

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

REVISION: 6/88

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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 ± 6999 and ± 0.001 . A High Resolution data point falls between ± 99999 and ± 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°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.

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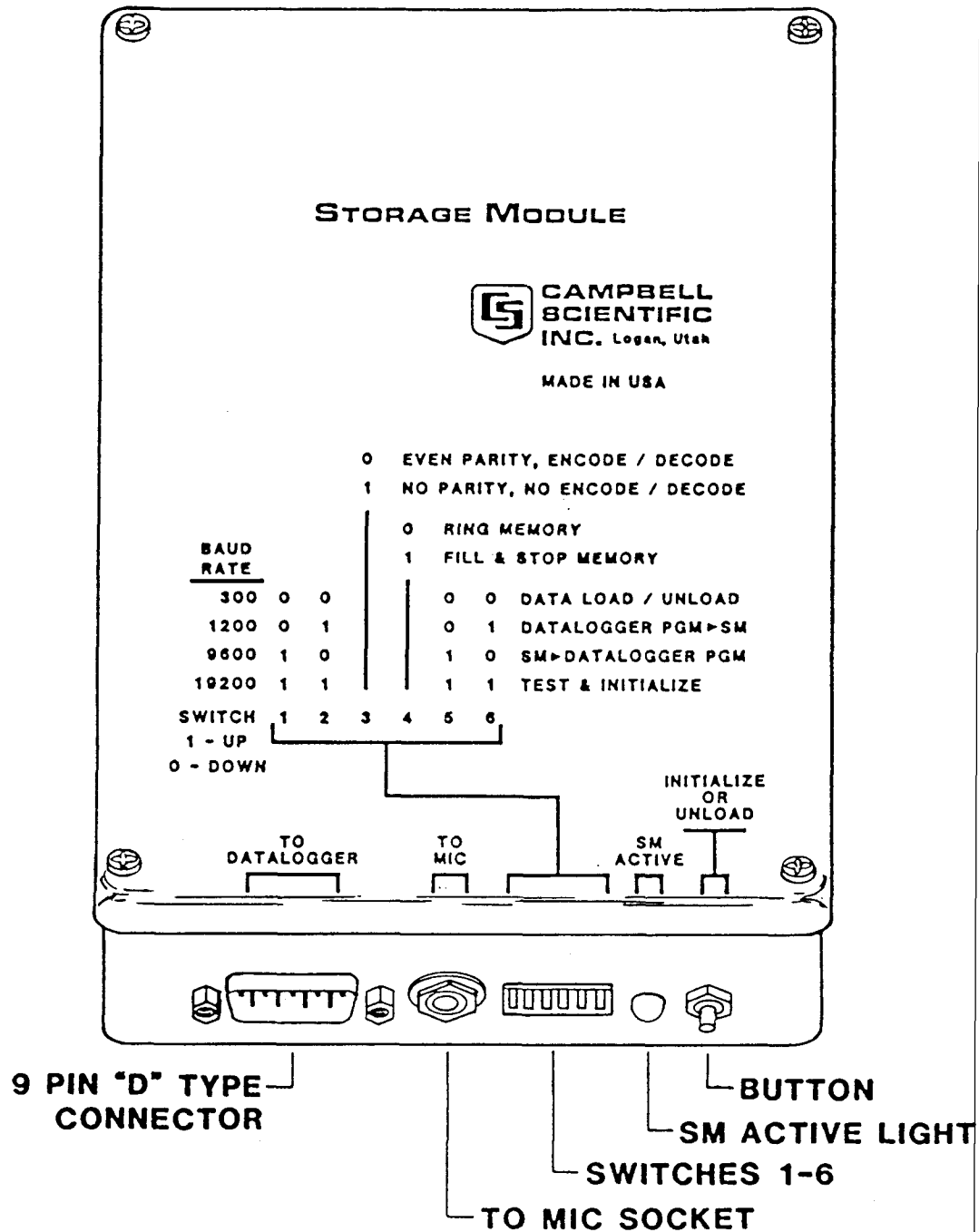


FIGURE 2-1. Storage Module

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>
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		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.
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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

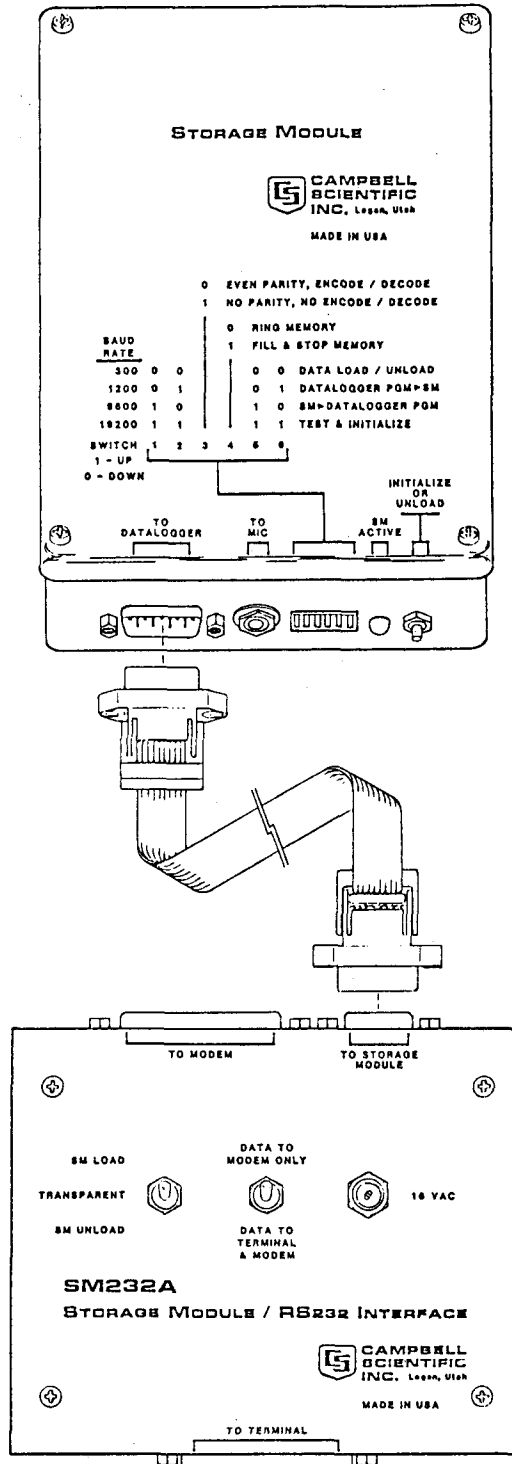


FIGURE 3-1. Storage Module and SM232A

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

SECTION 3. DATA RETRIEVAL

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.

SECTION 3. DATA RETRIEVAL

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

SECTION 3. DATA RETRIEVAL

separately removing the data from the SM between each visit, or 3) have one SM for each site and visit all of the sites storing the data from all of the SMs on one or more cassette tapes. The third option requires the user to purchase the C20 Cassette Interface but this cost could easily be less than the cost of the first option or less than the inconvenience and associated cost of the second option.

When transferring data to a cassette recorder from a SM, the SM must be connected by its ribbon cable to a datalogger. Once this is done, connect one end of a patch cord to the MIC socket on the cassette recorder and connect the other end of a patch cord to the SOCKET labeled "TO MIC" on the SM. If the user is NOT going to reinitialize the SM after the Tape Dump is completed, the datalogger can be left in the *0 mode. If it is to be reinitialized (SWITCH 4 in the UP position), it is recommended that the datalogger temporarily be put in the *9 Mode to stop the datalogger from sending data to the SM until all SM data are unloaded to tape. Be sure to return the datalogger to the *0 Mode when the tape dump is complete.

To UNLOAD the data from the SM onto cassette tape, press down the playback and record buttons on the cassette recorder to start the tape rolling. Be sure to let the tape advance until its non recording tape leader passes beyond the cassette recording head. Press the BUTTON (Figure 2-1) on the SM and the SM ACTIVE LIGHT will come on approximately two seconds after the switch is released. The light will remain lit for approximately 3.5 seconds while one 512 data point block is dumped to tape. It will continue to flash, 1.5 seconds off and 3.5 seconds on, until all the data in the SM's memory has been sent to tape. If the SM is full the light will flash either 16 or 64 times as 16 or 64 blocks

(8192 or 32768 data points contained in the SM16 or SM64) of data are sent to tape.

The SM tape dump always transmits data from the oldest to the most recent. A tape dump may be aborted any time by pressing the SM BUTTON a second time. The UNLOAD POINTER is reset to point at the oldest data each time the BUTTON is pressed.

SECTION 4. MAINTENANCE

While the SM232A Storage Module/RS232 Interface requires no periodic maintenance, the SM16s and SM64s require maintenance in three areas: 1) physical integrity, 2) desiccant replacement, and 3) battery voltage. Information for an experienced technician concerning replacement of the Lithium battery and methods of measuring the current drain is found at the end of this section.

PHYSICAL INTEGRITY

In spite of its built in ruggedness, the SM's button, switches, connector and internal components may all be damaged by accidental physical abuse. The button and switches are the most easily damaged parts. Another vulnerable part of the SM is the rubber gasket that is glued to the lid of the SM. The gasket, an important part of the moisture barrier, is easily damaged when the lid is screwed on too tightly. In most cases, physical damage to the storage module should be repaired at the factory.

DESICCANT REPLACEMENT

Desiccant is placed inside the semi-sealed steel enclosure to prevent water from condensing on the circuit cards when the storage module is used in humid environments. The crystal oscillator circuit is particularly sensitive to condensation. Condensation on the oscillator circuit will result in the SM failing to record data sent from the datalogger. It is difficult to say how frequently the desiccant should be replaced because of the varying conditions in which a SM may be used. Obviously, a humid environment will require that the desiccant be rejuvenated more frequently than a dry environment.

The desiccant is stored in a paper bag located in the lid of the SM. To reactivate the desiccant, remove the 4 retaining screws and the lid. Remove the paper bag of desiccant (HUMI-SORB) and heat the bag and its contents to 250°F (120°C) for 16 hours. Thereafter, reinsert the desiccant bag in the lid, making sure that the desiccant is distributed evenly inside the bag so that the enclosure lid fits properly. With the the rubber gasket properly seated, replace the lid and the 4 screws and tighten until the base and lid come into firm contact with the gasket but not so tight that the gasket is cut or damaged.

BATTERY VOLTAGE

Battery voltage should be checked AND RECORDED a few times each field season to insure recorded data will not be lost.

To measure the battery voltage unplug the SM from all host devices, remove the 4 screws and the lid. Once the lid is removed the memory card will be visible (Figure 4-1). The battery voltage of the SM can be checked by measuring the memory

SECTION 4. MAINTENANCE

board voltage between the corner pins 12 and 24 or between pins 14 and 28 for the SM16 or SM64 respectively. A digital volt meter with 0.1 V resolution or better is recommended.

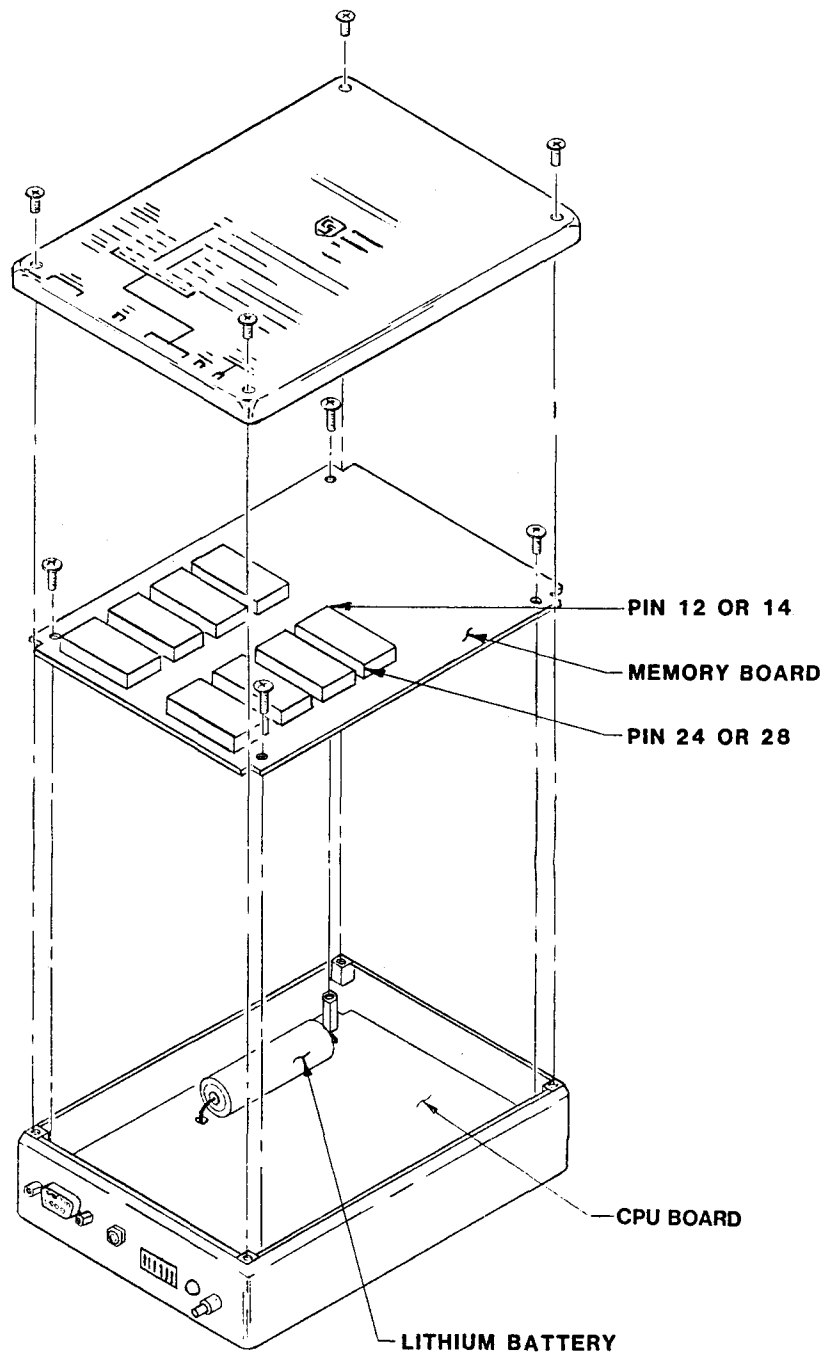


FIGURE 4-1. Storage Module Assembly

SECTION 4. MAINTENANCE

The memory board voltage reading should be greater than 3 volts (3.36 volts typical). Measured voltage may be higher depending on the brand of lithium battery used (up to 3.6 or 3.7 volts). Lithium batteries have a very flat discharge curve; therefore, each time the battery voltage is measured it should be very close to the previous voltage reading. Records should be kept of all battery voltage readings. If a voltage reading drops by two tenths of a volt since the previous measurement, the battery is probably very close to dead and should be changed. Typical battery life is rated from 6 to 10 years. The battery should be replaced by the Factory or by an experienced technician following the instructions given in the next paragraph.

EXPERIENCED TECHNICIAN INFORMATION -- BATTERY REPLACEMENT

Changing the battery is a little involved and should be done by an experienced technician. Damage done to the SM in an attempt to replace the battery will not be covered by warranty. Be sure the SM is unplugged from all host devices. The following three steps should be followed when replacing the battery:

STEP 1. Memory Card Removal

The memory card must be removed in order to change the battery (Figure 4-1). Once the SM's lid has been removed, remove the 4 screws at the corners of the memory board. The memory board is connected to the CPU board with a connector at one end of the SM. The memory board must be pulled straight up out of the box to avoid damage to the connector between the cards. The connectors are pulled apart with the aid of a small "hook-like device" placed under the edge of the memory card near the connector. The "hook-like device" could be made by making a 90 degree bend in a piece of stiff wire, etc..

STEP 2. Additional Battery Voltage Check

With the memory card removed, the Lithium battery will be exposed, soldered to the CPU board. The battery should be checked once more with a volt meter to verify that it needs changing. The voltage measured directly on the battery should only be 3 or 4 tenths of a volt higher than the voltage measured on the memory board. If the battery voltage is greater than the memory board voltage by more than 4 tenths of a volt then the memory board may have a bad component that is causing high current drain (see CURRENT DRAIN TEST below). In this case, the SM should be returned to the Factory for evaluation.

The voltage on a good battery should be within one tenth of a volt of the initial open circuit voltage of the battery (typically 3.68V for Tadiran Lithium battery, 3.9V for Electrochem Lithium battery). If the voltage reading is less than the initial open circuit voltage by more than 0.2 volts, then the battery is exhausted and should be replaced by a Lithium battery with an initial open circuit voltage greater than 3.4 V.

SECTION 4. MAINTENANCE

STEP 3. Replacement

Remove the exhausted battery with the aid of a solder sucker or solder wick and a soldering iron that is not too hot or cold. Trim the leads of the new battery in such a manner that they do not extend more than an eighth inch below the bottom of the CPU card. Solder in the new battery. It should be possible to replace the battery without removing the CPU card from the enclosure. Be sure to avoid any solder bridges or shorts.

EXPERIENCED TECHNICIAN INFORMATION -- CURRENT DRAIN TEST

Current drain can be checked by measuring the voltage across the 100 ohm resistor at location F2 on the CPU board (Appendix E, Figure E-4). With out the memory card the voltage should measure between 200 and 400 microvolts indicating that 2 to 4 micro amps of current are being drawn by the CPU board. The current drain of both the memory card and the CPU board should be between 3 and 5 micro amps (NOTE: To facilitate this measurement, solder a small insulated lead to each side of the resistor before replacing the memory card). If current drain is greater than 10 microamps then the SM should be returned and checked out by the Factory.

APPENDIX A. SWITCH AND BUTTON FUNCTIONS

A.1 STORAGE MODULE

Switch 1	Switch 2	Function <u>Baud Rate</u>	<u>Comments</u>
down	down	300	
down	up	1200	
up	down	9600*	See Section 2.4
up	up	19200*	for limitations.

SWITCHES 1 and 2 are used to select the appropriate SM baud rate. When connected to the CR21 datalogger the baud rate must be set to 300 (SWITCHES 1 and 2 DOWN). When the CR7 datalogger is used, it is possible to set the serial port baud rate to different values. REMEMBER: The SM baud rate setting must match the baud rate of the device attached in order for data transmission to occur.

Switch 3	<u>Function</u>
down	7 Data Bits, Even Parity, 2 stop bits, Encode/Decode
up	8 Data Bits, No Parity, 2 stop bits, No Encode/Decode

SWITCH 3 is used to select one of 2 data Format types handled by the SM. If SWITCH 3 is UP the storage module will accept and store data exactly as they are received (and transmit exactly what was stored). It will store all 8 bits of each character it received though the parity bit is not used. For example, if the SM was loaded with ASCII characters having even parity then that is what will come back out when the SM is unloaded.

If SWITCH 3 is DOWN the SM will transmit 7 data bits and an even parity bit when it is unloaded. Furthermore, the SM expects to receive ASCII characters which form data values such as those provided by CSI dataloggers when SWITCH 3 is DOWN. Each data value consists of a 2 digit data point ID followed by a + or - sign and a 3 to 5 digit number. As each character is received it is buffered up until the SM receives a complete data point after which the data point is encoded (converted) and stored in memory.

Data are stored into memory in CSI's own binary Format which is more thoroughly discussed in Appendix C of this Manual. Compared to ASCII Format, binary Format allows about five times as much data to be stored in the same memory space.

APPENDIX A. SWITCH AND BUTTON FUNCTIONS

If SWITCH 3 is DOWN when data are unloaded from the SM, each data point will be decoded (converted back) to its original ASCII Format and sent to the computer.

When using the ENCODE/DECODE Mode the SM16/SM64 will store up to 8192/32768 low resolution data values. If the data were not encoded the SM16/SM64 would store about 1600/6400 data values. When storing non-standard data the SM16/SM64 will store 16,384/65,536 bytes or characters of Information.

Switch 4	<u>Function</u>
down	Ring Memory
up	Fill & Stop Memory

SWITCH 4 is 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 storage module becomes full. This is called the RING MEMORY function because you can picture the memory as a ring with a pointer continually progressing around the ring as new values are entered and stored. SWITCH 4 should be left in the DOWN position when the most recent data are the information desired.

SWITCH 4 should be left in the UP position if the oldest data are more important. When SWITCH 4 is UP, new data will not be stored once the SM is full. This is referred to as the FILL and STOP MEMORY function because the SM stops recording when memory is full.

Switch 5	Switch 6	<u>Function</u>
down	down	Data Load/Unload
up	up	Test & Initialize

SWITCHES 5 and 6 must be DOWN before the SM will accept data.

SWITCHES 5 AND 6 also are used to test and initialize the SM. 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 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. 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. NOTE: This routine REMOVES all previously stored data values.

APPENDIX A. SWITCH AND BUTTON FUNCTIONS

Therefore, the Test & Initialization routine should be executed AFTER ALL VALUABLE DATA HAS BEEN UNLOADED AND CHECKED and BEFORE NEW DATA ARE STORED. 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.

As previously noted, the SM BUTTON is used to begin a Test & Initialize sequence OR to begin an unload sequence to tape OR to the printer. If SWITCHES 5 and 6 are DOWN and either the printer enable or unload enable line is inactive then a tape dump will occur when the BUTTON is released. If SWITCHES 5 & 6 are DOWN and both the printer enable and unload enable lines are active then a printer dump will be started when the BUTTON is released. If SWITCHES 5 and 6 are both UP when the BUTTON is pushed then the Test & Initialization routine will be executed.

A.2 SM232A STORAGE MODULE/RS232 INTERFACE

The SWITCH located in the center of the SM232A enclosure is used to identify the SOURCE of the commands sent to the SM. When in the DATA TO MODEM ONLY position, the command characters sent from a computer will go to the SM, but commands sent from a terminal will NOT be sent to the storage module. As the SWITCH label implies, data transmitted by the SM are sent to a computer ONLY. This SWITCH position is generally used with computers which echo all characters sent from a terminal.

When the SM232A SWITCH is in the DATA TO TERMINAL AND MODEM position, all command characters sent by either the computer or terminal to the SM and all data transmitted by the SM are sent concurrently to both the terminal and computer. This SWITCH position should be used on set-ups where the computer does not echo characters sent by the terminal or when a terminal ONLY is used.

The SM LOAD/SM UNLOAD SWITCH located on the left of the SM232A enclosure is set according to whether data are to be unloaded from the SM or loaded into the SM. When this SWITCH is in the TRANSPARENT position, there is no communication between the SM and the RS232 PORTS of the SM232A. Also, when the switch is moved from the TRANSPARENT position to the UNLOAD position the UNLOAD POINTER (Section 3.1) is reset to point at the oldest data in the SM.

APPENDIX B. CONNECTOR PINOUT DESCRIPTION AND ELECTRICAL SPECIFICATIONS

B.1 STORAGE MODULE

9 PIN D-TYPE CONNECTOR DESCRIPTION

Pin Description

1	+5V Supply
2	GND
3	RING
4	Serial data TRANSMITTED by SM
5	MODEM Enable (not used by SM)
6	PRINTER Enable
7	UNLOAD Enable (not connected or tied to grnd on datalogger)
8	TAPE Enable
9	Serial data RECEIVED by SM

ELECTRICAL SPECIFICATIONS

The SM is powered by the 5V supply from the datalogger. While the SM is active (storing or unloading data) it requires typically 8 mA (120 mA peak when first plugged in, and 25 mA max, thereafter) from the 5V supply. The SM requires 300-500 microamps from the 5 volt supply when inactive.

When unplugged, the SM uses power provided by it's own internal 3.6V 2AH lithium AA cell to retain data in CMOS RAM. When a 5 volt supply is available to the storage module no power is used from the internal battery. When unplugged (or datalogger powered down) the CMOS RAM requires 3-5 microamps (at room temp.) from the internal battery to stay alive. At this rate the battery should last between 6 and 10 years. The SM should be kept in a cool place to maximize battery life when not in use. Battery operating temperature range is from -40 to +72 degrees C.

B.2 SM232A STORAGE MODULE/RS232 INTERFACE

The 16 VAC wall transformer (included with the SM232A) is used to provide power to both the SM232A and the SM. There are three different regulated power supplies provided inside the SM232A: +12V and -12V supplies for driving the RS232 ports and a 5 VDC supply for powering both the SM and internal SM232A logic. The SM232A typically requires 80mA from the 16 VAC wall transformer to operate.

APPENDIX B. CONNECTOR DESCRIPTION/ELECTRICAL SPECIFICATIONS

The 9 pin D-type connector is set up to connect to the SM. A
pinout description follows:

<u>PIN</u>	<u>FUNCTION</u>
1	+5V supply
2	GND
3	RING (not connected on SM232A)
4	RXD (receive data line)
5	MODEM ENABLE (not connected)
6	PRINTER ENABLE (used to activate SM)
7	UNLOAD ENABLE (defines direction of data flow)
8	TAPE ENABLE (not connected)
9	TXD (transmit data line)

The 25 pin D-type connector pinouts are defined below (pins not specifically identified connect straight through to the corresponding pin on the other 25 pin D-type connector).

"TO MODEM" 25 Pin D-type Pinout

<u>PIN</u>	<u>FUNCTION</u>
2	TXD-TRANSMITTED data (Sourced by SM232A)
3	RXD-RECEIVED data (SM232A Input)
7	GND-SIGNAL Ground
8	DCD-DATA CARRIER DETECT (SM232A Input)
20	DTR-DATA TERMINAL READY (Sourced by SM232A)
22	RI-RING Indicator (SM232A Input)

"TO TERMINAL" 25 Pin D-type Pinout

<u>PIN</u>	<u>FUNCTION</u>
2	TXD-TRANSMITTED data (SM232A Input)
3	RXD-RECEIVED data (Sourced by SM232A)
7	GND-SIGNAL Ground
8	DCD-DATA CARRIER DETECT (Sourced by SM232A)
20	DTR-DATA TERMINAL READY (SM232A Input)
22	RI-RING Indicator (Sourced by MODEM)

APPENDIX C. BINARY FINAL STORAGE DATA FORMAT DESCRIPTION

The Binary Final Storage Data Format (also referred to as the CSI Format) is used to transfer and store data into the Final Storage area of the SM, CR7, CR21 and CR5-TC235A.

The first byte of each two byte pair designates the following:

Given bits ABCD EFGH where A is most significant, if bits D, E, and F are not all ones, then this byte is the first of a two byte data value. If D, E, and F are all ones, the data type and use of the other bits are as follows:

A B C D E F G H

1 1 1 1 1 1 X X

X X 0 1 1 1 X X

0 0 1 1 1 1 X X

0 1 1 1 1 1 1 1

0 1 1 1 1 1 0 0

DATA TYPE AND FIRST BYTE FORMAT

Start of array, G & H are the most significant bits of the array ID number.

First byte of a 4 byte value.

Third byte of a 4 byte value.

First byte of a 2 byte dummy or "fill" word. The second byte must exist but may be any value.

First byte of a 2 byte error word. This will only occur in data which have been read from tape in which irrecoverable errors were detected. Second byte is 00.

APPENDIX C. BINARY FINAL STORAGE DATA FORMAT DESCRIPTION

TWO BYTE FORMAT

If bits D, E, and F are not all ones, then the value is a two byte number as follows:

<u>BITS</u>	<u>DESCRIPTION</u>
A	Polarity, 0 = +, 1 = -.
B, C	Decimal locators.
D to end of 2nd byte	13 bit binary mantissa (MSB first).

The decimal locators can be thought of as a negative base 10 exponent with decimal locations as follows:

<u>B C</u>	<u>DECIMAL LOCATION</u>
0 0	XXXX.
0 1	XXX.X
1 0	XX.XX
1 1	X.XXX

The decimal range of the mantissa is 0 to 6999.

FOUR BYTE FORMAT

AB01 11CD XXXX XXXX 0011 11EF XXXX XXXX

<u>BITS OR BYTE</u>	<u>DESCRIPTION</u>
B	Polarity, 0 = +, 1 = -.
C, D, A	Decimal exponent.
E, F	Bits 17 and 16 respectively of binary mantissa.
2nd byte	Bits 15 - 8 (left to right) of binary mantissa.
4th byte	Bits 7 - 0 (left to right) of binary mantissa.

APPENDIX C. BINARY FINAL STORAGE DATA FORMAT DESCRIPTION

Interpretation of the decimal exponent is as follows:

<u>BITS</u>	<u>DECIMAL FORMAT</u>
C D A	5 digits
0 0 0	XXXXX.
0 0 1	XXXX.X
0 1 0	XXX.XX
0 1 1	XX.XXX
1 0 0	X.XXXX
1 0 1	.XXXXX

The exponent is actually a binary value indicating the negative decimal exponent.

APPENDIX D. MICROSOFT BASIC PROGRAM FOR STORAGE MODULE UNLOAD

The following pages in this appendix contain set up information and programs to unload SM data to a particular computer or printer device. Contributions to this section by the users are very much appreciated and will add to the completeness of this section. Because we do not have access to all the various computers, Campbell Scientific can not assume any responsibility for the accuracy of the information contained in this appendix. We will attempt to correct any errors we are made aware of. Information regarding this appendix should be sent to CSI, Attn: Storage Module Manual.

APPENDIX D. MICROSOFT PROGRAM FOR STORAGE MODULE

CSI'S C2000 MICROCOMPUTER

SM232A "TO TERMINAL PORT" - Connected to TeleVideo terminal set at 19200 baud.

SM232A "TO MODEM PORT" - Connected to C2000 Port A set at 19200 baud.

SM232A "TO STORAGE MODULE" - Connected to the Storage Module

SM232A SWITCHES

DATA TO MODEM ONLY

TRANSPARENT (Initially)

STORAGE MODULE SWITCHES - 1 & 2 are UP the rest are in the same position as when the data were recorded.

INSTRUCTIONS - Make the appropriate connections and set the switches as indicated. Load MBASIC and run the unload program given below. Follow the instructions given in the program.

SM UNLOAD PROGRAM (written in Microsoft's BASIC).

```
10 INPUT "SET SM232A TO 'UNLOAD' THEN ENTER FILE NAME: ",A$
20 REM
30 REM THE NEXT 4 STATEMENTS ARE USED TO PROGRAM THE SM
40 REM
50 PRINT CHR$(22);CHR$(17);CHR$(18);CHR$(19);CHR$(20);
60 PRINT CHR$(0);
70 PRINT CHR$(0);
80 PRINT CHR$(4);CHR$(13);CHR$(0);"END";CHR$(0)
90 OPEN "0",1,A$
100 I=0
110 REM REQUEST A LINE OF DATA
120 PRINT CHR$(17);
130 LINE INPUT A$
140 IF A$ = "END" THEN GOTO 180
150 PRINT #1,A$
160 I=I+INT((LEN(A$)/10)+.5)
170 GOTO 120
180 CLOSE #1
190 PRINT "THE NUMBER OF DATA POINTS RECEIVED = ";I
200 END
```

APPENDIX D. MICROSOFT PROGRAM FOR STORAGE MODULE

IBM PERSONAL COMPUTER MODEL XT OR MODEL PC

SM232A "TO TERMINAL PORT" - Connected to IBM's Asynchronous Communications Adaptor.

SM232A "TO MODEM PORT" - Not connected.

SM232A "TO STORAGE MODULE" - Connected to the Storage Module

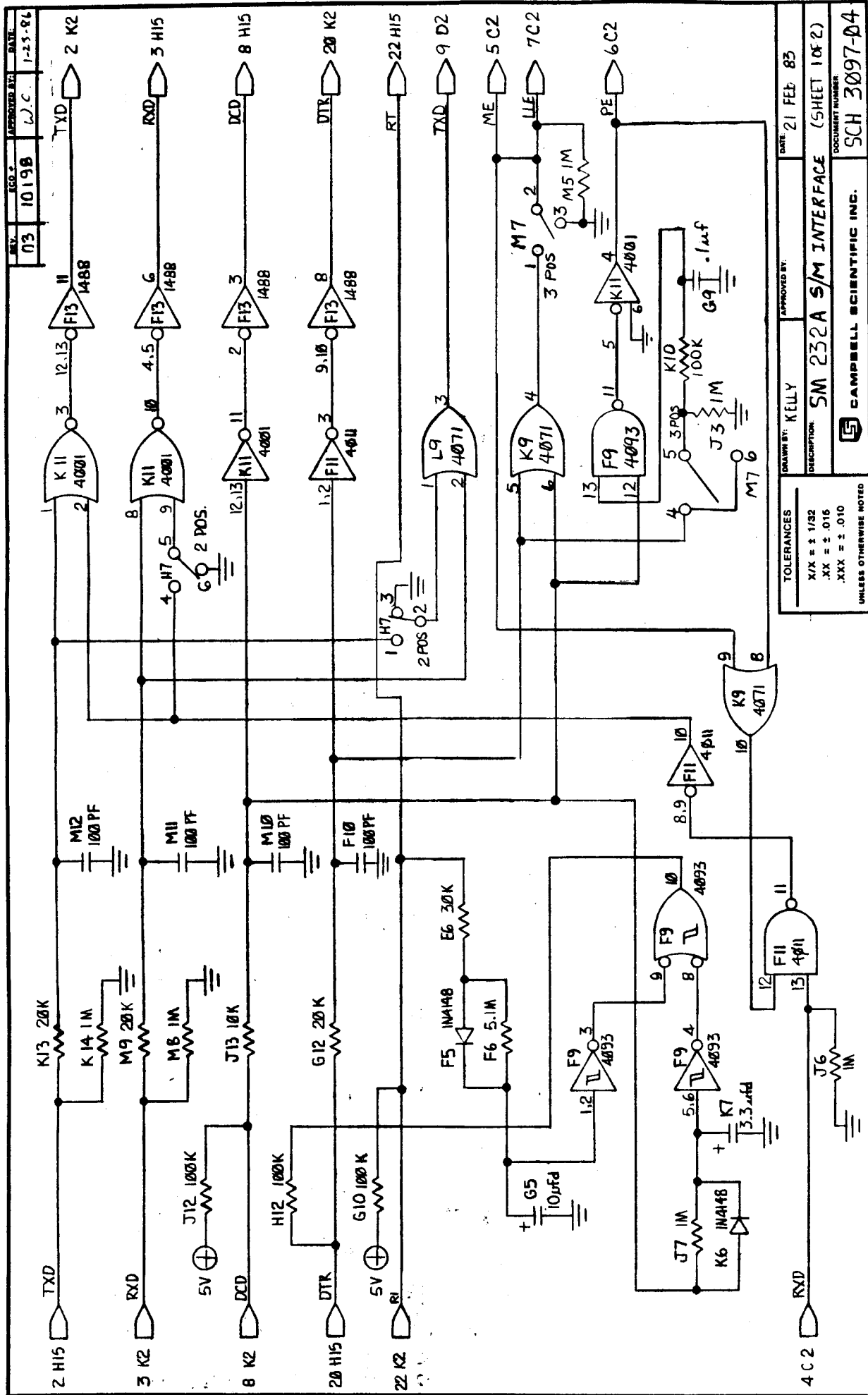
SM232A SWITCHES
DATA TO TERMINAL & MODEM
TRANSPARENT (Initially)

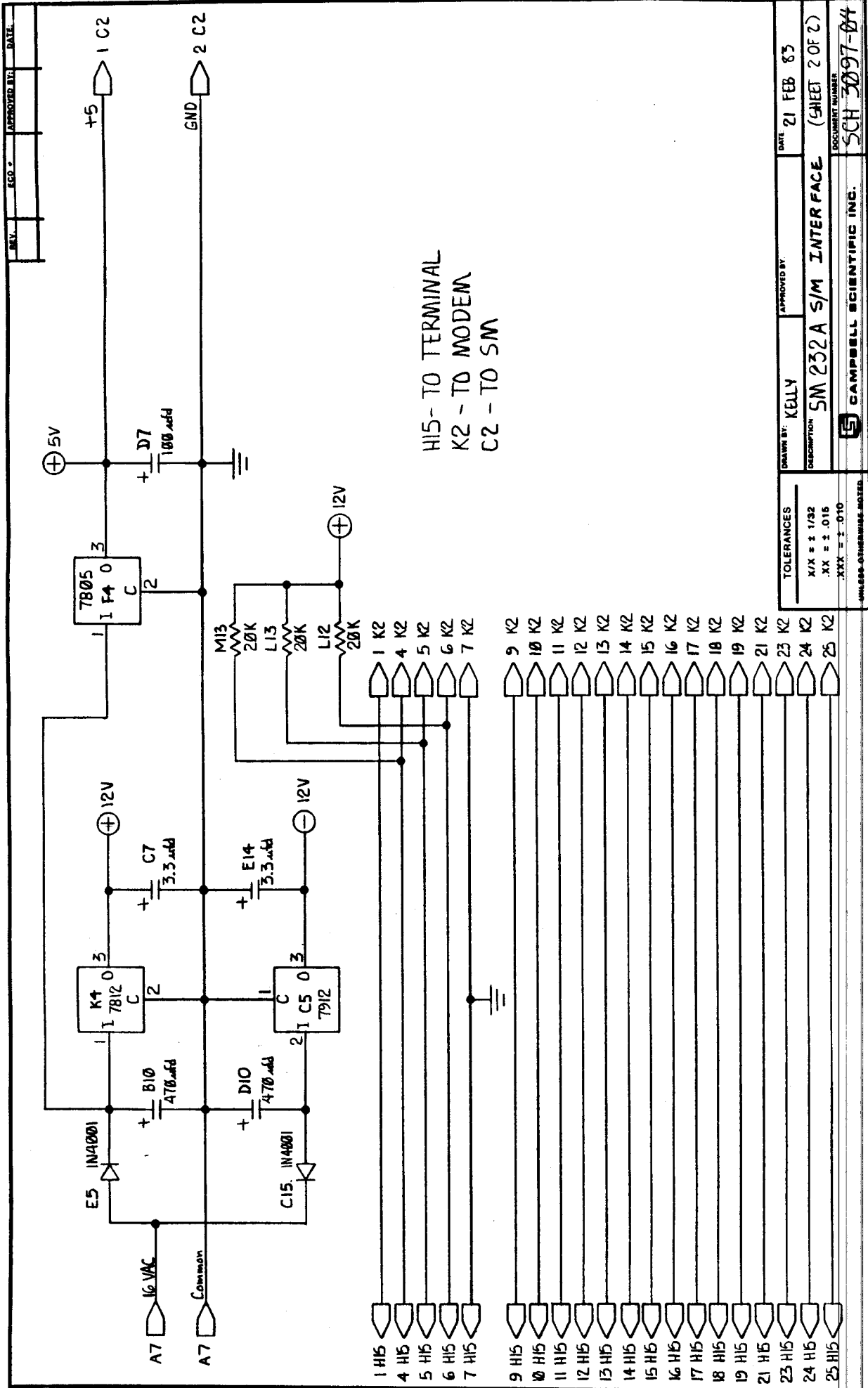
STORAGE MODULE SWITCHES - 1 is up, 2 is down and the rest are in the same position as when the data were recorded.

INSTRUCTIONS - Make the appropriate connections and set the switches as indicated. Get into MBASIC and run the unload program given below. Be sure to follow the instructions given in the program.

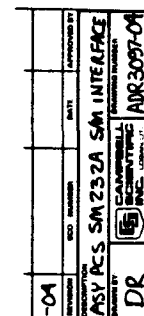
SM UNLOAD PROGRAM (BASIC version 2.0 written by Microsoft).

```
10 REM SET IBM ASYNCHRONOUS COMMUNICATIONS ADAPTER TO 9600 BAUD
20 OPEN "COM1:9600" AS 1
30 INPUT "SET SM232A SWITCH TO 'UNLOAD' THEN ENTER FILE NAME: ",A$
40 OPEN A$ FOR OUTPUT AS 2
50 REM
60 REM THE NEXT 3 LINES ARE USED TO PROGRAM THE STORAGE MODULE
70 REM
80 PRINT #1, CHR$(22);CHR$(17);CHR$(18);CHR$(19);CHR$(20);
90 PRINT #1, CHR$(0);CHR$(0);
100 PRINT #1, CHR$(4);CHR$(13);CHR$(0);"END";CHR$(0)
110 I=0
120 REM REQUEST A LINE OF DATA
130 PRINT #1, CHR$(17);
140 LINE INPUT #1, A$
150 PRINT A$
160 REM WRITE DATA POINTS TO DISK
170 PRINT #2, A$
180 IF A$ = "END" THEN GOTO 220
190 REM COUNT THE NUMBER OF DATA POINTS RECEIVED
200 I=I+INT((LEN(A$)/10)+.5)
210 GOTO 130
220 CLOSE #2
230 PRINT "THE NUMBER OF DATA POINTS RECEIVED = ";I
240 END
```



TOLERANCES		DRAWN BY: KELLY	APPROVED BY:	DATE: 21 FEB 83
X/X = ± 1/32		DESCRIPTION: SM 232A S/M INTERFACE (SHEET 2 OF 2)		
XX = ± .015		DOCUMENT NUMBER: SCH 3097-04		
XXX = ± .010		CAMPBELL SCIENTIFIC INC.		
UNLESS OTHERWISE NOTED				



-03	10130	28C	8/29/84
-04	10169	W2	1-9-85
REVISION			
05	10188		
06	10210		
06A	10216		
07	10226		12/5/81

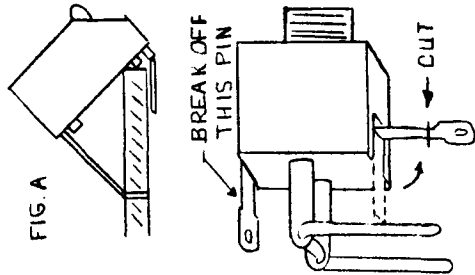
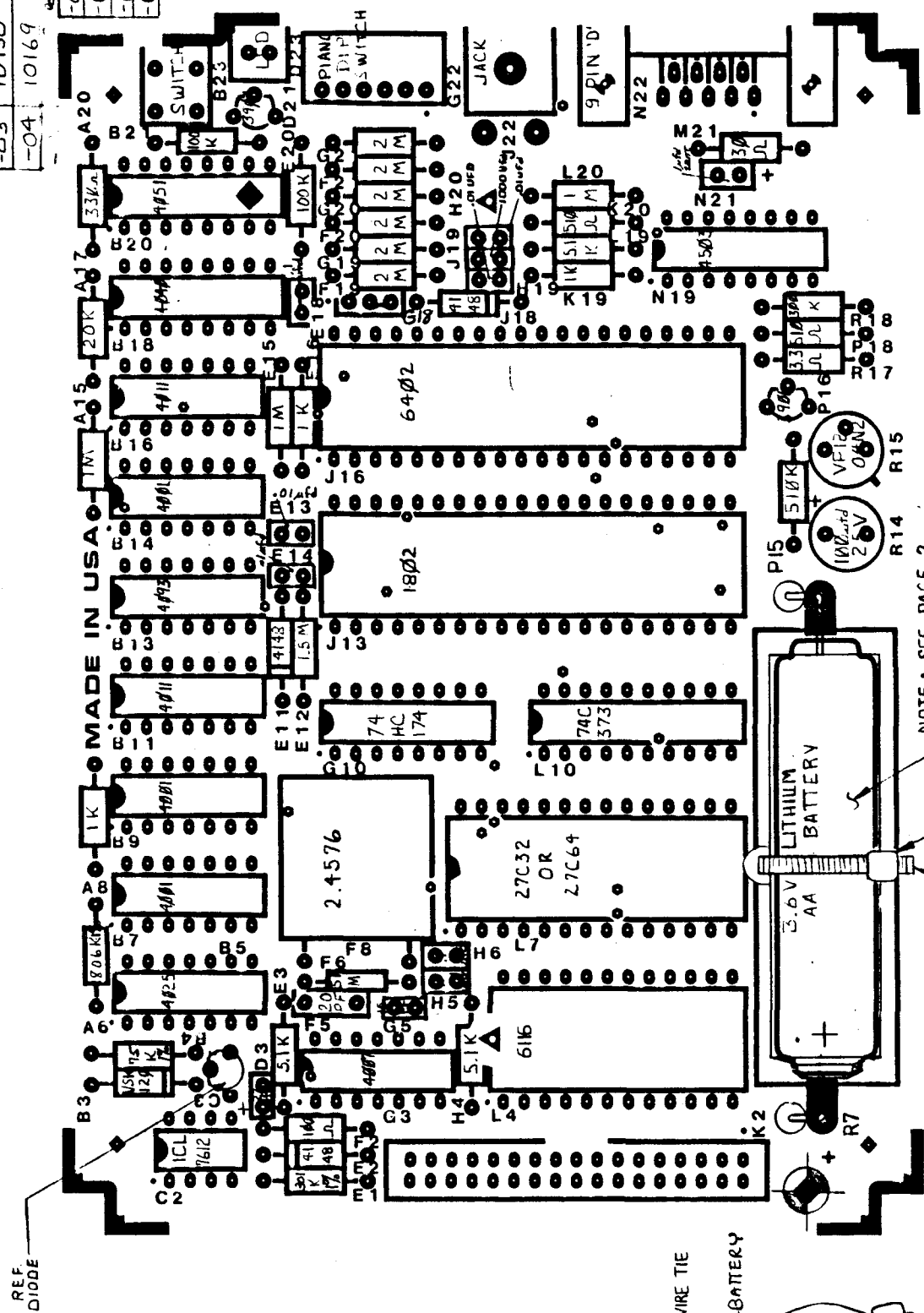
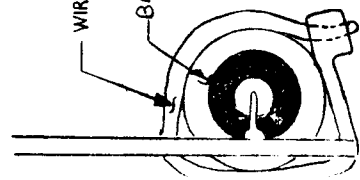


FIGURE C



THIS DIAGRAM SHOWS THE
CORRECT ORIENTATION OF THE
WIRE TIE

NOTE: SEE PAGE 2

CUT THE WIRE HERE
SEE FIGURE C

DESIGNED BY:	APPROVED BY:	DATE:
KAREN STOVER	ELC	Aug 22 '84
DESCRIPTION:		
SM-10 STORAGE MODULE CELL - PAGE 1 OF 3		
DOCUMENT NUMBER:		
ADF 3001-07		

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