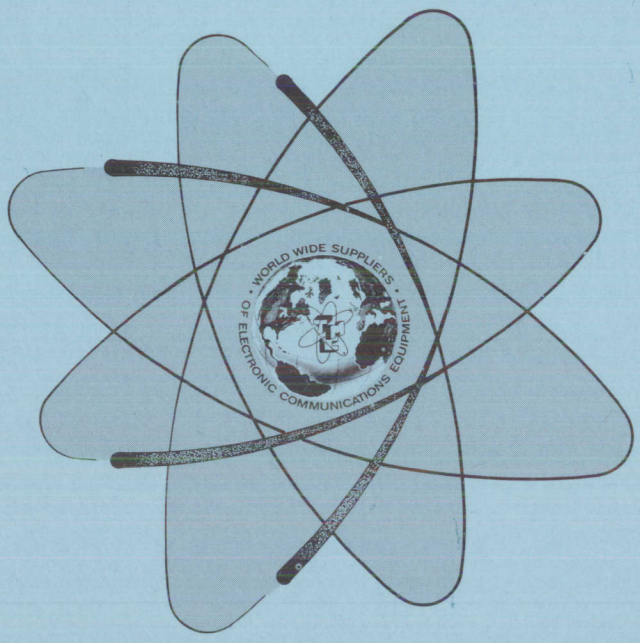
TECHNICAL MANUAL
for

AUTOMATED HIGH FREQUENCY TRANSMITTER

MODEL HFTA-1KJ2



THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

Printed in U.S.A.

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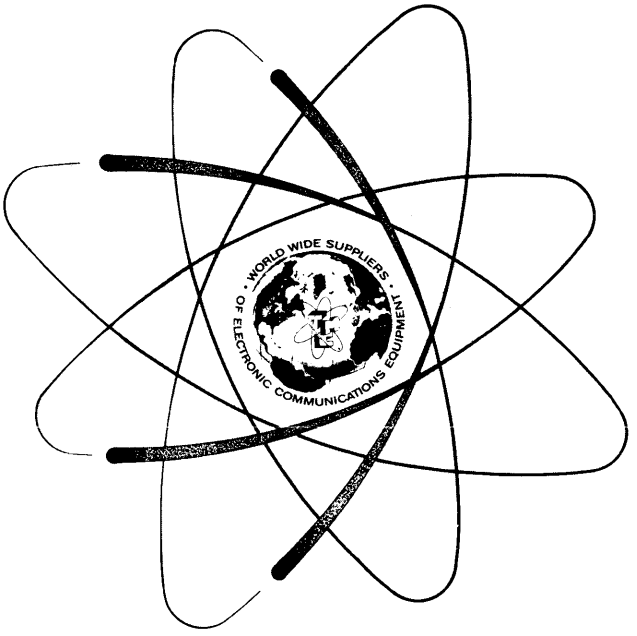

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THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

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 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

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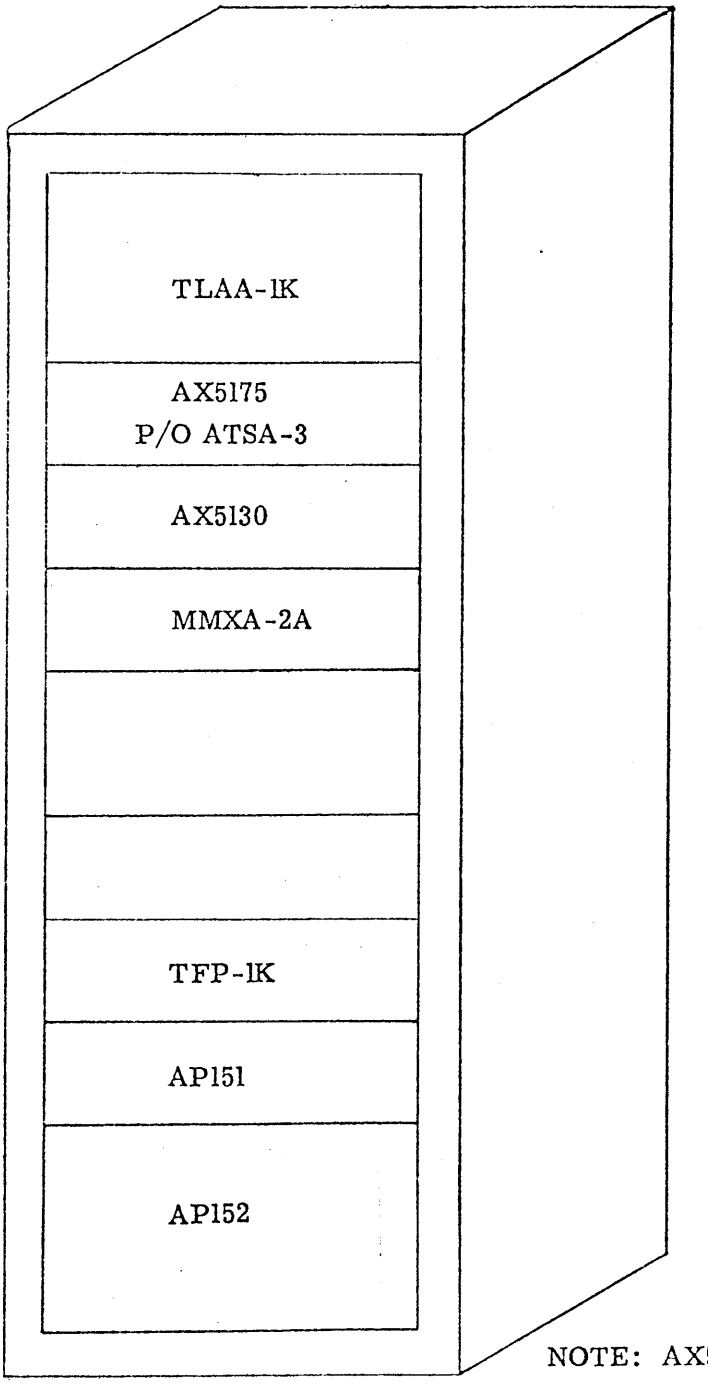

NOTE: AX5176 (P/O ATSA-3) mounted at base of antenna.

Figure 1-1. Automated High Frequency Transmitter, Model HFTA-1KJ2

SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

The HFTA-1KJ2 shown in figure 1-1, is a high frequency, automated transmitter. The HFTA-1KJ2 hereinafter referred to as the transmitter, consists of a solid state, multi-mode, exciter MMX(A)-2A, used in conjunction with a high frequency linear power amplifier HFLA-1K, a switchable harmonic filter TFP-1K, and an automatic antenna tuner ATSA-3. The exciter is capable of providing CW (carrier wave), AM (amplitude modulation), SSB (single sideband) including AME (amplitude modulation equivalent), and FSK (frequency shift keying) modes of operation. The linear power amplifier amplifies the exciter output to provide 1 kilowatt peak envelope power or average power throughout the frequency range of 2.0 to 30 MHz. Power output of the linear amplifier is routed through an automatically switched filter for harmonic content of the transmitter signal. The harmonically suppressed output signal is applied to the ATSA-3 Antenna Tuning Unit, which operates automatically to match the impedance of a 35 foot whip antenna to the impedance of a 50 ohm transmission line, at any frequency in the 2.0 to 30 MHz frequency range.

Table 1-1 lists the transmitter components supplied.

TABLE 1-1. MAJOR TRANSMITTER COMPONENTS

NOMENCLATURE	COMMON NAME
MMX(A)-2A	Multi-Mode Exciter
HFLA-1K	Linear Power Amplifier
TFP-1K	Switchable Harmonic Filter
ATSA-3	Antenna Tuning Control Unit (AX5175) (Antenna Tuning Unit (AX5176) located external to transmitter)

1-2. PHYSICAL DESCRIPTION

As shown in figure 1-1, the transmitter consists of a single equipment rack, which houses all of the transmitter components. The HFLA-1K portion of the transmitter consists of four individual units: (1) TLAA-1K, a three stage linear power amplifier, (2) AP-151, a low voltage and bias supply, (3) AP-152, a high voltage power supply, and (4) AX5130, a unit which contains all of the control and sensing circuitry for automatic tuning of the transmitter.

Primary power and external connections to the transmitter are made to interface panels in the bottom rear and side of the equipment rack, RF output power is routed from the directional coupler, located in the harmonic filter, to the external antenna tuning unit, (AX5176). The antenna connection is made at the output of the antenna tuning unit.

1-3. REFERENCE DATA

Table 1-2 lists the technical characteristics of the HFTA-1KJ2 transmitter. Table 1-3 lists the power tube complement of the transmitter; all power tubes are located in the TLAA-1K unit of the HFLA-1K Linear Power Amplifier.

TABLE 1-2. TECHNICAL SPECIFICATIONS

Frequency Range:	2.0 to 30 MHz standard.
Stability and Frequency Control:	Within 1 part in 10^8; higher stability may be achieved with the use of an external standard.
Operating Modes:	CW, AM, USB, AME, and FSK.
Sideband Response:	$\pm$ 1.5db from 350 to 2400 Hz.
Power Output:	1000 watts average or PEP; continuous key down service.
Output Impedance:	50 ohms, unbalanced.
VSWR:	Maximum of 2:1 without degrading performance.
ALDC:	Automatic Load and Drive Control to improve linearity, limit distortion, and maintain a relatively constant output level during high modulation peaks and load changes. Front panel control allows adjustment of the level at which the ALDC takes effect.
Tuning:	Automatic or manual; automatic has manual override.
Special Features:	Overload protection and alarm. Safety interlocks at all high voltage points. Automatic upper sideband with a degree of carrier (A3H) when the following emergency frequencies are selected: 2003, 2182, and 2638 kHz.
Carrier Suppression:	Carrier suppression is selectable in four positions and referenced to PEP. (1) 0: full carrier (2) -6: provides 3 to 6 db of carrier suppression (3) -16: provides 16 $\pm$2 db of carrier suppression (4) full: provides at least -40 db of carrier suppression
Spurious Response:	At least 73 db down from PEP output for CW and FSK: at least 70 db down from PEP for all other operating modes.

TABLE 1-2. TECHNICAL SPECIFICATIONS (continued)

Harmonic Filters:	Automatically switched harmonic filter meeting current FCC specifications.
Noise:	70 db down; special "white noise" protection.
Power Supply Ripple:	Power supply ripple 55 db down from full PEP output.
Cooling:	Filtered forced air cooling; semi-pressurized cabinet.
Environmental:	Designed to operate in any ambient temperature between the limits of 0 and 50°C for any value of humidity to 90%.
Primary Power:	115 vac signle phase, 50/60 Hz. (220, 440 vac three phase also available as option).
Power Requirements:	Approximately 3.75 kilowatts.
Size:	27 W x 25-1/2 D x (49-3/8, 61-5/8 or 73-7/8) (rack height is customer selected)
Installed Weight:	Approximately 800 pounds.
Components and Construction:	Manufactured in accordance with JAN/MIL where-ever practicable.

TABLE 1-3. TRANSMITTER POWER TUBE COMPLEMENT

Reference Designation	Part Number or Type	Function
V1201	8233	1st RF Amplifier
V1202	4CX350A	2nd RF Amplifier
V1301	8576	Power Amplifier

SECTION 2

INSTALLATION

NOTE

When the HFTA-1KJ2 transmitter is a part of a system, no installation information is provided in this modular technical manual. The installation information is provided in Section 2 of the system technical manual, -i.e. Technical Manual for High Frequency Transmit/Receive Ship Set, Model SYM5201.

SECTION 3

OPERATOR'S SECTION

3-1. GENERAL

This section gives detailed operating instructions for the transmitter. The operator should become throughly familiar with the location and function of each control on the individual units which comprise the transmitter. Although an extensive interlock and overload system is designed into the transmitter, a single incorrect control setting might still overload certain components, inviting early failure and consequently equipment "downtime", not to mention improper and illegel emission.

A definite operating sequence (as outlined in the operating instructions) should be strictly followed; the operator should establish a procedural pattern, thus insuring consistent operation.

3-2. OPERATING CONTROLS

For detailed functions of all operating controls and indicators on the transmitter, the operator should refer to the applicable technical manuals on the individual units which comprise the transmitter.

3-3. PRELIMINARY CONTROL SETTINGS

Before applying power to the transmitter, check that the antenna or dummy load connection is properly made at the output connector of the antenna tuning unit, and check that all controls on the transmitter are set in their proper position. These preliminary control settings are outlined in Table 3-1.

TABLE 3-1. PRELIMINARY CONTROL SETTINGS

Modular Unit	Control	Setting
AP-152	MAIN POWER circuit breaker	OFF
AP-151	SCREEN and PLATE circuit breakers	OFF
	ALARM switch	down, off position
MMX(A)-2A	ON/STANDBY switch	STANDBY
	CARRIER switch	0
	MODE switch	USB
	USB MIKE/LINE control	0
AX-5130	RF GAIN control	counterclockwise

TABLE 3-1. PRELIMINARY CONTROL SETTINGS (continued)

Modular Unit	Control	Setting
ATSA-3	ON/AC switch BYPASS/OFF switch	AC position (off) OFF position
TLAA-1K	LOAD control	0

3-4. OPERATING PROCEDURES

a. Operating Procedures for Transmitter Tuning On Carrier

The HFTA-1KJ2 transmitter is primarily designed for operation as an automatically tuned transmitter; however, in the event of failure in automation circuitry, it may be tuned manually.

TABLE 3-2. PROCEDURE FOR MANUAL TUNING ON CARRIER

Step	Modular Unit	Operation	Normal Indication
1	AP-152	Place MAIN POWER breaker to ON position.	PA blower must operate and MAIN POWER indicator must illuminate. When the time delay cycle (approximately 30 seconds) has been completed and if all safety interlocks are closed, the INTERLOCKS lamp on the AP-151 will illuminate.
2	AP-151	Place SCREEN and PLATE breakers to ON position.	No indications at this time.
3	MMX(A)-2A	Set the ON/STANDBY switch to ON position.	POWER lamp will be illuminated.
4		Set EXCITER switch to ON position.	No indications.

TABLE 3-2. PROCEDURE FOR MANUAL TUNING ON CARRIER (continued)

Step	Modular Unit	Operation	Normal Indication
5		Set frequency selector switches to the desired frequency.	No indications.
6	AX-5130	Set AUTO/MAN switch to the MAN position (AUTO/MAN switch located within the AX-5130 drawer).	No indications.
7	ATSA-3	Set AUTO/SENSE/P. POS switch to MANUAL P. POS position.	No indications.
8		Set BYPASS/OFF switch to OFF position. Set ON/AC switch to the ON position.	AC indicator lamp will illuminate. The appropriate BAND indicator will illuminate for the frequency selected on the exciter.

NOTE

Bandswitching for the ATSA-3 is accomplished automatically when the unit is interconnected in the transmitter system. The bandswitching, however, may be accomplished manually by setting the AUTO/MAN switch (located within the ATSA-3 unit) to the MAN position and by depressing and releasing the BAND push-button sequentially until the appropriate BAND indicator illuminates.

9		Hold L and C switches down (-position) until the tuning inductor and capacitor are properly prepositioned.	Refer to ATSA-3 technical manual for L and C meter readings for proper prepositioning.

NOTE

Operation of the HFTA-1KJ2 transmitter on different frequencies over an extended period of time will allow the operating station to compile a tuning chart. Once this has been accomplished, the operator should use the tuning chart for prepositioning the L and C components of the ATSA-3.

TABLE 3-2. PROCEDURE FOR MANUAL TUNING ON CARRIER (continued)

Step	Modular Unit	Operation	Normal Indication
10	TLAA-1K	Rotate the BAND switch (clockwise rotation only) to a band containing the desired frequency.	Band switch indicator for the selected band will illuminate.
		CAUTION Before applying high voltage to the transmitter, insure that the RF GAIN control on the AX-5130 is fully counterclockwise.	
11	AX-5130	Press the HIGH VOLTAGE switch to light indicator (it may be necessary to press the HIGH VOLTAGE switch twice).	HIGH VOLTAGE switch indicator will illuminate red.
		NOTE During initial tuning of the transmitter, output power will be increased or decreased with the RF GAIN control located on the AX-5130.	
		CAUTION During initial transmitter tuning and prior to antenna tuning, the power output of the transmitter should be kept between 150 watts and 200 watts. Excessive output power will cause damage to the antenna tuner. During initial tuning, the OUTPUT meter should be monitored continually, and the output power controlled accordingly with the RF GAIN control.	
12	AX-5130	Carefully adjust the RF GAIN control clockwise slightly to cause a noticeable increase in PA plate current.	Ip meter on the TLAA-1K will indicate an increase in meter reading (not to exceed 250 ma).
13	TLAA-1K	Adjust TUNE control for a peak on the OUTPUT meter.	The rotation of the TUNE control will cause the OUTPUT meter to indicate output. The peak on the OUTPUT meter should correspond with a dip on the Ip meter. (Keep output between 150 and 200 watts.)

TABLE 3-2. PROCEDURE FOR MANUAL TUNING ON CARRIER (continued)

Step	Modular Unit	Operation	Normal Indication
14	ATSA-3	Set the AUTO/SENSE/ P. POS switch to the MANUAL SENSE position.	No indication.
15		Adjust L by holding switch up (+ position) until the meter indicates a null or crossover.	L meter reads 0 (center on upper scale).
		NOTE If an initial null cannot be obtained (possible at frequencies above 13 MHz), the L should be reset to its preposition, and the C should be adjusted first for a null or crossover (0 on upper scale of C meter). For more detailed information on these adjustments, refer to ATSA-3 technical manual.	
16		Alternately adjust the L and C by holding switches up (+ positions) until a null or crossover is acheived.	The L and C meters read 0 (center on upper scales).
17	TLAA-1K	Readjust the tune control for resonance.	The OUTPUT meter will indicate a peak or highest value at resonance.
		NOTE Steps 18, 19 and 20 will insure that the proper null has been tuned to in steps 15 and 16.	
18	TLAA-1K	Depress and hold the REFL button.	OUTPUT meter will indicate reflected power.
19	ATSA-3	Adjust L and C switches for minimum reflected power.	OUTPUT meter will indicate minimum reflected power.
20	TLAA-1K	Release the REFL button.	Output meter will indicate output power.

TABLE 3-2. PROCEDURE FOR MANUAL TUNING ON CARRIER (continued)

Step	Modular Unit	Operation	Normal Indication
21	TLAA-1K	Carefully adjust the LOAD control clockwise from zero in slight increments causing an increase in PA plate current on the Ip meter. Readjust the TUNE control as per step 17. Continue to adjust the LOAD control clockwise in slight increments until there is no further increase in plate current. Back off slightly counter-clockwise with the LOAD control and readjust the TUNE control.	OUTPUT meter will indicate highest value when transmitter is properly tuned and loaded to match the impedance of the antenna or load.
		NOTE If loading adjustment does not give proper response, return the LOAD control CCW to zero and repeat the adjustment.	
22	AX-5130	Rotate the RF GAIN control clockwise to increase output power to the desired level. If necessary, repeat step 21 and readjust with RF GAIN control until desired output is achieved.	OUTPUT meter on the TLAA-1K indicates the desired average power level; Ip meter on the TLAA-1K indicates the plate current.
23	MMX(A)-2A	Set CARRIER switch to FULL.	The OUTPUT meter indication on the TLAA-1K should drop to zero.
		NOTE See paragraph 3-4 for operational modes.	

TABLE 3-3. PROCEDURE FOR AUTOMATIC TUNING ON CARRIER

Step	Modular Unit	Operation	Normal Indication
1	AP-152	Place MAIN POWER breaker to ON position.	PA blower must operate and MAIN POWER indicator must illuminate. When the time delay cycle has been completed and if all safety interlocks are closed, the INTERLOCKS lamp on the AP-151 will illuminate.
2	AP-151	Place SCREEN and PLATE breakers to ON position.	No indications at this time.
3	MMX(A)-2A	Set the ON/STANDBY switch to ON position.	POWER lamp will be illuminated.
4		Set the EXCITER switch to ON position.	No indications.
5		Set CARRIER switch to FULL position	
6		Set frequency selector switches to the desired frequency.	No indications.
7	AX-5130	Set AUTO/MAN switch to the AUTO position (AUTO/MAN switch located within the AX-5130 drawer).	No indications.
8	ATSA-3	Set AUTO/SENSE/P. POS switch to AUTO position. Set AUTO/MAN switch within ATSA-3 unit to AUTO position.	No indication.
9		Set BYPASS/OFF switch to OFF position. Set switch to ON position ON/AC.	AC indicator lamp should light. As soon as tuning elements are pre-positioned, P. POS indicator should illuminate.

TABLE 3-3. PROCEDURE FOR AUTOMATIC TUNING ON CARRIER (continued)

Step	Modular Unit	Operation	Normal Indication
10	AX-5130	Press the HIGH VOLTAGE switch to light indicator (it may be necessary to press the HIGH VOLTAGE switch twice.)	HIGH VOLTAGE switch indicator will illuminate red.
11	AX-5130	Set the POWER LEVEL switch to the position for the desired output power level.	No indications.
12		Press TUNE button to initiate automatic tuning.	Automatic tuning cycle will begin. Upon completion of the automatic tuning cycle, the OUTPUT meter will momentarily indicate the selected power level and then the indicator will drop to zero. The READY indicator will be illuminated (green).
13		Refer to paragraph 3-4b and Table 3-4 for intelligence operational procedures.	
		NOTE If the transmitter is already tuned automatically to a particular frequency and if the operator wishes to retune automatically on a different frequency, the operator should proceed as follows:	
14	AX-5130	Press the TUNE button	READY lamp will extinguish. RF GAIN control will automatically drive CCW to minimum.
15		Set the POWER LEVEL selector switch to the position for the desired output power level.	No indication

TABLE 3-3. PROCEDURE FOR AUTOMATIC TUNING ON CARRIER (continued)

Step	Modular Unit	Operation	Normal Indication
16	MMX(A)-2A	Set the frequency selector switches to the desired output frequency.	No indication.
17	AX-5130	Push TUNE button a second time to initiate automatic tuning.	Automatic tuning cycle will begin. Upon completion of automatic tuning cycle, the output meter will momentarily indicate the selected power level and then the indicator will drop to zero. The READY indicator will be illuminated (green).

b. Operating Procedures for Intelligence Modes

Once the transmitter has been tuned on carrier, it is ready for operation in its various intelligence modes (READY lamp illuminated). The mode selection, degree of carrier insertion, and intelligence levels are controlled by the operation of the MMX(A)-2A exciter unit. For operation of the exciter in its various modes, the operator should refer to the technical manual for the MMX(A)-2A. However, when operating the multimode exciter in its intelligence modes to drive the amplifier stages of the transmitter, the operator should be thoroughly familiar with procedures for determining the output power of the transmitter for proper operation. The output power of the transmitter is monitored on the OUTPUT meter located on the front panel of the linear power amplifier, TLAA-1K. This OUTPUT meter reads average power. The transmitter is conservatively rated as being capable of delivering a maximum output of 1,000 watts PEP (peak envelope power) or average power. A clarification of the transmitter's output power rating is provided in this section to insure that the operator has a complete understanding of this rating, thus, insuring proper operation of the transmitter.

When the transmitter was tuned on carrier to full output power or to a selected power level (dependent upon POWER LEVEL switch position, i.e. 1-150 watts, 2-400 watts, 3-800 watts, 4-1000 watts), the amplifier was driven to that power level and that same power level was indicated on the OUTPUT meter. The peak envelope power and average power were equal, since all of the power was contained in a single tone, the carrier. In multitone or voice transmission, however, the peak envelope power and average power are not equal. The peak envelope power is derived from the addition of the carrier voltage and the voltage of each individual tone when the carrier and tones are in phase, or at the crest of the modulation wave. The transmitter is capable of providing 1,000 watts PEP in all intelligence modes; however, the average power, the power which is monitored by the OUTPUT meter, will be decreased in a multitone transmission: The more tones (teletype tones, carrier, voice, etc.) which are being transmitted, the less average power, as indicate on the OUTPUT meter. Samples of intelligence transmission and related average power meter readings are given in the following paragraphs.

(1) A3H transmission of voice at the position 4 power level (1000 watts PEP): The MMX(A)-2A MODE switch should be in the USB position and the CARRIER SUPPRESSION switch in the 6 db position, providing carrier suppression of 3 to 6 db from PEP, or approximately 250 watts (1/4 power).

A voice transmission contains an infinite number of tones, and the average power for an infinite number of tones should be approximately 10% of the PEP available for tone transmission, or 10% of 250 watts (25 watts). The CARRIER SUPPRESSION switch in the 6 db position will provide approximately 250 watts on the transmitter OUTPUT meter, and the USB audio level control on the MMX(A)-2A should be adjusted so that the transmitter OUTPUT meter reads approximately 275 watts average (the addition of carrier and intelligence power).

(2) An A3J transmission of two teletype tones at the position 4 power level (1,000 watts PEP): The MMX(A)-2A MODE switch should be in the USB position and the CARRIER SUPPRESSION switch in the FULL position, providing full suppression of carrier. The USB audio level control on the MMX(A)-2A should be adjusted so that the transmitter OUTPUT meter reads approximately 500 watts average.

c. Exciter Control Settings for Operating Modes

Once the transmitter is initially tuned on a carrier frequency, operation consists of setting the EXCITER controls for the desired mode of transmission. Refer to Table 3-4 for exciter control settings.

TABLE 3-4. EXCITER CONTROL SETTINGS

NOTE

ONCE CARRIER TUNING IS COMPLETED DO NOT RE-ADJUST RF GAIN CONTROL.

INTELLIGENCE OPERATION

OPERATING MODE	CARRIER	MODE SWITCH	METER SWITCH	MODULATING TONE INPUT	USB MIKE/LINE CONTROL
A3H	-6 db	USB	USB	Voice or Multi-Tone	Adjust level so as not to exceed red region with highest audio input
A3J	Full	USB	USB	Voice or Multi-Tone	
A3A	-16 db	USB	USB	Voice or Multi-Tone	

3-5. EMERGENCY OPERATION

The transmitter exciter provides automatic upper sideband with a degree of carrier (A3H) when the frequency selector switches are positioned at the following emergency frequencies: 2003, 2182 and 2638 kHz. To operate the transmitter on the emergency frequencies, set the transmitter controls as indicated on Table 3-5.

TABLE 3-5. EMERGENCY AUTOMATIC OPERATION

NOTE

Press TUNE pushbutton before selecting emergency settings.

Step	Exciter Controls	Settings
1	Frequency Selectors	020030 or 021820 or 026380
2	METER switch	USB
3	USB MIKE/LINE control	Adjust level so as not to exceed red region with highest audio input.
	Transmitter Controls (Amplifier)	**Settings**
4	AUTO/MAN switch	AUTO
5	H.V. switch	ON
6	POWER level switch	Position 1 (150 watts PEP)
7	Press TUNE button	

TABLE 3-6. EMERGENCY MANUAL OPERATION

Step	Exciter Controls	Position
1	Frequency Selectors	020030 or 021820 or 026380
2	METER switch	USB
3	USB MIKE/LINE control	0
4	Set POWER LEVEL switch to pos 1.	
5	Refer to Table 3-2 for manual transmitter tuning.	
6	Adjust RF GAIN control for an output indication of 150 watts	
7	Adjust MIKE/LINE control not to exceed 150 watts PEP output.	

3-6. OPERATOR'S MAINTENANCE PROCEDURES

a. General

Operator's maintenance should be performed during idle periods of shut down. When a piece of equipment is operated on a fairly constant basis, cable connections and movable parts should be periodically inspected for mechanical and/or electrical operation.

b. Visual Inspection

The operator should inspect the front and rear of the equipment and observe that all meters, knobs, indicators and terminal strips are not broken or cracked. Refer to paragraph 3-4 and ascertain that all controls and indicators are operating properly. Should any component within a modular unit show signs of wear, aging or overheating refer to modular unit technical manual for replacement and repair information.

c. Maintenance Adjustments

Maintenance adjustments should include the adjustment and checking of quiescent current values and overload settings. Procedures for checking and resetting of overloads and bias adjustments are outlined in paragraphs 3-7 and 3-8.

d. Repair

Operator's maintenance should also include the repair of broken or cracked knobs, fuses or indicator lamps. Cable connections (coaxial or otherwise) where necessary should be repaired if found to be broken or loose. It's particularily important to check cabling for snagging if equipment is affixed with equipment slides and mounted in an equipment cabinet or transmitter frame.

3-7. TRANSMITTER BIAS ADJUSTMENT PROCEDURE

The bias adjustments outlined below are to obtain quiescent tube values. Before bias adjustments can be made the Low Voltage Power Supply AP-151 must be extended out on its slides to expose the bias adjustment potentiometers.

1. Remove top cover and adjust bias controls maximum clockwise (bias voltage will be at maximum value.)

2. Place MAIN POWER, PLATE and SCREEN breakers to the ON position.

3. Set AUTO/MANUAL switch to MANUAL.

4. Insure that RF GAIN control is at minimum (max counter clockwise rotation).

TABLE 3-7. RF AMPLIFIER TUBE QUIESCENT CURRENT VALUES

REF SYM	TUBE TYPE	TUBE FUNCTION	QUIESCENT PLATE CURRENT ADJ TO
V1201	8233	1ST AMP	60-80 ma
V1202	4CX350	2ND AMP	260-300 ma
V1301	8576	PA	200-210 ma

NOTE

1. MAX BIAS VOLTAGE WILL BE PRESENT IF:

   A. BANDSWITCH OR FILTER (OPTIONAL) NOT IN PROPER POSITION.
   B. PTT RELAY NOT ENERGIZED.
   C. BIAS CONTROLS ARE AT MAX CLOCKWISE.

2. WHEN MAX BIAS VOLTAGE IS PRESENT AT V1201, V1202, and V1301 THE PLATE CURRENTS ARE REDUCED OR NEAR CUTOFF.

5. Press HIGH VOLTAGE button to light HV indicator subsequently applying HIGH VOLTAGE.

6. Observe "Ip" meter and adjust PA BIAS control for an indication between 200 ma - 210 ma as read on Ip meter.

7. Hold meter switch "UP" (to 2ND AMP position), observe Ip meter, and adjust 2ND AMP bias control for an indication between 260 ma - 300 ma as read on Ip meter.

8. Hold meter switch down (1ST AMP position) observe Ip meter and adjust 1ST AMP bias control for an indication between 60 ma - 80 ma as read on the Ip meter.

9. Press HIGH VOLTAGE switch to OFF position. (HIGH VOLTAGE indicator must go out.) Replace top cover on Low Voltage Power Supply drawer and slide drawer back to original position.

3-8. OVERLOAD CIRCUIT TEST

a. Purpose

The Overload circuitry functions to protect the transmitter against excessive current and VSWR overloads. To set or check the overload circuitry, perform the following:

(1) Energize Transmitter (MAIN POWER breaker ON, PLATE SCREEN breaker ON).

(2) MANUAL/AUTO switch to MANUAL.

(3) Loosen panel locks and extend low voltage power supply (AP-151) drawer on its slides to expose bias adjustment controls.

(4) Press HIGH VOLTAGE switch to ON (HIGH VOLTAGE indicator should light).

NOTE

When overload occurs, HIGH VOLTAGE switch must be pressed twice to re-apply high voltage, (Press to reset overload and press to apply high voltage).

b. PA PLATE OVERLOAD ADJUSTMENT

(1) Adjust Overload indicator, adjustment screw part of meter, located directly below meter face, for 300 ma as indicated on PLATE current meter.

(2) Adjust PA Bias control counterclockwise until PLATE current meter indicates 300 ma. Observe the following.

a. When meter indicator reaches the value of overload indicator setting, the high voltage will trip off.

b. PLATE current (Ip) meter face will illuminate, indicating overload in plate current.

c. Meter indicator will remain at the overload value to indicate overload condition.

(3) Re-adjust PA bias control to maximum clockwise position and press HIGH VOLTAGE pushbutton to reset high voltage. (H.V. Switch must be pressed twice).

(4) To check further operation of plate overload, adjust bias control counterclockwise again, noting that HIGH voltage tripped as in (2): set overload indicator for indication of 900 ma. Re-adjust PA bias control for 200 - 210 ma as indicated on the Ip meter.

c. 2ND AMPLIFIER PLATE OVERLOAD ADJUSTMENT

(1) Extend TLAA out on its slides to expose the 2ND AMP and SWR overload adjustment controls.

(2) Push "PLATE meter switch" up and observe 2ND AMP plate current.

(3) Adjust 2ND AMP BIAS control counterclockwise until 2ND AMP plate current indicates 400 ma.

(4) Adjust 2ND AMP PLATE OVERLOAD potentiometer until high voltage trips off (located on bottom of TLAA-1K).

a. PLATE current meter will illuminate, indicating overload in 2ND AMP plate current.

b. High Voltage will trip OFF, HIGH VOLTAGE Indicator will go out.

c. PLATE current meter will indicate zero.

(5) Readjust 2ND AMP BIAS control to maximum clockwise position and press HIGH VOLTAGE pushbutton to reset high voltage (HIGH VOLTAGE switch must be pressed twice).

(6) To check further operation of 2ND AMP PLATE OVERLOAD, readjust bias control counterclockwise again, noting that high voltage tripped as in (4).

(7) Reset bias control for a 2ND AMP plate reading of 260 to 300 ma.

d. SWR OVERLOAD ADJUSTMENT

(1) Simulate a high reactive condition. (temporarily connect reactive component in series with antenna or dummy load).

(2) Press HIGH VOLTAGE pushbutton to apply high voltage.

(3) Manually tune transmitter into 50 ohm dummy load or antenna at any frequency between 2.0 MHz to 30 MHz.

(4) Push SWR pushbutton and increase drive until a reading of 110 watts (on KILOWATT meter, corresponding to VSWR of 2:1) is observed on the reflected power scale.

(5) Adjust SWR potentiometer until high voltage trips OFF (located on bottom of TLAA-1K).

a. The OUTPUT meter will illuminate.

b. High voltage will trip OFF; HIGH VOLTAGE Indicator will go out.

c. PLATE current meter will indicate zero.

d. To further check operation of SWR overload, reduce rf drive, press HIGH VOLTAGE pushbutton to ON and increase rf drive again until overload trips HIGH VOLTAGE OFF.

e. Remove reactive component in series with output antenna or dummy load and equipment will be protected against SWR of 2:1.

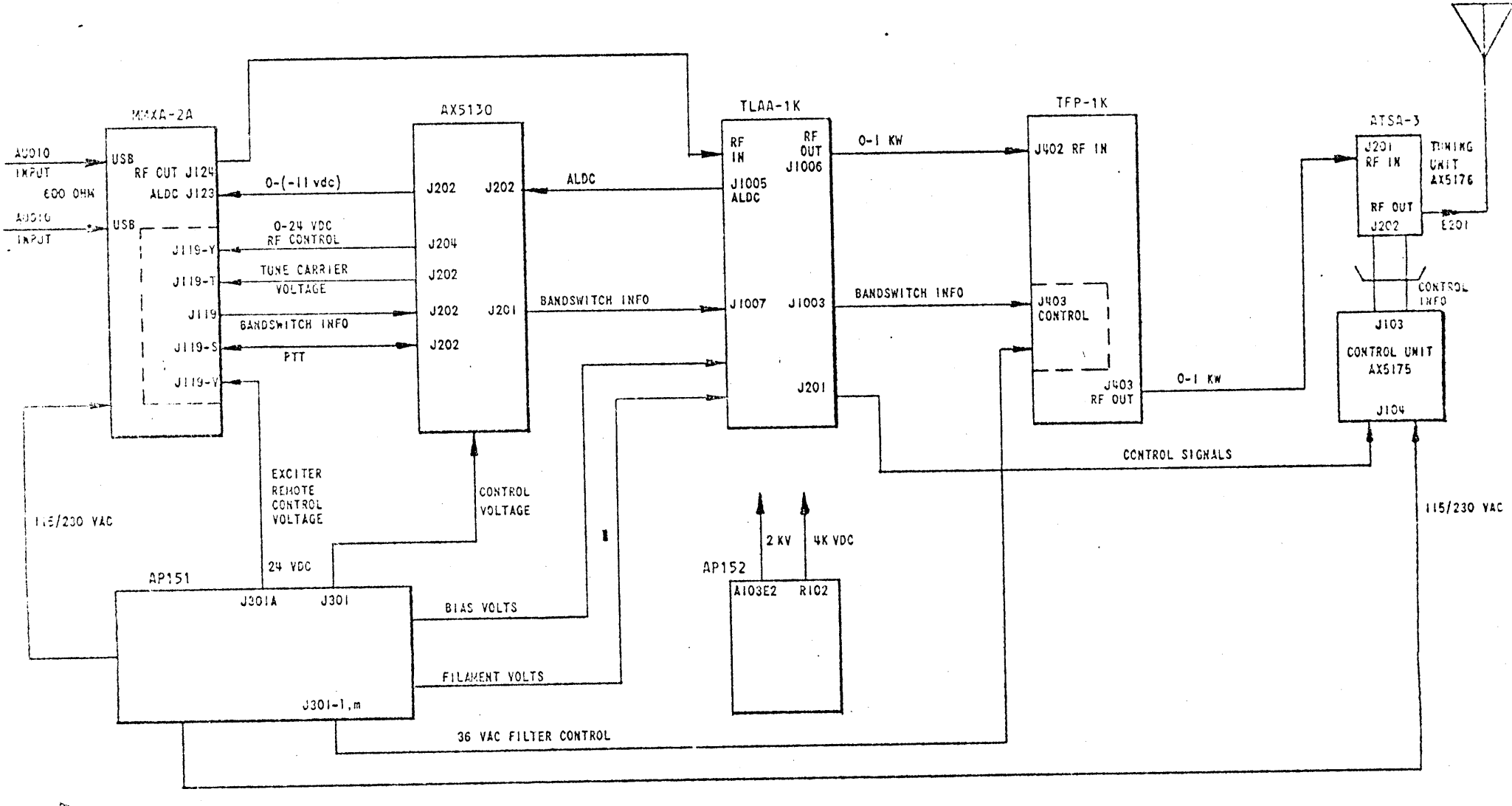

Figure 4-1. Functional Block Diagram HFTA-1KJ2 Transmitter

SECTION 4

PRINCIPLES OF OPERATION

4-1. GENERAL

The transmitter as shown in figure 4-1, is divided into functional unit sections as follows: exciter, linear power amplifier, harmonic filter and antenna tuner. These functional sections are individual modular units interconnected and mounted in a single equipment cabinet. Principles of operation, maintenance procedures, diagrams and parts list are presented in the individual modular unit technical manuals. Principles of operation presented in this section will discuss the transmitter on a block diagram level and only to the extent that each effects the overall system.

4-2. SYSTEM OPERATION

The transmitter as shown in figure 4-1 illustrates control circuitry inputs and outputs between the modular units that comprise the one kilowatt automated transmitter.

The basic carrier frequency is derived in the Multimode Sideband Exciter MMX(A)-2A. This unit (MMX) provides a maximum of 250 milliwatts RF that is utilized as a source excitation for the linear power amplifier portion of the transmitter.

The linear amplifier portion of the transmitter functions to amplify the exciter's output up to one kilowatt average or PEP power.

When the transmitter is in the AUTO mode of operation and primary power is applied, the following functions and voltages are present:

(1) 24 vdc is routed from the servo control unit at J202 pin "Q" to the exciter remote jack J119 pin "T" for tune carrier control.

(2) A PTT ground enable is routed from the exciter control jack (J119-S) and applied to the PTT circuitry via servo control unit (J202-P).

(3) A fixed 24 vdc is routed from AP-151 (J301-A) to exciter control jack (J119-V) for remote control of the exciters RF OUTPUT control.

(4) A variable dc voltage is routed from the Servo Control Unit (J204) to the exciter control jack (J119-Y). This variable voltage will control the exciter rf output.

The following paragraphs will discuss system operation for the following transmitter functions:

Pilot carrier for auto tuning, push-to-talk circuitry, RF gain control, band positioning and tuning sequence.

a. Carrier for Automatic Tuning

The AX-5130 (P/O HFLA-1K) provides 24 vdc to the MMX(A)-2A at J119-T, when the transmitter is in a tune state. This input energizes TUNE relay K104, which causes PTT relay K101 and EMERGENCY relays K105, K103 and K102 to energize. With all relays energized the following conditions will exist regardless of the position of the exciter's MODE, CARRIER, and EXCITER switches or intelligence inputs to the MMX(A)-2A: The 250 kHz used in normal CW operation (J109-J) will be routed via contacts on the TUNE relay to J108-2. On Z108 the 250 kHz will be mixed with 2.75 MHz, producing the 3 MHz signal utilized in translation to provide the carrier frequency output required by the transmitter for tuning. By means of contacts on the energized relays, AM, FSK, FAX and sideband generation circuitry will be defeated during transmitter initial auto tuning. Additionally, the MMX(A)-2A, via contacts on the PTT relay will route a ground (from J119-R to J119-S). This ground is supplied from the exciter for control of the transmitter output, and in the system it is connected so that the transmitter amplifiers will be biased on during the initial tune sequence.

b. Push-To-Talk Circuitry

The MMX(A)-2A has a push-to-talk relay K101, which controls the PTT circuitry within the exciter and within the automatic transmitter. When K101 is energized. a ground is routed through its contacts from the MODE switch (AM, USB and ISB positions only) to J109-11, enabling the operation of the final amplifier on Z112, which is a part of the amplifier stages for the exciter's final output. The energized K101 also routes a ground to J119-S, this ground is supplied from the exciter for control of the transmitter output, biasing its amplifiers on when the exciter's PTT relay is energized. The PTT relay K101 is energized in several ways: (1) the EXCITER ON/PTT switch in the ON position, (2) contacts on the TUNE relay K104 when it is energized, (3) when the EXCITER ON/PTT switch is in the PTT position, an external mike input (J119-Q or J118) or a ground supplied externally(TB103-5) will energize K101 and will also enable the mike input amplifiers on Z107.

c. RF GAIN Control

The MMX exciter provides the excitation voltage for the linear amplifier portion of the transmitter. The RF output of the exciter is controlled by a variable dc voltage present on the transmitter motorized RF GAIN control located within the AX-5130 unit. The RF OUTPUT control on the exciter's front panel is recessed and is not in the circuit when the MMX is connected into the system and the transmitter is on.

The transmitter provides a fixed +24 vdc to the MMX control jack J119-V which energizes the remote control circuitry and switches the exciter's RF OUTPUT control out of the circuit.

A variable dc voltage present on the transmitter motorized RF GAIN control is routed to the exciter control jack, J119-Y and applied to the RF adjust circuitry Z119 which controls the exciter output applied to the RF INPUT jack of the TLAA-1K linear amplifier.

d. Bandswitch Pre-Positioning

Automatic bandswitch control connections are made from the exciter control jack J119 to the Servo Control drawer as follows:

F MHz	MMX (J119)	AX5130 (J202)	AX5130 (J201)	XMTR BAND (MHz)
1.5- 1.9999	B	D	c	1.5- 2.0
2.0- 2.5999	C	E	b	2.0- 2.6
2.6- 2.9999	D	F	a	2.6- 3.0
3.0- 4.9999	E	G	Z	3.0- 5.0
5.0- 7.9999	F	H	Y	5.0- 8.0
8.0-11.9999	G	J	g	8.0-12.0
12.0-15.9999	H	K	f	12.0-16.0
16.0-23.9999	J	L	e	16.0-24.0
24.0-29.9999	K	M	d	24.0-30.0
COMMON	M	N		COMMON

When a carrier frequency is selected by the manual positioning of the frequency selector switches on the front panel of the MMX(A)-2A, the exciter will provide proper interconnections, via contacts on the frequency selector switches, for routing of bandswitch information to the transmitter. This bandswitching information will be utilized by the linear amplifier, the harmonic filter and the antenna tuner, to automatically pre-position their bandswitch(es) to a band which includes the selected carrier frequency.

A common input from the transmitting system is applied at pin M of J119 of the MMX()A-2A. This common is routed through contacts on the wafers of frequency selector switches S107, S106 and S105 (10 MHz, 1 MHz, and 100 kHz respectively) to output pins on J119. An example of the frequency selection of 23.5750 MHz is given as follows: The common of J119-M is routed to the wafer pin 12 of S107C. The 10 MHz selector is in position 3 for 20 MHz selection, routing the common from pin 3 to the wafer pin 12 of S106H. The 1 MHz selection, routing the common from pin 4 to pin J of J119. The common is also routed to pin 7 of S106G (also in position 4), but pin 7 is open with S106 in position 4. When 23.5750 MHz is selected, the common is routed through the 10 MHz and 1 MHz selector switches to pin J. The common at pin J will be utilized by the transmitter to pre-position its bandswitch(es) in the 16.0 to 24.0 MHz band. When the transmitter amplifier bandswitches are pre-positioned the harmonic filter receives an input at J401 to automatically pre-position its harmonic filter bands. Once the filter is connected in the transmitter system its operation is automatic regardless of the transmitters operation mode (manual of automatic). Once the harmonic filter is pre-positioned in its proper band the antenna tuning system receives an input and its bandswitch automatically pre-positions.

e. Tuning Sequence

The tuning sequence is initiated by depressing the TUNE pushbutton on the AX5130. The L and C tuning components within the antenna tuning unit pre-position for the selected frequency. Once pre-positioning is accomplished, the P. POS indicator on the AX5175 antenna tuning control unit illuminates and the transmitter is biased on. With the transmitter biased on, there is an indication of PA plate current on the TLAA-1K linear amplifier and the SERVO indicator on the AX5130 servo control unit illuminates. The PA cathode voltage is applied to the RF GAIN motor control assembly, where it is compared with a preset tune level voltage, causing the RF GAIN control the AX5130 to drive-up to tune level. Once tune level is achieved, the transmitter goes to its search mode: the SEARCH indicator on the AX5130 illuminates, the LOAD control on the TLAA-1K positions to 0 (fully unloaded), and the TUNE control on the TLAA-1K positions in search of resonance. At resonance, the rf output triggers the antenna tuning unit to begin its tuning sequence: the RF TRIG lamp on the AX5175 illuminates, transmitter loading is inhibited, and the L and C components within the AX5176 tuning unit tune to match the output impedance of the transmitter with that of the antenna. When the AX5176 completes its tuning sequence, the RDY indicator on the AX5175 tuning control unit illuminates, transmitter loading is initiated, and the OPER lamp on the AX5130 illuminates. On the TLAA-1K linear amplifier, the LOAD control positions for proper loading, the TUNE control readjusts to proper resonance, and the RF GAIN control on the AX5130 drives up to the selected power output level. At full output, the READY indicator on the AX5130 illuminates and the following functional changes take place in the transmitter:

1. 24 vdc is removed from the exciter's tune carrier circuitry (and the tune carrier is replaced with intelligence fed to the exciter input).

2. PTT line is open when in PTT mode. Transmitter is now ready for PTT operation.

3. The ground place on the ALDC input is removed once the READY lamp lights.

SECTION 5

MAINTENANCE AND TROUBLESHOOTING

5-1. INTRODUCTION

The transmitter is designed for long term, trouble-free operation. When it becomes necessary to perform alignmnet and/or adjustments to the equipment, it is recommended that technicians perform the necessary operations outlined in the associated HFLA-1K, MMX(A)-2A, TFP-1K, and RF601A technical manuals. The following maintenance aids are provided for system troubleshooting and localization of malfunctions.

a. Overall block diagram (Section 4, figure 4-1).

b. Interconnect Jacks Location (Section 2, figure 2-2).

c. Interconnect Wiring Diagram (Section 2, figure 2-3).

5-2. TEST EQUIPMENT REQUIRED

Table 5-1 lists the test equipment required for maintaining and troubleshooting the transmitter. Refer to the modular units technical manuals for additonal equipment required to maintain and troubleshoot the modular components.

TABLE 5-1. TEST EQUIPMENT REQUIRED

EQUIPMENT	TYPE
Signal Generator:	Hewlett-Packard Model 606A, or equivalent.
VTVM:	Hewlett-Packard Model 410B, or equivalent.
Multimeter:	Simpson Model 260, or equivalent.
Oscilloscope:	Tektronix Model 541A, or equivalent.

5-3. OPERATOR'S MAINTENANCE PROCEDURE

a. Refer to transmitter operating procedure (Tables 3-2 and 3-3).

b. Refer to (paragraph 3-6 thru 3-8).

c. Refer to maintenance procedures described in the HFLA-1K, TFP-1K, MMX(A)-2A, and ATSA-3 technical manuals.

5-4. PREVENTIVE MAINTENANCE

In order to prevent equipment failure due to dust, dirt or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to. At periodic intervals, the equipment should be pulled out on its slides for internal cleaning and inspection. The wiring and all components should be inspected for dirt, dust, corrosion, grease or other harmful conditions. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease 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. For detailed preventive maintenance procedures, refer to the applicable technical manuals.

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 painted surfaces, due to its paint-removing effects.

5-5. TROUBLESHOOTING

Troubleshooting the transmitter section consists of isolating faults to either the MMX(A)-2A Exciter , TFP-1K Haromnic Filter, ATSA-3 Antenna Tuner or the HFLA-1K Power Amplifier. Refer to the associated technical manuals for detailed troubleshooting procedures of the modular units. Refer to operator's section for normal indications.

a. MMX(A)-2A Exciter

To isolate the exciter unit from the transmitter for troubleshooting proceed as follows:

(1) Disconnect existing cable from MMX RF OUT jack (J124) and connect 50 ohm 1 watt non inductive dummy load to MMX RF OUT jack.

(2) Turn transmitter OFF (MAIN POWER break OFF), apply power to MMX independent of transmitter (115 or 230 vac as required).

(3) Refer to MMX(A)-2A technical manual for maintenance procedures. Bear in mind the MMX RF OUTPUT control is a screwdriver adjustment and should be used to control the exciter output when not part on the transmitter.

b. TFP-1K Harmonic Filter

Isolation of the harmonic filter for troubleshooting consist of removing cables from J401, J402 and J403 on the TFP-1K and perform the troubleshooting procedure outline in the TFP-1K technical manual.

c. ATSA-3 Antenna Tuner

When transmitter troubleshooting is necessary the ATSA-3 antenna tuner should be isolated from the transmitter. To isolate the antenna tuner set the antenna tuner controls in the following manner.

(1) Set AUTO/SENSE/P. POS switch to MANUAL P. POS position.

(2) Set ON/AC switch to the AC (off) position.

(3) Remove output cables connected TFP-1K RF OUT jack (J403) and connect J403 to a 50 ohm dummy load.

NOTE

The above procedure electrically places the antenna tuner functionally out of the transmitter circuit.

(4) Refer to ATSA-3 technical manual for detailed maintenance procedures.

d. Linear Amplifier RF Output Check

Disconnect the MMX exciter and connect a signal generator to the TLAA-1K RF INPUT jack. Place ATSA-3 functionally out of circuit as per paragraph c. Operate the transmitter manually into a dummy load (if available) and monitor the TLAA-1K meters for proper operation. (Refer to operating procedures in section three for normal indications.

SECTION 6

PARTS LIST

6-1. GENERAL

The HFTA-1KJ2 transmitter consists of the MMXA-2A exciter, and HFLA-1K linear power amplifier, the TFP-1K harmonic filter and the ATSA-3 antenna tuner. The parts lists for the MMXA-2A, HFLA-1K, TFP-1K and ATSA-3 are contained in their respective modular technical manuals; the parts lists for components external to these modular units (components mounted on equipment cabinet) are contained in the system technical manual of which this transmitter is a part, -i.e. SYM5201 High Frequency Transmit/Receive Ship Set.