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TECHNICAL MANUAL

for

GENERAL PURPOSE RECEIVER

MODEL DDR-7J

SYSTEM

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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MAMARONECK, N.Y. **OTTAWA, CANADA**

IN-366 ISSUE DATE: 15 APRIL 1966

NOTICE

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.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

FOREWORD

TMC's General Purpose Receiver, Model DDR-7J, consists of six major units, as follows:

(1) Frequency Shift Converter CFA-1

(1) Communications Receiver GPR-90 RXD

(1) Mode Selector Panel AX-625

(1) Mode Selector, Receiving MSR-4

(1) Line Patch Panel LPP-3-2

(1) Loudspeaker Panel LSP-4

(1) Utility Panel HPP-1

A manual for each unit is prepared, and the manuals are then combined for the specific receiver system. The DDR-7J system manual is made up of unit manuals as described in Table of Contents of General Purpose Receiver, Model DDR-7J.

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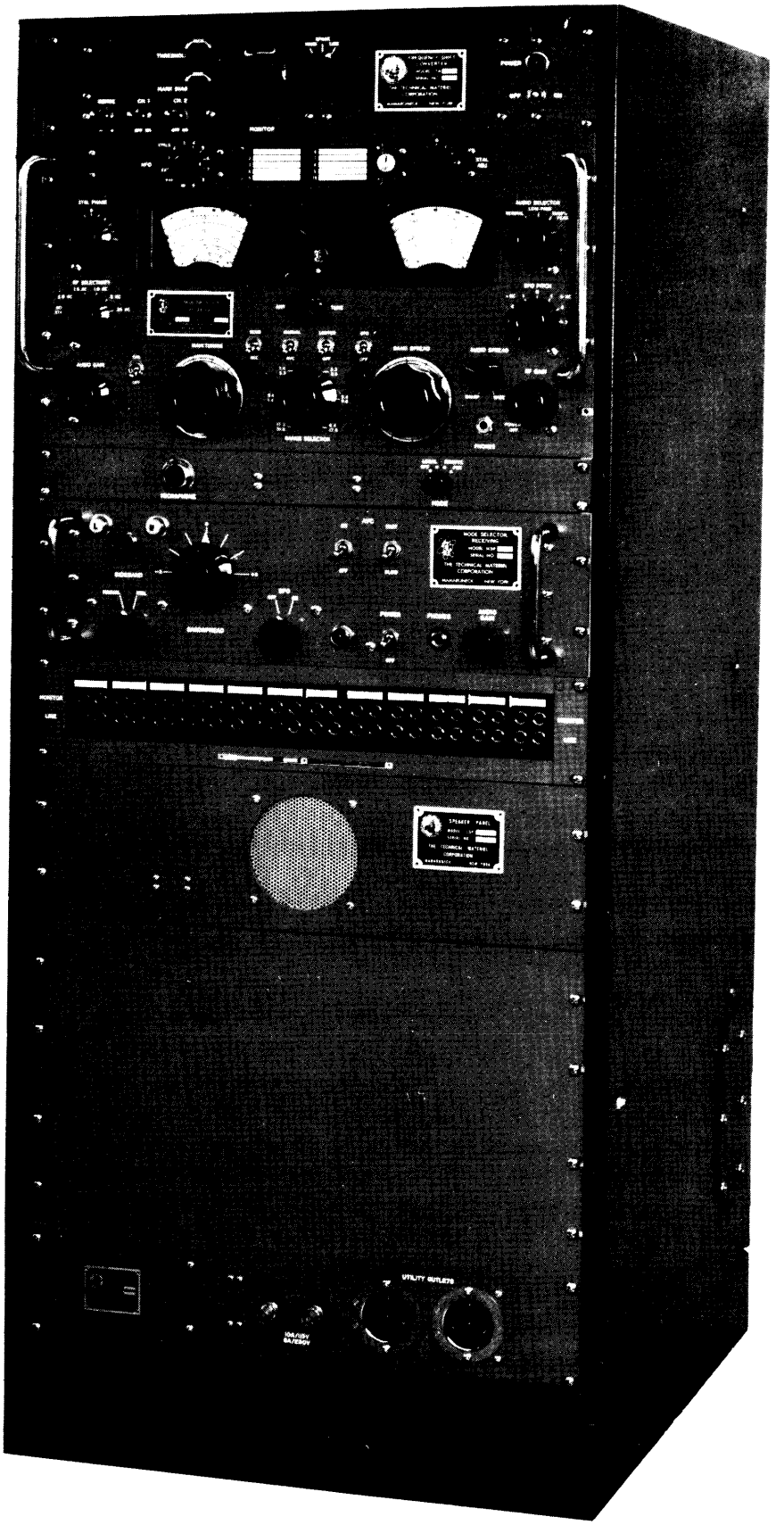


Figure 1-1. General Purpose Receiver, Model DDR-7J

SECTION 1

GENERAL INFORMATION

1-1. DESCRIPTION

General Purpose Receiver, Model DDR-7J (figure 1-1), is a double-, or triple-conversion super heterodyne communication receiver. The DDR-7J covers the frequency range of .54 to 31.5 megacycles. A flexible filtering and detection circuit provides for the reception of AM, SSB, CW, MCW, FSK, and FAX signals. Output facilities include a loudspeaker, 8-ohm and 600-ohm audio outputs, and teletype loop keying.

The DDR-7J also has remote control facilities for an associated transmitter and a patch panel that permits flexibility in the receiver output configuration and transmitter control circuitry.

The first conversion oscillator (HFO) and the final conversion oscillator may be either crystal-controlled or manually tuneable. Alternately, an external high-stability oscillator, TMC's Model VOX-5 (1 part in 10^6 per day) or Model CPO-1 (1 part in 10^8 per day), may be used for the receiver's HFO.

For SSB reception, final conversion, filtering, and detection is accomplished in the MSR. For all other modes of reception, all conversion, detection, and amplification may be accomplished in the GPR. The frequency-shift converter CFA employs the audio output of the GPR on MSR, to provide keying of a teletype loop.

Line Patch Panel LPP provides flexibility in the receiver output circuitry, and also provides patching facilities for external associated equipment.

Mode Selector Panel AX-625 provides remote control for an associated transmitter(including a microphone jack). A separate

48 volt power supply (AP-133 or AP-134) for the associated handset is located at the bottom rear of the cabinet.

Utility Panel HPP provides two fused utility receptacles for test equipment use, or a similar purpose.

The DDR-7J receiver system is contained in a 21-inch wide x 23-inch deep x 48-5/8-inch high steel cabinet. This cabinet is provided with mounting holes for standard 19-inch equipment panels, and a rear access door.

Tuning is provided with full electrical bandspread in the r-f and i-f sections. A 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-7J is made up of the following modular units:

Frequency Shift Converter	CFA-1
Communications Receiver	GPR-90RXD
Mode Selector Panel	AX-625
Mode Selector, Receiving	MSR-4
Line Patch Panel	LPP-3-2
Loudspeaker Panel	LSP-4
Utility Panel	HPP-1

The rack contains its own forced-air cooling system consisting of 2 exhaust blowers and an air intake and exhaust with removable filters. For shipping weights and other particulars, see Appendix section of this manual.

TABLE 1-1. ELECTRICAL CHARACTERISTICS, DDR-7J

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	4.3 - 9.6
5	9.4 -17.8
6	17.3 -31.5

Types of Reception:	AM, SSB, CW, MCW, FSK and FAX
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, FSK and FAX: Compensates for 40-db change in input signal.
Antenna input connection:	Type BNC jack for a nominal 70-ohm unbalanced transmission line.
Outputs:	Audio (for AM, SSB, CW, MCW, FAX): a. 1-mw output at terminal block for 600-ohm telephone line. b. 8-ohm speaker (at top of rack)

TABLE 1-1. ELECTRICAL CHARACTERISTICS, DDR-7J (CONT.)

	c. 2W/150 mv 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. 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:	100 to 1000 cps centered at 2550 cps.
b. Received signal frequency drift:	1-1/2 times maximum shift (1500 cps)
c. Keying speeds:	100 to 600 words per minute in high speed position and up to 100 words per minute in low speed position.

TABLE 1-1. ELECTRICAL CHARACTERISTICS, DDR-7J (CONT.)

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 drop-outs.
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).

SECTION 2

INSTALLATION

2-1. INTRODUCTION

Each DDR-7J General Purpose Receiver has been tested at the factory as a complete system before shipment; for shipment it is disassembled and packaged in three crates. Unpack and reassemble the equipment as outlined in the following paragraphs; recalibration of the individual modular units is not necessary.

2-2. INITIAL INSPECTION

When the equipment is delivered at the operating site, inspect each crate and its contents immediately for possible damage that may have occurred during transit. Unpack the equipment carefully, and inspect all packaging 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.

2-4. 230V LINE VOLTAGE MODIFICATION (REFER TO FIGURE 2-3).

a. GENERAL - The DDR-7J is factory-wired for 115 vac, 50/60 cycle, single phase line voltage, unless specified otherwise on order. If line voltage is 230 vac, perform wiring modifications outlined in paragraphs b, c, d, e, and f below. The 48-volt power source for remote telephone operation is provided by AP-133 or AP-134 (115- or 230-vac operation, respectively).

b. GPR - Refer to GPR technical manual. 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 - Refer to MSR technical manual. 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).

d. CFA - Refer to CFA technical manual, and rewire connections at T1 and T2 transformers. Replace 2-amp fuse (F1) cartridge with a 1-amp fuse cartridge (TMC part number F-100-1).

e. HPP - Refer to HPP technical manual. Replace 10-amp fuses with 5-amp fuses.

f. BLOWERS - Relocate jumpers at rack terminal block TB8501 as shown in figure 2-3, for 230 VAC line.

2-5. ASSEMBLY OF RECEIVER

Install units as shown in figure 1-1 and make cable connections as indicated in figure C of Appendix of this manual. The LSP, CFA, LPP, and HPP units are mounted in the rack supported by their front panels. The GPR and MSR units are slide-mounted; the track portion

of the slides arrive installed in the rack. Follow this general procedure for installing slide mounted units (refer to figure 2-1):

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

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

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

(4) When the units have been installed and cabled, press the release buttons and push the unit into the rack.

Use the take-up reel, located in the upper rear section of the rack, to secure cabling from slide-mounted units to prevent snagging when units are drawn in and out of rack.

2-6. CONNECTION OF EXTERNAL EQUIPMENT

a. GENERAL - Figure 2-2 illustrates the interconnections of DDR-7J units and external equipment connections. The following paragraphs describe each connection.

b. ANTENNA INPUT - The input impedance at J6 antenna jack on GPR 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. For telephone line operation, the OUTPUT LEVEL switch, at the rear of the MSR chassis, is set to LOW. This produces a maximum output of 1 mw.

d. TELEPRINTER OUTPUT - Terminal 3 and 4 on terminal block

TB602 are for the connection of the CFA 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 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 pulse generator. The DDR-7J Receiver is designed for working with a teleprinter that contains this source. (If the source is not contained in the teleprinter equipment, TMC's Model PSP Power Supply will furnish this capability.)

f. HEADSET OUTPUTS - In CW, MCW, AM and SSB reception, the MSR PHONES jack is used. The 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 the MSR chassis is an MS3102A-14S-2P receptacle furnished with mating MS3106-14S-2S plug. As shown in figure 2-2, the plug may be wired for any or all of the following auxiliary outputs with the MSR 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 OUTPUT LEVEL switch is set in the LOW position for simultaneous audio outputs to the headset and telephone line. When speaker operation is required, it is switched to HIGH, in which case the headset and telephone line output is not used. HIGH and LOW outputs may not be used simultaneously from the MSR.

h. LINE VOLTAGE INPUT - 115/230 VAC, 50/60 cps, single phase line voltage is connected to the DDR-7J Receiver at J8506 receptacle located at the bottom of the rack at the rear. See table B in Appendix for part number of mating plug furnished in shipment.

2-7. INITIAL ADJUSTMENTS

The DDR-7J 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 Frequency Shift Converter to the particular teleprinter in use.

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

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

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

(3) Set CFA 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-7J 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 MARK/SPACE/LINE switch to LINE position.

The CFA 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 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 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, 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-7J requires one plug-in crystal in the HFO circuit for each frequency to be received. Unless specified on order, crystals will not be included in the DDR-7J shipment. Ten HFO crystal sockets are located in a compartment in the top of the GPR 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. A chart mounted on the outside of the door, is provided for recording 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

* For FSK reception, F_C is the center frequency.

reception with suppressed carrier, as in SSB. For frequencies below 5.5 megocycles, the crystal frequency (F_X) is calculated by the formula:

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

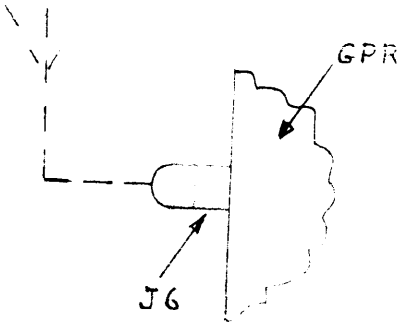
For reception above 5.5 megocycles, the crystal frequency (F_X) is calculated by the formula:

$$F_X = F_C + 3955 \text{ kc}$$

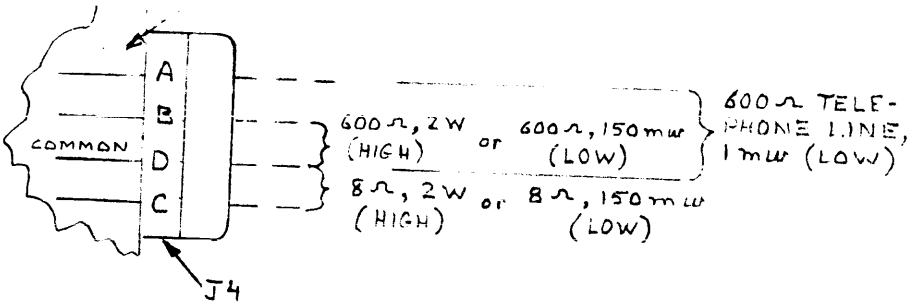
For FSK reception, a point 2.55 kc lower than the center frequency of transmission should be selected for F_C in the foregoing formulas. Use type CR-18/U quartz crystals with parallel resonant frequencies in the .995- to 31.955-mc range and housed in HC-6/U holders.

c. IFO CRYSTALS - For crystal-controlled IFO operation, the DDR-7J requires two plug-in crystals, one for each sideband, in the MSR unit. Unless specified otherwise on order, the DDR-7J is shipped with a 438-kc lower sideband crystal in XY1 socket and a 472-kc upper sideband crystal in XY2 socket in the MSR. The following crystals are required for the following types of reception (use type CR-46/U quartz crystals with parallel resonant frequencies and HC-6/U holders):

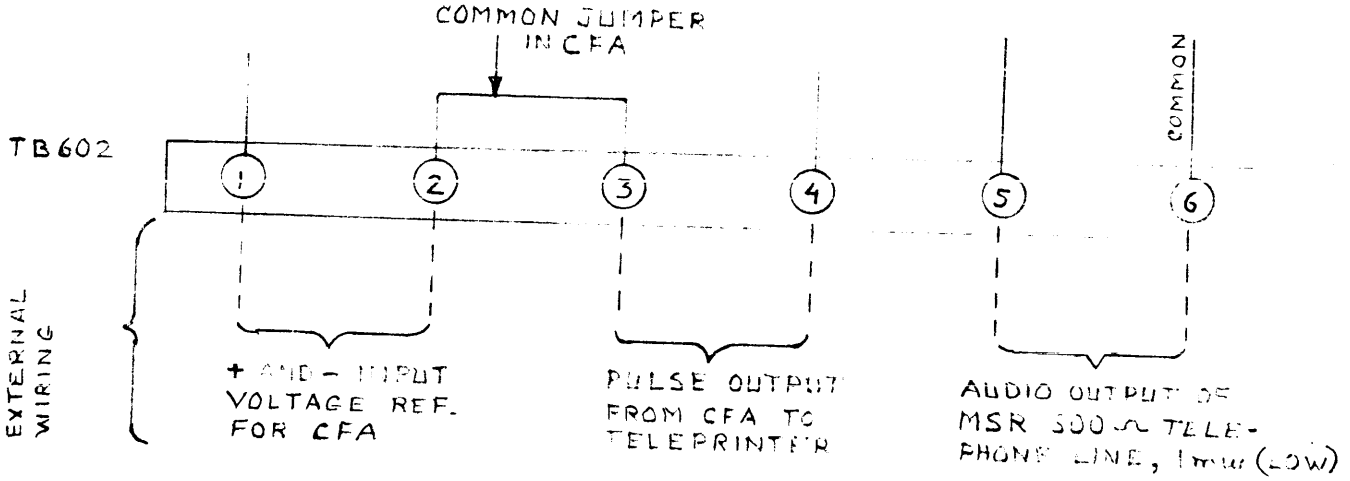
Reception	MSR-4 Crystal Frequencies in sockets: XY1	XY2
CW,MCW,AM,SSB.....	436-kc	474-kc
FSK.....	435-kc	none

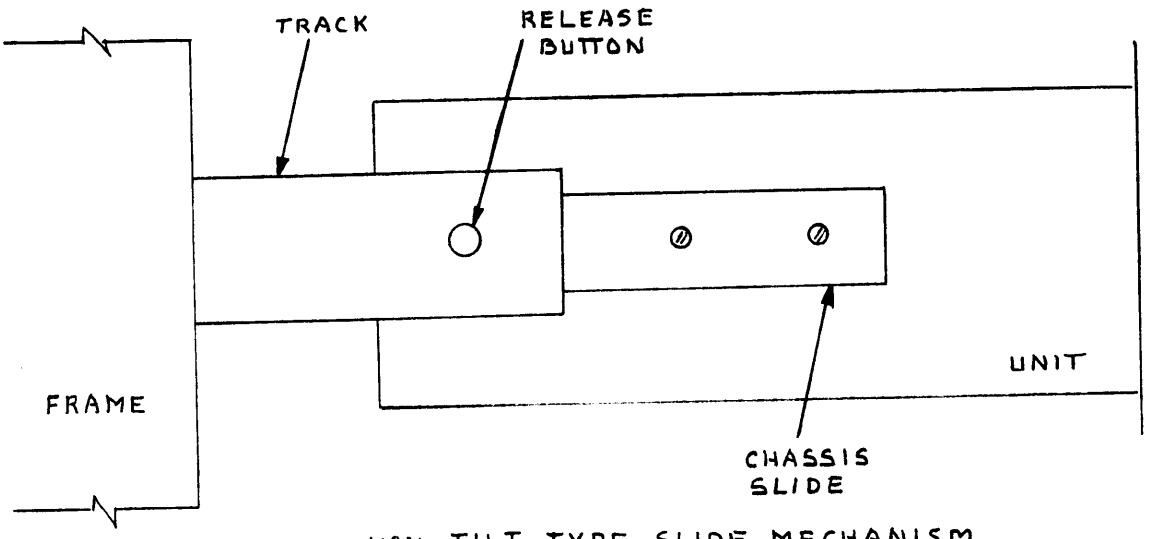


ANTENNA INPUT



AUXILIARY 600-/8-OHM AUDIO OUTPUTS





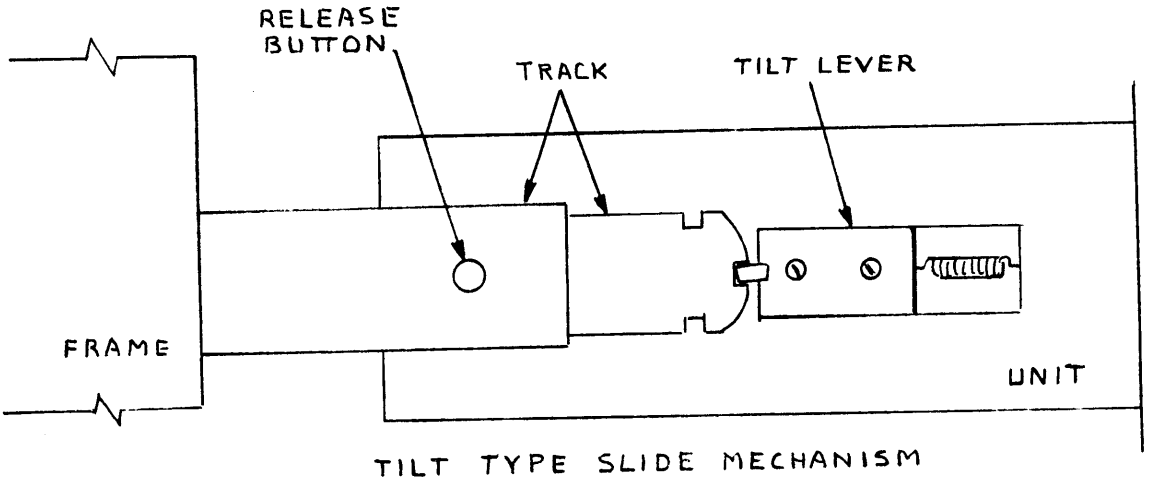


Figure 2-1. Slide Mounting Details

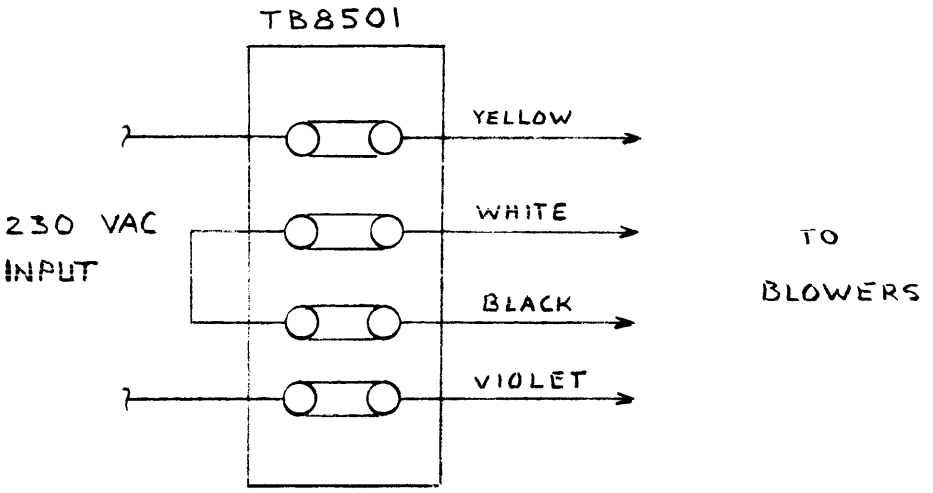


Figure 2-3. 230-V Line Voltage Modification, Cabinet Blowers

SECTION 3

OPERATOR'S SECTION

3-1. INTRODUCTION

a. GENERAL - Before tuning up the DDR-7J for the first time, it is advisable that the operator become familiar with the following characteristics and capabilities of the equipment:

1 - Functions of units

2 - Functions of controls

3 - Modes of reception

4 - HFO and IFO selection

5 - Types of output

b. FUNCTIONS OF UNITS - Refer to figure 4-1 for functional block diagram of the DDR-7J receiver system. Technical Materiel modular units 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. The a-f section of the GPR is not used; after i-f amplification in the GPR, the signal is routed to the MSR unit for sideband selection and i-f bandspread and through the MSR a-f amplifier section.

c. FUNCTIONS OF CONTROLS - Figure 3-1 shows DDR-7J panel controls; control numbers are for reference in "tune-up" tables 3-1 through 3-5. Refer to section 3 of each unit technical 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 - The DDR-7J Receiver System provides five main modes of reception:

(1) CW (keyed carrier)

(2) MCW (keyed modulated carrier)

(3) AM* (amplitude modulation)

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

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

Tuning procedures for the above five conventional modes are described in tables 3-1 through 3-5. MAIN TUNING and BANDSPREAD control settings on the GPR, and BANDSPREAD control setting on the MSR, must be calculated on the basis of width of signals and band-pass widths of the GPR and MSR units, as described in paragraph 3-2d.

e. HFO and IFO SECTION - Tables 3-1 through 3-5 outline required steps for using both fixed (crystal) and variable (non-crystal) oscillators for HFO (high frequency oscillator) and IFO (intermediate frequency oscillator) operation. Where greater receiver stability (.002% to .003%) is required, crystal oscillators are used; however, in this case a fairly stable incoming transmitted signal is required, since very little adjustment of the fixed oscillators is possible. Specifically, with both HFO and IFO on crystal control, this adjustment (XTL ADJ knob on the GPR) 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-7J Receiver System has the following 4 main** types of output available:

---

* Single Sideband reception from a transmitted AM signal.

** Additional outputs are available at J4 receptacle at the rear of the MSR unit (see paragraph 2-6g).

(1) Loudspeaker output from MSR

(2) PHONES headset output from MSR

(3) Telephone line output from MSR

(4) Teleprinter output from CFA

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

Switch Position	Output Level
LOW	150 mw
HIGH	2 watts

To provide audio for the loudspeaker, the MSR 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 MSR unit.

Tables 3-1 through 3-5 describe tune-up procedures in terms of an output normal for the listed modes of reception.

3-2. TUNING PROCEDURES

a. TUNING TABLES - Tables 3-1 through 3-5 describe tuning procedures for the 4 main modes of reception available with the DDR-7J. The tables describe procedures for using the system for CW, MCW, AM, SSB, FSK, and FAX reception.

b. RF BANDSPREAD - Bandspread of the r-f stage is accomplished with the GPR BANDSPREAD knob and movable dial. This control acts as a vernier adjustment for the GPR 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.

Example 1: To tune 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.

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* By referring to the amateur band calibrations on the BANDSPREAD dial, it is seen 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-f BANDSPREAD control on the MSR unit is used to move the 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. Specific procedure for this adjustment is outlined in each of the tune-up tables.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1		Connect power supply line to jack J8506; rack blowers will start.	Connects line voltage to a-c strip in rack, and to blowers.
2	30,12,13,18	Turn RF GAIN knob (30) fully clockwise. Dials (12), (13), and (18) will light up.	Supplies GPR with tube filament and oven element voltages.
3	41,42,43,44	Set POWER/OFF switch (41) to POWER. Power lamp (42) will light and either L lamp (43) or U lamp (44) will light.	Supplies MSR with filament and plate voltages.
4		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR oven temperatures to stabilize.
5	21	Set SEND/REC switch (21) to REC.	Supplies GPR with plate voltages.
6	15	Set ANT TUNE knob (15) to vertical position.	Sets ANT TUNE control at mid-position.
7	25	Set CAL/OFF switch (25) to OFF.	Disables 100-kc marker oscillator

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
8	17	For variable HFO: Set HFO knob (17) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
	17,10,11	For crystal HFO: Set HFO knob (17) to position 1-10 indicated for carrier frequency desired as shown on chart (10). Set XTAL ADJ knob (11) to 0 position.	Sets up HFO for fixed (crystal controlled) operation.
9	20	Set RF SELECTIVITY knob (20) to NON XTAL position.	Selects widest i-f response.
10	22	CW Mode: Set MANUAL/AVC switch(22) to MANUAL.	(CW) Shuts off AVC r-f and i-f stages in GPR.
		MCW Mode: Set MANUAL/AVC switch (22) to AVC.	(MCW) Turns on AVC in r-f and i-f stages in GPR.
11	39	Set AUDIO GAIN knob (39) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
12	38,37	CW Mode: Set AVC ON/OFF switch (38) to ON. Set AVC FAST/SLOW switch (37) to SLOW.	(CW) Sets i-f stage AVC to speed suitable for CW reception.
		MCW Mode: Set AVC ON/OFF switch (38) to ON. Set AVC FAST/SLOW switch (37) to FAST.	(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
13	48	CW Mode: Set BFO switch (48) to ON. MCW Mode: Set BFO switch (48) to OFF.	(CW) Turns on BFO (17-kc) oscillator in MSR to produce audio tone from second mixer.
14	47	For variable IFO: (1) Set MANUAL/XTAL knob (47) to MANUAL.	(1) Sets up 1st injection oscillator in MSR for subsequent i-f BANDSPREAD adjustment.
	45,43,46	(2) Push SIDEBAND button (45) until L lamp (43) lights; then set BANDSPREAD knob (46) to -2. or (optional) Push SIDEBAND button (45) until U lamp (44) lights; then set BANDSPREAD knob (46) to +2.	(2) De-tunes 1st injection oscillator in order to pass carrier through narrow band filter.
		For Crystal IFO:	
	47	(1) Set MANUAL/XTAL knob (47) to XTAL.	(1) Sets up 1st injection oscillator in MSR for crystal controlled operation.
	45,43	(2) Push SIDEBAND button (45) until L lamp (43) lights; then insert 436-kc crystal in XY1 socket in MSR.	(2) De-tunes 1st injection oscillator in order to pass carrier through narrow band filter. Inserts crystal for greater stability.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
14 (cont.)			
	45,44	Push SIDEBAND button (45) until U lamp (44) lights; then insert 474-kc crystal in XY 2 socket in MSR.	
15	29	Set RANGE SELECTOR knob (29) to appropriate position for carrier frequency.	Selects band-pass circuit at r-f input.
16	28,18	Adjust MAIN TUNING knob (28) to obtain reading slight higher * than carrier frequency on dial (18).	Coarse-tunes r-f stage and HFO for carrier frequency.
17	33,13	Set BANDSPREAD knob (33) to bring 100 on LOG scale on dial (13).	Sets r-f BAND-SPREAD vernier control at high end of adjustment range.
18	33	Rotate BANDSPREAD knob (33) counter-clockwise until desired signal is received. (Use headset as a monitor.)	Fine-tunes r-f stage and HFO for carrier frequency.
19	39	Adjust AUDIO GAIN knob (39) to obtain suitable volume.	Adjusts audio output level.
20	46	For variable IFO (with fixed or variable HFO): Adjust BANDSPREAD knob (46) until desirable tone is obtained.	Adjust MSR IFO for an agreeable audio tone.

* See paragraph 3-2b.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
20 (cont)			
	11	For crystal IFO (with fixed HFO): Adjust XTL ADJ knob (11) until desirable tone is obtained.	Adjusts GPR HFO for an agreeable audio tone.
	33	For crystal IFO (with variable HFO): Adjust BANDSPREAD knob (33) until desirable tone is obtained.	Adjust GPR HFO for an agreeable audio tone.
21	20,19	If the signal is accompanied by excessive background noise, adjust the RF SELECTIVITY knob (20) 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 (19) to reduce interference.	Adjusts i-f bandpass width to eliminate adjacent noise.
22	15,12,37,51	CW Mode: Adjust ANT TUNE knob (15) to obtain peak on meter (12). Then reset AUDIO GAIN knob (37) for suitable volume at LS speaker (51).	Tunes r-f input to antenna characteristics.
	22,15,12,39 51	MCW Mode: Set MANUAL/AVC switch (22) to MANUAL. Adjust ANT TUNE knob (15) to obtain peak on meter (12). Set MANUAL/AVC switch (22) to AVC. Readjust AUDIO GAIN knob (39) for suitable volume at LS speaker (51)	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
23	30,39	CW Mode only: When keyed signal commences, readjust RF GAIN knob (30) to a low point and AUDIO GAIN knob (39) to a relatively high point to receive the sharpest signals.	Adjust r-f and a-f gain time constants to best level for intermittent signal.

TABLE 3-2. TUNE-UP PROCEDURE FOR AM

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1		Connect power supply line to jack J8506; rack blowers will start.	Connects line voltage to a-c strip in rack and to blowers.
2	30,12,13, 18	Turn RF GAIN knob (30) fully clockwise. Dials (12), (13) and (18) will light up.	Supplies GPR with tube filament and oven element voltages. Turns up r-f stage gain to maximum.
3	41,42,43, 44	Set POWER/OFF switch (41) to POWER. POWER lamp (42) will light and either L lamp (43) or U lamp (44) will light.	Supplies MSR with filament and plate voltages.
4		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR oven temperatures to stabilize.
5	21	Set SEND/REC switch (21) to REC.	Supplies GPR with plate voltages.
6	40,51	Open rear rack door and set OUTPUT LEVEL switch on MSR 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 (40).	Increases MSR output level for LS speaker (51) 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	25	Set CAL/OFF switch (25) to OFF.	Disables 100-kc marker oscillator.
9	17	For variable HFO: Set HFO knob (17) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
	17,10,11	For crystal HFO: Set HFO knob (17) to position 1-10 indicated for carrier frequency desired as shown on chart (10). Set XTAL ADJ knob (11) to 0 position.	Sets up HFO for fixed (crystal controlled) operation.
10	20	Set RF SELECTIVITY knob (20) to NON XTAL position.	Selects widest i-f response.
11	22	Set MANUAL/AVC switch (22) to MANUAL.	Shuts off AVC in r-f and i-f stages in GPR to obtain RF GAIN control.
12	39	Set AUDIO GAIN knob (39) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
13	38,37	Set AVC ON/OFF switch (38) to ON. Set AVC FAST/SLOW switch (37) to FAST.	Sets i-f stage AVC (in MSR) to speed suitable for AM reception.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
14	48	Set BFO switch (48) to OFF.	BFO not needed in AM reception.
15	29	Set RANGE SELECTOR knob (29) to appropriate position for carrier frequency.	Selects band-pass circuit at r-f input.
16		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.
	47,45,43, 46, 28, 33, 51	A. Lower sideband 1. Variable IFO: Set MANUAL/XTAL knob (47) to MANUAL. Push SIDEBAND button (45) until L lamp (43) lights. Set BANDSPREAD knob (46) to -2. Tune GPR to point 1.6 kc below carrier frequency using MAIN TUNING knob (28) as a coarse adjustment and BANDSPREAD knob (33), as a vernier adjustment as described in paragraph 3-2b. Then adjust BANDSPREAD knob (46) for best reception of high and low tones at LS speaker (51).	De-tunes GPR and MSR 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
16 (cont)			
	47,45,43,28, 33,11,51	2. Crystal IFO: Set MANUAL/XTAL knob (47) to XTAL. Push SIDEBAND button (45) until L lamp (43) lights. Place 436-kc crystal in XY 1 socket in MSR. Tune GPR to point 1.6 kc below carrier frequency using MAIN TUNING knob (28) as a coarse adjustment and BANDSPREAD knob (33) as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (11) (for crystal HFO) or BANDSPREAD knob (33) (for variable HFO) for best reception of high and low tones at LS speaker (51).	Detunes GPR and MSR to accept lower sideband and carrier only. Adds crystal for higher stability.
	47,45,44,46, 28,33,51	B. Upper sideband 1. Variable IFO: Set MANUAL/XTAL knob (47) to MANUAL. Push SIDEBAND button (45) until U lamp (44) lights. Set BAND-SPREAD knob (46) to +2. Tune GPR to point 1.6 kc above carrier frequency using MAIN TUNING knob (28) as a coarse adjust-ment and BANDSPREAD knob (33) as a vernier adjust-ment as described in para-graph 3-2b. Then adjust BANDSPREAD knob (46) for best reception of high and low tones at LS speaker (51).	Detunes GPR and MSR to accept upper sideband and carrier only.

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

STEP	CONTROL NUMBER (See Figure (3-1)	OPERATION	PURPOSE
16 (cont)			
	47,45,44,28, 33,11,51	2. Crystal IFO: Set MANUAL/XTAL knob (47) to XTAL. Push SIDEBAND button (45) until U lamp (44) lights. Place 474-kc crystal in XY 2 socket in MSR. Tune GPR to point 1.6 kc above carrier frequency using MAIN TUNING knob (28) as a coarse adjustment and BANDSPREAD knob (33) as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (11) (for crystal HFO) or BANDSPREAD knob (27) (for variable HFO) for best reception of high and low tones at LS speaker (51).	Detunes GPR and MSR to accept upper sideband and carrier only. Adds crystal for higher stability.
17	15,12,51	Adjust ANT TUNE knob (15) to obtain peak on meter (12) and/or greater volume on LS speaker (51).	Tunes r-f input to antenna characteristics.
18	22,39, 51	Set MANUAL/AVC switch (22) to AVC. Then readjust AUDIO GAIN knob (39) for suitable volume on LS speaker (51).	Places r-f stage on AVC.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
19	20,19	If the signal is accompanied by excessive background noise, adjust the RF SELECTIVITY knob (20) 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 (19) to reduce interference.	Adjusts i-f bandpass width to eliminate adjacent noise.

TABLE 3-3. TUNE-UP PROCEDURE FOR SSB

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
1		Connect power supply line to jack J8506; rack blowers will start.	Connects line voltage to a-c strip in rack and to blowers.
2	30,12,13, 18	Turn RF GAIN knob (30) fully clockwise. Dials (12), (13), and (18) will light up.	Supplies GPR with tube filament and oven element voltages. Turns up r-f stage gain to maximum.
3	41,42,43, 44	Set POWER/OFF switch (41) to POWER. Power lamp (42) will light and either L lamp (43) or U lamp (44) will light.	Supplies MSR with filament and plate voltages.
4		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR oven temperatures to stabilize.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
5	21	Set SEND/REC switch (21) to REC.	Supplies GPR with plate voltages.
6	15	Set ANT TUNE knob (15) to vertical position.	Sets ANT TUNE control at mid-position.
7	40,51	Open rear rack door and set OUTPUT LEVEL switch on MSR 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 (40).	Increases MSR output level for LS speaker (51) operation.
8	25	Set CAL/OFF switch (25) to off.	Disables 100-kc marker oscillator.
9	17	For variable HFO: Set HFO knob (17) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
	17,10,11	For crystal HFO: Set HFO knob (17) to position 1-10 indicated for carrier frequency desired as shown on chart (10). Set XTAL ADJ knob (11) to 0 position.	Sets up HFO for fixed crystal controlled operation.
10	13	Set RF SELECTIVITY knob (13) to NON XTAL position.	Selects widest i-f response.
11	22	Set MANUAL/AVC switch (22) to MANUAL.	Shuts off AVC in r-f and i-f stages in GPR for SSB reception.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
12	39	Set AUDIO GAIN knob (39) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
13	36,35	Set AVC ON/OFF switch (36) to ON. Set AVC FAST/SLOW switch (35) to SLOW.	Sets i-f stage AVC (in MSR) to speed suitable for SSB reception.
14	48	Set BFO switch (48) to ON.	BFO injection required for SSB detection.
15	29	Set RANGE SELECTOR knob (29) to appropriate position for carrier frequency.	Selects band-pass circuit at r-f detection.
16		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	
	47,45,43,46 28,33,51	1. Variable IFO: Set MANUAL/XTAL knob (47) to MANUAL. Push SIDEBAND button (45) until L lamp (43) lights. Set BANDSPREAD knob (46) to -2. Tune GPR to point 2.0 kc below carrier frequency using MAIN TUNING knob (28) as a coarse adjustment and BANDSPREAD knob (33) as a vernier adjustment as described in paragraph 3-2b. Then adjust BANDSPREAD knob (46) for best reception of high and low tones at LS speaker (51).	Detunes GPR and MSR to accept lower sideband.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
16 (cont)	47,45,43, 28,33,11, 51	2. Crystal IFO: Set MANUAL/XTAL knob (47) to XTAL. Push SIDEBAND button (45) until L lamp lights. Place 436-kc crystal in XY1 socket in MSR. Tune GPR to point 2.0 kc below carrier frequency using MAIN TUNING knob (28) as a coarse adjustment and BANDSPREAD knob (33) as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (11) (for crystal HFO) or BANDSPREAD knob (33) (for variable HFO) for best reception of high and low tones at LS speaker (51).	Detunes GPR and MSR to accept lower sideband. Adds crystal for higher stability.
	47,45, 44,46,28 33,51	B. Upper sideband 1. Variable IFO: Set MANUAL/XTAL knob (47) to MANUAL. Push SIDEBAND button (45) until U lamp (44) lights. Set BANDSPREAD knob (46) to +2. Tune GPR to point 2.0 kc above carrier frequency using MAIN TUNING knob (28) as a coarse adjustment and BANDSPREAD knob (33) as a vernier adjustment as described in paragraph 3-2b. Then adjust bandspread knob (46) for best reception of high and low tones at LS speaker (51).	Detunes GPR and MSR to accept upper sideband.
	47,45,44, 28,33,11, 51	2. Crystal IFO: Set MANUAL/XTAL knob (47) to XTAL. Push SIDEBAND button (45) until U lamp (44) lights. Place 474-kc crystal in XY2 socket in MSR. Tune GPR to point 2.0 kc above carrier frequency using MAIN TUNING knob (28) as a coarse adjustment and	Detunes GPR and MSR to accept upper sideband. Adds crustal for higher stability.

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

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
16 (cont)	47,45,44, 28,33,11, 51 (cont)	BANDSPREAD knob (33) as a vernier adjustment as described in paragraph 3-2b. Then adjust XTAL ADJ knob (11) (for crystal HFO) or BANDSPREAD knob (33) (for variable HFO) for best reception of high and low tones at LS speaker (51).	
17	15,12	Adjust ANT TUNE knob (15) to obtain peak on meter (12)	Tunes r-f input to antenna characteristics.
18	20,19	If the signal is accompanied by excessive background noise, adjust RF SELECTIVITY knob (20) 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 (19) to reduce interference.	Adjusts i-f bandpass width to eliminate adjacent noise.
19	39,51	Readjust AUDIO GAIN knob (39) for suitable volume level at LS speaker (51).	Final adjustment of volume after tuning.

TABLE 3-4. TUNE-UP PROCEDURE FOR FSK

(Note: The MSR unit, with corresponding channel 1 controls on the CFA unit may be used. This procedure tunes the DDR-7J 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	30,12,13, 18	Turn RF GAIN knob (30) fully clockwise. Dials (12), (13), and (18) will light up.	Supplies GPR with tube filament and oven element voltages. Turns up r-f stage gain to maximum.
2	41,42,43, 44	Set POWER/OFF switch (41) to POWER. POWER lamp (42) will light and either L lamp (43) or U lamp (44) will light.	Supplies MSR with filament and plate voltages.
3	9,8	Set POWER OFF/ON switch (9) to ON. POWER lamp (8) will light.	Supplies CFA with filament and plate voltages.
4		If either crystal HFO or IFO is to be used, allow 24-hour warm-up period.	Allows GPR oven temperatures to stabilize.
5	21	Set SEND/REC switch (21) to REC.	Supplies GPR with plate voltages.
6	15	Set ANT TUNE knob (15) to vertical position.	Sets ANT TUNE control at mid-position.
7	25	Set CAL/OFF switch (25) to OFF.	Disables 100-kc marker oscillator.

TABLE 3-4. TUNE-UP PROCEDURE FOR FSK (CONT)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
8*	17	For variable HFO: Set HFO knob (17) to VAR.	Sets up HFO for variable control with MAIN TUNING and BANDSPREAD knobs.
	17,10,11	For crystal HFO: Set HFO knob (17) to position 1-10 indicated for center frequency as shown on chart (10). Set XTAL ADJ knob (11) to 0 position.	Sets up HFO for fixed (crystal controlled) operation.
9	20	Set RF SELECTIVITY knob (20) to NON XTAL position.	Selects widest i-f response.
10	22	Set MANUAL/AVC switch (22) to MANUAL.	Shuts off AVC in r-f and i-f stages in GPR.
11	39	Set AUDIO GAIN knob (39) to approximately mid-position.	Turns up a-f gain adjustment for tuning purposes.
12	38,37	Set AVC ON/OFF switch (38) to ON. Set AVC FAST/SLOW switch (37) to SLOW.	Sets i-f stage AVC to speed suitable for FSK reception.
13	48	Set BFO switch (48) to ON.	Turns on BFO (17-kc) oscillator in MSR to produce audio tone from second mixer.
14	7	Set MARK/SPACE/LINE switch (7) to LINE position.	Sets up CFA unit for operation.

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

TABLE 3-4. TUNE-UP PROCEDURE FOR FSK (CONT)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
15	2,1	Set CH 1 switch (2) to ON and CH 2 switch (1) to OFF.	Sets up CFA to receive channel 1 output.
16*	47	For Variable IFO: (1) Set MANUAL/XTAL knob (47) to MANUAL.	Sets up 1st injection oscillator in MSR for subsequent i-f BANDSPREAD adjustment.
	45,43,46,	(2) Push SIDEBAND button (45) until L lamp (43) lights; then set BANDSPREAD knob (46) to -3.	Detunes 1st injection oscillator in order to pass mark and space frequencies through narrow band filter.
	47	For crystal IFO: (1) Set MANUAL/XTAL knob (47) to MANUAL.	Sets up 1st injection oscillator in MSR for crystal controlled operation.
	45,43	(2) Push SIDEBAND button (45) until L lamp (43) lights; then insert 435-kc crystal in XY1 socket in MSR.	Detunes 1st injection oscillator in order to pass mark and space frequencies through narrow band filter. Inserts crystal for greater stability.
17	29	Set RANGE SELECTOR knob (29) to appropriate position to include "mark" and "space" frequencies.	Selects bandpass circuit at r-f input.
18	28,18	Adjust MAIN TUNING knob (28) to obtain reading slightly higher**than center frequency on dial (18).	Coarse-tunes r-f stage and HFO for center frequency.

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

** See paragraph 3-2b.

TABLE 3-4. TUNE-UP PROCEDURE FOR FSK (CONT)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
19	6,13,33,11	Observe CRT screen (6). Bring reading down on dial (13) with BANDSPREAD knob (33) (for variable HFO) or XTL ADJ knob (11) (for crystal HFO) until a thin vertical line is obtained in the center of screen (6). 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.
20	15,12	Adjust ANT TUNE knob (15) to obtain peak reading on meter (12).	Tunes r-f input to antenna characteristics.
21	3	Set SENSE switch (3) to + or - position for proper operation of teleprinter.	Adjusts DDR-7J d-c output to polarity of teleprinter.
22	39	Adjust AUDIO GAIN knob (39) for proper operation of teleprinter.	Adjusts DDR-7J d-c output to proper level for teleprinter input.

TABLE 3-4. TUNE-UP PROCEDURE FOR FSK (CONT)

STEP	CONTROL NUMBER (See Figure 3-1)	OPERATION	PURPOSE
23	5	Turn THRESHOLD knob (5) 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 manual.	Adjusts CFA for transmitted frequency shift.
24		A. 850 cps shift: Observe teleprinter. If signal is not clear, make the following adjustment:	Filters out frequencies on either side of "mark" and "space" frequencies.
	46,6	Variable IFO (with variable or crystal control HFO): Adjust SPREAD knob (46) slightly to obtain clearest signal at teleprinter without losing vertical line on CRT screen (6).	
	33,6	Crystal IFO (with variable HFO): Adjust BANDSPREAD knob (33) slightly to obtain clearest signal at teleprinter without losing vertical line on CRT screen (6).	
	11,6	Crystal IFO (with crystal HFO): Adjust XTL ADJ knob (11) slightly to obtain clearest signal at teleprinter without losing vertical line on CRT screen (6).	
	20	B. Shift other than 850 cps: Observe teleprinter. If signal is not clear, set RF SELECTIVITY knob (20) to KC marking equal to or greater than the frequency shift.	Filters out adjacent frequencies on either side of "mark" and "space" frequency range.

TABLE 3-4. TUNE-UP PROCEDURE FOR FSK (CONT)

STEP	CONTROL NUMBER (See Figure (3-1)	OPERATION	PURPOSE
24 (cont)	20,19	Example: If frequency shift is 1000 cps, set RF SELECTIVITY knob (20) to 1.0 KC. Adjust XTAL PHASE knob (19) for clearest signal at teleprinter.	

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, FSK - The "S" meter (11) on GPR 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 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 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 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 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 passband of the MSR unit. A small drift may be corrected by an adjustment of the MSR BANDSPREAD knob (or variable IFO); for crystal IFO, use GPR XTAL ADJ knob (for crystal HFO), or GPR BANDSPREAD knob (for variable HFO). If the signal has drifted excessively, retuning above or below the original point will be necessary.

(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 selectivity of the MSR. If this condition 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 XTAL ADJ knob (for crystal HFO), or GPR BANDSPREAD knob (for variable HFO). If the signal has drifted excessively, returning above or below the original point will be necessary.

(3) AM - Loss of high or low tones 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 XTAL ADJ knob (for crystal HFO), or GPR 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 - 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 the SSB reception. For variable IFO operation, a small drift may be corrected by an adjustment of the MSR BANDSPREAD knob. For crystal IFO, a small drift may be corrected by adjustment of GPR XTAL ADJ knob (for crystal HFO) or GPR BANDSPREAD 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 the 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 open into a rectangle towards the right of the screen; when the frequency drifts down, the pattern opens towards the left. The CFA unit contains a frequency drift compensation circuit, the limits of which are determined by the MSR bandpass filters. For crystal HFO operation (crystal or variable IFO), a small drift may be corrected by the GPR XTAL ADJ knob. If the pattern displayed on the CRT screen has drifted to the right, turn XTAL ADJ knob in + direction; if the pattern has drifted to the left, turn knob in - direction. For variable HFO operation (crystal or variable IFO), a small drift may be corrected by the GPR BANDSPREAD knob. If the pattern on the CRT screen has drifted to the right, turn BANDSPREAD knob toward higher frequency readings on the dial; if the pattern has drifted to the left, turn BANDSPREAD knob toward 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 on the left portion of the CRT screen; this pattern should not be confused with a drift indication.

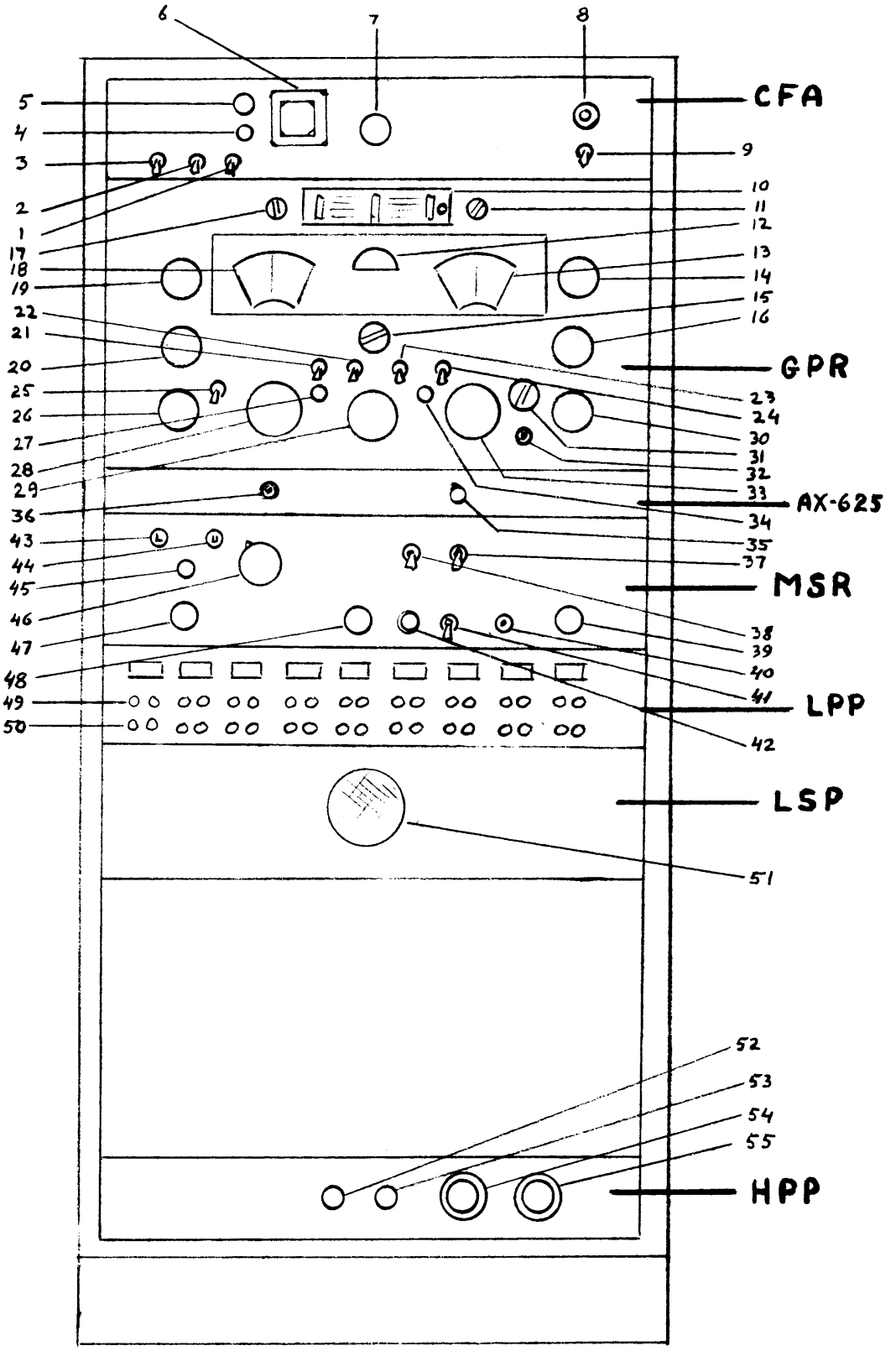

Figure 3-1. Controls and Indicators, DDR-7J

SECTION 4

PRINCIPLES OF OPERATION

4-1. BLOCK DIAGRAM ANALYSIS (refer to figure 4-1)

Signal from the antenna is routed to the GPR; the selected r-f signal is amplified by two tuned amplifiers, converted to an i-f of 455 kc, and routed to the MSR. For reception between .54 and 5.6 megacycles, conversion to 455 kc is accomplished in two steps. The higher first i-f frequency (3.955 mc), used for reception between 5.4 and 31.5 megacycles, maintains good image rejection. Conversion from 3.955 mc to 455 kc is accomplished with a crystal-controlled oscillator. The first converter uses either a variable oscillator ganged to the main tuning capacitors, or an externally supplied hfo signal.

Three stages of amplification are provided for the 455-kc signal in the GPR. This i-f amplifier chain contains a crystal filter; bandpass is selectable in steps from 250 cps to 7000 cps. The detector and audio stages of the GPR are not used.

Final conversion, detection, and amplification is accomplished in the MSR. The conversion oscillator in the MSR is operable at either 438 kc or 472 kc, and the final bandpass is centered slightly above 17 kc. The selected final conversion frequency determines what portion of the i-f signal is applied to the detector. When the final conversion frequency is 438 kc, i-f signals between 455.3 kc and 458.0 kc are heterodyned to the range of 17.3 to 20.0 kc, and applied to the detector. This corresponds to a spectrum between 300 and 3000 cps higher in frequency than that point to which the GPR is tuned. When the final conversion frequency is 472 kc, i-f signals between 452 and 447.7 kc are heterodyned to the range of 17.3 to 20.0 kc and applied to the detector. This corresponds to a spectrum

between 300 and 3000 cps lower in frequency than that point to which the GPR is tuned. In this manner, either the upper or lower sideband of a signal can be selected at the MSR.

In order to receive an AM signal, either the high frequency oscillator in the GPR or the final conversion oscillator in the MSR must be offset approximately 300 cps to place the receiver carrier and one sideband in the 17.3- to 20.0-kc bandpass of the MSR filter. Similarly, one of these oscillators must be offset in order to receive a CW, FSK, or FAX signal.

For SSB, CW, FSK, or FAX reception, the detector in the MSR operates as a product detector, and the BFO in the MSR is used. For AM or MCW reception, the BFO is disabled, and the detector operates as a plate detector.

In FSK reception (with the standard 850 cps shift), the i-f signal is routed to the MSR. The lower sideband filter is selected and detuned to produce (with the 17-kc BFO) a 2550 cps center-frequency output. This output includes "mark" and "space" frequencies, nominally 2975 cps (mark) and 2125 cps (space). The CFA Frequency Shift Converter converts the MSR audio signal into pulses for associated equipment.

4-2. SLOT TUNING

The GPR Receiver working with the MSR unit is essentially a "slot tuning" system. The GPR may be regarded as one movable "slot" (or bandpass width) of 6-kc, and the MSR 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 HFO and MSR IFO as described in the following paragraphs:

Frequency translation of the GPR and MSR units is illustrated in figure 4-2. A frequency (Fc) in the 0.54- to 31.5-mc range is received from the antenna by the amplifier stage of the GPR and routed to the 1st converter, V3. When operating with variable HFO, adjustment of the MAIN TUNING and BANDSPREAD knobs varies the output frequency of 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 band 1, 2 or 3, the 455 kc is routed directly to the i-f amplifier section. When the RANGE SELECTOR switch is turned to band 4, 5 or 6, 455-kc (3.955 mc) generated in V3 (1st converter), and is routed to V4 (2nd converter) and the 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 to the i-f amplifier stage (V2) of the MSR 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 474-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. $F_1sb = F_C - F_a$ and $F_1sb = F_C + Fa$.

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, F_1sb ($F_C - F_a$) 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. Similarly, an upper sideband frequency tone, F_{usb}, appears at this point as a lower sideband tone. Carrier (F_c) and inverted sidebands are sent to the 1st mixer in the MSR. With the MSR BAND-SPREAD knob set 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. Therefore in either condition, LSB or USB, side-band filter Z1 receives $F_c + F_a$. 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 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 signal. For selecting a sideband and carrier out of an AM or MCW signal, the MSR "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 move F_C up the frequency scale from 17 kc to be included in the 17.4 - to 20.8-kc filter passband. Carrier and sideband are now sent to V4 detector, the BFO is set to OFF, and diode detection takes place. In receiving a CW signal, the GPR "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 "slot" from its 6-kc width down to a .25-kc width, by means of the GPR RF SELECTIVITY knob.

In receiving an FSK signal, the DDR-7J is first tuned to a transmitted test signal containing mark and space frequencies. The GPR 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 i-f output. The required operating center frequency of the CFA Frequency Converter is 2550 cps; this frequency is produced by the MSR 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 HFO and with the aid of the CFA 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 the V3 mixer now appears as 19.55 kc, with mark and space frequencies of 19.975 kc and 19.125 kc, respectively, all within the passband 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. For shifts other than 850 cps, filtering of adjacent frequencies may be effected by narrowing the GPR "slot" by means of its RF SELECTIVITY knob.

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

The signal flow of the DDR-7J system is illustrated in figure 4-2.

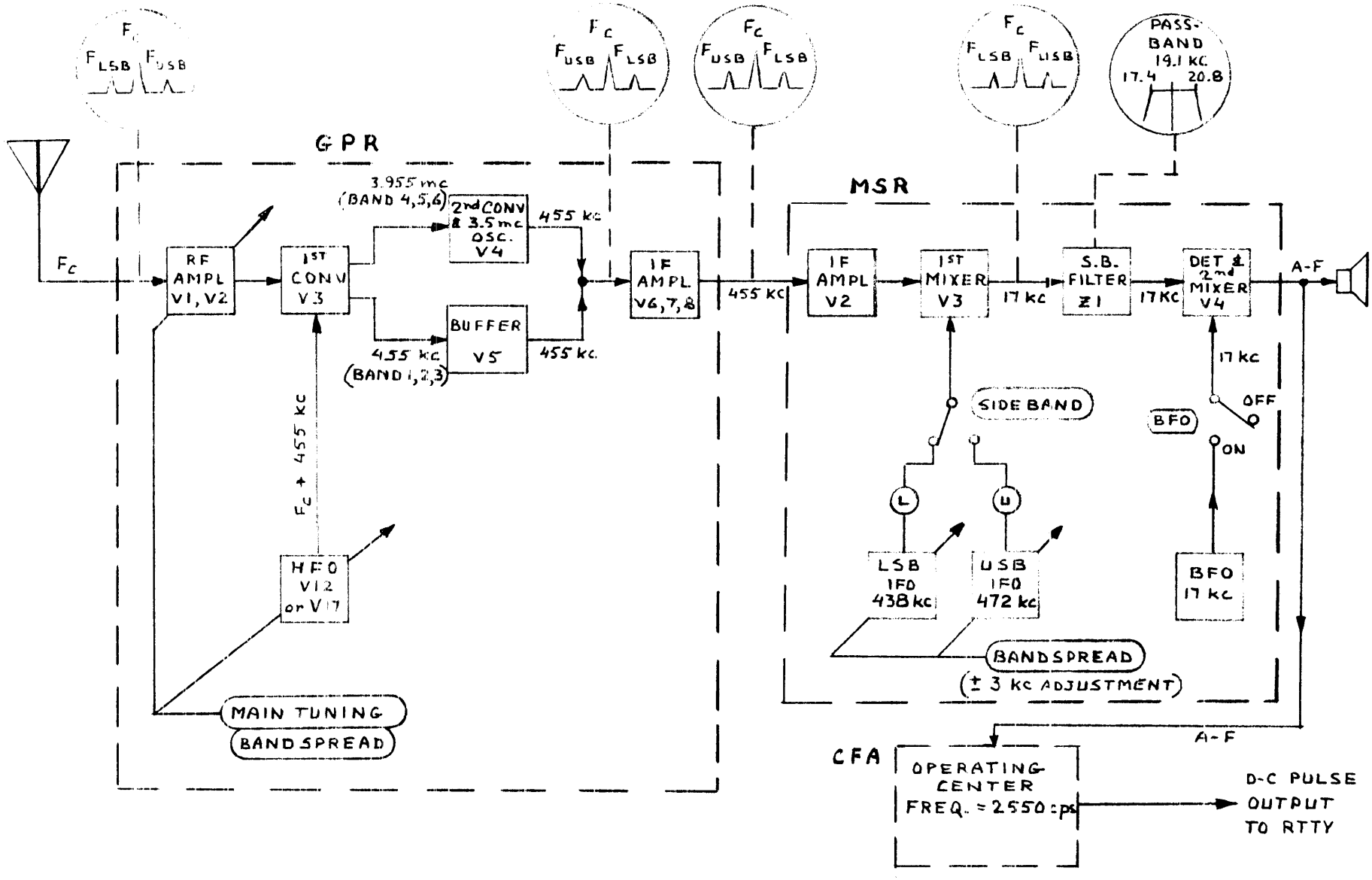

Figure 4-1. Functional Block Diagram, DDR-7J

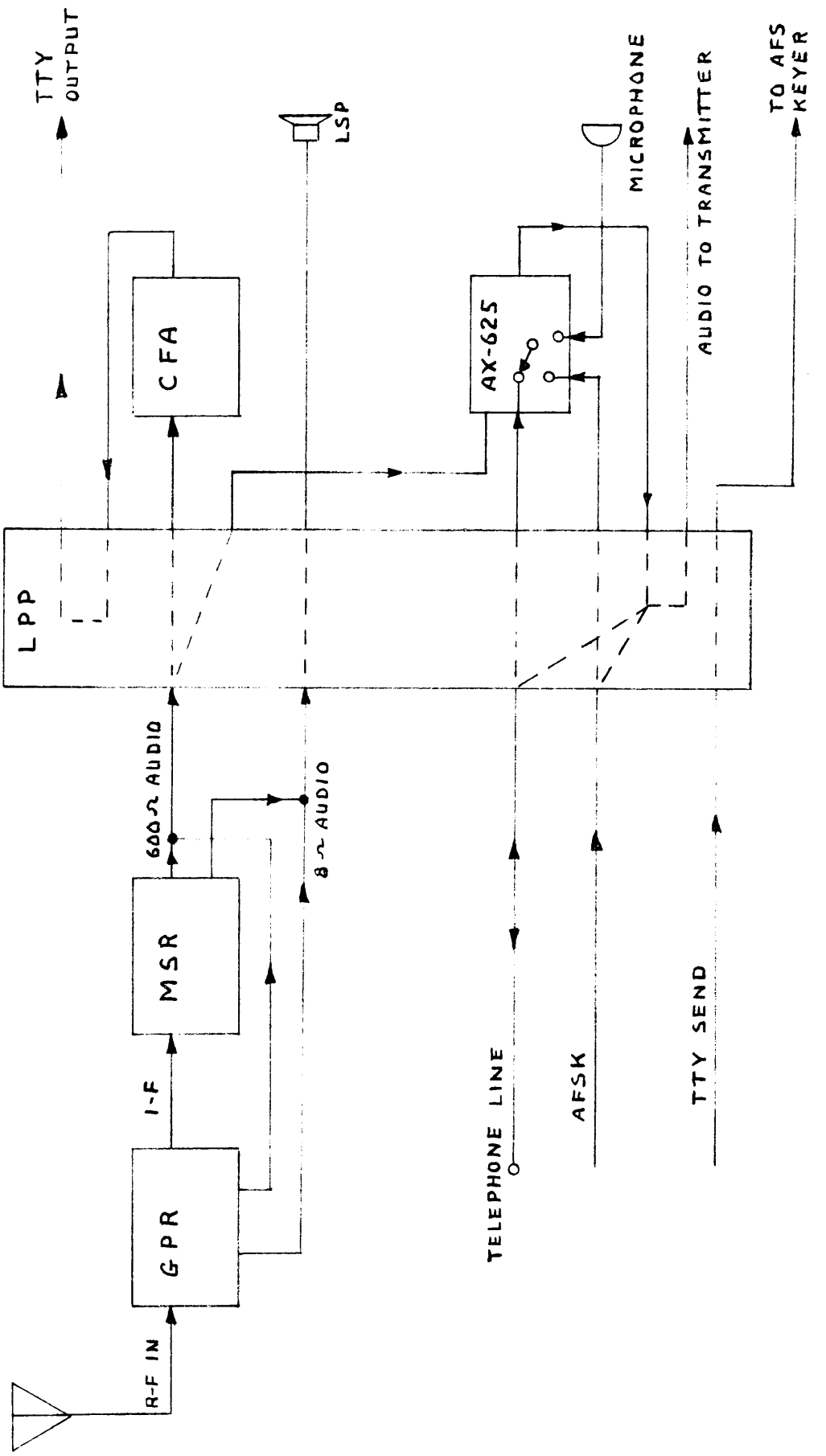

Figure 4-2. Signal Flow Diagram, DDR-7J