TECHNICAL MANUAL

for

TRANSPORTABLE
TRANSMITTER/RECEIVER SYSTEM

MODEL SYM5203

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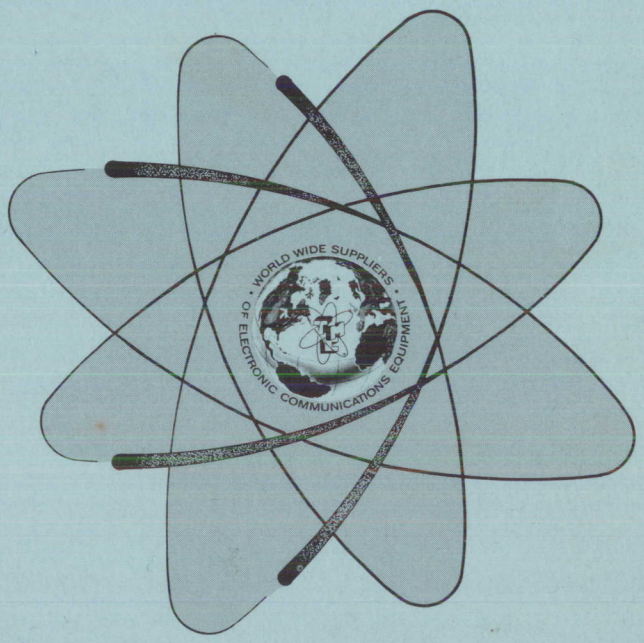

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, ONTARIO

Printed in U.S.A.

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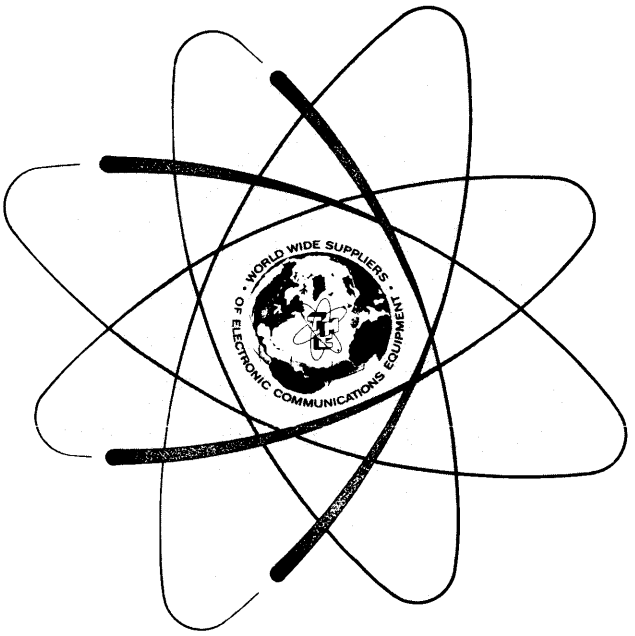

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NOTICE

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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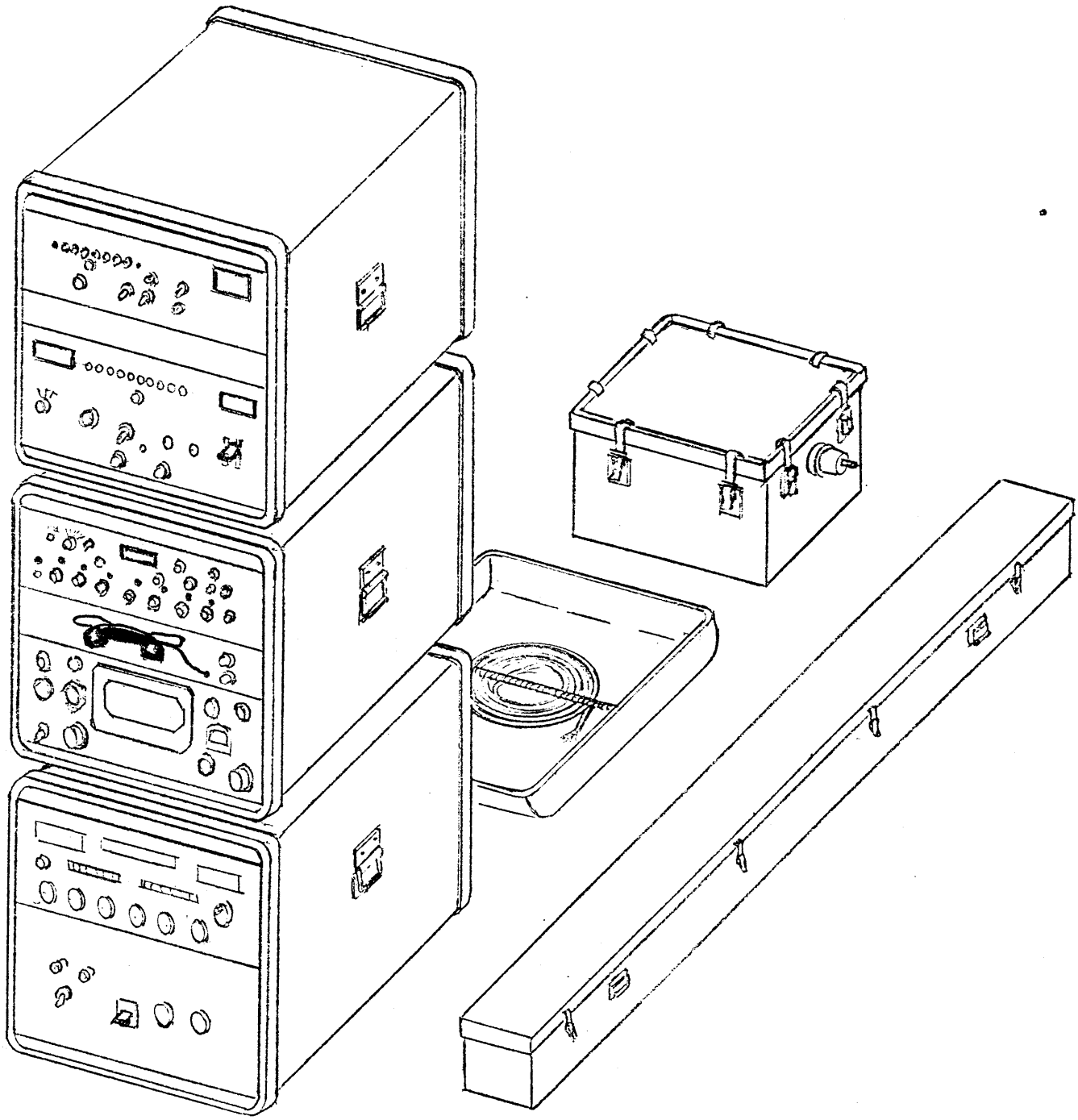

Figure 1-1. The SYM5203 System

SECTION 1

GENERAL INFORMATION

1-1. INTRODUCTION

In response to the need for a compact, transportable transmitter/receiver system, The Technical Materiel Corporation of Mamaroneck, New York, designed and manufactured the SYM5203 shown in figure 1-1. Except for the tuning unit of the antenna tuning system the SYM5203 is contained in three cubical transmit/operating cases and a fourth oblong case for the transportation of the collapsible antenna, and other accessories. The tuning unit is self contained.

All of the necessary cabling is part of the system so that when the components are interconnected only primary power need be supplied to have a working 1 KW (PEP) communications center.

The SYM5203 Transmitter/Receiver System consists of several modular units. Table 1-1 provides the nomenclature for the system components and shows their relationship by indention.

TABLE 1-1. THE SYM5203 COMPONENTS

Nomenclature	Name
SYM5203	Transmitter/Receiver System
MMX(M)-2	Exciter
HFL-100	High Gain Amplifier (IPA)
TMA-1K	Power Amplifier
ATS-2A	Antenna Tuning System
MCU-2	Monitor Control
CU2-50	Directional Coupler
TU-2	Antenna Tuner
GPR-110	General Purpose Receiver
RL-139	Transmit/Receive Relay
AX5199	Handset Panel
AX5201	Circuit Breaker Panel
VAS-1	Vertical Antenna System
	Cabling Set

1-2. FUNCTIONAL DESCRIPTION

The transmitter will operate in the range of 2.0 to 30.0 MHz in any of eight modes as indicated in table 1-2. Six receiving modes are available for frequencies between 100 kHz and 30 MHz.

TABLE 1-2. EMISSION CLASSIFICATION FOR THE SYM5203

Operating Mode	Abbreviation	Emission Code
Continuous Wave	CW	A1
Amplitude Modulation	AM	A3
Amplitude Modulation Equivalent	AME	A3H
Pilot Carrier	PC	A3A
Upper Sideband	USB	A3J
Lower Sideband	LSB	A3J
Independent Sideband	ISB	A3B
Frequency Shift Keying (optional with additional equipment)	FSK	F4

The system transmitter will deliver 1 KW of peak envelope power (PEP), 500 watts average power in any operating mode.

The sensitivity of the GPR-110 receiver is at least 5.0 uv at any operating frequency and mode, but better than 0.5 uv in the sideband modes.

The VAS-1 antenna system coupled with the RL-139 relay provides the single source for both the transmission and reception of the rf signals. It is tuned to a resonant condition by the ATS-2A antenna tuning system which is a component of the system transmitter.

In the transmitter the intelligence input controls or modulates the selected synthesized carrier frequency. The resultant rf signal with the carrier suppressed as required by the operating mode is filtered to remove the unwanted sideband and directed to the HFL-100 broadband amplifier.

The HFL raises the 100 mw rf input to the 50 watt level necessary to drive the TMA-1K power amplifier.

In the TMA the rf signal is raised to the full power level in two steps. The 500 watt (average) output is then sent to the antenna for transmission through the TU-2 antenna tuner.

The SYM5203 system is held in a "receive" status by the RL-139 transmit/receive relay except during the actual transmission of intelligence.

1-3. PHYSICAL DESCRIPTION

Three 4.5 cubic foot transmit cases house the modular components of the SYM5203 transmitter/receiver. These are referred to as:

1. Transmitter case
2. Exciter case
3. Receiver case

The vertical antenna system is transported in a metal case, 11 inches deep x 1 foot wide x 7.25 feet long. The tuning unit which mounts at the base of the antenna is protected during transit by the fiber glass case which is the unit housing.

Each of the cubical cases is fitted with snap-lock front and rear covers which are easily removed for access to the units during operation. Carrying handles have been provided on all the cases.

The HFL-100 linear amplifier and the TMA-1K power amplifier are housed in case No. 1, the transmitter case. Case No. 2, the exciter case, contains the MMX(M)-2 exciter, the MU-2 monitor control unit and the handset panel. The CU2-50 directional coupler and the RL-139 transmit/receive relay are also mounted in case No. 2. The GPR-110 receiver and the AC power control panels mount in case No. 3, the receiver case. The antenna case holds the A1486 antenna, the mounting base, and support legs as well as the antenna counterpoise and interconnecting cables, ground stakes and supporting rods.

The approximate transportable weight of the five cases is shown in table 1-3.

TABLE 1-3. TRANSPORT CASE WEIGHTS

Case No.	Name	Approx. Weight
1	Transmitter Case	103 lbs.
2	Exciter Case	80 lbs.
3	Receiver Case	81 lbs.
4	Antenna Case	74 lbs.
5	Tuning Unit	44 lbs.

Special interlocking feet have been provided so that the cubical cases may be stacked for operation in confined areas.

For efficient operation the controls and indicators on all units are located on the front panels. All interconnections and external inputs or system outputs are made at the rear panels. An interface panel located at the rear of the exciter case provides a convenient terminus for the external connections.

1-4. REFERENCE DATA

The technical characteristics of the SYM5203 are shown in table 1-4. Table 1-5 lists the power amplifying tube complement of the system.

TABLE 1-4. TECHNICAL SPECIFICATIONS

Transmitter

Operating Frequency Range:	2.0 to 30.0 MHz selectable in 100 Hz steps.
Stability:	Within 1 part in 10^8 per day.
Modes of Operation:	Eight switch selected modes as shown in table 1-2.
Power Output:	1000 watts PEP or 500 watts average.
Output Impedance:	50 ohms
VSWR:	Maximum of 2:1 without performance degradation.
Tuning:	Manual
ALDC:	Automatic Load and Drive Control circuit improves linearity, limits distortion and maintains a relatively constant output level during high modulation peaks and load changes. Rear panel adjustment sets the level at which ALDC takes effect.
Spurious Response:	At least 50 db down from full PEP output.
Power Requirement:	Approximately 1.8 KW at 115/230 volts, single phase, 50/60 Hz.
Environmental Limitations:	Operating, 0 to 50°C with a relative humidity to 90 percent. Storage, -40 to 80°C with a relative humidity to 95 percent.
Cooling:	Filtered forced air.
Features:	Safety interlocks, overload protection fused power inputs, monitored inputs and outputs.

TABLE 1-4. TECHNICAL SPECIFICATIONS (cont)

Receiver

Operating Modes:	AM, CW, USB, LSB, ISB, AME.
Frequency Range:	100 kHz to 30 MHz, continuous.
Stability:	One part in 10^8 per day, after warmup.
Sensitivity:	SSB, with 3 kHz passband: 0.5 uv from 400 kHz to 30 MHz for 10 db (S+N)/N.
	AM, with 6 kHz passband: 4.0 uv from 400 kHz to 30 MHz for 10 db (S+N)/N.
	CW, with 1 kHz passband: 5.0 uv from 400 kHz to 30 MHz for 10 db (S+N)/N.
Input Impedance:	50 ohms nominal, unbalanced.
Outputs:	
Internal Monitor Sepaker:	Switchable; LSB, USB or AM
External Monitor Speaker Output:	3 watts; less than 1 percent distortion at one watt.
Primary Power:	115/230 volts AC, single phase, 50/60 Hz.

TABLE 1-5. TUBE COMPLEMENT

Unit	Reference Designation	Part Number or Type	Function
HFL-100	V101	12HG7*	1st RF Amplifier
	V102	12HG7*	2nd RF Amplifier
	V103	4CX350	3rd RF Amplifier
TMA-1K	V101	8163*	Power Amplifier
	V102	8163*	Power Amplifier

* Operated in parallel

1-5. OTHER PUBLICATIONS

Technical manuals have been prepared for the several individual units which comprise the SYM5203 system. Perusal of these publications prior to working with or on the SYM5203 system is strongly recommended. Specific details pertinent to the installation, operation or repair of the modular units is often only found in these presentations.

SECTION 2

INSTALLING AND DISMANTLING THE SYSTEM

2-1. INITIAL RECEIPT AND INSPECTION

Experienced test personnel in the TMC test facility have ascertained that the SYM5203 transmitter/receiver system met all operational requirements prior to shipment.

Following the successful completion of the test procedures the system cabling was disconnected and stored in the covers under the retaining springs. The accessory equipment was similarly stored and the covers were installed on the three cubical cases. Foam packing, which should be retained, protects these items during transportation. The five transportable cases were then crated for shipment.

Upon arrival care should be exercised during the uncrating process to avoid damage to the contents. All packing and dunnage should be removed, and the equipment inspected for evidence of shipping damage. A claim against the carrier should be filed if damage for which he is responsible is discovered. The Technical Materiel Corporation will assist in rectifying any such damage by describing repair methods and recommending renewal parts.

The covers of the three cubical transit cases should be set aside and the equipment checked to be sure all controls are operable. An internal inspection of each modular unit should be conducted on a one at a time basis.

WARNING

The modular units are bracket mounted in the transit cases. Be careful when pulling them for internal inspection.

Be sure that the amplifier tubes are firmly seated and that all installed connectors and terminal board connections are secure.

Following the initial inspection of all of the equipment, and a final check of the packing list provided to be certain that all material has been received, the transit case covers may be replaced and the system transported to the initial installation site.

2-2. POWER REQUIREMENTS

The transmitter will operate from a 115 or a 230 volt single phase power source. Each unit is factory wired to accommodate the voltage level indicated by the customer. A change in source voltage level will require that the transformer primary windings be rewired. The internal interconnection diagram in the unit technical manuals show the necessary wiring changes which should be made prior to installation. The protective fuses must also be changed. The power source must be capable of supplying up to 1.8 kw.

2-3. INSTALLATION

When the SYM5203 transmitter/receiver system arrives at the site where the communications center is to be established the first task is the assembly of the vertical antenna system. Next, the interconnecting cabling must be installed, the accessory equipment added and primary power supplied.

a. Antenna System.

When the location where the antenna is to be erected has been determined, prepare a narrow trench six inches into the ground. This trench should be in the form of a cross with arms two feet long. Assemble the support legs as shown in figure 2-1 by sliding the slot in one leg over the vertical wall of the other. Mount the ten inch square antenna mounting base to the assembled support using the eight, 1/4-20 bolts supplied. Using the three 3/8 inch bolts mount the insulating base to the antenna base. Place the assembled support and base in the prepared trench at a level attitude and pack the earth firmly around it as shown in insert A on figure 2-1. Using a hardwood block to protect the threaded end, drive the four 3-foot support-rods through the holes at the end of each support leg, and secure with the nuts and washers supplied. Level the base by adjusting the nuts on the support rods and shimming as necessary. Secure the six wires of the counterpoise to the mounting base using the hardware supplied and extend then full length radially to the six five foot ground stakes spaced at 60 degree angles around the antenna base. Secure the wires to the stakes with the band clamps provided. Extend the four sections of the collapsible antenna mast full length and secure with the set-screws. Fasten the three guy ropes to the ring on the antenna mast and set the mast over the mounting bushing on the insulating base. Secure the mast to the mounting bushing with the two 2 inch 1/4-20 bolts and nuts provided as shown in insert B figure 2-1. Drive the three stakes for anchoring the guy ropes about 18 feet from the antenna base spaced 120 degrees apart around the antenna. Secure the guy ropes to the anchor stakes and pull taut. Figure 2-2 shows the antenna installed with the tuning unit in place.

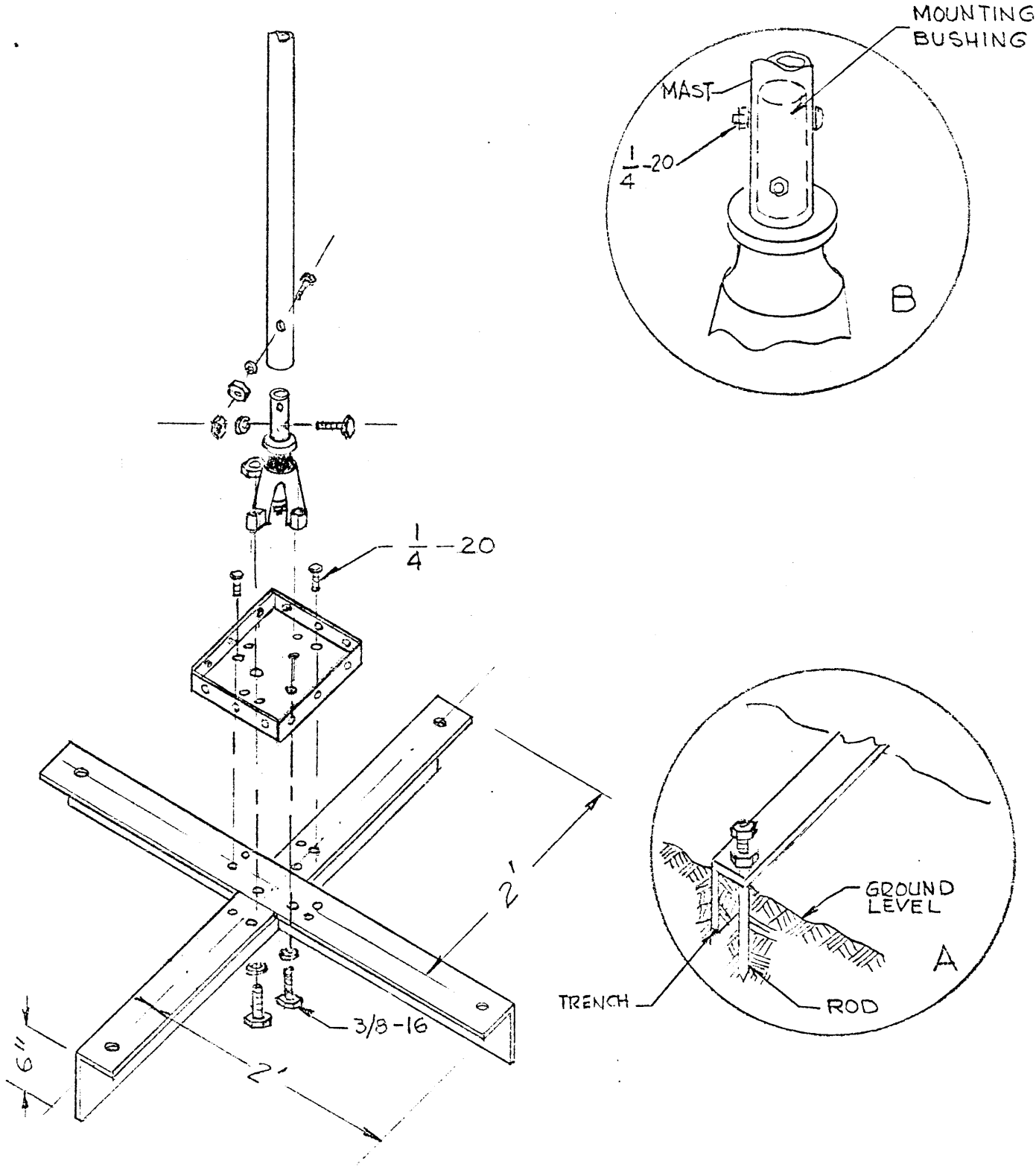

Figure 2-1. Antenna Assembly

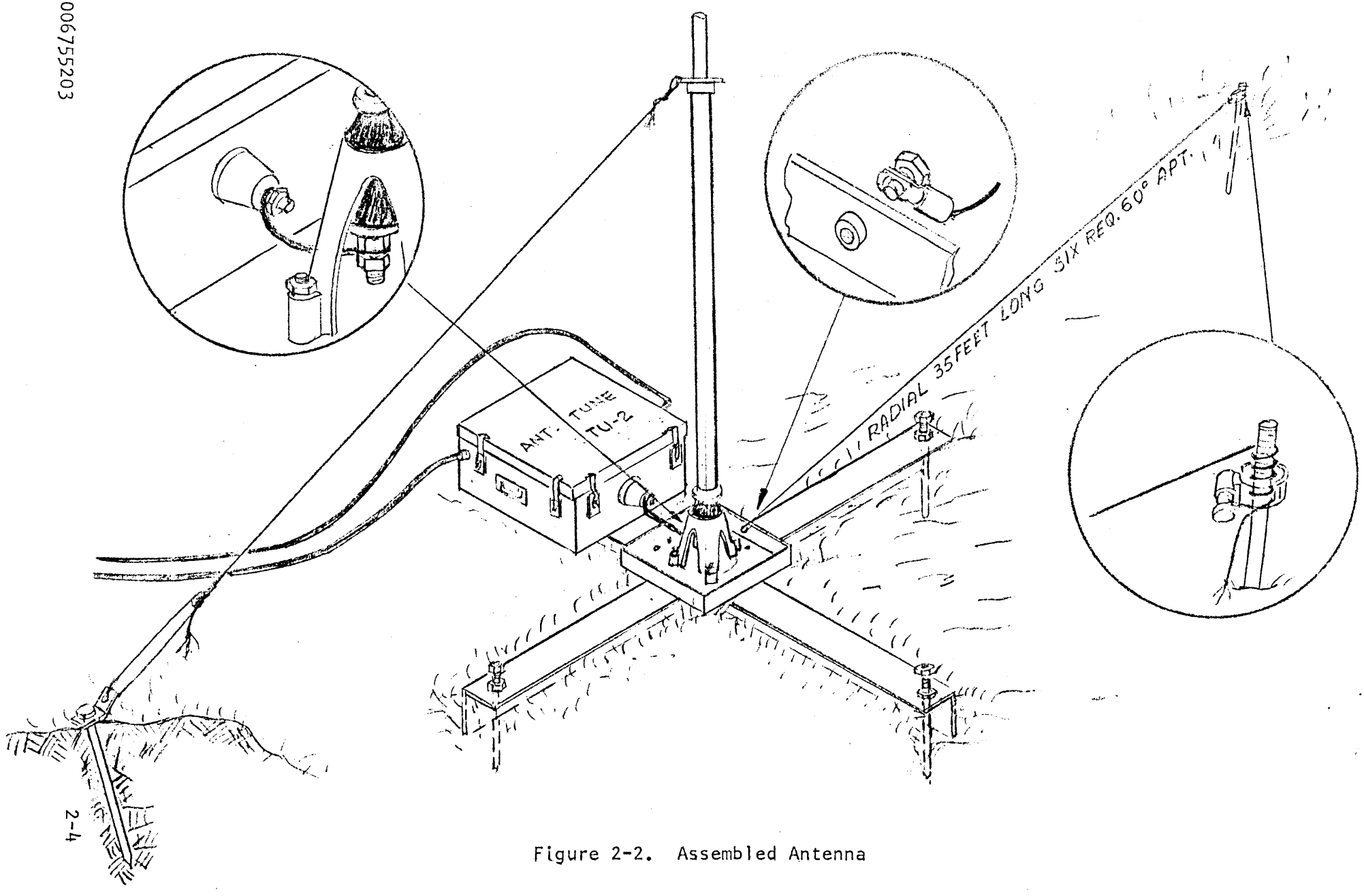

Figure 2-2. Assembled Antenna

b. Case Installation.

The modular nature of the SYM5203 afforded by the transit case mounting of the system components allows the user to vary the installation configuration to suit prevailing site conditions and operating needs. However, any variation of the design configuration shown in figure 1-1 is left to the users discretion. The tuning unit must, of course, be mounted at the antenna base.

When selecting an installation site, bear in mind, that adequate ventilation must be available as the SYM5203 is a air cooled system.

When the cases are in position remove the front and rear covers, and take out the cables and accessory equipment transported there in. The covers may then be stored.

Suitable protection must be provided at the rear of the installation to safeguard personnel, since voltages as high as 3 KV are present when the unit is operating.

c. Interconnecting Cabling.

There are twenty-two cables in the cable set for the SYM5203. Only thirteen need be installed when setting up the communications center. The balance were installed during factory test and remain with the equipment. Figure 2-3 is a block diagram of this internal cabling. Table 2-1 lists those which must be added as a step in the installation process. The loose cables are transported in the equipment covers. Each of the cables is marked with the cable number for easy identification.

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.

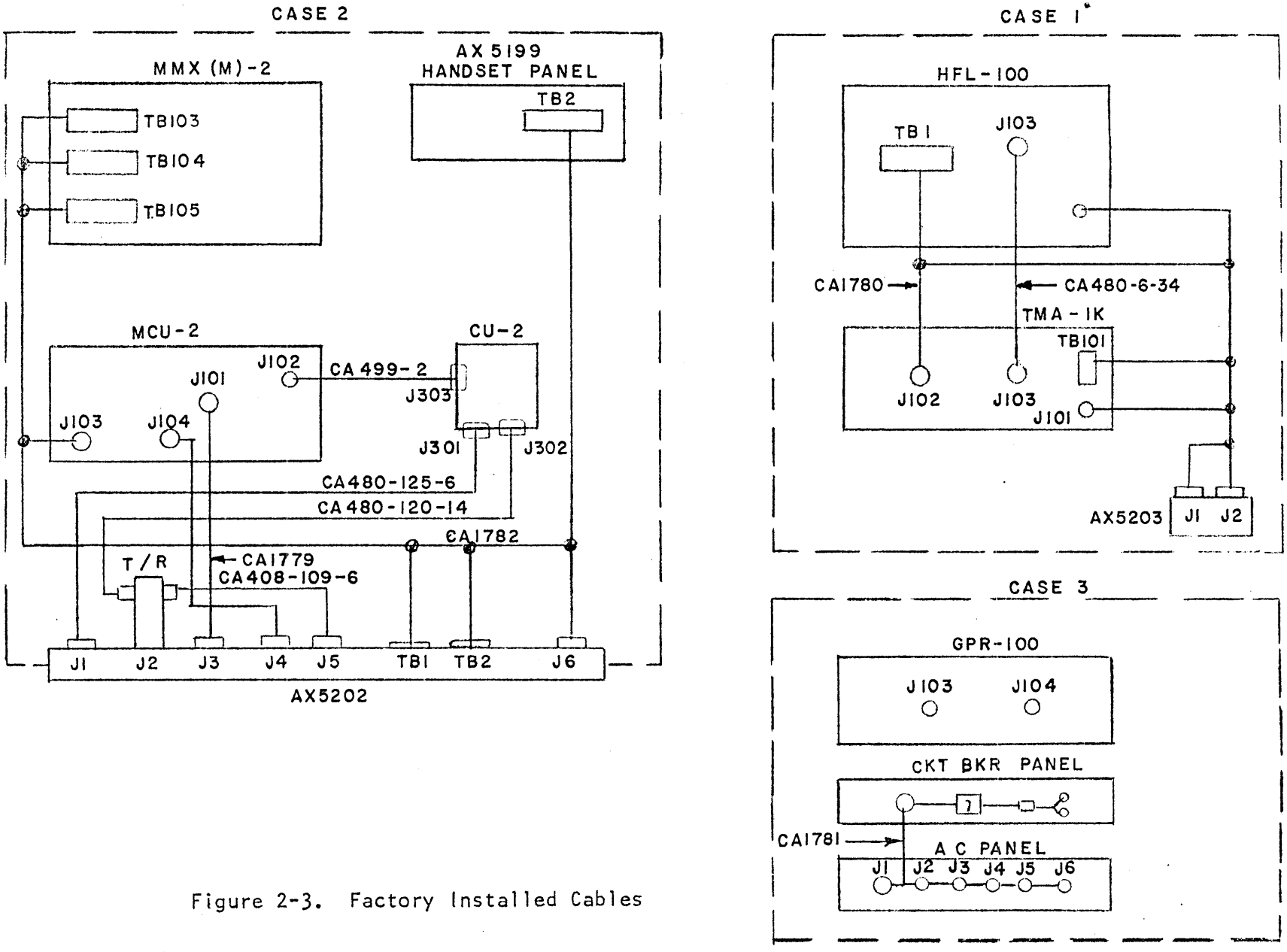

Figure 2-3. Factory Installed Cables

TABLE 2-1. LOOSE CABLES

Cable No.	Carries	From	To
CA480-5-42	100 mw RF	MMX-J124	HFL-J201
CA480-3-26	ALDC	TMA-J104	MMX-J123
CA1783	Control Signals	INTFC-J6	AX5023-J1 and GPR-J103
CA480-5-37	Received Signals	INTFC-J5	GPR-J104
CA480-34-24	500W RF	TMA-J102	INTFC-J1
CA1785	AC	AX5200-J5	INTFC-J4
CA1786	AC	AX5200-J4	AX5203-J2
CA1784	AC	AX5200-J2	MMX-J116
CA412-90-24	500W RF Signals	TU-E202	Antenna
CA1788	Control Signals	INTFC-J3	TU-J201
CA480-120-50F	500W RF Signal	INTFC-J2	TU-J203
CA409-234-8	Intercase ground	Case 1	Case 2
		Case 2	Case 3

Figures 2-4 and 2-5 delineate the installation of these cables. To complete the cabling primary power must be supplied. The plug (PL190-NG) which mates with J1 on the interface to supply primary power has been furnished, but a cable of suitable length for the installation must be fabricated and connected. Reference to the interconnection diagram figure 2-6 will assist the installer in making system connections. The cable number of those cables which are factory installed have been underlined on the interconnection drawing (figure 2-6).

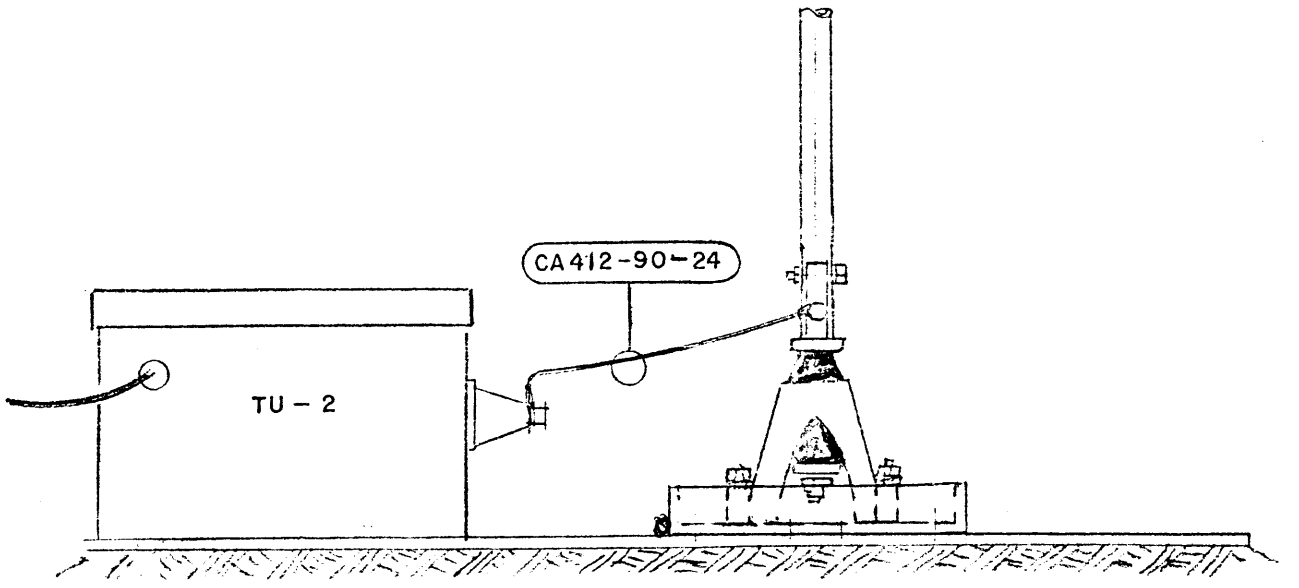

Figure 2-4. Antenna Installation Cabling

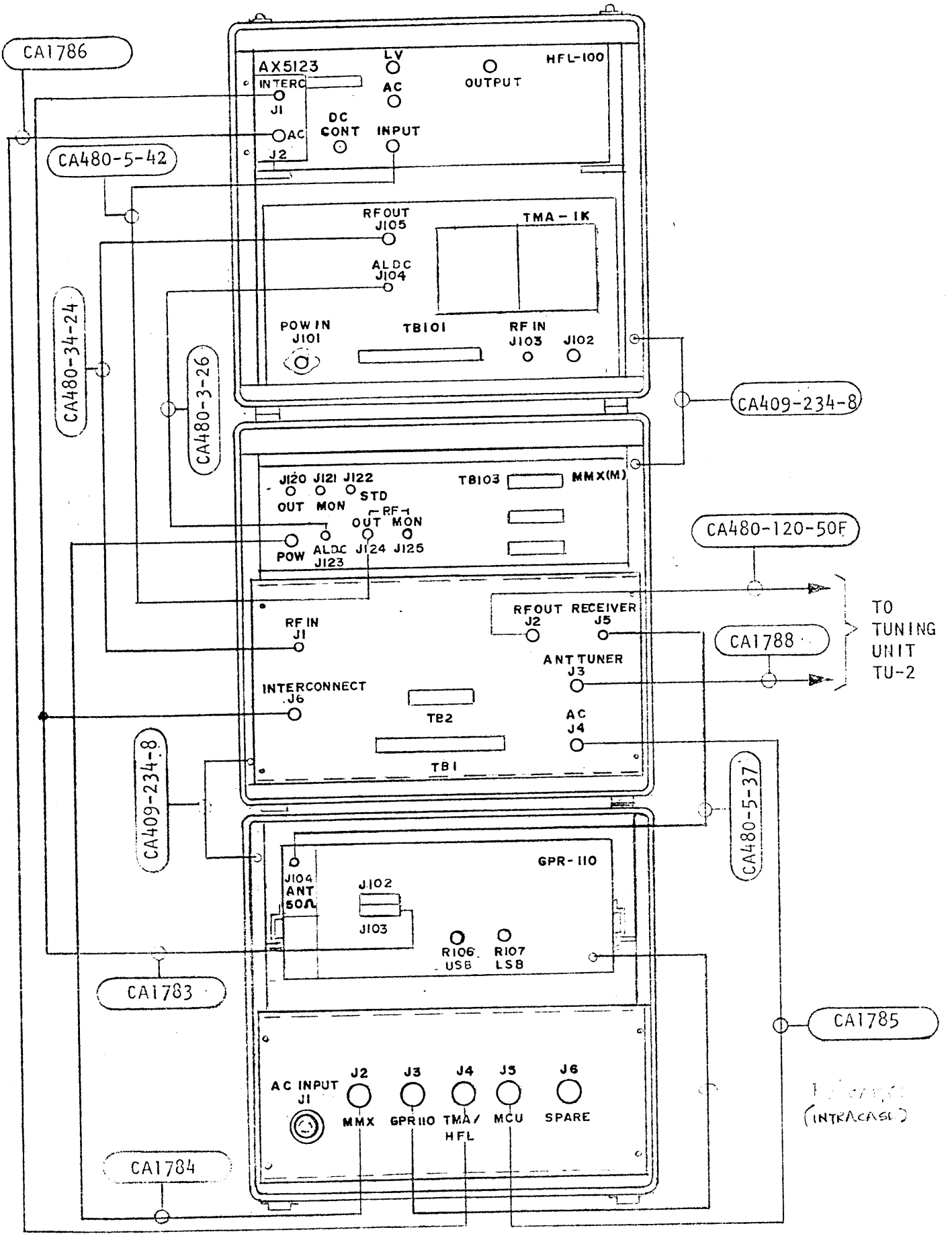

Figure 2-5. Intercase Cabling

Any additional peripheral equipment such as a remote speaker, or dry contact key should be added and the handset installed.

When the cabling is completed, the EXCITER POWER ON/OFF switch on the circuit breaker panel should be set to the ON position, and the AC switch on the GPR-110 turned slightly clockwise.

2-4. PREOPERATIONAL CHECKS

When the installation is complete the initial tests and preoperational checks described in the technical manuals for the system components should be performed. A thorough check at this time will prevent undue stress on any part of the system, thus, ensuring long-term, trouble-free operation. It is recommended that only electronic technicians familiar with the SYM5203 system perform these tests.

2-5. DISMANTLING THE SYM5203

The design of the SYM5203 is such that the location of the communications center which it provides can conveniently be changed.

Dismantling the system requires only that the installation process be reversed.

WARNING

Disconnect primary power by removing the PL-190 plug from the interface J1, and affix a warning tag to J1 to prevent inadvertant use.

A suggested procedure is as follows:

1. Set all control switches to an "off" position.

2. Disconnect the interconnect cabling.

3. Stow the thirteen disconnected cables and the power cable under the retaining springs in the rear covers.

4. Remove the handset and other accessory equipment and secure with the retaining springs in the covers.

5. Replace the foam packing in each cover.

6. Replace the front and rear covers on each transport case.

CAUTION

Make certain that all modular units are securely mounted in the transit cases before attaching covers.

7. Dismantle the antenna system and pack in the antenna case.

NOTE

To simplify the removal of the support rods and ground stakes, a stake pulling tool has been furnished.

8. Gather all loose hardware and pack in the antenna case.

9. Secure the cover of the antenna case.

Figure 2-6. Interconnect Wiring Diagram

(Enclosed in an envelope at the end of this volume)

SECTION 3

OPERATION

3-1. INTRODUCTION

The transmitter in the SYM5203 system will provide one kilowatt (PEP) or 500 watts average power at any frequency from 2.0 to 30.0 MHz in any of eight operating modes. This section gives instructions for tuning, operating and monitoring the transmitter. Instructions for the operation of the GPR-110 used in the receiver portion of the system will be found in the individual technical manual for that equipment included in this presentation.

3-2. OPERATING CONTROLS AND SEQUENCE

The technical manual for each modular component of the system shows the location and function of each control and indicator. The operator must be knowledgeably familiar with this information before attempting to work with or on the system.

It is also important to establish an approved sequence of operation which should be habitually followed. Undue stress on system components may be the result of taking operational procedural steps out of order. These instructions present an approved operating sequence.

3-3. PRELIMINARY CONTROL SETTINGS

Before applying any power to the system, the operator must be certain that the antenna or suitable dummy load is properly connected to the rf output connector (E202, the bowl type connector on the tuning unit).

The EXCITER POWER ON/OFF switch was set to the ON position at the end of the installation procedure. This switch setting allows a separately fused line built into the system to supply power to the oven heaters for the crystal oscillators in the exciter and receiver with the control switches in those units set to STANDBY and the AF GAIN switch on the receiver rotated slightly clockwise. Good operating practice dictates that these switches should remain in this position to maintain the frequency stability of the equipment. This switch setting also provides power to the auxiliary AC socket on the CB panel. The position of the other controls in accordance with table 3-1 must be verified by the operator as the first step in transmitter use.

TABLE 3-1. PRELIMINARY CONTROL SETTINGS

Modular Unit	Control	Setting
CB Panel (AX5201)	Main Circuit Breaker	OFF
HFL-100	AC ON/OFF switch	OFF
	LOCAL/REMOTE	LOCAL
	HV ON/OFF switch	OFF
	IP/RF switch	IP
TMA-1K	MANUAL/AUTO/REMOTE	MANUAL
	AC switch	down position (off)
	HV switch	down position (off)
MMX(M)-2	ON/STANDBY switch	STANDBY
	CARRIER switch	0
	MODE switch	USB
	MIKE/LINE controls	0
	RF OUTPUT control	fully counterclockwise
	METER switch	RF
	EXCITER switch	ON
MCU-2	POWER switch	OFF
	METER switch	RES
	TUNE/OPERATE switch	TUNE
GPR-110	AC switch	slightly clockwise
	STBY/REC switch	STBY

3-4. OPERATING PROCEDURE

The SYM5203 is a manually tuned system. The tuneable components of the units are adjusted by the operator to accommodate the selected carrier frequency and the achieve a resonant condition in the antenna system. The efficient operation of the system depends in a large measure on the skill and technical understanding of the operator. Only experienced operators with an intimate knowledge of the SYM5203 should attempt to use the system. Table 3-2 gives the procedural steps necessary to tune the transmitter. The instructions for tuning the receiver are given in the technical manual for the GPR-110 which is a part of this presentation.

TABLE 3-2. TRANSMITTER TUNING PROCEDURE

Step No.	Modular Unit	Operation	Normal Indication
1	All	Verify the switch settings listed in table 3-1.	Settings indicated by knob index.
2	MMX(M)-2	Select operating mode with MODE selector switch.	Index on knob shows setting.
3	MMX(M)-2	Set frequency selector switches to desired frequency.	Selected frequency is displayed on the digital indicator associated with each switch.
4	CB Panel (AX5201)	Set MAIN POWER circuit breaker to the on position (up).	AC indicator lamp lights.
5	HFL-100	Set AC switch to ON position.	AC indicator lights.
6	TMA-1K	Set AC switch to the ON position (up).	AC indicator lights. Band indicator lights.
7	MCU-2	Refer to the technical manual for the ATS-2A Antenna Tuning Ssystem and perform steps 1-7 given in table 3-2 of that manual.	Technical manual gives the results to be desired.
8	MMX(M)-2	Set ON/STANDBY switch to ON position.	Amber STANDBY indicator goes out. Red POWER indicator lights.
		CAUTION Allow sufficient time for tube filaments to heat (at least one minute) before proceding.	
9	HFL-100	Set HV switch to ON position.	HV indicator lamp lights. Band indicator lights. Ip meter indicates 50-70 ma.
10	HFL-100	Press and release the BAND pushbutton sequentially until bandswitch is properly positioned for the selected operating frequency.	Band indicators light to indicate selected band.

TABLE 3-2. TRANSMITTER TUNING PROCEDURE (cont)

Step No.	Modular Unit	Operation	Normal Indication
11	TMA-1K	Press and release the BAND pushbutton sequentially until bandswitch is properly positioned for the selected operating frequency.	Band indicators light to indicate selected band.
		CAUTION Be certain that band selected is the one which will accommodate the operating frequency.	
12	TMA-1K	Set HV switch to the on (up) position.	HV indicator lamp lights. Ip meter indicates 200 ma.
13	MMX(M)-2	Rotate RF OUTPUT switch slowly clockwise until Ip meter on the TMA-1K indicates 300 ma.	Ip meter indicates plate current.
14	TMA-1K	Operate the TUNE lever switch to obtain the required normal indication.	OUTPUT meter indicates the highest obtainable output under circuit conditions.
		CAUTION Maintain an output of less than 100 watts by the adjustment of the RF OUTPUT control on the MMX(M)-2 exciter.	
15	MCU-2	Perform steps 9-12 of table 3-2 in the technical manual.	Technical manual gives results to be desired.
16	TMA-1K	Readjust TUNE level to obtain peak output.	OUTPUT meter indicates average output power.
17	MMX(M)-2	Rotate RF OUTPUT control slowly clockwise to obtain approximately 450 watts average.	OUTPUT meter indicates average output power.
18	MCU-2	Perform steps 13-15 of table 3-2 in the technimanual.	Technical manual gives results to be desired.

TABLE 3-2. TRANSMITTER TUNING PROCEDURE (cont)

Step No.	Modular Unit	Operation	Normal Indication
19	TMA-1K	Readjust TUNE lever for peak output.	OUTPUT meter indicates maximum obtainable output (peak) when resonance is achieved.
		NOTE A peak reading on the OUTPUT meter should be accompanied by a decrease (dip) in the magnitude of the plate current as indicated on the Ip meter. The transmitter is then ready for transmission of intelligence. The operator must determine, by the observation of normal indications, that the transmitter is properly tuned. Refer to paragraph 3-5 for intelligence operation.	
20	TMA-1K	Adjust the ALDC control so that the maximum allowable output is not exceeded.	OUTPUT meter indicates average rf output power.
21	MMX(M)-2	Adjust RF OUTPUT control to obtain proper output.	Average output compatible with mode and intelligence is obtained. (Refer to paragraph 3-5).

This completes the tuning sequence.

NOTE

If the LOCAL/REMOTE switch on the HFL-100 is set to the REMOTE position step 10 need not be performed. The HFL-100 will be automatically adjusted during step 11.

3-5. OPERATING PROCEDURES FOR INTELLIGENCE MODE

Once the SYM5203 system transmitter has been tuned it may be operated at full power in any operating mode. The mode and power level at which it is operated is determined by the type of intelligence to be transmitted and by local conditions. In any case, neither the 500 watt average power limit, nor the 1 kw PEP limit should be exceeded. Thus in CW and FSK modes of operation the average power rating is the limiting factor since only a single tone is being transmitted. However, in the sideband modes with multi-tone or voice transmission the average output power must be reduced to maintain the PEP rating.

As shown graphically and by formula in figure 3-1, as the number of transmitted tones is increased, the average power must be decreased if the PEP limitation is to be met. In making this computation it was assumed that all tones were in phase, which in actual practice does not happen. With certain intelligence, the repetition rate of the peak envelope can be determined as can the ratio of average power to peak envelope power. With most intelligence however, the peaks occur at a random rate and at random amplitude. In actual practice the normal ratio of peak to average power is about 4 or 5 to 1 in sideband transmission.

The ALDC circuit, which is a feature of TMC transmitters, allows the operator to transmit as much average power as possible, while limiting the occasional high peaks of the envelope to a point within the capability of the transmitter at which a minimum of distortion is generated.

The average power, which is indicated on the OUTPUT meter, will necessarily vary with the operating mode and the type of intelligence being transmitted. That portion of the average power used to transmit the carrier frequency is determined by the amount of carrier suppression. In the CW, MCW, and FSK modes the transmission of the carrier is not suppressed; merely modulated or interrupted. The full average power, in this case 500 watts, may therefore be used for its transmission. In the AME mode the carrier is transmitted at a power level 6 db down from PEP or at 250 watts average. When transmitting in the pilot carrier mode 10 watts of power are used, as the carrier is suppressed to the 20 db level. In the suppressed carrier mode the transmission of the carrier is completely suppressed (-55 db) and consumes only three milliwatts of power.

That portion of the available power not used to transmit the carrier frequency is available to transmit intelligence. The nature of the intelligence being the determining factor. For example: a single sideband (A3J) transmission of two tones with the carrier fully suppressed (CARR SUPP set at FULL) could be made at the 500 watt average power level without exceeding the PEP rating of the equipment. The more complex the intelligence input in terms of the number of tones to be transmitted the lower the average power indication on the OUTPUT meter should be.

Careful adjustments of the ALDC circuit and operator skill in adjusting the RF OUTPUT and input levels will ensure efficient operation with a minimum chance of equipment damage.

Before operating the transmitter in any intelligence mode, recheck the tuning as outlined in table 3-2. If the operating frequency is not to be changed, do not perform step 3 but check the channel setting. Connect the external signal source to the transmitter. If a microphone is to be used set the EXCITER ON/PTT switch on the MMX(M)-2 exciter to the PTT position.

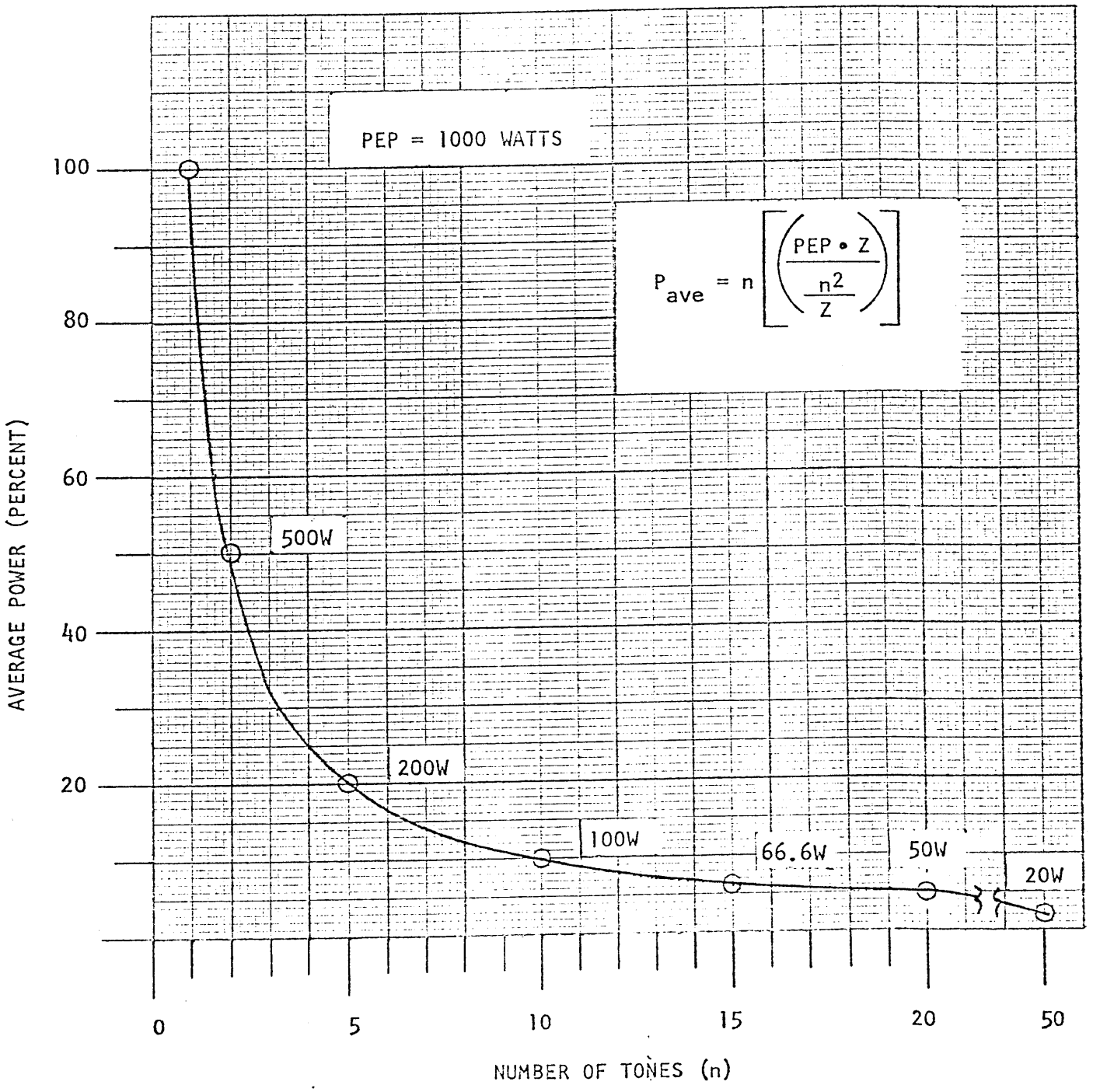

Figure 3-1. Ratio of Average Power to PEP as a function of tones

a. 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. When a limit is established, under design conditions, for that voltage the transmitter may be operated in any sideband mode without placing undue stress on the components if the established limit is not exceeded.

It will be seen by reference to figure 3-1 that the design criteria for the maximum average power and PEP (500 watts average 1000 watts peak) is met when two tones are applied to the transmitter. Thus, if a sample of the output is measured through a voltage divider network on an oscilloscope under these conditions, a visual reference will be established indicative of the transmitter design limits.

A numerical reference representing the absolute value of PEP may similarly be established with the use of a peak reading vacuum tube voltmeter with the scale calibrated in terms of RMS value. The Hewlett-Packard Model 410B is such an instrument.

For example: Since Power (P) equals E^2/R, if R is constant P will vary as the square of the voltage. Then, if PEP (max) = 1000 volts and Emax = Reading on VTVM when two tones are applied (e.g. 10 volts) the actual peak envelope power (PEPa) at anytime may be calculated by taking a voltmeter reading (E_r) and using the following formula.

$$PEP(a) = \frac{PEP\ (max)}{\left(\frac{Emax}{Er}\right)^2}$$

Let us say that a reading of 8.75 is obtained on the voltmeter. The actual PEP of the transmitter at that time is:

$$PEP(a) = \frac{1000}{\left(\frac{10V}{8.75V}\right)^2}$$

$$= \frac{1000}{1.142}$$

$$= \frac{1000}{1.306} = 765.7 \text{ watts}$$

Note that the figure 10 volts in the foregoing example was used only to demonstrate the measuring principle. In practice the value would depend upon the design of the voltage divider network but the principle will remain the same.

3-6. OPERATORS MAINTENANCE

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 "downtime".

CAUTION

Replacement parts should be identical to the part being replaced to ensure proper operation.

At regularly scheduled intervals each of the units which comprise the transmitter should be removed from the cabinet and given a very thorough cleaning and inspection. Each unit should be tested individually as called for in the technical manual for the unit.

An effective preventive maintenance program will extend the life of the unit and provide prolonged periods of trouble-free service.