SECTION 3

RECEIVERS RC5/1A AND RC5/1B

INTRODUCTION

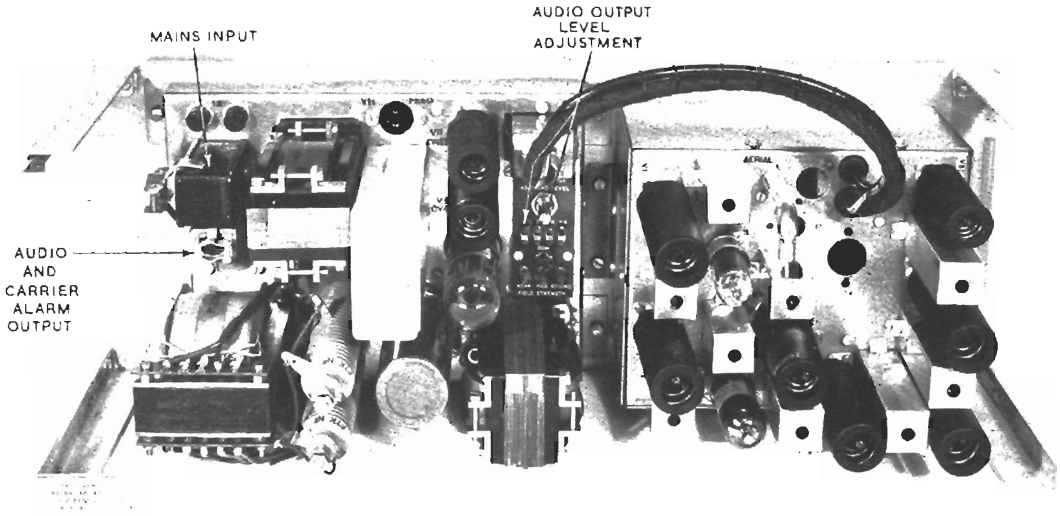
The RC5/1A and RC5/1B are single-frequency crystal-controlled f.m. receivers primarily intended for use at transmitting stations for rebroadcasting. They can also be used at studio centres for monitoring transmissions from nearby f.m. transmitters. The receivers incorporate a carrier failure alarm.

The RC/1A and RC/1B receivers consist of a commercial f.m. tuner (Dynatron model F.M.2) with a modified oscillator section. The receiver is mounted together with a combined mains unit, a.f. amplifier and carrier failure alarm circuit, on a standard 19-inch by 7-inch panel.

Each receiver is tuned to a specific frequency in the band 88 to 100 Mc/s, the oscillator being crystal-controlled for good frequency stability. Any alteration of frequency requires re-alignment of the signal-frequency and oscillator circuits and this must be carried out only by Equipment Department. In the RC5/1A the oscillator frequency is below the signal frequency and in the RC5/1B it is above the signal frequency. A photograph of an RC5/1A is given in Fig. 3.1.

Output levels of 0, +4 or +8 dB can be delivered into a 600-ohm load for an input frequency-modulated to ± 30 kc/s, a tag panel permitting selection of the desired output level. A gain control is provided for accurate adjustment of output level.

A single receiver can operate via 70- to 100-ohm feeder from a dipole or other suitable aerial. Several receivers can be operated from a common aerial by use of an Aerial Coupling Unit ACU/5 described in Section 4.



GENERAL DESCRIPTION OF THE RC5/1A

Receiver Circuit

The complete circuit diagram of the receiver up to the discriminator is given in Fig. 10: this applies only to receivers with serial numbers up to 120. The circuit differs from that of the HR/18 in the following respects:

1. There is no switched signal-frequency tuning in V1 anode circuit. The receiver is intended for a

single transmission only and the anode inductor L1 of V1 is adjusted to resonate with the shunt capacitance (chiefly V1 output capacitance and V2 input capacitance) at the frequency of the transmission.

2. The double-triode oscillator and reactance-valve circuit of the HR/18 have been replaced by a circuit incorporating two pentodes V3 and V4. V3 is a frequency doubler and V4 a combined oscillator and frequency tripler, the operation of the circuit being explained in detail later.
3. The spring-loaded switch and 2-pole socket associated with the a.f.c. circuit of the HR/18 are no longer necessary and are omitted.
4. Only one crystal diode MR1 is used to supply d.c. bias to the carrier failure alarm circuit of the RC5/1A. This is taken from the grid circuit of the final limiter stage V7. Satisfactory operation of the carrier failure alarm circuit is obtained using only one crystal output because the input-output characteristic of the receiver is a better approximation to the ideal shape than for the HR/18 and HR/18A.

The oscillator circuit operates in the following manner. The control grid and screen-grid of pentode V4 are connected as a tuned-grid tuned-anode oscillator. The tuned control grid circuit contains the crystal and the tuned screen grid circuit consists of an inductor L4 which is adjusted to resonate with the screen grid-earth capacitance at the oscillator frequency. The anode circuit contains an inductor L5 which is adjusted to resonate with the 6·8-pF capacitor C22 and the anode-earth capacitance at three times the crystal frequency.

The output at V4 anode is coupled to V3 control grid by C19 and R11. The anode circuit of V3 contains an inductor L4 which is adjusted to resonate with the 10-pF capacitor C18 and the anode-earth capacitance of V3 at six times the frequency of the crystal that is twice the frequency of the input signal. The ouput of V3 is applied to the mixer (V2) control grid via the 2·2-pF capacitor C12.

The required crystal frequency can be calculated as follows. If the carrier frequency of the transmission to be received is f_c, the oscillator frequency must be (f_c — 10·7) Mc/s, the intermediate frequency of the receiver being 10·7 Mc/s. The two valves V3 and V4 give a six-fold multiplication of frequency and thus

$$\text{crystal frequency} = \frac{f_c - 10{\cdot}7}{6} \text{ Mc/s}$$

As an example, if the carrier frequency is 93·5 Mc/s

$$\text{crystal frequency} = \frac{93{\cdot}5 - 10{\cdot}7}{6} \text{ Mc/s}$$

$$= \frac{82{\cdot}8}{6} \text{ Mc/s}$$

$$= 13{\cdot}8 \text{ Mc/s}$$

The i.f. amplifier and discriminator circuit is similar to that of the HR/17 and is described in Sections 1 and 2.

The circuit of receiver type F.M.2 was modified by the manufacturers after a number had been produced and the circuit diagram given in Fig. 11 applies to RC5/1A receivers with serial numbers after 120. The differences between the two circuits are as given for the HR/17A receiver with serial numbers above 200 in Section 2.

GENERAL DESCRIPTION OF THE RC5/1B Receiver Circuit

The RC5/1A receiver may in certain situations give unsatisfactory reception. For example there may be a heterodyne whistle due to second-channel interference. This can be avoided by using an RC5/1B receiver. In this type the oscillator frequency is above the signal frequency and second-channel breakthrough therefore occurs at a frequency 21·4 Mc/s higher than for the RC5/1A.

The complete circuit diagram of the RC5/1B up to the discriminator is given in Fig. 12: this applies only to receivers with serial numbers up to 120. The circuit has much in common with that of the RC5/1A but the tuning capacitances in the oscillator and frequency-multiplying stages are smaller to give higher operating frequencies. The following are the difference in component values:

1. the crystal frequency is given by

$$\text{crystal frequency} = \frac{f_c + 10{\cdot}7}{6} \text{ Mc/s}$$

For a carrier frequency of 93·5 Mc/s

$$\text{crystal frequency} = \frac{93{\cdot}5 + 10{\cdot}7}{6}\ \text{Mc/s}$$

$$= \frac{104{\cdot}2}{6}\ \text{Mc/s}$$

$$= 17{\cdot}38\ \text{Mc/s}$$

2. C22 is 4·7 pF instead of 6·8 pF
3. C18 is 4·7 pF instead of 10 pF
4. C12 is 0·5 pF instead of 2.2 pF

The circuit diagram for RC5/1B receivers with serial numbers after 120 is given in Fig. 13. This differs from the circuit of Fig. 12 as explained for the HR/17A in Section 2.

Power Supply, Audio Amplifier and Carrier Alarm Circuit

The circuit of the power supply, audio amplifier and carrier failure alarm for the RC5/1A and RC5/1B receivers is similar to that for the HR/18 shown in Fig. 5 and reference should be made to Section 1 of this Instruction for full details. Only one crystal output is however used and the FIELD STRENGTH control should always be set to WEAK.

Performance

The overall frequency response of the receiver is within ± 2 dB of a 50 μS de-emphasis curve (Fig. 3) from 40 c/s to 20 kc/s.

For an input modulated by a single frequency to a deviation of 75 kc/s, any individual harmonic in the audio output is less than 1 per cent. The total harmonic distortion is less than 1·7 per cent.

Limiting begins with an input of 6 μV. For an input of 31 μV the signal noise ratio is better than 40 dB and for an input of 100 μV it is better than 55 dB.

Adjustment of A.F. Output Volume Maintenance

These are as for the HR/17 and reference should be made to Section 1 for details.

Adjustment of Carrier Alarm Circuit

Operation of the alarm circuit can be checked as follows:—

1. Set the FIELD STRENGTH control to WEAK.
2. Connect a PTM/6 (or a 100μA meter built out to 10 kilohms) to V10 FEED.
3. Note the meter reading in the presence of the carrier. This should be greater than 40μA.
4. Disconnect the aerial or aerial feeder from the receiver and check that the carrier alarm operates.