UNCLASSIFIED

TECHNICAL MANUAL

for

GENERAL PURPOSE

RECEIVER

MODEL DDR-6K

SYSTEM

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

UNCLASSIFIED

TECHNICAL MANUAL

for

GENERAL PURPOSE

RECEIVER

MODEL DDR-6H

SYSTEM

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

IN-3003H ISSUE DATE: 30 OCTOBER 1963

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

FOREWORD

TMC's General Purpose Receiver, Model DDR-6H, consists of seven major components as follows:

Qty.	Component
1	GPR-90RXD Communications Receiver
2	MSR-4 Mode Selector, Receiving
1	LSP-7 Speaker Panel
1	CFA-1 Frequency Shift Converter
1	SFP-2 Filter Panel
1	DCP-1 Power Control Panel

These seven basic units are also included in various TMC receiver systems as well as in the DDR-6H. To satisfy this condition most practically, individual manuals on each unit are written, then combined, as required, to cover any receiver system. The DDR-6H manual is made up of individual manuals as described in Table of Contents of General Purpose Receiver, Model DDR-6H.

TABLE OF CONTENTS

GENERAL PURPOSE RECEIVER

MODEL DDR-6H

TABLE OF CONTENTS

DDR-1 SYSTEM

TABLE OF CONTENTS (Cont)

SECTION 2 (Cont)

TABLE OF CONTENTS (Cont)

SECTION 2 (Cont)

LIST OF ILLUSTRATIONS

LIST OF TABLES

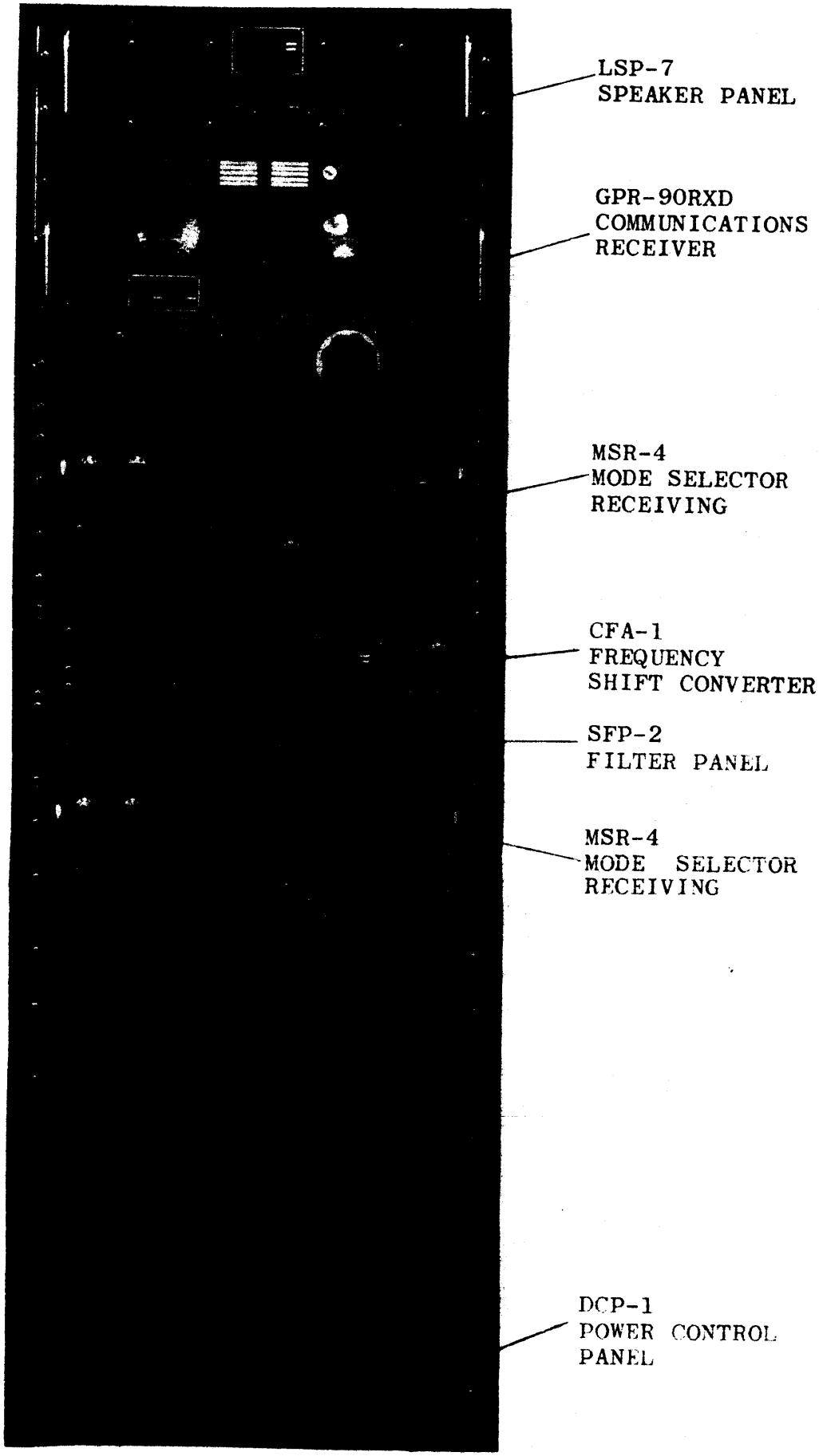


Figure 1-1. Front View, Model DDR-6H General Purpose Receiver

SECTION 1

GENERAL DESCRIPTION

1-1 GENERAL INFORMATION

Model DDR-6H, General Purpose Receiver system (figure 1-1), receives AM, SSB, ISB, CW, MCW and FSK transmission. Reception mode is selected by front panel controls. The input frequency range is 0.54 to 31.5 mc in six bands. Output facilities include two speakers, two sets of 8-ohm, 600-ohm and 600-ohm telephone line output connections and a pulse output for teleprinter operation.

Two types of HFO are available to produce the first i-f frequency (455 kc): a conventional variable oscillator and a crystal-controlled oscillator with ten crystal positions. In addition, an external HFO connection may be used for employing a high-stability oscillator such as Technical Materiel's Model VOX-5 (1 part in 1 x 10^6 per day) or Model CPO (1 part in 1 x 10^8 per day).

Two types of IFO are available to produce the second i-f frequency (17 kc): a variable frequency oscillator and a crystal-controlled oscillator.

Tuning is provided with full electrical/mechanical bandspread in the r-f and i-f sections. A 100-kc crystal-controlled calibrator provides 100-kc markers throughout the tuning range for absolute frequency identity.

Referring to figure 1-1 and reading from top to bottom, the DDR-6H is made up of the following modular units:

LSP-7	Speaker Panel
GPR-90RXD	Communications Receiver

MSR-4*	Mod S lector, Rec iving
CFA-1	Fr qu ncy Shift Conv rter
SFP-2	Filter Panel
MSR-4	Mode Selector, Receiving
DCP-1	Power Control Panel

The GPR-90RXD is used for tuning in the r-f stage and amplifying the r-f and first i-f stages. The MSR-4 is used for selecting one sideband and/or carrier for audio detection. In ISB reception, both MSR-4 units are used -- one for each sideband; in the other modes of reception, one MSR-4 unit is used. The CFA-1 converts audio frequency shift signals, in FSK reception, into d-c pulses for teleprinter operation. The SFP-2 Filter Panel effectively "cleans up" the mark and space signals for the teleprinter when particularly noisy reception problems are present.

The complete DDR-6H system is mounted in a single 13-gauge steel rack equipped with drawer slides for the GPR-90RXD and the two MSR-4 units and a servicing door at the rear. Total weight is approximately 412 pounds. Rack and modular components are finished with TMC RCAF Blue-grey smooth enamel. Two types of rack are available: rigid-mounted or shock-mounted. The rigid-mounted type (shown in figure 1-1) measures 20-5/8 inches wide x 22-1/2 inches deep x 62-1/2 inches high; the shock-mounted type is the same but lacks the separate 3-1/2 inch high mounting base at the bottom (not shown in Figure 1-1) and measures 61-1/2 inches high when installed. The rack contains its own forced-air cooling system consisting of 2 exhaust blowers and an air intake and exhaust with

removabl filters. For shippi weights and other particulars, see Appendix section of this m ual.

TABLE 1-1. ELECTRICA CHARACTERISTICS, DDR-6H

Frequency Range:	0.54 - 31.5 megacycles in six bands:

Band	Range (mc)
1	0.54 - 1.4
2	1.4 - 3.3
3	3.2 - 5.6
4	5.4 - 9.6
5	9.4 - 17.8
6	17.3 - 31.5

Types of Reception:	AM,SSB,ISB,CW,MCW and FSK
Sensitivity:	Better than 1 microvolt from 1.4 to 31.5 mc; intentionally desensitized to 5 microvolts from .54 to 1.4 mc.
Noise factor:	Better than 6 db.
Stability:	Better than .002% for .54 to 5.6 mc and .003% for 5.6 to 31.5 mc. These figures are after warm-up at a normal ambient temperature and will hold for usual operating periods.
Image ratio:	Average 80 db.
IF rejection:	455 kc - Average 85 db 3.955 mc - Average 100 db
AGC characteristics:	MCW,AM: Compensates for 80-db change in input signal. CW,SSB,ISB,FSK: Compensates for 40-db change in input signal.
Antenna input connection:	Type BNC jack for a nominal 70-ohm unbalanced transmission line.

TABLE 1-1. ELECTRICAL CHARACTERISTICS, DDR-6H (Cont)

Outputs:	Audio (for AM,SSB,CW,MCW): a. 1-mw output at terminal block for 600-ohm telephone line. b. 8-ohm speaker (at top of rack) c. 2W/150 mw output for 600-ohm line or 2W/150 mw output for 8-ohm load at MS3102A-14S-2P receptacle. d. Type JJ-034 jack for high or low impedance headset. Audio (for ISB): Two of each of the above are provided for ISB reception. D-c (for FSK): 75 ma maximum current into 2000-ohm load. Load adjustable up to 2000-ohms.
Tuning:	Continuously variable or (for crystal-controlled HFO) 10 front panel selectable frequencies available with 10 type CR-18/U plug-in HFO crystals (supplied as specified on order). Front panel controls: ANT TUNE, r-f RANGE SELECTOR, r-f MAIN TUNING, r-f BANDSPREAD, i-f BANDSPREAD, i-f SIDEBAND selector.
Filtering:	a. r-f, selectable in 6-kc bandwidth or the following 5 bandwidths through a crystal filter: .25-, .5-, 1.0-, 1.5-, and 2.0-kc. b. i-f, 17-kc stage, 3.5-kc wide B.P. filter c. a-f (for FSK) mark (2975 cps) and space (2125 cps) filters with 200 cps bandwidth.
Audio distortion:	Less than 5%.
Hum level:	At least 50 db down from full audio output.

Frequency shift characteristics:	
a. Input frequency shift limits:	] to 1000 cps centered at 2550 cps
b. Received signal frequency drift:	1-1/2 times maximum shift (1500 cps)
c. Keying speeds:	00 to 600 words per minute in high speed position and up to 100 words per minute in low speed position.
d. Tuning indicator:	Two-inch cathode ray tube
e. Bias correction:	A bias correction control permits correction of fixed "marking" or "spacing" bias of the received signals.
f. Mark hold:	Automatic "mark hold" feature places output circuit in "marking" condition during signal dropouts.
Power requirements:	110/220 volts, 50/60 cps line voltage
	75 ma d-c maximum current for 2000-ohm load with control for varying current (for CFA unit).

SE ON 2

INS LATION

2-1. INTRODUCTION

Each DDR-6H General Purp e Receiver has been tested as a complete system before shipme . Upon shipment it is disassembled and packed into crates. It is nly necessary to unpack and reassemble the equipment as outlined in the following paragraphs. Recalibration of the individual modular units is not necessary.

2-2. INITIAL INSPECTION

The complete DDR-6H will arrive in 3 crates containing components as listed in table E in the Appendix section of this manual. Inspect each crate and its contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items". With respect to damage to the equipment for which the carrier is liable, the Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

2-3. RACK INSTALLATION

a. LOCATION - In selecting the receiver location, refer to the Appendix for rack dimensional drawing, Figure A. A clearance of about two feet at the rear of the rack is needed for opening the door for servicing.

b. INSTALLATION - The four threaded holes on the top side of the rack and the four eyebolts included in the shipment are for lifting the rack with a crane hoist. The base-mounted rack is bolted to its own base. In the shock-mounted model, the four

threaded holes in the two cha[illegible]ls in the bottom of the rack are for the 4 shock mounts at the [illegible]ttom. The two holes in the rear rack wall near the top edge [illegible] for the two top shock mounts. To install the shock-mounted mod[illegible], use the base shock-mount pattern in figure A (Appendix) for drilling in the floor or mounting base. Assemble the receiver as descri[illegible]d in paragraph 2-5 and hoist it onto the 4 base mounts. Allow the receiver to settle with its own weight. Then install the t[illegible] top shock mounts, using the two top holes in the rack as a template for drilling holes in the structure.

2-4. 230V LINE VOLTAGE MODIFICATION

a. GENERAL - The DDR-6H is factory wired for 115 VAC 50/60 cycle, single phase line voltage unless specified otherwise on order. If line voltage is 230 VAC 50/60 cycle, single phase, refer to paragraphs 2-4b through 2-4f for modification of DDR-6H wired for 115 VAC.

b. GPR-90RXD - Disconnect black-and-yellow wire lead from T10 transformer at C103 capacitor and tape off end of lead. Attach black-and-red wire lead from T10 transformer to C103. Replace 2-amp fuse (F1) cartridge with a 1-amp fuse cartridge (TMC part number FU-100-1).

c. MSR-4 - Remove switch lead from terminal 2 of T5 transformer and connect it to terminal 3. Replace 3-amp fuse (F1) cartridge with a 1.5-amp fuse cartridge (TMC part number FU-100-1.5). Perform these changes on both MSR-4 units.

d. CFA-1 - Rewire connections at T1 and T2 transformers as shown in figure 2-1. Replace 2-amp fuse (F1) cartridge with a

1-amp fuse cartridge (TMC par number F-100-1).

e. DCP-1 - Remove jumper between I1 indicator light and E2 terminal block as shown in fi re 2-2. No change is necessary to CB1 circuit breaker.

i. BLOWERS - Relocate jumpers at rack terminal block E701 as shown in figure 2-3, for 230 VAC line.

2-5. ASSEMBLY OF RECEIVER

Refer to table E (Shipping List for DDR-6H) for parts and their functions. Install components as shown in figure 1-1 and make cable connections as described in paragraphs 6 and Figures B and E in Appendix of this manual. In some cases, some of the smaller parts may be partially assembled in shipment. The LSP-7, CFA-1, SPP-2 and DCP-1 units are mounted in the rack supported by their front panels. The GPR-90RXD and MSR-4 units are slide-mounted; the track portion of the slides arrive installed in the rack. Follow this general procedure for installing slide mounted units:

(1) Set the component in position on the tracks.

(2) Slide the component on the tracks until the release button catches.

(3) Press the release buttons and push the component into the rack until the release buttons engage in the holes in the equipment.

(4) When all the components have been installed and cabled, press the release buttons and push the component into the rack.

Use the take-up reel, located in the upper rear section of the rack, to secure cabling from GPR-90RXD to prevent snagging when unit is drawn in and out of rack on its drawer slides.

2-6. CONNECTION OF EXTERNAL EQUIPMENT

a. INTRODUCTION - Figure 5 illustrates all external equipment connections to the DDR-6B. The following paragraphs describe each connection.

b. ANTENNA INPUT - The input impedance at J6 antenna jack on GPR-90RXD Receiver chassis rear has been designed to match an unbalanced 70-ohm transmission line.

c. TELEPHONE LINE OUTPUT - Terminals 5 through 8 on terminal block TB602 (located in the lower rear left section of the rack) are for two separate audio outputs to match two separate 600-ohm telephone lines. In CW, MCW, AM and SSB reception, only one set is used, i.e. - either 5 and 6 or 7 and 8. Which set is used depends upon which of the two MSR-4 units is used to tune in the i-f portion of the signal. Terminals 5 and 6 correspond with the uppermost MSR-4; 7 and 8 correspond with the lowermost MSR-4. Either MSR-4 may be used, at the election of the operator. For ISB reception, however, both MSR-4 units are used to tune in the upper and lower sidebands separately, and both sets of telephone line outputs are used. The most convenient arrangement in this case, for purposes of reference, is to use the uppermost MSR-4 to tune in the upper sideband and the lowermost unit for the lower sideband. For telephone line operation, the OUTPUT LEVEL switch, at the rear of each MSR-4 chassis, is set to LOW. This produces a maximum output of 1 mw into each line.

d. TELEPRINTER OUTPUT - Terminal 3 and 4 on terminal block TB602 are for the connection of the CFA-1 to the teleprinter equipment in FSK reception. The output is 60 ma (maximum) adjustable up to a 200-ohm load; the procedure for the adjustment is described in paragraph 2-7, Initial Adjustments.

e. CFA-1 CURRENT INPUT Terminals 1 and 2 on terminal block TB602 are for the connection of an adjustable 75-ma maximum d-c current source for the CFA-1 pulse generator. The DDR-6H Receiver is designed for working with a teleprinter that contains this source. If the source is not contained in the teleprinter equipment, Technical Materiel Corporation's Model PSP-1 Power Supply will furnish this requirement.

f. HEADSET OUTPUTS - Separate headset outputs for upper and lower sidebands are available in PHONES jacks on the front panels of the two MSR-4 Sideband Converters, when tuning in ISB. In CW, MCW, AM and SSB reception, only one MSR-4 with its corresponding PHONES jack is used. It may be either the upper or lower unit, as elected by the operator. Each PHONES jack, type JJ-034, will take a high or low impedance headset. Plugging into the PHONES jack will not disconnect the loudspeaker.

g. AUXILIARY 600/8-OHM AUDIO OUTPUTS - On the rear of each MSR-4 chassis is an MS3102A-14S-2P receptacle furnished with mating MS3106-14S-2S plug (see Table E, Appendix). As shown in figure 2-5, the plug may be wired for any or all of the following auxiliary outputs with the MSR-4 top chassis OUTPUT LEVEL switch in the following positions:

Output	OUTPUT LEVEL switch position
600-ohm, 2 watt	HIGH
600-ohm 150 mw	LOW
600-ohm, 1 mw (for telephone line)	LOW
8-ohm, 2 watt	HIGH
8-ohm, 150 mw	LOW

NOTE

Normally, the MSR-4 OUTPUT LEVEL switch is set in the LOW position (see paragraph 2-6c) for simultaneous audio outputs to headset and telephone line. When speaker operation is required, it is switched to HIGH, in which case the headset and telephone line outputs are not used. HIGH and LOW outputs may not be used simultaneously from the same MSR-4.

In ISB reception, the most convenient arrangement, for reference purposes, is to use the uppermost MSR-4 to tune in the upper sideband and the lowermost MSR-4 for the lower sideband. In AM, CW and MCW reception, only one MSR-4, with its corresponding outputs, is used. It may be the upper or lower unit as elected by the operator.

h. LINE VOLTAGE INPUT - 115/230 VAC, 50/60 cps, single phase line voltage is connected to the DDR-6H Receiver at J601 receptacle located at the bottom of the rack at the rear. See table E in Appendix for part number of mating plug furnished in shipment.

2-7. INITIAL ADJUSTMENTS

The DDR-6H has been factory tested and adjusted before disassembly for crating. No initial adjustments of chassis mounted variable components are necessary except the following adjustment for FSK reception. This procedure adjusts the CFA-1 Frequency Shift Converter to the particular teleprinter in use.

After the CFA-1 has been installed in the rack and the teleprinter equipment attached, proceed as follows in order to adjust the CFA-1 to the teleprinter load.

(1) Turn LINE CURRENT INCREASE rheostat (on CFA-1 rear panel) to its full counterclockwise position.

(2) Set CFA-1 POWER switch to ON and teleprinter power supply switch to ON. Permit a sixty-second minimum warm-up period.

(3) Set CFA-1 MARK/SPACE/LINE switch to MARK position.

(4) Adjust LINE CURRENT INCREASE rheostat to obtain 60 ma at d-c current source in teleprinter (fed into DDR-6H at terminals 1 and 2 of TB602 rack terminal block).

(5) If the teleprinter does not revert to "standby" or "mark" condition, the printer load must be reversed at terminals 3 and 4 of TB602 for proper operation.

(6) Return CFA-1 MARK/SPACE/LINE switch to LINE position.

The CFA-1 unit has been factory-adjusted for an 850-cps shift in FSK teleprinter reception. If a shift other than 850 cps is to be received, refer to CFA-1 Manual for a detailed description of front panel THRESHOLD and MARK BIAS control positions. For FSK Morse reception, the MARK BIAS control setting is not critical; adjustment will merely vary the relative spacing of dots and dashes. For normal teleprinter speeds (not exceeding 100 wpm), the CFA-1 SPEED switch, located on the rear panel, should be left in the LOW position; for speeds over 100 wpm, place the switch in HIGH position.

On the back panel of GPR-90RXD Receiver, set SSB ON/OFF switch to OFF and RADIO/PHONO switch to RADIO.

2-8 CRYSTAL INSTALLATION

a. HFO CRYSTALS - For crystal-controlled HFO operation, the DDR-6H requires one plug-in crystal in the HFO circuit for each frequency to be received. Unless specified in order, crystals

will not be includ d in the DDR-6H shipment. T n HFO crystal sock ts ar locat d in a compartment in th top of the GPR-90RXD control panel, accessible by opening the hinged door adjacent to the HFO selector switch. Each socket is numbered to correspond with HFO switch position numbers 1 through 10. Mounted on the outside of the door is a chart to be filled in with available carrier frequencies vs. switch positions.

b. HFO CRYSTAL SELECTION VS. CARRIER - Determine carrier frequency (F_C) to be received*. (This also applies for modes of reception with suppressed carrier, as in SSB and ISB). The crystal frequency (F_X) is calculated by the following formula:

$$F_X = F_C + 455 \text{ kc}$$

Use type CR-18/U quartz crystals with parallel resonant frequencies in the .995- to 31.955-mc range and housed in HC-6/U holders.

c. IFO CRYSTALS - For crystal-controlled IFO operation, the DDR-6H requires two plug-in crystals, one for each sideband, in each of the two MSR-4 units. Four crystals will be required if both MSR-4 units are to be used (as in ISB reception). Unless specified otherwise on order, the DDR-6H is shipped with a 438-kc lower sideband crystal in XY1 socket and a 472-kc upper sideband crystal in XY2 socket in each of the two MSR-4 units. The following crystals are required for the following types of reception:

Reception	MSR-4 Crystal Frequencies in sockets:- XY1	XY2
CW,MCW,AM,SSB - - -	436-kc	474-kc
ISB - - - - - - - - -	438-kc	472-kc
FSK - - - - - - - - -	435-kc	none

* For FSK reception, F_C is the center frequency

Use type CR-46/U quartz crystals with parall l resonant frequencies and HC-6/U holders.

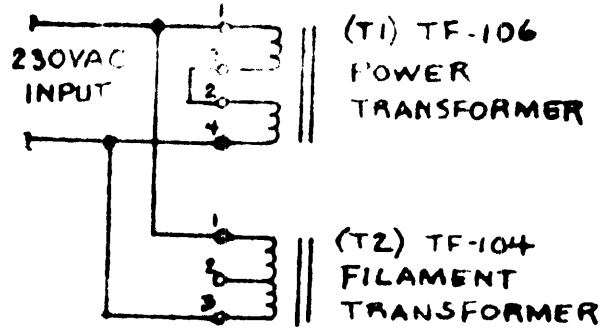


FIGURE 2-1. 230-V LINE VOLTAGE MODIFICATION DIAGRAM, CFA-1

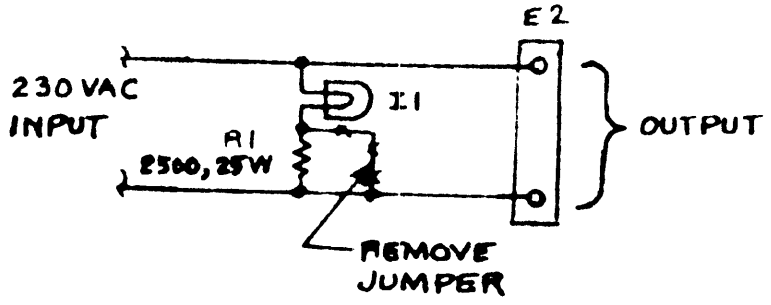


FIGURE 2-2. 230-V LINE VOLTAGE MODIFICATION DIAGRAM, DCP-1

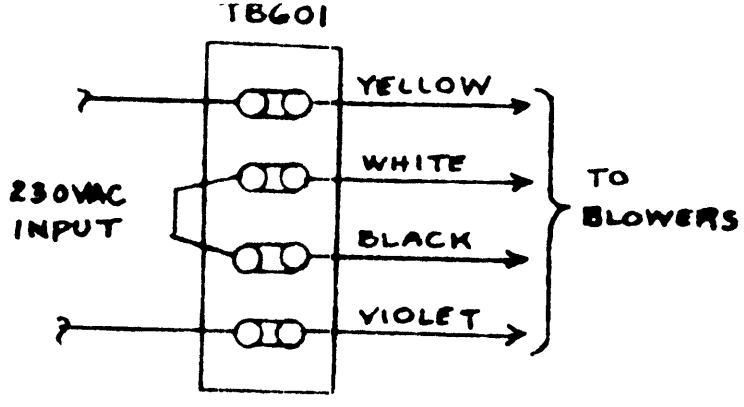
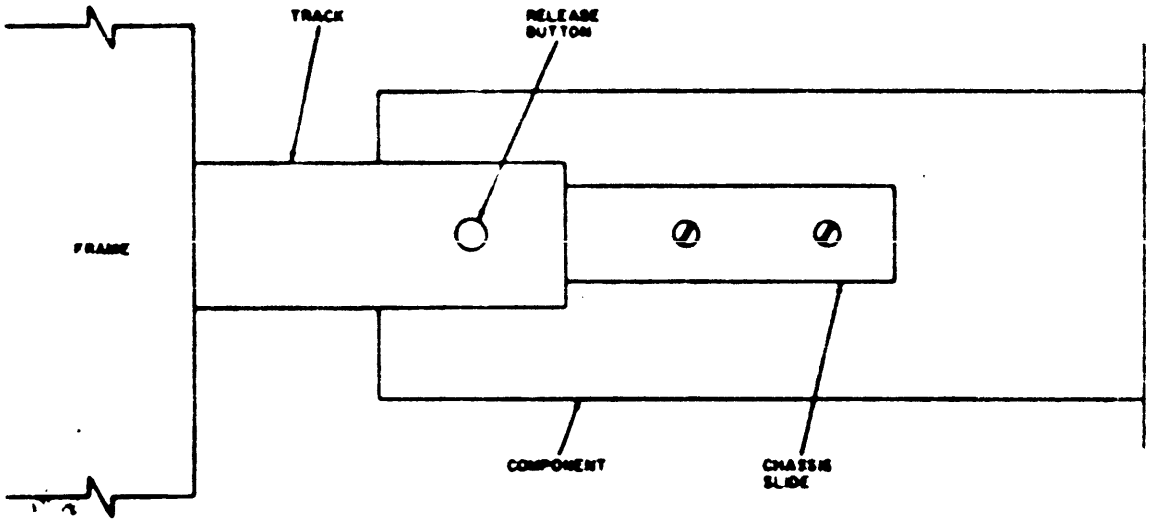
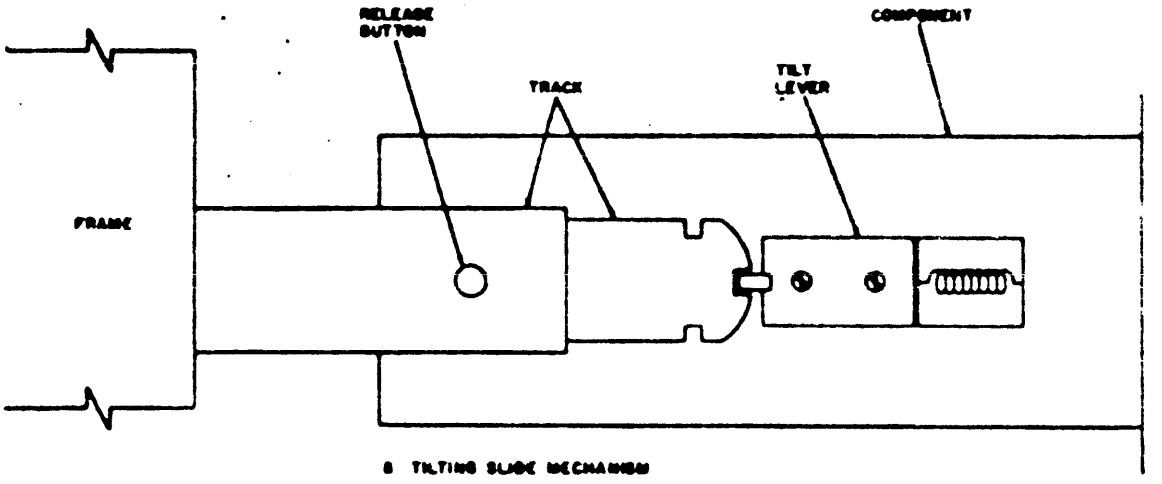


FIGURE 2-3. 230-V LINE VOLTAGE MODIFICATION DIAGRAM, RACK BLOWERS



A. NON-TILTING SLIDE MECHANISM



B. TILTING SLIDE MECHANISM

FIGURE 2-4. SLIDE-MOUNTING DETAILS

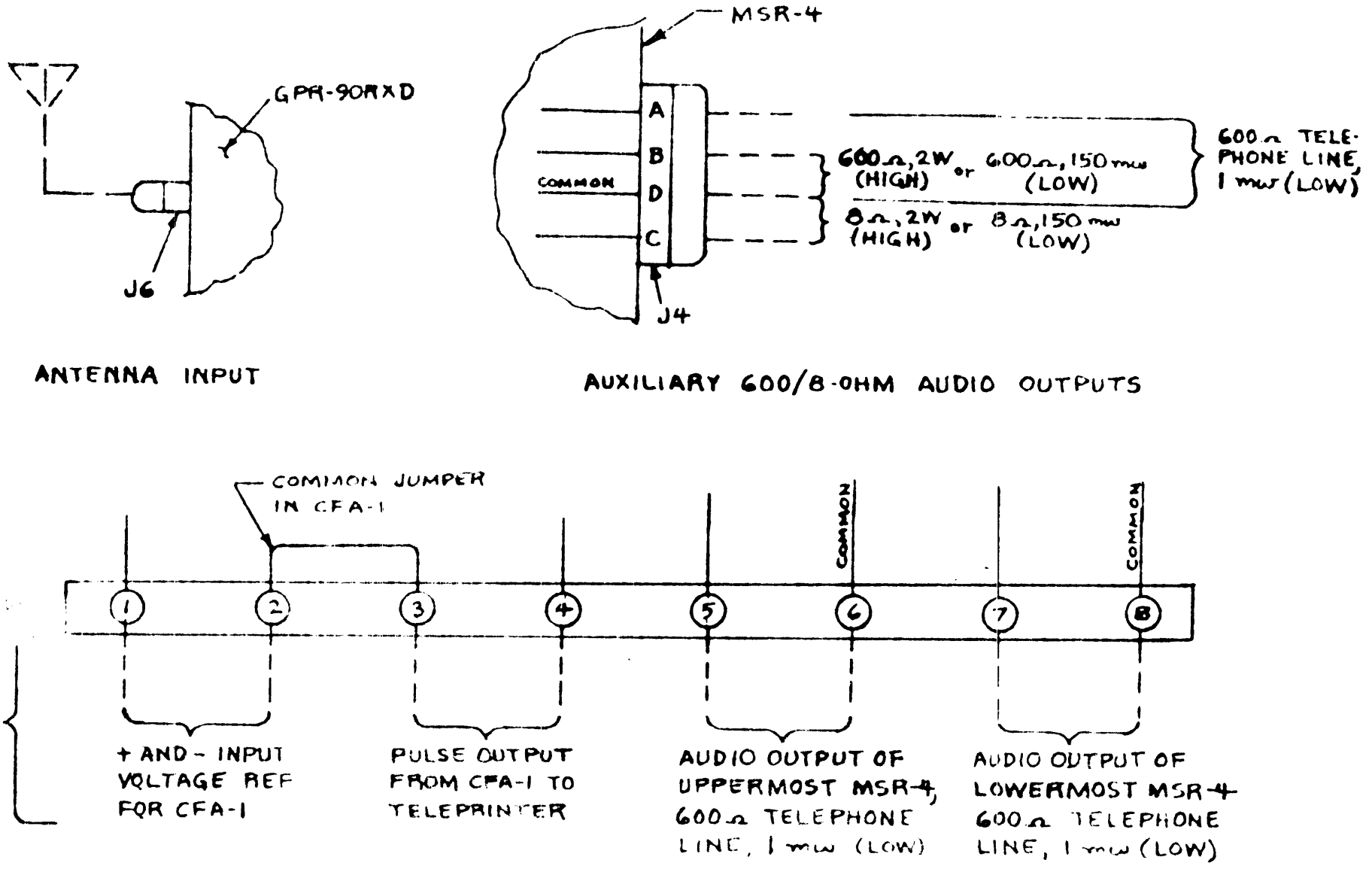


FIGURE 2-5. CONNECTION DIAGRAM, EXTERNAL EQUIPMENT TO DDR-6H

SECTION 3

OPERATOR'S SECTION

3-1. INTRODUCTION

a. GENERAL - Before tuning up the DDR-6H for the first time, it is advisable that the operator become familiar with the following characteristics and capabilities of the equipment:

1 - Functions of components

2 - Functions of controls

3 - Modes of reception

4 - HFO and IFO selection

5 - Types of output

b. FUNCTIONS OF COMPONENTS - Refer to figure 4-1 for functional block diagram of the DDR-6H receiver system. Technical Materiel modular components are designed to be compatible in many different systems. The function of each module may vary from system to system due to the particular interconnection of modules in each system. In the DDR-6H system both MSR-4 units are used in ISB reception; only one unit is used in the other reception modes. The SFP-2 and CFA-1 modules (used in FSK reception) include two channels for compatibility with diversity receiver systems. However, since the DDR-6H is not a diversity receiver system, only one channel is used. Either channel may be used, but the relationship of MSR-4 units to channels (see figure I-4-1), due to interconnecting cabling, should be kept in mind. The a-f section of the GPR-90RXD receiver is not used. After i-f amplification in the GPR-90RXD, the signal is routed to the MSR-4 unit for sideband selection and i-f bandspread and through the MSR-4 a-f amplifier section.

c. FUNCTIONS OF CONTROLS - Figure 3-1 shows DDR-6H panel controls; control numbers are for reference in "tune-up" tables 3-1 through.

3-5. Refer briefly to section 3 of each component manual for functions of controls. A "purpose" column is also included in tables 3-1 through 3-5 of this manual to familiarize the operator with control functions.

d. MODES OF RECEPTION - There are 6 main modes of reception available using the DDR-6H Receiver System. These are:

(1) CW (keyed carrier)

(2) MCW (keyed modulated carrier)

(3) AM* (amplitude modulation)

(4) SSB (single sideband) with suppressed or partial carrier

(5) ISB (independent sidebands) with suppressed or partial carrier

(6) FSK (frequency shift keying) for teleprinter operation

Tuning procedures for the above 6 conventional modes are described in tables 3-1 through 3-5. In addition, it will become evident to the operator that, because of the dual i-f tuning and dual a-f output facilities, simultaneous reception is possible in such combinations as CW/CW, CW/MCW, CW/SSB, CW/FSK, MCW/MCW, MCW/SSB, etc. In such cases, the individual table for each mode may be used to tune-in each half of the pair; however MAIN TUNING and BANDSPREAD control settings must be calculated on the basis of width of signals and band-pass widths of the GPR-90RXD and MSR-4 units, as described in paragraph 3-2d.

e. HFO and IFO SECTION - In tables 3-1 through 3-5, steps are included for using both fixed (crystal) and variable (non-crystal) oscillators for HFO (high frequency oscillator) and IFO (intermediate frequency oscillator) operation. In a case where the greater receiver

* Single Sideband reception from a transmitted AM signal

stability (.002% to .003%) is required, crystal oscillators are used. However, in this case, a fairly stable incoming transmitted signal is required, since the fixed oscillators afford very little subsequent adjustment. Specifically, with both HFO and IFO on crystal control, this adjustment (XTL ADJ knob on GPR-90RXD) is as follows for the two extremes of the receiver's frequency range:

Incoming Frequency	XTL ADJ Compensation
0.54 mc	125 cps
31.5 mc	8 kc

The "XTAL ADJ Compensation" as stated above is the compensation for the combined effect of receiver and transmitted signal drift.

f. TYPES OF OUTPUT - The DDR-6H Receiver System has the following 7 main* types of output available:

LS-1 Loudspeaker output from uppermost MSR-4

LS-2 Loudspeaker output from lowermost MSR-4

PHONES headset output at uppermost MSR-4

PHONES headset output at lowermost MSR-4

Telephone line output from uppermost MSR-4

Telephone line output from lowermost MSR-4

Teleprinter output from CFA-1

An OUTPUT LEVEL switch, located on the topside of each MSR-4 chassis at the rear, has 2 positions with corresponding MSR-4 output levels. These are:

Switch Position	Output Level
LOW	-150 mw
HIGH	-2 watts

* Additional outputs are available at J4 receptacle at the rear of each MSR-4 unit (see paragraph 2-7g)

To drive its loudspeaker, the MSR-4 must be switched to HIGH; for PHONES, telephone line or teleprinter output it is switched to LOW. Therefore, loudspeaker output cannot be used simultaneously with PHONES, telephone or teleprinter output from the same MSR-4 unit.

Tune-up tables 3-1 through 3-5 describe procedure in terms of using an output normal for those modes of reception. A note at the top of the table describes the output.

3-2. TUNING PROCEDURES

a. TUNING TABLES - Tables 3-1 through 3-5 describe tuning procedures for the 7 main modes of reception available with the DDR-6H.

In CW, MCW, AM, SSB and FSK reception it is possible to use either one of the 2 MSR-4 units and its corresponding loudspeaker or headset, telephone line output and channel routing. The tables describe procedure in terms of using one set, with a note at the top of the table to that effect.

b. RF BANDSPREAD - Bandspread of the r-f stage is accomplished with the GPR-90RXD BANDSPREAD knob and movable dial. This control acts as a vernier adjustment for the GPR-90RXD MAIN TUNING control. Calibration markings on the BANDSPREAD dial are set up in the following 6 amateur bands: -

Band (meters)	Frequency Range (mc)
10-11	26.8 - 30.0
15	20.5 - 21.8
20	13.9 - 14.5
40	6.85 - 7.40
80	3.45 - 4.10
160	1.80 - 2.00

Although the calibration markings are presented for convenience in tuning-in the amateur bands, the BANDSPREAD control may be used over the entire range of the receiver.

Exampl 1: To tun in an amateur frequency of 27.1 megacycles: -

(1) Set BANDSPREAD control to "100" on BANDSPREAD LOG scale.

(2) Set MAIN TUNING control to "10-11M" mark on MAIN TUNING LOG scale.

(3) Bring BANDSPREAD reading down to "27.1" on 10-11M scale.

Example 2: To tune in a frequency of 17 megacycles: -

(1) Set BANDSPREAD control to "100" on BANDSPREAD LOG scale.

(2) Set MAIN TUNING control to "17.5 mc"* on MAIN TUNING 9.4 - 17.8 scale.

(3) Using headset as a monitor, slowly decrease BANDSPREAD reading to area around "50" on LOG scale for the best reception.

Once a station has been tuned in, the operator may record MAIN TUNING and BANDSPREAD LOG scale settings for future tuning to that frequency.

---

* By referring to the amateur band calibrations on the BANDSPREAD dial, it is seem that 17 mc falls between the 20-meter (13.9 - 14.5 mc) and 15-meter (20.5 - 21.8 mc) bands. Since the 20-meter adjustment gives an 0.6-mc adjustment and the 15-meter gives a 1.3-mc adjustment, by interpolation, the BANDSPREAD control will give approximately 0.9 mc of adjustment in the 17-mc area. Therefore, placing the MAIN TUNING dial at 17.45 (or 17.5) and the BANDSPREAD at the high end of the range should place 17 mc approximately in the middle of the total BANDSPREAD adjustment.

c. IF BANDSPREAD - The i- BANDSPREAD control on each of the MSR-4 units is used to move th received signal either up or down on the frequency spectrum in order to fit the desired portion of it through the narrow bandpass filter in the MSR-4. Specific procedure for this adjustment is spelled out in each of the tune-up tables.

d. SIMULTANEOUS RECEPTION OF TWO RECEPTION MODES - Besides having the capability of receiving ISB, the DDR-6H may be tuned in to receive two different modes of transmission simultaneously, provided that both signals fall within the same 6-kc bandwidth on the frequency spectrum. In this way, one DDR-6H may be utilized to receive CW/CW, CW/MCW, CW/SSB, CW/FSK, MCW/MCW, MCW/SSB, etc.

As in ISB, both MSR-4 units are used. Each half of the signal may be tuned in by referring to the tune-up table (3-1 through 3-5) pertaining to that mode, with the following exceptions:

(1) HFO operated variable (non-crystal)

(2) IFO operated variable (non-crystal)

(3) RF SELECTIVITY switch kept on NON-XTAL

(4) GPR-90RXD MAIN TUNING and BANDSPREAD controls and MSR-4 BANDSPREAD control adjusted on the basis of the following information:

Figure 3-2 is a diagram illustrating the "slot-tuning" or relative positioning of GPR-90RXD and MSR-4 pass-bands in order to receive the two desired signals. The pass-bands are positioned up and down the transmitted frequency spectrum by means of the MAIN TUNING and BANDSPREAD controls. With GPR-90RXD RF SELECTIVITY switch in NON XTAL position, GPR-90RXD pass band is 6 kc wide. Each MSR-4 unit has a pass band of 3.4 kc width. With MSR-4(U) SIDEBAND switch pushed

to light its "U" lamp and its BANDSPREAD knob s t at "O", the center frequency (F_u) of the MSR-4 pass band is 2.1 kc above the center frequency (F_c) of the GPR-90RXD pass band. With MSR-4 (L) SIDEBAND switch pushed to light its "L" lamp and its BANDSPREAD knob set at "O", the center frequency (F_l) of the MSR-4 pass band is 2.1 kc below the center frequency (F_c) of the GPR-90RXD pass band.

The GPR-90RXD is first tuned to Fc. F_c is calculated as the center frequency of the total expanse of frequencies to be received from both signals. MSR-4(L) and MSR-4(U) may then be tuned (or "moved") 3 kc up or down the frequency spectrum to center on the desired frequencies of each signal. MSR-4(L) may be "moved" up by turning its BANDSPREAD knob in the + direction and down by turning the knob in the - direction. Conversely, MSR-4(U) is "moved" up by turning its BANDSPREAD knob in the - direction and down by turning the knob in the + direction.

Example: To receive a lower sideband signal of 3-kc width transmitted with a suppressed carrier of 10 mc and a CW signal of 10.002 mc: The lowest frequency in the LSB signal is 10.000 - .003 mc (or 9.997 mc) and the highest frequency in the CW signal is 10.002 mc. Therefore, the total expanse of frequencies to be received runs from 9.997 to 10.002 mc and the center frequency, Fc, is 9.9995 mc, or approximately 10 mc. The GPR-90RXD is tuned to 10 mc (F_c) by means of the MAIN TUNING and BANDSPREAD controls. The SIDEBAND button on the MSR-4(L) is pushed until the "L" lamp lights. MSR-4(L) (which will receive th 3-kc wide LSB signal) is tuned to F_l, which = 10.000 mc - .0015 mc, or 9.999 mc. This is done by its BANDSPREAD knob as follows: since,

with the BANDSPREAD knob at 0, it is tuned t 10.000 mc - .0021 mc, or 9.998 mc, to move the MSR-4(L) up the frequency spectrum from 9.998 mc to 9.999 mc its BANDSPREAD knob is turned .001 mc (or 1 kc) in the - (minus) direction. The SIDEBAND button on MSR-4(U) is then pushed to light the "U" lamp and the unit, which will receive the CW 10.002 mc signal, is tuned to F_0, which = 10,002 mc. With the BAND-SPREAD knob set at 0, MSR-4 (U) is tuned to 10.000 mc + .0021 mc, or 10,0021 mc. To bring it down the frequency spectrum from 10.0021 mc to 10.0020 mc, the MSR-4(L) BANDSPREAD knob is turned 0.1 kc (001 mc) in the - (minus) direction.

TABLE 3-1. TUNE-UP PRO URE FOR CW AND MCW

(Note: Either MSR-4 and s audio outputs may be used. In this case the upperm . MSR-4, with its correspond-ing headset and USB tele one line output, is used.)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1	68,69	Set circuit breaker (68) to ON. Light (69) will ignite and rack blowers will start.	Connects line voltage to a- strip in rack and to blowers.
2	30,10,11,12	Turn RF GAIN knob (30) fully clockwise. Dials (10), (11), and (12) will light up.	Supplies GPR-90-RXD with tube fil-ament and oven el-ment voltages. Turns up r-f stage gain to maximums.
3	40,65,39, 31,32	Set POWER/OFF switch (40) to POWER and POWER/OFF switch (65) to OFF. POWER lamp (39) will light and either L lamp (31) or U lamp (32) will light.	Supplies upper-most MSR-4 with filament and plate voltages. Disconnects power from lower-most MSR-4.
4		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR-90RXD oven temperatures to stabilize.
5	18	Set SEND/REC switch (18) to REC.	Supplies GPR-90-RXD with plate voltages
6	15	Set ANT TUNE knob (15) to vertical position.	Sets ANT TUNE control at mid-position.
7	17	Set CAL/OFF switch (17) to OFF.	Disables 100-kc marker oscillator
8	5	For variable HFO: - S t HFO knob (5) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.

TABLE 3-1. TUNE-UP PROCEDURE FOR CW AND MCW (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
8(Cont)	5,6,8	For crystal HFO:- Set HFO knob (5) to position 1-10 indicated for carrier frequency desired as shown on chart (6). Set XTAL ADJ knob (8) to 0 position.	Sets up HFO for fixed (crystal controlled) operation.
9	2	Turn INCR knob (2) fully counterclockwise.	Disconnects LS-1 (USB) speaker from output.
10	14	Set RF SELECTIVITY knob (14) to NON XTAL position.	Selects widest i-f response.
11	19	CW Mode: Set MANUAL/AVC switch (19) to MANUAL. MCW Mode: Set MANUAL/AVC switch (19) to AVC.	(CW) Shuts off AVC r-f and i-f stages in GPR-90RXD. (MCW) Turns on AVC in r-f and i-f stages in GPR-90RXD.
12	42	Set AUDIO GAIN knob (42) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
13	35,36	CW Mode: Set AVC ON/OFF switch (35) to ON. Set AVC FAST/SLOW switch (36) to SLOW. MCW Mode: Set AVC ON/OFF switch (35) to ON. Set AVC FAST/SLOW switch (36) to FAST.	(CW) Sets i-f stage AVC to speed suitable for CW reception. (MCW) Sets i-f stage AVC to speed suitable for MCW reception.

TABLE 3-1. TUNE-UP PROCEDURE FOR CW AND MCW (cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
14	38	CW Mode: Set BFO switch (38) to ON. MCW Mode: Set BFO switch (38) to OFF.	(CW) Turns on BFO (17-kc) oscillator in MSR-4 to produce audio tone from second mixer.
15		For variable IFO:	
	37	(1) Set MANUAL/XTAL knob (37) to MANUAL.	(1) Sets up 1st injection oscillator in MSR-4 for subsequent i-f BANDSPREAD adjustment.
	33,31,34	(2) Push SIDEBAND button (33) until L lamp (31) lights; then set BANDSPREAD knob (34) to -2. or * Push SIDEBAND button (33) until U lamp (32) lights; then set BANDSPREAD knob (34) to +2.	(2) De-tunes 1st injection oscillator in order to pass carrier through narrow band filter.
		For Crystal IFO:	
	37	(1) Set MANUAL/XTAL knob (37) to XTAL.	(1) Sets up 1st injection oscillator in MSR-4 for crystal controlled operation.
	33,31	(2) Push SIDEBAND button (33) until L lamp (31) lights; then insert 436-kc crystal in XY1 socket in MSR-4.	(2) De-tunes 1st injection oscillator in order to pass carrier through narrow band filter. Inserts crystal for greater stability.
	33,32	Push SIDEBAND button (33) until U lamp (32) lights; then insert 474-kc crystal in XY 2 socket in MSR-4.	

* Optional

TABLE 3-1. TUNE-UP PRO DURE FOR CW AND MCW (cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
16	25	Set RANGE SELECTOR knob (25) to appropriate position for carrier frequency.	Selects band-pass circuit at r-f input.
17	23,10	Adjust MAIN TUNING knob (23) to obtain reading slightly higher * than carrier frequency on dial (10).	Coarse-tunes r-f stage and HFO for carrier frequency.
18	27,12	Set BANDSPREAD knob (27) to bring 100 on LOG scale on dial (12).	Sets r-f BANDSPREAD vernier control at high end of adjustment range.
19	12,27,41	Bring reading down on dial (12) with BANDSPREAD knob (27) until headset at PHONES jack (41) indicates frequency has been tuned in.	Fine-tunes r-f stage and HFO for carrier frequency.
20	42	Adjust AUDIO GAIN knob (42) to obtain suitable volume.	Adjusts audio output level.
21	34	For variable IFO (with fixed or variable HFO):- Adjust BANDSPREAD knob (34) until desirable tone is obtained.	Adjusts MSR-4 IFO for an agreeable audio tone.
	8	For crystal IFO (with fixed HFO):- Adjust XTL ADJ knob (8) until desirable tone is obtained.	Adjusts GPR-90-RXD HFO for an agreeable audio tone.
	27	For crystal IFO (with variable HFO): - Adjust BANDSPREAD knob (27) until d sirable tone is obtained.	Adjusts GPR-90-RXD HFO for an agreeable audio tone.

S **paragraph 3-2b**

TABLE 3-1. TUNE-UP PROCEDURE FOR CW AND MCW (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
22	14,9	If the signal is accompanied by excessive background noise, adjust the RF SELECTIVITY knob (14) to most effectively reduce the interference. In addition, if the signal being received is interfered with or heterodynes with an adjacent carrier, adjust XTAL PHASE knob (9) to reduce interference.	Adjusts i-f bandpass width to eliminate adjacent noise.
23	15,10,42, 2,1	CW Mode: Adjust ANT TUNE knob (15) to obtain peak on meter (10). Then reset AUDIO GAIN knob (42) and INCR knob (2) for suitable volume at LS-1 speaker(1).	Tunes r-f input to antenna characteristics.
	19,15,10, 42,2,1	MCW Mode: Set MANUAL/AVC switch (19) to MANUAL. Adjust ANT TUNE knob (15) to obtain peak on meter (10). Set MANUAL/AVC switch (19) to AVC. Readjust AUDIO GAIN knob (42) and INCR knob (2) for suitable volume at LS-1 speaker (1).	Tunes r-f input to antenna characteristics.

TABLE 3-1 TUNE-UP PROCEDURE FOR CW AND MCW (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
24	30,42	CW Mode only: When keyed signal commences, readjust RF GAIN knob (30) to a low point and AUDIO GAIN knob (42) to a relatively high point to receive the sharpest signals.	Adjusts r-f and a-f gain time constants to best level for intermittent signal.

TABLE 3-2. TUNE-UP PROCEDURE FOR AM

(Note: Either MSR-4 and its audio outputs may be used. In this case the uppermost MSR-4, with its corresponding speaker (LS-1) is used.)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1	68,69	Set circuit breaker (68) to ON. Light (69) will ignite and rack blowers will start.	Connects line voltage to a-c strip in rack and to blowers.
2	30,10,11, 12	Turn RF GAIN knob (30) fully clockwise. Dials (10),(11) and (12) will light up.	Supplies GPR-90RXD with tube filament and oven element voltages. Turns up r-f stage gain to maximum.
3	40,65,39, 31,32	Set POWER/OFF switch (40) to POWER and POWER/OFF switch (65) to OFF. POWER lamp (39) will light and either L lamp (31) or U lamp (32) will light.	Supplies uppermost MSR-4 with filament and plate voltages. Disconnects power from lowermost MSR-4.
4		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR-90RXD oven temperatures to stabilize.
5	18	Set SEND/REC switch (18) to REC.	Supplies GPR-90RXD with plate voltages.
6	41,1	Open rear rack door and set OUTPUT LEVEL switch on uppermost MSR-4 unit to HIGH. Disconnect telephone line output at terminals 5 and 6 of rack terminal block TB602, if this connection is present. Close rear rack door. Disconnect headset at PHONES jack (41).	Increases MSR-4 output level for LS-1 speaker (1) operation.

TABLE 3-2. TUNE-UP PROCEDURE FOR AM (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
7	15	Set ANT TUNE knob (15) to vertical position.	Sets ANT TUNE control at mid-position.
8	17	Set CAL/OFF switch (17) to OFF.	Disables 100-kc marker oscillator.
9	5	For variable HFO:- Set HFO knob (5) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
	5,6,8	For crystal HFO:- Set HFO knob (5) to position 1-10 indicated for carrier frequency desired as shown on chart (6). Set XTAL ADJ knob (8) to 0 position.	Sets up HFO for fixed (crystal controlled) operation.
10	14	Set RF SELECTIVITY knob (14) to NON XTAL position.	Selects widest i-f response.
11	19	Set MANUAL/AVC switch (19) to MANUAL	Shuts off AVC in r-f and i-f stages in GPR-90RXD to obtain RF GAIN control.
12	42	Set AUDIO GAIN knob (42) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
13	2	Turn INCR knob (2) fully clockwise.	Turns up LS-1 speaker rheostat for full speaker output.
14	35,36	Set AVC ON/OFF switch (35) to ON. Set AVC FAST/SLOW switch (36) to FAST.	Sets i-f stage AVC (in MSR-4) to speed suitable for AM reception.
15	38	Set BFO switch (38) to OFF.	BFO not needed in AM r ception.

TABLE 3-2. TUNE-UP PROCEDURE FOR AM (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
16	25	Set RANGE SELECTOR knob (25) to appropriate position for carrier frequency.	Selects band-pass circuit at r-f input.
17		NOTE: The following procedures, A and B, are for selecting lower and upper sidebands, respectively. Since the same intelligence is present on both sidebands, either sideband may be selected. However, due to adjacent noise, terrain or environmental conditions, it may be found that one sideband gives better results than the other. Procedures A and B are further divided into variable and crystal IFO operation.	Tunes in one sideband and carrier for narrow band reception. Eliminates adjacent interference.
	37,33,31, 34,23,27, 1	A. Lower sideband 1. Variable IFO:-Set MANUAL/XTAL knob (37) to MANUAL. Push SIDEBAND button (33) until L lamp (31) lights. Set BAND-SPREAD knob (34) to -2. Tune GPR-90RXD to point 1.6 kc below carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27), as a vernier adjustment as described in paragraph 3-2b. Then adjust BANDSPREAD knob (34) for best reception of high and low tones at LS-1 speaker (1).	De-tunes GPR-90RXD and MSR-4 to accept lower sideband and carrier only.

TABLE 3-2. TUNE-UP PROCEDURE FOR AM (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
17(Cont)	37,33,31, 23,27,8, 1	2. Crystal IFO:- Set MANUAL/XTAL knob (37) to XTAL. Push SIDEBAND button (33) until L lamp (31) lights. Place 436-kc crystal in XY 1 socket in MSR-4. Tune GPR-90RXD to point 1.6 kc below carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (8) (for crystal HFO) or BANDSPREAD knob (27) (for variable HFO) for best reception of high and low tones at LS-1 speaker (1).	Detunes GPR-90RXD and MSR-4 to accept lower sideband and carrier only. Adds crystal for higher stability.
	37,33,32, 34,23,27, 1	B. Upper sideband 1. Variable IFO:- Set MANUAL/XTAL knob (37) to MANUAL. Push SIDEBAND button (33) until U lamp (32) lights. Set BANDSPREAD knob (34) to +2. Tune GPR-90RXD to point 1.6 kc above carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph I-3-2b. Then adjust BANDSPREAD knob (34) for best reception of high and low tones at LS-1 speaker (1).	Detunes GPR-90RXD and MSR-4 to accept upper sideband and carrier only.

TABLE 3-2. TU -UP PROCEDURE FOR AM (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
17(Cont)	37,33,32, 23,27,8, 1	2. Crystal IFO:- Set MANUAL/XTAL knob (37) to XTAL. Push SIDEBAND button (33) until U lamp (32) lights. Place 474-kc crystal in XY 2 socket in MSR-4. Tune GPR-90RXD to point 1.6 kc above carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (8) (for crystal HFO) or BANDSPREAD knob (27) (for variable HFO) for best reception of high and low tones at LS-1 speaker (1).	Detunes GPR-90RXD and MSR-4 to accept upper sideband and carrier only. Adds crystal for higher stability.
18	15,10,1	Adjust ANT TUNE knob (15) to obtain peak on meter (10) and/or greater volume on LS-1 speaker (1).	Tunes r-f input to antenna characteristics.
19	19,42,2, 1	Set MANUAL/AVC switch (19) to AVC. Then readjust AUDIO GAIN knob (42) and INCR knob (2) for suitable volume on LS-1 speaker (1).	Places r-f stage on AVC.
20	14,9	If the signal is accompanied by excessive background noise, adjust the RF SELECTIVITY knob (14) to most effectively reduce the interference. In addition, if the signal being received is interfered with or heterodynes with an adjacent carrier, adjust XTAL PHASE knob (9) to reduce interference.	Adjusts i-f bandpass width to eliminate adjacent noise.

TABLE 3-3. TUNE-UP PROCEDURE FOR SSB

(Note: Either MSR-4 and its audio outputs may be used. In this case the uppermost MSR-4, with its corresponding speaker (LS-1) is used. This procedure is written for receiving upper or lower sideband, suppressed or partial carrier.)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1	68, 69	Set circuit breaker (68) to ON. Light (69) will ignite and rack blowers will start.	Connects line voltage to a-c strip in rack and to blowers.
2	30, 10, 11, 12	Turn RF GAIN knob (30) fully clockwise. Dials (10), (11) and (12) will light up.	Supplies GPR-90RXD with tube filament and oven element voltages. Turns up r-f stage gain to maximum.
3	40, 65, 39, 31, 32	Set POWER/OFF switch (40) to POWER and POWER/OFF switch (65) to OFF. POWER lamp (39) will light and either L lamp (31) or U lamp (32) will light.	Supplies uppermost MSR-4 with filament and plate voltages. Disconnects power from lowermost MSR-4.
4	———	If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR-90RXD oven temperatures to stabilize.
5	18	Set SEND/REC switch (18) to REC.	Supplies GPR-90RXD with plate voltages.
6	15	Set ANT TUNE knob (15) fo vertical position.	Sets ANT TUNE control at mid-position.

TABLE 3-3. TUNE-UP PROCEDURE FOR SSB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
7	41,1	Open rear rack door and set OUTPUT LEVEL switch on uppermost MSR-4 unit to HIGH. Disconnect telephone line output at terminals 5 and 6 of rack terminal block TB602, if this connection is present. Close rear rack door. Disconnect headset at PHONES jack (41)	Increases MSR-4 output level for LS-1 speaker (1) operation.
8	17	Set CAL/OFF switch (17) to off.	Disables 100-kc marker oscillator.
9	5	For variables HFO:- Set HFO knob (5) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
	5,6,8	For crystal HFO:- Set HFO knob (5) to position 1-10 indicated for carrier frequency desired as shown on chart (6). Set XTAL ADJ knob (8) to 0 position.	Sets up HFO for fixed (crystal controlled operation.
10	14	Set RF SELECTIVITY knob (14) to NON XTAL position.	Selects widest i-f response.
11	19	Set MANUAL/AVC switch (19) to MANUAL.	Shuts off AVC in r-f and i-f stages in GPR-90RXD for SSB reception.
12	42	Set AUDIO GAIN knob (42) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
13	2	Turn INCR knob (2) fully clockwise.	Turns up LS-1 speaker rheostat for full speaker output.

TABLE 3-3. TUNE-UP PROCEDURE FOR SSB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
14	35,36	Set AVC ON/OFF switch (35) to ON. Set AVC FAST/SLOW switch (36) to SLOW.	Sets i-f stage AVC (in MSR-4) to speed suitable for SSB reception.
15	38	Set BFO switch (38) to ON.	BFO injection required for SSB detection.
16	25	Set RANGE SELECTOR knob (25) to appropriate position for carrier frequency.	Selects band-pass circuit at r-f detection.
17		NOTE: The following procedures, A and B, are for tuning in lower and upper sidebands, respectively; they are further divided into variable and crystal IFO operation.	Tunes in one sideband.
		A. Lower sideband	
	37,33,31, 34,23,27, 1	1. Variable IFO:- Set MANUAL/XTAL knob (37) to MANUAL. Push SIDEBAND button (33) until L lamp (31) lights. Set BANDSPREAD knob (34) to -2. Tune GPR-90RXD to point 2.0 kc below carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph 3-2b. Then adjust BANDSPREAD knob (34) for best reception of high and low tones at LS-1 speaker (1).	Detunes GPR-90-RXD and MSR-4 to accept lower sideband.

TABLE 3-3.. TUNE-UP PROCEDUR OR SSB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OP RATION	PURPOSE
17 (Cont)	37,33,31, 23,27,8, 1	2. Crystal IFO:- Set MANUAL/XTAL knob (37) to XTAL. Push SIDEBAND button (33) until L lamp (31) lights. Place 436-kc crystal in XY1 socket in MSR-4. Tune GPR-90-RXD to point 2.0 kc below carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (8) (for crystal HFO) or BANDSPREAD knob (27) (for variable HFO) for best reception of high and low tones at LS-1 speaker (1).	Detunes GPR-90-RXD and MSR-4 to accept lower sideband. Adds crystal for higher stability.
		B. Upper sideband	
	37,33,32, 34,23,27, 1	1. Variable IFO:-Set MANUAL/XTAL knob (37) to MANUAL. Push SIDEBAND button (33) until U lamp (32) lights. Set BANDSPREAD knob (34) to +2. Tune GPR-90RXD to point 2.0 kc above carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph 3-2b. Then adjust BANDSPREAD knob (34) for best reception of high and low tones at LS-1 speaker (1).	Detunes GPR-90-RXD and MSR-4 to accept upper sideband.
	37,33,32, 23,27,8, 1	2. Crystal IFO:-Set MANUAL/XTAL knob (37) to XTAL. Push SIDEBAND button (33) until U lamp (32) lights. Place 474-kc crystal in XY2 socket in MSR-4. Tune GPR-90RXD to point 2.0 kc above carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27), as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (8) (for crystal HFO) or BANDSPREAD knob (27) (for variabl HFO) for best r ception	Detunes GPR-90-RXD and MSR-4 to accept upper sideband. Adds crystal for higher stability.

TABLE 3-3. TUNE-UP PROCEDURE FOR SSB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
17 (Cont)		of high and low tones at LS-1 speaker (1).	
18	15,10	Adjust ANT TUNE knob (15) to obtain peak on meter (10).	Tunes r-f input to antenna characteristics.
19	14,9	If the signal is accompanied by excessive background noise, adjust RF SELECTIVITY knob (14) to most effectively reduce the interference. In addition, if the signal being received is interfered with or heterodynes with an adjacent carrier, adjust XTAL PHASE knob (9) to reduce interference.	Adjusts i-f bandpass width to eliminate adjacent noise.
20	42,1	Readjust AUDIO GAIN knob (42) for suitable volume level at LS-1 speaker (1).	Final adjustment of volume after tuning.

TABLE 3-4. TUNE-UP PROCEDURE FOR ISB

(Note: Both MSR-4 units are used for ISB reception. In this case, the uppermost MSR-4 is used for the upper sideband receiver and the lowermost MSR-4 is used for the lower sideband. The upper sideband telephone line output appears at terminals 5 and 6 of rack terminal block 3602; the lower sideband telephone line output appears at terminals 7 and 8. Speaker outputs (LS-1 and LS-2) are not used in this description.

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1	68, 69	Set circuit breaker (68) to ON. Light (69) will ignite and rack blowers will start.	Connects line voltage to a-c strip in rack and to blowers.
2	30, 10, 11, 12	Turn RF GAIN knob (30) fully clockwise. Dials (10), (11), and (12) will light up.	Supplies GPR-90-RXD with tube filament and oven element voltages. Turns up r-f stage gain to maximum.
3	40, 65, 39, 64, 31, 32, 56, 58	Set POWER/OFF switches (40) and (65) to POWER positions. POWER lamps (39) and (64) will light. L lamp (31) or U lamp (32) will light and L lamp (56) or U lamp (58) will light.	Supplies MSR-4 units with filament and plate voltages.
4		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR-90-RXD oven temperatures to stabilize.
5	18	Set SEND/REC switch (18) to REC.	Supplies GPR-90-RXD with plate voltages.

TABLE 3-4. TUNE-UP PR( )URE FOR ISB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
6	15	Set ANT TUNE knob (15) to vertical position.	Sets ANT TUNE control at mid-position.
7	17	Set CAL/OFF switch (17) to OFF.	Disables 100 kc marker oscillator.
8	5	For variable HFO:- Set HFO knob (5) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
	5, 6, 8	For crystal HFO:- Set HFO knob (5) to position 1-10 indicated for carrier frequency desired as shown on chart (6). Set XTAL ADJ knob (8) to 0 position.	Sets up HFO for fixed (crystal controlled) operation.
9	14	Set RF SELECTIVITY knob (14) to NON XTAL position.	Selects widest i-f response.
10	19	Set MANUAL/AVC switch (19) to MANUAL.	Shuts off AVC in r-f and i-f stages in GPR-90-RXD for ISB reception.
11	42, 67	Set AUDIO GAIN knobs (42) and (67) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
12	35, 60, 36, 61	Set AVC ON/OFF switches (35) and (60) to ON. Set AVC FAST/SLOW switches (36) and (61) to SLOW.	Sets i-f stage AVC (in MSR-4 units) to speed suitable for ISB reception.

TABLE 3-4 TUNE-UP PROCEDURE FOR ISB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
13	38,63	Set BFO switches (38) and (63) to ON.	BFO inj ction required f r sideband d - tection.
14	25	Set RANGE SELECTOR knob (25) to appropriate position for carrier frequency.	Sel cts band-pass circuit at r-f input.
15		NOTE: The following procedure is divided into variable and crystal IFO operation.	
	37,62,33, 32,57,56, 34,59,23, 27,41,66, 59	A. Variable IFO:-Set MANUAL/XTAL knobs (37) and (62) to MANUAL. Push SIDEBAND button (33) until U lamp (32) lights; push SIDEBAND button (57) until L lamp (56) lights. Set BANDSPREAD knobs (34) and (59) to 0 positions. Tune GPR-90RXD to carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph 3-2b. Plug headset into PHONES jack (41) and adjust BANDSPREAD knob (34) for best reception of high and low tones. Plug headset into PHONES jack (66) and adjust BANDSPREAD knob (59) for best reception of high and low tones. Repeat until optimum reception is obtained at both PHONES jacks.	Tunes GPR-90-RXD and MSR-4 units to acc pt upper and lower sid bands.

TABLE 3-4. TUNE-UP PROCEDURE FOR ISB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
15 (Cont)	37,62,33, 32,57,56, 23,27,41, 8,27,66, 59	B. Crystal IFO*- Set MANUAL/XTAL knobs (37) and (62) to XTAL. Push SIDEBAND button (33) until U lamp (32) lights, push SIDEBAND button (57) until L lamp (56) lights. Tune GPR-90RXD to carrier frequency using MAIN TUNING knob (23) as a coarse adjustment and BANDSPREAD knob (27) as a vernier adjustment as described in paragraph 3-2b. Plug headset into PHONES jack (41) and adjust XTL ADJ knob (8) (for crystal HFO) or BANDSPREAD knob (27) (for variable HFO) for best reception of high and low tones. Plug headset into PHONES jack (66) and adjust XTL ADJ knob (8) (for crystal HFO) or BANDSPREAD knob (59) (for variable HFO) for best reception of high and low tones. Repeat until optimum reception is obtained at both PHONES jacks.	Tunes GPR-90-RXD and MSR-4 units to accept upper and lower sidebands. Adds crystal for higher stability.
16	15,10	Adjust ANT TUNE knob (15) to obtain peak on meter (10).	Tunes r-f input to antenna characteristics.

* With standard 438-kc and 472-kc crystal in MSR-4 XY1 and XY2 sockets.

TABLE 3-4. TUNE-UP P EDURE FOR ISB (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
17	14,9	If either signal is accompanied by excessive background noise, adjust RF SELECTIVITY knob (14) to most effectively reduce the interference without impairing intelligibility on either or both signals. In addition, if either signal being received is interfered with or heterodynes with an adjacent carrier, adjust XTAL PHASE knob (9) in the same manner for best reception of both signals.	Adjusts i-f bandpass width to eliminate adjacent noise.
18	42,67	Readjust AUDIO GAIN knobs (42) and (67) for proper output levels for operating terminal equipment.	Adjusts audio outputs for proper operation of terminal equipment.

TABLE 3-5. TUNE-UP PROCEDURE FOR FSK

(Not : Eith r the uppermost MSR-4 unit, with corr sponding chann l l controls on the SFP-2 and CFA-1 units, or the lowermost MSR-4, with channel 2 controls, may be used. In this case, the uppermost MSR-4 unit is used. This procedur tunes the DDR-6H to the transmitted center frequency after the keyed test signal has started. It is assumed here that the frequency shift is the standard 850 cps.

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1	68,69	Set circuit breaker (68) to ON. Light (69) will ignite and rack blowers will start.	Connects line voltage to a-c strip in rack and to blowers.
2	30,10,11 12	Turn RF GAIN knob (30) fully clockwise. Dials (10),(11),and (12) will light up.	Supplies GPR90-RXD with tube filam nt and oven element voltages. Turns up r-f stage gain to maximum.
3	40,65,39, 31,32	Set POWER/OFF switch (40) to POWER.and POWER/ OFF switch (65) to OFF. POWER lamp (39) will light and either L lamp (31) or U lamp (32) will light.	Supplies upper-mos t MSR-4 with filament and plate voltages. Disconnect power from lowermost MSR-4.
4	51,47	Set POWER OFF/ON switch (51) to ON. POWER lamp (47) will light.	Supplies CFA-1 with filament and plate volt-ages.
5		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR-90-RXD ov n t m-peratur s to stabiliz .

TABLE 3-5. TUNE-UP PROCEDURE FOR FSK (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
6	18	Set SEND/REC switch (18) to REC.	Supplies GPR-90RXD with plate voltages.
7	15	Set ANT TUNE knob (15) to vertical position.	Sets ANT TUNE control at mid-position..
8	17	Set CAL/OFF switch (17) to OFF.	Disables 100-kc marker oscillator.
9*	5	For variable HFO:- Set HFO knob (5) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
..	5,6,8	For crystal HFO:- Set HFO knob (5) to position 1-10 indicated for center frequency as shown on chart (6). Set XTAL ADJ knob (8) to 0 position	Sets up HFO for fixed (crystal controlled) operation.
10	2	Turn INCR knob (2) fully counterclockwise.	Disconnects LS-1 (USB) speaker from output.
11	14	Set RF SELECTIVITY knob (14) to NON XTAL position	Selects widest i-f response.

* Crystal HFO and IFO operation is recommended for the frequency stability required to operate a teleprinter.

TABLE 3-5 TUNE-UP PROCEDURE FOR FSK (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
12	19	Set MANUAL/AVC switch (19) to MANUAL.	Shuts off AVC in r-f and i-f stages in GPR-90-RXD
13	42	Set AUDIO GAIN knob (42) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
14	35,36	Set AVC ON/OFF switch (35) to ON. Set AVC FAST/SLOW switch (36) to SLOW.	Sets i-f stage AVC to speed suitable for FSK reception.
15	38	Set BFO switch (38) to ON.	Turns on BFO (17-kc) oscillator in MSR-4 to produce audio tone from second mixer.
16	46	Set MARK/SPACE/LINE switch (46) to LINE position.	Sets up CFA-1 unit for operation.
17	53,54	Set CHANNEL 1 switch (53) to FILTER OUT and CHANNEL 2 switch (54) to PANEL OUT.	Sets up SFP-2 to receive uppermost MSR-4 output through channel 1 circuit.
18	49,50	Set CH 1 switch (49) to ON and CH 2 switch (50) to OFF.	Sets up CFA-1 to receive SFP-2 channel 1 output.

TABLE 3-5 TUNE-UP PROCEDURE FOR FSK (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
19*		For Variable IFO:-	
	37	(1) Set MANUAL/XTAL knob (37) to MANUAL.	(1) Sets up 1st injection oscillator in MSR-4 for subsequent i-f BANDSPREAD adjustment.
	33,31,34	(2) Push SIDEBAND button (33) until L lamp (31) lights; then set BANDSPREAD knob (34) to -3.	(2) De-tunes 1st injection oscillator in order to pass mark and space frequencies through narrow band filter.
		For crystal IFO:-	
	37	(1) Set MANUAL/XTAL knob (37) to MANUAL.	(1) Sets up 1st injection oscillator in MSR-4 for crystal controlled operation.
	33,31	(2) Push SIDEBAND button (33) until L lamp (31) lights; then insert 435-kc crystal in XY 1 socket in MSR-4.	(2) De-tunes 1st injection oscillator in order to pass mark and space frequencies through narrow band filter. Inserts crystal for greater stability.

* Crystal HFO and IFO operation is recommended for frequency stability required to operate the teleprinter.

TABLE 3-5. TUNE-UP PROCEDURE FOR FSK (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
20	25	Set RANGE SELECTOR knob (25) to appropriate position to include "mark" and "space" frequencies.	Selects band-pass circuit at r-f input.
21	23,10	Adjust MAIN TUNING knob (23) to obtain reading slightly higher* than center frequency on dial (10).	Coarse-tunes r-f stage and HFO for center frequency.
22	45,12,27 8,45	Observe CRT screen (45) Bring reading down on dial (12) with BAND-SPREAD knob (27) (for variable HFO) or XTL ADJ knob (8) (for crystal HFO) until a thin vertical line is obtained in the center of screen (45). NOTE: As the receiver is tuned to one side of the center frequency, the pattern will open into a rectangle to the left or right, depending upon direction of tuning. The operator should so tune the receiver that he may see one rectangle appear after the other rectangle disappears upon passing through the center. In this way he is assured of tuning on true center.	Fine-tunes r-f stage and HFO for center frequency.

* See paragraph 3-2b.

TABLE 3-5 TUNE-UP PROCEDURE FOR FSK (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
23	15,11	Adjust ANT TUNE knob (15) to obtain peak reading on meter (11)	Tunes r-f input to antenna characteristics.
24	48	Set SENSE switch (48) to + or - position for proper operation of teleprinter.	Adjusts DDR-6H d-c output to polarity of teleprinter.
25	42	Adjust AUDIO GAIN knob (42) for proper operation of teleprinter.	Adjusts DDR-6H d-c output to proper l vel for teleprinter input.
26	43	Turn THRESHOLD knob (43) to extreme counterclockwise position; then turn it approximately 250° in the clockwise direction (for 850-cps shift setting.) NOTE: For frequency shifts other than 850 cps, refer to CFA-1 Manual.	Adjusts CFA-1 for transmitt d frequency shift.
27	53	A. 850 cps shift: Observe teleprinter. If signal is not clear, set CHANNEL 1 switch (53) to FILTER IN position and make the following adjustment:-	A. Filters out frequ nci s on either side of mark and space frequenci s.

TABLE 3-5. TUNE-UP PROCEDURE FOR FSK (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
27(Cont)	34,45	Variable IFO(with variable or crystal control HFO)Adjust SPREAD knob (34) slightly to obtain clearest signal at teleprinter without losing vertical line on CRT screen (45).	
	27,45	Crystal IFO (with variable HFO) Adjust BANDSPREAD knob (27) slightly to obtain clearest signal at teleprinter without losing vertical line on CRT screen (45).	
	8,45	Crystal IFO (with crystal HFO) Adjust XTL ADJ knob (8) slightly to obtain clearest signal at teleprinter without losing vertical line on CRT screen (45).	
	53,14,9	B. Shift other than 850 cps: Observe teleprinter. If signal is not clear, leave CHANNEL 1 switch (53) in FILTER OUT position and set RF SELECTIVITY knob (14) to KC marking equal to or greater than the frequency shift.	B. Filters out adjacent frequencies on either side of mark and space fr quency range.

TABLE 3-5. TUNE-UP PROCEDURE FOR FSK (Cont)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
27(Cont)		Example: If frequency shift is 1000 cps, set RF SELECTIVITY knob (14) to 1.0 KC. Adjust XTAL PHASE knob (9) for clearest signal at teleprinter.	

I-3-3 OPERATING PROCEDURES

a. GENERAL - Operating procedure is defined here as procedure necessary to maintain the tuned-in signal through subsequent fading conditions and frequency drift.

b. SIGNAL FADE CONTROL

(1) CW, SSB, ISB, FSK - The "S" meter (11) on GPR-90RXD receiver gives immediate indication of signal fade as it occurs in the r-f input from the antenna. There is a slow-response AVC (automatic volume control) in the i-f stage in the MSR-4 unit; therefore, if the fade is not sudden, sound reduction will not occur until the r-f signal fades below the limit of the i-f AVC (40db) When this occurs, increase the volume by turning the AUDIO GAIN knob on the MSR clockwise.

(2) MCW, AM - In these modes of reception a rapid-response AVC is used in the r-f stage in the GPR-90RXD receiver. The limitation of this AVC is 80 db; as a result, no indication of signal fade will show up either in sound or on the "S" meter (which is in the output of the r-f stage) until the signal has dropped beyond 80 db. An occasional check should be made by switching the GPR-90RXD MANUAL/AVC switch to MANUAL and observing the "S" meter reading. Should a fade beyond the AVC boundary occur, volume may be increased by tuning the MSR AUDIO GAIN knob clockwise.

c. FREQUENCY DRIFT CONTROL

NOTE

Before making correction for drift, place GPR-90RXD RF SELECTIVITY switch in NON-XTAL position; after making correction, place switch in best position for clearest signal.

(1) CW - An immediate indication of frequency drift is a tone change at the headset or loudspeaker. When the drift exceeds approximately 1.7 kc, the signal will cut out due to exceeding the pass-band of the MSR unit.

A small drift may be corrected by adjustment of the MSR BANDSPREAD knob (for variable IFO); for crystal IFO, use GPR-90RXD XTAL ADJ knob (for crystal HFO), or GPR-90RXD BANDSPREAD knob (for variable HFO). If the signal has drifted excessively, retuning above or below the original point will be necessary. If tone has gone up, retune for a higher point; if tone has gone down, retune for a lower point.

(2) MCW - There is no indication of frequency drift in MCW reception. When the drift has exceeded 1.7 kc, however, the signal will be cut out at the headset or loudspeaker, due to the limitations of the MSR pass-band. If this should occur and if the drift has not continued, the signal will be brought back with an adjustment of MSR BANDSPREAD knob (for variable IFO); for crystal IFO, use GPR-90RXD XTAL ADJ knob (for crystal HFO), or GPR-90RXD BANDSPREAD knob (for variable HFO). If the signal has drifted excessively, retuning above or below the original point will be necessary.

(3) AM - Loss of high or low tones on the headset or loudspeaker indicates the beginning of frequency drift. A small drift may be corrected by an adjustment of the MSR BANDSPREAD knob (for variable IFO); for crystal IFO, use GPR-90RXD XTAL ADJ knob (for crystal HFO), or GPR-90RXD BANDSPREAD knob (for variable HFO). If the signal has drifted excessively, retuning above or below the original point will be necessary. Tune for a higher point when high tones are lost and tune for a lower point when low tones are lost.

(4) SSB, ISB - An immediate indication of frequency drift is a tone change at the headset or loudspeaker. This may be followed by loss of high or low tones as the frequency continues to drift. As the tones go up the scale, the higher tones disappear; conversely as the tones go down the scale, the lower tones disappear. This holds true for upper or lower sideband outputs in SSB and ISB reception. For variable IFO operation, a small drift may be corrected by an adjustment of the MSR BANDSPREAD knob (in the case of ISB, the two knob adjustments are made in the same amounts but in opposite directions). For

crystal IFO a small drift may b[illegible]orrected by adjustment of GPR-90RXD XTAL ADJ [illegible] (for crystal HFO) or GPR-90RXD [illegible]NDSPREAD knob (for variable HFO). If the signal has drifted excessively, retuning above or below the original point will be necessary. If tones have gone up, retune for a higher point; if tones have gone down, retune for a lower point.

(5) FSK - The CFA unit provides a CRT screen indication for frequency drift. When there is no frequency drift, a thin, vertical line remains in the middle of the screen during the reception of the keyed signal. When the frequency proceeds to drift up the scale, the pattern opens up into a rectangle towards the right of the screen; when the frequency drifts down, the pattern opens up towards the left. The CFA unit contains a frequency drift compensation circuit, the limits of which are determined by the MSR and SFP bandpass filters. Therefore, when the SFP CHANNEL 1 (or 2) switch is in the FILTER OUT position, the frequency (for a 850-cps shift) may be allowed to drift approximately 800 cps upward or 1200 cps downward without any adverse effect on the teleprinter. When these limitations are exceeded, the teleprinter will cease to operate. When the SFP CHANNEL 1 (or 2) switch is in the FILTER IN position, the frequency drift limit is ± 100 cps (the width of the SFP "space" filter). Therefore, under conditions where the transmitted FSK signal is controlled against drift and the shift is 850 cps, the SFP filters may be used; when the transmitted signal is inclined to drift, the SFP filters should be switched out (FILTER OUT position) for the channel being used. In the latter case, it is advisable to observe the CFA CRT screen for indication of the beginning of drift. For crystal HFO operation (crystal or variable IFO), a small [illegible] may be corrected by the GPR-90RXD XTAL ADJ knob. If CRT screen pattern [illegible]ifted to the right, turn XTAL ADJ knob in + direction; if pattern has

drifted to the left, turn knob i direction. For variabl HFO operation (crystal or variable IFO), a sma drift may be corrected by the GPR-90RXD BANDSPREAD knob. If CRT screen attern has drifted to the right, turn BANDSPREAD knob to bring higher frequency readings on its dial; if pattern has drifted to the left, turn knob to bring lower readings. Do not readjust MSR BANDSPREAD knob.

NOTE

When the keyed information ceases, on a transmitted FSK signal, the CFA reverts to "mark standby" condition. The pattern for this condition is a thin, vertical line in the left portion of the CRT screen and should not be confused with a drift indication.

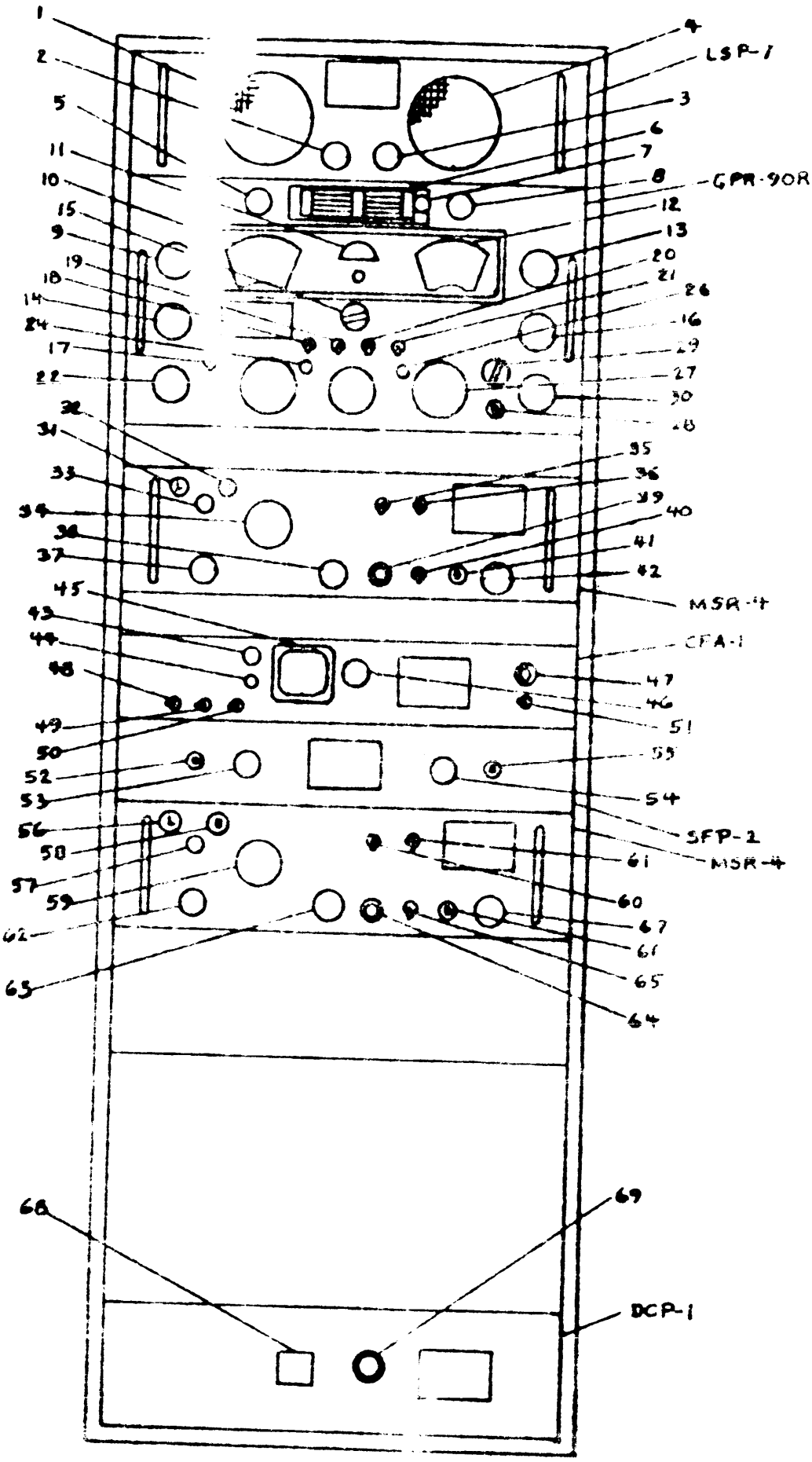


FIGURE 3-1. DDR-6H PANEL CONTROLS

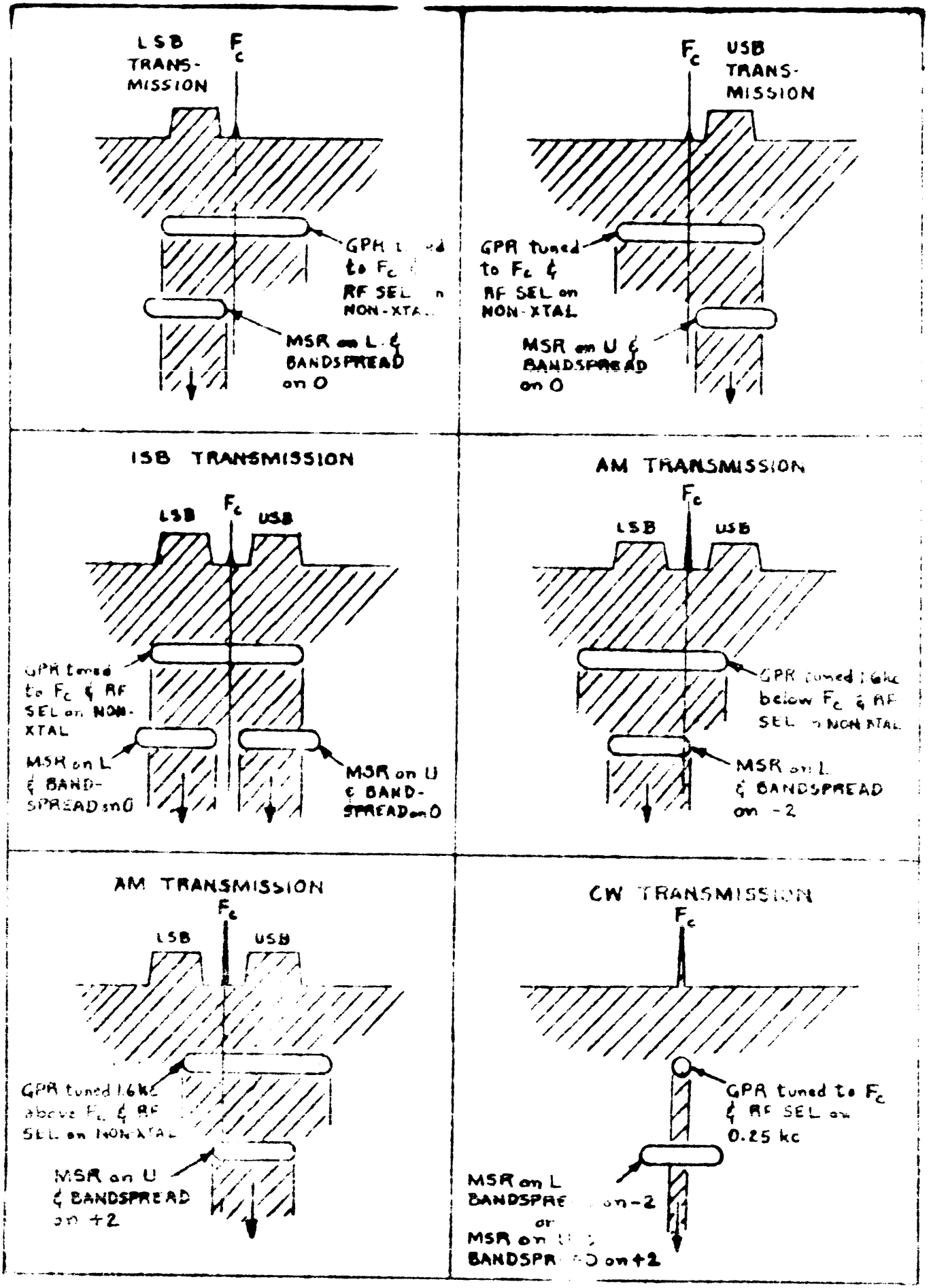


FIGURE 3-2. SLOT TUNING DIAGRAM DDR-6H (SHEET 1 OF 2)

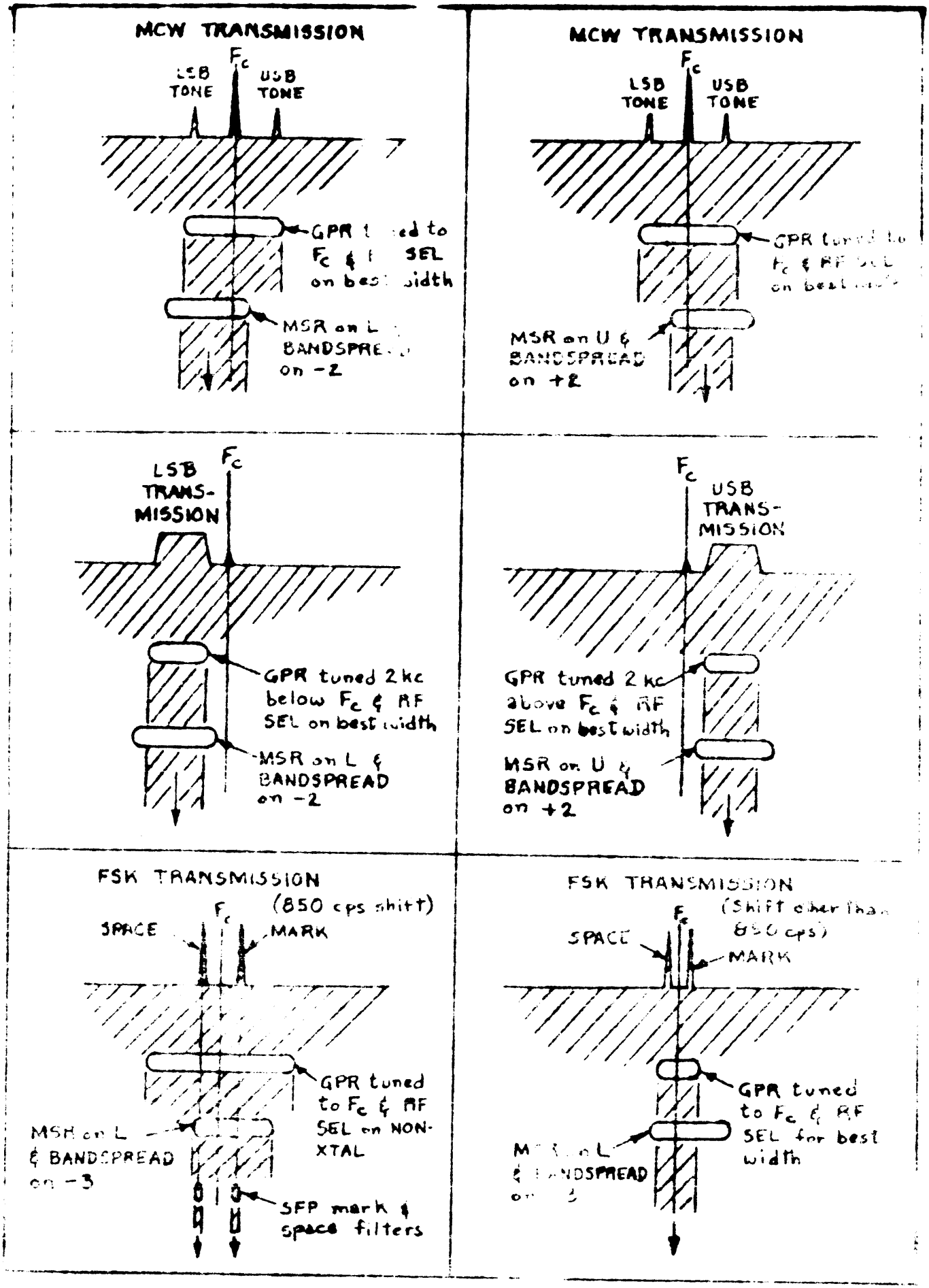


FIGURE 3-2. SLOT TUNING DIAGRAM, DDR-GH (SHEET 2 OF 2)

SECTION 4

PRINCIPLE OF OPERATION

4-1. GENERAL

Figure 4-1 is a functional block diagram of the DDR-6H General Purpose Receiver system. In all reception modes the r-f stage of the signal is tuned in and amplified in the GPR-90RXD Receiver. The first i-f stage (455 kc) is amplified and the signal is sent to one or both of the MSR-4 units; the a-f stage of the GPR-90RXD is not used. The MSR-4 Mode Selector contains an upper and lower sideband-pass filter, selectable by the SIDEBAND button on the front panel. Each filter may be tuned up or down the frequency scale by means of the BANDSPREAD knob to select a sideband only, sideband and carrier, or carrier only. Audio detection takes place in the MSR-4 unit by a diode detector for AM and MCW modes and by insertion of BFO for SSB, ISB, and FSK modes.

In CW reception, the signal is routed to one MSR-4 unit where the upper or lower sideband filter is selected and tuned to receive the carrier. The MSR-4 BFO is switched on to produce the a-f output of the coded signal.

In MCW and AM reception, the signal is routed to one MSR-4 unit where the upper or lower sideband filter is selected and tuned to receive a sideband with carrier. Audio is then produced from the MSR-4 diode detector in the conventional way.

In SSB reception, the signal is routed to one MSR-4 unit where the appropriate sideband filter is selected and tuned to pass on the sid band only. Th BFO is then ins rted into the signal as a 17-kc carri r r ins rtion for audio d tection.

In ISB reception, each independent sid band signal is routed to an MSR-4 unit. The appropriate sid band filter is selected in each unit and tuned to pass only the sideband only. The BFO in each MSR-4 unit is then inserted into the signal for audio detection.

In FSK reception (with the standard 850 cps shift), the signal is routed to one MSR-4 unit. The lower sideband filter is selected and detuned to produce (with the 17-kc BFO) the 2550 cps center frequency required to operate the CFA-1 Frequency Converter Unit. These mark and space frequencies are then channeled through CHANNEL 1 or 2 of the SFP-2 Filter Panel, which contains two filters for "cleaning up" the signal: 2975 $\pm$ 125 cps for mark and 2125 $\pm$ 100 cps for space. The output of SFP-2 is routed to the CFA-1 Frequency Shift Converter which converts the audio signals into pulses for the RTTY equipment. For shifts other than 850 cps, the SFP-2 filters are bypassed.

4-2. SLOT TUNING

The GPR-90RXD Receiver working with an MSR-4 unit is essentially a "slot tuning" system (see Figure 3-2). The GPR-90RXD may be regarded as one movable "slot" (or bandpass width) of 6-kc. By the same viewpoint, the MSR-4 is a movable "slot" of 3.4-kc width. These slots may be moved up and down the frequency spectrum of signals present in the air waves in such a way as to give a high degree of selectivity for the band of frequencies desired. The "slots" are "moved" by changing the frequency outputs of the GPR-90RXD HFO and MSR-4 IFO as described in the following paragraphs.

Figure 4-2 is a frequency translation diagram of the GPR-90RXD and MSR-4 units. A frequency (Fc) in the 0.54- to 31.5-mc range is received from the antenna by the RF Amplifier stage of the

GPR-90RXD and routed to th 1 conv rt r, V3. When operating with variable HFO, adjustment of t MAIN TUNING and BANDSPREAD knobs varies the output frequency o: the HFO, V12, to equal F_c + 455 kc. The F_c + 455 kc is routed to the 1st Converter where it mixes with F_c to produce the difference frequency of 455 kc. When the RANGE SELECTOR switch is turned to bands 1, 2, or 3, the 455 kc is routed directly to the IF Amplifier section. When the RANGE SELECTOR switch is turned to bands 4, 5 or 6, a harmonic of 455-kc (3.955 mc), generated in V3 1st Converter, is routed to V4 2nd Converter and 3.5-mc Oscillator. The 3.5 mc mixes with the 3.955 mc to produce a difference frequency of 455 kc. The second conversion stage for the upper bands performs the function of improving image rejection. The 455 kc is routed from the GPR-90RXD to the IF Amplifier stage (V2) of the MSR-4 and the 1st Mixer (V3). With the MSR BANDSPREAD knob set at 0, and according to the selection made by the SIDEBAND switch, either a 438-kc or 472-kc frequency is injected into the 1st Mixer. In either case, a difference frequency of 17 kc is produced when mixed with the 455 kc.

When an audio tone (Fa) is introduced at the transmitter, two sideband frequencies Flsb and Fusb are created. $F_{lsb} = F_c - F_a$ and $F_{usb} = F_c + F_a$.

The course of a sideband frequency tone takes the same route as F_c, which may be now considered as the carrier frequency. At the input of GPR-90RXD, F_{lsb} ($F_c - F_a$) a lower sideband frequency tone, mixes with F_c + 455 kc from the HFO to produce a difference frequency equal to $F_c + F_a$, becoming momentarily an upper sideband frequency tone. In like manner, an upper sideband tone, F_{usb}, appears at this point as a lower sid band ton . Carri r (F_c) and inv rt d sidebands are s nt to the 1st Mix r in th MSR-4.

With the MSR BANDSPREAD knob s at 0, the LSB IFO produces its center frequency of 438-kc and the USB IFO produces its center frequency of 472-kc. When the SIDEBAND switch is set to LSB, the 1st Mixer receives 438 kc and the incoming F_{lsb} (or $F_c + F_a$) and F_c at the input of V3. F_c (455 kc) mixes with the 438-kc to produce 17 kc; $F_c + F_a$ (455 kc + F_a) mixes with the 438-kc to produce 17 kc + F_a. When the SIDEBAND switch is set to USB, the 1st Mixer receives 472 kc and the incoming F_{usb} (or $F_c - F_a$) and F_c at the input of V3. F_c (455 kc) mixes with the 472 kc to produce 17 kc; $F_c - F_a$ (455 kc - F_a) mixes with the 472 kc to produce 17 kc + F_a. It is seen that in either condition, LSB or USB, sideband filter Z1 receives F_c and $F_c + F_a$. Since the filter passes only frequencies in the 17.4- to 20.8-kc range, the 17-kc F_c is dropped and the sideband frequency (17 kc + F_a) is passed on to the detector. By introducing 17-kc from the BFO, the audio frequency, F_a, is obtained.

The above description is for the GPR-90RXD 6-kc wide "slot" centered on (or tuned to) F_c, with the MSR-4 3.4-kc wide "slot" offset from F_c by 2.1 kc by the "0" setting of the MSR BANDSPREAD knob. With these settings, setting the SIDEBAND switch to U or L will automatically select upper or lower sideband from a SSB or ISB signal. In ISB reception, one MSR-4 is thus used to select one sideband. For selecting a sideband and carrier out of an AM or MCW signal, the MSR-4 "slot" may be "moved" over to include the carrier frequency by adjustment of the MSR BANDSPREAD knob. Adjustment of this knob changes the LSB or USB IFO frequency, thereby changing the frequency output of V3 Mixer sufficiently to mov F_c

up the frequency scale from kc to be included in the 17.4 - to 20.8-kc filter pass-band. (rier and sideband are now sent to V4 detector, the BFO is set t FF, and diode detection takes place. In receiving a CW signal, t e GPR-90RXD "slot" is centered on (or tuned to) F_c and the MSR "slot" is "moved" to center on F_c. This produces approximately a 19 kc tone from V3 which, when mixed with the 17-kc output of the BFO, produces a 2-kc tone from the V4 Mixer. The tone may be changed, if desired, by a further adjustment of the MSR BANDSPREAD knob. Adjacent frequencies are removed by narrowing the GPR-90RXD "slot" from its 6-kc width down to a .25-kc width, by means of the GPR-90RXD RF SELECTIVITY knob. In receiving an FSK signal, the DDR-6H is first tuned to a transmitted test signal containing mark and space frequencies. The GPR-90RXD is tuned to the theoretical center r-f frequency, midway between mark and space frequencies. The center frequency appears as 455 kc at the GPR-90-RXD i-f output. The required operating center frequency of the CFA-1 Frequency Converter is 2550 cps; this frequency is produced by the MSR-4 as follows. The SIDEBAND switch is set to L and the MSR lower sideband IFO is tuned to 435-kc. The 435-kc mixes with the incoming test signal in V3 Mixer to translate the theoretical center frequency of 455 kc into 20 kc. In the 2nd Mixer, V4, the BFO output of 17 kc translates the 20-kc center frequency to 3 kc. The 3 kc is brought down to 2550 cps by a subsequent frequency adjustment at the GPR-90RXD HFO and with the aid of the CFA-1 CRT visual indicator. The CRT displays a thin vertical line in the center of the screen when 2550 cps has been reached. The center frequency from th V3 Mix r now appears as 19.55 kc, with mark and spac frequencies of 19.975 kc and 19.125 kc, r spectively, all

within the pass-band of Z1 filter. The incoming frequency shift may vary up to 1400 cps and still pass through Z1 filter. For the standard 850-cps shift, mark and space frequencies of 2975 cps and 2125 cps, respectively, are produced at V4 Mixer output. The SFP-2 Filter Panel contains mark and space filters of these frequencies for use with this shift. For shifts other than 850 cps, the SFP-2 is bypassed and filtering of adjacent frequencies may be effected by narrowing the GPR-90RXD "slot" by means of its RF SELECTIVITY knob.

In tuning tables 3-1 through 3-2, in certain instances the GPR-90RXD receiver is slightly detuned in order to center the 6-kc width "slot" on the desired band of frequencies. The MSR-4 "slot" is then set accordingly. This detuning of the GPR-90RXD enables utilizing the highly stable GPR-90RXD crystal band-pass filters, selectable in 5 widths of 2.0 kc, 1.5 kc, 1.0 kc, 0.5 kc and 0.25 kc. These filters may be used to narrow the GPR-90RXD "slot" to the best position for eliminating adjacent noise while allowing the desired intelligence to come through. For example, in SSB reception, the GPR-90RXD is centered on the sideband frequencies, rather than the carrier, in order to afford filtering at the high and low ends of the sideband.

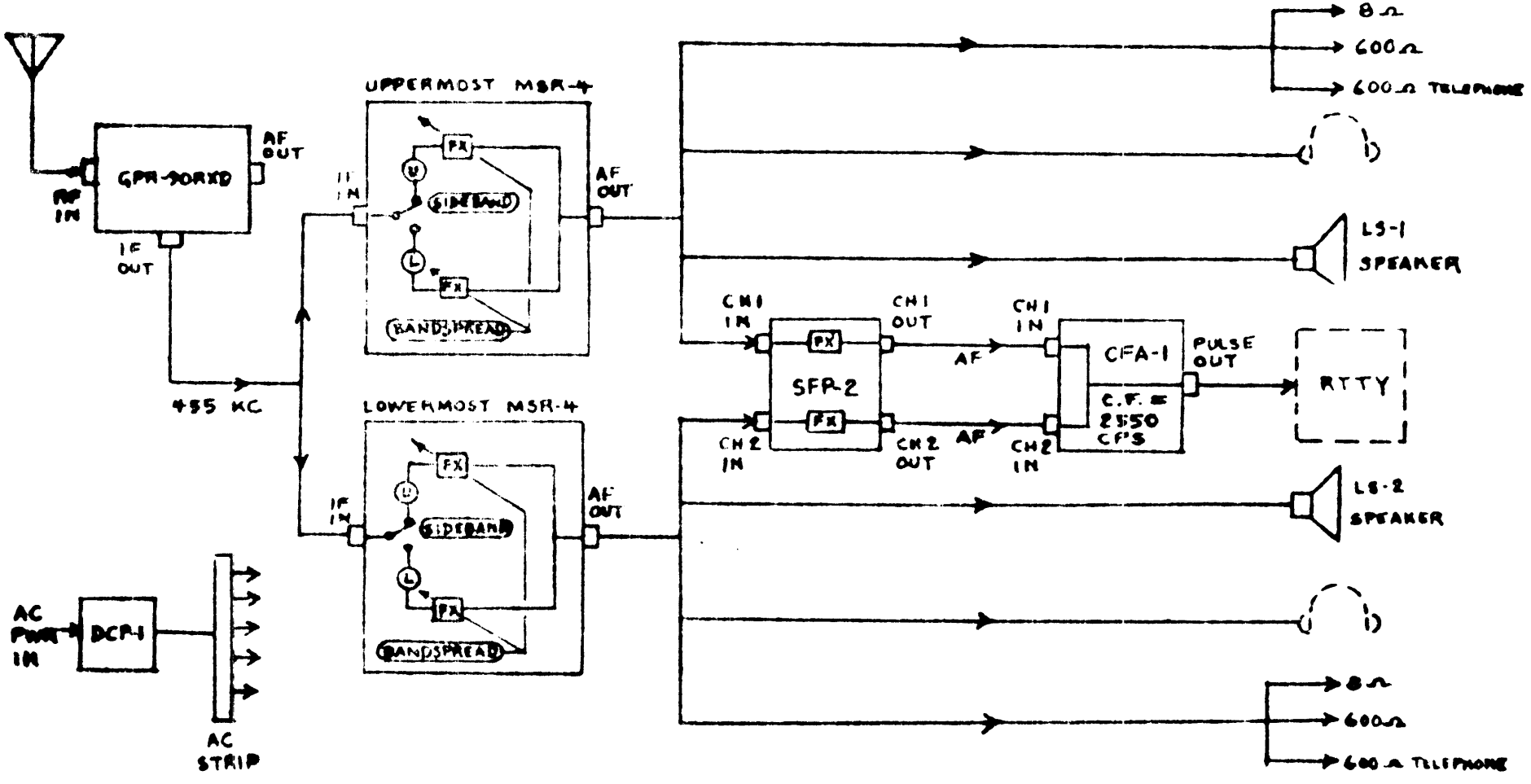


FIGURE 4-1. FUNCTIONAL BLOCK DIAGRAM, DDR-6

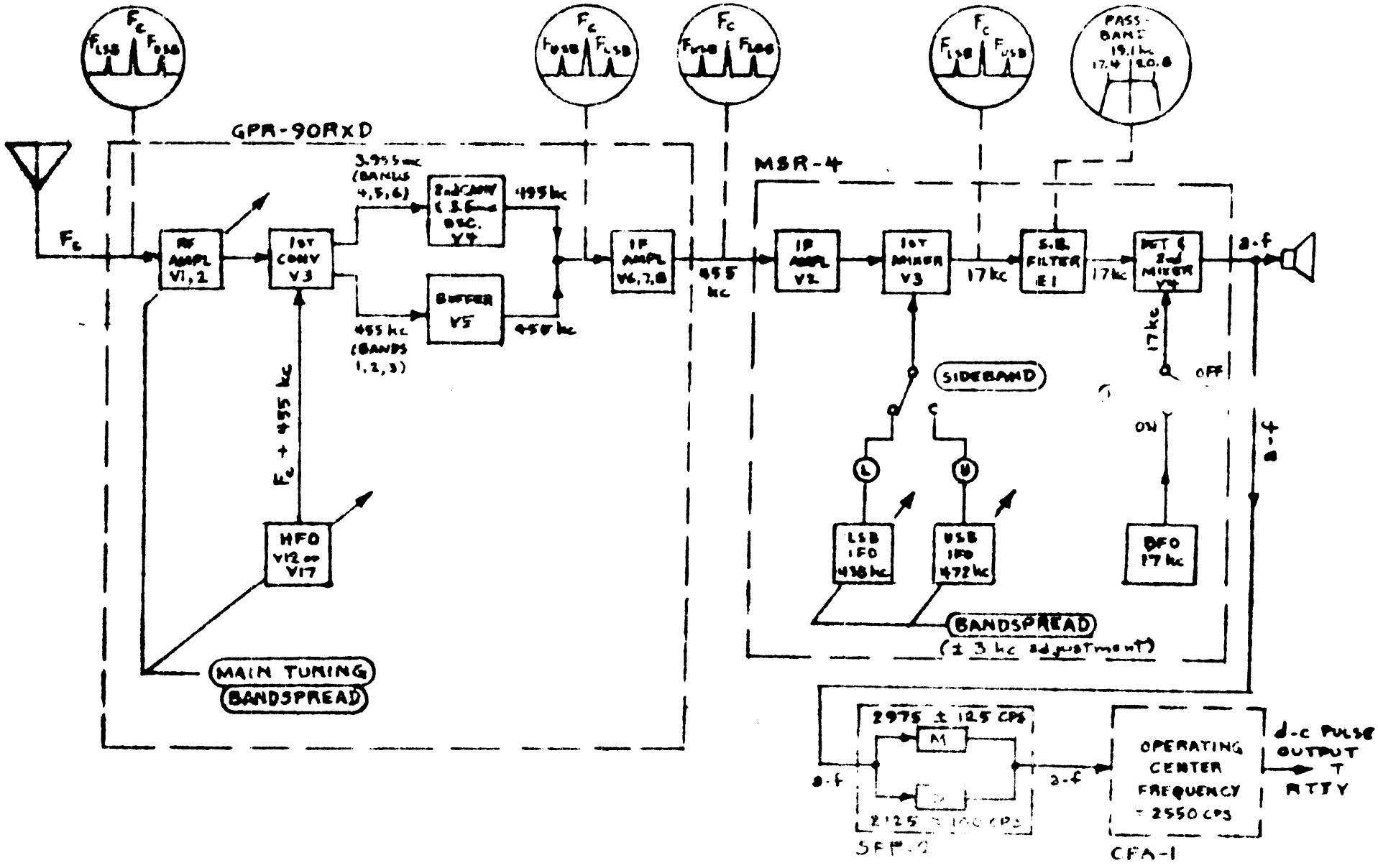


FIGURE 4-2. FREQUENCY TRANSLATION DIAGRAM, DDR-6H