REPORT

FIVE-CHANNEL SCANNING RADIOMETER

QUARTERLY REPORTS 17, 18, AND 19

Contract NAS 5-757
For the Period 15 October 1964 to 15 July 1965

5 August 1965

For - National Aeronautics and Space Administration
Goddard Space Flight Center
Aeronomy and Meteorology Division
Greenbelt, Maryland 20771

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Section 1

INTRODUCTION

This report covers the 17th, 18th, and 19th quarterly reporting periods, from 15 October 1964 to 15 July 1965, of the Five-Channel Scanning Radiometer Program under Contract NAS 5-757 and NAS 5-3648.

During this reporting period calibration of the F-5 and F-6 MRIR's was completed.

Check-of-calibration measurements were made on the F-2 MRIR after the radiometer had been subjected to orbital simulation testing at NASA. The check-of-calibration data obtained were in good agreement with the final calibration data that had been obtained approximately a year earlier, prior to the shipment of the radiometer to NASA.

An analysis on the behavior of the F-2 MRIR offset circuitry during orbital simulation testing at NASA was made.

High-vacuum, high-temperature, UV radiation testing was completed on a sample 14- to 16-micron filter. No degradation in filter transmission characteristics was detected as a result of this environmental exposure.

Check-of-calibration measurements were made on the F-5 MRIR when the radiometer was returned to SBRC for mirror cleaning. The check-of-calibration measurements were made before and after mirror cleaning.

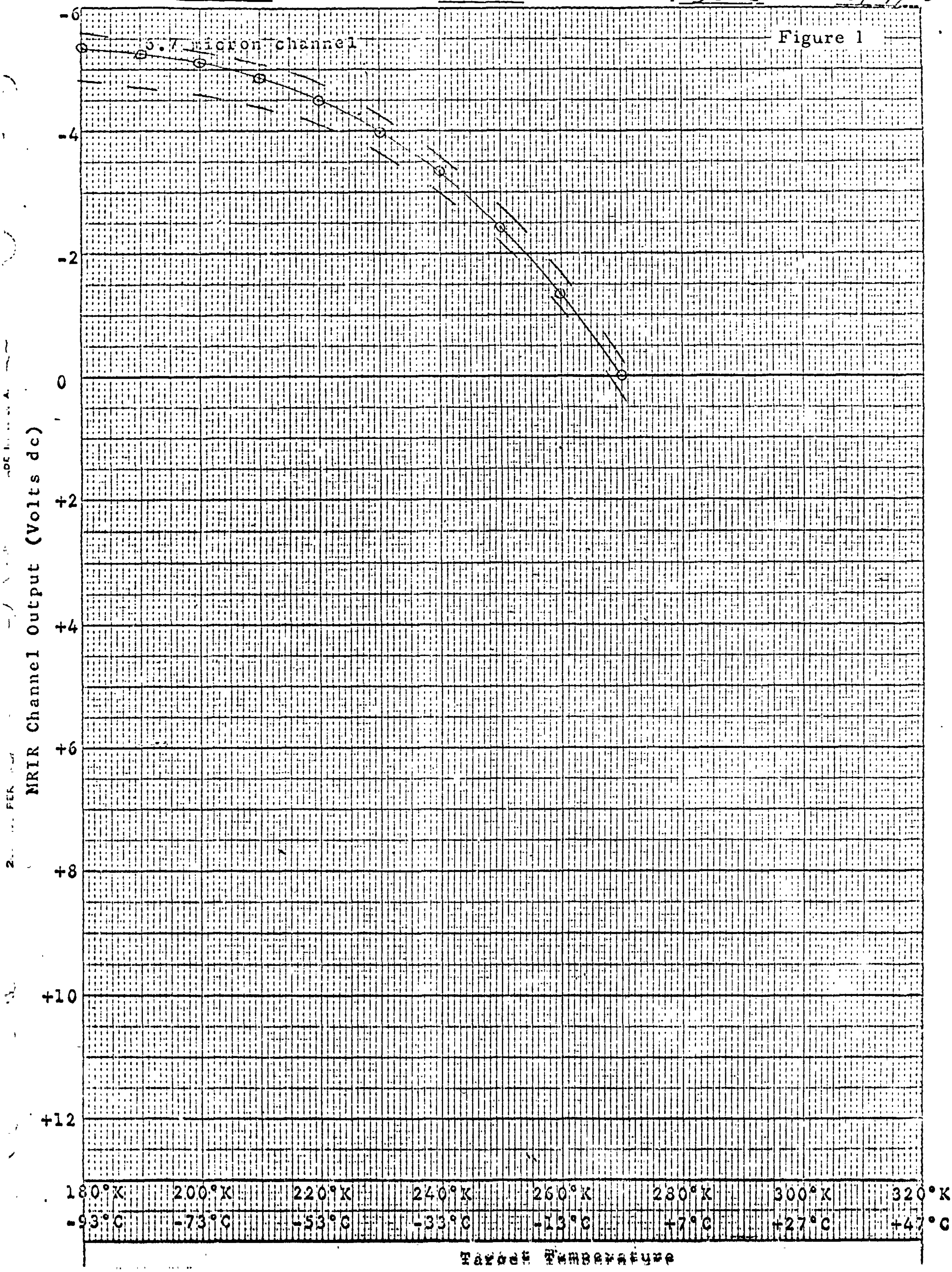
Section 2

F-5 AND F-6 MRIR FINAL CALIBRATION

The final Primary Integrated Spectral Response (calibration) measurements were performed on the F-5 and F-6 MRIR's. The calibration curves obtained from these measurements for five radiometer temperatures are shown in Figures 1 through 40. The dash lines shown in these figures represent the limits of allowable variation for radiometer temperature variation over a 0°C to 50°C temperature range.

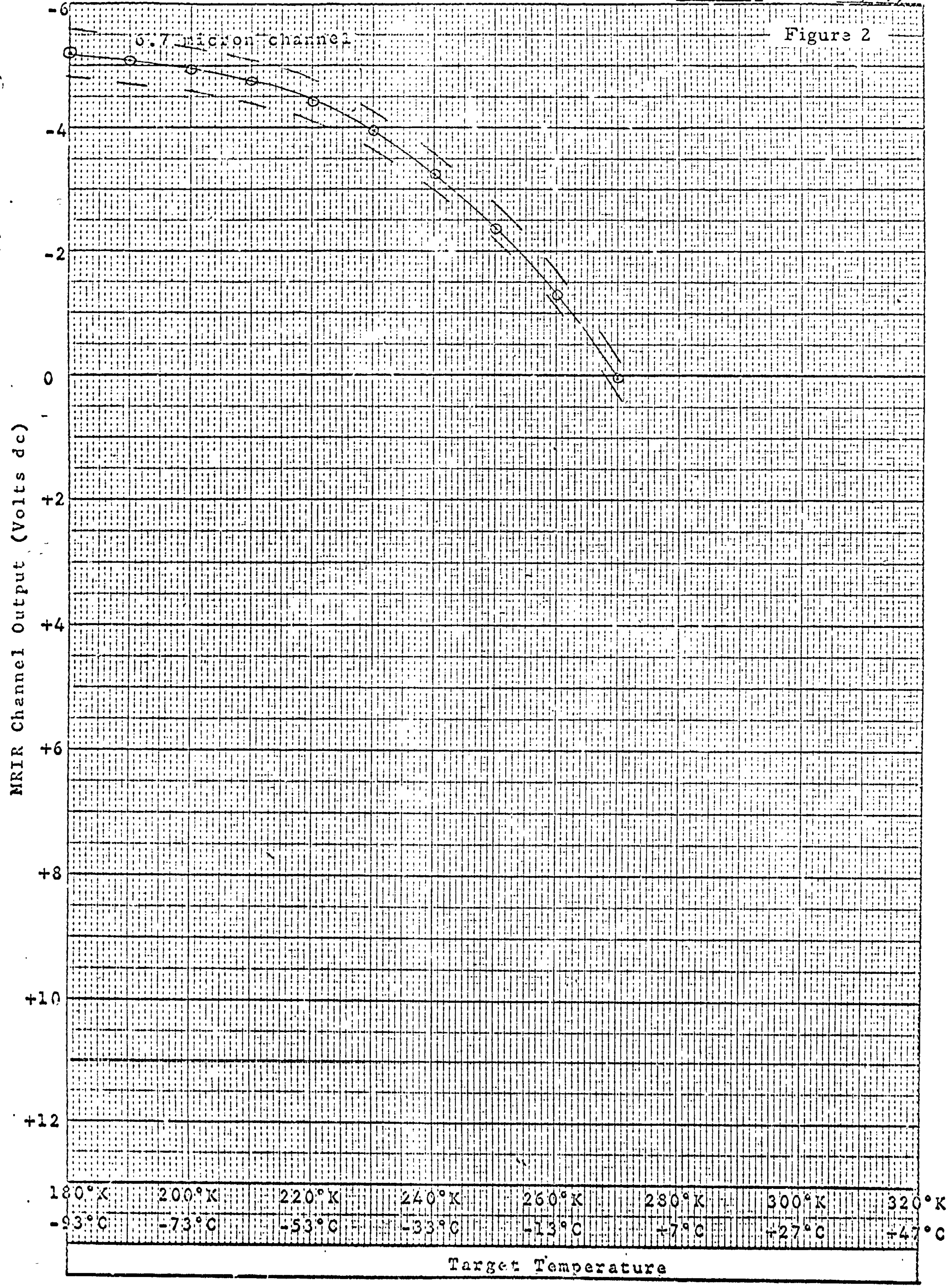
MRIR Calibration Curves (D)

System # F-5 Scanner Temp 50°C Module Temp 50°C Date 3/19/65



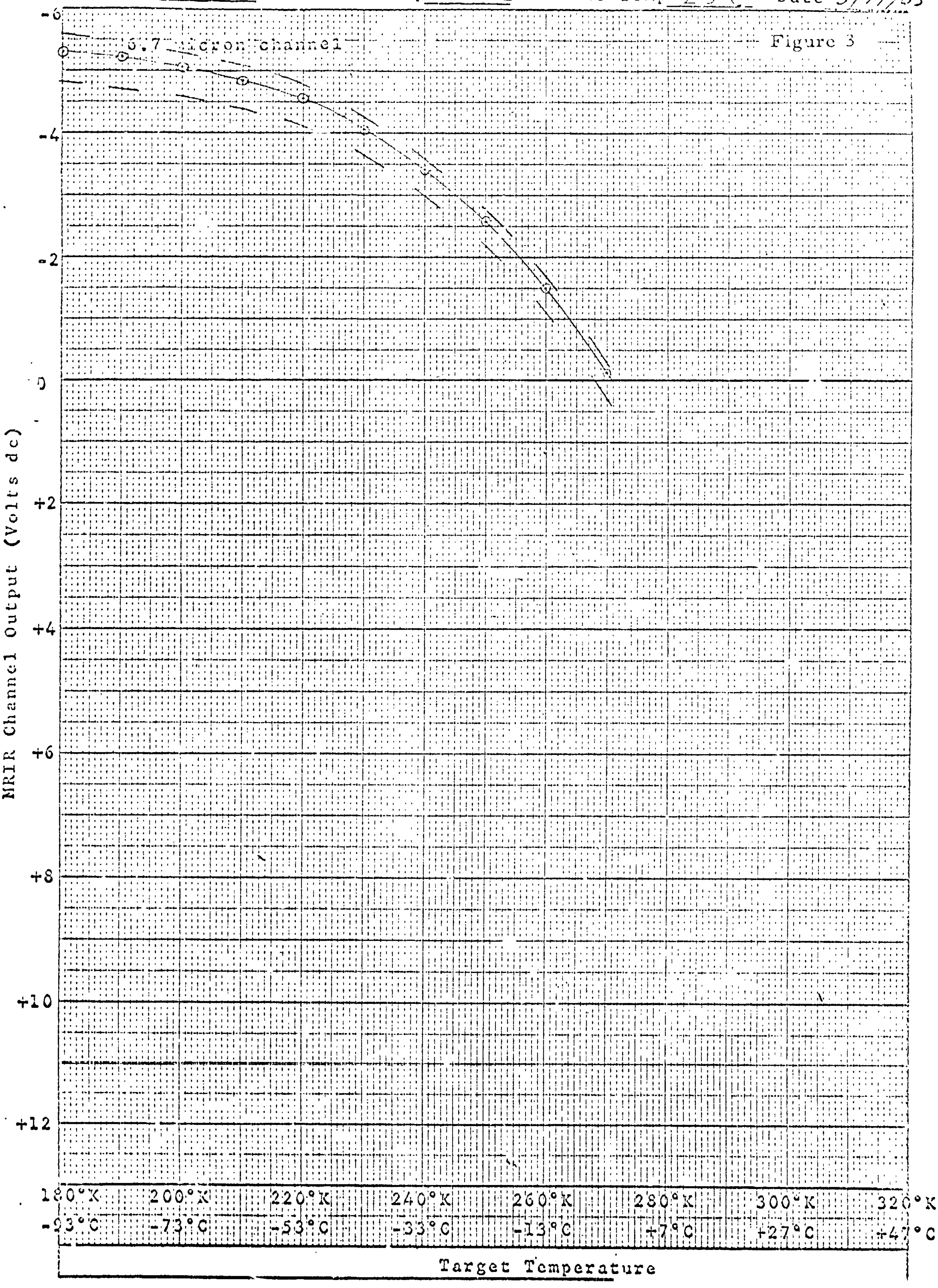
MRIR Calibration Curves (D)

System # F-5 Scanner Temp 40°C Module Temp 40°C Date 3/19/65



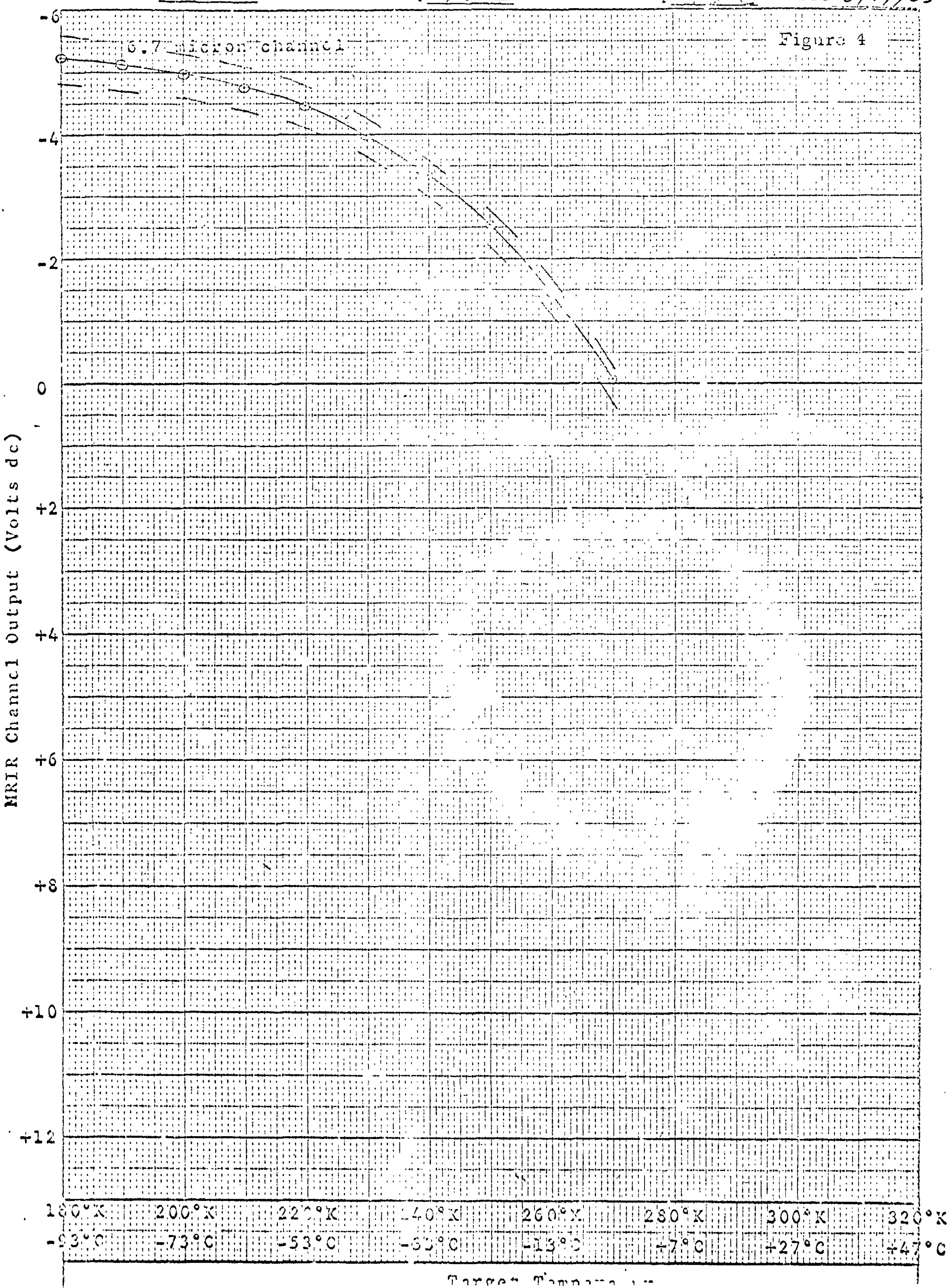
MRIR Calibration Curves (D)

System # F-5 Scanner Temp 25°C Module Temp 25°C Date 3/11/65



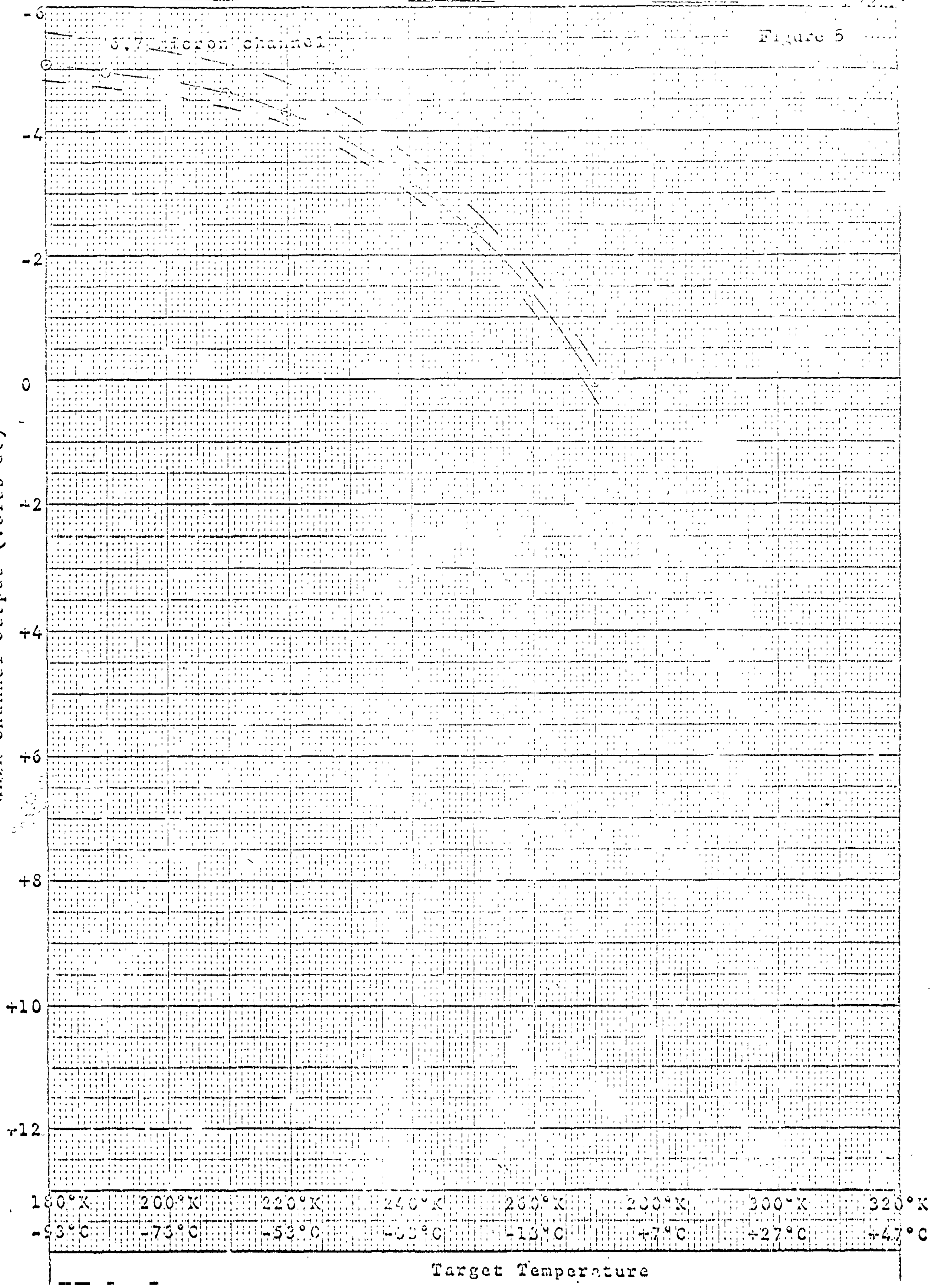
MRIR Calibration Curves (D)

System # F-5 Scanner Temp 10°C Module Temp 10°C Date 3/19/65



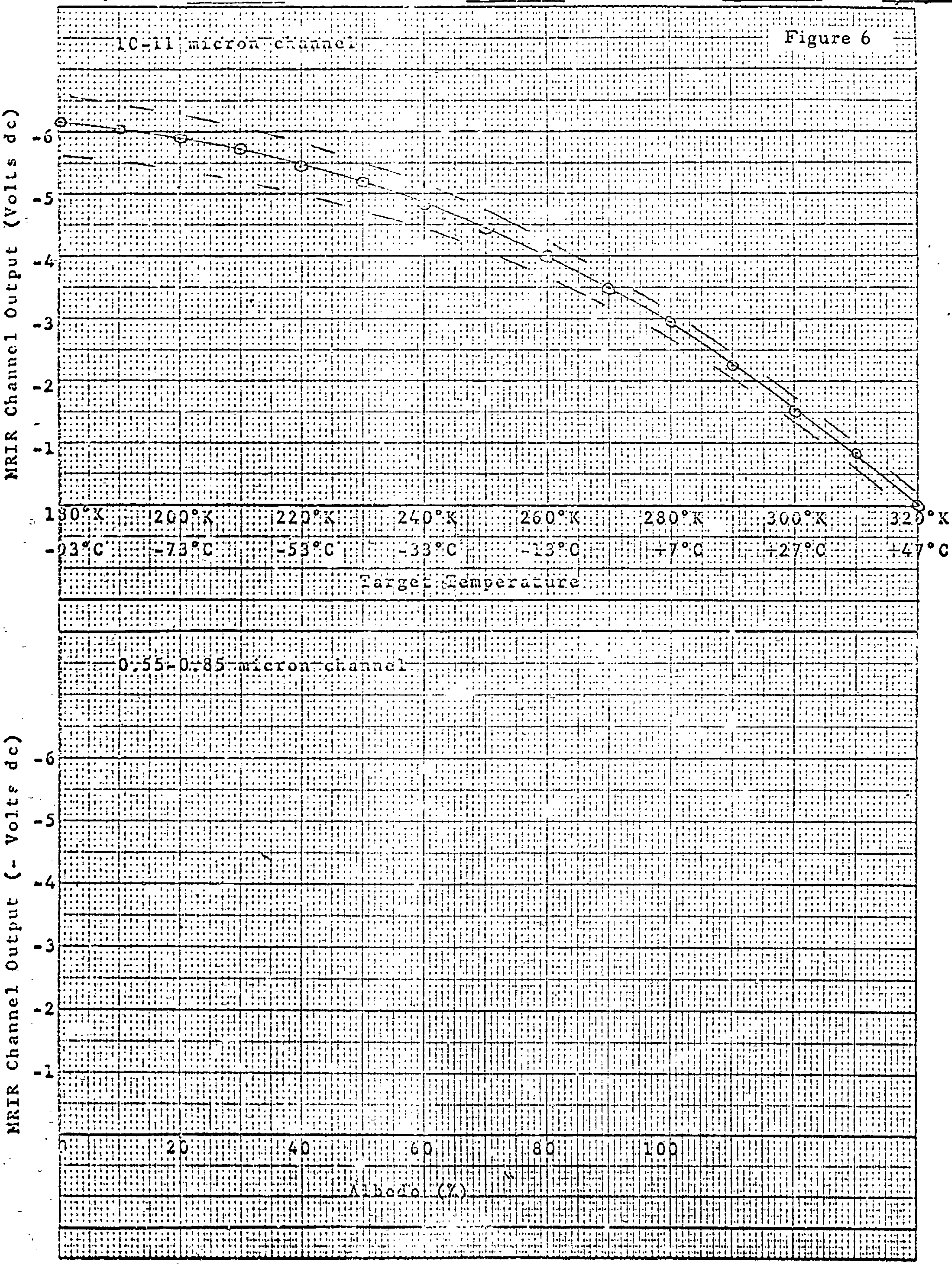
MRIR Calibration Curves (B)

System # F-5 Scanner Temp ___ Module Temp ___ Date 3/11/65



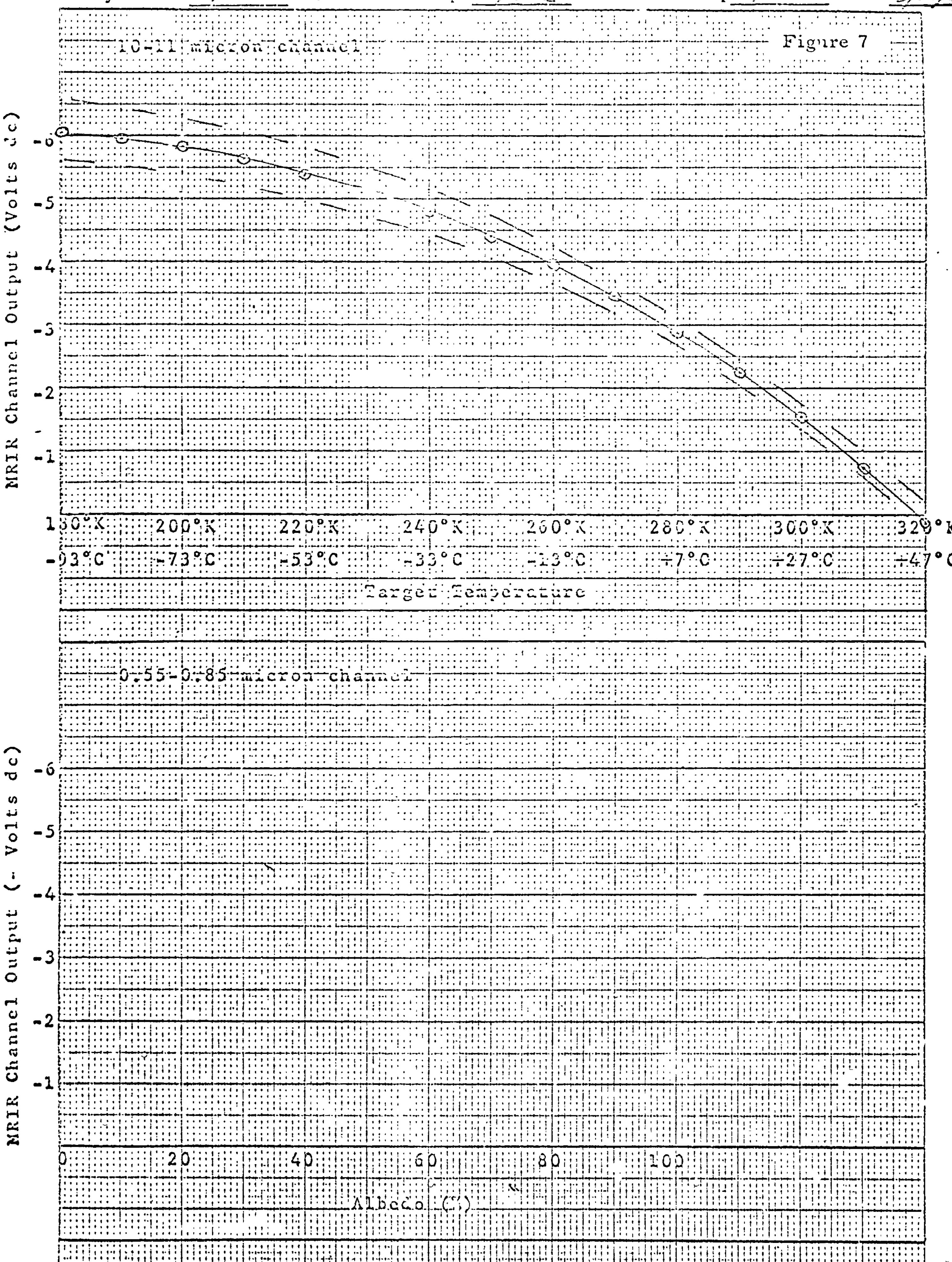
MRIR Calibration Curves (D)

System # F-5 Scanner Temp 50°C Module Temp 50°C Date 3/19/65



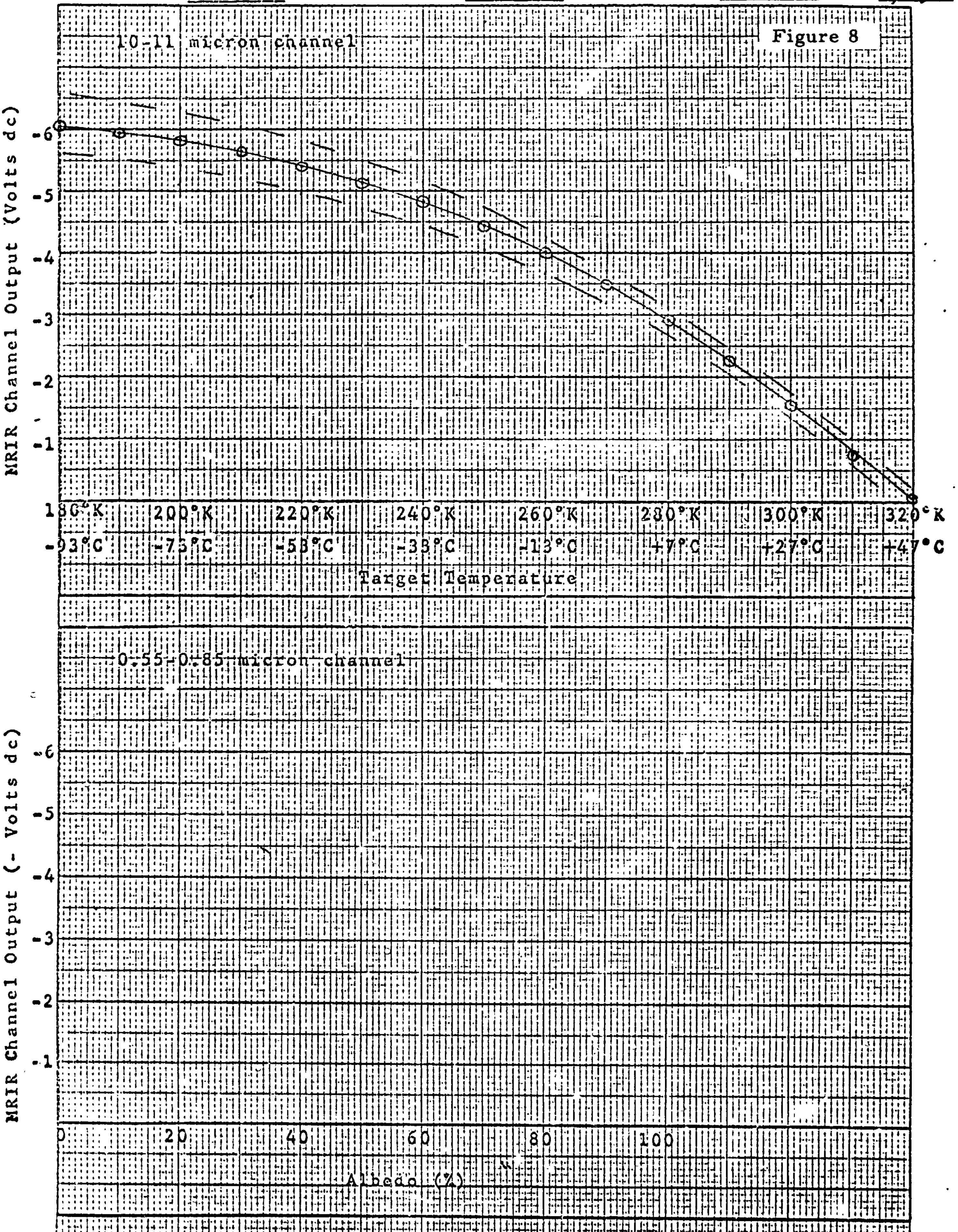
MRIR Calibration Curves (D)

System # E-5 Scanner Temp 45°C Module Temp 45°C Date 3/19/6



MRIR Calibration Curves (D) (28)

System # F-5 Scanner Temp 25°C Module Temp 25°C Date 3/19/6



MRIR Calibration Curves (D)

System # E-5 Scanner Temp 10°C Module Temp 10°C Date 3/19/65

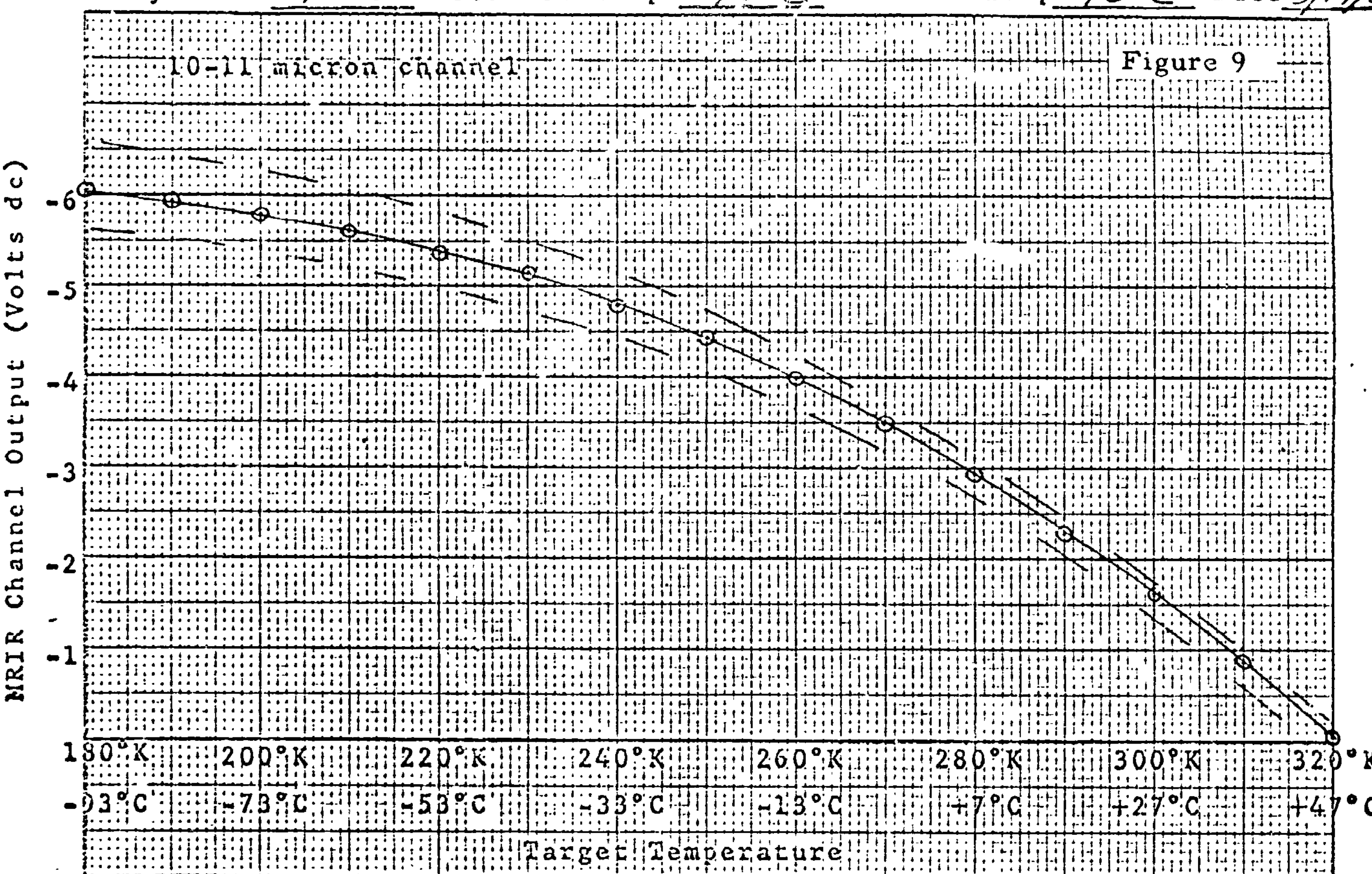
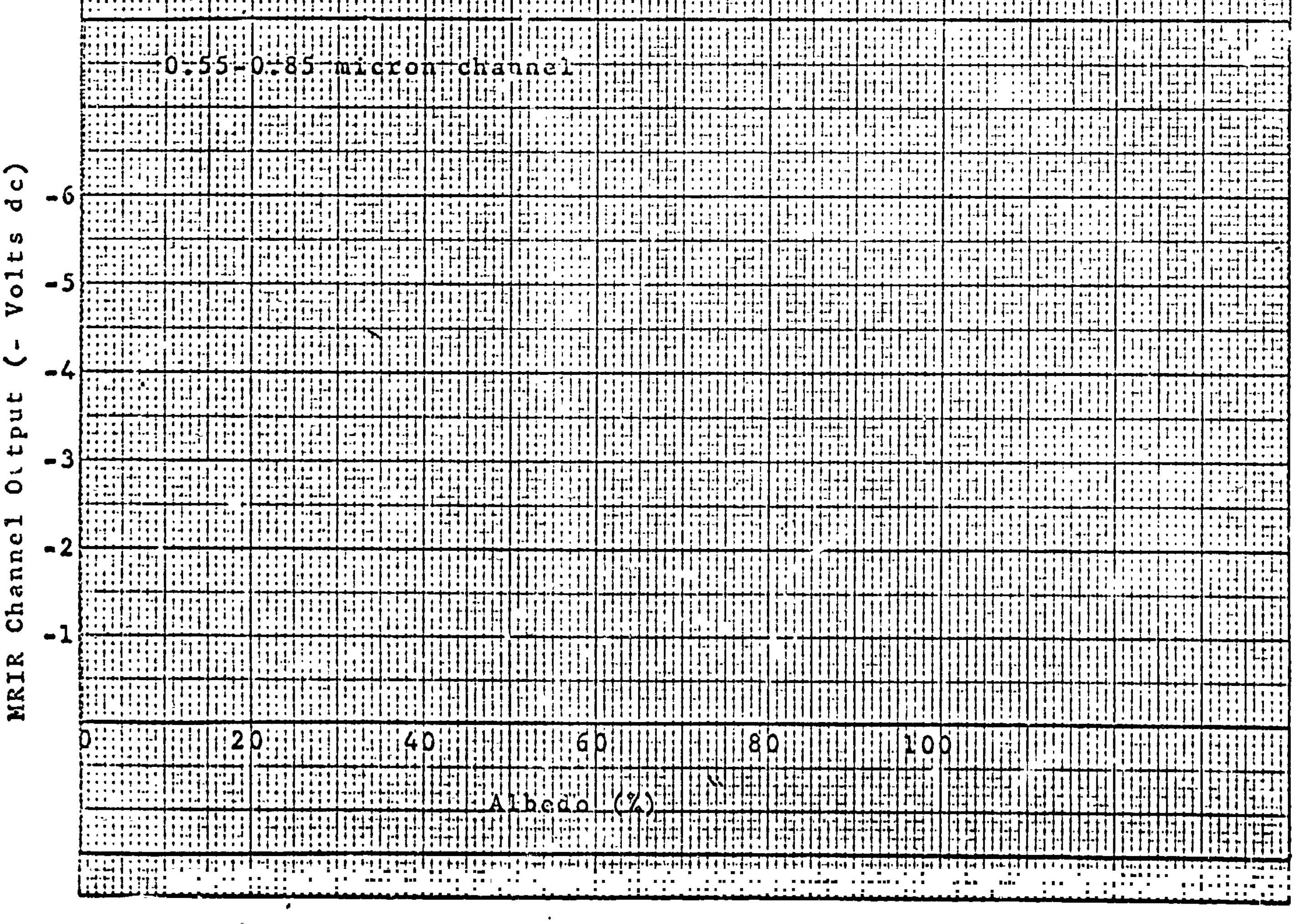
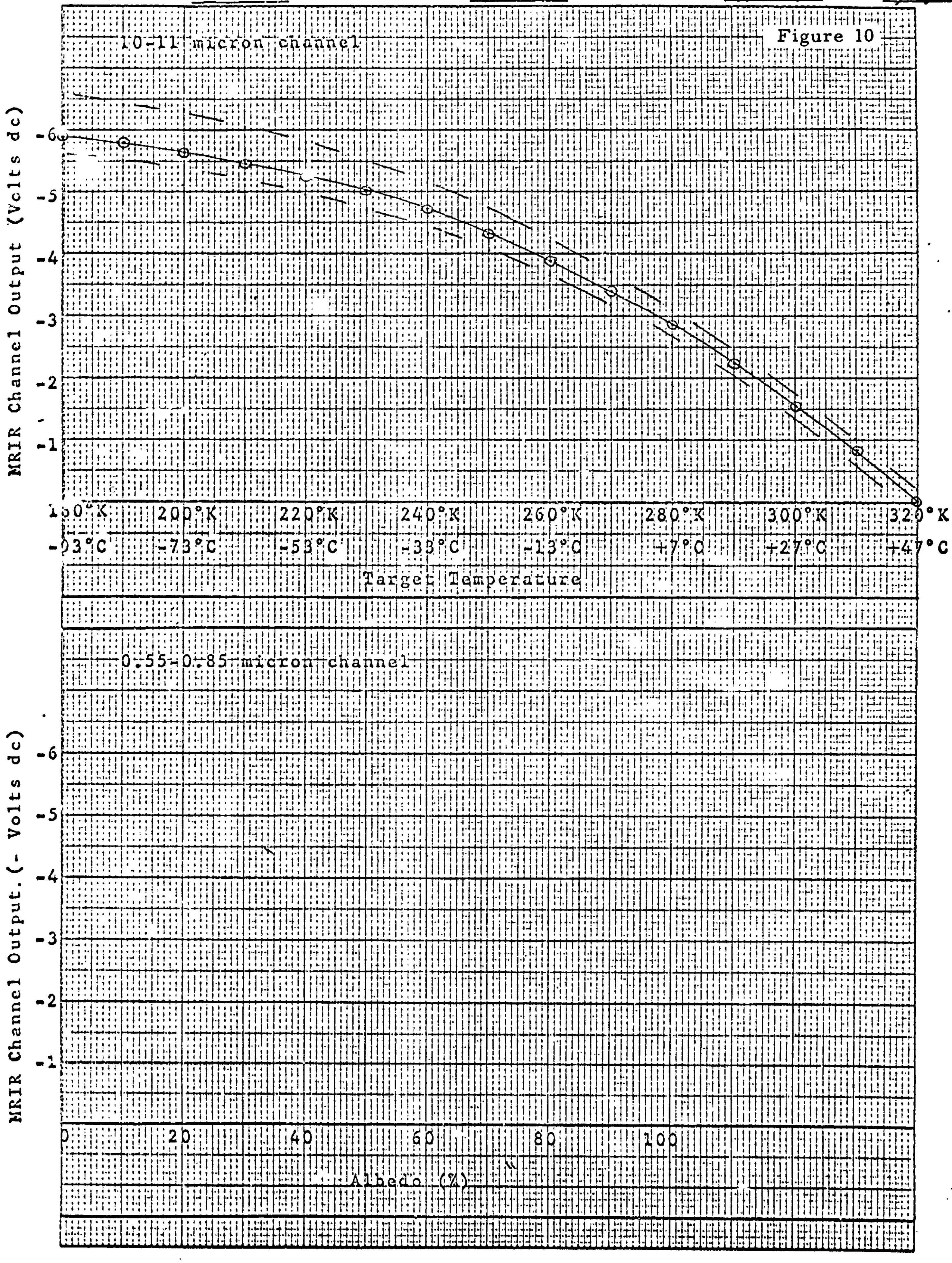


Figure 9



MRIR Calibration Curves (D)

System # F-5 Scanner Temp 0°C Module Temp 0°C Date 3/19/6



MRIR Calibration Curves (D)

System # E-5 Scanner Temp 50°C Module Temp 50°C Date 3/19/65

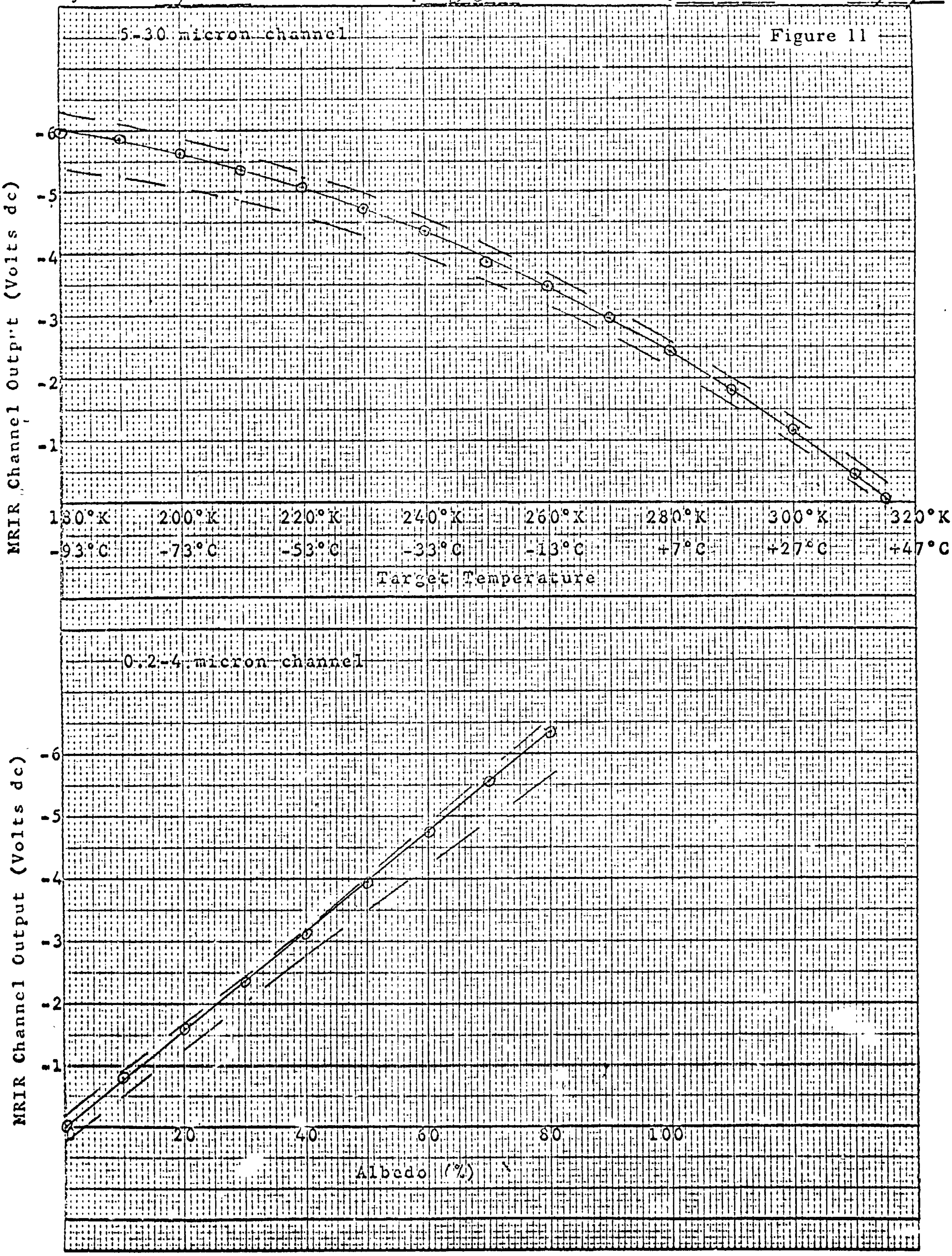
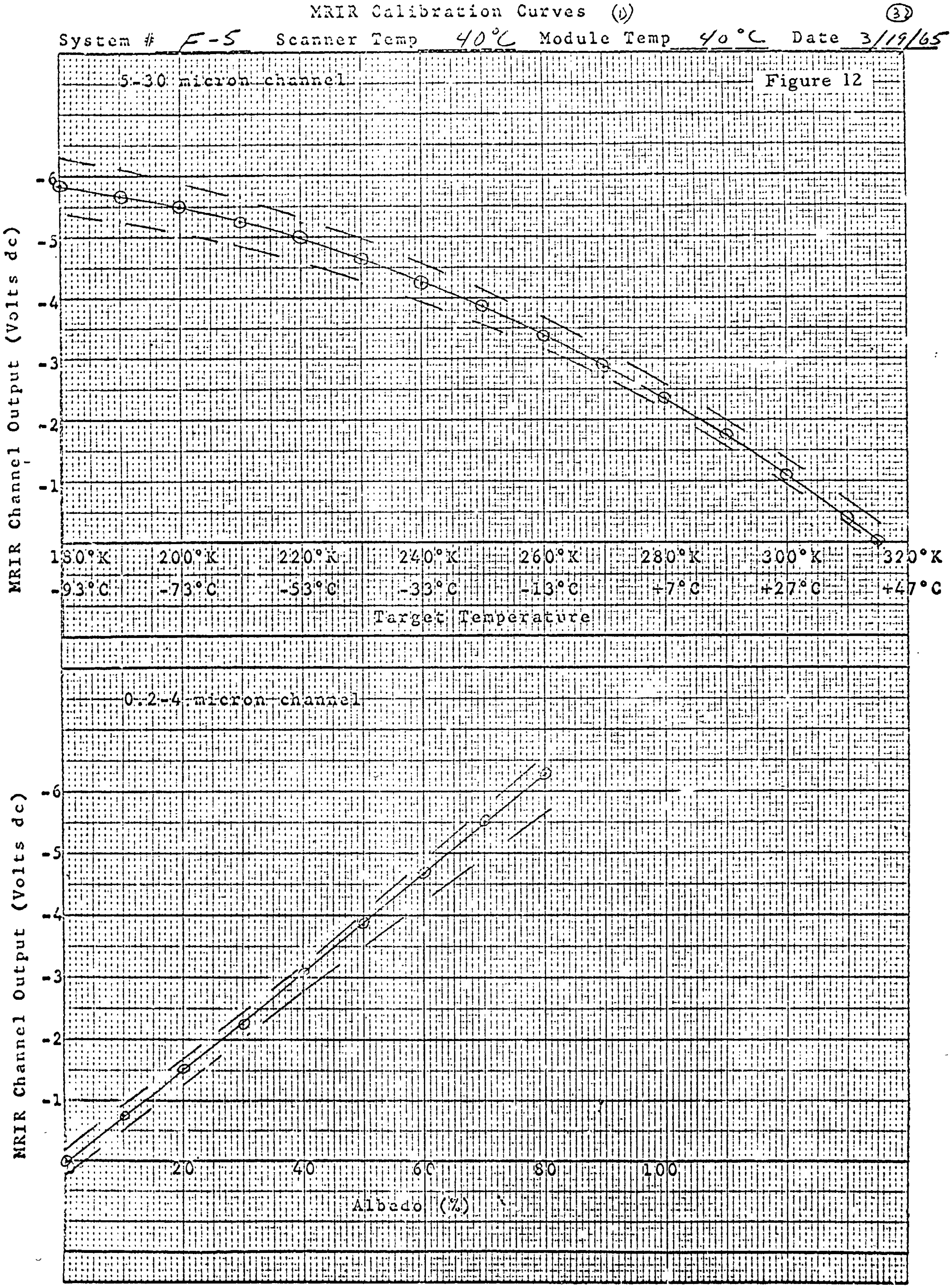
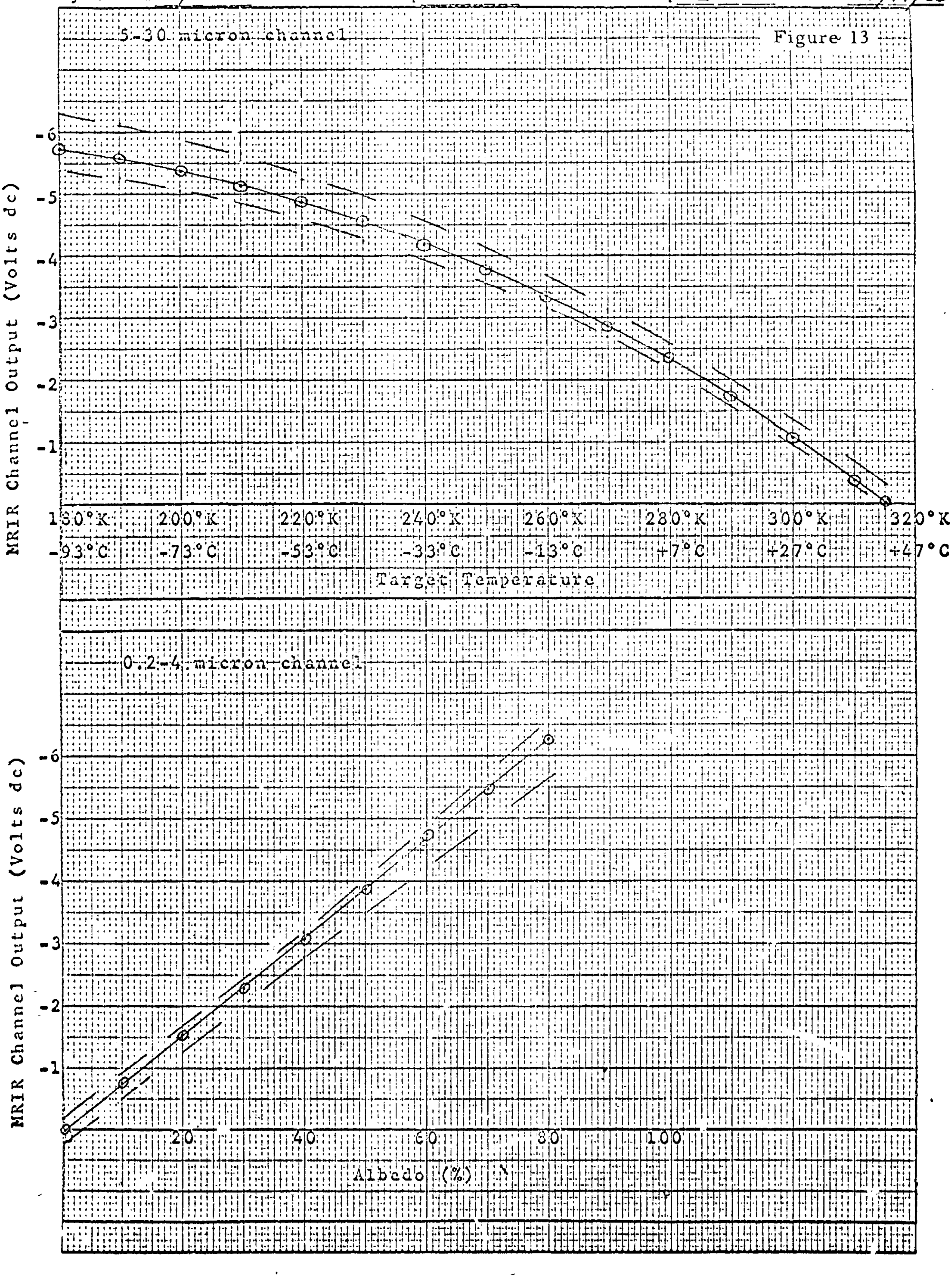


Figure 11


MRIR Calibration Curves (1)
System # E-5 Scanner Temp 40°C Module Temp 40°C Date 3/19/65
5-30 micron channel
Figure 12
MRIR Channel Output (Volts dc)
-6
-5
-4
-3
-2
-1
180°K
200°K
220°K
240°K
260°K
280°K
300°K
320°K
-93°C
-73°C
-53°C
-33°C
-13°C
+7°C
+27°C
+47°C
Target Temperature
0.2-4 micron channel
MRIR Channel Output (Volts dc)
-6
-5
-4
-3
-2
-1
20
40
60
80
100
Albedo (%)

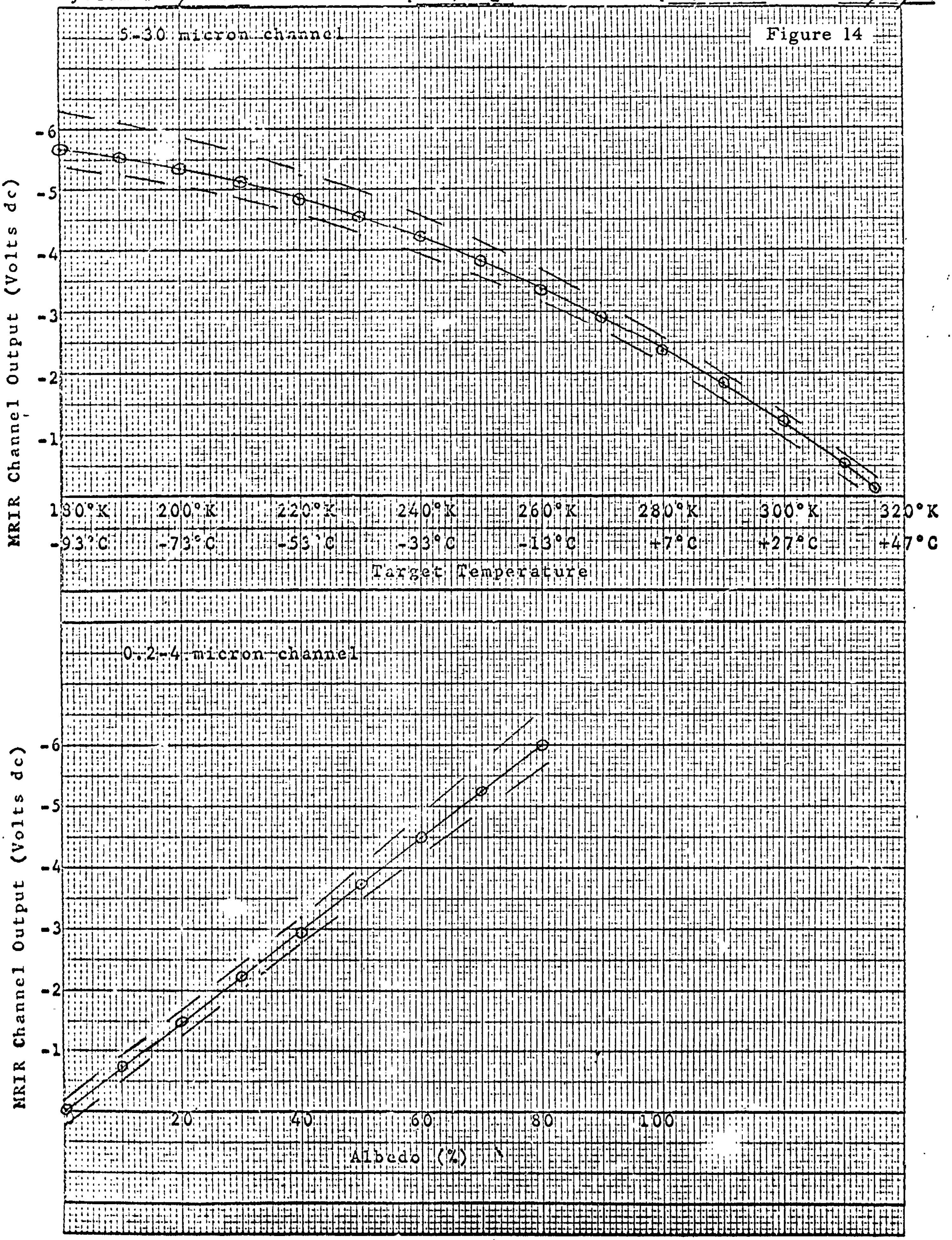
MRIR Calibration Curves (D)

System # E-5 Scanner Temp 25°C Module Temp 25°C Date 3/11/65



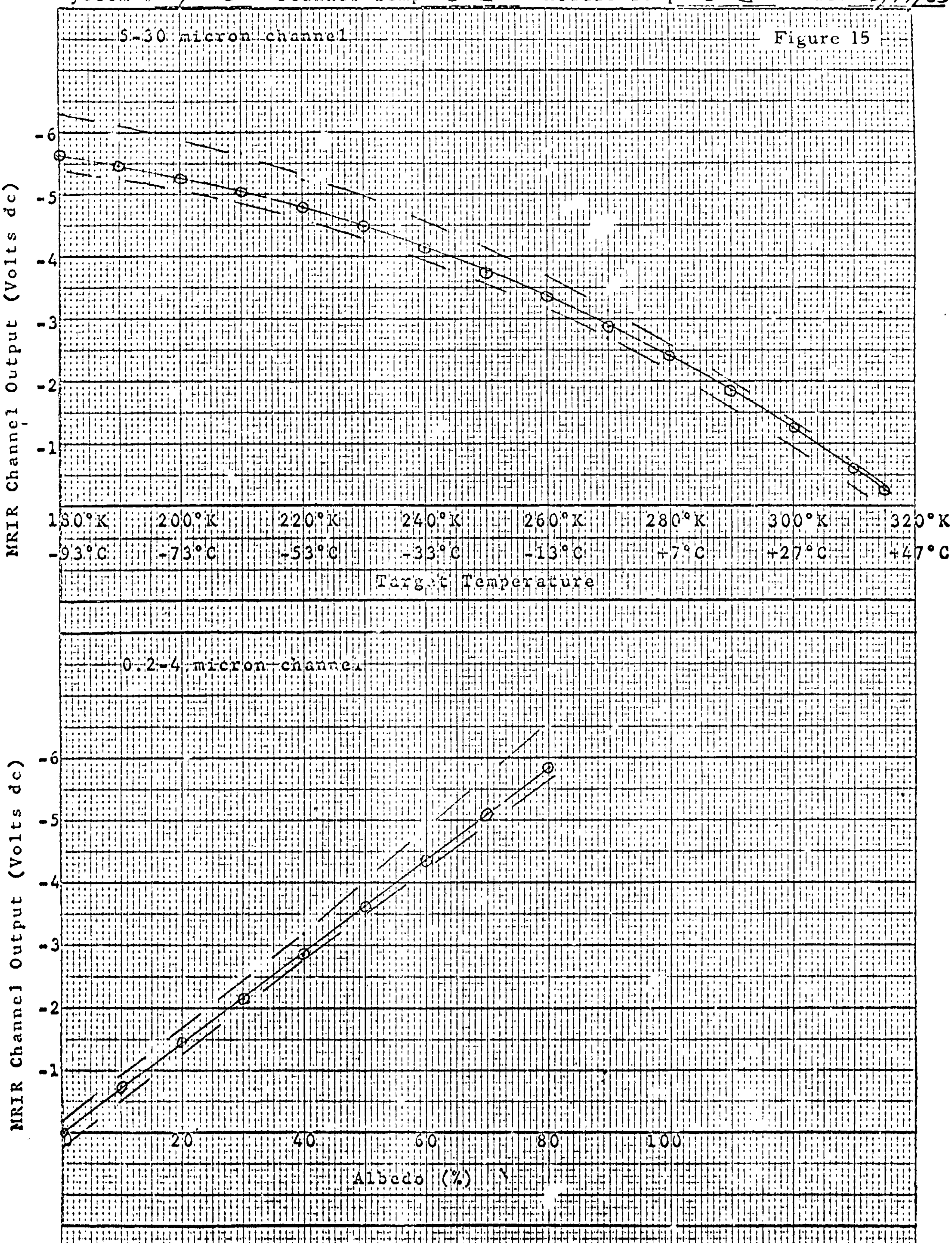
MRIR Calibration Curves (D)

System # E-5 Scanner Temp 10°C Module Temp 10°C Date 3/19/65



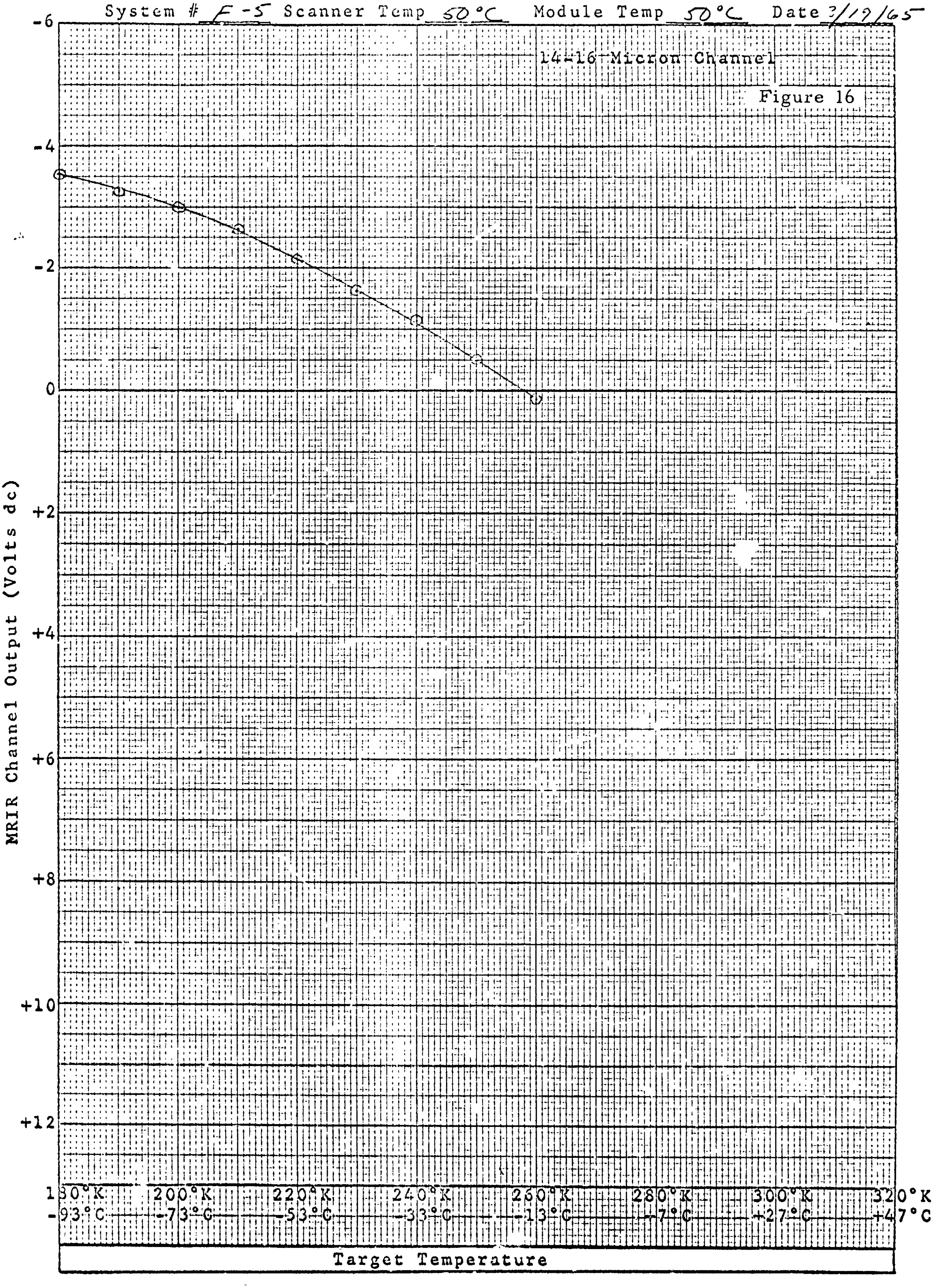
MRIR Calibration Curves (D)

System # E-5 Scanner Temp 0°C Module Temp 0°C Date 3/11/65



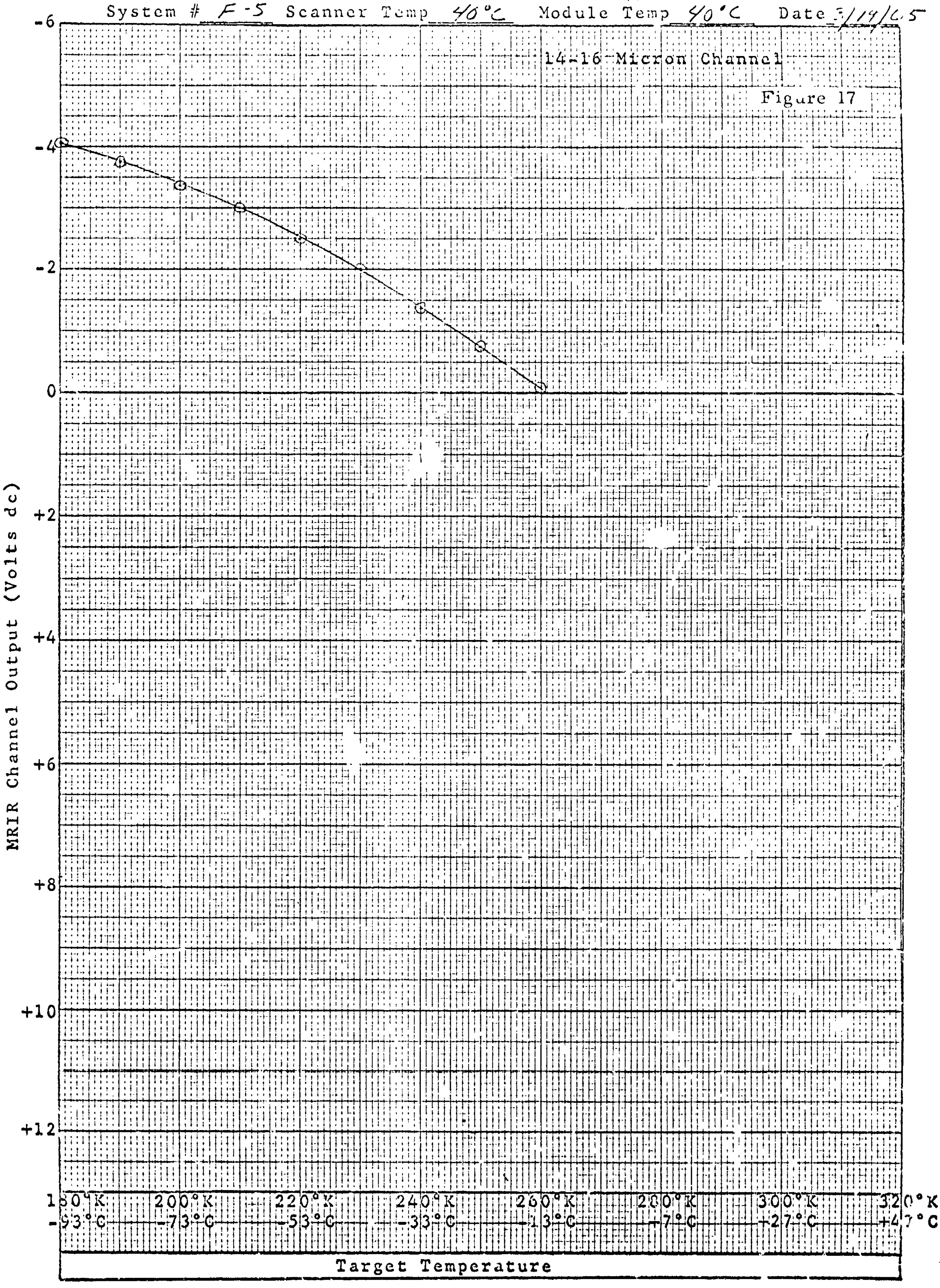
MRIR Calibration Curves (D)

System # F-5 Scanner Temp 50°C Module Temp 50°C Date 3/19/65



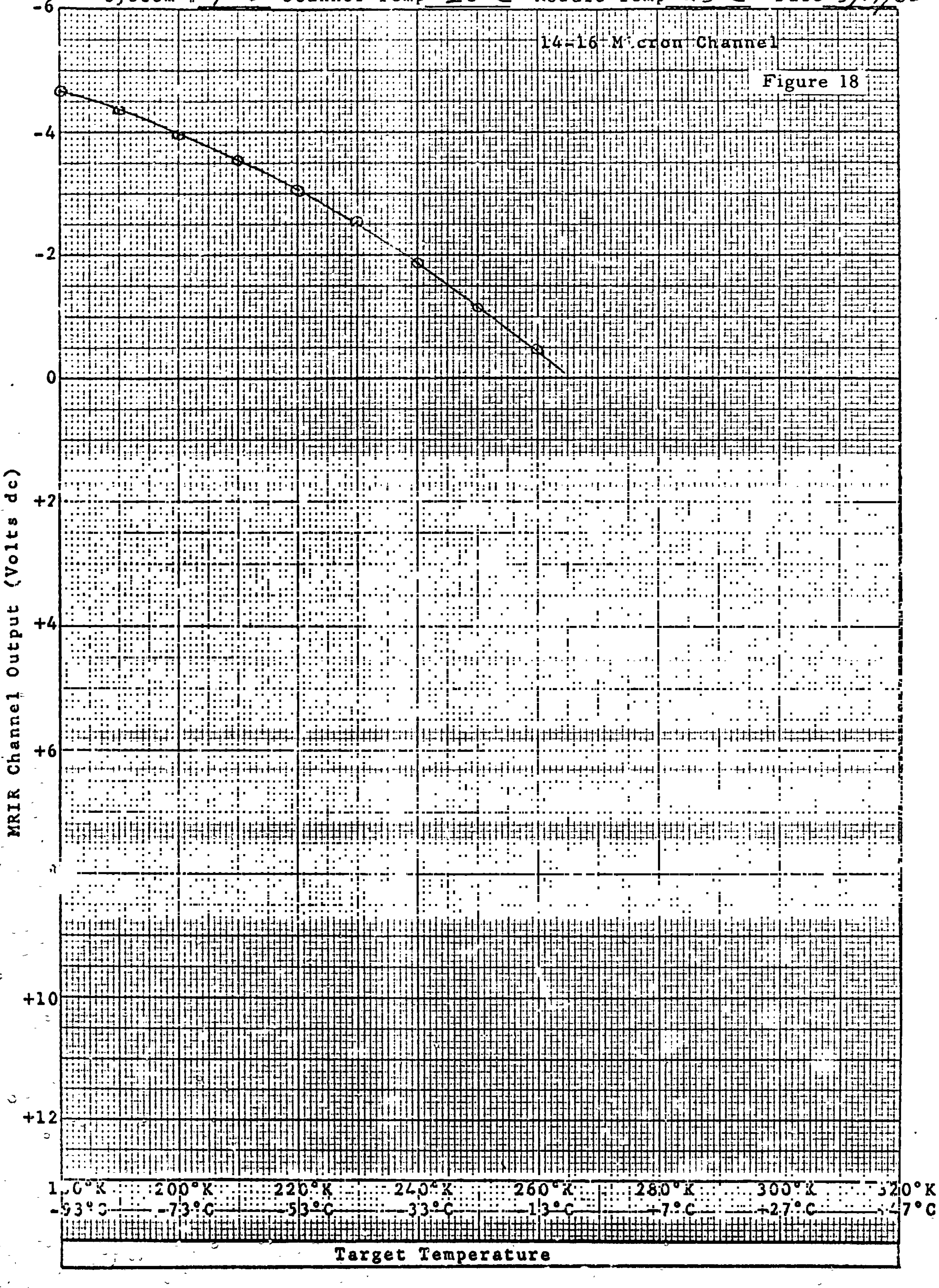
MRIR Calibration Curves (D)

System # F-5 Scanner Temp 40°C Module Temp 40°C Date 3/19/65



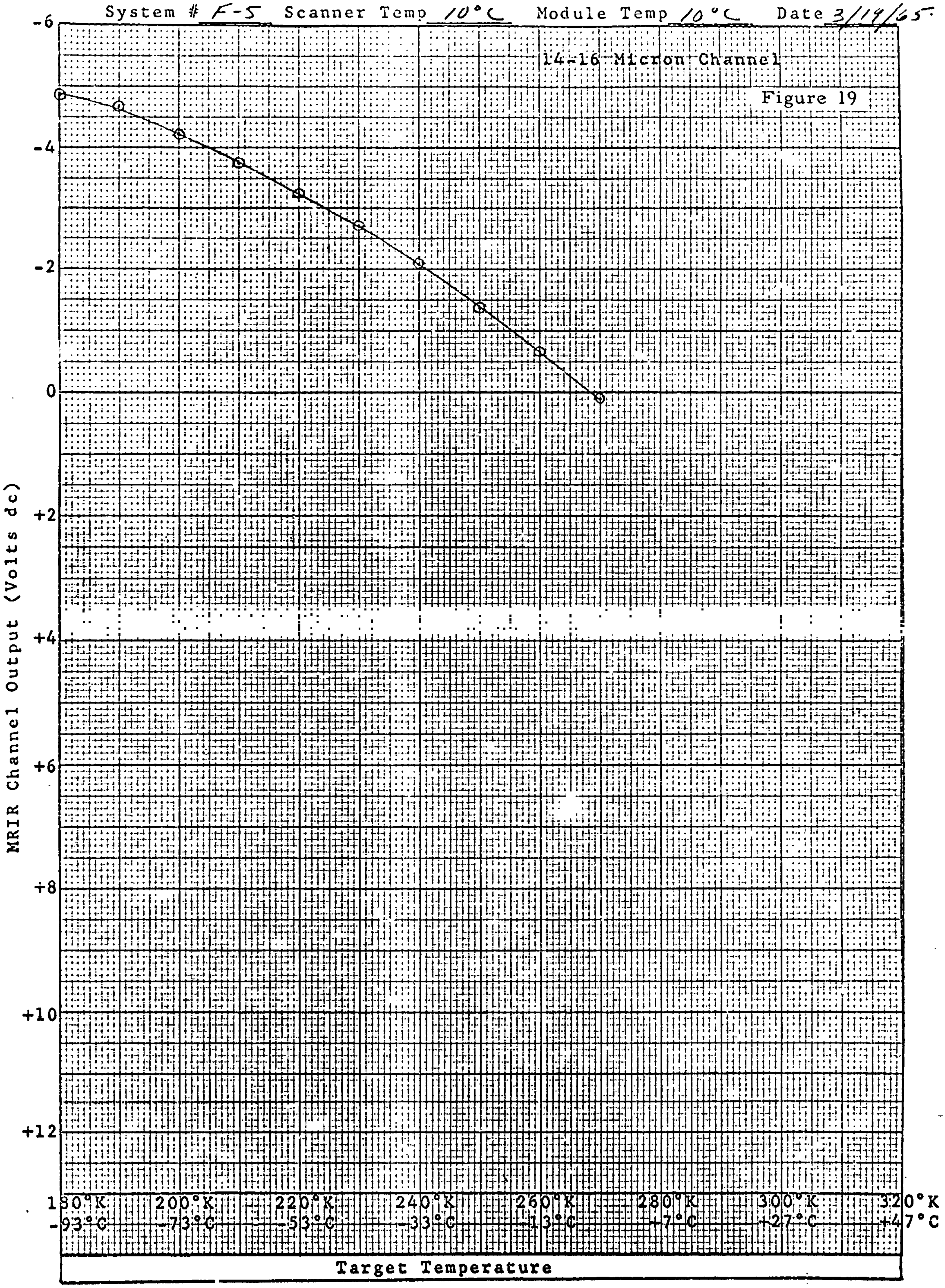
MRIR Calibration Curves (D)

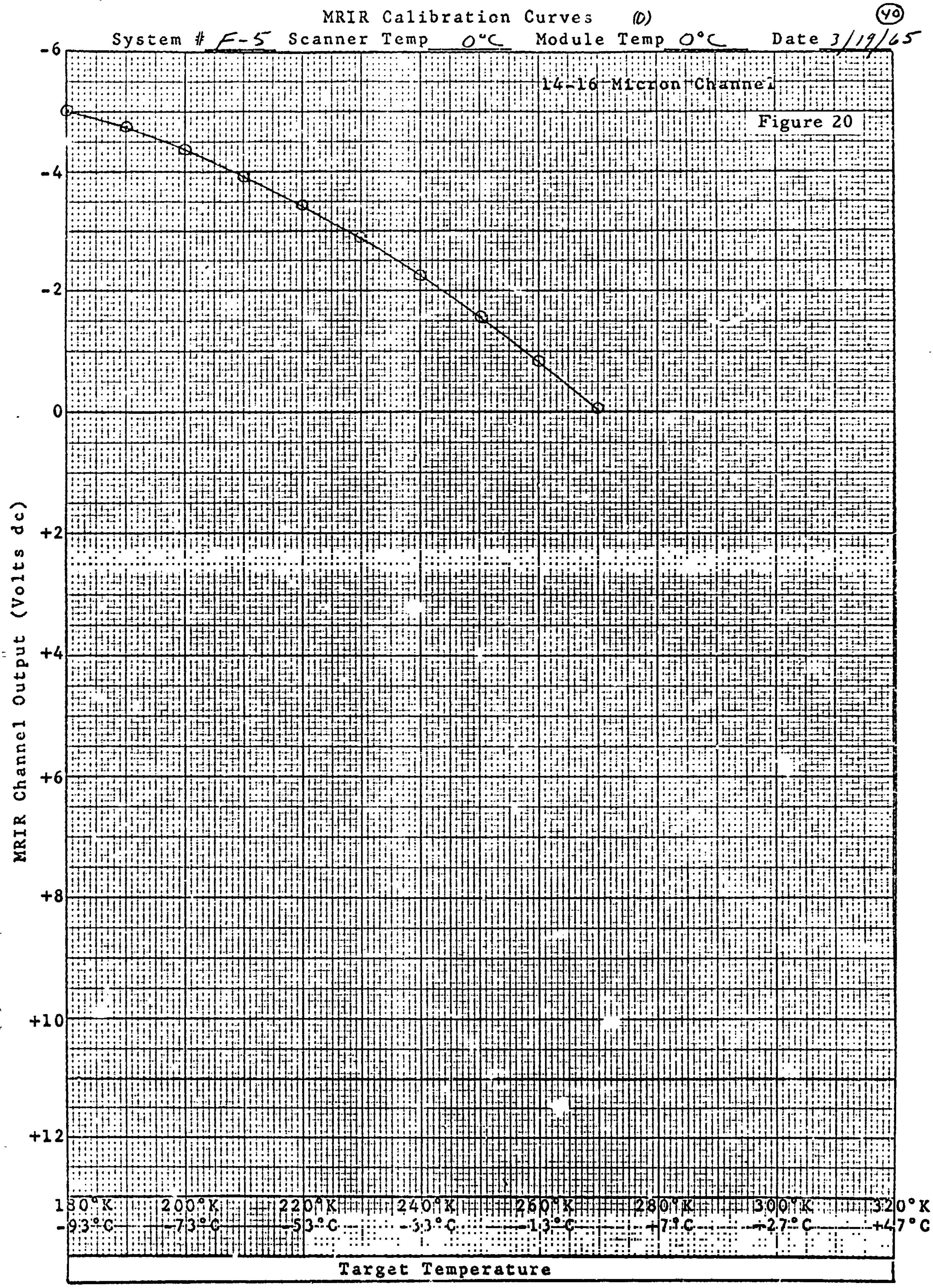
System # F-5 Scanner Temp 25°C Module Temp 25°C Date 3/19/65



MRIR Calibration Curves (D)

System # F-5 Scanner Temp 10°C Module Temp 10°C Date 3/19/65




MRIR Calibration Curves (D)
System # F-5 Scanner Temp 0°C Module Temp 0°C Date 3/19/65
14-16 Micron Channel
Figure 20
MRIR Channel Output (Volts dc)
-6
-4
-2
0
+2
+4
+6
+8
+10
+12
180°K
-93°C
200°K
-73°C
220°K
-53°C
240°K
-33°C
260°K
-13°C
280°K
+7°C
300°K
+27°C
320°K
+47°C
Target Temperature

MRIR Calibration Curves (D)

System # F-6 Scanner Temp 50°C Module Temp 50°C Date 1/15/65

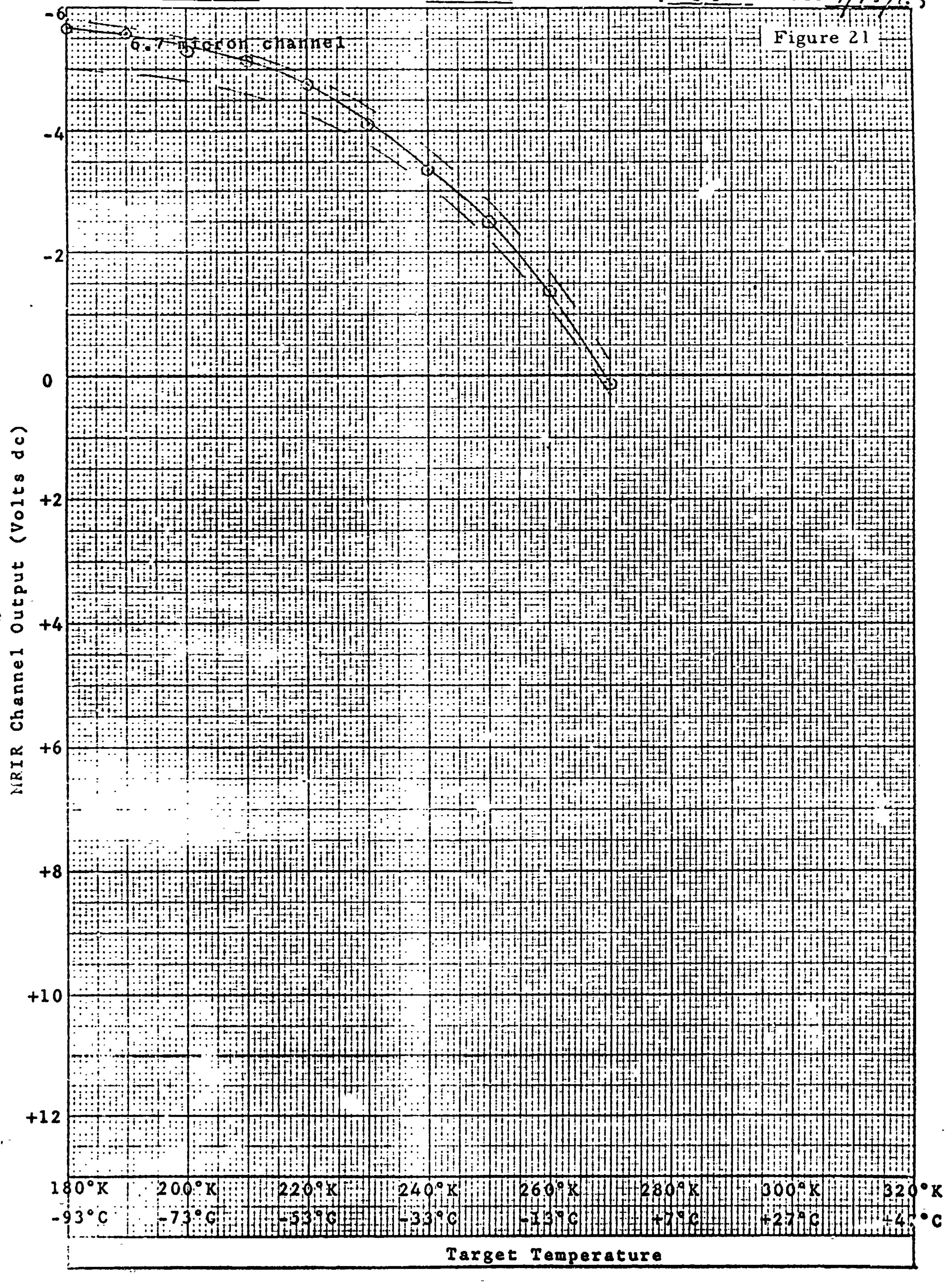
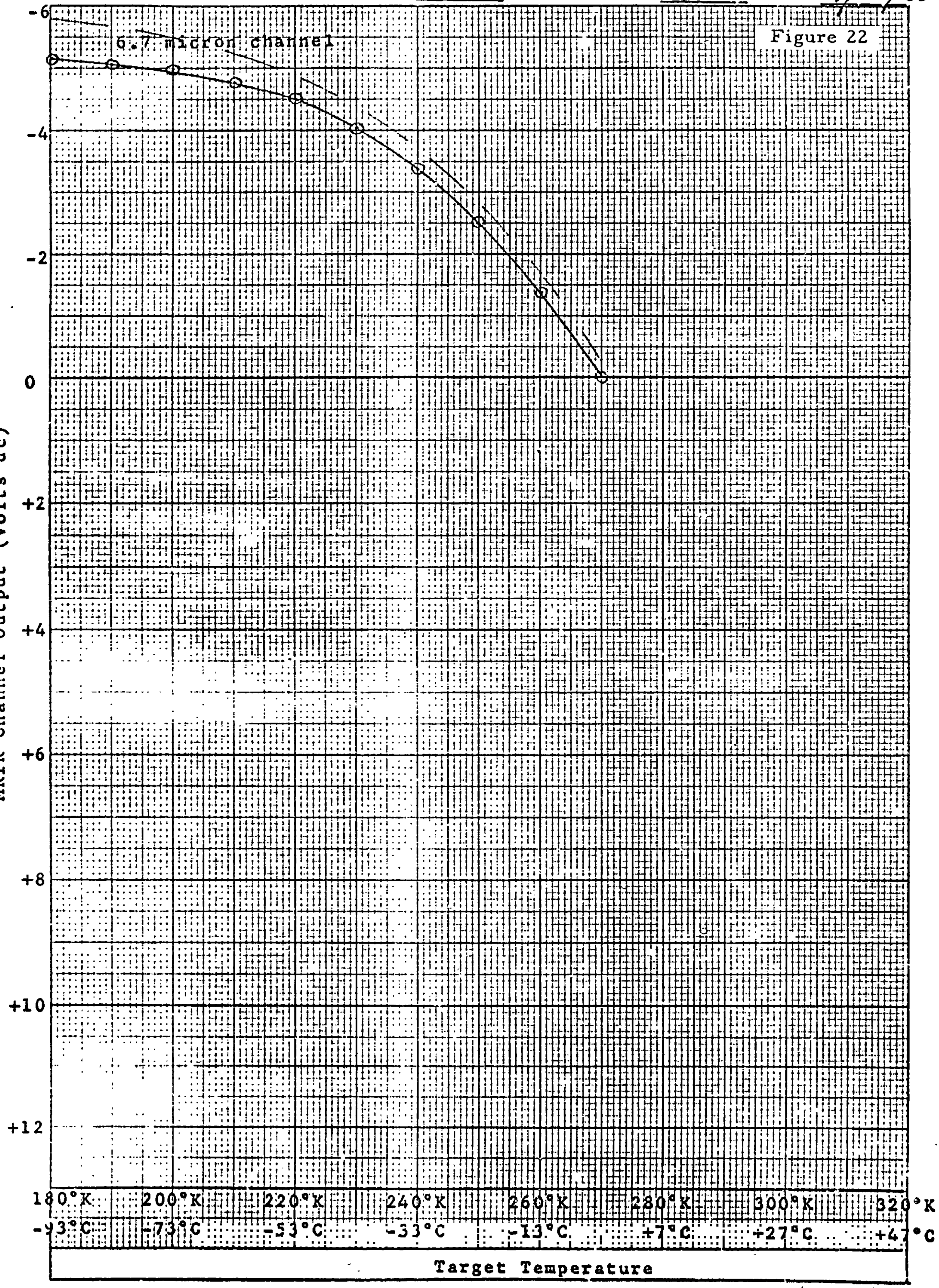


Figure 21

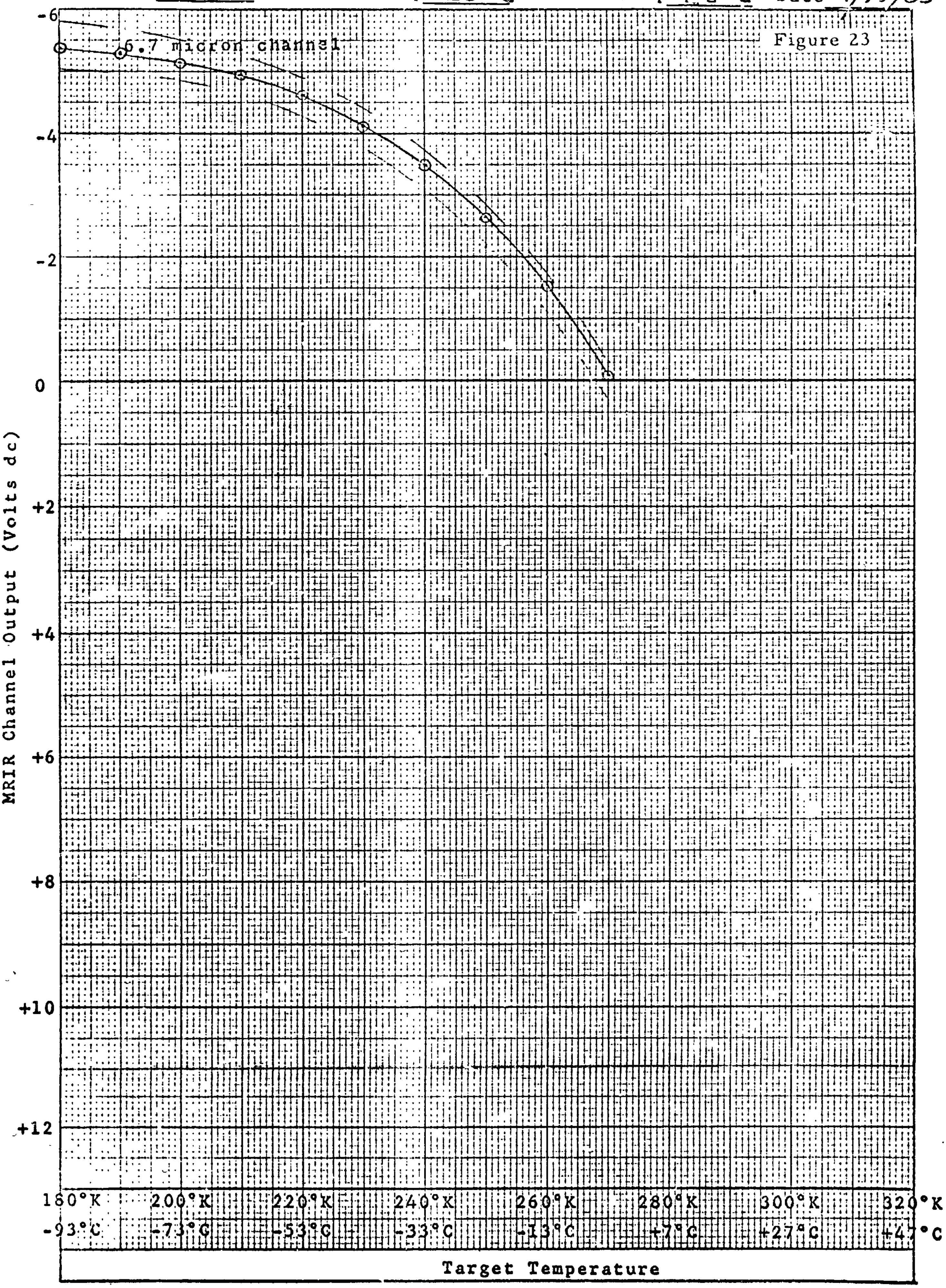
MRIR Calibration Curves (D)

System # F-6 Scanner Temp 40°C Module Temp 40°C Date 1/15/65



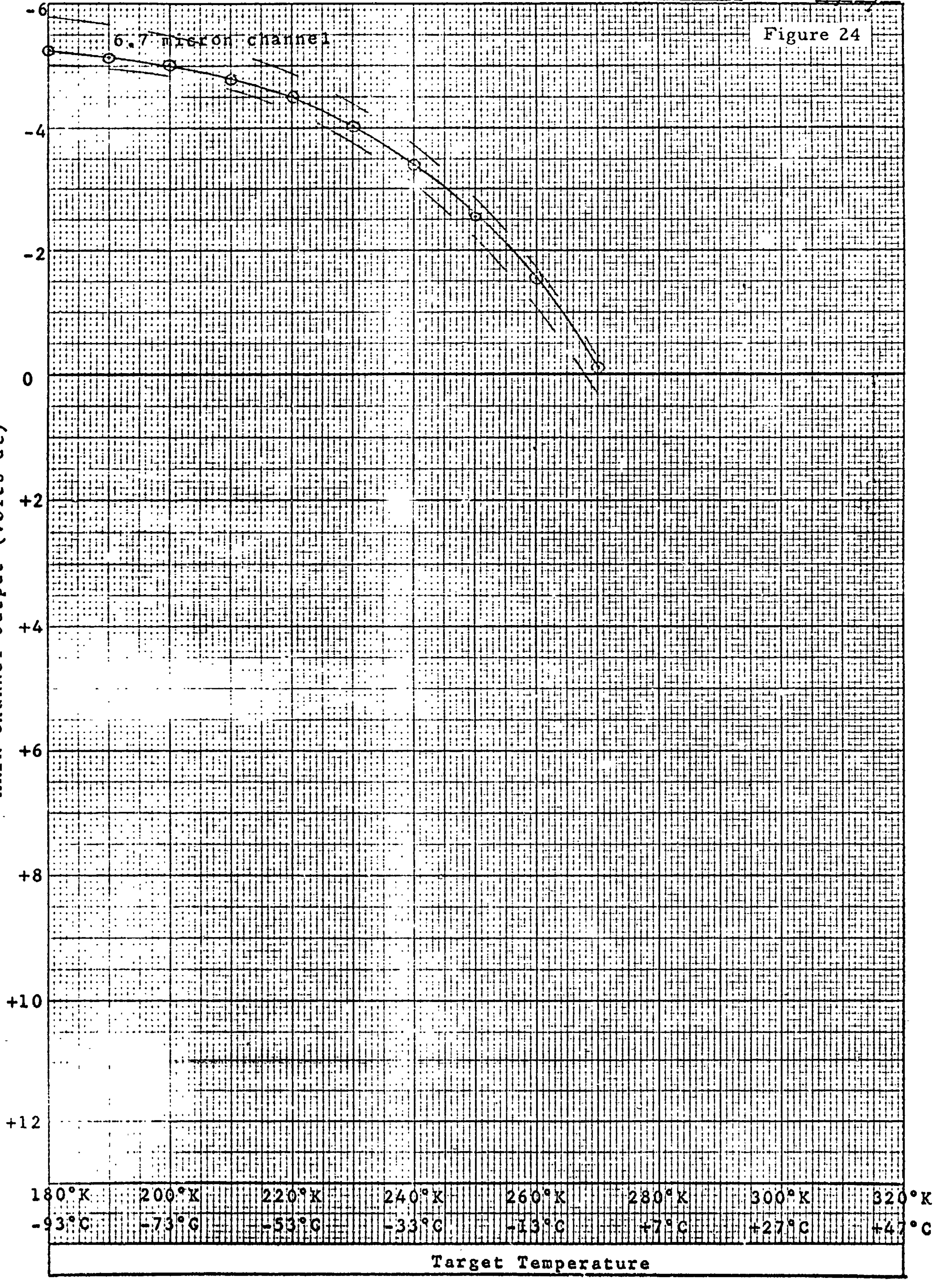
MRIR Calibration Curves (D)

System # F-6 Scanner Temp 25°C Module Temp 25°C Date 1/15/65



MRIR Calibration Curves (D)

System # F-6 Scanner Temp 10°C Module Temp 10°C Date 1/15/65



MRIR Calibration Curves (D)

System # E-6 Scanner Temp 0° C Module Temp 0°C Date 1/15/65

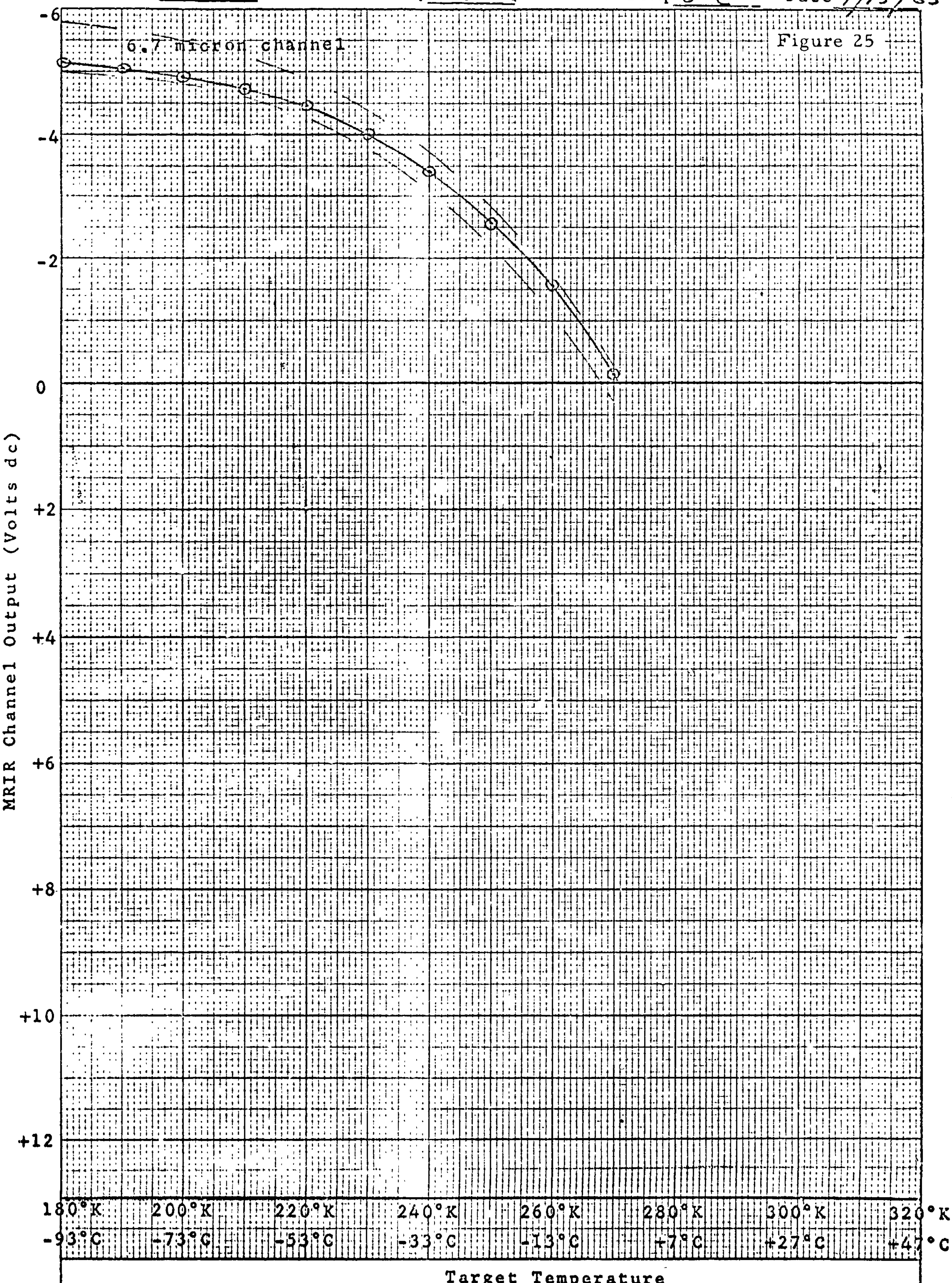


Figure 25

MRIR Calibration Curves (D)

System # F-6 Scanner Temp 50°C Module Temp 50°C Date 1/15/65

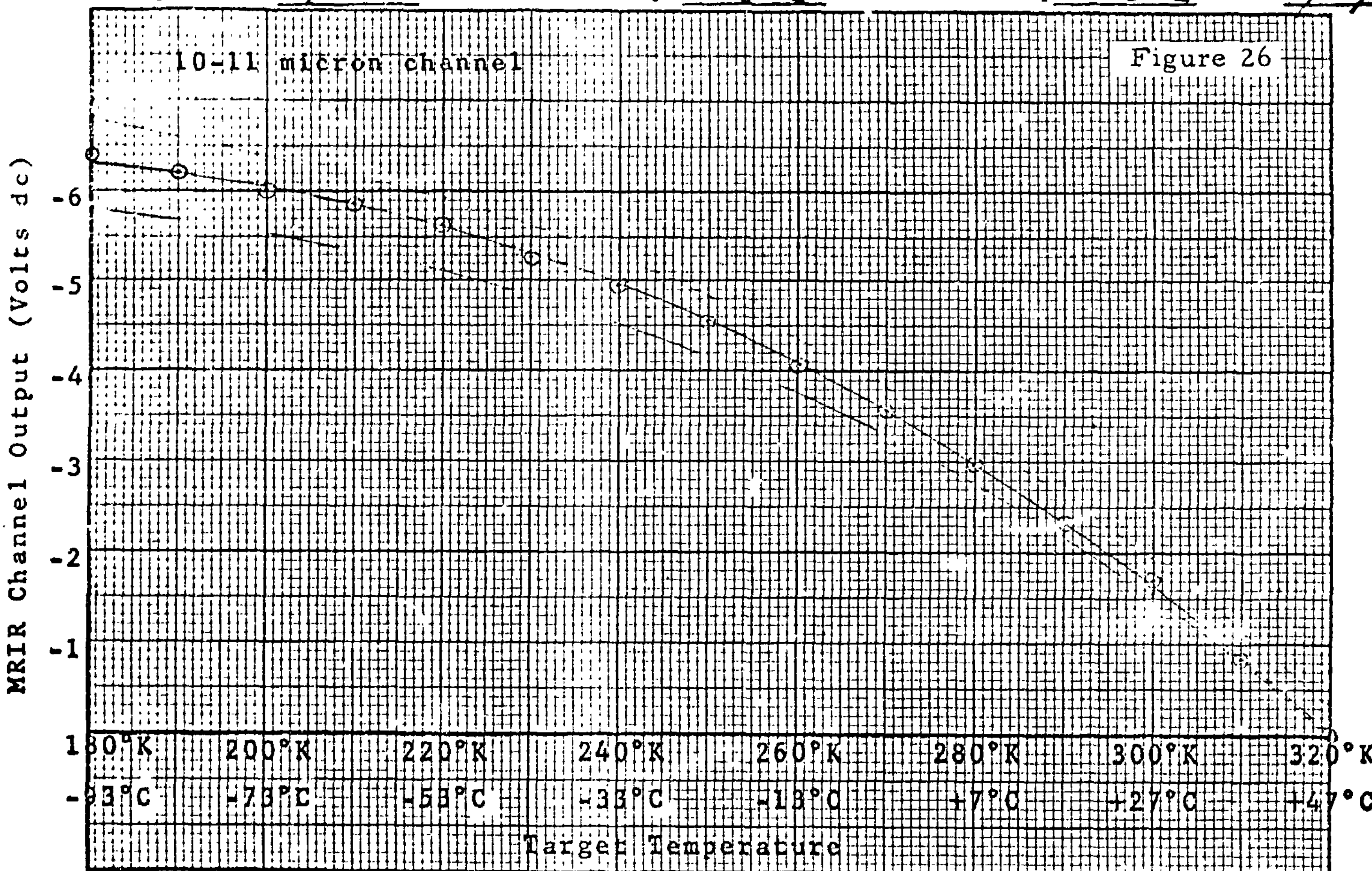
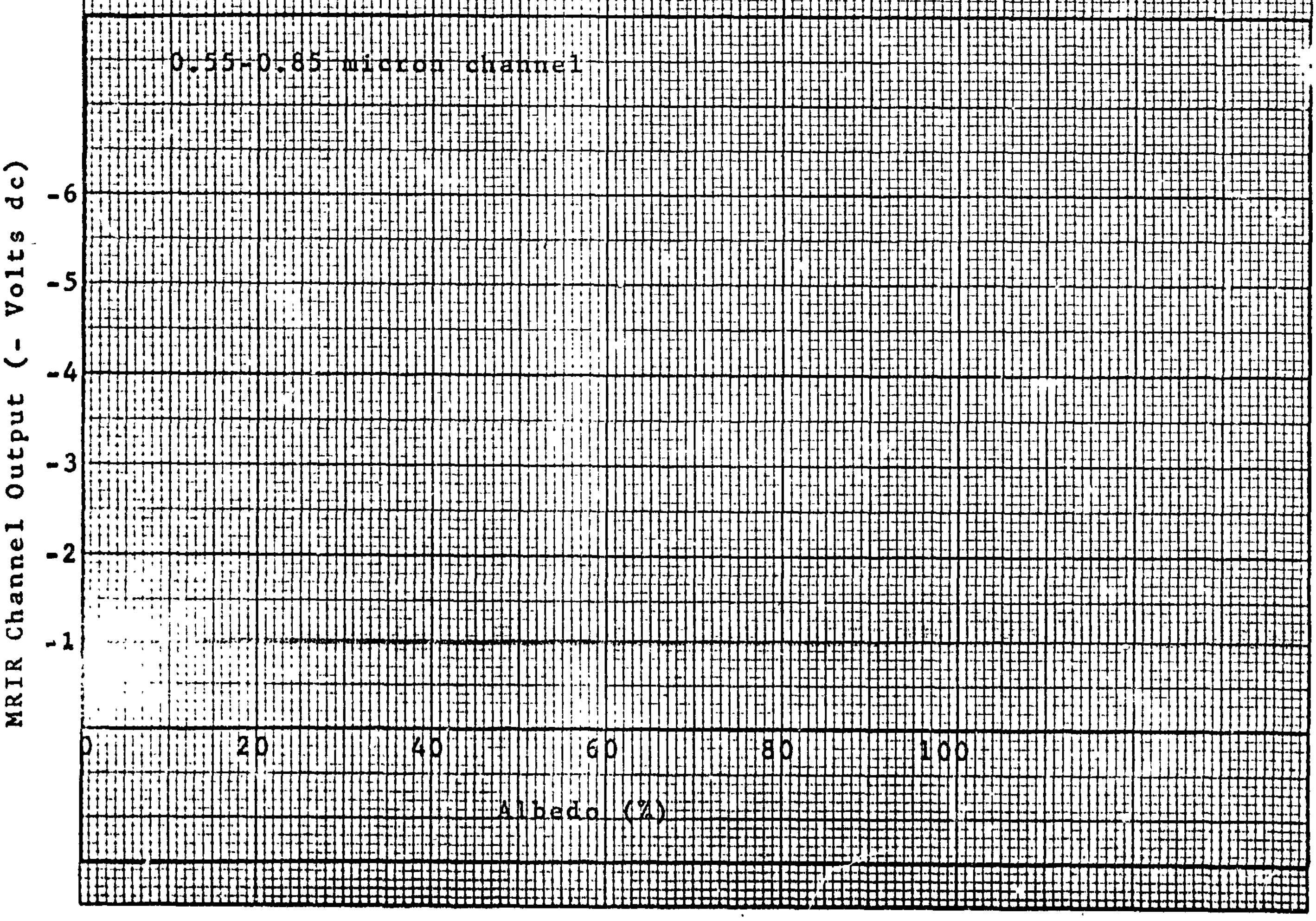
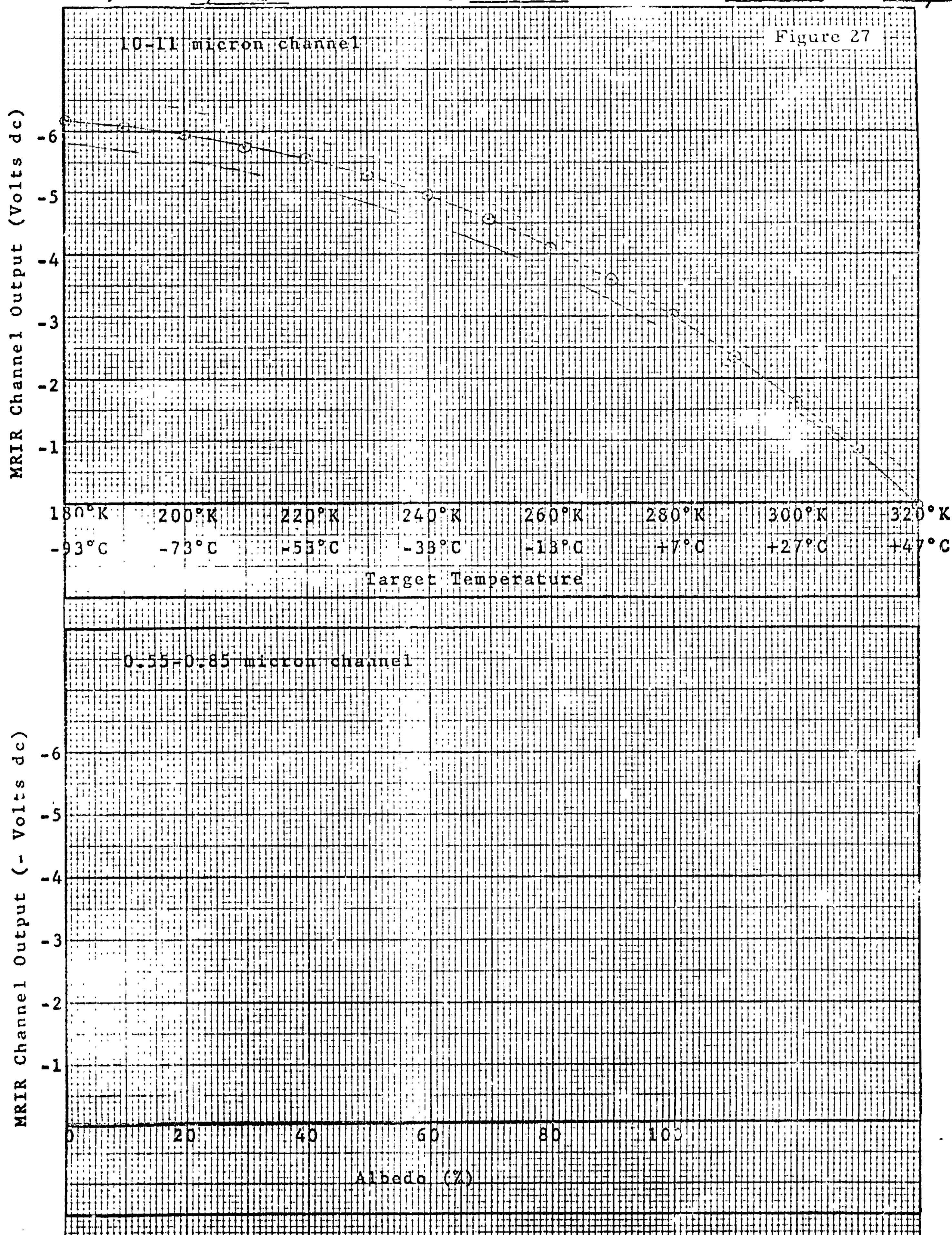


Figure 26



MRIR Calibration Curves (D)

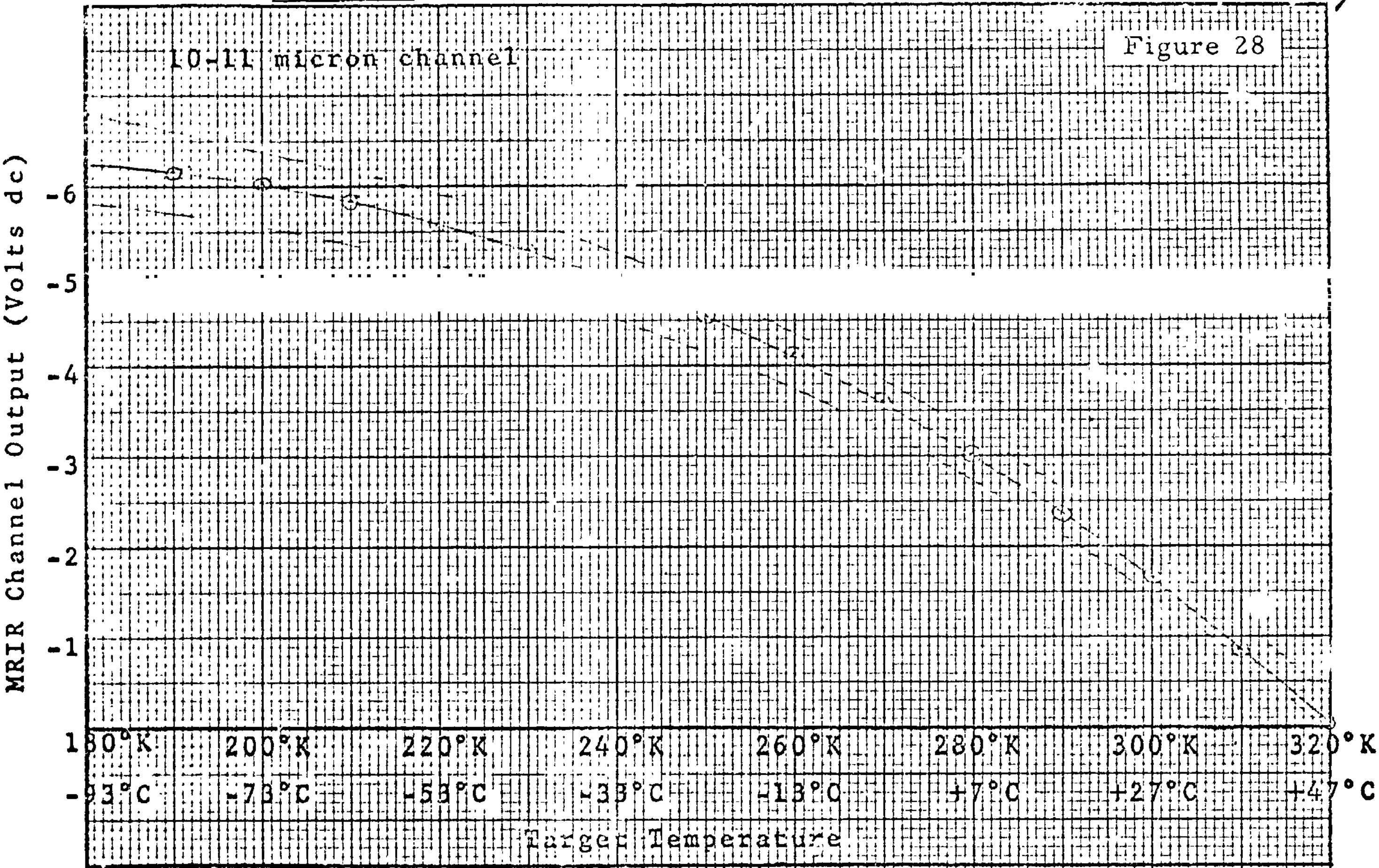
System # E-6 Scanner Temp 410°C Module Temp ... °C Date 1/15/65

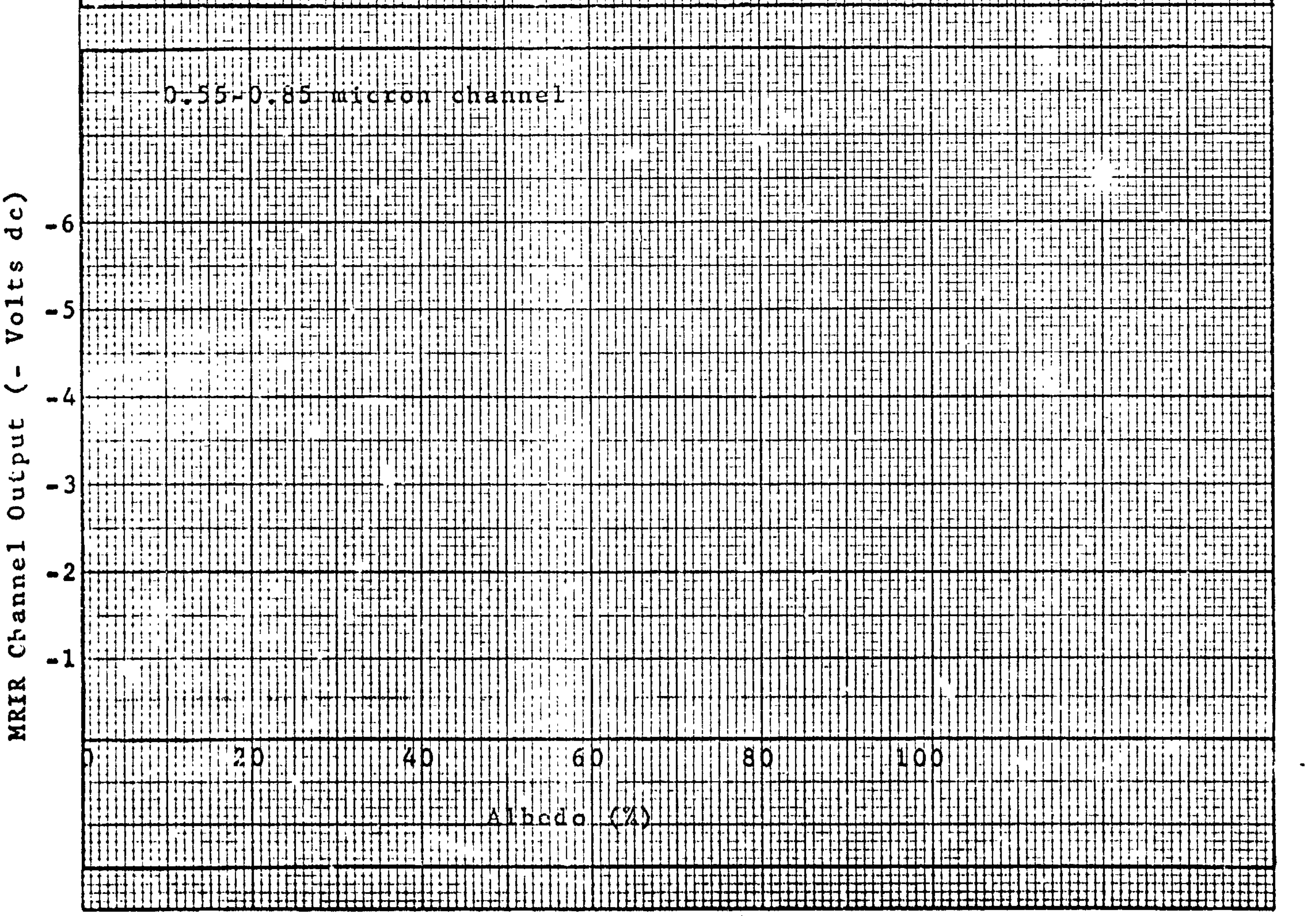


MRIR Calibration Curves (C)

System # F-6 Scanner Temp 25°C Module Temp 25°C Date 1/15/5

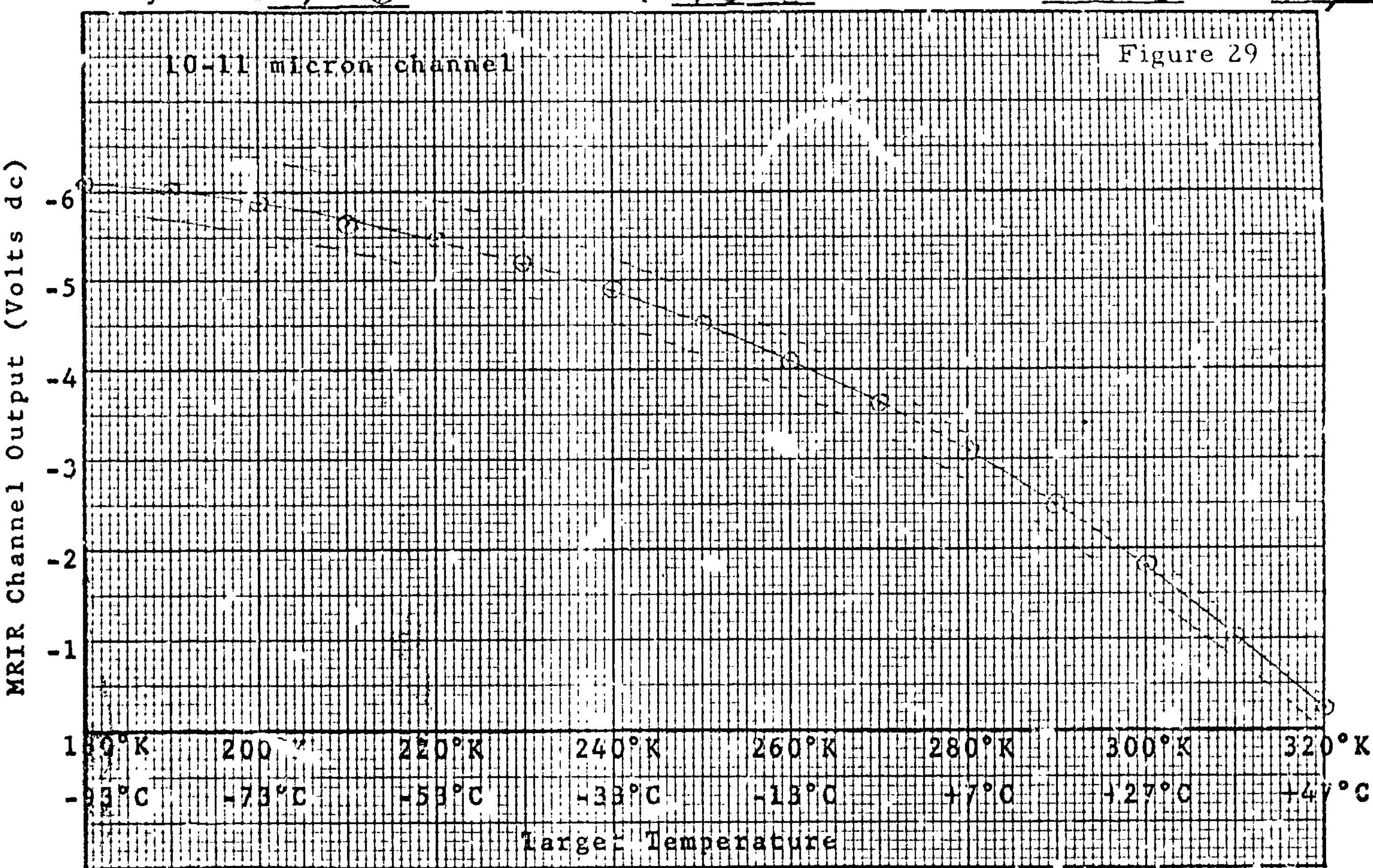
Figure 28

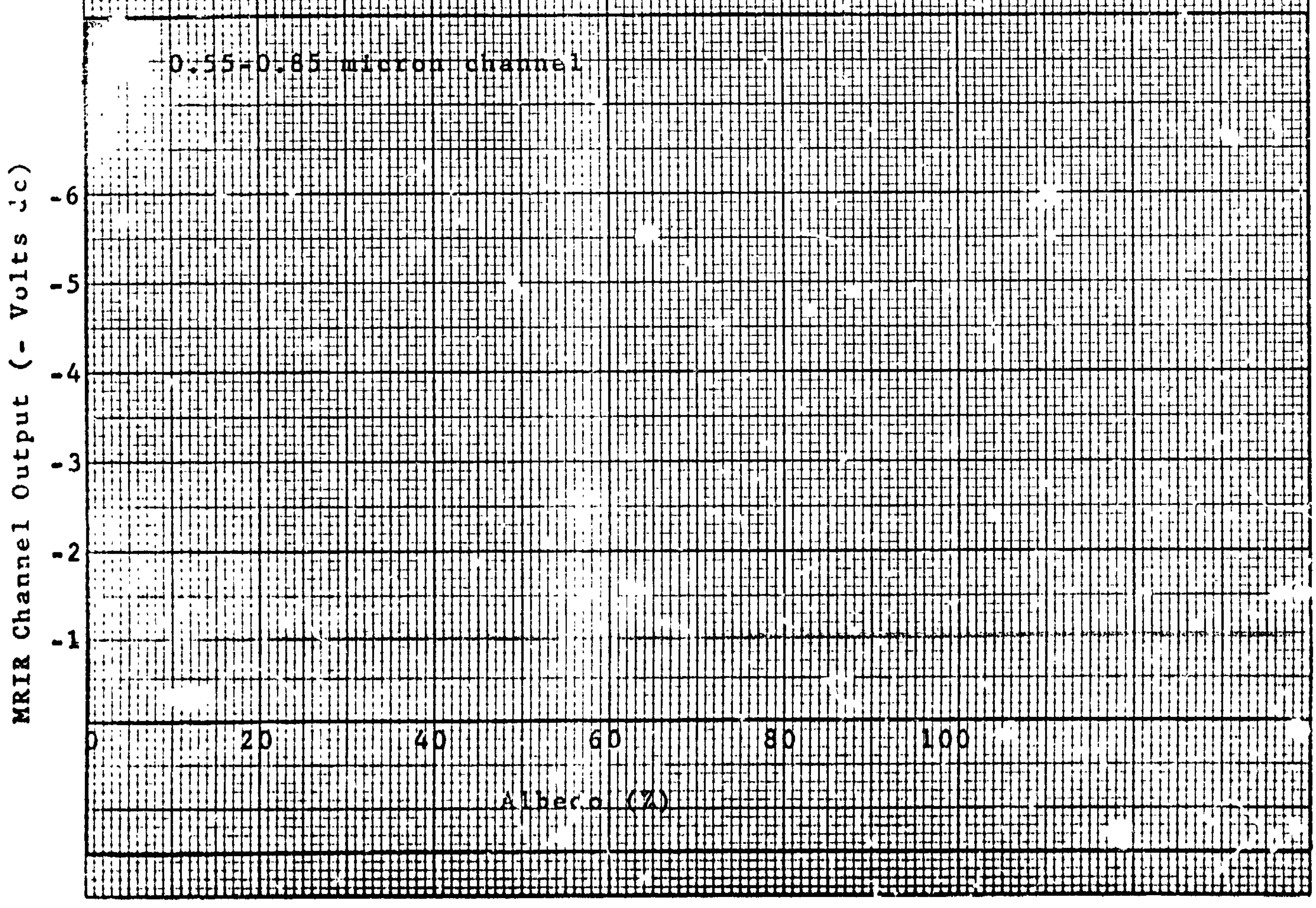




MRIR Calibration Curves (D)

System # F-6 Scanner Temp 10°C Module Temp 10°C Date 1/15/65

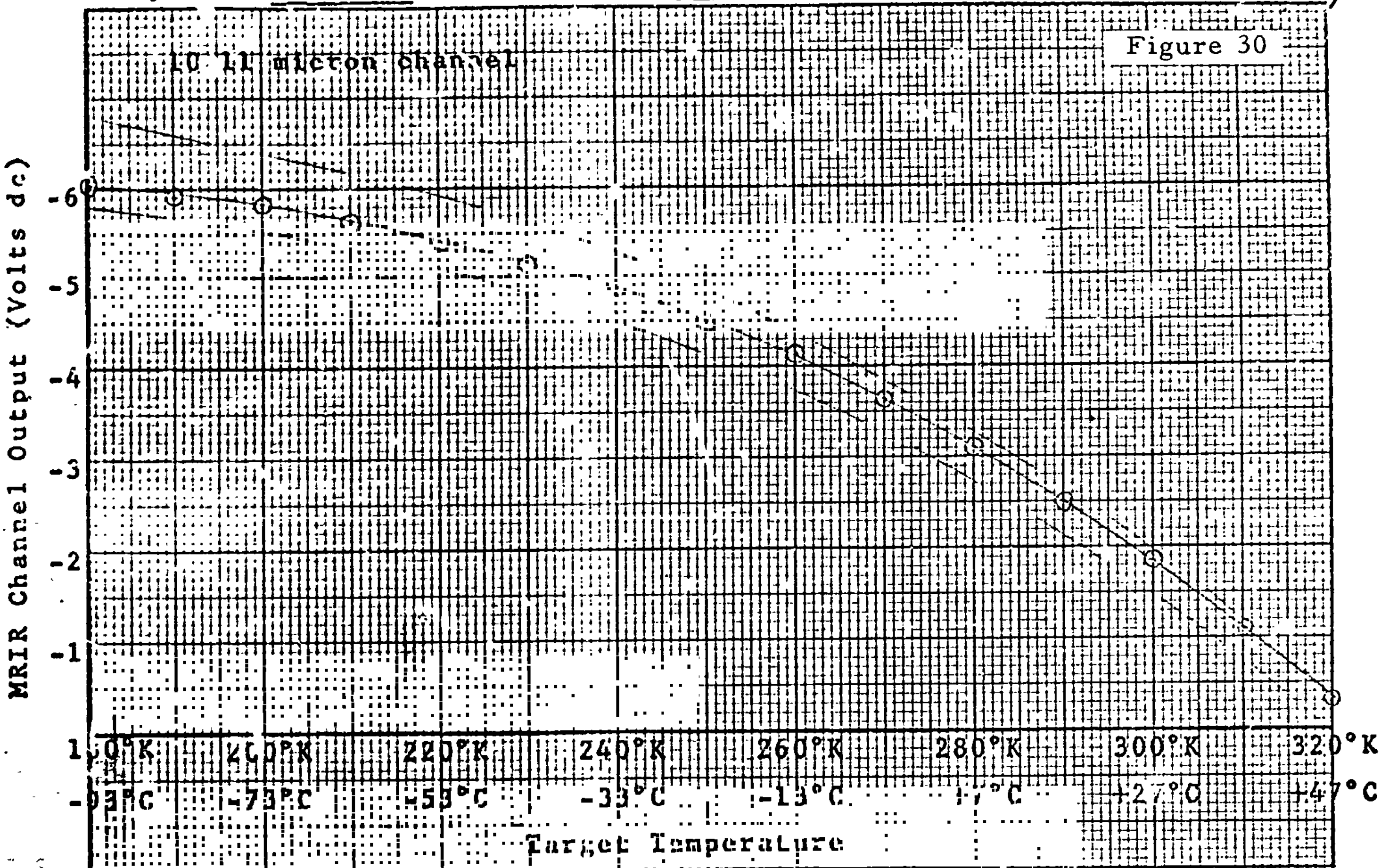


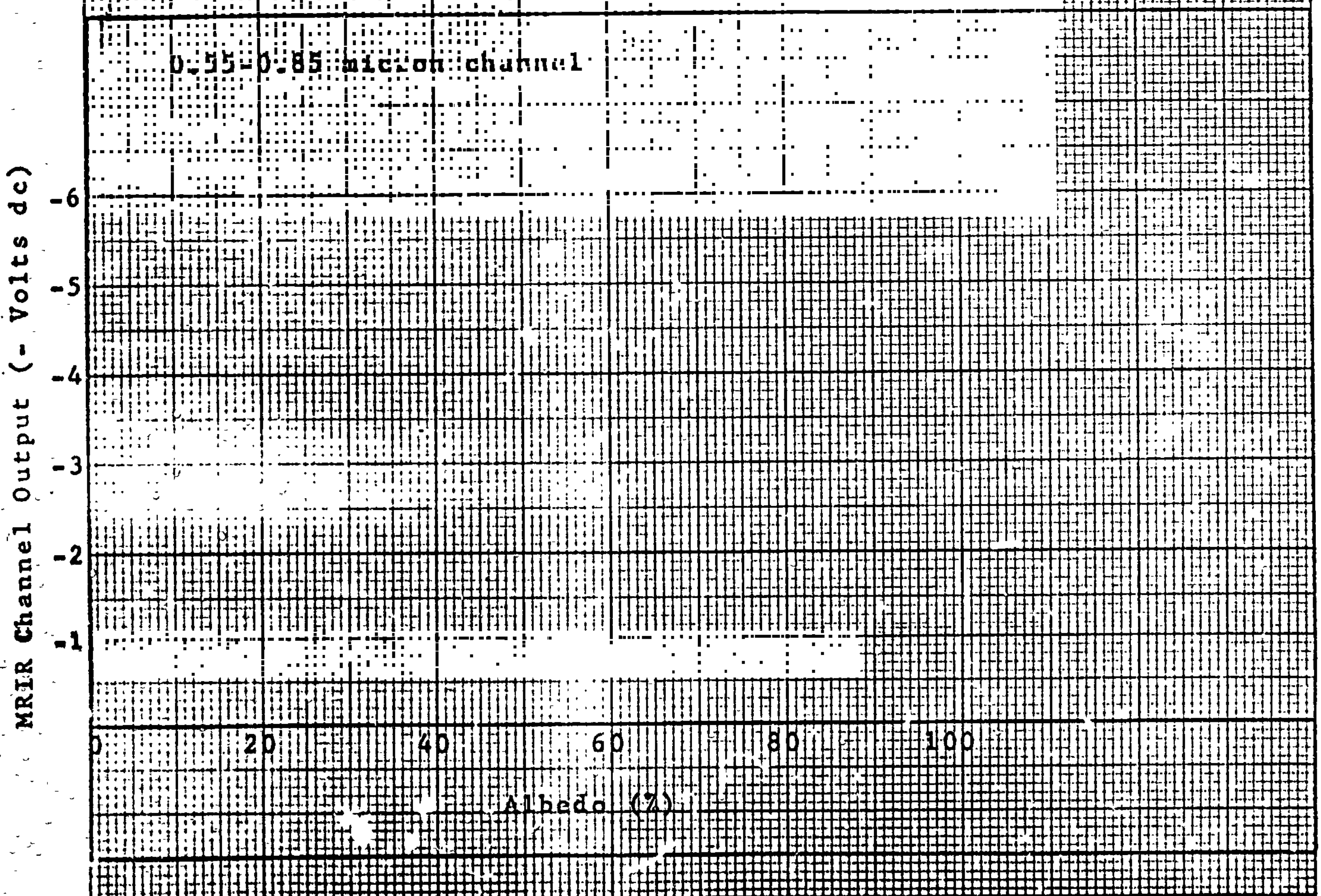


MRIR Calibration Curves (D)

System # F-6 Scanner Temp 0°C Module Temp 0°C Date 1/15/65

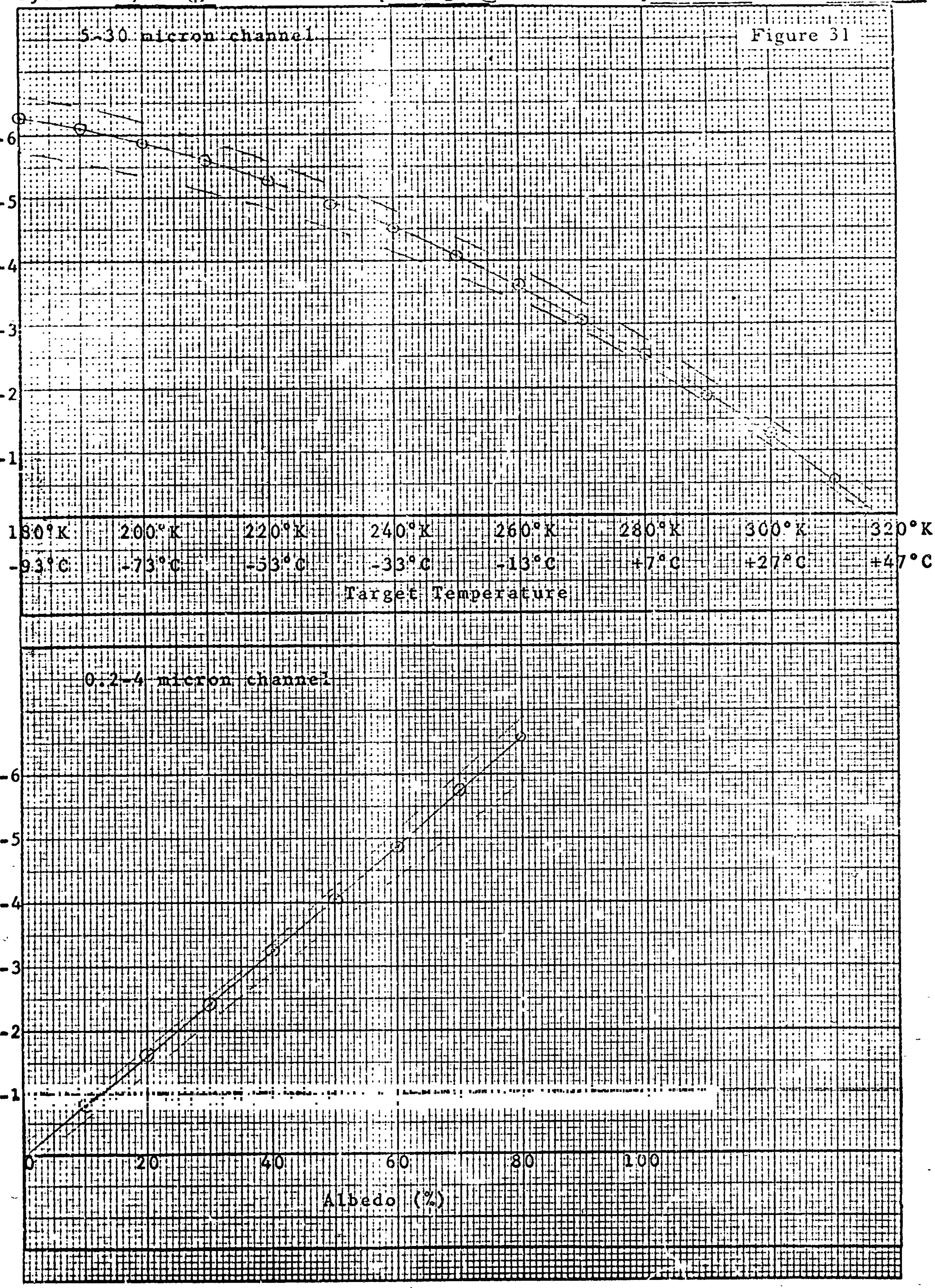
Figure 30





MRIR Calibration Curves (D)

System # F-6 Scanner Temp 50°C Module Temp 50°C Date 1/15/65



MRIR Calibration Curves (D)

System # F-6 Scanner Temp 40°C Module Temp 40°C Date 1/15/65

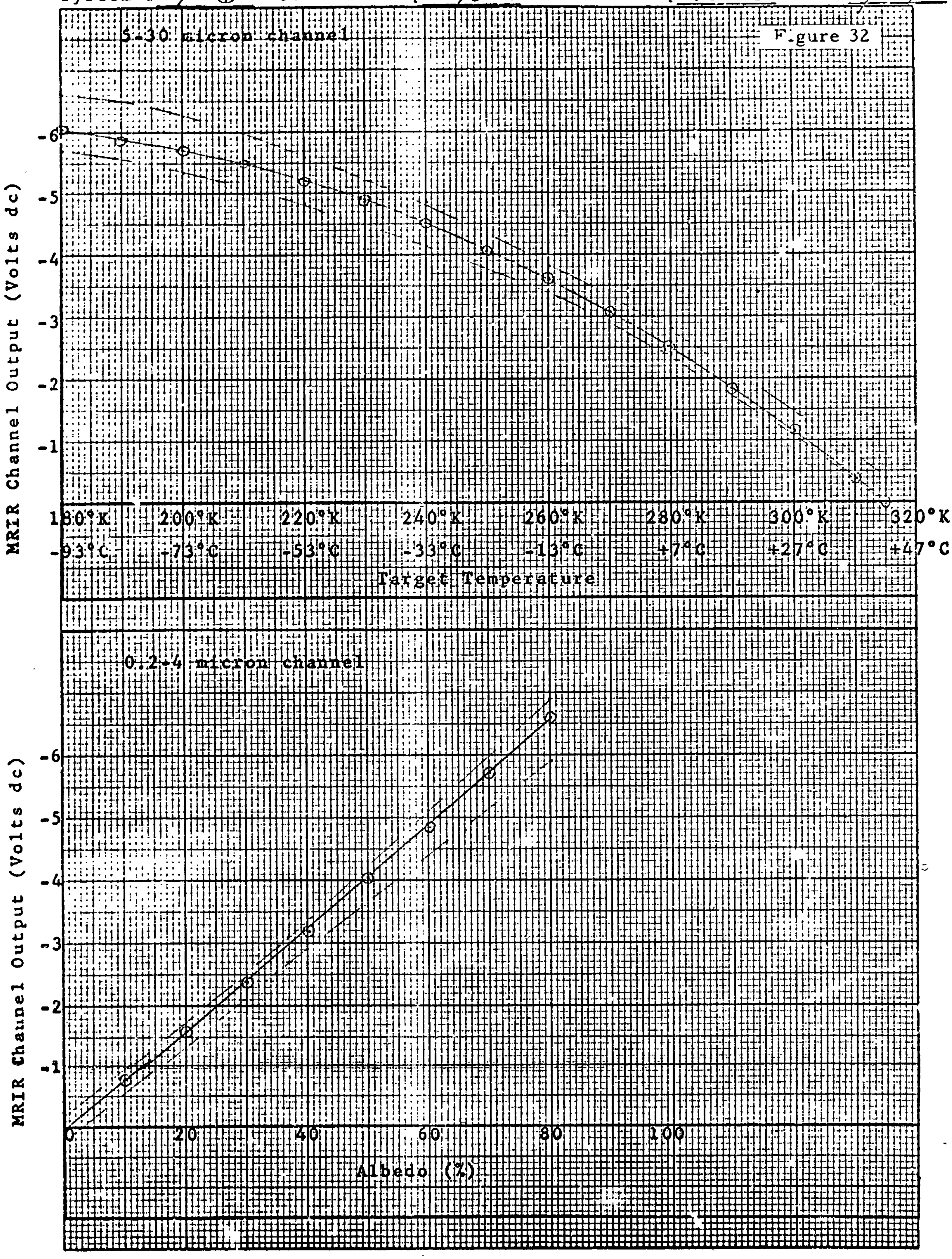
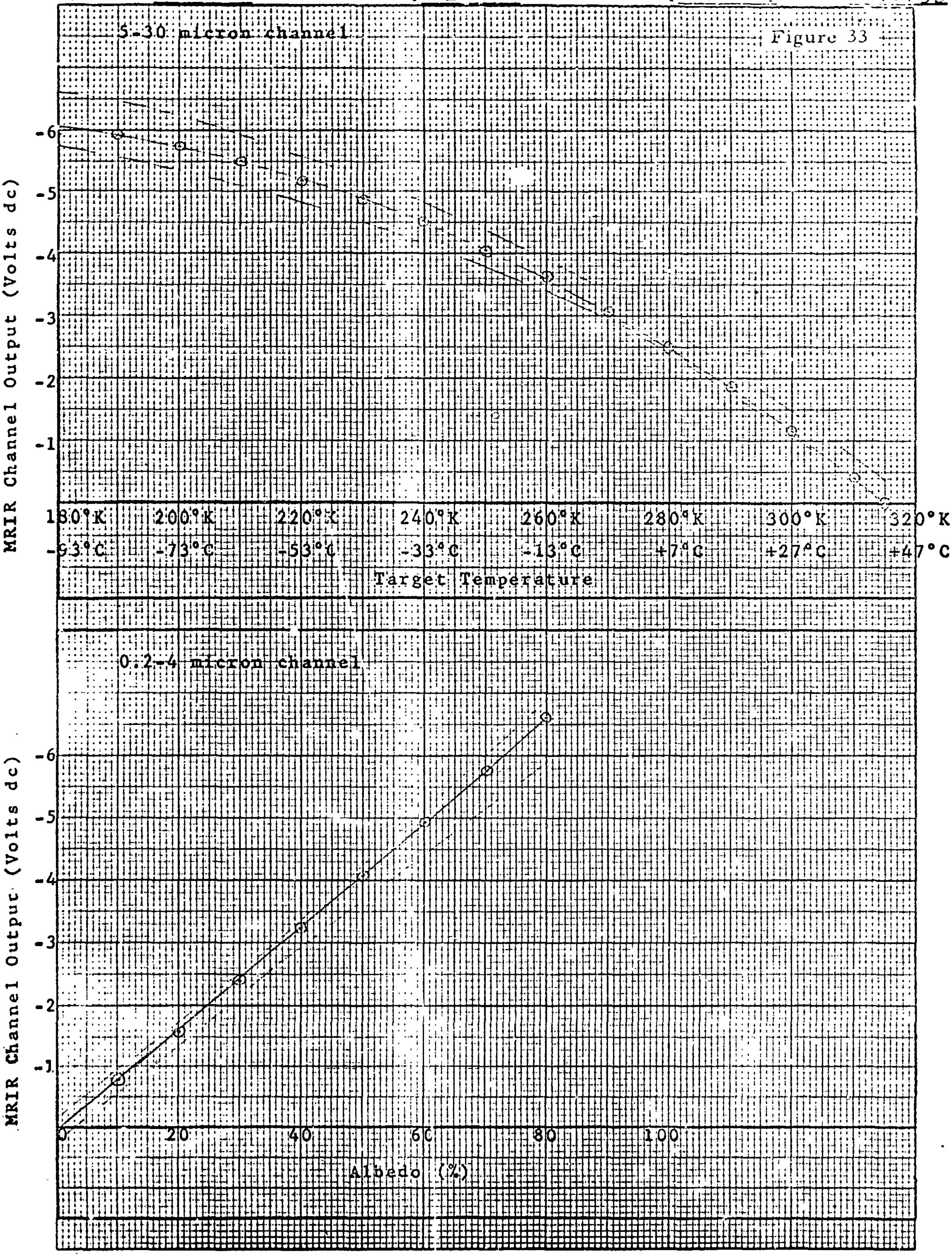


Figure 32

MRIR Calibration Curves (D) (38)

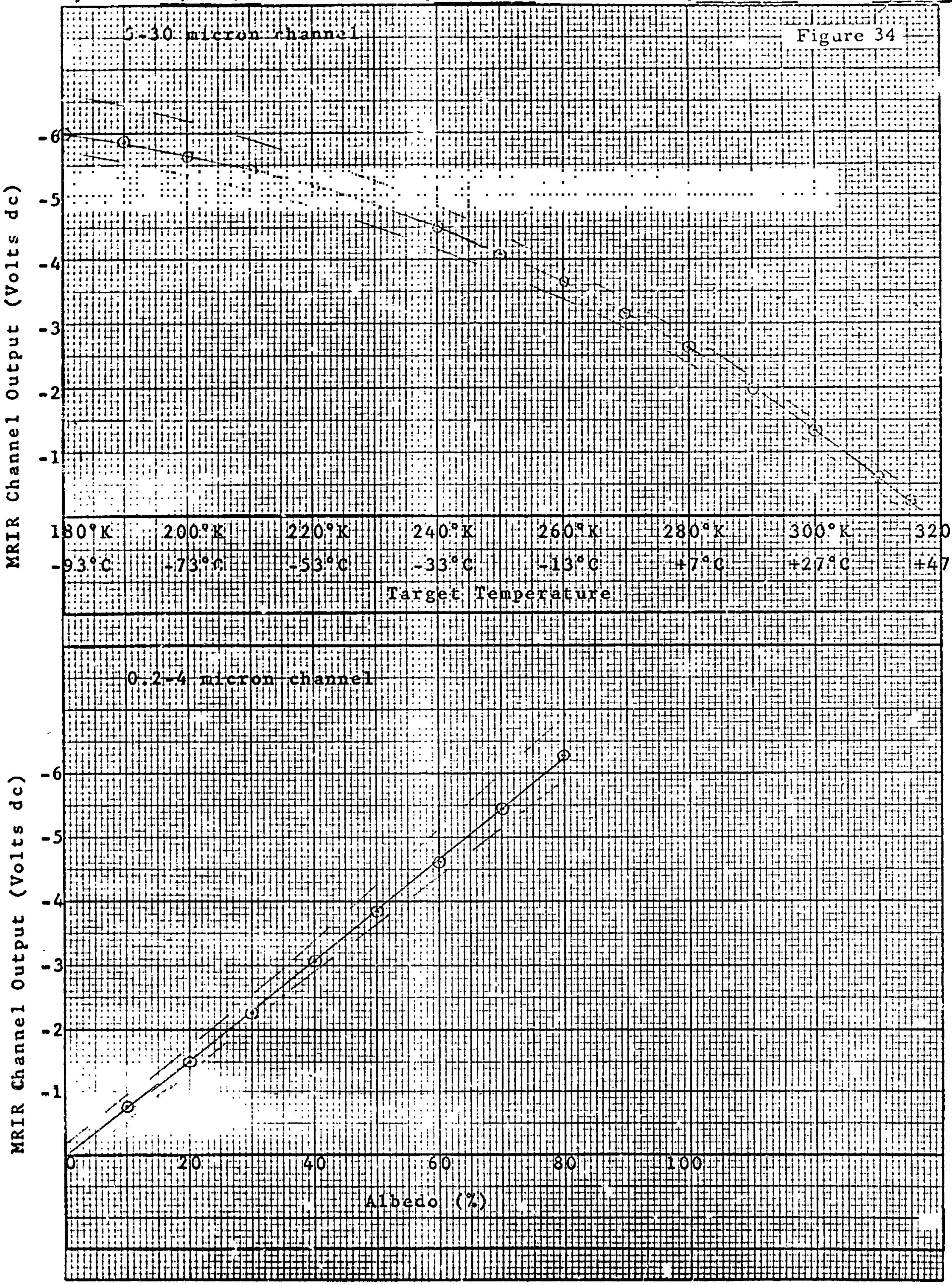
System # F-6 Scanner Temp 25°C Module Temp 25°C Date 1/15/65

Figure 33



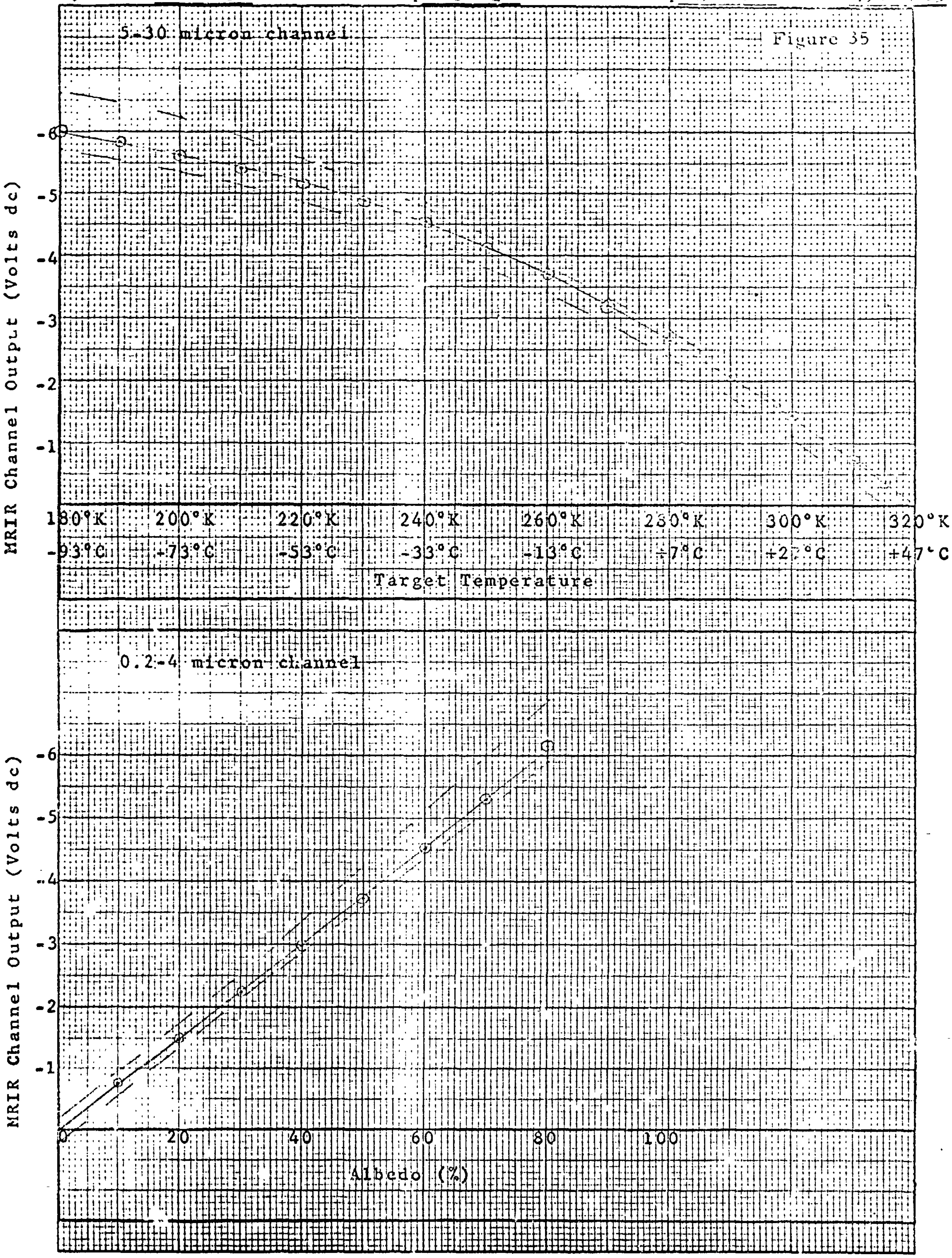
MRIR Calibration Curves (D)

System # F-6 Scanner Temp 10°C Module Temp 10°C Date 1/15/65



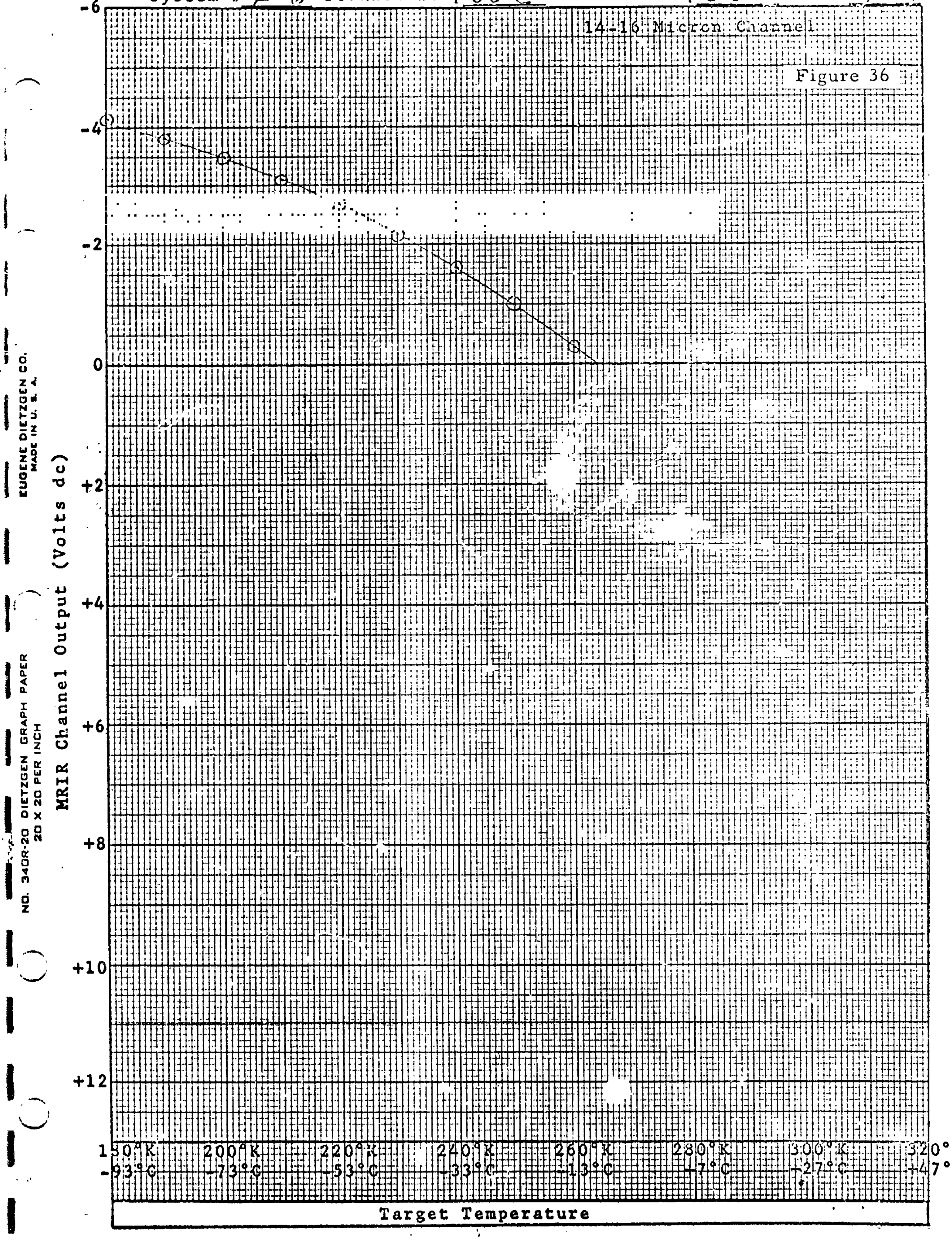
MRIR Calibration Curves (D)

System # F-6 Scanner Temp 0°C Module Temp 0°C Date 11/15/65



MRIR Calibration Curves (D)

System # F-6 Scanner Temp 50°C Module Temp 50°C Date 11/25/65



MRIR Calibration Curves

System # F-6 Scanner Temp 40°C Module Temp 41°C Date 11/25/63

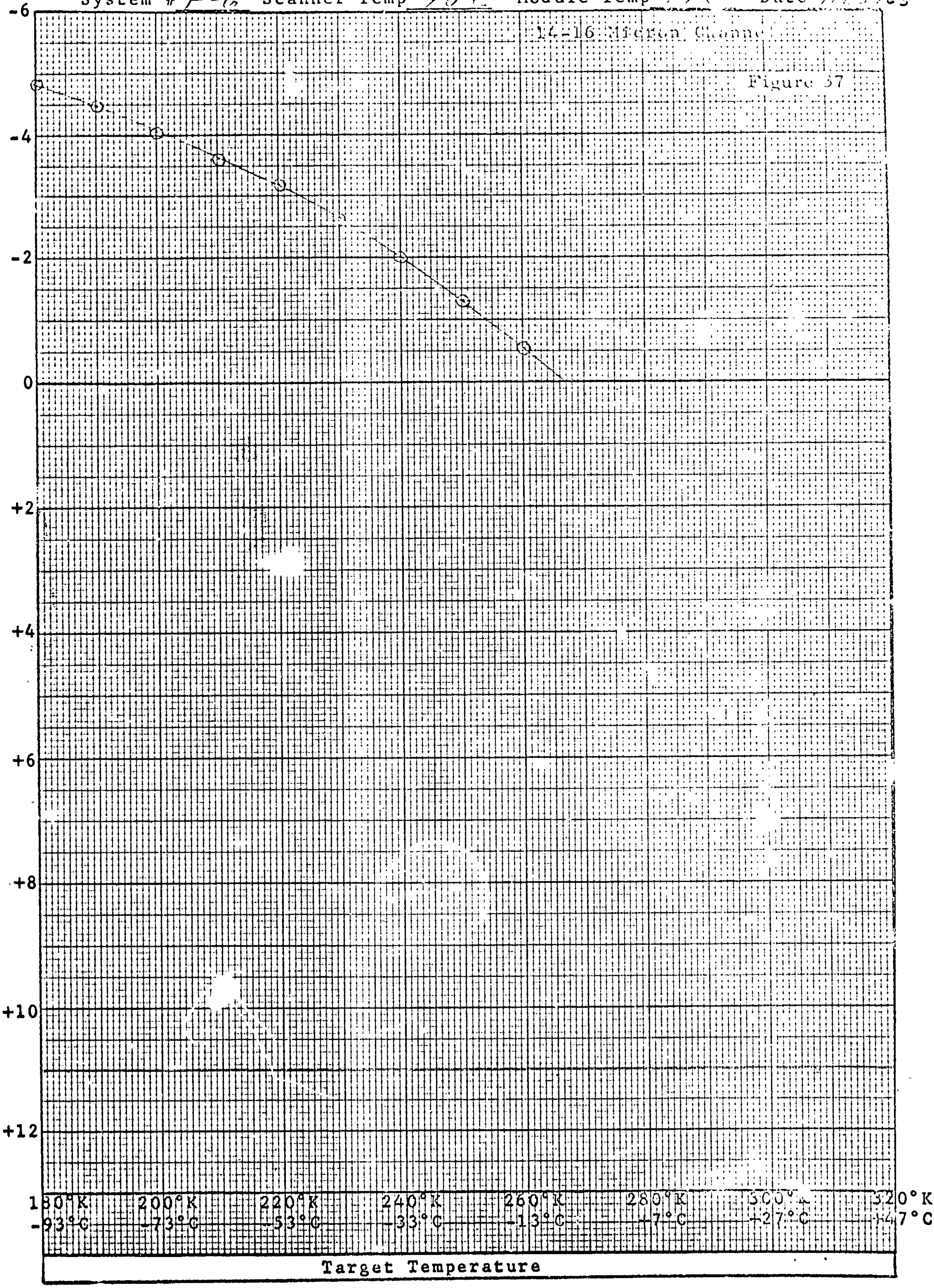
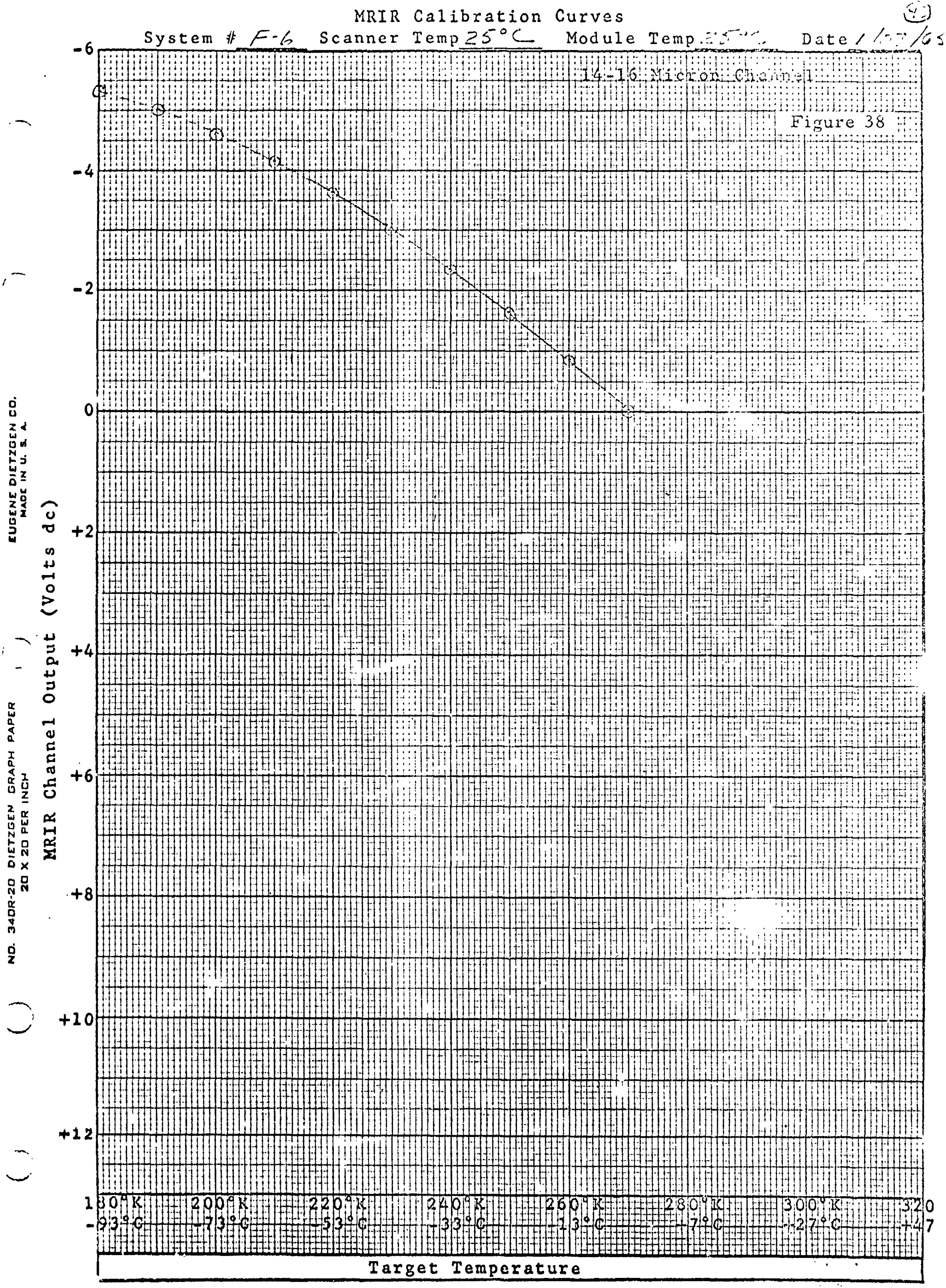
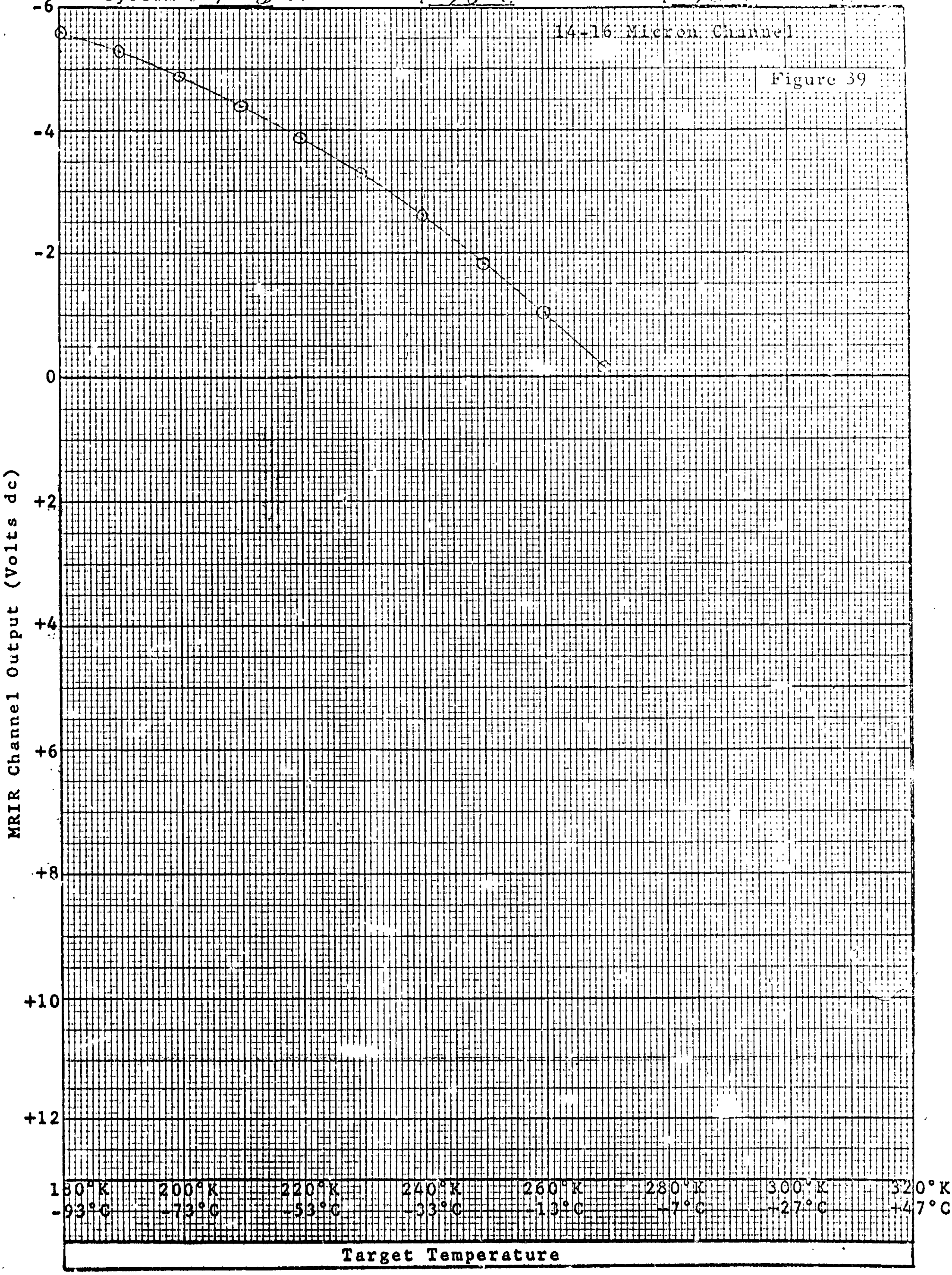


Figure 37


MRIR Calibration Curves
System # F-6
Scanner Temp 25°C
Module Temp
Date
14-16 Micron Channel
Figure 38
MRIR Channel Output (Volts dc)
-6
-4
-2
0
+2
+4
+6
+8
+10
+12
180°K
-93°C
200°K
-73°C
220°K
-53°C
240°K
-33°C
260°K
-13°C
280°K
+7°C
300°K
+27°C
320
+47
Target Temperature
NO. 340R-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

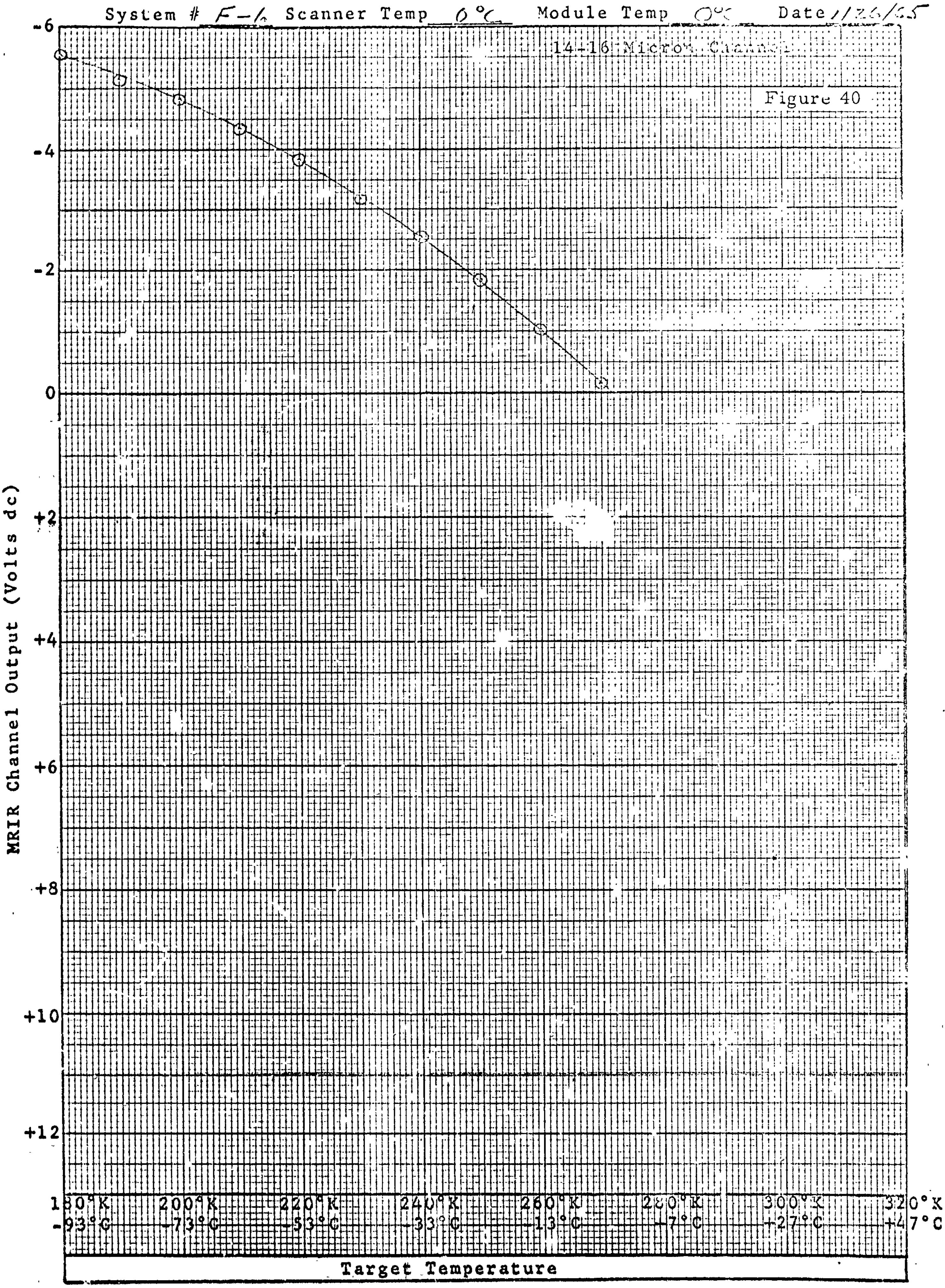
MRIR Calibration Curves

System # F-6 Scanner Temp 10 °C Module Temp 10 °C Date 11/26/65



MRIR Calibration Curves

System # F-1 Scanner Temp 0°C Module Temp 0°C Date 1/26/65



Section 3

F-2 MRIR CHECK-OF-CALIBRATION MEASUREMENTS

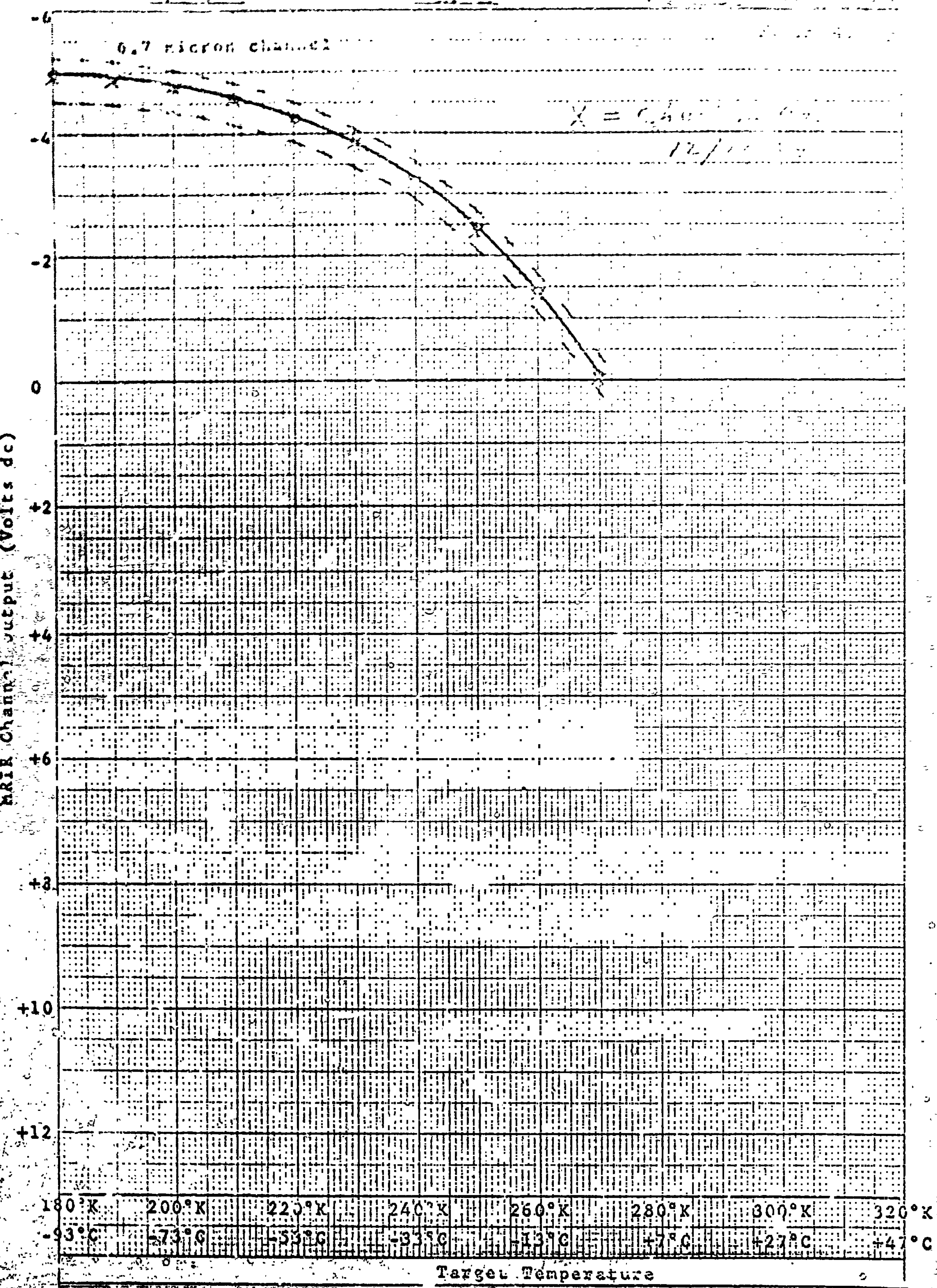
Check-of-calibration measurements were performed on the F-2 MRIR after the radiometer had been subjected to orbital simulation testing at NASA. The measurements were made at 25°C radiometer temperature.

The check-of-calibration data that were obtained from these measurements were compared with the final calibration data that had been obtained approximately a year earlier on the F-2 MRIR. The results of this comparison are shown in Figures 41 through 43.

It can be seen from these figures that very little change in calibration had occurred in the F-2 MRIR over a period of one year and after exposure to an orbital simulation environment.

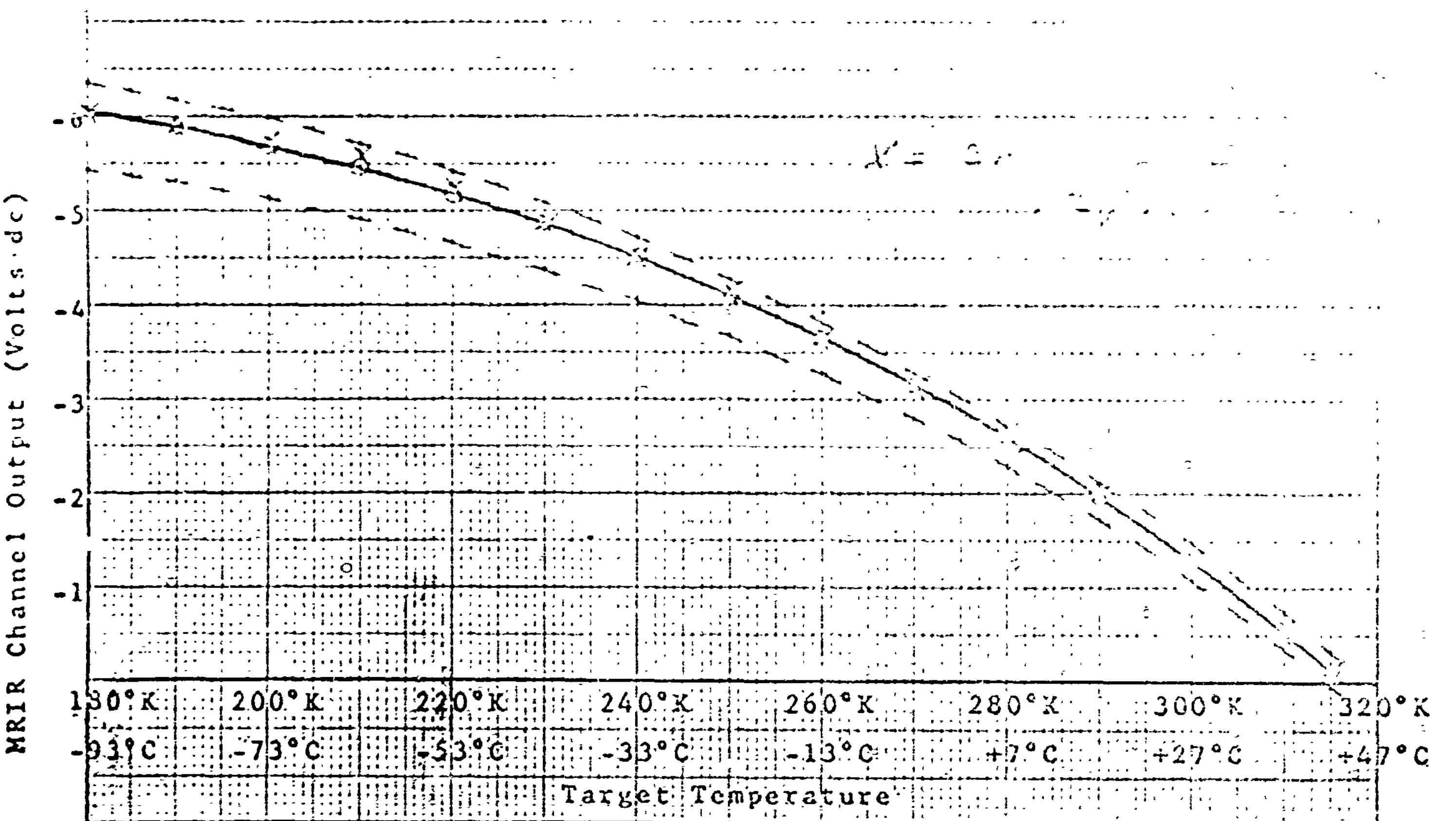
MRIR Calibration Curves (C)

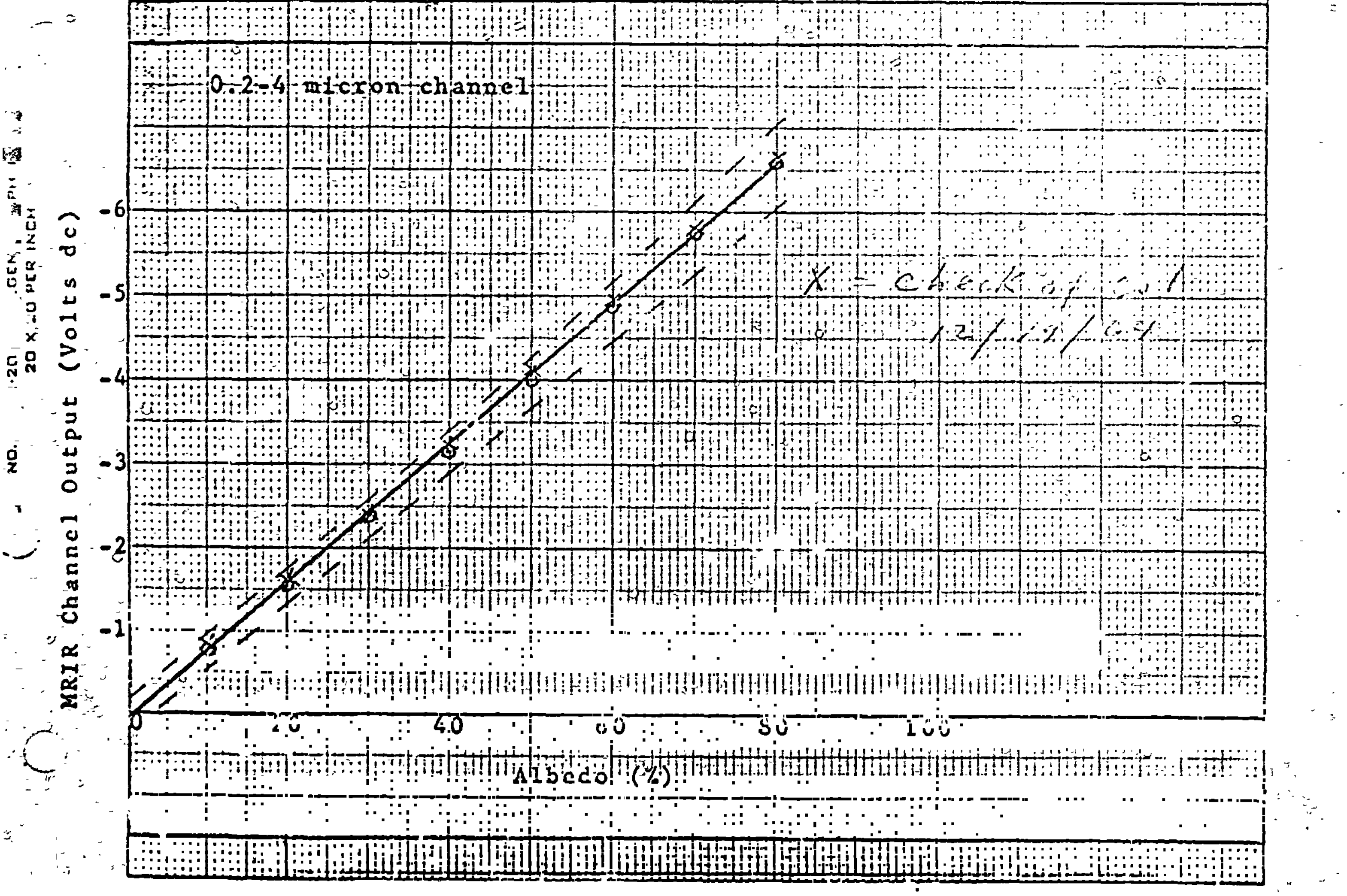
System # ____ Scanner Temp ____ Module Temp ____



System Scanner

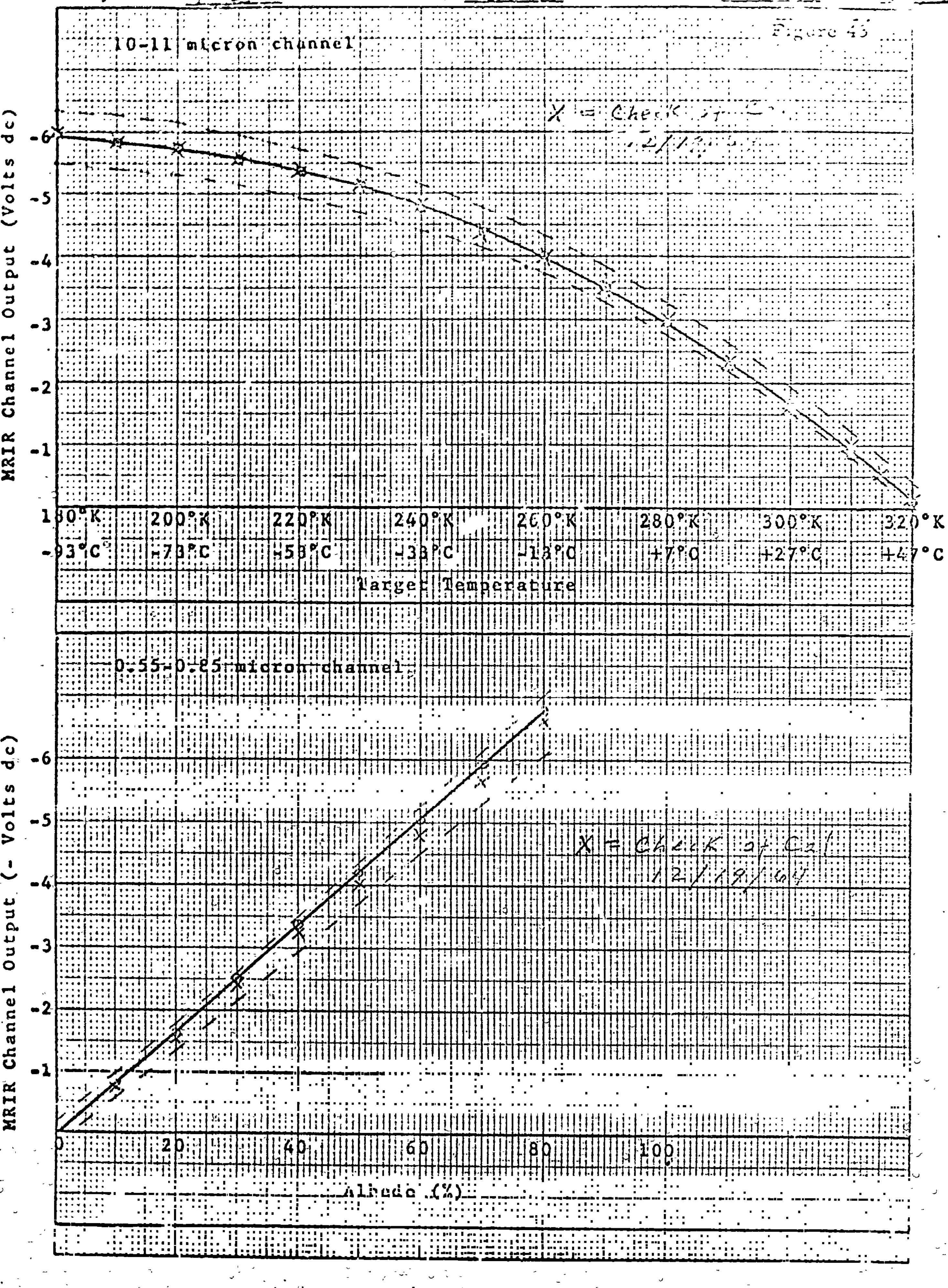
5-30 micron channel





MRIR Calibration Curves (D)

System # ____ Scanner Temp ____ Module Temp ____ Date ____



Section 4

ANALYSIS OF F-2 MRIR OFFSET CIRCUITRY BEHAVIOR DURING ORBITAL SIMULATION TESTING AT NASA

An analysis was performed on a limited portion of the test data obtained during the orbital simulation tests conducted by NASA on the F-2 MRIR. The purpose of this analysis was to determine whether the offset generating circuits of the three MRIR thermal channels functioned properly under an orbital simulation environment when the MRIR was protected by the NASA designed thermal radiation shield.

On the basis of the results of the analysis, it appears that the errors introduced into the radiometer by thermal gradients set up by the orbital simulation environment are less than or on the order of magnitude of the combined MRIR calibration errors and measurement errors associated with the tests. These errors are estimated to be approximately the equivalent of ±0.1 volt (radiometer output) or ±2°C (scene temperature) — the voltage error being applicable to the upper portion of the MRIR calibration curves (low scene temperature) and the temperature error being applicable to the lower portion of the calibration curves (high scene temperature).

However, it should be emphasized that because of the apparent interaction between the simulated space (cryo-walls) and the simulated earth — due to neither being a good blackbody — the analysis could only be performed on a limited portion of the test data and had to be, in part, based on correction factors obtained from the observed interaction of the simulated space and earth — from other portions of the data.

ANALYSIS AND RESULTS

The following describes the analysis that was carried out and the results that were obtained.

Basis

If the MRIR offset circuitry is functioning properly (and the radiometer gain has not changed) a one point check-of-calibration should result in a voltage that could be predicted from the calibration curves (which were obtained with the radiometer in a stabilized temperature environment). If the voltage is different from the predicted value, either an offset voltage error exists or a gain change has occurred and a second check-of-calibration point would be required.

Because a remote possibility exists that a correct one point check-of-calibration can occur when compensating gain and offset errors occur, a second check-of-calibration point is also desirable.

Gain Correction

The F-2 MRIR was calibrated under two sets of conditions: 1) the electronics module at 25°C and the scanner at different temperatures, and 2) the electronics module and the scanner at the same temperature. However, during the orbital simulation testing the electronics module was always warmer than the scanner. For the three spacecraft temperatures that were analyzed (1[illegible]C, 30°C, and 50°C) the average scanner temperature (in the chopper area) was approximately 4°C, 17.5°C, and 27.5°C, respectively, and the electronics module temperature was 12.5°C, 32°C, and 52°C, respectively.

The approach used to correct the calibration curves for the temperature conditions that existed was as follows:

1. The calibration curves (for the scanner and electronics module at the same temperature) were interpolated to obtain a curve which corresponded to the indicated scanner temperature. For example, for the 4°C scanner

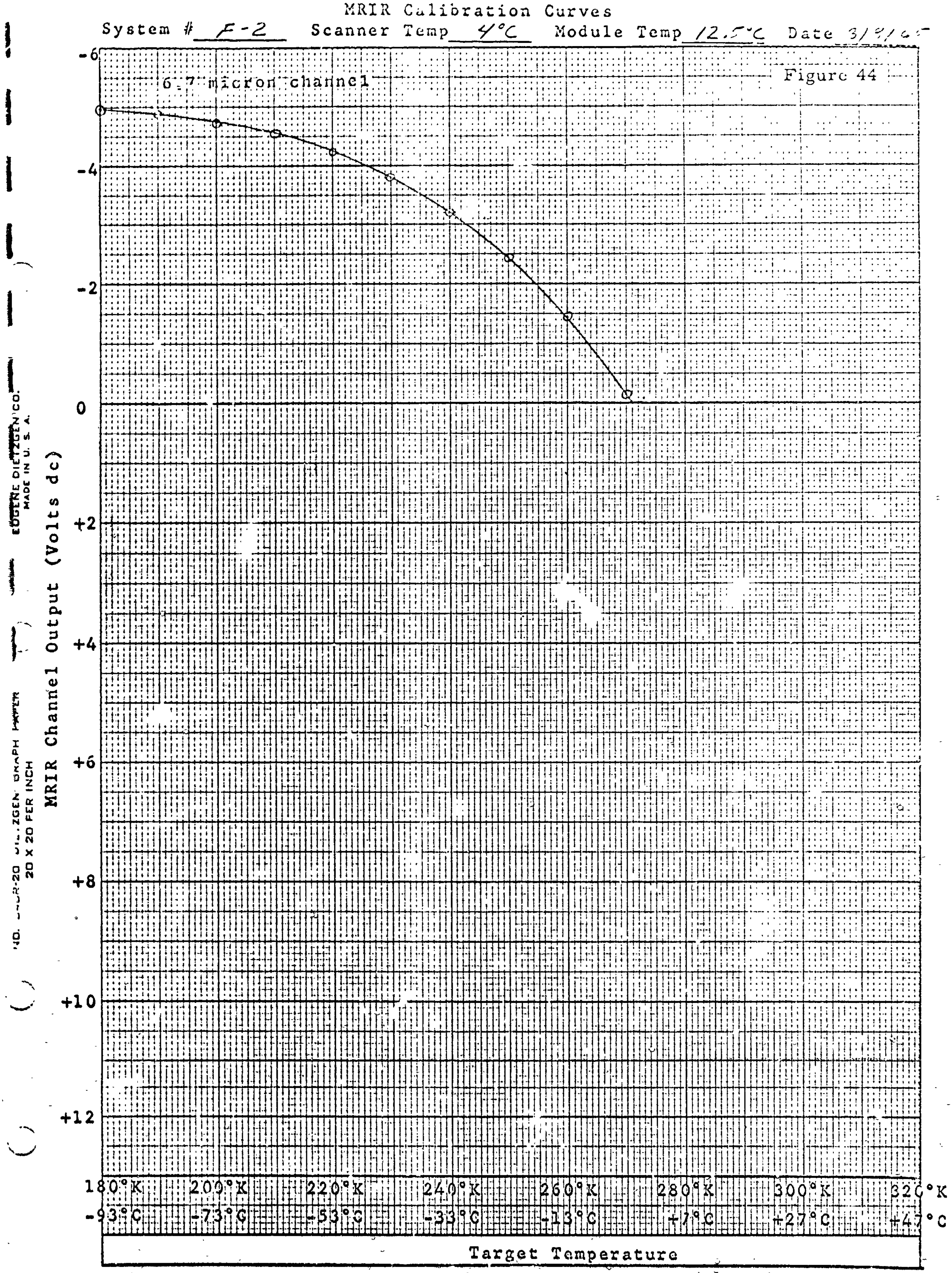
temperature, values falling 0.4 of the way between the 0°C calibration curve and the 10°C calibration curve were used to define a new curve.

2. The voltage values defining the new calibration curve generated in step (1) were multiplied by a correction factor to take into account the fact that the module is at a higher temperature. Information for this correction factor is located on pages 67 through 69 of Section 12 (Electronics Test Data) in the F-2 Data Book. Although these gain data only represent four points between 0°C and 50°C, a reasonable gain correction factor is obtained by plotting the gain values as a function of temperature (ambient temperature being approximately 25°C) and drawing a best-fit curve. The results obtained by doing this yielded the gain correction values presented in Table 1.

Table 1. Gain Correction Values for F-2 MRIR

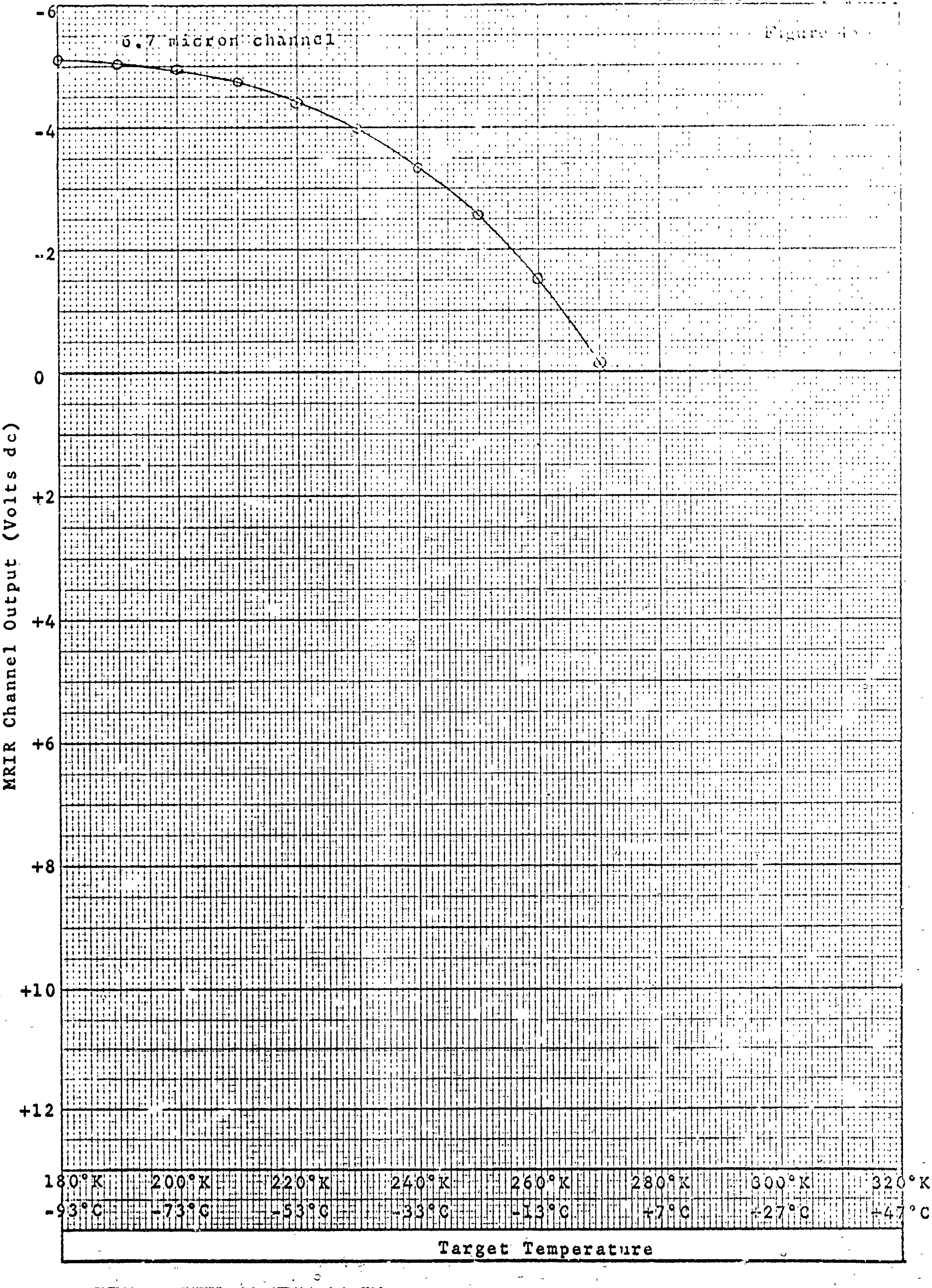
Temperature Change (°C)	Channel		
	6.7μ (%)	10-11μ (%)	5-30μ (%)
4 to 12.5	+1.5	+0.65	+1.25
17.5 to 32	+2.5	+1.5	+2.2
27.5 to 52	+3.5	+3.5	+3.0

The results of correcting the values obtained in step (1) by the values given in Table 1 are shown in Figures 44 through 52. The curves shown in these figures more closely represent the calibration curves that should be used for the 10°C, 30°C, and 50°C spacecraft runs. Although the resultant curve corrections are relatively small they must be taken into account since they are of the order of magnitude of the errors we are looking for.


MRIR Calibration Curves
System # F-2 Scanner Temp 4°C Module Temp 12.5°C Date 3/9/65
6.7 micron channel
MRIR Channel Output (Volts dc)
-6
-4
-2
0
+2
+4
+6
+8
+10
+12
180°K 200°K 220°K 240°K 260°K 280°K 300°K 320°K
-93°C -73°C -53°C -33°C -13°C +7°C +27°C +47°C
Target Temperature
EUGENE DIETZGEN CO. MADE IN U. S. A.
NO. 340R-20 DIETZGEN GRAPH PAPER 20 X 20 PER INCH
Figure 44

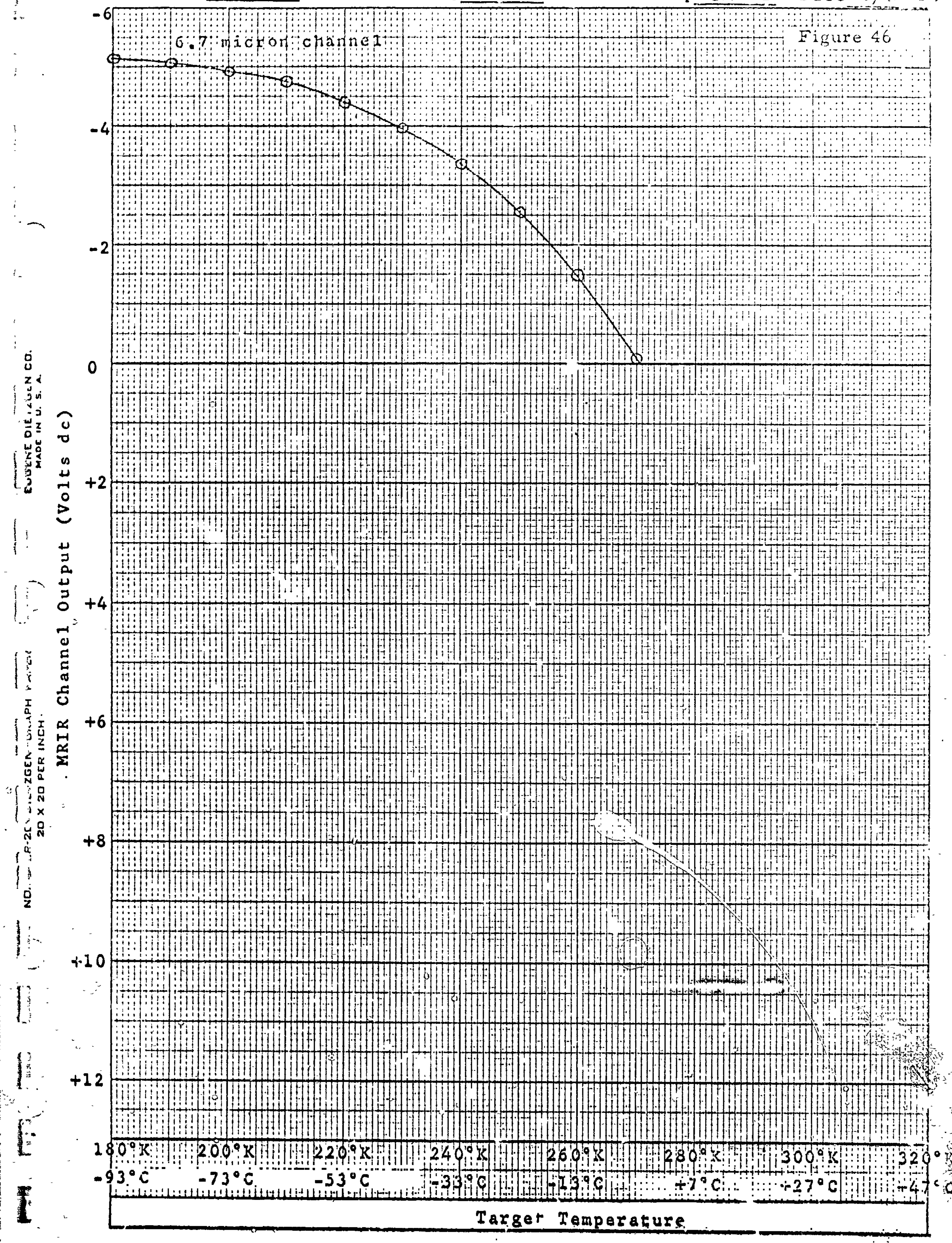
MRIR Calibration Curves

System # E-2 Scanner Temp 17.5°C Module Temp [illegible] Date [illegible]



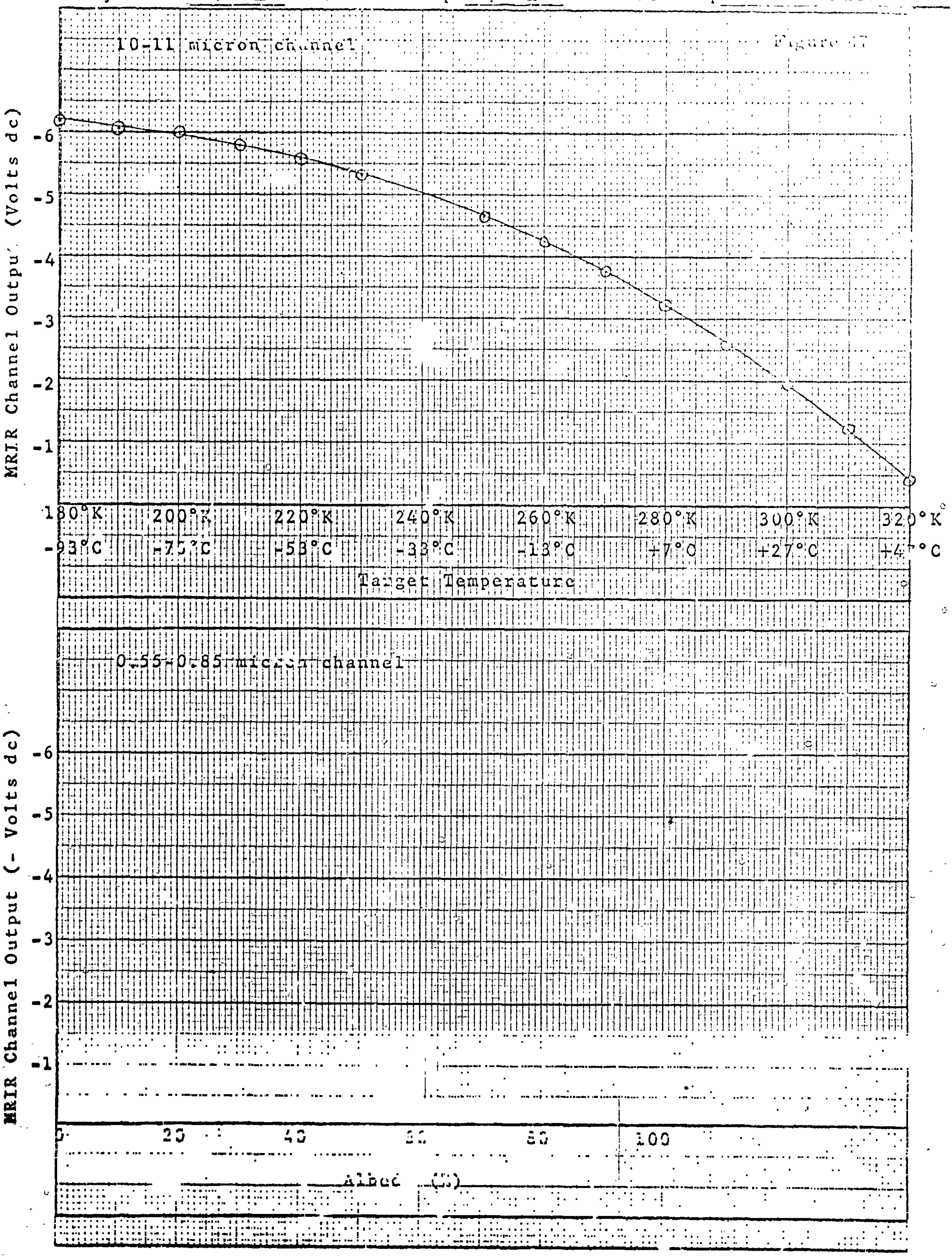
MRIR Calibration Curves

System # F-2 Scanner Temp 27.5°C Module Temp 52°C Date 3/[illegible]



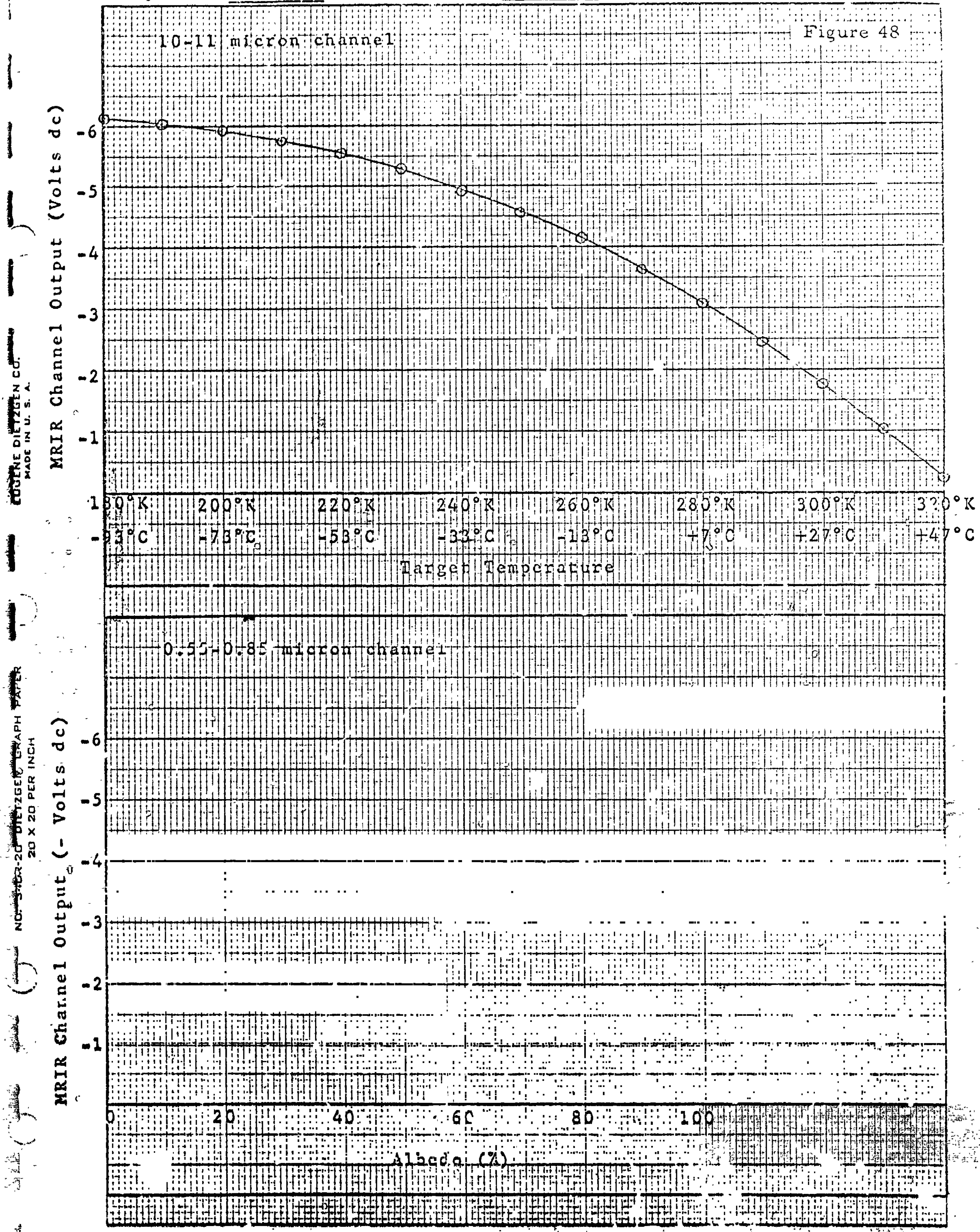
MRIR Calibration Curves

System # E-2 Scanner Temp 4°C Module Temp ____ Date ____



MRIR Calibration Curves

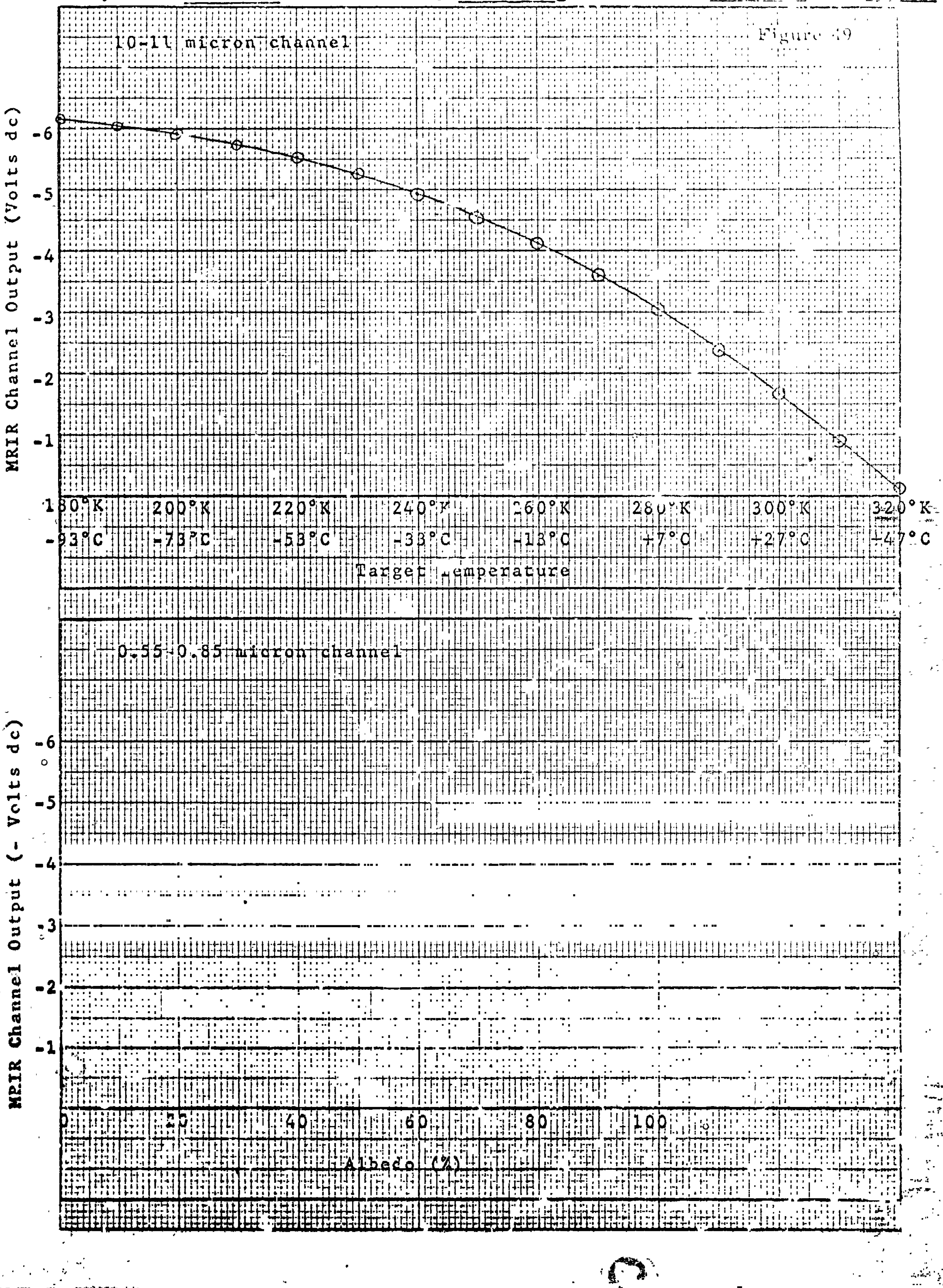
System # F-2 Scanner Temp 17.5 °C Module Temp 32 °C Date



MRIR Calibration Curves

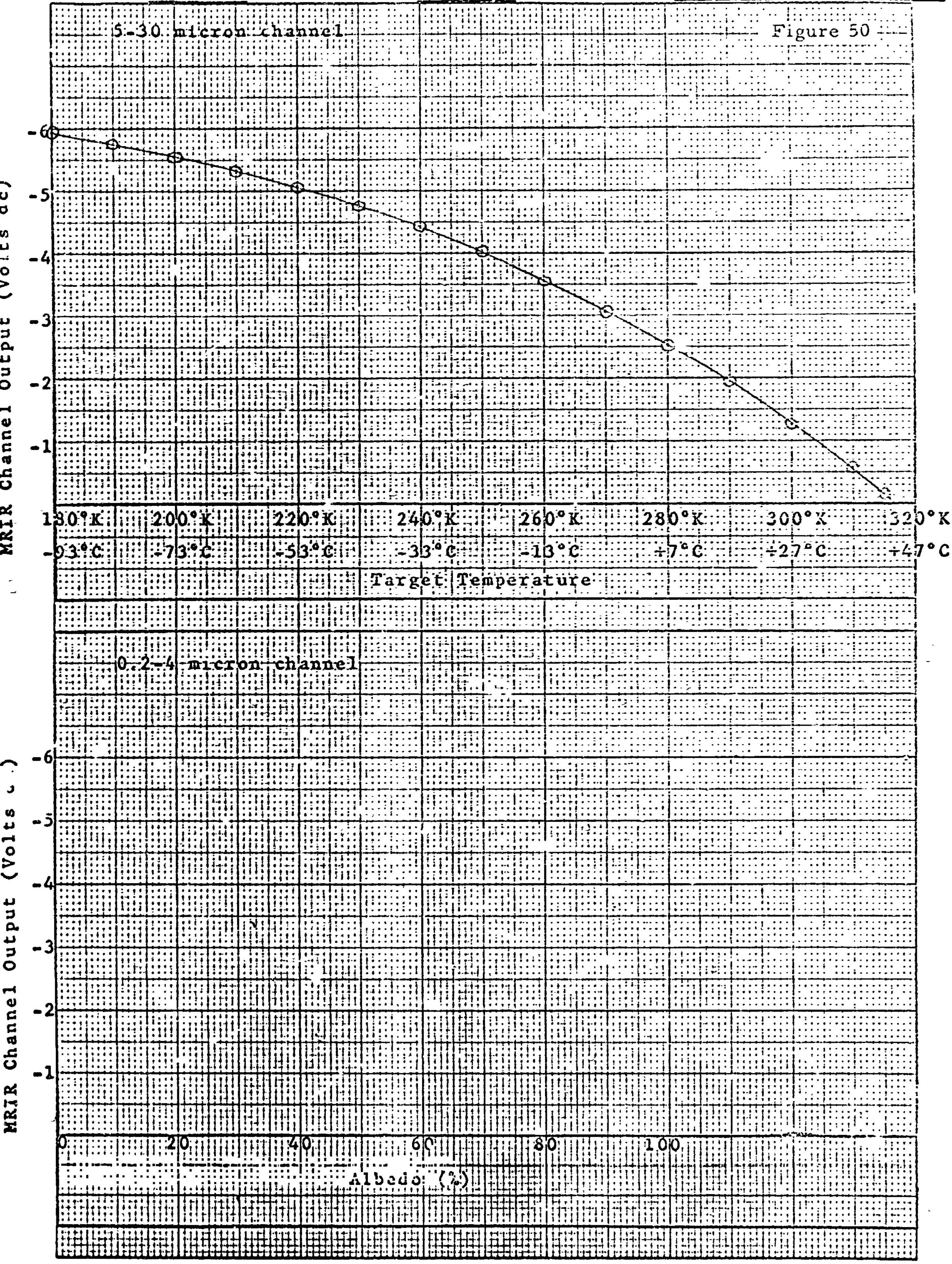
System # F-2 Scanner Temp 27.5°C Module Temp [illegible] Date [illegible]

Figure 49



MRIR Calibration Curves

System # F-2 Scanner Temp 4°C Module Temp 12.5°C Date [illegible]



MRIR Calibration Curves

System # F-2 Scanner Temp 17.5°C Module Temp 32°C Date

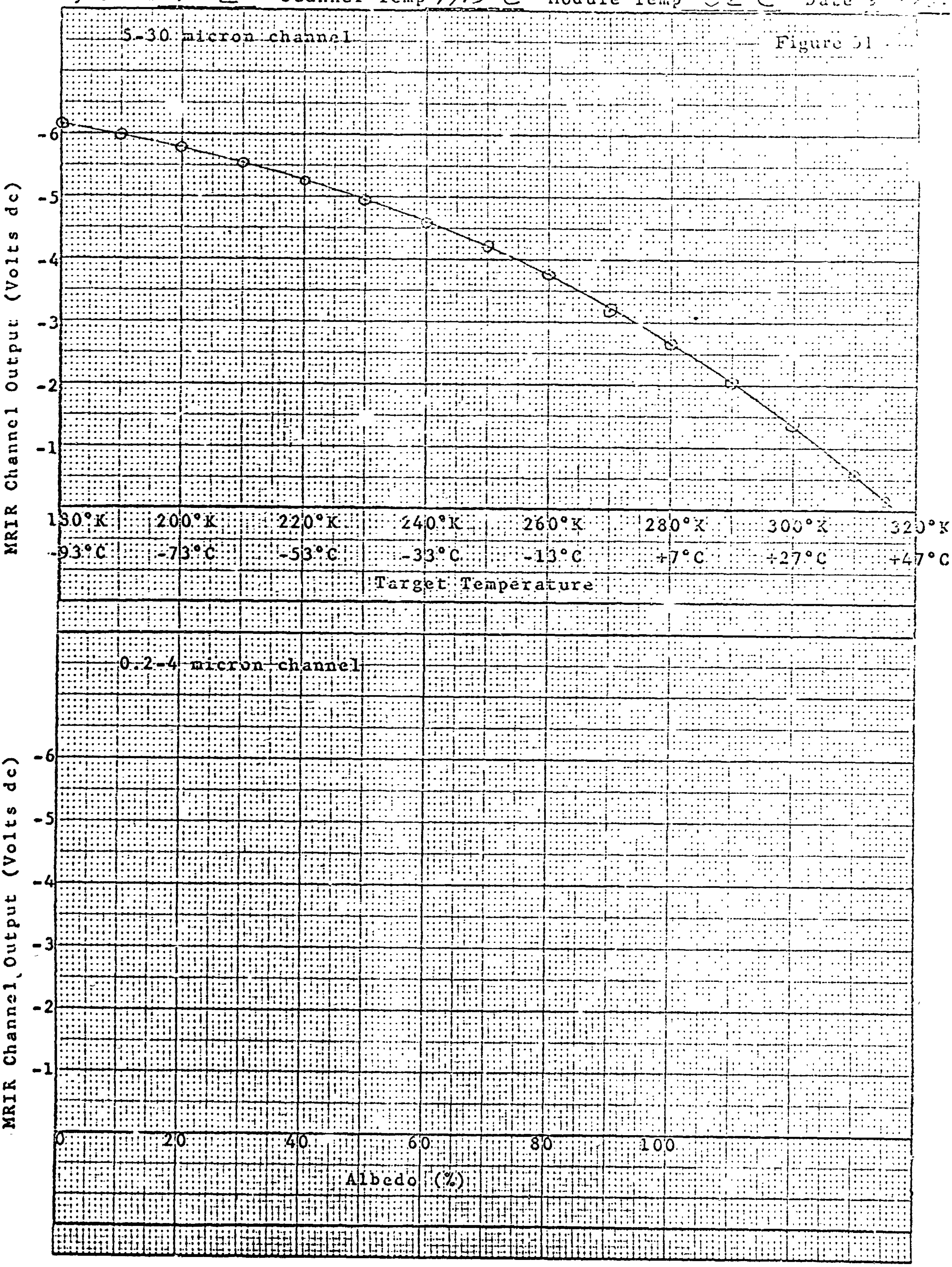
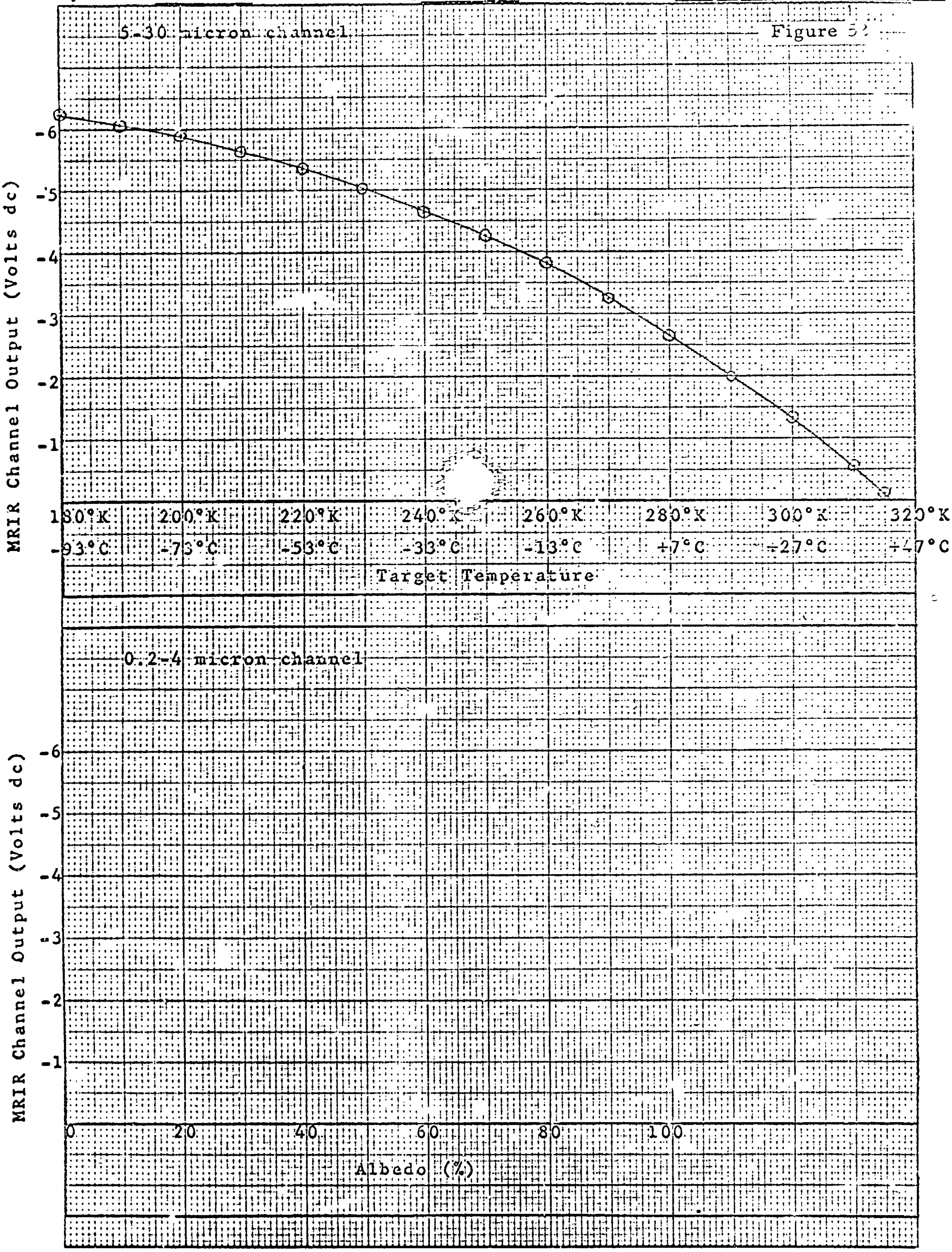


Figure 51

MRIR Calibration Curves

System # F-2 Scanner Temp 27.5°C Module Temp 52°C Date 3/?/?5



Target Emissivity and Radiation Correction

Normally the calibration curves that were obtained (Figures 44 through 52) would be sufficient to evaluate the orbital simulation test data directly to see if the MRIR were producing the correct output voltages when viewing the simulated space target (cryo-walls) and the simulated earth target. However, the space target and the earth target were not good blackbody targets. Therefore, a correction in radiation due to the emissivity being less than 1.0 should be made. This correction should take into account the change in target radiance due both to the decrease in emissivity and the effect of the remaining environment being partially reflected from the target. Unfortunately, this cannot be done directly and indirect correction can only be made for the space target.

This correction is accomplished as follows:

1. It was observed that when the earth temperature was changed from approximately 50°C (as indicated by the MRIR during stage 5 of orbit 8 for the 10°C, 30°C, and 50°C spacecraft runs) to approximately -13°C (stage 8), an apparent change in the cryo-wall (simulated space) radiance occurred.

Care must be taken in evaluating this change to note that the two cryo-walls, as viewed from the MRIR, have different radiance values and that the MRIR was rotated between stage 7 and stage 8. For the analysis performed, the cryo-wall consistently producing the smallest radiation — greatest negative voltage — was chosen. This is the cryo-wall seen by the MRIR after leaving the housing in stage 5 and is the cryo-wall seen just before entering the housing in stage 8.

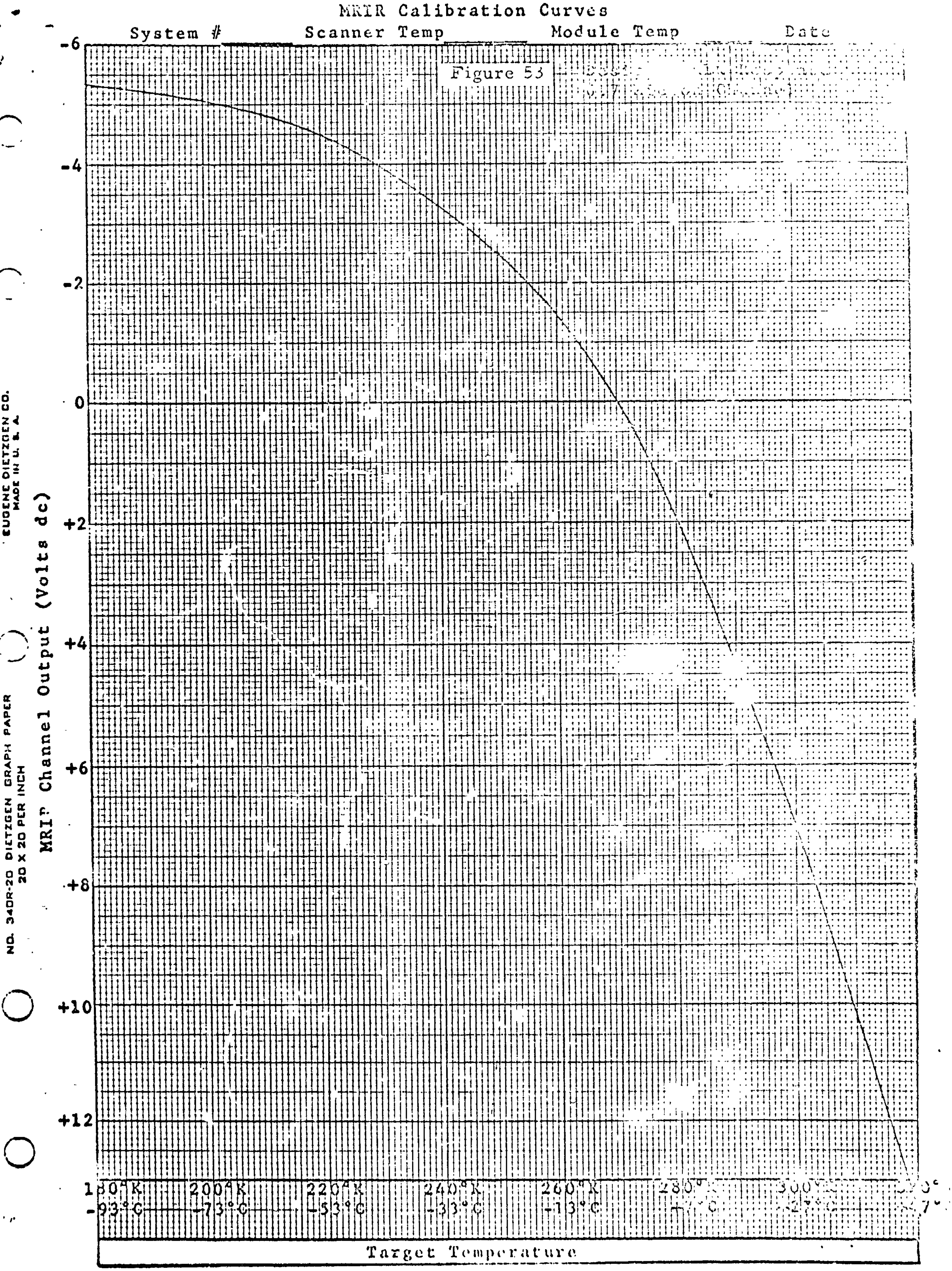
2. Since the offset voltage (bias off condition) does not show any appreciable change between these two stages, it was assumed that the apparent radiation change was due to the reflection of the earth's radiance from the cryo-walls.

B, noting the change in MRIR output voltage that occurred, when the cryo-wall was being viewed and the earth temperature was changed from 50°C to -13°C temperature, and by comparing this change with the change that would have occurred (in the MRIR voltage outputs for each channel) if the MRIR channels were viewing a blackbody target that was changed from 50°C to -13°C, the percentage of radiation from the earth target that is reflected from the cryo-walls can be determined. The percentage values that were obtained from this analysis are shown in Table 2. Nominal (desirable) MRIR calibration curves (Figures 53 through 55) were used in obtaining the expected voltage change for the three MRIR thermal channels for a 50°C to -13°C blackbody target change.

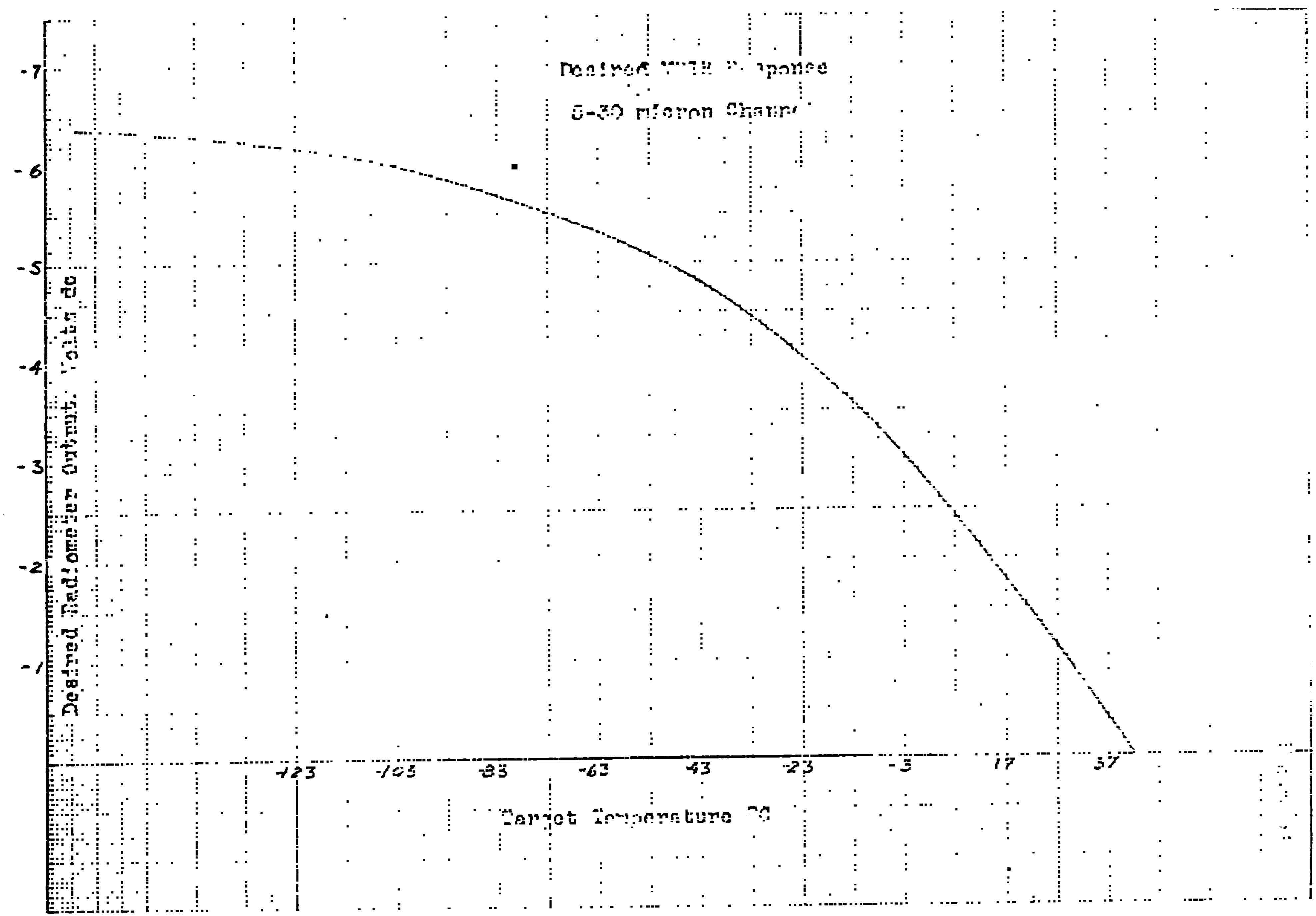
Table 2. Emissivity Correction Factors

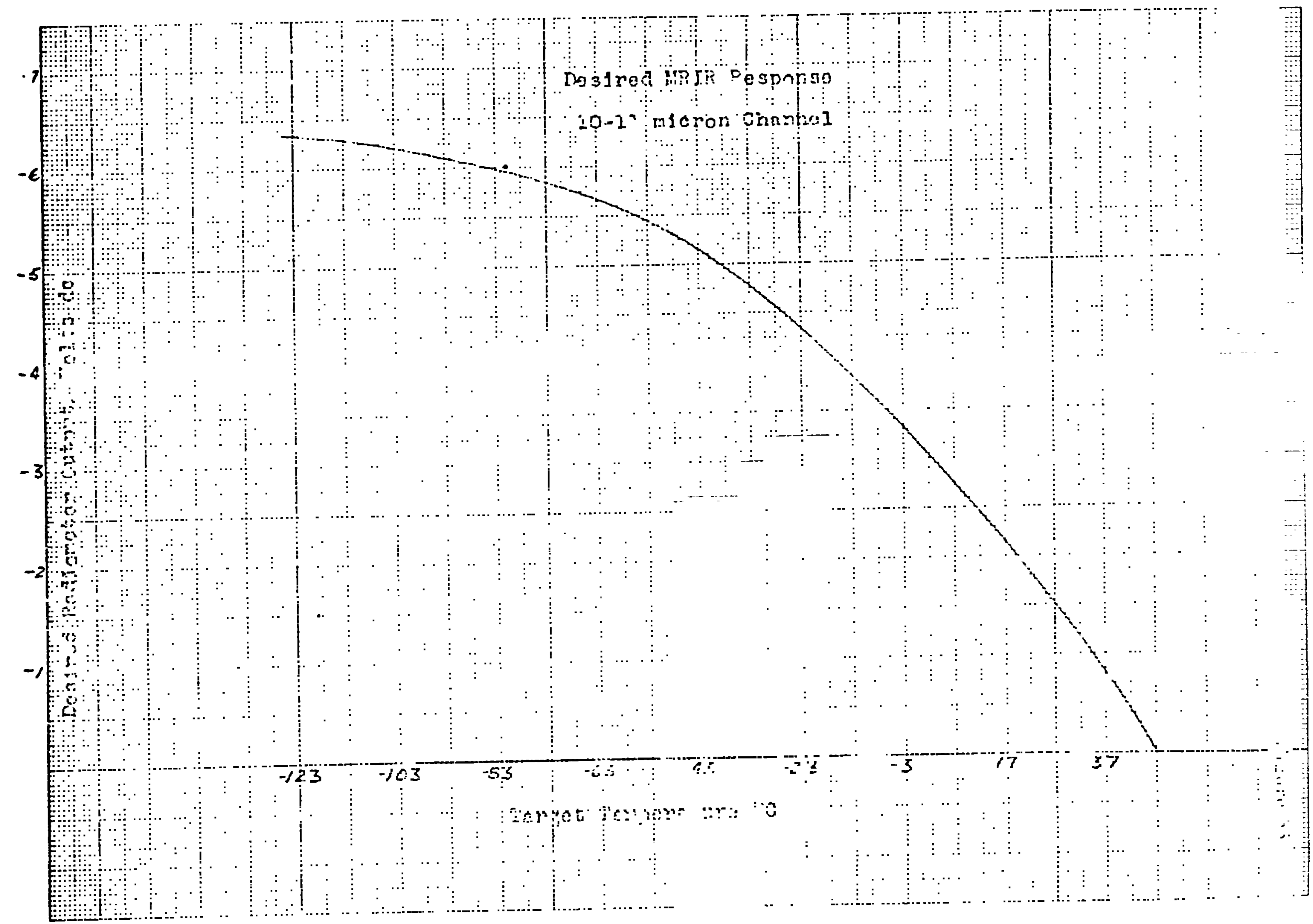
Channel/ Temperature Range (°C)	Spacecraft Temperature					
	10°C		30°C		50°C	
	(%)	(volts)	(%)	(volts)	(%)	(volts)
6.7μ						
50 to -13	3.5		4.0		5.5	
-13 to -196		0.14		0.16		0.22
10-11μ						
50 to -13	8.5		8.5		10.0	
-13 to -196		0.22		0.22		0.26
5-30μ						
50 to -13	7.7		6.4		7.7	
-13 to -196		0.22		0.18		0.22

3. Using the percentage values obtained, one can now calculate the change in voltages that would be expected to occur (due to the earth's radiance reflecting off the cryo-walls) if the earth temperature was reduced



MRIR Calibration Curves
System #
Scanner Temp
Module Temp
Date
Figure 53
-6
-4
-2
0
+2
+4
+6
+8
+10
+12
MRIR Channel Output (Volts dc)
180°K
-93°C
200°K
-73°C
220°K
-53°C
240°K
-33°C
260°K
-13°C
280°
300°
Target Temperature
NO. 340R-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.


Desired Radiometer Output, Volts dc
Target Temperature °C
-123
-103
-83
-63
-43
-23
-3
17
37
-7
-6
-5
-4
-3
-2
-1
MILLIMETER
MADE IN U. S. A


Desired MRIR Response
micron Channel
Target Temperature °C
-7
-6
-5
-4
-3
-2
-1
-123
-103
-53
-3
17
37

from -13°C to -196°C. These values were calculated and are also shown in Table 2.

These voltage changes calculated represent the error that can be expected to exist in determining the cryo-wall radiance (originally thought to be small enough at liquid nitrogen temperatures so as to be negligible) by the MRIR.

Space Temperature Calibration Point

Although the MRIR thermal channels are only calibrated to -93°C target temperature, the MRIR output voltages expected when viewing space can be obtained by adding the Δ voltage that exists between the voltage representing the -93°C target temperature (for the nominal calibration curves) and -6.4 volts (-5.4 volts for the 6.7-micron channel) to the actual calibrated voltage obtained at -93°C target temperature.*

These Δ voltage values are 0.07, 0.3, and 0.45 volts, respectively, for the 6.7-micron channel, 10- to 11-micron channel, and 5- to 30-micron channel.

When these Δ voltage values are added to the corresponding voltage values for -93°C target temperature shown in Figures 44 through 52, the expected space target values for the 10°C, 30°C, and 50°C spacecraft temperature runs are obtained. These values are shown in Table 3.

The values shown in Table 3 were compared with the actual values recorded (after the emissivity factor, Table 2, had been taken into account) for the 10°C, 30°C, and 50°C spacecraft temperature runs. The results of this comparison are summarized in Table 4.

---

*The maximum errors that are introduced in determining the MRIR output voltage when viewing space by this method is less than 0.5 percent.

Table 3. Expected MRIR Output Voltages When Viewing Space

Spacecraft Temperature (°C)	Channel		
	6.7μ (volts)	10-11μ (volts)	5-30μ (volts)
10	5.05	6.5	6.4
30	5.17	6.45	6.6
50	5.20	6.45	6.7

It can be seen from Table 4 that relatively good agreement exists between the expected MRIR output voltages and the actual (+ emissivity correction) voltages measured. The average difference is on the order of the test errors that might be expected.

Although no emissivity correction value could be assigned to the simulated earth, it was of interest to compare the temperature values measured by the MRIR (using Figures 44 through 52) to those measured by thermocouples. This was done for stage 8 of orbit 8 for the 10°C, 30°C, and 50°C spacecraft temperature runs. The results are summarized in Table 5. Again, relatively good agreement appears to exist.

Table 4. Comparison of Expected Output Voltage Values to Actual Output Voltage Values for a Space Target; for Orbit 8, Stage 8 of Orbital Simulation Tests of F-2

Channel	Spacecraft Temperature		
	10°C (volts)	30°C (volts)	50°C (volts)
<u>6.7μ</u>			
Expected Value (Table 3)	= 5.05	= 5.17	= 5.2
Measured Value (+ Emissivity Correction)	4.8 + 0.14 = 4.94	4.95 + 0.16 = 5.11	5.1 + 0.22 = 5.32
<u>10-11μ</u>			
Expected Value (Table 3)	= 6.5	= 6.45	= 6.45
Measured Value (+ Emissivity Correction)	6.35 + 0.22 = 6.57	6.2 + 0.22 = 6.44	6.35 + 0.26 = 6.61
<u>5-30μ</u>			
Expected Value (Table 3)	= 6.4	= 6.6	= 6.7
Measured Value (+ Emissivity Correction)	6.15 + 0.22 = 6.37	6.5 + 0.18 = 6.68	6.75 + 0.22 = 6.97

Table 5. Comparison of Earth Temperature Measured by F-2 MRIR and by Thermocouples; for Orbit 8, Stage 8 of Orbital Simulation Tests

Channel	Spacecraft Temperature								
	10°C			30°C			50°C		
	MRIR		TC	MRIR		TC	MRIR		TC
	Volts	Temp (°C)	Temp (°C)	Volts	Temp (°C)	Temp (°C)	Volts	Temp (°C)	Temp (°C)
6.7μ	1.4	-13	-14	1.2	-10.5	-13	1.05	-10	-12
10-11μ	4.4	-16	-14	4.1	-12	-13	4.15	-13	-12
5-30μ	3.6	-14	-14	3.75	-13	-13	3.85	-14	-12

Section 5

HIGH-VACUUM, HIGH-TEMPERATURE, UV RADIATION TESTING OF THE 14- TO 16-MICRON FILTER

A test sample of the 14- to 16-micron filters to be used in the F-4, F-5, and F-6 MRIR's was subjected to a high-vacuum, high-temperature, UV radiation environment for 50 hours. The filters were obtained from OCLI and the tests were conducted at Hughes Aircraft Company.

The 14- to 16-micron filter is composed of three elements: a short wavelength attenuator element on a germanium substrate and a long wavelength blocking element, Irtran 4, with an antireflection coating.

Table 6 summarizes the exposure test environment to which the filter elements were subjected. The UV radiation source was a General Electric BH-6 lamp. It was placed at a distance of 16 inches from the sample to produce a (space) solar radiation magnitude of unity in the 2000Å to 4000Å band.

At the completion of the tests, the samples were visually examined and found to be unchanged in appearance. In addition, no signs of material deposits on the chamber windows were observed.

The before and after transmission measurements of the filter elements are shown in Figures 56 through 58. The small differences observed are within the transmission measurement errors in this wavelength band.

Table 6. Experimental Data on Infrared Filter UV Exposure

Date	Time	Sample Temperature (°C)	Pressure (torr)	Comments
Oct 26	2:00 PM	20	5×10^{-9}	LN_2 started
	3:00	10	2×10^{-9}	Heater started
	3:05	40	2×10^{-7}	Heater outgassing
	3:15	65	1×10^{-8}	
	3:40	60	3×10^{-9}	
	3:45	60	10^{-6}	UV started
	3:50	61	5×10^{-8}	
	4:10	69	2.5×10^{-8}	Heater reduced
	4:20	64	1.8×10^{-8}	
	5:38	62	---	UV lamp burned out
Oct 27	8:40 AM	60	4×10^{-9}	Start LN_2 + UV
	9:00	60	2×10^{-8}	
	10:45	63	2×10^{-8}	
	11:05	67	2×10^{-8}	
	12:00	65	1.8×10^{-8}	
	3:00 PM	65	1×10^{-8}	
	11:45	65	1×10^{-8}	UV lamp burned out
Oct 28	8:45 AM	65	1.5×10^{-8}	Start LN_2 + UV
	10:35	64	1×10^{-8}	
	11:30	64	8×10^{-9}	
	12:30	64	8×10^{-9}	
	1:15 PM	64	8×10^{-9}	
	4:05	65	8×10^{-9}	
	11:45	68	8×10^{-9}	
	12:00	67	8×10^{-9}	
Oct 29	7:00 AM	65	5×10^{-9}	
	10:00	65	4×10^{-9}	
	11:45	65	4×10^{-9}	Test ended

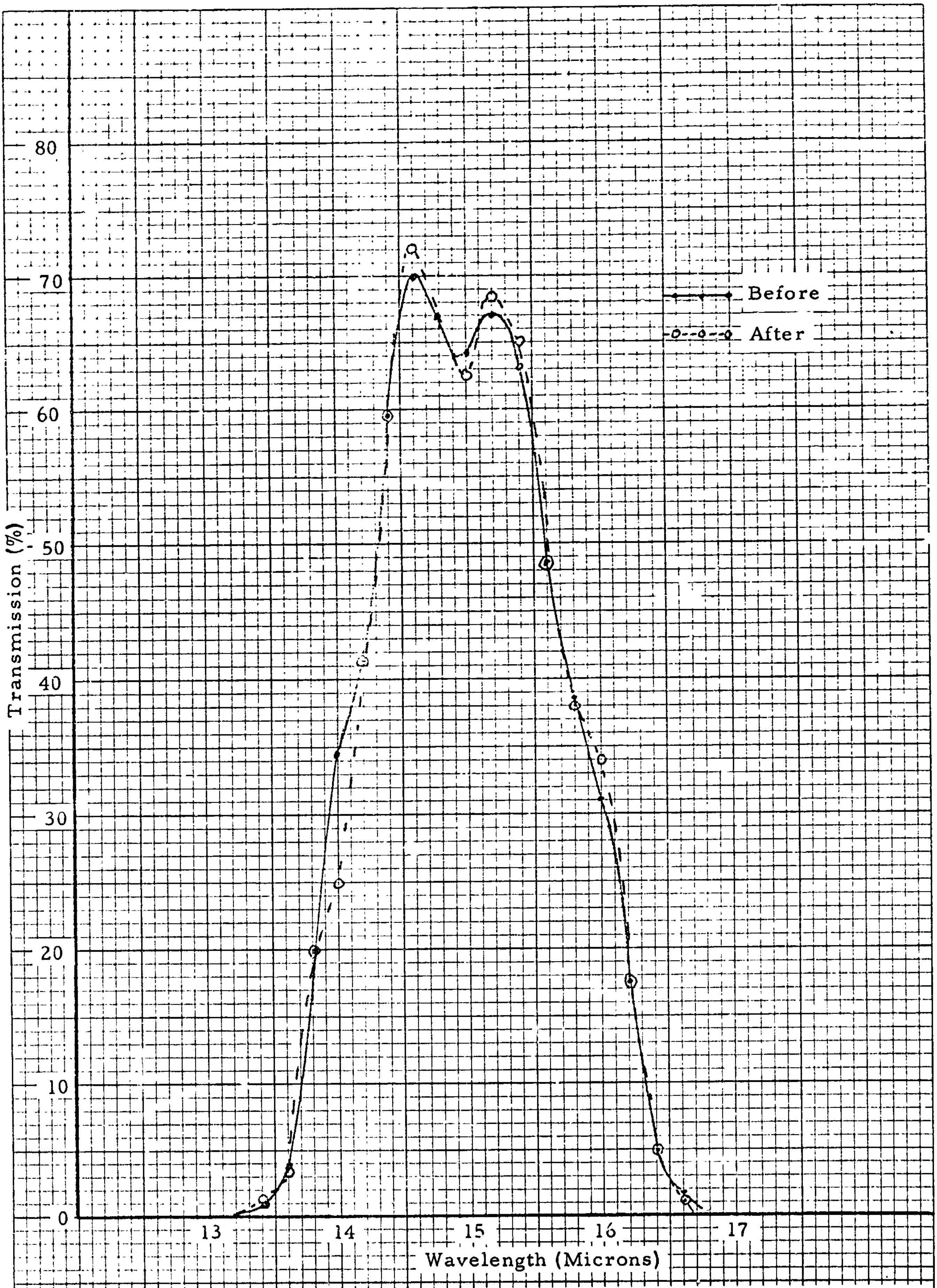


Figure 56. Transmission of Bandpass Element (14-16μ Filter) Before and After UV Radiation Tests

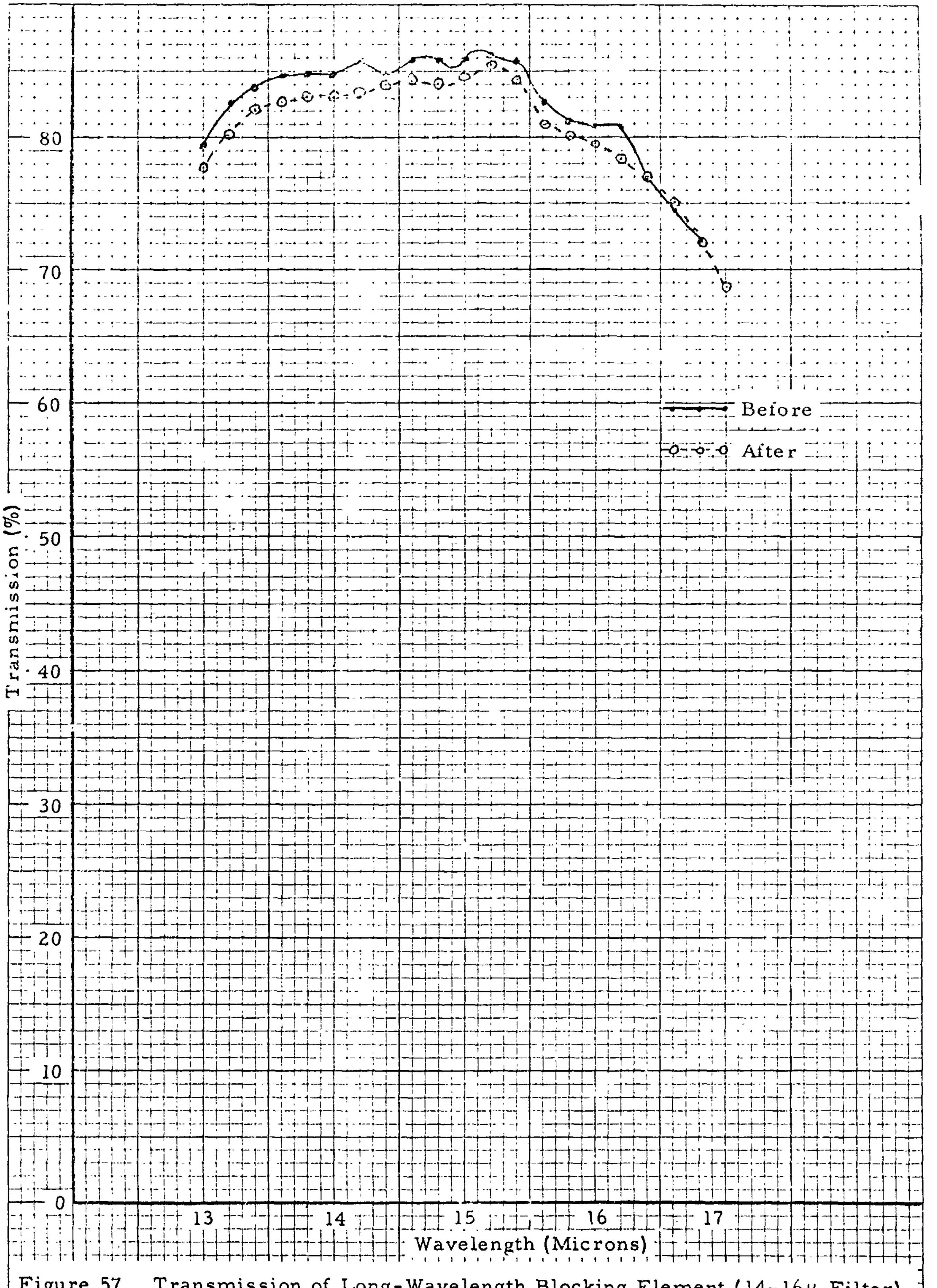


Figure 57. Transmission of Long-Wavelength Blocking Element (14-16μ Filter) Before and After UV Radiation Tests

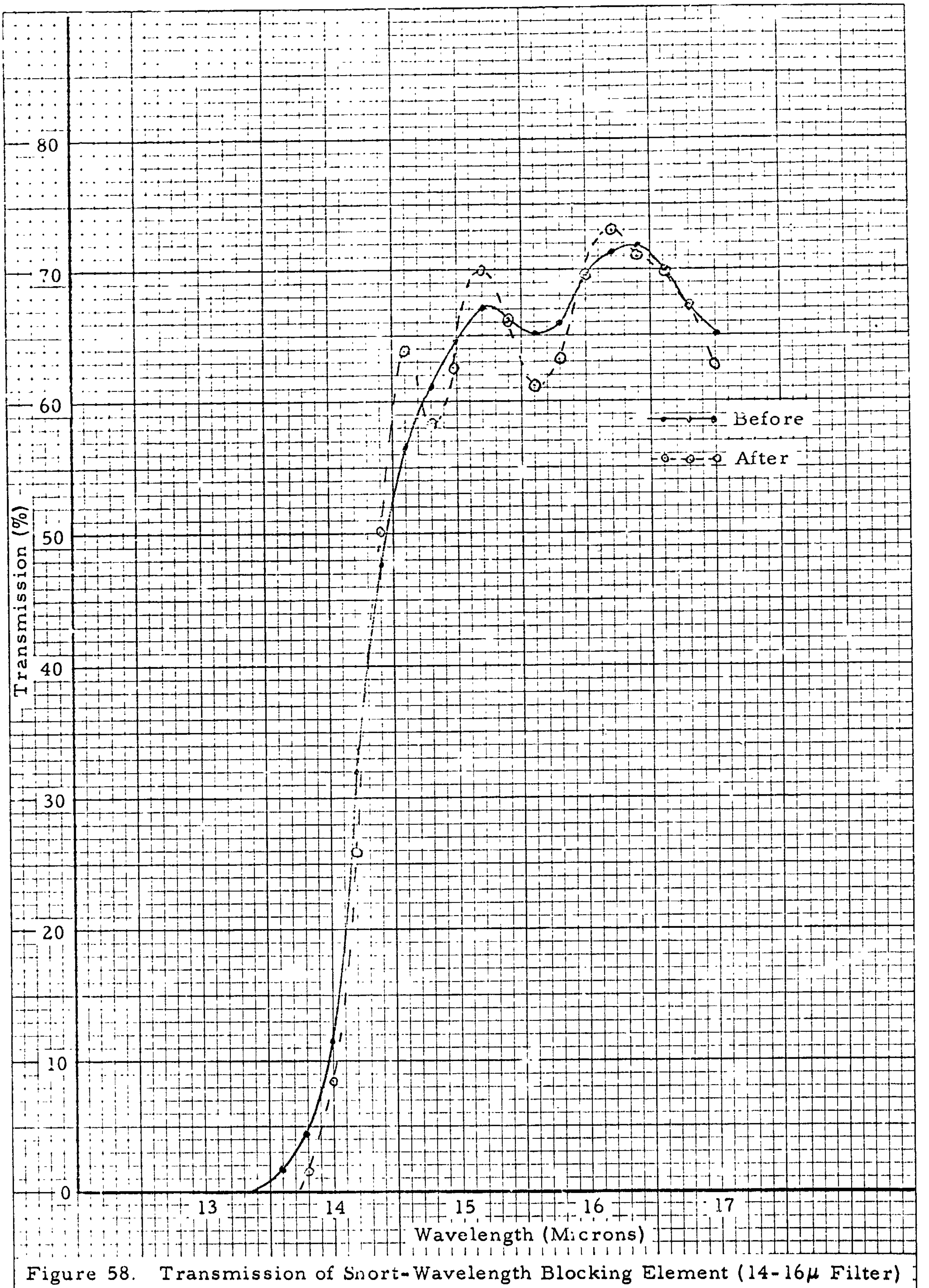


Figure 58. Transmission of Short-Wavelength Blocking Element (14-16μ Filter) Before and After UV Radiation Tests

Section 6

F-5 MRIR CHECK-OF-CALIBRATION MEASUREMENTS (BEFORE AND AFTER SCAN MIRROR CLEANING)

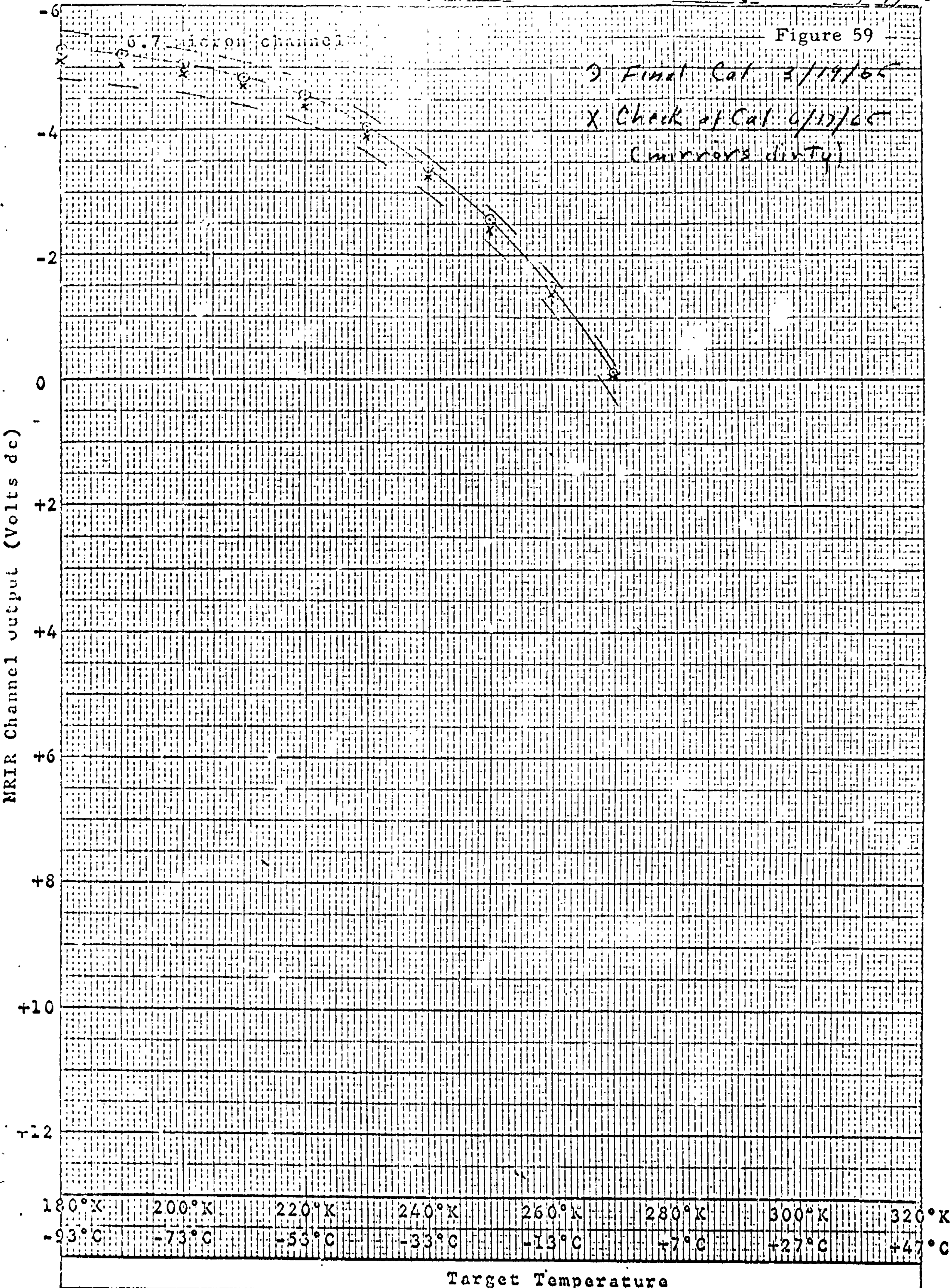
Check-of-calibration measurements were performed on the F-5 MRIR when the radiometer was returned to SBRC for scan mirror cleaning.

The MRIR scan mirror was found to be covered with what appeared to be a heavy coating of grease after it had been removed from the orbital simulation chamber at NASA. The coating was believed to have been caused by contaminants outgassing from the orbital simulation chamber walls and targets and redepositing on the scan mirror.

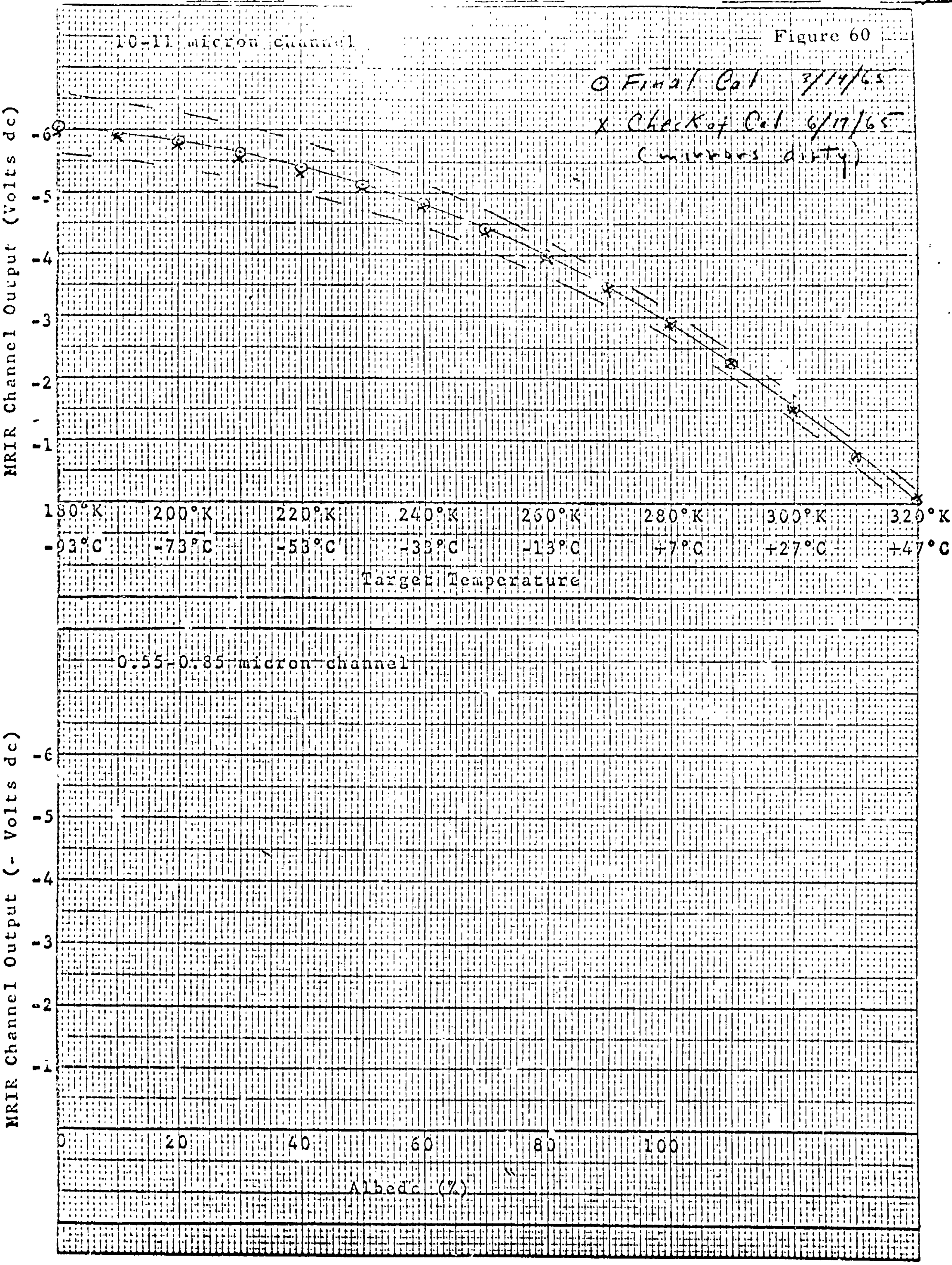
Check-of-calibration measurements were made both before and after the scan mirror was cleaned to determine the magnitude of error that was introduced into the MRIR calibration curves due to the mirror contamination.

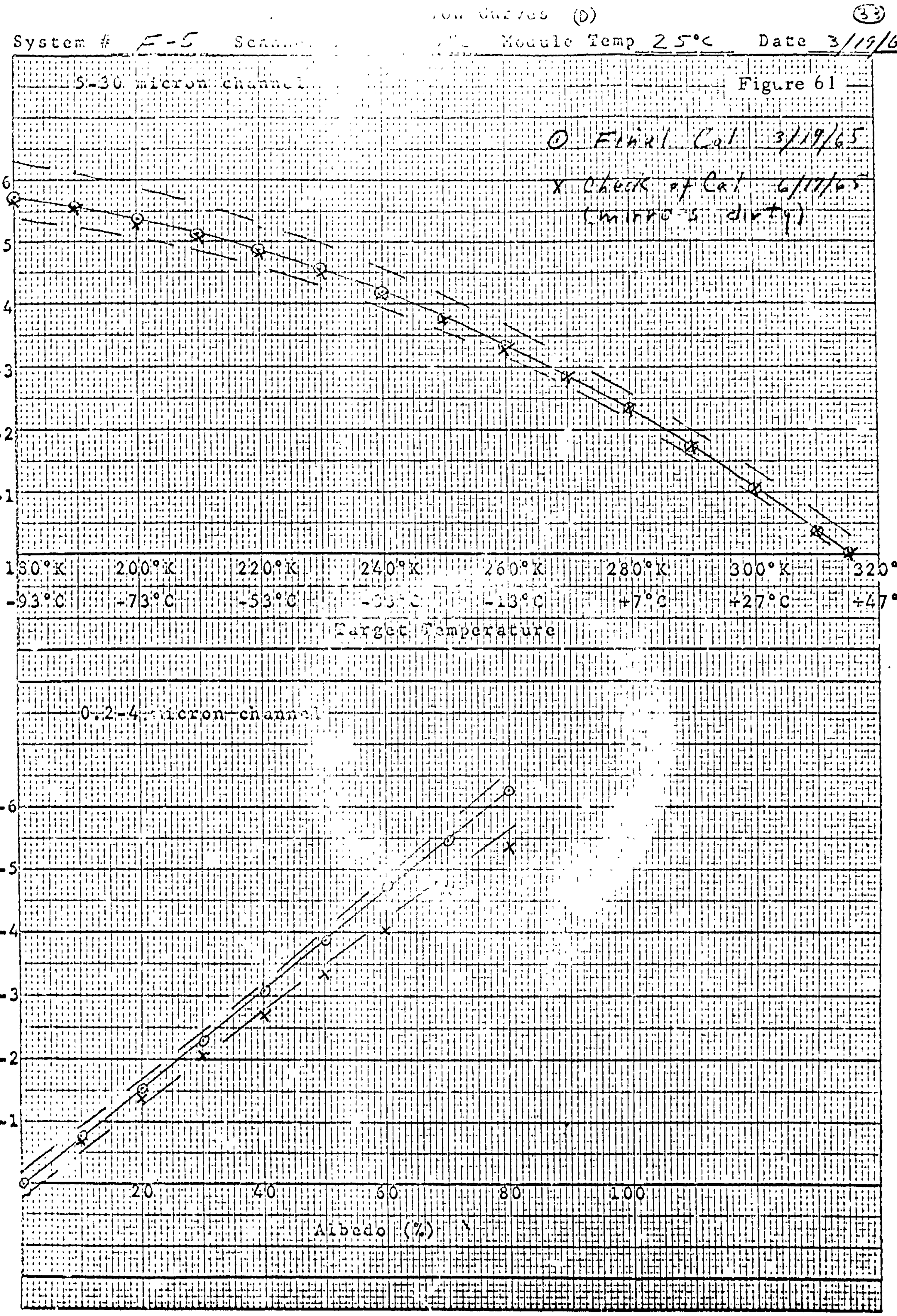
The data obtained from these measurements are plotted in Figures 59 through 65. It can be seen from these figures that the contaminated mirror had very little effect on the calibration of the MRIR thermal channels while calibration of the 0.2- to 4.0-micron channel changed approximately 17 percent.

System # F-5 Scanner Temp 25°C Module Temp 25°C Date 3/19/65



System # E-5 Module Temp 25°C Date 3/19/65





(D)
33
System # E-5
Module Temp 25°C
Date 3/19/6
5-30 micron channel
Figure 61
O Final Cal 3/19/65
X Check of Cal 6/17/65
(mirrors dirty)
MRIR Channel Output (Volts dc)
-6
-5
-4
-3
-2
-1
180°K
200°K
220°K
240°K
260°K
280°K
300°K
320°
-93°C
-73°C
-53°C
-13°C
+7°C
+27°C
+47°
Target Temperature
0.2-4 micron channel
MRIR Channel Output (Volts dc)
-6
-5
-4
-3
-2
-1
20
40
60
80
100
Albedo (%)

MRIR Calibration Curves (D)

System # F-5 Scanner Temp 25°C Module Temp 25°C Date 3/19/65

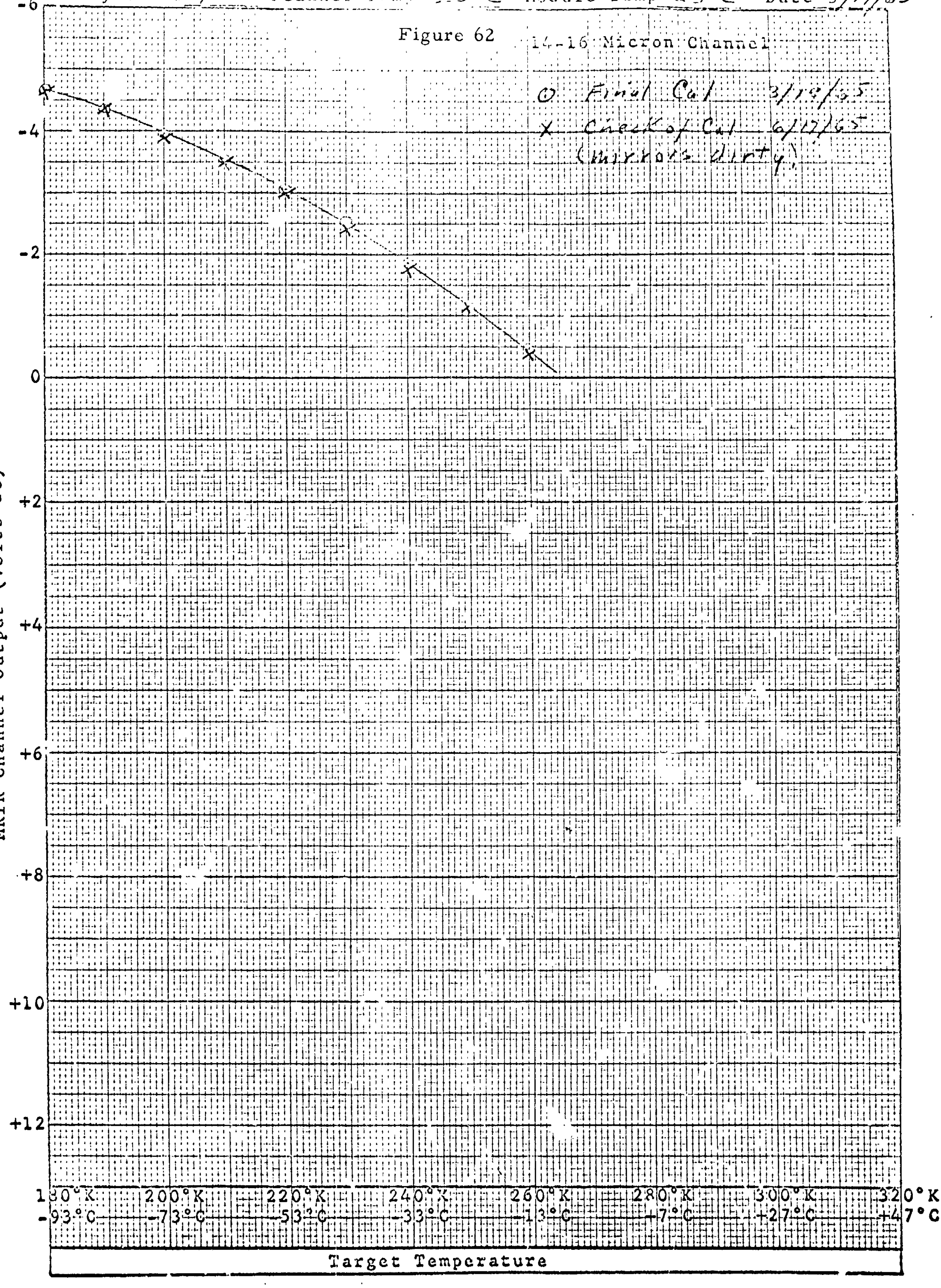


Figure 62

MRIR Calibration Curves (U)

System # F-5 Scanner Temp 25°C Module Temp 25°C Date 3/19/6

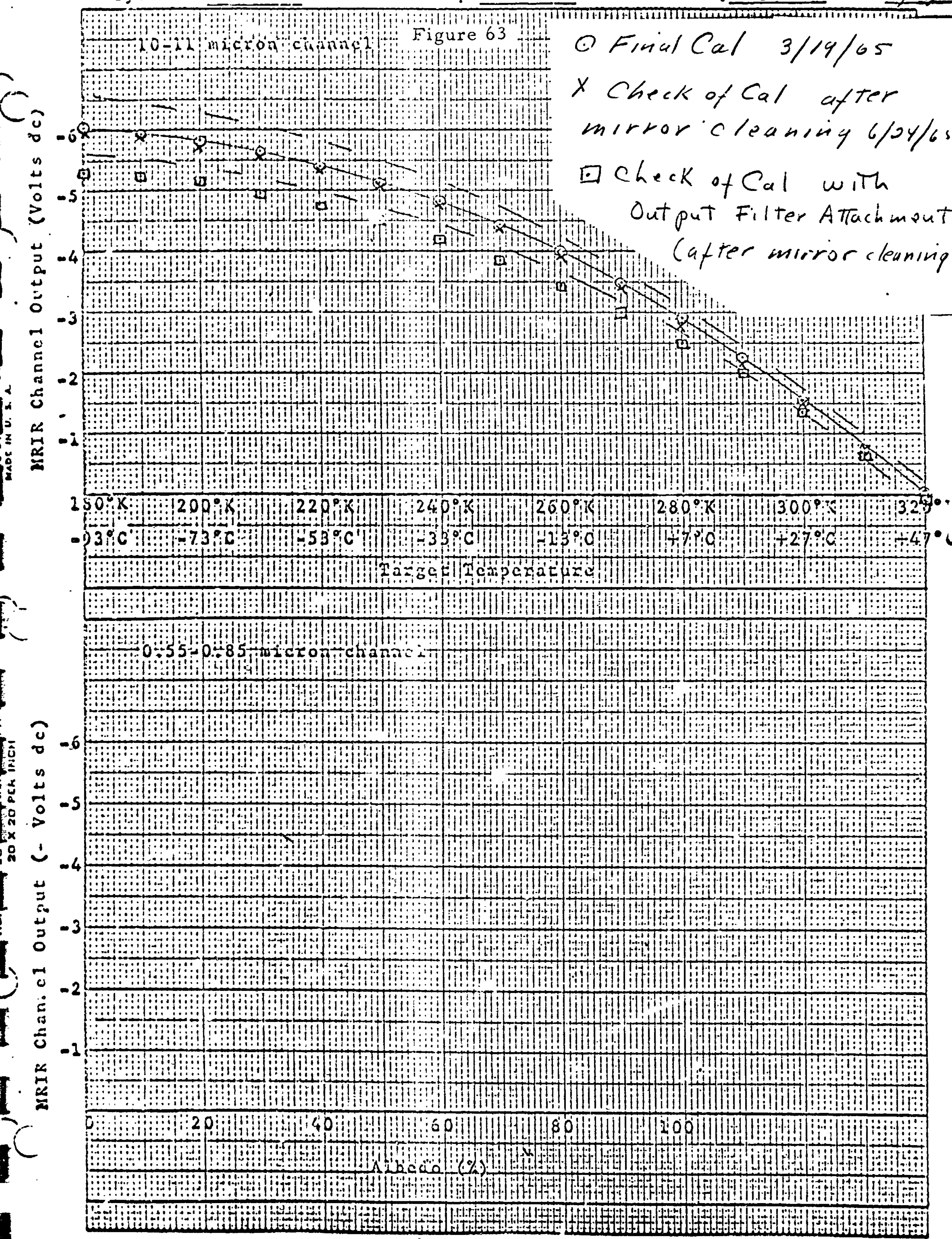
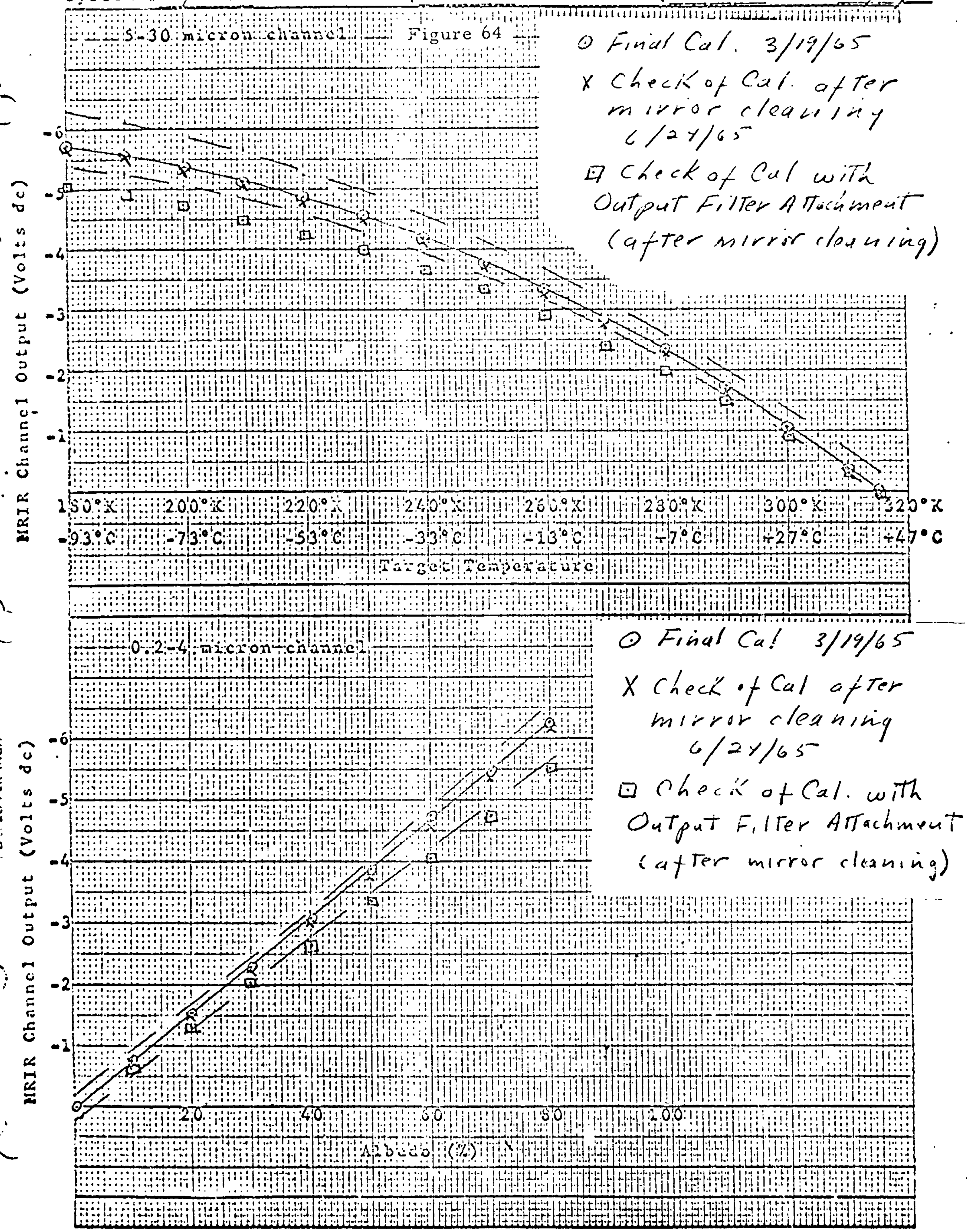


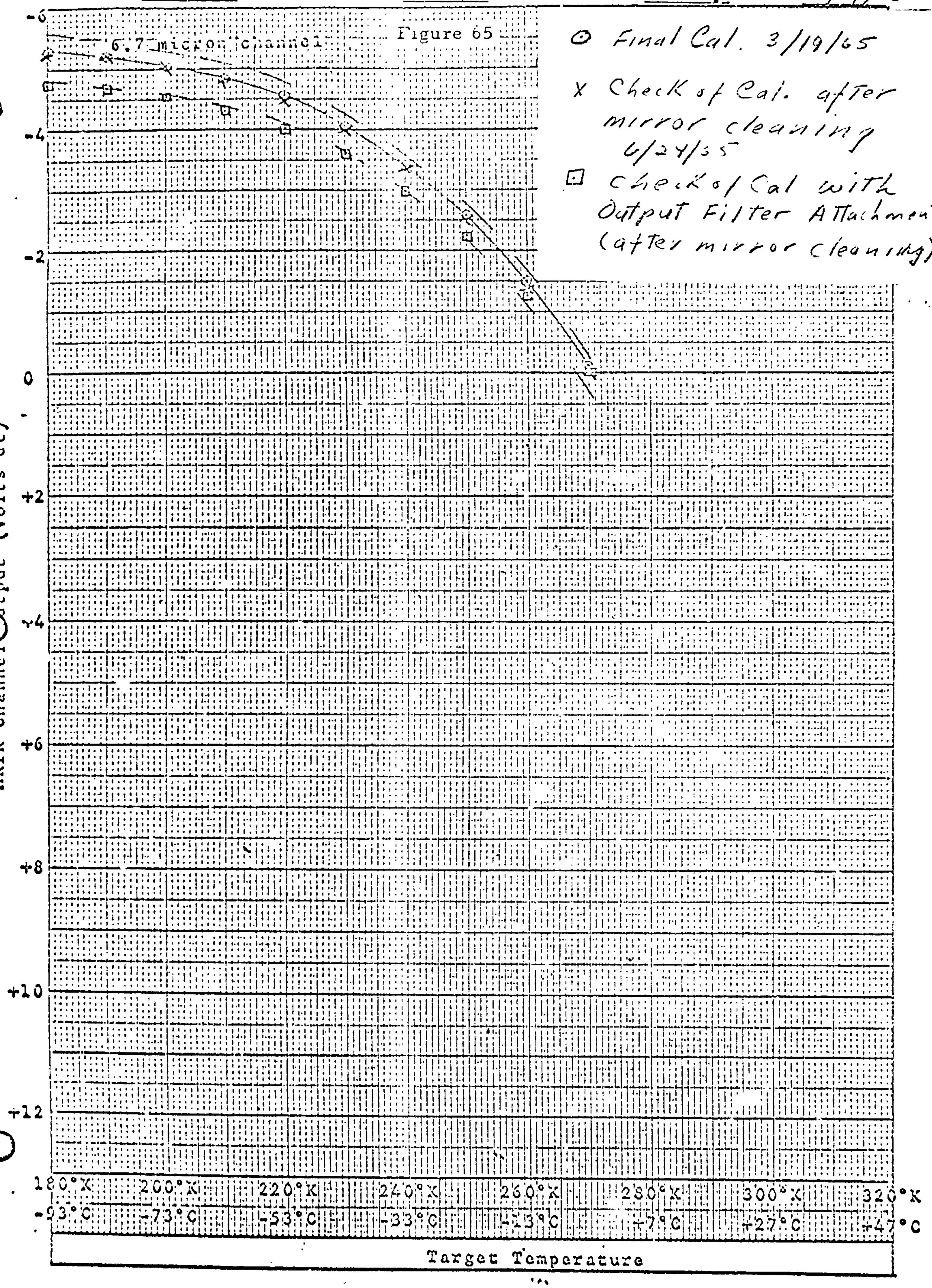
Figure 63

System # E-5 Scanner Temp 25°C Module Temp 25°C Date 3/19/65



MRIR Calibration Curves (D)

System # F-5 Scanner Temp 25°C Module Temp 25°C Date 3/19/65



SBRC

Section 7

FAILURE REPORTING

During this reporting period four system failures were reported. A summary of these failures is presented in Table 7.

Table 7. Failure Report Summary

Date	Failure Report Number	System	Failure	Fix	Action
12/11/64	50336	F-5	1. Audible noise in chopper shaft bearings increased after vibration.	1. Replace bearings.	1. None.
			2. Short in 14- to 16-micron channel offset shift generator developed after vibration. This was traced to marginal clearance associated with additional 14- to 16-micron circuitry incorporated in electronics module.	2. Provide additional clearance for 14- to 16-micron channel circuitry and revibrate radiometer.	2. Rework all electronics modules having 14- to 16-micron channel to provide necessary additional clearance.
2/4/65	50140	F-5	10- to 11-micron channel bolometer became excessively noisy during final calibration of radiometer.	Replace bolometer.	None.
3/1/65	50341	F-5	Excessive drag in chopper assembly traced to contaminated chopper shaft bearings. Marginal operation experienced at low radiometer temperatures and low power input voltage.	Replace bearing. Replace chopper motor Zener diode with lower value diode to increase chopper motor output torque. Revibrate radiometer.	None.

SBRC