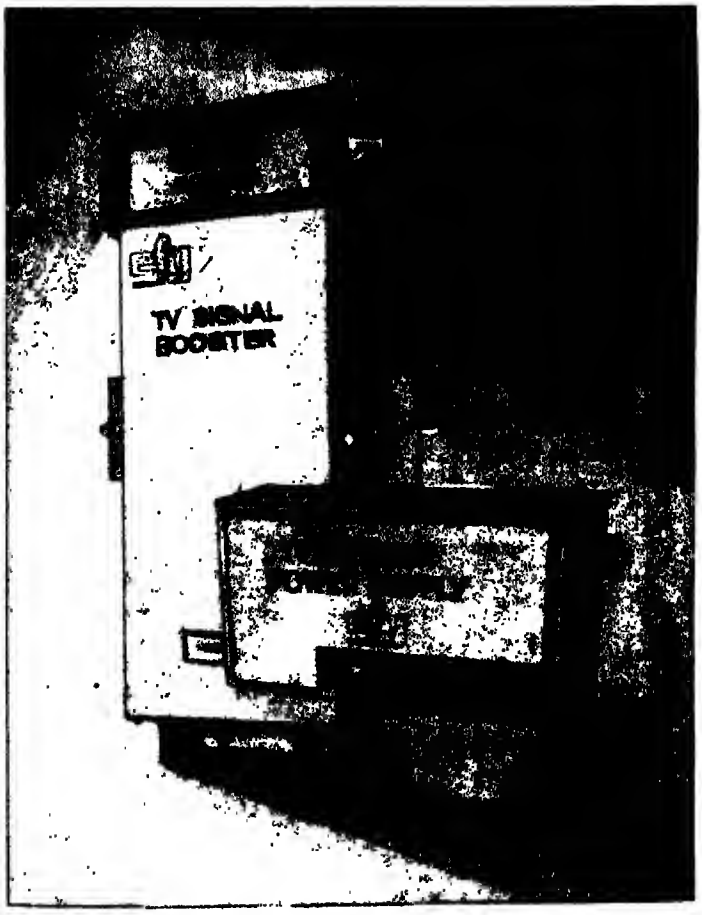
VHF TV Booster



Television boosters are generally used to improve the reception of signals in fringe areas where the strength of signals from far-off stations is weak. TV booster antennae are also used by TV DXers who wish to receive signals from distant TV stations, situated within the country or in a neighbouring country.

With the number of TV transmitters increasing rapidly, it becomes possible in some places to receive the off-air transmission programmes from more than one TV station. Sometimes, programmes from another country may also be received (e.g. Sri Lankan TV programmes in South India and Bangladesh TV in West Bengal). Many TV boosters are available in the market with a low gain and high noise. Commercially available TV boosters generally provide a voltage gain of about 30 dB which may not be sufficient for all purposes.

Why a TV booster?

TV transmission waves travel in straight lines and do not follow the curvature of earth. The strength of the signal

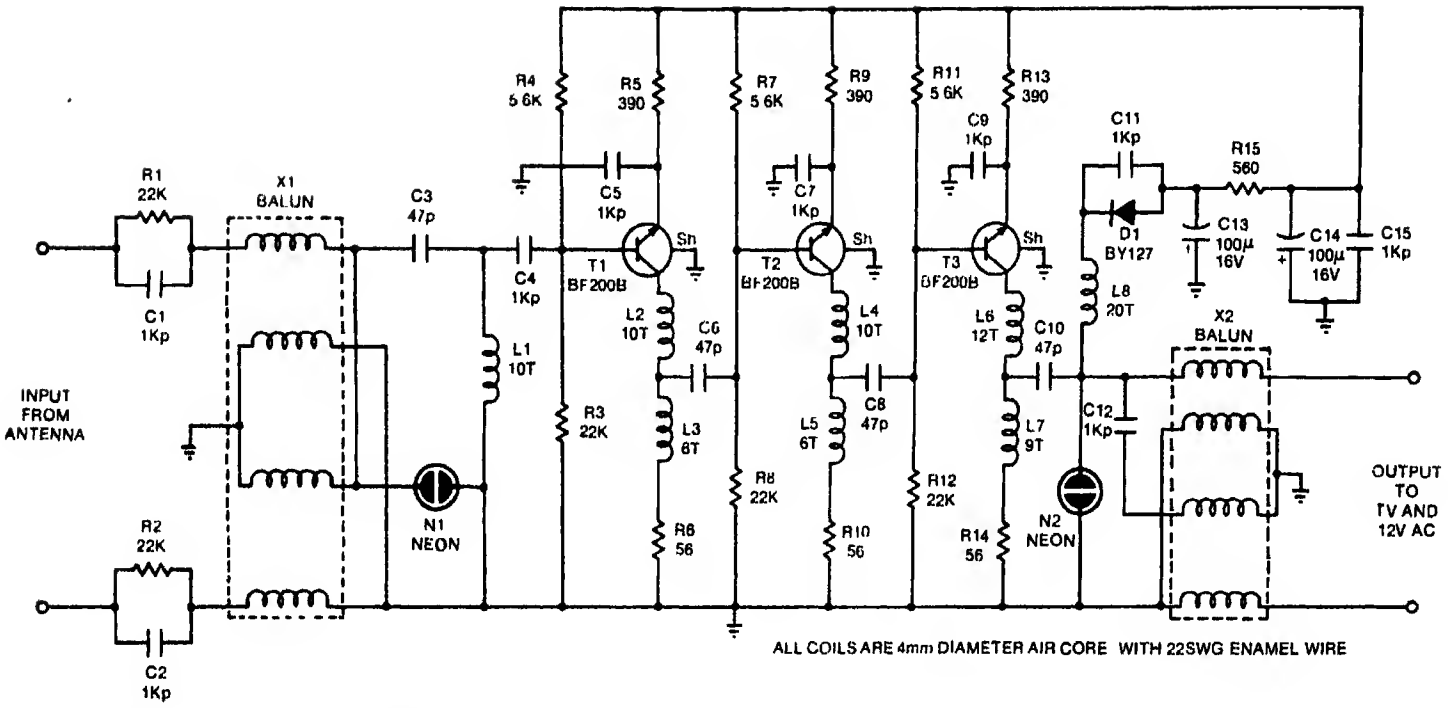


Fig. 1: Circuit diagram for the high-gain TV booster.

PARTS LIST

Semiconductors:

T1, T2, T3	— BF200B high frequency transistor
D1	— BY127 rectifier diode

Resistors [all ¼watt, ±5% carbon]:

R1, R2, R3, R8, R12	— 22-kilohm
R4, R7, R11	— 5.6-kilohm
R5, R9, R13	— 390-ohm
R6, R10, R14	— 56-ohm
R15	— 560-ohm

Capacitors:

C1, C2, C4, C5, C7, C9, C11, C12, C15	— 1kpF ceramic disc
C3, C6, C8, C10	— 47 pF styroflex
C13, C14	— 100µF, 16V electrolytic

Miscellaneous:

L1-L8	— (see Fig. 1)
L9-L12	— RFC (radio frequency choke)
N1-N3	— 230V neon
S1	— SPDT switch
X1, X2	— Balun transformer
X3	— 12V, 300mA secondary transformer
	— PCB, enclosure, mains cord, screws, spacers, hardwares etc.

decreases rapidly with increase in the distance between the transmitter and receiver. More so beyond the specified coverage area of the transmitter.

The 'line of sight' distance between the transmitting tower and the receiving antenna is determined by the following formula:

$$D = 4 (\sqrt{a} + \sqrt{b})$$

where 'D' is the distance between the two antennae in kms, 'a' is the height of the transmitting antenna, and 'b' is the height of the receiving antenna.

The area lying within 10 to 15 kms from the transmitting antenna is called primary area. Within this region, the transmitted signal is quite strong and can be received without any TV signal amplifier (booster). Beyond the primary area, say, between 15 to 40 kms, is the secondary area. Receivers in this area do not require a booster, and a suitable high-gain antenna should do the job adequately.

But at distances around 80 kms, called the fringe area, a high-gain antenna with a high-gain booster mounted high above ground level is required. The signal strength in this area is very low and no satisfactory picture can be formed. The low signal strength here may be due to low signal capture by the antenna, improper sensitivity of the set used.

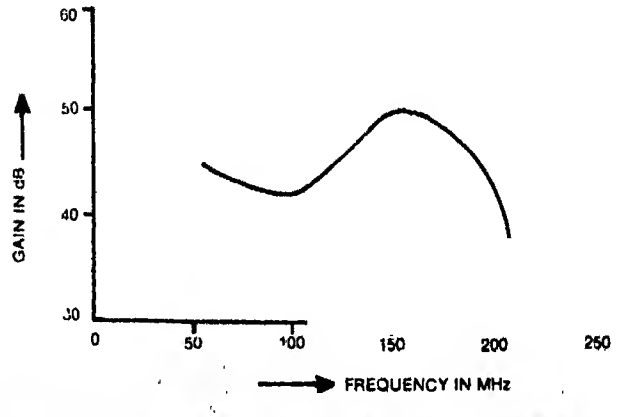


Fig. 2: Gain vs Frequency characteristics for TV booster.

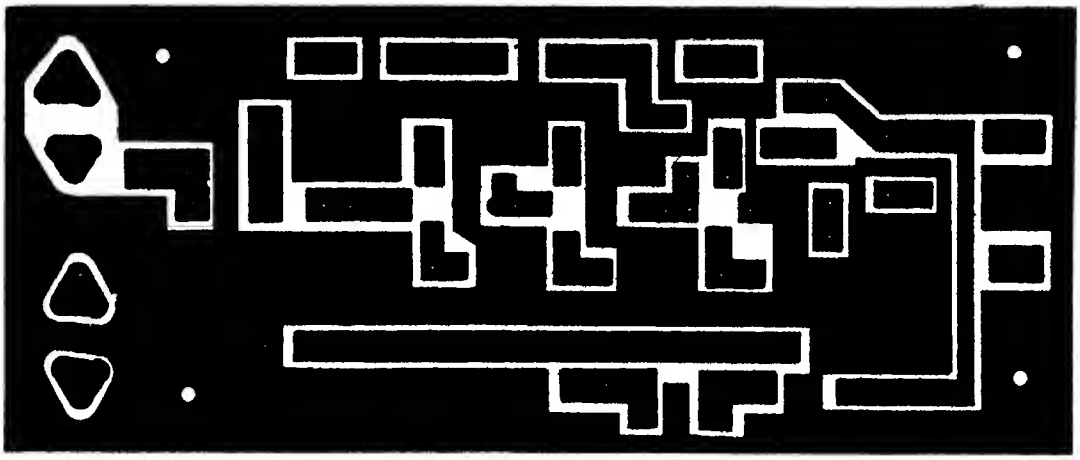


Fig. 3: Actual-size PCB layout for TV booster.

and high signal loss in the antenna connecting cable.

The feeder cable generally used between the receiving antenna and the TV set to complete the communication chain extends up to 15 to 25 metres. This is likely to lead to deterioration in reception as moisture and dirt reduce the ability of the cable to carry signals, and the signals received by the antenna are almost lost in transit in the cable.

Sometimes, noise due to RF interference from auto ignitions of vehicles, electrical sparking from nearby motor-operated equipment etc are picked up by the TV and these

ers should be connected in series with the signal line, i.e. the antenna cable. The number of preamplifiers cascading in series is limited to three or four since use of more preamplifiers creates a large signal-to-noise ratio and destroys the full amplification factor of the signal.

The transistors used as RF preamplifiers should be high-frequency, low-noise type. Otherwise they can create problems during amplification. A balun (BAlancing UNit) transformer is used to avoid impedance mismatching between the booster and the TV receiver.

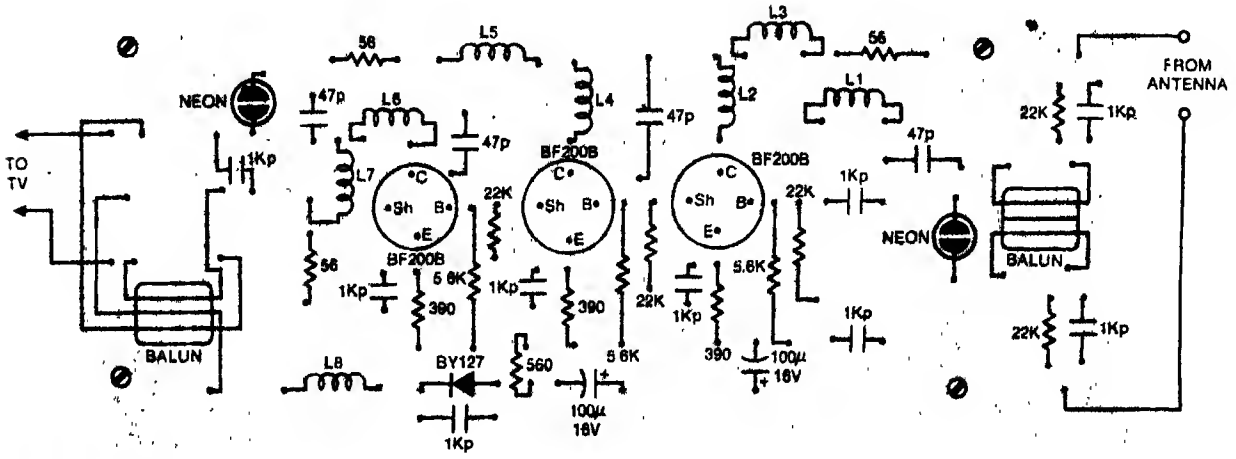


Fig. 4: Components layout for the PCB.

are found much stronger than the signal received. This may produce an unsynchronised picture (loss of vertical and horizontal synchronisation) with poor contrast and snow.

By including a TV booster, the TV signals are amplified several times compared with the interference signals picked up by the antenna or the cable.

Operation principle

The only solution to amplifying the weak TV signals is by the introduction of a number of preamplifiers having the same frequency bandwidth as that of the TV signals with a very little amount of noise figure. This set of RF preamplifi-

One booster amplifier may be connected near the antenna, the source of the incoming signals to amplify the same, and another with the TV set for further amplification since some signal losses are likely to occur in the lead from the antenna. So we can say that the TV booster is generally a two-piece device—the outdoor unit housed in a weatherproof enclosure is fitted to the antenna mast, and the indoor unit is connected to the TV set.

Both the units contain a number of preamplifiers as mentioned earlier, tuned to the TV tower's transmitting frequency. A cable from the antenna (it may be coaxial type or a feeder wire) is connected to the preamplifiers (TV booster) to feed

the received signal to their input. The amplified output signal from this booster runs down the mast to be fed to the TV set through another cable. The same cable also carries the low-voltage supply to the booster amplifier unit fitted to the antenna mast.

The indoor unit, also called the 'set-side' booster, contains

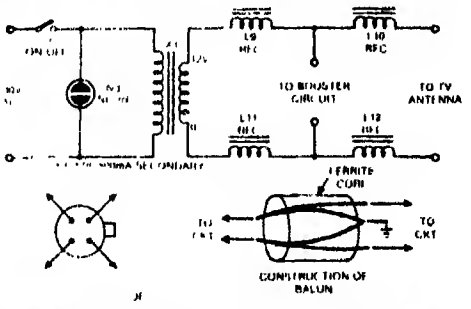


Fig. 5: Construction details of the balun transformer, BF200B transistor's pin diagram and the power supply circuit.

a power supply circuit in addition to the set of preamplifiers. This low voltage AC supply is carried by the same lead from TV set to antenna mast so that there is no need for a separate wire. A splitter may also be used with the set-side unit for feeding the amplified signal if more than one TV receiver is used, but is not necessary otherwise.

The circuit

BEL (Bharat Electronics Ltd) has recently developed a suitable circuit for high-gain TV booster amplifier for VHF operation using the newly developed BF200B transistor. The BF200B has higher gain than the existing BF200 devices. The transistion frequency of this device is more than 800 MHz and the noise figure is about 2.7 dB at frequency of 200 MHz. The circuit comprises three tuned preamplifier stages using BF200B, providing an overall gain of more than 40 dB in all the lower and upper VHF TV channels (i.e. ch. 2 to ch. 12).

Generally, circuits employing a number of inductors for broadband amplification tend to oscillate if proper care is not taken while providing the necessary shielding in printed circuit layout. Also, home constructors find difficulty in alignment. Keeping these points in mind, a three-stage RC coupled design (Fig. 1) is offered here along with a simple power supply. The unit offers a gain of 42 dB up to 100 MHz and about 50 dB up to 150 MHz (beyond 100 MHz) as shown in the gain vs frequency characteristics curve (Fig. 2). It is most suitable for fringe areas and deep fringe TV viewers.

TV signals picked up by the antenna are fed to the base of T1 via C1 to C4 through balun transformer X1 and the trap circuit comprising L1, L2 and L3. The balun transformer converts 300-ohm balanced antenna input to 75-ohm unbalanced output. The partly amplified signal from T1 is fed to the inputs of T2 and T3 for further amplification. Finally, the amplified output appearing at the collector of T3 is coupled to the other impedance-matching transformer (X2) by C10. X2 converts the 75-ohm unbalanced output to 300-ohm balanced output. A feeder cable may be connected to X2 to carry the signal down to power supply as well as to the set-side booster unit.

Construction

Transistorised preamplifiers carrying very high frequencies are used in the circuit. So a printed circuit board layout with proper shielding is required. A suitable PCB layout and the component layout are given in Figs 3 and 4 respectively. This makes the assembly job easier for an average home constructor. The whole booster assembly should be housed in a metal enclosure.

At the time of PCB wiring be careful about the pin configuration of the transistors. And after completing the soldering job, clean the greasy area on the copper track of PCB with the help of petrol and an old toothbrush.

Note: Generally only one TV booster is used in the antenna mast but here use of two boosters is suggested for better results but one can also be used (i.e. in antenna mast). □

—Courtesy: BEL NEWS