ELECTRONIC SYSTEMS

TVT

- Stand alone TVT
- 32 char/line, 16 lines, modifications for 64 char/line included
- Parallel ASCII (TTL) input
- Video output
- 1K on board memory
- Output for computer controlled curser
- Auto scroll
- Non-distructive curser
- Curser inputs: up, down, left, right, home, EOL, EOS
- Scroll up, down
- Requires +5 volts at 1.5 amps, and -12 volts at 30 mA

P.O. BOX 21638, SAN JOSE, CA 95151 (408) 226-4064

*** TVT ***

FEATURES

This TV typewriter is an ideal addition to any home computer system. It provides one of the most convenient and inexpensive means of getting data in and out of your computer. Among TVT's, one would be hard pressed to find a more versatile unit than this one. The six on-board memory chips will retain 1024 characters and spaces. These are arranged as thirty-two lines of thirty-two characters each, with sixteen lines displayed at a time and sixteen held off screen. The cursor, a flashing white rectangle, indicates where the next character inputted will appear on the screen. This cursor, however, can easily be caused to remain always on (white) or off (transparent). In addition, keyboard controls can move the cursor up, down, left, right, or to home (the upper left most position on the screen). When the cursor reaches the end of one line, it automatically moves to the beginning of the next. When it reaches the end of the screen it rolls the top line off the screen and moves the rest of the lines up one space to make room for a new line at the bottom. This allows the typist to fill the entire thirty-two lines with text without ever worrying about reaching the end of a line or the bottom of the screen. There are two "scroll" controls to move lines around without moving the cursor. One shifts lines off the bottom of the screen and brings new lines on at the top, while the other shifts them off the top and brings new ones on at the bottom.

Single characters can be changed or erased by placing the cursor over them and typing the new character or a space as desired. For larger changes there are "erase to end of line" (EOL) controls. The EOL starts at the cursor location and erases all the characters to the end of that line. The EOS starts at the cursor location and erases the rest of the screen, but doesn't touch any of the characters above and before the cursor or the sixteen off-screen lines. The TVT will accept parallel ASCII from a computer output port just as readily as it will from a key board. Separate input ports are provided on-board for the computer and the keyboard to make connection easy. A special memory output port is also provided to allow for computer inspection of the on-board memory contents.

The TVT logic will also decode and respond to the ASCII codes for a carriage return and line feed. This means that the computer can move the cursor around with a single ASCII word, just as easily as printing a character.

The output of the TVT is a composite video signal. This means that it contains horizontal and vertical sync signals, as well as blanking and video information. Sync lock and horizontal size and position controls are provided on-board to allow for easy adjustment. Vertical positioning is handled automatically.

In addition to this TV typewriter kit, all that is necessary to complete the system is an inexpensive video monitor, a keyboard, and a power supply capable of supplying 5V at 1,5 A. and -12V at 30 mA.

TV TYPEWRITER

BRIEF DESCRIPTION OF CIRCUIT OPERATION

INPUT:

The TV Typewriter will accept inputs coded in ASCII (American Standard Code for Information Interchange) from either a keyboard or directly from a computer output port. The seven ASCII bits coming directly from the keyboard are passed directly into a latch consisting of U35 and U36; except for bit six, which is inverted first, for reasons which will be explained later. A pulse on the input strobe line clocks the input word into the latch and passes the six least significant bits on to the 1K by 6 bit memory made up of U47 through U52. Bit 6 is taken from the inverted output of the latch to restore it to its original logic state. The six least significant bits from the computer input connector are combined with the six least significant bits from the latch at the memory inputs. All seven bits from both the keyboard latch and the computer input connector are presented to a control instruction recognizer for decoding of carriage return and line feed instructions.

CHARACTER GENERATION:

As each memory location is addressed, its contents appear at the memory output. This is fed both to a memory output connector, and to the most significant six of the nine address lines on the character generator, U46. These six bits select a unique character out of the sixty-four character patterns stored in the generator. Each character is made up of seven rows of five bits each, with an eighth row which is always blank. The other three address lines select which of the eight five bit rows is to be placed on the character generator's five output lines. These three address lines are driven by the three least significant bits of the dot counter, U6, which counts from zero to nine. The dot counter is incremented once for each horizontal scan of the television raster by the horizontal sync pulse. On count zero the blank line is output. For counts one through seven, the bits making up the character pattern are output. With counts eight and nine the three address lines are held low by control logic which causes the blank line to be output two more times. This results in three blank scan lines separating each set of seven scan lines which make up a row of characters. The five output lines of the character generator are clocked into a shift register, U22 and U23, by the system timing after they have had time to stabilize. They are in turn clocked out of the register, one at a time, into the video mixer. The rate at which they are clocked out determines the width of the displayed character and hence the entire display. This rate is controlled by trimmer pot R28 and multivibrator U18.

CURSOR OPERATION:

The cursor uses the count and compare technique of memory update wherein a semi-static cursor address, held by the cursor character and line counters, U26, U32, and U33, is compared to the ever-changing addresses of the display character and line counters, U7, U14, and U21. When the comparator, U38 and U39, senses a match between the instantaneous memory address and the cursor location, and the strobe line is pulsed, the memory write line is momentarily brought low and the new character waiting in the keyboard latch or on the bus input is loaded into the memory. If a character was already present in that location, i.e. the cursor was superimposed on a character, the new character will replace the old one. The cursor must always remain within the visible page, unlike individual characters, which can go off of the screen. To accomplish this, the output of the display line counter, U7, is added to the output of the roll counter, U45, for memory addressing. The value in the roll counter represents the number of lines between the cursor and the end of the page. When the cursor would otherwise go off the screen, the roll counter is either incremented or decremented as necessary to keep it on screen. This has the effect of rolling one line of text off one end of the screen while replacing it with another from the other end. The keyboard scroll controls, or "roll up" and "roll down" increment and decrement the roll counter directly to accomplish their function, while "cursor up" and "cursor down" increment and decrement the cursor line counter, U32. Similarly, "cursor left" and "cursor right" cause the cursor character counter, U26 and U33, to count up or down. Pulling low on the "home" control line clears both the cursor character and line counters.

ERASING:

The cursor symbol is an all white square which blinks off and on with the oscillations of U8. The flashing can be made to stop by pulling the "solid cursor" pin low, or to disappear entirely (become transparent), by pulling the "cursor off" pin low.

The keyboard latch is cleared after each entry. This clear causes all of the outputs to go low except for bit 6. As was mentioned earlier, bit 6 is taken from the inverted output. This means that the seven bit ASCII word normally at the latch output is 0100000, which is the code for a blank space. When the "EOL" pin is pulled low the memory write line is enabled and the latch contents (0100000) are clocked into consecutive memory locations until the end of the line is reached In this way the portion of the line after the cursor position is rewritten with blank spaces, effectively erasing the line. "EOS" works in exactly the same way except that it doesn't stop until the cursor reaches the end of the page.

SYNC GENERATION AND VIDEO OUTPUT:

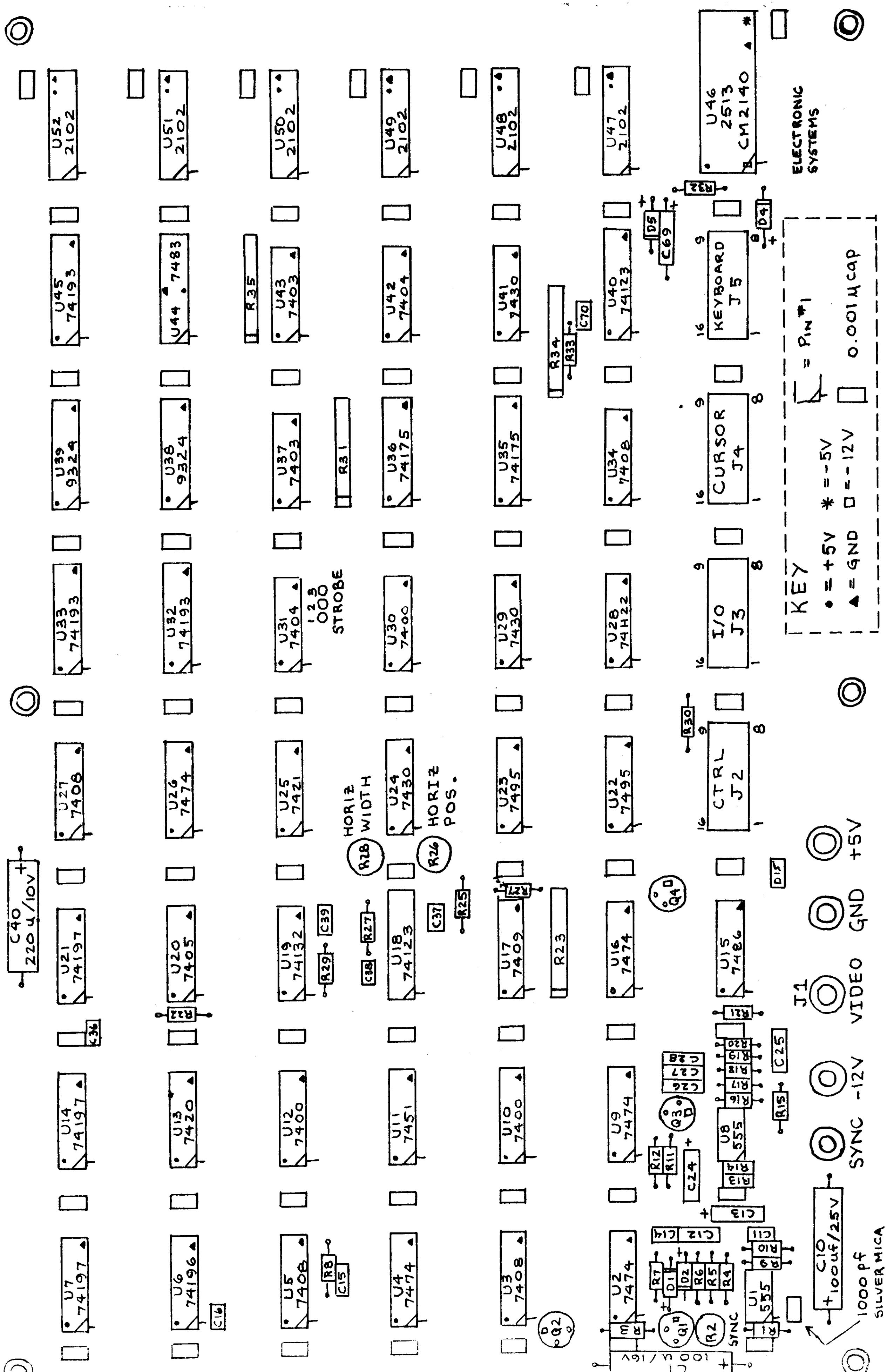
The horizontal oscillator is built around U1 and can be synchronized with the 60 Hz. power line by adjusting trimmer pot R2. Horizontal position is determined by R26 which sets the delay time between the horizontal sync pulse and the start of video from the sync generator. Vertical sync is derived by dividing down the output of the horizontal oscillator through the display line counter, U7 and U4. The horizontal pulse itself is shaped by a Schmitt trigger and is combined with the vertical sync pulse in U17. Composite sync from U17 is then joined with the video pulses from the shift register in video mixer, Q4, resulting in a full composite video output.

General Construction Notes

In assembling electronic equipment there are a few practices that should be followed which avoid problems and make trouble shooting easier. Take the time to read them and try to apply them.

1. Keep the soldering iron tip clean by wiping it off on a damp sponge.
2. Have all resistors inserted such that their value bonds can be read from left to right or from top to bottom. This allows for quicker checking of components.
3. When possible insert and solder all components of one type, i.e., all the resistors or all the sockets, etc. This sets the mind to check continuously the polarity of those components, such as electrolytic capacitors, or diodes and will reduce errors of this type. Furthermore, if such an error is made it is generally consistent and can be systematically corrected.
4. After soldering make sure that the wire is not clipped too short. A 1/16 to 1/8 of an inch should be left for test lead attachment. After the lead has been clipped off account for the waste, i.e., put it off to a side in a specific spot. Two things result: 1) it isn't caught in the circuit somewhere and 2) the owrk area is kept neat which also helps avoid errors.
5. When inserting a component ask the question, "will I be able to read its value or type when the assembly is completed?" Insert it so that there is this fighting chance. You may need it when checking a problem.
6. In choosing what group of components to insert first go from the physically lowest types, i.e., those extending the least from the circuit board, to the largest. This allows the table top to be used to press the components against the board when soldering.

7. Above all ... yea and verily I say unto you ... above all <u>LOOK</u> AT WHAT YOU HAVE DONE. At each step look and when the assembly is complete LOOK again. This is your greatest insurance against problems. You built ... take the time to look at what you have built. By far the majority of electronic construction problems can be seen visually. Examples of this are solder splashes, solder bridges, cold solder joints, touching leads, broken leads, solder balls, component in backwards, etc.



U52 2102
U51 2102
U50 2102
U49 2102
U48 2102
U47 2102
U46 2513 CM2140
ELECTRONIC SYSTEMS
U45 74193
U44 7483
R35
U43 7403
U42 7404
U41 7430
R34
R33
C70
U40 74123
D5
C69
R32
D4
KEYBOARD J5
U39 93324
U38 93324
U37 7403
R31
U36 74175
U35 74175
U34 7408
CURSOR J4
KEY
• = +5V
▲ = GND
* = -5V
□ = -12V
= PIN #1
0.001μ cap
U33 74193
U32 74193
U31 7404
1 2 3
0 0 0
STROBE
U30 7400
U29 7430
U28 74H22
I/O J3
U27 7408
U26 7474
U25 7421
HORIZ WIDTH
U24 7430
HORIZ POS.
U23 7495
U22 7495
R30
CTRL J2
C40 220μ/10V
U21 74197
U20 7405
U19 74132
U18 74123
U17 7409
R23
U16 7474
U15 7486
R28
R26
R27
R25
R29
C39
C38
C37
Q4
D15
+5V
GND
J1 VIDEO
R22
C36
R21
C25
U14 74197
U13 7420
U12 7400
U11 7451
U10 7400
U9 7474
Q3
U8 555
C26
C27
C28
R15
-12V
SYNC
U7 74197
U6 74196
U5 7408
U4 7474
U3 7408
U2 7474
U1 555
R8
C15
C16
Q2
Q1
R2
SYNC
C1 100μ/16V
C10 100uf/25V
1000 pf SILVER MICA
C13
C24
C12
C14
C11

TV TYPEWRITER

Parts List

QUANTITY	PART NUMBER	COMPONENT MARKING	DESCRIPTION
—1	* C1	100 uf./ 16 V.	Electrolytic Cap.
? 64 62	C2-9, 17-23, 29-35, 41-68, 71-84	0.001 uf.	Ceramic Cap.
—1	* C10	100 uf./ 25 V. 16V	Electrolytic Cap.
?1	C11	0.02 uf.	Ceramic Cap.
—5	C12, 25-28	0.1 uf. (104 markings)	Ceramic Cap.
—1	* C13	0.47 uf.	Ceramic Cap. Tantalum
?2	C14, 37	0.005 uf.	Ceramic Cap.
—2	C15, 39	0.01 uf.	Ceramic Cap.
?2	C16, 36	500 pf.	Ceramic Cap.
—2	* C24, 69	33 uf./ 10 V.	Tantalum Cap.
?1	C38	47 pf.	Ceramic Cap.
—1	* C40	220 uf./ 10 V. 16v	Electrolytic Cap.
?1	C70	100 pf.	Ceramic Cap.
— 3	* D1, 2, 5	1N4148 (FDH 999)	Si. Sw. Diode
— 1	* D3	1N5232B	5.6 V. Zener Diode
— 1	* D4	1N5235B	6.8 V. Zener Diode
— 2	Q1, 3	2N4416	N Channel FET
— 1	Q2	2N2907	Si. PNP Trans.
— 1	Q4	2N2222	Si. NPN Trans.
— 3	R1, 13, 14	4.7 KΩ, ¼ w.	Res. - Yel., Pur., Red
— 1	R2	Bourns 3329H-50K	Trimmer Pot.
— 2	R3, 20	100 Ω, ¼ w.	Res. - Brn., Blk., Brn.
—6	R4, 8, 16, 22, 24, 29	1 KΩ, ¼ w.	Res. - Brn., Blk., Red
—2	R5, 9	33 KΩ, ¼ w.	Res. - Org., Org., Org.
—6	R6, 12, 15, 17-19	10 KΩ, ¼ w.	Res. - Brn., Blk., Org.
—2	R7, 11	2.2 MΩ, ¼ w.	Res. - Red, Red, Grn.
—1	R10	100 KΩ, ¼ w.	Res. - Brn., Blk., Yel.
—1	R21	47 Ω, ¼ w.	Res. - Yel., Pur., Blk.,
—4	* R23, 31, 34, 35	Dale MSP08A-01-102G	8 Pin Res. Pack
—1	R25	3.9 KΩ, ¼ w.	Res. - Org., Wht., Red
—1	R26	Bourns 3329H-10K	Trimmer Pot.
—1	R27	3.0 KΩ, ¼ w.	Res. - Org., Blk., Red
—1	R28	Bourns 3329H-5K	Trimmer Pot.
—1	R30	470 Ω, ¼ w.	Res. - Yel., Pur., Brn.
—2	R32, 33	5.6 KΩ, ¼ w.	Res. - Grn., Blu., Red

QUANTITY	PART NUMBER	COMPONENT MARKING	DESCRIPTION
- 2	U1, 8	555	Timer IC
- 5	U2, 4, 9, 16, 26	7474	Dual D Flip Flop IC
- 4	U3, 5, 27, 34	7408	Quad 2-Input AND Gate IC
- 1	U6	74196	40 MHz. Presettable Decade Counter / Latch IC
- 3	U7, 14, 21	74197	40 MHz. Presettable Binary Counter / Latch IC
- 3	U10, 12, 30	7400	Quad 2-Input NAND Gate IC
- 1	U11	7451	Dual 2-Wide 2-Input AND-OR-INVERT Gate IC
- 1	U13	7420	Dual 4-Input NAND Gate IC
- 1	U15	7486	Quad EXCLUSIVE-OR Gate IC
- 1	U17	7409	Quad 2-Input AND Gate (Open Collector) IC
- 2	U18, 40	74123	TTL / Monostable Multi-vibrator IC
- 1	U19	74132	Quad 2-Input NAND Schmitt Trigger IC
- 1	U20	7405	Hex Inverter (Open Collector) IC
- 2	U22, 23	7495	4-Bit Right-Shift / Left-Shift Register IC
- 3	U24, 29, 41	7430	8-Input NAND Gate IC
- 1	U25	7421	Dual 4-Input AND Gate IC
- 1	U28	74H22	Dual 4-Input NAND Gate (Open Collector) IC
- 2	U31, 42	7404	Hex Inverter IC
- 3	U32, 33, 45	74193	Synchronous 4-Bit Up / Down Counters (Dual Clock With Clear) IC
- 2	U35, 36	74175	Quad D Flip Flop With Clear IC
- 2	U37, 43	7403	Quad 2-Input NAND Gate
- 2	U38, 39	9324	5-Input Comparator IC
- 1	U44	7483	4-Bit Binary Full Adder and Dual Single-Bit Binary Full Adder IC
- 1	U46	2513	5 x 7 CM2140 Chr. Gen. IC
- 6	U47-52	2102	1K x 1 RAM IC

Where substitutions have been made or where actual component markings differ substantially from the printed parts list, new part numbers have been shown for your convenience.

If an (RO-3-2513) is sued instead of the 2513 and if there is no need for external snyc, then the -12 volt supply is not needed.

Assembly and Trouble Shooting

CAUTION: The six memory I.C.'s, U47 through U52; the character generator, U46; and the two field effect transistors, Q1 and Q3, are all static sensitive devices. To avoid static damage, they should be left in the conductive foil until they are inserted in the board. When out of the foil, avoid finger contact with the leads.

ASSEMBLY:

1.) Examine the parts package carefully to see that all parts are present. Since the parts are inserted directly into the layout diagram, it should be immediately obvious from the diagram if any are missing. The printed circuit board should be positioned so that it matches the layout of the parts package for easiest assembly.

2.) Begin by inserting the fixed value resistors. The direction of insertion is not important with resistors. Solder the resistor leads, then clip off the excess wire next to the joint.

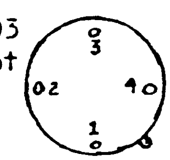
3.) Insert the four resistor networks R23, R31, R34, and R35; being careful to insert pin 1 in the hole with the square pad. Pin 1 is usually indicated by an indentation or a mark on the package. Solder the leads and clip off any excess wire.

4.) When inserting capacitors, careful attention must be paid to the polarity of C1, C10, C13, C24, C40, and C69. These six caps should be inserted with the positive terminal in the hole with the square pad. Their proper orientation is also indicated on the layout diagram. The rest of the capacitors can be inserted in either direction. As always, clip off any excess wire after soldering.

5.) Insert diodes D1 through D5 with their negative terminal in the hole with the square pad. The negative end is the end with a stripe around it. When soldering diodes, use as little heat as possible and allow the diode to cool after soldering the first lead before soldering the second.

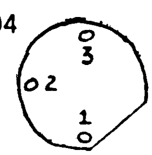
6.) Compare transistors Q1 through Q4 to the basing diagram below and note the location of pin 1. Insert the transistors in their respective locations with pin 1 going in the hole with the square pad. Solder the leads one at a time, allowing the transistor to cool between one lead and the next.

Q1 and Q3
Pin 4 not
used.



Bottom View

Q2 and Q4



7.) Insert the variable resistors R2, R26, and R28 next. In each case there are three holes, two of which are connected together. One of the end leads and the center lead should go in these holes, the other end lead should go in the third hole. Solder the leads and clip off the excess wire.

8.) Sockets have been supplied for I.C.'s U46 through U52. Solder the sockets into these locations, being careful to put pin 1 in the hole with the square pad. Do not insert the I.C.'s in the sockets yet.

9.) Insert the rest of the I.C.'s, U1 through U45, in their respective locations, being very careful to insert pin 1 in the hole with the square pad. Pin 1 is usually identifiable by a dot or indentation next to the pin or on its end of the package. When soldering the I.C.'s, be very careful not to overheat them, and also not to bridge solder between adjacent leads. Allow the package to cool between the soldering of one lead and the next.

10.) Next to U31 are three holes labeled 1, 2, and 3 on the layout diagram. If the strobe output from your keyboard is a positive pulse, connect pin 1 to pin 2; if it is a negative pulse, connect pin 3 to pin 2 instead.

11.) Insert U46 through U52 in their sockets, being careful to get pin 1 in the correct place.

12.) Connect the computer and the keyboard to J2 through J5 using the guide on the schematic.

13.) Before going any further, look the board over carefully. Make sure all of the I.C.'s are in the right places and oriented properly. Make sure the other polarized components like diodes, transistors, and electrolytic and tantalum capacitors are not reversed. Check the back of the board for cold solder joints and solder bridges.

14.) Connect the power supply to the Gnd., +5V., and -12 V. inputs. Connect the video monitor to J1 (OUT) and Gnd. If there is 60 Hz interference in the display a 60 Hz sine wave of up to 12.6 Vrms. can be applied to the sync input. This will lock the horizontal rate such that the interference will not "walk" through the display.

15.) The +5 V. input should draw about 1.5 A., while the -12 V. should only be in the 15 mA. range. If the currents are much greater than this, shut off the circuit immediately and go back to step 13.

16.) Adjust R2 for a stable display on the video monitor. The screen will be filled with random characters from memory power-up. There should also be a flashing rectangle, which is the cursor. Adjust R26 and R28 for the horizontal size and horizontal position of the display.

TROUBLE SHOOTING:

Listed below are some of the things to check if there are any problems.

1.) Cold solder joints or solder bridges.

2.) Reversed components like diodes, transistors, polarized capacitors, I.C.'s, or resistor networks.

3.) Components in wrong places. Check color codes and device markings with layout and parts list.

4.) Components damaged by heat while soldering.

5.) Variable resistors R2, R26, and R28 adjusted improperly.

6.) Input strobe not connected, see instruction #10.

7.) Keyboard or video monitor malfunction.

TROUBLE SHOOTING GUIDE

GENERAL CHECKLIST

1. Cold solder joints or solder bridges -- Inspect board carefully for solder joints that do not look shiny or for holes not completely soldered or not soldered at all. The holes that do not contain components need not be soldered. With a small screwdriver or similar sharp object cut carefully in between adjacent holes to remove flux and solder bridges that may be shorting connections.

2. Triple check polarized components like diodes, transistors, electrolytic capacitors and resistor networks as well as insuring proper placement of all I.C.'s. When checking I.C.'s don't rely on the markings only, but check also for the indentation next to Pin 1.

3. As many parts look alike and may have similar looking numbers, it's a good idea to recheck all parts placement against the parts layout. Recheck also the values for trimpots R2, R26, and R28 to make sure they haven't been switched or inserted with their pins in the wrong holes.

4. As it is possible to damage some parts by heat while soldering, it is a good idea to keep a list of those parts that may have been damaged. That is, if you had trouble soldering a part or had it reserved and had to remove it, it may have been subjected to too much heat. Diodes are particularly susceptible to this.

5. It is pretty easy to accidentally bend a pin or an I.C. while inserting it in it's socket. This is one of the harder problems to find. Make sure the I.C.'s are inserted so that all pins make contact with the socket connections. An ohmeter can check this for continuity.

6. Make sure the power supply is putting out the right voltages when connected to the circuit. A lamp regulated 5 volt supply may work for a few seconds but will soon shut down if you try to draw more current than this. Check that you have -12 volts and -5 volts at pins 1 and 12 on U46 respectively. Note that the -5 volts is obtained from the -12 volt supply.

7. If you have a problem it could also be due to the keyboard or video modulator or the TV or monitor. Leave the keyboard or computer unconnected until you get a screen of random characters with the proper cursor. Double check the keyboard wiring to the DIP socket to make sure you have the strobe going to pin 7 of J5 and the ASCII output going to the appropriate Bit inputs (the least significant bit is bit 1 pin 11-J5). Check the strobe polarity pins near U31 as directed in instruction 10 of the assembly instructions.

8. When using a monitor or direct video input into the video amp of a TV set it may be necessary to add a potentiometer (i.e. 10K pot) between the video out and the TV input to achieve the proper biasing and contrast. This is probably the problem if the display rolls and seems too bright in contrast.

INTRODUCTION TO TROUBLE SHOOTING

One of the nicest features of the TVT is the fact that many of the parts on the board are duplicated elsewhere in the board. This means that if a problem is suspected with one I.C. it may be possible to switch it with another I.C. on the same board and see if the switch affects the problem. If it does, then the I.C. is probably bad. For example, say you had a TVT that appeared to be working well but whenever you typed a number you got the shifted character above the number (i.e. when you type a "3" you get a "#"). Now if the keyboard is working and you don't have the shift-lock key on the keyboard in the shift position, then you might do this to trouble shoot the problem. Look at the schematic and you can see that the first place the information goes is to U35 + U36, the input latches. Since they are the same part #, you can switch them and put U35 where U36 was and vice versa. Please do this switching with the power off. Reapply the power and see if the problem is still there. If it is still there and hasn't changed to a new problem, then those I.C.'s are good. By looking at the outputs of the latches you can see that the information then gets put in the memories U47-U52. You could just start switching memory chips back and forth but if you refer to a chart of the ASCII code you can see that the only difference in code between a "3" and a "#" is bit 5, and bit 5 goes to U48. So switch U48 and one of the other memories. If the problem is different (i.e. a "3" now prints some other character) then the problem was with U48. Notice that this approach requires no test equipment or knowledge of electronics other than following the schematic and understanding how the ASCII code works. For those parts with no duplications on the board it may be necessary to purchase replacements to try switching. Keep a list of the parts you've switched so you don't repeat yourself.

It is very helpful in trouble shooting to have a basic idea of how the thing works. Please, in addition to the circuit description, refer to the TV Typewriter Cookbook by Don Lancaster (Howard W. Sams #21313 @$9.95) sold through Radio Shack and computer stores. Also, the TTL Databook is useful which is available from Radio Shack. The TTL book is especially useful for understanding the pin number assignments as related to the schematic.

GENERAL TROUBLE SHOOTING

These steps will require either a logic probe or an oscilloscope. The information on each pin will describe as either Hi or Lo or Pulsing, meaning that the information is going from Hi to Lo and back again repetitively. If you don't have any test equipment try the procedure at the end of this guide.

The sync circuitry around U1 on the schematic enhances the circuit operation. Even if it isn't working, it should not affect the operation of the rest of TVT unless it is wired wrong and is grounding out some other section of the TVT or preventing the -12 volt supply from working. Note, however, that U1 is very important as it is the horizontal oscillator.

As you proceed through this section, follow the schematic carefully so you can see what you're doing. Keep notes on what you find at each pin.

GENERAL DISPLAY PROBLEM TROUBLE SHOOTING

Pins 9 + 10 of U17 should both be pulsing. If pin 9 isn't pulsing then there is a problem with U1 or U12. If there is pulsing at pin 3 or U1 but not at pin 8 of U12, then U12 is bad. If there is pulsing at pin 8 or U12 then try replacing U19. If no pulsing at pin 3 of U1 switch U1 with U8. If still no pulsing, recheck the placement of the parts around it.

If pin 10 of U17 isn't pulsing, check pin 5 of U13. If no pulsing, check pins 9, 10, 11 of U20. If these are pulsing replace U20. If not, check U7 by switching with U14 or U21. If pin 5 of U13 is pulsing and pin 6 or U13 isn't pulsing then replace U13.

Once you have pins 9 + 10 of U17 pulsing you should have vertical and horizontal sync pulsed. Now you can proceed with the video section.

This section should cover most video problems, however for certain specific problems refer to the next section that lists a few specific problems. If you don't see the problem there, then proceed with this section.

Pin 10 of U22 should be pulsing. If it is pulsing then there should be video coming out of Q4. Check the placement of Q4 carefully (see parts layout) and try replacing U17. Recheck video modulator or TV monitor.

If pin 10 of U22 is not pulsing, check the output of the character generator U46 pin 4-8. If these are pulsing then switch U22 + U23 for pulsing. If this doesn't help then check pins 8 + 9 of U22 + U23 for pulsing. If no pulsing then U18 may be bad or check R28 for placement and make sure that C38 is 47 PF. Try also switching U21 + U14.

If pins 4-8 of the character generator U46 are not pulsing, then check pins 3, 6 or 8 of U34. If these aren't pulsing, try switching U34 with U3, U5 or U27. If there is still no pulsing on pins 3, 6 or 8 of U34 then check U6. There should be pulsing on pin 8 of U6 and pins 5, 9 or 12 of U6 should be pulsing. If no pulsing, replace U6.

If pins 3, 6 or 8 of U34 are pulsing but there is still no pulsing on pins 4-8 of U46 then check the inputs to the character generator pins 17-22 of U46; these should be pulsing. If not, try turning the TVT off and then on again. If there is still no pulsing on pins 12-22 of U46 then check for pulsing on pins 1, 2, 4, 5, 6, 7, 8, 14, 15 or 16 of any of the memory I.C.'s U47 through 52. If pin 1, 2, 6, 7 or 8 do not show pulsing then try replacing U44. If the others don't show any pulsing check U14, U21 or U7 by switching or replacing them.

If you have a blank screen and everything else appears o.k., there is the possibility that the memories have all spaces written into them. This can be caused by the "write" line to the memories being left grounded too long. To check this, turn off the power, remove U30, bend up pin 3, attach a wire in the socket of U30 at pin 3 to +5V, reinsert U30 and turn back on.

Now pin 3 of all the memory chips should be Hi. If you get video pulsing now or the screen is filled with characters try replacing or switching U30, U10, U12, U3 or U39. Note the function of U38 + U39.

The lines on the left of U38 + U39 on the schematic should all be pulsing whereas those on the right should all be static (either Hi or Lo0. Everytime you advance the cursor the lines on the right will count up indicating the cursor position. The lines on the left are constantly changing indicating the memory address. When the memory address (on the left of U38 + U39) and the cursor position (on the right of U38 + U39) match then a pulse is put put pin 14 of U38. This is the compare pulse and goes through U3, U12, U10, and U30 to become the write pulse. If for some reason this pulse occurs in the wrong place then information can be written into places on the screen other than where the cursor is.

In this next section when checking a part, see if it is working by monitoring the output with an oscilloscope or logic probe or switch the part with a good one. If you switch the part and the problem is different after the switch then that I.C. is probably bad.

SPECIFIC PROBLEMS

1. Characters will not line up. Screen shows diagonal lines of characters -- Check R2 for proper value (50K). Make sure there is a 1000 PF silver mico capacitor near pins 1 and 2 of U1. Adjust R2, R28 and R26.

2. Solid vertical or diagonal lines on screen -- Check -5 and -12 volt supply to the character generator pins 12 and 24. Switch U22 + U23 or replace them.

3. Characters all have a line through them vertically -- Switch U22 and U23 or replace them.

4. Characters don't "look" right or wiggle -- Try adjusting R2, R28 or R26. Make sure memories (U47-U52) are well inserted in their sockets. It could be that memory chips are too slow or the character generator is bad. If only certain characters change then you may be able to tell which bit is bad by looking at an ASCII chart.

5. One whole line of text is flashing like a cursor -- Check U38 and U39 by switching or replacing. Check also U32, U33 and U17.

6. Cursor advances part way across the page but returns before getting to the end -- Check U33 and U39.

7. Cursor stays on the same line -- Check U32 and U38 or possibly U31 or U37.

8. Cursor up, down, right or left doesn't work but cursor moves all right with the keyboard -- Check U20, U42, U31, U40, U19, U37 or U43 depending on which function won't work. (See schematic)

9. Second page of text is not accessible -- Check U27 or U45 or U44.

10. Line feed or return occurs when character is typed -- Check U25, U28 and U30.

11. Wrong characters are being entered -- Check keyboard connections U35 and U36; and U47-U52.

12. Keyboard won't move the cursor -- Check U31, U9 and U16. You should see a pulse at U9, pin 3, everytime you press a key. Check strobe polarity.

13. Problem with EOS or EOL erase controls -- Check U2 and U9 as well as U10.

14. Cursor won't blink but works -- Check U8 and its circuitry as well as U20 and U17.

HOW TO USE THE TVT TO TEST ITSELF

If you don't have any test equipment try this approach.
If parts of the TVT are operating then the output section of the TVT can be used to display pulsing information on the TV itself. With the TVT turned off remove U17 and bend pins 4 and 5 of the I.C. out so they're coming straight out of the body of the I.C. Replace the I.C. in its socket and attach an alligator clip or wire to both pins 4 and 5. The other end of this wire should be something you can use to attach to different I.C. pins to tell what they're doing. Attach a monitor or TV to the video output and reapply power.

If you look at the schematic you can see that what you've done is to disconnect the video going into U17 and replaced it with a test probe to check other areas of the circuit. If you take the wire that's attached to U17 and connect the other end to pin 3 of U1 or pin 3 of U19, you should see a bunch of lines on the TV set.

If you don't, then recheck Q4 to be sure it has been placed correctly. (You may have one wire in the wrong hole.) Recheck the video modulator or adjust the brightness and contrast of the TV or monitor. If none of these help get another 7409 and replace U17. You may want to see if that was your original problem before bending out the pins. Another check of U17 and Q4 is to connect the wire going to pins 4 and 5 to the +5 volts and then the ground power connection. The screen should flash briefly. If not, then there is a problem with either U17, Q4 or the video modulator or monitor.

Once this is working you can use your TV set as an "oscilloscope". The faster the pulsing at a point the more horizontal lines you should get and if the pulsing is greater than 15,750 cycles per second, you will start getting vertical lines. R2 can be adjusted to straighten out the display but if either pin 9 or pin 10 of U17 are not pulsing then you will not be able to get the display to stand still. Continue with the section marked Specific Problems using this setup as your "logic probe" and you can tell where there is pulsing at a given pin. If you find a bad I.C. or connection, reconnect U17 by either putting in a new 7409 or rebending the pins and reinserting to see if the TVT is working now.

TVT Circuit Description

INTRODUCTION

Before the circuit description of the TVT is presented it is necessary to consider some background material and establish some definition of terms and notation.

In looking at a television picture one sees the effect of an electron beam sweeping across the face of the picture tube. The overall picture is made up of successive horizontal sweeps such as the lines across a ruled pad of paper. Once one such set of sweeps has been completed the beam is returned to the top of the screen and another set of sweeps is started. However this second set of sweeps is not coincident with those of the first set. Rather they are arranged to fall half-way between the paths of the first set. This procedure is call interlacing, producing a full raster, Its objective is to reduce the flicker effect such as was present in old time motion pictures. The emphasis here is in the word motion pictures. In the case of the TVT, since stationary characters are being displayed, there is no picture motion and hence there is no need to preserve the interlace feature. Circuit simplification results when this requirement is removed. In normal commercial TV pictures there are 262-1/2 lines transmitted per each half of a complete raster scan and therefore 525 lines for one complete interlaced scan. In the TVT interlacing is eliminated and on there are 262 lines per picture.

Each horizontal sweep, comprising one line of the picture, is initiated by a horizontal sync pulse. After 262 horizontal sync pulses have occurred it is necessary to move the beam back to the top of the screen and repeat the scan procedure. This timing is initiated by a vertical sync pulse. Two features are required in this vertical sync pulse

(a) The sweep circuitry must recognize its unique nature and thereby start the verticle retrace procedure and

(b) The horizontal sync pulses must continue during the vertical retrace interval. If this were not preserved the picture would jitter horizontally.

Consider then that, at the time a verticle retrace is required, a very long duration pulse is generated...much longer in time than the horizontal sync pulses. Consider that this pulse is inserted in the train of horizontal sync pulses. When it comes along in time certainly it could be electronically recognized. But note it does not meet the second requirement of not losing horizontal sync. Suppose then that this wide verticle sync pulse be serrated i.e., notched at the horizontal sync pulse interval. In essence the verticle sync pulse would now consists of a series of "fat" horizontal sync pulses. This would keep it distinctive as a verticle sync pulse and yet preserve the horizontal sync timing. (In the TVT this serrated verticle sync pulse consists of 10 horizontal sync pulse intervals.)

As has been mentioned each horizontal sync pulse initiates a sweep of the picture tube. The picture information therefore is inserted in the interval of time between horizontal sync pulses. If we consider an arbitrary baseline then the verticle and horizontal sync pulses would go in one direction with respect to this baseline while the picture information would go in an opposite direction. This polarization keeps picture and timing information separated. If the baseline is considered black for the picture then the timing information is "blacker than black", as far as the picture signal is concerned, and therefore would not be seen on the screen.

There are 16 rows of characters present in the TVT display. These characters are centered both in a horizontal and a verticle direction. We will call the rightmost point possible in the last character in a row as the End Of Line (EOL). This is to be distinguished from the end of the sweep which is still further to the right, and in fact, is the most right hand position of the sweeping trace.

Consider the last character that could be present in the entire TVT display. It would appear in the low right hand corner. The lower most and right most element that could be present in that character constitutes the End of Screen (EOS) point. Note that since the character display is centered there still are horizontal scan lines below the End Of Screen point before the raster of this picture is completed.

Each character in the TVT display is formed from selected points in a matrix made up of 7 rows each of which contains 5 points. These points will be called dots. Consider for the moment that these dots are lamps. We would cause a particular character to be displayed by turning on a particular pattern of these lamps. We could do this in two ways. We could turn all of them on then off simultaneously at a rate so fast that the eye could not perceive the "blinking" effect. Or we could momentarily illiminate those in the first row followed by those in the second row and so forth until the seventh row was momentarily made to light. If we selected the repetition rate correctly we would not perceive the "blinking" nature of each row of lights. This is essence is the scheme used in character generation in the TVT.

Each row of characters consists of 10 horizontal line scans. The first scan contains no display information and is blank. Call this scan zero. The next seven scans contain display information in accordance with the 5x7 matrix display scheme indicated above. Scans numbered 8 and 9 (remember scan 0 was the first scan) are also blank. A sequence of 10 such horizontal scans, or correspondingly a row of characters, is called a LINE. So if we speak of a line counter we are talking about the counter that counts the number of rows of characters and not horizontal scans.

In describing the circuit it is necessary to refer to particular integrated circuits (IC's). Any particular IC may contain repeated elements such as a Quad 2 input Nand gate. It is necessary to distinguish the particular portion of the IC being considered. The notation UN1, N2 will be used to indicate IC designated UN1 and pin number N2. If more than one pin is being considered we will call it UN1, (N2,N3...N4). Here N2, N3....N4 are the pins on this particular IC.

The circuitry to be considered is involved. It may be necessary in the course of the description to assume certain conditions to exist which have not previously been explained. The reader is asked to be patient and we hope the patience will eventually be repayed by an overall understanding.

1. SYNC PULSE GENERATION

The basic clock for the TVT is the 555 timer U1 arranged as a bistable multivibration. The charging time is controlled by (R2+R4+R9) and the capacitor from U1, 2 to ground (.001 ufd). R9 and the same capacitor control the discharge time. Since there are 262 lines per overall picture and each picture is formed in 1/60 of a second this mullivibrator's frequency must be set at 262x60 = 15720 Hz. R2 is made adjustable for this purpose.

In some cases however the TVT may be used with a video monitor that has considerable interfering 60 Hz hum. If the horizontal scan rate is not an integral multiple of 60 Hz then the interfering hum will appear to walk through the character display. It is advantageous therefore to automatically lock the horizontal pulse generating frequency to the local 60 Hz power line frequency. This is done by the circuitry associated with Q1, Q2 and Q3. The control function is accomplished via U1, 5 and "fine tunes" the sync generating frequency. This circuitry will be explained in Section 12.

The rectangular pulse train appearing at U1, 3 is phase inverted by U12,8 and is applied at 3 points: U19,(5,2) and U13,4). The timing diagram in Figure 1 indicate the operation of the circuitry involving U19 (5,4,2,1,3). As can be seen in the waveform associated with U19,4, R29 and C39 delay the output at U19,6. The net effect is to create the narrow pulse train at U19,3. Contrast this with the "fat" pulse train at U19,(5,2). It is the fat pulse train that will eventually constitute the serrated verticle sync pulse while the pulses at U19,3 are used as horizontal sync pulses.

The composite verticle pulse and horizontal pulse train is formed in U17. As will be later shown pins U13 (5,2,4) remain positive for a duration of time equaling 10 horizontal sync pulses. Therefore 10 "fat" horizontal sync pulses appear at U13, 6. When the "AND" condition on U13, 6 is not satisfied it rests in a high position. Since furthermore the leading edges of the "fat" sync pulses are coincident with the leading edges of the narrow sync pulses either the fat verticle sync pulses or the horizontal sync pulses will appear at the output of U17, 8 thereby forming the composite sync signal. As will be later shown video information comprising the character formation is present at the base of Q4. So the entire video and sync signal is present in the emitter circuit of Q4. The circuit provides a low impedance driving source for the wideband signal present at this point.

One remaining IC, namely U18, is used to prepare the clock signal used in the TVT. This IC and its associated circuitry form a monostable multivibrator. The horizontal sync pulses on U18, 9 are used to trigger this monostable. The output pulse width present on U18, 12 is controlled by R26. As will be seen this control is used to horizontally center the character display in the TVT. The pulse train present at U18, 12 forms the "heart-beat", the basic timing, of the TVT.

2. CHARACTER GENERATOR, DOT COUNTER & LINE COUNTER

Memory addressing will be discussed later but as each memory location is addressed, its contents appear at the memory output. These six bits, representing the ASCII code for the character to be displayed, are placed on the character generator's character selection pins U46 (17,18,19,20,21,22). These six bits select a unique character out of the $2^6=64$ character patterns stored in the generator's memory. As has been explained each character is made up of seven rows of 5 bits each with zeroth row which is always blank. Three pins, U46(14,15,16) on the character generator are used to select one of the $2^3=8$ rows to be displayed.

The timing pulse from U18,12 is used to increment the Dot Counter, U6. The three least significant bits of this counter U6(5,9,2) address the character generator's row selection U46(14,15,16). The Dot Counter is incremented each time a horizontal sweep is initiated. During that scan a particular row in the character generator's memory has been selected and outputted in accordance with the character selected by the input from memory. As will be shown however the memory input changes as the beam sweeps across the picture tube face. Hence the same row in different characters is being displayed during a single horizontal line sweep. When the Dot Counter's output count is zero the output is blank. For counts one through seven, the bits making up the particular character is output on pins U46(4,5,6,7,8). On counts eight and nine the three address lines of U46(14,15,16) are held low and hence two more blank lines are output. The reason that these lines are held low follows: When a count of eight or nine is output U6,12 goes high. This causes the output from U12,11 to go low and hence U17,11 will go low (independent of any other inputs to U5,5 and U17,13). It follows that U34,1, U34,4, and U34,10 are all held low forcing the low condition on the row address pins of the character generator.

The display therefore consists of characters occupying 7 horizontal sweeps. There are three blank sweeps between each row of characters. Ten horizontal sweeps constitutes a line and hence U6 counts from zero to nine. It outputs a positive going pulse on line eight (U6,12) which remains high until <u>after</u> line 9 has been completed. On the next input pulse U6 is reset internally, since it is a modulo 10 counter. This in turn causes U7, the Line Counter, to increment. U7 is a normal binary type counter capable of counting from count zero to count 15 and hence keep track of 16 line counts.

3. VERTICLE SYNCHRONIZATION

Consider for the moment that U7 has been counting along and finally it reaches line count eight. U7,12 will then go high. If we assume, for the moment that U4,9 (the output of what we shall call the SCREEN FLIP-FLOP) is high then U19,11 will go low. This will cause U5,11 to go low. No action takes place at U4,9 since a low to high transition must occur on U4,11 before the SCREEN FLIP-FLOP will change its state. Hence when U7 changes from count 15 (the 16th line) back to count zero U5,11 will go high.

This in turn causes U4,9 to go low and U4,8 to go high. Two actions result:

(a) With U4,9 low, the gate U17,11 will be low forcing a blank output from the character generator U46. Hence the display will be blank until the SCAN FLIP-FLOP U4,(8,9) change state.

(b) With U4,8 high, U13,6 can develop the verticle serrated sync pulse train previously discussed. Note however the time that this occurs. We have just flipped U4,8 at the end of 16 line counts. During these 16 line counts characters have been displayed.

The Line Counter is now at zero. In succeeding sweeps however blank lines are being outputted. On line 4 U13,(3,2) will go high and as has been described in the SYNC GENERATION section verticle serrated sync pulse will be available on U13,6. (It should be clear now that since the LINE COUNTER is incremented for every 10 horizontal scan lines there will be the 10 serrated verticle sync pulses present at U13,6). Once the verticle sync pulse is generated the display should move to the top of the screen.

The display is still blank however. Examining the inputs U13(9,10,12,13) it is seen that with the

DOT COUNTER = 2

LINE COUNTER = 10

the conditions on this gate will cause U13,8 to go low. This in turn causes the DOT COUNTER and LINE COUNTER to be reset. the SCREEN FLIP-FLOP will change its state however on the next line count since it requires a low to a high transition on U4,11. Once this has been accomplished the entire display process repeats itself.

Now review what has happened. We have 16 lines of displayed characters, each line containing 10 sweeps. There are therefore 160 lines here. Once the SCREEN FLIP-FLOP has changes state an additional 5 lines (count 0 to and including 4) occur until the bottom of the display and the occurrences of the verticle retrace. So there are 50 lines here. From the top of the screen until the SCREEN FLIP-FLOP changes its state again we go from LINE 5 up to LINE 10 + 2 SWEEPS which is an additional 52 lines. Here all counters are reset and the display process is initiated. Total number of sweeps = 160+50+52 = 262 - which is the number required per raster.

4. MEMORY ADDRESSING

In addressing memory there are two matters of concern:

a) The ability to address a particular element of memory for the purposes of writing.

b) The ability to read over a particular range of memory for the purposes of displaying the contents within that range.

In the TVT, the cursor indicates where one can change the contents of memory. The range of memory display always contains 16 lines. There are however 32 lines available in memory. For the purposes of explanation the display can be likened to a cylinder. Consider that a page of text having 32 lines, each of which has 32 characters, is spun into a cylinder. If any line is arbitrarily assigned the count zero then it and the next 15 lines might be chosen for display purposes. Examination of a different area of the text next might be desired; say starting at line 23. Then lines 23 to 31 and lines 0 to 6 would be displayed. (Note line 31 is now next to line 0 on the surface of the cylinder). In memory therefore it is necessary to keep track of the starting point and the subsequent 15 lines. In the TVT the ROLL COUNTER keeps track of display's starting point. The CURSOR LINE COUNTER and the CURSOR CHARACTER COUNTER keeps track of the cursor's position on the display. The cursor's position indicates where the contents of memory may be changed by direct input. The cursor may be moved up and down and to the left or right. Note that the cursor's position on the display can be characterized by a line number and a character number. The line number ranges from 0 to 15 while the character number ranges from 0 to 31. For example (6,20). It is important to remember that these numbers are independent of what particular 16 lines are being displayed. Going back to the cylinder illustration of lines 23-31-0-6 being on the screen here cursor coordinates (6,20) would have the cursor located on line 28, character 20. The point to be made here

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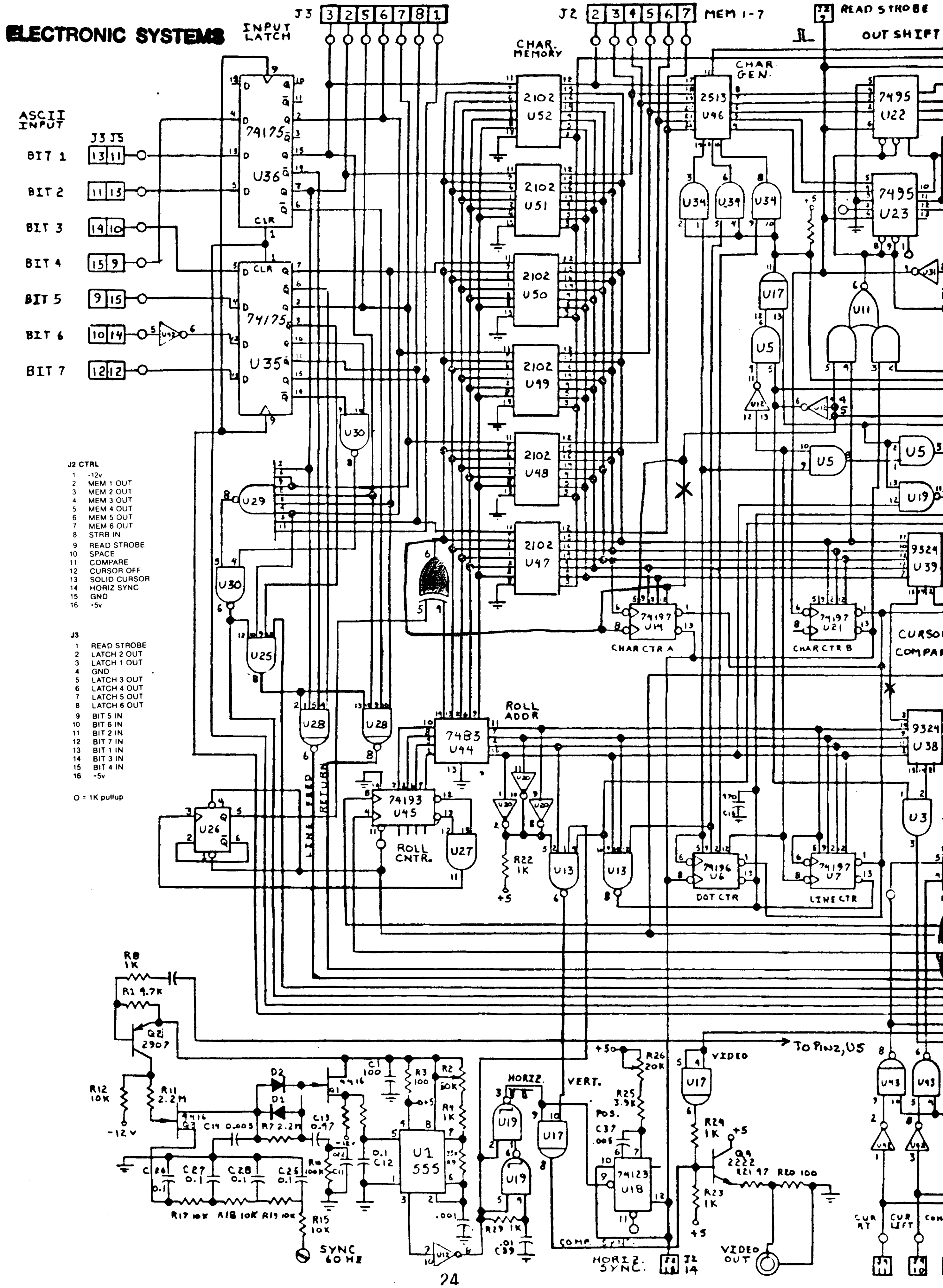


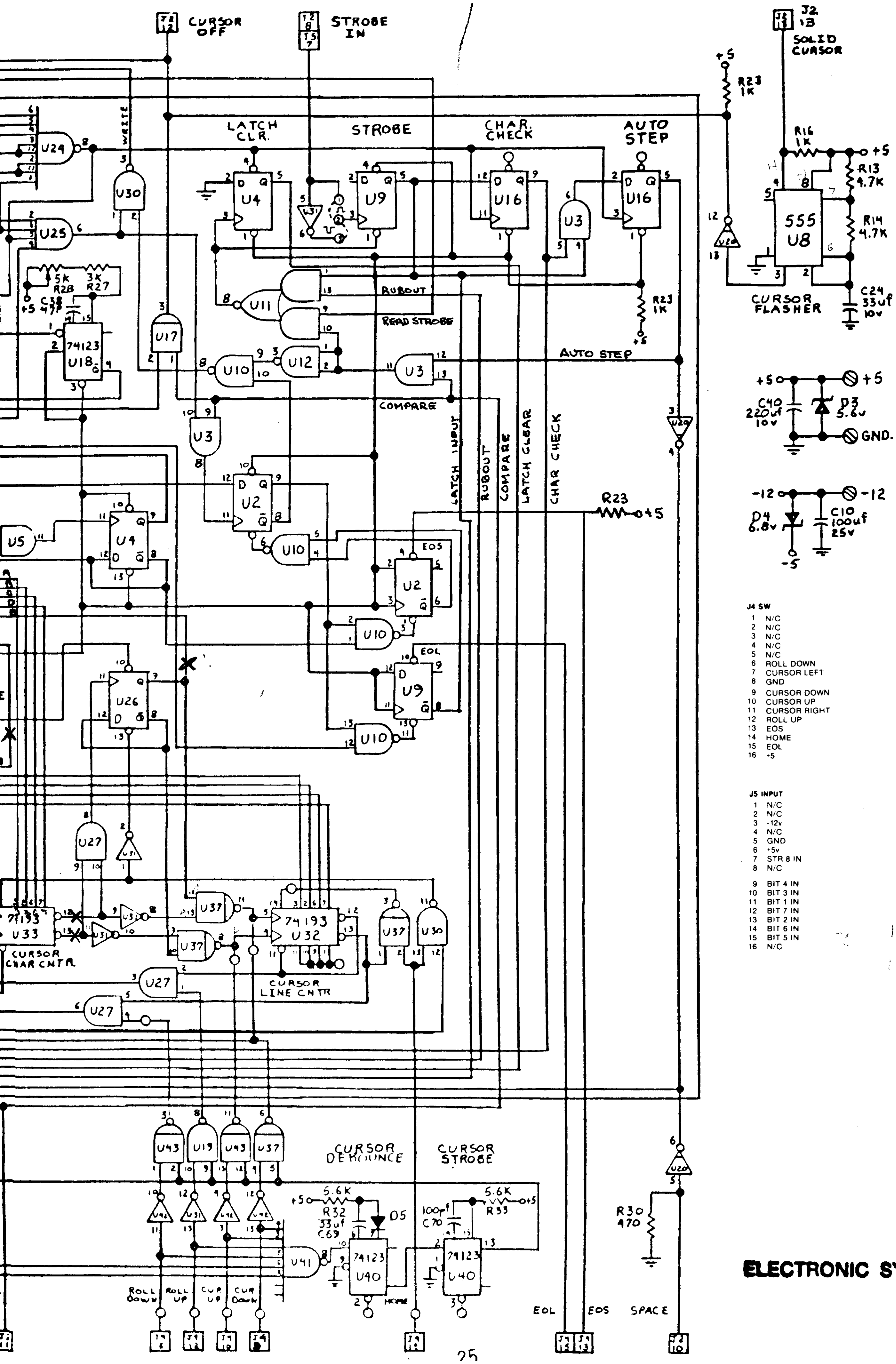
J2 CTRL

1 -12v
2 MEM 1 OUT
3 MEM 2 OUT
4 MEM 3 OUT
5 MEM 4 OUT
6 MEM 5 OUT
7 MEM 6 OUT
8 STRB IN
9 READ STROBE
10 SPACE
11 COMPARE
12 CURSOR OFF
13 SOLID CURSOR
14 HORIZ SYNC
15 GND
16 +5v

J3

1 READ STROBE
2 LATCH 2 OUT
3 LATCH 1 OUT
4 GND
5 LATCH 3 OUT
6 LATCH 4 OUT
7 LATCH 5 OUT
8 LATCH 6 OUT
9 BIT 5 IN
10 BIT 6 IN
11 BIT 2 IN
12 BIT 7 IN
13 BIT 1 IN
14 BIT 3 IN
15 BIT 4 IN
16 +5v

O = 1K pullup



J4 SW

1	N/C
2	N/C
3	N/C
4	N/C
5	N/C
6	ROLL DOWN
7	CURSOR LEFT
8	GND
9	CURSOR DOWN
10	CURSOR UP
11	CURSOR RIGHT
12	ROLL UP
13	EOS
14	HOME
15	EOL
16	+5

J5 INPUT

1	N/C
2	N/C
3	-12v
4	N/C
5	GND
6	+5v
7	STR 8 IN
8	N/C
9	BIT 4 IN
10	BIT 3 IN
11	BIT 1 IN
12	BIT 7 IN
13	BIT 2 IN
14	BIT 6 IN
15	BIT 5 IN
16	N/C

ELECTRONIC SYSTEMS

is that the ROLL COUNTER may be changed without changing the cursor's coordinate locations. This is known as SCROLL UP OR SCROLL DOWN. (The analogy would be to shine a light on a single character on the cylinder and then rotate the cylinder on line at a time. The light's position does not change). On the other hand the cursor's coordinates may be changed without changing the ROLL COUNTER. However if the cursor's position is at an extreme coordinate (0,0) or (15,31) it can force the ROLL COUNTER change.

U33 is the CURSOR CHARACTER COUNTER. A low to high transition on U33,5 causes this counter to increment while a low to high transition on U33,4 causes a decrement in its count.

The inputs for the Cursor Character Counter, Cursor Line Counter and Roll Counter are derived in the main from the Debouncer U40,12 and Cursor Strobe U40,13. Normally the cursor controls are pulled high. Bringing any one of them low causes a low to high transition on U41,8 forcing the retriggerable monostable to put out a pulse on its $\bar{Q}$ output U40,12. The retriggerable nature of this monostable, in combination with the long time constant of R32 and C69, assures a single pulse at the output of U40,12 despite a "bouncy" input. At the conclusion of this pulse the low to high transition forces U40,13 to go into its monostable state which produces a positive going pulse of 0.5 us duration. When a particular cursor input is low its associated output on U42 is high. This in combination with the narrow positive going pulse on U40,13 force the associated Nand gate U43 or U13 or U37 low. When the narrow pulse from U40,13 returns to its low state the outputs from the Nand gates go high even though the particular cursor input may still be pulled low. This circuitry assures a single cursor strobe despite bouncy, long inputs.

Consider that a Cursor Right strobe has occurred. On the low to high transition of U43, 8 the Cursor Character Counter will increment by one count. Remember that it is necessary to keep track of 32 characters. U33 can only count to 16. To extend this U26,(9,8) is employed as an additional divide by 2. It also provides sterring for the carry or borrow pulses from U33(12,13). These are directed to the count up or count down pins of U32(5,4). Consider that this input to U33 was the 16th input. (On the display the cursor would be midway on a line). The outputs on U33(3,2,6,7) would all be low indicating a zero count and the carry bit would have gone from high to low. U26,11 would have felt a high to low transition and U26,9 would have remained low. U37,11 remains low therefore and the line counter U32 will not register a count. When another count is input to U33,5 the carry will go from low to high forcing U26,8 to go high.

U31,8 goes low keeping U37,11 high and once again U32 experiences no count. After 15 more pulses the carry on U33,12 goes low forcing U31,8 high. Now both inputs U37,(12,13) are high and this forces U37,11 low. On the next count into U33,U26,9 will change its state as well as the carry pulse and U32,5 will experience a low to high transition incrementing the line counter U32. The same argument holds for the case where the cursor left input is used. Here now the Cursor Character Counter is counting down and the borrow lead U33,13 is activated. The Cursor Line Counter decrements in a manner completely similar to that previously discussed.

There is a distinction to be made however in the case of the Line Counter. When it receives its 16th count it produces a carry pulse which immediately loads from its count preset input U32,(15,1,10,9) a count of 15. If it receives another input a carry pulse would once again be generated and again the counters output would be set at 15. No apparent change has taken place in the Cursor Line Counter. But note each carry pulse generated by the Line Counter increments the Roll Counter U45,8. The situation being described corresponds to the cursor being in the extreme lower right corner [coordinates (15,31)] and the character counter is being incremented. This will generate a carry pulse from the Line Counter and the Roll Counter will increment. The cursor will now be at coordinates (15,0) and the display (like the cylinder example) will have rotated up by one line. This is known as scrolling up. As can be seen grounding the input of U31,13 produces exactly the same effect as a carry pulse out of the Line Counter U32,13, i.e., the Roll Counter is incremented by one.

When the Cursor Line Counter is decremented below a zero count a borrow pulse is created U32,13. This is used to reset the Cursor Line Counter back to zero but the borrow pulse also decrements the Roll Counter via (U27,6). Hence the display would scroll down, and as can be seen by the circuitry around U42,11, grounding the Roll Down input does indeed decrement the Roll Counter via U45,4.

One more small point. As should be obvious by now if both the Cursor Character counter and the Cursor Line Counter are reset to zero the cursor should be at coordinates 0,0. This is the HOME position. Pulling the HOME pin low U37,2 and U30,13 forces U32,14 and U33,14 high which clears these counters. Any bounce on this lead is of no importance so there is no need for debounce circuitry.

U44 is a 4 bit Binary Full Adder. It takes the 4 bit input on U44,(10,8,3,1) i.e., the Roll Counter's output and adds it, in a binary fashion, to the Line Counter's count U44, (11,7,4,16). This sum is used for 4 bits of the memory's address. A 5th bit is also generated by the carry or borrow pulse from U45(12,13) via U27,11 to the flip flop U26,3. This flip-flop's output U26,5 is exclusive or'd with the carry lead U44,14 in U15,(4,5).

The operation of this portion of the circuitry will become clear once a reason for its existence is understood. There are 10 address leads on each memory IC (U47 to U52). Consider that they are split into two groups of 5; Let us call one group the Character Group and the other the Line Group. Note that each group has 32 unique address (hence 32x32 = 1024 unique memory locations). During any horizontal line scan, as has been mentioned, 32 characters can be displayed which is accomplished by using all addresses available in the Character Group. The portion in the Line Group is held constant during one line's character generation (which is 10 horizontal scans). The next line of characters is obtained by incrementing the Line Group address portion and then sequentially repeating again all 32 addresses available in the Character Group.

In the Line Group we must be able to generate 32 different address. The Roll Counter provides the base or first address which is added to contents of the Line Counter. The Roll Counter also must be capable of addressing 32 numbers since any one of these may be the base or first address. Since U26, 5 changes state on the carry or borrow output of U45, (12,13) it can be considered as a adjunct to the output bits of the Roll Counter which gives it the capacity of addressing 32 unique addresses.

Since the Roll Counter provides the base address to which the Line Counters contents are added, a particular address might be obtained in many ways. For example, consider that the Roll Counter is at zero and the Line Counter is at 4. The Line Group address would be 4. Now consider the case where the Roll Counter is 27 and the Line Counter is 9 the Line Group address would still be 4. In examining the situation there are 4 possible cases:

a. The Roll Counter's contents are in the range 0-15 and the Line Counter contents are such that when added to the Roll Counter the result is less than 15.

b. The Roll Counter's contents are in the range 0-15 and the Line Counters contents are such that when added to the Roll Counter the result is greater than 15. A carry is produced in the adder.

c. U26,5 has changed state and hence the Roll Counter can be considered to be in the range of 16 to 31. The contents of the Line Counter when added to the Roll Counter produce no carry.

d. U26,5 has changed state and hence the Roll Counter can be considered to be in the range 16 to 31. The contents of the Line Counter when added to the Roll Counter produce a carry

In table form we can say:

Roll Counter	Line Counter	U45(12,13) Carry	U26,5 FLIP FLOP	XOR U15,6
0 to n $n \leq 15$	0 to (15-n)	0	0	0 (LOW)
	15-n to 15	1	0	1 (HIGH)
15 to n $n \leq 31$	0 to 15-n	0	1	1 (HIGH)
	15-n to 15	1	1	0 (LOW)

In the example given above when the Roll Counter is 0 and the Line Counter is 4 this would correspond to line 1 of the Table. Here the 5th bit, used for memory addressing, U15, 6=0. When the Roll Counter is 27 the flip-flop has flipped and U45(3,2,6,7) is set at 12. When the Line Counter reaches 9 the output of the adder will be 4 and a carry. This carry and the condition on the flip flop produce high on pins U15, (4,5) and hence a zero output for the 5th bit of the memory address. Line 4 of the table results in the same address as line 1, as it should be.

5. <u>MEMORY INPUT</u>

The TVT will accept inputs coded in ASCII (American Standard Code for Information Interchange) from either a keyboard or directly from a computer's output port. The seven ASCII bits coming directly from the keyboard are passed into an input latch consisting of U35 and U36; except for bit six, which is inverted first for reasons which will be explained later. A strobe pulse on U35,9 and U36,9 clocks the word into the latch which in turn pass the least significant bits onto the 1K by 6 bit memory made up of U47 through U52. Note that bit 6 is taken from the inverted output of the latch to restore it to its original logic state.

The computer inputs are placed directly onto the input leads of each of the 6 memory IC's. There is no need to latch these bits since the computer's output is in the effect doing this.

All seven bits from the output of the keyboard latch or the computer are presented to a control instruction circuit for decoding carriage return, line feed, and rubrout instructions. By means of Boolean Algebra it can be shown that the logic signal at U30, 6 follows the following table

Bit 6	Bit 7	Remaining 5 bits ANDED	U30,6 OUTPUT
0	0	X = Don't Care	HIGH-RUBOUT
1	0	X	LOW
0	1	X	LOW
1	1	0	LOW
1	1	1	HIGH-RUBOUT

Note that if bit 6 and bit 7 are both zero a Rubout will occur. This implies that all ASCII inputs up to and including 037 OCTAL will cause a Rubout. The legitimate rubout 177 corresponds to the last row of the above table.

Now all printable characters in the ASCII set occupy the octal range from 040 up. Non printable characters such as Leader/ Trailer, Bell Carriage Return, Line Feed etc., occupy the range from 000 to 037. These therefore correspond to line one of the above table their entry immediately causes a rubout or in effect a no action or no memory entry. The two special cases of Carriage Return and Line Feed however are exceptions and perform special action.

Consider the inputs at U28,(2,1,5,4). If one examines the logic on these input leads we see that resulting from the previous discussion U25,12 will be high for the "non printable characters", U25,10 = Bit 4, U25,9 = $\overline{\text{Bit 5}}$. If we then say that U25,8 is high we have $\overline{\text{Bit 7}}\cdot\overline{\text{Bit 6}}\cdot\overline{\text{Bit 5}}\cdot$ Bit 4$\cdot\overline{\text{Bit 3}}\cdot$ Bit 2$\cdot\overline{\text{Bit 1}}$ as the effective inputs to U28 to cause U28,6 to go low. Writing this as a binary number, and its octal equivalent, 0001010 = 012 octal, which is the ASCII Line feed. It follows therefore that when this is inputted we will cause U30,6 to go high (initiating a Rubout) and U28,6 going low. This low is felt by U32,5 the Cursor Line Counter. When the rubrout action is completed by clearing the latches, U35 and U36, the output of U26,6 will go high. This causes the Cursor Line Counter to increment by one which is precisely what is meant by "Line Feed".

A similar analysis exists for "Carriage Return" (Octal 015) resulting in U28,8 going low. This pulse is used to reset the Cursor Character Counter via U30,11 to the clear pin U33,14. This moves the cursor to the start of the line.

6. VIDEO OUTPUT

U22 and U23 are 4 bit parallel-access shift registers. When pin 6 on these IC's is high the logic levels on U22,(2,3,4,5) and U23(2,3,4,5) are loaded. These levels in the main come from the character generator. U22,5 and U23,3 are connected to ground. U23,6 is connected to high. When pin 6 on these IC's pulled low the data is shifted out of these registers on the high-to-low transition of a clock connected to pins 8 and 9. If we pictorially line up the parallel load before clocking it out serially we will see the following data.

$$H\ L\ D_5\ D_4\ D_3\ D_2\ D_1\ L$$

where D_1, $D_2 \ldots D_5$ = the 5 bits that represent the character to be displayed. When the clocking starts the right most low is output from U22,10 and all other data moves one position to the right. The last two left most positions both become high since U23,1 the serial input, is set high. The next bit out corresponds to D1 and so forth until the last bit is outputted. At this time all bits are High and the gate U24, 8 goes low. This then causes U22,6 and U23,6 to go high whereupon new data is parallel loaded into the shift register. The fact that the data is new is seen by noting that theload pulse also increments a counter U21,6 called the Character B counter. This is a binary counter and is used to count from 0 to 7. It in turns feeds the clock input of the Character A counter U14,6 another binary counter.

This combination forms a binary counter capable of counting from 0 to 31. The 5 outputs (2^5=32) are the Character Group memory address leads previously discussed, Hence the overall operation is as follows:

1. A horizontal scan pulse U18,12 goes low and resets the Character A and Character B counters. It also stops the clocking of the shift registers as will be explained later.

2. When the horizontal pulse goes high clocking starts.

3. The memory address corresponding to the Line Group + (Character Group = 0) is placed on the memory address leads.

4. This memory output determines a particular character in the character generator. The data suitable for that scan is now ready on the shift register data input leads and is loaded into the shift register.

5. Serial shift out from the shift register occurs until all 8 bits in the register are high. The Character B counter's is incremented, and this results in a new memory address.

6. The new memory output is loaded.

7. The content of the serial shift register is changed and hence the eight high bits previously inputted into the And gate U24 are changed. This removes the high on the shift register's load pin.

8. Clocking can now be effective to repeat the entire cycle of events.

9. These cycles continue until the Character A's U14, 12 goes high. This will occur on the 32nd character being outputted. When this character has been outputted via the serial register, Character B will be incremented forcing the least significant bit U21,2 high. These two conditions on U11,(4,5) cause U11,6 to go low stopping the clocking into the shift register.

10. This condition remains until the horizontal scan pulse clears the Character A and B's counters. The entire process can now be started to output another low in the 32 characters to be displayed per line.

The clock for the shift register is formed by the gate U11,6 and monostable multivibrator whose output is U18,4. This output is normally high. When the horizontal sync pulse has concluded both inputs U11,(3,2) are high 2. U11,6 has therefore gone from a high to low. This triggers U18,1. U18,4 therefore, goes low and U11,6 therefore goes high. When U18,4 times out, in accordance with the time constant determined by (R28+R27) C38, it will return to its stable high state. This, once again satisfies the gate condition and U11,6 goes low triggering, once again, U18,1. And so the cycle repeats.

Now note the following: R2, associated with U1, is used to set the horizontal repetition rate (≈15750 p.p.s). R26, associated with U18,(6,7), is used to set the width of the timing pulses used in the TVT. But the width of this pulse is the time that U11,6 is high which stops all clocking of the shift registers providing the video information. Since the horizontal scan begins at the beginning of this pulse and as long as the pulse is low no video is present this control allows the setting of the left hand margin of the TVT display. R28 associated with U18,(14,15) on the other hand determines the shift register clocking rate and hence the length of the row of characters. These three controls should be independent.

7. <u>DURING THE READ CYCLES</u>:

Consider the case where no input is present at either the ASCII input or computer input. Now examine some initial conditions:

We will call U2,6 the End of SCREEN flip-flop (EOS) and we will call U9,8 the End of Line flip-flop (EOL). Assume U2,6 and U9,8 both to be high. This will force U10,6 to be low holding U2,13 in a clear state. We will call U2,8 the Read/Write flip flow (R/W). This flip flop will ignore any pulses present or U2,11 as long as U2,13 is held low. Note that U2,9 is low (since it is being held clear) holding U10,2 and U10,13 low. This keeps U10,3 and U10,11 high regardless of what is on U10,1 and U10,13.

The first observation to be made is:

(1) As long as U2,8 is high the output at U10,8 is completely controlled by the conditions on the leads U3,(13,12).

U3,13 logic level is determined by the output of U3,3. The inputs to this gate are determined by two signals.

When the character rows are being generated during one horizontal scan, pin U14,12 in Character A's remains low until the completion of the 32nd character whereupon it goes high. We will call this transition the End of Line (EOL). U14,12 feeds the phase inverter U12,(4,5) whose output during the scan is high. This inturn determines the logic level on U3,1.

The other input, U3,2, is determined by U38 and U39, two comparators. For as long as the Character A and Character B's output leads (which are also addressing memory for the next character to be displayed) compare to the output of U33 the Cursor Character Counter. U39,15,2 will be low. If also during this time the Line Counter's output compares to that of the Cursor's Line Counter then and only then will U38,14 go high.

Therefore when the next character to be displayed has the same line and character count as that of the Cursor's Counters and there is a horizontal character row being generated (contrasted to rows above and below the display) then and only then will a positive going compare pulse be generated. Throughout any full display scan there must result at least one compare pulse. These compare pulses are present on U13,13. As long as U13,12 is low however these pulses are ineffective. Since, as we have determined U10,10 is high then as a result U30,2 is low and its output U30,3 must be high resulting in a READ memory level on U47 thru U52.

The level on U3,12 is determined by the state of the AUTO STEP flip-flop U16,5. The clock input to this flip flop is derived from U24,8 which it will be remembered makes a low to high transition after a new character has been read from memory. Consider that the D input to this flip-flop is low due to the conditions on the input to U3,(5,4). Then as character pulses are being generated by U24,8, there will be a constant low on the U16, output since the D input is being held low. As will be explained in what follows the strobe flip-flop U9,5 and Character Check flip-flop U16,9 both have low outputs. This then completes the circuit condition during a READ state.

8. DURING THE WRITE CYCLES

Consider that an input exists at either the terminal's input or at the computer's input followed by a STROBE in pulse.

U9,3 requires a low to high transition for toggling and the strapping at U31,5 should be chosen accordingly. If the input strobe is positive going then 2 may be strapped directly to 1, otherwise 2 is strapped to 3. The input strobe will cause U9,5 to go high. Upon the next character completion pulse from U24 (low to high transition after memory has been loaded) U16,9 will go high. Now both inputs U3,(5,4) are high and hence the D input to U16,2 goes high. Upon the next character pulse completion U16,5 will go high priming the gate U3,12. Note also that U16,5 feeds the phase inverter U20,3 whose output is low. U20,4 feeds the Cursor Character Counter U33,5 but it does not increment since it requires low to high transition.

Note the conditions now. At U3,11 we have a low because U3,13 the compare lead is low therefore the Read Strobe (generated at the completion of each character output (U24,8 going low) on U11,9 remains ineffective. The high to low transitions at U4,4 continually are causing a preset condition causing U4,5 to remain high. The low on U3,11 causes a low to exist at U30,2 keeping U30,3 high independent of any pulsing occuring on U30,1. This holds memory in the READ state.

Now consider that a compare pulse occurs. This, as we have seen, means that the memory address at this moment corresponds to the particular position indicated by the cursor. When U3, 13 goes high U30,2 follows and goes high. Note now the logical state of the leads U25,(1,2,4,5). Since the EOL has not been reached U12,6 is high and hence U25,4 is high. U25,5 is high since U24,8 is high. U25,1 is high because U23,2 is high by direct assignment. U25,2 is low because of the assignment of U23,2 during the load. U25,6 is low and therefore the output of U30 remains high. Memory is in the READ mode. On the next clock pulse into the shift register however a high is shifted onto U25,2. Now all input leads on U25(1,2,4,5) are high and U25,6 goes high U30(1,2) are both high and U30,3 accordingly goes low putting memory into the WRITE mode. The data on the TVT's input is written into memory at the address currently being specified. Memory will stay in the WRITE mode until the comparison pulse is completed. When U24 goes low indicating the completion of the character's output a positive going read strobe is generated via U31,4. This strobe is placed on U11,9 where (with the compare pulse still being present) forcing U11,8 low. This clears the STROBE flip-flop returning U9,5 to a low. On the next clock pulse into the shift registers U24,8 will return high. This will cause a number of events to occur

(a) The Character B counter will increment getting memory ready for its next input or output.

(b) The Read STROBE returns to a LOW therefore forcing U11,8 high. This causes the clock input to U4,3 to be effective (note the preset input is now high since U28,8 is high). U4,5 changes state i.e., becomes low and is used to clear the input latches U35,1 and U36,1.

(c) The low to high transition clocks U16,11 and U16,3 such that U16,9 and U16,5 both return low. [Note that the D input to the CHAR CHECK is LOW since the STROBE flip flop U9,5 was set low previously. This in turn caused the D input to U16,2 to be low since U3,4 is low].

(d) The output of U20,4 changes from low to high causing the CURSOR CHARACTER GENERATOR to increment. This readies the TVT for a successive input automatically.

(e) The compare pulse ceases which further augments the action indicated in (b) above. Since the compare pulse is absent the output of U30,3 returns to a high state forcing memory into a READ state.

9. <u>END OF LINE; ERASE</u>

In the above action it was pointed out that the input latches are cleared after each entry. This causes all Q outputs U35 and U36 to be low, with the exception of bit 6 whose output is taken from the $\overline{Q}$ pin (U35,11). (Remember the Bit 6 input to this latch is taken thru an inverter $U\overline{4}2$,6 and this $\overline{Q}$ output restores the inverted logic). The $\overline{Q}$ output, when cleared is high. The latch output therefore is 040 octal which is the ASCII code for a blank space.

Consider now that the EOL pin is pulled low. This will preset the EOL flip-flop such that U9,8 is low which in turn causes U2,13 to be high. Now clocking pulses on this R/W flip-flop can cause this unit to transfer its D input. This can only occur on line 9 of the dot counter U5 because of the And gates U5,8 and U5,3. But first the gate U3,(9,10) must be conditioned. This is done when the compare pulse becomes present on U3,9. Now clocking pulses from U25,6 can cause U2,8 to go low if the D input is high U10,8 goes high and U30,3 to go low as in the previously discussed memory write cycle. But note now this will stay low even after the compare pulse has ceased. This implies that the memory will stay in WRITE state until U2,8 changes its state. And what is being written into memory?... the blank space 040 since the latch is being cleared on each write cycle. With U2,8 low, U2,9 is high "priming" U10,13. When the EOL pulse arrives U10,11 will go low clearing U9,8 which will go high (dominating preset if it is still present). This will cause U10,6 to go low which clears U2,8 and restores U10,10 high. This ceases the memory write state and all memory from the cursor to the end of line has been replaced with a blank space.

10. <u>END OF SCREEN-ERASE</u>

Exactly the same operation as in End of Line - Erase occurs in End of Screen - Erase. This time when the EOS pin is pulled low U2,6 goes low allowing the clock input into U2,11 to become effective. On line 9 of the dot counter the compare pulse will permit the character start pulse on U3,10 to cause the R/W flip-flop U2,8 to change state putting a low on U10,10 and hence forcing U30,3 to a low. This is the WRITE state for memory. This will remain in this condition until the End of Screen pulse U4,8 goes high. Since U2,8 is already high then both inputs to U10,(2,1) satisfy this gate and U2,1 is forced low clearing this flip-flop. With U2,6 high U2,13 causes this flip flop to clear and hence force memory out of the WRITE state. The effect of all this was to write blank spaces into memory over the range from the position after the cursor until the end of the screen.

11. <u>CURSOR FLASHER</u>

U46,11 when pulled low enables the Character Generator. When it is high the generator's output is all ones. If when a specific memory location is being addressed the enable lead was allowed to go from a low to high alternately then the display would alternate between a character and a solid bright rectangle. The cursor flasher oscillator U8,3 outputs a rectangular pulse train that is non synchronous with the character compare pulse. The output of U17,3 therefore alternates at beat frequency between these two rates and produces the effect of a flashing cursor.

12. <u>60 Hz PHASE LOCK LOOP</u>:

As was mentioned at the start of this circuit description the basic clock frequency for the TVT is that present a U1,3. To avoid a display that changes with time, due to 60 Hz interference, it is recommended that the basic clock be locked to the local 60 Hz power mains frequency. This provision has been made in the TVT and is accomplished by the circuitry involving Q1, Q2 and Q3.

It is first to be recognized that voltages placed on U1,5 provide another means for controlling the output frequency of this astable oscillator. The circuitry to be described has this aim in mind. i.e., producing a controlling voltage on this terminal such as to cause a synchronous lock with the power line frequency.

The signal present on U2,5 appears once per full display which, as has been pointed out, is nominally at a 60 Hz rate. It is a narrow low going pulse which is coupled to the base of Q2. The resulting pulse in the collector circuit rises from -12 volts to essentially +5 volts. With a 60 Hz (approximately 12 volt rms signal) present on the SYNC 60 Hz terminal of the TVT, the source terminal of the FET Q3 is varying at a 60 Hz rate above and below ground potential. (The resistor capacitor ladder network at the 60 Hz sync input acts to filter hash that may be present on the power line). The positive going pulse on the Q3 gate forces this FET into a low resistance state and hence a narrow sample of the incoming, 60 Hz voltage is at this time. This voltage charges up capacitor C14 which retains the sampled value. This voltage is impressed on the gate of Q1 via the diodes D1, D2 and the loop response shaping network C13, R10 and C11. U1,5 also "feels" this voltage due to the source follower action of Q1. In essence the position of the sample on the 60 Hz wave is so adjusted, automatically, to produce a unique voltage at U1,5 which in turn adjusts the astable's frequency. This positioning of the sample on the 60 Hz wave is in essence "phase locking" the derived 60 Hz pulse train (verticle rate) to the 60 Hz line frequency.

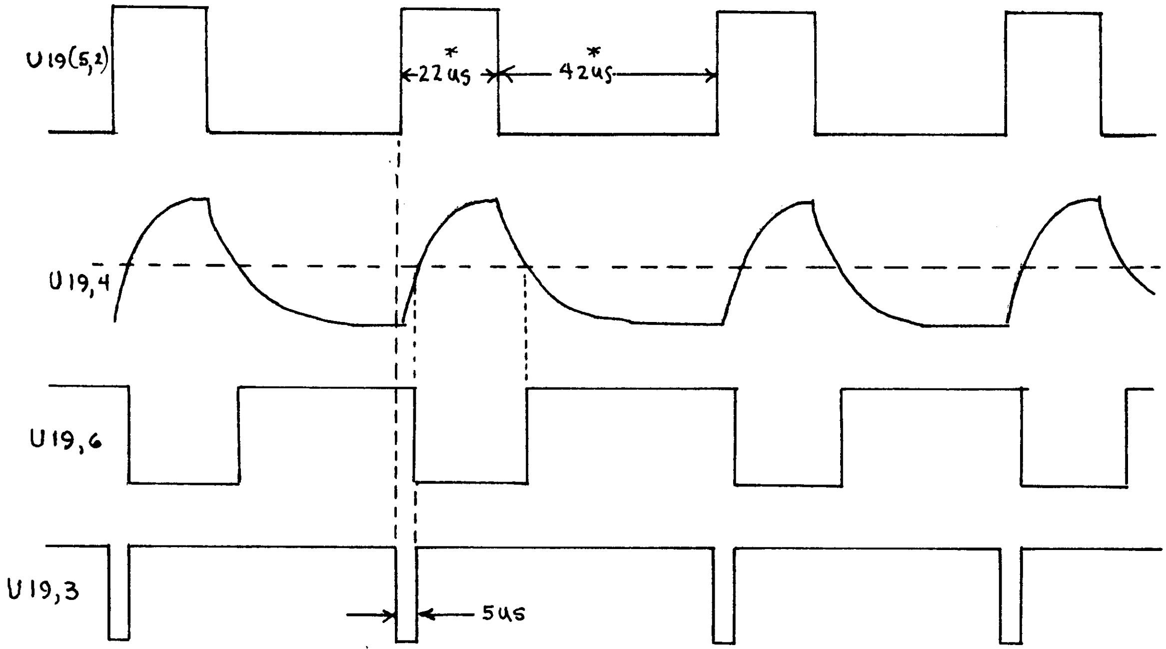


FIGURE 1

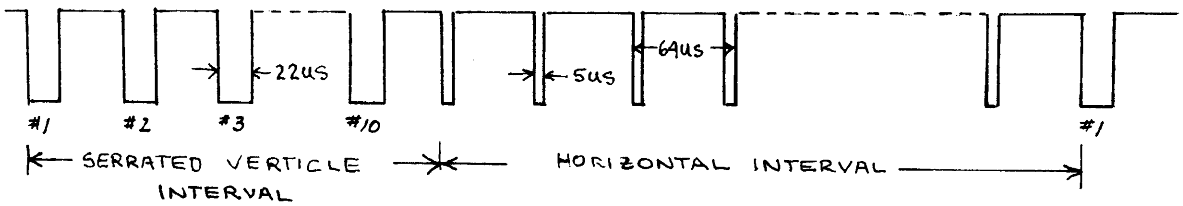


FIGURE 2

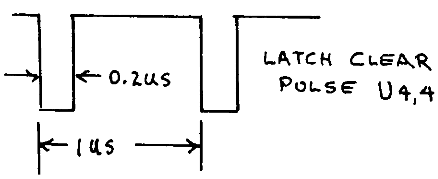


FIGURE 3

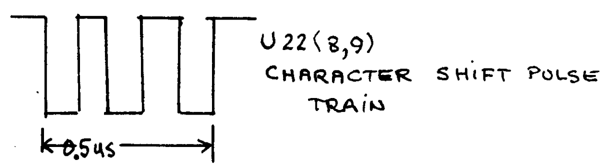
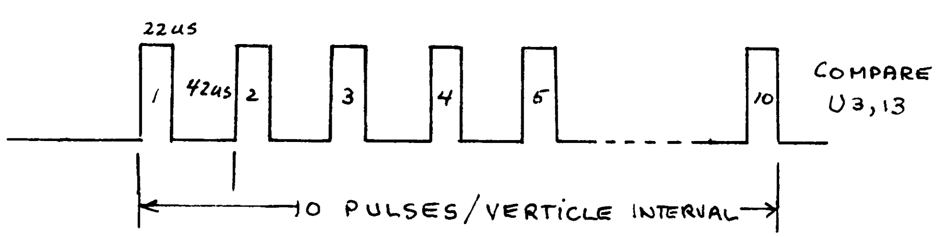


FIGURE 4



TVT BASIC WAVEFORMS & TIMING

* SOME TIMING WILL VARY DUE TO PARTICULAR HORIZONTAL REP RATE IN TV SET BEING USED. NUMBERS ABOVE ARE REPRESENTATIVE RATHER THAN SPECIFIC.

TVT MODIFICATION
64 Char per Line

MODIFICATION INSTRUCTIONS

1. DO NOT attempt this modification unless your TVT is completely functional. You may want to check the overall higher speed operation by applying step 5 and step 14 first. This will produce one half screen operation while excersing the memory and character generator at the new rate.

2. Refer to the attached drawings Fig. 1 showing circuit side and Fig. 2 showing component side. Make the circuit TRACE cuts on each side exactly as shown. (The 2 cuts in the circle at U-17 are only for the cursor Underscore change. Do not cut them unless you are going to install that change also.)

3. Remove the IC (7486) at location U-15. This is no longer needed.

4. Using small (30 AWG) wire connect the following points on the circuit side:

   (✓) Connect U14-5 to U12-5
   (✓) Connect U14-12 to U14-8
   (✓) Connect U14-8 to U15-6 (U15 is empty socket)
   (✓) Connect U27-9 to U31-11
   (✓) Connect U27-10 to U31-9

5. REMOVE C38 (47pf) character capacitor located next to U18-15 and REPLACE with a 18 pf capacitor.

6. Carefully Drill holes to mount two 14-pin and two 16-pin sockets along the edge of the board adjacent to U39 and U52. (ALternatively you may wish to mount these sockets on a small PC board.)

7. Using your favorite wiring technique (ie, wire wrap, point to point, or etched circuit) wire the 4 sockets as shown on the Fig. 3 schematic and connect to the locations indicated on the TVT.

8. Install the 4 IC's.

9. DOUBLE-CHECK all wiring and Trace Cuts.

10. Apply power and readjust the 3 POTS for a stable display.

11. If you do not have a stable 64x16 display RE-CHECK all wiring again.

12. If you do have a good display, enter all 64 ASCII Characters and verify they display correctly.

13. Turn off the power and then turn it back on to get a full screen of mixed characters.

14. Adjust the DOT RATE POT over its full range while watching the screen and see if any characters change their dot pattern. If they do, the most probable cause is SLOW MEMORIES. This problem has also been traced to a SLOW CHARACTER GENERATOR. It is possible, by observation to figure out which Memory is causing the problem. (If your memories are rated for 500ns or faster) You should have no problem, unless it is the 2513 Character Gen.

15. In some cases, it might not be possible to cover the entire range of the DOT RATE POT without some of the characters changing their pattern. This is OK as long as we can get a full 64 Char. line on the screen without errors.

    Since many MONITORS overscan the screen, you should try adjusting your Horiz. Width to JUST BARELY fill the screen. This will in effect, give the slowest DOT RATE requirement and the best operating point for the TVT.

    NOTE - SOME MONITORS use the overscan, to cover up Horizontal Linearity problems, so your width adjustment might have to be a Compromise between Linearity and DOT RATE.

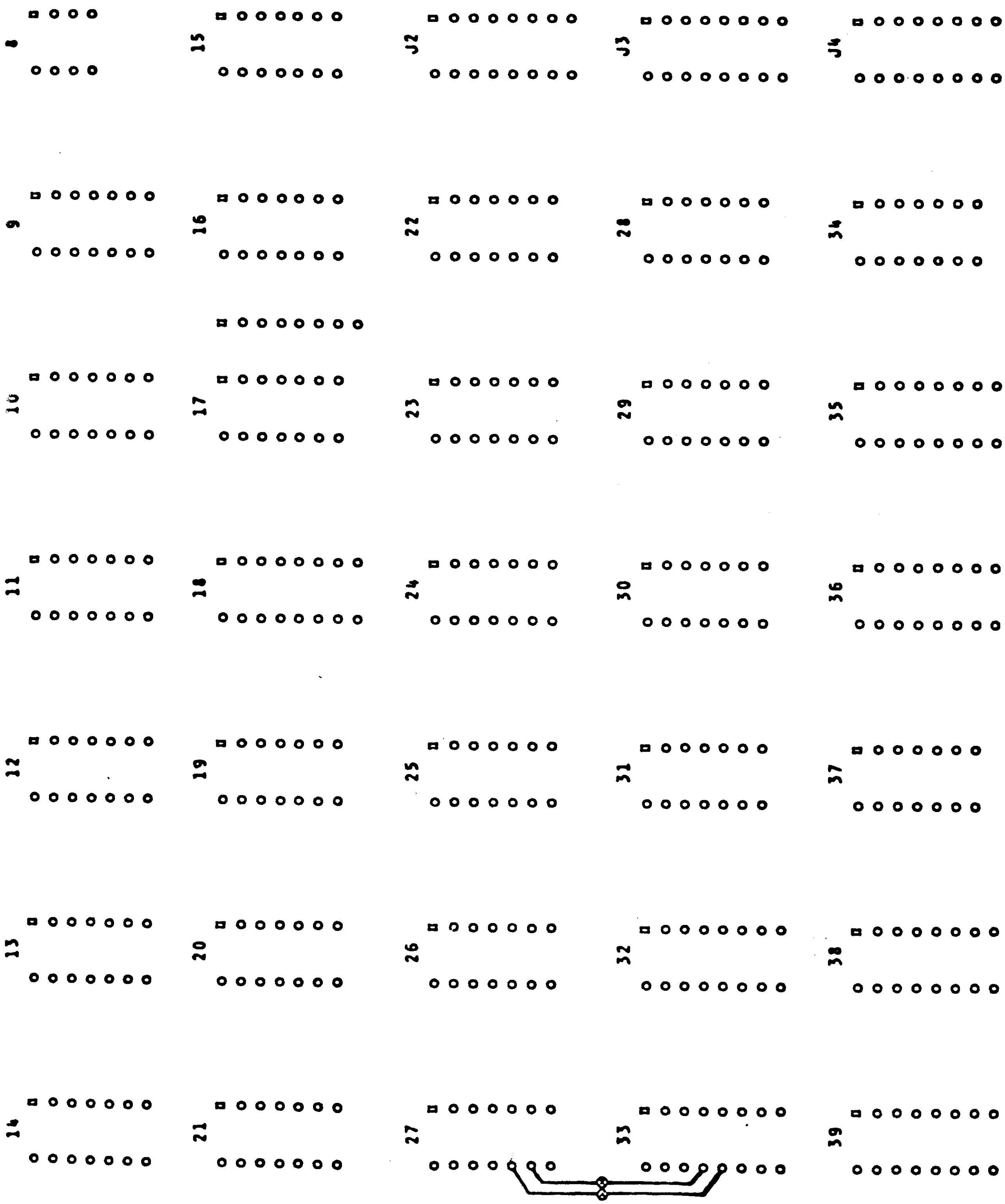


FIG. 1 CIRCUIT SIDE

—⊗— = CUT TRACE

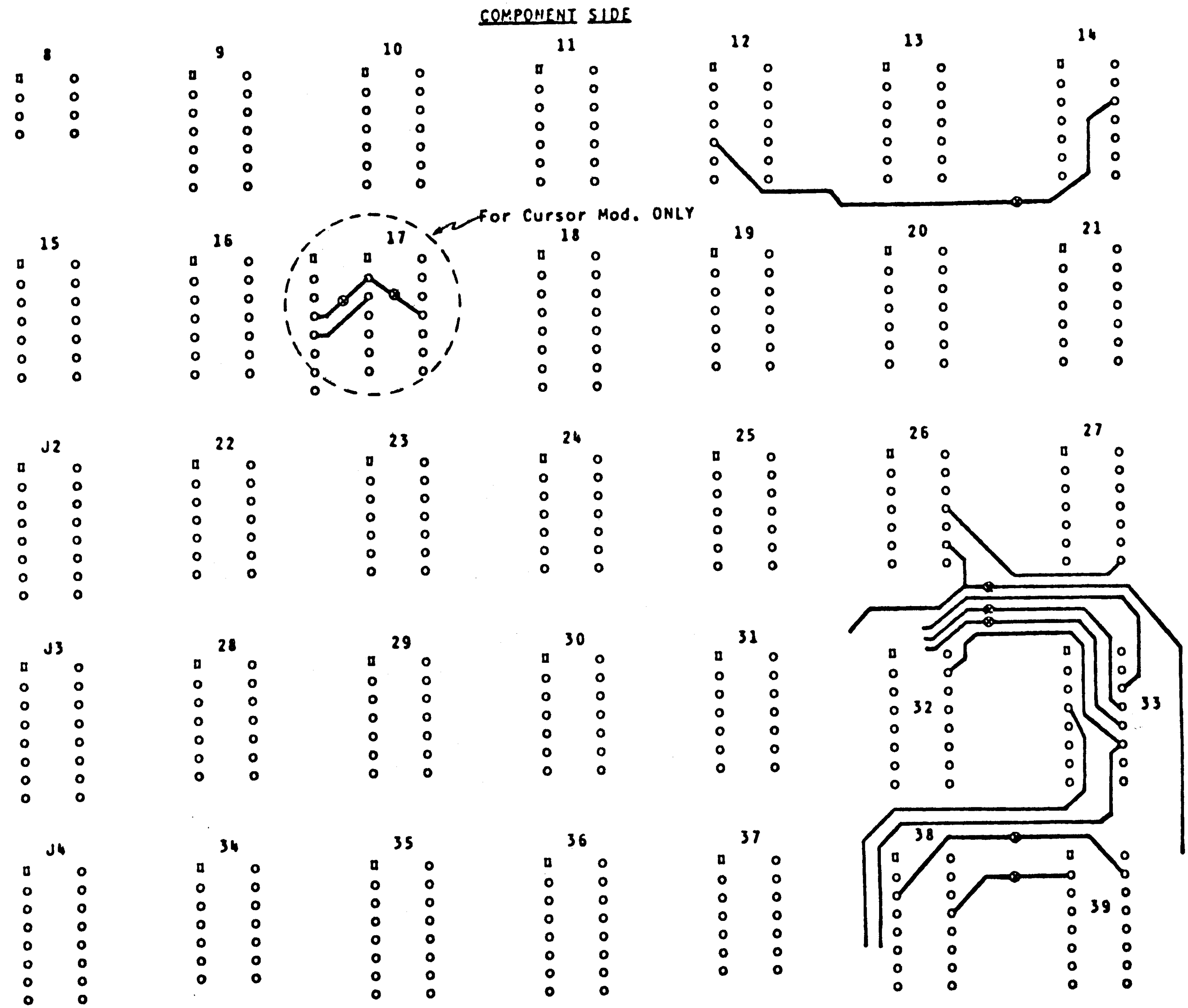
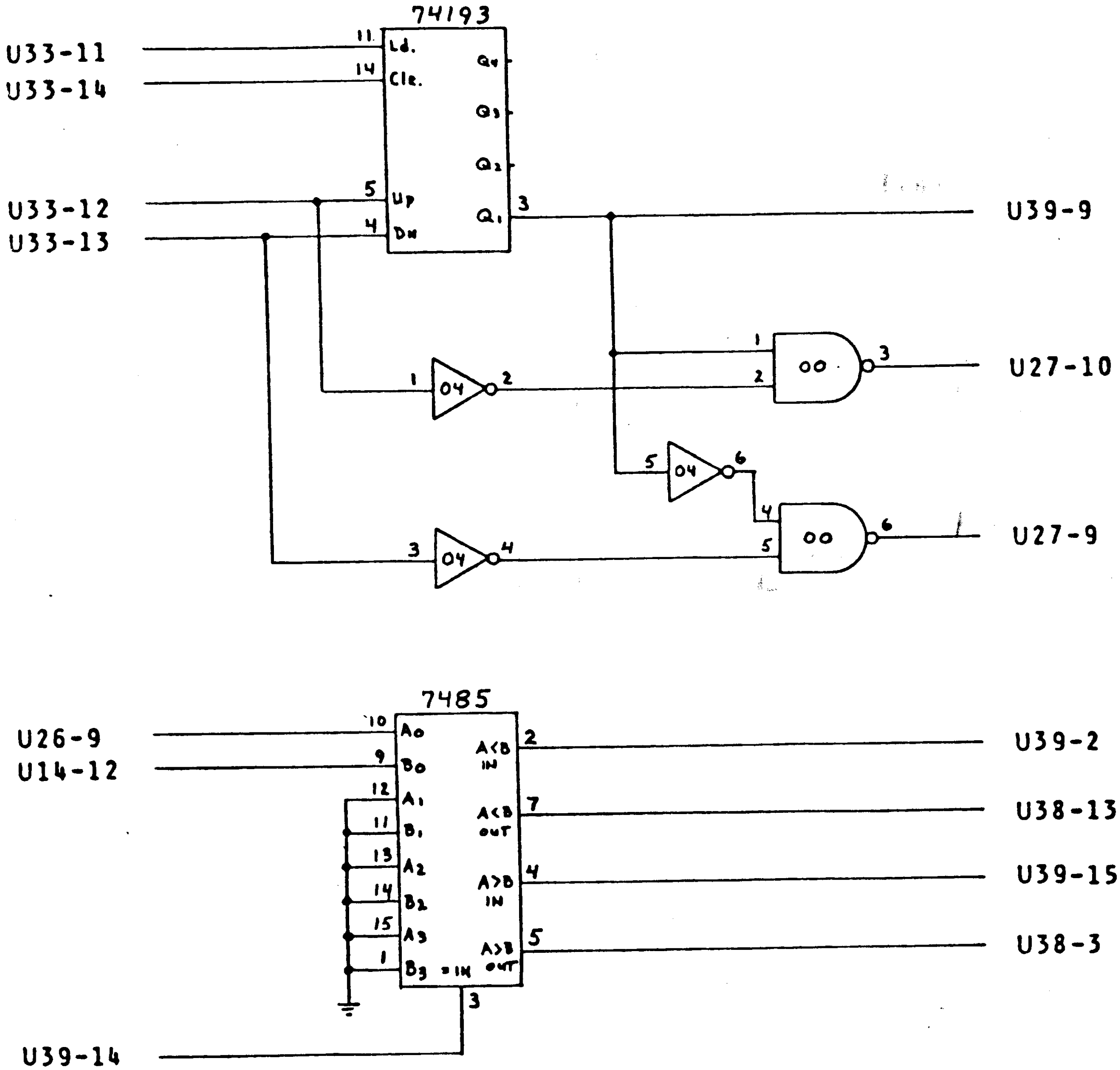


FIG. 2 COMPONENT SIDE
—⊗— = CUT TRACE

FIG.3

BAY AREA TVT MOD.
64 Char per Line

SCHEMATIC



NOTE - Voltage and Ground connections are IMPLIED.

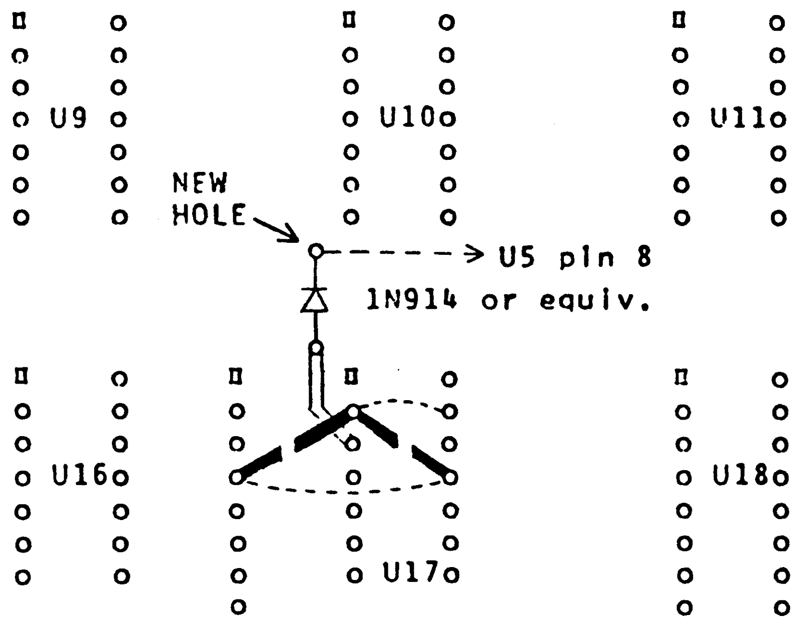
BAY-AREA TVT CURSOR MODIFICATION

PURPOSE: This modification changes the function of the CURSOR from a BIG flashing square to a flashing UNDERSCORE which will not obscure the character being marked!

COMMENTS: This modification is very simple and only requires the cutting of 2 PC Traces and the addition of a single diode and 3 JUMPERS.

NOTE: The IC and/or Socket located at U17 <u>MUST</u> be removed since one of the traces which must be cut is located on the component side under it! Install U17 when modification is completed.

MODIFICATION



COMPONENT SIDE

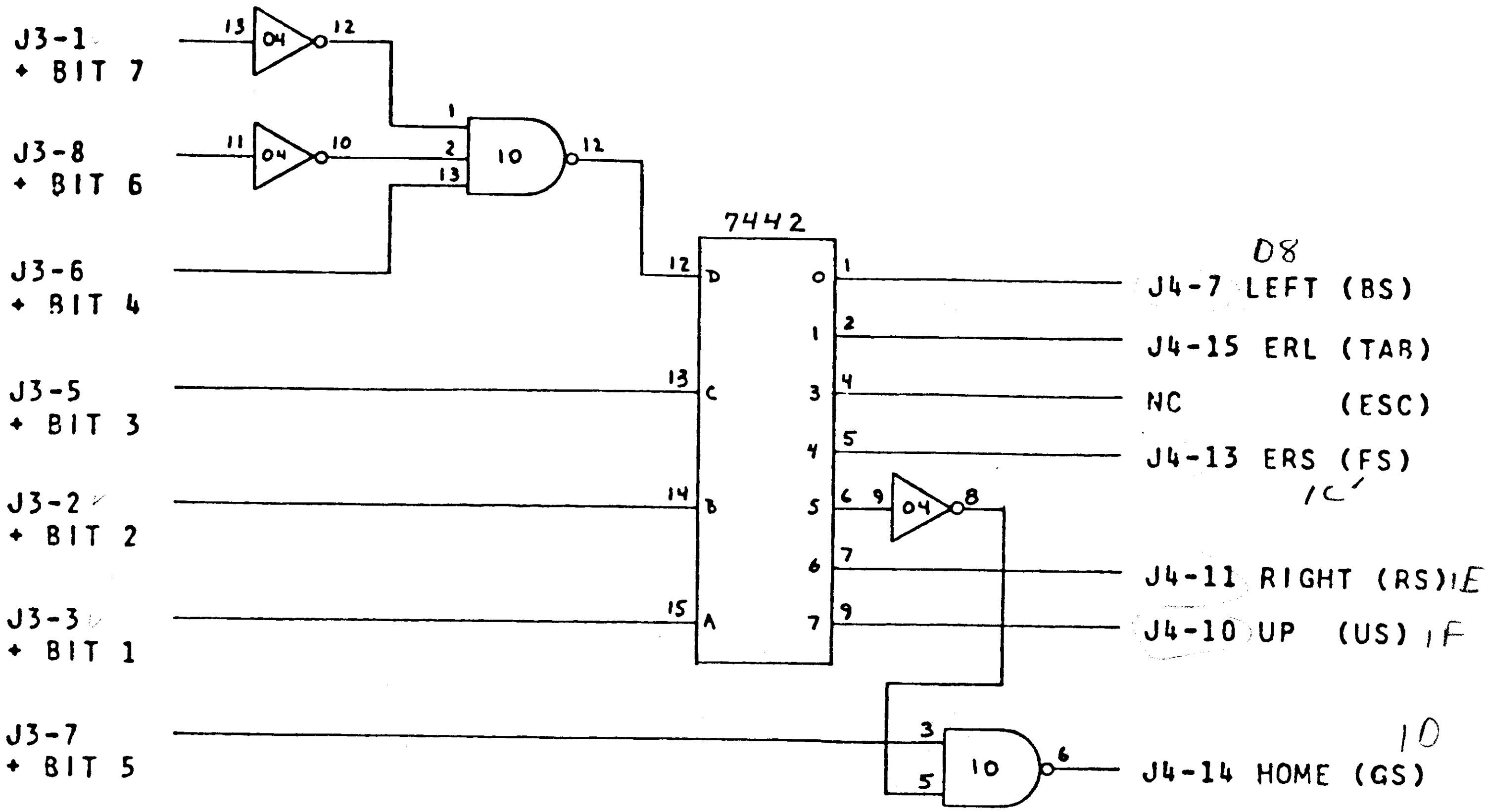
------ JUMPER

LAND (COMPONENT SIDE)

LAND (CIRCUIT SIDE)

CUT LAND

BAY AREA TVT
CURSOR CONTROL

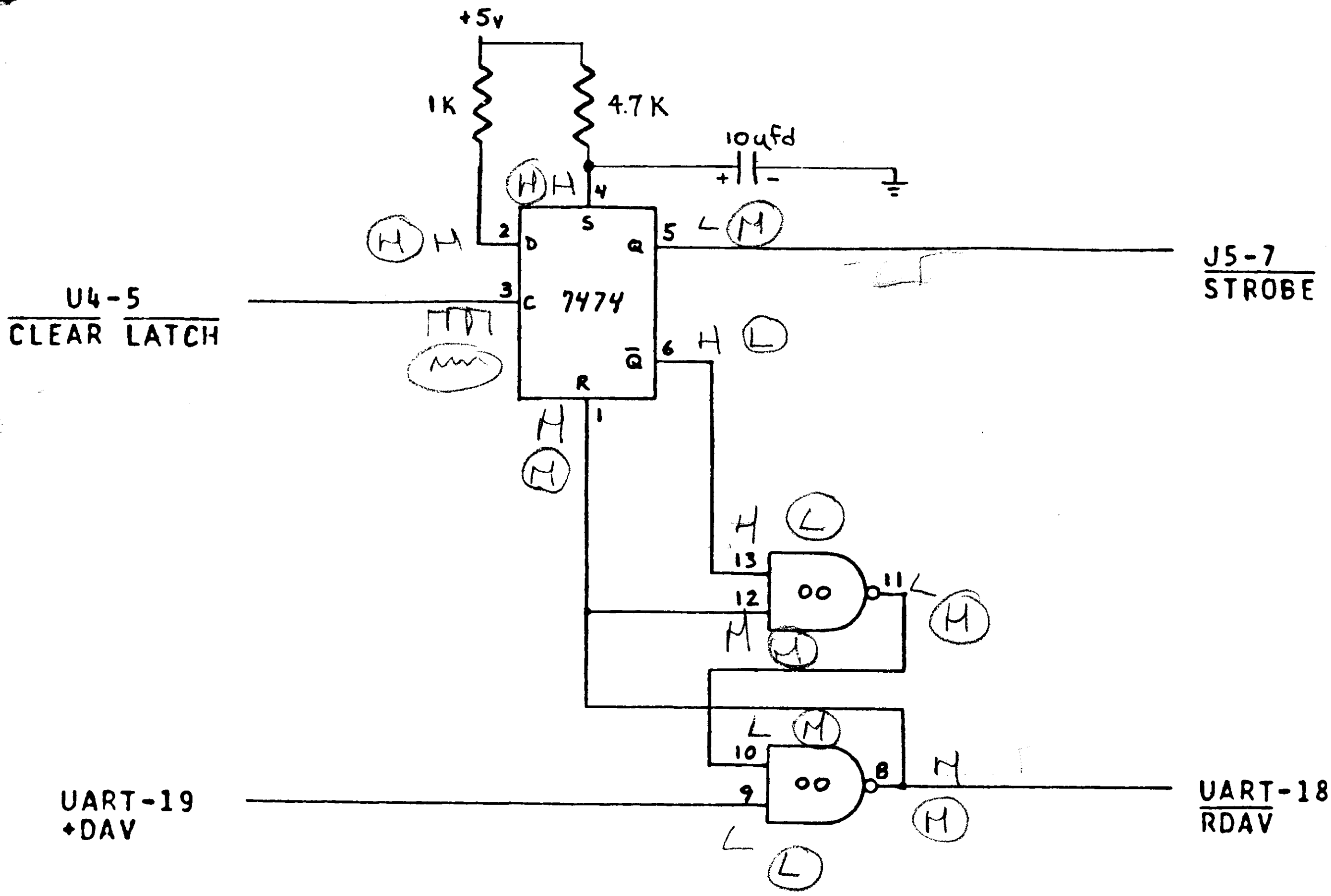


REMOVE IC's LOCATED AT U40 AND U41.

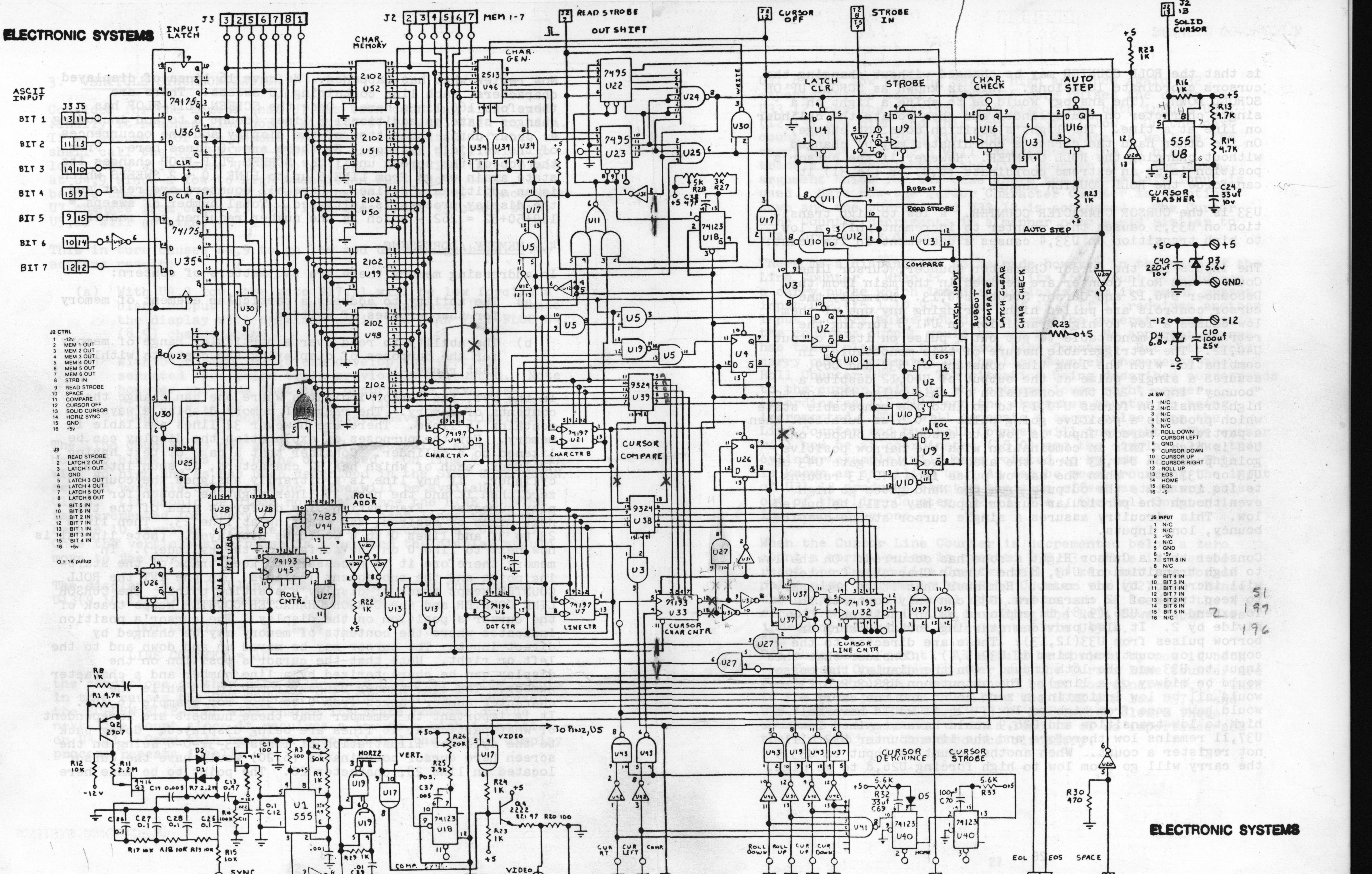
TIE UP U40-13 TO +5 THRU A 1K RESISTOR

NOTE- Voltage and Ground connections are IMPLIED.

1200 BAUD TVT MOD.



NOTE- Voltage and Ground connections are IMPLIED.

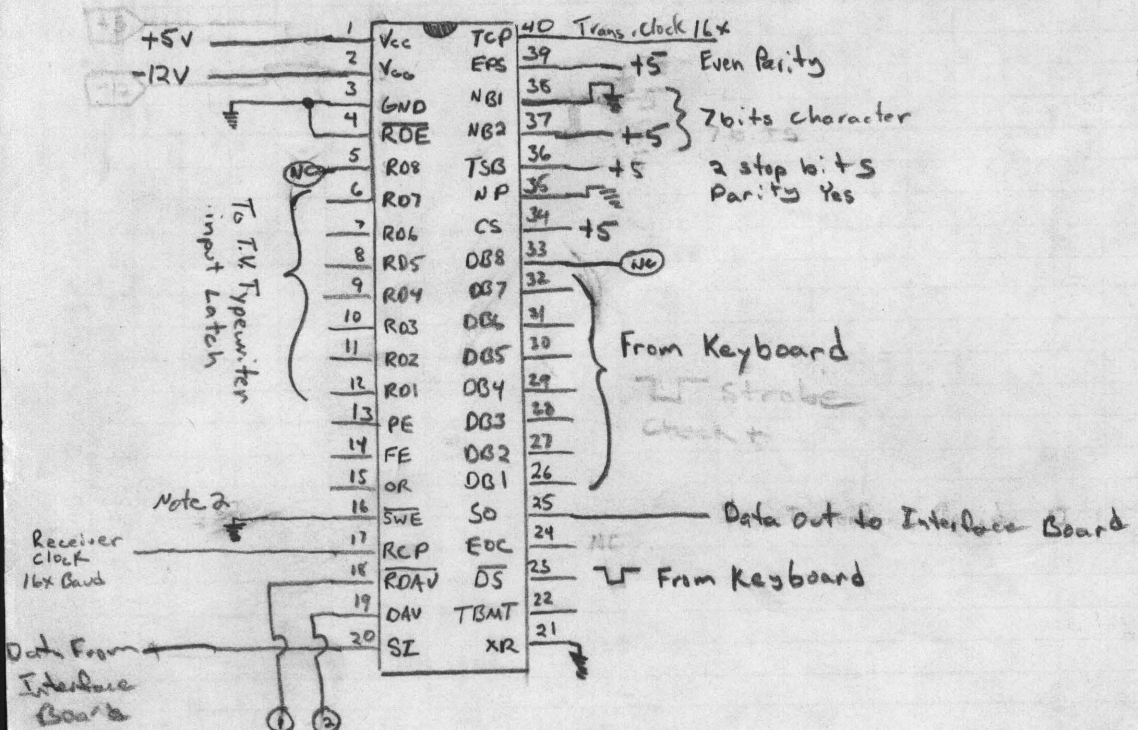


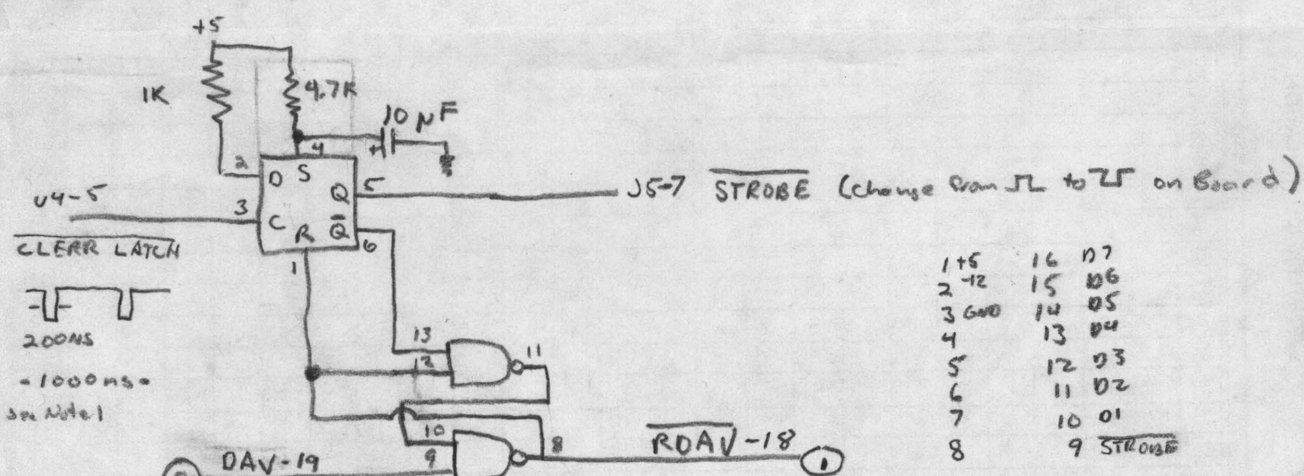
ELECTRONIC SYSTEMS

Note 1 — $\overline{RDAV}$ 250ns minimum
Note 2 — $\overline{SWE}$ for PE, FE, OR, DAV, TMBT must be true

Fantom — 7bits Character, Even Parity, 2 stop bits
$41

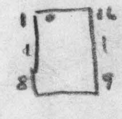
"A"
41
100 0001
8 4 2 1





1 +5	16 D7		
2 -12	15 D6		
3 GND	14 D5		
4	13 D4		
5	12 D3		
6	11 D2		
7	10 D1		
8	9 STROBE		

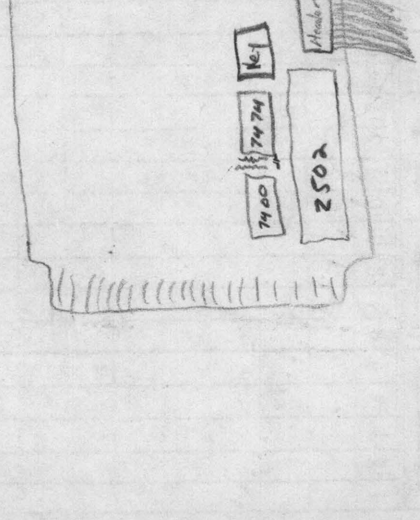
1 +5	16 GND
2 -12	15 RD7
3 GND	14 RD6
4 TCP	13 RD5
5 SI	12 RD4
6 SO	11 RD3
7 CL	10 RD2
8 ST	9 RD1



D0 - D7
+5
-12
GND
⊔ $\overline{STROBE}$

Keyboard

Pin
1 +5
2 -12
3 GND
4
5
6
7
8
9 STROBE
10 D1
11 D2
12 D3
13 D4
14 D5
15 D6
16 D7



Pin 1 +5
2 -12
3 GND — From I/O Board
4 TCP/RCP
5 SI
6 SO
7 CLEAR LATCH
8 STROBE
9 RD1 — To Latch T.V Typewriter
10 RD2
11 RD3
12 RD4
13 RD5
14 RD6
15 RD7
16 GND to T.V Typo.

PLANNED PROCUREMENT GUIDE
FORMAT A INPUT DOCUMENT

ITEM CODE	MARK	MOD	PRO. SEQ NO.	COMPLETE IDENTIFICATION	PROCURING ORGANIZATION	MLT O/H	MLT RE-PEAT	MLT IN-ITIAL	ITEM TYPE	RESERVED	FORMAT ID	TRANSACT-ION CODE
1 2 3 4 5	6 7 8 9	10 11 12 13	14 15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	61 62 63 64 65 66 67 68 69	70 71	72 73	74 75	76	77 78	79	80
											A	
1 2 3 4 5	6 7 8 9	10 11 12 13	14 15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	61 62 63 64 65 66 67 68 69	70 71	72 73	74 75	76	77 78	79	80