

The Command Set Receivers

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THE popular and useful Command receivers have been available for several years, but recently a new release has been made and at the present time the various types can be purchased at reasonable prices. Some readers may not be familiar with these receivers, while others may not have access to the many previous articles published about them, most of which have appeared in American radio journals. The purpose of the present article is to acquaint the reader with the units; to give the basic modifications necessary for use in amateur service, and to suggest further alterations designed to improve the performance.

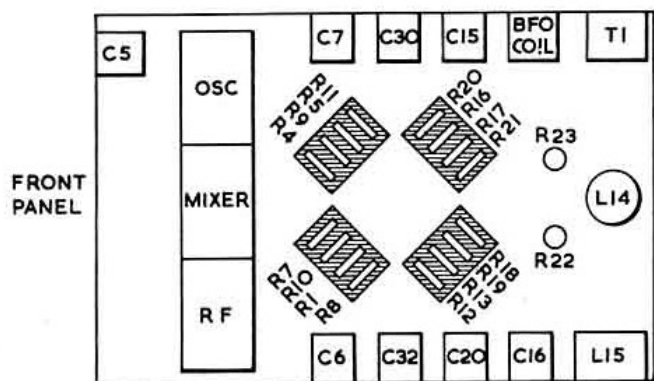


Fig. 1. Underchassis view showing location of principal components.

Types Available

The Command receivers commonly available are the BC453 covering 190 to 550 kc/s. (i.f. 85 kc/s.); the R25 covering 1.5 to 3.0 Mc/s. (i.f. 705 kc/s.); the BC454 covering 3 to 6 Mc/s. (i.f. 1415 kc/s.), and the BC455 covering 6 to 9 Mc/s. (i.f. 2830 kc/s.).

All these units have the same basic six valve super-heterodyne circuit using a 12SK7 r.f. stage; a 12K8 mixer; a 12SK7 in each of the two i.f. stages; a 12SR7 second detector and b.f.o., and a 12A6 output stage. The heaters of these valves are wired in series—parallel for operation from a 25 volt source.

In their original condition, these receivers are stable and reasonably sensitive, although the selectivity of the BC455, and to a lesser extent the BC454, is insufficient by present day standards. However, they may be usefully employed as standby receivers, or in the case of the BC453, as a 'Q5-er' fed from the last i.f. stage of the normal station receiver and thereby providing a dual conversion combination with very high selectivity. The units are also frequently used in mobile operation, although their physical shape introduces mounting problems in the modern car. Where coverage of a band not included in the original frequency range is desired, this may be obtained either by use of a simple converter or modification of the coil pack in the Command receiver.

Basic Modifications to the Receivers

The component references in the text and diagrams are taken from the circuit appearing in the official manual. The circuit has been reproduced frequently in amateur publications and can also be obtained from dealers selling the units. Diagrams showing the location of the main components are given in Figs. 1 and 2.

The initial step is to convert the heater wiring to parallel (6 volts or 12 volts) operation. First of all the heater choke L14 (5546) should be removed, exposing the 3 pin dynamotor plug (J2). The black lead on pin 1 is negative heater and the white lead from pin 2 is positive heater. The latter goes to pin 2 of V6 via a filter condenser C16c (5413). Remove the white lead from pin 7 of V6 and earth this pin; replace the white lead on pin 2 of V6. Pin 7 of V5 is therefore connected to the 'live' heater line. Earth pin 8 of V5. Remove the white lead from pin 2 of V3 and join to pin 7; earth pin 2. Remove white lead from pin 7 which runs to pin 6 on the front socket (J1). Remove the bare wire from pin 2 of V2, fit sleeving and join to pin 7; earth pin 2. Fig. 3 shows the connections after the above alterations have been carried out.

To permit the installation of the front panel controls the socket (J1) at the front of the receiver is removed, complete with box, to allow mounting of the b.f.o. switch, r.f./i.f. gain control and headphone jack on the small front panel.

The lead from pin 6 has already been removed, and the white lead from pin 7 which ran to the heater choke (previously removed) can also be cut out. The remaining leads should be connected thus: pin 1—green—gain control; pin 4—black—phone jack; pin 5—red—b.f.o. switch. The lead formerly connected to pin 2 should be earthed, as should the centre tag of the gain control, one side of the switch and one side of the phone jack.

The b.f.o. switch is of the single pole on-off toggle type. In the 'on' position this switch removes the earth connection from the b.f.o. h.t. line.

The gain control is a 50K ohm variable resistor which completes the cathode circuits of the r.f. and first i.f. valves. This control should be of a compact type and if fitted with a single pole switch, can be used to control the main h.t. supply.

The output transformer T1 (5631) will provide taps of 8,000 ohms impedance (terminal 3) and 600 ohms impedance (terminal 6). The first mentioned value will normally be used with high impedance headphones. The small neon across the primary of T1 strikes at about 80 volts, its purpose being to protect the unit when very strong signals are received.

In the BC453 receiver the bakelite rod seen protruding through the top of each i.f. transformer when the black screw cap is removed, should be carefully pulled out to

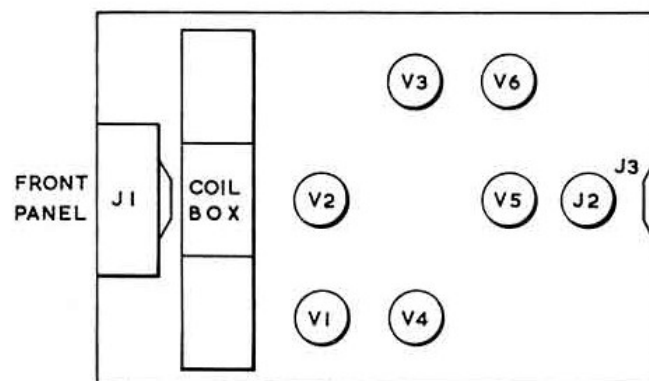


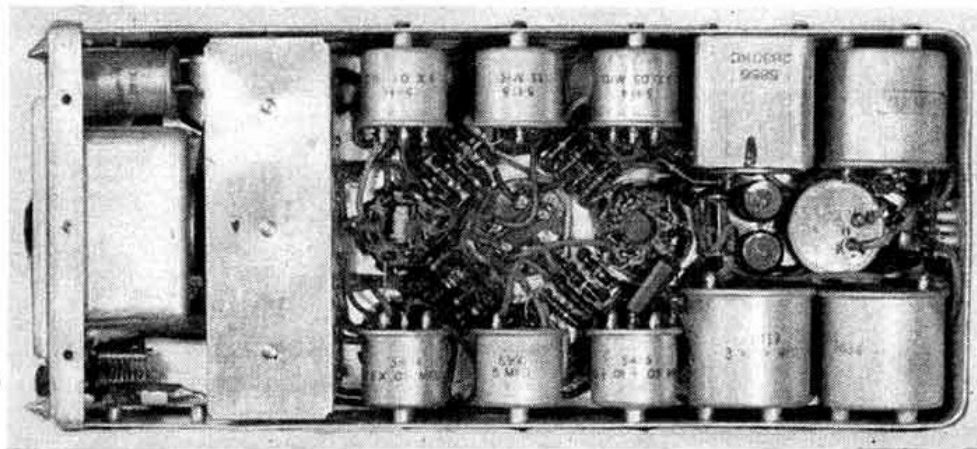
Fig. 2. Underchassis view showing location of valveholders.

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its maximum travel. This has the effect of reducing the coupling and thus giving greater selectivity.

There are several ways in which a tuning knob may be fitted to the toothed drive to the right of the dial, but it is probably easiest to use an extension coupler which can readily be adapted for this purpose by cutting the solid $\frac{1}{4}$ in. extension piece to the required length. A small knob can then be fitted in the usual way.

The simplest way of supplying the Command receivers with the necessary heater power of 12 volts at 0.9 amp or 6 volts at 1.9 amp (when a 6K6 output valve is used)



Underchassis view which, with Figs. 1 and 2, will assist identification of the major components.

and h.t. of 200-250 volts at 50 mA, is to utilize the former dynamotor plug J2. Pin 1 should be earthed; the 'live' heater connected to pin 2 and h.t. positive to pin 3. Alternatively J3 may be removed and replaced by an octal or 4 pin socket.

A Belling-Lee co-axial socket is installed in place of the existing aerial terminal and to accomplish this it will be found necessary to drill only one additional hole.

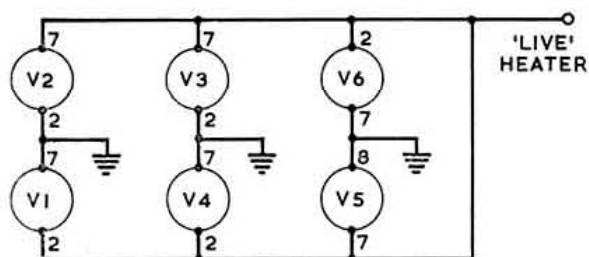


Fig. 3. Heater connections modified for parallel operation.

Further Modifications

When the modifications detailed above have been carried out the receiver will be found to give very good results over the appropriate frequency range. There are, however, further alterations which can be made and which will give improved performance.

The gain control in the original circuit completed the cathode circuits of the r.f. and first i.f. valves. This has been changed as shown in Fig. 4 and it will be seen that the control is now operative on the r.f. amplifier only, which enables overloading to be eliminated whilst retaining the gain of the i.f. stages.

Automatic volume control can easily be added by using the diode of the 12SR7 (pin 5) which is earthed in the original circuit. If the unit is revalved with

6 volt valves the same modifications may be applied to a 6SQ7 or 6SR7. The appropriate circuit is shown in Fig. 5.

If the receiver is to be used on the 21 Mc/s or 28 Mc/s bands either as a 'Q5-er' or by conversion, the need for a noise limiter will be apparent. Several circuits have been tried, including some using crystal diodes, but the arrangement shown in Fig. 6 was found to give best results. A 12H6 is shown but where it is desired to use valves with 6.3 volt heaters, a 6H6 or 6AL5 could be used, or alternatively an EA50, the latter requiring only the small cradle type valve holder which, with care, could be fitted below the chassis. An on-off switch for the noise limiter is unnecessary, but if one is fitted, the leads to it should be individually screened.

Greater audio output may be obtained by the addition of an a.f. amplifier (12J5 or similar) feeding into the 12A6 (or a 6K6 if 6 volt valves are used). If these alterations are made then the noise limiter can be fitted around the original 12A6 valveholder, and two new sockets mounted on the rear platform to accommodate the a.f. amplifier and output stage. A suitable circuit is suggested in Fig. 6 and it will be seen that an audio gain control is now incorporated.

The pitch control in these receivers is located in the b.f.o. coil assembly and needs screwdriver adjustment. To provide easier operation a trimmer, similar to the small aerial trimmer found in the set, was obtained and mounted in the position formerly occupied by the $3 \mu\text{F}$ by-pass condenser C5 (7582) on the right hand side of the front panel. One side of this trimmer is connected to pin 6 of the 12SR7, the other side being earthed. If a full range is to be obtained with this control, it will be necessary to disconnect the existing condenser in the b.f.o. coil can (C28).

Miniature rotary switches are now available at very reasonable prices and a 2 pole 3 way unit can be mounted on the front panel to give the following positions: A.v.c. on—A.v.c. off—B.f.o. on. If this is done then the toggle switch controlling the b.f.o. can be eliminated and the rotary switch mounted in its place.

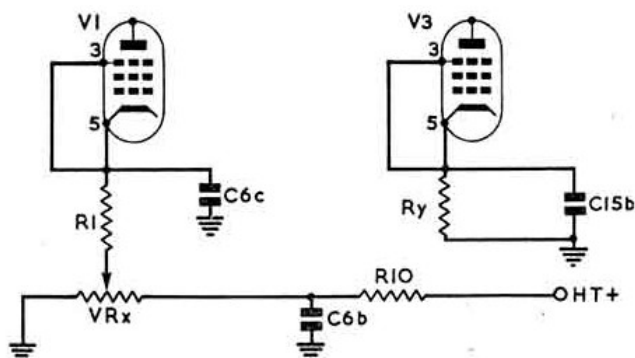


Fig. 4. R.f. gain control circuit after modification. R_y , 1,500 ohms $\frac{1}{4}$ watt. VR_x , 50,000 ohms potentiometer. All components except R_y and VR_x appear in the original circuit.

Conversion to 28 Mc/s

The BC454 Command receiver can be successfully converted for use on 14, 21 and 28 Mc/s, and one of these units is at present giving excellent results when used in a 28 Mc/s mobile installation. Assuming that the basic modifications have been carried out the conversion consists of modifying the tuning condenser; re-winding the r.f. coils and increasing the gain of the receiver.

All the rotor plates but one in each section of the tuning condenser should be removed. The plate left should be the slotted one so that tracking adjustments may be made; the remainder may be removed by careful flexing with a pair of long nose pliers. Next, remove the plug-in coil pack from the bottom of the receiver when it will be seen that the location of this pack is

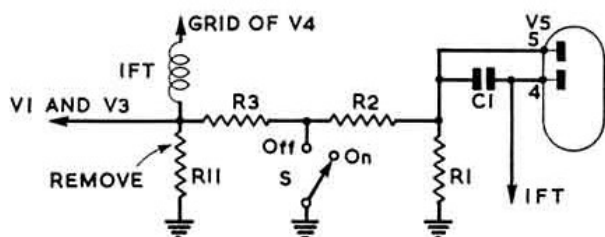
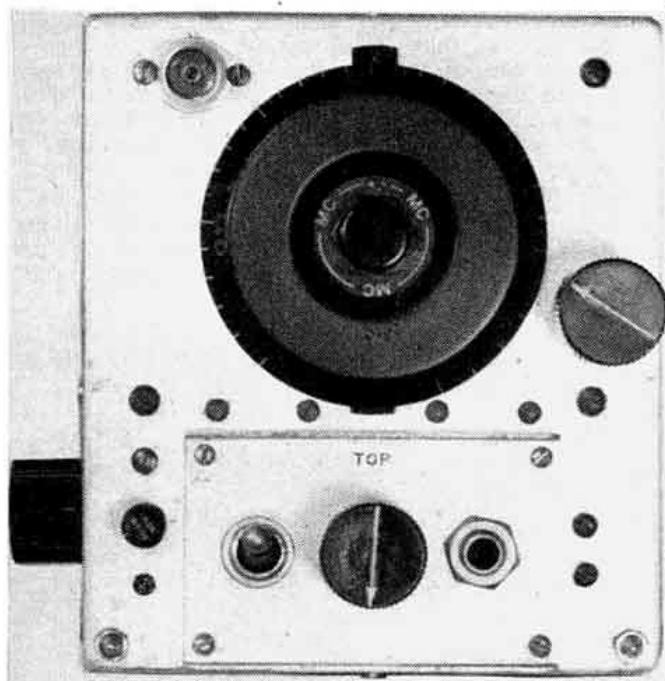


Fig. 5. Circuit showing modifications necessary for a.v.c. C1, 100pF mica; R1, 1 Megohm $\frac{1}{2}$ watt; R2, 0.5 Megohm $\frac{1}{2}$ watt; R3, 0.1 Megohm $\frac{1}{2}$ watt; S, s.p.s.t. toggle; V5, 12SR7. R11 appears in the original circuit (100,000 ohms).

determined by the pin arrangement of the three coil plugs. Remove each coil from its shield can, and the core from each coil, replacing the cores when the alterations have been completed.



Front view of the unit after the basic modifications have been carried out.

substitution rather than rewire the various stages. If, however, there is no objection to the latter procedure, the installation of a 6AK5 r.f. stage will, with correct circuit constants, give enhanced performance on 28 Mc/s. 12SG7 valves were substituted for the existing 12SK7 type in the r.f. and i.f. stages, and the screen volts were increased by fitting a 20,000 ohm 10 watt resistor in place of R23, the existing bleeder resistor on the

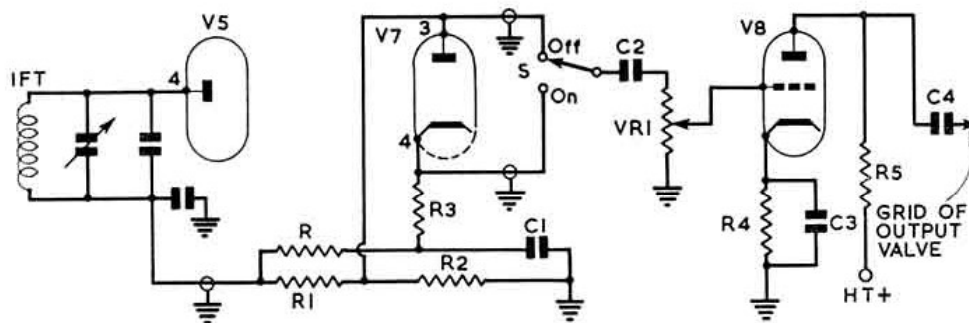


Fig. 6. Circuit showing addition of noise limiter and a.f. amplifier. Unmarked components appear in the original circuit.

C1, 0.05 μ F;
C2, C4, 0.01 μ F;
C3, 3 μ F (can be C5 of original circuit, previously discarded);

R, 1.2 Megohm $\frac{1}{2}$ watt;
R1, R2, 270K ohms $\frac{1}{2}$ watt;
R3, 820K ohms $\frac{1}{2}$ watt;
R4, 2.2K ohms $\frac{1}{2}$ watt;
R5, 220K ohms $\frac{1}{2}$ watt;

S, s.p.s.t. toggle;
VR1, 1 Megohm potentiometer;
V5, 12SR7;
V7, 12H6 (see text);
V8, 12J5 (or similar).

The r.f. coil should be rewound with 6 turns of 18 s.w.g. enamelled copper wire; the mixer coil secondary with 5 turns; the interwound mixer coil primary with 9 turns, and the oscillator coil grid winding with 5 turns. All these coils should be spacewound and the oscillator tuning range should be above the signal frequency. The final adjustments to obtain the required frequency coverage should be made with the condenser shield cover in place.

The gain of the receiver may be increased in several ways but it was preferred to make straightforward valve

screen grid line. If desired, some further improvements may be effected by connecting the heaters of the two i.f. stages in series and using two of type 6AB7 in place of the original 12SK7s.

This article has dealt with only a few of the many possible modifications to these versatile and useful receivers. The references which follow will provide additional information on this subject.

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Command Transmitters on the Amateur Bands

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In operation the coupling coil is advanced until the p.a. draws the required current, or until the maximum r.f. output is obtained. Over coupling will give a greater d.c. input, but efficiency falls off rapidly, and any harmonics which are present in the p.a. tank circuit are more easily radiated.

Telephony

To use telephony with these transmitters the simplest method is that for which they were originally intended, i.e., screen modulation. For this it becomes necessary to reduce the screen voltage to 150 volts maximum so that the standing input obtainable is correspondingly lower. The screen is fed through the secondary of a modulation transformer. A few watts of audio will fully modulate 50 watts input.

When setting up on 'phone, the coupling and aerial tuning must be adjusted until the p.a. anode current kicks upwards when modulation is applied, otherwise the radiated signal will be badly distorted, and probably unintelligible. It will be found that slightly more coupling than the optimum for maximum r.f. output is necessary to achieve good modulation.

TVI

Lacking a television receiver, the author can make no claims about the TVI aspect of the Command transmitter, but *Television Interference*, Third Edition (Remington Rand Laboratory of Advanced Research) carries on page 75 a short note on this subject, which broadly speaking, advocates the removal of the aerial tuning coil, as mentioned earlier, complete screening of the unit, with an aluminium plate over the front window, and copper mesh over the inside of the louvers, and the by-passing of all the supply and keying leads with 0.01µF disc ceramic capacitors at the power socket.

The 3.5 Mc/s unit has been on the air under the call-sign G3HTI for several months, with very satisfactory results from a poor aerial.

The Command Set Receivers

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