-232C Daisy-Chain and RS-485 Multi-drop SCM applications, respectively. The use of twisted pair wiring is strongly recommended for all data connections.

RS-485 Considerations. As shown in figure 7, data lines should be terminated at each end with 200 ohm resistors to minimize unwanted reflections on the transmission lines. Standard resistor values of 180 or 220 ohms are also acceptable.

Also, for wire runs greater than 500 feet, each end of the line should be terminated with a 220 ohm resistor, connected between the data line terminals.

During normal operation in a multi-drop application, there are periods of time where all RS-485 drivers are off and the communications lines are in an "idle", high impedance condition. At these times, the transmission lines are susceptible to noise pickup.

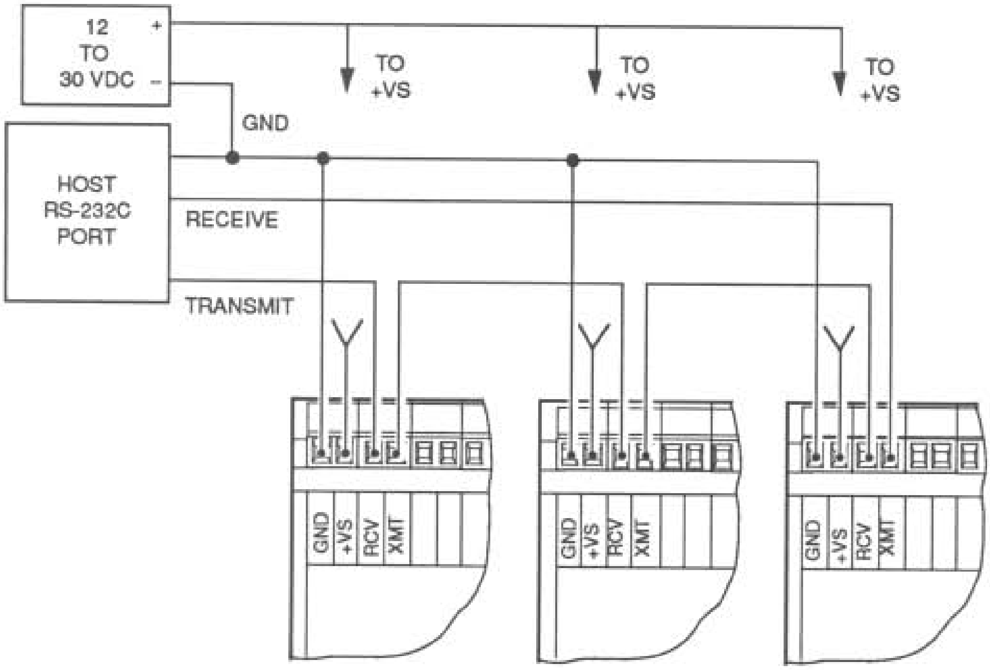


Figure 6. *The SCM in a Daisy-Chain Installation*

To prevent this, incorporate 1 kilohm bias resistors as shown in the figure, so that data lines will be maintained in a "mark" condition when all drivers are off.

RS-232C Considerations

The GND wire is used both as a power connection and the common reference for the transmission line receivers of the SCM. In applications that call for distances of 1000 feet or more between modules on the data bus, voltage drops in the power leads become an important consideration.

As a general rule, multiply the number of SCM's on a single data bus by the distance between modules. The result is a value that, when compared to the following constants, can be used to make installation adjustments as appropriate.

- For 18 gauge wiring, the number of SCM's in the application multiplied by the Distance from Host to SCM should be less than 10,000 feet.
- For 20 gauge wiring, the number of SCM's in the application multiplied by the Distance from Host to SCM should be less than 6,000 feet.
- For 22 gauge wiring, the number of SCM's in the application multiplied by the Distance from Host to SCM should be less than 4,000 feet.

NOTE

Larger gauge wiring may be required in applications with multiple modules communicating over long distance. Consult the factory for details.

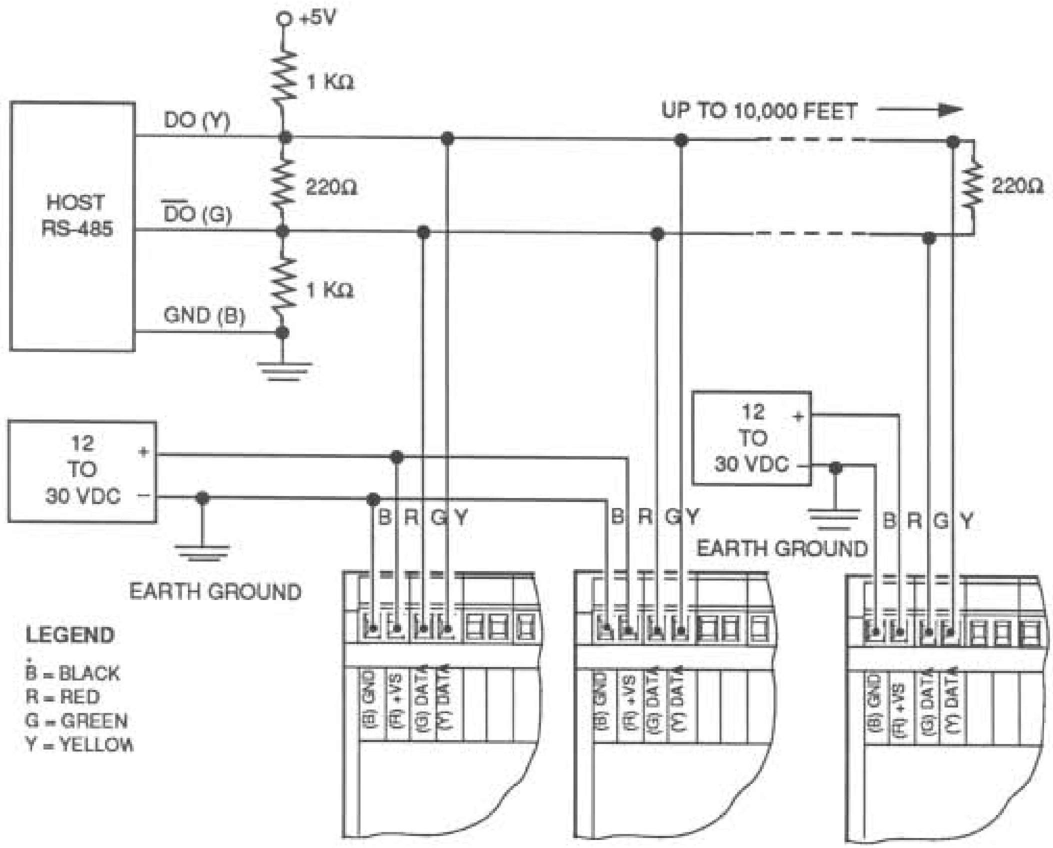


Figure 7. The SCM in a Multi-Drop Installation

To complete electrical connections, use a slotted head screwdriver (head width no greater than 2.54 mm (0.1 inch) to loosen the compression screws on the SCM terminal block. Strip a length of connection wire insulation, and hold the stripped end of the wire in the appropriate terminal opening while tightening the compression screw until secure.

All terminal labels on SCM's configured for RS-485 communications include designators for the wire colors typically used by standard 4-wire telephone cabling. "(B)" is for black, "(R)" is for red, "(G)" for green, and "(Y)" is for yellow.

Power Supply Requirements. All power supply specifications are referenced to the SCM connector; the effects of line voltage drops must be considered when the SCM is powered remotely.

SCM's without sensor excitation capability consume a maximum of 0.75 watts. Units with excitation consume 1 watt, maximum. Total power consumption in a multi-unit applications is determined by multiplying the rated consumption by the number of units.

Table 3 (repeated). SCM Terminals Labeling

Type of SCM ↓	Top Terminals 1	2	3	4	5	6	7	8	9	10	Bottom Terminals 11	12
VOLTAGE & CURRENT	+IN	–IN	DO1/HI	DIØ/ EV	DOØ/ LO	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	Not Used	Not Used
T/C	DO2	DI1	DO1/HI	DIØ/ EV	DOØ/ LO	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	–IN	+IN
RTD	C	B	A	D	DOØ/ LO	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	Not Used	Not Used
FREQ.	IN	+2.5V	SIG GND	HYSTR	DIØ/ EV	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	Not Used	Not Used
DISCRETE	BØ4	BØ3	BØ2	BØ1	BØØ/EV	DEF	XMT See Note 1	RCV See Note 1	+VS	GND	BØ5	BØ6 See Note 2

NOTES:
1. For RS-485 SCM's these terminals are labeled with a wire color code and the word "DATA", as in "(Y)DATA" and "(G)DATA". RS-485 communications are in parallel, and thus do no require specific Transmit and Receive connections.
2. Discrete SCM's have an additional 10 terminals. Terminals 13 thru 20 are labeled "BØ7, BØ8, BØ9, BØA, BØB, BØC, BØD," and "BØD".

Key to Abbreviations:

DATA – Receive or Transmit to system host. Used on RS-485 SCM's, these terminal designators are accompanied by abbreviations for the wire colors commonly used in making this type of connection, i.e. standard 4-wire telephone line. The abbreviations used for the colors are (B) for black, (G) for green, (R) for red, and (Y) for yellow.

DEF – Default. This terminal may be connected to ground to place the unit in its Default Mode of operation.

DI – Discrete Input.

DIØ/EV – Discrete Input/Event Counter

DO – Discrete Output.

DOØ/LO – Discrete Output/Low Alarm.

DO1/HI – Discrete Output/High Alarm.

GND – Power Supply or Discrete Output Ground.

HYSTR – Hysteresis

+IN – Positive Signal Input.

–IN – Negative Signal Input.

RCV – Data Receive. RS-232C hookups.

SIG GND – Signal Ground.

A, B, etc. – RTD Sensor Input.

+VS – Positive Voltage Source Input.

XMT – Data Transmit. RS-232C hookups.

+2.5V – Excitation Voltage.

For example, in an application with a 24 volt power supply and four SCM's with sensor excitation capability, the power requirement will be 4 times 1.00, or 4 Watts. The current will be 4 divided by 24, or 0.167 amps.

For best reliability, SCM's should be powered locally. Several instrument power supplies, such as the DPS-240 and DPS-1200 are available from Moore Industries. Consult your Sales Representative for details.

Sensor Connections for Current, Voltage, and Thermocouple SCM's

The labeling of the terminals of each Current, Voltage SCM is shown in table 3. The sensing equipment outputs should be connected to the +IN and –IN terminals of the SCM.

Thermocouple connections should be made at the +IN and –IN terminals as well. Note, however, that with DIN-housed units, these terminals are along the bottom edge of the front panel.

Connection for the Discrete Terminals of Analog SCM's

Connections for discrete input and output are shown in the following three figures. Figure 8 shows the hookup for discrete inputs, such as may be used for events counting (refer to Operation Section of this manual for information on the SCM Events Counter). Figure 9 shows discrete output to relays, and figure 10 illustrates the connections to logic.

Refer to the unit model number and the specifications table to determine the number of available discrete connections for the type of SCM being used.

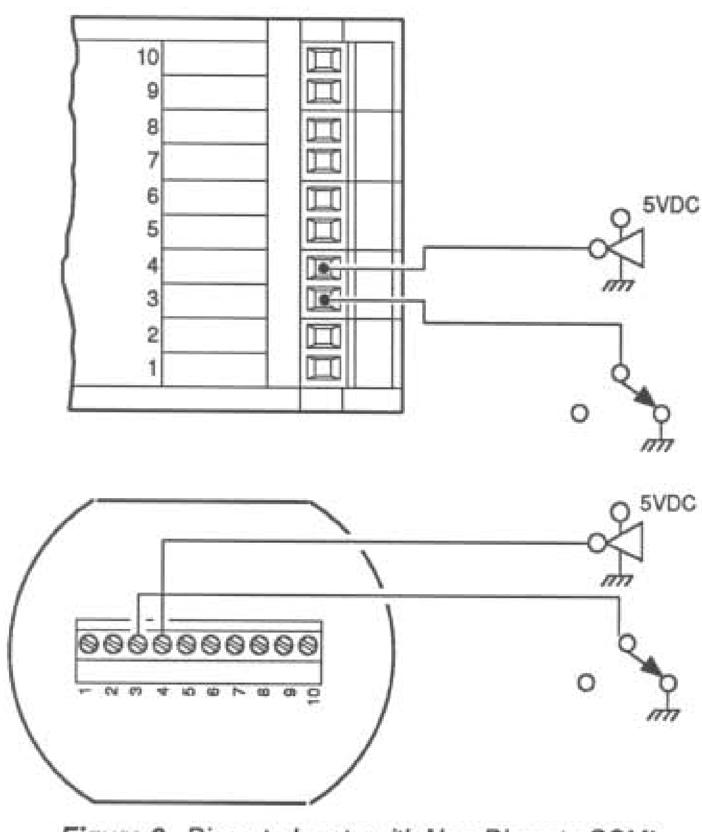


Figure 8. *Discrete Inputs with Non-Discrete SCM's*

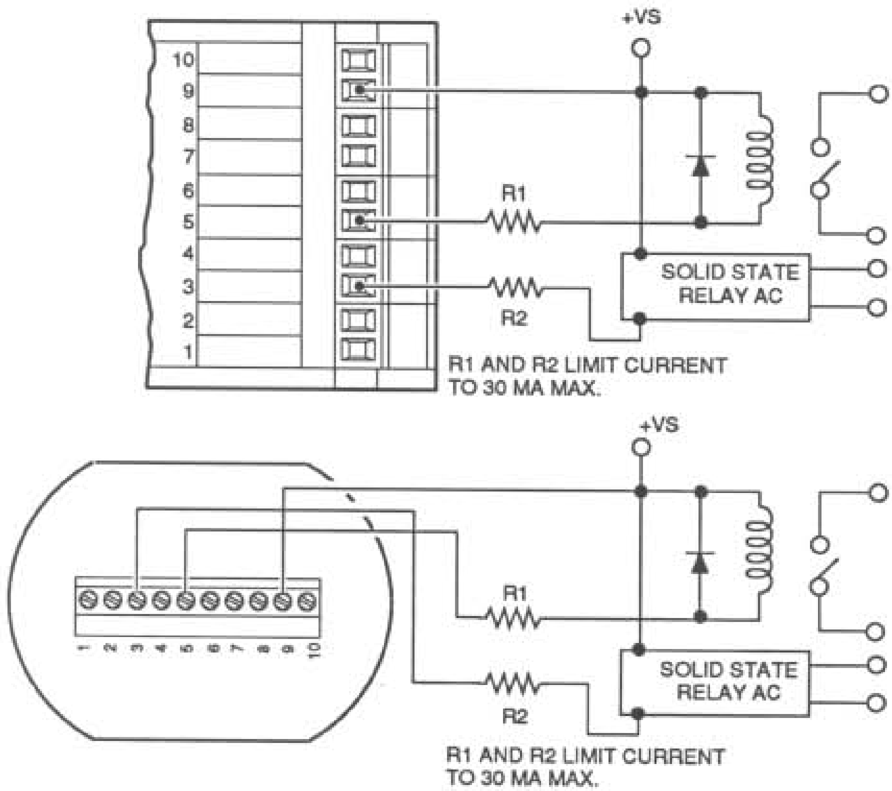


Figure 9. *Discrete Outputs from Analog SCM's to Relays*

Connections for RTD SCM's

Figures 11, 12, and 13 show the installation hookups for RTD's. In each case, the wires to the SCM should be matched in length and gauged for proper lead length compensation.

Make sure that the "Special Bit" field in the Setup window of the Utility program is set to Ø for 3-wire units, and to 1 for 4-wire units.

If using the RTD SCM with a 2-wire sensor, during normal operation the lead resistance is scanned and filtered by the SCM. This may result in large initial errors if the RTD is connected to a powered SCM. Connect sensors to the SCM before applying power to the installation hookup. If this is not possible, execute a "Module Reset" command, as described in the Operation Section of this manual.

If the lead resistance of the installation exceeds 50 , the SCM will output an over-range indication.

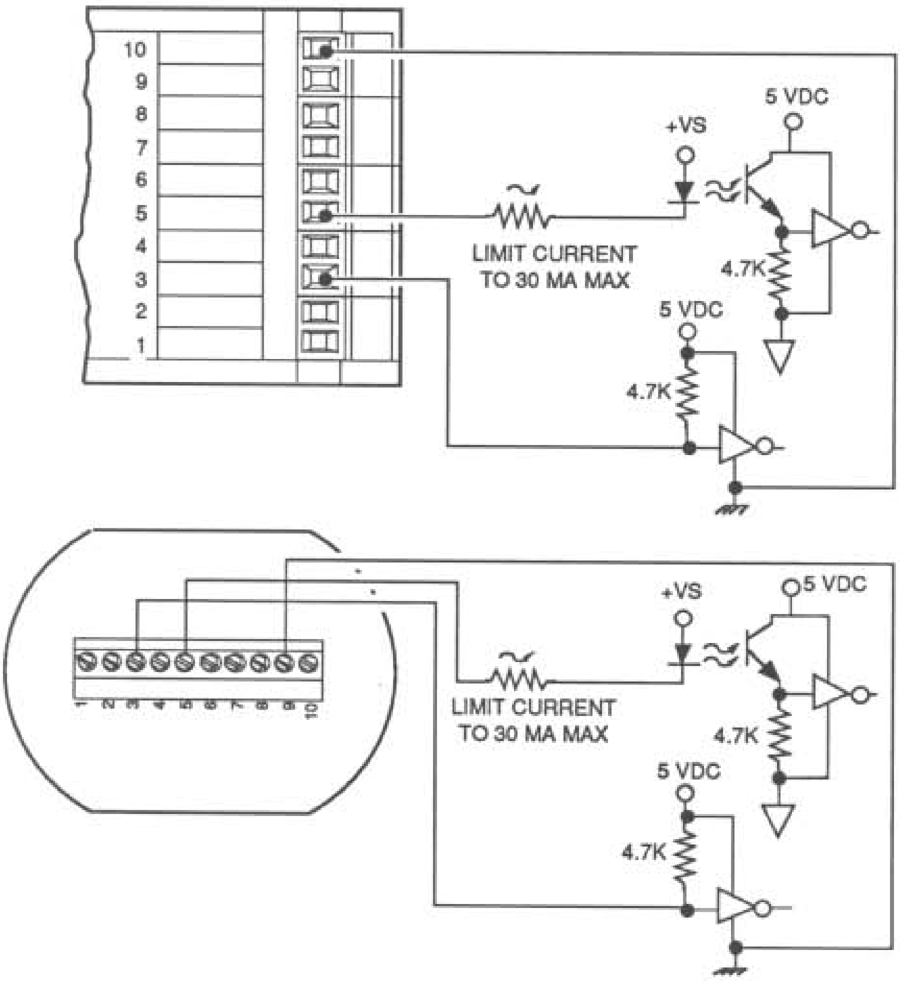


Figure 10. *Discrete Outputs from Analog SCM's to Logic*

NOTE

The remainder of this manual does not depict the HP-housed SCM in installation hookups. Use the numbers on the HP-style terminal label and table 3 to determine the correct connections.

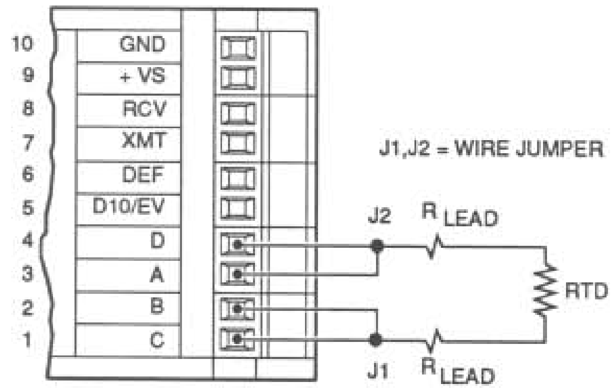


Figure 11. SCM Installation Hookup with 2-Wire RTD

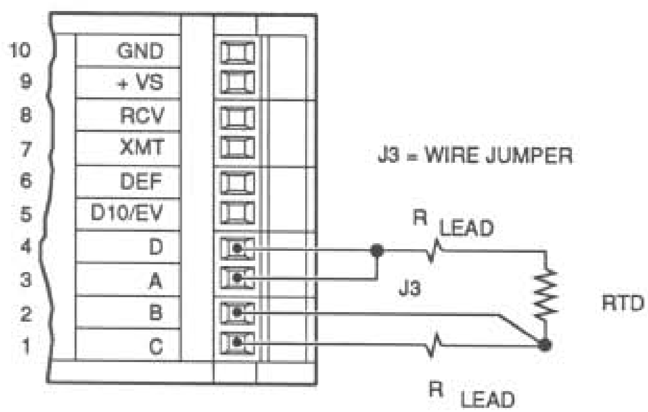


Figure 12. SCM Installation Hookup with 3-Wire RTD

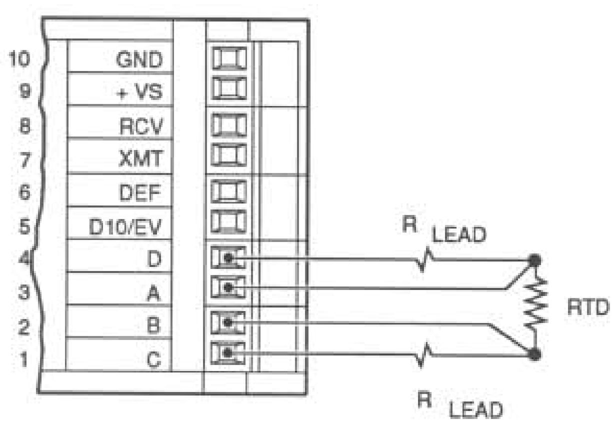


Figure 13. SCM Installation Hookup with 4-Wire RTD

Sensor Grounding. The sensor input is electrically isolated from the power and communications inputs for common-mode voltage up to 500 volts. If the sensor requires grounding or shielding, use terminal #4 of the SCM (labeled "D").

Connections for Frequency SCM's

The next three figures show the connection of the SCM to Frequency inputs.

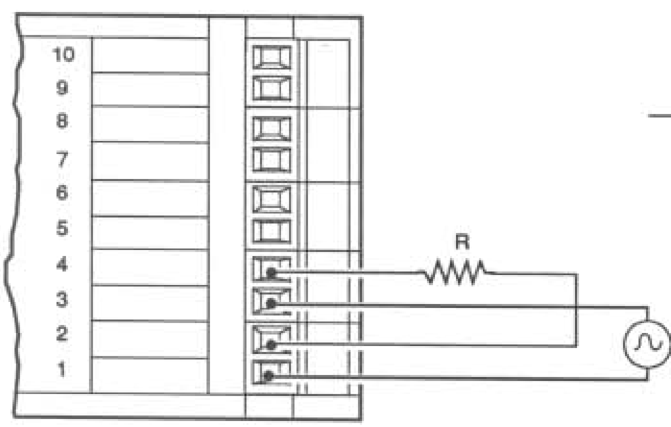
The first of these, figure 14, is the most common installation hookup. It shows the unit used with unipolar, positive-going frequency inputs. Hysteresis is centered around a +2.5 volts switching level. If "R" is left open, the switching levels are +2.5 volts, ±0.5 volts. With "R" shorted, hysterisis decreases.

By changing the "R" value, any hysteresis from ±5 mV to ±0.5 V may be obtained.

Figure 15 shows the hookup for application of the SCM for comparisons around zero volts. This connection is useful for AC or bipolar signals.

The hysteresis control may also be connected to ground, producing another set of switching levels as shown in figure 16.

To measure AC signals super-imposed on a DC value, the input may be AC-coupled by placing a capacitor in series with the +IN terminal of the SCM. The circuitry of the unit includes an internal 1M resistor between the +IN and +2.5V terminals for biasing. Use a 0.01 µF capacitor for frequencies down to 10 Hz.



R	$V_{SWITCHING} \pm V_{HYSTERSIS}$
OPEN	2.5 V ±0.5 V
ØΩ	2.5 V ±0.5 mV
	FOR $V_{HYSTERSIS}$ >5 mV AND <0.5 V
	$R\ (K\Omega) = \dfrac{34\ V_{HYSTERSIS}}{0.5 - V_{HYSTERSIS}}$

Figure 14. *Typical Installation Hookup for Frequency SCM's*

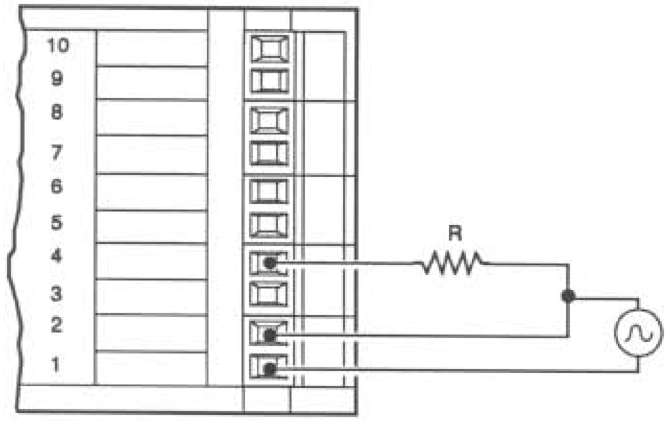
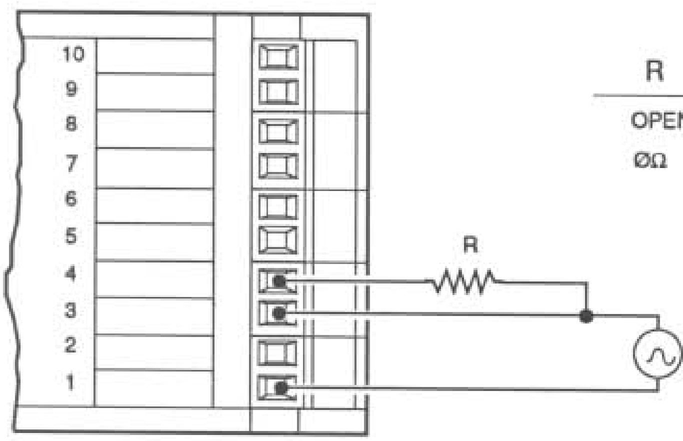


Figure 15. *Frequency SCM Installation Hookup to AC or Bipolar Inputs*



R	$V_{SWITCHING} \pm V_{HYSTERESIS}$
OPEN	2.5 V ±0.5 V
ØΩ	1.7 V ±0.5 mV
	FOR $V_{HYSTERESIS}$ >5 mV AND <0.5 V:
	$R\,(K\Omega) = \frac{34\ V_{HYSTERESIS}}{0.5 - V_{HYSTERESIS}}$
	$V_{SWITCHING} \quad + 2.5 - \frac{14}{17 + R}$

Figure 16. *Frequency SCM Installation Hookup to AC or Bipolar Inputs, Hysteresis to Ground*

Connections for Discrete SCM's

Figure 17 illustrates the typical Discrete SCM installation hookup. If the relay used is electromechanical, always include a flyback diode to prevent damage to the output driver.

Special Notes on Discrete SCM in Continuous Mode. Discrete SCM's can be configured for providing output to the Host without command prompting.

One of the ways in which a Discrete unit can be triggered to read terminals data when in this Continuous Mode is by the edge of an incoming positive-going pulse. Refer to the Operation Section of this manual for details on Continuous Mode Operation and Edge-Triggered Mode.

SCM's configured for this type of operation can also be triggered by an external switch by adding a pull-up resistor to the installation hookup, as shown in figure 18, on the next page.

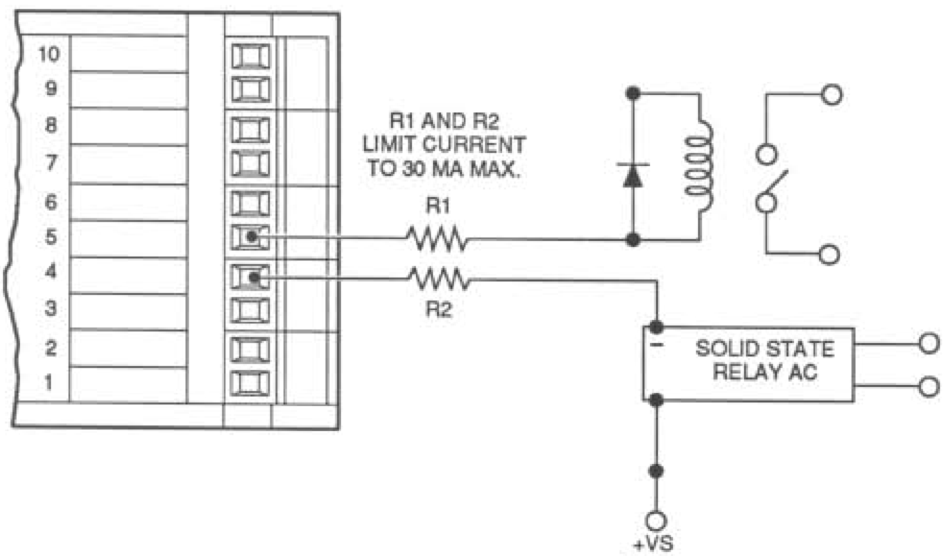


Figure 17. Installation Hookup for Discrete SCM's with Relays.

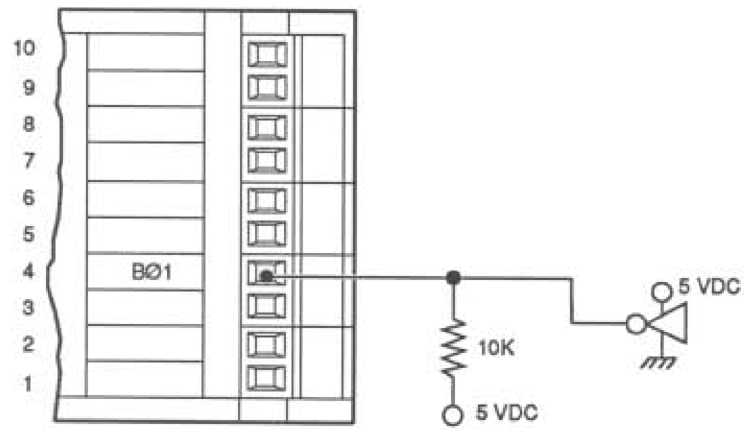


Figure 18. *Installation Hookup for Discrete SCM's in Continuous Mode, Edge-Triggered*

Operation

Once calibrated, mounted, and connected according to the instructions provided in the preceding section, the SCM can be interrogated from the Host or dumb terminal using any of three techniques; by Operational Commands, through use of the Scanning program provided by the factory, or by the appropriately formatted commands from "third party" applications.

In response to interrogation or "polling" from the Host, the SCM provides the appropriate sensor data from its input terminals, or generates discrete output at its output terminals, based on the settings loaded into module memory in the Utility program (refer to the Calibration Section, earlier in this manual).

It is possible to change the operating parameters of any SCM in a system "on the fly", i.e. without removing the unit from the application. This is not recommended, since doing so can result in problems with sensor data, and in some cases with communications system-wide.

If it is unavoidable, however, there are two methods for changing SCM operating parameters while the unit is installed.

The preferred method is to use the Utility program. The instructions for its use are provided in the Calibration Section of this manual. The second method is through use of the Setup command, $*a*SU*nnnnnnnn*↵. Its use is briefly documented in Appendix B of this manual. Contact the factory for a copy of the SCM Programmer's Guide for more information on the "Setup" command.

This section, SCM Operation, is divided into five parts. First is an explanation of the SCM Command/Response syntax and timing parameters, with a subsection on the use of the SCM Checksum. This is followed by overviews of the Operational Commands that are common to all SCM's, the General Operation Commands. Next is a section on those commands unique to the operation of Discrete units, including a subsection on Continuous Mode. There is a brief introduction to the menu-driven Scanning program, which provides an alternative means of performing several of the SCM basic operations. Finally, descriptions of the Accessory Programs are presented.

NOTE

If using a Discrete SCM, make sure to review the material presented in the Discrete SCM Operation Section. Certain aspects of unit operation and commands are unique to Discrete units.

The Command/Response Format

SCM commands must be composed of four parts. The first is the Prompt Character, which signals to the SCM that a Host message is to follow. Next is the Unit Address, the ASCII "label" unique to each SCM connected in the application. The Unit Address is followed by the Command Message itself, which usually consists of a two or three character string, or a string followed by a numerical value. The final element necessary to complete an SCM Command is the carriage return (ø).

As an option, a fifth element, a Command Checksum may be appended to the command (before the carriage return) to provide for verification of "good" Host-to-Unit communications. The Checksum for both commands and SCM responses is explained at the end of this section.

Command Prompt. There are two valid prompt characters; a dollar sign, "$"; and the pound or number sign, "#". They are operationally interchangeable, the difference being the Checksum facility provided with the SCM response when using commands that start with "#".

Unit Address. The SCM Address is a single place printable ASCII character used to distinguish one unit from another in multi-unit installations. When an SCM's Default Mode connections are effected, it will respond to any address, but once installed and supplied with the appropriate power, units respond only to the Address set by the user in the Utility program.

<u>NOTE</u>

In applications calling for the installation and operation of more than one SCM, make sure that each unit is configured with a unique address. Failure to do so will result in communications collisions and failure.

Command Message. The SCM Command Message usually consists of a two or three letter command, and in some cases numerical values. Refer to the sections entitled "SCM General Commands" and "Discrete SCM Commands" for descriptions of the Command Messages.

<u>NOTE</u>

The letter portion of all SCM Command Messages must be entered in upper case (all capital letters). It is suggested that when entering commands that the Caps Lock of the Host be used, if available.

Command Checksum. A two character hexadecimal value may be appended to any valid SCM command, before the carriage return, to "double check" the command itself for completeness.

It works like this. When an SCM receives a command from the Host, it looks for the two extra characters before the carriage return, the Command Checksum.

If the checksum was not used, the command is executed normally.

If the checksum was used, the SCM totals the hexadecimal values of all the ASCII characters used in the transmitted command, the Command Prompt, Unit Address, and the Command Message. It then compares that total to the transmitted Command Checksum. If the two values are the same, the transmitted command is executed normally. If there is disagreement, the SCM aborts the command, and responds with the error message:

?BAD CHECKSUM

When determining the Command Checksum, use the two lowest order (right-most) hex digits of the total (Command Prompt + Address + Command Message) as the Command Checksum. This ensures that the Command Checksum is a "printable" character. Append the two characters to the Command.

For example, to calculate the checksum for the command #1DOFFØØ:

Characters:	#	1	D	O	F	F	Ø	Ø
Hex values:	23	31	44	4F	46	46	30	30

Sum (hex addition):

23 + 31 + 44 + 4F + 46 + 46 + 30 + 30 = 1D3

The portion of the checksum to be used is D3 (hex). The characters D and 3 would be appended to the end of the message, as in "#1DOFFØØD3".

Always use the "#" Command Prompt when requesting the Checksum. If a module is setup to provide linefeeds, the linefeed characters are not included in the checksum calculation. Parity bits are never included in the checksum calculation.

NOTE

The Checksum is used in a somewhat different way with the Discrete SCM. For more information, refer to the explanation of the "ACKNOWLEDGE" command, in the Discrete SCM General Commands Section.

The SCM Programmer's Guide provides more information on the Command and Response Checksum.

Response Format. In much the fashion as the commands from the Host, the SCM response is comprised of distinct parts. There are two; the Response Tag and the Data Message.

The Response Tag. Responses from the SCM start with one of two characters. An asterisk indicates an acknowledgement, and immediately precedes either a line feed or data and a line feed. The question mark, "?" precedes an Error Message.

If a command is improperly formatted or if it is otherwise not received by the addressed SCM, the unit may not respond at all. If this occurs, re-check for correct command format and send again. If problems persist, refer to the Troubleshooting Section of this manual.

The Data Message. Most SCM responses represent analog data. This data is represented as a nine character string consisting of a positive or negative sign, five digits, a decimal point, and two more digits, i.e., +ØØØØØ.ØØ.

Another type of Data Message consists of hex and decimal numbers that represent the configuration of the unit being addressed.

The number of significant digits in the Data Message is controlled by the user in the Utility program.

The specifics regarding both types of SCM Data Messages can be found in the explanation of the General and Discrete SCM commands.

The Response Checksum. As with the Command Checksum, the Response Checksum facility is optional. It is provided only when the "#" Command Prompt is used to verify good Unit-to-Host communication.

The Response Checksum functions in the same manner as the Command Checksum, except that when providing the appropriate data or executing the commanded operation, the addressed SCM echoes the original command, and bases its calculation of the Response Checksum on the Response Tag (*), the echoed command, and the Data Message. Refer to the next section for examples of this.

Command Timing

When an SCM receives a valid command, it interprets that command, performs the proper function, and transmits the appropriate response back to the Host.

Each command has a default delay during which the module is "busy" performing the command cycle. If the Host does not receive a response from the addressed SCM at the end of this delay, a communications TIME OUT error will result, and the command will have to be re-issued.

The following commands have a default time-out delay of 5 milliseconds (ms) or less:

ACK, CB, CE, CP, DI, DO, RA, RAB, RAP, RB, RCM, RD, RIA, RP, RR, SB, SP, and WE.

These commands have a default time-out delay of 15 ms or less:

EC, RE, RWT, RID, RIV, RCT, AIB, AIP, AOB, AOP, CIA, CMC, CMD, CME, and CMT.

These commands have a default time-out delay of 100 ms or less:

WT, CT, SU, AIO, ID, and IV

In a daisy-chained multi-unit application, all of the characters of an incoming command must be echoed down the chain. Upon receiving the command, the addressed SCM in the chain begins the command cycle, and stops echoing any commands until the cycle is complete.

Characters sent to this "busy" SCM will be stored in the unit's internal receive buffer, and echoed immediately after the response string.

Command Timing is effected by the number of units in a daisy-chain installation. The increase in the delay times is equal to the time necessary to transmit one character at the baud rate being used by the modules. The additional time blocks are as follows:

Baud Rate	Delay in milliseconds
300	33.3
600	16.7
1200	8.33
2400	4.17
4800	2.08
9600	1.04

One delay block is added for each module in the chain.

All SCM types configured for RS-485 communications are set at the factory to provide two units of communications delay. This is necessary when using host computers that transmit a carriage return (ø) as a carriage return/line feed combination. Without the delay, the line feed character may collide with the first transmitted character from the module, resulting in garbled data. If the Host computer transmits a carriage return as a single character, the delay may be set to zero to improve the communications response time.

SCM General Operation Commands

Table 6 lists commands that are common to the operation of all types of SCM. Refer to the next section for commands unique to the Discrete SCM.

Use appendix B for a quick reference table of both Discrete and non-Discrete commands together with the Configuration Commands which perform the functions otherwise set and controlled in the Utility program.

The following paragraphs provide more information on the commands listed in the table. Use the key from table 6 when implementing these commands.

In addition to the items in the key, note that the term "CS" is used to indicate a checksum; "T" is used to indicate an alarm type.

<u>*NOTE*</u>

Refer to table 6 when determining which commands require Write Protection Disable.

DISABLE WRITE PROTECTION – WRITE ENABLE

FORMAT: $*a*WE↵
TYPICAL RESPONSE: *
FORMAT FOR COMMAND WITH CHECKSUM (FORMAT W/√): #*a*WE↵
TYPICAL RESPONSE: **a*WEF7

Any setting stored in the SCM non-volatile memory is protected against accidental over-writes. It is not possible to change any of the operational settings without first disabling this write protection. The "Write Enable" command disables the protection for the next command entered.

<u>*NOTE*</u>

If a syntax or communications error occurs in the "Write Enable" command, it must be re-entered. Attempting to make changes to the SCM protected parameters without first disabling the protection with this command will result in an error message.

Table 6. SCM General Operation Commands

If you want to:	Execute the following Command:	Response Format	Requires Write Protection Disable $WE
Disable Write Protection **(WRITE ENABLE)**	$aWE↵	*	NO
Read Data (Read Current Output Buffer)	$aRD↵	**Snnnnn.nn*	NO
Read New Data	$aND↵	**Snnnnn.nn*	NO
Read High Alarm Trip Point	$aRH↵	**Snnnnn.nnM*	NO
Read Low Alarm Trip Point	$aRL↵	**Snnnnn.nnL*	NO
Clear Alarms	$aCA↵	*	YES
Read Event Counter	$aRE↵	* *nnnnnnn*	NO
Clear Event Counter	$aCE↵	*	YES
Trim Zero	$aTZ*Snnnnn.nn*↵	*	YES
Read Zero Setting	$aRZ↵	**Snnnnn.nn*	NO
Clear Zero Setting	$aCZ↵	*	YES
Trim Span	$aTS*Snnnnn.nn*↵	*	YES
Set Deviation Output Zero Point	$aSP*Snnnnn.nn*↵	*	YES
Read Discrete Input ON/OFF State or Alarm Status	$aDI↵	**nnnn*	NO
Set ON/OFF State Discrete Outputs	$aDO*nn*↵	*	NO
Reset Module	$aRR↵	*	YES

KEY:

a = Appropriate module address.
n = Numeric value, corresponding to actual number, or to HEX value for desired settings (refer to appendix C).
S = Positive or negative sign.

READ DATA

FORMAT:	$aRD↵
TYPICAL RESPONSE:	*Snnnnn.nn
FORMAT W/√:	#aRD↵
TYPICAL RESPONSE:	*aRDSnnnnn.nnCS

This command is used to read the sensor data in the output buffer.

NOTE
As a shortcut for the "Read Data" command, enter the prompt character, the desired unit address. and ↵.

READ NEW DATA

FORMAT:	$aND↵
TYPICAL RESPONSE:	*Snnnnn.nn
FORMAT W/√:	#aND↵
TYPICAL RESPONSE:	*aNDnnnnn.nnCS

This command is used to read data from the SCM. It differs from the "Read Data" command in that the addressed SCM will not respond unless the data has changed since the last time a read was requested.

The SCM acquires analog input data eight times a second, storing it in the output buffer. The "Read Data" command simply reads the information in the buffer, so a fast Host communicating at a high baud rate could possibly read the same data several times.

To overcome this, the output data buffer is equipped with a New Data Flag. This flag is set when the SCM loads the output buffer with the result of the most recent data acquisition, and is cleared each time a "Read Data" or "New Data" command is executed. If a "New Data" command is received by the SCM when its flag is cleared, it waits until new data is present. This may be especially useful when using the SCM with Hosts that handle communications on an interrupt basis.

Special Note for Frequency SCM's. Frequency SCM's differ from the other types of unit in that they must receive an input trigger signal before the data in the output buffer is replaced. If no trigger is received, a "New Data" command will wait indefinitely.

To escape this condition, enter a single "control C", i.e., press the "control" and the letter "c" simultaneously to abort the New Data command. Upon receiving the break, the "New Data" command will output the current data in the output buffer.

NOTE
Using "control C" on an RS-485 system may create communications errors.

READ HIGH ALARM TRIP POINT

FORMAT:	$aRH↵
TYPICAL RESPONSE:	*Snnnnn.nnT
FORMAT W/√:	#aRH↵
TYPICAL RESPONSE:	*aRHnnnnn.nnTCS

The "Read High Alarm" command shows the value and the type of the High Alarm setting programmed into the SCM by the selections made in the Utility program.

The "T" in the example above represents the type of alarm operation selected. "M" will show for the momentary selection, where the alarm condition clears when the input drops below the setting (out of the alarm condition). "L" appears if the latching selection is made; the unit remains in alarm, regardless of the input state, until the "Clear Alarms" command is executed.

READ LOW ALARM TRIP POINT

FORMAT:	$aRL↵
TYPICAL RESPONSE:	*Snnnnn.nnT
FORMAT W/√:	#aRL↵
TYPICAL RESPONSE:	*aRLnnnnn.nnTCS

The "Read Low Alarm" command performs the same function as the "Read High Alarm" command, except that its response details the parameters of the Low Alarm setting.

CLEAR ALARMS

FORMAT:	$aCA↵
TYPICAL RESPONSE:	*
FORMAT W/√:	#aCA↵
TYPICAL RESPONSE:	*aCADF

The "Clear Alarms" command turns both the HI and LO alarms OFF. Its primary use is in the clearing of alarms that were configured for latching operation in the Utility program.

NOTE
This command does not effect the status of the alarms (enabled/disabled) or their continuing function (latching/momentary).

In cases where the alarm condition persists after the "Clear Alarms" command has been given, the SCM will again "trip" at the end of the very next input data conversion.

READ EVENTS COUNTER

FORMAT:	$aRE↵
TYPICAL RESPONSE:	*nnnnnnn
FORMAT W/√:	#aRE↵
TYPICAL RESPONSE:	*aREnnnnnnnCS

The "Read Events" command outputs a seven-digit decimal number that represents the value in the SCM Events Counter.

The SCM Events Counter is a facility for keeping track of the number of low-to-high transitions at the "DIØ/EV" or "BØ/EV" terminals. Input at these terminals is sampled by the unit once every millisecond. If the input is "high" for the time period set in Utility (Filtering Constants, in the Setup window), a transition will be added to the count.

The maximum number of events that can be recorded is 9999999. When this maximum is reached, the Counter stops, and will not record any more events until cleared using the "Clear Events" command.

NOTE
The Events Counter value is not stored in SCM memory. If power to the unit is interrupted, the Counter is reset to zero.

NOTE
A "Module Reset" command does not effect the Counter.

CLEAR EVENTS COUNTER

FORMAT:	$aCE↵
TYPICAL RESPONSE:	*
FORMAT W/√:	#aCE↵
TYPICAL RESPONSE:	*aCEE3

The "Clear Events Counter" command resets the SCM Events Counter to zero.

When the Events Counter reaches 9999999, this command must be executed in order for the module to begin counting events.

Debounce Filtering. The SCM features a user-programmable filter for debouncing the events counter input. This is very useful when the event signal is from mechanical contacts such as switches or relays.

The filter constant is chosen by the user in the Utility program. Refer to the Help screen for Filtering Constants in the Setup window of the program for more information.

TRIM ZERO

FORMAT:	$aTZSnnnnn.nn↵
TYPICAL RESPONSE:	*
FORMAT W/√:	#aTZSnnnnn.nn↵
TYPICAL RESPONSE:	*aTZSnnnnn.nnCS

The "Trim Zero" command is used to compensate for offsets created by sensors, or to null data to create a deviation output.

Trimming should only be executed when the SCM is installed and receiving the actual sensor data. When the sensor input is at a known zero level, execute a Read Data, or "New Data" command:

$a↵

If the response shows an initial offset, "*+00005.00" for example, correct it by issuing a "Trim Zero" command. For example:

$aTZSØØØØØ.ØØ↵

This will compensate for the five unit offset from the sensor in the example. The "Trim Zero" command loads the offset into the SCM's Offset Register.

The "Trim Zero" command is most commonly used to null an output to zero, so that subsequent outputs show a deviation from a known point in units relative to zero.

READ ZERO SETTING

FORMAT:	**$aRZ↵**
TYPICAL RESPONSE:	***Snnnnn.nn***
FORMAT W/√:	**#aRZ↵**
TYPICAL RESPONSE:	***aRZnnnnn.nnCS***

This command reads the value entered into the Offset Register by the Trim Zero command.

SET DEVIATION OUTPUT ZERO POINT

FORMAT:	**$aSPSnnnnn.nn↵**
TYPICAL RESPONSE:	*
FORMAT W/√:	**#aSPSnnnnn.nn↵**
TYPICAL RESPONSE:	***annnnCS***

The number loaded into the SCM memory by this command is multiplied by –1 and stored as the Output Offset Register value. Typically, this value is then used to provide a mathematical "null" for sensor input, allowing the user to read data from the unit as deviation from a chosen point.

It is possible to load a Deviation Output Zero Point that is beyond the output range of the sensor. This guarantees that the user-defined null is reached only in the case of an overload.

NOTE

The Deviation Output Zero Point overwrites any Trim Zero setting. Use the "Read Zero" command to check the value loaded by the $aSP command, and use the "Clear Zero" command to clear the Output Offset Register.

CLEAR ZERO SETTING

FORMAT:	**$aCZ↵**
TYPICAL RESPONSE:	*
FORMAT W/√:	**#aCZ↵**
TYPICAL RESPONSE:	***aCZF8**

The Clear Zero command clears the SCM Output Offset Register to zero. It clears any setting adjustments made with the Trim Zero command or in the selection of a Set Point in Utility.

TRIM SPAN

FORMAT:	**$aTSSnnnnn.nn↵**
TYPICAL RESPONSE:	*
FORMAT W/√:	**#aTSSnnnnn.nn↵**
TYPICAL RESPONSE:	***aTSSnnnnn.nnCS***

CAUTION

The Trim Span command is the only means of effecting changes to the span of the SCM. There is no provision for reading the span, or clearing any errors loaded by this command. Unwarranted use of the "Trim Span" command may destroy the calibration of the unit.

The "Trim Span" command loads a calibration factor into the SCM memory. It is intended for use in trimming the full scale output of the signal conditioning circuitry of the unit, compensating for long-term sensor drift.

The "Trim Span" command has a practical effectiveness of ±10% of full scale. The nominal setting is performed at the factory prior to unit shipment. Do not use the Trim Span to change the basic transfer function of the SCM.

READ DISCRETE INPUT ON/OFF STATE OR ALARM INPUT STATUS

NOTE
The following information applies to Non-Discrete SCM's ONLY. For information on the DI command when used with Discrete units, refer to that section, later in this manual.

FORMAT:	**$aDI↵**
TYPICAL RESPONSE:	***nnnn**
FORMAT W/√:	**#aDI↵**
TYPICAL RESPONSE:	***aDInnnnCS**

The Discrete Input command reads the ON/OFF status of the alarm and discrete inputs connected to the discrete terminals of Non-Discrete SCM's.

The response to this command is a four character hex number (and a checksum, if implemented in the command). The first two digits represent alarm status, and the next two stand for the status of the available discrete inputs, ON or OFF.

Alarm Status. The four possible alarm states and their corresponding hex values as they will be represented in the response to the Discrete Input command are:

ØØ = Both HI and LO alarms are OFF

Ø1 = HI is OFF and LO is ON

Ø2 = HI is ON and LO is OFF

Ø3 = Both HI and LO alarms are ON.

NOTES
This DOES NOT indicate whether the alarms are enabled or disabled, or whether the alarms are "tripped".

Frequency SCM's have no alarm connections.

Discrete Input Status. With the exception of RTD SCM's, all units have at least one discrete input connection. The second two characters in the SCM response to the Read Discrete Inputs command are a hex value that represents which of the available connections are ON, and which are OFF.

The available combinations are:

FC = DIØ is ON and DI1 is ON

FD = DIØ is OFF and DI1 is ON

FE = DIØ is ON and DI1 is OFF

FF = DIØ is OFF and DI1 is OFF

NOTES
The DI1 terminal is available only on T/C (and Discrete) SCM's.

RTD SCM's have no discrete input connections.

SET ON/OFF STATE OF DISCRETE OUTPUTS

NOTE
The following information applies to Non-Discrete SCM's ONLY. For information on the DO command when used with Discrete units, refer to that section, later in this manual.

FORMAT:	**$aDOnn↵**
TYPICAL RESPONSE:	*

This command turns the available discrete output terminals ON or OFF.

Current and Voltage SCM's have two discrete outputs, T/C units have three, and RTD units have a single discrete output terminal available. Frequency SCM's do not have an extra discrete output connection terminal. All fifteen of the Discrete units' terminals can be configured (individually or as a group) for input or output.

Refer to the section on Discrete Commands for more information on the Set Discrete Outputs as it applies to that unit.

In non-Discrete SCM's, the discrete output terminals are shared with the terminals of the alarm outputs. To set the discrete terminals ON or OFF, the Alarms must be disabled. This is accomplished in the Setup window of the Utility program (refer to the Calibration Section).

Open collector transistors wired to each output terminal comprise the discrete output available on the SCM. When the Set Discrete Output command is used to set a particular terminal to ON, the corresponding transistor is turned on, sinking current and limiting output to near zero volts. Using the command to set a terminal to OFF results in the corresponding terminal's being turned off, and no current sink.

The available combinations are listed in table 7. Choose the desired combination of ON/OFF channels, and enter the two-digit hex number from the left-most column of the table in the Set Discrete Output command.

NOTES

The settings entered are not stored in SCM memory. If a power failure occurs, all discrete outputs will default to OFF.

There is no way of checking the status of a Discrete Output. If in doubt as to its ON/OFF setting, execute the appropriate Set Discrete Output command.

Table 7. *Discrete Output Options*

"##" used in $ *a*DO##	DOØ/LO		DO1/HI		DO2 (when available)	
	ON	OFF	ON	OFF	ON	OFF
00		◆		◆		◆
01	◆			◆		◆
02		◆	◆			◆
03	◆		◆			◆
04		◆		◆	◆	
05	◆			◆	◆	
06		◆	◆		◆	
07	◆		◆		◆	

RESET MODULE

FORMAT:	**$aRR↵**
TYPICAL RESPONSE:	*
FORMAT W/√:	**#aRR↵**
TYPICAL RESPONSE:	***aRRCS**

The Reset command allows the Host to perform a program reset on the SCM. This is necessary if the unit's internal program is interrupted by static or other electrical disturbances, or any time the unit's baud rate is changed.

Once a Reset is received, the SCM re-calibrates itself. Any command sent during this self-calibration procedure (approximately two seconds) will return a NOT READY error.

NOTE

Any changes to unit baud rate settings do not take effect until a Reset has been executed. The Utility program can be used to execute a Reset. Refer to the Calibration Section, earlier in this manual.

Commands Unique to Discrete SCM's

Table 8, on the following page, summarizes the commands that are unique to the operation of the Discrete SCM.

The following paragraphs provide the supplemental information necessary to execute the commands that apply exclusively to the Discrete SCM. Unless otherwise noted, the commands explained in the previous section also apply to Discrete units.

ACKNOWLEDGE

FORMAT:	**$aACK↵**
TYPICAL RESPONSE:	*

The Acknowledge command is a hand-shaking element that is used with a command that effects the discrete outputs, such as the Set Discrete Outputs command (Discrete units only). It is used to confirm the data that was sent to the module from the Host, providing another level of security against transmission errors.

Using Acknowledge with the Command Checksum. The Acknowledge command works differently with the Checksum in the Discrete SCM.

FORMAT W/√:	**#1DOFFFF↵**
TYPICAL RESPONSE:	***1DOFFFFØ6**

In this example the address "1" is used. In the command the first pair of F's turns all the discrete outputs for SCM#1 ON. The second pair of F's is the checksum for the command.

The response echoes the command, including the command checksum, and calculates a second checksum.

More importantly, however, the command itself does not execute until the Acknowledge command is executed. Only when the correct response to the Acknowledge command is returned,"*", can it be assumed that the DO command has been executed.

If the response data to the original command shows a discrepancy of some kind, repeat the original command. For example:

Command:	**#1DOFFFF↵**
Response:	***1DOFFFEØ5**

In this case the response data does not match the original command, indicating that the module may have received the command incorrectly due to noise on the transmission line. However, the erroneous data does not effect the settings of the unit since the module must receive an ACK to complete the command. To correct the error, therefore, simply re-issue the original command:

Command:	**#1DOFFFF↵**
Response:	***1DOFFFFØ6**

This time the response data is correct, and the DO command may be completed by sending Acknowledge:

Command:	**$1ACK↵**
Response:	*

Table 8. Discrete SCM Operational Commands

If you want to:	Execute the following Command:	Response Format	Requires Write Protection Disable $WE
Acknowledge Command Handshaking	$aACK↵	*	NO
Set I/O Assignments For All Terminals Simultaneously	$aAIOnnnn↵	*	YES
Set I/O Assignment For Individual Terminal	• INPUT by label: $aAIBnn↵ • INPUT by terminal: $aAIPnn↵ • OUTPUT by label: $aAOBnn↵ • OUTPUT by terminal: $aAOPnn↵	*	YES
Read I/O Assignments for All Terminals at Once	$aRA↵	*nnnn	NO
Read I/O Assignment of Individual Terminal	• By label: $aRABnn↵ • By terminal: $aRAPnn↵	n	NO
Set ON/OFF State of All Terminals at Once (Terminals set for Inputs ignore this command)	$aDOnnnn↵	*	NO
Set ON/OFF State of Individual **Output** Terminal (Specifying Input Terminal generates ERROR)	• ON by Label: $aSBnn↵ • ON by terminal #: $aSPnn↵ • OFF by Label: $aCBnn↵ • OFF by terminal: $aCPnn↵	*	NO
Read ON/OFF State of All Terminals	$aDI↵	*nnnn	NO
Read ON/OFF State of Individual Terminals	• By label: $aRBnn↵ • By terminal: $aRPnn↵	*n	NO

NOTE: Table Continued Next Page.

Table 8. Discrete SCM Operational Commands (continued)

If you want to:	Execute the following Command:	Response Format	Requires Write Protection Disable $WE
Set Initial Value	$aIVnnnn↵	*	YES
Read Initial Value	$aRIV↵	*nnnn	NO
Set the Watchdog Timer	$aWT+nnnnn.nn↵	*	YES
Read the Watchdog Timer Setting	$aRWT↵	*+nnnnn.nn	NO
Set Module Identification	$aIDn.............n	*	YES
Read Module Identification	$aRID↵	*n..............n	NO
Read Events & Clear Counter	$aEC↵	*+nnnnnnn	YES

Discrete SCM commands that when used with a checksum require ACK handshaking are:

- **Assign Input Bit**
- **Assign Input/Output**
- **Assign Input Position**
- **Assign Output Bit**
- **Assign Output Position**
- **Clear Bit**
- **Clear Position**
- **Set Discrete Output**
- **Set Bit**
- **Set Position**

<u>*NOTE*</u>

The Acknowledge command used without an associated output command will generate a COMMAND ERROR.

SET I/O – ALL TERMINALS

TYPICAL FORMAT: **$aAIOnnnn↵**
TYPICAL RESPONSE: *
TYPICAL FORMAT W/√: **#aAIOnnnnCS↵**
TYPICAL RESPONSE: ***aAIOnnnnCS**
<u>REQUIRED</u> ACKNOWLEDGE: **$aACK↵**
RESPONSE: *

This command is used to configure all of the Discrete SCM terminals at once, either for input or output.

The two right-most n's from the example above control SCM terminals BØ/EV through BØ7. The two left-most "n's" control terminals BØ8 through BØE.

FF sets terminals to a logical "1", designating them as outputs. A "Ø" designates a terminal as an input. The available options are as follows:

FFFF =	All terminals are outputs.
FFØØ =	Terminals BØ/EV through BØ7 are inputs, BØ8 through BØE are outputs.
ØØFF =	Terminals BØ/EV through BØ7 are outputs, BØ8 through BØE are inputs.
ØØØØ =	All terminals are inputs.

SET I/O FOR INDIVIDUAL TERMINALS

TYPICAL FORMAT:	**$aAOB*nn*↵**
TYPICAL RESPONSE:	*
TYPICAL FORMAT W/√:	**#*a*AOB*nnCS*↵**
TYPICAL RESPONSE:	***a*AOB*nnCS***
<u>REQUIRED</u> ACKNOWLEDGE:	**$*a*ACK↵**
RESPONSE:	*

The Assign I/O commands, Assign Input Bit/Assign Input Position and Assign Output Bit/Assign Output Position, are used to specify the data direction of individual SCM terminals. The ***nn*** characters from the examples above refer to the individual terminals to which the assignment is being made.

The Assign Input commands, AIB and AIP, configure individual terminals to be used as input, reading external signals. The Output commands, AOB and AOP, set the addressed terminals to provide discrete output, which can be used to control external equipment.

Bit and Position. As is the case with all Discrete SCM commands that function based on Bit or Position, the type of command used depends only upon the user's preference for referencing the SCM terminals. "Bit" commands, as in "Assign Input Bit" and "Read Bit" reference terminals according to the actual unit label.

ØØ = BØ/EV	Ø8 = BØ8
Ø1 = BØ1	Ø9 = BØ9
Ø2 = BØ2	ØA = BØA
Ø3 = BØ3	ØB = BØB
Ø4 = BØ4	ØC = BØC
Ø5 = BØ5	ØD = BØD
Ø6 = BØ6	ØE = BØE
Ø7 = BØ7	

The command:

$3AOBØ5↵

for example, designates terminal BØ5 of the Discrete SCM whose address is "3" as an output terminal.

The "Position" command, as in "Assign Output Position", reference SCM terminals according to their ordinal significance. That is, terminals are simply numbered from Ø to 14, starting with BØ/EV as the number Ø.

Ø = BØ/EV	8 = BØ8
1 = BØ1	9 = BØ9
2 = BØ2	1Ø = BØA
3 = BØ3	11 = BØB
4 = BØ4	12 = BØC
5 = BØ5	13 = BØD
6 = BØ6	14 = BØE
7 = BØ7	

The following command designates terminal "BØC" of SCM "A" as an input terminal:

$AAIP12↵

SCM

READ I/O ASSIGNMENTS – ALL TERMINALS

FORMAT:	**$aRA↵**
TYPICAL RESPONSE:	***nnnn**
FORMAT W/√:	**#aRA↵**
TYPICAL RESPONSE:	***aRAnnnnCS**

This command may be used to determine how each terminal was set in the Utility program (under Setup, the "I/O Assignments" parameter), either for input or output.

The response is a pair of two-digit hex numbers whose binary equivalents represent the settings. A binary "1" represents an output terminal, and a "Ø" represents an input.

The right-most two-digit hex number in the response corresponds to the first eight terminals of the Discrete SCM, BØ/EV through BØ7. The left-most hex value reads out the setting for terminals BØ8 through BØE.

Use the hex-to-binary-to-ASCII conversion table in appendix C to read the unit's configuration, or access the settings in the Setup window of the Utility program (refer to Calibration, earlier in this manual).

In the following, for example:

Command:	**$ZRA↵**
Response:	***1A79**

"79", corresponding to terminals BØ/EV through BØ7, represents the binary value Ø1111ØØ1. This means that:

BØ/EV is configured as an OUTPUT.

BØ1 is configured as an INPUT.

BØ2 is configured as an INPUT.

BØ3 is configured as an OUTPUT.

BØ4 is configured as an OUTPUT.

BØ5 is configured as an OUTPUT.

BØ6 is configured as an OUTPUT.

BØ7 is configured as an INPUT.

From appendix C, we find that "1A" represents ØØØ11Ø1Ø. This indicates the configuration of terminals BØ8 through BØE in a manner similar to the first eight (the sixteenth terminal reference is ignored).

READ I/O ASSIGNMENTS – INDIVIDUAL TERMINALS

FORMAT:	**$aRABnn↵**
TYPICAL RESPONSE:	***n**

The Read I/O Assignment commands, Read Assignment Bit and Read Assignment Position, provide the user a means of checking whether individual terminals of a Discrete SCM have been configured as input or output.

The response is a "1" for output and "Ø" for input. Refer to the explanation of Bit" and Position" designators under the "Assign I/O for Individual Terminals" command.

Remember:

- The right-most, two-digit hex number in the response corresponds to terminals BØ/EV through BØ7.
- The left-most, two-digit hex number is for BØ8 through BØE (reference to the sixteenth terminal is ignored).
- When dealing with the binary numbers, the right-most digit corresponds to the lowest-numbered terminal; e.g., the "1" in "ØØØØØØØ1" would represent the (input) setting for terminal "BØ/EV".

SET ON/OFF STATE – ALL TERMINALS

TYPICAL FORMAT:	**$aDOnnnn↵**
TYPICAL RESPONSE:	*****
TYPICAL FORMAT W/√:	**#aDOnnnnCS↵**
TYPICAL RESPONSE:	***aDOnnnnCS**
REQUIRED ACKNOWLEDGE:	**$aACK↵**
RESPONSE:	*****

This command sets all terminals configured as outputs either ON or OFF (terminals configured as inputs ignore this command).

As in Non-Discrete SCM's the binary equivalents of the hex values entered are used to set the state.

Use the hex-to-binary-to-ASCII conversion table in Appendix C to select the desired configuration. A "1" sets the corresponding terminal ON. "Ø" sets the corresponding terminal OFF.

For example, in this command:

$ZDO457A↵

"7A" (hex), which represents the binary value Ø1111Ø1Ø, sets the configuration of terminals BØ/EV through BØ7 on SCM "Z". This implements the following configuration:

BØ/EV	OFF	Ø
BØ1	ON	1
BØ2	OFF	Ø
BØ3	ON	1
BØ4	ON	1
BØ5	ON	1
BØ6	ON	1
BØ7	OFF	Ø

The left-most hex value, "45", sets the configuration of terminals BØ8 through BØE (the sixteenth terminal is ignored) in a similar fashion.

NOTE
The number of hex values used in this command MUST agree with the Word Length parameter setting made during Calibration (Utility, under Setup).

If the Word Length for a Discrete unit is set for 1 Byte, and two, two-digit hex values are specified in the DO command, a SYNTAX ERROR will be returned.

SET ON/OFF STATE – INDIVIDUAL TERMINALS

TYPICAL FORMAT:	**$*a*CB*nn*↵**
TYPICAL RESPONSE:	*
TYPICAL FORMAT W/√:	**#*a*CB*nn*↵**
TYPICAL RESPONSE:	***a*CB*nnCS***
REQUIRED ACKNOWLEDGE:	**$*a*ACK↵**
RESPONSE:	*

The Clear Bit/Clear Position commands turn the terminals of the Discrete SCM OFF. The Set Bit/Set Position commands turn individual terminals ON.

For example, the following:

$3CBØB↵

turns the terminal BØB of SCM #3 OFF. The command:

$3CB11↵

turns terminal number 11 of SCM #3 OFF.

NOTE
Terminal 11 is labeled BØB on most Discrete SCM's. The commands in both of the preceding examples performed the same function.

The Clear Bit/Clear Position and Set Bit/Set Position commands will only work with terminals that have been designated as outputs (using one of the Assign commands). Addressing an input terminal with these commands will return an OUTPUT ERROR.

READ ON/OFF STATE – ALL INPUTS

TYPICAL FORMAT:	**$*a*DI↵**
TYPICAL RESPONSE:	***nnnn***
TYPICAL FORMAT W/√:	**#*a*DI↵**
TYPICAL RESPONSE:	***nnnnCS***

This command reads the ON/OFF state of all of the terminals of the Discrete SCM. It differs from the "$DI" command for non-Discrete SCM's in that none of the response's hex digits correspond to alarms. In the same manner as its non-Discrete cousins, however, the Discrete's response to the "$DI" command breaks out into binary numbers where a "Ø" signifies an OFF state, and a "1" represents ON.

NOTE
If desired, the Discrete SCM can be configured so that only its first eight terminals, BØ/EV through BØ7, respond to the Read Discrete Inputs command. To accomplish this, set the Word Length parameter (Utility, under Setup) to "1 Byte".

READ ON/OFF STATE – INDIVIDUAL TERMINALS

FORMAT:	$aRB*nn*↵
TYPICAL RESPONSE:	**n*
FORMAT:	$aRP*nn*↵
TYPICAL RESPONSE:	**n*

These commands, Read Bit and Read Position, indicate the logical state of individual terminals.

The response to these commands is either a "1", indicating ON, or a "Ø", indicating OFF.

NOTE
Attempting to read a non-existing terminal will result in a VALUE ERROR.

SET INITIAL VALUE

FORMAT:	$aIV*nnnn*↵
TYPICAL RESPONSE:	*
FORMAT W/√:	#aIV*nnnn*↵
TYPICAL RESPONSE:	*aIV*nnnnCS*

This command sets the ON/OFF state of the output terminals that the SCM will use at startup. When the SCM is powered up, it first reads the I/O direction data, then it reads the Initial Value and performs an internal "Set ON/OFF State of All Outputs" command ($aDOø) using the hex values set by the Initial Value command.

The command is intended to function as a "safe" switch. If power to the SCM is interrupted, the Initial Value ON/OFF settings for output terminals will be automatically invoked when power is restored.

The Initial Value may be set in the Setup window of the Utility program. The IV command is documented here for convenience. The "nnnn" in the examples above represent the hex values used to configure the available output terminals ON or OFF. Refer to the explanation of the "Set ON/OFF State of All Outputs" command, above, for the available options.

READ INITIAL VALUE

FORMAT:	$aRIV↵
TYPICAL RESPONSE:	**nnnn*
FORMAT W/√:	#aRIV↵
TYPICAL RESPONSE:	*aRIV*nnnnCS*

This command reads the Initial Value of the SCM terminals configured as outputs.

The response is a pair of two-digit hex numbers, whose binary equivalents correspond to the ON/OFF settings stored as the Initial Value in the memory of the unit.

Use the table in appendix C to determine the binary equivalents of the hex values in the response to the Read Initial Value command.

Remember:

- The right-most hex digits in the response correspond to terminals BØ/EV through BØ7.
- The left-most digits are for BØ8 through BØE (reference to the sixteenth terminal is ignored).
- When dealing with the binary numbers, the right-most digit corresponds to the lowest-numbered terminal; e.g., the "1" in "ØØØØØØØ1" would represent the (ON) setting for terminal "BØ/EV".

Alternatively, access the Setup Window of the Utility program, and check the Initial Value data entry field.

SET THE WATCHDOG TIMER

FORMAT:	**$*a*WT*snnnnn.nn*↵**
TYPICAL RESPONSE:	*****
FORMAT W/√:	**#*a*WT*snnnnn.nn*↵**
TYPICAL RESPONSE:	****a*WT*snnnnn.nnCS***

The Watchdog Timer (WT) command stores a time-out setting in SCM memory, after which the unit's terminals automatically configure themselves according to the Initial Value settings (refer to the Setup window of the Utility program, and the "Set or Read Initial Value" commands, earlier in this manual).

The data entered with the WT command is the time scaled in minutes. For example:

$1WT+ØØØ1Ø.ØØ↵

sets the timer for ten minutes in SCM #1. In this example, if the module does not receive a valid command for a period of 10 minutes, the outputs will automatically default to the Initial Value.

The purpose of the Watchdog Timer is to force the outputs to a known "safe" value in the event of a host or communications link failure.

NOTES

The Watchdog Timer may be disabled by setting the timer value to +99999.99.

Setting the Watchdog Timer to less than +ØØØØØ.16 minutes will result in a VALUE ERROR.

READ THE WATCHDOG TIMER SETTING

FORMAT:	**$*a*RWT↵**
TYPICAL RESPONSE:	****snnnnn.nn***
FORMAT W/√:	**#*a*RWT↵**
TYPICAL RESPONSE:	****a*RWT*snnnnn.nnCS***

This command reads the value set into SCM memory with the Enable Watchdog Timer command (WT).

SET MODULE IDENTIFIER

FORMAT:	**$*a*ID*name*↵**
TYPICAL RESPONSE:	*****
FORMAT W/√:	**#*a*ID*name*↵**
TYPICAL RESPONSE:	****a*ID*nameCS***

This command allows the user to write a message into the SCM memory which may be read back (refer to the Read Identification command) to distinguish a particular discrete unit from others in an application. The facility is available in the Setup window of the Utility program under "ID Register".

Identifications consisting of any combination of letters, numbers, and spaces may be used, up to a length of 16 characters.

Examples:

Command (module location):
$1IDBOILER ROOM↵

Command (calibration date):
$1ID 12/3/88↵

Command (model number):
$1ID 3125↵

NOTE

Since the ID command has a variable length syntax, checksums cannot be appended to the command message.

READ MODULE IDENTIFICATION

FORMAT:	**$*a*RID↵**
TYPICAL RESPONSE:	****name***
FORMAT W/√:	**#*a*RID↵**
TYPICAL RESPONSE:	****a*RID*nameCS***

This command reads the Identification Register of the addressed unit, as set with the ID command, or in the Utility program's ID Register selection.

READ EVENTS AND CLEAR COUNTER

FORMAT:	**$aEC↵**
TYPICAL RESPONSE:	***nnnnnnn**
FORMAT W/√:	**#aEC↵**
TYPICAL RESPONSE:	***aECnnnnnnnCS**

This command read the current value in the events counter buffer, and after the read, immediately clears the buffer to zero.

This eliminates the potential for lost event counts between the execution of a Read Events and a Clear Events command.

Discrete SCM Continuous Mode Operation

The Continuous Mode of SCM Operation, available as an option for other units, is part of the standard Discrete SCM package. Enabling Continuous Mode programs the SCM to transmit data without its being prompted by a Host command.

Discrete units can be set by the user for four types of Continuous Mode Operation; triggered by a change in input state, by the edge of an incoming pulse, by an internal timer, or by the input from another SCM that has been configured for Continuous Mode.

The format of the data output from a Discrete SCM in Continuous Mode is the same as that of a Non-Continuous unit prompted with a Read Discrete Inputs command and checksum:

***aDInnnnCS**

Table 9 lists the Continuous Mode commands. It is followed by detailed explanations and operational notes on the types of SCM Continuous Mode operation.

The Continuous Mode Output Trigger Signal. In order to facilitate daisy-chaining Continuous Mode SCM's, each module produces an output trigger signal each time it completes an output data string.

This output trigger is a 5 millisecond low pulse at the DEFAULT terminal. Remember that the DEFAULT is normally an input, used to place the module in a known communications setup. This is still the case when a module is set for Continuous Mode, however when a module produces a continuous output, the DEFAULT terminal momentarily becomes an output and produces a low-going trigger pulse.

The pulse may be used to trigger another module set in Edge-Triggered mode, for example, and in this manner, many modules may be daisy-chained together.

SET CHANGE-TRIGGERED CONTINUOUS MODE

Command:	**$aCMC↵**
Response:	*

This command sets the addressed SCM to respond to changes in the state of the input data stream. The module will output a data string that reports the new state of inputs.

For example, assume "Z", a Discrete SCM, has been set so that all its terminals are inputs (refer to the description of the Assign I/O command, (AIO). At power up, all terminals are OFF. When one of the terminals, terminal BØA for instance, changes state, the SCM outputs data to the host as though prompted by a Read Discrete Inputs command and checksum (#ZDI↵):

***ZDIØ4ØØD5**

After transmitting this data, SCM "Z" immediately begins scanning the I/O lines. When any other change of state occurs, another output to the Host is initiated.

Table 9. Discrete SCM Continuous Mode Commands

If you want to:	Execute the following Command:	Response Format	Requires Write Protection Disable $WE
Set Change-Triggered Continuous Mode	$*a*CMC↵	*	YES
Set Edge-Triggered Continuous Mode	$*a*CME↵	*	YES
Set Timer-Triggered Continuous Mode	$*a*CMT↵	*	YES
Set Continuous Timer	$*a*CT+*nnnnn.nn*↵	*	YES
Read Continuous Timer Setting	$*a*RCT↵	**nnnnn.nn*	NO
Set Input-Triggered Continuous Mode	$*a*CMI↵	*	YES
Read the Continuous Input Address	$*a*RIA↵	**nn*	NO
Read the Type of Continuous Mode being used	$*a*RCM↵	**n*	NO
Disable Continuous Mode Operations	$*a*CMD↵	*	NO

SET EDGE-TRIGGERED CONTINUOUS MODE

Command: $*a*CME↵
Response: *

This command is used to set the SCM to respond to an incoming positive-going trigger pulse. The trigger input should be connected to the BØ/EV terminal, and that terminal should be configured as an input (refer to the Set I/O for Individual Terminals command, AIB).

Figure 18, in the Installation Section, shows the hookup for the SCM in the Edge-Triggered Mode.

With the Edge-Triggered Mode enabled, the SCM will provide data whenever a trigger pulse is detected at the BØ/EV terminal.

The output format will be as though the unit were prompted by the Host with a #DI↵ command:

aDInnnnCS

SET TIMER-TRIGGERED CONTINUOUS MODE

Command: $*a*CMT↵
Response: *

This command sets the Discrete SCM to continuously output data to a host computer or display device based on the setting of the Continuous Timer in the Utility program.

<u>*NOTE*</u>

As with all of the Continuous Mode types, it is not necessary for the Host to poll the unit to obtain data. The Host must, however, have an interrupt-driven serial input for proper operation.

For example, an application calls for an SCM to output data every 10 seconds. (Write Protection Disable commands ($WE) are not shown in this example).

The unit is set up in the Utility program as usual (refer to the Calibration Section of this manual), and the Continuous Timer is set for a 10 second interval:

+00010.00

The unit is installed, and power is applied (refer to the Installation Section). All terminals are set for input:

$*a*AIOØØØØ

The Timer-Triggered command ($*a*CMT) is executed, and the unit immediately begins to output data at 10 second intervals. Every 10 seconds, the SCM will read the status of its I/O lines and output the status of those lines as if it was responding to a #1D1 command.

As a shortcut to the Utility program, the "Set Continuous Timer" command, $*a*CT, can be used to specifiy the interval for Timer-Triggered Mode. The command is formatted like this:

$*a*CT+*nnnnn.nn*↵

Where "nnnnn.nn" is the desired timer interval, in seconds. Ten seconds, for example, would be expressed as +00010.00.

Timer Mode With Outputs. With the terminals of the SCM configured for outputs, the Host may execute DO, SB, CB, or other output commands to control the discrete outputs in response to the input data or some other control decision.

It is not necessary to disable Continuous Mode before issuing the output command. However, to avoid communications collisions the host command should be timed to avoid the continuous response from the unit. Wait for an output string from the module and then immediately issue the output command, or disable the Continuous Mode Operations, execute the "CT" command, and then re-enable Continuous Mode.

SET INPUT-TRIGGERED CONTINUOUS MODE

Command: $*a*CMI↵
Response: *

This command enables the addressed SCM to respond to data transmitted by a second SCM. If the second unit is configured as a Continuous Output Module (Change-, Edge-, or Timer-Triggered), the loop can function entirely without Host intervention.

SET CONTINUOUS MODE INPUT ADDRESS

FORMAT: $*a*CIA*nn*↵
TYPICAL RESPONSE: *

This command is required when configuring an SCM to output data to a second unit configured for Continuous Input (refer to the explanation of the $aCMI command, above). It is used to specify the input address of the Continuous Input SCM. The ***nn*** in the examples above is the hex representation of the ASCII address of the second SCM.

For example, in the command:

$ZCIA41↵

SCM Z is set to respond to the input of a second SCM whose module address is set to the ASCII equivalent of hex 41, or "A".

NOTE

An SCM set to respond to a Continuous Output unit with the same address, as in:

$ZCIA5A↵

will result in an ADDRESS ERROR.

READ CONTINUOUS MODE SETTING

FORMAT: $*a*RCM↵
TYPICAL RESPONSE: **n*

This command reads the type of Continuous Mode operations set into the addressed SCM. The "n" in the example above will be replaced, in actual operations, by a "C" to indicate Change-Triggered Mode, by an "E" for Edge-Triggered, by an "I" for Input-Triggered, by a "T" for Timer-Triggered, or by a "D", which will indicate that the unit's Continuous Mode has been turned off.

READ INPUT ADDRESS

Command: $aRIA↵
Response: *a

This command reads back the Continuous Input Address setting stored in non-volatile memory. The response to the command is the ASCII code of the Continuous Input Address character.

READ CONTINOUS TIMER SETTING

Command: $aRCT↵
Response: *+ØØØØ5.ØØ (example)

This command is used to read back the value of the Continuous Timer. The Timer is set in the Setup window of the Utility program, or with the Set Continuous Timer command ($aCT). The value is scaled in units of seconds. This is not to be confused with the Watchdog Timer.

The Continuous Timer and Continuous Mode Operations

The Continuous Timer parameter, set in the Utility program, establishes a time interval after which the Discrete SCM issues an unprompted output. The input field for setting the Timer is found in the Utility program's Setup window.

The Continuous Timer is particularly useful in limiting responses from modules in a multi-unit scenario if triggering input is likely to turn on and off quickly. Such circumstances can cause a continuous stream of data in some cases.

Setting the Continuous Timer for a non-zero interval will implement a delay (in seconds) after a Continuous Mode response. The unit will wait for the programmed interval before beginning to scan the I/O terminals for another trigger input.

As an alternative to setting the Continuous Timer interval in the input field in the Utility program, a short-cut command, Set Continuous Timer Interval, may be executed:

$aCT*Snnnnn.nn*↵

a = the SCM address

CT = the Set Continuous Timer command

S = always positive (+)

nnnnn.nn = the number of minutes in the delay window.

DISABLE CONTINUOUS MODE

FORMAT: $aCMD↵
TYPICAL RESPONSE: *

It is not necessary to turn Continuous Mode operations off to send commands from the Host to the unit. To avoid communications collisions, the host should wait for a continuous output response, and then immediately issue the CMD command.

If, for example, the Continuous Timer has been set as follows:

$aCT+ØØØ1Ø.ØØ↵

(or "ØØØ1Ø.Ø" in the Continuous Timer field of the Setup window in the Utility program).

The user has ten seconds to issue the CMD command, so the likelihood of a collision is remote.

It is also possible for the Host to disable Continuous Mode even if the Continuous Timer is set for 0 seconds. The host must issue the CMD command immediately after the carriage return from the SCM is received. When the SCM reads a "$"or "#" character on the communications line, it will temporarily halt Continuous Mode output and look for an address character. If it detects its own address, it will read and process the rest of the command. Otherwise it will resume Continuous Mode output.

NOTE
Communications collisions are not harmful to RS-485 hardware. The host serial input must, however, be able to accept framing errors and "noise" characters when collisions occur.

The SCM Scanning Program

Along with the Utility diskette, shipped with each order of SCM's, is a second disk that contains a batch file named "Scanning.bat". This is a menu-driven program for performing some basic SCM operations.

Features of the Scanning program include:

- Real-time display of logged data,
- Automatic startup,
- Automatic routing of Time-stamped data to printer or disk,
- Automatic routing of time-stamped alarm data to printer,
- User control of scan interval for each SCM in the system,
- User control of log-to-printer and log-to-disk time intervals.

Loading the Scanning Program. To load the Scanning program, follow the same procedures described earlier in this manual under "Installing Utility". Substitute the diskette that contains the Scanning program and the name of the program itself as appropriate.

Running the Scanning Program. At the "C:>", or directory prompt where the Scanning program was loaded, enter:

SCAN.BAT↵

After a brief "logo" screen, the Scanning program main menu screen will come up. The tools in the program are self-explanatory.

Auxiliary Programs

In addition to the Utility and Scanning packages, Moore Industries also sends several relatively simple programs for use in operating the SCM.

"Terminal.exe" is a simple program that allows a PC to communicate with the SCM via its COM1 port at 300 baud, no parity. The program is written in Turbo Pascal. Source code is also provided.

Start the program by typing "terminal↵" at the appropriate system prompt.

The file "Programs.doc" is an overview of the other programs shipped. It can be printed using DOS's print function, or viewed with "type <filename>".

NOTE
The Scanning program will not work with Discrete SCM's.

Maintenance

The SCM is designed so that it will require little maintenance. A quick, periodic check of connections at the terminal blocks is all that is suggested.

In installations where the unit may be subjected to harsh environmental conditions, both the thermoplastic DIN and aluminum hockey-puck housing styles can be mounted in a variety of enclosures, providing excellent, maintenance-free protection for the SCM.

Troubleshooting

PROBLEM: An SCM in the system does not respond to Host commands.

ACTION:

1. **Check Connections.** Make sure all connections to and from the unit are secure. Refer to the figures in the Installation Section of this manual, and verify that the terminals of the SCM are connected to the appropriate sensor type or discrete input device, and that the data lines are properly connected to the communications port of the Host.

2. **Baud Rate.** Check that the baud rate being used by the Host is the same as that programmed in the SCM. If the setting of the SCM is unknown, connect the DEFAULT terminal to ground as shown in figures 1, 2, or 3 in the Calibration Section, and run Utility (it may be necessary to remove the unit from the application to accomplish this).

3. **Echo.** If the installation incorporates multiple SCM's in a daisy-chain hookup, make sure that the ECHO has been turned on in all units. Refer to the Setup window of the Utility program.

4. **Address.** If the installation incorporates multiple SCM's in either a daisy-chain or multi-drop hookup, make sure that each unit was setup with a unique address.

5. Finally, make sure that the command being entered is correctly formatted, and that the checksum, if used, is correctly calculated. If problems persist, contact Moore Industries' Customer Service Department.

PROBLEM: An SCM responds with an ERROR message.

ACTION:

1. **ADDRESS ERROR.** There are four ASCII values that are illegal for use as module addresses; the NULL character (ØØ hex), the carriage return (ØD hex), the $ character (24 hex), and the # character (23 hex). Use the Utility program to set the address of the SCM's used in the system. The program does not allow illegal addresses to be loaded into module memory.

<u>*NOTE*</u>

An attempt to use the Continuous Input Address command to specify an illegal address or an address identical to the polling address will cause an error.

2. **SYNTAX ERROR.** Command was improperly formatted. Refer to the explanation and example of the offending command in the Operation Section of this manual. Refer to appendix B for a listing of the correct syntax for all SCM commands.

3. **BAD CHECKSUM.** This error message is returned when the checksum included in the command does not match the value calculated by the unit. This can result from noise or other interference on the data lines. Repeat the command, and if the error persists, re-calculate the command checksum. If problems continue, attempt the command using a lower baud rate.

4. **COMMAND ERROR.** This occurs when a command is not recognized by the SCM. Make sure that the command is correctly formatted; all upper-case (capital) letters.

5. **OUTPUT ERROR.** An attempt to use a Clear Bit, Clear Position, Set Bit or Set Position command on a Discrete SCM terminal that was set for input (Assign I/O). Review the configuration of the terminals with one of the Read commands, or re-assign the desired I/O status.

6. **PARITY ERROR.** Make sure the parity of the host and all the SCM's in the system are set the same; even, odd, or none. Random parity errors are occasionally produced as a result of noise on the data lines. Attempt a re-issue of the command to correct this.

7. **VALUE ERROR.** This error results when an incorrect character is used as a numerical value. Remember, hex values range from 0 to 9 and A to F only. Refer to appendix C to check for the desired hex value and re-issue the command.

8. **WRITE PROTECTED.** The command was aborted because the SCM Write Protection was not disabled first. Execute a $*a*WE↵ command, and re-issue the offending command.

PROBLEM: Continuous Mode Producing Erratic Communications, Inaccurate/Incorrect Responses.

ACTION:

In some cases, especially if a large number of Edge-Triggered modules are connected in a daisy-chain, the amount of data transmitted may overload the serial port buffer of the Host device.

To remedy this, the incoming data should be slowed down by increasing the delay programmed by the Continuous Timer parameter in the Setup window of the Utility program ($*a*CT+*nnnnn.nn*↵, as an alternative).

The SCMPRG – Overview

Voltage, Current, and Frequency SCM's are offered with a Programmable Option, PRG, for performing user-defined scaling of the PRG-equipped SCM (SCMPRG) output, and for calculating non-linear input-to-output transfer functions.

Operationally, the SCMPRG is similar to standard units. A version of the standard units' Utility program, SCMPRG.BAT, is used to set unit operating parameters. The commands listed in the Operation Section of this manual (unless otherwise noted) can be used to control basic SCMPRG unit operation.

This appendix provides an overview of SCMPRG capabilities, and instructions for use of the SCMPRG.BAT program for unit configuration.

Linear Scaling

The SCMPRG can be set by the user to display sensor output in application-specific scaled engineering units. It performs all scaling and conversion of the sensor input internally, making it simpler to read the data at the control-room PC.

For example, a typical pressure sensor is hooked to a Current SCMPRG. The sensor provides 1-5 V linear output for pressures from 0 to 1000 psi.

With a standard, Current SCM, the output at the PC might look like this:

Pressure	Sensor Output	SCM Read-Out (mV)
0	1 V	+01000.00
500	3 V	+03000.00
1000	5 V	+05000.00

Though the standard SCM faithfully outputs the sensor voltage, the actual data required from the application is ***pressure***, not voltage, and the raw data of the SCM read-outs must therefore be converted.

Units equipped with the PRG Option, however, can be programmed to provide the ***converted*** data, scaled as desired:

Pressure	Sensor Output	SCMPRG Read-Out (in psi)
0	1 V	+00000.00
500	3 V	+00500.00
1000	5 V	+01000.00

Or in a percentage scaling scheme, for example (750 psi = "full"):

Pressure	Sensor Output	SCMPRG Read-Out (in % of "full")
0	1.0 V	+00000.00
375	2.5 V	+00050.00
750	4.0 V	+00100.00

SCMPRG Resolution. The SCMPRG is capable of a read-out range of 50,000 counts. If programmed for operation at this resolution, however, the units digit is relatively susceptable to noise. Though it is possible to lessen the impact of this by setting large digital filtering values it is probably more effective to choose a different resolution.

For example, a SCMPRG unit is to be used to provide read-outs of specific gravity based on input from a millivolt transmitting sensor. The range of input to the unit is to extend from 0.5 to 2.0 mV.

Probably the most obvious output format is from +00000.50 to +00002.00, however, this yields an effective resolution of only 150 counts.

Since the specific gravity of water is defined as "1", better use of the accuracy of the SCMPRG would be gained by programming for read-outs based on specific gravity of the material in the application as compared to that of water, a known constant.

SCM

The user would then program the SCMPRG for read-outs representing the specific gravity of the material in the application as a "percent of water", with "1" as 100%. The sensor data from the application would then be scaled accordingly for SCMPRG read-outs of +00050.00 to +00200.00, resulting in an effective resolution of 15,000 counts.

Non-linear Transfer Functions

The SCMPRG is ideal for providing data outputs from non-linear sensors. The unit uses a linear "piecing" algorithm to describe the non-linear function curve. Up to twenty-four segments can be used to approximate a given curve.

SCMPRG's may be programmed in the field with actual sensor inputs when the non-linearity of sensor input is unknown.

Table A1 is the model incorporated by the unit as the basis for the non-linear transfer calculations. Fill in the table values with data from your application, and use the table as a worksheet in programming the SCMPRG with the SCMPRG.BAT program, described later.

Perhaps the two most important points in the table are the Minimum and Maximum values from the application. These points specify the endpoints of the transfer function curve. They are the only points necessary in programming the SCMPRG to output linear sensor data to the PC.

The breakpoints are the key to the use of the SCMPRG with non-linear sensors. The curve of non-linear functions is specified in the SCMPRG by segments whose endpoints are between the minimum and maximum values. Each of the segment endpoints is a breakpoint in an approximation of the application curve.

Up to twenty-four breakpoints can be specified when defining a "curve". Figure A1 illustrates the technique. Figure A2 shows some of the common applications in which the SCMPRG's transfer function capability can be used.

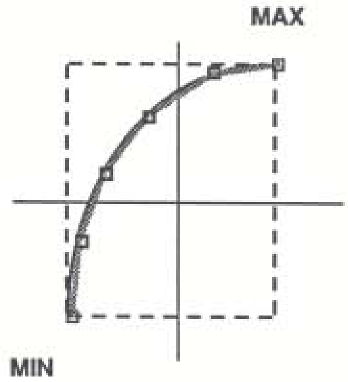


Figure A1. *Approximating an Application Curve with Linear Segments*

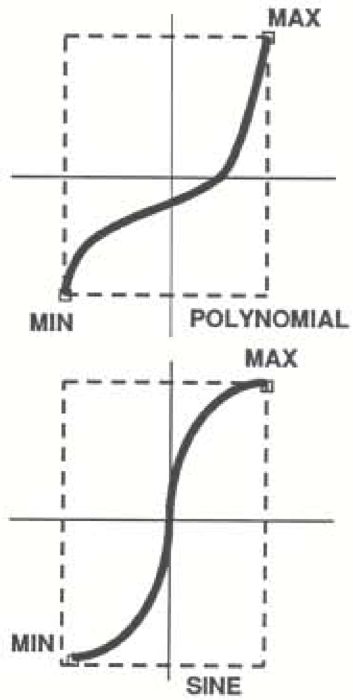


Figure A2. *Sample Application Curves*

Table A1. SCMPRG Breakpoints Worksheet

Breakpoints	Analog Sensor Input	SCM-PRG Output
Minimum	X_{MIN} =	Y_{MIN} =
Maximum	X_{MAX} =	Y_{MAX} =
00	X_{00} =	Y_{00} =
01	X_{01} =	Y_{01} =
02	X_{02} =	Y_{02} =
03	X_{03} =	Y_{03} =
04	X_{04} =	Y_{04} =
05	X_{05} =	Y_{05} =
06	X_{06} =	Y_{06} =
07	X_{07} =	Y_{07} =
08	X_{08} =	Y_{08} =
09	X_{09} =	Y_{09} =
0A	X_{0A} =	Y_{0A} =
0B	X_{0B} =	Y_{0B} =
0C	X_{0C} =	Y_{0C} =
0D	X_{0D} =	Y_{0D} =
0E	X_{0E} =	Y_{0E} =
0F	X_{0F} =	Y_{0F} =
10	X_{10} =	Y_{10} =
11	X_{11} =	Y_{11} =
12	X_{12} =	Y_{12} =
13	X_{13} =	Y_{13} =
14	X_{14} =	Y_{14} =
15	X_{15} =	Y_{15} =
16	X_{16} =	Y_{16} =

Modifying an "Illegal" Curve. If any of the breakpoints used in specifying a curve are greater than either Minimum or Maximum values, the curve is considered "illegal". The Minimum or Maximum value must be modified to compensate for the offending portion of the application curve.

Figure A3 shows a modified "illegal" curve.

SCMPRG.BAT – Programming the SCMPRG

The SCMPRG.BAT program is used to set the Minimum and Maximum values and breakpoints from the application curve. It may also be used to scale SCM readouts. Both of these operations can be performed with or without external excitation.

The program is loaded in the same fashion as the Utility.bat program for standard units. Refer to the Calibration Section of this manual for further instruction.

1. To begin the program, enter:

   SCMPRG↵

   at the C: (or appropriate) Host prompt.

After a brief logo screen, the program will bring up the Main Menu screen.

Navigating in the SCMPRG.BAT program is accomplished by:

F1 to change screens/menus

UP arrow (↑) to move selector highlight up

DOWN arrow (↓) to move selector highlight down

LEFT arrow (←) **or RIGHT arrow** (→) to change the value displayed inside selector highlight

<F1Ø> (PF1Ø on some keyboards) to exit current screen and load user selection(s) into SCMPRG memory.

Escape (Esc. on most keyboards) to exit menu without making changes.

Some input screens, such as the main "Reprogram" screen require the user to enter values, rather than using the navigation keys. As a general rule, try the navigation keys as described above, and if the value in the selector highlight does not change, enter the actual value based on the data from your application.

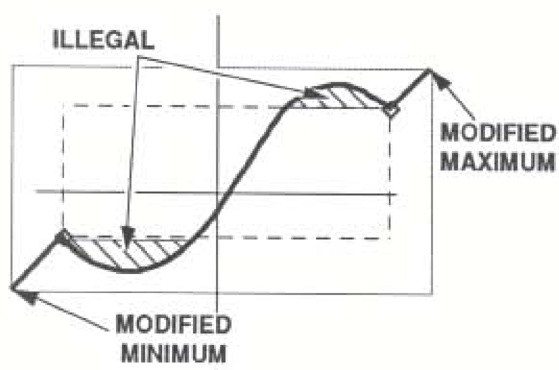


Figure A3. *Modifying an "illegal" Application Curve*

2. From the Main Menu, select the sub-menu for configuring the communication parameters of the Host, (#1, Config). Enter the values for the Host device being used, and return to the Main Menu.

3. Next choose sub-menu #2, "Save Memory". This is the means of saving the factory-set SCMPRG parameters in a file on the Host disk. If an error occurs during subsequent programming, the factory settings may be used to restore SCMPRG operation until the problem can be fixed.

4. Once step 3 is complete, choose the "Setup/Term" sub-menu from the Main Menu.

   NOTE

   Refer to the Calibration Section of this manual for instruction in hooking up the SCMPRG for Setup.

   The Setup/Term facility reads the factory settings of the connected module, then brings up an editting screen so that the user can make changes as necessary.

   Once any changes have been effected, follow the instructions at the bottom of the screen to return to the Main Menu.

   NOTES

   Changing the Baud Rate setting of the connected SCMPRG does not take effect until the unit's Default Mode is disabled.

   Remember that changing the Baud Rate setting for the SCMPRG without similarly changing the setting for the Host will cause a communications TIME OUT error. This error cannot be cleared until the settings are compatible.

5. The last two sub-menus in the SCMPRG.BAT program are for setting the Minimum and Maximum points from the application (#4, Rescale), and for loading the Breakpoints into the unit memory (#5, Reprogram).

Follow the instructions in the information bar at the bottom of each menu/entry screen to complete the SCMPRG programming as required for the intended application.

NOTE

Remember to save the factory-set Breakpoint table in a file on the Host disk before creating a new table (step #3).

General Notes

- Use of the SCMPRG software is REQUIRED when programing the SCMPRG without sources of external excitation. If using a "dumb" terminal, standard voltage, current, or frequency excitation sources (as appropriate) must be used. In such cases, the operational accuracy of the SCMPRG is directly proportional to the accuracy of the external excitation sources.

- The input characteristics of the SCMPRG cannot be changed by the user. That is, a voltage unit cannot be programmed to process Frequency inputs.

- There is no provision for changing the gain or offset of the analog processing circuitry.

- Any non-linear function must be totally enclosed by a rectangular area defined by the programmed Minimum and Maximum values. Figure A1 illustrates. Figure A3 shows how the Minimum and Maximum values can be modified to compensate for an "illegal" function.

- For each input value, there can be only one output value. Figure A4 gives two examples of "illegal" functions that cannot be modified to work with the SCM.

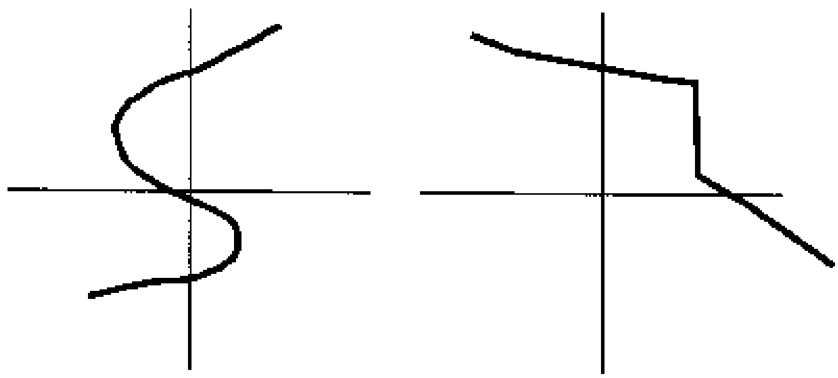


Figure A4. "Illegal" Function Curves

Appendix B

Table B1. *SCM General Commands Summary*

Command:	Executes	Response Format	Requires Write Protection Disable $WE
$*a*CA↵	Clear Alarms	*	YES
$*a*CE↵	Clear Event Counter	*	YES
$*a*CZ↵	Clear Zero Setting	*	YES
$*a*DA↵	Disable Available Alarm Inputs (Configure Alarm Inputs as Discrete Inputs)	*	YES
$*a*DL↵	Read Discrete Input ON/OFF State or Alarm Status	**nnnn*	NO
$*a*DO*nn*↵	Set ON/OFF State Discrete Outputs	*	NO
$*a*EA↵	Enable Available Alarm Inputs	*	YES
$*a*HI*Snnnnn.nnT*↵	Set HI Alarm Trip Point	*	YES
$*a*LO*Snnnnn.nnT*↵	Set LO Alarm Trip Point	*	YES
$*a*ND↵	Read New Data	**Snnnnn.nn*	NO
$*a*RD↵	Read Data (Read Current Output Buffer)	**Snnnnn.nn*	NO
$*a*RE↵	Read Event Counter	* *nnnnnnn*	NO
$*a*RH↵	Read High Alarm Trip Point	**Snnnnn.nnM*	NO
$*a*RL↵	Read Low Alarm Trip Point	**Snnnnn.nnL*	NO
$*a*RR↵	Reset Module	*	YES

NOTE: Table continued next page.

Table B1. SCM General Commands Summary (continued)

Command:	Executes	Response Format	Requires Write Protection Disable $WE
$aRS↵	Read All Module Settings	*nnnnnnnn	NO
$aRZ↵	Read Zero Setting	*Snnnnn.nn	NO
$aSPSnnnnn.nn↵	Set Deviation Output Zero Point	*	YES
$aSUnnnnnnnn↵	Change All Operating Parameters	*	YES
$aTSSnnnnn.nn↵	Trim Span	*	YES
$aTZSnnnnn.nn↵	Trim Zero	*	YES
$aWE↵	Disable Write Protection (WRITE ENABLE)	*	NO

The Setup Command

The SCM Setup Command, $aSU*nn nn nn nn*↵, sets the same basic operating parameters that are otherwise set with the Utility program, described in the Calibration Section of this manual.

The command message is comprised of four, two-digit hex numbers. These set the unit address, communications parameters, unit-specific special functions, and the number of displayed digits and filtering time constants.

The Utility program is the recommended method for entering the parameters for the SCM, but if needed, the SCM Programmer's Guide provides information on the use of the Setup Command.

Table B2. Discrete SCM Commands Summary

Command:	Executes:	Response Format	Requires Write Protection Disable $WE
$aACK↵	Acknowledge Command Handshaking	*	NO
$aAIOnnnn↵	Set I/O Assignments For All Terminals Simultaneously	*	YES
$aAIBnn↵	Configures Terminal as INPUT, referencing by LABEL designator	*	YES
$aAIPnn↵	Configures Terminal as INPUT, referencing by TERMINAL NUMBER	*	YES
$aAOBnn↵	Configures Terminal as OUTPUT, referencing by LABEL designator	*	YES
$aAOPnn↵	Configures Terminal as OUTPUT, referencing by TERMINAL NUMBER	*	YES
$aRA↵	Read I/O Assignments for All Terminals at Once	*nnnn	NO
$aRABnn↵	Read I/O Assignment of Individual Terminal, referencing LABEL designator	n	NO
$aRAPnn↵	Read I/O Assignment of Individual Terminal, referencing TERMINAL NUMBER	n	NO
$aDOnnnn↵	Set ON/OFF State of All Terminals at Once (Terminals configured as Inputs ignore this command)	*	NO
$aSBnn↵	Set State of Individual Output Terminal to ON, referencing by LABEL designator (Specifying Input Terminal generates ERROR)	*	NO
$aSPnn↵	Set State of Individual Output Terminal to ON, referencing by TERMINAL NUMBER (Specifying Input Terminal generates ERROR)	*	NO
$aCBnn↵	Set State of Individual Output Terminal to OFF, referencing by LABEL designator (Specifying Input Terminal generates ERROR)	*	NO

NOTE: Table continued next page.

Table B2. Discrete SCM Commands Summary (continued)

Command:	Executes:	Response Format	Requires Write Protection Disable $WE
$*a*CP*nn*↵	Set State of Individual Output Terminal to OFF, referencing by TERMINAL NUMBER (Specifying Input Terminal generates ERROR)	*	NO
$*a*DL↵	Read ON/OFF State of All Terminals	**nnnn*	NO
$*a*RB*nn*↵	Read ON/OFF State of Individual Terminal, referencing by LABEL designator	**n*	NO
$*a*RP*nn*↵	Read ON/OFF State of Individual Terminal, referencing by TERMINAL NUMBER	**n*	NO
$*a*IV*nnnn*↵	Set Initial Value	*	YES
$*a*RIV↵	Read Initial Value	**nnnn*	NO
$*a*WT+*nnnnn.nn*↵	Set the Watchdog Timer	*	YES
$*a*RWT↵	Read the Watchdog Timer Setting	*+*nnnnn.nn*	NO
$*a*ID*n*............*n*↵	Set Module Identification	*	YES
$*a*RID↵	Read Module Identification	**n*..............*n*	NO
$*a*EC↵	Read Events & Clear Counter	*+*nnnnnnn*	YES

Table B3. Discrete SCM Continuous Mode Commands

Command:	Executes:	Response Format	Requires Write Protection Disable $WE
$*a*CMC↵	Set Change-Triggered Continuous Mode	*	YES
$*a*CME↵	Set Edge-Triggered Continuous Mode	*	YES
$*a*CMT↵	Set Timer-Triggered Continuous Mode	*	YES
$*a*CT+*nnnnn.nn*↵	Set Continuous Timer	*	YES
$*a*RCT↵	Read Continuous Timer Setting	**nnnnn.nn*	NO
$*a*CMI↵	Set Input-Triggered Continuous Mode	*	YES
$*a*RIA↵	Read the Continuous Input Address	**nn*	NO
$*a*RCM↵	Read the Type of Continuous Mode being used	**n*	NO
$*a*CMD↵	Disable Continuous Mode Operations	*	NO

Appendix C

Table C1. Hex-ASCII-Binary Conversion

Module Settings Code Field/ Hex Value	Binary Value	Address Code/ ASCII Value (See Note)	Module Settings Code Field/ Hex Value	Binary Value	Address Code/ ASCII Value (See Note)	Module Settings Code Field/ Hex Value	Binary Value	Address Code/ ASCII Value (See Note)
00	00000000		20	00100000	(space)	40	01000000	@
01	00000001		21	00100001	!	41	01000001	A
02	00000010		22	00100010	"	42	01000010	B
03	00000011		23	00100011	■	43	01000011	C
04	00000100		24	00100100	■	44	01000100	D
05	00000101		25	00100101	%	45	01000101	E
06	00000110		26	00100110	&	46	01000110	F
07	00000111		27	00100111	'	47	01000111	G
08	00001000		28	00101000	(	48	01001000	H
09	00001001		29	00101001	)	49	01001001	I
0A	00001010		2A	00101010	*	4A	01001010	J
0B	00001011		2B	00101011	+	4B	01001011	K
0C	00001100		2C	00101100	,	4C	01001100	L
0D	00001101		2D	00101101	-	4D	01001101	M
0E	00001110		2E	00101110	.	4E	01001110	N
0F	00001111		2F	00101111	/	4F	01001111	O
10	00010000		30	00110000	0	50	01010000	P
11	00010001		31	00110001	1	51	01010001	Q
12	00010010		32	00110010	2	52	01010010	R
13	00010011		33	00110011	3	53	01010011	S
14	00010100		34	00110100	4	54	01010100	T
15	00010101		35	00110101	5	55	01010101	U
16	00010110		36	00110110	6	56	01010110	V
17	00010111		37	00110111	7	57	01010111	W
18	00011000		38	00111000	8	58	01011000	X
19	00011001		39	00111001	9	59	01011001	Y
1A	00011010		3A	00111010	:	5A	01011010	Z
1B	00011011		3B	00111011	;	5B	01011011	[
1C	00011100		3C	00111100	<	5C	01011100	\
1D	00011101		3D	00111101	=	5D	01011101	]
1E	00011110		3E	00111110	>	5E	01011110	^
1F	00011111		3F	00111111	?	5F	01011111	_

NOTES: 1. Non-printable ASCII characters are not recommended for use as SCM addresses, and are not shown in this table.

2. The ASCII characters for 23, 24, and 7F hex, represented by the symbol '■' in the table, are not to be used.

3. This table is continued on the next page.

Table C1. *Hex-ASCII-Binary Conversion (continued)*

Module Settings Code Field/ Hex Value	Binary Value	Address Code/ ASCII Value (See Note)	Module Settings Code Field/ Hex Value	Binary Value	Module Settings Code Field/ Hex Value	Binary Value	Module Settings Code Field/ Hex Value	Binary Value
60	01100000	'	80	10000000	A0	10100000	D0	11010000
61	01100001	a	81	10000001	A1	10100001	D1	11010001
62	01100010	b	82	10000010	A2	10100010	D2	11010010
63	01100011	c	83	10000011	A3	10100011	D3	11010011
64	01100100	d	84	10000100	A4	10100100	D4	11010100
65	01100101	e	85	10000101	A5	10100101	D5	11010101
66	01100110	f	86	10000110	A6	10100110	D6	11010110
67	01100111	g	87	10000111	A7	10100111	D7	11010111
68	01101000	h	88	10001000	A8	10101000	D8	11011000
69	01101001	i	89	10001001	A9	10101001	D9	11011001
6A	01101010	j	8A	10001010	AA	10101010	DA	11011010
6B	01101011	k	8B	10001011	AB	10101011	DB	11011011
6C	01101100	l	8C	10001100	AC	10101100	DC	11011100
6D	01101101	m	8D	10001101	AD	10101101	DD	11011101
6E	01101110	n	8E	10001110	AE	10101110	DE	11011110
6F	01101111	o	8F	10001111	AF	10101111	DF	11011111
70	01110000	p	90	10010000	B0	10110000	E0	11100000
71	01110001	q	91	10010001	B1	10110001	E1	11100001
72	01110010	r	92	10010010	B2	10110010	E2	11100010
73	01110011	s	93	10010011	B3	10110011	E3	11100011
74	01110100	t	94	10010100	B4	10110100	E4	11100100
75	01110101	u	95	10010101	B5	10110101	E5	11100101
76	01110110	v	96	10010110	B6	10110110	E6	11100110
77	01110111	w	97	10010111	B7	10110111	E7	11100111
78	01111000	x	98	10011000	B8	10111000	E8	11101000
79	01111001	y	99	10011001	B9	10111001	E9	11101001
7A	01111010	z	9A	10011010	BA	10111010	EA	11101010
7B	01111011	{	9B	10011011	BB	10111011	EB	11101011
7C	01111100	|	9C	10011100	BC	10111100	EC	11101100
7D	01111101	}	9D	10011101	BD	10111101	ED	11101101
7E	01111110	~	9E	10011110	BE	10111110	EE	11101110
7F	01111111	■	9F	10011111	BF	10111111	EF	11101111
					C0	11000000	F0	11110000
					C1	11000001	F1	11110001
					C2	11000010	F2	11110010
					C3	11000011	F3	11110011
					C4	11000100	F4	11110100
					C5	11000101	F5	11110101
					C6	11000110	F6	11110110
					C7	11000111	F7	11110111
					C8	11001000	F8	11111000
					C9	11001001	F9	11111001
					CA	11001010	FA	11111010
					CB	11001011	FB	11111011
					CC	11001100	FC	11111100
					CD	11001101	FD	11111101
					CE	11001110	FE	11111110
					CF	11001111	FF	11111111

The SCM with Modems – The RTS Option

The standard SCM has an average response time of approximately 10 milliseconds (ms). Most modems require an RS-232C "key-up" signal to activate their internal transmitter. There is also a delay associated with the turn-on of the transmitter itself. Typically, the total delay ranges from 150 to 500 ms. Refer to the manual for your modem for the total delay time.

The RTS Option is required for SCM use with radio, leased line, and standard dial-up modems with no auto-answer capability. SCM's equipped with RTS provide an RS-232C Request-to-Send (RTS) signal, and have three, user-programmable time delays for "holding" and sequencing data until the connected modem is ready to send.

NOTE
Depending upon the type of modem used in the application, certain installations may also require a separate Radio Modem Interface unit, available from the factory. Consult your Sales Representative for details.

The RTS Option Commands

There are nine command s that control and read the operating parameters of the RTS-equipped SCM.

They are:

- **Read T1 –** **$*a*RT1**
- **Read T2 –** **$*a*RT2**
- **Read T3 –** **$*a*RT3**
- ***Set Time Delay 1 (T1) –** **$*a*T1+*nnnnn.nn***
- ***Set Time Delay 2 (T2) –** **$*a*T2+*nnnnn.nn***
- ***Set Time Delay 3 (T3) –** **$*a*T3+*nnnnn.nn***
- ***Set RTS Active High –** **$*a*RTS+**
- ***Set RTS Active Low –** **$*a*RTS–**
- ***Disable RTS –** **$*a*RTSD**

* These commands must be preceded by a Write Enable command.

Delay Time 1

T1 is the "dead time" interval between the receipt of a command from the Host and a transmit from the SCM. The delay begins upon receipt of the carriage return at the end of a valid SCM command from the Host.

Command: $*a*T1+*nnnnn.nn*↵
Typical Response: *

Where "***nnnnn.nn***" stands for a time value in milli-seconds. For example, $2T1+00125.00↵ sets T1 in SCM "2" to 125 ms.

After the T1 interval, the setting for T2 is called, and that delay interval is begun.

Delay Time 2

This delay provides a time period for the transmitting of the RTS signal and modem "key up". The delay is triggered by the end of the T1 interval.

Command: $*a*T2+*nnnnn.nn*↵
Typical Response: *

The T2 setting, like T1, is also scaled in milli-seconds.

After the T2 interval, the setting for T3 is caled, and the final delay period begins.

Delay Time 3

The final delay, T3, is the period of time between the last character transmitted by the SCM and the trailing edge of the RTS signal, which is typically used to turn off the modem (remote transmitter).

Command: **$aT3+*nnnnn.nn*↵**
Typical Response: *

Like the other two delay settings, T3 is scaled in milliseconds.

Use the appropriate Read commands, RT1, RT2, or RT3, to check the settings of these parameters.

Setting the RTS Signal HIGH

This command sets the state of the RTS pin on the SCM to HIGH. When idle, this pin will be negative.

Command: **$aRTS+↵**
Typical Response: *

Use this command when connecting the SCM to modems that require a positive voltage signal to enable their transmitting cycle.

Setting the RTS Signal LOW

This command sets the state of the RTS pin on the SCM to LOW. When idle, this pin will be positive.

Command: **$aRTS–↵**
Typical Response: *

Use this command when connecting the SCM to modems that require a negative voltage signal to enable their transmitting cycle.

<u>*NOTE*</u>

Either of the preceding commands overrides the setting for an alarm or digital output on pin 5 of the SCM.

Disable the RTS Signal

This command disables the Option, returning pin 5 of the SCM to its standard discrete or alarm output setting.

Command: **$aRTSD↵**
Typical Response: *

Connecting the RTS-Equipped SCM

Pin 5 of the SCM, refer to table 3 of this manual, is used to connect the unit's RTS-associated outputs to the modem. This pin is labeled "DOØ/LO".

Any setting for this terminal, typically effected in the Utility program (refer to the Calibration Section), is over-ridden by the RTS. I.e., the default for pin 5 is the RTS signal. To use that terminal as a discrete or alarm output, the RTS Option must be disabled.

<u>*NOTE*</u>

The delay settings in the SCM serve only to guarantee a minimum turn-around time. The actual delay is a function of the command response time of the SCM and the amount of time necessary for the modem's transmitter to turn off, after the RTS signal becomes inactive.

Consult the factory for information on available RS-485-to-RS-232C converters, modems, and other communications devices.

NOTES

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

   Warranty Repair –
   If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

   Non-Warranty Repair –
   If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
   a) A note listing the symptoms that indicate the unit needs repair
   b) Complete shipping information for return of the equipment after repair
   c) The name and phone number of the person to contact if questions arise at the factory

3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.

4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

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