

PROJECTS—CB—HI-FI—SERVICING

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GERNSBACK PUBLICATION

build on-screen  
**TV CLOCK**  
connects to any set

HERE'S A DIGITAL CLOCK YOU CAN BUILD that displays its numerals on a TV screen. If you own any black-and-white or color TV, you can build the on-screen TV digital clock described here, available in kit form for \$29.95, and install it in your TV.

### How it works

The schematic is shown in Fig. 1. The MM5318 (IC3) is a Digital Clock IC with multiplexed BCD (Binary Coded Decimal) outputs. A transformer-powered full-wave rectifier (D1 and D2) provides an unregulated 12-volt DC output that is filtered by C1, C2 and R10. A low-voltage 60-Hz signal is fed into pin 19 of the MM5318 as the timebase signal. Line voltage transients are removed from this signal by R9, D3 and D4. Pin 13 is either connected to ground for a 12-hour display format, or +12 VDC for a 24-hour display. Switches S2, S3 and S4 are for time-setting.

The outputs of the MM5318 are fed directly to IC4, an MM5841 TV Time/Channel Generator IC. (Note: The channel display feature is not used in this project.) This IC contains counters, shift registers, ROM's (Read-Only Memories) and many other circuit functions for displaying the numerals on the TV screen. The video signal is available at pin 15 of IC4 and is applied to the TV set through C10, R14, Q3 and R15. (Specific data for this and all other IC's used in this project is available from National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, CA 95051.)

Three gates of IC1, a 74COO CMOS (Complementary-Metal-Oxide-Silicon) IC quad 2-input NAND gate, and C5, R11 and R12 form an external oscillator for the MM5841. This oscillator controls the height of the displayed digits. Another 74COO, IC2, together with C8, C9, R13 and R18, provides timing and gating to control how often and for how long the digits are displayed. Potentiometer R18 determines display interval, and S1 allows you to "call-up" the display on command.

To display the digital characters on the TV screen, the circuit must synchronize with the TV scan. This is done by connecting the TV Clock vertical and horizontal sync inputs to the proper points in your TV circuitry, as described later. Transistors Q1 and Q2 feed these synchronizing pulses to the MM5841 where they trigger outputs on pins 16, 17, 20 and 21. Trimmer R16 controls the horizontal position of the digits on the TV screen, while R17 controls the vertical position.

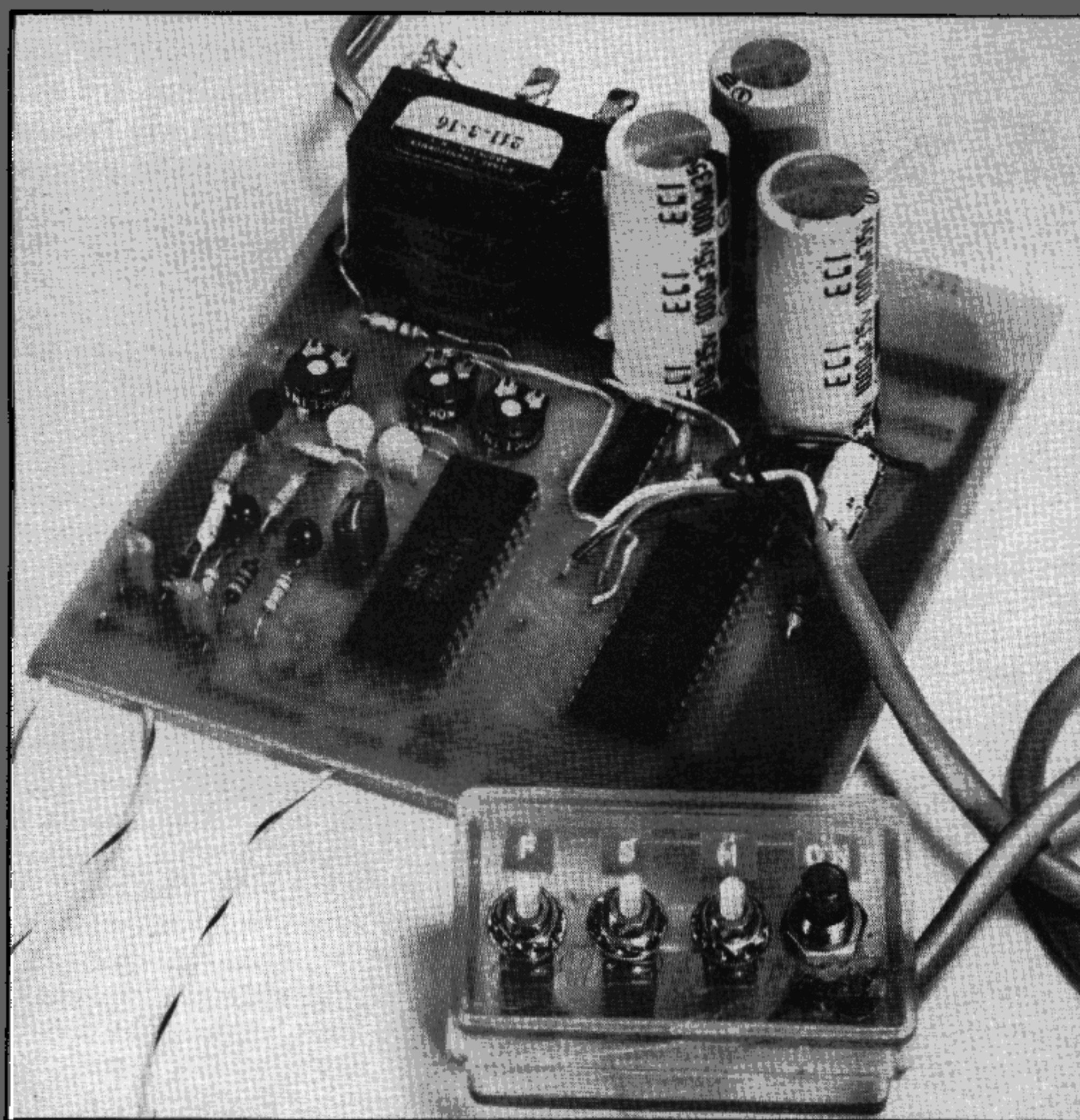
### Construction

This entire project can be built on a perforated board and hand-wired, but the circuit layout and lead lengths

# Build this Digital On-Screen TV Clock

*This digital clock displays either 4 or 6 digits of time on the screen of your TV set in either the 12- or 24-hour format*

FRED BLECHMAN



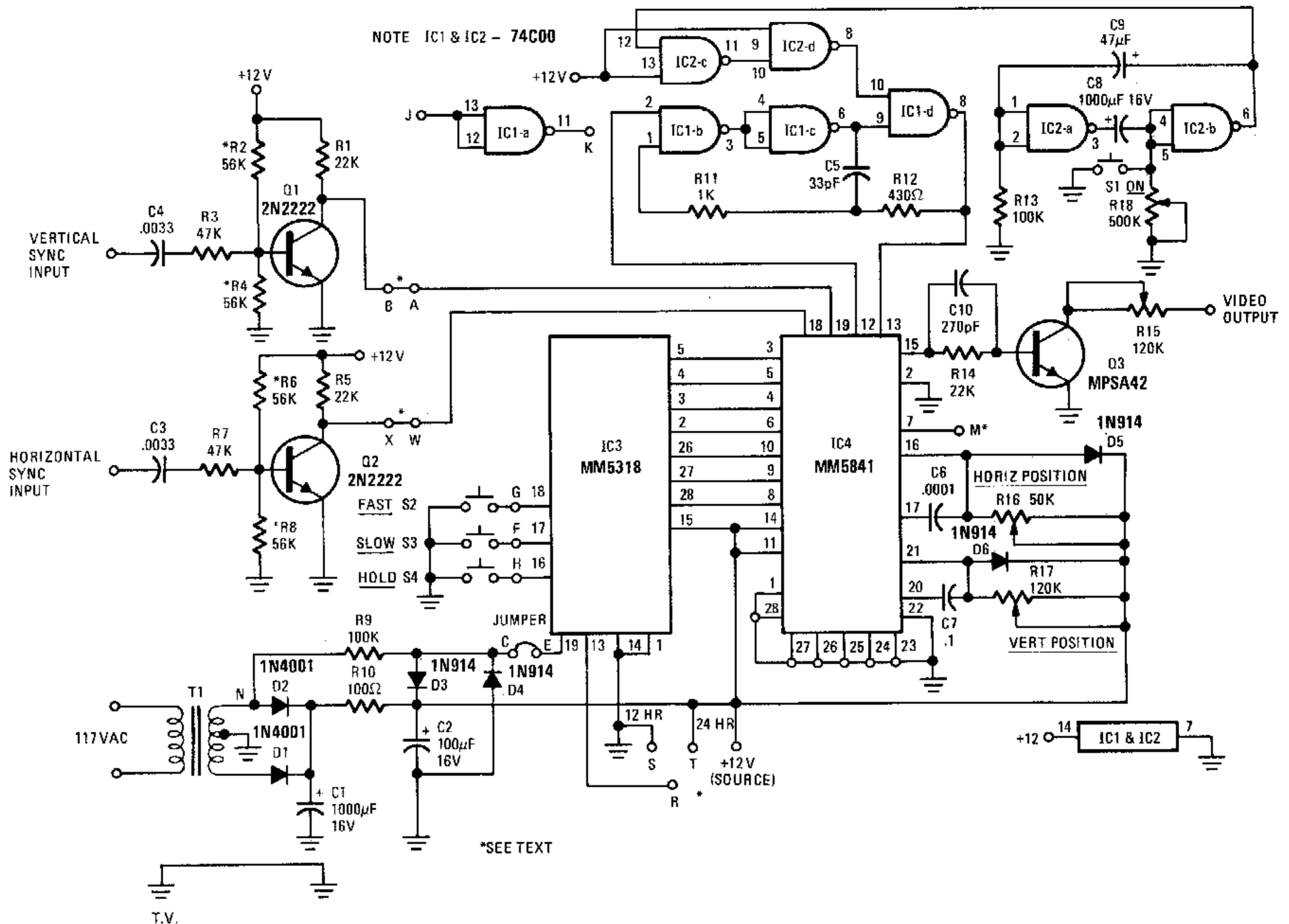


FIG. 1—ON-SCREEN DIGITAL CLOCK requires vertical and horizontal sync pulses from TV circuitry.

would be critical at these frequencies. It is better to use a printed circuit board; the foil pattern is shown in Fig. 2.

Using the PC board and the parts layout shown in Fig. 3, assembling this

project is easy. Carefully identify each resistor and be very sure to observe polarity when installing the diodes and those capacitors that are polarized. The transistors must be installed with the flat

sides as shown.

Start by installing the components on the PC board. Do not install R2, R4, R6 or R8 at this time; they will be installed later. Next mount the transformer to the PC board with two No. 6-32  $\times$   $\frac{3}{8}$  screws and nuts. Solder power diodes D1 and D2 (be careful not to confuse these with the smaller signal diodes) to the two top outside lugs of the transformer, with the cathodes (banded end) soldered into the PC board holes below. Various jumper wires are needed to complete the wiring and select options. Most jumpers are on top of the board. Run a jumper wire from the upper center transformer terminal to the PC board hole below. Also add jumper wires from the two bottom transformer terminals to the holes below them. Jumper point N on the PC board to the junction of D2 and the transformer terminal. (If your transformer is not the one specified in the parts list, you can determine the proper connections by referring to the schematic and the PC board layout.) Jumper points E and C on the PC board. Jumper IC2 pin 13 and IC2 pin 9 to +12V. There are convenient +12V holes in the board near R16 and just above C2.

On the bottom of the board, IC4 pin 11 should be jumpered or shorted to the

### R-E TRIES IT

The On-Screen TV Digital Clock was tested by connecting it to a Heathkit GR-25 color TV receiver. The performance was completely satisfactory. When first connected, the time display was located in the center of the screen. There was some de-focusing from right to left with the seconds digits as sharp as you would want, the minutes slightly out of focus and the hours badly blurred.

The positioning pots were adjusted to place the display in the upper right corner of the screen. Next, we experimented with the video output (whiteness) control to see what effect it had on the display. By backing off the control, we reduced the distortion in the display so all digits were equally sharp and bright without a trace of color.

#### Connections

After reading the input-signal requirements, we studied the wave-

forms available at various points in the GR-25 and examined the chassis for possible connecting points on the top side of the PC board. Both grids of the vertical multivibrator were driven by sawtooth waves with a fast falltime. We installed R2—as instructed in the article—and tacked the vertical sync lead on to pin 2 of the 6GF7 vertical multivibrator.

A reversed sawtooth with a fast risetime was present at the junction of the two horizontal phase detector diodes. Since this was a test point, it proved to be a convenient spot to pick up the horizontal sync signal. Resistor R8 was installed on the clock PC board as directed.

The clock's video output was fed into the set's video output circuit through test point TP7 at the output of the video amplifier. Since, in this set, this point is also connected to a terminal on the SERVICE switch, this would be an equally convenient point to feed in the video.

## PARTS LIST

All resistors are 1/4-watt, 10% or better, unless otherwise noted

- R1, R5, R14—22,000 ohms
- R2, R4, R6, R8—56,000 ohms
- R3, R7—47,000 ohms
- R9, R13—100,000 ohms
- R10—100 ohms
- R11—1000 ohms
- R12—430 ohms
- R15, R17—120,000-ohm trimmer, horizontal PC mount
- R16—50,000-ohm trimmer, horizontal PC mount
- R18—500,000-ohm, horizontal PC mount
- C1, C8—1000  $\mu$ F, 16-volt, electrolytic
- C2—100  $\mu$ F, 16 volt, electrolytic
- C3, C4—.0033  $\mu$ F, disk or Mylar
- C5—33 pF, disk
- C6—1000 pF, disk or Mylar
- C7—0.1  $\mu$ F, Mylar
- C9—47  $\mu$ F, 16 volt, electrolytic
- C10—270 pF, disk
- Q1, Q2—2N2222 or equal
- Q3—MPSA42 (Motorola) or HEP S0027
- D1, D2—1N4001 or equal
- D3-D6—1N914 or equal
- IC1, IC2—74C00 Quad 2-Input NAND Gate
- IC3—MM5318 Digital Clock (National)
- IC4—MM5841 TV Time/Channel Generator (National)
- S1-S4—SPST pushbutton switch
- T1—117-volt primary; 16 volt, 150 mA, secondary. (Signal Transformer No. 241-3-16 or equal)

The following parts are available from Interfab, 27963 Cabot Rd., Laguna Beach, CA 92677: A complete kit of parts, including PC board, for \$29.95 plus \$1 shipping. Order No. DC-12 TV Clock Module. A PC board is available separately for \$4.25 plus 50¢ shipping. California residents add state and local taxes as applicable.

printed-circuit trace (+12V) that runs between pins 11 and 12. Also, using a single bare wire that "snakes" from point-to-point, connect IC4 pins 1, 22, 23, 24, 25, 26, 27 and 28 (numbered 1-8 on the PC board) to ground near point 8.

Now you have to select some options. Do you want 4 digits (hours and minutes) or 6 digits (hours, minutes and seconds) to appear on the screen? For 4 digits, jumper point M (pin 7, MM5841) to ground. For 6 digits, jumper M to +12V. Do you want a 12 or a 24-hour display format? Jumper point R (pin 13, MM5318) to ground (point S) for a 12-hour format, or to +12V (point T) for a 24-hour display.

Four switches are used, and they can all be mounted on a single panel or in a small plastic box. Switch S1 should be readily accessible since it is used to manually call-up the display. It is a pushbutton type switch; if you want to be able to leave the clock display on for extended periods, use a slide or toggle SPST switch instead. The other switches are used for time setting and can be less

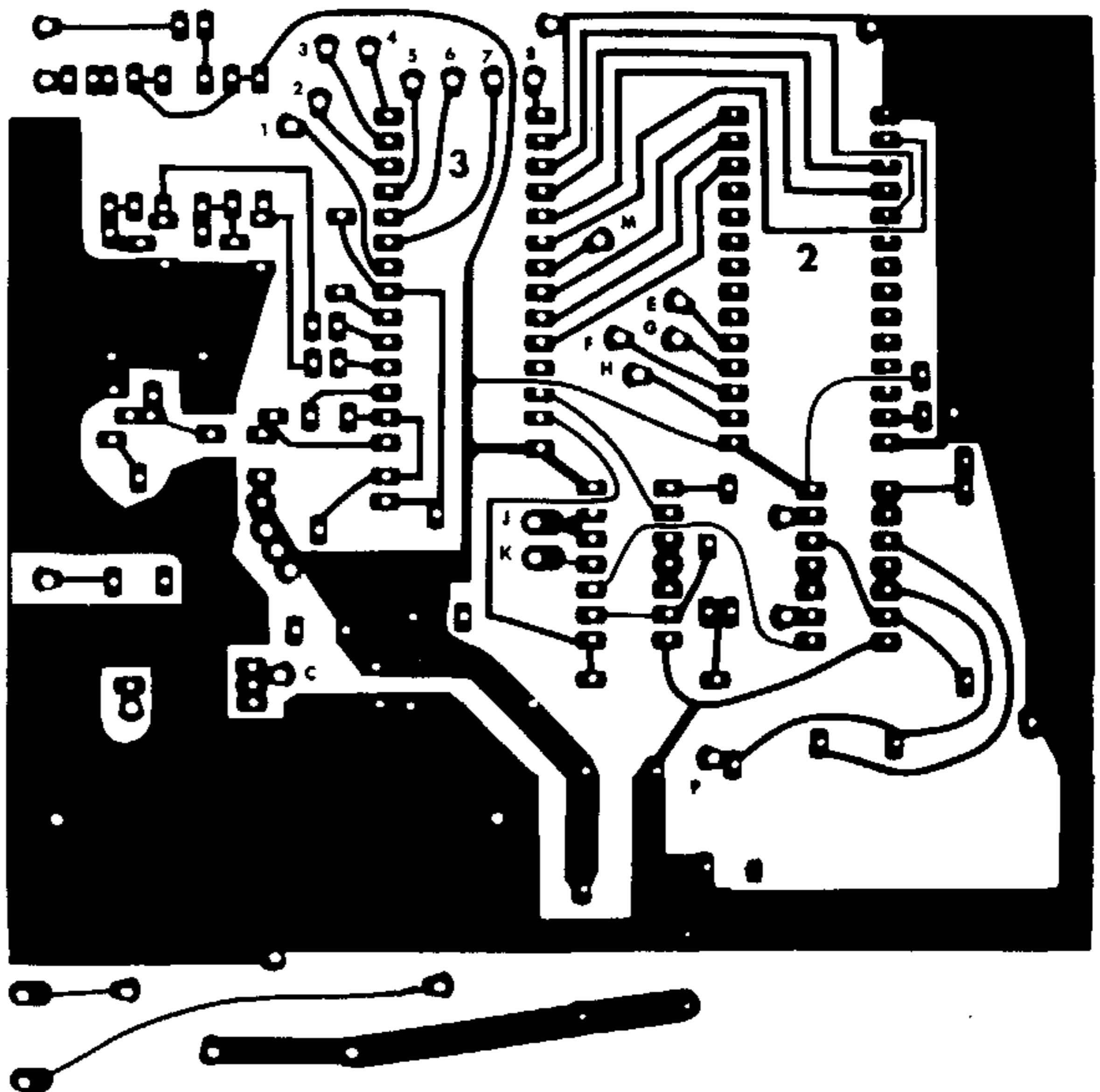


FIG. 2—FOIL PATTERN shown actual size.

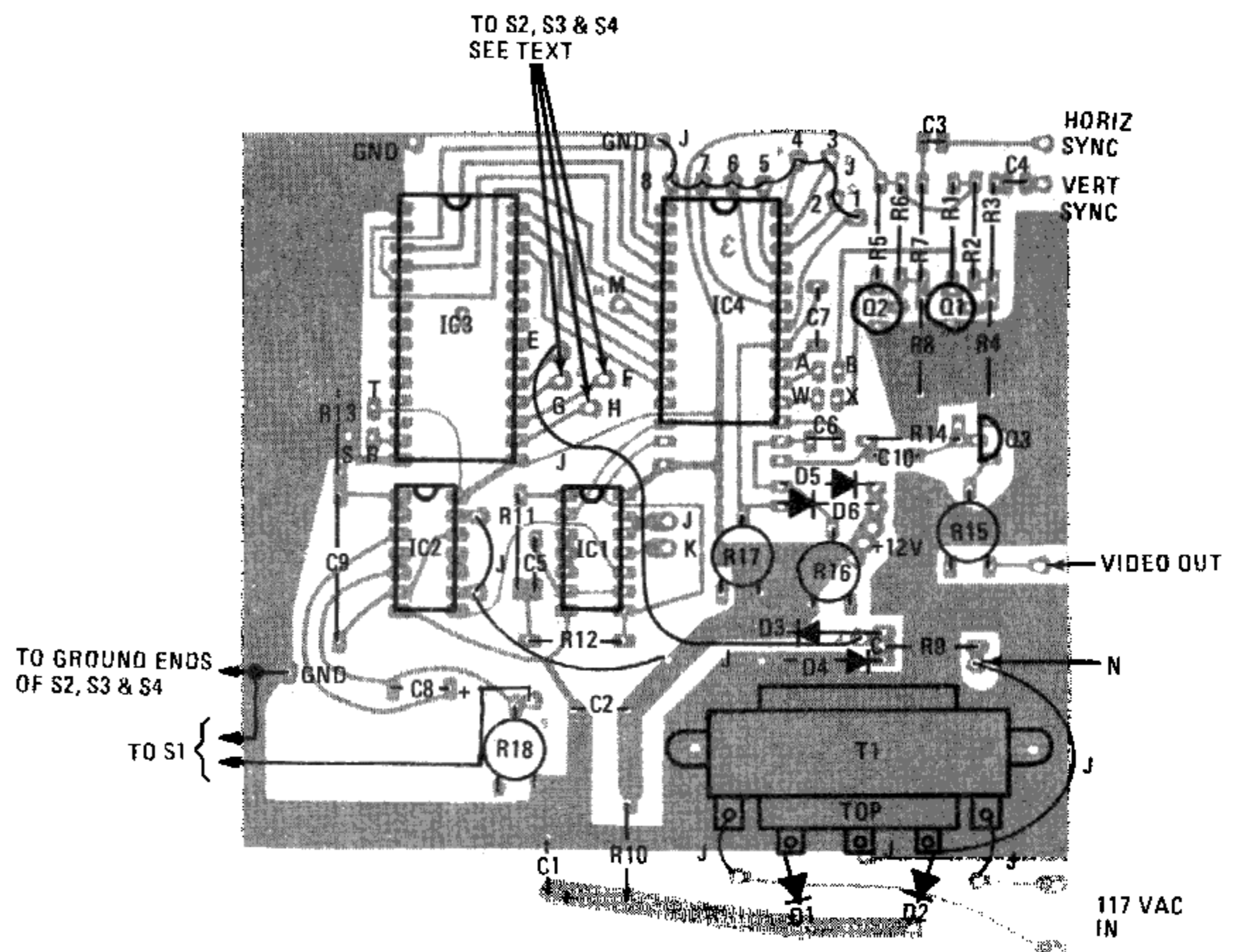


FIG. 3—COMPONENT PLACEMENT diagram.

accessible—you might even want to hide them behind a panel to prevent tampering. Using multiconductor or ribbon cable, wire one side of all switches to ground. Then wire the other switch terminals as follows: S2 to point G; S3

to point F; S4 to point H. These are pins 18, 17 and 16, respectively, of the MM5318.

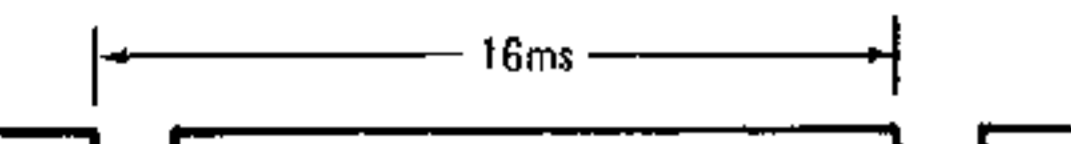
### Installation

Installing the TV Digital Clock into

your TV involves both physical and electronic connections. **Caution:** When installing this project in your TV set, remember that most TV's have a "hot" chassis wired directly to one side of the AC line. Make sure the chassis is at ground potential before you start working on it.

To begin with, you must connect the TV Clock board to a constant source of 117-VAC 60-Hz power—it must be powered even when the TV is off. You *could* do this by running a separate line cord to a wall socket, but it really makes

FIG. 4—PULSE TRAIN required at pin 19 of IC4.



Similarly, the horizontal sync is taken from the horizontal oscillator, with a typical TV circuit shown in Fig. 6. Look for a positive-going pulse with a fast risetime used for horizontal retrace, and install R8. Figure 7 shows the input needed at point W (IC4, pin 18) resulting from a signal with a fast risetime fed into C3. If you can't locate a signal with a fast risetime right away, keep looking, since there's only one spare inverter on the Clock PC board! If you used a positive-going signal for the vertical sync, then you can use a negative-going signal and inverter here, jumpering X to J and K to W, and installing R6 instead of R8. It's simpler, however, to find a positive-going horizontal signal and use R8 with a jumper

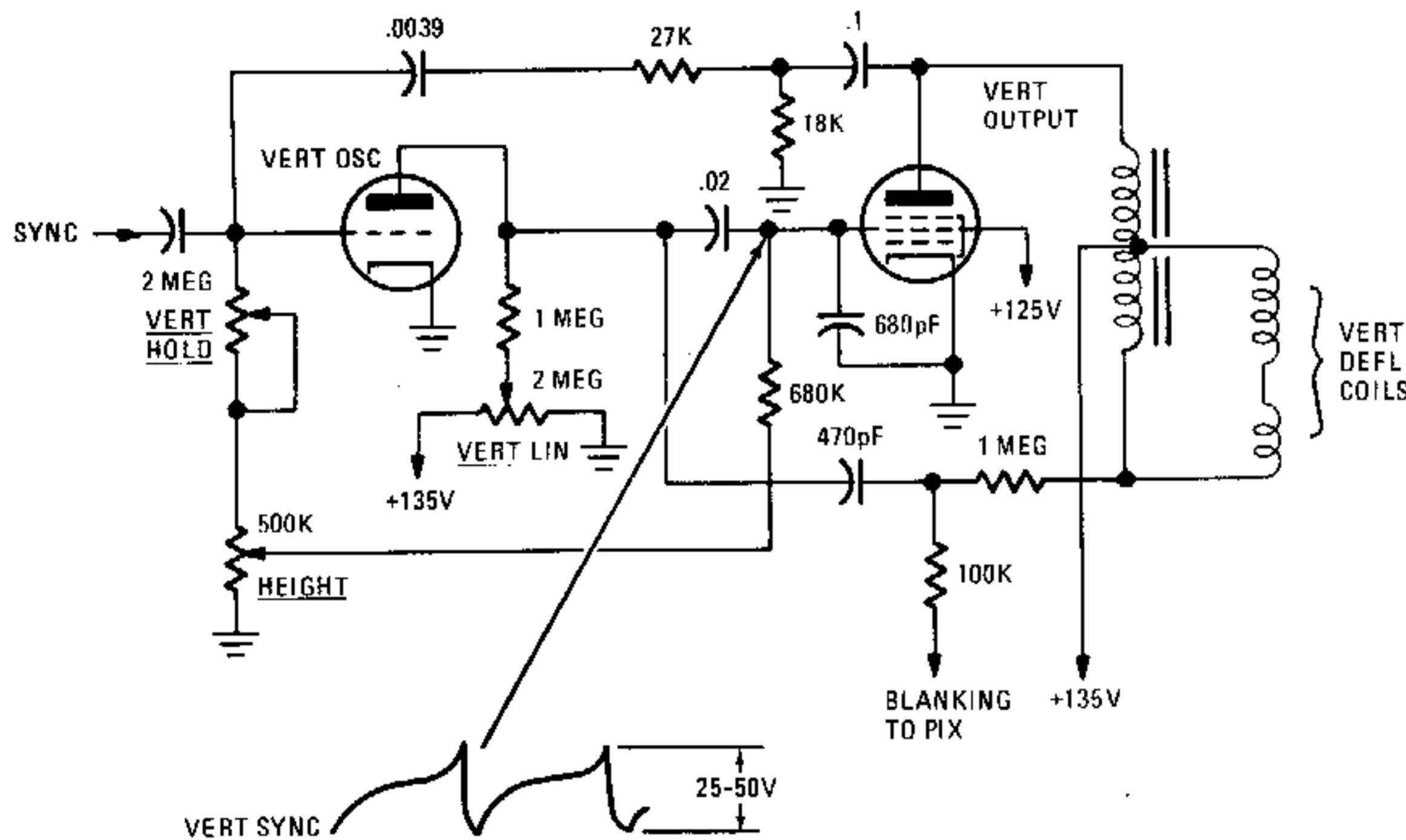
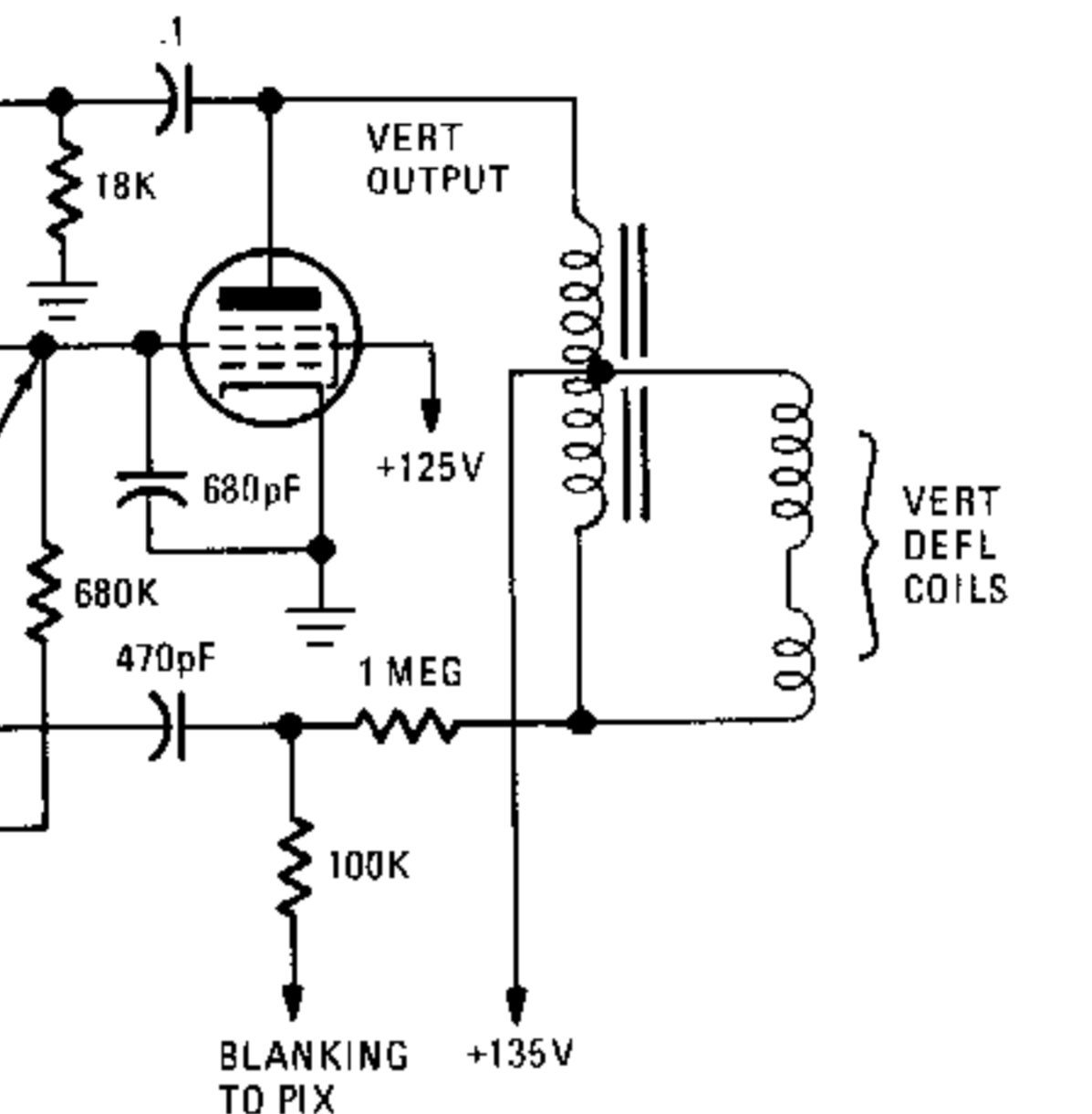


FIG. 5—TYPICAL VERTICAL AMPLIFIER showing location of vertical sync pulses.

more sense to connect the TV Clock board to the points in the TV where the AC power enters. Wire these points to the 117-VAC input pads on the TV Clock PC board. Also, be sure to connect a wire from the TV Clock board ground to the TV set ground.

Vertical sync can be taken from the vertical oscillator or vertical amplifier. You are looking for either a positive-going sync pulse with a fast risetime or a negative-going sync pulse with a fast falltime used for vertical retrace. A positive-going sync pulse requires R4 to be installed; a negative-going pulse requires R2. The pulse needed at point A (IC4, pin 19) is shown in Fig. 4. This results from a positive-going pulse fed into C4. Fig. 5 shows a typical vertical amplifier circuit. If you can't locate a positive-going pulse with a fast risetime (there's one there someplace!) and the output signal from Q1 is the inversion of the one shown in Fig. 4, there's a spare inverter section (IC1-a) at points J and K on the PC board. Use R2 and jumper B to J and K to A to invert the signal. If you find the preferred signal with a fast risetime, use R4 and jumper B to A directly.



### Using the TV Clock

With the TV set in operation, press switch S1. The digital time should appear somewhere on the screen for approximately 4 to 6 seconds, as determined by the time constant of R13 and C9. The time will appear automatically every 1 to 8 minutes, determined by C8 and the setting of potentiometer R18. Adjust R18 to a comfortable interval. To adjust the location of the display on the screen, hold down S1 and adjust

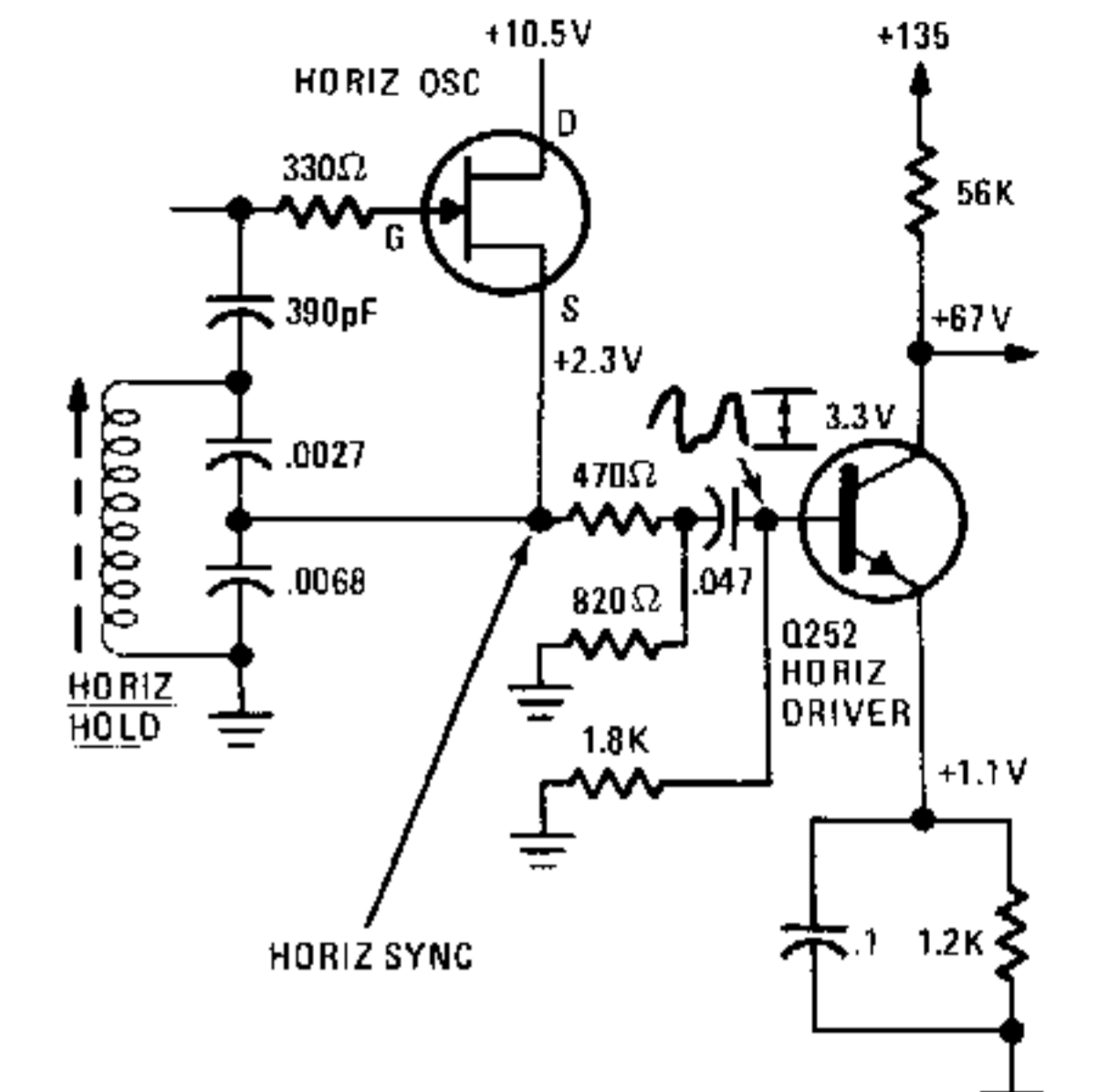


FIG. 6—TYPICAL HORIZONTAL OSCILLATOR showing location of horizontal sync pulses.

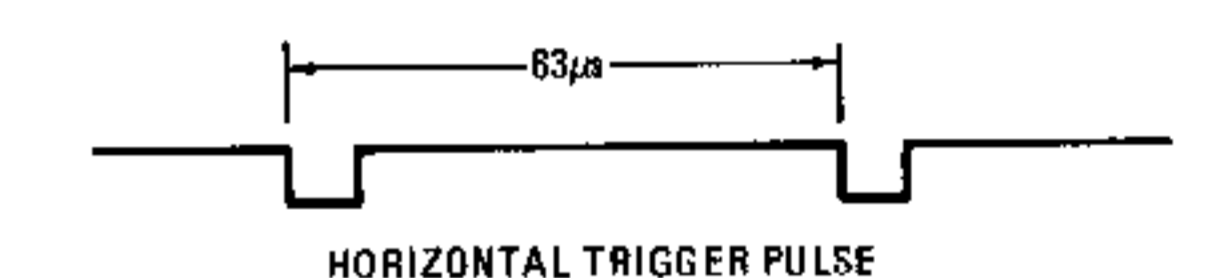


FIG. 7—PULSE TRAIN required at pin 18 of IC4.

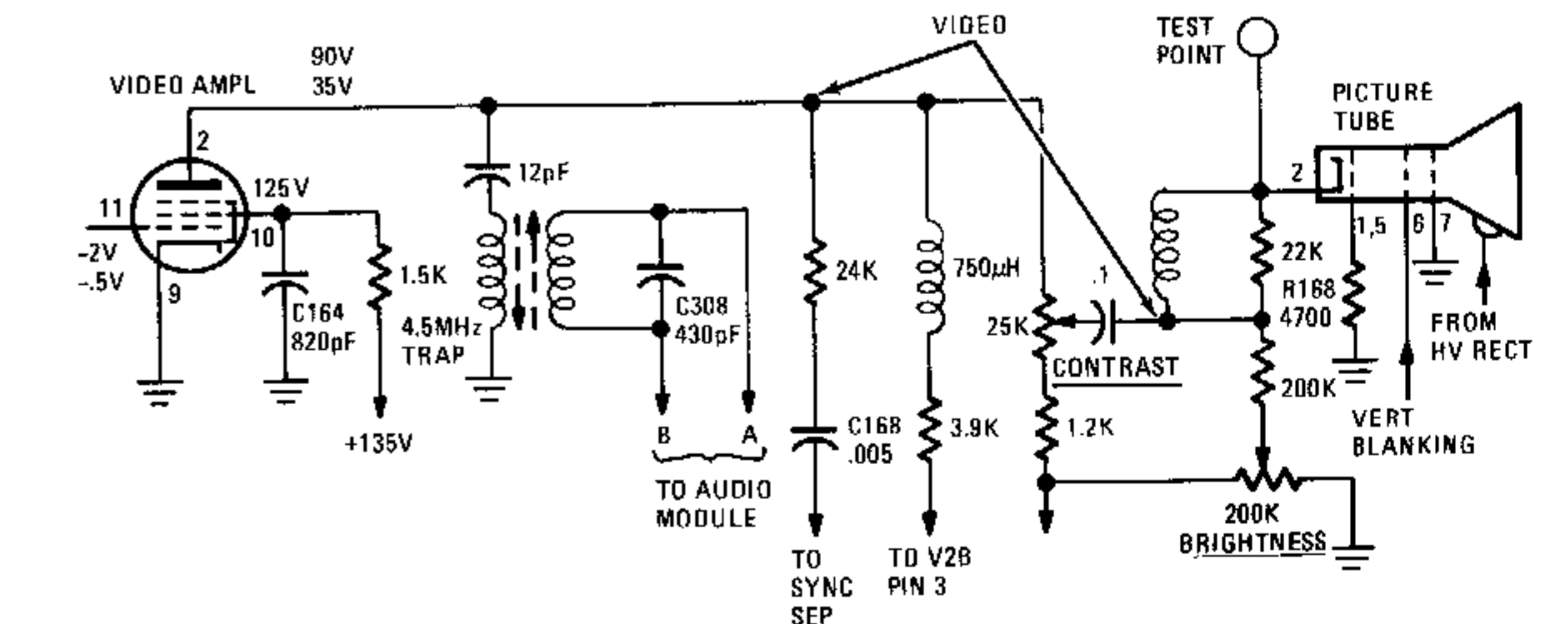


FIG. 8—TYPICAL VIDEO AMPLIFIER showing points where video from clock can be inserted.

directly from X to W, and ignore the spare inverter.

Now check your TV to see if it's operating normally and that no distortion is present as a result of this conversion.

The video output of the TV Clock circuit can be connected to the plate of the video amplifier or even on the brightness control. A typical video amplifier circuit is shown in Fig. 8. Use an oscilloscope to select a point where white images are noted by a decrease in voltage. The point of the tie-in should not have a DC voltage greater than 250 volts.

potentiometer R17 to control the vertical position of the display, and potentiometer R16 for the horizontal position. The brightness (whiteness) of the display is adjusted by R15.

To set the time, use a known time standard, such as the number provided by your phone company. Pressing S2 advances the hours once a second, pressing S3 advances the minutes once a second, and pressing S4 "freezes" the display until it's released. Simply advance the time slightly ahead of real time, and depress S4 to hold the count until the real time "catches up" with the displayed time.

R-E