MODIFY YOUR TV FOR VIDEO INPUT

How to turn your isolated TV into an MPU terminal

THIS ARTICLE GIVES SOME HINTS on how to modify a normal television receiver so that a signal can be fed directly into the video circuit. This enables you to use your TV for video games or other video displays without needing to use an RF modulator.

Besides the obvious reduction of cost and complexity, the use of a direct video connection has the advantage of higher resolution. A good RF modulator is quite a complex device and because of the UHF signals it must handle, it calls for special construction techniques.

Once modified for external video input, the receiver can be used for a variety of experiments. It can be used with the VDU section of the microcomputer terminal that has recently appeared in ETI, or as a simple video monitor for black and white TV cameras. (For colour TV use much more elaborate circuitry would be required to ensure the required bandwidth and phase characteristics).

Normal Receiver Operation

Figure 1 is a block diagram of the signal processing section of a normal TV set.

The signal from the antenna is a low level UHF signal of a few microvolts amplitude. The tuner outputs a signal at the receiver's intermediate frequency, which is amplified by the IF stages to give an RF signal of about 1-2 volts peak to peak amplitude. The detector rectifies the output of the IF amplifier, usually by means of a diode, in much the same way as a crystal set. The result is a composite video waveform — that is

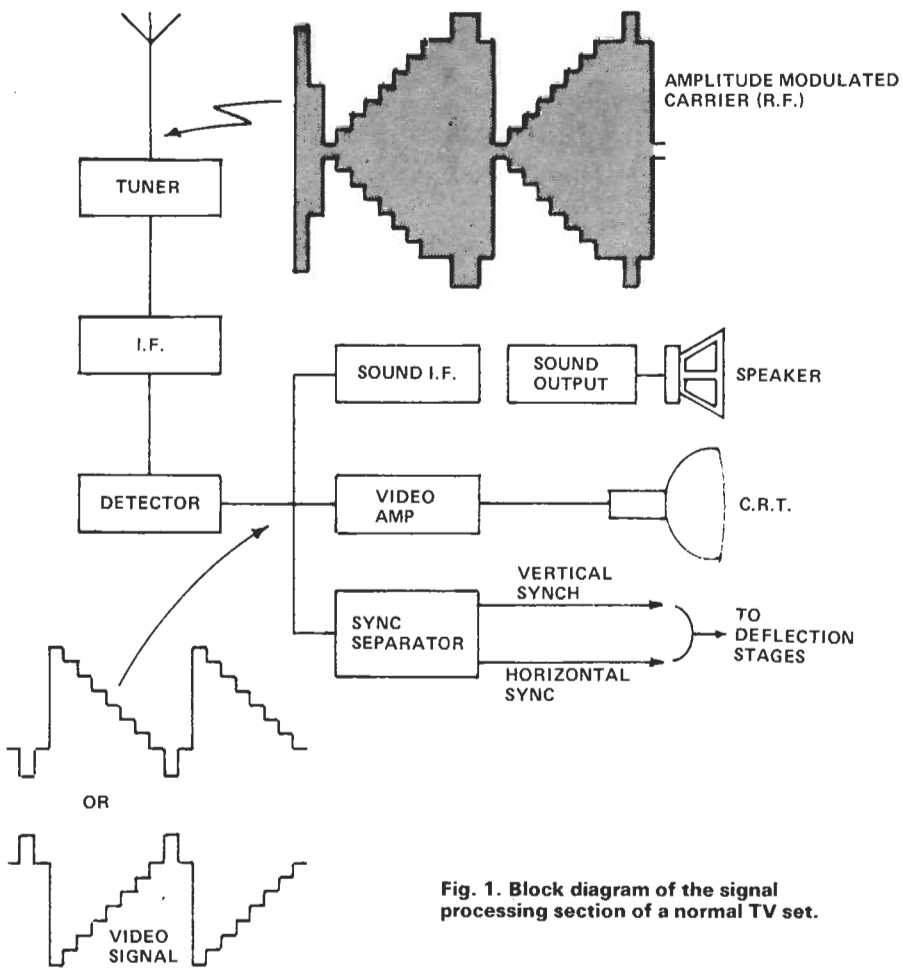

Fig. 1. Block diagram of the signal processing section of a normal TV set.

a waveform containing both picture and synchronising information. In addition, the 5.5 MHz sound carrier is usually extracted at the video detector.

This waveform would result from reception of a "staircase" test signal, which consists of a number of vertical bars ranging in greyscale from white to black. The output from the detector looks something like the waveform shown in Fig. 2(b). In this example it is assumed that the detector diode is configured so as to produce a more positive output with an increase in carrier amplitude.

The video amplifier provides a signal of sufficient amplitude for modulating the brightness of the dot displayed by the CRT.

The sync separator detects when the video signal reaches its maximum excursion, which corresponds to sync level. The horizontal and vertical sync pulses are then extracted from this composite sync signal and fed to the deflection circuitry.

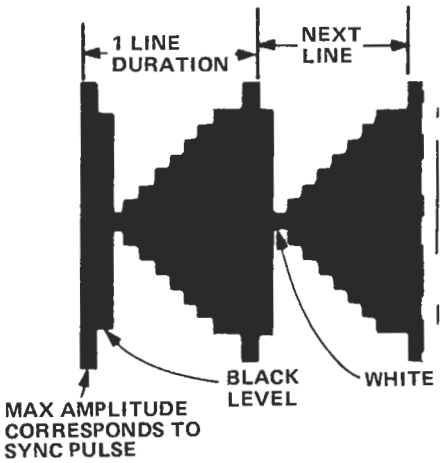

Fig. 2a. R.F. envelope before detection.

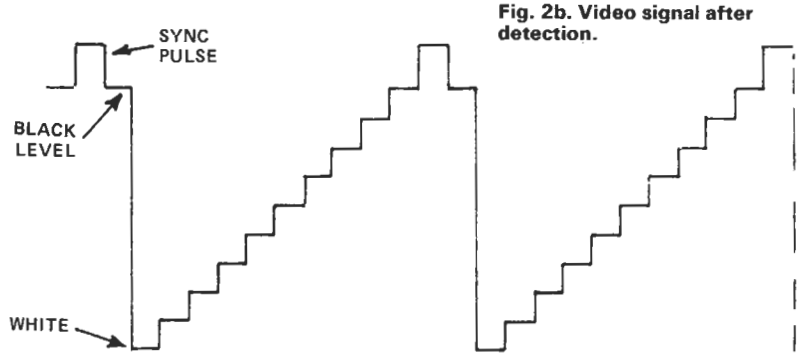

Fig. 2b. Video signal after detection.

Format

In England the vision information is put onto the radio wave at the TV transmitter using negative amplitude modulation. This means that the brighter the picture element is, the less the carrier amplitude. Maximum carrier amplitude corresponds to the sync pulses, minimum corresponds to white, and black level lies somewhere in between. The signal at the output of the IF amplifier therefore looks something like Fig. 2(a).

Requirements

The universally adopted standard for "line level" video is 1 volt peak-to-peak into 75 ohms positive-going (more positive means greater brightness). Most video games and the Video Display Unit in the ETI microcomputer terminal project provide such a video output suitable for feeding directly into a monitor or modified receiver. Alternatively an RF modulator can be used to generate a signal suitable for feeding into the TV set via the antenna terminals for viewing on a vacant TV channel. This latter alternative means that the video signal is modulated and then demodulated which can degrade the picture quality unless the modulator is carefully designed.

In many cases it is simpler to modify the TV set than build a modulator. The receiver can be fitted with a changeover switch which can be used to return it to normal reception when required, or an old black and white set can be butchered specifically for the job. In view of the low cost of second hand black and white sets it may be preferable to persue the latter course rather than strain family relationships by dissecting the new telly.

The modification involves feeding in the video signal where the detector normally goes. The input should be via a 75 ohm coaxial connector and it must present a 75 ohm terminating impedance to the source. In most cases a certain amount of additional circuitry will be required to match the 75 ohm, 1 V positive input to the impedance, amplitude and polarity required by the video stages of the receiver.

Before You Start

There are several important factors to consider before attempting the modification. Before you start check these points:

1 The TV must not be of the "hot chassis" type. These receivers do not use a transformer to isolate the works from the mains. In many cases one side of the mains connects directly to the chassis of the set. Check that the chassis is securely grounded via the power cord and that the power supply section does not use an isolating transformer. "Hot chassis" sets are not suitable for modifications. Moreover they are potentially lethal and should be left alone.

2 Unless you are sure about what's in your TV set you will need a circuit diagram of the chassis. These can be obtained from the manufacturers or their service departments.

3 Don't attempt the modification unless you are quite confident you know what you are doing. This is not meant to discourage the adventurous hobbyist spirit, but if you rush in without sufficient knowledge you could wind up with a smouldering wreckage where once your TV stood (or where you yourself stood).

Finding The Right Spot

The first task is to locate the video detector stage. This will often be ▷

labelled on the circuit diagram, but if it is not it can be found by following the circuit starting from the tuner. There will be a couple of stages of IF amplification followed by a detector in the form of a diode or, in more recent sets, part of an integrated circuit. Figure 3 shows a simplified diode detector stage. With the diode this way around, the recovered video waveform will be positive going, as shown. If the diode were reversed, an inverted video waveform would be present.

In some receivers the video detection and pre-amplification are accomplished by an integrated circuit. If the sync separator is internal to the IC you should look for a different receiver to modify as it may not be possible to find a suitable point to feed in the video signal. If the sync separator occurs after the IC you can treat the IC as a glorified diode detector and feed the video into the first transistor video stage.

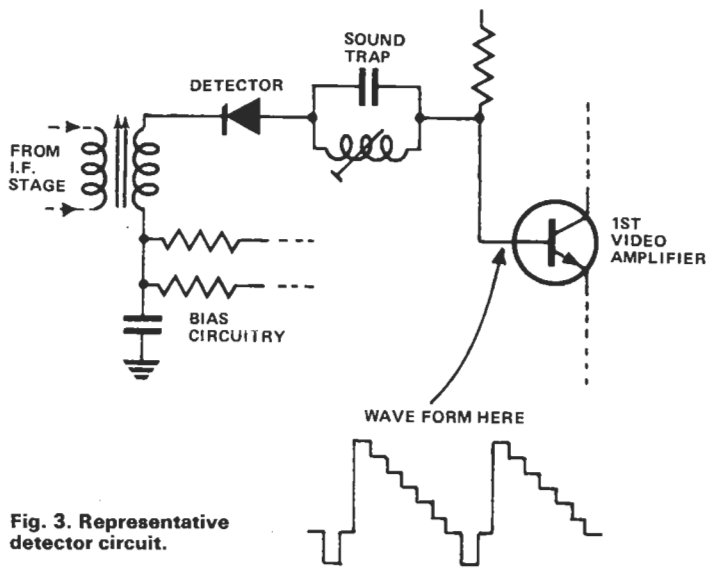

Fig. 3. Representative detector circuit.

The Simplest Case

If you are lucky the first video amplifier in your TV receiver will be designed to operate with a negative-going video signal of about 1 volt peak to peak. In this case very little extra circuitry will be required to modify the set. The simple arrangement shown in Fig. 4 will probably suffice.

The change-over switch SW1 selects an internal or external source of video for the 1st video amplifier transistor. When switched to *external* base bias for Q1 is provided by RV1 and R1. RV1 provides a large range of adjustment so that the DC level at the base of Q1 can be matched to the level present when the receiver is operating normally. Capacitor C1 provides DC isolation and R2 presents the required 75 ohm impedance to the coaxial video input.

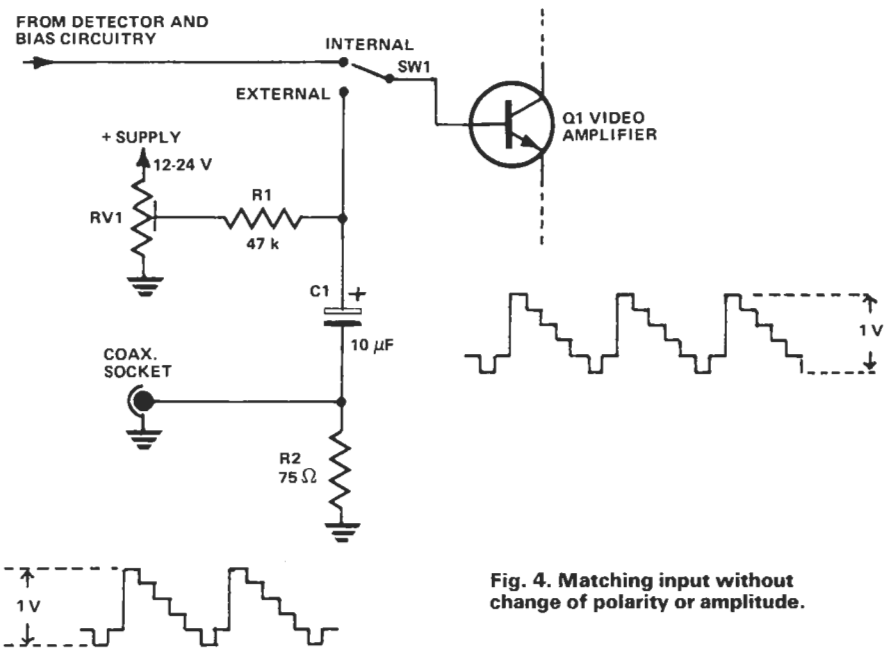

Fig. 4. Matching input without change of polarity or amplitude.

Input Buffering

In some cases the 1 volt video input will not be of sufficient amplitude to drive the video stages fully. Figure 5 shows the circuit of a simple non-inverting amplifier which will bring the input amplitude up to a suitable level.

Q1 is wired in common-base configuration which provides the low impedance input required and does not invert the signal. RV1 allows adjustment of the amplitude from 1 volt to 3 volts P-P. Once again, RV2 is provided for bias adjustment. The polarity of C2 will be determined by the relative settings of RV1 and RV2.

Inverting Buffer

If the receiver requires a positive-going video input, means must be provided for inverting the external video input. Depending on the exact requirements of the particular TV receiver in question, it may also be necessary to provide some gain as well.

Figure 6 shows a simple circuit which fulfills these requirements.

The gain is adjustable from 1 to 3 by means of VR2. VR1 adjusts the bias on the following stage of video amplification.

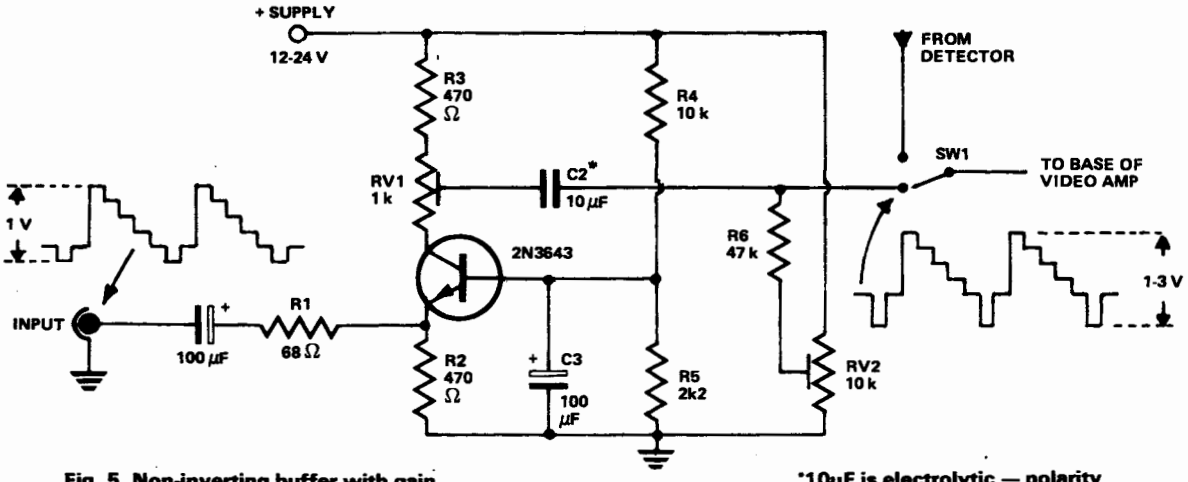

Fig. 5. Non-inverting buffer with gain.

***10uF is electrolytic — polarity is determined by setting of RVI**

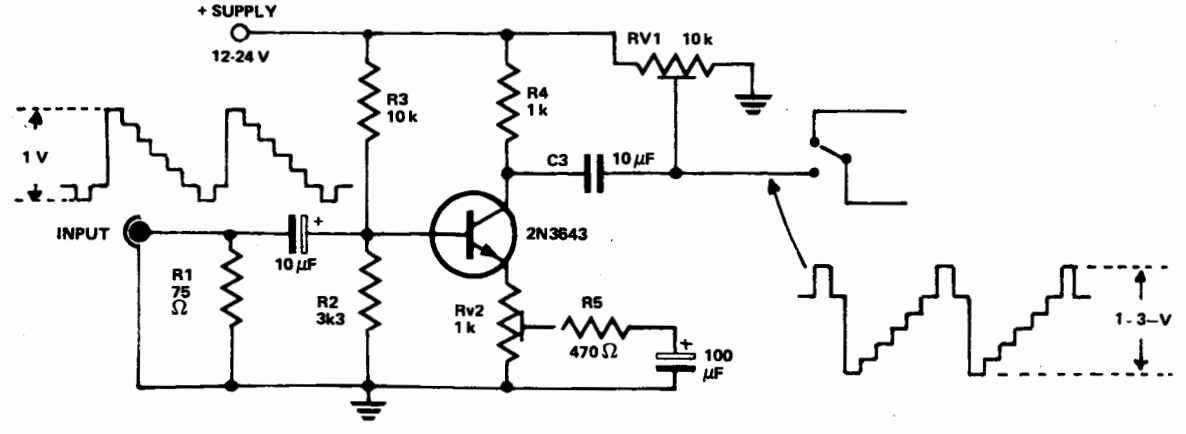

Fig. 6. Inverting buffer with gain.

Finishing Off

With a little experimentation a suitable circuit can be developed using the above hints as guidelines. Keep the wiring to the switch as short as possible. Mount a coaxial connector on the rear panel of the TV set for the external input.

The modern standard for video connectors is the "BNC" type, although there is still a lot of equipment using the more cumbersome "VHF" type (also known as a PL-259). A much cheaper alternative is the "Belling and Lee" coaxial connector commonly used at the antenna input connection of colour TV sets. □