C05025847
Approved for Release: 2024/06/08 C05025847

TOP SECRET [redacted]

12/8/61 SAC letter gives date of this one as 9/20/61

DI

(U) GRAB-1 Processing

CNO

THRU: Hq USAF

In reply to your request for SAC processing techniques, reference CNO message 242237Z August 1961, the attached documentation outlines in detail the procedures used by the Special Projects Section of the 544th Reconnaissance Technical Group, Defense Analysis Center, in the processing of GRAB-1 ELINT data.

FOR THE COMMANDER IN CHIEF:

[redacted]
Colonel, USAF
Deputy Director of Intelligence

1 Atch
Rpt - GRAB-1
ELINT Processing
~~w/7 Atch~~ six (6) Atch To

1 cc: USAF
1 cc: NSA

attachment #6 to attachment #1 missing
RADAR LOCATIONS
SEP '61

BY

TOP SECRET [redacted]

BYE 61950-61

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

LIMITED DISTRIBUTION

TOP SECRET [redacted]

[redacted] 1 ELINT PROCESSING

1. Objective: SAC's primary objective when processing GRAB-1 ELINT data is to select, from the total data available, that intelligence which is of immediate value to the current SIOP. Obviously the most valuable intelligence to be gleaned from such data consist of the type and location of radars considered pertinent to the Sino-Soviet defense structure. ELINT signals, the significance of which cannot be determined due to certain missing parameters or the inability to locate the source, contribute less to the development of the SIOP. Based upon this premise, only those ELINT signals considered truly significant, and which can be located with an acceptable degree of confidence, receive maximum attention and processing. This is not to say that all other signal intercepts are ignored. During the film readout any intercept which appears unusual, regardless of whether or not it can be located, will be recorded and analyzed. All signals contained on the magnetic tape are recorded in video form by time and signal parameters. This video record is always available for immediate and total readout in case a subsequent reference to any signal or signals becomes necessary.

2. Method: For the most part the method of processing the GRAB-1 ELINT data was basically the same as that outlined in Attachment #1 (Handbook of Operation Procedures). The uniqueness of the collection device did, however, require that certain existing procedures and techniques be modified along with the development of several entirely new processing techniques. This discussion deals with these modified and newly developed techniques.

3. Film Readout: Reference the "Rapid Signal Readout" section of Attachment #1. The viewer used in the film readout process was a specially designed viewer which displays an unusually long strip of film. Whereas only thirty (30) seconds of GRAB-1 activity may be viewed by use of the conventional 35mm film viewer, five (5) minutes of activity is displayed by this specially designed viewer. Along with an appreciable decrease in readout time, signal separation and correlation in highly dense areas is made much less difficult.

4. Signal Discrimination: In some cases the signal density in the PRF range of 360 to 400 was such that accurate measurement of [redacted] and [redacted] rates for location purposes became quite difficult. As a solution to this problem a technique for discrimination or separating a given signal of interest from a group of signals with nearly the same PRF was developed.

HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL SYSTEM

TOP SECRET [redacted]

LIMITED DISTRIBUTION

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

LIMITED DISTRIBUTION

TOP SECRET

a. This signal discrimination technique is accomplished by creating two separate signal pulse trains, delaying one train from the other by an amount equal to the PRI of the signal of interest and then recording the coincident pulses.

b. Reference figure 1. The procedure for accomplishing this technique is as follows:

(1) All signals from the magnetic tape are fed into pulse generator 1. The output of this generator is a square pulse occurring coincident with the input signal pulse.

(2) The output of pulse generator 1 is fed to the input of pulse generator 2. The output of this generator is a pulse train delayed by an amount equal to the PRI of the signal of interest.

(3) The outputs of both pulse generators are mixed and pulse coincidence will occur when and only when a PRI or multiple of a PRI which is equal to the preset delay between the two pulse trains is present.

(4) The two mixed pulse trains are now fed to the external trigger input and the Z axis input of an appropriate oscilloscope. The oscilloscope trigger level and Z axis intensity level are adjusted such that an oscilloscope presentation will occur only during the presence of coincident pulses.

(5) The PRF bandwidth may be adjusted by varying the pulse width of the delayed pulse train.

(6) Film recording is accomplished in the manner previously described.

(see next page)

TOP SECRET

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-
CONTROL SYSTEMS JOINTLY

TOP SECRET
LIMITED DISTRIBUTION

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

TOP SECRET [redacted]

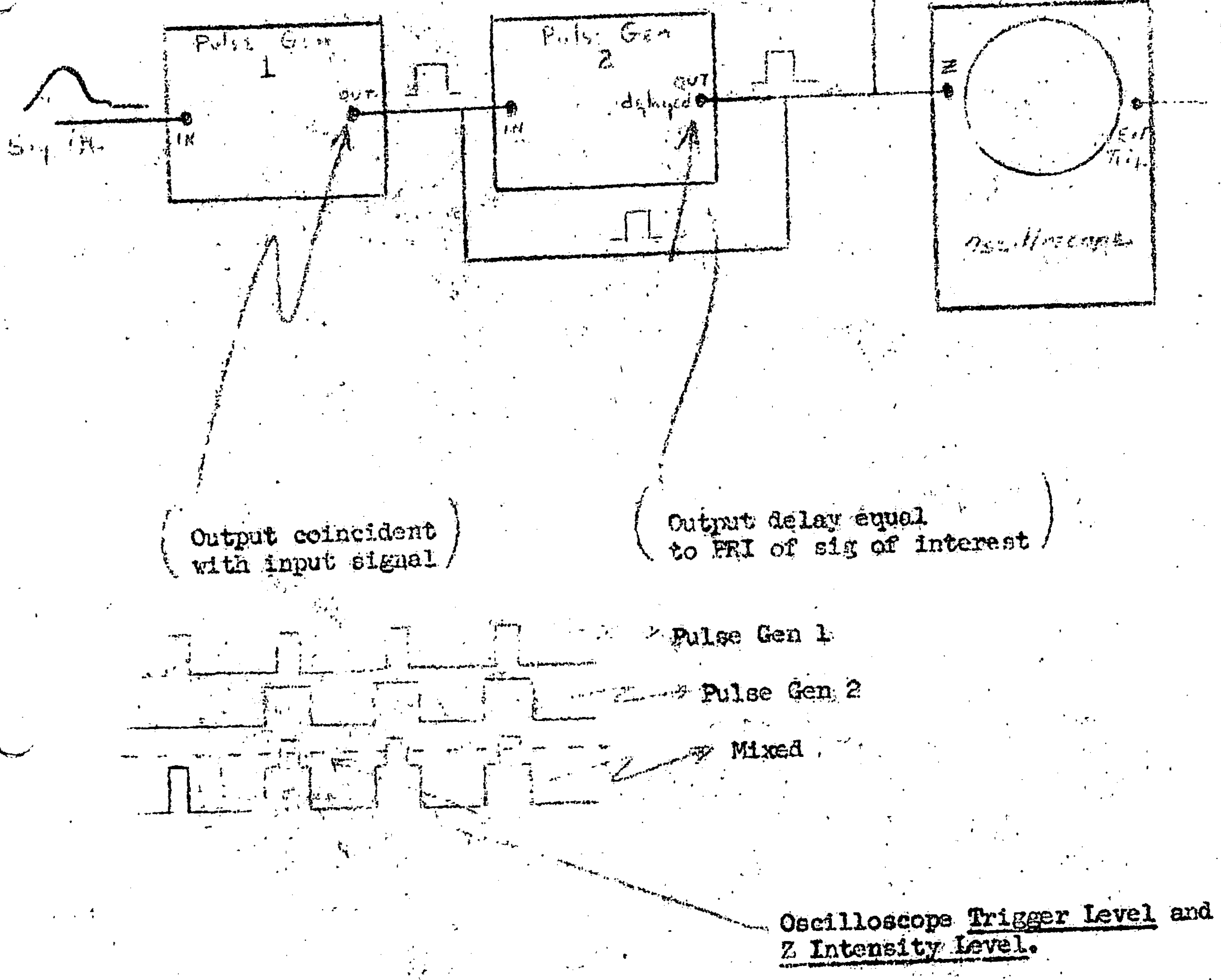


FIGURE #1

TOP SECRET [redacted]

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-[redacted]
CONTROL SYSTEMS JOINTLY

TOP SECRET
LIMITED DISTRIBUTION

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

TOP SECRET [redacted]

[redacted]

a. Measurements: In order to achieve the required beam separation and sweep time measurement accuracy, a film viewer/ computer (TELEREADEX) was used. This device projects an enlarged portion of the 35mm strip film onto a screen containing moveable cursor lines for accurate measurements along the X and Y axis. The computer, a component part, displays the measurements visually or a printout is available if desired. All measurements were made with an accuracy of one (1) second to three (3) decimal places.

b. Position Determination:

(1) Satellite ephemeris data, containing time, sub-orbital point and altitude are entered into the computer (Burroughs 220) via punched cards. From this information a table is formed retaining time, latitude, longitude, altitude of each sub-orbital point, and the increments of each of these values to the next point, and the ground speed and heading of the vehicle. This table, when subsequently accessed by time, allows the interpolated value of each of these parameters to be extracted for any given time.

(2) Intercept data are entered into the computer by punched card giving time, assigned signal number, scan period, beam separation, and an indication to identify [redacted] and [redacted] emitters.

c. Radar Range Computation: For each measurable intercept a range from the collector to the emitter is calculated. Satellite position at the time of intercept is calculated from the navigation table.

[redacted]

TOP SECRET [redacted]
LIMITED DISTRIBUTION
TOP SECRET
HANDLE VIA
BYEMAN-TALENT-KEYHOLE-[redacted]
CONTROL SYSTEMS JOINTLY
Approved for Release: 2024/06/08 C05025847

Approved for Release: 2024/06/08 C05025847

(2) Subsequent range computation is accomplished in the same manner for both types of emitters and is outlined in Attachment #4.

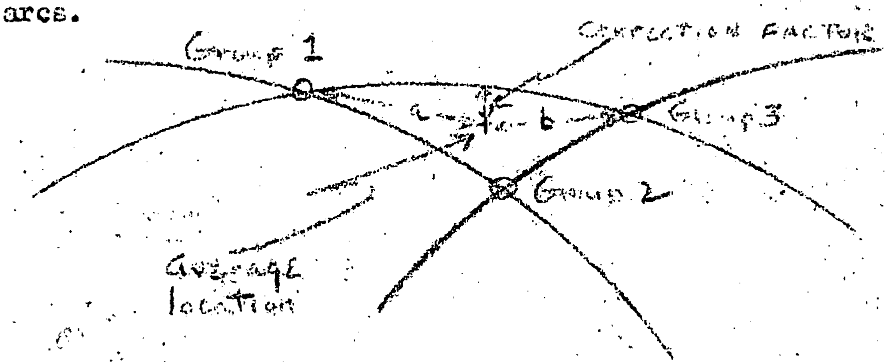
e. Location Estimation: In order to provide the analyst an aid in determining the emitter location, the computer makes estimates of the position.

(1) The range computations for each [redacted] signal are divided into three equal (plus - minus one) groups. For each group a bearing is estimated by comparing range magnitude and heading direction change to the computed time and ground speed. This bearing is matched with the average range for the group and an estimated latitude and longitude of the specific emitter is computed.

[redacted]

(3) Corresponding locations in each of the groups, determined above, are then averaged and an average distance from the averaged location, to the two most distant locations is computed. This distance is an indication of the pattern of the range arc cluster.

(4) A correction factor (In NM) is then computed to move the averaged location out (away from the vehicle) to the range arcs.



$(a+b)/2$ = Error Indicator

TOP SECRET [redacted]

When the error indicator is sufficiently small, the correction factor may be applied and the computer fix used as an estimate

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847
LIMITED DISTRIBUTION
TOP SECRET [redacted]

(2) Subsequent range computation is accomplished in the same manner for both types of emitters and is outlined in Attachment #4.

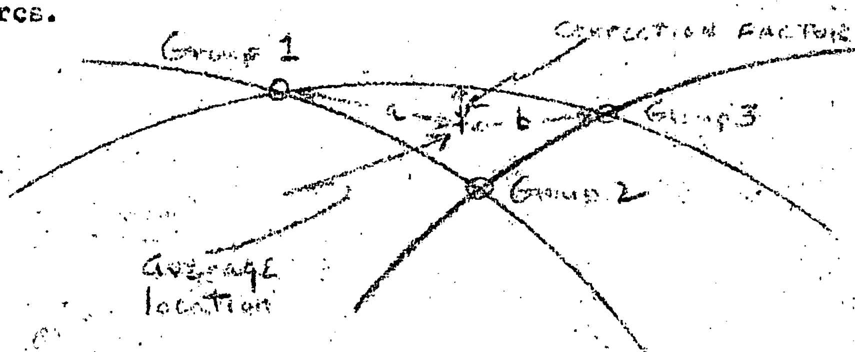
e. Location Estimation: In order to provide the analyst an aid in determining the emitter location, the computer makes estimates of the position.

(1) The range computations for each [redacted] signal are divided into three equal (plus - minus one) groups. For each group a bearing is estimated by comparing range magnitude and heading direction change to the computed time and ground speed. This bearing is matched with the average range for the group and an estimated latitude and longitude of the specific emitter is computed.

[redacted]

(3) Corresponding locations in each of the groups, determined above, are then averaged and an average distance from the averaged location, to the two most distant locations is computed. This distance is an indication of the pattern of the range arc cluster.

(4) A correction factor (In NM) is then computed to move the averaged location out (away from the vehicle) to the range arcs.



$$(a+b)/2 = \text{Error indicator}$$

TOP SECRET [redacted]

When the error indicator is sufficiently small, the correction factor may be applied and the computer fix used as an estimate

TOP SECRET
LIMITED DISTRIBUTION
HANDLE VIA
BYEMAN-TALENT-KEYHOLE-[redacted]
CONTROL SYSTEMS JOINTLY
Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

LIMITED DISTRIBUTION

TOP SECRET [redacted]

of the true location. In actual use, the intermediate locations are used to estimate the possible variation in location and to minimize any errors caused by plotting on a non-spherical surface.

(5) The computer program is written in ALGOL and is divided roughly into seven sections as contained in Attachment #5.

(6) The results of computer processing are examined by an analyst and those signals which evidence a low confidence factor (large error indicator) are eliminated from further processing. Only those [redacted] signals which can be reliably located continue to be processed. Each range arc provided as an output of the computer is manually plotted as a re-check on the analysis and measurements made up to this time. The range arc impact points are determined and the [redacted]

(7) A second check on the accuracy of the range arc impact point is made by the determination of an average line of relative bearing to the [redacted] radar at the mid-time of intercept and crossing this bearing with the average range arc. The average relative bearing is determined by computing the maximum range arc change (ground speed of vehicle) that could possibly occur for any particular intercept (as in the case of a radar located directly ahead or behind the heading of the vehicle) and comparing this value to the actual range arc change that occurred during a specific intercept.

$$\frac{\text{Actual } \Delta \text{ range arc}}{\text{Max range arc } \Delta} = \text{Sin } \theta \quad \text{or Cosecant } \theta$$

θ being the angle to the left or right of the vehicle heading. The comparison equals Sin when the actual range is decreasing and equals Cosecant when the actual range is increasing.

(8) A most probable position (MPP) is determined by the analyst by plotting each impact point on small scale map (i.e., Series 200 chart) and selecting a most probable position within the confidence circle established for each type [redacted] [redacted] radar located. Analysis of results indicate [redacted] type radars can be located with a circular error radius of 50 NM and [redacted] with a 75 NM circular error when the left-right ambiguity can be eliminated.

TOP SECRET [redacted]

TOP SECRET

LIMITED DISTRIBUTION

HANDLE VIA BYEMAN-TALENT-KEYHOLE-[illegible] CONTROL SYSTEMS JOINTLY

Approved for Release: 2024/06/08 C05025847

(9) A final location is selected by comparison of each DF impact point to all source ROB information. The distance each impact point falls from a previously known site location is recorded on the radar location listing, Attachment #6.

6. <u>Results</u>:

a. Processing of the initial 92 minutes of mission data made available to SAC included complete analysis of each intercept regardless of final significance. This processing encompassed 612 separate signals of which 42 could be reliably located using the [redacted] location procedures outlined above. Upon receipt of the complete GRAB - 1 data, procedures were modified to limit processing of those signals which presently cannot be located. This does not mean that these signals (single beam) are ignored, but are processed until they are identified and thereafter considered insignificant, with respect to war planning.

b. Attachment #6 contains a complete listing of all radars located as a result of processing the significant portions of the twenty-one active missions and are displayed on the map Attachment #7. One hundred three of one hundred seventy-one radars located confirmed existing EOB/CROB information. The locations of 68 radars were determined for the first time, thirty-five of which made a significant contribution to SIOP war planning.

7 6 ~~7~~ Atchs
1. Handbook of Operating Procedures
2, 3 & 4. [redacted]
HF range equations
5. Computer program
6. Radars located
7 ~~7. Map and overlay (radars located)~~

C05025847

Approved for Release: 2024/06/08 C05025847

~~TOP SECRET~~

~~SECRET~~

PREPARED BY

ELECTRONIC INTELLIGENCE CENTER

544TH RECONNAISSANCE TECHNICAL GROUP (SAC)

NOVEMBER 1959

RAPID SIGNAL READOUT

~~TOP SECRET~~

~~SECRET~~

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-
CONTROL SYSTEMS JOINT

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

~~SECRET~~ ~~TOP SECRET~~ [redacted]

544TH RECONNAISSANCE TECHNICAL GROUP (SAC)
UNITED STATES AIR FORCE
Offutt Air Force Base, Nebraska

F O R E W O R D

1. Present day ELINT collection facilities have the capability of producing extremely large quantities of signal data in the form of magnetic tape recordings. Unfortunately, however, the analysis equipment usually made available does not permit timely readout of such voluminous amounts of data. Confronted with this problem, the techniques set forth herein were developed and have been used successfully in minimizing signal readout time when limited to standard laboratory equipment.

2. This document classified SECRET to protect information which reveals the scope of effort or the measure of success of electronic analysis operations.

[redacted]
Colonel, USAF
Commander

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-
CONTROL SYSTEMS JOINTLY

~~TOP SECRET~~ [redacted]

~~SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

SECRET

TOP SECRET

CONTENTS

SECTION I

GENERAL

SECTION II

DETAILED PROCEDURES

HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL SYSTEM

SECRET

TOP SECRET

Approved for Release: 2024/06/08 C05025847

ILLUSTRATIONS

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-COMINT
CONTROL SYSTEMS JOINTLY

C05025847
Approved for Release: 2024/06/08 C05025847

SECTION I

GENERAL

1. INTRODUCTION: When wide open or wide band automatic scanning receivers and associated recording equipment are used for the collection of ELINT signals in areas of high signal density, numerous signals may be recorded simultaneously. It is not uncommon for as many as six or more signals to be present at any given instant of time. To separate these signals and perform the required analysis on each, by ordinary laboratory methods, becomes a very time consuming and laborious task. In the discussion that follows a continuous film recording technique is presented which enables an analyst to easily and quickly readout that signal information required for identification purposes.

2. BASIC: Suppose that a pulsed signal is used to intensity modulate the horizontal sweep of an oscilloscope and that the sweep is triggered by this signal. Under these two conditions if the PRF of the given signal is higher than the sweep frequency, two or more pulses, depending on the PRF, will appear on the oscilloscope as two or more stationary dots. Figure 1 is an illustration of three different PRF's, 300 PPS, 600 PPS, and 1200 PPS. The PRT and hence the PRF ($\frac{1}{PRT}$) may be determined by measuring the spacing between the dots. If a photographic film is moved vertically down across the oscilloscope at a slow rate, the dot presentation will be photographically recorded as vertical lines as shown by Figure 2. A visual record of the signal is now made possible and if a scale, calibrated in terms of PRF, were superimposed on the film display, the PRF could be easily read.

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

SECRET TOP SECRET

NOTE: All photographic illustrations contained in this document, with the exception of Figure 12, were made using the Type 302 Polaroid Camera. Where film movement was required, the camera was manually moved along the mounting track.

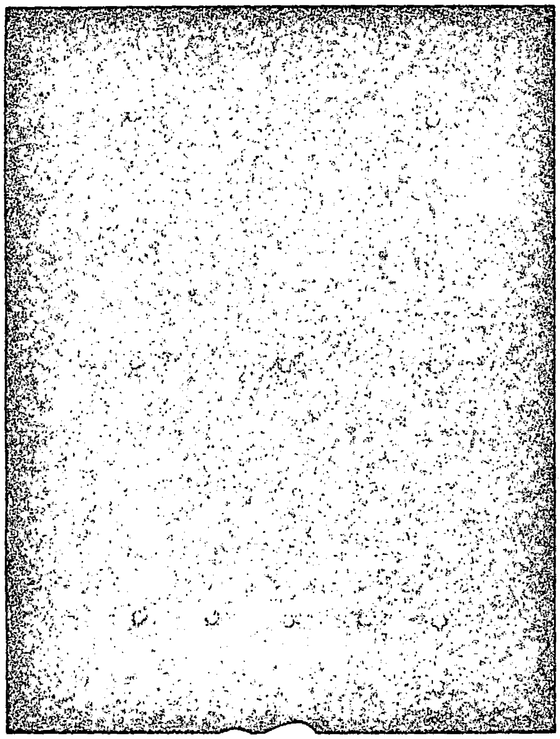


Figure 1

Intensity Modulation

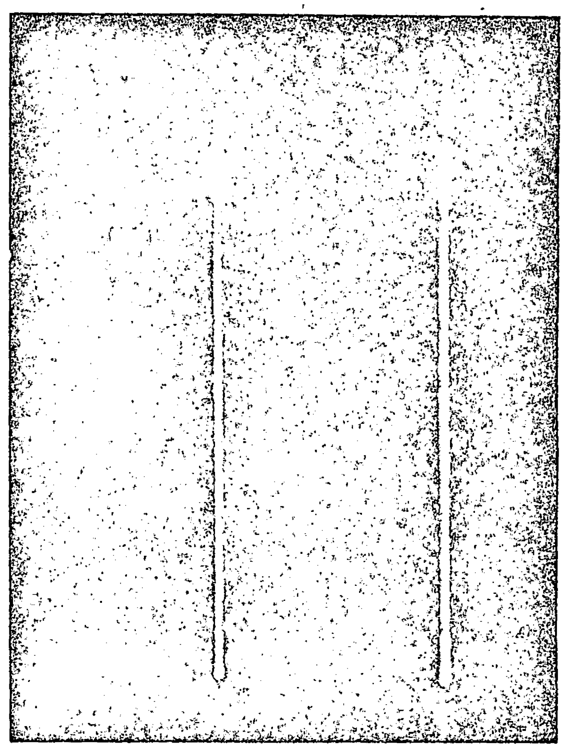


Figure 2

Continuous Motion Film Exposed to Intensity Modulation

3. PRF MEASUREMENT: Since the horizontal sweep of the oscilloscope can be adjusted to the same length as the oscilloscope graticule-scale, the graticule-scale may be used for measuring PRF. Assume that a PRF range of 300 PPS to infinity is desired and further that the oscilloscope graticule-scale is numbered zero to ten, reading

HANDLE VIA BYEMAN-TALENT-KEYHOLE-CONTROL

TOP SECRET

SECRET

Approved for Release: 2024/06/08 C05025847

from right to left. Now, if the horizontal sweep is adjusted to a frequency of 300 CPS, a 300 PPS signal will appear as two dots, one on line zero and one on line ten of the scale. As the signal PRF increases above 300 PPS, the spacing between the dots will decrease and the number of dots will increase. The PRT or PRF ($\frac{1}{PRT}$) is measured from the first dot, which always appears on line ten, to the next dot that follows. As an example, if the second dot should fall on line five the PRT would be 1667 microseconds (600 PPS), if it fell on line 7.5 the PRT would then be 833.3 microseconds (1200 PPS) etc. The PRT at any given point on the scale may be computed and then easily converted to PRF, if desired. The chart on page 4 is a computed listing of PRFs ranging from 300 PPS to 30,000 PPS. The numbers 0 to 9.9 on the chart correspond to the same numbers on the oscilloscope graticule-scale. To illustrate, assume that the second dot, or line in the case of continuous motion filming, of a signal falls on the scale number 6.4. Locating 6.4 on the chart reveals a PRF of 834 PPS. Figure 3 shows two signals with different PRF's. Using the superimposed scale in conjunction with the PRF chart, the PRF's are easily determined to be 1200 PPS and 374 PPS. Any PRF range may be selected by merely adjusting the oscilloscope sweep frequency to the lowest PRF desired. However, if the sweep frequency is other than 300 CPS, a conversion factor must be computed in order to use the chart on page 4. The conversion factor is obtained by dividing the sweep frequency into 300. This factor is then divided into the figure from the PRF Chart.

C05025847
Approved for Release: 2024/06/08 C05025847

~~SECRET~~ ~~TOP SECRET~~

PRF CHART

0.0	300	2.0	374	4.0	500	6.0	750	8.0	1500
.1	303	.1	380	.1	509	.1	769	.1	1580
.2	306	.2	384	.2	519	.2	790	.2	1667
.3	310	.3	390	.3	526	.3	810	.3	1761
.4	313	.4	396	.4	535	.4	834	.4	1880
.5	316	.5	400	.5	545	.5	858	.5	2000
.6	320	.6	405	.6	555	.6	880	.6	2090
.7	323	.7	412	.7	566	.7	909	.7	2310
.8	326	.8	417	.8	576	.8	937	.8	2500
.9	330	.9	423	.9	588	.9	967	.9	2630
1.0	333	3.0	429	5.0	600	7.0	1000	9.0	3000
.1	337	.1	435	.1	612	.1	1033	.1	3333
.2	341	.2	440	.2	625	.2	1073	.2	3750
.3	345	.3	448	.3	639	.3	1110	.3	4300
.4	349	.4	455	.4	652	.4	1155	.4	5000
.5	354	.5	460	.5	666	.5	1200	.5	6000
.6	357	.6	469	.6	683	.6	1250	.6	7500
.7	361	.7	476	.7	697	.7	1303	.7	10000
.8	366	.8	484	.8	714	.8	1365	.8	15000
.9	370	.9	493	.9	733	.9	1428	.9	30000

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-~~COMINT~~
CONTROL SYSTEMS JOINTLY

PRF CHART

~~TOP SECRET~~ ~~SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847
~~SECRET~~ ~~TOP SECRET~~ [redacted]

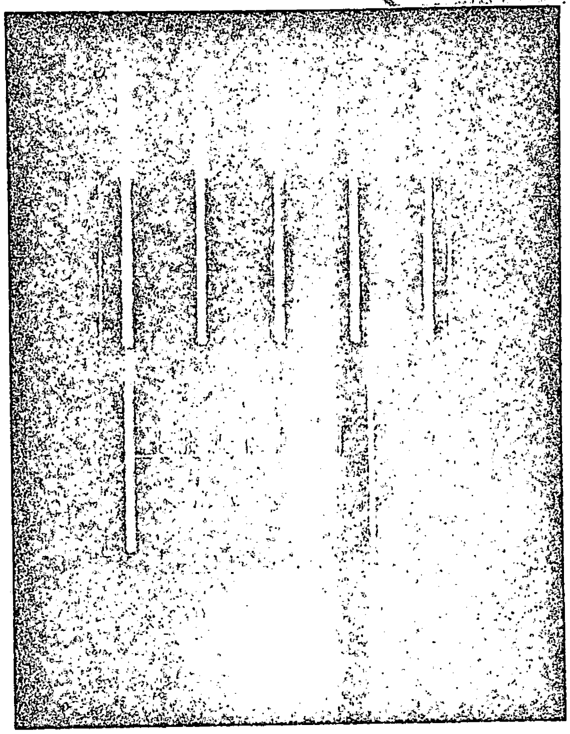


Figure 3

1200 PPS and 374 PPS Indication

EXAMPLE: Sweep Frequency = 100 CPS

Scale Reading = 5

Determine PRF

Conversion Factor = $\frac{300}{100}$ = 3

Scale Reading 5 = 600 (from PRF Chart)

Actual PRF = $\frac{600}{3}$ = 200 PPS

The film viewer used for readout purposes must contain a superimposed scale proportional to the oscilloscope graticule-scale. One successful arrangement is to draw the scale on clear acetate and attach it directly

~~TOP SECRET~~ [redacted]
~~SECRET~~
HANDLE VIA
BYEMAN-TALENT-KEYHOLE-COMINT
CONTROL SYSTEMS JOINTLY
Approved for Release: 2024/06/08 C05025847

on to the viewing screen. For adjustment and alignment purposes a single frame exposure is made of the oscilloscope graticule-scale at the beginning of each filming run. During readout, this photographed scale is adjusted in size, by the viewer image enlarger adjustment, to coincide with the scale attached to the viewing screen. Having the oscilloscope scale illumination adjusted to moderate intensity during the filming operation will result in ten vertical lines being presented on the film (reference Figure 12). These lines enable proper scale adjustment and alignment at any time during the readout process. An additional aid to proper scale adjustment, is the photographing of a calibration signal at the beginning of each film run.

4. <u>INTENSITY MODULATION FROM PULSE GENERATOR OUTPUT:</u> The signals illustrated in figures 1, 2, and 3 are narrow pulse signals produced by a pulse generator. When radar pulses are recorded on magnetic tape, they usually are subjected to excessive distortion and become too wide to be used successfully for intensity modulation purposes. Attempting intensity modulation with these distorted pulses results in the excessively wide presentation of Figure 4. This condition can be corrected by using the recorded signal to externally trigger a pulse generator which will then produce a signal of narrow pulses at the same PRF as the recorded signal. Now, if the output of the pulse generator is used for intensity modulation, the result will be as shown by Figure 5. Both Figures (4 and 5) were made using the same recorded signal. Experience has shown that the width of the signal presentation will vary somewhat with signal strength and the amount

C05025847
Approved for Release: 2024/06/08 C05025847

of pulse jitter present. Some presentations may seem almost too wide for sufficient accuracy. However, if the center of the presentation is always used as the point of measurement, accuracy of measurement of even the very wide signal presentations will not diminish appreciably.

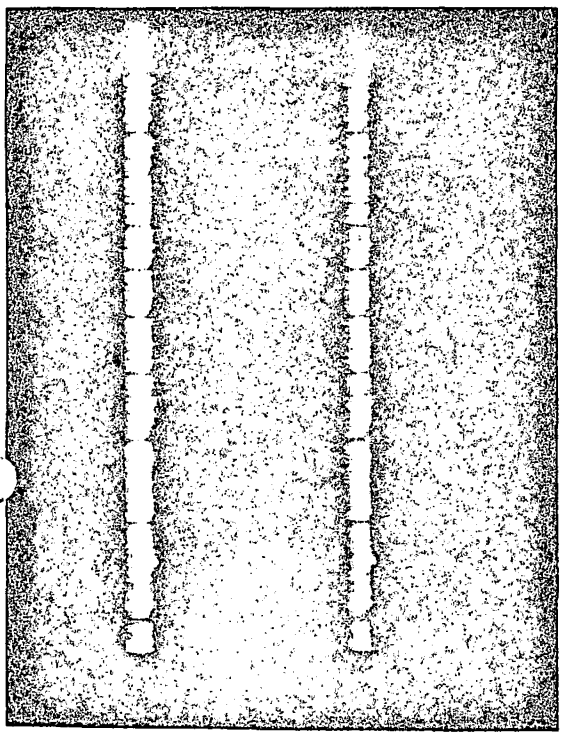


Figure 4

Tape Playback Output

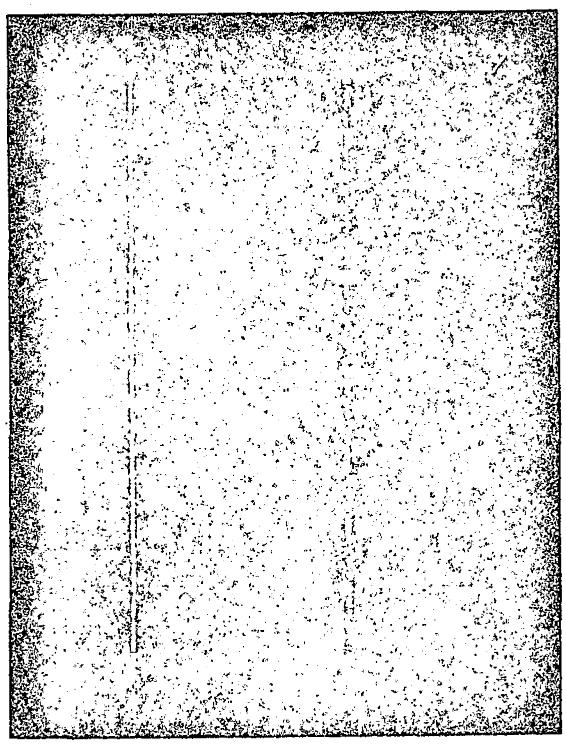


Figure 5

Pulse Generator Output

5. SIGNAL SEPARATION BY PRF: An extremely advantageous feature of this readout method is that almost any number of simultaneous signals may be effectively separated by PRF. Simultaneous signals cause alternate triggering by one signal and then another and any given signal within a multiple signal group will cause sufficient triggering

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

~~SECRET~~ ~~TOP SECRET~~

to permit relatively easy separation and identification. The triggering produced by simultaneous signals will cause random dots to appear on the film, however, this does not interfere, to any great degree, with the readout process. Figure 6 is a film recording of two simultaneous signals. By means of the superimposed scale and the PRF Chart the PRF's are found to be 337 PPS and 357 PPS.

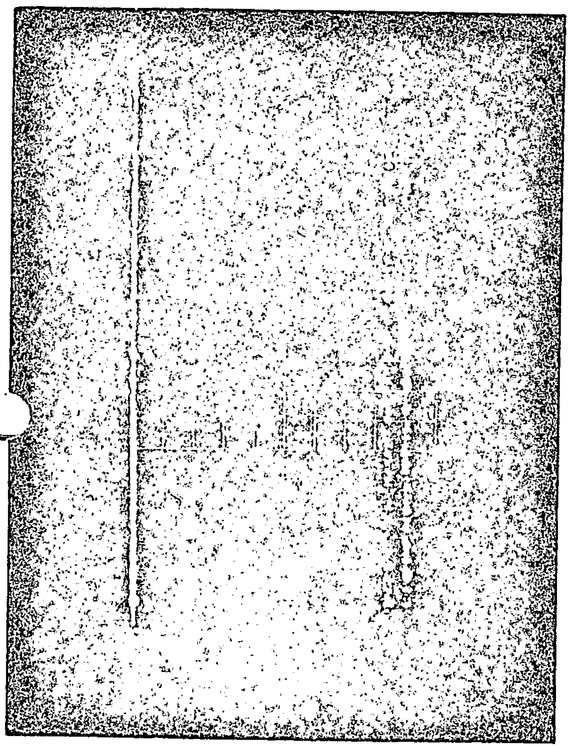


Figure 6

Simultaneous Signals

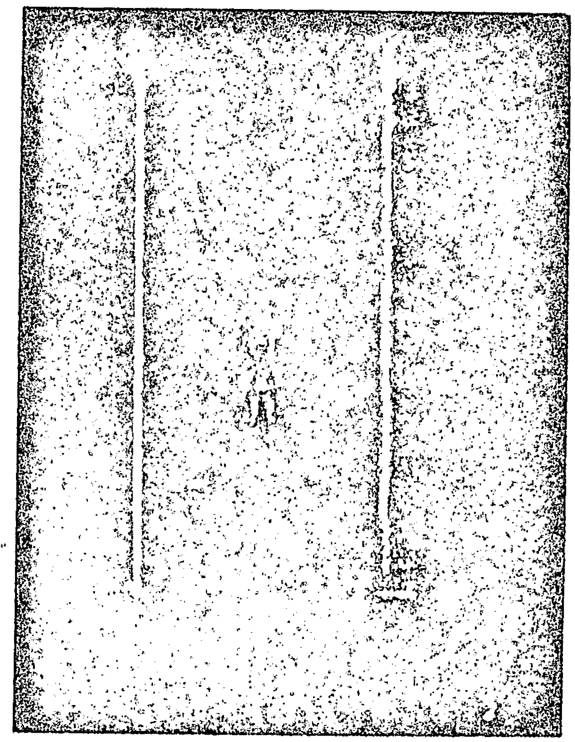


Figure 7

Simultaneous Signals
Near The Same PRF

6. <u>SIMULTANEOUS SIGNALS WITH A VERY NARROW PRF SEPARATION:</u> When two simultaneous signals are so near the same PRF that they will not separate into two distinct signal presentations, an "X" pattern as shown by Figure 7 may appear. This may be explained by assuming that

~~TOP SECRET~~ HANDLE VIA BYEMAN-TALENT-K SYSTEMS JOINTLY

~~SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

two signals are occuring simultaneously, one at 300 PPS and one at 301 PPS. First one signal and then the other will trigger the oscilloscope sweep. While the 300 PPS signal is triggering, the 301 PPS signal will move accross the scope, say from right to left. When triggering is caused by the 301 PPS signal, the 300 PPS signal will move from left to right. So, in effect, there are two signal pulses (or dots) moving in opposite direction and meeting at a point (center of "X") representing an addition of the two PRF's. This action coupled with the movement of the film, produces the appearance of the "X" pattern. For all practical purposes, when this "X" pattern occurs, there are two signals, with the same PRF, indicated by a single signal presentation. The configuration of the "X" pattern and the interval with which it occurs will depend upon the PRF difference. Figure 8 displays the filming of two simulated signals, separated by one PPS (300 PPS and 301 PPS) while Figure 9 shows two signals separated by two PPS (300 PPS and 302 PPS). The nonsymetrical patterns are due to movement of the Polaroid Camera at an uneven rate.

[redacted]

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847
SECRET
TOP SECRET

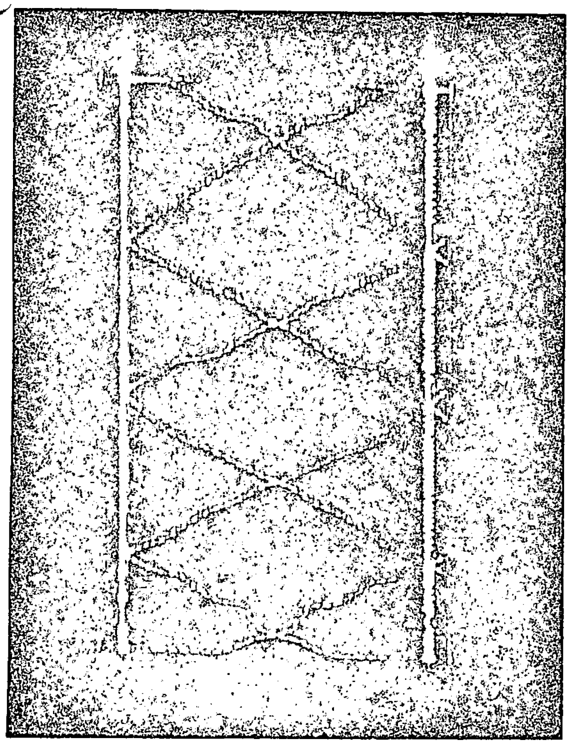


Figure 8

Two Simulated Signals
Separated By One PPS

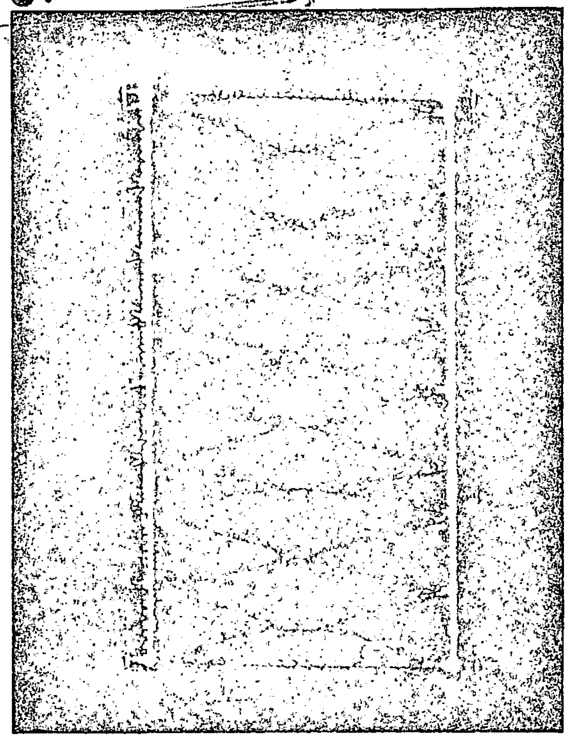


Figure 9

Two Simulated Signals
Separated By Two PPS

The very wide and cluttered presentation shown by Figure 10 is due to the presence of the signal PRF contained within the lobe structure plus the PRF of any simultaneous signals present. This can be corrected by filtering out the PRF (Figure 11). Once the PRF is eliminated, an envelope or pulse results from the signal lobe. A pulsed signal, with a frequency equal to the scan rate, is now available for triggering the pulse generator which in turn supplies the narrow pulses for proper intensity modulation. The definition of the signal presentation is greatly increased as shown by Figure 11. Note the clarity with which both the major and intermediate lobe are indicated. The same signal

TOP SECRET
SECRET
HANDLE VIA
BYEMAN-TALENT-KEYHOLE-
JOINTLY
Approved for Release: 2024/06/08 C05025847

was used to produce Figures 10 and 11. Scan rates may be readout in the same manner as PRF (reference paragraph 3). The scan rate of figure 11 is determined as follows:

Sweep Frequency = 10 CPS

Conversion Factor = $\frac{300}{10} = 30$

First major lobe presentation falls on graticule-scale line 7.5.

7.5 on the PRF Chart = 1200

Scan Rate = $\frac{1200}{30} = 40$ CPS

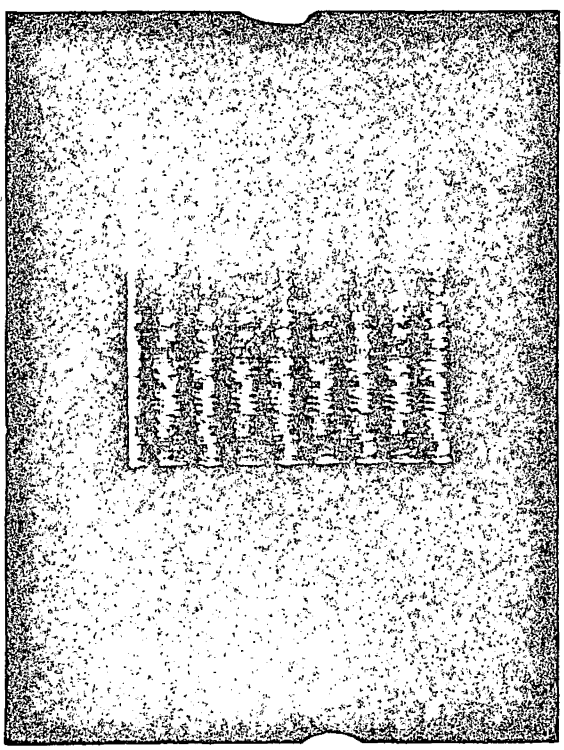


Figure 10

Scan Rate Presentation
Without Filtering

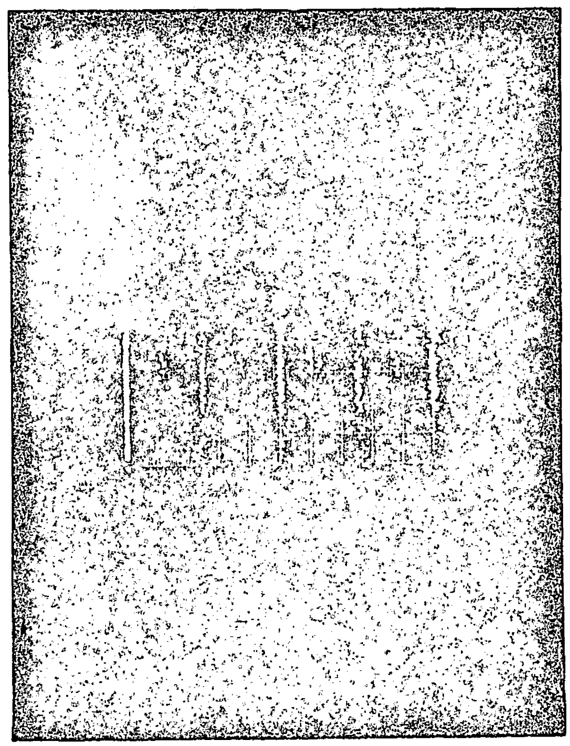


Figure 11

Scan Rate Presentation
With Filtering

C05025847
Approved for Release: 2024/06/08 C05025847

8. <u>TIME REFERENCE</u>: In order to measure signal duration, scan time, [redacted] etc., and to enable proper time correlation, some form of time reference or event mark must be displayed on the film. This is easily accomplished since most continuous motion oscilloscope cameras are equipped with a timing light. This timing light usually consists of a gas filled lamp (Argon) which, when subjected to the proper firing voltage, will expose one edge of the film to a spot of light. If the timing light is excited at regular time intervals, a series of dots will appear on the film corresponding to this time interval. Figure 12 shows timing dots at ten second intervals (left edge of film). In some cases the magnetic tape recording may contain a timing signal which can be fed to appropriate event marker equipment and the output of this equipment used to excite the camera timing light. Usually an amplifier will be needed to increase the output of the event marker to the required firing level of the timing light.

9. <u>ILLUSTRATED CAPABILITY</u>: Figure 12 is an enlarged print of a 35MM film strip of six actual ELINT signals, and is used to more realistically illustrate the capability of this technique. Relatively weak signals were intentionally selected to indicate reliability. An oscilloscope sweep frequency of 300 CPS was used and the time dots are at intervals of ten seconds. The attached scale along with the PRF Chart on page 4 will enable PRF determination of each signal. For simplicity of explanation, each individual signal is numbered. The following information is obtainable:

Approved for Release: 2024/06/08 C05025847

SECRET

TOP SECRET

Signal Number 1: PRF - 967

Steady Signal

Signal Number 2: PRF - 333

Scan Time - 19.3 seconds

Beam Separation - 1.0 seconds

Signal Number 3: PRF - 370

Scan Time - 10.0 seconds

Signal Number 4: PRF - 354

Scan Time - 18.5 seconds

Beam Separation - 1.0 seconds

Signal Number 5: PRF - 333

Scan Time - 19.0 seconds

Signal Number 6: PRF - 417

Scan Time - 0.7 and 1.8 seconds

NOTE: The Gerber Variable Scale may be used to facilitate measurement of scan time and beam separation.

TOP SECRET

SECRET

HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL SYSTEMS JOINTLY

C05025847
Approved for Release: 2024/06/08 C05025847

~~TOP SECRET~~
~~SECRET~~

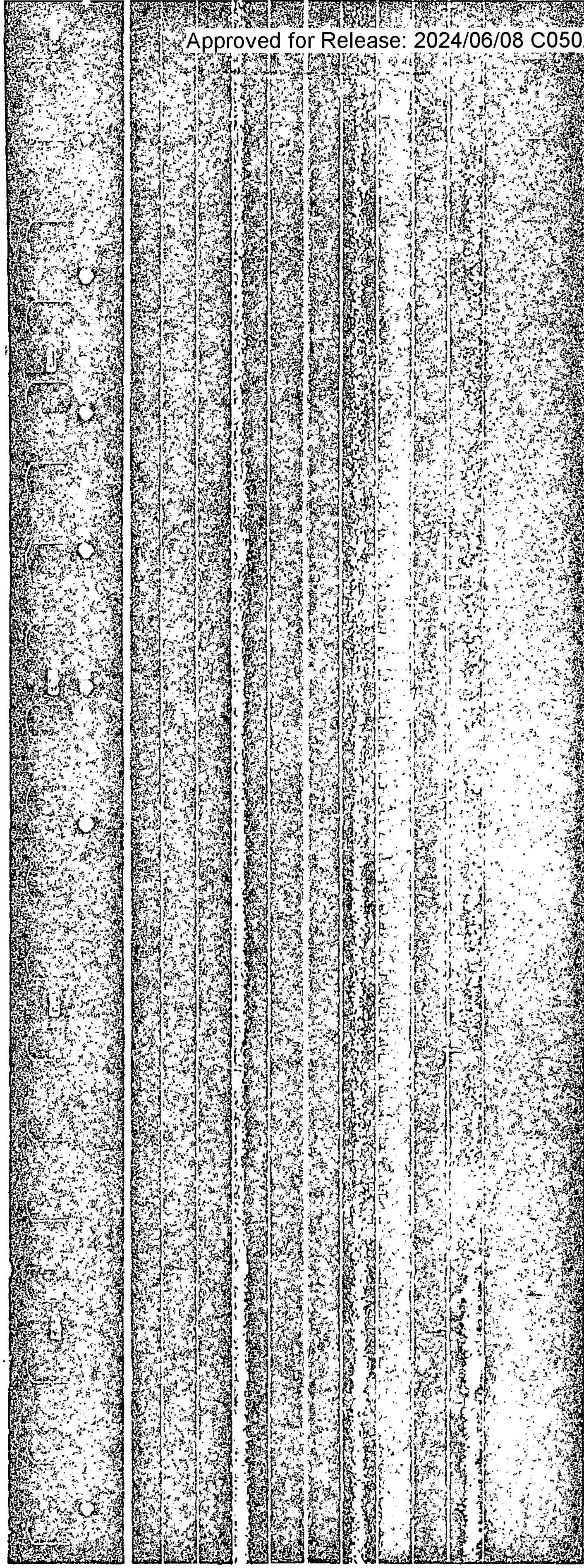


Figure 12
35MM Film Presentation of Actual ELINT Signals

~~TOP SECRET~~
~~SECRET~~
HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL SYSTEMS JOINTLY

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

SECRET

TOP SECRET

SECTION II

DETAILED PROCEDURES

1. GENERAL: The procedures that follow evolved from a considerable amount of research and experimentation and have been used to a high degree of success. The equipment necessary to perform this operation may consist of standard laboratory equipment and need not be confined to that listed here.

2. FILMING OPERATION:

a. Equipment List:

(1) Oscilloscope, Tektronix 535.

(2) Camera, Dumont 321A.

(3) Playback Equipment, "C" Rack.

(4) Event Marker Equipment, "F" Rack.

(5) Pulse Generator, LA-593.

(6) Electronic Counter, Berkely Model 7350.

(7) Filter, SKL Model 302.

(8) Oscillator, Hewlett-Packard Model 650A.

(9) Amplifier, AM-465/FR.

b. Equipment configuration: See Figure 13.

c. Playback Speed: A definite advantage of this technique is that the magnetic tape may be played back at speeds higher than the normal recording speed. Excellent results are presently being obtained by increasing the playback speed to four times that of the normal speed. In order to use existing PRF scales and to maintain proper film density, when the playback speed is increased, the

TOP SECRET

SECRET

HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

oscilloscope sweep and camera speeds must be increased proportionately.

d. Film Speed: Experience has shown that when filming signals by PRF, at 3 3/4 IPS, the ideal film speed is 2.5 inches per minute. Increasing the playback speed to 15 IPS would require a film speed of 10 inches per minute, or the nearest to this that is available. If it is desired to film signals by rapid scan rate, decrease the film speed to 0.8 inches per minute for 3 3/4 IPS playback speed and to 3.2 inches per minute, or the nearest to this available, for a playback speed of 15 IPS. This decreased film speed for scan rate filming is necessary in order to maintain proper signal density on the film.

e. Playback Gain: Particular attention should be given to the proper adjustment of the playback gain. In some instances excessive gain will result in false information being displayed and naturally if there is insufficient gain, weak signals may not be recorded. Figure 14 is an amplitude display of the result of an excessive gain setting. (Figure 14 is a Polaroid photograph, hence the sweep appears in reverse. When viewing the photo, sweep is from right to left.) It can be seen that following the major pulse is a minor pulse, caused by distortion, of much less amplitude. If excessive gain is allowed, this minor pulse will trigger the pulse generator and cause a false presentation on the film. The top portion of Figure 15 shows the signal of Figure 14 with the proper gain setting. The bottom portion of Figure 15 (same signal)

Approved for Release: 2024/06/08 C05025847

Approved for Release: 2024/06/08 C05025847

TOP SECRET

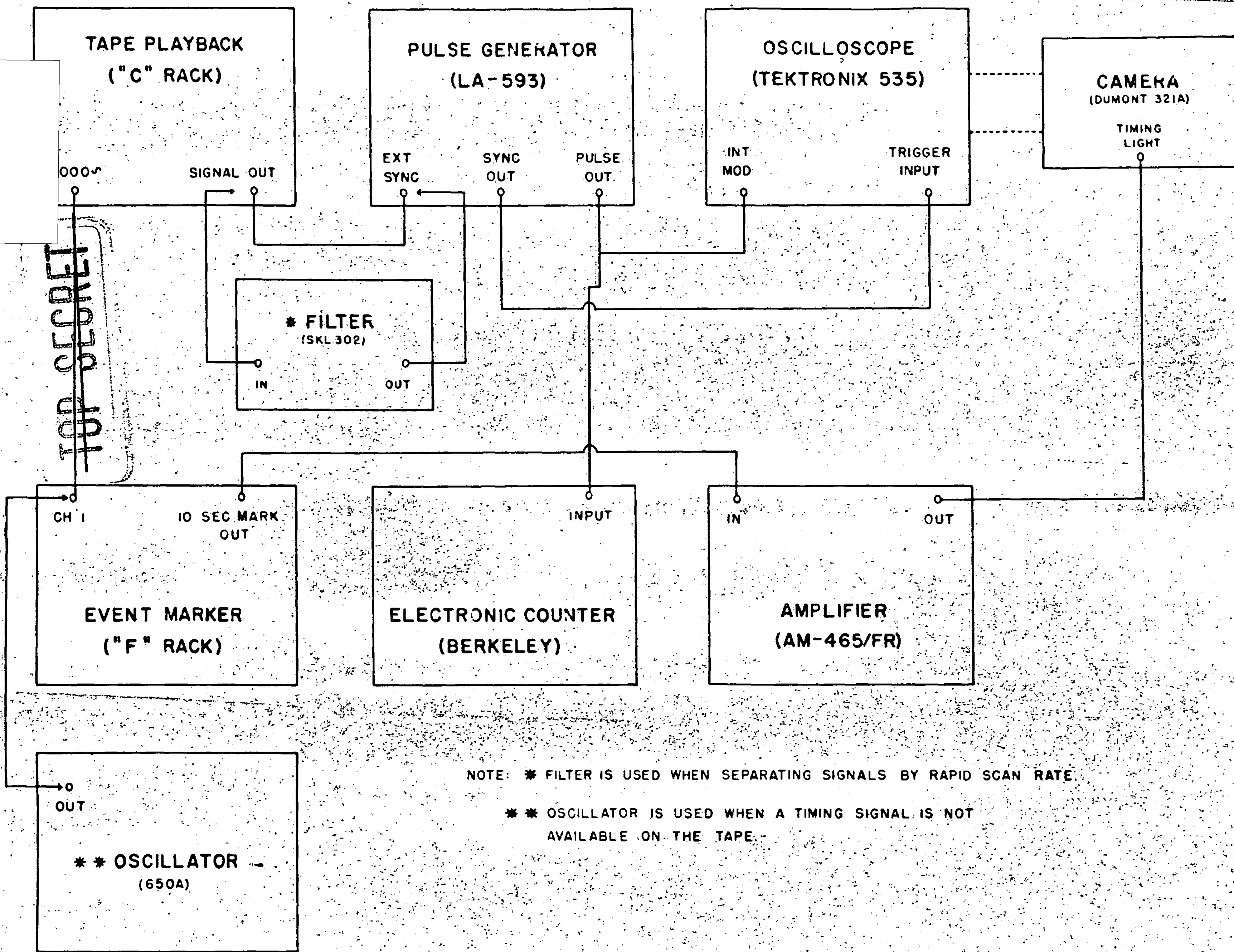


FIGURE 13

EQUIPMENT CONFIGURATION

TOP SECRET

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

Approved for Release: 2024/06/08 C05025847

C05025847

illustrates the result of excessive gain. Experience has proven that proper gain adjustment is indicated when random noise dots just begin to appear on the oscilloscope.

Figure 14

Amplitude Display
Of Excessive Gain

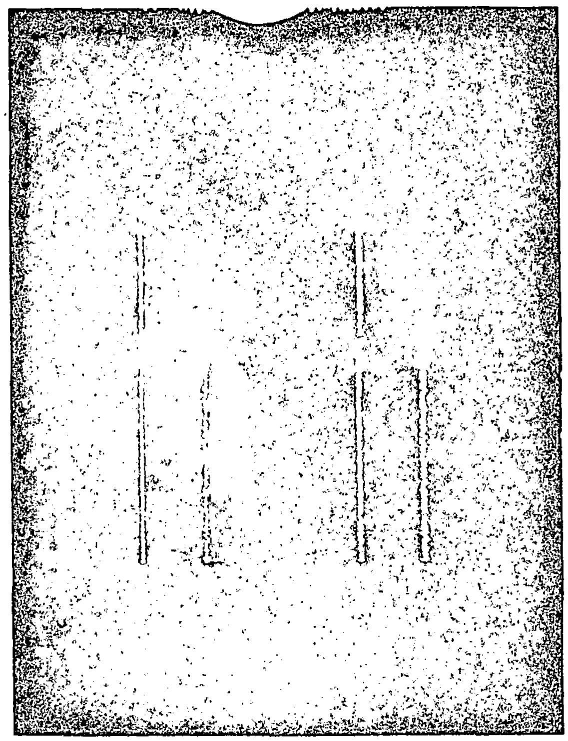


Figure 15

Presentation With Proper
Gain and Presentation
With Excessive Gain

f. Procedural Checklist: The following is a step-by-step procedure to aid in performing the filming operation when employing the equipment configuration of Figure 13.

(1) Connect equipment as shown by Figure 13.

(2) Turn on all equipment and allow at least 15 minutes for warm-up and stabilization.

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-
CONTROL SYSTEMS JOINTLY

(3) Set pulse generator INPUT SEL to INT.

(4) Set pulse generator (+ off -) switch to (-).

(5) Set pulse generator PARALLEL/SEPARATE switch as required.

(6) Set pulse generator impedance switch to 2000 ohms.

(7) Set up Berkerly counter to read PRF.

(8) Adjust pulse generator to the lowest PRF or lowest scan rate frequency to be filmed. Four times these readings will be necessary if playback speed is to be four times normal.

(9) Adjust pulse generator pulse width control to approximately 5.0 microseconds.

(10) Set oscilloscope TRIGGERING MODE to AC slow or DC.

(11) Set oscilloscope TRIGGER SLOPE to EXT (+ or -).

(12) Turn the oscilloscope STABILITY control full right. Now turn the STABILITY control left until the trace disappears, then two or three degrees further left.

(13) Turn the oscilloscope TRIGGERING LEVEL control toward the center of its range until the sweep is triggered properly.

(14) Turn the oscilloscope INTENSITY control fully counterclockwise. The output of the pulse generator should appear as one or more dots.

(15) By means of the oscilloscope HORIZONTAL POSITION control position the first dot (extreme left) so that it is perfectly aligned with the left end of the graticule-scale.

(16) Adjust the oscilloscope TIME/CM control until the second dot is perfectly aligned with the right end of the graticule-scale.

TOP SECRET [redacted]
...NDLE VIA
...YEMAN-TALENT-KEYHOLE-...
CONTROL SYST... JOINTLY

SECRET

Approved for Release: 2024/06/08 C05025847

(17) As a check, increase the pulse generator frequency until three dots appear, with the center dot in the exact center of the graticule-scale (line 5). The Berkerly counter should now read twice the lowest PRF or scan rate to be filmed.

(18) Adjust the following controls to obtain a small, bright and sharply focused dot presentation:

(a) Pulse generator AMPLITUDE.

(b) Pulse generator PULSE WIDTH.

(c) Oscilloscope FOCUS.

(d) Oscilloscope INTENSITY.

(e) Oscilloscope ASTIGMATISM.

(19) If scan rate filming is to be performed, adjust the SKL filter to properly filter out the signal PRF's.

(20) Set pulse generator INPUT SEL to EXT (+ or -).

(21) Locate an area on the tape which contains normal background noise.

(22) Adjust playback gain until random noise dots just begin to appear.

(23) Locate an area on the tape with signals present. Now, repeat steps (18) and (22), if necessary. Magnetic recordings with extremely good signal to noise ratio may require a decrease in gain setting.

(24) Ascertain that camera is properly loaded.

(25) Set camera aperture to f-16 (TRI-X Film).

(26) Adjust film speed as follows:

(a) 2.5 IPM for 3 3/4 IPS PRF filming.

(b) 7.4 IPM for 15 IPS PRF filming.

(c) 0.8 IPS for 3 3/4 IPS scan rate filming.

(d) 2.5 IPM for 15 IPS scan rate filming.

(27) Set camera timing light switch to REMOTE.

(28) Put event marker and associated equipment into operation.

(29) Check camera time light for proper firing.

(30) Photograph data plate using approximately 30 seconds exposure time.

(31) Adjust oscilloscope scale ILLUMINATION control for moderate intensity.

(32) Make several exposures of the oscilloscope scale using approximately 15 seconds exposure time.

(33) Set pulse generator INPUT SEL to INT.

(34) Adjust pulse generator to an appropriate PRF for use as a calibration signal.

(35) Start Camera:

(a) MOTOR/REMOTE switch to MOTOR.

(b) DRIVE/EXT CIRCUIT switch to DRIVE.

(c) TIMING/REMOTE switch to REMOTE.

(36) Film calibration signal for approximately 30 seconds. Make a note of the calibration PRF used.

(37) Stop camera.

(38) Set pulse generator INPUT SEL to EXT (+ or -)

(39) Return tape to proper starting point.

(40) Assure that oscilloscope scale is moderately illuminated.

HANDLE VIA
BYEMAN-TALENT KEYHOLE-COMINT
CONTROL SYSTEMS JOINTLY

C05025847
Approved for Release: 2024/06/08 C05025847

(41) Start camera. (Reference step 35).

(42) After camera is started switch DRIVE/EXT CIRCUIT switch back and forth to assure camera shutter is open.

(43) Start playback equipment.

(44) During filming operation, periodically check for proper scope presentation, operation of timing light, etc. Make any readjustments necessary.

3. FILM PROCESSING: The film currently being used for this operation consists of the TRI-X type. Experimentation has resulted in machine processing, using D-19 developing solution with a developing time of seven (7) minutes. With the camera aperture setting used (f-16) and a fairly bright scope presentation, this developing formula produces a film negative of sufficient contrast for ease of reading.

4. FILM READOUT: The only equipment required for readout of the film is a 35 MM film viewer, similar to the RECORDAK type, equipped with an appropriate PRF scale (reference Section I, paragraph 3) and a film light table for use in annotating the film with real time. The readout procedure follows:

a. Annotate the edge of the film containing the timing dots with real time. Any time interval may be used by merely counting off the number of dots corresponding to the interval desired. The time may be written directly on the film by means of India ink and a very small pen.

b. Thread the film on to the viewer.

c. Advance film until the oscilloscope graticule-scale appears.

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

SECRET

TOP SECRET

d. Adjust viewer for proper focus.

e. Adjust viewer image enlarger control until the graticule-scale on the film exactly coincides with the scale attached to the viewer screen.

f. Advance film until the calibration signal appears.

g. Check PRF of calibration signal by means of film viewer scale and PRF Chart. This reading should coincide with the PRF reading noted at the time the calibration signal was filmed.

h. If at any time the film and the viewer screen scale should become mal-aligned, proper alignment can be made by means of the vertical lines on the film. These lines are a result of having the oscilloscope scale illuminated during the filming, therefore, they correspond to the oscilloscope graticule-scale.

i. Determine PRF conversion factor (if sweep frequency was other than 300 CPS).

$$\text{Conversion Factor} = \frac{300}{\text{Sweep Frequency}}$$

j. Note which scale number signal of interest falls on.

k. Locate scale number on PRF Chart. Read PRF adjacent to this number.

l. If using a conversion factor, divide the PRF reading by this factor for the true PRF or scan rate.

m. Determine scan time, [redacted] etc., by means of the timing dots on the edge of the film. A Gerber Variable Scale is recommended for this purpose.

TOP SECRET

SECRET

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

n. Determine simultaneous signals with a very narrow PRF separation by noting the formation of an "X" pattern (reference Section I, paragraph 6).

o. The number of signals present, signal on and off times, etc., is self explanatory.

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

~~SECRET~~

~~TOP SECRET~~ [redacted]

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-
CONTROL SYSTEMS JOINTLY

HANDBOOK OF OPERATION PROCEDURES

Prepared by

SPECIAL PROJECTS SECTION
6 December 1960

~~TOP SECRET~~ [redacted]

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-
CONTROL SYST M

~~SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

FORWARD

The procedures outlined in this handbook are intended to provide a reference guide to personnel involved in the film processing, signal readout mission analysis and reporting of ELINT data derived from ferret missions. While not a technical publication mathematical terms and formulae are used when required to make the procedures being described more concise.

Throughout this handbook reference is made to 544TH RECON TECH GROUP manual, "Rapid Signal Readout", dated November 1959, and the "Handbook of Operations CP-216/APD-4".

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

~~SECRET~~

~~TOP SECRET~~

SECTION B

MISSION PROCESSING

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-[redacted]
CONTROL SYSTEMS

~~TOP SECRET~~

~~SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

SECRET

MISSION PROCESSING TOP SECRET [redacted]

1. PURPOSE: To establish procedures to be used in the processing of mission data.

2. SCOPE: This procedure covers all phases of mission processing of the Special Projects Section.

3. GENERAL: The procedures outlined are intended to provide a reference guide to personnel involved in film processing, signal readout, mission analysis and reporting of ELINT data derived from ferret missions.

4. PROCEDURES: When all mission data is received, a determ-ination will be made to establish a mission processing priority. This priority will be dependent upon the existing workload and results ex-pected from mission analysis.

4.1 FILM PROCESSING: All mission magnetic tape recordings containing ELINT signals will be filmed, using the method outlined in the 544TH RECON TECH GROUP manual, "Rapid Signal Readout", dated November 1959. All references in the following sub-paragraphs pertain to procedures outline in Section II of this manual.

a. Calibrate the equipment and adjust all controls as indicated in paragraph 2f.

b. Recordings of "P" and "L" band receivers will be filmed at an oscilloscope sweep frequency of 30 CPS. (240 cycles pulse generator frequency [redacted]; reference paragraph 2f(8)). This oscilloscope sweep frequency will display readible PRF's from 30 to 1000 CPS.

c. Recordings of "S" and "X" band receivers will be filmed at an oscilloscope sweep frequency of 300 CPS. (2400 cycles pulse generator frequency [redacted]; reference paragraph 2f(8)). This oscilloscope sweep frequency will display readable PRF's from 300 to 3000 CPS.

d. Adjust the camera and follow procedures outlined under paragraph 2f., steps (24) through (37) and (41) through (44).

(1) Reference step (30). Data plate will include:

Mission Number

BYEMAN HANDLE VIA TALENT-KEYHOLE CONTROL SYSTEM

TOP SECRET [redacted]

SECRET

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847
SECRET
TOP SECRET

Receiver Number

Track Number

Frequency

Date

(2) Reference Section I, paragraph 8 and Section II, step (29). Antenna switching on System VI recordings is indicated by a changing tone recorded on a separate channel of the mission tape. The output of this channel will be connected to the "F" rack Event Marker and a 1000 cycle filter. The outputs of the "F" rack and the 1000 cycle filter are both fed into an amplifier, where the signals are increased to a level sufficient to trigger the timing light of the camera. Insurethat the 1000 cycle tone (indicating right antenna connected to the aircraft receiver) causes the camera timing light event marker to illuminate at 10 second intervals. The 3000 cycle tone (indicating the left antenna is connected to the receiver) should cause the camera timing light to light continuously and blink off at 10 second intervals. In the latter case, the phase difference between the 3000 cycle tone and the Event Marker output causes the blinking every 10 seconds.

(3) With the volume of the tape recorder set at optimum gain, the tape will be closely monitored.

e. Exposed film will be hand carried to the Target Center for developing and will be picked up by Special Projects personnel when ready.

f. All signals within the sensitive area will be analyzed, using the procedures outlined in Section C of this Handbook. (This includes those unfriendly radars whose range is sufficient to cause them to be intercepted at long ranges, sometimes as far away as the staging base of the ferret aircraft). The film will be scanned for the existance of signals outside the PRF limits of the sweep frequency setting used on the initial film run.

(1) Signals with a PRF less than the oscilloscope sweep frequency at the time of filming will show evidence of their existance by appearing on reticle line 10 of the film.

(2) Signals with a PRF higher than 1000 on "P" and "L" bands, or more than 3000 on "S" and "X" bands will appear numerous times accross the film, with the first hits close to reticle line 10 of the

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY
TOP SECRET
SECRET
Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

film.

(3) Unusual signals or signals outside the PRF limits of the sweep frequency settings used on the initial run will be re-checked, using analysis equipment and procedures that will best provide their characteristics.

g. Receiver OFF time, or DC power OFF time is usually more easily determined than the initial start time. Therefore, the film is usually more accurately timed backward, from the receiver OFF time.

4.2 READOUT: Prepare the film readout, using procedures outlined in Section C of the Special Projects Handbook. ELINT DATA RECORD, 3902nd ABW Form 85, will be used to record the results of each mission analyzed manually.

a. Enter the mission number and readout date at the top left of this form. Draw a line down the center of the time column and annotate the top colums as follows: (from left to right)

Signal Number

Time On (Zulu)

Time Down (Zulu)

Total Time On

Scan Time

PRF

Set Type

Remarks

(1) The SET TYPE column is not required to be filled in during film readout.

(2) REMARKS: Enter any pertinent data that my be of aid in determining set type. This column will be used to indicate signal quality, if below normal, or to explain unusual signal displays.

Approved for Release: 2024/06/08 C05025847

the REMARKS section, indicating that this condition exists and the magnetic tape recording will be reviewed to determine the type of scan, along with any other unusual characteristics of the signal.

c. [redacted] type signals require additional measuremants, during readout. (Reference Section E of the Special Projects Handbook). [redacted] time, total sweep time and the ratio (factor) of these times, in addition to the aircraft altitude, will be noted on the ELINT DATA RECORD, immediately below the TIME ON-OFF entry for each signal, or on IBM cards in the proper programmed columns. If signal duration is less than 8 to 10 minutes, readings will be taken at one minute intervals.

d. [redacted] signals will be annotated in the same manner as [redacted] signals. The shortest time between each illumination (T1) compared to the longest time between illuminations (T2) and the ratio (factor) of these times will be noted, in addition to the altitude of the aircraft. Readings will be made in one to three minute intervals, as outlined for [redacted] intercepts.

e. If [redacted] range information cannot be read out, an explanation will be included in the REMARKS column of the ELINT DATA RECORD and/or IBM card. (i.e. single beam, nod rate too weak to read, etc.).

f. Upon completion of initial readout and recording of this information on the ELINT DATA RECORD or IBM card, a transparant overlay will be prepared for the entire route flown. The time for all major turning points will be indicated along this route.

(1) Compute aircraft position for all times of V-Beam or Height Finder range arcs.

(2) Determine which side of the aircraft (left or right antenna) is intercepting the signal and draw each range arc from the position determined in the preceding step.

g. A section of JN Chart will be prepared, showing the route flown and annotated with the following information:

Time of Major Turning Points

New or unusual signals, or signals of interest illuminating the aircraft will be depicted by colored lines along the track.

Unidentified signals or unusual events will be indicated along the track.

New sites located by the [redacted] ranging techniques will be plotted.

A legend, explaining all items plotted, will be annotated.

4.3 MISSION ANALYSIS: The parameters recorded on the IBM card or ELINT DATA RECORD, and flight overlays will be reviewed and a determination of set type will be made for each intercept.

a. Signals that evidence new and unusual parameters will be thoroughly checked, using all available analysis equipment, and a brief description prepared, to explain the most probable type and possible purpose.

b. Routine type signals that appear in new areas or in greater number than normal, for any given area, will be considered signals of interest and an effort will be made to explain the most probable significance of this situation.

c. Previous missions flown in the same area will be reviewed for possible correlation or confirmation of previously reported assumptions.

d. All available sources of intelligence will be reviewed in an attempt to correlate other activities with each mission.

e. The Data Center will be queried for all available collateral data in the event additional information is required on a specific location.

5. MISSION REPORTING: A formal mission report will be prepared for all missions that evidence significant or unusual activities, i. e. new or unusual signal intercepts, new site locations, etc. The chief of the Defense Analysis Branch will make the final determination, if doubt exists, for the need of any report. The final report will be prepared in the following format:

5.1 GENERAL: To include the following in narrative form:

a. Mission Number

b. Date Flown

c. Elint equipment installed, indicating receiver frequency bands.

d. Date and from whom raw data was received.

5.2 EQUIPMENT STATUS: Indicate quality of tape recording for each receiver band. In the event of equipment malfunction, indicate time of malfunction and possible effect on mission results.

5.3 RADAR ACTIVITY: Indicate the total number of signals intercepted on this mission and include a combined listing, by type of each radar intercepted. Make reference to the detailed signal listing to be included in the report following the summary and explain any unusual signal remarks.

5.4 UNIDENTIFIED INTERCEPTS: List signal number and signal up and down times. Indicate reason positive identification cannot be made. Include a brief description of the signal characteristics and remarks that might indicate most probable function of the signal. Reference the illustrated flight chart or any attachment needed to further explain the signal.

5.5 SITES LOCATED: Indicate the number of Radar Order of Battle (ROB) sites confirmed by mission data. Include set type and ROB pin number for each site located. List new sites located by set type and new ROB number or geographical coordinates. Make reference to the illustrated flight charts and detailed signal listings, as required.

5.6 MISSION ANALYSIS: Results of mission analysis will be prepared in narrative form and included within this section.

5.7 SUMMATION: A brief resume of the significance of the mission, specific intelligence gained, that was not known prior to the mission and its effect on the Soviet Air Defense structure will be entered in this section.

C05025847

Approved for Release: 2024/06/08 C05025847

SECRET

TOP SECRET

SECTION C

This section deals with procedures for readout of mission films using the CP-216/APD-4 Computer-Viewer. Two types of operations are involved: Manual, where the operator manually logs and computes the mission information obtained from the readout, and Semi-Automatic where the mission information is recorded on IBM cards for computation by an IBM computer.

In the Semi-Automatic mode of operation three different formats or run types, are used for recording information on IBM cards.

Run Type (1): General Analysis. This format is used for recording general signal information on IBM cards for automatic computation. The IBM card format is as follows:

Columns 1 through 6	Mission/Signal Identification
Columns 7 through 12	Signal Time Up
Columns 13 through 15	PRF Code
Columns 18 through 20	Scan Time Code
Columns 21 through 26	Signal Time Down

Run Type (2): Height Finder Radar Range Determination: This format is used for recording information required by the IBM computer for computation of the range of the emitter in relation to the aircraft position at the time of intercept. The IBM card format is as follows:

Columns 1 through 6	Mission/Signal Identification
Columns 7 through 12	Aircraft Altitude in hundreds of feet
Columns 13 through 15	T_1 Ratio Code
Columns 18 through 20	T_2 Ratio Code
Columns 21 through 26	Time of Intercept

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-COMINT
CONTROL SYSTEMS JOINTLY

TOP SECRET

SECRET

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

SECRET

TOP SECRET

MISSION READOUT USING
CP-216/APD-4 COMPUTER-VIEWER

1. PURPOSE: To establish procedures to be used in the readout of Special Projects film using the modified CP-216/APD-4 Computer-Viewer.

2. SCOPE: This section is prepared for all personnel who use the CP-216/APD-4 as a readout device.

3. INTRODUCTION: The Computer-Viewer, CP-216/APD-4, as modified, is a data reduction and viewing device designed to provide semi-automatic processing capability of data recorded on 35 MM film, by the Special Projects Laboratory. It is used to perform the following functions:

a. Provide PRF information.

b. Measure Scan Time.

c. [redacted]

d. Provide automatic time and duration of intercept information.

e. Provide data input to IBM 526 Summary Punch for automatic IBM card print-out.

Special Projects personnel will become thoroughly familiar with the equipment operation, as well as theory of operation, to be able to recognize visual indications of equipment malfunction on the monitor and viewing screen displays. The time required to localize circuit trouble can be reduced through the proper interpretation of these displays.

4. DESCRIPTION OF FUNCTIONS: A footswitch control is used to change the type of waveform displayed on the Cathode Ray Tube. The footswitch operates sequentially, simultaneously activating indicator lamps on the front panel, to provide a visible indication of which of the five (5) waveforms is being displayed.

4.1 BASELINE CALIBRATION (DISPLAY POSITION ONE): The operator calibrates the horizontal sweep of the Cathode Ray Tube display by adjusting the dot display presented in this function.

HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL

TOP SECRET

SECRET

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

4.2 TIME UP (DISPLAY POSITION TWO): The Cathode Ray Tube waveform present in this position will be ignored. Only nixie time indicator tubes at the top of the viewing screen will be considered. These are adjusted at the beginning of each mission film, at which time the proper time reference is set in.

[redacted]

NOTE: DISPLAY POSITION FOUR IS NOT USED.

4.4 TIME DOWN (DISPLAY POSITION FIVE): This position is used to provide automatic time down data to the IBM 526 Summary Punch. This data is provided by the nixie time indicator tubes located at the top of the viewing screen.

5. EQUIPMENT CHECK-OUT AND CALIBRATION PROCEDURES: This section contains information essential for procedural adjustment and calibration of the CP-216. Many references will be made to certain paragraphs of the basic document, "Handbook of Instructions for Computer-Viewer, CP-216/APD-4".

5.1 SWITCHES AND CONTROLS: Thread the film as outline in paragraph 3-4b, page 3-8 of basic document. Turn on equipment and allow a 15 minute warm-up period before making adjustments or measurements. Perform the following system operational checks during the warm-up period:

5.1.1 FILM SPEED: Set the FILM DRIVE switch to FORWARD. Check the film speed control for maximum (clockwise) and minimum (counterclockwise) operation. (The film speed should change from approximately 50 feet per minute maximum, to a point where it stops altogether at minimum).

5.1.2 EDITOR ILLUMINATION: Switching to ON position must cause two flourescent lamps in the EDITOR to light.

5.1.3 PROJECTOR SWITCH: Switching to ON must cause the Projector Lamp to light and the Projector Blower to operate.

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

SECRET TOP SECRET

5.1.4 DIM CONTROL: Rotating clockwise must decrease the viewing screen illumination.

5.1.5 MANUAL FILM DRIVE: Rotating this control clockwise must cause the film to move upward through the FILM EDITOR. Conversely, counterclockwise rotation results in moving the film downward in the FILM EDITOR.

5.1.6 CURSOR: Rotating the knob must result in tilt of CURSOR wire above and below horizontal.

5.1.7 MAG VAR CONTROL: This control is not used at any time. It must be left in the ZERO position, as indicated by the MAG VAR indicators, located at left center of the viewing screen.

5.1.8 HEADING: This control is not used at any time. It must be left in the NORTH position, indicated by the compass dial located at left center of viewing screen.

5.1.9 HORIZONTAL/VERTICAL SWEEP SELECTOR: Switching in the VERT position must cause the Cathode Ray Tube display to switch to the vertical plane. Conversely, switching to HORIZ position must cause it to be displayed in the horizontal plane.

5.1.10 INTENSITY: Clockwise rotation must cause an increase in the light intensity of the Cathode Ray Tube display.

5.1.11 FOCUS: With the INTENSITY control set for normal viewing, sharp focus should be obtained in approximate center of the Cathode Ray Tube "FOCUS" control range.

5.1.12 YOKE ROTATION: Clockwise rotation of control must result in clockwise tile of Cathode Ray Tube display.

5.1.13 DISPLAY POSITION ONE CONTROLS: Set mode switch to MAN and actuate the footswitch to display position one. Check the following controls for normal operation:

a. HORIZONTAL CENT. (POS 1): Clockwise rotation of control must result in shifting the Cathode Ray Tube display toward right of viewing screen.

b. VERTICAL CENT. (POS 1): Clockwise rotation of control must result in shifting the Cathode Ray Tube display toward the top of the viewing screen.

TOP SECRET
SECRET

HANDLE VIA
BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847
SECRET TOP SECRET

c. WIDTH (POS 1): Clockwise rotation of control must result in widening the Cathode Ray Tube display.

5.1.14 DISPLAY POSITION TWO CONTROLS: Actuate the footswitch to display position two. The Cathode Ray Tube display of this position is not used. Only the nixie time indicator tubes will be considered. Position the PHOTO CELL at bottom right of viewing screen directly over the filmed time dot display. Set the FILM SPEED to FORWARD and FILM SPEED CONTROL clockwise, for film speed of approximately 10 inches per second. Nixie time indicators should advance one increment for each filmed time dot scanned by the PHOTO CELL.

5.1.15 DISPLAY POSITION THREE CONTROLS: Actuate the footswitch to display position three. Check the following controls for proper operation:

a. X1: Right rotation must result in movement of pulse to the right and an increasing monitor reading.

b. X2: Right rotation must result in decreasing the amplitude of the pulse displayed on the Cathode Ray Tube.

c. Y: Forward rotation must increase amplitude of the pulse displayed on the Cathode Ray Tube.

5.1.16 DISPLAY POSITION FOUR CONTROLS: This position is not used. No checks are required.

5.1.17 DISPLAY POSITION FIVE: Only the nixie time indicators are used in this position. (Reference paragraph 5.1.14, above)

5.2 CALIBRATION

5.2.1 DISPLAY POSITION ONE CALIBRATION: Perform calibration of equipment as follows:

a. Set VERT-HORIZ switch to HORIZ. Actuate the footswitch to display position one and follow calibration procedures outlined in paragraph 5-14d, page 5-46 of basic document.

b. Adjust position one WIDTH and HORIZ CENT controls until 4th dot from left is positioned on the extreme left film reticle line and the 14th dot is positioned on the extremen right film reticle line.

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-COMINT
CONTROL SYSTEM
TOP SECRET
SECRET
Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847
~~SECRET~~ ~~TOP SECRET~~

5.2.2 DISPLAY POSITION TWO CALIBRATION: Actuate the footswitch to display position two. Perform alignment of clock as outlined in paragraph 5-12, page 5-43 of basic document. Initial time settings may be set into nixie time indicators using TIME SETTING SWITCHES located directly below the viewing screen on the front of the equipment.

NOTE: FILM DRIVE SWITCH MUST BE OFF BEFORE MAKING ANY OF THE ABOVE SETTINGS.

5.2.3 DISPLAY POSITION THREE CALIBRATION: Actuat the footswitch to display position three. Set VERT-HORIZ switch to HORIZ.

a. Rotate X1 thumbwheel to the left for monitor reading of 200. Set BEARING LEFT END potentiometer (R475), located on the front panel waveform generator, so the Cathode Ray Tube pulse rests on the left film reticle line.

b. Rotate X1 thumbwheel to the right for a monitor reading of 000. Set BEARING RIGHT END potentiometer (R477), located with R475, so the Cathode Ray Tube pulse rests on the right film reticle line.

c. Repeat steps a and b until no further adjustment is necessary.

NOTE: NO FURTHER DISPLAY POSITION CALIBRATION IS NECESSARY.

6. OPERATION:

6.1 INTRODUCTION: This section will deal with two categories of readout. They are;

a. MANUAL, using the values obtained by the CP-216/APD-4 for manual computation and recording.

b. SEMI-AUTOMATIC, using the IBM 526 Summary Punch for recording information to be sent to the computer.

The first category to be outlined will be MANUAL.

6.2 MANUAL READOUT:

6.2.1 INITIAL PREPARATIONS:

BYEMAN-TALENT-KEYHOLE-
HANDLE VIA
CONTROL SYSTEMS JOINTLY
~~TOP SECRET~~
~~SECRET~~
Approved for Release: 2024/06/08 C05025847

a. Prepare the film for readout using film threading pr[illegible]dures outline in paragraph 3-4b, page 3-8 of basic document.

b. 3902nd ABW Form 85, "ELINT DATA RECORD", will be used to record the results of each mission. (Reference paragraph 4.2a Section B of this handbook).

c. Advance the film to RECEIVER ON time, placing closest time dot to this time directly under the PHOTO CELL.

d. Place the MODE swithc to MAN.

e. Place BAND SELECTOR switch to any position except XA-1.

f. Using the TIME SETTING controls, set all nixie time indicators to desired time reference.

g. Advance CP-216 to display position three, with VERT-HORIZ switch to HORIZ.

h. Advance the film to the first signal of interest.

6.2.2 PRF DETERMINATION:

a. Using X1 thumbwheel, place Cathode Ray Tube pulse in the exact center of the filmed signal hit.

b. Noting monitor values, apply to the prepared conversion chart for actual PRF figure.

c. Frequent display calibration checks should be made to insure accuracy of signal PRF.

6.2.3. SCAN TIME MEASUREMENTS:

a. Place VERT-HORIZ awitch to VERT. Using X1 thumbwheel and position one HOR and VERT CENT controls, place Cathode Ray Tube trace over two successive hits of signal to be analyzed, with the Cathode Ray Tube pulse bisecting the exact center of the lower filmed hit, when the monitor reads 200.

b. Rotate X1 thumbwheel to the right until the Cathode Ray Tube pulse bisects the exact center of the next higher hit of the same signal.

C05025847
Approved for Release: 2024/06/08 C05025847
~~SECRET~~ TOP SECRET [redacted]

c. Note monitor reading and subtract 200. The result will be the scan time in 1/6 of a second.

EXAMPLE: Monitor reads 241. The scan time is 4 1/6 of a second or 6.85 seconds scan time.

6.2.4 [redacted] RANGE RATIO MEASUREMENTS:

a. Place the Cathode Ray Tube trace over two successive hits of the signal to be analyzed.

b. Shorten the trace, using the position one WIDTH control, until the trace extends approximately one half inch below and above the two signal hits being measured.

c. Using the X1 thumbwheel and position one HOR and VERT CENT controls, position the Cathode Ray Tube pulse for a monitor reading of 200 and bisecting the exact center of the bottom portion of the lower [redacted] hit.

d. Raise the Cathode Ray Tube pulse, using the X1 thumbwheel, until it bisects the upper portion of the lower [redacted] hit.

e. Note monitor reading on ELINT DATA RECORD, under T_1 column.

f. Position the Cathode Ray Tube pulse to bisect the upper portion of the lower [redacted] hit, with the monitor reading 200.

g. Raise the Cathode Ray Tube pulse, using the X1 thumbwheel, until it bisects the lower portion of the next higher [redacted] hit.

h. Record monitor reading on ELINT DATA RECORD, under T_2 column.

6.2.5 [redacted] RANGE RATIO MEASUREMENT:

a. For [redacted] measurement (Reference Section E of this handbook) position three Cathode Ray Tube is alined with two successive hits of the signal being analyzed, in the same manner as used for Scan Time. However, in order to provide greater accuracy, the sweep presentation is shortened to extend approximately one half inch above the top hit and below the bottom hit, using the position one WIDTH control. (This is to provide a greater incremental change on the monitor for a

HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL SYST
TOP SECRET [redacted]
~~SECRET~~
Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

given distance of Cathode Ray Tube pulse movement).

b. Using the X1 thumbwheel and position one VERT and HORIZ CENT control, position the Cathode Ray Tube pulse for a monitor reading of 200 and bisect the exact center of the lower portion of the [redacted] signal hit.

c. Raise the Cathode Ray Tube pulse, using the X1 thumbwheel, until it bisects the upper portion of the [redacted] hit. Note the monitor reading and subtract 200. The resulting value will be the Separation (T_1) Ratio.

d. Raise the Cathode Ray Tube pulse further, until it bisects the lower part of the next hit of the same [redacted] signal. Note the monitor reading and subtract 200. The resulting value will be the Scan Time (T_2) Ratio.

e. Enter into appropriate column of report and use procedures outlined in appropriate SOP to determine range factor.

6.2.6 Time up and down and time duration information will be provided by the nixie time indicators.

6.3 SEMI-AUTOMATIC READOUT:

6.3.1 INITIAL PREPARATIONS:

a. Connect the IBM 526 Summary Punch to the CP-216, using the cable provided. Insert the proper program board and card into the IBM 526.

b. Prepare the film for readout operation, according to procedures outlined in paragraph 3-4b, page 3-8 of basic document.

c. Advance the film to RECEIVER ON time, placing the closest time dot to this time directly under the PHOTO CELL.

d. Place the MODE switch to AUTO.

e. Place the BAND SELECTOR switch to any position except XA-1.

f. Using the TIME SETTING controls, set all nixie time indicators to proper time reference. (If ZULU time is desired, set nixie to receiver TIME ON value).

Approved for Release: 2024/06/08 C05025847

C05025847

Approved for Release: 2024/06/08 C05025847

SECRET TOP SECRET [redacted]

g. Place READOUT switch to CENTER position.

h. Cycle the IBM 526 Summary Punch by depressing REL button once.

6.3.2 POSITION ONE: MISSION/SIGNAL IDENTIFICATION:

a. Using SERIAL NUMBER controls ONE and TWO, set in Mission Number. (Sequentially from 01 to 99).

b. Using SERIAL NUMBER control THREE, set in type of run. (1 for General Analysis, 2 for [redacted]).

c. Using SERIAL NUMBER control FOUR, set in frequency band. (1 for "P", 2 for "L", 3 for "S" and 4 for "X").

d. Using SERIAL NUMBER controls FIVE and SIX, set in the signal number. (Sequentially from 01 to 99).

e. Advance film to first signal to be analyzed.

f. With the proper information set in, depress the CP-216 RECORD button. The information will be recorded on an IBM card and the CP-216 will advance to position number two.

6.3.3 POSITION TWO: SIGNAL TIME UP:

a. GENERAL ANALYSIS (RUN TYPE 1):

1. Using the IBM 526 Keyboard, manually punch the information displayed on the nixie time indicators onto the IBM card.

2. The CP-216 will automatically cycle to position three.

b. [redacted] (RUN TYPE 2 or 3):

1. Using the IBM Keyboard, manually punch in the aircraft altitude in hundreds of feet and depress the space bar three times to advance the CP-216 to position three.

6.3.4 POSITION THREE: PRF, SCAN TIME AND RANGING RATIOS:

a. GENERAL ANALYSIS (RUN TYPE 1):

HANDLE VIA BYEMAN-TALENT-KEYHOLE-COMINT CONTROL SYSTEMS JOINTLY

TOP SECRET [redacted]

SECRET

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

~~SECRET~~ ~~TOP SECRET~~ [redacted]

1. Using the Xl thumbwheel, palce the Cathode Ray Tube pulse in the exact center of the filmed signal hit.

2. Depress the CP-216 RECORD button. The information will be recorded on an IBM card and the CP-216 will cycle around completely to position three again.

3. Place the HOR-VERT switch to VERT. Using the Xl thumbwheel and position one HOR and VERT CENT controls, place the Cathode Ray Tube trace over two successive hits of the signal to be analyzed, with the Cathode Ray Tube pulse bisecting the exact center of the lower filmed signal hit, when the monitor reads 200. (Readout switch must be placed in the MONITOR position to check the monitor reading).

4. Rotate Xl thumbwheel to the right until the Cathode Ray Tube pulse bisects the exact center of the nixt higher hit of the same signal.

5. Depress the CP-216 RECORD button. The information will be recorded on an IBM card and the CP-216 will advance to position five.

b. [redacted] RANGE RATIO (RUN TYPE 2):

1. Place the Cathode Ray Tube trace over two successive hits of the signal to be analyzed.

2. Shorten the trace, using the position one WIDTH control, until the trace extends approximately one half inch below and above the two signal hits being measured.

3. Using the Xl thumbwheel and position one HOR and VERT CENT controls, position the Cathode Ray Tube pulse for a monitor reading of 200 and bisect the exact center of the bottom portion of the lower [redacted]r hit.

4. Raise the Cathode Ray Tube pulse, using the Xl thumbwheel, until it bisects the upper portion of the lower [redacted] hit.

5. Depress the CP-216 RECORD button. The information will be recorded on an IBM card and the CP-216 will recycle around to position three again.

6. Position the Cathode Ray Tube pulse to bisect the upper portion of the lower [redacted] hit, with the monitor reading 200.

7. Raise the Cathode Ray Tube pulse, using Xl thumbwheel,

~~TOP SECRET~~ [redacted]

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-[redacted]
CONTROL SYSTEMS JOINTLY

~~SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847
SECRET TOP SECRET [redacted]

until it bisects the lower portion of the next higher [redacted] hi[redacted]

8. Depress the CP-216 RECORD button. The information will be recorded on an IBM card and the CP-216 will advance to position five.

c. [redacted] RANGE RATIO MEASUREMENT (RUN TYPE 3)

1. Place the Cathode Ray Tube over two successive hits of the signal to be analyzed.

2. Shorten the trace, using position one WIDTH control, until the trace extends approximately one half inch above and below the two signal hits being used in this measurement.

3. Using X1 thumbwheel and position one HOR and VERT CENT controls, position the Cathode Ray Tube pulse for a monitor reading of 200, with the pulse bisecting the exact center of the bottom portion of the lower [redacted] hit.

4. Raise the Cathode Ray Tube pulse, using X1 thumbwheel, until it bisects the upper portion of the lower [redacted] hit.

5. Depress the CP-216 RECORD button. The information is recorded on an IBM card and the CP-216 will recycle around to position three again.

6. Continue to raise the pulse, with the X1 thumbwheel, until it bisects the lower portion of the next higher [redacted] signal hit.

7. Depress the CP-216 RECORD button. The information will be recorded on an IBM card and the CP-216 will advance to position five.

6.3.5 POSITION FIVE: TIME DOWN:

a. Depress the CP-216 RECORD button. The nixie time indicator information will be recorded on an IBM card. This is the last bit of information to be recorded on the card. The IBM 526 will eject this finished card and insert a new one. The CP-216 will recycle back to position one.

6.3.6 Repeat the above procedure on each signal analyzed.

HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL
TOP SECRET [redacted]
SECRET
Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

SECRET

TOP SECRET [redacted]

LOCATING PROCEDURES [redacted]

SECTION D

[redacted] RADAR LOCATING PROCEDURES

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-[redacted]
CONTROL SYSTEMS JOINTLY

TOP SECRET [redacted]

SECRET

Approved for Release: 2024/06/08 C05025847

Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

Approved for Release: 2024/06/08 C05025847

Page Denied

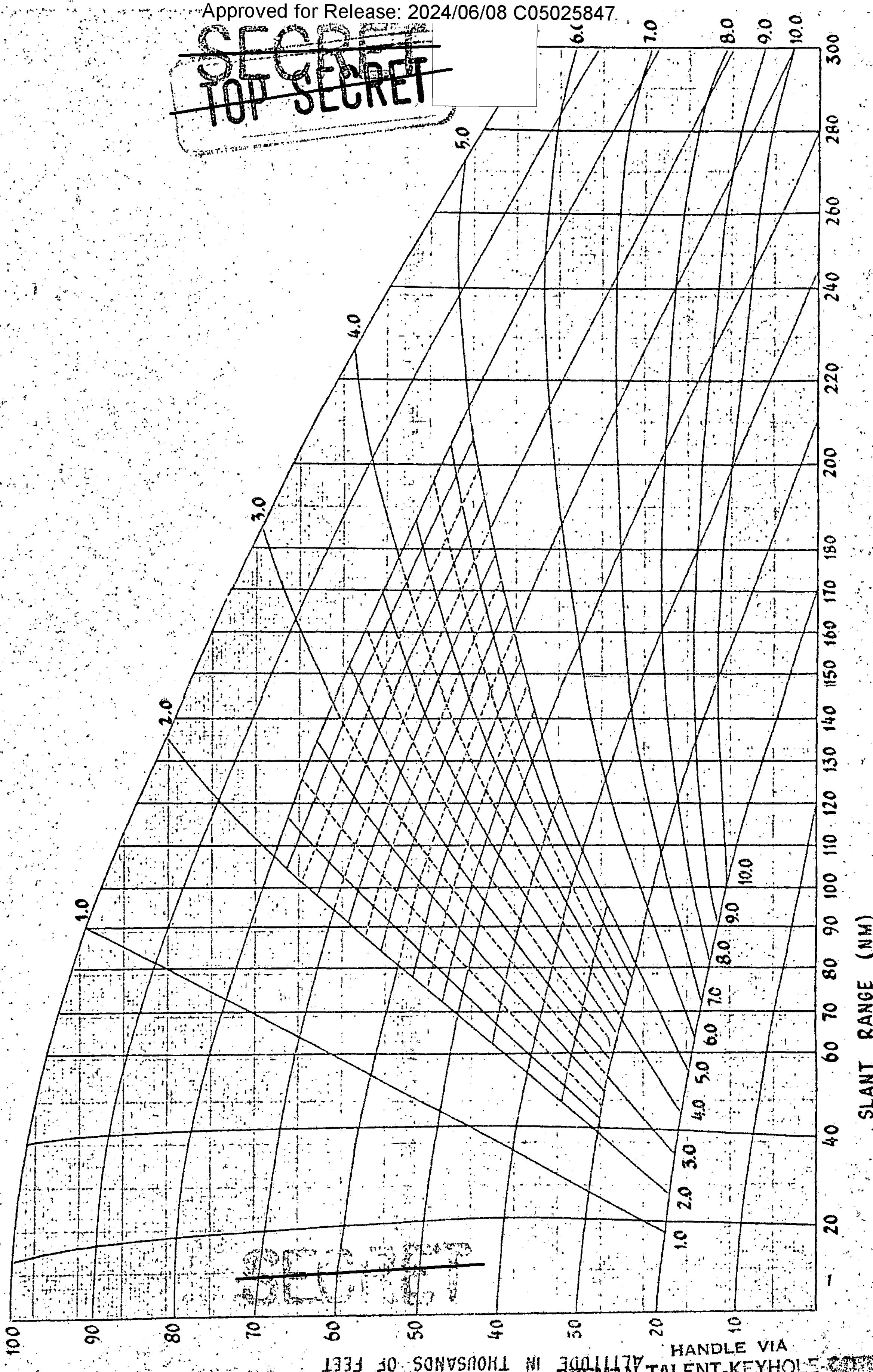
Approved for Release: 2024/06/08 C05025847

C05025847

Page Denied

C05025847
Approved for Release: 2024/06/08 C05025847

~~SECRET~~
~~TOP SECRET~~



~~SECRET~~

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-COMINT
CONTROL SYSTEMS JOINTLY

~~TOP SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

SECRET

~~TOP SECRET~~ [redacted]

SECTION E

[redacted] RANGE DETERMINATION

RANGE [redacted] DETERMINATION

~~TOP SECRET~~ [redacted]

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-[redacted]
CONTROL SYSTEMS JOINTLY

~~SECRET~~

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

C05025847
Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847

Page Denied

C05025847
Approved for Release: 2024/06/08 C05025847

Page Denied

Approved for Release: 2024/06/08 C05025847