NAVSHIPS
0967-055-4000

DDR

TECHNICAL MANUAL

for

GENERAL PURPOSE RECEIVER

MODEL DDR-5K

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, CANADA

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IN-355

Issue Date; 1 December 1965

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-5K consists of 9 major components as follows:

QTY	COMPONENT	
1	HFR-2	Continuous RF Tuner
1	HFS-1	Control Synthesizer and Standard
1	MSA-1	Multiple Sideband Adapter
1	MCG-1	Mux Carrier Generator
1	AFC-3	Automatic Frequency Control Unit
1	HSS-8	Bridging Speaker Panel
1	HFP-1	Power Supply
1	HPP-1	Utility Panel
1	MFP-1	Power Supply

These 9 basic units are also included in various TMC receiver systems as well as in the DDR-5K. To satisfy this condition most practically, individual manuals on each unit are written, then combined, as required to cover any receiver system. The DDR-5K manual is made up of a system manual and the individual manuals* as follows:

Technical Manual for General Purpose Receiver, Model DDR-5K

Technical Manual for Continuous RF Tuner, Model HFR-2

Technical Manual for Control Synthesizer and Standard, Model HFS-1

Technical Manual for Multiple Sideband Adapter, Model MSA-1

Technical Manual for Multiple Carrier Generator, Model MCG-1

Technical Manual for Automatic Frequency Control Unit, Model AFC-2A and AFC-3

Technical Manual for Loudspeaker Assembly, Model HSS-8

Technical Manual for Power Supply, Model HFP-1

Technical Manual for Power Supply, Model MFP-1

Technical Manual for Utility Panel, Model HPP-1

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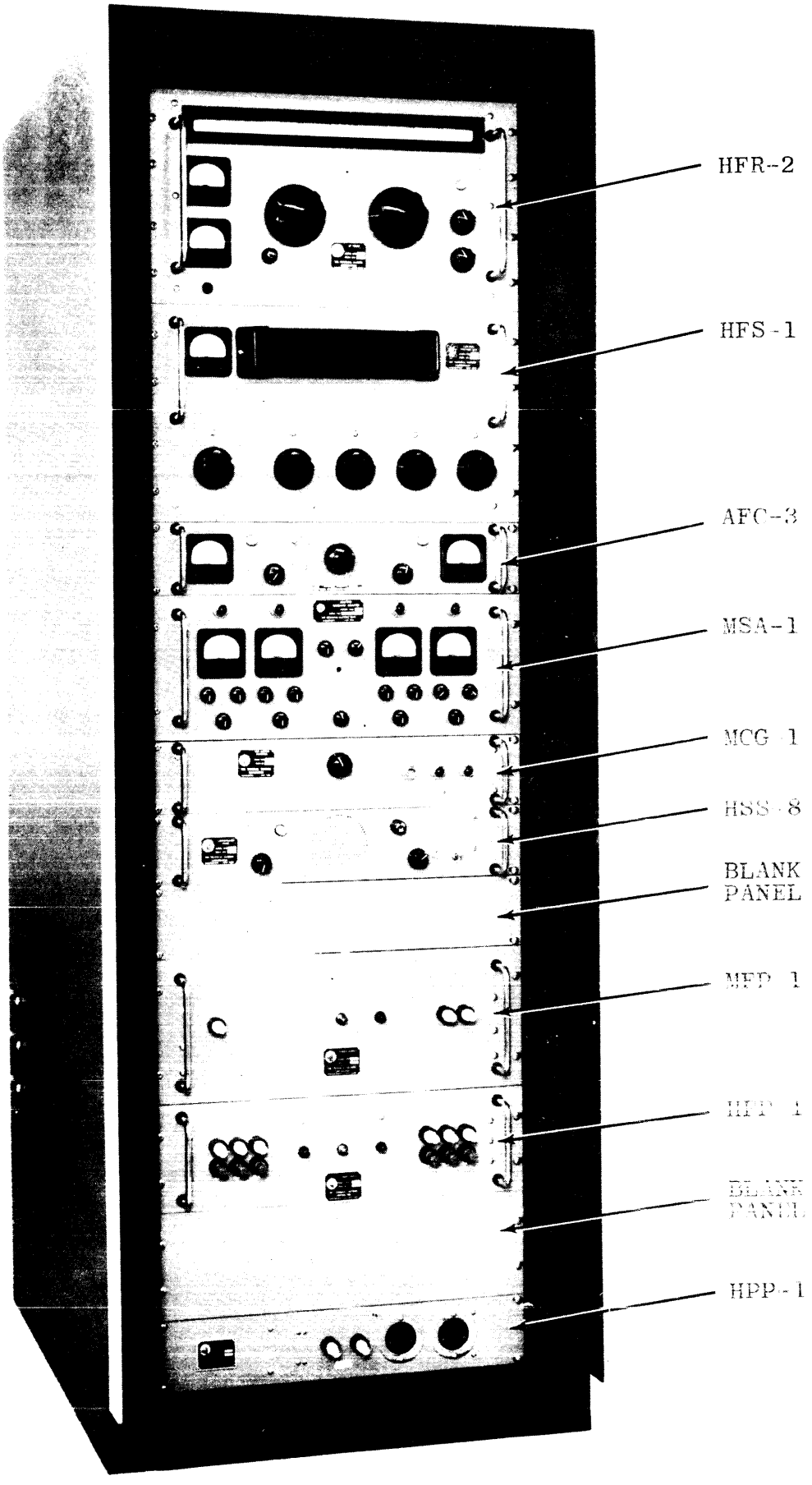


Figure 1-1. General Purpose Receiver, Model DDR-5K

SECTION 1

GENERAL INFORMATION

1-1. GENERAL DESCRIPTION.

General Purpose Receiver, Model DDR-5K (Figure 1-1) is a 4-channel receiving system covering the frequency range of 2 to 32 mc for the reception of SSB, ISB, AM, AME, CW, MCW, FSK, and FAX. In ISB reception, four independent channels may be received. Each channel may contain voice, a combination of voice frequency tone telegraph channels (from FSK transmission), a combination of FAX channels, data transmission or any type of information that can be contained within 250 cps to 3040 cps. Each channel has individually adjustable AGC and squelch circuits.

The 2 to 32 mc range covered by the DDR-5K is divided into eight r-f bands. The tuning coverage for each band is in 100 cps steps, for synthesized operation, or it can be continuous coverage for non-synthesized receiver operation. For sideband signals with a fully suppressed carrier, a synthesized carrier referenced to an internal 1-mc frequency standard produces receiver frequency stability within 1 part in 1×10^8 per 24-hour period, tunable in 100 cps steps. An automatic frequency control operates as an additional feature to compensate for combined transmitter/receiver drift to produce audio accurate to within 1 cps.

Other additional features include r-f tuning dial calibration signals (referenced to the 1-mc frequency standard), an r-f noise silencer circuit, carrier drift/level monitoring and monitoring of individual channel audio outputs by front-panel selection switch and bridging speaker amplifier.

All major components are mounted on tilt-lock type drawer slides. The equipment rack has its own forced-air cooling system using squirrel cage blowers and washable air filters in the rack intake and exhaust.

1-2. DESCRIPTION OF UNITS.

a. GENERAL. - Paragraphs b through j below, give a brief description of the modular units used in the receiver system. For more detailed information pertaining to these units, refer to the individual modular-unit manuals.

b. CONTINUOUS RF TUNER, MODEL HFR-2. - Continuous RF Tuner HFR provides coverage from 2- to 32-mc in eight bands and displays the tuned frequency on a 14-inch slide-rule dial. The HFR converts the selected incoming r-f signal to a first i-f of 1.75 mc. The local oscillator, contained within the HFR, can be maintained to a stability of 1 part in 10^8 per day by means of a control voltage from the HFS Synthesizer.

c. CONTROL SYNTHESIZER AND STANDARD, MODEL HFS-1. - Control Synthesizer and Standard HFS monitors the high-frequency oscillator of Continuous RF Tuner HFR, and provides d-c correction voltages to maintain the free-running oscillator to one part in 10^8 stability. Tuning of the HFS is accomplished by means of detented rotary switches; the frequency selected is displayed on 1-inch high illuminated numeric lights.

In addition, the HFS furnishes highly stable 2-mc and 250-kc carrier frequencies for Multiple Sideband Adapter MSA to be used in receiving fully suppressed sideband signals.

d. AUTOMATIC FREQUENCY CONTROL UNIT, MODEL AFC-3. - Automatic Frequency Control AFC is used in reception of sideband with reduced carrier suppression. It effectively locks on the carrier component of the signal in its 250-kc stage in Multiple Sideband Adapter MSA, and provides the four audio detectors with altered injection frequencies to compensate for carrier drift. In addition, it limits the effect to the frequency drift to small excursions in the injection frequency. By keeping the sideband-to-synthetic carrier frequency relationship true, the audio output of the receiver is maintained correct to within 1 cycle of the original transmitted signal. An included memory circuit maintains the stability of the unit's oscillator circuit to compensate for momentary carrier fades.

e. MULTIPLE SIDEBAND ADAPTER, MODEL MSA-1. - Multiple Sideband Adapter MSA receives a 1.75 mc signal (containing carrier and sidebands) from Continuous RF Tuner HFR. The MSA separates the 1.75 mc signal into 4 channels and extracts the audio intelligence from each channel in a product detector circuit. Injection frequencies for the four product detectors are obtained from Mux Carrier Generator MCG. Each channel has an adjustable AGC DECAY time and SQUELCH adjustment and a LINE LEVEL monitor.

f. MUX CARRIER GENERATOR, MODEL MCG-1. - Mux Carrier Generator MCG provides: (1) a carrier injection signal (250 kc) and demultiplexing carrier injection signals (256.29 kc and 243.71 kc) for the product detector contained in Multiple Sideband Adapter MSA; (2) an i-f translating sig-

nal (2 mc) for the mixer stage of Multiple Sideband Adapter MSA.

The demultiplexing carrier injection signals, used for demultiplexing translated channels (A2 and B2), are generated solely within the MCG. However, the carrier injection signal, used for demodulating non-translated channels A1 and B1, and the i-f translating signal may be obtained (by means of a front-panel selector switch) from the MCG, from Control Synthesizer and Standard HFS, or from Automatic Frequency Control AFC-3.

g. BRIDGING SPEAKER PANEL, MODEL HSS-8. - The HSS-8 is a high-impedance bridging speaker amplifier. A four-position rotary switch places the HSS-8 across any of the four 600-ohm audio output channels of the DDR-5K for dynamic monitoring purposes.

h. POWER SUPPLY, MODEL MFP-1. - Power Supply MFP-1 converts line voltage into regulated plate, regulated bias, and filament voltages for Multiple Sideband Adapter MSA.

i. POWER SUPPLY, MODEL HFP-1. - Power Supply HFP-1 converts line voltage into regulated plate, regulated bias and filament voltages for all units of the receiver system with the exception of the MSA. It also supplies crystal ovens throughout the system with heater element voltages. The STANDBY position of the rear chassis switch is used to place the receiver system in standby condition when not being used. This condition provides crystal oven heater voltages only, for mainteained frequency stabilization.

j. UTILITY PANEL, MODEL HPP-1. - Utility Panel HPP-1 receives line voltage from the line voltage input. It has two front-panel a-c outlets for

conveniently obtaining line voltage for auxiliary equipment used with the DDR-5K.

1-3. TECHNICAL SPECIFICATIONS.

Technical specifications for the DDR-5K receiver system are listed below. For technical specifications concerning the modular units used in the DDR-5K, refer to the individual modular-unit manuals.

Frequency Range:	2 to 32 mcs, 100 cps steps
Tuning:	Eight RF bands as listed below: BAND 1 ---2-3 mc BAND 2 ---3-4 mc BAND 3 ---4-6 mc BAND 4 ---6-8 mc BAND 5 ---8-12 mc BAND 6 ---12-16 mc BAND 7 ---16-24 mc BAND 8 ---24-32 mc
Modes of Operation:	SSB or 4 channel ISB in primary modes. Secondary reception modes include AME, CW, MCW, FSK and FAX.
Stability:	1. Synthesized stability of 1 part in 10^8 for 24 hours for a change in of 15°C within the limits of 0 to 50°C. 2. 20 to 50 parts in 10^6 without AFC. 3. With AFC the residual audio output will remain within 1 cycle of the transmitted intelligence.

AFC Characteristics:	Automatically synchronizes to a received signal ±50 cps and suppressed 25 db at 1 microvolt above noise threshhold and will remain synchronized for ±750 cps of drift at a maximum drift rate of 10 cps/ per second. Memory circuit will maintain tuning position during signal fades or momentary outages.
IF Bandpass:	±1.5 db, 250 to 3040 cps of channel.
Noise Figure and Sensitivity:	6 db or better over the band, i.e.: - with a 1 uv signal and a 7.5-kc bandwidth, the output signal-noise-to-noise ratio is 15 db or better.
Antenna Input Impedance:	Nominal 50 ohms, unbalanced.
Audio Outputs:	Four 3-kc width channels for 600-ohm loads; 0-10 mw nominal per channel.
Audio Response:	Flat within ±1.5 db from 50 cps to 3-kc.
Multiplexed Channel Translation:	Demuxing frequencies in National Standard of 6290 cps.
Intermodulation:	Intermodulation products are down at least 60 db from the maximum tone in the desired sideband as a result of two signals in the unwanted sideband.
Image Ratio:	80 db referenced to 1 uv input signal.
Spurious Response: (as defined by CCIR)	For synthesized operation, no greater than .01 uv when referred to the antenna.
IF Rejection:	Better than 80 db average.
AGC:	Four separate AGC systems, one for each channel, .1 second rise time with an adjustable 1-10 second decay time for each channel. Output remains within ±1.5 db for a 60 db change in input range of 1 uv to 0.1 volt.

Audio Frequency Distortion:	Audio distortion is at least 50 db below full audio output.
Hum Level:	At least minus 50 db at full audio output.
Power Supply Requirements:	1000 watts, average consumption. 115 VAC, 50 to 60 cps, single phase.
Ambient Tempertaure and Humidity:	0 to 50°C and up to 90% relative humidity.
O erall Dimensions:	72 inches high x 25-1/4 inches wide x 34-3/4 inches deep.

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

The DDR-5K is carefully packaged to insure maximum protection against damage during transit; inspect the DDR-5K packing cases for possible damage when they arrive at the operating site. With respect to equipment for which the carrier is liable, the Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts. Carefully inspect the packing material for parts that may have been shipped as loose items. Most of the cable assemblies used in the DDR-5K are mounted in the rack and taped in place.

2-2. RACK INSTALLATION.

Figure 2-1 shows overall dimensions, clearances and other installation data pertinent to locating the DDR-5K rack. The room or van in which the receiver is placed should have adequate ventilation.

2-3. POWER REQUIREMENTS.

Unless otherwise specified, all units of the DDR-5K leave the factory wired for 115 vac, 50 to 60 cycles, single phase operation. Power consumption of the complete DDR-5K is approximately 1000 watts; 3-conductor shielded power cabling #12 AWG is recommended. Connect the power cable to the AF-103 Line Filter, located in the rear of the receiver rack

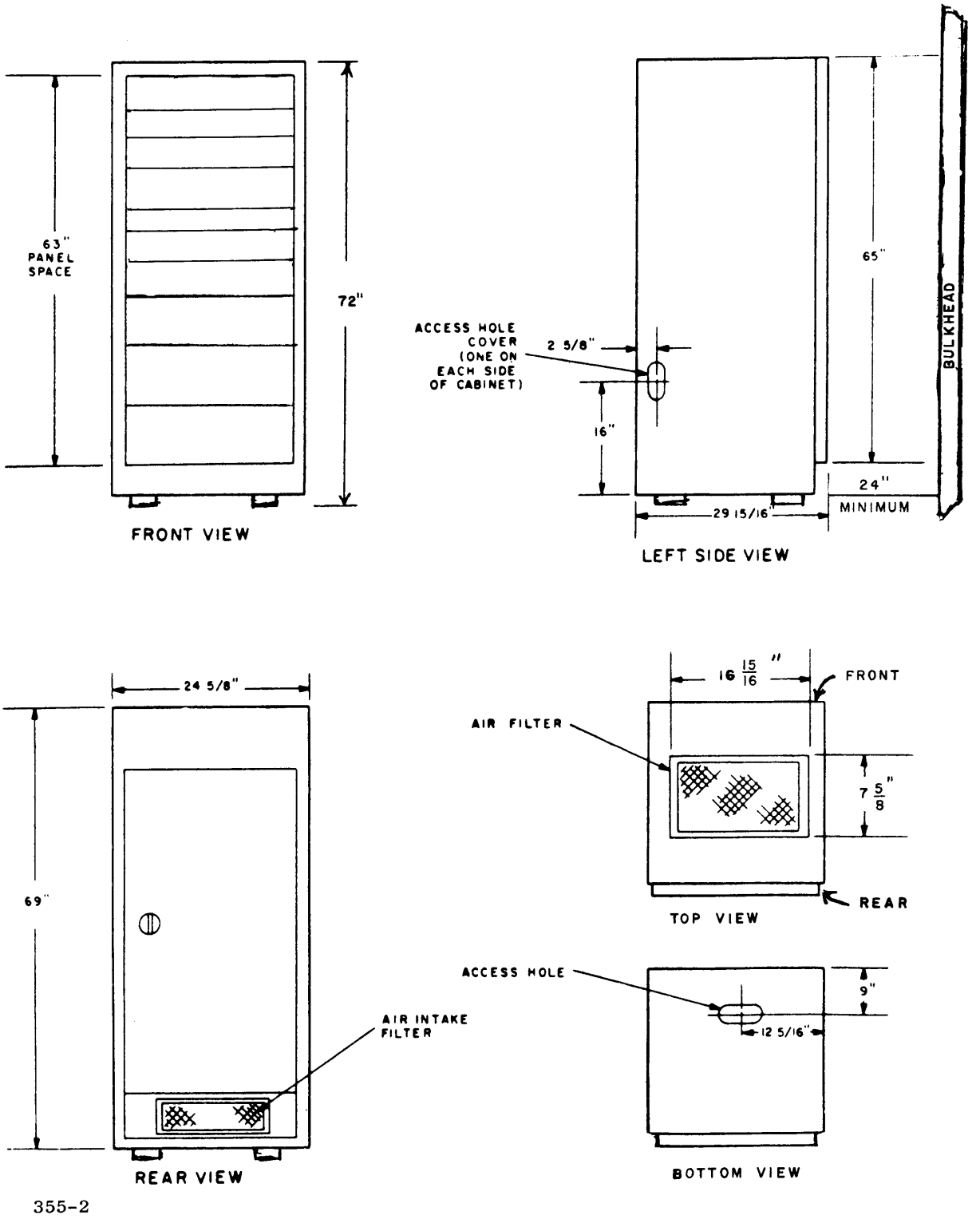


Figure 2-1. DDR-5K, Dimensional Outline Drawing

2-4. ASSEMBLY OF RECEIVER.

a. INSTALLATION OF MODULAR UNITS. - Refer to figure 1-1 for information regarding location of all modular units. All major units are slide-mounted on tilt-lock drawer slides. To install any slide-mounted unit in its compartment, refer to figure 2-2 and proceed as follows:

(1) Untape or unstrap cable assemblies and all other components fastened to the rack frame for shipment.

CAUTION

Start by installing bottom units first in order to avoid rack tipping over from extended center of gravity.

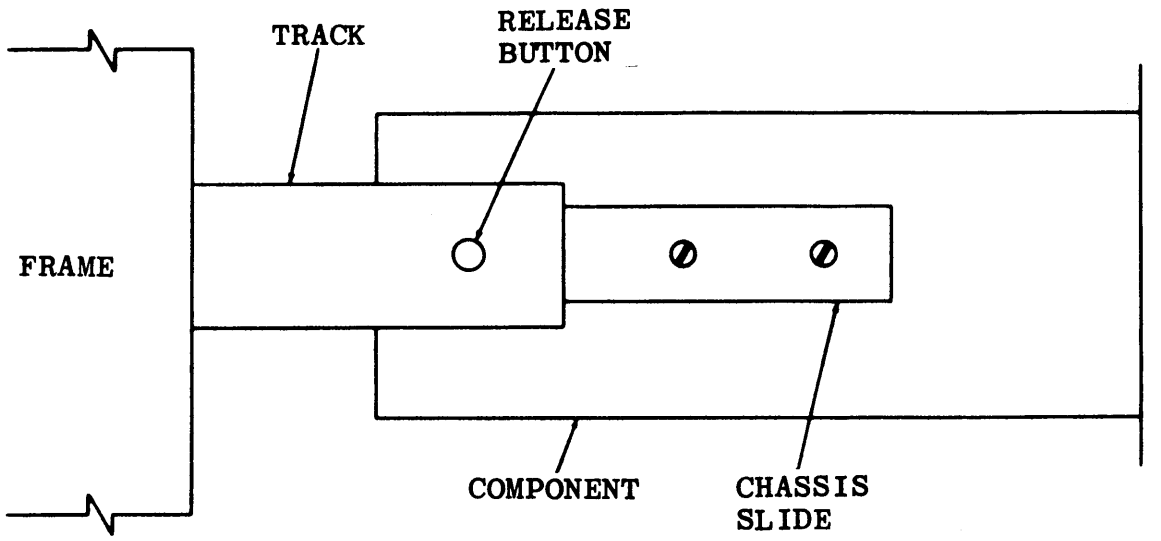
(2) Pull center section of associated compartment track out until it locks in an extended position.

(3) Position slide mechanisms of modular unit in tracks, and ease modular unit forward into rack until release buttons engage holes in track.

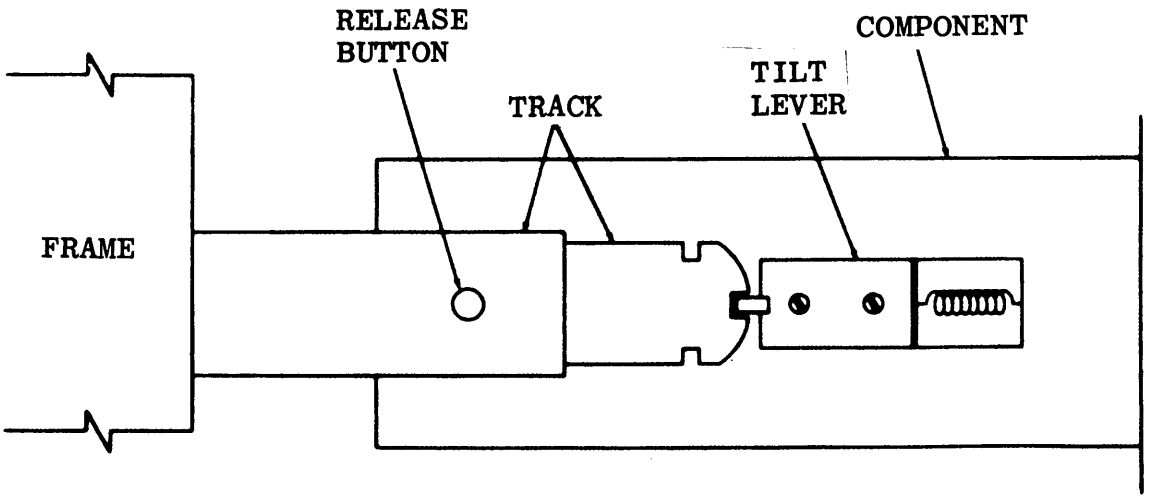
(4) Make necessary cable and electrical connections as described in paragraph 2-4b. To prevent the cables from snagging, utilize the cable retractor located inside the rack in the rear (see figure 2-3).

(5) Depress release buttons and slide modular unit completely into compartment.

(6) Secure front panel of modular unit to rack with screws.



A. NON-TILTING SLIDE MECHANISM



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B. TILTING SLIDE MECHANISM

Figure 2-2. Slide-Mounting Details

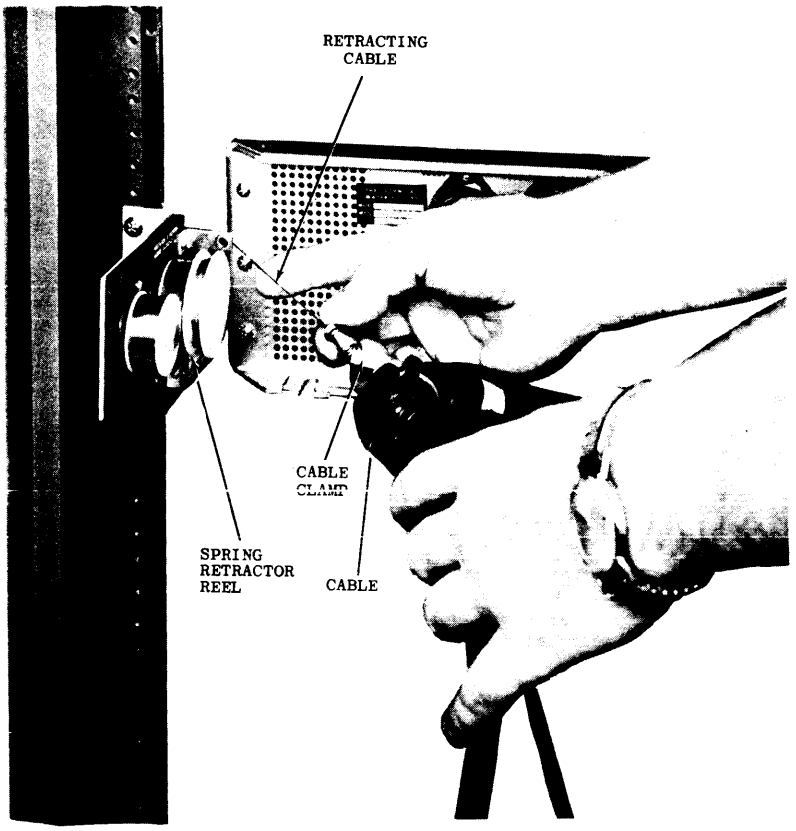


Figure 2-3. Attaching Cable Retractor

b. INTERCONNECT CABLING. - Connect cabling as shown in figure 2-5.

2-5. CONNECTION OF EXTERNAL EQUIPMENT.

a. ANTENNA. - The receiver in the DDR-5K is normally used with a sloping V, rhombic, or log-periodic antenna. The antenna input to the receiver is for a 50-ohm, unbalanced antenna. Make the antenna connection at the vertical panel located inside the rack rear door on right (see figure 2-4). Connect the antenna to J8501. One TMC # UG/88U BNC type plug is supplied in shipment.

b. AGC AND AUDIO LOADS. - Make AGC and audio-load connections for channels A1, A2, B1, and B2 at Terminal Board TB8501 as shown in figure 2-4.

2-6. INITIAL ADJUSTMENTS.

The DDR-5K has been factory tested and aligned as a complete system before disassembly for shipment. No initial adjustments of chassis-mounted variable components are necessary before operation.

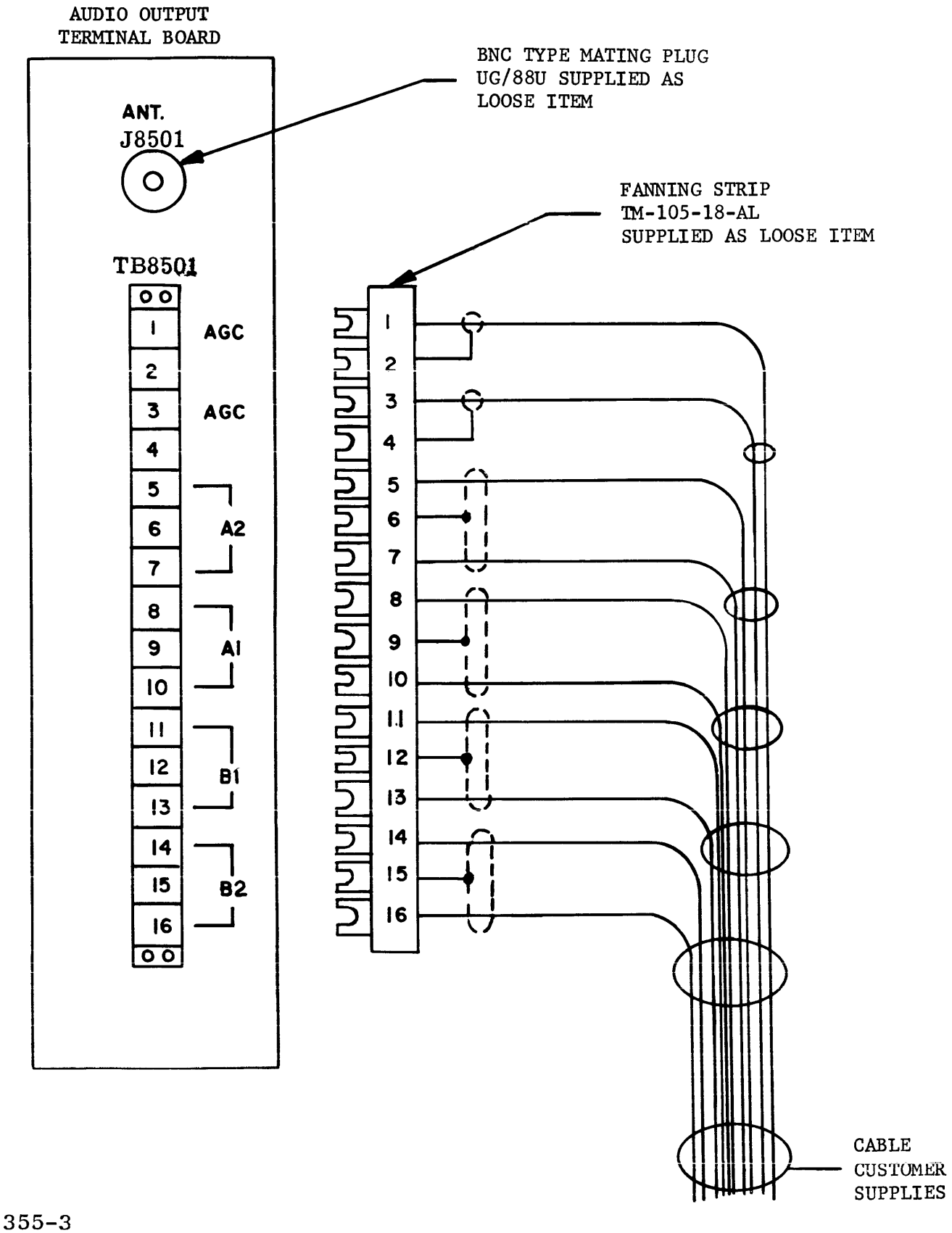
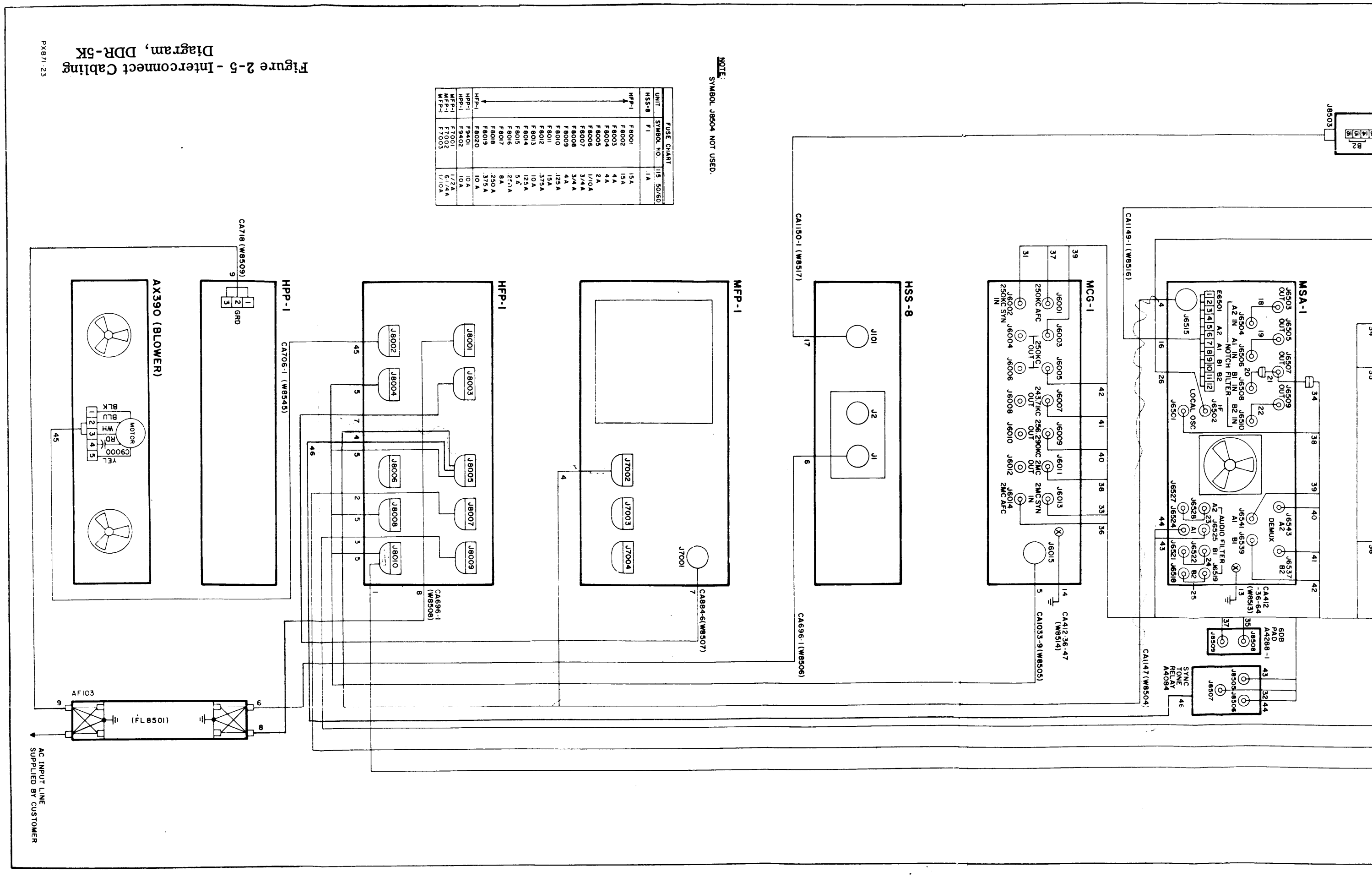


Figure 2-4. Antenna, AGC, and Audio Loads, Connection Diagram



NOTE: SYMBOL J8504 NOT USED.

	FUSE CHART		
UNIT	SYMBOL NO.	115	50/60
HSS-8	F1	1A	
HFP-1	F8001	15A	
	F8002	15A	
	F8003	4A	
	F8004	4A	
	F8005	2A	
	F8006	1/10A	
	F8007	3/4A	
	F8008	3/4A	
	F8009	4A	
	F8010	125A	
	F8011	15A	
	F8012	375A	
	F8013	10A	
	F8014	125A	
	F8015	5A	
	F8016	2.5A	
	F8017	8A	
	F8018	250A	
	F8019	375A	
HFP-1	F8020	10A	
HPP-1	F9401	10A	
HPP-1	F9402	10A	
MFP-1	F7001	6/7A	
MFP-1	F7002	6/7A	
MFP-1	F7003	1/10A	

Figure 2-5 - Interconnect Cabling Diagram, DDR-5K

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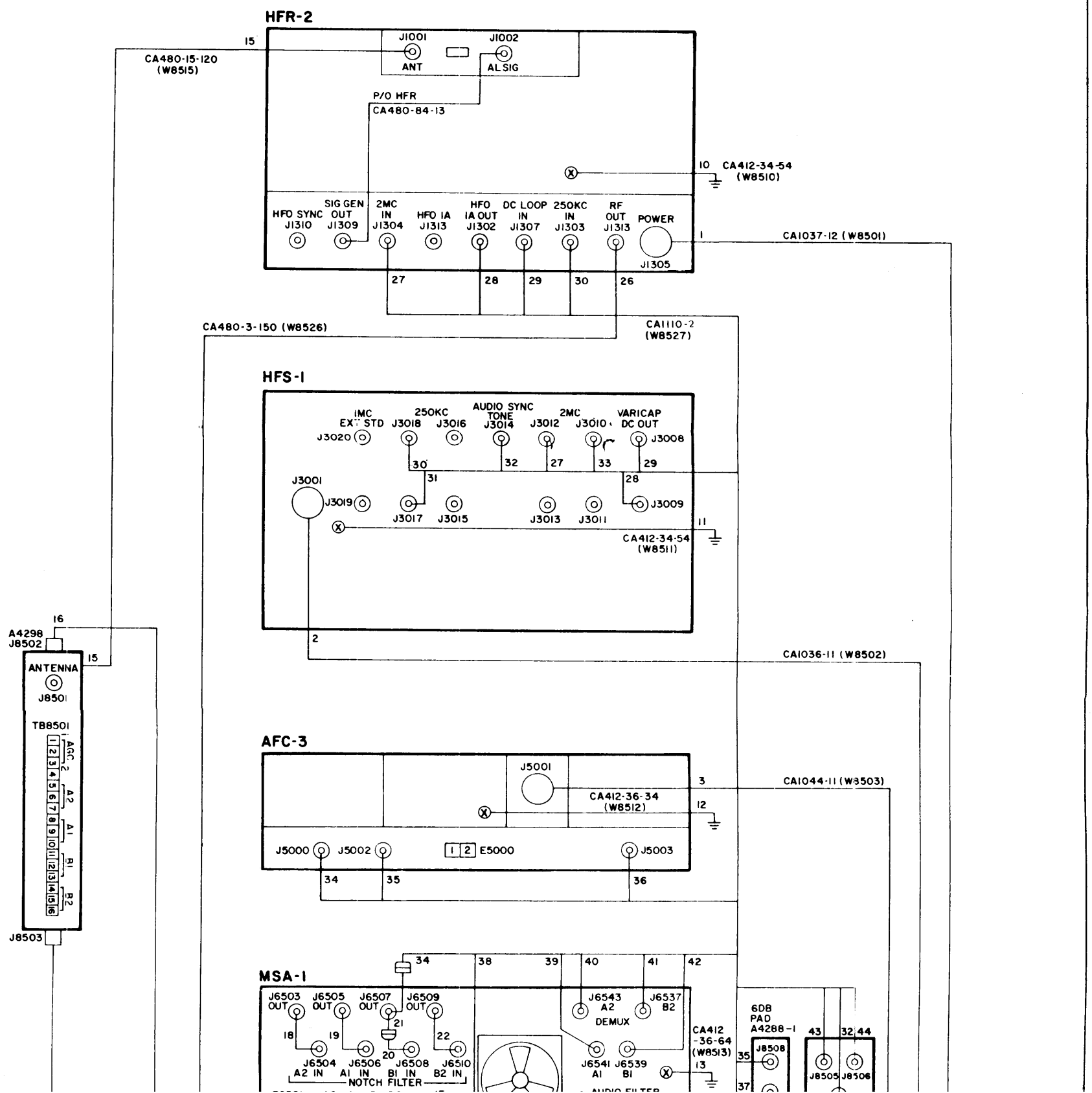
MAMARONECK, NEW YORK

MODEL DDR-5K CK1007



SECTION 3

OPERATOR'S SECTION

3-1. TUNING CAPABILITIES OF DDR-5K.

A review of paragraph 4-2 and figure 4-1 will familiarize the operator with the functioning of modular components and the resulting capabilities of the DDR-5K.

The receiver is capable of receiving up to 4 discrete voice channels symmetrical about one carrier and contained in the two sidebands of an ISB transmission. Each channel is 3-kc wide and may contain any form of audio intelligence: voice, code, teletype, etc. In two-channel ISB reception, the intelligence will appear at the direct channel outputs, A1 and B1. In four-channel multiplexed ISB, in addition to A1 and B1, the translated channels will appear at A2 and B2 outputs.

Although the primary design of this receiver is for use with SSB or ISB (4 channel) reception, it is possible to copy other signals such as AME, CW, MCW, FSK and FAX with attendant degradation of the inherent stability of the receiver. FSK or FAX reception is best accomplished on a transmission system using this receiver by the use of audio frequency tones placed in any one of the 4 channels in order that the correct audio output can be provided to the end terminal equipment.

In all SSB and ISB transmissions with a partial carrier (suppressed no lower than 30 db below PEP) and in all AME or MCW transmissions, the carrier component in the signal may be used in Automatic Frequency Control AFC to compensate for transmitted-signal drift. In SSB and ISB transmissions with no carrier component present, the AFC cannot be used. When receiving signals from a synthesized transmitter, the incoming signal remains stable enough that the AFC is not required. For simplicity, the operating instructions in Table 3-1 are in terms of receiving a 4-channel multiplexed ISB signal with and without the AFC. Following the table are notes on tuning in other types of signals.

3-2. OPERATING PROCEDURE.

a. GENERAL. - The DDR-5K is primarily designed for reception of SSB or ISB (4-channel) signals (paragraph 3-1). Accordingly, the tuning procedures given in this section are limited to 4-channel and 2-channel ISB (SSB) reception. Tuning procedures for other types of signal reception can be determined through a combined study of the principles of operation (Section 4) and the procedures outlined in this section.

b. STARTING. - Proceed as follows:

(1) Set all modular-unit power switches at OFF or STANDBY.

(2) Set MAIN POWER switch on rear of Power Supply HFP at STANDBY; the STANDBY lamp of HFP should light. Allow 24-hour warm-up period before proceeding to step 3.

NOTE

The DDR-5K is operational immediately after initial starting; however, to insure the specified stability (refer to paragraph 1-3), an initial warm-up period of 24 hours is required for oven-oscillator circuits contained in the receiver.

(3) After warm-up period is completed, set POWER switch of MSA at ON; STANDBY lamp of HFP will light. After 60 seconds, OPERATE lamps of MFP and HFP will light.

c. TUNING FOR 4-CHANNEL ISB. - Table 3-1 outlines the procedure for tuning the DDR-5K for 4-channel multiplexed ISB reception. Locations of the modular units are shown in figure 1-1.

TABLE 3-1. TUNING FOR 4-CHANNEL ISB

STEP	OPERATION
1	Start DDR-5K as outlined in paragraph 3-2b.
2	Set NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch of HFR at OFF. Set SYN/AFC/INT switch of MCG at SYN. Set all AGC DECAY controls (A1, A2, B1 and B2) of MSA fully counterclockwise. Set INCR control of HSS at mid position.
3	On AFC, set controls as indicated below.

CONTROL	POSITION
TUNING/KCS	0
CARRIER SELECTOR	OSC
SENSITIVITY	Fully counter-clockwise.

TABLE 3-1. TUNING FOR 4-CHANNEL ISB (CONT)

STEP	OPERATION
4	Rotate MC, 100 KC, 10 KC, 1 KC and .1 KC switches of HFS to desired operating frequency as indicated on nixie indicators.
5	On HFR, proceed as follows: a. Set TUNE/SYNC/OPERATE switch at SYNC. b. Using BAND and TUNE controls, tune HFR to operating frequency; SYNC indicator lamp should light. c. Set TUNE/SYNC/OPERATE switch at OPERATE. d. Adjust TUNE control for zero center-scale indication on SYNCHRONIZE meter. e. Tighten LOCK control.
6	Using Bridging Speaker HSS, monitor four channels (A1, A2, B1 and B2); simultaneously adjust AGC DECAY control on MSA for minimum variation in audio output signal.
7	When using the AFC in reduced carrier reception, proceed as outlined below; if not using the AFC, proceed to step 8. a. Set SYN/AFC/INT switch of MCG at AFC. b. Set AFC controls as listed below.

CONTROL	POSITION
TUNING/KCS	0
CARRIER/SELECTOR	OSC
SENSITIVITY	Fully counter-clockwise

c. On AFC, depress RESET button and adjust TUNING/KCS control as required to obtain peak indication on CARRIER LEVEL meter. Release RESET button.
d. It is necessary to insure that the carrier itself (rather than one of the tones contained within the sideband intelligence) has been locked into the carrier filter circuit of the AFC; a recommended

TABLE 3-1. TUNING FOR 4-CHANNEL ISB (CONT)

STEP	OPERATION
7 (cont)	procedure is as follows:*

a. Monitor channel A1.
b. Tune from the high side of the signal towards the carrier until the intelligence or tones in channel A1 sound normal. Then observe the carrier level meter which should remain fairly stable when the AFC has been correctly tuned.

CAUTION

If there is a VFTG channel adjacent to the carrier on a steady mark or a steady space condition, it is possible to lock the AFC on this tone erroneously. However, audio monitoring of other channels will assist in determining correct tuning.

8	Using CHANNEL SELECTOR switch of HSS, monitor all 4 channels. If impulse noise is present on any channel, try to eliminate noise by setting NOISE SILENCER/ OFF/ALIGNMENT switch of HFR at NOISE SILENCER.
9	Under no-signal input conditions for each channel, adjust SQUELCH ADJUST control of MSA to point where background noise disappears. Signal activity will then disable the squelch circuit and allow normal channel output.
10	Readjust LINE LEVEL control of MSA to obtain 0 VU indication on associated channel output meter.

*Tuning an ISB signal for AFC operations requires a minimum of operator experience.

d. TUNING FOR 2-CHANNEL ISB AND SSB. - Follow the same procedure as that in table 3-1. Outputs will appear on chanels A1 (for the upper sideband) and B1 (for the lower sideband) instead of A1, A2, B1 and B2.

e. PLACING RECEIVER IN STANDBY. - After operating the DDR-5K, the receiver may be set in standby condition. Set the POWER switch of Multiple Sideband Adapter MSA and the MAIN POWER switch of Power Supply HFP to their STANDBY positions. In this condition, the receiver draws line voltage current for its oscillator oven heating elements only, thus stabilizing the HFR, AFC and MCG oscillator frequencies.

SECTION 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

This section describes the major functions of modular components as they are employed in the DDR-5K system. For a more detailed analysis of each module, refer to the individual modular-unit manuals.

4-2. FUNCTIONAL ANALYSIS.

a. GENERAL. - The DDR-5K is capable of synthesized or non-synthesized operation in the reception of SSB, ISB (4-channel), AME, CW, MCW, FSK, and FAX. With the exception of an hfo correction loop between Continuous RF Tuner HFR and Control Synthesizer and Standard HFS, synthesized and non-synthesized operation are similar; therefore only synthesized operation is discussed in the following paragraphs. Further, since SSB and ISB are the primary modes of reception, circuit analysis given in the following paragraphs is limited to these modes; circuit analysis for other modes of reception can be easily derived through a study of the material contained in this section coupled with the information contained in the modular-unit manuals.

b. RF AMPLIFICATION AND FIRST CONVERSION. - R-f signals (consisting of partial or suppressed carrier and sideband intelligence) are applied to Continuous RF Tuner HFR. Within the HFR a selected frequency

in the 2- to 32-mc range undergoes four stages of amplification and is mixed with a 3.75- to 33.75-mc output signal of the high-frequency oscillator (hfo) to produce a first i-f of 1.75 mc. Noise silencer stages employed in the HFR eliminate impulse noise from the 1.75 mc output signal. The sideband-frequency spectrum of the 1.75 mc HFR output signal is inverted; this inverted i-f signal is applied to Multiple Sideband Adapter MSA.

A sample of the hfo output signal from Continuous RF Tuner HFR is applied to synthesizer and crystal oscillator circuits in Control Synthesizer and Standard HFS where it is converted to a 4.25- to 3.25-mc signal. This 4.25- to 3.25-mc signal contains the error, if any, of the hfo circuit contained in Continuous RF Tuner HFR. Depending upon the setting of front-panel controls, Control Synthesizer and Standard HFS develops a 4.25- to 3.25-mc standard signal. A phase detector circuit in the HFS compares the two nominally identical signals and developes a d-c voltage that is used to correct the hfo circuit of Continuous RF Tuner HFR.

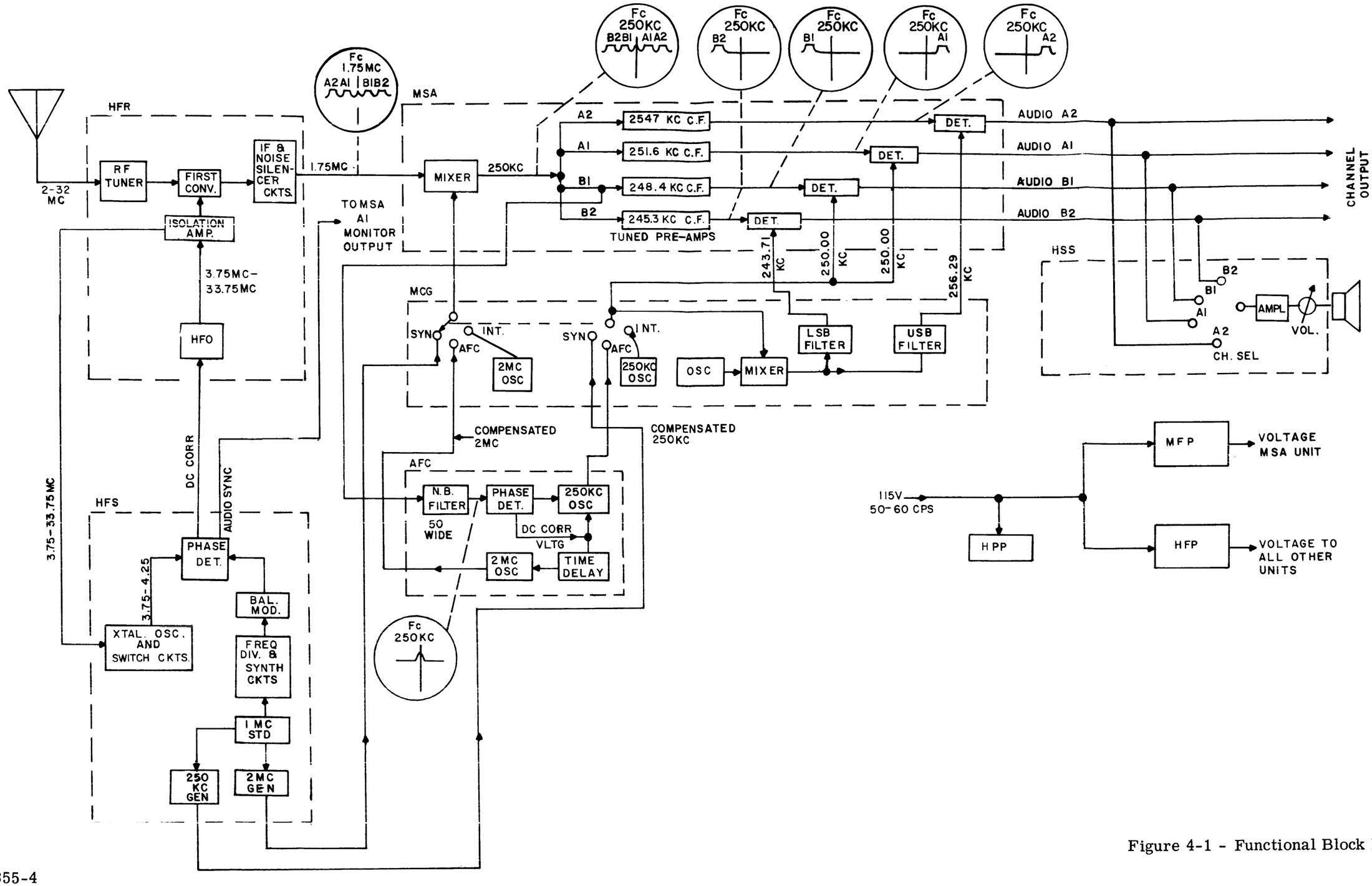
c. SECOND CONVERSION, DETECTION, AND AUDIO AMPLIFICATION. - The 1.75 mc i-f signals applied to Multiple Sideband Adapter MSA are beat with a 2-mc injection signal that is obtained from Control Synthesizer and Standard HFS, from Automatic Frequency Control AFC, or from Mux Carrier Generator MCG. The resultant, a highly-stable i-f of 250 kc (with sideband-frequency spectrum re-inverted to its original position) is applied simultaneously to four tuned i-f pre-amplifier stages. The output circuits of these pre-amplifier stages are tuned so that the 250-kc composite

i-f input signal is divided into its four separate intelligence channels (A1, A2, B1, and B2). The resultant narrow band i-f signals are each amplified and applied to associated product detectors. Non-translated channel (A1 and B1) signals are mixed with a 250-kc injection frequency from Mux Carrier Generator MCG, from Automatic Frequency Control AFC, or from Control Synthesizer and Standard HFS. Translated-channel (A2 and B2) signals are mixed with carrier injection frequencies (243.71 kc and 256.29 kc) from Mux Carrier Generator MCG. The resultant audio output signals from the MSA product detectors undergo three stages of amplification and are then applied, by means of a front-panel selector switch, to Bridging Speaker Amplifier HSS.

When used, Automatic Frequency Control AFC compares the reduced 250-kc carrier component of the signal applied to the MSA tuned pre-amplifier stages and the output of its own 250-kc oscillator. Any frequency difference between the two nominally identical signals causes a d-c correction voltage to be developed in the AFC detector stages; this d-c voltage tunes the 250-kc oscillator contained in the AFC. The corrected output signal of the local 250-kc oscillator is used in the detector stages of the MSA to compensate for any frequency error in the received signal. The detector output of the MSA, therefore, is a faithful reproduction of the original audio intelligence.

AGC voltages for each channel are developed in Multiple Sideband Adapter MSA so that level variations in one channel will have minimal

effect on the other three channels. Also, each channel has its own squelch circuit that disables the audio amplifier of that particular channel during no-traffic periods. An AGC comparator circuit in the MSA supplies an AGC signal that is proportional to the highest individual channel envelope level. This signal is applied to the r-f amplifier and i-f stages of Continuous RF Tuner HFR and to terminal board 8501 of the DDR-5K for possible use in a larger receiving system.



355-4

Figure 4-1 - Functional Block Diagram

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

a. GENERAL. - The DDR-5K 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 and mechanical parts, optimum performance and service life of the DDR-5 are dependent upon an adequate preventive maintenence schedule that is strictly adhered to.

b. CLEANING AND INSPECTION. - At periodic intervals (at least every six months) 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; in particular, the tube sockets should be carefully inspected for deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichloroethylene. Remove dirt or grease from other parts with any good dry cleaning fluid.

WARNING

When using trichloroethylene, make certain that adequate ventilation exists. Avoid prolonged contact with skin.

Carefully inspect equipment for loose solder connections or screws, especially those on solder lugs. Tighten and resolder connections as required.

c. REPLACEMENT OF ELECTRON TUBES. - While the modular units are out of the cabinet for periodic inspection, all electron tubes should be checked and replaced as required. Particular attention should be paid to the following:

(1) When withdrawing miniature tubes from their sockets, pull them straight out; do not rock or turn them. If pins of miniature tubes are bent, straighten them with a proper pin straightener before replacing the tube.

(2) Some circuits, for example oscillator circuits, may function better with one tube than with another even though both tubes are new or both tubes measure the same when checked on a tube tester.

(3) Tubes should not be replaced or discarded merely because they have been used for some time. Satisfactory operation in a circuit is the final proof of tube quality; the tube in use may work better than a new tube.

d. GEAR LUBRICATION. - Examine all gears and gear assemblies contained in the modular units. If any of the gears show signs of becoming dry, coat them heavily with a molybdenum disulphide compound such as Molykote Type G made by the Alpha Corporation of Greenwich, Conn.

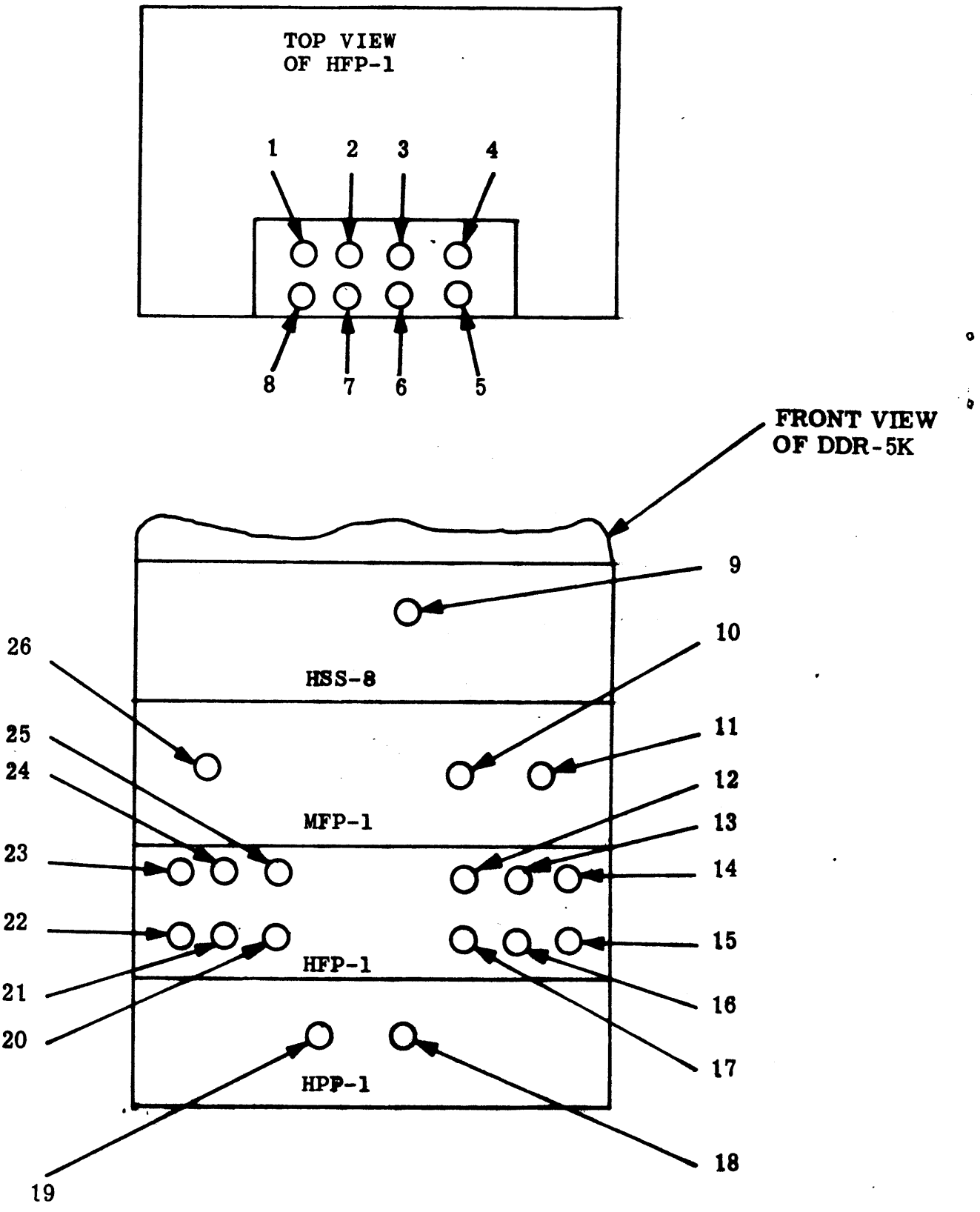
5-2. TROUBLESHOOTING.

a. GENERAL. - In addition to the test procedures outlined in paragraph 5-2b through 5-2_, the block diagram (figure 4-1) and the tuning procedure outlined in table 3-1 will serve as an aid in localizing troubles. Any indicator that fails to respond in the procedure outlined in table 3-1 will usually reveal that faulty unit. Additional troubleshooting hints are given in table 5-1. In the case of a repeatedly blown fuse, refer to figure 5-1 and table 5-2 for fuse versus circuit.

For tracing wiring, refer to rack inter-module wiring (figure 2-5) and technical manuals for the individual modules.

TABLE 5-1. FAULTY UNIT LOCATION

TROUBLE	UNIT
No power in receiver system	Line Filter AF-103 or HFP
Fuse cap lit in MFP or HFP (indicates blown fuse)	See table 5-2 for fuse vs. unit
No audio sync tone available	MSA Channel A1 audio section, SYNC TONE relay, or HFS phase detector
No sync indication on HFR SYNC IND light or SYNCRHONIZE meter	HFS or high-frequency oscillator in HFR.
Not possible to lock AFC onto carrier	HFS or AFC
No audio output	MSA or AFC
No audio output in channels A2 and B2	MCG



355-5 Figure 5-1. DDR-5K Fuse Locations

TABLE 5-2. FUSE FUNCTIONS, DDR-5K

ITEM NO. (figure 5-1)	REFERENCE SYMBOL	FUSE RATING	CIRCUIT PROTECTED
1	F8003	4A/115V	Line voltage to oscillator ovens in HFR,MCG,HFS and AFC.
2	F8007	3/4A	Input to "A" B+ regulator circuit in HFP.
3	F8008	3/4A	Input to "B" B+ regulator circuit in HFP.
4	F8001	15A/115V	Main line voltage input to HFP and MSA Blower.
5	F8002	15A/115V	Main line voltage input to HFP and MSA Blower.
6	F8006	1/10A	Input to bias supply circuit in HFP.
7	F8005	2A/115V	Utility line to J8004 in HFP.
8	F8004	4A/115V	Line voltage to oscillator ovens in HFR,MCG,HFS and AFC.
9	F1	.1A/115V	Main line voltage input to HSS.
10	F7001	1/2A	Output of B+ regulator circuit in MFP.
11	F7003	1/10A	Input to bias supply circuit in MFP.
12	F8016	.250A	"B" B+ to MCG.
13	F8014	.125A	"B" B+ (no connection).
14	F8018	.250A	"B" B+ (no connection).
15	F8017	8A	Filament supply (no connection).
16	F8013	10A	Filament supply to MCG.
17	F8020	10A	Filament supply to MSA.
18	F9402	10A/115V	HPP UTILITY OUTLET.

TABLE 5-2. FUSE FUNCTIONS, DDR-5K (CONT)

ITEM NO. (figure 5-1)	REFERENCE SYMBOL	FUSE RATING	CIRCUIT PROTECTED
19	F9401	10A/115V	HPP UTILITY OUTLET.
20	F8011	15A	Filament supply to HFS and HFR.
21	F8015	5A	Filament supply to AFC.
22	F8009	4A	Filament supply (no connection).
23	F8019	.375A	"A" B+ to Audio Sync Tone Relay and to MSA.
24	F8012	.375A	"A" B+ to HFS and HFR.
25	F8010	.125A	"B" B+ (no connection).
26	F7002	6.25A/115V	Main line voltage input to MFP.

b. TEST EQUIPMENT REQUIRED. - Table 5-3 lists the test equipment required to test the DDR-5K.

TABLE 5-3. TEST EQUIPMENT REQUIRED

QTY	ITEM	MANUFACTURER OR MODEL
1	Frequency Counter	Hewlett Packard, Model 524 or equivalent
1	Signal Generator	Hewlett Packard, Model 606 or equivalent
1	AC-VTVM	Ballantine, Model 314 or equivalent
1	VOM	Simpson, Model 260 or equivalent

c. POWER CHECK. - Proceed as follows:

(1) Start DDR-5K as outlined in paragraph 3-2b; initial warm-up period of 24 hours is not necessary for this test.

(2) Loosen screws securing front panel of Power Supply HFP to rack and pull HFP out of cabinet. Using VOM, measure d-c voltage at test points TP8001 and TP8002. Indication on VOM should be 200 vdc exactly; if necessary, adjust appropriate HFP potentiometers (VOLTAGE ADJUST A or VOLTAGE ADJUST B) to obtain correct indication.

(3) Push HFP into cabinet and secure front panel to rack.

(4) Loosen screws securing front panel of Multiple Sideband Adapter MSA to rack and pull MSA out of cabinet.

(5) Using VOM, measure B+ voltage in MSA; indication on VOM should be 200 vdc. If necessary, pull Power Supply MFP out of the cabinet and adjust R7007 as required to obtain correct indication.

(6) Push all units into cabinet and secure front panels to equipment rack.

d. TEST PROCEDURE FOR SYNTHESIZER AND HIGH-FREQUENCY OSCILLATOR CIRCUITS. - Proceed as follows:

(1) Remove termination from J1313 of Continuous RF Tuner HFR and connect frequency counter to J1313. Start DDR-5K as outlined in paragraph 3-2b.

(2) Set TUNE/SYNC/OPERATE switch of HFR at SYNC. Tune Control Synthesizer and Standard HFS and Continuous RF Tuner

HFR to 2.0000 mcs. SYNC IND lamp may flicker during this operation.

(3) Set TUNE/SYNC/OPERATE switch at OPERATE; SYNC IND lamp should light. Adjust TUNE control of HFR until SYNCHRONIZE meter indicates zero center scale; indication on frequency counter should be 3.75 mcs.

(4) Using procedure outlined in steps (2) and (3) above, check 100-KC selector stage of HFS and the high-frequency oscillator of HFR by tuning to frequencies indicated in table 5-4 and checking indications on frequency counter.

TABLE 5-4. TEST FREQUENCIES FOR 100-KC SELECTOR STAGE OF HFS AND HFO CIRCUIT OF HFR

FREQUENCY SETTING (HFS and HFR)	INDICATION ON FREQUENCY COUNTER
2.1 mc	3.85 mc
2.2 mc	3.95 mc
2.3 mc	4.05 mc
2.4 mc	4.15 mc
2.5 mc	4.25 mc
2.6 mc	4.35 mc
2.7 mc	4.45 mc
2.8 mc	4.55 mc
2.9 mc	4.65 mc

NOTE

In the above tests, a tolerance of ± 1 count on the counter readings is expected.

(5) Using procedure outlined in steps (2) and (3), check 10-KC selector stage of HFS and the high-frequency oscillator of HFR by tuning to frequencies indicated in table 5-5 and checking indications on frequency counter.

TABLE 5-5. TEST FREQUENCIES FOR 10-KC SELECTOR STAGE OF HFS AND HFO CIRCUIT OF HFR

FREQUENCY SETTING (HFS and HFR)	INDICATION ON FREQUENCY COUNTER
2.91	4.66
2.92	4.67
2.93	4.68
2.94	4.69
2.95	4.70
2.96	4.71
2.97	4.72
2.98	4.73
2.99	4.74

NOTE

In the above tests, a tolerance of +1 count on the counter readings is expected.

(6) Using procedure outlined in steps (2) and (3), check 1-KC selector stage of HFS and the high-frequency oscillator of HFR by tuning to frequencies indicated in table 5-6 and checking indications on frequency counter.

TABLE 5-6. TEST FREQUENCIES FOR 1-KC SELECTOR STAGE OF HFS AND HFO CIRCUIT OF HFR

FREQUENCY SETTING (HFS and HFR)	INDICATION ON FREQUENCY COUNTER
2.991	4.741
2.992	4.742
2.993	4.743
2.994	4.744
2.995	4.745
2.996	4.746
2.997	4.747
2.998	4.748
2.999	4.749

NOTE

In the above tests, a tolerance of ± 1 count on the counter readings is expected.

(7) Using procedure outlined in steps (2) and (3), check .1-KC selector stage of HFS and the high-frequency oscillator of HFR by tuning to frequencies indicated in table 5-7 and checking indications on frequency counter.

TABLE 5-7. TEST FREQUENCIES FOR .1-KC SELECTOR STAGE OF HFS AND HFO CIRCUIT OF HFR

FREQUENCY SETTING (HFS and HFR)	INDICATION ON FREQUENCY COUNTER
2.9991	4.7491
2.9992	4.7492
2.9993	4.7493
2.9994	4.7494
2.9995	4.7495
2.9996	4.7496
2.9997	4.7497
2.9998	4.7498
2.9999	4.7499

NOTE

In the above tests, a tolerance of ± 1 count on the counter readings is expected.

(8) Using procedure outlined in steps (2) and (3), check MC selector stage of HFS and high-frequency oscillator circuit of HFR at high and low ends of each band by tuning to frequencies in table 5-8 and checking indications on frequency counter.

TABLE 5-8. TEST FREQUENCIES FOR MC SELECTOR STAGE OF HFS AND HFO CIRCUIT OF HFR

BAND CONTROL SETTING (HFR)	FREQUENCY SETTING (HFS and HFR)	INDICATION ON FREQUENCY COUNTER
1	3 mcs	4.75 mcs
2	3 mcs	4.75 mcs
2	4 mcs	5.75 mcs
3	4 mcs	5.75 mcs
3	5 mcs	6.75 mcs
3	6 mcs	7.75 mcs
4	6 mcs	7.75 mcs
4	7 mcs	8.75 mcs
4	8 mcs	9.75 mcs
5	8 mcs	9.75 mcs
5	9 mcs	10.75 mcs
5	10 mcs	11.75 mcs
5	11 mcs	12.75 mcs
5	12 mcs	13.75 mcs
6	12 mcs	13.75 mcs
6	13 mcs	14.75 mcs
6	14 mcs	15.75 mcs
6	15 mcs	16.75 mcs
6	16 mcs	17.75 mcs

TABLE 5-8. TEST FREQUENCIES FOR MC SELECTOR STAGE OF HFS AND HFO CIRCUIT OF HFR (CONT)

BAND CONTROL SETTING (HFR)	FREQUENCY SETTING (HFS and HFR)	INDICATION ON FREQUENCY COUNTER
7	16 mcs	17.75 mcs
7	17 mcs	18.75 mcs
7	18 mcs	19.75 mcs
7	19 mcs	20.75 mcs
7	20 mcs	21.75 mcs
7	21 mcs	22.75 mcs
7	22 mcs	23.75 mcs
7	23 mcs	24.75 mcs
7	24 mcs	25.75 mcs
8	24 mcs	25.75 mcs
8	25 mcs	26.75 mcs
8	26 mcs	27.75 mcs
8	27 mcs	28.75 mcs
8	28 mcs	29.75 mcs
8	29 mcs	30.75 mcs
8	30 mcs	31.75 mcs
8	31 mcs	32.75 mcs

(9) Using procedure outlined in steps (2) and (3), test selector stage of HFS and high-frequency oscillator circuit of HFR at 31.999 mcs. Indication on frequency counter should be 33.7499 mcs.

(10) Remove frequency counter from J1313 of HFR and replace 50-ohm termination.

e. TEST PROCEDURE FOR AUTOMATIC FREQUENCY CONTROL AFC. - Proceed as follows:

(1) Start DDR-5K as outlined in paragraph 3-2b.

(2) Synchronize DDR-5K at 2.0000 mcs (if necessary, refer to table 3-1, steps (4) and (5)). Ensure that NOISE SILENCER/OFF/ ALIGNMENT SIGNAL switch is set at ALIGNMENT SIGNAL.

(3) On Mux Carrier Generator MCG, set INT/AFC/SYNTH switch at AFC.

(4) On Automatic Frequency Control AFC, depress red RESET button; at the same time, carefully adjust TUNING KCS control until conditions listed below are obtained. When proper conditions are obtained, release RESET button. Conditions noted should remain, and indication on DRIFT meter should be steady at 0 center scale.

(a) Maximum green-scale indication is obtained on CARRIER LEVEL meter.

(b) FADE lamp and DRIFT ALARM lamp go off.

(c) DRIFT meter indicates 0 center scale.

(5) On AFC, set CARRIER SELECTOR switch at RCC. Indications noted in step (4) should not change. Set CARRIER SELECTOR switch at OSC.

(6) On HFR, set NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch at OFF; following conditions should be noted on AFC.

(a) Indicator on CARRIER LEVEL meter should deflect.

(b) FADE lamp should light.

(7) Return NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch of HFR to ALIGNMENT SIGNAL; conditions noted in step (4) should be restored without adjustment of controls.

(8) On AFC, rotate SENSITIVITY control fully counter-clockwise; FADE lamp should light, and indicator of CARRIER LEVEL meter should deflect. After approximately one minute, rotate SENSITIVITY control fully clockwise; conditions noted in step (4) should be restored without readjustment of controls.

f. TEST PROCEDURES FOR MULTIPLE SIDEBAND ADAPTER MSA, MUX CARRIER GENERATOR MCG, AND BRIDGING SPEAKER AMPLIFIER, HSS. - Proceed as follows:

(1) Start DDR-5K as outlined in paragraph 3-2b.

(2) Synchronize DDR-5K at 2.0000 mcs (if necessary, refer to table 3-1, steps (4) and (5)). Insure that NOISE SILENCER/OFF/ ALIGNMENT SIGNAL switch on Continuous RF Tuner HFR is set at ALIGNMENT SIGNAL.

(3) On Multiple Sideband Adapter MSA, set all SQUELCH ADJUST controls fully counter-clockwise.

(4) On Mux Carrier Generator MCG, set INT/AFC/SYNTH at AFC.

(5) On Automatic Frequency Control AFC, depress red RESET button, and set TUNING KCS control at +3KC; indication should be obtained on CHANNEL B_2 LINE LEVEL meter.

(6) On MSA, proceed as follows:

(a) Rotate CHANNEL B_2 LINE LEVEL control as required to obtain 0 VU indication on CHANNEL B_2 LINE LEVEL meter.

(b) Rotate CHANNEL B_2 SQUELCH ADJUST control slowly clockwise until CHANNEL B_2 lamp goes off (Channel B_2 is de-activated).

(c) Slowly rotate CHANNEL B_2 SQUELCH ADJUST control until CHANNEL B_2 lamp lights.

(7) On AFC, set TUNING KCS control between +3KC and 0 (at

approximately +1. 5KC position); indication should be obtained on CHANNEL B_1 LINE LEVEL meter. Repeat procedure outlined in step (6).

(8) On AFC, set TUNING KCS control between 0 and -3KC (approximately -1. 5KC position); indication should be obtained on CHANNEL A_1 LINE LEVEL meter. Repeat procedure outlined in step (6).

(9) On AFC, set TUNING KCS control at -3KC; indication should be obtained on CHANNEL B_2 LINE LEVEL meter. Repeat procedure outlined in step (6).

(10) Rotate TUNING KCS control slowly from -3KC to +3KC; CHANNELS A_1, B_1, and B_2 should activate in turn to the exclusion of other channels. Leave TUNING KCS control set at +3KC with Channel B_2 activated.

(11) Plug headphones into MONITOR jack of MSA and rotate MONITOR LEVEL control fully clockwise. Tone should be heard when MONITOR SELECT switch is set at B_2.

(12) Slowly rotate TUNING KCS control of AFC counter-clockwise towards -3KC. As CHANNELS B_1, A_1, and A_2 activate, set MONITOR SELECT switch of MSA at appropriate position; tone should be heard in headphones.

(13) Using procedures outlined in steps (11) and (12), check Bridging Speaker Amplifier HSS for each channel (A_1, A_2, B_1 and B_2); audible tone should be heard on loudspeaker.

g. SENSITIVITY CHECK. - Proceed as follows:

(1) Start DDR-5K as outlined in paragraph 3-2b.

(2) Synchronize DDR-5K at 2.5 mcs. Insure that TUNE/SYNC/OPERATE switch of Continuous Tuner HFR is set at OPERATE; set NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch at OFF.

(3) Connect r-f signal generator to ANT jack J101 of HFR through 20db, 50-ohm attenuator pad.

(4) Tune signal generator to 2.501 mcs, 10 microvolts, unmodulated signal.

(5) Set CHANNEL A_1 SQUELCH ADJUST control of Multiple Sideband Adapter MSA fully counter-clockwise. All other squelch adjust controls on MSA should be set fully clockwise.

(6) Connect low-voltage (0-12 vdc) variable d-c power supply to pin 5 of J6513 in MSA.

(7) Connect 600-ohm resistor and AC-VTVM to terminals 8 and 10 (Channel A_1 audio output) of terminal board TB8501.

(8) Adjust variable d-c voltage supply until AC-VTVM indicates 2.45 vac.

(9) Disconnect r-f signal generator; indication on AC-VTVM should decrease to .08 vac or lower.

(10) Repeat the above steps with the DDR-5K tuned to 3.5, 5, 7, 10, 14, 20 and 28 mcs; in each case, signal generator should be

tuned 1 kc higher than receiver.

(11) Disconnect all test equipment and restore receiver to service.