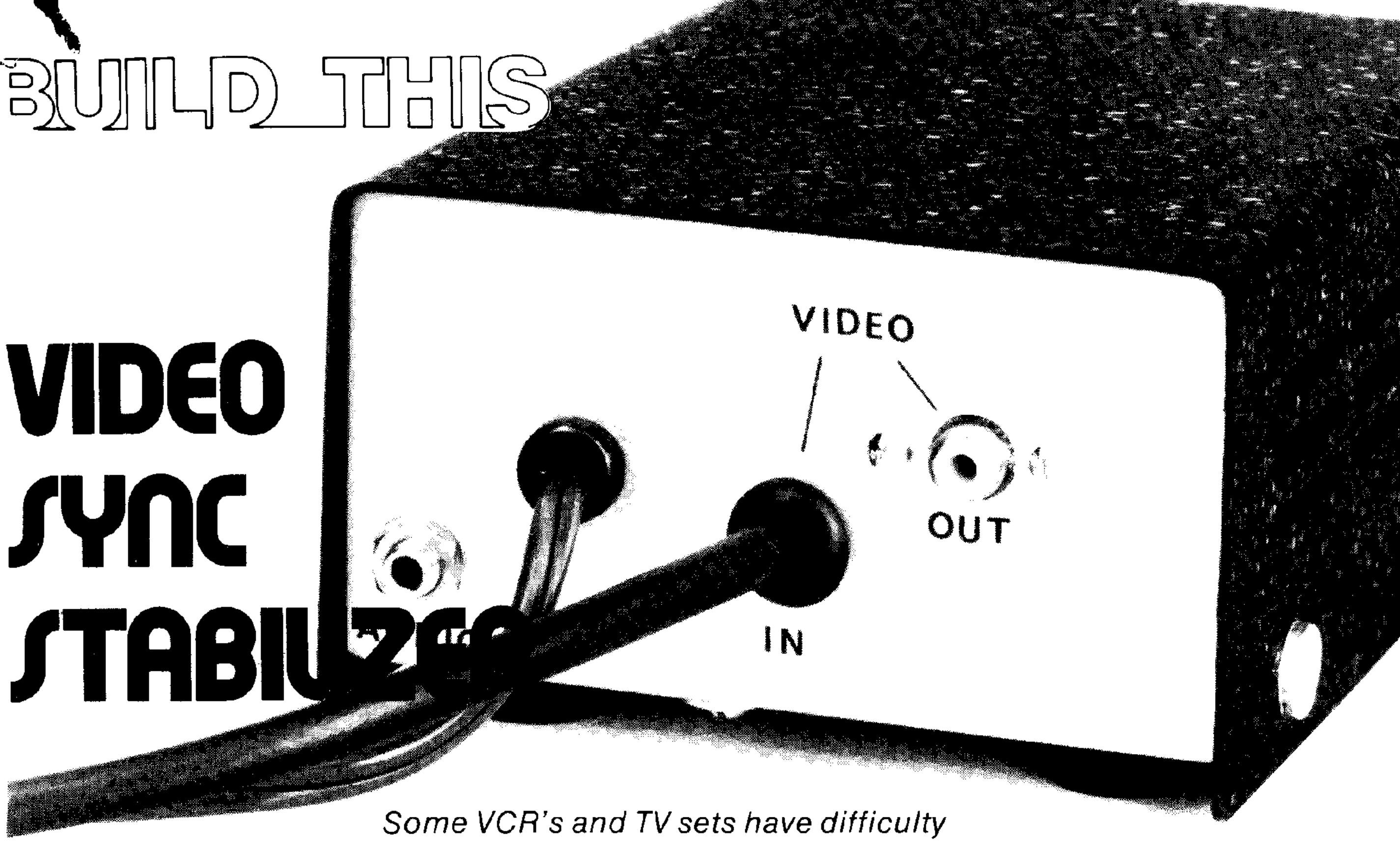
VIDEO SYNC STABILIZER



Some VCR's and TV sets have difficulty in playing back certain videotapes. This sync corrector will eliminate that problem.

GENE ROSETH

THE LAST FEW YEARS HAVE SEEN A REVOLUTION in home-TV entertainment as video cassette recorders (VCR's) and the program material available for them have proliferated.

A problem that has plagued many VCR users has been picture instability, in the form of vertical roll. It afflicts many of the older VCR's and *newer* TV receivers—the ones without external vertical or horizontal-hold controls. This can also occur when viewing prerecorded videocassettes that have been recorded using a system to prevent tape duplication. The instability is generally caused by a distortion of the vertical-sync pulse and, to say the least, is an annoyance.

The device described here will reconstitute distorted vertical-sync pulses and eliminate the vertical-roll problem. It can be built in two different versions: The first is a baseband-video unit that performs the sync-correction and outputs a video signal. It can be used only in video-to-video applications—it does not provide an RF signal.

The second version incorporates an RF modulator and outputs the corrected video (and the audio, as well) on VHF Channel 3 or 4. Feed the RF signal to your TV and glitch-free viewing is yours. Furthermore, this version can be used with a TV camera or computer to turn your TV set into a monitor.

Construction of the stabilizer is simple, and alignment can be done with only a voltmeter (although an oscilloscope is helpful).

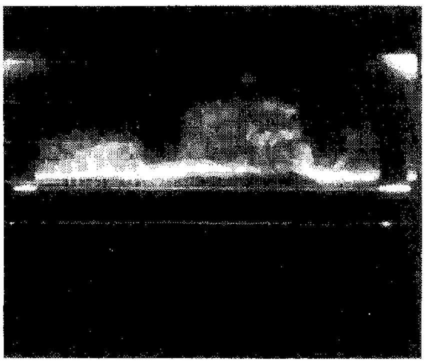


FIG. 1—ONE VIDEO FIELD. Vertical blanking-intervals are visible to right and left of video "fuzz."

A little background

Let's begin with a look at a video signal. Figure 1 shows one field of video (our system uses 60 fields per second). Most of what can be seen (the "fuzz") is picture information and will be different for each field. At 60 fields per second, the individual fields blend into a continuous, smoothly changing display on the screen. There is one element of the field, though, that does not change—the sync pulses.

At the left and right ends of the scope trace there is a short, flat area that contains no picture information, but just a short negative-going pulse. That portion of the signal is termed the vertical blanking-interval. We'll talk more about it momentarily. There are also other sync pulses (called horizontal sync pulses, and occurring 15,734 times per second) in addition to the vertical blanking-intervals. Since they are of very short duration, they do not show up well in Fig. 1. The purpose of the sync pulses is to match the timing of a TV receiver to that of a video source (VCR, camera, off-the-air signal, etc.).

The vertical blanking-interval can be seen more clearly in Fig. 2. It is at the center of the screen, with picture information to its right and left. The horizontal sync pulses can now be seen as well—their tips appear as two rows of dots below the picture information and the vertical blanking-interval. The negative-going pulse within the blanking interval is the vertical-sync pulse, and it is this that can cause picture instability if it is not recorded properly.

Circuit description

A circuit to correct distorted vertical-sync pulses is shown in Fig. 3. It contains two isolated video buffer/amplifier stages, Q1 and Q2, and a vertical-sync detection and regeneration subsection that adds a stable vertical-sync pulse to the composite-video signal through diode D6.

In operation, the clamped video (with the sync tips at +5 volts) is passed through buffer/amplifier Q1-Q2 and is simultaneously applied to pin 5 of IC1-a (one-fourth of a CA339 quad comparator). Pin 4 of that comparator is biased a few tenths of volt above the clamp level: that causes a positive-going pulse to appear at pin 2 every time a sync pulse occurs.

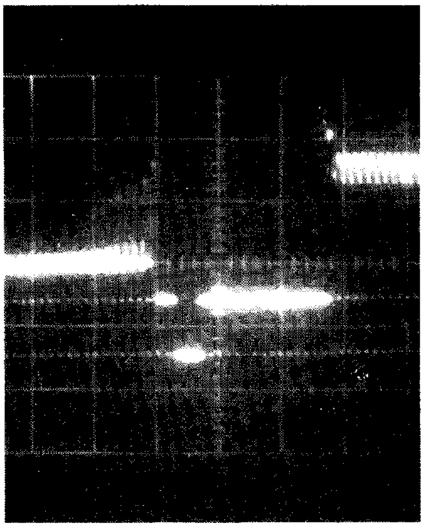


FIG. 2—EXPANDED VIEW of vertical blanking-interval showing vertical-sync pulse. Blips indicate tips of horizontal-sync pulses.

Resistor R5, R6, and capacitor C2 form an integrator circuit that allows the horizontal and vertical sync pulses to be distinguished from one another. The bias at pin 7 of IC1-b sets the level at which that will take place and a negative-going pulse occurs at pin 1 of that IC only when a vertical-sync pulse is present.

Another section of the quad comparator, IC1-c, is configured as a one-shot with a time constant of about 180 microseconds (the same as the vertical-sync pulse interval). The pulse generated is inverted by IC1-d and its amplitude adjusted by R14, after which it is mixed with the original video signal through D6. The result is a signal with a vertical-sync pulse of the proper strength and duration that "fills in" any gaps in the original signal.

RF modulator

The modulator shown in Fig. 4 will allow you to combine the audio and corrected video from the VCR and display them on your TV set using channel 3 or channel 4.

Most of the work is done by IC3. All that has to be added is an RF tank-circuit to determine the RF-carrier frequency, an audio tank-circuit for the FM audio-subcarrier, and a bias circuit. The RF tank-circuit is made up of L1 and C10; adjusting L1 allows the carrier to be tuned to either Channel 3 or Channel 4.

The audio tank-circuit uses L2 and C7 to generate a subcarrier 4.5 MHz above

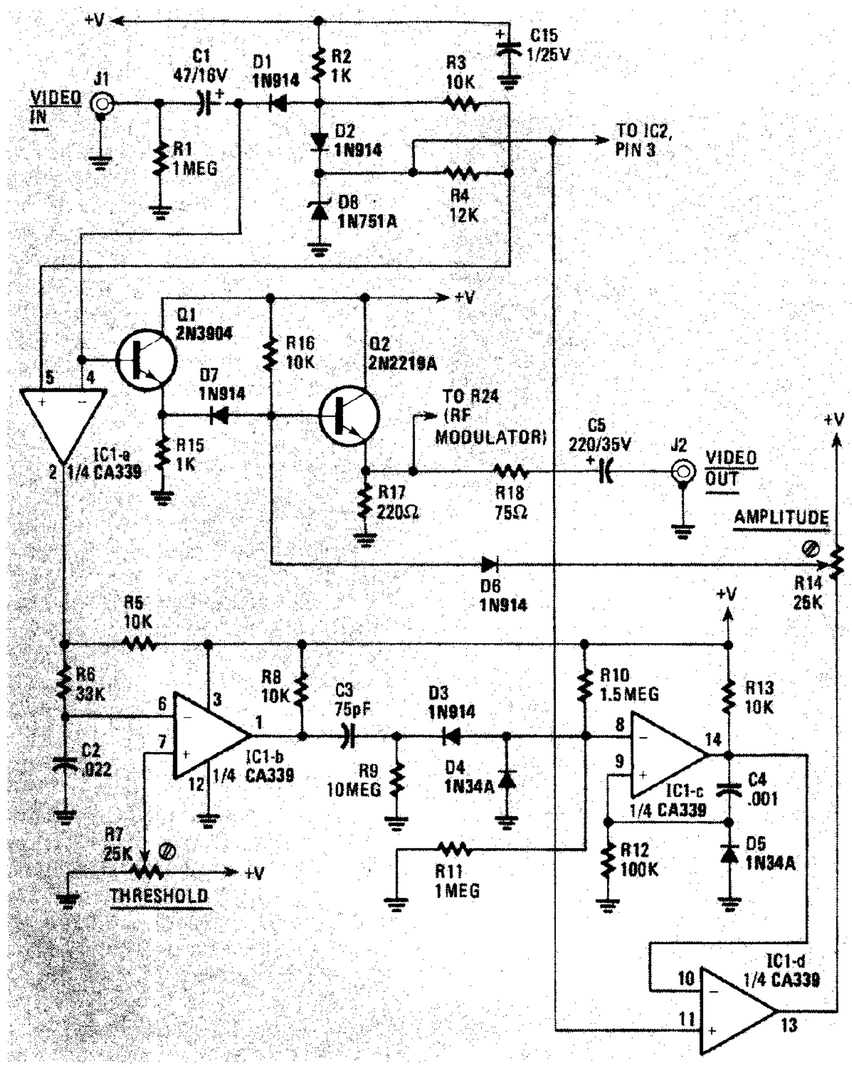


FIG. 3—DETECTION AND REGENERATION of vertical-sync pulse are performed by IC1.

PARTS LIST

All resistors 5%, ¼-watt
R1, R11—1 megohm
R2, R15, R30—1000 ohms
R3, R5, R8, R13, R16, R20, R32—10,000 ohms
R4—12,000 ohms
R6, R21—33,000 ohms
R7, R14—25,000 ohms, trimmer potentiometer
R9—10 megohms
R10—1.5 megohms
R12, R19—100,000 ohms
R17, R27, R28—220 ohms
R18, R29, R31—75 ohms
R22, R23—15,000 ohms
R24—2200 ohms
R25—1000 ohms, trimmer potentiometer
R26—100 ohms
Capacitors
C1—47 µF, 16 volts, electrolytic
C2—.022 µF, Mylar
C3, C10—75 pF, dipped silver mica
C4, C11—.001 µF ceramic disc
C5—220 µF, 35 volts, electrolytic
C6, C15—1 µF, 25 volts, tantalum
C7—100 pF ceramic disc
C8—.01 µF, Mylar
C9—22 pF ceramic disc
C12, C13, C16—0.1 µF, Mylar
C14—470 µF, 25 volts, electrolytic
Semiconductors
IC1—CA339 quad comparator
IC2—741 op amp
IC3—LM1889 video modulator
IC4—7812 twelve-volt regulator
Q1—2N3904
Q2—2N2219A
Q3—MPSA05
D1–D3, D6, D7—1N914
D4, D5—1N34A
D8—1N751A 5.1-volt Zener
BR1—full-wave bridge rectifier, 1 amp, 50 volts
T1—12.6 volts, 300 mA, PC-mount (Radio Shack 273-1385 or equivalent)
L1—.071–.082 µH (J.W. Miller 48A778MPC or equivalent)
L2—7–12 µH (J.W. Miller 23A105RPC or equivalent)
F1—¼amp, 3AG pigtail fuse
Miscellaneous: PC board, enclosure, hardware, connectors, optional vestigial-sideband filter (Plessy SW300), etc.

The following are available form JENGCO, 3232 San Mateo NE, Suite 75, Albuquerque, NM 87110: KRF-1—kit including etched, drilled, and plated PC board and all board-mounted components, $65.00; KRF-2—PC-board only, $15.00; KBBV-1—same as KRF-1 but without RF modulator (for video-to-video applications only), $42.00; KBBV-2—PC board only, $13.00. Kits do not include cables, hardware or connectors. Please add 5% for postage and handling; NM residents add 4% sales tax. Please allow six weeks for delivery.

the video carrier. This circuit is shunted by the base-collector capacitance of Q3. The audio input is buffered and amplified by IC2, and then applied to Q3 which acts as a varactor diode in parallel with C7-L2. (You can use a regular varactor diode in place of Q3, but may have to change the value of R21.)

The audio subcarrier and the corrected video are applied in the proper ratio to pin 12 of IC3. Resistor R25 supplies bias for the IC, and affects both the degree of modulation and the level of the RF carrier.

The output of IC3, from pin 10, is attenuated by R30 and R31, and then coupled to the RF-output connector by C13.

Capacitor C13, at the output jack, can be either a capacitor *or* a vestigial sideband SAW (*Surface Acoustic Wave*) filter. The filter eliminates the lower sideband of the TV signal and helps prevent adjacent-channel interference. Normally it is not needed, but should you experience interference problems, you may want to include it (see the "Construction" section).

Finally, as designed, the RF output is intended to match 75-ohm coaxial cable (RG-59). If you prefer to use 300-ohm twin-lead, change the value of R31 to 300 ohms.

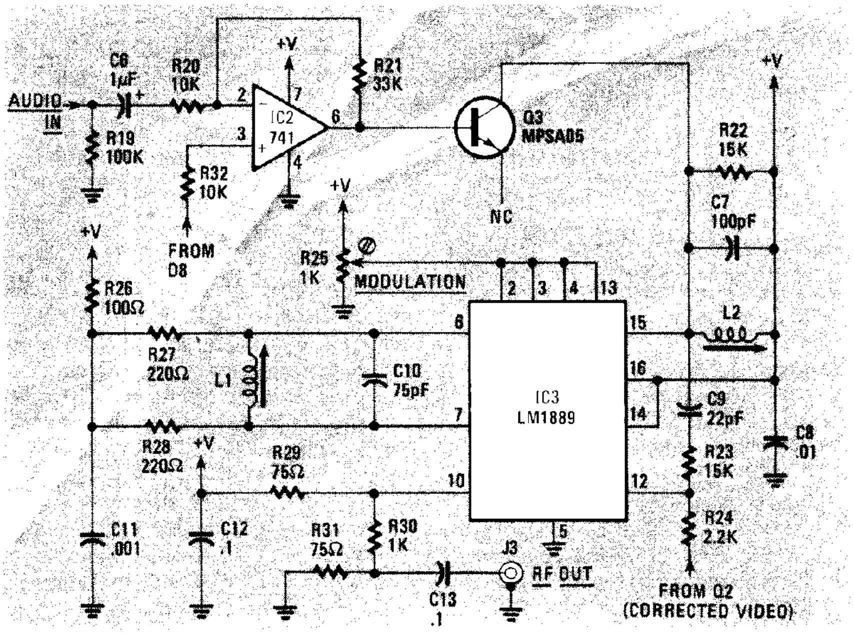


FIG. 4—RF MODULATOR. Capacitor C13 at RF OUT jack may be replaced by vestigial-sideband filter if desired (see text).

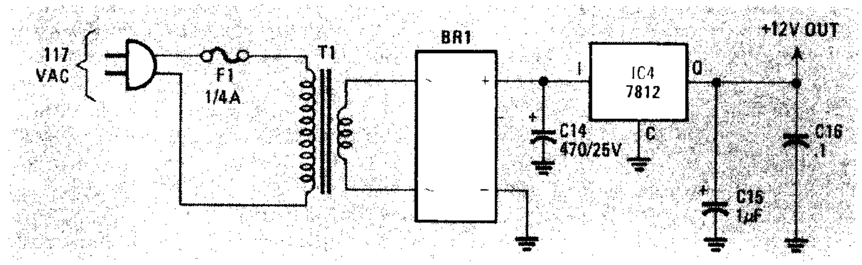


FIG. 5—SIMPLE 12-VOLT POWER SUPPLY is constructed on same PC board as rest of circuit.

Power supply

The power supply (Fig. 5) is of conventional design and is wholly contained on the same PC board as the rest of the circuit, making construction easier. A 7812 positive 12-volt regulator, IC4, supplies power for both the sync-corrector and RF modulator sections of the circuit.

Construction

Because lead length and layout are critical, wire-wrapping or point-to-point wiring techniques are not recommended for this circuit. A foil pattern is provided in Fig. 6 and a board is available from the source shown in the Parts List. A parts-placement diagram is shown in Fig. 7. Note that the section of the board to the right of the dashed line is used only for the RF modulator and may be omitted if a baseband video unit is required; the board could be reduced in size by about 25%.

When installing the polarized components (diodes, IC's, electrolytic capacitors, etc.) make sure they are oriented properly. That is especially true for the power transformer. It's also a good idea to put a piece of heat-shrink tubing over the pigtail fuse to reduce the possibility of getting a shock during the alignment procedure.

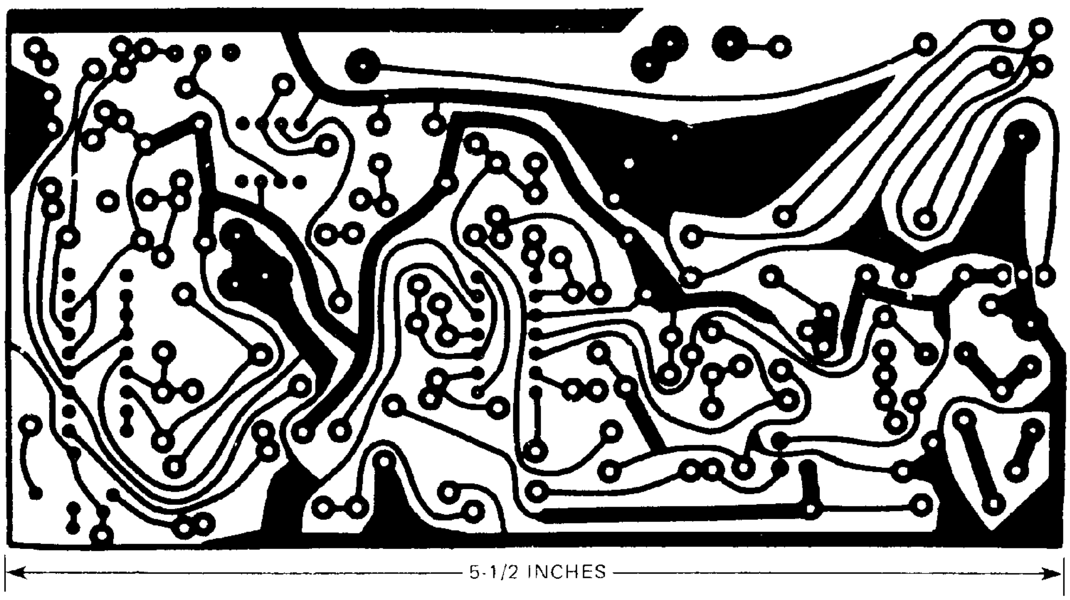


FIG. 6—SINGLE SIDED PC BOARD contains sync corrector, RF modulator, and power supply.

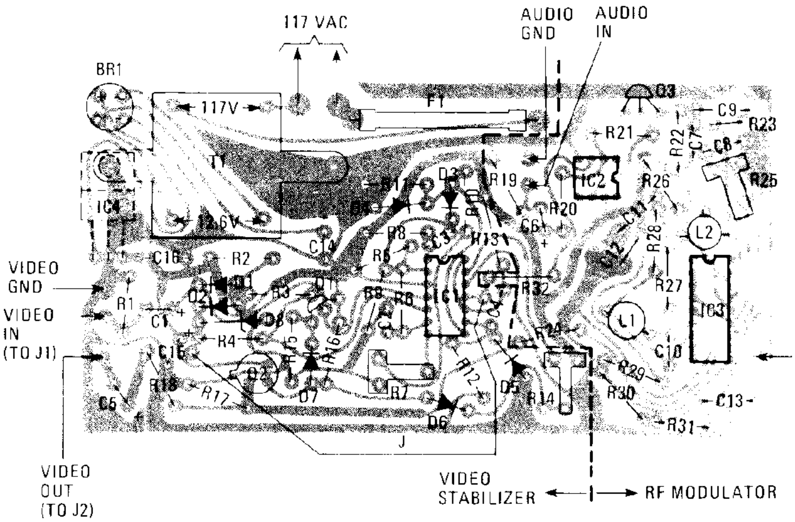


FIG. 7—REGULATOR IC4 mounts on *bottom* of board with tab away from it (see text). Area to right of dashed line contains RF-modulator circuit.

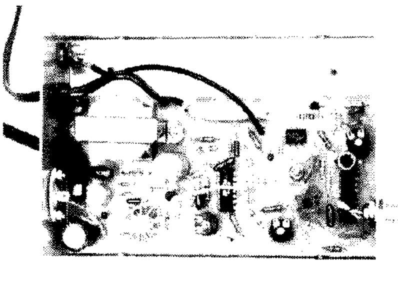


FIG. 8—VIDEO INPUT CABLE can be connected directly to board if desired. Audio jack is RCA phono-type; RF output uses "F" connector.

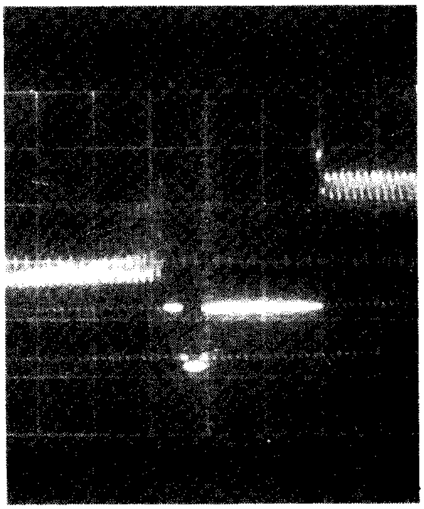


FIG. 9—CORRECTED VERTICAL-SYNC signal. Note extra amplitude added to tip of sync pulse.

Mount Q2 a little more than ⅛-inch above the PC board to allow its heat sink to clear adjacent components. The heat sink is not an absolute necessity, but serves to add some operating margin to the design.

To heat-sink the voltage regulator, IC4, mount it on the *bottom* of the board and then bend it over so its mounting hole aligns with one of the transformer's. Place a short spacer—about ¼ inch—between the tab of the IC and the board and pass the mounting bolt through the aligned holes so that the IC lies flat on the floor of the enclosure. The enclosure will then serve as the regulator's heat sink.

The 75-ohm RG-59 video-input line can be connected directly to the board, if desired, eliminating the need for J1. For best results keep it short—less than 1½ feet. The output line can be of any reasonable length.

Mount the PC board on spacers in a metal cabinet; add the appropriate input and output connectors, and the power cord.

If you intend to use the vestigial sideband filter, proceed as follows: Remove R31 and R30, and replace R30 with a jumper. Remove C13 and insert the filter in its place. The Plessy SW300 filter has about 20 dB of attenuation at midband, so the RF-output signal level will remain approximately the same as before (2 mV).

The completed board is shown in Fig. 8.

Checkout and alignment

This procedure assumes that you have included the RF modulator on your board. If not, disregard the portions that do not apply.

Apply power to the unit and insure that the 12-volt supply voltage is present at the output of the regulator. Use a meter or scope to verify that this voltage is present at several spots throughout the circuit, such as the IC supply-voltage pins. Also check for 5-volts DC at the cathode of Zener diode D8. (If the voltages are incorrect, D8 is probably installed backwards.)

Now turn R7 (THRESHOLD) fully clockwise and R14 (AMPLITUDE) fully counterclockwise. Adjust R25 until you read about seven volts at pin 2 of IC3. When you're satisfied that all the voltages are correct, you're ready to start the alignment procedure.

You'll need a video source to perform the alignment. That can be your VCR, a video camera, or any other video-generating device. If you use a VCR, make sure that it is supplying a clean, noise-free signal. Connect the video source to the video input of the sync corrector.

If you're using a scope, connect it to pin 1 of IC1 and adjust R7 until the display resembles the top trace of Fig. 9. The negative-going pulses should be about two milliseconds in duration.

If you are using a meter, connect it to pin 1 of IC1—it should read close to zero volts. *Slowly* turn R7 counterclockwise. At some point, the voltage should jump up to about 10 volts. As soon as that happens, stop turning R7—it's now correctly adjusted.

The AMPLITUDE pot, R14, can be adjusted by trial-and-error using a videotape with distorted sync (such as a rental movie) as a video source. If you don't have a scope, turn R14 about ⅔-turn clockwise (approximately its correct setting), jump ahead to the RF-modulator alignment, and return to this step last.

You can set R14 most accurately by connecting a scope to the video output (emitter of Q2) and observing the vertical-sync pulse. Most general-purpose scopes will not lock onto the composite-video signal due to its complex shape. These tips may help: Try using the scopes LINE SYNC position—the frequency of the vertical blanking-interval will either be locked to, or very close to, the 60-Hz power line frequency. If the scope has a trace expander (i.e. 5× or 10×), do the following: Trigger the scope's sync with the signal present at pin 1 of IC1; set the sweep rate at about 2 ms/division; expand the trace, and then adjust the trace's horizontal position until a vertical blanking-interval comes into view. (That is how the display shown in Fig. 2 was obtained.)

Once you have a good display, adjust R14 until the trace looks like the one shown in Fig. 9. Notice that it is exactly like the "ideal" trace in Fig. 2 except for the small addition to the peak of the sync pulse. Be sure you have that extra amplitude, because it will insure proper switching of diodes D6 and D7 when portions of the vertical-sync pulse are missing.

You are now ready to align the RF modulator. Leave the video signal connected to the input of the sync corrector and connect the RF output to the antenna terminals of your TV set. Use an impedance-matching transformer (balun) if necessary. Tune the set to Channel 3 or 4—whichever's not used in your area—and disable the set's AFT (*A*utomatic *F*ine *T*uning) if possible.

Use a non-conductive tuning wand to adjust L1 until you observe some sort of picture on the TV screen. Adjust R25

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(MODULATION) and L1 alternately until you get the best picture quality you can. Now you can bring in the sound by adjusting L2. The two coils and R25 are interactive. so you may have to readjust them several times to get the best results.

If you have been working without a scope. now is the time to return to R14 and carefully adjust it for the best and steadiest picture from the distorted tape you've been running (this stage had to wait until the RF modulator was adjusted so you could refer to the picture on the TV screen). As you turn the pot. the picture should suddenly "lock in. Stop at that point-if you go farther. the regenerated sync pulse may be too strong and interfere with the rest of the signal.

Should you run into any problems in performing the alignment. go back and check your work-especially for poor solder joints and solder bridges. and for the proper component-orientation. Also try readjusting R7 and R 14 slightly.

If the circuit seems to be working properly but you are still having problems with vertical roll. try increasing the value of R 12 to 150K or 220K. That will widen the vertical-sync pulse farther. and should lock-in even the most stubborn TV set. R-E