CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1052-1 and 1052-2

FTV 1653, J-46

Approved [redacted] Manager
Advanced Projects

Approved [redacted] Manager
Program [redacted]

INTRODUCTION

This report presents the final performance evaluation of Corona Mission 1052. The purpose of this report is to define the performance characteristics of the J-46 payload system and to evaluate the technical characteristics of the mission, including analysis of any in-flight anomalies.

The payload system was assembled, tested, and certified for flight at the Advanced Projects (A/P) facility of Lockheed Missiles and Space Company (LMSC). A/P also provided services including pre-flight mission parameter planning, preparation of the flight program, in-flight operations support, data analysis, and mission reports to the community. The initial evaluation of the recovered film was made by NPIC personnel at the processing facility. The full Performance Evaluation Team (PET) included representatives of LMSC, ITEK Corporation, Eastman Kodak Company, and cognizant government organizations. The PET meeting took place at the National Photographic Interpretation Center (NPIC). Off-line evaluation, using engineering photography acquired over the United States, was performed at facilities of individual contractors.

The quantitative data summarized in this report is originated by government and contractor organizations. Diffuse Density measurements are produced by the Air Force Special Projects Production Facility. Vehicle attitude readings and frame correlation times are provided by NPIC. The Processing Summary report is published by [redacted]

These quantitative data were used by A/P computer programs to provide processed information allowing correlation of operational photographic conditions with image quality. Analyses were made of image smear components and limiting ground resolution, and also of illumination/exposure/processing components in order to investigate exposure criteria.

FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1653.

Lockheed Missiles and Space Company has the responsibility for evaluating payload performance under the Level of Effort and "J" System contracts.

This document constitutes the final payload test and performance evaluation report for Mission 1052 which was launched on 22 September 1969.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION 1

MISSION SUMMARY

A. MISSION DESCRIPTION

Corona satellite mission 1052 was planned to acquire search, cartographic and reconnaissance photography of selected terrain areas. Two mission segments were planned for a total of fifteen days orbital operation. Both segments nominally would return over 6,000 operational frames, each covering approximately 1725 square miles.

The J-46 payload system was a standard J-1 (J-43 and up) dual reconnaissance camera system consisting of panoramic cameras 216 and 217 and stellar/index cameras D111/138/137 and D110/140/140. Other payload serial numbers are included in Figure No. 1.

The payload system was launched into orbit by FTV 1653 Agena vehicle (SS01B) flown in tail first attitude and boosted by a Thorad booster (SLV-2G) S/N 68-300.

Corona mission 1052 was launched from VAFB, pad SLC-3 West at 14:11 PDT on 22 September 1969. The -1 mission was terminated by air catch on Rev 115 on 29 September 1969 and the -2 mission was concluded on Rev 244 on 7 October 1969.

The -1 mission was seven (7) days followed by an eight (8) day -2 mission.

B. SUMMARY

Launch, ascent, and injection events occurred as programmed. The orbit attained was within the three (3) sigma dispersion.

Both panoramic cameras operated satisfactorily throughout the flight. Film analysis revealed the slave camera film was pulled out of the rails at the start of the last operate in the -2 mission. Photography ranged from fair to poor, and in general, the imagery is not comparable to that provided by the better J-1 missions. The photography from both missions exhibited a large degree of image quality variability. An MIP of 85 was assigned to this mission.

Both stellar/index cameras operated normally during the flight.

The V/H programmer failed to start on three revs during the flight.

The units digit on the slave cycle counter was intermittent throughout the -2 mission.

The command system, clock system, pressure make-up system, and the yaw function generator operated normally for the duration of the flight.

The thermal environment was within the pre-flight predictions.

Kik-Zorro 38 (early -1 to -2 switchover) was performed on Rev 105 [redacted] and all transfer functions were normal.

Both the -1 and -2 recovery system performance was satisfactory.

C. FLIGHT CONFIGURATION

1. Camera Settings and Film Types

1.1 Panoramic Cameras

	Master	Slave
Film Type/Feet	3404/16300	3404/16300
Slit Width	.225	.170
Film Type-Wratten	23A	21

1.2 Horizon Optics

	Master		Slave	
	Take-Up	Supply	Take-Up	Supply
Aperture	f/8.0	f/6.3	f/6.3	f/8.0
Exposure Time	1/100	1/100	1/100	1/100
Filter Type-Wratten	25	25	25	25

1.3 <u>Stellar/Index</u>

	-1		-2	
	Stellar	Index	Stellar	Index
Film Type/Feet	3401/75	3400/135	3401/75	3400/135
Aperture	f/1.8	f/4.5	f/1.8	f/4.5
Exposure Time-Sec.	2.0	1/500	2.0	1/500
Filter Type-Wratten	None	21	None	21

2. <u>Panoramic Film Consumption</u>

	Actual	
	Master	Slave
Pre-Launch	84	96
-1 Mission	2955	2976
-2 Mission	3112	3079
Total	6151	6151

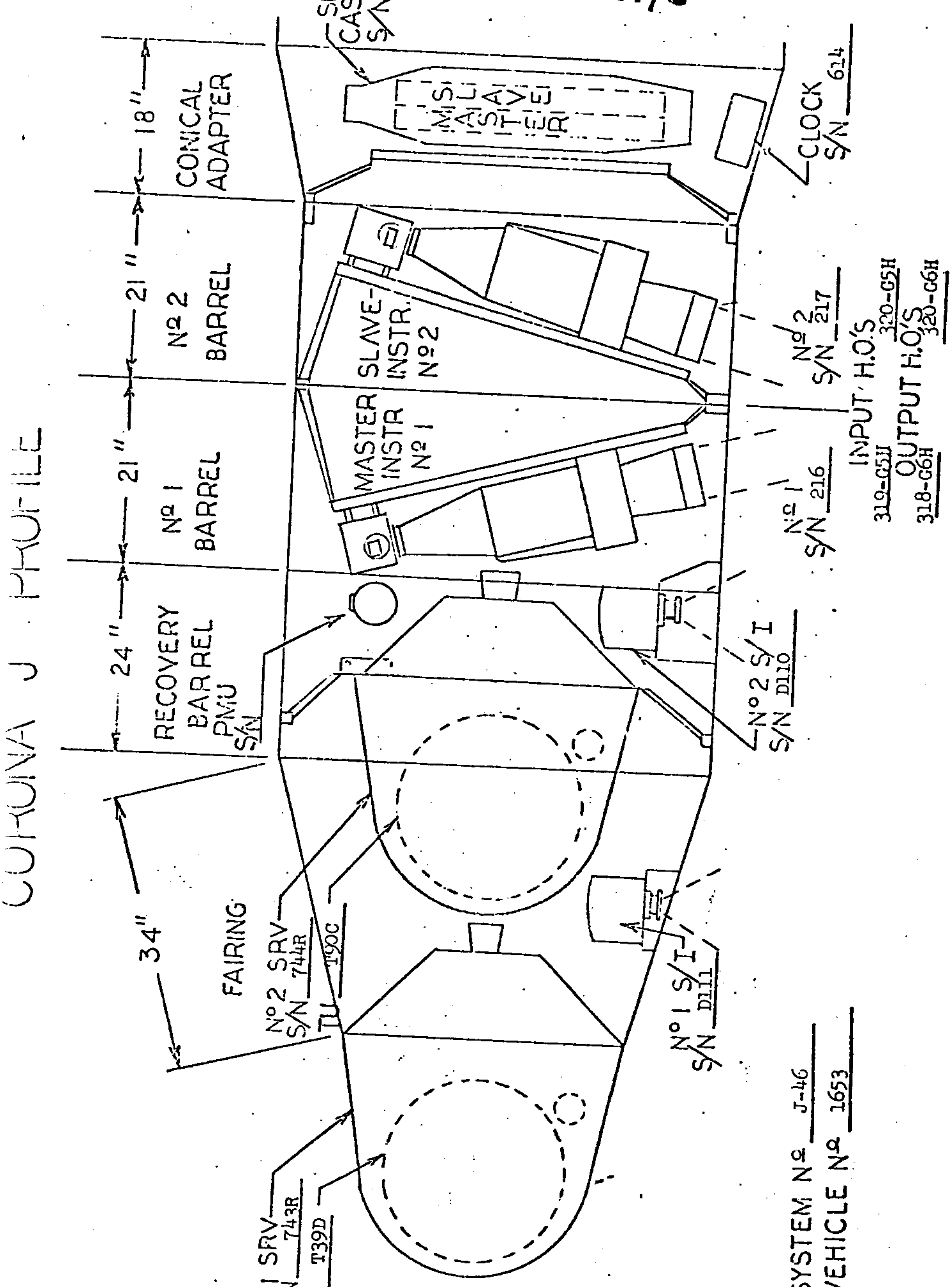

CORONA J PROFILE
SUPPLY CASSETTE S/N
CONICAL ADAPTER
18"
21"
No 2 BARREL
21"
No 1 BARREL
24"
RECOVERY BARREL
PMU S/N
34"
FAIRING
MASTER
SLAVE
CLOCK S/N 614
SLAVE-INSTR. No 2
MASTER INSTR No 1
No 2 S/N 217
No 1 S/N 216
INPUT H.O'S 319-G5H 320-G5H
OUTPUT H.O'S 318-G6H 320-G6H
No 2 S/I S/N D110
No 1 S/I S/N D111
No 2 SRV S/N 744R
TU T90C
No 1 SRV S/N 743R
TU T39D
SYSTEM No J-46
VEHICLE No 1653

FIGURE 1

SECTION 2

PRE-FLIGHT SYSTEMS TEST

A. SUMMARY

The J payload systems are subjected to extensive pre-flight testing and preparation by A/P, in order to demonstrate resolution of any system problems, and to provide confidence in system capability to reliably perform the flight mission. Standard tests include photographic resolution, thermal/altitude environment, vibration environment, light leak, and a test series for flight preparation. Additional tests are performed as required.

The J-46 system successfully passed all aspects of the testing operations, providing acceptable performance and adequate operational confidence.

B. ENVIRONMENTAL TESTING

Two altitude environmental tests were required, as the film from the first test was unacceptably marked by corona. However, J-46 was maintained as a back-up system until it was determined that the limited calendar life requirements of the camera system would be exceeded at the time of the proposed flight schedule. Consequently the system was returned to Boston for refurbishment.

The J-46 payload system was subjected to an environmental retest in the Sunnyvale HIVOS chamber from 15 April 1969 to 22 April 1969. Primary objectives were to verify proper system operation under the thermal-altitude environment, Corona marking susceptibility in the pressure sensitive ranges, and detect any anomalies that would detract from the system effectiveness after system refurbishment.

1. Pan Cameras

The material from both panoramic cameras was affected by very minor start-up corona on the first frames of a few operates. This occurred only at very low pressures and was considered to be acceptable. It was noted that no corona marking appeared on the film from the flight. The records from both instruments had weak and intermittent data presentation the cause of which was later traced to a remote sensing problem in one of the GSE power supplies.

All of the auxilliary optics formats exhibited light platen marks throughout the record material. Although minor, the platens were adjusted and the anomaly corrected. Heavier than normal rail scratches were present on the slave camera material. Removal of the emulsion build-up along the rails during a cleaning operation removed this problem. No other physical markings were noted on the processed material.

All camera dynamic functions on both main instruments exhibited normal operating characteristics.

All of the primary objectives were achieved except the system cycle rates were unacceptable. The cycle rates became progressively slower as the test progressed. Both instruments exhibited a 2% change in cycle rate from the start of the test to the end of the test. During some operations, both instruments indicated an error of approximately 2.5% slow of the calibrated values. These were adjusted properly prior to resolution testing.

2. Stellar/Index Cameras

The No. 1 and No. 2 Stellar/Index cameras operated normally throughout the test. The stellar records from the No. 1 S/I camera, D#110 exhibited medium start-up corona at sit frames. The corona was generally outside the useful format area. Minor corona markings occurred infrequently within the format area. The overall extent of the marking was minimal and acceptable.

The Stellar records from the No. 2 S/I, D#111, exhibited minor start-up corona. Continuous corona marks were present on approximately 55 frames at the end of the test. Although unacceptable, the markings were of a minor nature and it was concluded that comparable marking on the flight records would not significantly degrade its usefulness and a waiver was provided for this anomaly. All other data recordings on both stellar records were satisfactory.

3. Subsystem Performance

The clock system accuracy was checked with IRIG "C" time and the errors observed were acceptable.

The command system and the instrumentation system performed normally throughout the test.

The pressure make-up system performed satisfactorily throughout the test. A total of 1275 Δ PSI was expended during the test with an average gas consumption of 7.25 Δ PSI/min. in the -1 mission and 7.43 Δ PSI/min. in the -2 mission. A surplus of 175 PSI of gas pressure existed at the end of the test.

4. Thermal Performance

Mainplate thermal limits were established by standard procedure at 45°F to 100°F for orbital simulation. Master instrument No. 216 experienced temperatures from 60.9°F to 84.5°F. Slave instrument No. 217 experienced temperatures from 61.9°F to 86.7°F. No thermal problems were reported and the temperature sensor system performed normally.

C. RESOLUTION TESTING

The J-46 panoramic cameras were subjected to a resolution test on May 6, 1969 to revalidate the dynamic resolution after refurbishment. Evaluation of the type 3404 material used for this test indicated that both the resolution values and peak focal position were acceptable for each camera:

High-Contrast peak:	Master 168L/MM at -0.003 Slave 198L/MM at -0.003
Low-Contrast peak:	Master 125L/MM at -0.003 Slave 125L/MM at -0.003

The M/J1 collimator was still set for a 0.014 inch vacuum-focus shift compensation rather than the newer 0.016 inch standard. This properly corresponds to a minus 3 mil peak focal position instead of a 1 mil peak focal position established by the newer criteria.

D. DR. ASCHENBRENNER GRID TEST (AGT)

An AGT test was conducted on J-46 to evaluate the lift of the payload. This was done because the 200 cycle markers and pan geometry holes appeared soft and out-of-focus intermittently on Instrument No. 217. Evaluation of the test film indicated that Instrument No. 217 had excessive lift near the end of scan which location correlated with the out-of-focus 200 cycle markers. After shimming, payload analysis indicated that lift variation had been reduced to approximately 0.0005 inch. The time track imagery and pan geometry markers appeared sharp and distinct. The lift was concluded to be acceptable. No such problem was found on Instrument No. 216.

E. FLIGHT PREPARATIONS

1. Stellar/Index Camera Readiness

Film from the post-storage baseline test demonstrated acceptable performance. General appearance of the stellar material was good; fiducials were sharp and the grid intersections were clear. Faint metering sitmarks were noted in formats from both stellar units. A small minus density streak present on both units was corrected by a cleaning operation.

Material from the index units was also considered satisfactory.

The supply cassettes were loaded and the cameras installed in the J-46 flight structure. Sensitometric samples of the flight film indicated normal quality.

2. Panoramic Camera Readiness

Five tests were necessary to demonstrate readiness of the panoramic cameras. Minus density streaks caused by contamination on the filters caused minus density streaks on the processed film from both cameras. Both were thoroughly cleaned and the streaks eliminated. Slight plus density streaks were present within the format area of Instrument No. 217. They were caused by reflections from the Pan geometry lamps and since the density levels were minimal; it was concluded no significant degradation would result on the end product.

Scan rate variation was found on both cameras. This banding tendency had been noted throughout testing, and had been improved by adjustments to timing and balance of the units. This characteristic of the J-1 systems was considered minor on J-46 and would not constitute a detriment to flight film utilization. During inspection of test No. 4 material it was observed that the serial word index marker was marginal in density on Instrument No. 217. Since this could prevent use of the automatic time word readout equipment, the decision was made to increase the illumination of the index marker lamp. Readiness test No. 5 was conducted on 14 September and it was concluded the results were satisfactory.

Loading of the panoramic supply cassette was accomplished on the 15th of September.

3. System Confidence Operations

The system confidence operations at A/P were performed on 16 September. During the test the film pulled out of the rails on the master Instrument No. 216, thus invalidating the readiness test. Loss of take-up caused this anomaly and several tests were performed to revalidate the system. The recovery vehicles were demated and test collectors were installed. The instrument was run at near empty spool condition to full spool condition and the constant tension assembly was adjusted to provide uniform tension throughout the full range. The recovery vehicles were remated and the system performed satisfactorily.

After final assembly and test, the routine photometer light search indicated that the system had a minor residual light leak around the drums but was otherwise light tight. The system was deemed acceptable since this minor light leak would affect only the stow frame of each operate on the flight photography.

At the pre-flight audit meeting, held 15 September 1969, system data were reviewed by customer representatives and the system was found acceptable for flight.

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

Corona Mission 1052 was launched from VAFB, pad SLC-3 West at 14:11 PDT on September 1969. Ascent and injection into orbit were nominal. The flight was planned for 15 days and the -1 mission was terminated after 7 days by air catch on Rev. 115 on Sept. 29, 1969. The -2 mission ended in successful air catch after 8 days in Rev. 244 on 7 Oct. 1969.

The payload functioned normally throughout the mission, although photographic results were somewhat of lower quality than could be expected from a J-1 mission. Temperatures were within the predicted spread, vehicle functions were normal and payload functions were nominal with the exception of a V/H programmer anomaly. It failed to start on three revs during the flight. Both Stellar/Index cameras operated normally as well as the command system, clock system, pressure make-up system and the yaw function generator. The recovery systems functioned properly in both missions.

B. FLIGHT CONFIGURATION

The booster was a standard Douglas THORAD with three solid strap-on rockets for thrust augmentation. The LMSC AGENA satellite vehicle carried six 2000 lb. and one 3000 lb. drag make-up rockets for orbit adjustment. A 3/4 speed programmer for 325 subcycles was used. Payloads included [redacted] subsatellite [redacted] and the J-46 photographic system.

C. ORBITAL PARAMETERS

The actual orbit achieved was well within the predicted values. Orbital values are tabulated below:

	Predicted	Actual
Period (Min.)	88.65	88.56
Perigee (n.m.)	86.7	85.8
Apogee (n.m.)	143.5	138.4
Eccentricity	.0081	.0076
Inclination (Deg.)	85.01	85.04
Argument of Perigee (Deg.)	143	148

The 3000 pound rocket was used initially to assist the launch vehicle in achieving a nominal orbit. This was done as part of the launch plan in order to allow for additional on-orbit weight. Six 2000 lb-sec DMU rockets were fired during the flight for period/ground track control. The error was kept within the limits of 20 to 40 n.m. east of nominal ground track.

The following is a summary of the DMU firings.

Rocket No.	Rev.	Periods Seconds	Velocity Change ft/sec	Impulse lb/sec
1	2	15.0	*	*
2	14	9.93	15.96	2002
3	56	9.48	15.23	1913
4	94	9.65	15.54	1945
5	133	11.35	18.14	2028
6	172	11.25	18.02	2030
7	221	11.20	17.96	2015

* not available

D. PAYLOAD OPERATIONS

1) Panoramic Camera Performance

Both panoramic cameras indicated normal operation throughout the flight. Camera system dynamics, 99/101 clutch, start-up, shutdown, and film transport functions were normal on the observed engineering operations over the [redacted] and [redacted] tracking stations.

The cycle rates obtained from the engineering operations indicated the panoramic cameras were running approximately 1-2% slow from the calibrated value.

Film analysis indicated the slave camera material pulled out of the rails during the start of the last camera operate in the -2 mission. This condition is similar to the one experienced during pre-flight testing. This anomaly is believed to be caused by the low tension on the supply spool prior to film depletion, resulting in a slack loop in the payload path, causing the film to pull out of the rails.

Both panoramic cameras were depleted of film prior to the engineering operation on Rev. 242 over the [redacted] tracking station.

The slave camera center of format, lens rotation, and 99/101 clutch telemetry monitors indicated the slave camera drive system slipped a drive belt, resulting in mistiming of the instrument prior to the engineering operation on Rev. 242. The tag end of the material appeared to wrap on the input metering roller, causing the shift in the drive system timing.

This condition has been observed on other payload systems and is considered to be a system characteristic.

2) Stellar/Index Camera Performance

The -1 and -2 stellar/index cameras functioned normally throughout the flight. Telemetry data indicated the programmer and metering functions performed satisfactorily on the observed engineering passes. The index camera film supply was not exhausted because the normal film supply is in excess of the normal programming requirements.

3) Instrumentation and Command System Performance

The payload command system performed satisfactorily throughout the flight. The Uncle command link was utilized as the primary system with no reported anomalies.

The payload instrumentation system operation was normal except for the intermittent failure of the V/H programmer and the slave cycle counter.

The units digit of the slave cycle counter failed to advance properly during the flight. The counter failed to advance for 3 counts in the -1 mission and 195 counts in the -2 mission. Failure of the V/H programmer is discussed in the following section.

4) Forward Motion Control (FMC) Match

The FMC match maintained during the flight was satisfactory. However, three anomalies occurred when the programmer stopped on Revs 21 and 38 after running for only 300 seconds. The only excessively large mismatch occurred on Rev 21 where the V/H programmer failed to start. However, on Rev 38 the error was minimized by commanding to a flat ramp which provided the fastest cycle rate.

The following is a summary of the operations affected by the V/H programmer failure mode.

Rev.	Prog.	Op.	Ramp R	Ramp A	Percent Mismatch	Remarks
21	6	1	4	2	-44.9	Programmer failure w/ nom. ramp settings
38	8	2	1	11	+1.0	Programmer failure at 300 sec. up-ramp w/ fastest flat ramp
38	8	6	1	11	-6.0	
69	2	1	1	11	-1.7	No failure mode. Flat ramp used as a precaution against this possibility
85	4	1	1	11	-2.0	
166	3	3	1	11	-6.5	

These failures of the V/H programmer are attributed to the intermittent opening of a switch in the programmer motor operate circuit.

The actual V/H ratio error for each camera for each mission is shown in Figures 3-1 through 3-4. It can be observed from these plots that good FMC match was achieved. Consequently image smear was held to a minimum as discussed in Section 6.

5) Clock System Performance

The clock system operation was normal throughout the flight. Satisfactory time correlation between the flight clock and the [redacted] and [redacted] tracking stations was obtained and is included in Tables II and III. The following equations define the system time and clock time.

First order fit:

$$\text{System time} = A_0 + A_1 \text{ (clock time)}$$

A_0 = -0.2048685408D 05 A_1 = 0.100000001076D 01

Sigma = 0.01169 No. of points = 32

Second order fit:

$$\text{System time} - A_0 + A_1 \text{ (clock time)}^2$$

A_0 = -0.2048688435D 05 A_1 = 0.100000013044D 01

A_2 = -0.8277501356197D-13

Sigma = 0.00295   No. of points = 32

6) <u>Thermal Environment</u>

The thermal evnironment achieved with this system was near the pre-flight predictions. The actual system temperatures were 70° F and 69° F for the master and slave cameras respectively for the beginning of the -1 mission and 68° F and 70° F at the end of the -1 mission. The -2 mission system temperatures were 65° F and 66° F for the start and 58° F and 60° F for the end of the -2 mission for the master and slave cameras respectively. A graph depicting average camera temperatures versus predicted temperatures is included in Figures 3-5 and 3-6.

FRAMES 1-6 OF EACH OMITTED NO PERCENT = 3.73

V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)

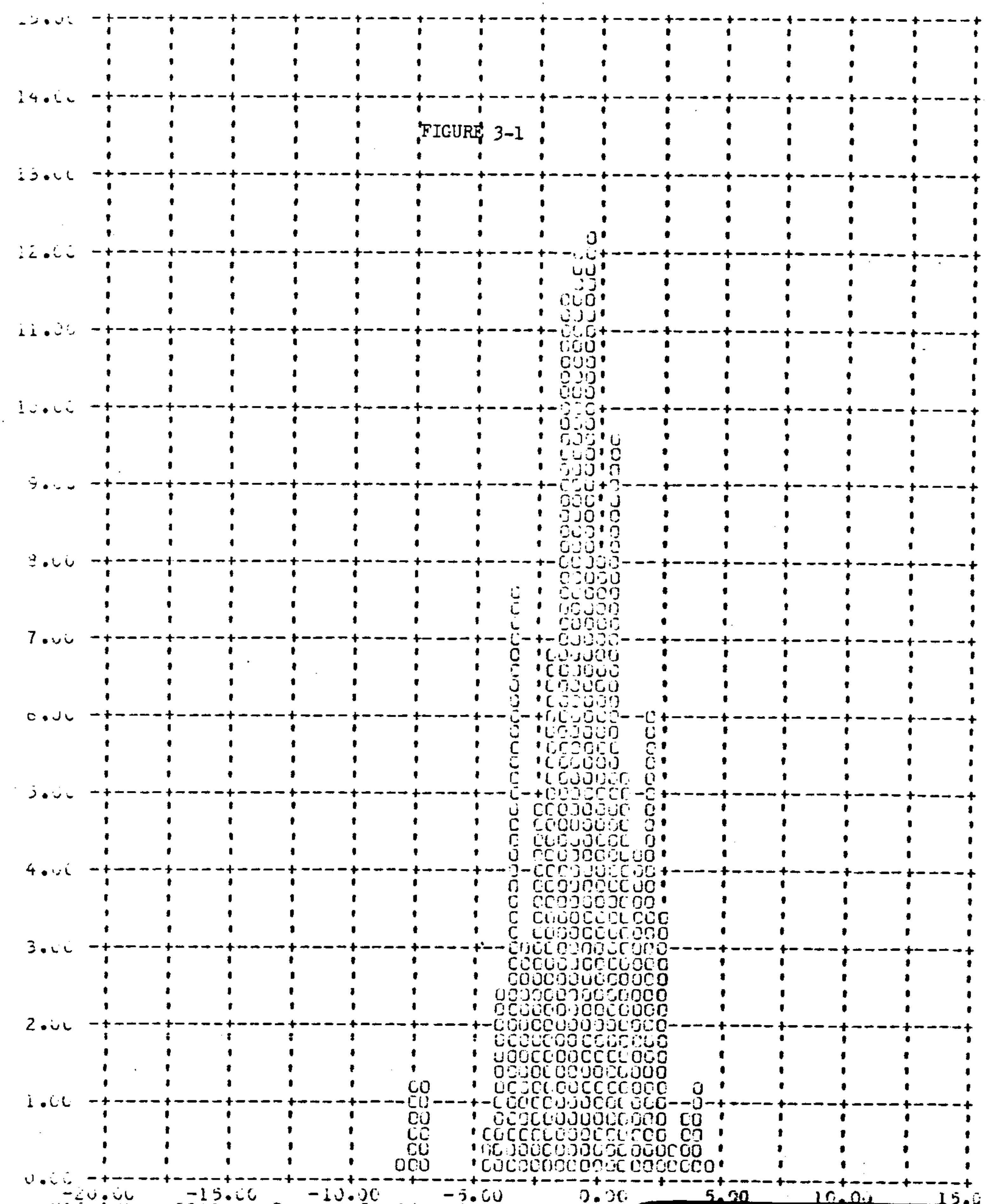


FIGURE 3-1

FRAMES 1-6 OF EACH OP OMITTED OC PERCENT = 5.4

V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)

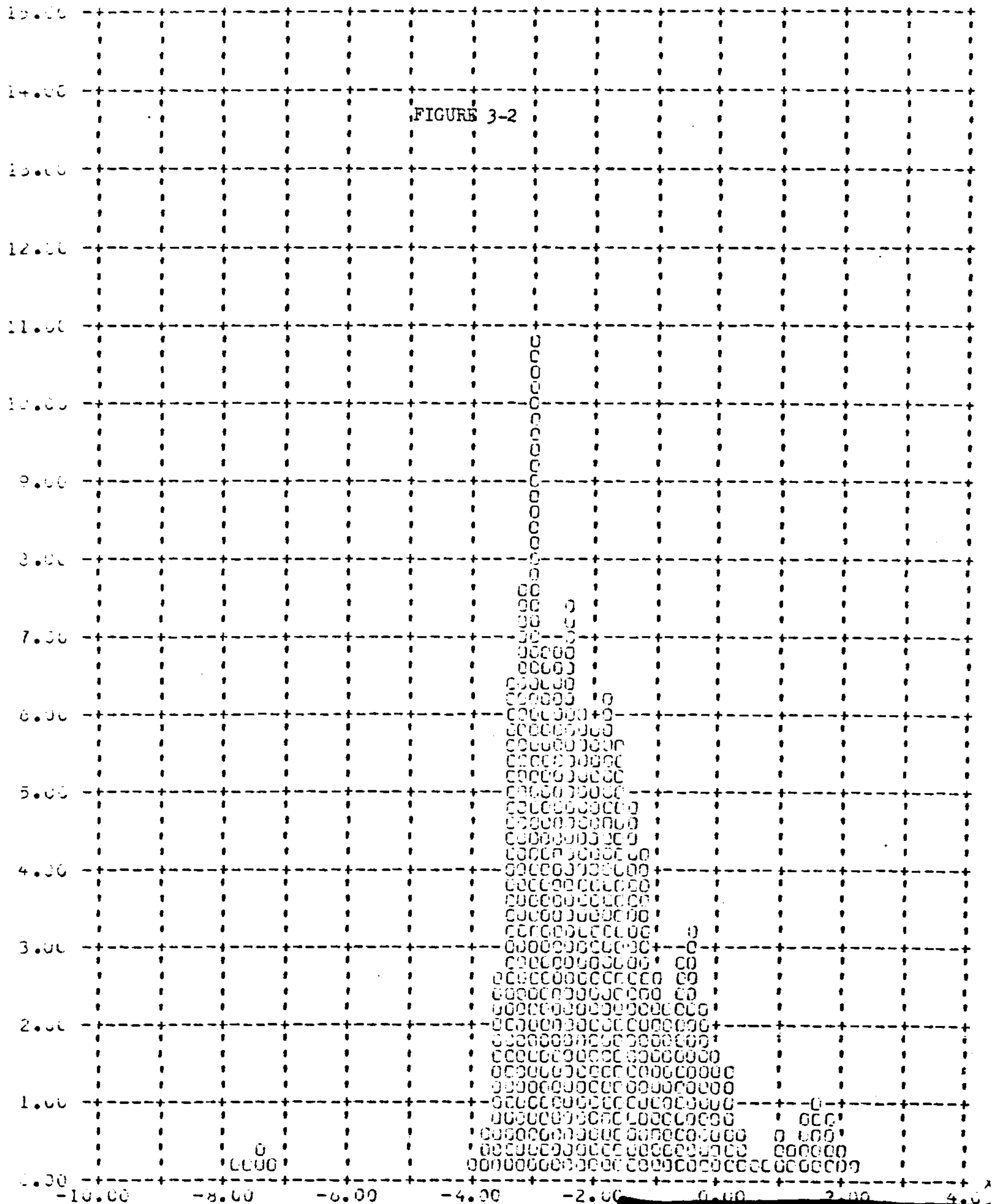
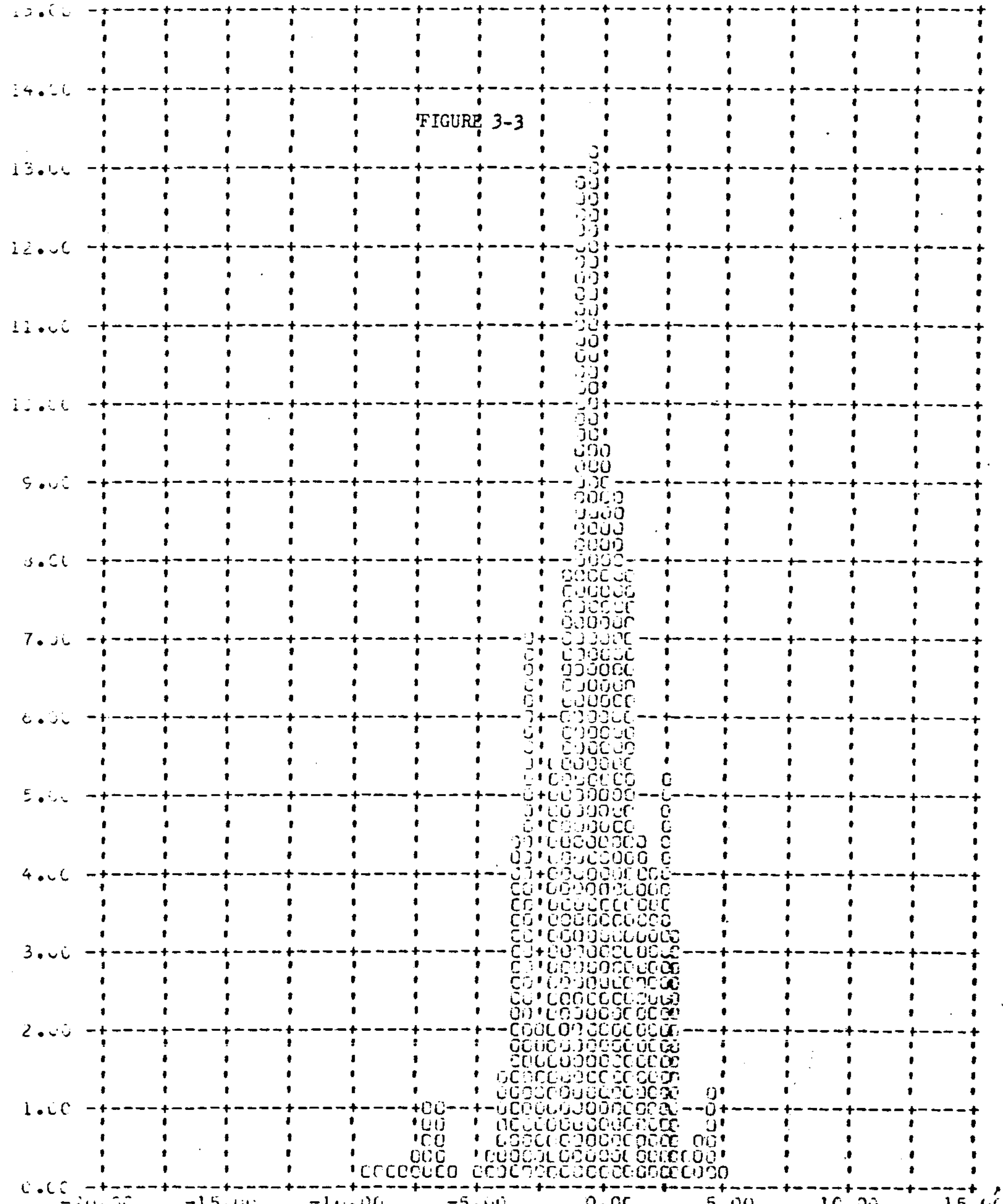


FIGURE 3-2

FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 3.51

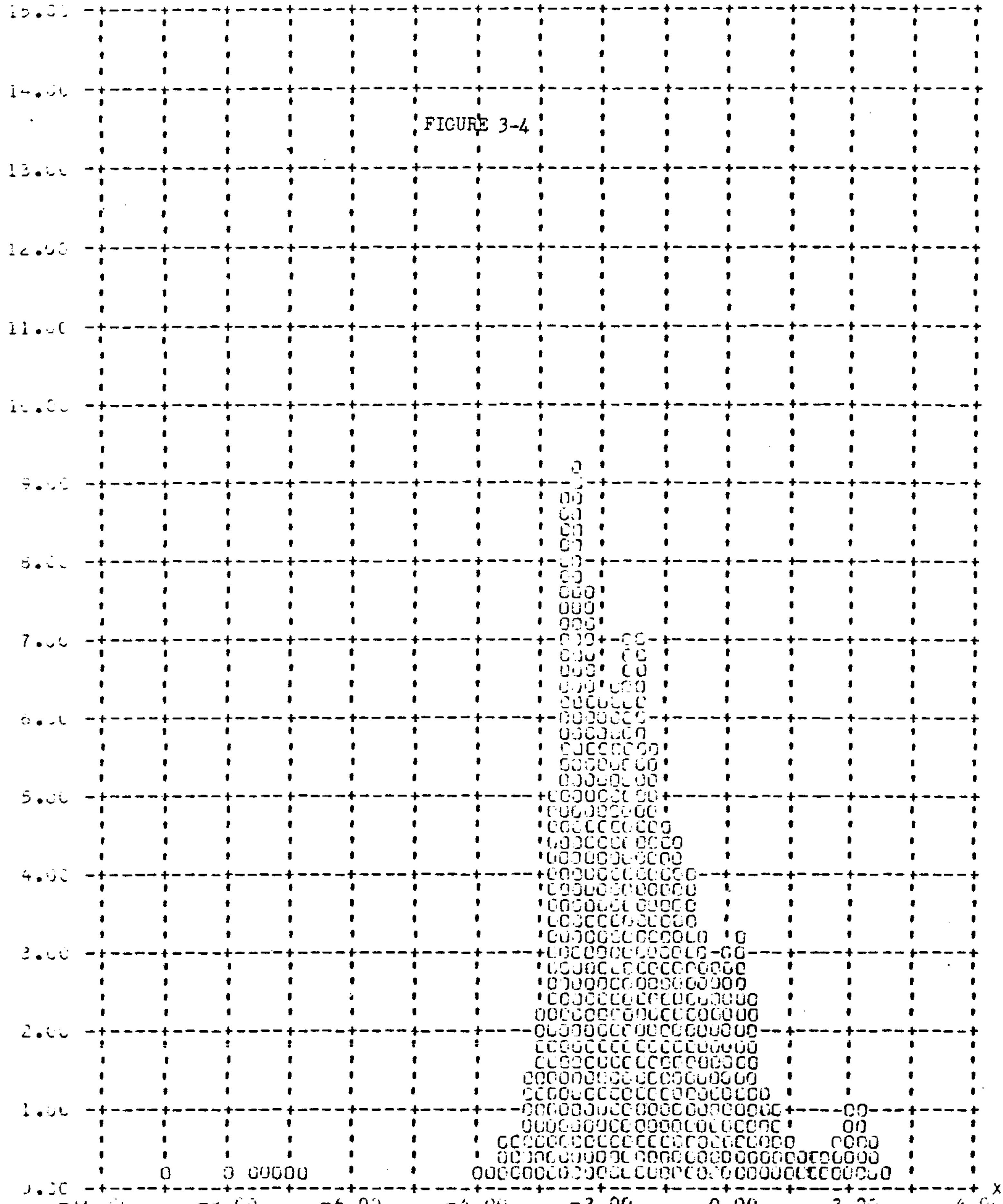
Y V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)



FRAMES 1-6 OF EACH OP OMITTED   90 PERCENT = 2.00

Y   V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 3-4



 [redacted]

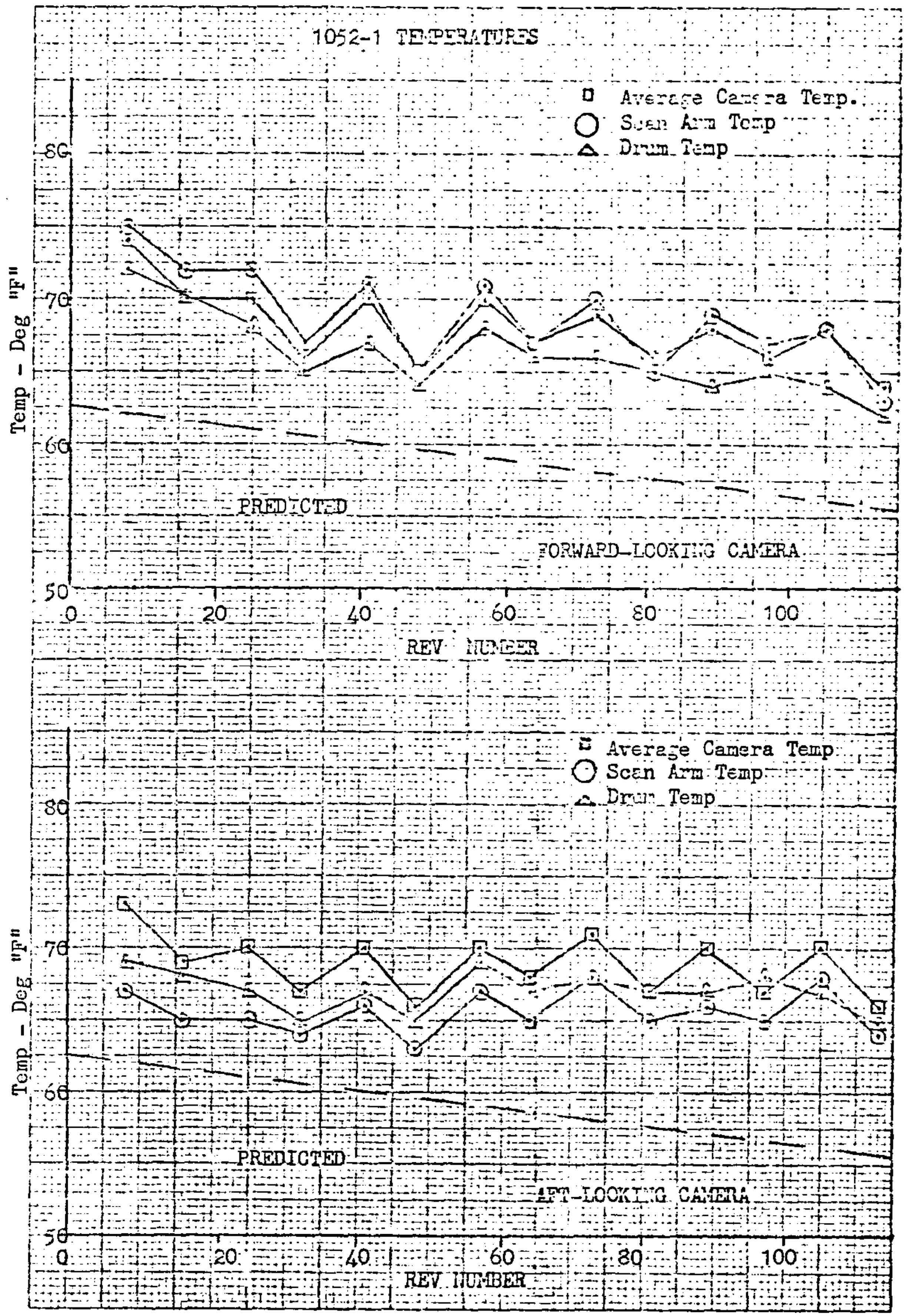

1052-1 TEMPERATURES
Average Camera Temp.
Scan Arm Temp
Drum Temp
80
70
60
50
Temp - Deg "F"
PREDICTED
FORWARD-LOOKING CAMERA
0
20
40
60
80
100
REV NUMBER
Average Camera Temp
Scan Arm Temp
Drum Temp
80
70
60
50
Temp - Deg "F"
PREDICTED
AFT-LOOKING CAMERA
0
20
40
60
80
100
REV NUMBER

FIGURE 3-5

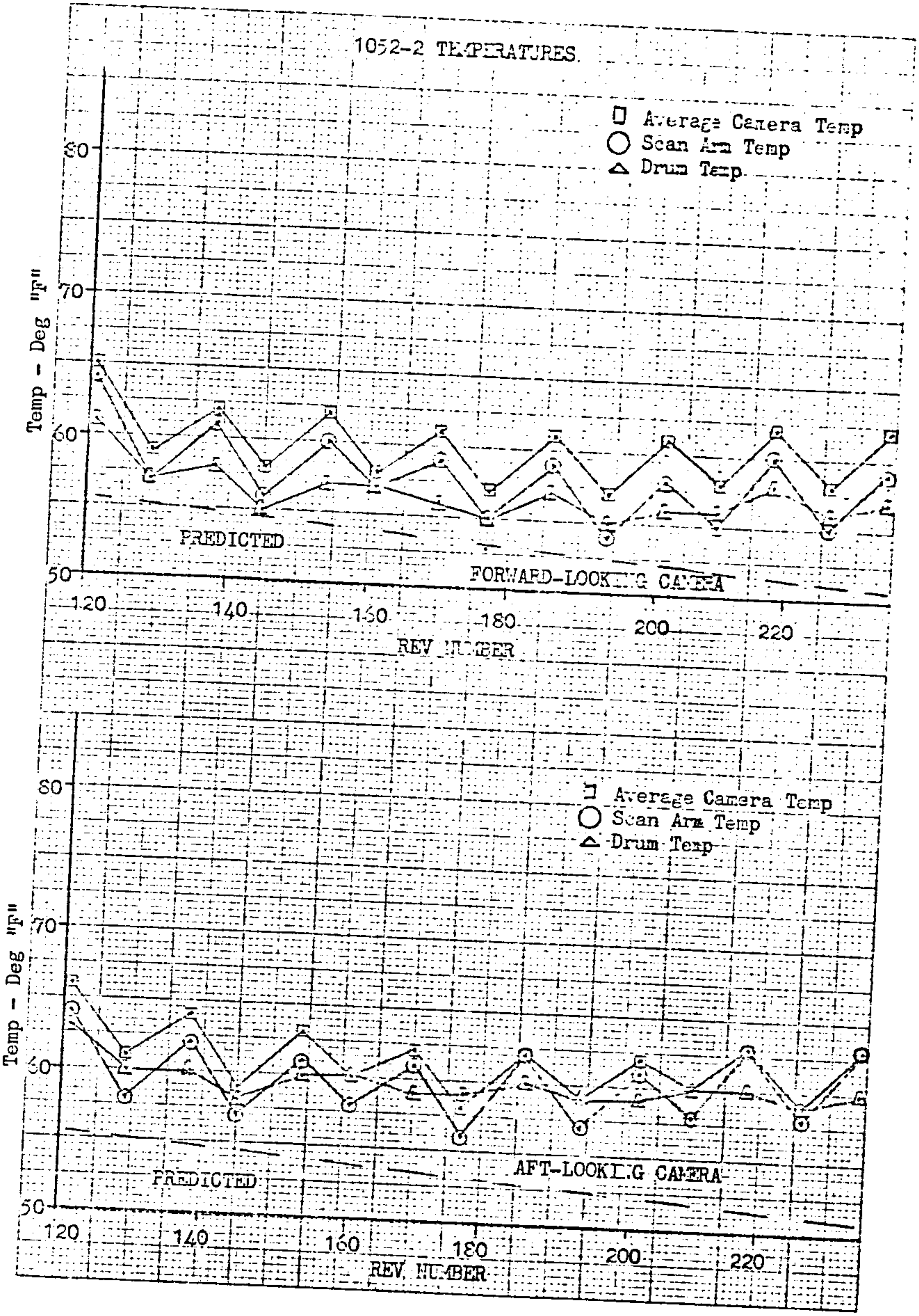

1052-2 TEMPERATURES
Average Camera Temp
Scan Arm Temp
Drum Temp
Temp - Deg "F"
80
70
60
50
PREDICTED
FORWARD-LOOKING CAMERA
120
140
160
180
200
220
REV NUMBER
Average Camera Temp
Scan Arm Temp
Drum Temp
Temp - Deg "F"
80
70
60
50
PREDICTED
AFT-LOOKING CAMERA
120
140
160
180
200
220
REV NUMBER

FIGURE 3-6

7) Pressure Make-Up System Performance

The pressure make-up system operated satisfactorily throughout the flight. The total operate time was 229 minutes with 126 camera operates.

The PMU flow rate was 7.5 Δ PSI/min. of camera operating time and was acceptable. Gas pressure of 400 PSI remained at the end of the -2 mission.

8) Post Event 2 Flight Testing

All experiments performed during this period were successful. The test sequence was as follows:

Pass	Experiment/Results
251	KIK UNCLE 32 (verified).
251	KIK UNCLE 31 in U1 mode.
252	L/B experiment execute successful.
256	UNCLE 135 for a gas transfer of 600 sec.(terminated by L/B timer runout) successful.
262	KIK ZORRO 36 was issued 4 times to check command disable circuitry.
271	UNCLE 135 followed by UNCLE 136 for an 88 sec. gas transfer.
291	KIK UNCLE 33 to enable L/B exercise No. 2.
292	L/B experiment executed successfully.
293-294	No acquisition.
295	Last stable pass.

The battery voltage dropped below 22 volts (21.41) during pass 292 with an amp hour reading of 2895 (minimum capacity was 2730 A/H), an average of 482 A/H per battery. The vehicle was last tracked on pass 295 [redacted]ith a bus voltage of 19 V. Re-entry occurred at approximately 1745 PDT on October 12, 1969 in the vicinity of 17° south latitude and 52° west longitude on pass 320.

9) Radiation Dosage

Each recovery system on Mission 1052 carried a sealed packet of types SO-102 and Royal-X Panchromatic film to determine the total radiation received at the take-up cassette. Both film types had been irradiated by LMSC at various levels and the base plus fog densities plotted after controlled processing. Following recovery, the film dosimeter packets were removed at A/P and hand processed with a pre-flight sample of the same film type and a sensitometric control film. The resulting base plus fog density measurement of the dosimeter strips was used to ascertain the total radiation level. The table below presents the base plus fog readings for the dosimeter strips and the radiation level equivalents. It is observed that these levels are well below those that could degrade the photography.

	Mission 1052-1		Mission 1052-2	
Emulsion	B+F Density	Radiation	B+F Density	Radiation
SO-102	0.11	0.11R	0.14	0.4R
Royal-X Pan	0.22	0.36R	0.27	0.52R

SECTION 4

PHOTOGRAPHIC PERFORMANCE

A. SUMMARY

A Mission Information Potential (MIP) of 85 was assigned to both segments of Mission 1052. The image quality ranged from fair to poor, and in general, the imagery was not comparable to that achieved by the better J-1 systems. The photography from the panoramic cameras was of inconsistent quality throughout both mission segments. The best image quality came from the forward looking camera. However, the image quality variability of the forward looking camera was greater than the variability observed in the quality of the aft looking camera records. Out-of-focus areas are detectable at various locations within the forward camera formats intermittently throughout both missions. Both cameras had more random image smear at the take-up side of the format than other J-1 systems. Photo-interpreters rated the utility of the photography from poor to fair for the first mission segment and somewhat less for the second segment due to adverse weather conditions.

B. PANORAMIC CAMERAS

1) Image Quality

Both Panoramic cameras were operational throughout both missions. The last titled frame of camera #216 was frame #36 of Rev D236 and the last titled frame of camera #217 was frame 120 of Rev 235.

The best imagery obtained on Mission 1052 was not considered equivalent to that produced by the better J-1 missions as evidenced by an MIP of 85 assigned to both segments. However, most of the material was considered to be useful by the photo-interpreters. The best image quality came from the forward looking camera. However, there was considerable variability in image quality of the forward looking camera. The aft looking camera records had less image quality variability than the forward looking camera. Out-of-focus-areas were observed at various locations within the forward looking camera format intermittently throughout both missions. Both cameras produced records having more random image smear at the tape-up side of the format than has been observed in recent J-1 missions.

As discussed in Section III, the failure of the Forward Motion Control (FMC) generator produced a large mismatch on Rev 21 only. The random smear experienced on this mission was not correlatable with FMC mismatch.

2) Quality Measurements

Microdensitometer edge trace measurements produced by AFSPPF were used to establish an objective basis for quality evaluation. The Aerial Image Modulation (AIM) curve for the appropriate (3404) film type at 2:1 contrast and the resultant Modulation Transfer Function for each edge traced were plotted to determine the point of intersection. The resultant MTF/AIM value is obtained from this intersection:

	1052-1	1052-2	msm. average	
	cy/mm	cy/mm	cy/mm	ground resol.
Fwd. looking	53	59	56	18 ft.
Aft looking	54	54	54	19 ft.

It was concluded that the major contributing factors to the low values achieved by J-46 instrument system is the inconsistent image quality and deteriorating weather conditions.

Since this is the last J-1 system, a comparison of resolution values for the last four systems is presented below:

System	Fwd. Camera cy/mm	Aft Camera cy/mm	Msn Average cy/mm	ground resol.
J-49	102	96	99	11.3 Ft.
J-50	64	65	64.5	16.+
J-44	58	62	60	19.3
J-46	56	54	55	19.6

It can be observed that J-46 has somewhat lower resolution values than the 3 previous J-1 systems flown.

3) Data Recording

The auxiliary data recording was generally satisfactory during both mission segments. The clock readout was operational and imaged properly. Most rail holes were sharp and well defined although approximately 25% became obscured due to emulsion buildup as the mission progressed. The frequency markers were operational and imaged properly. However, they were missing at the take up end of the first frame on some camera operations.

4) Anomalies

Anomalies noted on the panoramic records were generally characteristic of previous J-1 systems. The forward looking camera records were marred by a minor spur like fog pattern, extending from the titled edge into the format on the fifth frame of most passes. The aft camera records were marked by a minor rectangular shaped fog pattern on the last frame of some passes in the -1 mission and on the fourth frame from the end of most passes during the -2 mission. Minor traces of dendritic edge static were present along the data block edge of pass D85 on the aft looking instrument. Both camera records were otherwise free of static fog marks.

Minor transverse banding was present at the take-up end of most frames throughout the mission. This effect was observed and minimized during test operations but remained as a J-1 system characteristic.

In addition to the above, the following anomalies were observed on the panoramic camera records.

1) Two parallel plus density streaks were present on the aft looking records throughout the second mission segment. This marking occurred randomly and was frequently almost invisible. The take-up puck arm appears to have produced this affect.

2) A film tear was detected on the aft camera original records at the center of frame 43 of pass 56. After inspection and analysis, it appeared that it could have occurred during the de-spooling operation.

3) Aft camera frames 32 through 35 of pass D25 were fogged during defilming and severely degraded by a bright flash emanating from the SRV. A possible cause of the flash was the ignition of magnesium dust created by the scraping of an electrical connector along a spool edge. An attempt was made to duplicate this flash in a laboratory test at [redacted] It was verified that a magnesium dust cloud was generated but no subsequent flash resulted. Procedures during defilming have been instituted to prevent scraping the spool flanges.

4) A four inch long crease was present on the forward looking camera records between frames 81 and 82 of pass D136. The cause and source remain unidentified.

5) Both camera records have four diagonal marks intermittently across the formats approximately every 37 to 39 inches. They were very slight when visible and created a very minor degrading effect. No action was recommended.

6) The film from the forward looking camera came out of the rails beginning at frame 1 of pass 236. This was characteristic of J-1 systems when film transients occurred. This type of failure is not applicable to the 1100 series systems. The failure was experienced during test and the Supply cassette ramp-down circuit was adjusted with satisfactory results. However, when the anomaly occurred at the end of the mission; the film supply was even lower than had been duplicated during test and the ensuing film transients pulled the film from the camera rails.

C. HORIZON CAMERAS

Excellent performance was achieved by the horizon cameras. All were operational throughout both missions and produced well defined Horizon arcs. One random failure occurred on both forward looking Horizon cameras. They failed to operate on frames 135 and 137 of pass D072.

D. STELLAR-INDEX CAMERAS

Both Stellar-Index cameras were operational throughout both missions. Each frame of the Stellar cameras contained approximately 25 stellar images. The image quality was generally good and contrast ranged from thin to medium. No light leaks were present and only minor emulsion cracks were present on the second mission records. However, during the second mission an intermittently hung shutter caused 25 frames to be over exposed, creating minor fogging of adjacent frames. Although stellar images are difficult to detect on fogged formats, the overall product on these frames was suitable for attitude reduction. The image quality of the Terrain material was satisfactory on both missions. No physical defects were noted.

SECTION 5

PANORAMIC EXPOSURE AND DENSITY ANALYSIS

Exposure Control on the panoramic camera system is primarily a function of the slit widths and scan rate required to accommodate selected orbit parameters. The computer analysis employed to determine the optimum settings of these variables factors in the desired orbital criteria, filter attenuation and earth illumination profile. In addition, analysis of the computer program output provides detailed information for selecting the best launch window to optimize photographic coverage of northern latitudes.

A 0.225 inch slit and a Wratten 23A filter were selected for the forward looking camera. A 0.170 inch slit and a Wratten 21 filter were selected for the aft looking camera.

Solar elevations encountered during photographic operations were normal for a Sept. - Oct. mission. Solar elevations during photography ranged from 16° to 65° for the -1 mission and 13° to 69° for the -2 mission. Solar direction, relative to the system flight orientation, was maintained on the starboard side of the ground track. The exposures experienced on this flight are represented on the following graphs, Figures 5-1 through 5-6. The nominal exposure required is also included on the plots. In addition the frequency of operations is included and it can be observed that the majority of the photography was accomplished where the actual exposure achieved was in close approximation to the nominal exposure requirements. The following table represents the mean deviation (in stops) from the nominal requirements as encountered in the prime target area from 60° North to 20° North.

Exposure Deviations from Nominal
(in stops)

	Rev 40		Rev 120		Rev 200	
	Fwd.	Aft	Fwd.	Aft	Fwd.	Aft
60° North	-0.3	-0.7	-0.5	-0.8	-0.54	-0.4
40° North	+0.2	+0.2	0	0	+0.1	-0.3
20° North	+0.6	+0.6	+0.4	+0.5	+0.6	+0.2

The adequacy of the exposure performance for the J-46 flight system was based on analyses of the AFSPPF macrodensity data summarized below. The established criteria used to determine proper exposure is that minimum scene density should range between 0.4 and 0.9. If minimum scene density exceeds 0.9 it is over-exposed, and if minimum scene density is less than 0.4 it is under-exposed.

AFSPPF Macrodensity Measurements
(in % of total frames)

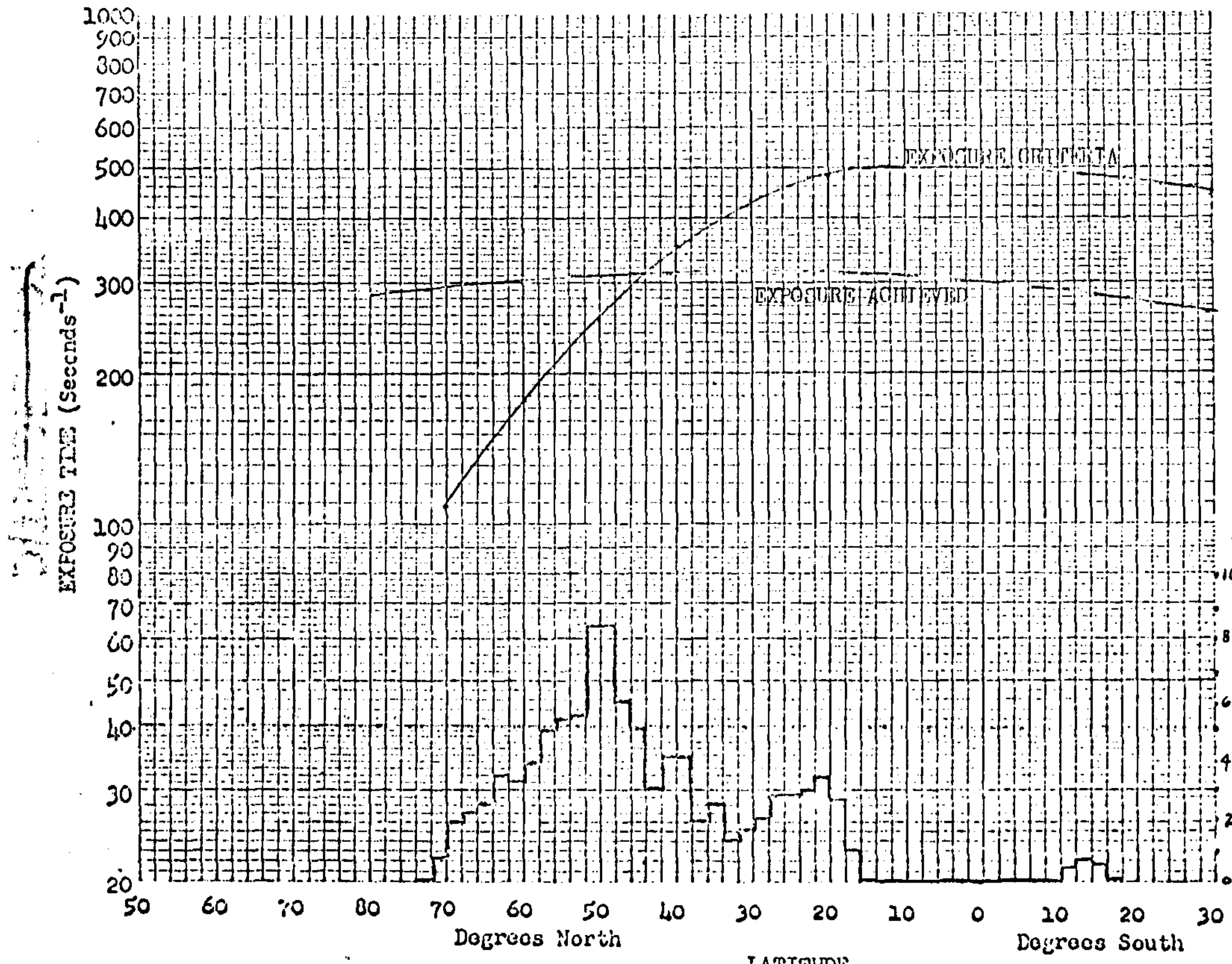
		1052-1		1052-2	
		Fwd	Aft	Fwd	Aft
Correct Exposure	(0.4 to 0.9 D_{MIN})	55.19	68.13	67.79	61.60
Over-exposed	($>$ 0.9 D_{MIN})	7.05	9.89	15.36	10.80
Under-exposed	($<$ 0.4 D_{MIN})	37.76	21.98	16.10	27.23

The scene area measured is selected subjectively, and does not necessarily represent the absolute minimum image density; the measurements are randomly made of relatively gross natural and cultural areas. But as the photograph is utilized by the photointerpreter, the information content is largely based upon density variations at or near the resolution threshold of cultural targets only. Therefore, the 0.4 to 0.9 criterion is not considered a completely adequate indicator of optimum target exposure.

Maximum intelligence is generally derived from specific cultural minimum densities ranging between 0.4 and 0.9. This will usually result in minimum gross scene densities below 0.4, as the reflectance value range for natural areas tends to be lower than that for cultural areas. It becomes apparent that missions with the more desirable information will probably be reported as tending towards underexposure, using these evaluation techniques.

The macrodensity measurements supplied by AFSPPF are processed by computer at Lockheed and result in the density plots shown in Figures 5-7 through 5-18. These plots show representative terrain and cloud cover densities experienced by each camera for both missions.

EXPOSURE POINTS



Mission No: 1052

Payload No. J-46

Camera No: 216

Pass No: 40

Launch Date: 09-22-69

Launch Time: 21-11-02 GMT

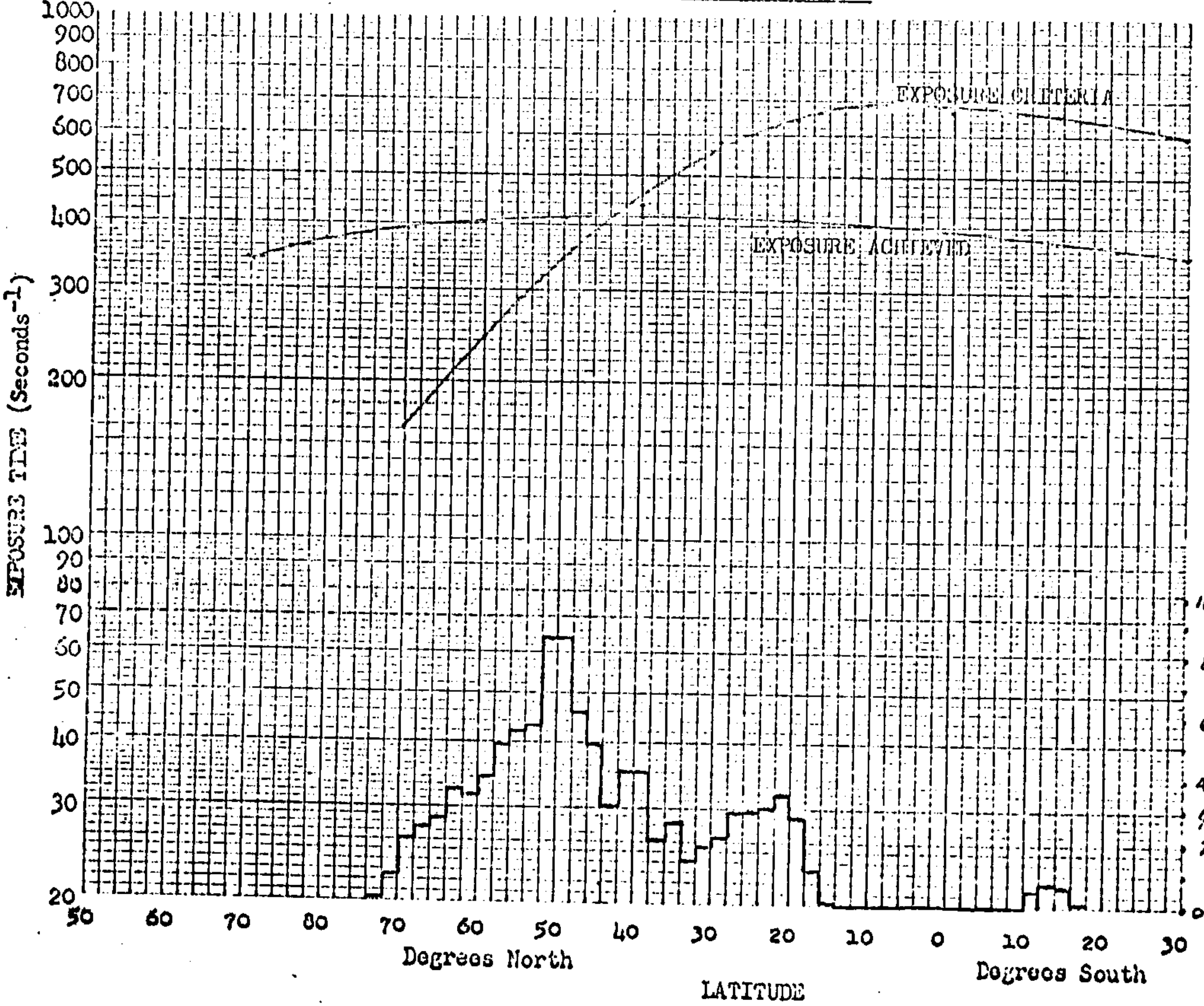
Slit Width: 0.225"

Filter Type: W23-A

Film Type: 3404

FIGURE 5-1

EXPOSURE POINTS



Mission No: 1052

Payload No: J-46

Camera No: 217

Pass No: 40

Launch Date: 09-22-69

Launch Time: 21-11-02 GMT

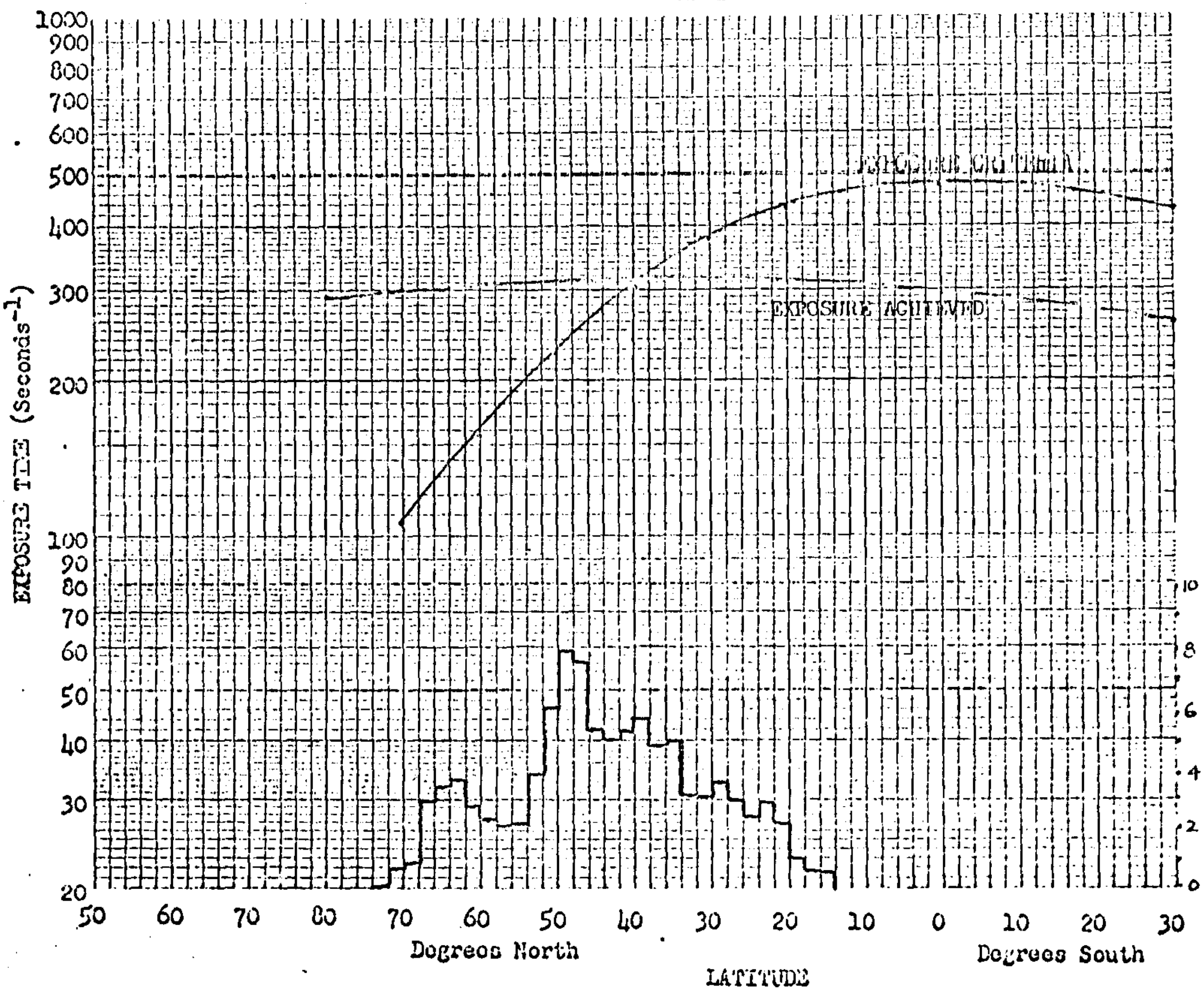
Slit Width: 0.170

Filter Type: W-21

Film Type: 3404

FIGURE 5-2

EXPOSURE POINTS



Mission No: 1052

Payload No: J-46

Camera No: 216

Pass No: 120

Launch Date: 09-22-69

Launch Time: 21-11-02 GMT

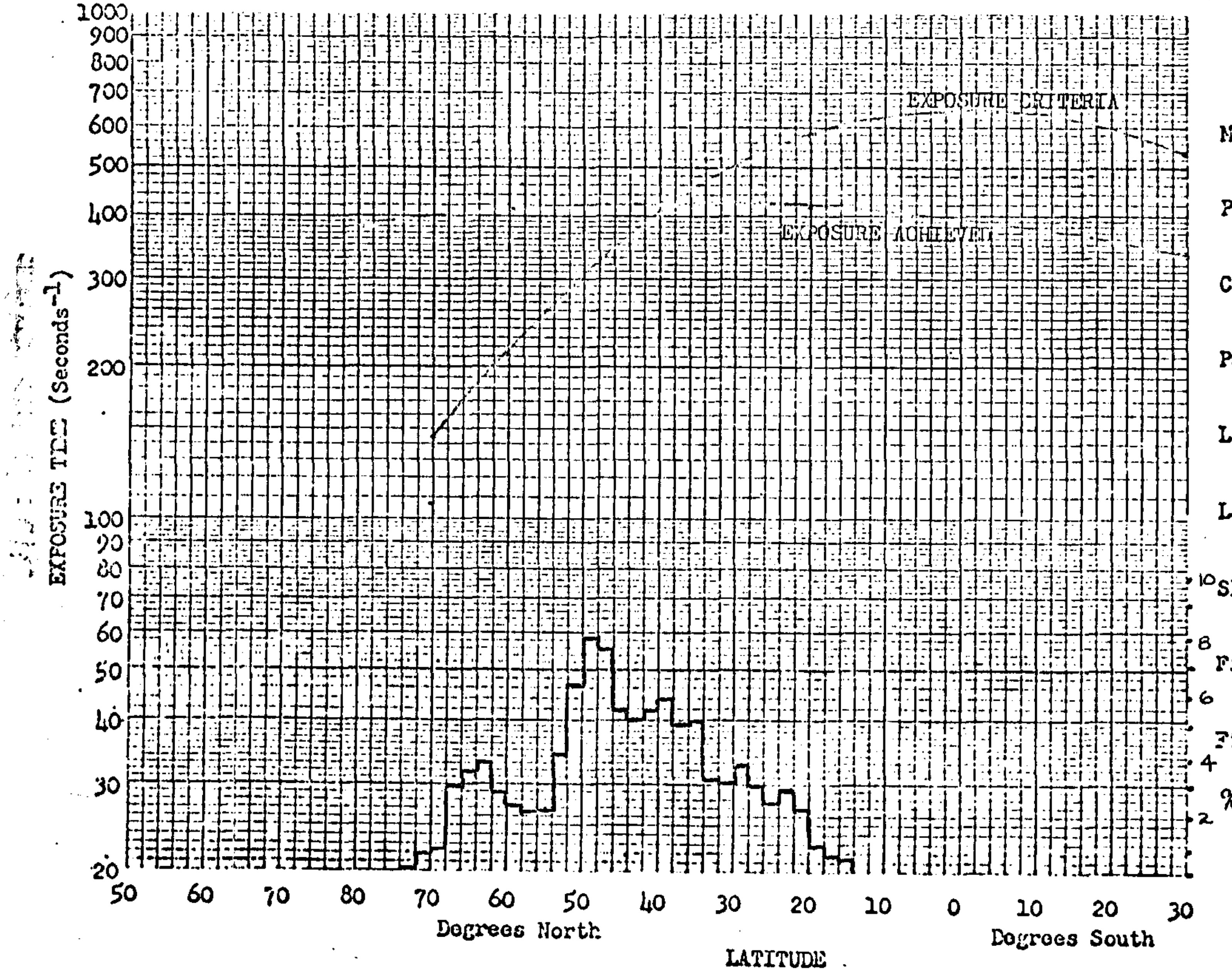
Slit Width: 0.225

Filter Type: W23-A

Film Type: 3404

FIGURE 5-3

EXPOSURE POINTS



Mission No: 1052

Payload No: J-46

Camera No: 217

Pass No: 120

Launch Date: 09-22-69

Launch Time: 21-11-02 GMT

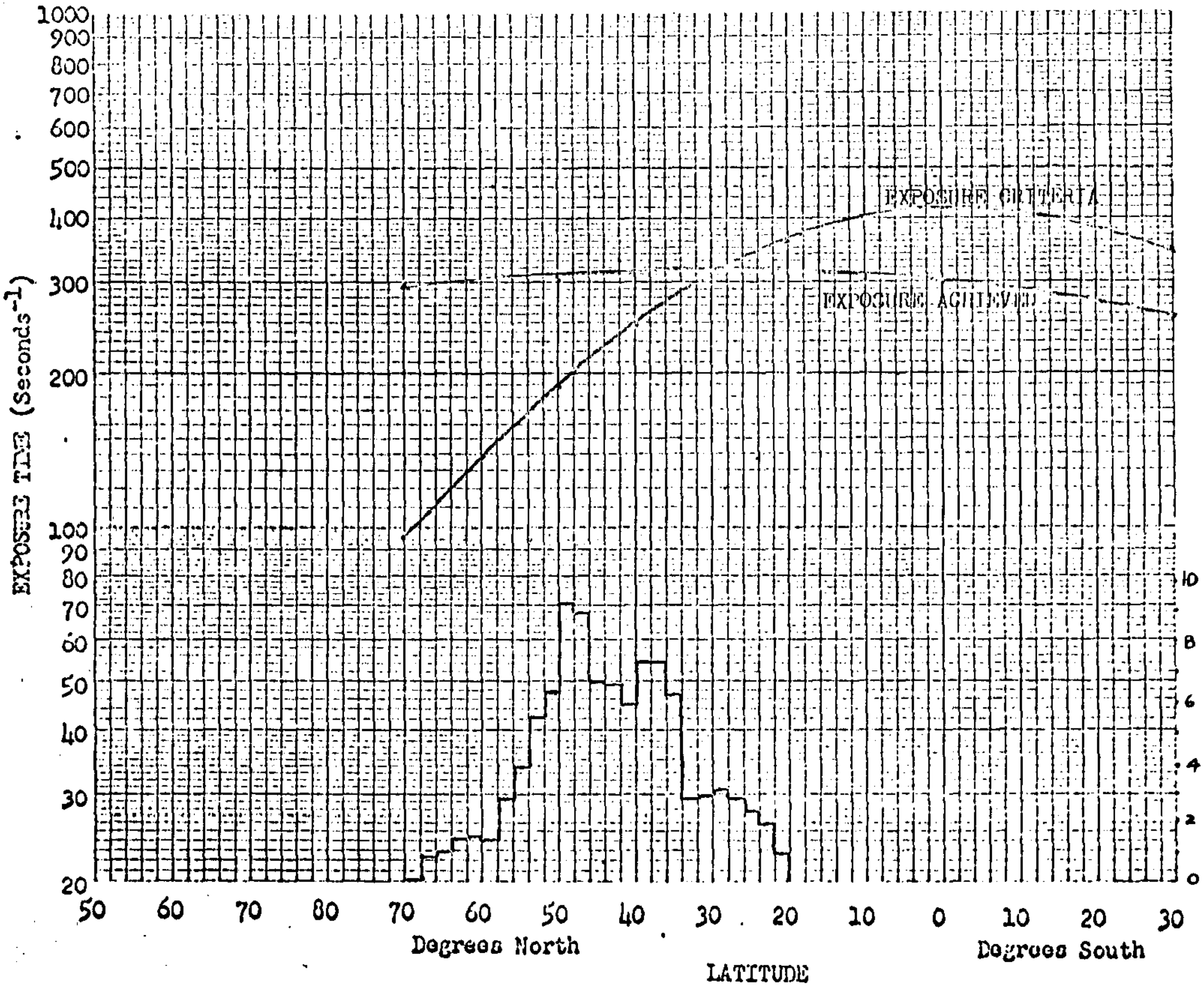
Slit Width: 0.170

Filter Type: W21

Film Type: 3404

FIGURE 5-4

EXPOSURE POINTS



Mission No: 1052

Payload No: J-46

Camera No: 216

Pass No: 200

Launch Date: 09-22-69

Launch Time: 21-11-02 GMT

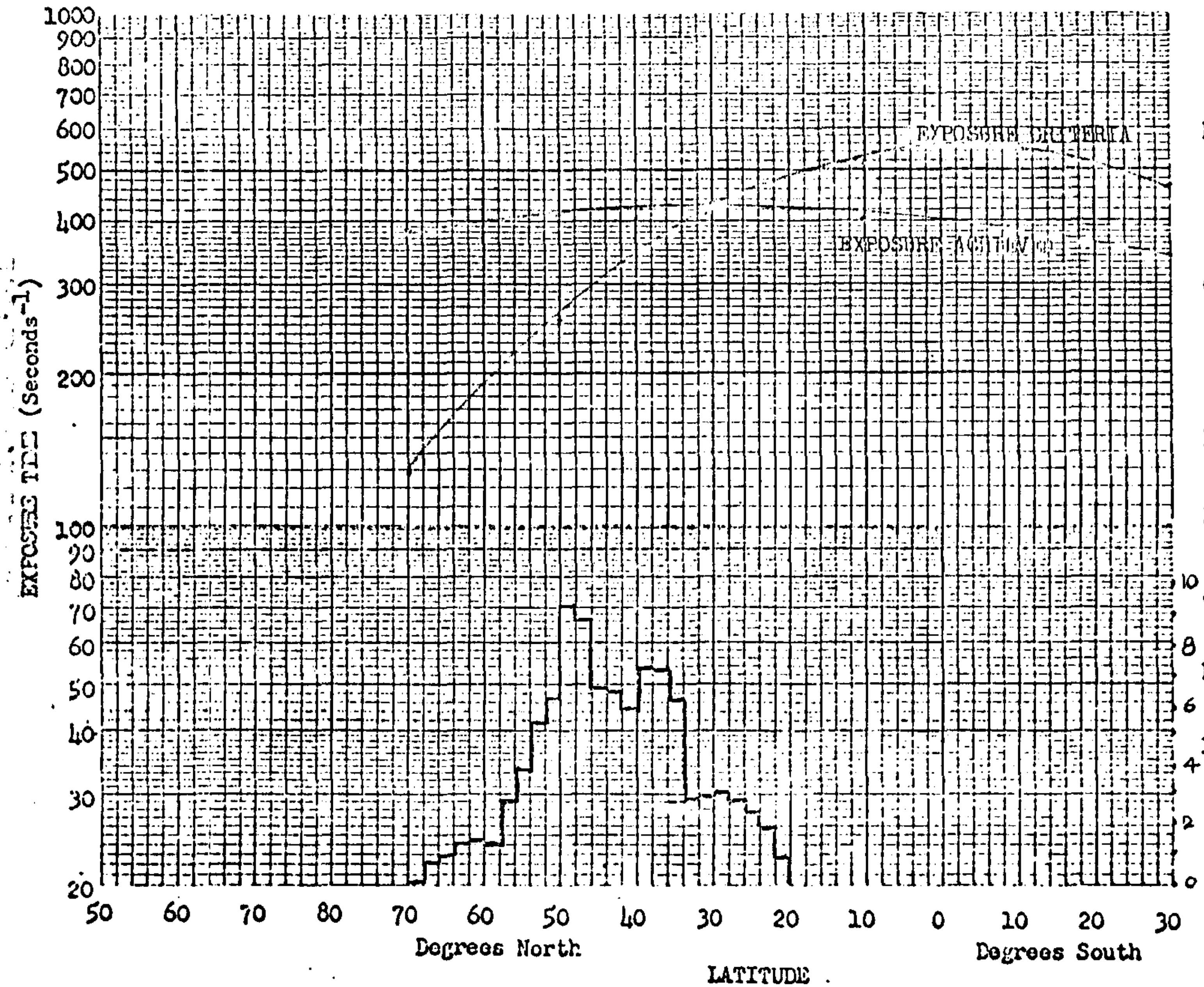
Slit Width: 0.225

Filter Type: W23-A

Film Type: 3404

FIGURE 5-5

EXPOSURE POINTS



Mission No: 1052

Payload No: J-46

Camera No: 217

Pass No: 200

Launch Date: 09-22-69

Launch Time: 21-11-02 GMT

Slit Width: 0.170

Filter Type: W21

Film Type: 3404

FIGURE 5-6

~~VIA [redacted] CONTROL SYSTEM ONLY~~

MISSION * 1052-1 * INSTR * ... * 5/22/... PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.15 * MEDIAN * 1.14 * STD DEV * 0.31 * RANGE * 0.54 TO 1.85 WITH 241 SAMPLES

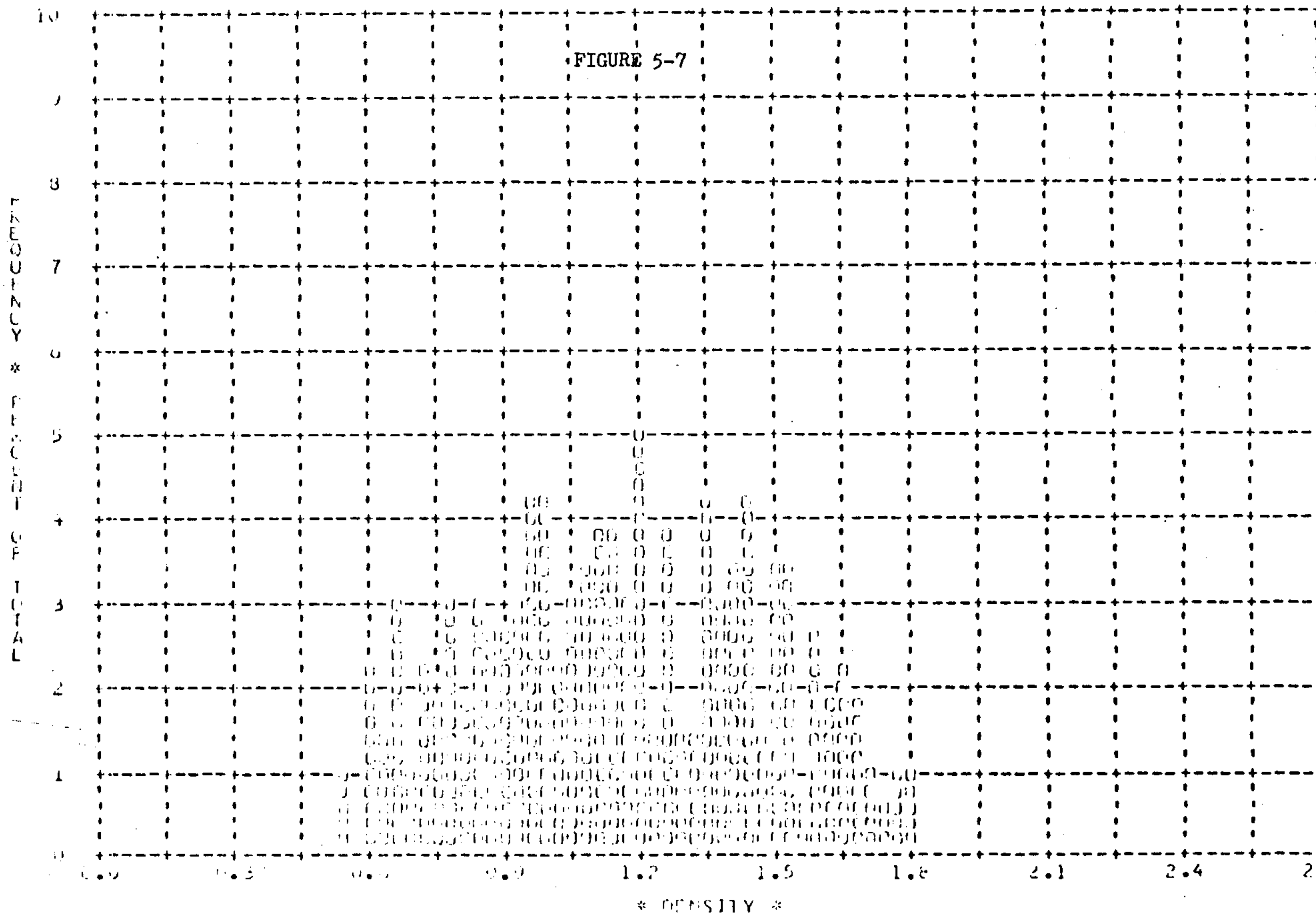
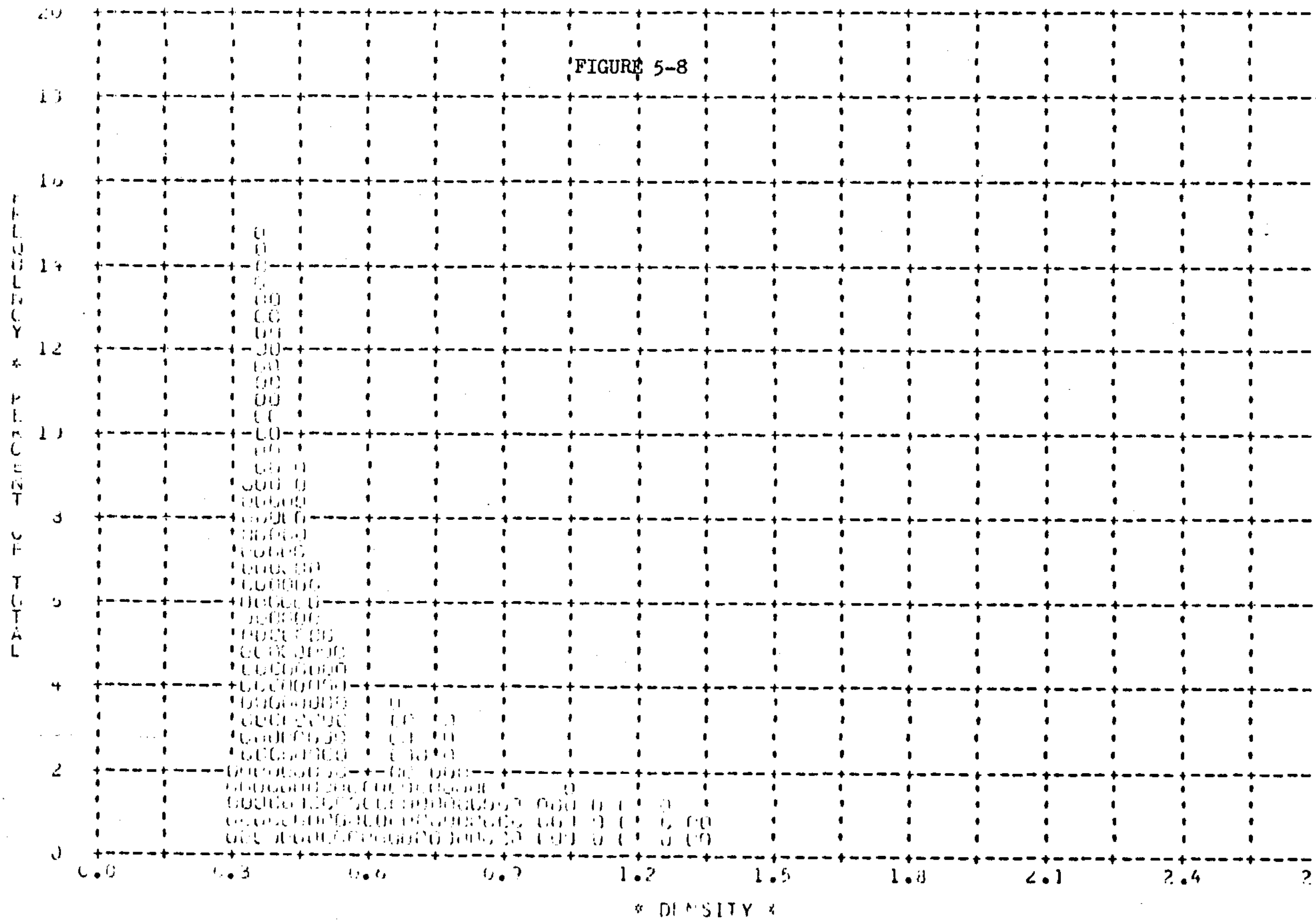


FIGURE 5-7

~~HANDLE VIA [redacted] CONTROL SYSTEM ONLY~~

MISSION * 1052-1 * INSTR * CAD * 7/22/69 PLOT OF D MIN * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 0.52 * MEDIAN * 0.46 * STD DEV * 0.22 * RANGE * 0.29 TO 1.34 WITH 241 SAMPLES



MISSION * 1052-1 * INSIDE * FWD * 5/22/69 PLOT OF D MAX * CLOUD * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.57 * MEDIAN * 1.6[illegible] * STD DEV * 0.15 * RANGE * 1.14 TO 1.82 WITH 133 SAMPLES

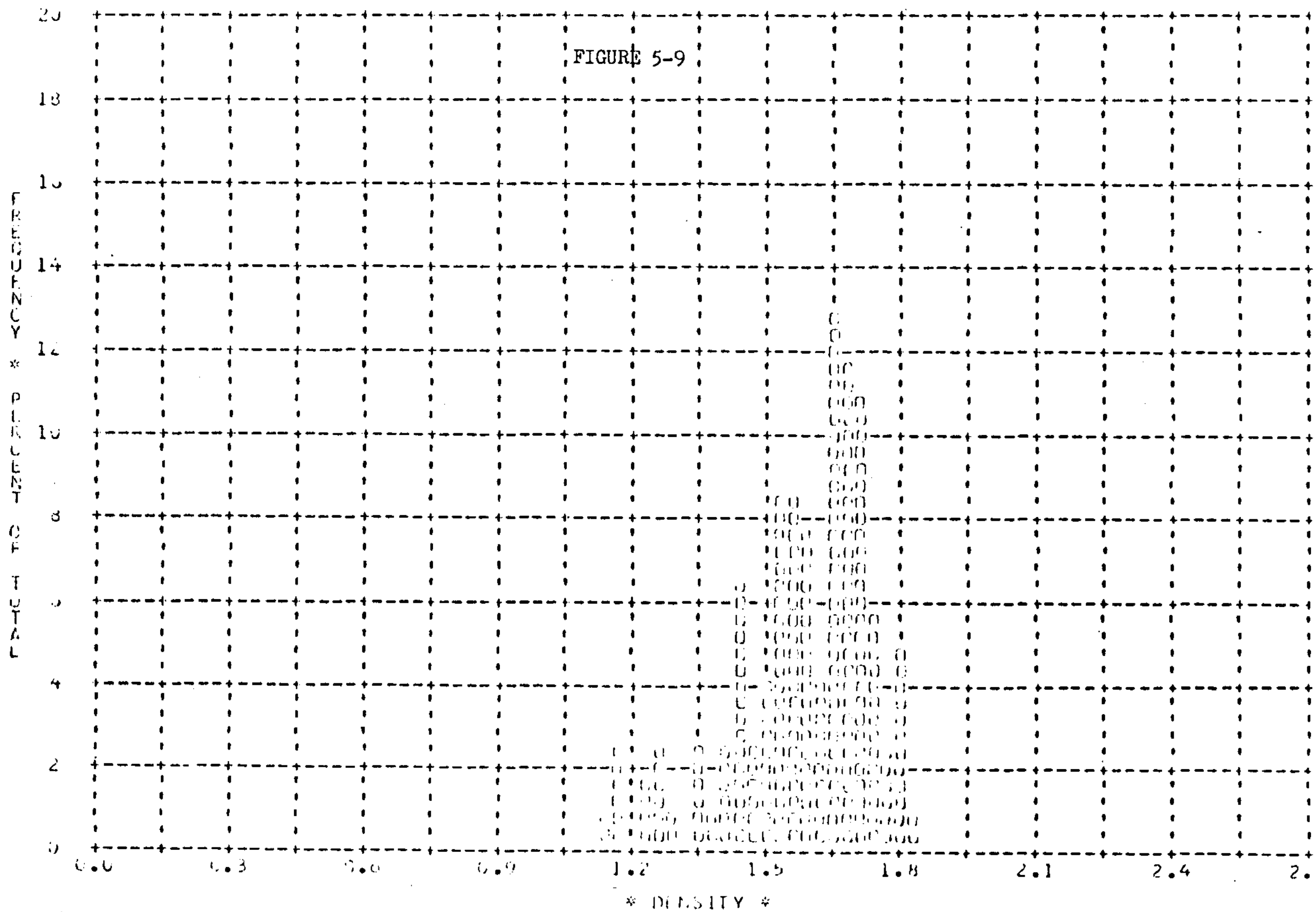
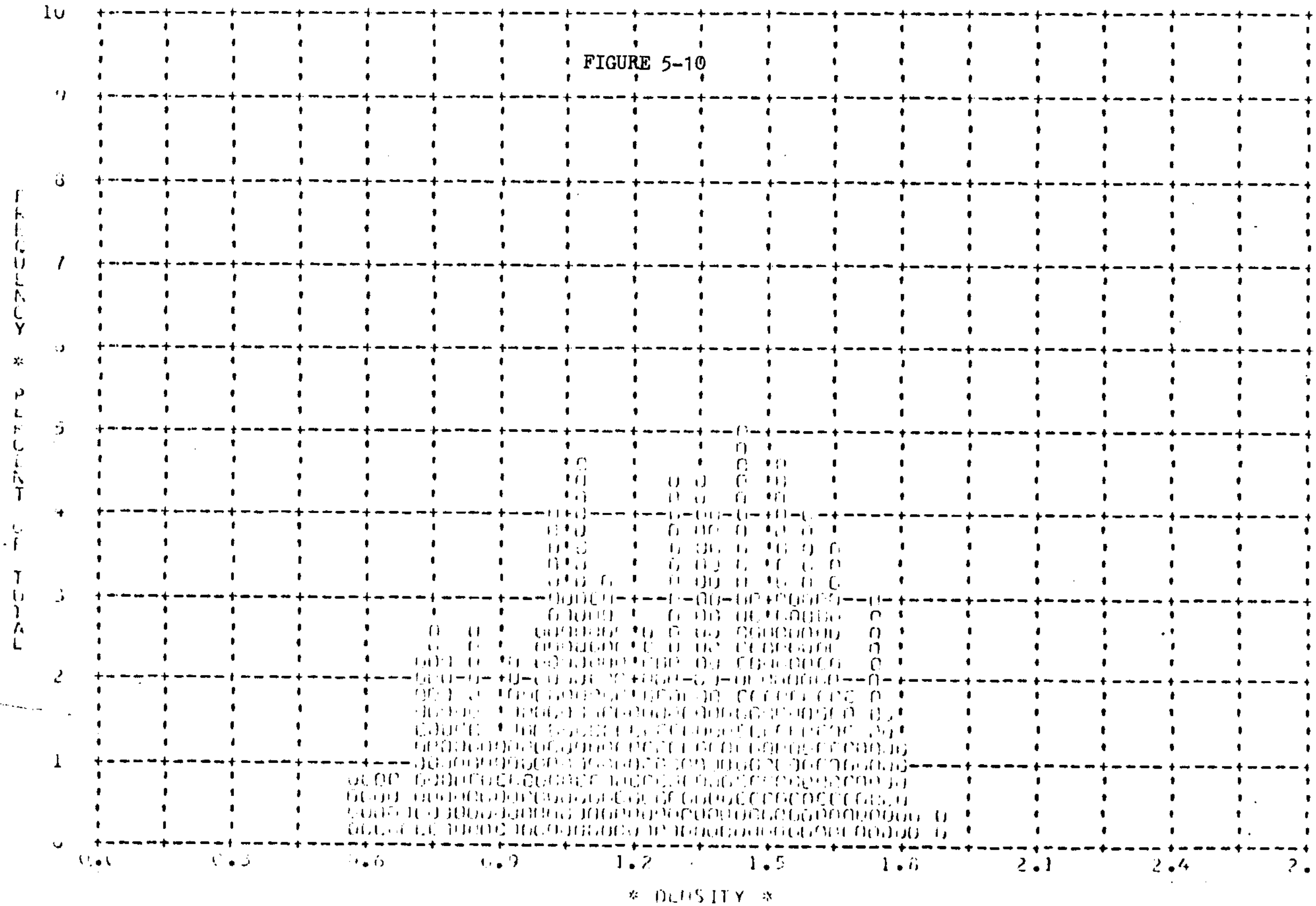


FIGURE 5-9

MISSION * 1052-2 * INSTR * FWD * 9/22/69 PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA

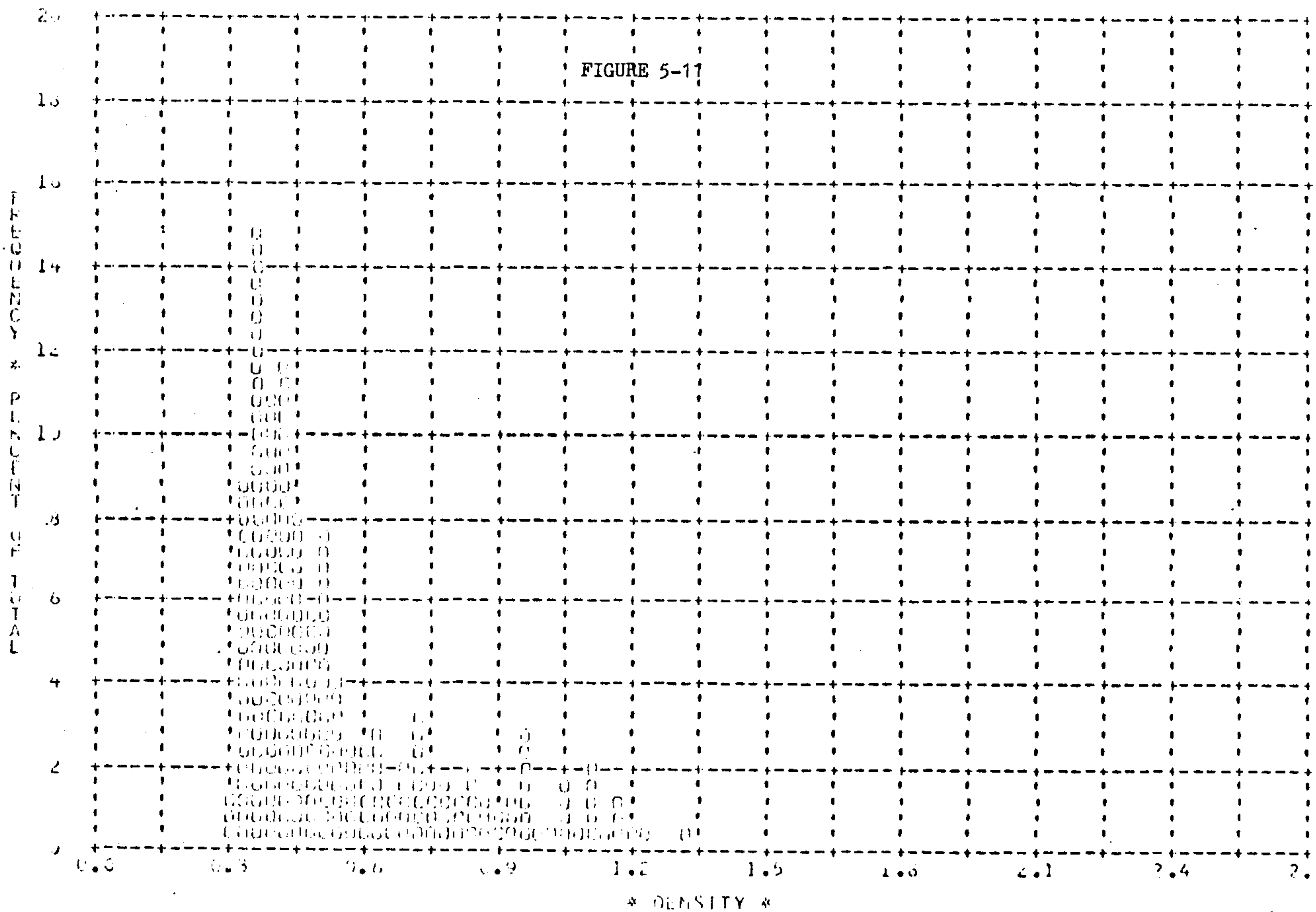
ARITH MEAN * 1.25 * MEDIAN * 1.23 * STD DEV * 0.31 * RANGE * 0.55 TO 1.37 WITH 284 SAMPLES



~~TOP SECRET/C HANDLE VIA [redacted] CONTROL SYSTEM ONLY~~

MISSION * 1052-2 * INSTR * FWD * 9/22/69 PLOT OF D MIN * TERRAIN * PROCESSING * DUAL GAMMA

AMIN MEAN * 0.50 * MEDIAN * 0.49 * STD DEV * 0.23 * RANGE * 0.30 TO 1.31 WITH 284 SAMPLES



~~TOP SECRET/C HANDLE VIA [redacted] CONTROL SYSTEM ONLY~~

MISSION * 1052-2 * INSTR * FWD * 9/22/69 PLOT OF D MAX * CLOUD * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.64 * MEDIAN * 1.66 * STD DEV * 0.14 * RANGE * 1.05 TO 1.86 WITH 212 SAMPLES

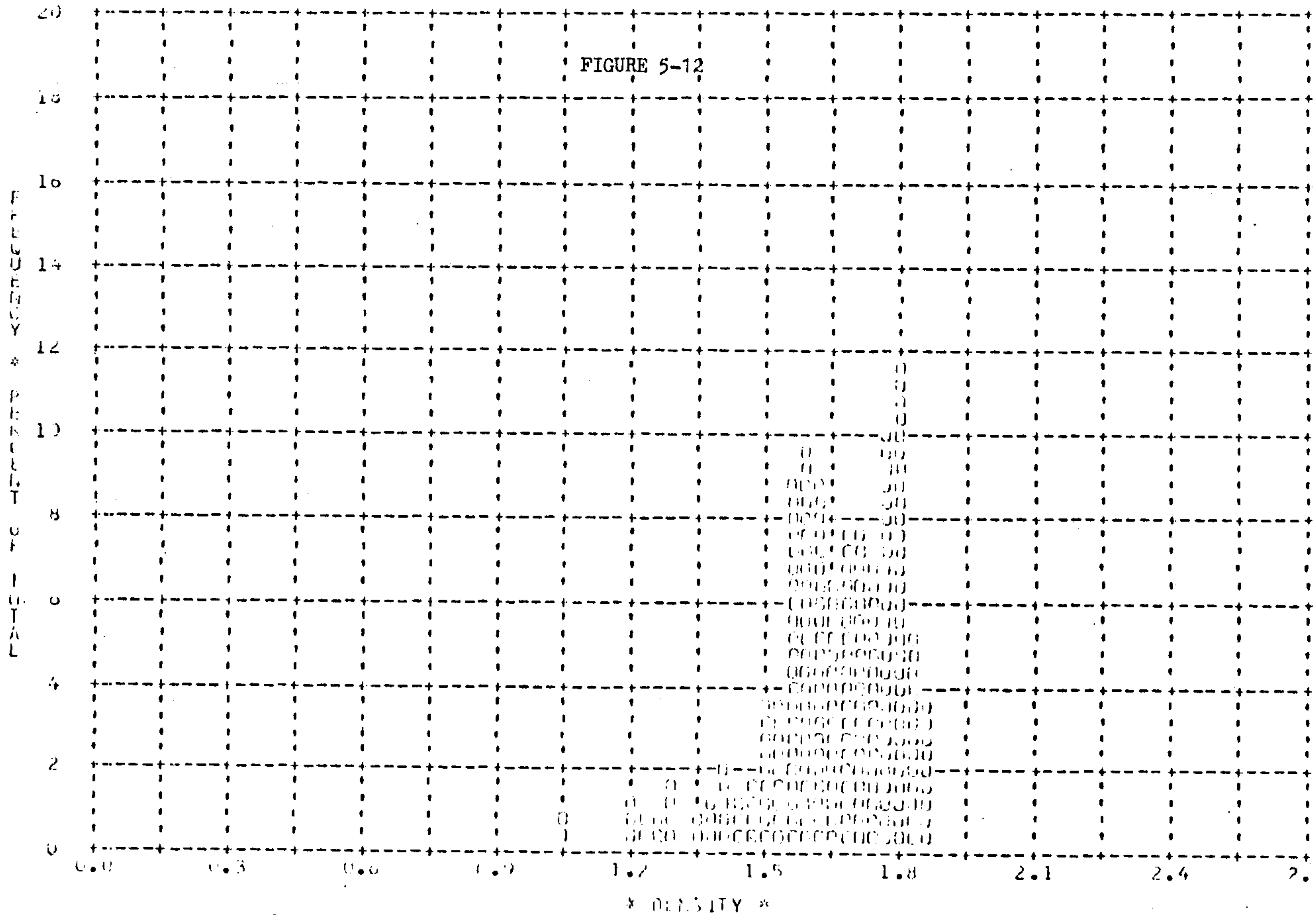
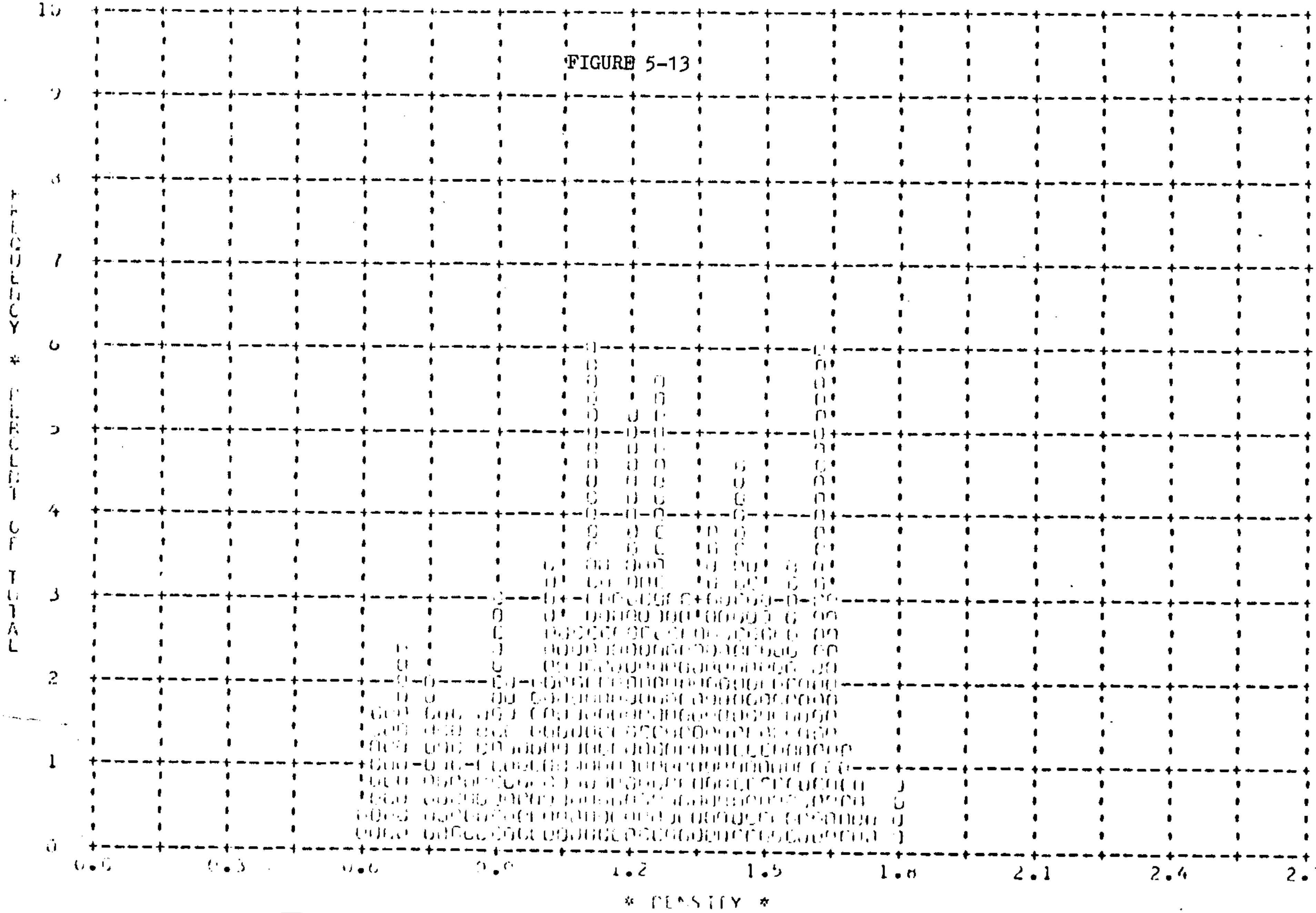


FIGURE 5-12

MISSION * 1052-1 * INSTR * AFT * 9/22/[illegible] PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA
WITH MEAN * 1.23 * MEDIAN * 1.24 * STD DEV * 0.26 * RANGE * 0.58 TO 1.77 WITH 272 SAMPLES



MISSION * 1052-1 * INSIS * AFT * 5/22/6? PLOT ... MIN * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 0.57 * MEDIAN * 0.51 * STD DEV * 0.22 * RANGE * 0.32 TO 1.49 WITH 272 SAMPLES

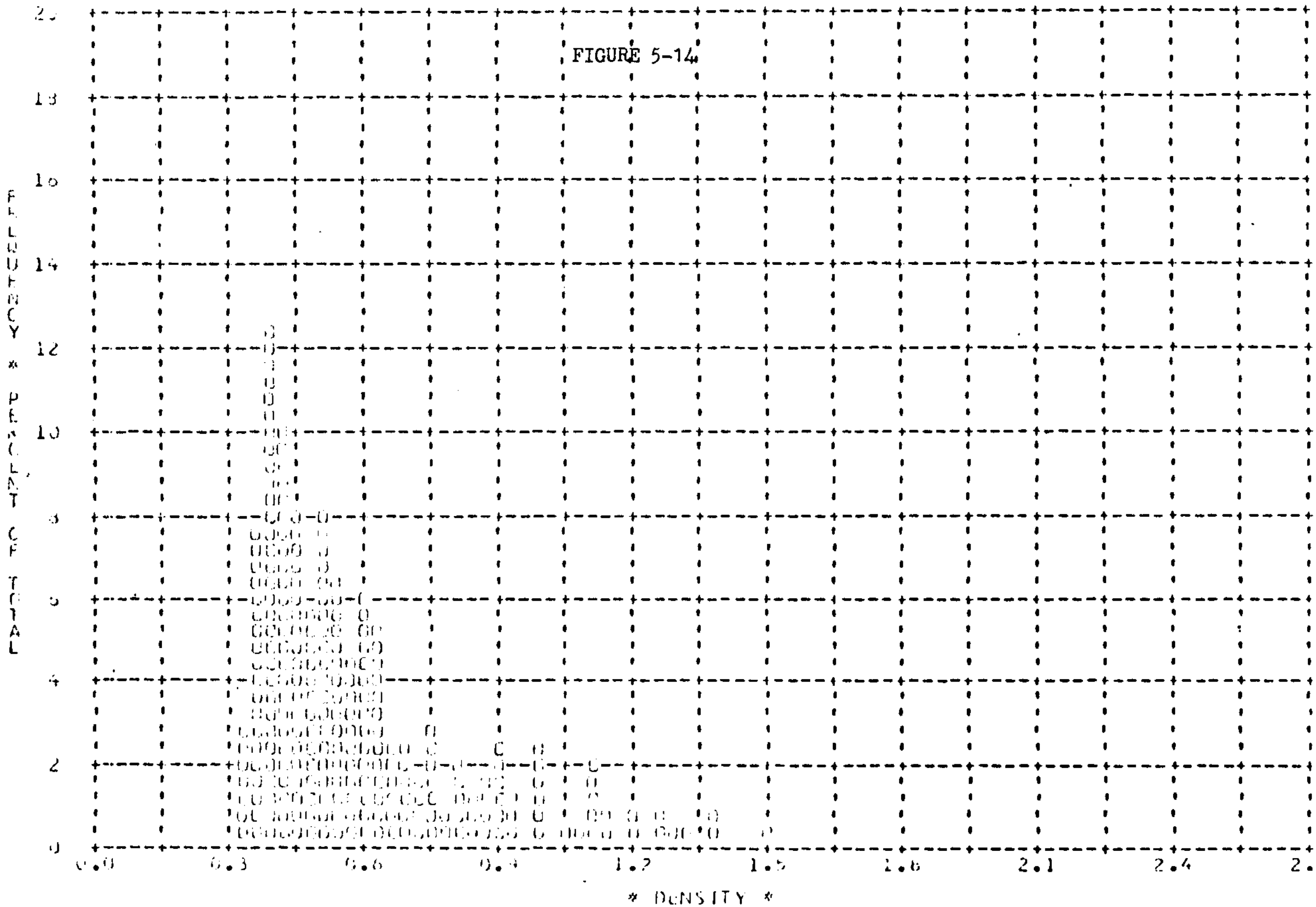
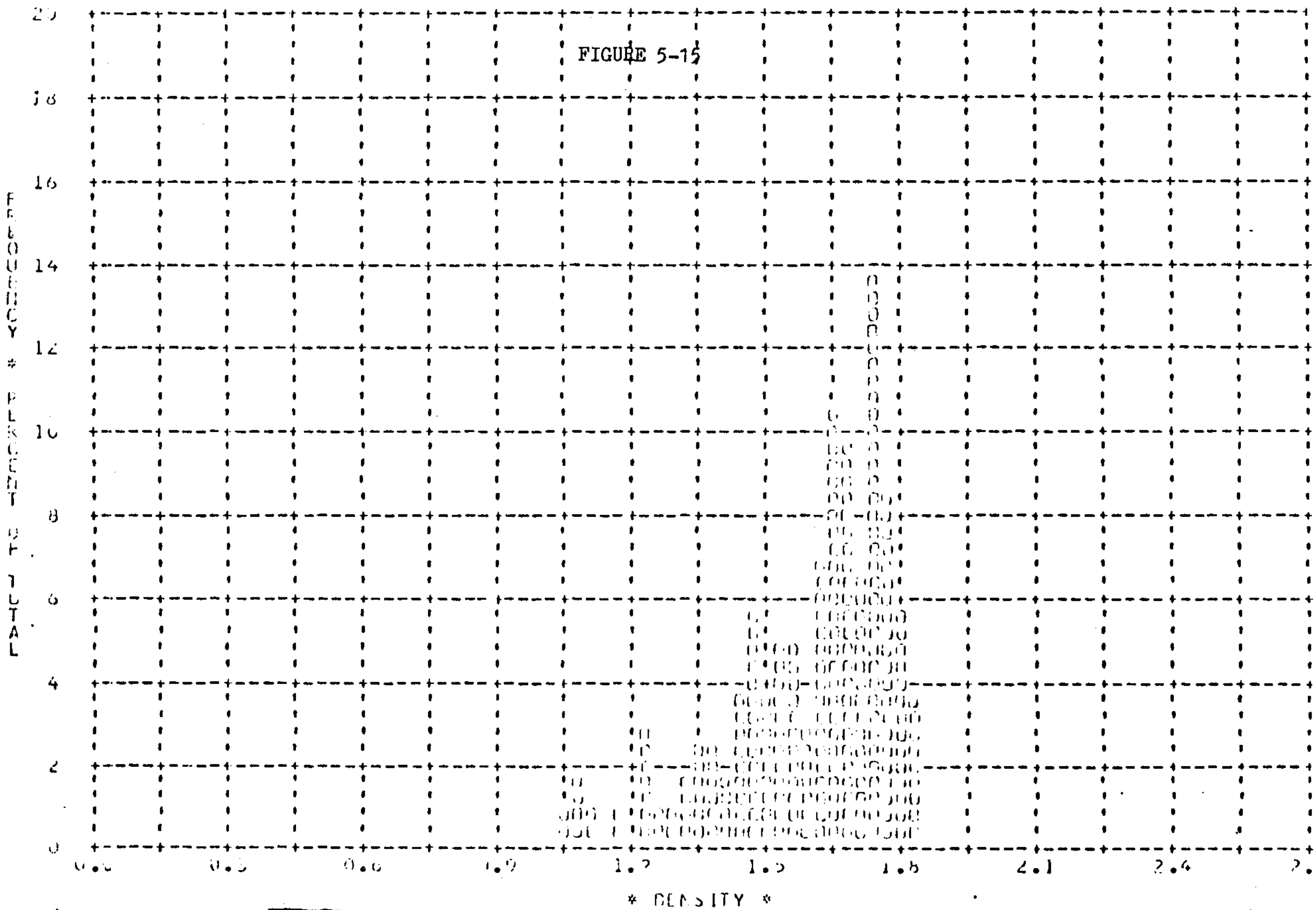


FIGURE 5-14

~~TOP SECRET/C - HANDLE VIA~~ [redacted] ~~CONTROL SYSTEM ONLY~~

MISSION * 1052-1 * INSTR * AFT * 9/22/69 PLOT OF D MAX * CLOUD * PROCESSING * DUAL GAMMA
ARITH MEAN * 1.59 * MEDIAN * 1.64 * STD DEV * 0.17 * RANGE * 1.05 TO 1.82 WITH 150 SAMPLES

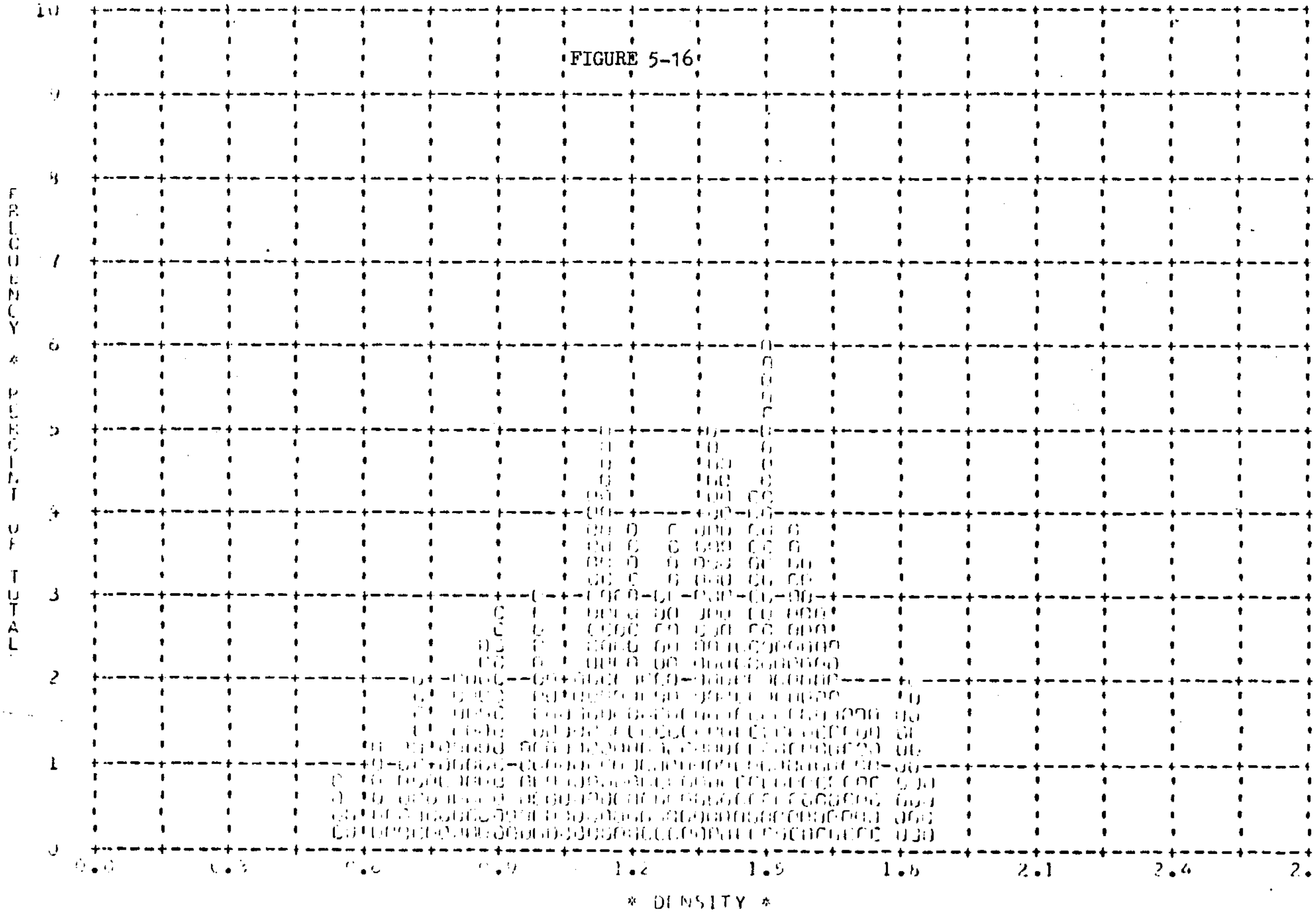
FIGURE 5-15



~~TOP SECRET/C - HANDLE VIA~~ [redacted] ~~CONTROL SYSTEM ONLY~~

MISSION * 1052-2 * INSTR * AFT * 9/22/69 PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA
WITH MEAN * 1.27 * MEDIAN * 1.20 * STD DEV * 0.31 * RANGE * 0.52 TO 1.85 WITH 267 SAMPLES

FIGURE 5-16



[illegible] [redacted] [illegible] SYSTEM ONLY

MISSION 1052-[illegible] * TEST * ALT * 5/22/6[illegible] PLOT OF 0 MIE * TERRAIN * PROCESSING * DUAL GAMMA
ARITH MEAN * [illegible] * MEDIAN * 0.51 * STD DEV * 0.25 * RANGE * 0.30 TO 1.41 WITH 267 SAMPLES

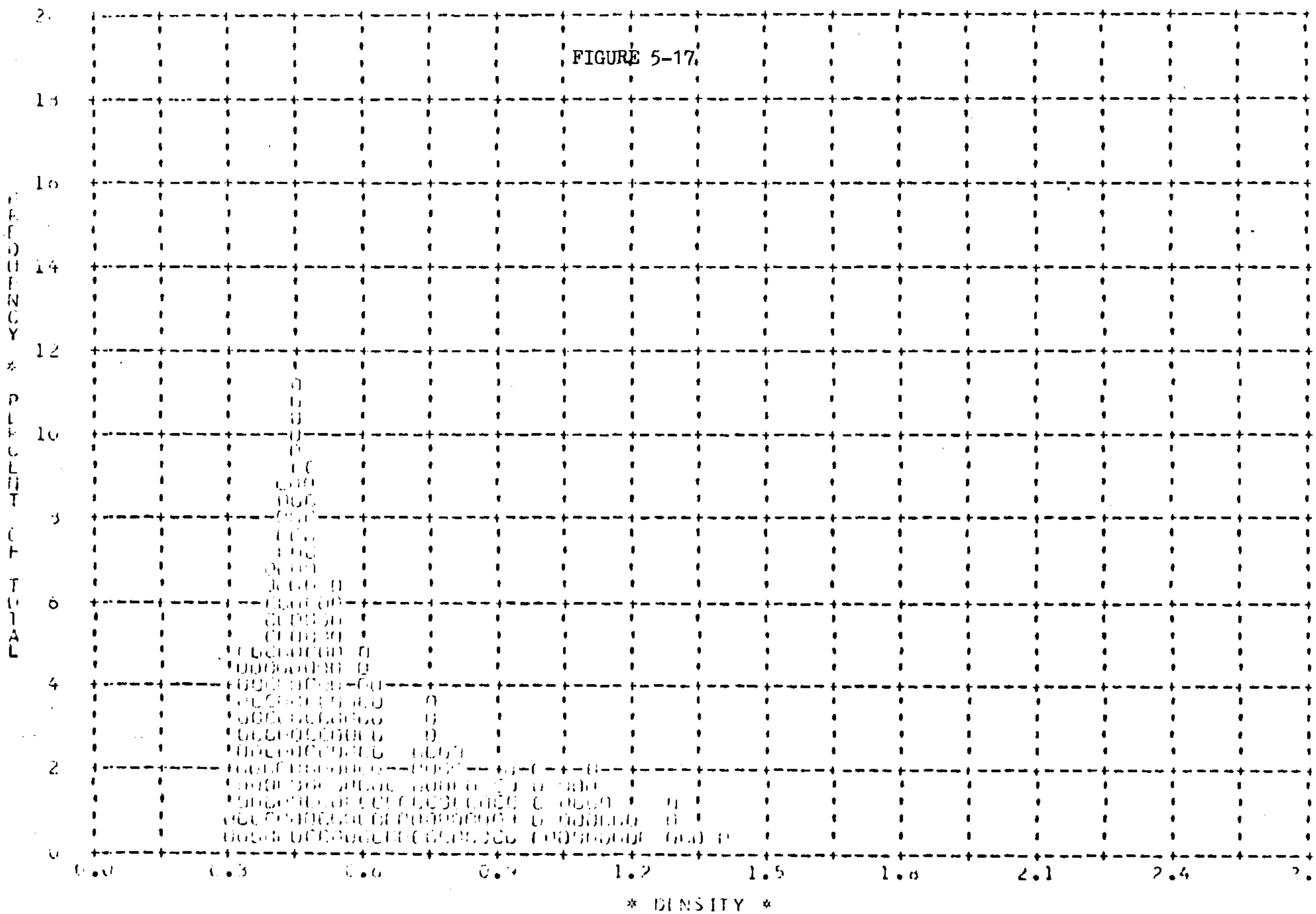


FIGURE 5-17

TOP SECRET/C HANDLE VIA [redacted] CONTROL SYSTEM ONLY

[redacted] CONTROL SYSTEM ONLY

MISSION * 1052-? * INSTR * AFT * 5/22/6? PLOT OF D MAX * CLOUD * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.6? * MEDIAN * 1.65 * STD DEV * 0.14 * RANGE * 1.08 TO ~~...~~ SAMPLES

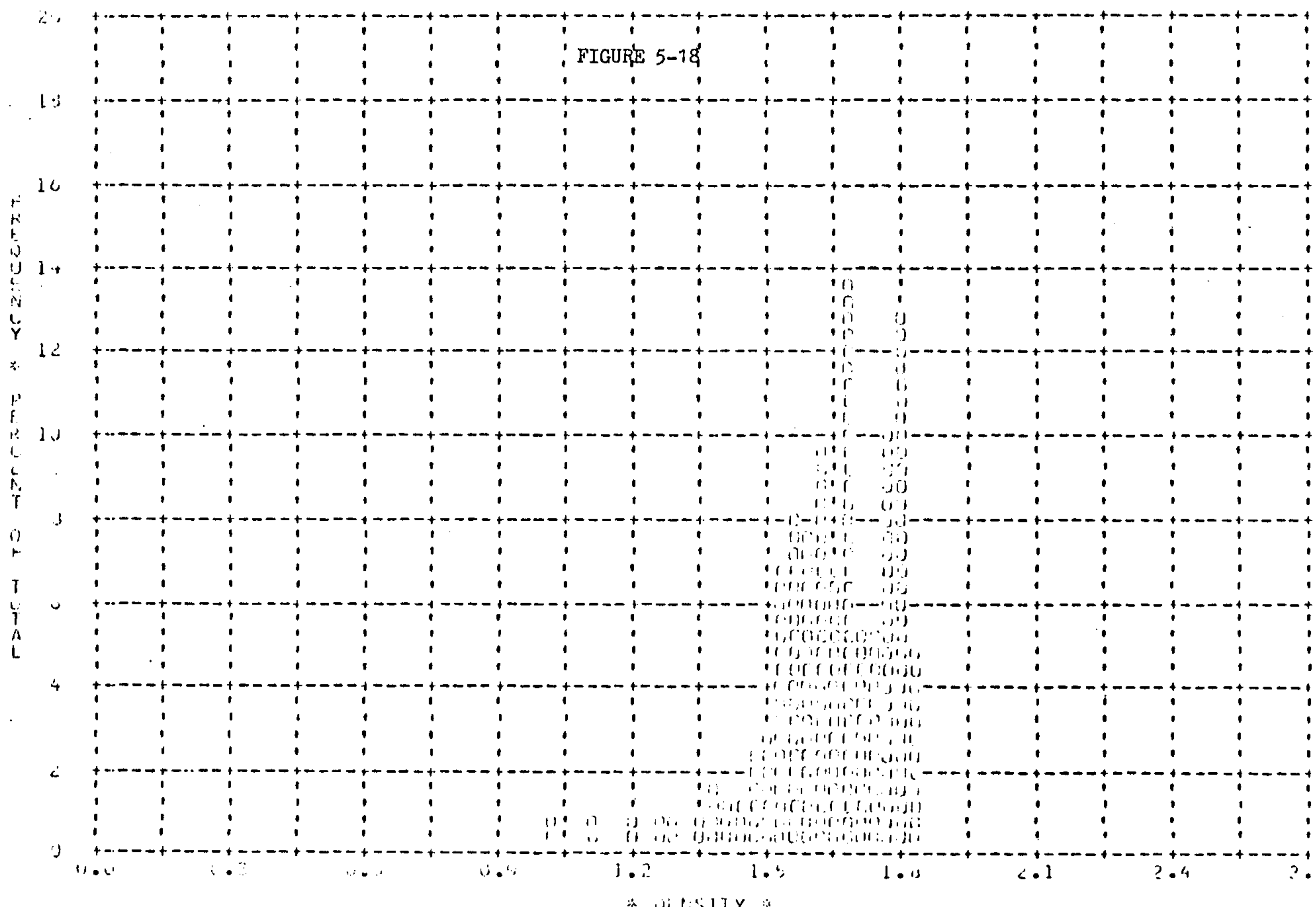


FIGURE 5-18

[redacted] CONTROL SYSTEM ONLY

SECTION 6

IMAGE SMEAR AND ATTITUDE ANALYSIS

A. VEHICLE ATTITUDE

The vehicle attitude performance data were derived from reduction of the Stellar photography by NPIC. These data are supplied to Lockheed where a computer program was employed to obtain attitude angle and rate deviations in the form of charts and tables.

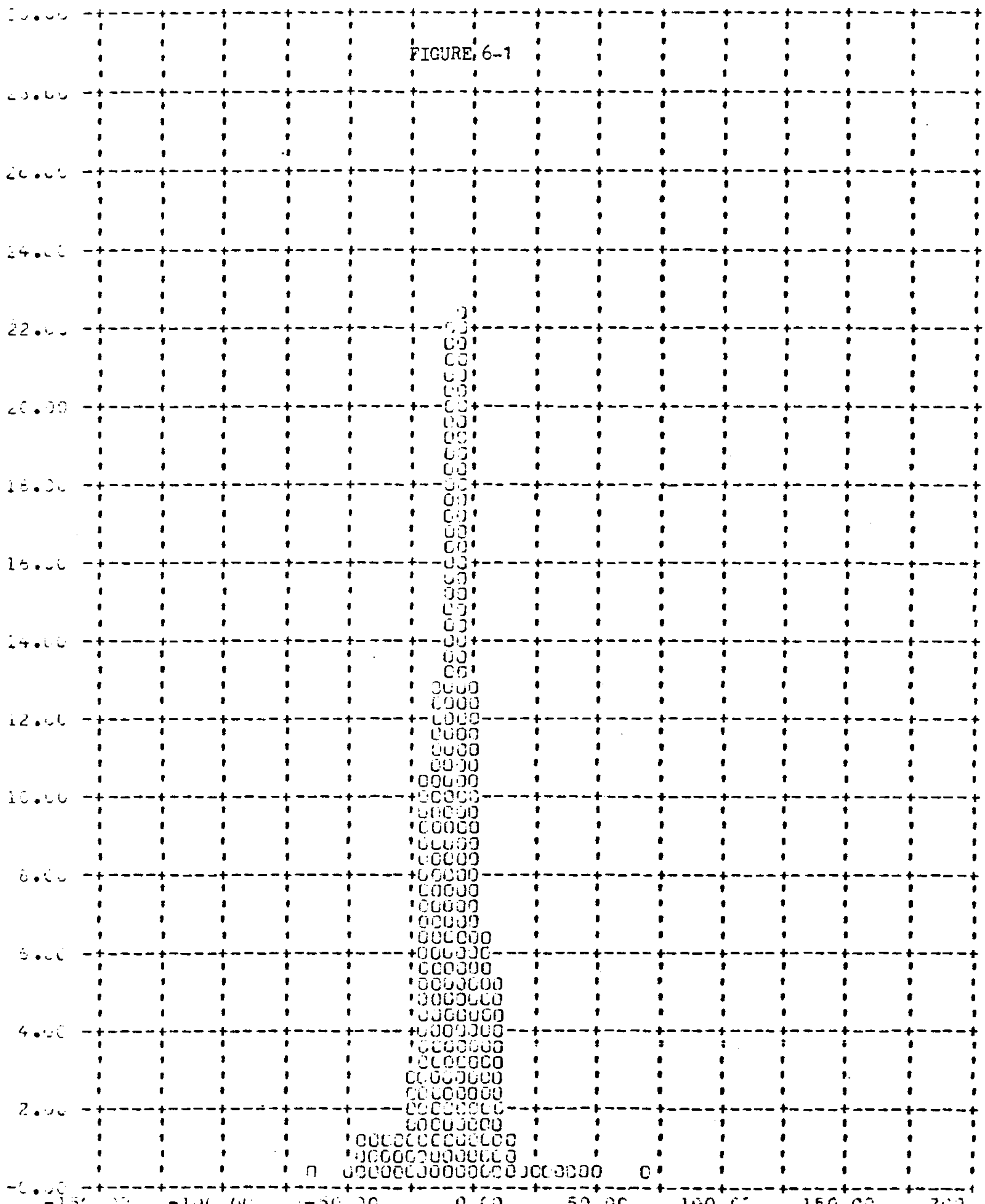
Performance of the attitude control system was normal and comparable to previous missions. While any angular deviation will cause geometric variation in the photography and any rate deviation will cause relative image motion, the deviations for mission 1052 were not considered degrading to the panoramic photography. The table below summarizes both the total range of attitude variation and that experienced during ninety percent of photographic operations:

	1052-1		1052-2	
	90%	Total Range	90%	Total Range
Angle Deviation (degrees):				
Pitch	0.64	-0.83 to -0.28	0.28	-0.30 to 0.58
Roll	0.25	-0.25 to 0.65	0.39	-.062 to 0.10
Yaw	0.43	-0.06 to +0.58	0.41	-0.55 to +1.0
Rate Deviation (degrees/hour):				
Pitch	18.21	-60 to +50	27.66	-40 to +75
Roll	21.41	-60 to +50	22.57	-60 to +75
Yaw	23.79	-50 to +50	26.93	-55 to +25

The computer outputted graphs of angular and rate deviations have been included in this last J-1 report on Figures 6-1 through 6-24.

FRAMES 1-6 OF EACH OF OMITTED OC PERCENT = 23.7

Y YAW RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)



TOP SECRET [redacted]

FRAMES 1-6 OF EACH OP OMITTED   ZC PERCENT =

YAW ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

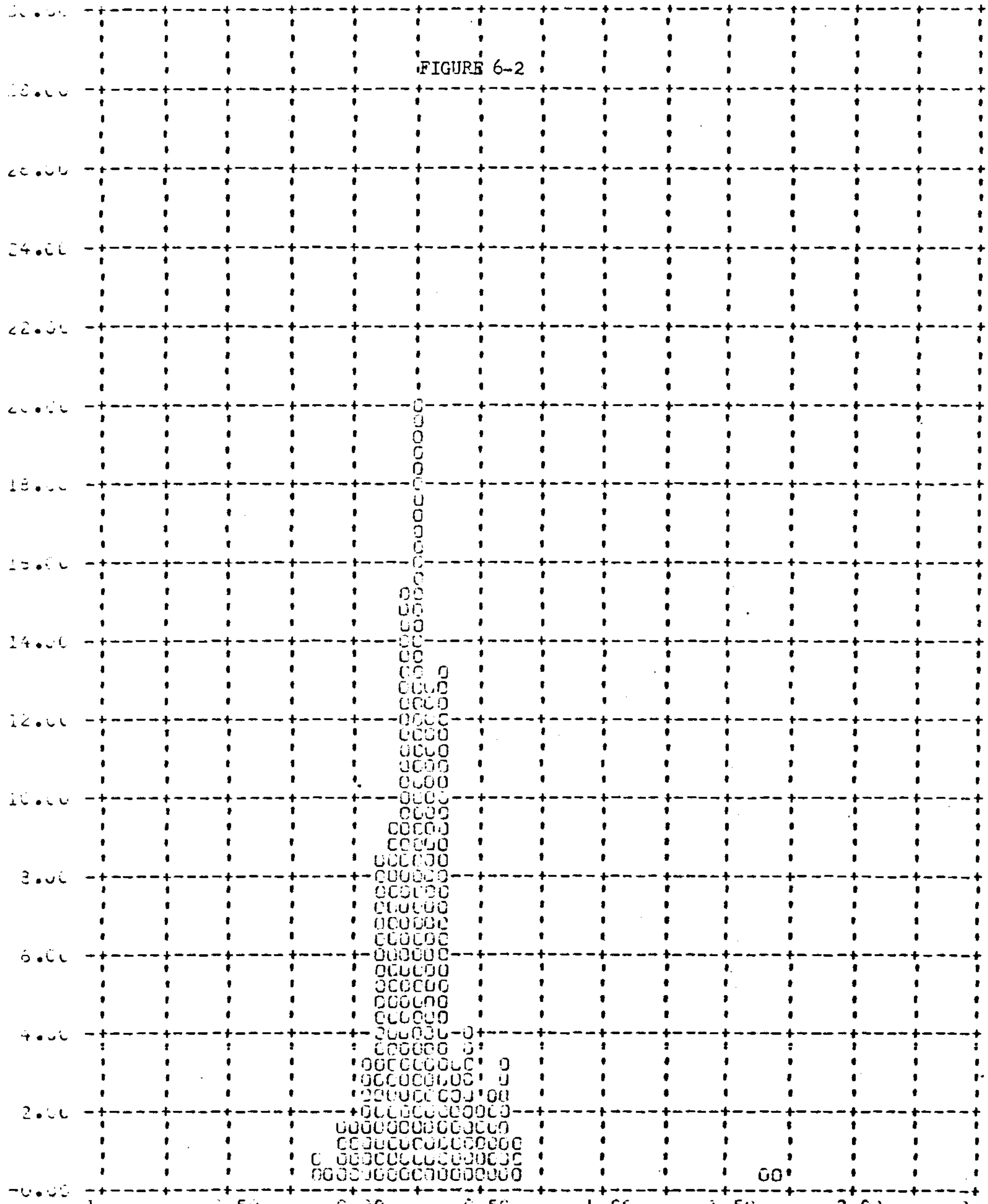


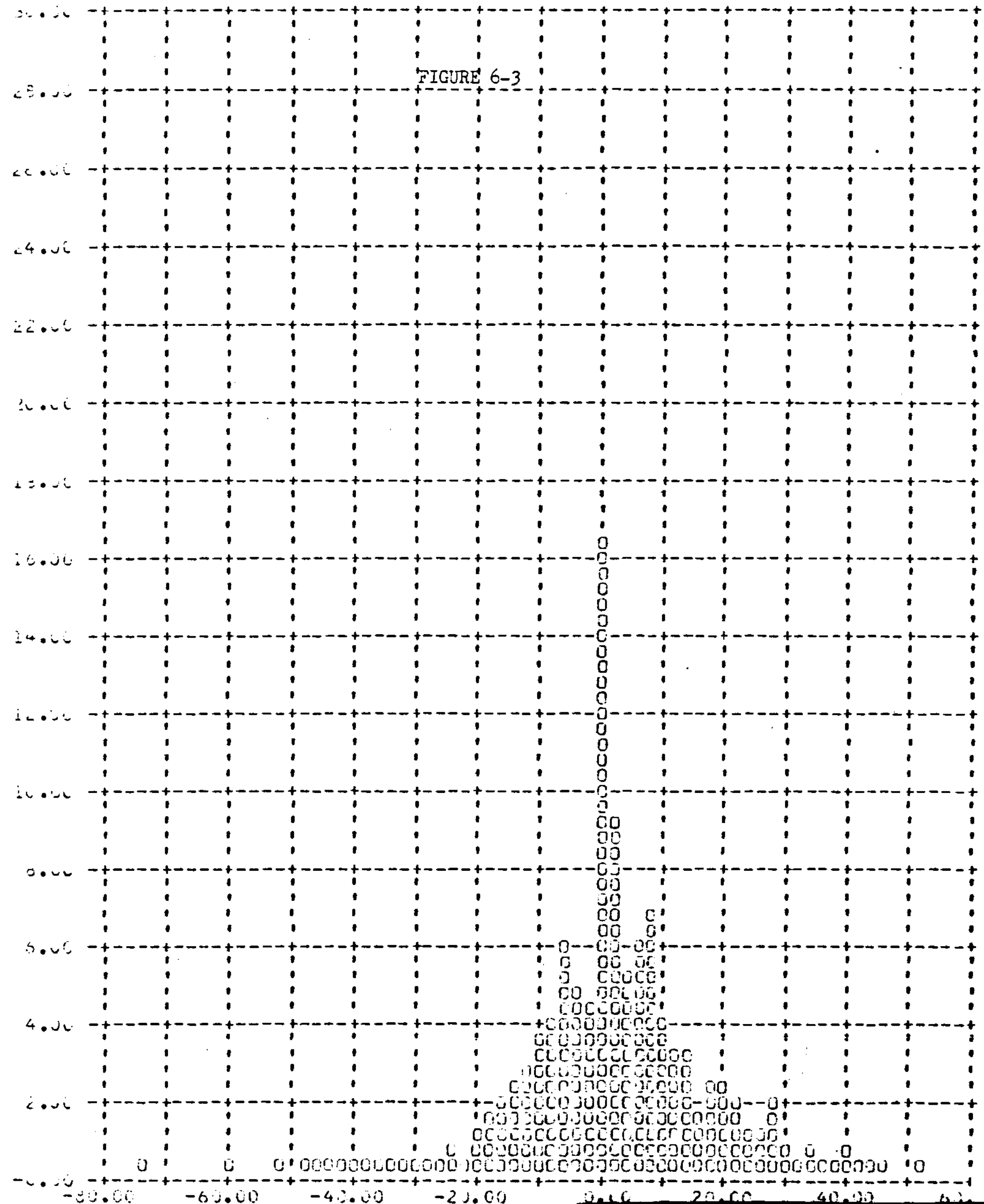
FIGURE 6-2

TOP SECRET/ [redacted]

FRAMES 1-6 OF EACH OF OMITTED 90 PERCENT = 21.41

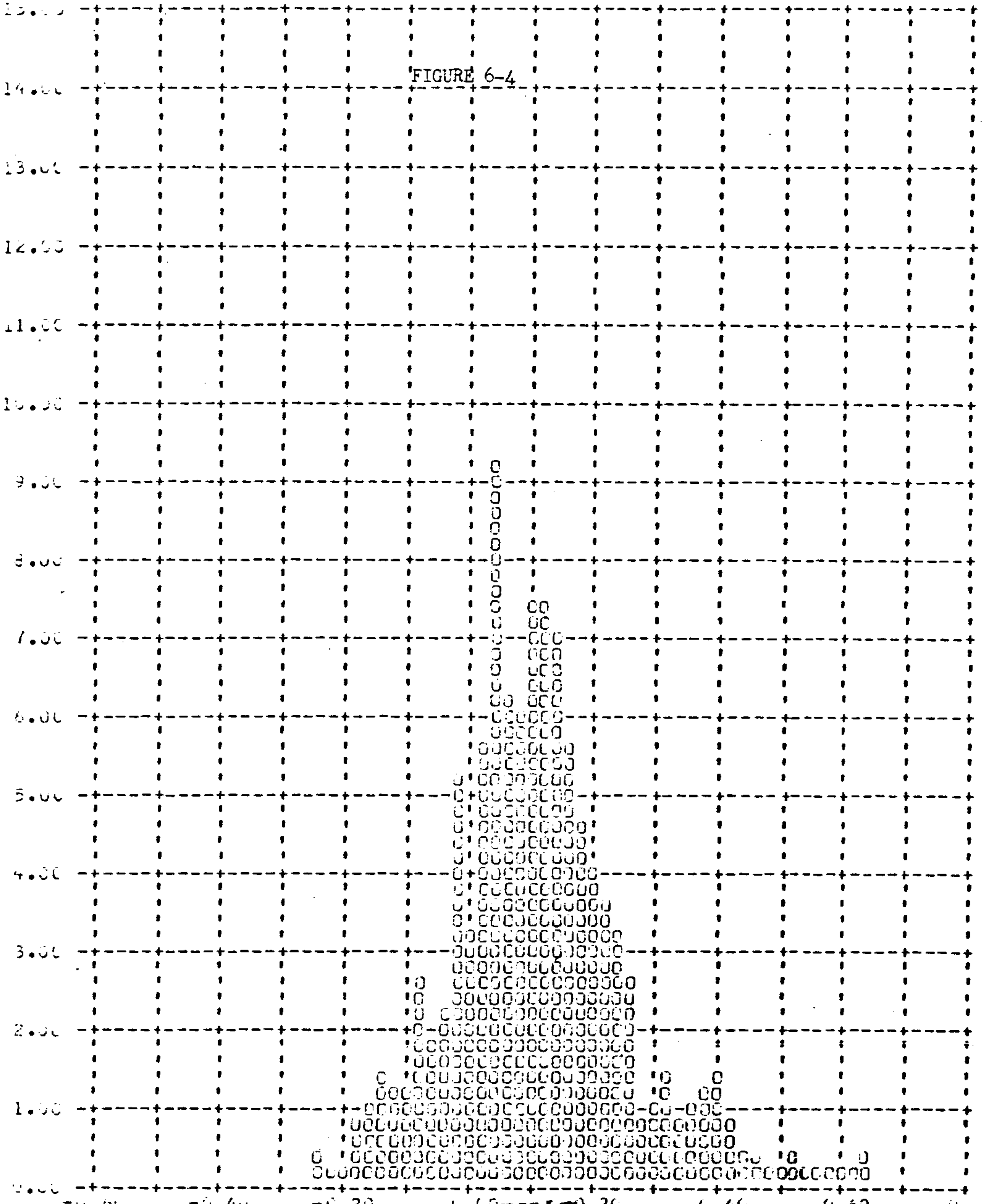
Y ROLL RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-3



FRAMES 1-6 OF EACH OF OMITTED   OT PERCENT = 0.25

Y   ROLL ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)



 [redacted]

FRAMES 1-6 OF EACH OF OMITTED   90 PERCENT = 15.21

Y   PITCH RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

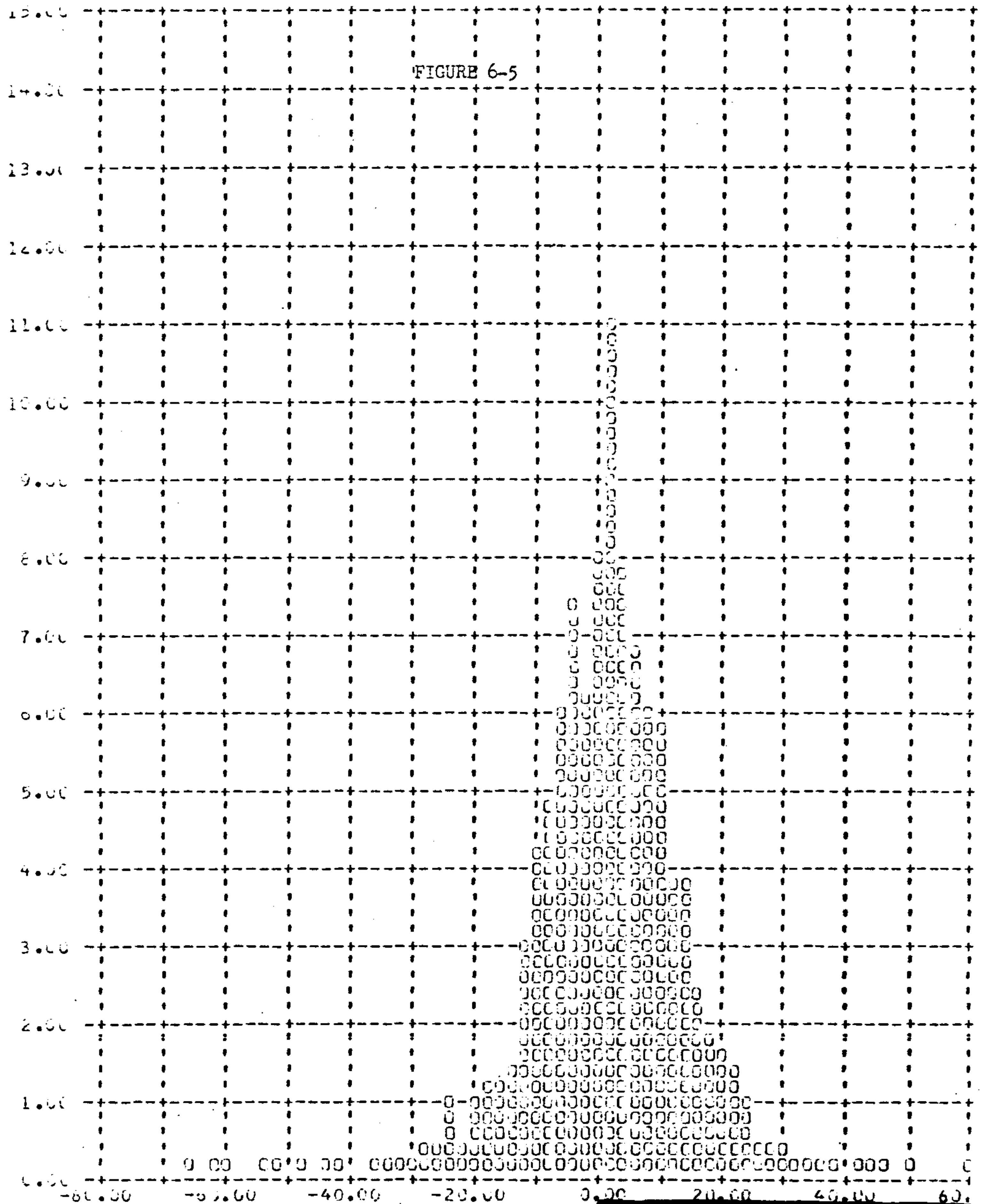


FIGURE 6-5

TOP SECRE[redacted]

FRAMES 1-6 OF EACH OP OMITTED   CU PERCENT = [illegible]

Y   PITCH ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

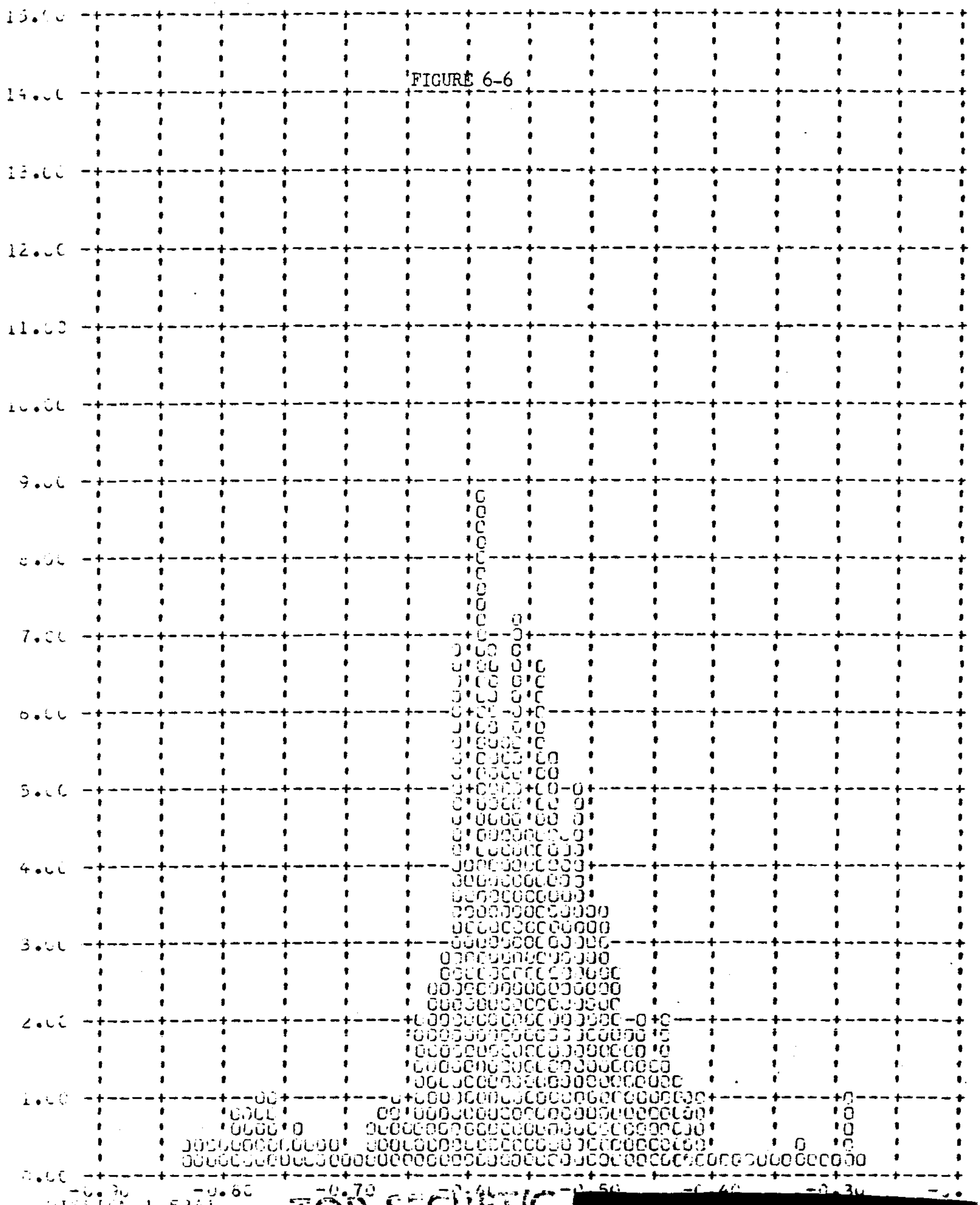
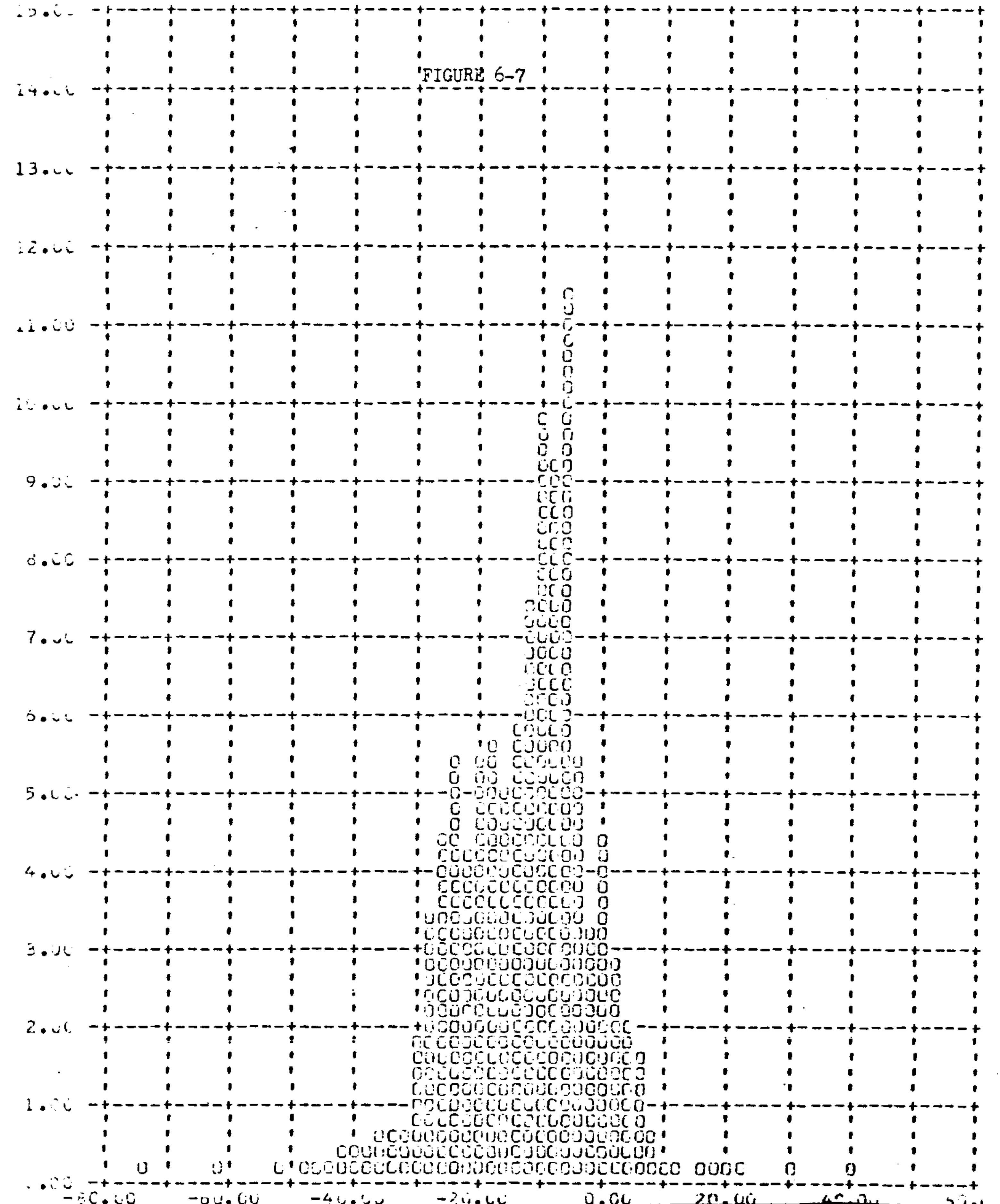


FIGURE 6-6

FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 28.93

Y YAW RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)



FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT =

Y YAW ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

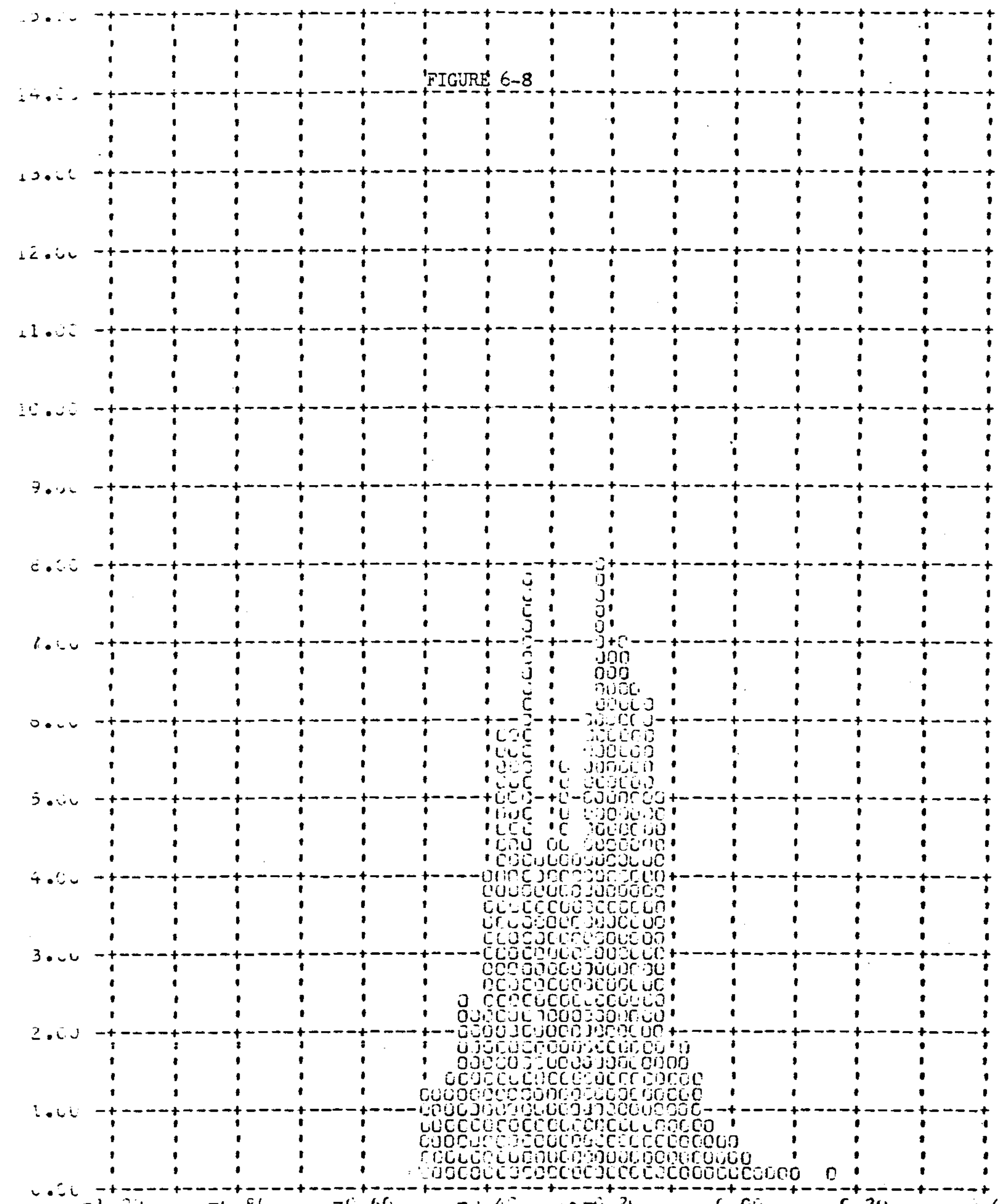


FIGURE 6-8

FRAMES 1-6 OF EACH LP OMITTED 90 PERCENT = 22.57

Y ROLL RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

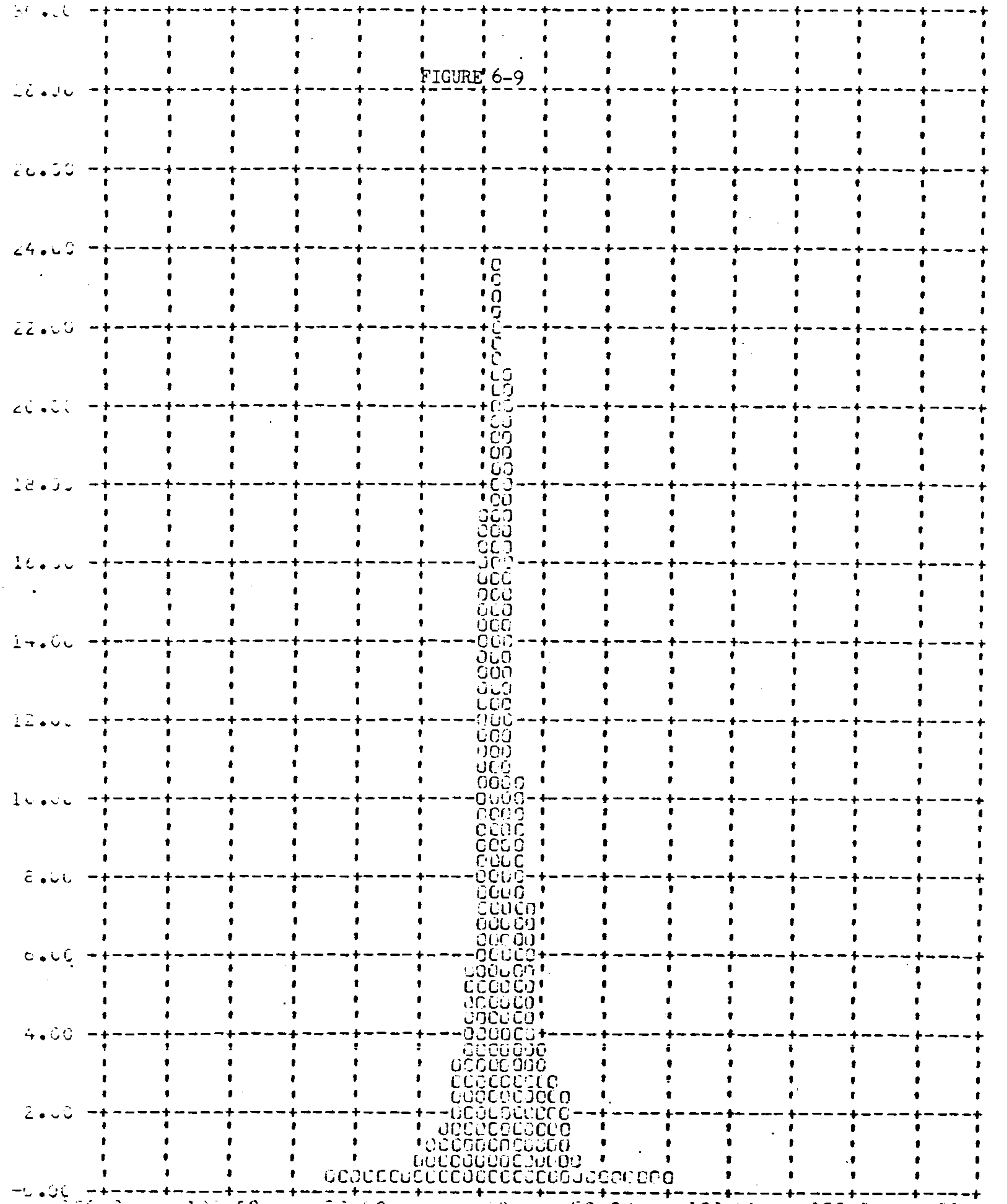


FIGURE 6-9

TOP SECRET [redacted]

FRAMES 1-6 OF EACH OP OMITTED   90 PERCENT = 0.59

Y   FULL ANGLE EARTH - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

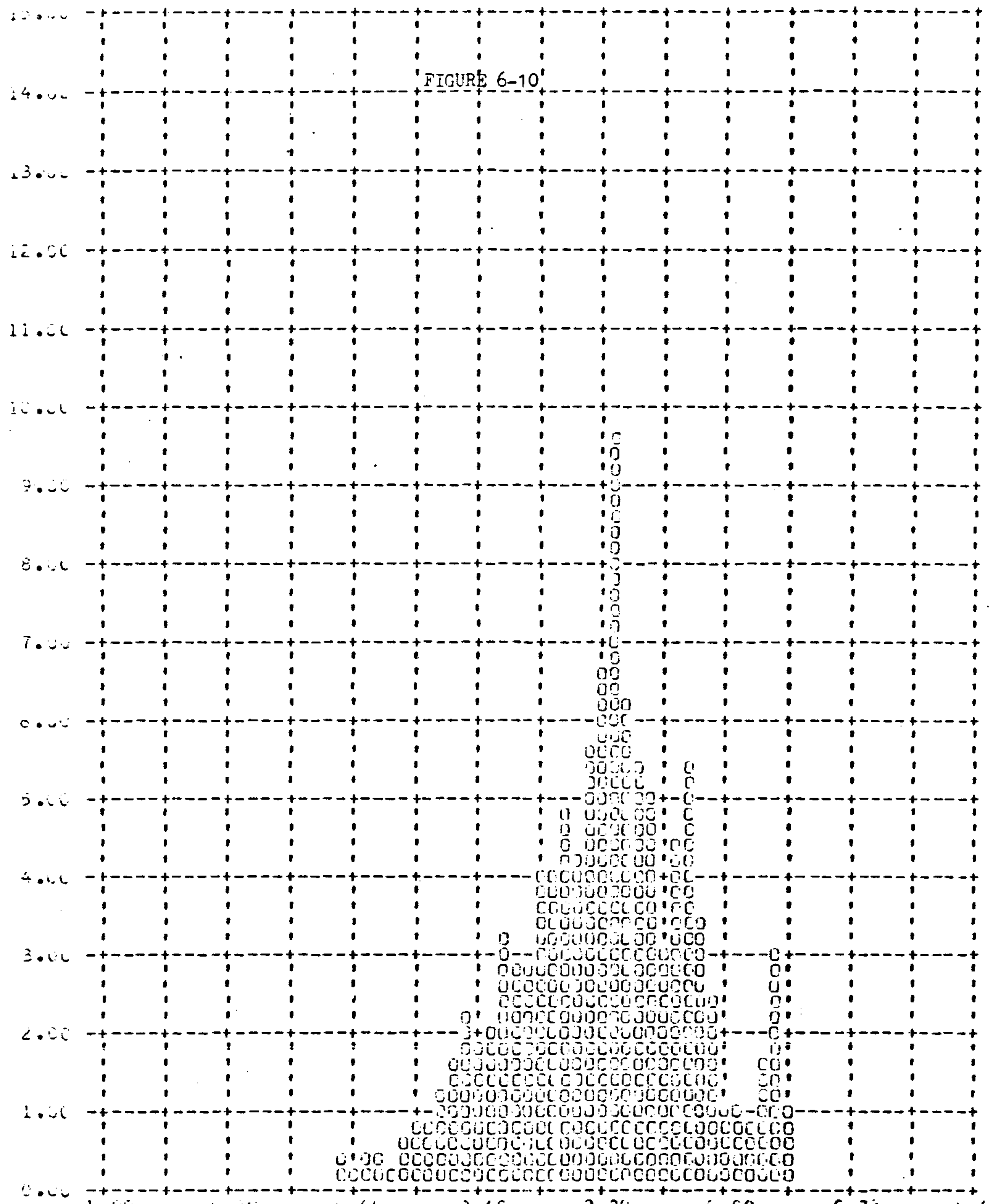


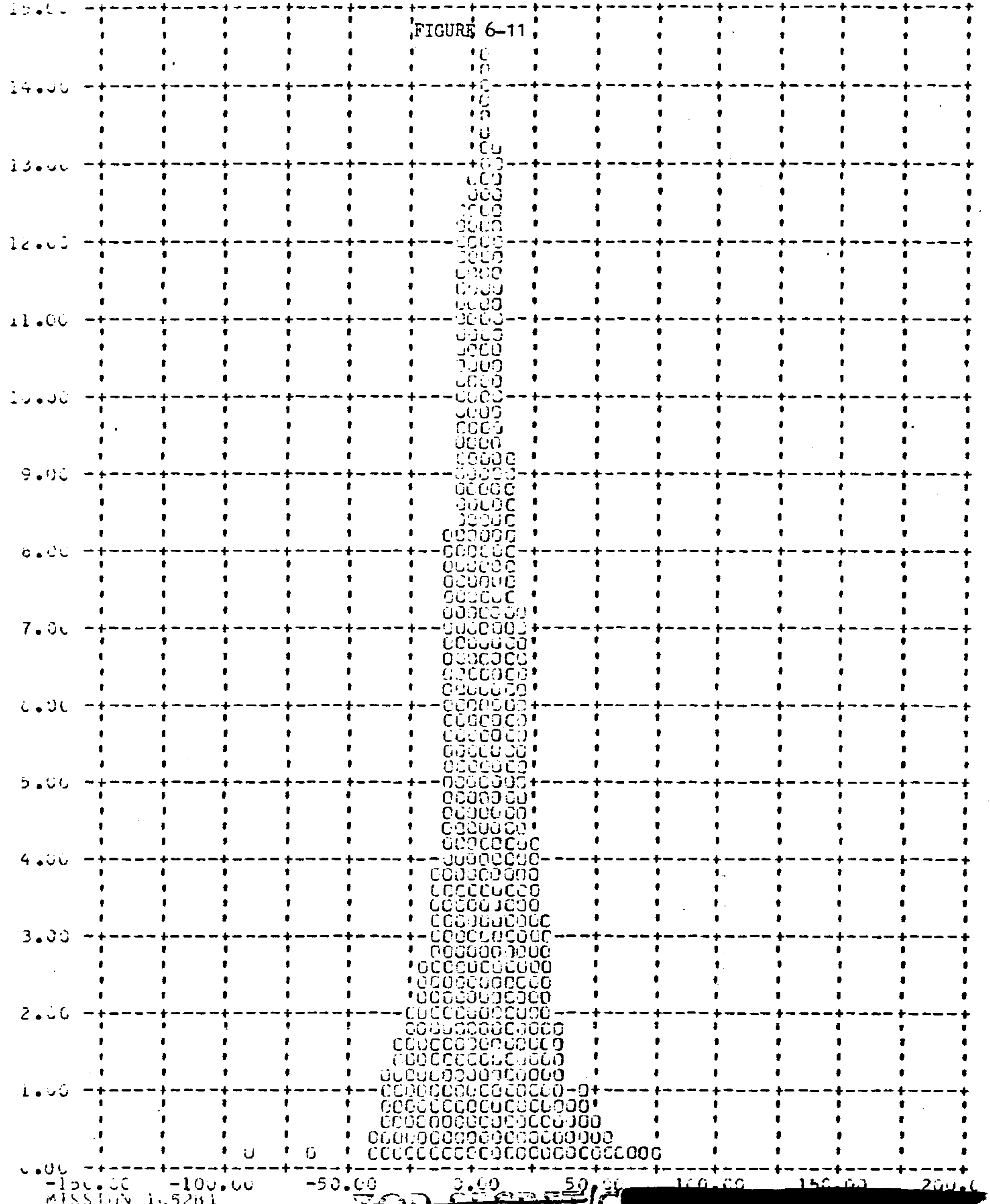
FIGURE 6-10

[redacted]

FRAMES 1-6 OF EACH OF OMITTED NC PERCENT = 27.5

Y PITCH RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-11



TOP SECRET [redacted]

MISSION 105281 [redacted]

FRAMES 1-6 OF EACH GP OMITTED   90 PERCENT =

Y   PITCH ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

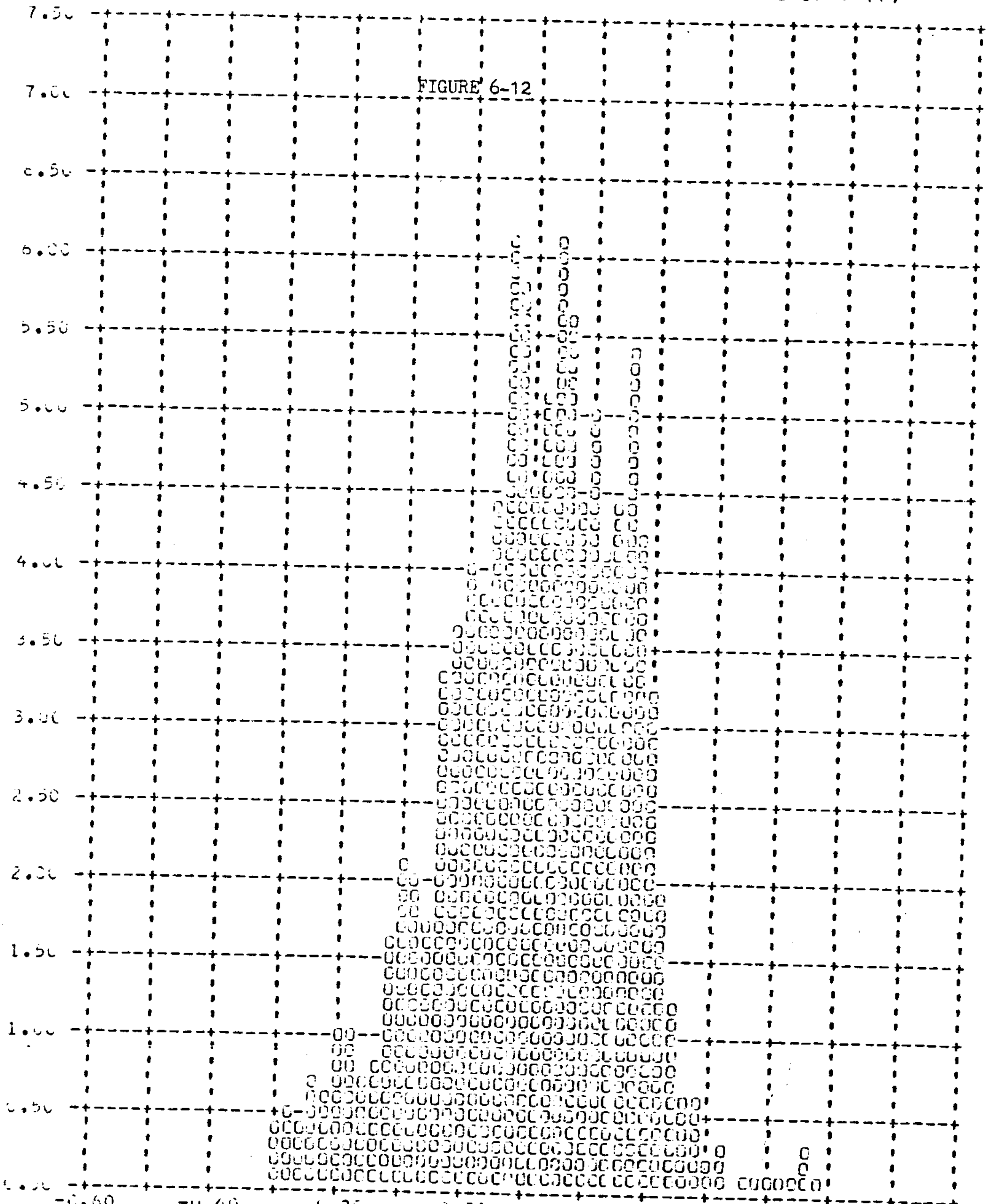


FIGURE 6-12

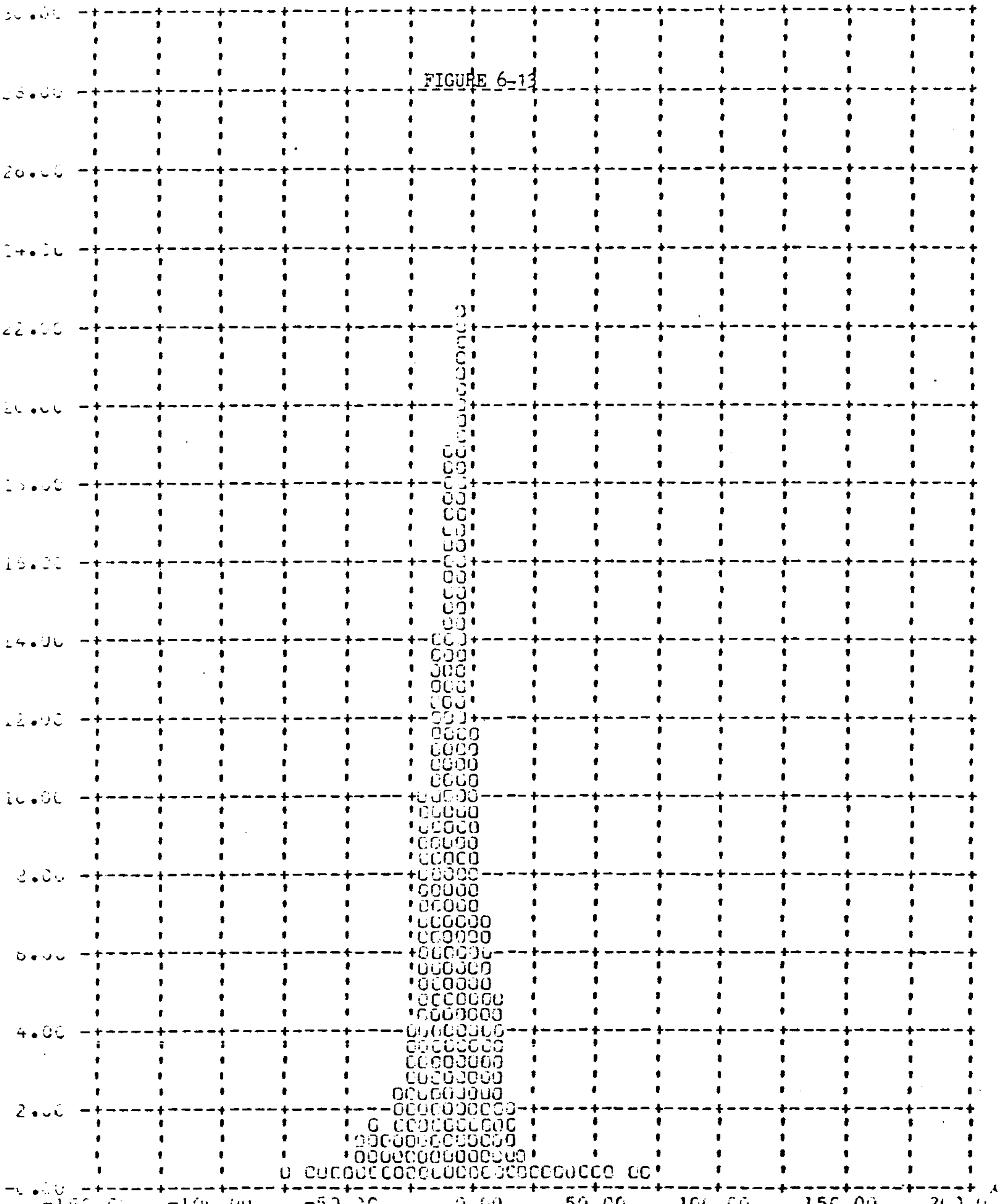
MISSION 105281 [redacted]

MISSION 1052A2

FRAMES 1-6 OF EACH OP OMITTED   90 PERCENT = 26.04

Y   YAW RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-13



MISSION 1052A2

[redacted]

FRAMES 1-6 OF EACH CP OMITTED   90 PERCENT = 0.43

Y   YAW ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

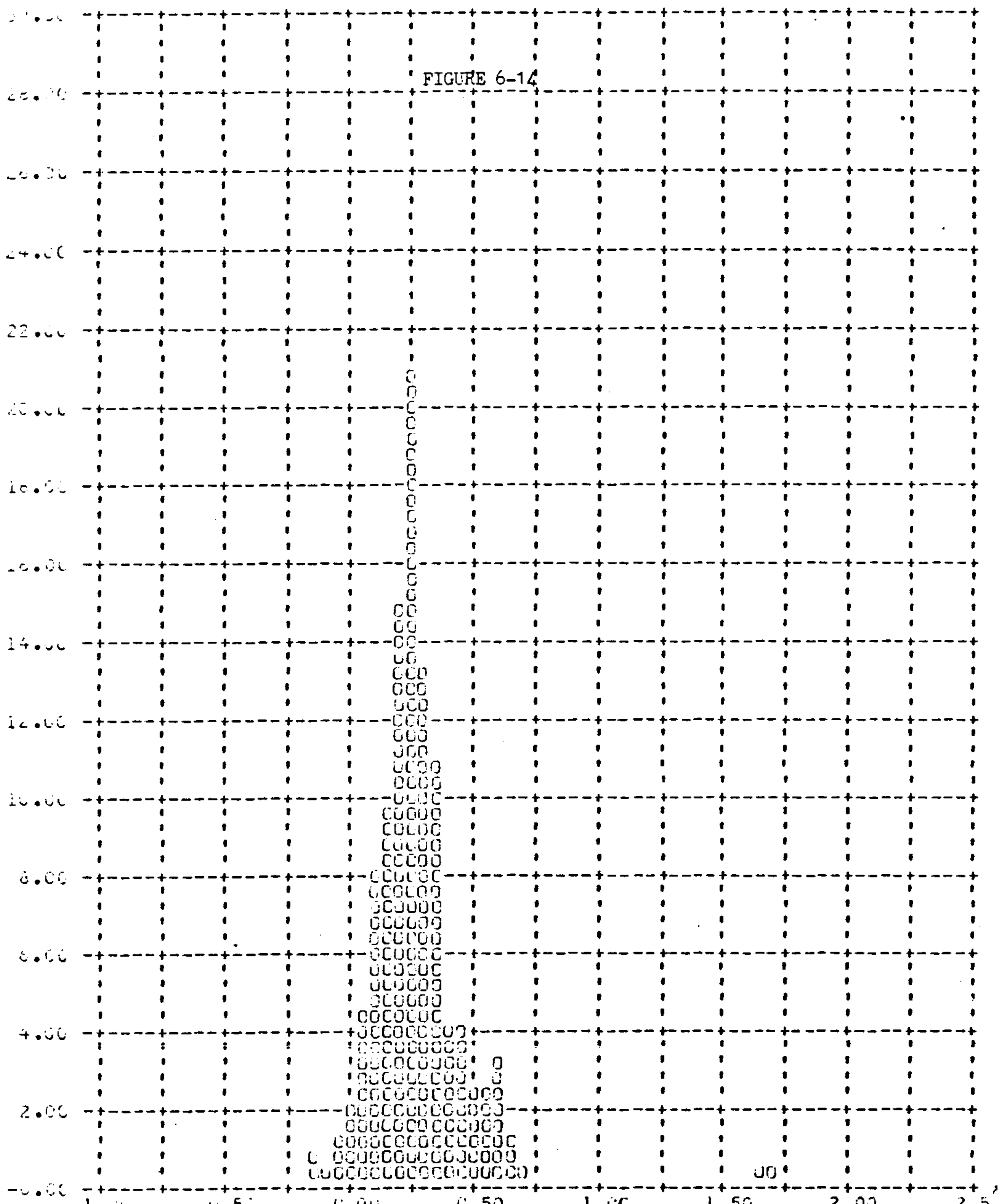


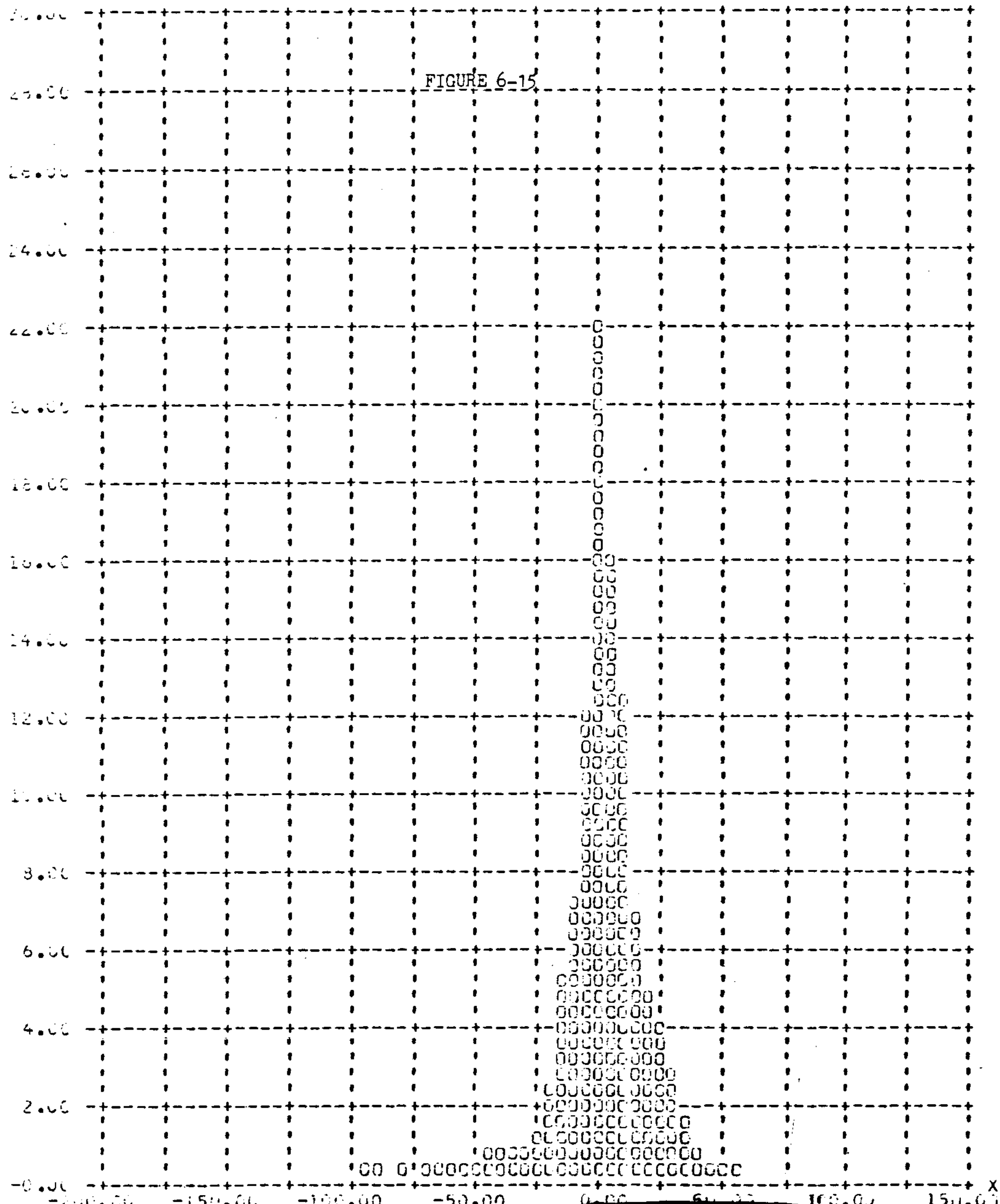
FIGURE 6-14

TOP SECRET/C [redacted]

FRAMES 1-6 OF EACH ID OMITTED   90 PERCENT = 23.94

Y   ROLL RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

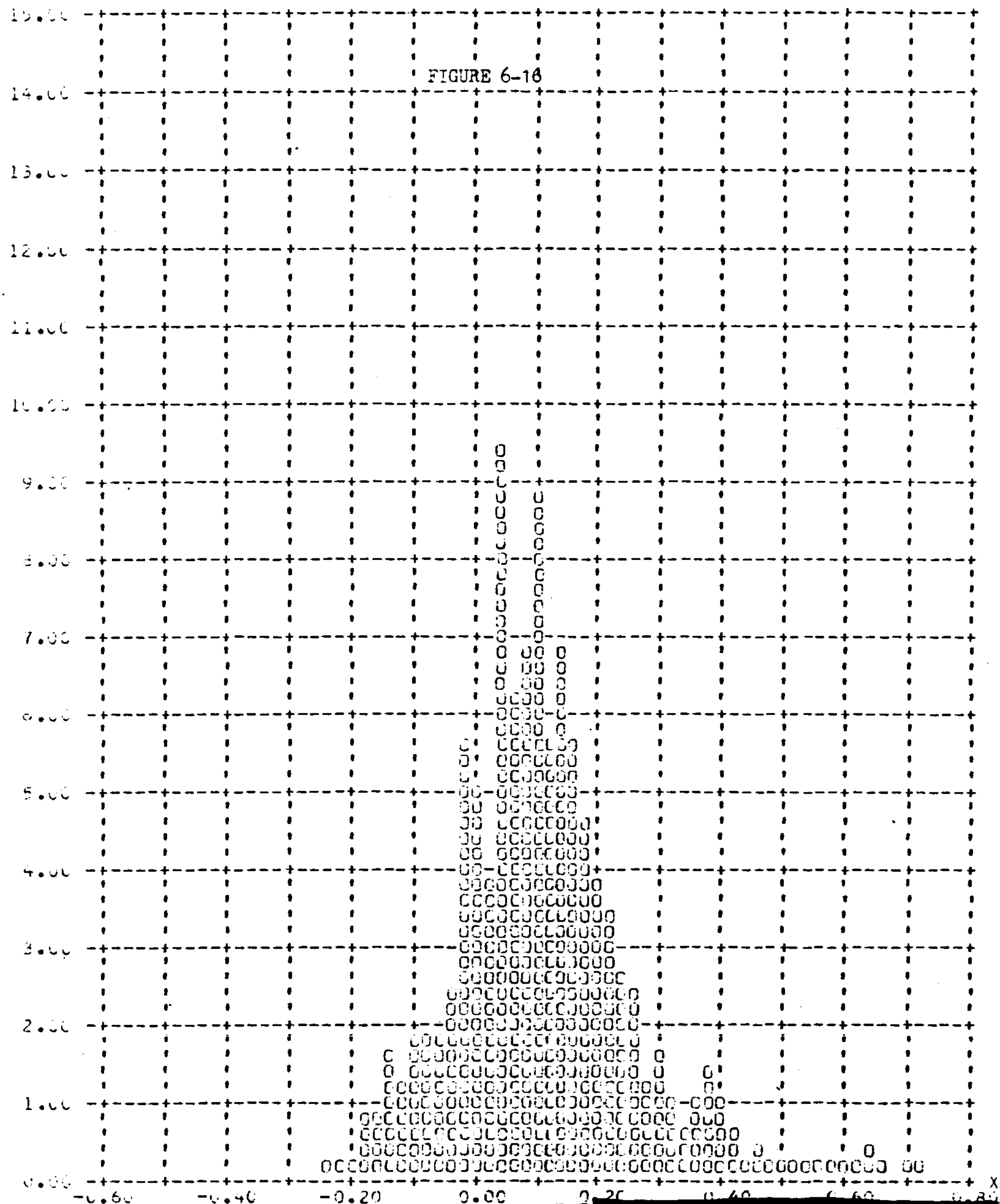
FIGURE 6-15



FRAMES 1-6 OF EACH ... OMITTED   PERCENT = 0.26

ROLL ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-16



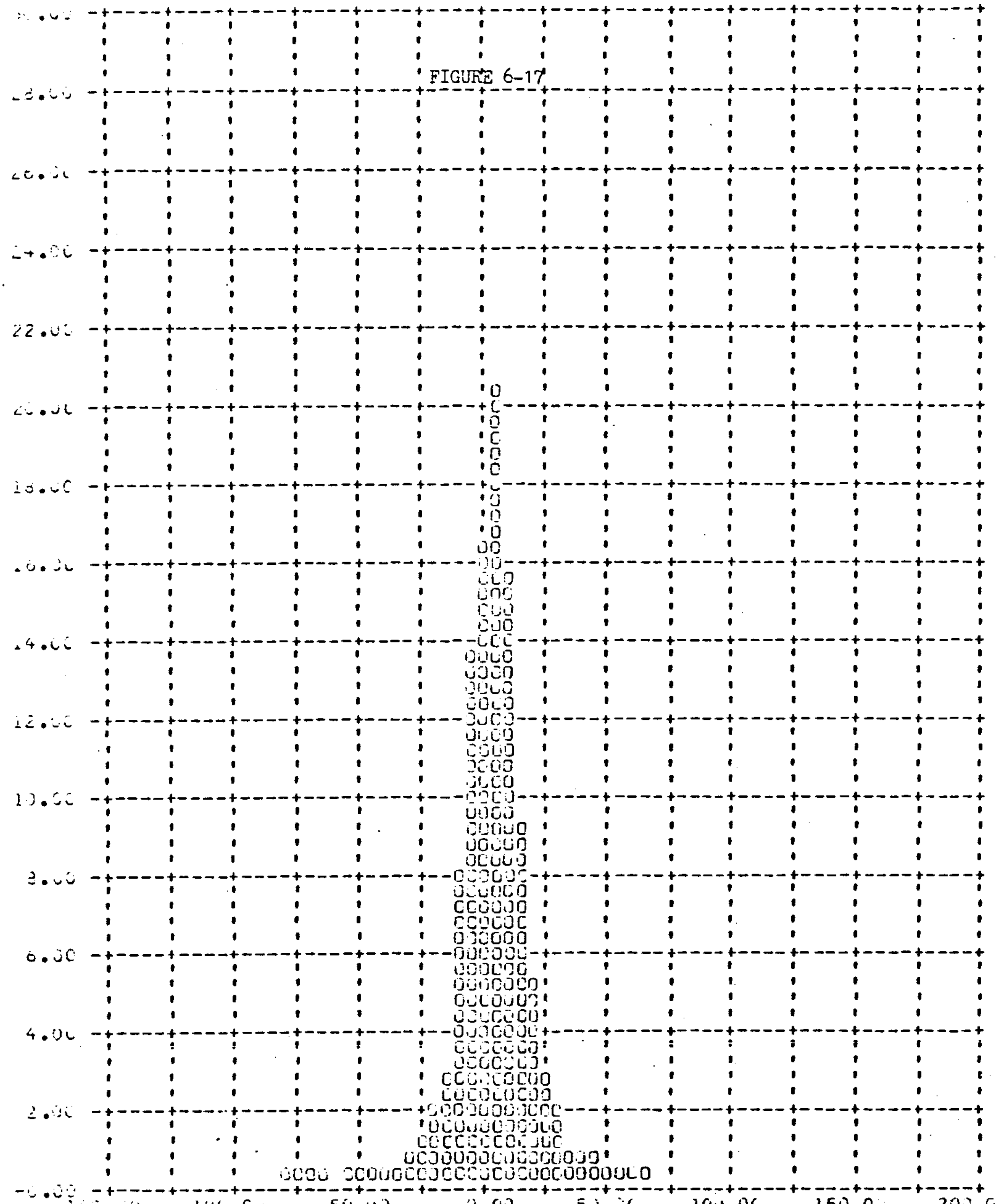
[redacted]

[redacted]

FRAMES 1-6 OF EACH OF OMITTED   90 PERCENT = 21.12

Y   PITCH RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-17



TOP SECRET/C [redacted]

Y PITCH ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

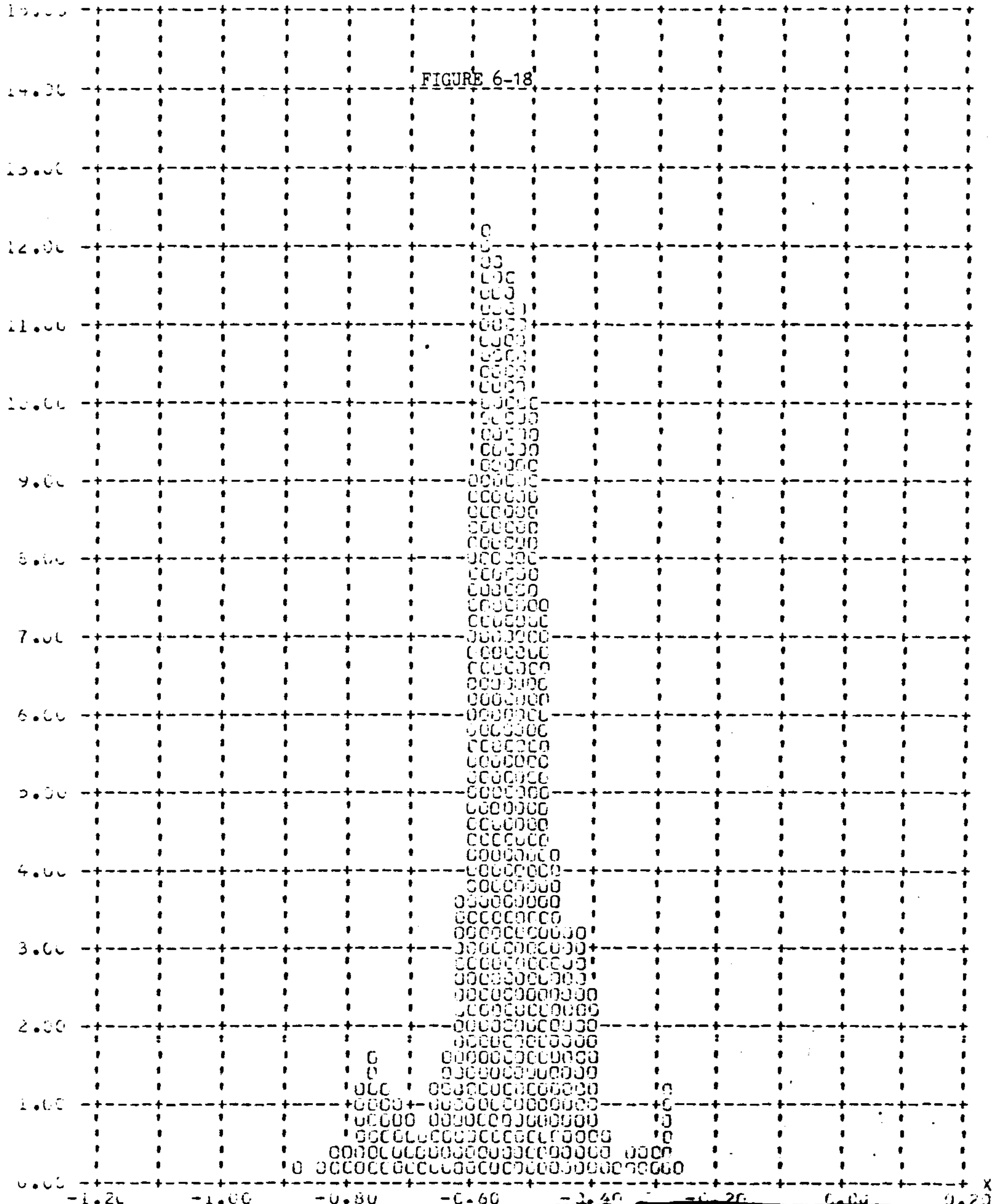


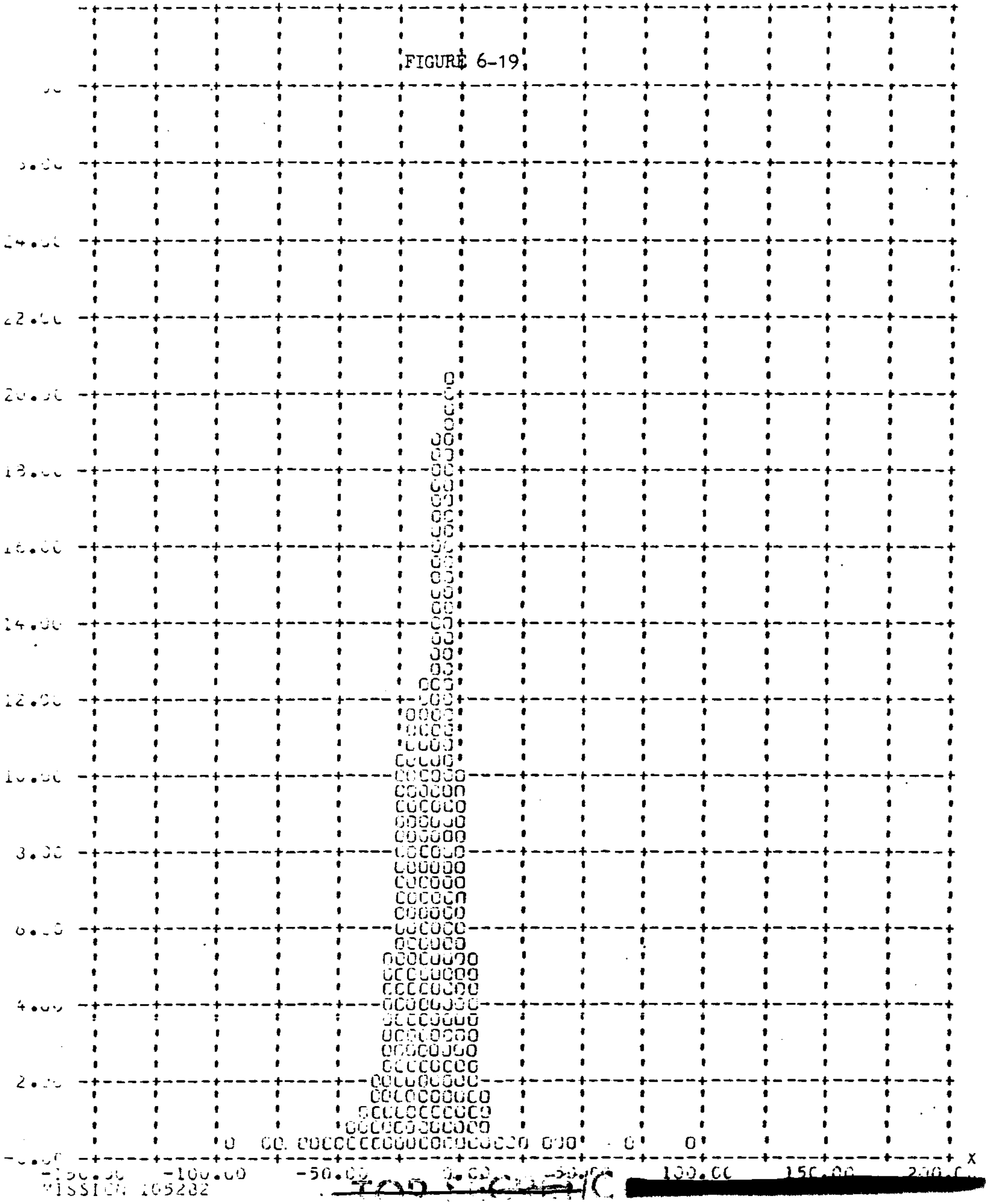
FIGURE 6-18

[redacted]

FRAMES 1-6 OF EACH OP OMITTED   90 PERCENT = 29.95

YAW RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-19

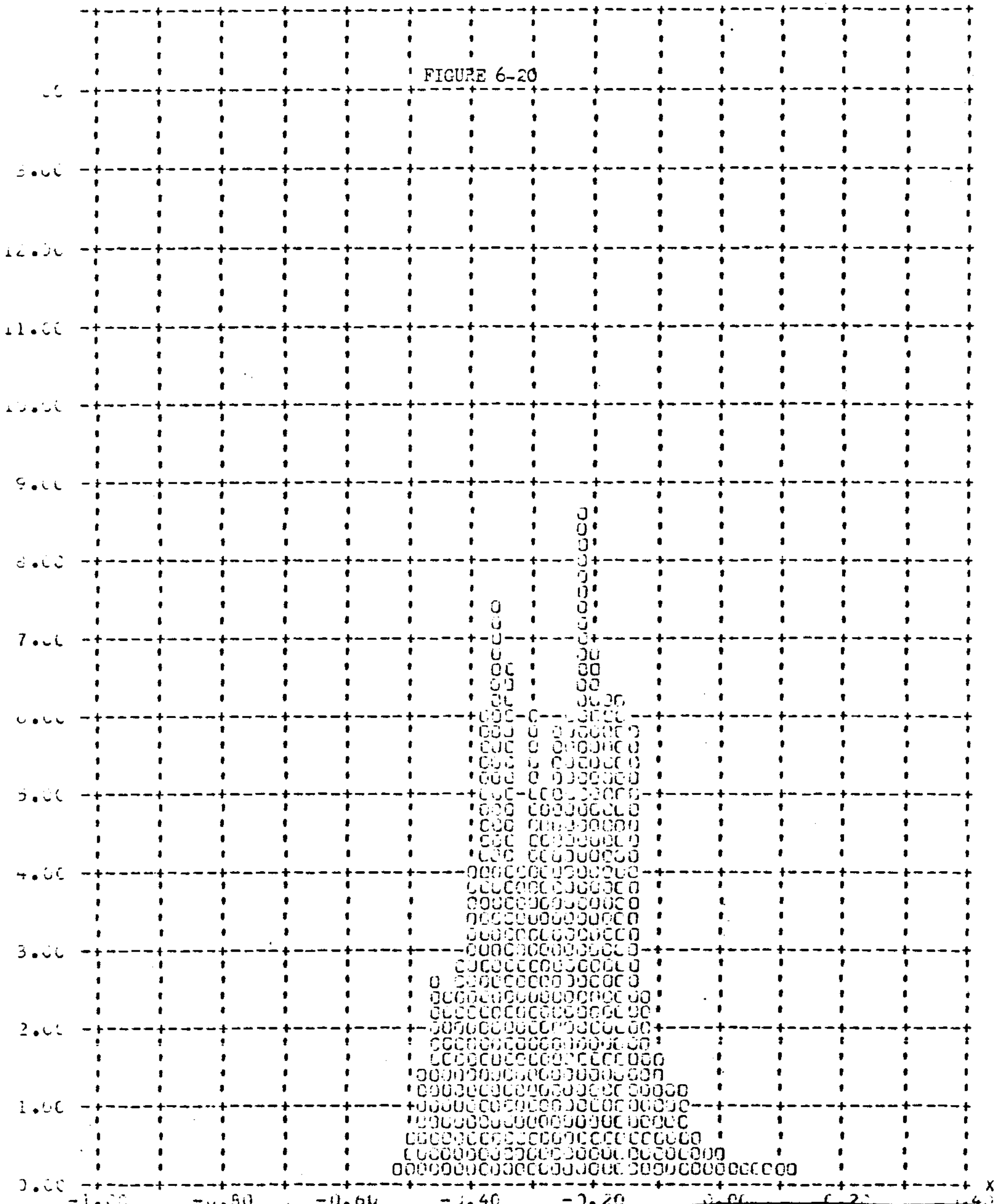


[redacted]

FRAMES 1-5 OF EACH OF OMITTED 90 PERCENT = 0.42

YAW ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-20



FRAMES 1-6 OF EACH OP OMITTED PC PERCENT = 24.05

ROLL RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

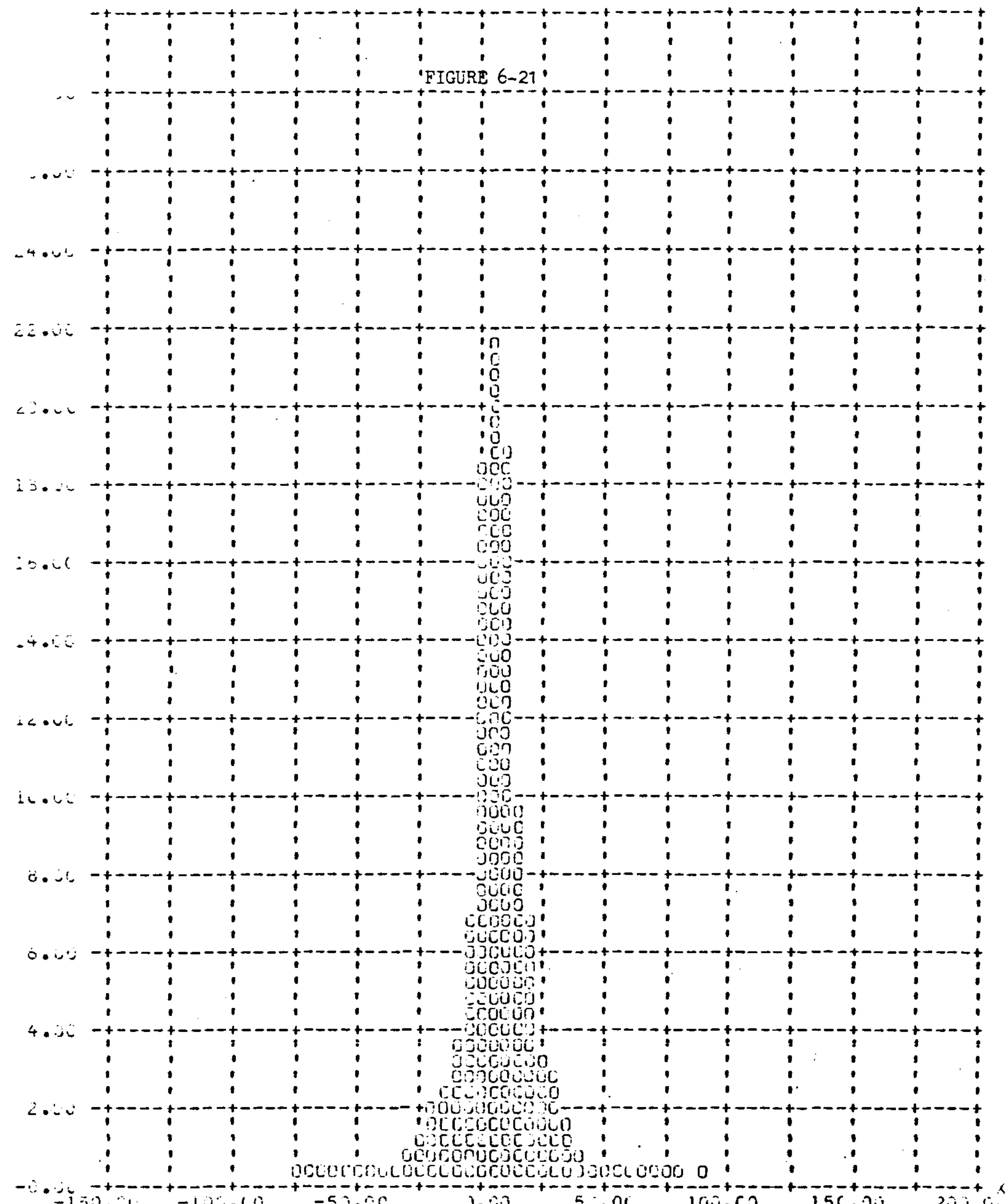


FIGURE 6-21

MISSION 105282 [redacted]

[redacted]

FRAMES 1-6 OF EACH OF OMITTED 90 PERCENT =

ROLL ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

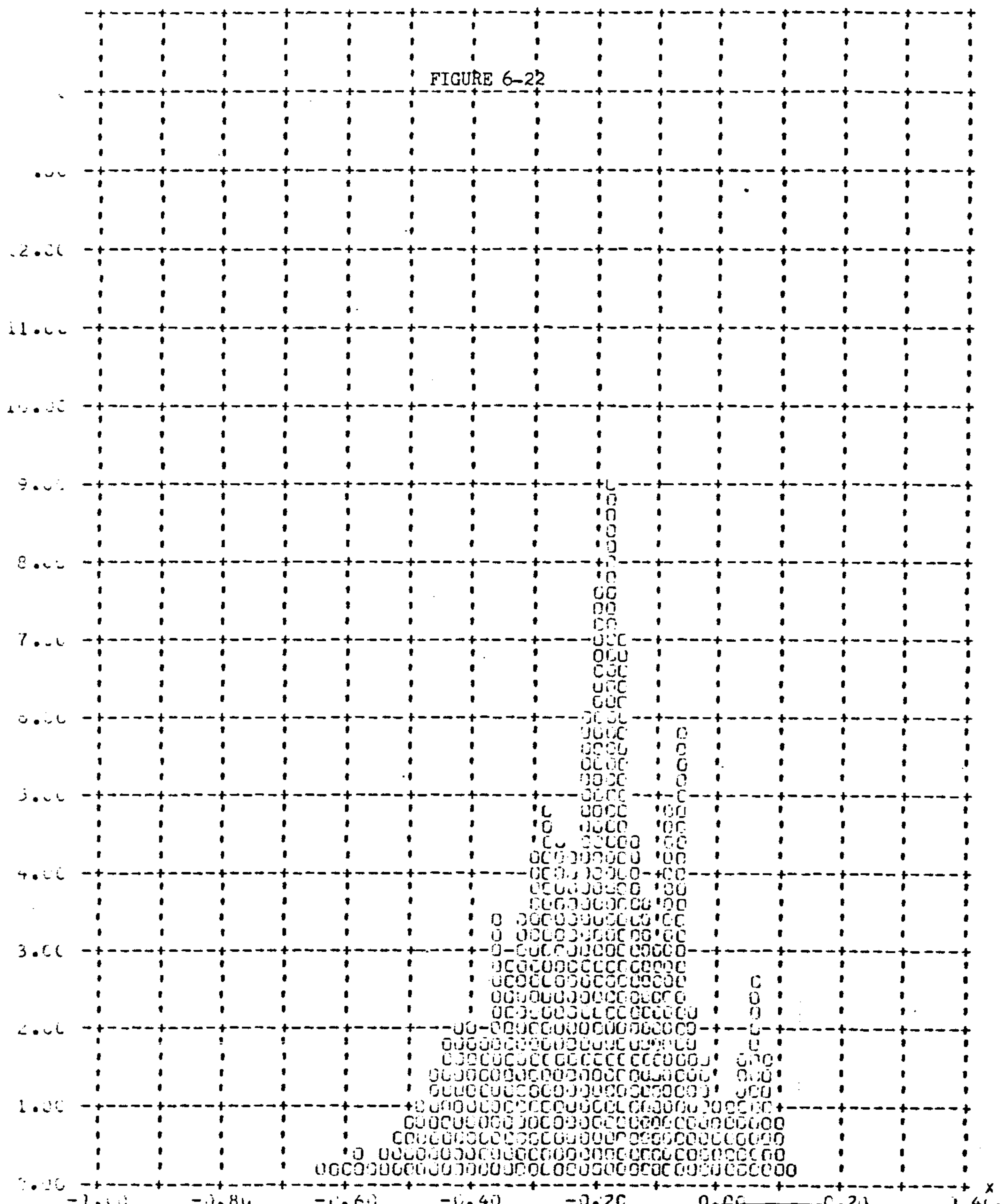


FIGURE 6-22

[redacted]

FRAMES 1-6 OF EACH OP OMITTED   90 PERCENT = 31.35

PITCH RATE ERROR - DEG/HOUR (X) VERSUS FREQUENCY - PERCENT (Y)

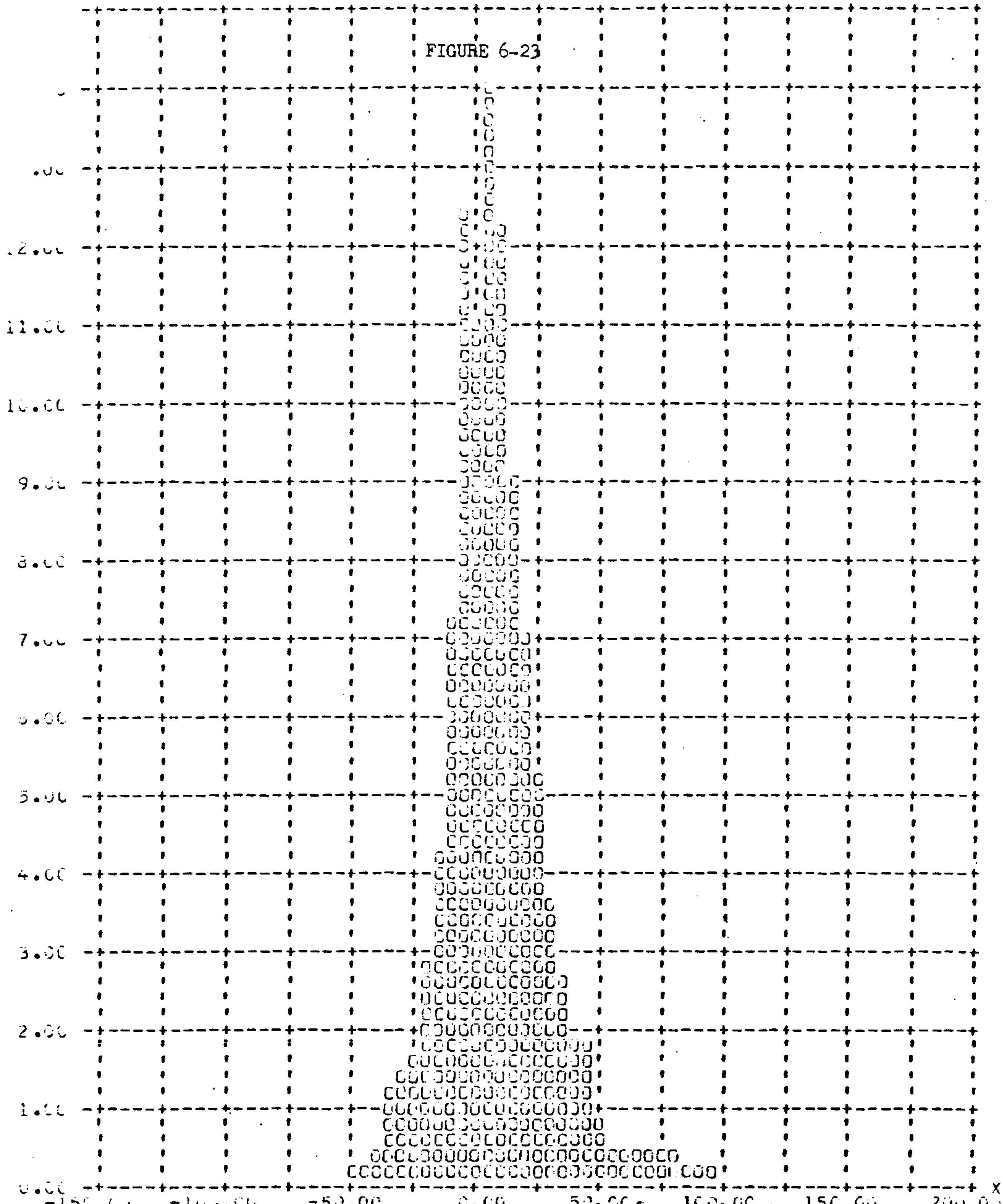
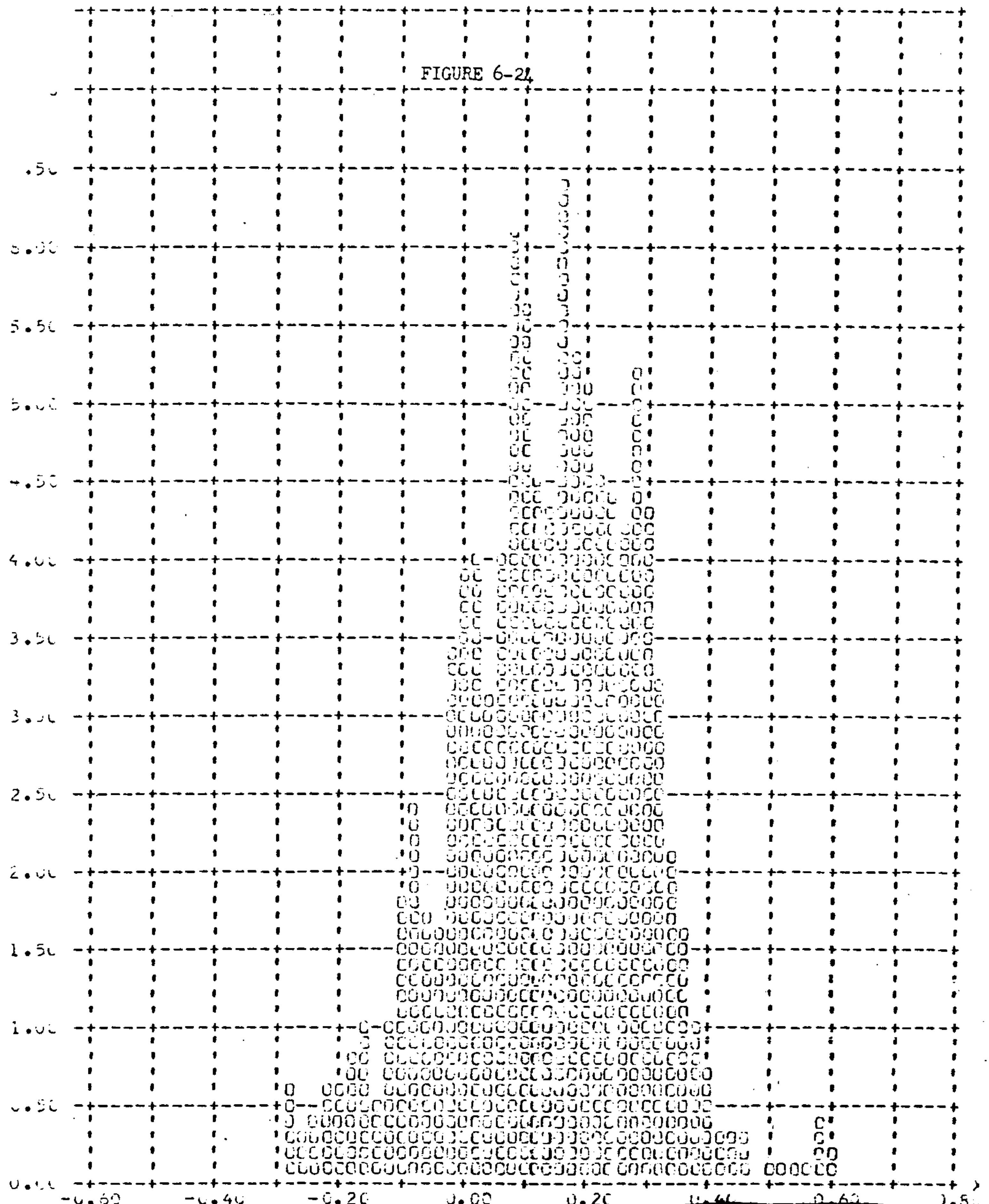


FIGURE 6-23

PITCH ANGLE ERROR - DEGREES (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-24



[redacted]

B. SMEAR ANALYSIS

Data containing the time word for each panoramic photograph are supplied by NPIC to A/P. These times are correlated with the LMSC Precision Fit ephemeris to produce an analysis of FMC error, and are then combined with the vehicle attitude data to produce the net image motion compensation (IMC) errors as well as the total in-track and cross-track ground resolution limits. These resolution limits would apply to any camera system, regardless of focal length or other system capabilities.

It was concluded that smear was not the significantly degrading factor on mission 1052; probably because of the general reduction of image quality from other causes. With the exception of the single operation affected by the Forward Motion Control programmer failure on Rev D21, total system limits were within the normal performance envelope. In addition to the above a flight anomaly occurred on the forward-looking camera when the film came out of the rails beginning with frame 1 of Rev D236 to the end of the mission. This resulted in considerable smear and out-of-focus photography. The formats were not well defined and the shrinkage markers were not detectable.

The table on the following page summarizes the net IMC range encountered during each mission segment, and the resolution limits. The computer outputted graphs from which this summary was made are included in Figures 6-25 through 6-36.

IMC RATIO AND RESOLUTION LIMITS

VALUE	UNITS	CAMERA	MISSION 1052-1 90%	MISSION 1052-1 RANGE	MISSION 1052-2 90%	MISSION 1052-2 RANGE
IMC Ratio Error	%	Fwd	4.14	-8.4 to +4.0	3.36	-4.4 to +2.2
		Aft	3.31	-9.0 to +5.5	3.07	-4.6 to +2.6
Along Track Resolution Limit	Feet	Fwd	4.86	0 to +10.6	4.00	0 to +10
		Aft	2.88	0 to +8.8	2.73	0 to 8.8
Cross Track Resolution Limit	Feet	Fwd	1.25	0 to +3.8	0.69	0 to 1.35
		Aft	0.76	0 to +2.5	0.89	0 to 1.55

FRAMES 1-6 OF EACH UP OMITTED 90 PERCENT = 4.14

IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)

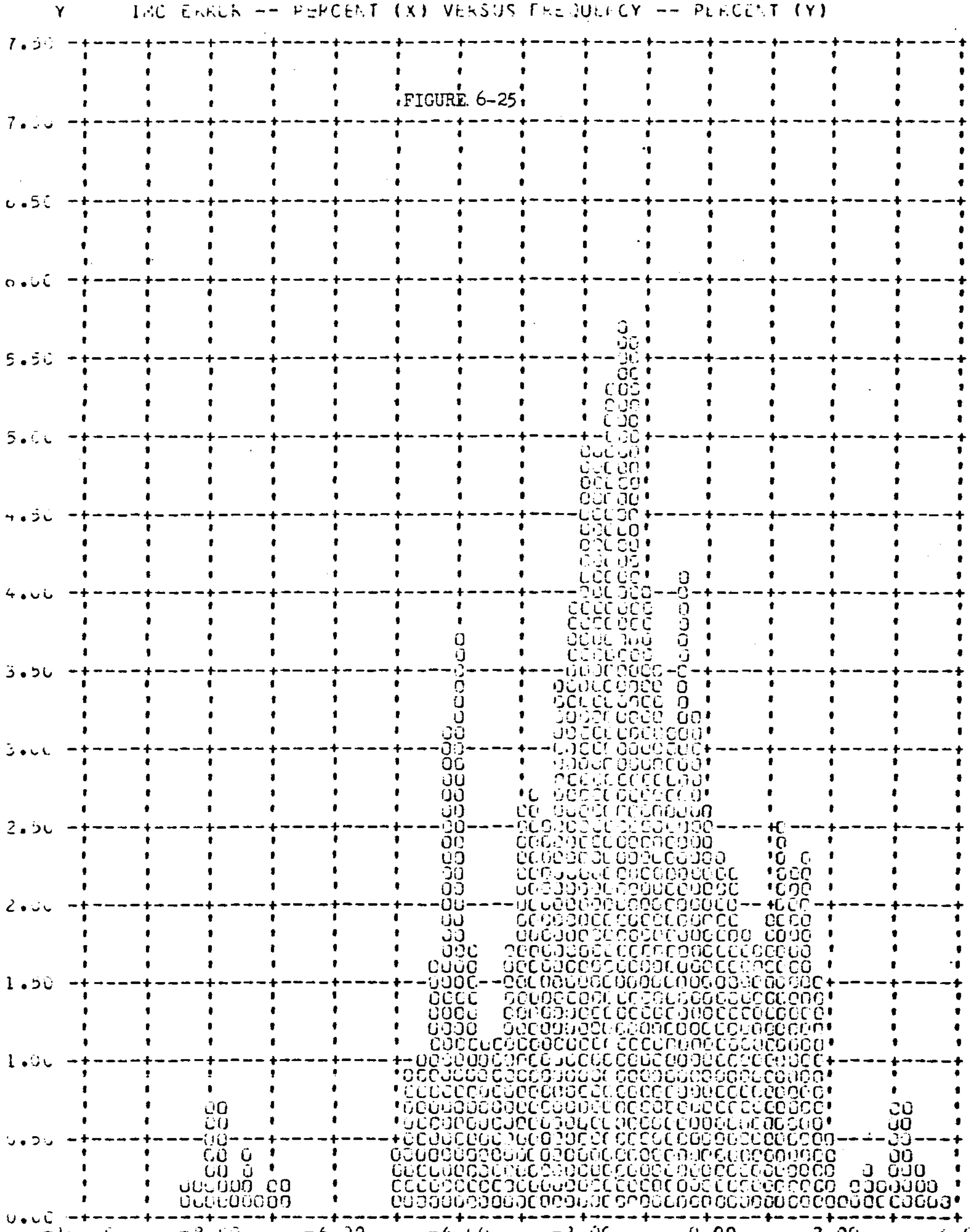
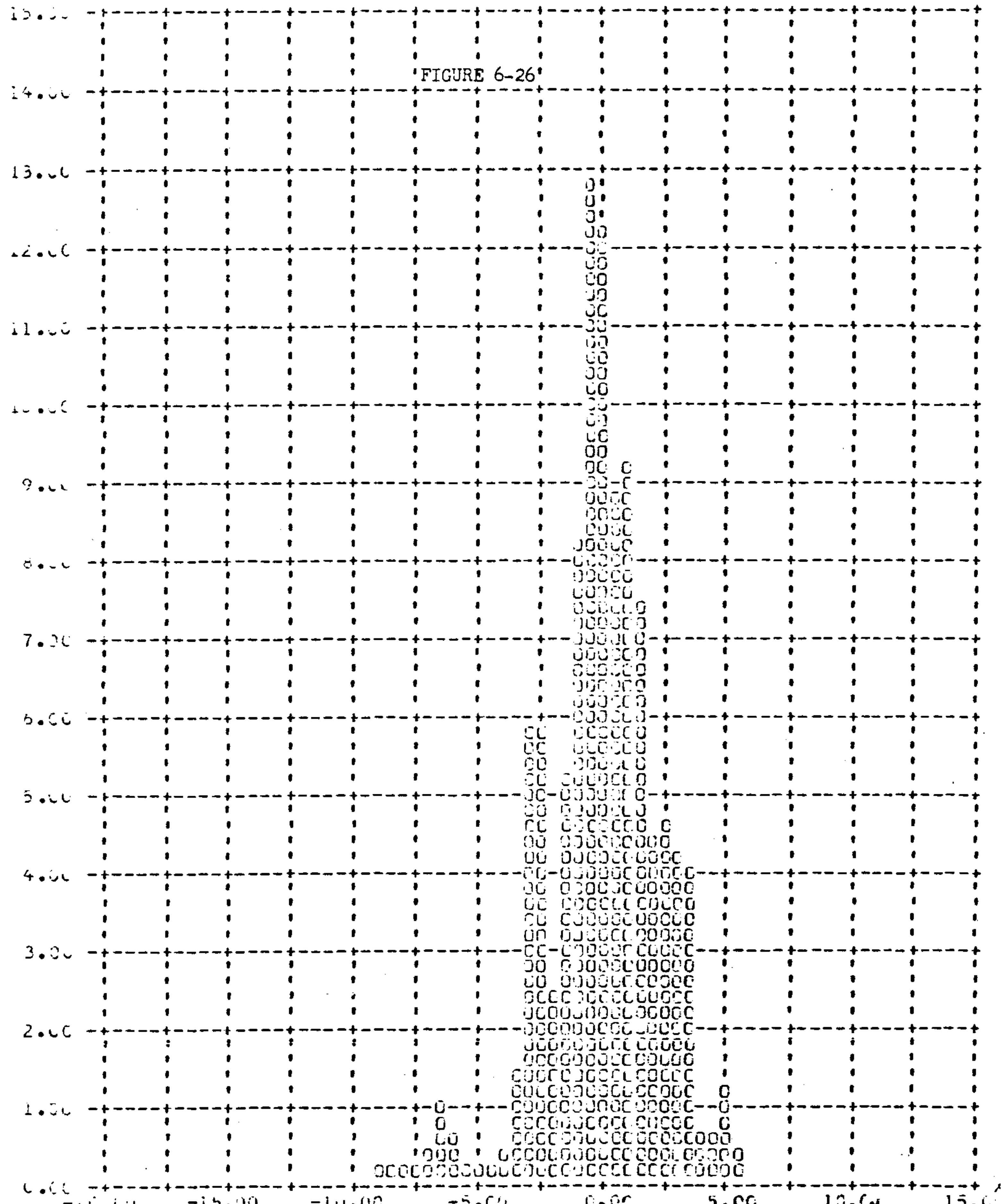


FIGURE 6-25

FRAMES 1-6 OF EACH OP OMITTED OO PERCENT = 3.31

Y IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)



FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 3.35

IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)

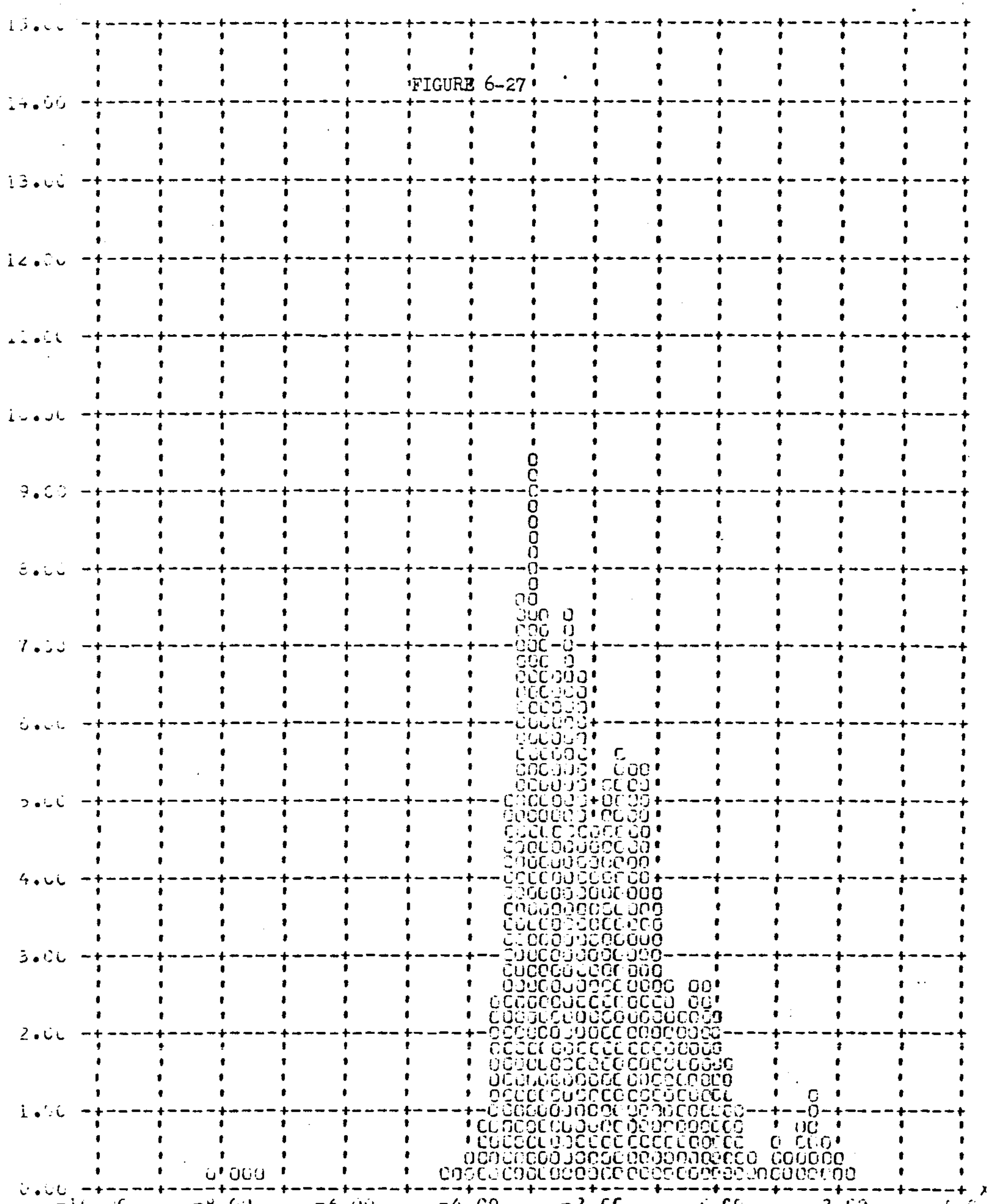


FIGURE 6-27

FRAMES 1-6 OF EACH OF OMITTED 90 PERCENT = 3.07

Y IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)

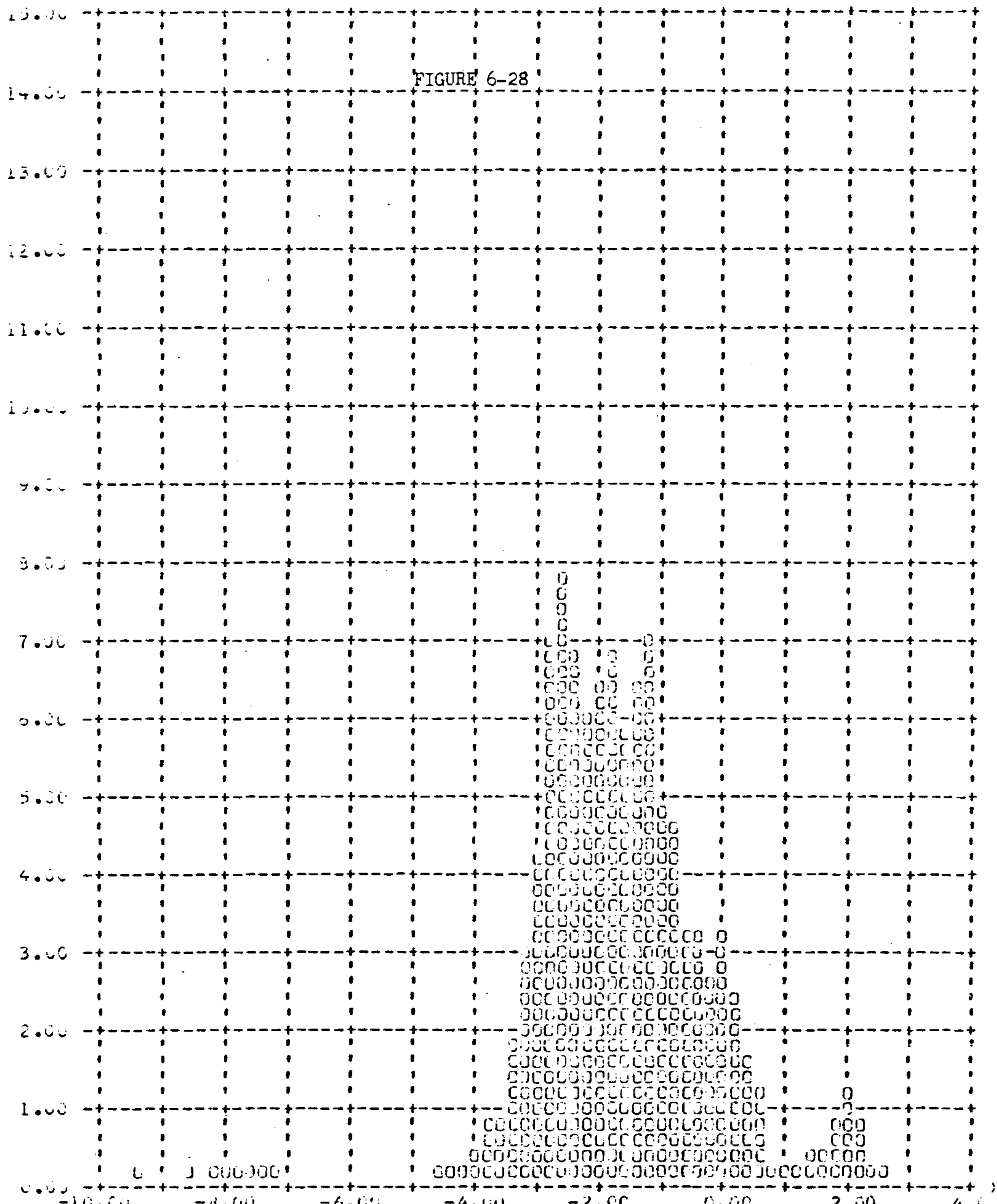
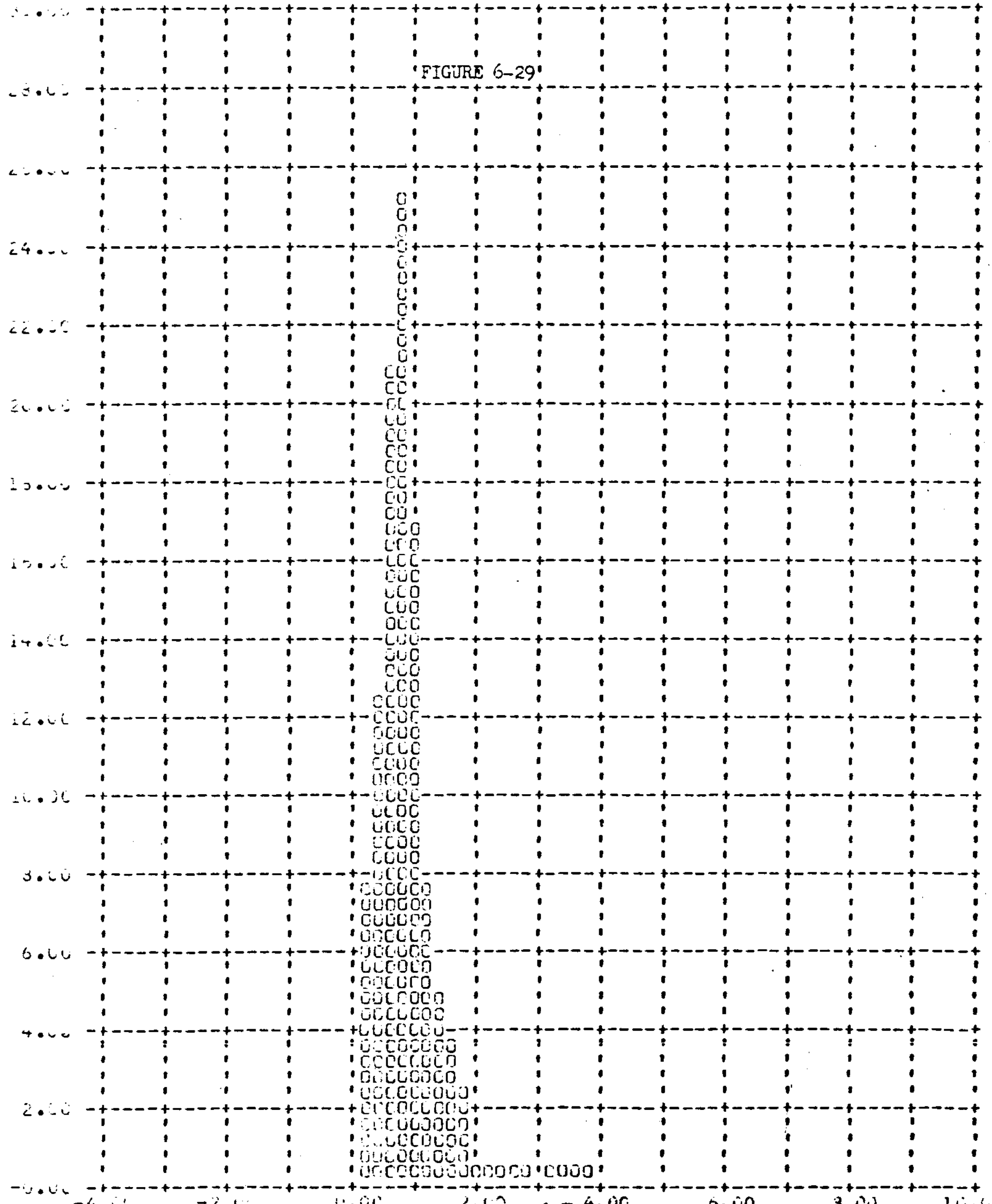


FIGURE 6-28

[redacted]

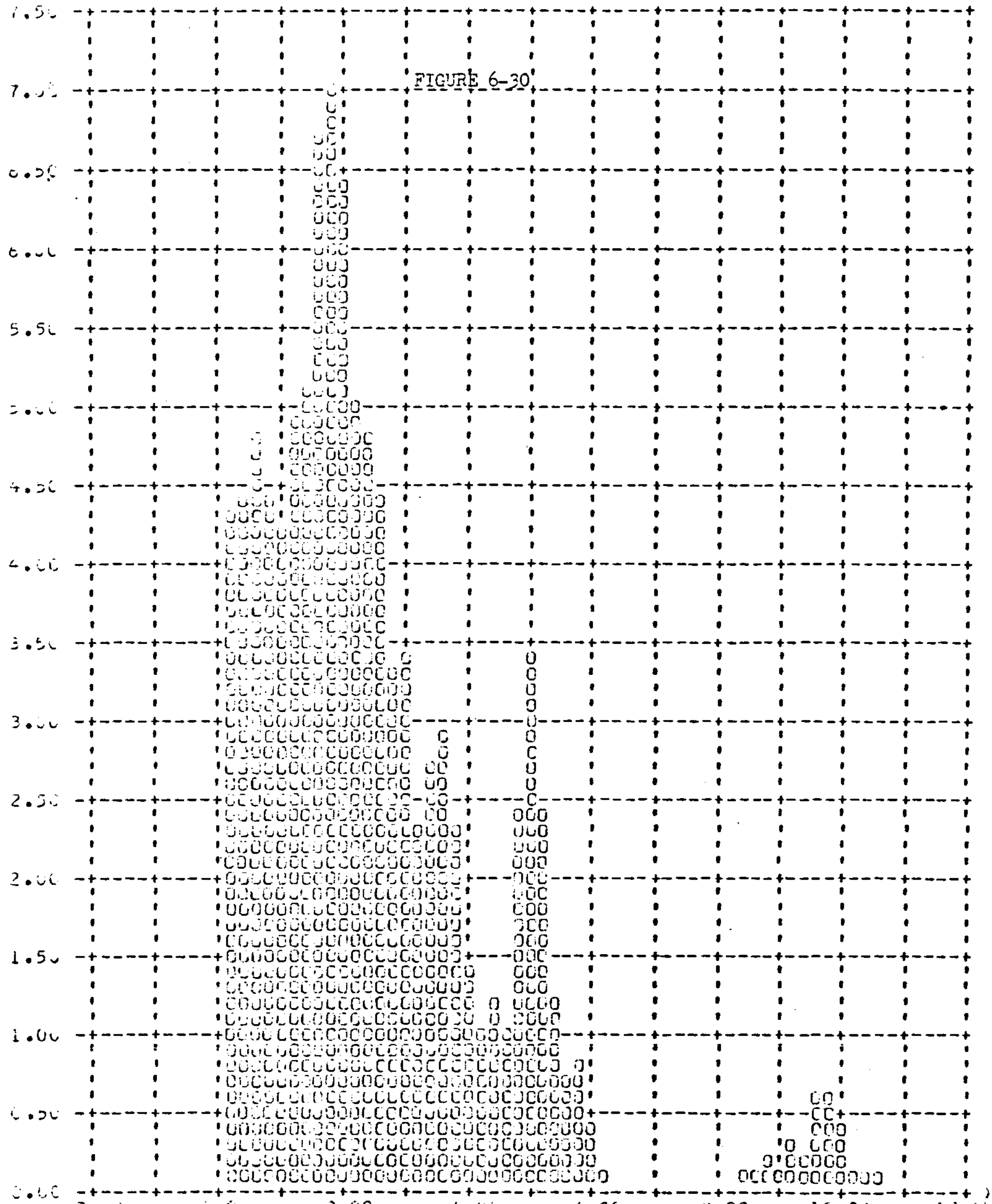
FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 1.25

Y CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



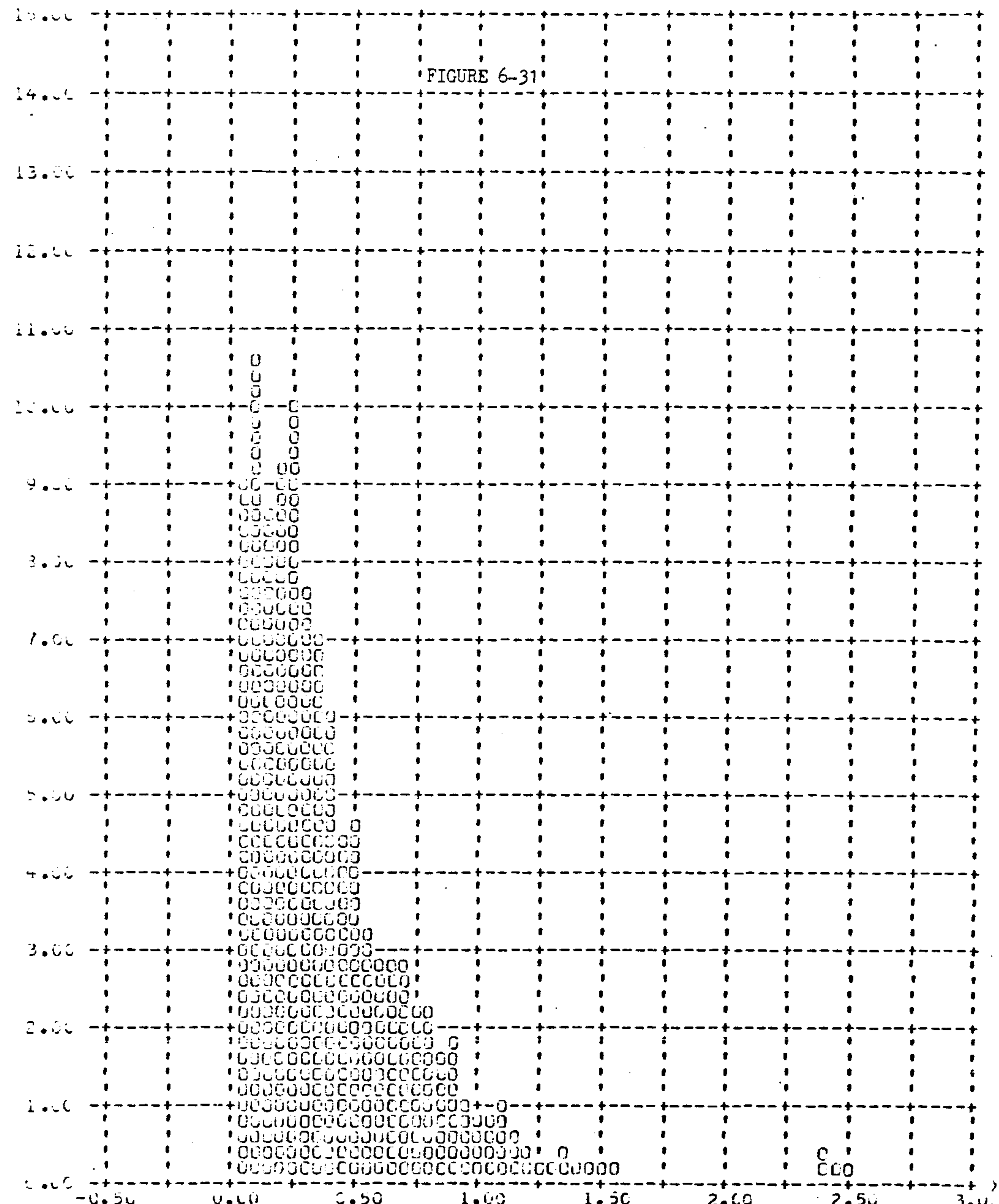
TOP SECRET/C [redacted]

Y   ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 0.76

Y CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



TOP SECRET [redacted]

FRAMES 1-6 OF EACH OF OMITTED 90 PERCENT = 2.86

Y ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)

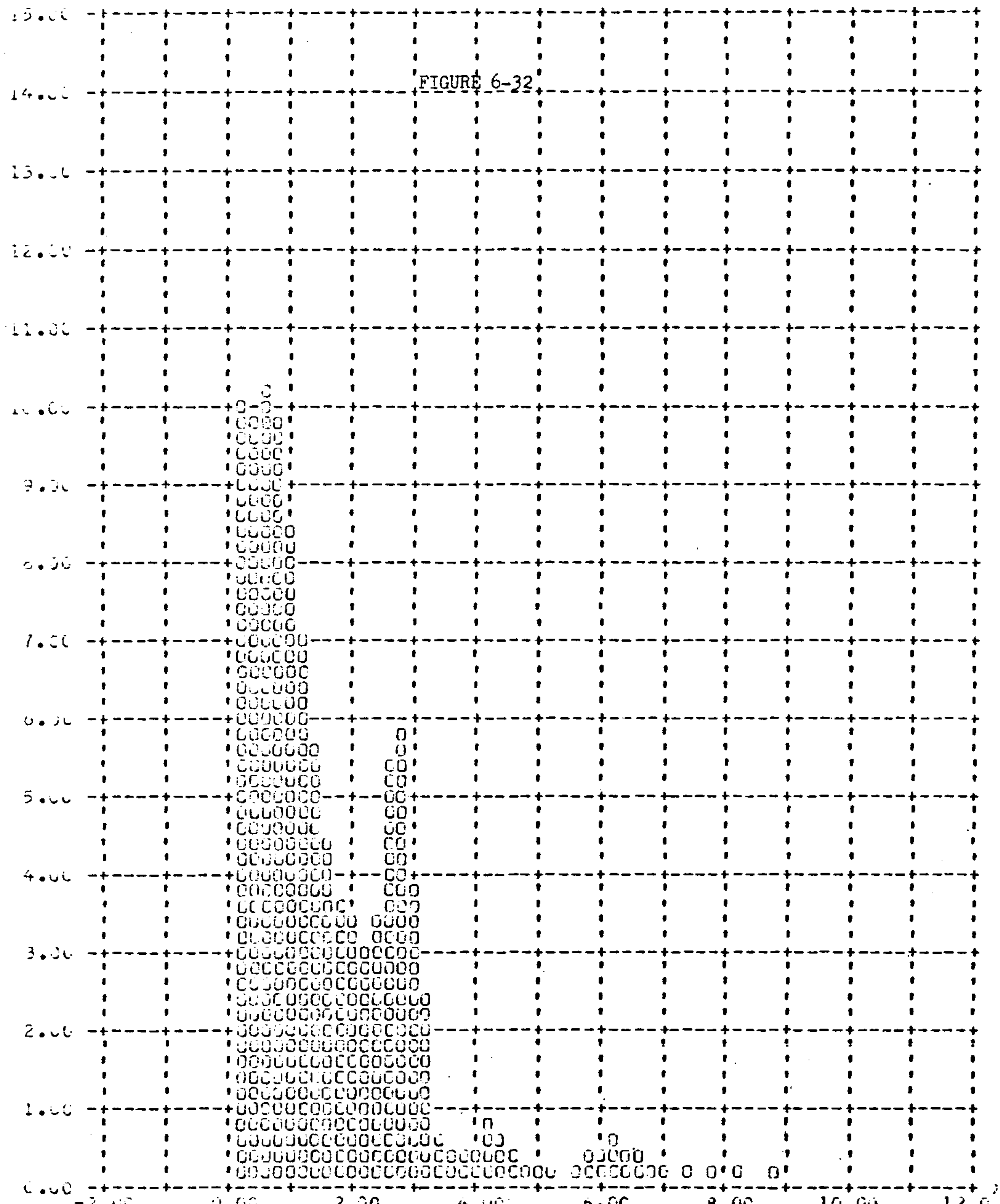
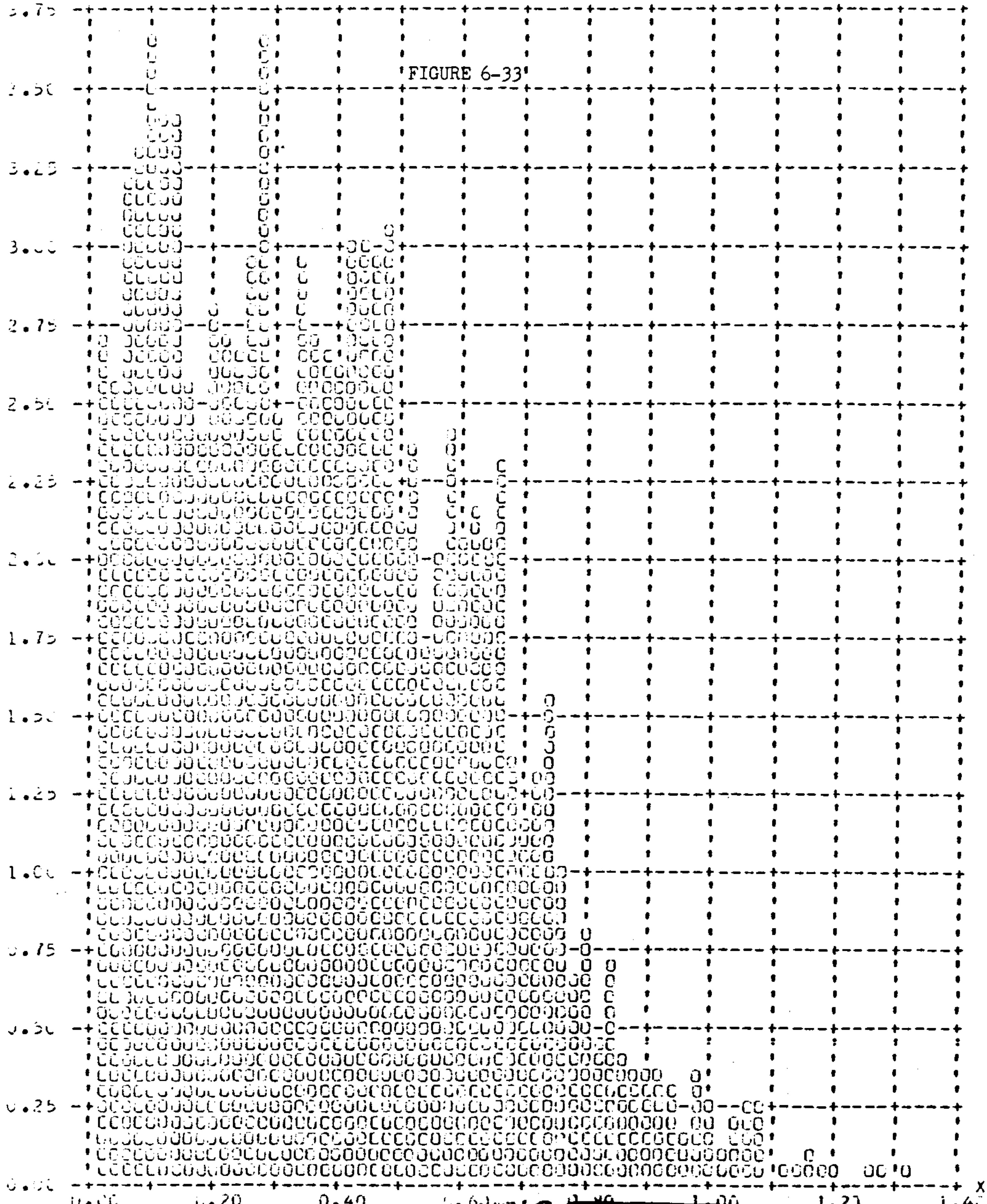


FIGURE 6-32

FRAMES 1-6 OF EACH OP OMITTED   OC PERCENT = 0.69

Y   CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



FRAMES 1-6 OF EACH UP OMITTED   90 PERCENT = 4.00

Y   ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)

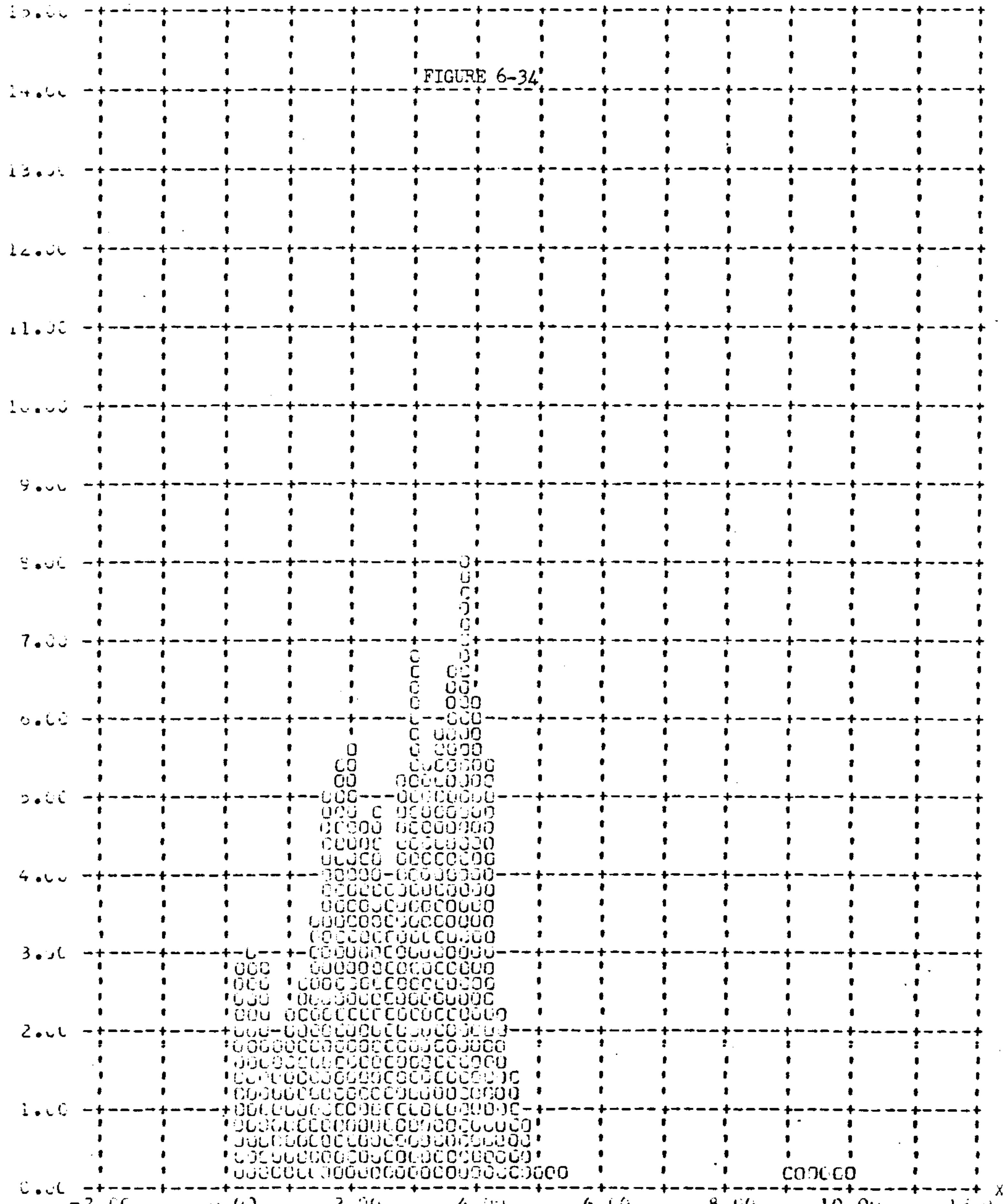
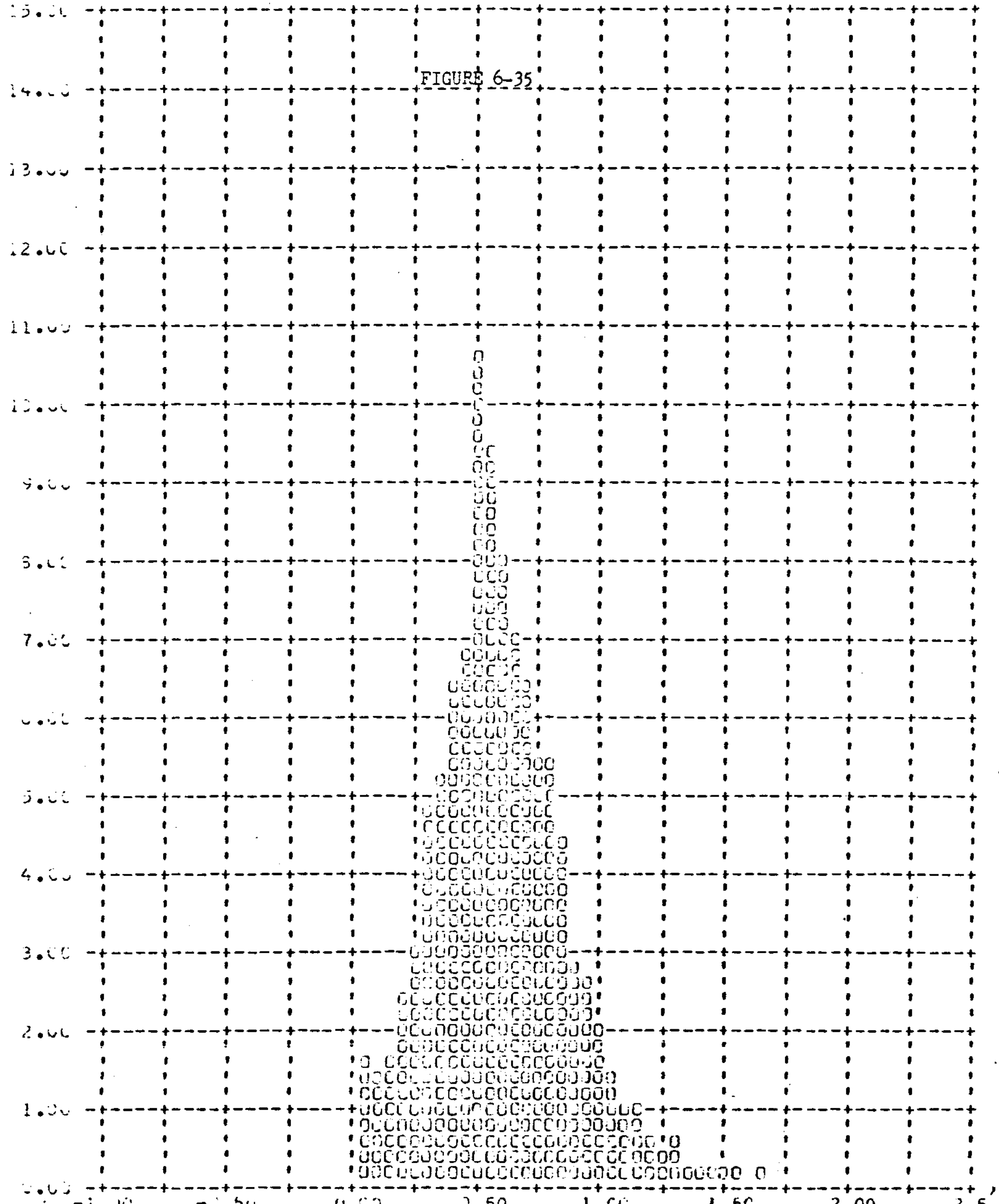


FIGURE 6-34

FRAMES 1-6 OF EACH OF OMITTED 90 PERCENT = [illegible]

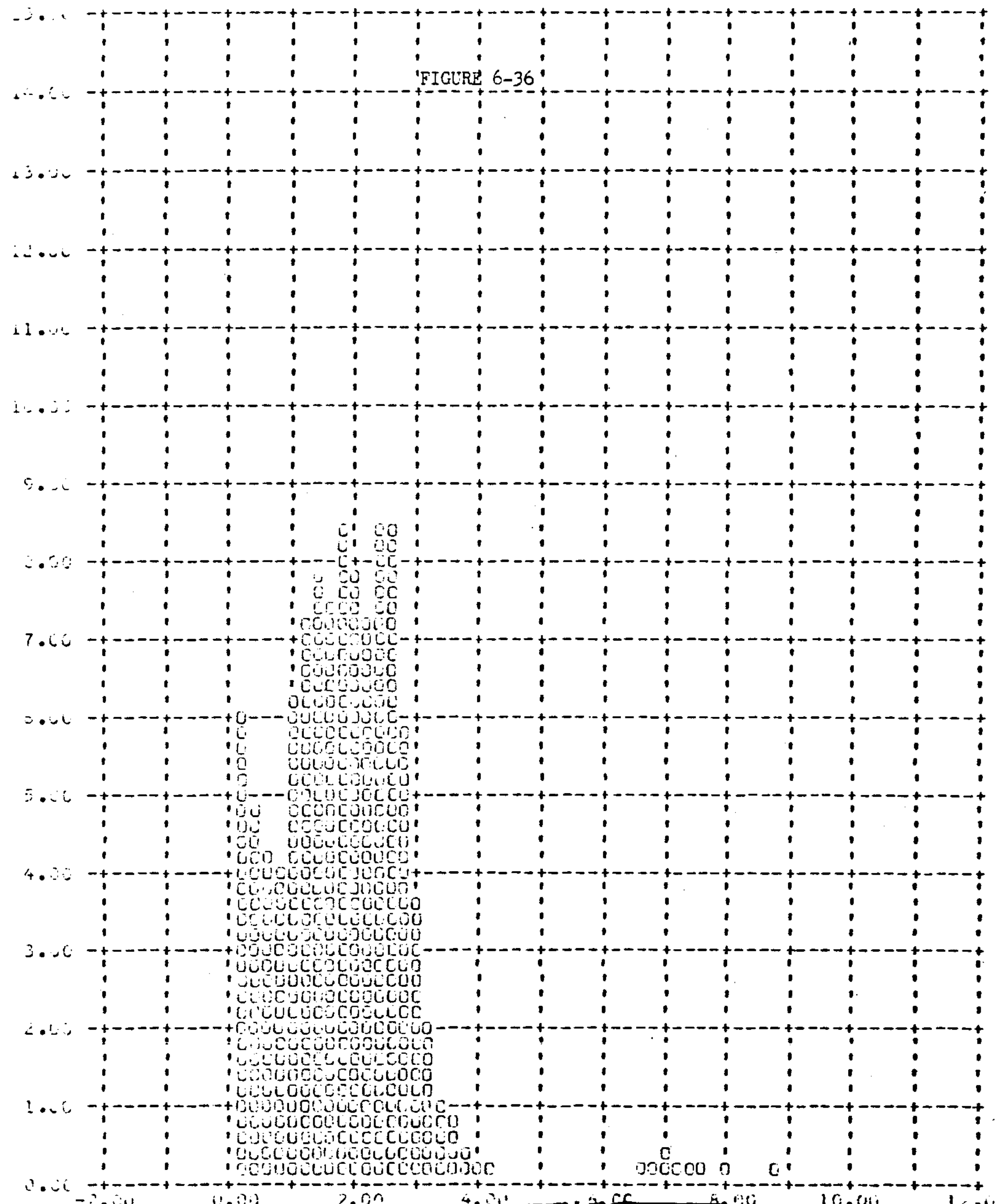
Y CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 6-35



FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 2.73

Y ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



TOP SECRET/C [redacted]

SECTION 7

SYSTEM RELIABILITY

Reliability calculations for the payload are based on a sample beginning with M-7. Hence both the major part of the Mural program and the "J" program are covered in the calculation. The sample size for the primary mission function is consistent with reliability reporting for the vehicle.

The reliability estimates of this section deal exclusively with the payload. Failures to achieve orbit or vehicle induced failures are thereby excluded. Recoveries before a complete mission has been completed are considered as full missions providing that early termination was caused by reasons not connected with payload operation. Film quality is not considered in the reliability estimate calculation. Hence, only electrical and mechanical functioning are considered.

The reliability estimate is also divided into primary and secondary functions. The primary functions are operation of the panoramic cameras, main camera door operation, operation of the payload clock, and recovery operations. The secondary mission functions are horizon camera operation excluding catastrophic open shutter failure mode, auxiliary data recording.

Panoramic Camera Reliability

Sample Size - 248 opportunities to operate
Three accumulated failures
Assume - 3000 cycles per camera per mission
Estimated Reliability = 98.54% at 50% confidence level

Main Camera Door Reliability

Sample Size - 73 vehicles x 2 doors = 146 opportunities to operate
Estimated Reliability = 99.5% at 50% confidence level

Payload Command and Control

Sample Size - 15,984 hours operation in sample

Two failures

Estimated Reliability = 97.2% at 50% confidence level

Payload Clock Reliability

Sample Size - 15,984 hours operation in sample

No failures

Estimated Reliability - 99.25% at 50% confidence level

Estimated Reliability of Payload Functioning on orbit = 94.65 at 50% confidence level

Recovery System Reliability

117 opportunities to recover

1 failure - improper separation due to water seal - cutter failure

Estimated Reliability - 98.6% at 50% confidence level

Horizon Camera Reliability

Sample begins with J-5 - Total Cycles = 217,266

Estimated Reliability of Single Camera - 99.4% at 50% confidence level