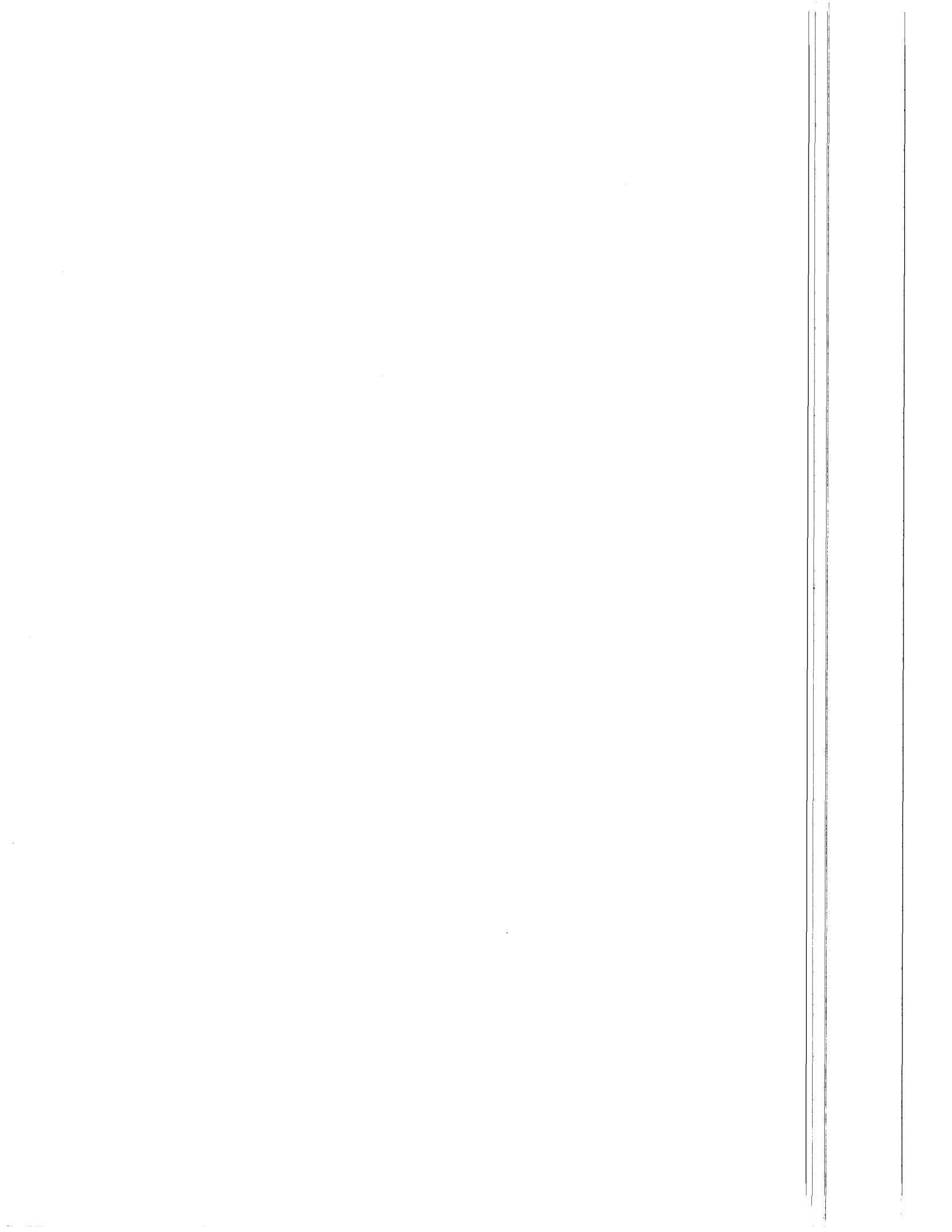


**MODEL SM16, SM64 STORAGE MODULES  
AND  
MODEL SM232A STORAGE MODULE/RS232 INTERFACE  
INSTRUCTION MANUAL**

**REVISION: 6/88**

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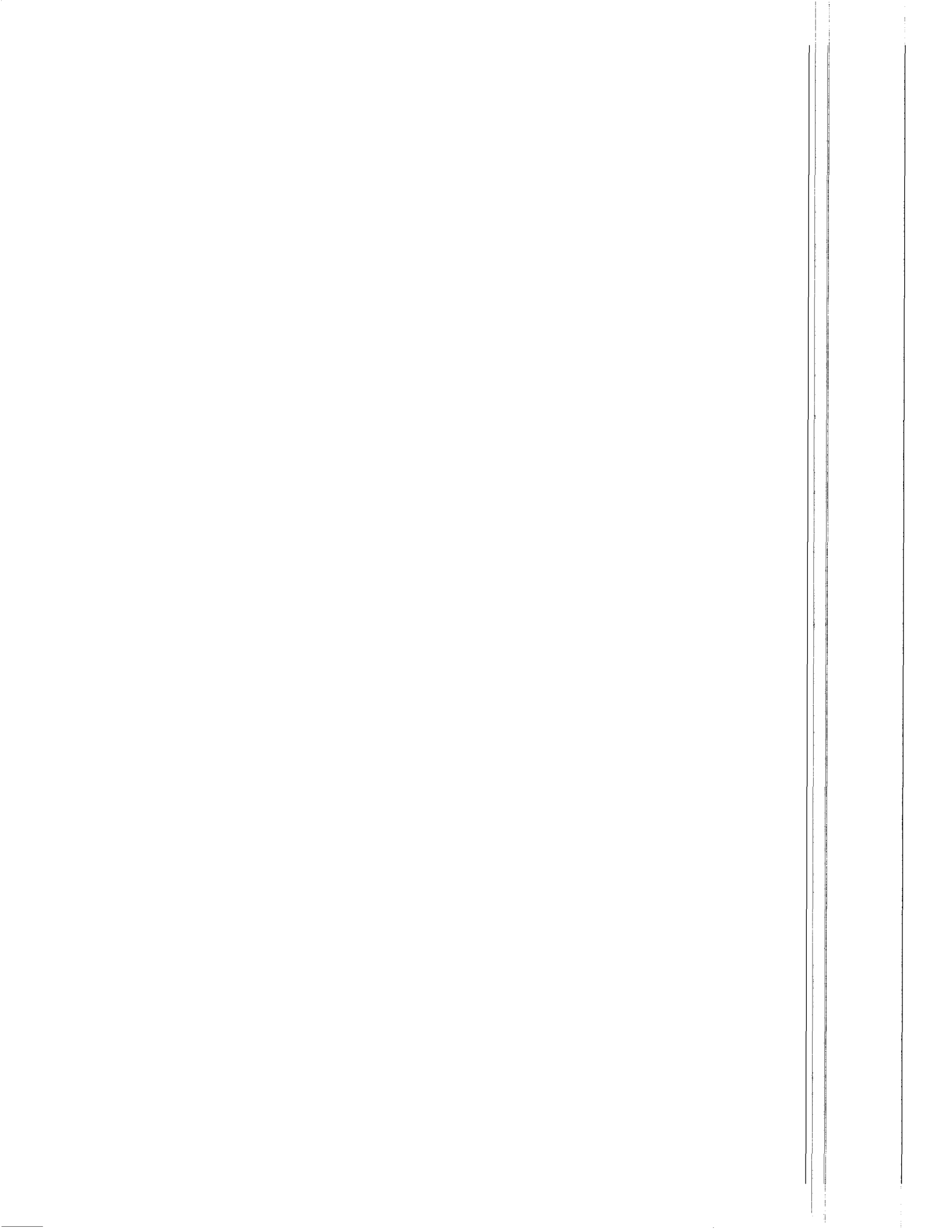
## WARRANTY AND ASSISTANCE

The SM16, SM64 STORAGE MODULES AND SM232A STORAGE MODULE/RS232 INTERFACE are warranted against defects in materials and workmanship. This warranty applies for twelve months from date of delivery. We will repair or replace products which prove to be defective during the warranty period provided they are returned prepaid to CAMPBELL SCIENTIFIC, INC. CAMPBELL SCIENTIFIC, INC. will return warranted equipment by surface carrier prepaid. No other warranty is expressed or implied. CAMPBELL SCIENTIFIC, INC. is not liable for consequential damages.

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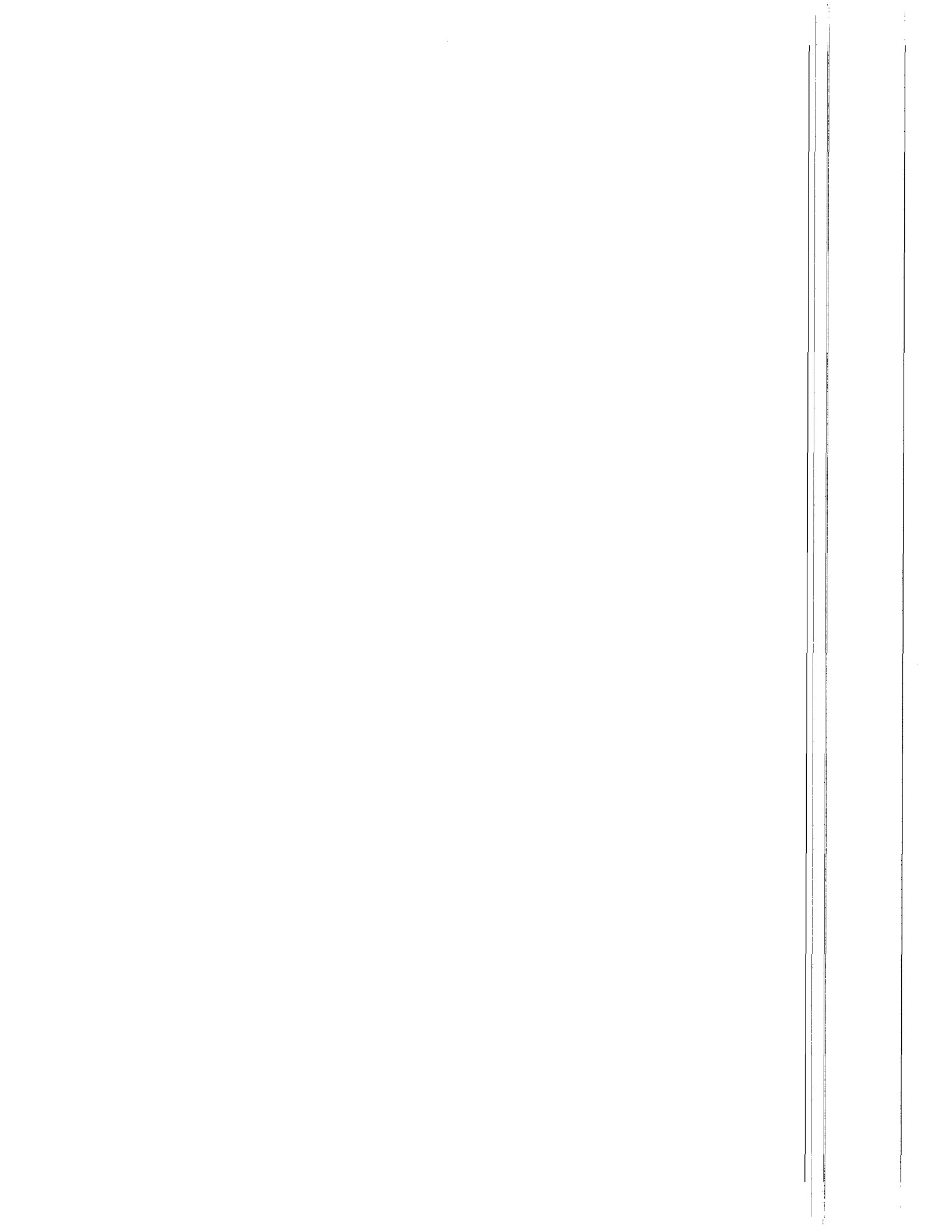
CAMPBELL SCIENTIFIC, INC. does not accept collect calls.

Non-warranty products returned for repair should be accompanied by a purchase order to cover the repair.



## PREFACE

Although the Storage Module shipped with this Manual is a fully operational version, two functions listed on the front panel have not been programmed into the firmware (EPROM). The unimplemented functions are (1) it cannot be used to transfer a program to a datalogger and (2) it cannot be used to receive a program from a datalogger. All other functions are implemented and working.



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## SECTION 1. GENERAL INFORMATION

CSI's Storage Modules (SM) and the SM232A Storage Module/RS232 Interface are designed to store and unload data recorded by Campbell Scientific dataloggers. The data are stored in the SM in battery backed solid state CMOS RAM. The SM can unload its data direct to a computer or printer via the SM232A or it can unload direct to cassette tape. Data on the cassette tape can be transferred to a computer using the C20 Cassette Interface or the PC201. The SM was developed to provide the user a convenient reliable method of data storage in temperatures between  $-35$  and  $+55^{\circ}\text{C}$ . This method of data storage eliminates many of the inconveniences and problems associated with the storage of data on cassette tape in sub-freezing temperatures.

The Model SM16 has 16,384 (16k) bytes of memory and will store up to 8192 Low Resolution or 4096 High Resolution data points. The Model SM64 is functionally identical to the SM16 except that it has 65,536 (64K) bytes of memory and will store up to 32,768 Low Resolution or 16,348 High Resolution data points. A Low Resolution data point falls between  $\pm 6999$  and  $\pm 0.001$ . A High Resolution data point falls between  $\pm 99999$  and  $\pm 0.00001$ . Refer to the Operator's Manual of the datalogger to determine whether or not the datalogger has the High Resolution option.

Before the SM leaves the Factory, it has been tested in CSI's environmental chamber for several hours at  $-35^{\circ}\text{C}$  and at  $+55^{\circ}\text{C}$ . The humidity operating range of the electrical components inside the SM is 0 to 90% RH provided it is noncondensing. Environmental testing of the SM at temperatures outside those referenced above can be performed. Contact the Factory for details.

The SM weighs two pounds and is 1.75 inches high, 4.4 inches wide and 6.25 inches deep with another inch of depth required for the connector. While it is connected to a datalogger or the SM232A it draws its operating power (aprox. 0.3 - 0.5 mA quiescent, 8 mA when storing/dumping) from the datalogger. In a typical situation this amount of current drain will reduce the 21X or CR21 battery life time by one third and the CR7 battery cycle time by 5%. The SM uses its own internal battery to hold the data in CMOS RAM when it is not connected to the datalogger or SM232A. When it is not connected, the current drain of the SM is small enough that its internal battery should last six to nine years.

The SM232A Storage Module/RS232 Interface is a device which allows communication to take place between the SM and a terminal, printer, Modem or computer. The user's terminal, etc. must have

## SECTION 1. GENERAL INFORMATION

a standard RS-232-C interface to connect to the SM232A. The SM232A functions primarily as a voltage level shifter to translate the 0 to 5 VDC level used by the SM to the standard RS232 voltage levels. Another function of the SM232A is to provide a 5 VDC power supply for the SM.

The SM232A comes with and is powered by a 110 VAC transformer that outputs 16 VAC. It is designed to operate in the 0 to +40°C temperature range and the 0 to 90%, noncondensing RH range. The weight of the SM232A is 0.7 pounds and it is 2 inches high, 5.1 inches wide and 4.8 inches deep.

The SM may also be interfaced to the IBM PC or a compatible via the PC201 card and the SC209 cable.

## SECTION 2. DATA STORAGE

### 2.1 GENERAL

The Storage Module (SM) receives data coming from the datalogger which otherwise is intended for a printer. The CR21 and the CR5 automatically send data to the printer/SM. The CR7 and 21X must be programmed (\*4 Mode) to send data to the printer/SM. The datalogger sends the data to the SM in ASCII where it is either converted and stored in CSI's binary Format or stored direct in ASCII. CSI's binary Format makes more efficient use of the memory and therefore is the preferred method for storing datalogger data.

The number of days that the SM can be left to store data is determined by deviding the total number of data points in the SM memory (SM16 = 8192, SM64 = 32768) by the total number of data points output by the datalogger in one day. Overhead information such as date, time and output table ID must be included in the total daily data point output. Storage of a High Resolution data point (datalogger operators manual will specify if this option is available) requires twice as much memory as a Low Resolution data point.

Information concerning the Test & Initialization procedure and some brief set up instructions for storing data generated by CSI's dataloggers, a terminal, or a computer are found in the following Sections. More detailed information concerning the various switch functions is found in Appendix A.

### 2.2 TEST & INITIALIZATION

The Test & Initialization routine is set up to allow the user to do a partial SM memory test and to initialize storage pointers. This test does not check the condition of the battery or verify the battery's ability to hold the data in memory. See Section 4 for the battery check procedure. NOTE: This routine REMOVES all previously stored data values. Therefore, the Test & Initialization routine should be executed AFTER ALL VALUABLE DATA HAS BEEN UNLOADED AND CHECKED and BEFORE NEW DATA ARE STORED.

To execute the Test & Initialization function the SM must be plugged into a host system (datalogger or SM232A) for power. If the SM is attached to the SM232A the SM232A LOAD/UNLOAD SWITCH (see Figure 3-1) should be in the TRANSPARENT position. SWITCHES 5 and 6 on the SM should be set in the UP position and the BUTTON pushed and released. About 2 seconds after the BUTTON is released the ACTIVE LIGHT will come on for a period of 2 seconds to indicate that the SM has completed the Test & Initialization function.

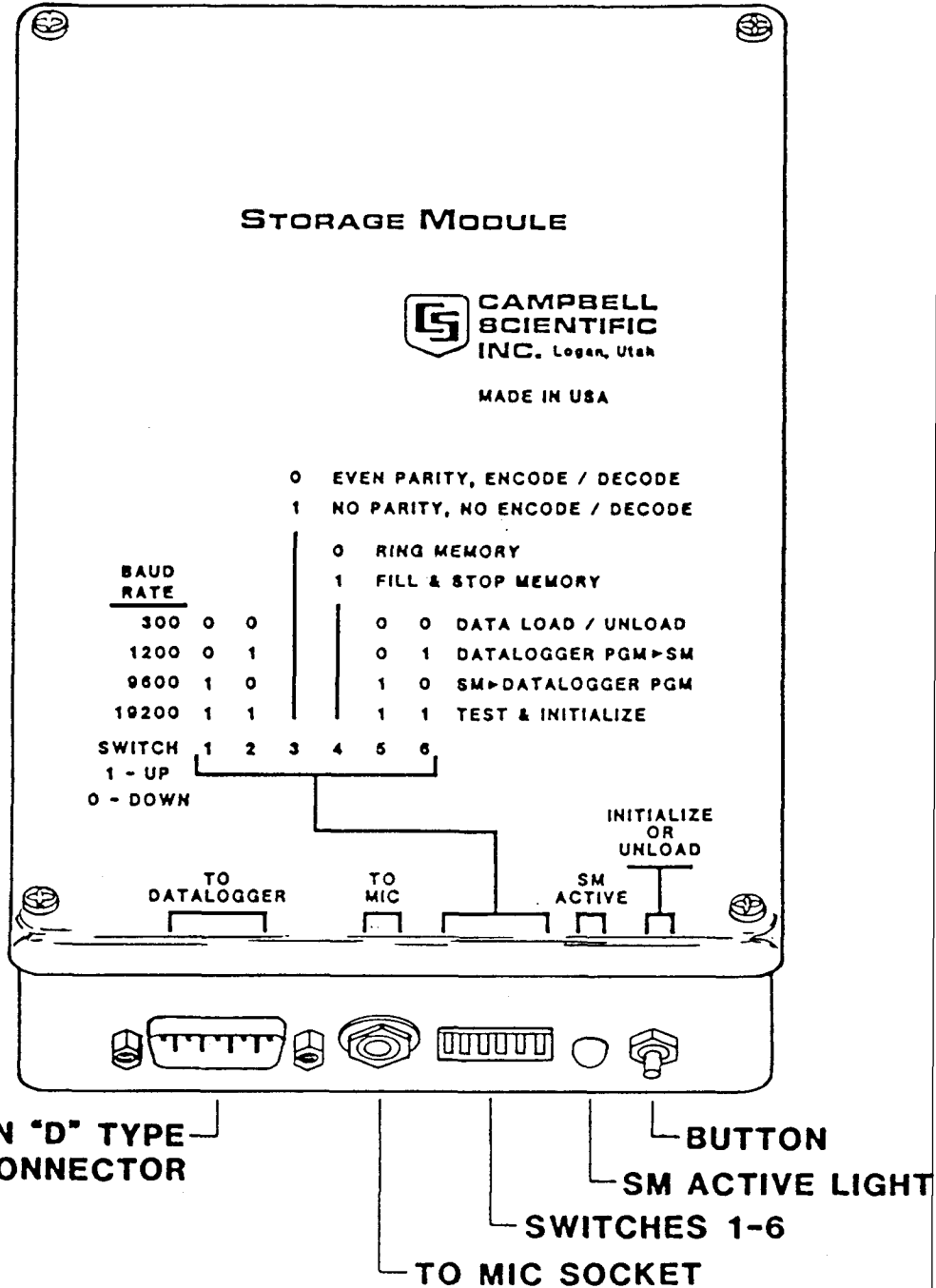


FIGURE 2-1. Storage Module

## SECTION 2. DATA STORAGE

The memory test function checks one byte out of every 256 bytes which should catch most memory failures. Because it is not a complete check of the memory, the user should occasionally check his data for small "holes" or scrambled information. If the test finds some of the memory is bad, the LIGHT will flash more than once: 10 times for bad EPROM, 15 times if RAM on CPU board is bad, 20 times if data storage memory is bad. If bad data storage memory is found, the SM will also "map out" the bad memory enabling the user to store data in the remaining good memory until the SM can be sent in for repair.

NOTE! SWITCHES 5 and 6 must be reset in the DOWN position before new data will be stored.

### 2.3 LOADING DATA FROM THE CR21

To load data from the CR21 to a SM, connect the "SERIAL I/O" port on the CR21 to the 9 pin D-type connector on the SM, using the Model SC12 Two Peripheral Connector Cable (Figure 2-1). Set the SWITCHES as follows:

<u>SWITCH</u>	<u>POSITION</u>	<u>FUNCTION</u>
1,2	DOWN	Used to select the appropriate baud rate. The baud rate of the CR21 is fixed at 300 baud. The baud rate setting of the SM must match that of the CR21; therefore, switches 1 and 2 must be down.
3	DOWN	This position selects the encode/decode option which is the most efficient way to store data generated by CSI dataloggers (see Appendix C).
4	????	Used to determine what is to be done when a user tries to store too much data in the SM.  If SWITCH 4 is DOWN, new data are written over old data when the SM memory becomes full.  If SWITCH 4 is UP, new data will NOT be stored once the SM is full. If the memory of the SM is over run, some of the lost data can be recovered by transferring the internal final memory of the CR21 to the replacement SM with the keyboard entry of a *9 printer dump.
5,6	DOWN	Data load position.

## SECTION 2. DATA STORAGE

With the SWITCHES properly set the SM is ready to accept data. The SM stores data coming from the datalogger which otherwise is intended for a printer. The CR21 Micrologger AUTOMATICALLY sends its data to a printer or storage module as data are stored in its final memory. As values are stored in the memory of the Storage Module the SM ACTIVE LIGHT will flash. This flashing action should be used as an indicator to help verify that the set-up procedure is correct.

### 2.4 LOADING DATA FROM THE CR7 OR 21X

To load data from the CR7 to a SM, connect the "SERIAL I/O" port on the CR7 to the 9 pin D-type connector on the SM, using the Model SC12 Two Peripheral Connector Cable (Figure 2-1). Set the SWITCHES as follows:

<u>SWITCH</u>	<u>POSITION</u>	<u>FUNCTION</u>
1,2	????	Used to select the appropriate baud rate. The baud rate of the CR7/21X serial port can be set by the user (see CR7/21X Operators Manual). The baud rates of the CR7/21X, the SM and any other external device must match in order for data transmission to occur. CAUTION: Key board entered printer dumps (*9) to the SM should not be done at baud rates exceeding 1200 baud because the SM can not convert and store the data at a faster rate.
3	DOWN	This position selects the encode/decode option which is the most efficient way to store data generated by CSI dataloggers (see Appendix C).
4	????	Used to determine what is to be done when a user tries to store too much data in the SM.  If SWITCH 4 is DOWN, new data are written over old data when the SM becomes full.

## SECTION 2. DATA STORAGE

<u>SWITCH</u>	<u>POSITION</u>	<u>FUNCTION</u>
---------------	-----------------	-----------------

If SWITCH 4 is UP, new data will NOT be stored once the SM memory is full. If the memory of the SM is over run, some of the lost data can be recovered by transferring the internal final memory of the CR7 to the replacement SM with the keyboard entry of a \*9 printer dump.

5,6	DOWN	Data load position.
-----	------	---------------------

With the SWITCHES properly set the SM is ready to accept data. The SM stores data coming from the datalogger which otherwise are intended for a printer. The CR7/21X datalogger must be programmed specifically (\*4 Mode) to send data to the printer/SM. As data are stored in the SM's memory the SM ACTIVE LIGHT will flash (Figure 2-1). This flashing action indicates that the set-up procedure is correct.

An alternate method of storing data in a SM is available for dataloggers that have Instruction 96. The CR7 with the 700X CPU board and the 21X with either ESX1 or ESX2 have Instruction 96. Instruction 96 allows the user to control when the datalogger outputs printer/SM data.

If the SM is the only device receiving printer/SM data and Instruction 96 is available then the data should be sent to the SM in binary. Binary transmission of the data is faster because fewer bits are required per data point and because the binary to ASCII to binary conversion time is eliminated. At 1200 baud the number of data points sent per second in ASCII and binary are 12 and 60, respectively.

When Instruction 96 is used to output printer/SM data in binary, then the third switch on the SM should be set to the NO PARITY, NO ENCODE / DECODE position. The rest of the switches should be set as described above. If the printer/SM data is output using the \*4 Mode instead of Instruction 96, switch 3 should be down (ENCODE / DECODE).

### 2.5 LOADING DATA FROM THE CR5

An alternate method of storing data in a SM is available for dataloggers that have Instruction 96. The CR7 with the 700X CPU board and the 21X with either ESX1 or ESX2 have Instruction 96. Instruction 96 allows the user to control when the datalogger outputs printer/SM data.

If the SM is the only device receiving printer/SM data then the data should be sent to the SM in binary. Binary transmission

## SECTION 2. DATA STORAGE

of the data is faster because fewer bits are required per data point and because the binary to ASCII to binary conversion time is eliminated. At 1200 baud the number of data points sent per second in ASCII and binary are 12 and 60, respectively.

When Instruction 96 is used to output printer/SM data in binary, then the third switch on the SM should be set to the NO PARITY, NO ENCODE / DECODE position. The rest of the switches should be set as described above. If the printer/SM data is output using the \*4 Mode instead of Instruction 96, switch 3 should be down (ENCODE / DECODE).

To load data from the TC235A module of the CR5 to a SM, connect the "SERIAL I/O" port on the TC235A to the 9 pin D-type connector on the SM, using the Model SC12 Two Peripheral Connector Cable (Figure 2-1). Set the SWITCHES as follows:

<u>SWITCH</u>	<u>POSITION</u>	<u>FUNCTION</u>
1,2	DOWN	Used to select the appropriate baud rate. The baud rate of the TC235A is fixed at 300 baud. The baud rate setting of the SM must match that of the TC235A; therefore, switches 1 and 2 must be down.
3	DOWN	This position selects the encode/decode option which is the most efficient way to store data generated by CSI dataloggers (see Appendix C).
4	????	Used to determine what is to be done when a user tries to store too much data in the SM.  If SWITCH 4 is DOWN, new data are written over old data when the SM memory becomes full.  If SWITCH 4 is UP, new data will NOT be stored once the SM memory is full. If the memory of the SM is over run, some of the lost data can be recovered by transferring the internal final memory of the TC235A to the replacement SM with a "memory dump to printer".
5,6	DOWN	Data load position.

With the SWITCHES properly set the SM is ready to accept data. The SM stores data coming from the datalogger which otherwise are intended for a printer. The CR5 AUTOMATICALLY sends its data to a printer/SM as data are stored in its final memory. As values are stored in the memory of the Storage Module



## SECTION 2. DATA STORAGE

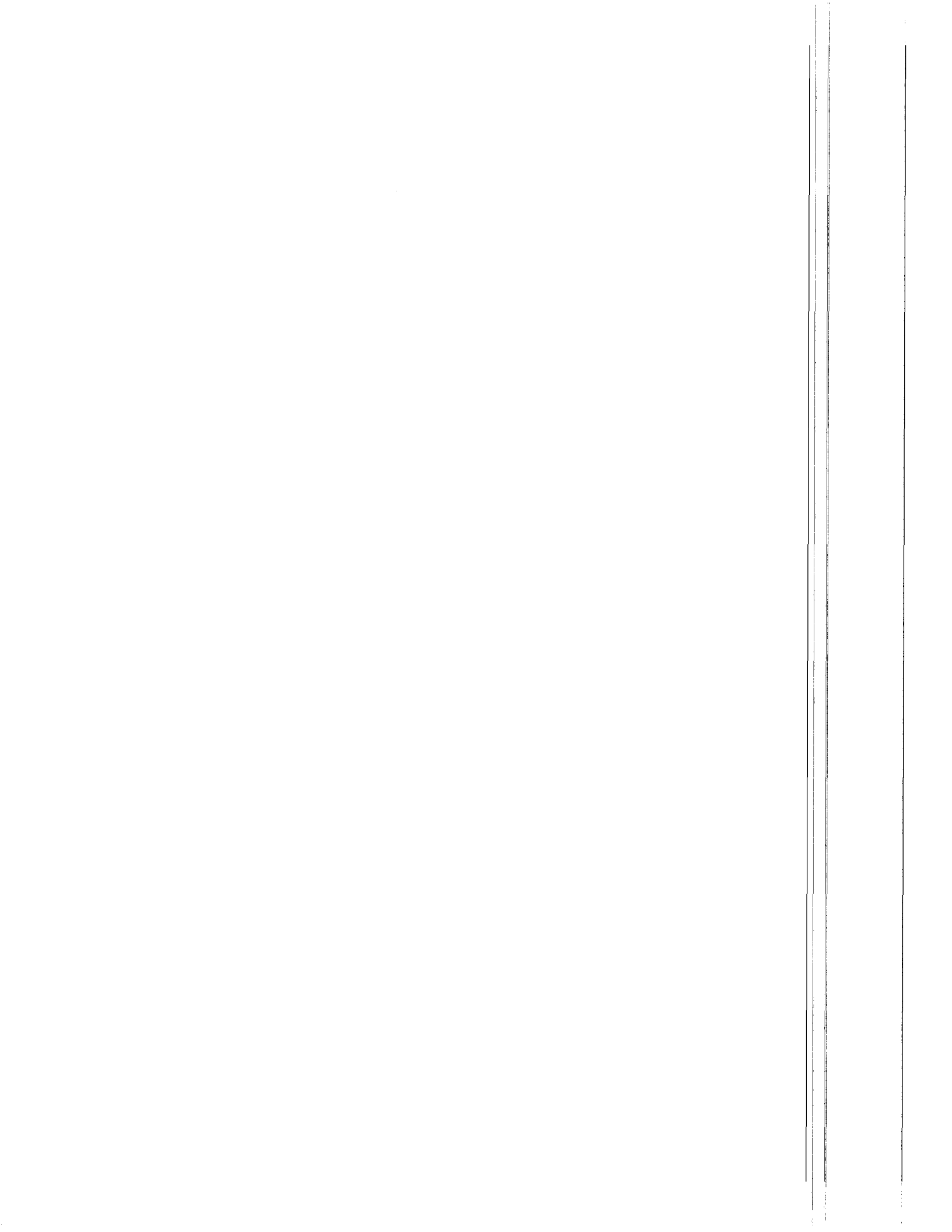
the SM ACTIVE LIGHT will flash. This flashing action helps to verify that the set-up procedure is correct.

### 2.6 LOADING DATA FROM COMPUTER, MODEM OR TERMINAL

To load data into a SM from a computer, modem or terminal, it must be connected to the computer etc. via the SM232A STORAGE MODULE/RS232 Interface or the PC201 Card. A terminal connects to the "TO TERMINAL" port while a modem or computer connects to the "TO MODEM" port. IBM PCs and compatibles connect to the "TO TERMINAL" port. The SM is connected to the SM232A by the SC12 Two Peripheral Connector Cable (Figure 3-1). Set the SWITCHES as follows:

<u>SWITCH</u>	<u>POSITION</u>	<u>FUNCTION</u>
1,2	????	Used to select the appropriate baud rate. REMEMBER: The baud rates of the SM and any other external device must match in order for data transmission to occur. Although the SM can communicate at baud rates greater than 1200, it can not store data much faster than 1200 baud. Therefore, it is best not to communicate with the SM at rates faster than 1200 baud unless it is verified that the actual data transfer rate is about 1200 baud.
3	UP	This position selects the ASCII Format option which stores 65,536 bytes or characters of information. The DOWN position or Encode/Decode option should not be used on data from sources other than CSI dataloggers.
4	????	Used to determine what is to be done when a user tries to store too much data in the SM. If SWITCH 4 is DOWN, new data are written over old data when the SM memory becomes full. If SWITCH 4 is UP, new data will not be stored once the SM memory is full.
5,6	DOWN	Data load position.

Once the connections are made and the SM SWITCHES are set in their proper positions, set the SM LOAD/UNLOAD SWITCH (Figure 3-1), located on the SM232A, to the SM LOAD position. Set the DATA TO MODEM ONLY/DATA TO TERMINAL & MODEM SWITCH to its appropriate setting. With the switches properly set, any characters sent through the SM232A will also be sent to and stored by the SM. As values are stored in the memory of the Storage Module the SM ACTIVE LIGHT will flash. This flashing action helps to verify that the set-up procedure is correct.



## SECTION 3. DATA RETRIEVAL

### 3.1 GENERAL

Direct unloading of SM data to a computer or printer requires the SM232A Storage Module/RS232 Interface (Figure 3-1) or the PC201 Card with the SC209 Cable. Data in the SM also may be unloaded indirectly to computer or printer by transferring the data onto cassette tape. The tape is then read into a computer or printer via the C20 Cassette Interface or the PC201 Card. The tape dump method is explained in detail in Section 3.5.

All data from the SM and all commands from the user's device pass through the SM232A. The baud rates of the SM and the user's device must match before communication can occur.

The SM has an internal UNLOAD POINTER that points to the next data point to be unloaded from the SM memory. The pointer always points to the oldest data until data are actually unloaded at which time it advances through the memory from the oldest to the newest. The UNLOAD POINTER is reset to point at the oldest data in memory 1) every time the SM LOAD/SM UNLOAD SWITCH on the SM232A is moved to the TRANSPARENT position, 2) every time the 5 volt supply to the SM is removed by disconnecting the cable, and 3) every time the SM is called by a modem.

### 3.2 DATA RETRIEVAL COMMANDS

When the SM is attached to a computer or terminal (or both) it can receive, from the computer/terminal, certain command characters which will initiate, control, and stop a data dump. With one exception, this default set of SINGLE CHARACTER COMMANDS can be changed by the user should one or more of the default commands prove unacceptable.

The default commands and their associated functions are listed in the following Table. The " " symbol identifies those character commands which are ASCII Control Characters.

TABLE 3-1. Default Commands

<u>CODE</u>	<u>FUNCTION</u>
^V (decimal 22)	Program command (cannot be altered).
^Q (decimal 17)	Request one LINE of data. Default postamble is CR.
^R (decimal 18)	Request one BLOCK of data. CR, LF after each line. Extra CR, LF after each array.
^S (decimal 19)	STOP
^T (decimal 20)	Request CONTINUOUS data dump. CR, LF after each line. Extra CR, LF after each array.

SECTION 3. DATA RETRIEVAL

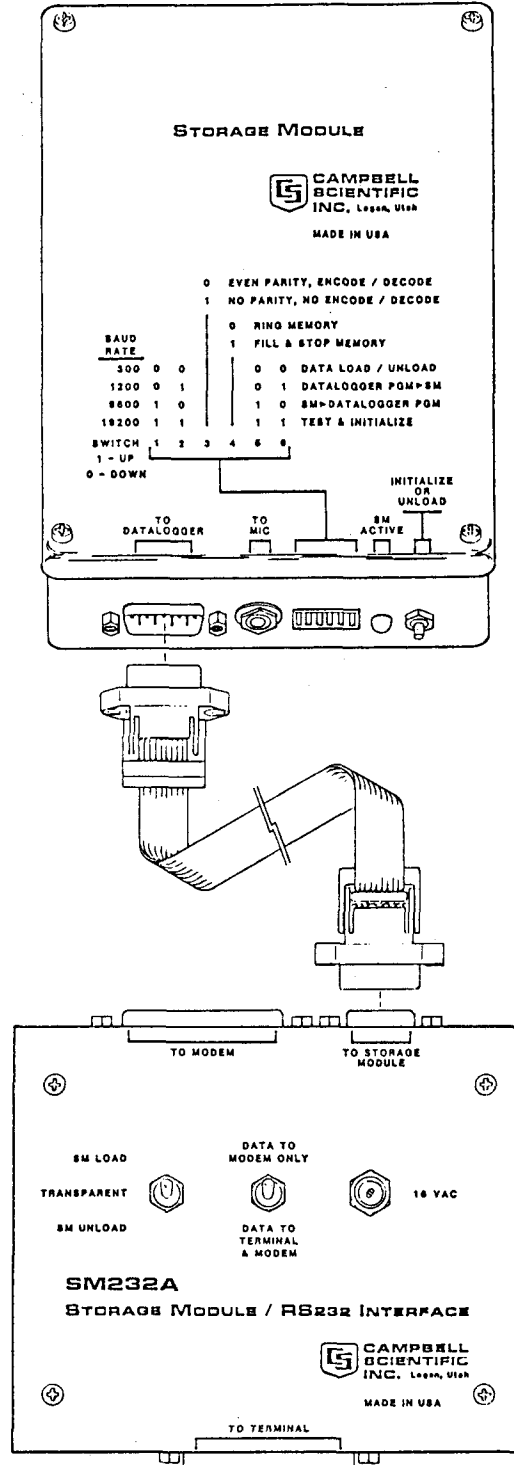


FIGURE 3-1. Storage Module and SM232A

### SECTION 3. DATA RETRIEVAL

To program the SM with a command character set of your choosing, send a ^V followed by a string of program characters. The ^V is the only command character that can not be changed. The following is a description of the characters that can be sent and their respective functions:

<u>CHARACTER NUMBER</u>	<u>FUNCTION</u>
1	Command code used to request a LINE of data.
2	Command code used to request a BLOCK of data.
3	Command code used to STOP.
4	Command code used to request a CONTINUOUS data dump.
5	One byte BINARY value defining the number of milliseconds delay between transmitted characters. Default is 0 (0 in BINARY = ASCII NULL = ^@).
6	One byte BINARY value defining the number of milliseconds between when a command is received and when the first character comes back. Default is 0 (0 in BINARY = ASCII NULL = ^@).
7	One byte BINARY value defining the number of characters or bytes to be sent when a block of data is requested. A 0 sets the BLOCK SIZE to one character, a 1 sets 256 characters, a 2 sets 512 characters, etc. Default is 4 or a BLOCK SIZE of 1024 characters. (0100 BINARY = 4 decimal = ^D in ASCII).
8	POSTAMBLE characters to be sent at the end of a line request. Up to 8 characters (followed by a NULL to terminate the string) may be specified. Note: NULL will NOT be sent as a postamble character. The POSTAMBLE is a set of characters used to indicate the end of a line. Carriage return, line feed are the most common postamble characters. (ASCII NULL = ^@).
?	END OF DATA MARKER. This character is sent when requesting a line of data and no more data exists in the SM. Up to 8 characters, followed by a NULL, may be specified. (ASCII NULL = ^@).

## SECTION 3. DATA RETRIEVAL

When DECODING data in the CONTINUOUS Mode or in the BLOCK mode, an extra CARRIAGE RETURN LINE FEED (CRLF) is sent between each array of data. In the LINE AT A TIME mode, there will be no empty lines. This feature improves the readability of the data as they appear on the terminal or printer.

When requesting BLOCKS of data and the SM is EMPTY, the SM fills the rest of the block with nulls if it is DECODING data OR it fills the rest of the block with 7FH (del) bytes if it is NOT DECODING data. If the END OF DATA MARKER has been altered by programing the SM with new commands, the first character of the END OF DATA MARKER is used to fill the end of a requested block when data runs out. The reprogrammed END OF DATA MARKER is used REGARDLESS of whether or not the SM is DECODING data.

When data are being requested LINE AT A TIME and the data DECODE Mode is inactive, the POSTAMBLE is sent each time a CRLF is encountered and the CRLF will not be sent. If two successive CRLF's are encountered, the POSTAMBLE ONLY will be returned on the second one.

Whenever the SM is sending data in the CONTINUOUS Mode and the data DECODE Mode is active, a data array having an ODD number of data points will be transmitted with the last data point of the array followed by 9 nulls. This feature allows CSI's CR56 Printer to keep up with datalogger data transmission. REMEMBER: SWITCH 3 on the SM must be in the DOWN position to DECODE data.

### 3.3 UNLOADING DATA TO A TERMINAL OR PRINTER ONLY

When connecting the SM232A to a TERMINAL ONLY or a PRINTER ONLY the terminal/printer should be connected to the SM232A port labeled TO TERMINAL. The centrally located SWITCH of the SM232A must be in the DATA TO TERMINAL & MODEM position (Figure 3-1). The DCD (Data Carrier Detect) line on the RS232 interface will be held active by the SM232A. The Data Terminal Ready line (DTR = Line 20) on the RS232 interface should be used as a TERMINAL/PRINTER STATUS line. If the terminal/printer is ready to accept data, Line 20 is high; if the terminal's/printer's buffer is full, Line 20 is low. Using Line 20 will insure that the SM will not over-run the terminal/printer. Other control lines are not connected.

To UNLOAD the SM, the SWITCHES on the storage module must be set to the positions they were in when the data were recorded with the exception of SWITCHES 1 AND 2 which must be set to match the baud rate of the terminal/printer. The SM LOAD/SM UNLOAD SWITCH located on the SM232A must be set to the SM UNLOAD position. After the SWITCHES are correctly set, the BUTTON (Figure 3-1) on the SM may then be pushed. Pressing the BUTTON will cause the SM to begin unloading data. Alternatively, a

## SECTION 3. DATA RETRIEVAL

terminal can send data retrieval commands (Section 3.2) to the SM, instructing it to unload its data. Once data transfer has begun, the data dump will be aborted if (1) the SM BUTTON is pressed again or (2) the position of the SM UNLOAD SWITCH on the SM232A is altered.

### 3.4 UNLOADING DATA TO A COMPUTER

The following sub-sections contain information concerning the transfer of data from the SM to a computer when used in a variety of configurations.

#### 3.4.1 SM232A BETWEEN TERMINAL AND COMPUTER

When the SM232A is used between a terminal and a computer the terminal is connected to the SM232A port labeled TO TERMINAL and the computer is connected to the SM232A port labeled TO MODEM. The SM is connected to the SM232A port labeled TO STORAGE MODULE. With 16 volts AC power connected and the SM LOAD/SM UNLOAD SWITCH on the SM232A in the TRANSPARENT position, the terminal should be able to communicate with the computer in a routine manner. If the SM232A is left connected between the terminal and computer when not being used with a SM the SM LOAD/SM UNLOAD SWITCH should be left in the TRANSPARENT position. NOTE: The SM232A remains ON until it is unplugged from the 16 VAC transformer.

All control lines in the RS232 interface are transferred straight through the SM232A with the exception of the DTR (Data Terminal Ready) line and the DCD (Data Carrier Detect) line. These two lines are used by the SM232A but their STATES are not modified by the SM232A. The DTR line should be sourced by the terminal. If it is sourced by the terminal, the SM232A will not modify what is sourced. If the DTR line is NOT sourced by the terminal, the SM232A will provide a source so that the DTR signal received by the computer becomes active (high). The DCD line should normally be sourced by the computer. If it is sourced by the computer, the terminal will receive what the computer sources. If the DCD line is NOT sourced by the computer, the DCD line that goes to the terminal will be held active by the SM232A.

The DATA TO MODEM ONLY/DATA TO TERMINAL & MODEM SWITCH should be set according to whether or not the computer echoes data to the terminal. If a character typed on the terminal IS echoed by the computer before it is printed on the screen of the terminal then the SWITCH should be in the DATA TO MODEM ONLY position. Alternatively, if a character typed on the terminal is NOT echoed by the computer then the SWITCH should be in the DATA TO TERMINAL & MODEM position. If this SWITCH is left in the wrong position, the computer will most likely continue to receive the data but the terminal will receive duplicate or scrambled data.

## SECTION 3. DATA RETRIEVAL

To UNLOAD data from the SM to the computer the SWITCHES on the SM must be set to the position they were in when the data were recorded with the exception of SWITCHES 1 AND 2. SWITCHES 1 AND 2 must be set to match the baud rate of the computer. Move the SM LOAD/SM UNLOAD SWITCH located on the SM232A to the "SM UNLOAD" position and have the computer send the proper commands to the SM to initiate the transfer of data (SM COMMANDS are discussed in Section 3.2). As data are sent to the computer they will also be sent to the terminal or echoed to the terminal so they can be viewed by the user. The most commonly used data transfer command is the "Request One Line Of Data" command. Appendix D contains a sample data retrieval program for the situation where the SM232A is between the terminal and the computer.

While UNLOADING data from the SM, the transfer process may be temporarily interrupted by using either the DCD line from the computer or the DTR line from the terminal. If either of these lines goes inactive, the SM stops transmitting and will resume transmitting from where it left off whenever the line goes active again. NOTE: If both lines go inactive at the same time, the SM will STOP and RESET. When both lines become active again the SM will proceed with sending data starting with the oldest data residing in its memory. NOTE: The STOP command also can be used to temporarily suspend data transfer from the SM.

When a computer is connected to the SM232A port labeled TO MODEM and the user wants to use the DCD (Data Carrier Detect) line of the RS232 interface to SLOW DOWN the rate at which data are being sent from the SM, the RI (Ring Indicator) line must be tied high or left disconnected.

NOTE: Command characters sent to the SM from the computer are sent to the terminal as well. Accordingly, it would be prudent to use command characters for the SM that have a minimal influence on the terminal.

### 3.4.2 SM232A BETWEEN TERMINAL AND MODEM

To set up the SM232A between a terminal and modem, refer to the information provided in Section 3.4.1 and substitute "modem" wherever "computer" appears.

### 3.4.3 SM232A TO AN IBM PC OR COMPATIBLE

When connecting the SM232A to an IBM PC or compatible, the serial RS232 port (COM 1 or COM 2) on the PC is connected to the SM232A port labeled TO TERMINAL. The centrally located SWITCH of the SM232A must be in the DATA TO TERMINAL & MODEM position (Figure 3-1). The DCD (Data Carrier Detect) line on the PC's RS232 port will be held active by the SM232A. The Data Terminal Ready line (DTR = Line 20) on the PC's RS232 port should be used as a



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status line. If the PC's buffer is full, Line 20 is low. Using line 20 will insure that the SM will not over-run the PC. Other control lines are not connected.

SM SWITCHES 3, 5, and 6 must be set to the position they were in when the data were recorded. SWITCHES 1 and 2 must be set to match the baud rate of the PC's serial port. The data may be transferred to the PC by either of the following methods:

Public domain and commercial communications packages such as Kermit, Crosstalk, etc. are capable of storing on disk, the data received at the PC's serial ports. Once the software has been set up properly (which COM port, what baud rate, etc...) all that is needed is to switch the SM LOAD/SM UNLOAD SWITCH to the SM UNLOAD position and press the SM BUTTON.

Appendix D contains the set up instructions and a basic program to transfer data from a storage module to an IBM PC or compatible.

### 3.4.4 SM232A TO A COMPUTER THAT IS NOT IBM PC COMPATIBLE

When connecting the SM232A to a COMPUTER ONLY the computer's DCE serial port should be connected to the SM232A port labeled TO MODEM. The centrally located SWITCH of the SM232A can be left in either position. The DTR (Data Terminal Ready) line on the RS232 interface will be held active by the SM232A. Other control lines are not connected. The computer must hold the DCD line active in order for the SM to transmit.

To UNLOAD data from the SM to the computer the SWITCHES on the SM must be set to the position they were in when the data were recorded with the exception of SWITCHES 1 AND 2. SWITCHES 1 AND 2 must be set to match the baud rate of the computer. Move the SM LOAD/SM UNLOAD SWITCH located on the SM232A to the "SM UNLOAD" position and have the computer send the proper commands to the SM to initiate the transfer of data (SM COMMANDS are discussed in the beginning of Section 3). The most commonly used data transfer command is the "Request One Line Of Data" command. Alternatively, a communications package such as Kermit, etc. can be used to capture the data that is output when the BUTTON is pressed.

If the port on the computer is designed to connect to a modem rather than a terminal (i.e., the computer looks like a terminal or DTE to the SM232A) then the computer should be connected to the SM232A port labeled TO TERMINAL. In this particular situation, the UNLOAD information given in the previous paragraph is valid but the line handshake information provided in Section 3.3 is more applicable.

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### 3.4.5 SM232A TO ANSWER MODEM

To set up the SM232A to talk to a MODEM ONLY, an answer modem is connected to the SM232A port labeled TO MODEM. This set-up typically would be used when the user intends to call the SM from another location and the SM is left unattended. For this situation, it will be assumed that the SM is already loaded with valid data.

In preparation to UNLOAD the SM, the switches on the SM must be set to the position they were in when the data were recorded with the exception of SWITCHES 1 AND 2. SWITCHES 1 AND 2 must be set to match the baud rate of the modem (usually 300 baud). The SM LOAD/SM UNLOAD SWITCH on the SM232A must be set to the SM UNLOAD position. Review the set-up to make sure the SM is connected to the SM232A and that the SM232A has power. Once these conditions are satisfied, the SM may be called and data transferred.

When a call comes in, the RI (Ring Indicator) line from the modem will go active. The SM232A will then pull the DTR (Data Terminal Ready) line active which goes to the modem. The modem should then answer the phone and apply a carrier signal to the phone line. The calling device would then apply its carrier signal to the phone line which should be detected by the answer modem which will then pull the DCD (Data Carrier Detect) line on the RS232 interface active. The DCD signal from the answer modem must make it back to the SM232A within 10 seconds of when the SM232A activates the DTR line. As long as the answer modem holds the DCD line active the SM232A will hold the DTR line active. Once the call is completed, the carrier signal is terminated (DCD line goes inactive) by hanging up the telephone receiver. This action will also cause the SM232A to deactivate the DTR line. During the "conversation" the calling device will be using SM commands (explained in Section 3.2) to retrieve data from the SM.

The UNLOAD POINTER is reset each time the SM is called by a modem. Therefore, if a portion of the data is missed and requires retransmission, the user must hang up the phone and start over again at the beginning of the data.

NOTE: The SM232A and a datalogger should NEVER be connected to the SM at the same time.

### 3.5 UNLOADING DATA TO CASSETTE TAPE

This function is most applicable to the situation where a user has several dataloggers recording data onto SMs. To retrieve data from these different sites the user must 1) have two SMs for each site substituting the empty SM for the full one, 2) have one SM for each site plus one extra SM and visit each site while