Solar Backscatter Ultraviolet Spectral Radiometer Mod 2

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SBUV/2

Specification Compliance and Calibration Data Book for SBUV/2 Flight Unit #3 (S/N 004)

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Data Book

Volume I

for

Flight Model No. 3, Serial No. 004

Solar Backscatter Ultraviolet

Spectral Radiometer Mod 2

Document No. B6802-73

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Section 1

TEST HISTORY 1985-1989

This listing provides a history of system-level tests and other major events of the SBUV/2 Flight Model 3 instrument (Serial No. 004). Test procedure numbers have been included for reference. These tests will be described in greater detail in later sections of this book. The "at" sign (@) listed after the test procedure numbers in **Table 1-1** indicates that this book includes some data from this test. An asterisk following the test procedure number indicates the test was not conducted in the usual manner. In most cases, this means the test was shortened, but it could also have been expanded, modified, or a prototype test could have been run to meet immediate testing requirements. Some of the major subsystems of the instrument have been changed, as have some of the procedures for collecting and reducing instrument data; therefore, test data collected from earlier tests is oftentimes not comparable to test data collected from later tests.

Table 1-1

TEST HISTORY 1985-1989

DATE	PROCEDURE	DESCRIPTION
FEB - APR 84	68021 @	Optical alignment
SEP - DEC 84	68025	Instrument integration completed, including signal-to-noise and preliminary response measurements. Nearly all of these tests will be redone in the following three years.
15 - 26 OCT 84	68029 *	Dynamic range and linearity tests
31 OCT - 2 NOV 84	68030	Wavelength calibration
19 NOV 84	68027	Field-of-view and out-of-field tests
13 - 17 DEC 84	68045 *	Time response tests
18 DEC 84	68042	Pre-vibe functional performance test
19 - 20 DEC 84	68026 8.3	Power profile test
28 DEC 84	68033	Electrical functional test, 28V
2 - 8 JAN 85	68042, 68038 @	3-axis vibration & functional performance tests: the cal-lamp power supply fails after 3rd axis, testing continues with Flt. 2 CLPS until Flt. 3 CLPS repaired 14 Jan 85 (?). Ref. GSFC Malfunction Report (MR) No. F04125
9 - 15 JAN 85	68026, 68028	Response repeatability & short term stability tests. Data review shows PMT response time affects radiometric data
FEB 85	68045 *	"Flashlight" time response tests begin: PMT response time still a problem with ITT tube
14 - 15 MAR 85	68037 7.3 @	SM & ELM envelope measurements
2 APR - 13 MAY 85	68044, * 68029 *	Engineering tests: time response and linearity with "off-the-shelf" Hamamatsu PMT. ITT PMT reinstalled after engineering tests complete.
MAY 85	--------	Grating shaft shimmed to improve encoder signals, Ref. GSFC MR F04113
28 - 30 MAY 85	68033	Electrical functional tests 28, 27, 29V
3 JUN 85	68033 8.3.2	Diffuser mechanism retest

DATE	PROCEDURE	DESCRIPTION
4 - 5 JUN 85	68037 7.2 @	Center-of-gravity measurements for SM & ELM. Weights are measured also, but change with later rework.
25 JUN - 19 JUL 85	68044, * 68029 *	Engineering tests: time response and linearity of the ITT PMT with various modifications to the bleeder string. Improvements are marginal.
22 JUL 85	68025 *	Diffuser & cal-lamp mechanisms reinstalled
24 JUL 85	68042 *	Functional performance test
29 - 31 JUL 85	68026 8.3	Power profile test
1 AUG 85	68031 8.4	Light leak test, Hg lamp only
5 - 6 AUG 85	68031 8.3, 68032	Light leak "sun" test, and out-of-band "sky" test
23 JAN - 5 FEB 86	-------	Engineering "albedo" tests: diffuser reflectance and position repeatability per contract NAS5-26400 modification #103
FEB 86	-------	Heater added to cal-lamp housing, checked - out
21 FEB 86	68042 *	Functional performance test
MAR 86	-------	SM structure reworked to provide attachment points for new lifting fixture
APR 86	--------	ITT PMT removed for installation of prototype Hamamatsu tube
MAY 86	--------	Engineering tests of prototype Hamamatsu PMT: linearity, time response and gain vs wavelength
JUN 86	--------	Engineering albedo tests to develop "brassboard" lamp housing per contract mod. #110
JUL 86	--------	Flight Hamamatsu PMT installed
21 - 25 JUL 86	68021 8.2.1 @	New SM alignment mirrors installed
30 JUL - 22 AUG 86	68025 8.6	Measurement and selection of PMT gain (voltage), also anode preamp rework
13 - 18 AUG 86	68044	Gain vs. wavelength measured and repeated with a "final" HVPS selection

DATE	PROCEDURE	DESCRIPTION
20 - 21 AUG 86	68025 8.15 @	Baseline radiance response test. This data is used simply to calculate minimum expected signal for the SNR test which follows.
22 AUG 86	68025 8.16 @	Signal-to-noise measurement
20 - 23 AUG 86	68026 8.7 @	Short term stability
27 - 29 AUG 86	68029	Dynamic range and linearity (three times)
9 - 16 SEP 86	---------	Temperature tests of brassboard cal-lamp housing
16 SEP - 30 OCT 86	---------	Rework to diffuser mechanism, and to ELM A10 & A11 boards to improve repeatability of diffuser position, ref. GSFC Request for Deviation (DD1694) No. SBUV-D-031 & SBUV-D-032
18 - 30 SEP 86	68029 *	Range 3 linearity troubleshooting, no major improvements
10 - 11 NOV 86	68042 *	Functional performance test
12 - 13 NOV 86	156184 @	Linearity equivalence test
19 - 21 NOV 86	68045 @	Response time test
26 NOV 86	68025 8.7 @	Preliminary field-of-view measurement
8 - 18 DEC 86	--------	More brassboard albedo temperature tests
30 DEC 86	68034 *	Engineering test with collimated source for goniometric calibration, results unsatisfactory
6 - 9 FEB 87	---------	ELM (A10 & A11) rework completed
10 - 12 FEB 87	68030	Wavelength calibration
13 - 17 FEB 87	---------	SM (diffuser & cal-lamp mechanisms) rework completed
19 - 26 FEB 87	68025 8.14 @	Angle-of-incidence measurements
16 - 18 MAR 87	68033 @	Electrical functional tests, 28, 27, 29V
19 - 20 MAR 87	68026 8.3 @	Power profile test, ref. GSFC Request for Waiver (DD1694) No. SBUV-W-018
23 - 25 MAR 87	68027	Field-of-view & out-of-field tests

DATE	PROCEDURE	DESCRIPTION
26 MAR 87	68031	Light leak test, "fails" due to stray light reaching the entrance aperture around (and through) the new cal-lamp door. It is decided that the door is not required to be a perfect shutter, and future tests will eliminate this stray light in order to check for leaks into the monochromator.
28 - 30 MAR 87	68034	Goniometric calibration (twice)
2 APR 87	--------	Reworked cal-lamp housing finish (to bare Al) to improve reflectivity, ref. GSFC SBUV-D-034
8 APR 87	68042 8.3	Engineering evaluation of cal-lamp assy
9 - 11 APR 87	157372	Diffuser reflectivity test
12 - 15 APR 87	--------	Hg lamp determined to be unstable, replaced with good lamp
16 - 17 APR 87	157372 @	Diffuser reflectivity test (with good lamp)
17 APR 87	68028	Response repeatability with FEL #131
18 - 20 APR 87	68042	Pre-vibe functional performance test
21 - 23 APR 87	68042, 68038 @	Three axis vibration & functional tests, due to redesign of cal-lamp and diffuser mechanisms, and new Hamamatsu PMT
24 - 28 APR 87	68040 *	Thermal-vacuum test aborted during pre-pumpdown functional, due to failure (from ESD) in the grating backup encoder power. ELM A6 board repaired, ref. GSFC MR F04118.
29 - 30 APR 87	68040 *	Thermal-vacuum test aborted during post-pumpdown functional, due to loss of lock in the grating servo loop. Failure is later found to be a cracked ball bearing retainer, ref. GSFC MR F04119.
3 - 22 JUN 87	--------	Troubleshooting of cal-lamp mechanism "hang-up" problem
21 - 28 AUG 87	--------	Temperature tests of Flt. 3 depolarizer show no problems, Flt. 3 depolarizer donated to save Flt. 4 instrument
23 OCT 87	--------	Flt. 3 cal-lamp power supply donated to Flt. 4 (at GE), Flt. 4 CLPS installed on Flt. 3 after repair

DATE	PROCEDURE	DESCRIPTION
16 - 23 NOV 87	68021 7.1	Installation & alignment of gratings on repaired shaft mechanism. G1 replaced due to scratches on grating.
4 - 12 JAN 88	--------	Flt. 2 depolarizer installed into Flt. 3 SM
12 JAN 88	--------	ELM A8 board reworked for new PROM
14 - 15 JAN 88	68025 *	Re-integration turn-on and check-out, chopper alignment, etc.
18 - 21 JAN 88	68030 @	Wavelength calibration
22 - 25 JAN 88	68029	Dynamic range & linearity, bad data due to fixture problem
26 JAN 88	68029	Dynamic range & linearity, good data
27 JAN - 10 FEB 88	68025 8.11 @	Programmed, verified, screened and installed new PROM
1 FEB 88	68025 8.13 68025 8.14	Cal-lamp & diffuser mechanisms installed and checked-out. Diffuser assy was pinned before removal to maintain alignment when re-installed.
3 - 4 FEB 88	68027 @	Field-of-view & out-of-field tests
11 - 12 FEB 88	68042, @ 68028 @	Functional performance test with FEL #191, response repeatability test with FEL #190
15 - 16 FEB 88	68038 8.4	SM & ELM Z-axis vibration test
16 - 17 FEB 88	68042	Post-vibe functional performance test with FEL #191, also grating encoder signals verified in six different orientations
21 FEB - 3 MAR 88	160861 @	Thermal-vacuum test has two minor problems: mechanical noise from heater/chiller units affects radiometric data (until units are turned off); and occasional loss of lock in the backup grating encoder at low temperatures, ref. GSFC SBUV-W-021
8 - 11 MAR 88	68042 @	Post-T/V functional performance test with FEL #191. Also R.F. antenna tests with foil shield.
14 MAR 88	68043 @	Radiometric calibration, primary test fixture with FEL #191
15 MAR 88	68043 cont'd.	PTF FEL #190

DATE	PROCEDURE	DESCRIPTION
16 MAR 88	68043 cont'd.	PTF D2 #YE-964
17 MAR 88	68043 cont'd.	PTF Ar mini-arc II
18 MAR 88	68043 cont'd.	Normal incidence test fixture with FEL #191
21 MAR 88	68043 cont'd.	NITF FEL #190
22 MAR 88	68043 cont'd.	NITF D2 #YE-964
29 MAR 88	68031 8.3 @	Light leak (sun) test
29 MAR 88	68032 @	Out-of-band test
31 MAR - 4 APR 88	--------	Decompression test of foil shield (for Flt. 4) using Flt. 3 SM in vacuum chamber, with R.F. antenna tests before and after, ref. contract modification #141
12 APR 88	68031 8.4	Light leak (Hg lamp) test. This data might have been overlooked, as test will be repeated in FEB 89.
18 APR - 9 MAY 88	--------	Testing delayed as clean room is shut down for repair of humidity and A/C equipment
10 - 18 MAY 88	160859 * @	Range 3 temperature response test per GSFC technical direction #15
19 MAY - 19 OCT 88	--------	Range 3 troubleshooting, problem is found to be noise on the unregulated 25V line to the HVPS
10 - 23 AUG 88	--------	Prototype screen EMI shield tests
25 OCT - 7 NOV 88	--------	Microphonic noise checks in conjunction with Flt. 2 range 1 troubleshooting. Flt. 3 does not have this problem.
19 - 22 DEC 88	68042 * @	Pre-rework baseline functional performance test with FEL #190
2 JAN - 13 FEB 89	--------	Rework to the ELM LVPS to regulate the 25V line which supplies the HVPS and CLPS
14 - 15 FEB 89	68029	Linearity and Dynamic Range test. The 25V regulator completely eliminates Range 3 nonlinearity problems.

DATE	PROCEDURE	DESCRIPTION
17 FEB 89	68044	Gain vs wavelength test. This characteristic does not change, but the elimination of Range 3 noise significantly improves the measurement.
21 - 22 FEB 89	68042 * @	Functional performance with FEL #190, after rework to LVPS (25V. regulator)
23 FEB 89	68031 8.4 @	Light leak (Hg lamp) test, cal-lamp housing thermal shield comes loose during test
6 - 11 APR 89	--------	R.F. antenna tests to verify the effectiveness of the flight-type EMI shield with thermal blankets
12 APR 89	68042 * @	Functional performance test with EMI shield, electrical only, no FEL data
20 APR 89	68034 @	Expanded (per contract mod. #148) goniometric calibration with Hg lamp. Data reduction now directly from instrument history tape.
24 APR 89	68034 @	Expanded goniometric calibration with FEL lamp, otherwise same as above
12 MAY 89	--------	Re-designed thermal shield installed on cal-lamp housing
30 MAY 89	68037 * @	Modified SM & ELM weighed, to account for all the rework
8 - 9 JUN 89	--------	Final installation of EMI shield, and fit-check of modified lifting fixture (to accommodate changes to the spacecraft, as well as to the instrument)
12 JUN 89	69821 @	Bench test at Ball
14 - 16 JUN 89	B6802-64	Final installation of thermal blankets, SM & ELM and all support equipment packed for shipment to GE-Astro
20 JUN 89	69821 @	Bench test at GE-Astro. No problems! Ball personnel assist in integrating instrument with TIROS spacecraft.

Section 2

VIBRATION TEST

(Reference Test Procedure 68038)

Vibration and shock tests were performed on Flight Model 3 from the 21st through the 23rd of April, 1987. After each axis the instrument was returned to the cleanroom and the Electrical/Optical Performance Functional Test (procedure 68042) was conducted.

After the Z-Axis of vibration (conducted on April 23, 1987) a significant increase in grating step and settle time was observed.

During Thermal Vacuum testing, which followed Vibration testing, digital lock errors occurred in both sweep and discrete modes at less than 5 deg. C. A broken bearing retainer was subsequently found to be the cause and the bearing was replaced. (See MDR-A45904.)

On February 15, 1988 and February 16, 1988, after a new bearing was installed and a repeat of all acceptance tests utilizing the grating assembly was made, a Z-Axis workmanship vibration was conducted on both the Sensor Module and the Electronics Module. The post vibration Electrical/Optical Functional Test was performed and all assemblies met specification.

Each test on the sensor module consisted of acceptance level sine, shown in **Table 2-1**, and random vibration, shown in **Table 2-2**. Acceptance level shock consisted of the spectra shown in **Figure 2-1**. The Electronics and Logic Module was tested to the same acceptance level vibration and shock as the sensor module. In each axis of vibration for both the ELM and the sensor module a low level sinusoidal survey (shown in **Table 2-3**) was run before full levels were applied.

Table 2-1

ACCEPTANCE LEVEL SINUSOIDAL VIBRATION

AXIS	FREQUENCY RANGE (Hz)	g LEVEL (0-PEAK)	FLIGHT UNIT SWEEP RATE (OCT/MIN)
Thrust (z)	5-70* 70-110	3.2 0.8	4.0
Lateral (x)	5-70* 70-110	3.6 1.0	4.0
Lateral (y)	5-70* 70-110	4.0 2.0	4.0

*Limited to 0.5" D.A.

Table 2-2

ACCEPTANCE LEVEL RANDOM VIBRATION

FREQUENCY RANGE (Hz)	POWER SPECTRAL DENSITY (g^2/Hz)	G-RMS	DURATION (Min/Axis)
20-75	0.005	5.9	1.0
75-150	+10dB/Oct.		
150-500	0.05		
500-2000	-7dB/Oct.		

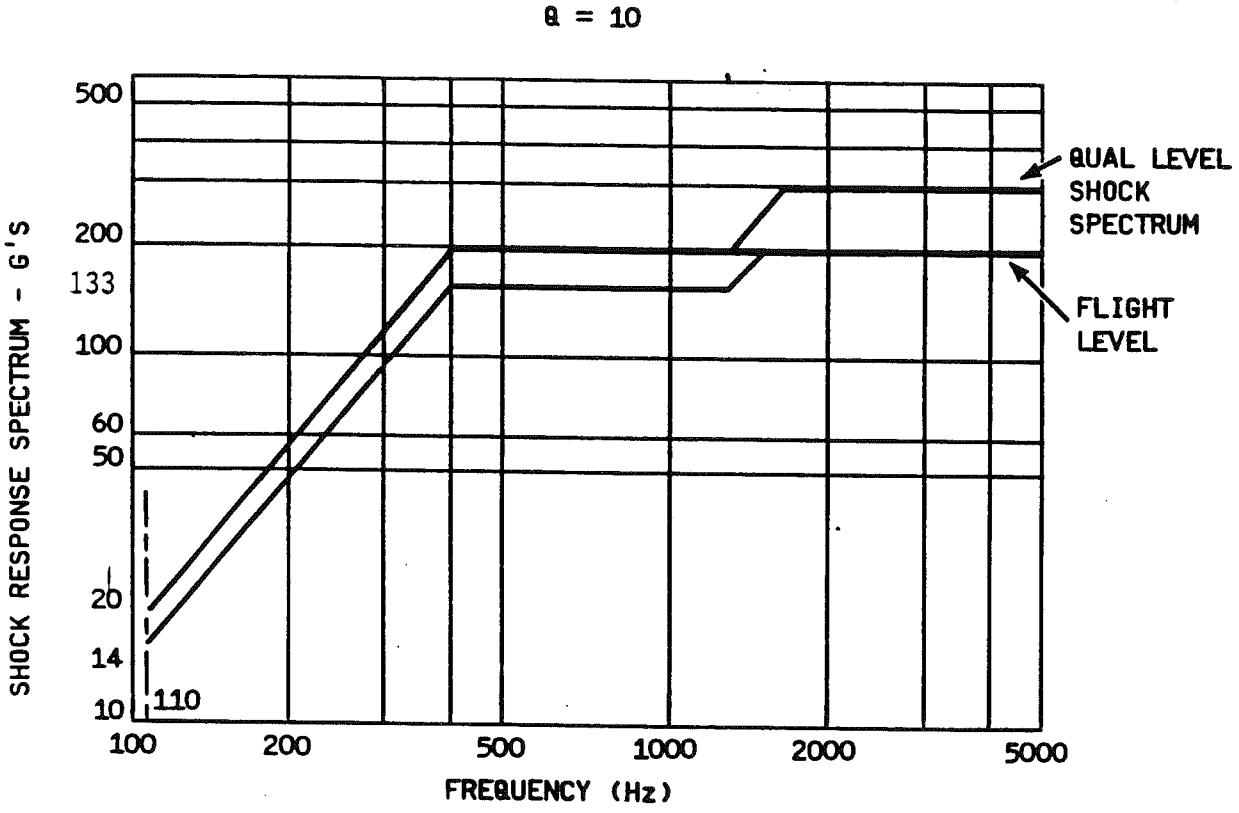


Figure 2-1 Qualification and flight level shock spectra

Table 2-3

LOW LEVEL VIBRATION LEVELS

INPUT	0.25g
FREQUENCY RANGE	10-2000 Hz
SWEEP RATE	2.0 Oct/Min

Section 3

THERMAL VACUUM TEST

(Reference Test Procedure 160861)

The final thermal vacuum test was performed in BASG vacuum chamber COMBO between February 21, 1988 and March 3, 1988. An aborted Thermal Vacuum test was attempted in April of 1987 but a grating bearing retainer was found to be cracked and had to be replaced before system testing could be continued. (Ref. GSFC MR 4-2 F04119.) The sensor module was mounted onto the vacuum test fixture and a cold plate was 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 throughout the test. **Figure 3-1** depicts the actual temperature profile used. **Figure 3-2** is a schematic profile.

Flight Model 3 electrical functional tests (software procedure MINIVAC) run during thermal vacuum testing were performed at Pre-Pumpdown (zone 0), 25 deg. C. (zone 1) Post Pumpdown, 30 deg. C. (zone 3), 0 deg. C. (zone 5), 30 deg. C. (zone 7), 0 deg. C. (zone 9), and 30 deg. C. (zone 11). At each of these zones, the instrument was allowed to thermally stabilize before all electrical functional tests were run.

The electrical functional tests in vacuum were completed with two anomalies. First, in discrete mode, the grating backup servo system would not lock into position at 0 deg. C. The grating system functioned within specification at +4 deg. C. and above. The performance meets specifications for all other modes of operation over the test temperature range of +30 deg. C. to 0 deg. C.; i.e., discrete, sweep, and calibrate modes with primary sensors, and sweep and calibrate modes with backup sensors. This operation is similar to the other sensor modules with the old grating shaft assembly in that gain margin in both sweep and discrete modes over the temperature range is not sufficient. The new mechanism (Serial No. 005 and subsequent) with a Beryllium shaft and Titanium housing have adequate margin. 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 was caused by microphonically induced noise. Because this did not affect data integrity, thermal vacuum testing continued, (heater/chiller was turned off during taking of data). The heater/chiller plumbing will be changed before the next T/V test to eliminate this problem.

Following the electrical functional tests, radiometric calibrations (software procedure VFLASH) were performed at 30 deg. C. (zone 11), 20 deg. C. (zone 13), 10 deg. C. (zone 15), 0 deg. C. (zone 17), and 25 deg. C. (zone 19). The radiometric calibration procedure that is used at zones 11, 17 and 19 is procedure "VFLASH1". This procedure takes data in discrete mode only using FEL lamps (S/N 190 and 191). Discrete mode data for each of the 12 discrete wavelengths are collected in the same manner using both of the calibration lamps. The calibration sequence used in zone 13 is procedure "VFLASH2". Data are taken in both sweep and discrete modes with the two FEL lamps. Sweep mode calibration is also done with the argon miniarc lamp. The calibration sequence used in zone 15 is procedure "VFLASH 3". Data are taken in two operating modes (sweep and discrete) during the thermal vacuum test. This procedure uses one FEL calibration lamp in both discrete mode and sweep mode. The other FEL lamp is used for discrete mode only; the miniarc lamp just for sweep mode data.

The subroutine CALSWEP for sweep mode calibration takes data for one sweep with the instrument diffuser deployed and then takes data on the following sweep with the test diffuser deployed. This sequence is repeated for a total of 10 consecutive sweeps. Then the subroutine is repeated making a total of 20 sweeps taken at that temperature plateau for each of the lamps. The subroutine GDFLCAL takes data in discrete mode for each of the 12 discrete wavelengths. Fifty data samples are recorded with the instrument diffuser deployed followed by 50 more samples with the test diffuser deployed. The wavelength calibration subroutine ALBEDO is run prior to the calibration sequences.

Table 3-1 and **Table 3-2** provide records of STE computer procedures, commands, and macros used during Thermal Vacuum Testing. **Table 3-3** provides additional information on the Thermal Vacuum Testing sequence.

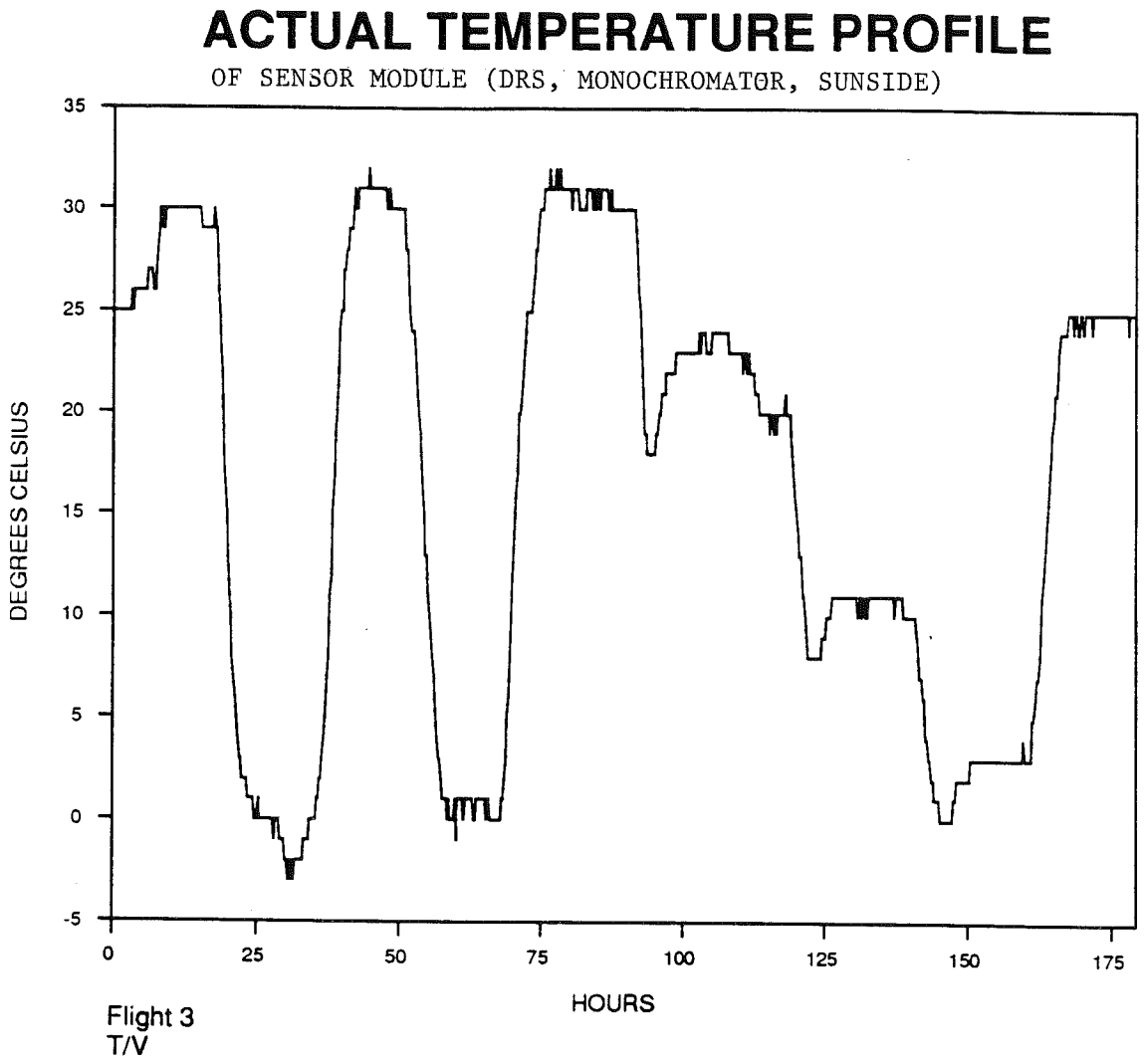


Figure 3-1

Actual daily temperature profile of DRS (monochromator temp.)

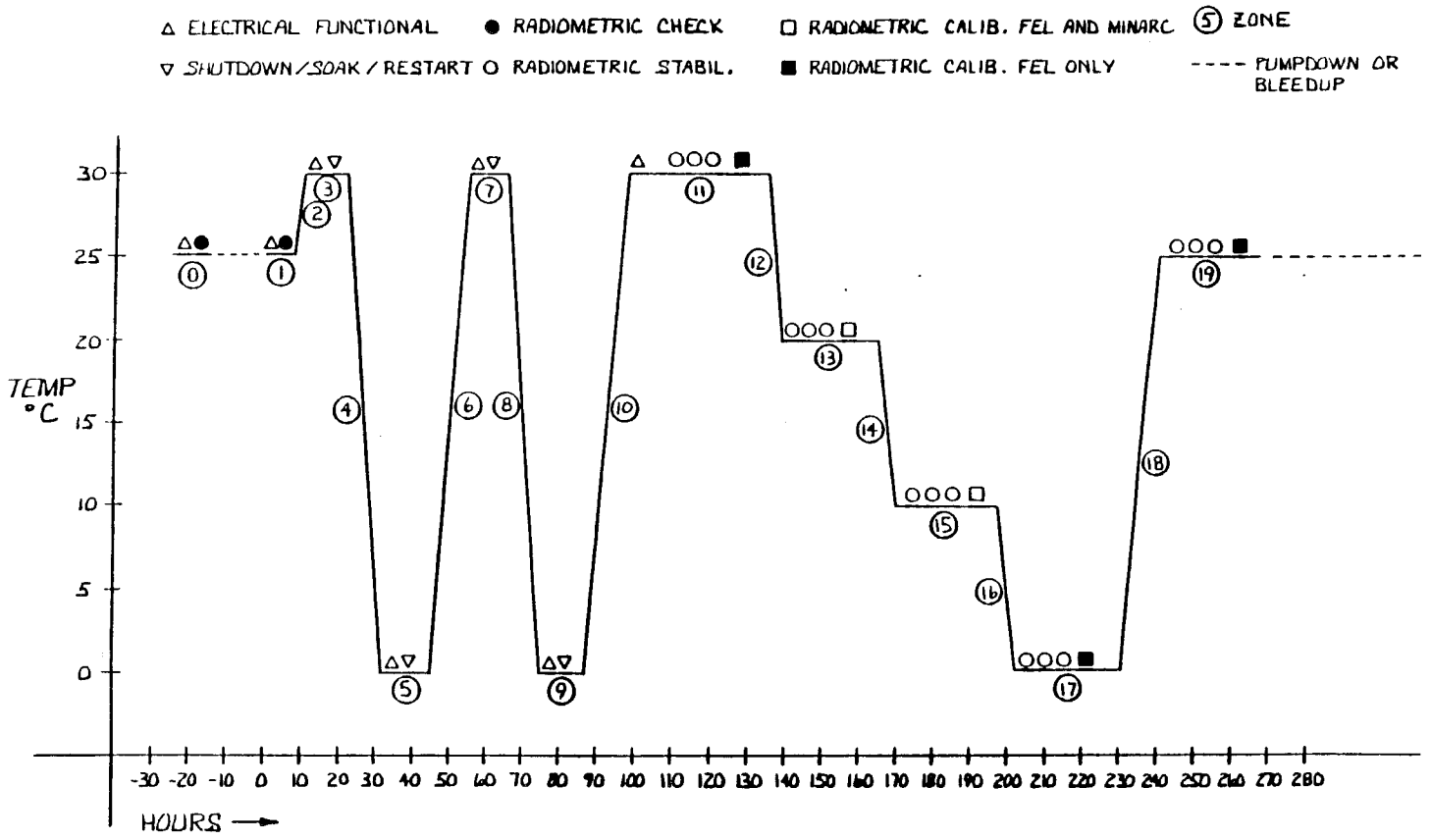


Figure 3-2

Acceptance test sequence and temperature profile

Table 3-1

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

ALBEDO	This macro checks the diffuser's reflectivity and the instrument's wavelength calibration.
COLDORB	This procedure retrieves SBUV orbital telemetry when the instrument is at or transitioning to cold temperatures.
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 3-2

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

ZONE	DATA	TIME	SOFTWARE PROCEDURE
0	22 FEB 1988 (053)	11:11:51	Procedure RESTART
		11:34:53	Procedure MINIVAC
		16:07:51	Macro ALBEDO - backup *
		16:37:07	Procedure VACHECK
		18:03:39	Macro POWEROF
	Instrument shut down prior to Pump-Down		
1	23 FEB 1988 (054)	07:44:46	Procedure RESTART
		08:20:46	Procedure MINIVAC
		10:43:44	Procedure VACHECK
		12:16:58	Macro ALBEDO - backup *
		12:46:40	Procedure VACHECK
		14:39:07	Procedure ORBIT
2	23 FEB 1988 (054)	16:19:21	Procedure ORBIT
		17:39:58	Procedure ORBIT
3	23 FEB 1988 (054)	19:26:47	Procedure MINIVAC
		21:49:00	Macro ALBEDO - backup *
		22:19:35	Procedure PWROFF
	24 FEB 1988 (055)	01:49:34	Procedure RESTART
4	24 FEB 1988 (055)	02:38:18	Procedure ORBIT
		03:53:06	Procedure COLDORB
5	24 FEB 1988 (055)	10:05:40	Procedure MINIVAC
		12:12:28	Macro ALBEDO - backup *
		13:34:43	Procedure PWROFF
		18:13:58	Procedure RESTART
6	24 FEB 1988 (055)	19:00:19	"Modified zone 6" - troubleshooting grating encoder
		22:02:35	Procedure COLDORB
	25 FEB 1988 (056)	00:14:11	Procedure ORBIT
7	25 FEB 1988 (056)	03:02:27	Procedure MINIVAC
		05:42:36	Macro ALBEDO - backup *
		06:55:54	Procedure PWROFF
		11:04:09	Procedure RESTART

*Time listed for Macro ALBEDO is beginning of 4th sweep. Lamp warmed up 30 minutes prior to 4th sweep.

ZONE	DATA	TIME	SOFTWARE PROCEDURE
8	25 FEB 1988 (056)	11:39:14	Procedure ORBIT
		13:44:14	Procedure COLDORB
9	25 FEB 1988 (056)	20:25:04	Procedure MINIVAC
		22:51:24	Macro ALBEDO - backup *
		23:38:54	Procedure PWROFF
	26 FEB 1988 (057)	03:53:46	Procedure RESTART
10	26 FEB 1988 (057)	05:03:48	Procedure COLDORB
		06:05:46	Procedure COLDORB
		12:43:19	Procedure ORBIT
		17:31:56	Macro ALBEDO - backup *
11	26 FEB 1988 (057)	14:10:52	Procedure MINIVAC
		18:10:09	Procedure VACHECK
		21:20:13	Procedure VACHECK
		22:37:25	Procedure VACHECK
	27 FEB 1988 (058)	00:11:01	Procedure VFLASH1
		00:53:32	Macro ALBEDO - primary *
12	27 FEB 1988 (058)	10:25:48	Procedure VACHECK
		12:29:21	Procedure VACHECK
		15:03:28	Procedure VACHECK
13	27 FEB 1988 (058)	17:05:59	Procedure VFLASH2
		17:43:45	Macro ALBEDO - primary*
14	28 FEB 1988 (059)	14:43:30	Procedure VACHECK
		16:56:52	Procedure VACHECK
		18:58:41	Procedure VACHECK
15	28 FEB 1988 (059)	20:31:55	Procedure VFLASH3
		21:08:01	Macro ALBEDO - primary *
16	01 MAR 1988 (060)	13:47:32	Procedure VACHECK
		16:03:09	Procedure VACHECK
		18:30:35	Procedure VACHECK
17	01 MAR 1988 (060)	20:51:05	Procedure VFLASH1
		21:27:27	Macro ALBEDO - primary *
18	02 MAR 1988 (061)	01:41:04	Procedure COLDORB
		06:10:39	Procedure ORBIT
		08:16:49	Procedure VACHECK
		10:26:44	Procedure VACHECK
		12:28:25	Procedure VACHECK

*Time listed for Macro ALBEDO is beginning of 4th sweep. Lamp warmed up 30 minutes prior to 4th sweep.

ZONE	DATA	TIME	SOFTWARE PROCEDURE
19	02 MAR 1988	13:56:56	Procedure VFLASH1
	(061)	14:33:24	Macro ALBEDO - primary *
		20:09:48	Macro PWROFF
	Instrument shut down prior to Bleed Up.		
Retest at 20 deg. C.			
	03 MAR 1988	08:58:48	Procedure RESTART
	(062)	13:17:50	Procedure VFLASH1
		16:28:28	Macro PWROFF

*Time listed for Macro ALBEDO is beginning of 4th sweep. Lamp warmed up 30 minutes prior to 4th sweep.

Table 3-3

ACCEPTANCE TEST THERMAL VACUUM SEQUENCE

HOURS	ZONE	TIME	ACTIVITY	SOFTWARE PROCEDURE
-24	0	8	Pre-Pumpdown Electrical Functional	RESTART/MINIVAC
			Pre-Pumpdown Radiometric Check	VACHECK
			Power Down/QC Verification	MACRO POWEROF
-16	*	16	Pump-Down Chamber	
0	1	8	Post Pumpdown Electrical Functional, 25°	RESTART/MINIVAC
			Post Pumpdown Radiometric Check	VACHECK
8	2	2	Transition to 30°	ORBIT
10	3	12	Electrical Functional, 30°	MINIVAC
			Shutdown/30° Soak/Restart	PWROFF/RESTART
22	4	10	Transition to 0°	ORBIT/COLDORB
32	5	12	Electrical Functional, 0°	MINIVAC
			Shutdown/0° Soak/Restart	PWROFF/RESTART
44	6	10	Transition of 30°	COLDORB/ORBIT
54	7	12	Electrical Functional 30°	MINIVAC
			Shutdown/30° Soak/Restart	PWROFF/RESTART
66	8	10	Transition to 0°	ORBIT/COLDORB
76	9	12	Electrical Functional, 0°	MINIVAC
			Shutdown/0° Soak/Restart	PWROFF/RESTART
88	10	10	Transition to 30°	COLDORB/ORBIT
98	11	36	Electrical Functional, 30°	MINIVAC
			Radiometric Stabilization, 30°	VACHECK
			Vacuum Calibration, 30°	VFLASH1
134	12	16	Transition and Stabilization, 20°	VACHECK
150	13	16	Vacuum Calibration, 20°	VFLASH2
166	14	16	Transition and Stabilization, 10°	VACHECK
182	15	16	Vacuum Calibration, 10°	VFLASH3
198	16	16	Transition and Stabilization, 0°	VACHECK
214	17	16	Vacuum Calibration, 0°	VFLASH1

*NOTE: All power removed, chamber pressure and temperature controlled by VAC Lab personnel.

HOURS	ZONE	TIME	ACTIVITY	SOFTWARE PROCEDURE
230	18	20	Transition and Stabilization, 25°	COLDORB/ORBIT/VACHECK
252	19	16	Vacuum Calibration, 25°	VFLASH1
			Power Down/QC Verification	MACRO POWEROF
268	*	*	Bleed Up Chamber	

*NOTE: All power removed, chamber pressure and temperature controlled by VAC Lab personnel.

Section 4

MASS PROPERTIES

(Reference Test Procedure 68037)

The weight, center of gravity, and envelope dimensions have been determined for the Electronics and Logic Module and for the Sensor Module. **Table 4-1** and **Figures 4-1** through **4-6** 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 4-1

INSTRUMENT WEIGHT

ASSEMBLY	WEIGHT	
	SPECIFICATION	MEASUREMENT
Sensor Module (with thermal blankets and EMI Shield)	60 Pounds (Target)	58.47 Pounds
Electronics and Logic Module	26 Pounds (Target)	25.34 Pounds
TOTAL	86 Pounds Maximum	83.81 Pounds

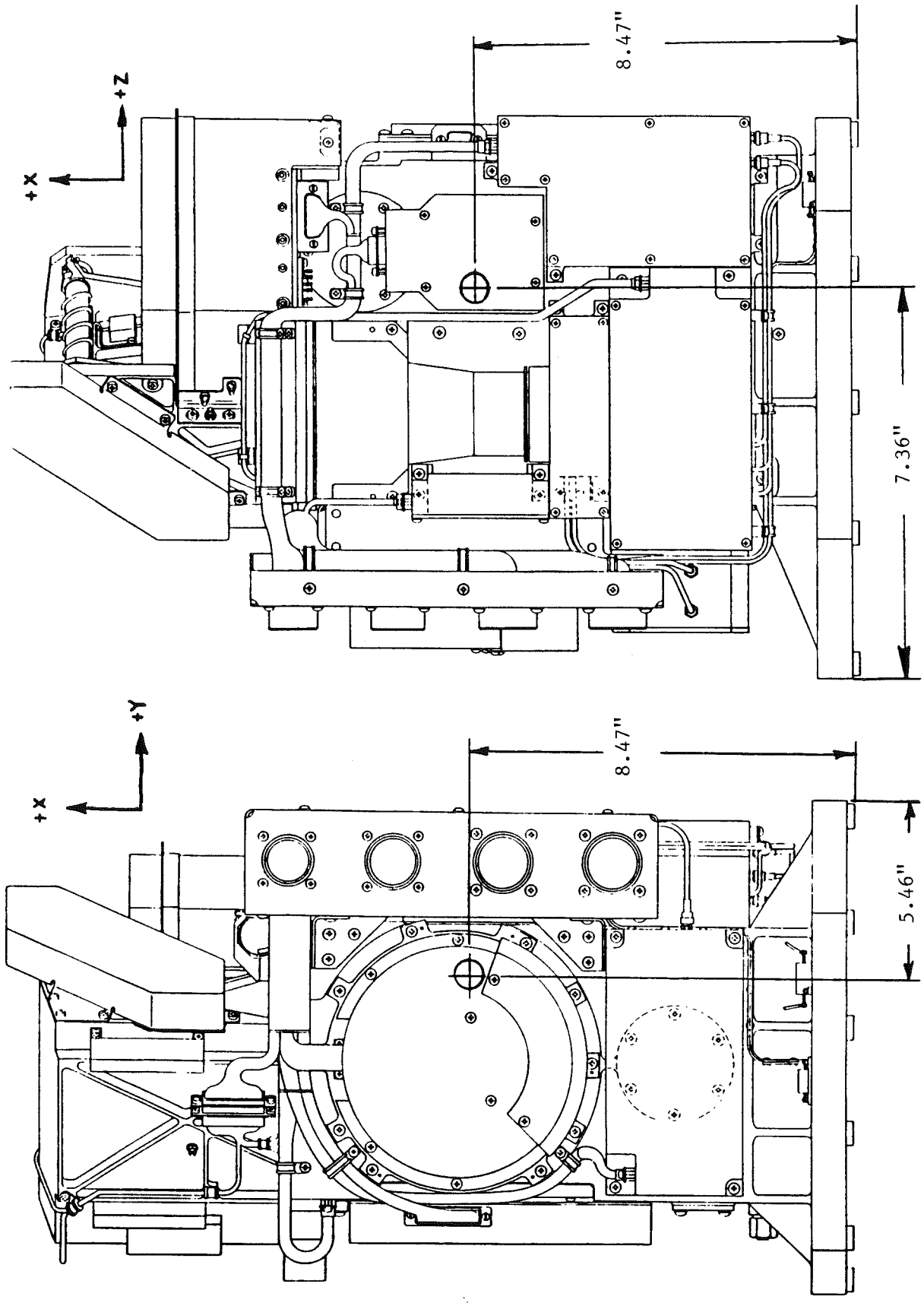


Figure 4-1 Sensor module center of gravity

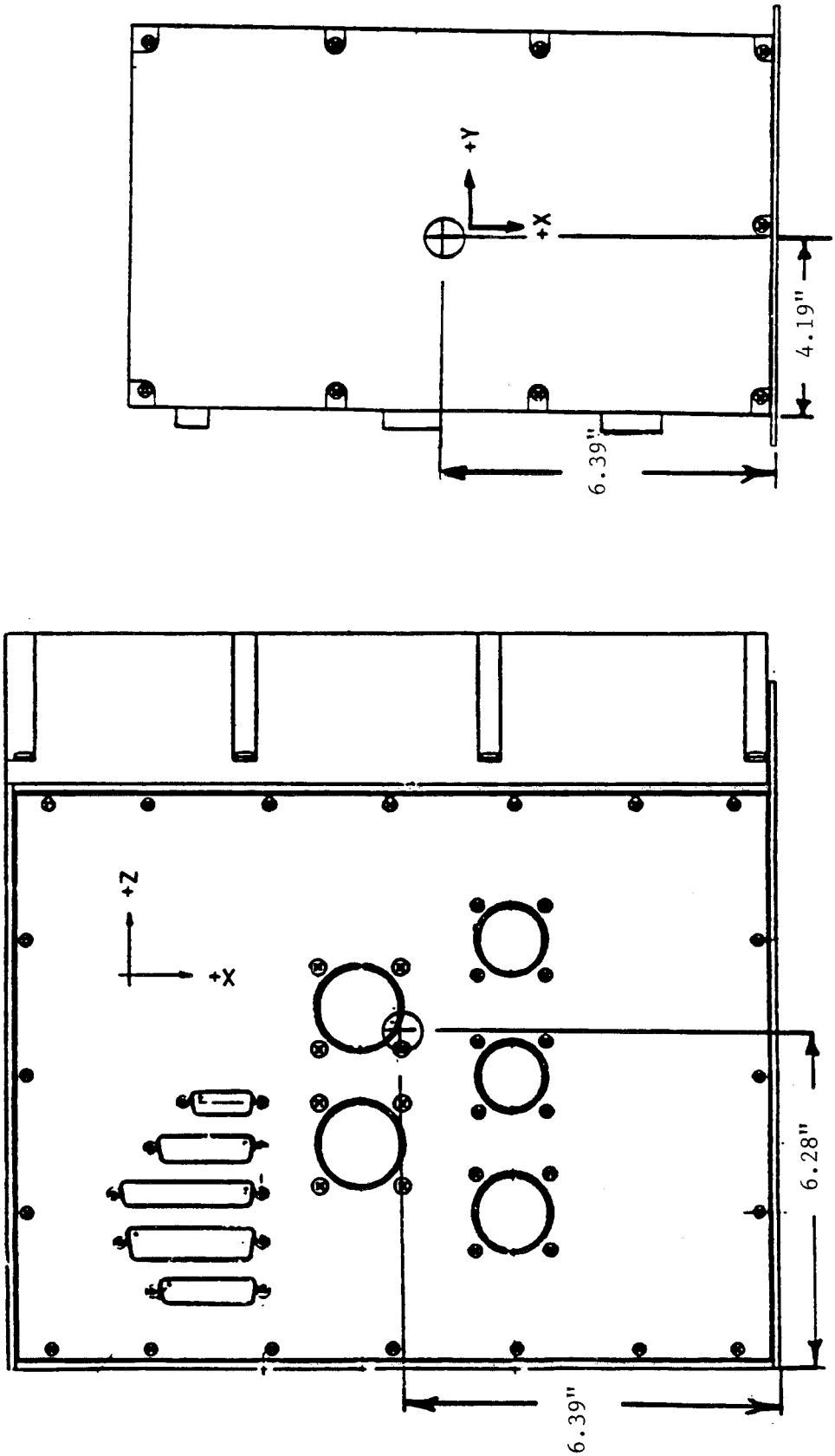


Figure 4-2 Electronics and logic module center of gravity

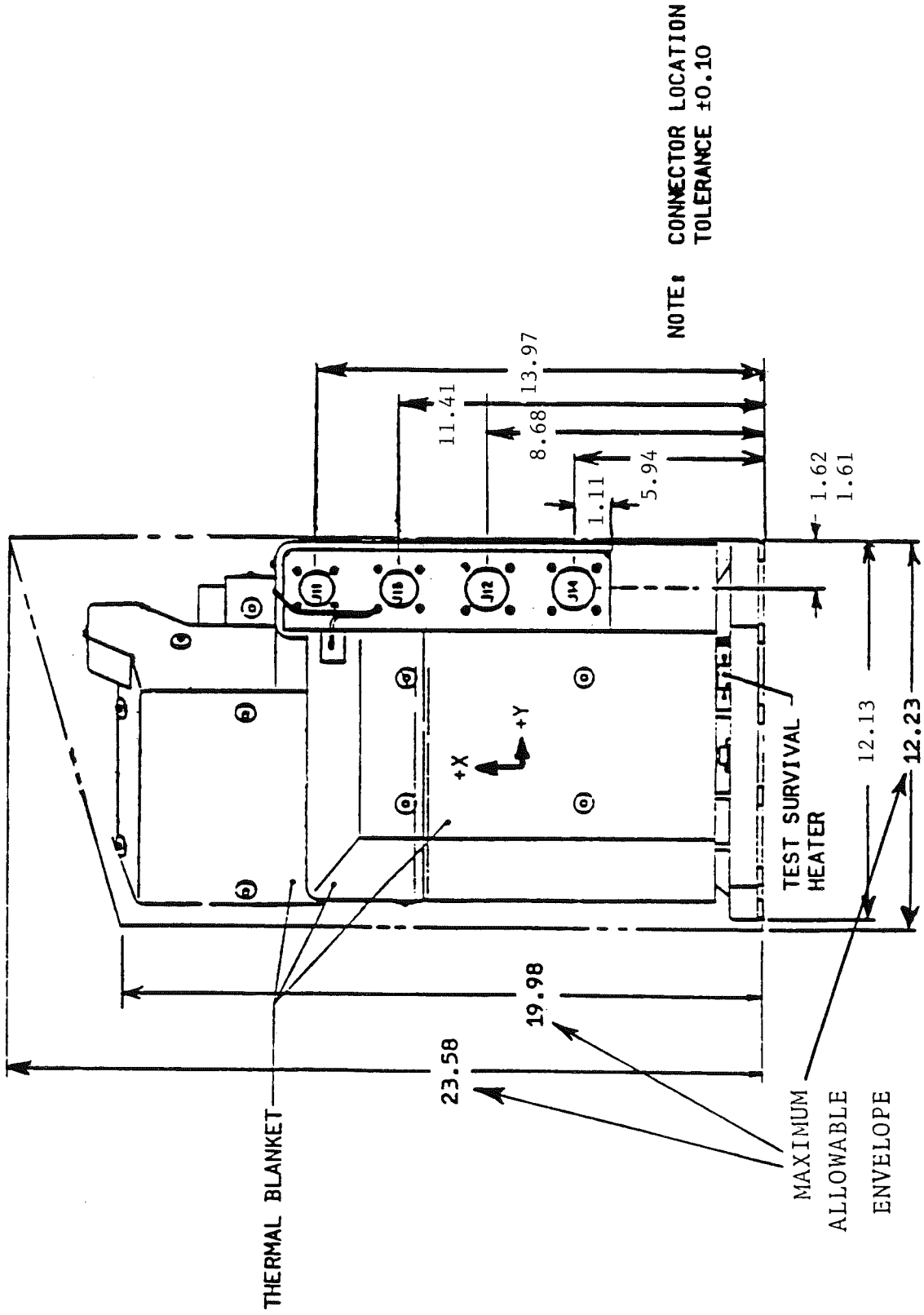


Figure 4-3 Sensor module envelope

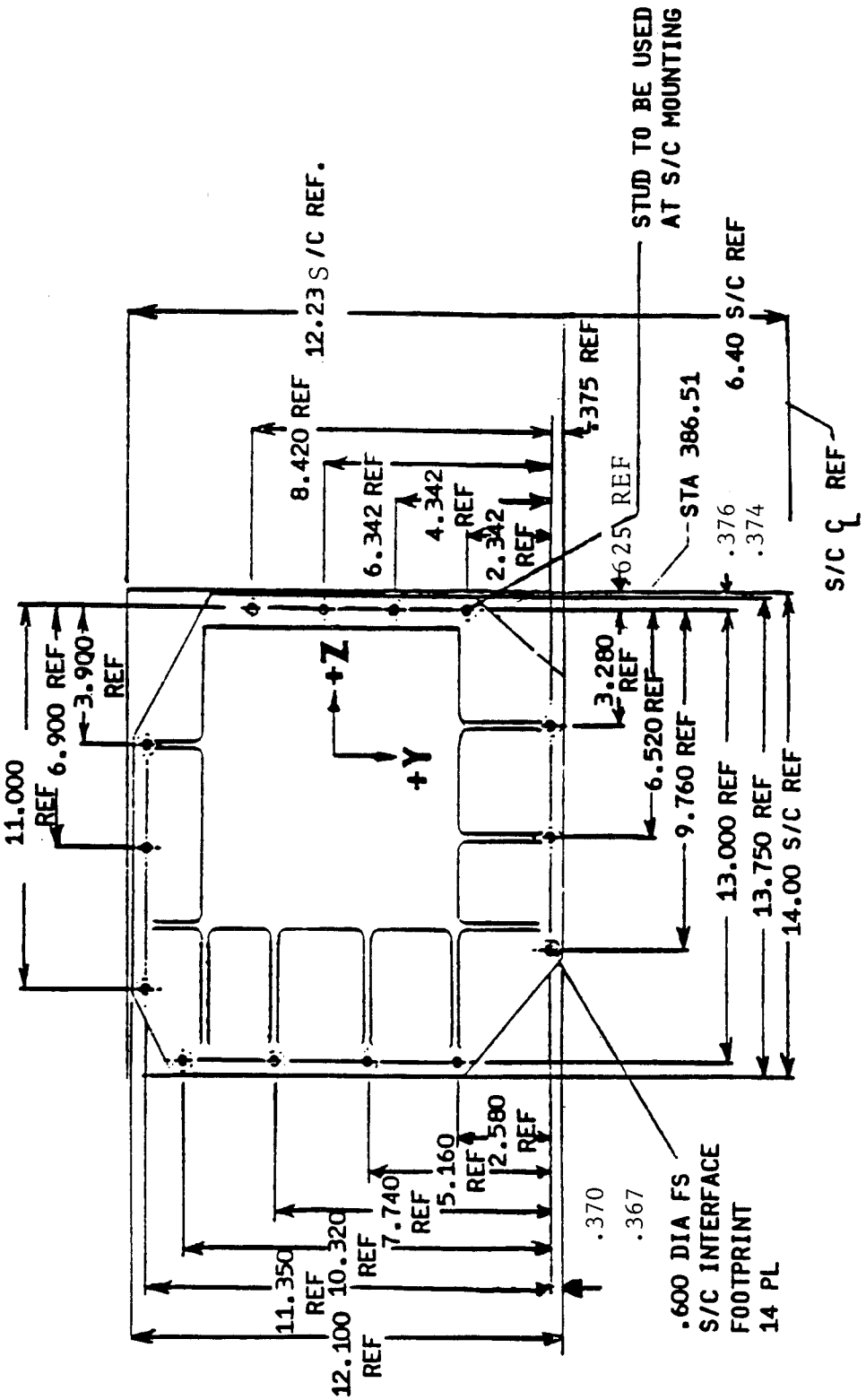


Figure 4-4 Sensor module interface footprint

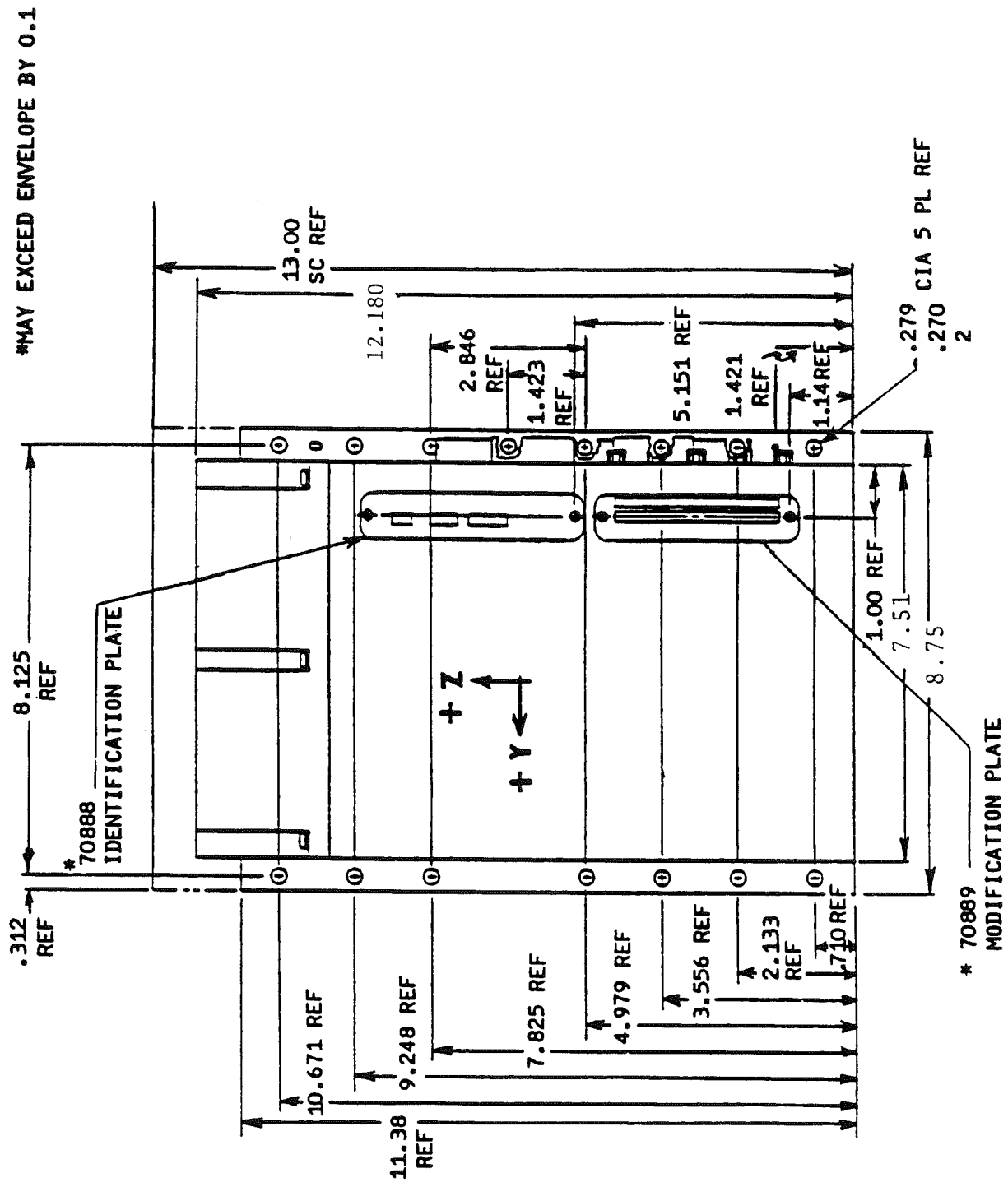


Figure 4-5 Electronics and logic module Y-Z dimensions

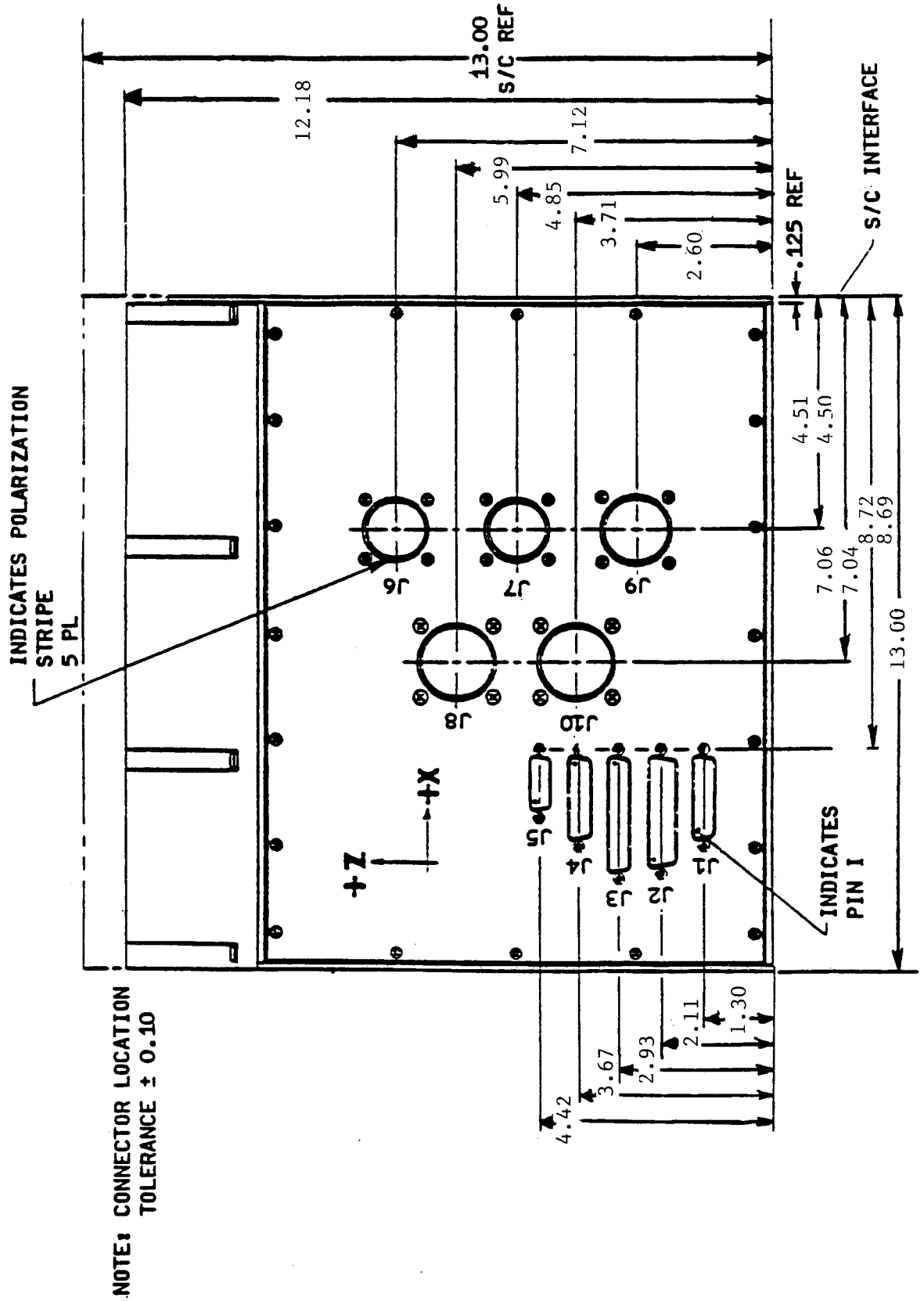


Figure 4-6 Electronics and logic module X-Y dimensions

ARS CHAIN

Section 5
TELEMETRY CALIBRATION

This section contains the conversion factors for both the Analog and Digital "A" Sub-Multiplexer temperature, voltage and current monitors. The calibrations of telemetry from these sensors are based on the circuit designs. No special tests are performed to calibrate these sensors, but data are recorded from each monitor circuit during all instrument testing. This specific Flight 3 telemetry data are presented here, along with conversions to the appropriate units.

The Digital "A" Sub-Multiplexer data points are sampled by the instrument every 16 seconds, and are included in the Digital "A" telemetry stream. Each value is an 8-bit binary number, ranging from 0 to 255 counts.

The Analog telemetry data points are voltages continuously available on discrete lines. The System Test Equipment (STE) samples these voltages periodically and converts them to counts for data processing. The data presented here are the actual voltages output by the instrument. For more details see the GE/Astro Space Division (RCA) "SBUV/2 Unique Instrument Interface Specification," document IS 2295548, Section 3.1.5.

TEMPERATURES

Only one thermistor component type is used for temperature monitoring within the SBUV/2 instrument, but each sensor is wired into one of five different circuit types. The circuit types are designed to provide the best resolution and linear response over different nominal ranges. **Table 5-1** shows the conversions for these five types. Note the mixture of Analog and Digital telemetry for the temperature data. The individual sensor temperatures are converted in only one kind of telemetry, and these are listed in **Table 5-2. Figures 5-1** through **5-7** show the conversions graphically. The temperature conversions have been extended beyond nominal ranges, in some cases, where the telemetry continues to supply useful data.

The two differential monitors are intended to measure the temperature difference across the Sensor Module (SM). The differential monitors consist of a pair of thermistors on opposite

sides of the SM. One is used as the reference; the other is used to calculate the difference:

If we call the reference telemetry (counts) A,

then we use **Table 5-1** to convert to temperature T_A.

But the differential telemetry (counts) B

must first be changed into corrected counts C,

by the formula $C = A + 0.107499B - 13.706$

C is now converted to temperature T_C

using the same column of **Table 5-1**.

The temperature differential is $T_D = T_A - T_C$.

The nominal temperature range for the differential sensors is +/-5 degrees C. Environmental tests have shown all of the temperature telemetry to be accurate and consistent.

VOLTAGES

Table 5-3 lists the conversion factors for the voltage monitors, the nominal telemetry values, as well as actual Flight 3 data. These actual data are included on the graphs of the conversions in **Figures 5-8** through **5-17**. Note that the -15 volt monitors (Servo and Sensor) are referenced to the +5 volt line; therefore, the conversion requires both values.

CURRENTS

Table 5-4 lists the conversion factors, nominal and actual values for the current monitors. **Figures 5-18** through **5-21** show the conversions and actual Flight 3 data. Both voltage and current telemetry have been repeatable throughout the instrument tests.

Table 5-1

TEMPERATURE SENSOR CONVERSIONS

SENSOR NOMINAL RANGE:	TYPE 1 0 TO 80		TYPE 2 -15 TO 45		TYPE 3 -5 TO 35	TYPE 4 -15 TO 45	TYPE 5 -30 TO 80
TLM: GRAPH: DEGREES C.	DIGITAL FIG. 5-1 COUNTS	ANALOG FIG.5-2 VOLTS	DIGITAL FIG.5-3 COUNTS	ANALOG FIG. 5-4 VOLTS	DIGITAL FIG. 5-5 COUNTS	DIGITAL FIG. 5-6 COUNTS	ANALOG FIG. 5-7 VOLTS
-30							4.74
-20				5.15			4.57
-15			250	5.01		179	4.45
-10		5.513	242	4.84		170	4.32
-5					247	161	4.16
0	249	4.98	221	4.42	235	150	3.99
5						140	3.79
10	217	4.35	196	3.92	206	128	3.57
15						117	3.34
20	183	3.67	168	3.36	176	105	3.10
25	167	3.33	154	3.08		94	2.86
30	150	3.00	139	2.79	145	84	2.61
35					130	74	2.37
40	119	2.39	112	2.25	116	65	2.14
45			100	2.01		57	1.91
50	93	1.86	89	1.78	91		1.71
60	72	1.44	69	1.39	70		1.35
70	55	1.10	54	1.08	54		1.05
80	42	.085	41	0.831			0.81

Table 5-2

TEMPERATURE SENSORS

LOCATION	SENSOR TYPE (Table 5-1)	TELEMETRY TYPE	GRAPH FIGURE NO.
Calibration Lamp Housing	1	Digital	5-1
Diffuser Plate	1	Digital	5-1
Diffuser Plate (#2 sensor)	1	Analog	5-2
Sensor Module Baseplate	2	Digitial	5-3
Sensor Module Baseplate (#2 sensor)	2	Analog	5-4
Calibration Lamp Motor	2	Analog	5-4
Calibration Lamp Power Supply	2	Analog	5-4
Diffuser Motor	2	Analog	5-4
Diffuser Radiator	2	Analog	5-4
Chopper Motor	2	Analog	5-4
Depolarizer Housing	2	Analog	5-4
Grating Motor	2	Analog	5-4
Electrometer	2	Analog	5-4
High Voltage Power Supply	2	Analog	5-4
Electronics & Logic Module	2	Analog	5-4
Low Voltage Power Supply (in ELM)	2	Analog	5-4
PMT Housing	3	Digital	5-5
CCR Diode	3	Digital	5-5
Sensor Module -Y Reference	4	Digital	5-6
Sensor Module +Y Differential	4	See Text	
Sensor Module -Z Reference	4	Digital	5-6
Sensor Module +Z Differential	4	See Text	
Sensor Module Shroud	5	Analog	5-7

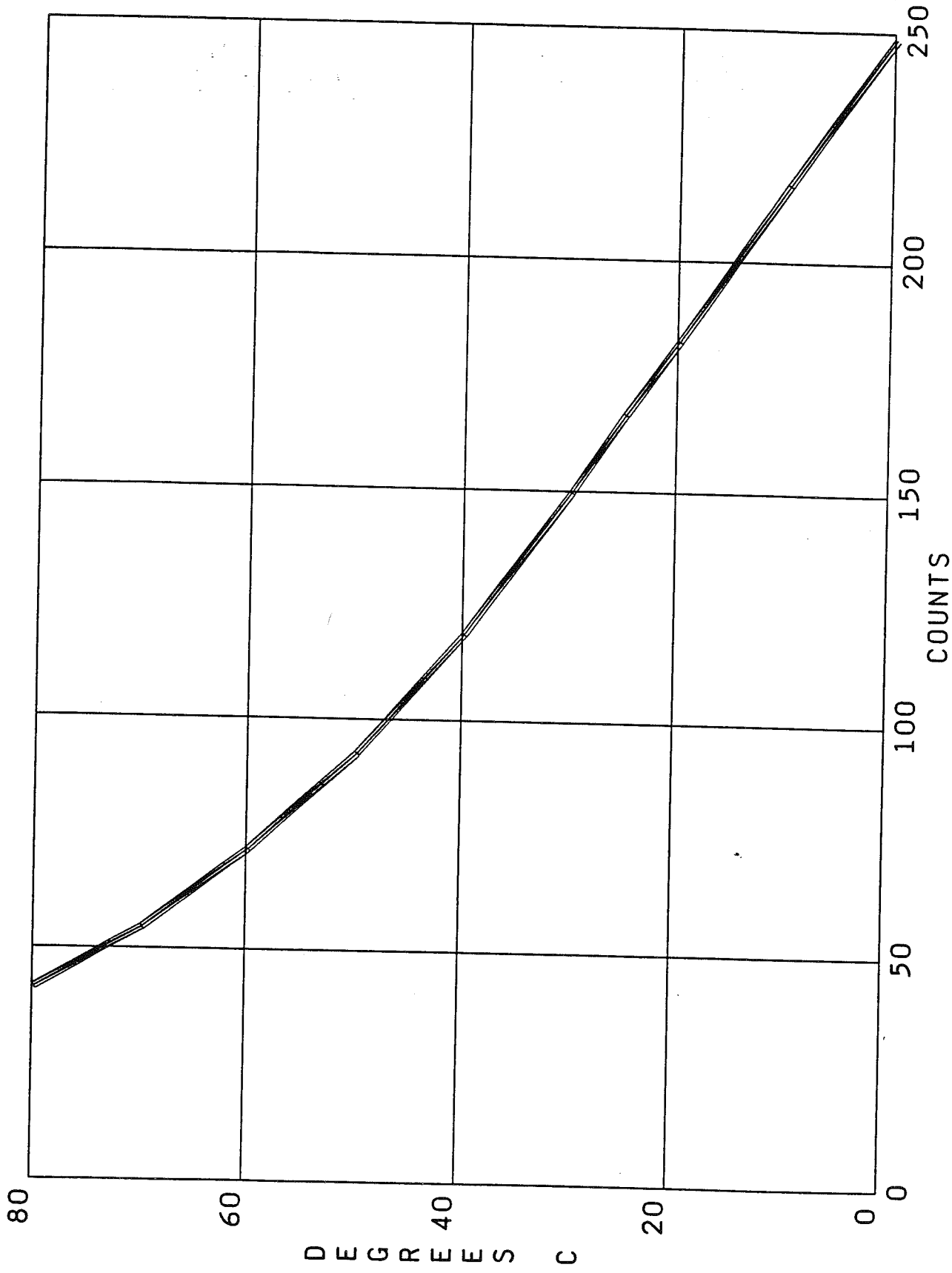


Figure 5-1: Type 1 Temperature sensor digital telemetry

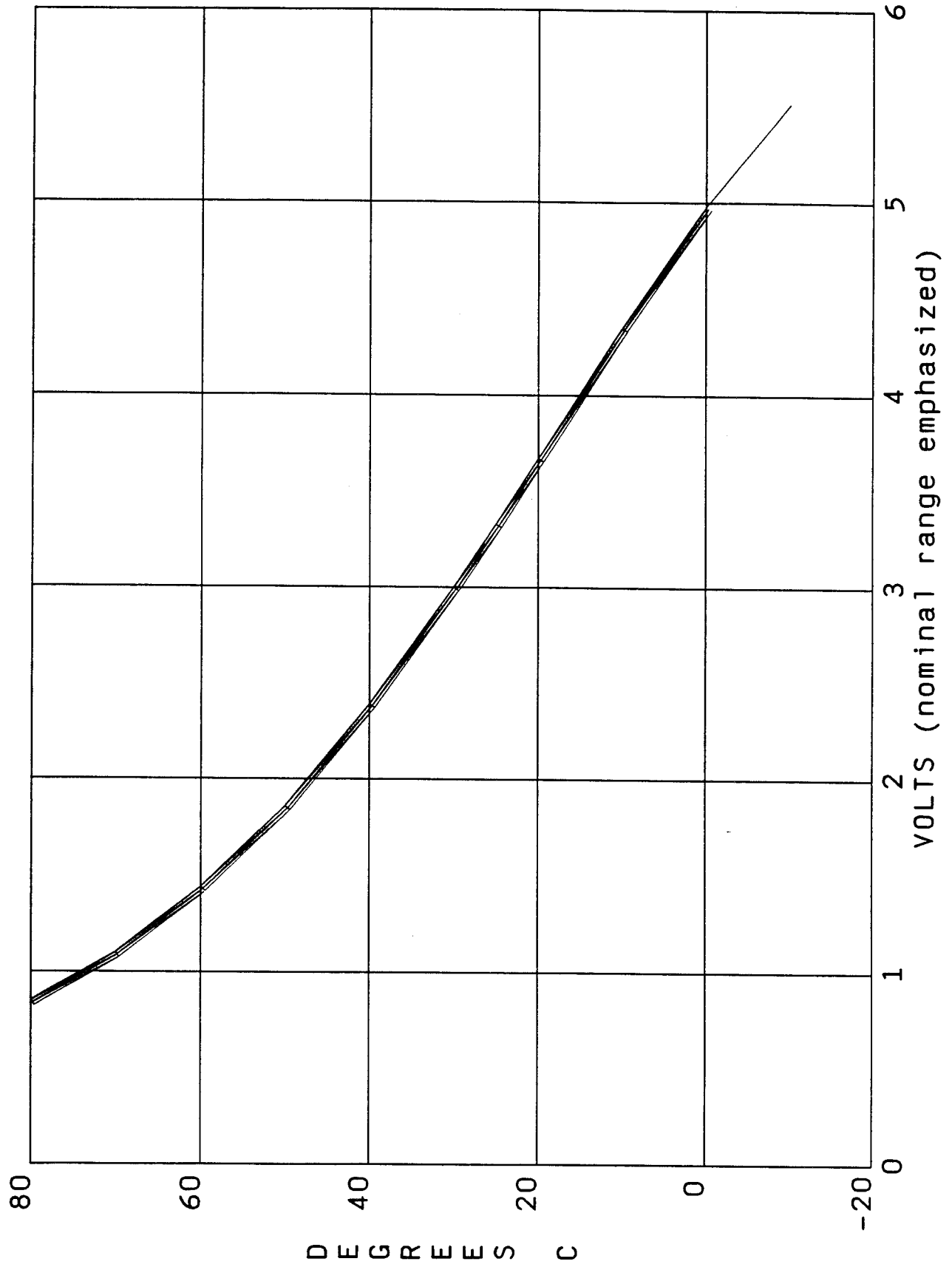


Figure 5-2: Type 1 Temperature sensor analog telemetry

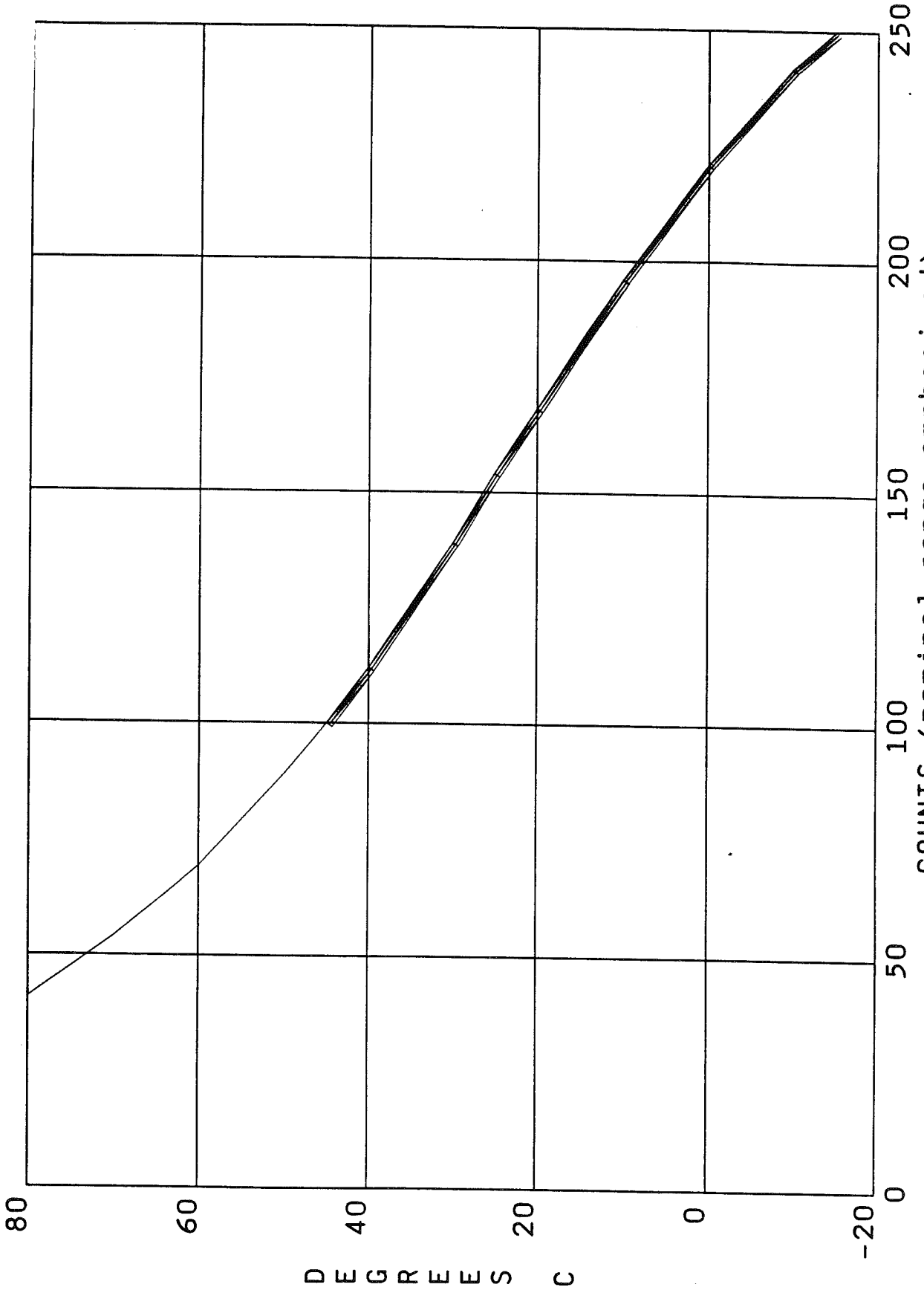


Figure 5-3: Type 2 Temperature sensor digital telemetry

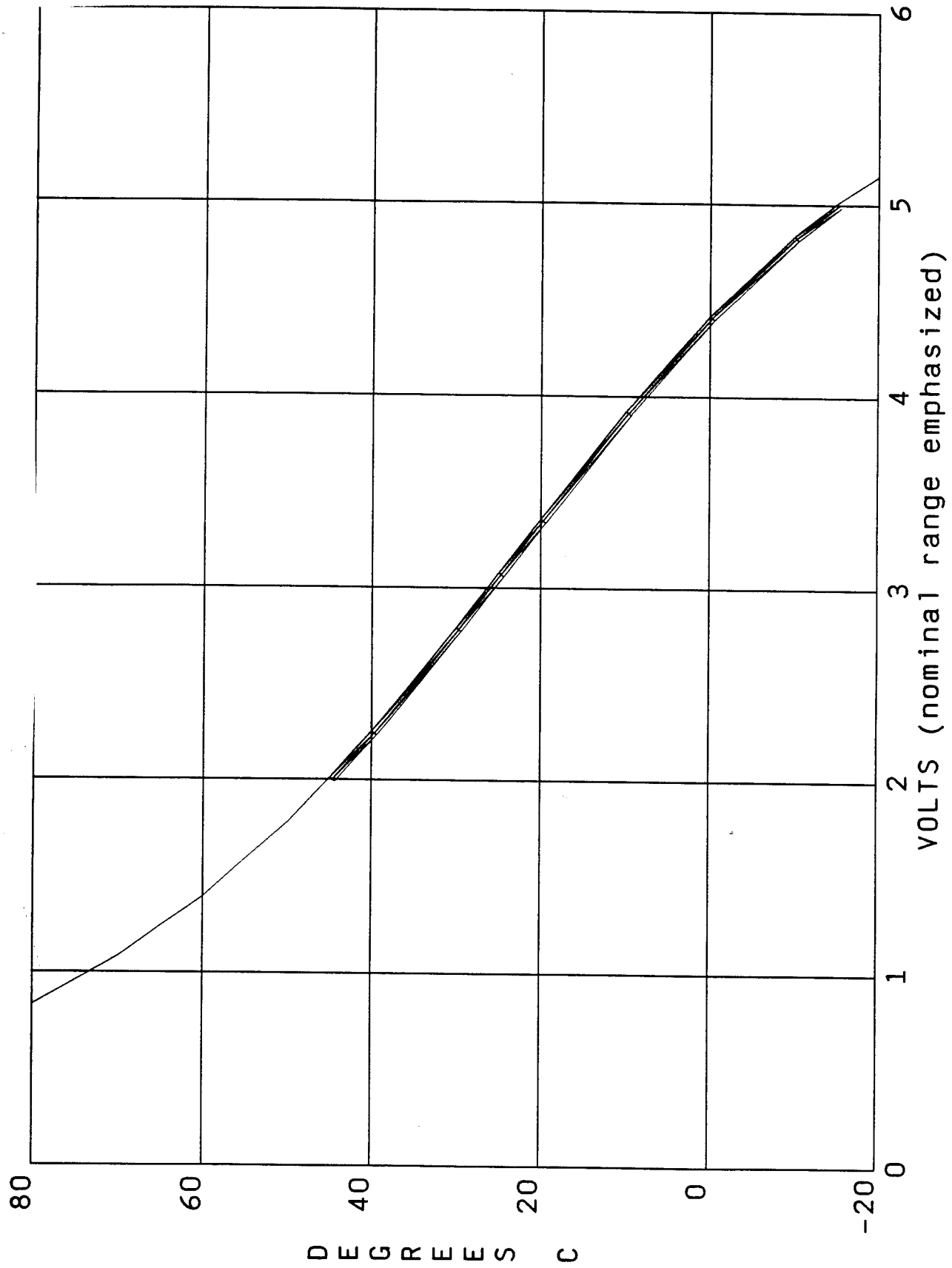


Figure 5-4: Type 2 Temperature sensor analog telemetry

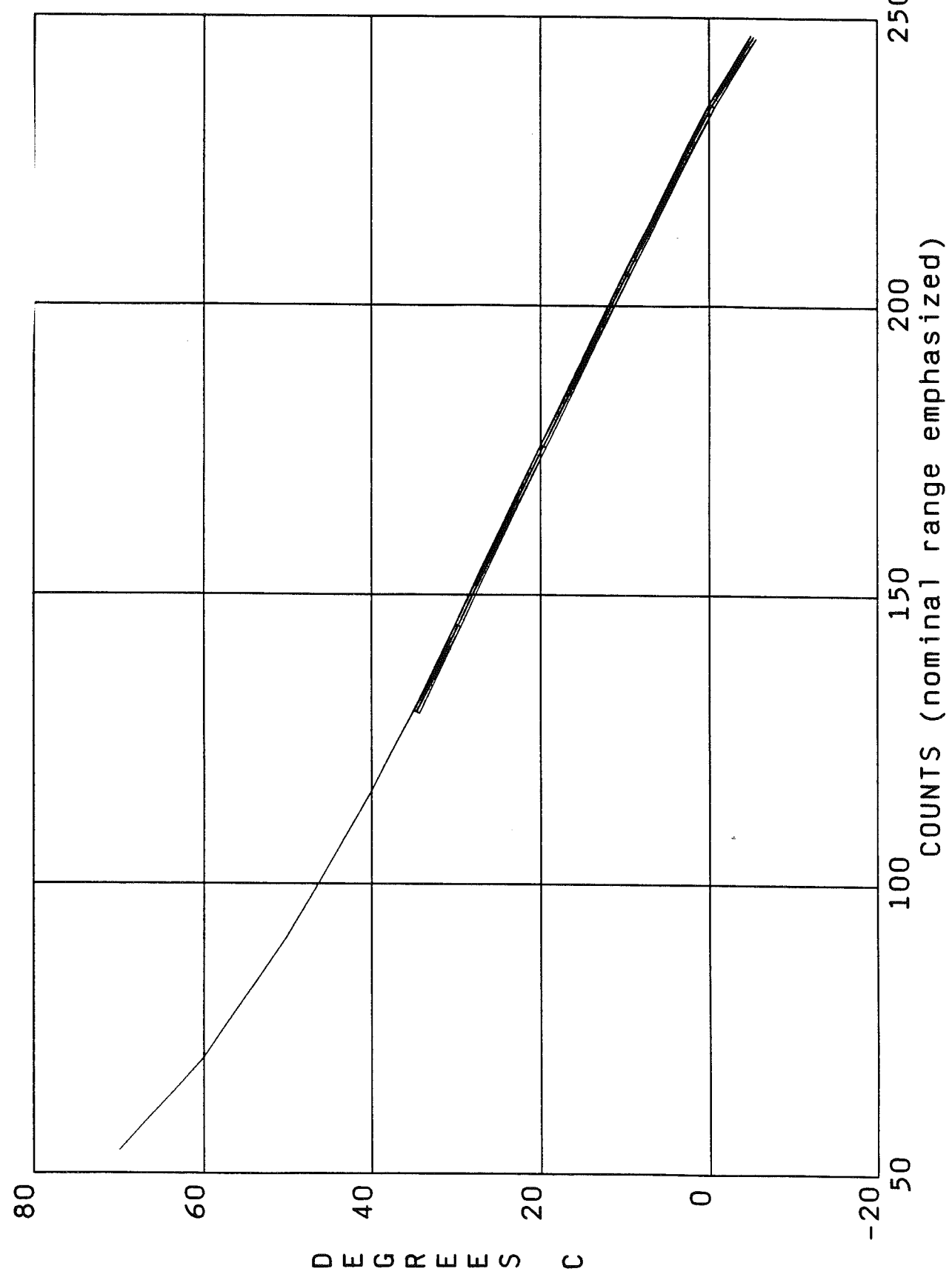


Figure 5-5: Type 3 Temperature sensor telemetry

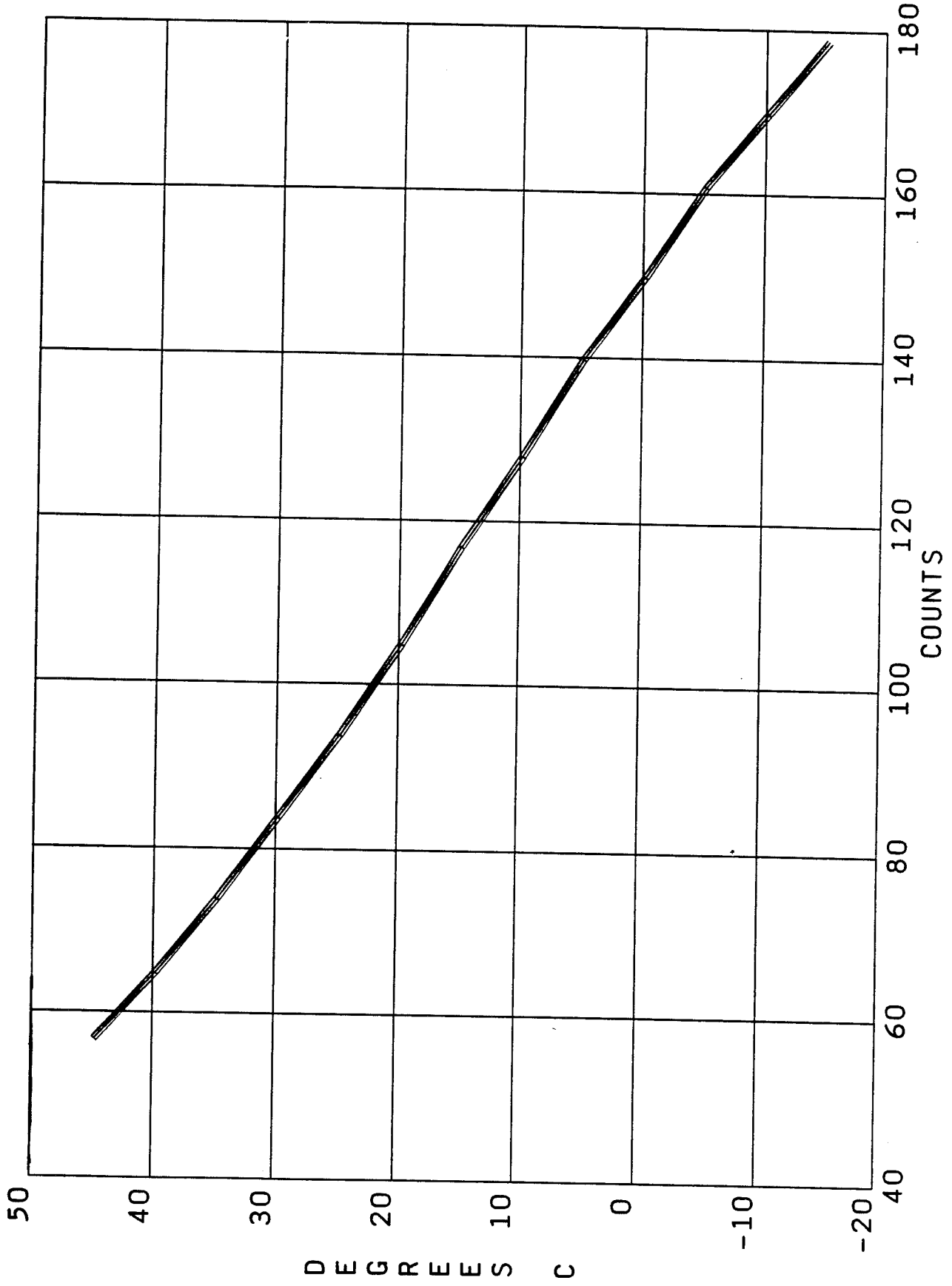


Figure 5-6: Type 4 (Differential) Temperature sensor telemetry

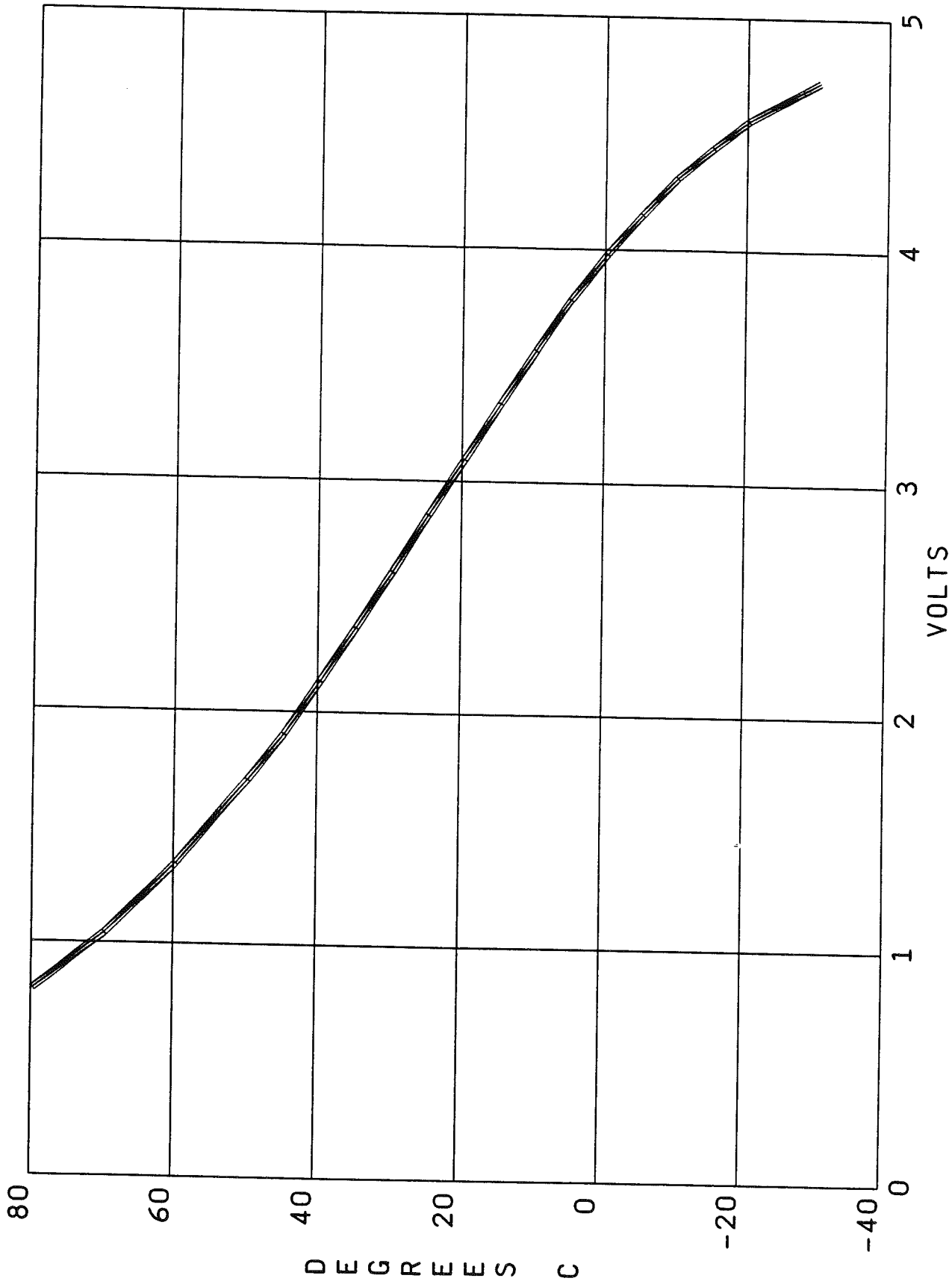


Figure 5-7: Type 5 Temperature sensor telemetry

Table 5-3

VOLTAGE MONITOR CONVERSIONS

VOLTAGE	TELEMETRY TYPE	CONVERSION FACTOR (N=COUNTS)	NOMINAL TELEMETRY VALUE	ACTUAL FLT.3 TELEMETRY VALUE	FIGURE NO.
5 V	Digital	0.0333 V/N	150	146-148	5-8
E-CAL Ref. (6.4 V)	Digital	0.04 V/N	160	160-161	5-9
10 V Logic, Thermistor Bias	Digital	0.667 V/N	150	149-152	5-10
15 V Servo, 15 V Sensor	Digital	0.1 V/N	150	146-149	5-11
-15 V. Servo, -15 V Sensor	Digital *	$V=0.6083N_5-0.5059N_{-15}$		145-147	5-12, 5-13
24 V Motor 25 V	Digital Digital	0.198 V/N 0.198 V/N	121 126	129-132 121-122	5-14 5-14
28 V	Analog	9.912 V/V	2.82 V	2.88-2.96 V	5-15
HVPS (750 V Flt. 3)	Digital	6.0 V/N	n/a	124-126	5-16
Chopper Phase Error Voltage	Digital	0.0985 V/N	n/a	86-89	5-17

* The -15 V conversion depends on the actual value of 5 V as well as -15 V.

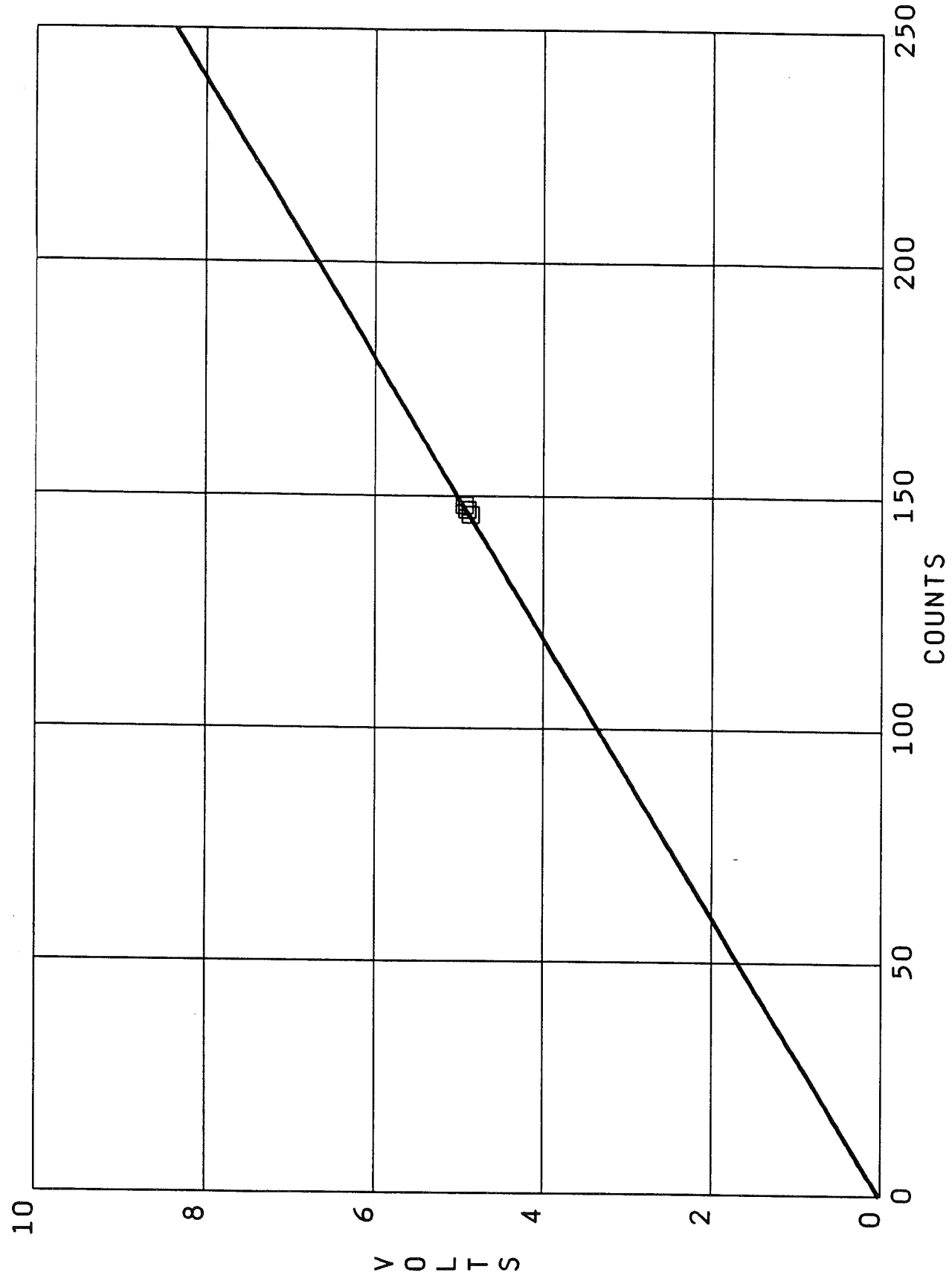


Figure 5-8: 5 volt monitor telemetry

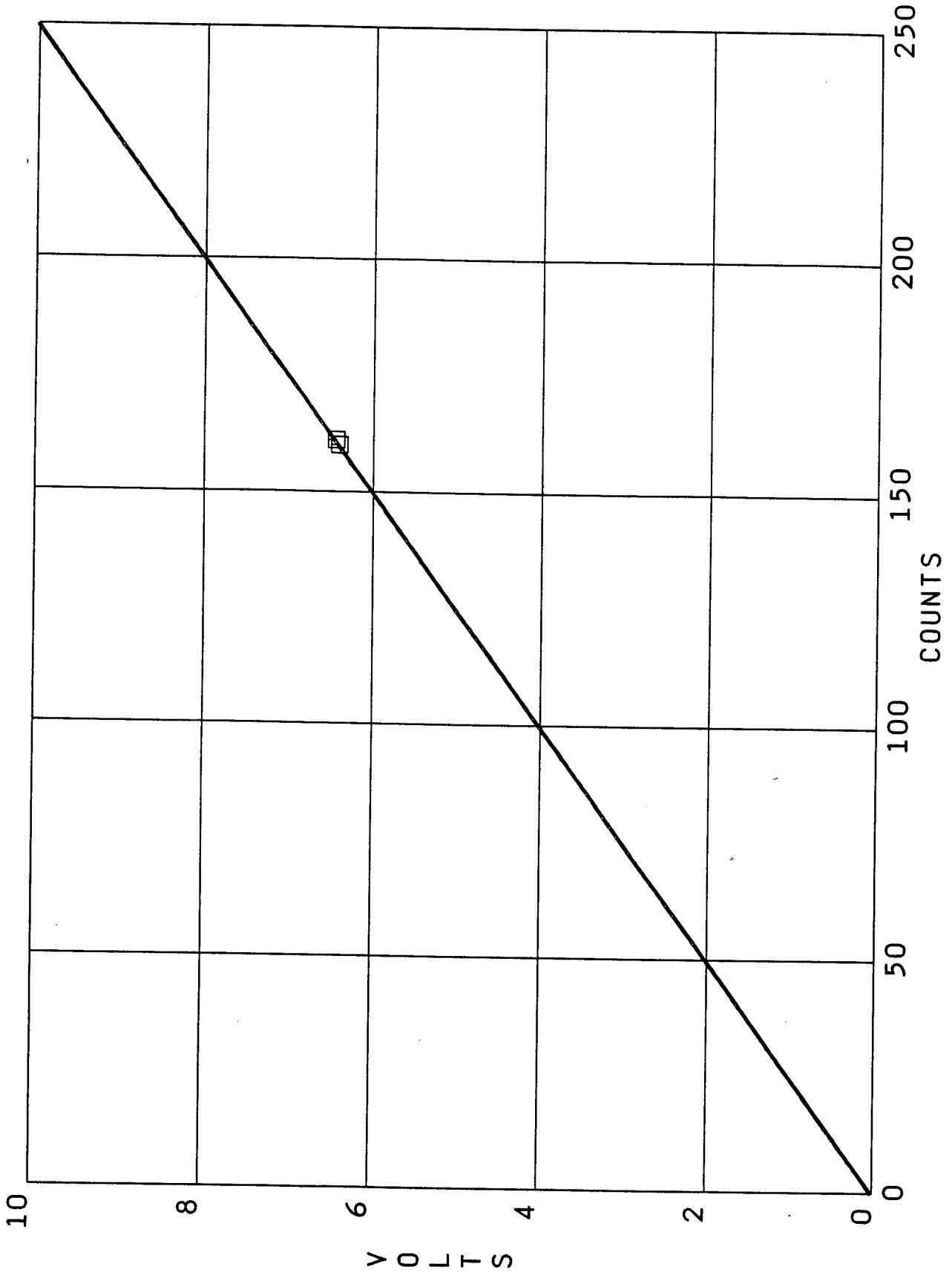


Figure 5-9: E-Cal reference voltage monitor telemetry

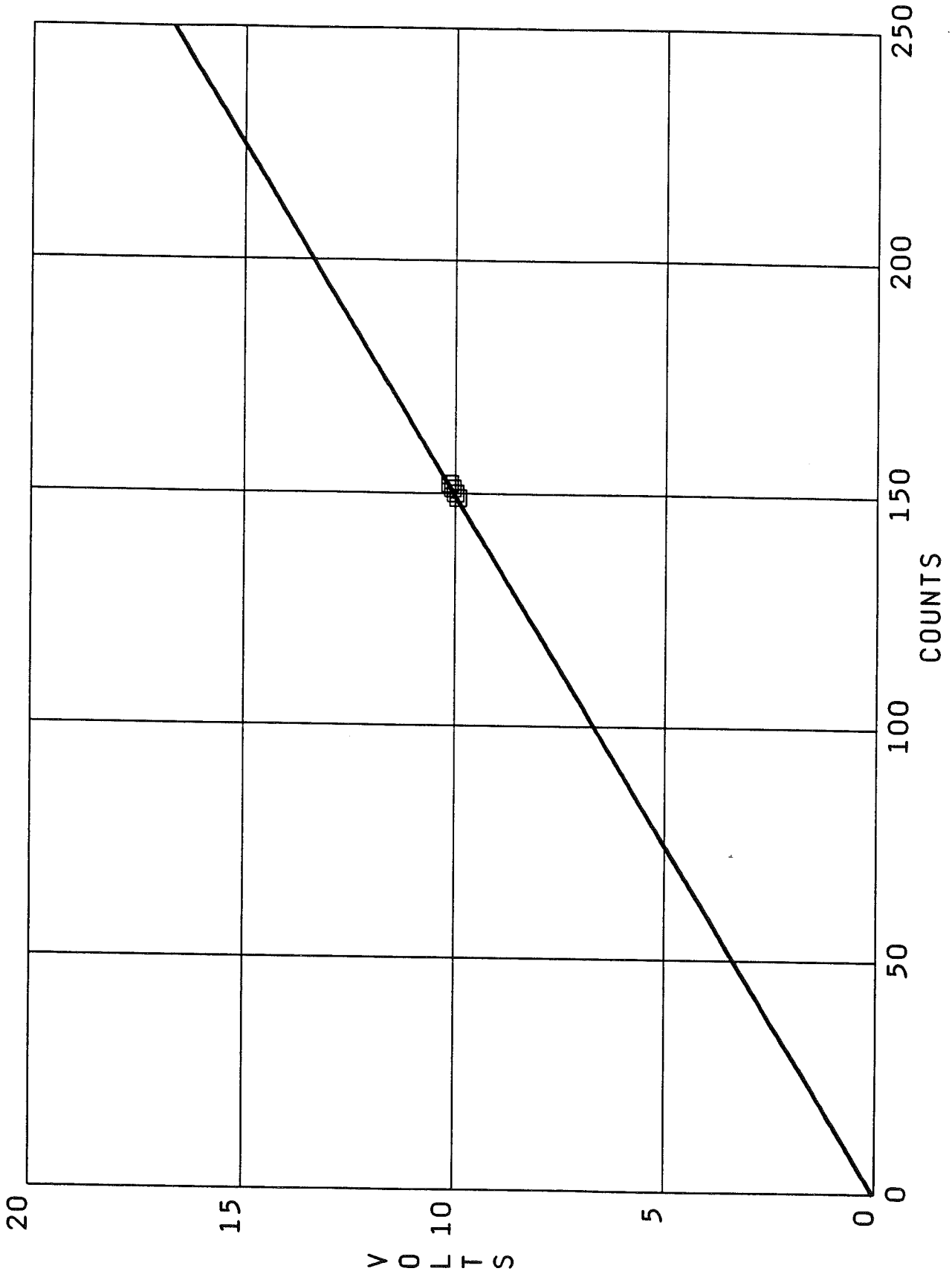


Figure 5-10: 10 volt monitor telemetry

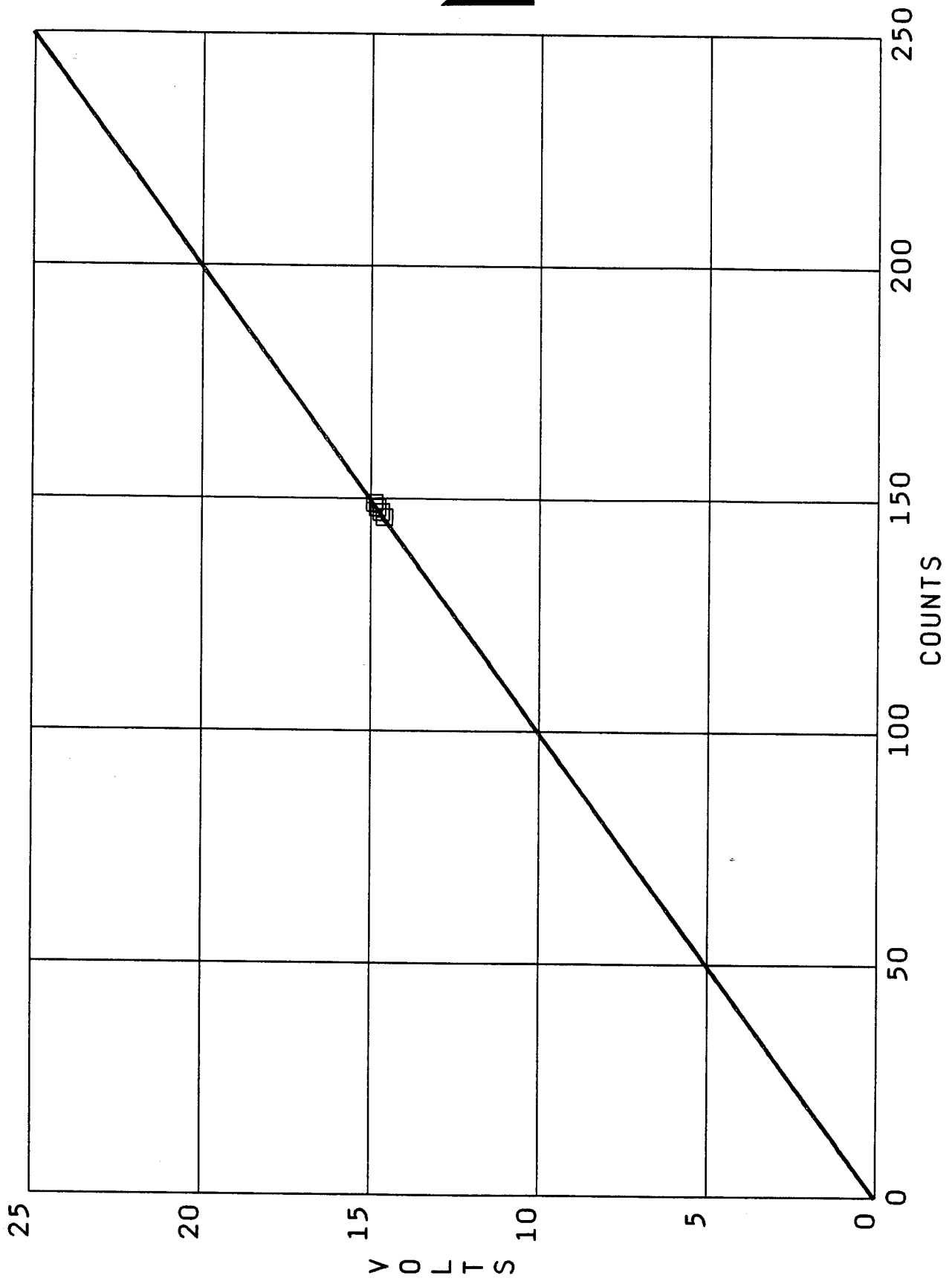


Figure 5-11: +15 volt monitor telemetry

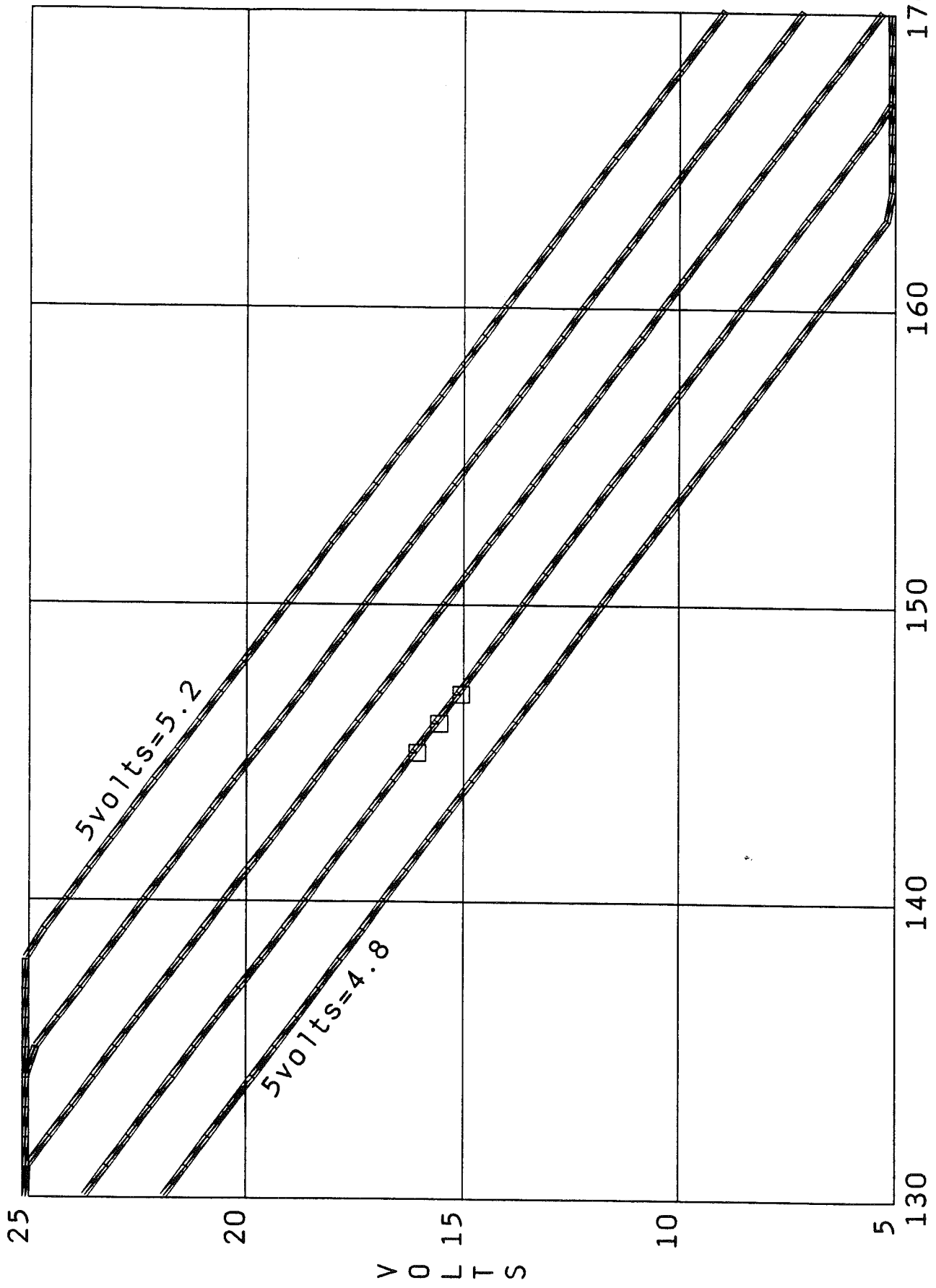


Figure 5-12: -15 volt monitor telemetry

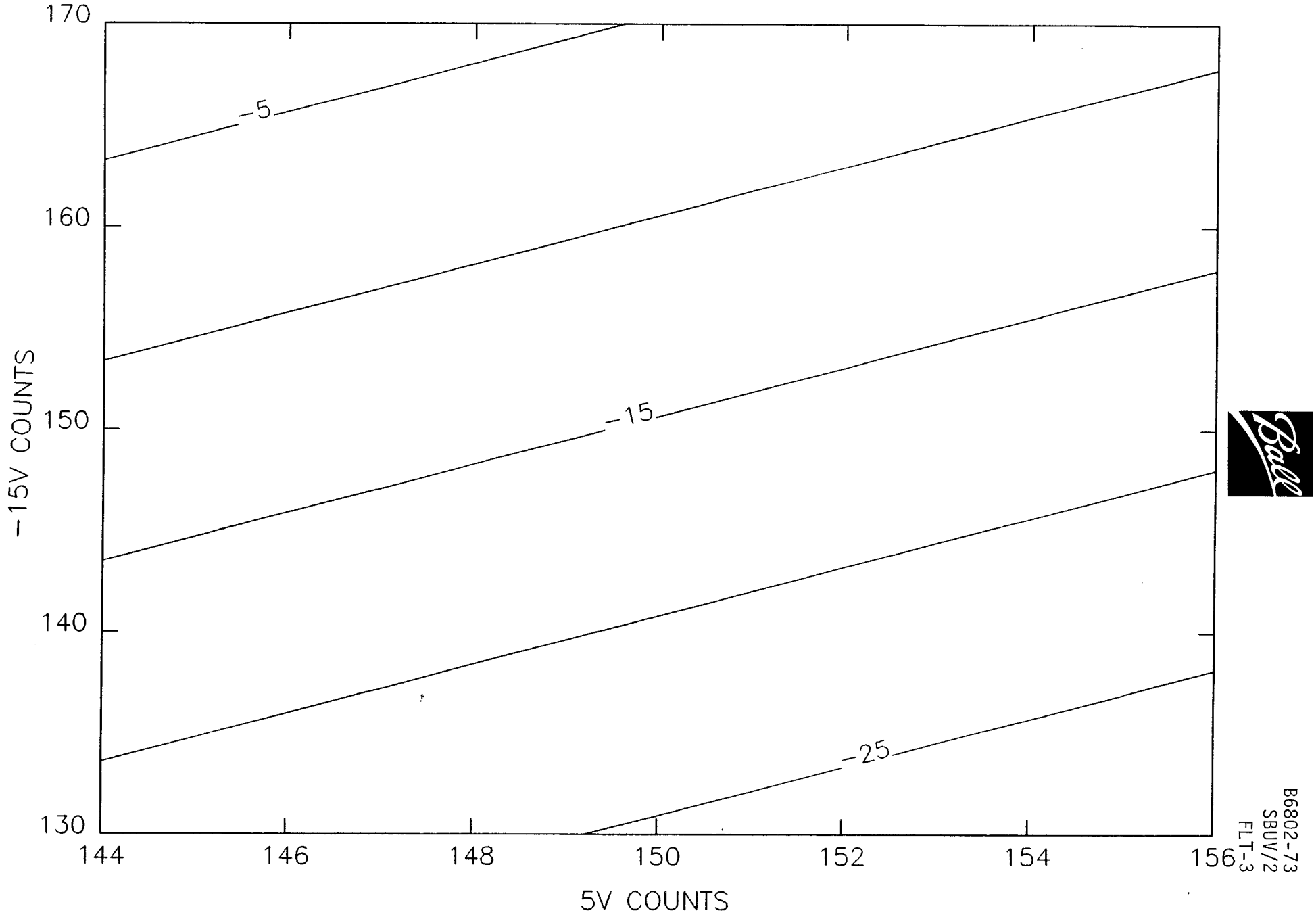


Figure 5-13: Voltage for -15V vs. 5V telemetry

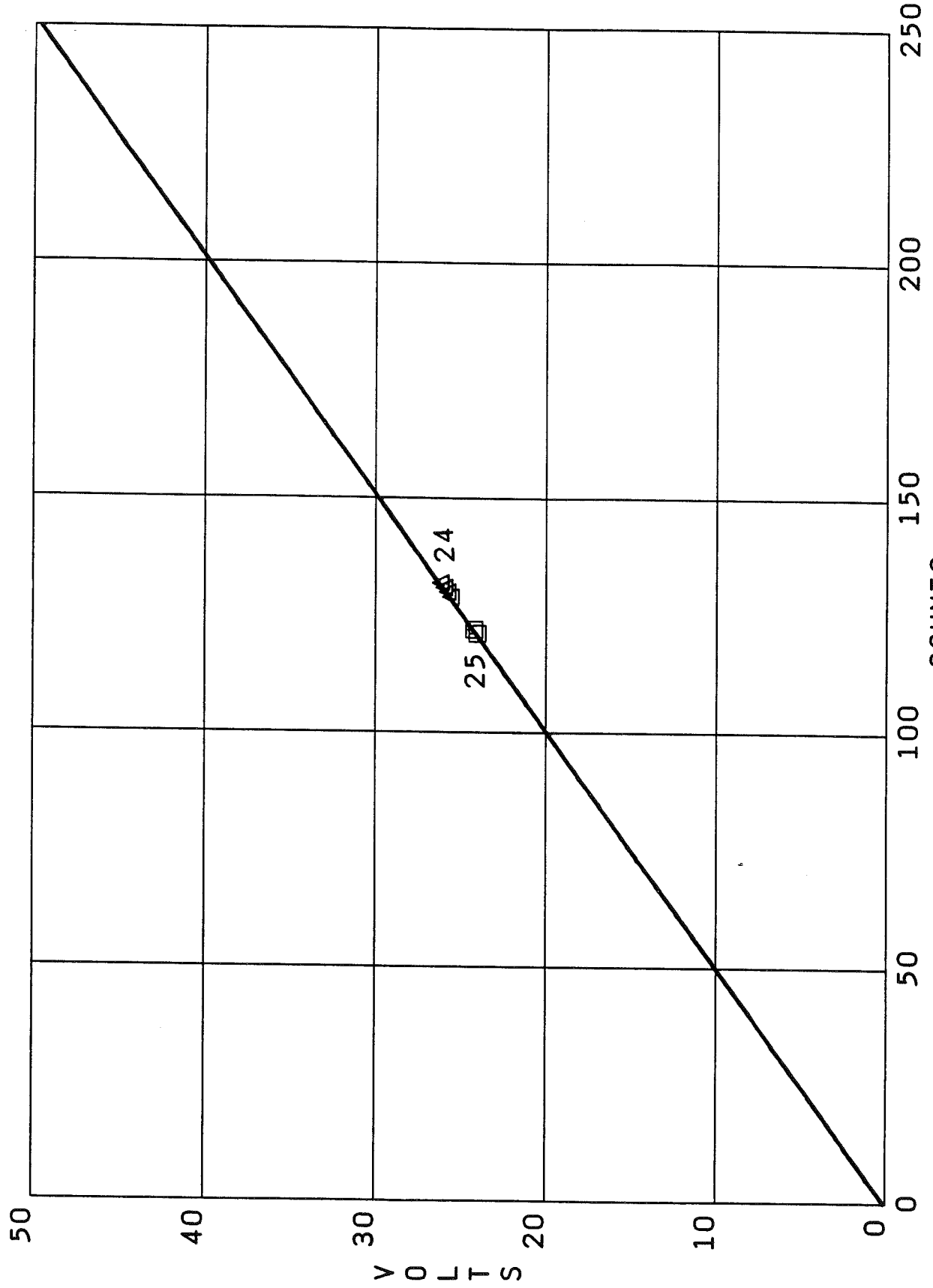


Figure 5-14: 24 & 25 volt monitor telemetry

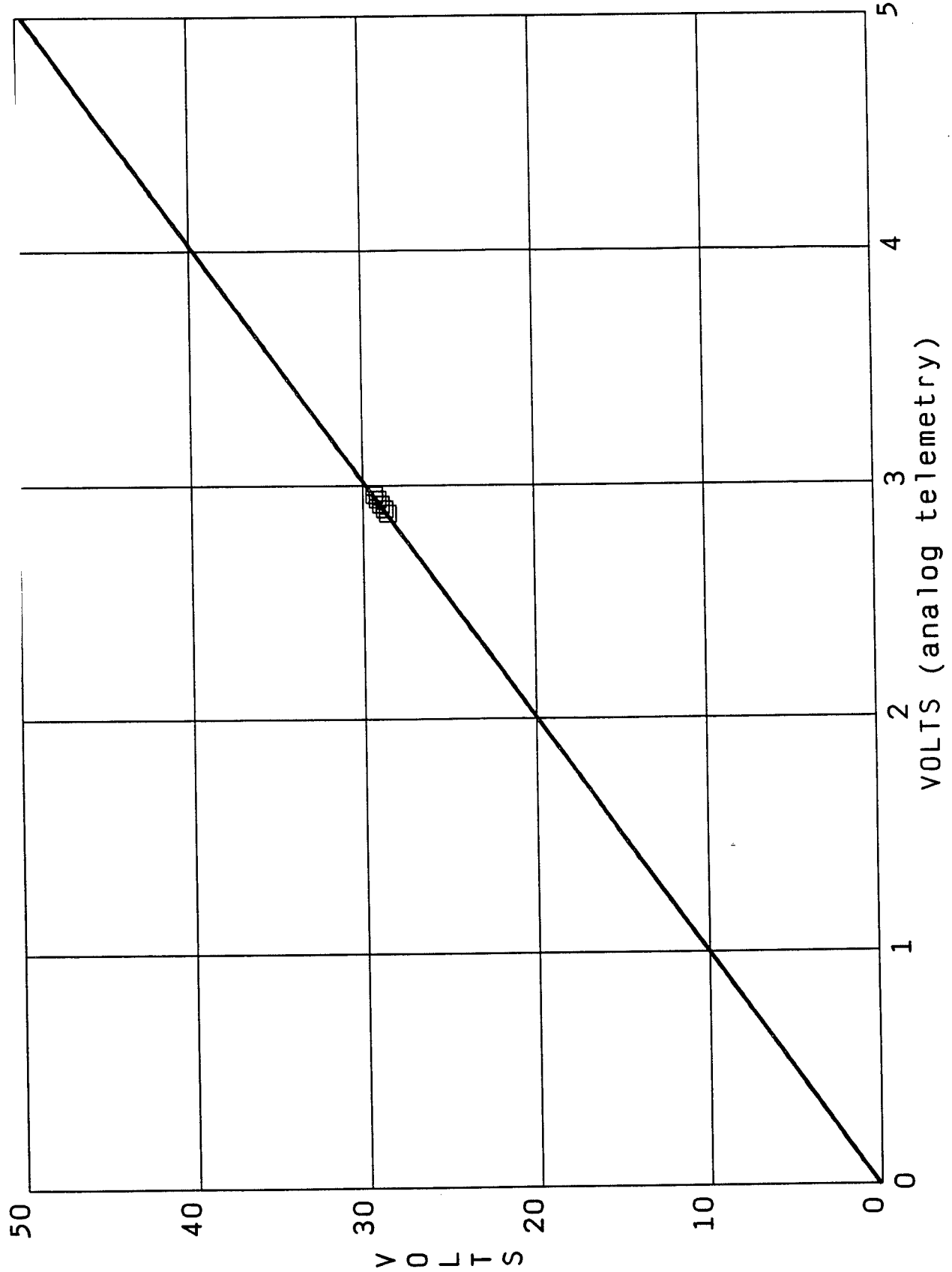


Figure 5-15: 28 volt monitor telemetry

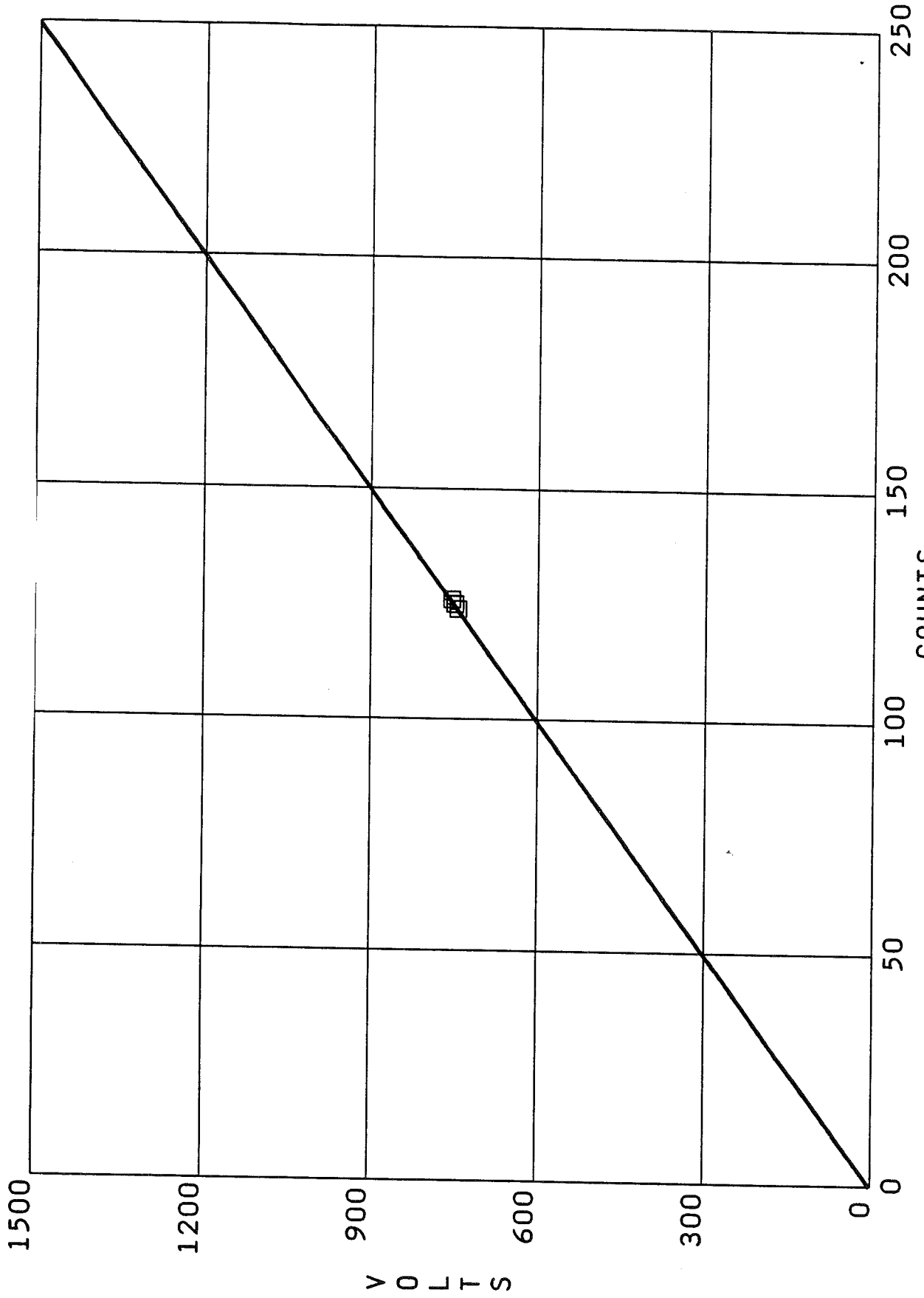


Figure 5-16: HVPS voltage monitor telemetry

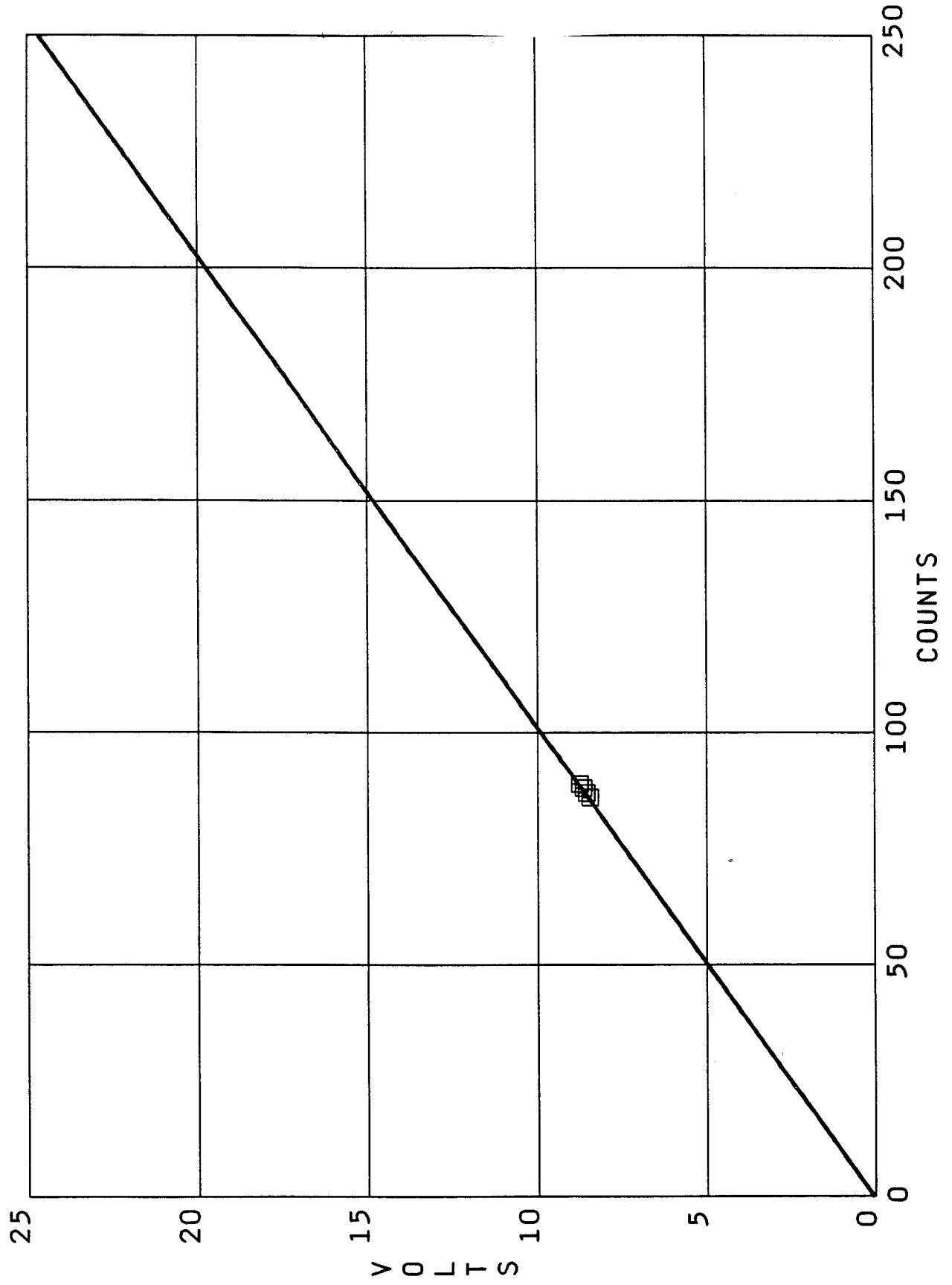


Figure 5-17: Chopper phase error voltage telemetry

Table 5-4

CURRENT MONITORS

CURRENT	TELEMETRY TYPE	CONVERSION FACTOR (N=COUNTS)	NOMINAL TELEMETRY VALUE	ACTUAL FLT.3 TELEMETRY VALUE	FIGURE NO.
Calibration Lamp	Digital	0.00522 mA/N	192	196-197	5-18
Chopper Motor	Digital	0.002 A/N	n/a	8-11	5-19
Calibration Lamp, Diffuser Motors	Digital Digital	0.004 A/N 0.004 A/N	n/a n/a	34 69	5-20 5-20
Calibration Lamp, Diffuser Heaters	Analog	0.1 A/V	1.73 V	1.78-1.80 V	5-21

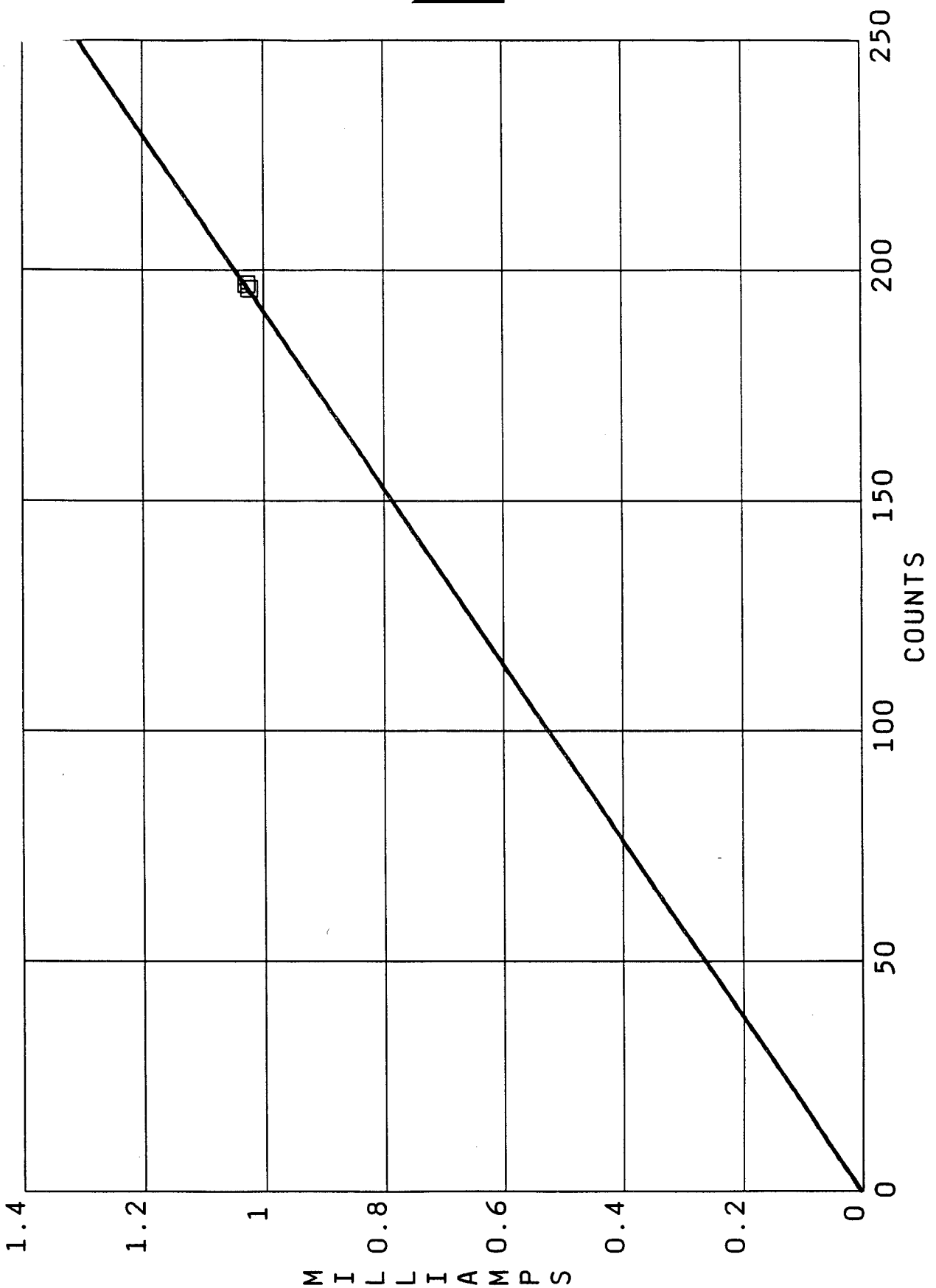


Figure 5-18: Calibration lamp current monitor telemetry

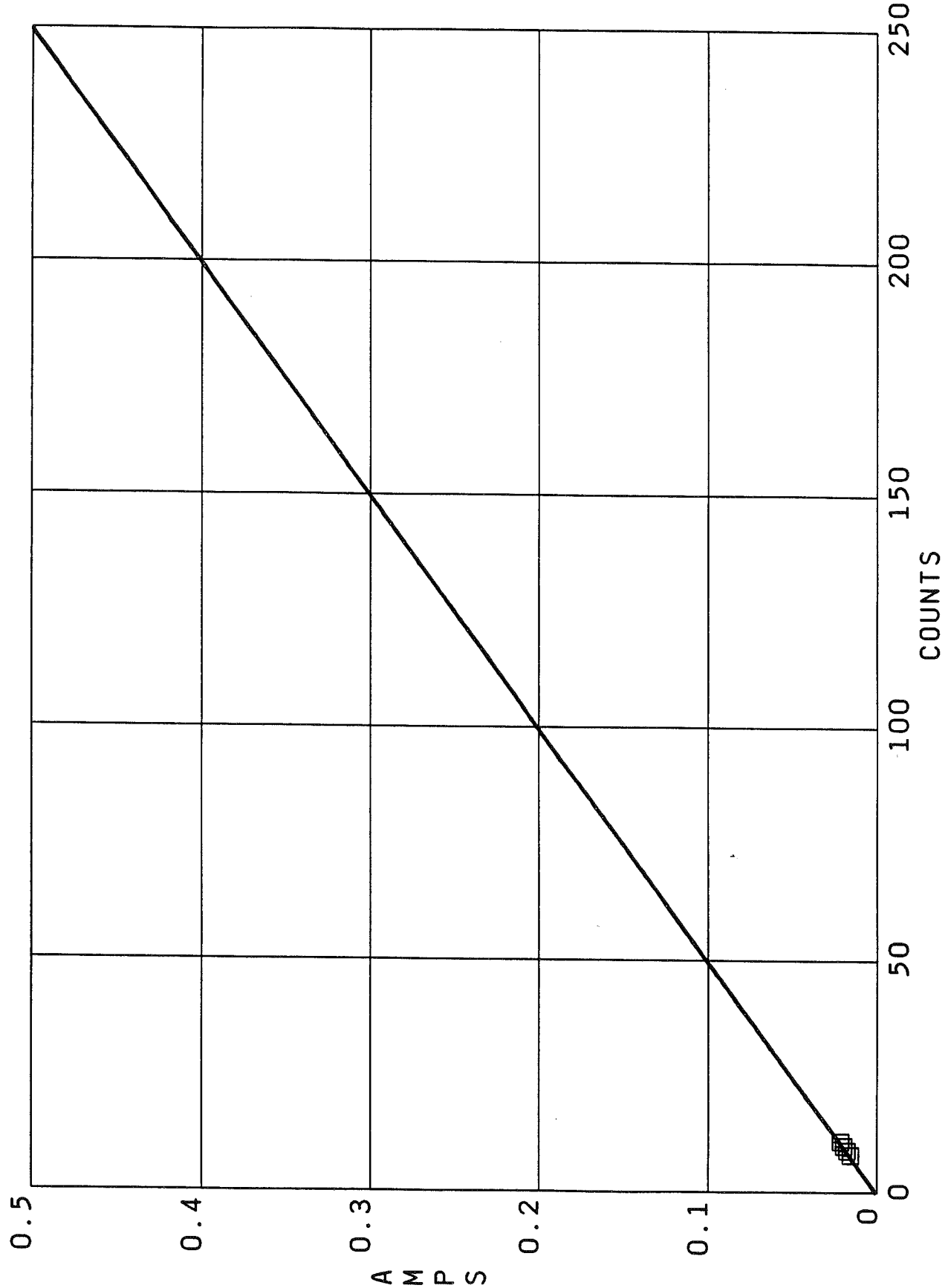


Figure 5-19: Chopper motor current monitor telemetry

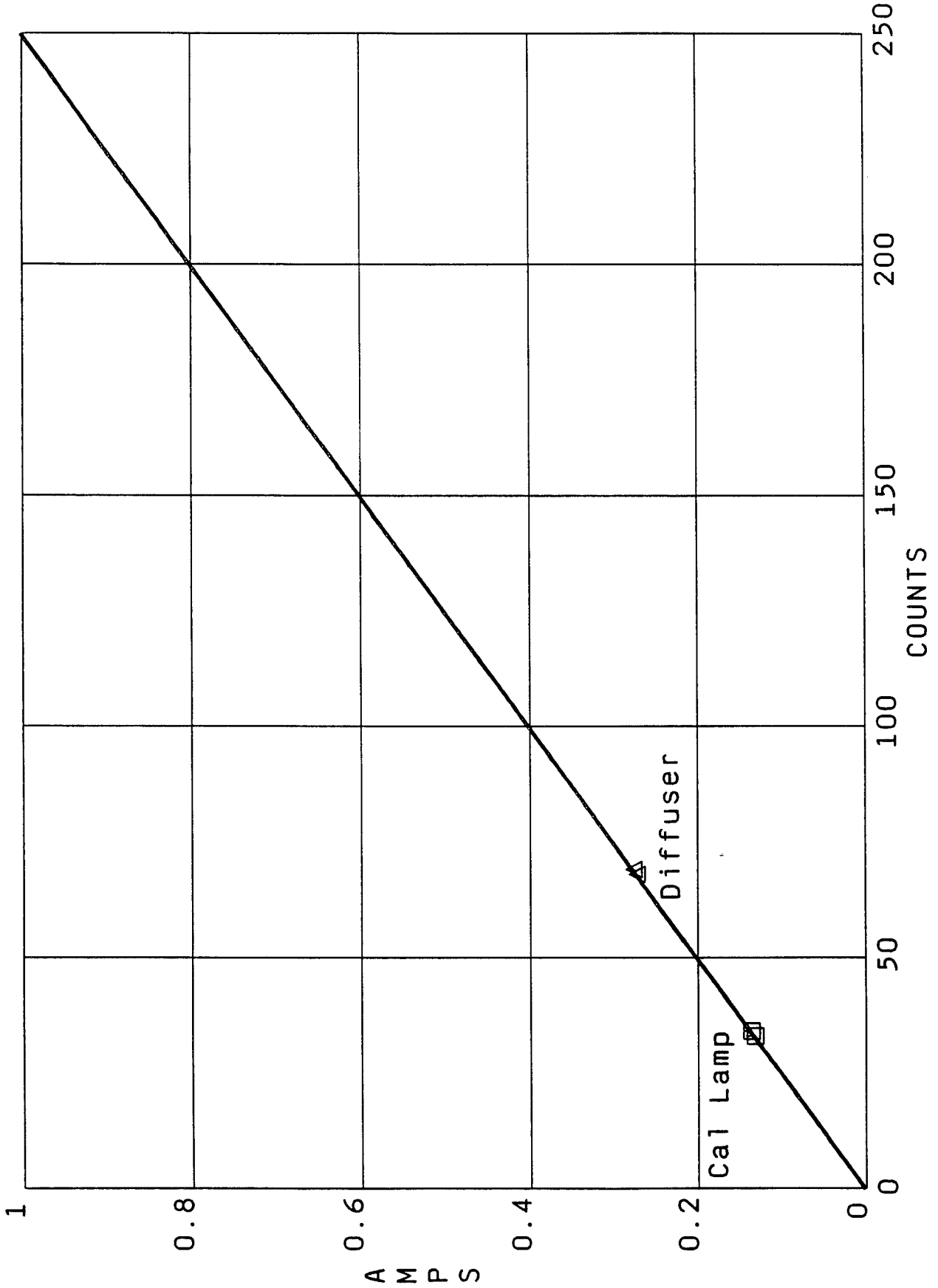


Figure 5-20: Mechanism motor current monitor telemetry

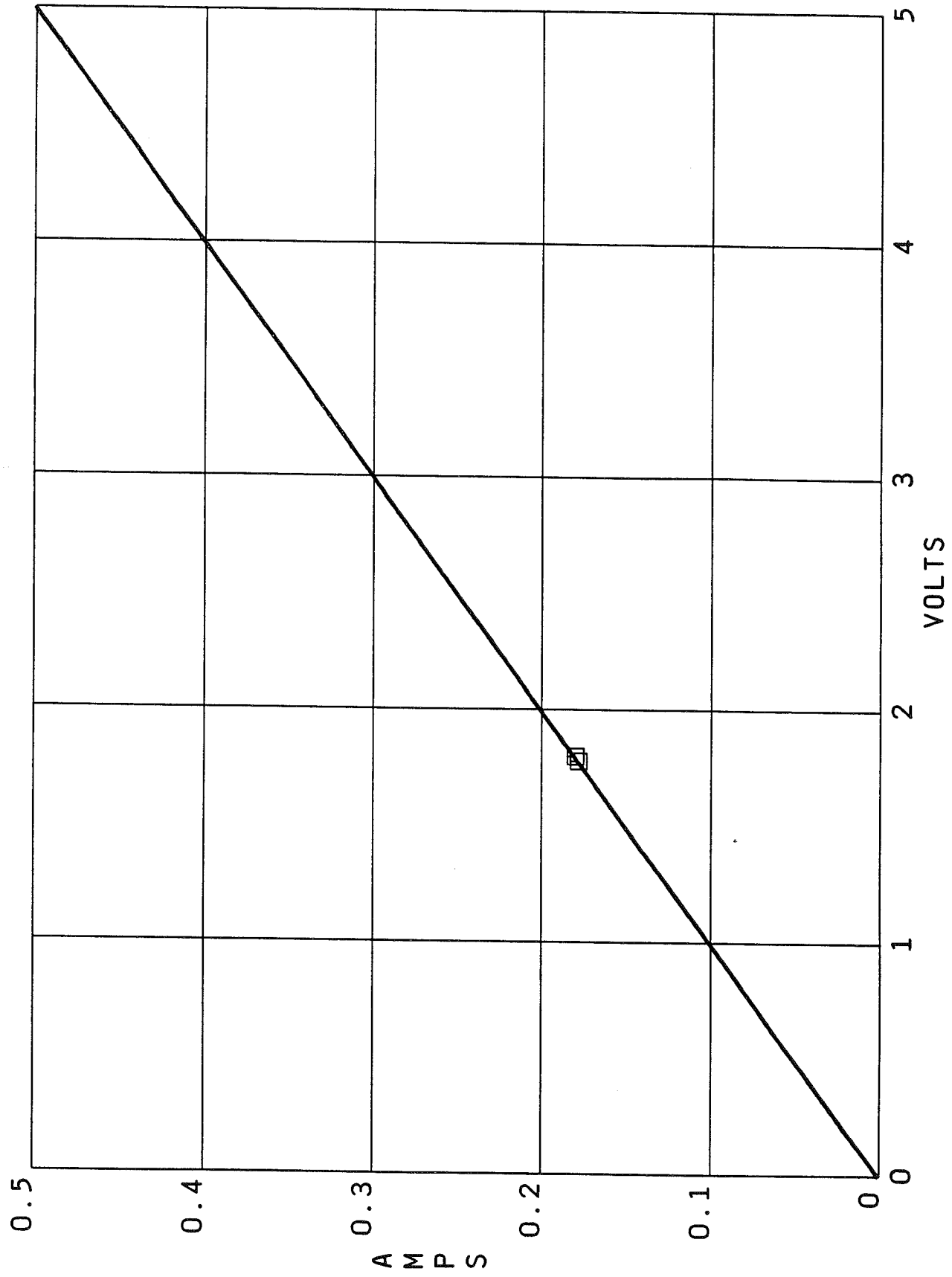


Figure 5-21: Heater current monitor telemetry

Section 6

POWER PROFILE/INPUT VOLTAGE

POWER PROFILE

The instrument power is summarized in **Table 6-1**. 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 the Baseline Functional (Power Profile) Procedure, number 68026.

NORMAL OPERATION/INPUT VOLTAGE RANGE

The instrument performed normally when operated from the main power bus and when 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 6-1

SBUV/2 FLIGHT 3 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	13.96	17.0	0.056	None	0.060	None
MAXIMUM ORBITAL AVERAGE POWER, WATTS Operating in Discrete Mode with one Wavelength Cal Enable sequence	17.14	None	0.056	None	0.060	None
PEAK CURRENT, AMPS*	1.55**	1.50	0.002	0.010	0.014**	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.

** See Waiver SBUV-W-018 for approval of out of specification conditions.

Section 7

ELECTRONIC CALIBRATION AND STABILITY

(Reference Test Procedure 68026)

Table 7-1 lists the mean E-CAL counts and percent errors for both the Cloud Cover Radiometer and PMT ranges in Discrete and Sweep Modes. Sixteen data points were used from day 15 through day 355 of 1988 and from day 52 through day 171 of 1989. **Table 7-2** lists the tests from which the data was gathered. **Figures 7-1** through **7-16** illustrate 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%. Normal system noise at the very low count rates, from 42 to 153 counts, is responsible for the larger percent error.

Table 7-1

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	8904.44	0.20	Overrange	N/A	42.88	**58.31	N/A	N/A
2	10481.56	0.11	153.06	**2.61	783.06	0.77	45.81	**52.39	N/A	N/A
3	65.38	**7.65	768.93	0.52	7217.07	0.19	37443.93	0.40	6085.5	0.36
CCR	44611.5	0.12	958.44	0.21	9138.94	0.18	44.56	**56.10	55957.06	0.13

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

**Normal system noise is responsible for large percent error at low counts.

NOTE: New voltage level inserted every two seconds.

Table 7-2

ELECTRONIC CALIBRATION STABILITY

NO.	DATE	PROCEDURE	NAME OF TEST
1	1/15/88	68025	Integration Test
2	2/11/88	68042	Electrical/Optical Performance
3	2/16/88	68042	Electrical/Optical Performance (Post Vib.)
4	2/22/88	160863 (Zone 0)	Minivac
5	2/23/88	160863 (Zone 1)	Minivac
6	2/23/88	160863 (Zone 3)	Minivac
7	2/24/88	160863 (Zone 5)	Minivac
8	2/25/88	160863 (Zone 7)	Minivac
9	2/25/88	160863 (Zone 9)	Minivac
10	2/26/88	160863 (Zone 11)	Minivac
11	3/10/88	68042	Electrical/Optical Performance
12	12/20/88	68042	Electrical/Optical Performance
13	2/21/89	68042	Electrical/Optical Performance
14	4/12/89	68042	Electrical/Optical Performance
15	6/12/89	69821	Bench Test at Ball
16	6/20/89	69821	Bench Test at GE-Astro

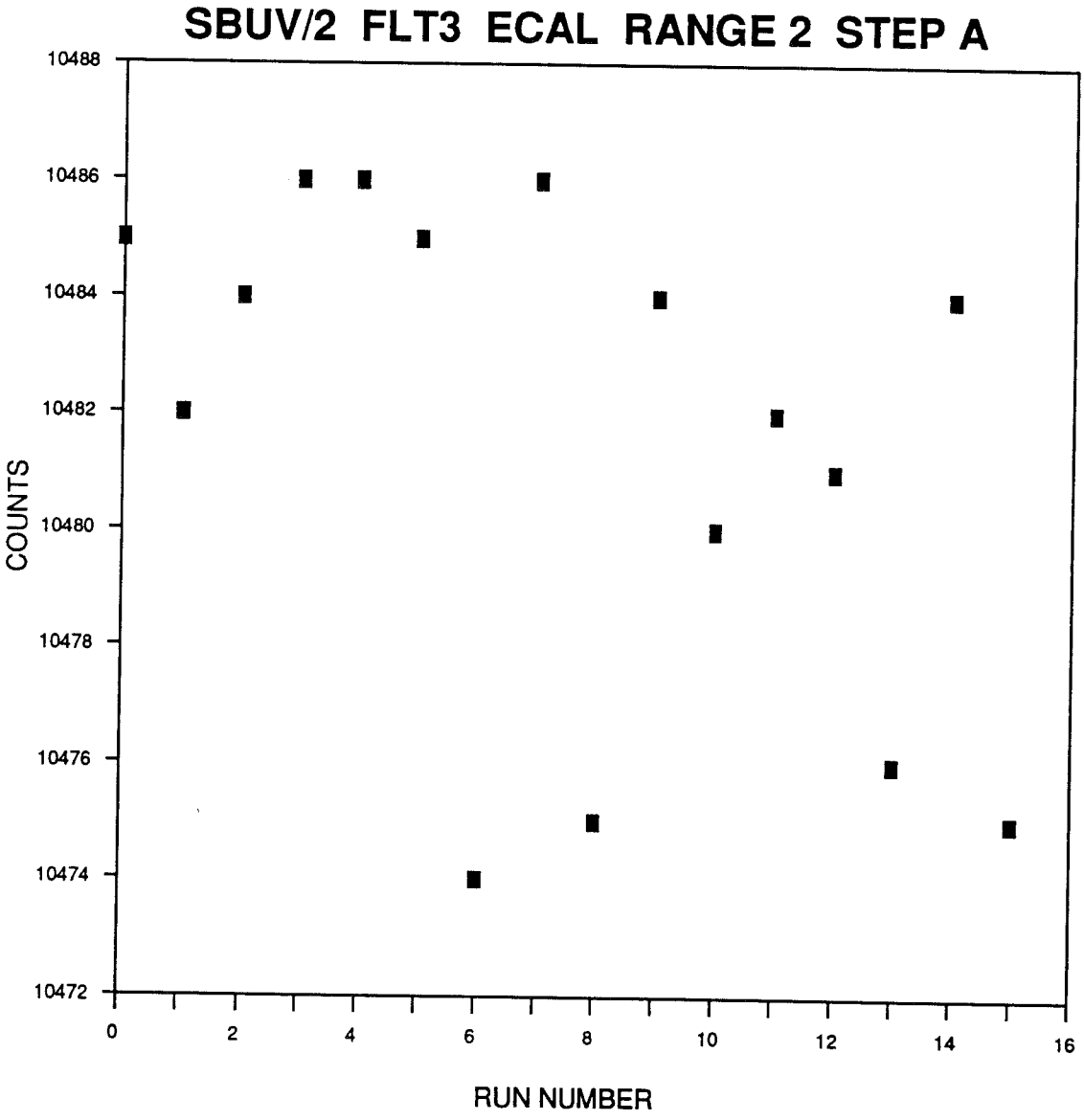


Figure 7-1 Flight 3 ECAL range 2 step A

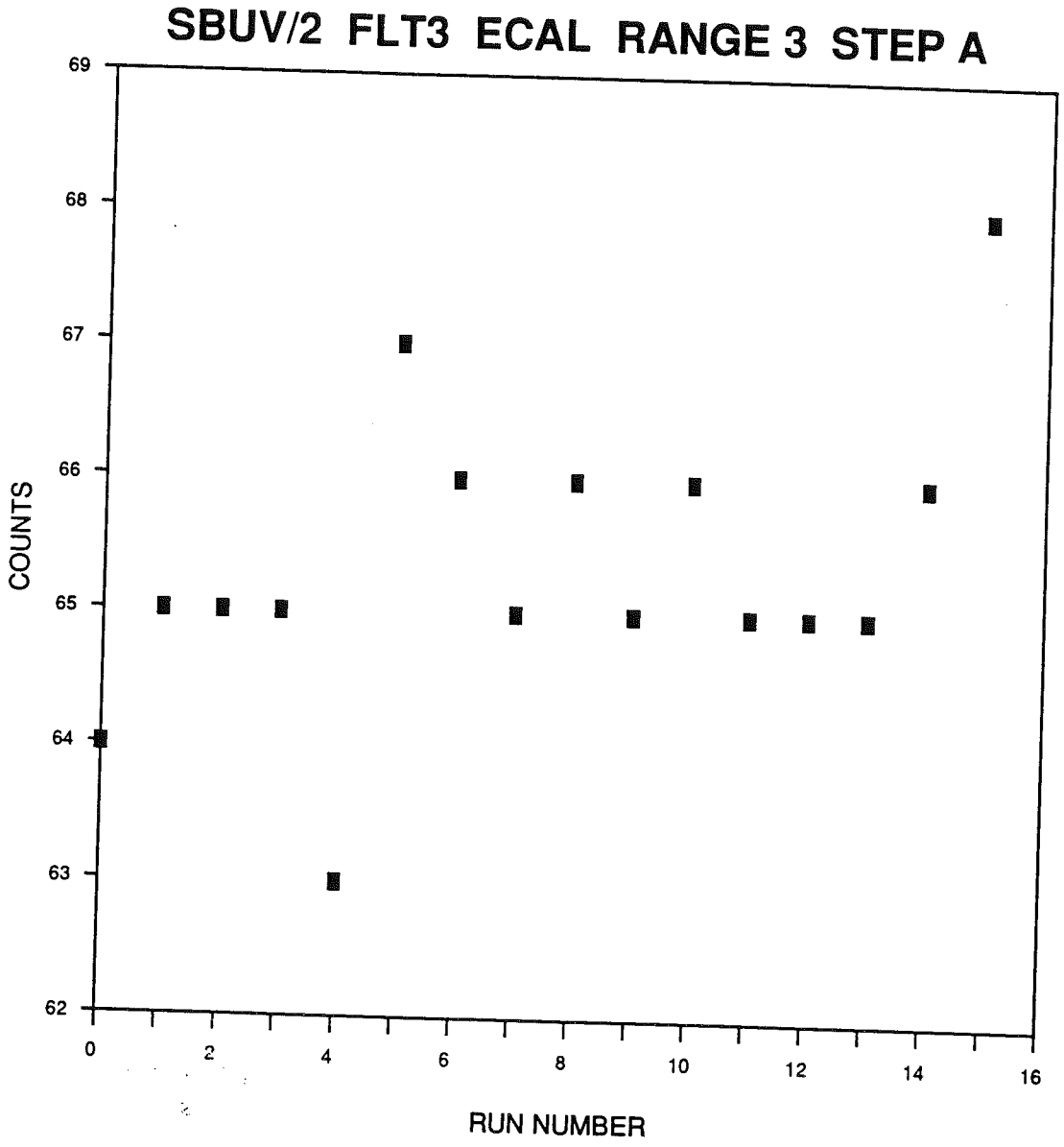


Figure 7-2 Flight 3 ECAL range 3 step A

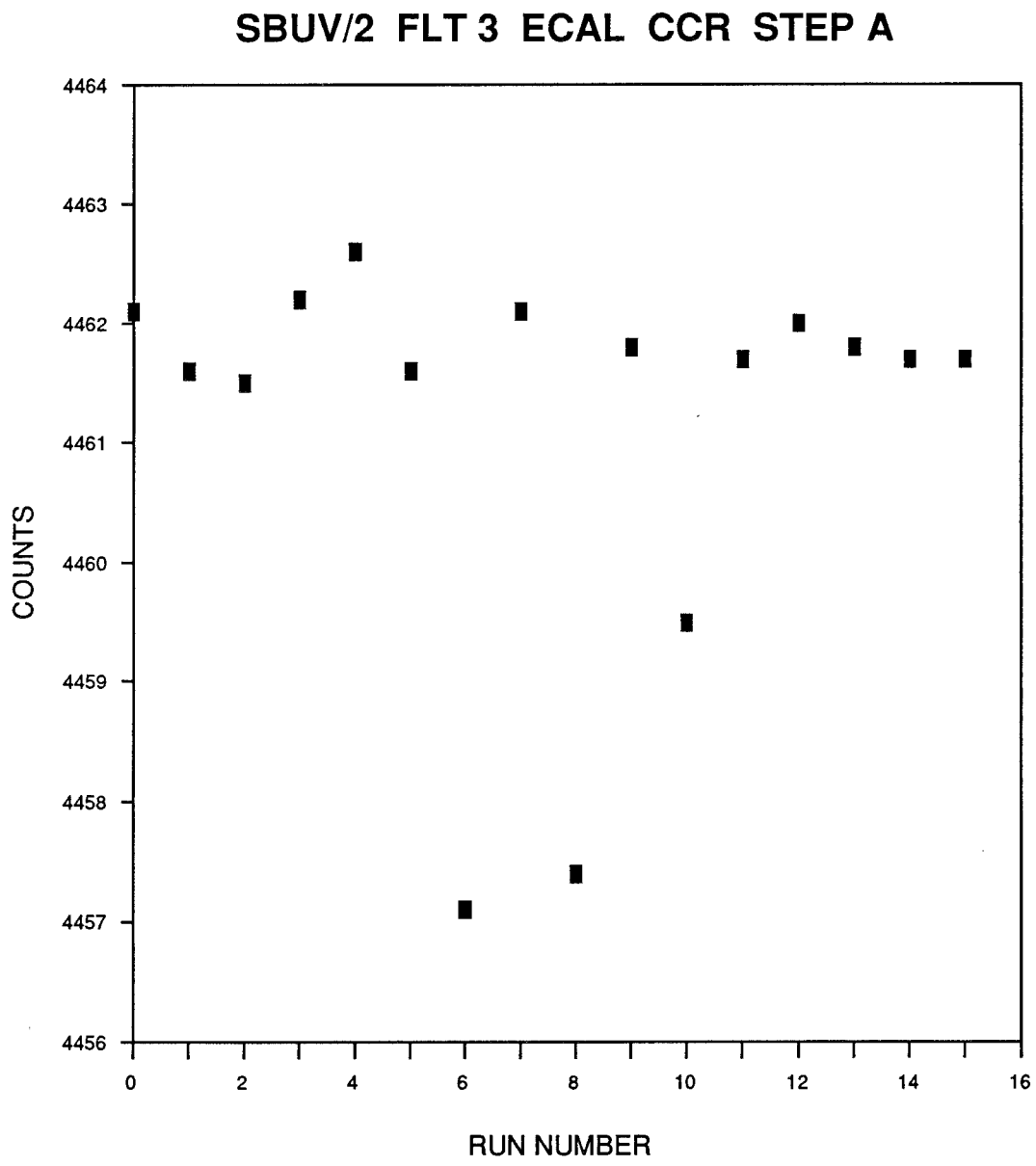


Figure 7-3 Flight 3 ECAL CCR step A

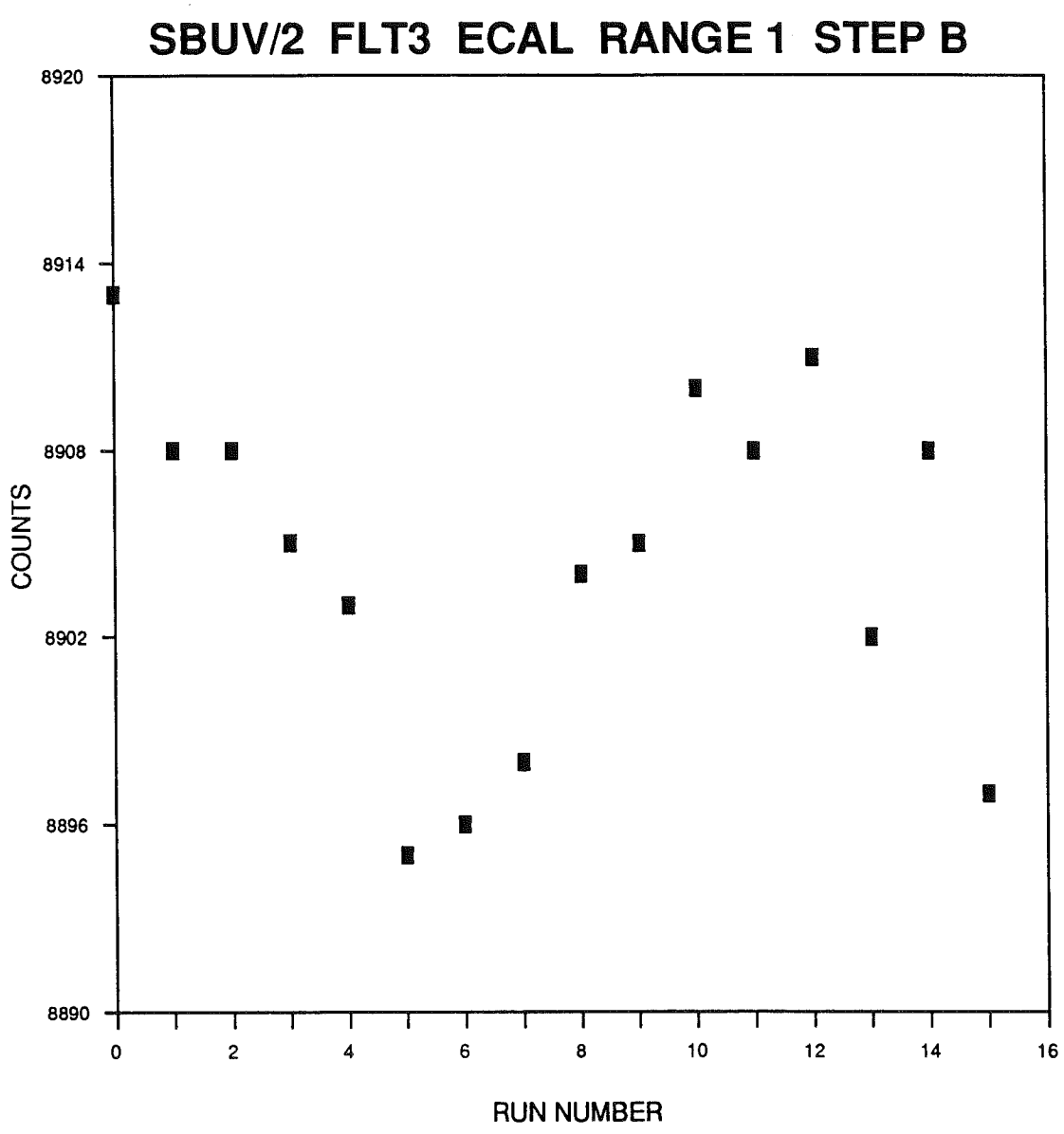


Figure 7-4 Flight 3 ECAL range 1 step B

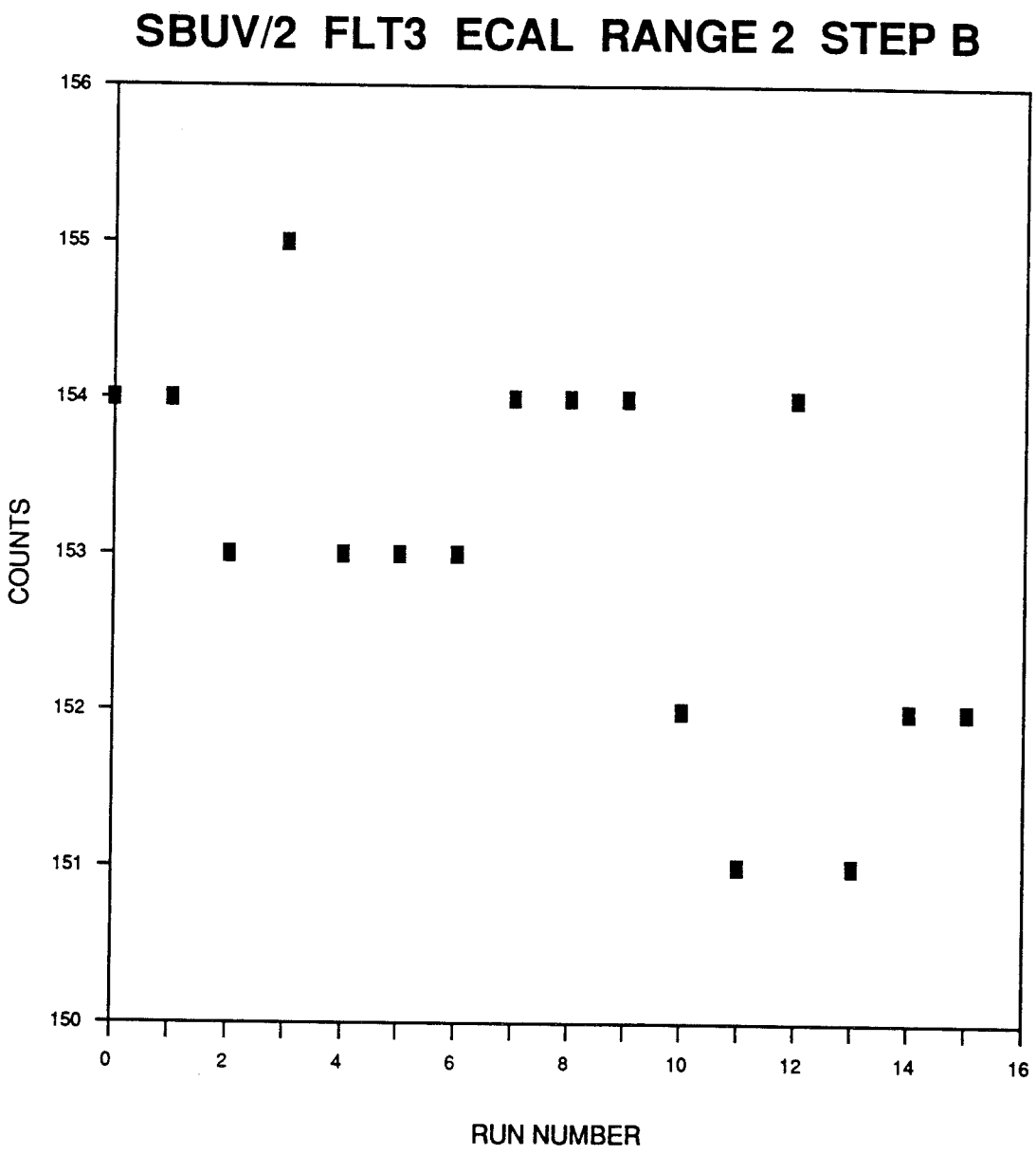


Figure 7-5 Flight 3 ECAL range 2 step B

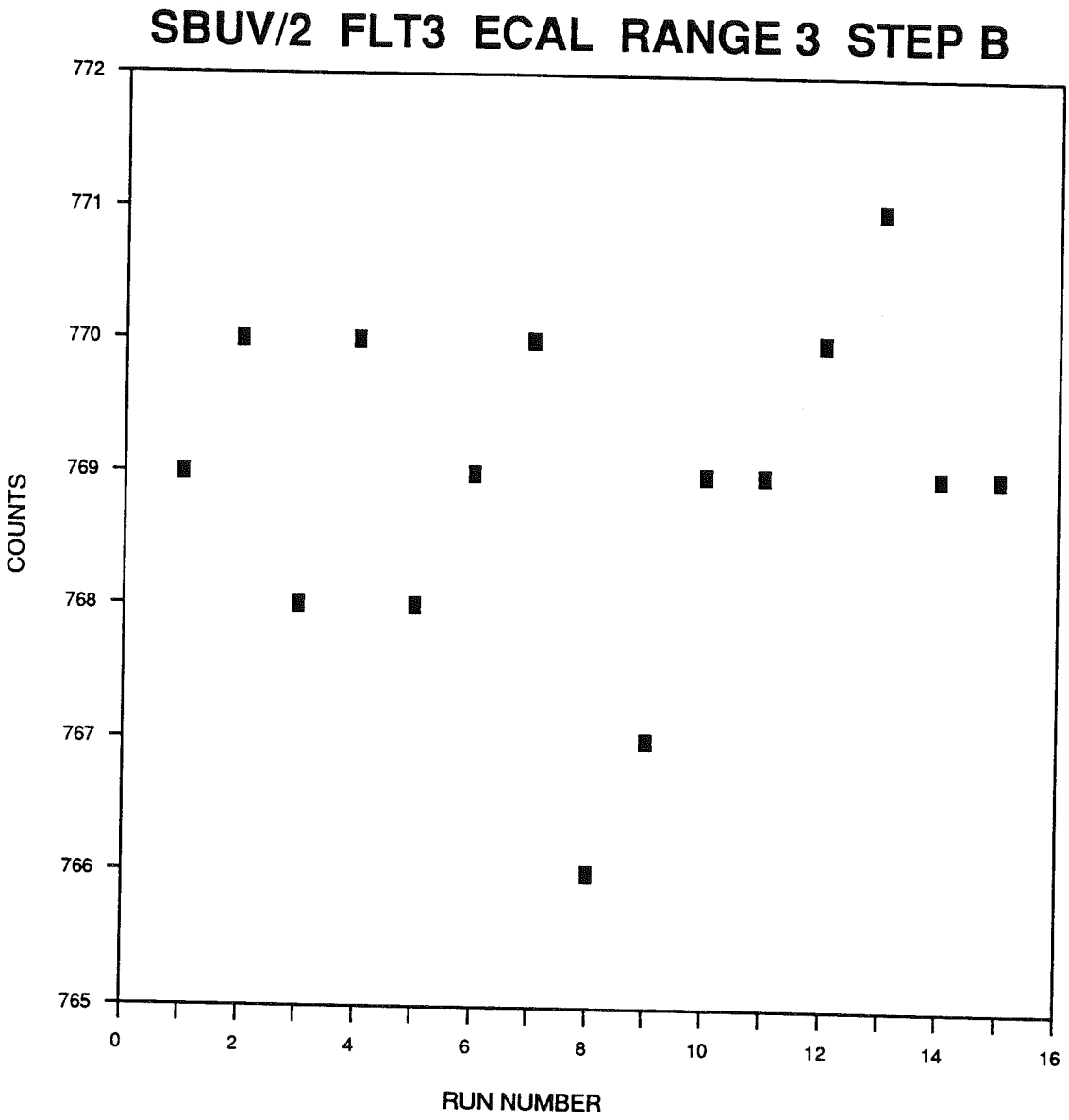


Figure 7-6 Flight 3 ECAL range 3 step B

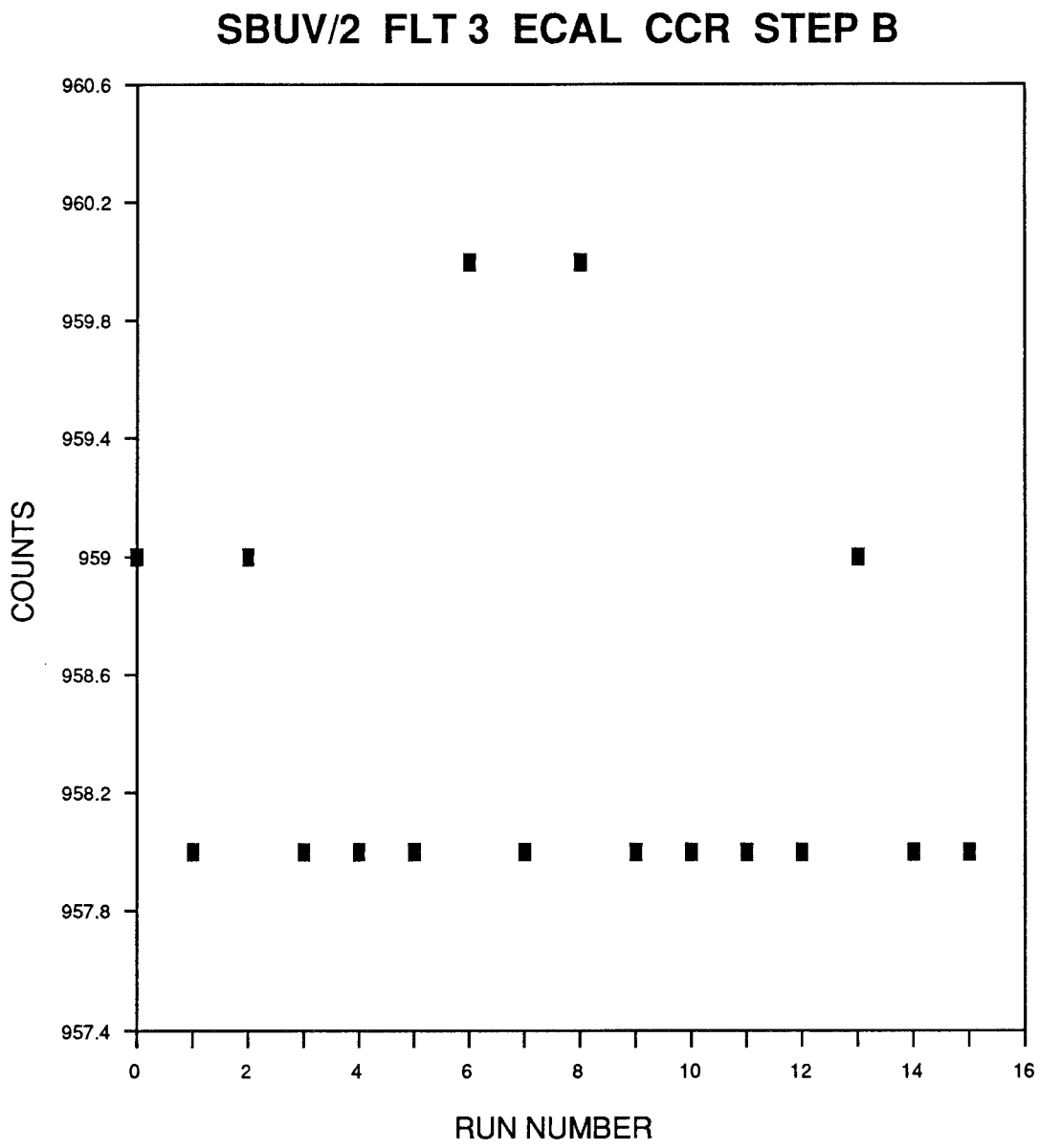


Figure 7-7 Flight 3 ECAL CCR step B

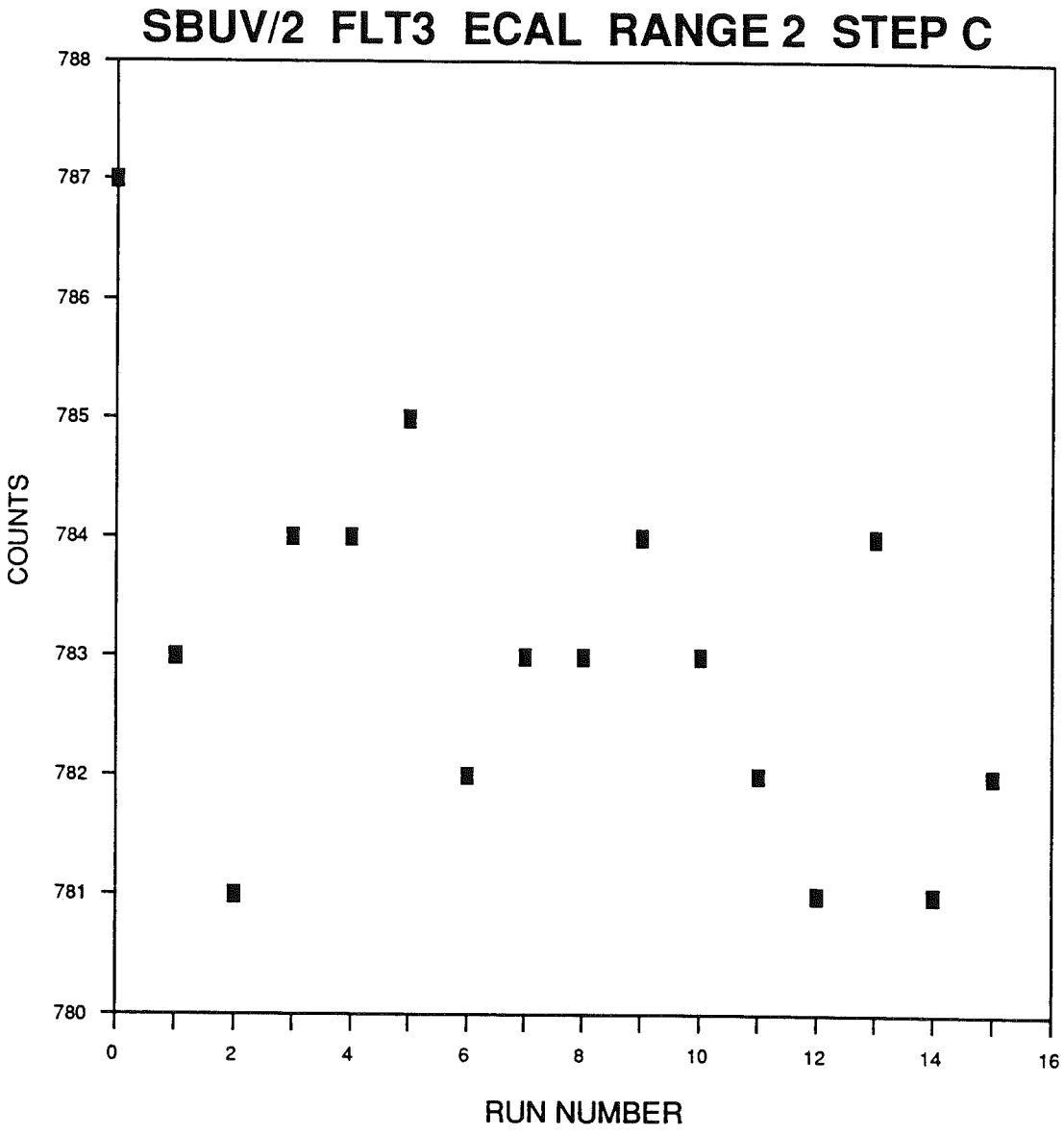


Figure 7-8 Flight 3 ECAL range 2 step C

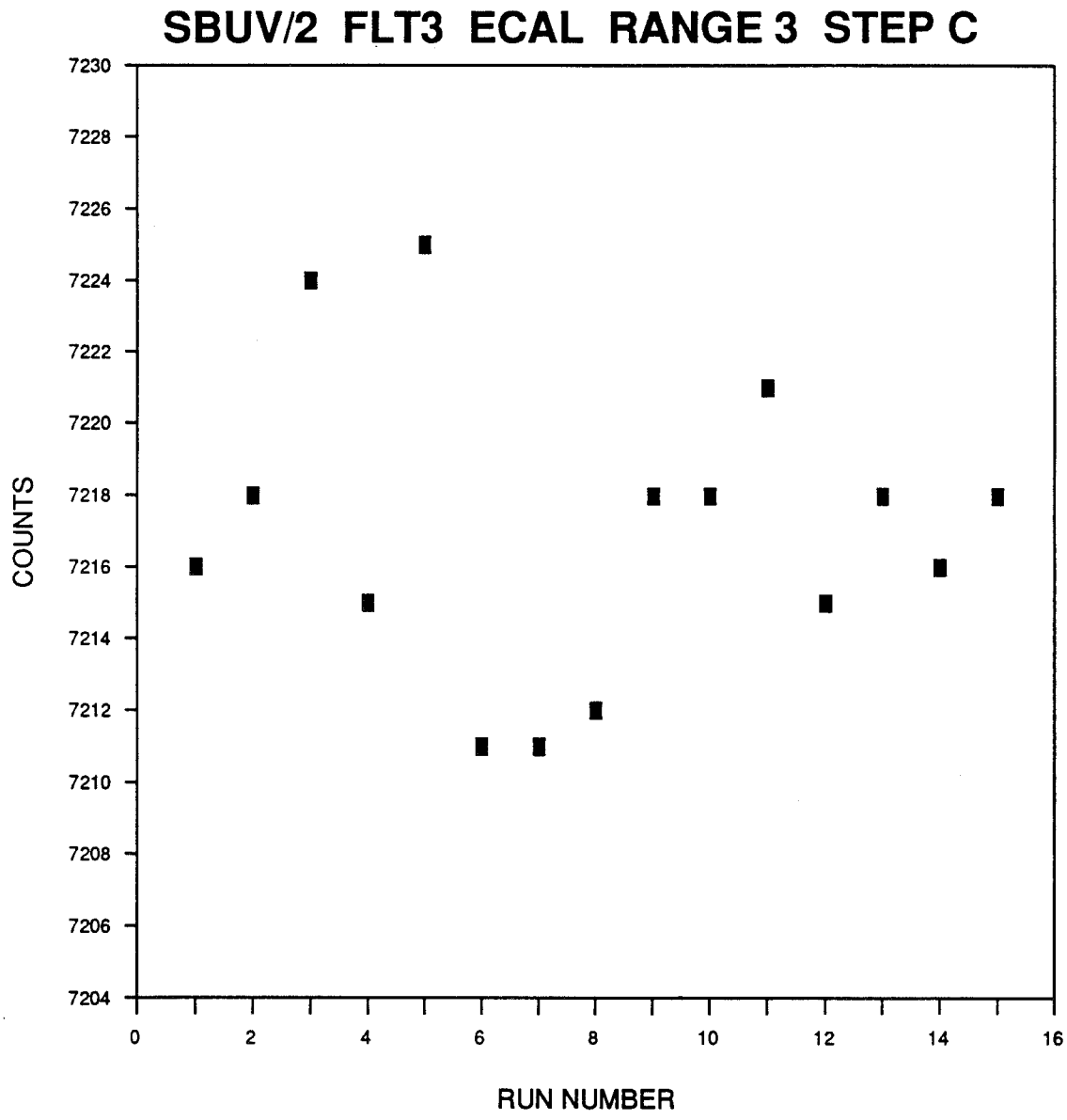


Figure 7-9 Flight 3 ECAL range 3 step C

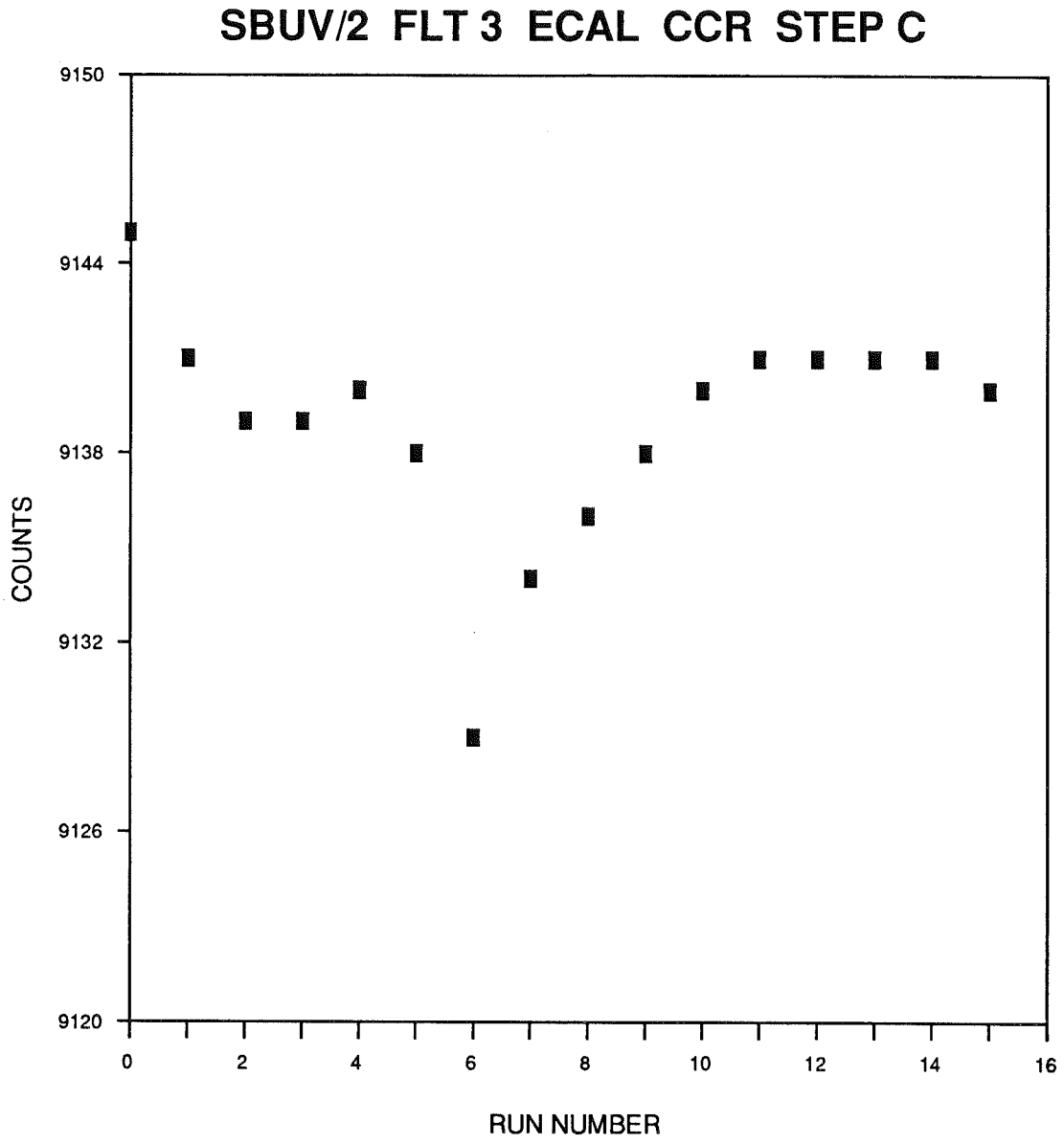


Figure 7-10 Flight 3 ECAL CCR step C

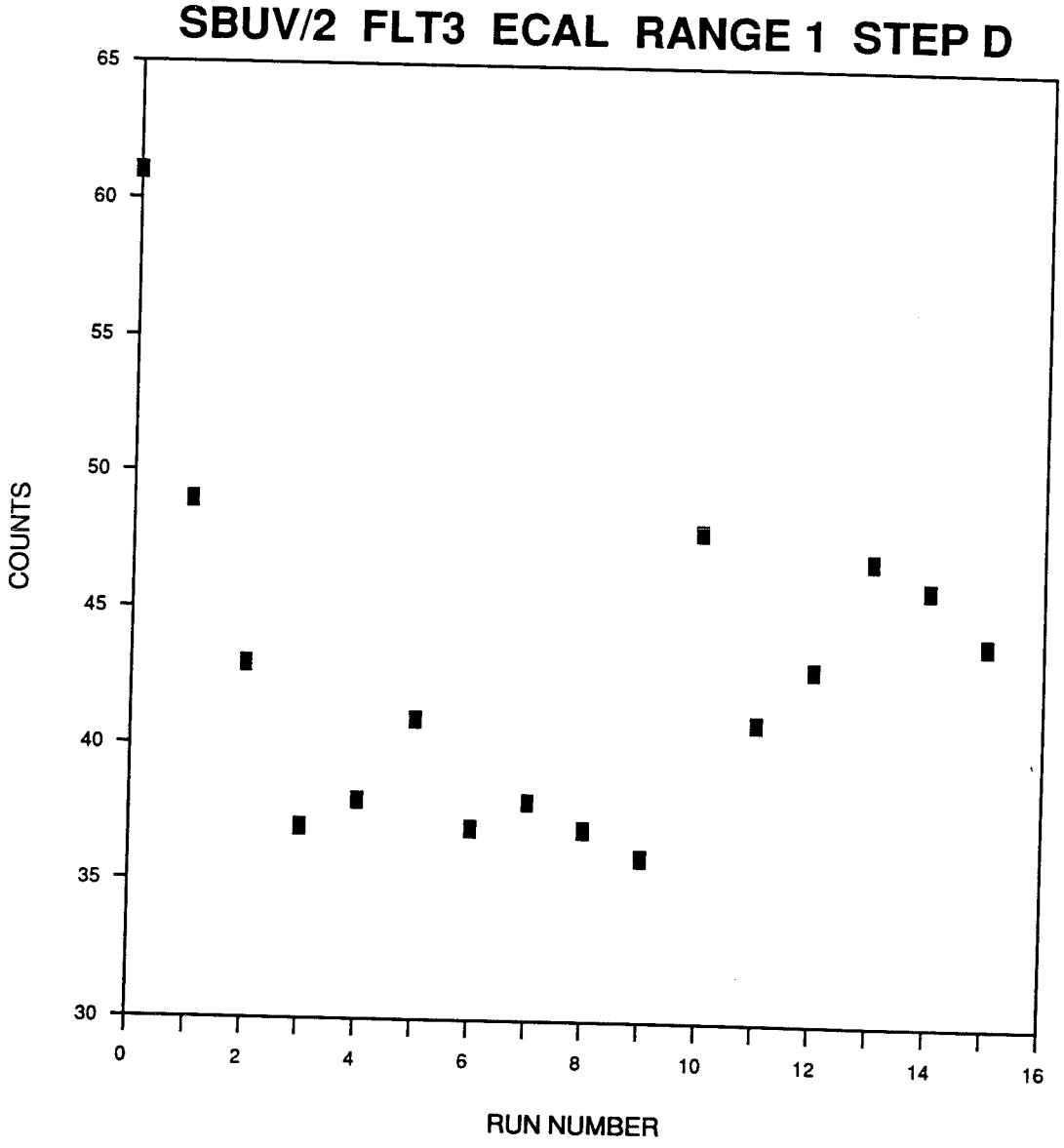


Figure 7-11 Flight 3 ECAL range 1 step D

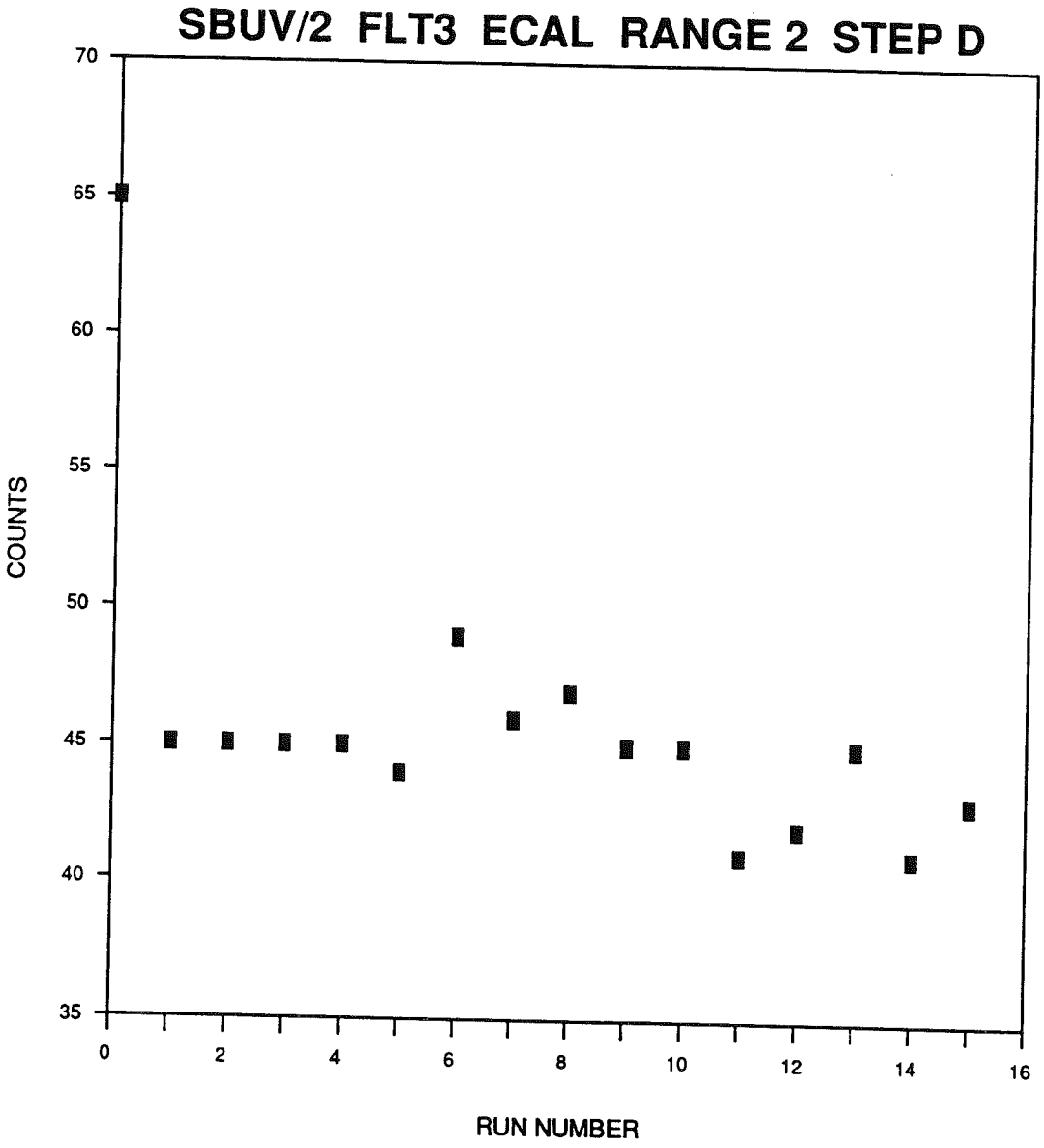


Figure 7-12 Flight 3 ECAL range 2 step D

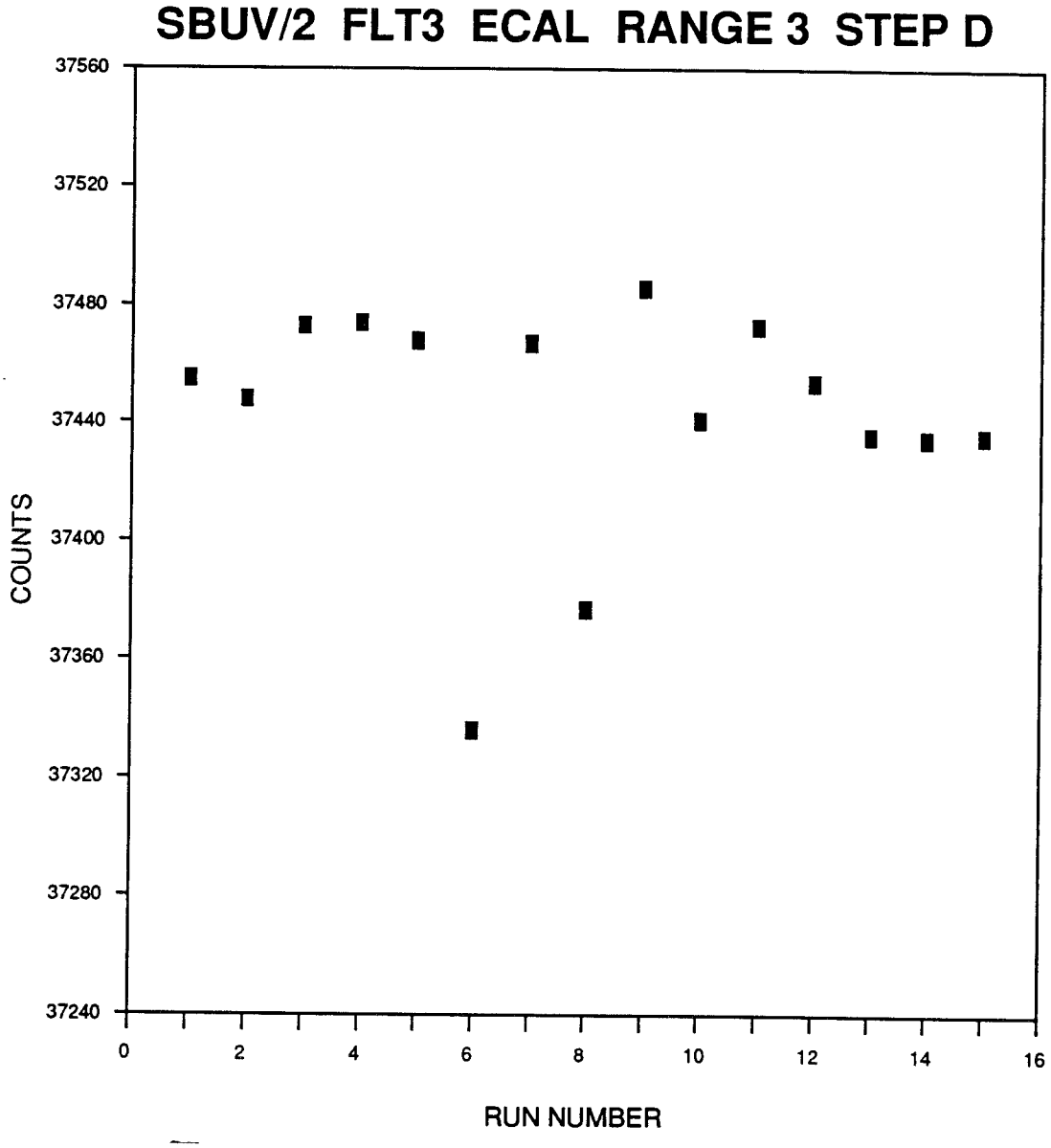


Figure 7-13 Flight 3 ECAL range 3 step D

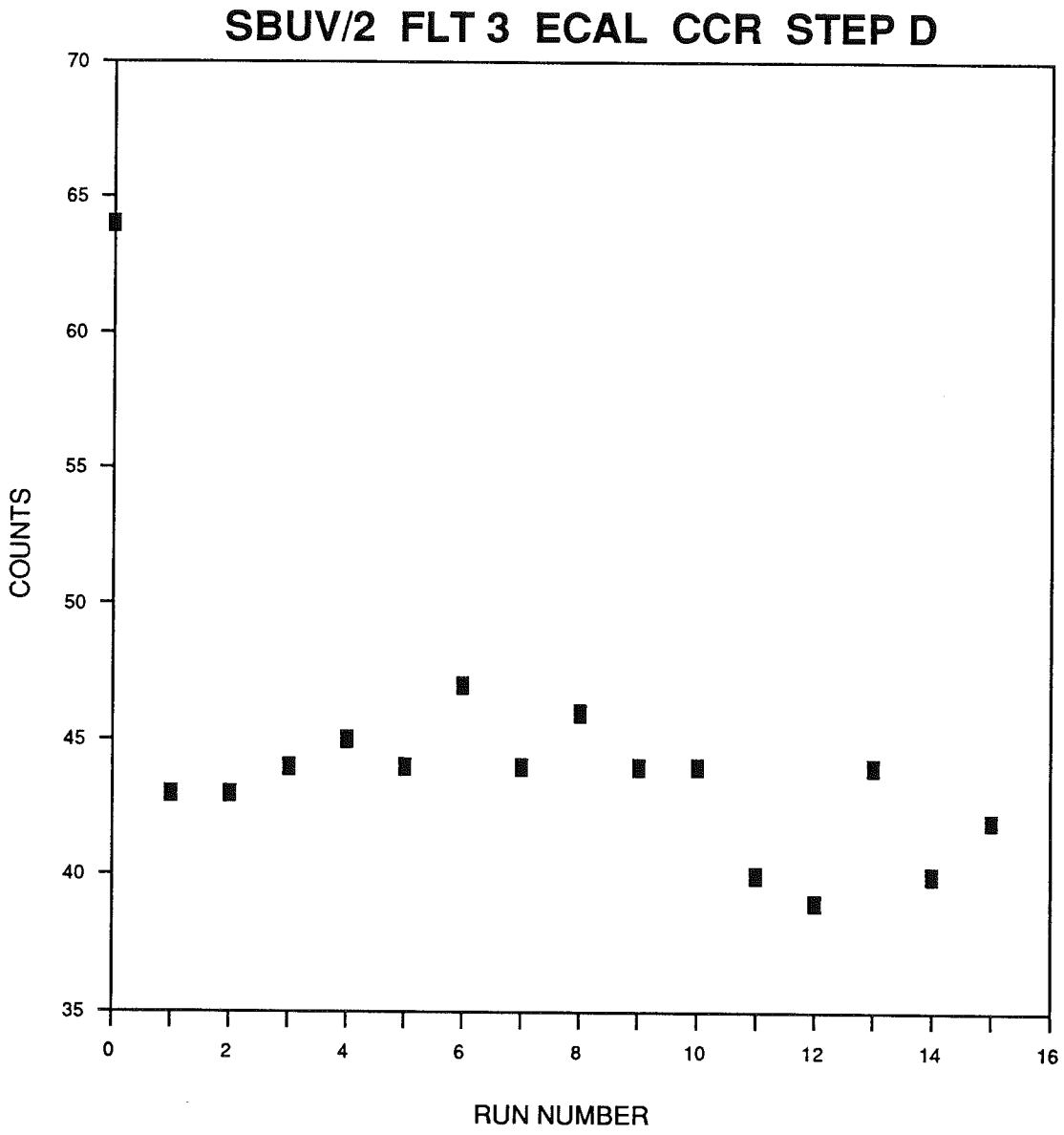


Figure 7-14 Flight 3 ECAL CCR step D

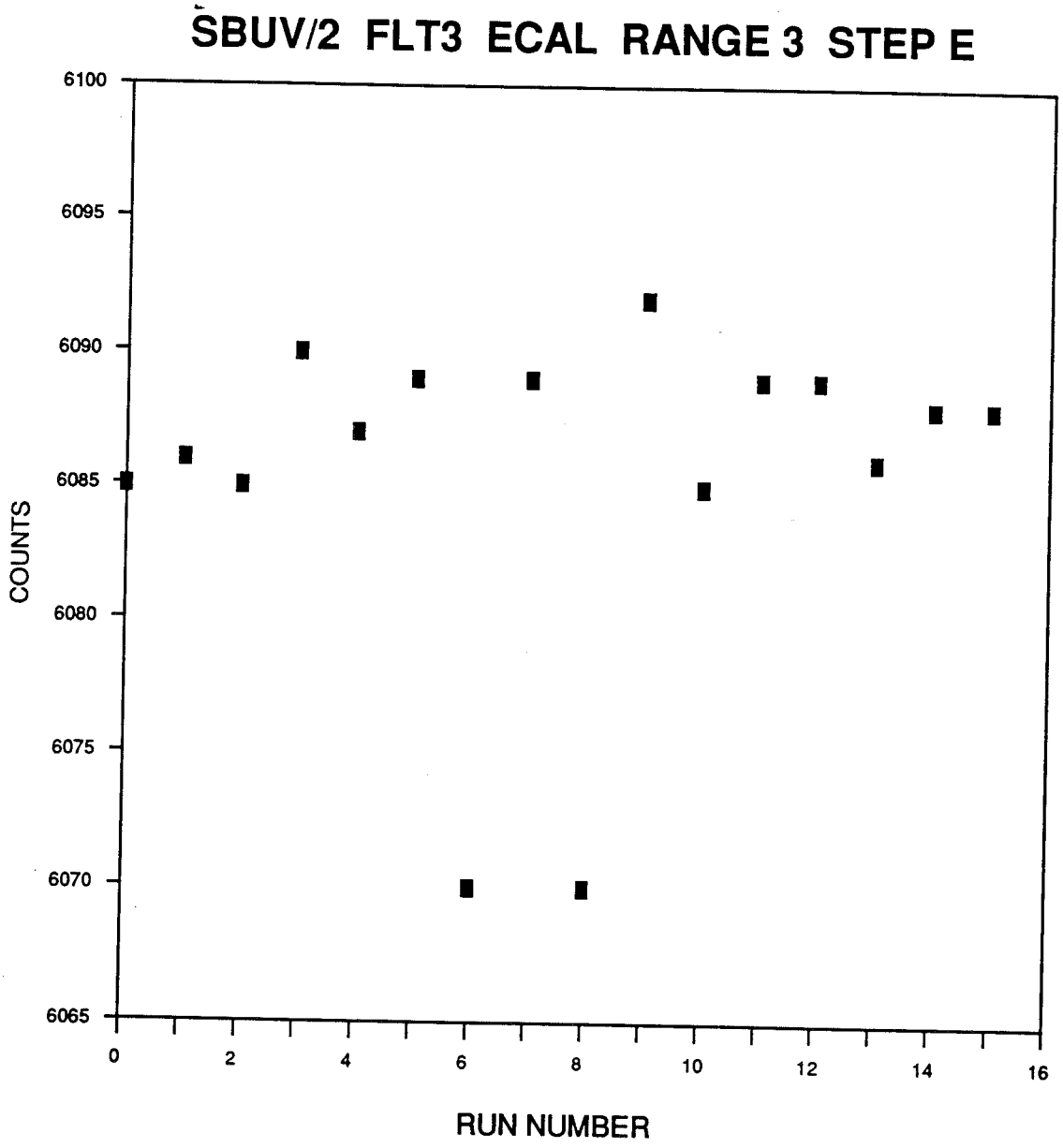


Figure 7-15 Flight 3 ECAL range 3 step E

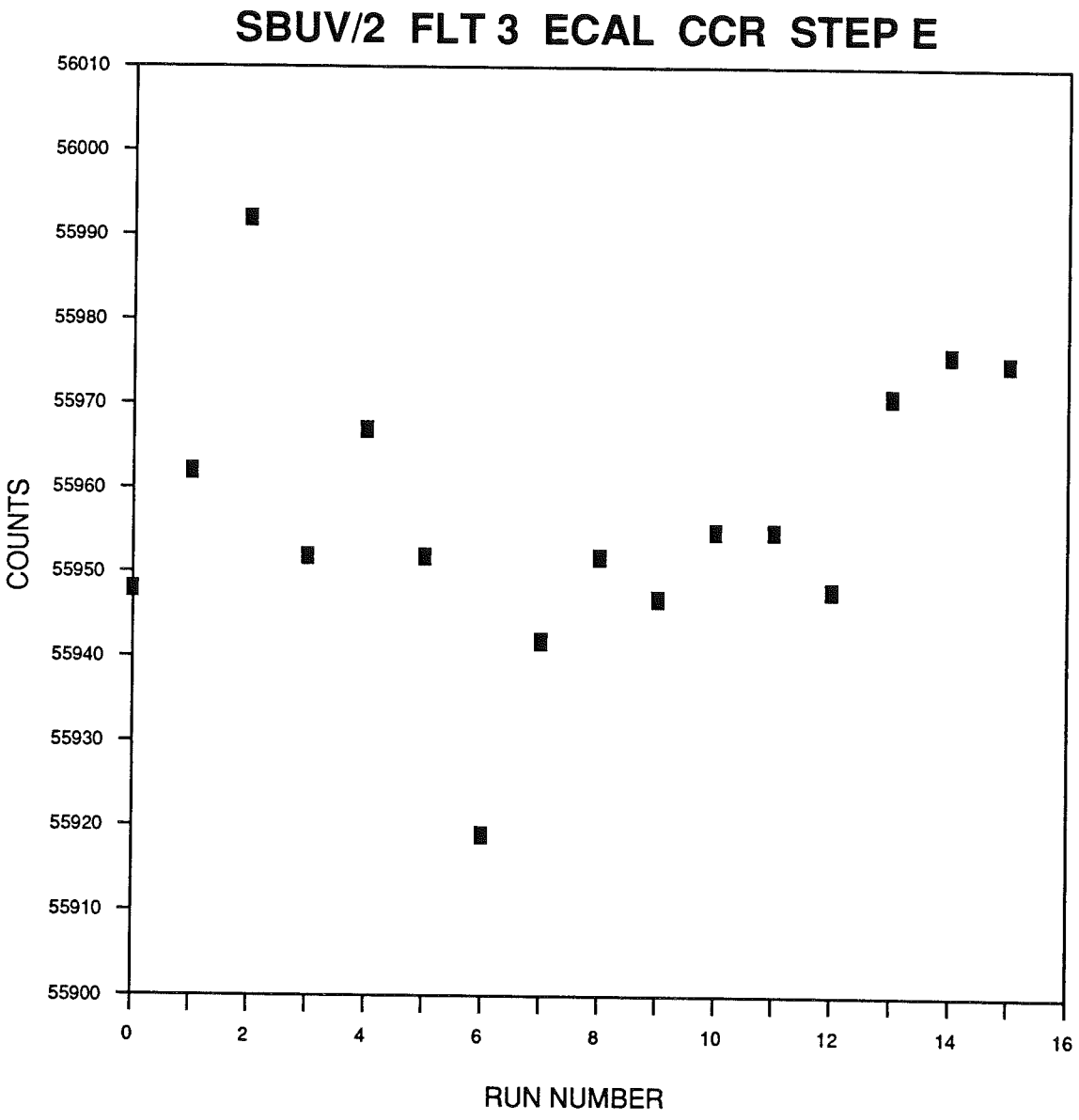


Figure 7-16 Flight 3 ECAL CCR step E

Section 8

SIGNAL-TO-NOISE RATIO AND STABILITY

(Reference Test Procedure 68025)

The signal-to-noise ratio (SNR) 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 8-1 gives the resulting values measured for signal-to-noise ratio, and describes how the ratios were calculated. In all cases, the signal-to-noise ratios measured were greater than the minimum requirements.

Table 8-2 shows the signal-to-noise ratio stability for the discrete and sweep modes. These data were taken during repeats of test procedure #68042. **Figure 8-1** is a graph of the data points for both modes. Only channel 1 data are presented since this is the best indication of the true SNR. The calculations are the same as for **Table 8-1**, since for other wavelengths the SNR depends entirely on background measurements.

Note that the initial points on the graph (**Figure 8-1**) are from the original Integration SNR Test Procedure 68025 (**Table 8-1**), and the remaining points are from the abbreviated SNR portion of the Electrical-Optical Performance Test 68042 (**Table 8-2**). Data collection is similar for these two tests. The results are effected by noise in the lamp, as well as noise in the instrument. Therefore, the increasing SNR values could indicate a reduction in instrument noise, an improvement in the measurement, or a combination of both these two causes.

Table 8-1

MEASURED SIGNAL-TO-NOISE RATIO

16 August 1986

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	54.7	10	14.3
273.5	4.98×10^{-3}	100	435.8	30	139.3
283.0	9.78×10^{-3}	200	1014.2	60	284.0
287.6	1.30×10^{-2}	260	1595.0	80	348.0
292.2	2.39×10^{-2}	400	2429.0	145	553.0
297.5	3.48×10^{-2}	400	2038.3	210	448.5
301.9	3.84×10^{-2}	400	3916.7	230	939.9
305.8	6.72×10^{-2}	400	7892.6	400	1533.4
312.5	1.49×10^{-1}	400	756.3	400	3348.1
317.5	3.09×10^{-1}	400	2095.1	400	7735.5
331.2**	2.08	400	3477.6	400	21407.7
339.8**	4.12	400	6540.0	400	34969.2
CCR	1.25	100	134.3	---	-----

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

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

** The signal-to-noise ratio for 331.2nm and 339.8nm 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 8-2

252NM SIGNAL-TO-NOISE RATIO STABILITY (CH 1)

DATE	DISCRETE	SWEEP
10 APR 87	61.20	50.47
21 APR 87	50.44	50.36
22 APR 87	78.60	52.84
23 APR 87	49.35	43.17
10 FEB 88	61.58	50.65
12 FEB 88	65.77	41.89
16 FEB 88	56.59	48.13
21 DEC 88	87.30	72.30
22 FEB 89	77.60	53.60

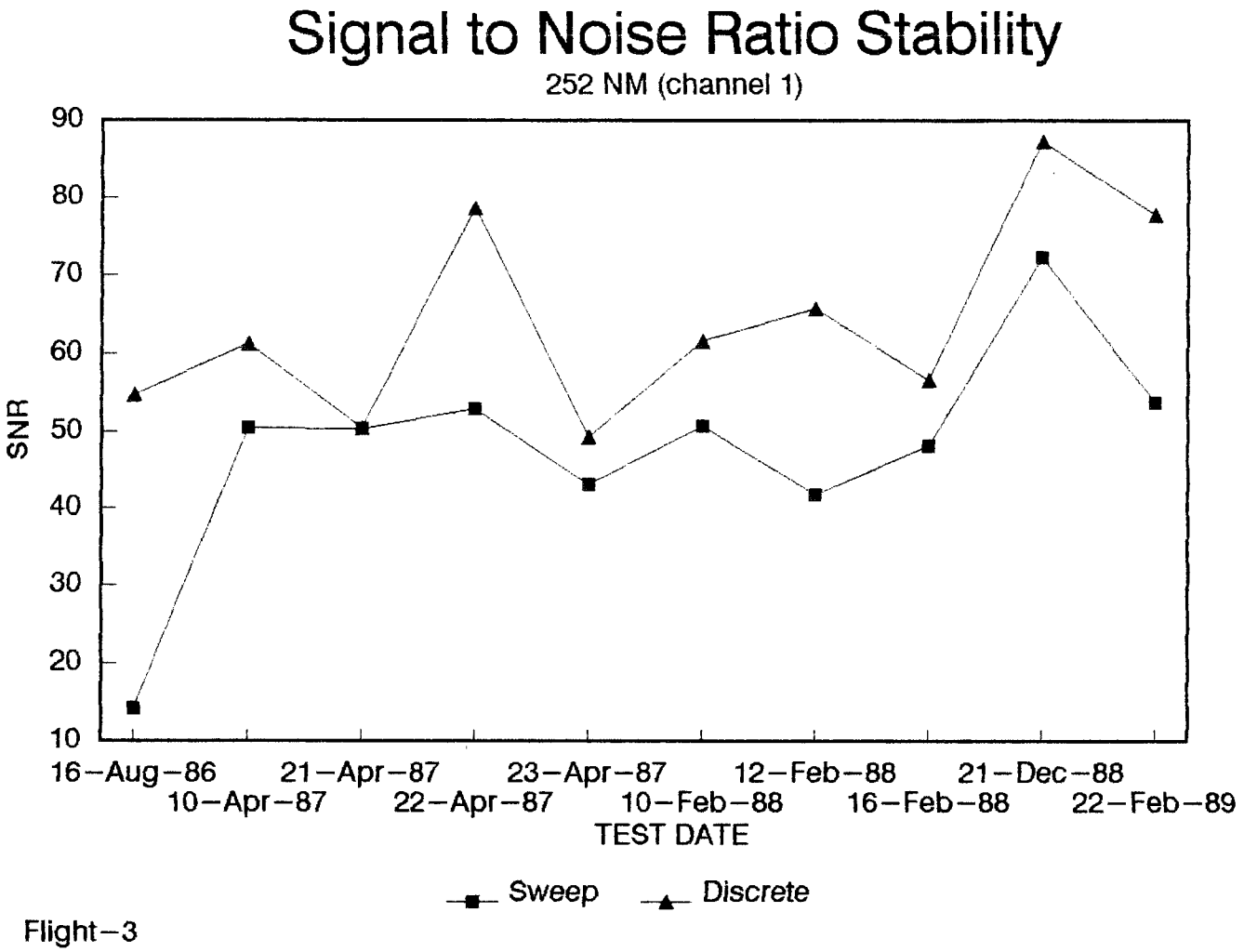


Figure 8-1 Signal-to-noise ratio stability

Section 9

BACKGROUND STABILITY

(Reference Test Procedure 68027)

The background stability of the SBUV/2 instrument was tabulated from Day 42 through Day 139 of 1988 and from Day 54 through Day 171 of 1989. The results are shown in **Table 9-1**. The average of twenty-six background tests is as follows: 66.25 for Range 1, calculated without the suppressed thermal vacuum data; 65.50 for Range 2; 65.17 for Range 3 data taken after the 25 volt regulator installation; and 64.49 for the CCR. It should be noted that Range 3 background data taken before the 25 volt regulator mod is not indicative of the instrument operation at delivery. **Table 9-2** lists the tests from which background stability data was taken. Graphs of each range and of the CCR are shown in **Figures 9-1** through **9-4**.

Table 9-1

BACKGROUND STABILITY DATA

NO.	DATE	RANGE 1	RANGE 2	RANGE 3	CCR
0	2/12/88	66.55	65.58	71.90	64.65
1	2/16/88	66.42	65.58	69.86	64.51
2	2/22/88	49.50	65.49	74.09	64.35
3	2/23/88	NO DATA	65.39	NO DATA	64.83
4	2/26/88	50.18	65.57	72.55	64.66
5	2/27/88	44.00	65.34	76.00	64.13
6	2/28/88	46.43	65.24	73.15	64.23
7	2/29/88	41.47	65.14	68.97	64.52
8	3/01/88	45.72	65.39	70.90	64.64
9	3/02/88	44.62	65.29	53.13	64.63
10	3/08/88	68.62	65.64	68.42	64.37
11	3/10/88	67.17	65.59	68.34	64.44
12	3/14/88	66.85	65.75	67.20	64.43
13	3/22/88	68.32	65.56	67.23	64.75
14	5/11/88	66.25	65.51	71.92	64.43
15	5/12/88	66.25	65.62	71.51	64.71
16	5/13/88	65.84	65.45	71.71	64.31
17	5/17/88	66.76	65.29	71.64	64.36
18	5/18/88	66.86	65.49	71.57	64.45
19	2/15/89	65.12	65.48	64.21	64.56
20	2/17/89	65.63	65.61	66.22	64.34
21	2/23/89	65.19	65.43	65.04	64.42
22	4/20/89	64.94	65.64	65.03	64.66
23	4/23/89	65.03	65.54	65.98	64.35
24	6/12/89	65.26	65.67	65.68	64.50
25	6/20/89	65.43	65.65	64.00	64.63

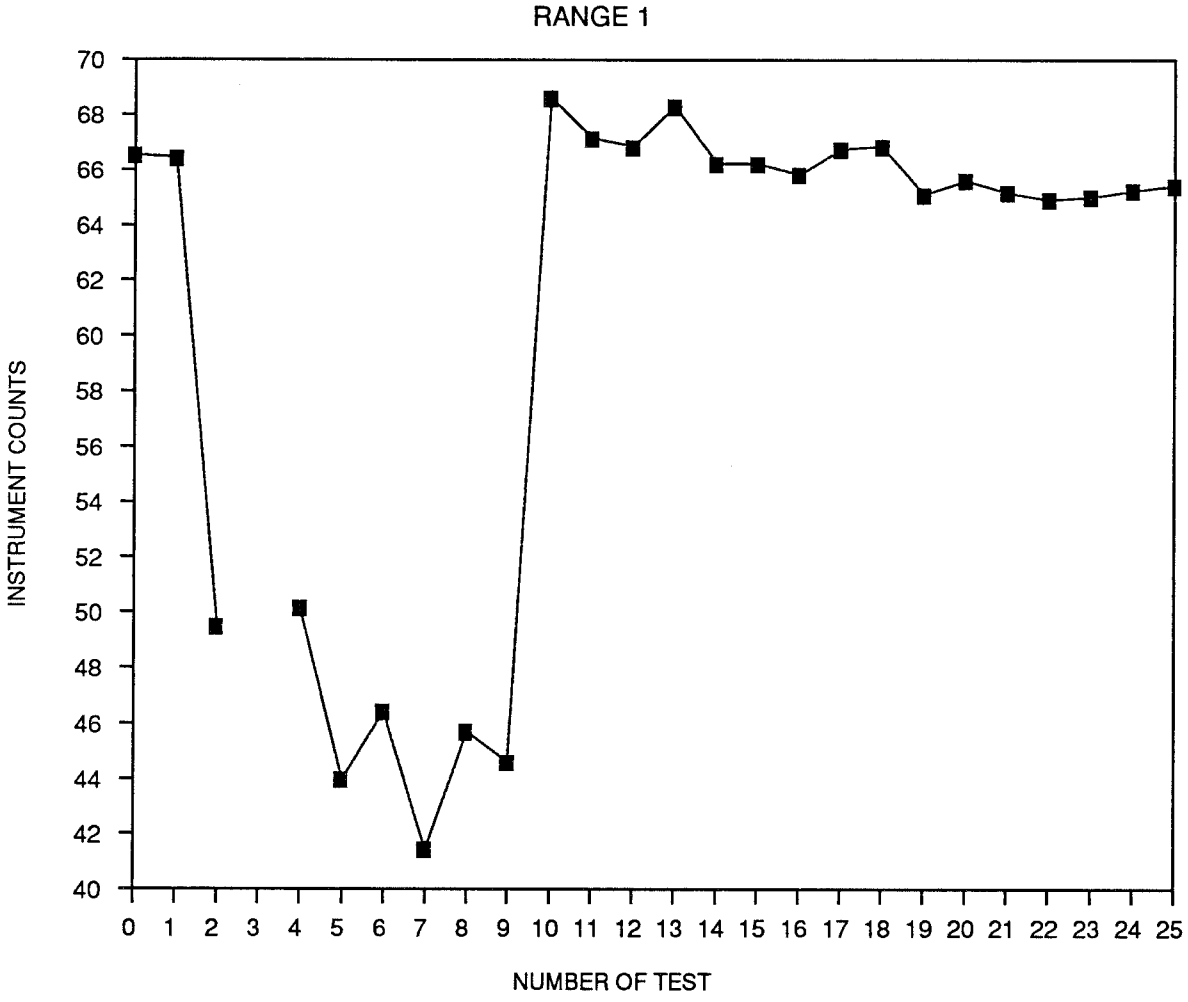
Table 9-2

BACKGROUND STABILITY TESTS

NO.	DATE	PROCEDURE	NAME OF TEST
0	2/12/88	68042	Electrical/Optical Performance
1	2/16/88	68042	Electrical/Optical Performance (Post Vib.)
2	2/22/88	160864 (Zone 0)	Radiometric Stabilization
3	2/23/88	160864 (Zone 1)	Radiometric Stabilization
4	2/26/88	160864 (Zone 11)	Radiometric Stabilization
5	2/27/88	160864 (Zone 13)	Radiometric Stabilization
6	2/28/88	160864 (Zone 15)	Radiometric Stabilization
7	2/29/88	160864 (Zone 17)	Radiometric Stabilization
8	3/01/88	160864 (Zone 19)	Radiometric Stabilization
9	3/02/88	160866 (Zone 13)	Vacuum Calibration (Retest)
10	3/08/88	68042	Electrical/Optical Performance
11	3/10/88	68042	Electrical/Optical Performance
12	3/14/88	68043	Radiometric Calibration
13	3/22/88	68032	Out of Band
14	5/11/88	168064 *	Oven Test, 20 deg. Baseline
15	5/12/88	168064 *	Oven Test, 30 deg. Baseline
16	5/13/88	168064 *	Oven Test, 10 deg. Baseline
17	5/17/88	168064 *	Oven Test, 0 deg. Baseline
18	5/18/88	168064 *	Oven Test, 20 deg. Repeat
19	2/15/89	68029	Dynamic Range & Linearity
20	2/17/89	68044	Gain vs. Wavelength
21	2/23/89	68031	Light Leak
22	4/20/89	68034	Goniometric Calibration - Hg Turnon
23	4/23/89	68034	Goniometric Calibration - FEL Turnon
24	6/12/89	69821	Bench Test at Ball
25	6/20/89	69821	Bench Test at GE-Astro

* Procedure number 168064 was a prototype for the Temperature Response Test, number 160859.

FLIGHT 3 BACKGROUND STABILITY

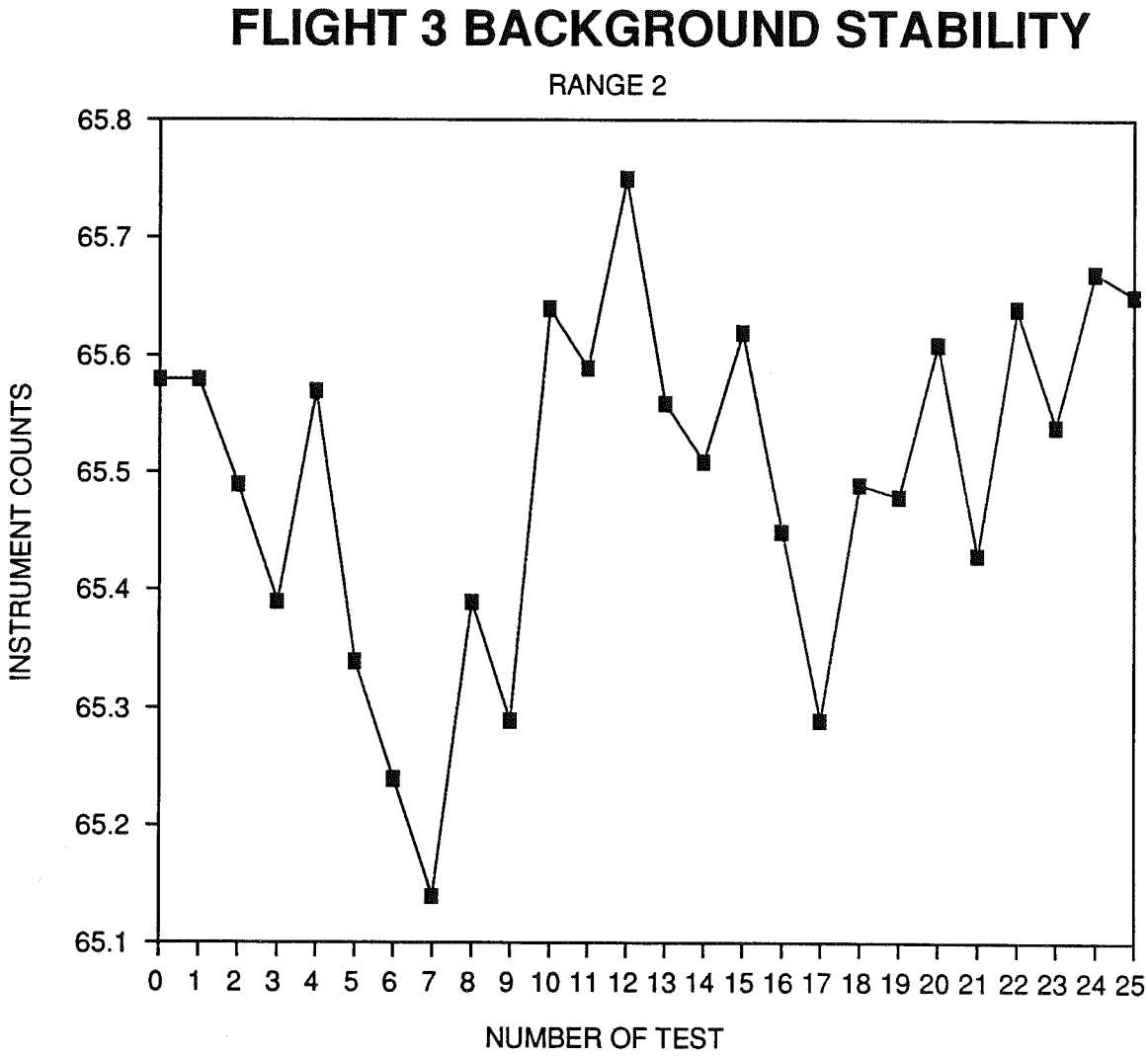


See Table 9-1 for tabulated data.

Data point 3 information is not available.

Low background data points 2 through 9 due to abnormal chamber grounding.

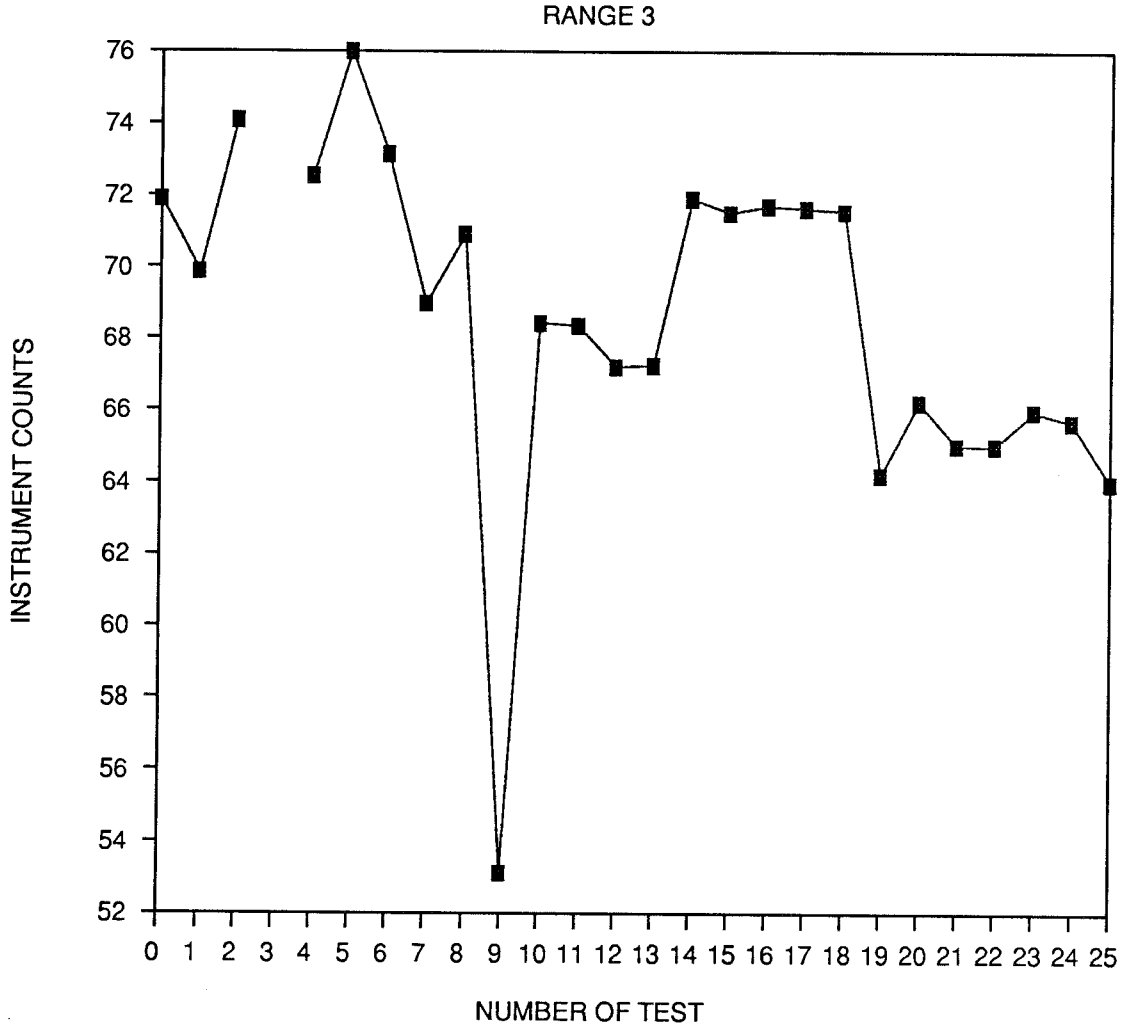
Figure 9-1 Background stability - range 1



See Table 9-1 for tabulated data.
Data points 2 through 9 taken in vacuum chamber with non-ideal grounding.

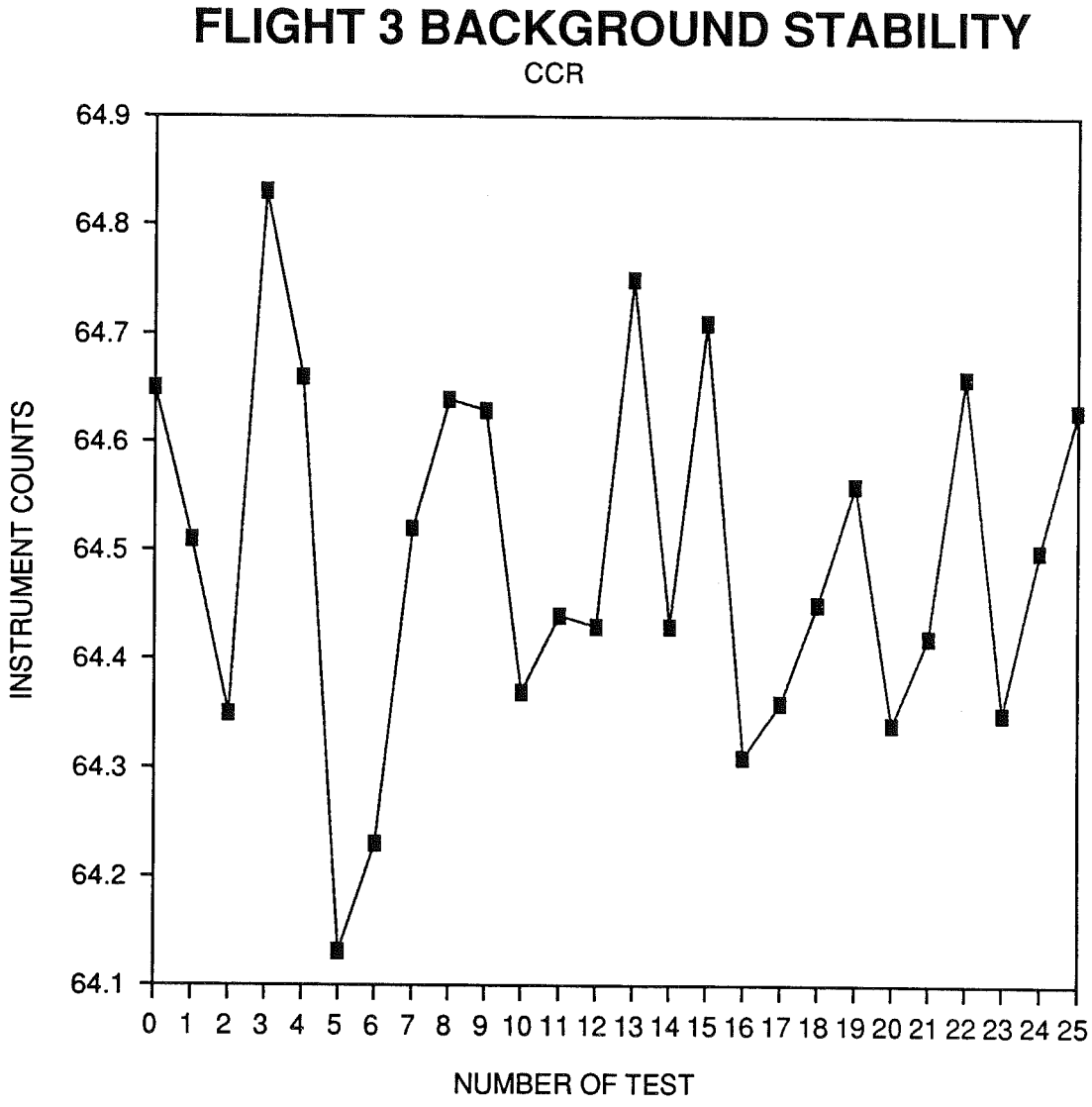
Figure 9-2 Background stability - range 2

FLIGHT 3 BACKGROUND STABILITY



See Table 9-1 for tabulated data.
Data point 3 information is not available.
25 Volt regulator installed between tests 18 and 19.
Data taken after test 18 is the "as delivered" background stability.
Test number 9 affected by non-standard grounding.

Figure 9-3 Background stability - range 3



See Table 9-1 for tabulated data.
Data points 2 through 9 taken in vacuum chamber.

Figure 9-4 Background stability - CCR

Section 10

POLARIZATION

(Reference Test Procedure 68006)

Due to element separation of the original Flight 4 depolarizer (S/N 006a), the Flight 3 depolarizer (S/N 006) was removed and placed into the Flight 4 instrument. The Flight 3 instrument eventually had depolarizer S/N 004 installed. After the problems experienced with element separation of S/N 006a depolarizer, all depolarizers were thermally tested to ensure that there would be no element separation. The Flight 3 depolarizer (S/N 004) was thermally cycled three times between -10 degrees C and 40 degrees C, (qualification temperatures), with a minimum one hour soak at each temperature plateau. During the thermal test, the depolarizer was visually inspected for evidence of fringe patterns or damage to its elements. The visual inspections were performed every 15 minutes throughout the test with no signs of separations. In addition to visual inspection, depolarizer transmission measurements were later performed at each plateau with no apparent anomalies.

Depolarizer transmission and depolarization efficiency are determined with a component level test. Transmission of the depolarizer is measured over the spectral range from 160nm to 400nm. A McPherson model 225 monochromator equipped with a Hinteregger type gas discharge source is used to make these measurements. The results ranged from 60.5 percent at 159.9nm to 91.9 percent at 366.3nm. See **Table 10-1** for transmission measurements.

The depolarization efficiency is a test to determine how well the depolarizer scrambles the state of polarization of incident light. The test fixture consisted of 1 of 2 mercury line bandpass filters (254 or 366nm) 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 analyzer, 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 10-2** and **Figure 10-1** for the results and see **Figure 10-2** for the schematic of the test fixture.

Table 10-1

SBUV/2 FLIGHT 3

DEPOLARIZER TRANSMISSION MEASUREMENTS

JUNE 18, 1982

Wavelength (nm)	S/N 004 Transmission (%)	S/N 006 Transmission (%)	Ratio S/N 006 / S/N 004
159.9	60.5	63.5	1.050
170.5	72.2	74.7	1.035
179.3	76.6	76.5	0.999
189.8	77.5	79.5	1.026
204.7	82.7	83.1	1.005
253.7	90.2	89.8	0.996
313.2	91.4	91.4	1.000
366.3	91.9	91.3	0.993

NOTE: S/N 006 was initially installed in Flight 3 and later removed from Flight 3 to be installed in Flight 4. S/N 004 was installed in Flight 3 in January of 1988.

Table 10-2

SBUV/2 FLIGHT 3

RESIDUAL POLARIZATION RESPONSE

JUNE 18, 1982 S/N 004

Angle	Residual Polarization at 254 nm (%)	Residual Polarization at 366 nm (%)
0	1.25	1.31
30	1.25	1.54
60	1.40	1.77
90	1.23	1.39
120	1.07	1.54
150	1.54	1.83
180	1.22	1.67

NOTE: S/N 006 was initially installed in Flight 3 and later removed from Flight 3 to be installed in Flight 4. S/N 004 was installed in Flight 3 in January of 1988.

These data are plotted on the following page.

The specification for sensitivity of the SBUV/2 instrument to polarized light is that it shall be no greater than 5%. The requirement for the component level test of the depolarizer is that residual polarization shall be no greater than 2%.

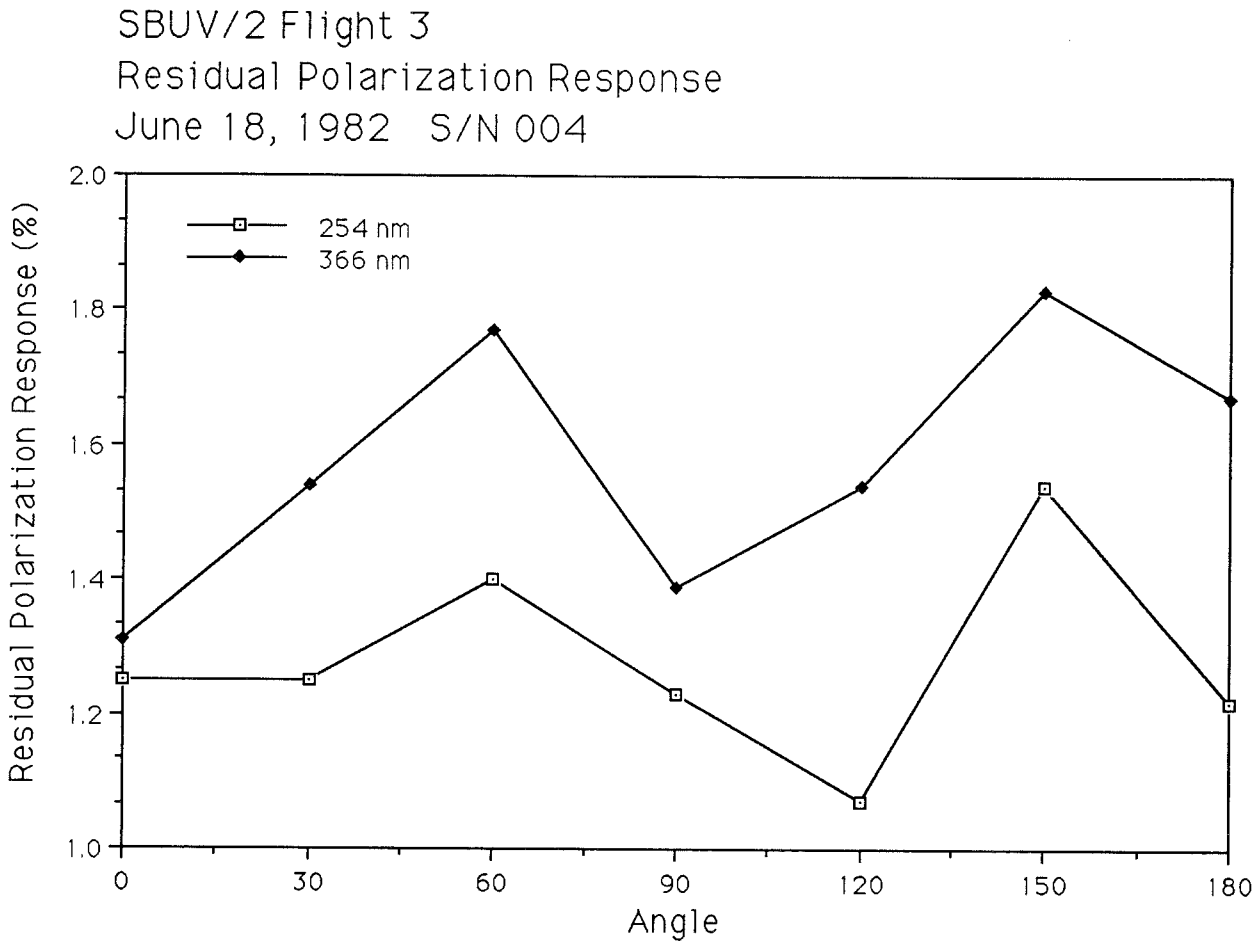


Figure 10-1 SBUV/2 Flight 3 residual polarization response

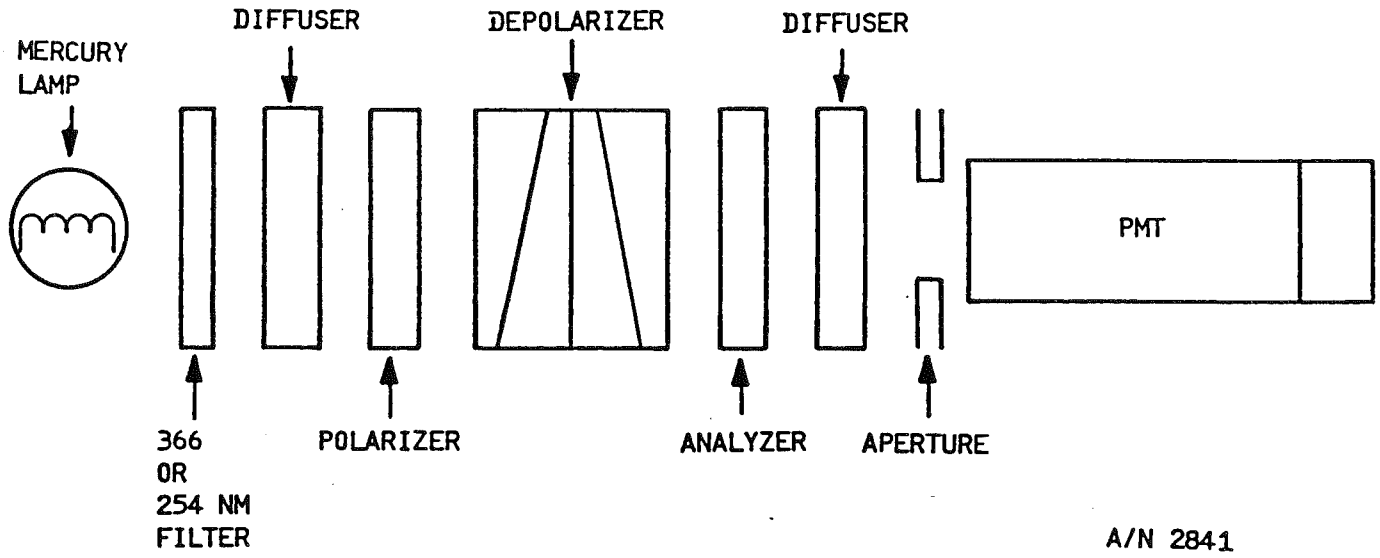


Figure 10-2 Test setup

Section 11

DIFFUSER REFLECTIVITY

(Reference Test Procedure 157372 April 1987)

The ability to measure the instrument's irradiance (solar) diffuser plate exceeds all requirements. There are 32 valid measurements in air and 11 in vacuum; the total spanning a two year period from 1987 to 1989. **Tables 11-1** through **11-4** contain listings of the test, fixture, run date and the mean albedos at six wavelengths.

The reflectivity of the instrument's diffuser plate is measured in several of our test procedures using the macro ALBEDO. After a 20 minute warm-up of the on board mercury lamp, the macro enables the automatic wavelength calibration sequence. This sequence takes 10 sweeps of data with the diffuser in the monitor position. Data for sweeps 1 through 3 are collected, but not processed, by the data reduction utility. This effectively adds ten minutes to the warm-up time, for a total of 30 minutes. Sweeps 1-4, 7 and 8 are with the instrument calibration lamp open, illuminating the diffuser. Sweeps 5, 6, 9 and 10 are done with the calibration lamp door closed directly over the entrance aperture.

The off-line utility, REFLECT, used to reduce the data selects six points on either side of, and including, the peak for each of the 10 spectral lines. The integrated area is then used as the signal for that particular wavelength.

Ratios for each wavelength are found for consecutive open/closed sweeps and the average of three of these ratios are recorded as the albedo measurement. **Table 11-5** is an example of the report produced by running the REFLECT utility. It should be noted that all of the data presented here were processed in May and June of 1989 to take advantage of the latest measurement of Flight 3 interrange ratios and a small correction to the utility itself. Wavelength calibration data are included in Volume II.

Measurements made in air have a definite trend for albedos to increase at the shorter wavelengths, however, in vacuum this is not a factor and should cause no problems in orbit. Instead, it appears that measurements made in air are reflecting real vibrations in fixtures, nitrogen purge rates and orientation of the instrument to both gravity and airflow. All of these conditions have an effect on the accumulation of ozone due to ionizing radiation from the Hg

lamp. The impact of this ozone build up may also be dependent on absorption varying with wavelength and time. The instrument's wavelength scan takes approximately three minutes so ozone build up may have a greater effect on shorter (later) wavelengths. However, it should be noted that data taken under controlled and repeatable conditions demonstrate the instrument's performance is accurate and repeatable.

Figure 11-1 shows the albedo ratios for the shortest (185nm) and longest (405nm) mercury wavelength as well as the most intense spectral line (254nm). The 185 wavelength is severely attenuated by air, and is of little value in these measurements. **Figure 11-2** is a plot of albedos at 5 wavelengths. The trend for albedos (measured in air) to increase at the shorter wavelengths is apparent here. **Figures 11-3** through **11-7** are plots of the changes, in percent, for each wavelength. All of the percent change graphs use the final mean (of eight consecutive tests) from the Diffuser Reflectivity test procedure as the baseline. Data at 185nm are included solely for comparison due to extreme sensitivity to conditions (**Figure 11-8**). Trends for the remaining 5 wavelengths range from a slight decrease in diffuser reflectivity of 1% at 405nm to a significant increase of approximately 5% at 254nm. It is not probable that the diffuser surface would change in this way. It is much more likely that these trends represent variations in the test environment.

The conditions under which a test is run can have a significant effect on the lamp output and the reflectivity measurements. Therefore, a brief description of the various test setups is provided.

The Diffuser Reflectivity Procedure is a repeatability test and test conditions are carefully controlled. Macro ALBEDO is repeated 8 consecutive times in this procedure, the average of which is used as a baseline to determine if there is any degradation of the diffuser in the future. The Hg lamp is warmed up before each data set and allowed a 2 hour cool down period before rerunning the macro ALBEDO. This test is done in the primary test fixture using the primary encoders. As to be expected under such repeatable conditions the albedo runs of this test (the first 8 points in **Figures 11-3** through **11-7**) are extremely consistent.

Another test procedure run under carefully controlled conditions is the Thermal Vacuum procedure. Marco ALBEDO is run during the vacuum functional and vacuum calibration portions of Thermal-vac. Vacuum functionals are run in zones 0, 1, 3, 7, 9 and 11 using backup

encoders. Vacuum calibration is run in zones 11, 13, 15, 17 and 19 using the primary encoders. Note that zone 0 (test #13 of those done in air) is done before the chamber is pumped down. The instrument is held in the vacuum test fixture which has similar orientation to that of the primary test fixture. **Figure 11-9** is a plot of three of the vacuum albedos. Note that the 185nm measurement is dramatically improved, compared to **Figure 11-1**. Data at 254nm have a temperature dependence. This is due to different temperature coefficients for ranges 2 and 3 used in this ratio. The 254nm line is the only one to reach range 3. These data were processed without any temperature correction. For 254nm data, points taken at the same temperature are within one percent. **Figure 11-10** is of vacuum data plotted at the same five wavelengths and scale as **Figure 11-2**. A comparison of the two clearly demonstrates the stability of the vacuum data. The fact that in some cases the albedo measured in air is larger than that measured in vacuum is most likely attributable to ozone build up produced by UV light from the lamp. Ozone accumulation within the instrument while the lamp is closed over the entrance aperture would decrease the amount of light getting through, and so increase the open/closed ratio. In further support of this, note that **Figure 11-11** shows the lamp output (histogram) and the albedos for 254nm. The lamp output is taken from the integrated signals of the closed sweeps (see AVG CLS area in **Table 11-1**). This being the denominator of an increasing Albedo ratio implies that signals for the open sweeps are increasing at a greater rate than the closed signals. From other data we know that the instrument's response to a known source is stable, therefore, the Hg lamp is putting out more UV light and should be generating more ozone.

Functional tests 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. There are some exceptions: the post EMI shield installation functional was done with the instrument on the bench in the vertical position. After a 20 minute lamp warm-up, macro ALBEDO is run first using primary encoders and then using the backup encoders. The lamp is turned off briefly between the primary and backup runs. The 20 minute warm-up is not repeated for the backup run, but the built-in 10 minute warm-up (sweeps 1-3) is a part of the backup data. It should be noted that the second set of data always gives the same result as the first, indicating the lamp has no warm-up problems, and that as long as test conditions remain the same, the results are repeatable.

In thermal-vacuum testing, the primary and backup runs are performed at different times during the test. Both types of data are collected in the same way. Both include the 20 minute warmup before running the automatic sequence.

During radiometric calibration 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° about its X-axis. All runs have a 20 minute lamp warm-up and are done using the primary encoders only.

All tests and their test fixtures are tabulated in **Tables 11-1** and **11-3**.

Table 11-1

ALBEDO IN AIR

NO.	TIME	DESCRIPTION	FIXTURE
1	1987-106-16-35	Diffuser Reflectivity	PTF
2	1987-106-19-36	Diffuser Reflectivity	PTF
3	1987-106-22-37	Diffuser Reflectivity	PTF
4	1987-107-01-35	Diffuser Reflectivity	PTF
5	1987-107-04-43	Diffuser Reflectivity	PTF
6	1987-107-07-48	Diffuser Reflectivity	PTF
7	1987-107-12-02	Diffuser Reflectivity	PTF
8	1987-107-15-22	Diffuser Reflectivity	PTF
9	1988-043-08-54	Pre-Vibration Functional (grating shaft)	PTF
10	1988-043-09-45	Same, Backup Encoders	PTF
11	1988-047-14-04	Post-Vibration Functional	PTF
12	1988-047-14-44	Same, Backup Encoders	PTF
13	1988-053-16-07	Pre-Vacuum Functional, Backup Encoders	VTF
14	1988-070-14-08	Post-Vacuum Functional	PTF
15	1988-070-14-48	Same, Backup Encoders	PTF
16	1988-074-13-51	Radiometric Calibration	PTF
17	1988-075-12-38	Radiometric Calibration	PTF
18	1988-076-13-50	Radiometric Calibration	PTF
19	1988-077-10-57	Radiometric Calibration	PTF
20	1988-078-16-37	Radiometric Calibration	NIF
21	1988-081-13-34	Radiometric Calibration	NIF
22	1988-082-12-52	Radiometric Calibration	NIF
23	1988-355-15-15	Pre-25V. Regulator Functional	PTF
24	1988-355-15-55	Same, Backup Encoders	PTF
25	1989-053-09-38	Post-Regulator Functional (Pre-Shield)	PTF
26	1989-053-10-19	Same, Backup Encoders	PTF
27	1989-102-15-13	Post-EMI-Shield Functional	none
28	1989-102-15-53	Same, Backup Encoders	none
29	1989-163-13-11	Bench Test at Ball	none
30	1989-163-13-51	Same, Backup Encoders	none
31	1989-171-13-06	Bench Test at G.E.	none
32	1989-171-13-45	Same, Backup Encoders	none

Table 11-2

MEAN ALBEDOS DETERMINED IN AIR

TEST RUN NO.	185nm	294nm	297nm	313nm	365nm	405nm
1	0.00563	0.01577	0.01656	0.01749	0.01860	0.01938
2	0.00565	0.01577	0.01656	0.01744	0.01856	0.01933
3	0.00571	0.01579	0.01655	0.01743	0.01857	0.01938
4	0.00574	0.01577	0.01654	0.01744	0.01860	0.01940
5	0.00561	0.01577	0.01657	0.01739	0.01859	0.01937
6	0.00558	0.01577	0.01656	0.01743	0.01857	0.01936
7	0.00565	0.01576	0.01655	0.01742	0.01855	0.01940
8	0.00561	0.01580	0.01657	0.01740	0.01853	0.01936
9	0.00606	0.01582	0.01651	0.01725	0.01812	0.01861
10	0.00601	0.01603	0.01658	0.01712	0.01839	0.01895
11	0.00537	0.01617	0.01685	0.01748	0.01849	0.01933
12	0.00539	0.01610	0.01675	0.01740	0.01843	0.01906
13	0.00763	0.01574	0.01611	0.01684	0.01802	0.01858
14	0.00651	0.01593	0.01662	0.01724	0.01826	0.01882
15	0.00645	0.01598	0.01663	0.01728	0.01825	0.01880
16	0.00540	0.01613	0.01677	0.01738	0.01828	0.01887
17	0.00534	0.01608	0.01663	0.01726	0.01819	0.01878
18	0.00560	0.01622	0.01680	0.01733	0.01831	0.01878
19	0.00591	0.01617	0.01676	0.01736	0.01829	0.01889
20	0.00560	0.01603	0.01678	0.01737	0.01844	0.01897
21	0.00601	0.01605	0.01682	0.01742	0.01844	0.01897
22	0.00598	0.01611	0.01688	0.01747	0.01850	0.01878
23	0.00573	0.01644	0.01708	0.01765	0.01862	0.01921
24	0.00577	0.01647	0.01708	0.01762	0.01860	0.01917
25	0.00563	0.01660	0.01718	0.01771	0.01863	0.01914
26	0.00553	0.01659	0.01718	0.01769	0.01863	0.01918
27	0.00781	0.01642	0.01710	0.01765	0.01863	0.01916
28	0.00790	0.01643	0.01708	0.01767	0.01867	0.01924
29	0.00724	0.01650	0.01708	0.01764	0.01857	0.01911
30	0.00721	0.01650	0.01712	0.01769	0.01861	0.01911
31	0.00484	0.01650	0.01709	0.01764	0.01858	0.01907
32	0.00500	0.01649	0.01714	0.01768	0.01862	0.01906

Table 11-3

VACUUM ALBEDOS

NO.	TIME	DESCRIPTION	TEMPERATURE
1	1988-54-12-16	Backup Encoders, Zone 1	25
2	1988-54-21-49	Backup Encoders, Zone 3	30
3	1988-55-12-12	Backup Encoders, Zone 5	0
4	1988-56-05-42	Backup Encoders, Zone 7	30
5	1988-56-22-51	Backup Encoders, Zone 9	0
6	1988-57-17-31	Backup Encoders, Zone 11	30
7	1988-58-00-53	Primary Encoders, Zone 11	30
8	1988-58-17-43	Primary Encoders, Zone 13	10
9	1988-59-21-08	Primary Encoders, Zone 15	20
10	1988-60-21-27	Primary Encoders, Zone 17	0
11	1988-61-14-33	Primary Encoders, Zone 19	25

Table 11-4

MEAN ALBEDOS DETERMINED IN VACUUM

TEST RUN NO.	185nm	294nm	297nm	313nm	365nm	405nm
1	0.01141	0.01611	0.01685	0.01757	0.01840	0.01893
2	0.01144	0.01597	0.01688	0.01757	0.01856	0.01896
3	0.01141	0.01687	0.01684	0.01751	0.01841	0.01894
4	0.01149	0.01591	0.01695	0.01758	0.01845	0.01899
5	0.01143	0.01686	0.01695	0.01752	0.01841	0.01892
6	0.01149	0.01595	0.01692	0.01755	0.01844	0.01894
7	0.01152	0.01590	0.01692	0.01755	0.01841	0.01895
8	0.01136	0.01608	0.01687	0.01749	0.01839	0.01876
9	0.01145	0.01653	0.01690	0.01752	0.01837	0.01890
10	0.01145	0.01670	0.01689	0.01750	0.01841	0.01892
11	0.01147	0.01609	0.01692	0.01752	0.01863	0.01895

Table 11-5

ALBEDO AND WAVELENGTH CALIBRATION UTILITY EXAMPLE

SBUV/2 ALBEDO & WAVELENGTH CALIBRATION UTILITY

TAPE #F821 TAPE GENERATED: 1989:171/09/52/37 OPERATOR ID: KWK TEST #001 TEST LABEL: FUNCTIONAL-CHECK-GE

SWEEP TEST START TIME: 1989:171/13/45 Backup

GRATING POS	-1577	-1005	-571	-279	-129	-53	373	529	603	1437
WAVELENGTHS	404.66	365.02	334.15	313.17	302.15	296.73	265.20	253.65	248.20	184.91
ALBEDO 4/5	.01899	.01855	.01803	.01763	.01728	.01712	.01635	.01651	.01597	.00519
ALBEDO 7/6	.01909	.01869	.01823	.01777	.01745	.01717	.01655	.01647	.01640	.00488
ALBEDO 8/9	.01910	.01861	.01807	.01764	.01725	.01714	.01660	.01649	.01611	.00493
MEAN ALB: GP	.01906	.01862	.01811	.01768	.01733	.01714	.01650	.01649	.01616	.00500
ALB STD DEV	.49051E-04	.57323E-04	.88312E-04	.63517E-04	.87463E-04	.20075E-04	.10830E-03	.16395E-04	.17875E-03	.13479E-03
ALB STD ERR	.28320E-04	.33095E-04	.50987E-04	.36672E-04	.50497E-04	.11590E-04	.62530E-04	.94656E-05	.10320E-03	.77819E-04
STD ERR/AVG	.14856E-02	.17775E-02	.28157E-02	.20747E-02	.29144E-02	.67608E-03	.37907E-02	.57400E-03	.63854E-02	.15561E-01
CENTROID 5	-1576.52	-1005.50	-569.69	-277.47	-128.62	-53.59	372.57	528.81	602.92	1437.15
CENTROID 6	-1576.52	-1005.49	-569.69	-277.47	-128.61	-53.59	372.58	528.81	602.92	1437.15
CENTROID 9	-1576.52	-1005.49	-570.31	-277.47	-128.62	-53.59	372.57	528.81	602.92	1437.15
CENTROID 10	-1576.52	-1005.49	-569.67	-277.47	-128.62	-53.59	372.57	528.81	602.92	1437.15
MEAN CENT GP	-1576.52	-1005.49	-569.84	-277.47	-128.62	-53.59	372.57	528.81	602.92	1437.15
MEAN CENT NM	404.72	365.12	334.17	313.07	302.23	296.74	265.30	253.65	248.11	184.92
CENT STD DEV	.18608E-02	.12896E-02	.27040E+00	.95663E-03	.73416E-02	.83908E-03	.44360E-02	.54936E-03	.20348E-02	.19442E-02
CENT STD ERR	.93042E-03	.64481E-03	.13520E+00	.47828E-03	.36708E-02	.41954E-03	.22180E-02	.27468E-03	.10174E-02	.97211E-03
FWHM 5	15.22	16.23	16.14	17.24	15.87	14.64	16.02	14.37	15.36	14.48
FWHM 6	15.21	16.22	16.03	17.25	15.94	14.66	15.80	14.36	15.39	14.48
FWHM 9	15.20	16.23	15.96	17.24	15.92	14.68	15.88	14.36	15.44	14.49
FWHM 10	15.21	16.21	16.12	17.25	15.99	14.64	16.00	14.37	15.32	14.49
MEAN FWHM GP	15.21	16.22	16.06	17.24	15.93	14.65	15.92	14.36	15.38	14.48
FWHM STD DEV	.81418E-02	.10007E-01	.72573E-01	.51605E-02	.43462E-01	.87873E-02	.88819E-01	.33346E-02	.43516E-01	.40206E-02
FWHM STD ERR	.40709E-02	.50033E-02	.36287E-01	.25802E-02	.21731E-01	.43937E-02	.44410E-01	.16673E-02	.21758E-01	.20103E-02
AVG CLS AREA	.38033E-07	.34914E-07	.92237E-09	.45663E-07	.17766E-08	.14921E-07	.88210E-09	.11275E-05	.39129E-09	.13093E-07

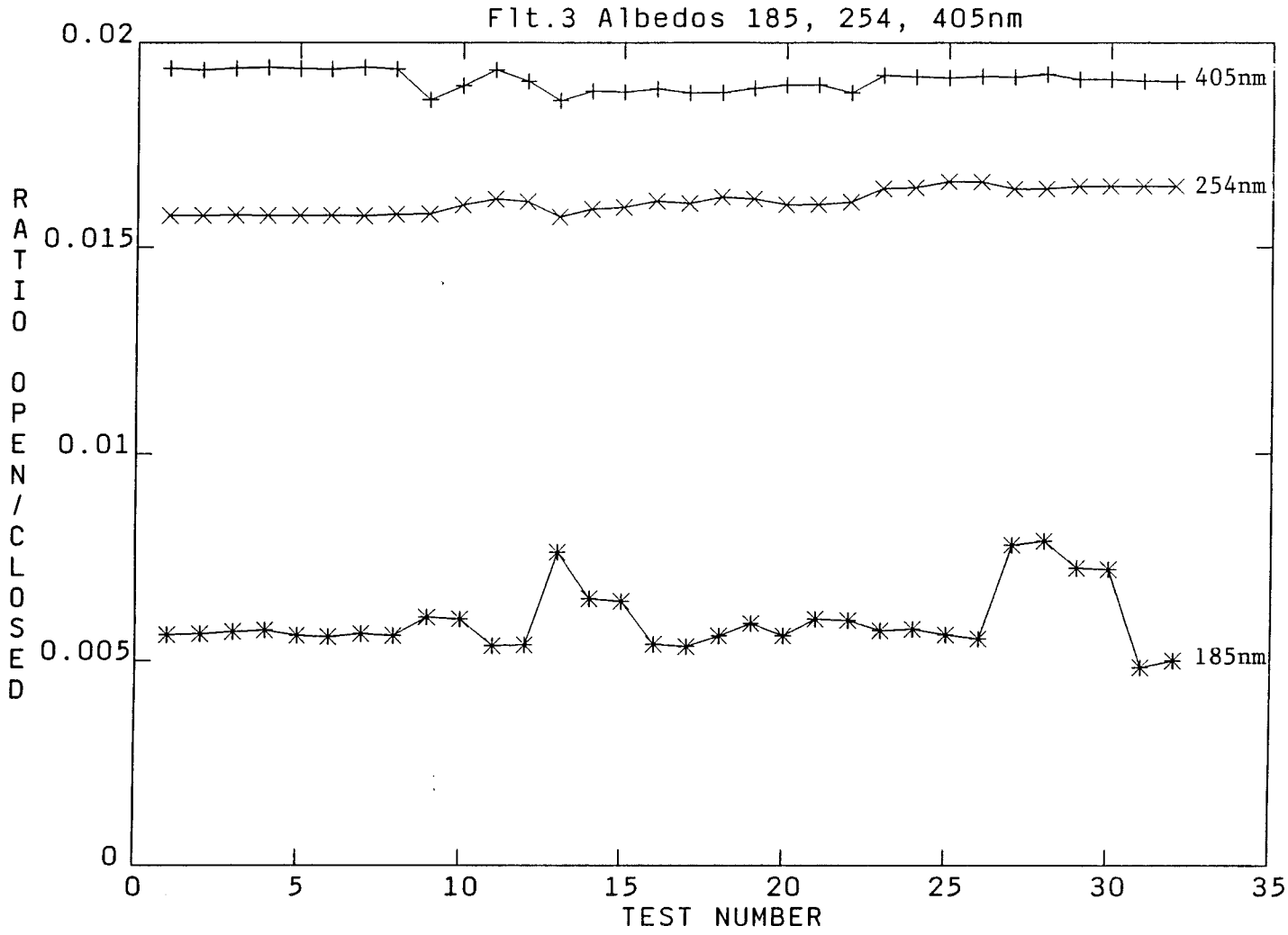


Figure 11-1

Flight 3 albedos 185, 254, 405nm

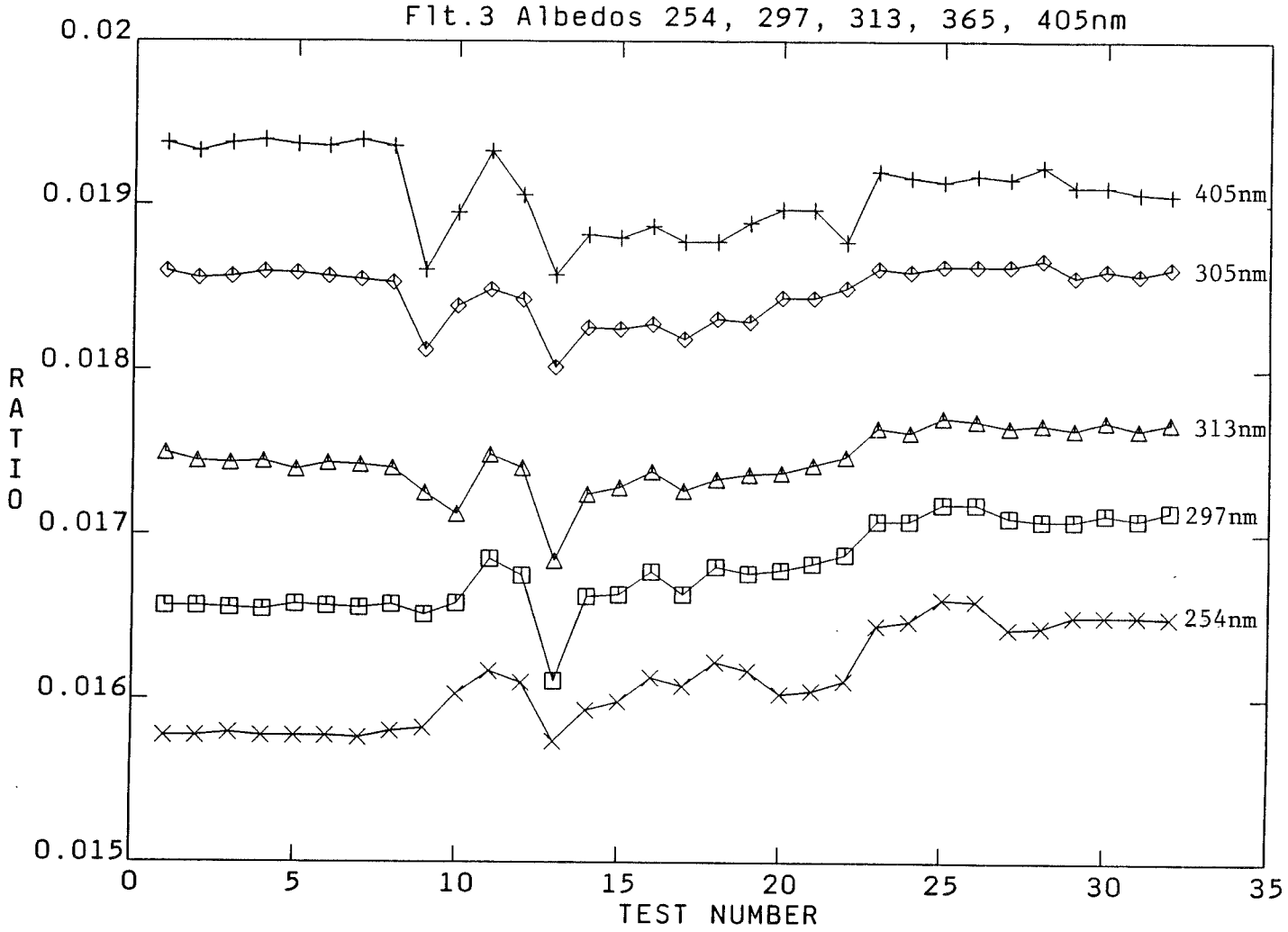


Figure 11-2

Flight 3 albedos 254, 297, 313, 365, 405nm

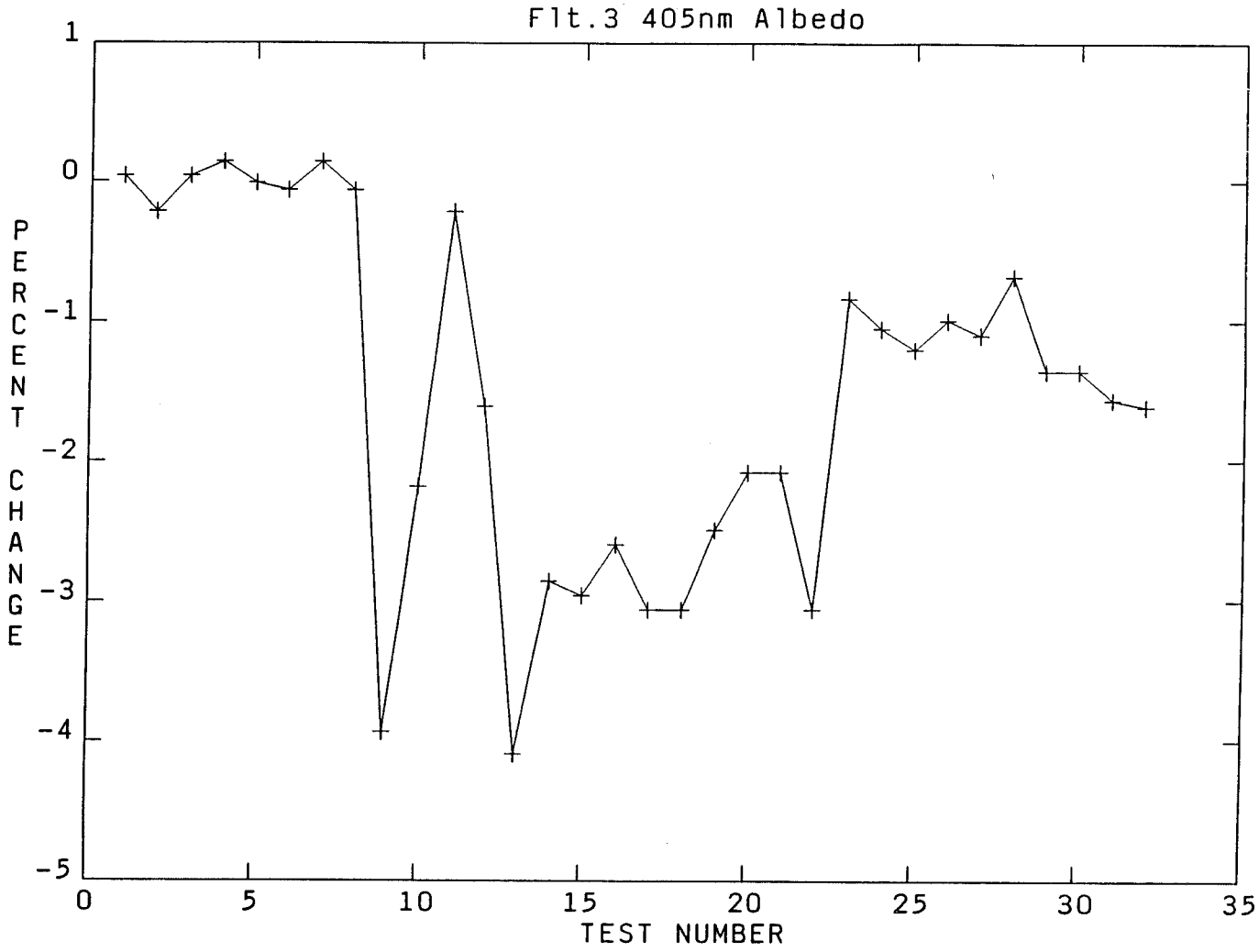


Figure 11-3

Flight 3 405nm albedo

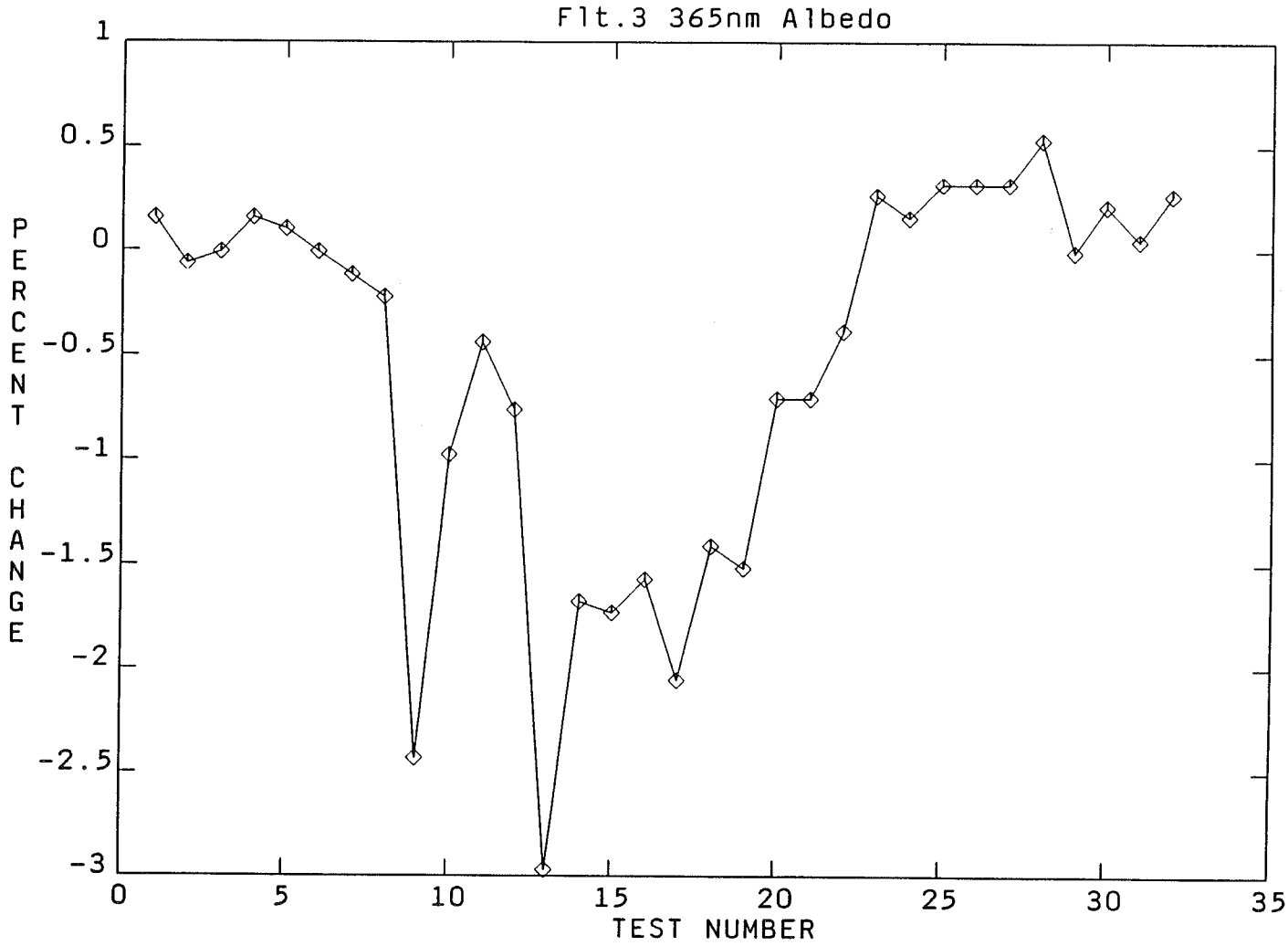


Figure 11-4

Flight 3 365nm albedo

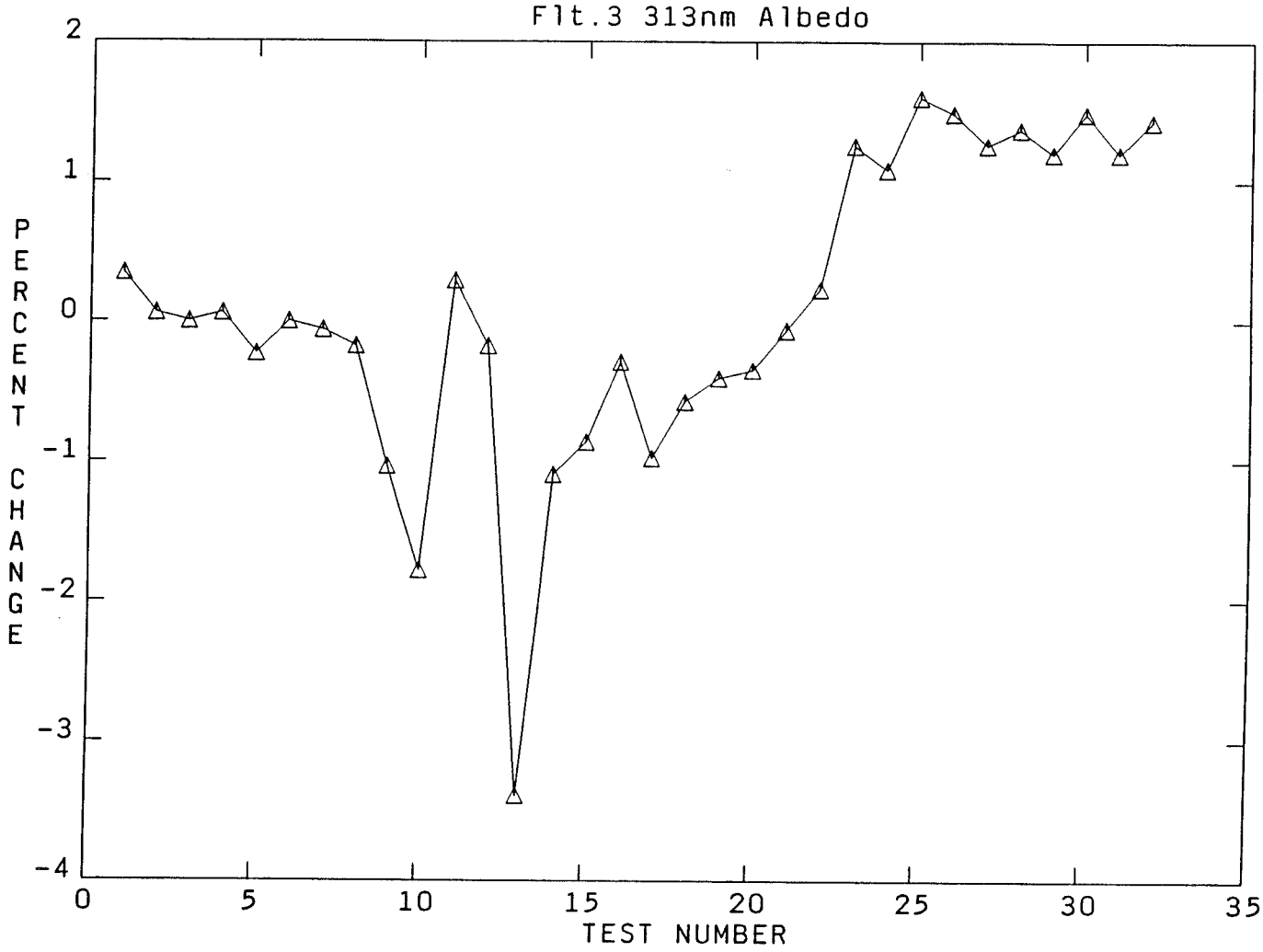


Figure 11-5

Flight 3 313nm albedo

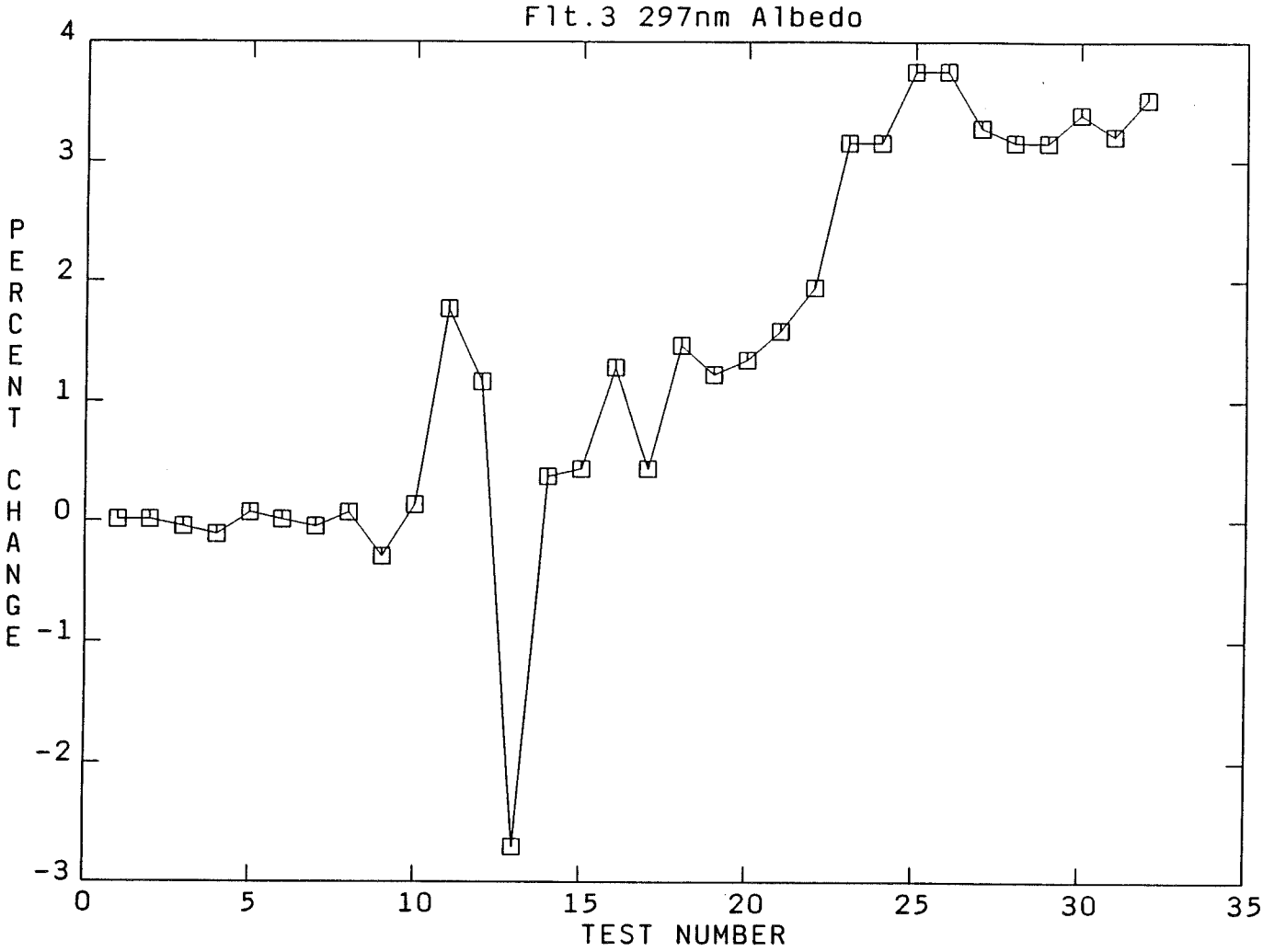


Figure 11-6

Flight 3 297nm albedo

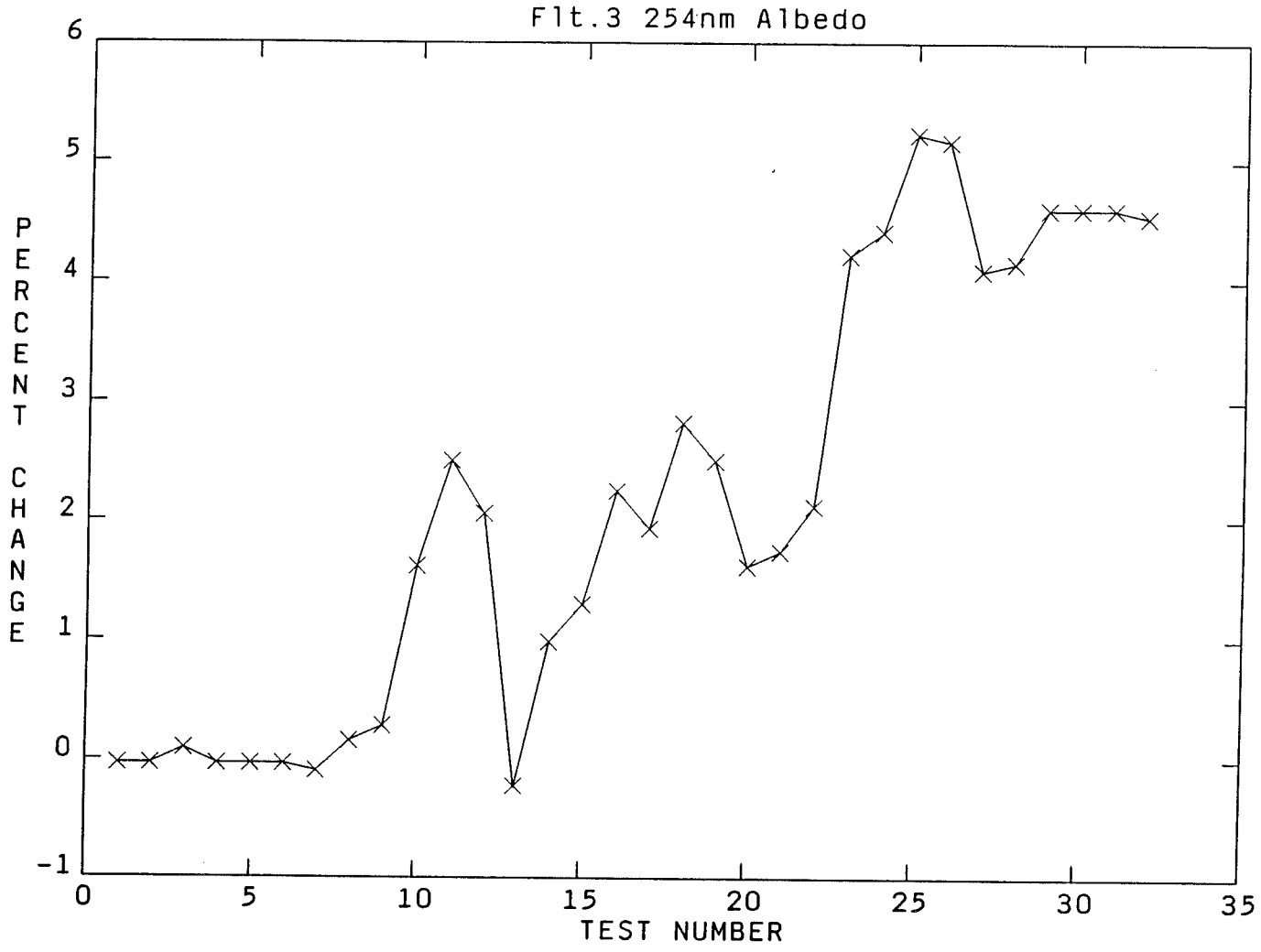


Figure 11-7

Flight 3 254nm albedo

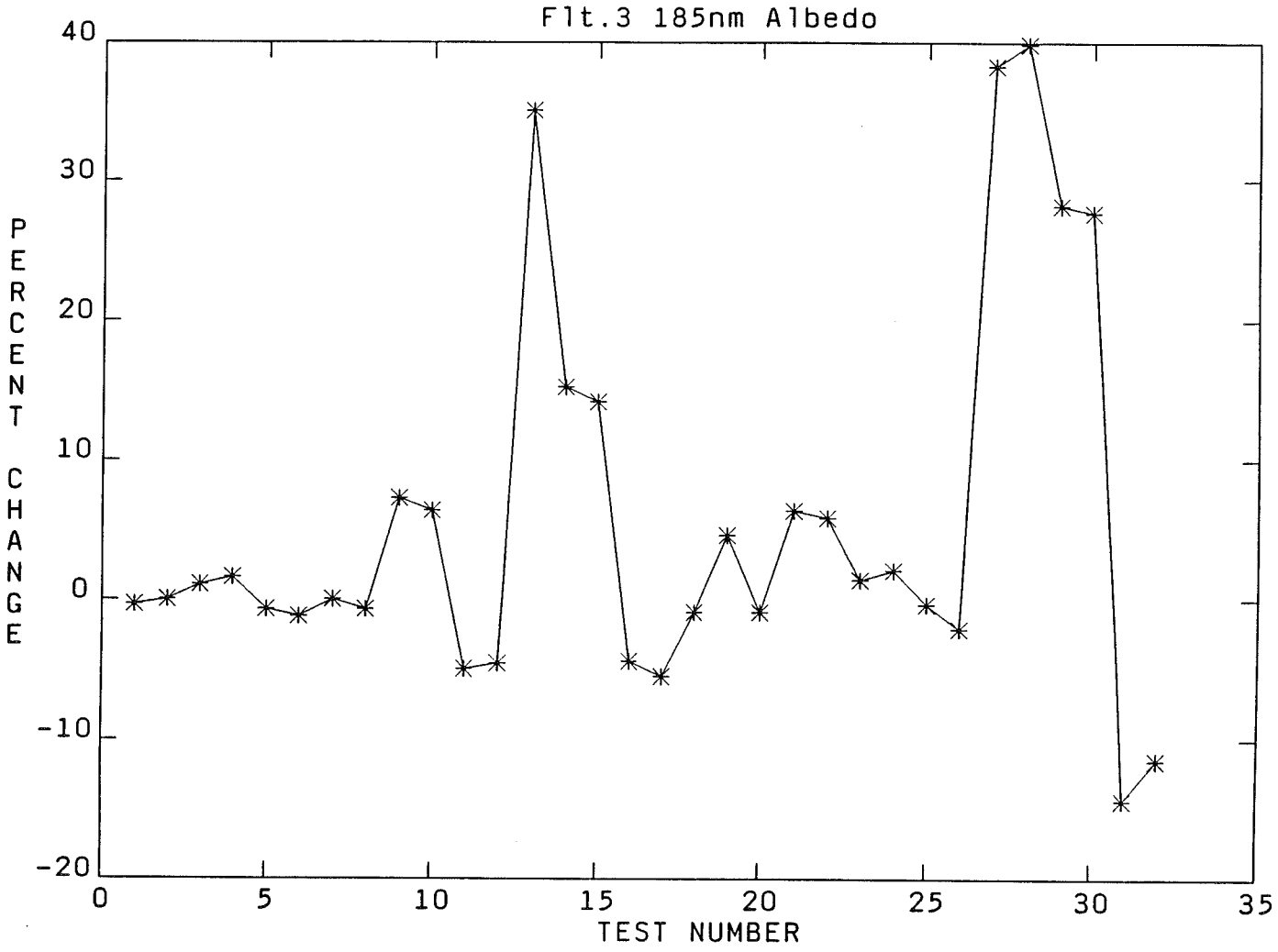


Figure 11-8

Flight 3 185nm albedo

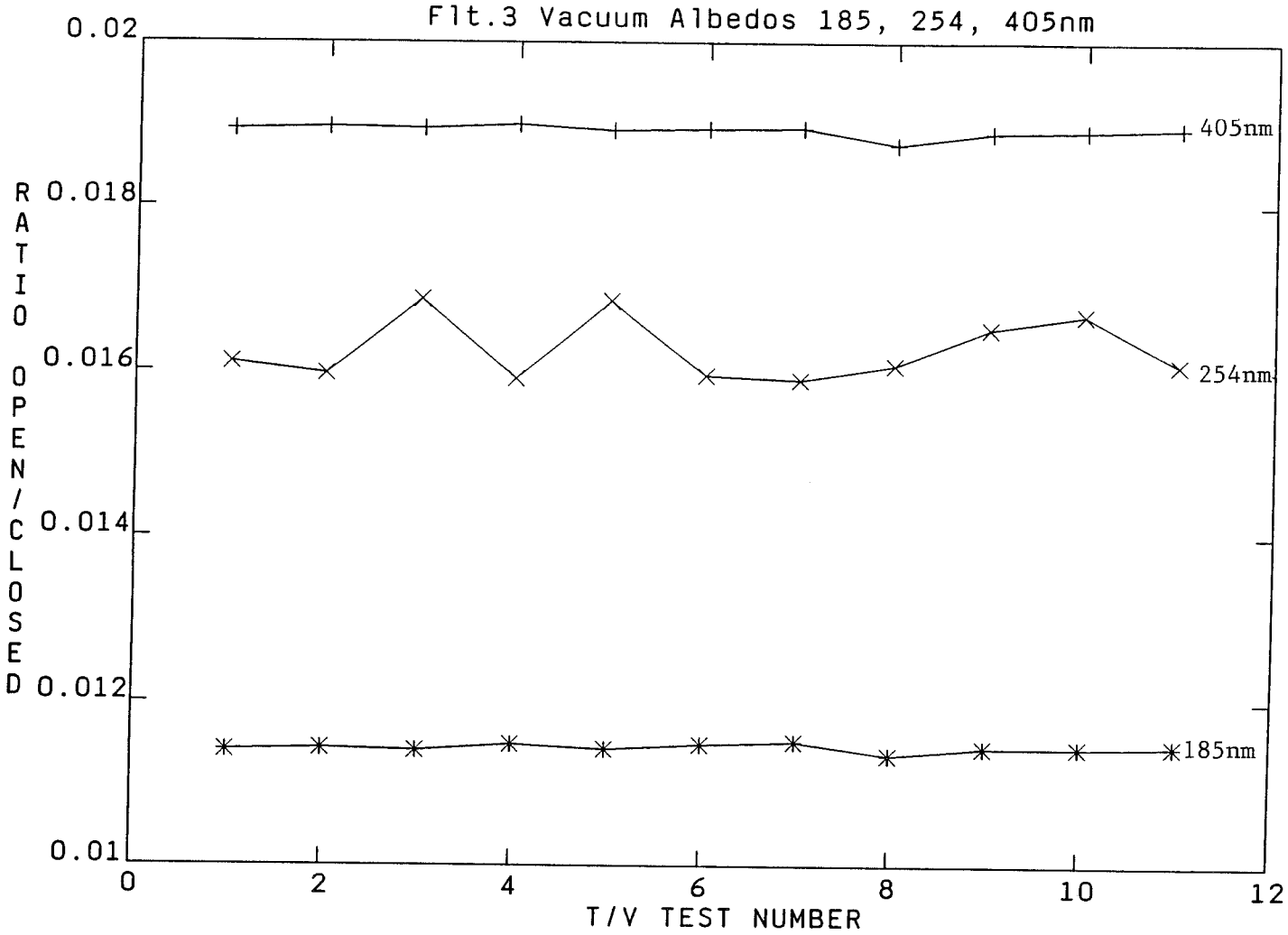


Figure 11-9

Flight 3 vacuum albedos 185, 254, 405nm

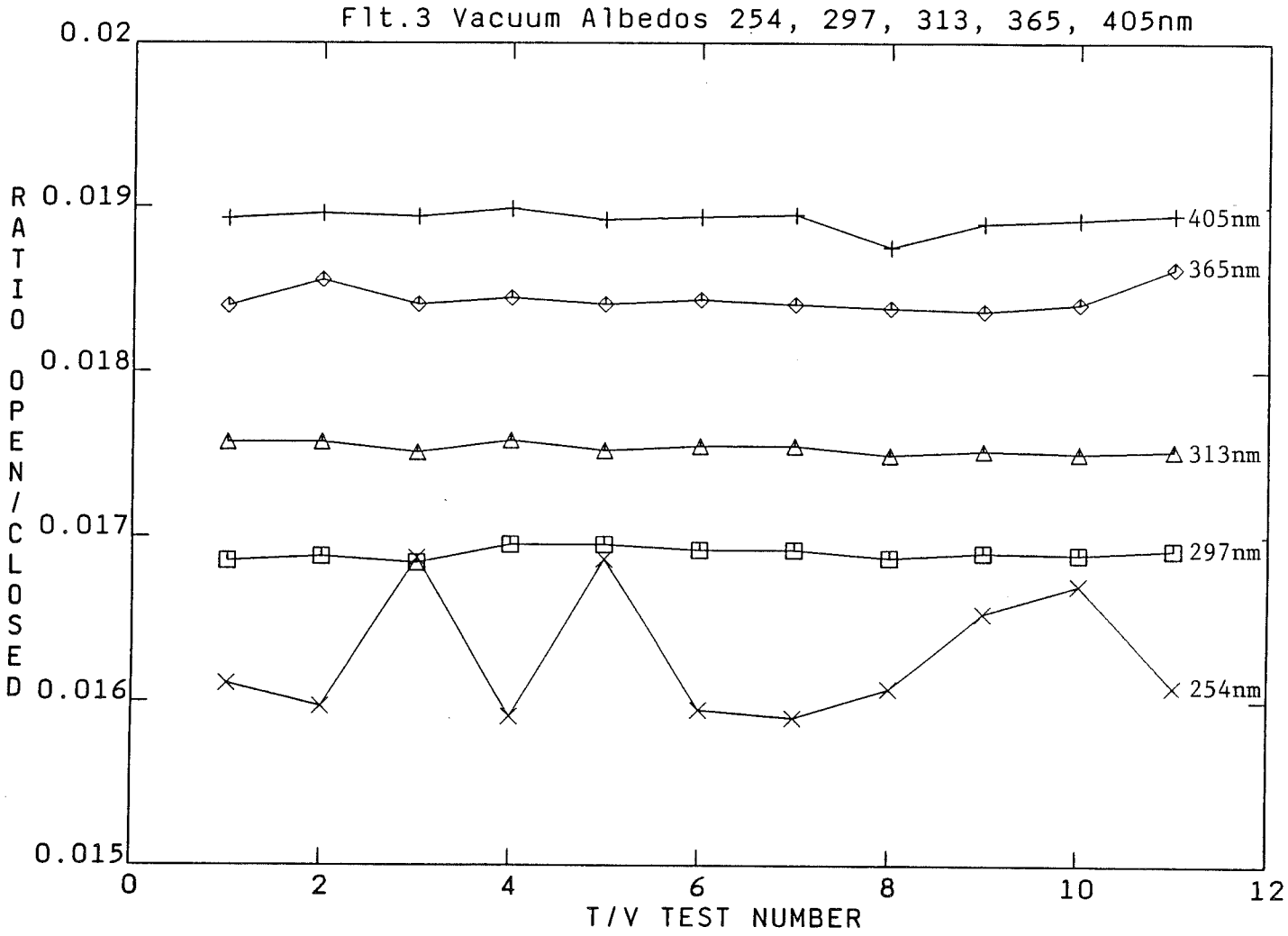


Figure 11-10

Flight 3 vacuum albedos 254, 297, 313, 365, 405nm

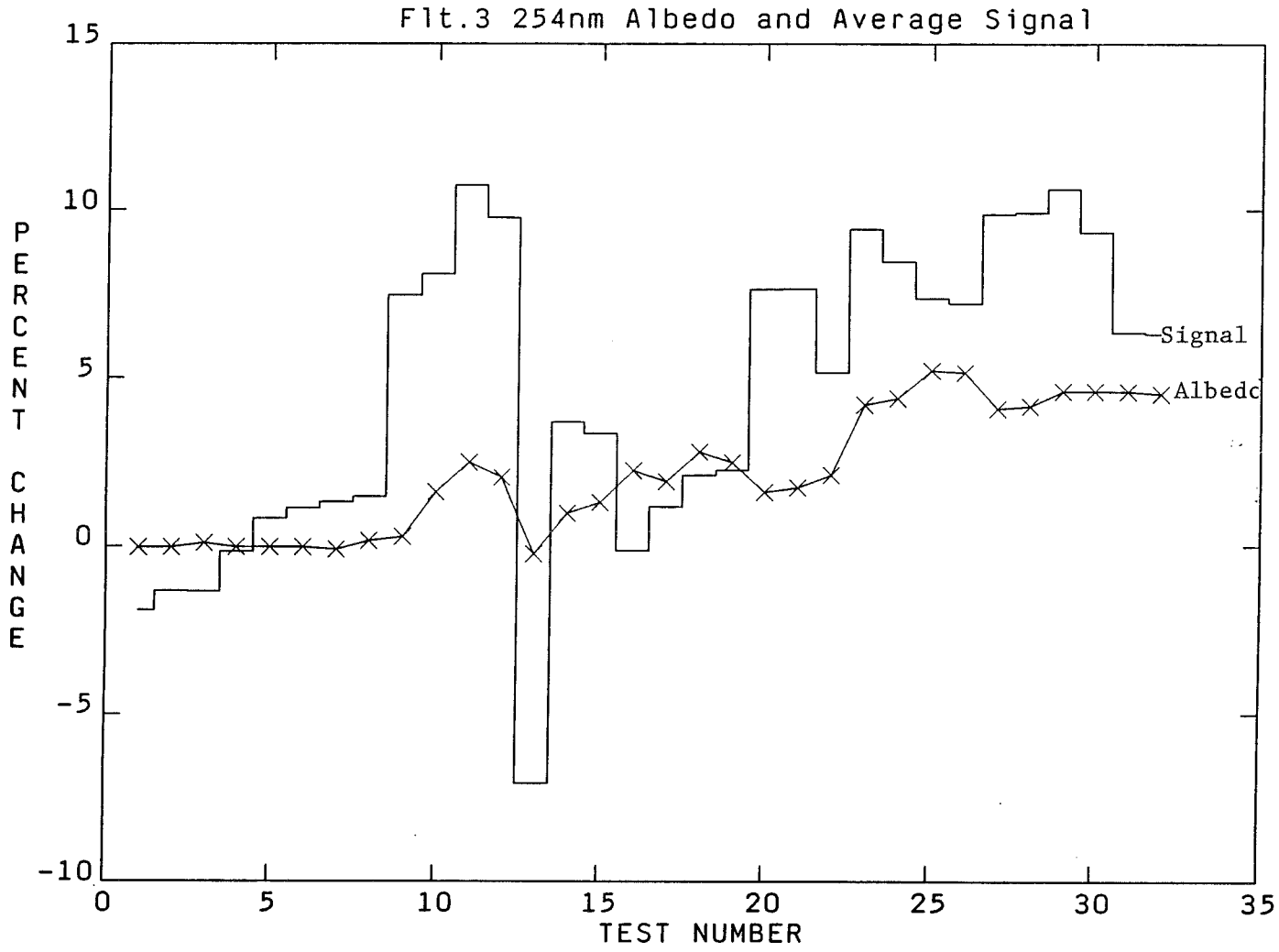


Figure 11-11

Flight 3 254nm albedo and average signal

Section 12

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 data 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 20-23 August 1986 using the Primary Test Fixture, Target Control Console, and an FEL 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 12-1** lists the raw data and the day to day differences in counts. **Table 12-2** lists the average counts of all data and the differences. The average short term instability was found to be 0.71 percent. No corrections to instrument data were required.

Table 12-1

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
252.0	4393	4459	-66	4376	-83	4419	43
273.6	16156	16381	-225	16118	-263	16257	139
283.1	25640	25980	-340	25589	-391	25801	212
287.7	31767	32220	-453	31712	-508	31962	250
292.3	39070	39623	-553	39002	-621	39330	328
297.6	49384	50082	-698	49273	-809	49690	417
301.9	59641	60470	-829	59484	-986	59982	498
305.9	756	766	-10	754	-12	760	6
312.6	952	963	-11	949	-14	956	7
317.6	1105	1119	-14	1102	-17	1110	8
331.3	1573	1593	-20	1567	-26	1579	12
339.9	1869	1892	-23	1861	-31	1875	14

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

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

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

Table 12-2

SHORT TERM STABILITY CALCULATIONS

NOMINAL WAVELENGTH	NOTE 1 $\frac{\Sigma \overline{C}}{4}$	NOTE 2 $\frac{\Sigma \overline{\Delta}}{3}$	NOTE 3 $\frac{\overline{\Delta}}{\overline{C}}$	REQUIREMENT
252.0	4412	-35.3	-7.86E-03	<0.01
273.6	16228	-116.3	-7.16E-03	<0.01
283.1	25752.5	-173	-6.72E-03	<0.01
287.7	31915.3	-237	-7.43E-03	<0.01
292.3	39256.3	-282	-7.18E-03	<0.01
297.6	49607.3	-363	-7.32E-03	<0.01
301.9	59894.3	-439	-7.33E-03	<0.01
305.9	759	-5.3	-6.98E-03	<0.01
312.6	955	-6	-6.28E-03	<0.01
317.6	1109	-7.7	-6.94E-03	<0.01
331.3	1578	-11.3	-7.16 E-03	<0.01
339.9	1874.3	-13.3	-7.10E-03	<0.01

Average -7.12E-03

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

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

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

Section 13

RESPONSE REPEATABILITY

Response repeatability earth (radiance) and sun (irradiance) data are taken from the Primary test fixture (PTF) in discrete mode. These data are all taken using the "flashlight" during the retrace portion of the discrete scan, in the same manner as the radiometric calibration data. **Table 13-1** lists the tests by date.

The main purpose for these tests is to determine if the instrument has suffered any degradation in response to a stable source during the time that environmental tests are being performed on the instrument. Pre and post-vibration, and post-vacuum tests are the most crucial. For this purpose, a change of ±1% is considered acceptable. The Flight 3 instrument shows an increase, rather than a decrease, in the response. These data are affected by changes in the lamp and test fixture, as well as instrument response. Since these responses are checked during the test program (and before the standards are recalibrated), no corrections are made to the data. Also, the calculation of percent difference in signal assume a nominal offset of 64 counts.

The Flight 3 instrument was extensively reworked in 1986 and 1987. New baselines were established afterward. The instrument test and calibration sequence was completed in March of 1988. These data are presented in **Tables 13-2** and **13-3**. **Figure 13-1** is a plot of these data.

Early in 1989 another modification (25V regulator) was added, and tests were done to demonstrate that there was no effect on response. A new basline was established, since the original standards and fixtures were not available at that time. The repeatability data for this rework are found in **Tables 13-4** and **13-5**, and are plotted in **Figure 13-2**.

Table 13-1

TESTS CONTAINING RESPONSE REPEATABILITY DATA

DATE	PROCEDURE	TEST DESCRIPTION
12-FEB-88	68042	Pre-vibration functional
17-FEB-88	68042	Post-vibration functional
10-MAR-88	68042	Post-vacuum functional with foil EMI shield on sensor module
11-MAR-88	68042	Post-vacuum data without foil shield
14-MAR-88	68028	Radiometric calibration
21-DEC-88	68042	Baseline for rework
22-DEC-88	68042	Repeat of above data
22-FEB-89	68042	Functional test with regulator

Table 13-2

RESPONSE REPEATABILITY DATA FOR FEL #191

	EARTH			SUN		
DATE	252nm CH. 1 RANGE 1	298nm CH. 6 RANGE 1	340nm CH.12 RANGE 2	252nm CH.1 RANGE 1	298nm CH.6 RANGE 1	340nm CH.12 RANGE 3
12-FEB-88	5141	58016	2066	4806	55252	1977
17-FEB-88	5127	57988	2067	4826	55621	1992
10-MAR-88	5178	58589	2088	4843	55921	2004
11-MAR-88	5208	58908	2098	4860	56131	2011
14-MAR-88	5212	58911	2097	4866	56137	2011
Mean	5173.2	58482.4	2083.2	4840.2	55812.4	1999
Sample STD DEV	38.44	457.75	15.74	24.68	377.28	14.54
STD ERR / Mean	0.33%	0.35%	0.34%	0.23%	0.30%	0.33%

Table 13-3

PERCENT DIFFERENCE FROM AVERAGE RESPONSE FOR FEL #191

	EARTH			SUN		
DATE	252nm CH. 1 RANGE 1	298nm CH. 6 RANGE 1	340nm CH.12 RANGE 2	252nm CH.1 RANGE 1	298nm CH.6 RANGE 1	340nm CH.12 RANGE 3
12-FEB-88	-0.63%	-0.80%	-0.85%	-0.72%	-1.01%	-1.14%
17-FEB-88	-0.90%	-0.85%	-0.80%	-0.30%	-0.34%	-0.36%
10-MAR-88	0.09%	0.18%	0.24%	0.06%	0.19%	0.26%
11-MAR-88	0.68%	0.73%	0.73%	0.41%	0.57%	0.62%
14-MAR-88	0.76%	0.73%	0.68%	0.54%	0.58%	0.62%

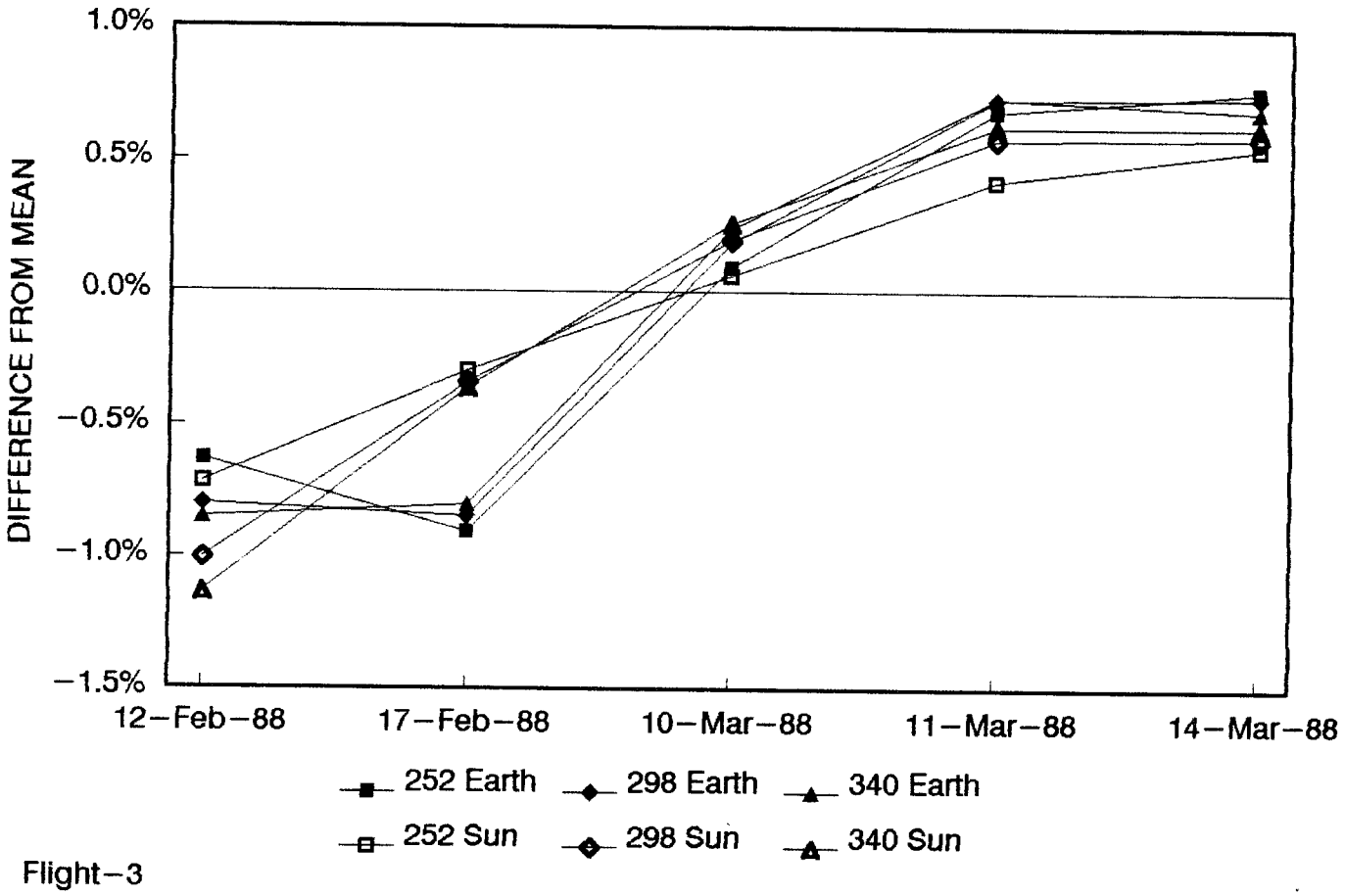


Figure 13-1 Response repeatability - FEL #191

Table 13-4

RESPONSE REPEATABILITY DATA FOR FEL #190

DATE	EARTH			SUN		
	252nm CH. 1 RANGE 1	298nm CH. 6 RANGE 1	340nm CH.12 RANGE 2	252nm CH.1 RANGE 1	298nm CH.6 RANGE 1	340nm CH.12 RANGE 3
21-DEC-88	4149	48303	1906	4436	53045	1934
22-DEC-88	4149	48372	1905	4468	53352	1942
22-FEB-88	4165	48569	1917	4473	53570	1948
Mean	4154.3	48414.7	1909.3	4459.0	53322.3	1941.3
Sample STD DEV	9.24	138.04	6.66	20.07	263.75	7.02
$\frac{\text{STD ERR}}{\text{Mean}}$	0.13%	0.16%	0.20%	0.26%	0.29%	0.21%

Table 13-5

PERCENT DIFFERENCE FROM AVERAGE RESPONSE FOR FEL #190

DATE	EARTH			SUN		
	252nm CH. 1 RANGE 1	298nm CH. 6 RANGE 1	340nm CH.12 RANGE 2	252nm CH.1 RANGE 1	298nm CH.6 RANGE 1	340nm CH.12 RANGE 3
21-DEC-88	-0.13%	-0.23%	-0.18%	-0.52%	-0.52%	-0.39%
22-DEC-88	-0.13%	-0.09%	-0.23%	0.20%	0.06%	0.04%
22-FEB-89	0.26%	0.32%	0.42%	0.32%	0.47%	0.36%

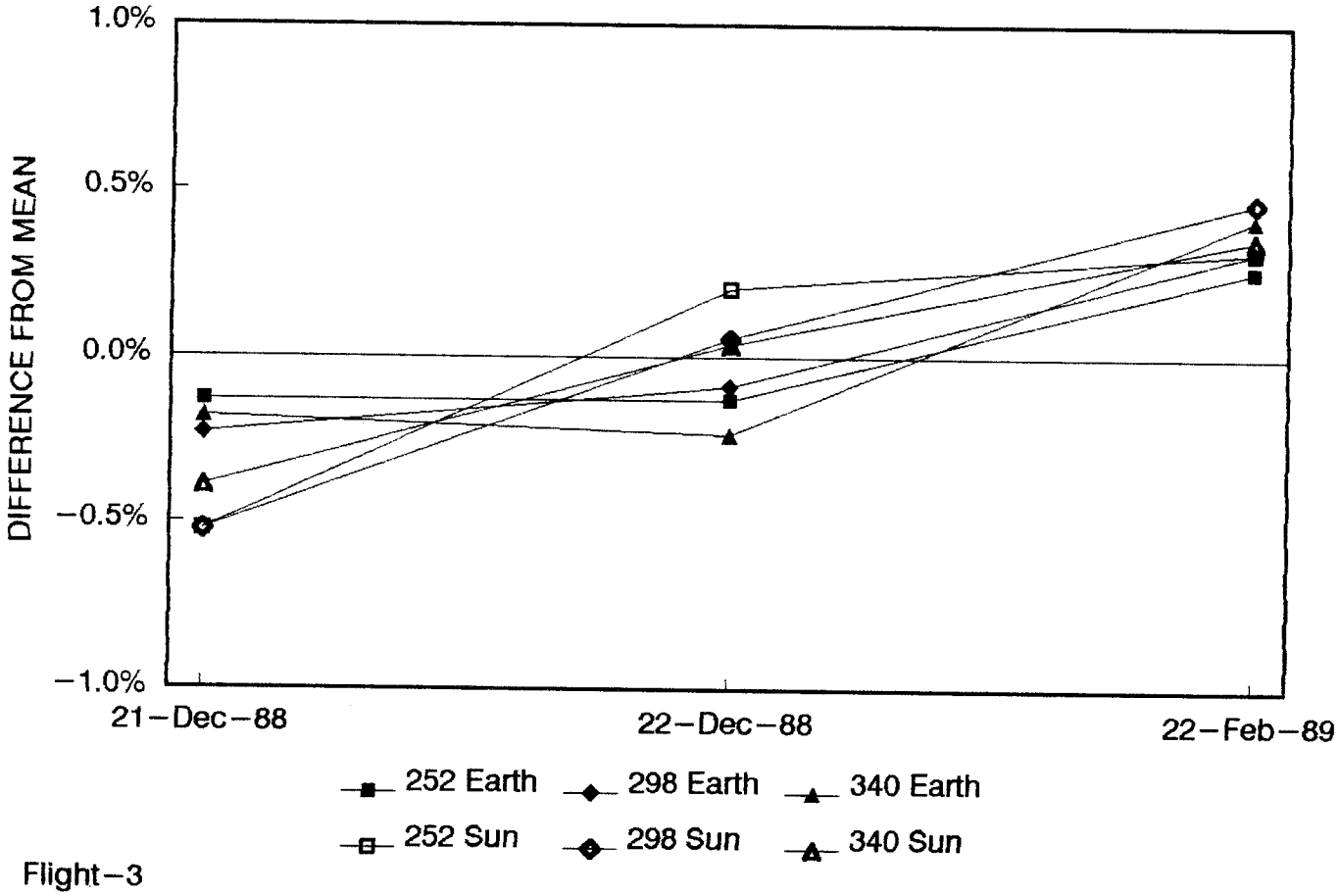


Figure 13-2 Response repeatability - FEL #190

Section 14

TIME RESPONSE

(Reference Test Procedure 68031)

The response time test measures the instrument's response to a changing light level, the same levels it will encounter in flight. During an orbit, the maximum light level input from the daylight portion of the test varies from approximately 1,000 to 16,000 counts on Range 3 at 340nm. For this 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 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, thereby giving the described counts.

The instrument is operated in discrete mode. It views a large diffuser plate illuminated by an FEL-type lamp. Each of the 12 discrete wavelength positions is set at a pre-selected wavelength which will give count levels covering Ranges 1, 2, and 3 as follows:

Channel	Counts	Range
1	900	1
2	5,000	1
3	7,500	1

Channel	Counts	Range
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 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 during the dark portion of the orbit (also 56 minutes). All 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 3 instrument response is +0.13% to -0.34% maximum for all eight orbits (see **Figure 14-5**). The CCR data shows a change of 0.39% during this test. The CCR is used to measure lamp drift. PMT response is corrected by this CCR data. (See **Figures 14-1** through **14-5**.) It can be seen from this data that the Flight 3 instrument shows almost no measurable time response effects. This significant improvement over the previous instrument with the ITT PMT is due to the Hamamatsu Photomultiplier 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 for orbit 1, zone 1

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

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

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

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

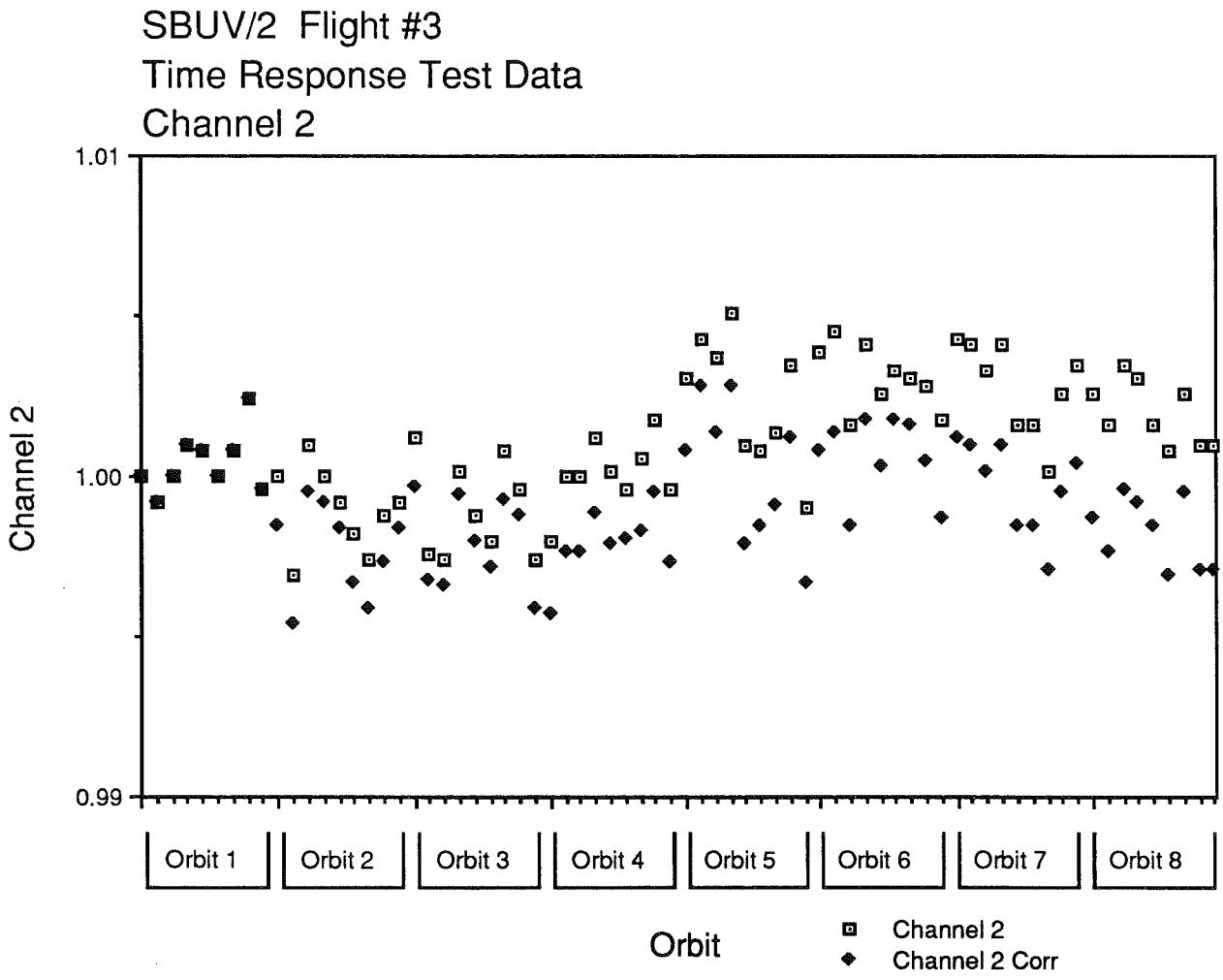


Figure 14-1 Channel 2 corrected and uncorrected response

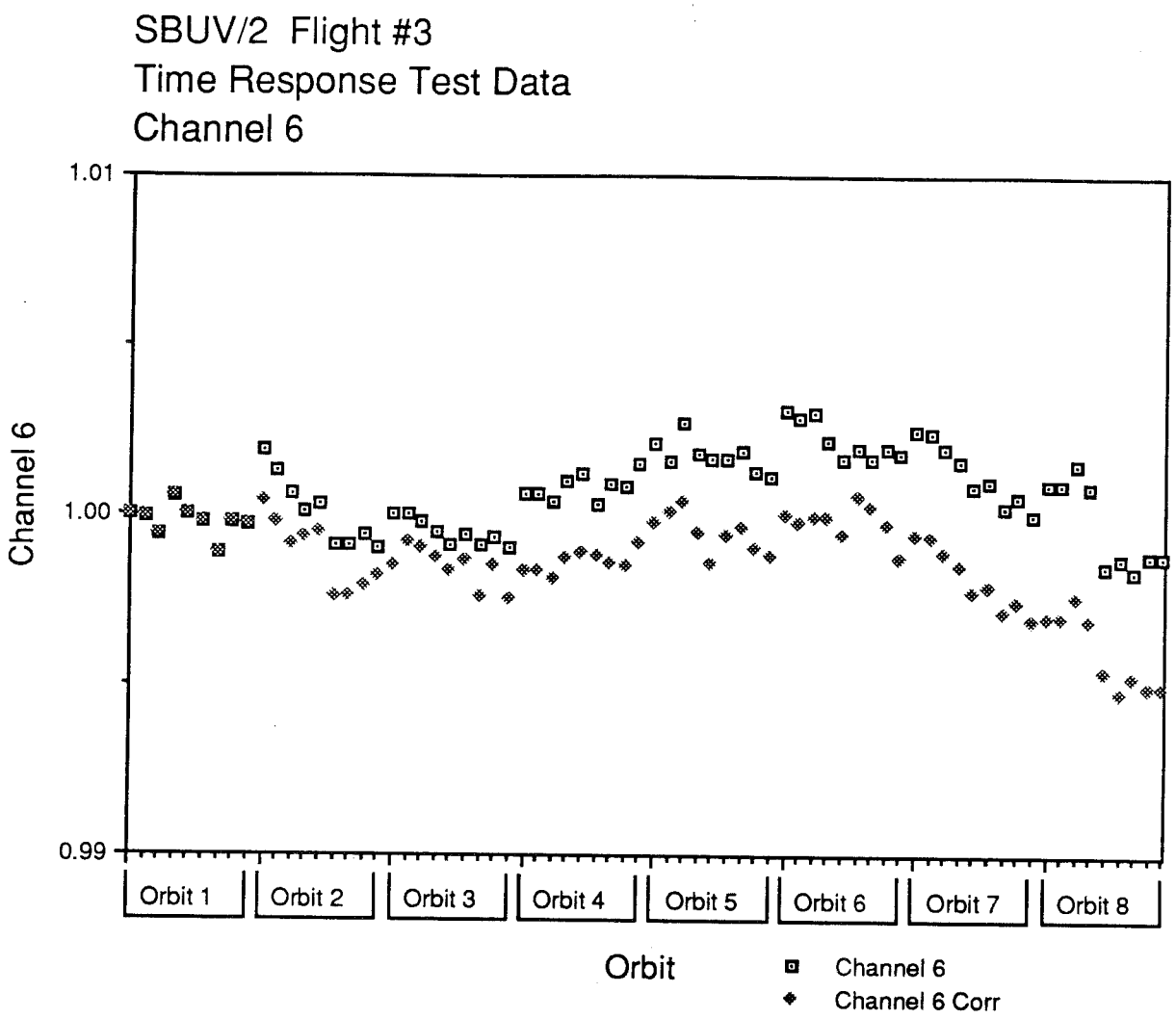


Figure 14-2 Channel 6 corrected and uncorrected response

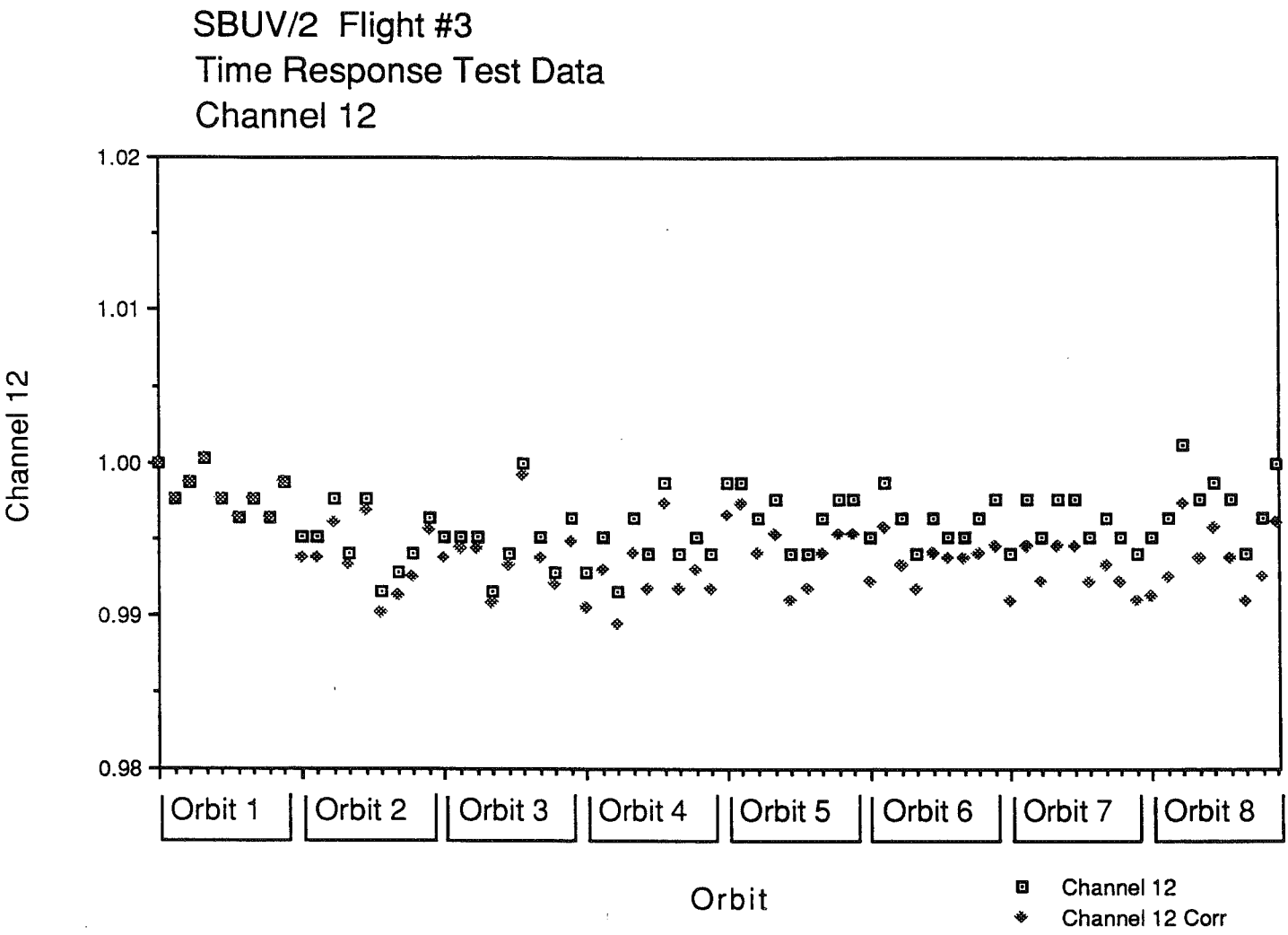


Figure 14-3 Channel 12 corrected and uncorrected response

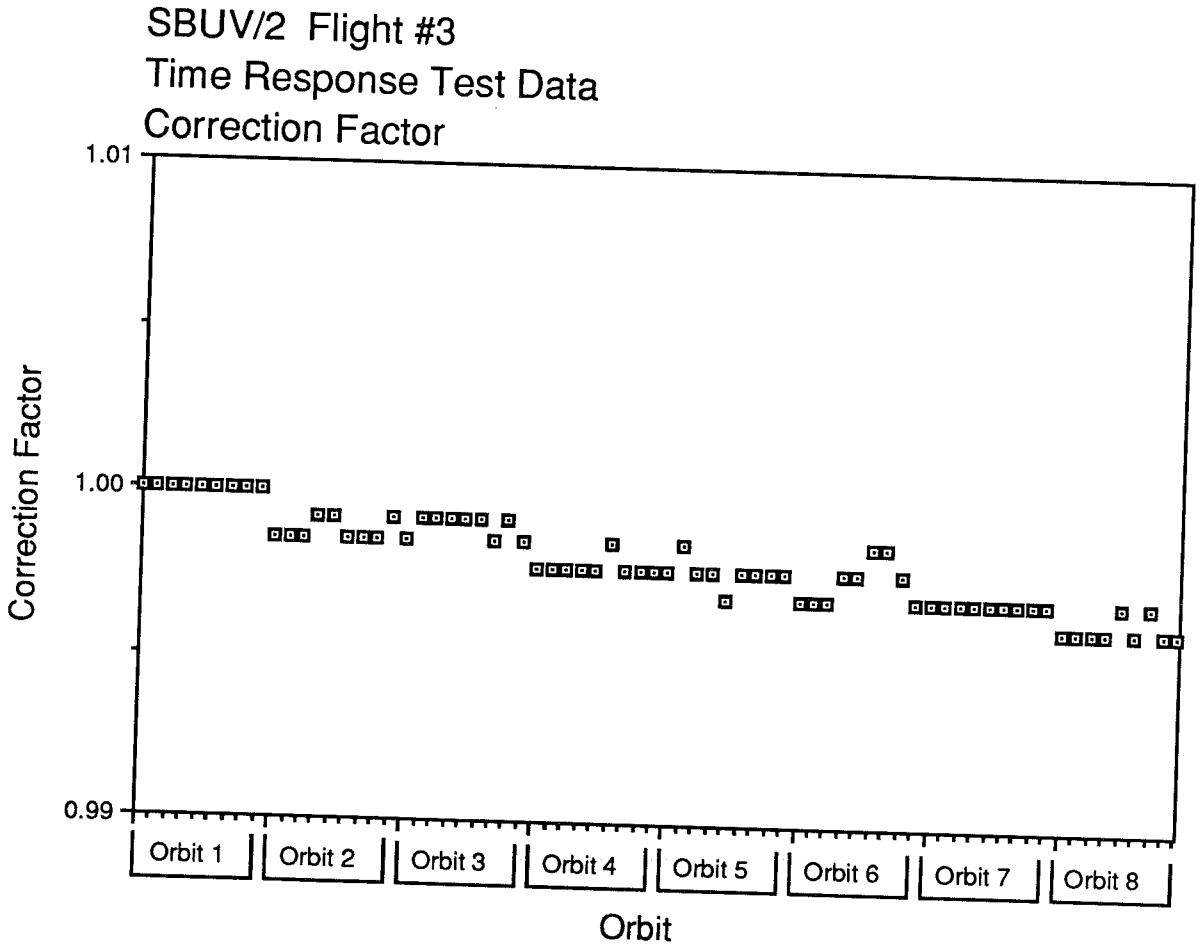


Figure 14-4 CCR correction factor

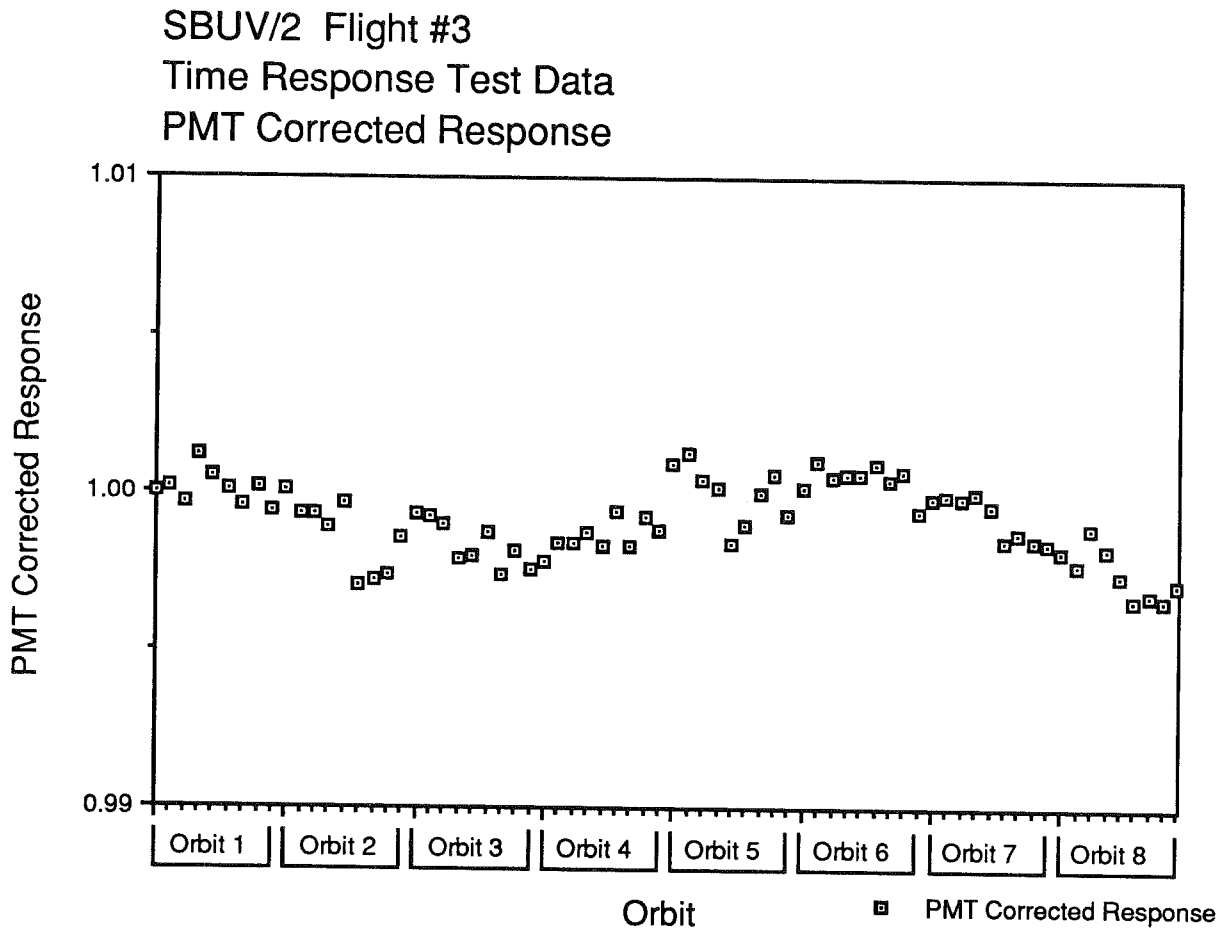


Figure 14-5 PMT corrected mean response

Section 15

CONTAMINATION MIRRORS

The four Flight 3 contamination mirrors were measured eleven times over the testing period. **Table 15-1** shows the reflectance over this period. **Figure 15-1** is a plot of the data.

Table 15-1

SBUV/2 FLIGHT 3

CONTAMINATION MIRRORS SUMMARY

	REFLECTANCE AT 254 NM			
Measurement Date	Mirror #16 D	Mirror #20 C	Mirror #25 B	Mirror #27 A
January 05, 1984	0.859	0.859	0.865	0.817
August 16, 1985	0.855	0.854	0.859	0.816
October 15, 1986	0.862	0.857	0.863	0.823
December 15, 1986	0.861	0.861	0.864	0.816
April 15, 1987	0.862	0.861	0.864	0.820
May 11, 1987	0.858	0.857	0.860	0.818
September 08, 1987	0.860	0.858	0.862	0.820
December 07, 1987	0.861	0.855	0.862	0.821
February 16, 1988	0.859	0.859	0.864	0.821
March 23, 1988	0.860	0.856	0.863	0.818
June 10, 1988	0.859	0.858	0.862	0.819
September 08, 1988	0.859	0.856	0.861	0.819
May 25, 1989	0.858	0.859	0.858	0.815

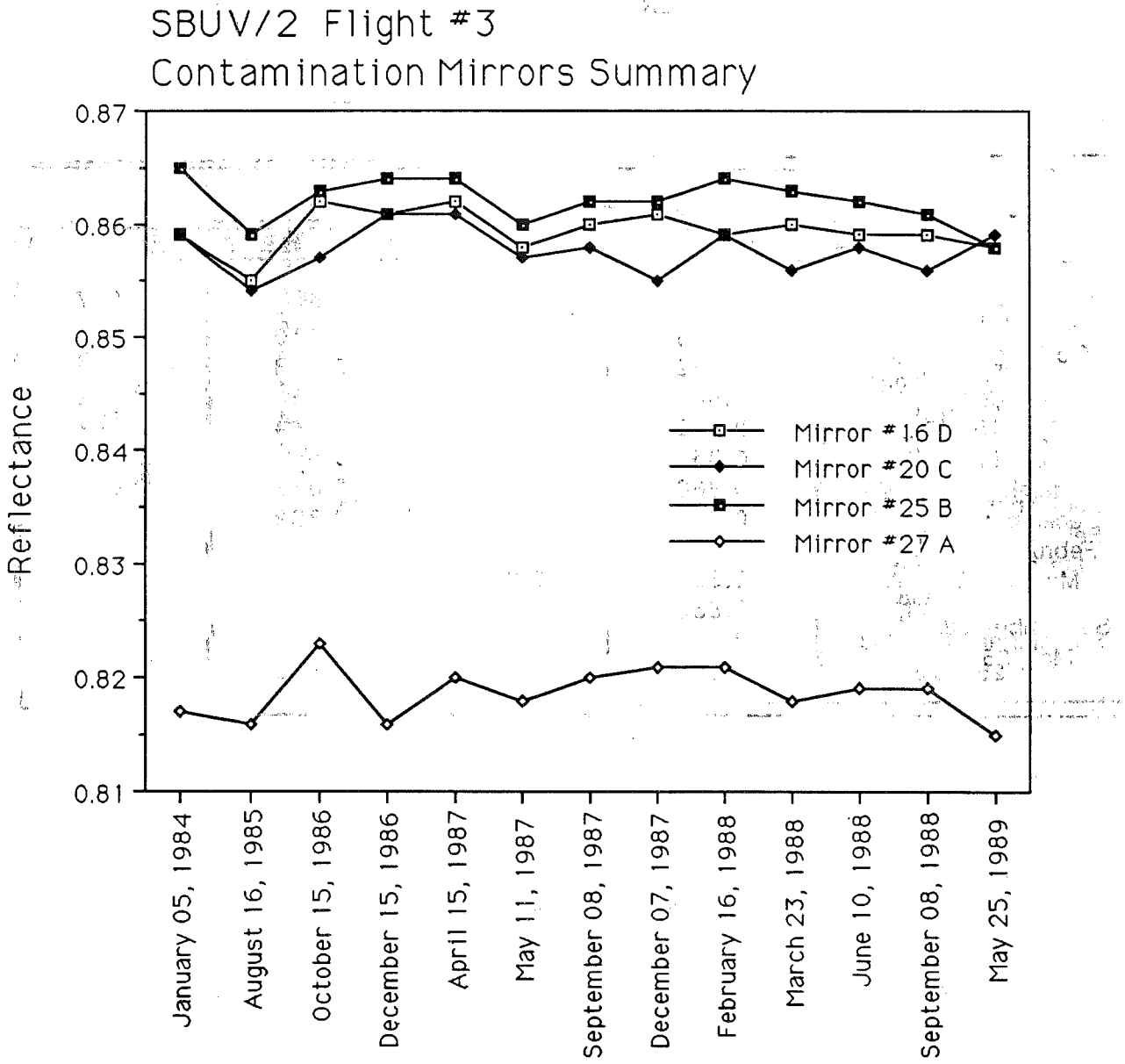


Figure 15-1 SBUV/2 Flight 3 contamination mirrors summary