TM 11-872

WAR DEPARTMENT TECHNICAL MANUAL

DIVERSITY RECEIVING EQUIPMENTS AN/FRR-3 AND AN/FRR-3A

WAR DEPARTMENT · JANUARY 1946

PART ONE

INTRODUCTION

Section I

DESCRIPTION

1. General

Diversity Receiving Equipments AN/FRR–3 and AN/FRR–3A (figs. 2 and 1) are fixed plant sets designed for use in a point-to-point radioteletype system of communication to overcome the effects of fading. Fading is a variation in the strength of a received signal and if present seriously reduces the effectiveness of a radioteletype system of communication. (See par. 79c.)

2. Diversity Receiving Equipments AN/FRR–3 and AN/FRR–3A

Diversity Receiving Equipments AN/FRR–3 and AN/FRR–3A use two identical superheterodyne receivers, receiver A and receiver B, operating from separate antennas (fig. 41). A common high-frequency oscillator is used to feed both receivers. The high-frequency signal fed to the mixer stage of each receiver comes from the high-frequency oscillator through an isolation amplifier, multiplier, buffer amplifier, and a separate isolation amplifier to each receiver. The signal from the common beat-frequency oscillator (bfo) is fed to the signal detector of each receiver through a separate isolation amplifier. For diversity operation automatic-volume-control (a-v-c) voltage can be made common to both receivers as shown in the block diagram (fig. 41) by placing both DIVERSITY-ON-OFF switches in the ON position. A tuning eye, OUTPUT INDICATOR operating from the output of one of the isolation amplifiers in the high-frequency channel is provided as an aid in tuning the high-frequency oscillator and its associated amplifier stages. A similar eye, operating from the output of the a-v-c intermediate-frequency (i-f) amplifier in each receiver, is provided as an aid in tuning the receivers and the system as a whole. The output of the receivers is fed to Radioteletype Terminal Equipment AN/FGC–1.

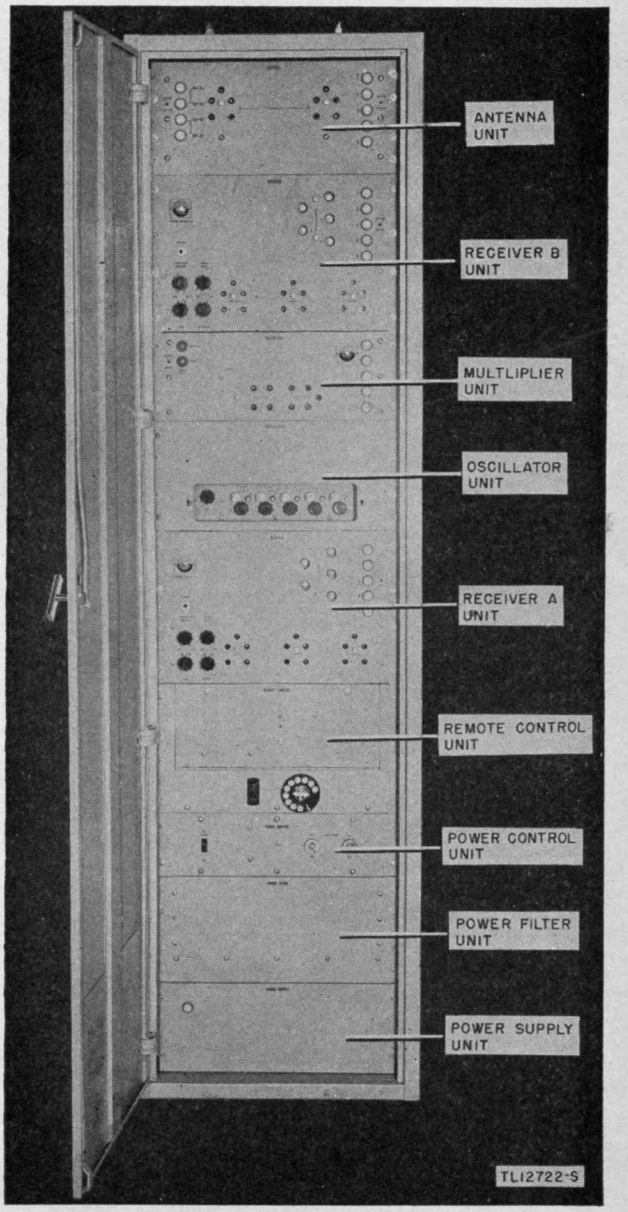

Figure 2. Diversity Receiving Equipment AN/FRR–3.

Both models of the receiving equipment are provided with a local and a remote telephone dial which may be used to turn the equipment on or off, and select any of five pretuned frequencies and any combination of four antennas.

3. Technical and Electrical Characteristics

a. TECHNICAL DATA.

Frequency range:

Band 1	2.4 to 4.2 mc
Band 2	4.2 to 6.9 mc
Band 3	6.9 to 11.2 mc
Band 4	11.2 to 17.5 mc
Band 5	15.0 to 23.0 mc

Receiver type	Superheterodyne
Types of signals which can be received	A-m and radio-teletype signals

Number of tubes:

AN–FRR–3	28
AN–FRR–3A	30

Power source	100 to 130 volts, 50 to 60 cycles or 200 to 260 volts, 50 to 60 cycles

Power consumption:

AN–FRR–3, AN–FRR–3A	400 watts approx.
AN/FGC–1	350 watts approx.

Sensitivity	3 uv or less for 50-mw output (any freq. with carrier 30 percent modulated at 400 cps)

Image ratio:

AN/FRR–3	Better than 50 db at 23 mc
AN/FRR–3A	Better than 60 db at any freq.

Signal-to-noise ratio	Better than 10 db at any freq.
Selectivity	5-kc bandwidth at 6 db down
A-v-c regulation	Within 3 db for a signal change of 10,000 to 1
Method of calibration	Crystal controlled
Antenna	Rhombic or similar antenna

b. FREQUENCY SPECTRUM CHART. For a list of other radio sets with which this equipment may be operated see figure 4.

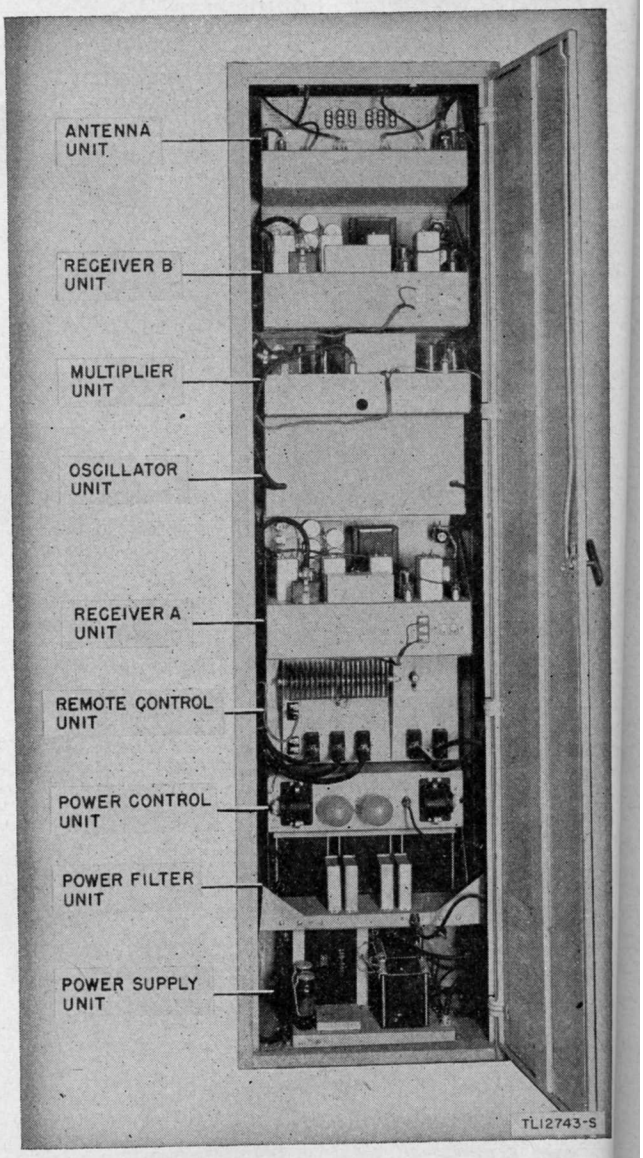

Figure 3. Diversity Receiving Equipment AN/FRR–3, rear view.

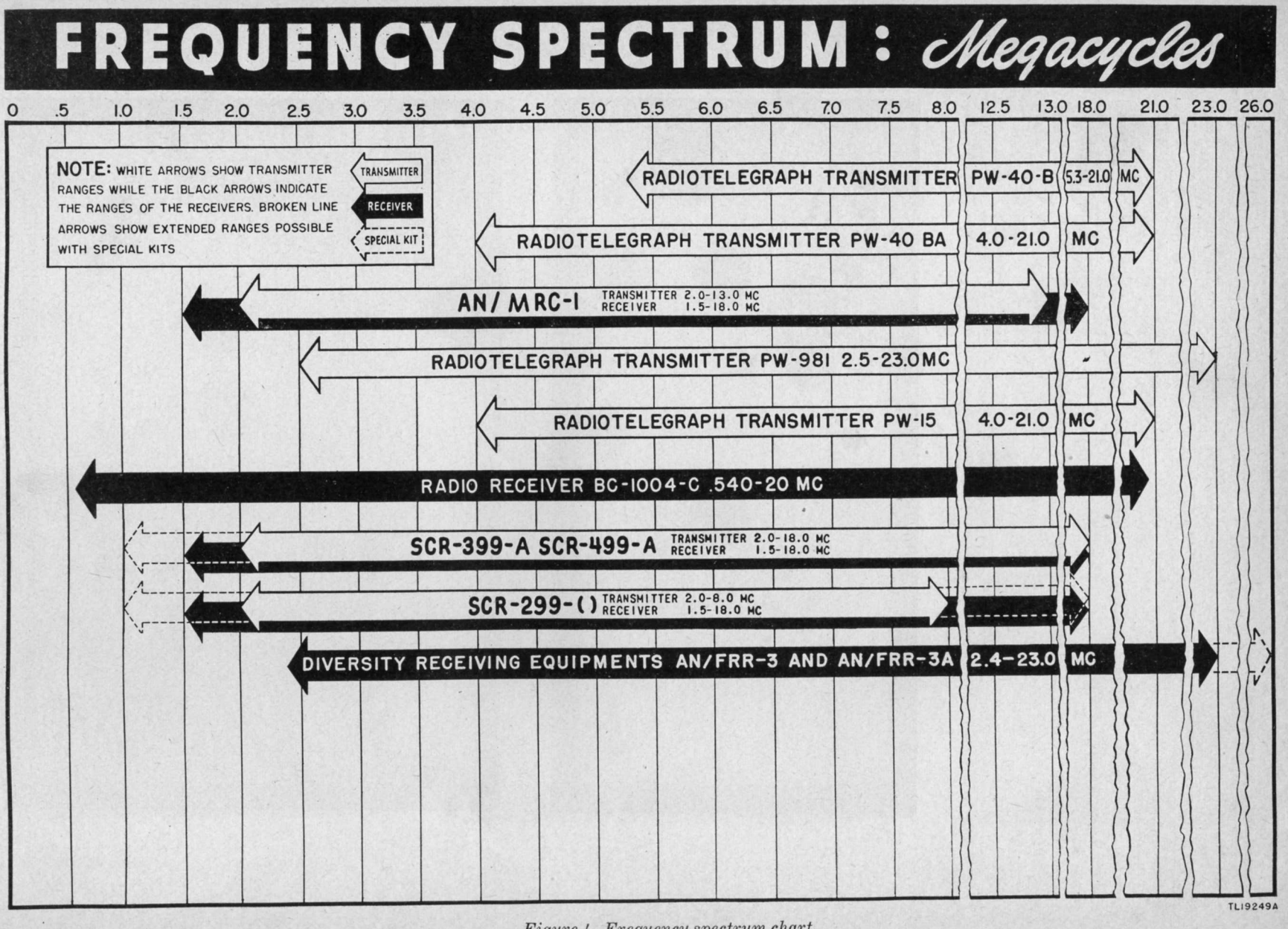

Figure 4. Frequency spectrum chart.

PART FIVE

REPAIR INSTRUCTIONS

Note. Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on WD, AGO Form 468 (Unsatisfactory Equipment Report); by Army Air Forces, on Army Air Forces Form 54 (Unsatisfactory Report).

Section XI

THEORY OF EQUIPMENT

75. General

a. The teletypewriter depends on two signals for its operation, the mark and the space (see par. 11, app. I). Each letter, numeral, or character sent is made up of a different combination of mark and space signals. In a radio-teletype system these mark and space signals are applied to radio-frequency carrier, and transmitted to another point where a receiver picks up the radio-frequency signal and removes the mark and space signals.

b. One method of applying the mark and space signals to the radio-frequency carrier is to shift the carrier frequency in one direction for the mark signal and in the opposite direction for the space signal. In practice, the carrier is shifted 425 cycles per second higher than no-signal frequency for the mark signal and 425 cycles per second lower than no-signal frequency for the space signal. The radio-frequency carrier remains on the air at all times during the transmission and merely changes frequency for the signal conditions.

c. In order to insure proper operation of the teletypewriter at the receiving location, a good steady signal must reach the receiver at all times. Fading or variation in the strength of the received signal, then, is a great problem. The occurrence of fading is explained as follows: the presence of the ionosphere sets up more than one path over which a radio wave may travel from a transmitter to a receiver. The phase difference between two received signals depends upon the length of each path measured in wavelengths. If the difference in length of the paths is an integral number of wavelengths, the fields will be in phase and add directly. If the difference in length is an integral number of wavelengths plus one-half wavelength, the two fields will be 180° out of phase and the resultant field will be the difference between the two received fields. Since the position of the ionosphere is not constant, this phase relation will change with time, and the resultant field will vary, producing what is known as fading. However, since the received signals do not come from the same angle, the cancellation or partial cancellation of the signals will not occur at more than one place in the vicinity of the receiving antenna. By spacing two antennas 1,000 feet apart and coupling each into a separate receiver, sufficient signal energy will always be received at one of the antennas to give satisfactory reception in one of the receivers. If the output of the receivers is combined, there will normally be sufficient output to operate the terminal equipment. This use of two receivers connected to separate antennas is known as a diversity receiving system.

d. After the r-f signal is received the mark and space signals must be removed from the carrier. In Diversity Receiving Equipments AN/FRR–3 and AN/FRR–3A this is done by beating the incoming r-f signal against a fixed frequency oscillator. This produces two audio signals, one for each position of the carrier, of 2,125 cycles and 2,975 cycles (see fig. 54). The individual tones are amplified and fed to Radio-teletype Terminal Equipment AN/FGC–1. The teletype terminal equipment filters, amplifies, limits, and rectifies the individual tones from the diversity receivers. The rectified direct-current (d-c) pulses energize the mark or space windings of a polar relay which in turn operates the teletypewriter unit.