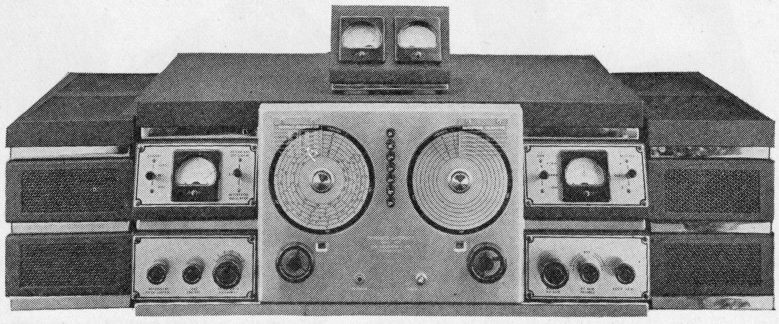
General Data

HALLICRAFTERS DD-1 DIVERSITY RECEIVER

By S. GORDON TAYLOR



The tuner is flanked at either end with the separate power supply and power amplifier units.

THE principle of diversity reception takes advantage of the fact that the instantaneous level of a fading signal may be widely different on two antennas which are spaced a few hundred feet apart or are of different polarization (as when placed at an angle of 90° or more to one another). By combining the outputs of the two or more such antennas a very definite improvement in the average level of a fading signal is obtainable, oftentimes making a really good signal out of one which on a single antenna might be fading hopelessly.

Unfortunately, the outputs of two antennas cannot be effectively mixed or combined at radio frequencies. Most fading is the result of a signal arriving at the antenna over different paths. If these separate components arrive in phase they aid each other, but if out of phase tend to cancel. With any variation in the length of one or more paths the phase relationship is altered and the signal rises or falls accordingly. Similar variations occur when combining the outputs of two antennas, with the result that at one instant their outputs may be aiding each other and at the next moment partially cancelling. This is true regardless of whether the outputs are mixed directly or are first fed through separate r-f amplifiers and then mixed. It is only by first rectifying the signals and then combining them at audio frequencies that they can be made additive.

In practice this means that the most effective form of diversity reception involves the use of a separate receiver with each antenna, mixing the outputs of these receivers in a common audio amplifier. This is the method employed in the transoceanic telephone and telegraph receiving stations. It is also the method employed in the Hallicrafters DD-1 "Dual-Diversity" receiver.

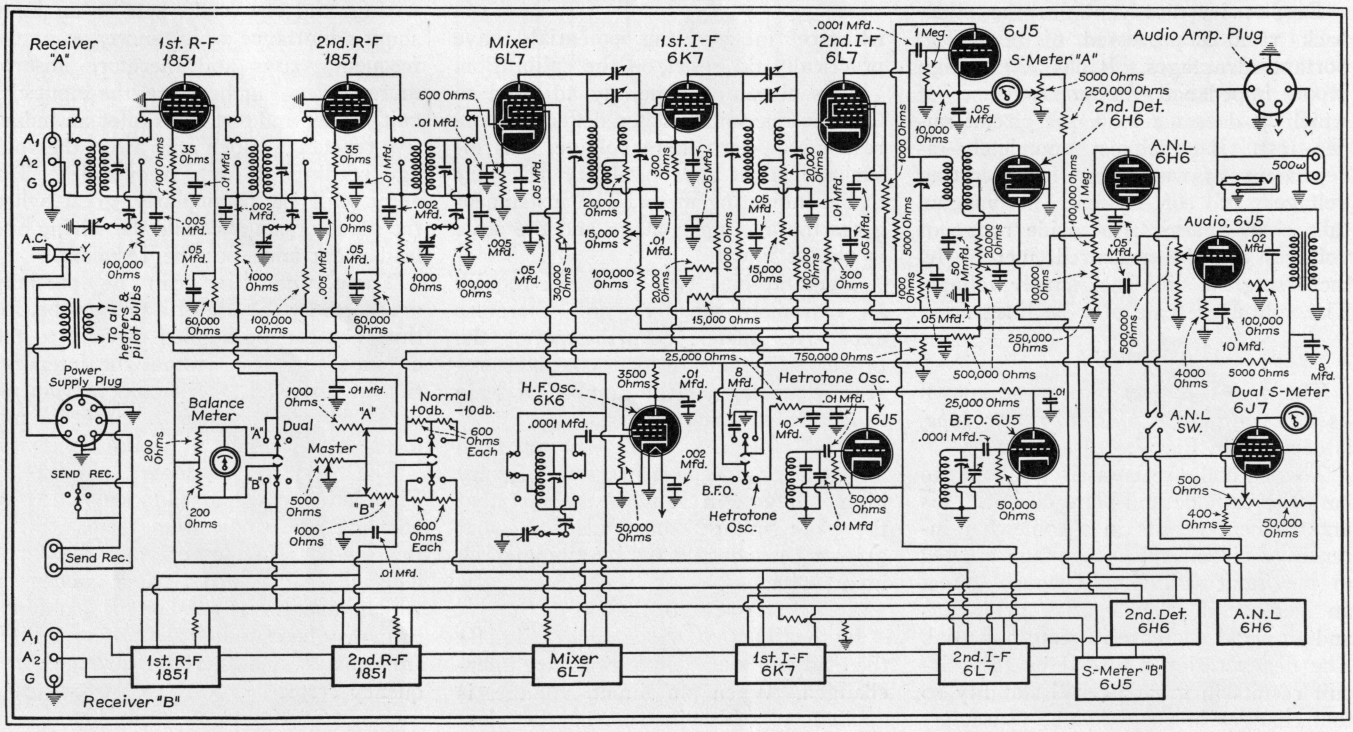
The circuit of this receiver is shown in Fig. 1. The following discussion will be limited to the special features involved in its diversity application.

Essentially, the DD-1 consists of two separate superheterodyne receivers mounted on a single chassis and feeding into a common audio amplifier. Each utilizes two r-f stages with 1851 tubes. Following this in each channel is a mixer, 2-stage i-f amplifier, diode detector and avc, noise limiter diode, and "S" meter amplifier stage.

A single r-f oscillator serves both receivers. This makes single-dial tuning practical and at the same time avoids the beats and birdies that would be almost impossible to eliminate were two separate oscillators employed. The oscillator voltage is fed to the parallel injector grids of the 6L7 mixers. These constitute a heavy capacitative load and if coupled to the oscillator in the conventional way would seriously limit its tuning range. By using a power oscilla-

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Two complete r-f and i-f channels are employed in the Hallicrafters Model DDI dual diversity receiver.



HALLICRAFTERS DD-1

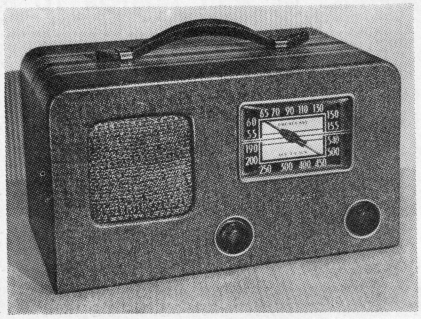
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tor it becomes possible to couple the injector grids at the oscillator cathode. While only a fraction of the oscillator output is available at this point, it is ample and the shunting effect of the parellel injector capacities is minimized. Moreover, this coupling arrangement results in greater oscillator stability.

While each channel has its own avc system, the two are interconnected so that the combined avc voltage is applied equally to both receiver channels. This is an important feature, because it means that when the signal is strong in one channel but weak in the other the relatively high control voltage developed in the avc system of the stronger channel will be applied to both and the noise which would develop with the weaker channel running wide open is eliminated. At no time does either channel operate at full gain except in instances where the signal is below avc threshold in both receivers. It is for these reasons that "diversity" offers a marked improvement in signal-to-noise ratios. In this connection it is interesting to note that the usable sensitivity of the DD-1 model is better than 0.29 microvolt from 7 mc to 25 mc. These figures represent the "equivalent noise sideband input" measurements made in accordance with standard practice.

The use of the same i-f peak in both receivers makes it practical to employ a common beat-frequency oscillator. In other receivers for best cw reception it is desirable to cut out the avc, but without avc diversity effectiveness is lost. For this reason a "heterotone" oscillator is provided. This is simply an audio tone oscillator, the output of which is fed into the injector grid of the 6L7 second i-f amplifier stages to modulate any carrier that may be present. Unlike the output of the beat-frequency oscillator, this does not tend to load the avc system. With no signal tuned in the tone is not heard but as soon as a carrier is tuned in it becomes audible in the form of a tone modulated signal.

RCA 94BP4 portable receiver is entirely self contained. A loop antenna located on the bottom of the portable case is sufficient for reasonable reception.



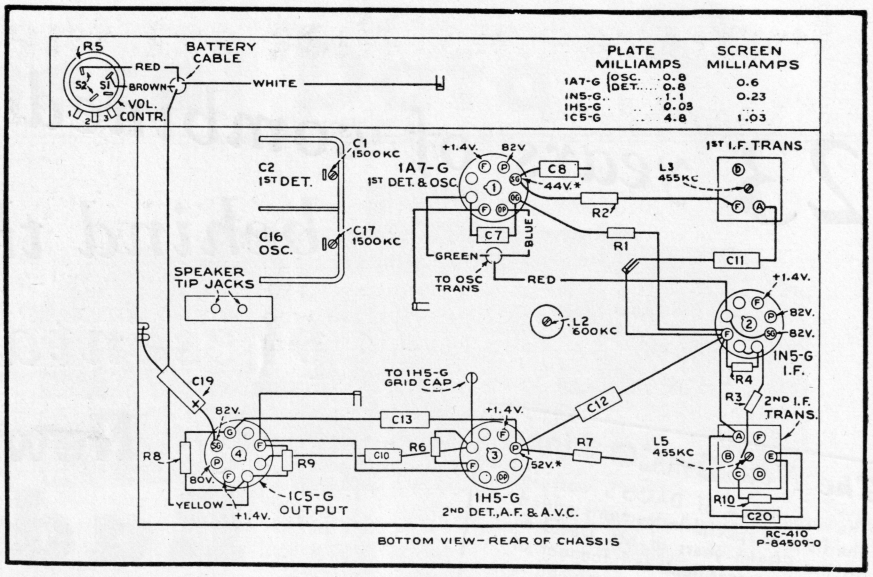


Fig. 2. The trimmer adjustments shown in the underchassis can be reached through holes provided in the portable carrying case.

Diversity action is most effective when the average outputs of the two channels are equal. Inasmuch as the pick-up of two antennas is likely to be unequal, compensation is accomplished by adjusting the gain of the individual r-f amplifiers. To simplify this operation the two controls are ganged to a single "balancing" knob and so designed that at mid-position of this knob maximum gain is available from both receivers. If the output of channel A is shown by its S meter to be greater than that of channel B the knob is moved to the left of center. This leaves the gain of channel B at maximum but reduces that of channel A. Or, if the output of B is higher the knob is rotated to the right of center to achieve a balance.

Other refinements included in the circuit are a switch by means of which either receiver can be cut off when diversity is not needed; an overall S meter actuated by the combined outputs; connections for plugging in a twin meter, one serving for each individual channel; variable adjacent-channel interference rejector system; push-button band selector switch; band-spread tuning control and dial; master r-f gain control and i-f gain control in three steps by means of 3-position switch.

PORTABLE RECEIVER

(See Front Cover)

WITH the advent of low-drain 1½-volt tubes, the receiver manufacturers are introducing completely self-contained portable receivers. The diagram on the front cover is RCA's contribution to this field.

The chassis is a high-gain, 4-tube superheterodyne with remarkably low battery drain. The entire receiver draws less than ¼ amp A battery current and only 9.0 ma for the total plate supply. The volume is ample and the tone quality good.

Service Data

An antenna and ground may be connected to "A" and "G" at the bottom of the cabinet. If the total length of the antenna and lead-in is more than 150 ft, a 300 mmfd capacitor should be connected in series with the lead-in.

In the chassis layout (Fig. 2) some voltages are shown with an asterisk (*). These are the actual operating voltages and do not take into account the voltmeter loading. In all cases the measured value will be less than this value by the amount of the voltmeter loading. Measurements are made to the chassis unless otherwise indicated, with

RCA 94BP4 ALIGNMENT OPERATIONS

Connect Generator to	Dummy Antenna	Generator Frequency	Dial Setting	Peak Trimmer
1N5G Grid	0.001 mfd	455 kc	550 kc	L5, L6
1A7G Grid	0.001 mfd	455 kc	550 kc	L3, L4
Antenna Term.	200 mmfd	1500 kc	1500 kc[1]	C17, C1
Antenna Term.	200 mmfd	600 kc	600 kc[2]	L2[3]

Repeat antenna and oscillator adjustments.

[1]*Use bottom of the* 1 *for* 1500-*kc calibration point.*
[2]*Use center of* 0 *in* 60 *for* 600-*kc calibration point.*
[3]*Rock dial for best adjustment.*