THE SMB™
MANUAL

**TECHNICAL
DESIGN
Z80 LABS**

SYSTEM MONITOR BOARD

User's Manual

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RESEARCH PARK, BUILDING H

1101 STATE ROAD

PRINCETON, NEW JERSEY 08540

System Monitor Board User's Guide

INTRODUCTION:

The System Monitor Board (SMB) is designed to be used with
the Technical Design Labs Z-80 CPU board, the ZPU. As such
it is meant to operate in an S-100 bus computer mainframe
such as TDL's Xitan series. The SMB is extremely versatile
in that it will perform the functions of several boards all
on one. The following is a list of it's princial functions:

1. 2K MONITOR operating system (the ZAPPLE(tm)
    Monitor) in ROM (read only memory).
2. 2K RAM, read/write storage for user programs,
    auxilliary monitor routines, and/or stack area.
3. 2 SERAL I/O PORTS, 110-9600 baud, RS232 or 20ma
    current loop for each port, and
    software-intialized via the monitor. Can be used
    for TTY, CRT terminal, or other serial device.
4. PARALLEL I/O PORT, bi-directional, can be
    configured as an input or output port or
    dynamically changed under program control.
5. SENSE SWITCH INPUT PORT, allows the user to specify
    the I/O configuration which the system will
    initialize to.
6. 1200 BAUD CASSETTE INTERFACE- Allows rapid loading
    and dumping of programs/data in either a
    checksummed hex file or a binary image format.
7. JUMP TO MONITOR- Contains circuitry for
    automatically jumping to the monitor at F000H
    prompted by a power on clear (POC) and/or reset.

TTY — top

2.2 CONNECTION

How to hook up various I/O devices to the SMB.

2.2.1 TTY
TTY stands for Teletype (a registered trademark for the
Teletype Corp.) which is the brand name fo the most popular
teleprinter. You may hook up your TTY to either of the two
serial I/O ports. That is, the one labelled "TTY" or the
one labelled "VIDEO". The diference between the two ports
lies in the fact that the monitor will handle paper tape
input and output via the "TTY" and not via the "VIDEO" port.
TTY RS232: Using the standard EIA 25 pin connector which
should be wired to the proper places on the TTY, the
following connections should be made:

```
TTY (DB25)                    SMB (J1)*
1 Frame Ground                16 Ground
2 Transmit                    13 TTY Input RS232
3 Receive                     11 TTY Output RS232
4 Request to Send             10 TTY 20ma IN
5 Clear to Send               14 minus (-) 12 volts
6 Data Set Ready
7 Signal Ground               *  J1 on the SMB is the blue
8 Rec'd Line Detect           Ansley ribbon cable connector
20 Data Terminal              at the top right corner of the
       Ready                  board.
                              ** Lift pin 8 of U32 (1489) out
                              of the socket if this jumper
                              is not installed.
```

TTY RS232 Checklist:

Make the following connections on the 25 pin RS232 connector (DB25) going to your TTY.

( )   Connect a jumper between pin 4, Request to Send, and pin 5, Clear to Send.

( )   Connect a jumper between pin 6, Data Set Ready, pin 8, Received Line Signal Detect, and pin 20, Data Terminal Ready.

( )   Connect a jumper between pin 1, Frame Ground, and pin 7, Signal Ground.

Make the following connections on the SMB's J1-- the blue Ansley ribbon cable connector at the top right of the board.

( )   Connect a jumper between pin 10, TTY 20ma IN, and pin 14, Minus (-) 12 Volts. Note: This is to disable the 20ma loop circuit. The RS232 circuit will not work if this is not done. The same disabling can also be accomplished by lifting pin 8 of IC U32 (1489) out of its socket.

Make the following connections between the DB25 connector and J1 on the SMB.

( )   Connect pin 1 of the DB25 to pin 16 of J1.
( )   Connect pin 2, Transmit, of the DB25 to pin 13, TTY RS232 IN, of J1.
( )   Connect pin 3, Receive, of the DB25 to pin 11, TTY RS232 OUT, of J1.

TTY 20ma CURRENT LOOP:
      Connection to the TTY's current loop can be made at either the Terminal Strip (TS) or J2. Note: In this reference, J1 refers to the jack on the SMB and J2 refers to the jack on the TTY. Follow the following proceedure:

( )   Connect pin 8 of J1 to either pin 6 of TS or pin 7 of
       J2.
( )   Connect pin 10 of J1 to either pin 4 of TS or pin 6 of
       J2.
( )   Connect pin 14 of J1 to either pins 3 and 7 of TS or
       pins 5 and 8 of J2.
( )   Make sure pin 8 of IC U32 (1489) has not been removed
       from its socket.

2.2.2 VIDEO

You may connect either a TTY or a CRT terminal to the
"Video" port, however, a CRT terminal is usually conneected.
The connections are very similar to the TTYconnections.
Refer to the TTY section for any abbreviations used here
without explanation. The explanations are not repeated.

( )   Make the same 3 jumper connections on e DB 25 as
       described for the TTY (i.e.- 4 to 5, 6 to 8 and 20,
       and 1 to 7).
( )   Connect a jumper between pins 12 and 14 of J1. Note:
       This disables the video port's 20 ma. loop circuit.
       This may also be done by removing pin 6 of IC U32
       (1489) from its socket.
( )   Connect pin 1 of DB 25 to pin 16 of J1.
( )   Connect pin 2, Transmit, of DB 25 to pin 15, VIDEO
       RS232 IN, of J1.
( )   Connect pin 3, Receive, of DB 25 to pin 9, VIDEO RS232
       OUT, of J1.·

VIDEO 20 MA CURRENT LOOP:

There should be two sets of 2 wires. One set for the
keyboard and one set for the screen. Proceed as follows:

( )   Take one wire from each of the two sets of wires and
       connect them together. Then connect that junction to
       the minus (-) 12 volts on J1 (pin 14).
    Note: Some terminals provide their own -12 volts and
           must be
       connected to it to work in the current loop mode.
    Check   --
       the terminal's manual.
( )   Connect the one remaining wire from the terminal's
       keyboard circuit to the VIDEO 20MA IN (pin 12) of J1.
( )   Connect the one remaining wire from the terminal's
       screen circuit to the VIDEO 20MA OUT (pin 9) of J1.

2.2.3 CASSETTE:

At the top of the SMB, to the right of U33, there are three connection points. The far left of these is labelled with an "R" and an arrow pointing up. The center one is labelled "GND" for ground. And the far right one is labelled with a "P" and an arrow ponting downward. The following is the connection proceedure:

( ) Connect the shields of two shielded audio cables together and then connect them to th center ("GND") terminal.
( ) Connect the center wire of the one going to the recorder's input to the left terminal ("R").
( ) Connect the center wire of the cable coming from the recorder's output to the right terminal ("P").

2.2.4 PARALLEL PORT:

See the schematic for the pin designtions on J1 which pertain to the parallel port. They are labelled "PB" for the port's data bits and "CB" for the port's control bits.

2.3   SETTINGS

How to configure jumpers and dip switches.

2.3.1 POC/RESET JUMPER:

At the bottom of the SMB and below IC U9 there is a jumper arrangement. There are three terminals comprising the jumper arrangement. One is not labelled and the other two are labelled POC and PRESET respectively. Install a jumper between the unlabelled terminal and one of the others. If you connect the jumper to the POC, a jump to the monitor will occur when the power is turned on. If TDL's ZPU board is used, the jump to the monitor will also occur during a reset since the ZPU issues a POC during reset. Should this be undisireabe in your system it can be easily disabled by severing the connection between the POC and reset line on the ZPU. Consult the ZPU schematic to find this connection. If you connect the jumper to the PRESET, a jump to the monitor will occur only when the reset switch is activated.

2.3.2 BAUD RATE JUMPERS:

Immediately above IC U24 (14411) in the upper left of the board, there are the "baud rate jumpers". There are two main terminals labelled "TTY" and "VIDEO" respctively. To their left is a row of Augat pins which may not have a silk-screened label indicating their function. These are the individual baud rate termnals. From left to right they are: 9600,4800,1200,600,300, and 110 baud. To set the SMB for the correct baud rate for the "TTY" port, merely place the jumper wire from the "TTY" terminal into the baud rate terminal which corresponds to that of the "TTY" port's terminal (usually 110). If a terminal is connected to the "VIDEO" port, place the VIDEO jumper into the proper baud rate pin (usually 9600). If the baud rate of both the "TTY" and the "VIDEO" ports are the same, there is an extra pin on each so that either one may be plugged into the other first and the remaining one plugged into the correct baud rate pin.

2.3.4 MEMORY PROTECT SWITCHES- S1 & S2:

In the upper left of the board there is a 4 bit dip switch. The two top switches are S1 and S2 respectively. Each protects a 1K segment of the SMB's 2K RAM memory. S1 protects the RAM from F800 to FBFF and S2 protects the RAM from FC00 to FFFF. Depressing the right side of the switch protects the RAM while depressing the left side causes it to be unprotected (may be written into as well as read from).

2.3.4 CASSETTE SWITCHES- S3 & S4:

Located directly below and on the same 4 bit dip switch as the RAM protect switches are two more switches, S3 and S4 respectively. S3 is used to choose either a microphone (MIC) of auxilliary (AUX) input for the cassette interface. This setting must match with the type of input your recorder has. Some have both. Depessing the right side of the switch selects the AUX input and depressing the left side selects the MIC input. S4 is the bottom switch. This switch causes the date coming into the interface to be inverted. If a particular cassette recorder has an odd number of inverting audio stages in its input circuit, the data recorded on the tape will be inverted. If the number of inverting audio stages in its output is odd, the data will appear inverted from what was recorded on the tape. Thus two conditions exist. One in which the data is either inverted or not on RECORD. And the other in which the data is either inverted or not on PLAYBACK. When recording a

tape and playing it back on the same unit, it is a simple
matter to determine the position of the invert switch. It
will be the same for all such recordings. However, when
playing back tapes recorded on another unit, the switch
should be tried in the opposite position if the recording
unit did not have the same inversion as yours. Trial and
error will find the correct setting quickly.

2.3.5 SENSE SWITCHES

This port consists of an 8-bit dip switch which is located
in the upper right corner of the System Monitor Board and is
examined by the operating system everytime initialization
occurs (i.e.- whenever the system is reset). It will
determine which of the user's I/O devices is to be assigned
to each one of the four (4) LOGICAL DEVICES. The four
LOGICAL DEVICES are as follows:

    a. CONSOLE - The console is defined as the device
            which enables the user to communicate to the
            computer and observe it's response.
            Teletypes (tm) and CRT terminals are the most
            commonly used console devices.
    b. TAPE READER - The tape reader is defined as the
            device which allows the computer to input
            from paper or magnetic tape. TTY paper tape
            readers, high speed paper tape readers, and
            cassette decks are typical tape reader
            devices.
    c. TAPE PUNCH - The tape punch is defined as the device
            which allows the computer to output to paper
            or magnetic tape. TTY paper tape punches,
            high speed paper tape punches, and cassette
            decks are typical tape punch devices.
    d. LIST DEVICE - The list device is defined as the
            device used for hard copy output. It is
            typically a line printer.

The dip switch is physically arranged upside down on the
board. This is done so that while looking at the top row of
switch paddles, a logical 0 is represented as a pushed in
paddle and a logical 1 as a protruding paddle (accomplished
by depressing the BOTTOM switch paddle). If you take a look
at the switch you will notice that each of the eight
switches is numbered starting with 1 on the right and ending
with 8 at the left.

    Switches 1 & 2 specify the CONSOLE device. Switches 3
& 4 specify the TAPE READER device. Switches 5 & 6
specify the TAPE PUNCH device. Switches 7 & 8 specify
the LIST DEVICE.

The following is a table showing how the switches are configured to enable the various I/O devices to be assigned as one or more of the LOGICAL DEVICES:

LOGICAL DEVICE > > >	LIST		PUNCH		READER		CONSOLE	
Switch > > >	8	7	6	5	4	3	2	1
Teletype > >	0	0	0	0	0	0	0	0
Video <CRT>	0	1	x	x	x	x		
High Speed * Paper Tape	x	x	0	1	0	1	x	x
Line Printer *	1	0	x	x	x	x	x	x
Cassette > >	x	x	1	0	1	0	x	x
Batch Mode(**)	x	x	x	x	x	x	1	0
User Defined(*)	1	1	1	1	1	1	1	1

NOTES: "x" means "not applicable"
   (*) The user must supply his own driver software to interface these devices to the monitor's operating system.
   (**) In the Batch Mode the assigned Reader becomes the Console input and the List Device becomes the Console output. Note that the computer will read from the assigned Reader as if it were a keyboard and consequently the bits on the tape are read and interpreted as an ASCII file rather than a binary dump or hex file as it normally would.

SOFTWARE CONTROL
        Please note that the assignment of the I/O device to one of the LOGICAL DEVICES as is done by the 8-bit dip switch can also be accomplished under software control by using the ASSIGN command of the monitor's operating system. For more details on this consult the section dealing with the ZAPPLE MONITOR.

2.4 OPERATION

This part of the manual covers the operation of the various parts of the System Monitor Board.

2.4.1 JUMP ON RESET

The System Monitor Board employs a special circuit that allows the user to exercise control over the computer by gaining access to the monitor system whenever the reset button is activated.

If the board is being used in a computer which has a front panel, the computer should be in the "RUN" mode. If the reset is then activated, the monitor will then sign on. The same is accomplished with just activation of the reset switch on those computers without front panels.

2.4.2 THE ZAPPLE MONITOR

The Zapple Monitor is a universal operating system with comprehensive DEBUG and I/O handling capabilities. It contains all the needed tools to fully debug both hardware and software as well as support the I/O used by the system. It has been instrumental in establishing the I/O independency of TDL software and thereby bringing it "big system" features not found elsewhere. All of our resident software contains NO I/O routines whatsoever! It handles all I/O through vectors at the begining of the program. As long as the I/O vectors are honored, then a Basic, Fortran, Text Editor, etc. program does not have to be concerned about whether the system is running a keyboard with video monitor display, model 33, CRT terminal or whatever. Another feature of the Zapple Monitor is its expandability. This feature is of tremendous use as it allows the user to attach his own additional monitor routines at the end of the monitor. Such routines often include I/O drivers. Typical additions might be a VDM driver routine or Tarbell cassette driver routine. Specific routines submitted to TDL will be made available to other users via TDL's newsletter and user's library. The monitor also includes many useful subroutines that may be used by user written programs. For details on these, see the assembly listing elsewhere in this manual.

THIS MONITOR WILL COME TO BE THE MOST IMPORTANT PIECE OF SOFTWARE IN YOUR SYSTEM.

COMMANDS

The following is a list of commands for the Zapple
Monitor. Precise definitions and usage notes are
covered in the next section.

A - ASSIGN reader, punch, console or list device
    options from the console.
B - BYE (system shut down).
C - COMPARE the contents of memory with the reader
    input and display any differences.
D - DISPLAY the contents of any defined memory area
    in Hex.
E - END OF FILE statement generator.
F - FILL any defined area of memory with a
    constant.
G - GOTO an address and execute. With
    breakpointing.
H - HEX MATH. Gives the sum and difference of two
    Hex numbers.
I * USER DEFINED.
J - JUSTIFY MEMORY - a non-destructive test for
    hard memory failures.
K * USER DEFINED.
L - LOAD a binary file.
M - MOVE a defined memory area to another starting
    address.
N - NULLS to the punch device.
O * USER DEFINED.
P - PUT ASCII characters into memory from the
    keyboard.
Q - QUERY I/O ports - may output or input any value
    to or from any I/O port.
R - READ a Hex file. Performs checksum, relocating,
    offsetting, etc.
S - SUBSTITUTE and/or examine any value at any
    address (in hex).
T - TYPEs the contents of a defined memory block in
    their ASCII equivalent.
U - UNLOAD a binary tape to the punch device.
V - VERIFY the contents of a defined memory block
    against that of another block and display the
    differences.
W - WRITE a checksummed hex file to the punch
    device.
X - EXAMINE and/or modify any or all registers
    including the special Z-80 registers.
X'- EXAMINE and/or modify any or all of the Z80's
    prime registers.
Y - "Yis there". Search memory for defined byte
    strings and display all the addresses where
    they are found.
Z - "Z end". Locate and display the highest address
    in memory.

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CAUTION: THE SYSTEM MONITOR BOARD KIT CONTAINS SEVERAL STATIC SENSITIVE DEVICES. DO NOT REMOVE THESE FROM THEIR PROTECTIVE PACKAGING UNTIL THEY ARE NEEDED IN ASSEMBLY. THEN FOLLOW THE HANDLING INSTRUCTIONS IN THIS MANUAL. FAILURE TO HEED THIS PRECAUTION MAY RESULT IN PERMANENT DAMAGE TO THESE DEVICES AND WOULD AUTOMATICALLY VOID THE WARRANTY.

A. ABOUT BUILDING KITS

Assembling a piece of equipment and finding that it works properly on its first checkout can be a great source of pride and enjoyment. Two factors can make this experience possible for you. The first is quality engineering, which involves properly designing the equipment, securing reliable components, and preparing clear assembly and operating instructions. The second is careful construction. We at TDL have taken care of the first factor. You must be responsible for the second. To help you in this, we offer the following construction tips, which are considered standard operating procedure in many commercial shops. Following these will help ensure that your kit works properly the first time.

1. ALWAYS read all of the instructions before starting to build.
2. Always work in a clean, well-lighted area.
3. Use only high quality rosin core solder of a gauge similar to that of the leads being soldered.
4. Make sure that you have all the parts needed in a given stage of construction before beginning that stage.
5. Use the lowest-power soldering iron that will get the job done. A 25 watt iron is quite adequate for this kit.
6. Use a fine-point soldering iron, and keep the tip clean and well-tinned.
7. Avoid overheating the PC board and components.
8. Before soldering a component, check to make sure that it belongs at that place. Having to remove and resolder a part is difficult, and it is likely that either the board or the component will be damaged in the process.
    Apply the solder to the iron tip, the pad and the

( )   The voltage at the cathode (band) of CR12 should be
       +12 volts.

( )   The voltage at the anode (arrow) of CR11 should be
       -12 volts. The leads will have to be reversed on
       voltmeters which   do   not   have   provision for
       measuring negative Turn the system's power off and
       remove the board.

Install all of the following except those with a double
asterisk, **, into their respective sockets:

POSITION		IC
R1-R8		ResistorPack
U1		74LS367	*
U2		8T97	*
U3		8T97	*
U4		74LS367	*
U5		74LS367	*
U6		74LS367	*
U7		74LS367	*
U8		74LS367	*
U9	**	4528	
U10		74LS02	
U11		74LS20	
U12		74LS02	
U13		74LS27	
U14		74LS20	
U15	**	4804	
U16	**	4804	
U17	**	4804	
U18	**	4804	
U19	**	MK34038NorC28050M	*
U20	**	6850	
U21	**	6850	
U22	**	6850	
U23		74LS138	
U24	**	14411	
U25		74LS04	
U26	**	6820	
U27		TIL113	
U28		TIL113	
U29		1488	
U30		TIL113	
U31		TIL113	
U32		1489	
U33	**	3130	
U34	**	4070	
U35	**	4528	
U36	**	4047	

* An IC with an asterisk indicates that the label on
   the silk-screen may not be exactly the same as the
   above list shows. Go by the above list when there

TECHNICAL DESIGN LABS

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Equipment: TDL System Monitor Board

Situation: Lack of EMM-SEMI 4804 RAMS prevents the implementation of user I/O routines.

Solution:

The enclosed routine, when placed at 0038 (Hex) will allow the implementation of user I/O routines and the 3 unused commands in the monitor.

Please Note!

This routine uses the RST 7 facility as does the break-point feature of the monitor. If a RST 7 is hit, and is not within the external transfer vector area of the monitor, this routine will restore all registers and trap to the break-point. However, if you use the G command with more than one address then the monitor will place a jump to its break-point at 00038 (Hex).

For routine see the two attached sheets.

```
                        .LIST
                        .PABS
                        .LADDR

                        IF THE EMM-SEMI 4804 RAM CHIPS ARE NOT
                 ; PRESENT IN THE SYSTEM MONITOR BOARD, THE
                 ; EXTERNAL TRANSFER VECTOR AT F800 (HEX) CANNOT
                 ; BE USED.  WHEN ATTEMPTING TO IMPLEMENT A USER
                 ; PROVIDED I/O ROUTINE OR ONE OF THE UNUSED
                 ; COMMANDS, THE PROCESSOR WILL EXECUTE A RST 7
                 ; INSTRUCTION.  IF THIS ROUTINE IS PLACED AT
                 ; 0038 (HEX) IT WILL CAUSE A BRANCH TO THE
                 ; PROPER ROUTINE, BASED UPON AN ADDRESS TAKEN
                 ; FROM A TABLE.

0038                    . LOC    0038H    ;RESTART 7 LOCATION
0038    C33B00   RST7:  JMP      NORAM    ;SPACE FOR TRAP

003B    E3       NORMA: XTHL              ;GET DUMMY RETURN
003C    F5              PUSH     PSW      ;SAVE IT
003D    3EF8            MVI      A,0F8H   ;TEST
003F    BC              CMP      H        ; RETURN
0040    2805            JRZ      OK

0042    F1       NG:    POP      PSW      ;GO
0043    E3              XTHL              ; TO
0044    C31EF0          JMP      0F01EH   ;  TRAP

0047    3E23     OK:    MVI      A,23H    ;CHECK FOR
0049    BD              CMP      L        ; BEYOND
004A    38F6            JRC      NG       ;  TABLE
004C    C5              PUSH     B        ;FOR LATER
004D    2D              DCR      L        ;ADJ VALUE
004E    2600            MVI      H,0
0050    010307          LXI      B,703H   ;FOR /3
0053    29              DAD      H        ;LEFT SHIFT
0054    29       DIV1:  DAD      H        ;AGAIN
0055    7C              MOV      A,H      ;SUBTRACT
0056    91              SUB      C        ; DIVISOR
0057    3802            JRC      DIV2     ;QUOTIENT 0
0059    23              INX      H        ;QUOTIENT 1
005A    67              MOV      H,A      ;NEW DIVIDEND
005B    05       DIV2:  DCR      B        ;DECREMENT COUNT
005C    20F6            JRNZ     DIV1     ;STILL MORE
                 ;L HAS QUOTIENT  H HAS REMAINDER
005E    2600            MVI      H,0      ;CLEAR REMAINDER
0060    29              DAD      H        ;TWO BYTES
0061    017400          LXI      B,TABLE ; PER ENTRY
0064    09              DAD      B        ;ENTRY ADDRESS
0065    017200          LXI      B,JUMP+1
0068    7E              MOV      A,M      ;GET LOW
0069    02              STAX     B        ; BYTE
006A    23              INX      H
006B    03              INX      B
006C    7E              MOV      A,M      ;GET HIGH
```

```
006D    02                      STAX    B           ; BYTE
006E    C1                      POP     B           ;IT S LATER
006F    F1                      POP     PSW         ;RESTORE
0070    E1                      POP     H           ; REGISTERS
0071    C30000      JUMP:       JMP     .-.         ;SPLIT


                        THIS TABLE IS TO BE FILLED WITH
                ; THE ADDRESSES OF THE VARIOUS I/O AND
                ; COMMAND ROUTINES.
                ;
                ; (THE PRESENT ADDRESSES ARE FOR THE TTY.)
                ;
0074    1FF6        TABLE:      .WORD   0F61FH      ;CONSOLE INPUT
0076    90F4                    .WORD   0F490H      ;CONSOLE OUTPUT
0078    1FF6                    .WORD   0F61FH      ;HIGH-SPEED READER
007A    1FF6                    .WORD   0F61FH      ;USER READER
007C    90F4                    .WORD   0F490H      ;HIGH-SPEED PUNCH
007E    90F4                    .WORD   0F490H      ;USER PUNCH
0080    90F4                    .WORD   0F490H      ;LINE PRINTER
0082    90F4                    .WORD   0F490H      ;USER PRINTER
0084    20F5                    .WORD   0F520H      ;CONSOLE STATUS
0086    1EF0                    .WORD   0F01EH      ;I COMMAND
0088    1EF0                    .WORD   0F01EH      ;K COMMAND
008A    1EF0                    .WORD   0F01EH      ;O COMMAND

                            .END


                +++++ SYMBOL TABLE +++++

DIV1    0054        DIV2    005B    JUMP    0071
NG      0042        NORAM   003B    OK      0047
RST7    0038        TABLE   0074
```

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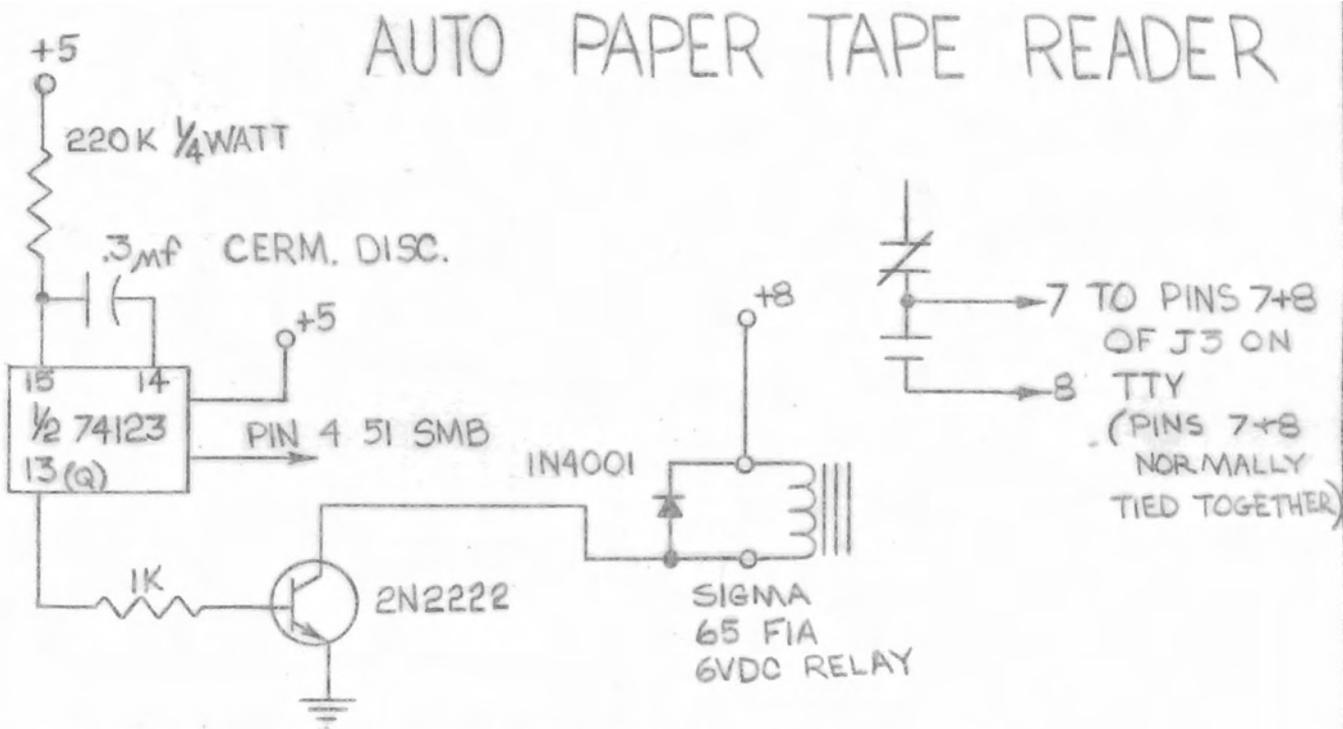**Equipment:**   System Monitor Board

Situation: Reset will not restart monitor, and will cause programs to blow-up.

Solution: The reset circuitry uses a CMOS one-shot CD4528, chip U9. The cassette circuit also uses the 4528, U35. But for various reasons involving response time, only one manufacturer's 4528 has been found to be satisfactory for U9, the Fairchild Chip. Due to the short supplies of Fairchild CMOS, only one is packed in each System Monitor Board. The SMB owner should make certain that the U9 is the Fairchild, and not some other brand chip. Any brand 4528 will suffice for U35.

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Technical Memorandum

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Date: 11/17/77

TM# 112

Equipment: TDL SMB board used with ASR-33 TTY for tape reader.

Situation: Macro Assembler needs a controlled reader.

Solution: The circuit below will cause the ASR-33 to read tape under control from computer, without further mods to the software. Be sure to note the modification to the SMB.

AUTO PAPER TAPE READER

+5

220K ¼ WATT

.3mf CERM. DISC.

+5

15 14
½ 74123   PIN 4 51 SMB
13 (Q)

1K   2N2222

1N4001

+8

SIGMA
65 FIA
6VDC RELAY

7 TO PINS 7+8
OF J5 ON
8 TTY
(PINS 7+8
NORMALLY
TIED TOGETHER)

SMB MODIFICATION
REMOVE CR1 + CR2 + R9
JUMPER INPLACE OF CR1