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TECHNICAL MANUAL

for

LF/MF RECEIVER SYSTEM

MODEL LRRA-1

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N. Y. OTTAWA, CANADA

IN-287

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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 includ 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

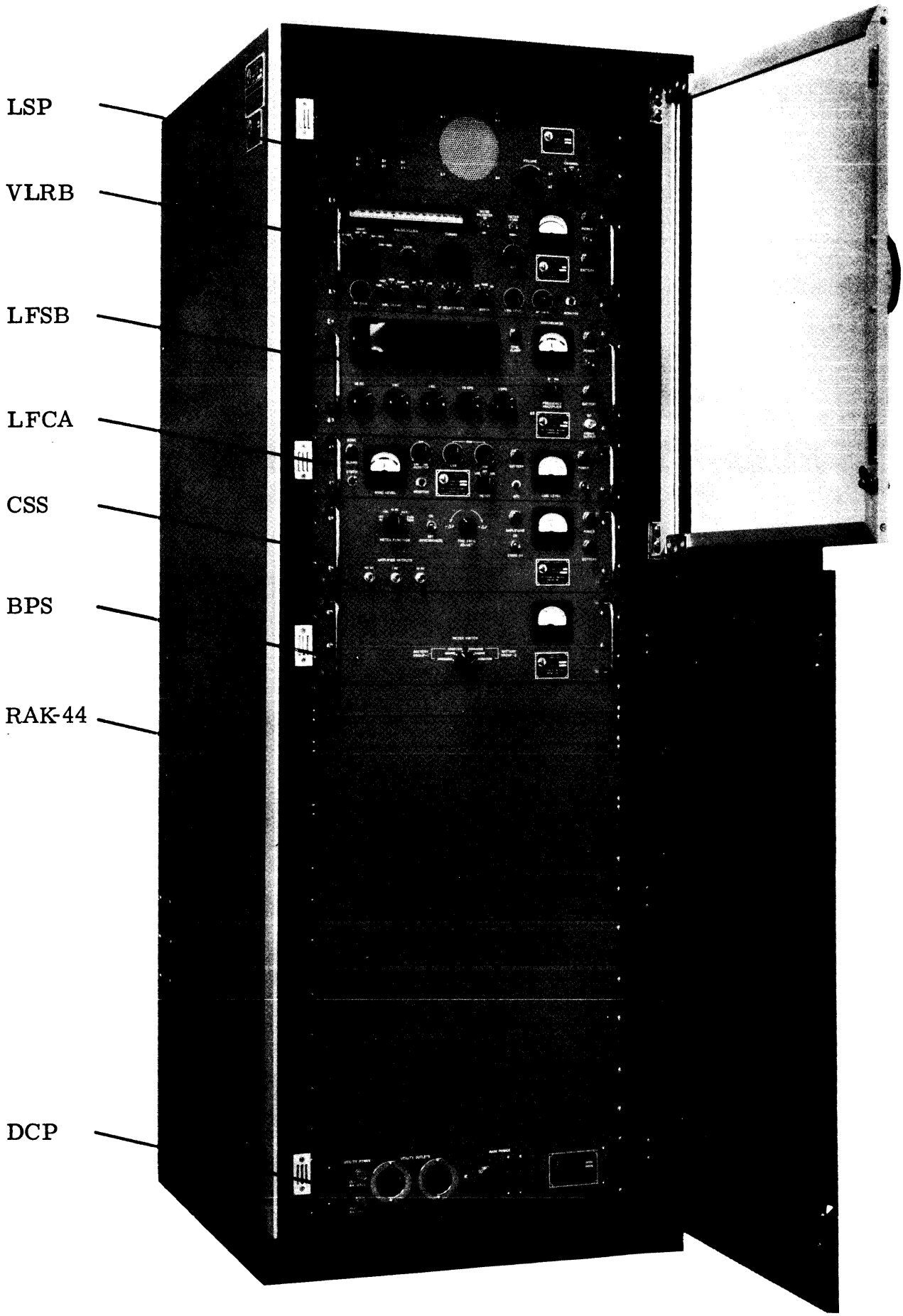


Figure 1-1. LF/MF Receiver System, Model LRRA

SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

The LF/MF Receiver System, Model LRRA-1 (figure 1-1) provides frequency coverage from 30- to 600-kilocycles for the reception of CW, MCW, AM, SSB, ISB, and FSK (with appropriate converter) signals. Reception of AM, SSB, and ISB is restricted to frequencies above 55 kilocycles by receiver bandpass characteristics. The system may be operated fully synthesized with a stability as high as one part in 10^9 per day. When operating synthesized, tuning is in 10 cycle-per-second increments over the entire frequency range, or in one cycle-per-second increments form 30- to 99.999- kilocycles. When operating unsynthesized, tuning is continuous. For SSB or ISB reception, the system may be synchronized to the incoming pilot carrier, therfore automatically compensating for transmitter and/or receiver drift. The system is automatically switched to a self-contained battery power supply in the event of a primary power failure.

1-2. DESCRIPTION OF UNITS.

a. LF/MF COMMUNICATIONS RECEIVER, MODEL VLRB-1. - The VLRB is a double conversion superheterodyne receiver covering the frequency range of 30- to 600- kilocyles. The receiver has a diode detector for AM and MCW reception, a BFO and product detector for CW and FSK reception, and two independent audio amplifiers (one supplying 0 dbm for external use, and one for monitoring purposes). The i-f output of the VLRB is extended to Sideband Converter LFCA.

b. SIDEBAND CONVERTER, MODEL LFCA-1. - The LFCA is a sideband converter that provides simultaneous USB and LSB outputs. The

LFCA contains independent i-f amplifiers, product detectors, and audio amplifiers for the reception of SSB and ISB signals. The carrier injection oscillator contained in the LFCA may be synchronized to the received pilot carrier, or to the ultra-stable 100-kilocycle signal from Frequency Standard CSS. The LFCA supplies a d-c signal to LF/MF Communications Receiver VLRB which may be used to phase-lock the high frequency oscillator with the received pilot carrier. The LFCA has an additional audio amplifier provided for monitoring purposes.

c. FREQUENCY STANDARD, MODEL CSS-2. - The CSS is a highly-stable frequency standard capable of generating 1-mc, 10-mc, and 100-kc reference signals with a long term stability of one part in 10^9 per day. The CSS supplies 1 mc and 100 kc signals at a level of 1 volt to Low Frequency Synthesizer LFSB, and a 100 kc signal at a level of 1 millivolt to Sideband Converter LFCA.

d. LOW FREQUENCY SYNTHESIZER, MODEL LFSB. - The LFSB is a synthesizer that is designed to operate with receivers in the 30- to 600-kilocycye frequency range. The LFSB uses the ultra-stable 1 mc and 100 kc signals from Frequency Standard CSS to produce a signal of the same frequency as that generated by the high frequency oscillator contained in LF/MF Communications Receiver VLRB. The output of the LFSB is used to stabilize the high frequency oscillator of the VLRB to one part in 10^9 per day.

e. BATTERY POWER SUPPLY, MODEL BPS ( )-1. - The BPS supplies Frequency Standard CSS, Low Frequency Synthesizer LFSB, Sideband Converter LFCA, and LF/MF Communications Receiver VLRB with 24-volt dc when primary a-c power fails. The batteries contained in the BPS receive a trickle charge from the power supplies of the externally associated equipments (CSS, LFSB, LFCA, and VLRB) when the system is operating normally on a-c power.

associated equipments (CSS, LFSB, LFCA, and VLRB) when the system is operating normally on a-c power.

f. LOUDSPEAKER PANEL, MODEL LSP-4A. - The LSP is a passive single speaker unit that contains a 4.5 watt speaker, a channel selector switch, and a volume control. Audio outputs from LF/MF Communications Receiver VLRB and Sideband Converter LFCA are connected to the LSP where either output may be selected for monitoring purposes.

g. POWER CONTROL PANEL, MODEL DCP-2. - The DCP is the main power panel for the LF/MF Receiver System. Primary power for the system is routed through a circuit breaker in the DCP; fused convenience outlets are also provided in the DCP.

h. EQUIPMENT CABINET, MODEL RAK-44. - All cabling for interconnecting the units of the LRRA system (VLRB, LFCA, CSS, LFSB, BPS, LSP, and DCP) is provided in the RAK. A low-pass filter is incorporated in the a-c power distribution system to prevent r-f signals from entering the receiver system through the power lines.

All major units of the system are provided with tilt-slide mechanisms for ease in maintenance.

1-3 TECHNICAL SPECIFICATIONS

FREQUENCY RANGE:	30 to 600 kilocycles in five ranges.
MODES OF RECEPTION:	AM, MCW, CW, FSK, SSB, and ISB; AM, SSB, AND ISB above 55 kilocycles only.
FREQUENCY STABILITY:	1. Synthesized, 1 part in 10^9 per day after 14 day warm-up. 2. Unsynthesized, $\pm$0.01% of operating frequency after 30 minute warm-up. 3. AFC operation, phase locked to within 0.1 degree of received pilot carrier.
TUNING:	1. Synthesized, in 10 cps increments over complete range, or 1 cps increments below 100 kilocycles. 2. Unsynthesized, continuous.
INPUT IMPEDANCE:	50 ohms nominal.
SENSITIVITY:	0.3 microvolt for 15 db signal plus noise to noise ratio at .5 kc bandpass.
SELECTIVITY:	1. Receiver RF; 3 kc at 3 db points at 30 kilocycles, not less than 8 kc above 55 kilocycles. 2. Receiver IF, .5, 2, 4 or 8 kc at 3 db points, selectable from front panel. 3. Converter IF; 3 db points removed 250 and 4000 cps from carrier frequency for each sideband.

TECHNICAL SPECIFICATIONS (CONT)

AGC CHARACTERISTICS:	No more than 1 db increase of output level with 100 db increase of input level from 0.3 microvolt. Selectable decay time of 16.5, 9.9 or 3.3 seconds.
AFC CHARACTERISTICS:	Will maintain synchronism to within ±0.1 degree of pilot carrier with no more than 0.1% combined receiver and/or transmitter drift, an input signal level of at least 1 microvolt and a carrier suppression of not more than 25 db. Receiver must be pre-tuned to within ±5 cps of carrier frequency to initiate lock-in.
IMAGE-RESPONSE RATIO:	HFO image is at least 80 db down when referenced to 0.1 microvolt input signal.
AUDIO OUTPUTS:	1. Three 0dbm balanced outputs (one from receiver, two from converter). 2. Loudspeaker at 1/2 watt, selectable from receiver or converter. 3. Headphone monitor jacks.
AUDIO DISTORTION:	On standard two tone test, audio distortion will be at least 40 db down.
HUM LEVEL:	Power supply hum at least 50 db below full audio output.
ENVIRONMENTAL CONDITIONS:	Designed to operate in any ambient temperature of 0^{O} C. to 50^{O} C., and any valve of relative humidity up to 90%.

TECHNICAL SPECIFICATIONS (CONT)

POWER REQUIREMENTS:	watts at 115/230 v, 47-400 cps, single phase. Will operate at least hours on self-contained batteries in the event of primary power failure.
INSTALLATION DATA:	The system is housed in a cabinet 69" high x 24-5/8" wide x 29-15/16 deep, and weighs 534 lbs.

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING

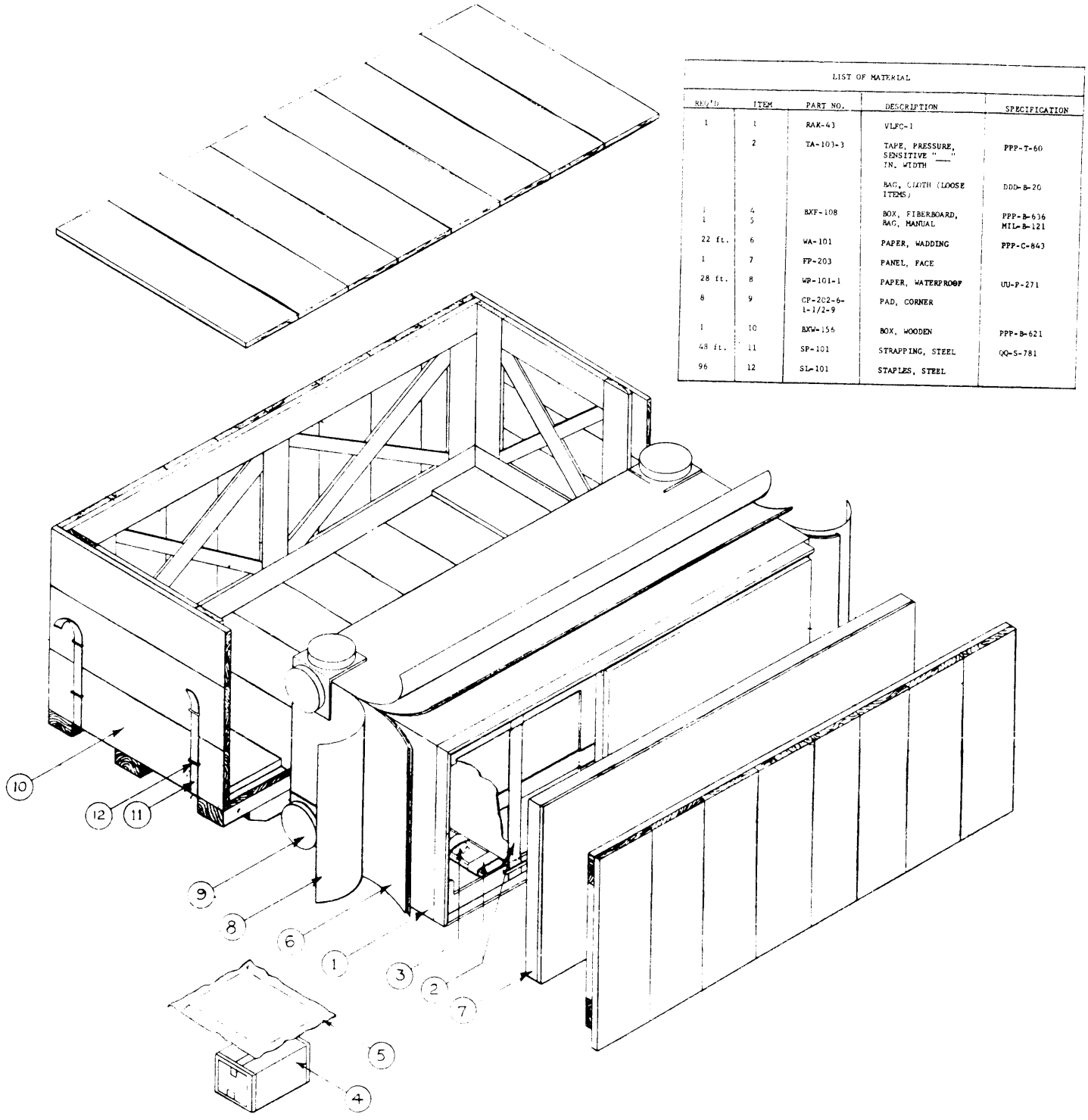
The LRRA system is shipped in 3 boxes, box number and contents are stenciled on the outside of each box. Inspect all boxes for possible damage when they arrive at the operating site. With respect to equipment damage for which the carrier is liable, the Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

Figures 2-1 and 2-3 are typical illustrations of the method used to pack RAK-44 and the LRRA system modules for shipment, respectively. Using figures 2-1 and 2-2 as a guide, unpack RAK-44 and the modular units in the reverse order of the indicated packing procedure; refer to table 1-1 for information regarding size and weight of RAK-44 and modular units.

Inspect the contents of each box for possible damage, and inspect the packing material for parts that may have been shipped as loose items. All cable assemblies used in the LRRA system are mounted in RAK-44 and taped in place.

2-2. POWER REQUIREMENTS

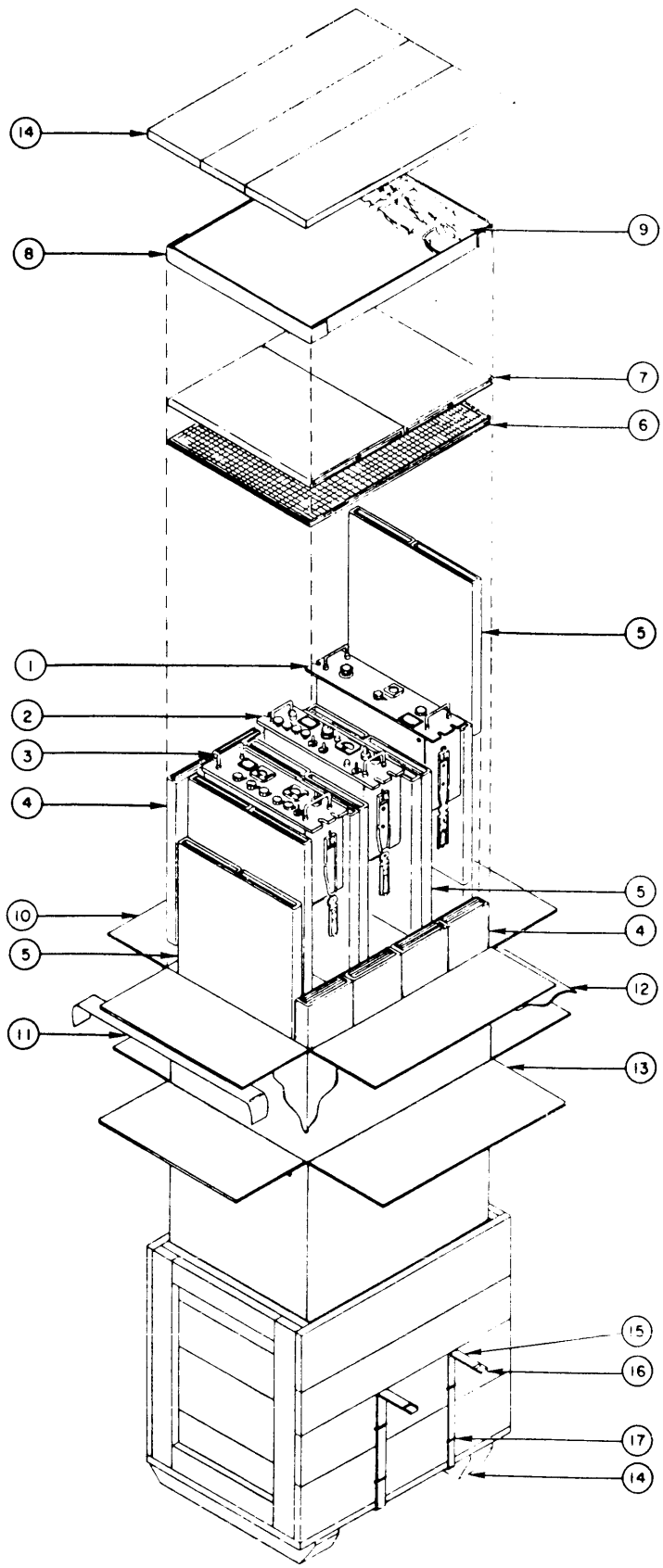
All units of the LRRA system, except the Battery Power Supply, leave the factory wired for 115 volt, 50/60 cycle operation. Change may be made to 230 volt, 50/60 cycle operation by making minor changes. Consult the



LIST OF MATERIAL

REQ'D	ITEM	PART NO.	DESCRIPTION	SPECIFICATION
1	1	RAK-43	VLFC-1	
	2	TA-103-3	TAPE, PRESSURE, SENSITIVE "___" IN. WIDTH	PPP-T-60
			BAG, CLOTH (LOOSE ITEMS)	DDD-B-20
1	4	BXF-108	BOX, FIBERBOARD,	PPP-B-636
1	5		BAG, MANUAL	MIL-B-121
22 ft.	6	WA-101	PAPER, WADDING	PPP-C-843
1	7	FP-203	PANEL, FACE	
28 ft.	8	WP-101-1	PAPER, WATERPROOF	UU-P-271
8	9	CP-202-6-1-1/2-9	PAD, CORNER	
1	10	BXW-156	BOX, WOODEN	PPP-B-621
48 ft.	11	SP-101	STRAPPING, STEEL	QQ-S-781
96	12	SL-101	STAPLES, STEEL	

Figure 2-1. RAK-44, Preparation for Shipment



LIST OF MATERIAL		
ITEM	DESCRIPTION	SPECIFICATION
1	MODULAR UNIT	
2	MODULAR UNIT	
3	MODULAR UNIT	
4	PAD, FIBERBOARD	PPP-B-636 TYPE I, CLASS I
5	CELL, FIBERBOARD	PPP-B-636 TYPE I, CLASS I
6	PAPER, TISSUE	UU-P-553
7	PAD, FIBERBOARD	PPP-B-636 TYPE I, CLASS I
8	TRAY, FIBERBOARD	PPP-B-636 TYPE I, CLASS I
9	DESICCANT	MIL-D-3464
10	BOX, FIBERBOARD	PPP-B-636 TYPE I, CLASS I
11	TAPE, PRESSURE SENSITIVE	PPP-T-60 TYPE III, CLASS I
12	BAG, BARRIER	MIL-B-131 CLASS I
13	BOX, FIBERBOARD	PPP-B-636 TYPE I, CLASS 2
14	BOX, WOOD	PPP-B-621 STYLE 2
15	STRAP	QQ-S-781
16	SEAL, STRAPPING	
17	STAPLE	FF-N-105

Figure 2-2. Modular Units, Typical Preparation for Shipment.

installation section of the individual modular-unit manuals for the applicable wiring-change information.

CAUTION

If 230 volt, 50/60 cycle operation is used, all line fuses must be reduced to one half their rated current values to assure adequate circuit protection. Regulated and high voltage fuses remain the same with either line voltage.

Power consumption of the LRRA system is approximately 100 watts. Power cabling of sufficient size to provide 46 amperes (approximately 1 ampere for the LRRA and 45 amperes for external test equipment connected to utility outlets of Power Control Panel DCP at 115 vac, single phase is adequate. DCP convenience outlets are intended for use of testing or servicing equipment only; an overload on any of the DCP outlets may cause loss of power to the LRRA. For information concerning the connection of power cables, refer to paragraph 2-3.

2-3. INSTALLATION

a. LOCATION OF RAK-44. - Before attempting to install the LRRA system, ensure that adequate power (paragraph 2-2) is available at the selected site or location. After unpacking and inspecting cabinet RAK-44, place it in its operating location. It is advisable to do this while the modular units are not installed because the added weight will make movement more difficult. Refer to dimensional outline drawing figure 2-3 when choosing the operating location. Sufficient space to open front and rear cabinet doors is one of the prime considerations when choosing the operating location.

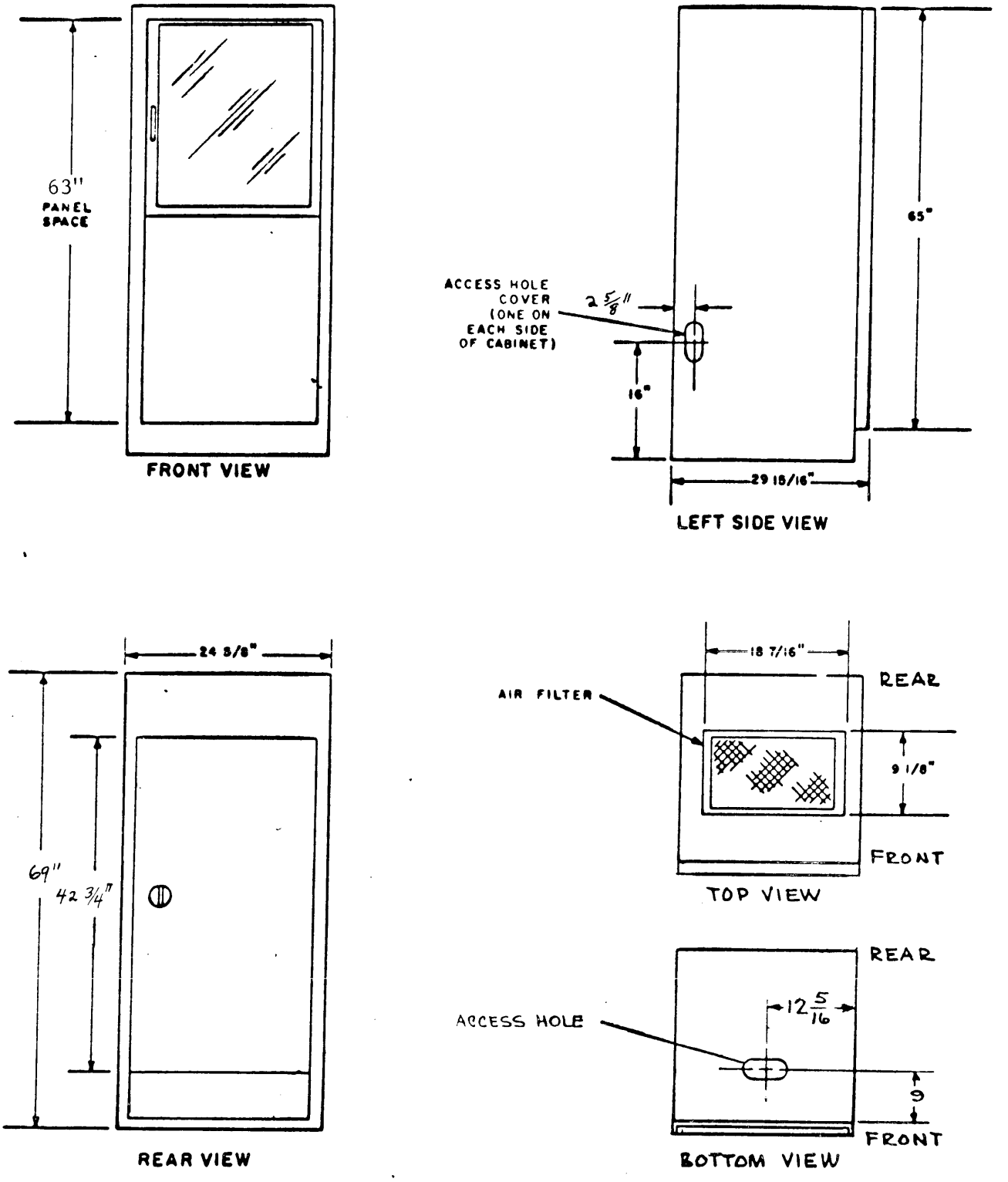


Figure 2-3. RAK-44. Dimensional Outline Drawing

b. CABLING. - Figure , illustrates the cabling connections between the various modular units contained in the LRRA. After installing RAK-44, untape or unstrap all cable assemblies, NEGATOR B motors, and all other components attached to frame of rack.

c. CABLE ENTRY. - Cable entry for main power, is accomplished through openings with removable covers. These openings are located on both sides and at the bottom of the cabinet.

d. POWER CONNECTION. - Refer to paragraph 2-2 for information regarding power requirements; connect ac power input as indicated in paragraph 2-3 of Technical Manual for Power Control Panel, Model DCP-2.

e. MODULAR UNIT. - Each compartment of the cabinet (RAK-44) is equipped with tracks that attach to slide mechanisms of the associated modular unit. To install any modular unit in its compartment refer to figure and proceed as follows:

(1) Pull center section of associated compartment track out until it locks in an extended position.

(2) Position slide mechanisms of modular unit in tracks, and ease modular unit forward into rack until rearward release fingers on lock buttons engage holes in tracks.

CAUTION

Cables and electrical wiring should be carefully positioned to prevent snagging or catching as units slide in and out of equipment rack. Ensure that NEGATOR B motors used to retract the cable assemblies are functioning properly.

(3) Depress forward release fingers or lock buttons, and slide modular unit completely into compartment.

(4) Secure front panel of modular unit RAK-44 with screws.

(5) Make the necessary cable and electrical connections as shown in figure . After all connections have been made, ensure that cable clamps are properly secured.

f. ANTENNA. - Connect appropriate 50-ohm unblanced antenna to J1 as indicated in figure 2-4.

g. AUDIO OUTPUTS. - Connect 600 ohm audio lines as indicated in figure 2-4 for upper sideband and lower sideband outputs. Connect a 600 ohm audio line to E101 on the rear of the VLRB for the AM, MCW, CW and FSK audio output. This line should be laced to the existing cable to prevent damage.

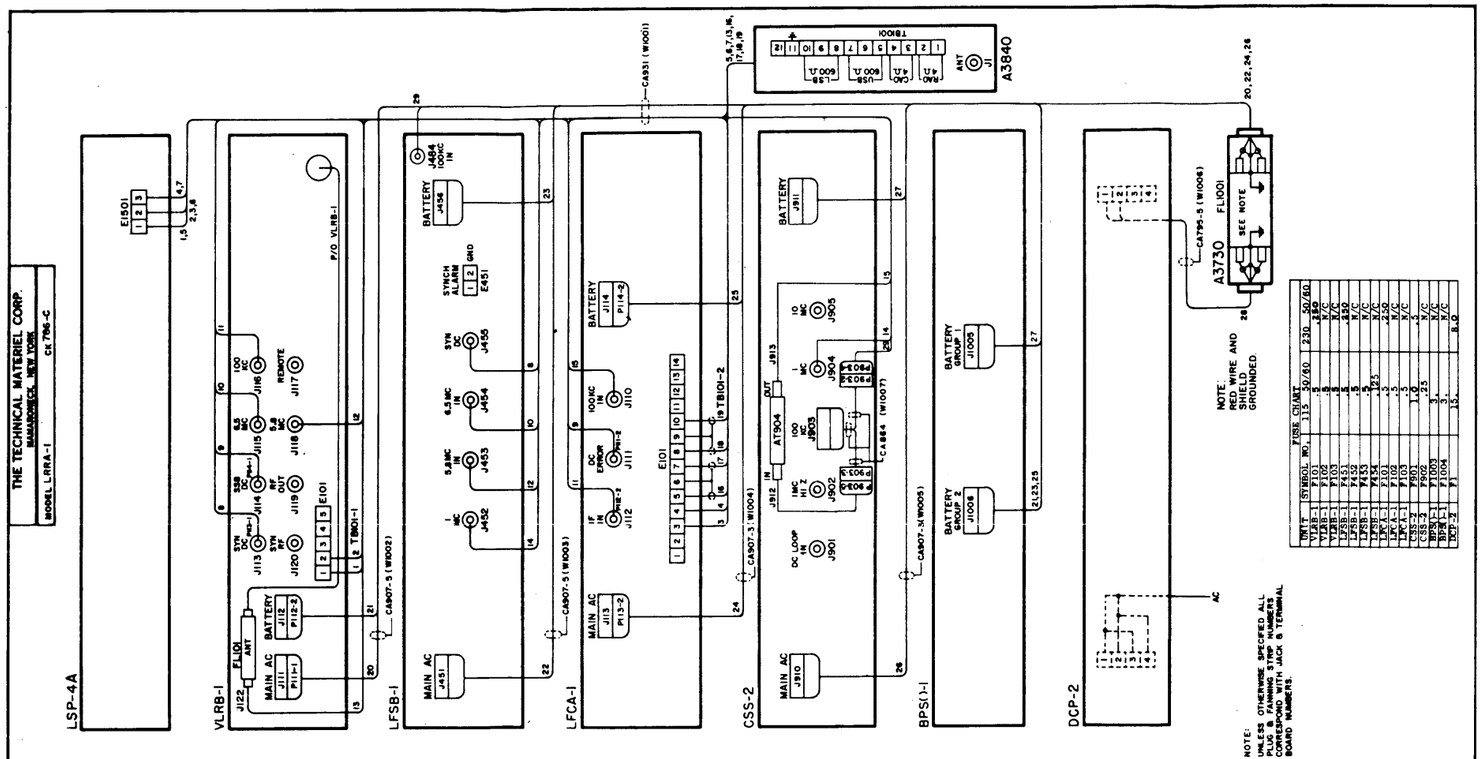


Figure 2-4. Interconnection Diagram, LRRA System.

SECTION 3

OPERATOR'S SECTION

3-1. GENERAL.

The LRRA may be operated synthesized or unsynthesized. Frequency stability for synthesized operation is 1 part in 10^9 per day after a 14 day warm-up; tuning is in 1 cycle per second steps from 30 to 99.999 kilocycles, or in 10 cycle per second steps from 30 to 600 kilocycles. Frequency stability for unsynthesized operation is $\pm$0.1% of the operating frequency, long term, after a 1/2 hour warm-up; tuning is continuous from 30 to 600 kilocycles. The operator should first familiarize himself with the front panel controls and indicators shown in figure 3-1 and listed in table 3-1 .

TABLE 3-1. CONTROLS AND INDICATORS

ITEM NO. FIG.3-1	EQUIP	PANEL DESIGNATION	FUNCTION
1	Loudspeaker Panel, Model LSP	VOLUME control	Adjusts level of audio signal applied to loudspeaker in conjunction with 20 or 39.
2		CHANNEL switch	At position A, connects loudspeaker to a-f output of VLRB, connects dummy load to MONITOR output of LFCA. At position B, connects loudspeaker to MONITOR output of LFCA, connects dummy loadto a-f output of VLRB. At OFF position, connects dummy loads to a-f output of VLRB and MONITOR output of LFCA, disconnects loudspeaker.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

ITEM NO. FIG. 3-1	EQUIP	PANEL DESIGNATION	FUNCTION
3	LF/MF Communications Receiver, Model VLRB	KILOCYCLES dial	Indicates setting of 11.
4		NOISE SILENCER switch	Turns on noise silencer of receiver
5		METER switch	At ODBM position, connects 6 to indicate output level to 600 ohm audio line, at SIGNAL position, connects 6 to indicate r-f input level.
6		(none)	Indicates audio output level to 600 ohm line, or r-f input level as selected by 5.
7		POWER lamp	Lights when receiver is powered by a-c line voltage.
8		POWER switch	Connects power supply to a-c line.
9		BAND switch	Selects range to which receiver may be tuned by 11.
10		LOCK knob	Prevents inadvertent turning of 11.
11		TUNING control	Selects frequency to which receiver is tuned.
12		BFO control	Tunes beat frequency oscillator.
13		BATTERY lamp	Lights when receiver is powered by BPS.
14		RF GAIN control	Adjusts gain of receiver r-f amplifiers when 15 is set at MAN.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

ITEM NO. FIG. 3-1	EQUIP	PANEL DESIGNATION	FUNCTION
15	VLRB (CONT)	AGC DECAY switch	At MAN position, enables 14 to control gain of r-f amplifiers, and disconnects AGC circuit. At FAST position, connects AGC circuit to r-f amplifiers, and sets decay at 3.3 seconds. At MED position, connects AGC circuit to r-f amplifiers, and sets decay at 9.9 seconds. At SLOW position, connects AGC circuit to r-f amplifiers, and sets decay at 16.5 seconds At RMTE position, disconnects AGC circuit, and enables gain of r-f amplifiers to be controlled externally.
16		MODE switch	At AM position, connects diode detector output to a-f and line amplifiers. At CW position, connects product detector output to a-f and line amplifiers. At SSB position, disconnects input to a-f line amplifiers, and connects AFC loop to 18.
17		IF SELECTIVITY switch	Selects bandpass of receiver i-f amplifiers.
18		SYNTH switch	At ON position, connects d-c loop from LFSB to receiver HFO. At TUNE position, connects d-c loop from LFSB to a-f and line amplifiers. At OFF position, connects HFO d-c loop input to 16.
19		LINE LEVEL control	Adjusts output level to 600 ohm audio line.
20		AF GAIN control	Adjusts output level to LSP and 21.
21		MONITOR jack	Permits headphone monitoring of audio output as controlled by 20.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

ITEM NO. FIG. 3-1	EQUIP	PANEL DESIGNATIONS	FUNCTION
22	Low Frequency Synthesizer, Model LFSB	(none)	Indicates frequency to which synthesizer is tuned. Actual frequency is 100 kc higher than indication.
23		(none)	Provides decimal point, in accordance with setting of 26, for indication of 22.
24		SYNC ALARM lamp	Lights when receiver HFO is not synchronized with synthesizer.
25		SYNCHRONIZE meter	Indicates degree of synchronism of receiver HFO with synthesizer output.
26		FREQUENCY MULTIPLIER switch	At X1 position, enables synthesizer to be tuned in 1 cps steps from 100.000 to 199.999 kilocycles. At X10 position, enables synthesizer to be tuned in 10 cps steps from 100.00 to 1999.9 kilocycles.
27		POWER lamp	Lights when synthesizer is powered by a-c line voltage.
28		POWER switch	Connects power supply to a-c line.
29		BATTERY lamp	Lights when synthesizer is powered by BPS.
30		10 KC switch	When 26 is at X1 position, tunes synthesizer in 10 kilocycle steps; when 26 is at X10 position, tunes synthesizer in 100 kilocycle steps.
31		1 KC switch	When 26 is at X1 position, tunes synthesizer in 1 kilocycle steps; when 26 is at X10 position, tunes synthesizer in 10 kilocycle steps.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

ITEM NO. (FIG. 3-1)	EQUIPT.	PANEL DESIGNATIONS	FUNCTION
32	LFSB (CONT)	.1 KC switch	When 26 is at X1 position, tunes synthesizer in 100 cycle per second steps; when 26 is at X10 position, tunes synthesizer in 1 kilo-cycle steps.
33		10 CPS switch	When 26 is at X1 position, tunes synthesizer in 10 cycle per second steps; when 26 is at X10 position, tunes synthesizer in 100 cycle per second steps.
34		1 CPS switch	When 26 is at X1 position, tunes synthesizer in 1 cycle per second steps; when 26 is set at X10, tunes synthesizer in 10 cycle per second steps.
35		SIGNAL OUTPUT jack	Permits monitoring of synthesized r-f signal.
36	Sideband Converter, Model LFCA	SYNC ALARM lamp	Lights when carrier injection oscillator is not synchronized with reference carrier from CSS or received pilot carrier as selected by 37.
37		SYNTH switch	At SYNTH position, connects reference carrier from CSS to phase lock circuitry for carrier injection oscillator. At lower (afc) position, connects received pilot carrier to phase lock circuitry for carrier injection oscillator.
38		SYNC LEVEL meter	Indicates degree of synchronization between carrier injection oscillator and reference carrier or pilot carrier as selected by 37.
39		MONITOR control	Adjusts output level to LSP and 40; selects output of either USB or LSB channel.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

ITEM NO. FIG. 3-1	EQUIP	PANEL DESIGNATION	FUNCTION
40	LFCA (CONT)	MONITOR jack	Permits headphone monitoring of audio output as controlled by 39.
41		LSB GAIN control	Adjusts output level of lower sideband channel to 600 ohm audio line.
42		USB GAIN control	Adjusts output level of upper sideband channel to 600 ohm audio line.
43		METER switch	At LSB positon, connects 46 to indicate output level to lower sideband 600 ohm audio line. At USB position, connects 46 to indicate output level to upper sideband 600 ohm audio line. At OFF position, disables 46.
44		BATTERY lamp	Lights when LFCA is powered by BPS.
45		AFC switch	Disconnects output of AFC loop from receiver HFO.
46		None	Indicates output level to USB or LSB 600 ohm audio line as selected by 43.
47		POWER lamp	Lights when LFCA is powered by a-c line voltage.
48		POWER switch	Connects power supply to a-c line.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

ITEM NO. (Fig. 3-1)	EQUIPT.	PANEL DESIGNATIONS	FUNTION
49	Frequency Standard, Model CSS	METER FUNCTION switch	At 100 KC position, connects 54 to indicate output level of 100 kilocycle amplifier; at 1 MC position, connects 54 to indicate output level of 1 megacycle amplifier; at 10 MC position, connects 54 to indicate output level of 10 megacycle amplifier; at 24 V position, connects 54 to indicate power supply voltage; at OVEN TEMP position, connects 54 to indicate oven temperature.
50		SYNCHRONIZE switch	Permits standard oscillator frequency to be controlled by externally supplied d-c voltage.
51		FINE FREQ. ADJUST control	Tunes standard oscillator.
52		AMPLIFIERS lamp	Lights when 100 kilocycle, 1 megacycle, and 10 megacycle amplifiers are turned on.
53		AMPLIFIERS switch	At ON position, turns amplifiers on as indicated by 52; at STANDBY position, turns amplifiers off, but leaves standard oscillator on.
54		None	Indicates various r-f levels, power supply voltage. or oven temperatures as selected by 49.
55		POWER lamp	Lights when CSS is powered by a-c line voltage.
56		FINE FREQ. ADJUST control	Lights when CSS is powered by BPS.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

ITEM NO. (FIG. 3-1)	EQUIPT.	PANEL DESIGNATION	FUNCTION
57	CSS (CONT)	100 KC jack	Permits monitoring output of 100 kilocycle amplifier.
58		1 MC jack	Permits monitoring output of 1 megacycle amplifier.
59		10 MC jack	Permits monitoring output of 10 megacycle amplifier.
60	Battery Power Supply, Model BPS( )-1	METER switch	At BATTERY GROUP-1 DISCHARGE position, connects 61 to indicate current drain of CSS; at BATTERY GROUP-1 CONDITION position connects 61 to indicate output voltage of batteries connected to CSS; at BATTERY GROUP-2 CONDITION position, connects 61 to indicate ouput voltage of batteries connected to VLRB, LFSB, and LFCA; at BATTERY GROUP-2 CHARGE positi connects 61 to indicate charge current from VLRB, etc; at BATTERY GROUP-2 DISCHARGE position, connects 61 to indicate current drawn by VLRB, etc.
61		None	Indicates various voltages or currents as selected by 60.
62	Power Control Panel, Model DCP-2	UTILITY POWER fuse and indicator lamp	Protects equipment connected to 65. When lit, fuse has blown.
63		UTILITY POWER fuse and indicator lamp	Protects equipment connected to 64. When lit, fuse has blown.
64		UTILITY OUTLET	Permits connection of accessory equipment.
65		UTILITY OUTLET	Same as 63.
66		MAIN POWER lamp	Lights when a-c power supplied to system.
67		MAIN POWER circuit breaker	Controls power application to system.

3-2. PRELIMINARY CONTROL SETTINGS.

Set controls at positions indicated in table 3-2.

NOTE

Numbers enclosed in parenthesis are callouts referenced to figure 3-1.

TABLE 3-2. PRELIMINARY CONTROL SETTINGS.

EQUIPMENT	PANEL DESIGNATION	POSITION
LSP	VOLUME control (1)	Fully clockwise
	CHANNEL switch (2)	A
VLRB	NOISE SILENCER switch (4)	OFF
	METER switch (5)	0 DBM
	POWER switch (8)	Up
	BAND switch (19)	At range that includes desired operating frequency.
	LOCK knob (10)	Fully counterclockwise
	TUNING control (11)	For indication of desired operating frequency on KILOCYCLES dial 3.
	RF GAIN control (14)	Mid-range
	AGC DECAY switch (15)	MAN
	IF SELECTIVITY switch (17)	8
	LINE LEVEL control (19)	Fully counterclockwise
	AF GAIN control (20)	Mid-range
	BAT. switch (inside VLRB)*	IN

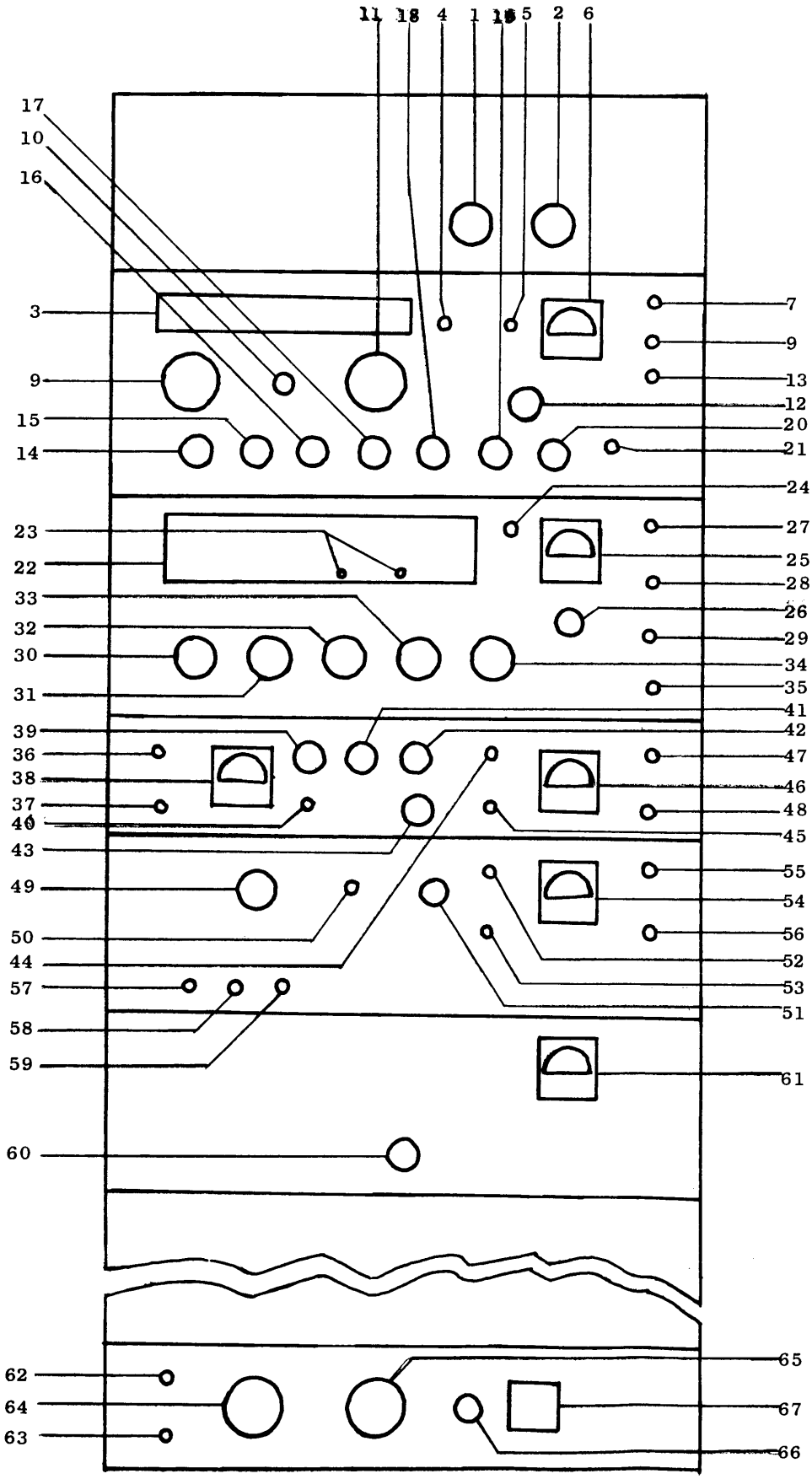


Figure 3-1. LF/MF Receiver System Front Panel Controls And Indicators

TABLE 3-2. PRELIMINARY CONTROL SETTINGS. (CONT)

EQUIPMENT	PANEL DESIGNATION	POSITION
LFSB	FREQUENCY MULTIPLIER switch (26)	As desired; must be at X10 when operating frequency is above 99.999 kilocycles.
	POWER switch (28)	Up
	10 KC, 1 KC, .1 KC, 10 CPS and 1 CPS switches (30, 31, 32, 33 and 34)	For display of operating frequency on (22).
	BAT. switch (on rear of LFSB)*	IN
LFCA	SYNTH switch (37)	SYNTH (up)
	LSB GAIN control (41)	Fully counterclockwise
	USB GAIN control (42)	Fully counterclockwise
	POWER switch (48)	Up
	BATTERY switch (on rear of LFCA)	IN
CSS	SYNCHRONIZE switch (50)	OFF
	FINE FREQ. ADJUST control (51)	At initial setting
	AMPLIFIERS switch (53)	STANDBY
	BAT. switch (on rear of CSS)*	IN
	CAUTION The FINE FREQ. ADJUST control on the CSS-2 should not be adjusted until the operator or technician completely famaliarizes himself with the procedure as explained in the CSS-2 Technical Manual.	

TABLE 3-2. PRELIMINARY CONTROL SETTINGS. (CONT)

EQUIPMENT	PANEL DESIGNATION	POSITION
BPS	METER SWITCH (60)	BATTERY GROUP-1 CHARGE or BATTERY GROUP-2 CHARGE
DCP	MAIN POWER circuit breaker (67)	ON
**The BATTERY switches are set at the OUT positions only when the BPS is supplied without batteries, or it is desired to turn the system off.		

3-3. AM AND MCW RECEPTION, SYNTHESIZED. - Refer to figure 3-1.

a. Make sure that controls are set according to paragraph 3-2.

b. Set AMPLIFIERS switch 53 at ON. Meter 54 should indicate a minimum of 1 (1v rms) when METER FUNCTION switch 49 is set at its 100 KC and 1 MC positions.

c. Set MODE switch 16 at AM.

d. Set SYNTH switch 18 at TUNE. An audio tone should be heard from the loudspeaker. Adjust TUNING control 11 to zero beat the tone.

e. Set SYNTH switch 18 at ON, and adjust TUNING control 11, for center scale indication on SYNCHRONIZE meter 25. SYNC ALARM lamp 24 should be extinguished.

f. Adjust RF GAIN control 14 and AF GAIN control 20 for minimum distortion and comfortable listening level.

g. If AGC (automatic gain control) is desired, set AGC DECAY switch 15 at FAST, MED or SLOW. With AGC DECAY switch at FAST; decay time is 3.3 seconds; at MED, decay time is 9.9 seconds; and at SLOW, decay time is 16.5 seconds.

h. If noise silencing is desired, set NOISE SILENCER switch 4 at ON.

i. Adjust LINE LEVEL control 19 for desired audio output to external equipment as indicated by 6.

3-4. CW AND FSK RECEPTION, SYNTHESIZED. - Refer to figure 3-1.

a. Make sure that controls are set according to paragraph 3-2.

b. Perform step b, paragraph 3-3.

c. Set MODE switch 16 at CW.

d. Perform steps d. and e., paragraph 3-3.

e. Adjust BFO control 12 for desired tone of received signal.

f. Perform steps f. through i., paragraph 3-3.

3-5. SSB AND ISB RECEPTION, SYNTHESIZED. - Refer to figure 3-1.

a. Make sure that all controls are set according to paragraph 3-2.

b. Perform step b, paragrpah 3-3.

c. Set MODE switch 16 at SSB.

d. Perform steps d. and e., paragraph 3-3.

e. Set CHANNEL switch 2 at B.

f. Adjust RF GAIN control 14 and MONITOR control 39 for minimum distortion and comfortable listening level.

g. Perform steps g. and h., paragraph 3-3.

h. Set METER switch 43 at LSB or USB to correspond with sideband being received, and adjust the associated GAIN control, 41 or 42, for desired audio output to external equipment as indicated by LINE LEVEL meter 46. For ISB reception, the METER switch must be set successively at its LSB and USB positions while the corresponding GAIN controls (USB and LSB) are adjusted.

3-6. AFC OPERATION. - AFC (automatic frequency control) may be employed when receiving SSB or ISB signals that include a pilot carrier that is reduced no more than 25 db. The CSS and LFSB units are not used in this type of operation.

a. Make sure that controls are set according to paragraph 3-2, except, that step c. (3) may be eliminated.

b. Set MODE switch 16 at SSB.

c. Set SYNTH switch 18 at OFF.

d. Set CHANNEL switch 2 at B.

e. Set SYNTH switch 37 down (AFC).

f Adjust RF GAIN control 14 and MONITOR control 39 for comfortable listening level of the sideband in which v-f telegraphy tones are not being transmitted.

g. Depresss AFC switch 45, and adjust TUNING control 11 to simultaneously zero beat the received pilot carrier and extinguish the SYNC ALARM lamp 36.

h. Release AFC switch 45, and adjust TUNING control 11 for a center scale indication on SYNC LEVEL meter 38.

i. Perform steps g. and h., paragraph 3-3.

j. Perform step h., paragraph 3-5.

3-7. AM AND MCW RECEPTION, UNSYNTHESIZED. - Refer to figure 3-1.

a. Make sure that controls are set according to paragraph 3-2, except that step c. (3) may be eliminated.

b. Set MODE switch 16 at AM.

c. Set SYNTH switch 18 at OFF.

d. Perform steps f. through i., paragraph 3-3.

3-8. CW AND FSK RECEPTION, UNSYNTHESIZED. - Refer to figure 3-1.

a. Make sure that controls are set according to paragraph 3-2, except that step c. (3) may be eliminated.

b. Set MODE switch 16 at CW.

c. Set SYNTH switch 18 at OFF.

d. Adjust BFO control 12 for desired tone of received signal.

e. Perform steps f. through i., paragraph 3-3.

3-9. SSB AND ISB RECEPTION, UNSYNTHESIZED. - In the event of a malfunction of the CSS or LFSB, it may be necessary to operate the system unsynthesized for the reception of SSB and ISB signals. If the desired signal includes a pilot carrier that is reduced no

more than 25 db, AFC should be employed as indicated in paragraph 3-6. Unsynthesized operation of the system for the reception of SSB and ISB signals may require frequent re-tuning to maintain intelligibility. Refer to figure 3-1.

a. Make sure that controls are set according to paragraph 3-2, except that step c. (3) may be eliminated.

b. Set MODE switch 16 at SSB.

c. Set SYNTH switch 18 at OFF.

d. Set CHANNEL switch 2 at B.

e. Perform step f., paragraph 3-5.

f. Adjust TUNING control 11 for maximum intelligbility.

g. Perform steps g. and h., paragraph 3-3.

h. Perform step h., paragraph 3-5.

3-10. STOPPING PROCEDURE

To stop the LRRA, set controls as follows:

CONTROL	POSITION
CSS	
AMPLIFIERS switch	STANDBY
BAT. switch	OUT
LFSB	
POWER switch	Down
BAT. switch	OUT

CONTROL	POSITION (cont)
VLRB	
POWER switch	Down
BAT. switch	OUT
LFCA	
POWER switch	Down
BATTERY switch	OUT
DCP	
MAIN POWER circuit breaker	OFF

NOTE

Because frequency stopping of this equipment may destroy the high accuracy and stability of its frequency standard, unnecessary stopping should be avoided.

3-11. OPERATOR'S MAINTENANCE. - The operator may, at times, be required to perform some aspects of maintenance. Generally this consists of ascertaining that all controls and indicators are functioning properly, insuring equipment cleanliness, and replacing defective fuses.

PRINCIPLES OF OPERATION

4-1. FUNCTIONAL DESCRIPTION

Signals in the frequency range of 30 to 600 kilocycles are routed from the antenna to the input of the VLRB. After amplification by tuned rf amplifiers, the selected signal is converted to the first i-f frequency of 6.4 megacycles. The 6.4 megacycle i-f signal, after amplification, is converted to the second i-f frequency of 100 kilocycles. The 100 kilocycle i-f signal is amplified and then routed to the LFCA, and to two detectors in the VLRB. For AM, MCW, CW or FSK reception, the output of one of the detectors is connected to two audio amplifiers; one providing 1 milliwatt output at 600 ohms impedance, and one providing 1/2 watt output at 4 ohms impedance for the LSP.

The second converter injection signal frequency is 6.5 megacycles. The first converter injection signal, in the range of 5.3 to 6.37 megacycles, is the difference product of the 6.5 megacycle second converter injection signal and the HFO output; which is in the range of 130 to 700 kilocycles. The 6.5 megacycle signal is used in both the up-conversion and the down-conversion processes in a manner so that its frequency instability is self-cancelling. Samples of the first and second converter injection signals are routed to the LFSB.

The CSS supplies the LFSB with 1 megacycles and 100 kilocycle signals at a level of 1 volt. These signals, after warm-up, are stable to 1 part in 10^9 per day. The CSS also supplies the LFCA

with a 100 kilocycle signal at a level of 1 milliwatt, stable to the same degree as the other two outputs.

The LFSB utilizes the 1 megacycle and 100 kilocycle signals from the CSS to generate a signal in the range of 130 to 700 kilocycles. This signal is mixed with the sample of the VLRB's first converter injection signal (5.3 to 6.37 megacycles). The resultant sum product will be 6.5 megacycles when the LFSB is tuned to the same frequency as the HFO in the VLRB. The 6.5 megacycle signal generated in the LFSB and the 6.5 megacycle sample from the VLRB are connected to a phase detector in the LFSB. The output of the phase detector is a d-c voltage proportional to the phase difference of the two 6.5 megacycle signals. This d-c voltage may be used to synchronize the HFO in the VLRB with the stable 130 to 700 kilocycle signal generated in the LFSB.

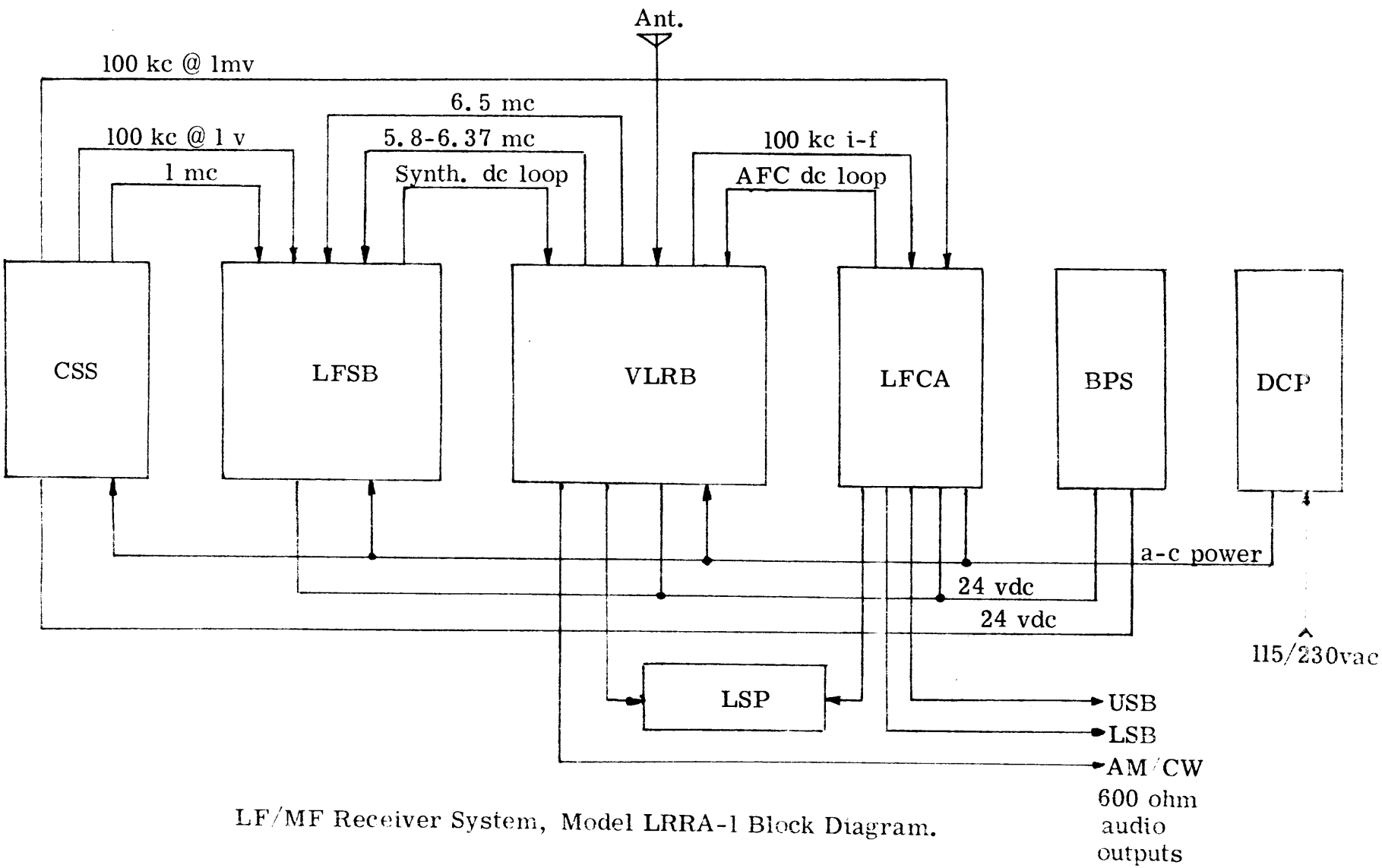
The 100 kilocycle i-f signal from the VLRB is routed to two independent i-f amplifiers in the LFCA. The outputs of these i-f amplifiers are connected to two independent product detectors, and the outputs of the product detectors are connected to two independent audio amplifiers. Each of these audio amplifiers provides 1 milliwatt output, and has an output impedance of 600 ohms. The outputs of the product detectors are also connected to a monitor audio amplifier that provides 1/2 watt output at 4 ohms for the LSP.

The carrier injection oscillator for the product detectors may be synchronized either to the stable 100 kilocycle output of the CSS, or to the receiver pilot carrier which is converted to the frequency of 100 kilocycles in the VLRB. The circuitry

in the LFCA that synchronized the carrier injection oscillator produces a d-c voltage which may also be used to tune the HFO in the VLRB over a small portion of its range.

The BPS supplies the CSS, LFSB, VLRB, and LFCA with 24 vdc when primary a-c power fails. The batteries in the BPS receive a trickle charge from the power supplies in these units when the system is operating normally on a-c power.

The 1/2 watt audio outputs of the VLRB and LFCA are connected to the LSP. A selector switch in the LSP connects one of these audio signals to the loudspeaker. The unused audio line is terminated in a 4-ohm dummy load.



LF/MF Receiver System, Model LRRA-1 Block Diagram.

SECTION 5

MAINTENANCE

5-1. GENERAL.

Maintenance is divided into three categories: operator's maintenance, preventive maintenance, and repair. Repair procedures as given in this section relate to cable connectors, cable assemblies and those items that are not part of any of the modular units. Repair procedures for RAK-44 components and any modular unit contained in the LRRA system are given in the appropriate modular-unit manual. Preventive maintenance includes information necessary to insure optimum performance of the LRRA system. Alignment and adjustment information is contained in the individual modular-unit manuals of the LRRA system. Operator's maintenance for the LRRA is described in Section 3.

5-2. SPECIAL TOOLS AND TEST EQUIPMENT.

Refer to the individual modular-unit manuals for the necessary test equipment required for modular-unit maintenance, alignment and adjustments. No special tools are required.

5-3. PREVENTIVE MAINTENANCE.

a. GENERAL. - The LRRA system has been designed to provide long-term, trouble-free operation under continuous duty conditions. However, similar to any other piece of equipment that contains assemblies of many electrical parts, optimum performance and service life of the LRRA system are dependent upon an adequate preventive maintenance

schedule that is strictly adhered to.

b. CLEANING AND INSPECTION. - At periodic intervals each modular unit should be removed from the cabinet for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring or grease. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methyl chloroform may be used, providing the necessary precautions are observed.

WARNING

When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated breathing of the vapor. Avoid prolonged or repeated contact with skin. Flammable solvents shall not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work," etc. is prohibited in the immediate area.

CAUTION

When using trichlorethylene, avoid contact with patinted surfaces, due to its paint removing effects.

5-4. REPAIR.

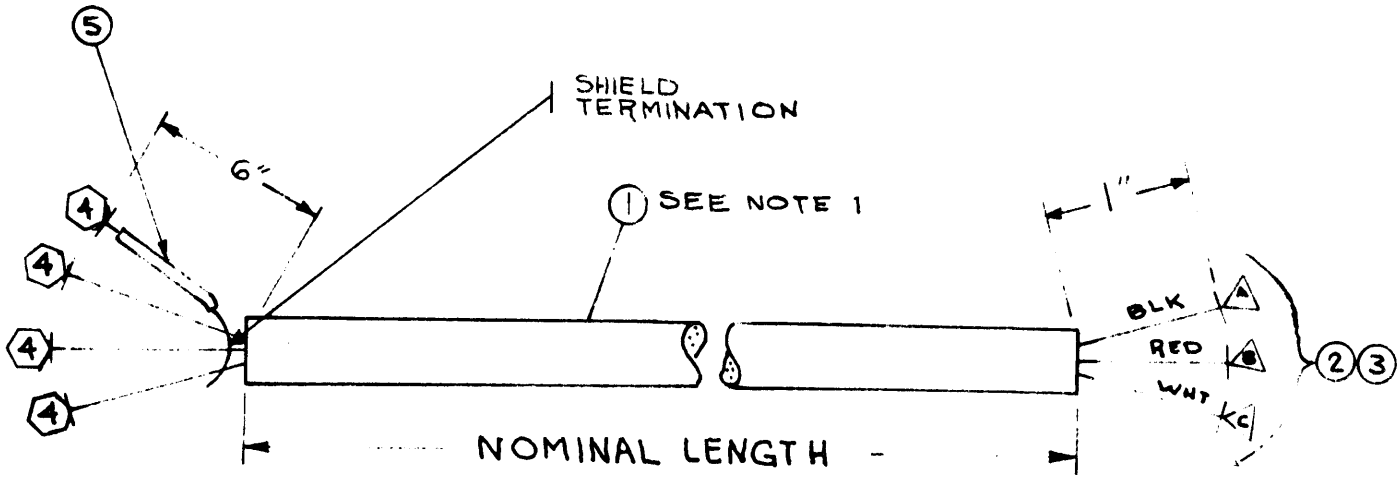
a. GENERAL. - Repair encompasses those procedures necessary to repair and replace defective LRRA components. As stated in paragraph 5-1, repair procedures given in this section are confined to cable connectors and cable assemblies. Repair procedures for RAK-44 com-

ponents or any modular unit contained in the LRRA can be found in the appropriate modular unit manual.

b. CABLE ASSEMBLIES CA-765-5 AND CA-864. - Cable assembly CA-765-5 is a 3-conductor BX cable used to connect Power Panel DCP to Line Filter FL1001 (refer to figure 2-4). Repair of CA-765-5 is obvious upon inspection; therefore, no further information is provided in this manual.

Cable assembly CA-864 is an r-f branched cable assembly used to terminate jack J903 on Frequency Standard CSS (refer to figure 2-4). Refer to the information provided in figure 5-1 when repairing cable assembly CA-864.

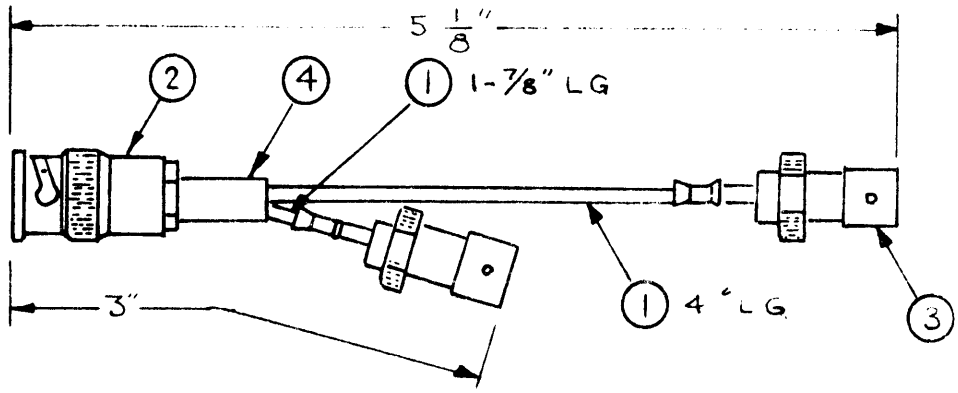
c. CABLE ASSEMBLY CA-931. - Cable assembly CA-931, composed of CA-907-3 and CA-907-5 cables, is used to interconnect the various modular units that constitute the LRRA system (refer to figure 2-4). Refer to the information provided in figure 5-1 when repairing any of the CA-907-3/5 cables that make up cable assembly CA-931.



CA-907-3 111 INCHES

CA-907-5 91 INCHES

CA-907	
ITEM	DESCRIPTION
1	CABLE, SPECIAL PURPOSE (WI-142-2)
2	CONNECTOR, PLUG, FEMALE
3	CLAMP
4	TERMINAL, SOLDERLESS (TE159-34161)
5	SLEEVING, INSULATION



CA-864

CA-864	
ITEM	DESCRIPTION
1	CABLE, COAXIAL (RG174/U)
2	CONNECTOR, BNC PLUG, CRIMP
3	CONNECTOR, BNC PLUG, CRIMP
4	INSULATION SLEEVING, ELECT (PX830-10-1)

NOTES:

1. CABLE ASSEMBLIES CA-907-3 and -5 ARE PART OF MAIN HARNESS CABLE ASSEMBLY CA-931.
2. O DENOTES ITEM NUMBER.
3. Δ DENOTES PLUG or SOCKET TERMINAL CONNECTIONS.
4. ⬡ DENOTES EQUIPMENT TERMINAL CONNECTIONS AND ITEM NUMBER.

Figure 5-1. Cable Assemblies CA-907 and CA-864