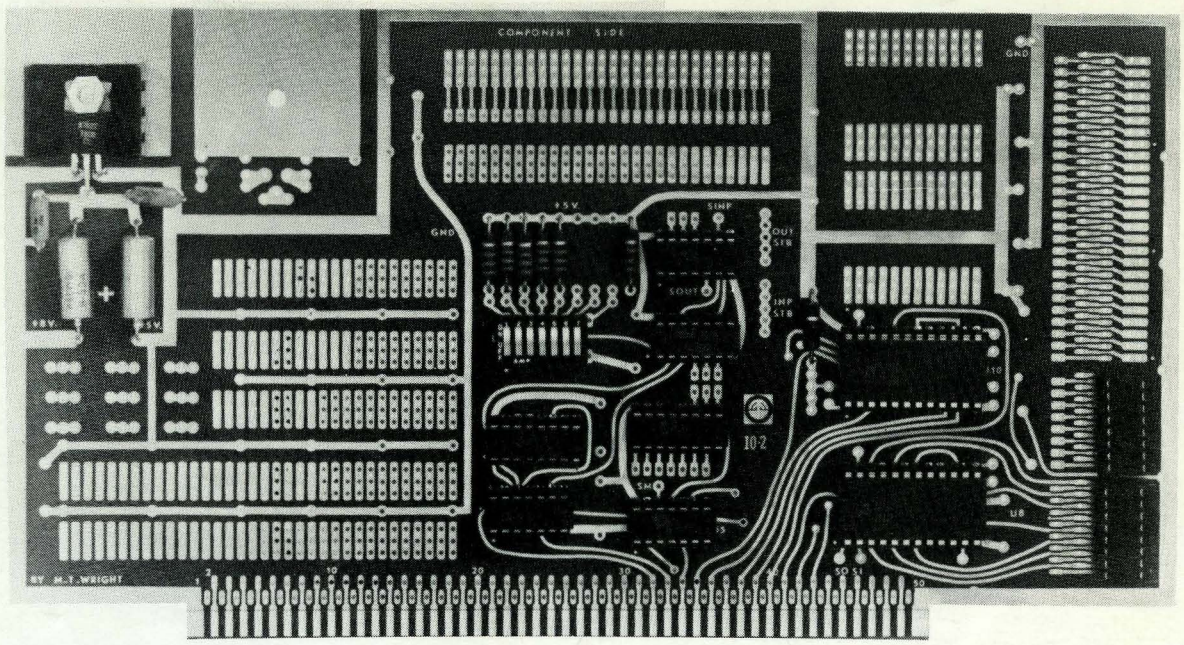
Microcomputer Products, 2116 Walsh Avenue, Santa Clara, CA 95050, (408) 246-2707

IO2 PARALLEL I/O BOARD

(5)



FEATURES:

SSM distributed only the PC board that is included with this kit or assembled board. The SSM warranty applies to the PC board only. SSM assumes no responsibility whatsoever for the other parts that are sold with the PC board.

SYSTEM COMPATIBILITY
. S-100 bus computer systems.

INPUT/OUTPUT CAPABILITY
. Committed circuitry provided for one parallel input and one parallel output port.
. Support circuitry provided for maximum I/O expansion includes DIP switch addressable circuitry for 8 consecutive port addresses.

PROTOTYPING CAPABILITY
. Prototyping area for:
  2 - 24 pin ICs
  1 - 40 pin IC
  9 - 16 pin ICs
  1 - 14 pin IC
  1 - spare regulator
. Can be used for either two more parallel ports or one serial I/O port (complete with baud rate generator),plus status bit ports as well as other miscellaneous circuits.

BUFFERING
. Input and output ports are buffered with 8212 tri-state latches.

OTHER FEATURES
. High grade glass epoxy PC board with gold plated edge connector contacts.
. Low profile sockets provided for all ICs.
. Power requirements -- +8V @ .35A typical.

CONTENTS

1.0 INTRODUCTION

1.1 General Description

The SSM IO-2 board was designed to give the user a parallel input and output port circuit as well as uncommitted card traces for mounting proto-type circuits for other S-100 needs. The IO-2 can be configured as a parallel I/O card or a *Serial interface card or as a **Prom card.

The addressing circuit on the IO-2 card will decode eight I/O addresses within a contiguous eight address block selected by a dip switch on the board. Since the upper address lines from the 8Ø8Ø CPU controls the addressing circuit, the card can enable up to eight 1702 proms when connected up as a memory mapped card.

1.2 Assembly Instructions (refer to assembly drawing)

Check kit contents against parts list.

Check PC board for possible warpage and straighten if required.

Insert 4 14-pin, 4 16-pin, & 2 24-pin sockets into the component side of the board. (The component side is the side on which "Solid State Music" is printed.) DON'T SOLDER!

Place a flat piece of stiff cardboard of appropriate size on top of the sockets to hold them in place.

Holding the cardboard in place against the sockets, turn the board over and lay it on a flat surface. (Be sure that all of the sockets pins are through the holes.)

Note: Keep solding iron tip clean to prevent rosin and sludge from being deposited on traces. Wipe tip frequently on a damp cloth or sponge.

On each socket, solder two of the corner pins, choosing two that are diagonally opposite of each other.

Once the sockets are secured, lift the board and check to see if they are flat against the board. If not, seat the sockets by pressing on top while reheating each soldered pin.

*.....If the user needs a flexible serial interface circuit or multiple serial ports, it is recommend that he purchase the IO-4 card.

**.....We recommend the MB-3 for this application.

1.0 INTRODUCTION (continued)

Complete soldering the remaining pins of each socket. Touch pin and pad with iron tip, allowing enough solder to flow to form a filet between pin and pad. Keep the tip against the pin and pad just long enough to produce the filet. Too much heat can cause separation of pad and trace from the board. A 600 degree iron tip is recommended.

Insert and solder 10 1/4w resistors in their respective locations.

Observing polarity, insert and solder 2 tantalum capacitors.

Insert and solder 6 ceramic capacitors.

Insert and solder 1 DIP switch with the OPEN (or "OFF") position toward the top of the board.

Place the regulator on the board so the mounting hole in the regulator is in line with the hole in the board. Mark leads for proper bending position to match the board holes--allow for a bend radius.

Bend regulator leads to match holes in board.

If available, apply thermal compound to the back side of the regulator case (the part that lies flat against the board).

Position the heatsink, drop the regulator in place on the front of board, insert #6 screw from behind and secure firmly with lock washers and nuts.

Solder regulator leads to pads on back of board. Do not use excessive heat.

2.0 FUCTIONAL CHECK

WARNING! DO NOT INSTALL OR REMOVE BOARD WITH POWER ON. DAMAGE TO THIS AND OTHER BOARDS COULD OCCUR.

Apply power (+8 volts approx.) to board by plugging into computer or by connection to a suitable power supply. Measure the outputs of the +5V regulators. If less than 4.8 volts is measured (allowing for meter accuracy) check for shorts or wiring errors. CAUTION: WHILE IT HAS NEVER HAPPENED TO US, SHORTED REGULATORS HAVE BEEN KNOWN TO EXPLODE WITH POSSIBLE INJURY TO EYES OR HANDS. BETTER SAFE THAN SORRY--KEEP FACE AND HANDS CLEAR OF THE REGULATOR SIDE OF THE BOARD DURING THIS AND SUBSEQUENT TESTS!

2.0 FUCTIONAL CHECK (continued)

Now look the board over carefully. Check for poor solder joints or bridges. Using the component layout drawing, look for improper part locations or polarity. A few minutes of careful inspection may save a few hours of troubleshooting.

Observing polarity, insert chips into their sockets as per assembly drawing.

After setting up the board to the desired configuration per paragraphs 3.0 (Set-up) and 4.0 (Applications), each port may be checked for proper operation.

3.0 SET-UP

3.1 I/O Card

3.1.1 Addressing

The dip switch on IO-2 card selects a block on eight possible I/O port addresses. As an example, if the first five switches from the left edge over on the dip switch is set to open (off), the IO-2 will address ports Ø thru 7.

Examples:

Ports ØØ thru Ø7

*A7	open
A6	open
A5	open
A4	open
A3	open

Ports Ø8 thru ØF

A7	open
A6	open
A5	open
A4	open
A3	closed (on)

Ports AØ thru A7

A7	closed
A6	open
A5	closed
A4	open
A3	open

Ports F8 thru FF

A7	closed
A6	closed
A5	closed
A4	closed
A3	closed

The actual port selection within a block of eight ports is controlled by U3. U3 provides eight control lines from pins 1 thru 7 and pin 9 to drive the individual ports. U3, pin 9 is the least significant port address select and pin 1 is the most significant port address.

* A7 is the first switch on the left end of the dip switch.

3.1.1 Addressing (continued)

Example:

Switches A3 thru A7 are all open.
U3, pin 9.....selects port Ø.
7.....selects port 1.
6.....selects port 2.
5.....selects port 3.
4.....selects port 4.
3.....selects port 5.
2.....selects port 6.
1.....selects port 7.

Switches A4 thru A7 are open, A3 is closed.
U3, pin 9.....selects port 8.
7.....selects port 9.
6.....selects port A.
5.....selects port B.
4.....selects port C.
3.....selects port D.
2.....selects port E.
1.....selects port F.

The IC's U8 & U10 are set to a particular port address by tying pin 1 for each IC over to U3, depending on the port address desired.

3.1.2 I/O Connections

To use the one parallel input and output ports a few jumpers must be placed onto the IO-2 card. The reason for the jumpers is to leave certain key signal lines to the 8212 IC's uncommitted for any special applications the user might have.
General I/O jumpers:

(1) Connect "SM" (U5, pin 12) to a logic one to disable memory read option. This is done by tying "SM" to the 1k ohm pull-up resister pad. (5 pads 1.25 inches to the right of the letters "SM" and up 0.62 inches on the front side of the card.)

(2) Now connect the output status control line. Connect SO (board edge connector pin 45) to SOUT (U6, pin 5).

(3) Similarly, connect input status control. Connect SI (board edge connector pin 46) to SINP (U6, pin 9).

(4) Note that there is a signal point (5 pads) called OUT STB (Output strobe). This signal is used to activate the 8212 IC's that are used as output ports. Connect OUT STB to pin 13 (DS2) of U1Ø.

3.1.2 I/O Connections (continued)

(5) Note that there is a signal point (5 pads) called INP STB (Input strobe). This signal is used to activate the 8212 IC's that are used as input ports. Connect INP STB to pin 13 (DS2) of U8. Also connect U8, pin 2 (MD) to ground (hole in ground trace 0.5 inch over to the right from pin 50 of the board's edge connector).

(6) If the clear signal (pin 14) is not going to be used on U8 or U1Ø for any special applications, then tie pin 14 to the 1k pull-up resistor (same point that "SM" in step 1 was tied).

3.2 Prom Card

3.2.1 Addressing

The dip switch on the IO-2 card selects a block on eight possible 1702 (256 x 8) prom addresses. Therefore the dip switch will select any 2k bytes of memory within a 65k byte range. Only the five switches to the left, on the 8 pole dip switch, are used to select addresses A11 thru A15. A15 is the first switch pole on the left.

Example Addressing:

Decode ØØØØH to Ø7FFH		Decode Ø8ØØH to ØFFFH	
A15	open (off)	A15	open
A14	open	A14	open
A13	open	A13	open
A12	open	A12	open
A11	open	A11	closed (on)

Decode A8ØØH to AFFFH		Decode FØØØH to F7ØØH	
A15	closed	A15	closed
A14	open	A14	closed
A13	closed	A13	closed
A12	open	A12	closed
A11	closed	A11	open

The actual prom selection within a 2k block of eight proms is controlled by U3. U3 provides eight control lines from pins 1 thru 7 and pin 9 to drive the individual prom chip selects. U3, pin 9 is the first address of a 2k block and pin 1 is the last address.

Example:

Switches A11 thru A15 are all open.
U3, pin 9.....selects address ØØØØH.
7.....selects address Ø1ØØH.
6.....selects address Ø2ØØH.
5.....selects address Ø3ØØH.
4.....selects address Ø4ØØH.

3.2.1 Addressing (continued)

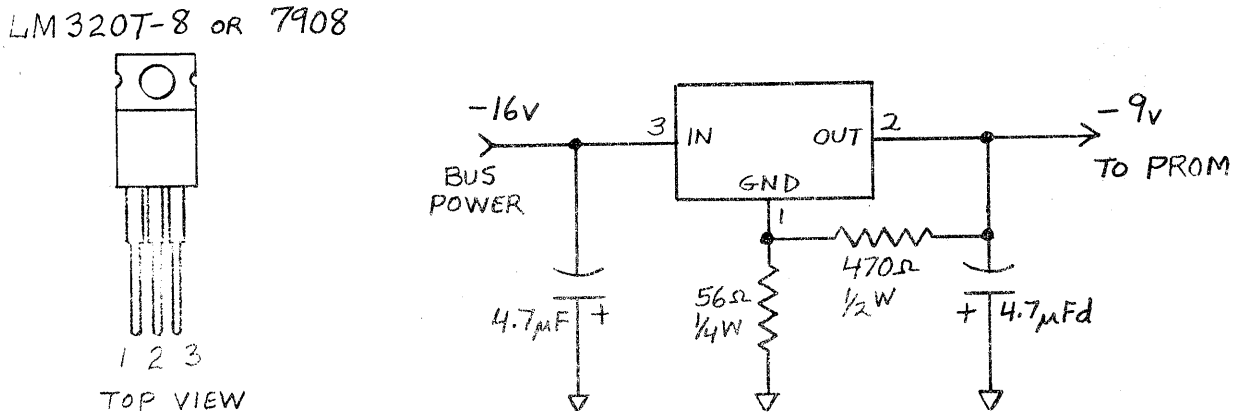
3.....selects address Ø5ØØH.
2.....selects address Ø6ØØH.
1.....selects address Ø7ØØH.

The proms are set to a particular memory address by tying pin 14 for each IC over to U3 pins 1 thru 7 or pin 9.

3.2.2 Rom Connections

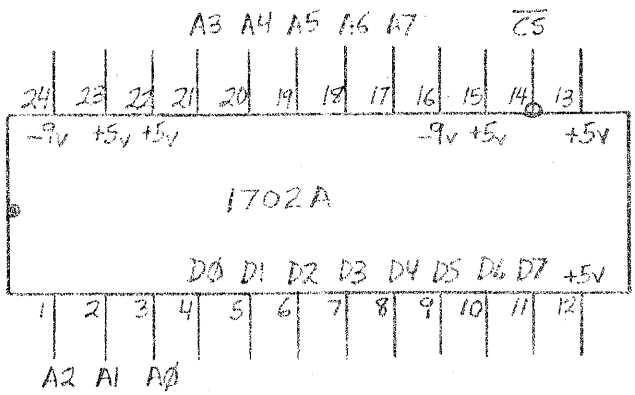
The 1702 prom requires -9 volts to operate, this can be obtained by placing a -9 volt regulator on the unused heat sink pattern to the left on the +5v regulator.

Regulator Circuit



The 1702 prom needs its address pins AØ thru A7 tied to the main bus address pins on the I0-2. The data output lines from the prom must be connected to the bus signals DIØ thru DI7 on the I0-2.

1702 Prom



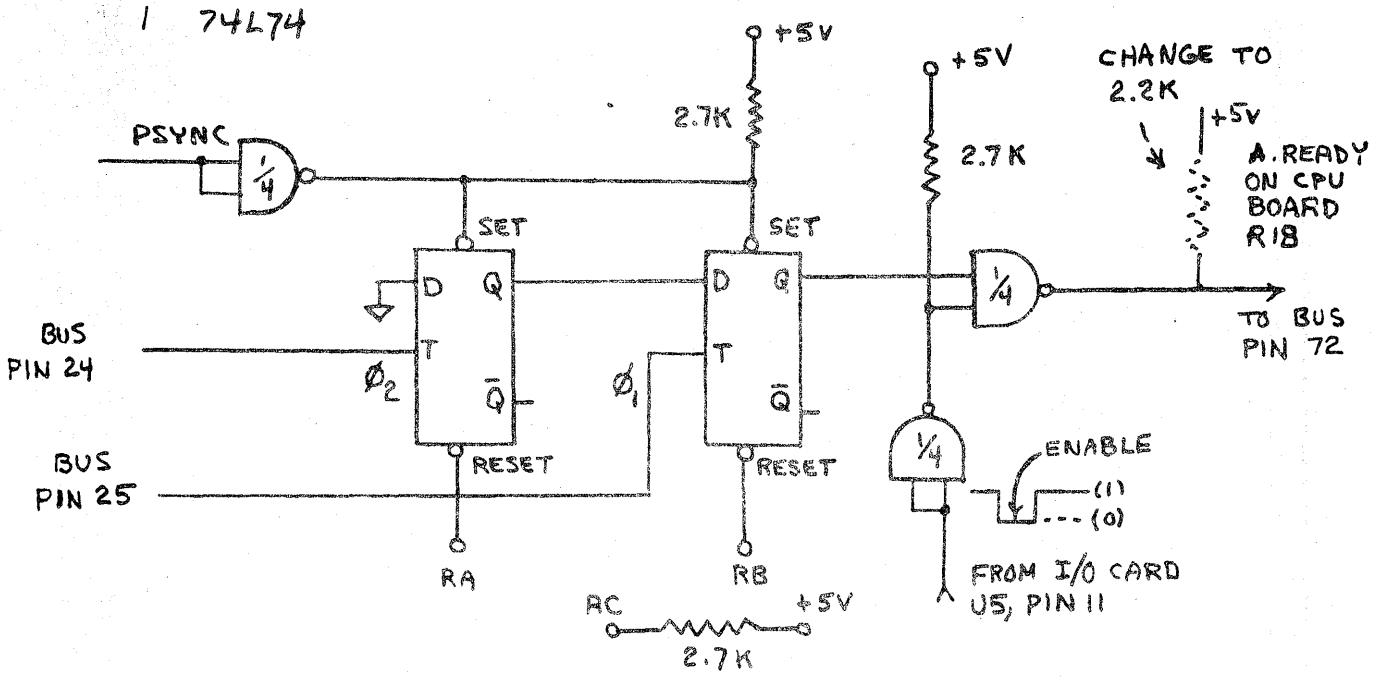
3.2.2 Rom Connections (continued)

The chip select pin (pin 14) from the prom connects to U3 (see addressing 3.2.1)

3.2.3 Wait Circuit

ICs REQUIRED:

1 74L03
1 74L74



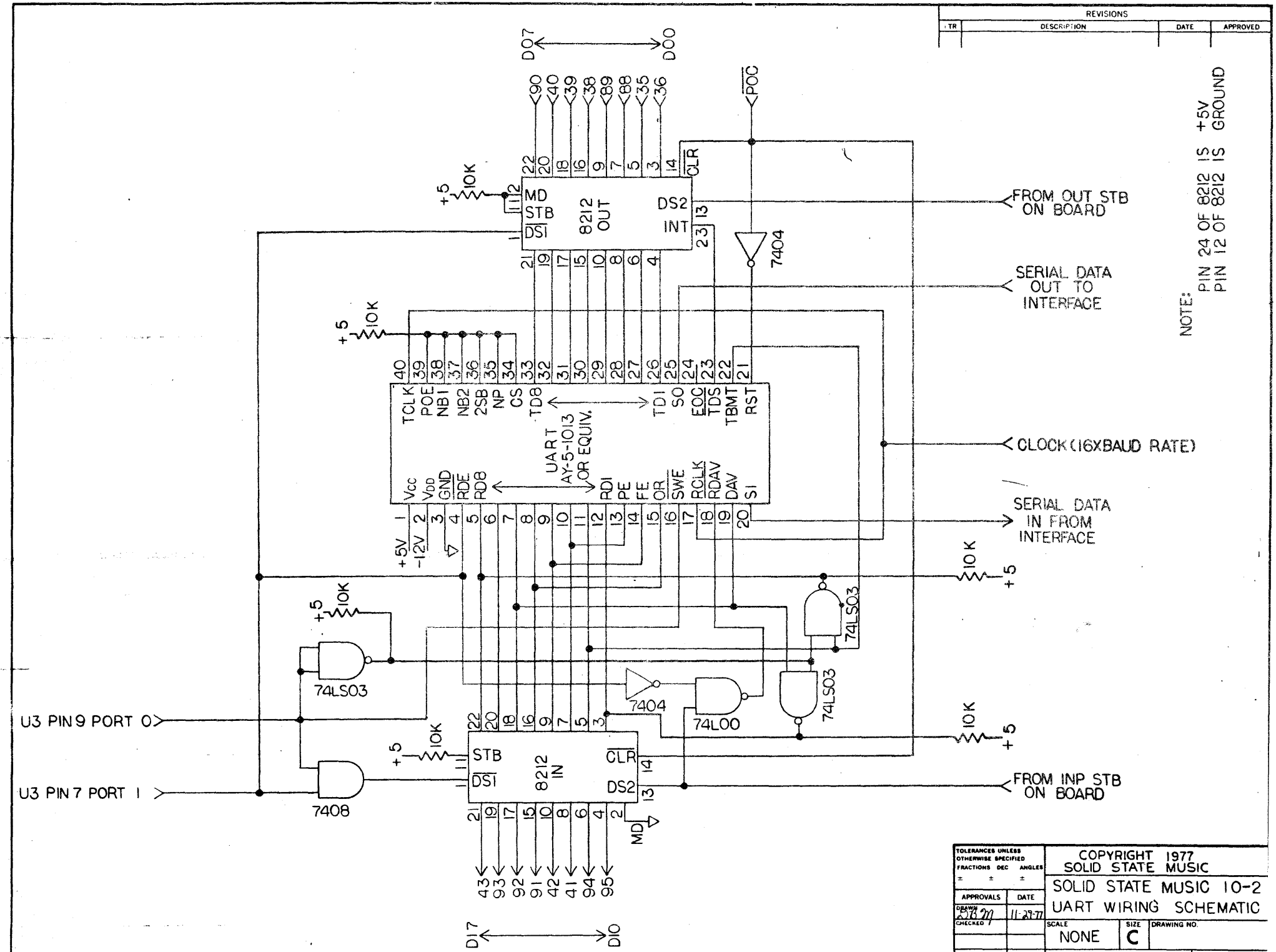
PROM SPEED	RA	RB	NUMBER OF WAIT CYCLES ADDED
.5 us	GND RC	GND GND	NO WAIT CYCLES (Circuit not required)
1 us	GND	RC	ONE WAIT CYCLE - 0.5 us added per byte
1.5 us	RC	RC	TWO WAIT CYCLES - 1.0 us added per byte

3.3 Serial Interface

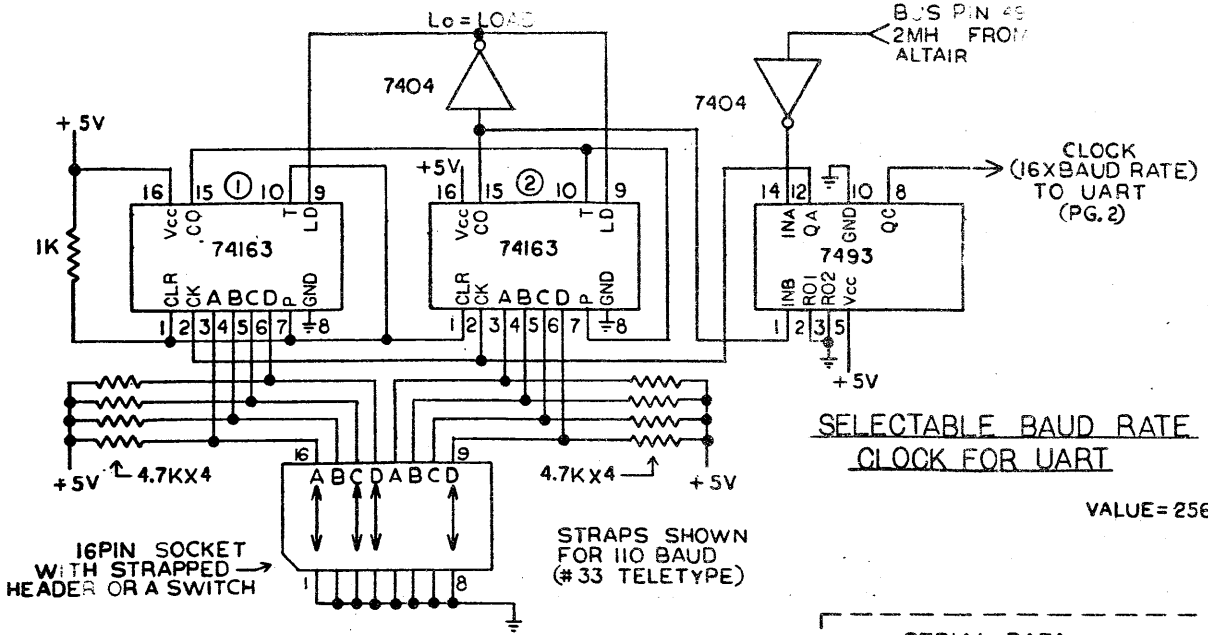
The schematics and assembly information for the serial interface contained in the following pages was configured as a *MITS Rev. Ø and Rev. 1 interface. The status port is at address zero and the data port is at one. The data-available bits are DØ (negative going) and D5 (positive going). The data-acknowledge bits are D7 (negative going) and D1 (positive going).

The IO-2 concept and tape master were created by Malcolm Wright. Important contributions were made by Lynn Cochran - The UART circuits and TTY interfaces, for example.

*MITS - Albuquerque, New Mexico

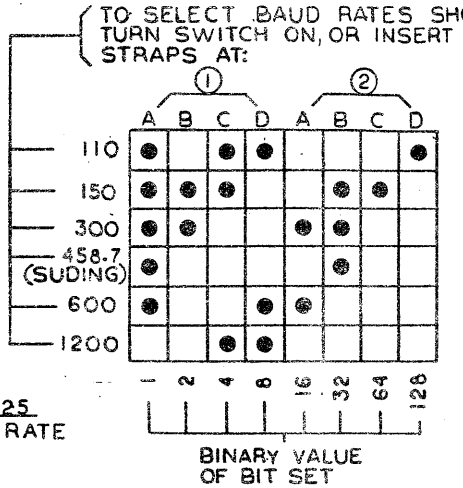

REVISIONS
TR
DESCRIPTION
DATE
APPROVED
D07
D00
8212 OUT
MD
STB
DS1
DS2
INT
CLR
POC
7404
+5
10K
FROM OUT STB ON BOARD
SERIAL DATA OUT TO INTERFACE
NOTE:
PIN 24 OF 8212 IS +5V
PIN 12 OF 8212 IS GROUND
UART AY-5-1013 OR EQUIV.
TCLK
POE
NB1
NB2
2SB
NP
CS
TD8
TD1
SO
EOC
TDS
TBMT
RST
Vcc
VDD
GND
RDE
RD8
RDI
PE
FE
OR
SWE
RCLK
RDAV
DAV
SI
+5V
-12V
CLOCK (16XBAUD RATE)
SERIAL DATA IN FROM INTERFACE
74LS03
74L00
7408
U3 PIN 9 PORT 0
U3 PIN 7 PORT 1
8212 IN
STB
DS1
DS2
CLR
MD
FROM INP STB ON BOARD
D17
D10
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS DEC ANGLES
APPROVALS
DATE
DRAWN
CHECKED
11-29-77
COPYRIGHT 1977 SOLID STATE MUSIC
SOLID STATE MUSIC 10-2
UART WIRING SCHEMATIC
SCALE
NONE
SIZE
C
DRAWING NO.
DO NOT SCALE DRAWING
SHEET

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



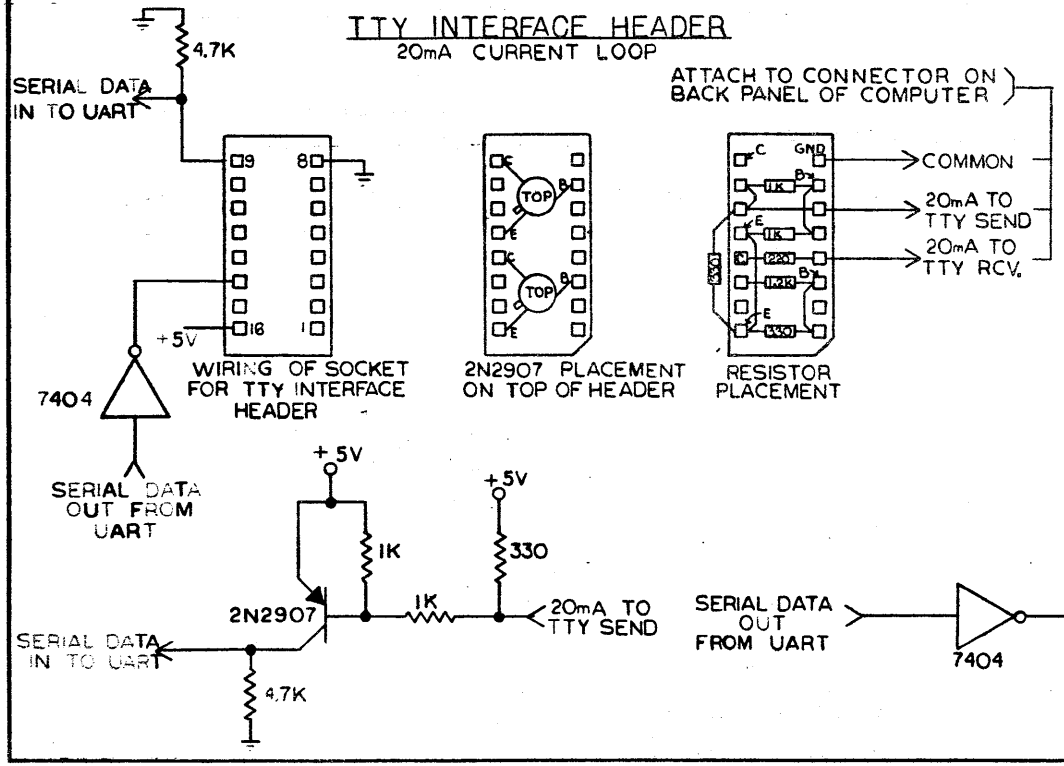
SELECTABLE BAUD RATE CLOCK FOR UART

VALUE = 256 − 15625 / BAUD RATE

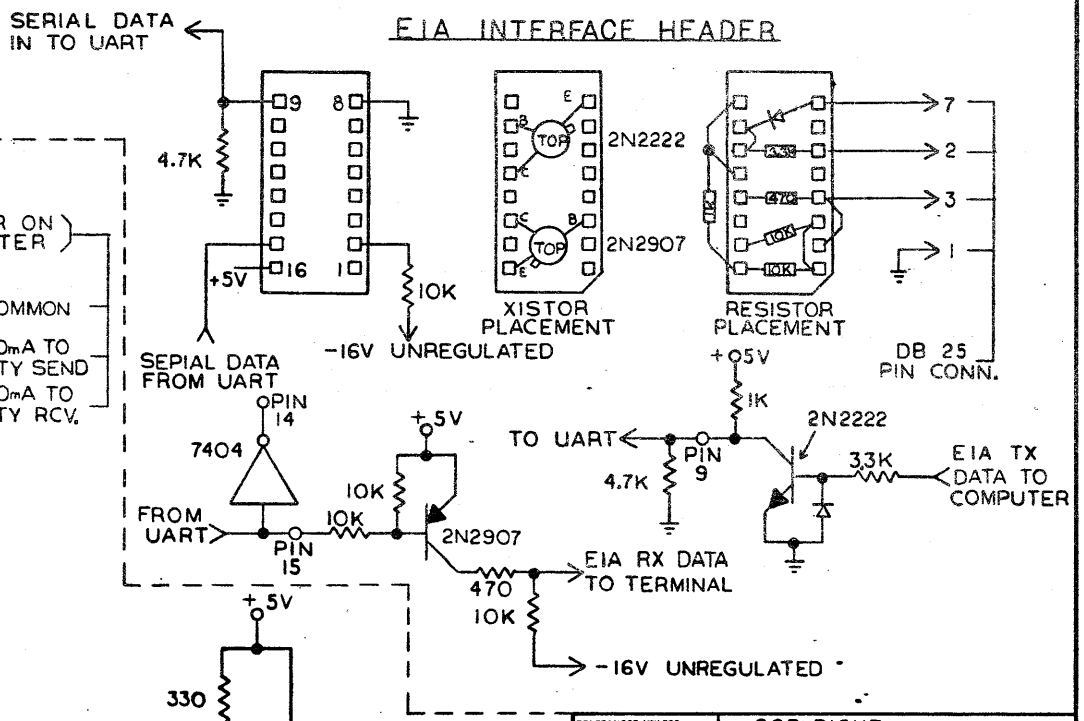


IF THE EIGHT LEADS WERE CONTROLLED BY AN OUTPUT PORT INSTEAD OF A SWITCH, THE COMPUTER COULD SELECT THE BAUD RATE BY ITSELF. IT SHOULD PUT ZEROS WHERE THE STRAPS TO GROUND ARE SHOWN.

TTY INTERFACE HEADER
20mA CURRENT LOOP



EIA INTERFACE HEADER



TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES ± ± ±	SERIAL INTERFACE SUPPLEMENTAL DRAWING
APPROVALS / DATE	
DRAWN 12-16-77	
CHECKED 12-16-77	SCALE NONE · SIZE C · DRAWING NO. 1 OF 1
DO NOT SCALE DRAWING	SHEET

4.0 APPLICATIONS (parallel I/O)

4.1 Altair Rev. Ø or Rev. 1

The 8282 IC (U8) is used as an input port at address Ø1. The keyboard or inputing device should provide a positive pulse for a DAV (data available) strobe to place data into U8.

To create a status port, two unused IC gates will be used on the IO-2 card. U4 and U6 spare gates will be connected up to form an address circuit for port ØØ. By adding an 8Ø97 (74367) IC to the IO-2 card a one bit status port is formed.

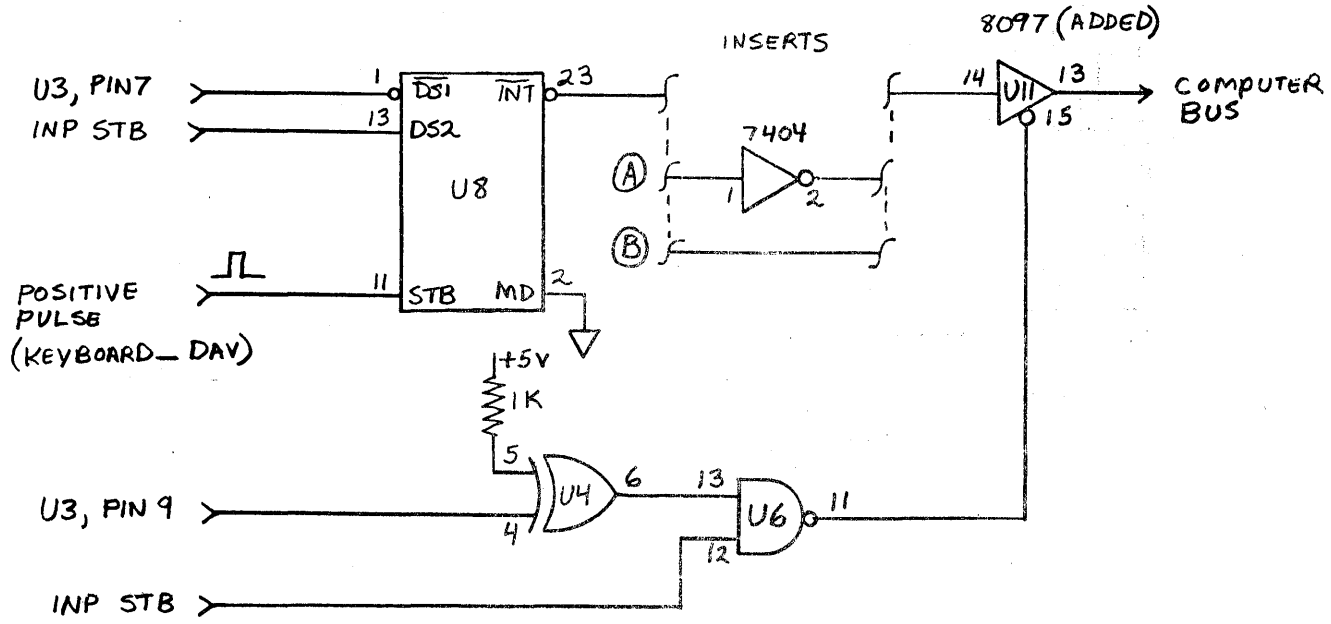


FIGURE 1

If a Rev. Ø port configuration is wanted, then insert A (add an inverter gate) between U8 and U11 and connect U11, pin 13 to DI5 (pin 92 of the card's edge connector).

If a Rev. 1 port configuration is wanted, then insert B (a direct connection) between U8 and U11 and connect U11, pin 13 to DIØ (pin 95 of the card's edge connector).

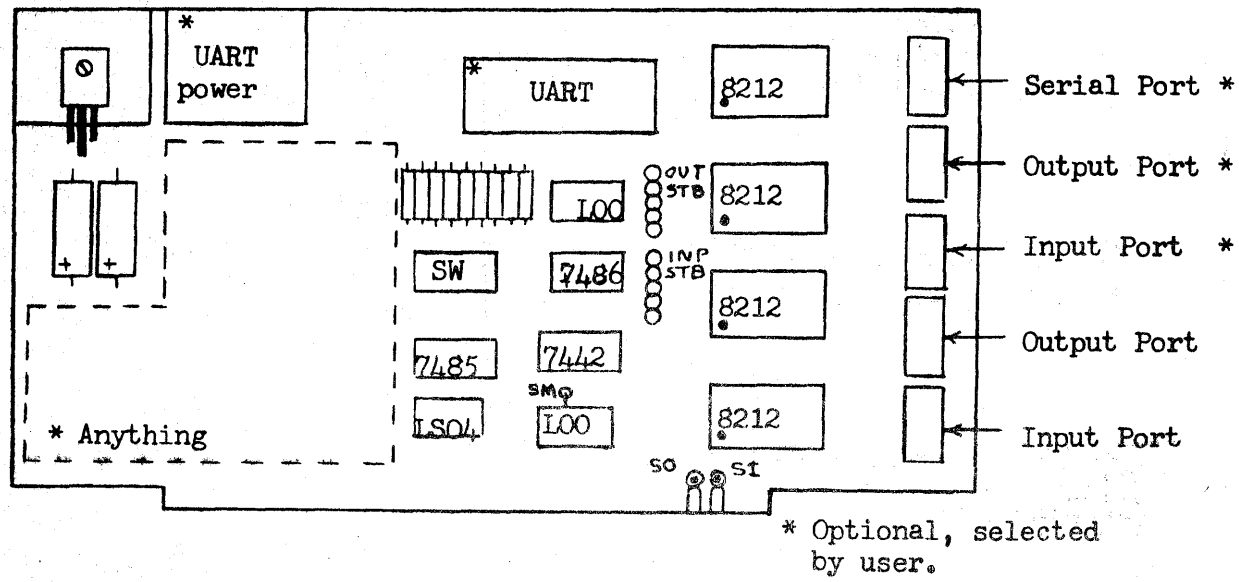
4.2 Processor Technology Input

The connections are the same as Altair Rev. Ø, except connect U11, pin 13 to DI6 (pin 93 of the card's edge connector).

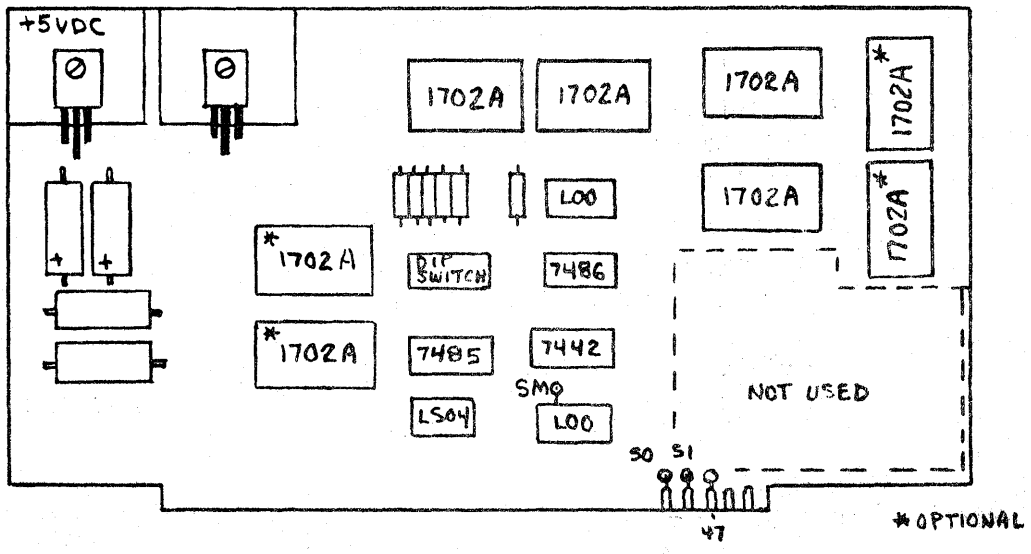
4.3 IMSAI Input

The connections are similar to Altair Rev. Ø, except the following:

a) U4, pin 4 connects to U3, pin 5.
b) U8, pin 1 connects to U3, pin 6.
c) U11, pin 13 connects to DI6, pin 93 (bus).



I/O CARD LAYOUT



1K/2K PROM CARD LAYOUT

REVISIONS			
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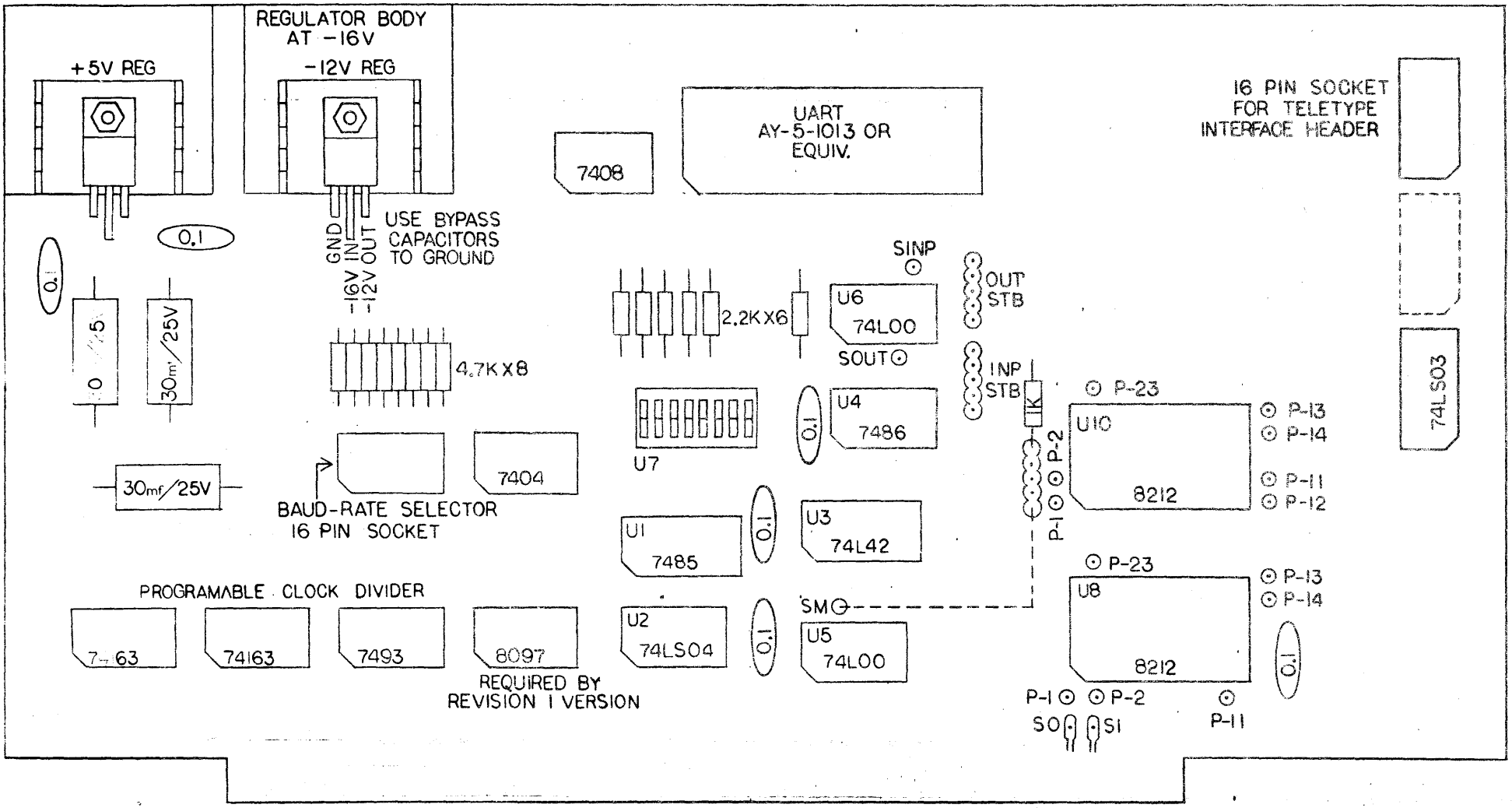

TOLERANCES UNLESS OTHERWISE SPECIFIED		
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±	±	±

APPROVALS	DATE
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ENGINEER	11-30-77

SOLID STATE MUSIC IO-2
SERIAL INTERFACE CKT.

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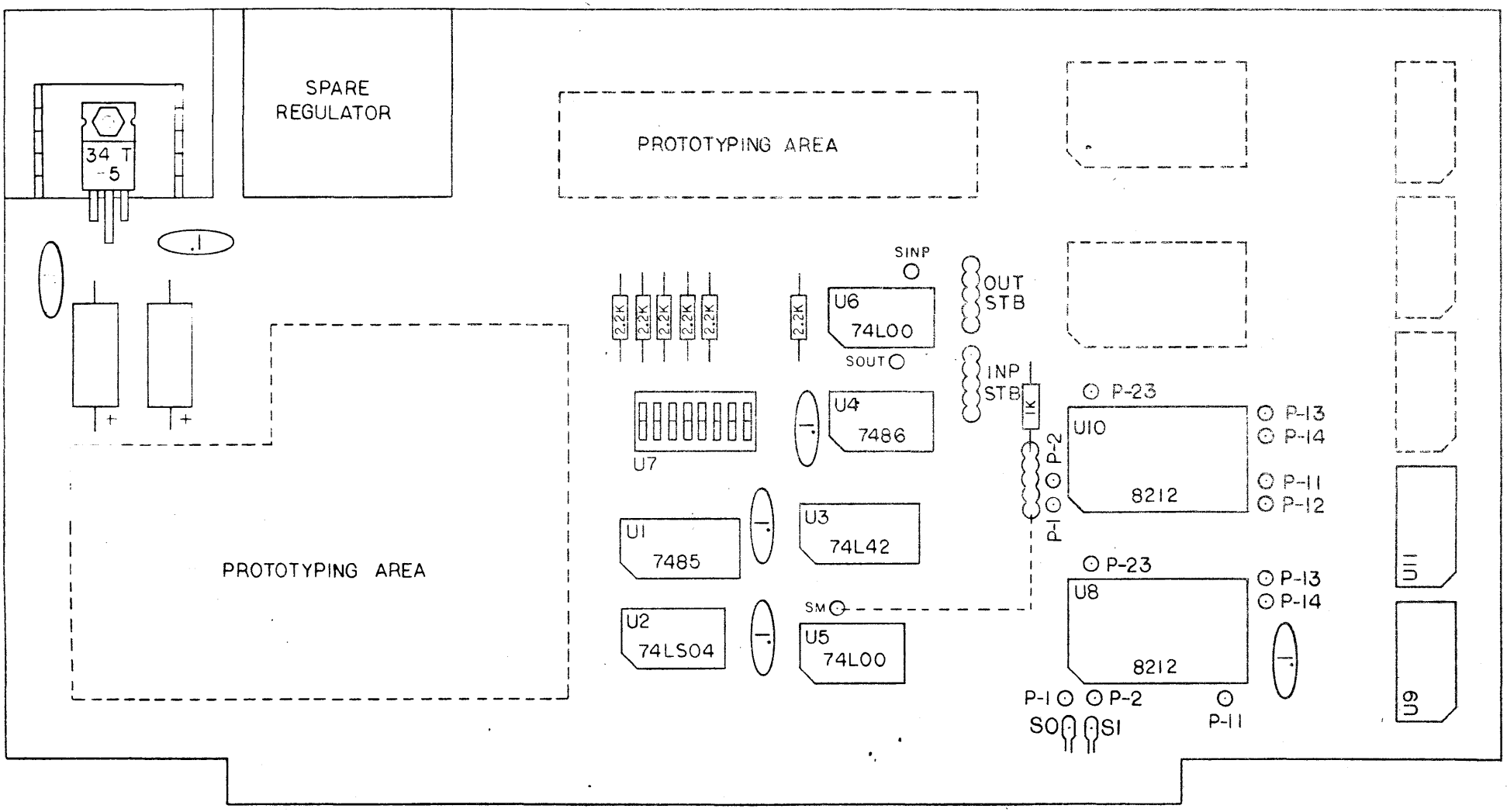
NONE	C	

DO NOT SCALE DRAWING | SHEET

REVISIONS			
TR	DESCRIPTION	DATE	APPROVED



TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONS DEC ANGLES ± ± ±		COPYRIGHT SOLID STATE MUSIC	
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CHECKED MTW	11-23-77	SCALE 2:1	SIZE C
		DRAWING NO 1	
		DO NOT SCALE DRAWING	SHEET

IO2 Parts List

Chip & Socket Pack

1 - U7	8 position DIP switch
4	14 pin sockets
4	16 pin sockets
2	24 pin sockets
2	16 pin headers
2 - U5,6	74L$00/74L00
1 - U2	74L$04
1 - U3	74L$42/7442
1 - U1	7485/74L$85
1 - U4	7486
2 - U8,10	74$412/8212

Resistor Pack

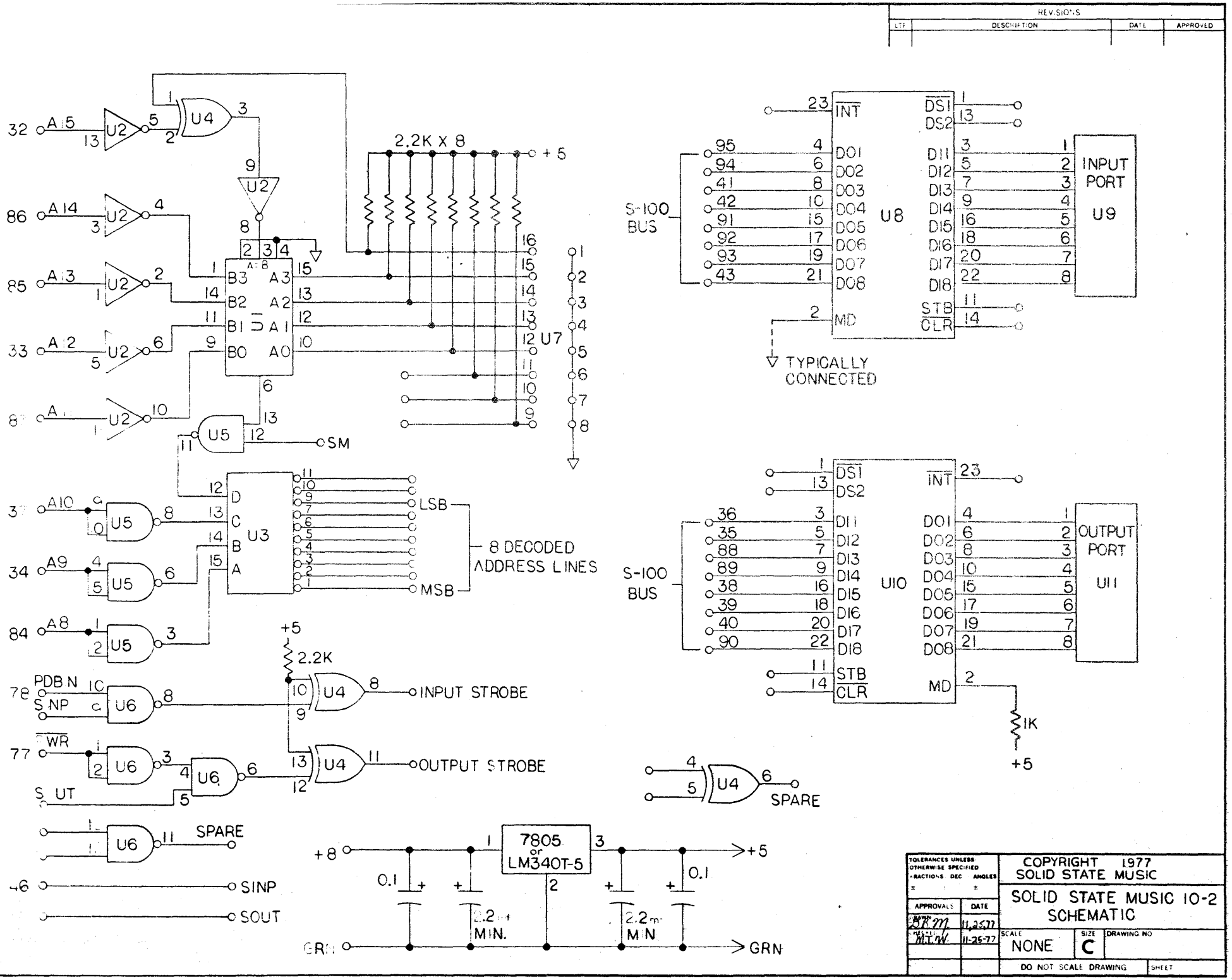
6	0.1 uf ceramic caps
9	2.2K - 4.7K 1/4w resistors
1	1K 1/4w resistor

Regulator Pack

2	filter caps, 10uf - 39uf, 10V dc
1	7805/340T-5
1	set #6 hardware
1	heatsink

Misc.

1	spectra wire
1	PC board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86 A14
85 A13
33 A12
A11
A10
34 A9
84 A8
78 PDBIN
SINP
77 WR
SOUT
U2
U4
U5
U6
U3
2.2K X 8
+5
U7
SM
LSB
MSB
8 DECODED ADDRESS LINES
2.2K
INPUT STROBE
OUTPUT STROBE
SPARE
SINP
SOUT
+8
7805 or LM340T-5
0.1
2.2mf MIN.
GRN
S-100 BUS
INT
DO1
DO2
DO3
DO4
DO5
DO6
DO7
DO8
MD
DS1
DS2
DI1
DI2
DI3
DI4
DI5
DI6
DI7
DI8
STB
CLR
U8
INPUT PORT U9
TYPICALLY CONNECTED
U10
OUTPUT PORT U11
1K
U4
SPARE
COPYRIGHT 1977 SOLID STATE MUSIC
SOLID STATE MUSIC IO-2 SCHEMATIC
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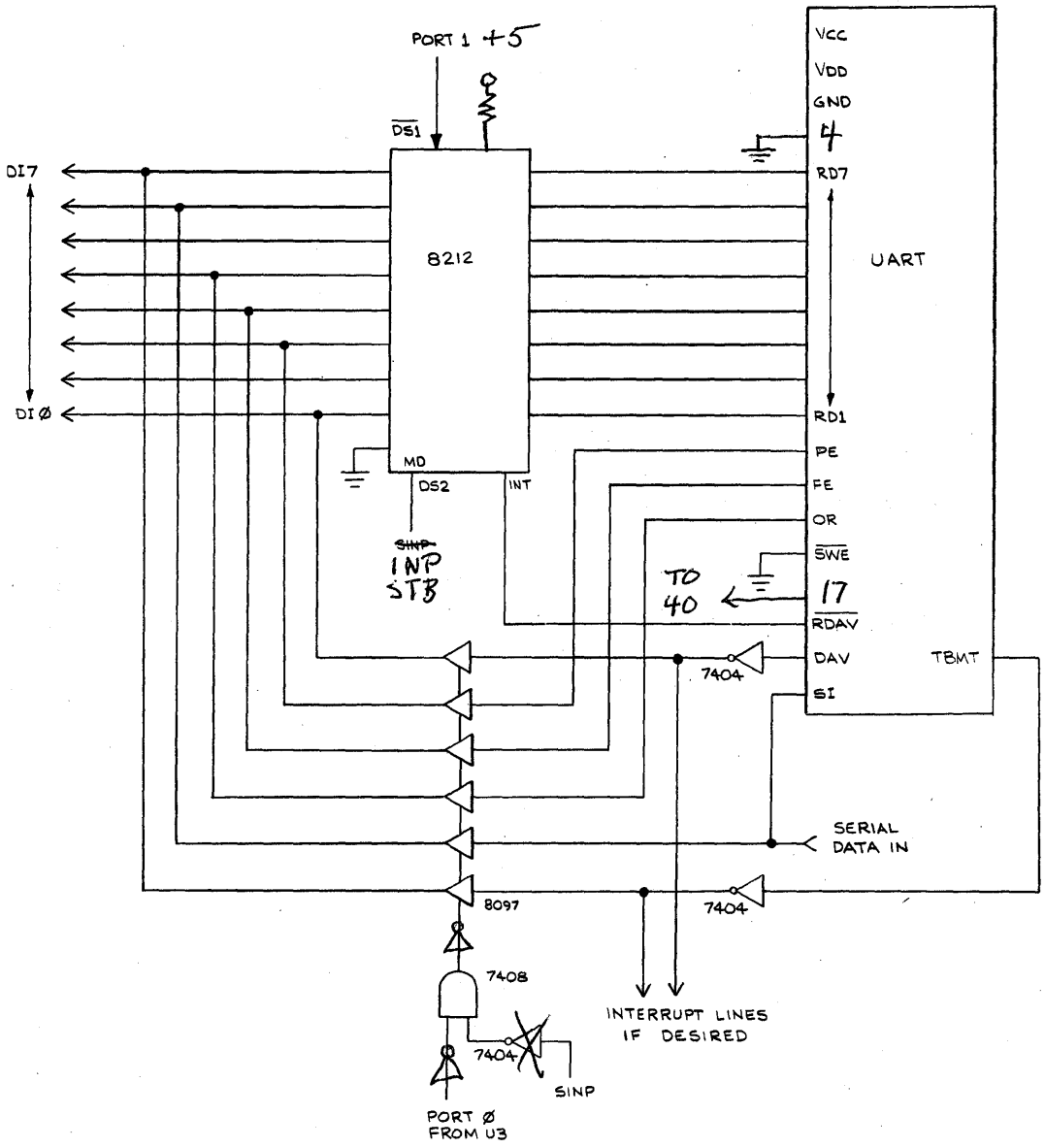
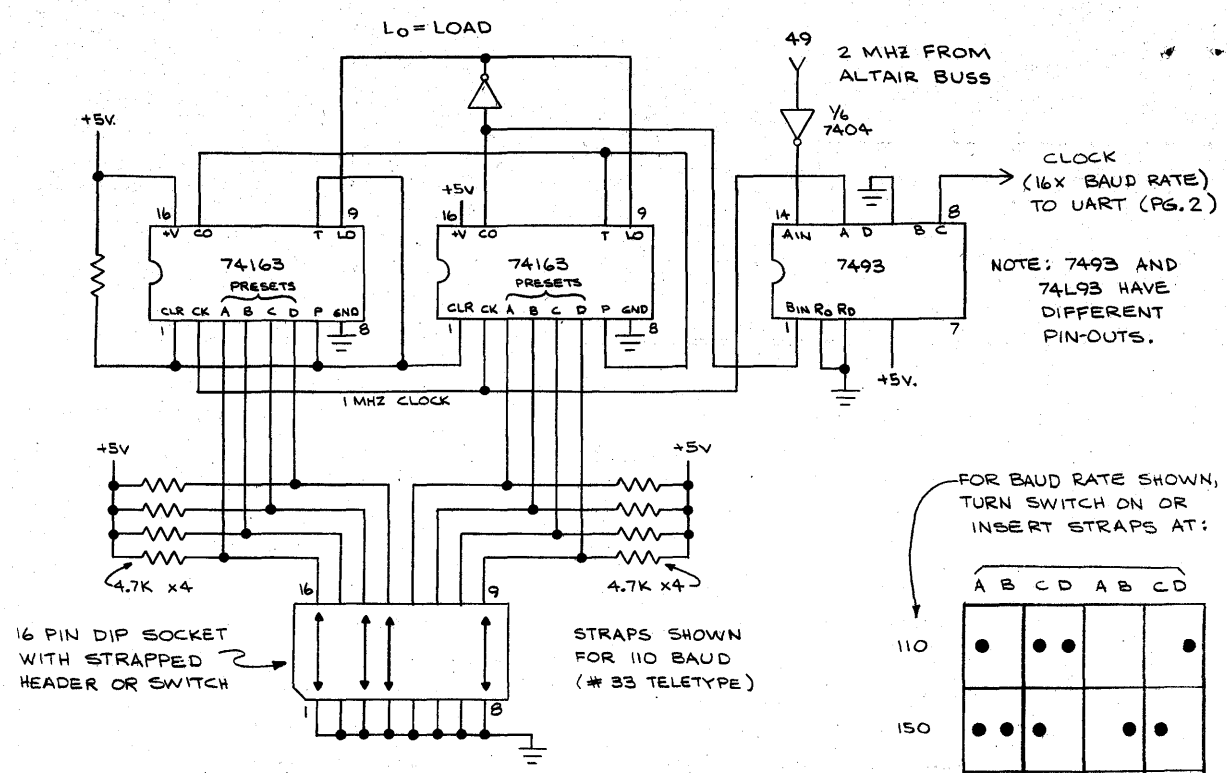


UNTESTED VARIATION WHICH SHOULD BE COMPATIBLE WITH REV 1 SERIAL I/O ALTAIR SOFTWARE



IF THE EIGHT LEADS WERE CONTROLLED BY AN OUTPUT PORT INSTEAD OF A SWITCH, THE COMPUTER COULD SELECT THE BAUD RATE BY ITSELF. IT SHOULD PUT ZEROS WHERE THE STRAPS TO GROUND ARE SHOWN.

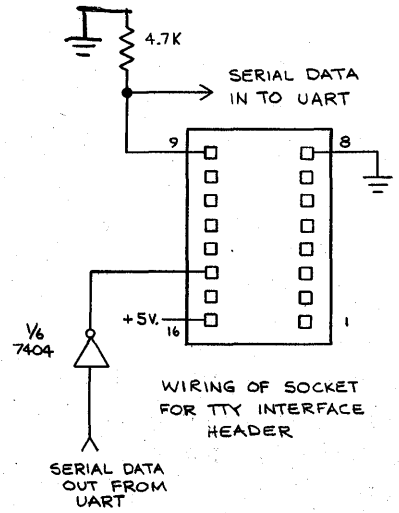
FOR BAUD RATE SHOWN, TURN SWITCH ON OR INSERT STRAPS AT:

	A	B	C	D	A	B	C	D
110	●		●	●				●
150	●	●	●			●		●
300	●	●			●	●		
458.7 SUDING	●					●		
600	●			●	●			
1200			●	●				

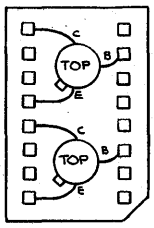
NUMBER LOADED $= 256 - \frac{15625}{\text{BAUD RATE}}$

SELECTABLE BAUD RATE CLOCK FOR UART

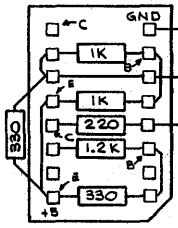
TTY INTERFACE HEADER



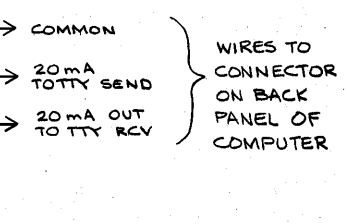
WIRING OF SOCKET FOR TTY INTERFACE HEADER



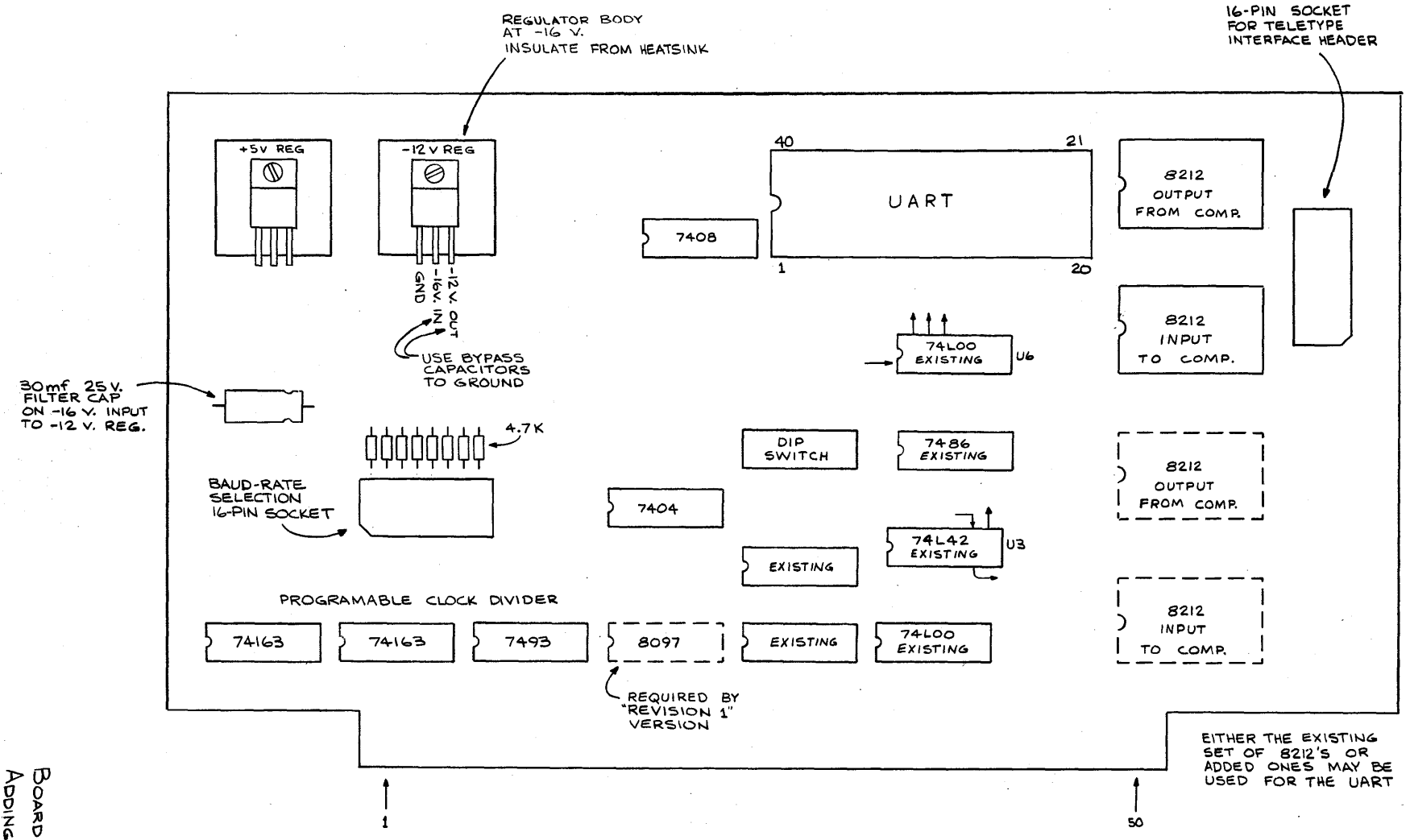
2N2907 PLACEMENT ON TOP OF HEADER



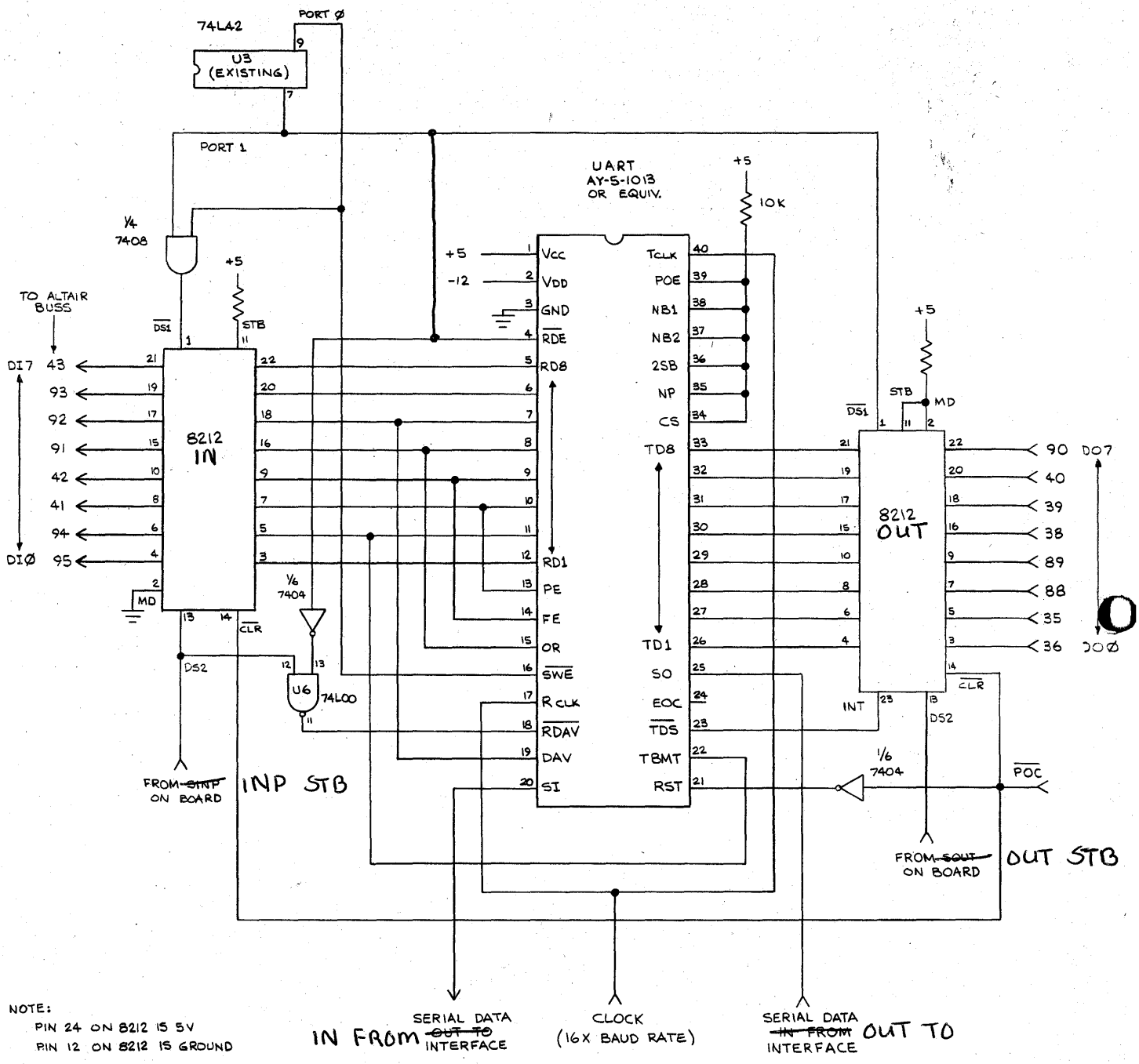
RESISTOR PLACEMENT



TOP VIEW OF 16-PIN HEADER CARRYING TELETYPE INTERFACE



Board Layout For Adding a UART To The I/O #2 Kit



NOTE:
PIN 24 ON 8212 IS 5V
PIN 12 ON 8212 IS GROUND

IN FROM ~~OUT TO~~ SERIAL DATA INTERFACE

CLOCK (16X BAUD RATE)

SERIAL DATA ~~IN FROM~~ INTERFACE OUT TO

UART WIRING COMPATIBLE
WITH ALTAIR SOFTWARE FOR
A REVISION 0 SERIAL I/O
(W/O MODIF)

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