Video modulator, with its 10-mc bandwidth, produces crisp, top-quality pictures on any good receiver. With suitable changes in rf system, it can be adapted to ham TV.

BUILD A VIDEO MODULATOR FOR CCTV

Low-cost video modulator makes it possible to use any closed-circuit TV camera with any ordinary home TV set

By EARL T. HANSEN

This TV modulator is the connecting link between a closed-circuit TV (CCTV) camera and standard television receivers. With it, the receivers need no internal modification. The modulator will feed several receivers along several hundred feet of transmission line. Crystal carrier control makes it extremely stable.

The bandwidth of the modulator exceeds that of standard receivers and of most cameras. The standard video signal of approximately 1 volt peak-to-peak, terminated in 75 ohms, is more than adequate to drive the modulator.

Tubes rather than transistors were used to keep the cost down. The small size and low power consumption of transistors were of no importance in the planned use. The tubes are operated conservatively for maximum life.

The modulator described here is a thoroughly debugged design. Several units are in operation. With each one, the design was changed to improve performance, simplify adjustment, and reduce the number of parts and cost.

V1 is a conventional overtone crystal oscillator, driving frequency multiplier V2. The output of V2 is coupled to push-pull grid-modulated amplifiers V3 and V4. V6 is a video amplifier and inverter. Its gain is controlled by varying the cathode degeneration (R11). The gain is variable from approximately 5 to 15. The dc component of the video signal (black reference) is restored by clamping in the grid circuit of V3 and V4. The grids conduct on the positive-going sync pulse tips and establish a charge on C11 which sets the sync pulse tips to maximum carrier amplitude regardless of average picture brightness. This effectively restores the dc level.

The power supply is a simple choke-input type. This lowers the dc voltage to the desired value and assures good load regulation at 250 volts for the output stage. Lower voltages for other stages are provided by series dropping resistors and decoupling capacitors. A diode in the rf output circuit provides a convenient test point (J2) for tuning (with a vtvm) and checking video modulation (with a scope). The low-value load resistor (R13, 1,800 ohms) on V6 and series peaking coil L4 extend the video bandwidth to approximately 10 mc.

The video input circuit was designed for a *high-impedance loop-through*. The signal from the coax cable goes in J5 and out J6 via coax, and is used or terminated in another part of the closed-circuit system. If you don't expect to need this feature, omit J6 and use R17 to terminate the line properly inside the modulator.

FREQUENCY AND COIL DATA FOR THE VIDEO MODULATOR

Channel	Video freq.	Crystal freq.	Approx. no. of turns L1	L2	L3
2	55.25	27.625	14	10	14
3	61.25	30.625	13	9	13
4	67.25	33.625	13	9	13
5	77.25	38.625	12	9	12
6	83.25	41.625	12	8	12
7	175.25	43.812	12	4	6½
8	181.25	45.312	12	4	5½
9	187.25	46.812	11	4	5½
10	193.25	48.312	11	4	5½
11	199.25	49.812	10	4	5½
12	205.25	51.312	10	3	4½
13	211.25	52.812	9	3	4½

Crystals (3rd- or 5th-overtone type) available from International Crystal Co., Texas Crystals, and others.
Feedback winding on L1 and secondaries on L2 and L8 are same for all channels.

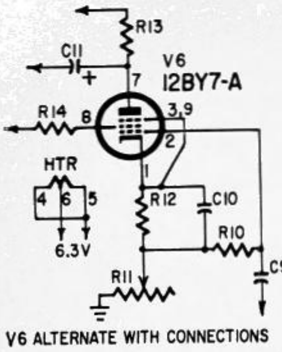
Construction and adjustment

Most component values are not at all critical and good judgment will allow wide deviation. But good layout and short leads are essential in the rf circuitry. I selected channel 10, but your choice will depend on channel allocations in your location. See the table for information on coils and crystal frequencies.

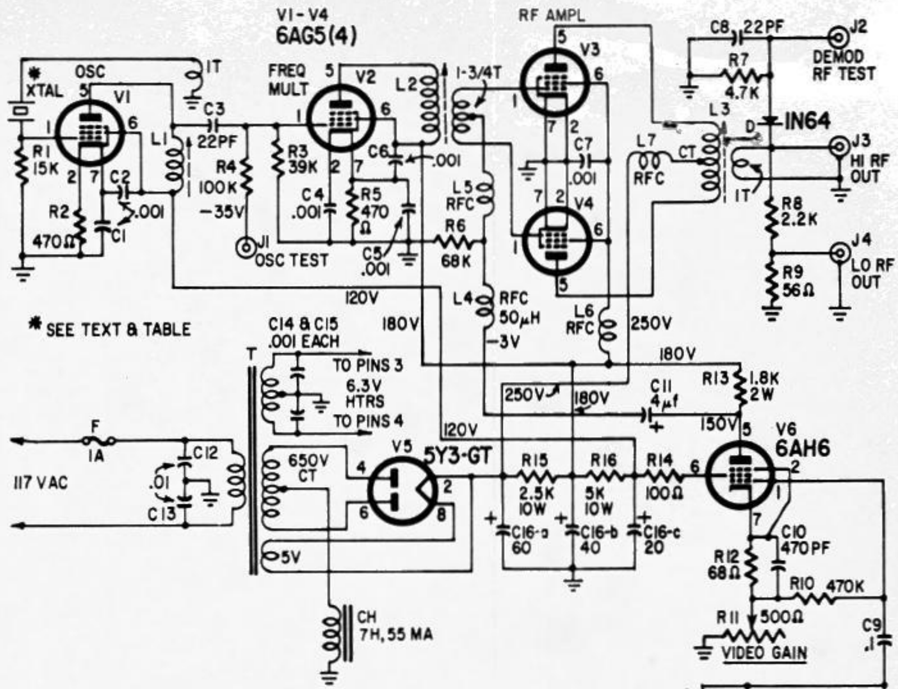
The coil forms were obtained from the i.f. strip of a junked TV chassis. The crystal is soldered in, and supported only by its leads. I used .001-μf ceramics for rf bypassing, but any capacitors from 470 pf to .005 μf may be used if they are physically small and the leads are kept short. L5, L6 and L7 are not critical and any high-frequency rf choke may be used. [Ohmite Z-50 should be good for channels 2 through 6, and Z-144 for 7 through 13.—*Editor*]

The sections of C16 may be of higher capacitance, if another type is more readily available. V2, V3 and V4 should be shielded. I dipped the shields part way in black paint to improve heat radiation. Shiny tube shields allow high bulb temperatures and may cause tube failure.

C14 and C15 are located at the V2 socket. R9 should be grounded at J4's mounting. The feedback winding on L1 must be phased correctly. If both wind-



Circuit of the video modulator. No unusual parts are used. The coils are easily wound to suit the chosen channel. Type 6AH6 (V6) may be hard to come by. If so use 12BY7-A, with a 9-pin miniature socket and altered connections as shown at left.



C1, C2, C4, C5, C6, C7, C14, C15—.001 μf disc ceramic
C3, C8—22 pf mica or ceramic
C9—0.1 μf, 400 volts, paper or Mylar
C10—470 pf ceramic
C11—4 μf, 450 volts, electrolytic
C12, C13—.01 μf, 600 volts
C16—60/40/20-μf 350-volt 3-section electrolytic (Sprague TVL-3640 or equivalent)
D—1N64 germanium diode
F—fuse, 1 ampere
J1, J2—banana or pin jacks
J3, J4, J5, J6—coax connectors, type SO-239 or similar
L1—No. 22 wire on ¼-in. slug-tuned form (Miller 4500 or equivalent). See Table
L2—No. 22 wire for high channels (7-13); No. 26 for low (2-6), on ¼-in. slug-tuned form. See Table
L3—No. 16 wire for high channels, No. 20 for low. See Table. Secondary is 1 turn No. 20 tightly coupled
L4—50-μh rf choke (Millen J300-50 or equivalent)
L5, L6, L7—rf chokes: approx. 25 turns No. 22 enameled, air-wound 3/16 in. dia.; or see text for commercial chokes.
CH—filter choke, 7 h, 55 ma (Thordarson 20C59 or equivalent)
R1—15,000 ohms
R2, R5—470 ohms
R3—39,000 ohms
R4—100,000 ohms
R6—68,000 ohms
R7—4,700 ohms
R8—2,200 ohms
R9—56 ohms
R10—470,000 ohms
R11—Pot, 500 ohms
R12—68 ohms
R13—1,800 ohms, 2 watts
R14—100 ohms
R15—2,500 ohms, 10 watts, wirewound
R16—5,000 ohms, 10 watts, wirewound
R17—75 ohms, 5% (optional—see text)
All resistors ½ watt, 10% except as noted
T—power transformer, 650 vct, 55 ma; 5 v, 2 amps; 6.3 vct, 2 amps (Stancor PC-8407 or equivalent)
V1, V2, V3, V4—6AG5
V5—5Y3-GT
V6—6AH6

J5 J6 VIDEO LOOP-THRU
R17 75Ω
OPTIONAL—SEE TEXT

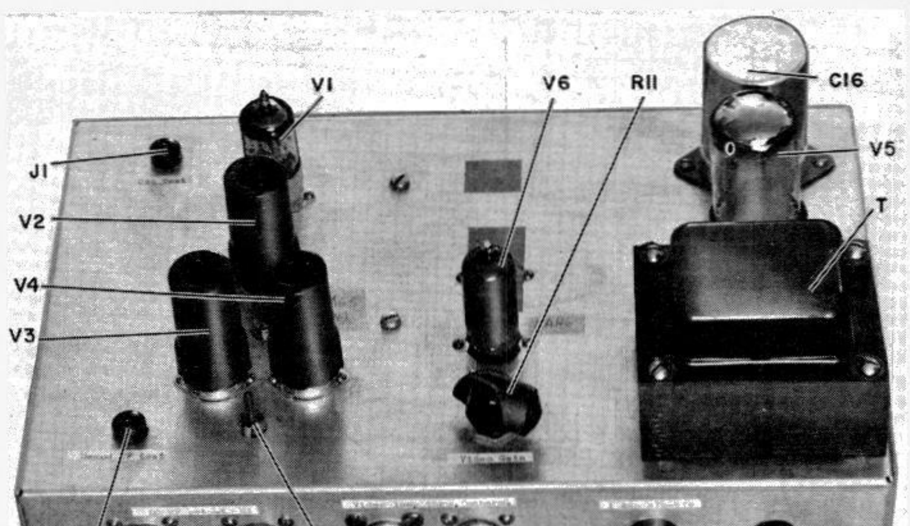
XTAL—third- or fifth-overtone crystal. See Table.
Chassis, sockets, shields, terminal strips, miscellaneous hardware

ings are wound in the same direction, the start of the primary connects to the plate of V1, and the start of the feedback loop goes to ground. Couple the secondary of L2 loosely to the bypassed end of the primary. The secondary of L3 should be tightly coupled to the center of the primary. If a grid-dip meter is available, check the tuning range of the coils. L1 should tune through the crystal frequency. L2 and L3 should tune to the video frequency of the selected channel.

Apply power and check approximate voltages to chassis, as shown on the schematic. Voltages are approximate and may vary considerably with transformer voltage and tube characteristics. Connect a vtvm to J1. Start with the −50-volt range. Adjust L1 for maximum voltage. If the feedback loop is too loosely coupled, V1 may not oscillate; if too tightly coupled, it will oscillate at any setting of the tuning slug as indicated by a continuous voltage at J1. Adjust coupling by sliding the L1 loop along the form. Tune L1 slightly on the high-frequency side of maximum output to assure reliable starting of the oscillator. Typical readings at J1 range from −25 to −40 volts.

Connect the vtvm to the junction of L4 and C11 and tune L2 for maximum negative voltage. If it is greater than −5 volts, reduce the coupling of the L2 secondary. Connect the vtvm to J2. Tune L3 for maximum output. Connect a 75-ohm load to the HI RF output, J3, and retune L3. The dc voltage at J2 is a direct indication of the average rf output and is very useful for tuning.

Apply a 1-volt peak-to-peak sine wave to the video input (60 cycles or any audio frequency will do). Connect a scope to J2 and observe a sine wave. Adjust the video gain for maximum



Tube shields over three of the 6AG5's were dipped in black paint to improve heat radiation.

amplitude without clipping.

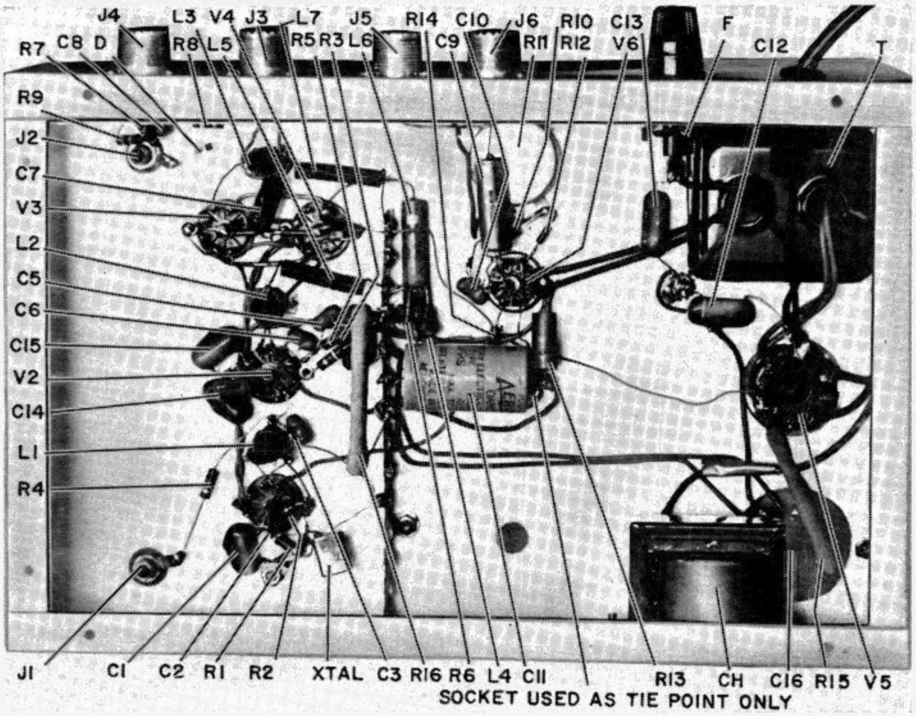
The average dc level at J2 will drop 25% to 50% as an input signal is applied. This is normal for this type of grid modulation and dc restoration. For actual video input, the voltage at J2 will depend on the average scene brightness.

Using the modulator

The modulator will work well with any video source of approximately 1 volt peak to peak, and negative-going sync. I used a Motorola transistor closed-circuit camera, coupled to the modulator through approximately 150 feet of 75-ohm RG-59/U, with excellent results. The high rf output (J3) puts out about 1 volt, and is intended to feed a long terminated line with coupling to the TV sets through highly attenuating tapoffs. The low output (J4) supplies about 5,000 microvolts and may be coupled directly to several standard receivers.

When only the low-output jack is used, the high-output jack should be terminated with a 75-ohm carbon resistor for best modulation linearity. Make the final adjustment of the video gain while watching a TV receiver. Low gain will show as low contrast. Excessive gain will cause loss of detail in the highlights.

For the final tuning of L3, with the unit connected to the distribution system, back the slug out for about 20% reduction in dc voltage at J2. This will favor the upper sideband. You need not attempt to reduce the lower sideband greatly. The receiver bandpass characteristics take care of the vestigal sideband problem. END



Resist the temptation to spread out too much in the roomy chassis. All leads except dc-carrying power-supply wires must be kept short and routed direct.

Selective AF Amplifier Boosts Receiver Performance

By I. QUEEN

EDITORIAL ASSOCIATE

THIS CIRCUIT ADDS HIGH SELECTIVITY when tacked onto the output of a ham CW receiver. It uses commonly available components and requires only two penlight cells. It has a bandwidth of less than 120 cycles at 20 db down, with sufficient output for a high-impedance earpiece. The circuit is peaked at 900 cycles.

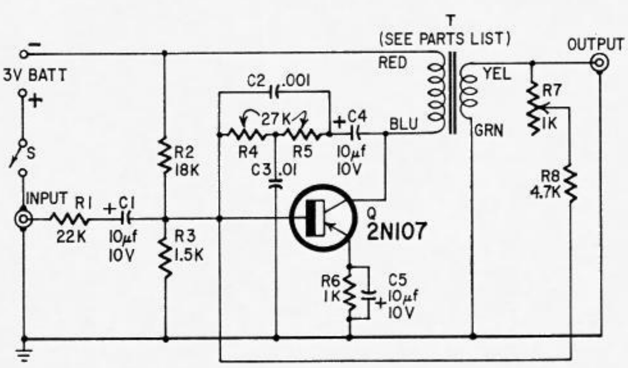
Positive feedback occurs through R7, which is adjustable. Negative feedback occurs through the bridged-T network tuned to 900 cycles. Because of the bridged-T, gain is very low at all frequencies except 900 cycles. As R7 is reduced, gain at resonance is boosted. Pushed too far, the circuit becomes unstable and eventually oscillates. Selectivity can be made extremely sharp, but the amplifier will tend to "ring". The bandwidth mentioned above is obtained *without* reducing R7 so far that ringing sets in.

For maximum selectivity, the signal must not be too great. Results are satisfactory when the voltage across the earpiece is about 30 mv.

The extreme selectivity of *120 cycles at 20 db down* may be compared with that of a modern ham receiver, whose selectivity may be rated at 500 cycles at 6 db down. Of course, when they are added together, the result is a very sharp peak, which rejects interference and noise.

R7 must have enough range. If you cannot get oscillation, reduce or eliminate R8. On the other hand, if oscillations cannot be stopped by R7, you may need to increase R8. The polarity of the output transformer must be correct also, otherwise the feedback through it will be negative instead of positive. If you can't get the circuit to oscillate, reverse the leads to *one* winding.

To use the filter, adjust the bfo tuning, bandspread tuning or both for the best performance. END



C1, C4, C5—10 µf, 10 volts electrolytic
C2—.001 µf, disc
C3—.01 µf, disc
R1—22,000 ohms
R2—18,000 ohms
R3—1,500 ohms
R4, R5—27,000 ohms
R6—1,000 ohms
R7—1,000-ohm potentiometer
R8—4,700 ohms
all resistors, ½ watt
T—transformer, 200,000-ohm pri to 1,500-ohm sec (Argonne AR-144 or equivalent)
Q—2N107 or similar
BATT—2 penlight cells, and holder (3 volts)
S—spst switch
perforated board, 3½ x 4¾"