Since line No. 1 is supposed to be all blanks, the character generator is told this and we get all blanks, except possibly for a brief cursor winking bar.

On the second scan line, we again clock the line register 32 times, letting it go once around. The main memory just waits. This time, the character generator is told to work on line No. 2 and please put down the *top row* of dots on each character. For instance, if a "T" comes up, we get five "1's" in a row. An "S" would be 01110 and so on. As the TV scans across, each top row of dots for each following character is put down.

On the next pass, we again clock the line register 32 times. This time, the *second* row of dots gets output, with a "T" being a 00100 and an "S" being 10001, and so on. Lines No. 4, 5, 6, 7, and 8 are handled the same way, with the character generator working on the line it is told to and the line register going once around for each line. By the end of the eighth line we have put down all the dots we need for a line of 32 complete dot-matrix characters. The circuitry is blanked for the next four scan lines, providing us with a space between character lines.

On line No. 13 (a new line "1"), our main character memory is once again clocked 32 times and the line register is simultaneously clocked. This fills up the line register with a new set of 32 characters. The same operation repeats for each of the sixteen rows of characters that we want to put down.

Notice that the timing runs in bursts and is not continuous. Thus, the line register runs for 32 counts and waits 16 for retrace and so on. The memory does the same thing, but only on every twelfth line during the active scan. Carefully established internal timing delays take care of settling times between memory, line register, character generator, and the final video generating output register. The output register converts the five parallel outputs of the character generator into serial, high speed video.

About the memory bus

So far, we've assumed that we were using the page-A memory with the page-A character generator. Thanks to the memory bus (b1 through b6) we can connect anything we like to the character generator, including the page-A memory, the page-B memory, or anything else we want to hang on these lines.

To run page-B, we simply disable the page-A memory and enable the page-B memory's output. The handy thing about bus organization is that no complex switching is involved. Whatever is enabled gets connected to the character generator; other things tacked on just sit there. The only restriction is that *we have to enable only one character source at a time.* We can also use the same memory bus optionally to output characters to a computer, a cassette recorder, or a phone line.

This way, with suitable add-ons we have a choice. We can send one character at a time directly from the keyboard, or we can send an entire page at a time from the memory. The latter is faster and more complex but has the advantages that you can fix all the mistakes first and don't tie up nearly as much outside equipment. **R-E**

PARTS LIST

MAINFRAME

C1—5000-μF 10-V electrolytic
C2, C3—1000-μF 25-V electrolytic
C4—100-μF 6-V electrolytic
C5, C7—470-pF disc for vhf bypassing
C6—3-30 pF trimmer
C8—27-pF mica
C9—47-pF mica
C10—Gimmick attenuator made of twin lead
D1 to D6—1N401 or equal 1N4001
D7—12-V, 1-W Zener, 1N4742 or equal
D8—6.8-V, 1-W Zener, 1N4736 or equal
D9—5.1-V, 1-W Zener, 1N4734 or equal
D10 to D14—1N914 or equal
F1—1-A fuse and fuseholder
IC1—7805 regulator (Fairchild or Motorola)
J1, J2—Binding posts, one yellow, one black (5 way)
L1—Coil made from 4" of No. 14 solid wire
Q1—2N918 transistor in metal can, **do not substitute!**
R1, R2—47 ohms, ½-W
R3—22 ohms, ¼-W
R4, R9, R10—2200 ohms, ¼-W
R7—4700 ohms, ¼-W
R8—470 ohms, ¼-W
S1, S2, S3, S4, S7, S8—dpdt rocker switch
S5 to S6—dpdt rocker switch, momentary spring return
SO1 to SO6—connector, Molex 09-52-3103
SO7—TV lead-in connector
T1—Power transformer, dual 12-V center tapped secondaries, 1.5-A. Signal 24-1A or equal
MISC:—PC Board, 8¾ x 6¾; mounting brackets and hardware (6); switch mounting hardware (8 sets); line cord and cable clamp; hardware for T1; vertical heat sink for IC1; No. 24 jumper wire; sleeving; No. 14 wire for L1; fuse clips and hardware, 300-ohm twinlead, 18"; PC terminals, optional-2; solder.

MEMORY BOARD

Note: Each system needs one "Memory A" board. Memory "B" boards are optional. These parts are needed for *either* a Page A or a Page B memory:
C1, C3, C5, C7—100-μF 15-V electrolytic
C2, C4, C6, C8, C9, C10, C11—0.1-μF disc ceramic
D1, D4, D5, D6—1N914 or equal
D2, D3, D7—1N4001 or equal
IC1 to IC 6—2524 MOS 512-bit recirculating shift register (Signetics)
IC7—7406 hex driver, TTL
P1 to P60—Connector pins to fit Molex 09-52-3103 connectors
Q1, Q2—2N5139
All resistors ¼-W carbon
R1 to R6, R25—2200 ohms
R7, R8, R15—2.7 ohms
R9, R23—10,000 ohms
R10, R12—22 ohms
R11, R13—4700 ohms
R14, R18, R19, R20—150 ohms
R16, R17—100 ohms
R21, R22—1000 ohms
R24—330 ohms
R26—470 ohms
These parts are needed ONLY for a page A memory:
C12—680-pF mica
C13—100-pF mica
C14—0.1-μF disc ceramic
IC8—2518 MOS hex 32-bit recirculating register (Signetics)
IC9—2513 character generator, MOS (Signetics)
IC10—74165 TTL 8-bit PISO register
IC11—7401 TTL open collector NAND gate
R34—220 ohms
R33, R35, R38, R40 to R42, R43, R44—2200 ohms
R27 to R32, R45 to R50—6800 ohms
R36—470 ohms
R37—47,000 ohms
R51—330 ohms
MISC: PC Board, 4½" x 6½"; #24 wire jumpers; Sleeving; PC Terminals (Optional-2), Solder.

TIMING BOARD

C1 to C4—01-μF 10-V disc ceramic
C5, C6—160-pF mica
C7—0.001-μF disc ceramic
C8—100-μF 6-V electrolytic
C9—33-μF 6-V electrolytic
IC1—MC4024 dual astable (Motorola)
IC2, IC3,IC5—8288 divide by 12 (Signetics)
IC4—7473 dual JK, TTL
IC6—8288
IC7, IC8—7432 quad OR gate, TTL
IC9, IC12—7402 quad NOR gate, TTL
IC10, IC11—7410
P1 to P60—Pins to fit Molex 09-52-3103 connector
R1—330 ohms ¼-W
R2, R3—220 ohms, ¼-W
R4—2200 ohms, ¼-W
SO1 to SO6—Molex 09-52-3103 socket
XTAL 1—4561, 920-kHz series-resonant crystal
MISC: PC Board, 4½" x 6½"; #24 solid wire jumpers; Sleeving; PC Terminals (optional-21); solder.

CURSOR

C1—1200-pF mica
C2—4300-pF mica
C3—620-pF mica
C4—6200-pF mica
C5—1000-pF mica
C6 to C9, C12 to C15—0.1-μF disc ceramic
C10—100-μF 6-V electrolytic
C11, 16—10-μF 6-V electrolytic
IC1—7408 quad AND gate, TTL
IC2, IC4—74197 or 74177 or 8281 or 8291 divide by 16 TTL
IC3—7473 dual JK TTL
IC5, IC6—7402 quad NOR gate TTL
IC7—7474 dual D flip-flop, TTL
IC8—7400 quad NAND gate, TTL
IC9—555 timer, Signetics
P1 to P60—pins to fit Molex 09-52-3103 connector
Q1—2N5129
R1, R5, R8, R13, R16, R21—1000 ohms, ¼-W
R2, R3, R4, R6, R7, R9, R11, R14, R17, R18, R22—2200 ohms, ¼-W
R10, R19—330 ohms, ¼-W
R12—100 ohms, ¼-W
R15—100,000 ohms, ¼-W
R20—150 ohms, ¼-W
SO1 to SO6—Molex 09-52-3103 connector
MISC: PC Board, 4½" x 6½"; No 24 wire jumpers; sleeving; PC terminals (optional-8); solder.

The following items are avilable from Southwest Technical Products, 219 West Rhapsody, San Antonio, Texas, 78216.

All circuit boards are etched and drilled

Mainframe board:	**No. TVT-1, $9.75**
Timing board:	**No. TVT-2, $5.75**
Cursor board:	**No. TVT-3, $5.75**
Page A or B board	**No. TVT-4, $5.75**
High-quality keyboard, custom remanufactured for TV typewriter use (less-encoder)	**No. TVT-5, $18.75**

A complete or nearly complete kit of parts will also be offered, but pricing depends on semiconductor availability at time of publication. Write for a complete list of available parts and prices for assembled units.