Surveyor V

TELEVISION DATA PACKAGE

1967

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

SURVEYOR V TELEVISION DATA PACKAGE

Forward

The enclosed image, tabular and text information represent the record of Surveyor V television data delivered to the scientific community to the present time. These contents are not a report on the scientific analysis of the Surveyor V data, but provide only the most complete and accurate TV data available to date. Scientific analyses are reported through other mechanisms, including Project Reports, Public Information Releases, and Scientific Journal articles.

The Surveyor V Mission Data Package was prepared by the staff of the Surveyor Project under contract NAS 7-100.

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TELEVISION DATA PACKAGE DESCRIPTION

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The material in this book has been compiled and edited by Em Bergschneider and John N. Strand. The contributors to this volume are:

Section	Author or Source of Data
2-a	M. Smokler
2-b	S. Dinsmore
2-c	S. Dinsmore
3-a	W. Leflang
3-b	U.S.G.S.
3-c	J. Rennilson
3-d	J. Lindsley and R. Norton
4-c	E. Johnson

INTRODUCTION

The information included in this document contains supporting material to assist scientific analysis and analysis of the Surveyor V television data. The contents are arranged to provide the following:

a) The calibration section explains and contains the calibration data available for the image and TV Identification data. Included are the light transfer function delineating the transfer characteristic from input lunar luminance to the film density of the duplicate negative. Additional calibration is provided to show the shading response of the camera and film recorder system and to show the extent and location of vidicon blemishes.

b) The operations information section includes a brief description of camera performance, the surveyor V landing location, and spacecraft attitude, and the ephemeris of the stars and earth when viewed by the Surveyor V television camera. Also the mission sequence log is included to list the type and period of science operations performed.

c) The image data description section describes the image format of the duplicate negative and the format of the mosaics included, in addition to listing the included mosaics. T description of the digital computer processing used to prepare the processed pictures contained in the mission data package is included. The method used to recombine the separate black and white images to form the color pictures included is provided in this section.

d) The television identification data description section describes the human and machine readable portion of the duplicate negative and identifies the parameters on the film and summary listing. By providing a blank computer magnetic tape to the National Science Data Center, Code 601, Green belt Maryland 20771, attention of Mr. John Campbell, a user may obtain an IBM 7094 Fortran II or Fortran IV (user specified) compatible recording of the time sorted television identification data. The format of this recording is described in this section.

Surveyor V carried a single fixed mounted television camera using a moveable mirror to scan the lunar surface. Two modes of vidicon or electronic scanning were included, 200 line mode and 600 line mode. The scanning raster used for both modes was 11mm by 11mm. The sequence included both 200 and 600 line modes, but the latter was emphasized. Of the more than 18,000 frames taken during the Surveyor V mission, 18 were in 200-line mode.

Accompanying each image transmission were 13 camera parameters, the television identification (TVID) data. The Surveyor V camera system was nominally identical to the Surveyor I camera system. Therefore, a detailed engineering description of the Surveyor V camera system can be found in JPL Technical Report No. 32-1023, Surveyor I Mission Report, Part III Television Data, Section II Television Subsystem, by Donald R. Montgomery, pages 3 to 17.

Introduction (cont.)

The television data transmitted by the Surveyor III was received by the worldwide Deep Space Stations (DSS) of the JPL managed and operated tracking network, the Deep Space Net (DSN). Control of the mission was exercised from the Space Flight Operations Facility (SFOF) at JPL in Pasadena. The primary recording facilities for television data were at Goldstone, California and at the SFOF facilities connected to the Goldstone DSS via a 6 mc microwave link.

Image and TVID data were recorded on film and magnetic tape during Goldstone (Station 11) view periods both at Goldstone and the SFOF. Overseas data was recorded only on magnetic tape and then replayed through the SFOF film recorder. The source of the image data for each frame is identified by the process code which is described in section 5. TVID data was validated and reconstructed buy reference to the command logs, engineering assessments of camera response and comparison with mosaics. The recording and processing system, called the Television Ground Data Handling System (TGDHS) and is described under that title in Surveyor V Mission Report Part I, 1967.

INTRODUCTION

On 18-21 July 1967, the television camera system of the Surveyor V Spacecraft (SC-5) was calibrated by a JPL Space Sciences team. The calibration was conducted according to JPL Test Procedure ETP-SUR-001-E and utilized JPL calibration equipment – including a light source, slide transparencies and a video tape recorder.

The test collected accurate data for verification of the Television Ground Data Handling System (TV-GDHS) for use by the Space Science Analysis and Command (SSAC) group during the Surveyor Mission E operations, and in postflight data processing.

CALIBRATION CONTENT

Procedures for this scientific calibration were based on past Ranger calibration experience and experience gained from Surveyor SC-1 through SC-4 calibrations. The main parameters were light transfer characteristics, sine wave response, geometric linearity, and erasure characteristics.

Calibration was performed in both 200- and 600-line TV scan modes and in both normal-shutter and open-shutter exposure modes for the narrow-angle field of view. In the 600-line scan mode, the color filter light transfer characteristics were taken and automatic-iris and commanded-iris position repeatability measurements were made.

All of the above calibrations were performed via spacecraft Transmitter A. Brief tests were made on Transmitter B and for the wide angle field of view.

Calibration data on the constants for reduction of color data were obtained. (Photometric charts on the spacecraft were calibrated at JPL previously.) Photogrammetry calibration was also performed.

Data were recorded on a modified Ampex VR 1560 portable video recorder, and selected single-line scans at the center (vertically) of the TV frame were recorded on Polaroid film by using an A-scan oscilloscope presentation.

EQUIPMENT AND DATA RECORDING

A special light source and calibration slides were developed by JPL to permit continuous luminance level changes and monitoring, coupled with rapid slide interchangeability. The light source has xenon lamps in conjunction with an integrating hemisphere. Resulting performance includes a field uniformity of 3 percent with a luminance range of 4 foot-lamberts to 2500 foot-lamberts, continuously adjustable by means of an iris control. Calibration slides are constructed of appropriate 8-inch-square film negatives mounted between glass plates, which in turn are mounted and retained in the light source. The slides individually consist of a 10-level grey wedge for erasure determination, low-contrast sine wave slides for sine wave response measurements, an accurately-measured grid pattern for geometric distortion calibration, and nine segment color slides. In addition, two scan slides are used to provide a visual indication of frequency response.

The recording/playback configuration and equipment are depicted by a block diagram (Figure 1). The predetection signal is recorded, providing calibration information free from unknown factors and nonlinearities associated with the normal video test equipment. The tape recorder consists of an Ampex VR 1560 rotating-head, helical-scan machine modified to a VR-660 configuration. Other modifications allow direct-level recording as well as recorder-servo control when applying non-standard (slow-scan) video information. Video information is obtained from the first IF stage of the receiver in the System Test Equipment Assembly (STEA), at which point the carrier frequency is 50 mc. This 50-mc signal is amplified in the JPL equipment and then converted to 4 megacycles. In the 600-line scan mode, this 4-mc signal is hard limited and applied to the predetection input (direct record) of the recorder. In the 200-line scan mode, the 4-mc signal is further converted to 500 kc and then applied FM-FM to the recording machine.

The 600-line scan mode playback is accomplished by demodulating the 4-mc carrier through a carefully calibrated pulse-averaging type demodulator to obtain the baseband video signal. The 200-line scan mode playback required another frequency conversion to 70 kc for demodulation through an existing 70-kc demodulator.

Resultant calibration tapes were played into the GDHS system at Goldstone on 2-3 Aug 1967. Consequent data at Station TV-11 (Goldstone) and Station TV-1 (Pasadena) is in the form of 35- and 70-mm film and tape recordings on Ampex

FR 1400 and FR 800 recorders. These tapes represent an overall S/C camera-GDHS system calibration and are the principal calibrations which will be used in processing the Mission E lunar pictures. The analysis presented in this report is obtained principally from the examination of the single-line Polaroids obtained during the ETR calibration.

USE OF CALIBRATION DATA

Data from the calibration have several uses. Principally, the entire calibration tape will be utilized in digital data reduction of pictures received during the mission, as previously mentioned. Geometric distortions can be removed, vidicon shading corrected, camera frequency response fall-off restored, and possibly the transfer characteristic data can be used to convert video output to absolute luminance units. In addition to the recording heretofore mentioned, an abbreviated tape from selected portions of the prime calibration tape was made on 4 Aug at TV-1 and will be used to calibrate, for each operating day, the Goldstone-SFOF Ground Data Handling System--thus providing a complete end-to-end calibration of the camera system.

Finally, the Polaroid data are used to make camera-characteristic plots for real-time mission operations. From this data, estimates of iris settings for a given sun position and each camera viewing direction can be made. Recommendations as to nonstandard procedures and camera operations take into account such calibration data.

DATA REDUCTION

LUMINANCE CORRECTIONS

Since the light source does not have exactly the same energy spectrum as sun light, corrections must be made to the luminance levels of the source so that the data are valid for lunar operations. Surveyor spectral measurements have indicated that the lunar reflection spectrum is essentially identical to the solar spectrum. A correction factor is calculated to give the ratio of source luminance to lunar luminance for equal response from the camera. The light source for SC-5 utilized xenon lamps in special reflectors. The source emission spectrum simulates the solar spectrum rather closely. A comparison of the source with the solar distribution is given by Figures 2 and 3. The correction factor calculation involves the spectra of the camera, the standard eye, the measuring photometer, the light source, the Sun, and the calibration light standard.

During the SC-5 calibration, measurements were made on two light standards--namely, Gamma Scientific Working Standard Models 200 and 220. Luminance correction factors were calculated using the Model 200 readings. Detailed procedures for the calculation are outlined in JPL Technical Memorandum 32-665. Resultant factors were:

$\frac{\text{Source Luminance}}{\text{Lunar Luminance}}$	Type Filter
1.1950	vidicon only
0.9422	vidicon + red filter
1.0257	vidicon + green filter
1.2480	vidicon + blue filter

Corrections were also made for photometer nonlinearities.

POLAROID DATA GRAPHS

Data for the characteristic curves in this report were obtained by measurement on Polaroid prints, each representing one scan line of video signal. Figure 4 is an idealized drawing of a typical print. The amplitude is scaled by appropriate calibration to the frequency deviation of the spacecraft transmitter carrier. In each curve, the scale is arbitrarily displaced so that sync tip deviation frequency falls on its nominal value of 5 kc and 1.25 mc for 200- and 600-line scan modes, respectively.

The scan line photographed is selected at the approximate center of the frame, vertically. Response is measured on each print at the same point (the nominal center) on the time scale. Therefore, curves drawn from such data represent response at one point in the frame. Where significant shading exists (Figure 9), transfer characteristics will change accordingly. Variation of data due to incomplete erasure is avoided by recording the first frame after exposure and by allowing ample erasure time after completion of a series of exposures at one illumination level.

Telemetry data representing a readout of camera functional setting is recorded on the back of each print. The data are in numerical units termed BCD (binary coded decimal) and include the full-scale value and measured value for each frame. Figure 5 is a calibration curve for iris position, showing the f-stop as a function of BCD ratio.

The 600-line scan mode transfer characteristic data (i. e., camera response to flat scenes at various light levels) are shown in Figure 6. The procedure utilized in obtaining such data was changed somewhat from those used in SC-1 and SC-2 calibrations, where luminance levels were varied at a fixed iris position. Because of time required to change luminance levels, only three iris positions were calibrated. The method used SC-3, SC-4 and SC-5 involved setting a light level and cycling through all iris positions, since this was faster and provided data for each iris position. The amount of data collected allows the construction of an accurate three-dimensional computer surface with axes of iris BCD, lunar luminance, and output video level-- thus permitting a more accurate computer reduction of the video data. This revised method was also used in the 200-line scan mode.

In the iris repeatability calibration, the iris was forced to several different conditions--for example, by stepping the iris to f/22 and then to f/8; or by stepping the iris to f/16, then f/5.6 and f/8. In these two cases, the iris potentiometer may give different readings--indicating that the lens iris varies around the nominal f/8 position. For iris positions around f/8, the luminance level of the source is known and the polaroid of the video level is obtained at the second frame of exposure. This procedure was conducted three times for the f/8 and f/11 iris positions. Resultant deviations were found to be small in terms of observed video levels (Figure 14), while no error at all was indicated in the iris BCD data. Exposure reciprocity is evaluated by measuring the luminance level required to produce approximately the same video deviation for the several iris positions. These data are presented in Figure 15. By comparing Figures 14 and 15, it can be seen that the small data scatter shown in the reciprocity plot correlates with errors in video level adjustment i.e., the video level was not exactly constant for all iris positions.

Figure 7 gives the light transfer curve in the 600-line scan mode for each of the four filter wheel positions. All data presented were obtained with the iris set to f/4.

Figure 8 shows the black level (or dark current) buildup for the 600-line scan mode as a result of integrating zero light intensity for various lengths of time. In this test, the camera is completely covered with a black cloth, the shutter is kept open, and no scanning is allowed for "x" minutes. After "x" minutes, the camera is allowed to read out and the dark current level is obtained. These data are useful in judging exposure levels for night operations or star sighting.

Figure 9 shows the shading which the camera exhibits near saturation in the 600-line scan mode. This figure is a depiction of composite frames taken from the A-scope display.

Figure 10 shows results of sine wave response tests. As the slides used have sine waves, not square waves, the data enable a true Fourier representation of the camera system. The 200-line scan mode light transfer, integrate exposure mode, and frequency response data are shown in Figures 11, 12, and 13, respectively. As in the other camera systems, the 200-line scan mode data shows a response well past 200 lines/pic length in the horizontal direction.

GEOMETRIC DISTORTION AND ERASURE

The geometric distortion and erasure data are principally used in computer reduction of the pictures and will not be analyzed in this report.

AUTOMATIC IRIS

This automatic iris functioning for each filter position is depicted in Figure 15. The iris appears to be functioning well in the clear position holding video level around 65 percent of the black to white frequency deviation. For the blue color filter, however, the auto iris mode will not be usable, as the iris servo stayed in the f/4 position at saturation exposure on the vidicon. As was observed for S/C-4, spectral sensitivity for red and green seems to be somewhat higher than for unfiltered light, since the exposure levels were maintained at about 45 percent at the black-to-white deviation for the red and green filters, for lunar brightness levels above 400 foot-lamberts. The auto iris sensor for S/C-5 is more sensitive than the one in S/C-4, however. In the case of the latter, exposures were held to 50 and 25 percent for the clear and red filters, respectively.

COLOR AND PHOTOGRAMMETRIC TESTS

The color and photogrammetric data require computer reduction, and will be presented in a later document.

DEVIATIONS FOR TV-GDHS AND SFO TV-GDHS TAPE PLAYBACK

From the calibration data, settings denoting the characteristic deviations and timing rates were derived and supplied to the GDHS. These settings are:

Modulation* characteristics (Δf)	XMTR A 600 line	XMTR B 600 line	XMTR A 200 line	XMTR B 200 line
Sync to porch	500 kc	470 kc	2.00 kc	2.00 kc
Porch to black	100 kc	100 kc	1.20 kc	1.18 kc
Porch to PCM '0'	1.870 mc	1.870 mc	7.50 kc	8.30 kc
Porch to PCM '1'	1.370 mc	1.390 mc	5.48 kc	6.20 kc
Porch to white**	2.730 mc	2.680 mc	6.00 kc	6.65 kc
Carrier to sync tip	1.210 mc	1.160 mc		
Carrier to porch	710 kc	690 kc		
Carrier to black	610 kc	590 kc		
Carrier to PCM "0"	1.160 mc	1.180 mc		
Carrier to PCM "1"	660 kc	700 kc		
Carrier to white**	2.020 mc	1.990 mc		

Timing characteristics	600-Line Scan Mode	200-Line Scan Mode
Sync pulse time	132 μs	7.9 ms
Porch time	132 μs	7.6 ms
Vertical blanking time	210 ms	620.0 ms
PCM time	201 ms	585.0 ms
Active line time	1.38 ms	85.9 ms

*XMTR-A carrier frequency at ambient is 2294.992489 mc.
**Average white level over the frame.

Timing characteristics	600-Line Scan Mode	200-Line Scan Mode
Total line time	1.620 ms	102 ms
Active frame time	990 ms	20.0 sec
Total frame time	1.401 sec	21.2 sec

Foregoing deviation values are measured on the polaroid frames. Although the white deviations noted for this camera are nearly 300 kc lower than in the case of the S/C-4 camera, special non-standard ground system configurations and techniques will again have to be employed during flight operations.

The VR 1560 tape recorded at Cape Kennedy during the SC-5 Survey Camera Calibration was played back at DSS-11 on 2 August 1967. Recordings of this playback were made by DSS-11/TV-11 on FR-1400 and FR-800 magnetic tapes.

The magnetic tapes contain the video signal, voice, and NASA Time Code made at the Cape.

Following are data on the tapes that were made during the playback:

Table I. Phase I VR-1560 playback at DSS-11 to FR-800 and FR-1400
Phase II FR-1400 reel No. same as Phase I at DSS-11

Test step number	DSS-11 FR-1400 reel No. (Phase I and II)	DSS-11 FR-800 reel No. (Phase I only)	Explanation
10.6 thru 10.11	1	1	
10A.16 thru 10A.19	1	1	Rerun
10.20 thru 10.29	1	1	
10.30 thru 10.36	2	1	
10A.30 f/8 only	2	1	Rerun
10A.28 f/8 only	2	1	Rerun
10.40 and 10.41	2	1	
10A.40 and 10A.41	2	1	Rerun
10.44 (special)	2	1	f/4 - 1500 foot lamberts
11.6 thru 11.15	2	1	
12.2 thru 12.20	2	1	

Table I. Phase I VR-1560 playback at DSS-11 to FR-800 and FR-1400 Phase II FR-1400 reel No. same as Phase I at DSS-11 (contd)

Test step number	DSS-11 FR-1400 reel No. (Phase I and II)	DSS-11 FR-800 reel No. (Phase I only)	Explanation
12.21 thru 12.31	3	2	
13.2 thru 13.5	3	2	
13A.5	3	2	4 frames-blue filter
13A.5	3	2	4 frames repeated-blue filter
13A.5A	3	2	4 frames-red filter
13A.5B	3	2	4 frames repeated-red filter
13.7 thru 13.30	3	2	
14.2 thru 14.7	3	2	
14.5 thru 14.7	3	2	Rerun
14.8 thru 14.41	4	2	
15.7 thru 15.18	4	2	
16.5 thru 16.15	4	2	
17.5 thru 17.24	4	2	
17A.24	4	2	Rerun
17A.24A	4	2	Rerun
17.25	4	2	
17A.25A	4	2	Rerun
17A.25B	5	3	Rerun
17.26	5	3	
TSS 5.7.29	5	3	Special test, refer to Test Log
10.25 (rerun)	5	3	f/5.6 - 280 FL - CL
10.25 (rerun)	5	3	f/4 - 280 FL - CL
12.31 (rerun)	5	3	f/4 - 1400 FL - R
12.21 (rerun)	5	3	f/4 - 1400 FL - B
12.10 (rerun)	5	3	f/4 - 1400 FL - G
18.1 thru 18.3	5	3	XMTR B
19.1 thru 19.15	5	3	
20.6 thru 20.13	5	3	

Table I. Phase I VR-1560 playback at DSS-11 to FR-800 and FR-1400 Phase II FR-1400 reel No. same as Phase I at DSS-11 (contd)

Test step number	DSS-11 FR-1400 reel No. (Phase I and II)	DSS-11 FR-800 reel No. (Phase I only)	Explanation
20.18 thru 20.19	5	3	
20.22 thru 20.30	5	3	
10A.22 - f/4 only	6	3	Rerun f/4
10A.23 - f/4 only	6	3	Rerun f/4
10A.24 - f/4 only	6	3	Rerun f/4
10A.23 - f/5.6 only	6	3	Rerun f/5.6
10A.24 - f/5.6 only	6	3	Rerun f/5.6
10A.25	6	3	Rerun f/5.6 and f/4
10A.26	6	3	Rerun f/5.6 and f/8
10A.27	6	3	Rerun f/8 and f/11
10A.28	6	3	Rerun f/11 and f/8
10A.30	6	3	Rerun f/11 and f/16
10A.32	6	3	Rerun f/16 and f/11
10A.34	6	3	Rerun f/16
10A.34	6	3	Rerun f/11
10A.36	6	3	Rerun f/16 and f/22
21.1 thru 21.11	6	3	
22.10 thru 22.20	6	3	
22.6 thru 22.9	7	4	
2.2 thru 2.79	7	4	
2.82 thru 2.179	8	4	

Table II. Phase II - DSS-11 FR-800 to TV-1 FR-800(700) and HW-7600

Test step number	TV-1 HW-7600 reel No.	TV-1 FR-800(700) reel No.	Explanation
10.6 thru 10.11	1	1	
10A.16 thru 10A.19	1	1	Rerun
10.20 thru 10.25 (f/8)	1	1	
10.25 (f/11) thru 10.29	2	2	
10.30 thru 10.36	3	2	
10A.30 f/8 only	3	2	Rerun
10A.28 f/8 only	3	2	Rerun
10.40 and 10.41	3	2	
10A.40 and 10A.41	3	2	Rerun
10.44 (special)	3	2	f/4 - 1500 foot lamberts
11.6 thru 11.15	3	2	
12.2 thru 12.20			
12.21 thru 12.31	4	3	
13.2 thru 13.5	4	3	
13A.5	4	3	4 frames - blue filter
13A.5	4	3	4 frames repeated blue filter
13A.5A	4	3	4 frames - red filter
13A.5B	4	3	4 frames repeated red filter
13.7 thru 13.30	4	3	
14.2 thru 14.7	4	3	
14.5 thru 14.7	4	3	Rerun
14.8 thru 14.41	5	3	
15.7 thru 15.18	5	3	
16.5 thru 16.15	5	3	
17.3 thru 17.24	5	3	
17A.24	5	3	Rerun
17A.24A	5	3	Rerun
17.25	5	3	
17A.25A	5	3	Rerun

Table II. Phase II - DSS-11 FR-800 to TV-1 FR-800(700) and MW-7600 (contd)

Test step number	TV-1 HW-7600 reel No.	TV-1 FR-800(700) reel No.	Explanation
17A.25B	6	4	Rerun
17.26	6	4	
TSS 5.7.29	6	4	Special test, refer to Test Log
10.25 (rerun)	6	4	f/5.6 - 280 FL - CL
10.25 (rerun)	6	4	f/4 - 280 FL - CL
12.31 (rerun)	6	4	f/4 - 1400 FL - R
12.21 (rerun)	6	4	f/4 - 1400 FL - B
12.10 (rerun)	6	4	f/4 - 1400 FL - G
18.1 thru 18.3	6	4	XMTR B
19.1 thru 19.15	6	4	
20.6 thru 20.13	6	4	
20.18 thru 20.19	6	4	
20.22 thru 20.30	6	4	
10A.22 - f/4 only	7	4	Rerun f/4
10A.23 - f/4 only	7	4	Rerun f/4
10A.24 - f/4 only	7	4	Rerun f/4
10A.23 - f/5.6 only	7	4	Rerun f/5.6
10A.24 - f/5.6 only	7	4	Rerun f/5.6
10A.25	7	4	Rerun f/5.6 and f/4
10A.26	7	4	Rerun f/5.6 and f/8
10A.27	7	4	Rerun f/8 and f/11
10A.28	7	4	Rerun f/11 and f/8
10A.30	7	4	Rerun f/11 and f/16
10A.32	7	4	Rerun f/16 and f/11
10A.34	7	4	Rerun f/16
10A.34	7	4	Rerun f/11
10A.36	7	4	Rerun f/16 and f/22
21.1 thru 21.11	7	4	

Table II. Phase II - DSS-11 FR-800 to TV-1 FR-800(700) and MW-7600 (contd)

Test step number	TV-1 HW-7600 reel No.	TV-1 FR-800(700) reel No.	Explanation
22.10 thru 22.20	7	4	
22.6 thru 22.9	8	5	
2.2 thru 2.79	8	5	
2.82 thru 2.179	9	5	

The FR-800 tape made on August 2 will be used as the data source for a complete TVGDHS playback planned for August 27, 1967.

For specific data relative to the above test steps, refer to the Calibration Log.

The following tabulation details data recorded on the TV-1 FR-700 tape for DSS-11 post-pass playback (abbreviated tape). This recording was made on August 4. Similar FR-700 tapes were made at the same time for DSS-42 and DSS-61 test and training.

Test step	GMT start	Source brightness (ft lamberts)	Total frames	f/4	f/5.6	Iris f/8	BCD readings		
							f/11	f/16	f/22
TEST NO. 10 - IRIS LIGHT TRANSFER - FLAT FIELD - 600 LINE SCAN MODE									
10.6	199-2316	0	4	-	Video black and noise			-	934
10.20	199-2343	50	24	022	212	406	597	777	936
10.22	199-2351	100	24	021	212	406	597	777	936
10.24	200-0002	200	24	022	213	406	597	777	936
				(saturation)					
10.29	200-0039	9	8	022	212	-	-	-	-
10.33	200-0056	18	8	022	213	-	-	-	-
10.35	200-0102	25	12	021	213	406	-	-	-
TEST NO. 15 - LINEARITY AND DISTORTION - 600 LINE SCAN MODE									
15.7	200-0626	70	6	f/4 -BCD-022					
15.13	200-0628	400	6	f/8 -BCD-406					
15.16	200-0630	2500	6	f/22-BCD-937					

Test step	GMT start	Source brightness (ft lamberts)	Total frames	f/4	f/5.6	Iris f/8	BCD readings		
							f/11	f/16	f/22
TEST NO. 17 - FREQUENCY RESPONSE - 600 LINE **SCAN MODE**									
17.5	200-0708	2500	8	f/16-BCD 778 - 25 TVL freq					
17.8	200-0709	2500	8	f/16-BCD 778 - 50 TVL freq					
17.9	200-0711	2500	8	f/16-BCD 778 - 75 TVL freq					
17.11	200-0713	2500	8	f/16-BCD 778 - 100 TVL freq					
17.12	200-0714	2500	8	f/16-BCD 778 - 150 TVL freq					
17.13	200-0715	2500	8	f/16-BCD 778 - 225 TVL freq					
17.14	200-0721	2500	8	f/16-BCD 778 - 300 TVL freq					
17.15	200-0723	2500	8	f/16-BCD 778 - 450 TVL freq					
17.16	200-0723	2500	8	f/16-BCD 778 - 600 TVL freq					
TEST NO. 10A - IRIS LIGHT TRANSFER - FLAT FIELD - 600 LINE **SCAN MODE** (THESE STEPS ARE RERUNS DURING CALIBRATION)									
10A.22	200-1658	100	4	021	-	-	-	-	-
10A.23	200-1701	150	4	021	-	-	-	-	-
10A.24	200-1704	200	4	021	-	-	-	-	-
10A.23	200-1720	150	4	-	212	-	-	-	-
10A.24	200-1721	200	4	-	212	-	-	-	-

CALIBRATION CONCLUSIONS

1. The 600-line scan mode light transfer characteristic of the SC-5 camera indicates a useful dynamic range which lies between those observed for the SC-3 and SC-1 cameras.

2. The 600-line scan mode frequency response (Figure 10) does not display the sharp minimum at 75-line/picture height observed at f/4 for the SC-3 camera. In addition, there is a much smaller difference between the data at f/4 and f/11 than was observed for the SC-4 camera.

3. The horizontal frequency response of the camera in 200-line scan mode extends well past 200 TV lines, thus creating a nonsymmetrical resolution. This effect has been observed for all Surveyor cameras.

4. Camera vertical shading is a little worse than that observed for SC-3, while horizontal shading is somewhat better toward the end of the frame.

5. The auto iris mode functions well in the clear position, but not with the blue filter where the iris remains at f/4 at saturation. The sensor is, however, apparently less sensitive than the one in the SC-4 camera, with the result that the auto iris mode will be usable with either the green or the red filter above 400 foot lamberts.

6. The SC-5 camera system produces white level frequency excursions beyond the established nominal limits. Calibration data obtained at ETR will be employed to evaluate the impact of those excessive deviations on the ground system, and to optimize data recovery techniques.

7. The rate of dark current buildup in the integrate exposure mode is significantly higher for the SC-5 camera than for the SC-3 and SC-4 cameras. In 600 line scan mode, after 20 minutes integration, the observed video level was 93, 83 and 50 percent of the total black to white deviation for the SC-5, SC-3 and SC-4 cameras, respectively. The correlative figures for 200 line scan mode (also 20 min integration) are 52, 40 and 37 percent, respectively.

8. A large shift in the position of the raster on the vidicon target was observed between the 600 and 200 line scan modes for the SC-5 camera. Multiple-line polaroids of the alignment target (Figure 17) illustrate this effect.

9. Coherent noise of high amplitude (~10% of p-p video) was observed sporadically in the 200 line scan mode data (Figure 16). Trouble shooting tests failed to identify the source of this noise. Its presence at the camera output (input to TV Aux) was, however, verified. The noise was not observed when a substitute camera was mounted on the spacecraft. Noise, if present, could not be observed in real time in the 600 line data, since the noise frequency (550 - 600 cps) was approximately equal to the line rate. It may have contributed, however, to the otherwise unexplained shift in saturation level (see below).

10. Significant shifts in saturation level was observed in the 600 line scan mode data. These are illustrated by the repeat data points (black) in Figures 6 and 7.

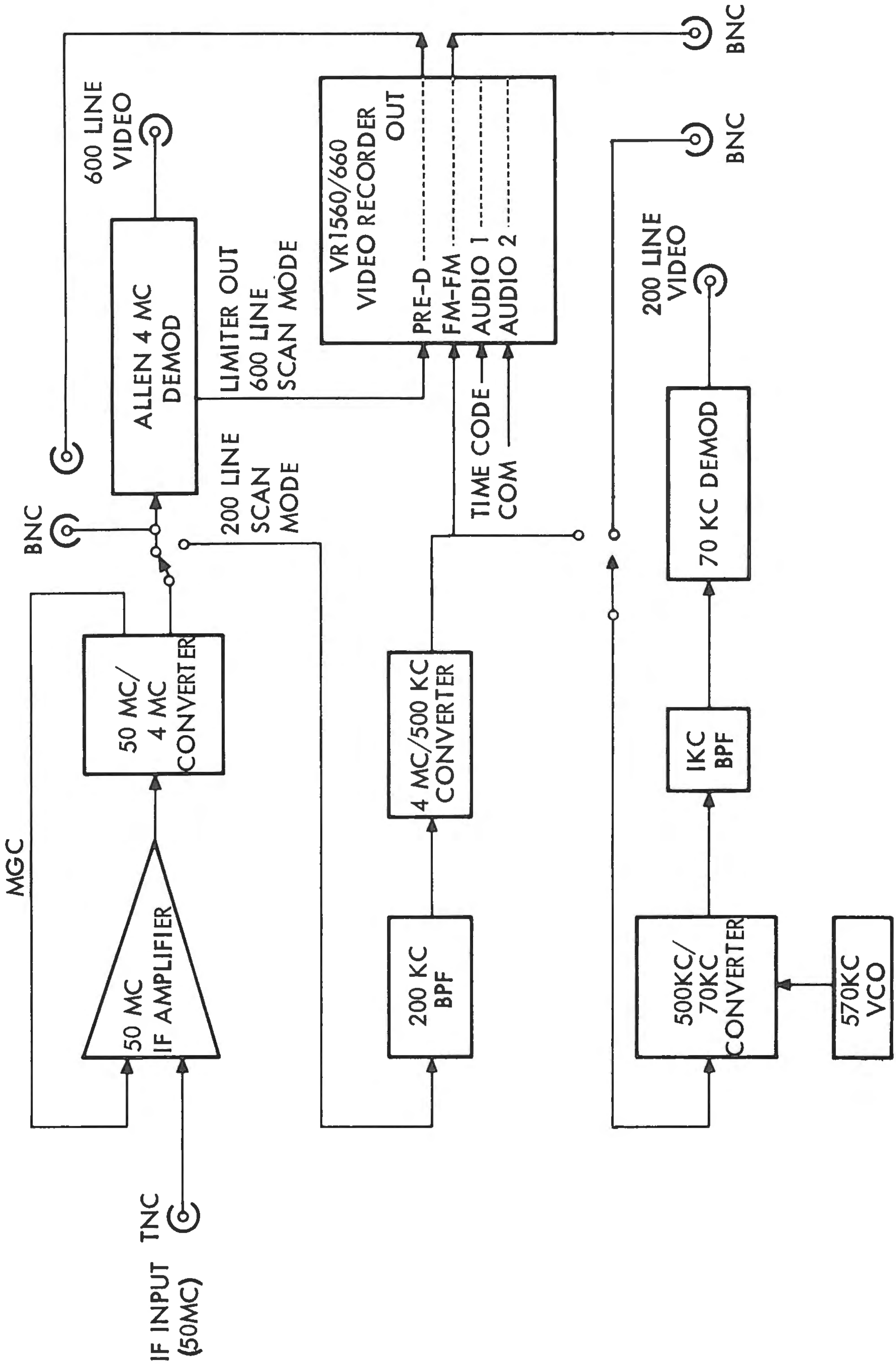


Figure 1. Video Recording System Block Diagram

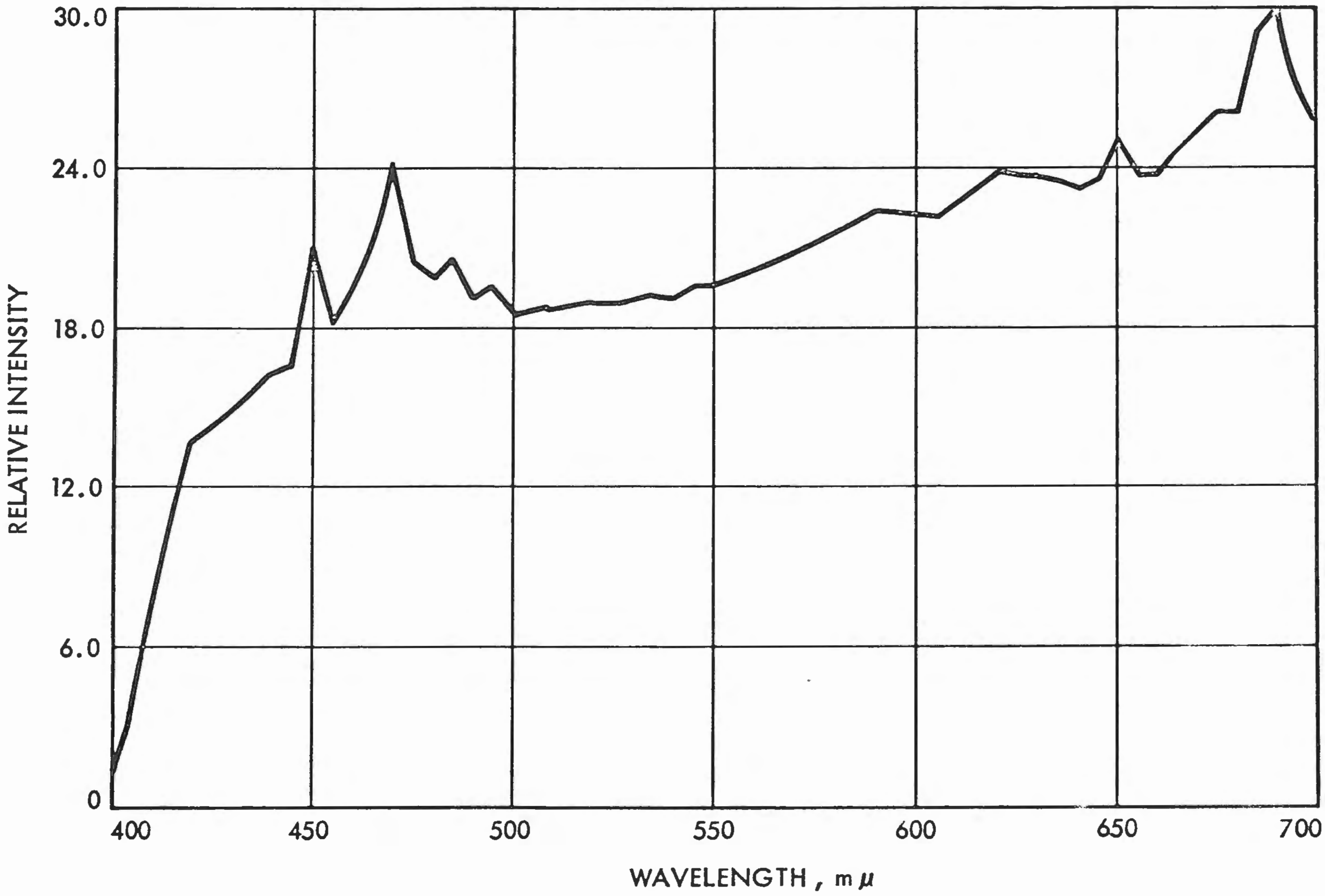


Figure 2. Spectrum of Surveyor TV Calibration Light Source

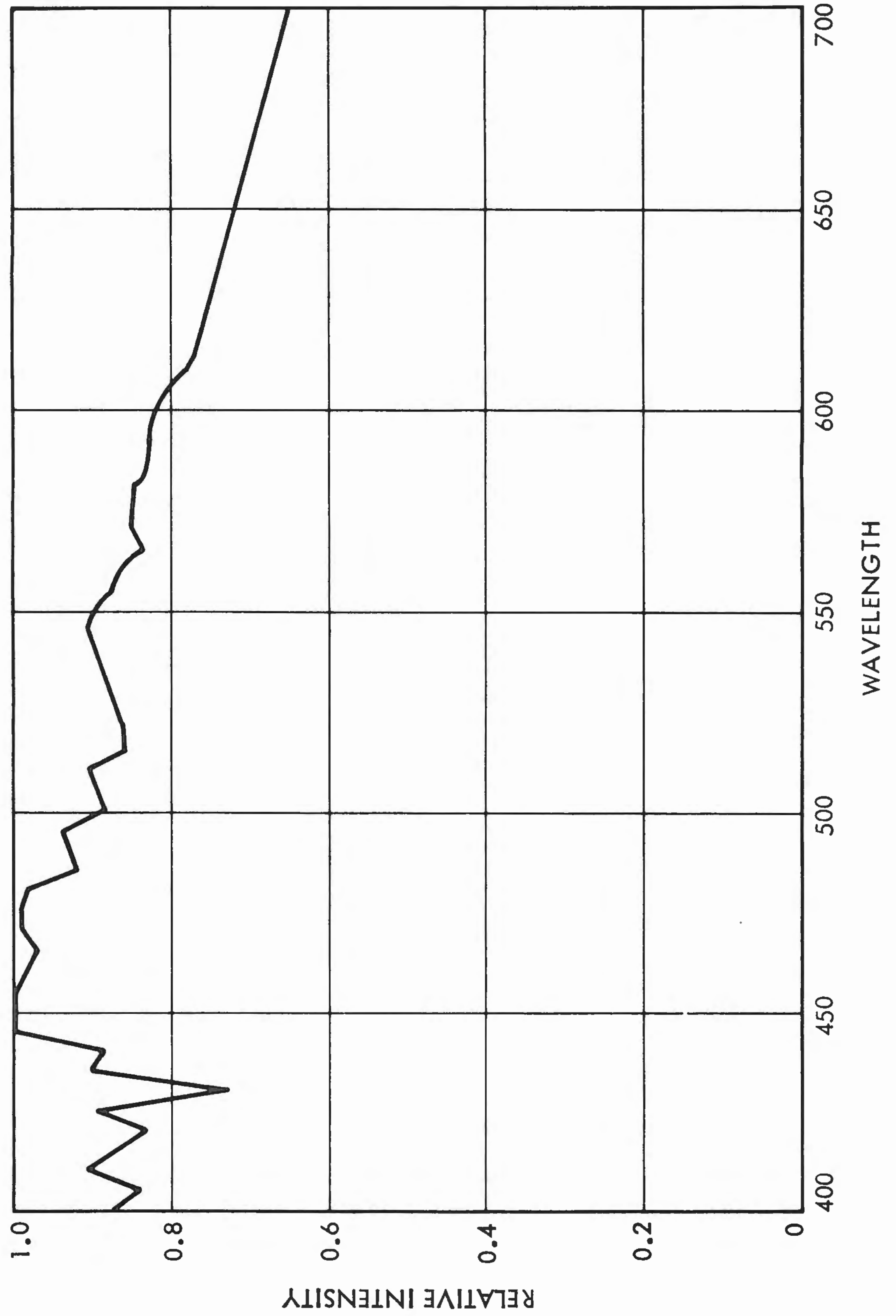


Figure 3. Solar Spectrum

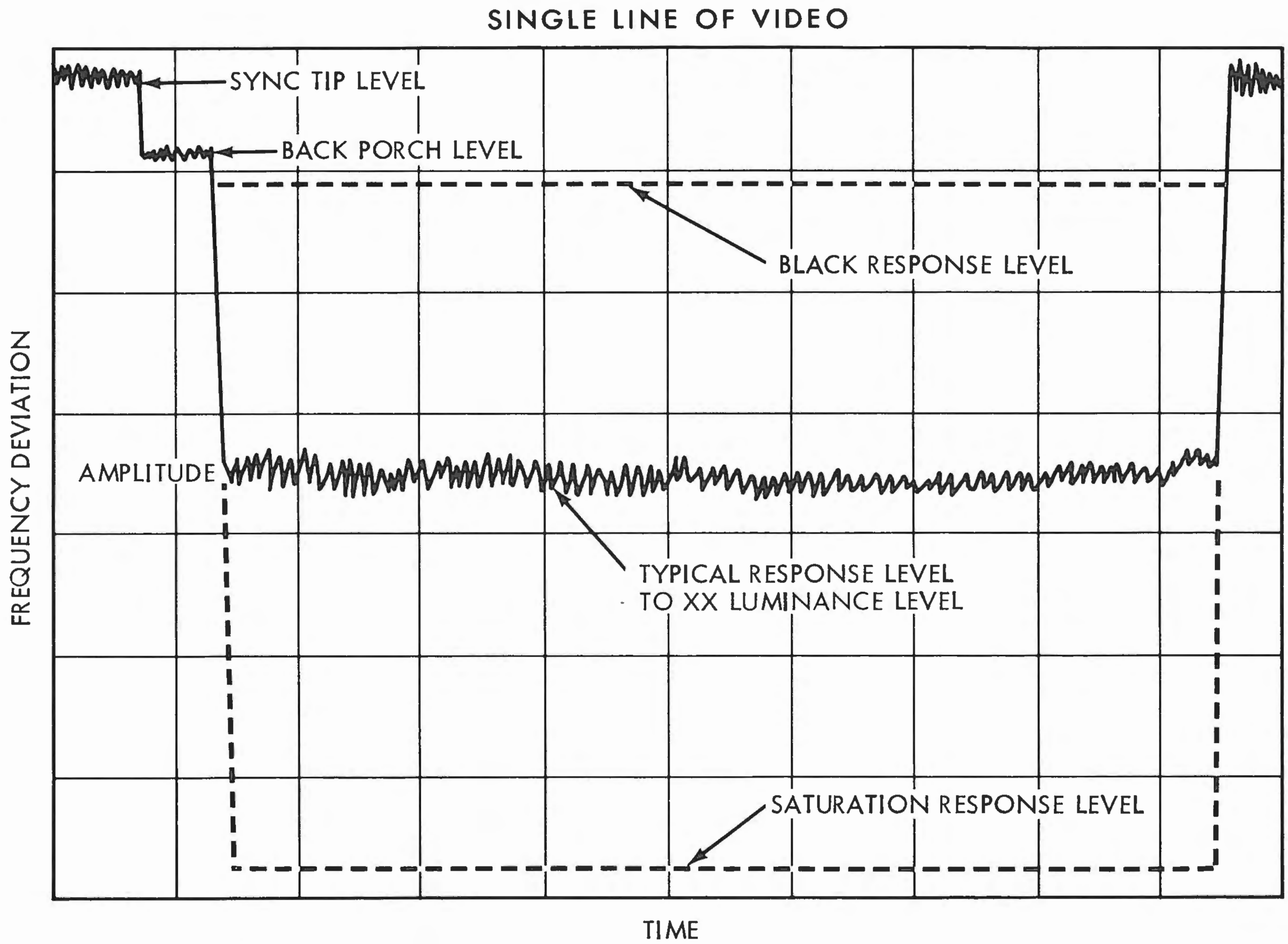


Figure 4. Drawing of Typical Polaroid Data

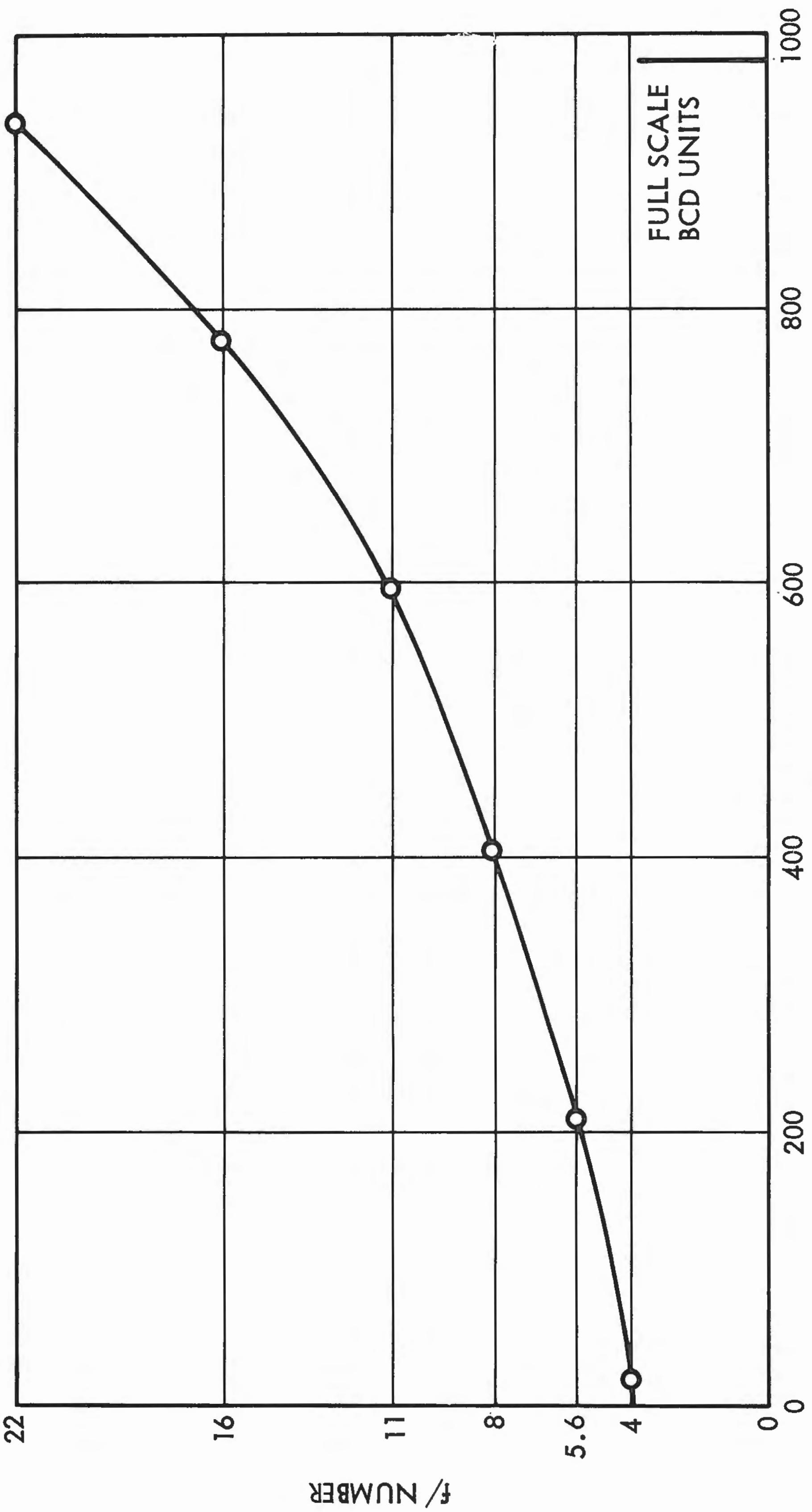


Figure 5. SC-5 Camera f/No. Versus Iris BCD Units

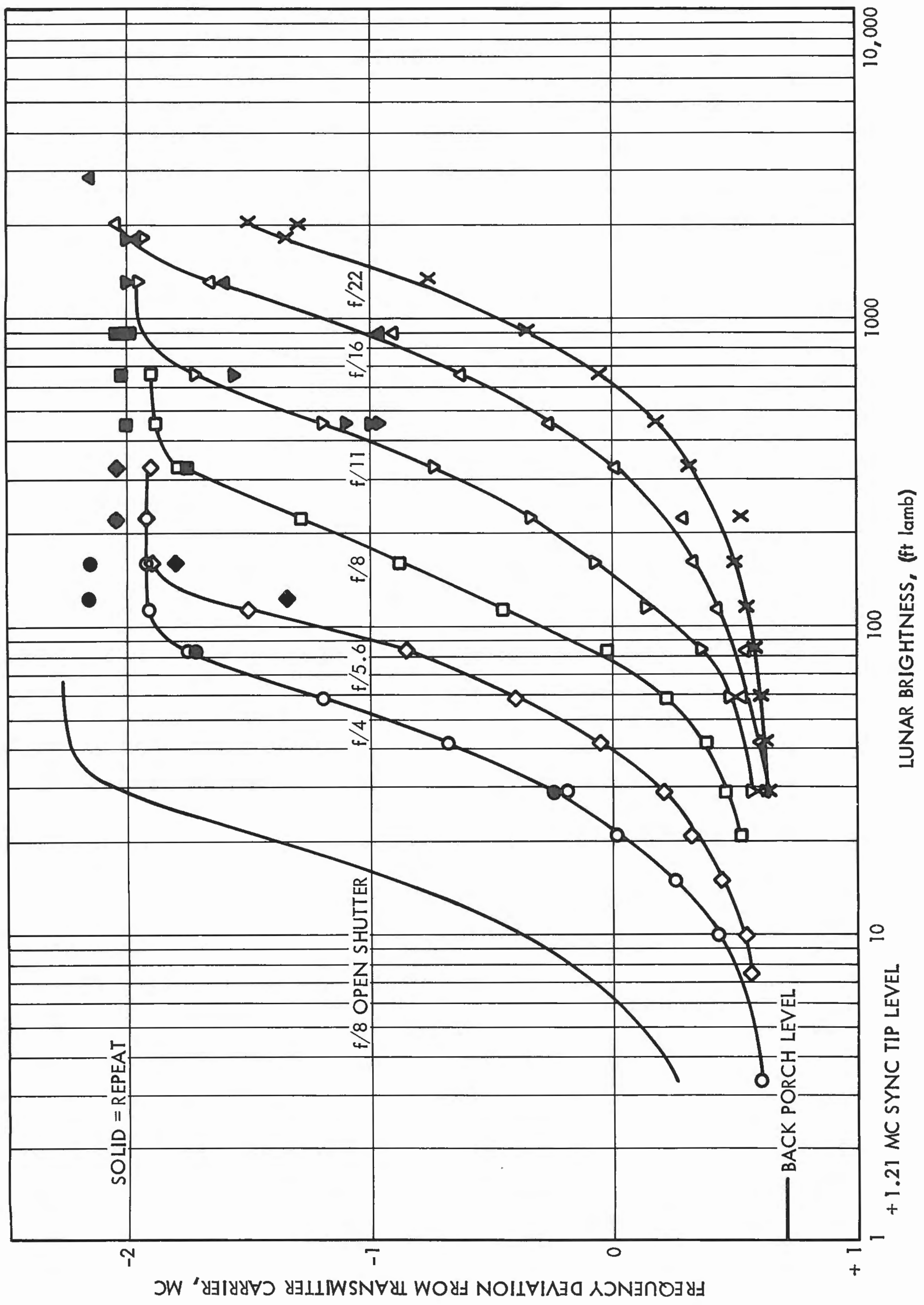


Figure 6. SC-5 Light Transfer Characteristic, 600-Line Scan Mode

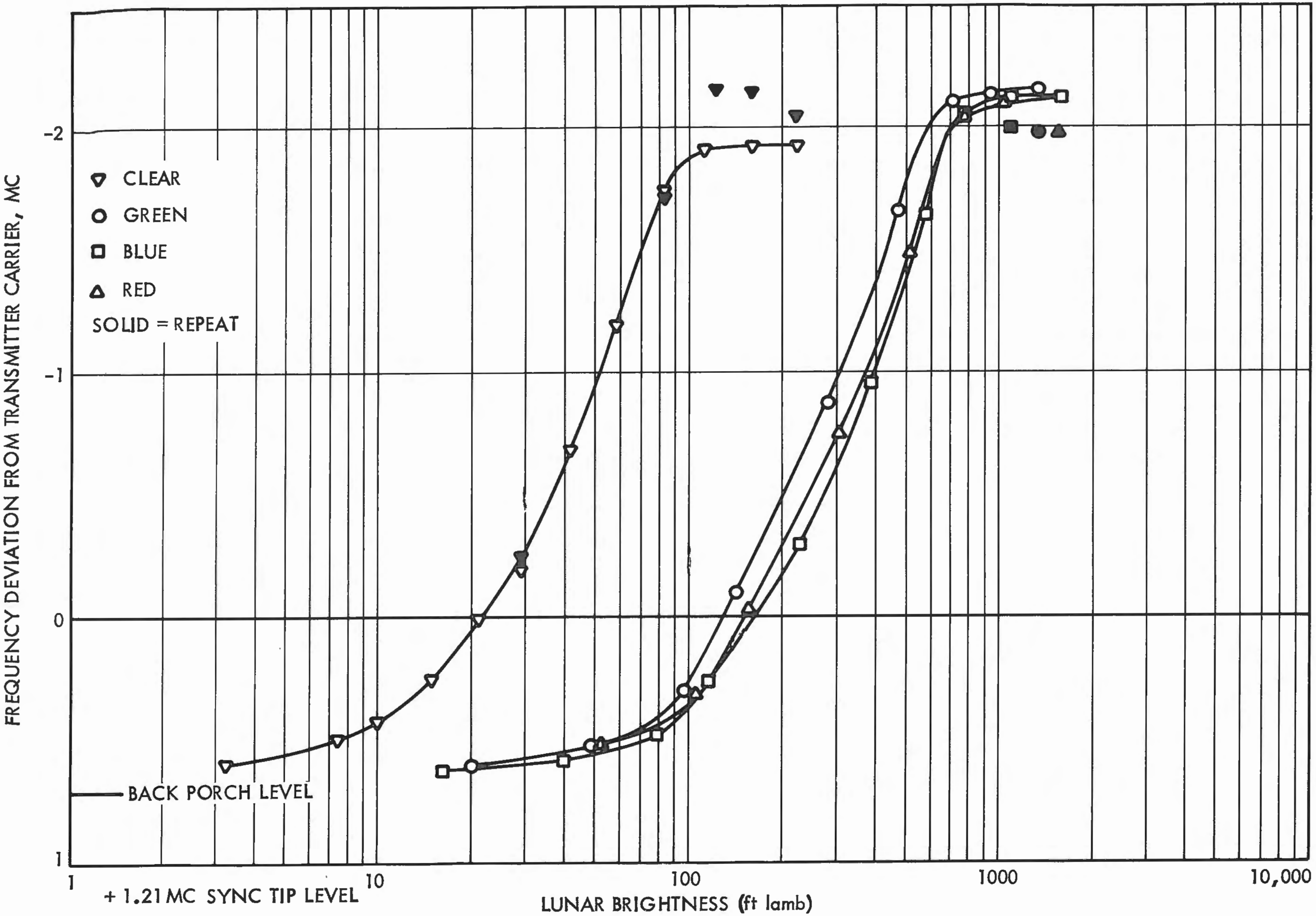


Figure 7. SC-5 f/4 Light Transfer Characteristic for All Filter Wheel Positions, 600-Line Scan Mode

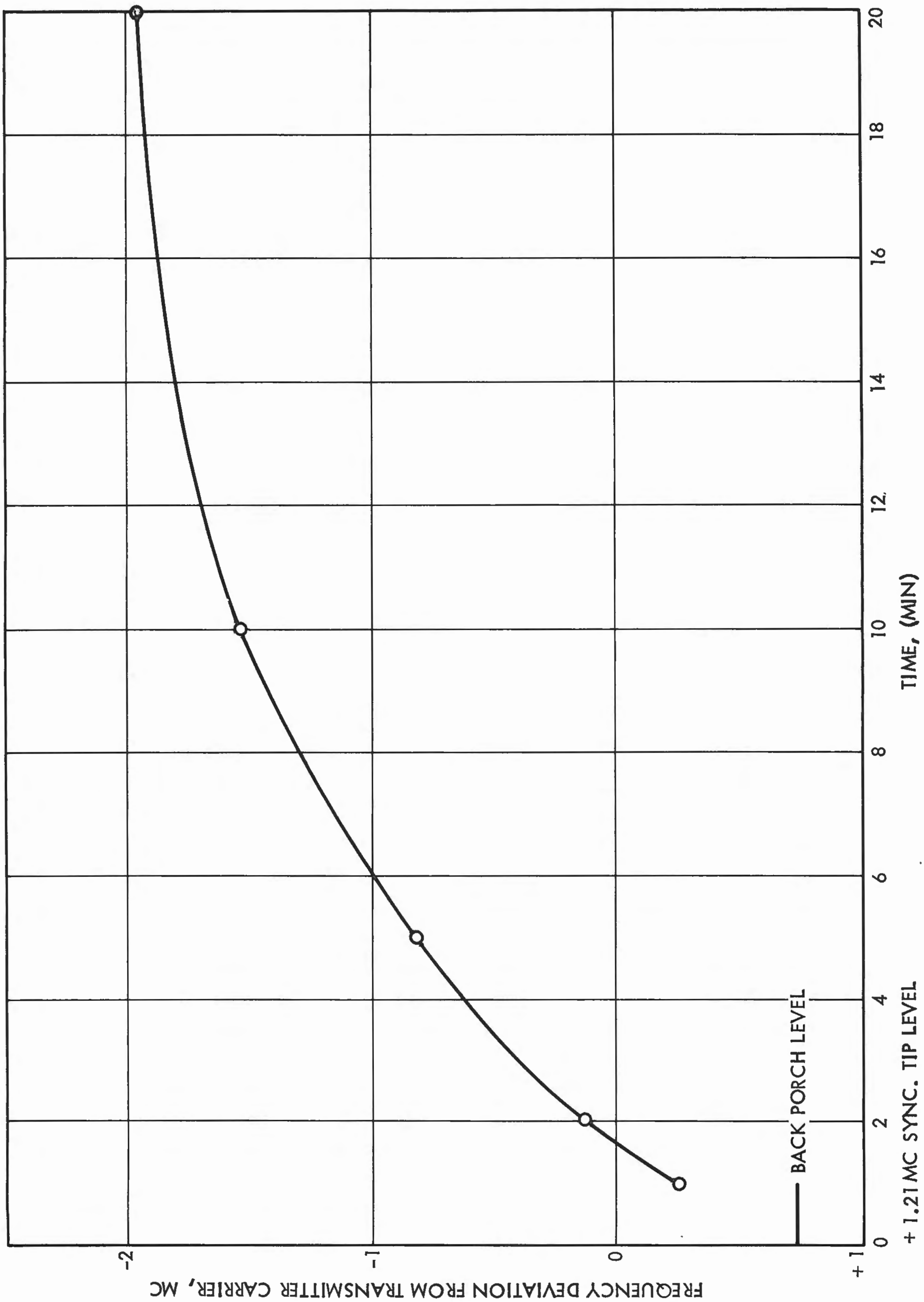


Figure 8. SC-5 Integrate Mode Dark Current Buildup, 600-Line Scan Mode

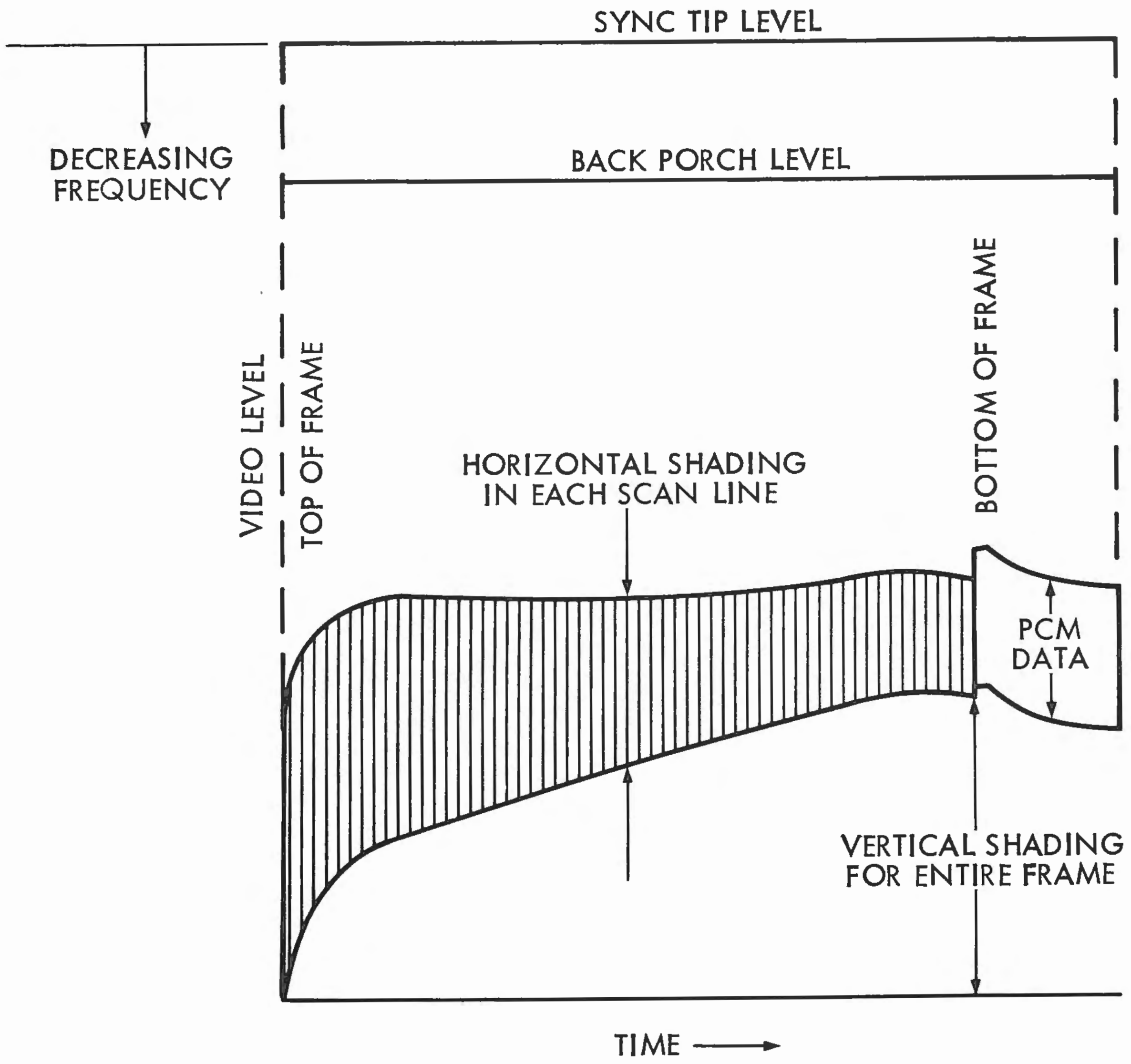


Figure 9. SC-5 Camera Shading Near Saturation
(Diagram Measured from Polaroid of Composite Frame), 600-Line Scan Mode

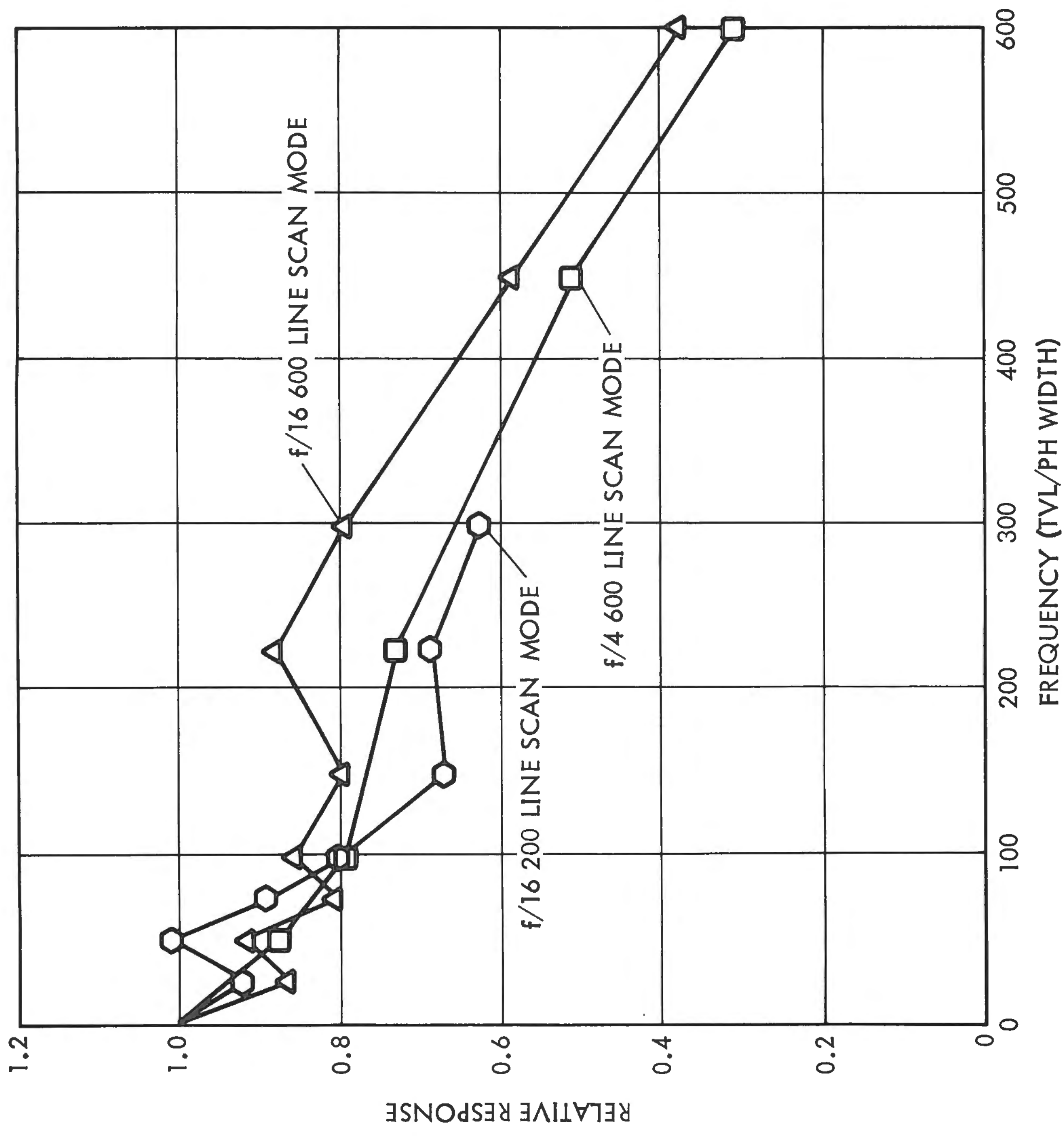


Figure 10. SC-5 Frequency Response, 200- and 600-Line Modes

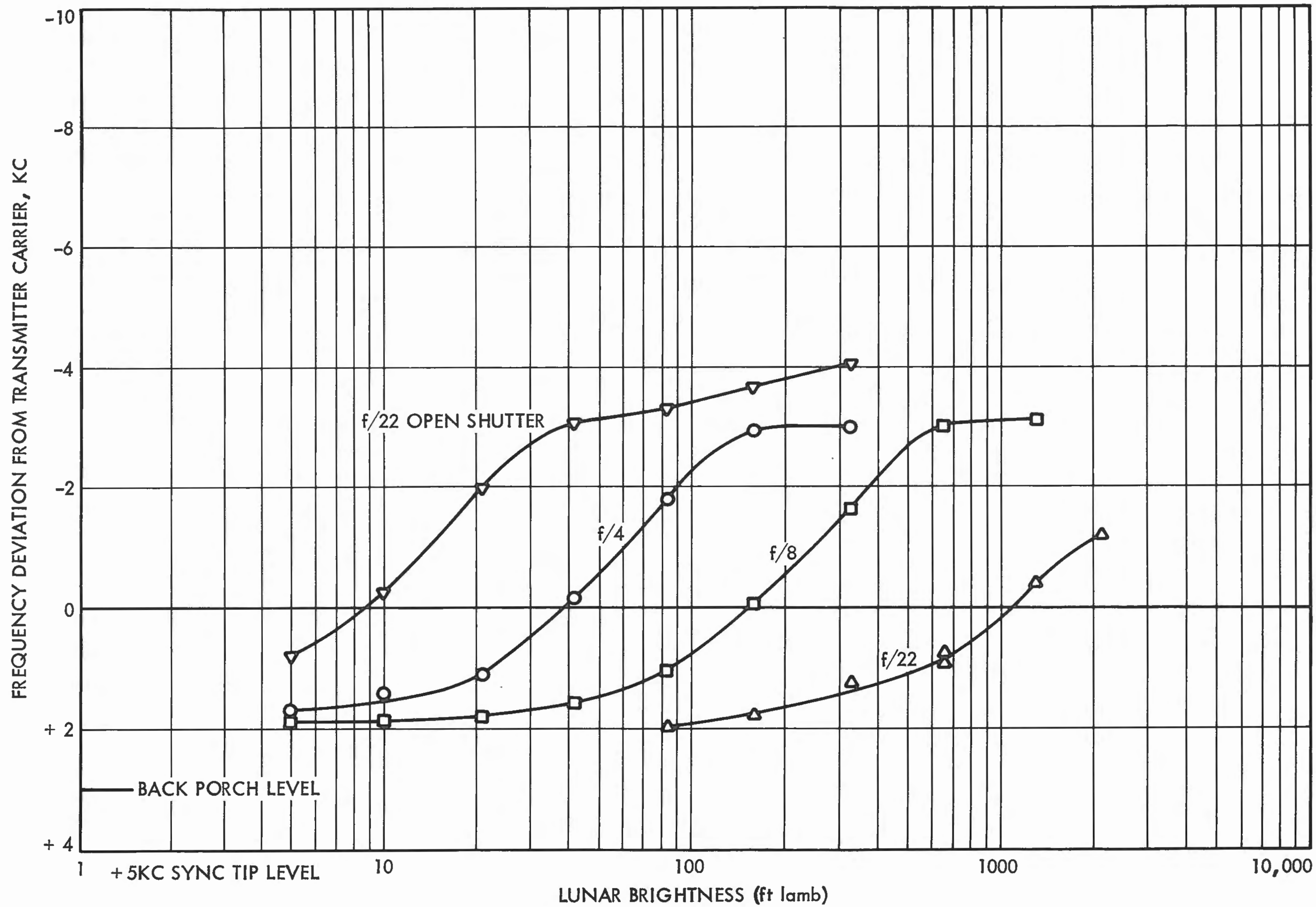


Figure 11. Light Transfer Characteristic, 200-Line Scan Mode

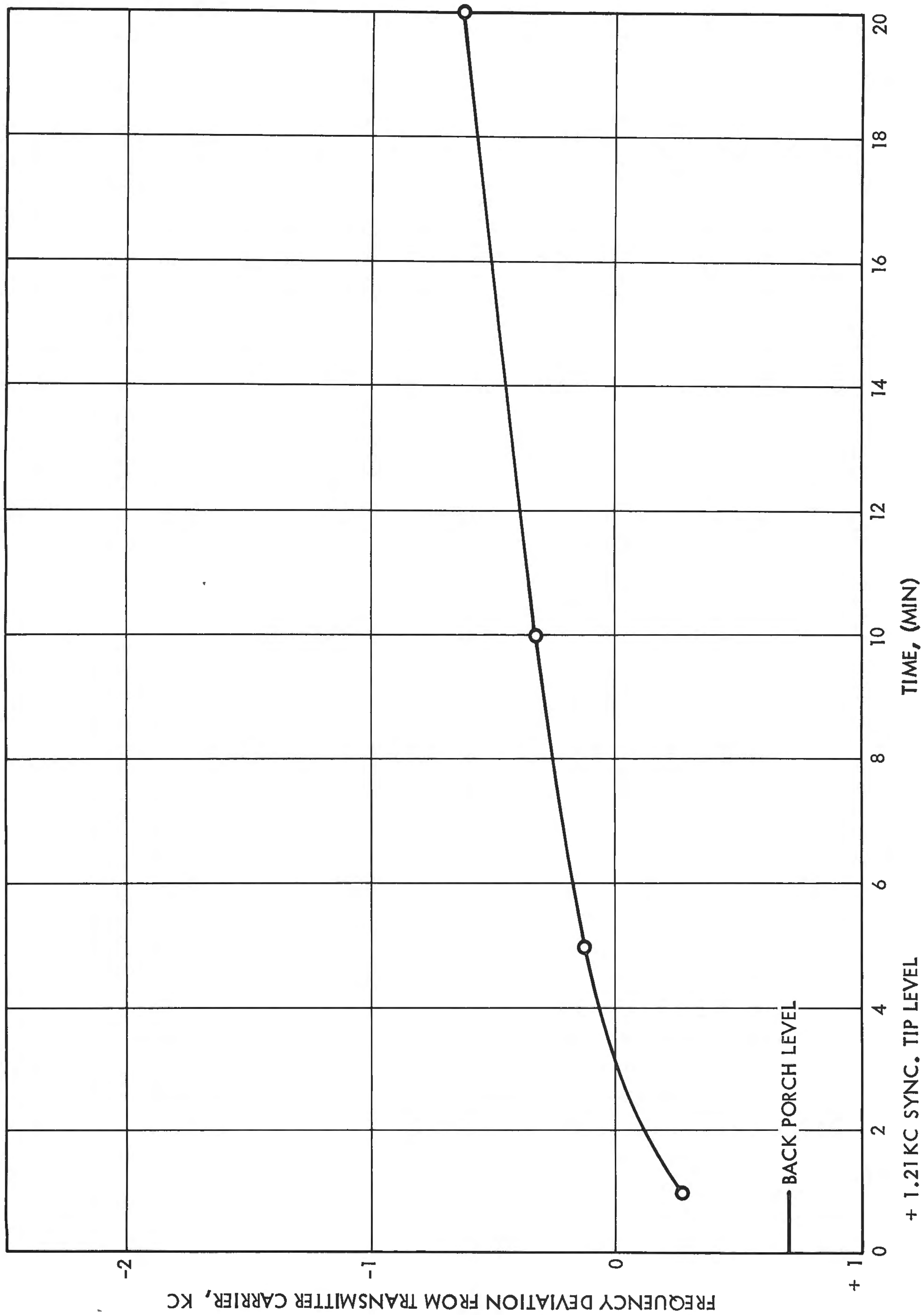


Figure 12. SC-5 Integrate Mode Dark Current Buildup, 200-Line Scan Mode

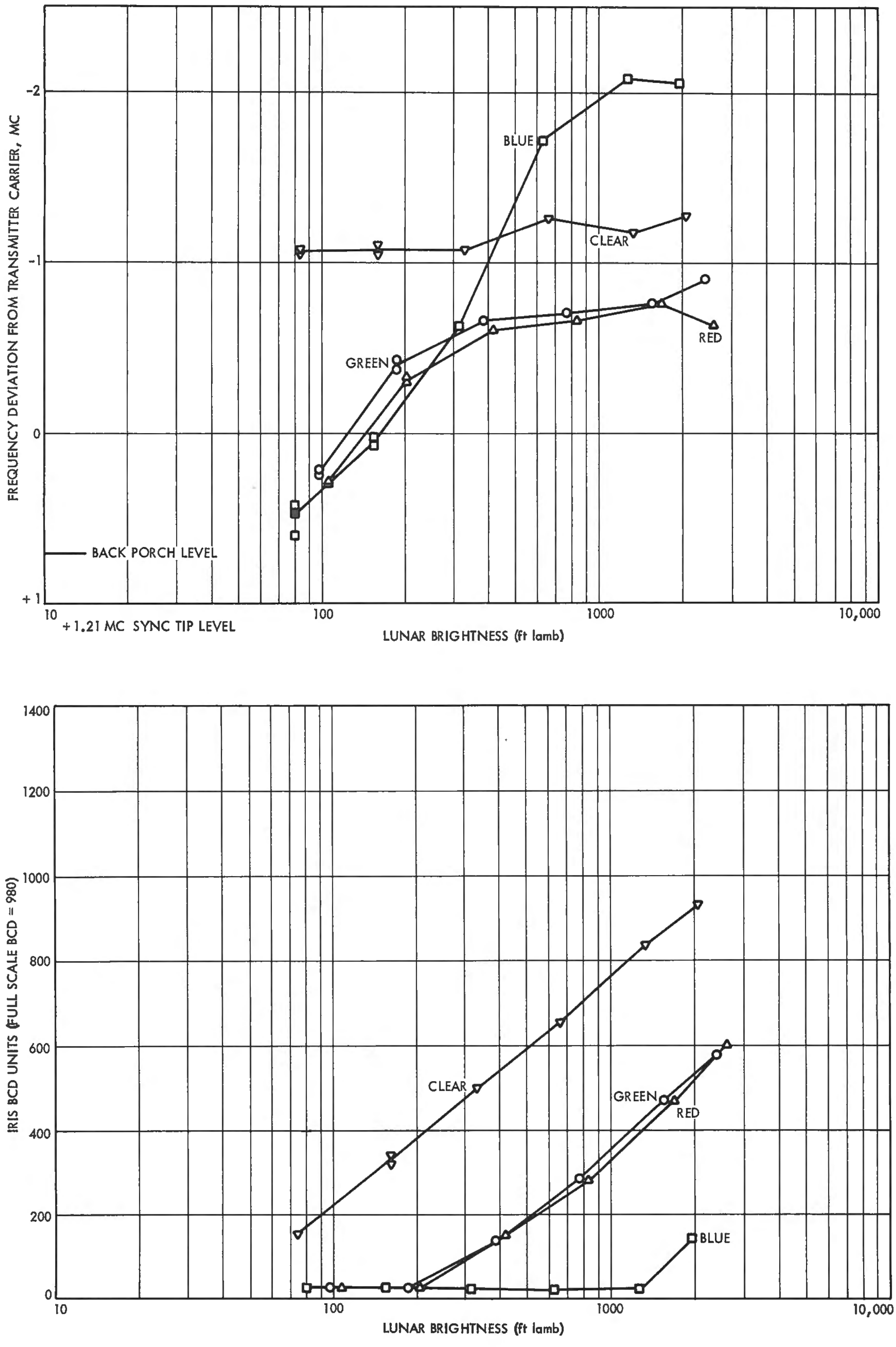


Figure 13. SC-5 Auto Iris Tracking, 600-Line Scan Mode

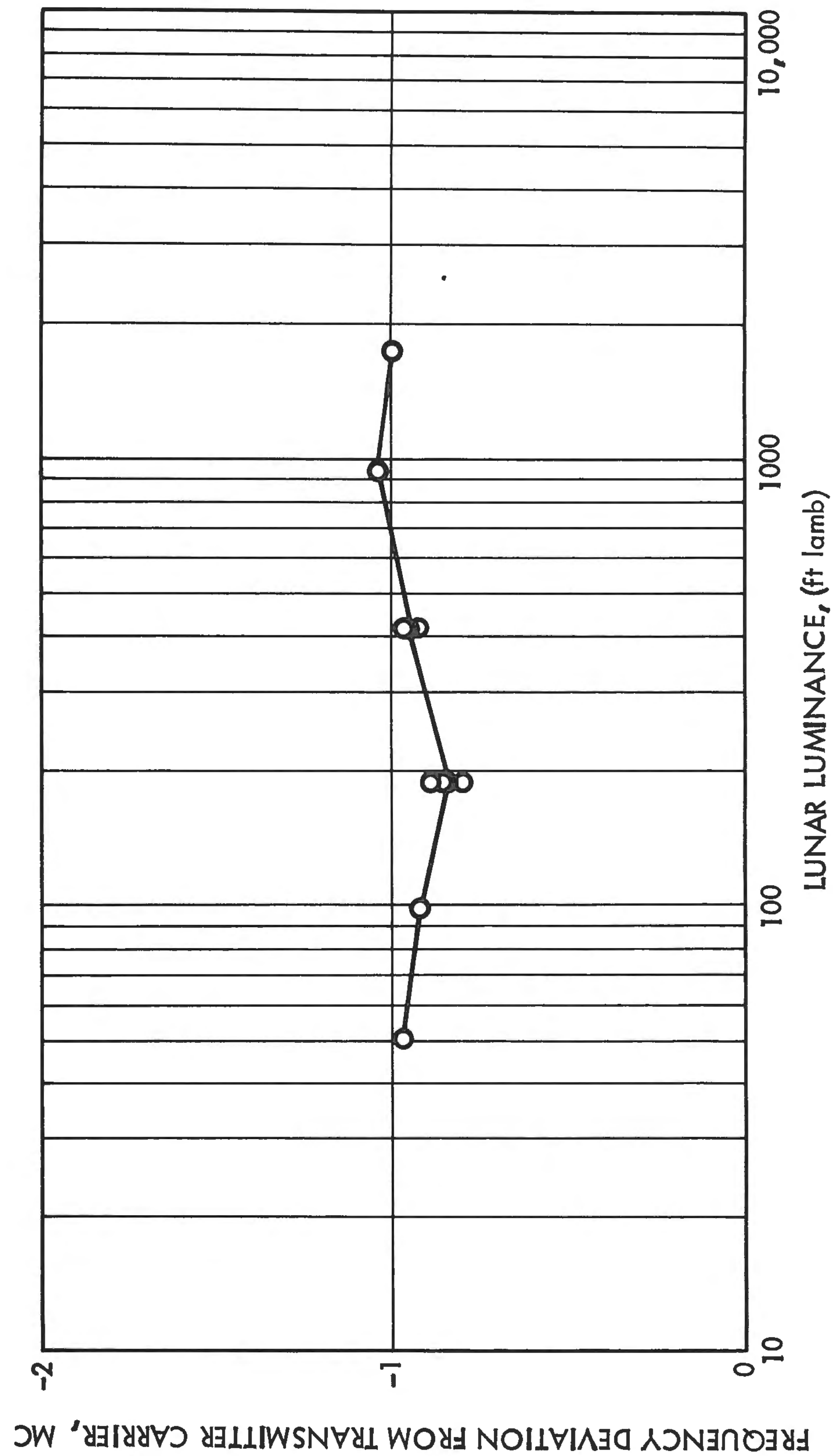


Figure 14. SC-5 Iris Repeatability, 600-Line Scan Mode

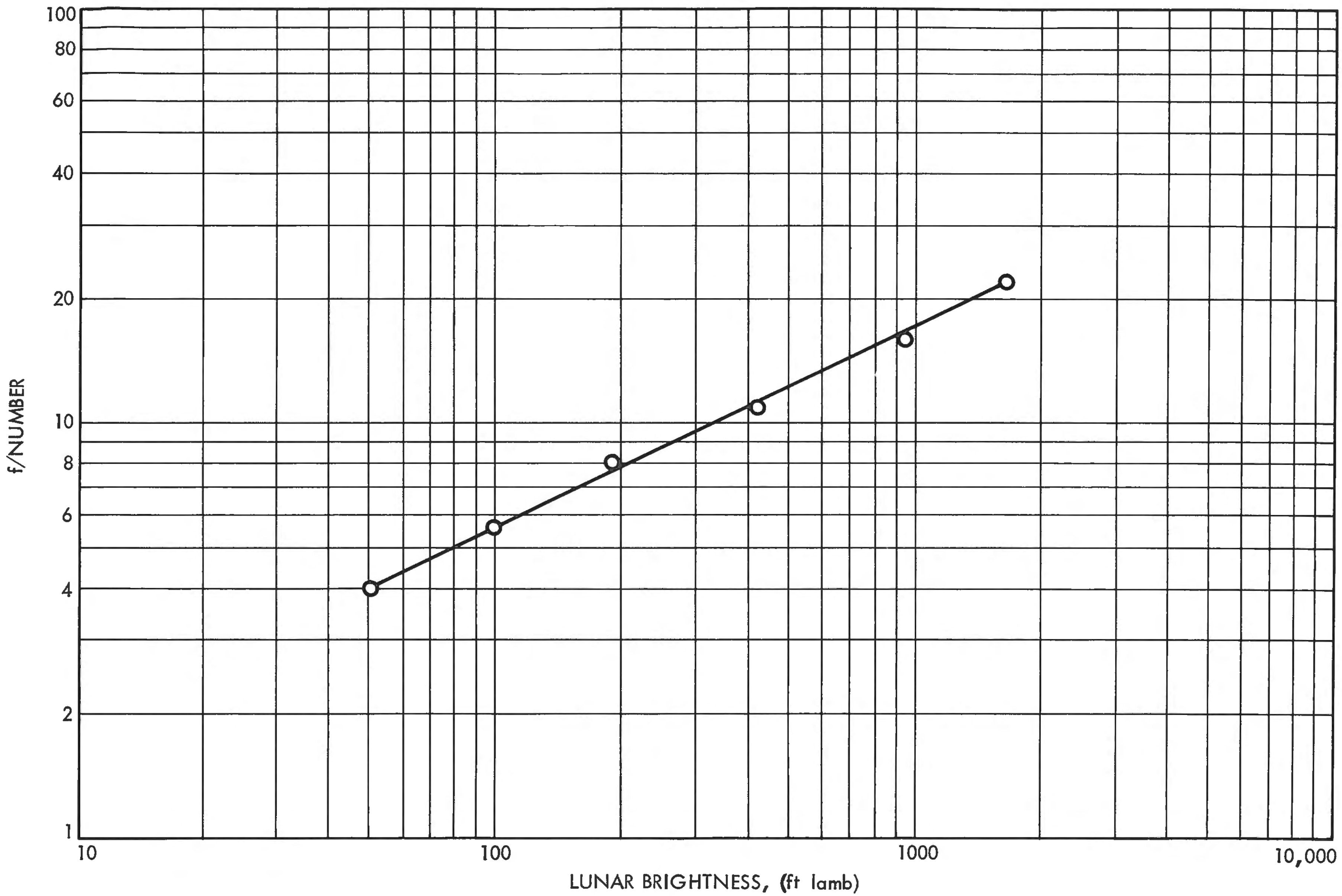


Figure 15. SC-5 Exposure Reciprocity, 600-Line Scan Mode

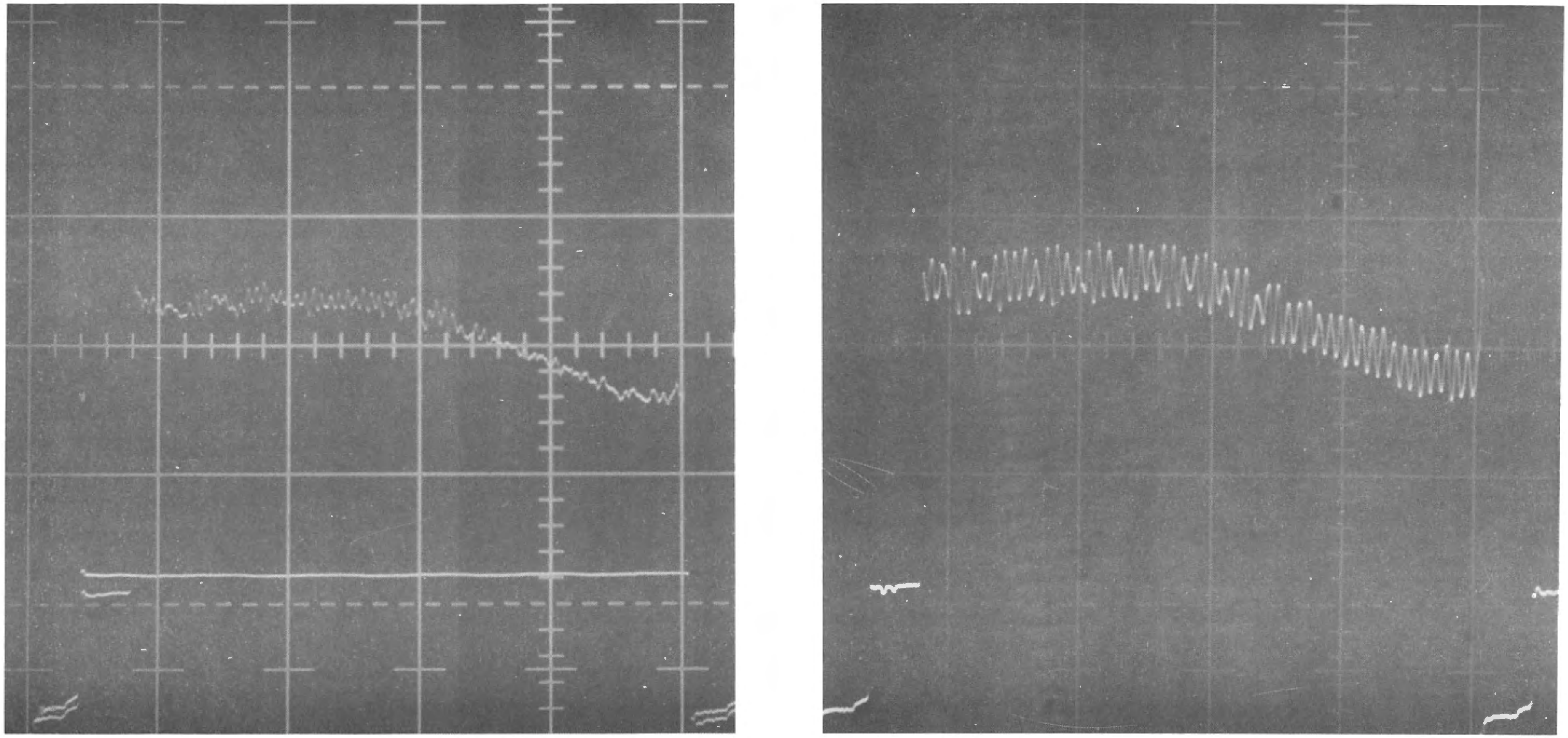


Figure 16. Single Line Polaroids (7th line) Showing Two Levels of the Approximate 600 cps Coherent Noise Observed in 200-Line Scan Mode on the SC-5 Camera. These Pictures Were Taken a Few Minutes Apart Under Identical Operating Conditions (f/4 80 f.1., Normal Shutter)

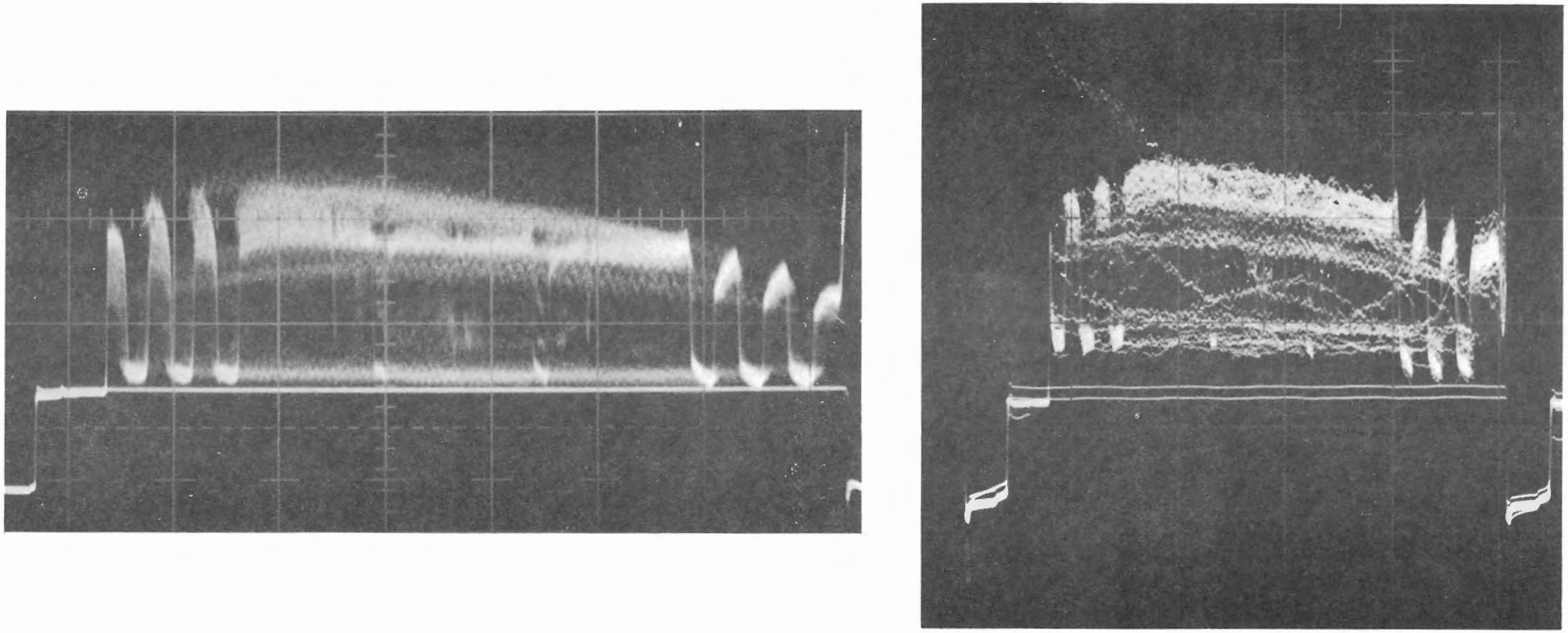


Figure 17. Multiple Line Polaroids Showing the Alignment Target as it Appears in 600 (left) and 200 (right) Line Scan Modes Using the SC-5 Camera

SURVEYOR MISSION E

TV-GDHS CALIBRATION DATA

A) DERIVING VIDEO CALIBRATION FROM DUPLICATE NEGATIVES

Photometric video calibration is directed to the objective of having the ability to determine Lunar Scene brightness from the recorded density of an image on film. Several aids have been designed into the film product to facilitate the meeting of this objective. These aids, the associated data, the restrictions and the tolerances for the use of these aids and data, are given below.

The Calibration Process and Data Flow

During the calibration of the TV-GDHS, the FM demodulator is set for a given voltage output at various discreet frequencies. The calibration results in a conversion ratio of 3 volts per 1.25 MHz. After demodulation, the video signal is processed by clamping the backporch to an adjustable reference voltage and normalizing the resultant video signal such that black level occurs at 0 volts and white level occurs at 1 volt. The black level and white level frequencies are determined from a calibration tape recording made at Cape Kennedy prior to launch. Only the delta frequencies, referenced to backporch, are required for the calibration of the ground equipment (absolute frequencies are required for operational reasons) See Reference (1).

An analog exposure computer operates on the normalized video signal to achieve the following functions.

1) To introduce a recording gamma to match the film processing gamma such that a desired system gamma may be achieved.

$$\gamma_S = \gamma_R \gamma_A$$

γ_S = System Gamma

γ_R = Recording Gamma

γ_A = Film Processing Gamma

Generally, the goal is a γ_S of 1.0 on the original archival negative.

2) To set a contrast ratio (CR) to be achieved on the original negative independent of γ_S. This is generally set for a contrast ratio of 25:1 or delta density of 1.4 between black and white when $\gamma_S = 1.0$.

3) To compensate for such things as CRT writing speeds, light filters, etc.

4) To supply a constant intensity signal which represents a flat white level field or a flat black level field for recording "calibrate" frames.

The Film Recorder then takes the video signal from the exposure computer and exposes the film with light from a CRT which is linearly related to its input signal. After a frame of video information is recorded, an electically generated gray scale is exposed along the left side of the video frame. The Film Recorder also position modulates the recording electron beam, in the vertical direction, to fill in the gaps between recording lines. This is known as dither.

The film is wet processed to obtain an original negative. The negatives distributed in this data package are duplicates which are made from the original negative via a master positive.

During the mission, it is the practice to expose film during the countdown procedures with graybar and white line grid patterns generated by the Video Data Simulator, and the flat white and flat black levels generated by the exposure computer to provide standard reference frames. At the conclusion of the pass, a dub of portions of the Calibration Tape made at Cape Kennedy is played through the system, and likewise recorded on film.

<u>Sources of Density Variation From Pass to Pass</u>

It is obvious that there are many steps between the Spacecraft and the final duplicate negative, each one of which can cause day to day density variation in the final product.

These sources of variation are listed here:

a) Variations of the output voltage versus input light intensity in the spacecraft camera itself.

b) Variations in the sensitivity of the modulator in the Spacecraft.

c) Variation in the set up of the test equipment used to perform the countdown calibration.

d) Variations in the ground equipment demodulator and associated video amplifiers.

e) Variation in the video processor and the normalization process and calibration.

f) Variations in the exposure computer.

g) Variations in the day-to-day set up of the light versus input voltage to the Film Recorder.

h) Variations in day-to-day processing of the original negative.

i) Variations in the exposure and processing of the master positive and duplicate negatives.

Calibration Aids

1) The Electrical Gray Scale (EGS)

An electrical gray scale (EGS) is exposed along the left edge of every frame. The EGS is generated internally by the exposure computer independen of any input signal. The intent of this gray scale is to provide a series of gray steps, the black and white steps of which are equivalent to the normalized input voltages corresponding to the calibrated black and white levels of the input signal. The gray scale is a series of eight equal voltage steps from 0 volts to 1 volt. 0 volts corresponds to black level, and 1 volt corresponds to white level. On the film exposed at Pasadena, a ninth step is included which is a repeat step of white level.

For Surveyor Mission E, the voltage steps have the following correspondences. See Reference (1).

	Step	Voltage	Representing A Frequency (From Back Porch)
Black Level	1	0.000 ± .001 Volts	100 KHz
	2	0.143 ± .001 Volts	476 KHz
	3	0.286 ± .001 Volts	851 KHz
	4	0.429 ± .001 Volts	1.227 KHz
	5	0.571 ± .001 Volts	1.603 MHz
	6	0.714 ± .001 Volts	1.979 MHz
	7	0.857 ± .001 Volts	2.354 MHz
White Level	8	1.000 ± .001 Volts	2.730 MHz

A recent modification to the film recorders at Pasadena has eliminated to a large extent the problems noted below for the 8 step EGS. The 9 step version utilizes the same dither and line spacing as is used in the video image.

Restrictions and problems encountered in using the 8 step EGS.

There are three phenomenon which have reduced the usefullness of the EGS.

a) The line spacing in the EGS is not the same as in the video frame.

b) The "dither" on each line is not the same as in the video frame.

c) Spot size changes in both the EGS and the video frame as a function of beam current.

The Phenomenon will affect the density measurement made on either an averaging densitometer or a microdensitometer. It is not clear at this time what the exact correspondence is between the densities in the EGS and the video frame, but it is known that for the same input voltage to the Film Recorder, different values of density will be read out from the EGS when compared to the Video Gray Bar.

2) The Video Gray Bar

The Video Gray Bar (VGB) is generated by the Video Data Simulator (VDS). During countdown, the VDS is set according to published S/C Video Calibration parameters. See Reference (1). The back porch is set to a nominal frequency; sync tip, black level and white level are then set to produce the published difference frequencies, all relative to back porch. Eight equal step voltage levels are generated between the black level and the white level in two series of staircases. The first series starts at midscale and goes to black level. The second series starts at white level and goes to black level immediately after the black level of the first series.

The following table lists the correspondences.

	Step	Demod Output	Representing a Δ Frequency	Processed Video (To Film Recorder Exposure Computer)
Black Level	1	-2.760 ± .03 Volts	100 KHz	0.000 ± .02 Volts
	2	-1.858 ± .03 Volts	476 KHz	0.143 ± .02 Volts
	3.	- .958 ± .03 Volts	851 KHz	0.286 ± .02 Volts
	4	- .055 ± .03 Volts	1.227 KHz	0.429 ± .02 Volts
	5	+ .847 ± .03 Volts	1.603 MHz	0.571 ± .02 Volts
	6	+1.750 ± .03 Volts	1.979 MHz	0.714 ± .02 Volts
	7	+2.650 ± .03 Volts	2.354 MHz	0.857 ± .02 Volts
White Level	8	+3.552 ± .03 Volts	2.730 MHz	1.000 ± .02 Volts
Back Porch		-3.000 ± .03 Volts	0.000 MHz	---
Sync Tip		-2.90 ± .03 Volts	500 KHz	---

3) White Level and Black Level Calibrate Frames

During countdown and at the conclusion of the Video operating pass, the Film Recorder is put into a calibrate mode in which the exposure computer puts out a signal corresponding to white level (1 volt input to the exposure computer), and a few frames are exposed on film. Similarly, a black level (0 volts input to the exposure computer) is recorded on film. Any shading introduced by the Film Recorder, or subsequent processing, can be measured from these frames.

4) The Optical Gray Wedge

The optical gray wedge is exposed onto the film by an independent light source. The film is exposed by this gray wedge during the countdown and subsequent to the video operating pass as well as automatically at 50 frame intervals during the pass. This provides a reference which will vary only because of film processing variation independent of changes in the Film Recorder.

5) Playback of the Dub of the S/C Calibration Tape

Subsequent to the end of a view period, a dub of selected frames from the S/C Calibration Tape is played back through the system. The tape playback originates at DSS-11. The entire system records the signal just as if it were a true real-time signal. See Reference (2) for a description of the data content of this playback.

Additional Remarks

To the eye used to viewing negatives intended for rapid production printing, the negatives in the data package may well appear relatively dense. The reason is that the toe of the H & D Curve extends up to approximately .3 to .4 density units. It is highly desirable from a photometric standpoint to place the image on the most linear part of the H & D Curve, hence black level is set to the minimum density possible, but still on the linear portion of the curve.

The Recording Function

All functions in the exposure computer are normalized with respect to an input voltage of 1.0 volts. The relationship of the exposure computer output to its input is:

$$V_{out} \approx (K_1 V_{in} + K_2)^{\gamma_R}$$

Where: $K_1 + K_2 = 1$

$0 \leq V_{in} \leq 1.0$

γ_R = Recording γ

$\frac{K_1 + K_2}{K_2}$ = Contrast Ratio

The density on the film, as measured by an averaging densitometer, is:

$$D \approx \log (K_1 V_{in} + K_2)^{\gamma_R \gamma_A}$$

Where: $\gamma_R \gamma_A = \gamma_S$

γ_A = Film Development γ

γ_S = System γ

A further refinement is:

$$D \approx \log (K_1 V_{in} + K_2)^{\gamma_S} + f(\text{Beam Current i.e., spot size and shape}) + f(\text{Line Spacing}) + f(\text{Dither})$$

The effect of the last three terms is known to exist, but no quantitative data is available at this time.

By plotting D versus log $(K_1 V_{in} + K_2)$ of the EGS or VGB, it is possible to derive V_{in} from density measurements in a video frame, and hence, spacecraft delta frequency which can then be related to the camera output voltage and Scene Brightness. The slope of the curve represents γ_S.

For the EGS or VGB and a Contrast Ratio setting of 25, the following relationships hold:

$$\frac{K_1 + K_2}{K_2} = 25, \quad K_1 + K_2 = 1 \quad \therefore \quad K_1 = .96, \; K_2 = .04$$

	Step	V_{in}	$K_1V_{in} + K_2$
Black	1	0.000 ± .02 Volts	0.040 ± .023 Volts
	2	0.143 ± .02 Volts	0.177 ± .027 Volts
	3	0.286 ± .02 Volts	0.315 ± .031 Volts
	4	0.429 ± .02 Volts	0.452 ± .035 Volts
	5	0.571 ± .02 Volts	0.588 ± .039 Volts
	6	0.714 ± .02 Volts	0.725 ± .042 Volts
	7	0.857 ± .02 Volts	0.863 ± .046 Volts
Black	8	1.000 ± .02 Volts	1.000 ± .050 V olts

If correctly adjusted, the error in the light intensity from the CRT in the Film Recorder is less than 1% compared to the output of the exposure computer. By measuring the densities over a white or black Calibrate frame the characteristic shading introduced by the film recorder can be measured.

References:

1) Surveyor V Spacecraft Survey Camera Science Calibration Report 1 September 1967 , Project Document No. 602-37, (page 2-a-9)

2) Ibid, (Page 2-a-16 and 2-a-17).

Pages 2-b-1 to 2-b-8 are from IOM # 272-B-67-693, of 12 October 1967.

TELEVISION IDENTIFICATION DATA CALIBRATION

The television identification parameters transmitted back from the spacecraft were calibrated prior to launch by Hughes Aircraft Company personnel. Essentially, tables of each parameter function in engineering units vs. the binary coded decimal equivalent were delivered for each parameter. Fifth-degree polynomials were fit to these by JPL personnel for operational use, with the calculated functions plotted and visually examined for goodness of fit to the calibration data. These ploynomials were then used in the TVGDHS computing system to obtain the engineering units in the TVID contained in this data package.

Polynomials were fit to the vidicon faceplate and electronics temperatures, mirror azimuth and elevation, lens faces and iris positions, and the filter wheel positions. The lens iris servo, multistep focus, focal length and time exposure words are transmitted as full binary words, but actually can be in only one of two states, hence were handled merely by level detection.

Shading Characteristics

The EDR and the Duplicate negatives in this Data Package were produced from Optics I of the Film Recorder in the SFOF, Pasadena. Figure B-1 shows an isodensity plot of the shading characteristics of this optics. Figure B-2 shows a series of orthogonal microdensitometer traces taken at approximate equal spacing across and down a white calibration frame. The frame used to make these measurements was made as part of the calibrate frames exposed for the first video pass of the mission. Figure B-3 & B-4 show the same data taken from a special test during the 1st lunar night.

A close examination of the films show some mottling which appears to account at least partially for the apparently large differences between the patterns. However, it can be stated that there is a general density gradient from upper left (highest) to lower right.

System Gamma Plots

Figure B-5 shows an example of a System Gamma Plot. A corrected EGS plot is shown which has been constructed using the left edge shading curve of the image area. It is to be noted that the VGB is near the center line of the frame and the shading curve has smaller variations, as shown in the boxed in area indicated on Figure B-2. The measurements were made from the same frame as Figures B-1 and B-2.

Demodulator Curve

Figure B-6 shows the output voltage of the FM Demodulator VS input frequency at a point prior to final amplification.

Original Film Measurements

Table B-1 gives the measurements of the output of the exposure computer and density for the Electrical Gray Bar and 9 points on a white Calibrate Frame.

The relationship between the input to the exposure computer to its output is:

$$V_{out} = K_3 \left(K_1 V_{in} + K_2\right)^{\gamma_R}$$

For Mission E $K_1 = .96$, $K_2 = .04$ (as discussed in Section A), $K_3 = 22.458$ and $\gamma_R = \frac{1}{2}$

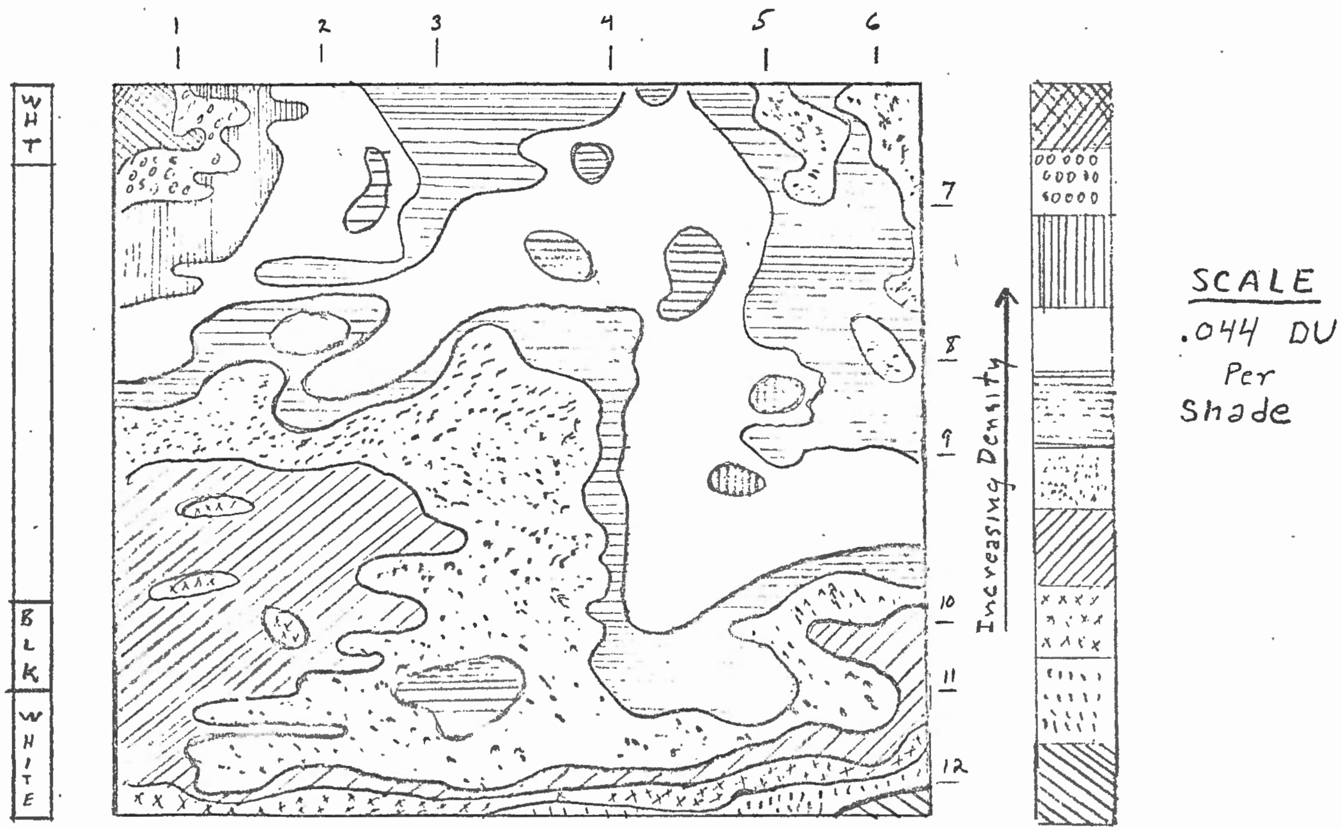
The light output of the film recorder optics is directly proportional to the exposure computer output voltage except for any shading characteristics.

Density vs Delta Frequency

Figure b-7 shows density vs delta frequency from back porch as measured on a series of original negatives recorded on Optics I, SFOF, Pasadena. These original negatives are the sources for the duplicate negatives in the data package and for the EDR.

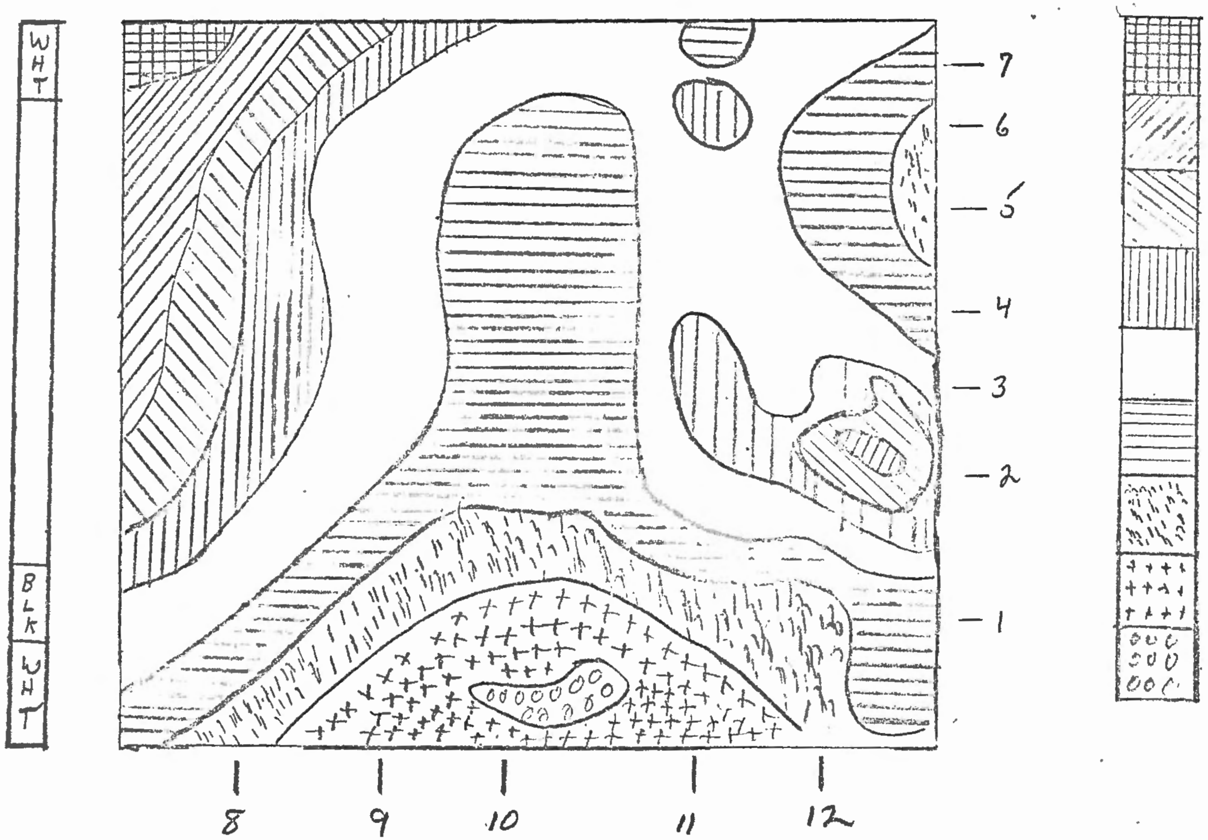
Some caution should be exercised when using these curves.

1) The spread of density vs frequency is that experienced on all films.
2) For any one roll the spread or tolerance is approximately ± .03 density units, i.e. Figure B-7 is an envelope of a family of curves, essentially parallel to the boundary of the envelope.
3) Since these are measured on the original negatives, a similar set of curves should be generated from measurements made on the duplicate negatives.



TV-1 OPTICS I
SHADING CHARACTERISTICS

FIGURE B-1



SCALE
.044 DU
Per
shade

TV-1
OPTICS I
SHADING
CHARACTERISTICS

Fig B-3

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 253/254
Film Control No. WO 346

COMPUTER OUTPUT EGS	DENSITY MEASUREMENTS EGS	DENSITY MEASUREMENTS VGB
1. 4.525	.52	.56
2. 9.310	.96	1.02
3. 12.32	1.20	1.25
4. 14.82	1.39	1.39
5. 16.99	1.62	1.47
6. 18.94	1.69	1.54
7. 20.70	1.78	1.58
8. 22.35	1.82	1.63

WHITE CALIBRATE FRAME

1.67	1.70	1.76
1.69	1.65	1.68
1.61	1.67	1.66

Average: 1.677

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 254/255
Film Control No.________

COMPUTER OUTPUT		DENSITY MEASUREMENTS	
	EGS	EGS	VGB
1.	4.535		
2.	9.225		
3.	12.37		
4.	14.69		
5.	16.929		
6.	18.96		
7.	20.255		
8.	22.48		

WHITE CALIBRATE FRAME

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 255/256
Film Control No. WO 368

	COMPUTER OUTPUT EGS	DENSITY MEASUREMENTS EGS	DENSITY MEASUREMENTS VGB
1.	4.55	.56	
2.	9.16	1.02	
3.	12.26	1.24	
4.	14.71	1.36	
5.	16.975	1.50	
6.	18.86	1.62	
7.	20.495	1.69	
8.	22.23	1.74	

WHITE CALIBRATE FRAME

1.57	1.54	1.66
1.69	1.65	1.68
1.68	1.59	1.67

Average: 1.636

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 257
Film Control No. WO 379

COMPUTER OUTPUT		DENSITY MEASUREMENTS	
	EGS	EGS	VGB
1.	22.24	.50	.60
2.	20.775	1.02	1.05
3.	19.09	1.28	1.24
4.	17.145	1.44	1.37
5.	14.95	1.61	1.46
6.	12.39	1.71	1.53
7.	9.24	1.79	1.60
8.	4.38	1.83	1.68

WHITE CALIBRATE FRAME

1.63	1.67	1.79
1.74	1.69	1.65
1.66	1.66	1.66

Average: 1.650

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 258
Film Control No. WO 399

	COMPUTER OUTPUT EGS	DENSITY MEASUREMENTS EGS	DENSITY MEASUREMENTS VGB
1.	22.52	.56	.66
2.	20.86	1.00	1.12
3.	19.02	1.23	1.32
4.	17.00	1.42	1.43
5.	14.81	1.66	1.50
6.	12.37	1.78	1.56
7.	9.29	1.87	1.60
8.	4.53	1.90	1.62

WHITE CALIBRATE FRAME

1.76	1.78	1.86
1.83	1.75	1.76
1.75	1.71	1.73

Average: 1.770

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 258/259
Film Control No.________

COMPUTER OUTPUT		DENSITY MEASUREMENTS	
	EGS	EGS	VGB
1.	22.35	.47	.54
2.	20.70	.89	.96
3.	18.82	1.14	1.14
4.	16.87	1.32	1.24
5.	14.78	1.51	1.31
6.	12.48	1.62	1.39
7.	9.35	1.74	1.46
8.	4.56	1.81	1.54

WHITE CALIBRATE FRAME

1.56	1.54	1.66
1.61	1.48	1.50
1.53	1.48	1.50

Average 1.540

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 260
Film Control No. WO 427

	COMPUTER OUTPUT	DENSITY MEASUREMENTS	
	EGS	EGS	VGB
1.	22.36	.61	.66
2.	20.71	1.10	1.15
3.	18.82	1.36	1.36
4.	16.88	1.54	1.50
5.	14.775	1.70	1.60
6.	12.41	1.82	1.66
7.	9.36	1.90	1.72
8.	4.56	1.95	1.76

WHITE CALIBRATE FRAME

1.74	1.76	1.76
1.75	1.78	1.84
1.89	1.79	1.79

Average: 1.786

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 261
Film Control No. WO 438

COMPUTER OUTPUT		DENSITY MEASUREMENTS	
	EGS	EGS	VGB
1.	22.36	.56	.60
2.	20.56	1.03	1.08
3.	18.92	1.29	1.28
4.	16.94	1.48	1.40
5.	14.80	1.63	1.50
6.	12.37	1.75	1.58
7.	9.33	1.85	1.64
8.	4.53	1.86	1.70

WHITE CALIBRATE FRAME

1.58	1.58	1.66
1.60	1.56	1.55
1.58	1.56	1.57

Average 1.582

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 262
Film Control No. WO 413

COMPUTER OUTPUT EGS	DENSITY MEASUREMENTS EGS	DENSITY MEASUREMENTS VGB
1. 22.74		
2. 21.11		
3. 19.27		
4. 17.34		
5. 15.11		
6. 12.66		
7. 9.49		
8. 4.67		

WHITE CALIBRATE FRAME

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 263
Film Control No. WO 461

COMPUTER OUTPUT	DENSITY MEASUREMENTS	
EGS	EGS	VGB
1. 22.355	.56	.60
2. 20.78	1.02	1.06
3. 19.11	1.28	1.26
4. 17.14	1.45	1.40
5. 14.95	1.54	1.50
6. 12.42	1.71	1.58
7. 9.42	1.90	1.63
8. 4.565	1.96	1.71

WHITE CALIBRATE FRAME

1.74	1.74	1.74
1.71	1.77	1.82
1.86	1.80	1.78

Average: 1.773

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 264
Film Control No. WO 482

	COMPUTER OUTPUT EGS	DENSITY MEASUREMENTS EGS	DENSITY MEASUREMENTS VGB
1.	4.580	.52	.58
2.	9.240	.94	1.03
3.	12.27	1.18	1.26
4.	14.745	1.36	1.39
5.	16.99	1.57	1.49
6.	19.065	1.72	1.54
7.	20.695	1.82	1.62
8.	22.410	1.92	1.69

WHITE CALIBRATE FRAME

1.72	1.70	1.82
1.78	1.72	1.68
1.73	1.70	1.66

Average: 1.723

TABLE BI

MEASURED DATA ON ORIGINAL NEGATIVES
EXPOSED ON OPTICS I, SFOF, PASADENA

GMT Day 265
Film Control No. WO 505

	COMPUTER OUTPUT EGS	DENSITY MEASUREMENTS EGS	DENSITY MEASUREMENTS VGB
1.	4.53	.53	.60
2.	9.40	.97	1.02
3.	12.73	1.22	1.23
4.	15.01	1.40	1.34
5.	17.235	1.58	1.44
6.	19.25	1.70	1.52
7.	21.02	1.82	1.59
8.	22.685	1.87	1.67

WHITE CALIBRATE FRAME

1.68	1.70	1.78
1.72	1.68	1.68
1.70	1.70	1.71

Average: 1.705

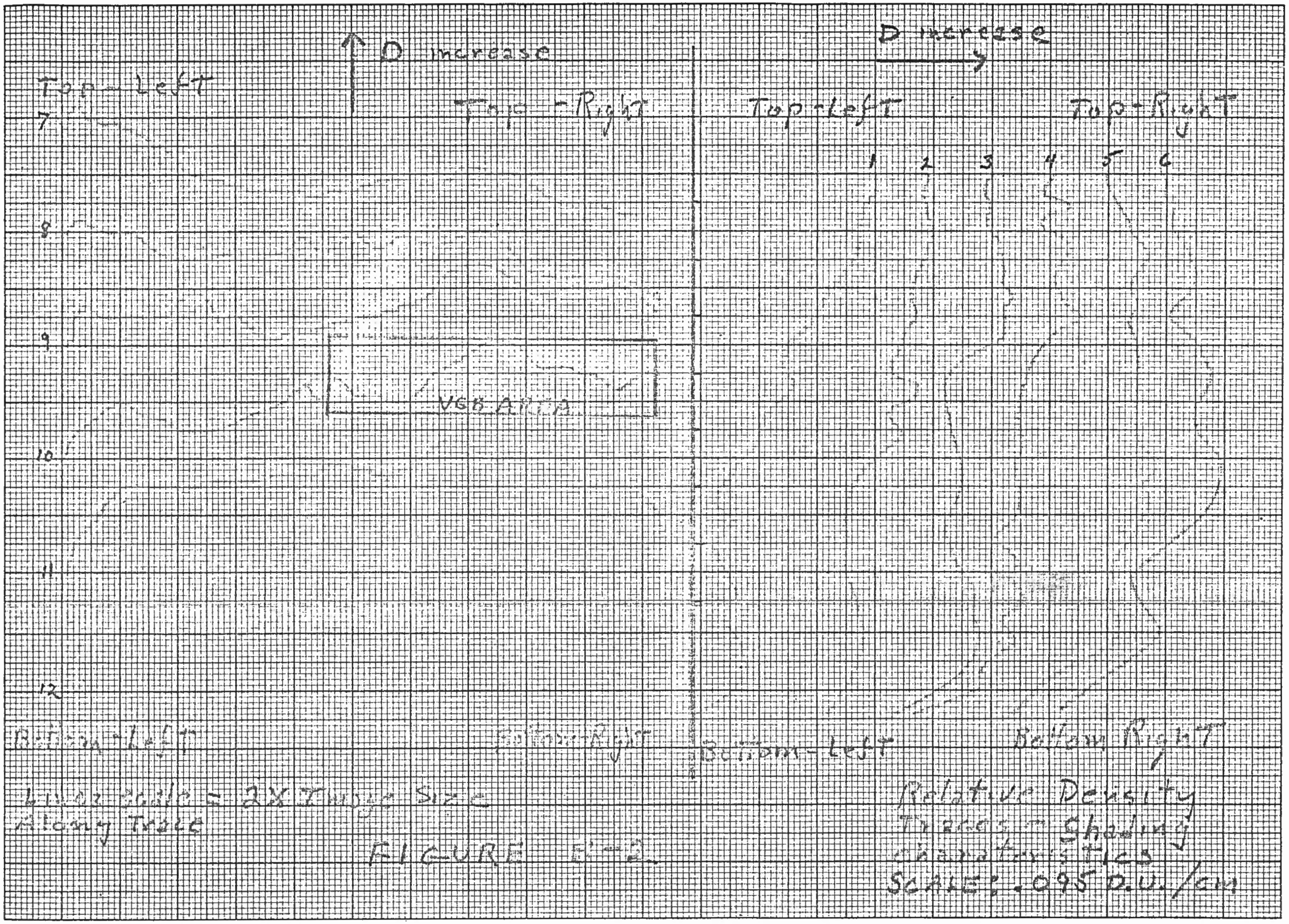

D increase
Top-Left
Top-Right
Top-Left
Top-Right
1 2 3 4 5 6
7
8
9
10
11
12
VGB AREA
Bottom-Left
Bottom-Right
Bottom-Left
Bottom-Right
Linear Scale = 2X Image Size
Along Trace
Relative Density
Traces - Shading
Characteristics
SCALE: .095 D.U./cm

FIGURE E-2

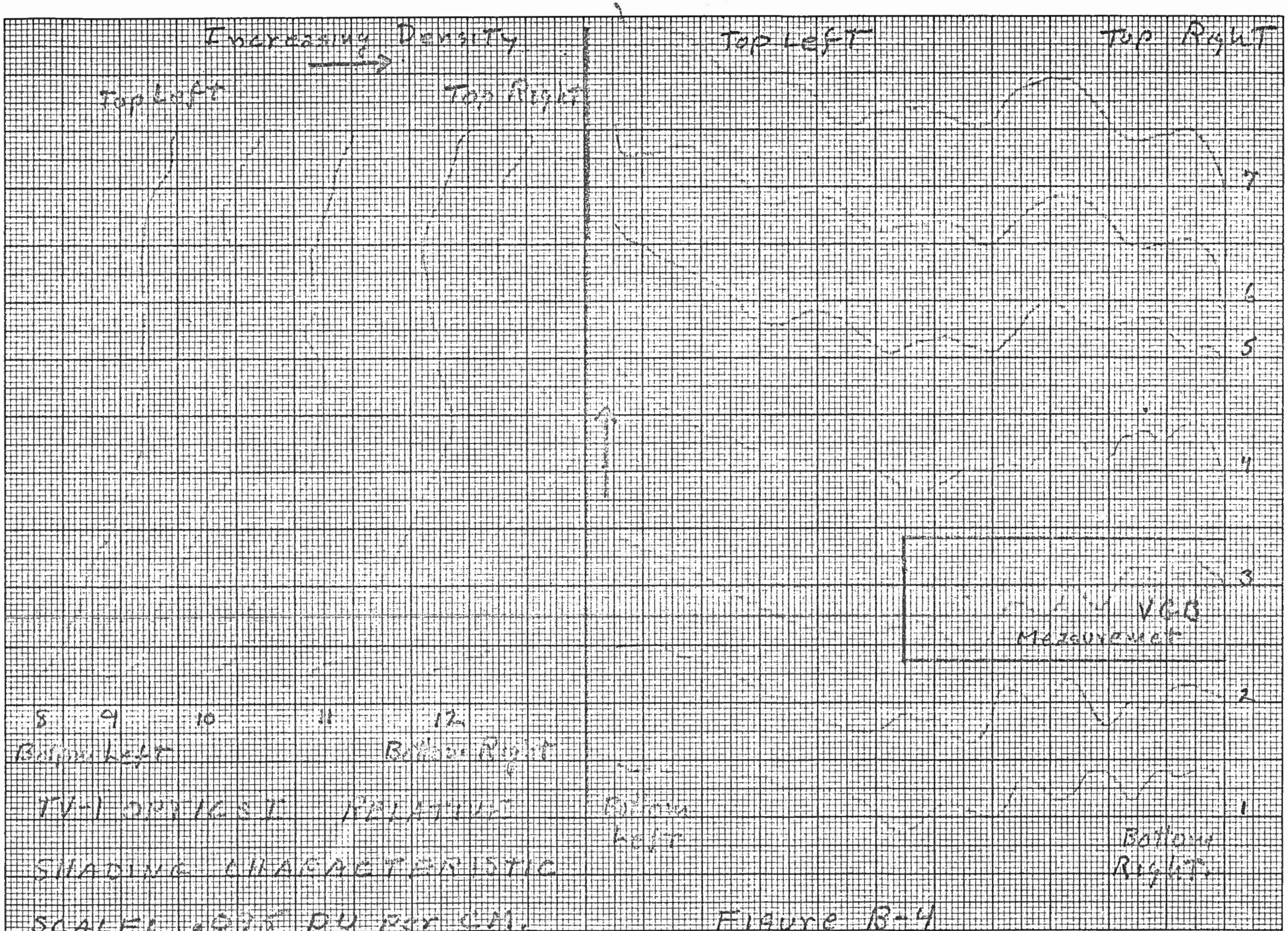
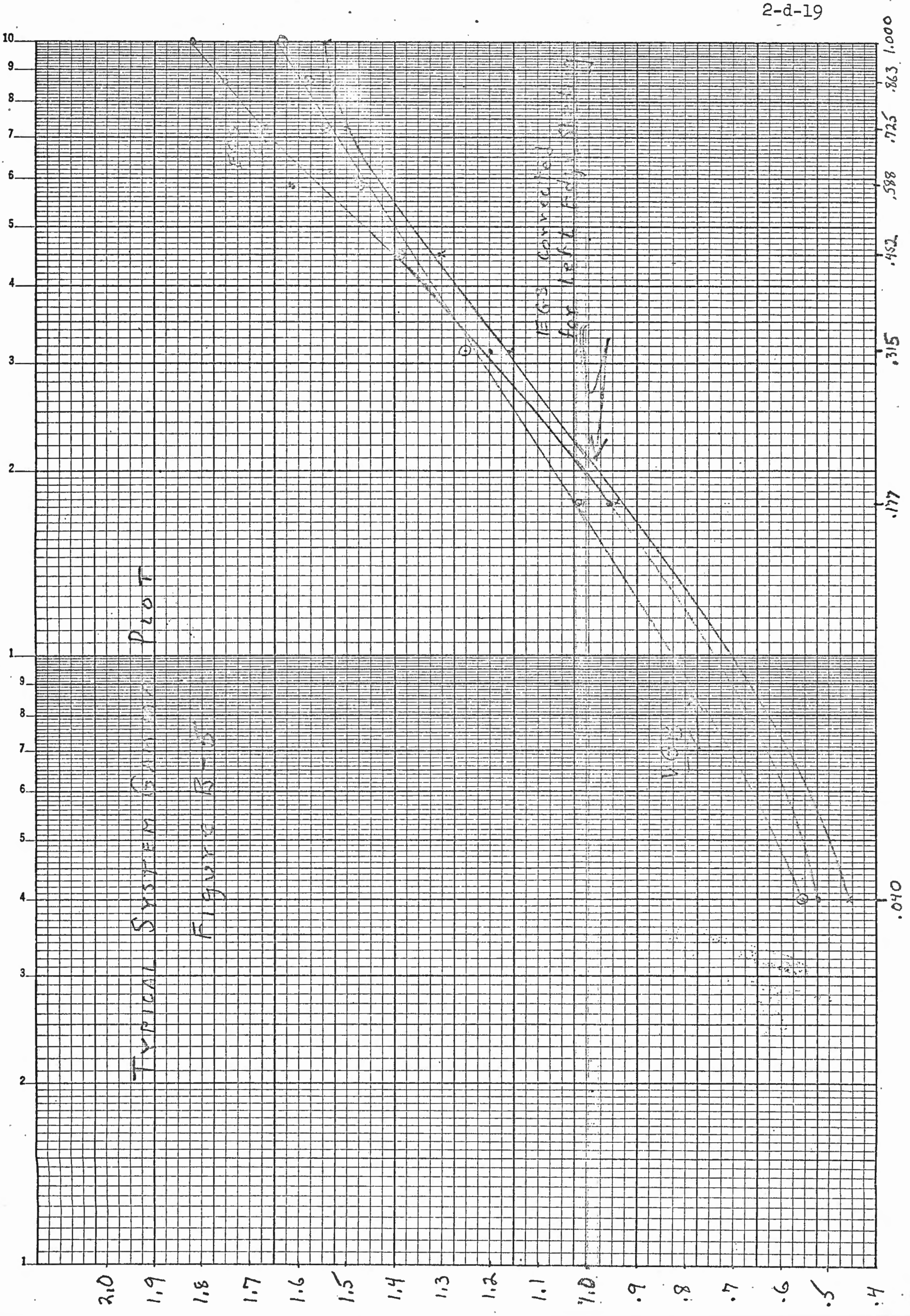

Increasing Density
Top Left
Top Right
Top Left
Top Right
7
6
5
4
3
2
1
VGB
Measurement
8
9
10
11
12
Bottom Left
Bottom Right
Bottom Left
Bottom Right
TV-1 OPTICS I RELATIVE
SHADING CHARACTERISTIC
SCALE: .025 DU per CM.

Figure B-4


TYPICAL SYSTEM
PLOT
Figure B-5
1.000
.863
.725
.588
.452
.315
.177
.040
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4

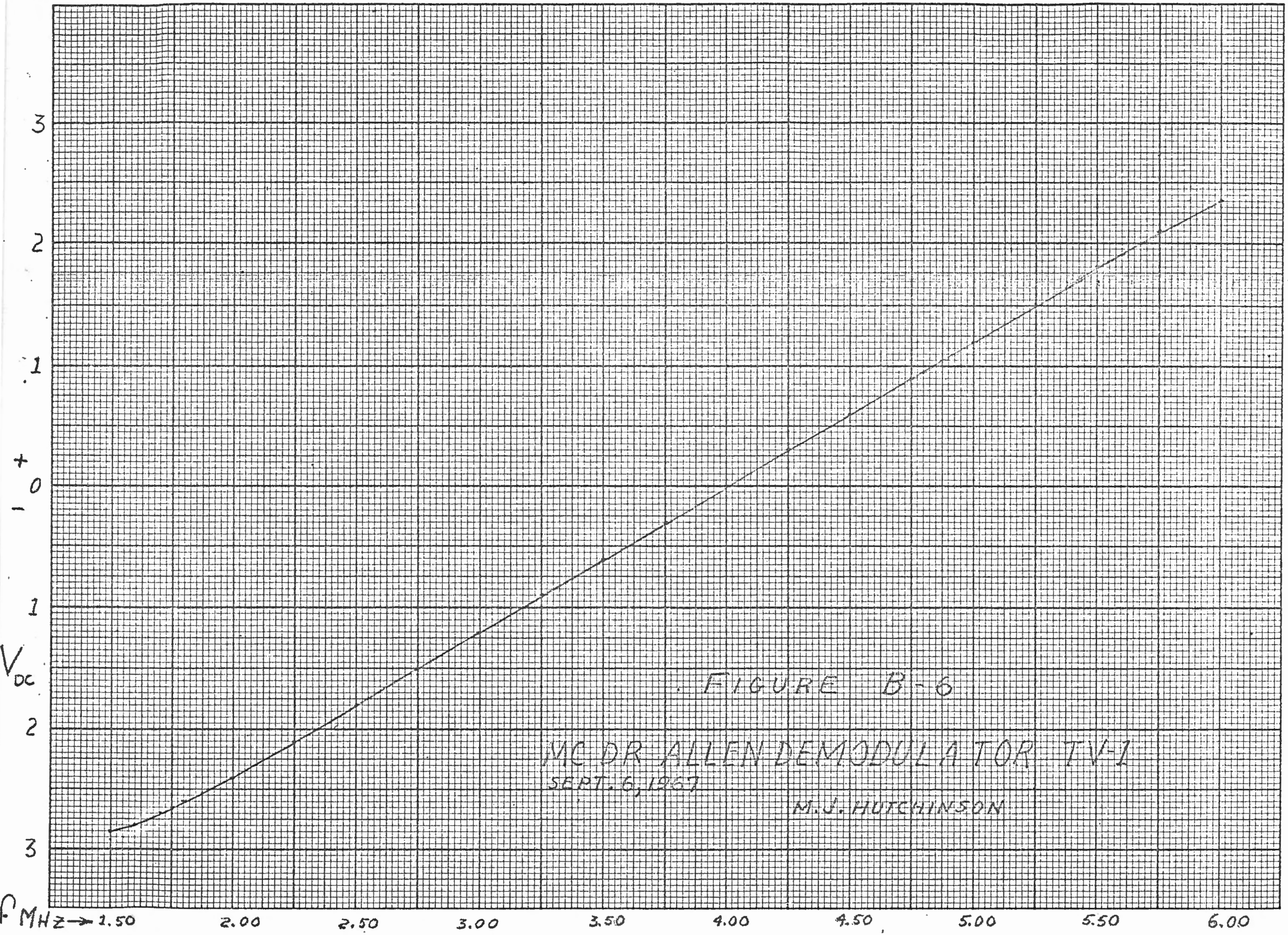


FIGURE B-6
MC DR ALLEN DEMODULATOR TV-1
SEPT. 6, 1967
M.J. HUTCHINSON
V DC
3
2
1
+ 0 -
1
2
3
f MHz → 1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
5.50
6.00

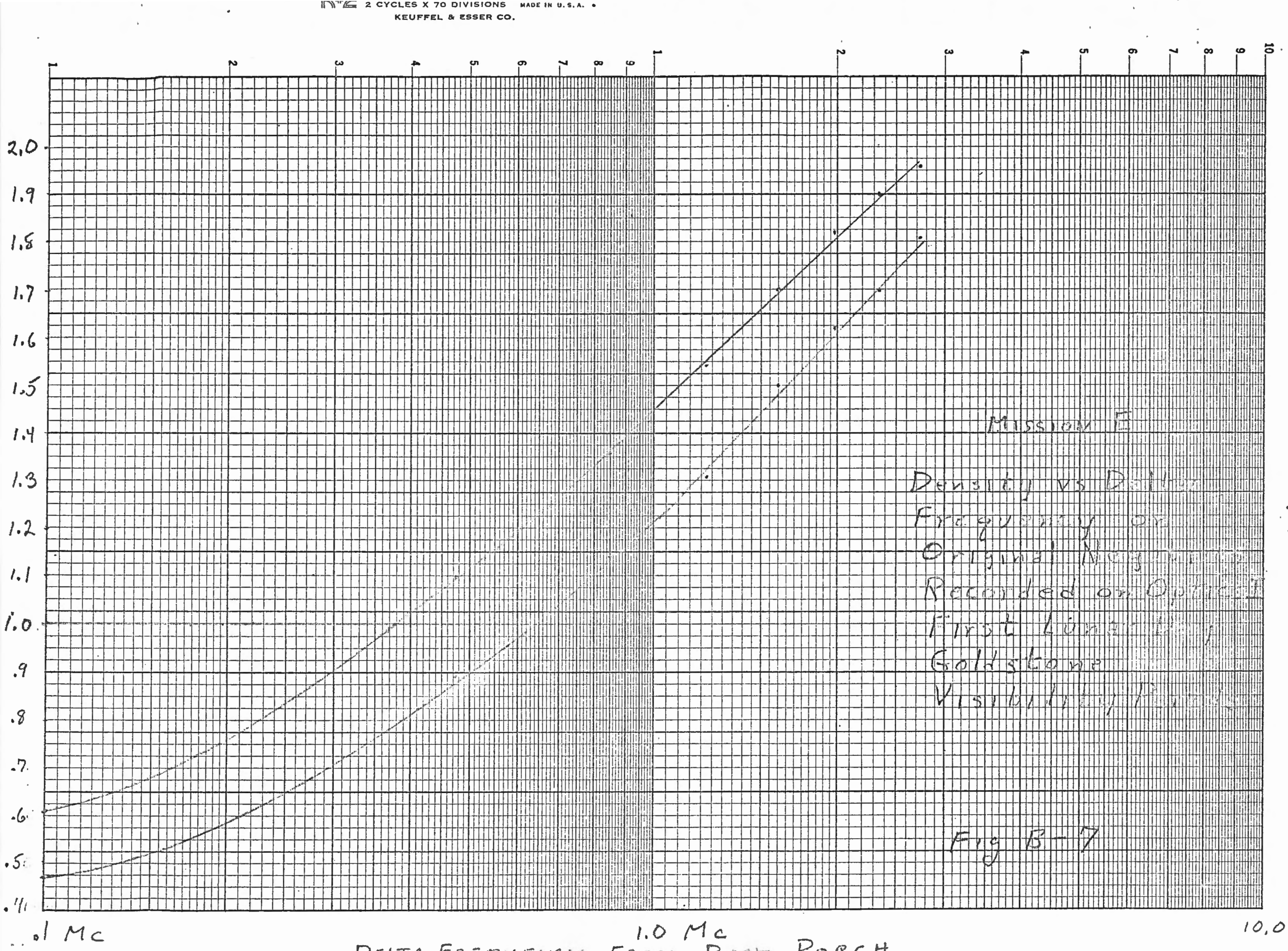

2 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.
Mission E
Density vs
.1 Mc
1.0 Mc
10.0 Mc

Fig B-7

CAMERA PERFORMANCE

The Surveyor V spacecraft camera was landed with the hood closed. Furthermore, when the vernier engines were fired as part of a post-touchdown test, the hood was also closed. Therefore, there were no problems with dust on the mirror as there were on S/C III.

During the last part of the pass over station 42 and during the last pass over station 11, the TV camera was stuck in the green filter, focus step 39, and narrow angle. Other than this, the camera operated in an excellent manner.

However, there was a phenomenon associated with the frequency deviation of the transmitters. This is detailed on the next pages.

S/C-5 VIDEO WHITE LEVEL DEVIATION

The frequency deviation of the S/C-5 transmitters corresponding to white video was vastly greater than the design range, resulting in potential degradation of bright Lunar scenes. This degradation results from the effect of various bandpass filters used in the ground processing system.

Figure I shows both the design and measured S/C-5 video frequency deviations. Also shown are two composite bandpass filter responses of the ground system.

In order to show the effect of video outside the bandpass of the ground system, a greybar test pattern with ten levels was used. Figure II shows the frequency deviation corresponding to each of the ten levels of the test pattern. The S/C-5 peak white video lies between the ninth and tenth levels of the test pattern.

Figure III shows the bandpass effect of the TV-GDHS when processing the test pattern video. The salt-pepper effect in the white level is due to the filter response. The signal level used corresponds to that actually received from S/C-5 during Lunar TV operation.

In order to partially compensate for the expected loss of extreme bright video, an operational procedure was developed whereby the DSS receiver supplying video to the TV-GDHS and FR-800 tape recorders was detuned by 500 KHz in a direction to more center the video signals in the passband of the ground system. The DSS receivers supplying video to the CDC, at Goldstone and overseas, were detuned by 200 KHz in the same direction. The effect of this detuning is shown in Figure IV using again the same test pattern and equivalent received signal level as in Figure III. The reduction of the salt-pepper noise in the white level is the result of moving the video signals more within the passband of the ground processing system.

The receiver detuning described above served to reduce noise in bright Lunar scenes. Video photometric calibrations were not affected since video levels are referenced to the back porch portion of the video waveform in the ground processing system.

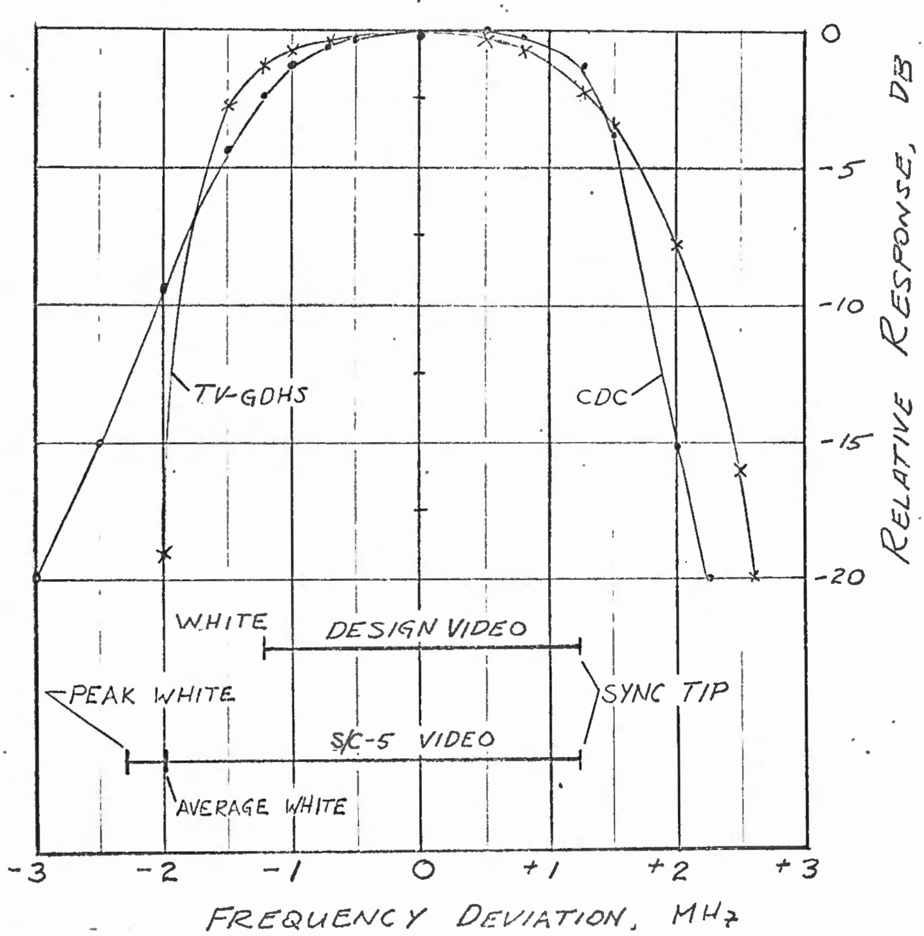


Figure I Ground System Filter Response and Video Frequency Deviations

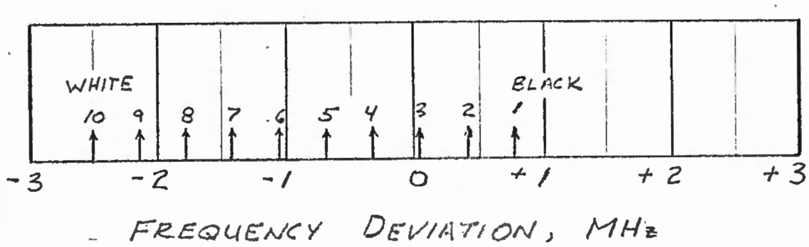


Figure II Test Pattern Greybar Levels

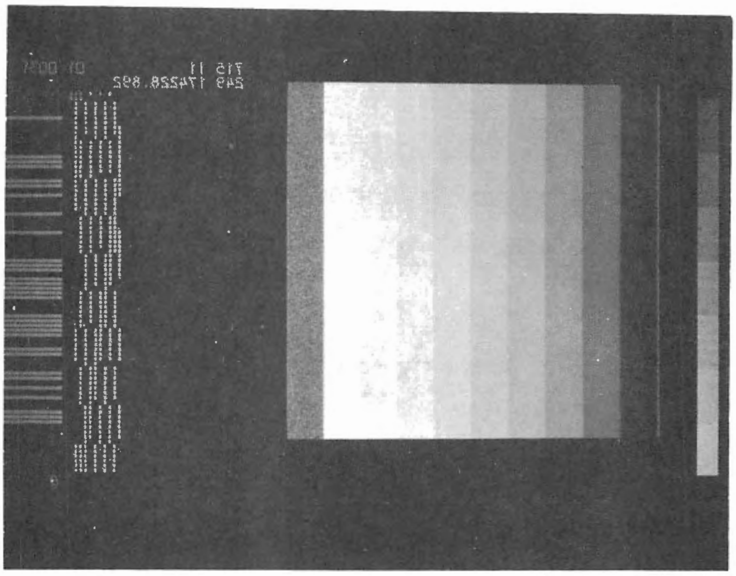


FIGURE III Greybar Test Pattern Without Receiver Detuning

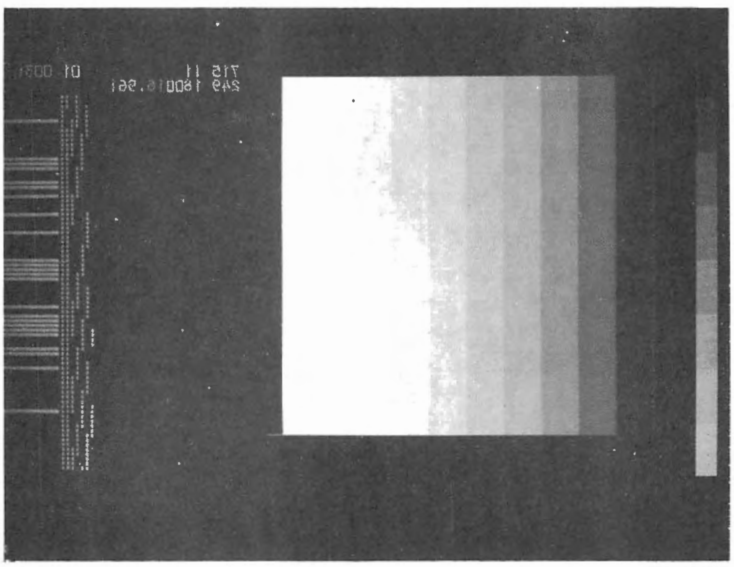


FIGURE IV Greybar Test Pattern With 500 KHz Receiver Detuning

SURVEYOR V ORIENTATION AND LOCATION

The landing site of the spacecraft, as determined from inflight tracking data, is at 1.50°N latitude and 23.19°E longitude. On the basis of post-landing tracking data, the landing site is at 1.41°N latitude and 23.15°E longitude. This site is in the southwestern part of Mare Tranquillitatis, about 70 km north of the southern boundary of the mare and a little over 80 km east of the crater Sabine. It is near the periphery of a complex system of mare ridges, but no known mare ridges occur within 19 km of the most probable position of the the landing site. The region is crossed by faint rays associated with the major crater Theophilus Theophilus, 350 km to the south, and the landing site may be within one of the Theophilus rays.

The orientation of the spacecraft and of the camera has been determined from television camera observations of stars and planets and of the lunar horizon, and also from the angular settings of the solar panel sun sensor and positional tuning of the spacecraft's planar array antenna. The stars Sirius, Arcturus, Agena, and Capella and the planets Venus and Jupiter were observed. Preliminary reduction of these observations showed that the spacecraft was tilted 19.7 deg at an azimuth of N17°E. Observations of the lunar horizon, on the other hand, indicate that the spacecraft was tilted 19.4 deg at an azimuth of N13°E. The amount of tilt of the spacecraft, at the time of these observations, is known within a few tenths of a degree, but the present solution for the azimuth of tilt has a probable error of several degrees. The camera 0-deg azimuth was found from the stellar and planetary observations to be oriented approximately N24.7°E. This solution is accurate to within a degree. Near the end of the first lunar day, the shock absorbers on legs 2 and 3 compressed, and the spacecraft was tilted about 3 deg more to the northeast.

Figures 1 and 2 are topographic maps of the Surveyor V landing site. The information for construction of these maps was collected by a technique called focus ranging. This technique utilizes pictures taken at eight to ten different focus settings at each camera elevation position along a given azimuth. Small areas in best focus in each picture are located on a mosaic of pictures taken at specific focus settings; the azimuth and elevation of the centers of each small area in best focus are determined by graphical measurement.

The location of a point on the lunar surface with respect to the intersection of the camera-mirror rotation axes is computed from azimuth, elevation, and calibrated focus distance. Focus-ranging surveys of the Surveyor V landing site were taken at each available camera elevation position along camera azimuth lines 18 deg apartment. The elevation angles are separated by 4.96-deg increments.

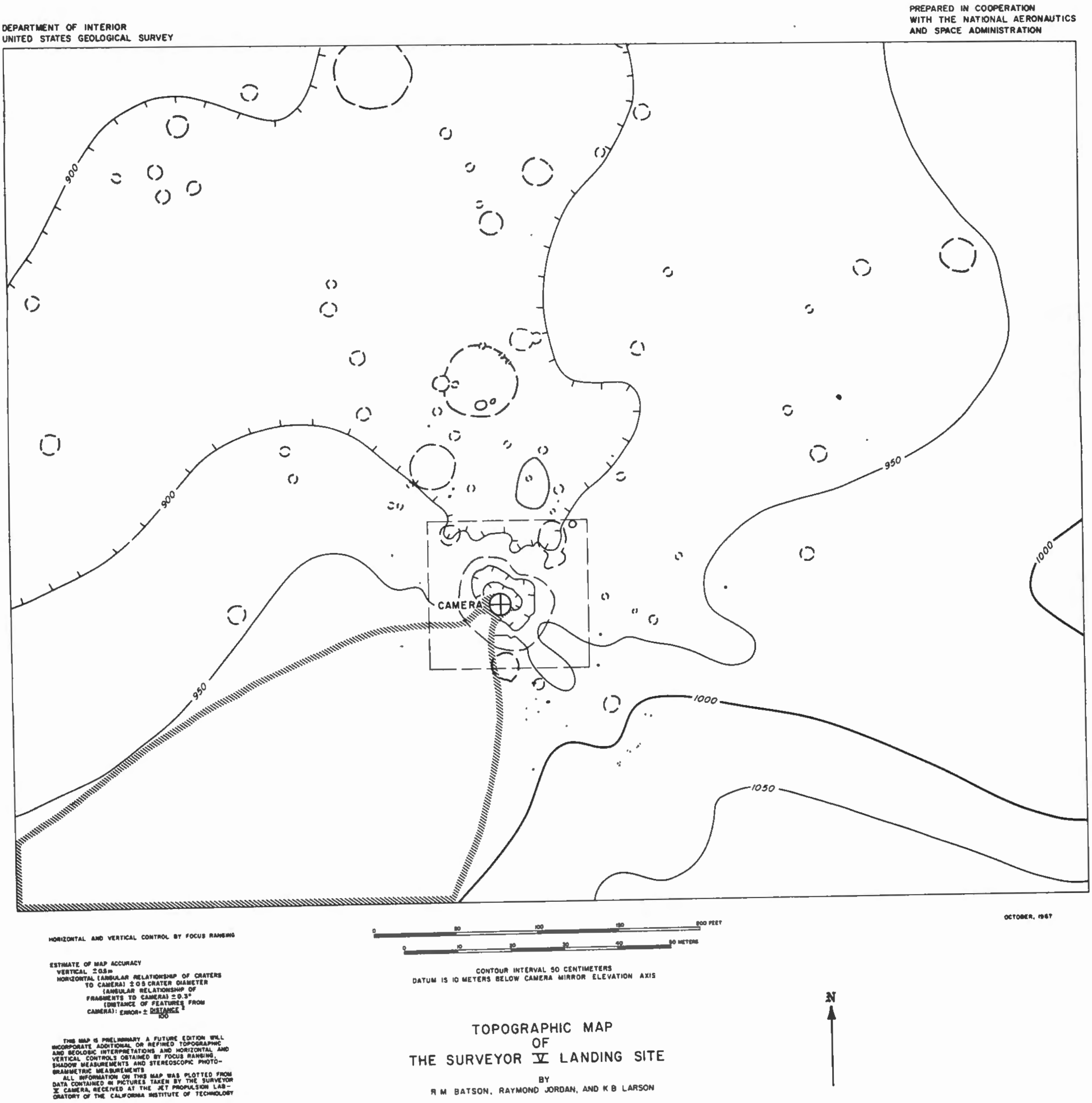


Figure 1. Small Scale Topographic Map of the Surveyor V Landing Site.

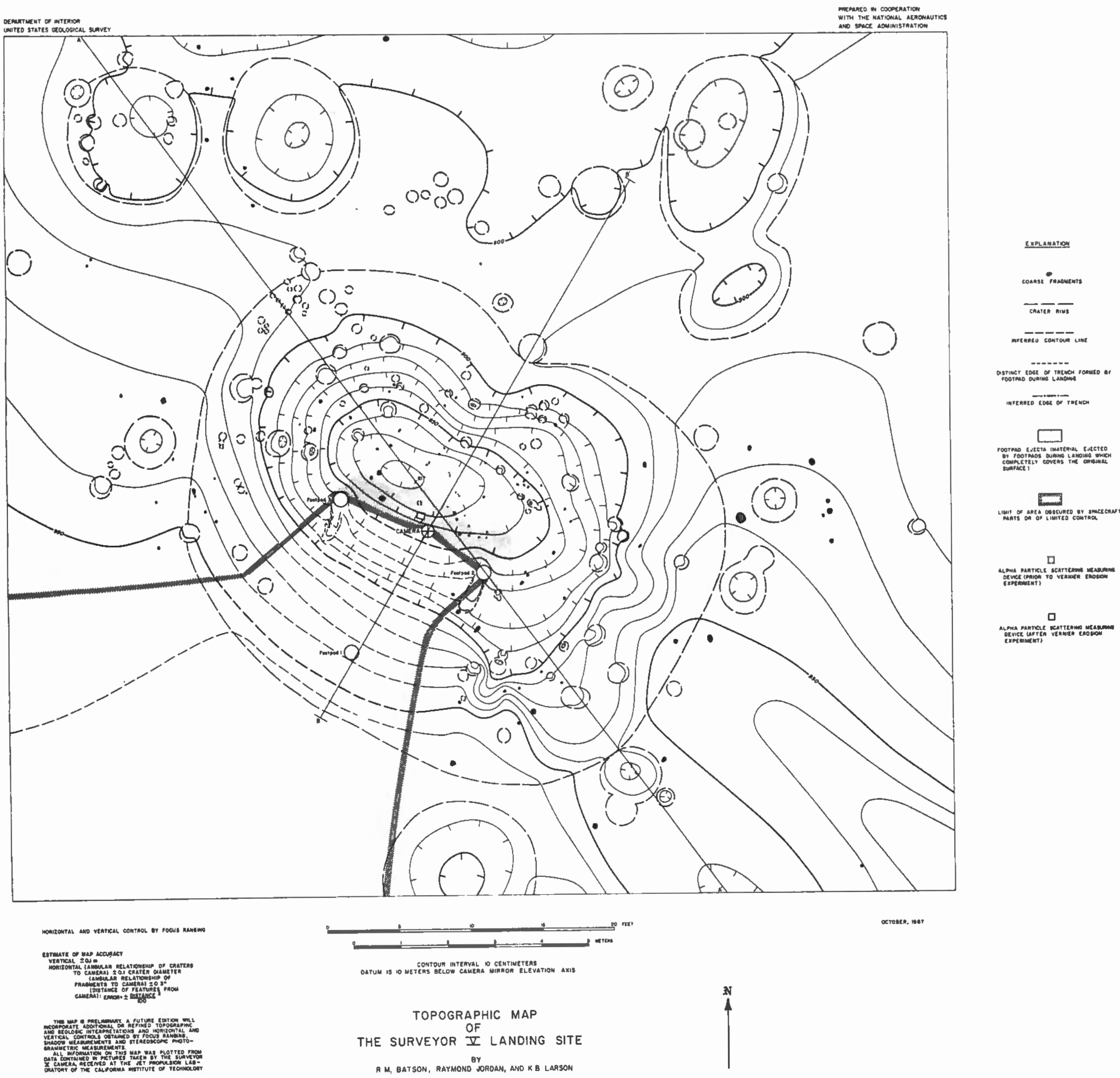


Figure 2. Large Scale Topographic Map of the Surveyor V Landing Site.

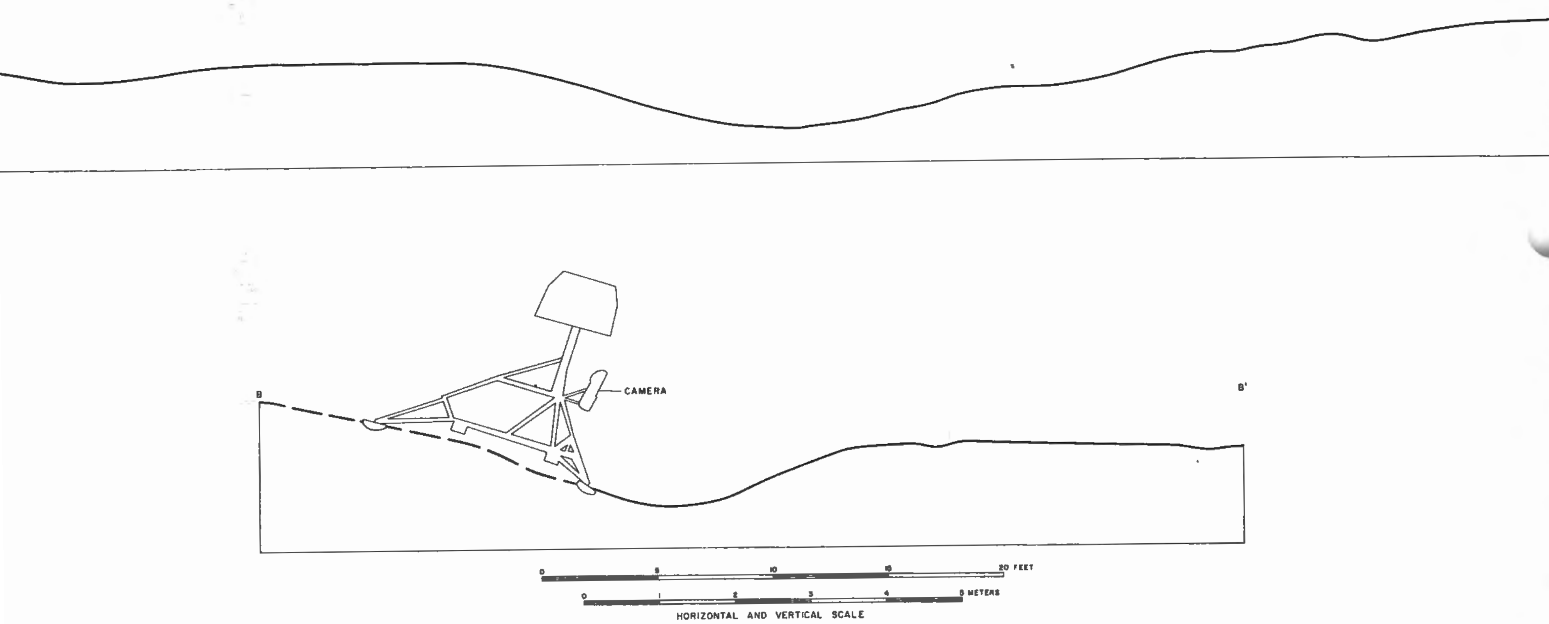


Figure 3. Longitudinal and Traverse Profiles of the Surveyor V Crater.

CELESTIAL EPHEMERIS

The following pages contain the lunicentric positions of the following celestial bodies:

AAUR	alpha Auriga	Capella
ABOO	alpha Bootes	Arcturus
BCEN	beta Centauri	Agena
ACMA	alpha Canis Major	Sirius
Venus		
Jupiter		
Sun		
Earth		

SURVEYOR 5 STELLAR PREDICTION

AAUR

DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
253.	24.04	37.10	34.35	26.22
254.	24.05	23.92	5.98	22.57
255.	24.06	10.75	334.37	25.62
256.	24.06	357.57	314.04	33.59
257.	24.07	344.40	303.27	43.86
258.	24.07	331.22	297.48	55.13
259.	24.08	318.04	294.36	66.87
260.	24.08	304.86	292.88	78.82
261.	24.08	291.69	292.60	-89.14
262.	24.08	278.51	293.41	-77.16
263.	24.08	265.33	295.45	-65.33
264.	24.08	252.15	299.19	-53.86
265.	24.08	238.97	305.62	-43.05
266.	24.08	225.80	316.87	-33.64
267.	24.08	212.62	336.45	-27.13

ABOO

DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
253.	30.90	160.78	48.67	-51.75
254.	30.89	147.61	54.81	-61.94
255.	30.89	134.43	58.48	-72.77
256.	30.89	121.26	60.41	-83.93
257.	30.88	108.09	60.96	84.77
258.	30.88	94.92	60.20	73.51
259.	30.88	81.74	57.92	62.47
260.	30.88	68.57	53.59	51.90
261.	30.88	55.39	46.08	42.26
262.	30.89	42.22	33.45	34.43
263.	30.89	29.04	13.71	29.90
264.	30.89	15.87	349.41	30.23
265.	30.89	2.69	328.76	35.28
266.	30.89	349.51	315.29	43.41
267.	30.90	336.33	307.25	53.21

BCEN

DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
253.	-44.72	188.08	165.42	-45.27
254.	-44.73	174.90	153.48	-49.97
255.	-44.73	161.72	144.64	-56.65
256.	-44.74	148.54	138.64	-64.64
257.	-44.74	135.37	134.92	-73.43
258.	-44.75	122.19	133.04	-82.63
259.	-44.75	109.00	132.75	88.01
260.	-44.75	95.82	133.99	78.76
261.	-44.75	82.64	136.86	69.90
262.	-44.75	69.47	141.67	61.75
263.	-44.75	56.29	148.84	54.75
264.	-44.74	43.11	158.76	49.48
265.	-44.74	29.93	171.26	46.61
266.	-44.74	16.75	185.08	46.59
267.	-44.74	3.57	198.11	49.44

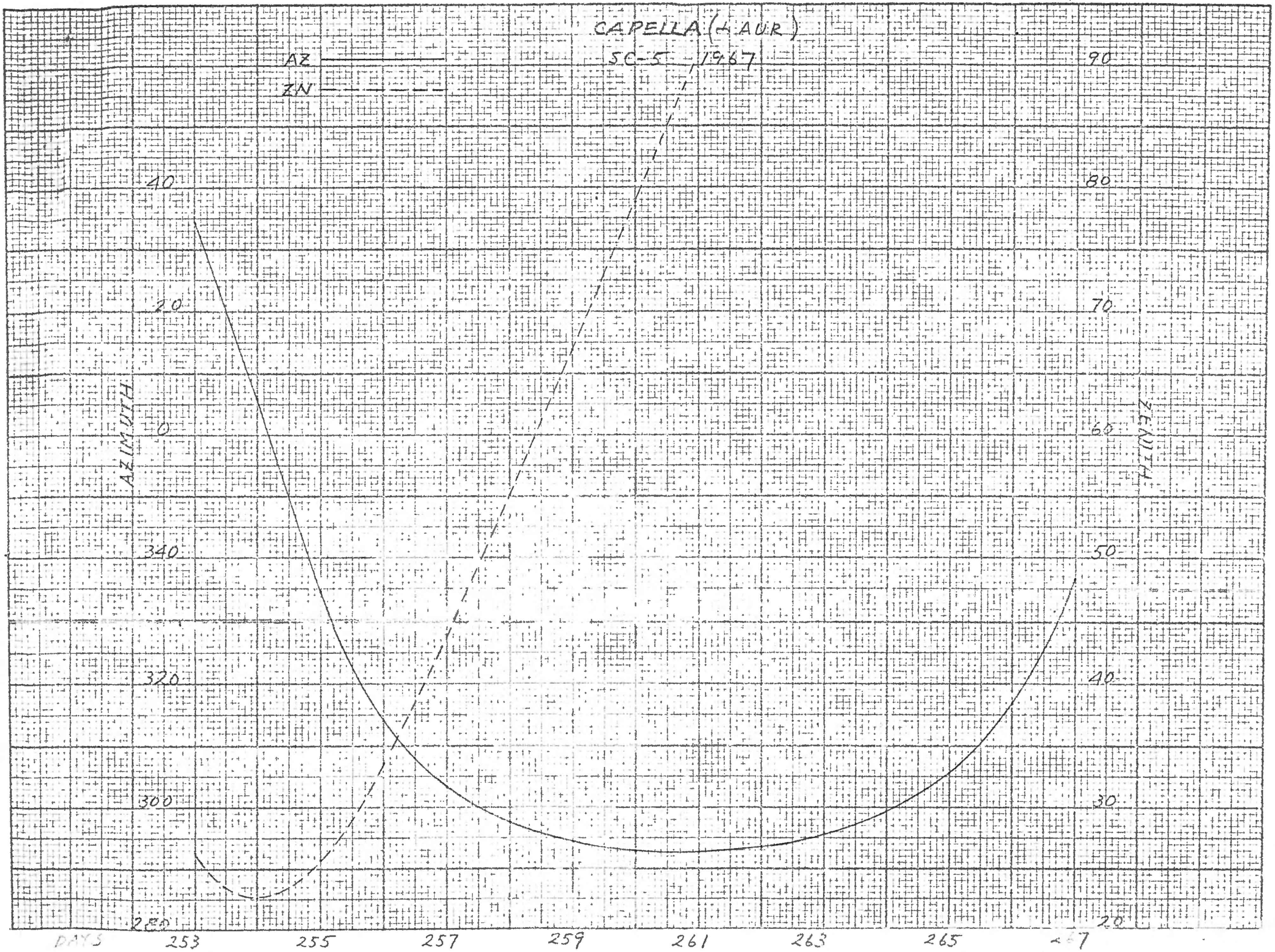
ACMA	DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
	253.	-38.14	60.07	140.29	52.14
	254.	-38.13	46.89	150.38	45.21
	255.	-38.13	33.71	164.41	40.77
	256.	-38.12	20.53	181.37	39.69
	257.	-38.12	7.36	198.06	42.25
	258.	-38.11	354.18	211.50	47.84
	259.	-38.11	341.01	221.03	55.53
	260.	-38.10	327.83	227.34	64.53
	261.	-38.10	314.66	231.25	74.30
	262.	-38.10	301.48	233.35	84.48
	263.	-38.10	288.31	233.93	-85.16
	264.	-38.10	275.13	233.03	-74.86
	265.	-38.10	261.95	230.49	-64.84
	266.	-38.10	248.78	225.85	-55.42
	267.	-38.10	235.60	218.29	-47.09

VENUS	DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
	253.	-6.77	92.16	97.20	69.22
	254.	-6.63	78.61	98.26	55.81
	255.	-6.48	65.13	100.17	42.52
	256.	-6.33	51.71	103.92	29.43
	257.	-6.17	38.35	113.24	16.88
	258.	-6.02	25.03	153.72	7.70
	259.	-5.86	11.77	235.03	13.65
	260.	-5.70	358.54	253.65	25.74
	261.	-5.54	345.34	259.52	38.54
	262.	-5.38	332.18	262.28	51.50
	263.	-5.22	319.04	263.85	64.52
	264.	-5.06	305.93	264.82	77.54
	265.	-4.90	292.83	265.44	-89.42
	266.	-4.74	279.76	265.82	-76.40
	267.	-4.57	266.71	265.98	-63.38

JUPITER	DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
	253.	2.08	85.42	88.55	62.10
	254.	2.08	72.46	88.66	49.15
	255.	2.09	59.49	88.65	36.19
	256.	2.09	46.53	88.40	23.23
	257.	2.09	33.56	87.17	10.29
	258.	2.10	20.60	300.31	2.75
	259.	2.10	7.63	272.58	15.65
	260.	2.10	354.67	271.64	28.61
	261.	2.10	341.70	271.44	41.57
	262.	2.11	328.73	271.45	54.53
	263.	2.11	315.76	271.57	67.49
	264.	2.11	302.79	271.76	80.45
	265.	2.11	289.81	272.04	-86.58
	266.	2.11	276.83	272.43	-73.62
	267.	2.11	263.86	272.98	-60.66

SUN	DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
	253.	1.04	109.41	89.12	86.10
	254.	1.02	97.21	89.41	73.90
	255.	1.00	85.00	89.68	61.70
	256.	.98	72.81	89.97	49.51
	257.	.97	60.62	90.31	37.32
	258.	.95	48.44	90.81	25.15
	259.	.93	36.26	91.89	12.98
	260.	.91	24.08	102.06	.98
	261.	.89	11.91	266.85	11.38
	262.	.86	359.74	268.76	23.55
	263.	.84	347.75	269.38	35.53
	264.	.82	335.39	269.77	47.88
	265.	.79	323.22	270.05	60.05
	266.	.77	311.04	270.31	72.23
	267.	.74	298.86	270.56	84.41

EARTH	DAY	LATITUDE	LONGITUDE	AZIMUTH	ZENITH
	253.	3.66	4.83	277.22	18.56
	254.	4.91	5.61	281.67	17.97
	255.	5.86	6.12	285.18	17.67
	256.	6.46	6.37	287.38	17.59
	257.	6.71	6.37	288.20	17.65
	258.	6.61	6.13	287.63	17.86
	259.	6.19	5.67	285.84	18.19
	260.	5.47	4.99	283.03	18.69
	261.	4.51	4.11	279.55	19.38
	262.	3.36	3.04	275.73	20.31
	263.	2.07	1.82	271.88	21.46
	264.	.70	.47	268.26	22.82
	265.	-.70	359.06	265.01	24.32
	266.	-2.06	357.62	262.25	25.91
	267.	-3.34	356.24	259.95	27.46
	268.	-4.49	354.98	258.10	28.91


CAPELLA (α AUR)
SC-5 1967
AZ
ZN
AZIMUTH
ZENITH
40
20
0
340
320
300
280
90
80
70
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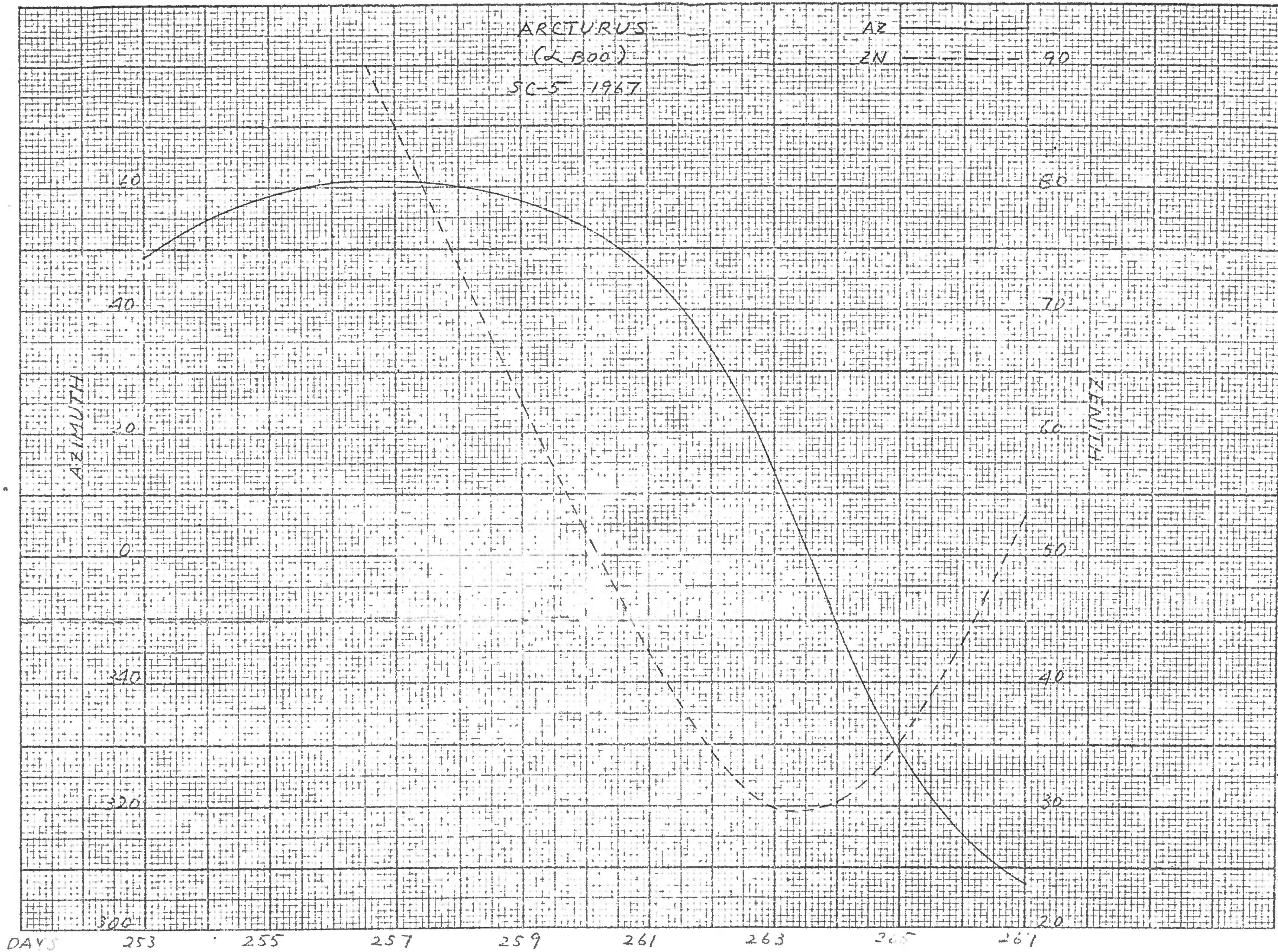
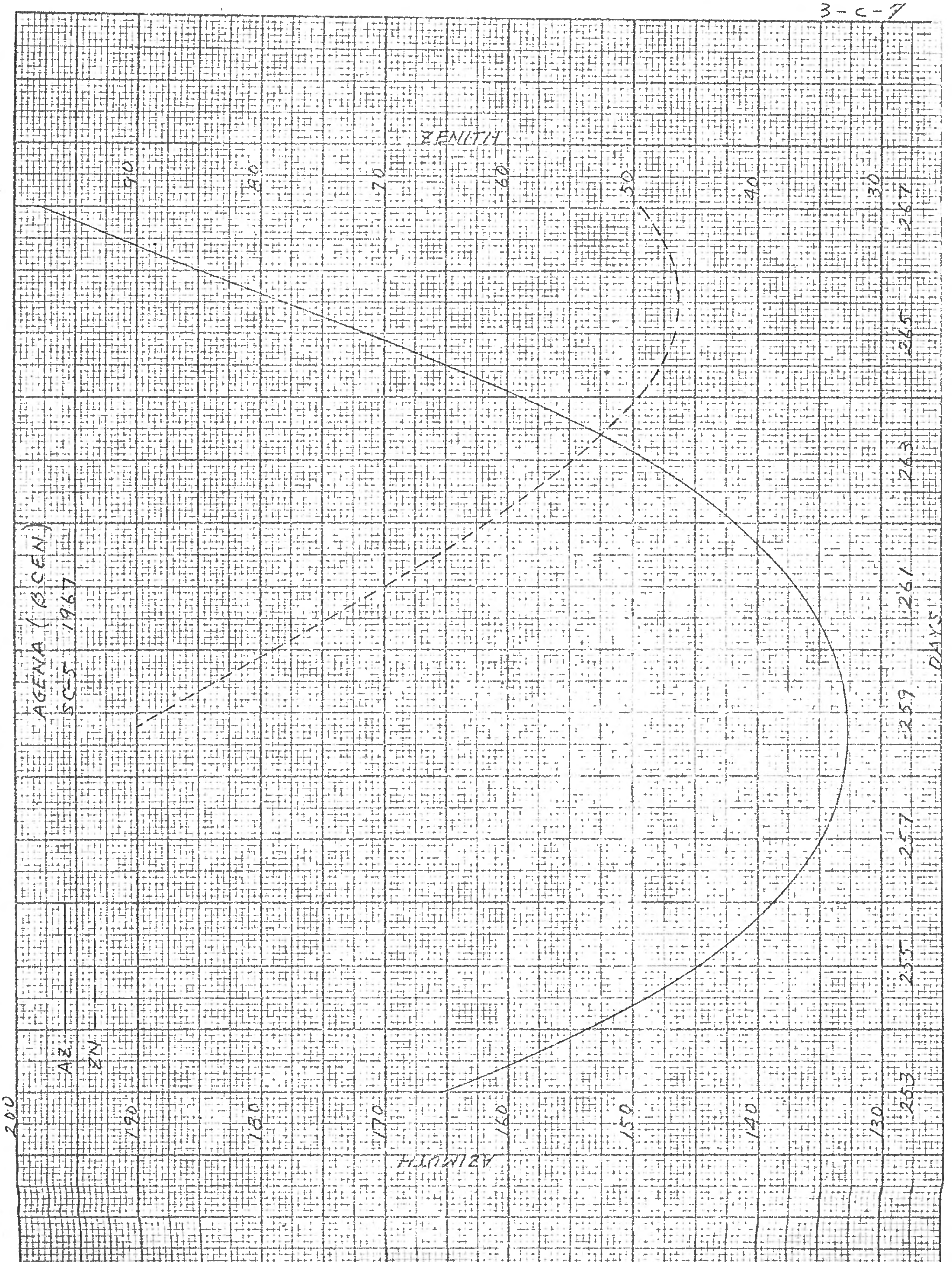
30
20
DAYS
253
255
257
259
261
263
265
267

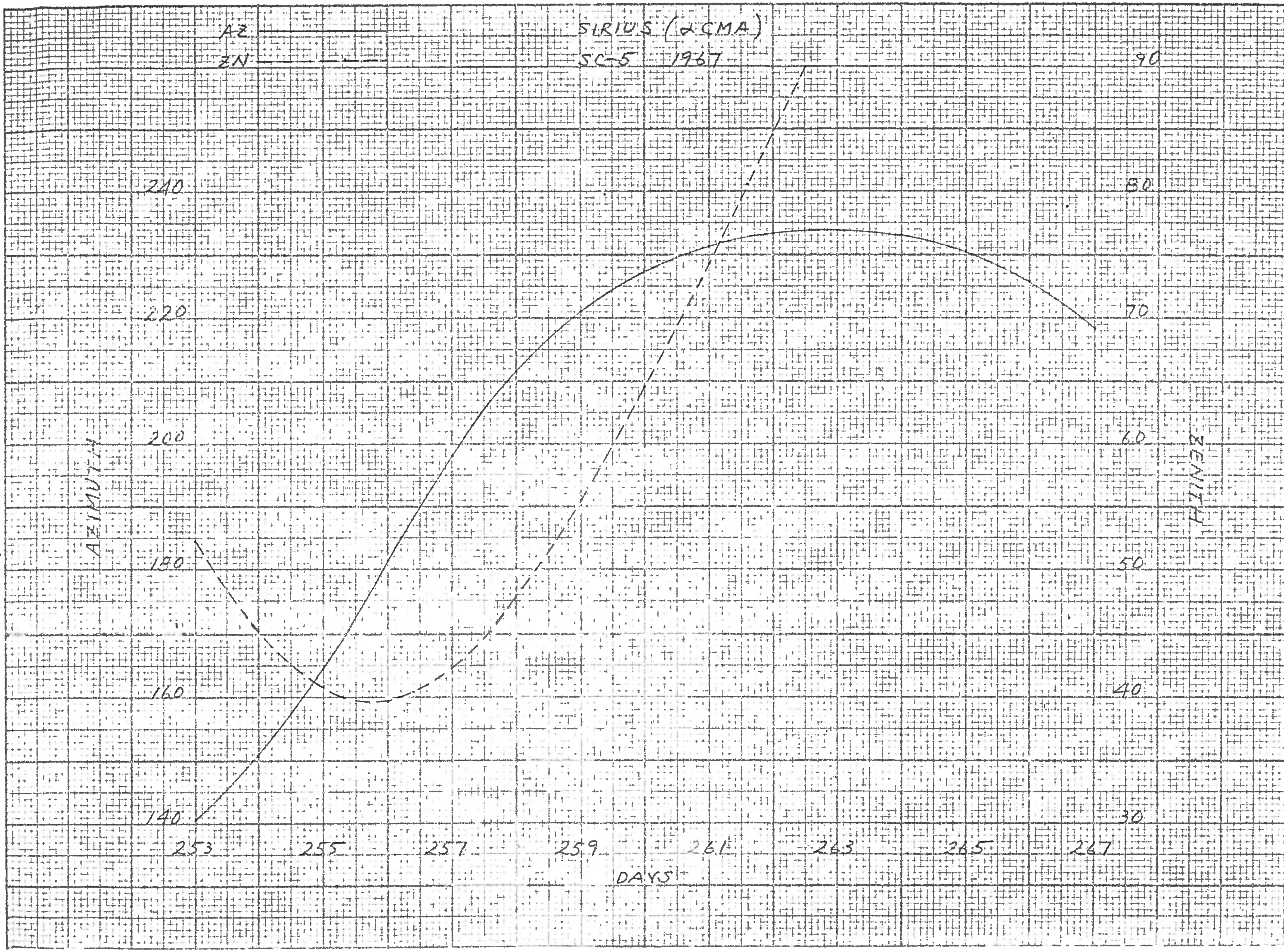
3-c-5

3-C-6

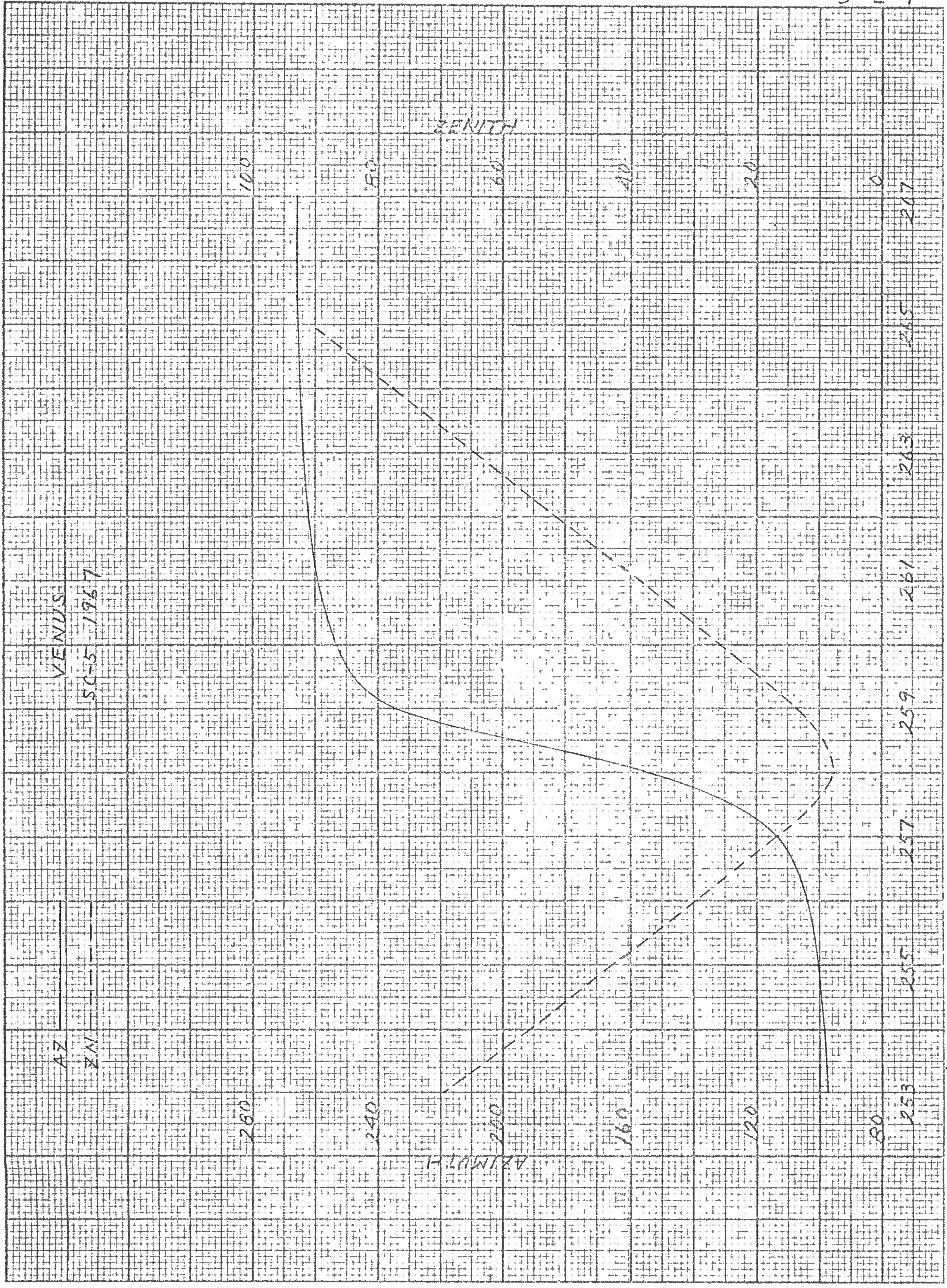


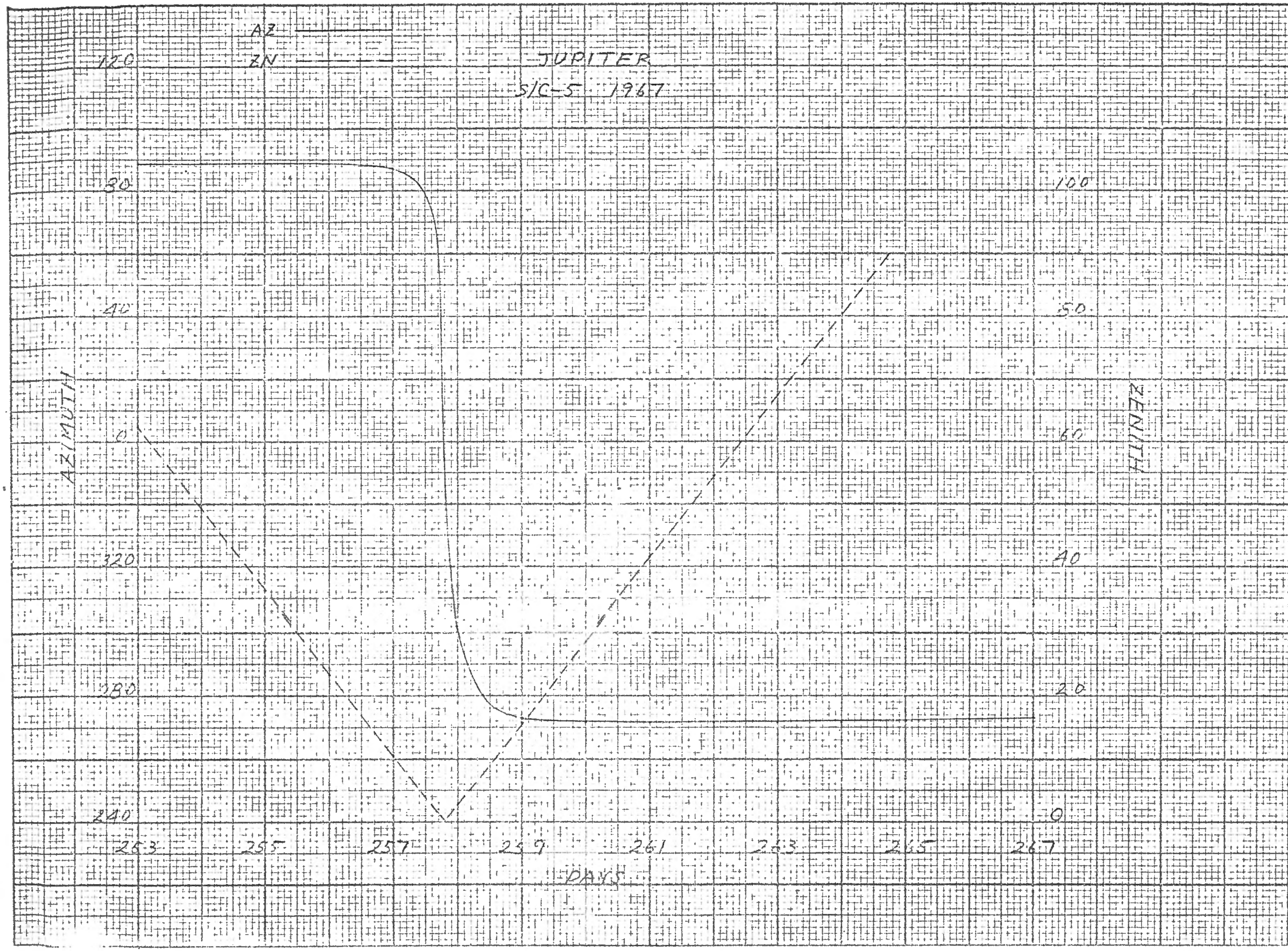
ARCTURUS
(α BOO)
SC-5 1967
AZ
ZN
AZIMUTH
ZENITH
60
40
20
0
340
320
300
90
80
70
60
50
40
30
20
DAYS
253
255
257
259
261
263
265
267

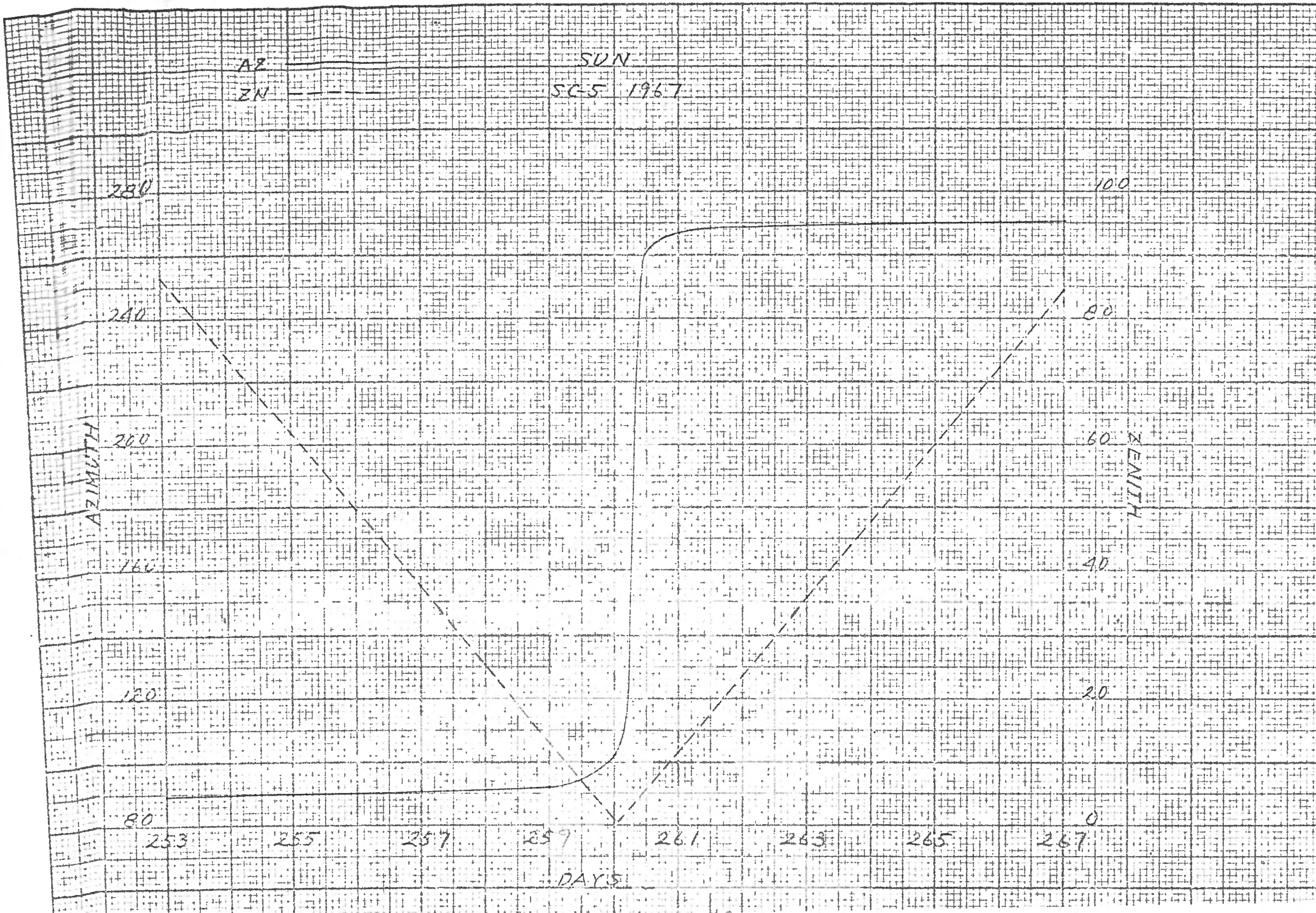

AGENA (B CEN.)
SC-5 1967
AZ
ZN
ZENITH
90
80
70
60
50
40
30
AZIMUTH
200
190
180
170
160
150
140
130
DAYS
253
255
257
259
261
263
265
267



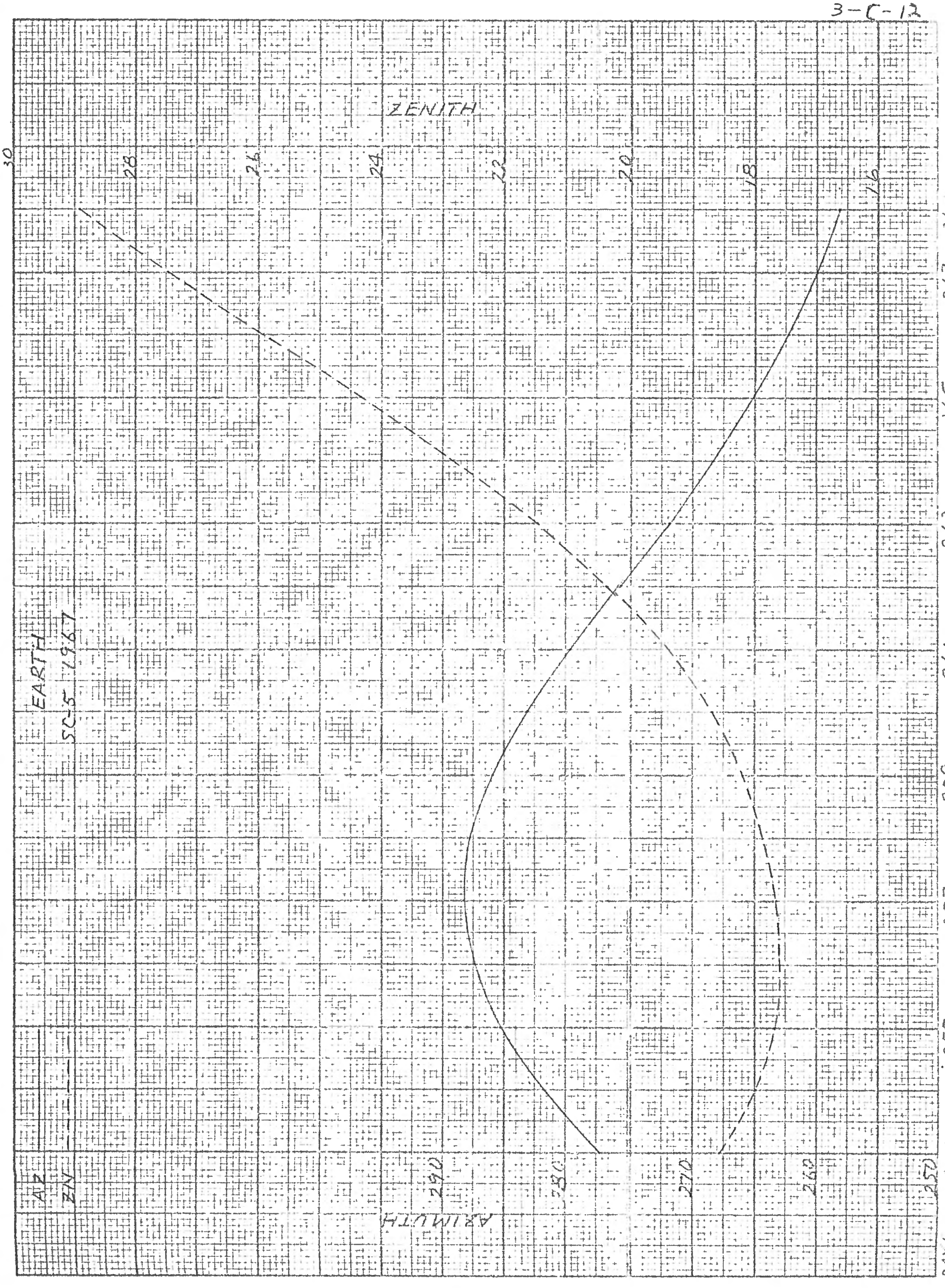
AZ
ZN
SIRIUS (α CMA)
SC-5 1967
AZIMUTH
ZENITH
DAYS
240
220
200
180
160
140
90
80
70
60
50
40
30
253
255
257
259
261
263
265
267


VENUS
SC-5 1967
AZ
ZN
ZENITH
100
80
60
40
20
0
267
265
263
261
259
257
255
253
280
240
200
160
120
80
AZIMUTH


AZ
ZN
JUPITER
S/C-5 1967
AZIMUTH
120
80
40
0
320
280
240
ZENITH
100
80
60
40
20
0
253
255
257
259
261
263
265
267
DAYS


AZ
ZN
SUN
SC-5 1967
280
240
200
160
120
80
AZIMUTH
100
80
60
40
20
0
ZENITH
253
255
257
259
261
263
265
267
DAYS

3-C-12


EARTH
SC-5 1967
AZ
ZN
ZENITH
30
28
26
24
22
20
18
16
AZIMUTH
290
280
270
260
250
DAYS
253
255
257
259
261
263
265
267

III. SSAC SURVEYOR V TELEVISION OPERATIONS

FIRST LUNAR DAY

Post TD Pass	Station CMDG	Survey Number	Activity	Time GMT Start	End
1	DSS-11	010	Pad 3-2 (200 Line)	254-0140	254-0232
		020	360° W/A Pan.	-0530	-0545
	DSS-42	020	Continuation of W/A 360° Pan.	254-0547	254-0713
		020	Continuation of W/A 360° Pan.	-0813	-0830
		021	ASI Mirror Coverage	-0834	-0850
		020	Completion of W/A 360° Pan.	-0852	-0857
2	DSS-11	010	360° W/A Pan.	254-2338	254-2359
		020	Special Area	255-0003	255-0239
		021	Aux. Mirrors	-0239	-0251
		030	Focus Range Az. +36°	-0308	-0333
		031	Focus Range Az. +18°	-0409	-0441
		040	N/A Segment 4	-0449	-0516
		041	N/A Segment 5	-0523	-0546
		042	N/A Segment 3 (not completed)	-0552	-0612
	DSS-42	042	N/A Segment 3	255-0700	255-0725
		043	N/A Segment 2	-0737	-0758
		050	Photometric Data (East-West)	-0759	-0853
3	DSS-11	010	Special Area	256-0015	256-0112
		011	Aux. Mirror	-0113	-0128
		012	Special Area	-0129	-0146
		020	Star Survey (Venus, Rigel, Sirius, Canopus)	-0250	-0330
			Stow Camera for Vernier Test	-0330	-0335
		030	Special Area	-0622	-0707
		031	Aux. Mirrors	-0727	-0735
	DSS-42	040	W/A 360° Pan.	256-0758	256-0815
		050	N/A Segment 3	-0913	-1022
			Camera Shutdown Due to Temp.		
4	DSS-11	010	Magnet Survey	257-0104	257-0108
		020	Photometric Survey	-0110	-0350
		030	W/A Color ASI	-0351	-0407
		040	Special Area and Manual Mod.	-0433	-0510
		050	Aux. Mirrors	-0514	-0551
		060	W/A 360° Pan	-0554	-0610
		070	Star Survey - Arcturus	-0632	-0651
		080	N/A Segment 4	-0653	-0723

Post TD Pass	Station CMDG	Survey Number	Activity	Time GMT Start	- End
4	DSS-42	081	Magnet Survey	257-0757	257-0803
		082	N/A Segment 3	-0804	-0833
		090	Focus Range Az. +108°	-0833	-0847
5	DSS-11	010	Photometric Survey	258-0115	258-0317
		020	W/A 360° Pan	-0320	-0341
		030	Magnet Color Survey	-0341	-0353
		040	Special Area	-0358	-0510
		050	Focus Ranging Az. -90°	-0510	-0554
		051	Focus Ranging Az. -72°	-0558	-0621
		052	Focus Ranging Az. -54°	-0624	-0700
		060	Star Survey - Sirius	-0725	-0754
		070	Aux. Mirrors	-0800	-0820
		080	N/A Segment 2	-0823	-0848
		081	N/A Segment 5	-0931	-0951
6	DSS-11	010	Photometric Survey	259-0148	259-0440
		020	Magnet Color Survey	-0440	-0451
		030	Crush Block 1 Area	-0451	-0503
		040	Aux. Mirrors	-0504	-0526
		050	Focus Ranging Az. -36°	-0552	-0703
		051	Focus Ranging Az. -18°	-0724	-0806
		052	Focus Ranging Az. 0°	-0811	-0941
		053	Focus Ranging Az. +18°	-0945	-1020
		060	Star Survey - Capella	-1020	-1040
		070	W/A 360° Pan	-1044	-1103
	DSS-42	-	N/A Segment 3	259-1130	259-1220
		-	N/A Segment 4	-1221	-1328
		-	N/A Segment 5	-1330	-1350
		-	Magnet Color Survey	-1441	-1523
		-	W/A Color (CT-202, Seq. 041-257)	-1618	-1732
7	DSS-11	010	Magnet Survey	260-0213	260-0230
		020	Photometric Data Collection	-0230	-0313
		030	Crush Block 1 Area	-0313	-0322
		020	Photometric Data Collection	-0322	-0337
8	DSS-11	010	Photmetric Data Collection	261-0248	261-0430
		020	W/A 360° Pan.	-0449	-0516
		030	Compartment "B" Photometric	-0517	-0649
		040	Magnet Survey	-0650	-0655
		050	Aux. Mirrors	-0655	-0710
		060	W/A Color (CT-202, Seq. 0257-0372)	-0713	-0731
		070	Solar Corona Glare Test	-0735	-0757
	DSS-42	-	Solar Corona Glare Test	261-1508	261-1541

Post TD Pass	Station CMDG	Survey Number	Activity	Time GMT Start	End
9	DSS-11	010	Star Survey	262-0324	262-0349
		020	Photometric Data Collection	-0354	-0503
		030	Magnet Survey	-0505	-0510
		040	Special Area	-0510	-0615
		050	Aux. Mirrors	-0617	-0624
		060	W/A 360° Pan.	-0626	-0702
		011	Star Survey - Mars	-0702	-0714
		070	N/A Rock Color	-0715	-0751
10	DSS-11	010	Photometric Survey	263-0358	263-0450
		020	Focus Ranging, Az. -144°	-0451	-0511
		021	Focus Ranging, Az. -126°	-0511	-0533
		022	Focus Ranging, Az. +124°	-0533	-0547
		023	Focus Ranging, Az. +108°	-0547	-0642
		030	W/A 360° Pan to Seq. 240	-0644	-0654
		040	Star Survey, Jupiter and Venus	-0655	-0711
		030	W/A 360° - Continued	-0714	-0720
		050	N/A Segment 1	-0721	-0743
		051	N/A Segment 2	-0805	-0831
		052	N/A Segment 3	-0832	-0918
		053	N/A Segment 4	-0921	-0957
		054	N/A Segment 5	-0957	-1025
		060	Magnet Survey	-1056	-1059
		070	Special Area	-1059	-1144
		080	Aux. Mirrors	-1144	-1149
		070	Special Area	-1149	-1201
	DSS-42	-	SPAC TV Gain Margin Test	263-1640	263-1805
11	DSS-11	010	Photometric Data Collection	264-0354	264-0442
		020	W/A 360° Pan.	-0444	-0459
		030	Magnet Survey	-0516	-0518
		040	Special Area	-0521	-0606
		050	Aux. Mirrors	-0609	-0621
		060	Focus Ranging, Az. +90°	-0624	-0652
		061	Focus Ranging, Az. +72°	264-0655	264-0755
		062	Focus Ranging, Az. +54°	-0755	-0825
		063	Focus Ranging, Az. +36°	-0826	-0916
		070	W/A Color Survey	-0920	-0947
		080	Shadow Progression	-0948	-1025
		090	N/A Segment 1	-1026	-1044
		091	N/A Segment 2	-1044	-1103
		092	N/A Segment 3	-1104	-1202
		093	N/A Segment 4	-1206	-1252
		094	N/A Segment 5	-1253	-1324
		081	Shadow Progression	-1325	-1329
	DSS-42	-	Shadow Progression and Magnet Survey	264-1743	264-1812

Post TD Pass	Station CMDG	Survey Number	Activity	Time GMT Start	- End
11	DSS-61	-	Shadow Progression and Magnet Survey	265-0208	265-0230
12	DSS-11	010	W/A 360° Pan	265-0438	265-0509
		011	W/A Survey at El. -70°	-0510	-0516
		020	Special Area	-0517	-0601
		030	Aux. Mirrors	-0603	-0607
		040	N/A Segment 1, Lower Half	-0610	-0627
		041	N/A Segment 5, Lower Half	-0659	-0714
		050	Photometric Data Collection	-0714	-0756
		060	Focus Ranging	-0757	-0933
		070	Shadow Progression	-0934	-1002
		060	Focus Ranging	-1003	-1103
		080	N/A Segment 1	-1107	-1122
		081	N/A Segment 2	-1122	-1142
		082	N/a Segment 3	-1143	-1241
		090	Special Area	-1316	-1404
		100	Aux. Mirrors	-1405	-1410
		110	Shadow Progression	-1419	-1442
		120	W/A Survey, El. -70°	-1449	-1456
		083	N/A Segment 4	-1457	-1538
		084	N/A Segment 5 to Seq. 440	-1539	-1614
	DSS-42	1	N/A Segment 5, Start Seq. 0346	265-1609	265-1636
		2	Shadow Progression and Auxiliary Mirrors	-1731	-1833
		3	Shadow Progression and W/A 360° Pan.	-1925	-2034
	DSS-61	1	Shadow Progression	265-2143	265-2207
		2	Shadow Progression	-2303	-2331
		3	Shadow Progression and Auxiliary Mirrors	266-0013	266-
		4	Shadow Progression and W/A 360° Pan.	-0117	-0155
		5	Shadow Progression	-0215	-0225
		6	Shadow Progression	-0312	-0341
		7	Shadow Progression	-0418	-0427
13	DSS-11	010	W/A 360° Pan.	266-0530	266-0552
		020	Magnet Survey	-0553	-0557
		030	Aux. Mirrors	-0558	-0604
		040	Crush Block 1 and 3 Areas	-0631	-0639
		050	Photometric Data Collection	-0642	-0749
		060	Magnet Color Survey	-0749	-0753
		070	Shadow Progression	-0828	-0853
		080	N/A Segment 1	-0856	-0918
		081	N/A Segment 2	-0922	-0941
		082	N/A Segment 3 to Seq. 056	-0943	-0946
		090	Magnet Color Survey	-0948	-1002

Post TD Pass	Station CMDG	Survey Number	Activity	Time GMT Start	- End
13	DSS-11	082	N/A Segment 3, Continued	266-1002	266-1118
		100	W/A 360° Pan.	-1119	-1142
		083	N/A Segment 4	-1147	-1240
		084	N/A Segment 5	-1318	-1411
		110	Shadow Progression	-1411	-1425
		120	Star Survey - Agena	-1428	-1443
		041	Special Area	-1454	-1520
		071	Shadow Progression	-1521	-1539
	DSS-42	072	Shadow Progression	266-1635	266-1658
			Shadow Progression	-1804	-1828
			Shadow Progression	-1926	-1947
			Shadow Progression	-2047	-2129
			Camera Problems		
	DSS-61		Camera Interrogation	266-2218	266-2304
			Shadow Progression	-2338	-2342
			Shadow Progression Each 30 Minutes (10 Times)	267-0112	267-0539
14	DSS-11	010	N/A Horizon, Seg. 1, 2, 3, 4	267-0609	267-0750
		020	N/A Horizon, Seg. 1, 2, 3, 4	-0803	-0841
		030	N/A Horizon, Seg. 1, 2, 3, 4	-0900	-0927
		040	N/A Horizon, Seg. 1, 2, 3, 4	-0957	-1030
		050	Zero Phase Monitoring	-1030	-1057
		060	Solar Corona Cycled with Engineering	-1058	-1428
		070	Earth Shine and Shutdown	-1429	-1506

Total frames, all stations, first lunar day - 18006

TIME EXPOSURE FRAMES

During lunar sunset, some of the pictures were taken in the integrate mode. These sunset time exposure frames are as follows:

Day 267

GMT	IRIS	EXPOSURE	AZ	EL
11-02-13	f/8	1.2 sec.		
11-05-39	f/22	10 sec.		
11-07-20	f/22	30 sec.		
11-08-32	f/22	30 sec.		
11-10-55	f/22	1.2 sec.	+114	+7
11-18-19	f/22	90 sec.	+114	+7
11-23-35	f/22	5 min.	+114	+7
11-35-21	f/22	10 min.	+114	+7
11-45-55	f/22	10 min.	+114	+7
11-54-25	f/11	7 min.	+114	+7
12-02-49	f/11	5 min.	+114	+7
12-09-10	f/11	5 min.	+114	+7
12-14-49	f/11	5 min.	+114	+7
12-20-25	f/11	5 min.	+114	+7
12-22-44	f/4	40 sec.	+114	+7
12-30-15	f/8	5 min.	+114	+7
12-37-33	f/8	5 min.	+114	+7
12-43-00	f/8	5 min.	+114	+7
12-48-36	f/8	5 min.	+114	+7
12-54-55	f/4	5 min.	+114	+7
13-00-35	f/4	5 min.	+114	+7
13-06-26	f/4	5 min.	+114	+7
13-12-48	f/4	5 min.	+114	+7
13-20-03	f/4	5 min.	+114	+7
13-29-44	f/4	5 min.	+117	+7
13-36-26	f/4	5 min.	+117	+7
13-42-21	f/4	5 min.	+117	+7
13-49-26	f/4	Shutter closed	+117	+7

TIME EXPOSURE FRAMES

(cont.)

Day 267

GMT	IRIS	EXPOSURE	AZ	EL
13-55-31	f/4	Shutter closed	+117	+7
14-04-11	f/4	5 min.	+117	+7
14-10-07	f/4	5 min.	+117	+12
14-16-56	f/4	5 min.	+117	+12
14-22-44	f/4	5 min.	+117	+12
14-28-26	f/4	5 min.	+117	+12

FRAME IMAGES

The frames contain fairly complete identification data which appears from left to right on each frame. This data is described below:

1. The vertical electrical gray scale. For an explanation of this, and its use, see the section on TVGDHS calibration.
2. The 48mm by 48mm image.
3. Identification information, taken either from returned television identification or added on ground receipt. Here is provided only a decoding of the TVID abbreviations. For more information please refer to the section on television identification data.

   a. Octal file number

   b. Greenwich mean time of receipt

   c. Mission code and receiving station code

   d. Mission — always E, Surveyor V

   e. STA — receiving station; DSS 11 is Goldstone, California

   f. CAM — camera number 3

   g. AZ — azimuth angle of the camera mirror

   h. EL — elevation angle of the camera mirror

   i. FOC — computed distance to the plane of principal focus, in meters

   j. FL — focal length of the camera in millimeters

   k. IRIS — f number of the iris

l.	FLTR	color filter wheel position
m.	SHTR	camera shutter mode
n.	IS	state of the iris servo
o.	MSF	state of the camera multiple step focus
p.	ELEC	electronics temperature in degrees centigrade
q.	VID	vidicon faceplate temperature in degrees centigrade
r.	CAL	calibration voltage
s.	EREC	computed erection angle in degrees to bring the horizon to a horizontal position
t.	ALARMS	alarms or errors detected in the transmitted TVID
u.	WDS	number of transmitted TVID frames processed to provide the above data

4. A process code above the television identification data recorded as a machine readable dot pattern.
5. A frame of film roll number above a machine readable bar pattern containing the mission, receiving station, process and frame of roll number codes, and GMT.

MOSAICS

A number of USGS prepared mosaics have been included to aid in the interpretation of individual frames and to provide an integrated view of the Surveyor and its landing site. The following is a list of the mosaics which have been selected for inclusion in the data package.

Day	Lense Angle	Sector	Catalog Number
255	N/A	4	13 SI
255	N/A	4 & 5	14 SI
257	N/A	3	34 SI
258	N/A	2	40
258	N/A	2	41
258	N/A	5	43 SI
256	N/A	3	58 SI
263	N/A	3	69
263	N/A	4	72
264	N/A	2	88
264	N/A	4	91
264	N/A	4	92
264	N/A	5	94
265	N/A	1	101
265	N/A	1	107
265	N/A	2	108
265	N/A	2	109
265	N/A	3	110
265	N/A	3	111
266	N/A	2	132
266	N/A	3	133
266	N/A	3	134

N/A = Narrow
W = Wide

MECHANICAL PROPERTIES WORKING GROUP
SURVEYOR MISSION E MOSAIC PHOTOS

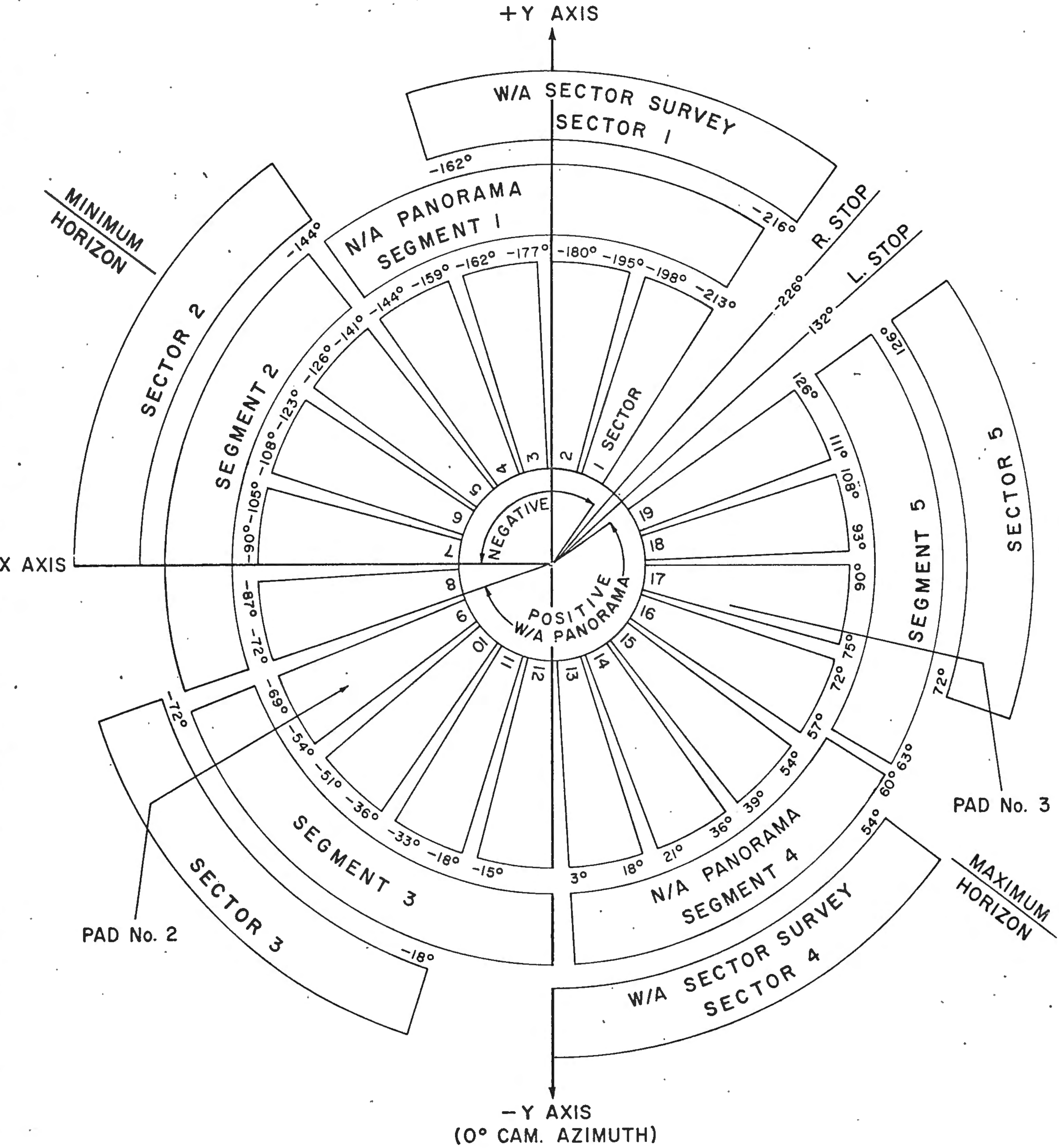
Catalog #	JPL Photo Lab Negative #	GMT Day	Description
5-MP-9	211-1995	254	WA Mosaic from Pad 2 to Pad 3
5-MP-17	211-1996	256	NA - Mirrors - Prefiring
5-MP-18	211-1997	256	NA - Mirrors - Postfiring
5-MP-19	211-2023A	257	WA Pad 2 trench
5-MP-22	211-2023B	265	NA - Mirrors - Postfiring
5-MP-24	211-1998	255	NA-ASI Area - Prefiring
5-MP-25	211-1999	257	NA - ASI Area - Postfiring
5-MP-26	211-2000	255	NA - Pad 2 Area - Prefiring
5-MP-27	211-2001	256	NA - Pad 2 Area - Postfiring
5-MP-28	211-2002	263	NA - Mirrors - Postfiring
5-MP-29	211-2003	258	NA - Pad 3 Area - Postfiring
5-MP-30	211-2024A	264	NA - Pad 3 Area - Postfiring
5-MP-31	211-2004	255	NA - Mirrors - Prefiring
5-MP-32	211-2024B	255	NA - Pad 3 Area - Prefiring
5-MP-33	211-2039	263	WA - Pad 3 Area - Postfiring
5-MP-34	211-2041	258	NA - Pad 2 Trench Area (Full Mosaic)
5-MP-35	211-2025A	266	NA - Mirrors - Postfiring
5-MP-36	211-2025B	256	NA - Detail of Pad 2 trench (5 Frames)
5-MP-37	211-2021B	255	NA - V3 Direct view - Prefiring
5-MP-38	211-2022	256	NA - V3 Direct view - Prefiring
5-MP-39	211-2020A	263	NA - V3 Direct view - Postfiring

MECHANICAL PROPERTIES WORKING GROUP
SURVEYOR MISSION E MOSAIC PHOTOS

Catalog #	JPL Photo Lab Negative #	GMT Day	Description
5-MP-40	211-2020B	264	NA - V3 Direct View - Postfiring
5-MP-41	211-2021A	265	NA - V3 Direct View - Postfiring
(5-MP-34)*	211-2040B	258	Trench area from Mosaic 5-MP-34
(5-MP-34)*	211-2040A	258	Detail of trench in Mosaic 5-MP-34

* (These are close up detail views of the photo data from mosaic catalog # 5-MP-34)

STANDARD SECTOR NUMBERING WORKSHEET



DIGITALLY PROCESSED DATA

The following pictures have been processed digitally in the JPL Image Processing Laboratory. After being digitized, the pictures were processed by the IBM 360-44 computer using the Sine Wave Response Filter (SWRF) program. This program restores high frequency data (fine details in the picture) in both the horizontal direction along the camera scan lines and in the vertical direction. The amount of enhancement necessary is obtained from pre-launch calibration where optical sine wave targets of known frequency are scanned by the spacecraft camera. Any noise present is also enhanced by the SWRF program; therefore pictures which have been SWRF processed will appear more noisy than the original but will be much sharper and will show more detail. The maximum amount of enhancement is controlled to minimize the increase in noise. Since the SWRF program uses a 15 x 15 element matrix to apply the filter to a picture, the processed pictures are labeled "FILTERED 15 x 15". Each frame is identified with the GMT and TVGDHS File Number.

DAY	HOUR	MINUTE	SECOND	FRAME NO.	PHOTO NO.	DESCRIPTION
254	05	29	53	44	211-1988	Magnet & Footpad imprint.
254	08	26	08	3335	211-1976B	Wide angle mirror view of area under vernier 3
255	00	33	33	307	211-1987A	Magnet
255	00	39	53	344	211-1958A	Alpha Scattering device
255	02	50	31	566	211-1958B	Narrow angle mirror view of area under crush block 3
255	05	56	33	2116	211-1987B	Magnet
256	00	35	29	2407	211-1985A	Magnet
256	00	36	15	2421	211-1985B	Magnet
256	06	31	16	2741	211-1986A	Magnet
256	06	32	34	2762	211-1986B	Texture of Lunar surface
257	01	07	36	3373	211-1984A	Magnet
257	07	59	21	4735	211-1984B	Magnet
257	08	00	22	4736	211-1983A	Magnet
257	08	02	05	4737	211-1983B	Magnet
257	08	03	34	4740	211-1982A	Magnet

DAY	HOUR	MINUTE	SECOND	FRAME NO.	PHOTO NO.	DESCRIPTION
257	08	03	45	4741	211-1982B	Magnet
257	08	04	25	4742	211-1981A	Magnet
257	08	08	00	4745	211-1981B	Magnet
257	08	08	41	4756	211-1980A	Magnet
257	08	08	46	4757	211-1980B	Magnet
258	03	48	09	7760	211-1979B	Magnet
258	03	49	07	7764	211-1979A	Magnet
258	03	51	19	7774	211-1978A	Magnet
258	03	53	11	10000	211-1978B	Magnet
259	04	48	26	12246	211-1968A	Magnet
263	11	46	49	23332	211-1976A	Mirror view of area under crush block 3
266	09	52	49	40113	211-1977A	Magnet

TELEVISION IDENTIFICATION DATA DESCRIPTION

Source of Frame Data

Television Identification (TVID) data is generated and transmitted between each television frame. On ground receipt, the TVID is decomutated, converted to engineering units, time tagged, assigned a file number, and stored in TVGDHS computer systems disc storage unit. The data thus accumulated in real time during the mission or by tape playback of overseas data has been manually examined and all observed anomalies corrected to their most likely value. This correction has been accomplished by comparison of the image data associated with each TVID set with the images and TVID of adjacent pictures, and also by comparison with the TVID theoretically to be expected in response to the command stream sent to the camera. Final production of the TVID catalog included with this data package has been by a computer program which selects and prints a subset of the corrected TVID as stored on the disc file. As such it represents our best estimate of correct TVID to be associated, through GMT correlation, with each image frame taken during the mission.

Summary Listing

The catalog presents a time sorted listing of the TVID. A list of abbreviations, their meaning, allowable ranges and least significant units (LSU) follows:

Abbreviation	Meaning	Range	LSU
DAY	Day of Year	0-366	1
HR	Hour of Day	0-23	1
MIN	Minute of Hour	0-59	1
SC	Second of Minute	0-59	1
FILE NO	Octal File Number	1-20000	1
AZ	Azimuth angle of camera mirror	-222 to +132	1 rounded, not truncated from ±0.1 values
EL	Elevation angle of camera mirror	-90.0 to +90.0	0.1
FCS ST	Focus Step	0-49	1
FCS DIST	Distance in meters to plane of principal focus	0.00 to 99.9	0.1
IRIS	Camera iris setting in f stop numbers	4.0 to 22.0	0.1
FILTER	Filter wheel position	CLR 1 GRN 2 BLU 3 RED 4 CLR 5	
F/L	Camera focal length	Wide or Narrow	

FORTRAN COMPATIBLE TAPE FORMAT DESCRIPTION

An ancillary output of the TVID processing programs is an IBM 7094 Fortran IV compatible magnetic tape record of all TVID. A copy of this tape is available from the National Space Science Data Center, Greenbelt, Maryland. The tape is written (and can be read) in Fortran IV binary mode, using the statement WRITE (i) List, where "i" and "List" are described in the Fortran IV manuals.

Following is the format of this tape:

BCD = A format

Floating = F format

Fixed = I format

Octal = O format

b = Hollerith blanks

* = Hollerith asterisk

RECORD	LOGICAL LENGTH	WORD	MODE	DESCRIPTION
1	1	1	BCD	Date the tape was generated, month, day, & year
2, 3, ..., Last-1	63	1	Floating	Azimuth corrected. (bbbbb* if no entry, "b" meaning "blank")
		2	Floating	Azimuth
		3	Fixed	Azimuth T/M Word Count.
		4	BCD	Camera number alarm (ALARMb or OKbbbb)
		5	Fixed	Camera number.
		6	BCD	Calibration voltage alarm (ALARMb or OKbbbb)

RECORD	LOGICAL LENGTH	WORD	MODE	DESCRIPTION
		7	Floating	Calibration voltage corrected. (bbbbb* if no entry)
		8	Floating	Calibration voltage
		9	Fixed	Calibration voltage T/M word count
		10	Fixed	Days
		11	Fixed	DSIF code
		12	Fixed	Erection angle
		13	Fixed	Erection angle option
		14	Floating	Elevation angle corrected (bbbbb* if no entry)
		15	Floating	Elevation
		16	Fixed	Elevation T/M word count
		17	Floating	Electronic temperature corrected (bbbbb* if no entry)
		18	Floating	Electronic temperature
		19	BCD	Focal length angle corrected. (bbWIDE or NARROW) (bbbbb* if no entry)
		20	BCD	Focal length angle. (bbWIDE or NARROW)
		21	Floating	Focus corrected (bbbbb* if no entry)
		22	Floating	Focus
		23	Fixed	Focus T/M word count
		24	BCD	Filter position alarm. (ALARMb or OKbbbb)
		25	Fixed	Filter position corrected (bbbbb* if no entry)
		26	Fixed	Filter position
		27	Fixed	Filter position T/M word count

RECORD	LOGICAL LENGTH	WORD	MODE	DESCRIPTION
		28	BCD	Focal length alarm (ALARMb or OKbbbb)
		29	Floating	Focal length corrected (bbbbb* if no entry)
		30	Floating	Focal length
		31	Fixed	Format number
		32	Octal	File munber
		33	Fixed	Frame number
		34	Fixed	Focus step corrected (bbbbb* if no entry)
		35	Fixed	Focus step
		36	Fixed	Hours
		37	Fixed	ID quality
		38	Floating	Iris setting corrected (bbbbb* if no entry)
		39	Floating	Iris setting
		40	Fixed	Iris T/M word count
		41	BCD	Iris servo corrected (bbONbb or bbOFFb) (bbbbb* if no entry)
		42	BCD	Iris servo (bbONbb or bbOFFb)
		43	BCD	Multiple step focus corrected (bbONbb or bbOFFb) (bbbbb* if no entry)
		44	BCD	Multiple step focus, (bbONbb or bbOFFb)
		45	Fixed	Milliseconds
		46	Fixed	Minutes
		47	Fixed	Mission number code
		48	Fixed	Process code
		49	Floating	Sun Azimuth (bbbbb* if no entry)

RECORD	LOGICAL LENGTH	WORD	MODE	DESCRIPTION
		50	Fixed	Seconds
		51	Floating	Sun elevation (bbbbb* if no entry)
		52	BCD	Shutter mode alarm (ALARMb or OKbbbb)
		53	BCD	Shutter mode corrected (NORMAL or bbOPEN) (bbbbb* if no entry)
		54	BCD	Shutter mode (NORMAL or bbOPEN)
		55	Fixed	Stereo mate's file number (bbbbb* is no entry)
		56	Fixed	Survey number
		57	Fixed	Camera axis tilt angle
		58	Floating	Camera axis tilt direction
		59	Floating	Vidicon temperature corrected (bbbbb* if no entry)
		60	Floating	Vidicon temperature
		61, 62 & 63	BCD	Searchable subjective data
Last	63	1, 2, 3-63	BCD BCD	ENDbOFbDATAb "blanks"

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