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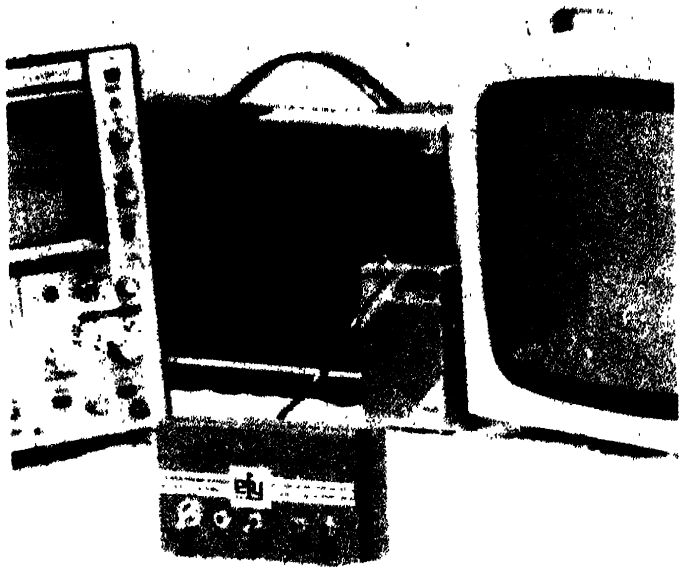
# FM SIGNAL GENERATOR



Alignment of tuned circuits of a radio receiver is the most essential process required for perfect reception and reproduction of a signal to be received. Since the sound section of a TV receiver comprises a number of 'LC' tuned circuits, it also requires alignment. The FM signal generator described here would enable you to do this easily and perfectly.

In the signal generator, the frequency of an RF oscillator is modulated by the signal of an AF oscillator to produce an FM signal having a carrier frequency of 5.5 MHz. Whenever this modulated signal is coupled to the sound section of a TV receiver, the signal behaves as a 5.5MHz standard FM sound IF signal. So the generator can be used for testing the related sound sections in a TV. The generator has some additional areas of application also, which are covered later in the article.

### Circuit details

The circuit for the signal generator is very simple. It comprises two oscillators. Oscillator 'A' is an RF oscillator oscillating at 5.5 MHz and 'B' is an 800Hz AF oscillator. The tank circuit of oscillator 'A', which determines its frequency of oscillation, comprises inductance L2, capacitance C3, C4 and a variable capacitor C5. A variable capacitance diode (varicap) or varactor (BB105) is also included in the tank circuit through a large capacitor (C6).

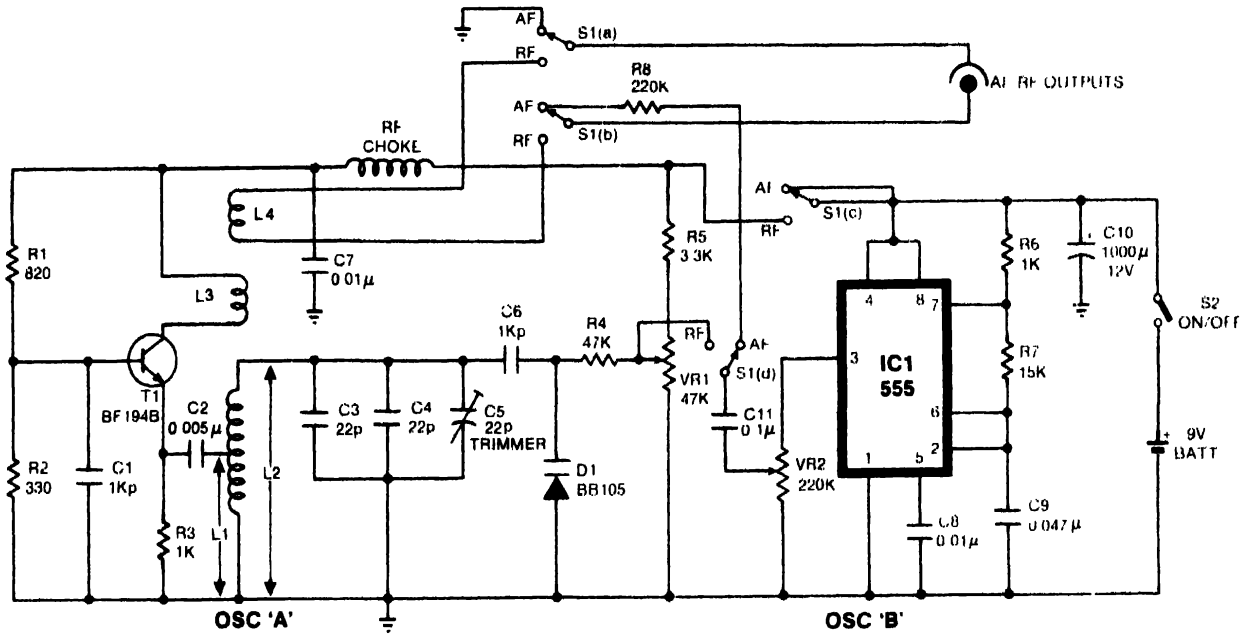
To modulate the frequency of oscillator 'A', output of oscillator 'B' is coupled to the tank circuit of oscillator A. As the amplitude of the 800Hz squarewave signal varies in a cycle, the reverse voltage across the varicap diode varies accordingly, from a quiescent value set by VR1, thereby varying the diode's capacitance. For positive half cycles of the modulating signal, the varicap's capacitance decreases and for negative half cycles it increases. Since it is a part of the tank circuit of oscillator A, and as the frequency of oscillation of a 'LC' tuned circuit depends upon its 'C' value, the frequency of oscillator A varies in accordance with the amplitude of the modulating signal. The frequency modulated output can be had at the marked output terminals.

Potentiometer VR2 determines the maximum amplitude of the modulating signal to be coupled to the varicap diode. So, the maximum deviation of carrier frequency and hence the modulation index, which determines the amplitude of the 800Hz AF signal after demodulation in the coupled receiver, depends upon the setting of VR2.

### Construction

The complete signal generator can be mounted on a single PCB. Special attention is required regarding wire dressing as unnecessary coupling may affect the frequency of oscillation of oscillator A, and hence the generator's performance.

Since frequencies of the two oscillators are independent of power supply variation, stabilised power supply is not required for them. However, due to the presence of the varicap diode, variation of supply voltage produces some unwanted frequency modulation. Due to the stated reason




**1: Circuit diagram of the FM signal generator.**

### PARTS LIST

**Semiconductors:**

| | |
|---|---|
| IC1 | NE555 timer |
| T1 | BF194B RF transistor |
| D1 | BB105 varicap diode |

**Resistors** (all ¼ watt, ±5% carbon):

| | |
|---|---|
| R1 | 820-ohm |
| R2 | 330-ohm |
| R3, R6 | 1-kilohm |
| R4 | 47-kilohm |
| R5 | 3.3-kilohm |
| R7 | 15-kilohm |
| R8 | 220-kilohm |
| VR1 | 47-kilohm, vertical preset |
| VR2 | 220-kilohm, vertical preset |

**Capacitors:**

| | |
|---|---|
| C1, C6 | 1kpF, ceramic disc |
| C2 | 0.005µF, ceramic disc |
| C3, C4 | 22pF, styroflex |
| C5 | 22pF, mini button trimmer |
| C7, C8 | 0.01µF, ceramic disc |
| C9 | 0.047µF, ceramic disc |
| C10 | 1000µF, 12V electrolytic |

**Miscellaneous:**

| | |
|---|---|
| L1-L4 | Oscillator coil (see text) |
| RFC | RF choke (see text) |
| S1 | 4-pole, 2-way switch |
| S2 | On/off switch |
| BATT. | 9V PP3 battery |
| | Battery holder, PCB, BNC socket, enclosure, flexible wire etc. |

some amplitude modulation persists as well. Allowing a little variation, a battery of four cells in series with a terminal voltage ranging from 5 to 6 volts, may be used without affecting the operation of the generator greatly.

Inductances L2, L3 and L4 are three coils wound one over the other. Coil L2 is wound first, then L3 is wound over it and finally L4 is wound over L3. L1 is tapped from L2. The details of coil windings are given below:

| Inductance | No. of Turns | Wire |
|---|---|---|
| L1 | 2 | 36SWG enamelled |
| L2 | 42 | copper wire to |
| L3 | 20 | be used for each |
| L4 | 4 | coil |

The outside diameter of the coil former is approximately 7.5 mm – a standard coil former available in the market – and no core is used. The RFC is an air core coil having 30 turns of 24 SWG enamelled copper wire. The diameter of the coil is 7.5 mm approximately.

### Tuning procedure

Before using it as a service aid, the signal generator should first be tuned with the help of a good TV receiver. To do this, connect the generator output terminals to the inputs of the sound IC (viz, 3065, TBA750 etc), i.e. to the secondary of the sound IF transformer. Switch on both the TV and the signal generator.

Adjust VR1 to get a potential of the order of 0.3V at the junction of VR1 and 47k resistor. Position the arm of VR2 to the middle of its span. Adjust C3 to get an 800Hz audio tone (max.) from the speaker. Now by little adjustment of VR1, maximise this response.

If now VR2 is varied, it would only change the volume of the reproduced tone. The volume control of the receiver should be kept at normal listening position.

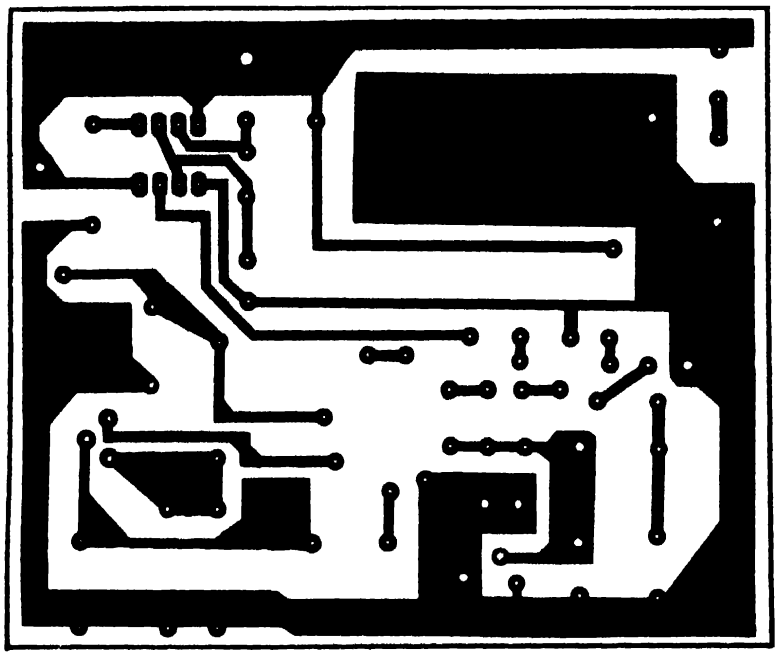


Fig. 2: The PCB layout of the FM signal generator.

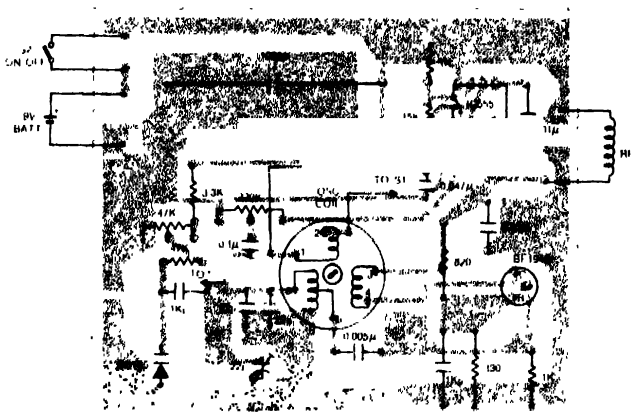


Fig. 3: Components layout for the above PCB.

## APPLICATIONS

### Alignment of the discriminator coil of a TV receiver

Connect the output of the generator to the input of the sound IC. Set the channel selector to a blank channel. Adjust the core of the discriminator coil for maximum undistorted audio tone.

If no sound signal can be traced, the IC is defective or stages after the IC are malfunctioning.

### Checking the tuner and IF stages

Connect the generator to the antenna terminals of the TV under test. Set the channel selector to channel '4' and rotate the fine tuner. Though oscillator A is oscillating at 5.5 MHz, harmonics even of the order of 10, 11, 12 etc are also produced.

With channel selector at channel '4', a slight adjustment of fine tune control enables the receiver to tune two adjacent (12th and 13th) harmonics, simultaneously. These two harmonics, after being processed by different RF and IF stages of the receiver, produce a 5.5MHz (difference frequency between these two harmonics) FM signal at the input of the sound IC, and we get the 800Hz audio tone from the speaker as before.

If no sound is heard, then the tuner or IF stages are operating abnormally - provided all other stages concerned are functioning well.

Instead of connecting to the antenna terminals, the generator may be connected to the IF input for checking its operation separately. The orders of the harmonics in this case are 6th and 7th respectively.

### Checking the video section

During checking the tuner and/or IF stages some inconsistent picture pattern appears on the screen, formed by a normally operating video section. If, on the other hand, no such pattern appears, but sound is there, it may be inferred that the video section is defective.

Of course, synchronising circuits cannot be tested with this instrument, for which a pattern generator is required.

### AM receiver testing

The fact that the frequency modulation is accompanied with an amplitude modulation, can be used effectively for alignment of the front section of an AM shortwave receiver. To do this, place the generator 30 cm to 60 cm from a good shortwave radio receiver. Locate the harmonics on the dial and note their frequencies. You may get unaccounted harmonics produced by unwanted coupling. If so, you may increase the distance between the generator and the receiver to minimise such interference.

Now replace the good receiver with the receiver to be aligned. Select a shortwave band. Adjust the receiver's oscillator coil, antenna coil and corresponding trimmers to get all the harmonics present in the selected band at their proper position on the dial.

The same procedure can be applied to a FM receiver.

### Testing the AF stages

Testing of AF stages beyond the detector of an AM or FM receiver can be done by throwing the RF/AF switch to AF position. Then output of oscillator B can be used as an 800Hz AF signal source, and the generator would then act as AF signal injector. □