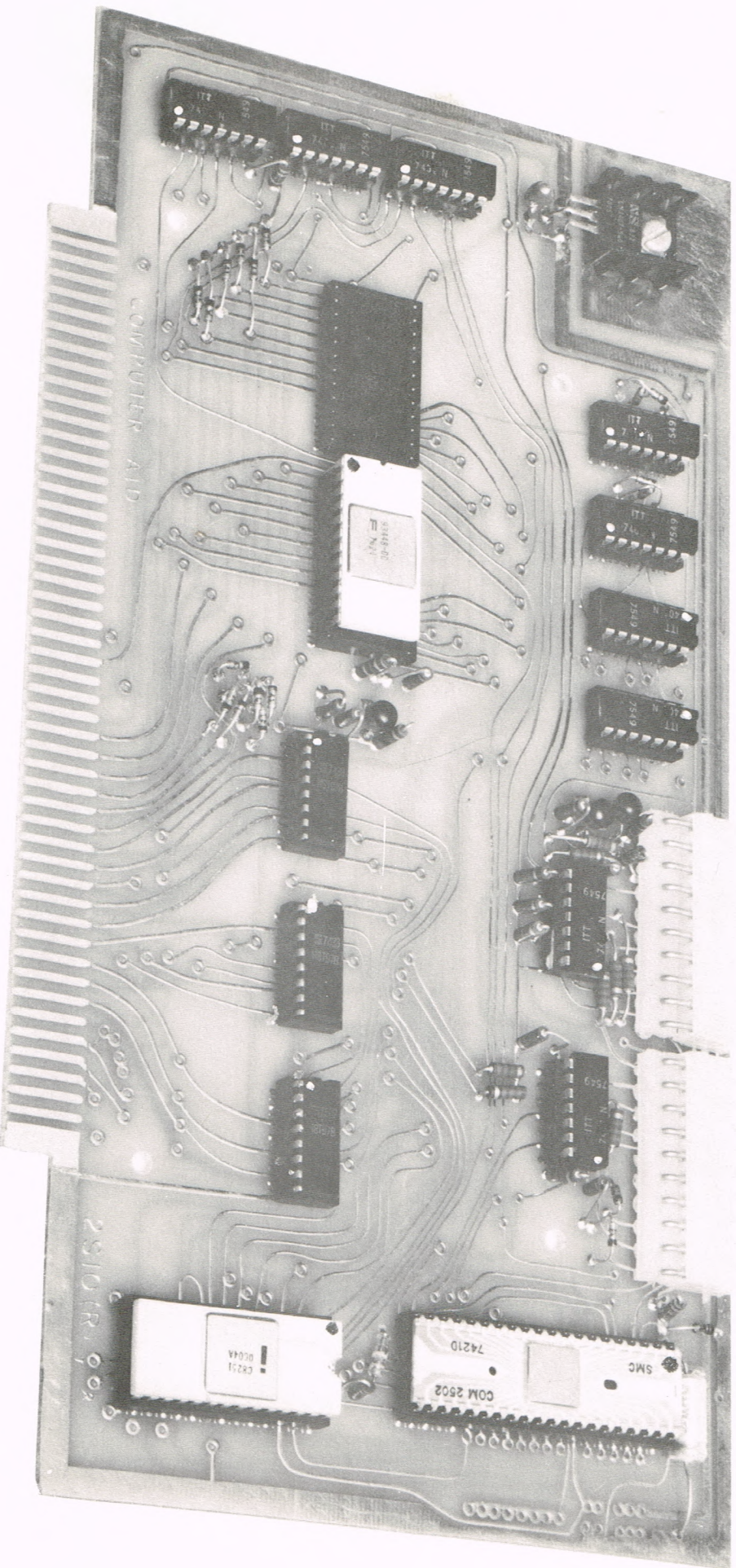


# NATIONAL MULTIPLEX COMPUTER OPERATING SYSTEM



2510(R)

2 S I O ( R )   B O A R D  
GENERAL INFORMATION

The 2SIO(R) Board is a plug in I/O board compatible with MITS and IMSAI 8080 type computers. It will control one terminal such as a Teletype, Video Terminal or other serial device and one or two cassettes under full or partial software control. In addition, it offers "Turnkey" operation of the computer since all basic monitor or housekeeping functions are programmed in ROM. While intended primarily for use with the National Multiplex cassette or cartridge units, it will operate other cassettes such as the Phi-Deck.

The user turns on his computer, examines address C000 (Hex) and goes to run. The terminal will answer with a question mark. The user then types in what he wants done. The ROM program enables him to load memory (L), Dump Memory (D), Load a file from Cassettes (Control L), Dump a formatted file to cassettes (Control D), Search for a file and store it in designated memory (S) and to search for and store all repeated file entries such as bookkeeping entries of a given class (Control S). It also permits (with the aid of a second board\* which bolts to the master 2SIO(R) Board) the full keyboard control of cassette systems having full software control capability. This function uses the DC1, DC2, DC3 and DC4 commands. (Control Q, R, S, T). This board is not provided since there are too many possible control situations. We can provide design assistance to those requesting it. When used with the 3M1 and 3M3 recorders with the two ROM set, these functions are provided without the second board.

The ROM program automatically formats a file so that the user need only give it a six letter name. This includes putting the name at the start and the necessary stop character at the end.

The E and P functions in software\* allow the use of the computer as a word processor when suitable editing type terminals are employed. With a suitable printer these functions will enable one to type error free letters and do automatic mailing lists. Combined with string functions in basic or even the multiple file search on the ROM, you can do selected mailing lists. The E and P functions utilize CALL's on the ROM, but must be typed in to a suitable memory location by the user of a 1 ROM set.\*

Since one high density cartridge such as the 3M 300 Cartridge used in the 3M3 model can store 2.5 mega bytes and a reel to reel recorder several times that, the 2SIO(R) with a suitable tape storage medium is the equal of most disc systems except for speed.

\* E, P and other programs are provided in RAM software for the 1 ROM set and on the ROM with the two ROM set.

T H E O R Y   O F   O P E R A T I O N

I   S W I T C H I N G   C I R C U I T S

The switching circuits are responsible for selecting what function is to take place - such as clear, read and write. Together with the addressing circuits they control the flow of information on the board.

Refer to Figure 1. This shows the three IC's labelled A, B and C. IC "A" controls the read, write and clear (reset) functions. Pins 1 and 2 receive Power on clear and front panel clear signals which then leave the area to reset the UART and USART at the opposite side of the board. SINP enters via a jumper to pin 4, where mixed with PDBIN it generates the Read signal. This signal (0 on read) is used to gate the bi-directional gates and control the UART and USART read functions. SOUT and PWR combine to give the write signal via pins 9 and 10. Both the read and write signals have outputs only when addressed by the address decoder. This address signal is applied via pins 3 and 11.

IC "B" is a Hex inverter used as the name implies. Pins 1 and 2 are part of the address circuitry to be discussed later. Pin 3 receives an  $A_0$  signal which is inverted to give  $\overline{A_0}$ . This is combined with  $\overline{A_1}$  in IC "C" to give a status enable signal to the UART (SWE).  $\overline{A_0}$  is inverted to restore  $A_0$  which is used to control the UART read function (RDE) and the USART Control/Data function.  $(C/\overline{D})$ . Pin 8 receives  $A_9$  which is inverted for the ROM to select ROM 1 or ROM 2. Pins 11 and 10 invert the Read for use by the UART and USART and pins (2 and 13 invert the PWR signal before it is applied to IC "A" to provide PWR.

In terms of logic:

$$PDBIN + SINP + \text{Proper address} = \overline{\text{Read}}$$

$$SOUT + PWR + \text{Proper address} = \overline{\text{Write}}$$

IC "C" performs three functions. (1) It is used to invert  $A_1$  which is used to select the USART. It also performs the following logic functions.

$$(2) \quad \text{Read} + \overline{A_1} + \overline{A_0} = \overline{\text{SWE}}$$

$$(3) \quad \text{Read} + \overline{A_1} + A_0 = \overline{\text{RDE}}$$

All that we are saying here is that if  $A_1$  is high (The USART is selected), you cannot obtain  $\overline{\text{SWE}}$  or  $\overline{\text{RDE}}$ , and that which of the above you obtain depends on whether  $A_0$  is a "1" or zero. (Zero for control status read and 1 for data read). This selects port 00 for control and 01 for data.

II ADDRESSING Diode logic is used for addressing. Since the only addresses used by the UART and USART are 0, 1, 2 and 3, address lines 2, 3, 4, 5, 6 and 7 must all be zero. Diodes connect these addresses to the input of one section of IC "B", a hex inverter. This input is held low by a 330 ohm resistor. If any of the above lines goes to a "1", the output of this inverter shuts off the USART and UART.

Figure 1 shows the circuits involved. Similar logic is used to select the ROM's. Having selected C000 as the ROM address,  $A_{15}$  and  $A_{14}$  must be high, but  $A_{10}$ ,  $A_{11}$ ,  $A_{12}$  and  $A_{13}$  must be low. (Addresses  $A_0 - A_9$  are used by the ROM).

The diode transistor logic here says if 14 or 15 go low, the ROM is off, or if 10, 11, 12, or 13 go high the ROM is off. This cutoff signal is applied to the ROM via one of the four gating inputs where  $A_9$  or  $\overline{A_9}$  plus MEMR and PDBIN are mixed to select the output reading from the ROM.

III BAUD RATE TIMING

IC's "D, E, F and G" are 7493 counters which may be programmed to count from 2 to 16. IC "D" is set by means of diode feedback to divide by 13. This counter divides the 2 mhz clock to obtain a 154 Khz signal which is 16 times the 9600 baud clock. A signal taken from its D output is labelled by a silk screened letter. The "C" output of this counter (labelled A) gives a series of pulses which compares to a 19,200 baud clock x 16. There will be a position error of a few percent here, but this is of no consequence. Successive divide by 2 counts give the baud rates from 9600 to 75. The 2400 baud output is divided by 11 in IC "E" to get 220, which is then divided by 2 to get 110 baud.

BAUD RATE TABLE

	x 16	x 1
A	19,200	
B	9,600	
C	4,800	
D	2,400	38,400
E	1,200	19,200
F	600	9,600
G	300	4,800
H	150	2,400
I	110	1,750
J	75	1,200

IV ROM

The ROM used is the Fairchild 93448 which is a fused link (NOT REPROGRAMMABLE) ROM with tri-state outputs. When all four of the inputs are correct, the ROM outputs its data to the DI buss. In order for the ROM to be "on" MEMR, PDBIN, A<sub>9</sub> or A<sub>9</sub> and the address logic must all be at the proper voltage level.

One or two ROMs are provided with the Monitor program. A socket for a second ROM is provided for future expansion of the 1 ROM set. The ROM provided is addressed at C000 (Hex) and is selected by switches A<sub>14</sub>, A<sub>15</sub> up, all others down and examine. The output of these ROM's is connected to the DI buss by means of a 8 color coded jumper.

NOTE: These jumpers are left long so that you can cut them to install the ROM blowing circuit should you later wish to blow ROM's.

ROM's with your special programs are available. If you have a special program developed, contact us for instructions on ordering. We also provide a blow it yourself circuit so that you can automatically blow your own in the computer - which is the reason for the ribbon lead.

ROM sockets are designated H and I. Use the Right hand socket for ROM I and the left-hand socket for ROM II.

Three 8097, 74367 or 8T97 bidirectional switches (IC's J, K,L) are used to determine whether the bidirectional buss is used for read or write functions. The selection of these switches is done by IC's A,B, C. Figure 1 shows the sections used and their pin numbers. The appropriate edge card connector (main buss) is also shown.

INTERFACING Two buffer IC's M and N are used to buffer between the UART, USART and the cassettes and terminal.

IC "N" buffers the inputs for RS232 and one possible TTY output. Connector II from the area above it has 10 pins which connect to this IC. Pin J is for RS232 from the Terminal to the UART. A diode and resistor in series between this pin and the 7406 limit the current and voltage applied to pin 1. At pin 2 the output is inverted and goes to the UART. A connection from this point to the connector, pin I serves a dual function. It gives a TTL output from Pin J and serves as a TTL input for the UART.

Pin 3 receives the TTL level signal from the UART and inverts it for magnet or cassette drive use. (See Interfacing Instructions). Pin 5 accepts the RS232 input from Pin H for the USART. Its output on pin C is a TTL inversion. Pin C of the connector also serves as a TTL input for the USART. Two other sections of the 7406 are used to invert TBE and ODA from the UART. These are added to the Status buss inverted from their polarity leaving the UART so that a "Go" condition on the status buss is all zeros. One section is not used.

IC "M" is non-inverting. Signals to and from the USART at TTL levels are passed through this 7407 to buffer it from outside inputs and provide current drive for turning cassettes on or off. These signals are RTS, CTS, DTR and DSR. One section is used to provide non-inverted, i.e. TTL magnet drive for the UART. Another section provides a TTL output from the USART to cassettes. Both of these TTL outputs are also connected to RS232 driving transistors for RS232 outputs (+5 to -15 volts).

USART AND UART

The USART is programmed by means of commands sent from the ROM. It cannot use other commands without a ROM change. One factor in its use has been noticed. The program requires that it always start from a reset mode. If the cassette should fail to start and stop on keyboard command, stop the computer, press "External Clear" and then restart. DO NOT hit "Reset." The ROM program calls for the program on the cassettes to be recorded 8 bits, even parity and 1 stop bit.

OPERATING INSTRUCTIONS - R O M 1

The NATIONAL MULTIPLEX PROM MONITOR is a 512 BYTE program stored in Read Only MEMORY. When used with a serial terminal, it allows the user to free himself from the front panel of an 8080 based computer. It also interfaces to any NATIONAL MULTIPLEX DATA RECORDER, giving the capability to automatically store and retrieve tape files. It may also be used with other recorders having RS232 or TTL interfaces and software start/stop.

Since the Monitor requires a small amount of read-write memory, it will automatically search through the address space until it locates a page of RAM. It will automatically locate and use the top 30 decimal bytes in the highest page of implimented memory. Thus, anything the user stores in these locations will be lost when the monitor is entered.

All files stored on tape by the monitor are in the NATIONAL MULTIPLEX format. This is shown below.

FILE ) -----FILE NAME xxx.....xxx, EOF -----  
FORMAT) 4 sec leader File (Binary) 1 sec trailer

This format consists of a leader (blank), the file name, file, three control x's as an EOF, and a trailer (blank). Note that because of the EOF code, no more than two consecutive control x's (18 Hex) can be in a file. The monitor searches for three control x's to use as a cassette turn off signal. These control x's are inserted automatically and should not be typed in by the user.

When using the monitor, it is necessary for the operator to manually load and rewind tapes. He must also depress the PLAY button before a SEARCH and the record buttons before a DUMP. The first ten seconds or so of the tape should not be used as it usually contains dropouts. Also, a READ (i.e. search) should not be started in the middle of recorded data since a parity error will occur, spoiling the READ. Normally it is not necessary for the operator to bother with these problems if he allows the monitor to position the tape itself. He only need rewind to just before the start of tape and let the computer do the rest. If not starting at the beginning, start at a silent spot. Always avoid stopping and starting tape in the middle of a data block.

A listing of the monitor has been included to allow the use of the subroutines it contains. These are documented on the listing. Also, the source for some additional commands is included. They can be assembled into RAM the user has and executed via the "G" command. They will also be available later in an optional PROM to plug into the second socket on the I/O board.

The following is a description of the commands recognized by the monitor and how to use them. In the format of each, the following conventions are used:

[ ] Delimiter - any non-hex character except control x (space will do)  
bbb Variable number of blanks  
Opt. Optional  
Cntl. Control  
Control x Return to command mode

As an example of the monitor commands. See No.2 below. Type D, a space is optional, then the four character start address in Hex (for example 0000) space, then the stop address (for example 2000) and another character. This time try carriage return although space will also do.

A control function does not print. Hence a space or non-Hex character here can be a good idea to let you see what you did.

COMMANDS:

I-LOAD HEX L [ ] START ADDRESS [ ] BYTE 1 [ ] BYTE 2 [ ]...[ ] BYTE 'n' [ ] CNTLx \*  
Opt.

The "L" command allows the user to load memory from the terminal. Both the starting address and bytes to be loaded are in hexadecimal. It is not necessary to type leading zeros, but a 00 must be entered as at least one zero. In the event more than the required number of digits are entered, the computer will use only the four on the right for address or two on the right for data. This is invaluable in correcting errors. The [ ] represent delimiters which may be any non-hex character except CNTL x. Control x is used to return to the command mode.

\* NOTE that the final delimiter is required before the CNTL x if the last byte is to be stored.

The computer will automatically line feed and carriage return as required, printing the present loading address each time it does so when the last Hex character in the address is 0.

II DUMP HEX D [ ] START ADDRESS [ ] END ADDRESS [ ]  
Opt.

This command dumps memory in hexadecimal to the terminal, from the starting address to the ending address. Both addresses are read in standard Hex format. The output will be displayed with a four-digit address starting each line, followed by the two-digit bytes in the successive memory locations. The ADDRESS corresponds to the left most data byte on the printed line.

III Control D - Binary Dump (No slash)  
CNTL D [ ] START ADDRESS [ ] END ADDRESS - CR  
Opt. (Do not use a slash at the end)

This command dumps memory to the cassette recorder in binary from Start address to stop address. (non-formatted). Two addresses are read in under the standard hexadecimal input format. As soon as the end address is terminated by a CR, the recorder is started and the computer waits 4 sec. before dumping the memory. After the dump it will put approximately one second of trailer on the tape, and then shut off the recorder.

NOTE: The record buttons on the Recorder must be depressed before using this command.

IV Control D - Formatted Binary Dump (with slash)  
(Note that a slash is used here.)  
CNTL D [ ] START ADDRESS [ ] END ADDRESS/ bbb FILE NAME \*[CR]  
Opt. Opt. Opt.

This command dumps a block of memory to the cassette recorder in the NATIONAL MULTIPLEX file format. The start and end addresses are read in under the standard hexadecimal format, but the end address must be terminated with a slash. The file name consists of six characters (no restrictions except not a CNTL x), and leading blanks will not be included. However, imbedded and trailing blanks must be entered. This command is used for both single and repetitive search (S and Control S).

NOTE 1) The record buttons on the Recorder must be depressed before using this command.

NOTE 2) The dump starts as soon as the sixth letter of the file name is typed. Therefore, if you need to set up your recorder or make any other arrangements, do so before typing the sixth character.

Three Control X's are automatically added at the end of the dump and need not be inserted by the user. This enables the cassette to stop at the end of the file when search is used.

For repetitive file use, the first four characters must be entered. For example, the file name is JOHN. We enter JOHN01, JOHN02, JOHN03 etc. The repetitive search will look for and store all JOHN files. If you want only JOHN03, ask for it in single search.

V S(Search)  
S bbb FILE NAME [ ] LOADING ADDRESS [ ]  
Opt. Opt.

This command searches a tape for the specified file, and if found, loads it into memory starting at the loading address. The loading address is in the standard Hex format. The file name is six characters (No Control X's), with leading blanks ignored. Imbedded and trailing blanks must be entered, however. When the last character is entered, the recorder is automatically started and the search begun. When the file is found, the bell on the terminal is rung and loading started. When the EOF mark is found, the recorder stops automatically and the monitor returns with a '?' If a parity error occurred during the read, '02' will be printed across the terminal. The user must hit any key to exit this condition. (This key will be interpreted as a command). Note that since 3CNTL x's are used as an EOF mark, no file may contain more than 2 consecutive CNTL X's since this would prematurely terminate loading.

NOTE: The play button on the Recorder must be depressed before using this command. In general, the recorder or recorders must be in a standby (button down condition) for either load or dump sequences in automatic from the ROM to function.

VI CONTROL S (Repetitive Search)

CNTL S bbb FILE NAME [] LOADING ADDRESS []  
Opt. Opt.

This command allows loading of all files on a tape which have file names containing the same first four characters. The file name is entered as the four characters on which the multiple search is based, with leading blanks ignored. Imbedded or trailing blanks must be included however. This command allows you to separate out all files (check data or customer transactions) with a common four letter heading.

For repetitive file use, the first four characters are used for the search, but six file name characters must be entered. For example, the file name is JOHN. We enter JOHN01, JOHN02, JOHN03, etc. The repetitive search will look for and store all JOHN files. If you want only JOHN03, ask for it in single search.

VII CONTROL L (Unformatted Binary Load)

CNTL L [] LOADING ADDRESS []  
Opt.

A space between Control L and the address is optional.

This command is provided to allow loading of unformatted tapes into memory. When the load address is terminated, the Recorder is started and reading begun. Information on the tape is loaded as binary characters, starting at the loading address with the first character on the tape. Loading will continue until a key on the terminal is pressed. This stops the Recorder and executes the command the key indicates. A parity error on read causes 02's to be printed across the terminal, until the user types a key.

NOTE: The play key on the Recorder must be pressed before using this command.

VIII GOTO

G [] Go To Address []  
Opt.

This command starts execution at the specified GoTo Address. The Address is in standard Hex format, and the processor will jump to this address as soon as it is terminated by the ending non-Hex character, i.e., space - CR or period.

ERROR CHECK

When programs are loaded from the tape, the software checks for parity errors. If a parity error is found, the software outputs an 02 via the terminal continuously until the USART is reset.

If this occurs, hit any key on the keyboard to break the load loop and return to the monitor. Clean the head in the recorder and rewind the tape. Then try again.

If you start the recorder in the middle of a data block, the first 60-70 characters will all give parity errors and set the parity error latch on the USART. This will cause a constant string of 02's to be printed until you exit the command. For this reason always locate a silent spot on the tape before starting. In normal operation the machine stops between data batches and is up to speed before data starts. For this reason, you should always use file names and auto starts if at all possible. If you have unlabelled files, it is a good idea to reload them with labels. At any rate you must start loading from a silent spot or leader section. This also protects the tape since leaving the capstan engaged for long periods on one spot can cause stretching.

When starting and stopping a tape under manual control, the motor switch causes static or arcing noise which can start the USART off on the wrong foot. If at all possible, use the auto start. The schematics given on page 12 of the CC-7 Manual show how this is done. The 4.7 mfd condenser shown has been changed to 33 mfd to prevent this noise on manual starts. On automatic (software controlled) starts the only noise or false signal comes from the tape or transients.

All CC-7A units shipped after June 15, 1976, have these circuits installed. All CC-7 units shipped after that date have the automatic reset but not the motor start transistors installed.

NOTE: To start a tape from the beginning with a clean 15 second leader, use the following routine -

- ||| With the cassette player on record, type in S space AAAAAA space (CR)
- ||| This will start the recorder searching for a non-existent file, but recording a space condition on the tape. After 10-15 seconds, hit the space bar to stop the recorder.
- ||| You are now ready to dump files using the Control D routines.

H A N D L I N G M I T S B A S I C

Enter the basic to your computer the first time by the method you normally use. DO NOT, however, use two I/O boards on Ports 0,1 or 2,3 at the same time. If you enter by TTY, use the 2SIO(R). If you use the ACR and ports 6,7 there is no conflict.

Once entered, modify the addresses shown for your basic to the data shown in the boxes, i.e., your dump of these addresses should read the same as ours. Use the L Command and D commands.

This changes the CSAVE and CLOAD routines to call on the 2SIO(R) monitor for cassette dump and load. Once this is done, dump the Basic to a cassette with a formatted heading - say BASIC8 - or BASICE. Then you can reload it with the S command. Dump it 3 or 4 times to make sure you have a good error free copy in case one dump gets a crimp or break.

NOTE: This dump should be uninitialized, i.e., once it is in, do not respond to requests but dump it as it is.

CSAVE - To use this command, insert a tape and depress the record buttons (The Recorder should not start at this time). Type in CSAVE followed by the letter you wish to name the file. (For example, CSAVEA). Then hit return, and the recorder will start. When Basic comes back with an 'ok', press the external clear switch on the computer front panel. This will shut off the Recorder. The file has now been dumped to tape. Try to get 10-15 seconds of leader before dumping to avoid using the front end of the tape which usually has glitches.

CLOAD - To Load a file off tape, insert the tape and depress the play button. Type in CLOAD followed by the file name (1 letter) - (For example, CLOADA). Hit return which will start the Recorder and begin the search. When Basic has found the file, it will ring the terminal bell and type an 'OK' when it is loaded. Press the external clear switch on the computer front panel to stop the recorder.

NOTE 1 - The reading is done under the I/O Board's Prom Monitor which checks for parity errors. Should an error occur, 02's will be printed across the terminal. Pressing any key will exit this condition, but will enter the Monitor. Simply type GØ (zero) to reenter Basic and try the LOAD again.

NOTE 2 - The tape files are done in MITS format so that they can be used on other systems.

NOTE 3 - You can only use CSAVE and CLOAD when BASIC is in the machine already.

MODIFICATIONS TO ALTAIR BASIC FOR 2SIO(R)

<u>ADDRESS</u>	<u>DATA BITS</u>
<u>8K Basic (3.2)</u>	
01A4	36
01A6	07
1007	E5 CD 4B C1 3E 21 D3 03 CD
1010	AC C1 3E D3 CD BA C1 CD BA C1 CD BA C1 E1 E5 7E
1020	CD BA C1 2A 43 02 EB 2A 45 02 1A 13 CD BA C1 E7
1030	C2 2A 10 E1 D7 C9 F5 CD 4B C1 00 00 00 00 00 F1
1055	CD E0 C1
1061	CD E0 C1
106D	CD E0 C1

1A00 is upper end.

8K Basic (3.1)

01A4	15
01A6	E0
0FE0	E5 CD 4B C1 3E 21 D3 03 CD AC C1 3E D3 CD BA C1
0FF0	CD BA C1 CD BA C1 E1 E5 7E CD BA C1 2A 43 02 EB
1000	2A 45 02 1A 13 CD BA C1 E7 C2 03 10 CD BA C1 CD
1010	BA C1 E1 D7 C9 F5 CD 4B C1 00 00 F1
1024	CD E0 C1
1033	CD E0 C1
103F	CD E0 C1

Extended 3.2

0200	C7
0202	98
1598	E5 CD 4B C1 3E 21 D3 03
15A0	CD AC C1 3E D3 CD BA C1 CD BA C1 CD BA C1 E1 E5
15B0	7E CD BA C1 2A F6 03 EB 2A F8 03 1A 13 CD BA C1
15C0	E7 C2 BB 15 E1 D7 C9 F5 CD 4B C1 00 00 00 00 00
15D0	F1
15E6	CD E0 C1
15F2	CD E0 C1
15FE	CD E0 C1

Ends 2AC0

\* CD E0 C1 is a call routine to the USART software.

I M S A I     S O F T W A R E

ASSEMBLER: The IMSAI assembler is loaded by means of an INTEL checksum loader. The first time this loader is used, via the 2SIO(R), type in the loader with the changes indicated below. Once the Assembler is in the computer, alter the locations shown so that it now responds to terminal ports 00 and 01. Then dump the Assembler on a cassette using the heading ASMBLR and it can be retrieved the next time you use it using S ASMBLR.

IMSAI basic is handled the same way. Locate the I/O routines in the Basic and alter them the same way the Assembler I/O routine has been altered here. Change I/O Ports, status bits and jump addresses plus C2 instead of CA.

IMSAI 8080 - Self-Contained System  
Assembler, Revision 1

FOR USART - Normal IMSAI loader.

```
1000 3E CE D3 03 3E 17 D3 03 3E 11 D3 02 31 67 10 CD
1010 51 10 FE 3A C2 0F 10 CD 37 10 B7 CA 36 10 47 CD
1020 37 10 67 CD 37 10 6F CD 37 10 CD 37 10 77 23 05
1030 C2 2A 10 C3 0F 10 76 CD 44 10 87 87 87 87 57 CD
1040 44 10 B2 C9 CD 51 10 FE 3A FA 4E 10 C6 09 E6 0F
1050 C9 DB 03 E6 02 CA 51 10 DB 02 E6 7F C9
```

FOR UART - Change last line to:

```
1050 C9 DB 00 E6 01 C2 51 10 DB 01 E6 7F C9
```

Omit all but last four bytes in line 1.

To load the assembler (from the ROM) type G1000CR, then start the tape. When the tape loading ends, stop and examine 0050. Go to Run. Nothing will happen. If the assembler is in, it will echo the keyboard. Type DUMP 0050 0060 CR. If the assembler is running, it will dump between the addresses. Note errors in assembler listed in IMSAI manual. Then make the following changes.

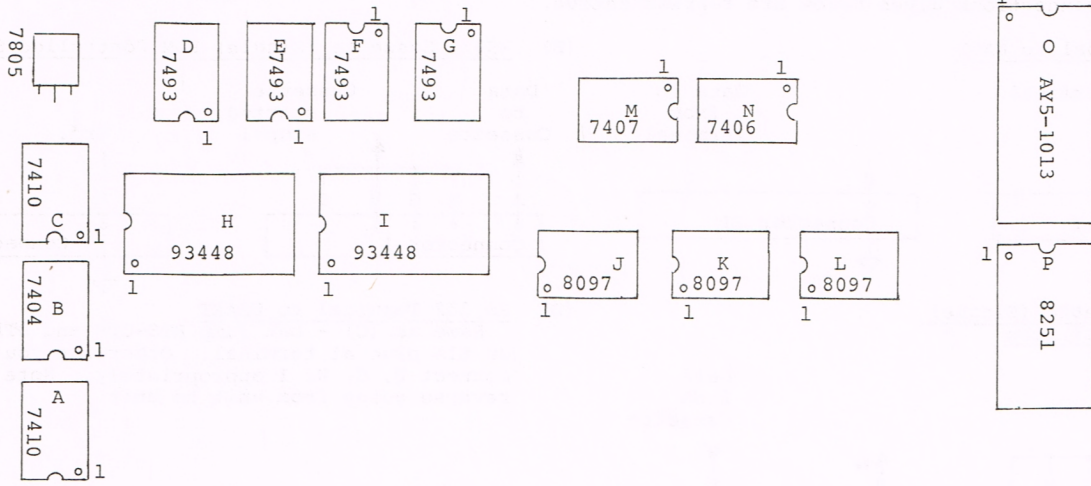
Since the USART has been replaced by the UART for the assembler under keyboard control, initializing the USART is not required. Then change the start to:

0050 C3 90 00

Then change the following addressed because of I/O port differences.

INPUT	OUTPUT
0129 DB 00	0136 DB 00
012B E6 01	0138 E6 80
0120 C2 29 01	013A C2 36 01
0130 DB 01	013D 78
0132 E6 7F	013E D3 01
0134 47	0140 C9
0135 C9	

Layout of IC's; use caution not to bend pins and to get the IC's inserted with pin 1 in the proper position.



CONNECTOR I

Jumpers  
Required

A	B	C	D	E	F	G	H	I	J
○	○	○	○	○	○	○	○	○	○
TXD- <u>TTL</u> (USART)	TXD- <u>TTL</u> (USART)	TSO-232 (UART)	TSO- <u>TTL</u> (UART) (TTY drive normal)	<u>CTS</u>	TXD <u>TTL</u>	<u>DSR</u>	<u>DTR</u>	<u>RTS</u>	RXC (USART) (for synch. use)

CONNECTOR II

A	B	C	D	E	F	G	H	I	J
○	○	○	○	○	○	○	○	○	○
+5 V	gnd	RXD- <u>TTL</u> (USART)	Inverted TTY drive ( <u>TSO</u> ) (UART)	EXT. CIR.	TTY Commutator (Keyboard)	TTY Commutator (Keyboard)	RXD-232	RSI- <u>TTL</u> (UART)	RSI-232 (UART)

\* Be sure the UART Jumpers are compatible with your terminal on data bits, stop bits, and parity bits. If not, the unit will not work.

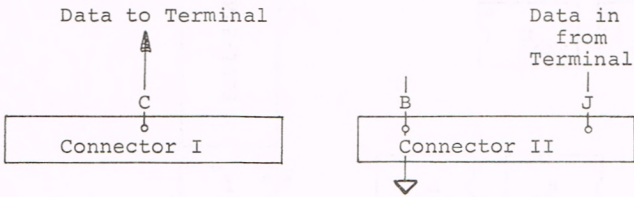
\* If the teletype spaces continuously when connected to pin D of connector I, connect it to pin D of connector II.



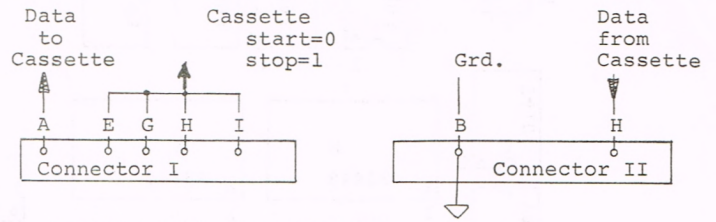
INTERFACING THE 2SIO(R)

The 2SIO(R) is intended to control one or two cassettes and one terminal. However, it can be used many ways. The connections given below are representative.

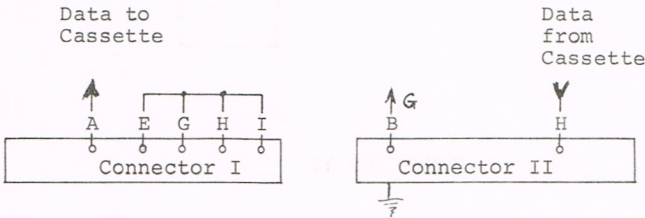
(A) RS232 Terminal to UART



(B) RS232 Cassette (Single) ROM Controlled Start Stop



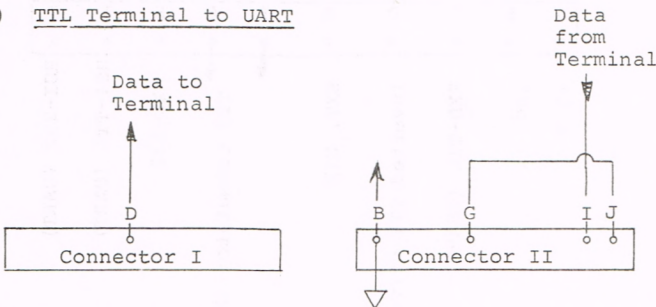
(C) RS 232 Cassette (Single) Manual Start Stop



(D) RS 232 Terminal to USART

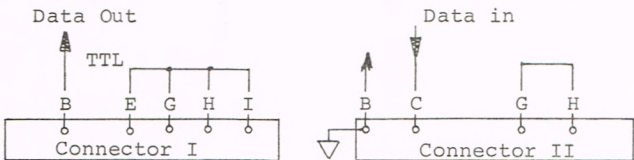
Same as (C) - but jump RTS-CTS and DTR-DSE on EIA plug at terminal. Otherwise you must connect E, G, H, I appropriately. Note that these reverse going from unit to unit.

(E) TTL Terminal to UART

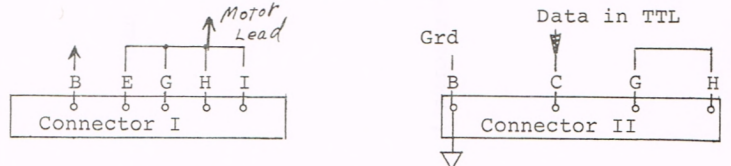


(F) TTL Cassette to UART - Same as E

(G) TTL to USART



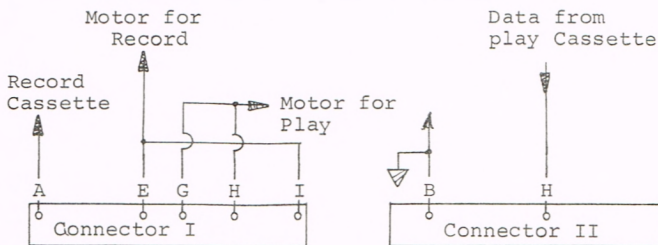
(H) Single Cassette (TTL) to USART



(I) Dual Cassettes (Read/Write) RS232

Dual Cassettes (REad/Write) TTL

Motor Controls same as (I); data in out as in (G)

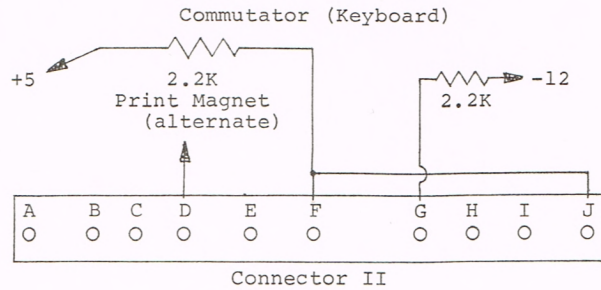
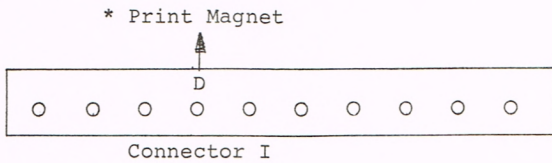


TELETYPE While you can use a teletype on the USART, we recommend that you use the UART only. There are many different teletype connections and we can cover only a few here. Many teletypes use RS232 in/out hence the circuit is the same as that in (A) above.

For current loop systems, typically the magnet driver (Print magnet) input is held at +5 volts in the "mark" state, going to 0 for space. This is the same as a TTL output. MITS uses this with MITS Teletype call units.

The commutator, which is only a switch, is generally connected through two resistors to cause an RS232 voltage swing.

There are two pads on the I/O board above pins F and G on Connector II. Use one for the positive resistor, the other for the negative. Since these pads are hidden by the plug, put the resistors on the side opposite that of the plug.

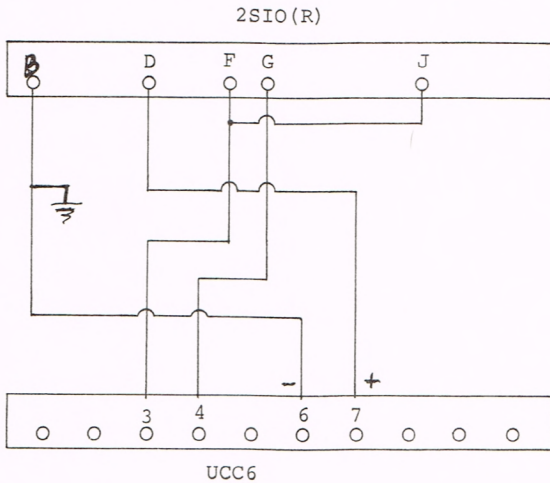


The MITS style connection is shown above.

\* If for some reason your teletype requires a reversed drive polarity on the print magnet, connect to pin D on Connector II. This will be indicated by continuous running (spacing) when connected as shown above.

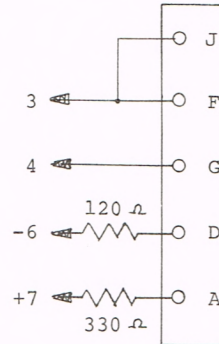
The 2.2K resistors shown above are on the back side of the board (i.e.) opposite side from the components.

The connections below apply to the UCC6 line local call control unit. Pins 6,7 must effectively be shorted to stop spacing. If unit does not print, reverse 6,7.



Some users report this will not work for them. They recommend the 3 P+S recommended connection. This is the more or less standard 20 mil. loop connection. If you don't have a MITS teletype, or make your connections directly to the print magnet as shown in the CC-7 manual, try this connection first.

TTY

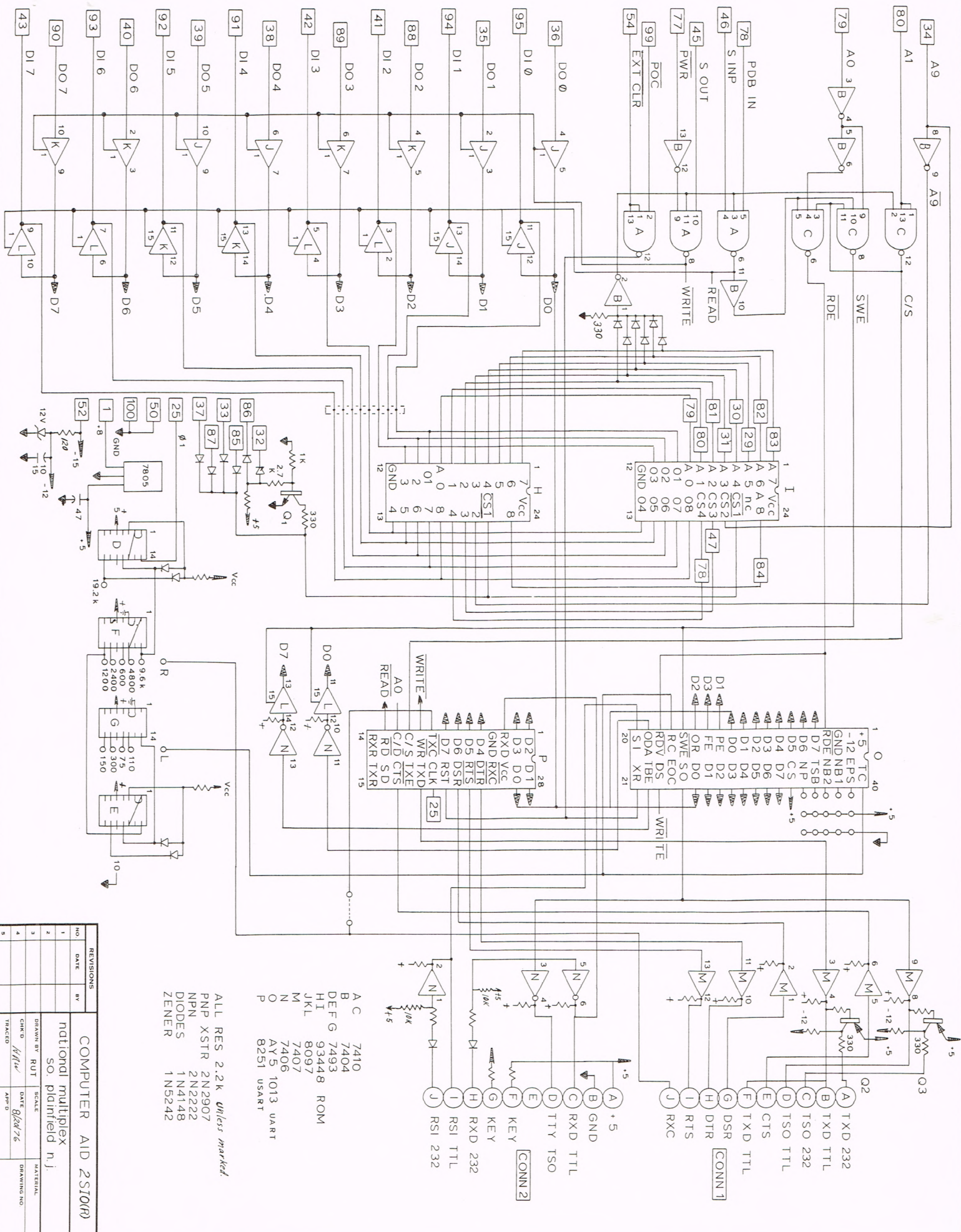


If you wish to change terminal bits, stop bits and parity, use the following table to set up the UART (AY5 -1013).

35	No Parity	NP	A logic "1" on this lead will eliminate the parity bit from the transmitted and received character (no PE indication). The stop bit (a) will immediately follow the last data bit. If not used, this lead must be tied to a logic "0".
36	Number of Stop Bits	TSB	This lead will select the number of stop bits, 1 or 2, to be appended immediately after the parity bit. A logic "0" will insert 1 stop bit and a logic "1" will insert 2 stop bits.
37-38	Number of Bits/Character	NB2, NB1	These 2 leads will be internally decoded to select either 5,6,7 or 8 data bits/character.

NB2	NB1	Bits/Character
0	0	5
0	1	6
1	0	7
1	1	8

39	Odd/Even Parity Select	EPS	The logic on this pin selects the type of parity which will be appended immediately after the data bits. It also determines the parity that will be checked by the receiver. A logic "0" will insert odd parity and a logic "1" will insert even parity.
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REVISIONS	
NO	DATE
1	
2	
3	
4	
5	

COMPUTER AID 2510(R)	DRAWN BY RUT	SCALE	MATERIAL
national multiplex	DATE 8/24/76		
so. plainfield n.j.	APP'D		
	TRACED		

ALL RES 2.2k unless marked:

PNP XSTR 2N2907  
 NPN 2N2222  
 DIODES 1N4148  
 ZENER 1N5242

A C 7410  
 B 7404  
 DEF G 7493  
 H I L 93448 ROM  
 J K L 8097  
 M 7407  
 N 7406  
 O AYS 1013 UART  
 P 8251 usART





C210		0200	*	THIS IS THE ROUTINE TO PRINT		
C21C		0210	*	MEMORY IN ASCII ON THE TERMINAL.		
C21C		0220	*			
C21C	CD 89 C0	0230	PASCII	CALL	TWOADR	
C21F	CD 7F C0	0240		CALL	CRLF	
C222	0A	0250	HERE2	LDAX	B	
C223	CD F2 C0	0260		CALL	WRCHR	
C226	21 00 C0	0270		LXI	H,FNDSTK	
C229	CD A5 C0	0280		CALL	1PCMP	
C22C	C3 22 C2	0290		JMP	HERE2	
C22F		0300	*			
C22F		0310	*	THIS IS THE ROUTINE TO ENTER		
C22F		0320	*	ASCII CHARACTERS INTO MEMORY.		
C22F		0330	*			
C22F	CD 8E C0	0340	LASCII	CALL	RDNUM	
C232	CD E3 C0	0350		CALL	RDCHR	
C235	FE 5F	0360		CPI	5FH BKARROW	
C237	CA 3D C2	0370		JZ	ERASE	
C23A	12	0380		STAX	D	
C23B	13	0390		INX	D	
C23C	13	0400		INX	D	
C23D	1B	0410	ERASE	DCX	D	
C23E	C3 32 C2	0420		JMP	LASCII+3	

To use the E and P functions in RAM, locate them at some convenient place. Let the calls to ROM alone. Change the jump addresses to fit your location (3 places).

To use E, manual examine the LASCII address, go to run, type starting address for your ASCII data storage and (CR). Then start typing.

To dump ASCII, examine PASCII address, go to run, enter start address, space, end address. Now if you don't want that on your copy, get everything set and hit return. It will print it out.

PASCII can also be used to punch 8 bit tape, but you will have to find the start and mark it. CR for example will appear ahead of your data dump.

These things will be corrected as the 2nd ROM Program grows.