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WIND IMAGING INTERFEROMETER (WINDII)

FLIGHT SEGMENT TO RAC INTERFACE CONTROL DOCUMENT

007-AIT-433ID-001

REV. C

30 September, 1990

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1.0 INTRODUCTION

1.1 SCOPE

This Flight Segment to RAC Interface Control Document (FRICD) establishes the software related interface control definitions to be used in support of the Wind Imaging Interferometer (WINDII) Instrument interface between the WINDII Flight Segment's Instrument Control and Data Handling (ICDH) computer; and the WINDII Ground Segment's Remote Analysis Computer (RAC).

1.2 PURPOSE

This Interface Control Document (ICD) between the WINDII Flight Segment and the Remote Analysis Computer (RAC) has two main purposes:

1. To describe the communication link between the Flight Segment and the RAC.
2. To identify the types of data interchanged between the Flight Segment and the RAC, and specify the formats of these data.

2.0 RELEVANT DOCUMENTS

Two classes of documents form part of the system requirements document:

- Applicable documents
- Reference documents

2.1 APPLICABLE DOCUMENTS

The following form part of this document, to the extent defined by the paragraph that calls up the document.

The issue of an applicable document shall be the latest revision.

In the event of a conflict between this document and an applicable document, the order of precedence shall be the WAR documents, specifically, WAR 1.1.

Where no restrictions on applicability are stated in this document it is to be taken that all requirements in the Applicable Documents are to be met.

Document No.	Title	Issue	Issuer
47277594	WINDII Command & Telemetry Compendium(CATC)	Final 23/06/87	UARS
WAR-1.1	Instrument Operations Requirements	Rev. 3 (05/05/87)	NRCC
007-AIT-200IS-001	WINDII Instrument Specification	Rev. C (10/89)	AIT
430-1601-002	General Instrument Interface Specification (GIIS)	Rev D (03/89)	UARS

2.2 REFERENCE DOCUMENTS

The following documents are for reference only; they contain information pertinent to the understanding of the WINDII and UARS systems:

Document No.	Title	Issue	Issuer
WAR-1.0	Mission Description Document	Issue 2 (04/01/85)	NRCC
WAR-2.0	System Performance Requirements	Rev. 3 (05/87)	NRCC
WAR-2.1	System Interface Control Document	Issue 3 (05/05/87)	NRCC

3.0 UARS GROUND SYSTEM

3.1 Command System Processing

The WINDII Instrument, when in orbit, will be commanded by the YORK University Remote Analysis Computer (RAC) through the NASA/UARS Ground System via a circuitous route (see Figure 3.1). After a Mission Planning Group, Command Management System (CMS) and YORK RAC iterative process on the general instrument tasking, WINDII Commands are sent from the YORK RAC to the CMS, from where they are relayed to the NASA/UARS Payload Operations Control Center (POCC). After some NASA checks, the WINDII commands are relayed to the UARS spacecraft via the NASA Communications (NASCOM) Network, utilizing the Deep Space Network (DSN) or the Tracking Data Relay Satellite System (TDRSS). The spacecraft in turn relays the commands to the WINDII Instrument.

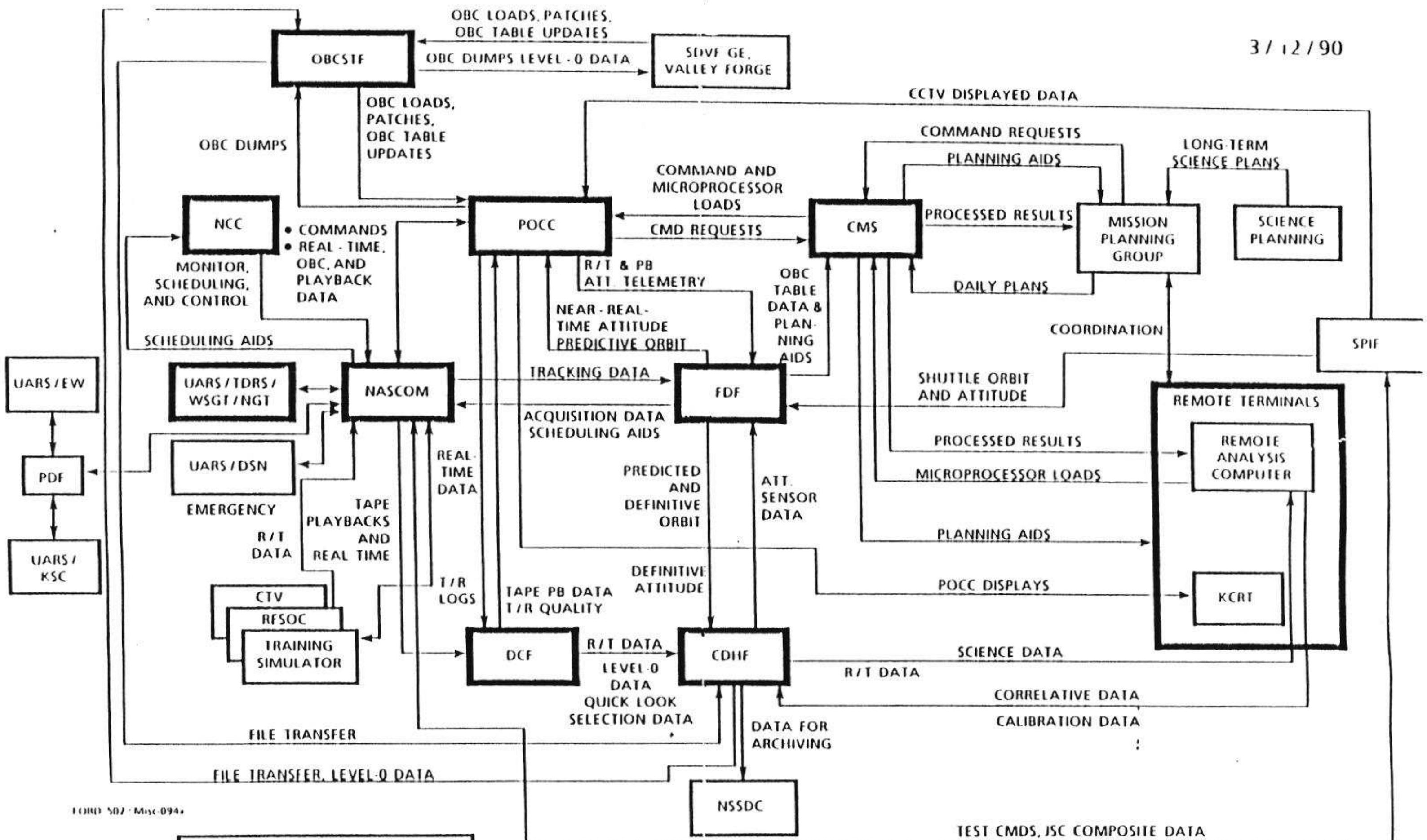
In addition, certain WINDII orbital event commands originate directly within the POCC (and are uplinked to the UARS spacecraft for timed relay to WINDII) or originate within the UARS spacecraft on board computer (OBC).

3.2 Telemetry System Processing

WINDII Instrument telemetry is stored and relayed by the UARS spacecraft to the NASCOM network (via DSN or TDRSS). The telemetry data is sent to the POCC or the Data Capture Facility (DCF). The POCC strips out Engineering telemetry and displays the data for NASA POCC operators, and/or remotes the display to a remote CRT at the YORK RAC (when connected to the POCC).

The DCF, after some processing in turn, forwards the telemetry data on to the Central Data Handling Facility (CDHF). The WINDII RAC can access WINDII telemetry that is present in the CDHF via the UARS DECnet.

3/12/90



ACRONYMS

ATT - ATTITUDE
CCTV - CLOSED CIRCUIT TELEVISION
CDHF - CENTRAL DATA HANDLING FACILITY
CMD - COMMAND
CMS - COMMAND MANAGEMENT SYSTEM
CTV - COMPATIBILITY TEST VAN
DCF - DATA CAPTURE FACILITY
DSN - DEEP SPACE NETWORK
FDF - FLIGHT DYNAMICS FACILITY
KCRT - KEYBOARD CATHODE RAY TUBE
NSSDC - NATIONAL SPACE SCIENCE DATA CENTER
OBCSTF - ONBOARD COMPUTER SOFTWARE TOOLS FACILITY
PB - PLAYBACK
POCC - PAYLOAD OPERATIONS CONTROL CENTER
RFSOC - RADIO FREQUENCY SIMULATIONS OPERATIONS CENTER
R/T - REAL TIME
SDVF - SOFTWARE DEVELOPMENT AND VALIDATION FACILITY
SN - SPACE NETWORK
SPIF - SHUTTLE/POCC INTERFACE FACILITY
UARS - UPPER ATMOSPHERE RESEARCH SATELLITE

Figure 3.1

4.0 SOFTWARE SYSTEM

This section describes WINDII Flight Software aspects particular to the understanding of Instrument operation.

4.1 CALIBRATION COMPONENT TURN-ON SEQUENCES

The Emission Line Sources (ELS) are activated/deactivated by the Broadband Electronics (BBE) through a straight-forward ON/OFF command issued by the Instrument Control and Data Handling (ICDH) computer.

The activation of the Broadband Source (BBS) and Laser are as described below.

4.1.1. BBS TURN-ON SEQUENCE

The turn-on sequence for the BBS source shall be as follows:

a) toggle BBS/BBE relay to alternate state
b) select BBS source on
c) wait 1 second
d) turn on CAL 28V
e) wait for source warmup time as indicated in Cal. Source Warmup Data Table (para. 6.4.12)

4.1.2 LASER TURN-ON SEQUENCE

The turn-on sequence for the Laser shall be as follows:

a) turn on Laser + 28V
b) wait for 1 minute
c) turn on Laser +/-15V
d) wait for source warmup time as indicated in Cal. Source Warmup Data Table (para. 6.4.12)
e) toggle Laser Retune high for 1 second and then set it low
f) wait 2 seconds for Laser to stabilize

5.0 SCIENCE TELEMETRY

5.1 INTRODUCTION

WINDII science telemetry consists of the following types of packets:

Measurement Header Packet
Calibration Image Header Packet
Measurement Image Header Packet
Calibration Header Packet
Image Data Packet
Memory Dump Packet

All are of a fixed length except for the Image Data Packet (which follows Image Header Packets) and the Memory Dump Packet (which is at the start of a SMAF).

Operation of the WINDII instrument is monitored via 8 telemetry channels: 3 active analog, 3 passive analog, 1 bilevel digital, and 1 serial digital. The WINDII science serial digital telemetry data are sent to the RIU via channel 8 and appear in the UARS 32 kbps science telemetry data stream; 8 bytes out of this 128 byte Science Minor Frame (SMIF) are devoted to the flight instrument and provide data for WINDII. Each SMIF contains 128 8-bit bytes and appears in the telemetry stream at a rate of 32 ms/frame. Each Science Major Frame (SMAF) appears every 1.024 seconds and is composed of 32 SMIFs. The UARS SMIF format is illustrated in Figure 5.1.1

The science data are listed according to the packet in which they appear in Sections 5.2.1 through 5.2.7 of this document. The notation used throughout the document utilizes "N" an integer, as the input range (binary input) and "n" as the output range (decoded output).

For serial digital telemetry, command and time-code signals that represent quantitative values, the most significant bit (MSB) shall be the first bit shifted across the instrument/spacecraft interface; as specified in the GIIS, para 3.8. For documentation purposes, the first bit of all serial digital data shall be labeled bit "0" (i.e. an 8-bit word shall consist of bits "0" to "7"), with bit 0 being the most significant bit. (This is opposite to standard data processing usage).

WD	FUNCTION	WD	FUNCTION	WD	FUNCTION	WD	FUNCTION
0	SYNC 'D7'	1	SYNC '99'	2	SYNC '07'	3	CDCUSTAT
4	CDFRMCNT	5	CDFRMCNT	6	CDCMDCNT	7	AAIAUXARY
8	ENG_DATA	9	ENG_DATA	10	ENG_DATA	11	ENG_DATA
12	OBC	13	OBC	14	OBC	15	OBC
16	OBC	17	OBC	18	OBC	19	PWIIMLO
20	PSIPULSEA	21	PSIPULSEB	22	PMREMBATC	23	PMREMDATC
24	PMREMBDTRC	25	PMREMACTRC	26	PMREMAATC	27	PMREMCATC
28	ACRIM II	29	ACRIM II	30	ESADATA	31	PWIBAT1HI
32	CLAES	33	CLAES	34	CLAES	35	CLAES
36	CLAES	37	CLAES	38	CLAES	39	CLAES
40	CLAES	41	CLAES	42	CLAES	43	CLAES
44	HALOE	45	HALOE	46	HALOE	47	HALOE
48	HALOE	49	HALOE	50	HALOE	51	HALOE
52	HALOE	53	HALOE	54	HALOE	55	HALOE
56	HALOE	57	HALOE	58	HALOE	59	HALOE
60	HRDI	61	HRDI	62	HRDI	63	HRDI
64	HRDI	65	HRDI	66	HRDI	67	HRDI
68	HRDI	69	HRDI	70	HRDI	71	HRDI
72	HRDI	73	HRDI	74	HRDI	75	HRDI
76	HRDI	77	HRDI	78	HRDI	79	PWIBAT2HI
80	ISAMS	81	ISAMS	82	ISAMS	83	ISAMS
84	MLS	85	MLS	86	MLS	87	MLS
88	MLS	89	SSPPAPOS	90	SSPPBPOS	91	PWIACS
92	PEM	93	PEM	94	PEM	95	PEM
96	PEM	97	PEM	98	PEM	99	PEM
100	PEM	101	PEM	102	PEM	103	PEM
104	PEM	105	PEM	106	SOLSTICE	107	PWICDH
108	SUSIM	109	SUSIM	110	SUSIM	111	SUSIM
112	SUSIM	113	SUSIM	114	SUSIM	115	SUSIM
116	WINDII	117	WINDII	118	WINDII	119	WINDII
120	WINDII	121	WINDII	122	WINDII	123	WINDII
124	PWIBAT3HI	125	PWISCCU	126	PARITY	127	PARITY

Figure 5.1.1: UARS Science Minor Frame Format (SMIF)

5.2 SCIENCE TELEMETRY PACKETS

5.2.1 MEASUREMENT HEADER PACKET

The Measurement Header Packet contains sufficient information for the ground processing to correctly identify the measurement and its parameters. The packet consists of 24 8-bit words which begin at the start of a SMAF. Measurement Header Packet functions are listed and decoded in Sections 5.2.1.1 and 5.2.1.2.

5.2.1.1 Measurement Header Packet Format Table

* Note: For all Science Telemetry Header Packets (5.2.1.1 through 5.2.6.2) bit 0 is the most significant bit (msb).

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REF PARA.
0	0	Sentinel	SNTNL0	always=1			5.2.1.2.1
	1		SNTNL1	always=0			
	2		SNTNL2	always=1			
	3		SNTNL3	always=0			
	4		SNTNL4	always=1			
	5		SNTNL5	always=1			
	6		SNTNL6	always=1			
	7		SNTNL7	always=1			
1	0		SNTNL8	always=1			
	1		SNTNL9	always=1			
	2		SNTNL10	always=1			
	3		SNTNL11	always=1			
	4		SNTNL12	always=0			
	5		SNTNL13	always=0			
	6		SNTNL14	always=0			
	7		SNTNL15	always=0			
2	0		SNTNL16	always=1			
	1		SNTNL17	always=1			
	2		SNTNL18	always=1			
	3		SNTNL19	always=1			
	4		SNTNL20	always=0			
	5		SNTNL21	always=0			
	6		SNTNL22	always=0			
	7		SNTNL23	always=0			
3	0	Meas. ID	ID0	always=1			5.2.1.2.2
	1		ID1	always=1			
	2		ID2	always=0			
	3		ID3	always=0			
	4		ID4	always=1			
	5		ID5	always=1			
	6		ID6	always=0			
	7		ID7	always=0			
4	0	Orbit Number	ORBT0		(0-14)	n=N	5.2.1.2.3
	1		ORBT1				
	2		ORBT2				
	3		ORBT3				
	4	Orb. Sequence	ORBTSEQ		0=I, 1=II		5.2.1.2.4 6.4.7 6.4.7.1

Measurement Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REF PARA.
	5	Fwd/Rev	FWDREV		0=Forward, 1=Reverse (this represents spacecraft orientation about the z-axis)		
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
5	0	Cycle	CYCL0		(0-23)	n=N	5.2.1.2.5
	1		CYCL1		=A-Z		
	2		CYCL2		(excl. I, O)		
	3		CYCL3				
	4		CYCL4				
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
6	0	Cycle Repeat No.	CYCLRPT0		(0-255)	n=N	5.2.1.2.6
	1		CYCLRPT1				
	2		CYCLRPT2				
	3		CYCLRPT3				
	4		CYCLRPT4				
	5		CYCLRPT5				
	6		CYCLRPT6				
	7		CYCLRPT7				
7	0	Filter Group	FLTRGP0		(0-31)	n=N	5.2.1.2.7
	1		FLTRGP1				
	2		FLTRGP2				
	3		FLTRGP3				
	4		FLTRGP4				
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			

Measurement Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REF PARA.
8	0	Start Time	STRTTM0		(0-65535)	{0-8388.48}	5.2.1.2.8
	1		STRTTM1			n=0.128N	
	2		STRTTM2			units=seconds	
	3		STRTTM3				
	4		STRTTM4				
	5		STRTTM5				
	6		STRTTM6				
	7		STRTTM7				
9	0		STRTTM8				
	1		STRTTM9				
	2		STRTTM10				
	3		STRTTM11				
	4		STRTTM12				
	5		STRTTM13				
	6		STRTTM14				
	7		STRTTM15				
10	0	Meas. Filter	MSRFLTR0		(0-7)	{1-8}	5.2.1.2.9
	1		MSRFLTR1		where 0=8		
	2		MSRFLTR2				
	3	Obs. Category	OBSCAT0		(0-3)	n=N	5.2.1.2.10
	4		OBSCAT1				6.4.1
	5	Special Obs. ID	SOBSID0		(0-7)	n=N+1 {1-8}	5.2.1.2.11
	6		SOBSID1				6.4.1
	7		SOBSID2				
11	0	No. of Images	IMGNBR0		(0-3)	n=N {0-2}	5.2.1.2.12
	1		IMGNBR1			n=3 not assigned	
	2	Not Assigned		always=0			
	3	Horz. Bin Dim.	HBIN0		(0-31)	n=N+1	5.2.1.2.13
	4		HBIN1			{1-32}	
	5		HBIN2			units=pixels	
	6		HBIN3				
	7		HBIN4				
12	0	No. of Repeats	NBRRPT0		(0-1)	n=N	5.2.1.2.14
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Vert. Bin Dim.	VBIN0		(0-31)	n=N+1	5.2.1.2.15
	4		VBIN1			{1-32}	
	5		VBIN2			units=pixels	
	6		VBIN3				
	7		VBIN4				

Measurement Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REF PARA.
13	0	Win. Vert. Ht.	HIGH0		(0-255)	n=N	5.2.1.2.16
	1		HIGH1		where 0=256	{1-255}	
	2		HIGH2			units=bins	
	3		HIGH3				
	4		HIGH4				
	5		HIGH5				
	6		HIGH6				
	7		HIGH7				
14	0	Win. Vert. Offset	VOFFSET0		(0-255)	n=N	5.2.1.2.17
	1		VOFFSET1			{0-255}	
	2		VOFFSET2			units=bins	
	3		VOFFSET3				
	4		VOFFSET4				
	5		VOFFSET5				
	6		VOFFSET6				
	7		VOFFSET7				
15	0	Win. Horz. Width	WIDE0		(1-160)	n=N	5.2.1.2.18
	1		WIDE1			units=bins	
	2		WIDE2				
	3		WIDE3				
	4		WIDE4				
	5		WIDE5				
	6		WIDE6				
	7		WIDE7				
16	0	Win. Horz. Offset	HOFFSET0		(0-159)	n=N	5.2.1.2.19
	1		HOFFSET1			units=pixels	
	2		HOFFSET2				
	3		HOFFSET3				
	4		HOFFSET4				
	5		HOFFSET5				
	6		HOFFSET6				
	7		HOFFSET7				
17	0	Window Sep'n	SEPARAT0		(0-254)	n=N	5.2.1.2.20
	1		SEPARAT1		where 0=1	units=pixels	
	2		SEPARAT2		window/FOV		
	3		SEPARAT3				
	4		SEPARAT4				
	5		SEPARAT5				
	6		SEPARAT6				
	7		SEPARAT7				
18	0	Apert. 1 Status	APR1STAT		1=Open, 0=Closed		
	1	Apert. 2 Status	APR2STAT		1=Open, 0=Closed		

Measurement Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REF PARA.
	2	Filter Wheel Position	FWSTAT		1=Correct, 0=Unknown		
	3	Not Assigned		always=0			
	4	Exposure Time	EXPTIM0		(0-4095)	n=0.128N	5.2.1.2.21
	5		EXPTIM1			{0-524.16}	6.4.3
	6		EXPTIM2			units=	6.4.3.1
	7		EXPTIM3			seconds	
19	0		EXPTIM4				
	1		EXPTIM5				
	2		EXPTIM6				
	3		EXPTIM7				
	4		EXPTIM8				
	5		EXPTIM9				
	6		EXPTIM10				
	7		EXPTIM11				
20	0	Oblateness FOV1	FOV1OBL0		(0-255)	n=2.5N	5.2.1.2.22
	1		FOV1OBL1			{0-637.5}	
	2		FOV1OBL2			units=km.	
	3		FOV1OBL3				
	4		FOV1OBL4				
	5		FOV1OBL5				
	6		FOV1OBL6				
	7		FOV1OBL7				
21	0	Oblateness FOV2	FOV2OBL0		same as Byte 20		
	1		FOV2OBL1				
	2		FOV2OBL2				
	3		FOV2OBL3				
	4		FOV2OBL4				
	5		FOV2OBL5				
	6		FOV2OBL6				
	7		FOV2OBL7				
22	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			

Measurement Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REF PARA.
	7	EMAF Timetag	EMAFTT0				
23	0		EMAFTT1		(0-511)	n=0.128N	5.2.1.2.23
	1		EMAFTT2			{0-65.408}	
	2		EMAFTT3			units=seconds	
	3		EMAFTT4				
	4		EMAFTT5				
	5		EMAFTT6				
	6		EMAFTT7				
	7		EMAFTT8				

5.2.1.2 Measurement Header Packet Format Summary

5.2.1.2.1 Sentinel

SNTNL word is comprised of bits SNTNL0 through SNTNL23 of Bytes 0, 1 and 2 of the Measurement Header Packet.
Equivalence: Byte 0 = AF hex always
Byte 1 = F0 hex always
Byte 2 = F0 hex always

5.2.1.2.2 Measurement ID

ID word is comprised of ID0 through ID7 bits of Byte 3 of the Measurement Header Packet.
Equivalence: Byte 3 = CC hex always

5.2.1.2.3 Orbit Number

ORBT number is comprised of bits ORBT0 through ORBT3 of Byte 4 of the Measurement Header Packet. This represents the orbit number minus one where the orbit number is a unique integer describing the specific orbit.

Equivalence: ORBT=n=N where N(0-14)

5.2.1.2.4 Orbital Sequence

ORBTSEQ number is comprised of bit 4 of Byte 4 of the Measurement Header Packet. Orbital Sequences "I" and "II" identify two pre-defined sequences (refer to Orbital Sequence Data Table, paras. 6.4.7 and 6.4.7.1).

5.2.1.2.5 Cycle

CYCL number is comprised of bits CYCL0 through CYCL4 of Byte 5 of the Measurement Header Packet. The cycle numbers are represented alphabetically as A through Z omitting the letters I and O.

Equivalence: CYCL=n=N where N(0-23)=A-Z (I and O not used)

5.2.1.2.6 Cycle Repeat Number

CYCLRPT word is comprised of bits CYCLRPT0 through CYCLRPT7 of Byte 6 of the Measurement Header Packet.
Equivalence: CYCLRPT=n=N where N(0-255)

5.2.1.2.7 Filter Group

FLTRGP number is comprised of bits FLTRGP0 through FLTRGP4 of Byte 7 of the Measurement Header Packet.
Equivalence: FLTRGP=n= N, output range {0-31}

5.2.1.2.8 Start Time

STRTTM word is comprised of STRTTM0 through STRTTM15 bits of Bytes 8 and 9 of the Measurement Header Packet.
Equivalence: STRTTM=n=0.128N
units=seconds

This represents the time that the START command of the first image is sent to the camera relative to the orbit time which is reset by UARS (through the EQXNADIR command) upon any spacecraft south to north equatorial crossing.

5.2.1.2.9 Measurement Filter

MSRFLTR number is comprised of bits MSRFLTR0 through MSRFLTR2 of Byte 10 of the Measurement Header Packet.
Equivalence: MSRFLTR=n=N where N(0-7), and N=0 corresponds to filter #8; output range {1-8}
See Table 5.2.1.2.9 for decode

N	Filter No.	Emission Line	Wavelength in Air (nm at 15 deg. C, 760 mm) (Specified IAW Instrument Spec.; Table 3.2.1)
0	8	Blank	
1	1	Background	552.50
2	2	OI(1S)	557.73
3	3	OI(1D)	630.03
4	4	OII(2D)/OH $P_1(2)$	733.0/732.0/731.63
5	5(a/b)	OH/Background	730.0/715.0
6	6	OH $P_1(3)$	734.09
7	7	O_2	763.22

Table 5.2.1.2.9: Decode for Measurement Filter

5.2.1.2.10 Observation Category

OBSCAT number is comprised of bits OBSCAT0 to OBSCAT1 of Byte 10 of the Measurement Header Packet.
Equivalence: OBSCAT=n=N where 0=Local
1=Special
2=Global
3=Global and Special
output range {0-3}

This represents a value uploaded as part of the Filter Group Data Table (para 6.4.1). It is also totally transparent to the instrument.

5.2.1.2.11 Special Observation ID

SOBSID number is comprised of bits SOBSID0 through SOBSID2 of Byte 10 of the Measurement Header Packet.
Equivalence: SOBSID=n=N+1, output range {1-8}

This represents a value uploaded as part of the Filter Group Data Table (para 6.4.1).

The Special Observation ID directs the Science Data Processing Production Software (SDPPS) processing path to be taken for special observation categories *yet to be defined.* It is also totally transparent to the instrument.

5.2.1.2.12 Number of Images

NBRIMG number is comprised of bits NBRIMG0 and NBRIMG1 of Byte 11 of the Measurement Header Packet.
Equivalence: NBRIMG=n=N, output range {0-2} where:
n= 0=1 image/measurement
1=4 images/measurement
2=8 images/measurement
3=Not Assigned

5.2.1.2.13 Horizontal Bin Dimension

HBIN number is comprised of bits HBIN0 through HBIN4 of Byte 11 of the Measurement Header Packet.
Equivalence: HBIN=n=N+1, output range {1-32}
units=pixels

5.2.1.2.14 Number of Repeats

NBRRPT number is comprised of bit NBRRPT0 of Byte 12 of the Measurement Header Packet.
Equivalence: NBRRPT=n=N where N(0-1)
units=number of repeats

5.2.1.2.15 Vertical Bin Dimension

VBIN number is comprised of bits VBIN0 through VBIN4 of Byte 12 of the Measurement Header Packet.
Equivalence: VBIN=n=N+1, output range {1-32}
units=pixels

5.2.1.2.16 Window Vertical Height

HIGH word is comprised of bits HIGH0 through HIGH7 of Byte 13 of the Measurement Header Packet.
Equivalence: HIGH=n=N, N(1-255, 0=256)
units=bins

The values of n=1-255 are represented verbatim, but the value of n=256 is represented as N=0.

5.2.1.2.17 Window Vertical Offset

VOFFSET word is comprised of bits VOFFSET0 through VOFFSET7 of Byte 14 of the Measurement Header Packet.
Equivalence: VOFFSET=n=N where N(0-255)
units=bins

5.2.1.2.18 Window Horizontal Width

WIDE word is comprised of bits WIDE0 through WIDE7 of Byte 15 of the Measurement Header Packet.
Equivalence: WIDE=n=N where N(1-160)
units=bins

5.2.1.2.19 Window Horizontal Offset

HOFFSET word is comprised of bits HOFFSET0 through HOFFSET7 of Byte 16 of the Measurement Header Packet.
Equivalence: HOFFSET=n=N where N(0-159)
units=pixels

5.2.1.2.20 Window Separation

SEPARAT word is comprised of bits SEPARAT0 through SEPARAT7 of Byte 17 of the Measurement Header Packet.
Equivalence: SEPARAT=n=N where N(0-254, where 0 also represents 1 window/FOV)
units=pixels

5.2.1.2.21 Exposure Time

EXPTIM number is comprised of bits EXPTIM0 through EXPTIM11 of Bytes 18 and 19 of the Measurement Header Packet.
Equivalence: EXPTIM=n=0.128N; N(0-4095), output {0-524.16}
n(units)=seconds

This exposure time value represents the commanded duration of the image exposure and the exposure times are illustrated in the Exposure Data Table (paras. 6.4.3 and 6.4.3.1).

5.2.1.2.22 Oblateness - FOV1, FOV2

FOV1OBL word is comprised of bits FOV1OBL0 through FOV1OBL7 of Byte 20 of the Measurement Header Packet.

FOV2OBL word is comprised of bits FOV2OBL0 through FOV2OBL7 of Byte 21 of the Measurement Header Packet

Equivalence: FOV1OBL} = n=2.5N, N(0-255), output range {0-637.5}
FOV2OBL}
n(units)=kilometres

5.2.1.2.23 EMAF Timetag

EMAFTT number is comprised of bits EMAFTT0 through EMAFTT8 of Bytes 22 and 23 of the Measurement Header Packet.

Equivalence: EMAFTT=n=0.128N
input N(0-511); output {0-65.408}
n(units)=seconds

This represents the time, relative to the receipt of the last EMAF synchronization signal, at which the START command was sent to initiate the first image.

5.2.2 CALIBRATION IMAGE HEADER PACKET

The Calibration Image Header Packet consists of *sixteen* 8-bit words which precede each Calibration Image Data Packet. It contains sufficient information to identify the image. The packet begins at the start of a SMIF. Image data immediately follows the Header Packet, starting with the next SMIF. Calibration Image Header Packet functions are listed and decoded in Sections 5.2.2.1 and 5.2.2.2.

5.2.2.1 Calibration Image Header Packet Format Table

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
0	0	Sentinel	SNTNL0	always=1			5.2.2.2.1
	1		SNTNL1	always=0			
	2		SNTNL2	always=1			
	3		SNTNL3	always=0			
	4		SNTNL4	always=1			
	5		SNTNL5	always=1			
	6		SNTNL6	always=1			
	7		SNTNL7	always=1			
1	0		SNTNL8	always=1			
	1		SNTNL9	always=1			
	2		SNTNL10	always=1			
	3		SNTNL11	always=1			
	4		SNTNL12	always=0			
	5		SNTNL13	always=0			
	6		SNTNL14	always=0			
	7		SNTNL15	always=0			
2	0		SNTNL16	always=1			
	1		SNTNL17	always=1			
	2		SNTNL18	always=1			
	3		SNTNL19	always=1			
	4		SNTNL20	always=0			
	5		SNTNL21	always=0			
	6		SNTNL22	always=0			
	7		SNTNL23	always=0			
3	0	Image ID	ID0	always=0			5.2.2.2.2
	1		ID1	always=1			
	2		ID2	always=0			
	3		ID3	always=1			
	4		ID4	always=0			
	5		ID5	always=1			
	6		ID6	always=0			
	7		ID7	always=1			
4	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Image Number	IMGNBR0		(0-39)	n=N+1 {1-40}	5.2.2.2.3
	3		IMGNBR1				
	4		IMGNBR2				
	5		IMGNBR3				
	6		IMGNBR4				
	7		IMGNBR5				

Calibration Image Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
5	0	Mirror Pos'n	MIRPOS0	(0-4095)		n=N	5.2.2.2.4
	1		MIRPOS1			{-2048 to +2047}	
	2		MIRPOS2		MIRPOS is		
	3		MIRPOS3		a 12-bit		
	4		MIRPOS4		signed twos-		
	5		MIRPOS5		complement		
	6		MIRPOS6		value		
	7		MIRPOS7				
6	0		MIRPOS8				
	1		MIRPOS9				
	2		MIRPOS10				
	3		MIRPOS11				
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	EMAF Timetag	EMAFTT0				
7	0		EMAFTT1		(0-511)	n=0.128N	5.2.2.2.5
	1		EMAFTT2			{0-65.408}	
	2		EMAFTT3			units=	
	3		EMAFTT4			seconds	
	4		EMAFTT5				
	5		EMAFTT6				
	6		EMAFTT7				
	7		EMAFTT8				
8	0	Calib. Source Output	CSRCOUT0		Source 1 - 4 ELS		5.2.2.2.6
	1		CSRCOUT1		Source 5 - BBS		
	2		CSRCOUT2		Source 6 - Laser		
	3		CSRCOUT3				
	4		CSRCOUT4				
	5		CSRCOUT5				
	6		CSRCOUT6				
	7		CSRCOUT7				
9	0	CCD Temperature	CCDTMP0		(0-255)		See App.III
	1		CCDTMP1				for decode &
	2		CCDTMP2				output range
	3		CCDTMP3				
	4		CCDTMP4				
	5		CCDTMP5				
	6		CCDTMP6				
	7		CCDTMP7				

Calibration Image Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
10	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
11	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
12	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
13	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
14	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			

Calibration Image Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
15	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			

5.2.2.2 Calibration Image Header Packet Format Summary

5.2.2.2.1 Sentinel

SNTNL number is comprised of bits SNTNL0 through SNTNL23 of Bytes 0, 1 and 2 of the Calibration Image Header Packet.
Equivalence: Byte 0 = AF hex always
Byte 1 = F0 hex always
Byte 2 = F0 hex always

5.2.2.2.2 Image ID

ID word is comprised of bits ID0 through ID7 of Byte 3 of the Calibration Image Header Packet.
Equivalence: Byte 3 = 55 hex always

5.2.2.2.3 Image Number

IMGNBR number is comprised of bits IMGNBR0 through IMGNBR5 of Byte 4 of the Calibration Image Header Packet.
Equivalence: IMGNBR=n=N+1, where N(0-39); output {1-40}

Image Number represents a sequential number associated with each image.

5.2.2.2.4 Mirror Position

MIRPOS number is comprised of bits MIRPOS0 through MIRPOS11 of Bytes 5 and 6 of the Calibration Image Header Packet. Mirror Position is specified as a signed twos-complement 12-bit number.
Equivalence: MIRPOS=n=N, where N(0-4095),
output range {-2048 to +2047}

The units represent incremental units of the MI mirror displacement from mirror position in units of step size. Step size is nominally 0.215 nanometers.

The extremes represent the ends of the mirror's travel.

5.2.2.2.5 EMAF Timetag

EMAFTT number is comprised of bits EMAFTT0 through EMAFTT8 of Bytes 6 and 7 of the Calibration Image Header Packet.
Equivalence: EMAFTT=n=0.128N
input N(0-511), output {0-65.408}
n(units)=seconds

This represents the time, relative to the receipt of the last EMAF synchronization signal, at which the START command was sent to initiate each image.

5.2.2.2.6 Calibration Source Output

CSRCOUT word is comprised of bits CSRCOUT0 through CSRCOUT7 of Byte 8 of the Calibration Image Header Packet.

Equivalence: n(units)= 40 nwatts/count for Source 1-4 (ELS)
40 nwatts/count for Source 5 (BBS)
400 nwatts/count for Source 6 (Laser)

5.2.2.2.7 CCD Temperature

CCDTMP word is comprised of bits CCDTMP0 through CCDTMP7 of Byte 9 of the Calibration Image Header Packet.

Refer to Appendix III for decode and output range.

Note: The calibration curve for CCDTMP will be revised, as required, based upon actual measured calibration values.

5.2.3 MEASUREMENT IMAGE HEADER PACKET

The Measurement Image Header Packet consists of sixteen 8-bit telemetry words which precede each Measurement Image Data Packet. This packet contains sufficient information to identify the image and appears at the start of a SMIF with image data immediately following, starting with the next SMIF. Measurement Image Header Packet functions are listed and decoded in Sections 5.2.3.1 and 5.2.3.2.

5.2.3.1 Measurement Image Header Packet Format Table

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
0	0	Sentinel	SNTNL0	always=1			5.2.3.2.1
	1		SNTNL1	always=0			
	2		SNTNL2	always=1			
	3		SNTNL3	always=0			
	4		SNTNL4	always=1			
	5		SNTNL5	always=1			
	6		SNTNL6	always=1			
	7		SNTNL7	always=1			
1	0		SNTNL8	always=1			
	1		SNTNL9	always=1			
	2		SNTNL10	always=1			
	3		SNTNL11	always=1			
	4		SNTNL12	always=0			
	5		SNTNL13	always=0			
	6		SNTNL14	always=0			
	7		SNTNL15	always=0			
2	0		SNTNL16	always=1			
	1		SNTNL17	always=1			
	2		SNTNL18	always=1			
	3		SNTNL19	always=1			
	4		SNTNL20	always=0			
	5		SNTNL21	always=0			
	6		SNTNL22	always=0			
	7		SNTNL23	always=0			
3	0	Image ID	ID0	always=1			5.2.3.2.2
	1		ID1	always=0			
	2		ID2	always=1			
	3		ID3	always=0			
	4		ID4	always=1			
	5		ID5	always=0			
	6		ID6	always=1			
	7		ID7	always=0			
4	0	Not Assigned		always=0			
	1			always=0			
	2			always=0			
	3			always =0			
	4	Meas. No.	MSRNBR0		(0-1)	n=N+1 {1-2}	5.2.3.2.3
	5	Image No.	IMGNBR0		(0-7)	n=N+1 {1-8}	5.2.3.2.4
	6		IMGNBR1				
	7		IMGNBR2				

Measurement Image Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
5	0	Mirror Pos'n	MIRPOS0		(0-4095)	n=N	
	1		MIRPOS1		MIRPOS is	{-2048,+2047}	5.2.3.2.5
	2		MIRPOS2		a 12-bit		
	3		MIRPOS3		signed twos-		
	4		MIRPOS4		complement		
	5		MIRPOS5		value		
	6		MIRPOS6				
	7		MIRPOS7				
6	0		MIRPOS8				
	1		MIRPOS9				
	2		MIRPOS10				
	3		MIRPOS11				
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	EMAF Timetag	EMAFTT0				
7	0		EMAFTT1		(0-511)	n=0.128N	5.2.3.2.6
	1		EMAFTT2			{0-65.408}	
	2		EMAFTT3			units=	
	3		EMAFTT4			seconds	
	4		EMAFTT5				
	5		EMAFTT6				
	6		EMAFTT7				
	7		EMAFTT8				
8	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
9	0	CCD Temperature	CCDTMP0		(0-255)		See App.III
	1		CCDTMP1				for decode &
	2		CCDTMP2				output range
	3		CCDTMP3				
	4		CCDTMP4				
	5		CCDTMP5				
	6		CCDTMP6				
	7		CCDTMP7				

Measurement Image Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
10	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
11	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
12	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
13	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
14	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			

Measurement Image Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
15	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			

5.2.3.2 Measurement Image Header Packet Format Summary

5.2.3.2.1 Sentinel

SNTNL number is comprised of bits SNTNL0 through SNTNL23 of Bytes 0, 1 and 2 of the Measurement Image Header Packet.
Equivalence: Byte 0 = AF hex always
Byte 1 = F0 hex always
Byte 2 = F0 hex always

5.2.3.2.2 Image ID

ID word is comprised of bits ID0 through ID7 of Byte 3 of the Measurement Image Header Packet.
Equivalence: Byte 3 = AA hex always

5.2.3.2.3 Measurement Number

MSRNBR number is comprised of bit MSRNBR0 of Byte 4 of the Measurement Image Header Packet.
Equivalence: n=N+1, input N(0-1); output {1-2}

5.2.3.2.4 Image Number

IMGNBR number is comprised of bits IMGNBR0 through IMGNBR2 of Byte 4 of the Measurement Image Header Packet.
Equivalence: IMGNBR=n=N+1 where N(0-7), output range {1-8}

5.2.3.2.5 Mirror Position

MIRPOS number is comprised of bits MIRPOS0 through MIRPOS11 of Bytes 5 and 6 of the Measurement Image Header Packet. Mirror Position is specified as a signed twos-complement 12-bit number.
Equivalence: MIRPOS=n=N, where N(0-4095), output {-2048,+2047}

The mirror position represents the scan mirror's position (same as in Calibration Image Header Packet.

5.2.3.2.6 EMAF

EMAFTT number is comprised of bits EMAFTT0 through EMAFTT8 of Bytes 6 and 7 of the Measurement Image Header Packet.
Equivalence: EMAFTT=n=0.128N
input N(0-511); output {0-65.408}
n(units)=seconds

This represents the time, relative to the receipt of the last EMAF synchronization signal, at which the START command was sent to initiate each image.

5.2.3.2.7 CCD Temperature

CCDTMP word is comprised of bits CCDTMP0 through CCDTMP7 of Byte 9 of the Measurement Image Header Packet.

Refer to Appendix III for decode and output range.

Note: The calibration curve for CCDTMP will be revised, as required, based upon actual measured calibration curves.

5.2.4 IMAGE DATA PACKET

The Image Data Packet immediately follows the Measurement or Calibration Image Header Packet, starting with the next SMIF. The data packet is of variable length and is organized into 12 bits per image bin with the data packed together without gaps. Any gaps between an Image Data Packet and subsequent packet is filled with idle code (00 hex).

Image data represent the signal level for each image bin within the specified window. The image data appear in the telemetry stream in the order in which the image is read out from the CCD. The first four image data values provide a measure of the dark current generated in the CCD storage area. The data are read out line by line starting with the highest altitude and the outside edge of the window(s) for FOV2.

Image data is limited to a maximum of 20,480 12-bit samples per measurement or per calibration.

The data in the packet is inverted and byte swapped; that is, the two bytes in a 16-bit word must be interchanged (because the ICDH requires this for program efficiency) and inverted (because this is the way the image is received from the camera controller).

The Image Data Packet functions are listed and decoded in Sections 5.2.4.1 and 5.2.4.2.

5.2.4.1 Image Data Packet Format Table

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
0	0	DC Monitor 1 Low	DC1MON8		(0-4095)	n=ones-	5.2.4.2.1
	1		DC1MON9			complement	
	2		DC1MON10			of N	See Note
	3		DC1MON11				
	4	DC Monitor 2 High	DC2MON0				
	5		DC2MON1				
	6		DC2MON2				
	7		DC2MON3				
1	0	DC Monitor 1 High	DC1MON0				
	1		DC1MON1				
	2		DC1MON2				
	3		DC1MON3				
	4		DC1MON4				
	5		DC1MON5				
	6		DC1MON6				
	7		DC1MON7				
2	0	DC Monitor 3 High	DC3MON0				
	1		DC3MON1				
	2		DC3MON2				
	3		DC3MON3				
	4		DC3MON4				
	5		DC3MON5				
	6		DC3MON6				
	7		DC3MON7				
3	0	DC Monitor 2 Low	DC2MON4				
	1		DC2MON5				
	2		DC2MON6				
	3		DC2MON7				
	4		DC2MON8				
	5		DC2MON9				
	6		DC2MON10				
	7		DC2MON11				
4	0	DC Monitor 4 Low	DC4MON4				
	1		DC4MON5				
	2		DC4MON6				
	3		DC4MON7				
	4		DC4MON8				
	5		DC4MON9				
	6		DC4MON10				
	7		DC4MON11				

Image Data Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
5	0	DC Monitor 3 Low	DC3MON8				
	1		DC3MON9				
	2		DC3MON10				
	3		DC3MON11				
	4	DC Monitor 4 High	DC4MON0				
	5		DC4MON1				
	6		DC4MON2				
	7		DC4MON3				
6	0-7	FOV2, line 1					5.2.4.2.2
7	0-7	FOV2, line 1					See Note
8	0-7	FOV1, line 1					
9	0-7	FOV2, line 1					
10	0-7	FOV1, line 1					
11	0-7	FOV1, line 1					
12	0-7	FOV2, line 2					
13	0-7	FOV2, line 2					
14	0-7	FOV1, line 2					
15	0-7	FOV2, line 2					
16	0-7	FOV1, line 2					
17	0-7	FOV1, line 2					

Note: Bytes 6 through 17 represent the 'raw' telemetry for a ***sample image*** with a window size of 2X2 (where m=2 bins/line and n=2 lines/FOV). For decode, see para 5.2.4.2.2.

5.2.4.2 Image Data Packet Format Summary

5.2.4.2.1 Dark Current Monitor (#1-4)

DC1MON number is comprised of bits DC1MON0 through DC1MON11 of Bytes 0 and 1 of the Image Data Packet.

DC2MON number is comprised of bits DC2MON0 through DC2MON11 of Bytes 0 and 3 of the Image Data Packet.

DC3MON number is comprised of bits DC3MON0 through DC3MON11 of Bytes 2 and 5 of the Image Data Packet.

DC4MON number is comprised of bits DC4MON0 through DC4MON11 of Bytes 4 and 5 of the Image Data Packet.

DC Monitor is specified as a 12-bit number. Units are nominally 73 electrons per count.

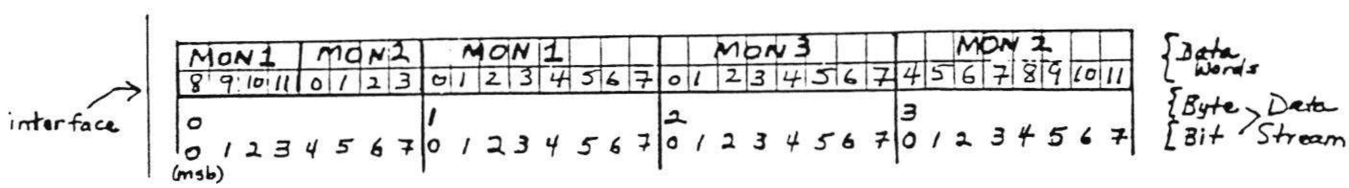
Each 12-bit value follows the previous one and is packed into a 16-bit field at a ratio of 3 to 4. Thus each 12-bit value spans two bytes. Because of the way the 8085 processor handles two-byte words, each pair of bytes must be swapped prior to accessing the data.

Example:

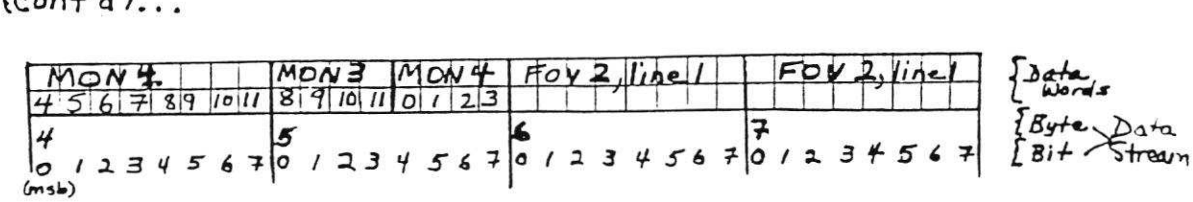
Raw Telemetry (as received in Telemetry Stream):
Note that bit 0 is the Most Significant Bit, as specified in the GIIS.

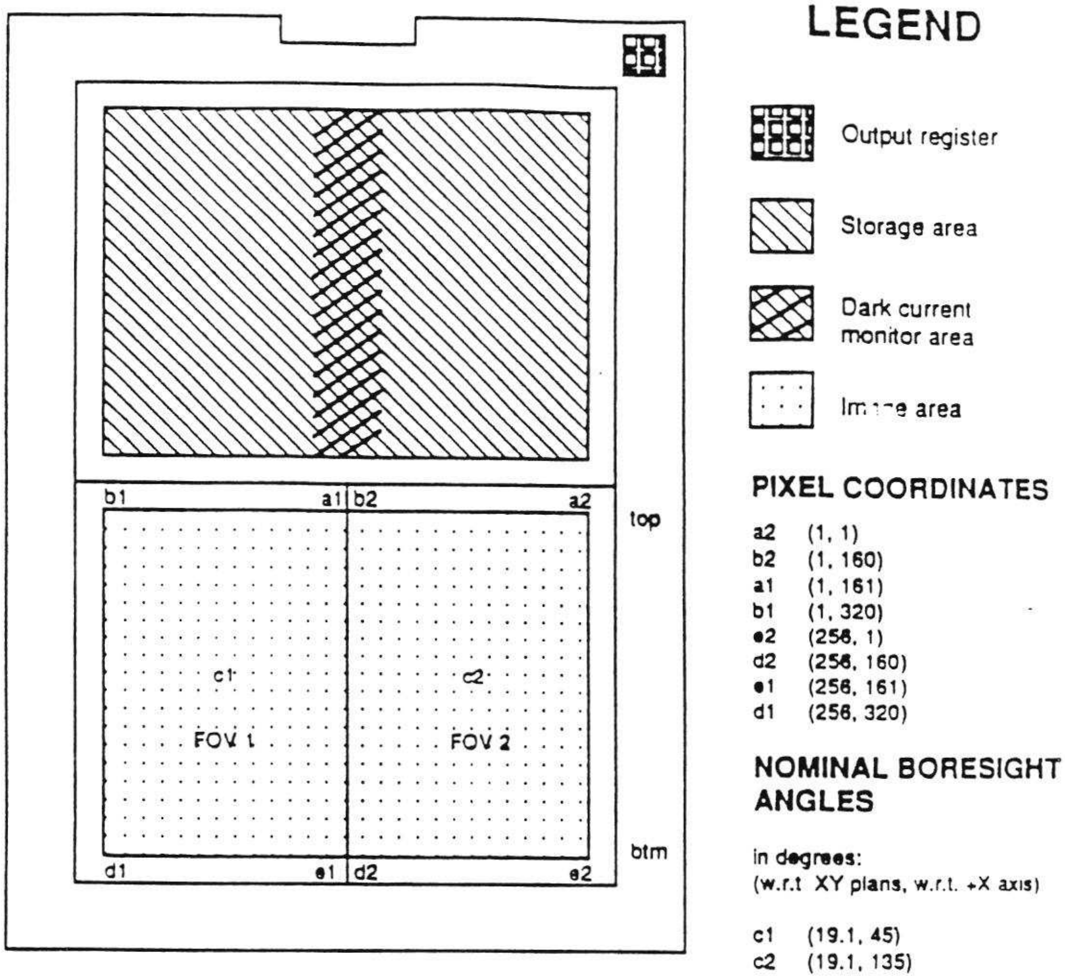
Byte 0:	DC Monitor 1 Low	occupies bits 0-3	1st pair of bytes
	DC Monitor 2 High	occupies bits 4-7	
Byte 1:	DC Monitor 1 High	occupies bits 0-7	
Byte 2:	DC Monitor 3 High	occupies bits 0-7	2nd pair of bytes
Byte 3:	DC Monitor 2 Low	occupies bits 0-7	

etc.



(cont'd)...





Vel vector	Fwd. FOV	Aft. FOV	Lead edge	Trail. edge
Parallel to				
+X	FOV 1	FOV 2	ae	bd
-X	FOV 2	FOV 1	bd	ae

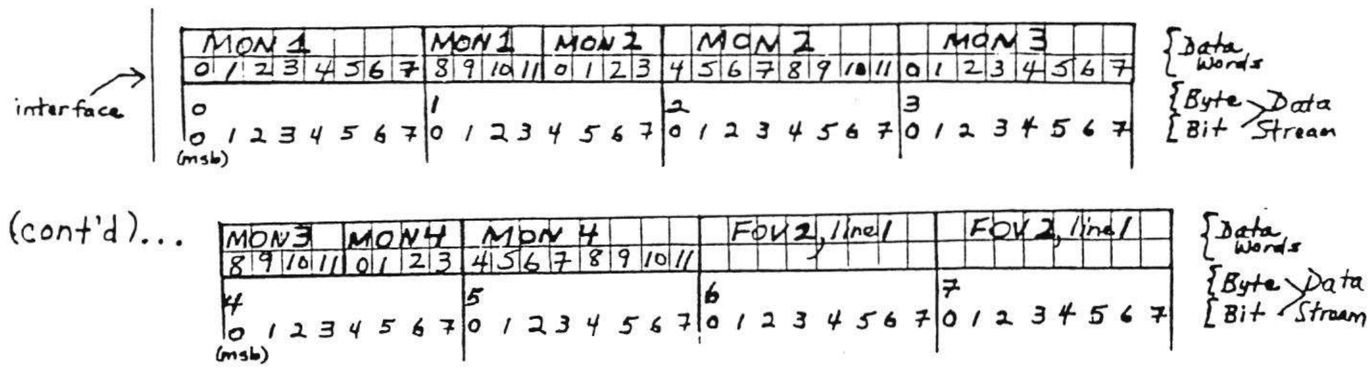
Figure 5.2.4.2 : CCD Viewed from Image Side

Normalized Telemetry:

The following diagram shows how the telemetry stream appears after each pair of bytes is reversed. Before each byte is used, it must be exclusive-ORed with hexFF to complement all the bits.

Byte 0:	DC Monitor 1 High occupies bits 0-7	1st 12-bit value	first pair of bytes
Byte 1:	DC Monitor 1 Low occupies bits 0-3		
	DC Monitor 2 High occupies bits 4-7	2nd 12-bit value	
Byte 2:	DC Monitor 2 Low occupies bits 0-7		second pair of bytes
Byte 3:	DC Monitor 3 High occupies bits 0-7	3rd 12-bit value	

etc.



5.2.4.2.2 FOV2 and FOV1, lines 1-n

The decode for image data telemetry is as follows:

Byte		Parameter
6	to 5+1.5*m	FOV2, line 1
6 + 1.5*m	to 5+3*m	FOV1, line 1
	to	
	to	
	to	
6 + 1.5*m(2n-2)	to 5+1.5*m(2n-1)	FOV2, line n
6 + 1.5*m(2n-1)	to 5+3*n*m	FOV1, line n

where: m=number of bins in each line (per window)
n=number of lines/FOV

See Figure 5.2.4.2 for definition of image parameters.

5.2.5 MEMORY DUMP PACKET

Upon receipt of a memory dump command, the contents of the processor memory is sent to the ground starting at the specified address. The packet contains the number of bytes specified by the memory dump command. The Memory Dump Packet is inserted into the telemetry stream at the start of a SMAF. The Memory Dump Packet functions are listed and decoded in Sections 5.2.5.1 and 5.2.5.2.

5.2.5.1 Memory Dump Packet Format Table

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
0	0	Sentinel	SNTNL0	always=1			5.2.5.2.1
	1		SNTNL1	always=0			
	2		SNTNL2	always=1			
	3		SNTNL3	always=0			
	4		SNTNL4	always=1			
	5		SNTNL5	always=1			
	6		SNTNL6	always=1			
	7		SNTNL7	always=1			
1	0		SNTNL8	always=1			
	1		SNTNL9	always=1			
	2		SNTNL10	always=1			
	3		SNTNL11	always=1			
	4		SNTNL12	always=0			
	5		SNTNL13	always=0			
	6		SNTNL14	always=0			
	7		SNTNL15	always=0			
2	0		SNTNL16	always=1			
	1		SNTNL17	always=1			
	2		SNTNL18	always=1			
	3		SNTNL19	always=1			
	4		SNTNL20	always=0			
	5		SNTNL21	always=0			
	6		SNTNL22	always=0			
	7		SNTNL23	always=0			
3	0	Mem. Dump ID	ID0	always=0			5.2.5.2.2
	1		ID1	always=0			
	2		ID2	always=1			
	3		ID3	always=1			
	4		ID4	always=1			
	5		ID5	always=1			
	6		ID6	always=0			
	7		ID7	always=0			
4	0	Not Assigned		always=0			
	1	Code Length	CDLNTH0		(0-32759)*	n=N	5.2.5.2.3
	2		CDLNTH1				
	3		CDLNTH2				
	4		CDLNTH3				
	5		CDLNTH4				
	6		CDLNTH5				
	7		CDLNTH6				

* This is maximum code length value to ensure packet fits into telemetry buffer.

Memory Dump Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
5	0		CDLNTH7				
	1		CDLNTH8				
	2		CDLNTH9				
	3		CDLNTH10				
	4		CDLNTH11				
	5		CDLNTH12				
	6		CDLNTH13				
	7		CDLNTH14				
6	0	Start Address	STRTAD0		(0-65535)	n=N	5.2.5.2.4
	1		STRTAD1				
	2		STRTAD2				
	3		STRTAD3				
	4		STRTAD4				
	5		STRTAD5				
	6		STRTAD6				
	7		STRTAD7				
7	0		STRTAD8				
	1		STRTAD9				
	2		STRTAD10				
	3		STRTAD11				
	4		STRTAD12				
	5		STRTAD13				
	6		STRTAD14				
	7		STRTAD15				
8	0	First byte of code					
.							
.							
7+M		Last byte of code, where M=code length					
8+M	0	Checksum			(0-255)	n=N	5.2.5.2.5
	1						
	2						
	3						
	4						
	5						
	6						
	7						

5.2.5.2 Memory Dump Packet Format Summary

5.2.5.2.1 Sentinel

SNTNL number is comprised of bits SNTNL0 through SNTNL23 of Bytes 0, 1 and 2 of the Memory Dump Packet.

Equivalence: Byte 0 = AF hex always
Byte 1 = F0 hex always
Byte 2 = F0 hex always

5.2.5.2.2 Memory Dump ID

ID word is comprised of bits ID0 through ID7 of Byte 3 of the Memory Dump Packet.

Equivalence: Byte 3 = 3C hex always

5.2.5.2.3 Code Length

CDLNTH number is comprised of bits CDLNTH0 through CDLNTH14 of Bytes 4 and 5 of the Memory Dump Packet.

Equivalence: Bytes 4 and 5 = CDLNTH0 through CDLNTH14
n=N, where N(0-32759)

Code length constraint ensures Memory Dump Packet will fit into 32k telemetry buffer.

5.2.5.2.4 Start Address

STRTAD number is comprised of bits STRTAD0 through STRTAD15 of Bytes 6 and 7 of the Memory Dump Packet.

Equivalence: Bytes 6 and 7 = STRTAD0 through STRTAD15
n=N, where N(0-65535)

5.2.5.2.5 Checksum

Checksum is based on the M bytes of code plus the Start Address and Code Length bytes.

The Checksum is the 7 least significant bits of the arithmetic sum of bytes 4+5+6+7+8 through [M+7] (where M is the code length in bytes).

5.2.6 CALIBRATION HEADER PACKET

The Calibration Header Packet contains 40 8-bit bytes with sufficient information for the ground processing to correctly identify the calibration and its parameters. The packet starts at the beginning of a SMAF. During calibration source warmup, this header is repeated in each SMAF only for the Broadband source and Laser. Calibration Image Header and Image Data Packets are used to present the calibration image data. The Calibration Header Packet functions are listed and decoded in Sections 5.2.6.1 and 5.2.6.2.

5.2.6.1 Calibration Header Packet Format Table

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
0	0	Sentinel	SNTNL0	always=1			5.2.6.2.1
	1		SNTNL1	always=0			
	2		SNTNL2	always=1			
	3		SNTNL3	always=0			
	4		SNTNL4	always=1			
	5		SNTNL5	always=1			
	6		SNTNL6	always=1			
	7		SNTNL7	always=1			
1	0		SNTNL8	always=1			
	1		SNTNL9	always=1			
	2		SNTNL10	always=1			
	3		SNTNL11	always=1			
	4		SNTNL12	always=0			
	5		SNTNL13	always=0			
	6		SNTNL14	always=0			
	7		SNTNL15	always=0			
2	0		SNTNL16	always=1			
	1		SNTNL17	always=1			
	2		SNTNL18	always=1			
	3		SNTNL19	always=1			
	4		SNTNL20	always=0			
	5		SNTNL21	always=0			
	6		SNTNL22	always=0			
	7		SNTNL23	always=0			
3	0	Calibration ID	ID0	always=1			5.2.6.2.2
	1		ID1	always=1			
	2		ID2	always=0			
	3		ID3	always=0			
	4		ID4	always=0			
	5		ID5	always=0			
	6		ID6	always=1			
	7		ID7	always=1			
4	0	Orbit	ORBT0		(0-14)	n=N	5.2.6.2.3
	1		ORBT1				
	2		ORBT2				
	3		ORBT3				
	4	Orbital Seq.	ORBTSEQ		0=I, 1=II		5.2.6.2.4 6.4.7 6.4.7.1
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			

Calibration Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
5	0	Non-Obs. Proc.	NONOBS0		(0-40)	n=N	5.2.6.2.5
	1		NONOBS1				
	2		NONOBS2				
	3		NONOBS3				
	4		NONOBS4				
	5		NONOBS5				
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
6	0	Filter Group	FLTRGP0		(0-31)	n=N	5.2.6.2.6
	1		FLTRGP1				
	2		FLTRGP2				
	3		FLTRGP3				
	4		FLTRGP4				
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
7	0	Start Time	STRTTM0		(0-65535)	n=0.128N	5.2.6.2.7
	1		STRTTM1			{0-8388.48}	
	2		STRTTM2			units=	
	3		STRTTM3			seconds	
	4		STRTTM4				
	5		STRTTM5				
	6		STRTTM6				
	7		STRTTM7				
8	0		STRTTM8				
	1		STRTTM9				
	2		STRTTM10				
	3		STRTTM11				
	4		STRTTM12				
	5		STRTTM13				
	6		STRTTM14				
	7		STRTTM15				
9	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Calib. Filter	CALFLTR0		(0-7)	n=N	5.2.6.2.8
	3		CALFLTR1		0=8	{1-8}	
	4		CALFLTR2				
	5	Calib. Source	CALSRC0		(0-6)	n=N	5.2.6.2.9
	6		CALSRC1				
	7		CALSRC2				

Calibration Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
10	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	No. of Images	NBRIMG0		(0-39)	n=N+1	5.2.6.2.10
	3		NBRIMG1			{1, 4, or 40}	
	4		NBRIMG2				
	5		NBRIMG3				
	6		NBRIMG4				
	7		NBRIMG5				
11	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Horiz. Bin Dim.	HBIN0		(0-31)	n=N+1	5.2.6.2.11
	4		HBIN1			{1-32}	
	5		HBIN2			units=pixels	
	6		HBIN3				
	7		HBIN4				
12	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Vert. Bin Dim.	VBIN0		(0-31)	n=N+1	5.2.6.2.12
	4		VBIN1			{1-32}	
	5		VBIN2			units=pixels	
	6		VBIN3				
	7		VBIN4				
13	0	Win. Vert. Height	HIGH0		(0-255)	n=N	5.2.6.2.13
	1		HIGH1		where	{1-256}	
	2		HIGH2		0=256	units=bins	
	3		HIGH3				
	4		HIGH4				
	5		HIGH5				
	6		HIGH6				
	7		HIGH7				
14	0	Win Vert. Offset	VOFFSET0		(0-255)	n=N	5.2.6.2.14
	1		VOFFSET1			{0-255}	
	2		VOFFSET2			units=bins	
	3		VOFFSET3				
	4		VOFFSET4				
	5		VOFFSET5				
	6		VOFFSET6				
	7		VOFFSET7				

Calibration Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
15	0	Win Horz. Width	WIDE0		(1-160)	n=N	5.2.6.2.15
	1		WIDE1			units=bins	
	2		WIDE2				
	3		WIDE3				
	4		WIDE4				
	5		WIDE5				
	6		WIDE6				
	7		WIDE7				
16	0	Win. Horz. Offset	HOFFSET0		(0-159)	n=N	5.2.6.2.16
	1		HOFFSET1			units=pixels	
	2		HOFFSET2				
	3		HOFFSET3				
	4		HOFFSET4				
	5		HOFFSET5				
	6		HOFFSET6				
	7		HOFFSET7				
17	0	Window Sep'n	SEPARAT0		(0-254)	n=N	5.2.6.2.17
	1		SEPARAT1		where 0=1	units=pixels	
	2		SEPARAT2		window/FOV		
	3		SEPARAT3				
	4		SEPARAT4				
	5		SEPARAT5				
	6		SEPARAT6				
	7		SEPARAT7				
18	0	Apert. 1 Status	APR1STAT		1=Open, 0=Closed		
	1	Apert. 2 Status	APR2STAT		1=Open, 0=Closed		
	2	Filter Wheel Position	FWSTAT		1=Correct, 0=Unknown		
	3	Not Assigned		always=0			
	4	Exposure Time	EXPTIM0		(0-4095)	n=0.128N	5.2.6.2.18
	5		EXPTIM1			{0-524.16}	6.4.3
	6		EXPTIM2			units=	6.4.3.1
	7		EXPTIM3			seconds	
19	0		EXPTIM4				
	1		EXPTIM5				
	2		EXPTIM6				
	3		EXPTIM7				
	4		EXPTIM8				
	5		EXPTIM9				
	6		EXPTIM10				
	7		EXPTIM11				

Calibration Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
20	0	Laser Consumption	LSRCONS0		(0-255)		App. III
	1		LSRCONS1				
	2		LSRCONS2				
	3		LSRCONS3				
	4		LSRCONS4				
	5		LSRCONS5				
	6		LSRCONS6				
	7		LSRCONS7				
21	0	Laser PZT	LSRPZT0		(0-255)		App. III
	1		LSRPZT1				
	2		LSRPZT2				
	3		LSRPZT3				
	4		LSRPZT4				
	5		LSRPZT5				
	6		LSRPZT6				
	7		LSRPZT7				
22	0	Laser Output	LSROUT0		(0-255)		App. III
	1		LSROUT1				
	2		LSROUT2				
	3		LSROUT3				
	4		LSROUT4				
	5		LSROUT5				
	6		LSROUT6				
	7		LSROUT7				
23	0	Laser Current	LSRCURR0		(0-255)		App. III
	1		LSRCURR1				
	2		LSRCURR2				
	3		LSRCURR3				
	4		LSRCURR4				
	5		LSRCURR5				
	6		LSRCURR6				
	7		LSRCURR7				
24	0	Laser Temperature	LSRTMP0		(0-255)		App. III
	1		LSRTMP1				
	2		LSRTMP2				
	3		LSRTMP3				
	4		LSRTMP4				
	5		LSRTMP5				
	6		LSRTMP6				
	7		LSRTMP7				

Calibration Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
25	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Laser Stable	LSRSTAT		1=Stable, 0=Not Stable		
26	0	Broadband	WSRCOUT0		(0-255)		App. III
	1	Source Output	WSRCOUT1				
	2		WSRCOUT2				
	3		WSRCOUT3				
	4		WSRCOUT4				
	5		WSRCOUT5				
	6		WSRCOUT6				
	7		WSRCOUT7				
27	0	BBS Temp.	WSRCTMP0		(0-255)		App. III
	1		WSRCTMP1				
	2		WSRCTMP2				
	3		WSRCTMP3				
	4		WSRCTMP4				
	5		WSRCTMP5				
	6		WSRCTMP6				
	7		WSRCTMP7				
28	0	Mirror Error.X	MIRERRX0		(0-255)	n=N	5.2.6.2.26
	1		MIRERRX1			{-128 to 127}	
	2		MIRERRX2			n is a twos-	
	3		MIRERRX3			complement	
	4		MIRERRX4			value	
	5		MIRERRX5				
	6		MIRERRX6				
	7		MIRERRX7				
29	0	Mirror Error.Y	MIRERRY0		See Byte 28		
	1		MIRERRY1				
	2		MIRERRY2				
	3		MIRERRY3				
	4		MIRERRY4				
	5		MIRERRY5				
	6		MIRERRY6				
	7		MIRERRY7				

Calibration Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
30	0	Mirror Error.Z	MIRERRZ0		See Byte 28		
	1		MIRERRZ1				
	2		MIRERRZ2				
	3		MIRERRZ3				
	4		MIRERRZ4				
	5		MIRERRZ5				
	6		MIRERRZ6				
	7		MIRERRZ7				
31	0	Mirror Integ.X	MIRINTX0		(0-255)	n=N	5.2.6.2.27
	1		MIRINTX1			{-128 to 127}	
	2		MIRINTX2			n is a twos-	
	3		MIRINTX3			complement	
	4		MIRINTX4			value	
	5		MIRINTX5				
	6		MIRINTX6				
	7		MIRINTX7				
32	0	Mirror Integ.Y	MIRINTY0		See Byte 31		
	1		MIRINTY1				
	2		MIRINTY2				
	3		MIRINTY3				
	4		MIRINTY4				
	5		MIRINTY5				
	6		MIRINTY6				
	7		MIRINTY7				
33	0	Mirror Integ.Z	MIRINTZ0		See Byte 31		
	1		MIRINTZ1				
	2		MIRINTZ2				
	3		MIRINTZ3				
	4		MIRINTZ4				
	5		MIRINTZ5				
	6		MIRINTZ6				
	7		MIRINTZ7				
34	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			

Calibration Header Packet (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	REFER. PARA.
	7	EMAF Timetag	EMAFTT0		See Byte 35		
35	0		EMAFTT1		(0-511)	n=0.128N	5.2.6.2.28
	1		EMAFTT2			{0-65.408}	
	2		EMAFTT3			units=	
	3		EMAFTT4			seconds	
	4		EMAFTT5				
	5		EMAFTT6				
	6		EMAFTT7				
	7		EMAFTT8				
36	0	ELS Output	ELSOUT0		(0-255)		App. III
	1		ELSOUT1				
	2		ELSOUT2				
	3		ELSOUT3				
	4		ELSOUT4				
	5		ELSOUT5				
	6		ELSOUT6				
	7		ELSOUT7				
37	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
38	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			
39	0	Not Assigned		always=0			
	1	Not Assigned		always=0			
	2	Not Assigned		always=0			
	3	Not Assigned		always=0			
	4	Not Assigned		always=0			
	5	Not Assigned		always=0			
	6	Not Assigned		always=0			
	7	Not Assigned		always=0			

5.2.6.2 Calibration Header Packet Format Summary

5.2.6.2.1 Sentinel

SNTNL number is comprised of bits SNTNL0 through SNTNL23 of Bytes 0, 1 and 2 of the Calibration Header Packet.
Equivalence: Byte 0 = AF hex always
Byte 1 = F0 hex always
Byte 2 = F0 hex always

5.2.6.2.2 Calibration ID

ID word is comprised of bits ID0 through ID7 of Byte 3 of the Calibration Header Packet.
Equivalence: Byte 3 = C3 hex always

5.2.6.2.3 Orbit

ORBT number is comprised of bits ORBT0 through ORBT3 of Byte 4 of the Calibration Header Packet.
Equivalence: ORBT=n=N, where N(0-14)

This represents the orbit number minus one; where the orbit number is a unique integer describing the specific orbit.

5.2.6.2.4 Orbital Sequence

ORBTSEQ number is comprised of bit 4 of byte 4 of the Calibration Header Packet. Orbital Sequences "I" and "II" identify two pre-defined sequences (refer to Orbital Sequence Data Table, paras. 6.4.7 and 6.4.7.1).

5.2.6.2.5 Non-Observation Procedures

NONOBS number is comprised of bits NONOBS0 through NONOBS5 of Byte 5 of the Calibration Header Packet.
Equivalence: n=N where N(0-40)
See Table 5.2.6.2.5 for decode.

Procedure ID No.	Non-Observation Procedure	Procedure ID No.	Non-Observation Procedure
0	Non-Obs 0	16	Non-Obs 16
1	Non-Obs 1	17	Non-Obs 17
2	Non-Obs 2	18	Non-Obs 18
3	Non-Obs 3	19	Non-Obs 19
4	Non-Obs 4	20	Non-Obs 20
5	Non-Obs 5	21	Non-Obs 21
6	Non-Obs 6	22	Non-Obs 22
7	Non-Obs 7	23	Non-Obs 23
8	Non-Obs 8	24	Non-Obs 24
9	Non-Obs 9	25	Non-Obs 25
10	Non-Obs 10	26	Non-Obs 26
11	Non-Obs 11	27	Non-Obs 27
12	Non-Obs 12	28	Non-Obs 28
13	Non-Obs 13	29	Non-Obs 29
14	Non-Obs 14	30	Non-Obs 30
15	Non-Obs 15	31	Non-Obs 31
		32-38	Reserved for Commands
		39	Frequent Phase
		40	Frequent Dark Current

Note: Procedure ID No. 0-30 are directly mapped to Non-Observation Data Table which have default values IAW Table 6.6.4. Procedure ID No 31 initiates an integrity check of areas of RAM (refer para. 7.4.2.2). Thus, a program patch to the Non-obs Jump Table must be done before the Non-obs Data Table procedure 31 can be executed. ID No 32 to 38 are reserved for Commands. (Refer to para 7.4.1, Byte 0, RIU Command).

Table 5.2.6.2.5 Decode for Non-Observation Procedures

5.2.6.2.6 <u>Filter Group</u>

FLTRGP number is comprised of bits FLTRGP0 through FLTRGP4 of Byte 6 of the Calibration Header Packet.

Equivalence: FLTRGP=n=N, N(0-31); output {0-31}

5.2.6.2.7 Start Time

STRTTM number is comprised of STRTTM0 through STRTTM15 bits of Bytes 7 and 8 of the Calibration Header Packet.
Equivalence: STRTTM=n=0.128N
n(units)=seconds

This represents the time that the START command of the first image is sent to the camera relative to the orbit time which is reset by UARS (through the EQXNADIR command) upon any spacecraft south to north equatorial crossing.

5.2.6.2.8 Calibration Filter

CALFLTR number is comprised of bits CALFLTR0 through CALFLTR2 of Byte 9 of the Calibration Header Packet.
Equivalence: CALFLTR=n=N, where N(0-7), output {1-8}
N=0 corresponds to filter #8.

5.2.6.2.9 Calibration Sources

CALSRC number is comprised of bits CALSRC0 through CALSRC2 of Byte 9 of the Calibration Header Packet.
Equivalence: CALSRC=n=N where N(0-6), N=7 is undefined

where:
0 = none
1 = 557.0 nm (nanometre)
2 = 630.4 nm
3 = 738.4 nm
4 = 763.5 nm
5 = Broadband
6 = Laser

5.2.6.2.10 Number of Images

NBRIMG number is comprised of bits NBRIMG0 through NBRIMG5 of Byte 10 of the Calibration Header Packet.
Equivalence: NBRIMG=n=N+1, where N(0-39), output range {1-40}

5.2.6.2.11 Horizontal Bin Dimension

HBIN number is comprised of bits HBIN0 through HBIN4 of Byte 11 of the Calibration Header Packet.
Equivalence: HBIN=n=N+1 where N(0-31), output range {1-32}
units=pixels

5.2.6.2.12 Vertical Bin Dimension

VBIN number is comprised of bits VBIN0 through VBIN4 of Byte 12 of the Calibration Header Packet.
Equivalence: VBIN=n=N+1 where N(0-31), output range {1-32}
units=pixels

5.2.6.2.13 Window Vertical Height

HIGH word is comprised of bits HIGH0 through HIGH7 of Byte 13 of the Calibration Header Packet.
Equivalence: HIGH=n=N where N(0-255); output {1-256}
units=bins
The value N=0 represents a value of 256.

5.2.6.2.14 Window Vertical Offset

VOFFSET word is comprised of bits VOFFSET0 through VOFFSET7 of Byte 14 of the Calibration Header Packet.
Equivalence: VOFFSET=n=N where N(0-255)
units=bins

5.2.6.2.15 Window Horizontal Width

WIDE word is comprised of bits WIDE0 through WIDE7 of Byte 15 of the Calibration Header Packet.
Equivalence: WIDE=n=N where N(1-160)
units=bins

5.2.6.2.16 Window Horizontal Offset

HOFFSET word is comprised of bits HOFFSET0 through HOFFSET7 of Byte 16 of the Calibration Header Packet.
Equivalence: HOFFSET=n=N where N(0-159)
units=pixels

5.2.6.2.17 Window Separation

SEPARAT word is comprised of bits SEPARAT0 through SEPARAT7 of Byte 17 of the Calibration Header Packet.
Equivalence: SEPARAT=n=N where N(0-254, where N=0 represents 1 window/FOV)
units=pixels

5.2.6.2.18 Exposure Time

EXPTIM number is comprised of bits EXPTIM0 through EXPTIM11 of Bytes 18 and 19 of the Calibration Header Packet.
Equivalence: EXPTIM=n=0.128N; N(0-4095), output {0-524.16}
n(units)=seconds

The exposure time represents the duration of the image exposure and the exposure times are illustrated in the Exposure Data Table (paras. 6.4.3 and 6.4.3.1).

5.2.6.2.19 Laser Light Output

LSROUT word is comprised of bits LSROUT0 through LSROUT7 of Byte 22 of the Calibration Header Packet.

This represents the output intensity of the laser.

Refer to Appendix III for ouput range and decode.

5.2.6.2.20 Laser Current

LSRCURR word is comprised of bits LSRCURR0 through LSRCURR7 of Byte 23 of the Calibration Header Packet.

This represents the measured current of the laser.

Refer to Appendix III for output range and decode.

5.2.6.2.21 Laser Temperature

LSRTMP word representing the measured laser temperature and is comprised of bits LSRTMP0 through LSRTMP7 of Byte 24 of the Calibration Header Packet.

Refer to Appendix III for output range and decode.

5.2.6.2.22 Laser PZT

LSRPZT word represents the measured laser piezo voltage value and is comprised of bits LSRPZT0 through LSRPZT7 of Byte 21 of the Calibration Header Packet.

Refer to Appendix III for output range and decode.

5.2.6.2.23 Laser Consumption

LSRCONS word represents the measured laser current consumption value and is comprised of bits LSRCONS0 through LSRCONS7 of Byte 20 of the Calibration Header Packet.

Refer to Appendix III for output range and decode.

5.2.6.2.24 Broadband Source Output

WSRCOUT word is comprised of bits WSRCOUT0 through WSRCOUT7 of Byte 26 of the Calibration Header Packet.

Refer to Appendix III for output range and decode.

5.2.6.2.25 Broadband Source Temperature

WSRCTMP word is comprised of bits WSRCTMP0 through WSRCTMP7 of Byte 27 of the Calibration Header Packet.

Refer to Appendix III for output range and decode.

5.2.6.2.26 Mirror Error - X,Y,Z

MIRERRX word is comprised of bits MIRERRX0 through MIRERRX7 of Byte 28.

MIRERRY word is comprised of bits MIRERRY0 through MIRERRY7 of Byte 29.

MIRERRZ word is comprised of bits MIRERRZ0 through MIRERRZ7 of Byte 30.

All three words are 8-bit words in the Calibration Header Packet and are expressed as a signed 2's complement.

Equivalence: n=N, where N(0-255)
where n is an 8-bit signed twos-complement value,
output range n is {127 to -128}
units=volts

Mirror Error refers to the Michelson Mirror and the values are measured by the Mirror Controller Component (MCC). These values are in turn used to determine voltage error.

5.2.6.2.27 Mirror Integrated - X,Y,Z

MIRINTX word is comprised of bits MIRINTX0 through MIRINTX7 of Byte 31.

MIRINTY word is comprised of bits MIRINTY0 through MIRINTY7 of Byte 32.

MIRINTZ word is comprised of bits MIRINTZ0 through MIRINTZ7 of Byte 33.

All three words are 8-bit words in the Calibration Header Packet and are expressed as a signed 2's complement. Mirror integrated values are employed in a transmit operation between the MCC (Mirror Controller Component) and ICM (Interface Control Module) to determine monitor outputs.

Equivalence: n=N, where N(0-255)
where n is an 8-bit signed twos-complement value,
output range n is {127 to -128}
units=volts

5.2.6.2.28 EMAF Timetag

EMAFTT number is comprised of bits EMAFTT0 through EMAFTT8 of Bytes 34 and 35 of the Calibration Header Packet.

Equivalence: EMAFTT=n=0.128N
input N(0-511); output {0-65.408}
n(units)=UARS seconds

This represents the time, relative to the receipt of the last EMAF synchronization signal, at which the START command was sent to initiate the first image.

5.2.6.2.29 ELS Output

ELSOUT word is comprised of bits ELSOUT0 through ELSOUT7 of Byte 36 of the Calibration Header Packet and measures the intensity of the Emission Line Sources (Sources 1 through 4).

Refer to Appendix III for output range and decode.

6.0 COMMANDS

6.1 INTRODUCTION

The WINDII flight instrument is controlled by the Instrument Control and Data Handling (ICDH) computer in the Electrical Unit (EU). Command distribution is via the logic interface circuitry within the instrument and is in accordance with the UARS General Instrument Interface Specification (GIIS) and the RIU User's Guide. There are 1 discrete command and 15 serial digital commands. These are described in the following paragraphs.
RIU commands or data words are received into a buffer by the RIU interrupt handler. The maximum this buffer can hold is 300 commands or data words.

6.2 DISCRETE COMMAND

This command is a hardware reset, which resets the ICDH without removing power from the system. The ICDH processor shall halt, the real-time clock shall be reset, the program counter shall be set to the start of the operations table and the RAM shall not be cleared. In addition, the ISU shall be re-initialized as required, forcing the Mirror and Camera Controllers into default configurations. The line shall normally be 'high', but shall be asserted 'low' (via a short circuit to RIU signal ground) for a duration of 7 ms when the ICDH is to be reset. An open circuited condition detected at the receive input shall be interpreted as logical 'high'.

The power-on RESET and the discrete command RESET shall both terminate in the instrument being configured to the SAFEHOLD state. The instrument can only exit this SAFEHOLD state with a HALT command, following which an EXECUTE or RESUME command is required to initiate operations.

The discrete RESET and the power-on reset are differentiated by the ICDH through checking for memory continuity in specific areas of RAM. The power-on reset performs the following additional functions: zeroes the orbit time, copies data from PROM to RAM and powers on the ISU Quiet Bus.

This discrete RESET command comes across from the WINDII RIU to the ICDH on command channel 55. On the ICDH side, this equates to the RESIN line. Figure 6.2.1 illustrates the interfaces between the RIU, the ICDH and the ISU.

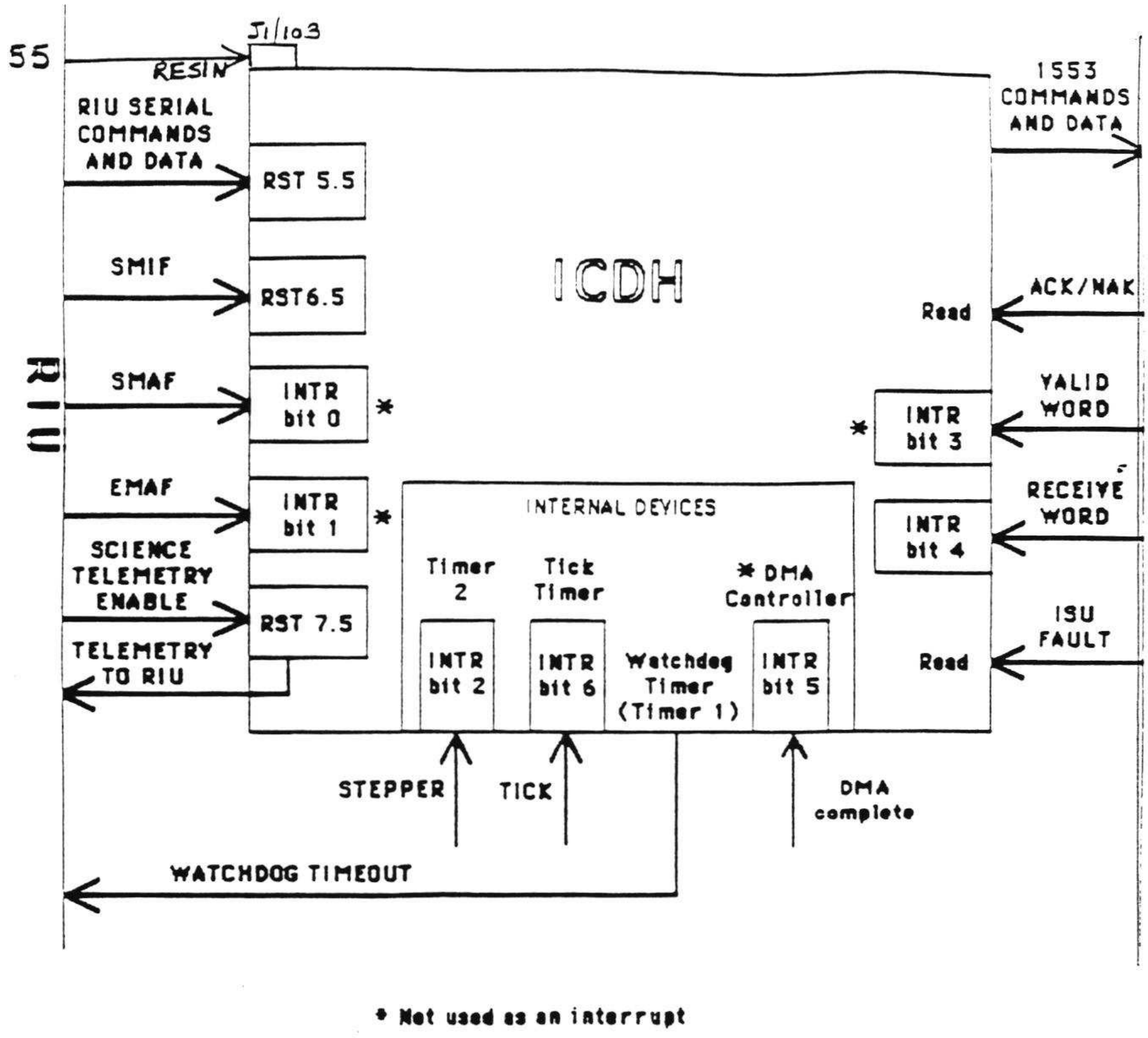


Figure 6.2.1: Software Interfaces (RIU to ICDH to ISU)

6.3 SERIAL DIGITAL COMMANDS

The serial digital commands are categorized as being either functional commands (instrument control - channel 7) or data commands (data load, program patch and memory dump - channel 6). The RIU will provide clock and enable signals as required.

Instrument Control - 4 in total
Orbital Events - 7 in total
Observation Data Tables - 1 in total
Non-Observation Procedures - 1 in total
Processor Access - 2 in total

RIU/ICDH Serial Commands:

Notes	LABEL	HEX FORMAT	FUNCTION
	Instrument Control:		
(1)	HALT	00AA	Stops instrument operations.
	EXECUTE	00AB	Starts instrument operations.
	RESUME	00AC	Re-starts operations after HALT.
(2)	SAFEHOLD	00AD	Stops operations and deploys calibration mirrors. Instrument operation can only restart after a HALT command, followed by EXECUTE or RESUME.
	Orbital Events:		
(3)	OBLAT45	1XXX	Oblateness data for 45 deg. boresight.
(3)	OBLAT135	3XXX	Oblateness data for 135 deg. boresight.
	SUNRS45	60A1	Sunrise indicator for 45 deg. boresight.
	SUNRS135	60A2	Sunrise indicator for 135 deg. boresight.
	SUNST45	60B1	Sunset indicator for 45 deg. boresight.
	SUNST135	60B2	Sunset indicator for 135 deg. boresight.
4)	EQXNADIR	CXXX	Equatorial crossing for Nadir point.
(5)	**Non-Observation Procedures Command:**		
(6)	NONOBS	20YY	Non-Observation Procedures Command
	Observation Data Tables:		
(7)	DATALD	41CA	Loads daily operations data tables.
	Processor Access:		
(8)	PGMPCH	41CB	Loads revised program code.
(9)	MEMDMP	41CC	Reads back memory contents.

Notes:

(1) All commands are serial and provided on RIU channel 7 unless otherwise noted.

(2) SAFEHOLD command required prior to any maneuvers and prior to removal of operational power (quiet and pulse buses).

(3) XXX represents a 12-bit signed 2's complement data field for altitude of the specified boresight with the lsb representing 2.5 km. WINDII only uses the least significant 8 bits plus the most significant (sign) bit.

(4) XXX represents a 12-bit data field which is ignored by WINDII. EQXNADIR is not buffered and it resets the ICDH internal clock.

(5) All Non-Observation Procedures Commands must be executed in the HALT state.

(6) YY represents an 8-bit field containing a value in the range 00 hex to 1F hex specifying a non-observation procedure. Thirty-two standard procedures are defined in Table 6.6.4. 39 and 40 are designated as Frequent Phase and Dark Current, respectively. Note that Non-Obs 31 initiates an Integrity check (ref 7.4.2.2) and should be the Non-Obs Proc. 31 (in accordance with the data table definition) be required, a program patch to the Non-Obs Jump Table is first required.

(7) This command is followed by 272 data bytes on RIU channel 6. These data consist of eight sets of mini-loads, each comprised of a 2-byte load address followed by 32 bytes of data table entries, for a total of 34 bytes per mini-load. A 16-bit checksum word is provided following the last mini-load. The software will buffer the 5 latest DATALD Commands. DATALD can be executed in any state.

(8) This command is followed by 262 data bytes on RIU channel 6. These data consist of a 2-byte load address, followed by a 2-byte word count, from 2 to 256 bytes of program code, and a 16-bit checksum. The program patch command is limited to 128 words and can be executed the in the HALT, SAFEHOLD and EXECUTE states.

(9) This command is followed by 4 data bytes on RIU channel 6. These data consist of a 2-byte start address for the memory dump, followed by 2 bytes indicating the number of bytes to be read out. Must be executed in HALT and SAFEHOLD states.

6.3.1 Instrument Control

HALT: Stops the observation mode of the instrument and turns off any calibration source. Since HALT is buffered, depending upon the instrument mode of operation, the HALT command takes different lengths of times to be initiated. For instance, before moving on to the next orbital sequence, after each measurement in a measurement cycle, after each filter group in a frequent calibration cycle, and after the complete non-observation procedure in a non-observation cycle, the HALT command will be recognized and acted upon. The HALT command is the only command used to exit the SAFEHOLD state. The HALT command is required before RESUME, EXECUTE or NONOBS commands can be executed from the SAFEHOLD condition.

EXECUTE: Starts Observation mode by loading any new data table definitions into the working area of the processor memory, thus updating the operations plan. Also sets the program counter to the first orbital sequence of the operations table. Instrument shall wait for the real-time clock to equal the first cycle sequence start time before implementing the operations plan. See para. 6.3.6 for a detailed account of the execution of the Operations Plan.

RESUME: Starts the Observation mode after a HALT. The Cycle sequences for which the start time has passed shall be skipped.

SAFEHOLD: This buffered command stops the Observation mode, deploys the calibration mirrors and turns off the calibration source. SAFEHOLD is similar to the HALT command in that it is first buffered and then initiated: before moving on to the next orbital sequence, after each filter group in a frequent calibration cycle, or after the completed non-obs. procedure in a non-observation cycle, whichever comes first.

6.3.2 Orbital Events

Oblateness (OBLAT45, OBLAT135):
Provides the effective altitude for each FOV boresight. A command shall be sent whenever the altitude changes by 2.5 km. This command is buffered and the measurement windows shall be adjusted accordingly, at the next measurement.

Sunrise (SUNRS45, SUNRS135):
Provides an indication when the 20 km. horizon below each FOV traverses into day. This command is buffered and the corresponding aperture stop shall be closed at the start of the next Cycle (or repeat of a Cycle) unless an aperture override has been specified within the Cycle.

Sunset (SUNST45, SUNST135):
Provides an indication when the 20 km. horizon below each FOV traverses into night. This command is buffered and the corresponding aperture stop shall be opened at the start of the next Cycle (or repeat of a Cycle) unless an aperture override has been specified within the Cycle.

Equatorial Crossing (EQXNADIR):
Provides an indication when the spacecraft Nadir crosses the equator. This command shall cause the real-time clock to be reset and the orbit number incremented. This command is not buffered, and thus executed immediately.

6.3.3 Non-Observation Procedures

Commands shall be provided to select specific non-observation procedures for execution, namely:

infrequent phase
infrequent dark current
responsivity

visibility
parallelism
mirror step size
filter pass band calibrations
star map

The Non-Observations procedures are as shown below:

Procedure ID No.	Non-Observation Procedure	Procedure ID No.	Non-Observation Procedure
0	Non-Obs 0	19	Non-Obs 19
1	Non-Obs 1	20	Non-Obs 20
2	Non-Obs 2	21	Non-Obs 21
3	Non-Obs 3	22	Non-Obs 22
4	Non-Obs 4	23	Non-Obs 23
5	Non-Obs 5	24	Non-Obs 24
6	Non-Obs 6	25	Non-Obs 25
7	Non-Obs 7	26	Non-Obs 26
8	Non-Obs 8	27	Non-Obs 27
9	Non-Obs 9	28	Non-Obs 28
10	Non-Obs 10	29	Non-Obs 29
11	Non-Obs 11	30	Non-Obs 30
12	Non-Obs 12	31	Non-Obs 31
13	Non-Obs 13	32-38	Reserved for Commands
14	Non-Obs 14	39	Frequent Phase
15	Non-Obs 15	40	Frequent Dark Current
16	Non-Obs 16		
17	Non-Obs 17		
18	Non-Obs 18		

Table 6.3.3 : Decode for Non-Observation Procedures

Note: Procedure ID No. 0-31 have default values IAW Table 6.6.4.
Procedure ID No. 32-38 are reserved for Commands (Refer to para 7.4.1, Byte 0, RIU Cmd). Note that Non-Obs 31 will initiate an integrity check routine (ref. par. 7.4.2.2) unless a program patch to the Non-Obs. Jump Table is done first.

6.3.4 **Observation Data Tables**

DATALOAD (DATALD):

Provides a set of eight mini-loads, each consisting of a 2-byte load address followed by 32 bytes of data to be stored starting at the load address. These data bytes are high-low order pairs. First, the low byte is put into the low address and then the high byte is put into the high address. A 16-bit checksum is provided at the end of the set. The checksum shall be computed during the receipt of the data and if the checksum of the 272 data bytes agrees with the checksum in the command packet, the data shall be accepted. Upon receipt of the EXECUTE command, the checksum shall be computed once again, and if correct, the data shall be copied into the processor working area at the specified load addresses.

DATALD sends one word at a time to the ICDH. The data is byte swapped by the ICDH when it writes into memory, and so if the data has not been byte swapped prior to transmission to the ICDH, the ICDH will cause the data to be incorrectly reversed. This error can be visually detected by a memory dump resulting in the high byte being returned first, followed by the low byte. Thus, for the order of data to be correct for ICDH software execution, it is necessary to byte-swap the data before sending a DATALD.

The software will only buffer the latest five DATALD commands.

If an error is detected, either when the DATALD command is received or when the data is copied into the working area, a Command Error code shall be set in the Engineering Telemetry and the data rejected. Once loaded, the new data table shall remain in effect until the instrument power is turned off or another data table is loaded.

A list of the data tables follows and the detailed format for each is in section 6.4 of this document.

NO.	DATA TABLE	BYTES PER ENTRY	NO. OF ENTRIES	REFERENCE PARAGRAPH
1.	Filter Group	8	32	6.4.1
2.	Cycle	8	24	6.4.2
3.	Exposure	2	16	6.4.3
4.	Mirror Parallelism	16	1	6.4.4
5.	Window Displacement	1	8	6.4.5
6.	Heater Control	2	1	6.4.6.1
7.	Cooler Control	2	1	6.4.6.2
8.	Orbital Sequence	8	24	6.4.7
9.	Operations	8	1	6.4.8
10.	Non-Observation Procedures	8	32	6.4.9
11.	MCC Step Size Lookup	16	4	6.4.10
12.	Heater Set Point	4	1	6.4.11.1
13.	Cooler Set Point	2	1	6.4.11.2
14.	Calibration Source Warmup	8	1	6.4.12

Notes:
1) An RIU pause in the middle of a WINDII data load has no effect (as long as it resumes in the identical location where it paused).
2) Should a processing command come through on RIU channel 7 at the same time a data load is taking place on RIU channel 6, the command on RIU channel 7 will be serviced. The dataload can continue where it left off. If the data was corrupted, the dataload will eventually fail checksum or a new command followed by data will be received, which will stop the wait for a dataload.

6.3.5 Processor Access

Program Patch (PGMPCH):

Provides a 2-byte load address, a 2-byte word count, from 2 to 256 bytes of code (in high-low order), and a 16-bit checksum word. The length indicates the number of 2-byte words to be patched. If the checksum of the code, the length, and the load address agrees with the checksum in a command packet, the code shall be copied into the processor working area. If not, the code shall not be used and a Command Error code shall be set in the Engineering Telemetry.

For each pair of data bytes, the low byte is first put into the low address and the high byte is then put into the high address. PGMPCH sends one word at a time to the ICDH. The data is byte swapped by the ICDH when it writes it into memory, and if the data has not been byte swapped prior to transmission to the ICDH, the ICDH memory will cause the data to be incorrectly reversed. This error can be visually detected by a memory dump resulting in the high byte being returned first, followed by the low byte. Thus, for the order of the data to be correct for ICDH software execution, it is necessary to byte-swap the data before sending a program patch.

PGMPCH is limited to 128 words and shall be serviced by the ICDH in the Halt, Safehold and Execute states. The program patch can be used in place of PROM based code, provided the Jump Table is also patched. Patches to the Jump Table should be small (1 or 2 words) as they will cause interrupts to be disabled when the patch to the Jump Table is applied. When program patching to the Jump Table and Non-Obs Jump Table, the data bytes (which is the address to which a jump shall occur) do not have to be byte-swapped.

Note: An RIU pause in the middle of this uplink will have no effect (as long as it resumes in the identical location where it paused).

Memory Dump (MEMDMP):

Provides a 2-byte start address and a 16-bit word containing the number of bytes to be read back to the ground from the processor memory. This command may be used to verify the program patch or the contents of the data tables. This command shall not be serviced by the ICDH unless the program is halted.

Due to the size of the telemetry RAM in ICDH, the Memory Dump can output only 32,759 bytes maximum. This allows a MEMDMP Packet, with 9 bytes of overhead, to fit into 32,768 bytes of RAM for telemetry.

6.3.6 Execution of Operations Plan

The EXECUTE command starts the Observation mode of the instrument by loading any new data table definitions into the working area of the processor memory, thus updating the operations plan.

If EQXNADIR is received prior to an EXECUTE command, the orbit will be executed at the next valid start time.

If an EXECUTE command is received while the instrument is in the HALT state, and has not received an EQXNADIR signal since the last RESET, the orbit number is zeroed and the instrument awaits the EQXNADIR signal.

When EQXNADIR is received, the orbit number is incremented to 1 and the orbit time is set to zero. The instrument shall then execute the orbital sequence for Orbit 1. Upon receipt of the next EQXNADIR signal, the orbit time is set to zero and the orbit number is incremented to 2. If the previous orbital sequence is complete, the instrument shall commence with Orbit 2. If the previous orbital sequence is not complete the sequence shall continue until the end of the current cycle sequence, and then look for the next cycle sequence appropriate for Orbit 2 with a valid start time. This process shall continue until the orbit number is 14 and a EQXNADIR signal is received, at which time the orbit number is reset to 0.

If an EXECUTE command is received while in the execute state, the contents of the Dataload Buffer shall be used to update data tables as required, the orbit number shall be zeroed and the ICDH shall wait for EQXNADIR before continuing with the operations program.

If RESUME is received while the instrument is in the HALT state, the RESUME command shall cause the execution of the operations program to commence at the first cycle sequence with a valid start time.

If RESUME is received while the instrument is in the EXECUTE state, the RESUME shall be reported in telemetry but otherwise ignored. Specifically, the execution of the current cycle sequence shall continue.

6.4 Data Tables

For all 14 Data Tables (6.4.1 through 6.4.12), bit 7 is the most significant bit (msb), which is the industry standard convention. Data Tables start at address 4000 hex. A memory map of the Data Tables is shown in section 6.5.

6.4.1 Filter Group Data Table Format

The below filter group data table (bytes 0 through 7) is repeated 32 times as illustrated in section 6.4.1.1. See Note 1.

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	
0	7 6 5	Meas. Filter			(0-7) 0 represents filter #8	{1-8}	Note 2
	4 3	Obs. Category			(0-3) where 0=Local, 1=Special, 2=Global, 3=Glob.&Spec	n=N	Note 3
	2 1 0	Special Obs. ID			(0-7)	n=N+1, {1-8}	Note 3
1	7	Dark Current Cal.			1=Yes, 0=No		Note 4
	6 5 4 3	Calib. Exposure			(8-15) Exposure Data Table, para 6.4.3) N=0 not allowed, N=1 to 7 are reserved for measurement exposures	n=N (locations in	Note 5
	2 1 0	Calib. Source			(0-7) 0=none, 1=557.0, 2=630.4, 3=738.4, 4=763.5, 5=not assigned 6=not assigned 7=no calib.	n=N	Note 6
2	7 6	No. of Images			(0-3)	n=N, {0-3} 0=1 image/meas. 1=4 images/meas. 2=8 images/meas. 3=Not Assigned	Note 7
	5	Not Assigned		always=0			

Filter Group Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	
	4	Horiz. Bin Dim.			(0-31)	n=N+1, {1-32} units=pixels	Note 8
	3						
	2						
	1						
	0						
3	7	No. of Repeats			(0-1)	n=N	Note 9
	6	Not Assigned		always=0			
	5	Not Assigned		always=0			
	4	Vert. Bin Dim.			(0-31)	n=N+1, {1-32} units=pixels	Note 10
	3						
	2						
	1						
	0						
4	7	Window Range			(0-255)	n=N units=km	Note 11
	6						
	5						
	4						
	3						
	2						
	1						
	0						
5	7	Window Altitude			(0-255)	n=N+60 {60-315} units=km	Note 12
	6						
	5						
	4						
	3						
	2						
	1						
	0						
6	7	Window Horiz. Width			(1-160)	n=N, {1-160} units=bins	
	6						
	5						
	4						
	3						
	2						
	1						
	0						

Filter Group Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}	
7	7	Window Horiz. Offset			(0-159)	n=N units=pixels	Note 13
	6						
	5						
	4						
	3						
	2						
	1						
	0						

Notes:

1. The least significant bit in the byte is bit 0.
   N is the value of the binary number specified by the field.

2. Measurement Filter indicates the emission line or background being measured by the Filter Group.

3. Observation Category and Special Observation ID are used by the SDPPS (Science Data Processing Production Software). The categories (local, global and special) specify which emissions are to be measured and to what scale.

4. If a dark current calibration is to be performed the window size, bin size and exposure time will be the same as those parameters in the measurement. The calibration mirrors will be deployed, the blank filter selected and the apertures will be as specified in the cycle sequence.

5. Calibration Exposure points to the exposure time to be used in a frequent phase calibration.

6. Calibration Source indicates which source is used to perform a frequent phase calibration. If 0 is selected, a frequent phase calibration will be performed using no source. This feature was included for ground test purposes. If 7 is selected, no frequent phase calibration will be performed.

7. Number of Images is typically 1 image/measurement for background measurements and 4 or 8 images/measurement for emission line measurements.

8. Horizontal Bin Dimension is required by CDB (Characterization Data Base) (used with SDPPS) to be an exact multiple of 5. Typical values are 10, 15 and 20.

9. Number of Repeats represents the number of times the measurement is repeated. If 1 is specified, the number of images (with accompanying Measurement Image Header Packet) is repeated once. Note that the Measurement Header Packet is not repeated.

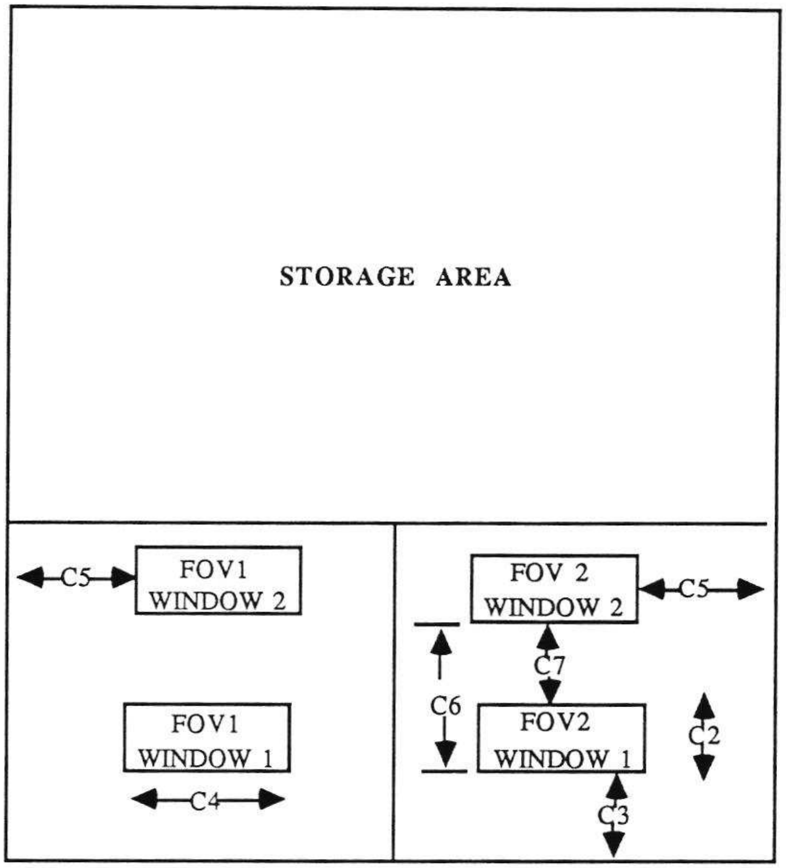
10. Vertical Bin Dimension has a typical range of 1 to 8 pixels.

11. Window Range is selected to include the oblateness effects on window altitude for both FOV's. The minimum altitude of the bottom of the WINDII FOV's. is specified in the Operations Data Table (para. 6.4.8; Byte 4 and Note). To be compliant with SDPPS, the window range must be in the range of 0 to 240.

12. Window Altitude is the height, in km, from the Earth's surface to the bottom of the window. This value is used by the oblateness calculation to ensure that the distance is an integer number of bins and that the window range is greater than or equal to the required window range. The Window Altitude is subject to limitations of the oblateness algorithms. If filter 5 is used, the top of the first window must not exceed the window displacement and the top of the second window must not exceed 240 (to be compliant with SDPPS).

13. Window Horizontal Offset is the distance from the outside edge of the CCD to the left edge of the window. The CDB window is offset by 2 and thus when horizontal offset is used, for CDB to be in conjunction with SDPPS, a value of 2 or an exact multiple of 5 must be used.

The window parameters are illustrated below:



CCD VIEWED FROM IMAGE SIDE

LEGEND

C2, WINDOW HEIGHT
C3, WINDOW VERTICAL OFFSET
C4, WINDOW WIDTH
C5, WINDOW HORIZONTAL OFFSET
C6, WINDOW DISPLACEMENT
C7, WINDOW SEPARATION (AS REPORTED IN SCIENCE TELEMETRY - CALIBRATION AND MEASUREMENT HEADERS)

Figure 6.4.1 : Image Window Parameters

6.4.1.1 Filter Group Format Summary

Structure:

Group Address (lo byte)	Group Number	Group Address (lo byte)	Group Number
00000XXX	00	10000XXX	16
00001XXX	01	10001XXX	17
00010XXX	02	10010XXX	18
00011XXX	03	10011XXX	19
00100XXX	04	10100XXX	20
00101XXX	05	10101XXX	21
00110XXX	06	10110XXX	22
00111XXX	07	10110XXX	23
01000XXX	08	11000XXX	24
01001XXX	09	11001XXX	25
01010XXX	10	11010XXX	26
01011XXX	11	11011XXX	27
01100XXX	12	11100XXX	28
01101XXX	13	11101XXX	29
01110XXX	14	11110XXX	30
01111XXX	15	11111XXX	31

Notes:

XXX allows addressing specific bytes within 8 byte entry.
The 32 entries have been located in a 256 byte block of memory.
The window displacement will be provided in the Window Displacement Data Table (para 6.4.5) for all filters.

6.4.2 Cycle Data Table Format

The below cycle data table (bytes 0 through 7) is repeated 24 times as illustrated in the section 6.4.2.1.

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
0	7 6 5 4 3	Filter Group			(0-31) Filter Group Number (from paras. 6.4.1 and 6.4.1.1)	n=N
	2 1 0	Exposure Time			(1-7) If N=0, it indicates no further measurements will be made within the cycle. Locations in Exposure Data Table (6.4.3).	n=N
1	7 6 5 4 3	Filter Group			Same as Byte 0	
	2 1 0	Exposure Time			Same as Byte 0	
2	7 6 5 4 3	Filter Group			Same as Byte 0	
	2 1 0	Exposure Time			Same as Byte 0	
3	7 6 5 4 3	Filter Group			Same as Byte 0	
	2 1 0	Exposure Time			Same as Byte 0	

Cycle Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
4	7 6 5 4 3	Filter Group			Same as Byte 0	
	2 1 0	Exposure Time			Same as Byte 0	
5	7 6 5 4 3	Filter Group			Same as Byte 0	
	2 1 0	Exposure Time			Same as Byte 0	
6	7 6 5 4 3	Filter Group			Same as Byte 0	
	2 1 0	Exposure Time			Same as Byte 0	
7	7 6 5 4 3	Filter Group			Same as Byte 0	
	2 1 0	Exposure Time			Same as Byte 0	

Notes:

The least significant bit in the byte is bit 0.
N is the value of the binary number specified by the field.
The exposure time N(1-7) refers to the first set of 7 exposure times in the Exposure Data Table (para 6.4.3.1).
If the exposure time is 0, no further measurements will be made within the Cycle.

6.4.2.1 Cycle Format Summary

Structure:

Cycle Address (lo byte)	Cycle Letter	Cycle Address (lo byte)	Cycle Letter
00000XXX	A	01100XXX	N
00001XXX	B	01101XXX	P
00010XXX	C	01110XXX	Q
00011XXX	D	01111XXX	R
00100XXX	E	10000XXX	S
00101XXX	F	10001XXX	T
00110XXX	G	10010XXX	U
00111XXX	H	10011XXX	V
01000XXX	J	10100XXX	W
01001XXX	K	10101XXX	X
01010XXX	L	10110XXX	Y
01011XXX	M	10111XXX	Z

Notes:

XXX allows addressing specific bytes within 8 byte entry.
The 24 entries have been located in 192 bytes of a 256 byte block of memory.

6.4.3 Exposure Time Data Table Format

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
0	7	Exposure Time	EXPTIM7		See Byte 1	
	6		EXPTIM6			
	5		EXPTIM5			
	4		EXPTIM4			
	3		EXPTIM3			
	2		EXPTIM2			
	1		EXPTIM1			
	0		EXPTIM0			
1	7	Not Assigned		always=0		
	6			always=0		
	5			always=0		
	4			always=0		
	3	Exposure Time	EXPTIM11		(0-4095)	n=0.128N
	2		EXPTIM10		N is 8 bits	{0-524.16}
	1		EXPTIM9		from byte 0	units=seconds
	0		EXPTIM8		and 4 bits	
					from byte 1	

Notes:

The least significant bit in the byte is bit 0.
The bytes are swapped due to the ICDH's method of handling words.

6.4.3.1 Exposure Format Summary

Structure:

Exposure Number	Expt. Time Location (lo byte)	Used for:
00	11000000	N=0, *Used to indicate end of cycle*
01	11000010	Measurement
02	11000100	Measurement
03	11010110	Measurement
04	11001000	Measurement
05	11001010	Measurement
06	11001100	Measurement
07	11001110	Measurement
08	11010000	Calibration
09	11010010	Calibration
10	11010100	Calibration
11	11010110	Calibration
12	11011000	Calibration
13	11011010	Calibration
14	11011100	Calibration
15	11011110	Calibration

Notes:

The 16 entries have been located in the 32 bytes following the 192 bytes used by the Cycle Data Table. Two bytes have been allocated to each entry.
The first entry is not available as an exposure time as it is used to designate the end of a set of Filter Groups within a Cycle. The next 7 entries are used for normal measurements. The last 8 entries are used for frequent phase calibration only.

6.4.4 Mirror Parallelism Data Table Format

See Note 1

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
0	7	Displace.X.Re-Lo	DISPXR7		See Byte 1	
	6		DISPXR6			
	5		DISPXR5			
	4		DISPXR4			
	3		DISPXR3			
	2		DISPXR2			
	1		DISPXR1			
	0		DISPXR0			
1	7			always=0		Upper nibble
	6			always=0		of Byte 1 is
	5			always=0		always set to
	4			always=1		value = 1
	3	Displace.X.Re-Hi	DISPXR11		(0-4095)	{-2048 to 2047}
	2		DISPXR10		12-bit signed twos-complement	
	1		DISPXR9		N is 8 bits from Byte 0 and	
	0		DISPXR8		4 bits from Byte 1	
2	7	Displace.Y.Re-Lo	DISPYR7		See Byte 3	
	6		DISPYR6			
	5		DISPYR5			
	4		DISPYR4			
	3		DISPYR3			
	2		DISPYR2			
	1		DISPYR1			
	0		DISPYR0			
3	7			always=0		Upper nibble of
	6			always=0		Byte 3 is always
	5			always=1		set to value = 3
	4			always=1		
	3	Displace.Y.Re-Hi	DISPYR11		(0-4095)	{-2048 to 2047}
	2		DISPYR10		12-bit signed twos-complement	
	1		DISPYR9		N is 8 bits from Byte 2 and 4 bits	
	0		DISPYR8		from Byte 3	
4	7	Displace.Z.Re-Lo	DISPZR7		See Byte 5	
	6		DISPZR6			
	5		DISPZR5			
	4		DISPZR4			
	3		DISPZR3			
	2		DISPZR2			
	1		DISPZR1			
	0		DISPZR0			

Mirror Parallelism Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
5	7			always=0		Upper nibble of
	6			always=1		Byte 5 is always
	5			always=0		set to value = 5
	4			always=1		
	3	Displace.Z.Re-Hi	DISPZR11		(0-4095)	{-2048 to 2047}
	2		DISPZR10		12-bit signed twos-complement	
	1		DISPZR9		N is 8 bits from Byte 4 and	
	0		DISPZR8		4 bits from Byte 5	
6	7	Not Assigned		always=0		Note: Bytes 6 & 7
	6			always=0		are used during
	5			always=0		the Mirror
	4			always=0		Parallelism Special
	3			always=0		Test as the Range
	2			always=0		& Offset data
	1			always=0		values
	0			always=0		
7	7	Not Assigned		always=0		
	6			always=0		
	5			always=0		
	4			always=0		
	3			always=0		
	2			always=0		
	1			always=0		
	0			always=0		
8	7	Displace.X.Im-Lo	DISPXI7		See Byte 9	
	6		DISPXI6			
	5		DISPXI5			
	4		DISPXI4			
	3		DISPXI3			
	2		DISPXI2			
	1		DISPXI1			
	0		DISPXI0			
9	7			always=0		Upper nibble of
	6			always=0		Byte 9 is always
	5			always=1		set to value = 2
	4			always=0		
	3	Displace.X.Im-Hi	DISPXI11		(0-4095)	{-2048 to 2047}
	2		DISPXI10		12-bit signed twos-complement	
	1		DISPXI9		N is 8 bits from Byte 8 and	
	0		DISPXI8		4 bits from Byte 9	

Mirror Parallelism Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
10	7	Displace.Y.Im-Lo	DISPYI7		See Byte 11	
	6		DISPYI6			
	5		DISPYI5			
	4		DISPYI4			
	3		DISPYI3			
	2		DISPYI2			
	1		DISPYI1			
	0		DISPYI0			
11	7			always=0		Upper nibble of
	6			always=1		Byte 11 is always
	5			always=0		set to value = 4
	4			always=0		
	3	Displace.Y.Im-Hi	DISPYI11		(0-4095)	{-2048 to 2047}
	2		DISPYI10		12-bit signed twos-complement	
	1		DISPYI9		N is 8 bits from Byte 10 and	
	0		DISPYI8		4 bits from Byte 11	
12	7	Displace.Z.Im-Lo	DISPZI7		See Byte 13	
	6		DISPZI6			
	5		DISPZI5			
	4		DISPZI4			
	3		DISPZI3			
	2		DISPZI2			
	1		DISPZI1			
	0		DISPZI0			
13	7			always=0		Upper nibble of
	6			always=1		Byte 13 is always
	5			always=1		set to value 6
	4			always=0		
	3	Displace.Z.Im-Hi	DISPZI11		(0-4095)	{-2048 to 2047}
	2		DISPZI10		12-bit signed twos-complement	
	1		DISPZI9		N is 8 bits from Byte 12 and	
	0		DISPZI8		4 bits from Byte 13	
14	7	Not Assigned		always=0		
	6			always=0		
	5			always=0		
	4			always=0		
	3			always=0		
	2			always=0		
	1			always=0		
	0			always=0		

Mirror Parallelism Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
15	7	Not Assigned		always=0		
	6			always=0		
	5			always=0		
	4			always=0		
	3			always=0		
	2			always=0		
	1			always=0		
	0			always=0		

Notes:

1. The least significant bit in the byte is bit 0.

   Re indicates a real value and Im indicates an imaginary value.

   The displacement values are 12-bit signed twos-complement values where bit 11 is the sign bit. The range of the values is 2047 to -2048.

   The bytes are swapped due to the ICDH's method of handling words.

2. Displace.X.Im, Displace.Y.Im and Displace.Z.Im are adjustments made to compensate for phase errors in the MCC (Mirror Controller Component).

   Displace.X.Re and Displace.Y.Re compensate for mechanical alignment error in the scanning mirror mechanism so as to minimize the optical wavefront distortion.

   Displace.Z.Re balances the z-axis (optical axis) capacitance bridge.

3. The code necessary to perform a Mirror Parallelism calibration resides in PROM. To initate the calibration, a program patch to the Non-Obs Jump Table is first required, followed by pre-determined NONOBS command which executes the code.

6.4.4.1 Mirror Parallelism Format Summary

Entry Location (low byte of address)	Entry Value
11100000	Displace.X.Re
11100010	Displace.Y.Re
11100100	Displace.Z.Re
11101000	Displace.X.Im
11101010	Displace.Y.Im
11101100	Displace.Z.Im

Notes:

Each entry consists of two bytes. These values will be used by the ICDH to command the Mirror Controller and may be changed as a result of the Parallelism Calibration. This table is located within 16 bytes in the 256 byte block with the Cycle Data following the Exposure Data table (para 6.3.3.3).
The default values for the Mirror Parallelism Data Table are shown in Table 6.6.1

6.4.5 Window Displacement Data Table Format

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
0	7	Window Displacement		(0-254)		n=N
	6					units=pixels
	5				When N=0 (i.e. zero	
	4				displacement) there is	
	3				only 1 window.	
	2					
	1					
	0					

Notes:

The least significant bit in the byte is bit 0.
A single byte has been allocated for each filter

6.4.5.1 Window Displacement Format Summary

Structure:

Filter Number	Entry Location (lo byte)	Wavelength (nm)
8	11110000	Open
1	11110001	552.5
2	11110010	557.73
3	11110011	630.03
4	11110100	733.0/732.0/731.63
5	11110101	730.0/715.0
6	11110110	734.09
7	11110111	763.22

Notes:

A single byte has been allocated for each filter. Only one filter requires two windows/FOV. The window displacement value for this filter will be determined during the instrument characterization.
This table is located in the 256 byte block with the Cycle Data following the Exposure and Parallelism Data Tables (para 6.4.3 and para 6.4.4).

The window displacement value for all filters is retrieved from this table to be sent to the camera controller as one of the camera parameters.

The default values for the Window Displacement Data Table are shown in Table 6.6.2.

6.4.6.1 Heater Control Data Table Format

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
0	7	Heater 4B			1/0=Enable/Disable	
	6	Heater 3B			1/0=Enable/Disable	
	5	Heater 2B			1/0=Enable/Disable	
	4	Heater 1B			1/0=Enable/Disable	
	3	Heater 4A			1/0=Enable/Disable	
	2	Heater 3A			1/0=Enable/Disable	
	1	Heater 2A			1/0=Enable/Disable	
	0	Heater 1A			1/0=Enable/Disable	
1	7	Not assigned		always=0		
	6	Not assigned		always=0		
	5	Not assigned		always=0		
	4	Not assigned		always=0		
	3	Not assigned		always=0		
	2	Not assigned		always=0		
	1	Not assigned		always=0		
	0	Not assigned		always=0		

6.4.6.1.1 Heater Control Format Summary

Structure:

Entry Location (1o byte)	Entry Value
11111000	Heater Configuration Mask

The default values for the Heater Control Data Table are shown in Table 6.6.3.1.

Notes:

1. The least significant bit in the byte is bit 0.
2. A single byte is used to indicate the current heater configuration. The ICDH will use this byte as a mask to condition the heater driver command data.
3. *Heaters 1 through 4 are dual, co-located and redundant, hence heaters 1A through 4A, and 1B through 4B are located in the instrument as follows:*
   1(A or B)=OTE
   2(A or B)=Optical Bench
   3(A or B)=Rear Telescope
   4(A or B)=Camera Bracket

6.4.6.2 Cooler Control Data Table Format

0	7	Not Assigned	always=0	
	6	Not Assigned	always=0	
	5	Not Assigned	always=0	
	4	Not Assigned	always=0	
	3	Not Assigned	always=0	
	2	Not Assigned	always=0	
	1	Not Assigned	always=0	
	0	Cooler Mask		1/0 = Enable/Disable (0=cooler off,1=cooler on)
1	7			
	6	Not Assigned	always=0	
	5	Not Assigned	always=0	
	4	Not Assigned	always=0	
	3	Not Assigned	always=0	
	2	Not Assigned	always=0	
	1	Not Assigned	always=0	
	0	Not Assigned	always=0	

6.4.6.2.1 Cooler Control Format Summary

Structure:

Entry Location (10 Byte)	Entry Value
11111011	Cooler Configuration Mask

The default value for the Cooler Control Data Table is shown in Table 6.6.3.2.

6.4.7 **Orbital Sequence Data Table Format**

The below orbital sequence data table (bytes 0 through 7) is repeated twenty-four (24) times as illustrated in section 6.4.7.1. See Note 1.

BYTE	BIT	PARAMETER	LABEL	VALUE	(N)	{n}	
0	7 6 5 4 3 2 1 0	Start Time (Lo)			See Byte 1		See Note 2
1	7 6 5 4 3 2 1 0	Start Time (Hi)			(0-65535) N=byte 0 and 1	n=0.128N {0-8388.48} units=seconds	
2	7 6 5 4 3	Cycle Address - Lo			(0-31)n=N Any value of N other than the range of N=0 to 31 is undefined. For a cycle=n{0-23} For a non-obs.=n{0-31}		
	2	Not Assigned		always=0			
	1	Not Assigned		always=0			
	0	Not Assigned		always=0			
3	7 6 5 4 3 2 1 0	Cycle Address - Hi			N=65 (41 hex) - Cycle or N=67 (43 hex) -Non-Obs. Proc. Any value of N other than N=65 or N=67 is undefined.		
4	7 6 5 4 3 2 1 0	Repeat			(0-255) *This represents the number of times a cycle will be repeated.*	n=N	See Note

Orbital Sequence Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	(N)	{n}
5	7 6 5 4 3 2 1 0	Freq. of Calib.			(0-255) N measurement cycles between calib. cycles 0 indicates frequent calibration at start of cycle only.	
6	7 6	FOV2 Cal. Apt. O/R			00=don't care, 01=open aperture, 10=close aperture, 11=undefined	See Note
	5 4	FOV1 Cal. Apt. O/R			Same as bits 6 and 7.	
	3 2	FOV2 Meas. Apt. O/R			Same as bits 6 and 7.	
	1 0	FOV1 Meas. Apt. O/R			Same as bits 6 and 7.	
7	7 6 5 4 3 2 1 0	Cycle Duration			(0-255)	n=1.024N {max. 261.12} units= UARS seconds

Notes:

1. The least significant bit in the byte is bit 0.
   N is the value of the binary number specified by the field.
2. A Start Time of 0 is invalid and indicates that the data tables are invalid.
   A Start Time of all 1's (FFFFh) denotes the end of the Orbital Sequence.
3. Repeat - If a repeat is specified for a CYCLE and the CYCLE is a Non-Observation procedure, the repeat is ignored.
4. Byte 6 represents an over-ride setting when the data table entry over-rides the natural aperture setting in accordance with sunrise/sunset commands.
   O/R represents "over-ride".

6.4.7.1 Orbital Format Summary

Structure:

ORBITAL SEQUENCE I Entry Number	Entry Location (lo byte)	ORBITAL SEQUENCE II Entry Number	Entry Location (lo byte)
00	00000XXX	00	01100XXX
01	00001XXX	01	01101XXX
02	00010XXX	02	01110XXX
03	00011XXX	03	01111XXX
04	00100XXX	04	10000XXX
05	00101XXX	05	10001XXX
06	00110XXX	06	10010XXX
07	00111XXX	07	10011XXX
08	01000XXX	08	10100XXX
09	01001XXX	09	10101XXX
10	01010XXX	10	10110XXX
11	01011XXX	11	10111XXX

Notes:

XXX allows addressing specific bytes within 8 byte entry.

The 24 entries have been located in 192 bytes of memory which is the top part of a 256 byte block shared with the Operations Data Table (para 6.4.8).
The Table entries represent cycle sequences and contain the addresses of the selected cycles (from the Cycle Data Table, para 6.4.2 (cycles A to Z), or the addresses of the selected non-observation procedures from the Non-Observation Procedures Data Table, para 6.4.9).

A Start Time of all 1's indicates the end of an orbital sequence and a start time of 0 indicates that the data tables are invalid.

6.4.8 Operations Data Table Format

The input range for bytes 0 to 1 specify which sequence table (as per para 6.4.7.1) is to be used.

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
0	7	Orb.Seq. for Orbit 7			0=I/1=II	
	6	Orb. Seq. for Orbit 6			0=I/1=II	
	5	Orb. Seq. for Orbit 5			0=I/1=II	
	4	Orb. Seq. for Orbit 4			0=I/1=II	
	3	Orb. Seq. for Orbit 3			0=I/1=II	
	2	Orb. Seq. for Orbit 2			0=I/1=II	
	1	Orb. Seq. for Orbit 1			0=I/1=II	
	0	Orb. Seq. for Orbit 0			0=I/1=II	
1	7	Not Assigned		always=0		
	6	Orb. Seq. for Orbit 14			0=I/1=II	
	5	Orb. Seq. for Orbit 13			0=I/1=II	
	4	Orb. Seq. for Orbit 12			0=I/1=II	
	3	Orb. Seq. for Orbit 11			0=I/1=II	
	2	Orb. Seq. for Orbit 10			0=I/1=II	
	1	Orb. Seq. for Orbit 9			0=I/1=II	
	0	Orb. Seq. for Orbit 8			0=I/1=II	
2	7	Not Assigned		always=0		
	6	Not Assigned		always=0		
	5	Not Assigned		always=0		
	4	Not Assigned		always=0		
	3	Not Assigned		always=0		
	2	Not Assigned		always=0		
	1	Not Assigned		always=0		
	0	Not Assigned		always=0		
3	7	Not Assigned		always=0		
	6	Not Assigned		always=0		
	5	Not Assigned		always=0		
	4	Not Assigned		always=0		
	3	Not Assigned		always=0		
	2	Not Assigned		always=0		
	1	Not Assigned		always=0		
	0	Not Assigned		always=0		

Operations Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
4	7	Minimum altitude			(0-255)	n=N
	6					units=km
	5					(default=70 km)
	4					
	3					
	2					
	1					
	0					
5	7	Not assigned		always=0		
	6	Not assigned		always=0		
	5	Not assigned		always=0		
	4	Not assigned		always=0		
	3	Not assigned		always=0		
	2	Not assigned		always=0		
	1	Not assigned		always=0		
	0	Not assigned		always=0		
6	7	Fwd/Rev				
	6				for forward ; N=0	
	5				for reverse; N=255	
	4					(default=forward)
	3					
	2					
	1					
	0					
7	7	Not assigned		always=0		
	6	Not assigned		always=0		
	5	Not assigned		always=0		
	4	Not assigned		always=0		
	3	Not assigned		always=0		
	2	Not assigned		always=0		
	1	Not assigned		always=0		
	0	Not assigned		always=0		

Notes:

The least significant bit in the byte is bit 0.

A single byte is used to set the minimum altitude of the bottom of the FOV. This represents the predicted (by the RAC) minimum altitude of the bottom of the WINDII FOV for all subsequent measurements This data is used to locate the top of the calibration window on the CCD.

A single byte is used to flag the direction of motion of the spacecraft, that is, whether the spacecraft +X axis is parallel (forward) or anti-parallel (reverse) to the nominal spacecraft velocity vector. This data is used to set a flag in the Measurement Header.

Minimum Altitude

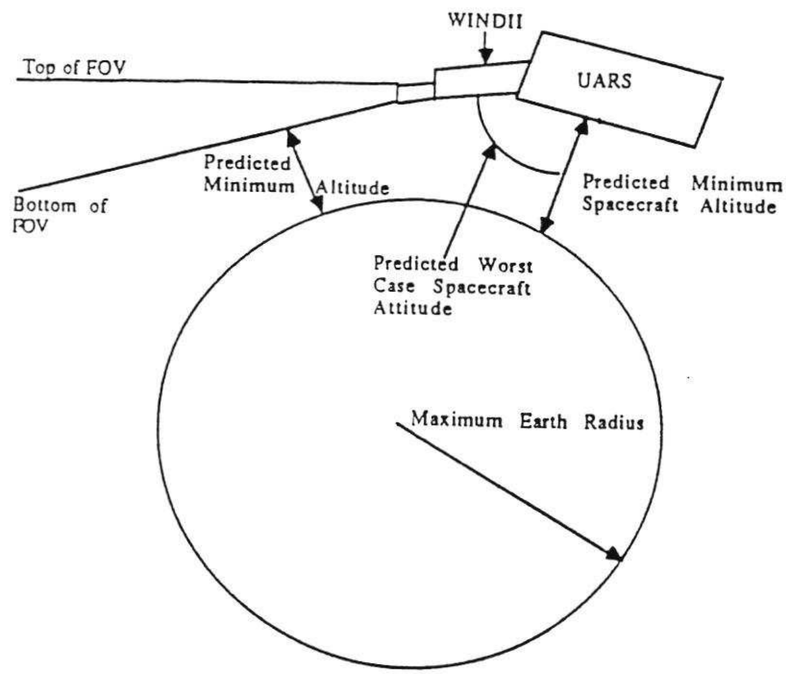


Figure 6.4.6 : Minimum Altitude Definition

Note: Predicted minimum altitude of WINDII FOV is to be based upon a combination of predicted minimum spacecraft altitude (due to perturbations) with maximum earth radii (due to oblate earth), and worst case predicted spacecraft attitude.

6.4.8.1 Operations Format Summary

Structure:

Data Table Location (lo byte)		
11000000	Byte 0	Orb. Seq. for oribits 0-7
11000001	Byte 1	Orb. Seq. for orbits 8-14
11000010	Byte 2	Not Assigned
11000011	Byte 3	Not Assigned
11000100	Byte 4	Minimum Altitude
11000101	Byte 5	Not Assigned
11000110	Byte 6	Forward/Reverse
11000111	Byte 7	Not Assigned

Notes:

The 15 entries of Bytes 0 and 1 have been located in the 2 bytes following the 192 bytes used by the Orbital Sequence Data Table (para 6.4.7).

6.4.9 Non-Observation Procedures Data Table Format

The below non-observation procedures data table (bytes 0 through 7) is repeated twenty-four (24) times as illustrated in section 6.4.9.1.

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
0	7	Exposure Resolution	EXPTIM7		(0-1)	0=tick=0.128 sec 1=tick=4.096 sec
	6	Exposure Value	EXPTIM		(0-127)	units=seconds
	5		EXPTIM5			{0-520.192}
	4		EXPTIM4			See Note 1
	3		EXPTIM3			
	2		EXPTIM2			
	1		EXPTIM1			
	0		EXPTIM0			
1	7 6 5	Calib. Filter			(0-7) 0 represents filter #8 See Table 5.2.1.2.9.	n=N
	4 3	No. of Images			(0-3)	00=1 image/cal. 01=4 images/cal. 10=40 images/cal. 11=Not Assigned
	2 1 0	Calib. Source			(0-6)	See 5.2.6.2.9.
2	7 6	Apertures			(0-3)	00=don't care, 01=open, 10=close, 11=undefined
	5	Not Assigned		always=0		
	4 3 2 1 0	Horiz. Bin Dim.			(0-31)	n=N+1 {1-32} units=pixels

Non-Observation Procedure Data Table (cont'd)

BYTE	BIT	PARAMETER	LABEL	VALUE	INPUT (N)	OUTPUT {n}
3	7	Calib. Mirrors			1/0=both	deployed/retracted
	6	Source Control			1=leave on, 0=turn off	See Note 2
	5	Not Assigned		always=0		
	4 3 2 1 0	Vert. Bin Dim.			(0-31)	n=N+1 {1-32} units=pixels
4	7 6 5	Window Vert. Ht.			(0-255)	n=N {1-256} units=bins
	4 3 2 1 0				The value N=0 represents n=256.	
5	7 6 5 4 3 2 1 0	Window Vert. Offset			(0-255)	n=N units=bins
6	7 6 5 4 3 2 1 0	Window Horiz. Width			(1-160)	n=N units=bins
7	7 6 5 4 3 2 1 0	Window Horiz. Offset			(0-159)	n=N units=pixels

Notes:

The least significant bit in the byte is bit 0.
N is the value of the binary number specified by the field.

1. If Exposure Resolution (bit 7) = 0, then R=0,n=N ticks
   1, then R=1,n=32N ticks

   Exposure Value (bits 0-6) has an input range of N(0-127) and an output range n (depending on Exp. Resolution) of {0-520.192} where n $_{\text{units}}$=seconds.

   An Exposure Value of 0 is invalid and the image data will be whatever was left in the telemetry buffer.

2. Source Control - When the Source Control is set the selected calibration source will stay ON until either a calibration Command instructs it to turn OFF, or until a HALT or SAFEHOLD command is executed.

6.4.9.1 Non-Observation Procedures Format Summary

Structure:

Procedure Location (lo byte)	Non-Observation Procedure	Procedure Location (lo byte)	Non-Observation Procedure
00000XXX	Non-Obs 0	10000XXX	Non-Obs 16
00001XXX	Non-Obs 1	10001XXX	Non-Obs 17
00010XXX	Non-Obs 2	10010XXX	Non-Obs 18
00011XXX	Non-Obs 3	10011XXX	Non-Obs 19
00100XXX	Non-Obs 4	10100XXX	Non-Obs 20
00101XXX	Non-Obs 5	10101XXX	Non-Obs 21
00110XXX	Non-Obs 6	10110XXX	Non-Obs 22
00111XXX	Non-Obs 7	10111XXX	Non-Obs 23
01000XXX	Non-Obs 8	11000XXX	Non-Obs 24
01001XXX	Non-Obs 9	11001XXX	Non-Obs 25
01010XXX	Non-Obs 10	11010XXX	Non-Obs 26
01011XXX	Non-Obs 11	11011XXX	Non-Obs 27
01100XXX	Non-Obs 12	11100XXX	Non-Obs 28
01101XXX	Non-Obs 13	11101XXX	Non-Obs 29
01110XXX	Non-Obs 14	11110XXX	Non-Obs 30
01111XXX	Non-Obs 15	11111XXX	Non-Obs 31*

Notes:

XXX allows addressing specific bytes within 8 byte entry. The 32 entries have been located in the 256 byte block of memory reserved for Non-Observation Data Tables.

There is no access to Frequent Phase or Frequent Dark Current via the Non-Observation Data Table. Access to Frequent Phase and Frequent Dark Current is only from the Filter Group Data Table.

* See Note 4 in 6.4.9.2

6.4.9.2 General Procedure Format Summary

Procedure ID	Function	Note
00 through 31	Non-Observation Procedure	1,4
32 through 38	Reserved for Other Use	2
39	Frequent Phase	
40	Frequent Dark Current	
41 through 62	Not Assigned	3
63	Reserved for Other Use	2

Notes:

1. Parameters assigned by RAC as required.

2. Procedure ID never transmitted in Calibration Header. Used in Engineering Telemetry.

3. Not assigned to Engineering or Science Telemetry.

4. Non-Obs 31 initiates the Integrity Check routine unless a program patch to the Non-Obs Jump Table is sent. Refer to Section 7.4.2.2 for a detailed account of the Integrity Check/Non-Obs 31 procedure.

The default values for the Non-Obs. Procedures Data Table are shown in Table 6.6.4.

6.4.10 MCC Step Size Lookup Data Table

6.4.10.1 Measurements:

The MCC Step Size for measurements is indirectly obtained from the Filter Group Data Table (para. 6.4.1) by decoding the number of images (byte 2, bits 7-6) as either 1, 4, or 8 images and by decoding the Filter number (byte 0, bits 7-5) as filters 1 to 8. The MCC Step Size Lookup Data Table specifies a single step that will uniformly step the scanning mirror for each successive image in the measurement.

6.4.10.2 Non-Observation Calibrations:

The MCC Step Size for calibrations is indirectly obtained from the Non-Observation Data Table (para. 6.4.9) by decoding the number of images (byte 1, bits 4-3) as either 1, 4 or 40 images and by decoding the calibration source (byte 1, bits 0-2) as sources 0 (none) to 6 (laser). The MCC Step Size Lookup Data Table specifies a single step that will uniformly step the scanning mirror for each successive image in the calibration.

6.4.10.3 Frequent Calibrations:

As per Non-Observation Calibrations, except the Calibration Source data is obtained from the Filter Group Data Table (byte 1, bits 0-2).

6.4.10.4 Calculation:

The instrument software shall calculate the mirror position for each image as follows:

image 1:	default
image 2:	(default + step)
image n:	(default + (n-1)*step)

6.4.10.5 MCC Step Size Lookup Data Table Format:

Note: Each value occupies 12 bits in a 16-bit field with the upper 4 bits unused and set to zero.

4 IMAGE MEASUREMENTS:

BYTE	BIT	DESCRIPTION			DECODE
0	0-7	Step for Filter 8:	low byte	4 Images	N(0-4095)
1	0-7	upper byte			
2	0-7	Step for Filter 1:	low byte	4 Images	N(0-4095)
3	0-7	upper byte			
4	0-7	Step for Filter 2:	low byte	4 Images	N(0-4095)
5	0-7	upper byte			
6	0-7	Step for Filter 3:	low byte	4 Images	N(0-4095)
7	0-7	upper byte			
8	0-7	Step for Filter 4:	low byte	4 Images	N(0-4095)
9	0-7	upper byte			
10	0-7	Step for Filter 5:	low byte	4 Images	N(0-4095)
11	0-7	upper byte			
12	0-7	Step for Filter 6:	low byte	4 Images	N(0-4095)
13	0-7	upper byte			
14	0-7	Step for Filter 7:	low byte	4 Images	N(0-4095)
15	0-7	upper byte			

8 IMAGE MEASUREMENTS:

BYTE	BIT	DESCRIPTION			DECODE
0	0-7	Step for Filter 8:	low byte	8 Images	N(0-4095)
1	0-7	upper byte			
2	0-7	Step for Filter 1:	low byte	8 Images	N(0-4095)
3	0-7	upper byte			
4	0-7	Step for Filter 2:	low byte	8 Images	N(0-4095)
5	0-7	upper byte			
6	0-7	Step for Filter 3:	low byte	8 Images	N(0-4095)
7	0-7	upper byte			
8	0-7	Step for Filter 4:	low byte	8 Images	N(0-4095)
9	0-7	upper byte			
10	0-7	Step for Filter 5:	low byte	8 Images	N(0-4095)
11	0-7	upper byte			
12	0-7	Step for Filter 6:	low byte	8 Images	N(0-4095)
13	0-7	upper byte			
14	0-7	Step for Filter 7:	low byte	8 Images	N(0-4095)
15	0-7	upper byte			

4 IMAGE CALIBRATIONS:

BYTE	BIT	DESCRIPTION	DECODE
0	0-7	Zero step for no source: low byte	N(0-4095)
1	0-7	upper byte	
2	0-7	Step for ELS 1: low byte 4 Images	N(0-4095)
3	0-7	upper byte	
4	0-7	Step for ELS 2: low byte 4 Images	N(0-4095)
5	0-7	upper byte	
6	0-7	Step for ELS 3: low byte 4 Images	N(0-4095)
7	0-7	upper byte	
8	0-7	Step for ELS 4: low byte 4 Images	N(0-4095)
9	0-7	upper byte	
10	0-7	Step for BBS: low byte 4 Images	N(0-4095)
11	0-7	upper byte	
12	0-7	Step for Laser: low byte 4 Images	N(0-4095)
13	0-7	upper byte	
14	0-7	Not Assigned	
15	0-7	Not Assigned	

40 IMAGE CALIBRATIONS:

BYTE	BIT	DESCRIPTION	DECODE
0	0-7	Zero step for no source: low byte	N(0-4095)
1	0-7	upper byte	
2	0-7	Step for ELS 1: low byte 40 Images	N(0-4095)
3	0-7	upper byte	
4	0-7	Step for ELS 2: low byte 40 Images	N(0-4095)
5	0-7	upper byte	
6	0-7	Step for ELS 3: low byte 40 Images	N(0-4095)
7	0-7	upper byte	
8	0-7	Step for ELS 4: low byte 40 Images	N(0-4095)
9	0-7	upper byte	
10	0-7	Step for BBS: low byte 40 Images	N(0-4095)
11	0-7	upper byte	
12	0-7	Step for Laser: low byte 40 Images	N(0-4095)
13	0-7	upper byte	
14	0-7	Not Assigned	
15	0-7	Not Assigned	

The Default values for the MCC Step Size Lookup Data Table are shown in Table 6.6.5.

6.4.11.1 Heater Set Point Data Table Format

BYTE	BIT	DESCRIPTION	DECODE
0	0-7	Temperature Set Point for OTE	N(0-255)
1	0-7	Temperature Set Point for Optical Bench	N(0-255)
2	0-7	Temperature Set Point for Rear Telescope	N(0-255)
3	0-7	Temperature Set Point for Camera Bracket	N(0-255)

Note: The temperature set points are achieved by a control mechanism. Input values in the range of N=0-255 (O-FFh) adjust the thermistors according to a linear relationship where 0 (0h) counts represent 17.2 degrees Celsius and 255 (FFh) counts represent 30 degrees Celsius. However, the instrument heater algorithm will check to see if the temperature set point is exceeded by the monitored thermistor value before switching off the heater. Hence, 255 (FFh) (which cannot be exceeded) will turn the heaters full on. Therefore, 254 (FEh) counts is the maximum set point close to 30 degrees Celsius for a controlled instrument temperature.

The default values for the Heater Set Point Data Table are shown in Table 6.6.6.1.

6.4.11.2 Cooler Set Point Data Table Format

BYTE	BIT	DESCRIPTION	DECODE
0	0-7	Temperature Set Point for CCD	N(0-255)
1	0-7	Not Assigned	always=0

Note: The temperature set point is achieved by a control mechanism. Input values in the range of N=0=255 (0-FFh) adjusts the thermistor according to an algorithm. An inverter preceding the control mechanism results in 0h causing the CCD cooler to be full on.

The default value for the Cooler Set Point Data Table is shown in Table 6.6.6.2.

6.4.12 Calibration Source Warmup Data Table Format

BYTE	BIT	DESCRIPTION	DECODE
0	0-7	ELS 1 Warmup Time	N(0-255) ticks
1	0-7	ELS 2 Warmup Time	N(0-255) ticks
2	0-7	ELS 3 Warmup Time	N(0-255) ticks
3	0-7	ELS 4 Warmup Time	N(0-255) ticks
4	0-7	BBS Warmup Time (low byte)	N(0-65535) ticks
5	0-7	BBS Warmup Time (high byte)	
6	0-7	Laser Warmup Time (low byte)	N(0-65535) ticks
7	0-7	Laser Warmup Time (high byte)	

The default values for the Calibration Source Warmup Data Table are shown in Table 6.6.7.

6.5 DATA TABLE MEMORY MAPS

RAM Address (hex)	Data Table Variable	
4000-4007	Filter Group 0	(IAW FSW PROM ver. 23 Aug. 1990)
4008-400F	Filter Group 1	
4010-4017	Filter Group 2	
4018-401F	Filter Group 3	
4020-4027	Filter Group 4	
4028-402F	Filter Group 5	
4030-4037	Filter Group 6	
4038-403F	Filter Group 7	
4040-4047	Filter Group 8	
4048-404F	Filter Group 9	
4050-4057	Filter Group 10	
4058-405F	Filter Group 11	
4060-4067	Filter Group 12	
4068-406F	Filter Group 13	
4070-4077	Filter Group 14	
4078-407F	Filter Group 15	
4080-4087	Filter Group 16	
4088-408F	Filter Group 17	
4090-4097	Filter Group 18	
4098-409F	Filter Group 19	
40A0-40A7	Filter Group 20	
40A8-40AF	Filter Group 21	
40B0-40B7	Filter Group 22	
40B8-40BF	Filter Group 23	
40C0-40C7	Filter Group 24	
40C8-40CF	Filter Group 25	
40D0-40D7	Filter Group 26	
40D8-40DF	Filter Group 27	
40E0-40E7	Filter Group 28	
40E8-40EF	Filter Group 29	
40F0-40F7	Filter Group 30	
40F8-40FF	Filter Group 31	
4100-4107	Cycle 0	
4108-410F	Cycle 1	
4110-4117	Cycle 2	
4118-411F	Cycle 3	
4120-4127	Cycle 4	
4128-412F	Cycle 5	
4130-4137	Cycle 6	
4138-413F	Cycle 7	
4140-4147	Cycle 8	
4148-414F	Cycle 9	
4150-4157	Cycle 10	
4158-415F	Cycle 11	
4160-4167	Cycle 12	
4168-416F	Cycle 13	
4170-4177	Cycle 14	
4178-417F	Cycle 15	
4180-4187	Cycle 16	
4188-418F	Cycle 17	
4190-4197	Cycle 18	
4198-419F	Cycle 19	
41A0-41A7	Cycle 20	
41A8-41AF	Cycle 21	
41B0-41B7	Cycle 22	
41B8-41BF	Cycle 23	

RAM Address (hex)	Data Table Variable	
41C0-41DF	Exposure Time Data Table	
41E0-41EF	Mirror Parallelism Data Table	
41F0-41F7	Window Displacement Data Table	
41F8-41F9	Heater Control Data Table	
41FA	Not Assigned	
41FB-41FC	Cooler Control Data Table	
41FD-41FF	Not Assigned	
4200-4207	Orbital Sequence I	-Cycle Sequence 0
4208-420F		-Cycle Sequence 1
4210-4217		-Cycle Sequence 2
4218-421F		-Cycle Sequence 3
4220-4227		-Cycle Sequence 4
4228-422F		-Cycle Sequence 5
4230-4237		-Cycle Sequence 6
4238-423F		-Cycle Sequence 7
4240-4247		-Cycle Sequence 8
4248-424F		-Cycle Sequence 9
4250-4257		-Cycle Sequence 10
4258-425F		-Cycle Sequence 11
4260-4267	Orbital Sequence II	-Cycle Sequence 0
4268-426F		-Cycle Sequence 1
4270-4277		-Cycle Sequence 2
4278-427F		-Cycle Sequence 3
4280-4287		-Cycle Sequence 4
4288-428F		-Cycle Sequence 5
4290-4297		-Cycle Sequence 6
4298-429F		-Cycle Sequence 7
42A0-42A7		-Cycle Sequence 8
42A8-42AF		-Cycle Sequence 9
42B0-42B7		-Cycle Sequence 10
42B8-42BF		-Cycle Sequence 11
42C0-42C7	Operations Data Table (42C4 Minimum Altitude; 42C6 Forward/Reverse)	
42C8-42FF	Not Assigned	
4300-4307	Non-Observation 0	
4308-430F	Non-Observation 1	
4310-4317	Non-Observation 2	
4318-431F	Non-Observation 3	
4320-4327	Non-Observation 4	
4328-432F	Non-Observation 5	
4330-4337	Non-Observation 6	
4338-433F	Non-Observation 7	
4340-4347	Non-Observation 8	
4348-434F	Non-Observation 9	
4350-4357	Non-Observation 10	
4358-435F	Non-Observation 11	
4360-4367	Non-Observation 12	
4368-436F	Non-Observation 13	
4370-4377	Non-Observation 14	
4378-437F	Non-Observation 15	
4380-4387	Non-Observation 16	
4388-438F	Non-Observation 17	
4390-4397	Non-Observation 18	
4398-439F	Non-Observation 19	
43A0-43A7	Non-Observation 20	
43A8-43AF	Non-Observation 21	

RAM Address (hex)	Data Table Variable
43B0-43B7	Non-Observation 22
43B8-43BF	Non-Observation 23
43C0-43C7	Non-Observation 24
43C8-43CF	Non-Observation 25
43D0-43D7	Non-Observation 26
43D8-43DF	Non-Observation 27
43E0-43E7	Non-Observation 28
43E8-43EF	Non-Observation 29
43F0-43F7	Non-Observation 30
43F8-43FF	Non-Observation 31
4400-440F	MCC Step Size Lookup Table -4 Image Measurement
4410-441F	-8 Image Measurement
4420-442F	-4 Image Calibration
4430-443F	-40 Image Calibration
4440-4443	Heater Set Point Data Table
4444-4445	Cooler Set Point Data Table
4446-4447	Not Assigned
4448-444F	Calibration Source Warmup Times Lookup Table
4450-44C7	Jump Table - 60 Entries
44C8-4507	Non-Observation Jump Table - 32 Entries
4508-4597	Velocity Table - 72 Entries
4598-45F7	CRC Table (16 Entries of 3 words each)

Data Table	RAM Address (hex)	Contents	(total bytes/data table)
Filter Group Data Table	4000	Fltr, Rpt, #Images, Calib, Bin, Window	Filter Groups (256)
	:	Filter Groups 0-31 (32 entries x 8 bytes)	
	40FF		
Cycle Data Table	4100	Fltr/Exp1, ..., Fltr/Exp 8	Cycles (192)
	:	Cycles A-Z (24 entries x 8 bytes)	
	41BF		
Exposure	41CO	Exp Time 0, ..., Exp Time 3	Exposures (32)
	:	Exp Time 4, ..., Exp Time 7	
	:	Exp Time 8, ..., Exp Time 11	
	41DF	Exp Time 12, ..., Exp Time 15	
Mirror	41EO	Displace.X,Y,Z.Re (6 bytes)	Parallel. (16)
Parallel.	41EF	Displace.X,Y,Z.Im (6 bytes)	
Win Disp	41FO	Fltr8,Fltr1, ..., Fltr 7	Disp. (8)
Heater Control	41F8	Htr Config,1 null byte	Heater (2)
Cooler Control	41FB	CCD Cooler, 1 null byte	Cooler (2)

Table	Address	Contents	Size
Orbital Sequence Data Table	4200	Start, Cycle, Rpt, Freq. Cal, Apert, Dur.	Orbital Sequences (192)
		Orbital Sequence I (12 entries x 8 bytes)	
		Orbital Sequence II (12 entries x 8 bytes)	
	42BF		
Operation Data Table	42CO	Orbit 1 to 15, 2 null bytes, Min.Alt, 1null byte, Fwd/Rev., 1 null byte	Operations (8)
	42C8	*Not Assigned* (56 bytes)	
	42FF		
Non-Observs. Data Table	4300	Exp, #Images, Fltr, Step, Lamp, Bin, Window	Non-Obs Procs. (256)
		Non-Observation Procedures (32 entries x 8 bytes)	
	43FF		

	4400	MCC Step Size for 4 Image Measurements	
	:	MCC Step Size for 8 Image Measurements	
MCC Step Size	:	MCC Step Size for 4 Image Calibrations	MCC Step Size (64)
	:	MCC Step Size for 40 Image Calibrations	
	443F	(4 entries x 16 bytes)	
Heater Set	4440	Heater Set Point	Htr Set (4)
Cooler Set	4447	Cooler Set Point	Cooler Set (2)
Source Warmup	4448 444F	Calibration Source Warmup (6 entries for sources)	Source Warmup (8)
	4450	Jump Table (120 bytes)	Jump (120)
	44C8	Non-Obs Jump Table (64 bytes)	Non-Obs Jump (64)
	4508	Velocity Table (144 bytes)	Velocity (144)
	4598	CRC Table (96 bytes)	CRC (96)

6.6 DEFAULT DATA TABLES

The data tables previously outlined in para. 6.4 fall into two categories: those with default values and those without default values.

Data tables without default values are not located in the ICDH's memory and must be uploaded via a DATALD command (as specified in para. 6.3, note 7 and para. 6.3.4).

The data tables which must be uploaded are:

	Refer. Para.
Filter Group	6.4.1
Cycle	6.4.2
Exposure	6.4.3
Orbital Sequence	6.4.7
Operations	6.4.8

Data tables with default values are present in the PROM memory of the ICDH. Upon system power-on the data tables are copied from PROM to RAM. If the default values are to be modified, a program patch must be performed (as specified in para. 6.3, note 8 and para. 6.3.5).

The default data tables are:

	Refer. Para.	Default Values
Mirror Parallelism	6.4.4	Table 6.6.1
Window Displacement	6.4.5	Table 6.6.2
Heater Control	6.4.6.1	Table 6.6.3.1
Cooler Control	6.4.6.2	Table 6.6.3.2
Non-Observation Procedures	6.4.9	Table 6.6.4
MCC Step Size Lookup	6.4.10	Table 6.6.5
Heater Set Point	6.4.11.1	Table 6.6.6.1
Cooler Set Point	6.4.11.2	Table 6.6.6.2
Calibration Source Warmup	6.4.12	Table 6.6.7

The Default Data Tables and associated default values follow.

Table 6.6.1 Mirror Parallelism Default Values

Displace.X.Re	=	17E5h
Displace.Y.Re	=	350Fh
Displace.Z.Re	=	55E8h
Displace.X.Im	=	2E30h
Displace.Y.Im	=	4E68h
Displace.Z.Im	-	6E88h

Table 6.6.2 Window Displacement Default Values

Filter	Displacement (pixels)
8.	0
1.	0
2.	0
3.	0
4.	0
5.	83
6.	0
7.	0

This translates into the following hex format:

Entry	Address Hex-dec	Content (hex)
(30)	F0-240	00 00 00 00 00 53 00 00

Table 6.6.3.1 Heater Control Default Values

Heaters Configuration

4B - Disable	4A - Enable
3B - Disable	3A - Enable
2B - Disable	2A - Enable
1B - Disable	1A - Enable

This translates into the following hex format:

Entry	Address Hex-dec	Content (hex)
(31)	41F8	0F 00

Table 6.6.3.2 Cooler Control Default Values

Cooler Configuration

Cooler Mask = Disable

This translates into the following hex format:

Entry	Address Hex-dec	Content (hex)
(31)	41FB	00 00

TABLE 6.6.4 NON-OBSERVATION PROCEDURES DEFAULT VALUES

Star Map | ← Responsivity →

Non Obs. procedure No.	0	1	2	3	4	5
Exposure time (secs) -	2.048	3.072	3.072	1.536	1.536	0.512
Calibration Filter -	8	1	2	3	4	5
No. of Images/Calib. -	1	1	1	1	1	1
Calibration Source -	0	5	5	5	5	5
Apertures -	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT
Bin Dimensions						
Horiz. (pixels) -	1	5	5	5	5	5
Vert. (pixels) -	1	1	1	1	1	1
Calibration Mirrors -	RETR	DEPL	DEPL	DEPL	DEPL	DEPL
Source Control -	OFF	ON	ON	ON	ON	ON
Window Definitions						
Vert. Ht. (bins) -	102	240	240	240	240	82
Vert. Off. (bins) -	138	0	0	0	0	0
Horiz. Width (bins) -	100	31	31	31	31	31
Horiz. Off. (pixels)-	30	2	2	2	2	2

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+Non Observation Data Table

Edit fields, F10=Exit, F11=Quit OVERSTRI*P
File: $DISK2:[ZUBAC.TABLES]DEFAULT1.TBL;2

→ | ← Infrequent Phase →

Non Obs. procedure No.	6	7	8	9	10	11
Exposure time (secs) -	3.072	* 32.768	3.200	3.200	3.200	3.200
Calibration Filter -	6	7	8	8	8	8
No. of Images/Calib. -	1	1	4	4	4	4
Calibration Source -	5	5	1	2	3	4
Apertures -	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT
Bin Dimensions						
Horiz. (pixels) -	5	5	5	5	5	5
Vert. (pixels) -	1	1	5	5	5	5
Calibration Mirrors -	DEPL	DEPL	DEPL	DEPL	DEPL	DEPL
Source Control -	ON	OFF	OFF	OFF	OFF	OFF
Window Definitions						
Vert. Ht. (bins) -	240	240	48	48	48	48
Vert. Off. (bins) -	0	0	0	0	0	0
Horiz. Width (bins) -	31	31	31	31	31	31
Horiz. Off. (pixels)-	2	2	2	2	2	2

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+Non Observation Data Table

Edit fields, F10=Exit, F11=Quit OVERSTRI*P
File: $DISK2:[ZUBAC.TABLES]DEFAULT1.TBL;2

← Filter Passband → | DC for NOP 14 | ← Step Size →

Non Obs. procedure No.	12	13	14	15	16	17
Exposure time (secs) -	15.360	6.400	* 65.536	* 65.536	0.512	0.512
Calibration Filter -	2	3	7	8	8	8
No. of Images/Calib. -	4	4	4	1	40	40
Calibration Source -	1	2	4	0	1	2
Apertures -	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT
Bin Dimensions						
Horiz. (pixels) -	5	5	5	5	15	15
Vert. (pixels) -	5	5	2	2	10	10
Calibration Mirrors -	DEPL	DEPL	DEPL	DEPL	DEPL	DEPL
Source Control -	OFF	OFF	OFF	OFF	OFF	OFF
Window Definitions						
Vert. Ht. (bins) -	48	48	80	80	24	24
Vert. Off. (bins) -	0	0	0	0	0	0
Horiz. Width (bins) -	31	31	31	31	10	10
Horiz. Off. (pixels)-	2	2	2	2	7	7

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+Non Observation Data Table

Edit fields, F10=Exit, F11=Quit OVERSTRI*P
File: $DISK2:[ZUBAC.TABLES]DEFAULT1.TBL;2

→ | ← Visibility → | ← D.C. Responsivity →

Non Obs. procedure No.	18	19	20	21	22	23
Exposure time (secs) -	0.512	0.512	0.384	1.536	1.536	3.072
Calibration Filter -	8	8	8	8	8	8
No. of Images/Calib. -	40	40	40	4	1	1
Calibration Source -	3	4	6	6	0	0
Apertures -	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT
Bin Dimensions						
Horiz. (pixels) -	15	15	15	5	5	5
Vert. (pixels) -	10	10	10	5	1	1
Calibration Mirrors -	DEPL	DEPL	DEPL	DEPL	DEPL	DEPL
Source Control -	OFF	OFF	ON	OFF	OFF	OFF
Window Definitions						
Vert. Ht. (bins) -	24	24	24	48	240	240
Vert. Off. (bins) -	0	0	0	0	0	0
Horiz. Width (bins) -	10	10	10	31	31	31
Horiz. Off. (pixels)-	7	7	7	2	2	2

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+Non Observation Data Table

Edit fields, F10=Exit, F11=Quit OVERSTRI*P
File: $DISK2:[ZUBAC.TABLES]DEFAULT1.TBL;2

DC Filter Pass (25) → DC Visibility (27) | D.C. Phase (28) | DC Filters (29)

Non Obs. procedure No.	24	25	26	27	28	29
Exposure time (secs) -	0.512	6.400 *	32.768	1.536	3.200	15.360
Calibration Filter -	8	8	8	8	8	8
No. of Images/Calib. -	1	1	1	1	1	1
Calibration Source -	0	0	0	0	0	0
Apertures -	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT	NIGHT
Bin Dimensions						
Horiz. (pixels) -	5	5	5	5	5	5
Vert. (pixels) -	1	5	1	5	5	5
Calibration Mirrors -	DEPL	DEPL	DEPL	DEPL	DEPL	DEPL
Source Control -	OFF	OFF	OFF	OFF	OFF	OFF
Window Definitions						
Vert. Ht. (bins) -	82	48	240	48	48	48
Vert. Off. (bins) -	0	0	0	0	0	0
Horiz. Width (bins) -	31	31	31	31	31	31
Horiz. Off. (pixels)-	2	2	2	2	2	2

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+Non Observation Data Table

Edit fields, F10=Exit, F11=Quit OVERSTRI*P
File: $DISK2:[ZUBAC.TABLES]DEFAULT1.TBL;2

Default Integrity Checker

DC Vis. (30) | DC Step (data table def'n) (31)

Non Obs. procedure No.	30	31
Exposure time (secs) -	0.384	0.512
Calibration Filter -	8	8
No. of Images/Calib. -	1	1
Calibration Source -	0	0
Apertures -	NIGHT	NIGHT
Bin Dimensions		
Horiz. (pixels) -	15	15
Vert. (pixels) -	10	10
Calibration Mirrors -	DEPL	DEPL
Source Control -	OFF	OFF
Window Definitions		
Vert. Ht. (bins) -	24	24
Vert. Off. (bins) -	0	0
Horiz. Width (bins) -	10	10
Horiz. Off. (pixels)-	7	7

Page 6 of 6

+Non Observation Data Table

Edit fields, F10=Exit, F11=Quit OVERSTRI*P
File: $DISK2:[ZUBAC.TABLES]DEFAULT1.TBL;2

Procedures 0 through 31 translate into the following hex format:

** Non Observation Data Table **

Entry	Address hex	Content (hex)							
(00)	4300	10	00	40	00	66	8A	64	1E
(01)	4308	18	25	44	C0	F0	00	1F	02
(02)	4310	18	45	44	C0	F0	00	1F	02
(03)	4318	0C	65	44	C0	F0	00	1F	02
(04)	4320	0C	85	44	C0	F0	00	1F	02
(05)	4328	04	A5	44	C0	52	00	1F	02
(06)	4330	18	C5	44	C0	F0	00	1F	02
(07)	4338	88	E5	44	80	F0	00	1F	02
(08)	4340	19	09	44	84	30	00	1F	02
(09)	4348	19	0A	44	84	30	00	1F	02
(10)	4350	19	0B	44	84	30	00	1F	02
(11)	4358	19	0C	44	84	30	00	1F	02
(12)	4360	78	49	44	84	30	00	1F	02
(13)	4368	32	6A	44	84	30	00	1F	02
(14)	4370	90	EC	44	81	50	00	1F	02
(15)	4378	90	00	44	81	50	00	1F	02
(16)	4380	04	11	4E	89	18	00	0A	07
(17)	4388	04	12	4E	89	18	00	0A	07
(18)	4390	04	13	4E	89	18	00	0A	07
(19)	4398	04	14	4E	89	18	00	0A	07
(20)	43A0	03	16	4E	C9	18	00	0A	07
(21)	43A8	0C	0E	44	84	30	00	1F	02
(22)	43B0	0C	00	44	80	F0	00	1F	02
(23)	43B8	18	00	44	80	F0	00	1F	02
(24)	43C0	04	00	44	80	52	00	1F	02
(25)	43C8	32	00	44	84	30	00	1F	02
(26)	43D0	88	00	44	80	F0	00	1F	02
(27)	43D8	0C	00	44	84	30	00	1F	02
(28)	43E0	19	00	44	84	30	00	1F	02
(29)	43E8	78	00	44	84	30	00	1F	02
(30)	43F0	03	00	4E	89	18	00	0A	07
(31)	43F8	04	00	4E	89	18	00	0A	07

Table 6.6.5 MCC Step Size Lookup Default Values

Step for		4 Images	8 Images
Filter 8	-	0	0
Filter 1	-	292	146
Filter 2	-	295	148
Filter 3	-	334	167
Filter 4	-	388	194
Filter 5	-	378	189
Filter 6	-	389	194
Filter 7	-	404	202

MCC Step Size (Measurement)

Step for		4 Images	40 Images
No source	-	0	0
ELS 1	-	295	30
ELS 2	-	334	33
ELS 3	-	391	39
ELS 4	-	404	40
BBS	-	0	0
Laser	-	335	34

MCC Step Size (Calibration)

Table 6.6.6.1 Heater Set Point Default Values

Temp. Set Point	Typical Value
OIE	7Fh
Optical Bench	7Fh
Rear Telescope	7Fh
Camera Bracket	7Fh

Table 6.6.6.2 Cooler Set Point Default Value

Temp. Set Point	Default Value
CCD	00h (TEC full on)

Table 6.6.7 Calibration Source Warmup Default Values

Source	Warmup Time	
	Ticks	Decode
ELS 1	16	2 sec.
ELS 2	16	2 sec.
ELS 3	16	2 sec.
ELS4	16	2 sec.
BBS	4688	10 min.
Laser	14062	30 min.

7.0 ENGINEERING TELEMETRY

7.1 INTRODUCTION

Engineering telemetry is sub-commutated into the science telemetry stream with separate RIU channels for each of the engineering sub-commutation rates. The 1 kbps engineering telemetry data stream contains the essential instrument health and safety data and includes: active and passive analog, bilevel digital and engineering serial digital telemetry functions. These functions are described in the following paragraphs.

For serial digital telemetry, command and time-code signals that represent quantitative values, the most significant bit (MSB) shall be the first bit shifted across the instrument/spacecraft interface; as specified in the GIIS, para 3.8. For documentation purposes, the first bit of all serial digital data shall be labeled bit "0" (i.e. an 8-bit word shall consist of bits "0" to "7"), with bit 0 being the most significant bit. (this is opposite to standard data processing usage).

7.2 ANALOG TELEMETRY

The WINDII instrument is monitored by 6 analog telemetry channels; 3 active and 3 passive. The active analog telemetry signals are available only when instrument power is on and are contained in 31 words in total. The passive analog telemetry is always valid, while all other telemetry functions are invalid unless instrument power is on. There are 20 spare RIU channels for the analog telemetry.

Each Engineering Minor Frame (EMIF) contains 128 8-bit bytes and appears in the telemetry stream at a rate of 1.024 s/frame. Each Engineering Major Frame (EMAF) appears every 65.536 seconds and is composed of 64 EMIFs. The UARS EMIF format is illustrated in Figure 7.2.1.

WD	FUNCTION	WD	FUNCTION	WD	FUNCTION	WD	FUNCTION
0	SYNC 'D7'	1	SYNC '99'	2	SYNC '07'	3	CDCUSTATENG
4	CDCMDCNT	5	CDEFRMCNT	6	CDXPAAGC	7	CDXPBAGC
8	CDBLWORD1	9	CDBLWORD2	10	CDFLXDUMP	11	OBCWORD1
12	OBCWORD2	13	OBCWORD3	14	OBCWORD4	15	OBCWORD5
16	NBAANAMUX1	17	NBAANAMUX2	18	NBBANAMUX1	19	NBBANAMUX2
20	NBADIGMUX	21	NBBDIGMUX	22	NBATUSERERR	23	NBBTUSERERR
24	HGENGDATAA	25	HGENGDATAB	26	ES1RPM	27	ES2RPM
28	ES1ROLLF	29	ES2ROLLF	30	ES1PITCHF	31	ES2PITCHF
32	PSPULSEAI	33	PSPULSEBI	34	PEMENGDATA	35	ISENGDATA
36	PWTLI	37	CDH8	38	CDH8	39	CDH8
40	ACS8	41	ACS8	42	ACS8	43	ACS8
44	ACS8	45	ACS8	46	ACS8	47	ACS8
48	PM8	49	PM8	50	PM8	51	PM8
52	MPS8	53	MPS8	54	MPS8	55	MPS8
56	SCCU8	57	SCCU8	58	PWIACS	59	THERMAL64
60	SUBCOM64	61	SUBCOM64	62	SUBCOM64	63	SUBCOM64
64	MAXRATE1	65	MAYRATE1	66	MAZRATE1	67	MAXRATE2
68	MAYRATE2	69	MAZRATE2	70	MAIRUAMTI	71	MAIRUBMTI
72	MAIRUCMTI	73	ACBREF2	74	CLENGDATA1	75	CLENGDATA2
76	PSQBAI	77	PSQBBI	78	PSHBAI	79	PSHBBI
80	PMREMAATC	81	PMREMCATC	82	PMREMBATC	83	PMREMDATC
84	HRENGDATA	85	HRENGDATA	86	HRENGDATA	87	HRENGDATA
88	PMREMACTRC	89	PMREMBDTRC	90	PECEPENGDATA	91	PEAXENGDATA
92	SOENGDATA	93	SUENGDATA	94	WIENGDATA	95	PWICDH
96	PWISCCU	97	ACINVMON	98	ACINIMON	99	ISENGDATA
100	PWIIMLO	101	ESAM8	102	SAD8	103	PSU8
104	PSU8	105	PSU8	106	PSU8	107	PSU8
108	SSPP8	109	HGA8	110	SUS/WIN8	111	HRDI8
112	CLA/PEM8	113	CLA/PEM8	114	CLA/PEM8	115	CLAES8
116	HALOE8	117	HALOE8	118	HALOE8	119	SUBCOM8
120	ISAMS8	121	ISAMS8	122	Spare	123	THERMAL64
124	SUBCOM64	125	SUBCOM64	126	SUBCOM64	127	SUBCOM64

Figure 7.2.1: UARS Engineering Minor Frame (EMIF) Format

7.2.1 Analog Telemetry Sampling Rates

The analog telemetry is sampled once every EMAF (1/65.536 seconds) on the following RIU channels:

	RIU Channel	EMIF	Byte Displacement
Active:			
Quiet Bus Voltage	40	29	60
Quiet Bus Current	41	29	61
Pulse Bus Voltage	42	29	62
Passive:			
EU Temperature	30	29	125
ISU Temperature	31	29	124
Filter Wheel Temperature	22	62	62

7.2.2 Analog Telemetry Decode

Refer to Appendix IV for Analog (active + passive) telemetry decode and output ranges.

7.2.2.1 <u>(deleted)</u>

7.2.2.2 <u>(deleted)</u>

7.3 BILEVEL DIGITAL TELEMETRY

The bilevel digital telemetry is available only when the instrument's quiet bus power is on and is contained in one word. There are 6 spare RIU channels for the bilevel digital telemetry. The Bilevel words have 8 bits each; 1 bit is designated with the remainder not yet allocated.

7.3.1 Bilevel Digital Telemetry Sampling Rates

The bilevel digital telemetry is sampled eight times every EMAF (1/8.192 seconds) on the following RIU channels:

	RIU Channel	EMIF	Byte Displacement
Watchdog Timer	48	0	110
Baffle Door Indicator	49	0	110

7.3.1.1 <u>Watchdog Timer</u>

The Watchdog Timer sets a telemetry flag as a result of the following fault conditions:

a) CPU-related fault resulting in a failure of the processor to update the timer at 128 millisecond intervals. The Watchdog Timer will time-out and cause its associated telemetry flag to be set.

b) (deleted)

c) Loss of power to the ICDH, causing the Watchdog Timer line to go to a logical '0', indicating a fault condition.

If the Watchdog Timer indicates a "Not OK", a System Reset (RESET) command should be sent. If this does not restore proper operation, the instrument should be turned off to prevent damage due to possible loss of operational temperature control of the ISU.

7.3.1.2 Baffle Door Indicator

This function monitor indicates the open position of the baffle door in the outer baffle assembly (OBA). This door is to remain closed during all integration and test activities, except for Post-Acoustic Tests at G.E. facilities in East Windsor, and throughout launch, orbital insertion and outgassing activities. It is opened during the initial instrument turn-on procedure by activation of the pyrotechnic initiators. To check the baffle door status, it is necessary to perform a RESET command after the baffle doors are released.

7.3.2 Bilevel Digital Telemetry Decode

BIT	FUNCTION	LABEL	DECODE	TELEMETRY CHANNEL
0	Watchdog Timer	WATCHDOG	1/0=OK/Not OK	48B
1	Baffle Door Indicator	BAFFDOOR	1/0=Not Open/Open	49B

7.4 ENGINEERING SERIAL DIGITAL TELEMETRY

Additional WINDII instrument status is monitored by one engineering serial digital telemetry word which contains eight bits of engineering data.

This engineering digital serial telemetry is sampled by the RIU once every EMIF (1/1.024 seconds). WINDII in turn subcommutates this telemetry byte such that a "standard" set of 8 engineering serial digital telemetry bytes are transmitted 8 times per EMAF (every 65.536 seconds). These "standard" 8 bytes are sequentially transmitted, with a different byte being transmitted every EMIF (1.024 seconds). This transmission sequence of "standard" engineering bytes will be repeated after 8.192 seconds. Note that byte 7 (which is transmitted every 8.192 seconds) is subcommutated a further level such that it will represent a different telemetry description every transmission (every 8.192 seconds). However every EMAF (65.536 seconds), each of these individual sub-bytes (contained in byte 7) will repeat.

Paragraph 7.4.1 lists the breakout of the detailed contents of each subcommutated EMIF.

To: Rejean Michaud, David Kendall
From: Gordon Shepherd
Date: July 18, 2000
Subject: More on WINDII

We haven't progressed much with WINDII beyond my report of a few days ago. The UARS FOT got us some engineering data, which showed that all the WINDII functions we monitor are fine. So we have yet to find definitive evidence of a malfunction, but on the other hand we can't extract any data either. We will continue as far as we can go.

We had been waiting until July to discuss the WINDII contract renewal with you. This was the month in which NASA was to decide whether UARS operations would continue past September 30. However, if we can't obtain WINDII data then this is irrelevant.

Thus I would like to give you a brief update of our current thinking. The porting of the SDPPS to Unix has turned out to be more difficult than we thought, and so this task will not be complete before our current contract ends on September 30. On the other hand we cannot embark on the final reprocessing until that is done. The contract is currently carrying 40% of Brian and 75% of Alain Soltesz, who has been doing the operations work. If operations cease, then there is no justification for the continued support of Alain. Thus our preferred approach would be to extend the current contract by about six months in order to complete the SDPPS conversion. This extension would be to support Brian at a desired level of 50% since he is really the only person that can do this work. Once we have demonstrated its performance we could then negotiate with you a final contract to complete the WINDII re-processing and data archival; this contract could start on April 1 of 2003 if things go as planned. We can provide further details as required.

In early April I did express to you some concern about the support level for the CRESS Space Instrumentation Laboratory (CSIL) and we are monitoring that situation as well. We have another grant from CRESTech for this year, at $50K, and EMS will we think again provide $25K. We are doing some work on MANTRA for Jim Drummond, and on VOLE for Ted Llewellyn. We also will be doing some etalon measurements for SWIFT, but we are still falling a little short of supporting our two technical staff. Brian is going to talk to Ian McDade about whether there is any more SWIFT work that might be supported, possibly in the calibration or detector areas. Its worth remembering that our lab is donating the use of a $70K detector for SWIFT use. There is another possibility we will find out about in September, and we expect to have our Canada Research Chair announcement then as well. While the incumbent won't arrive until next year, we expect him to be a significant user of the laboratory, so do want to maintain our staffing level until then if at all possible.

In summary, I'm not asking for anything with regard to CSIL now, but will keep you informed. For WINDII however, we do need to make some decisions soon as the contract end is very close at hand. Thus I would like to exchange ideas as soon as possible that will determine our future direction here. I'll be grateful for your perspective on this.

7.4.1 Engineering Serial Digital Telemetry Decode

Note: For all Engineering Serial Digital Telemetry bit 0 is the most significant bit (msb).

Byte	Bit	Name	Description
0	7 6 5 4 3 2	RIU Cmd	Range (0 - 63) RIU command currently executing/last executed (excluding orbital events). Command numbers decode as: 0-31 Non-Observation Procedures (Table 5.2.6.2.5 and para. 6.3.3) 32 Halt 33 Execute 34 Resume 35 Safehold 36 Dataload 37 Program Patch 38 Memory Dump 62 Power-On Reset 63 Discrete Reset
	1 0	State	Range (0 - 3) ICDH current state, decoded as: 0 - Halt 1 - Safehold 2 - Execute 3 - Command in Progress Flag - Note 1
1	7 6 5	Orbital Event Code	Range (0 - 7) 3-bits to indicate the last orbital event command executed, decodes as follows: 0 - No event since last reset/power-on 1 - OBLAT45 2 - OBLAT135 3 - SUNRISE45 4 - SUNRISE135 5 - SUNSET45 6 - SUNSET135 7 - EQXNADIR
	4	Not assigned	always=0
	3 2 1	CAL Source	Range (0 - 7) 3-bits to indicate the calibration source currently in use, decoded as follows: 0 - No calibration source in use 1 - ELS1 2 - ELS2 3 - ELS3 4 - ELS4 5 - BBS 6 - LASER 7 - not assigned

Engineering Serial Digital Telemetry Decode (cont'd)

Byte	Bit	Name	Description
	0	Source Warmup	Range (0 - 1) Indicates that the ICDH has waited the appropriate amount of time for the calibration source to warmup 0 - Not Stable 1 - Stable
2	7	Apert1 Closed	Aperture 1 Closed 1/0 = Closed/Not Closed
	6	Apert1 Open	Aperture 1 Open 1/0 = Open/Not Open
	5	Apert2 Closed	Aperture 2 Closed 1/0 = Closed/Not Closed
	4	Apert2 Open	Aperture 2 Open 1/0 = Open/Not Open
	3	Not Assigned	always=0
	2	Not Assigned	always=0
	1	Apert1 Cmd	Aperture 1 Cmd 1/0 = Closed/Open
	0	Apert2 Cmd	Aperture 2 Cmd 1/0 = Closed/Open
3	7	Calmi1 Cmd	Cal Mir 1 Cmd 1/0 = Deploy/Retract - Note 2
	6	Calmi2 Cmd	Cal Mir 2 Cmd 1/0 = Deploy/Retract - Note 2
	5	Not Assigned	always=0
	4	Not Assigned	always=0
	3	Calmi1 Deployed	Cal Mir 1 Deployed 1/0 = Deployed/Not Deployed
	2	Calmi1 Retracted	Cal Mir 1 Retracted 1/0 = Retracted/Not Retracted
	1	Calmi2 Deployed	Cal Mir 2 Deployed 1/0 = Deployed/Not Deployed
	0	Calmi2 Retracted	Cal Mir 2 Retracted 1/0 = Retracted/Not Retracted
4	7 6 5 4 3 2	RIU Cmd	Range (0 - 63) RIU command currently executing/last executed (excluding orbital events). Command numbers decode as: 0-31 Non-Observation Commands 32 Halt 33 Execute 34 Resume 35 Safehold 36 Dataload 37 Program Patch 38 Memory Dump 62 Power-On Reset 63 Discrete Reset
	1 0	State	Range (0 - 3) ICDH current state, decoded as: 0 - Halt 1 - Safehold 2 - Execute 3 - Command in Progress Flag - Note 1

Engineering Serial Digital Telemetry Decode (cont'd)

Byte	Bit	Name	Description
5	7 6 5 4	Filter Wheel Position	Range (0 - 15) 4-bits to indicate the last filter wheel position the software commanded the filter wheel to move to, decoded as a filter position from 1 to 8, Decode:

Filter No	Line	Wavelength (nm in air)
1 -	Bkgrd	552.5
2 -	OI (1S)	557.73
3 -	OI (1D)	630.03
4 -	OII(2D)/OH $P_1(2)$	733.0/732.0/731.63
5 a/b	OH/Bkgrd	730.0/715.0
6 -	OH $P_1(3)$	734.09
7 -	O_2	763.22
8 -	Open	

Byte	Bit	Name	Description
	3	Filter Wheel Status	Indicate the status of the filter wheel position read from the hardware 1/0 = OK/Not OK
	2	Not Assigned	always=0
	1	Not Assigned	always=0
	0	MCC Fault	MCC Fault flag as read from MCC 1/0=Not OK/OK
6	7 6 5 4 3 2 1 0	Error Code	Range (0 - 7) 8-bit error code indicating reason for error and subroutine encountering error or area of PROM RAM if Integrity Check is activated Remains in effect until a new error code is encountered or system is reset. Zeroed only on power-on reset or if special patch code is sent and executed or if ICDH passes Integrity Check Refer to Section 7.4.2.2 for Decode

Engineering Serial Digital Telemetry Decode (cont'd)

Byte	Bit	Name	Description
7	7-0	Temperature	Range (0 - 255) 8-bit temperature (and heater power) value which is further subcommutated (resulting in each byte being sent once/UARS minute) as follows - Note 3:

Sub-Byte	Bit	Name	Description
0	0-7	OTE Temp	Range (0-255) Refer to App. IV for output range & decode
1	0-7	Optical Bench Temp	Range (0-255) Refer to App. IV for output range & decode
2	0-7	Rear Telescope Temp	Range (0-255) Refer to App. IV for output range & decode
3	0-7	Camera Bracket Temp.	Range (0-255) Refer to App. IV for output range & decode
4	0-7	CCD Temp	Range (0-255) Refer to App. IV for output range & decode
5	0-7	Heater Cooler Utilization (Note 4) :	
	0	Heater 1A or 1B	If either ON=0, else both OFF=1
	1	Heater 2A or 2B	If either ON=0, else both OFF=1
	2	Heater 3A or 3B	If either ON=0, else both OFF=1
	3	Heater 4A or 4B	If either ON=0, else both OFF=1
	4	Cooler	If ON=0, if OFF=1
	5-7	Not assigned	always=0
6	0-7	Not assigned	always=0
7	0-7	Not assigned	always=0

Note 1: Command in Progress state indicates a Non-Observation procedure, Data Load, Program Patch, or Memory Dump are currently in progress

Note 2: Currently both Calibration Mirrors are simultaneously commanded to either deploy or retract. The allocation of two bits for this function is to reserve a bit for each mirror in the event of future patch code to command the mirrors to different positions.

Note 3: Byte 7 (which is transmitted every 8.192 seconds) is subcommutated a further level such that it will represent a different telemetry description every 8.192 seconds. However every EMAF (65.536 seconds) each of the individual sub-bytes (contained in byte 7) will repeat.

Note 4: Heaters are located in the instrument as follows:
1 (A or B) = OTE
2 (A or B) = Optical Bench
3 (A or B) = Rear Telescope
4 (A or B) = Camera Bracket

7.4.2 Error Code Decode

7.4.2.1 Normal Operations Errors

Code	Procedure	Reason
0	CLEARED	Power-on reset or special patch used to clear error flag or ICDH passed Integrity Check
1	RXISU	Did not receive a valid response from ISU
2	TXISU	NAK received from ISU
3	EXDMA	DMA Timed-out
4	EXECUTE	Data Tables undefined when EXECUTE command received
5	HWINIT-FW	Filter Wheel position not valid at initialization
6	EX_SAFE	Execute command received in SAFEHOLD state
7	RESUME_SAFE	Resume command received in SAFEHOLD state
8	NONOBS	NON-OBS command received when not in HALT state
10	MD_EXEC	Memory Dump command received in EXECUTE state
11	RIUCMD	Unrecognized RIU command
12	DLCKSM_UP	Dataload checksum not correct
13	PPCKSM	Program patch checksum not correct
14	RIUBUFF	RIUBUFF overflow
15	DLCKSM_EX	Dataload checksum not correct

Error code is only zeroed on power-on reset or if special patch is executed or if ICDH passes Integrity Check.

7.4.2.2 Integrity Check

An integrity check on the contents of PROM and specific areas of RAM can be invoked by commanding NON-OBS 31 which is not the standard Non-Obs 31 Data Table procedure, but a routine which resides in PROM. (It is for this reason that if one wishes to perform a standard NON-OBS 31 in accordance with the Non-Obs Data Table definition, a program patch to the Non-Obs Jump Table must first be done to disable the Integrity Check routine).

The Integrity Check routine first performs a memory dump of working RAM from address 4000h to 7FFFh. It next performs a checksum on the PROM and specific areas of RAM and compares each calculated checksum to a previously stored checksum value in the CRC Table. If an area of RAM is to be altered via a program patch, an accompanying program patch to the CRC Table must also be done in order to keep the stored check sum values valid.

If the calculated Checksum/CRC Table value comparison passes then a zero value will be returned in the Error Code (Byte 6) of Engineering Telemetry, and the Integrity Check routines continues with the next comparison. If the comparison fails (i.e. the calculated Checksum/CRC Table contents are not equal) then a non-zero value shall be returned in the Error Code (Byte 6) of Engineering Telemetry and the Integrity check routine halts.

The returned error will have the value Fχ, where χ is in the range of O-Fh and indicates which area of memory contained the error.

The error decode and areas of investigation are as shown below:

Error	PROM/RAM Contents	Address (h)
F0	PROM-1	000-02FF
F1	PROM-2	0360-3FFF
F2	MIRROR PARALLELISM	41E0-41EF
F3	WINDOW DISPLACEMENT	41F0-41F7
F4	HEATER CONTROL	41F8-41F9
F5	COOLER CONTROL	41FB-41FC
F6	NON_OBS PROCEDURES	4300-43FF
F7	MCC STEP SIZE	4400-443F
F8	HEATER SET POINT	4440-4443
F9	COOLER SET POINT	4444-4445
FA	CALIBRATION SOURCE WARMUP	4448-444F
FB	JUMP TABLE	4450-44C7
FC	NON-OBS JUMP TABLE	44C8-4507
FD	VELOCITY TABLE	4508-4597
FE	Not Assigned	
FF	Not Assigned	

8.0 APPENDICES

APPENDIX I

SCIENCE TELEMETRY - FORMAT SUMMARY PARAGRAPHS

Paragraph Number	Title
	MEASUREMENT HEADER
5.2.1.2.1	Sentinel
5.2.1.2.2	Measurement ID
5.2.1.2.3	Orbit Number
5.2.1.2.4	Orbital Sequence
6.4.7	
6.4.7.1	
	Forward Reverse
5.2.1.2.5	Cycle
5.2.1.2.6	Cycle Repeat Number
5.2.1.2.7	Filter Group
5.2.1.2.8	Start Time
5.2.1.2.9	Measurement Filter
5.2.1.2.10	Observation Category
6.4.1	
5.2.1.2.11	Special Observation Category
6.4.1	
5.2.1.2.12	Number of Images
5.2.1.2.13	Horizontal Bin Dimension
5.2.1.2.14	Number of Repeats
5.2.1.2.15	Vertical Bin Dimension
5.2.1.2.16	Window Vertical Height
5.2.1.2.17	Window Vertical Offset
5.2.1.2.18	Window Horizontal Width
5.2.1.2.19	Window Horizontal Offset
5.2.1.2.20	Window Separation
5.2.1.2.21	Exposure Time
6.4.3	
6.4.3.1	
5.2.1.2.22	Oblateness FOV1, FOV2
5.2.1.2.23	EMAF Timetag

Paragraph Number	Title
	CALIBRATION IMAGE HEADER
5.2.2.2.1	Sentinel
5.2.2.2.2	Image ID
5.2.2.2.3	Image Number
5.2.2.2.4	Mirror Position
5.2.2.2.5	EMAF Timetag
5.2.2.2.6	Calibration Source Output
5.2.2.2.7	CCD Temperature
	MEASUREMENT IMAGE HEADER
5.2.3.2.1	Sentinel
5.2.3.2.2	Image ID
5.2.3.2.3	Measurement Number
5.2.3.2.4	Image Number
5.2.3.2.5	Mirror Position
5.2.3.2.6	EMAF Timetag
5.2.3.2.7	CCD Temperature
	IMAGE DATA
5.2.4.2.1	Dark Current Monitor (#1-4)
5.2.4.2.2	FOV2 and FOV1, lines 1-n
	MEMORY DUMP
5.2.5.2.1	Sentinel
5.2.5.2.2	Memory Dump ID
5.2.5.2.3	Code Length
5.2.5.2.4	Start Address
5.2.5.2.5	Checksum
	CALIBRATION HEADER
5.2.6.2.1	Sentinel
5.2.6.2.2	Calibration ID
5.2.6.2.3	Orbit
5.2.6.2.4	Orbital Sequence
6.4.7	
6.4.7.1	
5.2.6.2.5	Non-Observation Procedure
5.2.6.2.6	Filter Group
5.2.6.2.7	Start Time
5.2.6.2.8	Calibration Filter

Paragraph Number	Title
	Calibration Header Packet (cont'd)
5.2.6.2.9	Calibration Source
5.2.6.2.10	Number of Images
5.2.6.2.11	Horizontal Bin Dimension
5.2.6.2.12	Vertical Bin Dimension
5.2.6.2.13	Window Vertical Height
5.2.6.2.14	Window Vertical Offset
5.2.6.2.15	Window Horizontal Width
5.2.6.2.16	Window Horizontal Offset
5.2.6.2.17	Window Separation
5.2.6.2.18	Exposure Time
6.4.3	
6.4.3.1	
5.2.6.2.19	Laser Light Out
5.2.6.2.20	Laser Current
5.2.6.2.21	Laser Temperature
5.2.6.2.22	Laser PZT
5.2.6.2.23	Laser Consumption
5.2.6.2.24	W Source Output
5.2.6.2.25	W Source Temperature
5.2.6.2.26	Mirror Error - X,Y,Z
5.2.6.2.27	Mirror Integrated - X,Y,Z
5.2.6.2.28	EMAF Timetag
5.2.6.2.29	ELS Output

APPENDIX II

LABELS USED FOR SCIENCE TELEMETRY

PARAMETER	LABEL
Aperture 1 Open Status	APRT1OPN
Aperture 1 Closed Status	APRT1CLS
Aperture 2 Open Status	APRT2OPN
Aperture 2 Closed Status	APRT2CLS
Aperture 1 Status	APR1STAT
Aperture 2 Status	APR2STAT
Camera Bracket Temperature	BRKTMP0-BRKTMP7
Calibration Exposure Time	CEXPTM0-CEXPTM11
Calibration Filter	CALFLTR0-CALFLTR2
Calibration Mirror 1 Deploy Status	CALM1DEP
Calibration Mirror 1 Retract Status	CALM1RET
Calibration Mirror 2 Deploy Status	CALM2DEP
Calibration Mirror 2 Retract Status	CALM2RET
Calibration Source	CALSRC0-CALSRC2
Calibration Source Output	CSRCOUT0-CSRCOUT7
CCD Temperature	CCDTMP0-CCDTMP7
Code Length	CDLNTH0-CDLNTH15
Cycle	CYCL0-CYCL4
Cycle Repeat No.	CYCLRPT0-CYCLRPT7
DC Monitor.1	DC1MON0-DC1MON11
DC Monitor 2	DC2MON0-DC2MON11
DC Monitor 3	DC3MON0-DC3MON11
DC Monitor 4	DC4MON0-DC4MON11
ELS Output	ELSOUT0-ELSOUT7
EMAF Timetag	EMAFTT0-EMAFTT8
Exposure Time	EXPTIM0-EXPTIM11
Filter Group	FLTRGP0-FLTRGP4
Filter Wheel Position	FWSTAT
Forward/Reverse	FWDREV
Heater Power	HTRPWR0-HTRPWR7
Horizontal Bin Dimension	HBIN0-HBIN5
Housekeeping ID	HID0-HID7
IBA Temperature	IBATMP0-IBATMP7
Image ID/Measurement ID	ID0-ID7
Image Number (Meas. Header)	IMGNBR0-IMGNBR2
Laser Consumption	LSRCONS0-LSRCONS7
Laser Current	LSRCURR0-LSRCURR7
Laser Light Out	LSROUT0-LSROUT7
Laser PZT	LSRPZT0-LSRPZT7
Laser Stable	LSRSTAT
Laser Temperature	LSRTMP0-LSRTMP7
Meas. Filter	MSRFLTR0-MSRFLTR2
Meas. Number	MSRNBR0-MSRNBR2
Memory Dump ID	DUMPID0-DUMPID7
Mirror Error X	MIRERRX0-MIRERRX7
Mirror Error Y	MIRERRY0-MIRERRY7

Mirror Error Z	MIRERRZ0-MIRERRZ7
Mirror Integrated X	MIRINTX0-MIRINTX7
Mirror Integrated Y	MIRINTY0-MIRINTY7
Mirror Integrated Z	MIRINTZ0-MIRINTZ7
Mirror Position	MIRPOS0-MIRPOS11
No. of Images (Cal.Header)	NBRIMG0-NBRIMG5
No. of Repeats	NBRRPT0-NBRRPT2
Non-Obs. Procedure	NONOBS0-NONOBS4
Oblateness FOV1	FOV1OBL0-FOV1OBL7
Oblateness FOV2	FOV2OBL0-FOV2OBL7
Obs. Category	OBSCAT0
Optical Bench Temperature	BNCHTMP0-BNCHTMP7
Orbit	ORBT0-ORBT3
Orbit Sequence	ORBTSEQ
OTE Temperature	OTETMP0-OTETMP7
Sentinel	SNTNL0-SNTNL23
Special Obs. ID	SOBSID0-SOBSID2
Start Address	STRTAD0-STRTAD15
Start Time	STRTTM0-STRTTM15
Vertical Bin Dimension	VBIN0-VBIN5
W Source Output	WSRCOUT0-WSRCOUT7
W Source Temperature	WSRCTMP0-WSRCTMP7
Window Horizontal Offset	HOFFSET0-HOFFSEET7
Window Horizontal Width	WIDE0-WIDE7
Window Separation	SEPARAT0-SEPARAT7
Window Vertical Height	HIGH0-HIGH7
Window Vertical Offset	VOFFSET0-VOFFSET7

APPENDIX III

SCIENCE TELEMETRY DECODE

i) CCD Temperature (with a -22.0 degree offset)
(Calibration Image Header (Byte 9) and Measurement Image Header (Byte 9) Packets)

$$CCDTMP = n = -70.050 + 1.084E\text{-}1N - 6.598E\text{-}4N^2 + 1.2168E\text{-}5N^3 - 7.4870E\text{-}8N^4 + 1.7027E\text{-}10N^5$$

where: N=(0-255)
output n={-70.05 to -16.53}
n(units)=degrees Celsius

ii) Laser Consumption
(Calibration Header Packet (Byte 20))

LSR~~OUT~~ CNSP = n = 1.6N where: N=(0-255)
output n={0 to 408}
n(units)=milliamps

iii) Laser PZT
(Calibration Header Packet (Byte 21))

LSRPZT = n = N where: N=(0-255)
output n={0-255}
n(units)=volts

iv) Laser Output
(Calibration Header Packet (Byte 22))

LSROUT = n = 400N where: N={0-255}
output n={0 to 102000}
n(units)=nanowatts

v) Laser Current
(Calibration Header Packet (Byte 23))

LSRCURR = n = 8N where: N=(0 - 255)
output n={0 to 2040}
n(units)=microamps

vi) Laser Temperature
(Calibration Header Packet (Byte 24))

$$LSRTMP = n = -12.873 + 4.317N - 2.427E\text{-}3N^2 + 1.260E\text{-}5N^3 - 3.549E\text{-}8N^4 + 4.099E\text{-}11N^5$$

where: N=(0-255)
output n={-12.9 to 42.5}
n(units)=degrees Celsius

vii) Broadband Source (BBD) Output
(Calibration Header Packet (Byte 26))

WSRCOUT = n = 40N where: N=(0-255)
output n={0 to 10200}
n(units)=nanowatts

viii) Broadband Source (BBS) Temperature
(Calibration Header Packet (Byte 27))

WSRCTMP = $n = 20.08 + 3.9E\text{-}1N - 2.022E\text{-}3N^2 + 2.069E\text{-}5N^3 - 1.003E\text{-}7N^4 + 2.050E\text{-}10N^5$

where: N=(0-255)
output n={20.1 to 128.1}
n(units)=degrees Celcius

ix) ELS Output
(Calibration Header Packet (Byte 36))

ELSOUT = n = 40N where: N=(0-255)
output n={0 to 10200}
n(units)=nanowatts

APPENDIX IV

Engineering Telemetry Decode

IV.1 Analog Telemetry Decode (ref. para. 7.2)

a) Active Analog

Function	Decode	Output Range n	Units
Quiet Bus Voltage	0.156N	{0 to 39.7}	volts
Quiet Bus Current	-0.186 + 0.011N	{-0.19 to 2.52}	amps
Pulse Bus Voltage	0.164N	{0 to 41.7}	volts

Note: Input N=(0-255).

b) Passive Analog

Electrical Unit (EU)

EUTMP =

$$n = 99.380 - 2.120N + 2.640E\text{-}2N^2 - 1.987E\text{-}4N^3 + 7.538E\text{-}7N^4 - 1.141E\text{-}9N^5$$

where: N=(0-255)
output n={-65.31 to 99.38}
n(units)=degrees Celsius

Instrument Sensor Unit (ISU) Temperature

$$ISUTMP = n = 84.34 - 1.2222\,N + 1.0143E\text{-}2N^2 - 5.0905E\text{-}5N^3 + 1.3285E\text{-}7N^4 - 1.3928E\text{-}10N^5$$

where: N=(0-255)
output n = {-0.30 to 84.34}
n(units) = degrees Celsius

Filter Wheel (FW) Temperature

$$FWTMP = n = 86.05 - 1.3373N + 1.11556E\text{-}2N^2 - 6.18897E\text{-}5N^3 + 1.7158E\text{-}7N^4 - 1.9221E\text{-}10N^5$$

where: N=(0-255)
output n = {-11.51 to 86.05}
n(units) = degrees Celsius

IV.2 Serial Digital Telemetry (ref. para. 7.4.1)

Outer Thermal Enclosure (OTE), Optical Bench (OB), Rear Telescope (RT) and Camera Bracket (CB) Temperatures (Byte 7, Sub-Bytes 0-1 respectively)

OTE = OB = RT = CB =

$$n = 17.222 + 4.659E\text{-}2N + 1.390E\text{-}5N^2$$

where: N=(0-255)

output n={17.22 to 30.00}
n(units)=degrees Celsius

CCD Temperature (Byte 7, Sub-Byte 4)
(Calibration Image Header (Byte 9) and Measurement Image Header (Byte 9) Packets)

$$CCDTMP = n = -70.05 + 1.084E\text{-}1N - 6.598E\text{-}4N^2 + 1.2168E\text{-}5N^3 - 7.4870E\text{-}8N^4 + 1.7027E\text{-}10N^5$$

where: N=(0-255)
output n={-70.05 to -16.53}
n(units)=degrees Celsius

9.0 GLOSSARY

Telemetry data stream: A continuous single serial bit stream of time division multiplexed data.

Format: The general arrangement of the data in a telemetry data stream. Each format shall have a pre-established bit rate, frame size, word size, commutation sequence, measurement set and frame overhead (synchronization pattern, frame counter, identifier, time words, etc.). See Figure 9.1.

Major Frame: Includes more than one minor frame. The length of a major frame is defined as the number of minor frames necessary to include at least one sample of all measurements for this format. For WINDII, a Science Major Frame (SMAF) consists of 32 Science Minor Frames (SMIF) at a rate of 1.024 seconds per SMAF. An Engineering Major Frame (EMAF) is 64 Engineering Minor Frames (EMIF); 65.536 seconds in length. See Figure 9.2.

Minor Frame: A recurring fixed integer number of words which includes a single synchronization pattern. For WINDII, a Science Minor Frame (SMIF) is 128 telemetry words at 32 milliseconds per SMIF (see Figure 5.1.1). An Engineering Minor Frame (EMIF) is 128 engineering telemetry words at a rate of 1.024 seconds per EMIF (see Figure 7.2.1). Figure 9.2 illustrates standard telemetry format.

Minor Frame Counter: A single binary word which is included in each minor frame to uniquely identify the frames position in the major frame sequence. The counter should increment by one for each new minor frame with a starting value of zero for the first minor frame in a major frame. The minor frame counter shall occupy the same word position in every minor frame.

Word: An integral subdivision of the minor frame defining the basic package size for measurements for this telemetry data stream. See Figure III-1.

Commutated Data: That data which is sampled only once in a minor frame.

Decommutated Data: Data that is multiplexed at sample rates which are submultiples of the minor frame rate or when several minor frames are required to generate a complete measurement set.

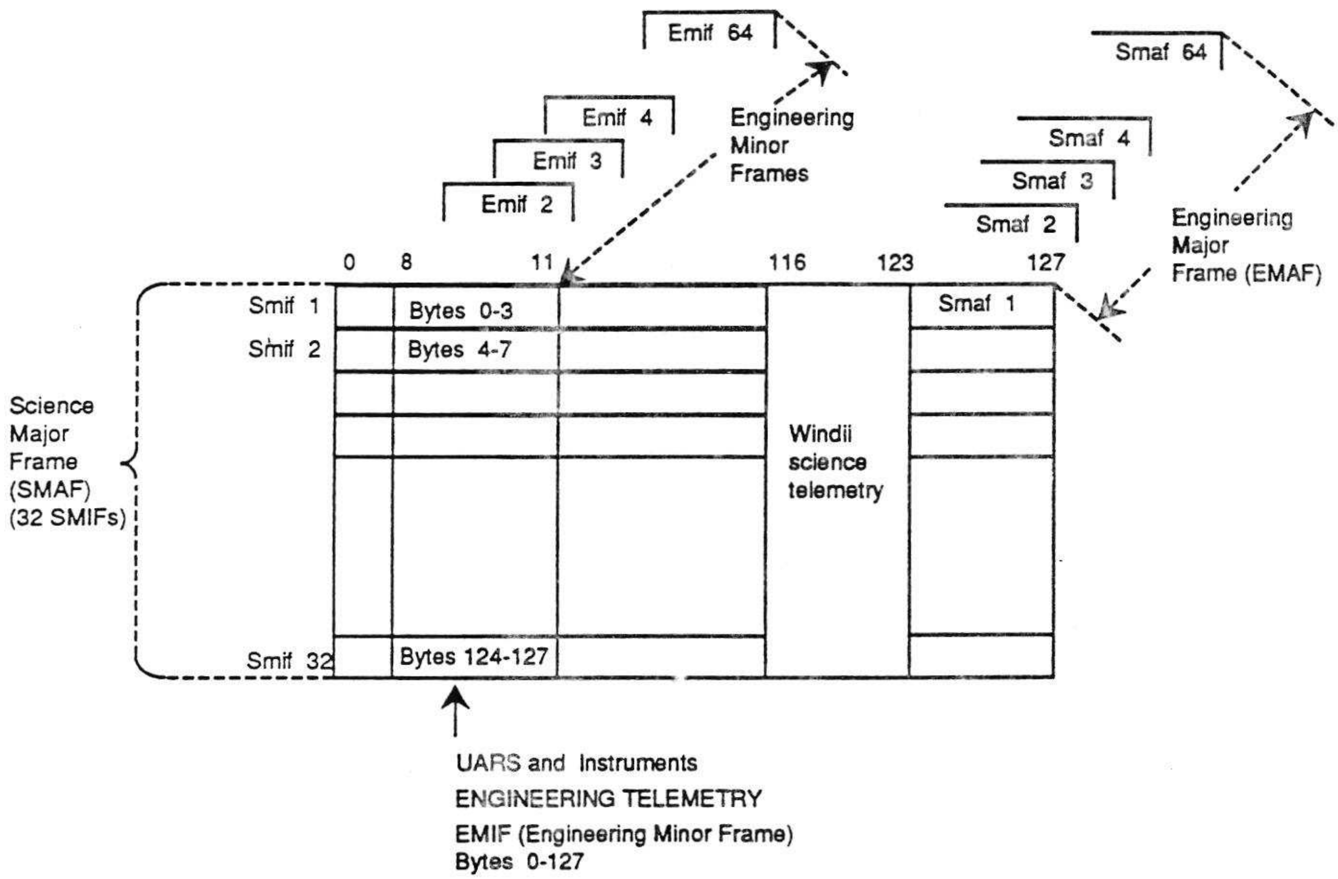

Figure 9.1: Standard Telemetry Format