Solar Backscatter Ultraviolet Spectral Radiometer Mod 2

NASA
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SBUV/2

Specification Compliance and Calibration Data Book for SBUV/2 Flight Unit #4 (S/N 005)

Volume I
Doc. No. B6802-97

Specification Compliance and Calibration Data Book
Volume I

for

Flight Model No. 4, Serial No. 005
Solar Backscatter Ultraviolet
Spectral Radiometer Mod 2

Document No. B6802-97
October 1, 1988
Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Goddard Space Flight Center
Greenbelt, Maryland 20771

in accordance with
Contract NAS 5-29230, Item 40C

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SBUV/2
VOLUME I
SUMMARY

Several differences distinguish the reworked FLIGHT #4 (S/N005) instrument from FLIGHT #1 (S/N002). These may be catagorized as:

- Modification to accommodate the new location of the Sensor Module on the Spacecraft. Such as:
  - Foil Wrap for EMI Protection and
  - New Alignment Mirrors
- Modification to improve the thermal characteristics of the Sensor Module.
- Procedural changes that increase both the quality and quantity of some calibration data.
- Installed a Hamamatsu photomultiplier tube and associated electronics.
- Redesigned the grating shaft and encoder for improved performance.
- Increased the stepping frequency and positioning accuracy of the diffuser assembly.
- Redesigned the cal lamp assembly to fill the field of view more uniformly.
- The instrument's survival heater was moved from the baseplate to the cal lamp housing to prevent Hg lamp cold start failures.
- Modification to the anode preamp to prevent saturation on Range 2.

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Section 1
VIBRATION TEST
(Reference Test Procedure 68038)

Vibration and shock tests were performed on Flight 4 from July 10 through July 14, 1987. The Sensor Module (SM) and the Electronics and Logic Module (ELM) were vibrated separately to minimize the size of the test fixture and to allow for a maximum number of accelerometer data channels for the test. The instrument was tested in one of BASD's vibration/shock facilities -- a Ling B335 Vibration System. The instrument was tested without thermal blankets and in a power off state.

A resonant survey of the test fixture was performed prior to vibration testing with satisfactory results. Each test axis on the sensor module consisted of protoflight qualification level sine and random vibrations (**Tables 1-1, 1-2**) and a protoflight qualification level shock (**Figure 1-1**). Sinusoidal vibration on the sensor module was over the frequency range of 5-110 hz. Protoflight qualification levels were used for the sensor module in order to qualify the redesigned grating assembly, diffuser assembly, calibration lamp assembly, and Hamamatsu PMT. The Electronics and Logic Module was tested to acceptance level vibration and shock (see **Table 1-3** for acceptance sine levels). In each axis of vibration for both the ELM and the sensor module a low level sinusoidal survey (**Table 1-4**) was run before full level was applied. Acceptance level random vibration for all axes of the ELM was the same as the Z-axis qualification level for the SM.

The instrument was given a thorough visual inspection after each axis of vibration and shock before it was removed from the vibration lab. After each axis, it was returned to the clean room and an electrical/optical performance functional test was conducted, always with satisfactory results. A typical shift in wavelength of approximately one grating step was noted.

The Flight 4 Sensor Module and Electronics and Logic Module performed to specification after being subjected to vibration and shock testing.

The Flight 4 Sensor Module (only) was vibrated in the Z-axis at Acceptance random level on September 16, 1987 following rework to the depolarizer. Functional tests run before and after vibration testing demonstrated satisfactory instrument performance.

Table 1-1

QUALIFICATION LEVEL SINUSOIDAL VIBRATION

Frequency Range (Hz)	X-Axis g Level	Y-Axis g Level	Z-Axis g Level	Sweep Rate (Octave/Min)
5-70	4.5*	5.0*	4.0*	4.0
70-110	1.5	2.5	1.0	

*Displacement Limited to 0.5 inch Double Amplitude

Table 1-2
QUALIFICATION LEVEL RANDOM VIBRATION

Sensor Module - Z Axis

Frequency Range (Hz)	Power Spectral Density (g^2/Hz)	G-RMS	Duration (Min)
20-75	0.005		
75-150	+10dB/Octave		
150-500	0.05	5.9	1.0
500-2000	-7dB/Octave		

Sensor Module - X and Y Axes

Frequency Range (Hz)	Power Spectral Density (g^2/Hz)	G-RMS	Duration (Min/Axis)
20-75	0.011		
75-150	+10dB/Octave		
150-310	0.11		
		7.1	1.0
310-350	-18dB/Octave		
350-500	0.05		
500-2000	-7dB/Octave		

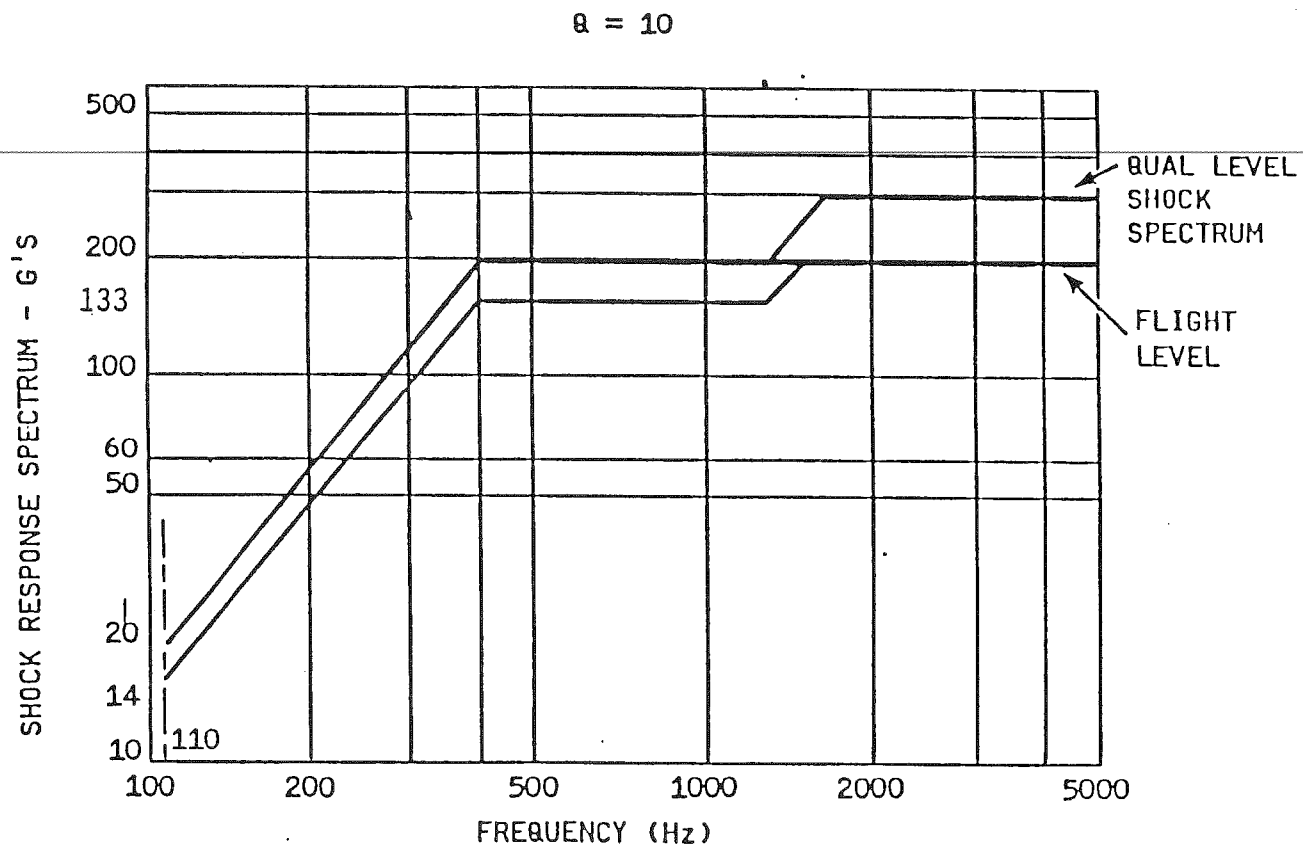


Figure 1-1 Qualification and Acceptance (flight) level shock spectra

Table 1-3
ACCEPTANCE LEVEL SINUSOIDAL VIBRATION

Frequency Range (Hz)	X-Axis g Level	Y-Axis g Level	Z-Axis g Level	Sweep Rate (Octave/Min)
5-70	3.6*	4.0*	3.2*	4.0
70-110	1.0	2.0	0.8	

*Displacement Limited to 0.5 inch Double Amplitude

Table 1-4
LOW LEVEL SINE SWEEP

Each Axis		
Frequency Range (Hz)	g Level	Sweep Rate (Octave/Min)
10-2000	0.25	2.0*

Section 2
THERMAL VACUUM TEST
(Reference Test Procedure 68040)

The thermal vacuum test was performed in BASD vacuum chamber COMBO between July 21 and August 8, 1987. The sensor module was mounted onto the vacuum test fixture and a cold plate attached to the fixture base for temperature control. The instrument was tested without thermal blankets to expedite temperature changes from plateau to plateau. Acceptance temperature levels were used except at zones 7 and 9 which were retested at the qualification levels of 40 °C and -10 °C, respectively. Qualification levels were used to verify the redesigned grating assembly, diffuser assembly, calibration lamp assembly, and Hamamatsu PMT. **Figure 2-1** depicts the actual temperature profile used. Figure **2-2** is a schematic profile.

Flight Model 4 electrical functional tests (software procedure MINIVAC) during thermal vacuum were performed at 25 °C (zone 0) prepump down, 25 °C (zone 1) post pumpdown, 30 °C (zone 3), 0 °C (zone 5), 40 °C (zone 7), -10 °C (zone 9), and again at 30 °C (zone 11). At each of these zones, the instrument was allowed to thermally stabilize before all electrical functional tests.

The electrical functional tests in vacuum were completed with two anomalies. First, the flex (RAM) memory of the ELM would not consistently load grating positions. This anomaly was later traced to an incorrect capacitor connection on the ELM memory board and reinstalled correctly. Second, Range 1 noise increased when the vacuum chamber heater/chillers were turned on and cycling. Analysis of COMBO's vibration profile with and without the heaters turned on indicated that the Range 1 noise could have been caused by microphonically induced noise. Because this did not affect data integrity, thermal vacuum testing continued.

Following the electrical functional tests, radiometric calibrations (software procedure VFLASH) were performed at 30 °C (zone 11), 20 °C (zone 13), 10 °C (zone 15), and 0 °C (zone 17). Two calibrated FEL lamps (190 and 131), one uncalibrated FEL lamp, and the argon mini-arc lamp were used at each plateau.

During the retrace portion of discrete mode the flash-light was used to provide a Range 3 signal level. At each plateau, the instrument response was measured at four hour intervals using the uncalibrated FEL. When radiometric stabilization had been achieved to within 1 percent, radiometric data was taken using one of the calibrated sources. Upon inspection, the data showed inconsistencies between sources and between like source runs at each temperature. It was found that the filament of the uncalibrated FEL lamp was off-center, causing a change in instrument response if reversed in the holder. The test was stopped and optical alignment changes were made to the test fixture. Data was repeated at several plateaus with the repositioned lamps which now proved to be consistent.

However, the data did not vary monotonically with temperature. It was suspected that this effect was caused by the depolarizer and zones 20 to 30 were done to demonstrate a hystoresis in the instrument response. The decision was made to continue testing in a specially built temperature chamber inside the cleanroom where it was possible to access the instrument for troubleshooting. Here the anomaly could be reproduced and it was found that at cold temperatures a fringe pattern could be seen in the depolarizer. These fringe patterns indicated that the elements of the depolarizer were separating at low temperatures. It was decided to replace the Flight Model 4 depolarizer assembly with its Flight Model 3 counterpart. The Flight Model 3 depolarizer assembly was temperature tested before installation in the Flight Model 4 instrument and showed no visible signs of fringe patterns or changes in optical throughput.

After the Electrical Optical Functional portion of the test was successfully completed, temperature testing continued inside the temperature chamber to determine the instrument response temperature coefficients. The results showed a range of 0.1 percent/degree at 385 nm to 0.2 percent/degree C at 252 nm. [See Volume 2, Section 5 for temperature data.] See **Tables 2-1** and **2-2** for a record of STE computer procedures, commands, and macros used during Thermal Vacuum Testing.

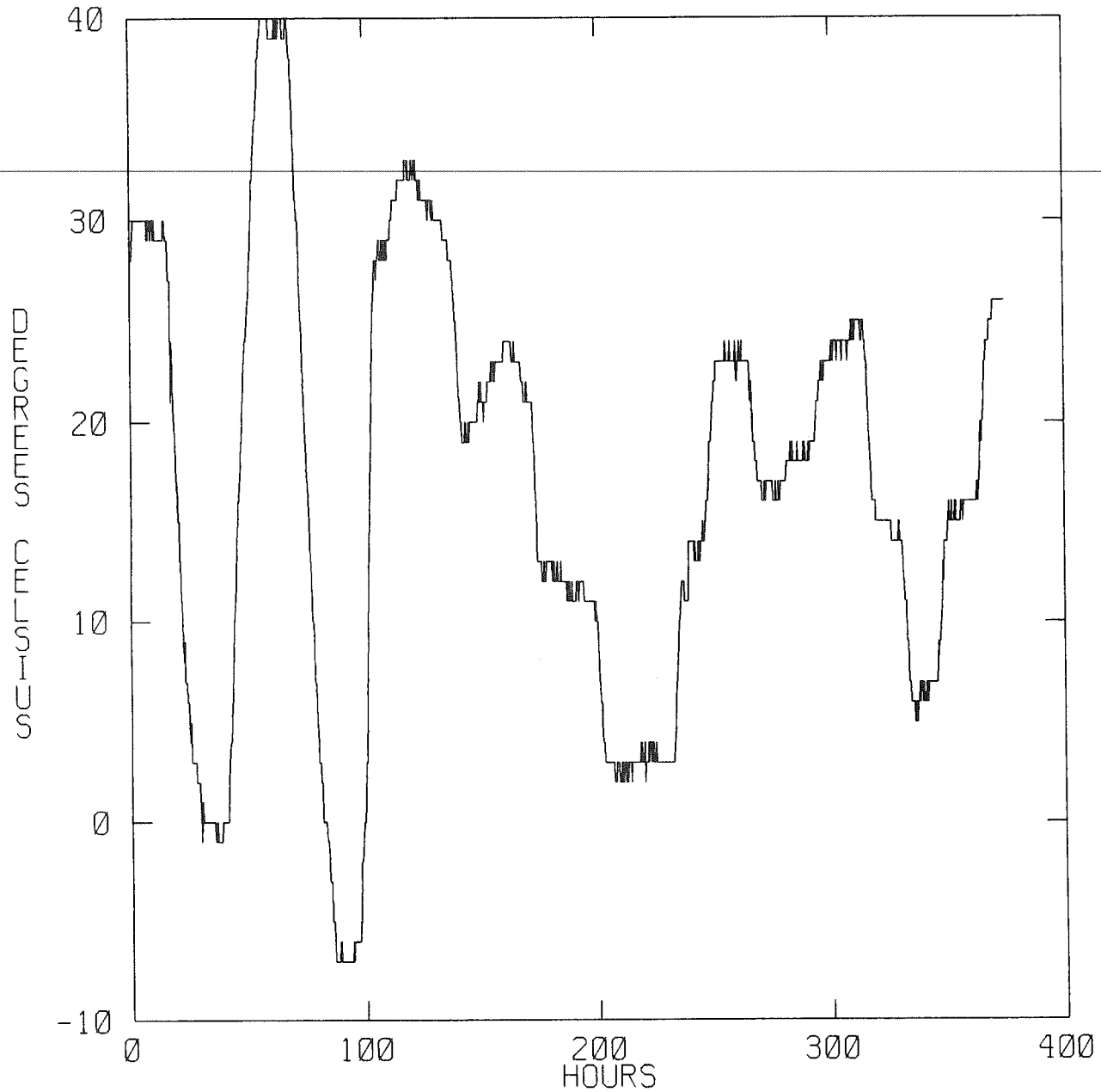


Figure 2-1 Actual daily temperature profile of DRS

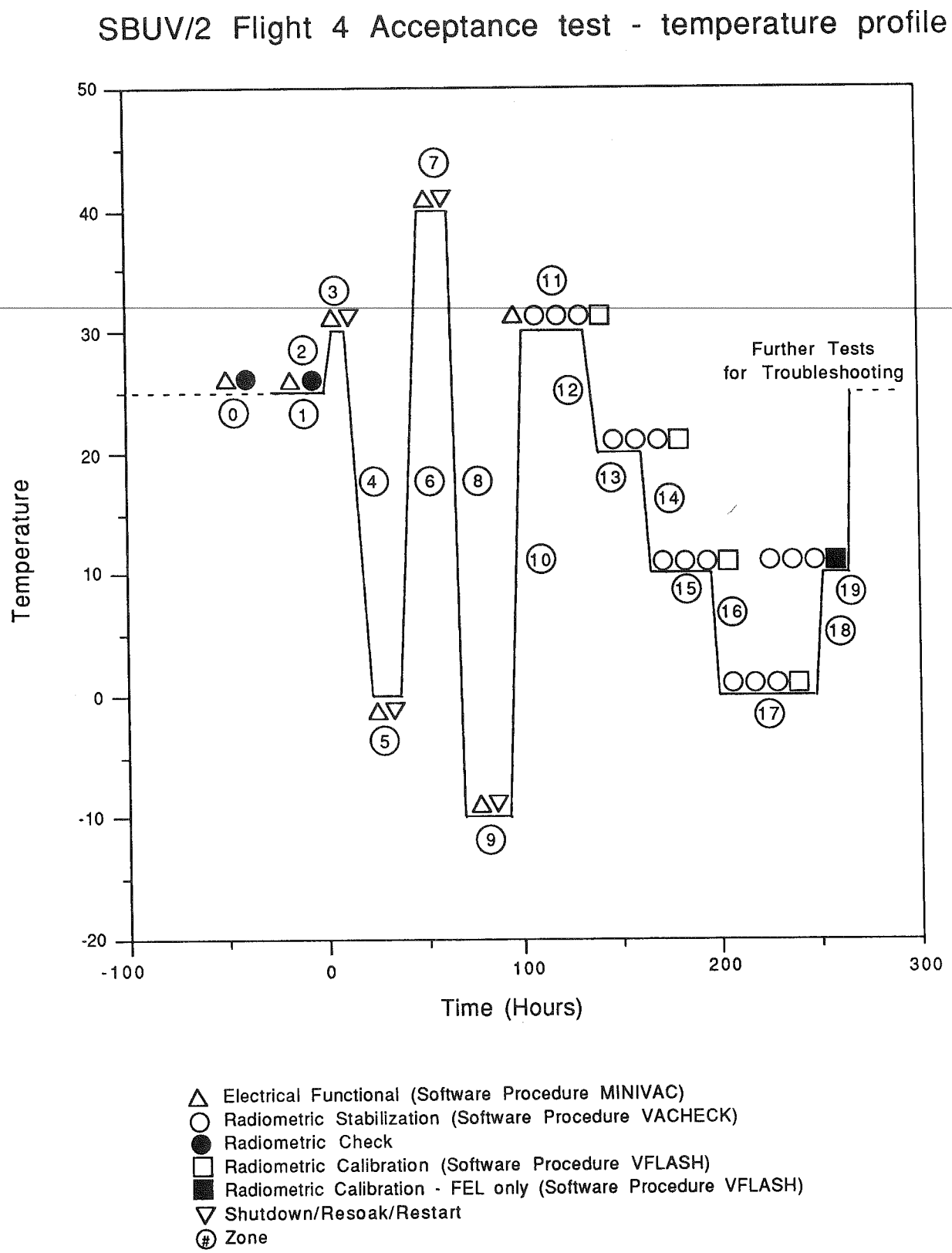


Figure 2-2 Flight 4 Acceptance test - temperature profile

Table 2-1

DESCRIPTION OF STE COMPUTER PROCEDURES, COMMANDS, AND MACROS USED DURING THERMAL VACUUM TESTING

ALBEDO	This macro checks the diffuser's reflectivity.
BACKGND	This procedure determines the background noise of the PMT inside the Sensor Module for all ranges.
COLDORB	This procedure retrieves SBUV orbital telemetry when the instrument is at or transitioning to cold temperatures.
GSWECHK	This procedure is a quick check of the grating sweep mode.
MINIVAC	This is a quick electrical functional check of the SBUV instrument.
ORBIT	This procedure retrieves SBUV orbital telemetry when the instrument is at above normal temperatures.
PWROFF	This procedure turns off the high voltage power supply and instrument power, but collects temperature telemetry.
RESTART	This procedure prepares the SBUV for telemetry transmittal, with all power on.
VACHECK	This procedure is a radiometric check for the stabilization of test light sources.
VFLASH	This procedure takes radiometric calibration data.

Table 2-2

TIME TABLE OF STE COMPUTER PROCEDURES, COMMANDS, AND MACROS USED DURING THERMAL VACUUM TESTING

21 JULY 1987 (202)	11:30	**Zone 0.** Installed sensor unit in the vacuum chamber.
	13:21:03	Turned on sensor unit in vacuum chamber per 68040.
	14:03:56	Procedure MINIVAC.
	14:50:54	Procedure MINIVAC.
	18:24:34	Procedure VACHECK.
	19:40	**Zone 1.** Started vacuum pump down.
22 JULY 1987 (203)	08:34:54	Procedure RESTART.
	09:06:26	Procedure MINIVAC.
	10:39:39	Procedure RESTART.
	10:54:28	Procedure MINIVAC.
	10:55:10	Procedure MINIVAC.
	14:14:54	Procedure VACHECK.
	15:00	**Started Zone 2 temperature transition.**
	16:20	Procedure ORBIT.
	22:49	**Zone 3 functional tests.**
	22:51:16	Procedure MINIVAC.
23 JULY 1987 (204)	07:27:11	Procedure RESTART.
	10:50	**Started Zone 4 temperature transition.**
	14:30	Procedure COLDORB.
	18:40	Macro ALBEDO.
	19:30	Macro BACKGND.
24 JULY 1987 (205)	00:14	**Zone 5.**
	00:14:18	Procedure MINIVAC.
	00:56:08	Procedure BOOT.
	00:59:12	Procedure MINIVAC.
	03:50:40	Procedure PWROFF.
	07:45:23	Procedure RESTART.
	12:20:31	**Started Zone 6 temperature transition.**
	12:29:14	Procedure COLDORB.
	15:22:31	Procedure COLDORB.

	16:28:38	Macro BACKGND.
	16:54:20	Procedure ORBIT.
	17:11:08	Procedure ORBIT.
	18:10:09	Macro BACKGND.
	19:01:30	Procedure ORBIT.
	20:14:19	Macro RAM.
	20:21:59	Macro RAM.
	20:28:38	Procedure ORBIT.
	21:27:59	Macro BACKGND.
	21:41:19	Macro RAM.
	21:49:15	Procedure ORBIT.
	22:48:16	Macro BACKGND.
	23:02:35	Macro RAM.
	23:10:21	Macro RAM.
	23:17:06	Procedure ORBIT.
25 July 1987	00:23:49	Macro BACKGND.
(206)	00:36:17	Macro RAM.
	00:54:41	Macro RAM.
	01:01:39	Procedure ORBIT.
	02:34:36	Macro BACKGND.
	02:48:18	Macro RAM.
	02:55:53	Macro RAM.
	03:02:27	Procedure ORBIT.
	04:06:15	Macro BACKGND.
	04:18:02	Macro RAM.
	04:30	**Zone 7.**
	04:51:55	Procedure MINIVAC.
	06:05	During procedure MINIVAC the grating lost lock. Restarted procedure MINIVAC at macro GSWECHK.
	07:15:17	Procedure MINIVAC - flex memory not loaded.
	10:13:56	Started power off period.
	14:25:21	Procedure RESTART complete.
	15:15	**Started Zone 8 temperature transition.**
	15:58:41	Procedure ORBIT.
	21:42:28	Procedure COLDORB.

26 JULY 1987	00:19:58	Procedure COLDORB.
(207)	01:30	Procedure COLDORB.
	04:00:23	Procedure RESTART.
	04:15:49	Procedure COLDORB.
	05:00	Restarted macro WLCAL (part of procedure COLDORB).
	05:00:31	Procedure COLDORB.
	10:30	**Zone 9.**
	10:55:47	Procedure MINIVAC.
	19:06:25	Procedure RESTART.
	22:05:41	Procedure COLDORB.
		Zone 10 temperature transition to +30° C.
27 July 1987	00:35:21	Procedure COLDORD.
(208)	03:37:25	Macro BACKGND.
	03:56:53	Procedure ORBIT.
	07:00	**Zone 11.**
	07:14:05	Procedure MINIVAC.
	08:06:31	Macro CONFIG.
	10:29:59	Restarted procedure MINIVAC.
	13:15:01	Procedure VACHECK.
	17:14:19	Procedure VACHECK.
	21:18:10	Procedure VACHECK.
	22:53:43	Procedure VFLASH.
	23:44:44	Macro GDFLCAL.
	23:51:15	Restarted macro GDFLCAL.
28 July 1987	00:51:49	Procedure VACHECK.
(209)	04:00	Procedure VFLASH.
	10:10	**Started miniarc test for Zone 11.**
	10:10:20	Macro GDFLCAL.
	14:41	**Started Zone 12 temperature transition to 20° C.**
	20:15	**Zone 13.**
29 July 1987	00:51:49	Procedure VACHECK.
(210)	06:19:45	Macro BACKGND.
	04:49:17	Procedure VACHECK.
	10:43:13	Macro BACKGND.
	11:07:49	Procedure VFLASH.

30 July 1987	00:48:45	**Started Zone 14 transition to 10° C.**
(211)	05:00	**Zone 15.**
	05:01:13	Procedure VACHECK.
	06:31:04	Procedure BACKGND.
	09:01:48	Procedure VACHECK.
	10:58:38	Turned uncalibrated FEL lamp around in its mount and ran a special VACHECK. This special test found that the orientation of the FEL lamp affected the data.
	13:02:23	Procedure VACHECK.
	14:56:32	Procedure VFLASH.
31 July 1987	04:00	**Started Zone 16 transition to 0° C.**
(212)	09:30	**Zone 17.**
	09:47:32	Procedure VACHECK.
	11:20	Ran macro BACKGND.
	13:45:13	Procedure VACHECK.
	18:15:03	Procedure VACHECK.
	19:47:42	Procedure VFLASH
1 August 1987	04:50	Procedure MINIARC.
(213)	10:42	Started memory loading tests. (RAM and RAMA macros)
	14:37	Completed memory loading tests. NOTE: Memory tests showed that there was a intermittent problem with loading ELM RAM.
	15:00	**Started Zone 18 transition to 10° C.**
	17:30	**Zone 19.**
	17:44:41	Procedure VACHECK.
2 August 1987	00:15	Macro BACKGND.
(214)	00:33:11	Procedure VACHECK.
	01:38	Macro BACKGND.
	01:45	**Zone 20 transition to 20° C.**
	05:15:06	**Zone 21.**
	05:53	Procedure VACHECK.
	06:55	Macro BACKGND.
	09:48:19	Procedure VACHECK.
	11:29:32	Procedure VACHECK.

	13:09:01	**Finished Flight 4 Thermal Vacuum Acceptance Tests.The following procedures are additional tests that are redlined into the Flight 4 T/V procedure.**
	14:23:33	Procedure VACHECK.
	16:36:02	Procedure VACHECK.
	20:02:15	Procedure VACHECK.
	21:30	**Zone 22 transition to 17° C.**
	00:30	**Zone 23.**
3 August 1987	00:47:33	Procedure VACHECK.
(215)	04:58:15	Procedure VACHECK.
	06:44:53	Procedure VACHECK.
	11:24:43	Procedure VACHECK.
	14:05:56	Procedure VACHECK.
	16:02:29	Macro RAM.
	16:46:09	Macro CONFIG.
4 August 1987	08:19:38	Macro RAM.
(216)	08:36:31	Macro RAM.
	08:38:42	Macro ROM.
	08:44:39	Macro BACKGND.
	08:55:25	Macro BACKGND.
	09:03:44	Macro BACKGND.
	09:13:44	Macro BACKGND.
	09:49:18	Macro POWEROF.
	10:00	**STE turned off and chamber brought to 1 atm at 25° C**
	10:36:18	Procedure BOOT.
	11:40:09	Procedure RESTART.
	17:25	**Zone 24 transition to vacuum.**
5 August 1987	07:30	**Zone 25 at 25° C.** Booted STE and turned
(217)		on SBUV power.
	09:01:14	Procedure VACHECK.
	10:43:55	Procedure VACHECK.
	12:57:07	Procedure VACHECK.
	14:38:56	Procedure VACHECK.
	16:19	**Zone 26 transition to 15° C.**

6 August 1987	00:00	**Zone 27.**
(218)	00:05:36	Procedure VACHECK.
	01:39:11	Procedure VACHECK.
	03:20	Macro BACKGND.
	04:05:18	Procedure VACHECK.
	05:46:53	Procedure VACHECK.
	07:26	**Zone 28 transition to 10° C.**
	12:25	**Zone 29 at 10° C.**
	12:26:20	Procedure VACHECK.
	14:13:19	Procedure VACHECK.
	16:20:13	Procedure BOOT.
	16:35:37	Procedure VACHECK.
	18:28:56	Procedure VACHECK.
	21:13:30	Procedure VACHECK.
	22:45:45	Stopped procedure VACHECK.
	22:48	**Zone 30 transition to 15° C.**
7 August 1987	03:50	**Zone 31 at 15° C.**
(219)	03:57:28	Procedure VACHECK.
	05:29:24	Procedure VACHECK.
	09:05:51	Procedure VACHECK.
	10:27:52	Procedure VACHECK.
	12:53:13	Procedure VACHECK.
	16:33:14	Procedure VACHECK.
	16:56:32	Stopped procedure VACHECK.
	17:37	**Zone 32 transition to 25° C.**
	22:00	**Zone 33 at 25° C.**
	22:05:58	Procedure VACHECK.
	23:45:53	Procedure PWROFF.
8 August 1987	00:00 to	Vacuum chamber brought to ambient pressure.
(220)	12:00	Returned Sensor Module and ELM to clean room #2.

Section 3

MASS PROPERTIES

(Reference Test Procedure 68037)

The weight, center of gravity, and envelope dimensions have been determined for the Electronics and Logic Module and the Sensor Module. The following table and figures give the weight, show the location of the center of gravity, and give the envelope dimensions for both the Sensor Module and the Electronics and Logic Module. All measurements are within specification.

Table 3-1

INSTRUMENT WEIGHT

ASSEMBLY	WEIGHT	
	SPECIFICATION	MEASUREMENT
SENSOR MODULE ELECTRONICS and LOGIC MODULE	55 Pounds (Target) 29 Pounds (Target)	57.5 Pounds 25.6 Pounds
TOTAL	84 Pounds Maximum	83.1 Pounds

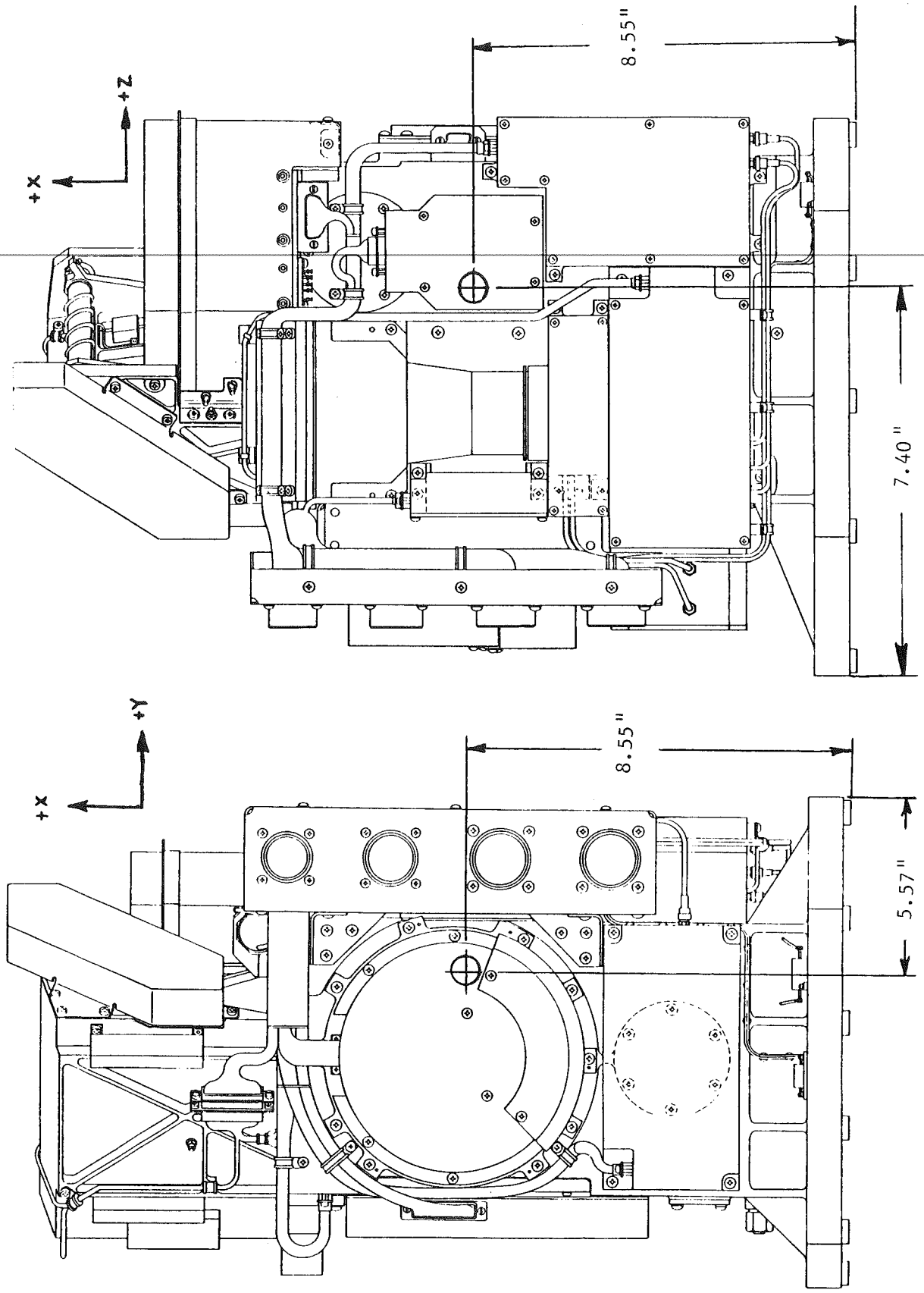


Figure 3-1 Sensor module center of gravity

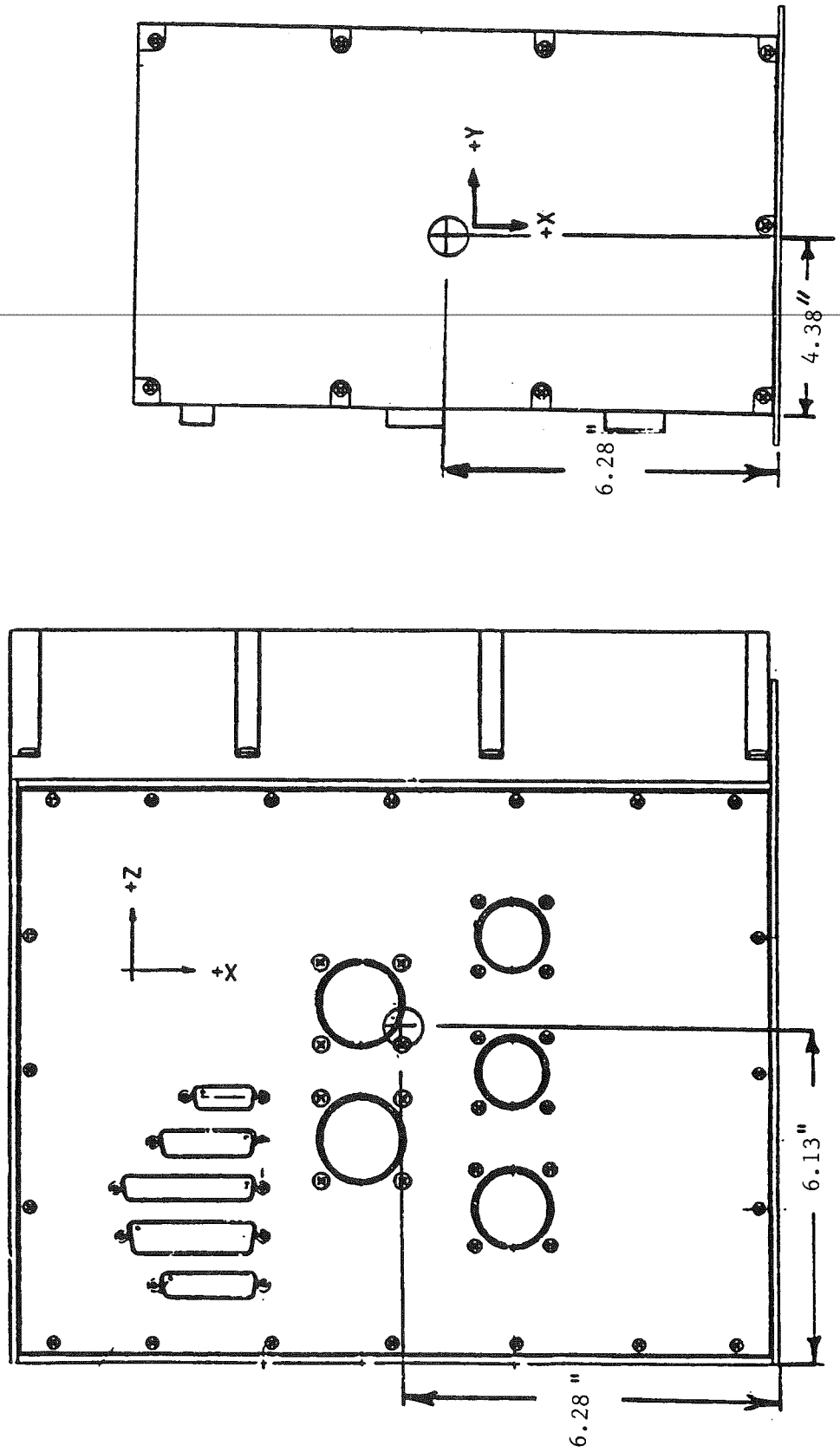
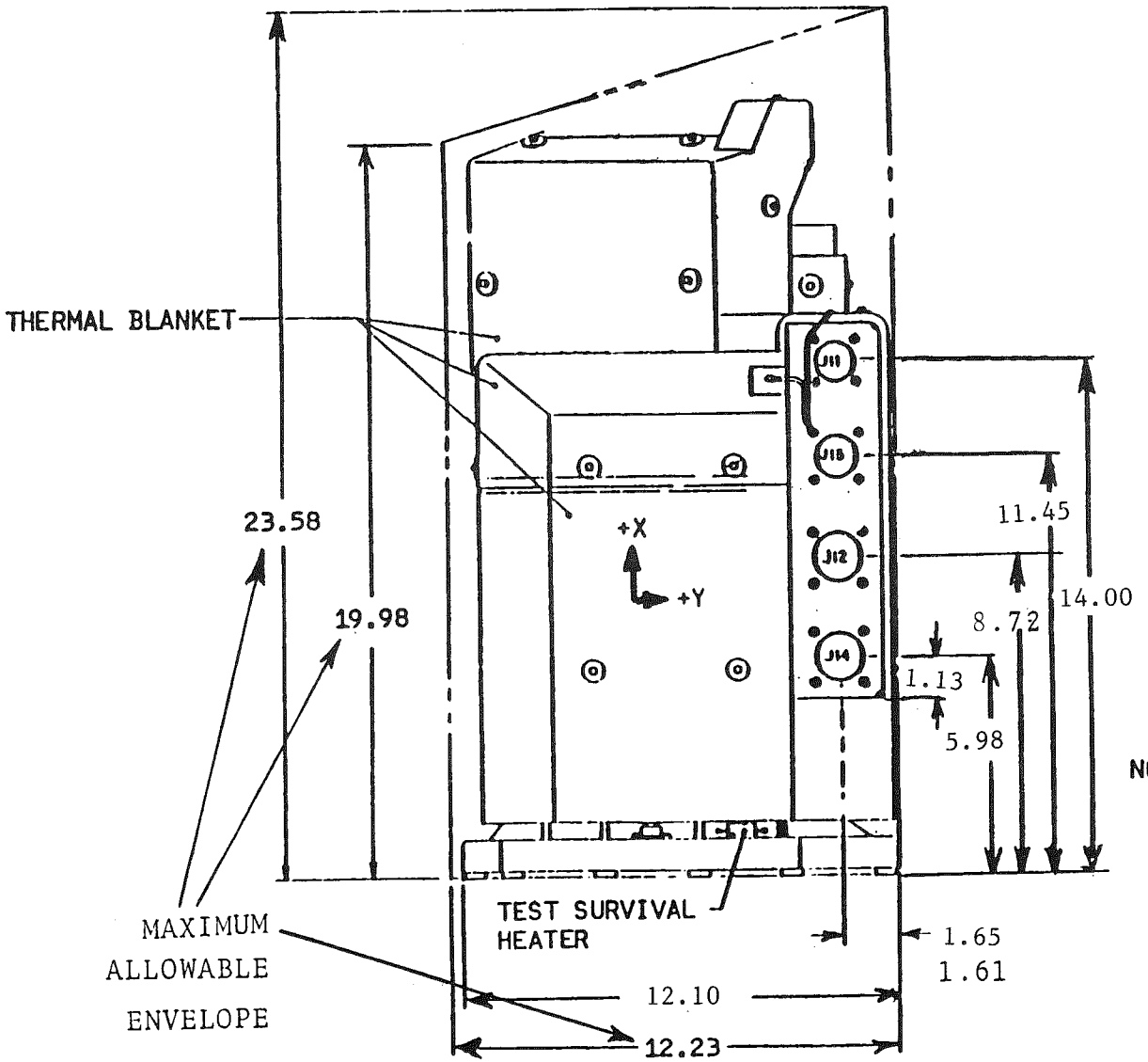


Figure 3-2 Electronics and logic module center of gravity



NOTE: CONNECTOR LOCATION TOLERANCE ±0.10

Figure 3-3 Sensor module envelope

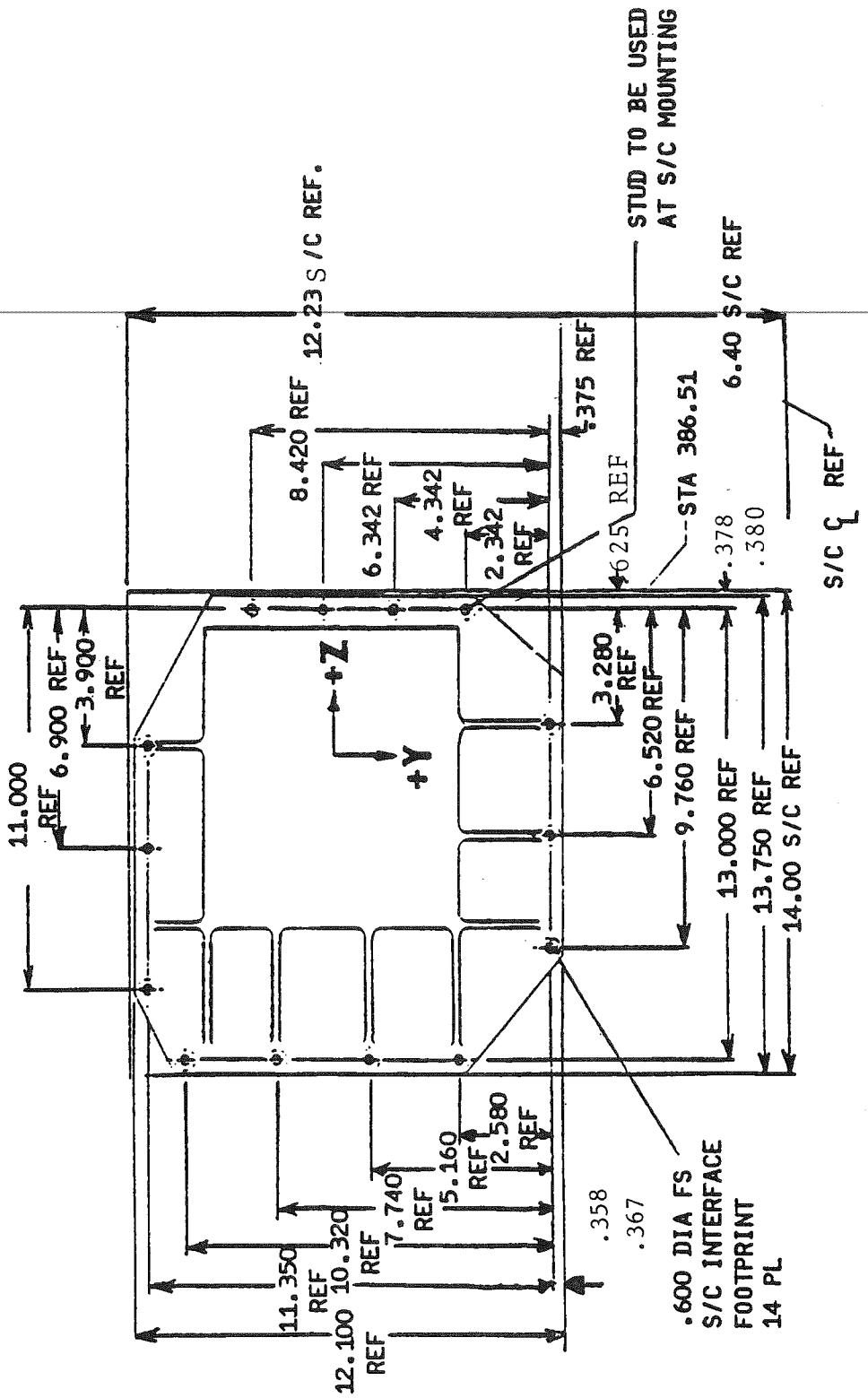


Figure 3-4 Sensor module interface footprint

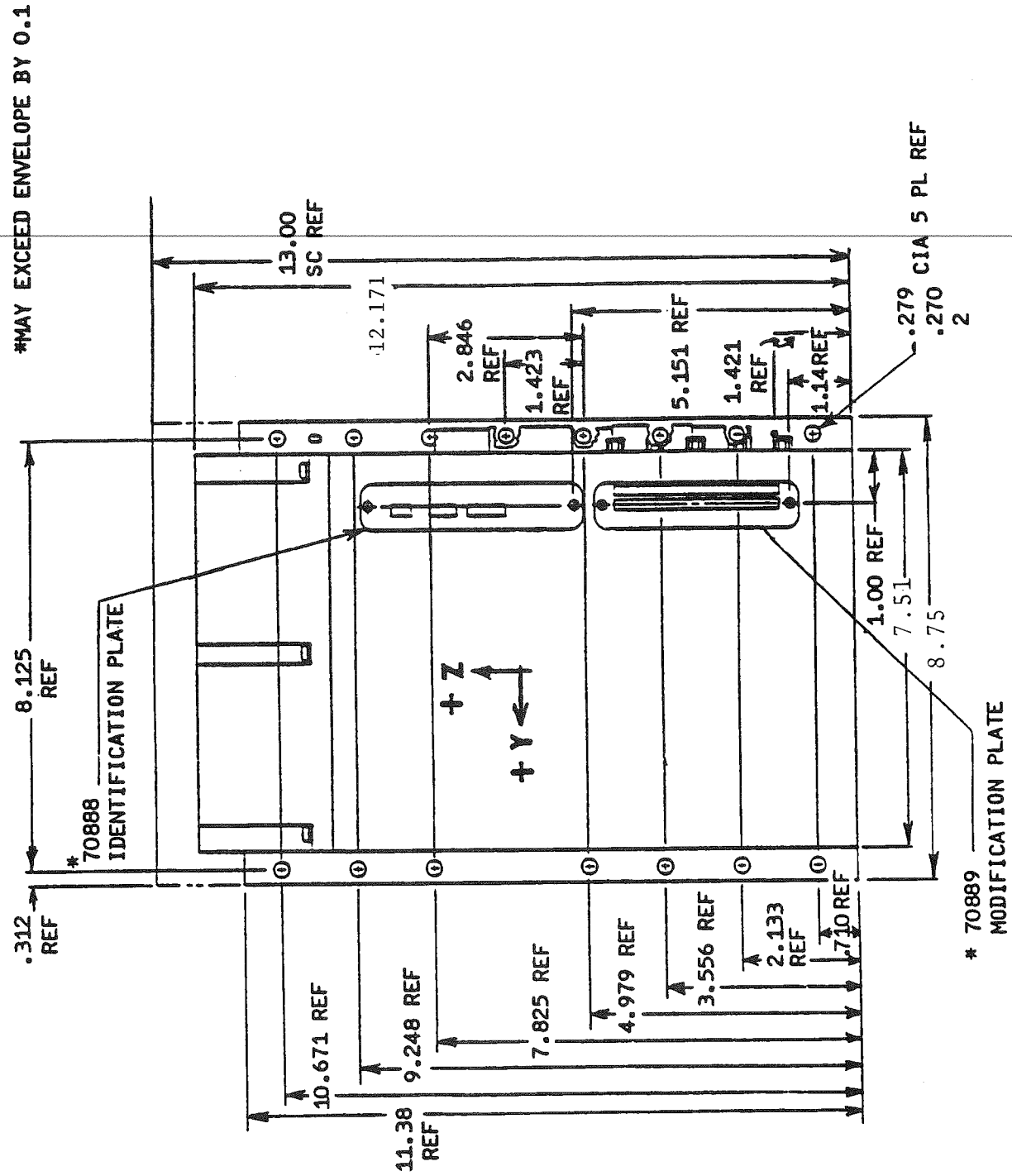


Figure 3-5 Electronics and logic module Y-Z dimensions

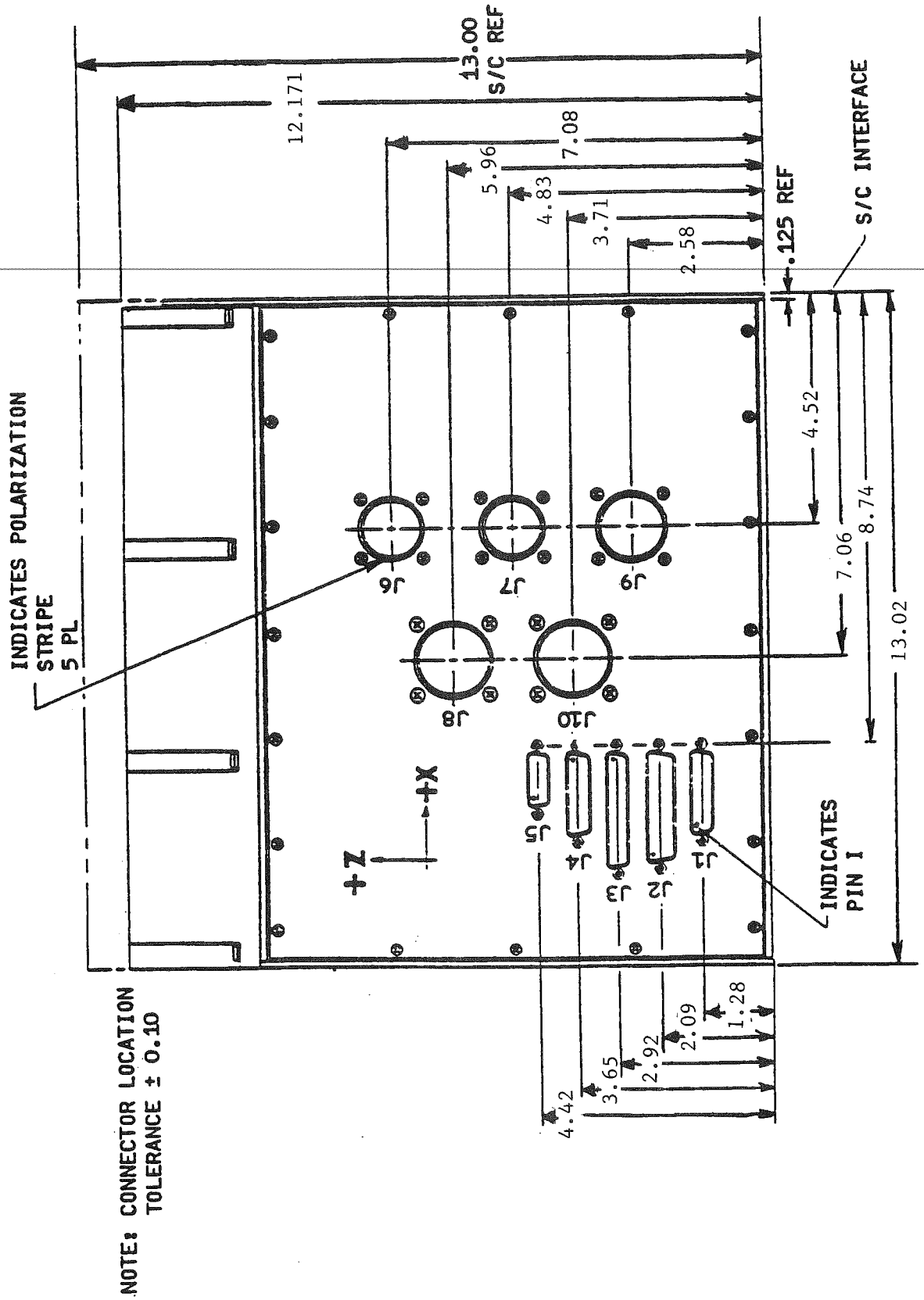


Figure 3-6 Electronics and logic module X-Y dimensions

Section 4
TELEMETRY CALIBRATION

This section contains the calibration curves for the Analog and Digital"A" analog sub-multiplexer data. **Table 4-1** lists Telemetry. The calibration curves are shown in **Figures 4-1** through **4-18**.

The Digital "A" analog sub-multiplexer data are output as counts from 0 to 255, each point is sampled every 16 seconds, and included in the instrument Digital "A" telemetry. The Analog Telemetry are continuous voltages available on discrete lines. In the system test equipment (STE) these voltages are converted to counts for data processing. Figures for Analog Telemetry have both voltage and count scales for convenience.

Additional details can be found in the SBUV/2 Unique Instrument Interface Specification, RCA Document IS 2295548, Section 3.1.5.

TABLE 4-1

TELEMETRY

Telemetry Points	Mnemonic	Figure #
Differential Reference Temperature Sensor Anti-Sun Side	DRA	4-1
Differential Reference Temperature Sensor Sun Side	DRS	4-1
Sensor Module Differential Temperature Sun Side	SDS	4-1
Sensor Module Differential Temperature Anti-Sun Side	SDA	4-1
PMT Cathode Temperature Sensor	PMT	4-2
CCR Diode Temperature	CDT	4-2
Sensor Module Shroud Temperature Sensor	SMS	4-3 *
Diffuser Plate Temperature Sensor #2	DF2	4-4 *
Diffuser Plate Temperature Sensor	DFP	4-4
Calibration Lamp Temperature Sensor	LMP	4-4
Sensor Module Baseplate Temperature	SMB	4-5
Diffuser Motor Temperature Sensor	DFM	4-5 *
Low Voltage Power Supply Temperature Sensor	LVP	4-5 *
High Voltage Power Supply Temperature Sensor	HVP	4-5 *
Grating Motor Temperature Sensor	GRM	4-5 *
Electrometer Temperature Sensor	ELT	4-5 *
Depolarizer Housing Temperature Sensor	DPH	4-5 *
Sensor Module Baseplate Temperature Sensor #2	SM2	4-5 *
Calibration Lamp Motor Temperature Sensor	CLM	4-5 *
Calibration Lamp Power Supply Temperature Sensor	CLP	4-5 *
Diffuser Radiator Temperature Sensor	DFR	4-5 *
Electronics and Logic Module Temperature Sensor	ELM	4-5 *
Chopper Motor Temperature Sensor	CHM	4-5 *
Electronic Calibration Reference Voltage	ECL	4-6
5 Volt LED Voltage	5	4-7
15 Volt Sensors Voltage	15SR	4-8

* Indicates Analog Telemetry

TABLE 4-1
TELEMETRY (Concluded)

Telemetry Points	Mnemonic	Figure #
24 Volt Motor Voltage	24	4-9
25 Volt Power Voltage	25	4-9
Chopper Motor Phase Error	CPERR	4-10
Chopper Motor Current	CMCUR	4-11
Diffuser Motor Current	DCR	4-12
High Voltage Power Supply Volts	HVPS	4-13
Thermistor Bais Voltage (10V REF)	THB	4-14
10 Volt Logic Voltage	10	4-14
-15 Volt Sensors Voltage	-15SR	4-15
-15 Volt Servo Voltage	-15SN	4-15
Calibration Lamp Motor Current	MCR	4-16
Diffuser Heater Current	DFHTR	4-17 *
Baseplate Heater Current	BPHTR	4-17 *
Calibration Lamp Current	LCR	4-18
28 Volt Main Power	28	4-19 *

* Indicates Analog Telemetry

Conversion of Differential Temperature

1) Convert the differential reference temperature from counts to temperature using the conversion chart shown in **Figure 4-1**.
DRS or DRA = TD

2) Next, calculate the differential temperature counts from the following:

$$T_{(SDS)} = (0.107499)\ (C_{SDS}) - (13.706) + C_{(DRS)}$$

where

$T_{(SDS)}$ = Differential Temperature in Counts

$C_{(SDS)}$ = Counts from Differential Temperature

$C_{(DRS)}$ = Counts from Differential Reference Temperature

3) Convert $T_{(SDS)}$ from counts calculated in the above equation to temperature (TS) using the conversion chart shown in **Figure 4-1**.

4) The differential temperature T, then is determined from the following:

$$T = TD - TS$$

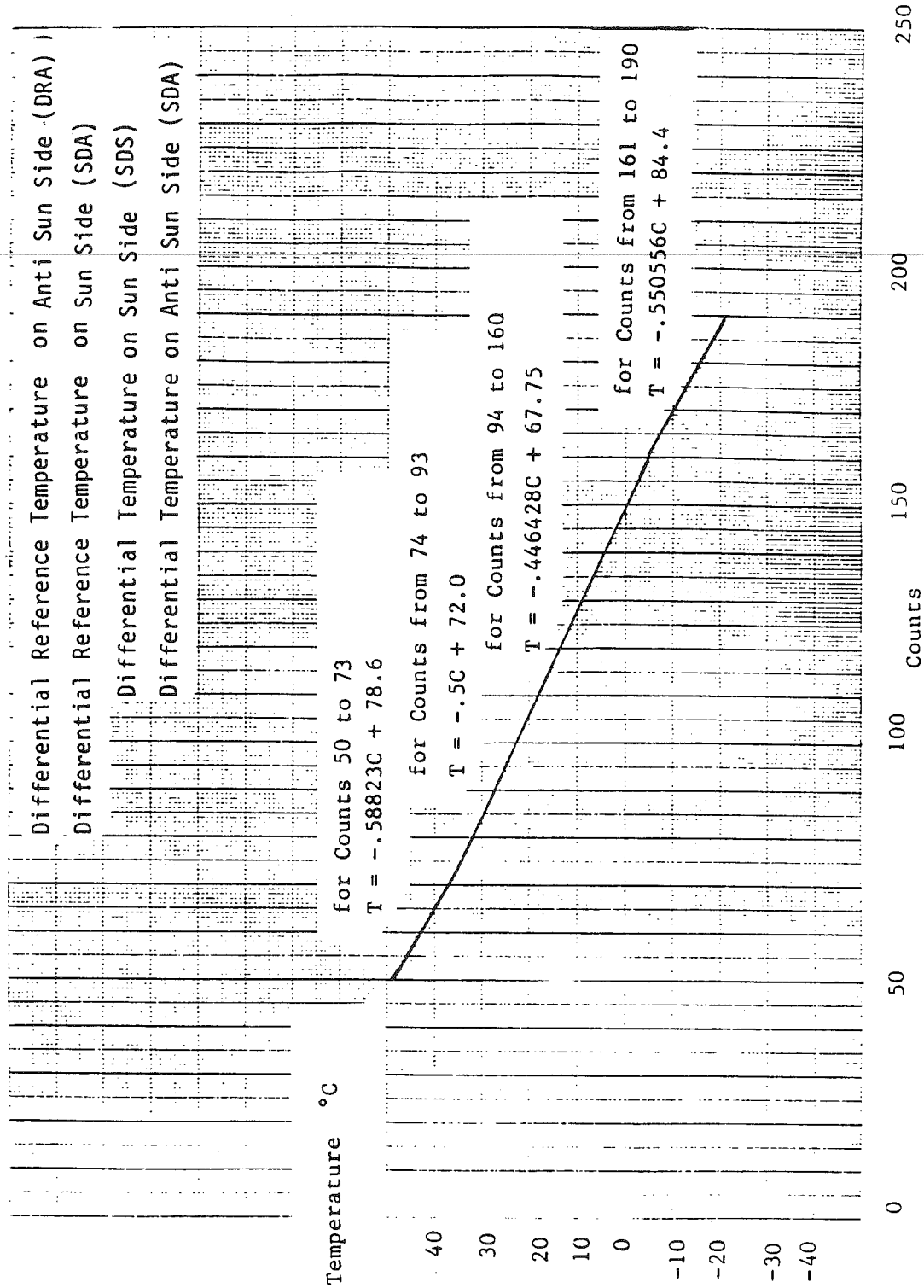


Figure 4-1 Differential reference temperature

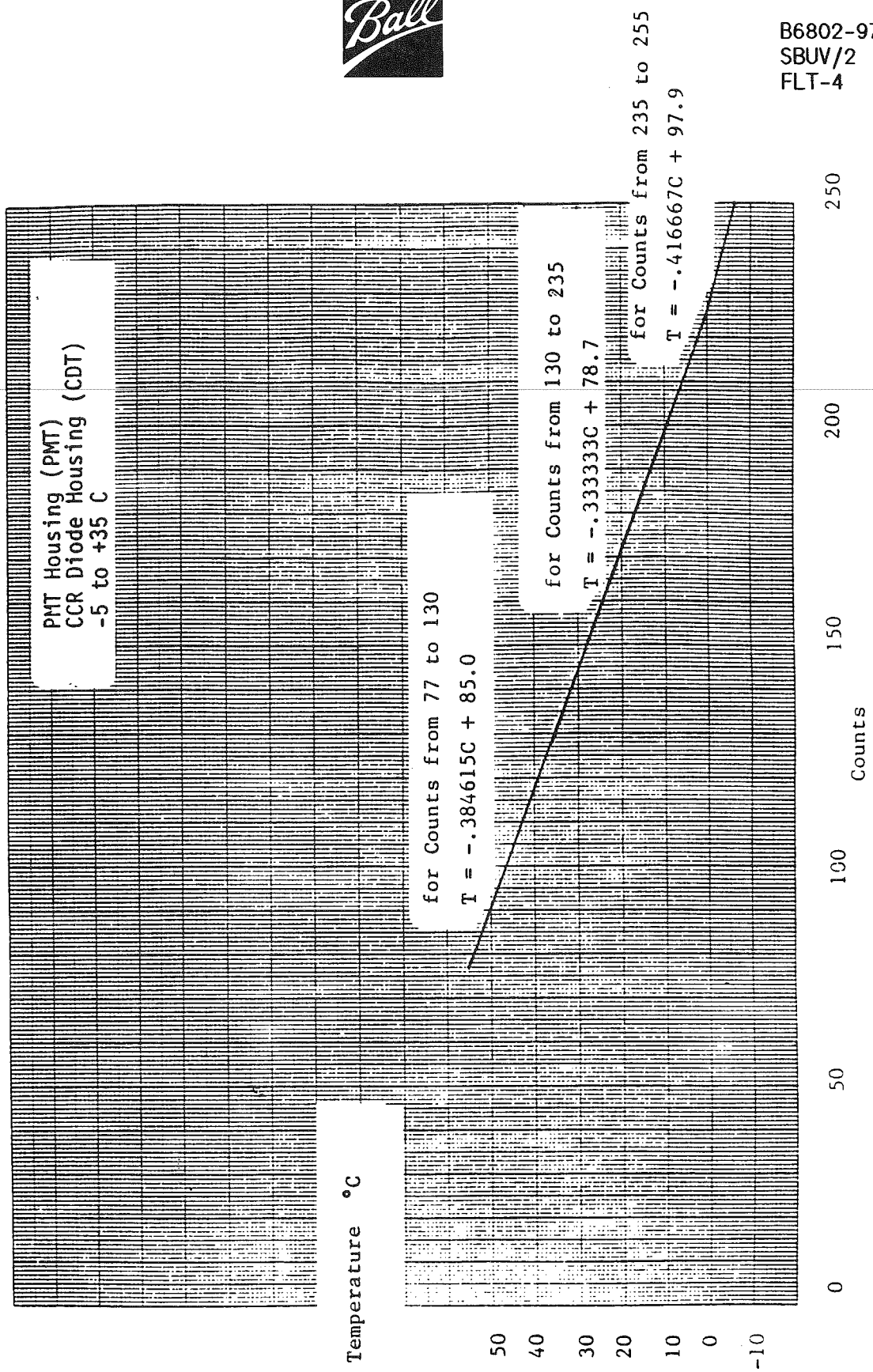


Figure 4-2 Temperature sensor (PMT & CCR)

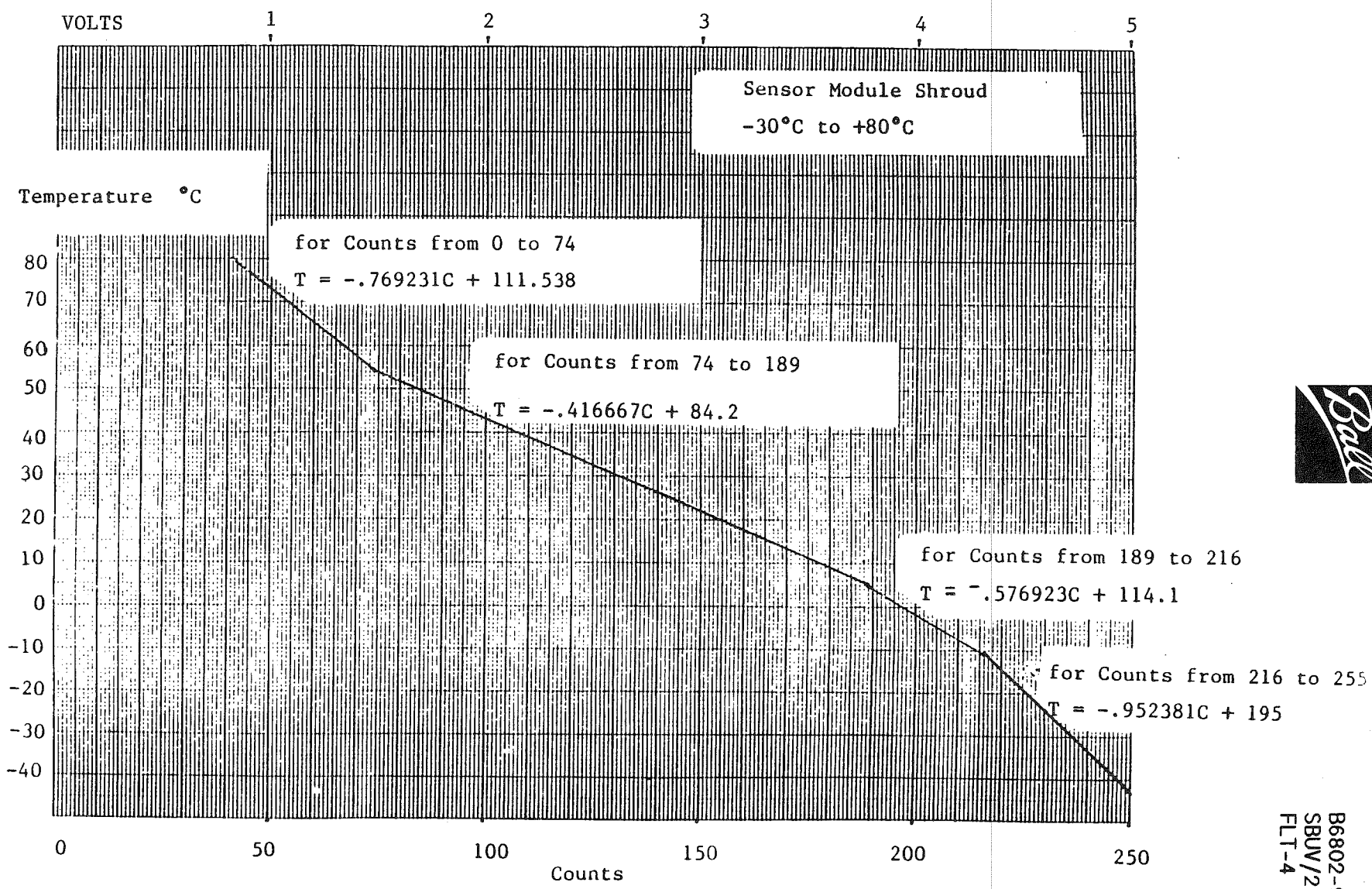


Figure 4-3 Temperature sensor (sensor module shroud)

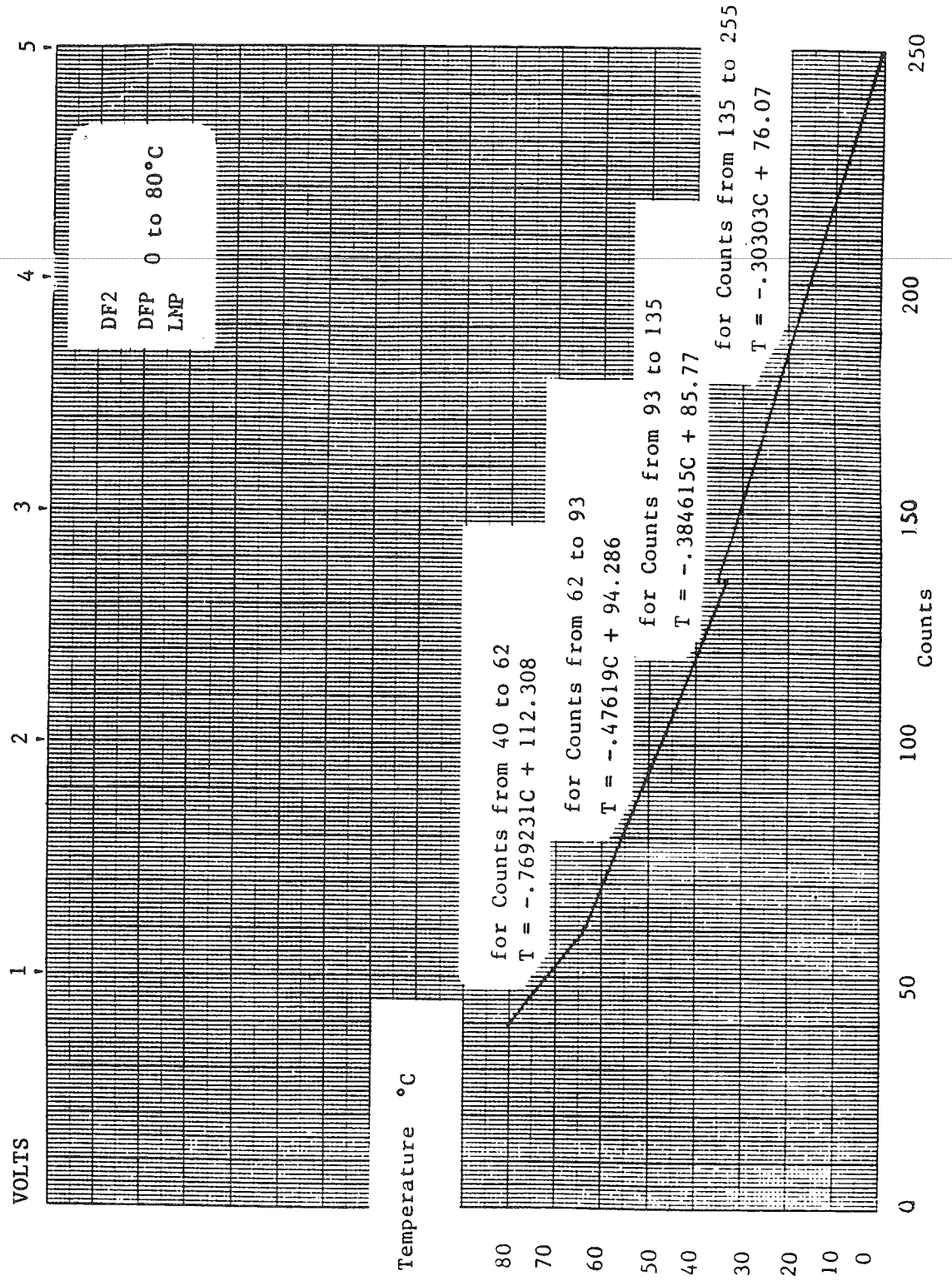


Figure 4-4 Temperature sensor (diffuser plate)

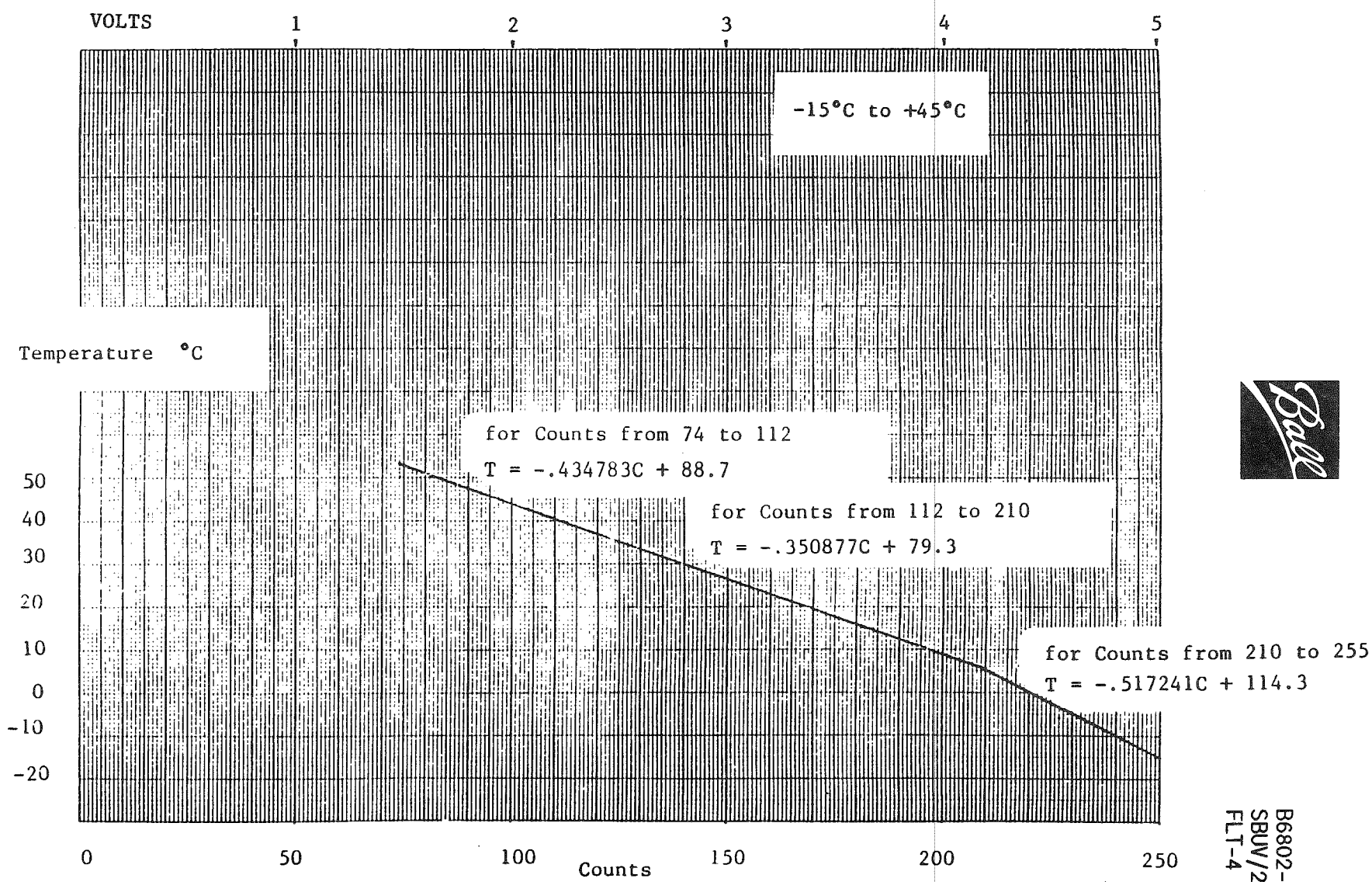


Figure 4-5 Temperature sensor (-15° to 45° C range)

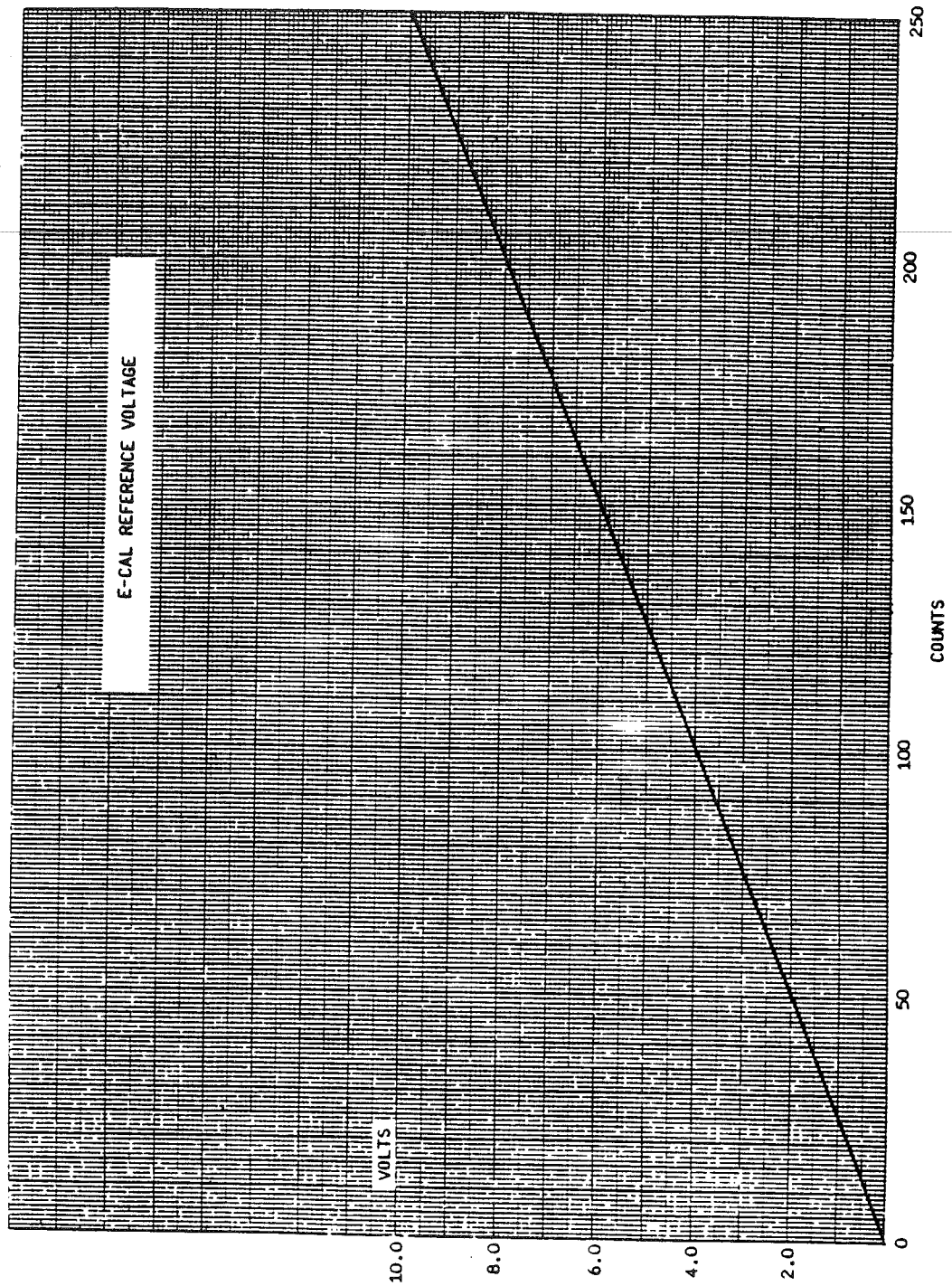


Figure 4-6 E-Cal reference voltage

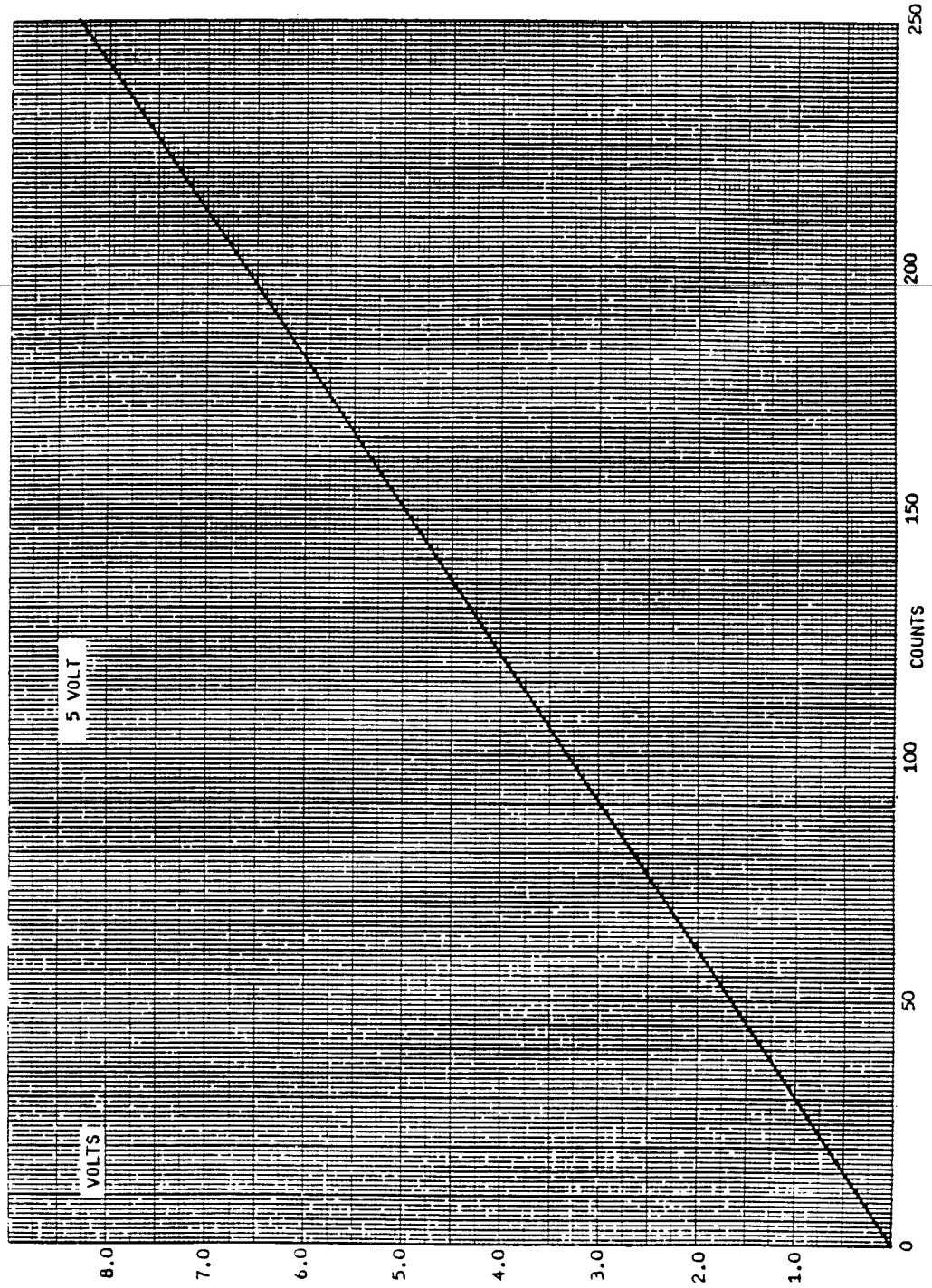


Figure 4-7 5 Volt

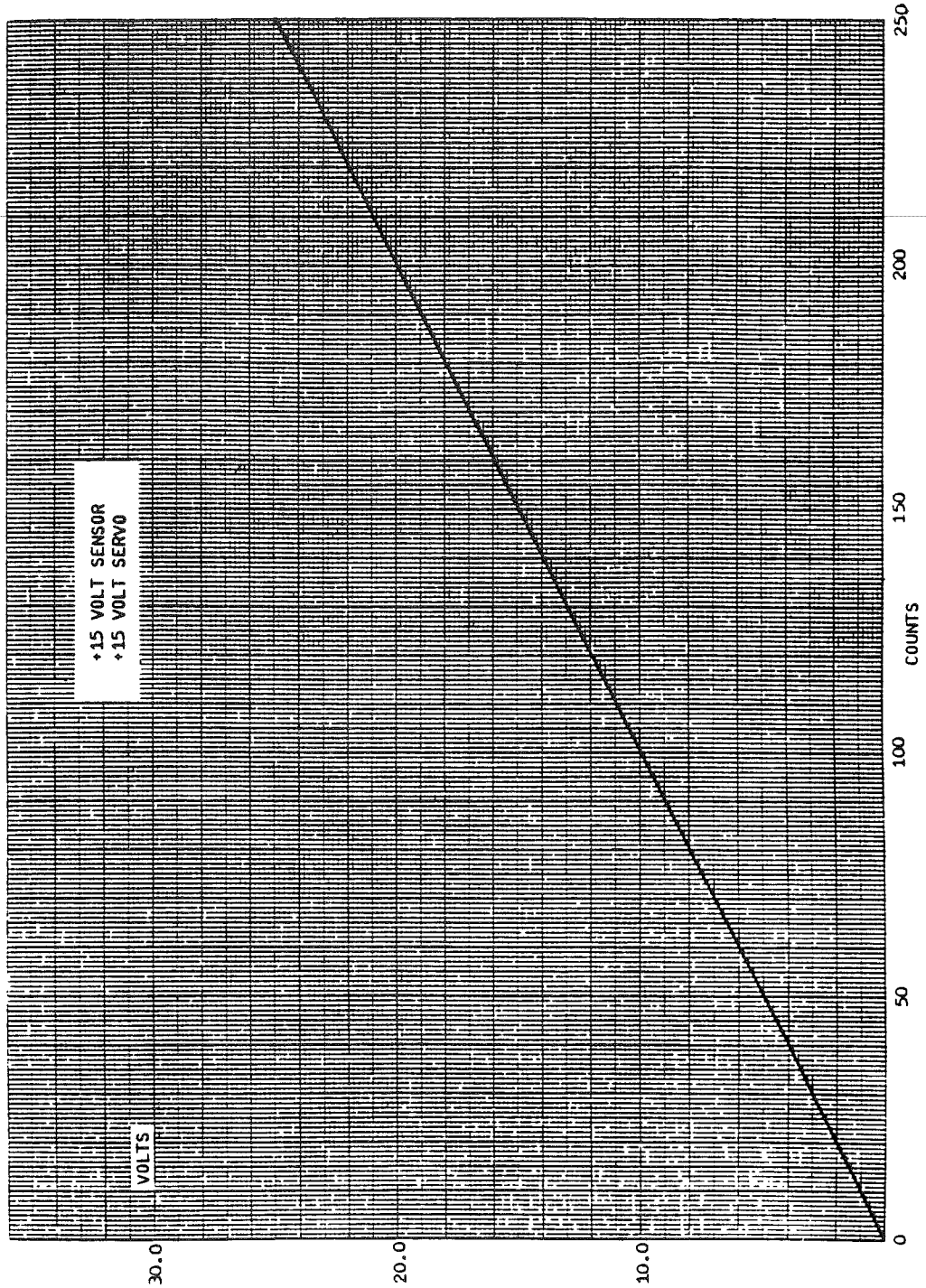


Figure 4-8 +15 Volt sensor and servo

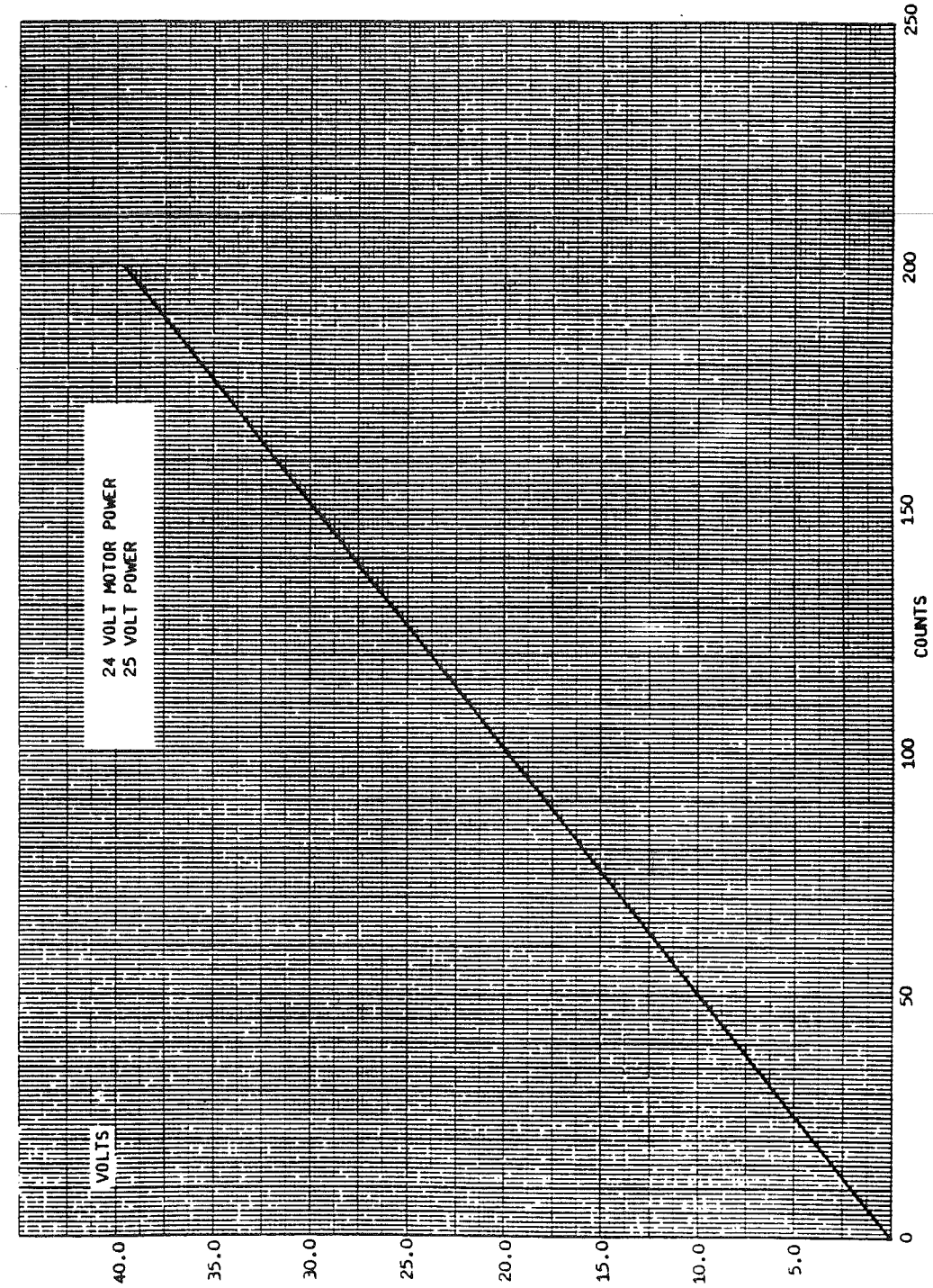


Figure 4-9 24 Volt motor power and 25 volt power

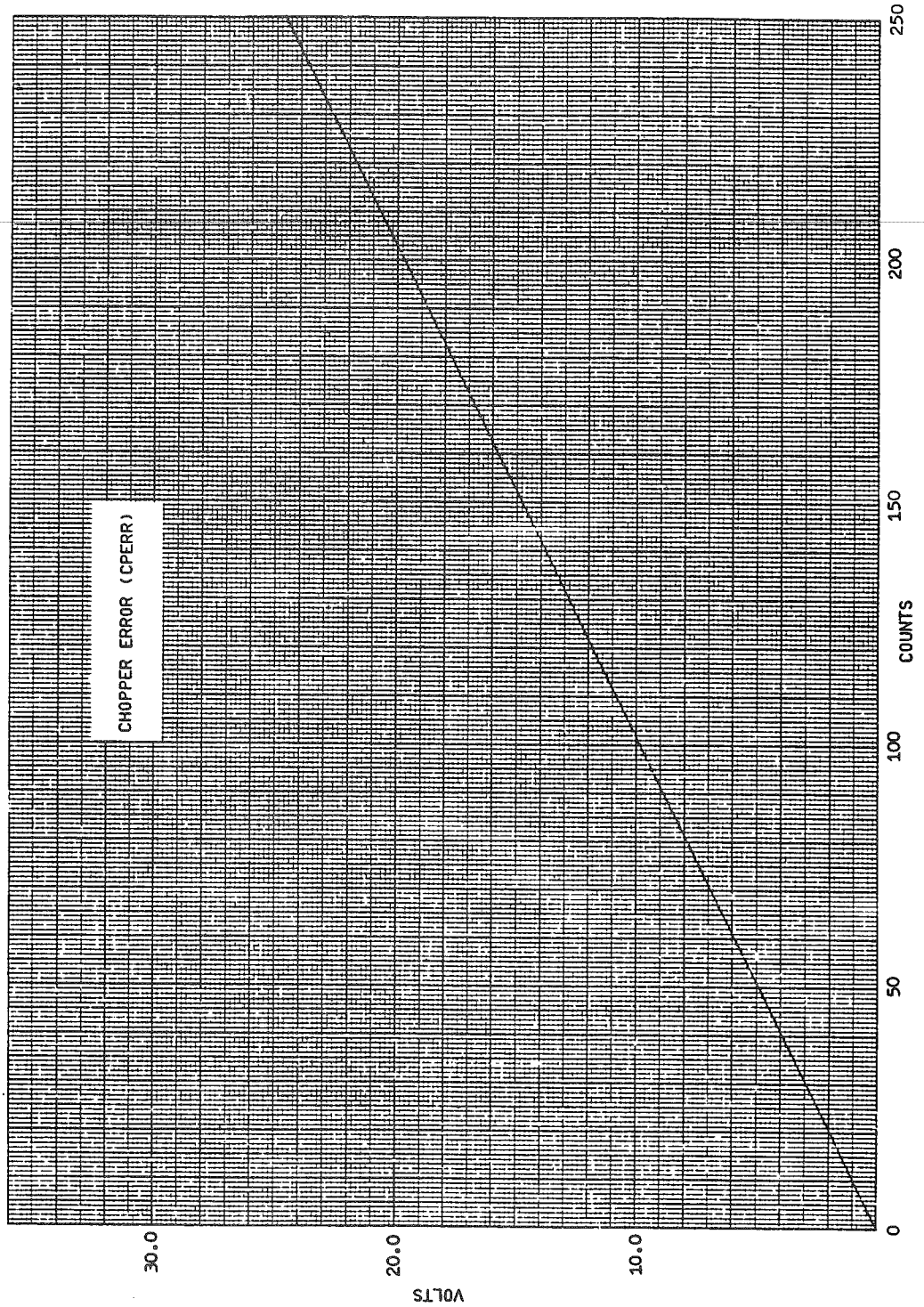


Figure 4-10 Chopper error

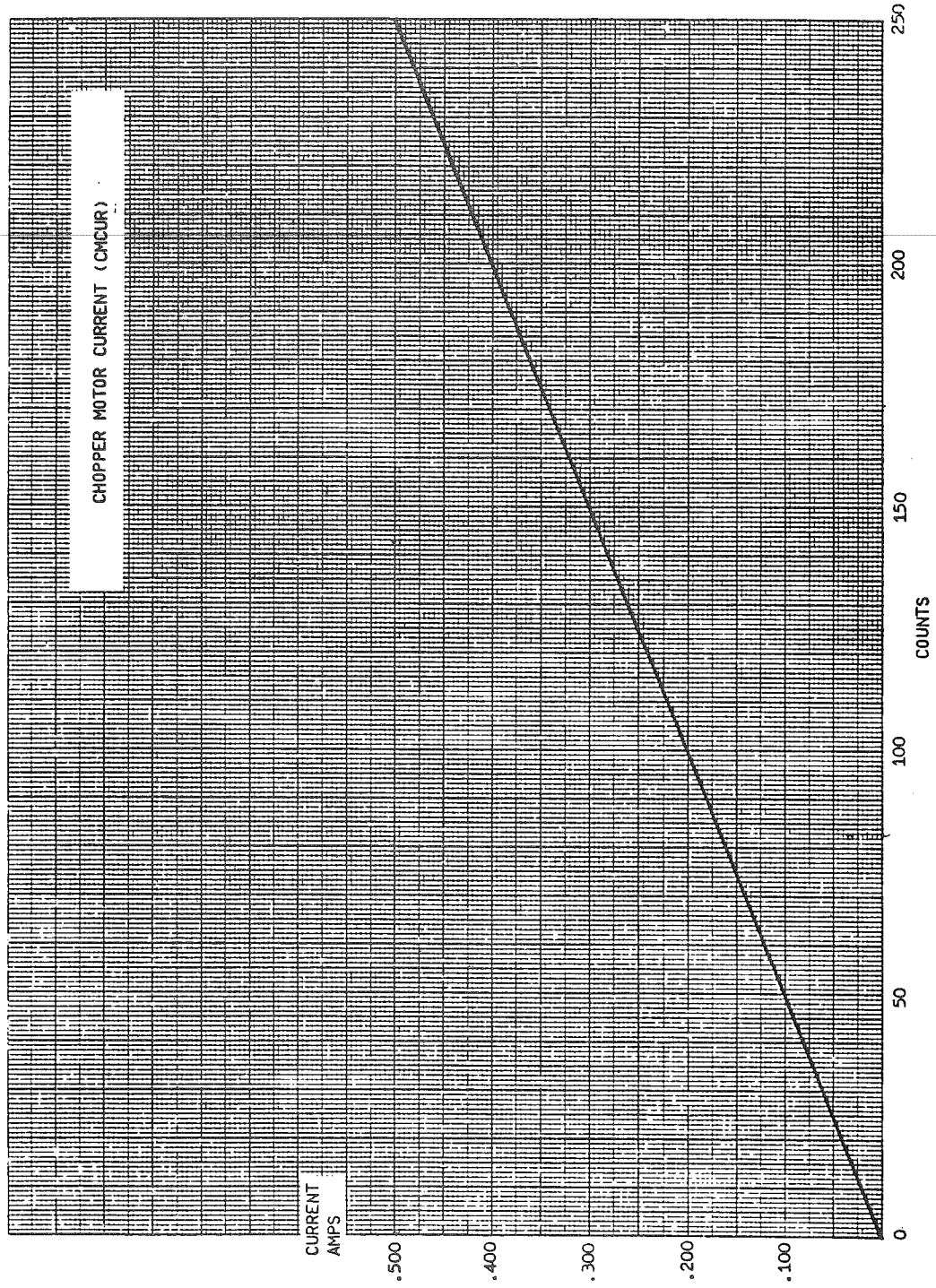


Figure 4-11 Chopper motor current

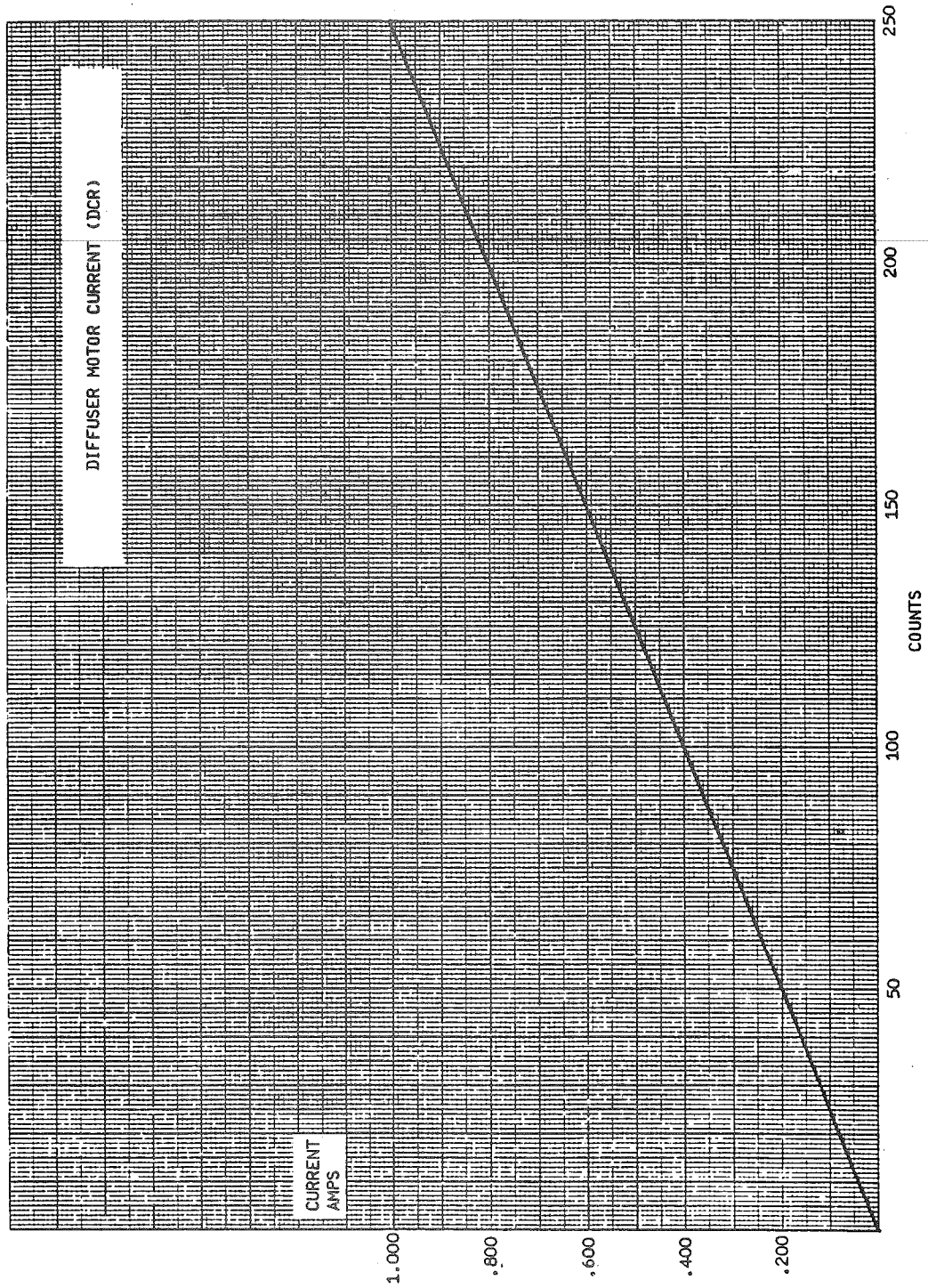


Figure 4-12 Diffuser motor current

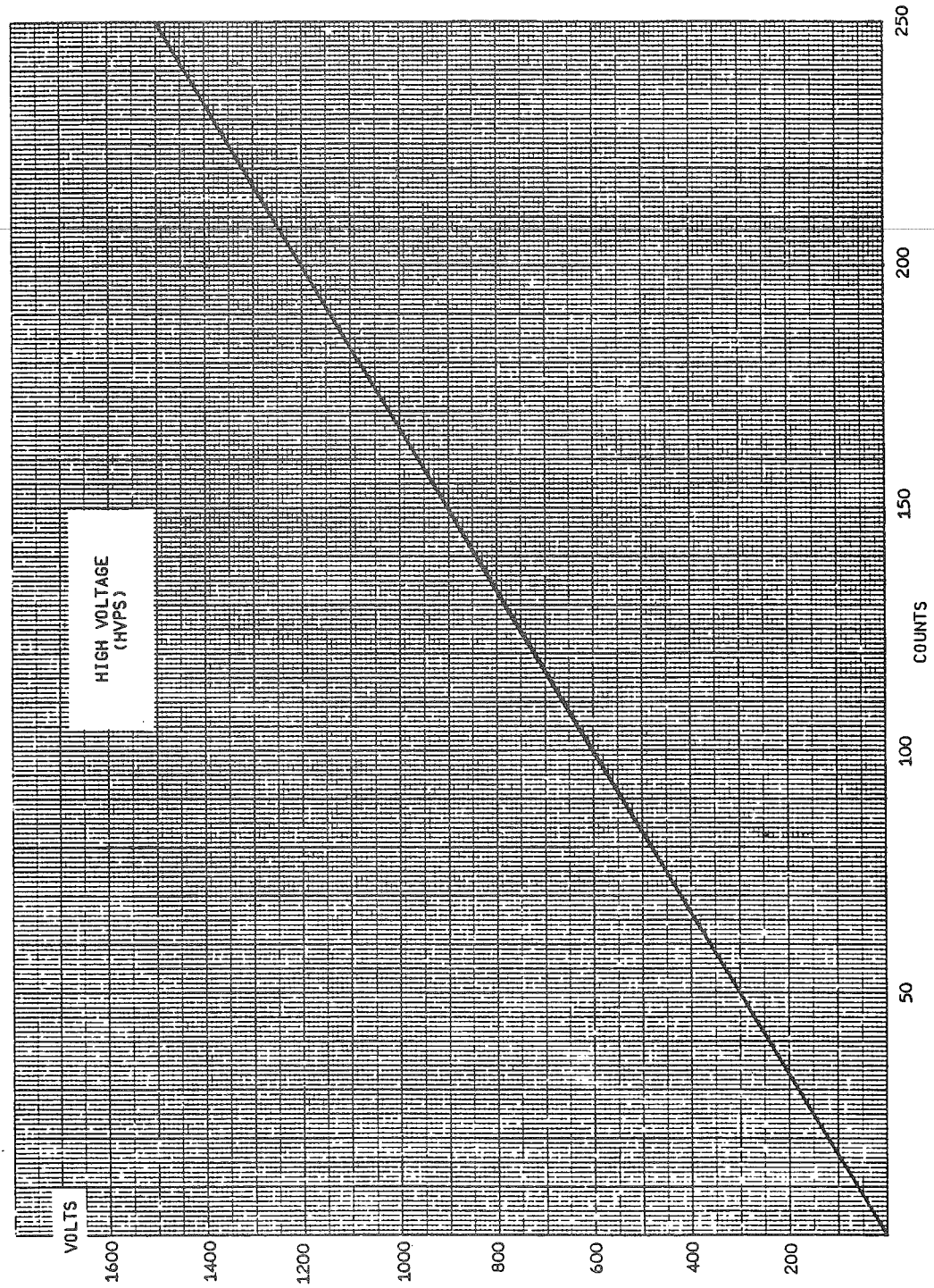


Figure 4-13 High voltage

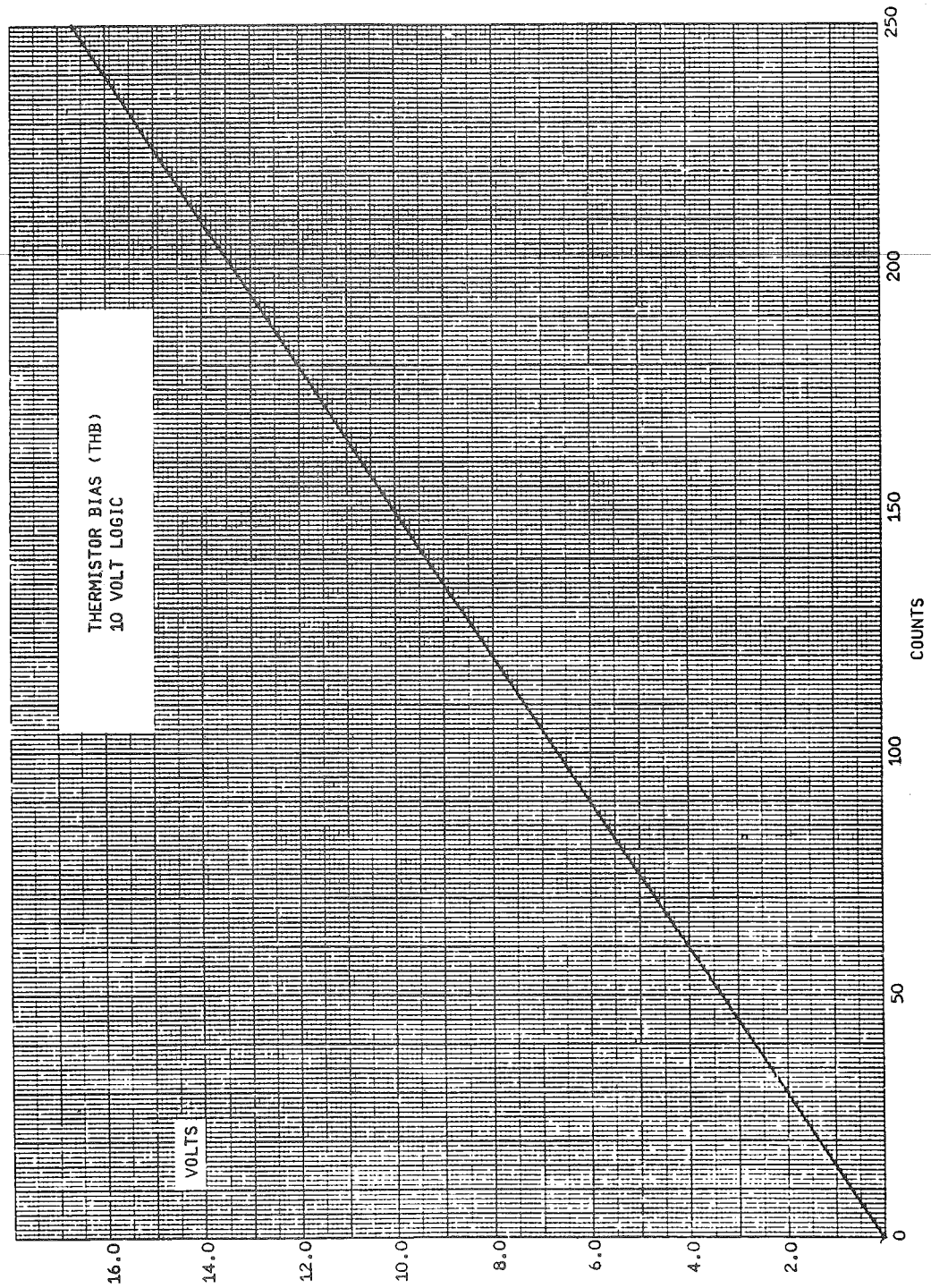


Figure 4-14 Thermistor bias and 10 volt logic

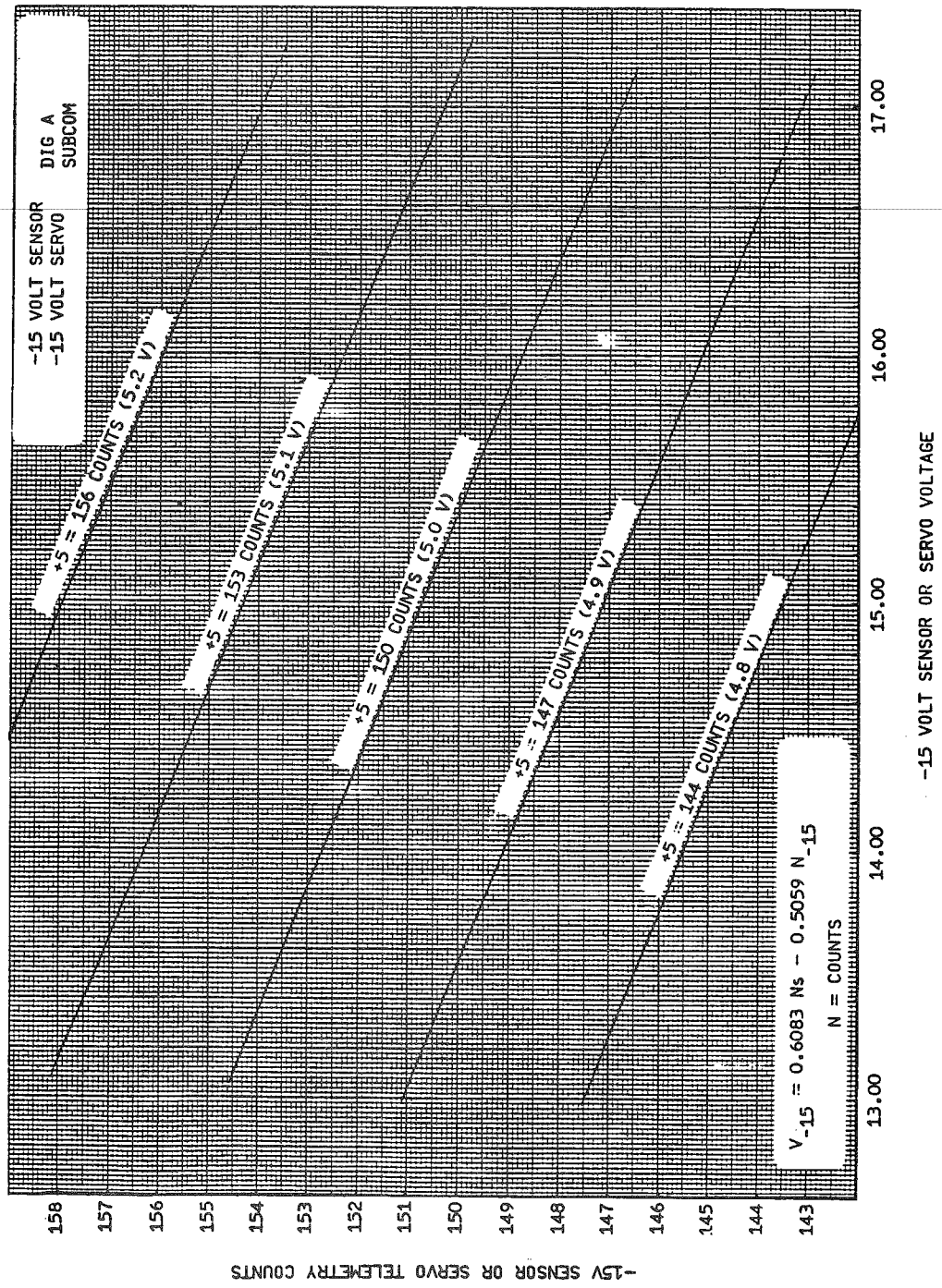


Figure 4-15 -15 Volt sensor and servo

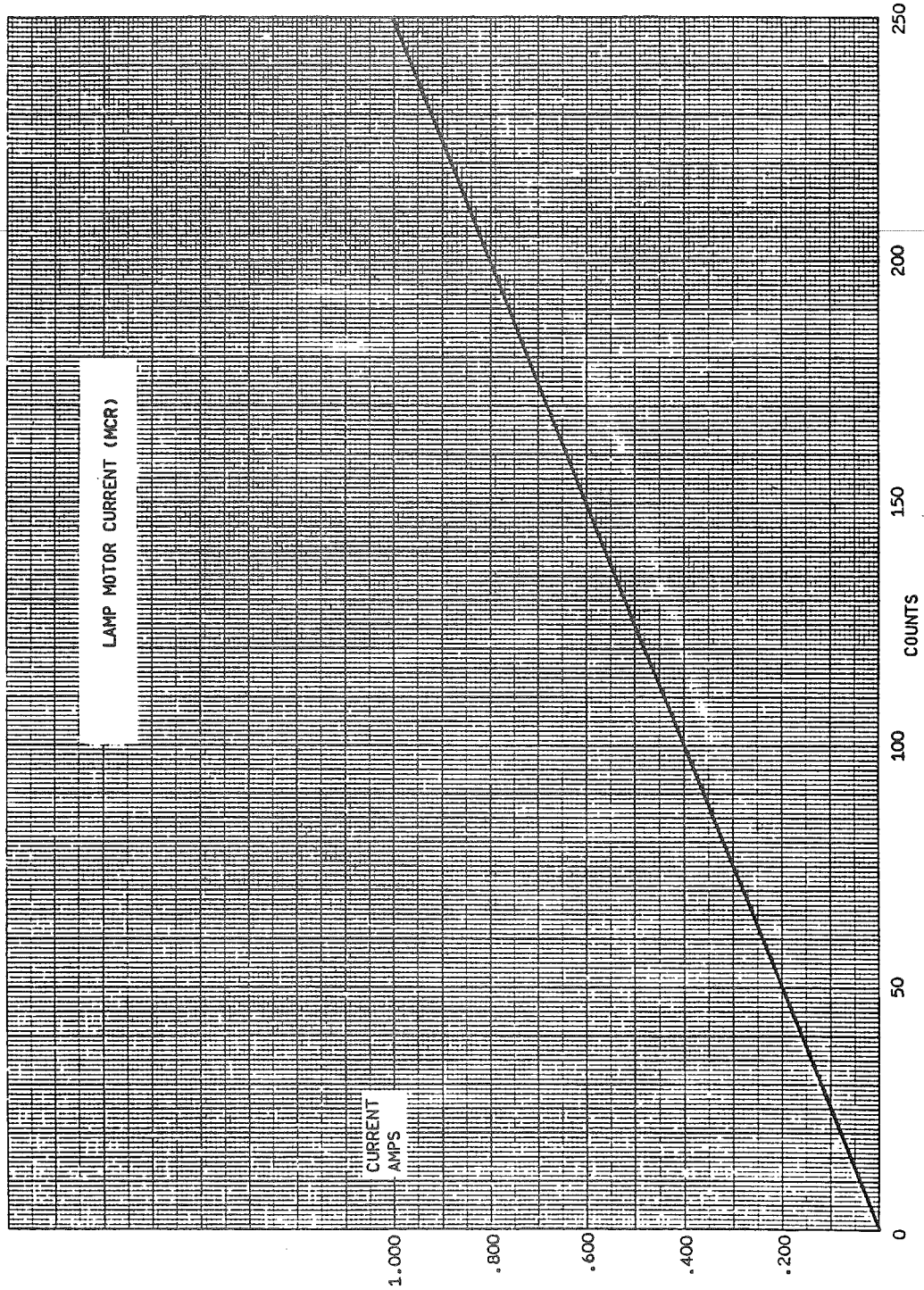


Figure 4-16 Lamp motor current

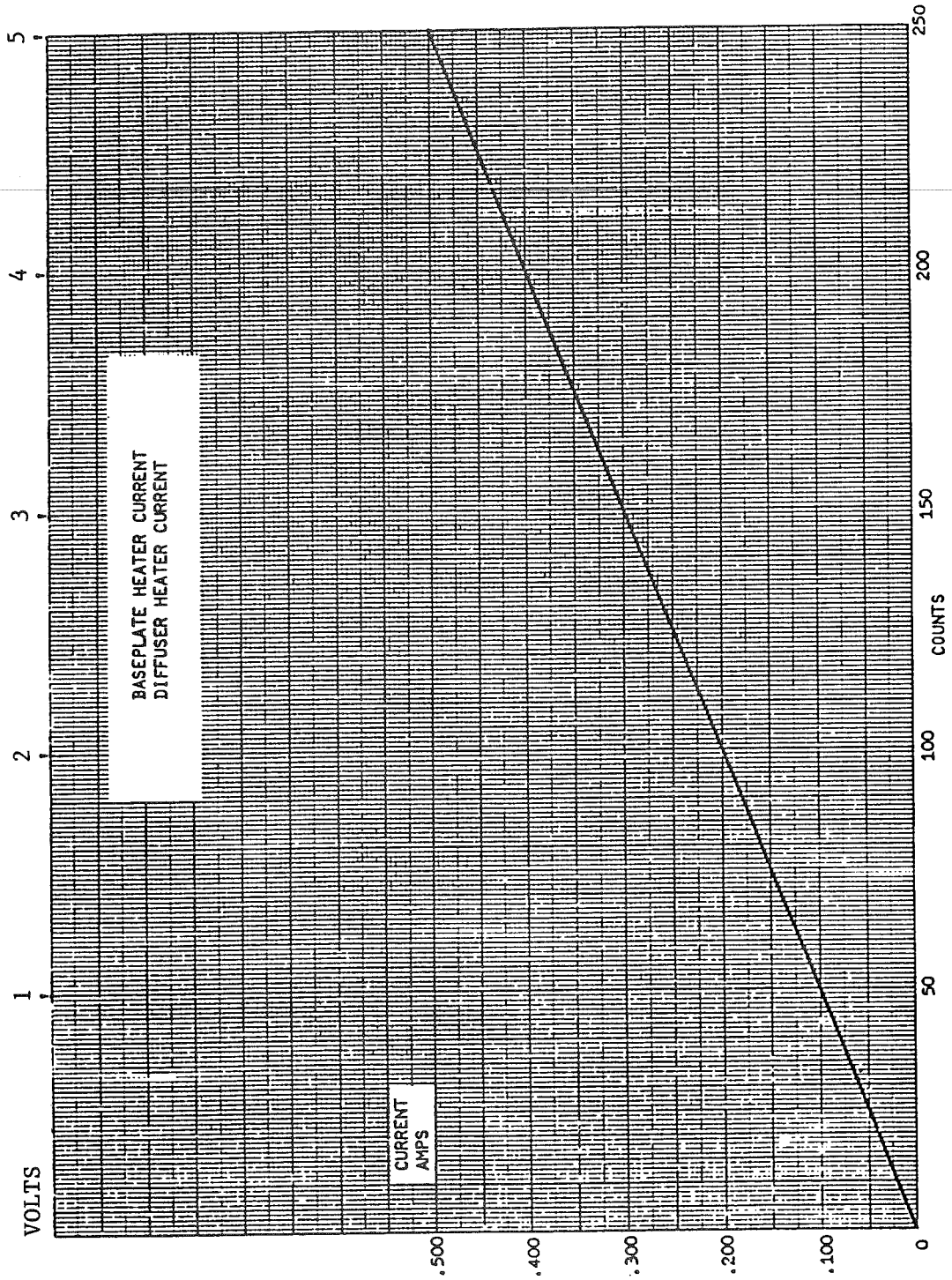


Figure 4-17 Baseplate and diffuser heater current

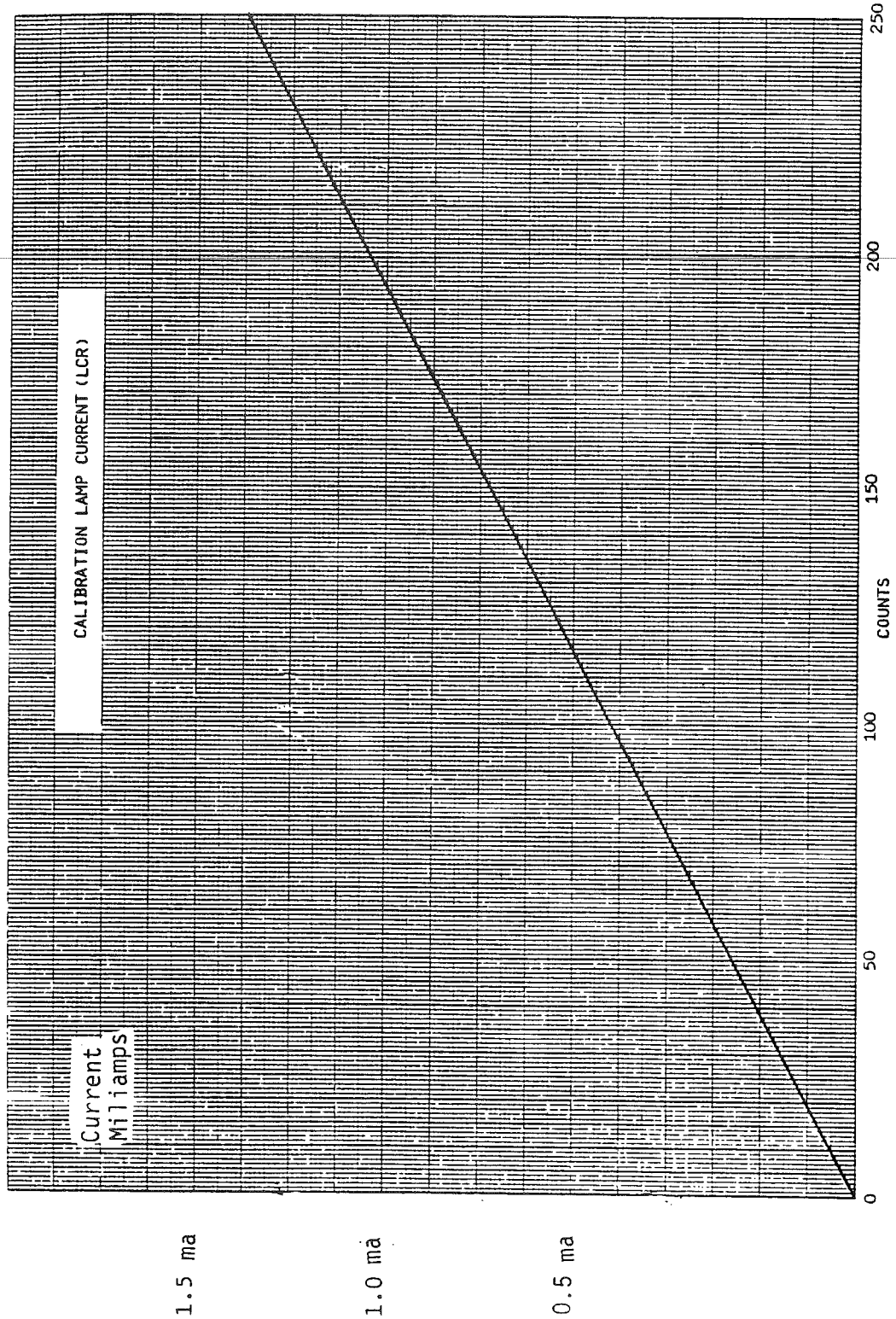


Figure 4-18 Calibration lamp current

Section 5
POWER PROFILE/INPUT VOLTAGE
(REFERENCE TEST PROCEDURE 68026)

Power Profile

The instrument power is summarized in **Table 5-1**. It shows an average orbital power for the various buses as well as a maximum orbital average. For more detailed data, see section 8.3 of 68026.

Normal Operation/Input Voltage Range

The instrument performed normally when operated from the main power bus and the voltage was varied from +27.00 to +29.00 volts. The complete Electrical Functional Test Procedure (68033) was run three times: at 27, 28, and 29 volts. All telemetry was within nominal limits, and instrument performance was within specifications.

Table 5-1

SBUV/2 FLIGHT 4 POWER MEASUREMENTS

Specific Parameter	+28 Volt Main Bus Plus Pulse Load Bus		+28 Volt Telemetry Bus		+10 Volt Interface Bus	
	Measured	Spec	Measured	Spec	Measured	Spec
TYPICAL AVERAGE POWER, WATTS Operating in Discrete Mode with one Discrete Sun Enable sequence	14.56	17.0	0.092	None	0.080	None
MAXIMUM ORBITAL AVERAGE POWER, WATTS Operating in Discrete Mode with one Wavelength Cal Enable sequence	18.17	None	0.092	None	0.080	None
PEAK CURRENT, AMPS*	1.53	1.50	0.0033	0.010	0.0084	0.01

*During motor pulse turn-on, the 28 volt pulse sustained a 5.5 Amp pulse. This was measured by connecting a 10,000 μF electrolytic capacitor to the 28 volt pulse bus at the ELM input.

Waivers 010 and 011 describe out-of-spec power conditions.

Section 6
ELECTRONIC CALIBRATION AND STABILITY
(Reference Test Procedure 68026)

Table 6-1 lists the mean E-CAL counts and percent errors in the Discrete and Sweep Modes for both the Cloud Cover Radiometer and Monochrometer. Twenty-six data points were used from day 119 through day 300 1987. **Table 6-2** lists the tests the data was gathered from, **Figures 6-1** through **Figure 6-13** i ll ustrate the stability of the system.

The E-Cal voltage measurements show good stability over the course of the test program. With the exception of the zero voltage input, all deviations in the data are less than 2%. System noise at zero volts, approximately 64 counts, is responsible for the larger deviations.

Table 6-1
ELECTRONIC CALIBRATION

MODE	DISCRETE								SWEEP	
RANGE	2 SECONDS AFTER RETRACE "A"	PERCENT ERROR *	4 SECONDS AFTER RETRACE "B"	PERCENT ERROR *	6 SECONDS AFTER RETRACE "C"	PERCENT ERROR *	8 SECONDS AFTER RETRACE "D"	PERCENT ERROR *	10 SECONDS AFTER RETRACE "E"	PERCENT ERROR *
1	Overrange	N/A	9032.8	0.35	Overrange	N/A	64.14	23.39	N/A	N/A
2	10627	0.24	Underrange	N/A	798.85	1.38	Underrange	N/A	N/A	N/A
3	63.45	17.34	759.69	1.58	7148.3	0.21	37090	0.15	6030.3	0.18
CCR	44667	0.17	954.19	0.42	9261.3	0.18	61.64	3.24	56191	0.24

$$* \text{ Percent Error} = \frac{\text{Maximum} - \text{Minimum}}{\text{Mean}} \times 100\%$$

Table 6-2

ELECTRONIC CALIBRATION STABILITY

#	Date	Procedure	Name of Test
0	4/29	68025	Baseline from Integration Test
1	5/27	68042	Minifunctional
2	6/2	68033	Electrical Functional
3	6/1	68033	Electrical Functional
4	6/3	68033	Electrical Functional
5	7/8	68042	Minifunctional during Vibration
6	7/11	68042	Minifunctional during Vibration
7	7/13	68042	Minifunctional during Vibration
8	7/14	68042	Minifunctional during Vibration
9	7/21	68040	Minivac
10	7/22	68040	Minivac
11	7/22	68040	Minivac
12	7/24	68040	Minivac
13	7/25	68040	Minivac
14	7/26	68040	Minivac
15	7/27	68040	Minivac
16	8/10	68042	Minifunctional
17	9/8	68042	Minifunctional
18	9/15	68042	Minifunctional
19	10/9	69821	Benchtest
20	10/15	68040	Thermal Test
21	10/15	68040	Thermal Test
22	10/16	68040	Thermal Test
23	10/16	68040	Thermal Test
24	10/19	69821	Benchtest
25	10/27	69821	Benchtest

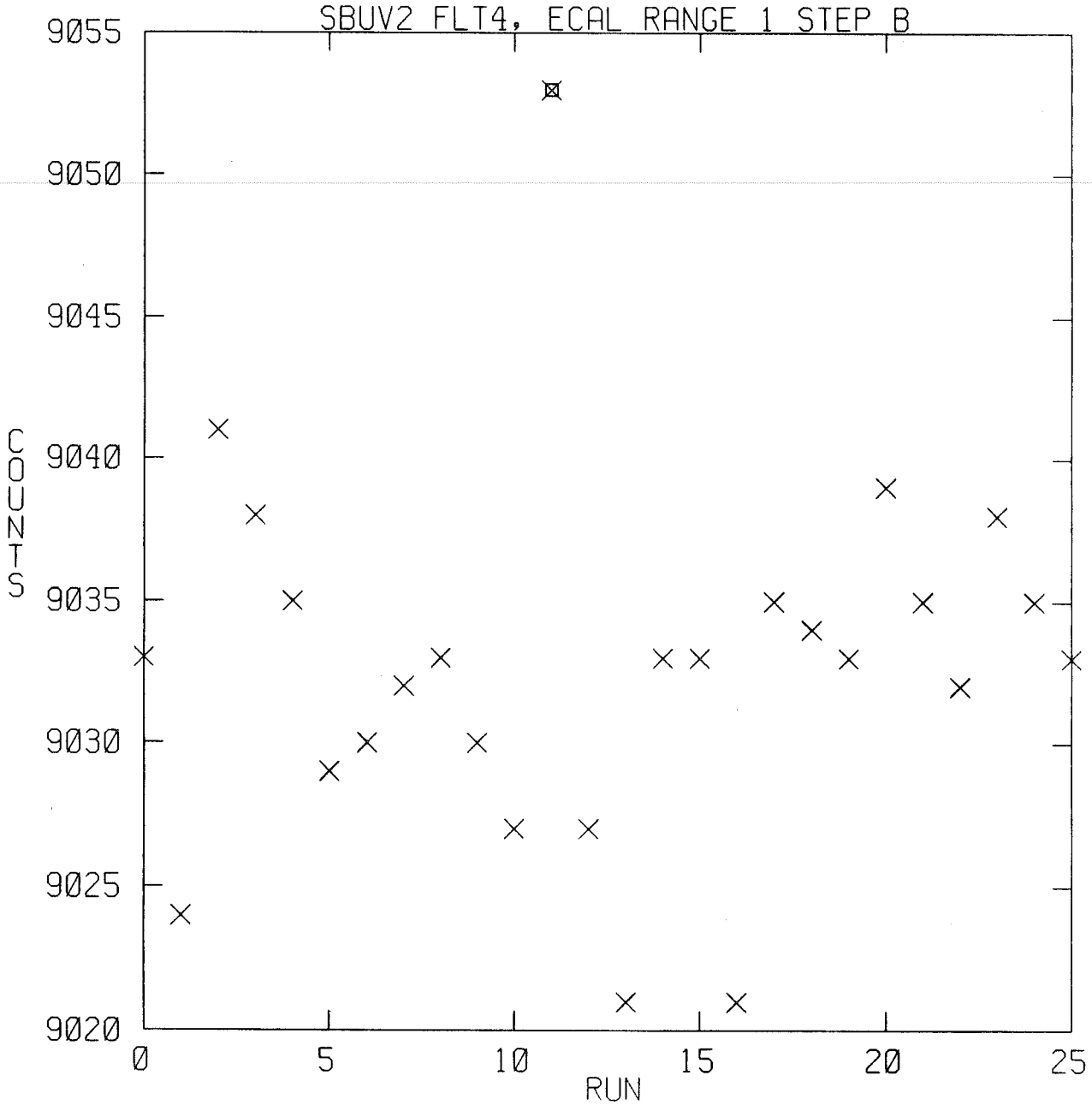


Figure 6-1 Flight 4 ECAL range 1 step B

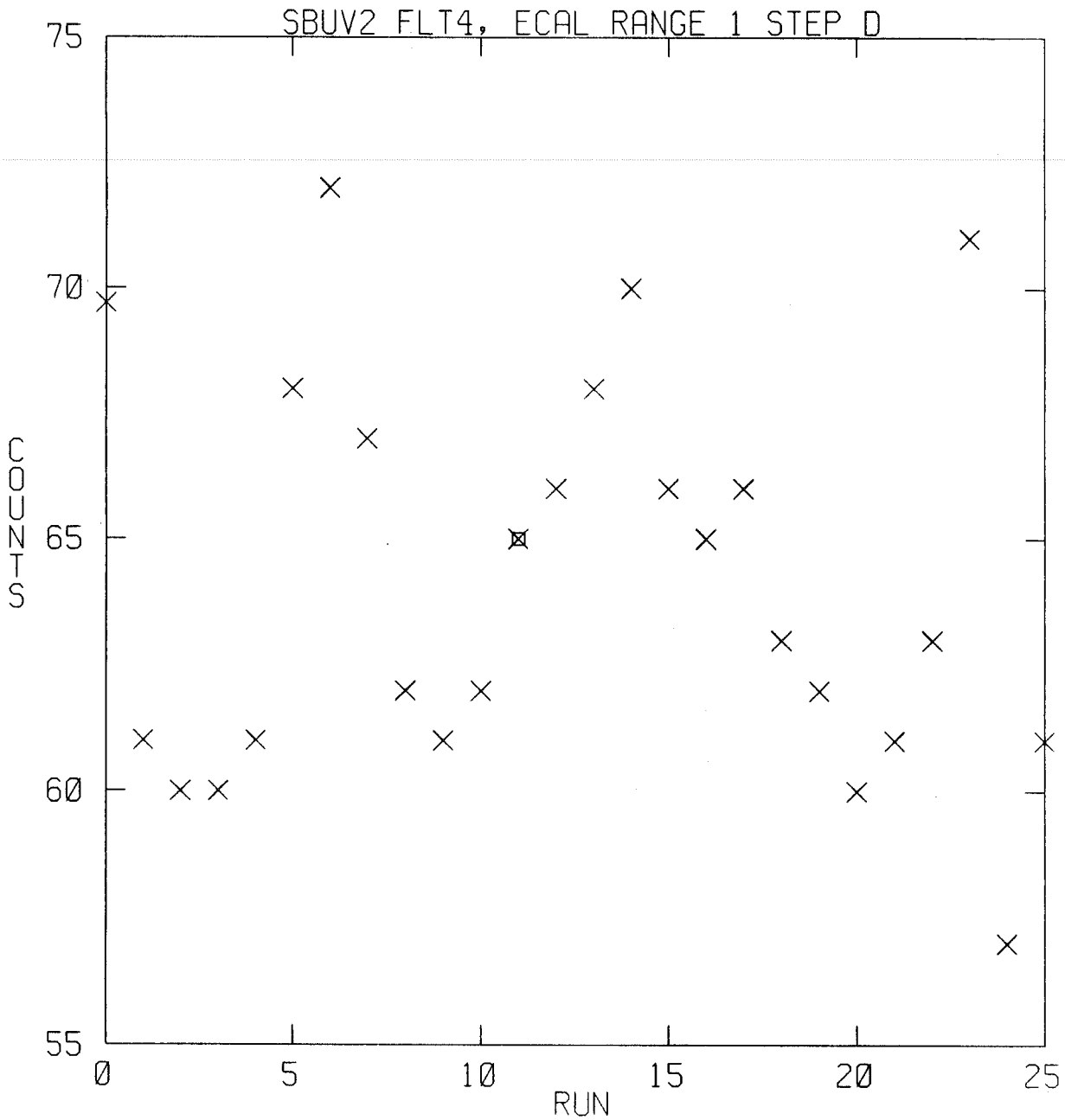


Figure 6-2 Flight 4 ECAL range 1 step D

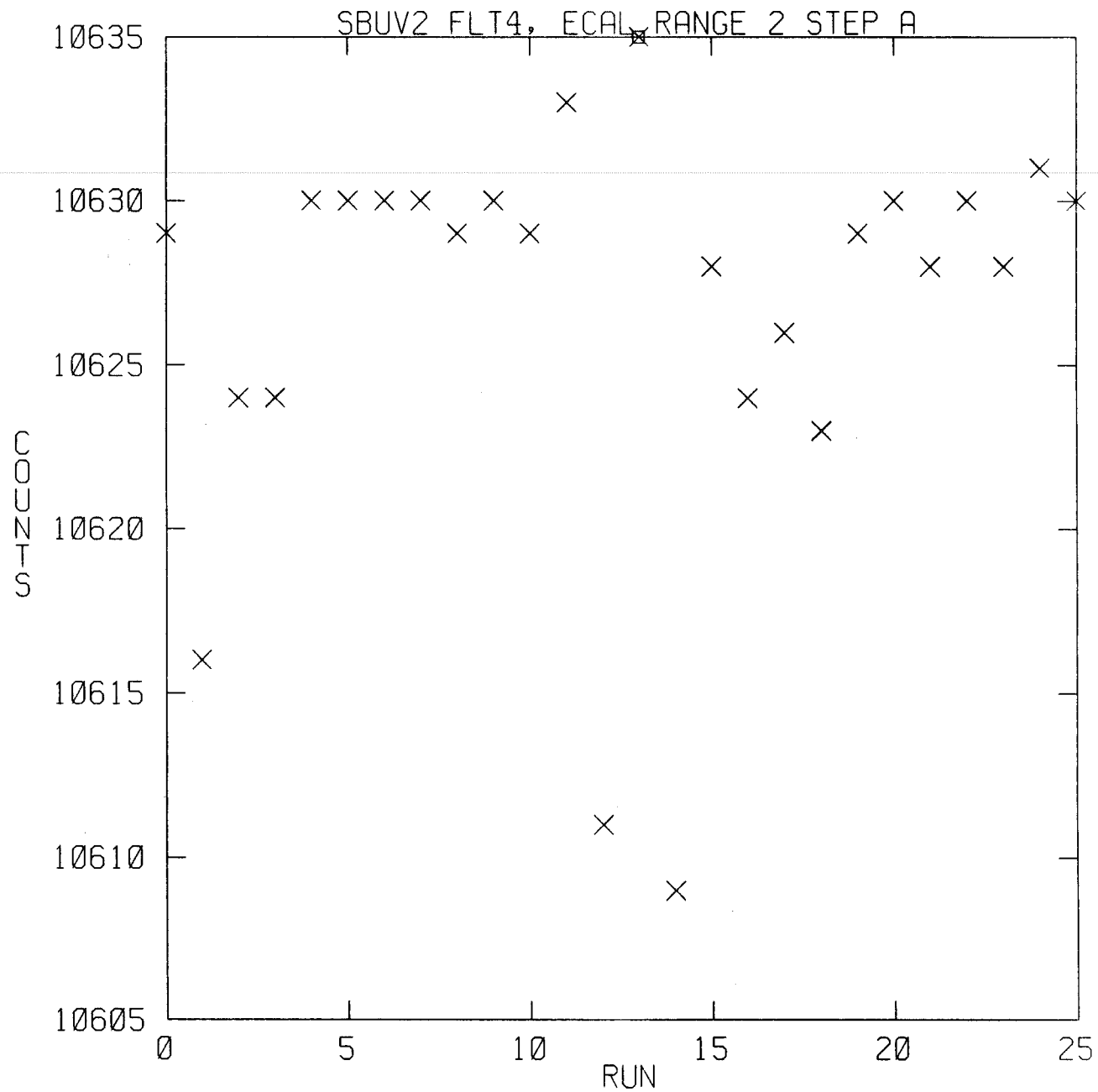


Figure 6-3 Flight 4 ECAL range 2 step A

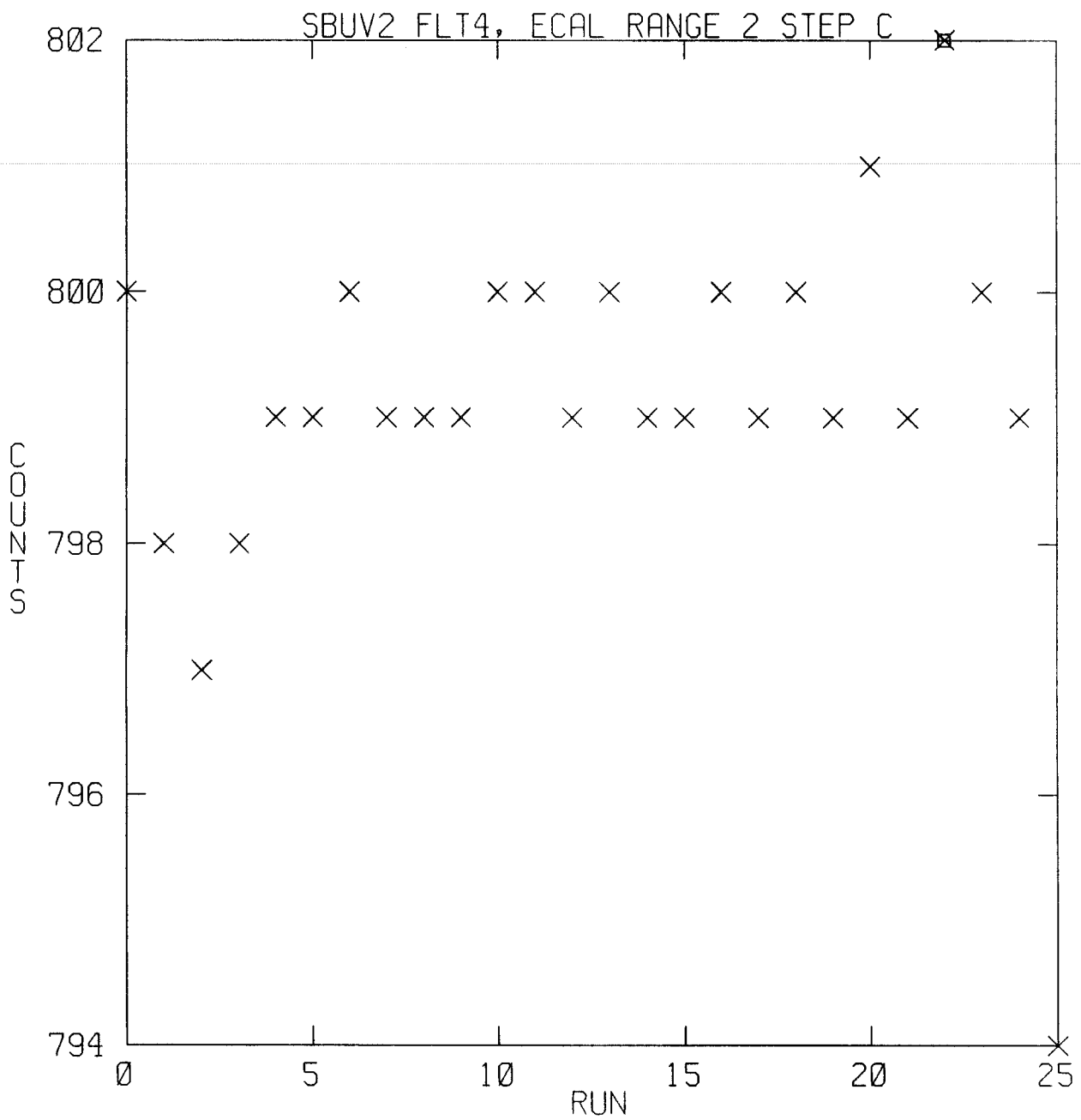


Figure 6-4 Flight 4 ECAL range 2 step C

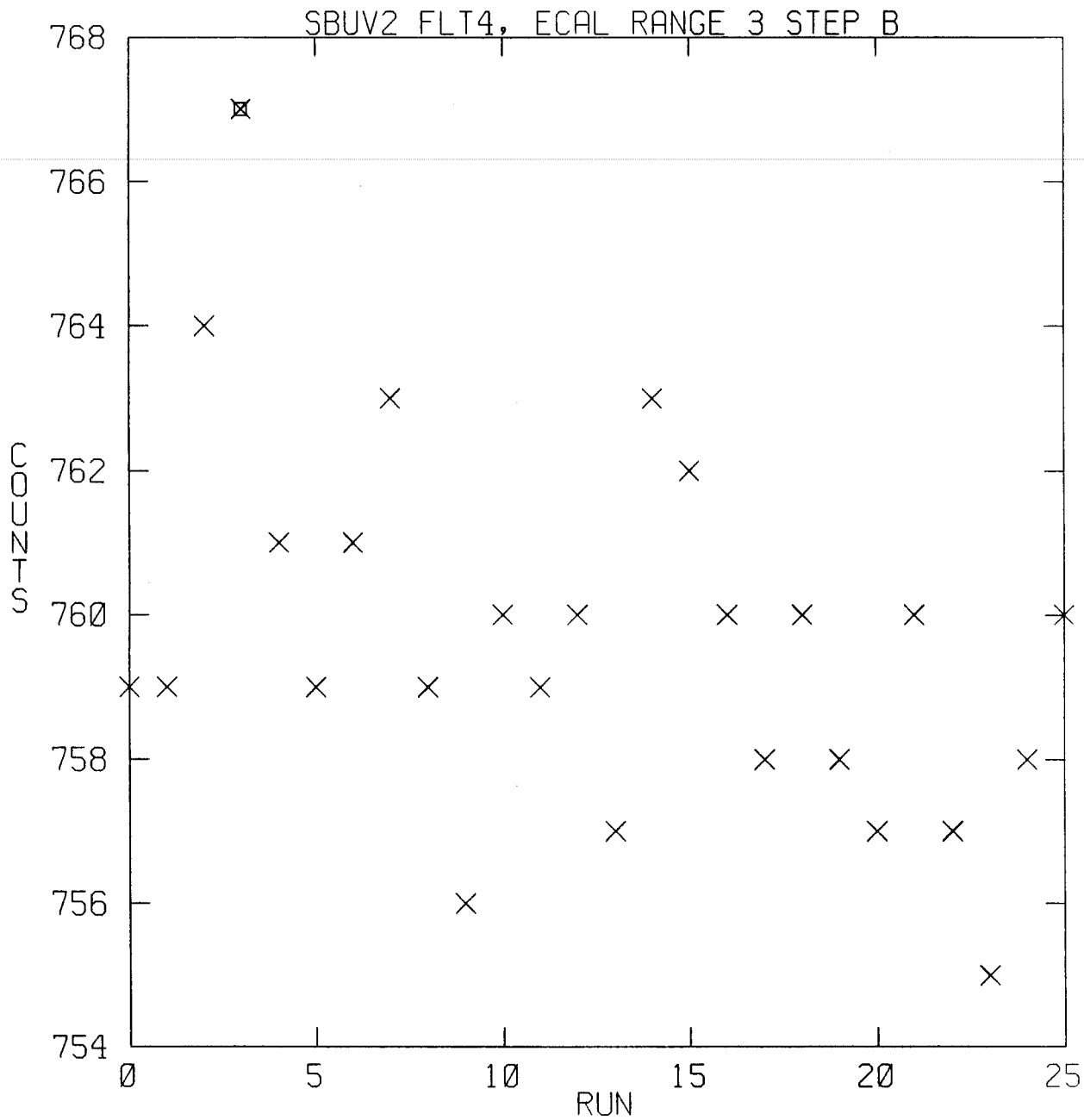


Figure 6-5 Flight 4 ECAL range 3 step B

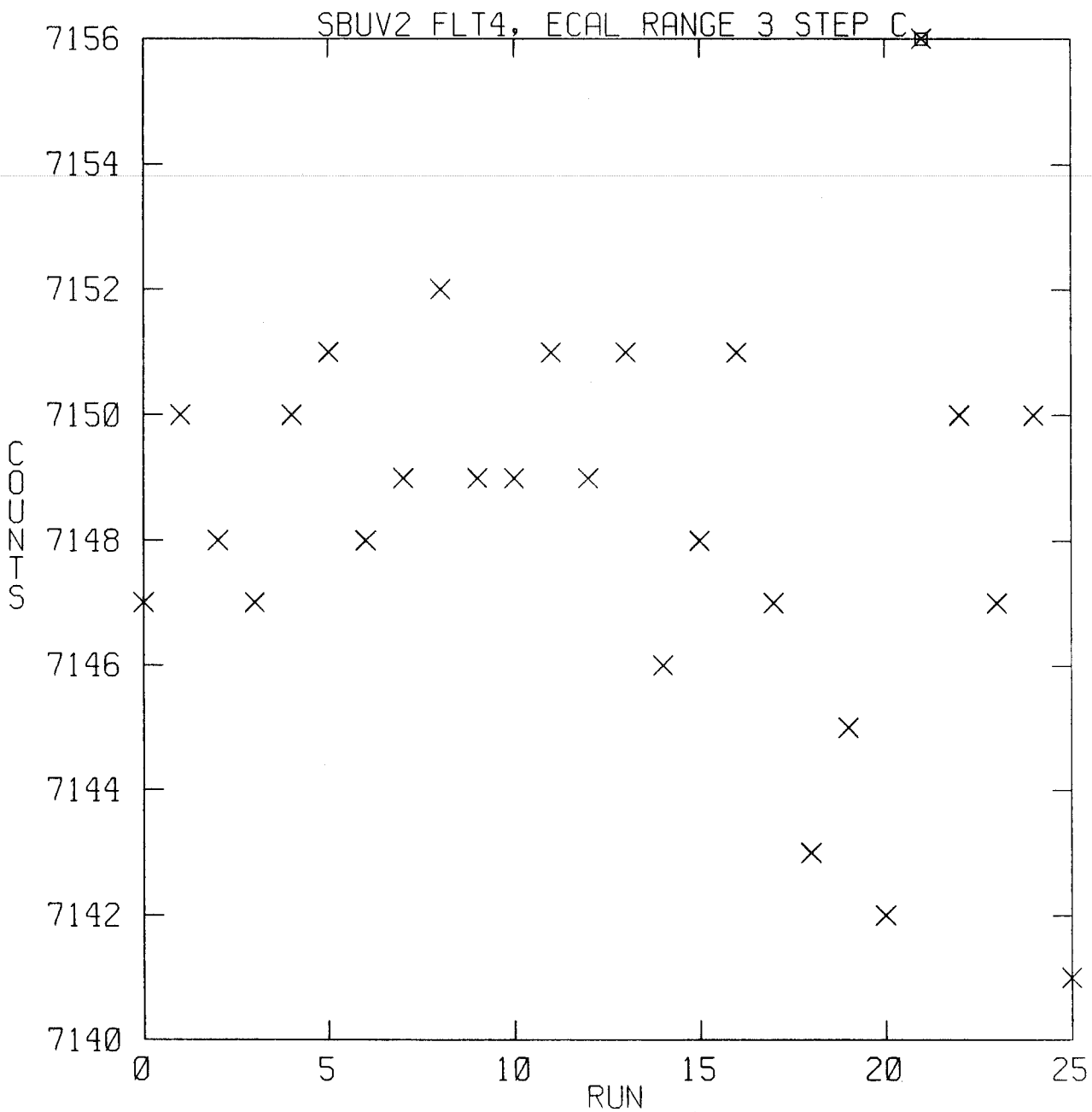


Figure 6-6 Flight 4 ECAL range 3 step C

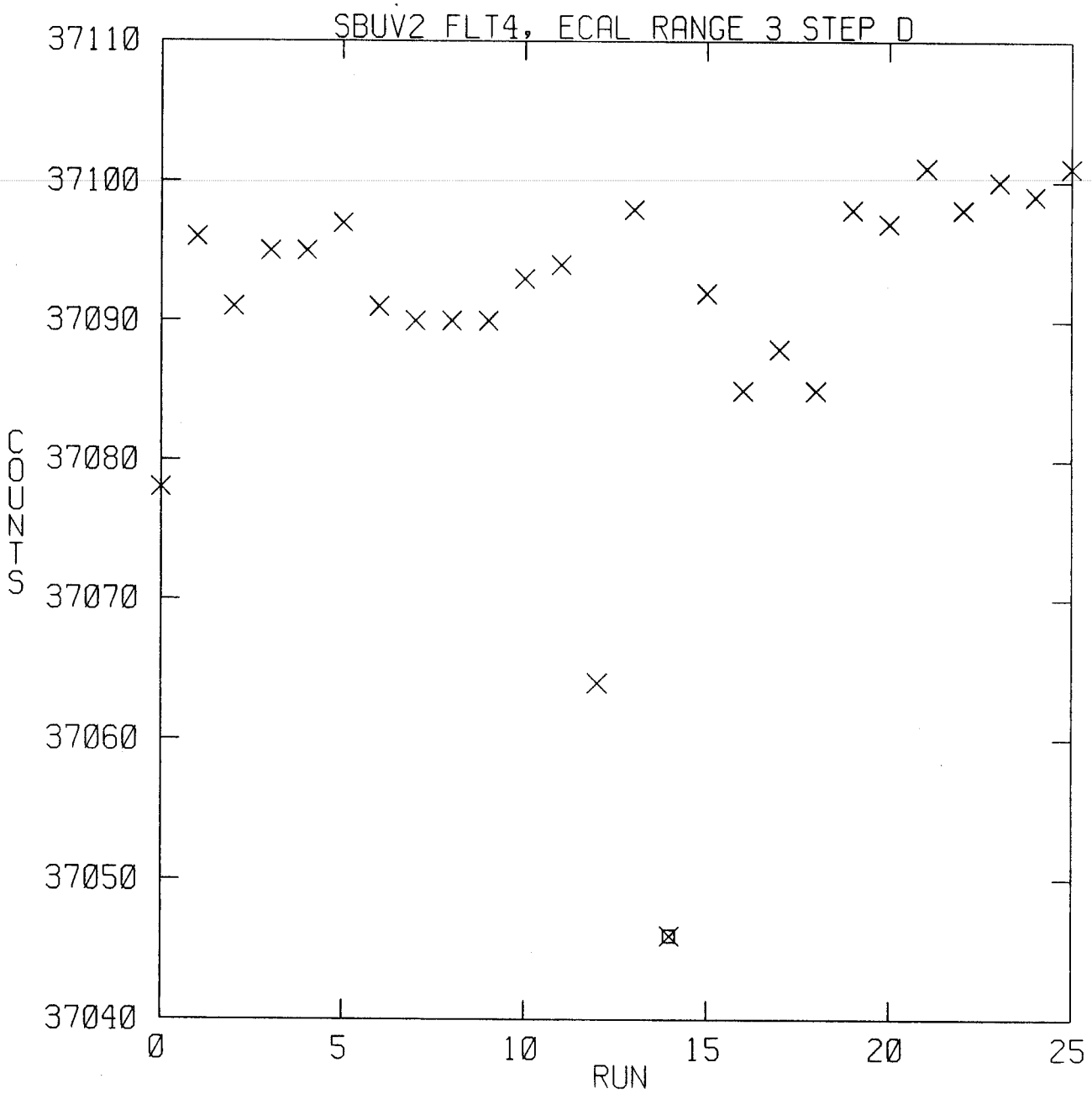


Figure 6-7 Flight 4 ECAL range 3 step D

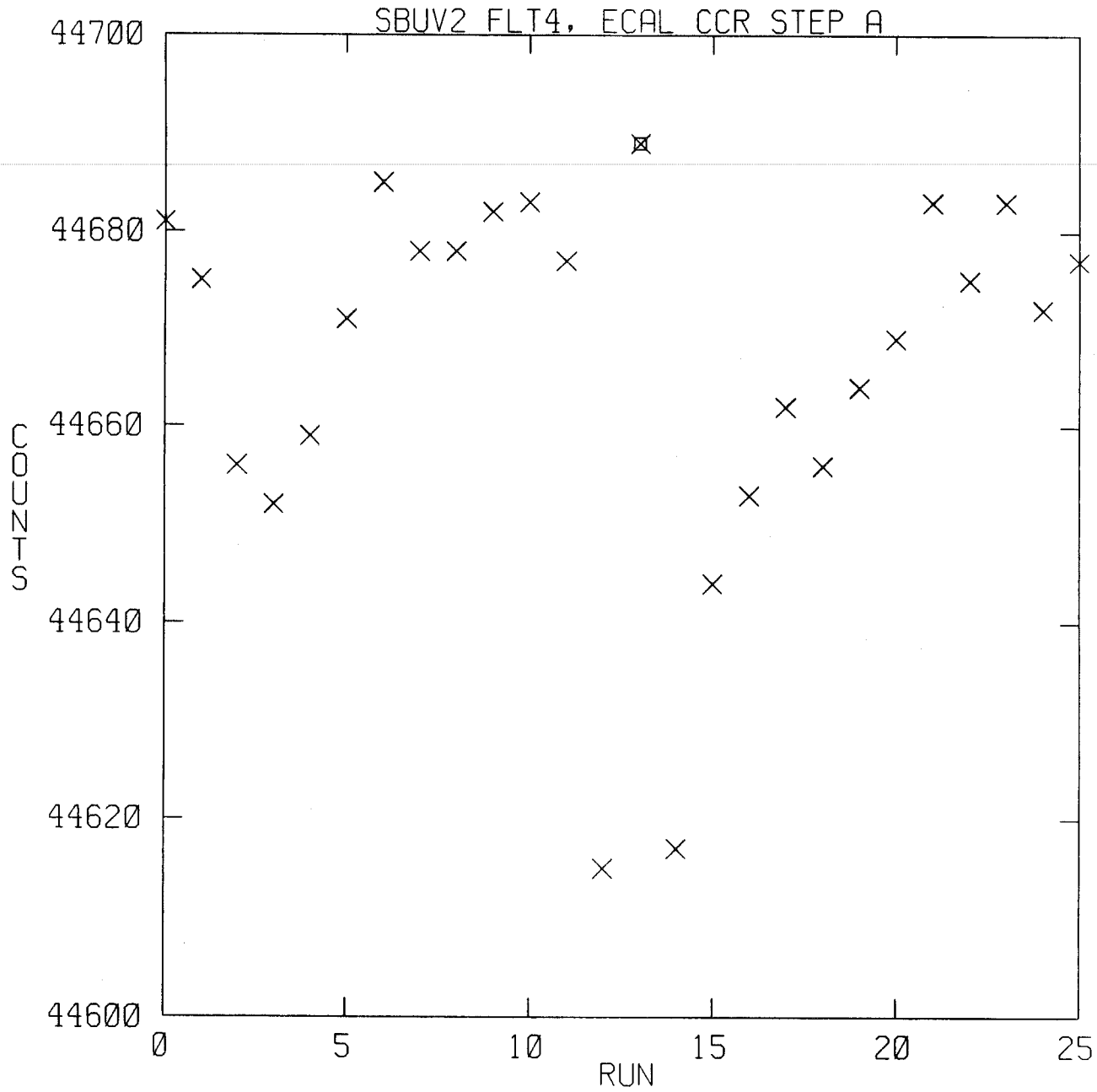


Figure 6-8 Flight 4 ECAL CCR step A

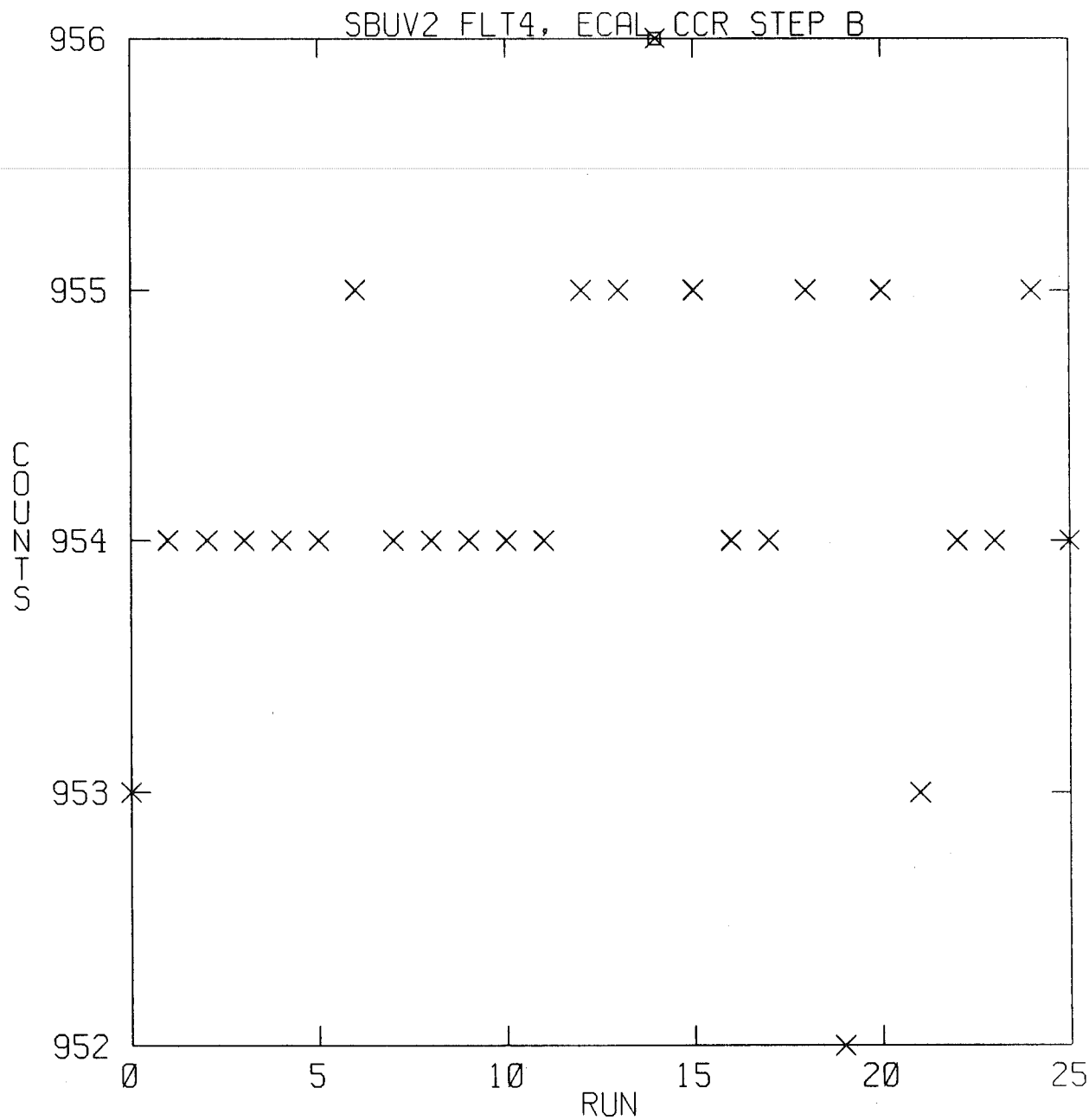


Figure 6-9 Flight 4 ECAL CCR step B

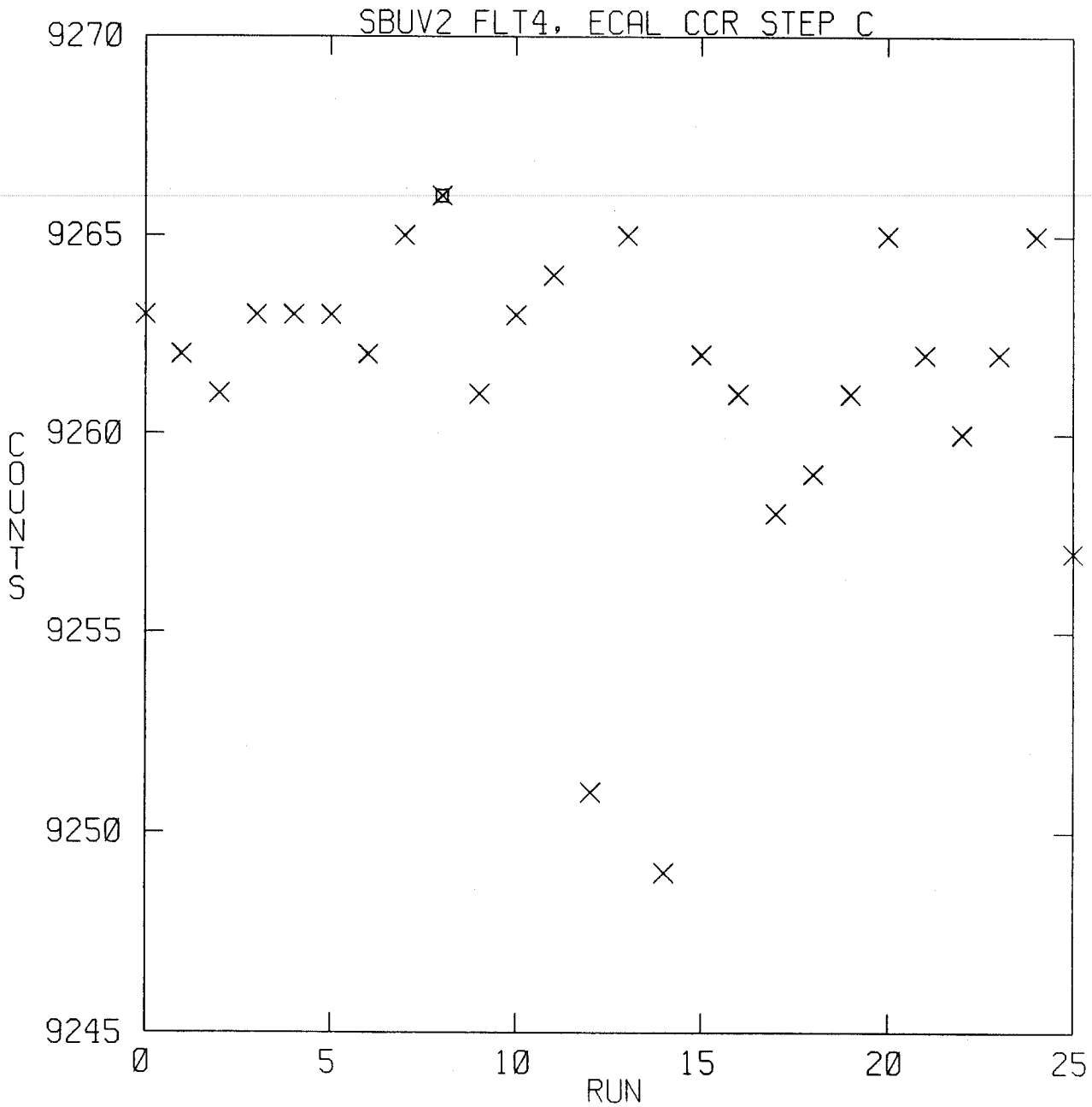


Figure 6-10 Flight 4 ECAL CCR step C

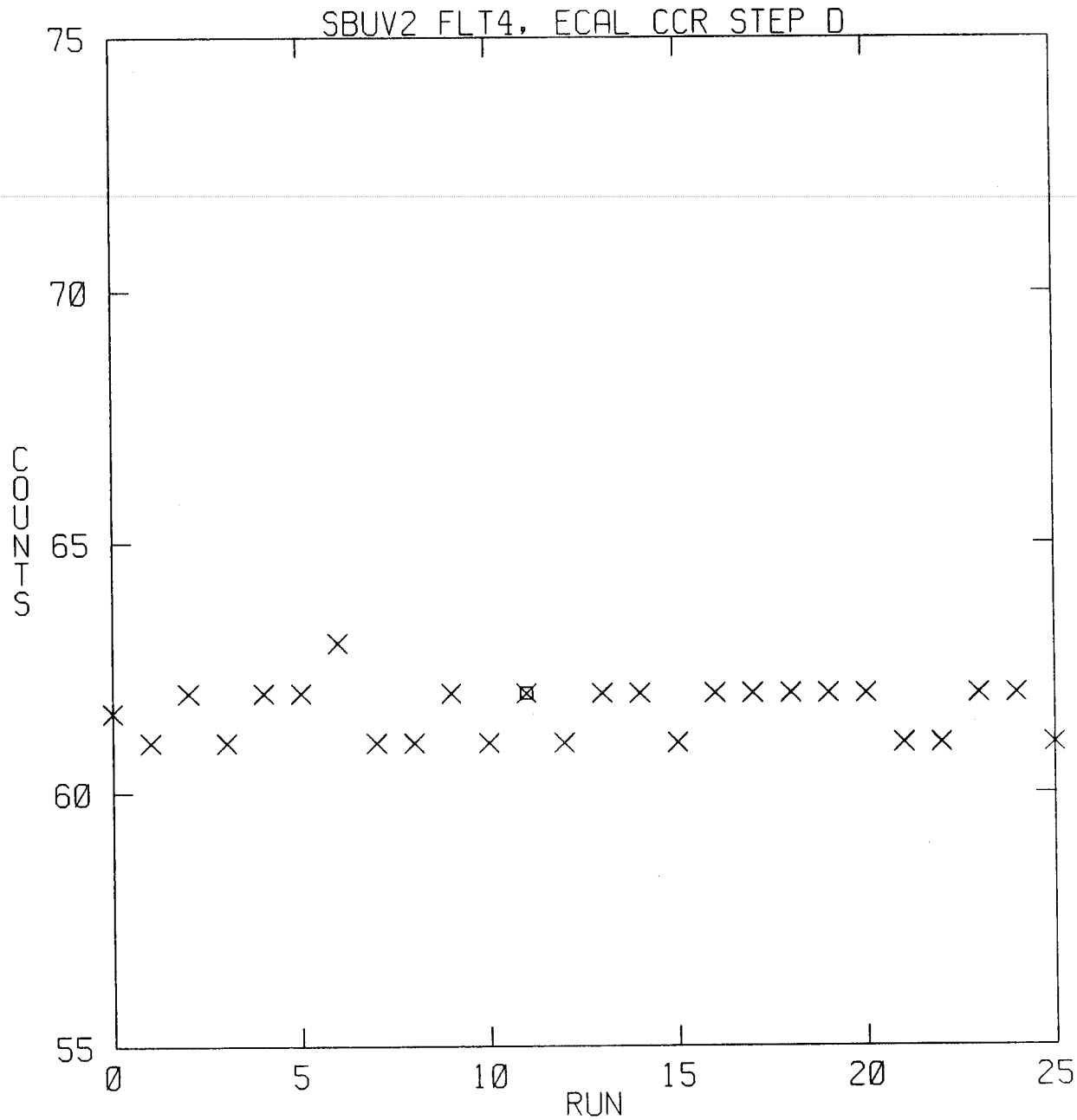


Figure 6-11 Flight 4 ECAL CCR step D

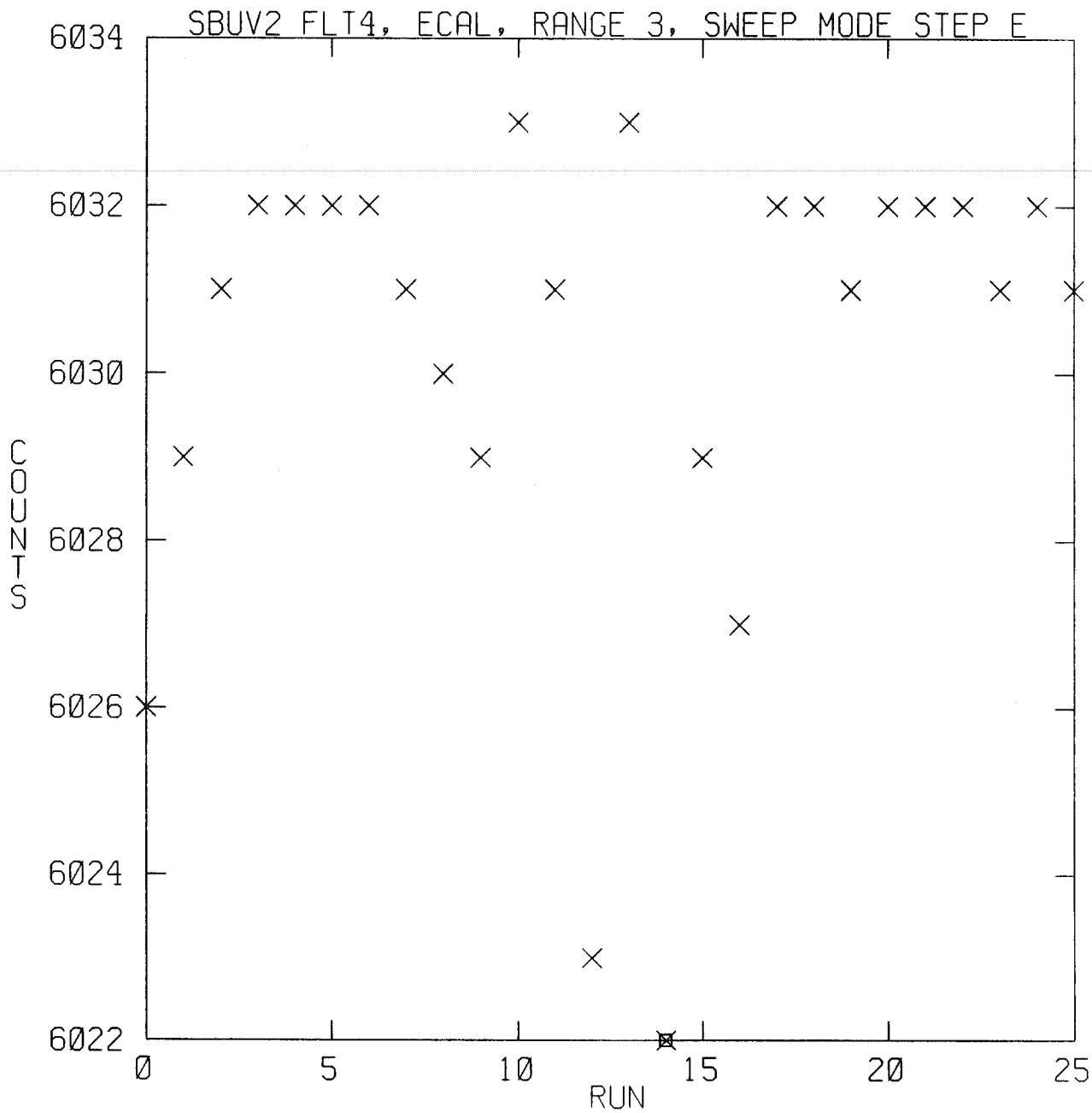


Figure 6-12 Flight 4 ECAL range 3 sweep mode step E

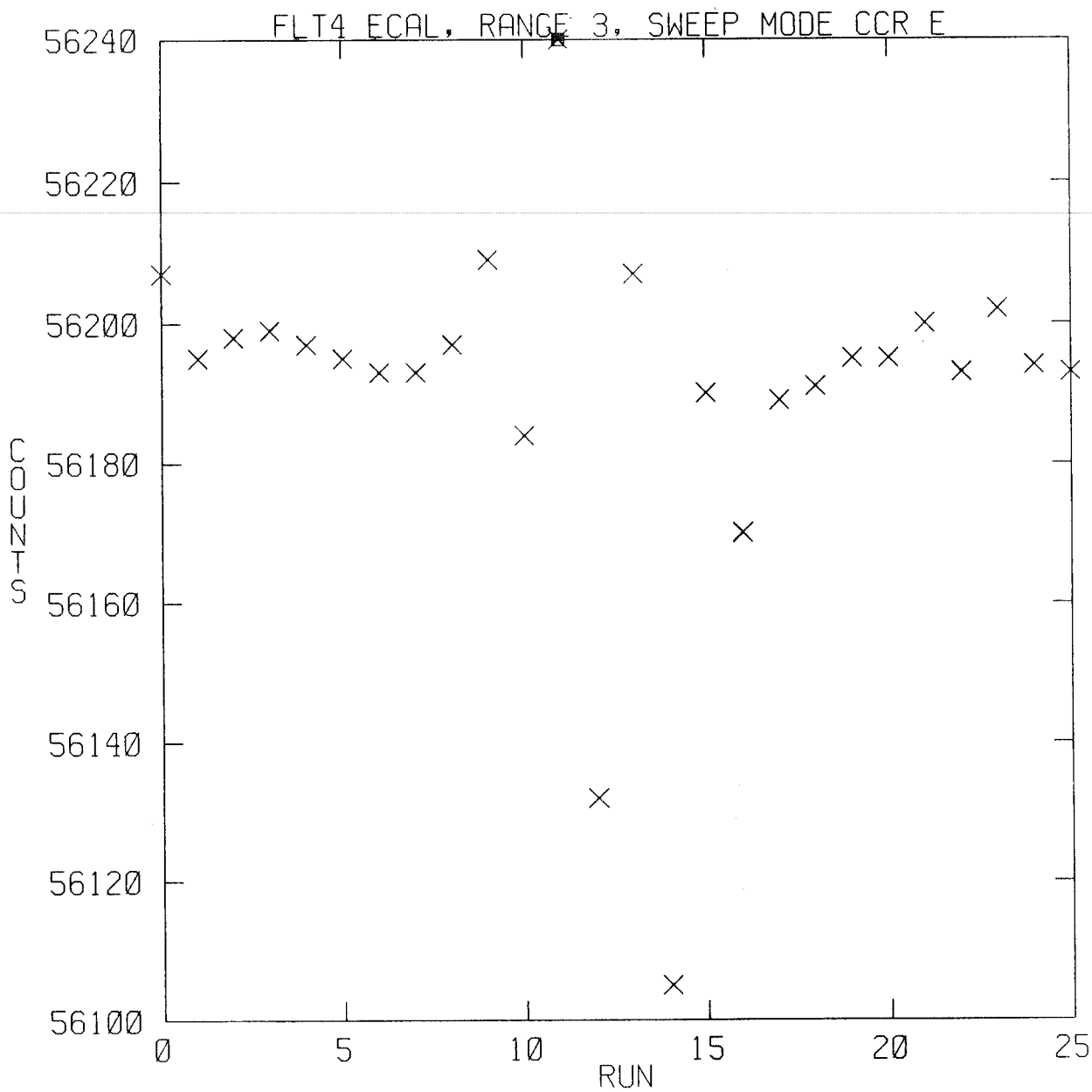


Figure 6-13 Flight 4 ECAL range 3 sweep mode CCR E

Section 7

SIGNAL-TO-NOISE RATIO AND STABILITY

(Reference Test Procedure 68026)

The signal-to-noise ratio was measured at signal levels which were approximately 0.8 times, 1.2 times, and very near the required radiance level. With three data points, a curve is established and the signal-to-noise ratio at the required radiance level interpolated from it.

Table 7-1 gives the resulting values measured for signal-to-noise ratio, and describes how the ratios were calculated. In all cases, the signal-to-noise ratio measured was greater than the minimum requirement.

Table 7-2 shows the signal-to-noise ratio stability for the discrete and sweep modes. This data was taken during test procedure #68042. Figure 7-1 is a graph of the data points for both modes.

Table 7-1

MEASURED SIGNAL-TO-NOISE RATIO

Wavelength	Required Source Intensity (Radiance)	Discrete Required Minimum Signal-to-Noise	Measured Signal-to-Noise	Sweep Required Minimum Signal-to-Noise	Measured Signal-to-Noise
252.0*	1.20×10^{-3}	35	48	10	11
273.5	4.98×10^{-3}	100	607	30	49
283.0	9.78×10^{-3}	200	1,032	60	83
287.6	1.30×10^{-2}	260	1,093	80	100
292.2	2.39×10^{-2}	400	2,150	145	173
297.5	3.48×10^{-2}	400	4,681	210	377
301.9	3.84×10^{-2}	400	3,705	230	321
305.8	6.72×10^{-2}	400	6,893	400	549
312.5	1.49×10^{-1}	400	890	400	3,243
317.5	3.09×10^{-1}	400	3,356	400	19,680
331.2**	2.08	400	9,539	400	12,864
339.8**	4.12	400	14,504	400	26,174
CCR	1.25	100	110	---	---

* The signal-to-noise ratio for 252 nm was calculated as follows:

$$\frac{\text{Mean Counts}}{\text{Standard Deviation}} = \text{Signal-to-Noise Ratio}$$

** The signal-to-noise ratio for 331.2 nm and 339.8 nm was calculated as follows:

$$\left(\frac{\text{Mean Counts}}{\text{Background Noise}}\right)\sqrt{\frac{\text{Required Radiance}}{\text{Radiance for Counts}}} = \text{Signal-to-Noise at the Required Radiance}$$

• The following calculation was used to determine the remaining signal-to-noise ratios:

$$\text{Signal-to-Noise Ratio} = \frac{\text{Mean Counts}}{\text{Background Noise}}$$

Table 7-2

FLIGHT 4 SIGNAL-TO-NOISE RATIO STABILITY (CH 1)

DATE	DISCRETE	SWEEP
6/6/87	60.3	26.5
7/8/87	90.2	49.7
7/11/87	76.7	43.4
7/14/87	83.9	50.2
7/16/87	66.1	47.4
8/19/87	45.7	19.6
9/8/87	55.9	5
9/16/87	77	43.6

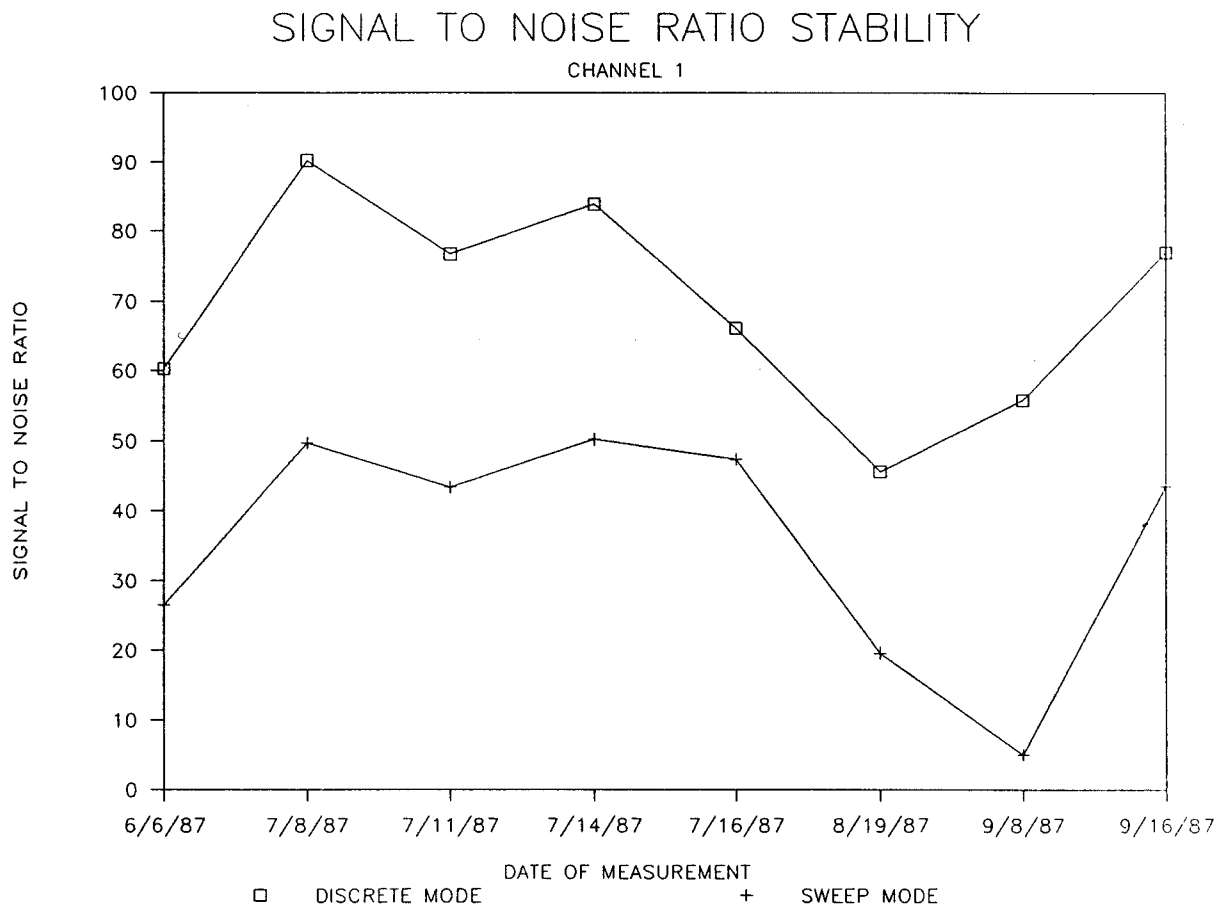


Figure 7-1 Signal-to-noise ratio stability

Section 8
BACKGROUND STABILITY
(Reference Test Procedure 68027)

The background stability of the instrument was tabulated from Day 119 through Day 314 1987 in **Table 8-1**. The average of the twenty-four background tests is 67.29 for range 1, 65.51 for range 2, 62.00 for range 3, and 64.63 for the CCR. **Table 8-2** lists the tests that the data was taken from. A graph of each range and the CCR is shown in **Figure 8-1** through **Figure 8-4**.

TABLE 8-1

BACKGROUND STABILITY

#	Date	Range 1	Range 2	Range 3	CCR
1	4/29	68.99	65.59	61.22	***
2	5/27	67.19	65.57	61.69	64.81
3	6/1	67.13	65.54	60.33	64.84
4	6/2	66.68	65.46	62.97	64.49
5	6/3	67.44	65.53	67.4	64.04
6	7/8	67.45	65.6	60.96	64.77
7	7/11	66.74	65.61	62.82	64.58
8	7/13	70.2	65.7	62	64.7
9	7/14	68.5	65.5	60.3	64.7
10	7/21	57.86	65.16	58.4	64.8
11	7/22	64.34	65.17	69.88	63.48
12	7/23	**	65.22	57.46	64.75
13	7/24	**	65.32	65.92	64.04
14	7/25	73.18	65.35	71.47	63.24
15	7/26	**	65.58	57.35	65.15
16	8/10	68.71	65.58	61.58	64.86
17	9/8	67.55	65.55	59.2	64.95
18	9/15	68.73	65.63	60.36	65.03
19	10/8	66.59	65.54	58.89	64.99
20	10/15	64.86	65.54	62.58	64.44
21	10/16	67.68	65.64	59.76	65.13
22	10/19	68.34	65.64	63.64	65.54
23	10/27	67.49	65.69	62.34	64.54
24	11/10	67.39	65.49	59.44	64.89
	AVERAGE:	67.29	65.51	62.00	64.63

**: overranged in Thermal-Vac Testing
***: not recorded on data sheet

FLT425AY8-1

TABLE 8-2

BACKGROUND STABILITY

TEST PROCEDURES

Flight 4 Background Stability

#	Date	Procedure	Name
1	4/29	68025	Baseline from Integration Test
2	5/27	68042	Minifunctional
3	6/2	68033	Electrical Functional
4	6/1	68033	Electrical Functional
5	6/3	68033	Electrical Functional
6	7/8	68042	Minifunctional during Vibration
7	7/11	68042	Minifunctional during Vibration
8	7/13	68042	Minifunctional during Vibration
9	7/14	68042	Minifunctional during Vibration
10	7/21	68040	Minivac
11	7/22	68040	Minivac
12	7/22	68040	Minivac
13	7/24	68040	Minivac
14	7/25	68040	Minivac
15	7/26	68040	Minivac
15	7/27	68040	Minivac
16	8/10	68042	Minifunctional
17	9/8	68042	Minifunctional
18	9/15	68042	Minifunctional
19	10/8	69821	Benchtest
20	10/15	68040	Thermal Test
21	10/16	68040	Thermal Test
22	10/19	69821	Benchtest
23	10/27	69821	Benchtest
24	11/10	69821	Benchtest

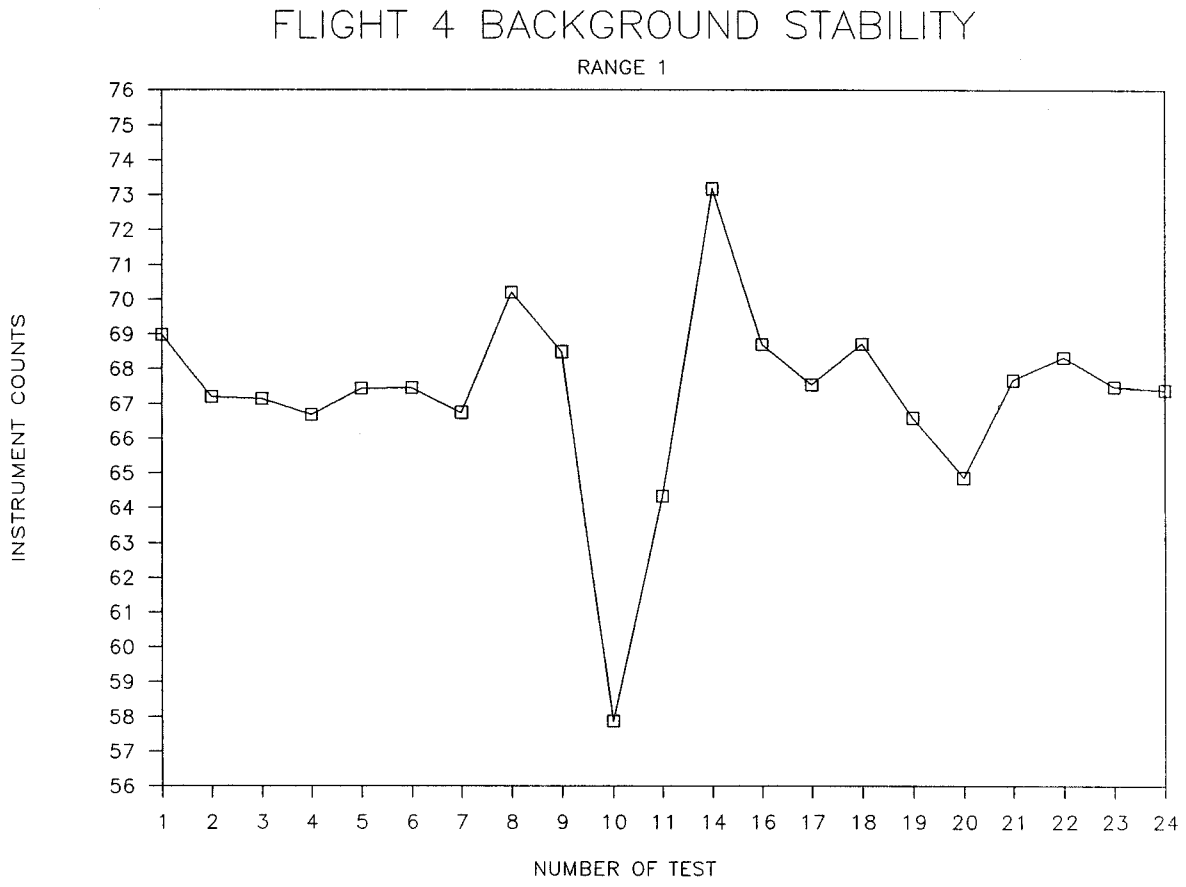


Figure 8-1 Background stability - range 1

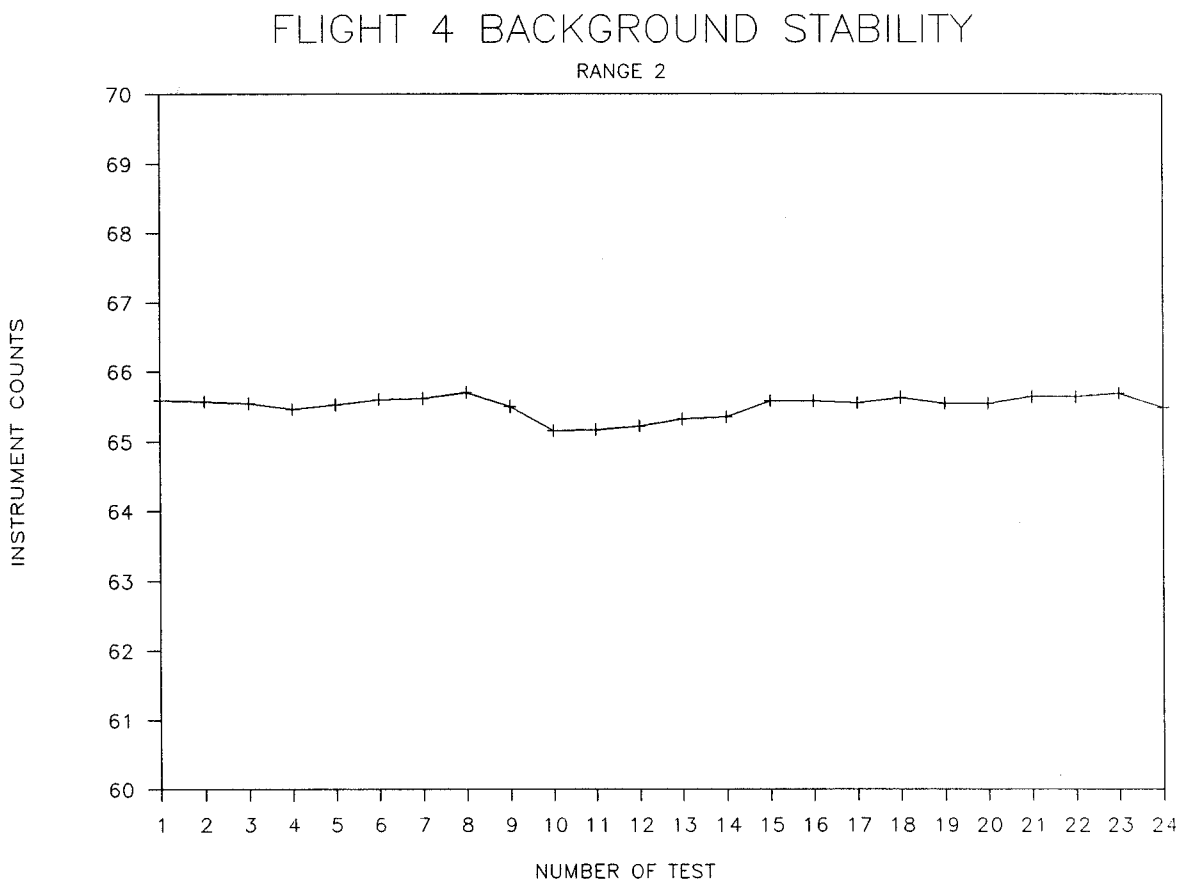


Figure 8-2 Background stability - range 2

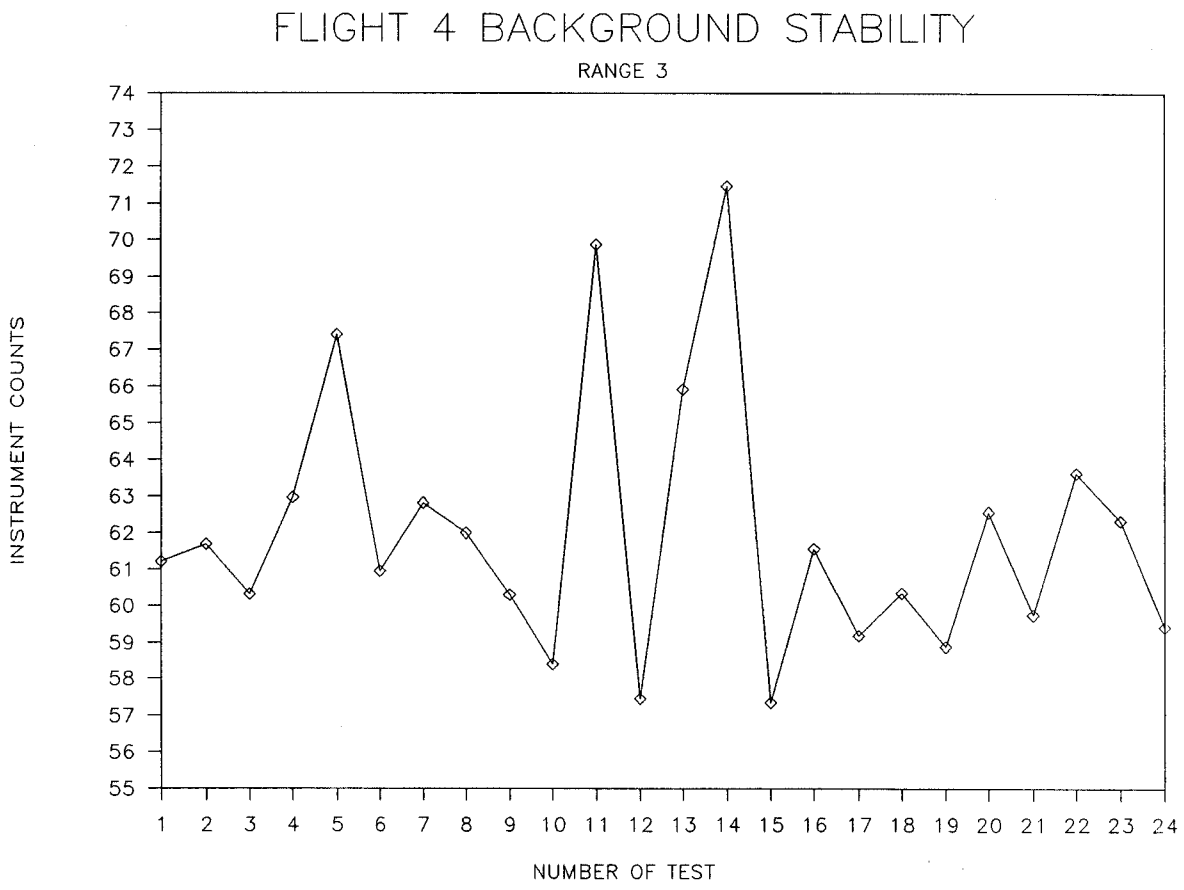


Figure 8-3 Background stability - range 3

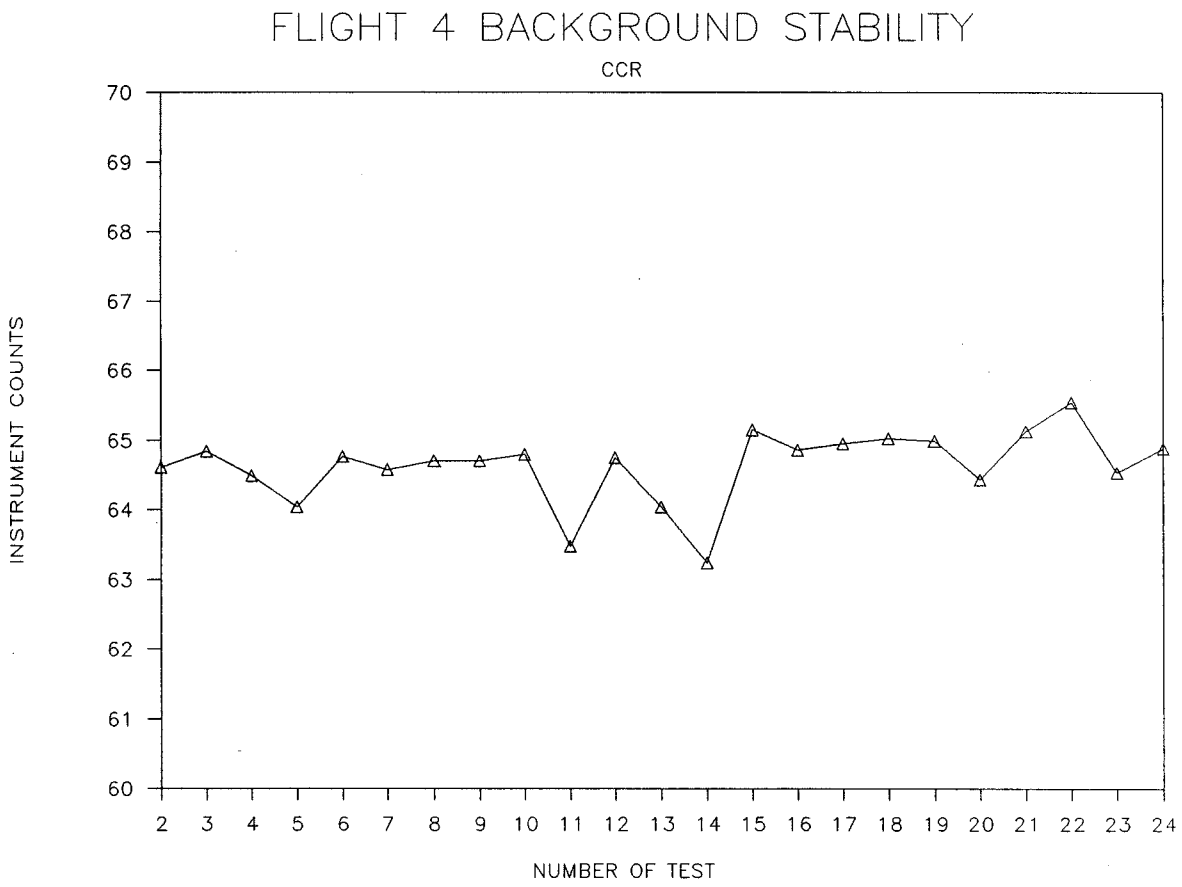


Figure 8-4 Background stability - CCR

Section 9
POLARIZATION
(Reference Test Procedure 68006)

During Thermal Vacuum testing of the Flight 4 instrument the elements of its depolarizer (SN006a) began to separate, it was therefore replaced with the depolarizer assembly from the Flight 3 instrument (depolarizer SN006). To ensure that the depolarizer in Flight 3 would not also separate during temperature cycling, its sensor module was first placed in a temperature chamber and cycled three times between -10° and +40°C with a minimum one hour soak at each temperature plateau. The instrument was situated so that the depolarizer could be visually inspected by looking through the optical axis for evidence of fringe patterns or damage to its elements. This visual inspection was done every 15 minutes throughout the test with no signs of separation. Secondly, the depolarizer assembly was removed from the sensor module and placed in the temperature chamber with a UDT radiometer test setup to measure transmission. During this test as well, the depolarizer was visually inspected every 15 minutes for evidence of bond weakening between the elements.

Depolarizer transmission and depolarization efficiency are determined at the component level of test. Transmission of the depolarizer is measured over the spectral range from 160 nm to 400 nm. A McPherson model 225 monochromator equipped with a Hinteregger type gas discharge source is used to make these measurements. The results ranged from 63.5 percent at 159.9 nm to 91.3 percent at 366.3 nm. See **Table 9-1** for transmission measurements.

The depolarization efficiency is tested to determine how well it scrambles the state of polarization of incident light. The test fixture consisted of 1 of 2 mercury line bandpass filters (254 or 366 nm) and a 3M polaricoat polaroid filter in the incident beam. A second polaricoat polaroid filter was used as an analyzer in front of the photomultiplier tube detector. The source used was a mercury pen ray lamp. With the depolarizer removed from the test fixture, the polarizer and light source are rotated 180 degrees to determine the modulation of the fixture. The depolarizer is then placed in the fixture, and again the polarizer and light source are rotated 180 degrees. The depolarizer is then rotated, with respect to the analyser, in

30 degree increments for a total of 180 degrees rechecking the modulation at each measurement. The residual polarization is determined from the ratio of these two measurements. See **Table 9-2** for the results and **Figure 9-1** of a schematic for the test fixture.

Table 9-1

DEPOLARIZER TRANSMISSION MEASUREMENTS

λ, nm	6/82 SN006	9/9/87 SN006A	RATIO 006A/006
159.9	63.5	58.4	0.920
170.5	74.7	73.9	0.989
179.3	76.5	77.8	1.017
189.8	79.5	79.9	1.005
204.7	83.1	83.9	1.010
253.7	89.8	88.5	0.986
313.2	91.4	90.7	0.992
366.3	91.3	91.6	1.003
	Now in Flight 4	Taken out of Flight 4	

Table 9-2

DEPOLARIZER TRANSMISSION MEASUREMENTS

	At 366 nm	At 254 nm
Maximum	0.646×10^{-7}	0.360×10^{-7}
Minimum	0.707×10^{-8}	0.171×10^{-8}
M_{AN}	80.3%	90.9%
Maximum	0.809×10^{-8}	0.370×10^{-8}
Minimum	0.788×10^{-8}	0.364×10^{-8}
M_{DEP}	1.31%	0.82%

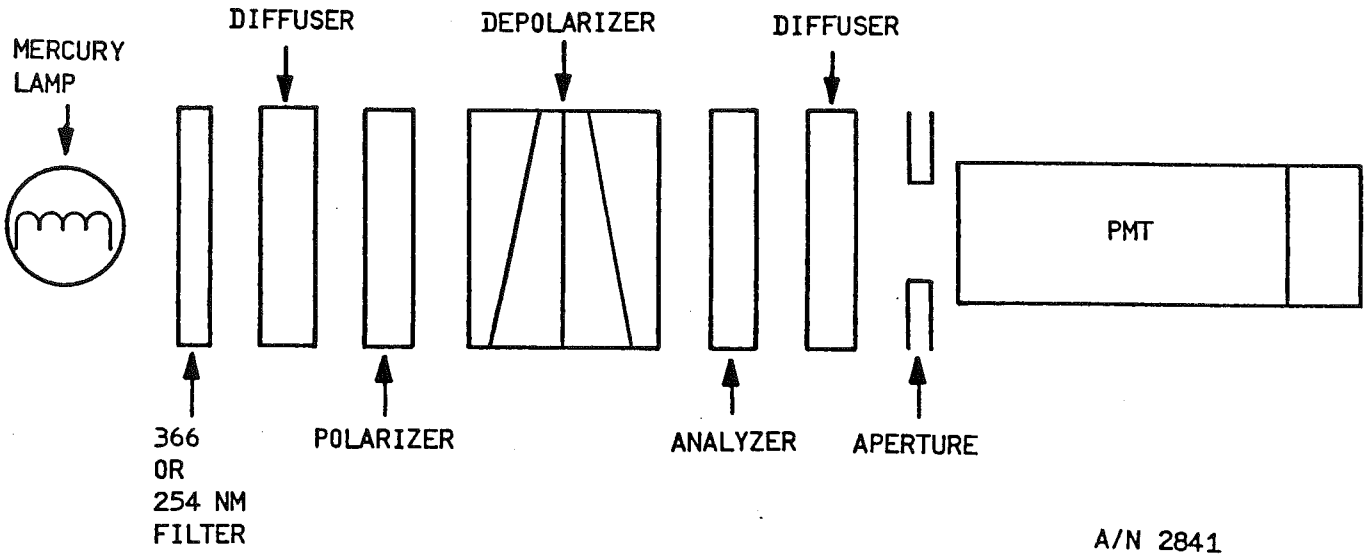


Figure 9-1 Test setup

Section 10
DIFFUSER REFLECTIVITY
(Reference Test Procedure 157372)

This test is done to measure the relative reflectivity of the instruments' irradiance (solar) diffuser plate. Macro Albedo is the portion of the test software that retrieves diffuser reflectivity data. After a 20 minute warm-up of the on board mercury lamp this macro enables the automatic wavelength calibration sequence (WLCAL), which takes 10 sweeps of data with the diffuser in the monitor position. Sweeps 1 through 4 are with the cal lamp door open, sweeps 5 and 6 with the door closed, sweeps 7 and 8 with the door open, and sweeps 9 and 10 with the door closed again.

The off-line utility program (Reflect) used to reduce the data selects 6 points on either side, and the peak, of each of the 10 spectral lines chosen. The signals from these data points are added, and these summed signals represent the area under the envelopes of each of the spectral lines. These areas are then used to find the ratios of consecutive lamp open to lamp closed sweeps. The ratios or "albedos" are first found for each of the three open closed pairs of sweeps and then the mean is calculated.

In the Diffuser Reflectivity Test Procedure, Macro Albedo is run eight consecutive times, the average of these eight measurements is used as a baseline to determine if there is any degradation of the diffuser in the future. The test procedure requires that these averages have no more than 0.5 percent standard error. For Flight Model 4 the standard error ranged between 0.03 percent at 404.7 nm to 0.11 percent at 365.4 nm, well within the required specification. Because this is a repeatability test, the set-up is held constant. The mercury lamp is warmed up for 20 minutes before data is taken and allowed a cool down period in between the eight runs. This test is done on the primary test fixture and using the primary encoders. See **Table 10-1** for test results.

To monitor diffuser reflectivity over time Macro Albedo has also been incorporated into several of our system level test procedures. **Figures 10-1** to **10-3** show the diffusers reflectivity at 184.9 nm, 253.7 nm and 404.7 nm throughout the testing period of the Flight 4 instrument. Test conditions

Table 10-1
RESULTS OF DIFFUSER REFLECTIVITY
SYSTEM LEVEL TEST

WAVELENGTH	MEAN ALBEDO	STANDARD DEVIATION	PERCENT ERROR SPEC: ≤0.5%
184.9 nm	0.00526	6.0×10^{-5}	0.40
253.7 nm	0.01548	1.5×10^{-5}	0.03
296.7 nm	0.01656	2.0×10^{-5}	0.04
313.2 nm	0.01687	4.9×10^{-5}	0.10
365.4 nm	0.01756	5.3×10^{-5}	0.11
404.7 nm	0.01799	1.5×10^{-5}	0.03

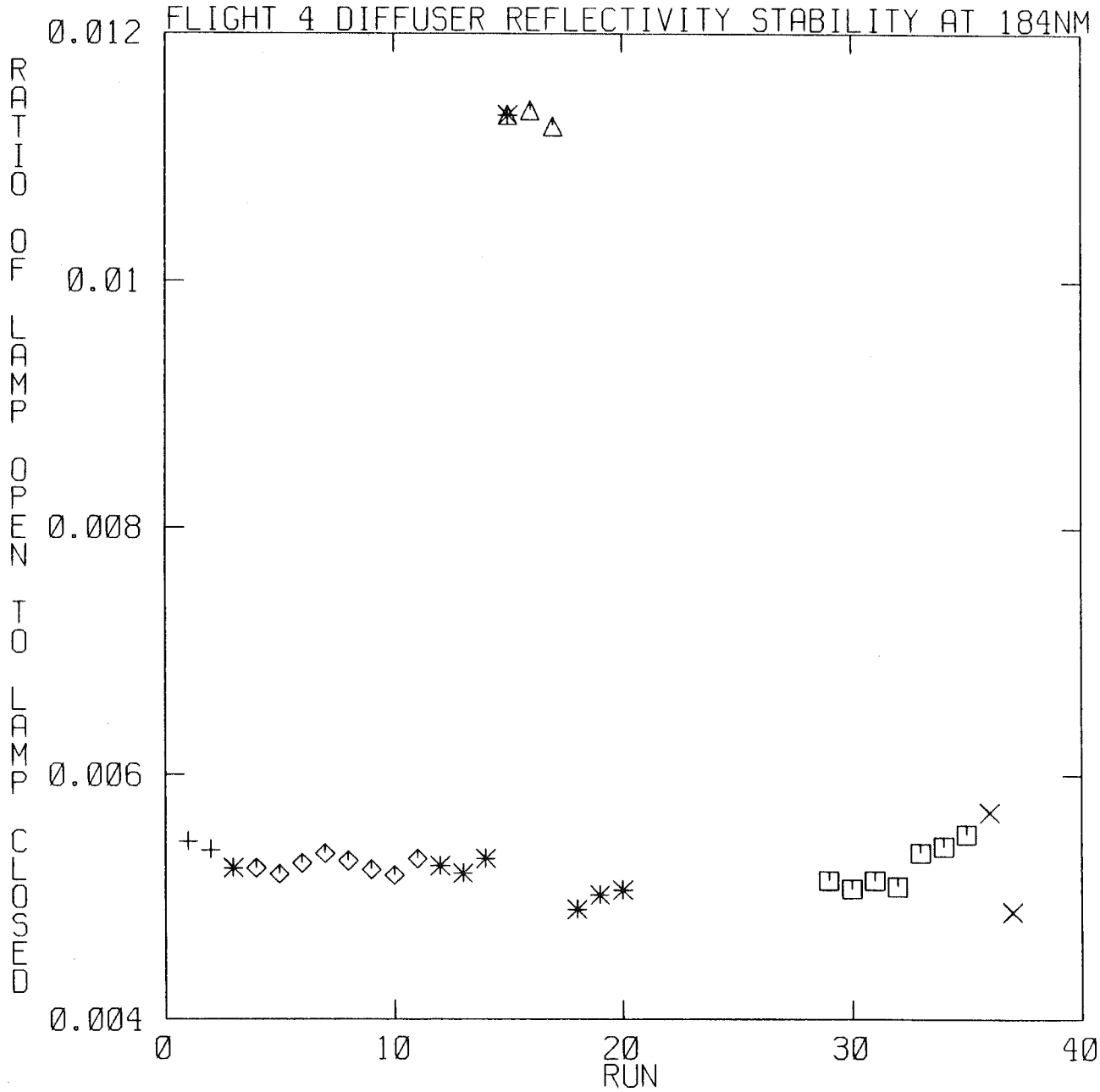


Figure 10-1 Flight 4 diffuser reflectivity stability at 184 nm

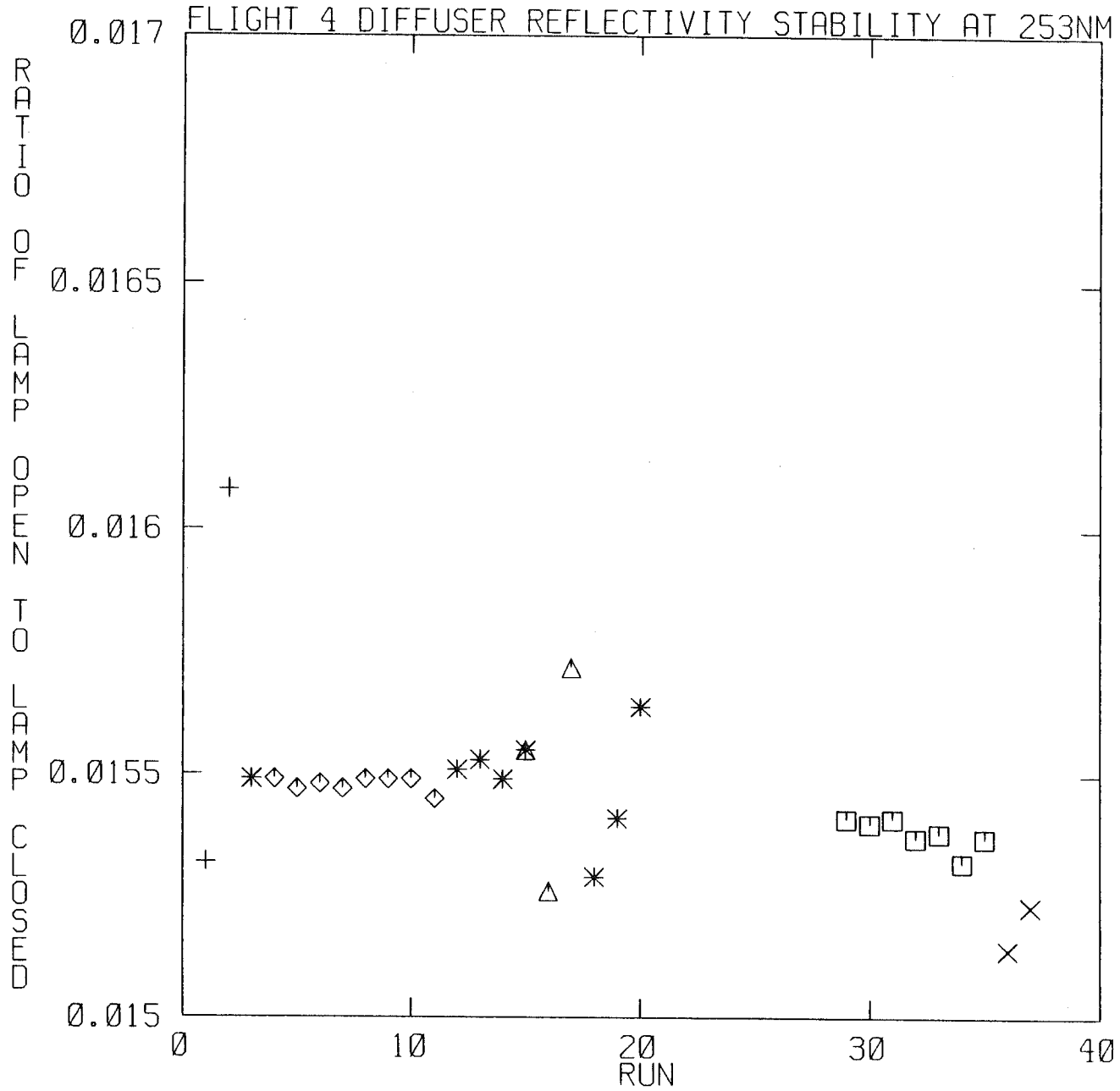


Figure 10-2 Diffuser reflectivity stability at 253 nm

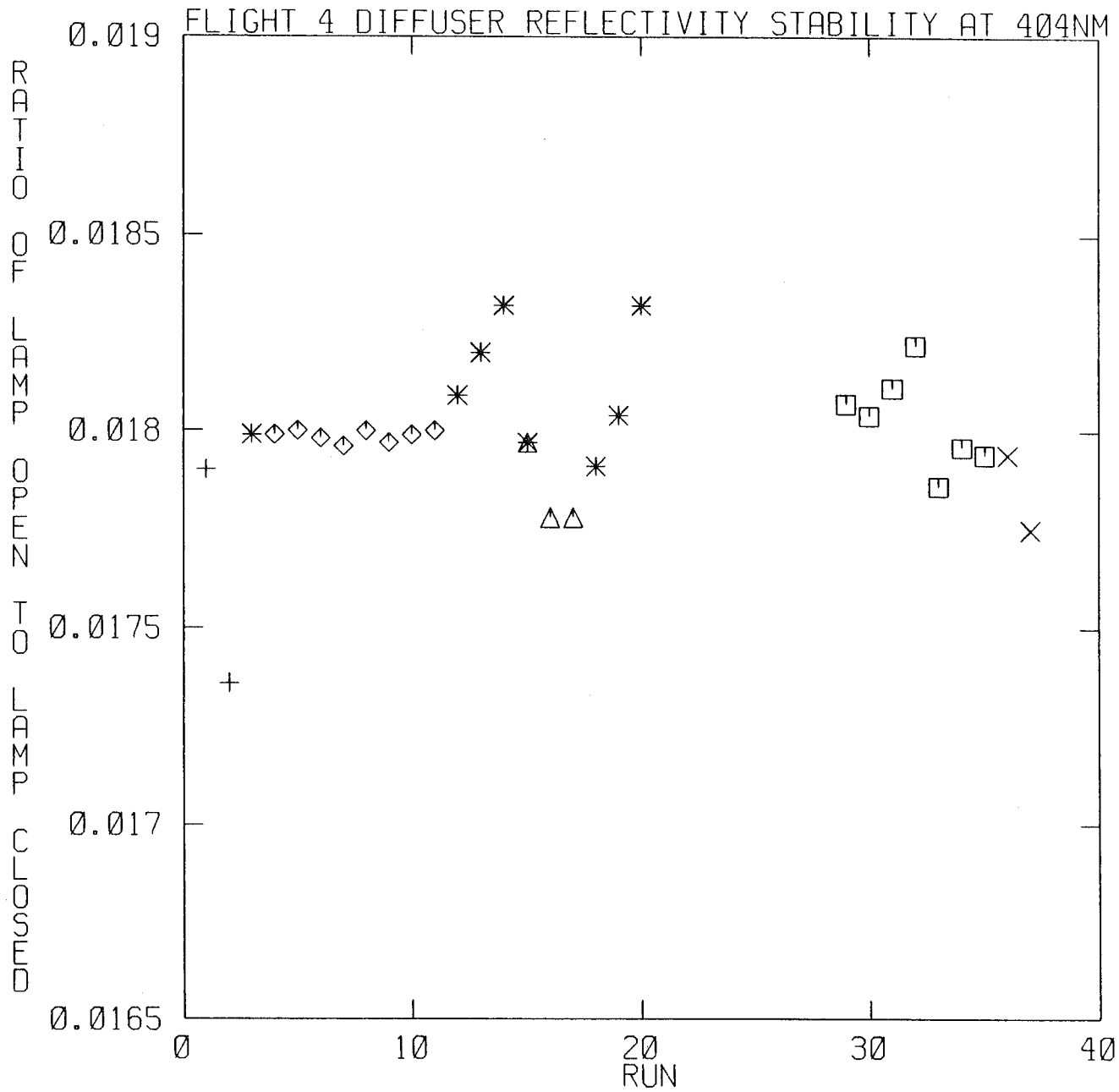


Figure 10-3 Diffuser reflectivity stability at 404 nm

can have a measurable effect on lamp output and reflectivity measurements. Therefore a brief description of the various test setups represented follows.

Electrical Functionals. All three command enable sequences are run during an electrical functional and verified for correct operation. The wavelength calibration sequence is run during Macro Wcalen, but a precise measurement of diffuser reflectivity was not intended for this test. So although the data is reduced using Reflect, no lamp warm-up is done. These electrical functionals were done with the instrument sitting on the bench and using primary encoders.

Minifunctionals. Minifunctionals are run before vibration, after each axis of vibration and after thermal-vac. Usually the test is run with the instrument in the primary test fixture. After a 20 minute lamp warm up, Macro Albedo is run first in primary then in the backup mode.

Vacuum Functionals. Macro Albedo is run during the Vacuum Functional and Vacuum Calibration portions of Thermal-Vac. Vacuum Functionals are run in zones 0, 1, 3, 5, 7, 9, and 11 using the backup encoders. Vacuum Calibration is run in zones 11, 13, 15, 17, and 19 using the primary encoders. Note that zone 0 is done before the chamber is pumped down. The lamp is warmed up each time. The instrument is held in the vacuum test fixture which has a similar orientation to that of the primary test fixture.

Radiometric Calibration. During Radiometric Calibration Macro Albedo is used during the run of each lamp. The first four runs are done on the primary test fixture and the remaining on the normal incidence test fixture, where the instrument is rotated 146 degrees about its X-axis. All runs have a 20 minute lamp warm up and are done using the primary encoders.

Section 11
SHORT TERM STABILITY
(Reference Test Procedure 68026)

The instrument short term radiometric stability is specified in GSFC S-480-12 Para 4.4.3.3.1 as follows:

"The radiometric response of the instrument shall meet the following stability requirements. The corrected mean response of the instrument shall not differ by more than 1 percent from a previous or subsequent response measurement made while viewing the same source operating at equal intensity but separated in time by at least 24 hours, for each wavelength in the Discrete Mode. The mean response is to be determined from at least 50 successive date samples taken with the wavelength drive stopped at each Discrete Mode position. This instrument data is to be corrected for changes in instrument temperature and other response-dependent parameters, if any, before comparisons are made."

A short term stability test was conducted using the Primary Test Fixture, Target Control Console, and an FEL (S/N190) light source calibrated by the National Bureau of Standards. Fifty samples of data for each wavelength were collected with the instrument in discrete mode using the 'flash-lite' to stabilize the instrument. A second set of data was taken approximately 24 hours later, a third set taken approximately 48 hours later, and a fourth set taken 72 hours later with the instrument remaining on and with the 'flash-lite' operating for the duration of test. **Table 11-1** lists the raw data and the day to day differences in counts. **Table 11-2** lists the average counts of all data and the differences. The average short term instability was found to be 0.036 percent.

TABLE 11-1

SHORT TERM STABILITY DATA

NOMINAL WAVELENGTH	$\bar{C}$ BASE-LINE DATA	$\bar{C}$ 24 HOUR DATA	Δ_1	$\bar{C}$ 48 HOUR DATA	Δ_2	$\bar{C}$ 72 HOUR DATA	Δ_3
252	6551R1	6602	-51	6597	-5	6605	8
273.6	21644	21804	-160	21769	-35	21796	27
283.1	32892	33162	-270	33084	-78	33139	55
287.7	40460	40782	-322	40707	-75	40752	45
292.3	49618	50007	-389	49913	-94	49967	54
297.6	62581	63042	-461	62931	-111	63010	79
301.9	817R2	823	-6	821	-2	822	1
305.9	951	958	-7	956	-2	957	1
312.6	1215	1223	-8	1220	-3	1221	1
317.6	1425	1434	-9	1430	-4	1433	3
331.3	2077	2091	-14	2084	-7	2087	3
339.9	2511	2527	-16	2519	-8	2522	3

$\Delta_1 = \bar{C}_{Baseline} - \bar{C}_{24\ hour}$

$\Delta_2 = \bar{C}_{48\ hour} - \bar{C}_{24\ hour}$

$\Delta_3 = \bar{C}_{72\ hour} - \bar{C}_{48\ hour}$

TABLE 11-2

SHORT TERM STABILITY

NOMINAL WAVELENGTH	NOTE 1	NOTE 2	NOTE 3	REQUIREMENT
252	6589	21.33	3.24 E-03	< 0.01
273.6	21753	74.0	3.40 E-03	< 0.01
283.1	33069	134.33	4.06 E-03	< 0.01
287.7	40675	147.33	3.62 E-03	< 0.01
292.3	49876	179.0	3.59 E-03	< 0.01
297.6	62891	217.0	3.45 E-03	< 0.01
301.9	821	3.0	3.65 E-03	< 0.01
305.9	956	3.33	3.48 E-03	< 0.01
312.6	1220	4.0	3.28 E-03	< 0.01
317.6	1431	5.33	3.72 E-03	< 0.01
331.3	2085	8.0	3.84 E-03	< 0.01
339.9	2520	9.0	3.57 E-03	< 0.01
			Average 0.00358	

Note 1 $$\frac{\Sigma \bar{C}}{4} = \frac{\bar{C}_{Baseline} + \bar{C}_{24} + \bar{C}_{48} + \bar{C}_{72}}{4}$$

Note 2 $$\frac{\Sigma \Delta}{3} = \frac{\Delta_1 + \Delta_2 + \Delta_3}{3}$$

Note 3 $$\frac{\bar{\Delta}}{\bar{C}} = \frac{\frac{\Sigma \bar{\Delta}}{3}}{\frac{\Sigma \bar{C}}{4}}$$

Section 12
RESPONSE REPEATABILITY
(REFERENCE TEST PROCEDURE 68026)

The response repeatability is taken in discrete mode on the primary test fixture, with FEL #190, for both earth and sun data. It has been measured to within 0.3%. **Tables 12-1** through **12-3** show the nine tests from the Day 192 through Day 272 that were normalized to the baseline taken on Day 163. **Figure 12-1** shows the earth data and **Figure 12-2** shows the sun data.

In September a new depolarizer was installed in the Flight 4 instrument. Both the September 8 and September 16 post-vibration tests were measured when the fixture was misaligned. These two tests are still useful in showing that the vibration did not have detrimental effects.

The realignment of the fixture was performed by the 29th of September. These Numbers differ from the original response due to the chopper phase being slightly different after the installation of the new depolarizer. This affects the demodulation of the signal. There is good test repeatability within the morning and afternoon of the 29th.

TABLE 12-1

TEST PROCEDURES

#	Date	Test
Baseline	12 Jun 87	Baseline
1	11 Jul 87	Previbration
2	11 Jul 87	Post-X vibration
3	13 Jul 87	Post-Y vibration
4	14 Jul 87	Post-Z vibration
5	10 Aug 87	Post-Thermal Vacuum
6	8 Sept 87	New depolarizer*
7	16 Sept 87	Post-vibration*
8	29 Sept 87	Radiometric**
9	29 Sept 87	Radiometric**

* Fixture misaligned
** Fixture realigned

TABLE 12-2
INSTRUMENT COUNTS
FOR FEL #190

#	Earth			Sun		
	Ch.1 RANGE 1	Ch.6 RANGE 1	Ch.12 RANGE 2	Ch.1 RANGE 1	Ch.6 RANGE 1	Ch.12 RANGE 2
Baseline	6601	62950	2521	6186	59991	2257
1	6550	62263	2498	6108	59107	2231
2	6727	63700	2546	6277	60461	2273
3	6538	62163	2491	6113	59149	2230
4	6614	62995	2525	6194	59964	2261
5	6617	63180	2523	6163	59855	2251
6	6723	64486	2594	6284	61117	2304
7	6685	63993	2576	6271	60939	2301
8	6340	60831	2455	5982	58209	2198
9	6365	61127	2464	6012	58370	2203

TABLE 12-3
INSTRUMENT COUNTS
NORMALIZED TO BASELINE

	Earth			Sun		
#	Ch.1	Ch.6	Ch.12	Ch.1	Ch.6	Ch.12
1	0.99	0.99	0.99	0.99	0.99	0.99
2	1.02	1.01	1.01	1.01	1.01	1.01
3	0.99	0.99	0.99	0.99	0.99	0.99
4	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00
6	1.02	1.02	1.03	1.02	1.02	1.02
7	1.01	1.02	1.02	1.01	1.02	1.02
8	0.96	0.97	0.97	0.97	0.97	0.97
9	0.96	0.97	0.98	0.97	0.97	0.98

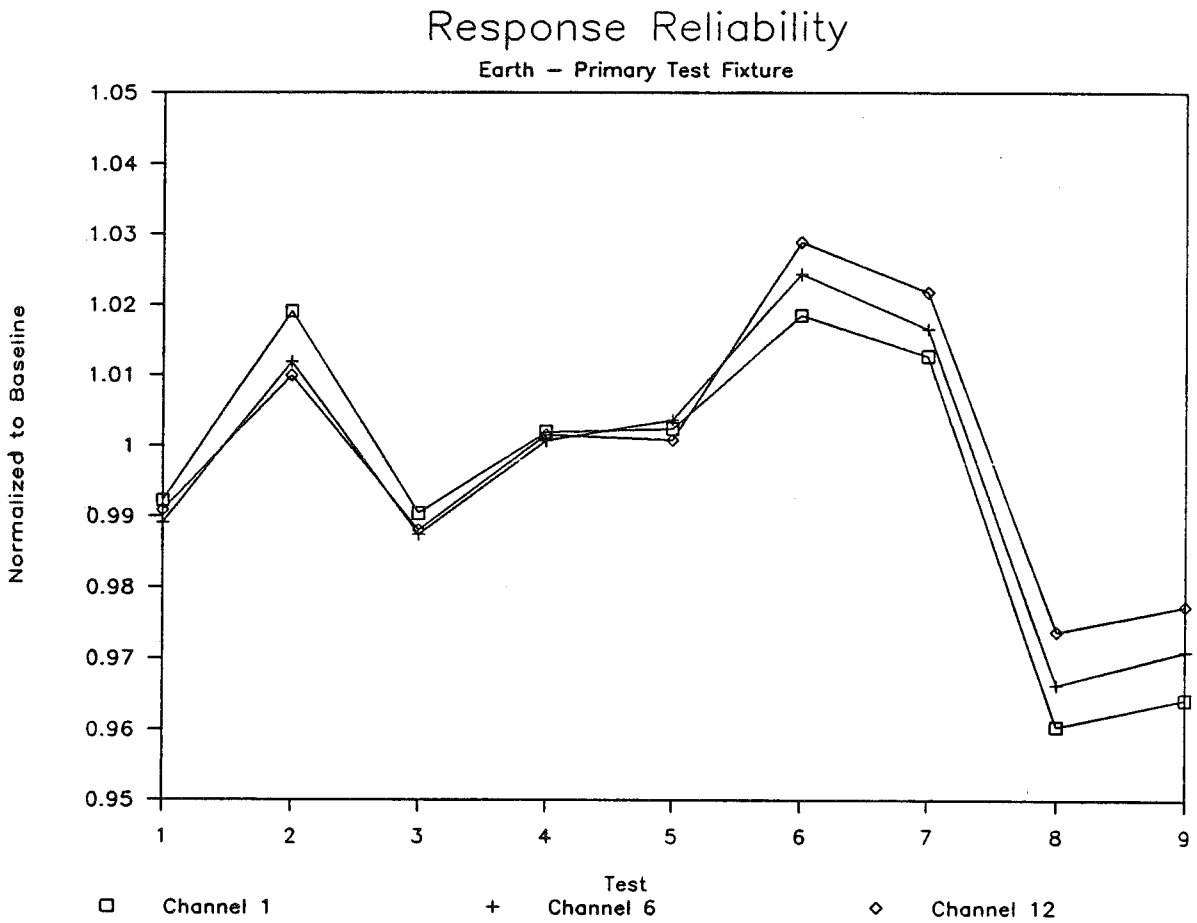


Figure 12-1 Response reliability - Earth

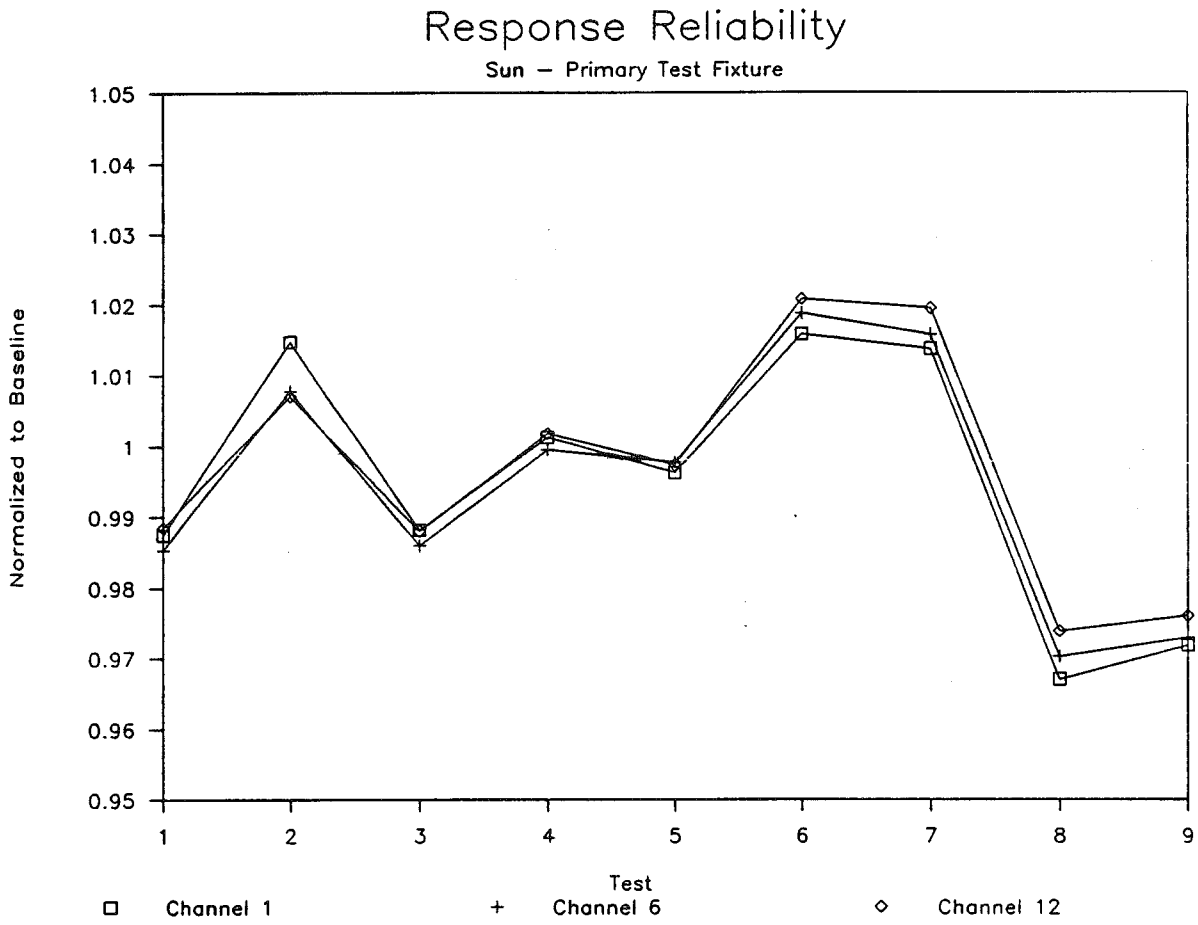


Figure 12-2 Response reliability - Sun

Section 13
TIME RESPONSE
(Reference Test Procedure 68031)

The response time test measures the instrument's response to a changing light level such as it will be exposed to in flight. During an orbit, the maximum light level input from the daylight portion of the orbit varies from approximately 1,000 to 16,000 counts on Range 3 at 340 nm. For the test the daylight portion of the orbit is divided into nine (9) zones of 6.4 minutes each with the following maximum light levels:

Zone	Counts	Range
1	1,000	3
2	2,000	3
3	4,000	3
4	8,000	3
5	16,000	3
6	8,000	3
7	4,000	3
8	2,000	3
9	1,000	3

The instrument is operated in discrete mode viewing a large diffuser plate illuminated by a FEL-type lamp. Each of the 12 discrete wavelength positions is set at a pre-selected wavelength which will give count levels covering both Range 1 and 2 as follows:

Channel	Counts	Range
1	900	1
2	5,000	1
3	7,500	1
4	16,000	1
5	31,000	1
6	64,000	1
7	800	2
8	3,000	2
9	15,000	2
10	30,000	2
11	60,000	2
12	900	3

The photomultiplier tube is exposed to the maximum levels by the use of a "flashlite" (a bank of LEDs turned on and off in phase with the chopper during the electronic calibration portion of the discrete scan). The intensity of the "flashlite" is changed for each zone to give the described counts.

The test is set-up and run in continuous operation with data collected during the daylight portion of the orbit (56 minutes in nine zones) and the instrument placed in the dark for 56 minutes. All of the data are normalized to the first orbit, zone 1. The time response test procedure specifies that the mean response for all 12 discrete mode channels (when corrected for lamp drift) for six simulated orbits shall not vary more than +0.5%. Average Flight Model 4 instrument response is +0.1 to -0.4% maximum for all seven orbits (see Figure 3-5). The CCR data shows a change of 1% during this test. The CCR is used to measure lamp drift, and the PMT response is corrected by this CCR data. (See **Figure 13-1** through **13-5**) It can be seen from these data that the Flight 4 instrument shows almost no measurable time response effects. This significant improvement over previous instruments is due to the Hamamatsu Photmultiplier Tube used in this model.

The data reduction is accomplished for each orbit by the following:

n is zone number

S is signal in counts, S1 is the signal from orbit 1, zone 1

$$\text{Normalized Response } (NRn) = \frac{Sn - 64}{S1 - 64} \qquad \text{for each channel}$$

$$\text{Mean } (\overline{NRn}) = \sum_{\text{Channel 12}}^{\text{Channel 1}} NRn/12$$

$$\text{CCR Correction Factor } (Fn) = \frac{S1 - 64}{Sn - 64}$$

$$\text{Corrected Mean Response} = \overline{NRn} \times Fn$$

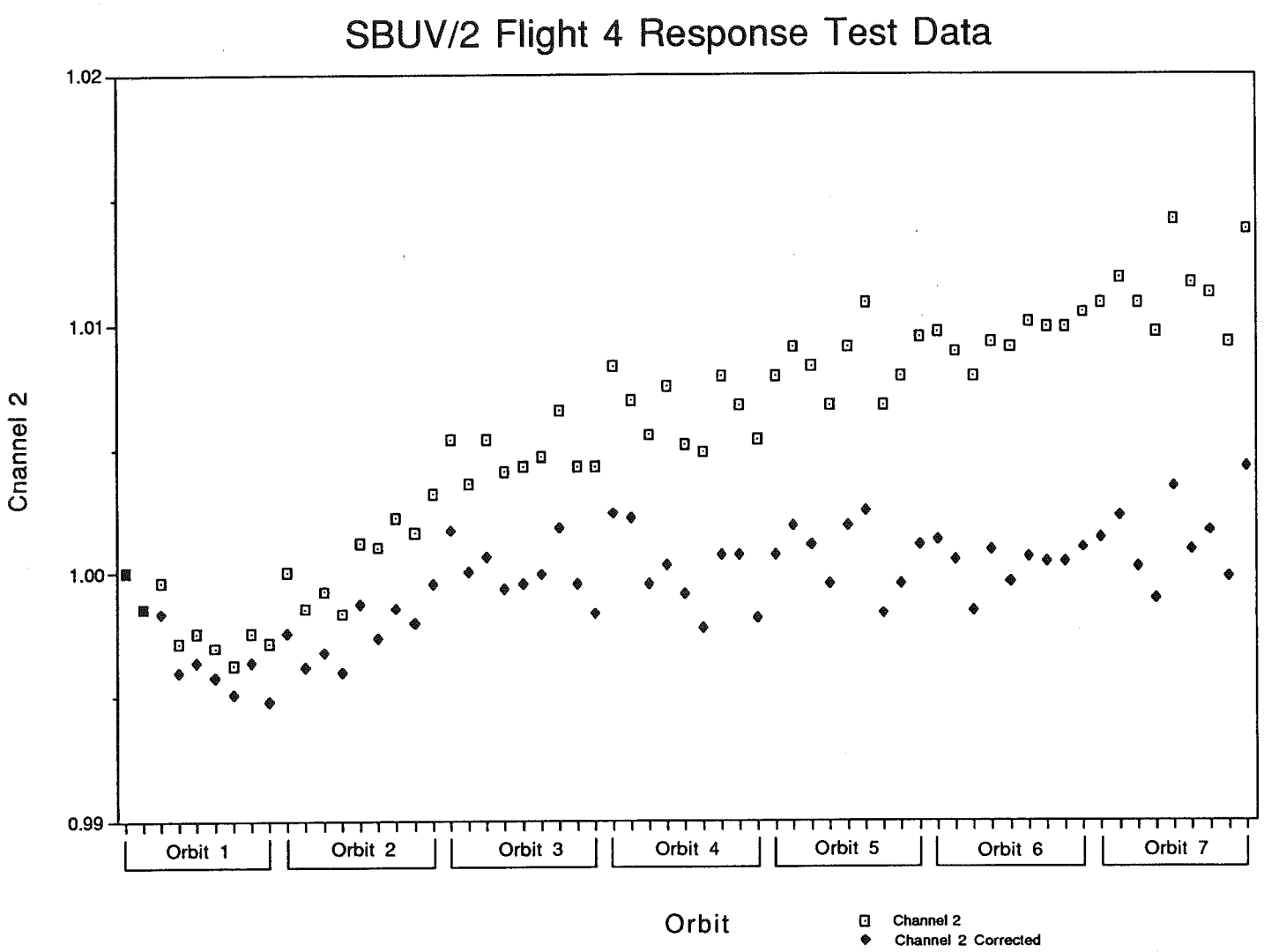


Figure 13-1 Channel 2 corrected and uncorrected response

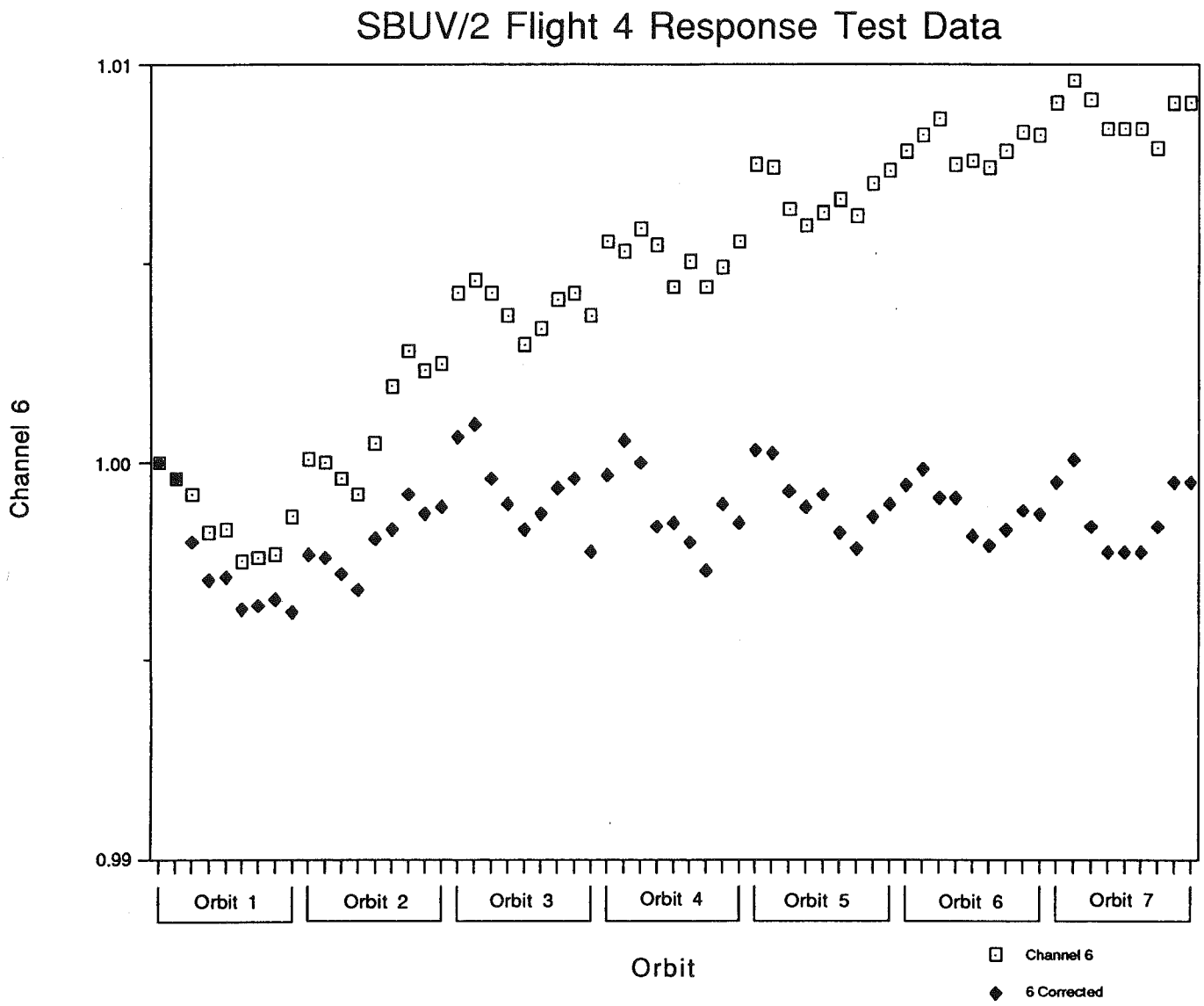


Figure 13-2 Channel 6 corrected and uncorrected response

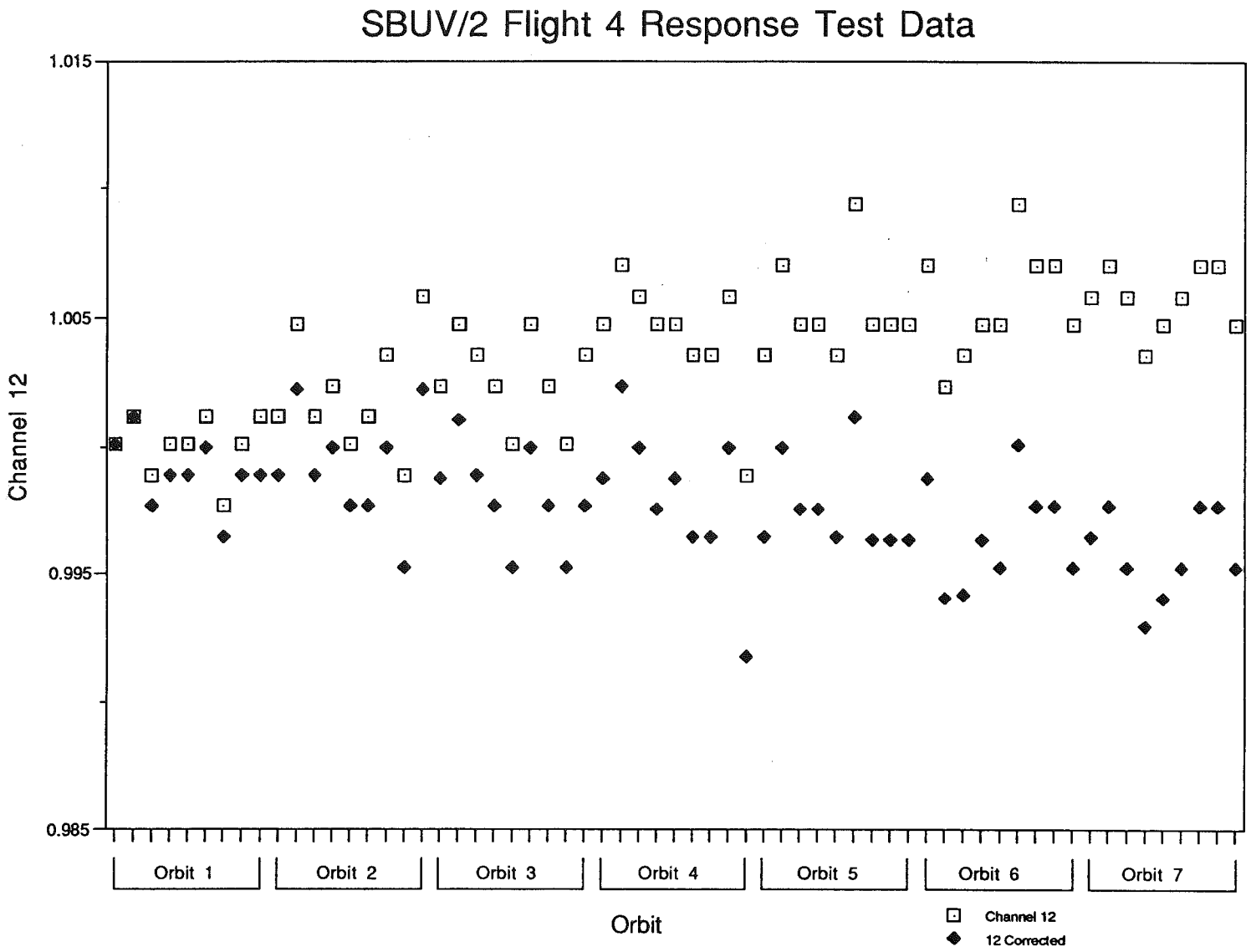


Figure 13-3 Channel 12 corrected and uncorrected response

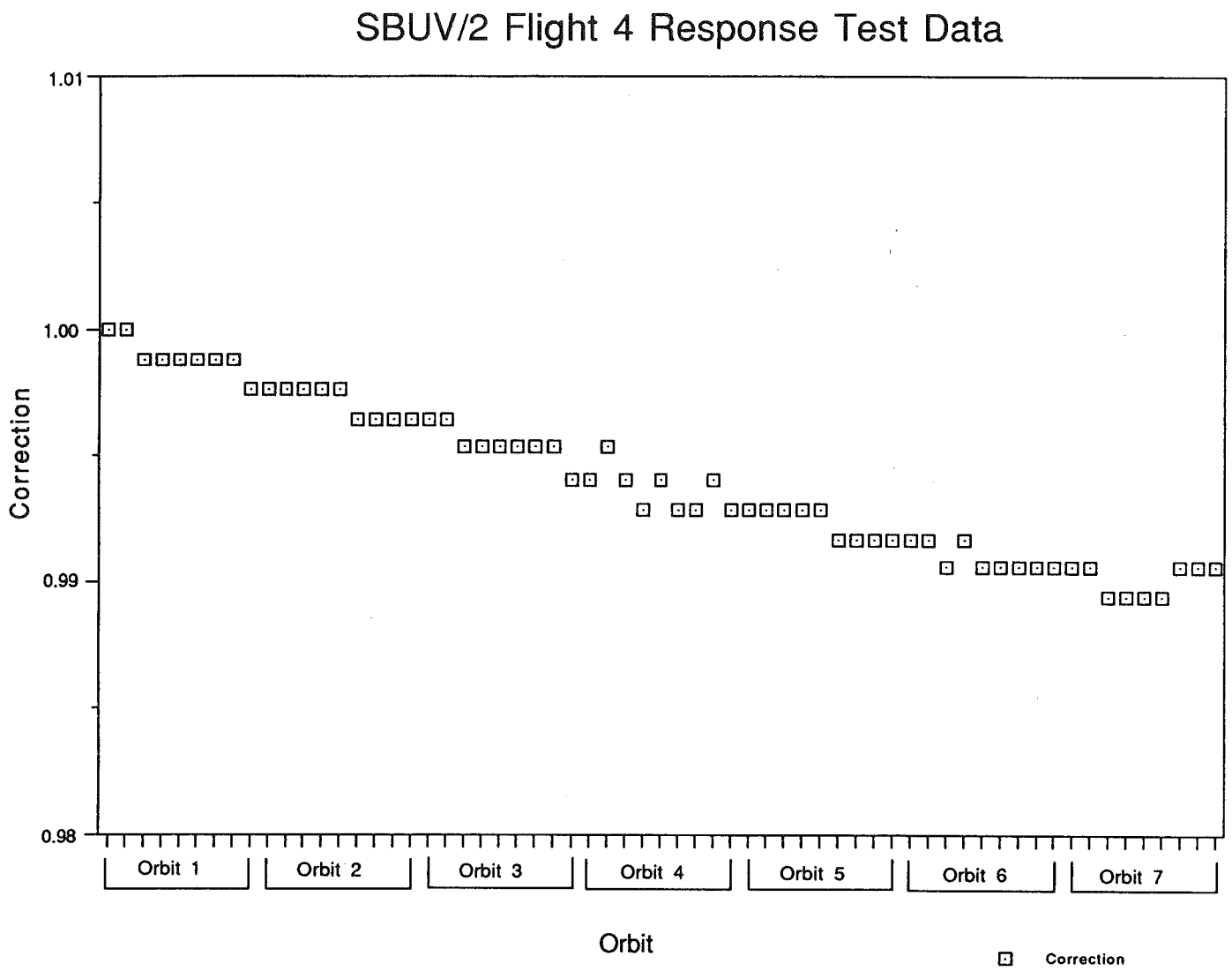


Figure 13-4 CCR correction factor

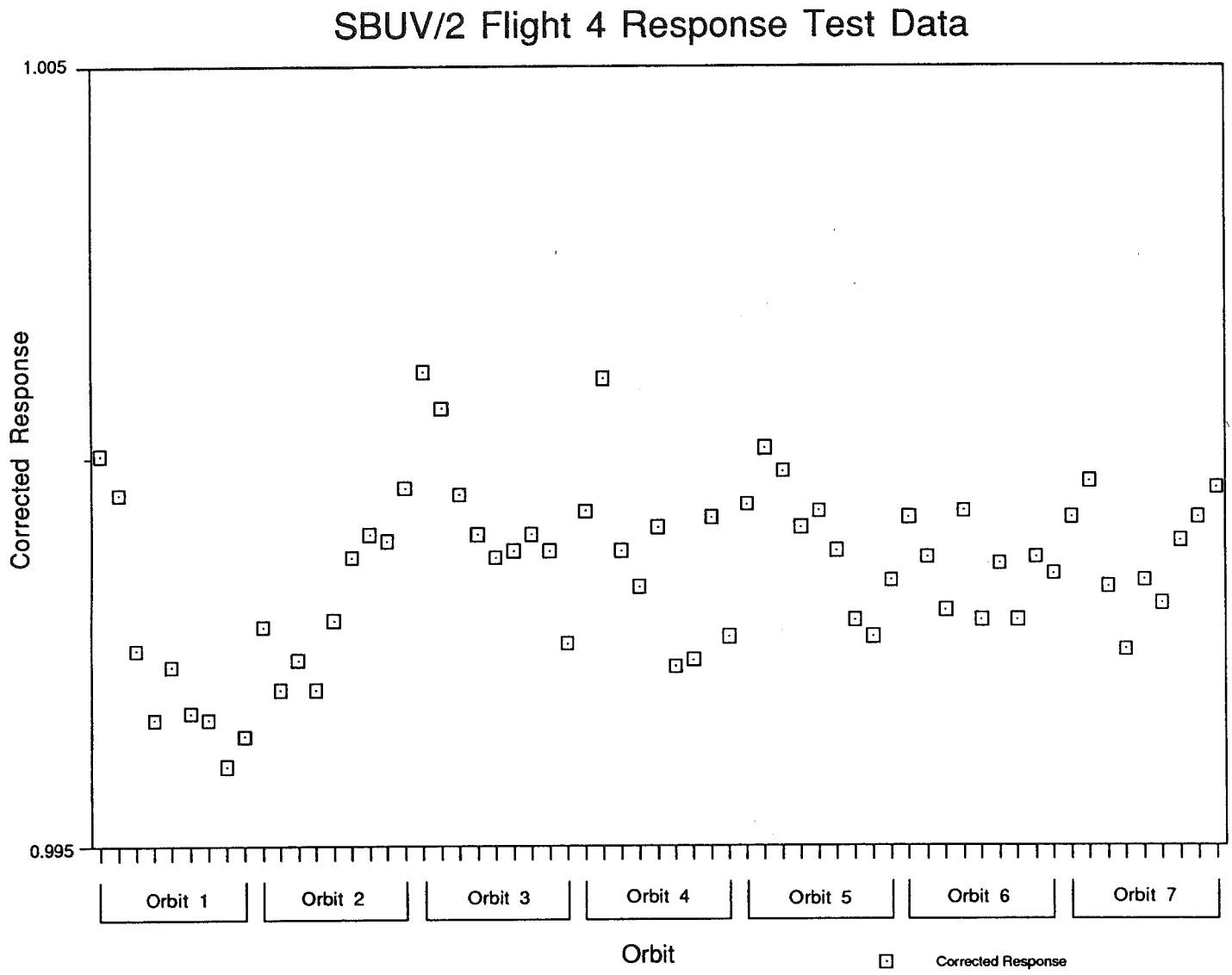


Figure 13-5 PMT corrected mean response

Section 14
CONTAMINATION MIRRORS

The four Flight 4 contamination mirrors were measured four times over the testing period. **Table 14-1** shows the percent reflectance over this period. **Figure 14-1** is a plot of the data.

TABLE 14-1
FLIGHT 4 CONTAMINATION MIRRORS

DATE	MIRROR NO. 4	MIRROR NO. 5	MIRROR NO. 6	MIRROR NO. 7
9/30/86	84.4	86.1	83.4	84.6
12/12/86	84	85.9	83.2	85
4/16/87	84.3	86.1	82.5	84.4
8/26/87	83.9	86	82.6	84.7

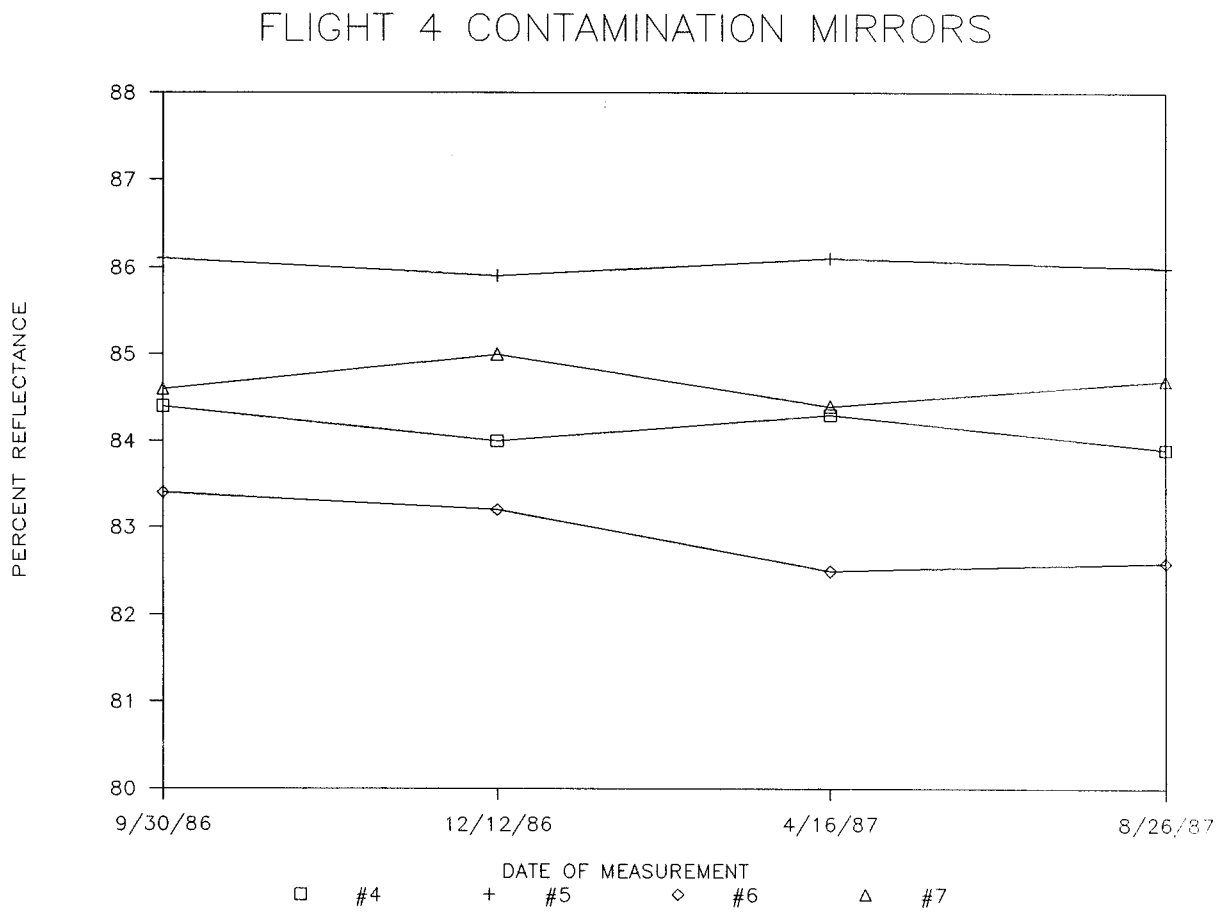


Figure 14-1 Plot of Flight 4 contamination mirrors