

CHAPTER 7

SIGNAL ANALYSIS EQUIPMENT

The signal analysis equipment discussed in this chapter will pertain to equipments used in analyzing communication signals and include audio spectrum analyzers (sound spectragraphs), paper tape recorders, and the oscillograph.

AN/GSH-14 AUDIO SPECTRUM ANALYZER

The AN/GSH-14 Audio Spectrum Analyzer, (figure 7-1) commonly referred to as the "Sonograph", is used extensively in the field of speech as an aid in the study of foreign languages and as an aid in correcting speech impediments. It has been modified and adapted to the signal analysis field to study the nature of frequency and time distributions of energy in all types of simple and complex waves.

The AN/GSH-14 is used for visual analysis of any type of audio signal in the frequency range of 85-8000 Hz. Analysis of the pictorial display produced by the Audio Spectrum Analyzer may yield information such as type of modulation, frequency shift/excursion, and bandwidth. It provides a FREQUENCY versus TIME graphic presentation with 2.4 seconds of time represented along the horizontal axis and the frequency along the vertical axis. A relative amplitude is represented by the intensity of the light-and-dark shading on the graph. The graph is visually displayed on chemically treated paper known as "sonagram" paper. Figure 7-2 is a sonagram voice presentation.

The input to the AN/GSH-14 is audio frequency (AF), normally from a receiver. It has two AF outputs and one visual output. The AF

outputs are a built-in speaker and a phone jack that will accept either headphones or an external speaker. The visual output is the sonagram.

Major Units

The Sonograph consists of three major units as follows:

RECORDER UNIT.—The Recorder Unit (figure 7-3) records an audio signal on a 12-inch diameter turntable with a layer of magnetic material.

AMPLIFIER ANALYZER UNIT.—This unit (figure 7-4) contains seven major circuits which perform the necessary amplification, mixing and filtering of the incoming signal for both recording and reproducing.

POWER SUPPLY UNIT.—This unit furnishes the power to operate the other units; it has no operating controls or indicators.

Controls, Indicators and Functions

The controls, indicators and functions of the AN/GSH-14 will be explained in tables 7-1 (Recorder unit) and 7-2 (Amplifier-analyzer unit).

Operating Procedures

The operating procedures for the AN/GSH-14 are explained below:

PRELIMINARY SETTINGS.—Prior to operating the analyzer unit, set the controls to

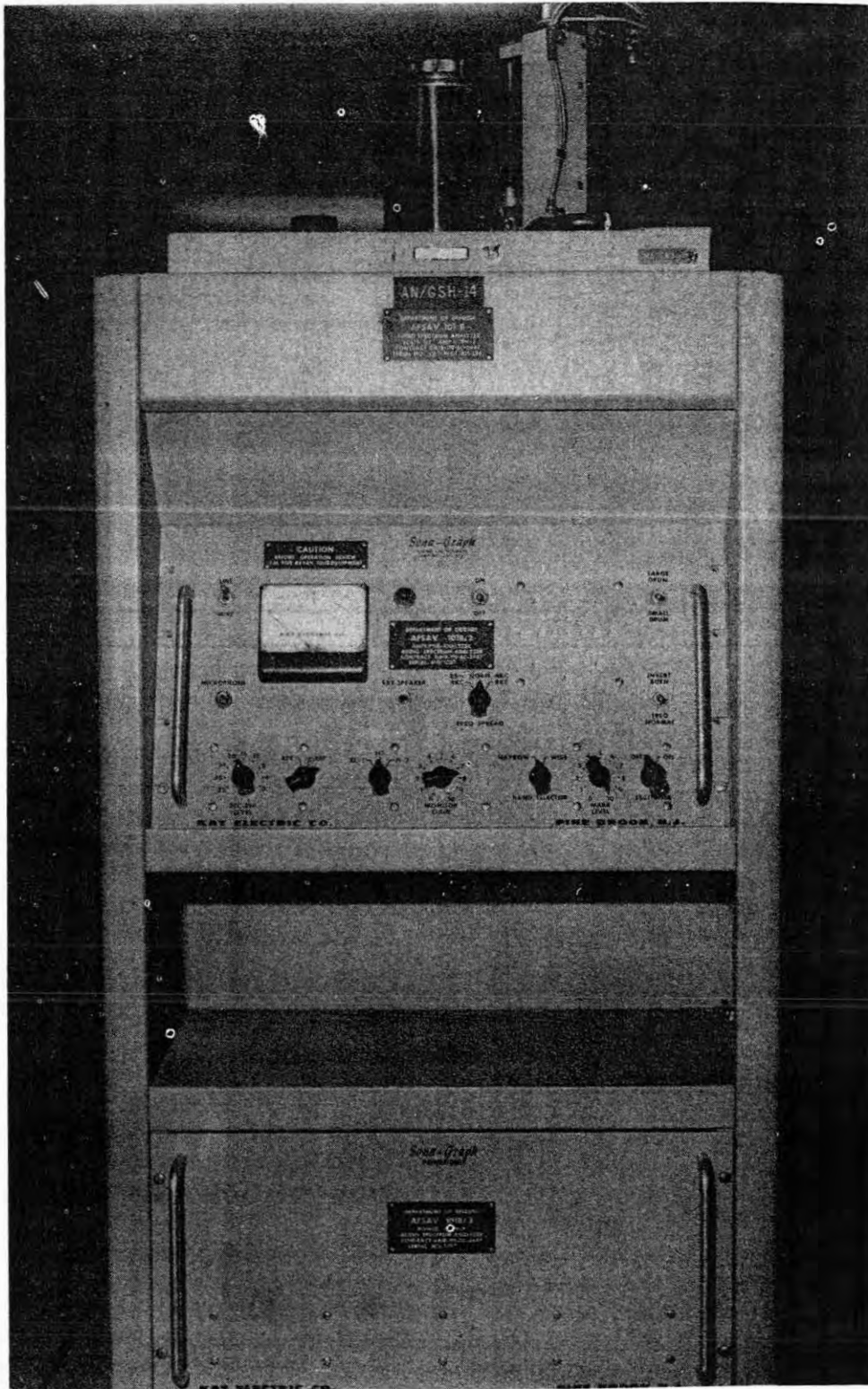


Figure 7-1.—AN/GSH-14 audio spectrum analyzer.

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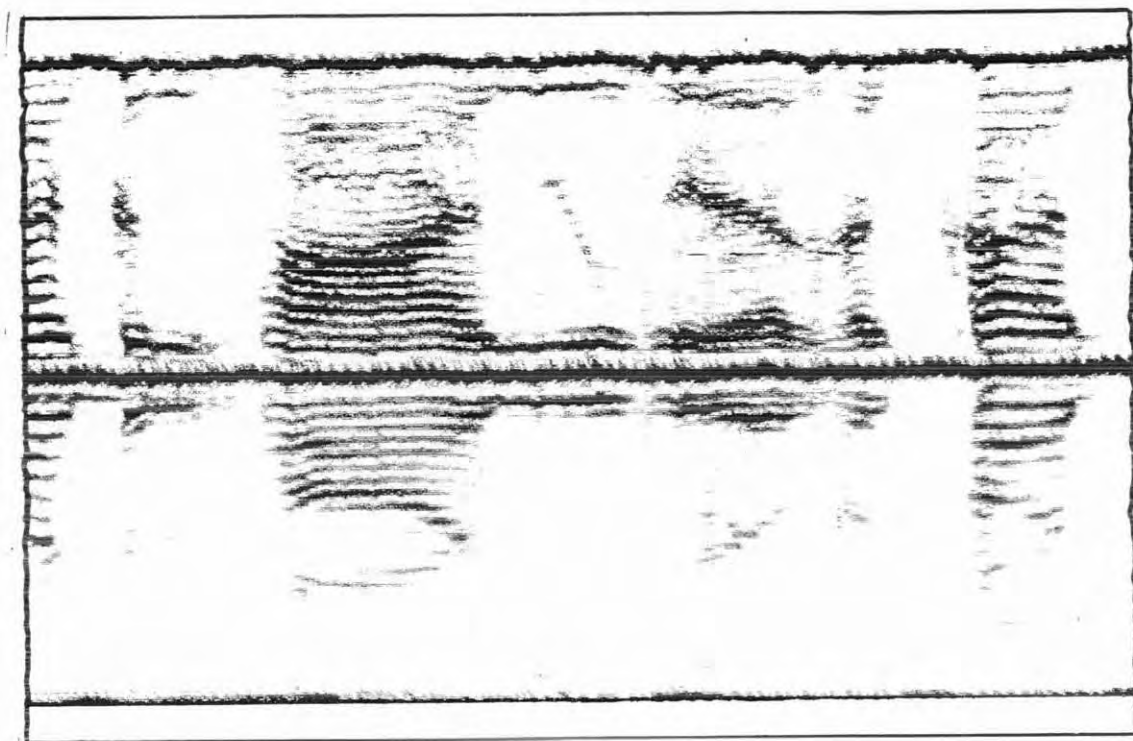


Figure 7-2.—Sonagram voice presentation.

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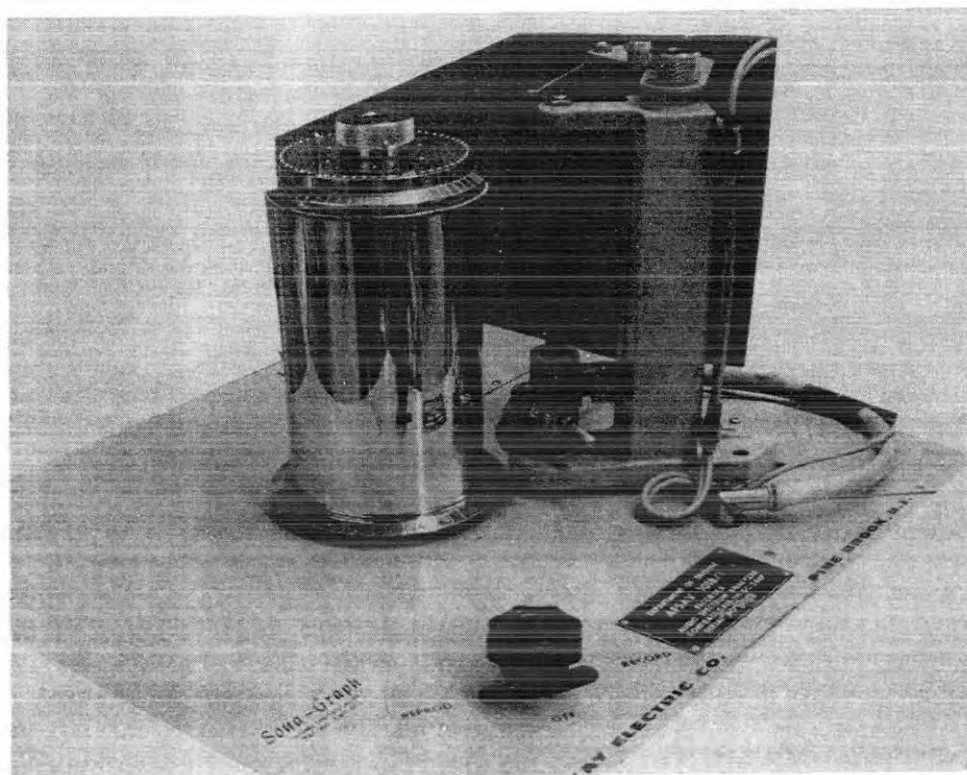


Figure 7-3.—AN/GSH-14 recorder unit.

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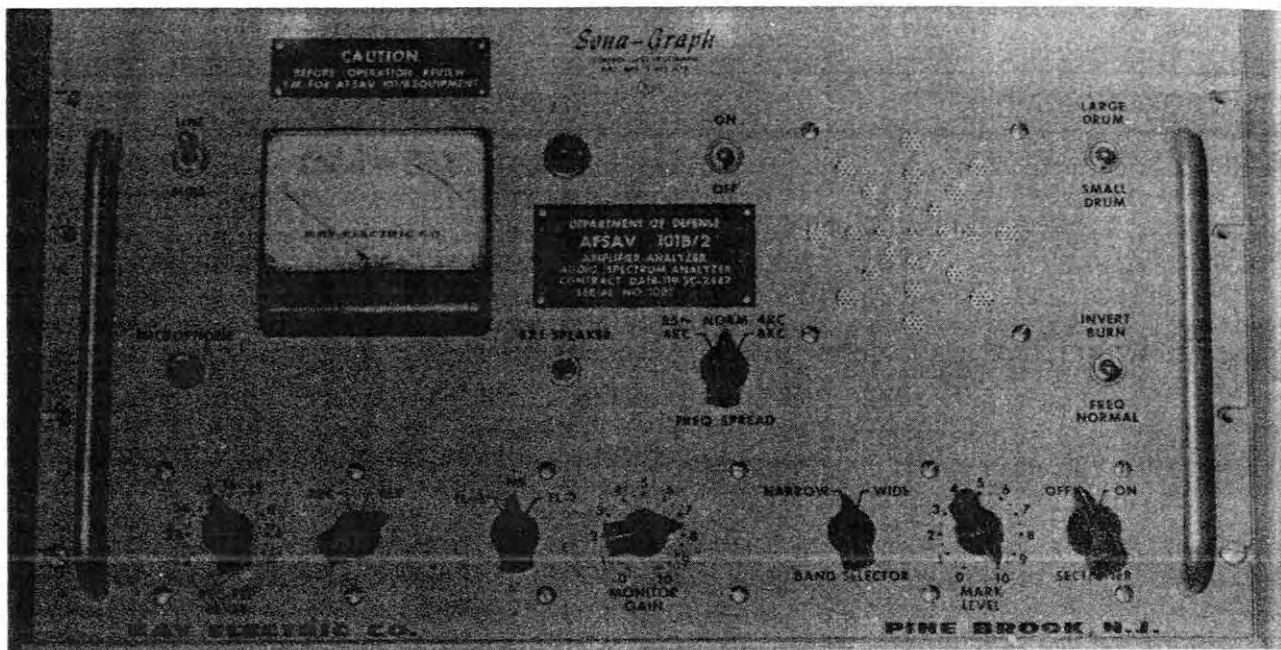


Figure 7-4.—AN/GSH-14 amplifier/analyser unit.

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Table 7-1.—AN/GSH-14 Recorder Unit Operating Controls, Indicators, and Functions

CONTROL, INDICATOR	FUNCTION
RECORD-OFF-REPROD lever	Controls the record/reproduce application. RECORD position - Record Disc/Paper Drum rotates at 24 RPM and feeds the input signal to the Record head. REPROD position - Record Disc/Paper Drum rotates at 80 RPM and transfers the recorded signal to the Stylus. OFF position - Paper Drum and Magnetic disc are stationary.
Neon Baseline Indicator	This lamp glows when the stylus is at the baseline frequency, and acts as an amplitude monitor of the signal as the stylus moves up the leadscrew.
Alarm Buzzer	The alarm buzzer provides an audible signal when the ON-OFF switch of the Amplifier-Analyser is set to OFF while the RECORD-OFF-REPROD lever is engaged in the RECORD or REPROD position.
STYLUS Control Lever	This lever engages the stylus assembly with the leadscrew for preparing sonagrams.
PAPER DRUM (Small/Large)	A round metal drum on which the Sonograph paper is placed, overlapping the left end over the right end. On the bottom of the Drum is a numbered index which is used to reference any point on the Drum. The small drum is 4-7/8 inches in diameter. The large drum is 12½ inches in diameter.

CRYPTOLOGIC COLLECTION EQUIPMENTS

Table 7-2.—AN/GSH-14 Amplifier-Analyzer Unit Operating Controls, Indicators and Functions

CONTROL, INDICATOR	FUNCTION
Sectioner Micrometer Plate	The index, provided only on the small drum, is used to divide the time of the recorded sonagram into 300 units for preparing sections. Sixty holes positioned around the top of the plate provide for actuator pin placement, while the vernier on the plate provides five intermediate settings.
Sectioner Microswitch	A microswitch is located at the top of the stylus housing for preparing sections. The switch is operated each time a pin in the sectioner micrometer plate hits the actuating arm. A half-round pin, with knurled knob, is provided to disengage the microswitch when preparing sonagrams.
ON-OFF switch	Controls the application of input power to the analyzer.
Pilot Lamp	The pilot lamp glows to indicate the presence of a.c. power.
LINE-MIKE switch	This switch selects the type of input device to be used as the signal source: <div style="margin-left: 40px;"> <p data-bbox="786 991 1480 1055">LINE - Used for audio input from source other than microphone.</p> <p data-bbox="786 1087 1463 1151">MIKE - Used only when someone is speaking into a microphone.</p> </div>
REC-REP switch	This switch selects the mode of operation of the record-reproduce amplifier of the analyzer.
REC-REP LEVEL control	This control is used to adjust the gain of the record-reproduce amplifier of the analyzer during recording and reproducing.
FL-1-HS-FL-2 switch	A three position switch used to shape the frequency response of the recording and reproducing system of the analyzer: <div style="margin-left: 40px;"> <p data-bbox="786 1555 1538 1683">FL-1 position - Passes a narrow band of frequencies and is normally used for analyzing pulse element based (radioprinter) signals.</p> <p data-bbox="786 1715 1538 1810">HS and FL-2 positions - Passes a wide band of frequencies and are used for analyzing signals such as voice or multitones.</p> </div>

Table 7-2.—AN/GSH-14 Amplifier-Analyzer Unit Operating Controls, Indicators and Functions—Continued

CONTROL, INDICATOR	FUNCTION
MONITOR GAIN control	This control varies the volume of the signal from the speaker or the external speaker.
FREQ SPREAD switch	This switch controls the range of frequencies displayed in the sonagram.
	85 Hz-4 KC - All frequency components from 85-4,000 Hz are presented vertically over the entire display of the paper.
	NORM - All frequency components from 85-8,000 Hz are presented vertically over the entire display of the paper.
	4 KC - 8 KC - All frequency components from 4,000-8,000 Hz are presented vertically over the entire display of the paper.
BAND SELECTOR switch	This switch controls the bandwidth of the filter during reproduction. When set to NARROW, the band-pass of the filter is approximately 45 Hz; and when set to WIDE, the band-pass is approximately 300 Hz. (See figures 7-4 and 7-5).
MARK LEVEL control	This control adjusts the degree (intensity) of burning on the sonagram.
	CAUTION: THE FUMES GENERATED BY BURNING THE SONAGRAPH PAPER ARE TOXIC. TOO HIGH A DEGREE OF BURN WILL RESULT IN AN UNNECESSARY AMOUNT OF FUMES. WHILE THESE FUMES ARE NOT DEADLY, THEY MAY CAUSE NAUSEA.
SECTIONER switch	A two position switch (ON-OFF) used to display portions of the frequency spectrum at one or more points along the time scale.
INVERT BURN - FREQ NORMAL switch	This switch reverses the vertical scale of the Sonagram.
	INVERT BURN - 8,000 Hz appears at the bottom of the Sonagram; 85 Hz appears at the top.
	FREQ NORM - 85 Hz appears at the bottom of the Sonagram; 8,000 Hz appears at the top.

CRYPTOLOGIC COLLECTION EQUIPMENTS

Table 7-2.—AN/GSH-14 Amplifier-Analyzer Unit Operating Controls, Indicators and Functions—Continued

CONTROL, INDICATOR	FUNCTION
MICROPHONE jack	This jack is the signal input jack for the analyzer unit.
EXT SPEAKER jack	This jack provides monitoring with an external or remote speaker.
VU meter	This meter provides an indication of the recording and reproducing level at the output of the record-reproduce amplifier of the analyzer.
SMALL DRUM - LARGE DRUM switch	This switch controls the application of plate supply voltage to the power amplifier. SMALL DRUM position - Used when using the small drum. LARGE DRUM position - Used when using the large drum.

the positions indicated below; controls not listed may be left in any position.

<u>Control</u>	<u>Position</u>
ON-OFF switch	ON (allow at least 10 minutes to warm up)
REC-REP switch	REC
REC-REP LEVEL control	Fully counter-clockwise
MONITOR GAIN control	Fully counter-clockwise
MARK LEVEL control	Fully counter-clockwise
SECTIONER switch	OFF
INVERT BURN - FREQ NORMAL switch	FREQ NORMAL
RECORD-OFF-REPROD	OFF
Stylus control lever	Resting at the bottom of the leadscrew
FREQ SPREAD switch	NORM

RECORDING.—Follow the steps listed below when making a recording for reproduction.

1. Connect the input signal to the MICROPHONE jack, and set the LINE-MIKE switch to the position corresponding to the input source.
2. Set the FL-1-HS-FL-2 switch to the desired filtering position. In general, FL-1 position is recommended for pulse signals, while HS and FL-2 are recommended for multitones and voice signals; however, voice signals can be recorded in any filter position.
3. Set the RECORD-OFF-REPROD lever of the recorder to the RECORD position.
4. Rotate the REC-REP LEVEL control until the VU meter indicates approximately 0 VU for pulse signals or multitone signals, or between -3 and +1 VU for the peaks of a speech signal. Only the 2.4 second portion of the signal immediately preceding the erase head is present on the turntable.
5. Set the REC-REP switch to REP to stop the recording process and to monitor what has been recorded on the turntable. Adjust the MONITOR GAIN control as required.

6. After a satisfactory recording has been obtained, set the RECORD-OFF-REPROD lever to OFF.

S O N A G R A M P A P E R I N S T A L L A T I O N .—Before making a Sonagram presentation of the recorded signal, Sonagram paper must be installed. Recording paper for the small drum is 5-5/8 inches wide by 12-3/4 inches long. The paper for the large drum is 5-5/8 inches wide by 40-1/8 inches long. The procedure for installing sonagram paper is as follows:

1. Set the MONITOR GAIN and REC-REP LEVEL controls to provide a convenient listening level. Manually rotate the drum (using the knob on the paper drum) until a click is heard over the speaker, indicating the end of the recorded signal.

2. Note the index number on the drum where the stylus would normally contact the recording paper. (Use the stylus control lever to move the stylus toward the drum.)

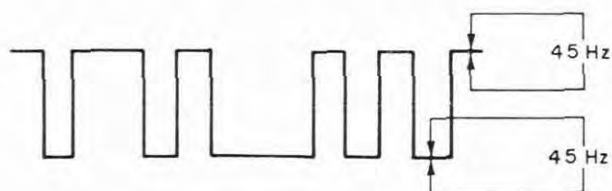
3. Manually rotate the drum until the index point from step (2) is away from the stylus assembly.

4. Wrap the sonagram paper, in a counterclockwise direction, around the drum, with the outside end of the paper aligned with the index point from step (2). Gently align the paper so that it rests on the bottom flange of the drum and secure it with the two rolling springs at the top and bottom of the drum.

NOTE: Care should be exercised to ensure that the sonagram paper is properly installed. Improper installation will cause the stylus to lift and tear the edge of the sonagram paper.

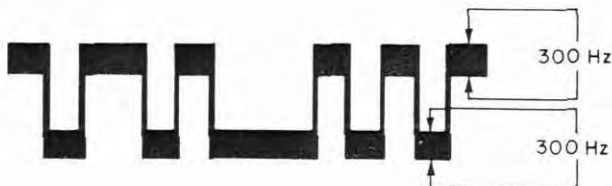
REPRODUCTION.—Follow the steps listed below when making a reproduction of a recorded signal.

1. Set the REC-REP switch to REP, and the BAND SELECTOR switch to WIDE or NARROW, depending upon the type of signal to be reproduced. WIDE is normally used for pulse signals (figure 7-5) while NARROW (figure 7-6) is normally used for voice or multitone signals. Set the FL-1, HS, and FL-2 switches to the same



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Figure 7-5.—Sonagram presentation of an FSK signal with Band Selector switch in NARROW position.



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Figure 7-6.—Sonagram presentation of an FSK signal with Band Selector switch in WIDE position.

positions as those used during recording, and set the LARGE DRUM-SMALL DRUM switch to the position corresponding to the drum to be used.

2. Set the RECORD-OFF-REPROD lever of the recorder unit to REPROD. (The turntable should rotate.)

3. Adjust the REC-REP LEVEL control to obtain an indication of about 0 VU on the VU meter for pulse or multitone signals, or approximately -2 VU for the peaks of voice signals.

4. Adjust the MARK LEVEL control until the stylus voltage is sufficient to mark the recording paper without overburning.

5. Lift and move the stylus control handle to bring the stylus into contact with the sonagram paper. DO NOT allow the stylus to touch the sonagram paper unless the drum is rotating.

6. The stylus will automatically travel from the bottom to the top of the drum to produce the sonagram.

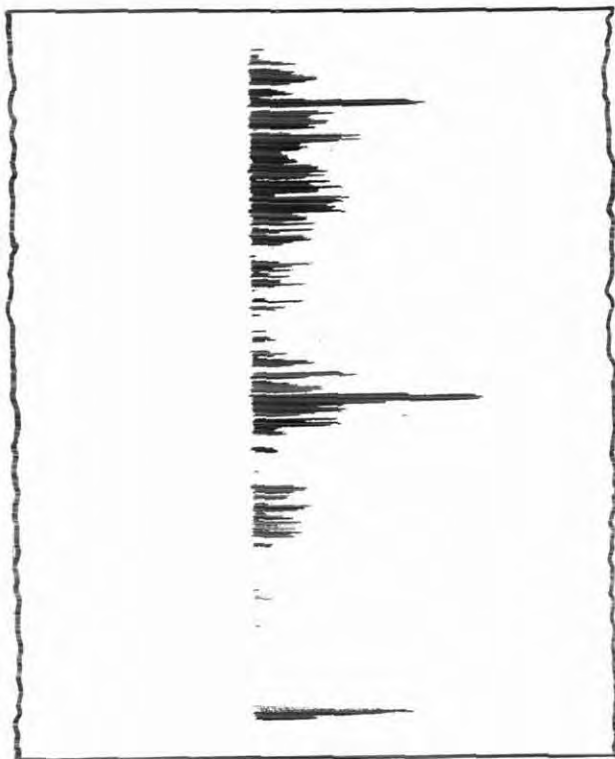
7. When the sonagram is completed, return the stylus to its rest position at the bottom of

the leadscrew; set the RECORD-OFF-REPROD lever to the OFF position and remove the sonagram paper.

NOTE: For the first and last few revolutions of the turntable, no burning occurs. This assures a proper frequency range across the recording paper.

MARKING A SECTION.—A section gives an amplitude vs frequency display (figure 7-7) at any preselected point on the time scale of the recording. Several sections may be made simultaneously, provided they are more than 0.4 second apart (approximately 60 degrees of drum rotation). Only the small drum can be used when making a section display. Follow the steps listed below when making a section:

1. Prepare a sonagram in accordance with the above procedure. DO NOT remove the sonagram paper.



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Figure 7-7.—Sonagram SECTION presentation.

2. Determine the points at which the sections are to be taken from the sonagram. If the desired points are closer than 0.4 second, more than one section shot is required.

3. Manually rotate the drum (using the knurled knob) until the stylus is in line with the point at which the section is to be taken.

4. Release the section microswitch by rotating the microswitch control one-half turn.

5. Insert one of the knurled pins (stored in the top of the drum) into one of the sixty holes in the drum index; the drum index will contact the actuating arm of the microswitch at this position. Place the other knurled pins into the holes at the top of the drum where other sections are to be taken.

6. Manually rotate the drum, using the knurled screw, and check to see that the microswitch is actuated as each pin passes the actuating arm. (An audible click occurs as the microswitch is actuated.)

7. For future reference, mark the points on the sonagram where sections are to be taken.

8. Note the index position of the sonagram paper and remove the sonagram paper.

9. Install a new piece of sonagram paper and align it with the index position noted in step (8).

10. Set the SECTIONER ON-OFF switch to the ON position.

11. Set the LARGE DRUM—SMALL DRUM switch to SMALL DRUM and the REC-REP LEVEL and MARK LEVEL controls to the positions required for marking.

12. Set the RECORD-OFF-REPROD lever to REPROD and engage the stylus.

13. When the section is completed, return the stylus to its rest position at the bottom of the leadscrew; set the RECORD-OFF-REPROD lever to the OFF position and remove the sonagram paper.

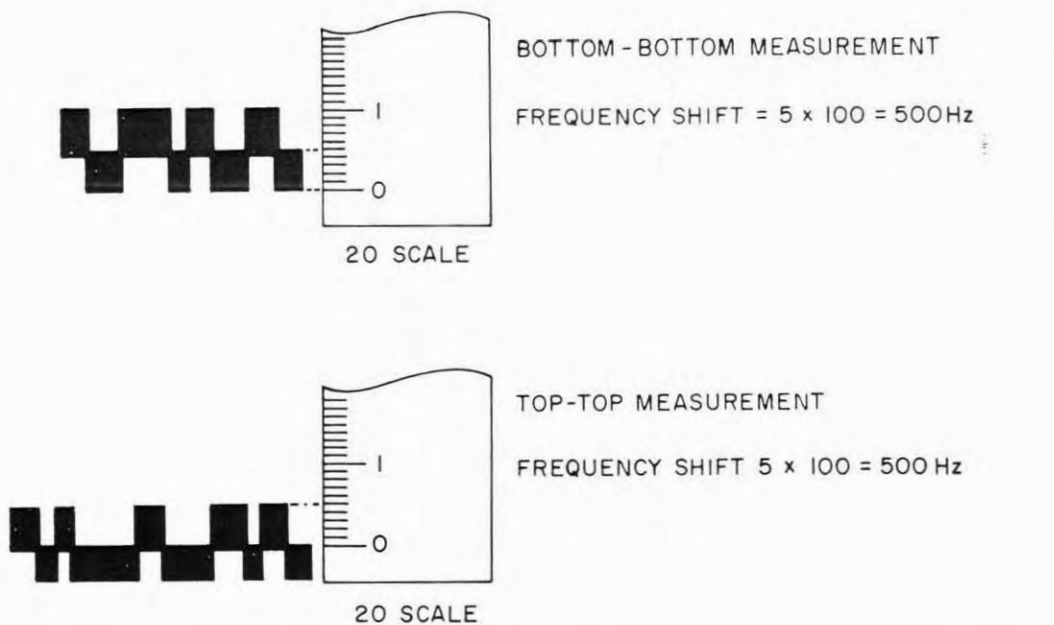
FREQUENCY MEASUREMENTS ON SONAGRAM PRESENTATION.—Measurements on a sonagram shot are made with "scale 20" of an engineer scale and are taken from the bottom-bottom or top-top portion of the signal presentation. It should be noted that, to obtain

the proper measurement in Hz, the resultant number from the 20 scale should be multiplied by 100 (see figure 7-8).

Place \emptyset gradient on the bottom or top portion of the signal element's lowest frequency and obtain the frequency shift and/or excursion from the corresponding bottom or top portion of the highest frequency keyed. (See figures 7-9 and 7-10).

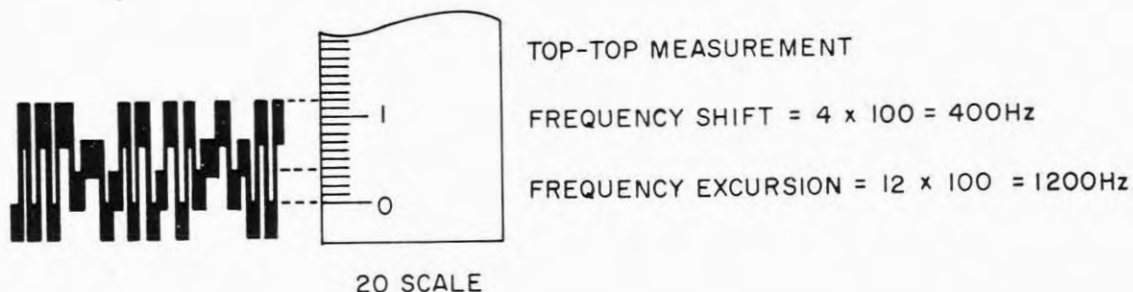
**AN/GSH-23A(V)/AN/GSH-24A(V)
AUDIO SPECTRUM ANALYZER**

The AN/GSH-23A(V)/AN/GSH-24A(V) audio spectrum analyzer, (figure 7-11) produces permanent, graphic recordings of audio signals in the frequency range of 85 to 16,000 Hz. The AN/GSH-24A(V) audio spectrum analyzer is



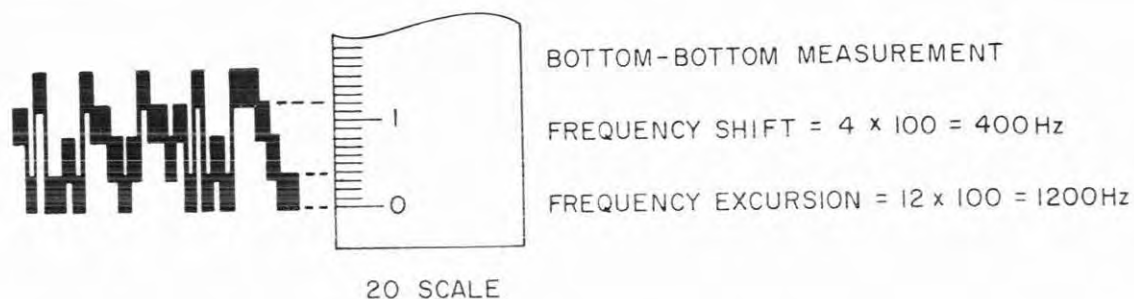
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Figure 7-8.—Sonogram Measurements (FSK).



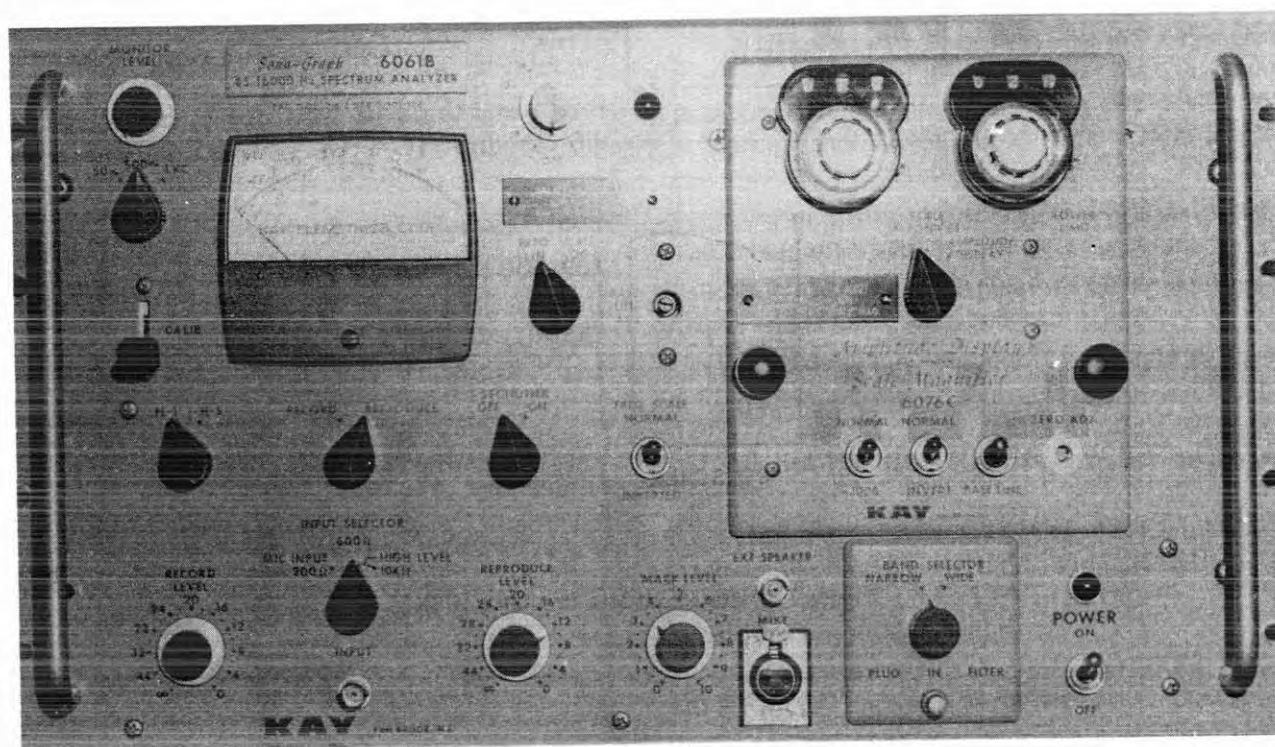
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Figure 7-9.—Sonogram measurements (DFSK - Top to Top).



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Figure 7-10.—Sonogram measurements (DFS-K - Bottom to Bottom).



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Figure 7-11.—AN/GSH-23A(V) Audio Spectrum Analyzer.

operationally the same as the AN/GSH-23A(V), with the only difference being that the AN/GSH-23A(V) is portable and the AN/GSH-24A (V) is rack mounted. For this reason, only the AN/GSH-23A(V) will be referenced for discussion purposes.

The AN/GSH-23A(V) is similar to the AN/GSH-14, but has additional capabilities. In addition to studying TIME and FREQUENCY, as with the AN/GSH-14, AMPLITUDE can also be analyzed with the AN/GSH-23A(V). A recording time of 2.4 seconds is allowed for

audio signals within the frequency range of 85 to 8,000 Hz, 1.2 seconds for audio signals within the frequency range of 160 to 16,000 Hz. A built-in calibration tone generator can provide frequency markers every 50, 500, or 1,000 Hz along the frequency scale of the signal pattern. A small and/or large drum is also used with the AN/GSH-23A(V).

The AN/GSH-23A(V) consists of three major units: RECORDER, AMPLIFIER-ANALYZER and POWER SUPPLY. It also has two plug-in units: AMPLITUDE DISPLAY AND SCALE MAGNIFIER (6076-C) and CONTOUR DISPLAY (6076-A). The amplitude display function permits a display of AMPLITUDE vs TIME on the upper third of the normal sonagram. The scale magnifier function allows

the expansion of any portion of the normal pattern to the full four inch width. The Contour Display unit provides a contour display (similar to a contour map) for studying amplitude and signal strength characteristics of complex signals. Because this is normally done only in advanced signal analysis, the Contour Display unit will not be discussed in this publication.

Controls, Indicators and Functions

The operating controls, indicators and functions for the RECORDER, AMPLIFIER-ANALYZER, and AMPLITUDE DISPLAY AND SCALE MAGNIFIER units will be explained in tables 7-3, 7-4, and 7-5 respectively. The POWER SUPPLY unit has no operating controls.

Table 7-3.—AN/GSH-23A(V) Recorder Unit Operating Controls, Indicators, and Functions

CONTROL/FEATURE	FUNCTION
RECORD-OFF-REPROD	Controls the application of power to the three drive system and blower motors, and activates the control circuits for the recorder. When set to either RECORD or REPROD position, the turntable rotates at selected speeds. The speed selected determines the recording time of either 2.4 seconds or 1.2 seconds.
Stylus Control Lever	Engages the Stylus Assembly with the leadscrew and stylus wire with the paper.
Micrometer Plate	This plate can be used to divide the time of the recorded sonagram into 300 units (for sectioning purposes). It provides four intermediate settings between each pin hole.
Neon Baseline Indicator	This lamp glows when the stylus is at the baseline frequency, and acts as an amplitude monitor of the signal as the stylus moves up the leadscrew.
Stylus Adjust Screw	If the stylus wire becomes worn, this screw can be used to adjust the length and pressure of the wire on the sonagram paper. Since there is a HIGH VOLTAGE on this adjusting screw, TURN OFF the POWER switch on the Analyzer unit before attempting to adjust the stylus.
Blower Motor*	This is used to remove the smoke caused by the burning of the sonagram paper.

*This item is not visible on the top of the unit

CRYPTOLOGIC COLLECTION EQUIPMENTS

Table 7-4.—AN/GSH-23A(V) Amplifier-Analyzer Unit Operating Controls, Indicators, and Functions

CONTROLS	POSITION	FUNCTION
POWER switch	ON	Line voltage is applied to the power supply unit. Pilot light is on.
	OFF	Electrical circuitry is completely de-energized.
INPUT SELECTOR switch	MIC INPUT	Used when speaking into a microphone.
	HIGH LEVEL	Used for audio input from source other than microphone.
RECORD-REPRODUCE switch	_____	Selects mode of operation of the ANALYZER unit.
RECORD LEVEL control	Stepped variable	Provides an adjustment of the record gain in 2 dB increments.
REPRODUCE LEVEL control	Stepped variable	Provides an adjustment of the reproduce gain in 2 dB increments.
FL-1-HS switch	FL-1	Passes narrow band of frequencies. Normally used with pulse element based signals.
	HS	Passes a wide band of frequencies. Normally used with voice signals.
MONITOR LEVEL control	Variable	Controls the audio output at the speaker.
CALIB ON switch	Momentarily depressed	Provides calibration marks at selected intervals on the frequency scale of the sonagram.
CALIB FREQ SELECT	Switchable	Allows the selection of 50, 500, or 1,000 Hz calibration lines.
BAND SELECTOR switch	NARROW	Provides selection of narrow bandwidths. (45 Hz - 80 to 8,000 Hz frequency range; 90 Hz - 160 to 16,000 Hz frequency range).
	WIDE	Provides selection of wide bandwidths. (300 Hz - 80 to 8,000 Hz frequency range; 600 Hz - 160 to 16,000 Hz frequency range).
SECTIONER switch	OFF	Provides for an overall picture of the signal being analyzed.

Table 7-4.—AN/GSH-23A(V) Amplifier-Analyzer Unit Operating Controls, Indicators, and Functions—Continued

CONTROLS	POSITION	FUNCTION
SECTIONER switch (Continued)	ON	Energizes the Sectioner circuits to provide a section of the signal being analyzed.
FREQ SCALE switch	NORMAL	Frequency presentation is normal.
	INVERT	Frequency presentation is inverted.
AGC switch	Variable	Compresses the maximum recorded signal to 10 dB.
	OFF	The AGC is turned off.
BASELINE Adjust control	Variable	Enables the position of the baseline to be adjusted on the sonagram.
MARK LEVEL control	Variable	Controls the darkness of the sonagram.
FREQ SCALE LIN-LOG switch	————	Enables the frequency scale to have a linear (even) or logarithmic (uneven) presentation.
VU meter	————	Provides a visual means of monitoring the recording of a signal.
SHORT POINT indicator	————	This lamp glows when the stylus control is at the bottom and the top of the sonagram; at this point the Marking amplifier circuitry is disabled and no mark will appear on the sonagram.
TAPE RECORD input	JONES PLUG	Provides a means of feeding data from a tape recorder into the analyzing circuits.
MIKE INPUT	————	This is the input to the record amplifier circuitry.
EXT SPEAKER	————	Provides an output for a remote speaker.
INPUT connector	————	This is the input to the record amplifier circuitry.

CRYPTOLOGIC COLLECTION EQUIPMENTS

Table 7-5.—AN/GSH-23A(V) Amplitude Display and Scale Magnifier Unit Operating Controls, Indicators, and Functions

CONTROL	POSITION	FUNCTION
FUNCTION switch	OFF	Amplitude Display Scale Magnifier unit is completely bypassed.
	SCALE MAGNIFIER	SCALE MAGNIFIER function is energized.
	AMPLITUDE DISPLAY	AMPLITUDE DISPLAY function is energized.
10 dB Pad	—————	When selected, provides 10 dB of attenuation to the input of the AMPLITUDE DISPLAY.
BASELINE switch	ON (down)	Inserts a baseline on the paper, in the place of the signal input, to be used as a referenced line for AMPLITUDE DISPLAY patterns.
UPPER LIMIT	Variable	When the function switch is in the SCALE MAGNIFIER position, this control determines the upper limits of the magnification.
LOWER LIMIT	Variable	Determines the lower limits of the magnification.
ZERO ADJ	Variable	Vernier adjustment of the baseline.
NORMAL-INVERT	Invert	Inverts the sonagram display.

Operating Procedures

The operating procedures for the AN/GSH-23A(V) are as follows:

PRELIMINARY SETTINGS.—Make the following preliminary settings prior to operating the AN/GSH-23A(V): (Controls not mentioned may be in any position.)

- | | |
|-----------------------|-------------------------------------|
| 1. POWER switch | ON (allow a few minutes for warmup) |
| 2. SECTIONER switch | OFF |
| 3. MARK LEVEL control | Ø |
| 4. REC-REP switch | REPRODUCE |

NOTE: Allow the turntable to come to a complete halt before changing from the RECORD speed or from one reproduce speed to another.

RECORDING.—Follow the steps listed below when making a recording for reproduction:

1. Set the INPUT SELECTOR to the appropriate position.
2. Plug the output of your signal source into the INPUT jack.
3. Set the FL-1-HS switch to the appropriate position. (HS for voice.)
4. Set the RECORD LEVEL control to approximately 44.

5. Place the REC-OFF-REP lever in the RECORD position.

6. Turn up the RECORD LEVEL control until an approximate reading of 0 VU on signal peaks is attained.

7. Turn the RECORD-REPRODUCE switch to RECORD.

8. Turn the RECORD-REPRODUCE switch to REPRODUCE and the REC-OFF-REP lever to the OFF position immediately after recording.

9. The recorded signal will now be reproduced repetitively and may be monitored by advancing the MONITOR GAIN control until a convenient volume is obtained.

INSERTING FREQUENCY MARKERS.—The calibration tone is selectable; it will produce harmonics every 50, 500, or 1,000 Hz. This tone can be recorded either as the input signal is recorded, or after switching to the REPRODUCE mode.

1. If the input signal is being recorded and calibration is desired, merely depress the CALIB ON switch momentarily, and the frequency markers will be recorded along with the signal.

2. If a signal has already been recorded and calibration is desired, listen to the signal being played back and depress the CALIB ON switch momentarily between the end and beginning of the recording. If the CALIB ON switch is depressed during the playback of the recorded material, erasure of the signal will occur.

3. It should be noted that when the CALIB ON switch is depressed, the record circuits of the Sonograph are energized. Therefore, if there is a signal at the INPUT jack, it will be recorded along with the calibration tone.

SETTING THE BASELINE.—The baseline is used as a reference point on the sonagram.

1. Place the REC-OFF-REP in the OFF position and lift the stylus holder to the point at which the SHORT POINT light is barely extinguished. Partially engage the stylus, but avoid letting the wire touch the drum.

2. Turn the AGC control to zero (minimum AGC).

3. Place the BAND SELECTOR switch in the NARROW position and set the MARK LEVEL control to approximately (4).

4. Select either a LINEar or LOGarithmic display, using the FREQ SCALE switch, and place the INVERTED-NORMAL switch in the NORMAL position.

5. Set the SELECTOR switch on the AMPLITUDE DISPLAY AND SCALE MAGNIFIER or CONTOUR DISPLAY unit, if applicable, to the OFF position.

6. Rotate the BASELINE ADJUST control until the BASELINE INDICATOR lights. This adjustment insures the position of the baseline at the bottom of the sonagram.

7. Return the stylus holder to the bottom of the leadscrew.

SONOGRAM PAPER INSTALLATION.—The procedures for installing sonagram paper on the AN/GSH-23A(V) are the same as those described for the AN/GSH-14.

REPRODUCING THE RECORDED SIGNAL.—Follow the steps listed below when making a normal sonagram presentation.

1. Using the AGC control, select the desired amount of AGC action. A minimum setting of the control permits signals approximately -20 dB down from the reference level to be displayed on the sonagram. A maximum setting of this control will enable levels down to -40 dB to be displayed.

2. Set the MARK LEVEL control for the desired pattern contrast. For a minimum AGC setting, a mark level of (2.5) should be sufficient; a level of about (7.5) should provide proper contrast for maximum AGC settings.

3. Set the REC-OFF-REP lever to the REPRODUCE position.

4. Adjust the REPRODUCE LEVEL control for a reading of 0 on the VU meter.

5. The BAND SELECTOR switch may be set to either the NARROW or WIDE position. (WIDE position is normally used for voice and multitone signals.)

6. Lift the stylus slightly and engage it with the leadscrew making sure the stylus wire is touching the paper. (Avoid leaving the stylus

close to the paper with the MARK LEVEL at a high value. Arcing could occur, causing damage.)

7. Allow the stylus to travel up the paper until the upper SHORT POINT indicator lights up.

8. Disengage the stylus and return it to the bottom of the leadscrew.

REPRODUCING A SECTION DISPLAY.—A SECTION gives an AMPLITUDE vs FREQUENCY display at a preselected point in time. The SECTIONER MICROMETER PLATE is divided into 300 units, eight milliseconds apart; a section may be taken at any one of these points.

1. Make a normal sonagram reproduction as described previously. Do not remove the completed sonagram from the drum. Determine the point or points where you wish to see the sections. (A maximum of (6) sections may be made at one time, since each section requires a 2 inch segment of the sonagram paper.)

2. With the stylus at the bottom of the leadscrew, manually rotate the drum and turntable assembly until the tip of the stylus wire is exactly in line with the point to be sectioned.

3. Loosen the knurled knob holding the micrometer plate.

4. Insert a magnetic pin in the hole in the micrometer plate nearest to the pointer, and holding the drum and turntable in place, rotate the micrometer plate until the pin is exactly in line with the pointer.

5. Tighten the knurled knob.

6. Additional pins may be inserted, but the spacing between pins may NOT be less than (10) holes. The section will be taken at the point where the stylus rests on the paper when a pin passes the pointer.

7. For future reference, mark the sonagram at the points where the Sections are to be taken. Also note the position of the overlap on the index.

8. Remove the sonagram and replace it with a new sheet of paper. Carefully position the overlap at the same index point as the previous sheet.

9. Turn the SECTIONER switch to the ON position, the MARK LEVEL control to (4), and the BAND SELECTOR switch to NARROW.

10. Place the REC-OFF-REP lever in the REPRODUCE position. Lift the stylus control slightly and engage the paper. When the upper SHORT POINT indicator lights, the SECTION is complete. Disengage the stylus and return it to its rest position.

11. With the FREQ SCALE switch in the NORMAL position, the frequency presentation on the SECTION will be inverted (higher frequencies will be at the bottom of the paper).

NOTE: If you desire a SECTION at a different point in time, with reference to the original SECTION, you must readjust the MICROMETER PLATE or magnetic pin. Both the magnetic pin holes in the MICROMETER PLATE and the graduation in the upper portion of the drum are 40 milliseconds apart. In addition to the 60 pin holes, the MICROMETER PLATE also contains (5) graduations on its outside, which may subdivide any or all of the aforementioned holes, thus providing 300 possible divisions, 8 milliseconds apart. ($300 \times .008 \text{ sec.} = 2.4 \text{ sec.}$ recording time). An example is now given to show how to set the MICROMETER after a section run is made at a selected time ($t = 0$):

(a) Assume it is desired to sample a place 8 milliseconds earlier ($t-8$ milliseconds). Do this by loosening the knurled knob slightly and rotate the plate clockwise, in relation to the drum below, one micrometer division. This will cause the reed switch to be closed 8 milliseconds earlier than that of the previous setting. Tighten the large knurled knob and take the section.

(b) If a sample is desired 24 milliseconds later (i.e. $t+24$ milliseconds) perform the following operations: Loosen the knurled knob slightly and rotate the plate counterclockwise, in relation to the drum below, three micrometer divisions. This will cause the reed switch to close 24 milliseconds later than the referenced setting. Tighten the large knurled knob before taking a Section at this new point in time. Do this for all settings up to $t+32$ milliseconds, and, at $t+40$ milliseconds, go to the next hole on the plate, which is the same point.

12. Note the position of the recording paper on the drum. Remove the completed Section display.

13. If sonagrams and sections are to cover only the ranges from \emptyset to 4 kHz and 8 kHz,

both can be placed on one sheet of paper, with the sonagram recorded on the lower half of the recording paper and the section starting immediately above, or vice versa. This can be done because the frequency scale is reversed when making a section; consequently, the section will start at 4 kHz directly above the sonagram and end at zero frequency at the top of the sonagram paper.

AMPLITUDE DISPLAY.—Follow the steps listed below for an **AMPLITUDE vs TIME** display on the upper one third of the sonagram paper. (See figure 7-12.)

1. Set the controls for a normal sonagram display.
2. Turn the selector switch on the 6076-C plug-in unit to the **AMPLITUDE DISPLAY** position.
3. Place the **REC-OFF-REP** lever in the **REPRODUCE** position and adjust the

REPRODUCE LEVEL control to obtain -2 on the VU meter.

4. Set the **MARK LEVEL** control to (4).
5. Raise the stylus assembly to a point approximately one-third the way down from the top of the paper.
6. Depress the **BASELINE** switch and move the stylus up or down until the **BASELINE INDICATOR** lights. Then lower the stylus slightly and, still holding down the **BASELINE** switch, engage the stylus.
7. As soon as the baseline has been marked on the paper, release the switch.
8. When the **SHORT POINT** indicator lights up, return the stylus to its reset position.
9. If the pattern has gone off the upper limit of the paper, reduce the **REPRODUCE LEVEL** control or switch in the 10 dB attenuator, engage the stylus slightly above the Amplitude Display baseline and remark the paper.

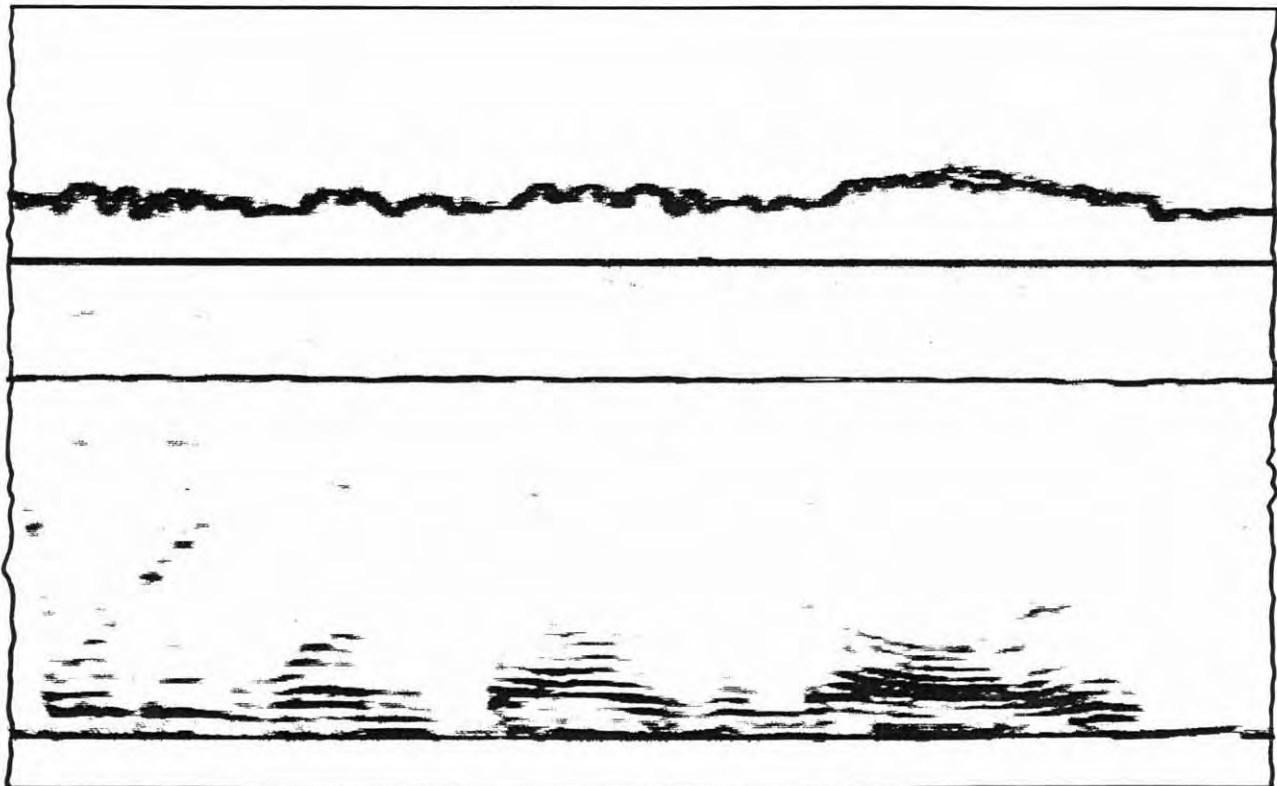


Figure 7-12.—Amplitude vs Time sonagram display.

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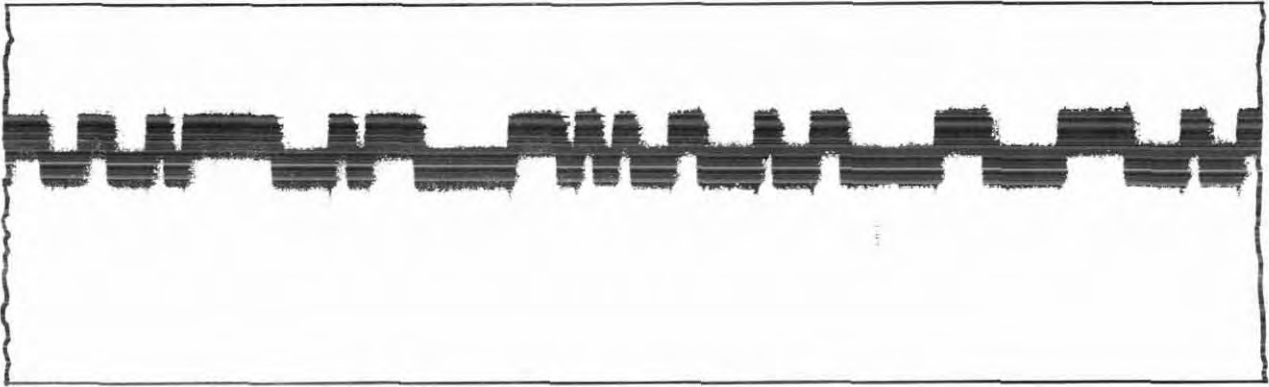
CRYPTOLOGIC COLLECTION EQUIPMENTS

SCALE MAGNIFIER.—Follow the steps listed below to expand a portion of the normal sonagram display. (See figure 7-13.)

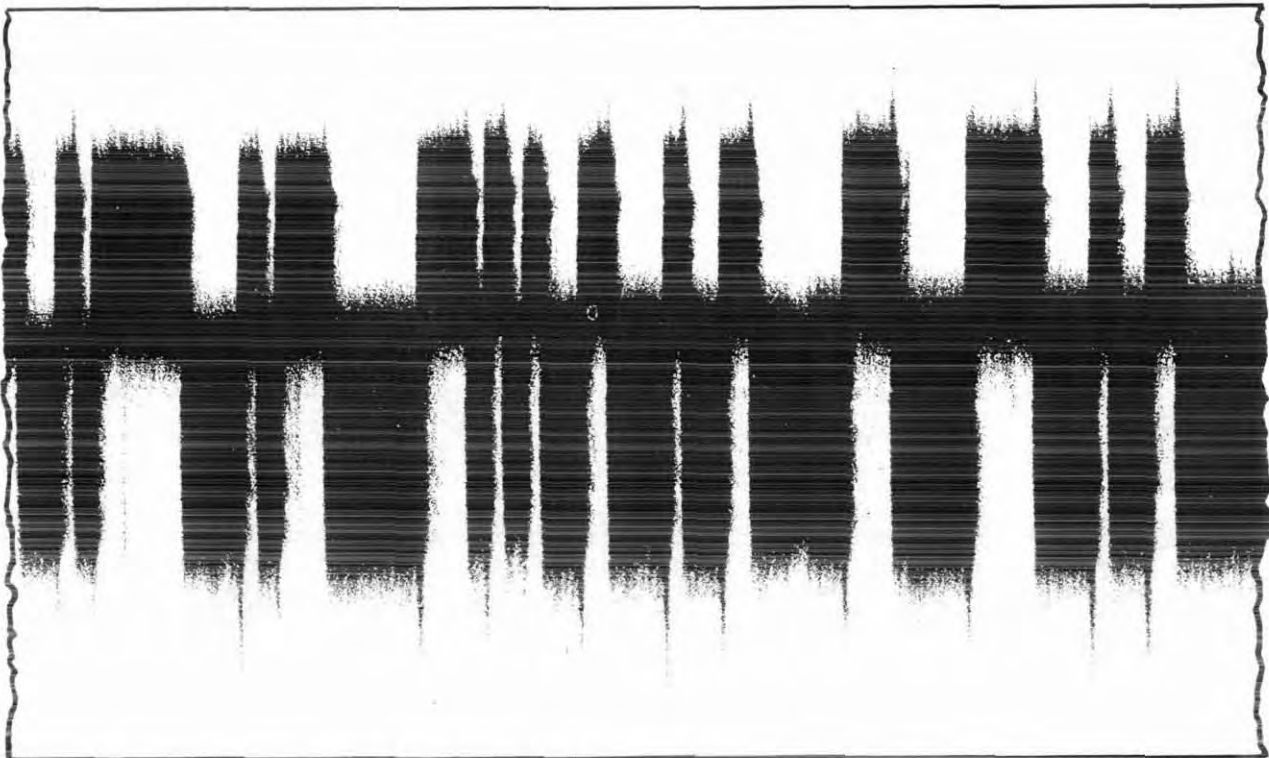
1. Place a fresh piece of sonagram paper on the drum.

2. Set the controls as if a normal sonagram display were to be made.

3. Turn the selector on the 6076-C to the SCALE MAGNIFIER position. Set the LOWER LIMIT control and the UPPER LIMIT control to $\emptyset\emptyset\emptyset$.



NORMAL SONAGRAM DISPLAY



MAGNIFIED SONAGRAM DISPLAY

Figure 7 13.—Magnified sonagram display.

264.69

4. Raise the stylus until the SHORT POINT indicator goes out—then partially engage it.

5. Set the AGC control to minimum, the MARK LEVEL control to (4), and the BAND SELECTOR to NARROW.

6. Turn the ZERO ADJ control until the BASELINE INDICATOR lights.

7. Now adjust the UPPER and LOWER LIMIT controls for the desired frequency range. The lower limit should correspond to the lowest frequency and the upper limit to the highest frequency of the portion of the signal to be expanded. The calibration of these controls is only approximate.

8. Where precise measurements are involved, the calibration tone may be used.

9. Place the REC-OFF-REP lever in the REPRODUCE position, set the MARK LEVEL and the AGC controls as desired, and engage the stylus.

10. Return the stylus to the bottom of the leadscrew when the display is complete.

RO-240/U SIGNAL DATA RECORDER

The main purpose of the RO-240/U (figure 7-14) is to provide graphic presentations on paper undulator tape of electromagnetic signals

so that signal parameters can be obtained for analysis purposes, (i.e., element length, speed, operations per minute, etc., but it CANNOT be used to determine the frequency shift or frequency excursion of any signal). It can, however, be used to make signal comparison (quality) checks of enciphered systems in order to ascertain the reliability of page-printing equipment. By comparing the extracted intelligence from the paper tape with the area of the pageprint which represents the same time frame, operators are able to verify proper operations of pageprinting equipment.

The RO-240/U is a fully transistorized recorder that provides instantaneous direct recording of two channels of information. The input can be binary or analog signals. One of the chief advantages of the RO-240/U over other paper tape recorders is that two signals can be recorded at the same time. One of the signals being recorded can be a timing signal which can be a valuable aid to analyst. The primary input signal can be either keyed tone (100 to 15,000 Hz) or Direct Current (d.c.). The primary output is two binary levels represented by a series of dots which closely approximate a solid line on the electrosensitive paper tape. The recorder operates at selectable speeds of 1, 2, 5, 10, 20, or 50 inches per second. The tape supply

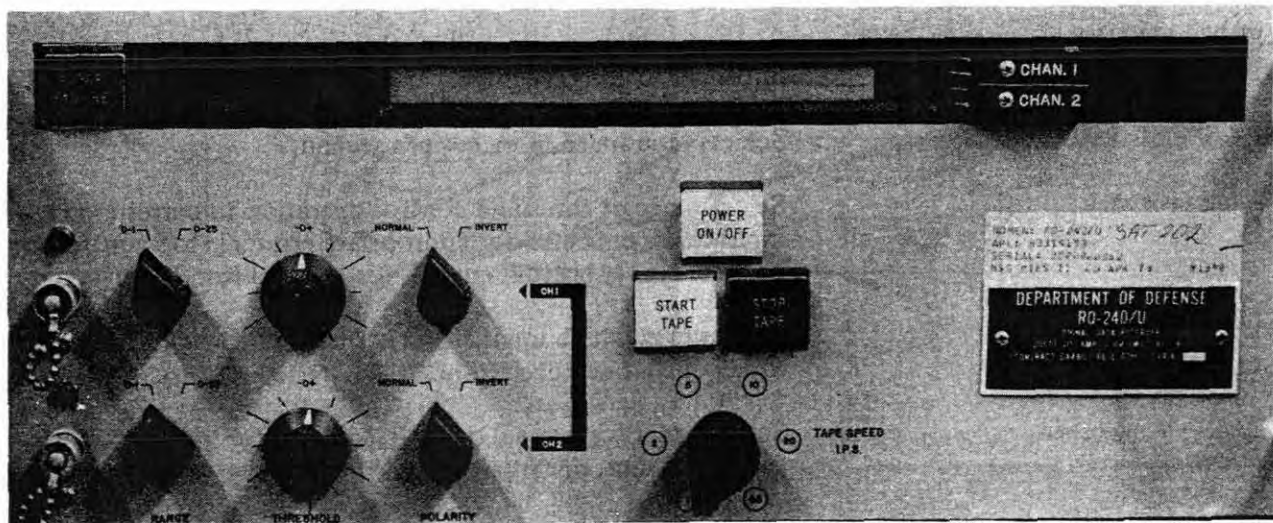


Figure 7-14.—RO-240/U Signal Data Recorder.

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consists of a 1000-foot roll of ½-inch wide electrosensitive paper tape which will record continuously for 3 hours and twenty minutes at a tape speed of 1 inch per second.

Transport Assembly

The Transport Assembly translates the electronic signals into a permanent written record on electrosensitive tape, provides the path of travel for the tape, and supplies the drive power and transmits it to the tape deck. It consists of four principal sections:

Tape Transport

The tape transport feeds the tape from the supply reel, past the stylus assembly, and onto the take-up reel.

Stylus Assembly

The stylus assembly records the electronic signals fed from the keys onto the tape.

Transmission

The transmission section furnishes the power and correct tape feed to the tape transport.

Blower Assembly

The blower assembly removes the odor and residue caused by the stylus printing on the tape.

Operating Controls, Indicators and Functions

The operating controls, indicators, and functions located on the front panel are described in table 7-6.

Table 7-6.—RO-240/U Operating Controls, Indicators, and Functions

CONTROL/INDICATOR	FUNCTION
POWER ON switch (white)	Applies and removes primary power from the equipment, and indicates power is ON when lit.
START TAPE switch (white)	Applies drive power to the tape transport and keys.
STOP TAPE switch (red)	Interrupts power to the tape transport and keys.
PAPER FAILURE indicator (red) also internal buzzer	Lights (and buzzes) to indicate lack of tape, tape breakage, improper loading, or improper Stylus Array condition.
TAPE SPEED I.P.S. switch	Selects tape speed in inches per second.
RANGE switches (CH. 1 and CH. 2)	Select range of threshold control operation to correspond to input levels expected for appropriate channel (top control for channel No. 1, bottom control for channel No. 2).
THRESHOLD controls (CH. 1 and CH. 2)	Sets level at which input signal is thresholded (voltage level at which output switches from "Ø" to "1" or "1" to "Ø").
POLARITY switches (CH. 1 and CH. 2)	Set recorder for normal or inverted polarity; that is, "Ø" in yields "Ø" out, or "Ø" in yields "1" out.
Signal Monitor Lamps (CH. 1 and CH. 2) (2 lamps per channel)	Indicates change of state of input signal when the threshold is adjusted correctly; upper lamps for "1" and lower lamps for "Ø".

Operating Procedure

The operating procedures for the RO-240/U are as follows:

TAPE LOADING.—Follow the steps listed below to load tape into the recorder. (Refer to figure 7-15.)

1. Open the top cover, lift the supply reel tape hub lever, and place a roll of tape over the hub so that it unwinds in a clockwise direction. Snap the tape hub locking lever back into place to lock the tape roll into place.

2. Lift the spring-loaded button on the roller-platen assembly counterclockwise and allow it to lock in its fully open position.

3. Following the path marked on the transport plate, thread the tape past the dancer arm, over the roller platen, and over the front of the writing table.

4. Rotate the pressure roller to its fully open (locked) position. Thread the tape counterclockwise around the drive capstan and thread for internal take-up or front discharge.

5. For front-panel discharge, feed the tape through the tape channel, past the drive roller, and through the tape discharge slot.

6. For internal tape take-up, wind the tape past the idler, around the dancer arm, and onto the take-up reel hub, following the path marked on the transport plate.

NOTE: It is easier to thread the tape onto the take-up reel hub when the cardboard core of an empty reel of tape is first locked into place over the hub.

7. Snap roller platen and pressure roll into place, then rotate both supply and take-up reels counterclockwise to take up any slack in the tape.

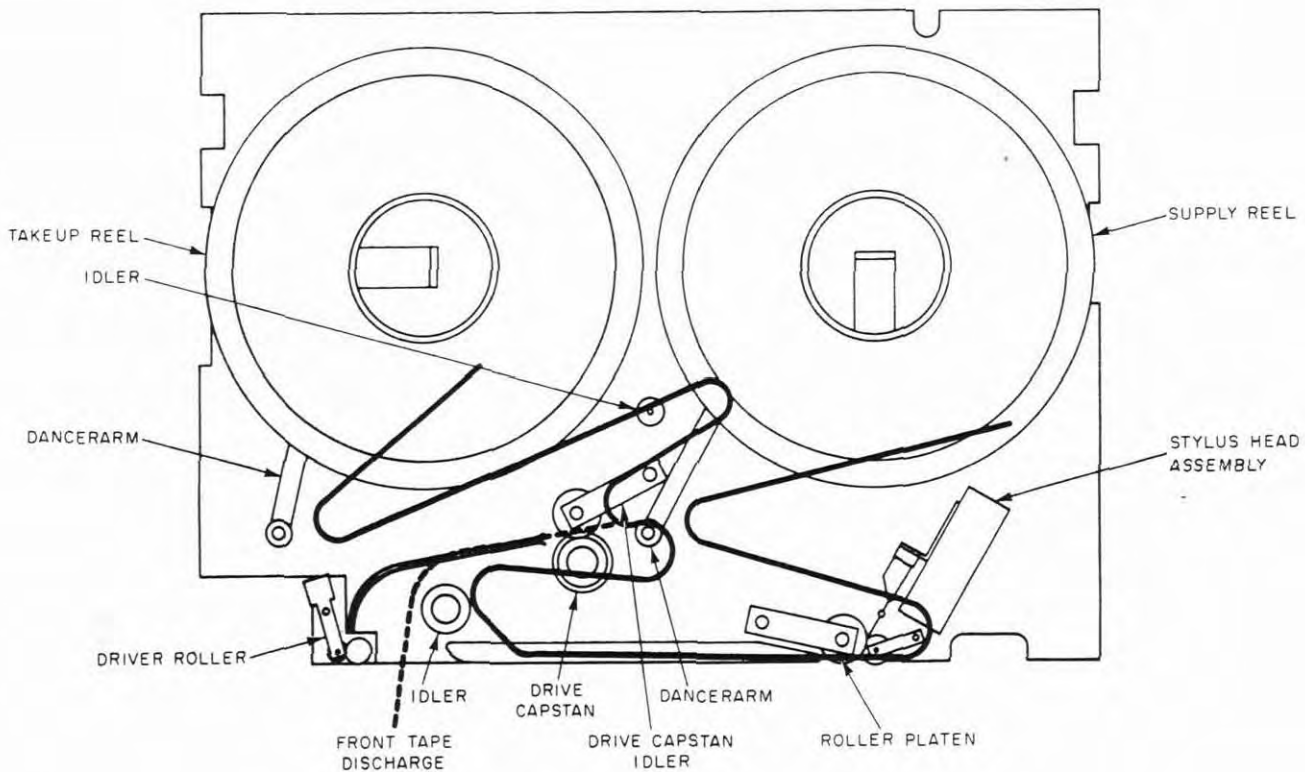


Figure 7-15.—RO-240/U tape loading.

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RECORDING PROCEDURES.—Follow the steps listed below to record data:

1. Depress the POWER switch. (Both the POWER ON and STOP TAPE switch indicators should light up.)

2. Set the RANGE selector for the channel(s) used to 0-25V (normal position) or 0-1V (if low-level signals are anticipated).

3. Set the TAPE SPEED switch to 5 IPS. This is the normal position for obtaining signal parameters; however, to extract intelligence, the speed may be changed while the recorder is in operation.

4. Set the THRESHOLD switch to midway position. Care must be taken that the threshold level is not to be crossed through noise modulation of the signal. A more positive (clockwise adjustment) or negative

(counterclockwise) threshold level may be obtained within the range indicated on the RANGE switch.

5. Set the POLARITY switch in NORMAL position if the "0" level is to be presented at the bottom of the channel. If the "1" level is to be presented at the bottom, set the POLARITY switch to the INVERT position.

6. Depress the START TAPE switch and check the recording as the tape passes through the viewing window. Representations of the input will appear on the tape if the threshold level is correct.

RD-112A/U PAPER TAPE RECORDER

The RD-112A/U (figure 7-16) is a paper tape recorder that responds to pulses of audio tones

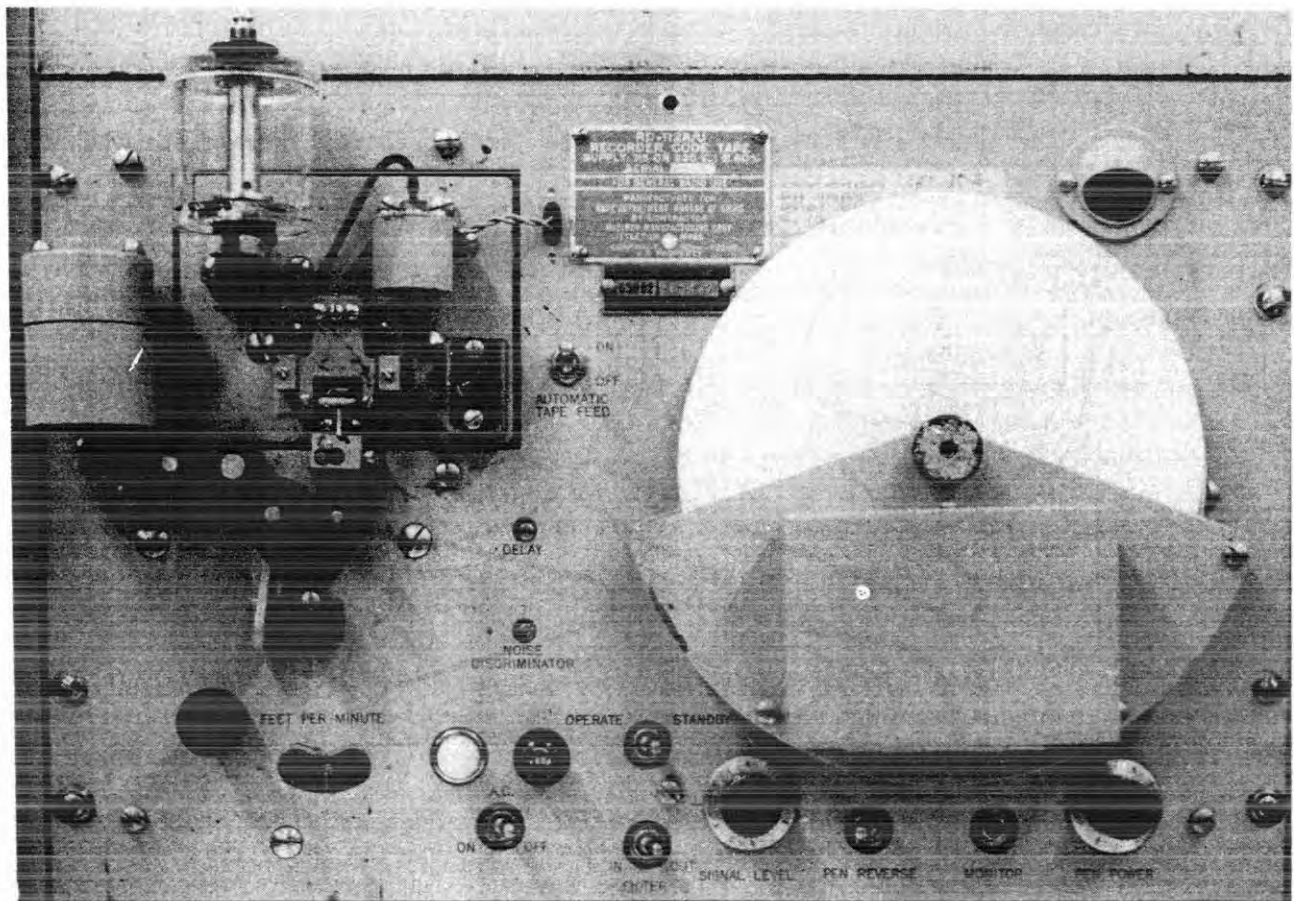


Figure 7-16.—RD-112A/U paper tape recorder.

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(Audio Frequency or Keyed Tone) and records them with ink on paper tape. It is used to record high-speed morse code for subsequent visual transcribing and to record non-morse signals for analysis purposes. (Element length, element speed, operations per minute, etc. can be determined, but neither the frequency shift nor the frequency excursion can be determined from the undulator recording.) It can also be used for signal comparison (quality) checks of enciphered systems to ascertain the reliability of pageprinting equipment.

The RD-112A/U has an adjustable tape drive mechanism that permits tape speeds from 5 to

35 feet per minute, making it possible to record signals of up to 350 words per minute. The pulses of audio tone used for an input can be anywhere in the frequency range of 500 to 5,000 Hz, and may be supplied either directly from the phone jack of a radio receiver, or any other equipment that provides an audio tone output (AF or KT).

Controls, Indicators and Functions

The controls, indicators and functions are explained in table 7-7.

Table 7-7.—RD-112A/U Operating Controls, Indicators, and Functions

CONTROL/INDICATOR	FUNCTION
A.C. ON-OFF switch	Applies and removes primary power from the recorder (the indicator light should be lit in the ON position).
OPERATE-STANDBY switch	A two position switch which, when placed in the STANDBY position, removes power from the Tape Puller unit. In the OPERATE position, tape is fed out by the Tape Puller unit.
AUTOMATIC TAPE FEED ON-OFF switch	A two position ON-OFF switch which, when placed in the ON position, will automatically feed tape when a signal is present at the input terminal. When in the OFF position, tape feed is possible only when the OPERATE-STANDBY switch is in the OPERATE position.
FILTER IN-OUT switch	A two position switch (IN-OUT), when placed in the IN position, allows the filter to remove high noise peaks from the signal. In the OUT position, the filter is out of the circuit.
SIGNAL LEVEL control	A rotary type gain control that adjusts the level of the input signal for optimum performance.
PEN REVERSE switch	A switch which can be used to reverse the signal polarity.
MONITOR jack	A jack that allows the input signal to be monitored by means of headphones.
PEN POWER control	A rotary type control that controls the driving power of the recording pen.
FEET PER MINUTE control	A rotary type control that controls the recording speed of the recorder. The tape speed is visible through the glass window.
Inkwell Valve Control	A thumbscrew mounted on the inkwell that controls the amount of ink flowing through the pen to the paper tape.
"Magic Eye" indicator	An indicator located at the upper right-hand corner of the front panel that may be used as an aid for tuning signals. With the FILTER switch in the IN position, maximum closure of the "magic eye" indicates that the signal frequency is tuned to the filter center frequency and that the highest signal-to-noise ratio has been attained under the existing conditions of radio reception.

Loading and Threading the Tape

Follow the steps listed below when loading and threading tape:

1. Obtain a blank roll of standard 3/8 inch wide recorder tape.
2. Loosen the knurled thumbnut that positions the tape hub on the tape bin and remove the hub assembly.
3. Press the hub into the tape roll in such a manner that, when mounted, the tape will unwind in a clockwise direction.
4. Mount the tape roll in the tape bin and tighten the hub nut firmly.
5. Break the tape seal (if seal has not been broken) and unwind several feet of tape to ensure that the tape unwinds freely.
6. Tear off excess tape, leaving approximately 12 inches for threading.
7. Move the platen lever to the left. This lowers the tape platen and exposes the penpoint.
8. Thread the tape over the platen and between the drive roller and idler roller of the pressure arm, being careful not to engage the point of the recording pen.
9. Return the platen lever to its original position.

Preliminary Operating Procedures

1. Place the AC POWER ON-OFF switch to the ON position.
2. Place the AUTOMATIC TAPE FEED switch to the OFF position.
3. Adjust the FEET PER MINUTE control to the desired operating speed. (25 feet per minute is the speed used to obtain signal parameters.)
4. Place the OPERATE-STANDBY switch in the STANDBY position.
5. Place the FILTER IN-OUT switch in the OUT position.
6. The SIGNAL LEVEL control should be rotated counterclockwise as far as possible (zero dial reading).
7. The PEN REVERSE switch may be in either position.
8. The PEN POWER control should normally be set at five (5).

Calibration Procedures

It is necessary to calibrate the RD-112A/U at 25 feet per minute when any signal analysis functions are to be performed. The procedures for calibration are listed in the steps below:

1. Use a radio receiver to locate a timing signal (normally WWV/WWVH), located at 5, 10, and 15 MHz. A series of clicks and a voice transmission announcing the correct time will be heard. The clicks should be center-tuned in the receiver.
2. Plug your headphones into the MONITOR jack and make certain the signal input is present.
3. Place the OPERATE-STANDBY switch in the OPERATE position.
4. Open the Inkwell Valve control until a clear, well defined ink line appears on the undulator tape.
5. Rotate the SIGNAL LEVEL control in a clockwise direction until the pen follows the signal without skipping. (This control must be set in conjunction with the PEN POWER control.)
6. Rotate the PEN POWER control in a clockwise direction until sufficient driving force is delivered to the pen and causes it to follow the signal cleanly and quickly. Too much power to the pen will cause the ink to splatter and damage the pen.
7. The FILTER IN-OUT switch may be placed in the IN position to determine whether or not noise and distortion can be eliminated from the signal.
8. Using an "engineer scale" (20 scale), align the clicks on the tape with every ten major divisions on the scale by adjusting the SPEED control. In case an engineer scale is not available, a regular ruler may be used. Align the clicks so that they fall every five (5) inches. Once this has been accomplished, the RD-112A/U will have been calibrated for 25 feet per minute.

Final Operating Procedures

The input to the RD-112A/U can be taken either directly from a receiver (AF) or from the output of the AN/FRA-86 (KT); however, the KT from the AN/FRA-86 produces a much better recording. Only FSK or OOK type signals

can be recorded directly from the receiver. DFSK signals will require a demodulator to separate the canals of intelligence. When recording FSK signals directly from the receiver, one side of the signal must be ZERO BEAT OUT by using the BFO PITCH control (R-390A/URR). The BANDWIDTH switch must be set as low as possible while still maintaining a clear signal. Follow the steps listed below for normal (nonautomatic) operating procedures:

1. Place the AC POWER ON-OFF switch to the ON position.
2. Place the OPERATE-STANDBY switch to the OPERATE position and ensure that the AUTOMATIC TAPE FEED switch is in the OFF position.
3. Open the Inkwell Valve until a clear, well-defined ink line appears on the paper tape.
4. Adjust the SIGNAL LEVEL control until the signal follows the pen without skipping.
5. If background noise is present and your receiver has a BFO, place the FILTER switch in

the IN position. Tune the BFO pitch control to give a condition of maximum closure of the "Magic Eye" indicator. Maximum closure of the magic eye indicates that the signal frequency is tuned to the filter center frequency. With the FILTER switch in the IN position, it may be necessary to change the setting of the SIGNAL LEVEL control.

6. The PEN REVERSE switch may be switched to the alternate position for the desired polarity.

7. Adjust the PEN POWER control only as far as necessary to produce a clear and accurate recording.

8. The SPEED control should be calibrated to 25 feet per minute, when recording, to obtain signal parameters. When recording morse code, the recording speed should be adjusted so that the dot (dit) characters appear to be approximately square. (This means that the horizontal and vertical lines should be equal in length.) Figure 7-17 shows examples of recorded tape signals.

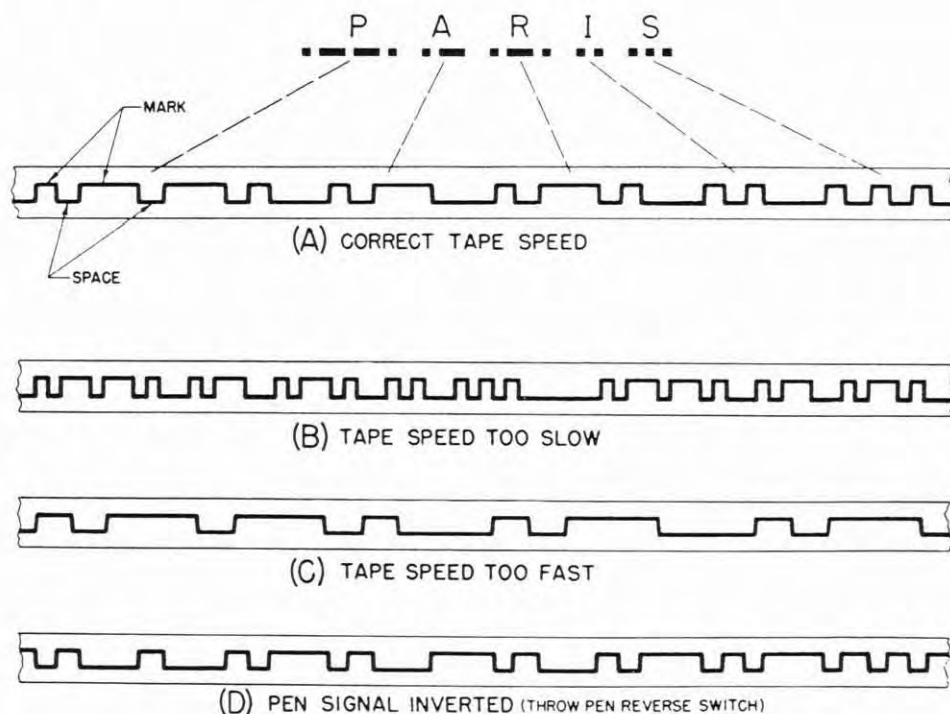


Figure 7-17.—RD-112A/U recorded tape signals.

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9. The RD-112A/U may be stopped by placing the OPERATE-STANDBY switch to the STANDBY position. (Make certain that the Inkwell Valve has been closed before the switch is placed in the STANDBY position.) If the recorder is to be out of service for several hours, place the AC POWER switch in the OFF position.

If the RD-112A/U is to be used for AUTOMATIC TAPE FEED operations, follow the steps listed below:

1. Place the AUTOMATIC TAPE FEED in the ON position and place the OPERATE-STANDBY switch in the OPERATE position.

2. Place the FILTER switch in the IN position to reduce the background noise.

3. Follow steps 3 through 9 above for the remaining steps.

NOTE: When the AUTOMATIC TAPE FEED switch is in the ON position, the ink supply is automatically shut off and on, depending upon whether or not a signal is present.

HONEYWELL 1508 OSCILLOGRAPH

The Honeywell 1508 (figure 7-18), commonly referred to as a "Visicorder," is a direct-recording oscillograph which simultaneously records up to 24 channels of data on light-sensitive paper. A Galvanometer Amplifier amplifies weak signals to a level

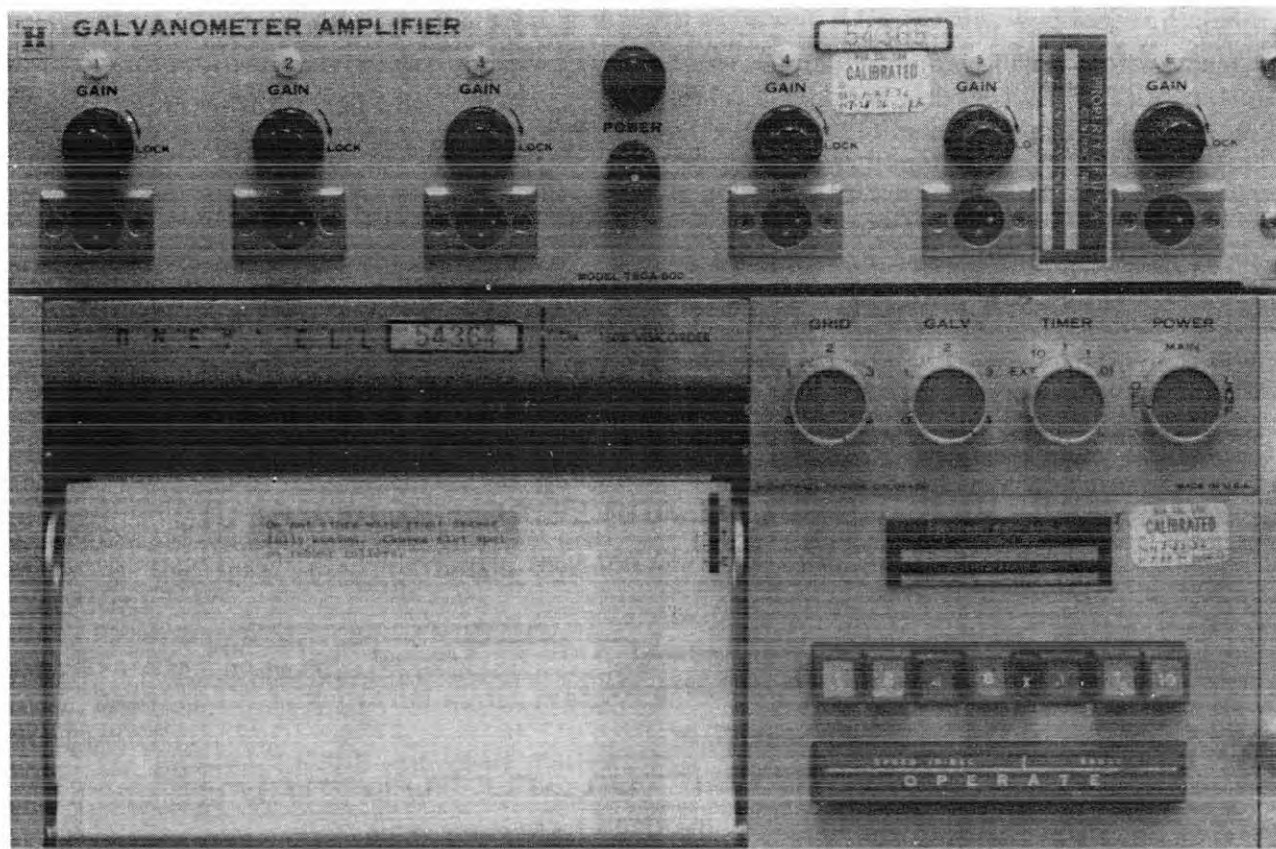


Figure 7-18.—Honeywell 1508 Oscillograph.

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suitable for presentation on the Visicorder and provides individual trace amplitude controls. (A galvanometer is an instrument that detects and converts small changes in electric current into physical motion; this means that when a signal changes in amplitude, the Galvanometer recognizes these changes and moves accordingly.) A mirror attached to the Galvanometer causes a small reflected beam of high intensity light to expose a portion of the light-sensitive paper giving an AMPLITUDE vs TIME presentation of the actual amplitude changes in the input signal.

The Honeywell 1508 Visicorder will accept either Keyed Direct Current (KDC) or Keyed Tone (KT) inputs within the frequency range of

0 to 8,000 Hz. It uses 100 feet rolls of extra thin Kodak linagraph direct print paper and records at 12 speeds of from 0.1 to 80 inches per second. Gridlines have 0.1 inch spacing; every fifth line is heavier and time lines of either 100, 10, 1.0, or 0.1 lines per second can be selected in those instances where no external time signal is available.

Operating Controls, Indicators and Functions

The operating controls, indicators and functions for the Visicorder and Galvanometer amplifier units are described in tables 7-8 and 7-9, respectively.

Table 7-8.—Honeywell 1508 Visicorder Unit Operating Controls, Indicators, and Functions

CONTROL/INDICATOR	FUNCTION
POWER-LAMP switch	Three position switch; MAIN position applies a.c. power to the magnet bank heaters, fan motor, view lamp, and all internal circuits. When advanced to the LAMP position, a.c. power is applied to the recording lamp rectifier circuit. No power is applied when in the OFF position.
PAPER SUPPLY indicator	Indicates the amount of paper remaining on the supply spool.
GALV (galvanometer) control	Regulates the intensity of the trace(s).
GRID control	Regulates the intensity of the gridlines.
TIMER control	Selects the desired time line interval of 1/100, 1/10, 1.0, or 10 seconds. Use the EXT (external) position with external timing signals.
Speed Buttons	Selects a record speed of 1, 2, 4, or 8 inches per second, in conjunction with the RANGE setting.
Range Buttons	Selects a desired range multiplier of 0.1, 1.0, or X 10 in conjunction with the SPEED setting.
Record Drive Operate Bar	Push to start record drive, push again to stop.

Table 7-9.—Honeywell 1508 Galvanometer Operating Controls, Indicators, and Functions

CONTROL/INDICATOR	FUNCTION
POWER switch	Applies power to the amplifier circuitry.
GAIN controls	Varies the amplitude of individual input trace signals.
LOCK ring	Allows the operator to lock the gain control at any level.

Operating Procedures

Follow the steps listed below when operating the Honeywell 1508 Visicorder and the Galvanometer Amplifier:

1. Place the POWER switch to the MAIN position. The view lamp will light up, showing that power is being furnished to the cooling fan, recording lamp, timer power supplies, and Galvanometer magnet bank heaters. The magnet heaters should be turned on at least 20 minutes prior to operation.

2. Check the Paper Supply indicator prior to each usage. The indicator is calibrated at EMPTY (E), 1/4, 1/2, 3/4, and FULL (F).

3. If needed, load the Visicorder with recording paper as follows:

a. Open the supply cradle by pulling outwards on the finger holds at each side of the platen.

b. Remove the spindle by lifting straight out.

c. Insert the spindle into a full roll of paper.

d. Replace the spool in the Visicorder with the paper unwinding from the top of the roll. Make certain that the spindle is firmly seated in the cradle.

e. Pull out about six inches of paper and close the platen.

4. Advance the POWER switch to the LAMP position. (If the lamp does not illuminate immediately, leave the POWER switch in the LAMP position until it does.) After the lamp has

illuminated, wait at least one minute for the lamp arc to stabilize.

5. Adjust the GALV control to obtain a desired intensity presentation. (This control should be set to a higher position as the recording speed is increased; decrease the intensity presentation when the recording speed is decreased.) No traces are present in the OFF position.

6. If gridlines are desired, adjust the GRID intensity control to a higher position as the recording speed is increased; adjust to a lower position as the recording speed is decreased. No gridlines are present in the OFF position.

7. Select the time-line interval by rotating the TIMER selector knob to the desired position, i.e., a setting of 1/10 means that the light beam will cross one (1) gridline segment in one-tenth of a second or 10 gridline segments in one second.

8. Select the desired speed by depressing one of the RANGE pushbuttons and one of the SPEED pushbuttons, i.e., a recording speed of four (4) inches per second is obtained by selecting a RANGE setting of 4 and a SPEED setting of multiplier X1.0.

9. Patch a selected demodulated signal source into the desired trace via the patch panel. If more than one signal source is being used, and enough traces are available, patch the signals so that a blank trace appears between each signal trace. Placing blank traces between signal traces aids in preventing signal overlap.

10. Adjust the corresponding Galvanometer Amplifier gain control for proper deflection, i.e., if you patch a signal into trace 3, gain knob 3 on

the Galvanometer Amplifier controls the amplitude of the signal trace.

11. Start the RECORD DRIVE by depressing the Record Drive Operate bar.

12. Stop the RECORD DRIVE by depressing the Record Drive Operate bar again.

13. To place the Visicorder in a "standby mode", stop the record drive motor, place the

POWER switch in the MAIN position, place the TIMER in the EXT position, and disconnect the signal input.

14. To shut down the Visicorder after use, stop the record drive motor, place the POWER switch to the MAIN position, allow the fan to cool the Visicorder for a few minutes, then turn the POWER switch to the OFF position.