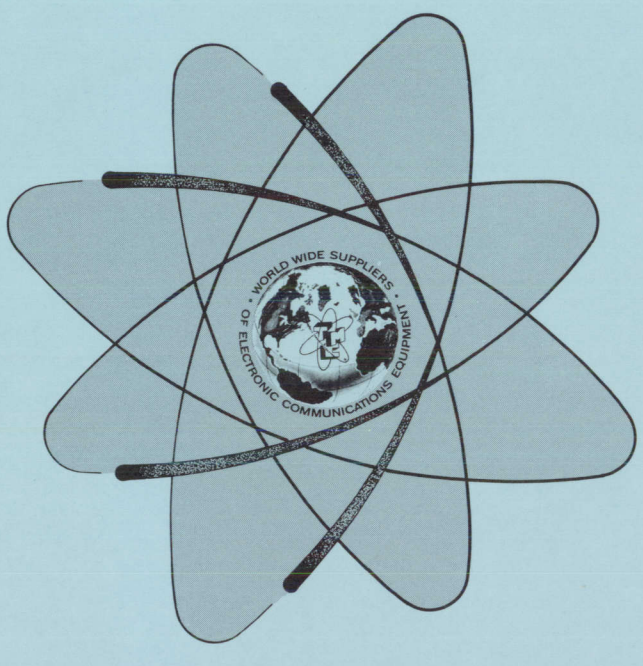
TECHNICAL MANUAL

for

HIGH FREQUENCY AUTOMATED TRANSMITTER

MODEL HFTA-1KJ2/1P



THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

Printed in U.S.A.

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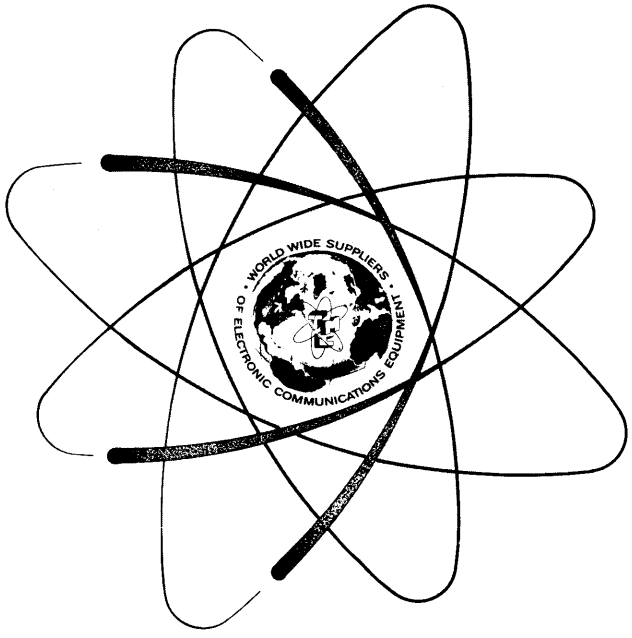

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MAMARONECK, N.Y. OTTAWA, ONTARIO

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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

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SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

The high frequency, automated transmitter shown in figure 1-1 is the HFTA-1KJ2/1P, designed and manufactured by the Technical Materiel Corporation of Mamaroneck, New York. Throughout this publication it will be referred to as the transmitter or by the model number alone. The transmitter consists basically of two major sub-systems; a solid-state, multi-mode exciter, model MMX(A)-2 and a high frequency linear power amplifier, model HFLA-1K. Two optional sub-systems are available for use in conjunction with the basic units and become integral parts of the transmitter system. One option is the switchable harmonic filter, model TFP-1K; a second option is the automatic antenna tuning system, model ATSA-3.

The MMX(A)-2 exciter generates an rf output signal in one of six operating modes; CW (carrier wave), AM (amplitude modulation), SSB (single sideband) including AME (amplitude modulation equivalent), ISB (independent sideband - USB and LSB), FSK (frequency shift keying) and FAX (facsimile) at a selectable frequency in the range of 2.0 to 29.9999 Mhz.

The HFLA-1K linear power amplifier provides 1 kilowatt peak envelope power or 1 kilowatt average power. The linear power amplifier consists of four units. Each of the four units, the AP152 high voltage power supply, the AP151 low voltage and bias power supply, the TLAA-1K three-stage amplifier, and the AX5130 servo control unit, is individually packaged in a separate chassis. The AX5130 contains all of the sensing and control circuitry for the automatic tuning of the transmitter.

The rf output of the amplifier may be routed directly to an antenna or, if optional equipment has been added, through this equipment. Either one or both of the optional equipments (the TFP-1K harmonic filter and the ATSA-3 antenna tuner) may be incorporated into the system. The filter provides a harmonically suppressed signal for transmission. The ATSA-3 tuning system, if included, operates automatically to match the impedance of a 35-foot whip antenna to the impedance of a 50-ohm transmission line at any selected transmission frequency. Both the filter and the tuning system are tied electrically to the frequency selection circuitry of the transmitter to synchronize their operation to the correct transmission band over the frequency range of 2.0 to 29.9999 Mhz.

Table 1-1 shows the nomenclature and interrelationship (by indention) of the various system components.

TABLE 1-1. TRANSMITTER COMPONENTS

NOMENCLATURE	NAME
MMX(A)-2	Multi-mode Exciter
HFLA-1K	Linear Power Amplifier
AP-152	High Voltage Power Supply
AP-151	Low Voltage and Bias Power Supply
TLAA-1K	Three-stage Amplifier
AX5130	Servo Control Unit
*TFP-1K	Harmonic Filter
*ATSA-3	Antenna Tuning System
AX5175	Tuning Control Unit
AX5176	Antenna Tuning Unit (located at antenna base)

*Optional Equipment

1-2. PHYSICAL DESCRIPTION

With the exception of the AX5176 antenna tuning unit, all system components, including optional equipment, are mounted in a single standard equipment rack. The antenna tuning unit is mounted in the proximity of the antenna.

Primary power, and most of the external connections to the transmitter are made at the rear of the cabinet; however, jacks for microphone or key inputs are provided on the front panel of the exciter. Connecting plugs which mate with the jacks on the interface panels at the rear of the unit are supplied as loose items.

1-3. REFERENCE DATA

Table 1-2 lists the technical characteristics of the HFTA-1KJ2/1P 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.

TABLE 1-2. TECHNICAL SPECIFICATIONS (cont)

Operating Modes:	CW, AM, SSB, ISB, AME, FAX, and FSK.
Sideband Response: (customer selected)	±1.5 db from 350 to 3500 Hz, or ±1.5 db from 250 to 3040 Hz, or ±1.5 db from 250 to 6080 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. Rear 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.
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 ±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.
Power Supply Ripple:	Power supply ripple 55 db down from full PEP output.
Cooling:	Filtered forced air cooling: semi-pressurized cabinet.

TABLE 1-2. TECHNICAL SPECIFICATIONS (cont)

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:	115/230 vac single phase, 50/60 Hz.
Power Requirements:	Approximately 3.75 kilowatts.
Size:	19 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 550 to 800 lbs depending upon selected optional equipment.
Components and Construction:	Manufactured in accordance with JAN/MIL wherever 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

2-1. INITIAL UNPACKING AND INSPECTION

The HFTA-1KJ2/1P transmitter was assembled, calibrated and tested at the factory prior to shipment. Following successful completion of all operational tests, the transmitter was partially disassembled and the several individual units packed and crated separately. This shipping technique reduces the possibility of equipment damage in transit and provides for more efficient material handling.

When received at the installation site, each of the crates and cartons should be carefully examined to be sure that no damage to the contents occured during shipment. If damage is discovered, a claim should be filed with the carrier at once. The Technical Materiel Corporation will assist in rectifying such damage by recommending replacement parts and by describing repair methods.

Refer to the packing list provided with each shipment and make certain that all material has been received. Carefully inspect all packing material to be sure that no material or parts shipped as "loose items" (cabinet hardware, connectors, cables, technical manuals and the like) have been overlooked.

2-2. POWER REQUIREMENTS

The HFTA-1KJ2/1P transmitter requires a single phase source of 115 or 230 volt, 50 or 60 cycle ac power at approximately 3.75 kilowatts. The equipment has been factory wired for use with the ultimate power supply indicated by the customer. If a decision is made to use an alternate power source, wiring changes must be made to accommodate a change in voltage. The technical manuals for each individual unit should be consulted and the necessary changes made before installation.

2-3. INITIAL INSTALLATION

a. GENERAL. The equipment rack or cabinet should be conveniently located in relation to any associated equipment, taking into consideration that from time to time access to the rear of the equipment will be required, and that adequate ventilation is necessary.

Disconnected cabling and wiring has been tagged for proper connection and secured to the interior of the cabinet. Free this cabling and be certain that all packing material has been removed prior to component installation.

b. COMPONENT INSTALLATION. The component locations for a typical installation of the HFTA-1KJ2/1P transmitter including the optional equipment (TFP-1K, harmonic filter and ATSA-3 antenna tuning system) is shown in figure 2-1. All rack-mounted units are supported by slide mountings. Refer to the individual technical manuals for specific mounting instructions and carefully slide each modular unit into position beginning with the lowest unit in the rack (AP-152, high voltage power supply).

NOTE

Blank panels are furnished to fill the rack space required by unincorporated optional equipment. The cabling and harnesses have, however, been wired to accommodate this equipment.

The AX5176 tuning unit of the optional ATSA-3 antenna tuning system is mounted at the base of the associated antenna. For installation details refer to the ATSA-3 technical manual.

c. ELECTRICAL CONNECTIONS. The electrical connections and interconnections required to make the HFTA-1KJ2/1P transmitter operative may vary slightly from system to system depending upon what, if any, available optional equipment has been added to the basic transmitter. In any case all of the wiring necessary to complete the internal connections is supplied either as part of the wiring harness or as separate cabling. Provision has also been made so that the currently available optional equipment may be added without extensive wiring changes.

An interface panel mounted at the rear of the transmitter cabinet below the AX5130 servo control unit is provided to support the mating jacks for unit interconnections and for most of the external connections to be made to the transmitter. The layout of this panel showing the locations of these connections is shown in figure 2-2.

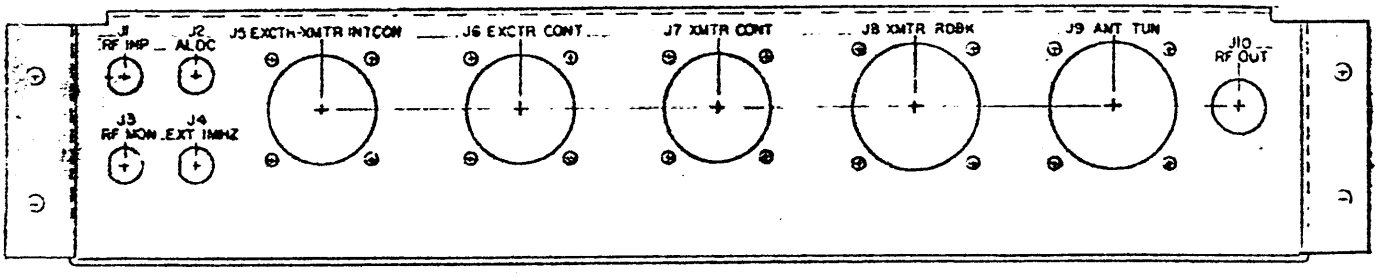

Figure 2-2. Interface Panel

WARNING

BEFORE MAKING ANY ELECTRICAL CONNECTIONS TO THE TRANSMITTER BE CERTAIN THAT NO CONNECTION HAS BEEN MADE TO ANY POWER SOURCE AND THAT THE POWER SUPPLY JACK IS TAGGED TO PREVENT ACCIDENTAL USE.

(1) Internal Connections. Each of the connecting jacks and terminal boards at the rear of the modular units has been marked with the appropriate "J" or "TB" number to facilitate interconnecting the units with the internal cabling. The connectors on the wiring harness have also been similarly identified.

One internal connection is dependant on whether or not a TFP-1K harmonic filter (optional equipment) is included in the transmitter package. If the filter is included P3002 which is part of the wiring harness is mated to J402 (RF IN) on the TFP-1K filter and a separate cable (furnished with the unit) is used to connect J403 (RF OUT) of the TFP-1K to the internal side of J10 (RF OUT) on the interface panel. When the filter is not part of the transmitter the connector mates directly with the internal side of J10 on the interface panel, and the interconnecting cable terminated by plug P2012 on the wiring harness (which mates with J403 of the filter) attaches to a mating jack mounted on the right cabinet wall (as viewed from rear of transmitter) which by passes signal circuits required by the filter.

Reference should be made to the interconnecting wiring diagram, figure 2-3, for assistance in making these connections.

(2) External Connections. Most of the external connections to the transmitter are made at the interface panel. Mating connectors for the jacks mounted on the panel are furnished as "loose items" and are to be used to terminate those cables and connections which must be fabricated by the customer.

Connector J6 on the interface panel provides access to the transmitter for the external operating signals. The cabling to this connector is provided by the customer. Shielded wire should be used and the connections made as shown in table 2-1 to the mating plug provided.

TABLE 2-1. CONNECTIONS TO PLUG P6

Pin No.	Signal Input
A	Upper Sideband (600 ohm)
B	Upper Sideband (600 ohm)
C	Center Tap
D	Ground
E	Lower Sideband (600 ohm)
F	Center Tap
G	Lower Sideband (600 ohm)
H	Ground
K	FSK (-)
L	FSK (+)
M	Ground
N	FAX
P	FSK Contact Key
Q	FSK ground
R	CW Key
S	CW ground
T	PTT (need not be shielded)
U	PTT ground
V	None - 24VDC output

Connector J7 on the interface panel provides the customer with the means of adding remote controls and indicators to the transmitter. Refer to the wiring diagram figure 2-3 and make such connections as may be desirable. If certain controls are not used, jumper wires must be installed in the mating plug for this connector to ensure proper operation of the transmitter. Refer to table 2-2 for these connections.

TABLE 2-2. CONNECTIONS ON PLUG P7

Pin No.		Pin No.
B	jumper to	C
E	jumper to	G
R	jumper to	S
T	jumper to	U

Connector J8 allows the customer to monitor certain transmitter functions on remotely installed devices. The wiring diagram, figure 2-3, gives specific pin connection information.

Connector J10 on the interface panel is the point where the rf output signal from the transmitter is obtained. The mating plug is furnished as a "loose item" with the equipment. The customer must fabricate the shielded cable to carry this signal to the antenna or to the AX5176 tuning unit portion of the ATSA-3 antenna tuning system, if this equipment is a part of the specific configuration of the HFTA-1KJ2/1P transmitter. This cabling should conform to specification RG215/U.

If the tuning system is incorporated, a control cable must also be fabricated to carry the control signals to the AX5176 tuner at the antenna base. Table 2-3 shows the pin to pin connections to be made between the mating plug for P9 on the interface panel and the mating plug for J202 on the tuning unit. The length of this cable should not exceed 100 ft. For specific installation details and a preoperational check of the ATSA-3 system refer to the tuning system technical manual.

TABLE 2-3. CONNECTIONS ON PLUG P9

P9 Pin No.	To P202 Pin No.	P9 Pin No.	To P202 Pin No.	P9 Pin No.	To P202 Pin No.
A	A	P	P	d	c
B	B	R	R	e	d
C	C	S	S	f	e
D	D	T	T	g	f
E	E	U	U	h	g
F	F	V	V	j	h
G	G	W	W	k	j
H	H	X	X	m	k
J	J	Z	Y	n	l
K	K	a	Z	p	m
L	L	b	a	r	n
M	M	c	b	s	6
N	N				

Primary power for the transmitter must be supplied to the transmitter through a customer supplied connection to J2001. Plug P2001 (PL190-NG) is furnished as a "loose item" to facilitate the fabrication of this connection. This connector is located at the lower left rear of the equipment cabinet.

Two jacks, MIKE (J118) and KEY (J117) on the front panel of the MMX(A)-2 exciter accept respectively the input from a 47,000 ohm impedance microphone and the input from a dry contact keyer for CW mode of operation. The mating connectors, P117 (PJ055B) and P118 (PJ068B) are furnished as "loose items" with the transmitter, but the cabling must be fabricated by the customer.

2-4. FINAL INSPECTION

After all electrical connections have been completed the transmitter should be visually inspected to be sure of the following:

a. The interlocks are mechanically operable. One interlock switch is located on the rear wall of the cabinet and is closed when the rear door

is mounted on the cabinet. A second switch is located on the front cabinet wall and is closed when the AP152 high voltage power supply (the bottom unit) is in place and secured with panel locks.

b. All electrical connections have been properly made and that the connectors are mechanically secure in the correct positions.

c. The protective top and bottom cover are securely affixed to each modular unit and that the units are secured in the cabinet with panel locks or mounting hardware.

d. The rear cabinet door is in place and secured with the mounting hardware provided.

e. The antenna system or equivalent dummy load is properly connected to the rf output connector of the transmitter system.

2-5. PRE-OPERATIONAL CHECK

Although the HFTA-1KJ2/1P transmitter has been aligned and throughly tested to the manufacturer's specifications prior to shipment, it is necessary to verify correct installation by performing the pre-operational checks detailed in the technical manual for each of the components. It is most important to perform the high voltage check of the linear power amplifier (HFLA-1K) and the initial checkout of the MMX(A)-2 exciter.

Figure 2-3. Interconnect Wiring Diagram
Model HFTA-1KJ2/1P

(enclosed in envelope at the end of this volume)

SECTION 3

OPERATOR'S SECTION

3-1. GENERAL

The HFTA-1KJ2/1P transmitter provides 1 kilowatt average power output or 1 kilowatt PEP (peak envelope power) output in any of six operating modes. This section gives instructions for tuning, operating and monitoring the transmitter. These instructions consider the most complex transmitter configuration, that is, with both optional equipments (ATSA-3 antenna tuning system and TFP-1K harmonic filter) included. They are applicable, however, to any transmittr configuration in the HFTA-1K series if references to those units not included are omitted.

3-2. OPERATING CONTROLS AND SEQUENCE

The operator should become throughly familiar with the location and function of each control and indicator. Reference to the individual technical manual for each unit in the system will provide this information.

It is also important for the operator to establish a definite operating sequence as outlined in these instructions and to consistently follow it. Improper operation may place undue stress on system components.

3-3. PRELIMINARY CONTROL SETTINGS

Before applying any power to the transmitter the operator must be certain that the antenna or a dummy load is properly connected to the RF OUT connector of the system (J10 on the interface panel). The operator should also see that the transmitter controls are positioned as 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

TABLE 3-1. PRELIMINARY CONTROL SETTINGS (cont)

Modular Unit	Control	Setting
MMX(A)-2	ON/STANDBY switch	STANDBY
	CARRIER switch	0
	MODE switch	USB
	USB MIKE/LINE control	0
AX-5130	RF GAIN control	counterclockwise
ATSA-3	ON/AC switch	AC position (off)
	BYPASS/OFF	OFF position
TLAA-1K	LOAD control	0

3-4. OPERATING PROCEDURES

The HFTA-1KJ2/1P is primarily designed for operation as an automatically tuned transmitter. The desired operating frequency is manually set on the MMX(A)-2 exciter. The tunable components of the other units which comprise the transmitter are then automatically adjusted to accommodate the selected frequency. The complete procedure for automatic tuning is given in Table 3-2. If the transmitter has already been tuned and only a change in operating frequency is required, the operator should perform the necessary procedural steps in Table 3-3 to accomplish this retuning.

Provision has also been made in the design of the transmitter to tune each of the units manually should such an operating technique be required. Naturally such a procedure is more complex and requires more skill and understanding on the part of the operator. The procedural steps and directions given in Table 3-4 should be followed to manually tune the transmitter.

a. OPERATING PROCEDURES FOR TRANSMITTER TUNING. To initially tune or to retune the transmitter, proceed as directed in Tables 3-2, 3-3 or 3-4.

TABLE 3-2. PROCEDURE FOR AUTOMATIC TUNING ON CARRIER

Step	Modular Unit	Operation	Normal Indication
1	AX5130	Set AUTO/MAN switch (on chassis) to AUTO position	None

TABLE 3-2. PROCEDURE FOR AUTOMATIC TUNING ON CARRIER (cont)

Step	Modular Unit	Operation	Normal Indication
2	AX5175	Set AUTO/MAN switch (on chassis) to AUTO position.	None
3	AX5175	Set AUTO/SENSE/P.POS switch to AUTO position.	None
4	AX5175	Set BYPASS/OFF switch to OFF position.	None
5	MMX(A)-2	Set frequency selector switches to the desired frequency.	Selected frequency is displayed on the digital indicator associated with each switch.
6	MMX(A)-2	Set EXCITER switch to ON position.	None
7	AP151	Set ALARM switch to the down (off) position.	None
8	AP152	Place MAIN POWER circuit breaker to ON position.	MAIN POWER indicator lights PA blower operates (audible). Band indicator lights on TFP-1K unit for selected band. When time delay cycle (approx. 30 sec.) is complete INTERLOCKS indicator, on the AP151 lights. (BLUE)
		CAUTION If transmitter has not been operated for sometime, wait 10 to 15 minutes for all tube filiments to warm up.	
9	AP151	Set SCREEN and PLATE breakers to ON position.	None
10	MMX(A)-2	Set ON/STANDBY switch to ON position.	STANDBY indicator lamp (WHITE) goes off and POWER indicator lights. (RED)

TABLE 3-2. PROCEDURE FOR AUTOMATIC TUNING ON CARRIER (cont)

Step	Modular Unit	Operation	Normal Indication
		NOTE STANDBY indicator lights when external power is supplied to the transmitter.	
11	AX5175	Set ON/AC switch to ON position.	AC indicator lights. Band indicator for selected band lights. When elements are pre-positioned, P.POS indicator lights.
12	AX5130	Set POWER LEVEL switch to the position for the desired output power level.	None
13	AX5130	Press HIGH VOLTAGE pushbutton switch.	Both HIGH VOLTAGE indicators light (one on the AP151 unit).
		NOTE It may be necessary to press the HIGH VOLTAGE pushbutton switch twice.	
14	AX5130	Press TUNE button to initiate automatic tuning.	SERVO indicator then SEARCH indicator light on the AX5130 as tuning cycle progresses. Next, the RF TRIG indicator on AX5175 unit lights followed by the RDY indicator at the completion of the antenna tuning cycle. The OPER indicator on the AX5130 lights and the RF GAIN control adjusts to the selected power level momentarily indicated on the OUTPUT meter. When tune cycle is complete green READY indicator lights on the AX5130.

TABLE 3-2. PROCEDURE FOR AUTOMATIC TUNING ON CARRIER (cont)

Step	Modular Unit	Operation	Normal Indication
15	AP151	Set ALARM switch to ON position.	None

This completes the automatic tuning sequence.

TABLE 3-3. PROCEDURE FOR RETUNING TO A DIFFERENT FREQUENCY

Step	Modular Unit	Operation	Normal Indication
1	AX5130	Press TUNE push button.	READY light goes off RF GAIN control rotates in a counter clockwise direction to the minimum output position.
2	MMX(A)-2	Set frequency selector switches to the desired frequency.	Selected frequency is displayed on the digital indicator associated with each switch. The appropriate band indicators on the TLAA-1K, the AX5175 and the TFP-1K units light.
3	AX5130	Set POWER LEVEL switch to the position for the desired power level.	None
4	AX5130	Press TUNE push button again.	SEARCH indicator then SERVO indicator light as tuning cycle progresses. Next the RF TRIG indicator on the AX5175 unit lights followed by the RDY indicator at the completion of the antenna tuning cycle. The OPER indicator on the AX5130 lights and the RF GAIN control adjusts to the selected power level momentarily indicated on the OUTPUT meter. When tune cycle is complete green READY indicator lights.

This completes the automatic retuning sequence.

TABLE 3-4. PROCEDURE FOR MANUAL TUNING TRANSMITTER

Step	Modular Unit	Operation	Normal Indication
1	AX5130	Set AUTO/MAN switch (on chassis) to MAN position.	None
2	AX5175	Set AUTO/MAN switch (on chassis) to AUTO position.	None
3	AX5175	Set BYPASS/OFF switch to OFF position.	None
4	AX5175	Set AUTO/SENSE/P.Pos switch to P.Pos position.	None
5	MMX(A)-2	Set frequency selector switches to the desired frequency.	Selected frequency is displayed on the digital indicator associated with each switch.
6	MMX(A)-2	Set EXCITER switch to ON position.	None
7	AP151	Set ALARM switch to OFF position.	None
8	AP152	Place MAIN POWER circuit breaker to ON position.	MAIN POWER indicator lights. PA blower operates (audible). Band indicator on TFP-1K unit lights. When time delay cycle (approx. 30 sec.) is complete INTERLOCKS indicator lights.

CAUTION

If transmitter has not been operated for sometime, wait 10 to 15 minutes for all tube filaments to warm up.

9	AP151	Set SCREEN and PLATE breakers to ON position.	None
10	MMX(A)-2	Set ON/STANDBY switch to ON position.	STANDBY indicator lamp goes off. POWER indicator lights.

TABLE 3-4. PROCEDURE FOR MANUAL TUNING TRANSMITTER (cont)

Step	Modular Unit	Operation	Normal Indication
		NOTE STANDBY indicator lights when external power is supplied to the transmitter.	
11	AX5175	Set ON/AC switch to the ON position.	AC indicator lights. BAND indicator lights.
12	AX5130	Rotate RF GAIN control fully counterclockwise.	None
13	TLAA-1K	Rotate BAND switch in clockwise direction one step at a time until positioned for the appropriate band for the selected frequency.	Indicator lamps light to indicate band selected.
		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 pushbutton sequentially until the appropriate BAND indicator illuminates.	
14	TFP-1K	Observe that the bandswitch has been properly positioned for the selected frequency (action controlled by the AX5130 servo unit).	Lighted indicator lamp shows band selected.

TABLE 3-4. PROCEDURE FOR MANUAL TUNING TRANSMITTER (cont)

Step	Modular Unit	Operation	Normal Indication
		NOTE Bandswitch on the TFP-1K filter unit may be manually rotated if necessary.	
		CAUTION Be certain that the RF GAIN control switch is in the fully counterclockwise position before proceeding with the steps which follow.	
15	AX5175	Refer to the individual technical manual for the ATSA-3 antenna tuning system (table 3-3 step 4) and preposition the tuning elements as directed before continuing with these procedures.	The ATSA-3 manual gives a complete description of the required indications.
16	AX5130	Press HIGH VOLTAGE pushbutton switch. (It may be necessary to press the HIGH VOLTAGE pushbutton twice).	Both HIGH VOLTAGE indicators light (one on the AP151 unit).
		NOTE During initial tuning of the transmitter, output power will be increased or decreased with the RF GAIN control located on the AX5130.	

TABLE 3-4. PROCEDURE FOR MANUAL TUNING TRANSMITTER (cont)

Step	Modular Unit	Operation	Normal Indication
		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.	
17	AX5130	Carefully adjust the RF GAIN control in a clockwise direction to increase the PA plate current.	Ip meter on the TLAA-1K indicates the plate current (DO NOT exceed 250 ma).
18	TLAA-1K	Adjust TUNE control for a peak on the OUTPUT meter.	The output of the transmitter is indicated on the OUTPUT meter.
19	AX5175	Set AUTO/SENSE/P.Pos to MANUAL SENSE.	None
20	AX5175	Refer to the individual technical manual for the ATSA-3 antenna tuning system (table 3-3, step 8) and tune the antenna.	The ATSA-3 manual gives a complete description of the required indications.
21	TLAA-1K	Readjust the TUNE control to achieve resonance.	At resonance, the OUTPUT meter indicates a maximum or peak value.

TABLE 3-4. PROCEDURE FOR MANUAL TUNING TRANSMITTER (cont)

Step	Modular Unit	Operation	Normal Indication
22	TLAA-1K	Press and hold the REFL pushbutton.	OUTPUT meter indicates reflected power.
23	AX5175	Carefully adjust the L and C switches to obtain a minimum value of reflected power.	OUTPUT meter indicates reflected power.
24	TLAA-1K	Release the REFL pushbutton.	OUTPUT meter indicates output power.
25	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 in step 21. Continue to adjust the LOAD control clockwise in slight increments until there is no further increase in plate current. Turn the LOAD control slightly counterclockwise 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.	
26	AX5130	Rotate the RF GAIN control clockwise to increase output power to the desired level.	OUTPUT meter on the TLAA-1K indicates the average power level; Ip meter on the TLAA-1K indicates the plate current.

TABLE 3-4. PROCEDURE FOR MANUAL TUNING TRANSMITTER (cont)

Step	Modular Unit	Operation	Normal Indication
		If necessary, repeat step 25 and readjust with RF GAIN control until desired output is achieved.	
27	MMX(A)-2	Set CARRIER switch to FULL.	Zero output indicated on OUTPUT meter on TLAA-1K unit.
28	AP151	Set ALARM switch to ON position.	None

This completes the manual tuning sequence.

NOTE

When the transmitter is tuned automatically, the green READY indicator lights to indicate completion of tuning. The transmitter is then ready for transmission of intelligence. When the transmitter is tuned manually, the operator must determine, by the observation of normal indications, that the transmitter is properly tuned and ready to transmit intelligence. Refer to paragraph 3-4 b for intelligence operation.

b. OPERATING PROCEDURES FOR INTELLIGENCE MODES. The intelligence mode in which the HFTA-1KJ2/1P transmitter is operated is determined by the type of intelligence to be transmitted and by local conditions. The operator should be familiar with the capabilities and limitations of the transmitter in each of the operating modes. The transmitter is capable of delivering 1 KW of peak envelope power (PEP) or 1 KW average power (Pave). When the transmitter is initially tuned on carrier, PEP and Pave are equal since all of the power is contained in a single tone, the carrier. This power level is indicated on the OUTPUT meter, an average power indicating device. In voice or other multitone transmissions however, PEP and Pave are NOT equal. The PEP value is inherent in the design of the equipment. The average power is derived from the addition of the carrier power and the power of each individual modulating tone when the carrier and the tones are in phase or at the crest of the modulation wave. The transmitter is capable of providing 1 KW peak envelope power in all intelligence modes; however the average power, the power monitored on the OUTPUT meter, must be decreased in multitone transmission.

The more tones (teletype tones, carrier, voice, etc.) which are being transmitted, the less average power, as indicated on the OUTPUT meter. Figure 3-1 shows average power (measured in percent of peak envelope power) as a function of the number of tones being transmitted.

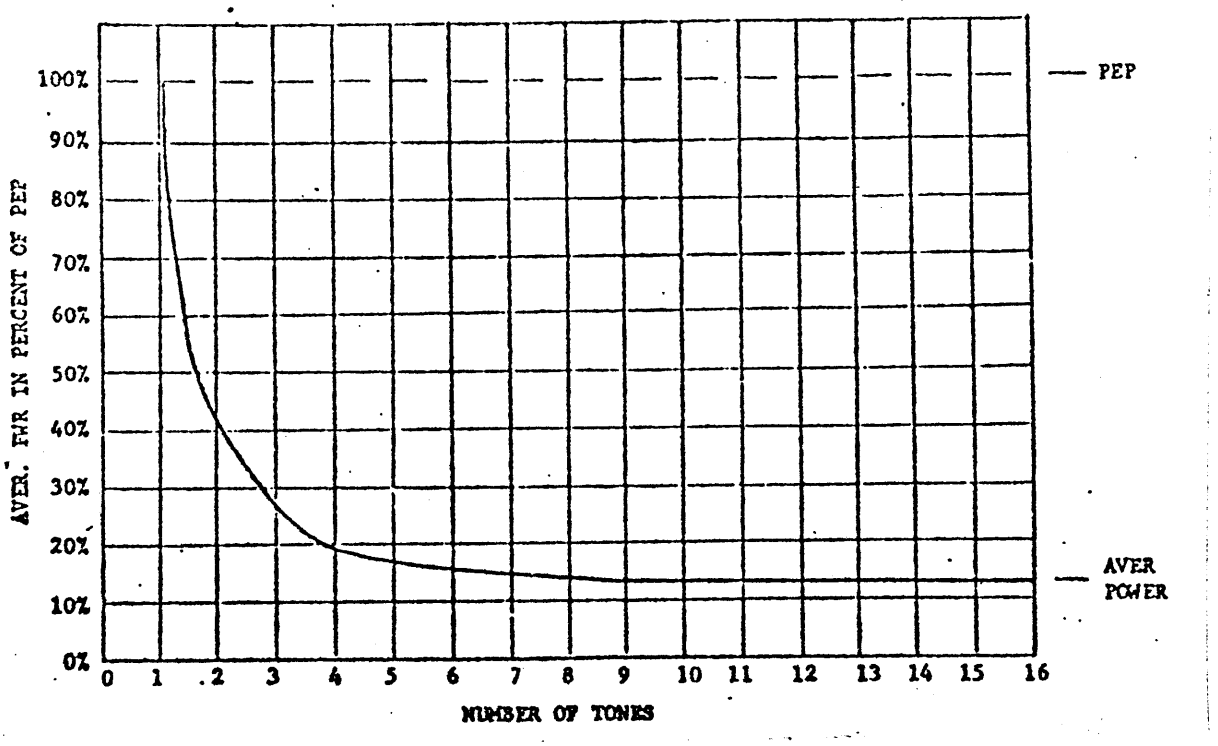

Figure 3-1. Ratio of Average Power and PEP
As a Function of Tones

Two typical examples of proper operation, utilizing the relationship shown in figure 3-1, are given as follows:

(1) A single sideband transmission of two teletype tones with suppressed carrier at the full power level (1,000 watts PEP): The MMX(A)-2 MODE switch should be in the USB position and the CARRIER SUPPRESSION switch in the FULL position, providing full suppression of carrier. The transmission contains two tones, and by reference to figure 3-1 the maximum average power should be approximately 50% of the 1,000 watt PEP, or 500 watts average. The USB audio level control on the MMX(A)-2 should be adjusted so that the transmitter OUTPUT meter reads approximately 500 watts average.

(2) AME transmission of voice at the 800 watts PEP power level: The MMX(A)-2 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 200 watts (1/4 power). PEP is derived from the addition of carrier voltage and tone voltages. With carrier suppressed 6 db from PEP, the carrier voltage is already one half of the total voltage at PEP. The sum of the tone voltages must not exceed the remaining one half of the total voltage at PEP. Similarily, since the carrier voltage and the voltage available for tones are equal, so are the carrier power and the total tone power available. A maximum of approximately 200 watts PEP is available for tone transmission. A voice transmission contains an infinite number of tones, and by reference to figure 3-1, the average power for an infinite number of tones should be approximately 10% of 200 watts (20 watts). The CARRIER SUPPRESSION switch in the 6 db position will provide approximately 200 watts on the transmitter OUTPUT meter, and the USB audio level control on the MMX(A)-2 should be adjusted so that the transmitter OUTPUT meter reads approximately 220 watts average (the addition of carrier and intelligence power).

It is important that the exciter's intelligence levels be adjusted properly for the approximate average power on the OUTPUT meter, so that the transmitter's peak envelope power rating will not be exceeded. The transmitter also features automatic load and drive control (ALDC) circuits, which perform the function of limiting the exciter output during high modulation peaks, so that the transmitter's PEP will not be exceeded. The average power (Pave) will also vary in different operating modes as does the carrier power (Pc).

In the conventional AM mode the carrier power (Pc) is limited to one fourth of the maximum available power so that at the peak of the modulation cycle the design rating will not be exceeded resulting in destortion or exceeding component specifications. This is accomplished by suppressing the carrier 6 db. In the HFTA-1KJ2/1P transmitter this limits the carrier power to 250 watts.

For similiar reasons when transmitting a multitone signal (voice for instance) in a SSB mode the average power (Pave) should not exceed 10 percent of the rated PEP.

Before operating the transmitter in the intelligence modes recheck the tuning as outlined in table 3-3. If the operating frequency is not to be changed, do not perform step 3 but check the frequency setting. Steps 1 thru 13 of table 3-2 outline the procedure for applying power to the transmitter. Connect the external signal source to the transmitter. If a microphone is used set the EXCITER switch on the MMX(A)-2 to the PTT position.

c. MONITORING THE TRANSMITTER. Perhaps the most practical method of ensuring that the design limits of the transmitter are not exceeded, while making the most efficient use of the power available to transmit intelligence, is to monitor the rf voltage output of the transmitter. Peak envelope power (PEP) is a direct function of that voltage as expressed in the formula Epev (or Emax)= PEP Z, where Z is equal to the resistive impedance load of the antenna system. This value (Z) remains constant, and is assumed to be 50 ohms.

The rf output voltage may be measured with an oscilloscope. To monitor the rf output voltage proceed as follows:

(1) Using the oscilloscope, monitor a sample of the transmitter's rf output.

(2) Set the MODE switch on the MMXA-2 exciter to the CW mode and close the keyline. (In this mode the average power and the PEP will be equal).

(3) Apply power to the transmitter (refer to table 3-2 steps 1 through 13).

(4) Adjust the RF GAIN control on the AX5130 unit so that the OUTPUT meter indicates the desired output power level but does not exceed the 1 KW rated power level.

(5) Adjust the oscilloscope controls so that the amplitude of the oscilloscope pattern is set at an easily measured or observable value, i.e. two vertical scale units.

NOTE

The oscilloscope display is indicative of Epev or Emax.

(6) Set the MODE switch to the desired operating mode.

(7) If carrier is to be transmitted, adjust it to its proper level.

(8) Continue to observe the oscilloscope display and adjust the audio gain (MIKE/LINE) control(s) as necessary so that the maximum value of Epev (established in step 3) is not exceeded.

NOTE

Do not readjust the oscilloscope controls unless the base measurement of Epev is maintained.

(9) The transmitter may be operated in any intelligence mode without exceeding the design limitations, providing that the maximum voltage output (Epev) is maintained within the established limit.

3-5. OPERATOR MAINTENANCE PROCEDURES

Day-to-day visual checks of the equipment will detect the most obvious defects; frayed cables, blown fuses, burned-out indicator lamps, cracked glass or broken knobs. A more thorough visual inspection including those components housed in the equipment cabinet should be made at regular intervals. Components showing signs of wear, aging or overheating should be noted and replaced if necessary. Accumulated dust or other foreign material should be removed. A regular program of operator care and the repair or replacement of defective minor parts may prevent serious failures and unnecessary "down-time".

A complete test of the transmitter operation including the tests mentioned in paragraph 2-5 and those detailed in this section should be performed at regularly scheduled intervals. All of the necessary adjustments, major repairs or replacement of components should be made at this time.

3-6. TRANSMITTER BIAS ADJUSTMENT PROCEDURE

The bias adjustments outlined below are to obtain proper quiescent plate current in each amplifier stage. Before bias adjustments can be made, the low voltage power supply AP151 must be extended on its slides to expose the bias adjustment potentiometers.

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

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

c. Set AUTO/MANUAL switch to MANUAL.

d. Be sure that RF GAIN control is at minimum setting (maximum counter-clockwise rotation).

TABLE 3-5. 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

Maximum bias voltage will be present if:
1. Bandswitches are not in proper positions.
2. PTT relay is not energized.
3. Bias controls are set in maximum clockwise position.

When maximum bias voltage is present at V1201, V1202, and V1301 the plate currents are reduced or near cutoff.

e. Press HIGH VOLTAGE button to apply high voltage, as shown when the HV indicator lights.

f. Observe "Ip" meter and adjust PA BIAS control as necessary to obtain an indication between 200 ma - 210 ma as shown on Ip meter.

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

h. Hold meter switch down (1St AMP position) observe Ip meter and adjust 1ST AMP bias control as necessary to obtain an indication between 60 ma-80 ma as shown on the Ip meter.

i. Press HIGH VOLTAGE switch to remove high voltage, (HIGH VOLTAGE indicator must go out). Replace top cover on low voltage power supply drawer and slide drawer back to original position and secure.

3-7. OVERLOAD CIRCUIT TESTS

a. PURPOSE. The overload circuitry functions to protect the transmitter against damage from excessive current and VSWR overloads. Because of the importance of providing this protection the overload circuit should be checked occasionally for proper operation and correct limit settings. These tests are outlined in the following paragraphs.

b. PA OVERLOAD TEST.

(1) Reset the overload indicating pointer (red) on the Ip meter to 240 ma by turning the adjustment screw (upper screw) located just below the meter face. (The lower screw is the meter zero adjust).

NOTE

The normal setting of this indicator is at 300 ma.

(2) Set the AUTO/MANUAL switch in the AX5130 servo control unit to the MAN position.

(3) Loosen panel locks and extend the low voltage power supply (AP151) drawer on the slide mounting to gain access to the bias adjustment (BIAS ADJUST) controls located just behind of the front panel.

(4) Energize the transmitter (MAIN POWER circuit breaker ON PLATE and SCREEN breakers ON and HIGH VOLTAGE on).

(5) Note that the Ip meter indicates a normal plate current on the plate of the PA amplifier tube (200 - 210 ma). Then, slowly increase this plate current to 240 ma (the indicator test setting) by turning the PA BIAS ADJUST control in a counterclockwise direction.

(6) When the plate current reaches a value of 240 ma observe the following:

(a) The high voltage circuit breakers open and the alarm sounds.

NOTE

For convenience during tests the alarm may be silenced after acertaining that it operates correctly. The alarm is silenced by placing the ALARM switch in the (down) position.

(b) The face of the Ip meter is illuminated to indicate the trouble source.

(c) The pointer of the Ip meter remains at the overload value.

(7) Readjust the PA BIAS ADJUST control to a maximum clockwise position.

(8) Reapply the high voltage and repeat steps (5) (6) and (7).

NOTE

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

(9) Following the second successful test of the PA overload circuit, reset the overload indicator on the Ip meter to 300 ma.

(10) Reapply the high voltage and adjust the PA bias so that the plate current on the PA amplifier as indicated on the Ip meter is 200 - 210 ma.

(11) Reactivate the alarm by placing the ALARM switch in the ON position.

(12) Reset the AUTO/MAN switch in the AX5130 servo control unit to the AUTO position.

(13) Slide the AP151 power supply back into place and secure panel locks.

c. SECOND AMPLIFIER OVERLOAD TEST AND ADJUSTMENT.

(1) Place AUTO/MAN switch in the AX5130 servo control unit in the MAN position.

(2) Loosen panel locks and extend the TLAA-1K three-stage amplifier drawer on the slide mounting to gain access to the 2ND AMP potentiometer (A1001R1) located on the underside of the unit on the outer left hand corner of the PC board.

(3) Loosen panel locks and extend the AP151 low voltage power supply on the slide mounting to gain access to the bias adjustment controls located just behind the front panel.

(4) Energize the transmitter (MAIN POWER circuit breaker ON, PLATE and SCREEN breakers ON, and HIGH VOLTAGE on).

(5) Set the toggle switch of the meter selector switch to the 2ND AMP position and hold in place.

(6) Note that the Ip meter indicates a normal plate current on the plate of the second amplifier tube of 260 - 300 ma. Then, slowly increase this plate current by turning the 2ND AMP BIAS ADJUST control in a counterclockwise direction.

(7) When the plate current displayed on the Ip meter reaches a value of 400 ma observe the following:

(a) The high voltage circuit breakers open and the alarm sounds.

(b) The face of the Ip meter is illuminated to indicate the trouble source.

(c) The Ip meter indicates zero.

(8) If an indication of 400 ma fails to actuate the overload circuit, adjust the potentiometer (A1001R1) while maintaining a plate current of 400 ma, until action described in step (7) takes place.

(9) Readjust 2ND AMP BIAS ADJUST control to a maximum clockwise position.

(10) Recheck the operation of the overload circuit by repeating steps (4), (5) and (6).

CAUTION

Test failures, after proper adjustments have been made, require trouble shooting procedures beyond the normal scope of operator maintenance.

(11) Adjust the 2ND AMP BIAS control to provide a normal plate current of 260 - 300 ma as indicated on the Ip meter.

(12) Set the AUTO/MAN switch in the AX5130 servo unit to the AUTO position.

(13) Return the extended units to the rack and secure.

(14) Reactivate the alarm.

d. SWR OVERLOAD TEST & ADJUSTMENT.

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

(2) Place AUTO/MAN switch in the AX5130 servo control unit in the MAN position.

(3) Extend the TLAA-1K three stage amplifier unit on the mounting slides to gain access to the SWR adjust potentometer (A1001R2) located on the underside of the unit.

(4) Energize the transmitter (MAIN POWER circuit breaker ON PLATE and SCREEN breakers ON, HIGH VOLTAGE on).

(5) Manually tune the transmitter into a 50 ohm dummy load or antenna at any frequency between 2.0 and 30.0 MHz.

(6) Push REFL pushbutton and increase the RF GAIN until a reading of 110 watts is indicated on the REFLECTED POWER scale (red) of the OUTPUT meter. (This setting corresponds to a VSWR of 2:1).

(7) Observe that the SWR overload circuit is activated and the following action takes place when step (6) is completed.

(a) The high voltage circuit breakers open and the alarm sounds.

(b) The face of the OUTPUT meter is illuminated indicating the trouble source.

(c) The Ip meter indicates zero.

(8) Reduce the rf gain by turning the RF GAIN control in counter-clockwise direction.

(9) Push the HIGH VOLTAGE switch twice to re-energize the transmitter.

NOTE

HIGH VOLTAGE indicating lamps in switch housings must light.

(10) Recheck the operation of the SWR overload circuit by repeating steps (6), (7) and (8).

(11) Completely shut down the transmitter (PLATE and SCREEN circuit breakers off and MAIN POWER circuit breaker off).

(12) Remove the reactive components temporarily installed in the antenna circuit.

(13) Set the AUTO/MAN switch in the AX5130 servo control unit to AUTO.

(14) Return the extended units to the rack and secure.

(15) Reactivate the alarm.

SECTION 4

PRINCIPLES OF OPERATION

4-1. GENERAL

The HFTA-1KJ2/1P consists of several precision electronic equipments modularly housed and mounted in a single equipment rack or cabinet. The units are electrically linked together and interact to provide a stable output signal in the frequency range of 2.0 to 29.9999 MHz, in any of six operating modes.

The technical manuals for each of the subsystems which comprise the transmitter give the technical details for each unit. Reference should be made to these publications for specific circuit data. The principles of operation presented in this section discuss the transmitter on a functional level and only to the extent that each unit effects the overall system.

4-2. SYSTEM OPERATION

The system block diagram figure 4-1 illustrates the basic interconnect of the system components. The basic carrier frequency is derived in the multi-mode exciter MMX(A)-2. This unit provides a maximum of 250 milliwatts rf output which 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 PEP or average power.

When the transmitter is in the automatic 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-Q to the exciter remote jack J119-T for tune carrier control.

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

(3) A fixed 24 vdc is routed from AP151 (J301-A) to exciter control jack (J119-V) for remote control of the exciter's RF OUTPUT control.

(4) A variable dc voltage is routed from the AX5130 servo control unit (J204) to the exciter control jack (J119-Y). This variable voltage will control the exciter's rf output.

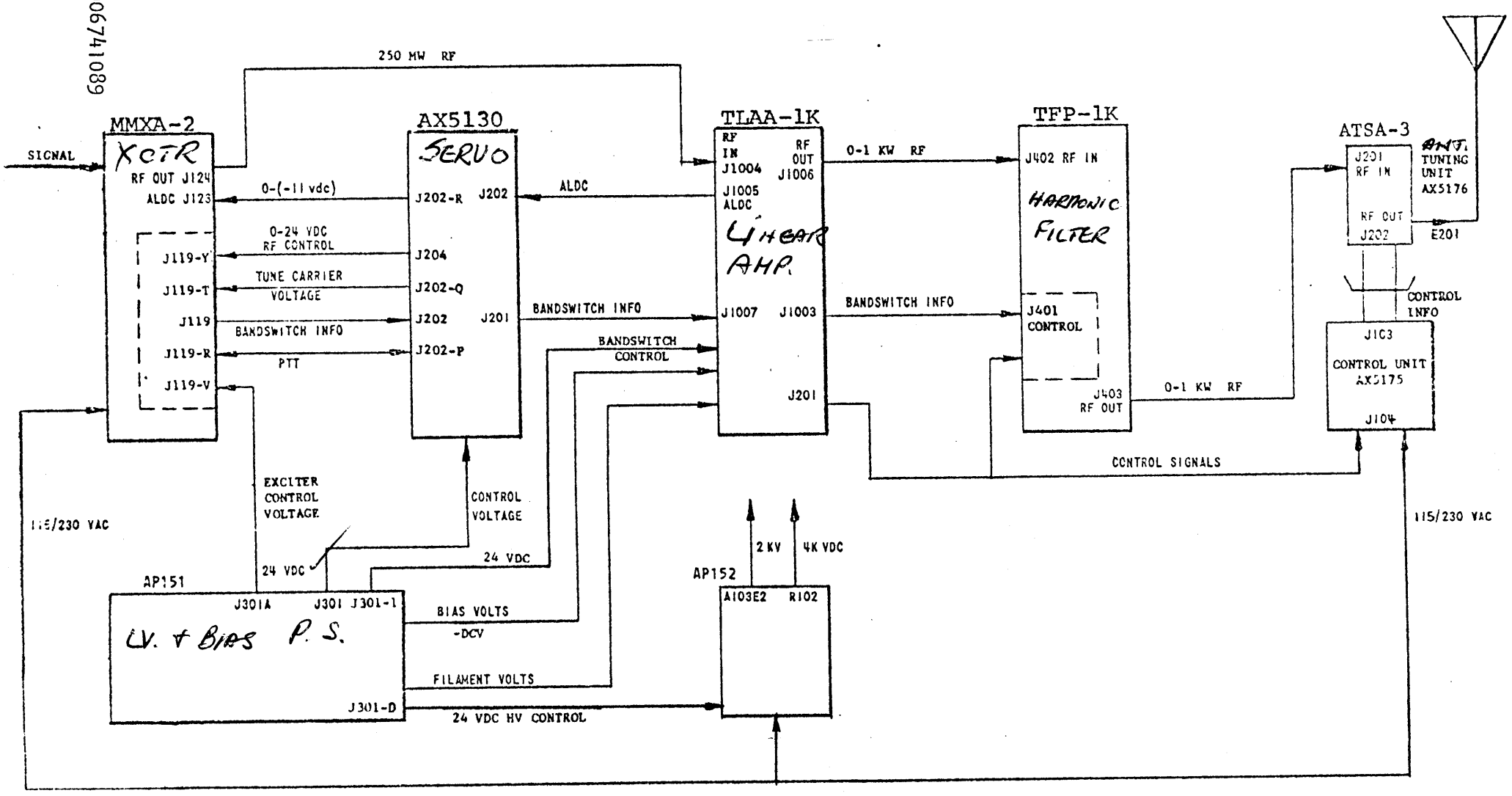

Figure 4-1. Functional Block Diagram HFTA-1KJ2/1P Transmitter

The paragraphs which follow 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 AX5130 (P/O HFLA-1K) provides 24 vdc to the MMX(A)-2 at J119-T, when the transmitter is in a tune state. This input to the MMX(A)-2 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)-2: 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)-2, via contacts on the PTT relay will route a ground (from J119-S to J119-R). 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)-2 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-R. 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) and 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(A)-2 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 AX5130 unit. The RF OUTPUT control on the exciter's front panel is recessed and is not in the circuit when the MMX(A)-2 is connected into the system and the transmitter is on.

The transmitter provides a fixed +24 vdc to the MMX(A)-2 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's motorized RF GAIN control (on AX5130) is routed to the exciter control jack J119-Y and applied to the rf adjust circuitry Z119 which controls the exciter output (J124), applied to the RF INPUT jack (J1004) of the TLAA-1K linear amplifier.

d. BANDSWITCH POSITIONING. Automatic bandswitch control connections are made between the components of the HFTA-1KJ2/1P as follows:

MMXA-2		AX5130	
FREQUENCY (MHZ)	BAND SELECT OUTPUT (J119)	BAND SELECT INPUT (J202)	BAND SELECT OUTPUT (J201)
2.0 - 2.5999	C	E	b
2.6 - 2.9999	D	F	a
3.0 - 4.9999	E	G	z
5.0 - 7.9999	F	H	y
8.0 -11.9999	G	J	g
12.0 -15.9999	H	K	f
16.0 -24.9999	J	L	e
24.0 -29.9999	K	M	d

TLAA-1K		
BAND SELECT INPUT (J1007)	BAND (MHZ)	BAND SELECT OUTPUT (J1007)
N	2.0 - 2.6	3
M	2.6 - 3.0	2
L	3.0 - 5.0	z
K	5.0 - 8.0	y
T	8.0 -12.0	x
S	12.0 -16.0	w
R	16.0 -24.0	v
Q	24.0 -30.0	w

TFP-1K

BAND SELECT INPUT (J401)	BAND (MHZ)
B	2.0 - 3.0
C	2.0 - 3.0
D	3.0 - 5.0
E	5.0 - 8.0
F	8.0 -12.0
G	12.0 -16.0
H	16.0 -30.0
J	16.0 -30.0

ATSA-3

BAND SELECT INPUT (J104)	BAND (MHZ)
A	2.0 - 2.6
B	2.6 - 3.0
C	3.0 - 5.0
D	5.0 -30.0
E	5.0 -30.0
F	5.0 -30.0
G	5.0 -30.0
H	5.0 -30.0

When a carrier frequency is selected by the manual positioning of the frequency selector switches on the front panel of the MMX(A)-2, 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 preposition 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 MMXA-2. 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 pin 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 selector is in position 4, 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 preposition its bandswitch(es) in the 16.0 to 24.0 MHz band. When the transmitter amplifier bandswitches are prepositioned, the harmonic filter receives an input at J401 to automatically preposition its harmonic filter bands. Once the filter is connected in the transmitter system its operation is automatic regardless of the transmitter's operation mode (manual or automatic). Once the harmonic filter is prepositioned in its proper band the antenna tuning system receives an input and its bandswitch automatically prepositions.

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 preposition for the selected frequency. Once prepositioning 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 on 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, 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) The PTT line opens if the exciter is in the PTT mode. The transmitter is now ready for PTT operation.

(3) The ground inhibit placed on the ALDC input is removed once the READY lamp lights, enabling the ALDC circuitry.

SECTION 5

MAINTENANCE AND TROUBLESHOOTING

5-1. INTRODUCTION

The transmitter is designed for long term, trouble-free operation. If it becomes necessary to perform alignment and/or adjustments to the equipment, it is recommended that technicians thoroughly familiar with the equipment perform the necessary operations outlined in the associated HFLA-1K, MMX(A)-2, TFP-1K, and ATSA-3 technical manuals. The following maintenance aids are provided for system troubleshooting and localization of malfunctions.

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

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

(3) 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 unit technical manuals for additional 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

Section 3 of this publication presents maintenance instructions to the extent of the operator's responsibility . Reference should also

be made to the individual technical manuals for the equipments which comprise the transmitter. It is suggested that the preventive maintenance outlined in the following paragraph (5-4) may well be assigned to the operator.

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.

CAUTION

When using trichlorethylene, avoid allowing it to contact painted surfaces, because of its paint-removing effects.

5-5. TROUBLESHOOTING

Troubleshooting the transmitter section consists of isolating faults to the MMX(A)-2 exciter, TFP-1K harmonic 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 the operator's section for normal indications.

a. MMX(A)-2 EXCITER. To isolate the exciter unit from the transmitter for troubleshooting proceed as follows:

(1) Disconnect existing cable from the MMX(A)-2 RF OUT jack (J124) and connect 50 ohm 1 watt non inductive dummy load to the MMX(A)-2 RF OUT jack.

(2) Turn transmitter OFF (MAIN POWER breaker off (down) position), apply power to MMX(A)-2 independently of the transmitter (115 or 230 vac as required).

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

b. TFP-1K HARMONIC FILTER. Isolation of the harmonic filter for troubleshooting consists of removing cables from J401, J402 and J403 on the TFP-1K and performing the troubleshooting procedure outlined 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 to 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(A)-2 exciter and connect a signal generator to the TLAA-1K RF INPUT jack. Place the ATSA-3 functionally out of circuit as described in paragraph c. Operate the transmitter manually into a 50 ohm resistive dummy load or an antenna system and monitor the TLAA-1K meters for proper operation. (Refer to operating procedures in section 3 for normal indications).

SECTION 6

PARTS LIST

6-1. GENERAL

The HFTA-1KJ2/1P transmitter consists of the MMX(A)-2 exciter, the HFLA-1K linear power amplifier, the TFP-1K harmonic filter and the ATSA-3 antenna tuner. The parts lists for these components are contained in their respective technical manuals.