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TECHNICAL MANUAL

for

SINGLE SIDEBAND ANALYZER MODEL PTE-1 (AN/GRM-33(A))

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N. Y. OTTAWA, ONTARIO

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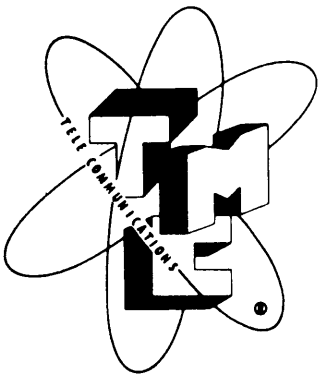

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

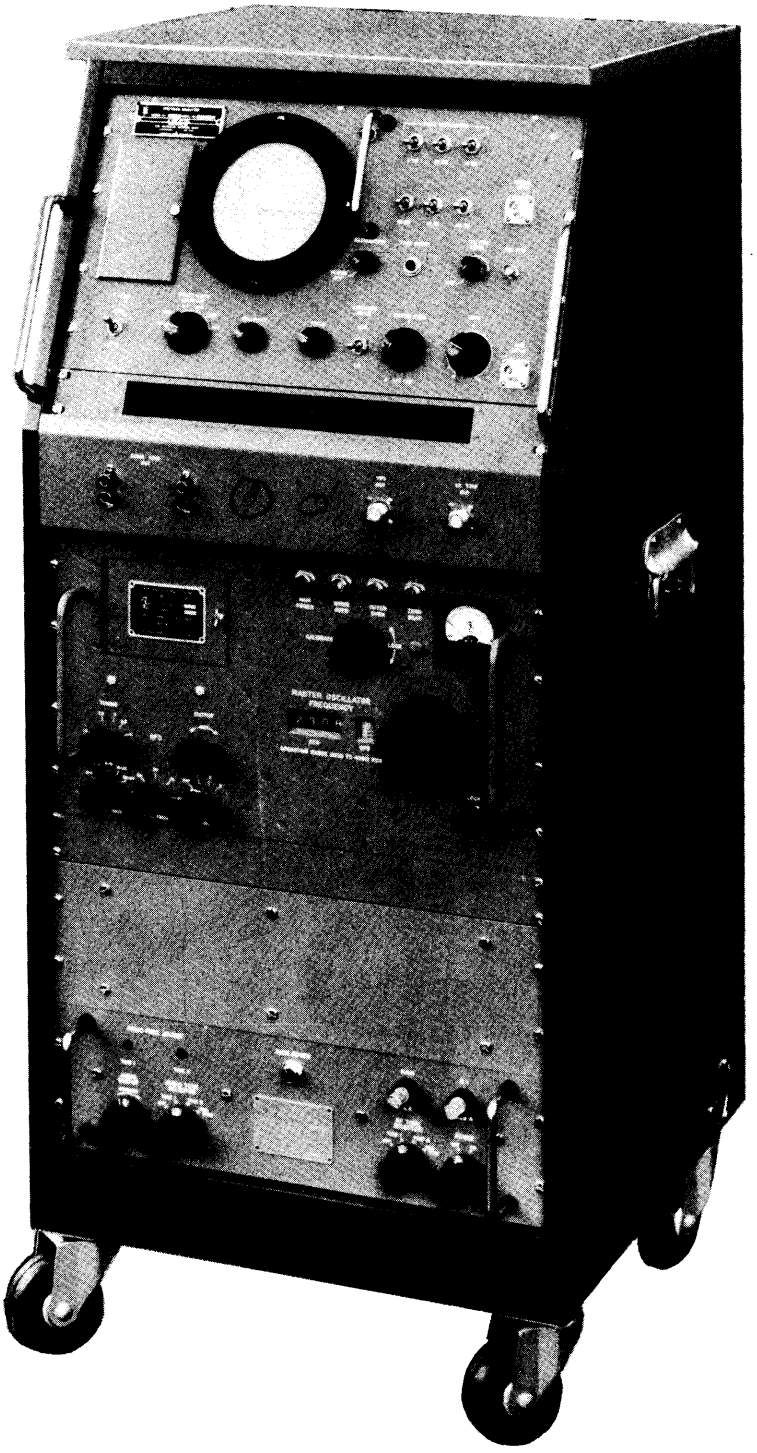

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Figure 1-1 Front View, Model PTE-1

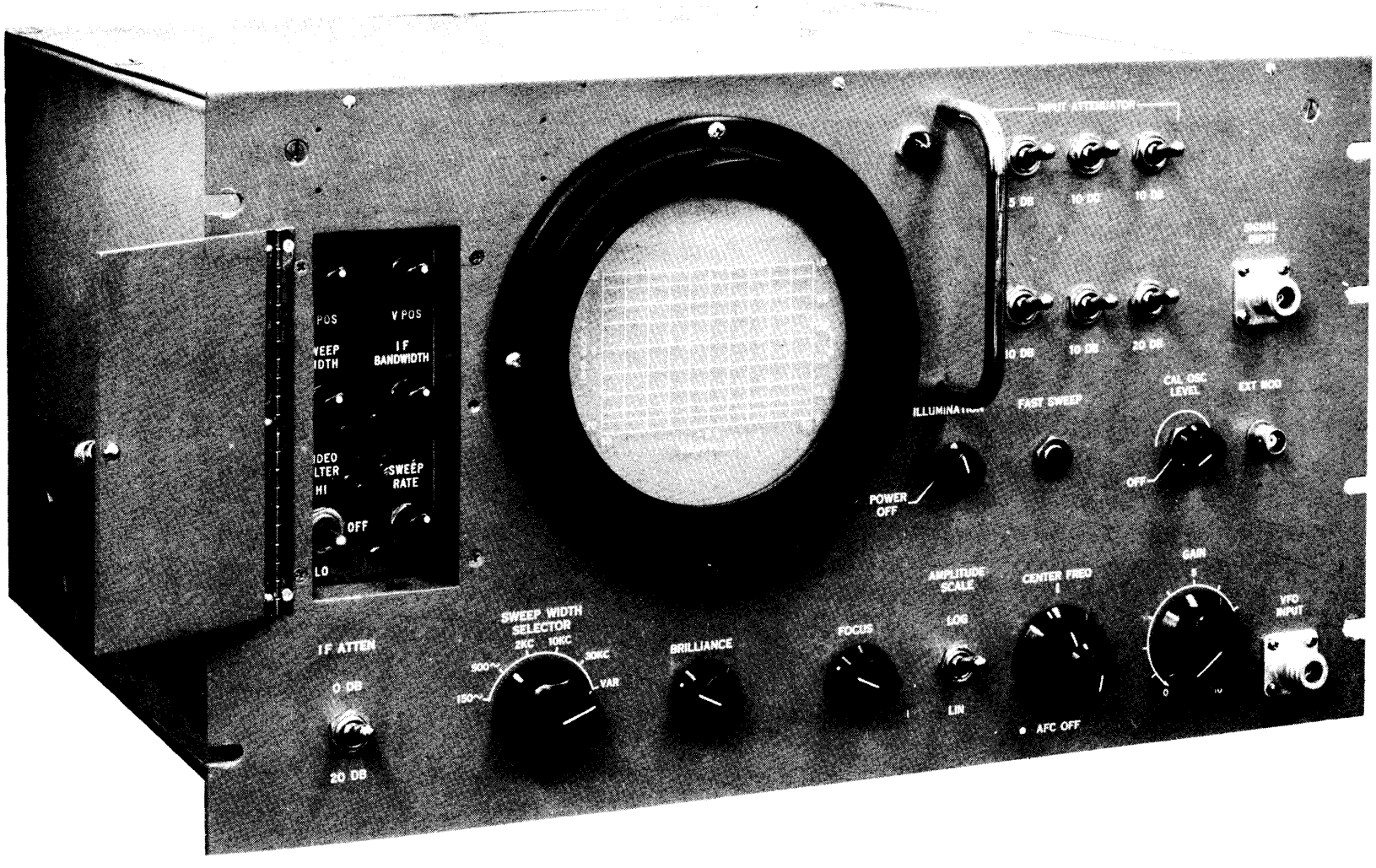

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Figure 1-2 Front View, Model FSA

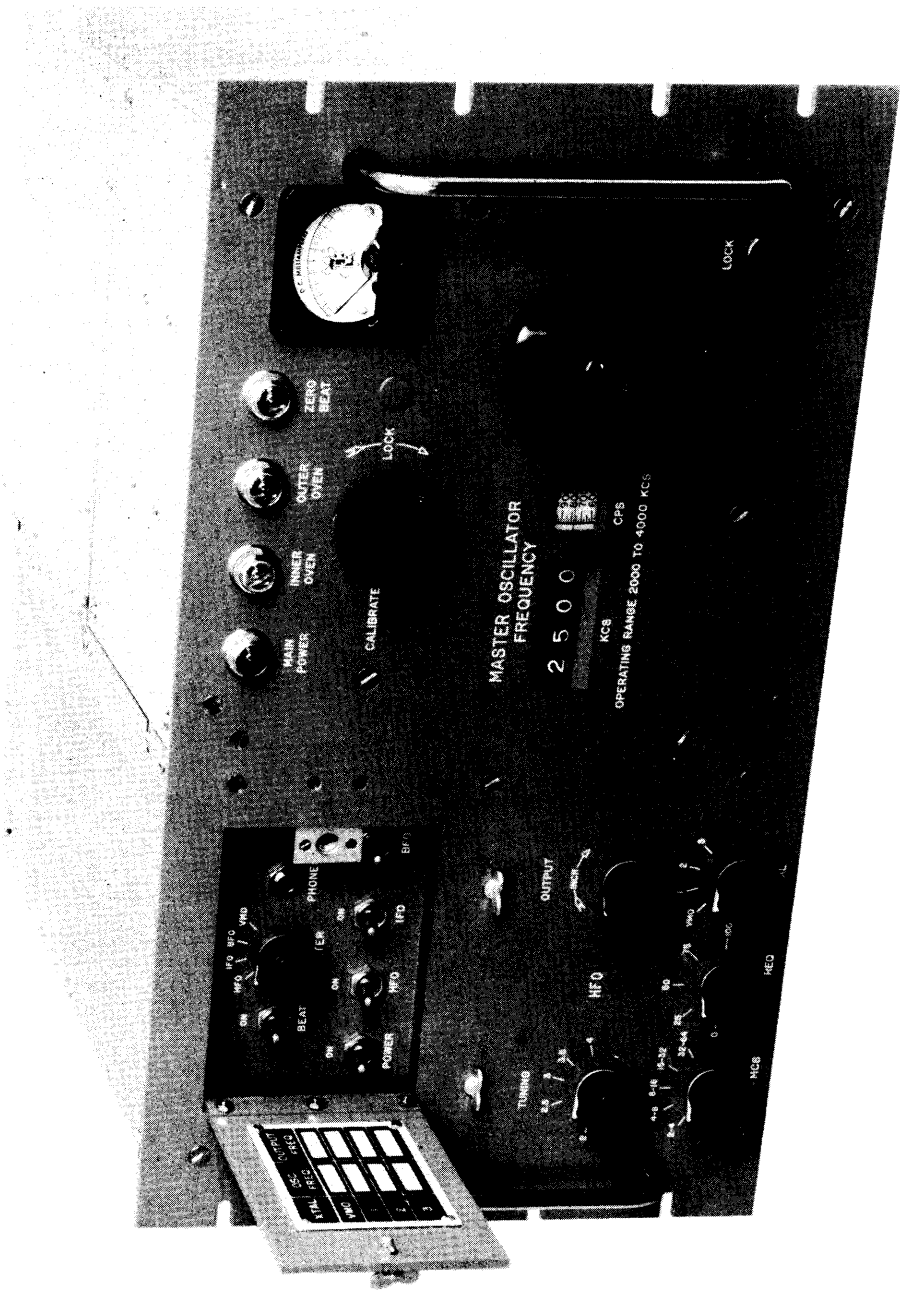

Figure 1-3 Front View, Model VOX-3

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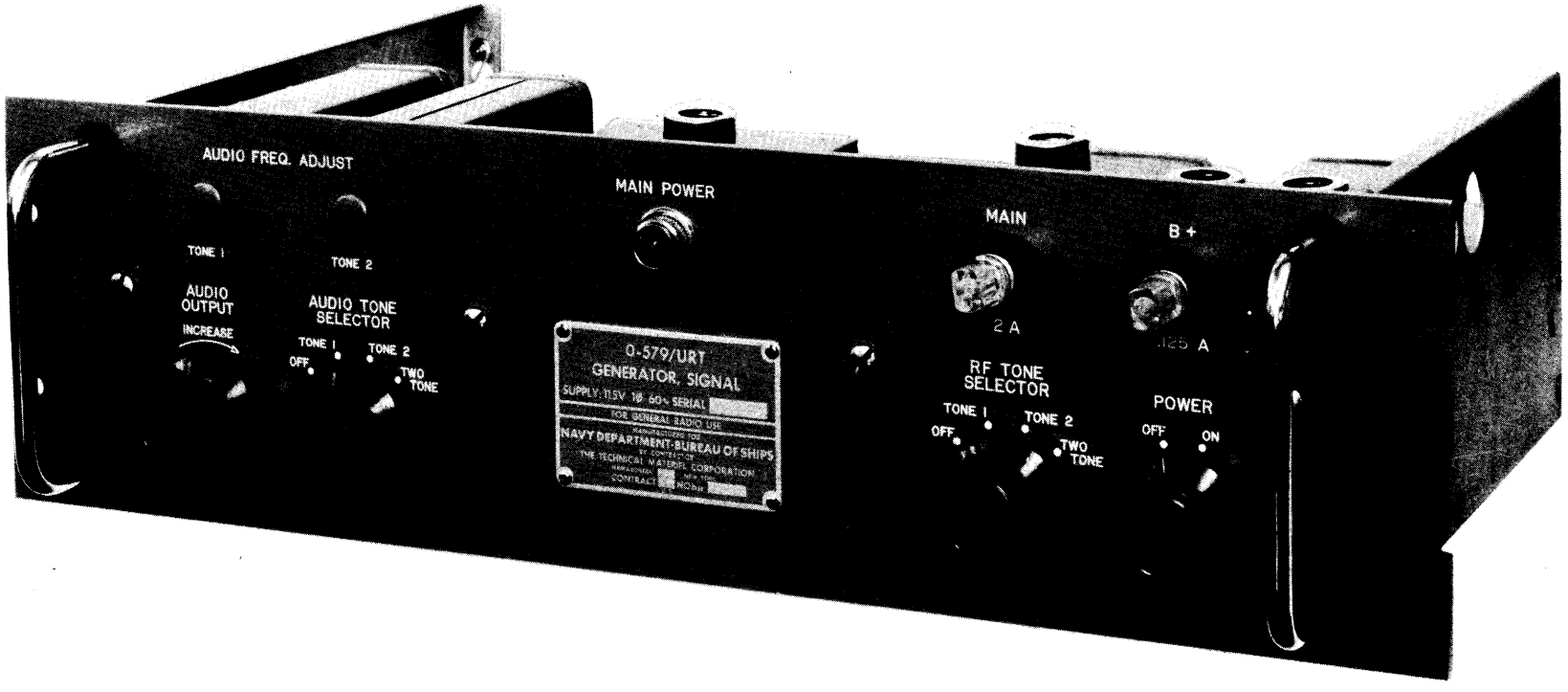

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Figure 1-4 Front View, Model TTG-1

SECTION I
GENERAL DESCRIPTION

1-1 GENERAL

1-1-1 The PTE-3, Single Sideband Analyzer, was designed for the specific purpose of tuning and aligning single sideband exciters and transmitters permitting a visual analysis of intermodulation distortion products, hum and noise.

1-1-2 The PTE-1 consists of three basic TMC units:

a. Spectrum Analyzer-TMC Model FSA (AN/URM-116)
b. Variable Frequency Oscillator - TMC Model VOX-5 (0-330B/FR)
c. Two-tone Generator - TMC Model TTG-1 (C-279/URT)

1-1-3 The tone generator, Model TTG, supplies two AF and two RF tones. The AF tones are chosen to permit visual analysis of the 3rd, 5th and 7th order products. The RF tones are generated for the purpose of checking the proper operation of the Spectrum Analyzer.

1-1-4 The TMC Model VOX, Variable Frequency Oscillator, is provided as part of the PTE-3 because of its accuracy and stability. It permits easy tuning and long-term testing.

1-1-5 The PTE-3 rack is equipped with four heavy duty casters which permit the analyzer to be moved to the equipment to be tested. The front panel of the FSA is sloped for convenient visibility from either a standing or sitting position. All controls and test connections are made on the front panels. The system is supplied with all cables and connections necessary for operation. Each unit may be used independently of the other units in the PTE-3. Consult the applicable instruction manuals for specifications and operation of the units when used alone.

1-2 TECHNICAL SPECIFICATIONS

SWEEP WIDTHS:
Fixed - 150, 500 cps, 2, 10, 30 kc.
Continuously variable - 0-100 kc, 0-2 kc.

INPUT CENTER FREQUENCY;
500 kc

BANDPASS REGION:
(after input mixer)
450-550 kc

IMAGE REJECTION:
Better than 130/1 at input center frequency.

INPUT IMPEDANCE:
50 ohms at each of the two terminals.

INPUT ATTENUATOR:
0 - 65 db attenuation of the input signal in 5 db steps. Accuracy ±2% to 30 mc.

AMPLITUDE SCALES:
Linear and 2 decade log selectable by front panel switch. A front panel 20 db I. F. attenuation may be used to extend calibrated range to 60 db.

TWO-TONE TEST:
All in-band residual (odd order) intermodulation products better than 60 db below level of the two equal reference signals deflected 20 db above full scale log.

FREQUENCY RANGE:
2 - 64 megacycles continuously tuned.

AF TEST TONES:
935 cps
2805 cps

RF TEST TONES:
1999 Kc crystal controlled
2001 Kc crystal controlled

HARMONIC DISTORTION TEST TONES:
AF: more than 65 db down
RF: more than 60 db down

AF OUTPUT IMPEDANCE:
600 ohms unbalanced

AF OUTPUT LEVEL:
0 - 0.5 volts continuously variable.

POWER REQUIREMENTS:
* 115/230 volts, 50/60 cps, single phase.

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* The Model PTE-3 is supplied for 115 volt, 50 or 60 cps operation. The unit will be supplied for 230 volt operation only at customers specific request.

POWER CONSUMPTION:

Approximately 315 watts average or 465 watts peak depending upon cycling of oven heating element.

Line regulator supplied. Special regulators available for 230 volts.

SHIPPING WEIGHT:

500 lbs.

COMPONENTS AND CONSTRUCTION:

Equipment manufactured in accordance with JAN/MIL specifications wherever practicable.

SIZE:

23-1/2" x 24" x 51" o/a.

SECTION II
THEORY OF OPERATION

2-1 GENERAL

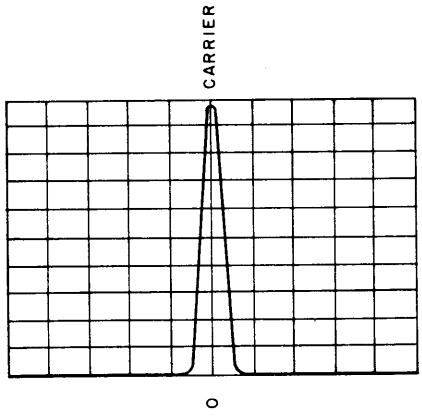
2-1-1 Figure 2-1 shows the combined Block Diagram of the Model PTE-3. Specific simplified circuits or circuit descriptions may be found in the individual instruction manuals for each unit.

2-2 BASIC THEORY FOR OPERATORS

2-2-1 With a properly operating single sideband transmitter, the operator may use the PTE-3 to illustrate the various factors described in this short explanation of single sideband and test techniques. This exercise is recommended as it will help familiarize the operator with PTE-3 operation and use. See INSTALLATION and OPERATION (Section III).

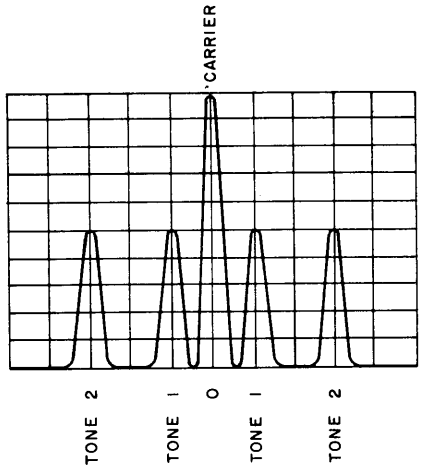
2-2-2 The major signal components may be observed with the SWEEP WIDTH selector in the 10 Kc position.

2-2-3 The carrier, whether suppressed or not, is the center frequency or the frequency upon which a radio signal is based. Illustrate the carrier by increasing the carrier insertion control of the transmitter's sideband exciter. Do not use audio modulation. A single "pip" will be observed on the screen of the analyzer as illustrated below.



A. CARRIER

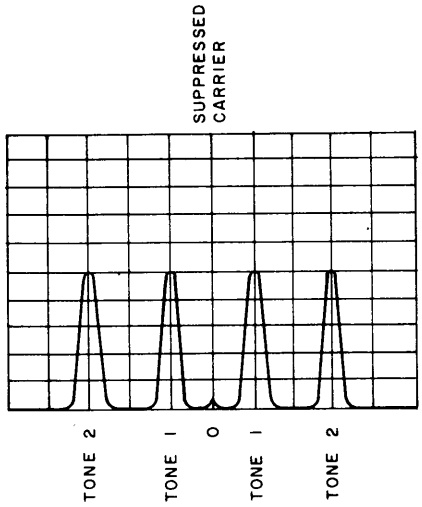
2-3 This carrier is modulated by audio frequencies to produce sidebands which carry the information. An AM signal consists of the carrier with sidebands occurring above and below the carrier. The upper sideband is the mirror image of the lower sideband. Insert both sidebands and carrier at the exciter. Use the TTG to modulate the sidebands.



B. CARRIER + USB + LSB (AM)

2-3-1 Standard AM, amplitude modulation, is shown above. For 100% modulation, the maximum power in each sideband cannot exceed 25% of the carrier power.

2-4 Since the carrier conveys no information and serves as a reference point it may be suppressed. The power in each sideband is 50% of the total signal power. Turn carrier insert control of exciter off. A double sideband signal is the result.



C. DOUBLE SIDEBAND SUPPRESSED CARRIER

2-5 The LSB conveys the same information as the USB. All the information is conveyed in the

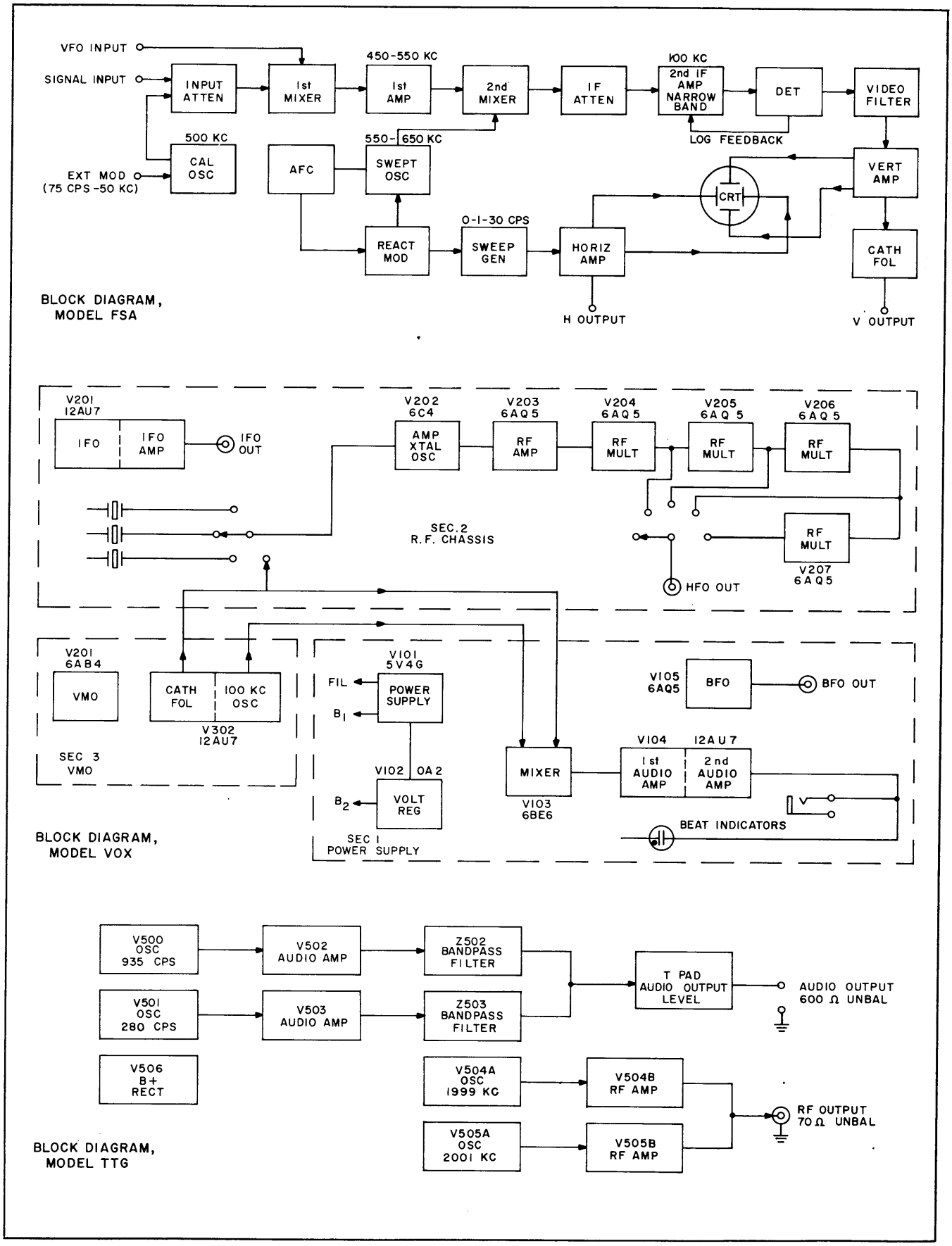
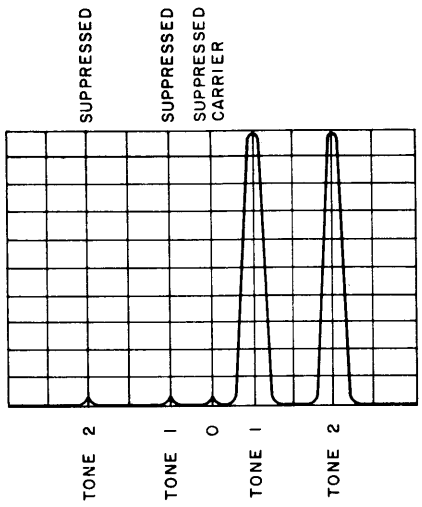


Figure 2-1 Block Diagram Model PTE-1

upper sideband when the lower sideband is suppressed. Inversely the USB may be suppressed instead of the LSB.



D. SINGLE SIDEBAND SUPPRESSED. CARRIER

2-5-1 Note that all the power is used to convey information and that the signal occupies about one-half the spectrum space used by AM or DSB. In ISB (independent sideband) operation, different information may be carried on each sideband.

2-5-2 The above can be illustrated by turning carrier insert and LSB controls of exciter off.

2-6 DISTORTION

2-6-1 The operator will notice while performing the above that other signal components are present. These additional "pips" may indicate that distortion, hum and/or noise are present. The observation of these in order to adjust SSB transmitting equipment is the function of the Model PTE-1.

2-6-2 Intermodulation distortion is one of the most prevalent types of distortion which must be eliminated. The TTG is used to provide two tones which have a definite intermodulation spectrum. The predominate intermodulation products are the odd order frequencies shown in Figures 2-2 and 2-3.

2-7 HUM

2-7-1 Hum appears on the analyzer screen as "pips" at the frequency or multiples of the line frequency. In a 60 cps source, hum will appear at 60, 120 and 180 cps. Hum is difficult to observe due to its low frequency and usually low amplitude.

The FSA SWEEP WIDTH SELECTOR set at the 500 cycle position will show hum. The hum may be accentuated for illustration by attaching a few feet of wire to the audio input of the exciter. The wire is used to pick up radiation from the power lines.

2-8 NOISE

2-8-1 Noise which may occur in the SSB transmitter is usually in the form of a periodic transients. The analyzer will show irregular deflections flashing along the frequency sweep axis.

2-8-2 External noise, such as produced by motors, vibration, buzzers etc., appears as signals moving along the frequency sweep baseline in one direction or another. An engine which is accelerating will produce a set of deflections which may move first in one direction, slow down, stop and then move in an opposite direction. A few feet of wire connected to the FSA INPUT and placed near a noise source such as an electric razor or automobile engine will serve to illustrate external noise.

2-9 TEST AND MAINTENANCE OF SSB TRANSMITTERS

2-9-1 The test and maintenance using the PTE-1 is difficult to predict as the unit can be used in numerous ways. The type of equipment to be tested cannot be known and therefore specific instructions are difficult to originate. The operator should consult the equipment manufacturer's technical manual.

2-9-2 The PTE-1 is useful for monitoring the SSB transmitter, or for use during tune-up. A continuous monitor of distortion products will ensure that the transmitter is functioning properly. When tuning a SSB transmitter, the meters of the transmitter will not necessarily indicate the optimum operating adjustments. Using the PTE-1, the operator may "juggle" the drive, tuning or loading, etc. controls to eliminate distortion products. This may mean increasing one order product to reduce a less desirable order product. Often a slight decrease in power or drive will decrease distortion to a large degree. Small power changes will not greatly influence communication reliability, but will result in a cleaner more effective transmitted signal.

2-9-3 The PTE-1 is used for alignment and adjustment of SSB exciters. The VOX and TTG supply RF and audio tones which may be used independently.

2-9-4 The operator should not overlook the use

of the PTE for examination and test of equipment using other modes of transmission such as standard amplitude modulation, frequency shift, facsimile, etc.

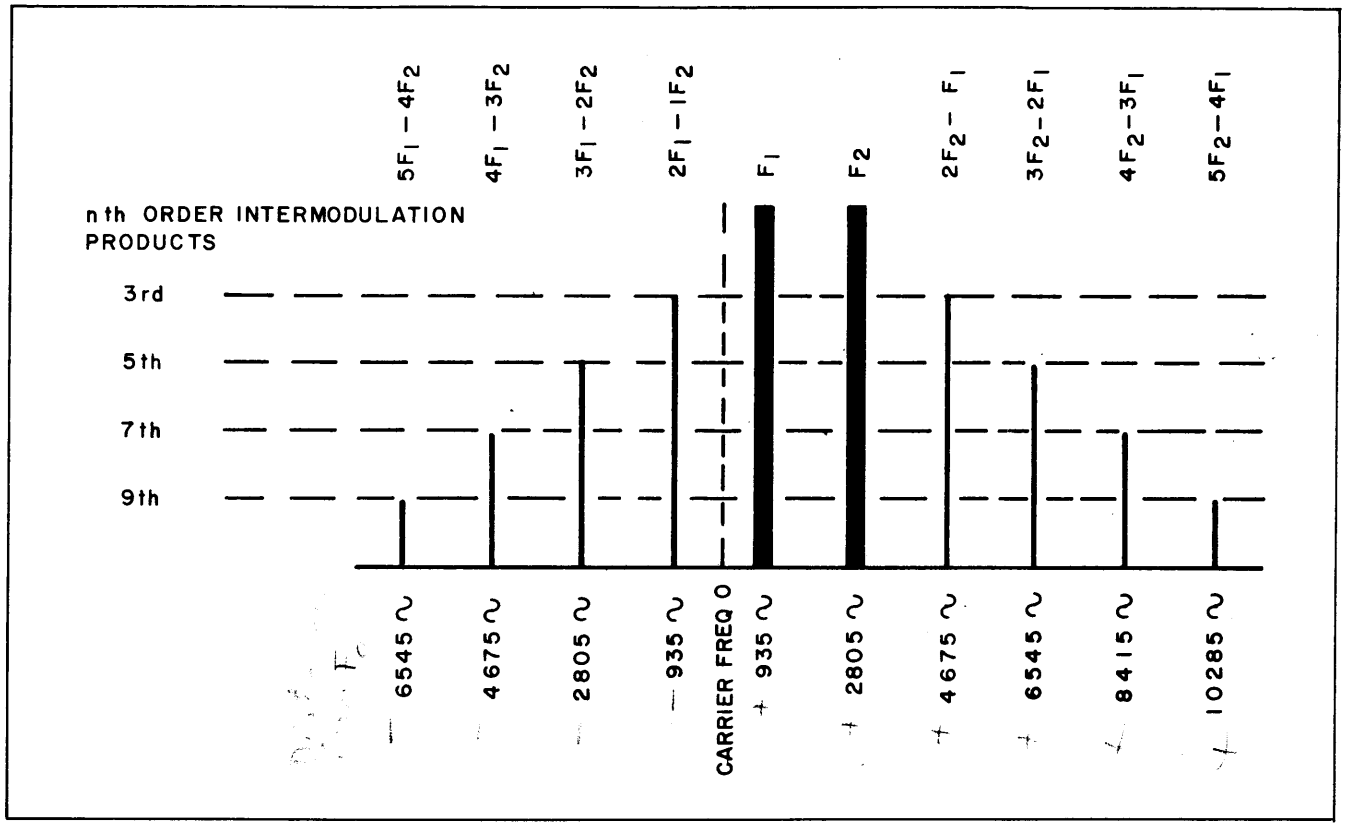


Figure 2-2 Intermodulation Spectrum, USB

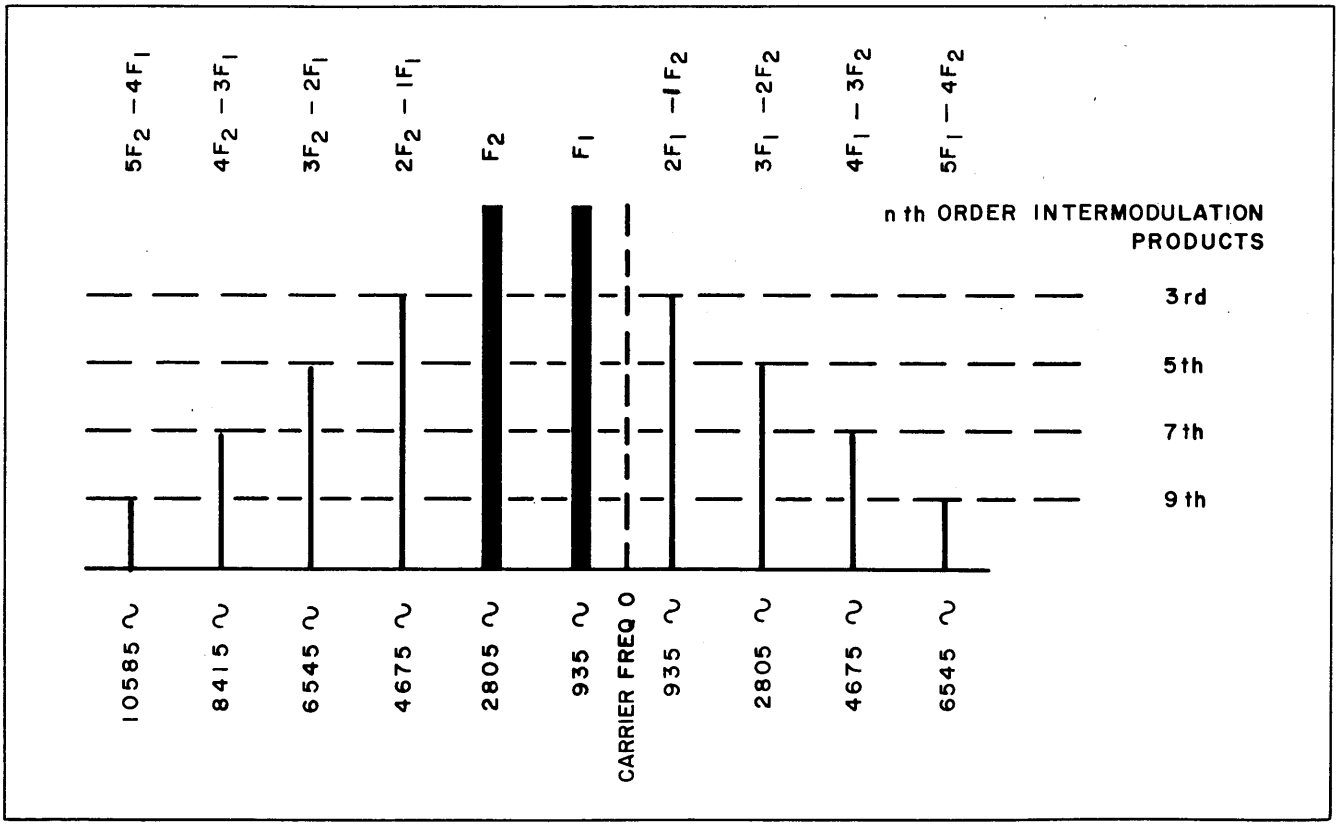


Figure 2-3 Intermodulation Spectrum, LSB

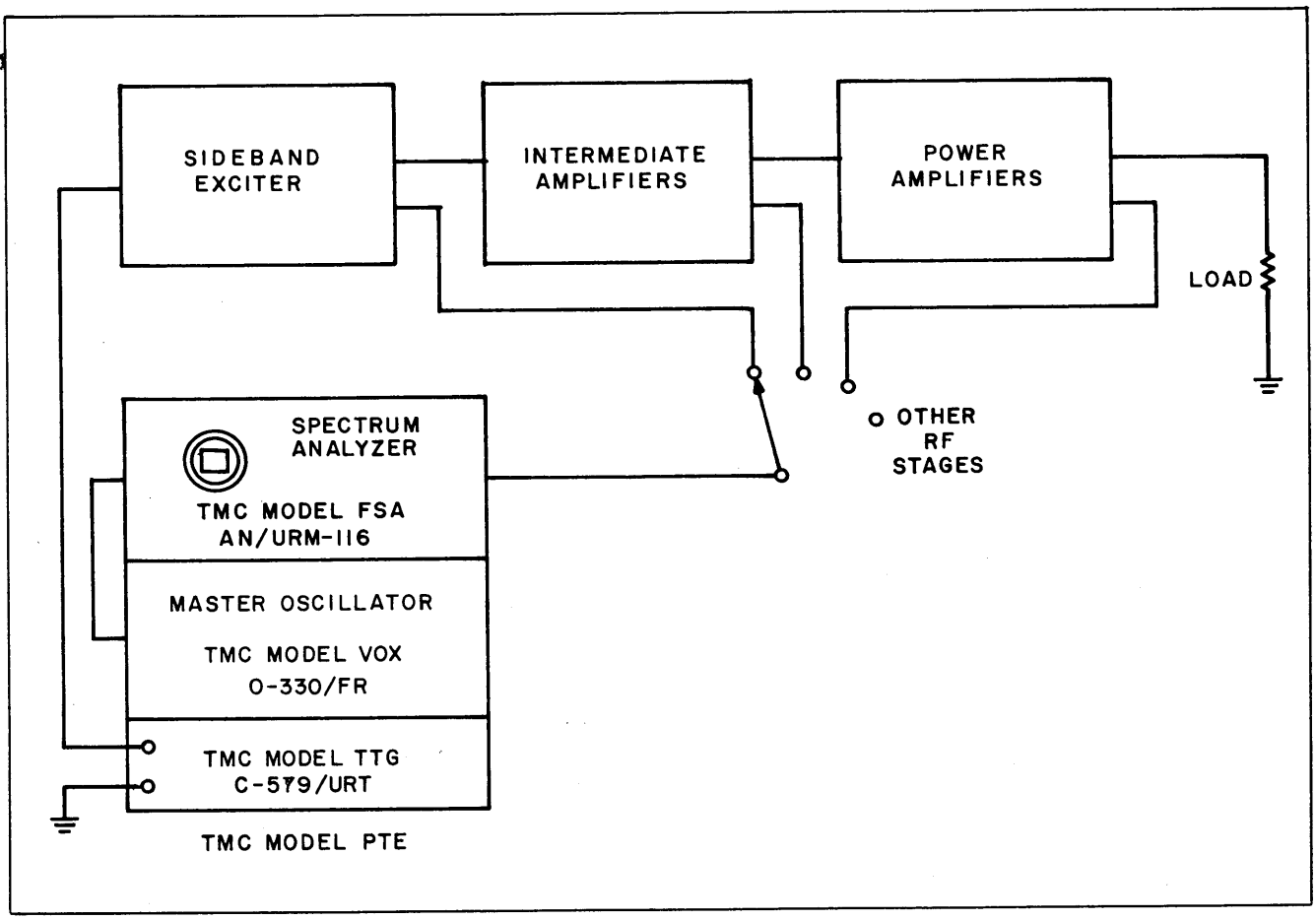
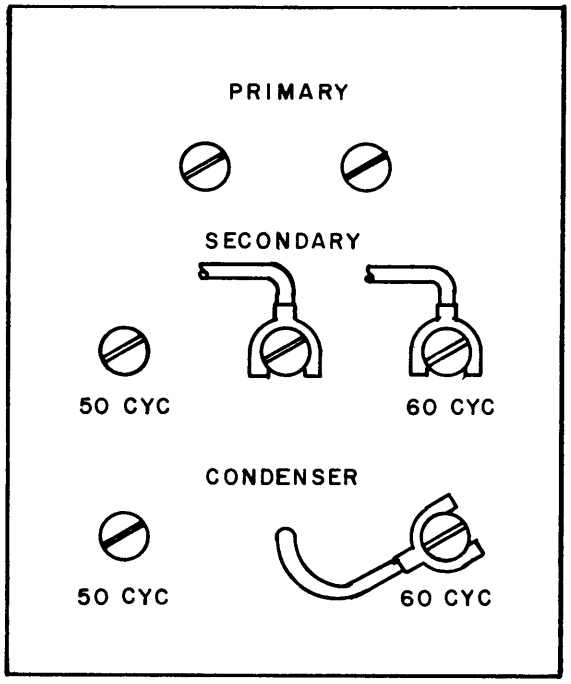
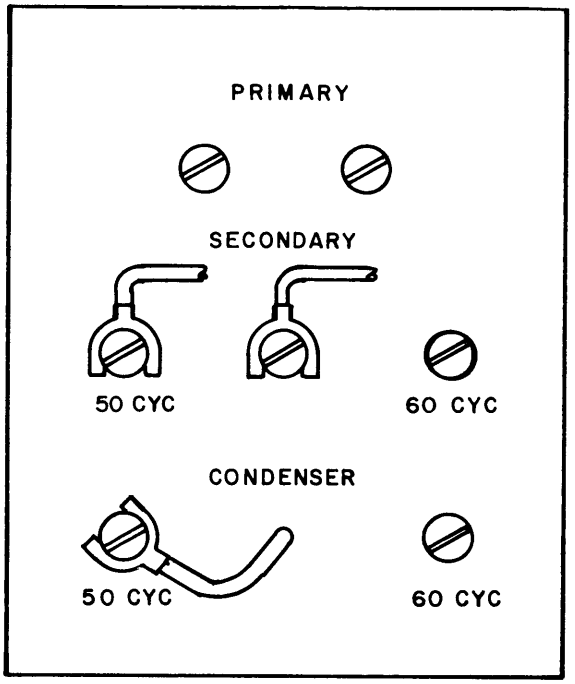


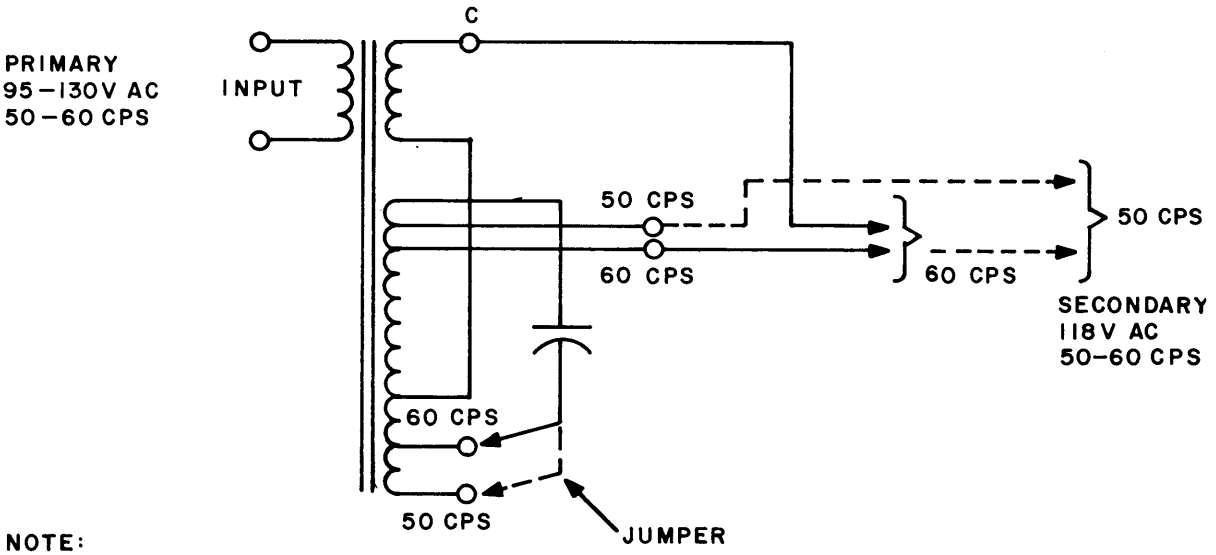
Figure 2-4 Two Tone Test for Distortion



60 CYCLE OPERATION



50 CYCLE OPERATION



NOTE:
DOTTED LINE REPRESENT
50 CYCLE OPERATION.

REGULATOR TRANSFORMER TERMINAL WIRING

Regulator Transformer Terminal Wiring

SECTION III
INSTALLATION AND OPERATION

3-1 GENERAL

3-1-1 The TMC Model PTE-1, Single Sideband Analyzer, has been designed for ease of installation and minimum effort in operation. The major units and the rack with associated panels are packed in individual shipping containers and should be carefully unpacked. Packing material should be examined for loose items before discarding. A close visual inspection should be made to determine any physical damage due to rough handling during shipment. If damage is found, notify carrier immediately.

3-2 INSTALLATION

3-2-1 Mount the equipment in the cabinet as shown in Figure 1-1. Before installing panels make the internal cable connections with the cables supplied. Refer to figure 3-1 for the correct connections. If crystals are to be used in the Model VOX, insert crystals before installing the VOX.

3-2-2 The PTE-1 is normally operated from a 115 volt, 50 or 60 cycle, single phase power source. The unit is supplied for 60 cycle operation unless specifically ordered for 50 cycle operation.

NOTE

THE LINE VOLTAGE REGULATOR SUPPLIED WITH THE EQUIPMENT MUST BE USED TO INSURE PROPER OPERATION. THE REGULATOR IS OF THE SATURABLE REACTOR TYPE AND IS DESIGNED FOR A 50 OR 60 CYCLE POWER SOURCE. IT MUST BE USED ONLY AT THAT FREQUENCY FOR WHICH IT IS WIRED.

3-3 CONNECTIONS FOR TWO TONE TEST

3-3-1 Provided with the Model PTE-1 are several cables with connectors used for interconnecting the various front panel jacks. Usually, such as when a two tone test is being made, the connections are made as follows:

A. Connect the VFO OUT jack to the VMO INPUT jack (Figure 5-1)

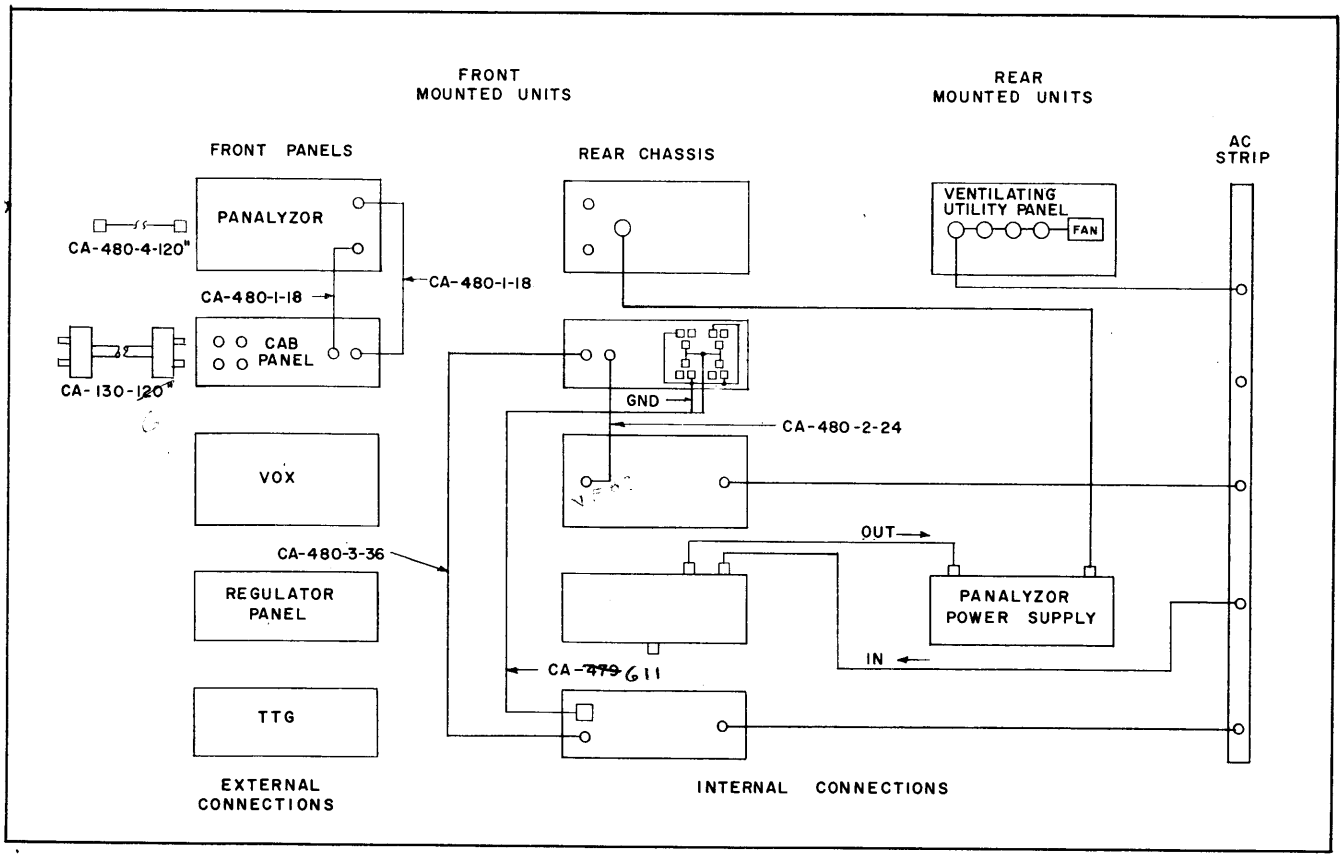


Figure 3-1 Internal Connections Model PTE-1

B. Connect the transmitter or exciter monitor output to the SIGNAL INPUT jack.
C. Connect each of the AUDIO TONE OUT jacks to each of the 600 ohm audio inputs of the transmitter or exciter.

3-4 DESCRIPTION OF CONTROLS

3-4-1 Model FSA

INPUT ATTENUATOR - Provides attenuations of 5 db, 10 db, 10 db, 10 db, 10 db, 20 db in the SIGNAL INPUT circuit. When the switches are in the down position, the indicated attenuation is inserted.

GAIN - Adjusts amplitude of the indication on the crt screen. Maximum gain is obtained at maximum clockwise position. The GAIN control should be operated at the maximum setting consistent with low noise on the crt display to reduce internal distortion in the FSA input circuits.

IF ATTEN (uator) - Inserts 20 db of attenuation in IF amplifier. When used, the input signal may be adjusted for full scale LOG deflection. Placing the IF ATTEN switch in the 0 db position permits the full 60 db dynamic range of the FSA to be used. Only the lower 40 db portion is displayed on the crt screen. This switch must always be in the 0 db position when making measurements.

CAL (ibrating) OSC (illator) LEVEL - Varies the output amplitude of the 500 Kc crystal oscillator, which is internally connected to the signal input receptacle. This signal may be used to locate the center frequency of the analyzer, and may be modulated by an external audio oscillator to provide marker sidebands for setting up any desired sweep width. The 500 kc signal, in conjunction with the INPUT ATTENUATOR may be used to check the accuracy of the LOG amplitude scale calibrations (which appear as dots at the left side of the calibrated screen). In its fully counterclockwise position, the control reduces the oscillator output to zero.

CENTER FREQ(uency) - Sets or maintains the frequency modulated local oscillator at its specified mean frequency. The deflection corresponding to a signal at the input center frequency is centered on the crt screen. When using AFC stabilized sweeps, this control acts as a vernier.

AFC - Clockwise rotation of this control turns on the AFC circuit. It reduces the normal 100 Kc maximum sweep width to 2 Kc. This frequency stabilized narrow scanning width in conjunction with the 0.1 cps scanning rate provides the best resolution of which the instrument is capable. Further rotation of the control adjusts the center frequency. The AFC should only be used with sweep rates of 5 cps or less.

ILLUMINATION - When rotated in a clockwise direction turns on power. Continued clockwise rotation increases the edge illumination of the crt screen.

BRILLIANCE - Adjusts the sharpness of the screen presentation.

SWEEP WIDTH SELECTOR - Provides a choice of five pre-set sweep widths of 150 cps, 500 cps, 2 Kc, 10 Kc, and 30 Kc and a sixth position marked VAR(iable). In the VAR position, the sweep width may be set to any value from 0 to 100 Kc, the IF bandwidth may be set for any desired resolution within the capability of the instrument, and the sweep rate may be set to any value from 0.1 cps to 30 cps. The video filter switch is also operative in this position. In the pre-set positions, the IF bandwidth is automatically set for optimum resolution. On the three narrowest ranges, the AFC circuit is automatically turned on: on the 10 Kc and 30 Kc ranges it is disabled. On the three narrowest ranges the sweep rate is 0.1 cps, and a low pass video filter with a bandwidth of approximately 40 cps is switched on. The sweep rate on the 10 Kc and 30 Kc ranges is 1 cps, and the video filter bandwidth is approximately 400 cps. The sensitivity of the FSA is constant on all ranges, within ±15%.

FAST SWEEP - Speeds up the sweep rate from 0.1 cps to 1 cps on the 150 cps, 500 cps, and 2 Kc pre-set sweep ranges. This facilitates centering the display on the crt screen without the need to wait 10 seconds between sweeps. It also enables the operator to skip undesired portions of the frequency range being scanned.

NOTE: The following controls are used relatively infrequently or are only needed when setting up the analyzer on the VAR position of the SWEEP WIDTH SELECTOR. They are located behind the door to the left of the crt.

H(orizontal) POS(ition) - Adjusts the position of the baseline trace along the horizontal axis.

V(ertical) POS(ition) - Adjusts the position of the baseline trace along the vertical axis.

SWEEP WIDTH - Adjusts the scanning width of the instrument. When turned completely clockwise, the maximum spectrum width for which the instrument is designed, i.e., 100 Kc when AFC is off, or 2 Kc when AFC is on, can be seen on the screen. As the control is backed off in a counterclockwise direction, the bandwidth viewed becomes narrower. The part that can be seen, however, is expanded across the screen and

hence is virtually magnified. The stability required for narrow sweep width and slow sweep rates is provided by turning on the AFC.

The SWEEP WIDTH control, in conjunction with the IF BANDWIDTH control, is useful for separating two or more signal deflections which are so close as to merge into each other.

IF BANDWIDTH - Resolution, or the ability to separate individual signals, is dependent upon two factors; the rate of frequency scan and the bandwidth of the IF section of the instrument. Optimum resolution requires a definite relationship between the two. Resolution sharpens as both the frequency-scanning rate and IF bandwidth are decreased.

The IF BANDWIDTH control is used to narrow the IF bandwidth. Counter-clockwise rotation of this control narrows the width of the IF section. It should be noted that as this control is adjusted, there will be some degree of change in the sensitivity of the equipment.

The frequency-scanning rate is diminished by increasing the scanning period or conversely by decreasing the spectrum width scanned within a given time. The AFC and SWEEP WIDTH controls provide the latter method. For a given setting of the SWEEP WIDTH CONTROL there is a setting of the IF BANDWIDTH control to obtain optimum resolution.

On the pre-set sweep ranges the IF bandwidth is automatically set for optimum resolution.

VIDEO FILTER - Provides two degrees of video filtering to suppress such unwanted effects as noise, spurious beating between closely adjacent signals, hum, etc.

In the upper (HI) position, the video bandwidth is moderately reduced. In the lower (LO) position of the VIDEO FILTER switch the video bandwidth is greatly reduced. This position is suitable for use with very slow sweep rates and narrow sweep widths.

On the 150 cps, 500 cps, and 2 Kc pre-set sweep ranges, the LO filter is automatically switched on. On the 10 Kc and 30 Kc ranges, the HI filter is automatically switched on.

SWEEP RATE - This control provides continuously adjustable scanning rates between 0.1 cps and 30 cps. Counter-clockwise rotation of this control reduces the sweep rate.

The control is operative only in the VAR position of the SWEEP WIDTH SELECTOR.

3-4-2 Model VOX

TUNING - Adjusts tuned circuits in multiplier-amplifiers for maximum output of the HFO.

OUTPUT - Provides adjustment of HFO output level.

BAND - MCS - Selects the output frequency range of the HFO.

XTAL FREQ - Permits trimming crystal frequency to the exact value required.

VMO 1-2-3 - Selects the variable oscillator or one of 3 crystals in the HFO.

MASTER OSCILLATOR FREQUENCY - Counter reads the fundamental frequency of the HFO in Kc; the dial reads the frequency in additional cps. The large knob permits convenient adjustment of frequency. In models equipped with motor tuning mechanisms the frequency may be adjusted by either the knob or the motor which is actuated by the INCREASE/DECREASE switch.

CALIBRATE - Permits adjustment of the HFO frequency to coincide with the calibration oscillator frequency.

LOCK - When actuated, the dial lock prevents accidental movement of the tuning mechanism.

NOTE: The following controls are used infrequently, usually only when setting up the equipment. They are located behind the door located on front panel.

ON/BEAT - Switches 100 Kc calibrating oscillator on or off.

METER - Switches the front panel meter to monitor the level of the HFO, IFO, BFO, or VMO.

ON/POWER - Applies AC line voltage to the unit. Normally this switch will be in the ON position continuously.

ON/HFO - ON/IFO - ON/BFO - These switches actuate their respective oscillators. Normally the HFO is used for PTE-1 operation.

3-4-3 Model TTG

AUDIO OUTPUT - Permits adjustment of audio output from 0 to 0.5 volts continuously variable.

AUDIO TONE SELECTOR - Actuates any combination of the available audio frequencies desired. Tone 1 is 935 cps; tone 2 is 2805 cps.

RF TONE SELECTOR - Actuates any desired

combination of the available RF frequencies. Tone 1 is 1999 Kc; tone 2 is 2001 Kc.

POWER - Applies AC line voltage to the unit.

3-5 OPERATION AND CALIBRATION OF THE MODEL VOX

NOTE

When the Model PTE-1 has been connected to the power line and the power switches of the individual units switched ON, allow at least 48 hours warm up time in order to permit the frequency determining elements to reach maximum stability.

The PTE-1, for maximum stability, should be powered continuously. The oscillator will remain highly stable if it is not subjected to ON/OFF operation. The unit should not be turned off except for repairs or for long term shut-down.

3-5-1 For greater accuracy the Oscillator must always be calibrated before use. To calibrate the Model VOX at any desired frequency, the operator should perform the following steps:

A. Turn the ON/BEAT switch to the ON position.
B. Plug a headset into J105, marked PHONES.
C. Turn the BAND-MCS switch to the desired band and the XTAL switch to the VMO position.
D. Observe the master oscillator frequency dial and tune until the dial reads to the nearest 50 Kc point of the desired frequency. For accurate calibration and resetability, care must be taken to rotate the dial in the same direction (preferably from a lower dial reading to a higher), in order to prevent any error due to backlash. Then, by varying the CALIBRATE control, a zero beat indication will be obtained in the headset and on the front panel indicator. With a little experience, the operator will find that the visual indication alone is adequate, although he may continue to use the phones as an added convenience.
E. When the calibration procedure is completed, return the dial to the desired frequency of operation. Turn the ON/BEAT switch off. Set the METER switch to HFO and the ON/HFO switch to ON.
F. Rotate the TUNING control to a position roughly approximating the master oscillator frequency dial. A reading will be observed on the front panel meter if the OUTPUT control is advanced. The TUNING control will have been set properly when the highest milliammeter reading is obtained.

3-5-2 Crystal Operation - High Frequency Oscillator (Refer to Analyzer Operation for Selection of HFO Crystal).

3-5-2-1 When using a crystal, installed in the crystal oven of the VOX, for the HFO instead of the variable oscillator proceed as follows:

A. Turn the ON/POWER switch to ON.
B. Turn the ON/HFO switch to ON.
C. Turn the METER switch to HFO.
D. Select the desired crystal with the XTAL switch.
E. Turn the BAND-MCS switch to the proper band.
F. Trim the crystal frequency by adjusting the XTAL-FREQ trimmer until the exact frequency desired is reached.
G. Rotate the TUNING control to a position roughly approximating the master oscillator frequency dial, at which point a reading will be observed on the front panel meter as the OUTPUT control is advanced. The TUNING control will have been set properly when the highest milliammeter reading is obtained.

3-6 ADJUSTMENTS AND CHECKS

3-6-1 Model FSA

A. Set the front panel controls as follows:

INPUT ATTENUATOR	All switches UP
GAIN	Fully counter-clockwise
CAL OSC LEVEL	OFF
CENTER FREQ	Center
AFC	OFF
AMPLITUDE SCALE	LIN
FOCUS	For a sharp trace
BRILLIANCE	As desired
SWEEP WIDTH SELECTOR	VAR
IF ATTEN	O DB
VIDEO FILTER	OFF
SWEEP RATE	Fully clockwise
IF BANDWIDTH	Fully clockwise
SWEEP WIDTH	Fully clockwise
V POS	So that baseline trace coincides

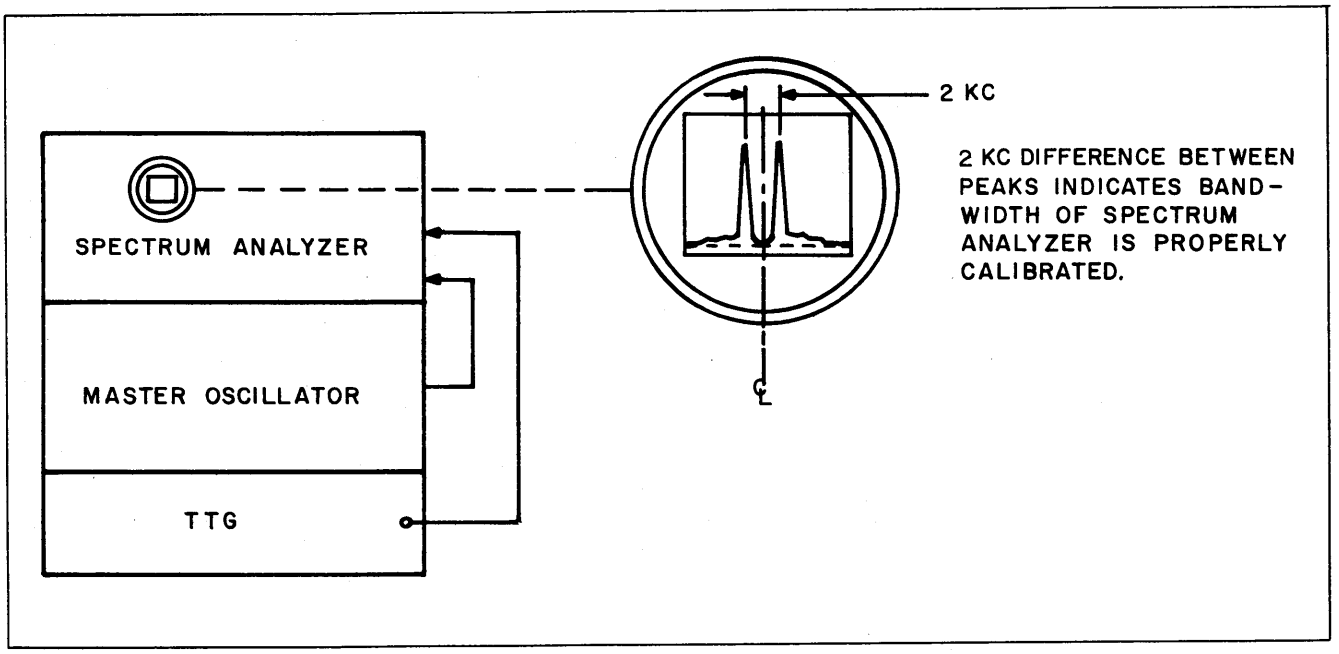


Figure 3-2 Center Frequency Check

with the frequency scale.

H POS — To approximately center the baseline on the crt screen.

B. Turn the CAL OSC LEVEL control fully clockwise. Advance the GAIN control until a "pip" is displayed at approximately full screen deflection.

C. Rotate the SWEEP WIDTH control counterclockwise until the "pip" opens up into a horizontal line. Adjust the CENTER FREQ control for maximum height of the trace. Set the SWEEP WIDTH control fully clockwise. A "pip" should appear near the center frequency calibration. Adjust the H POS control until the "pip" coincides with the center frequency calibration.

D. Rotate the SWEEP RATE control through its range. At its clockwise extreme (30 cps) the trace will appear as a line. At its counter-clock wise extreme (0.1 cps) a spot should move from right to left on the crt screen with a 10 second period.

E. Turn the SWEEP RATE control fully clockwise. Adjust the SWEEP WIDTH control until the "pip" base covers approximately one - third of the screen. Turn the IF BANDWIDTH control counterclockwise; the "pip" width should decrease. At the same time, there may be a change in "pip" height. It will also be noticed that "ringing" will appear on the trailing edge of the "pip". Optimum resolution occurs when the first "ringing" notch beyond the apex of the "pip" dips into the baseline.

F. Turn on the AFC by clockwise rotation of the control. This automatically provides a maximum scanning width of approximately ±1 Kc with the necessary center frequency stability. Counter-clockwise rotation of the SWEEP WIDTH control reduces the scanning width from ±1 Kc to nominally zero. The AFC control is used as the CENTER FREQ control. As it is rotated in a clockwise direction, the display may shift to the left, then to the right. Normally, the best centering action is had with the AFC control in approximately a "2 o'clock" position. The CENTER FREQ control is used as a vernier. The maximum sweep is checked most conveniently by feeding a 1 Kc audio signal to the EXT MOD jack. This will generate sidebands which may be set on the end frequency calibrations of the crt screen by means of the SWEEP WIDTH control. Use only sufficient audio amplitude to produce visible and usable sidebands, since excessive amplitude may prevent the crystal oscillator from functioning.

It should be noted that there may be an extraneous "pip" or "pips" present on the right side of the screen

(but outside the calibrations) when the AFC is on. The SWEEP RATE control should be set for a rate of approximately 5 cps or lower and the IF BANDWIDTH control set appropriately.

G. Set the controls as outlined for CENTER FREQ test. Carefully adjust the GAIN control for full scale deflection of the "pip". Switch AMPLITUDE SCALE to LOG. The "pip" should read 0 db (center of screen). The LOG calibration appears at the left edge of the screen. Dots are engraved at 5 db intervals on the screen.

Set IF ATTEN to 20 db. The "pip" should now reach the -20 db calibration.

H. Increase the GAIN and CAL OSC LEVEL controls until full screen deflection is obtained. Operate the INPUT ATTENUATOR switches so as to insert attenuations up to 40 db in 5 db steps. At each setting the "pip" height should coincide with the corresponding screen calibration within ±1 db.

I. Set the IF ATTEN to 0 db and continue to insert attenuation as before until the "pip" is at the -20 db calibration. At this point the signal has been reduced 60 db from its original level, which is 20 db over full scale. With all switches down (65 db) the "pip" should go below the -20 db calibration point.

J. Set the INPUT ATTENUATOR to zero (all switches up) and adjust the GAIN control for full scale deflection. Switch the VIDEO FILTER to the HI position. This reduces the video bandwidth to about 400 cps. Any noise on the screen should be filtered, and signal "pips" will be integrated and shifted slightly. The SWEEP RATE should be reduced to prevent excessive distortion of the "pip" shape. Switch the VIDEO FILTER to the LO position. The video bandwidth is now about 40 cps, and a much greater filtering effect should be observed. This position of the VIDEO FILTER should only be used with sweep rates of the order of 1 cps or less.

L. With a full scale optimally resolved "pip" (LIN amplitude scale) displayed in the center of the screen, set the SWEEP WIDTH SELECTOR to 30 Kc. The "pip" should appear at or near the center of the screen. The amplitude should be essentially unchanged. The sweep width is now +15 Kc, and the sweep rate is 1 cps. The SWEEP RATE, IF BANDWIDTH, and VIDEO FILTER controls are not effective on this and the other pre-set sweep width ranges.

M. Set the SWEEP WIDTH SELECTOR to 10 Kc. The "pip" should appear with essentialy the same amplitude near the center of the screen. In this position, the sweep width is ±5 Kc.

N. Set the SWEEP WIDTH SELECTOR to 2 Kc. The AFC circuit is automatically switched on for this and the 500 cycle and 150 cycle sweep widths and the sweep rate is 0.1 cps. The amplitude of the "pip" should be essentially constant on all ranges.

O. To facilitate locating a signal on the ranges employing a 0.1 cps sweep rate, a FAST SWEEP button has been provided on the front panel. Pressing this button speeds up the sweep rate to 1 cps, and it immediately returns to 0.1 cps when the button is released. The "pip" shape is distorted when the FAST SWEEP is used, but this does not impair its usefulness for locating signals on narrow sweep widths, or for repeated examination of a portion of the sweep width without requiring a 10 second wait between scans.

P. An external audio signal from the TTG may be connected to the EXT MOD connector to aid in setting up any desired sweep width. This signal amplitude modulates the CAL OSC.

For example, a 935 cps audio signal will produce sidebands at ±935 cps relative to the center frequency "pip". When the SWEEP WIDTH control is adjusted so that these sidebands appear at the left and right extremities of the calibrated screen, the sweep width is ±935 cps or 1870 cps overall. Excessive audio amlitude should be avoided, since it may prevent the crystal oscillator from functioning.

Q. The H OUTPUT and V OUTPUT connectors on the rear apron of the chassis provide voltages proportional to the horizontal and vertical position of the crt spot. They are intended for operation of a slave oscilloscope or other external indicator.

3-7 GENERAL OPERATION - MODEL FSA

3-7-1 Turn on the power with the ILLUM-

INATION control and allow a one hour warm-up period before operating adjustments are made. When the baseline appears (usually within thirty seconds) set up the controls as follows:

CENTER FREQ - On vertical marker
SWEEP WIDTH - Maximum clockwise
IF BANDWIDTH - Maximum clockwise
BRILLIANCE - For desired trace brightness
SWEEP WIDTH SELECTOR - VAR
FOCUS - Sharpest trace
AMPLITUDE SCALE - LIN
GAIN - Between half and maximum clockwise
SWEEP RATE - Maximum clockwise
VIDEO FILTER - OFF
HORIZONTAL POSITION - For centered position of center-frequency "pip".
VERTICAL POSITION - For baseline coincident with bottom screen calibration
AFC - OFF
INPUT ATTENUATOR - All switches up

3-7-2 When the SWEEP WIDTH and IF BANDWIDTH controls are concurrently set close to their maximum counterclockwise position the centered signal will appear as an elevated baseline or "pip" with hum superimposed. This is normal.

3-7-3 Although the frequency of the Model VOX may be either above or below the test-signal frequency by a frequency equal to the input-center frequency of the equipment (500 Kc) use the following rules in choosing this frequency.

NOTE

The signal generator frequency can be recognized as being below the test signal frequency if the "pip" moves from left (-) to right (+) as the generator frequency is increased. When the generator frequency is above the test signal frequency a "pip" will move from right (+) to left (-) as the generator frequency is increased. When the frequency of the external oscillator is above the test signals, the plus and minus signs on the screen apply; that is signals on the (+) side are higher in frequency than the center signal while those on the (-) side are lower. If the oscillator frequency is below the test signals, the signs are reversed. Note that when signals whose frequencies are within the bandpass region, i.e., 450 Kc to 550 Kc are fed directly into the input, the screen signs are reversed.

3-7-4 Slowly search the spectrum with the external oscillator until the signal appears at the center of the screen.

3-7-5 To locate the signal, it may be found convenient to operate the analyzer at maximum gain, the signal generator for high output. Once the signal is located, the GAIN control may be backed off counterclockwise and the generator output lowered to obtain a signal which falls below full scale. The INPUT ATTENUATOR may also be used to reduce signal level.

3-7-6 Frequencies of signals appearing on the screen may be quickly determined by adding or subtracting the screen calibration for a given signal to the frequency to which the signal generator is adjusted and then subtracting or adding the input center frequency. See NOTE in paragraph 3-7-3 above.

Example: The Model FSA is set for maximum scanning width. At maximum scanning width each frequency calibration mark for the T-100 is equivalent to a 10 Kc separation. A "pip" appears at +30. The heterodyne oscillator is set to 2,450 Kc.

3-7-7 The input center frequency of the Model FSA is 500 Kc. When the generator is raised, the signal moves right to left. Therefore, the screen calibration is added in this example since it is determined by following the procedure indicated in NOTE of Paragraph 3-7-3 above that the oscillator was above the test signal. Therefore, the + sign applied.

Signal Freq. = Oscillator freq. ±
Screen Calib. ∓ Input Center Freq.

Signal Freq. = 2,450 Kc + 30 Kc -500
Signal Freq = 1,980 Kc

3-7-8 The relative amplitudes of presented signals are proportional to the relative heights of the corresponding deflections, within the limits specified for flatness of response. The use of a pre-amplifier may effect this flatness.

3-7-8-1 To observe signals of comparable amplitude (10:1 or less) the AMPLITUDE SCALE switch should be set to LIN. On the other hand, examination of signals widely divergent in amplitude will require the LOG setting of this control. This will allow simultaneous reading of amplitudes having a 40 db range.

3-8 NARROW BAND ANALYSIS

3-8-1 When signals or a carrier and its sidebands are so closely spaced in frequency that at full sweep width their corresponding deflections tend to merge into each other or mask one another, it may be possible to separate or resolve them by sharpening the IF bandwidth, and concurrently

reducing the scanning width or by reducing the scanning rate or by doing both of the foregoing. The following procedure applies when the SWEEP WIDTH SELECTOR is set to VAR.

A. To obtain better resolution by increasing the scanning time, lower the SWEEP RATE with the SWEEP RATE control. See "C" below for use of AFC.

B. To increase the resolution capabilities by diminishing scanning width, narrowing the IF bandwidth, and increasing scanning time, use the following procedure:
   (1) Keep the IF BANDWIDTH control at maximum clockwise (broad).
   (2) With the external oscillator tune in the particular band of signals to the center of the screen.
   (3) Spread the band of signals across the screen by turning the SWEEP WIDTH knob counterclockwise. See "C" below for use of AFC. Note that at reduced scanning width each frequency calibration mark represents a frequency separation equal to one-tenth of the reduced sweep width. Keep the band centered with the CENTER FREQ control.
   (4) Turn the IF BANDWIDTH control counterclockwise until individual signals are most clearly resolved.

   Illustrations (a) to (f) indicate progressive variations in "pip" width effected by counterclockwise rotation of IF BANDWIDTH control. In (a) and (b) IF width is broad for the particular scanning velocity. (c) shows beginning of "ringing". Extent of "ringing" in (d) shows optimum resolution. As the IF section is made narrower, excessive "ringing" widens "pip", and amplitude decreases as shown in (e) and (f).

   If the resolution adjustment results in practically complete separation of signal "pips" maximum resolution can be recognized by the presence of "ringing" on one side of the "pip". "Ringing" can be seen more easily with the video filter in the OFF position.

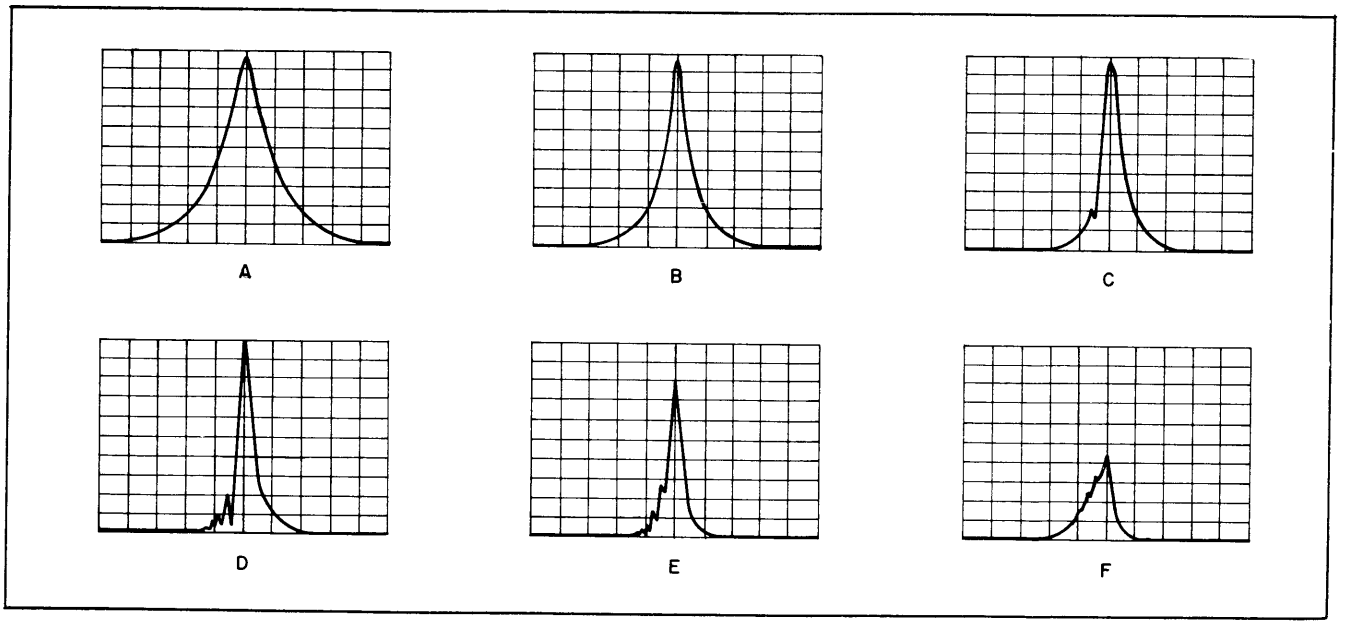
NOTE

Rotation of the IF BANDWIDTH control may result in increased or decreased "pip" height. "Pip" amplitude may be returned to suitable level with the GAIN control. Turning the IF BANDWIDTH control counterclockwise after optimum resolution is reached will decrease the resolving power and result in greatly reduced sensitivity.

   Further counterclockwise rotation of the IF BANDWIDTH control causes a reduction in amplitude and a tendency of remerging of the "pips".
   (5) To better separate the signals the SWEEP WIDTH and IF BANDWIDTH controls can be further backed off counterclockwise and the SWEEP RATE set to a lower rate. See "C" below for use of AFC.

   If it is mandatory to observe a given bandwidth at one time and the signals contained therein are so closely spaced that they cannot be completely resolved, maximum resolution is recognized by the appearance of the clearest picture. Further counterclockwise rotation of the IF BANDWIDTH control will result in lessened resolution and a "bobbing" presentation.

C. For best separation of signals the 0.1 cps scanning rate can be used. Turning AFC on



provides a suitably small scanning width (± 1 Kc) as well as the necessary frequency stability. The following procedure should be used. AFC may be used with faster rates, up to approximately 5 cps.

(1) With the IF BANDWIDTH control fully clockwise and SWEEP WIDTH set completely clockwise, tune in the signals to the center of the screen with the external oscillator.
(2) Turn AFC on. If necessary, adjust the external oscillator for a centered presentation. The AFC control may be used as an aid to centering the presentation. The CENTER FREQ control may be used as a vernier on the AFC control.
(3) Set SWEEP RATE control to a suitable rate, less than 5 cps, depending upon the desired degree of frequency separation and the nature of the signals. AFC should not be used at sweep rates greater than 5. Note that with the AFC on and SWEEP WIDTH at maximum clockwise, each frequency-calibration mark on the screen represents 200 cps. Further reduction of sweep width can be had by counter-clockwise rotation of the SWEEP WIDTH control.
(4) Turn the IF BANDWIDTH control counter-clockwise until optimum resolution is obtained. See B.4 above.
(5) Use the VIDEO FILTER as required to reduce objectionable beating between closely adjacent signals, hum, etc. The HI position provides a moderate amount of filtering. The LO position provides heavy filtering, suitable for use with very low sweep rates. Note that the use of the VIDEO FILTER results in integration of the signal "pips" as well as slight shifting of the "pips".

D. In many cases, it will be most convenient to use the SWEEP WIDTH SELECTOR to set up operating conditions for narrow band analysis. In this mode of operation, the sweep width, sweep rate, IF bandwidth, and video filtering are automatically set for optimum presentation.

3-9 OPERATING PROCEDURE FOR ODD ORDER DISTORTION MEASUREMENT

3-9-1 In measuring odd-order distortion in a single-sideband (SSB) transmitter or exciter, the transmitter is usually modulated by two audio tones of equal amplitude from the TTG. The RF output consists of two signals separated by the audio difference frequency. The presence of odd-order distortion in the transmitter is indicated by the appearance of spurious signals higher and lower in frequency than the RF carrier by an amount equal to the difference frequency.

3-9-2 The Panalyzor, Model FSA has very low internal odd-order distortion (at least 60 db down from the level of the two test signals). In order to obtain this order of performance, the following procedure is recommended.

A. Set the amplitude of the VOX to at least 0.3 volts rms. Greater amplitudes (up to approximately 1 volt) may be used without degradation of performance.
B. Follow the regular operating procedure to display the two RF signals on the screen. Use a sweep width at least three times the separation between the two signals.
C. Set the AMPLITUDE SCALE switch to LOG. Set the IF ATTEN(uator) to 20 db. Set the Gain to maximum (fully clockwise) and adjust the INPUT ATTENUATOR to obtain full scale deflection. The GAIN control may be reduced slightly for the final adjustment.
D. Set the IF ATTEN(uator) to 0 db. The Panalyzor display now shows signals from -20 db to -60 db relative to the two input signals. The amplitude of odd-order distortion pips may be read from the LOG scale calibration on the screen adding 20 db to account for the fact that the signals are deflected 20 db over full scale.

SECTION IV
MAINTENANCE

4-1 GENERAL

Consult the respective instruction manuals for each unit for specific alignment and trouble shooting instructions.

4-1-1 Vacuum tubes should be checked regularly (according to the amount of use received) on a reliable tube tester.

4-1-2 An indication of "GOOD" on a tube tester does not necessarily mean that a tube will function properly in its circuit, but a "REPLACE", "BAD" borderline indication frequently means that better service will result if the tube is replaced. The average commercial tube tester should not be called upon to give more information than this.

4-1-3 Many questions regarding the condition of a particular tube in a given circuit can be answered by trying a good tube in the same location.

4-1-4 In order to prevent failure of the equipment due to corrosion, dust, and other destructive ambient conditions, thoroughly inspect the inside of the chassis for signs of dirt, dampness, molding, charring or corrosion. This should be done periodically depending upon the severity of the conditions. Correct any defect with a cleaning agent of proven quality.

SECTION V
ELECTRICAL PARTS LIST

SEE INSTRUCTION MANUALS FOR INDIVIDUAL UNITS.

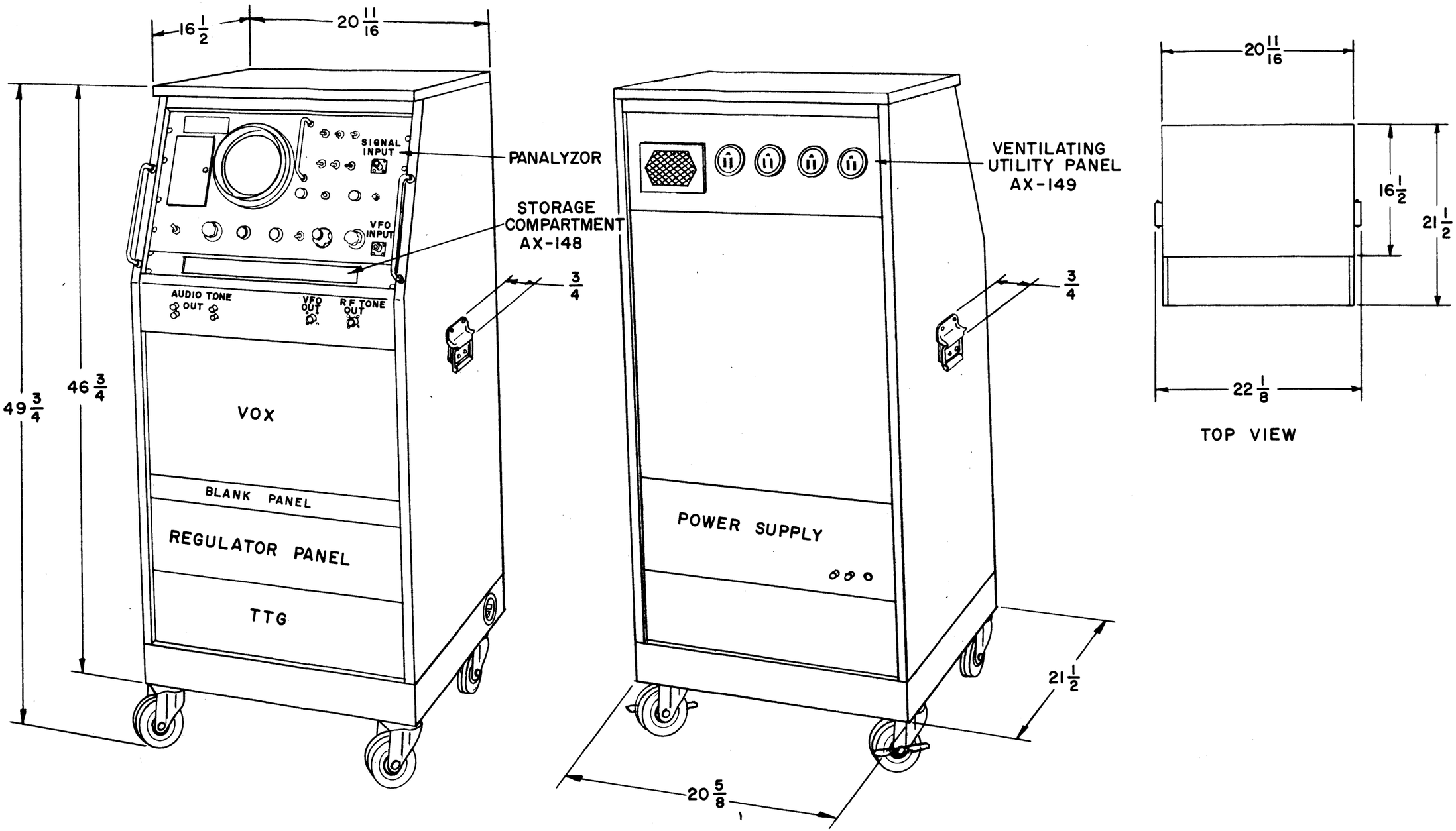


Figure 5-1 Dimensional Outline, Model PTE-1

IN-1093