CASSINI/CAPS
CAPS FLIGHT SOFTWARE
Delta Software Requirements Document

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Table of Contents

1 INTRODUCTION 1

1.1 PURPOSE 1
1.2 RELEVANT DOCUMENTS 1
1.2.1 JPL Documents 1
1.2.2 SwRI Documents 1
1.2.3 Acronyms, Abbreviations and Other Terms 1

REVISION 4.0 REQUIREMENTS 3

1.3 CPU1 3
1.3.1 Defects 3
1.3.1.1 ELS Noise 3
1.3.1.2 Correct the STM transition for physical 0 kbps 3
1.3.1.3 Loading an IEB while another IEB is active 3
1.3.1.4 ELS sweep monitor trickle data contains duplicate readings 3
1.3.1.5 Revise the address table for the tolerance table entries 3
1.3.1.6 Add a software actuator limit 5
1.3.2 Changes and Enhancements 5
1.3.2.1 BIU watchdog handling 5
1.3.2.2 Resetting CPU2 during an STM change 5
1.3.2.3 IEB Timing 5
1.3.2.4 Increase IEB space and revise IEB layout 6
1.3.2.5 IBS search and track mode 7
1.3.2.6 Data product revision ID in A-Cycle header 7
1.3.2.7 Add ESA Sweep table identifiers to housekeeping 7
1.3.2.8 Revised STMs 7
1.3.2.9 New Data Products 8
1.3.2.10 Safing CAPS when invalid STMs are encountered 9
1.3.2.11 Flushing Telemetry Buffers on STM change 9
1.4 CPU 2 10
1.4.1 Defects 10
1.4.1.1 Handling of Unimplemented 1750A Interrupts 10
1.4.1.2 CPU2 ALF Process 10
1.4.1.3 Executing 82SAM_MOL_LEF on an A-Cycle Boundary 10
1.4.1.4 No Ion Data During Event Mode 10
1.4.1.5 Event Mode Commanding 10
1.4.1.6 Handling of 82DPU_B_CYCLE 10
1.4.1.7 Handling of 82DPU_CLEAR_ERRS 11
1.4.1.8 CPU2 to CPU1 B-Cycle Interrupt Timing 11
1.4.2 Changes or Enhancements 11
1.4.2.1 Data Products 11
1.5 SAM 11
1.5.1 Defects 11
1.5.1.1 Hardware Binning 11
1.5.1.2 SAM Performance 12
1.5.2 Changes or Enhancements 12
1.5.2.1 Background Subtraction 12

Tables

Table 1 IEB Configuration 6
Table 2 Data Product Identifiers 7
Table 3 CDS Version 9 STM Id and Housekeeping Values 2

Table 4 CDS Version 9 CAPS Science Physical Telemetry Rates 2
Table 5 CDS Version 9 CAPS Collection Repeat Cycles 3
Table 6 CDS Version 9 Cassini Spacecraft Schedule Repeat Cycles 3
Table 7: ELS Data Products 5
Table 8: IBS Data Products ..... **Error! Bookmark not defined.**
Table 9 IBS Data Product Collapse and Compress Map 6
Table 10: IMS Ions Data Products 1
Table 11: IMS TOF Data Products 1
Table 12: IMS Singles Data Products 1
Table 13: IMS Logicals Data Products 1
Table 14 CPU1 MRO 2
Table 15 CPU2 MRO 2
Table 16 Utilized Telemetry Bandwidth (Bytes) 2
Table 17 Revised A-Cycle Header 3
Table 18 Data Product Id Assignments by Logical TLM 2
Table 19 Summary Of Data Products 3
Table 20 CCSDS Application Ids 2
Table 21 IBS Data Product Header 5
Table 22 - CAPS Housekeeping 2
Table 23 CPU 1 Error Bit Definitions 28
Table 24 CPU 2 Error Bit Definitions 29
Table 25 Memory Readout Tables 30
Table 26 Solar Wind Search Table 12
Table 27 Mag. Mode Sweep 1 13
Table 28 Mag. Mode Sweep 2 14

Appendices

Appendix A CDS Version 9 Spacecraft Telemetry Modes A-1
Appendix B Data Product Formats B-4
Appendix C Data Product Ids C-1
Appendix D CCSDS Packet Application Ids D-1
Appendix E IBS Search and Track E-1
Appendix F New or Revised CAPS Commands F-1
Appendix G Revised Housekeeping G-1
Appedix H IBS Sweep and Sweep Index Tables H-1

REVISION NOTICE

Version Identifier	*Date of Issue*	*Summary of Changes*
Draft	9/25/02	Initial draft release
Draft1	10/31/02	Revisions based upon comments from J. Furman
Draft2	12/12/02	Added Commanding, telemetry and data product formats
Draft 5	2/19/03	Added HK and ACT sw DP Ids, Revised IBS DP sizes, Revised IBS_MODE command.
R0C0	3-24.03	Release 0 Change 0
R1C0	7-03	Updates to match final S/W release
R1C1	8-03	Minor corrections

This document contains information that is as complete as possible. Where final numerical values or specification references are not available, best estimates are given and noted **TBR** (To Be Reviewed). Items which are not yet defined are noted **TBD** (To Be Determined). The following table summarizes the TBD/TBR items in this revision of the document, and supplements the revision notice above.

Section(s)	*Description*
2.3.1.2	Percent spare processor for SAM
2.3.2.1	Definition of background subtraction
Appendix E	Description of IBS search and track mode

1 INTRODUCTION

1.1 Purpose

This document describes the planned changes to the Cassini/CAPS flight software product. Currently, CAPS is running software version 3.2.1 delivered to the Jet Propulsion Laboratory in July 2000. The new version of flight software will be designated version 4.0 and will include features and capabilities for Saturn tour.

1.2 Relevant Documents

The following documents and standards form a part of this document to the extent specified in the body of this document. In cases where no date is shown for a document, the latest issue shall be assumed. In the event of a conflict between the contents of this document and the contents of one or more of the referenced documents, this document shall take precedence.

1.2.1 JPL Documents

CAS-3-271	Cassini Orbiter Functional Requirements Book Spacecraft Intercommunications
CAS-3-281	Cassini Orbiter Telemetry Formats and Measurements
CAS-3-291	Cassini Orbiter Uplink Formats and Command Tables

1.2.2 SwRI Documents

5548-FSFD-01	CAPS Flight Software Functional Design for CPU 1
5548-FSFD-02	CAPS Flight Software Functional Design for CPU 2
5584-FSFD-03	CAPS Flight Software Functional Design For SAM

1.2.3 Acronyms, Abbreviations and Other Terms

A-Cycle – A 32 second period of time. The instrument's primary telemetry cycle
B-Cycle – 8, 16, or 32 A-cycles. The IMS TOF acquisition cycle
BIU – Bus Interface Unit
C-Cycle – 8 A-Cycles. Primary period for IBS mode controls.
CAPS – Cassini Plasma Spectrometer
DPU – Data Processing Unit
ELS – Electron Spectrometer
ESA – Electrostatic Analyzer
IBS – Ion Beam Spectrometer
IEB – Instrument Expanded Block
IMS – Ion Mass Spectrometer
LEF – Linear Electric Field
RLE – Run Length Encoding
JPL – Jet Propulsion Laboratory
SAM – Spectrum Analyzer Module

ST – Straight Through
STM – Spacecraft Telemetry Mode

2 Revision 4.0 Requirements

2.1 CPU1

2.1.1 Defects

This section describes known CPU1 errors in revision 3.2.1. It describes the error and the correction to be implemented in the flight software.

2.1.1.1 ELS Noise

The ELS sensor step counter is read during active data acquisition by the ELS hardware. This results in digital noise being introduced into the ELS hardware.

The flight software shall read the ELS step counter only during the ELS dead time.

2.1.1.2 Correct the STM transition for physical 0 kbps

When the flight software transitions from a STM that is defined at a physical telemetry rate of 0 KBPS to a physical rate of 2 kbps 4 kbps, 8 kbps or 16 kbps, the flight software transitions to the defined physical rate. The flight software should transition to the last commanded logical telemetry rate.

The flight software shall transition from a physical 0 kbps telemetry rate to the last logical telemetry rate greater than 0 kbps or the current physical rate if the current physical rate is less than the current logical rate.

2.1.1.3 Loading an IEB while another IEB is active

Loading an inactive IEB while another IEB is active causes the active IEB to become corrupted.

The flight software shall be able to load an inactive IEB while one or more IEBs are active. The target IEB must be inactive to perform a load. If the IEB is active, the flight software shall reject the sequence load commands.

2.1.1.4 ELS sweep monitor trickle data contains duplicate readings

ELS sweep monitor data is trickled down in telemetry at a rate of two samples per housekeeping packet. There appears to be duplicate values in the data, i.e. two analog values contain exactly the same digital value.

The flight software shall collect ELS monitor data without reporting duplicate values.

2.1.1.5 Revise the address table for the tolerance table entries

The table addresses contained in the global address table contain erroneous address for table ids 2-9, high voltage tolerance tables. Revise the global address table to contain the correct addresses.

The flight software shall utilize the correct address for table ids 2 through 9.

Dest ID	Destination
00	CPU 1 - memory
01	CPU 2 – memory
02	ELS MCP Tolerance Table
03	IBS CEM Tolerance Table
04	IBS ESA Tolerance Table
05	HVU1 ACC Tolerance Table
06	HVU1 RET Tolerance Table
07	HVU2 ESA Tolerance Table
08	HVU2 LEF Tolerance Table
09	HVU2 ST Tolerance Table
10	ACT -Default step Table
11	ACT - Compensated Table 1
12	ACT - Compensated Table 2
13	ACT - Accel/Decel Table
14	Spare
15	ELS/IBS 16->8 Compression Table
16	Revision ID
17	Spare
18	Spare
19	ELS - Sweep Monitor Table
20	IBS - Sweep Data Table (DAC)
21	IBS - Sweep Index Table, Solar Wind Search
22	IBS - Sweep Index Table, Solar Wind Track
23	IBS - Sweep Index Table, Magnetosphere Table 1
24	IBS - Sweep Index Table, Magnetosphere Table 2
25	IBS - Sweep Index Table, Standard/Satellite Encounter Table
26	IBS - Stim Table 1
27	IBS - Stim Table 2
28	IBS - Sweep Monitor Table
29	Spare
30	IMS Data Sweep Table #1
31	IMS Data Sweep Table #2
32	IMS Data Sweep Table #3
33	IMS Data Sweep Table #4
34	HVU2 - Sweep (ESA) Monitor Table
35-39	Spare
40	SAM Group table #1
41	SAM Group table #2
42	SAM Group table #3
43-49	Spare
50	IEB - Sequence Master IEB 0
51	IEB - Sequence Master IEB 1
52	IEB – Observation IEB 0
53	IEB – Survey Mode IEB 0
54-58	Spare

59	IEB Low Pwr to Normal Sci
60	IEB Normal Sci to Low Pwr
61	IEB Normal Sci to Sleep
62	IEB Sleep to Normal Sci
63	IEB Sleep to Low Pwr

2.1.1.6 Add a software actuator limit

The actuator motor incorporates both limit switches and hard mechanical stops to prevent the actuator from operating in ranges that are not valid. During ICO #1, the actuator encountered an unanticipated mechanical problem at the approximate actuator position of -90°. Since then the instrument has operated with a range of –80° to +100°. During operations in 2002, a software problem caused the actuator to move into the keep out zone (position < -80°).

The flight software shall implement a software stop to prevent the actuator from operating beyond -85°. Should the position exceed -85°, the actuator shall be stopped (holding -85° with the power on) and an error reported in housekeeping (Word 61, Bit 28). Ground intervention will be required to resume actuator operations.

2.1.2 Changes and Enhancements

This section describes changes or enhancements to CPU1 software, version 3.2.1.

2.1.2.1 BIU watchdog handling

Currently, the flight software will safe the CAPS high voltage power supplies and transition to the low-power science mode. The Cassini spacecraft has begun to regularly use the BIU watchdog function to silence the 1553 bus for an instrument during critical spacecraft activities.

The flight software shall not safe the CAPS high voltage power supplies when the BIU watchdog expires. The flight software shall remain in normal science mode and continue normal data acquisition activities. The event shall be reported as a CPU1 error (Error bit = 27) and cleared with a 82DPU_CLEAR_ERRS command.

2.1.2.2 Resetting CPU2 during an STM change

To improve operability of the flight software, the flight software should not reset CPU2 during an STM change. Currently the flight software resets CPU2 during either an STM change or a DPU TLM rate change. This is done to force CPU2 to re-synchronize to the new telemetry rate.

The flight software shall not reset CPU2 during any telemetry rate change. CPU2 shall synchronize to new telemetry rates without requiring a reset.

2.1.2.3 IEB Timing

Currently, the timing of IEBs is relative to the start of a CAPS IEB, i.e. the trigger time.

The flight software shall delay the execution of an IEB command using a relative timing. The time delay shall be relative to the execution of the last executed command in the IEB. This shall give a maximum inter-command delay of 65535 seconds.

2.1.2.4 Increase IEB space and revise IEB layout

To improve flight operations, the flight software shall provide the following IEB layout:

Table 1 IEB Configuration

IEB Number	Description	Size (words)
0	Master IEB #1	1024
1	Master IEB #2	1024
2	Observation IEB #1	64
3	Observation IEB #2	64
4	Observation IEB #3	64
5	Observation IEB #4	64
6	Observation IEB #5	64
7	Observation IEB #6	64
8	Observation IEB #7	64
9	Observation IEB #8	64
10	Observation IEB #9	64
11	Observation IEB #10	64
…		64
58	Observation IEB #57	64
59	Observation IEB #58	64
60	Observation IEB #59	64
61	Observation IEB #60	64
62	Survey Mode IEB #1	128
63	Survey Mode IEB #2	128
64	Survey Mode IEB #3	128
65	Survey Mode IEB #4	128
66	Survey Mode IEB #5	128
67	Survey Mode IEB #6	128
68	Survey Mode IEB #7	128
69	Survey Mode IEB #8	128
70	Survey Mode IEB #9	128
71	Survey Mode IEB #10	128
72	Survey Mode IEB #11	128
73	Survey Mode IEB #12	128
74	Survey Mode IEB #13	128
75	Survey Mode IEB #14	128
76	Survey Mode IEB #15	128
77	Survey Mode IEB #16	128
78	Survey Mode IEB #17	128
79	Survey Mode IEB #18	128
80	Survey Mode IEB #19	128
81	Survey Mode IEB #20	128
82	Mode Transition IEB - Low Power to Normal Science	256
83	Mode Transition IEB - Normal Science to Low Power	256
84	Mode Transition IEB – Normal Science to Sleep	256

85	Mode Transition IEB – Sleep to Normal Science	256
86	Mode Transition IEB – Sleep to Low Power	256
	Total IEB Space (words)	9792

2.1.2.5 IBS search and track mode

Reference Appendix E.

2.1.2.6 Data product revision ID in A-Cycle header

To improve the flow of science data through the ground system, the flight software will provide a data product revision ID in the A-Cycle header.

The flight software shall provide a data product revision ID in the A-Cycle header The id will be located at byte 11, bits 0 to 3 (A-Cycle Status 3) and will indicate the following revisions:

Table 2 Data Product Identifiers

FSW Data Product Revision	Revision Id Value
3.2/3.2.1	2
4.0	3

2.1.2.7 Add ESA Sweep table identifiers to housekeeping

To facilitate ground processing, the CAPS flight software will need to include a table identifier to uniquely identify HVU2 ESA sweep tables. Each HVU2 and IBS ESA table will include a unique 8 bit identifier for identifying the active sweep table.

The flight software shall utilize spare housekeeping bits to report the active ESA sweep table for the HVU2 ESA. The data for HVU2 will be reported at word 31, bits 8 to 15 in CAPS housekeeping telemetry. Each HVU2 table will include a table identifier. The table identifier will be loaded as part of a HVU2 ESA table load.

2.1.2.8 Revised STMs

A new set of spacecraft telemetry modes has been defined by JPL, reference ECR 101094.

The flight software shall implement the STMs defined in Appendix A.

WARNING: When booting CAPS from power on, the spacecraft MUST be placed into a STM that is supported by the CAPS boot PROM. The following are valid power on STMs:

S & ER 1, S & ER 2, S & ER 3, S & ER 4, S & ER 5, S & ER 5a, S & ER 6, S & ER 7, S & ER 8, SAF 142.2, SAF 248.85

2.1.2.9 New Data Products

2.1.2.9.1 Summing and Averaging

Currently the CAPS flight software averages all data products. To improve statistics, ELS and IMS data products will now be summed.

ELS Data products shall be summed by default. A command shall be provided to change to averaging.

CPU2 shall compute the sum of TOF values for 512 ST channels and 512 LEF channels. These sums are double words (32 bits). 512 words of ST TOF and 512 words of LEF TOF data are read each energy step from SAM, and dead-time corrected. The TOF command specifies how the data is acquired. It specifies a start Channel and whether to select every consecutive, 2nd, or 4th Channel for the data products.

The TOF channel data is additionally collapsed to 32 energy steps per sweep. The collapsing may be commanded to sum adjacent energy steps, take even numbered energy steps, or take odd numbered energy steps. Summing is the method by which all IMS data products are collapsed. For IMS 32 energy step data products energies 1 and 63 shall not be collapsed. Energy step 63 shall not be collapsed with energy 62. Energy step 63 shall be used for measuring background caused by penetrating radiation. Energy step 1 shall not be collapsed with energy step 2. At these high energies ion peaks move quite a bit which makes the data complicated to interpret. IMS 32 energy step data products shall be collapsed as followings 1, 2 – 3, 4 – 5, … 58 – 59, 60 – 61, 62 and 63.

2.1.2.9.2 Data products for 8 and 4 kBPS

Reference Appendix B and E.

2.1.2.9.3 Revised 2, 1, 0.5 and 0.25

Reference Appendix B and E.

2.1.2.9.4 Eight and Four KBPS Physical Telemetry Rate

The CAPS flight software was designed to support two physical science telemetry rates, 16 kbps and 2 kbps. JPL has since added two additional physical science telemetry rates in association with STMs S & ER 5, S & ER 5a and S & ER 6. These rates are 8 kbps and 4 kbps.

The CAPS flight software shall support STMs S & ER 5, S & ER 5a and S & ER 6. It shall support the 8 and 4 kbps physical science telemetry rates. For 8 kbps, it shall produce one 500 word CCSDS science packet per second. For 4 kbps, it shall produce one 500 word CCSDS science packet every two seconds. The CCSDS application process ids for the 8 and 4 kbps packets are described in Appendix D. The housekeeping parameter SC_TLM_RATE (S-3157) will now require 3 bits instead of two. The current parameter does not support the 8kbps physical rate. The parameter will be moved. SC_TLM_RATE shall now be at word 62, bits 13-11. The bit assignments are as follows:

0 = 16 kbps
1 = 8 kbps
2 = 4 kbps
3 = 2 kbps
4 = 0 kbps

2.1.2.10 Safing CAPS when invalid STMs are encountered

When a STM is transmitted to CAPS that commands CAPS to a mode in which the spacecraft collects no housekeeping from CAPS the CAPS flight software safes the CAPS high voltages

The flight software shall not safe the high voltage power supplies when a valid but unsupported STM is encountered. The flight software shall remain in normal science mode and continue normal data acquisition activities. The flight software shall safe the instrument when an invalid or unrecognized STM is encountered. This shall be reported as a CPU1 error, INVALID_TLM_MODE and cleared with a 82DPU_CLEAR_ERRS.

2.1.2.11 Flushing Telemetry Buffers on STM change

Currently, the flight software clears the telemetry buffers when the spacecraft changes spacecraft telemetry mode.

The flight software shall not clear the telemetry buffers when an STM change occurs, unless the new telemetry rate is less than the current logical telemetry rate. In this case, the flight software shall transition the logical telemetry rate to the physical telemetry rate.

2.2 CPU 2

2.2.1 Defects

2.2.1.1 Handling of Unimplemented 1750A Interrupts

Some of the 1750a non-maskable/no-disable interrupts do not have service routines.

The CPU2 flight software shall handle all 1750a interrupts. For interrupts that are unexpected, a bit in CPU2 housekeeping telemetry, CPU2 ERRORS, shall be set to indicate their occurrence.

2.2.1.2 CPU2 ALF Process

The CPU2 ALF software shall not reject ALF commands that are outside of the range specified by 82ALF_RANGE.

2.2.1.3 Executing 82SAM_MOL_LEF on an A-Cycle Boundary

The 82SAM_MOL_LEF command is not executed on A-cycle boundary

2.2.1.4 No Ion Data During Event Mode

During event mode, no ion data is being collected. The trouble is caused by a hardware race condition. This race condition on the CPU2 board causes SAM to receive an incorrect indication of where ion data was accumulated.

CPU2 shall set a control variable in CPU2/SAM shared memory to replace the hardware indicator. SAM software shall utilize this software indicator to process ion data.

2.2.1.5 Event Mode Commanding

Unexpected problems occurred following the vent mode test performed in flight. CPU2 failed to respond to configuration commands after event mode was executed. There were no IMS data products created. CPU2 required a reset to clear the condition.

CPU2 shall gracefully recover from an event mode command and not drop data products.

2.2.1.6 Handling of 82DPU_B_CYCLE

During normal operations, command sequences may contain CPU1 commands that are scheduled on a B-Cycle boundary. These commands will end with a 82DPU_BCYCLE command. The only command to be sent to CPU2 will be the 82DPU_BCYCLE command. CPU2 does not handle the condition where there are no commands in the B-Cycle queue. The result was dropped a-cycle data.

CPU2 software shall be capable of executing an 82DPU_BCYCLE command with no other B-Cycle commands pending.

2.2.1.7 Handling of 82DPU_CLEAR_ERRS

The CPU2 received and executed commands counts indicate 1 after executing a 82DPU_CLEAR_ERRS.

The CPU2 software shall report 0 for received and executed command counts after executing 82DPU_CLEAR_ERRS.

2.2.1.8 CPU2 to CPU1 B-Cycle Interrupt Timing

CPU2 is sending the B-Cycle starting indicator at the beginning of e-step 62 of the last sweep in an A-Cycle.

The B-Cycle starting interrupt shall be generated as the last action CPU2 performs in the 63rd e-step of last sweep of an A-Cycle.

2.2.2 Changes or Enhancements

2.2.2.1 Data Products

2.2.2.1.1 Summing and Averaging

Reference Appendix B.

2.2.2.1.2 Add 8 KBPS and 4 KBPS Data Products

Reference Appendix B.

2.2.2.1.3 Revised 2 KBPS, 1 KBPS, 0.5 KBPS and 0.25 KBPS Data Products

Reference Appendix B.

2.3 SAM

2.3.1 Defects

2.3.1.1 Hardware Binning

Hardware binning for LEF data does not appear to work.

The SAM software shall correctly support hardware binning.

2.3.1.2 SAM Performance

Quantify the performance of SAM software. Determine the spare processor resources.

SAM shall provide TBD percent spare processor time.

2.3.2 Changes or Enhancements

2.3.2.1 Background Subtraction

This requirement is deferred to a future release of CAPS flight software.

Appendix A
CDS Version 9 Spacecraft Telemetry Modes

Table 3 CDS Version 9 STM Id and Housekeeping Values

Mode Name	STM (hex)	HK Value (hex)	Mode Name	STM (hex)	HK Value (hex)
RTE_5	0300 0303	0	S&ER10 (Online)	0312 0327	N/A
RTE_10	C300 0306	1	RTE&SPB-14220	0321 03B1	10
RTE_20	C300 0309	2	RTE&SPB-22120	0321 03C0	11
RTE_1896	C300 0315	3	RTE&SPB-27650	0321 03C9	12
PCHK-24.885	C000 031E	4	RTE&SPB-33180	0321 03CF	13
PRLY (Prime)	C303 0321	5	RTE&SPB-35550	0321 03D2	14
PRLY (Online)	C303 0321	N/A	RTE&SPB-41475	0321 03D8	15
S&ER1	0306 0324	6	RTE&SPB-47400	0321 03DB	16
S&ER2	0309 0324	7	RTE&SPB-66360	0321 03E4	17
S&ER3	030C 0324	8	RTE&SPB-82950	0321 03EA	18
S&ER4	030F 0324	9	RTE&SPB-99540	0321 03ED	19
S&ER5	0312 0324	A	RTE&SPB-110600	0321 03F0	1A
S&ER5a	0B12 0324	B	RTE&SPB-124425	0321 03F3	1B
S&ER6	0315 0324	C	RTE&SPB-142200	0321 03F6	1C
S&ER7	0318 0324	D	RTE&SPB-165900	0321 03F9	1D
S&ER8	031B 0324	E	SAF-248.85(2)	1327 0342	1E
S&ER10 (Prime)	0312 0327	F	SAF-142.2	0327 0342	1F

Table 4 CDS Version 9 CAPS Science Physical Telemetry Rates

Mode Name	Physical Telemetry Rate (kbps)	Mode Name	Physical Telemetry Rate (kbps)
RTE_5	0	S&ER10 (Online)	0
RTE_10	0	RTE&SPB-14220	16
RTE_20	0	RTE&SPB-22120	16
RTE_1896	0	RTE&SPB-27650	16
PCHK-24.885	0	RTE&SPB-33180	16
PRLY (Prime)	16	RTE&SPB-35550	16
PRLY (Online)	0	RTE&SPB-41475	16
S&ER1	16	RTE&SPB-47400	16
S&ER2	16	RTE&SPB-66360	16
S&ER3	16	RTE&SPB-82950	16
S&ER4	16	RTE&SPB-99540	16
S&ER5	4	RTE&SPB-110600	16
S&ER5a	4	RTE&SPB-124425	16
S&ER6	8	RTE&SPB-142200	16
S&ER7	16	RTE&SPB-165900	16
S&ER8	16	SAF-248.85(2)	16
S&ER10 (Prime)	16	SAF-142.2	2

Table 5 CDS Version 9 CAPS Collection Repeat Cycles

Mode Name	CRC		Mode Name	CRC	
	HK	SCI		HK	SCI
RTE_5	0	0	S&ER10 (Online)	0	0
RTE_10	64	0	RTE&SPB-14220	64	0.5
RTE_20	64	0	RTE&SPB-22120	64	0.5
RTE_1896	64	0	RTE&SPB-27650	64	0.5
PCHK-24.885	0	0	RTE&SPB-33180	64	0.5
PRLY (Prime)	64	0.5	RTE&SPB-35550	64	0.5
PRLY (Online)	0	0	RTE&SPB-41475	64	0.5
S&ER1	64	0.5	RTE&SPB-47400	64	0.5
S&ER2	64	0.5	RTE&SPB-66360	64	0.5
S&ER3	64	0.5	RTE&SPB-82950	64	0.5
S&ER4	64	0.5	RTE&SPB-99540	64	0.5
S&ER5	64	2	RTE&SPB-110600	64	0.5
S&ER5a	64	2	RTE&SPB-124425	64	0.5
S&ER6	64	1	RTE&SPB-142200	64	0.5
S&ER7	64	0.5	RTE&SPB-165900	64	0.5
S&ER8	64	0.5	SAF-248.85(2)	64	0.5
S&ER10 (Prime)	64	0.5	SAF-142.2	64	4

Table 6 CDS Version 9 Cassini Spacecraft Schedule Repeat Cycles

Mode Name	SRC	Mode Name	SRC
RTE_5	8192	S&ER10 (Online)	64
RTE_10	4096	RTE&SPB-14220	64
RTE_1896	64	RTE&SPB-22120	64
PCHK-24.885	64	RTE&SPB-27650	64
PRLY (Prime)	64	RTE&SPB-33180	64
PRLY (Online)	64	RTE&SPB-35550	64
S&ER1	64	RTE&SPB-41475	64
S&ER2	64	RTE&SPB-47400	64
S&ER3	64	RTE&SPB-66360	64
S&ER4	64	RTE&SPB-82950	64
S&ER5	64	RTE&SPB-99540	64
S&ER5a	64	RTE&SPB-110600	64
S&ER6	64	RTE&SPB-124425	64
S&ER7	64	RTE&SPB-142200	64
S&ER8	64	RTE&SPB-165900	64
S&ER9	64	SAF-248.85(2)	64
S&ER10 (Prime)	64	SAF-142.2	64

Appendix B
Data Product Formats

Table 7: ELS Data Products

Data Rate	Energy	Elevation	Azimuth	Σ
250 bps	32	8	2	512
500 bps	32	8	4	1024
1 kbps	32	8	4	1024
1 kbps SW	32	8	4	1024
2 kbps	63	8	4	2016
2 kbps SW	63	8	4	2016
4 kbps	63	8	8	4032
8 kbps	63	8	16	8064
16 kbps	63	8	16	8064

[1]*Long scan data will be telemetered as 255 steps of sweep data at 3.39% spacing followed by the second sweep at 3.39% spacing. This gives an effective spacing of 1.67% for 510 steps. It will be the ground system's responsibility to merge the sweeps into a single 510 step sweep.*

Table 8 IBS Data Product Collapse and Compress Map

Logical TLM	DPU Acquire = Solar Wind					DPU Acquire = Normal				
	IBS Mode= Standard	IBS Mode = Solar Wind		IBS Mode = Magnetosphere		IBS Mode= Standard	IBS Mode = Solar Wind		IBS Mode = Magnetosphere	
		Search	Track	Search	Survey		Search	Track	Search	Survey
250 bps	128 Sweep Collapse, RLE, 16->8 Compress 3x255x1	128 Sweep Collapse, RLE, 16->8 Compress 3x255x1	128 Sweep Collapse, RLE, 16->8 Compress 3x127x2	128 Sweep Collapse, RLE, 16->8 Compress 3x255x1	64 Sweep Collapse, RLE, 16->8 Compress 3x255x1	128 Sweep Collapse, RLE, 16->8 Compress 3x255x1	128 Sweep Collapse, RLE, 16->8 Compress 3x255x1	128 Sweep Collapse, RLE, 16->8 Compress 3x127x2	128 Sweep Collapse, RLE, 16->8 Compress 3x255x1	64 Sweep Collapse, RLE, 16->8 Compress 3x255x1
500 bps	16 Sweep Collapse, RLE, 16->8 Compress 3x255x8	16 Sweep Collapse, RLE, 16->8 Compress 3x255x8	Peak Snap Shot, RLE, 16-8 Compress 3x127x32	16 Sweep Collapse, RLE, 16->8 Compress 3x255x8	16 Sweep Collapse, RLE, 16->8 Compress 3x510x4	16 Sweep Collapse, RLE, 16->8 Compress 3x255x8	16 Sweep Collapse, RLE, 16->8 Compress 3x255x8	Peak Snap Shot, RLE, 16-8 Compress 3x127x32	16 Sweep Collapse, RLE, 16->8 Compress 3x255x8	16 Sweep Collapse (long scan), RLE, 16->8 Compress 3x510x4
1000 bps	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x127x256	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x510x64	32 Sweep Collapse, RLE, 16->8 Compress 3x255x4	32 Sweep Collapse, RLE, 16->8 Compress 3x255x4	32 Sweep Collapse, RLE, 16->8 Compress 3x127x8	32 Sweep Collapse, RLE, 16->8 Compress 3x255x4	32 Sweep Collapse (long scan), RLE, 16->8 Compress 3x510x2
2000 bps	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x127x256	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x510x64	8 Sweep Collapse, RLE, 16->8 Compress 3x255x16	8 Sweep Collapse, RLE, 16->8 Compress 3x255x16	8 Sweep Collapse, RLE, 16->8 Compress 3x127x32	8 Sweep Collapse, RLE, 16->8 Compress 3x255x16	8 Sweep Collapse, RLE, 16->8 Compress 3x510x8
4000 bps	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress	RLE, 16->8 Compress

Logical TLM	DPU Acquire = Solar Wind					DPU Acquire = Normal				
	IBS Mode= Standard	IBS Mode = Solar Wind		IBS Mode = Magnetosphere		IBS Mode= Standard	IBS Mode = Solar Wind		IBS Mode = Magnetosphere	
		Search	Track	Search	Survey		Search	Track	Search	Survey
	Compress 3x255x128	Compress 3x255x128	Compress 3x127x256	Compress 3x255x128	Compress 3x510x64	Compress 3x255x128	Compress 3x255x128	Compress 3x127x256	Compress 3x255x128	Compress 3x510x64
8000 bps	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x127x256	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x510x64	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x127x256	RLE, 16->8 Compress 3x255x128	RLE, 16->8 Compress 3x510x64
16000 bps	16->8 Compress 3x255x128	16->8 Compress 3x255x128	16->8 Compress 3x127x256	16->8 Compress 3x255x128	16->8 Compress 3x510x64	16->8 Compress 3x255x128	16->8 Compress 3x255x128	16->8 Compress 3x127x256	16->8 Compress 3x255x128	16->8 Compress 3x510x64

Notes:

1) data product dimensions are for a C-Cycle (8 A-Cycles). To determine the data product dimensions for an A-Cycle, divide the azimuthal dimension by 8 (dimensions are EL x E/Q x AZ).

2) Solar wind track will generate two sweeps of 127 steps. One flyback step is included giving a total of 255 steps per 2 seconds.

Table 9: IMS Ions Data Products

Data Rate	Energy	Elev.	Az.	Ions	Σ
250 bps	---	---	--	---	0
500 bps	---	---	--	---	0
1 kbps	32	8	1	1	256
1 kbps SW	---	---	--	---	0
2 kbps	63	8	1	3	1514
2 kbps SW	---	---	--	---	0
4 kbps	63	8	2	3	3026
8 kbps	63	8	2	7	7056
16 kbps	63	8	8	7	28224

Table 10: IMS TOF Data Products

Data Rate	ST		LEF		Σ
	En.	TOF	En.	TOF	
250 bps	----	----	----	----	0
500 bps	----	----	----	----	0
1 kbps	2 (32)	128	2 (32)	128	1024
1 kbps SW	2 (32)	128	----	----	512
2 kbps	2 (32)	256	2 (32)	256	2048
2 kbps SW	2 (32)	256	----	----	1024
4 kbps	4 (32)	256	4 (32)	256	4096
8 kbps	4 (32)	512	4 (32)	512	8192
16 kbps	4 (32)	512	4 (32)	512	8192

Table 11: IMS Singles Data Products

Data Rate	Energy	Elevation	Azimuth	Σ
250 bps	32	8	1	256
500 bps	63	8	1	504
1 kbps	63	8	1	504
1 kbps SW	32	4	1	128
2 kbps	63	8	1	504
2 kbps SW	63	8	1	504
4 kbps	63	8	2	1008
8 kbps	63	8	4	2016
16 kbps	63	8	8	4032

Table 12: IMS Logicals Data Products

Data Rate	Energy	Azimuth	Logical	Σ

Data Rate	Energy	Azimuth	Logical	Σ
250 bps	16	1	1	18
500 bps	63	1	1	66
1 kbps	63	8	1	506
1 kbps SW	63	1	1	66
2 kbps	63	8	1	506
2 kbps SW	63	1	1	66
4 kbps	63	8	2	1010
8 kbps	63	8	3	1514
16 kbps	63	8	4	2018

Table 13 CPU1 MRO

Data Rate	Size
250 bps	576
500 bps	1280
1 kbps	1280
1 kbps SW	1280
2 kbps	3040
2 kbps SW	3040
4 kbps	6080
8 kbps	12160
16 kbps	20304

Note: Size is the amount of data dumped from memory. Add 4 bytes to the size to account for the starting location reported at the beginning of the data product.

Table 14 CPU2 MRO

Data Rate	Size
250 bps	TBD
500 bps	TBD
1 kbps	TBD
1 kbps SW	TBD
2 kbps	TBD
2 kbps SW	TBD
4 kbps	TBD
8 kbps	TBD
16 kbps	TBD

- Develop cyclic mode for survey
  - Survey will be 1 B cycle in 4 kbps, N-1 B cycles in 500 bps
  - No loss of data during mode changes (TOF included)
  - Generalize to N B cycles in one mode and M B cycles in another mode
- Reserve energy step for IMS background
  - Energy step 63 is never collapsed
    - Collapse to 16 means steps 1-4,5-8,9-12,...,53-56,57-60,63
- 16 A cycles per B cycle in 1 and 2 kbps modes, 8 A cycles per B cycle at all other rates
- Ion selection
  - Ion selection works the same way it currently does in 1, 8 and 16 kbps modes
  - In 2 and 4 kbps modes, the third ion may cycle through the remaining ions on a B cycle basis rather than retuning the first three ions
    - The ions returned as a function of B cycle shall be:

B cycle number	*Ions returned*
1	1,2,3
2	1,2,4
3	1,2,5
4	1,2,6
5	1,2,7
6	1,2,8

Table 15 Utilized Telemetry Bandwidth (Bytes)

Product	16 kbps	8 kbps	4 kbps	2 kbps	2 kbps SW	1 kbps	1 kbps SW	500 bps	250 bps
ELS	8064	8064	4032	2016	2016	1024	1024	1024	512
IBS	12240	4096	2048	1024	4074	256	2048	234	54
IBSHeader	20	20	20	20	20	20	20	20	20
IMSIon	28224	7056	3024	1512	0	256	0	0	0
IMSSingles	4032	2016	1008	504	504	504	128	504	256
IMSLogicals	2016	1512	1008	504	64	504	64	64	16
IMSLogicalsHdr	2	2	2	2	2	2	2	2	2
IMSSTTOF	4096	4096	2048	1024	1024	512	512	0	0
IMSLEFTOF	4096	4096	2048	1024	0	512	0	0	0
Actuator	64	64	64	64	64	0	0	0	0
A-CycleHeader	24	24	24	24	24	24	24	24	24
Housekeeping	164	82	82	82	82	82	82	82	82
HK Header	0	2	2	2	2	2	2	2	2
DPID	16	16	16	16	12	16	10	8	8
Checksum	18	18	18	18	14	16	12	10	10
CCSDS	768	384	192	96	96	48	48	24	12
Total	63846	31550	15638	7934	8000	3778	3978	2000	1000
Available	64000	32000	16000	8000	8000	4000	4000	2000	1000
Spare	156	452	364	68	2	224	24	2	2

[1]The IBS data product size represents the total of the IBS secondary header and compressed data.

Table 16 Revised A-Cycle Header

Function	Size (Bytes)	Data Organization
Sync	2	EB90h
A-cycle Counter	1	Counts from 0 to 255 (incremented every A-cycle) and then rolls over.
Data Product Counter	1	Number of data products in this 6-cycle packet.
A-cycle Time Tag	4	CCSDS S/C time format. 32 bit value representing the S/C at beginning of A-cycle (Number of seconds since S/C epoch).
A-cycle Status1	1	Bits 7-6 - TDC singles 13 & 14 selection 5 - CPU2/SAM Mode Change

Function	Size (Bytes)	Data Organization
		0 = No 1 = Yes 4 - Background Data 0 = No 1 = Yes 3-0 - Ion Selection Index
A-cycle Status2	1	Bits 7 – Spare 6 – Ion Deadtime Compensation 5-4 – TDC Config. Register #1 (D5 and D4) 3-2 - Molecule/LEF 00 = N/A 10 = LEF Only 01 = Molecule Only 11 = Both 1 – SAM Bkgnd Comp Function 0 = Disable 1 = Enable 0 - Suspect Data Product 0 = No 1 = Yes
A-cycle Status3	1	Bits 7-5 – Spare Bit 4 – ELS Summing And Averaging 0 – Averaging 1 – Summing Bits 3-0 – Data Product Revision
CPU 2's A-cycle Counter	1	A-cycle number within current B-cycle.
Actuator Position	6	Bits 47-36 - A-cycle start + 0 sec 35-24 - A-cycle start + 8 sec 23-12 - A-cycle start + 16 sec 11-0 - A-cycle start + 24 sec
B-cycle Word 1	2	See 5548-FSFD2
B-cycle Word 2	2	See 5548-FSFD2
Checksum	2	Word by word unsigned summation of header.
Total	24	

Appendix C
Data Product Ids

Table 17 Data Product Id Assignments by Logical TLM

Data Product	16	8	4	2	1	0.5	0.25	Spare
Reserved	0	20	40	60	80	A0	C0	E0
ELS	1	21	41	61	81	A1	C1	E1
IBS	2	22	42	62	82	A2	C2	E2
ELS SW				71	91			
IBS SW				72	92			
IMS ION	4	24	44	64	84	A4	C4	E4
IMS TDC LOG	5	25	45	65	85	A5	C5	E5
IMS TDC SING	6	26	46	66	86	A6	C6	E6
IMS TDC SING SW				76	96			
IMS TDC LOG SW				75	95			
IMS TOF-LEF	7	27	47	67	87	A7	C7	E7
IMS TOF-ST	8	28	48	68	88	A8	C8	E8
IMS TOF-ST SW				78	98			
IMS EVENT-1	9							E9
Spare		29	49	69	89	A9	C9	
IMS EVENT-2	A							EA
Spare		2A	4A	6A	8A	AA	CA	
IMS EVENT-ION	B							EB
Spare		2B	4B	6B	8B	AB	CB	
ACTUATOR	C	2C	4C	6C				EC
ACTUATOR SW				7C				
Spare	3	23	43			A3	C3	E3
Spare							CC	
CPU 1 MRO	D	2D	4D	6D	8D	AD	CD	ED
CPU 2/SAM MRO	E	2E	4E	6E	8E	AE	CE	EE
Housekeeping	F	2F	4F	6F	8F	AF	CF	EF
Housekeeping SW				7F	9F			
Reserved	10	30	50	70	90	B0	D0	F0

Data Product	16	8	4	2	1	0.5	0.25	Spare
Spare	11	31	51			B1	D1	F1
Spare	12	32	52			B2	D2	F2
Spare	13	33	53	73	93	B3	D3	F3
Spare	14	34	54	74	94	B4	D4	F4
Spare	15	35	55			B5	D5	F5
Spare	16	36	56			B6	D6	F6
Spare	17	37	57	77	97	B7	D7	F7
Spare	18	38	58			B8	D8	F8
Spare	19	39	59	79	99	B9	D9	F9
Spare	1A	3A	5A	7A	9A	BA	DA	FA
Spare	1B	3B	5B	7B	9B	BB	DB	FB
Spare	1C	3C	5C		9C	BC	DC	FC
Spare	1D	3D	5D	7D	9D	BD	DD	FD
Spare	1E	3E	5E	7E	9E	BE	DE	FE
Spare	1F	3F	5F			BF	DF	FF

†Product ID's are in hexadecimal representation
*Implementation of these logical telemetry modes is deferred until after launch.

Table 18 Summary Of Data Products

Data Product Length			
DPID (hex)	Source	LTLM (kbps)	Length (bytes)
1	ELS	16	8,064
2	IBS	16	12,240[2]
4	IMS ION	16	28,224
5	IMS TDC LOG	16	2,016
6	IMS TDC SING	16	4,032
7	IMS TOF-LEF	16	4,096
8	IMS TOF-ST	16	4096
9	IMS EVENT-1	16	TBD

Data Product Length			
DPID (hex)	Source	LTLM (kbps)	Length (bytes)
A	IMS EVENT-2	16	TBD
B	IMS EVENT-ION	16	TBD
C	ACT	16	64
D	CPU 1 MRO	16	20,304
E	CPU 2 MRO	16	28,228
F	Housekeeping	16	164
21	ELS	8	8,064
22	IBS	8	4,096[1]
24	IMS ION	8	7,056
25	IMS TDC LOG	8	1,512
26	IMS TDC SING	8	2,016
27	IMS TOF-LEF	8	4,096
28	IMS TOF-ST	8	4,096
2C	ACT	8	64
2D	CPU 1 MRO	8	12,160
2E	CPU 2 MRO	8	TBD
2F	Housekeeping	8	82
41	ELS	4	4,032
42	IBS	4	2,048[1]
44	IMS ION	4	3,024
45	IMS TDC LOG	4	1,008
46	IMS TDC SING	4	1,008
47	IMS TOF-LEF	4	2,048
48	IMS TOF-ST	4	2,048
4C	ACT	4	64
4D	CPU 1 MRO	4	6080
4E	CPU 2 MRO	4	TBD

Data Product Length			
DPID (hex)	Source	LTLM (kbps)	Length (bytes)
4F	Housekeeping	4	82
61	ELS	2	2,016
62	IBS	2	1,024[1]
64	IMS ION	2	1,512
65	IMS TDC LOG	2	504
66	IMS TDC SING	2	504
67	IMS TOF-LEF	2	1,024
68	IMS TOF-ST	2	1,024
6C	ACT	2	64
6D	CPU 1 MRO	2	3,040
6E	CPU 2 MRO	2	3,040
6F	Housekeeping	2	82
71	ELS	2 SW	2,016
72	IBS	2 SW	4,074[1]
75	IMS TDC LOG	2 SW	64
76	IMS TDC SING	2 SW	504
78	IMS TOF-ST	2 SW	1,024
7C	ACT	2 SW	64
7F	Housekeeping	2 SW	82
81	ELS	1	1,024
82	IBS	1	256[1]
84	IMS ION	1	256
85	IMS TDC LOG	1	504
86	IMS TDC SING	1	504
87	IMS TOF-LEF	1	512
88	IMS TOF-ST	1	512
8D	CPU 1 MRO	1	1280
8F	Housekeeping	1	82

Data Product Length			
DPID (hex)	Source	LTLM (kbps)	Length (bytes)
91	ELS	1 SW	1,024
92	IBS	1 SW	2,048[1]
95	IMS TDC LOG	1 SW	64
96	IMS TDC SING	1 SW	128
98	IMS TOF-ST	1 SW	512
9F	Housekeeping	1 SW	82
A1	ELS	0.5	1,024
A2	IBS	0.5	234[1]
A5	IMS TDC LOG	0.5	64
A6	IMS TDC SING	0.5	504
AF	Housekeeping	0.5	82
AD	CPU 1 MRO	0.5	1,280
C1	ELS	0.25	512
C2	IBS	0.25	54[1]
C5	IMS TDC LOG	0.25	16
C6	IMS TDC SING	0.25	256
CD	CPU 1 MRO	0.25	576
CF	Housekeeping	0.25	82

[1]IBS utilizes a second level of compression. The resulting data product size will not be deterministic. The length indicated above represents the maximum telemetry bandwidth allocated to the data product, i.e. IBS data products may be less than but never exceed the allocated bandwidth.
The size does not include a 20 byte IBS header. The total IBS data product size is 12260.

Appendix D
CCSDS Packet Application Ids

Table 19 CCSDS Application Ids

Packet Type ID	Packet Extension Value (hex)	Size (bits)	Packet Description		
			Data Type	S/C TLM Rate (bps)	Logical TLM Rate (bps)
000001	0D01	8000	CAPS DATA	16000	16000
000010	0D02	8000	CAPS DATA	16000	8000
000011	0D03	8000	CAPS DATA	16000	4000
000100	0D04	8000	CAPS DATA	16000	2000
000101	0D05	8000	CAPS DATA	16000	1000
000110	0D06	8000	CAPS DATA	16000	500
000111	0D07	8000	CAPS DATA	16000	250
010100	0D14	8000	CAPS DATA	2000	2000
010101	0D15	8000	CAPS DATA	2000	1000
010110	0D16	8000	CAPS DATA	2000	500
010111	0D17	8000	CAPS DATA	2000	250
011000	0D18	1408	SCI HK	22	N/A
011001	0D19	1408	MAINT HK	11	N/A
100010	0D22	8000	CAPS DATA	8000	8000
100011	0D23	8000	CAPS DATA	8000	4000
100100	0D24	8000	CAPS DATA	8000	2000
100101	0D25	8000	CAPS DATA	8000	1000
100110	0D26	8000	CAPS DATA	8000	500
100111	0D27	8000	CAPS DATA	8000	250
110011	0D33	8000	CAPS DATA	4000	4000
110100	0D34	8000	CAPS DATA	4000	2000
110101	0D35	8000	CAPS DATA	4000	1000
110110	0D36	8000	CAPS DATA	4000	500
110111	0D37	8000	CAPS DATA	4000	250

Appendix E
IBS Search and Track

The CAPS flight software shall provide the following capabilities for IBS data acquisition:

- **Provide a command to configure IBS for one of three operational modes.**
  - The IBS mode command will need a variable parameter list depending on the desired operating mode. The operating mode is switchable on either an A-Cycle or B-Cycle boundary.

    1. Standard Mode (Starting_ESA_Index)
    2. Solar Wind Mode (Search_to_Track_Cycles)
    3. Magnetosphere mode

    Note, the text inside the parentheses indicates parameters for that mode.

- **Provide a static table of ESA voltage steps**
  - The voltage table shall range from 1 eV to 50 keV in 1.67% steps. All ESA sweeps will be derived from this base table. A step index table shall be used to access this table.

- **2 kbps normal, 1 kbps normal, 500 bps and 250 bps data shall be collapsed**
  - The 2 kbps normal, 1kbps normal, 500 bps and 250 bps data products shall be collapsed as specified in table ***Table 8 IBS Data Product Collapse and Compress Map***, compressed and then run length encoded.

- **All data shall be compressed using the existing compression table.**
  - The IBS data shall be compressed from16 to 8 bits utilizing the existing 3% table.
  - In 16 kbps telemetry mode, IBS data shall be compressed using the current 16 to 8 bit compression, but no additional compression shall be performed.

- **IBS data shall be compressed using a lossless run length encoding technique as well as 16 to 8 compression.**
  - For data rates less than 16 kbps, the IBS data shall be compressed a second time using a lossless run length encoding technique.
  - The compressed size of the data packet and the original size shall be reported in the data product.
  - In 8 kbps, 4 kbps, 2 kbps SW and 1 kbps SW telemetry modes, given a threshold value and a data volume limit, IBS shall be compressed using a run length encoding (RLE) of values below the threshold
    - 16 bit values above 7264 counts (0.93 MHz) shall be converted to 8 bit DN 191 (=0xBF=1011 1111)
    - 16 bit values between 7264 counts and the threshold value shall be converted to 8 bit numbers using the current 16 to 8 bit conversion
    - Values below threshold shall be run length compressed using 8 bit data numbers 192 (0xC0 = 1100 0000) to 255 (0xFF =1111 1111).
    - Bits 1 to 5 shall contain the number of sequential data numbers below threshold (1-32 sequential values)
    - Bit 0 shall be an even parity for on-ground identification and correction of single bit errors

  - The IBS data shall be truncated if the compressed data exceeds the data volume limit
    - CPU1 shall count the number of 8 bit data numbers generated per A-cycle
    - When this counter exceeds the data volume limit, CPU1 will truncate the data for that A-Cycle.
    - The data volume limit will be set by telemetry mode as specified in Table 18 Summary Of Data Products.

- CPU1 will use automatic threshold control (ATC) to set the IBS compression threshold.
  - The threshold value shall be based on the last IBS C-cycle in the same sweep pattern as the current cycle
  - CPU1 will approximate the compression threshold when change telemetry rates or IBS modes.
  - When changing collapsed products, the new compression threshold shall be ratio of the previous collapse factor and the new collapse factor.

- **Provide a Standard mode**
  - A SE sweep table that contains the ESA voltages for the encounter. The sweep table will be built from a static on board table containing 1.67% steps. The sweep length shall be 256 steps every 2 seconds
  - Data shall be acquired on second sweeps and telemetered on 32 second boundaries (A-Cycle)

- **Provide a solar wind mode**
  - Provide a search submode.
    - Shall operate on a IBS-cycle which is 8 A-cycles.
    - This shall be the default mode when entering solar wind mode.
    - Shall scan from 150 eV to 10 keV in 255 steps (plus 1 flyback) in 2 seconds. The sweep table will be built from the static on board sweep table.
    - Shall calculate a background level from the raw data (not dead time corrected); BL[Detector]
      - Shall calculate 32 energy blocks
        - Each energy block is the count average of 16 consecutive sweeps and 64 consecutive energies. See Figure 1.

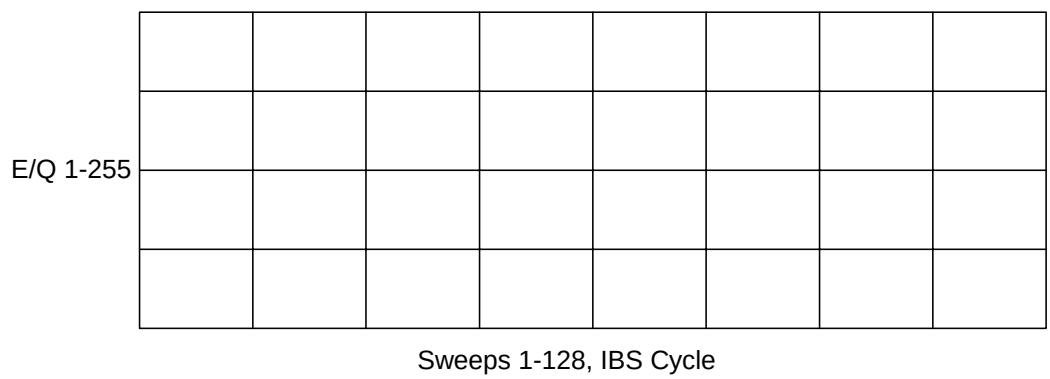

Figure 1 Background Level Energy Blocks

      - Shall select three lowest energy block averages per detector and average those three together to arrive at BL per detector
      - Background level shall be included in telemetry

    - Shall calculate valid beam threshold where T[Detector]=BL[detector] + C*sqrt(BL[Detector]); C shall be configurable and defaults to 5
    - Determine if a valid beam is present in any active detector
      - Find the max count per sweep; save the index to max count
      - If max count > T and the counts in four of the nearest eight bins exceed T then declare a valid beam. See

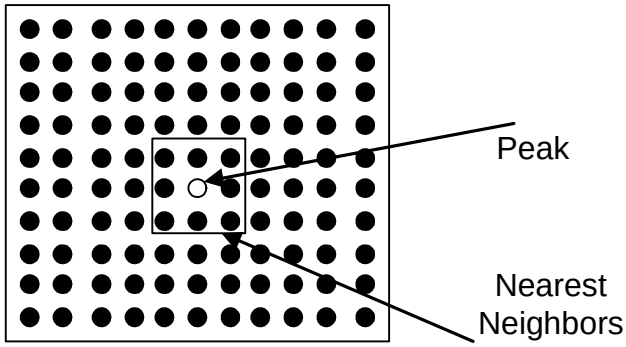

Figure 2 Nearest Neighbors

- If valid beam is declared, transition to track submode on an IBS cycle-boundary

- Provide a track submode
  - Shall sweep 127 energy steps, 1.67% spacing, in 1 second. The sweep table will be built from a static on board table containing 1.67% steps.
  - Shall track the beam peak and adjust the sweep to center the peak once per IBS Cycle
    - Find the energy bin containing the maximum counts
    - Center the beam by adjust the ESA sweep table to ensure the peak occurs at step 63
    - If no beam is found, the peak will remain unchanged.
    - If no beam is. found after three consecutive IBS cycles, the software shall transition to Search submode.
  - Every N IBS cycles the software shall transition to search submode for one cycle. Where N is configurable and defaults to 24.

- **Provide a Magnetosphere Mode**
  - Provide a solar wind search submode
    - Shall scan from 150 eV to 10 keV in 255 steps (plus 1 flyback) in 2 seconds. The sweep table will be built from a static on board table containing 1.67% steps.
  - Provide a magnetosphere/magnetopause survey submode
    - Shall scan from 10eV to 50 keV in two two second sweeps at 1.67% resolution. Each sweep shall alternate energy steps. The actual energy resolution for a given sweep is 3.39%. The effective energy resolution for 510 steps is 1.67%.
  - The flight software shall switch between these two modes on IBS cycle boundaries.
  - Shall calculate background level. The background level shall be included in telemetry.

- The following data shall telemetered in a header in the IBS science telemetry.

Table 20 IBS Data Product Header

Word	Starting Bit	Size	Description	
0	15	8	Data Product Sync	0xB8
0	7	8	Data Product Id	See Table 17
1	15	16	Compressed Data Product Size	Number of words of data to follow header
2	15	16	Uncompressed Data Product Size	Number of “samples” in the data product
3	15	2	IBS Mode	0 = Solar Wind 1 = Magnetosphere 2 = Standard 3 = Calibration
3	13	1	IBS Sub Mode	Solar Wind: 0 = Search 1 = Track Normal: 0 = Search 1 = Survey
3	12	4	Product Sub-part Counter	
3	8	1	Strategy	0=Normal 1=Solar Wind
3	7	8	Unused	
4	15	16	Background Level Fan 1	
5	15	16	Background Level Fan 2	
6	15	16	Background Level Fan 3	
7	15	10	Starting Energy	
7	5	6	Subcycle counter	
8	15	6	Peak Energy Index, A-Cycle	
8	9	2	Detector	
8	7	4	Unused	
8	3	4	Peak Energy Index, Sweep	
9	15	8	Peak Energy Index, Energy Step	
9	7	8	Compression Threshold	
10	15	Var.	Compressed Data	

Appendix F
New or Revised CAPS Commands

Stem: 82DPU_ACQ

Name: DPU Acquisition and Compression Strategies

Purpose: Set CAPS acquisition and compression strategies

Routing: Channel 1; CAPS; Nominal, Critical, System Fault Protection

Command Input Format: 82DPU_ACQ, *Boundary, Strategy*

Input Parameter Descriptions:

Cmd Field	Data Type	Legal Values	Units	Accuracy
Boundary	Enumerated	A_CYCLE, B_CYCLE	n/a	n/a
Strategy	Enumerated	NORMAL, SOLAR_WIND	n/a	n/a

Translation:

Word #	Bit #	Cmd Field	Data Type	Binary Data (MSB to LSB)	Hex
01	15-8	82DPU_ACQ ID	Unsign Integer	1010 1011	AB
01	7-6	Boundary: A_CYCLE	Enumerated	01	1
		Boundary: B_CYCLE	Enumerated	10	2
01	5-1	Unused	Unsign Integer	00 000	0
01	0	Strategy: NORMAL	Unsign Integer	0	0
		Strategy: SOLAR_WIND		1	1

Expanded Parameter Description:

Boundary - CAPS time related boundary for command execution. This parameter has two values:

A_CYCLE - executed on the next A-cycle boundary following an 82DPU_A_CYCLE command
B_CYCLE - executed on the next B-cycle boundary following an 82DPU_B_CYCLE command.

Strategy – Sets the acquisition and compression strategy for the instrument. For ELS, this has no affect. For IBS, this sets the compression ratio and for IMS this determines which data products are produced and the format of the data products. The acquisition strategy is reflected in both housekeeping and the data product identifier.

Discussion:

This command is categorized as a ground (individual) and instrument sequenced command.

Constraints:

This command only affects the following telemetry rates and sensors:

IBS: 2 kbps, 1 kbps

IMS: 2 kbps, 1kbps

ELS: 2 kbps, 1kbps (only affects the DPID, product format remains the same)

Stem: 82ELS_SUM_AVG

Name: ELS Sum Average Control

Purpose: Sets ELS data product summing or averaging

Routing: Channel 1; CAPS; Nominal, Critical, System Fault Protection

Command Input Format: 82ELS_SUM_AVG, *State*

Input Parameter Descriptions:

Cmd Field	Data Type	Legal Values	Units	Accuracy
State	Enumerated	AVERAGE, SUM	n/a	n/a

Translation:

Word #	Bit #	Cmd Field	Data Type	Binary Data (MSB to LSB)	Hex
01	15-8	82ELS_SUM_AVG ID	Unsign Integer	0101 1110	5E
01	7-1	Unused	Unsign Integer	0000 000	00
01	0	State: AVERAGE	Unsign Integer	0	0
		State: SUM		1	1

Expanded Parameter Description:

State - Selects whether the ELS data product is averaged or summed.

Discussion:

This command is an implicit A-cycle command. This command will be executed on the A-cycle boundary following the receipt of an 82DPU_A_CYCLE command.

This command is categorized as a ground (individual) and instrument sequenced command.

The command status is returned in the housekeeping stream at word 12, bit 13.

Constraints:

No SEQTRAN MACRO will be developed for this command. It must be wrapped if issued individually during flight operations.

Stem: 82IBS_MODE

Purpose: Sets IBS data acquisition mode

Routing: Channel 1; CAPS; Nominal, Critical, System Fault Protection

Command Input Format: 82IBS_MODE, *Boundary, Mode, ESA Starting Index, Search To Track Cycles*

Input Parameter Descriptions:

Cmd Field	Data Type	Legal Values	Units	Accuracy
Boundary	Enumerated	A_CYCLE, B_CYCLE	n/a	n/a
Mode	Enumerated	SW_SRCH_TRACK MAG_MODE, STANDARD	n/a	n/a
ESA Starting Index		0 to 392	n/a	n/a
Search To Track Cycles	Unsign Integer	0-31		

Translation:

Word #	Bit #	Cmd Field	Data Type	Binary Data (MSB to LSB)	Hex
01	15-8	82IBS_MODE	Unsign Integer	0110 1111	6F
01	7-6	Boundary: A_CYCLE	Enumerated	01	1
01		Boundary: B_CYCLE	Enumerated	10	2
01	5-2	Unused	Unsign Integer	00 00	
01	1-0	Mode: SW_SRCH_TRACK	Enumerated	00	0
		Mode: MAG_MODE	Enumerated	01	1
		Mode: STANDARD	Enumerated	10	2
02	15-10	Unused	Unsign	0000 00	0
02	9-0	ESA Starting Index	Unsign Integer	XX XXXX XXXX	X
03	15-8	Unused	Unsign Integer	0000 0000	0
03	7-3	Search To Track Cycles	Unsign Integer	XXXX X	X
03	2-0	Unused	Unsign Integer	000	0

Expanded Parameter Description:

Boundary - CAPS time related boundary for command execution. This parameter has two values:

A_CYCLE - executed on the next A-cycle boundary following an 82DPU_A_CYCLE command
B_CYCLE - executed on the next B-cycle boundary following an 82DPU_B_CYCLE command.

Mode – Sets the IBS operating mode.
STANDARD – Sets the IBS sweeping mode to 2 seconds 256 steps.
SW_SRCH_TRACK – Configures IBS for the solar wind search and track mode
MAG_MODE – Configures IBS for Magnetosphere mode

ESA Starting Index – The command sets the starting ESA sweep index. This parameters is only applicable to STANDARD mode. It should be set to 0 for all other modes.

Search to Track Cycles – This parameter sets the number of C- cycles (1 C-Cycle is 8 A-Cycles) that IBS will track the solar wind before searching again. The default is 24 C-Cycles

Discussion:

The command status is returned in the IBS data product header.

This command is categorized as a ground (individual) and instrument sequenced command.

Constraints:

No SEQTRAN MACRO will be developed for this command. It must be wrapped if issued individually during flight operations.

Stem: 82IMS_LOG_SLCT

Purpose: Selects the IMS logicals configuration

Routing: Channel 1; CAPS; Nominal, Critical, System Fault Protection

Command Input Format: 82IMS_ION_SLCT, *Boundary, Logical1, Logical2, Logical3, Logical4*

Input Parameter Descriptions:

Cmd Field	Data Type	Legal Values	Units	Accuracy
Boundary	Enumerated		n/a	n/a
Logical 1	Unsign Integer	0 – 7	n/a	n/a
Logical 2	Unsign Integer	0 – 7	n/a	n/a
Logical 3	Unsign Integer	0 – 7	n/a	n/a
Logical 4	Unsing Integer	0 – 7	n/a	n/a

Translation:

Word #	**Bit #**	**Cmd Field**	**Data Type**	**Binary Data (MSB to LSB)**	**Hex**
01	15-8	82IMS_LOG_SLCT	Unsign Integer	0111 0101	75
01	7-6	Boundary: A_CYCLE	Enumerated	01	1
01		Boundary: B_CYCLE	Enumerated	10	2
01	5-0	Unused	Unsign Integer	00 0000	0
02	15-13	Logical 1	Unsign Integer	xxx	X
02	12-10	Logical 2	Unsign Integer	X xx	X
02	9-7	Logical 3	Unsign Integer	xx x	X
02	6-4	Logical 4	Unsign Integer	xxx	X
02	3-0	Unused	Unsign Integer	0000	0

Expanded Parameter Description:

Boundary - CAPS time related boundary for command execution. This parameter has two values:

A_CYCLE - executed on the next A-cycle boundary following an 82DPU_A_CYCLE command
B_CYCLE - executed on the next B-cycle boundary following an 82DPU_B_CYCLE command.

IMS Logical 1 – Logical selection returned in all telemetry modes

IMS Logical 2 – Logical selection returned in 4, 8 and 16 kbps modes

IMS Logical 3 – Logical selection returned in 8 and 16 kbps modes

IMS Logical 4 – Logical selection returned only in 16 kbps

The mapping of logical values is as follows:

Logical Selections:

0 - Unused
1 - LEF Stop
2 - ST Stop
3 - Timeouts
4 - Total Events (As used in SAM dead time correction)

5 - Logical 13
6 - Logical 14
7 – Unused

Discussion:

This command is categorized as a ground (individual) and instrument sequenced command.
The configuration of the IMS logical values can be found in a 1 word header at the beginning of every logical data product.

Constraints:

No SEQTRAN MACRO will be developed for this command. It must be wrapped if issued individually during flight operations.

Stem: 82IMS_ION_CFG

Purpose: Sets the IMS ion configuration

Routing: Channel 1; CAPS; Nominal, Critical, System Fault Protection

Command Input Format: 82IMS_ION_CFG, *Boundary, State*

Input Parameter Descriptions:

Cmd Field	Data Type	Legal Values	Units	Accuracy
Boundary	Enumerated	A_CYCLE, B_CYCLE	n/a	n/a
State	Enumerated	DISABLE, ENABLE	n/a	n/a

Translation:

Word #	Bit #	Cmd Field	Data Type	Binary Data (MSB to LSB)	Hex
01	15-8	82IMS_ION_CFG	Unsign Integer	0111 0110	76
01	7-6	Boundary: A_CYCLE	Enumerated	01	1
01		Boundary: B_CYCLE	Enumerated	10	2
01	5-2	Unused	Unsign Integer	00 000	00
01	0-1	State: DISABLE	Unsign Integer	00	0
		State: ENABLE		01	1

Expanded Parameter Description:

State –

ENABLE – The first two ions in the data product shall always include ions 1 and 2. The third ion in the data product shall cycle through ion 3 to 7.
DISABLE - the first three ions 1, 2, and 3 shall be included in the data product

Discussion:

This command only affects logical telemetry rates 2 and 4 kbps.

This command is an implicit A-cycle command. This command will be executed on the A-cycle boundary following the receipt of an 82DPU_A_CYCLE command.

This command is categorized as a ground (individual) and instrument sequenced command.

The status of the ion configuration can be found in the housekeeping telemetry stream at word 67, bit 0. The ion number that is currently in ion 3 of telemetry can be found as the first word in the IMS ION data product for 4kbps and 2kbps data

Constraints:

No SEQTRAN MACRO will be developed for this command. It must be wrapped if issued individually during flight operations.

The following command are no longer supported by CAPS:

82IBS_SWP_TBL

82IBS_SWP_INDEX

82IBS_STRATEGY

Appendix G
Revised Housekeeping

Table 21 - CAPS Housekeeping

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
1	15-0	PRIME_HDR_1	CCSDS Primary Header Word 1	16	0-15	*Note 1*	N/A	N/A
2	15-0	PRIME_HDR_2	CCSDS Primary Header Word 2	16	16-31	*Note 1*	N/A	N/A
3	15-0	PRIME_HDR_3	CCSDS Primary Header Word 3	16	32-47	*Note 1*	N/A	N/A
4	15-0	SEC_HDR_1	CCSDS Secondary Header Word 1	16	48-63	*Note 2*	N/A	N/A
5	15-0	SEC_HDR_2	CCSDS Secondary Header Word 2	16	64-79	*Note 2*	N/A	N/A
6	15-0	SEC_HDR_3	CCSDS Secondary Header Word 3	16	80-95	*Note 2*	N/A	N/A
7	15-8	SYS_m5_2V_MN	-5.2 Voltage Supply Monitor	8	96-103	V = VMON * -0.02553 (V)	S-2902	UNSIGNED
7	7-0	SYS_LVPS_IMN	LVPS Current Monitor	8	104-111	I = IMON * 3.922 (mA)	S-2903	UNSIGNED
8	15-8	SYS_p8V_MN	+8 Voltage Supply Monitor	8	112-119	V = VMON * 0.03827 (V)	S-2904	UNSIGNED
8	7-0	SYS_m8V_MN	-8 Voltage Supply Monitor	8	120-127	V = VMON * -0.03922 (V)	S-2905	UNSIGNED
9	15-8	SYS_p5V_MN	+5 VoltageSupply Monitor	8	128-135	V = VMON * 0.02336 (V)	S-2906	UNSIGNED
9	7-0	SYS_p5V_AMN	+5 Analog Voltage Supply Monitor	8	136-143	V = VMON * 0.02336 (V)	S-2907	UNSIGNED
10	15-8	SYS_p15V_MN	+15 Voltage Supply Monitor	8	144-151	V = VMON * 0.06956 (V)	S-2908	UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)

Position W	Position Bit	Parameter Name	Description	Sz	Stream Pos	Interpretation/Conversion	Channel ID	Channel Type
10	7-0	SYS_m15V_MN	-15 Voltage Supply Monitor	8	152-159	V = VMON * -0.07323 (V)	S-2909	UNSIGNED
11	15-8	SYS_LVPS_TMN	Low Voltage Power Supply Temperature Monitor	8	160-167	T = -47.9005394 + 0.6271286011*TMON - 0.001936307643*TMON^2 - 1.115957616E-6*TMON^3 + 2.579906422E-8*TMON^4 °C	S-2910	UNSIGNED
11	7-0	*Spare*	Spare	8	168-175	0	S-2911	UNSIGNED
12	15	ELS_p15_PWR	ELS +15 V High Voltage Power	1	176	0 = OFF 1 = ON	S-2912	STATUS
12	14	ELS_SYNC	ELS Synchronized	1	177	0 = OK 1 = ERROR	S-2913	STATUS
12	13	ELS_SUM_AVG	ELS Summing/Averaging	1	178	0=AVERAGING 1=SUMMING	S-2914	STATUS
12	12	ELS_DTM_PER	ELS Deadtime Period	1	179	0 =1/8 1 = 1/4	S-2915	STATUS
12	11	ELS_DTM_CTRL	ELS Deadtime Algorithm Control	1	180	0 = DISABLE 1 = ENABLE	S-2916	STATUS
12	10	ELS_GRD_CTRL	ELS Grid Control	1	181	0 = DISABLE 1 = ENABLE	S-2917	STATUS
12	9	ELS_SWP_LEN	ELS Sweep Length	1	182	0 = 1 or 32 Steps 1 = 64 Steps	S-2918	STATUS
12	8	ELS_SWP_CTRL	ELS Sweep Control	1	183	0 = DISABLE 1 = ENABLE	S-2919	STATUS
12	7	ELS_SHV_CTRL	ELS Sweep High Voltage Control	1	184	0 = DISABLE 1 = ENABLE	S-2920	STATUS
12	6-2	ELS_PSET_ADJ	ELS Preset Adjust	5	185-189	0-31	S-2921	UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
12	1-0	ELS_dE_CTRL	ELS delta E/E Control	2	190-191	0 = 16% 2 = 25% 1 = 16% 3 = 36%	S-2922	STATUS
13	15-14	ELS_STATE_MN	ELS High Voltage State Monitor	2	192-193	0 = Both SAFE 2 = MCP ARM 1 = Sweep ARM 3 = Both ARM	S-2923	STATUS
13	13-8	ELS_MCP_ADJ	ELS MCP High Voltage Adjust	6	194-199	V_{DAC} = DAC * 58.73 (V)	S-2924	UNSIGNED
13	7	ELS_MCP_CTRL	ELS MCP High Voltage Control	1	200	0 = DISABLE 1 = ENABLE	S-2925	STATUS
13	6	ELS_STM_MODE	ELS Stimulation Mode	1	201	0 = CONSTANT 1 = VARIABLE	S-2926	STATUS
13	5	ELS_STM_CTRL	ELS Stimulation Control	1	202	0 = DISABLE 1 = ENABLE	S-2927	STATUS
13	4-2	ELS_STM_ADJ	ELS Stimulation Adjust	3	203-205	0 = 14.8 mV 4 = 32.7 mV 1 = 19.3mV 5 = 37.2 mV 2 = 23.7mV 6 = 41.6 mV 3 = 28.2mV 7 = 108.8 mV	S-2928	STATUS
13	1-0	*Spare*	Spare	2	206-207	0	S-2929	UNSIGNED
14	15-8	ELS_p15V_MN	ELS +15 Volt Monitor	8	208-215	V = VMON * 0.08994 (V)	S-2930	UNSIGNED
14	7-0	ELS_MCP_MN	ELS MCP High Voltage Monitor	8	216-223	V = VMON * 19.61 (V)	S-2931	UNSIGNED
15	15-8	ELS_MCP_IMN	ELS MCP Current Monitor	8	224-231	I = IMON * 0.196078 (μA)	S-2932	UNSIGNED
15	7-0	ELS_MCP_TMN	ELS MCP Temperature Monitor	8	232-239	T = -52.67739487 +	S-2933	UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
						0.9737095833*TMON - 0.007247802336*TMON^2 + 3.0067853E-5*TMON^3 - 3.6325428E-8*TMON^4 °C		
16	15	ELS_TRAFFIC	ELS Traffic Control	1	240	0 = DISABLE 1 = ENABLE	S-2934	STATUS
16	14-12	ELS_MODE	ELS Operational Mode	3	241-243	0 = Mode A 3 = Mode C1 1 = Mode B 4 =Mode D 2 = Mode C0 5 = Mode E	S-2935	STATUS
16	11-0	ELS_SWP_MN	ELS Sweep High Voltage Monitor (peak)	12	244-255	V = VMON * 1.221 (V)	S-2936	UNSIGNED
17	15	ELS_MN	ELS Monitor value error status	1	256	0 = OK 1 = ERROR	S-2937	STATUS
17	14-12	ELS_MN_ADDR	ELS Monitor Address	3	257-259	0 = +15V 4 = MCP Tmp 1 = Swp HV 5 = HV Safe/Arm 2 = MCP HV 6 = Not Used 3 = MCP Curr 7 = Stim Ampl	S-2938	STATUS
17	11-0	ELS_SWP_MN1	ELS Sweep High Voltage Monitor 1 (trickle)	12	260-271	V = VMON * 1.221 (V)	S-2939	UNSIGNED
18	15-12	ELS_SWSTAT	ELS Software Status	4	272-275	*Not Currently Used*	S-2940	
18	11-0	ELS_SWP_MN2	ELS Sweep High Voltage Monitor 2 (trickle)	12	276-287	V = VMON * 1.221 (V)	S-2941	UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
19	15-4	IBS_ESA_DACO IBS_ESA_DACL IBS_ESA_DACM IBS_ESA_DACH	IBS ESA Sweep High Voltage DAC value (peak)	12	288-299	Range Conversion (V) Off V = DAC * -0.000451880 Low V = DAC * -0.000451880 Med V = DAC * -0.016938349 High V = DAC * -0.634920635	S-2942 S-2943 S-2944 S-2945	UNSIGNED UNSIGNED UNSIGNED UNSIGNED
19	3-2	IBS_ESA_DRNG	IBS ESA Sweep High Voltage DAC range (peak)	2	300-301	0 = Off 2 = Med 1 = Low 3 = High	S-2946	STATUS
19	1	IBS_HV_STATE	IBS High Voltage State	1	302	0 = SAFE 1 = ARM	S-2947	STATUS
19	0	IBS_HV_POWER	IBS High Voltage Power	1	303	0 = OFF 1 = ON	S-2948	STATUS
20	15-8	IBS_CEM_DAC	IBS CEM High Voltage DAC value	8	304-311	V = DAC * (-15.68627451)	S-2949	UNSIGNED
20	7-5	IBS_STM_CHNL	IBS Stimulator Channel Mask	3	312-314	Bit 5:Channel 1 0 = OFF 1 = ON Bit 6:Channel 2 0 = OFF 1 = ON Bit 7:Channel 3 0 = OFF 1 = ON	S-2950	DIGITAL
20	4	IBS_STM_CTRL	IBS Stimulator Control	1	315	0 = DISABLE 1 = ENABLE	S-2951	STATUS
20	3-0	IBS_SIM_FREQ	IBS Stimulator Frequency	4	316-319	0=65.536 kHz 8=131.072 kHz 1=69.905 kHz 9=149.797 kHz 2=74.898 kHz 10=174.763 kHz 3=80.660 kHz 11=209.715 kHz	S-2952	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
						4=87.381 kHz 12=262.144 kHz 5=95.325 kHz 13=349.525 kHz 6=104.858 kHz 14=524.288kHz 7=116.508 kHz 15=No stim		
21	15-4	IBS_ESA_MNO IBS_ESA_MNL IBS_ESA_MNM IBS_ESA_MNH	IBS ESA Sweep High Voltage Monitor (peak)	12	320-331	Range Conversion (V) Off V = VMON * -0.0004744 Low V = VMON * -0.0004744 Med V = VMON * -0.017785 High V = VMON * -0.6667	S-2953 S-2954 S-2955 S-2956	UNSIGNED UNSIGNED UNSIGNED UNSIGNED
21	3-2	IBS_ESA_MRNG	IBS ESA Sweep High Voltage Monitor Range (peak)	2	332-333	0 = Off 2 = Med 1 = Low 3 = High	S-2957	STATUS
21	1	IBS_TRAFFIC	IBS Traffic Control	1	334	0 = DISABLE 1 = ENABLE	S-2958	STATUS
21	0	IBS_HV_CTRL	IBS High Voltage Control	1	335	0 = DISABLE 1 = ENABLE	S-2959	STATUS
22	15-8	IBS_CEM_MN	IBS CEM High Voltage Monitor	8	336-343	V = VMON * -16.470588	S-2960	UNSIGNED
22	7-0	IBS_TMN	IBS Temperature Monitor	8	344-351	T = -47.93090439 + 0.6965667605*TMON - 0.002877314575*TMON^2 + 4.231294952E-6*TMON^3 + 1.539952699E-8*TMON^4 °C	S-2961	UNSIGNED
23	15-12	IBS_SWP_TBL	IBS Sweep Table ID Number	4	352-355	0-15	S-2962	UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
23	11-0	IBS_SWSTAT	IBS Software Status	12	356-367	*Not Currently Used*	S-2963	DIGITAL
24	15-4	IBS_ESA_MN1O IBS_ESA_MN1L IBS_ESA_MN1M IBS_ESA_MN1H	IBS ESA Sweep High Voltage Monitor #1 (trickle)	12	368-379	Range Conversion (V) Off V = VMON * -0.0004744 Low V = VMON * -0.0004744 Med V = VMON * -0.017785 High V = VMON * -0.6667	S-2964 S-2965 S-2966 S-2967	UNSIGNED UNSIGNED UNSIGNED UNSIGNED
24	3-2	IBS_ESA_RNG1	IBS ESA Sweep High Voltage Monitor #1 Range (trickle)	2	380-381	0 = Off 2 = Med 1 = Low 3 = High	S-2968	STATUS
24	1	IBS_DTM_CTRL	IBS Deadtime Algorithm Control	1	382	0 = DISABLE 1 = ENABLE	S-2969	STATUS
24	0	*Spare*	Spare	1	383	0	S-2970	UNSIGNED
25	15-4	IBS_ESA_MN2O IBS_ESA_MN2L IBS_ESA_MN2M IBS_ESA_MN2H	IBS ESA Sweep High Voltage Monitor #2 (trickle)	12	384-395	Range Conversion (V) Off V = VMON * -0.0004744 Low V = VMON * -0.0004744 Med V = VMON * -0.017785 High V = VMON * -0.6667	S-2971 S-2972 S-2973 S-2974	UNSIGNED UNSIGNED UNSIGNED UNSIGNED
25	3-2	IBS_ESA_RNG2	IBS ESA Sweep High Voltage Monitor #2 Range (trickle)	2	396-397	0 = Off 2 = Med 1 = Low 3 = High	S-2975	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
25	1-0	IBS_SWP_SKIP	IBS ESA Sweep Table Index Skip	2	398-399	0-3	S-2976	UNSIGNED
26	15-0	IBS_SWP_INDX	IBS ESA Sweep Table Index	16	400-415	0-600	S-2977	UNSIGNED
27	15-2	IMS_SWSTAT	IMS Software Status	14	416-429	*Not Currently Used*	S-2978	DIGITAL
27	1	IMS_TRAFFIC	IMS Traffic Control	1	430	0 = DISABLE 1 = ENABLE	S-2979	STATUS
27	0	*Spare*	Spare	1	431	0	S-2980	UNSIGNED
28	15	*Spare*	Spare	1	432	0	-	UNSIGNED
28	14-4	CP1_RCVD_CNT	CPU1 Received Command Count	11	433-443	0-4047	S-2981	UNSIGNED
28	3	HVU1_PWR2	HVU1 Power Switch 2	1	444	0 = OFF 1 = ON	S-2982	STATUS
28	2	HVU1_PWR1	HVU1 Power Switch 1	1	445	0 = OFF 1 = ON	S-2983	STATUS
28	1	HVU1_CTRL	HVU1 Control	1	446	0 = DISABLE 1 = ENABLE	S-2984	STATUS
28	0	HVU1_STATE	HVU1 State	1	447	0 = SAFE 1 = ARM	S-2985	STATUS
29	15-8	HVU1_RET_DAC	HVU1 Retarding High Voltage DAC	8	448-455	V = DAC * 0.0627451 (kV)	S-2986	UNSIGNED
29	7-0	HVU1_ACC_DAC	HVU1 Accelerating High Voltage DAC	8	456-463	V = DAC * -0.0627451 (kV)	S-2987	UNSIGNED
30	15-8	HVU1_RET_MN	HVU1 Retarding High Voltage Monitor	8	464-471	V = VMON * 0.0829435 (kV)	S-2988	UNSIGNED
30	7-0	HVU1_ACC_MN	HVU1 Accelerating High Voltage Monitor	8	472-479	V = VMON * -0.0829435 (kV)	S-2989	UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
31	15-8	HVU2_ESA_TBL_ID	HVU2 ESA Sweep Table Id	8	480-487	0-255	TBD	STATUS
31	7-4	*Spare*	Spare	4	488-491	0	-	
31	3	HVU2_SWP_CTR	HVU2 Sweep Control	1	492	0 = DISABLE 1 = ENABLE	S-2990	STATUS
31	2	HVU2_PWR	HVU2 Power	1	493	0 = OFF 1 = ON	S-2991	STATUS
31	1	HVU2_CTRL	HVU2 Control	1	494	0 = DISABLE 1 = ENABLE	S-2992	STATUS
31	0	HVU2_STATE	HVU2 State	1	495	0 = SAFE 1 = ARM	S-2993	STATUS
32	15-8	HVU2_ST_DAC	HVU2 ST MCP DAC	8	496-503	V = DAC * -14.1176 (V)	S-2994	UNSIGNED
32	7-0	HVU2_LEF_DAC	HVU2 LEF MCP DAC	8	504-511	V = DAC * -9.4118 (V)	S-2995	UNSIGNED
33	15-14	*Spare*	Spare	2	512-513	0	S-2996	UNSIGNED
33	13-12	HVU2_ESA_DRG	HVU2 ESA Sweep High Voltage DAC Range (peak)	2	514-515	0 = Off 2 = Med 1 = Low 3 = High	S-2997	STATUS
33	11-0	HVU2_ESA_DAO HVU2_ESA_DAL HVU2_ESA_DAM HVU2_ESA_DAH	HVU2 ESA Sweep High Voltage DAC (peak)	12	516-527	Range Conversion (V) Off V = VMON * -0.00125033 Low V = VMON * -0.00125033 Med V = VMON * -0.04758171 High V = VMON * -1.810745	S-2998 S-2999 S-3000 S-3001	UNSIGNED UNSIGNED UNSIGNED UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
34	15-8	HVU2_ST_MN	HVU2 ST MCP Monitor	8	528-535	V = DAC * -14.82353 (V)	S-3002	UNSIGNED
34	7-0	HVU2_LEF_MN	HVU2 LEF MCP Monitor	8	536-543	V = DAC * -9.88235 (V)	S-3003	UNSIGNED
35	15-14	*Spare*	Spare	2	544-545	0	S-3004	UNSIGNED
35	13-12	HVU2_ESA_MRG	HVU2 ESA Step High Voltage Monitor Range (peak)	2	546-547	0 = Off 2 = Med 1 = Low 3 = High	S-3005	STATUS
35	11-0	HVU2_ESA_MNO HVU2_ESA_MNL HVU2_ESA_MNM HVU2_ESA_MNH	HVU2 ESA Step High Voltage Monitor (peak)	12	548-559	Range Conversion (V) Off V = VMON * -0.0013128 Low V = VMON * -0.0013128 Med V = VMON * -0.0499677 High V = VMON * -1.9012821	S-3006 S-3007 S-3008 S-3009	UNSIGNED UNSIGNED UNSIGNED UNSIGNED
36	15-14	*Spare*	Spare	2	560-561	0	S-3010	UNSIGNED
36	13-12	HVU2_ESA_RG1	HVU2 ESA Step High Voltage Monitor #1 Range (trickle)	2	562-563	0 = Off 2 = Med 1 = Low 3 = High	S-3011	STATUS
36	11-0	HVU2_ESA_M1O HVU2_ESA_M1L HVU2_ESA_M1M HVU2_ESA_M1H	HVU2 ESA Step High Voltage Monitor #1 (trickle)	12	564-575	Range Conversion (V) Off V = VMON * -0.0013128 Low V = VMON * -0.0013128 Med V = VMON * -0.0499677	S-3012 S-3013 S-3014 S-3015	UNSIGNED UNSIGNED UNSIGNED UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
						High V = VMON * -1.9012821		
37	15-14	*Spare*	Spare	2	576-577	0	S-3016	UNSIGNED
37	13-12	HVU2_ESA_RG2	HVU2 ESA Step High Voltage Monitor #2 Range (trickle)	2	578-579	0 = Off 2 = Med 1 = Low 3 = High	S-3017	STATUS
37	11-0	HVU2_ESA_M2O HVU2_ESA_M2L HVU2_ESA_M2M HVU2_ESA_M2H	HVU2 ESA Step High Voltage Monitor #2 (trickle)	12	580-591	Range Conversion (V) Off V = VMON * -0.0013128 Low V = VMON * -0.0013128 Med V = VMON * -0.0499677 High V = VMON * -1.9012821	S-3018 S-3019 S-3020 S-3021	UNSIGNED UNSIGNED UNSIGNED UNSIGNED
38	15-8	HVU2_TMN	HVU2 Temperature Monitor	8	592-599	T = -47.93090439 + 0.6965667605*TMON - 0.002877314575*TMON^2 + 4.231294952E-6*TMON^3 + 1.539952699E-8*TMON^4 °C	S-3022	UNSIGNED
38	7-0	CP1_RJCT_CNT	CPU1 Rejected Command Count	8	600-607	0-255	S-3023	UNSIGNED
39	15-11	*Spare*	Spare	5	608-612	0	-	
39	10	TDC_LOGICAL	TDC Logical Single Select	1	613	0 = ES14 1 = TIMEOUTS	S-3024	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
39	9	TDC_BIT_STAT	TDC Built-In-Test State	1	614	0 = OFF 1 = ON	S-3025	STATUS
39	8	TDC_THRS_ADJ	TDC Threshold Adjust	1	615	0 = DISABLE 1 = ENABLE	S-3026	STATUS
39	7	TDC_ID_CFD	TDC ID CFD	1	616	0 = NO COINCIDENCE 1 = COINCIDENCE	S-3027	STATUS
39	6	TDC_SNG_MODE	TDC Single Mode	1	617	0 = NO COINCIDENCE 1 = COINCIDENCE	S-3028	STATUS
39	5-4	TDC_ENG_SNGS	TDC Engineering Singles ID	2	618-619	0 = Start CFD/Stop CFD 1 = Acq Err/Deadtimes 2 = Single TOFs/Dbl TOFs 3 = Data Strobes/Resets	S-3029	STATUS
39	3	TDC_SAM_FIFO	TDC SAM FIFO State	1	620	0 = DISABLE 1 = ENABLE	S-3030	STATUS
39	2	TDC_NUM_HITS	TDC Number of Hits	1	621	0 = 1 HIT 1 = 2 HITS	S-3031	STATUS
39	1	TDC_PARA_DTM	TDC Paralyzable Deadtime	1	622	0 = DISABLE 1 = ENABLE	S-3032	STATUS
39	0	TDC_RESET	TDC Reset	1	623	0 = OFF 1 = ON	S-3033	STATUS
40	15-14	TDC_DTM_ADJ	TDC Deadtime Adjust	2	624-625	0 = 2.2 µs 2 = 4.0 µs 1 = 2.2 µs 3 = 8.0 µs	S-3034	STATUS
40	13-12	TDC_VERN_ADJ	TDC Vernier Adjust	2	626-627	0 = 0 ps 2 = 1500 ps 1 = 750 ps 3 = 2250 ps	S-3035	STATUS
40	11-9	*Spare*	Spare	3	628-630	0	S-3036	UNSIGNED

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
40	8	FEE_STOP_BIT_HR	Fee Stop Bit High Res	1	631	0 = DISABLE 1 = ENABLE	TBD	STATUS
40	7	FEE_START8	FEE Start 8	1	632	0 = DISABLE 1 = ENABLE	S-3037	STATUS
40	6	FEE_START7	FEE Start 7	1	633	0 = DISABLE 1 = ENABLE	S-3038	STATUS
40	5	FEE_START6	FEE Start 6	1	634	0 = DISABLE 1 = ENABLE	S-3039	STATUS
40	4	FEE_START5	FEE Start 5	1	635	0 = DISABLE 1 = ENABLE	S-3040	STATUS
40	3	FEE_START4	FEE Start 4	1	636	0 = DISABLE 1 = ENABLE	S-3041	STATUS
40	2	FEE_START3	FEE Start 3	1	637	0 = DISABLE 1 = ENABLE	S-3042	STATUS
40	1	FEE_START2	FEE Start 2	1	638	0 = DISABLE 1 = ENABLE	S-3043	STATUS
40	0	FEE_START1	FEE Start 1	1	639	0 = DISABLE 1 = ENABLE	S-3044	STATUS
41	15	FEE_STOP_BIT_MR	Fee Stop Bit Med Res	1	640	0 = DISABLE 1 = ENABLE	S-3045	STATUS
41	14	FEE_STRT_BIT	FEE Start Built-In-Test	1	641	0 = DISABLE 1 = ENABLE	S-3046	STATUS
41	13	FEE_MDRESTOP	FEE Medium Resolution Stop	1	642	0 = DISABLE 1 = ENABLE	S-3047	STATUS
41	12	FEE_HIRESTOP	FEE High Resolution Stop	1	643	0 = DISABLE 1 = ENABLE	S-3048	STATUS
41	11-8	FEE_BIT_FREQ	FEE Built-In-Test Stimulation Frequency	4	644-647	0 = 62.5 kHz 8 = 125 kHz 1 = 66.7 kHz 9 = 142 kHz 2 = 71.4 kHz 10 = 166 kHz 3 = 76.9 kHz 11 = 200 kHz	S-3049	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
						4 = 83.3 kHz 12 = 250 kHz 5 = 90.9 kHz 13 = 333 kHz 6 = 100 kHz 14 = 500 kHz 7 = 111 kHz 15 = 1000 kHz		
41	7-4	FEE_STOP_THR	FEE Stop Threshold	4	648-651	0 = 0.00 8 = OT 1 = TBD 9 = TBD 2 = 0.25 x OT 10 = 1.25 x OT 3 = TBD 11 = TBD 4 = 0.5 x OT 12 = 1.5 x OT 5 = TBD 13 = TBD 6 = 0.75 x OT 14 = 1.75 x OT 7 = TBD 15 = TBD	S-3050	STATUS
41	3-0	FEE_START_TH	FEE Start Threshold	4	652-655	0 = 0.00 8 = OT 1 = TBD 9 = TBD 2 = 0.25 x OT 10 = 1.25 x OT 3 = TBD 11 = TBD 4 = 0.5 x OT 12 = 1.5 x OT 5 = TBD 13 = TBD 6 = 0.75 x OT 14 = 1.75 x OT 7 = TBD 15 = TBD	S-3051	STATUS
42	15-12	FEE_BITSTOP2	FEE Built-In-Test Stop 2 Delay	4	656-659	0 = 62 ns 8 = 1062 ns 1 = 187 ns 9 = 1187 ns 2 = 312 ns 10 = 1312 ns 3 = 437 ns 11 = 1437 ns 4 = 562 ns 12 = 1562 ns 5 = 687 ns 13 = Timeout (1688 ns) 6 = 812 ns 14 = Timeout (1813	S-3052	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
						ns) 7 = 937 ns 15 = Timeout (1938 ns)		
42	11-8	FEE_BITSTOP1	FEE Built-In-Test Stop 1 Delay	4	660-663	0 = 125 ns 8 = 1125 ns 1 = 250 ns 9 = 1250 ns 2 = 375 ns 10 = 1375 ns 3 = 500 ns 11 = 1500 ns 4 = 625 ns 12 = 1625 ns 5 = 750 ns 13 = 1750 ns 6 = 875 ns 14 = 1875 ns 7 = 1000 ns 15 = 2000 ns	S-3053	STATUS
42	7-0	SAM_SECTR_BL	SAM Sector Anode Blank	8	664-671	0: 0 = S 0 OFF 1 = S 0 ON 1: 0 = S 1 OFF 1 = S 1 ON 2: 0 = S 2 OFF 1 = S 2 ON 3: 0 = S 3 OFF 1 = S 3 ON 4: 0 = S 4 OFF 1 = S 4 ON 5: 0 = S 5 OFF 1 = S 5 ON 6: 0 = S 6 OFF 1 = S 6 ON 7: 0 = S 7 OFF 1 = S 7 ON	S-3054	DIGITAL
43	15-12	SAM_ION_IDX	SAM ION Index	4	672-675	0-15	S-3055	UNSIGNED
43	11	SAM_MLUT_IDX	SAM Mass Look Up Table Index	1	676	0-1	S-3056	UNSIGNED
43	10-9	SAM_DP_SELCT	SAM Data Product Select	2	677-678	0 = None 1 = MOL 2 = LEF 3 = Both	S-3057	STATUS
43	8	SAM_HEALTH	SAM Health	1	679	0 = OK 1 = ERROR	S-3058	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
43	7	SAM_WATCHDOG	SAM Watchdog	1	680	0 = DISABLE 1 = ENABLE	S-3059	STATUS
43	6	SAM_SELF_TST	SAM Self Test	1	681	0 = OK 1 = ERROR	S-3060	STATUS
43	5	SAM_FIFO	SAM FIFO	1	682	0 = OK 1 = ERROR	S-3061	STATUS
43	4	SAM_TOF	SAM Time-of-Flight	1	683	0 = OK 1 = ERROR	S-3062	STATUS
43	3	SAM_EVNT_ACC	SAM Event Accumulator	1	684	0 = OK 1 = ERROR	S-3063	STATUS
43	2	SAM_TOF_ACC	SAM Time-of-Flight Accumulator	1	685	0 = OK 1 = ERROR	S-3064	STATUS
43	1	SAM_OPSTATE	SAM Operating State	1	686	0 = RESET 1 = RUN	S-3065	STATUS
43	0	SAM_PWR	SAM Power	1	687	0 = OFF 1 = ON	S-3066	UNSIGNED
44	15-0	SAM_GRP_TBL	SAM Group Table Number	16	688-703	0-65535	S-3067	UNSIGNED
45	15-12	*Spare*	Spare	4	704-707	0	S-3068	UNSIGNED
45	11	SAM_TOF_BKUP	SAM TOF Backup	1	708	0 = DISABLE 1 = ENABLE	TBD	STATUS
45	10	SAM_FIFO_BKUP	SAM FIFO Backup	1	709	0 = DISABLE 1 = ENABLE	TBD	STATUS
45	9	SAM_EV_BKUP	SAM Event Backup	1	710	0 = DISABLE 1 = ENABLE	TBD	STATUS
45	8	SAM_TOF_CMPR	SAM TOF Compress Mode	1	711	0 = OFF 1 = ON	S-3069	STATUS
45	7	SAM_TEST	SAM Test Mode	1	712	0 = Self Test 1 = Normal Op	S-3070	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
45	6	SAM_EV1_2	SAM Dual Stop Event Acc. Mode	1	713	0 = 1st Event 1 = Both Events	S-3071	STATUS
45	5	SAM_CFG_IDX	SAMConfiguration Index	1	714	0 = OFF 1 = ON	S-3072	STATUS
45	4	SAM_BKGD_CMP	SAM Background Compensation	1	715	0 = DISABLE 1 = ENABLE	S-3073	STATUS
45	3	SAM_DTM_CTRL	SAM Deadtime Algorithm Control	1	716	0 = DISABLE 1 = ENABLE	S-3074	STATUS
45	2	SAM_HDWR_BIN	SAM Hardware Binning	1	717	0 = OFF 1 = ON	S-3075	STATUS
45	1-0	SAM_HDWR_LUT	SAM Hardware Look Up Table	2	718-719	0-3	S-3076	UNSIGNED
46	15	*Spare*	Spare	1	720	0	S-3077	UNSIGNED
46	14	ACT_EXEC	Actuator Execution	1	721	0 = STOP 1 = START	S-3078	STATUS
46	13	ACT_TEMP_CMP	Actuator Temperature Compensation	1	722	0 = DISABLE 1 = ENABLE	S-3079	STATUS
46	12	ACT_WOBL_CMP	Actuator Wobble Compensation	1	723	0 = DISABLE 1 = ENABLE	S-3080	STATUS
46	11-0	ACT_FOV_POS1	Actuator Field-of-View Position 1	12	724-735	θ=MON – 104	S-3081	UNSIGNED
47	15-12	ACT_OPMODE	Actuator Operating Mode	4	736-739	0 = FOV 8 = Reserved 1 = PARK 9 = Reserved 2 = RAM 10 = Reserved 3 = SLEW 11 = Reserved 4 = Reserved 12 = Reserved 5 = Reserved 13 = Reserved 6 = Reserved 14 = SEARCH 7 = Reserved 15 = MAINT	S-3082	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
47	11-0	ACT_FOV_POS2	Actuator Field-of-View Position 2	12	740-751	θ=MON – 104	S-3083	UNSIGNED
48	15-8	ACT_CONV_MN	ACT Converter Monitor	8	752-759	V = VMON * 0.09608 (V)	S-3084	UNSIGNED
48	7-0	ACT_TMN	Actuator Temperature Monitor	8	760-767	T = -47.9005394 + 0.6271286011*TMON - 0.001936307643*TMON^2 - 1.115957616E-6*TMON^3 + 2.579906422E-8*TMON^4 (EC)	S-3085	UNSIGNED
49	15-8	ACT_5V_MN	Actuator 5 Volt Monitor	8	768-775	V = VMON * 0.02464 (V)	S-3086	UNSIGNED
49	7-0	ACT_20V_MN	Actuator 20 Volt Monitor	8	776-783	V = VMON * 0.09608 (V)	S-3087	UNSIGNED
50	15-12	ACT_RATE	Actuator Step Execution Rate	4	784-787	0 = 1°/sec 1 = 1/2°/sec 2 = 1/4°/sec 3 = 1/8°/sec	S-3088	STATUS
50	11-0	ACT_POSITION	Actuator Position Decoder	12	788-799	θ = -169.88 + 0.0996 * θMON (°)	S-3089	UNSIGNED
51	15-8	*Spare*	Spare	8	800-807	0	S-3090	UNSIGNED
51	7	BIU_CMD_BIT7	BIU Discrete Command Bit #7 (Reserved)	1	808	0 = DISABLE 1 = ENABLE	S-3091	STATUS
51	6	BIU_CMD_BIT6	BIU Discrete Command Bit #6 (Reserved)	1	809	0 = DISABLE 1 = ENABLE	S-3092	STATUS
51	5	BIU_CMD_BIT5	BIU Discrete Command Bit #5	1	810	0 = DISABLE 1 = ENABLE	S-3093	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
			(Reserved)					
51	4	BIU_WTA_ILCK	BIU Wax Thermal Actuator Interlock	1	811	0 = DISABLE 1 = ENABLE	S-3094	STATUS
51	3	BIU_DPU_BOOT	BIU DPU Boot Address	1	812	0 = 80000h 1 = 90000h	S-3095	STATUS
51	2-1	BIU_OPMODE	BIU CAPS Power Mode Interlock	2	813-814	00 = SLEEP 01 = OP 10 = SLEEP2 11 = OPWART	S-3096	STATUS
-	-	*Spare Channel*	Spare Channel	-	-	0	S-3097	UNSIGNED
51	0	*Spare*	Spare	1	815	0	S-3098	UNSIGNED
52	15	BIU_STA_BIT7	BIU Discrete Status Bit 7 (Reserved)	1	816	0 = NO 1 = YES	S-3099	STATUS
52	14	BIU_STA_BIT6	BIU Discrete Status Bit 6 (Reserved)	1	817	0 = NO 1 = YES	S-3100	STATUS
52	13	BIU_STA_BIT5	BIU Discrete Status Bit 5 (Reserved)	1	818	0 = NO 1 = YES	S-3101	STATUS
52	12	BIU_DPU_SMEM	BIU DPU Shared Memory Test	1	819	0 = OK 1 = ERROR	S-3102	STATUS
52	11	BIU_DPU_ROM	BIU DPU ROM Test	1	820	0 = OK 1 = ERROR	S-3103	STATUS
52	10	BIU_DPU_RAM	BIU DPU RAM Test	1	821	0 = OK 1 = ERROR	S-3104	STATUS
52	9	BIU_DESC_LOC	BIU Descriptor Location	1	822	0 = AUTO 1 = RAM	S-3105	STATUS
52	8	BIU_ROM_BOOT	BIU ROM Boot Complete	1	823	0 = INCOMPLETE 1 = COMPLETE	S-3106	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)

Position W	Position Bit	Parameter Name	Description	Sz	Stream Pos	Interpretation/Conversion	Channel ID	Channel Type
52	7	BIU_HKFORMAT	BIU Housekeeping Format Type	1	824	0 = MAINT 1 = NORMAL	S-3107	STATUS
52	6	*Spare*	Spare	1	825	0	S-3108	UNSIGNED
52	5	BIU_XTRA_RTI	BIU Extra Real Time Interrupt	1	826	0 = NO 1 = YES	S-3109	STATUS
52	4	*Spare*	Spare	1	827	0	S-3110	UNSIGNED
52	3	BIU_MISD_RTI	BIU Missed Real Time Interrupt	1	828	0 = NO 1 = YES	S-3111	STATUS
52	2	BIU_DESC_TBL	BIU Descriptor Table	1	829	0 = OK 1 = ERROR	S-3112	STATUS
52	1	BIU_RAM	BIU RAM	1	830	0 = OK 1 = ERROR	S-3113	STATUS
52	0	BIU_AUTO_INI	BIU Auto Initialization	1	831	0 = OK 1 = ERROR	S-3114	STATUS
53	15-12	*Spare*	Spare	4	832-835	0	S-3115	UNSIGNED
53	11-8	BIU_XTRA_RTC	BIU Extra RTI Count	4	836-839	0-15	S-3116	UNSIGNED
53	7-4	*Spare*	Spare	4	840-843	0	S-3117	UNSIGNED
53	3-0	BIU_MISD_RTC	BIU Missed RTI Count	4	844-847	0-15	S-3118	UNSIGNED
54	15	CPU2_EVENT	CPU2 Event Mode	1	848	0 = DISABLE 1 = ENABLE	S-3119	STATUS
54	14-13	CPU2_LEF_INT	CPU2 TOF LEF Interval	2	849-850	0 = 1 1 = 2 2 = 4	S-3120	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
54	12-11	CPU2_LEF_COL	CPU2 TOF LEF Collapse Option	2	851-852	0-3	S-3121	UNSIGNED
54	10-0	CPU2_LEF_STR	CPU2 TOF LEF Start Channel	11	853-863	0-2047	S-3122	UNSIGNED
55	15	CPU2_EXE_STA	CPU2 Execution State	1	864	0 = ROM 1 = RAM	S-3123	STATUS
55	14-13	CPU2_ST_INT	CPU2 TOF ST Interval	2	865-866	0 = 1 1 = 2 2 = 4	S-3124	STATUS
55	12-11	CPU2_ST_COLL	CPU2 TOF ST Collapse Option	2	867-868	0-3	S-3125	UNSIGNED
55	10-0	CPU2_ST_STA	CPU2 TOF ST Start Channel	11	869-879	0-2047	S-3126	UNSIGNED
56	15-7	*Spare*	Spare	9	880-888	0	S-3127	UNSIGNED
56	6	CPU2_SHMEM	CPU2 Shared Memory Test Status	1	889	0 = OK 1 = ERROR	S-3128	STATUS
56	5	CPU2_SAM_MEM	CPU2 SAM Memory Test Status	1	890	0 = OK 1 = ERROR	S-3129	STATUS
56	4	CPU2_RAM_MEM	CPU2 RAM Memory Test Status	1	891	0 = OK 1 = ERROR	S-3130	STATUS
56	3	CPU2_ROM_MEM	CPU2 ROM Memory Test Status	1	892	0 = OK 1 = ERROR	S-3131	STATUS
56	2	CPU2_WATCHDG	CPU2 Watchdog	1	893	0 = DISABLE 1 = ENABLE	S-3132	STATUS
56	1	CPU2_HEALTH	CPU2 Health	1	894	0 = OK 1 = ERROR	S-3133	STATUS
56	0	CPU2_STATE	CPU2 State	1	895	0 = RESET 1 = RUN	S-3134	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
57	15-0	CPU2_ERROR_1	CPU2 Error Word #1	16	896-911	See Table 22 CPU 1 Error Bit Definitions	S-3135	DIGITAL
58	15-0	CPU2_ERROR_2	CPU2 Error Word #2	16	912-927	See Table 22 CPU 1 Error Bit Definitions	S-3136	DIGITAL
59	15-5	CP1_EXEC_CNT	CPU1 Executed Command Count	11	928-938	0-2047	S-3137	UNSIGNED
59	4	CPU1_SHMEM	CPU1 Shared Memory Test Status	1	939	0 = OK 1 = ERROR	S-3138	STATUS
59	3	CPU1_RAM_MEM	CPU1 RAM Memory Test Status	1	940	0 = OK 1 = ERROR	S-3139	STATUS
59	2	CPU1_ROM_MEM	CPU1 ROM Memory Test Status	1	941	0 = OK 1 = ERROR	S-3140	STATUS
59	1	CPU1_WATCHDG	CPU1 Watchdog	1	942	0 = DISABLE 1 = ENABLE	S-3141	STATUS
59	0	CPU1_EXE_STA	CPU1 Execution State	1	943	0 = ROM 1 = RAM	S-3142	STATUS
60	15-0	CPU1_ERROR_1	CPU1 Error Word #1	16	944-959	See Table 22 CPU 1 Error Bit Definitions	S-3143	DIGITAL
61	15-0	CPU1_ERROR_2	CPU1 Error Word #2	16	960-975	See Table 22 CPU 1 Error Bit Definitions	S-3144	DIGITAL
62	15-14	*Spare*	Spare	2	976-977	0	S-3145	UNSIGNED
62	13-11	SC_TLM_RATE	Spacecraft Telemetry Rate	3	978-980	0 = 16 kbps 1 = 8 kbps 2 = 4 kbps 3 = 2 kbps 4 = 0 kbps	S-3157	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
62	10	DPU_BKG_CTRL	DPU Background Cntl	1	981	0 = DISABLE 1 = ENABLE	S-3146	STATUS
62	9-4	DPU_BKG_INT	DPU Background Interval	6	982-987	0-63	S-3147	UNSIGNED
62	3	DPU_SHTR_PWR	DPU Supplemental Heater Power	1	988	0 = OFF 1 = ON	S-3148	STATUS
62	2	DPU_MODE_CHG	DPU Mode Change	1	989	0 = NO 1 = YES	S-3149	STATUS
62	1-0	DPU_PWR_OPMD	CPU Power Operation Mode	2	990-991	0 = SLEEP 1 = SLEEP 2 = OP 3 = OPWART	S-3150	STATUS
63	15-12	DPU_MODE	DPU Mode	4	992-995	0 = MAINT 1 = LOWPWR (ROM) 2 = CPU2/SAM RDY 3 = LOWPWR (SCI) 4 = NORMAL SCI 5 = SLEEP 6-15 = Reserved	S-3151	STATUS
63	11-8	DPU_BCYCLE	DPU B-cycle Counter	4	996-999	0-15	S-3152	UNSIGNED
63	7-0	DPU_ACYCLE	DPU A-Cycle Counter	8	1000-1007	0-255	S-3153	UNSIGNED
64	15-8	CP1_ILL_CNT	CPU1 Illegal Command Count	8	1008-1015	0-255	S-3154	UNSIGNED
64	7-0	SC_TLM_MODE	Spacecraft Telemetry Mode	8	1016-1023	See Table 3 CDS Version 9 STM Id and Housekeeping	S-3155	DIGITAL

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
						Values		
65	15	SC_MODE_CHG	Spacecraft Mode Change	1	1024	0 = NO 1 = YES	S-3156	STATUS
65	14-13	*spare*	Spare	2	1025-1026	0	S-TBD	UNSIGNED
65	12-10	LTLM_RATE	Logical Telemetry Rate	3	1027-1029	0 = 16 kbps 4 = 1 kbps 1 = 8 kbps 5 = 0.5 kbps 2 = 4 kbps 6 = 0.25 kbps 3 = 2 kbps 7 = n/a	S-3158	STATUS
65	9	SC_CLOCK_STA	Spacecraft Clock Status	1	1030	0 = OK 1 = ADJUSTED	S-3159	STATUS
65	8	TELEMETRY	Telemetry Data Stream Status	1	1031	0 = INVALID 1 = VALID	S-3160	STATUS
65	7-0	CP1_LAST_RCV	CPU1 Last Command Received	8	1032-1039	0-255	S-3161	UNSIGNED
66	15-8	SCLK_MULTR	Sample Clock Multiplier	8	1040-1047	0-255	S-3162	UNSIGNED
66	7-0	SEQ_LAST	Last Activated Sequence Number	8	1048-1055	0-255	S-3163	UNSIGNED
67	15-8	CPU1_INV_CNT	CPU1 Invalid Commands count	8	1056-1063	0	S-3164	UNSIGNED
67	7-4	SEQ_CNT	Active Sequence Counter	4	1064-1067	0-15	S-3165	UNSIGNED
67	3	ALF_LOAD	ALF Block Load	1	1068	0 = OK 1 = ERROR	S-3166	STATUS
67	2	DIST_SEQ	Distributed Sequence	1	1069	0 = OK 1 = ERROR	S-3167	STATUS
67	1	DPU_ACQ	DPU Acquisition and Compression Strategy	1	1070	0=NORMAL 1=SOLAR_WIND	S-3168	STATUS

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
67	0	IMS_ION_CFG	IMS Ion Configuration	1	1071	0=DISABLE 1=ENABLE	S-3169	STATUS
68	15-8	CP2_RCVD_CNT	CPU2 Received Command Count	8	1072-1079	0-255	S-3170	UNSIGNED
68	7-0	CP2_EXEC_CNT	CPU2 Executed Command Count	8	1080-1087	0-255	S-3171	UNSIGNED
69	15-8	CP2_RJCT_CNT	CPU2 Rejected Command Count	8	1088-1095	0-255	S-3172	UNSIGNED
69	7-0	CP2_ILL_CNT	CPU2 Illegal Command Count	8	1096-1103	0-255	S-3173	UNSIGNED
70	15-8	CP2_LAST_RCV	CPU2 Last Command Received	8	1104-1111	0-255	S-3174	UNSIGNED
70	7-0	CP2_INV_CNT	CPU2 Invalid Count	8	1112-1119	0	S-3175	UNSIGNED
71	15-8	HK_MRO_TBLNO	Housekeeping MRO Table Number	8	1120-1127	See Conversion Table 2	S-3176	UNSIGNED
71	7-0	HK_MRO_ADMSB	HK MRO Address MSB	8	1128-1135	MRO Addr MSB	S-3177	DIGITAL
72	15-0	HK_MRO_ADLSW	HK MRO Address LSW	16	1136-1151	MRO Addr LSW	S-3178	DIGITAL
73	15-0	HK_MRO_0	Housekeeping MRO Word #0	16	1152-1167	Hexadecimal	S-3179	DIGITAL
74	15-0	HK_MRO_1	Housekeeping MRO Word #1	16	1168-1183	Hexadecimal	S-3180	DIGITAL
75	15-0	HK_MRO_2	Housekeeping MRO Word #2	16	1184-1199	Hexadecimal	S-3181	DIGITAL
76	15-0	HK_MRO_3	Housekeeping MRO Word #3	16	1200-1215	Hexadecimal	S-3182	DIGITAL
77	15-0	HK_MRO_4	Housekeeping MRO Word #4	16	1216-1231	Hexadecimal	S-3183	DIGITAL

Cassini/CAPS Housekeeping Stream Format (Packet ID 2082.24)								
Position		**Parameter Name**	**Description**	**Sz**	**Stream Pos**	**Interpretation/Conversion**	**Channel ID**	**Channel Type**
W	**Bit**							
78	15-0	HK_MRO_5	Housekeeping MRO Word #5	16	1232-1247	Hexadecimal	S-3184	DIGITAL
79	15-0	HK_MRO_6	Housekeeping MRO Word #6	16	1248-1263	Hexadecimal	S-3185	DIGITAL
80	15-0	HK_MRO_7	Housekeeping MRO Word #7	16	1264-1279	Hexadecimal	S-3186	DIGITAL
81	15-0	HK_MRO_8	Housekeeping MRO Word #8	16	1280-1295	Hexadecimal	S-3187	DIGITAL
82	15-0	HK_MRO_9	Housekeeping MRO Word #9	16	1296-1311	Hexadecimal	S-3188	DIGITAL
83	15-0	HK_MRO_10	Housekeeping MRO Word #10	16	1312-1327	Hexadecimal	S-3189	DIGITAL
84	15-0	HK_MRO_11	Housekeeping MRO Word #11	16	1328-1343	Hexadecimal	S-3190	DIGITAL
85	15-0	HK_MRO_12	Housekeeping MRO Word #12	16	1344-1359	Hexadecimal	S-3191	DIGITAL
86	15-0	HK_MRO_13	Housekeeping MRO Word #13	16	1360-1375	Hexadecimal	S-3192	DIGITAL
87	15-0	HK_MRO_14	Housekeeping MRO Word #14	16	1376-1391	Hexadecimal	S-3193	DIGITAL
88	15-0	HK_MRO_15	Housekeeping MRO Word #15	16	1392-1407	Hexadecimal	S-3194	DIGITAL

Table 22 CPU 1 Error Bit Definitions

CPU 1 Error Bit Definitions	
Error 1	**Bit**
INVALID_TLM_MODE	0
INVALID_OP_MODE	1
INVALID_TABLE_ID	2
INVALID_ALF_SEQ_NO	3
INVALID_ALF_CHKSUM	4
INVALID_SYS_STATE_ALF	5
INVALID_OP_CODE	6
ILLEGAL_OPCODE	7
INVALID_COMMAND_FORMAT	8
INVALID_COMMAND_CHKSUM	9
INVALID_ACT_STATE_MODE	10
INVALID_BIU_STATE_MODE	11
INVALID_ELS_STATE_MODE	12
INVALID_IBS_STATE_MODE	13
INVALID_CPU2_STATE	14
BIU_RECEIVE_ERROR	15
Error 2	
SEQ_CHECKSUM_ERROR	16
SEQ_TRIGGER_ERROR	17
INVALID_COMMAND_STATE	18
ELS_THRESHOLD	19
IBS_THRESHOLD	30
IMS_THRESHOLD	21
DIST_SEQUENCE_ERROR	22
MEM_CHECKSUM_ERROR	23
CPU2_WATCHDOG_EXPIRED	24
SYSTEM_RAM_ERROR	25
HIGH_VOLTAGE_ERROR	26
BIU_WDOG_EXPIRE	27
ACT_LIMIT_ERROR	28
Spare	29

Spare	30
Spare	31

Table 23 CPU 2 Error Bit Definitions

CPU 2 Error Bit Definitions	
Error 1	**Bit**
Spare	0
Spare	1
Spare	2
Spare	3
Spare	4
Spare	5
Spare	6
Spare	7
Spare	8
Spare	9
Spare	10
Spare	11
Spare	12
Spare	13
Spare	14
Spare	15
Error 2	
Spare	16
Spare	17
Spare	18
Spare	19
Spare	30
Spare	21
Spare	22
Spare	23
Spare	24
Spare	25
Spare	26

Spare	27
Spare	28
Spare	29
Spare	30
Spare	31

Table 24 Memory Readout Tables

Table Name	Table ID
ELS MCP TOLERANCE TABLE	2
IBS CEM TOLERANCE TABLE	3
IBS ESA TOLERANCE TABLE	4
HVU1 ACC TOLERANCE TABLE	5
HVU1 RET TOLERANCE TABLE	6
HVU2 ESA TOLERANCE TABLE	7
HVU2 LEF TOLERANCE TABLE	8
HVU2 ST TOLERANCE TABLE	9
ACT STEP TABLE 1	10
ACT STEP TABLE 2	11
ACT STEP TABLE 3	12
ACT ACCEL/DECEL TABLE	13
ELS/IBS COMPRESSION TABLE	15
REVISION ID	16
ELS SWEEP MONITOR TABLE	19
IBS SW SEARCH TABLE	20
IBS MAG TABLE 1	21
IBS MAG TABLE 2	22
IBS STD TABLE	23
IBS SWEEP MONITOR TABLE	24
HVU2 ESA SWEEP TABLE 1	30
HVU2 ESA SWEEP TABLE 2	31
HVU2 ESA SWEEP TABLE 3	32
HVU2 ESA SWEEP TABLE 4	33
IMS SWEEP MONITOR TABLE	34

GROUP TABLE 1	40
GROUP TABLE 2	41
GROUP TABLE 3	42
ANCILLARY S/C DATA	44
IEBs	50
MODE TRANSITION SEQUENCE LOW/PWR TO NORMAL SCIENCE	59
MODE TRANSITION SEQUENCE NORMAL SCIENCE TO LOW/PWR	60
MODE TRANSITION SEQUENCE NORMAL_SCIENCE TO SLEEP	61
MODE TRANSITION SEQUENCE SLEEP TO NORMAL SCIENCE	62
MODE TRANSITION SEQUENCE SLEEP TO LOW/PWR	63

Logical Id	Description
0	Not Used
1	LEF Stop
2	ST Stop
3	Timeouts
4	Total Events (As used in SAM dead time correction)
5	Logical 13
6	Logical 14
7	Not Used

Appendix H
IBS Sweep and Sweep Index Tables

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
0	48946.42	2576.13	4057			3FDA	2576.51
1	48142.44	2533.81	3991			3F97	2533.97
2	47351.67	2492.19	3925			3F56	2492.70
3	46573.89	2451.26	3861			3F15	2451.43
4	45808.88	2410.99	3797			3ED6	2411.43
5	45056.44	2371.39	3735			3E97	2371.43
6	44316.35	2332.44	3674			3E5A	2332.70
7	43588.43	2294.13	3613			3E1E	2294.60
8	42872.46	2256.45	3554			3DE2	2256.51
9	42168.25	2219.38	3496			3DA8	2219.68
10	41475.60	2182.93	3438			3D6F	2183.49
11	40794.34	2147.07	3382			3D36	2147.30
12	40124.26	2111.80	3326			3CFF	2112.38
13	39465.19	2077.12	3271			3CC8	2077.46
14	38816.95	2043.00	3218			3C92	2043.17
15	38179.36	2009.44	3165			3C5D	2009.52
16	37552.23	1976.43	3113			3C29	1976.51
17	36935.41	1943.97	3062			3BF6	1944.13
18	36328.72	1912.04	3011			3BC4	1912.38
19	35732.00	1880.63	2962			3B92	1880.63
20	35145.08	1849.74	2913			3B62	1850.16
21	34567.79	1819.36	2865			3B32	1819.68
22	33999.99	1789.47	2818			3B03	1789.84
23	33441.52	1760.08	2772			3AD5	1760.63
24	32892.22	1731.17	2727			3AA7	1731.43
25	32351.94	1702.73	2682			3A7A	1702.86
26	31820.54	1674.77	2638			3A4E	1674.92
27	31297.87	1647.26	2594			3A23	1647.62
28	30783.78	1620.20	2552			39F8	1620.32
29	30278.13	1593.59	2510			39CE	1593.65
30	29780.79	1567.41	2469			39A5	1567.62
31	29291.62	1541.66	2428			397D	1542.22
32	28810.49	1516.34	2388			3955	1516.83
33	28337.26	1491.43	2349			392E	1492.06
34	27871.80	1466.94	2310			3907	1467.30
35	27413.98	1442.84	2272			38E1	1443.17
36	26963.69	1419.14	2235			38BC	1419.68
37	26520.79	1395.83	2198			3897	1396.19
38	26085.17	1372.90	2162			3873	1373.33
39	25656.70	1350.35	2127			384F	1350.48
40	25235.27	1328.17	2092			382C	1328.25
41	24820.77	1306.36	2058			380A	1306.67
42	24413.07	1284.90	2024			37E8	1285.08
43	24012.07	1263.79	1990			37C7	1264.13
44	23617.65	1243.03	1958			37A6	1243.17
45	23229.72	1222.62	1926			3786	1222.86
46	22848.15	1202.53	1894			3766	1202.54
47	22472.86	1182.78	1863			3747	1182.86
48	22103.72	1163.35	1832			3729	1163.81
49	21740.65	1144.24	1802			370B	1144.76
50	21383.55	1125.45	1773			36ED	1125.71
51	21032.31	1106.96	1743			36D0	1107.30
52	20686.84	1088.78	1715			36B3	1088.89
53	20347.04	1070.90	1687			3697	1071.11
54	20012.83	1053.31	1659			367B	1053.33
55	19684.10	1036.01	1632			3660	1036.19
56	19360.78	1018.99	1605			3645	1019.05
57	19042.77	1002.25	1579			362B	1002.54
58	18729.97	985.79	1553			3611	986.03
59	18422.32	969.60	1527			35F8	970.16
60	18119.72	953.67	1502			35DF	954.29
61	17822.09	938.00	1477			35C6	938.41
62	17529.35	922.60	1453			35AE	923.17
63	17241.42	907.44	1429			3596	907.94
64	16958.22	892.54	1406			357E	892.70

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
65	16679.67	877.88	1383			3567	878.10
66	16405.69	863.46	1360			3550	863.49
67	16136.22	849.27	1338			353A	849.52
68	15871.17	835.32	1316			3524	835.56
69	15610.48	821.60	1294			350F	822.22
70	15354.06	808.11	1273			34F9	808.25
71	15101.86	794.83	1252			34E4	794.92
72	14853.80	781.78	1231			34D0	782.22
73	14609.82	768.94	1211			34BC	769.52
74	14369.84	756.31	1191			34A8	756.83
75	14133.81	743.88	1172			3494	744.13
76	13901.65	731.67	1152			3481	732.06
77	13673.31	719.65	1133			346E	720.00
78	13448.71	707.83	1115			345B	707.94
79	13227.81	696.20	1097			3449	696.51
80	13010.53	684.76	1079			3437	685.08
81	12796.83	673.52	1061			3425	673.65
82	12586.63	662.45	1043			3414	662.86
83	12379.88	651.57	1026			3403	652.06
84	12176.54	640.87	1009			33F2	641.27
85	11976.53	630.34	993			33E1	630.48
86	11779.81	619.99	976			33D1	620.32
87	11586.31	609.81	960			33C1	610.16
88	11396.00	599.79	945			33B1	600.00
89	11208.81	589.94	929			33A2	590.48
90	11024.70	580.25	914			3392	580.32
91	10843.61	570.72	899			3383	570.79
92	10665.50	561.34	884			3375	561.90
93	10490.31	552.12	870			3366	552.38
94	10318.00	543.05	855			3358	543.49
95	10148.52	534.13	841			334A	534.60
96	9981.82	525.36	827			333C	525.71
97	9817.87	516.73	814			332E	516.83
98	9656.60	508.24	800			3321	508.57
99	9497.98	499.89	787			3314	500.32
100	9341.97	491.68	774			3307	492.06
101	9188.52	483.61	762			32FA	483.81
102	9037.60	475.66	749			32EE	476.19
103	8889.15	467.85	737			32E1	467.94
104	8743.14	460.17	725			32D5	460.32
105	8599.53	452.61	713			32C9	452.70
106	8458.27	445.17	701			32BE	445.71
107	8319.34	437.86	690			32B2	438.10
108	8182.69	430.67	678			32A7	431.11
109	8048.28	423.59	667			329C	424.13
110	7916.08	416.64	656			3291	417.14
111	7786.06	409.79	645			3286	410.16
112	7658.17	403.06	635			327B	403.17
113	7532.37	396.44	624			3271	396.83
114	7408.65	389.93	614			3267	390.48
115	7286.96	383.52	604			325D	384.13
116	7167.26	377.22	594			3253	377.78
117	7049.54	371.03	584			3249	371.43
118	6933.74	364.93	575			323F	365.08
119	6819.85	358.94	565			3236	359.37
120	6707.83	353.04	556			322D	353.65
121	6597.65	347.24	547			3223	347.30
122	6489.28	341.54	538			321A	341.59
123	6382.69	335.93	529			3212	336.51
124	6277.85	330.41	520			3209	330.79
125	6174.73	324.99	512			3200	325.08
126	6073.31	319.65	503			31F8	320.00
127	5973.55	314.40	495			31F0	314.92
128	5875.43	309.23	487			31E8	309.84
129	5778.92	304.15	479			31E0	304.76
130	5684.00	299.16	471			31D8	299.68

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
131	5590.63	294.24	463			31D0	294.60
132	5498.80	289.41	456			31C8	289.52
133	5408.48	284.66	448			31C1	285.08
134	5319.64	279.98	441			31B9	280.00
135	5232.27	275.38	434			31B2	275.56
136	5146.32	270.86	427			31AB	271.11
137	5061.79	266.41	420			31A4	266.67
138	4978.65	262.03	413			319D	262.22
139	4896.87	257.73	406			3196	257.78
140	4816.43	253.50	399			3190	253.97
141	4737.32	249.33	393			3189	249.52
142	4659.51	245.24	386			3183	245.71
143	4582.97	241.21	380			317C	241.27
144	4507.69	237.25	374			3176	237.46
145	4433.65	233.35	368			3170	233.65
146	4360.83	229.52	361			316A	229.84
147	4289.20	225.75	356			3164	226.03
148	4218.74	222.04	350			315E	222.22
149	4149.45	218.39	344			3158	218.41
150	4081.29	214.80	338			3153	215.24
151	4014.25	211.28	333			314D	211.43
152	3948.31	207.81	327			3148	208.25
153	3883.46	204.39	322			3142	204.44
154	3819.67	201.04	317			313D	201.27
155	3756.93	197.73	311			3138	198.10
156	3695.22	194.49	306			3133	194.92
157	3634.53	191.29	301			312E	191.75
158	3574.83	188.15	296			3129	188.57
159	3516.11	185.06	291			3124	185.40
160	3458.35	182.02	287			311F	182.22
161	3401.55	179.03	282			311A	179.05
162	3345.67	176.09	277			3116	176.51
163	3290.72	173.20	273			3111	173.33
164	3236.67	170.35	268			310D	170.79
165	3183.50	167.55	264			3108	167.62
166	3131.21	164.80	260			3104	165.08
167	3079.78	162.09	255			3100	162.54
168	3029.19	159.43	251			30FC	160.00
169	2979.43	156.81	247			30F7	156.83
170	2930.49	154.24	243			30F3	154.29
171	2882.36	151.70	239			30EF	151.75
172	2835.01	149.21	235			30EC	149.84
173	2788.45	146.76	231			30E8	147.30
174	2742.65	144.35	227			30E4	144.76
175	2697.60	141.98	224			30E0	142.22
176	2653.29	139.65	220			30DC	139.68
177	2609.70	137.35	216			30D9	137.78
178	2566.84	135.10	213			30D5	135.24
179	2524.68	132.88	209			30D2	133.33
180	2483.21	130.70	206			30CE	130.79
181	2442.42	128.55	202			30CB	128.89
182	2402.30	126.44	199			30C8	126.98
183	2362.84	124.36	196			30C4	124.44
184	2324.03	122.32	193			30C1	122.54
185	2285.85	120.31	189			30BE	120.63
186	2248.31	118.33	186			30BB	118.73
187	2211.38	116.39	183			30B8	116.83
188	2175.05	114.48	180			30B5	114.92
189	2139.33	112.60	177			30B2	113.02
190	2104.19	110.75	174			30AF	111.11
191	2069.62	108.93	172			30AC	109.21
192	2035.63	107.14	169			30A9	107.30
193	2002.19	105.38	166			30A6	105.40
194	1969.31	103.65	163			30A4	104.13
195	1936.96	101.95	161			30A1	102.22
196	1905.14	100.27	158			309E	100.32

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
197	1873.85	98.62	155			309C	99.05
198	1843.07	97.00	153			3099	97.14
199	1812.80	95.41	150			3097	95.87
200	1783.02	93.84	148			3094	93.97
201	1753.73	92.30	145			3092	92.70
202	1724.93	90.79	143			308F	90.79
203	1696.59	89.29	141			308D	89.52
204	1668.73	87.83	138			308B	88.25
205	1641.32	86.39	136			3089	86.98
206	1614.36	84.97	134			3086	85.08
207	1587.84	83.57	132			3084	83.81
208	1561.76	82.20	129			3082	82.54
209	1536.10	80.85	127			3080	81.27
210	1510.87	79.52	125			307E	80.00
211	1486.06	78.21	123			307C	78.73
212	1461.65	76.93	121			307A	77.46
213	1437.64	75.67	119			3078	76.19
214	1414.02	74.42	117			3076	74.92
215	1390.80	73.20	115			3074	73.65
216	1367.95	72.00	113			3072	72.38
217	1345.48	70.81	112			3070	71.11
218	1323.38	69.65	110			306E	69.84
219	1301.65	68.51		4045		2FCD	-32.38
220	1280.26	67.38		3978		2F8B	-74.29
221	1259.24	66.28		3913		2F49	-116.19
222	1238.55	65.19		3848		2F09	-156.83
223	1218.21	64.12		3785		2ECA	-196.83
224	1198.20	63.06		3723		2E8C	-236.19
225	1178.52	62.03		3662		2E4E	-275.56
226	1159.16	61.01		3602		2E12	61.01
227	1140.12	60.01		3543		2DD7	60.01
228	1121.39	59.02		3484		2D9D	59.03
229	1102.97	58.05		3427		2D64	58.06
230	1084.85	57.10		3371		2D2B	57.10
231	1067.04	56.16		3316		2CF4	56.17
232	1049.51	55.24		3261		2CBE	55.25
233	1032.27	54.33		3208		2C88	54.34
234	1015.31	53.44		3155		2C53	53.44
235	998.64	52.56		3103		2C20	52.58
236	982.23	51.70		3052		2BED	51.71
237	966.10	50.85		3002		2BBA	50.85
238	950.23	50.01		2953		2B89	50.02
239	934.62	49.19		2904		2B59	49.21
240	919.27	48.38		2856		2B29	48.39
241	904.17	47.59		2809		2AFA	47.60
242	889.32	46.81		2763		2ACC	46.82
243	874.71	46.04		2718		2A9E	46.04
244	860.34	45.28		2673		2A72	45.29
245	846.21	44.54		2629		2A46	44.55
246	832.31	43.81		2586		2A1B	43.82
247	818.64	43.09		2544		29F0	43.09
248	805.19	42.38		2502		29C6	42.38
249	791.97	41.68		2461		299D	41.69
250	778.96	41.00		2420		2975	41.01
251	766.16	40.32		2381		294D	40.33
252	753.58	39.66		2342		2926	39.67
253	741.20	39.01		2303		2900	39.03
254	729.03	38.37		2265		28DA	38.38
255	717.05	37.74		2228		28B5	37.76
256	705.27	37.12		2191		2890	37.13
257	693.69	36.51		2155		286C	36.52
258	682.30	35.91		2120		2849	35.93
259	671.09	35.32		2085		2826	35.33
260	660.07	34.74		2051		2803	34.74
261	649.22	34.17		2017		27E2	34.18
262	638.56	33.61		1984		27C1	33.62

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
263	628.07	33.06		1952		27A0	33.06
264	617.75	32.51		1920		2780	32.52
265	607.61	31.98		1888		2760	31.98
266	597.63	31.45		1857		2741	31.45
267	587.81	30.94		1826		2723	30.95
268	578.15	30.43		1796		2705	30.44
269	568.66	29.93		1767		26E7	29.93
270	559.32	29.44		1738		26CA	29.44
271	550.13	28.95		1709		26AE	28.96
272	541.09	28.48		1681		2692	28.49
273	532.21	28.01		1654		2676	28.02
274	523.46	27.55		1627		265B	27.56
275	514.87	27.10		1600		2640	27.10
276	506.41	26.65		1574		2626	26.66
277	498.09	26.22		1548		260C	26.22
278	489.91	25.78		1522		25F3	25.80
279	481.86	25.36		1497		25DA	25.37
280	473.95	24.94		1473		25C1	24.95
281	466.16	24.53		1448		25A9	24.54
282	458.51	24.13		1425		2591	24.14
283	450.97	23.74		1401		257A	23.75
284	443.57	23.35		1378		2563	23.36
285	436.28	22.96		1356		254C	22.97
286	429.11	22.58		1333		2536	22.60
287	422.07	22.21		1311		2520	22.22
288	415.13	21.85		1290		250A	21.85
289	408.31	21.49		1269		24F5	21.49
290	401.61	21.14		1248		24E0	21.14
291	395.01	20.79		1227		24CC	20.80
292	388.52	20.45		1207		24B8	20.46
293	382.14	20.11		1187		24A4	20.12
294	375.86	19.78		1168		2490	19.78
295	369.69	19.46		1149		247D	19.46
296	363.62	19.14		1130		246A	19.14
297	357.65	18.82		1111		2458	18.84
298	351.77	18.51		1093		2446	18.53
299	345.99	18.21		1075		2434	18.23
300	340.31	17.91		1057		2422	17.92
301	334.72	17.62		1040		2411	17.63
302	329.22	17.33		1023		23FF	17.33
303	323.81	17.04		1006		23EF	17.06
304	318.49	16.76		990		23DE	16.77
305	313.26	16.49		973		23CE	16.50
306	308.12	16.22		957		23BE	16.23
307	303.06	15.95		942		23AE	15.96
308	298.08	15.69		926		239F	15.70
309	293.18	15.43		911		238F	15.43
310	288.37	15.18		896		2381	15.19
311	283.63	14.93		881		2372	14.94
312	278.97	14.68		867		2363	14.69
313	274.39	14.44		853		2355	14.45
314	269.88	14.20		839		2347	14.21
315	265.45	13.97		825		2339	13.97
316	261.09	13.74		811		232C	13.75
317	256.80	13.52		798		231E	13.52
318	252.58	13.29		785		2311	13.30
319	248.43	13.08		772		2304	13.08
320	244.35	12.86		759		22F8	12.87
321	240.34	12.65		747		22EB	12.65
322	236.39	12.44		735		22DF	12.45
323	232.51	12.24		722		22D3	12.25
324	228.69	12.04		711		22C7	12.04
325	224.93	11.84		699		22BB	11.84
326	221.24	11.64		687		22B0	11.65
327	217.60	11.45		676		22A5	11.47
328	214.03	11.26		665		229A	11.28

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
329	210.51	11.08		654		228F	11.09
330	207.06	10.90		643		2284	10.91
331	203.66	10.72		633		2279	10.72
332	200.31	10.54		622		226F	10.55
333	197.02	10.37		612		2265	10.38
334	193.78	10.20		602		225B	10.21
335	190.60	10.03		592		2251	10.04
336	187.47	9.87		583		2247	9.88
337	184.39	9.70		573		223D	9.71
338	181.36	9.55		564		2234	9.55
339	178.38	9.39		554		222B	9.40
340	175.45	9.23		545		2222	9.25
341	172.57	9.08		536		2219	9.10
342	169.74	8.93		527		2210	8.94
343	166.95	8.79		519		2207	8.79
344	164.21	8.64		510		21FF	8.66
345	161.51	8.50		502		21F6	8.50
346	158.86	8.36		494		21EE	8.37
347	156.25	8.22		485		21E6	8.23
348	153.68	8.09		478		21DE	8.10
349	151.16	7.96		470		21D6	7.96
350	148.67	7.82		462		21CE	7.83
351	146.23	7.70		454		21C7	7.71
352	143.83	7.57		447		21BF	7.57
353	141.47	7.45		440		21B8	7.45
354	139.14	7.32		432		21B1	7.33
355	136.86	7.20		425		21AA	7.22
356	134.61	7.08		418		21A3	7.10
357	132.40	6.97		411		219C	6.98
358	130.22	6.85		405		2195	6.86
359	128.08	6.74		398		218E	6.74
360	125.98	6.63		391		2188	6.64
361	123.91	6.52		385		2182	6.54
362	121.88	6.41		379		217B	6.42
363	119.87	6.31		372		2175	6.32
364	117.91	6.21		366		216F	6.22
365	115.97	6.10		360		2169	6.11
366	114.06	6.00		354		2163	6.01
367	112.19	5.90		349		215D	5.91
368	110.35	5.81		343		2157	5.81
369	108.53	5.71		337		2152	5.73
370	106.75	5.62		332		214C	5.62
371	105.00	5.53		326		2147	5.54
372	103.27	5.44		321		2141	5.44
373	101.58	5.35		316		213C	5.35
374	99.91	5.26		310		2137	5.27
375	98.27	5.17		305		2132	5.18
376	96.65	5.09		300		212D	5.10
377	95.07	5.00		295		2128	5.01
378	93.50	4.92		291		2123	4.93
379	91.97	4.84		286		211E	4.84
380	90.46	4.76		281		211A	4.78
381	88.97	4.68		276		2115	4.69
382	87.51	4.61		272		2110	4.61
383	86.07	4.53		267		210C	4.54
384	84.66	4.46		263		2108	4.47
385	83.27	4.38		259		2103	4.39
386	81.90	4.31		254		20FF	4.32
387	80.56	4.24		250		20FB	4.25
388	79.23	4.17		246		20F7	4.18
389	77.93	4.10		242		20F3	4.12
390	76.65	4.03		238		20EF	4.05
391	75.39	3.97		234		20EB	3.98
392	74.15	3.90		230		20E7	3.91
393	72.94	3.84		227		20E3	3.85
394	71.74	3.78		223		20DF	3.78

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
395	70.56	3.71		219		20DC	3.73
396	69.40	3.65		216		20D8	3.66
397	68.26	3.59		212		20D5	3.61
398	67.14	3.53		209		20D1	3.54
399	66.04	3.48		205		20CE	3.49
400	64.95	3.42		202		20CA	3.42
401	63.88	3.36		199		20C7	3.37
402	62.84	3.31		195		20C4	3.32
403	61.80	3.25		192		20C1	3.27
404	60.79	3.20		189		20BD	3.20
405	59.79	3.15		186		20BA	3.15
406	58.81	3.10		183		20B7	3.10
407	57.84	3.04		180		20B4	3.05
408	56.89	2.99		177		20B1	3.00
409	55.96	2.95		174		20AE	2.95
410	55.04	2.90		171		20AC	2.91
411	54.13	2.85		168		20A9	2.86
412	53.24	2.80		165		20A6	2.81
413	52.37	2.76		163		20A3	2.76
414	51.51	2.71		160		20A1	2.73
415	50.66	2.67		157		209E	2.68
416	49.83	2.62		155		209B	2.63
417	49.01	2.58		152		2099	2.59
418	48.21	2.54		150		2096	2.54
419	47.42	2.50		147		2094	2.51
420	46.64	2.45		145		2091	2.46
421	45.87	2.41		143		208F	2.42
422	45.12	2.37		140		208D	2.39
423	44.38	2.34		138		208A	2.34
424	43.65	2.30		136		2088	2.30
425	42.93	2.26		133		2086	2.27
426	42.23	2.22		131		2084	2.24
427	41.53	2.19		129		2082	2.20
428	40.85	2.15		127		207F	2.15
429	40.18	2.11		125		207D	2.12
430	39.52	2.08		123		207B	2.08
431	38.87	2.05		121		2079	2.05
432	38.23	2.01		119		2077	2.02
433	37.60	1.98		117		2075	1.98
434	36.99	1.95		115		2073	1.95
435	36.38	1.91		113		2072	1.93
436	35.78	1.88		111		2070	1.90
437	35.19	1.85		109		206E	1.86
438	34.61	1.82			4032	1FC0	1.82
439	34.05	1.79			3965	1F7E	1.79
440	33.49	1.76			3900	1F3D	1.76
441	32.94	1.73			3836	1EFD	1.73
442	32.40	1.71			3773	1EBE	1.71
443	31.86	1.68			3711	1E80	1.68
444	31.34	1.65			3650	1E43	1.65
445	30.83	1.62			3590	1E07	1.62
446	30.32	1.60			3531	1DCC	1.60
447	29.82	1.57			3473	1D92	1.57
448	29.33	1.54			3416	1D59	1.54
449	28.85	1.52			3360	1D21	1.52
450	28.38	1.49			3305	1CEA	1.49
451	27.91	1.47			3251	1CB3	1.47
452	27.45	1.44			3197	1C7E	1.45
453	27.00	1.42			3145	1C49	1.42
454	26.56	1.40			3093	1C16	1.40
455	26.12	1.37			3042	1BE3	1.38
456	25.69	1.35			2992	1BB1	1.35
457	25.27	1.33			2943	1B80	1.33
458	24.85	1.31			2895	1B4F	1.31
459	24.45	1.29			2847	1B20	1.29
460	24.04	1.27			2801	1AF1	1.27

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
461	23.65	1.24			2755	1AC3	1.24
462	23.26	1.22			2709	1A96	1.22
463	22.88	1.20			2665	1A69	1.20
464	22.50	1.18			2621	1A3E	1.18
465	22.13	1.16			2578	1A12	1.16
466	21.77	1.15			2536	19E8	1.15
467	21.41	1.13			2494	19BE	1.13
468	21.06	1.11			2453	1996	1.11
469	20.72	1.09			2413	196D	1.09
470	20.37	1.07			2373	1946	1.07
471	20.04	1.05			2334	191F	1.06
472	19.71	1.04			2296	18F8	1.04
473	19.39	1.02			2258	18D3	1.02
474	19.07	1.00			2221	18AD	1.00
475	18.76	0.99			2185	1889	0.99
476	18.45	0.97			2149	1865	0.97
477	18.14	0.95			2113	1842	0.96
478	17.85	0.94			2079	181F	0.94
479	17.55	0.92			2044	17FD	0.92
480	17.26	0.91			2011	17DB	0.91
481	16.98	0.89			1978	17BA	0.89
482	16.70	0.88			1945	179A	0.88
483	16.43	0.86			1913	177A	0.86
484	16.16	0.85			1882	175A	0.85
485	15.89	0.84			1851	173C	0.84
486	15.63	0.82			1821	171D	0.82
487	15.38	0.81			1791	16FF	0.81
488	15.12	0.80			1761	16E2	0.80
489	14.87	0.78			1732	16C5	0.78
490	14.63	0.77			1704	16A8	0.77
491	14.39	0.76			1676	168C	0.76
492	14.15	0.74			1648	1671	0.75
493	13.92	0.73			1621	1656	0.73
494	13.69	0.72			1595	163B	0.72
495	13.47	0.71			1569	1621	0.71
496	13.25	0.70			1543	1607	0.70
497	13.03	0.69			1517	15EE	0.69
498	12.81	0.67			1493	15D5	0.67
499	12.60	0.66			1468	15BC	0.66
500	12.40	0.65			1444	15A4	0.65
501	12.19	0.64			1420	158D	0.64
502	11.99	0.63			1397	1575	0.63
503	11.80	0.62			1374	155E	0.62
504	11.60	0.61			1351	1548	0.61
505	11.41	0.60			1329	1532	0.60
506	11.22	0.59			1307	151C	0.59
507	11.04	0.58			1286	1506	0.58
508	10.86	0.57			1265	14F1	0.57
509	10.68	0.56			1244	14DC	0.56
510	10.50	0.55			1224	14C8	0.55
511	10.33	0.54			1203	14B4	0.54
512	10.16	0.53			1184	14A0	0.54
513	10.00	0.53			1164	148D	0.53
514	9.83	0.52			1145	147A	0.52
515	9.67	0.51			1126	1467	0.51
516	9.51	0.50			1108	1454	0.50
517	9.35	0.49			1090	1442	0.49
518	9.20	0.48			1072	1430	0.48
519	9.05	0.48			1054	141F	0.48
520	8.90	0.47			1037	140D	0.47
521	8.76	0.46			1020	13FC	0.46
522	8.61	0.45			1003	13EB	0.45
523	8.47	0.45			987	13DB	0.45
524	8.33	0.44			970	13CB	0.44
525	8.19	0.43			954	13BB	0.43
526	8.06	0.42			939	13AB	0.42

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
527	7.93	0.42			923	139C	0.42
528	7.80	0.41			908	138D	0.41
529	7.67	0.40			893	137E	0.40
530	7.54	0.40			879	136F	0.40
531	7.42	0.39			864	1361	0.39
532	7.30	0.38			850	1352	0.38
533	7.18	0.38			836	1344	0.38
534	7.06	0.37			822	1337	0.37
535	6.94	0.37			809	1329	0.37
536	6.83	0.36			795	131C	0.36
537	6.72	0.35			782	130F	0.35
538	6.61	0.35			769	1302	0.35
539	6.50	0.34			757	12F5	0.34
540	6.39	0.34			744	12E9	0.34
541	6.29	0.33			732	12DD	0.33
542	6.18	0.33			720	12D1	0.33
543	6.08	0.32			708	12C5	0.32
544	5.98	0.31			697	12B9	0.31
545	5.88	0.31			685	12AE	0.31
546	5.79	0.30			674	12A3	0.31
547	5.69	0.30			663	1297	0.30
548	5.60	0.29			652	128D	0.30
549	5.51	0.29			641	1282	0.29
550	5.42	0.29			631	1277	0.29
551	5.33	0.28			620	126D	0.28
552	5.24	0.28			610	1263	0.28
553	5.15	0.27			600	1259	0.27
554	5.07	0.27			590	124F	0.27
555	4.99	0.26			581	1245	0.26
556	4.90	0.26			571	123C	0.26
557	4.82	0.25			562	1232	0.25
558	4.74	0.25			553	1229	0.25
559	4.67	0.25			543	1220	0.25
560	4.59	0.24			535	1217	0.24
561	4.51	0.24			526	120E	0.24
562	4.44	0.23			517	1206	0.23
563	4.37	0.23			509	11FD	0.23
564	4.30	0.23			500	11F5	0.23
565	4.22	0.22			492	11ED	0.22
566	4.16	0.22			484	11E4	0.22
567	4.09	0.22			476	11DD	0.22
568	4.02	0.21			468	11D5	0.21
569	3.95	0.21			460	11CD	0.21
570	3.89	0.20			453	11C5	0.20
571	3.82	0.20			445	11BE	0.20
572	3.76	0.20			438	11B7	0.20
573	3.70	0.19			431	11AF	0.19
574	3.64	0.19			424	11A8	0.19
575	3.58	0.19			417	11A1	0.19
576	3.52	0.19			410	119B	0.19
577	3.46	0.18			403	1194	0.18
578	3.41	0.18			397	118D	0.18
579	3.35	0.18			390	1187	0.18
580	3.30	0.17			384	1180	0.17
581	3.24	0.17			377	117A	0.17
582	3.19	0.17			371	1174	0.17
583	3.14	0.17			365	116E	0.17
584	3.08	0.16			359	1168	0.16
585	3.03	0.16			353	1162	0.16
586	2.98	0.16			347	115C	0.16
587	2.93	0.15			342	1156	0.15
588	2.89	0.15			336	1151	0.15
589	2.84	0.15			331	114B	0.15
590	2.79	0.15			325	1146	0.15
591	2.75	0.14			320	1140	0.14
592	2.70	0.14			315	113B	0.14

Index	Energy (eV)	ESA (V)	DAC Hi	DAC Mid	DAC Low	Cmd Value	Actual ESA (V)
593	2.66	0.14			309	1136	0.14
594	2.61	0.14			304	1131	0.14
595	2.57	0.14			299	112C	0.14
596	2.53	0.13			294	1127	0.13
597	2.49	0.13			290	1122	0.13
598	2.45	0.13			285	111D	0.13
599	2.41	0.13			280	1119	0.13
600	2.37	0.12			276	1114	0.12
601	2.33	0.12			271	1110	0.12
602	2.29	0.12			267	110B	0.12
603	2.25	0.12			262	1107	0.12
604	2.21	0.12			258	1102	0.12
605	2.18	0.11			254	10FE	0.11
606	2.14	0.11			250	10FA	0.11
607	2.11	0.11			245	10F6	0.11
608	2.07	0.11			241	10F2	0.11
609	2.04	0.11			237	10EE	0.11
610	2.00	0.11			234	10EA	0.11
611	1.97	0.10			230	10E6	0.10
612	1.94	0.10			226	10E2	0.10
613	1.91	0.10			222	10DF	0.10
614	1.88	0.10			219	10DB	0.10
615	1.85	0.10			215	10D7	0.10
616	1.82	0.10			211	10D4	0.10
617	1.79	0.09			208	10D0	0.09
618	1.76	0.09			205	10CD	0.09
619	1.73	0.09			201	10CA	0.09
620	1.70	0.09			198	10C6	0.09
621	1.67	0.09			195	10C3	0.09
622	1.64	0.09			191	10C0	0.09
623	1.62	0.09			188	10BD	0.09
624	1.59	0.08			185	10BA	0.08
625	1.56	0.08			182	10B7	0.08
626	1.54	0.08			179	10B4	0.08
627	1.51	0.08			176	10B1	0.08
628	1.49	0.08			173	10AE	0.08
629	1.46	0.08			170	10AB	0.08
630	1.44	0.08			168	10A8	0.08
631	1.42	0.07			165	10A5	0.07
632	1.39	0.07			162	10A3	0.07
633	1.37	0.07			160	10A0	0.07
634	1.35	0.07			157	109D	0.07
635	1.33	0.07			154	109B	0.07
636	1.30	0.07			152	1098	0.07
637	1.28	0.07			149	1096	0.07
638	1.26	0.07			147	1093	0.07
639	1.24	0.07			144	1091	0.07
640	1.22	0.06			142	108F	0.06
641	1.20	0.06			140	108C	0.06
642	1.18	0.06			137	108A	0.06
643	1.16	0.06			135	1088	0.06
644	1.14	0.06			133	1085	0.06
645	1.12	0.06			131	1083	0.06
646	1.10	0.06			129	1081	0.06
647	1.09	0.06			127	107F	0.06
648	1.07	0.06			124	107D	0.06
649	1.05	0.06			122	107B	0.06
650	1.03	0.05			120	1079	0.05
651	1.02	0.05			118	1077	0.05
652	1.00	0.05			116	1075	0.05

Table 25 Solar Wind Search Table

Step	Index	Step	Index	Step	Index	Step	Index
0	96	64	160	128	224	192	288
1	97	65	161	129	225	193	289
2	98	66	162	130	226	194	290
3	99	67	163	131	227	195	291
4	100	68	164	132	228	196	292
5	101	69	165	133	229	197	293
6	102	70	166	134	230	198	294
7	103	71	167	135	231	199	295
8	104	72	168	136	232	200	296
9	105	73	169	137	233	201	297
10	106	74	170	138	234	202	298
11	107	75	171	139	235	203	299
12	108	76	172	140	236	204	300
13	109	77	173	141	237	205	301
14	110	78	174	142	238	206	302
15	111	79	175	143	239	207	303
16	112	80	176	144	240	208	304
17	113	81	177	145	241	209	305
18	114	82	178	146	242	210	306
19	115	83	179	147	243	211	307
20	116	84	180	148	244	212	308
21	117	85	181	149	245	213	309
22	118	86	182	150	246	214	310
23	119	87	183	151	247	215	311
24	120	88	184	152	248	216	312
25	121	89	185	153	249	217	313
26	122	90	186	154	250	218	314
27	123	91	187	155	251	219	315
28	124	92	188	156	252	220	316
29	125	93	189	157	253	221	317
30	126	94	190	158	254	222	318
31	127	95	191	159	255	223	319
32	128	96	192	160	256	224	320
33	129	97	193	161	257	225	321
34	130	98	194	162	258	226	322
35	131	99	195	163	259	227	323
36	132	100	196	164	260	228	324
37	133	101	197	165	261	229	325
38	134	102	198	166	262	230	326
39	135	103	199	167	263	231	327
40	136	104	200	168	264	232	328
41	137	105	201	169	265	233	329
42	138	106	202	170	266	234	330
43	139	107	203	171	267	235	331
44	140	108	204	172	268	236	332
45	141	109	205	173	269	237	333
46	142	110	206	174	270	238	334
47	143	111	207	175	271	239	335
48	144	112	208	176	272	240	336
49	145	113	209	177	273	241	337
50	146	114	210	178	274	242	338
51	147	115	211	179	275	243	339
52	148	116	212	180	276	244	340
53	149	117	213	181	277	245	341
54	150	118	214	182	278	246	342
55	151	119	215	183	279	247	343
56	152	120	216	184	280	248	344
57	153	121	217	185	281	249	345
58	154	122	218	186	282	250	346
59	155	123	219	187	283	251	347
60	156	124	220	188	284	252	348
61	157	125	221	189	285	253	349
62	158	126	222	190	286	254	95
63	159	127	223	191	287	255	95

Table 26 Mag. Mode Sweep 1

Step	Index	Step	Index	Step	Index	Step	Index
0	7	64	135	128	263	192	391
1	9	65	137	129	265	193	393
2	11	66	139	130	267	194	395
3	13	67	141	131	269	195	397
4	15	68	143	132	271	196	399
5	17	69	145	133	273	197	401
6	19	70	147	134	275	198	403
7	21	71	149	135	277	199	405
8	23	72	151	136	279	200	407
9	25	73	153	137	281	201	409
10	27	74	155	138	283	202	411
11	29	75	157	139	285	203	413
12	31	76	159	140	287	204	415
13	33	77	161	141	289	205	417
14	35	78	163	142	291	206	419
15	37	79	165	143	293	207	421
16	39	80	167	144	295	208	423
17	41	81	169	145	297	209	425
18	43	82	171	146	299	210	427
19	45	83	173	147	301	211	429
20	47	84	175	148	303	212	431
21	49	85	177	149	305	213	433
22	51	86	179	150	307	214	435
23	53	87	181	151	309	215	437
24	55	88	183	152	311	216	439
25	57	89	185	153	313	217	441
26	59	90	187	154	315	218	443
27	61	91	189	155	317	219	445
28	63	92	191	156	319	220	447
29	65	93	193	157	321	221	449
30	67	94	195	158	323	222	451
31	69	95	197	159	325	223	453
32	71	96	199	160	327	224	455
33	73	97	201	161	329	225	457
34	75	98	203	162	331	226	459
35	77	99	205	163	333	227	461
36	79	100	207	164	335	228	463
37	81	101	209	165	337	229	465
38	83	102	211	166	339	230	467
39	85	103	213	167	341	231	469
40	87	104	215	168	343	232	471
41	89	105	217	169	345	233	473
42	91	106	219	170	347	234	475
43	93	107	221	171	349	235	477
44	95	108	223	172	351	236	479
45	97	109	225	173	353	237	481
46	99	110	227	174	355	238	483
47	101	111	229	175	357	239	485
48	103	112	231	176	359	240	487
49	105	113	233	177	361	241	489
50	107	114	235	178	363	242	491
51	109	115	237	179	365	243	493
52	111	116	239	180	367	244	495
53	113	117	241	181	369	245	497
54	115	118	243	182	371	246	499
55	117	119	245	183	373	247	501
56	119	120	247	184	375	248	503
57	121	121	249	185	377	249	505
58	123	122	251	186	379	250	507
59	125	123	253	187	381	251	509
60	127	124	255	188	383	252	511
61	129	125	257	189	385	253	513
62	131	126	259	190	387	254	5
63	133	127	261	191	389	255	5

Table 27 Mag. Mode Sweep 2

Step	Index	Step	Index	Step	Index	Step	Index
0	6	64	134	128	262	192	390
1	8	65	136	129	264	193	392
2	10	66	138	130	266	194	394
3	12	67	140	131	268	195	396
4	14	68	142	132	270	196	398
5	16	69	144	133	272	197	400
6	18	70	146	134	274	198	402
7	20	71	148	135	276	199	404
8	22	72	150	136	278	200	406
9	24	73	152	137	280	201	408
10	26	74	154	138	282	202	410
11	28	75	156	139	284	203	412
12	30	76	158	140	286	204	414
13	32	77	160	141	288	205	416
14	34	78	162	142	290	206	418
15	36	79	164	143	292	207	420
16	38	80	166	144	294	208	422
17	40	81	168	145	296	209	424
18	42	82	170	146	298	210	426
19	44	83	172	147	300	211	428
20	46	84	174	148	302	212	430
21	48	85	176	149	304	213	432
22	50	86	178	150	306	214	434
23	52	87	180	151	308	215	436
24	54	88	182	152	310	216	438
25	56	89	184	153	312	217	440
26	58	90	186	154	314	218	442
27	60	91	188	155	316	219	444
28	62	92	190	156	318	220	446
29	64	93	192	157	320	221	448
30	66	94	194	158	322	222	450
31	68	95	196	159	324	223	452
32	70	96	198	160	326	224	454
33	72	97	200	161	328	225	456
34	74	98	202	162	330	226	458
35	76	99	204	163	332	227	460
36	78	100	206	164	334	228	462
37	80	101	208	165	336	229	464
38	82	102	210	166	338	230	466
39	84	103	212	167	340	231	468
40	86	104	214	168	342	232	470
41	88	105	216	169	344	233	472
42	90	106	218	170	346	234	474
43	92	107	220	171	348	235	476
44	94	108	222	172	350	236	478
45	96	109	224	173	352	237	480
46	98	110	226	174	354	238	482
47	100	111	228	175	356	239	484
48	102	112	230	176	358	240	486
49	104	113	232	177	360	241	488
50	106	114	234	178	362	242	490
51	108	115	236	179	364	243	492
52	110	116	238	180	366	244	494
53	112	117	240	181	368	245	496
54	114	118	242	182	370	246	498
55	116	119	244	183	372	247	500
56	118	120	246	184	374	248	502
57	120	121	248	185	376	249	504
58	122	122	250	186	378	250	506
59	124	123	252	187	380	251	508
60	126	124	254	188	382	252	510
61	128	125	256	189	384	253	512
62	130	126	258	190	386	254	4
63	132	127	260	191	388	255	4