

**ELECTRONIC
SYSTEMS**

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TVT

P. O. BOX 212, BURLINGAME, CA

TV TYPEWRITER

This TV Typewriter (TVT) 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 which indicates where on the screen the next character will appear, is a flashing white rectangle; but 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), and "erase to end of screen" (EOS) 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 keyboard. 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 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, while 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 5 V. at 1.5 A. and -12 V. at 30 mA.

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Theory of 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, O4, resulting in a full composite video output.

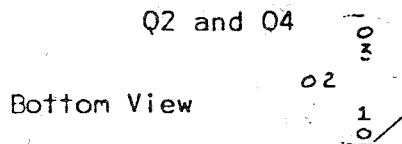
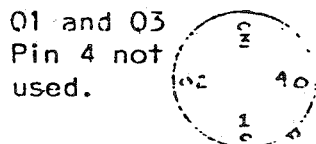
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Assembly and Trouble Shooting

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.



- 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,

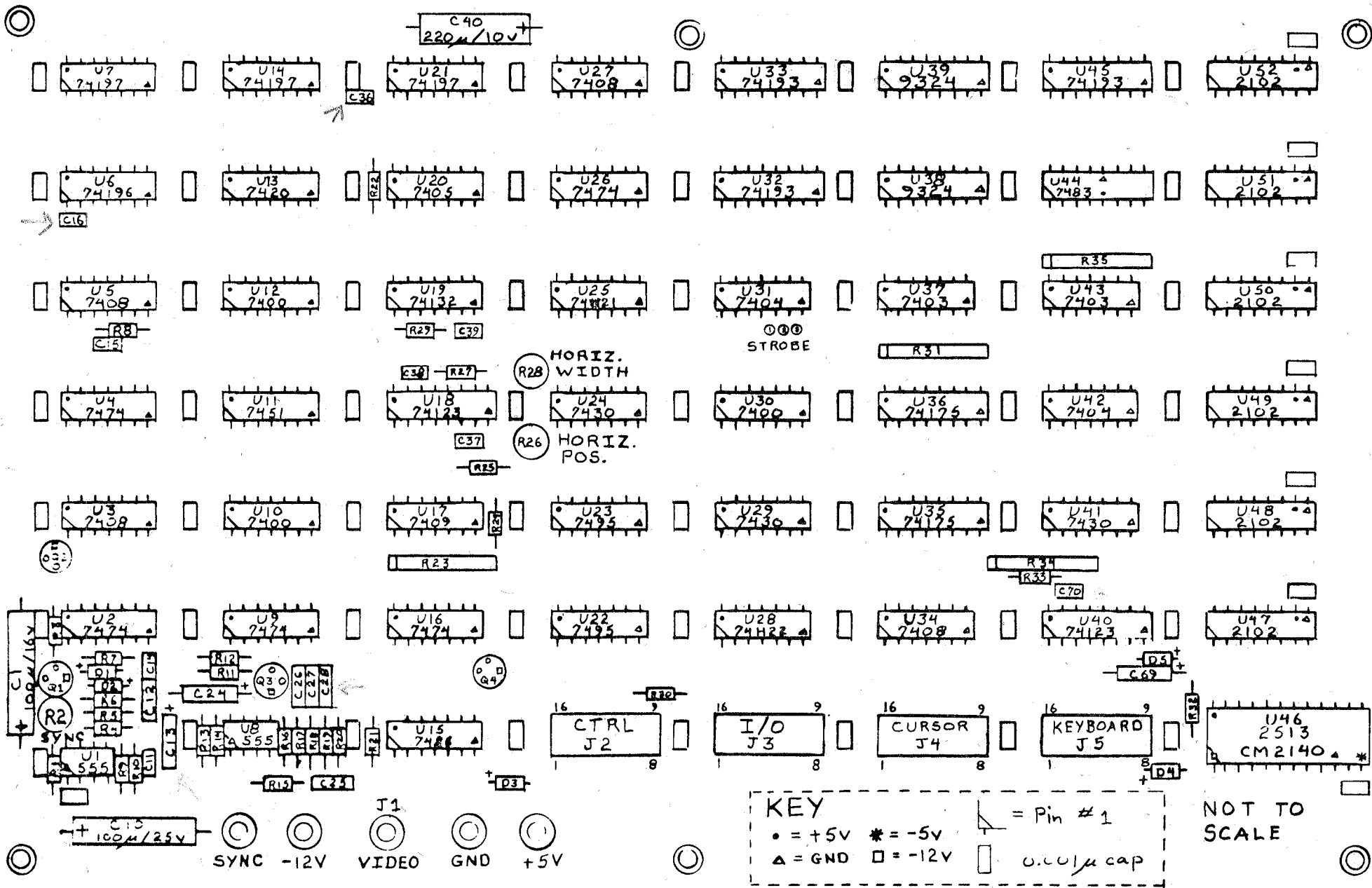
being very careful to insert pin 1 in the hole with the square pad. Pin 1 is usually identifiable by a dot or indentation next to the pin or on its end of the package. When soldering the I.C.'s, be very careful not to overheat them, and also not to bridge solder between adjacent leads. Allow the package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

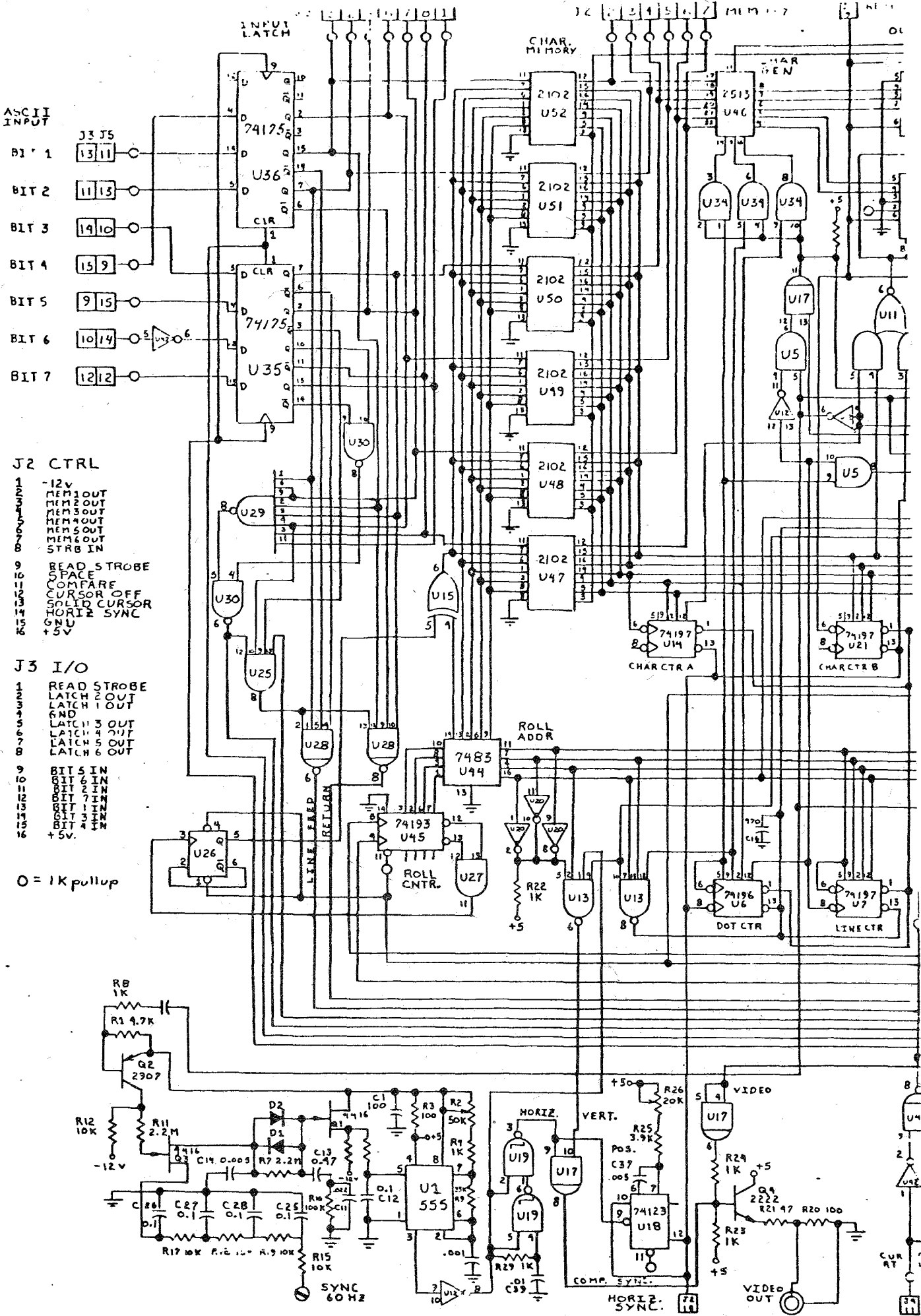
- 10.) Next to U31 are three holes labeled 1, 2, and 3 on the layout diagram. If the strobe output from your keyboard is a positive pulse, connect pin 1 to pin 2; if it is a negative pulse, connect pin 3 to pin 2 instead.
- 11.) Insert U46 through U52 in their sockets, being careful to get pin 1 in the 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., +5 V., and -12 V. inputs. Connect the video monitor to J1 (OUT) and Gnd. A 60 Hz. sine wave of up to 12.6 Vrms. can be applied to the sync input, but is usually not required since the circuit is sensitive enough to sync with 60 Hz. radiated from house wiring.
- 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 size and 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.





ASCII INPUT

- BIT 1 [13 11]
- BIT 2 [11 13]
- BIT 3 [19 10]
- BIT 4 [15 9]
- BIT 5 [9 15]
- BIT 6 [10 14]
- BIT 7 [12 12]

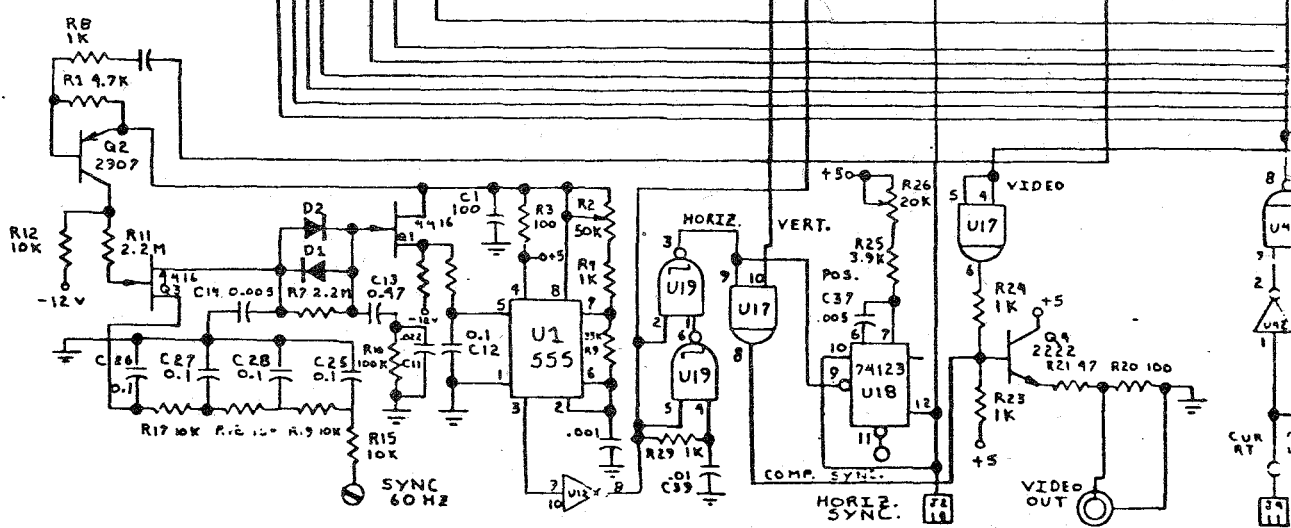
J2 CTRL

- 1 -12V
- 2 MEM1 OUT
- 3 MEM2 OUT
- 4 MEM3 OUT
- 5 MEM4 OUT
- 6 MEM5 OUT
- 7 MEM6 OUT
- 8 STRB IN
- 9 READ STROBE
- 10 SPACE
- 11 COMPARE
- 12 CURSOR OFF
- 13 SOLID CURSOR
- 14 HORIZ SYNC
- 15 GNU
- 16 +5V

J3 I/O

- 1 READ STROBE
- 2 LATCH 2 OUT
- 3 LATCH 1 OUT
- 4 GND
- 5 LATCH 11 3 OUT
- 6 LATCH 11 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



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Parts List

QUANTITY	PART NUMBER	COMPONENT MARKING	DESCRIPTION
1	C1	100 uf. / 16 V.	Electrolytic Cap.
64	C2-9, 17-23, 29-35, 41-68, 71-84	0.001 uf.	Ceramic Cap.
1	C10	100 uf. / 25 V.	Electrolytic Cap.
1	C11	0.02 uf.	Ceramic Cap.
5	C12, 25-28	0.1 uf.	Ceramic Cap.
1	C13	0.47 uf.	Ceramic Cap.
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.	Electrolytic Cap.
1	C70	100 pf.	Ceramic Cap.
3	D1, 2, 5	1N4148	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 K Ω , $\frac{1}{4}$ w.	Res. - Yel., Pur., Red
1	R2	50 K Ω	Trimmer Pot.
2	R3, 20	100 Ω , $\frac{1}{4}$ w.	Res. - Brn., Blk., Brn.
6	R4, 8, 16, 22, 24, 29	1 K Ω , $\frac{1}{4}$ w.	Res. - Brn., Blk., Red
2	R5, 9	33 K Ω , $\frac{1}{4}$ w.	Res. - Org., Org., Org.
6	R6, 12, 15, 17-19	10 K Ω , $\frac{1}{4}$ w.	Res. - Brn., Blk., Org.
2	R7, 11	2.2 M Ω , $\frac{1}{4}$ w.	Res. - Red, Red, Grn.
1	R10	100 K Ω , $\frac{1}{4}$ w.	Res. - Brn., Blk., Yel.
1	R21	47 Ω , $\frac{1}{4}$ w.	Res. - Yel., Pur., Blk.,
4	R23, 31, 34, 35	1 K Ω x 7	8 Pin Res. Pack
1	R25	3.9 K Ω , $\frac{1}{4}$ w.	Res. - Org., Wht., Red
1	R26	10 K Ω	Trimmer Pot.
1	R27	3.0 K Ω , $\frac{1}{4}$ w.	Res. - Org., Blk., Red
1	R28	5 K Ω	Trimmer Pot.
1	R30	470 Ω , $\frac{1}{4}$ w.	Res. - Yel., Pur., Brn.
2	R32, 33	5.6 K Ω , $\frac{1}{4}$ 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 Bi- nary 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.