ADD-ON IMPROVES PAY-TV DECODER

If you can't get your pay-TV decoder to work, it may be because your set does not have enough IF gain. If so, try this simple circuit.

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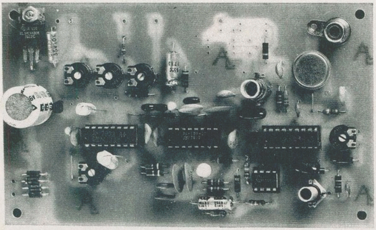

A TYPICAL DECODER BOARD. The gated IF amplifier can be used to improve this device's performance.

BUILDING OVER-THE-AIR, SUBSCRIPTION-TV decoders, such as the one featured in the January and February 1981 issues of **Radio-Electronics,** has become popular with electronic experimenters and hobbyists. Many popular decoder designs require the unit to be attached to the IF strip in the receiver. A drawback to that scheme, however, is that sometimes signal levels at that stage are inadequate for proper decoder operation. This article offers one solution to that problem—a gated IF-amplifier that is installed in the TV set between the tuner output and the IF input. It is intended for use only with suppressed-sync-signal system decoders.

Suppressed-sync-signal encryption

To understand the problems here better, let's look at the differences between a standard and encoded TV signal. Both signals are shown in Fig. 1. Each complete picture, called a *frame*, is made up of 525 lines; 30 such frames are sent each second, for a total of 15,734 lines per second. To recreate the transmitted signal, the receiver must take those lines and display them in the correct sequence and location. That is why sync pulses are needed—they tell the television receiver *when* to display the lines. Two types of sync pulses are used: One, the *vertical*-sync pulse identifies the beginning of each frame and field (a field is a half frame); the other, called the *horizontal*-sync pulse, identifies the beginning of each line. In a suppressed-sync television signal, the horizontal-sync pulse is missing, as shown in Fig. 1-b, destroying picture sync.

To restore the sync, some type of "decoder" is needed. What those devices do is to restore the sync pulses artificially during the interval that it is supposed to be present. The technique used is to reduce the AGC voltage so that there is enough IF gain to raise the signal to the proper level.

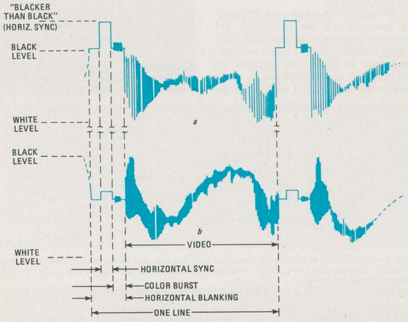

FIG. 1—THE DIFFERENCE BETWEEN a standard television signal (*a*) and a suppressed-sync signal (*b*) is shown here.

NOTE:

The legality of the use of privalety-owned devices to decode subscription TV broadcasts is currently the subject of much debate and pending litigation. The subscription companies have taken the position that decoding of broadcasts without payment is "theft of service" and the FCC has issued a notice to the effect that subscription-TV decoders are subject to FCC approval.

That system, however, is based on the premise that there is enough IF gain available to do that. Unfortunately, the signal received by the television is often so low that the IF is running wide open, with little or no AGC required. If that is the case, there is little or no IF gain available and the signal can not be raised to the proper sync level.

The easiest way to correct that problem is to insure that a strong enough signal is available from the antenna. If the signal from the antenna can be boosted sufficiently, the decoder will function exactly as intended. In many cases, however (especially if you live in a fringe reception area), picture quality cannot be improved enough to make a difference, and the decoder still will not work properly. The solution is to add more gain to the IF amplifier.

A schematic diagram of a simple IF amplifier with adjustable gain is shown in Fig. 2. The heart of that circuit is an MC1590G differential input/differential output amplifier; that device is used as a wide-band (i.e., un-tuned) amplifier. The gain is controlled by adjusting the voltage level at the device's gain control (AGC) terminal. In this design, the decoder's AGC voltage is used as the AGC control voltage for the gated IF-amp. That signal determines when the additional gain is required.

The circuit was built on a copper-clad perforated construction board; the small number of parts made designing and etching a PC board unnecessary. The construction is quick and straightforward. While component tolerances are not critical, all leads should be kept as short as possible. To avoid the use of a separate heat sink, the IC was mounted upside-down.

For best results, you'll need an RF signal generator and either an oscilloscope or an RF voltmeter to align the circuit. Set the output of the signal generator to an amplitude equal to the lowest level that can be measured by the scope or voltmeter; the generator's frequency should be set at 44 MHz. Attach a variable power-supply to the amp's AGC input (pin 2) and set it to 10 volts. Using the meter or the scope, measure both the input and the output amplitudes, and adjust the AGC input until they are equal. That is the approximate 0-dB AGC input level, the level that is applied to the amp during normal (i.e. unscrambled) operation. Next adjust the voltage input to the AGC until the output of the amp is 2.5 times higher than the input. That corresponds to about an 8-dB gain, the level that is required to reproduce the sync pulse. The voltage applied to the AGC input at that point is the value that will have to be applied whenever the sync pulse is to be generated. If you do not have access to the equipment required to make those tests, use 10V for the 0-dB control voltage, and 8V for 8-dB gain.

Hooking it up

The gated IF-amp can be interfaced easily with the decoder, using the circuit shown in Fig. 3. That simple circuit inverts and amplifies the decoder's output. To align the circuit:

1) Attach the interface to the decoder, set S1 to NORMAL, and adjust R5 so that the output of the circuit matches the voltage required for 0-dB gain as found above, or 10 volts.
2) Set S1 to DECODE, connect the circuit input (R1) to ground, and adjust R3 so that the voltage from step 1 still appears at the output.
3) Apply 5 volts to the circuit input and verify that the output drops to the 8-dB voltage, or about 8 volts. If not, re-adjust R3 until that occurs. If readjustment is required, repeat step 2 and verify that the output is still close to the 0-dB voltage (do not readjust R3 at this point, however).

Mount the amplifier circuit inside a metal box, and connect the box to ground. Cut the coax from the tuner to the IF and insert the amplifier. The cables' braids should be soldered to the copper board, and the center conductors should be connected to the appropriate points, as shown in Fig. 2. If you wish, a better approach would be to use BNC connectors. Make your power connections, and the connection from the decoder, using shielded cable. In the test circuit, the cable braid was connected only at the decoder; there were no interference problems, but some experimentation may be required for best results.

The decoder interface (Fig. 3) should be mounted near the decoder so that the final alignment and any future servicing is made easier. If it ever becomes necessary to remove the interface for servicing, it can be replaced by a 10-volt power supply, and normal TV operation can be maintained while the gated IF-amplifier remains connected. As a precaution, you should be sure that the amplifier's power supply is always on, but that the supply to the decoder is off when it is not in use.

Final alignment is accomplished by watching the TV screen while receiving a "scrambled" picture. No test equipment is used for that procedure. Resistor R3 is adjusted slightly until the picture quality is as good as possible. You should note in which direction the pot was adjusted, and approximately how much rotation was used. That could become important in the event that total loss of sync occurs, and it becomes necessary to start again from the beginning. **R-E**

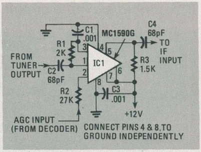

FIG. 2—SCHEMATIC DIAGRAM of the gated IF amplifier. The heart of the circuit is an MC1590G differential input/differential output amplifier. It's control signal is taken from the decoder's output.

PARTS LIST—AMPLIFIER

Resistors, ¼ watt, 5%
R1—2000 ohms
R2—27,000 ohms
R3—1500 ohms
Capacitors
C1, C3—.001 μF, ceramic disc
C2, C4—68 pF, ceramic disc
Semiconductors
IC1—MC1590G differential input/differential output amplifier (Motorola)
Miscellaneous: copper-clad perforated construction board, metal enclosure, shielded cable, wire, solder, etc.

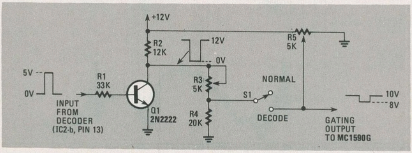

FIG. 3—THIS CIRCUIT IS REQUIRED to interface the IF amplifier with the decoder. It inverts the output from the decoder, gives you enough range for adjustments, and gives you a way to switch from NORMAL to DECODE modes.

PARTS LIST—INTERFACE

Resistors, ¼ watt, 5%, unless otherwise noted
R1—33,000 ohms
R2—12,000 ohms
R3, R5—5000-ohm potentiometer, linear
R4—20,000 ohms
Semiconductors
Q1—2N2222 NPN transistor
S1—SPST switch
Miscellaneous: wire, solder, etc.

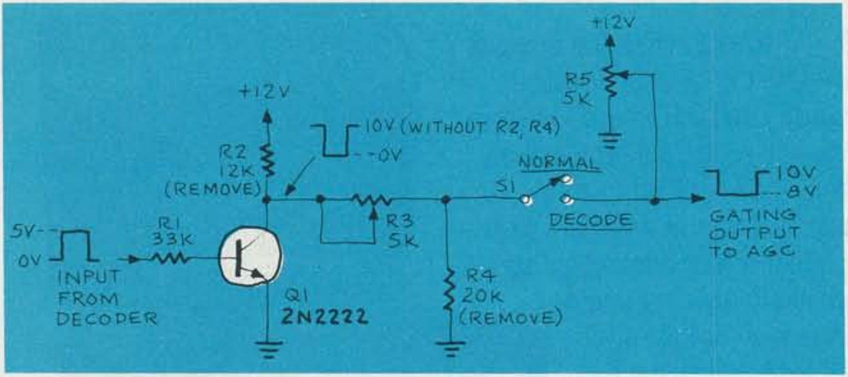

FIG. 1

PAY-TV DECODER ADD-ON

I enjoyed reading about the add-on for improving pay-TV decoders in the June 1982 issue of **Radio-Electronics.** Fortunately, a problem I found in the interface can be solved by removing two resistors (see Fig. 1).

Step two of the alignment procedure asks us to connect the input (R1) to ground and, in effect, adjust R3 so that the voltage to S1 is the same as the voltage from R5 (about 10 volts). That is clearly not possible, because the voltage to S1 (S1 open) can be at maximum only 7 volts (12V × 20K/32K). Removing R2 and R4 stops the action of R3 on the 0-dB gain adjustment, and eliminates the need for the second step in alignment. The circuit will function as described with R3 adjusted to about 2.8K.

I suspect that R2 and R4 are leftovers from an earlier version of the circuit, because they serve no apparent function.

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ON NIKOLA TESLA

It is fascinating that there have been so many readers commenting on Nikola Tesla's work in the last few months. Alfred C. Powell, and most recently George de Lucenay, come to mind. Something needs to be done here to revive and *re-examine* some of the amazing work that Tesla did.

I'd be willing to act as a collection point for information and comments on Tesla's work as uncovered by your readers. Perhaps I could afford to print a "newsletter" type of publication occasionally, covering such things as little-known facts about Tesla's work and reviews of books relating to his life and accomplishments.

If I receive enough interesting items, may-