~~TOP SECRET~~ [redacted]

CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1023-1 and 1023-2

FTV 1618; J-23

22 December 1965

Approved: [redacted] Mgr.

Approved: [redacted] Mgr.

~~TOP SECRET~~ [redacted]

[redacted]

FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1618.

Lockheed Missiles and Space Company has the responsibility for evaluating payload performance under the Systems Integration and "J" System contracts.

This document is the final payload test and performance evaluation report for Missions 1023-1 and 1023-2 which was launched on 17 August 1965.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

INTRODUCTION

This report presents the final performance evaluation of Missions 1023-1 and 1023-2 of the Corona Program. The purpose of this report is to define the performance characteristics of the J-23 payload system, to identify the source of in-flight anomalies and recommend the appropriate corrective action.

The performance evaluation was jointly conducted by representatives of Lockheed Missiles and Space Company (LMSC) and ITEK at the facilities of NPIC and AFSPPL. The off-line evaluation using Corona engineering photography acquired over the United States was performed at the individual contractors plants.

The quantitative data used for this report is obtained from government organizations. The diffuse density data, visual RES values and MTF/AIM resolution are produced by AFSPPL. The vehicle attitude error values, frame correlation times are made at NPIC who also supply the Processing Summary and MTF/AIM resolution reports published by [redacted]

Computer programs developed by A/P are utilized to calculate and plot the frequency distribution of the various contributors to image smear to permit analysis and correlation of the conditions of photography to the information content and quality of the acquired pictures. Computer analysis of the exposure, processing and illumination data provides the necessary data to analyze the exposure criteria selected for the mission.

SECTION 1

SYSTEM PERFORMANCE

A. MISSION OBJECTIVES

The payload section of Mission 1023, placed into orbit by Flight Test Vehicle # 1618 and SLV-2A booster #449, consisted of two panoramic cameras, two Stellar-Index cameras, two Mark 5A recovery capsules and a space structure to enclose the cameras and provide mounting surfaces for all equipments. Figure 1-1 presents an inboard profile of the J-23 payload system. This Corona "J" system is designed to acquire search and reconnaissance photography of selected areas of the earth from orbital altitudes. The planned mission was a nine day photographic period with no inactive period.

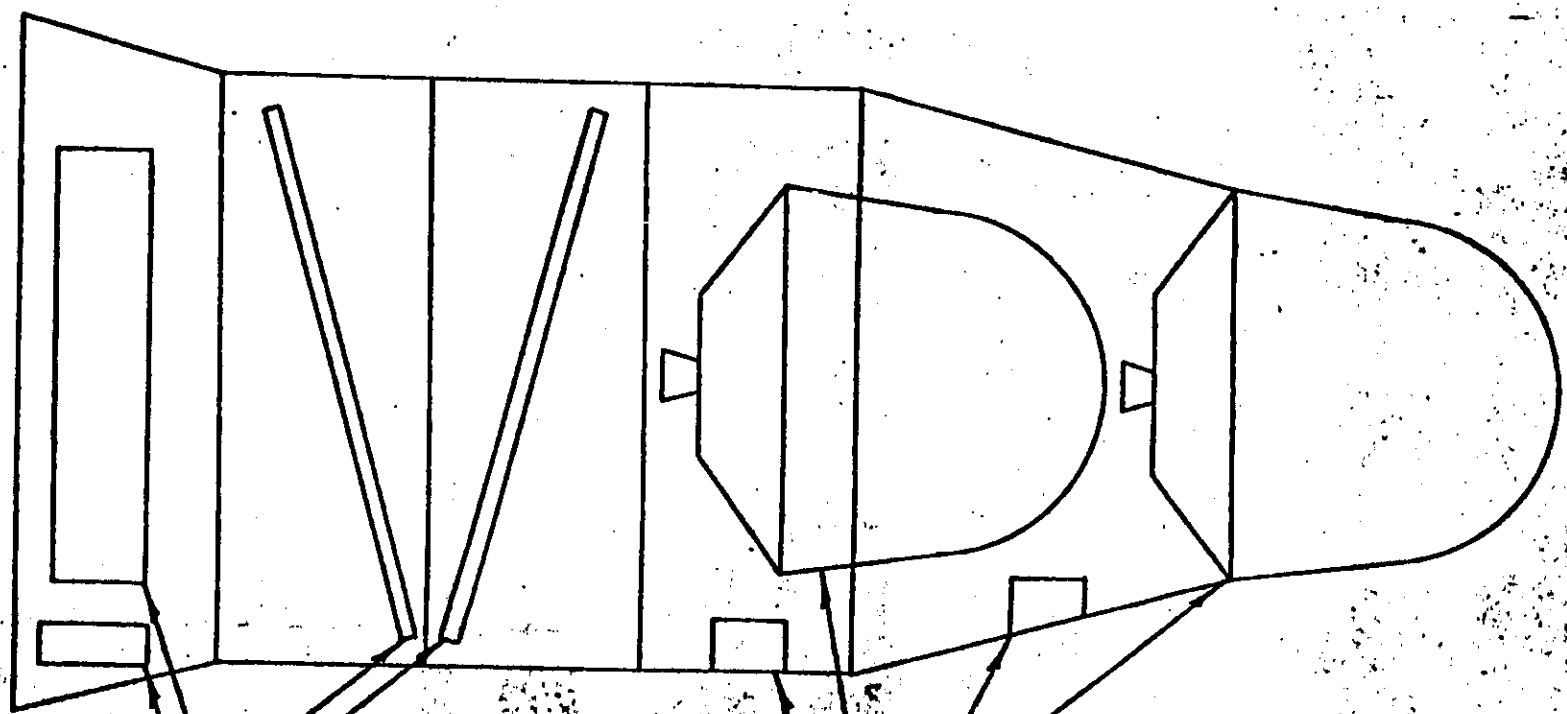
B. MISSION DESCRIPTION

The payload was launched from Vandenberg Air Force Base (VAFB) at 2059:57 Z (1:59:57 PDT) on 17 August 1965. Ascent and injection were normal and the achieved orbit was within nominal tolerances. Tracking and command support was effected by the Air Force Satellite Control Facility consisting of tracking and command stations at [redacted] under central control of the Satellite Test Center at Sunnyvale, California. Mission 1023-1 consisted of five days operation and was completed by air recovery on 22 August 1965. Mission 1023-2 was completed with an air recovery on 26 August 1965 following four days of photographic operations.

The comparison of the planned and actual orbit parameters is tabulated as follows:

SCHEMATIC INBOARD PROFILE - CORONA J SYSTEM

MISSION 1023



Master Camera No: 170

Slave Camera No: 171

Supply Cassette No: SC-31

Clock No: 522

Yaw Programmer No: N/A

"A" Recovery Subsystem No: 621

"A" Stellar-Index Camera No: D17/19/82

"B" Recovery Subsystem No: 649

"B" Stellar-Index Camera No: D66/75/72

Pressure Make-up Unit No: 1006

FIGURE 1.1

ORBITAL PARAMETERS

Parameter	Predicted	Orbit 1 Actuals
Period (Min.)	90.50	90.47
Perigee (N.M.)	100.00	97.98
Apogee (N.M.)	226.66	226.45
Inclination (Deg.)	70.00	70.04
Perigee Latitude (Deg. N.)	22.39	24.09
Eccentricity	0.01759	0.01782

Orbit Adjust System experiments were conducted after the second recovery and were apparently successful.

C. PANORAMIC CAMERAS

The Master panoramic camera operated satisfactorily until pass 102. Failure occurred on pass 102 during a programmed 147 cycle operation. Intermittent operations on passes 133, 134, and 135 occurred after the initial failure.

The Slave panoramic camera operated normally throughout the flight.

D. STELLAR-INDEX CAMERAS

The Mission 1023-1 Stellar/Index camera operated normally throughout the mission. The Mission 1023-2 Stellar/Index camera operated normally until rev 102. Further operation was precluded by the Master Camera failure.

E. OTHER SUB-SYSTEMS

The clock, instrumentation, command and thermal control sub-systems performed satisfactorily through both missions.

F. CONCLUSIONS

Mission 1023-1 and 1023-2 achieved the objective of acquiring high quality search and reconnaissance photography from orbital altitudes.

SECTION 2

PRE-FLIGHT SYSTEMS TESTS

A. ENVIRONMENTAL TESTING

1. Test Objective

As a standard procedure, the J payload systems are subjected to thermal/altitude environmental testing which simulates orbital environment. One of the purposes of this test is to demonstrate the system susceptability to corona discharge. Such discharge fogs the film thus degrading the operational photography.

2. Test Summary

The J-23 payload system was subjected to an environmental test in TASC chamber at Sunnyvale from 1 April 1965 to 4 April 1965. The test consisted of 3 days of operation in each of the "A" and "B" modes. The payload system was only operated during the daytime.

Both panoramic cameras operated satisfactorily throughout the test with the exception of film movement on the Master camera. This movement was observed when the seven second relays dropped out. This condition was present several times only in the "B" mode.

Both the "A" and "B" recovery sequences were satisfactory with proper transfer to the "B" phase during the cut and wrap operation. A deactivate sequence was conducted between the "A" and "B" phase with all functions operating satisfactorily.

Both the "A" and "B" phase Stellar/Index cameras operated satisfactorily. The clock and pressure make-up unit operation appeared normal throughout the test.

3. Panoramic Camera Performance

Both panoramic cameras operated satisfactorily throughout the test. The only dynamic camera anomoly occurred at camera shut-down.

When the seven second relay dropped out after the camera off command, the horizon idler on the master unit indicated payload movement. This condition was present on several occasions during the "B" phase only.

For both instruments the cycle periods were approximately 0.5 to 1.5% slower than predicted during the "A" phase and 0.5 to 2.0% faster than the predicted during the "B" phase. All cycle periods in both the "A" phase and "B" phase were less than 3% from the predicted for both instruments as shown in Table 2-1.

The cut and wrap operation was normal, with both instruments operating 4 cycles and both lens stopped in the stowed position. A deactivate command was given between the "A" and "B" phase with both instruments operating 6 cycles and the lens stopping in the stowed position.

Minor start-up corona marking was produced by both panoramic cameras. The frequency and intensity of this marking was within the acceptable level hence the cameras were recommended for flight.

4. Stellar-Index Camera Performance

The Stellar/Index camera operated satisfactorily throughout the "A" phase with normal camera slewing during the cut and wrap sequence.

The "B" phase Stellar/Index camera operated satisfactorily with normal camera slewing during the simulated "B" recovery sequence.

The "A" bucket stellar fiducials are poor but acceptable and the index camera is acceptable. The "B" bucket index is acceptable.

The "B" bucket stellar contained corona marking on 4.6% of the total frames to a density higher than the 0.40 maximum density allowable. The quantity is acceptable but the density does not meet the acceptance criteria.

It was recommended that this requirement be waived and the entire system accepted for flight for the following reasons:

1. This corona marking occurred only when PMU was off.

J-23 170/171 ENVIRONMENTAL TEST CYCLE RATES 04-01-65

REV/MODE		RAMP		T.U.R.	INST 170 ACT.	INST 170 NOM.	INST 170 DEV.	INST 171 ACT.	INST 171 NOM.	INST 171 DEV.	170/171 DIFF.
1	A	7	7	382	3.550	3.534	-0.45	3.585	3.530	-1.54	0.99
1	A	7	7	2201	2.560	2.537	-0.90	2.577	2.529	-1.89	0.66
2	A	4	1	1420	2.220	2.203	-0.78				
2	A	4	1	1605				2.220	2.184	-1.67	
2	A	4	1	2125	2.185	2.175	-0.46	2.205	2.176	-1.32	0.92
4	A	7	7	2275	2.573	2.568	-0.20	2.590	2.560	-1.17	0.66
4	A	8	2	340	5.250	5.192	-1.12	5.300	5.208	-1.76	0.95
5	A	8	2	1710	2.230	2.216	-0.65				
5	A	8	2	2250				2.240	2.251	0.51	
5	A	11	1	1460	2.713	2.690	-0.86	2.730	2.682	-1.77	0.63
6	A	11	1	2040	2.283	2.289	0.26	2.305	2.281	-1.05	0.96
6	A	5	8	1090	2.740	2.714	-0.97	2.760	2.706	-1.99	0.73
6	A	5	8	1445	2.540	2.514	-1.05	2.543	2.506	-1.49	0.12
7	A	7	7	1180	2.930	2.901	-1.00	2.940	2.894	-1.58	0.34
7	A	7	7	1590	2.593	2.583	-0.40	2.600	2.575	-0.98	0.27
8	A	7	7	2530	2.733	2.732	-0.04	2.737	2.724	-0.46	0.15
8	A	4	1	1015	2.797	2.763	-1.22	2.807	2.756	-1.86	0.36
8	A	4	1	1750	2.188	2.176	-0.57				
9	A	4	1	2620				2.318	2.306	-0.53	
9	A	4	1	3210	3.400	3.415	0.44	3.405	3.411	0.17	0.15
9	A	11	1	885	4.665	4.599	-1.44	4.690	4.606	-1.83	0.54
10	A	11	1	1880	2.295	2.283	-0.54	2.305	2.275	-1.34	0.44

TABLE 2-1

REV/MODE	RAMP	T.U.R.	INST 170 ACT.	INST 170 NOM.	INST 170 DEV.	INST 171 ACT.	INST 171 NOM.	INST 171 DEV.	170/171 DIFF.
10 A	11 1	2970	4.365	4.418	1.19	4.395	4.423	0.62	0.69
10 A	7 7	235	3.605	3.599	-0.16	3.630	3.596	-0.94	0.69
11 A	7 7	2005	2.500	2.493	-0.27	2.510	2.485	-0.99	0.40
11 A	7 7	2435	2.623	2.661	1.42	2.627	2.653	0.98	0.15
12 A	8 2	1150	3.093	3.049	-1.45	3.107	3.042	-2.12	0.45
12 A	8 2	1851				2.240	2.203	-1.68	
12 A	8 2	840	3.830	3.783	-1.23	3.860	3.782	-2.07	0.78
13 A	4 1	2630	2.355	2.330	-1.09	2.350	2.322	-1.22	-0.21
13 A	11 1	1970	2.283	2.276	-0.30	2.305	2.268	-1.62	0.96
14 A	11 1	3075	4.890	4.916	0.54	4.955	4.928	-0.54	-1.33
1 B	7 7	385	3.500	3.532	0.92	3.530	3.529	-0.03	0.86
01 B	7 7	2210	2.537	2.540	0.13	2.550	2.533	-0.69	0.51
02 B	4 1	1425	2.200	2.202	0.09				
02 B	4 1	1605				2.205	2.184	-0.98	
02 B	4 1	2125	2.178	2.175	-0.14	2.190	2.176	-0.63	0.55
04 B	7 7	2275	2.533	2.568	1.36	2.543	2.560	0.67	0.39
04 B	8 2	335	5.060	5.204	2.76	5.120	5.220	1.92	1.19
05 B	8 2	1725	2.205	2.214	0.43				
05 B	8 2	2245				2.248	2.248	-0.02	
05 B	11 1	1460	2.667	2.690	0.85	2.677	2.682	0.20	0.37
06 B	11 1	2040	2.255	2.289	1.49	2.268	2.281	0.57	0.58
06 B	5 8	1090	2.670	2.714	1.61	2.700	2.706	0.23	1.12

TABLE 2-1

REV/MODE	RAMP	T.U.R.	INST 170 ACT.	NOM.	DEV.	INST 171 ACT.	NOM.	DEV.	170/171 DIFF.
06 B	5 8	1445	2.495	2.514	0.74	2.500	2.506	0.23	0.20
07 B	7 7	1180	2.870	2.901	1.07	2.877	2.894	0.59	0.24
07 B	7 7	1580	2.540	2.588	1.85	2.540	2.580	1.55	-0.
07 B	7 7	2530	2.687	2.732	1.64	2.687	2.724	1.38	-0.
08 B	4 1	1015	2.730	2.763	1.20	2.730	2.756	0.94	-0.
08 B	4 1	1750	2.163	2.176	0.58				
09 B	4 1	2620				2.283	2.306	0.98	
09 B	4 1	3210	3.343	3.415	2.11	3.340	3.411	2.07	-0.09
09 B	11 1	885	4.560	4.599	0.84	4.580	4.606	0.56	0.44
10 B	11 1	1875	2.263	2.284	0.91	2.265	2.276	0.47	0.09
J B	11 1	2965	4.265	4.396	2.97	4.295	4.400	2.39	0.70
10 B	7 7	140	3.570	3.624	1.50	3.580	3.621	1.14	0.28
11 B	7 7	1910	2.450	2.492	1.68	2.460	2.484	0.96	0.41
11 B	7 7	2280	2.530	2.570	1.57	2.530	2.563	1.27	-0.
11 B	8 2	1154	3.060	3.039	-0.70	3.080	3.032	-1.58	0.65
12 B	8 2	846	3.800	3.767	-0.87	3.820	3.766	-1.45	0.53
13 B	4 1	2631	2.350	2.331	-0.81	2.350	2.323	-1.15	-0.
13 B	11 1	1976	2.280	2.277	-0.15	2.290	2.269	-0.94	0.44
15 B	5 8	1931	2.380	2.393	0.56	2.400	2.385	-0.61	0.84
15 B	5 8	3121	2.880	2.887	0.24	2.900	2.880	-0.70	0.69
15 B	8 2	1771	2.200	2.211	0.52	2.240	2.206	-1.56	1.82
15 B	8 2	2621	2.750	2.766	0.56	2.780	2.758	-0.79	1.09

TABLE 2-1

REV/MODE	RAMP	T.U.R.	INST 170 ACT.	INST 170 NOM.	INST 170 DEV.	INST 171 ACT.	INST 171 NOM.	INST 171 DEV.	170/171 DIFF.
16 B	8 2	0	5.580	5.586	0.11	5.600	5.609	0.16	0.36
16 B	8 2	0	5.580	5.586	0.11	5.620	5.609	-0.19	0.72

DEV. AND DIFF. ARE IN PERCENT
THE (-) SIGN INDICATES THAT THE INST IS SLOWER THAN PREDICTED OR THAT INST 1 IS SLOWER THAN INST 2

TABLE 2-1

2. Even if the PMU were to fail in flight, an exposure analysis shows that 6th magnitude stars would still be discernable above the corona level encountered.

5. Instrumentation Performance

Film correlation between the film footage pots and the cycle counter on both instruments was satisfactory throughout the test. The only instrumentation discrepancies observed during the test were:

1. Master instrument temp sensor No. 13 was approximately 15° F lower than average instrument No. 1 temperature throughout the test.

2. Commutated channel 13 exhibited stray voltage on several commutator points during orbit 2 of the "B" phase. Some instrument monitor points were driven out of band low and the plus calibrate was driven out of band high. However, the tape recorder output of channel 13 did not contain this anomoly, and this condition was attributed to a Sanborn recorder problem.

6. Pressure Environment

The pressure make-up system operated satisfactorily throughout the test. The maximum pressure attained with the PMU on was approximately 72 microns during an instrumentation operation. The minimum pressure attained during the test was approximately 1.6 microns. The table below shows the test pressure environment during non-operate periods.

PRESSURE MICRONS

	Chamber	Alphatron #1	Alphatron #2
Day 1	.017	10.0	9.0
Day 2	.012	6.0	6.0
Day 3	.014	6.0	4.0
Day 4	.010	3.6	2.9
Day 5	.012	5.3	4.6
Day 6	.012	2.6	1.7

The average gas consumption was approximately 6.7 lbs/minute of operate time.

7. Temperature Environment

A tabulation of the temperature environment encountered during the test is included in the table below.

AVERAGE TEMPERATURE ENVIRONMENT

A PHASE	Orbit 1	Orbit 14
Master Instrument	69	69
Slave Instrument	61	62

B PHASE	Orbit 1	Orbit 8	Orbit 16
Master Instrument	70	92 (Max)	72
Slave Instrument	63	93 (Max)	71

8. Clock Performance

The clock unit operated properly throughout the test with the following errors observed:

CLOCK PERFORMANCE

IRIG "C" Rev	Day	Hr.	Min	Sec.	CLOCK (Seconds)	ERRORS (Seconds)
1	91	08	30	39.930	307538.848	--
6	92	08	37	55.730	394369.626	-0.012
11	93	07	57	25.570	478344.477	-0.011
14	93	13	07	02.890	496911.790	-0.018
1	94	08	00	22.560	308699.242	--
6	95	08	57	56.500	398553.195	+ .013
16	96	15	57	48.820	510145.496	- .006

B. RESOLUTION TEST

Resolution and theodolite tests of the J-23 system were completed on 22 April, 1965. Results of the thru-focus resolution tests of pan instruments 170 and 171 show the following characteristics:

MASTER PAN INSTRUMENT NO. 170

Maximum high contrast resolution 206 lines/mm at .000 focal position.

Maximum low contrast resolution 116 lines/mm at .000 focal position

SLAVE INSTRUMENT NO. 171

Maximum high contrast resolution 179 lines/mm at .001 focal position

Maximum low contrast resolution 108 lines/mm at .001 focal position.

The resolution test data for both instruments as shown in Figures 2-1 and 2-2, has been reviewed and appears normal in all respects. The demonstrated resolution performance meets the system requirements specification.

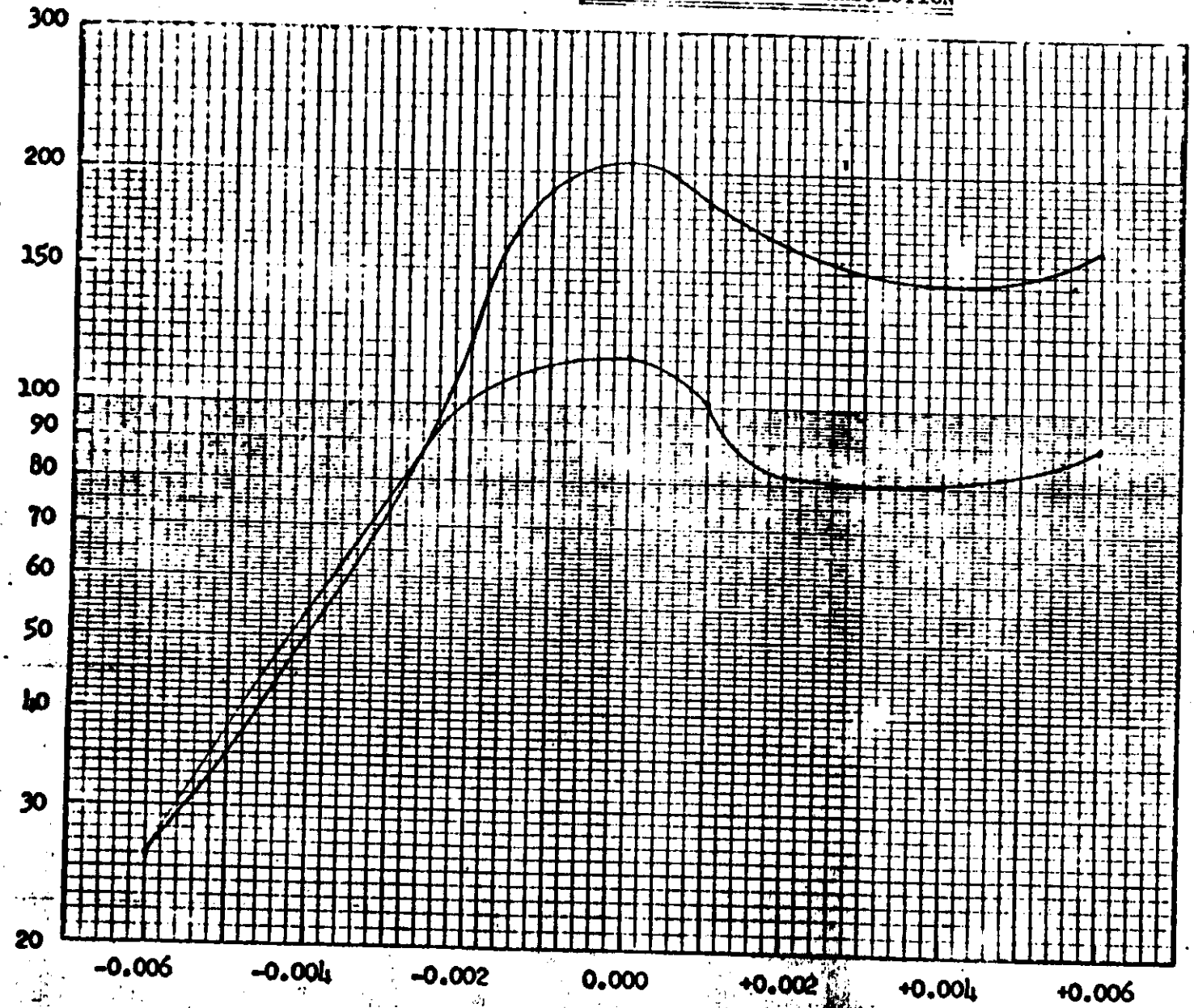
C. LIGHT LEAK TEST

This system was subjected to the following test conditions:

The light leak test was conducted on 7 May 1965 using a 15 minute soak at a distance of 24 inches producing approximately 2000 foot candles. With the system sitting on blocks, nose up, the light bank was raised by crane for exposing both top and bottom of the "A" SRV-Fairing Interface. With the light bank on the floor, soaks were then performed on both sides of the system horizon optics, and directly into the main door openings.

After these 5 soaks, 15 cycles of instrument operation transferred all film between the supply and T/U cassettes into the T/U cassette. All test film, approximately 40 cycles, was retrieved and processed. 4401 film was used.

PRE-FLIGHT DYNAMIC RESOLUTION



Camera No: 170

Payload No: J-23

Resolution (l/mm)

High Contrast: 206

Low Contrast: 116

Film Type: 3404

Test Date: 4/22/65

FIGURE 2-1

PRE-FLIGHT DYNAMIC RESOLUTION

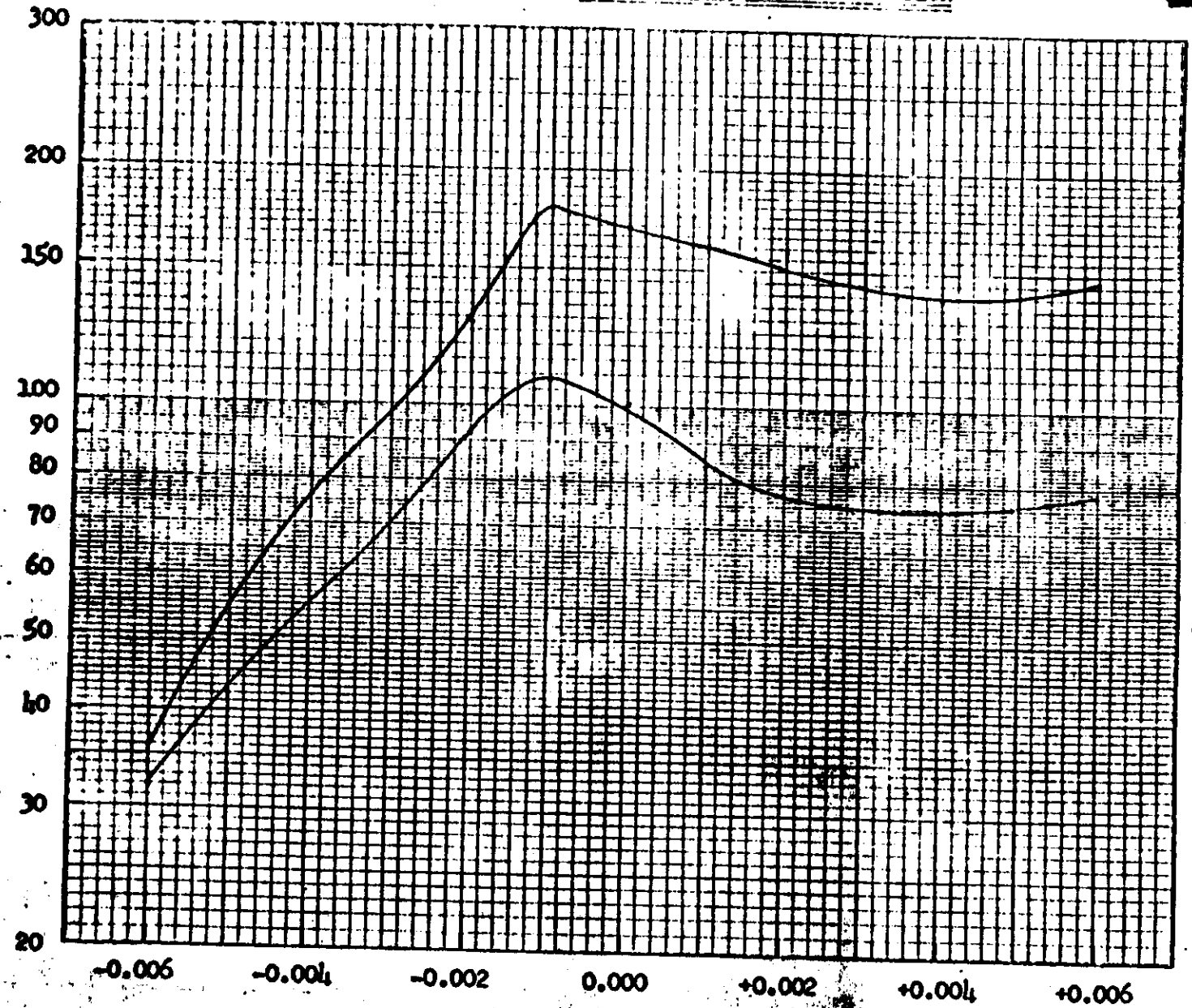


FIGURE 2-2

Camera No: 171

Payload No: J-23

Resolution (l/mm)

High Contrast: 179

Low Contrast: 108

Film Type: 3404

Test Date: 4/22/65

Examination of the processed film revealed the usual handling marks plus one small fogged area. Since this area was traced to the inside of the "B" bucket during the soak, it was concluded to have resulted from some source other than the soak.

J-23 system is recommended for flight without further light leak testing.

D. FLIGHT LOADING AND CERTIFICATION

Film from J-23 pad run and flight readiness was examined at VAFB on 12 August 1965. No difference in system performance could be detected between this film and film from previous operations at A/P. All data was present and acceptable. All scratch marks found were outside the format areas. No appreciable banding was found.

Some slight minus density longitudinal streaks were found, as before, where the fogging density was fairly uniform across the film. It is doubtful that these streaks could be detected in the random densities of a ground scene.

Most of the film samples were badly stained in processing. It is recommended that steps be taken to checkout the people and equipment responsible for this procedure to insure adherence to the applicable TP.

J-23 has been and is an exceptionally trouble free system and meets all established criteria for flight readiness.

SECTION 3

FLIGHT OPERATIONS

A. INSTRUMENTATION AND COMMAND PERFORMANCE

All Instrumentation System functions operated properly throughout both missions. All monitors also operated properly.

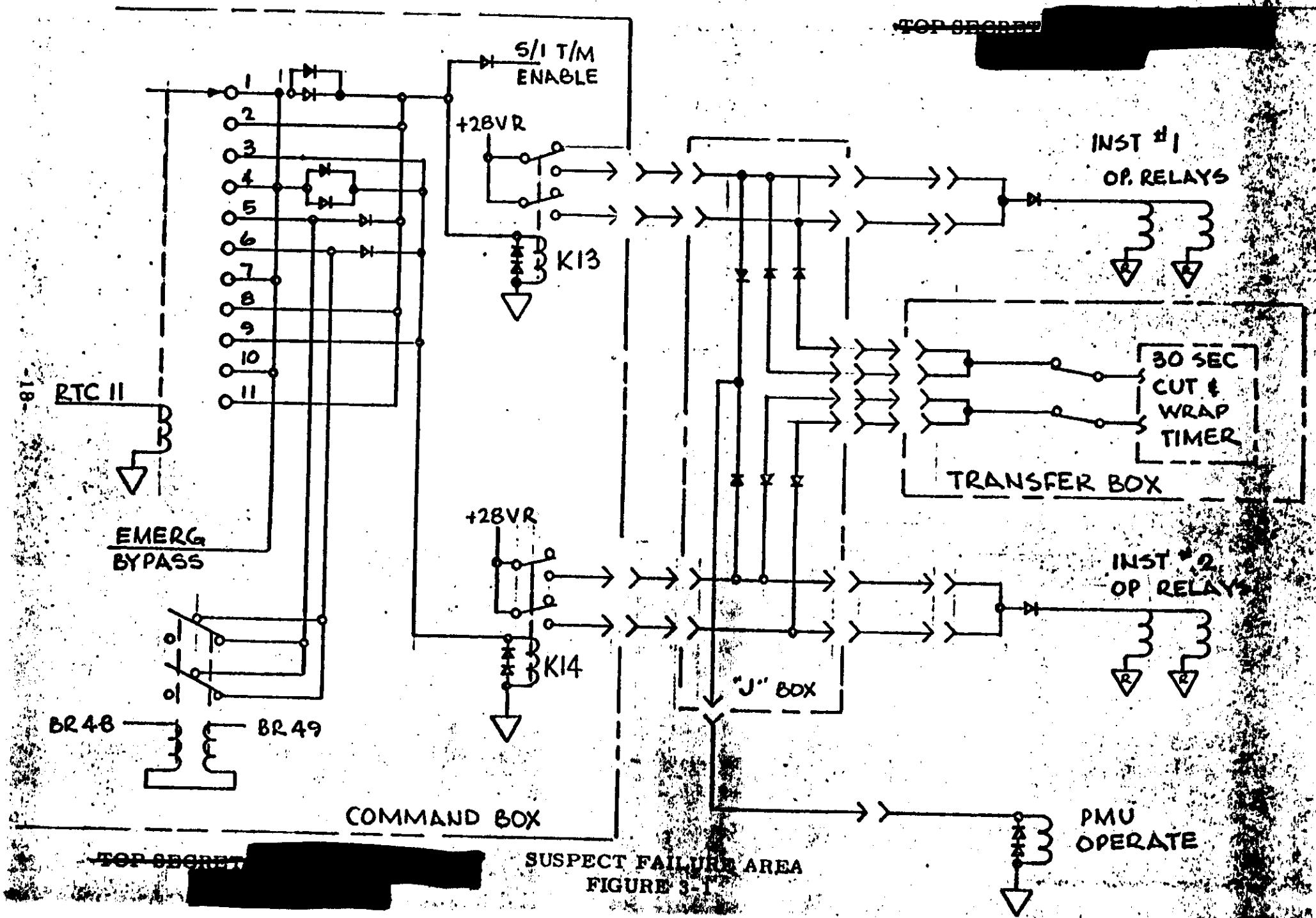
It was determined from Rev 2 tracking data that the orbit perigee altitude was approximately two miles lower than predicted pre-flight. As a result of this, a change in V/h ramp amplitude was made on Rev 7 at [redacted] This V/h ramp setting, as made on Rev 7, provided acceptable V/h ramp-to-orbit match for the balance of both missions.

V/h ramp-to-orbit match was well below the five percent allowable mismatch figure during both missions except on very high latitude operations (above 69 degrees north descending).

On pass 102, the system was in a programmed intermix OFF emergency operate mode with a 147 cycle programmed operation. Cycle counter data indicated completion of 34 of the programmed 147 cycles. An engineering pass was taken on pass 104 confirming failure of the Master camera. Neither the transport or scan functions operated. Telemetry data indicated no operate signal was received by the camera operate relays. A series of command combinations were tried, without success, in an attempt to isolate and program around the faulty component or components. A schematic of the primary suspect area is contained in Figure 3-1. Table 3-1 is a tabulation of the command settings from rev 101 through the end of the mission.

In all of the combinations of stereo and mono No. 1 operations tried on engineering passes, a signal was verified to the S/I, T/M enable (ref. Figure 3-1). At these same times no operate signal was observed at the instrument No. 1 operate relays or the PMU operate relays.

Sufficient operate time was logged in a mono 1 mode to significantly decrease the PMU gas supply had an operate signal been received by the PMU system. Figure 3-2 is a plot of the PMU consumption. The solid line indicates the consumption during stereo operation and the dash lines show the consumption with the mono No. 1 operate time added.



SUSPECT FAILURE AREA
FIGURE 3-1

[redacted]

TABLE 3-1
1618 J-23 RTC SETTINGS

Master Operation	6	8	9	10	11	12	15	Remarks
101 Normal	7	3	9	6	7	7	4	Stereo - On
102 34 for 147	7	3	1	6	7	8	4	Stereo - On (Emerg)
103 Failed	7	3	1	6	7	9	4	Stereo - On (Emerg)
104 Failed	7	3	3	6	7	11	4	Stereo - On
105 Failed	7	3	2	6	1	2	4	Stereo - On
106 Failed	7	3	2	6	2	5	4	Mono -1 - On
107 Failed	7	3	5	6	4	8	4	Stereo - Off
108 Failed	7	3	5	6	4	9	4	Stereo - On
109 Failed	7	3	8	6	4	4	4	Stereo - Off
110 Failed	7	3	9	6	4/8	6	4	Stereo/Mono -1 - On
111 Failed	7	3	9	6	8	7	4	Mono -1 - On
112 Failed	7	3	9	6	8	9	4	Mono -1 - On
113 Failed	7	3	9	6	10	5	1	Stereo - Off
114 Failed	7	3	9	6	10	6	1	Stereo - Off
115 Failed	7	3	9	6	10	7	1	Stereo - Off
116 Failed	7	3	9	6	10	8	1	Stereo - On
117 Failed	7	3	7	6	10	10	1	Stereo - On
118 Failed	7	3	8	6	10	11	4	Stereo - On
119 Failed	7	3	1	6	10	11	4	Stereo - On (Emerg)
120 Failed	7	3	1/2	6	10	11	4	Stereo - On
121 Failed	7	3	8	6	11	11	4	Mono -1 - On
122 Failed	7	3	5	6	11	11	4	Mono -1 - On
123 Failed	7	3	9	6	11	11	4	Mono -1 - On
124 Failed	7	3	9	6	1	3	4	Stereo - Off
125 Failed	7	3	9	6	1	4	4	Stereo - Off
126 Failed	7	3	9	6	1	5	4	Stereo - On
127 Failed	7	3	9	6	2	6	4	Mono -1 - On
128 Failed	7	3	4	6	2	7	4	Mono -1 - On
129 Failed	7	3	9	6	4	10	4	Stereo - Off
130 Failed	7	3	9	6	4	11	4	Stereo - On
131 Failed	7	3	9	6	4	11	4	Stereo - On
132 Failed	7	3	9	6	4	11	4	Stereo - On