Title: **IASW UM**
IASW USER MANUAL

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CHANGE - RECORD

Issue	Date	Sheet	Description of change
1.0	January 2000	all	
1.1	February 2000	3.3	VETO additional HK collection
		3.2.5.3.2	Transmission of Histogram data
		2.8	Change to science mode
		3.3.8	Science Sub mode switching (point/slew)
		2.1.2	IASW Initialisation (default values)
		2.1.3	HEPI Initialisation (default values)
		2.8	Scientific Mode
1.2	February 2000	2.1.2	IASW Initialisation
		2.1.3	HEPI Initialisation
		3.2.1	Rise time representation
		3.2.2	Rise time representation
		3.2.3	Rise time representation
		6.1	TM type generation
1.3	March 2000	3.3.1.2	Exception list added
		2.8, 3.4	HEPI register II verification added
1.4	May 2000	2.1.2	Added compton flag in science function tables
		6.5.2	Update of H2 TM format
		6.5.1	Added H1 science function flags ISGRI,PICSIT,COM
1.5	May 2000	4.4	OBT wrap arround
		6.2	TM Threshold (max. value)
		6.6.4	Compton multiple calibration flag deleted
		3.2	Spectral Imaging histogram overflow
		3.2	Spectral timing histogram overflow
		4	Time distribution accuray
		3.3.1.3	HEPI On Event Messages
1.6	August 2000	2.1.2	Updated TM max. TM thresholds for HK TM
1.7	March 2001	3.4.1.2	Change of OEM structure of OEM 20-26 according PST (INT-RP-AI-0030, 3.2.8), deleted OEM 22 (TC timeout)
		2.1.2	Initialisation values of ISGRI energy correction parameters and LUT added in table
		3.3.1	ISGRI Energy Calculation adapted
		6.5.1	IASW HK data field: AC error flag deleted
1.8	May 2001	3.4.1.2	OEM Message table (formal changes)
		3.4.1.2	Table with Task ID
		3.3.5.13, 6.6.6.2, 6.6.7.2, 6.6.8.2	Description of histogram compression scheme
2.0draft	June 2001		

Issue	Date	Sheet	Description of change
		2.1.1	Initial Power up (Parameter field in H1)
		2.1.2	IASW Initialisation: Table 1, Table 6 (Initialisation and default values added)
		2.1.4	Peripheral initialisation (parts of text deleted, refers to IBIS UM)
		2.1.5	Initial Set-up
		2.1.6	Periphery Parameter Storage in DPE
		2.2	Mode Transitions (point/slew automatism added)
		2.5	Patch and Dump: Note about Polling sequence table added
		2.8	Scientific Mode (synchronisation added)
		2.12	Scientific Events: Compton calibration added
		3.4.9	HEPI and detector Re-Synchronisation
		3.5	Start of observation
		6.5.1	IASW HK data field (H1): Table 26, Table 27
		6.6.9.2	Timing information and dummy structure
2.0	November 2001	3.4.3.1	Start of eclipse
		3.4.3.2	End of eclipse
		3.4.4.1	Begin of radiation belt: VETO HV switch off independently of VETO ECR
		3.4.7	PICSIT pixel monitoring: more details
		3.4.10	IASW Broadcast packet processes:
		4.1	Distribution of timing and synchronisation information: HEPI delay time added
		7.1.1	Internal tables: List of table added
		7.1.2.1	Peripheral tables (table added)
		7.1.2.2	HEPI Context saving (table of structure added)
2.1	January 2001	3.4.2.3	VETO HK H4: Min. VETO integration time
2.2	March 2002	8	Update of memory budget report
	June 2002	9.2	Update of CPU time and TM rate calculations
2.3	January 2003	3.3.1	Remark about low risetime threshold.
2.4	January 2003	6.6.9.2	Spectral timing packet structure filling

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1 Introduction

1.1 Scope

The scope of this document is to describe operation of the IBIS IMAGER Data Handling System (DHS).
In the first part describes in general the concept of the IBIS DHS and the different operational modes.
In the next chapter the DHS data processing including automatism and observation is explained. The next chapter treated the timing of the DHS. This comprises the distribution of the time information from the detectors until the TM packets.
In the next last two chapters the TC and TM is discussed.
Chapter 7 describes the IASW table handling of internal and external tables.
The memory budget and data processing capabilities are described in the last two chapters.

1.2 Applicable and reference documents

1.2.1 Applicable documents

AD.1: EID-A rev 5
AD.2: DPE HW Design Description, INT-DD-CRS-0001, Is.1
AD 3: URD, Is.3 draft, August 1999

1.2.2 Reference documents

RD 1: HEPI Interface Description, IN-IM-TUB-TN/EL-018, Is. 5.6
RD 2: IBIS Communication Protocol Definition, IN-IM-TUB-ICD-01, Is. 2.4
RD 3: HEPI Design Description, IN-IM-TUB-DES-001, Is 6.7
RD 4: Software I/F Control Document, INT-IC-GMV-0001 Is. 3
RD 5: Integral Packet structure Definition, INT-RP-AI-0030, Is.04
RD 6: IASW SDD, IN-IM-TUB-SDD-001, Is. 7.2
RD 7: IBIS UM, Is. 4.2
RD 8: The Onboard Compton selection, IN-IB-SAP-RP-045; 9/1998

2 Operational Concept

2.1 Initial Start-Up

2.1.1 Initial Power-Up

At the initial power up or at any power up after power switch down the DPE is power on.
After power up the DPE boots from their PROMs.
The DPE runs the Bootstrap and starts CSSW.
The HEPI is also powered on and is reset by itself. This switches HEPI into transparent mode.

The IASW does not run at this moment. The CSSW generates HK packet with parameters specified in CSSW ICD.

The DPE configures itself into CSSW Initialisation Mode.

Parameter fields in H1 related to IASW, HEPI, ISGRI, PICSIT and VETO are meaningless and set to 0.

2.1.2 IASW Initialisation

A TC (5,5) (Change to nominal Mode) from Ground to DPE/CSSW starts the IASW.
Tables and parameters in the DPE are filled with DPE PROM default values. Those tables in the DPE which are not fully resident in the PROM are filled with software defined default values (except HEPI LUT, ISGRI PICSIT and VETO context tables). In Table 1 to Table 6 the initialisation parameters of IASW are listed. Initialisation values of Parameters reflected in H1 or H2 are shown in 6.5.

Table 1: Initilisation values of IASW parameters

Parameter acronym	Parameter description	Initialisation Value
S1E-AMPCORR_T0	Maximum of the risetime extrapolation in the CdTe amplitude correction algorithm	167
S1E-ISGRI_ E1_BINNING	amplitude binning parameter of CdTe amplitude correction step 1.	122
S1E-GAIN_T_GAIN	factor of the linear formula for gain_t inside the risetime correction of the CdTe amplitude correction algorithm.	0.16
S1E-GAIN_T _OFFSET	offset of the linear formula for gain_t inside the risetime correction of the CdTe amplitude correction algorithm.	2.141
S1E-OFFSET_T _GAIN	factor of the linear formula for offset_t inside the risetime correction of the CdTe amplitude correction algorithm.	3.803
S1E-OFFSET_T _OFFSET	offset of the linear formula for offset_t inside the risetime correction of the CdTe amplitude correction algorithm.	-30.122
S1E-GAIN_H_GAIN	factor of the linear formula for gain_h inside the risetime correction of the CdTe amplitude correction algorithm.	0.024
S1E-GAIN_H _OFFSET	offset of the linear formula for gain_h inside the risetime correction of the CdTe amplitude correction algorithm.	1.0
S1E-OFFSET_H _GAIN	factor of the linear formula for offset_h inside the risetime correction of the CdTe amplitude correction algorithm.	5.390
S1E-OFFSET_H _OFFSET	offset of the linear formula for offset_h inside the risetime correction of the CdTe amplitude correction algorithm.	23.455
S1E-SCALE_FACTOR	scale factor for the values of the shape value table inside the CdTe amplitude correction algorithm.	0.0002
S1S-PICSIT_RT	PICSIT count rate threshold (noisy pixel thresh.)	1000

Parameter acronym	Parameter description	Initialisation Value
S1E-VRESYNC_RT	Resynchronisation minimum valid event rate: the minimal event rate of valid events which must occur in science mode when HEPI must not be resynchronized. The event rate is defined by number of events per 8 seconds (housekeeping period).	0
S1E-IRESYNC_RT	Resynchronisation maximum invalid event rate: the maximal evwent rate of invalid events which might occur in science mode before HEPI will be resynchronized. The event rate is defined by the number of events per 8 seconds (housekeeping period).	1000
V0S-SPCAL	spectra with/without coincidence with (1) or without (0) calibration	0
V0S-SPEHKPER	integration time of VETO spectra	300
V0S-SPEHKINF	IF – increment spectra source channel flag (7th bit) defines whether (1) or not (0) channels will increase. If not, V0S-SPEHKCH will define the channel to integrate into.	0
V0S-SPEHKCH	N - channel number (4,3,2,1,0 bit) to integrate VETO spectra	0
S1E-SPT_CELL_8 ...4	Status of spectral timing histogram cell	0
S1E-SPT_CELL_3	Status of spectral timing histogram cell	1
S1E-SPT_CELL_2	Status of spectral timing histogram cell	0
S1E-SPT_CELL_1	Status of spectral timing histogram cell	1
S1E-SCI_INT_TM	integration time of science histograms	1000 seconds
S1S-CAL_INT_TM	integration time of calibration histograms	1800 seconds
	CdTe amplitude correction LUT (refer 3.3.1): gain_h (y,z) offset_h (y,z) gain_t (y,z) offset_t (y,z)	 -5 -1 -1 0
	CdTe Charge Loss Table s (refer 3.3.1)	5000
S1E-RAD_THR1..3	IREM thresholds table	65535
	HEPI LUT in DPE	not initialized

Table 2 shows the initialisation and default values of the TM initialisation table. The default (D) values are also put into the table, where they are different to the initialisation values.

Table 2: TM threshold initialisation (I) and default (D) values

Parameter acronym	parameter description	Initialisation (I), Default (D) Value
S1E-APID_UD	Lowest 7 bit of APID used when sending TM type "UNDEFINED"	I: 64
S1E-HI_THR_UD	Higher threshold for TM "UNDEFINED" above which ICB filling requires discarding this event.	I: 0
S1E-LO_THR_UD	Lower threshold for TM "UNDEFINED" below which ICB filling enables sending of TM.	I: 0
S1E-HI_THR_UD	Priority of sending TM "UNDEFINED" (High Priority are sent first)	I: 0
S1E-APID_S1	Lowest 7 bit of APID used when sending TM "CDTE_SINGLE"	I: 68
S1E-HI_THR_S1	Higher threshold for TM "CDTE_SINGLE " above which ICB filling requires discarding this event.	I: 40 D: 35
S1E-LO_THR_S1	Lower threshold for TM "CDTE_SINGLE " below which ICB filling enables sending of TM.	I: 30 D: 15
S1E-PRI_S1	Priority of sending TM "CDTE_SINGLE " (High Priority are sent first)	I: 1
S1E-APID_S2	Lowest 7 bit of APID used when sending TM "CDTE_CALIBRATION"	I: 72
S1E-HI_THR_S2	Higher threshold for TM "CDTE_CALIBRATION" above which ICB filling requires discarding this event.	I: 40 D: 46
S1E-LO_THR_S2	Lower threshold for TM "CDTE_CALIBRATION" below which ICB filling enables sending of TM.	I: 30 D: 26
S1E-PRI_S2	Priority of sending TM "CDTE_CALIBRATION" (High Priority are sent first)	I: 1
S1E-APID_D1	Lowest 7 bit of APID used when sending TM "CDTE_DIAGNOSTIC"	I: 117
S1E-HI_THR_D1	Higher threshold for TM "CDTE_DIAGNOSTIC" above which ICB filling requires discarding this event.	I: 40
S1E-LO_THR_D1	Lower threshold for TM "CDTE_DIAGNOSTIC" below which ICB filling enables sending of TM.	I: 30
S1E-PRI_D1	Priority of sending TM "CDTE_DIAGNOSTIC" (High Priority are sent first)	I: 1
S1E-APID_S4A	Lowest 7 bit of APID used when sending TM "CSI_SINGLE"	I: 80
S1E-HI_THR_S4A	Higher threshold for TM "CSI_SINGLE" above which ICB filling requires discarding this event.	I: 40 D: 30

Parameter acronym	**parameter description**	**Initialisation (I), Default (D) Value**
S1E-LO_THR_S4A	Lower threshold for TM "CSI_SINGLE" below which ICB filling enables sending of TM.	I: 30 D: 10
S1E-PRI_S4A	Priority of sending TM "CSI_SINGLE" (High Priority are sent first)	I: 1
S1E-APID_S4B	Lowest 7 bit of APID used when sending TM "CSI_MULTIPLE"	I: 81
S1E-HI_THR_S4B	Higher threshold for TM "CSI_MULTIPLE" above which ICB filling requires discarding this event.	I: 40 D: 20
S1E-LO_THR_S4B	Lower threshold for TM "CSI_MULTIPLE" below which ICB filling enables sending of TM.	I: 30 D: 5
S1E-PRI_S4B	Priority of sending TM "CSI_MULTIPLE" (High Priority are sent first)	I: 1
S1E-APID_D2	Lowest 7 bit of APID used when sending TM "CSI_DIAGNOSTIC"	I: 118
S1E-HI_THR_D2	Higher threshold for TM "CSI_DIAGNOSTIC" above which ICB filling requires discarding this event.	I: 40
S1E-LO_THR_D2	Lower threshold for TM "CSI_DIAGNOSTIC" below which ICB filling enables sending of TM.	I: 30
S1E-PRI_D2	Priority of sending TM "CSI_DIAGNOSTIC" (High Priority are sent first)	I: 1
S1E-APID_S3A	Lowest 7 bit of APID used when sending TM "COMPTON_SINGLE"	I: 76
S1E-HI_THR_S3A	Higher threshold for TM "COMPTON_SINGLE" above which ICB filling requires discarding this event.	I: 40
S1E-LO_THR_S3A	Lower threshold for TM "COMPTON_SINGLE" below which ICB filling enables sending of TM.	I: 30 D: 20
S1E-PRI_S3A	Priority of sending TM "COMPTON_SINGLE" (High Priority are sent first)	I: 1
S1E-APID_S3B	Lowest 7 bit of APID used when sending TM "COMPTON_MULTIPLE"	I: 77
S1E-HI_THR_S3B	Higher threshold for TM "COMPTON_MULTIPLE" above which ICB filling requires discarding this event.	I: 40 D: 25
S1E-LO_THR_S3B	Lower threshold for TM "COMPTON_MULTIPLE" below which ICB filling enables sending of TM.	I: 30 D: 5
S1E-PRI_S3B	Priority of sending TM "COMPTON_MULTIPLE" (High Priority are sent first)	I: 1
S1E-APID_S8	Lowest 7 bit of APID used when sending TM "SPECTRAL_TIMING"	I: 96
S1E-HI_THR_S8	Higher threshold for TM "SPECTRAL_TIMING" above which ICB filling requires discarding this event.	I: 40 D: 30
S1E-LO_THR_S8	Lower threshold for TM "SPECTRAL_TIMING" below which ICB filling enables sending of TM.	I: 30 D: 10
S1E-PRI_S8	Priority of sending TM "SPECTRAL_TIMING" (High Priority are sent first)	I: 1

Parameter acronym	parameter description	Initialisation (I), Default (D) Value
S1E-APID_D3	Lowest 7 bit of APID used when sending TM "TRANSPARENT"	I: 119
S1E-HI_THR_D3	Higher threshold for TM "TRANSPARENT" above which ICB filling requires discarding this event.	I: 39
S1E-LO_THR_D3	Lower threshold for TM "TRANSPARENT" below which ICB filling enables sending of TM.	I: 30
S1E-PRI_D3	Priority of sending TM "TRANSPARENT" (High Priority are sent first)	I: 1
S1E-APID_S6	Lowest 7 bit of APID used when sending TM "HISTOGRAM_POLARIMETRY"	I: 88
S1E-HI_THR_S6	Higher threshold for TM "HISTOGRAM_POLARIMETRY" above which ICB filling requires discarding this event.	I: 45 D: 46
S1E-LO_THR_S6	Lower threshold for TM "HISTOGRAM_POLARIMETRY" below which ICB filling enables sending of TM.	I: 44 D: 46
S1E-PRI_S6	Priority of sending TM "HISTOGRAM_POLARIMETRY" (High Priority are sent first)	I: 1
S1E-APID_S7A	Lowest 7 bit of APID used when sending TM "HISTOGRAM_CSI_SINGLE"	I: 92
S1E-HI_THR_S7A	Higher threshold for TM "HISTOGRAM_CSI_SINGLE" above which ICB filling requires discarding this event.	I: 45 D: 46
S1E-LO_THR_S7A	Lower threshold for TM "HISTOGRAM_CSI_SINGLE" below which ICB filling enables sending of TM.	I: 44 D: 46
S1E-PRI_S7A	Priority of sending TM "HISTOGRAM_CSI_SINGLE" (High Priority are sent first)	I: 1
S1E-APID_S7B	Lowest 7 bit of APID used when sending TM "HISTOGRAM_CSI_MULTIPLE"	I: 93
S1E-HI_THR_S7B	Higher threshold for TM "HISTOGRAM_CSI_MULTIPLE" above which ICB filling requires discarding this event.	I: 45 D: 46
S1E-LO_THR_S7B	Lower threshold for TM "HISTOGRAM_CSI_MULTIPLE" below which ICB filling enables sending of TM.	I: 44 D: 46
S1E-PRI_S7B	Priority of sending TM "HISTOGRAM_CSI_MULTIPLE" (High Priority are sent first)	I: 1
S1E-APID_S5	Lowest 7 bit of APID used when sending TM "HISTOGRAM_CSI_CALIBRATION"	I: 84
S1E-HI_THR_S5	Higher threshold for TM "HISTOGRAM_CSI_CALIBRATION" above which ICB filling requires discarding this event.	I: 45
S1E-LO_THR_S5	Lower threshold for TM "HISTOGRAM_CSI_CALIBRATION" below which ICB filling enables sending of TM.	I: 44
S1E-PRI_S5	Priority of sending TM "HISTOGRAM_CSI_CALIBRATION" (High Priority are sent first)	I: 1
S1E-APID_H2	Lowest 7 bit of APID used when sending TM "HK_SCIENCE (H2)"	I: 1

Parameter acronym	parameter description	Initialisation (I), Default (D) Value
S1E-HI_THR_H2	Higher threshold for TM "HK_SCIENCE (H2)" above which ICB filling requires discarding this event.	I: 48
S1E-LO_THR_H2	Lower threshold for TM "HK_SCIENCE (H2)" below which ICB filling enables sending of TM.	I: 50
S1E-PRI_H2	Priority of sending TM "HK_SCIENCE (H2)" (High Priority are sent first)	I: 2
S1E-APID_H3	Lowest 7 bit of APID used when sending TM "HK_PICSIT_ISGRI(H3)	I: 1
S1E-HI_THR_H3	Higher threshold for TM "HK_PICSIT_ISGRI(H3)" above which ICB filling requires discarding this event.	I: 48
S1E-LO_THR_H3	Lower threshold for TM "HK_PICSIT_ISGRI(H3)" below which ICB filling enables sending of TM.	I: 50
S1E-PRI_H3	Priority of sending TM "HK_PICSIT_ISGRI(H3)" (High Priority are sent first)	I: 2
S1E-APID_H4	Lowest 7 bit of APID used when sending TM "HK_VETO" (H4)	I: 1
S1E-HI_THR_H4	Higher threshold for TM "HK_VETO" above which ICB filling requires discarding this event.	I: 48
S1E-LO_THR_H4	Lower threshold for TM "HK_VETO" below which ICB filling enables sending of TM.	I: 50
S1E-PRI_H4	Priority of sending TM "HK_VETO" (High Priority are sent first)	I: 2
S1E-APID_RT	Lowest 7 bit of APID used when sending TM "REPORT_TASK"	I: 5
S1E-HI_THR_RT	Higher threshold for TM "REPORT_TASK" above which ICB filling requires discarding this event.	I: 48
S1E-LO_THR_RT	Lower threshold for TM "REPORT_TASK" below which ICB filling enables sending of TM.	I: 50
S1E-PRI_RT	Priority of sending TM "REPORT_TASK" (High Priority are sent first)	I: 2
S1E-APID_RS	Lowest 7 bit of APID used when sending TM "REPORT_TELEMETRY_STATUS"	I: 9
S1E-HI_THR_RS	Higher threshold for TM "REPORT_TELEMETRY_STATUS" above which ICB filling requires discarding this event.	I: 48
S1E-LO_THR_RS	Lower threshold for TM "REPORT_TELEMETRY_STATUS" below which ICB filling enables sending of TM.	I: 50
S1E-PRI_RS	Priority of sending TM "REPORT_TELEMETRY_STATUS" (High Priority are sent first)	I: 2

Table 3: Standard sub mode table initialisation values

Parameter acronym	parameter description	Initialisation value

Parameter acronym	parameter description	Initialisation value
S1E-SF_S1S_S	CdTe PPM (S1) in STANDARD slew sub mode	1
S1E-SF_S2S_S	CdTe calibration (S2) in STANDARD slew sub mode	1
S1E-SF_S3S_S	CdTe compton PPM(S3) in STANDARD slew sub mode	1
S1E-SF_S4S_S	CsI PPM (S4) in STANDARD slew sub mode	1
S1E-SF_S5S_S	CsI calibration (S5) in STANDARD slew sub mode	1
S1E-SF_S6S_S	CsI Polarimetry (S6) in STANDARD slew sub mode	0
S1E-SF_S7S_S	Spectral Imaging (S7) in STANDARD slew sub mode	0
S1E-SF_S8S_S	Spectral Timing (S8) in STANDARD slew sub mode	0
S1E-SF_S9S_S	Veto Spectra (S9) in STANDARD slew sub mode	1
S1E-SF_IS_S	ISGRI ON in STANDARD slew sub mode	1
S1E-SF_PS_S	PICSIT ON in STANDARD slew sub mode	1
S1E-SF_COMS_S	Compton ON in STANDARD slew submode	1
S1E-SF_S1P_S	CdTe PPM (S1) in STANDARD pointing sub mode	1
S1E-SF_S2P_S	CdTe calibration (S2) in STANDARD pointing sub mode	1
S1E-SF_S3P_S	CdTe compton PPM(S3) in STANDARD pointing sub mode	1
S1E-SF_S4P_S	CsI PPM (S4) in STANDARD pointing sub mode	0
S1E-SF_S5P_S	CsI calibration (S5) in STANDARD pointing sub mode	1
S1E-SF_S6P_S	CsI Polarimetry (S6) in STANDARD pointing sub mode	0
S1E-SF_S7P_S	Spectral Imaging (S7) in STANDARD pointing sub mode	1
S1E-SF_S8P_S	Spectral Timing (S8) in STANDARD pointing sub mode	1
S1E-SF_S9P_S	Veto Spectra (S9) in STANDARD pointing sub mode	1
S1E-SF_IP_S	ISGRI ON in STANDARD pointing sub mode	1
S1E-SF_PP_S	PICSIT ON in STANDARD pointing sub mode	1
S1E-SF_COMP_S	Compton ON in STANDARD pointing submode	1

Table 4: PPM sub mode table initialisation values

Parameter Acronym	parameter description	Initialisation value
S1E-SF_S1S_P	CdTe PPM (S1) in PPM slew sub mode	1
S1E-SF_S2S_P	CdTe calibration (S2) in PPM slew sub mode	1
S1E-SF_S3S_P	CdTe compton PPM(S3) in PPM slew sub mode	1
S1E-SF_S4S_P	CsI PPM (S4) in PPM slew sub mode	1
S1E-SF_S5S_P	CsI calibration (S5) in PPM slew sub mode	1
S1E-SF_S6S_P	CsI Polarimetry (S6) in PPM slew sub mode	0
S1E-SF_S7S_P	Spectral Imaging (S7) in PPM slew sub mode	0
S1E-SF_S8S_P	Spectral Timing (S8) in PPM slew sub mode	0
S1E-SF_S9S_P	Veto Spectra (S9) in PPM slew sub mode	1

Parameter Acronym	parameter description	Initialisation value
S1E-SF_IS_P	ISGRI ON in PPM slew sub mode	1
S1E-SF_PS_P	PICSIT ON in PPM slew sub mode	1
S1E-SF_COMS_P	Compton ON in PPM slew submode	1
S1E-SF_S1P_P	CdTe PPM (S1) in PPM pointing sub mode	1
S1E-SF_S2P_P	CdTe calibration (S2) in PPM pointing sub mode	1
S1E-SF_S3P_P	CdTe compton PPM(S3) in PPM pointing sub mode	1
S1E-SF_S4P_P	CsI PPM (S4) in PPM pointing sub mode	1
S1E-SF_S5P_P	CsI calibration (S5) in PPM pointing sub mode	1
S1E-SF_S6P_P	CsI Polarimetry (S6) in PPM pointing sub mode	0
S1E-SF_S7P_P	Spectral Imaging (S7) in PPM pointing sub mode	0
S1E-SF_S8P_P	Spectral Timing (S8) in PPM pointing sub mode	0
S1E-SF_S9P_P	Veto Spectra (S9) in PPM pointing sub mode	1
S1E-SF_IP_P	ISGRI ON in PPM pointing sub mode	1
S1E-SF_PP_P	PICSIT ON in PPM pointing sub mode	1
S1E-SF_COMP_P	Compton ON in PPM pointing submode	1

Table 5: Polarimetry sub mode table initialisation values

Parameter acronym	parameter description	Initialisation value
S1E-SF_S1S_O	CdTe PPM (S1) in POLARIMETRY slew sub mode	1
S1E-SF_S2S_O	CdTe calibration (S2) in POLARIMETRY slew sub mode	1
S1E-SF_S3S_O	CdTe compton PPM(S3) in POLARIMETRY slew sub mode	1
S1E-SF_S4S_O	CsI PPM (S4) in POLARIMETRY slew sub mode	1
S1E-SF_S5S_O	CsI calibration (S5) in POLARIMETRY slew sub mode	1
S1E-SF_S6S_O	CsI Polarimetry (S6) in POLARIMETRY slew sub mode	0
S1E-SF_S7S_O	Spectral Imaging (S7) in POLARIMETRY slew sub mode	0
S1E-SF_S8S_O	Spectral Timing (S8) in POLARIMETRY slew sub mode	0
S1E-SF_S9S_O	Veto Spectra (S9) in POLARIMETRY slew sub mode	1
S1E-SF_IS_O	ISGRI ON in POLARIMETRY slew sub mode	1
S1E-SF_PS_O	PICSIT ON in POLARIMETRY slew sub mode	1
S1E-SF_COMS_O	Compton ON in POLARIMETRY slew sub mode	1
S1E-SF_S1P_O	CdTe PPM (S1) in POLARIMETRY pointing sub mode	1
S1E-SF_S2P_O	CdTe calibration (S2) in POLARIMETRY pointing sub mode	1
S1E-SF_S3P_O	CdTe compton PPM(S3) in POLARIMETRY pointing sub mode	1
S1E-SF_S4P_O	CsI PPM (S4) in POLARIMETRY pointing sub mode	0

Parameter acronym	parameter description	Initialisation value
S1E-SF_S5P_O	CsI calibration (S5) in POLARIMETRY pointing sub mode	1
S1E-SF_S6P_O	CsI Polarimetry (S6) in POLARIMETRY pointing sub mode	1
S1E-SF_S7P_O	Spectral Imaging (S7) in POLARIMETRY pointing sub mode	0
S1E-SF_S8P_O	Spectral Timing (S8) in POLARIMETRY pointing sub mode	1
S1E-SF_S9P_O	Veto Spectra (S9) in POLARIMETRY pointing sub mode	1
S1E-SF_IP_O	ISGRI ON in POLARIMETRY pointing sub mode	1
S1E-SF_PP_O	PICSIT ON in POLARIMETRY pointing sub mode	1
S1E-SF_COMP_O	Compton ON in POLARIMETRY pointing submode	1

Table 6 shows the initialisation values of the used BCPK parameters until no BCPK was received by IASW. They will be overwritten by the content of the first received BCPK. The last parameters in the table (from start of last Pointing until end) are used to control the processing of the histograms, eclipse and radiation belt automatism.

Table 6: BCPK parameter initialisation values

parameter description	Expected value
Radiation_Belt_Entry_Time => latest OBT	16#FFFF# 16#FFFF#
Radiation_Belt_Exit_Time => latest OBT	16#FFFF# 16#FFFF#
Eclipse_Entry_Time => latest OBT	
Eclipse_Entry_Time => latest OBT	16#FFFF# 16#FFFF#
Eclipse_Exit_Time => latest OBT	16#FFFF# 16#FFFF#
Disregard_Rad_Mon_Flag => do NOT take radiation monitor into account	TRUE
Pointing_ID => no pointing	0,0
Pointing_Duration => without duration	0
TM_Share =>	0
Imminent_Switch_Off => no imminent exit	FALSE
Hand_Over => no hand over	FALSE
Radiation_Monitor_Cts1 => nothing measured	0
Radiation_Monitor_Cts2 => nothing measured	0
Radiation_Monitor_Cts3 => nothing measured	0
On Target => we are not on target, for we dont know	FALSE
ACC => just started	ACC_INACTIVE_MODE
Emergency_Save_Acq => no save exit	FALSE
AOCS_SubMode => not relevant	AOCS_POINTING

Last_Pointing_OBT: the on board time of last start of pointing necessary to compute the slew-time	(0,0,0)
Last_Slew_OBT - the on board time of last start of slew	(0,0,0)
In_Pointing - Flag which reflects pointing status when point-slew automatism is off	TRUE
In_Eclipse - flag which is set when time is between eclipse enter and eclipse_exit	FALSE
In_Radiation_Belt - flag which is set when time is between enter radiation belt and exit radiation belt	FALSE
Radiation_Exceeded - flag which shows that countrate exceeded threshold(s)	FALSE

2.1.3 HEPI Initialisation

IASW sends a initialisation pulse and a initialisation command to HEPI.
HEPI initialize the LUT and registers in HEPI with default values.

HEPI LUT in DPE RAM should be uploaded from ground.

2.1.4 Peripheral initialisation

The IASW is now in the Stand By mode.
The HK packets are filled by CSSW and IASW (including HEPI). So far no Scientific Data (TM) are generated.

The peripheral power on and initialisation is not controlled by ground. IASW has no control over the power of the periphery (refer RD 7).

The electrical Configuration Register (ECR) describe the status (On/Off) of the periphery. The default value is Off: No H/K data for periphery are collected.
The ECR register must be set ON from ground. Essential and additional H/K data are collected from sub-instruments according the ECR.

2.1.5 Initial Set-up

All context tables of the periphery residing in DPE RAM.They will be updated by TC from ground. Specific context restore commands apply the data the periphery.
LUT for amplitude and rise time correction for ISGRI in IASW must be updated by ground commands. This could be done either by memory patch commands or by TC (5,3) commands.

HEPI amplitude correction tables for PICSIT data and binning tables for histograms must be updated by TC from ground in DPE. They will be applied with a restore HEPI context command.

TCs from Ground through DPE to the periphery can configures peripheral Subsystems (HEPI tables must be updated after each DPE power off).

The HW configuration (e.g. HV of Veto) is changed to normal by TC from ground to the periphery.

The DPE is now ready to receive a specific parameter setting for a scientific observation and then to be commanded to a specific scientific sub mode in the Scientific Mode or to be commanded into Diagnostic Mode.

2.1.6 Periphery Parameter Storage in DPE

The DPE keeps a full copy of the sub instrument context in its RAM.
The DPE copies by ground commands the context of the periphery microcontroller into the DPE RAM.
This transfer is accomplished via the slow serial line.
This tables will be down linked by ground commands.

2.2 Mode Transitions

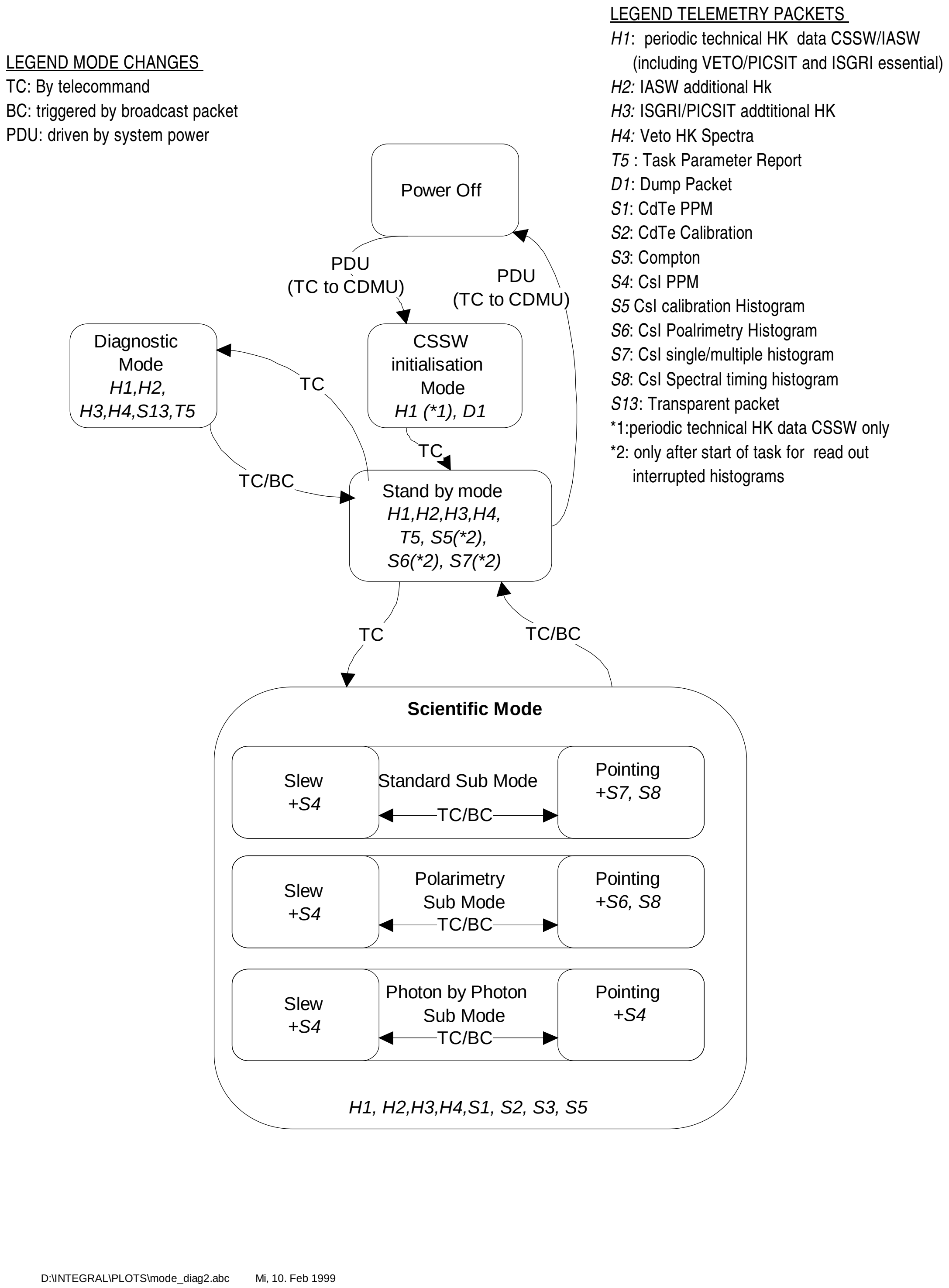

Figure 1: Mode change concept of IASW

The default logic for the IBIS mode transitions is that they are ground commanded (exceptions to be explained later.) The transition from one mode to another mode always goes via Stand By Mode.

From Off Mode (instrument power completely switched off) the instrument goes autonomously into CSSW initialisation Mode.
The transition to Off Mode is ”commanded” by the system by powering off the periphery. This transition is normally preceded by Broadcast Packet messages. (Generic imminent switch off flag only in emergency.)

The transition to Stand By mode is commanded from ground or initiated by broadcast message information.
The transition from Stand By mode to Diagnostic Mode are commanded from ground. Also the transition back to Stand By Mode is commanded from ground.

The transition to Scientific Mode (Standard, Polarimetry, PPM) is commanded from ground. According to the content of the Broadcast Packet the IASW switches in a Scientific Sub mode. In case of pointing/slew automatism is off the IASW could change between pointing and slew and reverse by TC.
The instrument stays in Scientific Mode until it is commanded otherwise.
Only at eclipse, radiation belt passing, imminent switch off, ESAM and exceeding IREM threshold the IASW goes autonomously to stand by mode.

2.3 CSSW INITIALISATION MODE

In CSSW initialisation Mode the DPE can receive commands and sends housekeeping packets as defined in CSSW ICD.

In CSSW initialisation Mode no IASW is running.
To switch in Stand By a TC from ground is needed.
From CSSW initialisation Mode it is only possible to switch into Stand By or Power off Mode.
When switching in Stand By Mode IASW sends an init pulse and an init command to HEPI. This will initialize HEPI with default values.

2.4 Stand By Mode

In Stand By Mode the DPE can receive commands and sends housekeeping packets. It also receives the Broadcast Packet. The DPE communicates with the periphery via the slow speed serial line, i.e. it sends commands to the periphery and polls their housekeeping packets (H1, H2, H3, H4) according the Electrical configuration register.

In Stand By Mode the DPE receives load task parameter commands to update parameters and tables and the parameter settings for transitions into other modes.

In Stand By Mode the DPE receives load task parameters to change the HW settings of the periphery (e.g. VETO HV) by routing this commands to the dedicated instrument.

This mode is normally used to transmit TC from ground to the periphery.

2.5 Patch and Dump

The RAM area in the periphery processors can be analysed and changed in Stand by Mode of the IASW.

To Patch and Dump the peripheral RAM the DPE can receive TC with included Memory Load and Dump Commands of the periphery. This commands are transmitted to the periphery. The dump data received by the DPE from the periphery are transmitted to ground as TM(5,4).

The DPE communicates with the periphery via the slow speed serial line.

DPE Memory normally is changed via CDMU.

Dumping of code areas could also be performed by the CSSW. The CSSW receives memory dump commands TC(6,2) according RD5. Also memory checksums could be calculated by the CSSW according a TC(6,3).

Note: CSSW does not use TM thresholds for control of filling the TM buffer. So CSSW can prevent putting TM from IASW into the buffer. To avoid a loss of additional HK TM the polling sequence table (PST) of IBIS must have more then 67 slots for IBIS during CSSW dump for larger (more than about 40 expected TM packets) memory areas.

2.6 Patch and Dump Mode

No Patch and Dump Mode is implemented.

2.7 Diagnostic Mode

In Stand By Mode IBIS has received parameter settings to the DPE and to the periphery that activate certain instrument processes with appropriate parameter setting when switched into Diagnostic Mode (e.g. switching off some modules to reduce the count rate)

Specific TM packet generation could be disabled/enabled during diagnostic mode.
In diagnostic mode a transparent packet could be generated. This packet includes the raw data reading in without processing in HEPI and IASW. The packet length is 80 bit for each event.
Also CsI and CdTe raw data TM packets could be generated. This TM packets uses reduced sizes of the event data field.
For HEPI exists a transparent periphery mode that can be used during Diagnostic Mode.

In Diagnostic Mode special processes in the instrument, e.g. raw data transmission, can be performed. The ground control can analyse the result of internal software/hardware processes of the instrument.

The DPE can receive mode switching commands back to Stand By Mode. The DPE also receives the Broadcast Packet, the only reaction to the broadcast packet is to switch back to Stand By Mode in case of a emergency, radiation belt passing or coming eclipse.

The DPE sends housekeeping packets and Diagnostic Packets according ECR (H1, H2, H3, H4).

The DPE receives scientific data from ISGRI and PICSIT via HEPI.

The maximum number of events which could be processed and sent down depends only on the available TM rate..

2.8 Scientific Mode

Before the changing to the Scientific Mode all observational parameters should be set by TC from ground accordingly. This must include the HEPI LUT and HEPI II registers. The master of the HEPI LUT (uploaded from ground) should be transmitted from DPE to HEPI before changing to this mode.

When switching to Science mode a H2 packet is generated, the detector layers will be synchronised and HEPI will be initialised (HEPI control register, HEPI data register type II set by IASW accordingly).
The HEPI II register is set, read out and verified by IASW. If the contents in HEPI II register on the board is not the same as in IASW, the software generates an on event message and IASW goes back into stand by mode.

Changing into Science mode should be during satellite slew mode.

In this mode the only possible commands are the transition to Stand By Mode and in case of point/slew automatism off to change from point to slew and reverse. When change from pointing to slew and back the HEPI and detectors will be synchronized each time. The Broadcast Packet is received and the switching of functions within a scientific subside is performed by the IASW according to the broadcast packet content. The switching back to Stand By Mode in case of radiation belts or eclipse or out of other reasons is performed by broadcast packet content.

No command to the periphery could be send during science mode

The IASW and CSSW generate housekeeping packets H1, H2, H3, H4 and Scientific Packets .

The DPE receives scientific data from ISGRI and PICSIT via HEPI.

Each scientific function is represented by its own TM type. The processing of events related to a scientific function is done in IASW (Software) and HEPI (Hardware). Each scientific function initialized a specific bit pattern in HEPI control register.

The scientific functions could be independently programmed by TC from ground for each point and slew sub mode. During IASW initialisation a default table is set (Table 7). Changing from one sub mode to the other is only possible via stand by mode.

Scientific Sub modes	Scientific Functions	Packet Generated in: Pointing	Packet Generated in: Slew
Standard	Spectral Imaging (CsI single/multiple histogram.)	S7	-
	Spectral Timing	S8	-
	ISGRI PPM	S1	S1
	Compton PPM	S3	S3
	PICSIT PPM	-	S4
	CdTe Calibration	S2	S2
	CsI Calibration	S5	S5
	CdTe Raw (*)	S13.1	S13.1
	CsI Raw (*)	S13.2	S13.2
	Housekeeping	H1 - H4	H1 - H4
Polarimetry	Spectral Timing	S8	-
	ISGRI PPM	S1	S1
	Compton PPM	S3	S3
	PICSIT PPM	-	S4
	CsI Polarimetric	S6	-
	CdTe Calibration	S2	S2
	CsI Calibration	S5	S5
	CdTe Raw (*)	S13.1	S13.1
	CsI Raw (*)	S13.2	S13.2
	Housekeeping	H1 - H4	H1 - H4
PPM	ISGRI PPM	S1	S1
	Compton PPM	S3	S3
	PICSIT PPM	S4	S4
	CdTe Calibration	S2	S2
	CsI Calibration	S5	S5
	CdTe Raw (*)	S13.1	S13.1
	CsI Raw (*)	S13.2	S13.2
	Housekeeping	H1 - H4	H1 - H4
(*): only after synchronisation of the detectors and HEPI			

Table 7: Default scientific sub mode table

IASW reads in all valid scientific events generated by HEPI and process them.Only the control register of HEPI determine the generation of possible scientific packet types. This is the reason why during change to scientific mode between pointing and slew a small number of raw events are produced between synchronisation of HEPI and detectors and setting of the HEPI control register with the next IASW command.

2.9 Photon by Photon SUB MODE

Independent of pointing cycles scientific events of the two layers are send to ground event by event with time information.
After entering the mode PICSIT calibration events are collected in a histogram in one memory area. The HEPI buffer containing the previous histogram data will be send down.

For the PICSIT data a bandwidth filter could be set. This could be done by setting a high and low threshold in HEPI II register for energy selection.

In case of high data rates a filter could be applied by setting dedicated parameters to select only ISGRI single events with energies lower then a programmable threshold (refer 3.3.1) or with a rise time lower then a programmable threshold.

For Compton events a filter excludes impossible events which are not out o the direction of the field of view (refer 3.3.3).

When Photon by Photon Sub Mode is finished the integration of the calibration histogram is also stopped and the data remains in HEPI memory. They will be send down when changing in any other science sub mode or on request by TC in Stand By mode.

2.10 Standard SUB MODE

Independent of pointing cycles ISGRI, ISGRI Calibration and Compton events are sent to ground event by event with time information.
After entering the mode PICSIT calibration events are collected in a histogram in one memory area. The HEPI buffer containing the previous histogram data will be send down.

In case of high data rates a filter could be applied by setting dedicated parameters to select only ISGRI single events with energies lower then a programmable threshold (refer 3.3.1) or with a rise time lower then a programmable threshold.

For Compton events a filter excludes impossible events which are not out o the direction of the field of view (refer 3.3.3).

During pointing standard histograms are accumulated in HEPI and the HEPI buffer containing the last standard histogram is read out by the DPE. In the DPE a data reduction is applied and the data are sent to ground during the pointing.

During slew no histograms are accumulated and no histogram data are sent to ground. PICSIT data are sent to ground photon by photon with time information.

When Standard sub mode is finished the last science histogram is hold in the HEPI memory. This remains in HEPI memory and will be send down to ground as first histograms during integration in the next Histogram Sub mode , Standard or Polarimetry or on request by TC from ground in Stand By mode.
The integration of the calibration histogram is also stopped and the data remains in HEPI memory. They will be send down when changing in any other science sub mode or on request by TC in Stand By mode.

2.11 Polarimetry SUB MODE

Independent of pointing cycles ISGRI, ISGRI Calibration and Compton are send to ground event by event with time information.
After entering the mode PICSIT calibration events are collected in a histogram in one memory area. The HEPI buffer containing the previous histogram will be send down.

In case of high data rates a filter could be applied by setting dedicated parameters to select only ISGRI single events with energies lower then a programmable threshold (refer 3.3.1) or with a rise time lower then a programmable threshold.

For Compton events a filter excludes impossible events which are not out o the direction of the field of view (refer 3.3.3).

During pointing polarimetry histograms are accumulated in HEPI and the HEPI buffer containing the last polarimetry histogram is sent to the DPE. In the DPE a data reduction is applied and the data are sent to ground during the pointing.

During slew no histograms are accumulated and no histogram data are sent to ground. PICSIT data are sent to ground photon by photon with time information.

When Standard sub mode is finished the last science histogram is hold in the HEPI memory. This remains in HEPI memory and will be send down to ground as first histograms during integration in the next Histogram Sub mode , Standard or Polarimetry or on request by TC from ground in Stand By mode.
The integration of the calibration histogram is also stopped and the data remains in HEPI memory. They will be send down when changing in any other science sub mode or on request by TC in Stand By mode.

2.12 Scientific Events

There are 7 different types of scientific events:

- ISGRI events: Events created by (low energy) γ-ray photons in the CdTe detector layer
- ISGRI calibration events: Events created in the CdTe detector layer by the calibration source 511 keV gamma-ray photons (marked by a calibration flag)

- Compton events: Events created by gamma-ray photons that are scattered in the detector layers. Signals are recorded in both layers at the same time (these events are identified and sorted in HEPI).
- Compton calibration events: Events created by the calibration source and that are scattered in the detector layers. Signals are recorded in both layers at the same time and marked by a calibration flag (these events are identified and sorted in HEPI).
- PICSIT single events: Events created by (high energy) γ-ray photons in one cell of the CsI detector layer.
- PICSIT multiple events: Events created by (high energy) γ-ray photons in two or three cells of the CsI detector layer in parallel by γ-ray scattering. These multiple events are sorted and energy added within HEPI. They get a multiple event flag.
- PICSIT calibration events: Events created in the CsI detector layer by the calibration source 511 keV or 1.275 MeV γ-ray photons (marked by a calibration flag)

The Veto subsystem and the calibration unit generate strobes. Coincident events of PICSIT and ISGRI are cancelled for a veto strobe and marked by a calibration flag for a calibration strobe.

For some events:

- CsI Photon by Photon
- CdTe Photon by Photon
- Compton events
- Spectral timing

a dummy packet handling could be necessary to keep the right time synchronisation.

3 HEPI and IASW Data Processing

3.1 HEPI Data Path

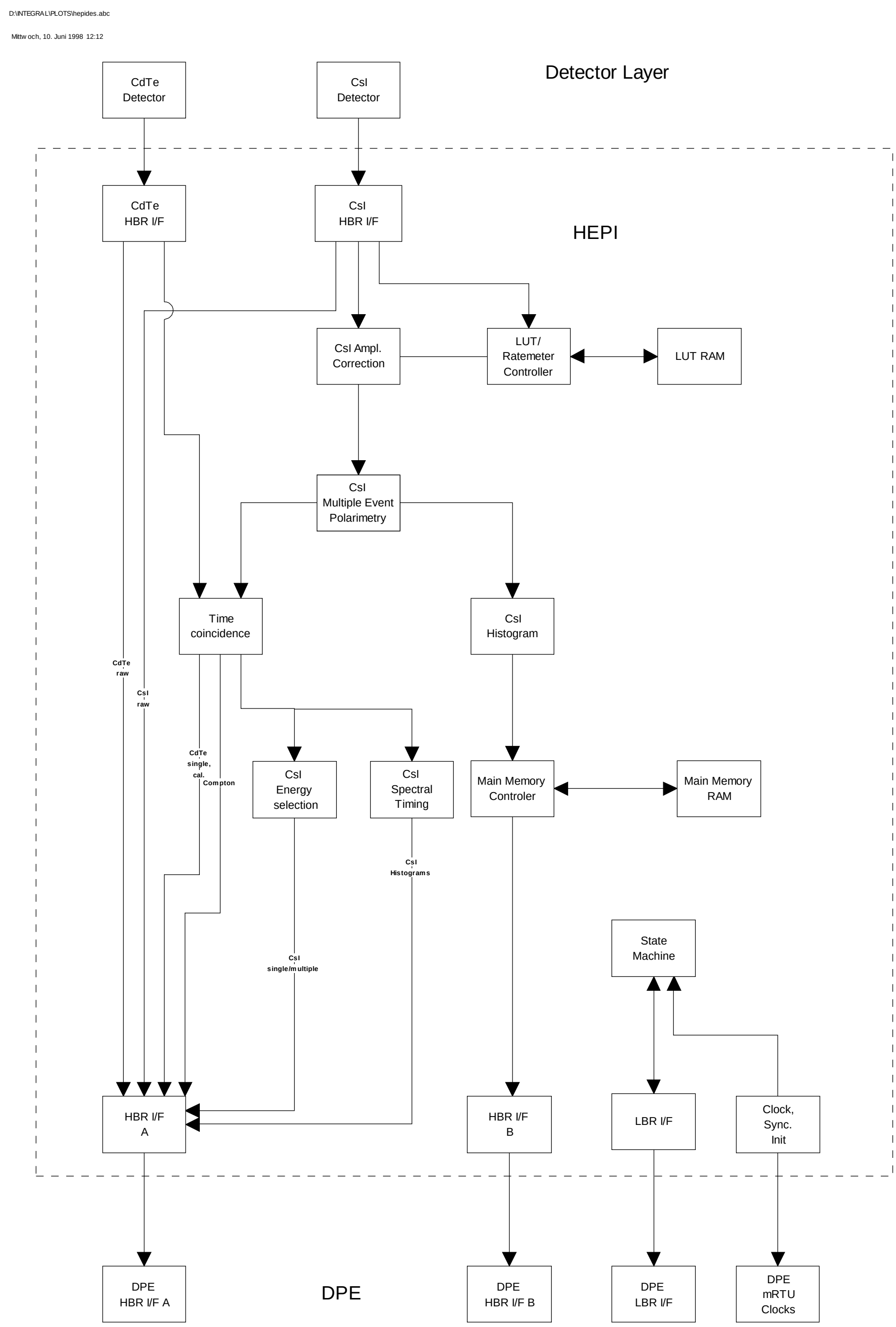

Figure 2 : HEPI Data Path

3.2 HEPI Functions

HEPI housekeeping:

–PICSIT and ISGRI overall events counter

–PICSIT pixel rate meters

HEPI scientific functions:

HEPI provides the time synchronisation of PICSIT and ISGRI.

Scientific event data from ISGRI and PICSIT are sent via high speed lines to HEPI. HEPI provides the following pre-processing for PICSIT data:

- amplitude correction
- multiple event reconstruction

and for both data types:

- ISGRI and PICSIT time coincidences identification (could be disabled by setting the science function table)
- ISGRI and PICSIT time format change

HEPI routes the ISGRI data through to the DPE. ISGRI and PICSIT events are analysed for time coincidences. In case of a time coincidence HEPI creates a Compton event, that contains the data of the two coincident events. For PICSIT data there are six different functions in HEPI:

- PICSIT Photon by Photon:	an energy bandwidth filter is applied and PICSIT data are routed through to the DPE event by event
- PICSIT Standard Histogram:	PICSIT single and double events are put into separate energy histograms
- PICSIT Polarimetry Histogram:	PICSIT double events are put into a histogram with energy bins and scattering angle bins (only alternatively to Standard Histogram)
- PICSIT Calibration Histogram:	PICSIT single events are put into histograms
- PICSIT Spectral Timing:	A eight energy channel histogram without spatial resolution over periods of some msec.
- PICSIT Rate meters:	counter for each individual pixel

In all scientific sub modes PICSIT calibration histograms are accumulated in HEPI. IASW controls by histogram-switch-on/off commands the accumulation time. After this time the two HEPI calibration buffers are switched between histogram accumulation and sending data to DPE.

In Diagnostic mode HEPI provides a transparent mode where data from selected detector layers are transmitted without processing.

The mapping from scientific function to HEPI control register is shown in Table 8. For each scientific function the control bits of HEPI are shown. They are set to 0, 1 or do not change according this mapping table, when the function is chosen in the science function table.

Bit number	Description	Value (0/1)	Module	Transparent	S1, S2	S3	S4	S5	S6	S7	S8	S13
1.	CdTe HBR I/F detector - HEPI	ON/OFF	CDTE_HBR	0/1	X	X	X	X	X	X	X	0/1
2.	CsI HBR I/F detector - HEPI	ON/OFF	CSI_HBR	0/1	X	X	X	X	X	X	X	0/1
3.	Amplitude correction	OFF/ON	AC	0	X	1	1	1	1	1	1	0
4.	Rate meters	OFF/ON	LUT	0	X	X	X	X	X	X	X	X
5.	Multiple event reconstruction	OFF /ON	MP	0	X	1	1	1	1	1	1	0
6.	Only for tests used (LBR I/F)	ON/OFF	LBR	0	X	X	X	X	X	X	X	X
7.	CsI spectral timing	OFF/ON	SPT	0	X	X	X	X	X	X	1	0
8.	CsI Energy selection+PPM	OFF/ON	ES,HBR_A	0	X	X	1	X	X	X	X	0
9.	Spare			0	X	X	X	X	X	X	X	X
10.	CsI Calibration event histogram	OFF/ON	HIST	0	X	X	X	1	X	X	X	0
11.	CsI single/multiple event histogram	OFF/ON	HIST	0	X	X	X	X	0	1	X	0
12.	Only for tests used (HBR HF FIFO flag)	OFF/ON	HBR	0	X	X	X	X	X	X	X	X
13.	Status Polarimetry histogram	OFF/ON	HIST	0	X	X	X	X	1	0	X	0
14.	Time coincidence module	OFF /ON	TC	0	1	1	1	1	1	1	1	0
15.	Disable compton detection	OFF /ON	TC	0	X	X	X	X	X	X	X	0
16.	Spare			0	X	X	X	X	X	X	X	X
17.	CdTe PPM	OFF/ON	HBR_A	0	1	X	X	X	X	X	X	0
18.	Only used for Tests (On event message Built in test)			0	X	X	X	X	X	X	X	X
19.	CsI sing./mult. histogram Memory Area	I/II	HIST	0	X	X	X	X	0/1	0/1	X	0
20.	CsI cal. histogram Memory Area	I/II	HIST	0	X	X	X	0/1	X	X	X	0
21.	Spare			0	X	X	X	X	X	X	X	X
22.	Spare			0	X	X	X	X	X	X	X	X
23.	Spare			0	X	X	X	X	X	X	X	X
24.	Spare			0	X	X	X	X	X	X	X	X

Table 8: Mapping of Science function table to HEPI control register

3.3 IASW Functions

The IASW receives the pre-processed data from HEPI via two High Bit Rate I/F (HBR I/F). HBR I/F A is used to transmit time tagged data (events with timing information). HBR I/F B is used to transmit the integrated histograms from HEPI.

Each received event is counted in individual counters also specified if the event was processed or killed (only by TM function).

All generated TMs will be counted in IASW. The information is part of the additional HK packet (H2).
The events coming from HEPI will be processed according their type.

3.3.1 ISGRI Energy and Rise Time Estimation and Selection Function (S1)

On ISGRI single events an energy estimation is applied to select events below programmable thresholds (rise time and energy). The selected events are put into the TM packet type S1. Also the timing information will be processed (ref. 4.1).
Only the seven MSBit (bit 0 to bit 6) of the rise time will be interpreted by IASW (HEPI delivers all 8 bit).
Each event is processed by following algorithm (energy estimation):

FORMULAE:

The three formulae below calculates a rough energy.
First the rise time will be calculated. If the corrected rise time T is above a programmable threshold (S1E-ISGRI_RT set by TC from ground) the event will be discarded.
If the raw risetime is zero or the corrected rise time T is below or equal 7 the event will be discarded.
From the energy E1 only a 4 bit precision is used to address the s(E1,T) LUT. s(E1,T) is a LUT (CdTe Charge Loss Table) with 4 kbyte size (16*128*2 byte). The parameter within this table has 16 bit precision and gives the ratio between the energy and amplitude as a function of rise time (Charge Loss Curves). This information is used in the last (4) formula to calculate the more precise energy value E2.
If the energy E2 is above a programmable threshold (S1O-ISGRI_EMAX set by TC from ground) the event will be discarded.

Calculation of corrected rise time T:
T = (risetime * G_T) + O_T (1)

Calculation of corrected energy (1st step):

H = (amplitude * G_H) + O_H (2)

Pixel Parameter LUT
The four variables G_T, O_T, G_H, and O_H are calculated with the alias formula given in Table 9 from the 4 bit parameters gain_h, offset_h, gain_t and offset_t stored in a LUT.
The selection of the above parameters is done by the pixel position. The total size is of the LUT is 16 kWord.

	Alias curve in Formula
G_T	GAIN_T_OFFSET + GAIN_T_GAIN * gain_h(y,z)
O_T	OFFSET_T_OFFSET+ OFFSET_T_GAIN * offset_t(y,z)
G_H	GAIN_H_OFFSET + GAIN_H_GAIN * gain_h (y,z)

O_H	OFFSET_H_OFFSET + OFFSET_H_GAIN * offset_h (y,z)

Table 9: Alias curves for 4-bit signed table values with possible range -7 .. +8

The LUT will be assigned during IASW initialisation with:
gain_h (y,z): -5
offset_h (y,z): -1
gain_t (y,z): -1
offset_t (y,z): 0

E1 = ((To * H) / (To - T)) / ISGRI_E1_Binning (3)

Calculation of corrected energy (2^{nd} step):

E2 = H * Scale_factor * s(E1,T) (4)

To:	maximum possible value of rise time correction (S1E-AMPCORR_T0 set by TC, default 167)
ISGRU_E1_Binning:	scale factor for E1 calculation (default 122)
Scale_factor:	scale factor for E2 calculation (default 0.0002)
s(E1, T)	CdTe Charge Loss Table (default 5000)

All formulae are processed with floating point values.
For E1 a rounding of the value will be applied.
Both LUT could be set by ground TC.

3.3.2 CdTe calibration function (S2)

The CdTe calibration events are not processed by IASW. They will be only written into the TM packet type S2. Only the seven MSBit (bit 0 to bit 6) of the rise time information will be interpreted by IASW (HEPI delivers all 8 bit).

3.3.3 Compton Selection Function (S3)

A compton selection is applied to each Compton event (except Compton calibration events). If the total energy of the event below a threshold (programmable by TC from ground) and within an acceptance angle, the event is put in the TM, else it will be deleted. Also the timing information will be processed (ref. 4.1).
Only the seven MSBit (bit 0 to bit 6) of the rise time information will be interpreted by IASW (HEPI delivers all 8 bit).
For details of the compton selection function see the description below:

A_CSI: Amplitude of CsI event after HEPI amplitude correction processing (default input= output value) and multiple event reconstruction.
Calibration of CsI events default values (could be set by TC from ground)

CAL_SIN: 5 keV/step for single events
CAL_MUL: 10 keV/step for multiple events

A_CDTE: Amplitude of CdTE events from detectors

A_RT: Rise time value of CdTe events from detectors

THR: Threshold for Compton event selection

```
If (A_CSI > THR) Then        { event to TM buffer}
else
{

        if (A_CSI = 0) Then {Event will be deleted}

        E_CDTE=energy_Correction_CDTE(A_CDTE, RT_CDTE, POS_CDTE)

        if (CSI_MULTIPLE) THEN {E_CSI=CAL_MUL * A_CSI}
                else {E_CSI= _CAL_SIN * A_CSI}

        if ( (E_CSI+E_CDTE) > THR) THEN        { event to TM buffer}

        else
        {
        Compton_selection(E_CSI,E_CDTE,POS_CSI, POS_CDTE)
                ### for further details ref. RD 8.
                If (angle_comton_Event < acceptance_angle) { event to TM buffer}
                else {event deleted}
        }
}
```

3.3.4 CsI single/multiple event function (S4)

Single and multiple events will be transmitted from HEPI to DPE after applying an energy selection. All events (single and multiple) between two programmable thresholds will be written into the TM packet type S4.0 (single events) or S4.1 (multiple events).

3.3.5 Specification of the Histogram-Mode (S5, S6 and S7)

3.3.5.1 Overview

Histograms are memory areas which reside in HEPI. HEPI could be commanded to count for each pixel position and energy range (bin) the number of photons during the integration time. These informations are stored in histograms. If the counted value exceed 255 an error flag in

HEPI HK will be set by HEPI and the value of the number of collected events will be fixed at 255 in this channel.
The histograms must be read out via HBR B if the integration is finished.

A histogram could be integrated in one buffer, while a second buffer will be read out (toggle buffers 1 and 2).
After start of a histogram (science or calibration) IASW will generate a H2 TM. Also on stop of a histogram a H2 will be generated. Integration, start and stop of a histograms will occur only in science mode.

Integration and read out of histograms are different tasks in the IASW.
The integration and read out of science histograms (S6, S7) is different with respect to calibration histograms (S5).

Histograms will be linked down with a roughly constant data rate so that the current histograms are read out when a new integration will start. The TM rate is calculated from the next requested integration time of the same type.

3.3.5.2 Start and integration of science histograms (S6, S7)

To **start** a **new** integration of a science histogram following precondition must be fulfilled:

1. IASW must be in pointing
2. On target flag must be set
3. at least one toggle buffer must be empty
4. no other science integration is running
5. integration time condition must be fulfilled (ref. 3.3.5.3 or 3.3.5.4 below).

When integration starts the HEPI memory toggle buffer according to the planned histogram will be cleared. A unique histogram ID of each histogram will be generated. After start of the integration a H2 TM will be generated. To start a histogram IASW requires arround 4 to 8 sec.

Following times are controling the integration of the science histogram:

- Requested integration time (ReqT): This is the time (duration) which could be set by TC from ground to define how long an integration should last. This time could be set individually for science and calibration histograms.
- Integration duration (ID): How long an histogram was integrated (effective integration time). This time will be written in the header of the TM.
- Waiting period (WP): Total sum of time during the integration was interrupted (On target flag = 0).
- Start of pointing time (SPT): this is the time, when the pointing starts (IASW changes from slew to pointing).

- Pointing duration (PD): this is the time (duration), which is distributed to all DPEs with the BCKP and set by TC from ground. It defines the planned duration of the next pointing.
- End of Pointing time (EPT): It will be calculated as: EPT = SPT + PD – WP. This time will be updated after each interruption (change of WP).
- Start time of next slew (SST): Time when pointing to slew change occured (after integration). This could be different to EPT because the EPT is only estimated on the beginning of a pointing.
- Current time (CurT): Current time when condition is checked
- Start of histogram (SHT): Start time of current histogram. It will be set to CurT when histogram was started. This time will be put into the header of the TM.
- End of histogram integration time (EHT): Time when integration of histogram was finished.
- Read histogram time (RHT): estimated time to read out a histogram (refer also 3.3.5.8 and 3.3.5.9 below)

3.3.5.3 S6 and S7 time conditions with point slew automatism on

Following main timing conditions will be checked, when a histogram should start:

a) CurT + ReqT > (SPT + PD) = EPT: no histogram will be start because remaining time is to less.
   Note: also no new histogram will start to be read out.

b) CurT + ReqT < EPT < CurT + 2* ReqT: Only one histogram will be possible until estimated end of pointing. The integration will last until SST (independently of EPT or SHT + ReqT). The integration duration will be ID = EHT – SHT – WP. The ReqT could be less, equal or greater than the ID depending on the WP and SST. The RHT will be calculated on start of integration as RHT = EPT – SHT. It will be used to control the read out frequency of the histogram data.

c) CurT + 2*ReqT < EPT: A histogram will be integrated until:
   CurT > SHT+ReqT+WP. The integration duration will be: ID = ReqT. After finish of the integration the above conditions will be checked again for a new integration.

Note: If SHT +2*ReqT + WP > CurT + ReqT > EPT due to a long waiting period, a new histogram will not be started, because condition a) is fulfilled.
Therefor the ReqT should be set that:

n*ReqT+MT < PD ,

where MT is the margin time, which should be larger than the waiting period but less than the requested integration time. (WP < MT < ReqT). ***n*** is an integer and defines the number of histograms in which the pointing will be splitted.

3.3.5.4 *S6 and S7 time conditions with point slew automatism off*

The integration will start with no timing condition (except requested integration time).
It will last until:
CurT – SHT – WP < ReqT
The integration duration will be: ID = ReqT. If are the conditions 3.3.5.2 above are fulfilled the next histogram will be started.

3.3.5.5 *Interruption of S6 and S7 (WAIT-STATE)*

While integrating an On-Target (BCPCK information) flag will be checked. If it shows that the satellite is not stable pointing (OTF = 0) the integration goes in WAIT-STATE which means the integration is stopped to be resumed later.

The requested integration time is increased by the off-target-time when the integration leaves the wait-state (i.e. OTF=1).

3.3.5.6 *End of S6 and S7 integration*

The integration will be end, when

1. the above timing conditions will be fulfilled,
2. the IASW change the submode (pointing to slew) or
3. IASW change from science mode to stand by.

The exact start of integration time SHT and integration duration (EHT – SHT –WP) will be stored in the header of the TM packets. When the integration stopped in wait-state the start time of the wait-state is the stop time and WP = 0.

3.3.5.7 *Start, stop and integration of calibration histograms (S5)*

The integration of calibration starts according the science function table when IASW switches to any science sub mode. The integration starts with clearing the HEPI memory buffer according the planned histogram. After start of integration a H2 will be generated.
The integration will last either the requested integration time (ReqT) or until switch back to stand by mode (normal case for the last calibration histogram in science mode).
No interruption of the integration of calibration histograms is possible.
The integration start time and duration will be stored in the header of the TM packets.

3.3.5.8 *Read out of science histograms (S6, S7)*

The read out of S6 and S7 is normally done during science mode in pointing. The SW is designed, that the read out will be finished a short time before end of integration of the current science histogram . This avoid the inhibit of starting a new histogram in the next pointing due to read out of the last one.
The last integrated histograms could be read out by TC request after IASW change to stand by mode (refer 3.3.5.10).
No histogram TM will be send during ground station hand-over (if corresponding BCPK flag is set).

The IASW reads the histogram data from the memory in blocks of 1024 byte. The total number of blocks is 2 MByte/ 1024 =2048 blocks for science histograms and 262 kbyte / 1204 = 256 blocks for calibration histograms.
In the best case each block will be packet into:
1024 byte / 2 (best compression factor) / 420 byte (TM size) = 1.22 TM packets.

The DPE can read out as maximum 1 block each 125 msec (8 per sec). This time has to be shared with the read out of calibration histogram. The minimum required TM rate is 78 TM / 8sec at maximum read out speed.

2048/8=256 sec is the minimum time to read out one science histogram. For the calibration histogram 256 / 8 = 32 sec have to be added.

IASW calculates the read our speed (number of blocks per sec) with following algorithm:

(CurT - SRT)/(RHT*0.95) > CurB / TotB

where:

- Current time (CurT): current time when condition is checked
- Start of reading histogram time (SRT): Start time of reading + interruption time (e.g. due to ground station hand over or stayed in stand by)
- Read histogram time (RHT):estimated time to read out histogram (for calculation refer 3.3.5.3 and 3.3.5.7 above)
- 0.95: margin implemented to be more save, that read out will be finished during current pointing cycle.
- Current block (CurB): next block number to be read out
- Total number of blocks (TotB): Total number of blocks to be read out from HEPI memory

Each time where the above condition is true a block will be read out and packed into TMs.
The TM rate depends therefore on the read histogram time (RHT) and the possible compression.

Notes:

i) The maximum RHT time should not exceed 2^17 =131000 sec (constraint from integer calculation).

ii) If no integration was started due to timing constraints no start of read out of histogram will occur.

3.3.5.9 Read out of calibration histograms (S5)

Calibration histograms will be normally read out during science mode in pointing or slew.
The SW is designed, that the read out will be finished a short time before end of integration of the current calibration histogram . This avoid the inhibit of starting a new histogram.
The last integrated histograms could be read out by TC request after IASW change to stand by mode (refer3.3.5.10).

No histogram TM will be send during ground station hand-over (if corresponding BCPK flag is set).

The IASW reads the calibration histogram data from the memory in blocks of 1024 byte. The total number of blocks is 262 kByte/ 1024 =256 blocks for calibration histograms.

In the best case each block will be packet into 1024 byte / 2 (best compression factor) / 420 byte (TM size) = 1.22 TM packets.

The DPE can read out as maximum 1 block each 125 msec (8 per sec). This time has to be shared with the read out of the science histogram The minimum required TM rate is 78 TM / 8sec at maximum read out speed.

256 / 8 = 32 sec is the minimum time to read out one calibration histogram.

The IASW calculates the read our speed (number of blocks per sec) as for science histograms (ref.3.3.5.8).
IASW stops the read out of a calibration histogram by change to stand by mode. The read out will be continued with the same read out period when IASW goes back to science mode.

3.3.5.10 Read out of remaining histograms in Stand by mode

Remaining histogram data could be read out also during stand by mode via TC. The IASW should be in pointing for read out of science histograms. This could be achieved by change to Stand by pointing via TC and point/slew automatism is off or by actual settings of the BCPK for pointing.
Calibration histograms could be request also during slew.
The TC includes a parameter which defines the read out time.

3.3.5.11 Discard remaining histograms

Remaining histogram data in HEPI memory could killed during stand by mode via TC. All read out, under integration and filled toggle buffer flags will be set to 0 in H1. The data will be erased before starting of a new integration.

3.3.5.12 Compression scheme

The data field of a spectral imaging histogram TM packet (S5,S6 or S7) starts with an 8 bit histogram cell (address) which is used as a first reference cell. This cell contains the absolute value (8 bit) of that histogram cell which address is written inside the data field header.

The difference between the histogram cell (address+1) and the reference cell (address) is calculated. In case that the difference between the absolute values of this cells is in range -7..+7 (=range of 4 bit signed integer) then this difference value (4 bit) is written inside the TM packet. The histogram cell (address+1) becomes the new reference cell for the next histogram cell (address+2). If the difference between histogram cell (address+2) to cell (address+1) is not in the range -7..+7 then a 4 bit flag and then the absolute value (8 bit) of this histogram cell (address+2) is written into the TM packet. The flag is the not used value -8 of the 4 bit signed integer range. As before the histogram cell (address+2) is the new reference cell for next histogram cell (address+3).

THE 4 BIT SIGNED INTEGER VALUES:

DEC:	BIN:	HEX:	
-8	1000	8	<= used as flag value
-7	1001	9	
-6	1010	A	
-5	1011	B	
-4	1100	C	
-3	1101	D	
-2	1110	E	
-1	1111	F	
0	0000	0	
1	0001	1	
2	0010	2	
3	0011	3	
4	0100	4	
5	0101	5	
6	0110	6	
7	0111	7	

3.3.5.13 Number of used fields

A parameter in the last 12 bit of the data field indicates the number of the first unused data field in packet. Counting starts with 1. The maximum number of valid events could be 845. A complete filled TM has 846 as number of this parameter. Not used histogram cells are filled with the 2#1000.
This could happen either the TM packet will be closed due to end of observation (switching to stand by mode) or due to the fact, that the next histogram cell fits not into the remaining size of the TM packet (e.g. histogram cell requires 12 bit but only 4 or 8 bit are only available until end of packet. The current cell will be written into the next TM packet).

3.3.6 Spectral timing function (S8)

Histogram bins of the spectral timing histograms from HEPI are packet into science TM according a programmable scheme. Each bin could be individually selected for transmission by TC from ground. The default number of transmitted bins is 2.
The histograms are compressed. The standard size of one bin is 4 bit. If the count rate of one bin is larger then 14, a flag (F) is used to indicate, that the bin has 8 bit format.
The integration time of the spectral timing histograms is programmable between 0.97 msec and 500 msec (must be set in HEPI II register values in DPE).

If in HEPI the counter of one histogram cell overflows, an error flag in HEPI HK will be set. The values stored in the cell is actual value modulo 255.

3.3.7 Raw event data processing function (S13)

In scientific mode only CdTe raw and CsI raw events are processed. These events are generated between synchronising the detectors and setting the HEPI status register according the current scientific sub mode.
It is also possible to switch off all other science functions in the science function table. Then only CsI raw and CdTe raw will be generated by HEPI and processed by IASW.
The raw data are only packet into the according TM packet types (TM 13.1 or TM 13.2).
In diagnostic mode a transparent packet type exists (TM 13.3). IASW put all data coming from DPE into this packets without any compression ore other processing (full 80 or 160 bit of HEPI output types).

3.4 IBIS Automatism

All automatism are **on** after initialisation of IASW.

3.4.1 Periodic HK data collection (H1)

3.4.1.1 Collecting HK

IASW collects according the Electrical configuration register the essential HK data from each sub instrument via LBR line. The collecting period is 8 sec.
The collecting sequence of the HK data is the following for the sub instruments:

1. PICSIT
2. VETO
3. HEPI
4. ISGRI MCE1 .. MCE8

The peripheral essential HK data (except the on event messages) are copied to the IASW HK data buffer. Together with the IASW HK data this buffer is handed over each 8 sec to the CSSW HK data (TM 1,8). The APID of the H1 packet is either 1280 (nominal) or 1408 (redundant). (Refer also to Table 24).

3.4.1.2 On event messages

IASW and peripheral on event messages are handed over to the CSSW on event message buffer. The CSSW generates the on event message generation time before putting into the CSSW essential HK data.
IASW sets a flag in H1 HK data in case of full on event message buffer and possible lost of on event messages.
Following on event messages could be generated (ref. also RD 4 for CSSW on event messages):

	On Event Messages for IBIS IASW				

Number	Description	Parameter(6 Bit)	Class (2 Bit)	ID (8 Bit)	Message1	Message 2
1	VETO switch off performed due to automatism (eclipse, radiation belt, immanent switch off)	0	0	128	0	0
2	Context saved	0	0	129	Context save flags	0
3	Context restored	0	0	130	Context restore flags	0
4	Emergency switch off performed (goto standby)	0	0	131	0	0
5	HEPI resynchronized	0	0	132	0	0
6	Exception was raised	0	1	128	MS Byte: Exception ID; LS Byte : Task ID	Logical address of exception string
7	Deleted (noisy pixel handling)					
8	TM threshold exceeded for certain TM: If during TM package building TM buffer threshold is exceeded (by e.g. HK packages)	TM Identifier of killed TM	1	130	MS Byte: TM Threshold; LS Byte: ICB Buffer state	Sequence counter of killed TM
9	HEPI data includes time overrun (time of one event is larger than time of following one)	Science Function (S1:1, S3:3 S4 :4)	1	131	Current Event time (LS Word)	Previous Event time (LS Word)
10	Time-out fetching analogue/bilevel value (no answer form CSSW driver during at least one RTC)	0	2	128	MS Byte: channel; LS Byte: 0	0
11	Time-out transmitting LSL data (no answer	MSB: 0-sending command	2	129	MS Byte: Sub instrument address	Sequence counter of command

	On Event Messages for IBIS IASW					
Number	Description	Parameter(6 Bit)	Class (2 Bit)	ID (8 Bit)	Message1	Message 2
	data (no answer from CSSW during at least one RTC))	command 1- receiving data 5 LSB Bit: Task ID of caller			LS Byte: Command ID	command
12	Time-out transmitting HSL data: No Data available (HBR B) or Data read in but no EOT. Probably HW error.	Task ID of caller	2	130	MS Byte: Line number (0: A, 1: B)	Block Address (always 0 if HBR A or HBR B when no EOT occurred)
13	LSL transfer fail report for high-level module – reseted (other LSL errors, together with [2,133])	MSB: 0-sending command 1- receiving data 5 LSB Bit: Task ID of caller	2	131	MS Byte: Sub instrument address LS Byte: Command ID	Sequence counter of command
14	HSL transfer fail report for high-level module - reseted.(together with [2,134])	Task ID of caller	2	132	MS Byte: Line number (0: A, 1: B)	0
15	LSL transfer failed (low level) (together with [2,131])	0	2	133	MS Byte: Reason of failure: 0 : LSL Parity error 1 : LSL Overrun error; LS Byte : 0	0
16	HSL transfer failed (low level) (together with [2,132])	0	2	134	MS Byte: Reason of failure: 0 : HSL FIFO full error LS Byte : 0	0
17	Pulse command failed: Return from CSSW	0	2	135	MS Byte: Relays pulse channel; LS Byte : 0	0

	On Event Messages for IBIS IASW					
Number	Description	Parameter(6 Bit)	Class (2 Bit)	ID (8 Bit)	Message1	Message 2
18	VETO switch off failed: e.g. command to VETO failed (probably not possible)	0	2	136	0	0
19	Histogram TM sending time-out: Try to send HISTOGRAM TM failed within 10 RTC.	Type of TM according TM ID	2	137	Sequence counter of TM	0
20	TC rejected - Invalid type-/subtype	0	3	128	MS Byte: type/subtype; LS Byte:8 LS Bit of TC APID	14 LS Bits TC sequence counter
21	TC rejected - Invalid task/function ID	0	3	129	MS Byte: 0 LS Byte:8 LS Bit of TC APID	14 LS Bits TC sequence counter
23	TC rejected - Wrong parameter range	0	3	132	MS Byte: 0 LS Byte:8 LS Bit of TC APID	14 LS Bits TC sequence counter
24	TC rejected - Wrong parameter length	0	3	133	MS Byte: length in word LS Byte:8 LS Bit of TC APID	14 LS Bits TC sequence counter
25	External TC rejected - could not be executed: E.g. external command could not transmitted (together with 11+14) or report table failed (data rate to high, check 480 times, one check in one RTC)	0	3	134	MS Byte: 0 LS Byte:8 LS Bit of TC APID	14 LS Bits TC sequence counter
26	TC rejected – Wrong Mode	0	3	135	MS Byte: current mode LS Byte:8 LS Bit of	14 LS Bits TC sequence counter

	On Event Messages for IBIS IASW					
Number	Description	Parameter(6 Bit)	Class (2 Bit)	ID (8 Bit)	Message1	Message 2
					TC APID	

Table 10: IASW On event Messages

Exception Name	Exception ID
HBR_A_TASK_ID	0
HBR_B_TASK_ID	1
READ_HISTOGRAM_TASK_ID	2
LINE_MANAGER_TASK_ID	3
MAIN_CONTROL_TASK_ID	4
MAIN_TASK_ID	5
TC_TASK_ID	6
HK_TASK_ID	7
TM_INTERFACE_ID	8
TM_MUST_I_PROCESS_ID	9
S1_PROCESS_ID	10
S1_RESET_ID	11
S1_CLOSE_ID	12
S2_PROCESS_ID	13
S2_RESET_ID	14
S2_CLOSE_ID	15
S3_PROCESS_MULTI_ID	16
S3_PROCESS_SINGLE_ID	17
S3_RESET_ID	18
S3_CLOSE_ID	19
COMPTON_SELECT_ID	20
S4_PROCESS_MULTI_ID	21
S4_PROCESS_SINGLE_ID	22
S4_RESET_ID	23
S4_CLOSE_ID	24
S5_PROCESS_ID	25
S5_RESET_ID	26
S5_CLOSE_ID	27
S6_PROCESS_ID	28
S6_RESET_ID	29
S6_CLOSE_ID	30
S7_PROCESS_SINGLE_ID	31
S7_PROCESS_MULTI_ID	32
S7_RESET_ID	33
S7_CLOSE_ID	34

Exception Name	Exception ID
S8_PROCESS_ID	35
S8_RESET_ID	36
S8_CLOSE_ID	37
DIAGNOSTIC_PROCESS_CSI_ID	38
DIAGNOSTIC_PROCESS_CDTE_ID	39
DIAGNOSTIC_RESET_ID	40
DIAGNOSTIC_CLOSE_ID	41
TRANSPARENT_PROCESS80_ID	42
TRANSPARENT_PROCESS160_ID	43
TRANSPARENT_RESET_ID	44
TRANSPARENT_CLOSE_ID	45
E_CORR1_ID	46
E_CORR2_ID	47
E_CORR3_ID	48
E_CORR4_ID	49
E_CORR5_ID	50
ENERGY_CORRECTION_ID	51
ANALOG_IF_ANALOG_ID	52
ANALOG_IF_BILEVEL_ID	53
HEPI_CONTEXT_ID	54
PICSIT_CONTEXT_ID	55
ISGRI_CONTEXT_ID	56
VETO_CONTEXT_ID	57
TABLE_HANDLER_ID	58
SCIENCE_HK_ID	59
DETECTOR_IF_ID	60
LINE_MANAGER_LSL_NOT_BLOCKED	61
LINE_MANAGER_HSL_NOT_BLOCKED	62
LINE_MANAGER_HSL_NESTED	63
LINE_MANAGER_LSL_NESTED	64
S5_ADDRESSES_NONCONTINUOUS	65
S6_ADDRESSES_NONCONTINUOUS	66
S7_ADDRESSES_NONCONTINUOUS	67
HEPI_REG_II_NONCONSISTENT	68
DIAG_MODE_ID	69
SCIENCE_MODE_ID	70

Table 11: List of exeption of On event message 128, class 2, message 1

Task Name	Task ID	Task Priority
Main	1	3
Telecommand (TC)	2	T_IASW_TASK_PRIORITY'LAST-2
HBR A	3	8

Housekeeping (HK)	4	T_IASW_TASK_PRIORITY'LAST-1
Histogram Integration	5	10
Read Histogram	6	4

Table 12: List of IASW task numbers and priorities

3.4.1.3 HEPI On Event Messages

HEPI generates only On Event Messages in case of detected failure during reception of commands via LBR I/F.
Table 13 shows the structure of the generated OEM. In case of parity error it could happens that HEPI will generate two OEM instead of one. The second one is not valid.
Additional the rejected command counter will be increased by one.

Byte	Description	
1.	Message #1 Sub instrument ID and On event Class (131)	
2.	Message Identifier (152=Illegal cmd, 153=Paritiy error,157=Illegal length,158=time out, empty=255)	
3.	command ID	
4.	APID	
5.	bit 0,1='00', bit 2..7=PSC(bit2..7)	
6.	PSC (bit 8..15)	

Table 13: HEPI On Event Messages

3.4.2 Additional periodic HK data collection

IASW collects according the electrical configuration register and the current mode additional HK data from the periphery. All additional HK are send in VC0. The APIDs are either 1281 (nominal) or 1409 (redundant). (Refer also to Table 24)

Sub System	Collecting Period	Data [word]	Sub Type	Name
PICSIT	32 sec	37	2 to 9	H3 (joined with ISGRI)
ISGRI MCE 1 to 8	32 sec	171	2 to 9	H3 (joined with PICSIT)
VETO	100 to 600 sec	192	10,11	H4

Table 14: Collecting period of peripheral additional HK

3.4.2.1 Additional IASW HK H2

IASW generates additional HK data packets H2. The packet will be generated on different events:
In following cases IASW generates an non periodic additional HK:

- Start Science Mode
- Stop Science Mode
- Start Histogram (calibration and science)

- Stop Histogram (calibration and science)
- Start of Pointing
- Start of Slew
- On Request by command from Ground
- Restart Processing of dedicated TM type
- Resynchronisation of HEPI

The packet type is TM(1,1) in VC 0.

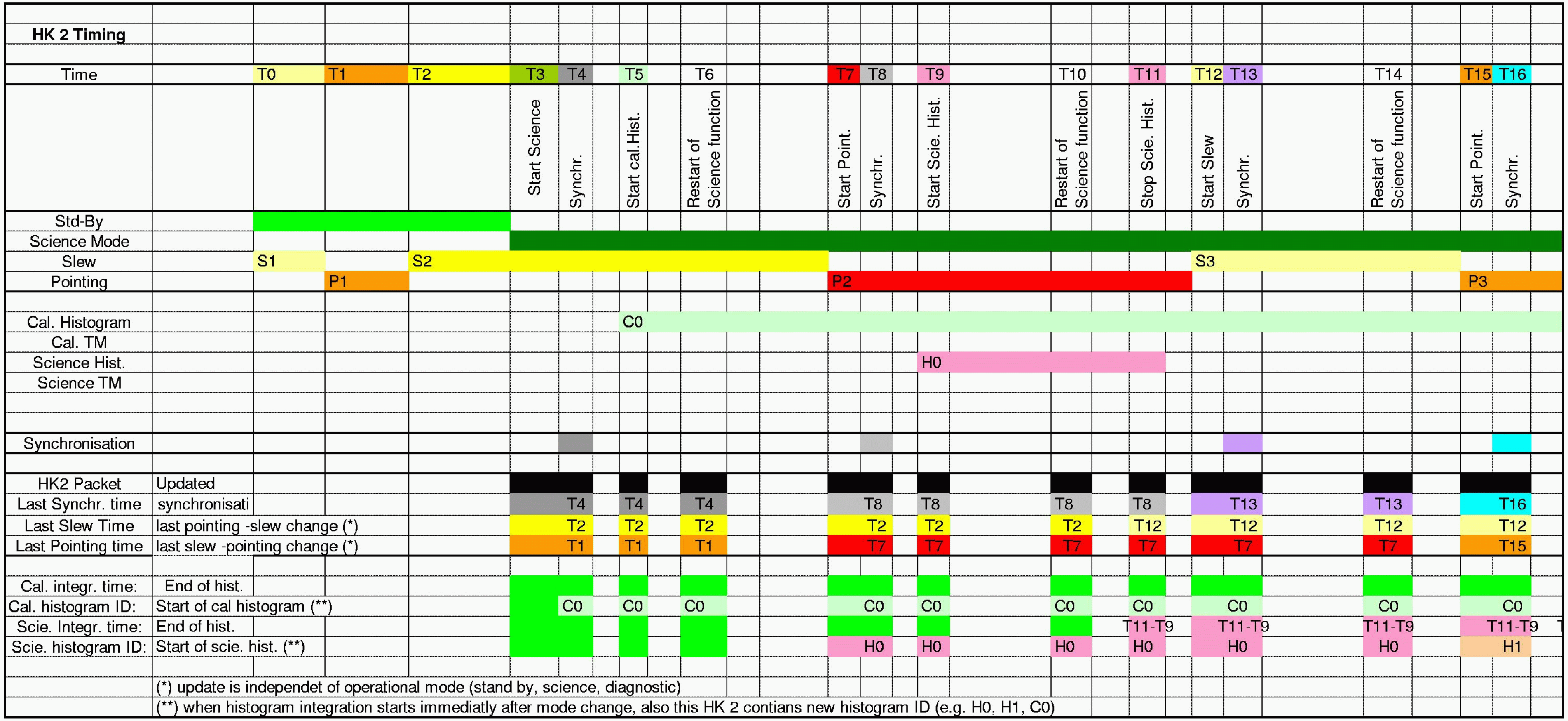

Figure 3: H2 generation and update of specific fields (Part I)

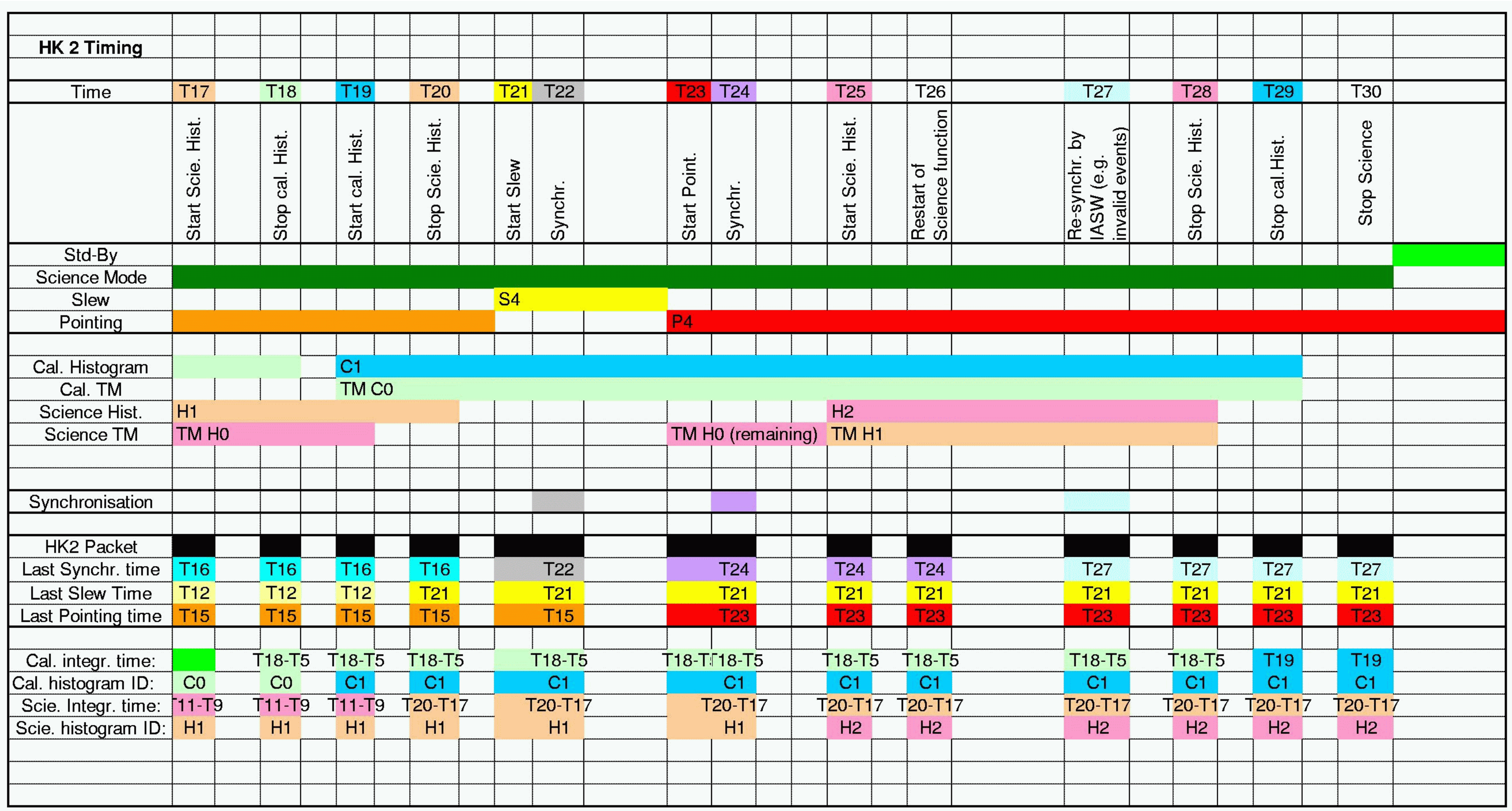

Figure 4: H2 generation and update of specific fields (Part II)

3.4.2.2 *ISGRI and PICSIT HK H3*

For ISGRI the periodicity is 32 sec for the entire system, but 4 min for a specific MCE. For each MCE one specific TM packet type (H3) is build (TM (1,2) to TM (1,9)). The PICSIT update time (transferring the data from the periphery to IASW) is 32 sec. The PICSIT additional HK data are joined with the different MCE additional HK in packet type (TM(1,2) to TM(1,9)).

3.4.2.3 *VETO HK H4*

VETO additional HK Data (H4) are sampled by the IASW periodically about 300 sec (default value) from the VEB. This collection time is programmable by TC from ground. The minimum value should be 72 sec.

Control of collecting of VETO H4 is done by flags of a special TC to IASW. The parameters will be send from ground to IASW and stored there. Then IASW send this parameters to VETO and either VETO change the channel (flag is not set) or set channel number to the selected one (flag is set).
To change the parameters you have only send the corresponding command to IASW.

This mechanism has the following advantages:

- all commands are send to IASW.
- The chosen channel number is fully transparent to the IASW (important , because IASW doesn't know, if one channel is on or of) and all parameters will be transferred to VETO
- The collecting is fully synchronous with IASW and VETO and from operation point of view, you have only send one TC.

CID of new VETO VSPEHKPAR command is 32 in decimal format (equals 20 in hexadecimal). VSPEHKPAR is 5 words (16 bit) long and has 4 parameters in 4 bytes:

1st byte		2nd byte	3rd byte		4th byte
CF	TH	TL	IF	N	spare

CF - calibration flag (as it was in VSPHKTIMPARxx - 7th bit)
TH - time of aquisition spectra: 7 bits of high byte
TL - time of aquisition spectra: low byte
IF - increment flag (7th bit)
N - channel number (4,3,2,1,0 bit)

If increment flag is set (IF = 1) channel number N is not valid and next spectra is collected from the next channel which is switched on (current number of spectra channel is saved in HK4). If increment flag is reset (IF = 0) channel number N is valid and next spectra is collected from this chosen channel.
The sketch below describes this collection scheme.

Time	Ground	IASW	VETO
↓			
	TC to IASW with:		
	integration time T		
	Cal. Flag CF		
	increment flaf IF		
	channel number N		
↓			
		IASW stores these parameters and send them also to VETO	
			VETO starts integration of new spectra with transmitted integration time T, channel number either selected by previous command (IF=0, N) or autonomously (IF=1)
			After integration time of last spectra VETO copies them into RAM and starts new integration with same channel
		After integration time of last spectra plus small margin IASW requests last spectra from VETO	
↓			
			VETO send last spectra
		IASW collects data and send them to ground	
	Ground recieve last spectra		
		IASW send command with parameter T, CF, IF,N to VETO	
			VETO starts integration of new spectra with transmitted integration time T, channel number either selected by previous command (IF=0, N) or autonomously (IF=1)
			After integration time of last

Time	Ground	IASW	VETO
			spectra VETO copies them into RAM and starts new integration with same channel
↓			
		IASW waits time T plus small margin and request next spectra from VETO	
			VETO send new spectra
		IASW collects data and send them to ground	
	Ground recieve spectra		
and so on			

These data are packed into two packet types TM(1,10) to TM (1,11). One TM packet contains the first part of VETO spectra, the second one the second part.

3.4.3 Eclipse

During the eclipse the DPE and HEPI stay powered on and all other periphery units are powered off.
The DPE keeps a full copy in its RAM of all parameters and tables used in the periphery.
The eclipse times will be taken from Broadcast Packet (BCPCK).
This automatism could be switched off by TC from ground.

3.4.3.1 Start of eclipse

If not disabled the eclipse automatism is active in any mode.

- According to BCPCK autonomously change to stand by at eclipse start time (stop data acquisition) from each mode.
  → IASW generates additional HK TM (1,1) (exit scientific mode)
- IASW Mode could be checked in essential HK (1280 TM (8,1))
- ISGRI will be switched into stand by mode
- The ISGRI bias will be switched off
- IASW save peripheral context autonomously if automatism is on(except HEPI, because DPE is the master of HEPI tables) . This includes VETO switch into stand by mode.
- Sequence of context saving of the sub instruments is following:
  1. ISGRI MCE1 .. MCE 8
  2. PICSIT
  3. VETO

  → Sequence of internal commands to sub instruments (ref. 7.1.2).

- The transmission of the context is controlled by a check sum (CS) after transmission.
- Context saving flags (CSF) set to 1 (in HK data) in case of successful transmission and context restore flags (CRF) set to 0.
- ECR will be set by IASW to 0.
- IASW stays in stand by until end of eclipse and generates HK data, but not from the periphery (according ECR information).
- Periphery is switched off according eclipse start time (this is controlled by the satellite or ground, not by IASW).The switch off of periphery should be delayed by a about 3 min.

3.4.3.2 End of eclipse

No reaction of IASW on end of eclipse. The peripheral context could be restored according context save flags by TC. IASW could be switched now into science mode.

3.4.4 Radiation Belt passing

This automatism could be switched off by TC from ground.
The radiation belt start time will be taken from Broadcast Packet (BCPCK).

3.4.4.1 Begin of radiation belt

If not disabled, this automatism is active in any mode.

- At BCPCK time radiation belt entry IASW change to stand by from each mode.
- IASW generate HK TM(1,1) packet (exit scientific mode)
- Switch off Veto HV by changing into stand by mode. Command will be send independently of the status of VETO ECR (e.g. if eclipse occured before radiation belt starts).
- Switch ISGRI Bias off and change to stand by
- IASW stays in stand by until end of radiation belt passing and generates HK (H1, H3, H4) data also of the periphery (according ECR)
- PICSIT pixel monitoring is switched off (because not active in stand by)

3.4.4.2 End of radiation belt

No reaction at exit radiation belt time. IASW is now out of the belts and could be switch into science mode.

3.4.5 SOLAR Flare

Deleted because covered by 3.4.6.

3.4.6 Emergency reactions

All information about emergency reactions are based on then content of the BCPCK.

3.4.6.1 IREM thresholds

If not disabled the IREM automatism is active in any mode.
This automatism could be switched off by TC from ground.

- The IASW monitors the count rates of IREM of 3 channels of BCPCK

- after exceeding one of the thresholds IASW switch immediately to stand by mode from each mode
- VETO HV will be switched off by change to stand by mode
- ISGRI bias will be switched off and go to stand by mode
- IASW stays in stand by until reception of TC for mode transition.

3.4.6.2 ESAM

If not disabled the ESAM automatism is active in any mode.
This automatism could be switched off by TC from ground (together with the Imminent switch off flag).

- IASW monitors the ESAM field in BCPCK
- If flag is set IASW goes to stand by mode from any other mode,
- VETO HV will be switched off by change to stand by mode
- ISGRI bias will be switched off and go to stand by mode
- IASW stays in stand by until reception of TC.

3.4.6.3 Imminent switch off

If not disabled the imminent switch off automatism is active in any mode.
This automatism could be switched off by TC from ground (together with ESAM).

- IASW monitors the imminent switch off field in BCPCK
- If flag is set IASW goes to stand by mode from any other mode,
- VETO HV will be switched off by change to stand by mode
- ISGRI bias will be switched off and go to stand by mode
- IASW save peripheral context (except HEPI)
- Context saving flags (CSF) set to 1 (in HK data) in case of successful transmission and context restore flags (CRF) set to 0.
- ECR will be set by IASW to 0.
- IASW stays in stand by until reception of TC and generates HK data, but not from the periphery (according ECR information).

3.4.7 PICSIT pixel monitoring

This automatism is active only in any science mode.
This automatism could be switched off by TC from ground .
IASW monitors the PICSIT pixel by following procedure:
PICSIT will generate an on event message if the count rate of at least one of the half modules exceeds a programmable threshold The on event message with the information of half module number of the first affected half module and flags for each other possible affected half modules is passed together with the standard HK to IASW.
IASW monitors the on event message from PICSIT. In case that the threshold is exceeded only in one half module and IASW is in any scientific mode then IASW reads the PICSIT rate meters on HEPI according the half module number and looks for noisy pixel.

If only one noisy pixel exceed a programmable threshold, IASW generates a command to switch off the pixel. Also an on event message is generated by PICSIT SW to inform ground about the switched off pixels.
The count rate threshold on PICSIT of semi modules and the threshold in IASW on the noisy pixel level could be set independently by TC.

3.4.8 Science Sub Mode switching

In science mode the IASW switches within a science sub mode between slewing and pointing according the broadcast packet content.
The configuration table of the scientific mode determines the valid science functions for pointing and slewing in this sub mode.
This automatism is active only in science mode.
If the automatism is off, point or slew mode could be changed by dedicated TC from ground.
Pointing condition (processing of Broadcast package contents):
-AOCS Mode: ACC Internal Pointing mode (decimal mode representation: 5)
-AOCS Sub mode: AOCS Pointing (decimal representation: 6)
-Pointing ID: 0

The IASW works on following assumptions for changing between slew/pointing
and change into science mode:

3.4.8.1 Point slew automatism is on (default)

- After start up slew mode is assumed, because PID is assigned as internal variable to 0
- After reception of first broadcast packet (BCPK) the internal values will be updated.
- From pointing duration and change from slew to pointing the time of end of pointing start of next slew) will be calculated at receiving of each new BCPK.
- Changing into Science mode should be during slew mode.
- When the satellite changes into pointing mode (refer above conditions)
    - -> IASW also change into pointing mode according BCPK information and start of integration of Science Histograms in standard science sub mode
- The actual valid pointing duration is used for calculating end of pointing.
- The time difference between current time and end of pointing is used to decide if new histogram with chosen integration time could be finished before end of pointing. If not it will not started and the probably current one will be continued.

3.4.8.2 Point slew automatism is off

- Default mode after power up is pointing mode
- change between slew/pointing is possible by applying TC (5,5) commands. (note: This is possible in all modes, but affects only the science mode. The science function table is chosen according the current mode)
- BCPK information is not respected concerning point/slew.

3.4.9 HEPI and detector Re-Synchronisation

In science mode HEPI and the detectors will be re-synchronised under the following conditions:

- when IASW changes from stand by mode to any science mode
- when IASW changes from pointing to slew during science mode
- when IASW changes from slew to pointing during science mode
- when the event rate of valid events is less or equal than valid events rate threshold or invalid event rate is higher than invalid event rate threshold

.

All values are measured on DPE HBR A I/F .
The valid and invalid event rate thresholds are programmable by TC.

3.4.10 IASW Broadcast packet processes

Table 15 list the INTEGRAL Broadcast flags and IASW reactions.

A] On-Board generated Data:

Flag	Description	IBIS IASW Reaction	IASW OEM
A1	OTF: On Target Flag	Start/Stop of Histogram Integration	
A2	ESAM Emergency Safe Acquisition	IASW go to standby VETO switch to stand by (HV off) ISGRI Bias off	131,0 128,0
A3	AOCS Modes:		
	3.1 Inactive Mode	not used	
	3.2 Standby Mode	not used	
	3.3 ISA Initial Sun Acquisition	not used	
	3.4 SSA Sun Sensor Acquisition	not used	
	3.5 STA Star Tracker Acquisition	not used	
	3.6 IPM Inertial Pointing Mode	Science Mode: Detection of Pointing	
	3.7 TCM Thrust Control Mode	not used	
A4	AOCS **Sub modes**	Detection of Pointing	
A5	Radiation Monitor Count Rate #1	IASW go to stand by VETO switch to stand by (HV off) ISGRI Bias off	131,0 128,0
A6	Radiation Monitor Count Rate #2	IASW go to stand by VETO switch to stand by (HV off) ISGRI Bias off	131,0 128,0
A7	Radiation Monitor Count Rate #3	IASW go to stand by VETO switch to stand by (HV off) ISGRI Bias off	131,0 128,0

B] Orbital Data

Flag	Description	IBIS IASW Reaction	IASW OEM
B1	Radiation Belts Entry Time	IASW go to stand by VETO switch to stand by (HV off) ISGRI Bias off.	131,0 128,0
B2	Radiation Belts Exit Time	No reaction but used for “in belts” condition.	
B3	Eclipse Entry time	IASW go to stand by ISGRI Bias off Save peripheral context (includes VETO switch to stand by)	131,0 129,0
B4	Radiation Monitor Data Validity Flag	Monitored	
B5	Eclipse Exit Time	No reaction but used for “in eclipse” condition	

C] Operational Data

Flag	Description	IBIS IASW Reaction	IASW OEM
C1	SPI Telemetry Share	not used	
C2	IBIS Telemetry Share	not used	
C3	JEM-X1 Telemetry Share	not used	
C4	JEM-X2 Telemetry Share	not used	
C5	OMC Telemetry Share	not used	
C6	All Instrument Switch-off Imminent	IASW go to stand by VETO switch to stand by (HV off) ISGRI Bias off, save peripheral context	131,0 128,0 129,0
C7	Ground Station Hand-Over Flag	Stop sending histograms	
C8	Pointing ID	pointing/slew switching	
C9	Pointing Duration	pointing/slew switching	

Table 15: IASW Broadcast Reactions

3.5 Start of observation

- Before the observation starts, parameters of the periphery could be changed
- This includes upload of HEPI LUT into DPE and then storage into HEPI (with HEPI context restore command) and also the update of the master of HEPI II register stored in DPE.
- At start of an observation IASW receives a TC to switch into scientific mode

- and IASW sends command to HEPI to start with the next synchronisation pulse (BCP 2) with the observation and to reset the detector output FIFO.
- IASW saves the on board time (OBT) of this BCP 2 in the IASW
- With the next BCP 2 HEPI
  - clears HEPI output FIFO
  - clears all science data in HEPI except the RAM area (so HEPI contains no old events with incorrect time information except the histograms)
  - clears all counters (including the 2 sec zero crossing counter)
  - sends clear signals to the detectors. This discard all old events on the detectors
  - sends synchronisation pulses to detectors. This reset the timers on the detectors.
- Each detector fills their output FIFOs with newly measured events and mark them with a time tag with 238 nsec time resolution within 2 sec .
- IASW will set HEPI status according current scientific function table, broadcast packet information (slew/pointing) and automatism on/off. The status register will be read out each 8 seconds as part of the HEPI HK.
- The HEPI II register is set, read out and compared with the original by IASW. If the contents in HEPI II register is not the same as in IASW, the software generates an on event message and IASW goes back into stand by mode.
- IASW will set the HEPI register type II according the programmed values. IASW read out also the register to verify the correct setting in HEPI.
- An additional HK TM packet (H2) which includes the start of observation time is generated.
- HEPI reads in the data according the programmed control register.
- All events after starting the observation (switching into science mode) have a time field with values close to 0.
  - sends individually delayed synchronisation pulses to the detector layers (0.5 Hz)
  - individually delayed pulses clears the output FIFOs of the detectors

3.6 Observation

The next Table shows a typical observation in Standard Science Mode. The observation starts in slew mode and it is assumed, that HEPI (LUT) and the detectors are ready for observation.
Following assumptions are made:

- Slew time: 300 sec
- Pointing duration: 1800 sec
- Requested science histogram integration time: 1750 sec
- Calibration histogram integration time: 10000 sec

The observation starts e.g. at On Board time (OBT) [sec]: E3D70A
H2 contains only 16 bit with a one second resolution of the OBT in the header (as all other HK TM also), but the full representation (45bit) with full resolution within one of the data fields.

Time after Start of Obser-vation	Event	IASW Input	IASW Output (additonal to periodic HK)	Comments	Time of TM packet header (examples) [HEX]	Time of event (examples) [HEX]
	Mode Transistion e.g. during a slew of the satellite	TC(5,5)		Start of Observation Standard Science Mode		
	HEPI reset		command to HEPI			
0	Detector Synchronisation		command to HEPI	Start time of synchronisation saved in IASW		
	Set HEPI status according the science function table for slewing		command to HEPI			
	Set HEPI parameter (type II)		command to HEPI, response from HEPI	(with verification H1)		
	HEPI starts to collect data from the detectors and process them according the HEPI status register.					
	Start of integration of CsI calibration histogram. Integration until end of calibration integration time (Calibration toggle buffer, CTB, 1)		command to HEPI; H2	TM is delayed because of initialition of HEPI memory	D70C	
2	IASW is now in Science Mode and generate H2 TM		H2	On Board Time in Header (resolution 1 sec)	D70A	
	Polling of HEPI HBR A starts and IASW generates TM packets according the data comming from HEPI		S1, S2, S3, S4	Time is detector time until last synchronisation.	000000	00 05 ....
300	IASW goes to pointing (information from BCPK)	BCPK				
	Set HEPI status according the science function table for pointing		command to HEPI; H2		D836	
302	Start of integration of CsI single and multiple histograms (toggle buffer, TB, 1).Integration until end of pointing.		command to HEPI; H2		D838	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1,S2, S3, S8	Time is detector time until last synchronisation. Header of S8 contains the complete 32 bit time information.	004B00	01 ....
2100	IASW goes to slew	BCPK				

Time after Start of Obser-vation	Event	IASW Input	IASW Output (additonal to periodic HK)	Comments	Time of TM packet header (examples) [HEX]	Time of event (examples) [HEX]
	IASW stops integration of science histograms (TB 1)		command to HEPI; H2		DF3E	
	Set HEPI status according the science function table for slewing		command to HEPI; H2		DF3E	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1, S2, S3, S4	Time is detector time until last synchronisation	020D00	06 1A ....
2400	IASW goes to pointing	BCPK				
	Set HEPI status according the science function table for pointing		command to HEPI; H2		E06A	
	Start of integration of new CsI single and multiple histograms (TB 0).Integration until end of pointing.		command to HEPI; H2		E06B	
	Start of read out of science Histogram from HEPI (TB 1) and send down the data with TM S7		S7	Time is OBT of start of integration of histogram	E3D837	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1,S2, S3, S8		025800	1A ....
4200	IASW goes to slew	BCPK				
	IASW stops integration of science histograms (TB 0)		command to HEPI; H2		E772	
	Set HEPI status according the science function table for slewing		command to HEPI; H2		E772	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1, S2, S3, S4	Time is detector time until last synchronisation	041A00	29 ....
4500	IASW goes to pointing	BCPK				
	Set HEPI status according the science function table for pointing		command to HEPI; H2		E89E	
	Start of integration of new CsI single and multiple histograms (TB 1).Integration until end of pointing.		command to HEPI; H2		E89F	

Time after Start of Obser-vation	Event	IASW Input	IASW Output (additonal to periodic HK)	Comments	Time of TM packet header (examples) [HEX]	Time of event (examples) [HEX]
	Start of read out of science Histogram from HEPI (TB 0) and send down the data with TM S7		S7	Time is OBT of start of integration of histogram	E3E06B	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1,S2, S3, S8		046500	B3 ....
6300	IASW goes to slew	BCPK				
	IASW stops integration of science histograms (TB 1)		command to HEPI; H2		EFA6	
	Set HEPI status according the science function table for slewing		command to HEPI; H2		EFA6	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1, S2, S3, S4	Time is detector time until last synchronisation	062700	07 ....
6600	IASW goes to pointing	BCPK				
	Set HEPI status according the science function table for pointing		command to HEPI; H2		F0D2	
	Start of integration of new CsI single and multiple histograms (TB 0).Integration until end of pointing.		command to HEPI; H2		F0D3	
	Start of read out of science Histogram from HEPI (TB 1) and send down the data with TM S7		S7	Time is OBT of start of integration of histogram	E3E89F	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1,S2, S3, S8		067200	AA ....
8400	IASW goes to slew	BCPK				
	IASW stops integration of science histograms (TB 0)		command to HEPI; H2		F7DA	
	Set HEPI status according the science function table for slewing		command to HEPI; H2		F7DA	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1, S2, S3, S4	Time is detector time until last synchronisation	083400	D7 ....

Time after Start of Obser-vation	Event	IASW Input	IASW Output (additonal to periodic HK)	Comments	Time of TM packet header (exampl es) [HEX]	Time of event (examp les) [HEX]
8700	IASW goes to pointing	BCPK				
	Set HEPI status according the science function table for pointing		command to HEPI; H2		F906	
	Start of integration of new CsI single and multiple histograms (TB 1).Integration until end of pointing.		command to HEPI; H2		F907	
	Start of read out of science Histogram from HEPI (TB 0) and send down the data with TM S7		S7	Time is OBT of start of integration of histogram	E3F0D3	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1,S2, S3, S8		087F00	AA ....
10000	Stop of integration of calibration histogram (CTB 1).		command to HEPI; H2		FE1A	
	Start of integration of new CsI calibration histogram (CTB 0) .		command to HEPI; H2		FE1A	
	Read out of calibration histogram (CTB 1)		S5	Time is OBT of start of integration of histogram	E3D70B	
10500	IASW goes to slew	BCPK				
	IASW stops integration of science histograms (TB 1)		command to HEPI; H2		000E	
	Set HEPI status according the science function table for slewing		command to HEPI; H2		000E	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1, S2, S3, S4	Time is detector time until last synchronisation	0A4100	E1 ....
10800	IASW goes to pointing	BCPK				
	Set HEPI status according the science function table for pointing		command to HEPI; H2		013A	
	Start of integration of new CsI single and multiple histograms (TB 0).Integration until end of pointing.		command to HEPI; H2		013A	
	Start of read out of science Histogram from HEPI (TB 1) and send		S7	Time is OBT of start of integration of histogram	E3F907	

Time after Start of Obser-vation	Event	IASW Input	IASW Output (additonal to periodic HK)	Comments	Time of TM packet header (exampl es) [HEX]	Time of event (examp les) [HEX]
	down the data with TM S7					
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1,S2, S3, S8		0A8C00	34 ....
12600	IASW goes to slew	BCPK				
	IASW stops integration of science histograms (TB 0)		H2		0842	
	Set HEPI status according the science function table for slewing		command to HEPI; H2		0842	
	Polling of HEPI HBR A and IASW generates TM packets according the data comming from HEPI		S1, S2, S3, S4	Time is detector time until last synchronisation	0C4E00	
12700	IASW leaves Science Mode and goes to stand by	TC(5,5)	H2		08A6	
	Stop of integration of calibration histogram (CTB 0).		H2		08A6	
	Closing of all current open science TM Packets		S1, S2, S3, S4, S8, S13	Two histograms (S5 TB 0 and S7 TB 0) remains still in HEPI memory		

Table 16: Typical observation in Standard Science Mode (MUST BE UPDATED!)

4 Timing

4.1 Distribution of timing and synchronisation information

DPE internal timing resolution is 43 bit with a resolution of 2^{-19} sec.
DPE distributes to HEPI

- 4,194,304 Hz
- 1 sec pulse (BCP 2/BCP 4)

From BCP 2 HEPI generates synchronisation pulses with a 2 sec time period. BCP 2 is synchronous with BCP 4, which could processed by IASW. The uncertainly is about 18 µsec, because this is the accuracy of the distribution of the BCP 4. HEPI delays the timing information about 1.43 µsec with respect to the OBT.

- HEPI distributes the 4,194,304 Hz to the detectors
- The 2 sec pulse is individually delayed and distributed to ISGRI and PICSIT and resets every 2 sec the detector time counters.

- The detectors counts the 4,194,304 Hz clock and uses the counter value as time stamps of the events.
- HEPI reads individually the events from the detector output FIFOs.
- HEPI looks for time coincidences between events of the two detector layers:
  - if no time coincidence between two events is detected, the oldest one (e.g. a CdTe event) is further processed (e.g. written to the HEPI out put FIFO) and a new one from the same detector layer (e.g. ISGRI) is read in
  - if a time coincidence is detected the events are marked as Compton events and further processed. From both detector layer a new event is read in.
- after looking for time coincidences HEPI cut off the last 8 bit of the time information and adds 17 bit additional time information (number of passed periods)
- the number of passed time periods (2 sec) is detected with following algorithm
  - it is assumed, that the events are ordered in time
  - if an event with a lower time value as the previous one is detected, a counter (zero crossing or period counter) is increased
- The resulting time resolution is 61.035 µsec within 72.8 h (32 bit).
- With this time information the events are handed over to the DPE.
- If a wrap around occurs (after about 72h), an error bit in HEPI HK will be set.

4.2 TM packet timing scheme

For S1, S3, S4 and S8 event types the event time of the first event within the TM is put into the TM header (24 bit: 2^18 about 72.8 h and 2^(-6) about 15.6 msec resolution). Refer also to the description of the individual TM packets 6.6.1f.
Due to the fact, that the current implementation of the ADA compiler from TLD is not able to handle 32 bit unsigned types of variables, the internal 32 bit time processing is splitted into one 1 bit (MSB) and one 31 bit part. This triggers that after 2^{17} sec observation time the current TM packet of the individual types and sub types (S1, S3, S4, S8) will be closed and a new one is started. No time information will be lost in this case.
The remaining 8 bit time information is put together with the other event information into the data field. If the difference of two succeeding events is larger than 255, a dummy event with a counter is put between both events. This dummy indicates how often the time field was overflowed.

The absolute time of the event is delayed with respect to the On board time (OBT) by the time of the last synchronisation (H2 information).

If the time of a succeeding event is lower then the previous one the current TM packet will be closed and an on event message generated. S1, S3, S4, S8 and S13 event types keep their full timing resolution generated by HEPI.

For S5, S6 and S7 TM packet types the header time is the start time of the integration of the histogram.

An overview of the time information in different TM packets is given in Table 17.

TM Type	Data Field Header Resolution Number of bits: max. time : resolution [bit : h: msec]	Header time	Data Field time resolution Number of bits: max time : resolution [bit : msec : µsec]	Event time	Calibration of event time
S1	24 : 72.8 : 15.6	Detector time of first event in TM packet	8 : 15.6 : 61	relative to TM header time	Adding of last synchronisation time (OBT mentioned in H2)
S2	24 : 72.8 : 15.6	Detector time of first event in TM packet	no	no	Only first event: adding of last synchronisation time (OBT mentioned in H2)
S3	24 : 72.8 : 15.6	Detector time of first event in TM packet	8 : 15.6 : 61	relative to TM header time	Adding of last synchronisation time (OBT mentioned in H2)
S4	24 : 72.8 : 15.6	Detector time of first event in TM packet	8 : 15.6 : 61	relative to TM header time	Adding of last synchronisation time (OBT mentioned in H2)
S5	24 : 4660 : 1000	OBT of start of histogram integration	n/a	n/a	n/a
S6	24 : 4660 : 1000	OBT of start of histogram integration	n/a	n/a	n/a
S7	24 : 4660 : 1000	OBT of start of histogram integration	n/a	n/a	n/a
S8	32 : 72.8 : 0.061	Detector time of first histogram (start of integration) in TM packet.	-:-:integration time	relative to TM header time	Adding of last synchronisation time (OBT mentioned in H2)
S13.1	16 : 18.2 : 1000	Packet creation time (OBT)	24 : 2000: 0.238	Detector time of	n/a

TM Type	Data Field Header Resolution Number of bits: max. time : resolution [bit : h: msec]	Header time	Data Field time resolution Number of bits: max time : resolution [bit : msec : µsec]	Event time	Calibration of event time
				events	
S13.2	16 : 18.2 : 1000	Packet creation time (OBT)	24 : 2000: 0.238	Detector time of events	n/a
S13.3	16 : 18.2 : 1000	Packet creation time (OBT)	depends on event types in this packets	Detector time of events	n/a (depends on event type)

Table 17: Overview of time information in different science data packets

4.3 Loss of synchronisation

Loss of time synchronisation can occur if within 2 sec no valid event is generated on the detectors and transmitted to HEPI. This loss of time synchronisation is not directly detectable by IASW or HEPI.
IASW monitors the event rate in 8 sec of valid and invalid events between HEPI and DPE.
If the valid event rate falls below a programmable threshold and the resychronisation automatism is enabled, IASW generate a new synchronisation.
If the invalid event rate exceeds a programmable threshold and the resychronisation automatism is enabled, IASW generate also a new synchronisation.
When IASW generates a new synchronisation an on event message is send and also a H2 TM packet with the new synchronisation time.

4.4 OBT Wrap Around

In case that the timer (48 bit) of OBT time overflows the IASW must be in stand by mode.
If the wrap around occurs during radiation belt or eclipse (start time is greater then exit time) the IASW reacts accordingly.

5 TC Handling

5.1 General description of IBIS IASW TC

The IASW verifies the commands by on event messages for rejected commands.
IASW copies the on event messages to the on event message buffer of the CSSW.

The peripheral commands are not interpreted by the DPE and only routed through to the periphery (also for TCs which requested data from the periphery).
The periphery verifies the commands by on event messages for rejected commands.

The on event messages are copied to the on event message field of the essential HK data from the periphery. The IASW copies the on event messages from the periphery to the on event buffer of the CSSW.

Table 18 lists the modes and the accepted TC by type.

TC Type (Type, Sub Type)	Accepted in Mode
2,1	SB, D
5,1	SB, D
5,2	SB, D
5,3	SB, D
5,4	SB, D
5,5	SB, D, SC
6,1	not
6,2	(CSSW)
6,3	(CSSW)
9,1	SB, D
9,4	SB, D
9,5	SB, D
13,1	(CSSW)
15,1	SB, D, SC

Table 18: TC accepted by IASW (SB: Stand by, D: Diagnostic, SC: Science)

Table 19 list the description of all IASW TC.

Type/ Subtype	Task-ID	Function-ID	Description	Parameter	Verification
2/1	N/A	N/A	Pulse Command	Bus: 0; PM: 0; Channel bit 8 .. 12= '00000'; Channel bit 13..15: ID	H1;Depends on the channel
5/1	21	N/A	Addressed to CSSW: HW_7anomaly		
5/1	22	N/A	Addressed to CSSW: TM_Cycle		
5/1	23	N/A	Addressed to CSSW: Current_TC		
5/1	24	N/A	Addressed to CSSW: TC_inp?ut buffer		
5/1	25	N/A	Addressed to CSSW: minor cycle		
5/1	26	N/A	Addressed to CSSW: Idle_process		
5/1	27	N/A	Addressed to CSSW: DPE_State _process		
5/1	0	N/A	Start saving all context		On event message
5/1	1	N/A	Start restoring all context		On event message
5/1	8	N/A	Start HEPI Histogram read out task		Science data packages
5/1	9	N/A	Discard all histogram buffers		H1: reception failure
5/2	21	N/A	Addressed to CSSW: HW_anomaly		
5/2	22	N/A	Addressed to CSSW: TM_Cycle		
5/2	23	N/A	Addressed to CSSW: Current_TC		
5/2	24	N/A	addressed to CSSW: TC_input buffer		
5/2	25	N/A	addressed to CSSW: minor cycle		
5/2	26	N/A	addressed to CSSW: Idle_process		
5/2	27	N/A	addressed to CSSW: DPE_State _process		
5/2	8	N/A	Stop HEPI histogram read out task		H2
5/3	16	0	Set Isgri rise time threshold	Rise time threshold	H2, TM(5,4) on request
5/3	16	1	Set ISGRI Emax – High Energy Threshold	Energy Threshold (W1)	H2, TM(5,4) on request
5/3	16	2	Set Compton selection threshold	Energy Threshold (W1)	H2, TM(5,4) on request

Type/ Subtype	Task-ID	Function-ID	Description	Parameter	Verification
5/3	16	3	PICSIT Pixel count rate threshold	Count rate (W1)	H2
5/3	16	4	set compton Single Energy Scaling	Energy Threshold (W1)	H2, TM(5,4) on request
5/3	16	5	set compton Multi Energy Scaling	Energy Threshold (W1)	H2, TM(5,4) on request
5/3	16	6	Set compton selection angle	Energy Threshold (W1)	H2, TM(5,4) on request
5/3	16	7	set min valid event rate for resync	Energy Threshold (W1)	H2, TM(5,4) on request
5/3	16	8	set max invalid event rate for resync	Energy Threshold (W1)	H2, TM(5,4) on request
5/3	16	9	set veto H4 integration parameters		H2, TM(5,4) on request
5/3	16	10	Set status of the spectral timing histogram cells.		H2, TM(5,4) on request
5/3	17	0	Pointing/Slew switch Automatism	Boolean (On/Off) (W1)	H1: Automatism table
5/3	17	1	Eclipse Automatism	Bool?ean (On/Off) (W1)	H1: Automatism table
5/3	17	2	Radiation Belt Automatism	Boolean (On/Off) (W1)	H1: Automatism table
5/3	17	3	Pixel switch off Automatism	Boolean (On/Off) (W1)	H1: Automatism table
5/3	17	4	Emergency switch off Automatism	Boolean (On/Off) (W1)	H1: Automatism table
5/3	17	5	Resynchronize HEPI Automatism	Boolean (On/Off) (W1)	H1: Automatism table
5/3	17	6	Set Radiation Monitor Automatism	Boolean (On/Off) (W1)	H1: Automatism table
5/3	18	0	Set integration time of science histograms (CsI single, multiple; Polarimetry histograms)	Integration time (W3)	H2, TM(5,4) on request
5/3	18	1	Set integration time of calibration histograms (CsI calibration histogram)	Integration time (W3)	H2, TM(5,4) on request
5/3	32	0	Set IASW Energy Correction LUT (CdTe)	Table-Parameter	TM(5,4)
5/3	32	1	Set IASW Rise time Correction LUT	Table-Parameter	TM(5,4)
5/3	32	2	Update table of lower/higher TM threshold	Table-Parameter (TM thresholds)	TM(5,4)
5/3	32	3	IREM Counting threshold	Table-Parameter	TM(5,4)
5/3	32	16	Set IASW Science Mode functions for Standard	Table-Parameter	H1:science configuration, TM(5,4)
5/3	32	17	Set IASW Science Mode functions for PPM	Table-Parameter	H1:science configuration, TM(5,4)
5/3	32	18	Set IASW Science Mode functions for Polarimetry	Table-Parameter	H1:science configuration, TM(5,4)
5/3	128	0	Update ECR Register	ECR-Register contents (W1)	H1
5/3	144	0	Restore of HEPI context Table from DPE memory		H1: command counter

Type/ Subtype	Task-ID	Function-ID	Description	Parameter	Verification
5/3	144	64	Restore of PICSIT context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	128	Restore of Veto context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	193	Restore of ISGRI MCE 5 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	194	Restore of ISGRI MCE 1 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	210	Restore of ISGRI MCE 3 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	211	Restore of ISGRI MCE 7 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	225	Restore of ISGRI MCE 6 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	226	Restore of ISGRI MCE 2 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	241	Restore of ISGRI MCE 8 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	144	242	Restore of ISGRI MCE 4 context Table from DPE memory		H1: reception failure TM(5,4) on request CRC
5/3	145	0	HEPI Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	64	PICSIT context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	128	Veto context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	193	ISGRI MCE 5 context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	194	ISGRI MCE 1 context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	210	ISGRI MCE 3 context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	211	ISGRI MCE 7 context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	225	ISGRI MCE 6 context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	226	ISGRI MCE 2 context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	241	ISGRI MCE 8 context Table saving in DPE memory		H1: reception failure, CRC on request
5/3	145	242	ISGRI MCE 4 context Table saving in DPE memory		H1: reception failure, CRC on request

Type/ Subtype	Task-ID	Function-ID	Description	Parameter	Verification
5/3	146	0	Change Context table of HEPI in DPE	Table-Parameter	TM(5,4),TM(5,4) report CRC on request
5/3	146	64	Change Context table of PICSIT in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	128	Change Context table of VETO in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	193	Change Context table of ISGRI MCE 5 in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	194	Change Context table of ISGRI MCE 1 in DPE	Table-Parameter	TM(5,4) ,TM(5,4) report CRC on request
5/3	146	210	Change Context table of ISGRI MCE 3 in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	211	Change Context table of ISGRI MCE 7 in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	225	Change Context table of ISGRI MCE 6 in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	226	Change Context table of ISGRI MCE 2 in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	241	Change Context table of ISGRI MCE 8 in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	146	242	Change Context table of ISGRI MCE 4 in DPE	Table-Parameter	TM(5,4) , TM(5,4) report CRC on request
5/3	192	0..255	HEPI Command (peripheral)	According I/F Protocol	
5/3	193	0..255	ISGRI Command (peripheral)	According I/F Protocol	
5/3	194	0..255	PICSIT Command (peripheral)	According I/F Protocol	
5/3	195	0..255	VETO Command (peripheral)	According I/F Protocol	
5/3	208	0	Set HEPI Register data type II	HEPI data register type II (W3)	H2, TM(5,4) on request
5/3	224	0	read histogram for diagnostic purposes	histogram type, transmission rate	S5, S6, S7

Type/ Subtype	Task-ID	Function-ID	Description	Parameter	Verification
5/4	16	0	report Isgri risetime threshold		TM(5,4)
5/4	16	1	Read ISGRI Emax – High Energy Threshold		TM(5,4)
5/4	16	2	Read compton selection threshold		TM(5,4)
5/4	16	3	Read PICSIT Pixel count rate threshold		TM(5,4)
5/4	16	4	Read compton Single Energy Scaling		TM(5,4)
5/4	16	5	Read compton Multi Energy Scaling		TM(5,4)
5/4	16	6	Read compton selection angle		TM(5,4)
5/4	16	7	Read min valid event rate for resync		TM(5,4)
5/4	16	8	Read max invalid event rate for resync		TM(5,4)
5/4	16	9	report veto H4 integration parameters		TM(5,4)
5/4	16	10	report status of spectral timing histogram cell		TM(5,4)
5/4	18	0	Report integration time of science histograms (CsI single, multiple; Polarimetry histograms)		TM(5,4)
5/4	18	1	Report integration time of CsI calibration histograms		TM(5,4)
5/4	32	0	Read IASW Energy Correction LUT (CdTe) (table report)		TM(5,4)
5/4	32	1	Read IASW Rise time Correction LUT (table report)		TM(5,4)
5/4	32	2	Read table of lower/higher TM threshold		TM(5,4)
5/4	32	3	Report IREM Counting threshold		TM(5,4) on request
5/4	32	16	Read IASW Science Mode functions table for Standard		TM(5,4)
5/4	32	17	Read IASW Science Mode functions table for PPM table		TM(5,4)
5/4	32	18	Read IASW Science Mode functions table for Polarimetry		TM(5,4)
5/4	33	0	report all IASW LUT's		TM(5,4)
5/4	64	0	Report last command		TM(5,4)
5/4	65	1	Report additional IASW HK data (H2)		TM(5,4)
5/4	146	0	Read Context table of HEPI in DPE		TM(5,4)
5/4	146	64	Report Context table of PICSIT in DPE		TM(5,4)
5/4	146	128	Report Context table of VETO in DPE		TM(5,4)
5/4	146	193	Report Context table of ISGRI MCE 5 in DPE		TM(5,4)

Type/ Subtype	Task-ID	Function-ID	Description	Parameter	Verification
5/4	146	194	Report Context table of ISGRI MCE 1 in DPE		TM(5,4)
5/4	146	210	Report Context table of ISGRI MCE 3 in DPE		TM(5,4)
5/4	146	211	Report Context table of ISGRI MCE 7 in DPE		TM(5,4)
5/4	146	225	Report Context table of ISGRI MCE 6 in DPE		TM(5,4)
5/4	146	226	Report Context table of ISGRI MCE 2 in DPE		TM(5,4)
5/4	146	241	Report Context table of ISGRI MCE 8 in DPE		TM(5,4)
5/4	146	242	Report Context table of ISGRI MCE 4 in DPE		TM(5,4)
5/4	147	0	Report CRC of context tables HEPI		TM(5,4)
5/4	147	64	Report CRC of context tables PICSIT		TM(5,4)
5/4	147	128	Report CRC of context tables VETO		TM(5,4)
5/4	147	193	Report CRC of context tables ISGRI MCE 5		TM(5,4)
5/4	147	194	Report CRC of context tables ISGRI MCE 1		TM(5,4)
5/4	147	210	Report CRC of context tables ISGRI MCE 3		TM(5,4)
5/4	147	211	Report CRC of context tables ISGRI MCE 7		TM(5,4)
5/4	147	225	Report CRC of context tables ISGRI MCE 6		TM(5,4)
5/4	147	226	Report CRC of context tables ISGRI MCE 2		TM(5,4)
5/4	147	241	Report CRC of context tables ISGRI MCE 8		TM(5,4)
5/4	147	242	Report CRC of context tables ISGRI MCE 4		TM(5,4)
5/4	148	0	Report all Contexts on DPE		TM(5,4)
5/4	208	0	Read HEPI Register data type II on DPE		TM(5,4)
5/4	208	1	Read HEPI Status Register mirrored on DPE		TM(5,4)
5/5	N/A	N/A	Mode Transition addressed to CSSW	0: CSSW initialise mode 1: transition to nominal mode	H1
5/5	N/A	N/A	Mode Transition – Defines next Mode to switch into. Mode 0: Standby, Mode 2: Diagnostic, Mode 3: Science PPM, Mode 4: Science Standard, Mode 5: Science Polarimetry	Mode to switch into, slew/pointing	H1,H2 (only science mode)
6/1	N/A	N/A	Patch DPE RAM via CDMU (addressed to CDMU)		TM(6,3) on request

Type/ Subtype	Task-ID	Function-ID	Description	Parameter	Verification
6/1	N/A	N/A	Patch DPE RAM via DPE(addressed to CDMU)		TM (6,3) on request
6/2	N/A	N/A	Dump DPE RAM via CDMU (addressed to CDMU)		TM(6,2)
6/2	N/A	N/A	Dump DPE RAM via DPE		TM(6,3)
6/3	N/A	N/A	Calculate Memory checksum		TM(6,3)
9/1	N/A	N/A	Report TM generation status (for Diagnostic mode TMs)		TM(9,1)
9/4	N/A	N/A	Enable generation of specific TM packets (Diagnostic mode)	CsI raw, CdTe raw, Transparent TM (Type, Subtype)	TM(9,1) on request
9/5	N/A	N/A	Disable generation of specific TM packets (Diagnostic mode)	CsI raw, CdTe raw, Transparent TM (Type, Subtype)	TM(9,1) on request
10/2	N/A	N/A	addressed to CSSW: enable time synchronisation		
10/3	N/A	N/A	Add time code (addressed to CSSW)		TM (10,5) on request
10/5	N/A	N/A	Enable Time verification (addressed to CSSW)		TM (10,5)

Table 19: Table of accepted IASW TC

5.2 TC verification

All commands are verified by on event messages in case of not executed.
A TC counter for executed and not executed commands exists in each sub system.

5.2.1 Internal commands

Internal commands are commands which are not transmitted to the periphery. They are directed to the IASW, CSSW.
The PSD should be applicable for verification for this commands.

All TC(5,3) commands related to tables stored in DPE RAM generates autonomously a TM(5,4) packet with the successful uploaded parameter. These are commands have TID $\in$ {32,146}.

Parameters which are updated with TC(5,3) and TID $\in$ {0,16,18,208} could be reported with the respective TC(5,4) commands. These TC (5,4) commands generate a TM(5,4) packet.

All other parameters updated by TC(5,3) and (TID $\in$ {17,128} are verified by periodic housekeeping (H1).

5.2.2 External commands

External commands are directed to the periphery and only routed by the DPE. Only TC(5,3) commands are transmitted to the periphery.

5.2.3 Verification with TM(5,4) packets

Parameters uploaded to the periphery with TC(5,3) commands could be verified by TM(5,4) packets on request. The request command must be also a TC(5,3). This TC is different from the upload command.

Example:
Set HEPI status register TC(5,3):

	MSB															LSB
Bit No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Word #1	192 (TID)								3 (FID)							
Word #2	0 (Data request)								0 (Sub ID)							
Word #3	5 (Internal length)								3 (Internal CID)							
Word #4	filled by IASW (APID)								0 (SUB ID)							
Word #5	Filled by IASW (PSC)															
Word #6	Parameter															
Word #6	Parameter															

(Grey shaded area is passed by to the periphery)

The parameters could be verified by a

Read HEPI status register TC(5,3) command:

	MSB															LSB
Bit No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Word #1	192 (TID)								4 (FID)							
Word #2	3 (Data request)								0 (SUB ID)							
Word #3	3 (internal length)								4 (Internal command ID)							
Word #4	filled by IASW (APID)								0 (SUB ID)							
Word #5	Filled by IASW (PSC)															

(Grey shaded area is passed by the DPE to the periphery)

This command generates a TM(5,4) with following structure

(Package Data Field)

	MSB															LSB
Bit No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Word #1	192 (TID)								4 (FID)							
Word #2	3 (Internal data length)								4 (Internal request CID)							
Word #3	Parameter															
Word #4	Parameter															

(Grey shaded area is send from the periphery to DPE)

For HEPI the above scheme is applicable to all uploaded parameters. Only the **internal** load request command structure changes in case of parameter stored in tables. Also the most important ones are monitored in the periodic HK (H1).

5.2.4 Verification with housekeeping data

Uploaded Parameter which could not verified by the above schemes must be reflected at least in periodic HK.

6 TM Handling

6.1 General

IASW can handle the maximum possible TM rate of 184 TM / 8 sec. It has a dynamic mechanism which allows to handle different TM allocation (ref. 6.2). Table 20 shows in which mode IASW handle which TM packet type.

Operational Modes	TM Packet Generated
Scientific	S1.0, S2.0, S3.0, S3.1 S4.0, S4.1, S5.0,S6.0,S7.0, S7.1,S8,,S13.1, S13.2, H1, H2, H3, H4
Diagnostic	S13.1, S13.2, S13.3, H1, H2, H3, H4, S5 – S7 only on request
Stand-By	H1, H2, H3, H4, S5 – S7 only on request
CSSW Initialisation	H1
Off	-

Table 20: Possible TM types and operation modes

Name	Description	APID	Type (DEC)	Subtype (DEC)	TID (DEC)	FID (DEC)
tms0018	H1: IASW HK data	1280	1	8	n/a	n/a
tms0111	H2: IASW additional science HK data	1281	1	1	n/a	n/a
	H3: ISGRI and Picsit additional HK	1281	1	2 to 9	n/a	n/a
	H4: VETO additional HK	1281	1	10,11	n/a	n/a
st540000	Report global version string		5	4	0	0
st540001	Report version number as string		5	4	0	1
st540002	Report version number as digits		5	4	0	2
st540100	Report Relais Line statuses		5	4	1	0
st541000	report Isgri low energy threshold		5	4	16	0
st541001	report Isgri high energy threshold		5	4	16	1
st541002	report compton energy low threshold		5	4	16	2
st541003	report picsit count rate threshold		5	4	16	3
st541004	report compton Single Energy Scaling		5	4	16	4
st541005	report compton Multi Energy Scaling		5	4	16	5
st541006	report compton selection angle		5	4	16	6
st541007	report min valid event rate for resync		5	4	16	7
st541008	report max invalid event rate for resync		5	4	16	8
st541009	report veto H4 integration parameters		5	4	16	9

Name	Description	APID	Type (DEC)	Subtype (DEC)	TID (DEC)	FID (DEC)
st54100A	Status of spectral timing histogram cells		5	4	16	10
st541200	report science histogram integration time		5	4	18	0
st541201	report calibration histogram integration time		5	4	18	1
st542000	report energy correction LUT		5	4	32	0
st542001	report energy shape value LUT		5	4	32	1
st542002	report tm threshold table		5	4	32	2
st542003	report IREM threshold table		5	4	32	3
st542010	report standard submode table		5	4	32	16
st542011	report PPM submode table		5	4	32	17
st542012	report polarimetry submode table		5	4	32	18
st544000	report last command		5	4	64	0
st549200	report context table hepi		5	4	146	0
st549240	report context table picsit		5	4	146	64
st549280	report context table veto		5	4	146	128
st5492C1	report context table isgri mc5		5	4	146	193
st5492C2	report context table isgri mc1		5	4	146	194
st5492D2	report context table isgri mc3		5	4	146	210
st5492D3	report context table isgri mc7		5	4	146	211
st5492E1	report context table isgri mc6		5	4	146	225
st5492E2	report context table isgri mc2		5	4	146	226
st5492F1	report context table isgri mc8		5	4	146	241
st5492F2	report context table isgri mc4		5	4	146	242
st549300	report CRC of context table hepi		5	4	147	0
st549340	report CRC of context table picsit		5	4	147	64
st549380	report CRC of context table veto		5	4	147	128
st5493C1	report CRC of context table isgri mc5		5	4	147	193
st5493C2	report CRC of context table isgri mc1		5	4	147	194
st5493D2	report CRC of context table isgri mc3		5	4	147	210
st5493D3	report CRC of context table isgri mc7		5	4	147	211
st5493E1	report CRC of context table isgri mc6		5	4	147	225
st5493E2	report CRC of context table isgri mc2		5	4	147	226
st5493F1	report CRC of context table isgri mc8		5	4	147	241

Name	Description	APID	Type (DEC)	Subtype (DEC)	TID (DEC)	FID (DEC)
st5493F2	report CRC of context table isgri mc4		5	4	147	242
st54C004	HEPI status register		5	4	192	4
st54C00A	HEPI LUT content		5	4	192	10
st54C06F	HEPI Register content		5	4	192	111
st54C075	HEPI Data Register type II		5	4	192	117
st54C076	HEPI HK data block		5	4	192	118
st54D000	report hepi register type II		5	4	208	0
st54D001	report hepi status register on DPE		5	4	208	1
st91	TM packet generation status report		9	1		

Table 21: TM packets generated by IASW in VC0

Name	Description	APID	Type (DEC)	Subtype (DEC)
tms4410	S1: CdTe PPM	1348	1	0
tms4820	S2: CdTe Cal	1352	2	0
tms4C30	S3.0 : Compton single (and Calibration)	1356	3	0
tms4D31	S3.1 : Compton multiple	1357	3	1
tms5040	S4.0: CsI PPM single	1360	4	0
tms5141	S4.1: CsI PPM multiple	1361	4	1
tms5450	S5: CsI calibration histogram	1364	5	0
tms5860	S6: CsI Polarimetry histogram	1368	6	0
tms5C70	S7.0: CsI Histogram single	1372	7	0
tms5D71	S7.1: CsI Histogram multiple histogram	1373	7	1
tms6080	S8: CsI Spectral timing histogram	1376	8	0
tms0DD1	S13.1: CdTe raw data	1397	13	1
tms0DD2	S13.2: CsI raw data	1398	13	2
tms0DD3	S13.3: Transparent	1399	13	3

Table 22: TM packets generated by IASW in VC1

6.2 TM Threshold

Science TM packet types are using individual lower and upper thresholds for TM packet controlling. This is also valid for TM(5,4) with task ID 32 and 146 (dump of table) .
TM handling between IASW and CSSW stops for the specific type after exceeding the upper threshold. Also processing of the according science data is stopped. This gives more CPU power for the processing of the other event. So it is possible to control with the TM threshold the priority of the science functions.

The TM thresholds could be set by a dedicated TC. The value of the high TM threshold of a specific type should not exceed 48 events for any type.
If the TM buffer is read out by the CSSW under a specific threshold IASW starts handling of the specific TM packets to the CSSW again.
The deleted events are counted and this value is down linked in a special HK packet (H2)
This causes a very dynamic behaviour of the IASW data processing. A upper or lower threshold could be exceeded a lot of times per second. This depends on the available data rate and the chosen thresholds. To avoid a overflow of the on event message buffer, only at switch on of the specific function, an additional IASW HK is transmitted (except histogram packages, see below). This contains the total number of killed events from one type. Within the current TM package of this type the event time of the last event before interruption and the time of the first event after interruption are stored (part of the standard information). Also a dummy is inserted in the TM packet to indicate the interruption.

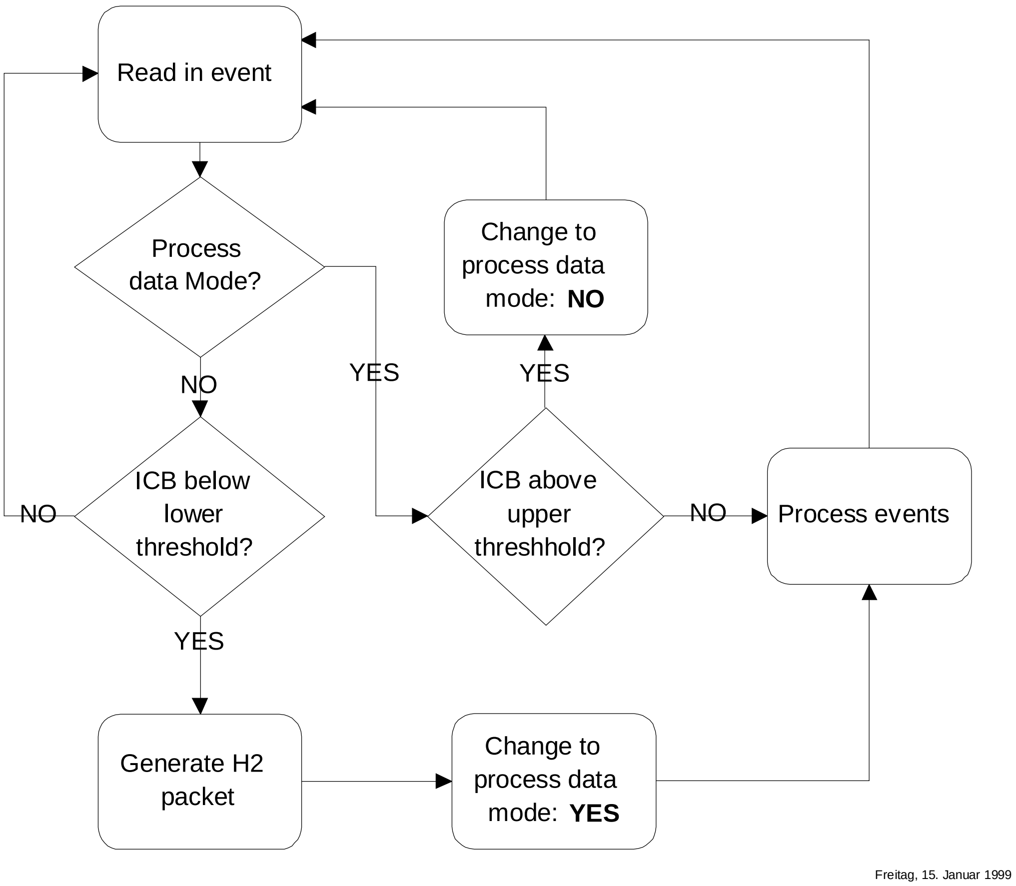

Figure 5: Processing of S1, S2, S3, S4, S8, S13 event types

Histogram data are packed in any case in TM packages. They are written into the TM buffer, if the specific upper threshold of this type is not exceed. If it is exceeded, each RTC (at most

10 times) the histogram function asked again about sending the TM. If the lower threshold not reached during this time the TM package will be deleted. and an on event message is sent and processing of a new Histogram data block starts.

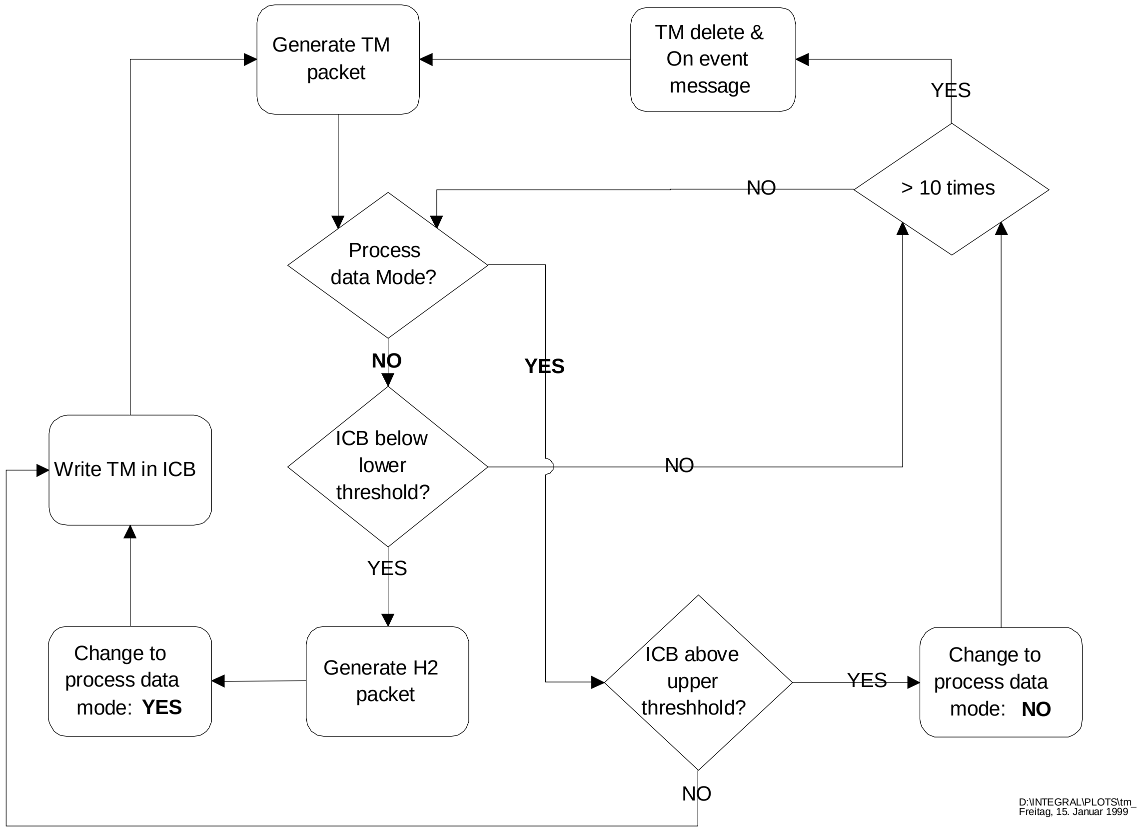

Figure 6: Processing of S5, S6, S7 TM packet types

According the scientific requirements it is possible to define tables with APID, priority, lower threshold and upper threshold of all TM packet types with a specific TC from ground.

The sending of TM(5,4) with task ID 32 and 146 is similar to the histogram types. Only the number of times for repetition of asking to send is 480 (about one minute) for the total dump.

All other TM are send to ground if the ICB is filled with less than 50 TM packets. If the buffer is completely filled, the TM will be deleted (except H1) and an on event message generated.

Warning: in the special case of CSSW dump data and a low available TM rate (< 68 TM / 8sec) a H2-4 could be lost. The CSSW will fill up the TM buffer completely and no space is left for housekeeping (only H2 to H4). This generates an OEM.

In Table 23 the behaviour of each TM type is summarised:

TM Type	Upper threshold	Lower threshold	TM Buffer filled

TM Type	Upper threshold	Lower threshold	TM Buffer filled
H1	not defined, will be transmitted in any case by CSSW		n/a
H2 - H4	ignored	Ignored	generate OEM
TM (5,4)	ignored	Ignored	generate OEM
TM (5,4) (Table dump)	Retry one minute to send TM, if not successful delete TM and generate OEM	Send TM when reaching threshold after less then one minute	generate OEM (only if upper threshold is >50)
S1 to S4, S8, S13	Stop processing of specific data type	Start processing of specific data type. Generation of H2 packet, marker in TM packet with start time.	generate OEM (only if upper threshold is >50)
S5 to S7	Retry eight times to send TM packet, if not successful, delete TM and generate OEM	Send TM when reaching threshold after less then 1,25 sec	generate OEM (only if upper threshold is >50)

Table 23: TM threshold behaviour of different TM types

6.3 Priority

To each TM type and subtype (except APID 1280 and 1408) a priority (low, medium, high) is assigned.
The Standard Periodic HK (APID 1280 or 1408) will be transmitted with the highest priority.
By default VC 0 APIDs will gets a high priority, the VC 1 a medium priority.
The CSSW gets first TM packets out of the ICB with the highest priority.
The priority of each type and subtype could be changed by TM.

6.4 Application Process Identifier (APID)

The IASW are able to generate TM packets according following Table 24.

Packet header APID			Data field header				Description of Packet type
Source ID	VC	Format ID	Type	Sub Type	Spare	Time	
bit 0 - bit 3	bit 4	bit 5 - bit 10	bit 0 - bit 3	bit 4 - bit 7	bit 8 - bit 15	bit 16 - bit 32	
					not used set to 0000 0000	OBT inserted	
		all other bit combinations are reserved	repetition of APID bit 7 - bit 10				

Packet header APID			Data field header				Description of Packet type
Source ID	VC	Format ID	Type	Sub Type	Spare	Time	
bit 0 - bit 3	bit 4	bit 5 - bit 10	bit 0 - bit 3	bit 4 - bit 7	bit 8 - bit 15	bit 16 - bit 32	
					not used set to 0000 0000	OBT inserted	
		00 0000	0001	1000		by CSSW	VC 0: Periodic (or CSSW) HK
1010 : IBIS		00 0001	0001	up to 16		by IASW	VC0: IASW Housekeeping
nominal	0	00 0101	0101	Different		by IASW	VC0: On-request - Task Management
		00 0110	0110	Subtypes		by IASW	VC0: On-request - Memory Dump
1011 : IBIS		00 1000	1000			by IASW	VC0: On-request - Monitoring
redundant		00 1001	1001			by IASW	VC0: On-request - TLM Management
		00 1101	1101			by IASW	VC0: On-request - Diagnostic
			repetition of APID bit 5 - bit 8	repetition of APID bit 8 - bit 10 with two leading "0"			
		00 0000	0000	0000		by IASW	VC 1: Science Packet type (0,0)
		00 0001	0000	0001		by IASW	VC 1: Science Packet type (0,1)
	1	to					
		11 1110	1111	0010		by IASW	VC 1: Science Packet type (15,2)
		11 1111	1111	0011		by IASW	VC 1: Science Packet type (15,3)

Table 24: APID Allocation for IBIS TM Packets

6.5 HK and other TM in VC 0

The general structure of TM packets in VC0 is according RD 5. An overview is given in Table 25.

Field Name	Field Dimension
Packet Header	6 bytes
Data Field Header	4 bytes
Data Field	428 bytes
CRC	2 bytes

Table 25: Standard TM packet format

6.5.1 IASW HK data field (H1)

The IASW HK data field is part of the CSSW HK data (APID 1280 or 1408, type (1,8)). It is sub divided in five parts: ISGRI, PICSIT, VETO, HEPI and IASW.
The instruments gets the following amount of bytes for their essential HK data:

ISGRI: 80 byte
PICSIT: 88 byte
VETO: 38 byte
HEPI: 28 byte
IASW: 56 byte
Total: 290 byte

The definition of the data fields of the HEPI and IASW part is shown in Table 26. Initialisation values of HEPI (H) and IASW are shown in the last column. Also useful default (D) values are mentioned, if they are different from the initialisation values.

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
0	0	640	n/a	ISGRI part of H1			
80	0	704	n/a	PICSIT part of H1			
168	0	304	n/a	VETO part of H1			
206	0	1	H1S-CDTEHBR	CdTe HBR I/F detector - HEPI	log	0=ON,1=OFF	H: 0
206	1	1	H1S-CSIHBR	CsI HBR I/F detector - HEPI	log	0=ON,1=OFF	H: 0
206	2	1	H1S-AC	Amplitude correction	log	0=OFF,1=ON	H: 0
206	3	1	H1S-RM	Rate meters	log	0=OFF,1=ON	H: 0
206	4	1	H1S-MP	Multiple event reconstruction	log	0=OFF,1=ON	H: 0
206	5	1	n/a	Spare	n/a	n/a	n/a
206	6	1	H1S-SPT	CsI spectral timing	log	0=OFF,1=ON	H: 0
206	7	1	H1S-ES	Energy selection+PPM	log	0=OFF,1=ON	H: 0
207	0	1	n/a	Spare	n/a	n/a	n/a
207	1	1	H1S-HISTCAL	CsI Calibration event histogram	log	0=OFF,1=ON	H: 0
207	2	1	H1S-HISTCSI	CsI single/multiple event histogram	log	0=OFF,1=ON	H: 0
207	3	1	n/a	Spare	n/a	n/a	n/a
207	4	1	H1S-HISTPOL	Polarimetry histogram	log	0=OFF,1=ON	H: 0
207	5	1	H1S-TC	Time coincidence	log	0=OFF,1=ON	H: 0
207	6	1	n/a	Spare	n/a	n/a	n/a
207	7	1	n/a	Spare	n/a	n/a	n/a
208	0	1	H1S-CDTEPPM	CdTe PPM	log	0=OFF,1=ON	H: 0
208	1	1	n/a	Spare	n/a	n/a	n/a
208	2	1	H1S-MEMCSI	CsI sing./mult. histogram Memory Area	log	0=OFF,1=ON	H: 0
208	3	1	H1S-MEMCAL	CsI cal. histogram Memory Area	log	0=OFF,1=ON	H: 0
208	4	1	n/a	Spare	n/a	n/a	n/a
208	5	1	n/a	Spare	n/a	n/a	n/a
208	6	1	n/a	Spare	n/a	n/a	n/a
208	7	1	n/a	Spare	n/a	n/a	n/a
209	0	32	H1S-CSI_DET_EV	Counter of CsI events from detector	int	e.v.=r.v.	H: 0
213	0	32	H1S-CDTE_DET_EV	Counter of CdTe events from detector	int	e.v.=r.v.	H: 0
217	0	16	H1S-CSI_EV_10MEV	Counter of CsI events > 10 MeV	int	e.v.=r.v.	H: 0
219	0	24	H1S-CDTE_PRD	Counter of CdTe time periods	int	e.v.=r.v.	H: 0
222	0	24	H1S-CSI_PRD	Counter of CsI time periods	int	e.v.=r.v.	H: 0

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
225	0	8	H1E-COM_EX	Counter of executed commands	int	e.v.=r.v.	H: 0
226	0	8	H1E-COM_REQ	Counter of request commands	int	e.v.=r.v.	H: 0
227	0	8	H1E-COM_REJ	Counter of rejected commands	int	e.v.=r.v.	H: 0
228	0	8	H1E-COM_LAST	Last received command	n/a	e.v.=r.v.	H: 0
229	0	1	n/a	Spare	n/a	n/a	n/a
229	1	1	H1E-ER_CSIRM	Ratemeters overflow	log	0=no overflow,1= overflow	H: 0
229	2	1	H1E-ER_CSIHIST	Error overflow histogram	log	0=no overflow,1= overflow	H: 0
229	3	1	H1E-ER_CSISPT	Spectral timing error	log	0=no overflow,1= overflow	H: 0
229	4	1	H1E-ER_CSIPRD	Overflow counter of CsI time period	log	0=no overflow,1= overflow	H: 0
229	5	1	H1E-ER_10MEV	Overflow counter of CsI events > 10 MeV	log	0=no overflow,1= overflow	H: 0
229	6	1	H1E-ER_CDTEHBR	Overflow counter of CdTe events from detector	log	0=no overflow,1= overflow	H: 0
229	7	1	H1E-ER_CSIHBR	Overflow counter of CsI events from detector	log	0=no overflow,1= overflow	H: 0
230	0	32	n/a	Spare	n/a	n/a	n/a
234	0	1	S1E-ECR_I1	Electrical configuration ISGRI MCE 0	log	Instrument off : 0, On : 1	I: 0
234	1	1	S1E-ECR_I2	Electrical configuration ISGRI MCE 1	log	Instrument off : 0, On : 1	I: 0
234	2	1	S1E-ECR_I3	Electrical configuration ISGRI MCE 2	log	Instrument off : 0, On : 1	I: 0
234	3	1	S1E-ECR_I4	Electrical configuration ISGRI MCE 3	log	Instrument off : 0, On : 1	I: 0
234	4	1	S1E-ECR_I5	Electrical configuration ISGRI MCE 4	log	Instrument off : 0, On : 1	I: 0
234	5	1	S1E-ECR_I6	Electrical configuration ISGRI MCE 5	log	Instrument off : 0, On : 1	I: 0
234	6	1	S1E-ECR_I7	Electrical configuration ISGRI MCE 6	log	Instrument off : 0, On : 1	I: 0
234	7	1	S1E-ECR_I8	Electrical configuration ISGRI MCE 7	log	Instrument off : 0, On : 1	I: 0
235	0	1	S1E-ECR_P	PICSIT electrical configuration	log	Instrument off : 0, On : 1	I: 0
235	1	1	S1E-ECR_V	VETO electrical configuration	log	Instrument off : 0, On : 1	I: 0
235	2	6		Spare	n/a	n/a	n/a
236	0	8	S1E-A3_5V_P	Analogue channel 3#TBD for PICSIT +5V	V	TBD	n/a
237	0	1	S1E-A5_BI_P	Watchdog status PICSIT (bi-level channel 5)	log	TBD	n/a
237	1	1	S1E-A4_BI_V	Watchdog status VEB set by IASW (bi-level channel 4)	log	TBD	n/a
237	2	6	n/a	Spare	n/a	n/a	n/a
238	0	8	S1E-A0_VECU1_V	5 V VECU1 set by IASW	V	TBD	n/a
239	0	8	S1E-A1_VECU2_V	5 V VECU2 set by IASW	V	TBD	n/a
240	0	8	S1E-A2_PMT_V	28 V PMT set by IASW	V	TBD	n/a
241	0	8		Spare	n/a	n/a	n/a

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
242	0	8		Spare	n/a	n/a	n/a
243	0	8		Spare	n/a	n/a	n/a
244	0	8		Spare	n/a	n/a	n/a
245	0	4	S1E-IASW_MODE	Current Mode	n/a	Mode 0: Standby, Mode 1: Patch&Dump, Mode 2: Diagnostic, Mode 3: Science PPM, Mode 4: Science Standard, Mode 5: Science Polarimetry	I: 0
245	4	3		Spare	n/a	n/a	n/a
245	7	1	S1E-IASW_PS	Current setting of POINT-SLEW	n/a	0 : pointing; 1 : slew	I: 1
246	0	1	S1E-SF_D1	CdTe Diagnostic TM	log	0 : Disabled 1 : Enabled	I: 1
246	1	1	S1E-SF_D2	CsI Diagnostic TM	log	0 : Disabled 1 : Enabled	I: 1
246	2	1	S1E-SF_D3	Transparent Diagnostic TM	log	0 : Disabled 1 : Enabled	I: 1
246	3	5	n/a	Spare	n/a	n/a	I:
247	0	1	S1E-SF_S1	CdTe PPM (S1)	log	0 : Disabled, 1 : Enabled	I: 0
247	1	1	S1E-SF_S2	CdTe Calibration (S2)	log	0 : Disabled, 1 : Enabled	I: 0
247	2	1	S1E-SF_S3	Compton (S3)	log	0 : Disabled, 1 : Enabled	I: 0
247	3	1	S1E-SF_S4	CsI PPM (S4)	log	0 : Disabled, 1 : Enabled	I: 0
247	4	1	S1E-SF_S5	CsI Calibration (S5)	log	0 : Disabled, 1 : Enabled	I: 0
247	5	1	S1E-SF_S6	CsI Polarimetry (S6)	log	0 : Disabled, 1 : Enabled	I: 0
247	6	1	S1E-SF_S7	Spectral Imaging (S7)	log	0 : Disabled, 1 : Enabled	I: 0
247	7	1	S1E-SF_S8	Spectral Timing (S8)	log	0 : Disabled, 1 : Enabled	I: 0
248	0	1	S1E-SF_S9	Veto Spectra (S9)	log	(Not used)	
248	1	1	S1E-SF_I	ISGRI ON (part of science function)	log	0 : Disabled, 1 : Enabled	I: 0
248	2	1	S1E-SF_P	PICSIT ON (part of science function)	log	0 : Disabled, 1 : Enabled	I: 0
248	3	1	S1E-SF_COM	Compton ON (part of science function)	log	0 : Disabled, 1 : Enabled	I: 0
248	4	4	n/a	Spare	n/a	n/a	
249	0	1	S1E-SV_CTX_H	HEPI context saving (not used)	n/a	n/a	
249	1	1	S1E-SV_CTX_P	PICSIT context saving	log	0 : failed; 1 : succeeded	I: 0
249	2	1	S1E-SV_CTX_V	VETO context saving	log	0 : failed; 1 : succeeded	I: 0
249	3	1	S1E-SV_CTX_I1	Context saving ISGRI MCE 0	log	0 : failed; 1 : succeeded	I: 0
249	4	1	S1E-SV_CTX_I2	Context saving ISGRI MCE 1	log	0 : failed; 1 : succeeded	I: 0
249	5	1	S1E-SV_CTX_I3	Context saving ISGRI MCE 2	log	0 : failed; 1 : succeeded	I: 0

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
249	6	1	S1E-SV_CTX_I4	Context saving ISGRI MCE 3	log	0 : failed; 1 : succeeded	I: 0
249	7	1	S1E-SV_CTX_I5	Context saving ISGRI MCE 4	log	0 : failed; 1 : succeeded	I: 0
250	0	1	S1E-SV_CTX_I6	Context saving ISGRI MCE 5	log	0 : failed; 1 : succeeded	I: 0
250	1	1	S1E-SV_CTX_I7	Context saving ISGRI MCE 6	log	0 : failed; 1 : succeeded	I: 0
250	2	1	S1E-SV_CTX_I8	Context saving ISGRI MCE 7	log	0 : failed; 1 : succeeded	I: 0
250	3	5	n/a	Spare	n/a	n/a	
251	0	1	S1E-RS_CTX_H	HEPI context restoring (not used)	log	n/a	
251	1	1	S1E-RS_CTX_P	PICSIT context restoring	log	0 : failed; 1 : succeeded	I: 0
251	2	1	S1E-RS_CTX_V	VETO context restoring	log	0 : failed; 1 : succeeded	I: 0
251	3	1	S1E-RS_CTX_I1	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
251	4	1	S1E-RS_CTX_I2	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
251	5	1	S1E-RS_CTX_I3	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
251	6	1	S1E-RS_CTX_I4	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
251	7	1	S1E-RS_CTX_I5	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
252	0	1	S1E-RS_CTX_I6	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
252	1	1	S1E-RS_CTX_I7	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
252	2	1	S1E-RS_CTX_I8	ISGRI MCE 0..7 context restoring	log	0 : failed; 1 : succeeded	I: 0
252	3	5	n/a	Spare	n/a	n/a	
253	0	1	S1E-AUT_PT_SL	Automatism status: Regard Point/Slew changing	log	Disabled : 0 Enabled : 1	I: 1
253	1	1	S1E-AUT_ECL	Automatism status: Eclipse switch	log	Disabled : 0 Enabled : 1	I: 1
253	2	1	S1E-AUT_RB	Automatism status: Radiation Belt switch	log	Disabled : 0 Enabled : 1	I: 1
253	3	1	S1E-AUT_NP	Automatism status: PICSIT Noisy pixel	log	Disabled : 0 Enabled : 1	I: 1
253	4	1	S1E-AUT_EM	Automatism status: Emergency	log	Disabled : 0 Enabled : 1	I: 1
253	5	1	S1E-AUT_HS	Automatism status: Resynchronize HEPI	log	Disabled : 0 Enabled : 1	I: 1
253	6	1	S1E-AUT_RM	Automatism status: Ratemeter consideration for auto switch off	log	Disabled : 0 Enabled : 1	I: 1
253	7	1	n/a	Spare	n/a	n/a	
254	0	32	S1E-S_TMP_CTR	Sended TM counter: Total number of successfully sent TM packets	n/a	n/a	I: 0
258	0	32	S1E-L_TMP_CTR	Lost TM counter	n/a	n/a	I: 0
262	0	1	S1E-TMF_UD	TM in-threshold-flag for TM "UNDEFINED"	log	0: TM will be lost 1: TM will be sent	I: 1
262	1	1	S1E-TMF_S1	TM in-threshold-flag for TM "CDTE SINGLE"	log	0: TM will be lost	I: 1

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
				"CDTE_SINGLE"		1: TM will be sent	
262	2	1	S1E-TMF_S2	TM in-threshold-flag for TM "CDTE_CALIBRATION"	log	0: TM will be lost 1: TM will be sent	I: 1
262	3	1	S1E-TMF_D1	TM in-threshold-flag for TM "CDTE_DIAGNOSTIC"	log	0: TM will be lost 1: TM will be sent	I: 1
262	4	1	S1E-TMF_S4A	TM in-threshold-flag for TM "CSI SINGLE"	log	0: TM will be lost 1: TM will be sent	I: 1
262	5	1	S1E-TMF_S4B	TM in-threshold-flag for TM "CSI_MULTIPLE"	log	0: TM will be lost 1: TM will be sent	I: 1
262	6	1	S1E-TMF_D2	TM in-threshold-flag for TM "CSI_DIAGNOSTIC"	log	0: TM will be lost 1: TM will be sent	I: 1
262	7	1	S1E-TMF_S3A	TM in-threshold-flag for TM "COMPTON_SINGLE"	log	0: TM will be lost 1: TM will be sent	I: 1
263	0	1	S1E-TMF_S3B	TM in-threshold-flag for TM "COMPTON_MULTIPLE"	log	0: TM will be lost 1: TM will be sent	I: 1
263	1	1	S1E-TMF_S8	TM in-threshold-flag for TM "SPECTRAL_TIMING"	log	0: TM will be lost 1: TM will be sent	I: 1
263	2	1	S1E-TMF_D3	TM in-threshold-flag for TM "TRANSPARENT"	log	0: TM will be lost 1: TM will be sent	I: 1
263	3	1	S1E-TMF_S6	TM in-threshold-flag for TM "HISTOGRAM POLARIMETRY"	log	0: TM will be lost 1: TM will be sent	I: 1
263	4	1	S1E-TMF_S7A	TM in-threshold-flag for TM "HISTOGRRAM CSI SINGLE"	log	0: TM will be lost 1: TM will be sent	I: 1
263	5	1	S1E-TMF_S7B	TM in-threshold-flag for TM "HISTOGRAM CSI MULTIPLE"	log	0: TM will be lost 1: TM will be sent	I: 1
263	6	1	S1E-TMF_S5	TM in-threshold-flag for TM "HISTOGRAM CSI CALIBRATION"	log	0: TM will be lost 1: TM will be sent	I: 1
263	7	1	S1E-TMF_H2	TM in-threshold-flag for TM "HK SCIENCE"	log	0: TM will be lost 1: TM will be sent	I: 1
264	0	1	S1E-TMF_H3	TM in-threshold-flag for TM "HK PICSIT ISGRI"	log	0: TM will be lost 1: TM will be sent	I: 1
264	1	1	S1E-TMF_H4	TM in-threshold-flag for TM "HK VETO"	log	0: TM will be lost 1: TM will be sent	I: 1
264	2	1	S1E-TMF_RT	TM in-threshold-flag for TM "REPORT TASK"	log	0: TM will be lost 1: TM will be sent	I: 1
264	3	1	S1E-TMF_RS	TM in-threshold-flag for TM "REPORT TELEMETRY STATUS"	log	0: TM will be lost 1: TM will be sent	I: 1
264	4	12	n/a	Spare	n/a	n/a	
266	0	32	n/a	Spare	n/a	n/a	
270	0	16	n/a	Spare	n/a	n/a	
272	0	1	S1E-HIST-I-S7S-0	CsI single buffer, toggle 0 used for integration	log	0: Currently not integrating into CsI single, Toggle=0 buffer 1: Currently integrating into buffer	I: 0
272	1	1	S1E-HIST-I-S7M-0	CsI multiple buffer, toggle 0 used for integration	log	0: Currently not integrating into CsI multiple, Toggle=0 buffer 1: Currently integrating into	I: 0

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
						buffer	
272	2	1	S1E-HIST-I-S6-0	Polarimetry buffer, toggle 0 used for integration	log	0: Currently not integrating into polarimetry, Toggle=0 buffer 1: Currently integrating into buffer	I: 0
272	3	1	S1E-HIST-I-S5-0	CsI calibration buffer, toggle 0 used for integration	log	0: Currently not integrating into CsI calibration, Toggle=0 buffer 1: Currently integrating into buffer	I: 0
272	4	1	S1E-HIST-I-S7S-1	CsI single buffer, toggle 1 used for integration	log	0: Currently not integrating into CsI single, Toggle=1 buffer 1: Currently integrating into buffer	I: 0
272	5	1	S1E-HIST-I-S7M-1	CsI multiple buffer, toggle 1 used for integration	log	0: Currently not integrating into CsI multiple, Toggle=1 buffer 1: Currently integrating into buffer	I: 0
272	6	1	S1E-HIST-I-S6-1	Polarimetry buffer, toggle 1 used for integration	log	0: Currently not integrating into polarimetry, Toggle=1 buffer 1: Currently integrating into buffer	I: 0
272	7	1	S1E-HIST-I-S5-1	CsI calibration buffer, toggle 1 used for integration	log	0: Currently not integrating into CsI calibration, Toggle=1 buffer 1: Currently integrating into buffer	I: 0
273	0	1	S1E-HIST-F-S7S-0	CsI single buffer, toggle 0 is filled	log	0: CsI single, Toggle=0 buffer is not filled for reading 1: buffer is filled	I: 0
273	1	1	S1E-HIST-F-S7M-0	CsI multiple buffer, toggle 0 is filled	log	0: CsI multiple, Toggle=0 buffer is not filled for reading 1: buffer is filled	I: 0
273	2	1	S1E-HIST-F-S6-0	Polarimetry buffer, toggle 0 is filled	log	0: polarimetry, Toggle=0 buffer is not filled for reading	I: 0

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
						1: buffer is filled	
273	3	1	S1E-HIST-F-S5-0	CsI calibration buffer, toggle 0 is filled	log	0: CsI calibration, Toggle=0 buffer is not filled for reading 1: buffer is filled	I: 0
273	4	1	S1E-HIST-F-S7S-1	CsI single buffer, toggle 1 is filled	log	0: CsI single, Toggle=1 buffer is not filled for reading 1: buffer is filled	I: 0
273	5	1	S1E-HIST-F-S7M-1	CsI multiple buffer, toggle 1 is filled	log	0: CsI multiple, Toggle=1 buffer is not filled for reading 1: buffer is filled	I: 0
273	6	1	S1E-HIST-F-S6-1	Polarimetry buffer, toggle 1 is filled	log	0: polarimetry, Toggle=1 buffer is not filled for reading 1: buffer is filled	I: 0
273	7	1	S1E-HIST-F-S5-1	CsI calibration buffer, toggle 1 is filled	log	0: CsI calibration, Toggle=1 buffer is not filled for reading 1: buffer is filled	I: 0
274	0	1	S1E-HIST-R-S7S-0	CsI single buffer, toggle 0 is read out	log	0: Currently not reading from CsI single, Toggle=0 buffer 1: Currently reading out buffer	I: 0
274	1	1	S1E-HIST-R-S7M-0	CsI multiple buffer, toggle 0 is read out	log	0: Currently not reading from CsI multiple, Toggle=0 buffer 1: Currently reading out buffer	I: 0
274	2	1	S1E-HIST-R-S6-0	Polarimetry buffer, toggle 0 is read out	log	0: Currently not reading from polarimetry, Toggle=0 buffer 1: Currently reading out buffer	I: 0
274	3	1	S1E-HIST-R-S5-0	CsI calibration buffer, toggle 0 is read out	log	0: Currently not reading from CsI calibration, Toggle=0 buffer 1: Currently reading out buffer	I: 0
274	4	1	S1E-HIST-R-S7S-1	CsI single buffer, toggle 1 is read out	log	0: Currently not reading from CsI single, Toggle=1 buffer 1: Currently reading out buffer	I: 0
274	5	1	S1E-HIST-R-S7M-1	CsI multiple buffer, toggle 1 is read out	log	0: Currently not reading from CsI multiple, Toggle=1	I: 0

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value (H: by HEPI I: by IASW)
						buffer 1: Currently reading out buffer	
274	6	1	S1E-HIST-R-S6-1	Polarimetry buffer, toggle 1 is read out	log	0: Currently not reading from polarimetry, Toggle=1 buffer 1: Currently reading out buffer	I: 0
274	7	1	S1E-HIST-R-S5-1	CsI calibration buffer, toggle 1 is read out	log	0: Currently not reading from CsI calibration, Toggle=1 buffer 1: Currently reading out buffer	I: 0
275	0	16	S1E-VS_HBRA-RT	Valid event rate on HBR A	n/a	n/a	I: 0
277	0	16	S1E-US_HBRA-RT	Undefined event rate on HBR A	n/a	n/a	I: 0
279	0	16	S1E-VS_HBRB-RT	HBR B data block rate	n/a	n/a	I: 0
281	0	1	S1E-OEM_OV_F	Overflow on event flag	log	0 : no on event overflow occurred, 1 : on event overflow occurred	I: 0
281	1	15	S1E-OEM_CTR	On event message counter	n/a	n/a	I: 0
283	0	8	S1E-OB_CTR_H	On-board TC sequence counter : HEPI	n/a	n/a	I: 0
284	0	8	S1E-OB_CTR_I	On-board TC sequence counter : ISGRI	n/a	n/a	I: 0
285	0	8	S1E-OB_CTR_P	On-board TC sequence counter : PICSIT	n/a	n/a	I: 0
286	0	8	S1E-OB_CTR_V	On-board TC sequence counter : VETO	n/a	n/a	I: 0
287	0	8	S1E-LST_SUB_ID	Sub Instrument Id of last on board command	n/a	n/a	I: 0
288	0	8	S1E-EX_TC_CTR	Accepted and executed TC Counter	n/a	n/a	I: 0
289	0	8	S1E-RE_TC_CTR	Rejected TC Counter	n/a	n/a	I: 0

Table 26: IASW periodic HK data block

6.5.2 Structure of IASW additional HK (H2)

The structure of the IASW additional HK H2 is given in Table 27.

Offset bytes	start bit	width [bits]	para acronym	para description	units	alias cal curve	Initialisation value
0	0	4	n/a	TM packet type	n/a	n/a	1
0	4	4	n/a	TM packet subtype	n/a	n/a	1
1	0	8	n/a	Spare	n/a	n/a	0
2	0	16	n/a	Packet creation time	sec	n/a	
4	0	16	n/a	Constant	n/a	n/a	FFFF
6	0	16	n/a	Constant	n/a	n/a	FFFF

8	0	16	n/a	Reason for the packet	n/a	0=Start Mode, 1=Stop Mode, 2=Start Histogram, 3=Stop Histogram, 4=Pointing, 5=Slew, 6=On Request, 7=Restart Processing, 8=Resynchronisatio n	
10	0	48	S1E-LST_SYN_TM	Last synchronisation time	sec	/32 * 2exp-19	
16	0	48	S1E-LST_SL_TM	Time of last slew start	sec	/32 * 2exp-19	
22	0	48	S1E-LST_PT_TM	Time of last pointing start	sec	/32 * 2exp-19	
28	0	16	S1E-PID_REV_NO	Pointing ID - revolution number	n/a	n/a	
30	0	16	S1E-PID_PT_NO	Pointing ID – pointing number	n/a	n/a	
32	0	16	n/a	Constant	n/a	n/a	FFFF
34	0	48	S1E-OBT	On board time	n/a	n/a	
40	0	16	n/a	Constant	n/a	n/a	FFFF
42	0	16	S1E-EVENT_SORT	Event sort	n/a	0=undefined event, 1=S1, 2=S2, 3=D1, 4=S4s, 5=S4m, 6=D2, 7=S3s, 8=S3m, 9=S8, 10=D3, 11=S6, 12=S7s, 13=S7m, 14=S5, 15=H2, 16=H3, 17=H4, 18=Report Task, 19=Report TLM	
44	0	16	n/a	Constant	n/a	n/a	FFFF
46	0	32	S1E-S_TMP_CTR	Sended TM packet counter (total)	count s	n/a	I: 0
50	0	32	S1E-L_TMP_CTR	Lost TM packet counter (total)	count s	n/a	I: 0
54	0	16	n/a	Constant	n/a	n/a	FFFF
56	0	16	n/a	Used ICB TM Packet Buffer	n/a	n/a	
58	0	16	n/a	Constant	n/a	n/a	CCCC
60	0	16	n/a	Constant	n/a	n/a	CCCC
62	0	16	n/a	Constant	n/a	n/a	CCCC
64	0	16	n/a	Constant	n/a	n/a	CCCC
66	0	16	n/a	Constant	n/a	n/a	CCCC
68	0	16	n/a	Constant	n/a	n/a	CCCC
70	0	16	n/a	Constant	n/a	n/a	CCCC

72	0	16	n/a	Constant	n/a	n/a	CCCC
74	0	16	S1E-SEQCTR_S1	Sequence Counter of S1 TM Packet (total)	counts	n/a	I: 0
76	0	16	S1E-SEQCTR_S2	Sequence Counter of S2 TM Packet (total)	counts	n/a	I: 0
78	0	16	S1E-SEQCTR_S3S	Sequence Counter of S3_Single TM Packets (total)	counts	n/a	I: 0
80	0	16	S1E-SEQCTR_S3M	Sequence Counter of S3_Multiple TM Packet (total)	counts	n/a	I: 0
82	0	16	S1E-SEQCTR_S4S	Sequence Counter of S4_Single TM Packet (total)	counts	n/a	I: 0
84	0	16	S1E-SEQCTR_S4M	Sequence Counter of S4_Multiple TM Packet (total)	counts	n/a	I: 0
86	0	16	S1E-SEQCTR_S8	Sequence Counter of S8 TM Packet (total)	counts	n/a	I: 0
88	0	16	n/a	Constant	n/a	n/a	FFFF
90	0	16	S1E-SEQCTR_D1	Sequence Counter of Diag_CdTe TM Packet (total)	counts	n/a	I: 0
92	0	16	S1E-SEQCTR_D2	Sequence Counter of Diag_CsI TM Packet (total)	counts	n/a	I: 0
94	0	16	S1E-SEQCTR_D3	Sequence Counter of Transparent TM Packet (total)	counts	n/a	I: 0
96	0	16	n/a	Constant	n/a	n/a	FFFF
98	0	16	S1E-SEQCTR_AHK	Sequence Counter of Additional Housekeeping TM Packets (total)	counts	n/a	I: 0
100	0	16	S1E-SEQCTR_RT	Sequence Counter of Report Task TM Packets (total)	counts	n/a	I: 0
102	0	16	S1E-SEQCTR_RTLM	Sequence Counter of Diagnostic Telemetry Status TM Packets (total)	counts	n/a	I: 0
104	0	16	n/a	Constant	n/a	n/a	FFFF
106	0	16	n/a	Constant	n/a	n/a	AAAA
108	0	16	n/a	Constant	n/a	n/a	AAAA
110	0	16	n/a	Constant	n/a	n/a	AAAA
112	0	16	n/a	Constant	n/a	n/a	AAAA
114	0	16	n/a	Constant	n/a	n/a	AAAA
116	0	16	n/a	Constant	n/a	n/a	AAAA
118	0	16	n/a	Constant	n/a	n/a	AAAA
120	0	16	n/a	Constant	n/a	n/a	AAAA
122	0	32	S1D-VS_HBRA_RT	Event counter of science mode (0 on start of science mode)	counts	n/a	I: 0
126	0	16	n/a	Constant	n/a	n/a	FFFF
128	0	32	S1D-US_HBRA_RT	Undefined event counter (0 on start of science mode)	counts	n/a	I: 0
132	0	16	n/a	Constant	n/a	n/a	FFFF
134	0	16	n/a	Constant	n/a	n/a	FFFF
136	0	16	n/a	Constant	n/a	n/a	FFFF
138	0	32	S1E-P_S1_CTR	Counter of processed S1 events (0 on start of science mode)	counts	n/a	I: 0
142	0	32	S1E-K_S1_CTR	Counter of killed S1 events (0 on start of science mode)	counts	n/a	I: 0

146	0	32	S1E-P_S2_CTR	Counter of processed S2 events (0 on start of science mode)	counts	n/a	I: 0
150	0	32	S1E-K_S2_CTR	Counter of killed S2 events (0 on start of science mode)	counts	n/a	I: 0
154	0	32	S1E-P_S3S_CTR	Counter of processed S3_Single events (0 on start of science mode)	counts	n/a	I: 0
158	0	32	S1E-K_S3S_CTR	Counter of killed S3_Single events (0 on start of science mode)	counts	n/a	I: 0
162	0	32	S1E-P_S3M_CTR	Counter of processed S3_Multiple events (0 on start of science mode)	counts	n/a	I: 0
166	0	32	S1E-K_S3M_CTR	Counter of processed S3_Multiple events (0 on start of science mode)	counts	n/a	I: 0
170	0	32	S1E-P_S4S_CTR	Counter of processed S4_Single events (0 on start of science mode)	counts	n/a	I: 0
174	0	32	S1E-K_S4S_CTR	Counter of killed S4_Single events (0 on start of science mode)	counts	n/a	I: 0
178	0	32	S1E-P_S4M_CTR	Counter of processed S4_Multiple events (0 on start of science mode)	counts	n/a	I: 0
182	0	32	S1E-K_S4M_CTR	Counter of killed S4_Multiple events (0 on start of science mode)	counts	n/a	I: 0
186	0	32	S1E-P_S8_CTR	Counter of processed S8 events (0 on start of science mode)	counts	n/a	I: 0
190	0	32	S1E-K_S8_CTR	Counter of killed S8 events (0 on start of science mode)	counts	n/a	I: 0
194	0	32	S1E-P_SD1_CTR	Counter of CdTe raw events in science mode (0 on start of science mode)	counts	n/a	I: 0
198	0	32	S1E-K_SD1_CTR	Counter of Killed CdTe raw events in science mode (0 on start of science mode)	counts	n/a	I: 0
202	0	32	S1E-SD2_CTR	Counter of CsI raw events in science mode (0 on start of science mode)	counts	n/a	I: 0
206	0	32	S1E-K_SD2_CTR	Counter of Killed CdTe raw events in science mode (0 on start of science mode)	counts	n/a	I: 0
210	0	16	n/a	Constant	n/a	n/a	DDDD
212	0	16	n/a	Constant	n/a	n/a	DDDD
214	0	16	n/a	Constant	n/a	n/a	DDDD
216	0	16	n/a	Constant	n/a	n/a	DDDD
218	0	32	S1D-VD_HBRA_RT	Event counter of diagnostic mode (0 on start of science mode)	counts	n/a	I: 0
222	0	16	n/a	Constant	n/a	n/a	
224	0	16	n/a	Constant	n/a	n/a	
226	0	32	S1E-P_D1_CTR	Counter of processed CdTe raw events (0 on strt of diagnostic mode)	counts	n/a	I: 0
230	0	32	S1E-K_D1_CTR	Counter of killed CdTe raw events (0 on strt of diagnostic mode)	counts	n/a	I: 0
234	0	32	S1E-P_D2_CTR	Counter of processed CsI raw events (0 on strt of diagnostic mode)	counts	n/a	I: 0
238	0	32	S1E-K_D2_CTR	Counter of killed CsI raw events (0 on strt of diagnostic mode)	counts	n/a	I: 0

242	0	32	S1E-P_D3_CTR	Counter of processed transparent events (0 on strt of diagnostic mode)	counts	n/a	I: 0
246	0	32	S1E-K_D3_CTR	Counter of killed transparent events (0 on strt of diagnostic mode)	counts	n/a	I: 0
250	0	16	n/a	Constant	n/a	n/a	BBBB
252	0	16	n/a	Constant	n/a	n/a	BBBB
254	0	16	n/a	Constant	n/a	n/a	BBBB
256	0	16	n/a	Constant	n/a	n/a	BBBB
258	0	16	n/a	Constant	n/a	n/a	BBBB
260	0	16	n/a	Constant	n/a	n/a	BBBB
262	0	16	n/a	Constant	n/a	n/a	BBBB
264	0	16	n/a	Constant	n/a	n/a	BBBB
266	0	16	S1E-SEQCTR_S5	Sequence Counter of S5 TM packet (total)	counts	n/a	I: 0
268	0	48	S1E-INT_TM_S5	Integration time of S5 histogram (last finished histogram)	sec	/32 * 2exp-19	I: 0
274	0	16	S1E-BLK_NO_S5	S5 HBR_B block (counter of block number)	n/a	n/a	I: 0
276	0	8	n/a	Constant	n/a	n/a	
277	0	8	S1E-HST_ID_S5	S5 histogram ID	n/a	n/a	I: 0
278	0	16	n/a	Constant	n/a	n/a	BBBB
280	0	16	n/a	Constant	n/a	n/a	BBBB
282	0	16	S1E-SEQCTR_S6	Sequence Counter of S6 TM packet	counts	n/a	I: 0
284	0	48	S1E-INT_TM_S6	Integration time of S6 histogram (last finished histogram)	sec	/32 * 2exp-19	I: 0
290	0	16	S1E-BLK_NO_S6	S6 HBR_B block	n/a	n/a	I: 0
292	0	8	n/a	Constant	n/a	n/a	
293	0	8	S1E-HST_ID_S6	S6 histogram ID	n/a	n/a	I: 0
294	0	16	n/a	Constant	n/a	n/a	BBBB
296	0	16	n/a	Constant	n/a	n/a	BBBB
298	0	16	S1E-SEQCTR_S7S	Sequence Counter of S7_Single TM packet	counts	n/a	I: 0
300	0	48	S1E-INT_TM_S7S	Integration time of S7_Single histogram (last finished histogram)	sec	/32 * 2exp-19	I: 0
306	0	16	S1E-BLK_NO_S7S	S7_Single HBR_B block	n/a	n/a	I: 0
308	0	8	n/a	Constant	n/a	n/a	
309	0	8	S1E-HST_ID_S7S	S7_Single histogram ID	n/a	n/a	I: 0
310	0	16	n/a	Constant	n/a	n/a	BBBB
312	0	16	n/a	Constant	n/a	n/a	BBBB
314	0	16	S1E-SEQCTR_S7M	Sequence Counter of S7_Multiple TM packet	counts	n/a	I: 0
316	0	48	S1E-INT_TM_S7M	Integration time of S7_Multiple histogram (last finished histogram)	sec	/32 * 2exp-19	I: 0
322	0	16	S1E-BLK_NO_S7M	S7_Multiple HBR_B block	n/a	n/a	I: 0
324	0	8	n/a	Constant	n/a	n/a	
325	0	8	S1E-HST_ID_S7M	S7_Multiple histogram ID	n/a	n/a	I: 0

326	0	16	n/a	Constant	n/a	n/a	BBBB
328	0	16	n/a	Constant	n/a	n/a	BBBB
330	0	8	S1E-AC_MEM_SCI	Active memory area of science histogram (actual histogram)	n/a	0 = memory 0-2 MB, 1 = memory 2,25 - 4,25 MB	I: 0
331	0	8	S1E-AC_MEM_CAL	Active memory area of calibration histogram (actual histogram)	n/a	0 = memory 2 - 2,25 MB , 1 = memory 4,25 - 4,5 MB	I: 0
332	0	16	n/a	Constant	n/a	n/a	FFFF
334	0	16	n/a	Constant	n/a	n/a	FFFF
336	0	16	n/a	Constant	n/a	n/a	FFFF
338	0	16	n/a	Constant	n/a	n/a	FFFF
340	0	16	n/a	Constant	n/a	n/a	FFFF
342	0	16	n/a	Constant	n/a	n/a	FFFF
344	0	16	n/a	Constant	n/a	n/a	FFFF
346	0	16	S1E-ISGRI_EMAX	ISGRI high energy threshold.	counts	n/a	65535
348	0	16	S1E-S3_EMIN	Compton energy low threshold.	n/a	n/a	1000
350	0	32	S1E-S3_ACC_AN	Compton minimum acceptance angle threshold (cos)	cos	cos (acceptance angle in degree)	0,968
354	0	32	S1E-S3_S_CALIB	Compton single event calibration factor.	n/a	n/a	5
358	0	32	S1E-S3_M_CALIB	Compton multiple event calibration factor	n/a	n/a	10
362	0	16	n/a	Constant	n/a	n/a	FFFF
364	0	16	n/a	Constant	n/a	n/a	FFFF
366	0	16	S1E-ISGRI_RT	ISGRI high rise time threshold	n/a	n/a	128
368	0	16	n/a	Constant	n/a	n/a	FFFF
370	0	16	n/a	Constant	n/a	n/a	FFFF
372	0	16	n/a	Constant	n/a	n/a	FFFF
374	0	16	n/a	Constant	n/a	n/a	FFFF
376	0	16	n/a	Constant	n/a	n/a	FFFF
378	0	8	{S/H}1S-MP_2TH	Multiple event reconstruction threshold for double events	int	MSB..MSB-7	H: 0 I: 0 D: 14
379	0	8	{S/H}1S-MP_3TH2	Multiple event reconstruction upper threshold for tripple events	int	MSB..MSB-7	H: 0 I: 0 D: 14
380	0	8	{S/H}1S-MP_3TH1	Multiple event reconstruction lower threshould for tripple events	int	MSB..MSB-7	H: 0 I: 0 D: 6
381	0	8	{S/H}1S-SPT_TI	CsI Spectral timing integration time	sec	2^(-10+SPT_TI)	H: 0 I: 0 D: 3
382	0	8	{S/H}1S-SPT_TH9	Spectral timing threshold 9 (upper threhold)	int	MSB..MSB-7	H: 0 I: 0 D: 255

383	0	8	{S/H}1S-SPT_TH8	Spectral timing threshold 8	int	MSB..MSB-7	H: 0 I: 0 D: 224
384	0	8	{S/H}1S-SPT_TH7	Spectral timing threshold 7	int	MSB..MSB-7	H: 0 I: 0 D: 192
385	0	8	{S/H}1S-SPT_TH6	Spectral timing threshold 6	int	MSB..MSB-7	H: 0 I: 0 D: 160
386	0	8	{S/H}1S-SPT_TH5	Spectral timing threshold 5	int	MSB..MSB-7	H: 0 I: 0 D: 128
387	0	8	{S/H}1S-SPT_TH4	Spectral timing threshold 4	int	MSB..MSB-7	H: 0 I: 0 D: 96
388	0	8	{S/H}1S-SPT_TH3	Spectral timing threshold 3	int	MSB..MSB-7	H: 0 I: 0 D: 64
389	0	8	{S/H}1S-SPT_TH2	Spectral timing threshold 2	int	MSB..MSB-7	H: 0 I: 0 D: 32
390	0	8	{S/H}1S-SPT_TH1	Spectral timing threshold 1 (lower threshold)	int	MSB..MSB-7	H: 0 I: 0
391	0	8	{S/H}1S-ES_TH1	Energy selection threshold 1 (lower threshold)	int	MSB..MSB-8	H: 0 I: 0
392	0	8	{S/H}1S-ES_TH2	Energy selection threshold 2 (lower threshold)	int	MSB..MSB-9	H: 255 I: 0 D: 255
393	0	8	{S/H}1E-CSI_DELAY	Delay of CsI detector	sec	2^(-22+CSI_DELAY)	H: 0 I: 0 D: ?
394	0	8	{S/H}1E-CDTE_DELAY	Delay of CdTe detector	sec	2^(-22+CDTE_DELAY)	H: 0 I: 0 D: ?
395	0	8	{S/H}1E-TC_TI	Time acceptance window for compton events	sec	2^(-22+TC_TI)	H: 0 I: 0
396	0	16	{S/H}1E-HBRA_REQ	On request value HBR A (HEPI-DPE)	int	e.v.=r.v.	H: 999 I: 0 D: 1009
398	0	16	{S/H}1E-HBRB_REQ	On request value HBR B (HEPI-DPE)	int	e.v.=r.v.	H: 512 I: 0 D: 512
400	0	16	n/a	Constant	n/a	n/a	FFFF
402	0	16	n/a	Constant	n/a	n/a	FFFF
404	0	16	n/a	Constant	n/a	n/a	FFFF
406	0	16	n/a	Constant	n/a	n/a	FFFF
408	0	16	n/a	Constant	n/a	n/a	FFFF
410	0	16	n/a	Constant	n/a	n/a	FFFF
412	0	16	n/a	Constant	n/a	n/a	FFFF
414	0	16	n/a	Constant	n/a	n/a	FFFF
416	0	16	n/a	Constant	n/a	n/a	FFFF
418	0	16	n/a	Constant	n/a	n/a	FFFF
420	0	16	n/a	Constant	n/a	n/a	FFFF
422	0	16	n/a	Constant	n/a	n/a	FFFF
424	0	16	n/a	Constant	n/a	n/a	FFFF
426	0	16	n/a	Constant	n/a	n/a	FFFF
428	0	16	n/a	Constant	n/a	n/a	FFFF
430	0	16	n/a	Constant	n/a	n/a	FFFF

432	0	16	n/a	CRC	n/a	n/a	

Table 27: IASW additional HK data block

The structure of ISGRI, PICSIT and VETO additional HK is given in RD 7.

6.6 Scientific TM packet structure

All Science TM are generated in VC 1. An Overview is given in Table 28 (nominal DPE) and Table 29 (redundant DPE).

APID	Packet Type	Packet Sub Type	Function name	Function number
			Spectral Timing TM interrupted	
1348	1	0	CdTe PPM	S1
1352	2	0	CdTe calibration	S2
1356	3	0	Compton single	S3.0
1357	3	1	Compton multiple	S3.1
1360	4	0	CsI PPM single	S4.0
1361	4	1	CsI PPM multiple	S4.1
1364	5	0	CsI Calibration	S5
1368	6	0	CsI Polarimetric	S6
1372	7	0	Spectral Imaging CsI single histograms	S7.1
1373	7	1	Spectral Imaging CsI multiple histograms	S7.2
1376	8	0	Spectral Timing	S8
1397	13	1	CdTe raw	S13.1
1398	13	2	CsI raw	S13.2
1399	13	3	Transparent	S13.3

Table 28: Scientific data package APIDs (VC = 1) of IBIS DPE nominal

APID	Packet Type	Packet Sub Type	Function name	Function number
1476	1	0	CdTe PPM	S1
1480	2	0	CdTe calibration	S2
1484	3	0	Compton	S3.0
1485	3	1	Compton multiple	S3.1
1488	4	0	CsI PPM TM	S4.0
1489	4	1	CsI PPM multiple	S4.1
1492	5	0	CsI Calibration	S5
1496	6	0	CsI Polarimetric	S6

APID	Packet Type	Packet Sub Type	Function name	Function number
1500	7	0	Spectral Imaging CsI single histograms	S7.0
1501	7	1	Spectral Imaging CsI multiple histograms	S7.1
1504	8	0	Spectral Timing	S8
1525	13	1	CdTe raw	S13.1
1526	13	2	CsI raw	S13.2
1527	13	3	Transparent	S13.3

Table 29: Scientific data package APIDs (VC = 1) of IBIS DPE redundant

6.6.1 S1 TM packet (CdTe single PPM)

6.6.1.1 Data field header

For S1 the header of each TM packet contains the type and sub type information and the 24 MSB of the time of the first event in the packet.

6.6.1.2 Timing information and dummy structure

The remaining 8 bit time information are put in the data field of the first event.
If the time difference of the succeeding events is less then 256 to the preceding the last 8 bit of the timing information is put into the data field.
If the time difference is larger or equal 256 then a timing dummy event is put into the data field of the TM. The dummy structure is similar the corresponding event type. Within this 40 bit structure a dummy counter is implemented, which counts how often the 8 bit event time field has overflowed.
The maximum value allowed for this dummy counter is 16#(FF-2), the maximum value 16#FF is used as a flag that the counter itself has overflowed, 16#(FF-1) is used for restart purposes.
In case of dummy counter overflow two dummy records _(2 * 40 bit) are written into the TM packet before the current event. The first dummy keeps the counter with the flag value 16#FF.
The second dummy keeps the 32 bit time information of the current event.

6.6.1.3 Data field

The size of the event structure in the data field is 40 bit. This contains in addition to the time the amplitude (11 bit), the rise time (7 bit), the Y-position (7 bit) and the Z-Position (7 bit).

Not used parts of the data field are filled with 16#FF (e.g. when leaving the science mode).

6.6.1.4 Restart dummy

When production of S1 TM packet starts after stopping due to TM threshold exceeding (ref. 6.2), a dummy event is written into the TM packet before the first event after restart.
The value of 16#(FF-1) is used for the dummy counter field in the dummy to indicate a restart of processing. If the time difference between the last event before stop of processing and the

first event after restart is larger then the 256, a timing dummy event is also included before the first science event.

6.6.1.5 Example

6.6.2 CdTe-PPM TM(1,0)

Data Field Header: 2 Word:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype =16#10								MSB	MSB- Time [24 bit]						
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MSB- Time of First Event [24 bit]															LSB

Data-Field 43 x 5 Word Record:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Amplitude (Event-1) [11 bit]											Risetime-1 [7 bit]				
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
LSB		Y_Pos_1 [7 bit]							Z_Pos_1 [7 bit]						
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
LSB_Time_1 [8 bit]								LSB_Time_2 [8 bit]							
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Amplitude (Event_2) [11 bit]											Rise_Time_2 [7 bit]				
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
LSB		Y_Pos_2 (7 bit)							Z_Pos_2 (7 bit)						

First Dummy :
odd structure

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Amplitude1=2047											Risetime1=0				
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
LSB		Y_Pos1=127							Z_Pos1=0						
32	33	34	35	36	37	38	39								
Dummy - Counter [8bit]															

even structure

								40	41	42	43	44	45	46	47
								Dummy - Counter [8 bit]							
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Amplitud2=2047											Risetime2=0				
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
LSB		Y_Pos2=127							Z_Pos2=0						

Second Dummy:
odd structure

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MSB								absolute event time [32 bit]							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
								absolute event time [32 bit]							LSB
32	33	34	35	36	37	38	39								
			Dummy Counter =16#FF#												

even structure

								40	41	42	43	44	45	46	47
											Dummy Counter = 16#FF#				
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
MSB								absolute event time [32 bit]							
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
								absolute event time [32 bit]							LSB

6.6.3 S2 TM packet (CdTe calibration PPM)

6.6.3.1 Data field header

For S2 the header of each TM packet contains the type and sub type information and the 24 MSB of the time of the first event in the packet.

6.6.3.2 Timing information and dummy structure

All other timing information of the events is disregarded.
In case of restarting of processing of the event type (ref. 6.2) also a dummy structure (32 bit) is written into the data field of the TM packet.

6.6.3.3 Data field

The size of the event structure in the data field is 32 bit. This contains the amplitude (11 bit), the rise time (7 bit), the Y-position (7 bit) and the Z-Position (7 bit).

Not used parts of the data field are filled with the 16#FF (e.g. switch to stand by at the end of an observation).

6.6.3.4 Restart dummy

When production of S2 TM packet starts after stopping due to TM threshold exceeding, a dummy event is written into the TM packet before the first event after restart.

6.6.3.5 Example

Data-Field-Header: 2 Word:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype [8 bit] 16#20								MSB MSB_ Time [24 bits]							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MSB_ Time of first Event [24 bits]															LSB

Data-Field 107 x 2 Word Records:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Amplitude [11 bit]											Rise_Time [7 bits]				
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
LSB		Y_Pos [7 bit]							Z_Pos [7 bit]						

Function restarted:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16#FF								16#FF							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
16#FF								16#FF							

6.6.4 S3 TM packet (Compton PPM)

6.6.4.1 Data field header

For S3.0 and S3.1 the header of each TM packet contains the type and sub type information and the 24 MSB of the time of the first event in the packet.

6.6.4.2 Timing information and dummy structure

The remaining 8 bit time information are put in the data field of the first event.
If the time difference of the succeeding events is less then 256 to the preceding the last 8 bit of the timing information is put into the data field.
If the time difference is larger or equal 256 then a dummy counter within the data structure is implemented, which counts how often the 8 bit event time field has overflowed.
The maximum value allowed for this dummy counter is 16#(3F-2), the maximum value 16#3F is used as a flag that the counter itself has overflowed and the value 16#(3F-1) is used to indicate a restart of processing of the event type (ref. 6.2).
In both cases an additional dummy record (64 bit) is written into the TM packet before the current event. The dummy keeps flags for indication of restart or dummy counter overflow and in case of dummy counter overflow the 32 bit time information of the current event.

6.6.4.3 Data field

The size of the event structure in the data field is 64 bit. This contains in addition to the time and dummy fields the CdTe amplitude (8 bit), the CdTe rise time (7 bit), the CdTe Y-position (7 bit) the CdTe Z-Position (7 bit), the CsI amplitude (8 bit), the CsI Y-position (6 bit), the CsI Z-position and a flag, which indicates if both of the events are calibration events (only single events). This flag is set to **0** if both are an calibration event and set **1** if the events are not calibration events.
If the CsI part a multiple event, then it will be written in an extra TM sub type (3.1).

Not used parts of the data field are filled with the 16#FF (e.g. when switch to stand by at the end of an observation).

6.6.4.4 Examples

Compton (single) TM(3,0)

Data-Field-Header 2 Word:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype = 16#30								MSB MSB_ Time [24 bit]							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MSB_Time of First Event [24 bit] LSB															

Data-Field 53 x 4 Word Record:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CsI_Amplitude [8 bit]								CdTe_Amplitude [8 bit]							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
CdTe_Risetime [7 bit]							CsI_Y_Pos [6 bit]						MSB of CsI_Z_Pos [6bit]		
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
LSB of CsI_Y_Pos [6 bit]			CdTe_Y_Pos [7 bit]							MSB of CdTe_Z_Pos [7 bit]					
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
[7 bit] LSB	Cal. Flag	Dummy_Counter [6 bit]						LSB of Time [8 bit]							

Counter-Overflow:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MSB Absolute Time [32 bit]															

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Absolute Time [32 bit]															LSB
32	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**
Spare = 0															
48	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
0	1	Flag = 16#3F						Spare = 0							

Function Restarted:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Spare = 0															
16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
Spare = 0															
32	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**
Spare = 0															
48	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
0	1	Flag = 16#3E						Spare = 0							

Compton (Multiple) TM(3,1)

Data-Field-Header 2 Word:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype = 16#31								MSB MSB_ Time [24 bit]							
16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
MSB_Time of First Event [24 bit]															LSB

Data-Field 53 x 4 Word Record:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CsI_Amplitude [8 bit]								CdTe_Amplitude [8 bit]							
16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
CdTe_Risetime [7 bit]							CsI_Y_Pos [6 bit]						MSB of CsI_Z_Pos [6bit]		
32	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**
LSB of CsI_Y_Pos [6 bit]			CdTe_Y_Pos [7 bit]							MSB of CdTe_Z_Pos [7 bit]					
48	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
LSB	not used	Dummy_Counter [6 bit]						LSB of Time [8 bit]							

Counter-Overflow:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MSB							Absolute Time [32 bit]								
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
							Absolute Time [32 bit]								LSB
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
							Spare = 0								
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
0	1	Flag = 16#3E						Spare = 0							

Function Restarted:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							Spare = 0								
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
							Spare = 0								
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
							Spare = 0								
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
0	1	Flag = 16#3E						Spare = 0							

6.6.5 S4 TM packet (CsI single and multiple PPM)

6.6.5.1 Data field header

For S4.0 and S4.1 the header of each TM packet contains the type and sub type information and the 24 MSB of the time of the first event in the packet.

6.6.5.2 Timing information and dummy structure

The remaining 8 bit time information are put in the data field of the first event.
If the time difference of the succeeding events is less then 256 to the preceding the last 8 bit of the timing information is put into the data field.
If the time difference is larger or equal 256 then a dummy event is written into the TM packet. Within this dummy a counter is implemented, which counts how often the 8 bit event time field has overflowed.
The maximum value allowed for this dummy counter is 16#(FF-2), the maximum value 16#FF is used as a flag that the counter itself has overflowed and the value 16#(FF-1) is used to indicate a restart of processing of the event type (ref. 6.2).
In case of dummy counter overflow an additional dummy record _(32 bit) is written into the TM packet before the current event. The second dummy type keeps the 32 bit time information of the current event.

6.6.5.3 Data field

The size of the event structure in the data field is 32 bit. This contains in addition to the time the CsI amplitude (8 bit), the CsI Y-position (6 bit) and the CsI Z-position.
If the CsI event a multiple event, then it will be written into an extra TM sub type (4.1).

Not used parts of the data field are filled with the 16#FF (e.g. when switch to stand by at the end of an observation).

6.6.5.4 Example

Data-Field-Header 2 Word:

<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="8">Type - Subtype = 16#(40 or 41)</td><td colspan="8">MSB MSB_ Time</td></tr>
<tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr>
<tr><td colspan="16">MSB_Time of First Event [24 bit] LSB</td></tr>
</table>

TM_Event Record Format:

<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="10">Amplitude [10 bit]</td><td colspan="6">Y_Pos [6 bit]</td></tr>
<tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr>
<tr><td colspan="2">Dummy</td><td colspan="6">Z_Pos [6 bit]</td><td colspan="8">LSB_Time [8 bit]</td></tr>
</table>

First Dummy:

<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="10">Amplitude=0</td><td colspan="6">Y_Pos=0</td></tr>
<tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr>
<tr><td colspan="2">16#3</td><td colspan="6">Z_Pos1=0</td><td colspan="8">Dummy_Counter</td></tr>
</table>

Second Dummy:

<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="16">MSB absolute event time [32 bit]</td></tr>
<tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr>
<tr><td colspan="16">absolute event time [32 bit] LSB</td></tr>
</table>

6.6.6 S5 TM packet (CsI calibration histograms)

6.6.6.1 Data field header

For S5 the header of each TM packet contains the type and sub type information, the start time of the histogram, the integration time, the histogram identification number and the start HEPI memory address of the first histogram cell.

6.6.6.2 Data field and compression

The memory cells are written in ascending order in the data field. The cells of the histogram contains the count rate during the integration time on different positions (4096) and in different energy ranges (64).

The data field of a TM packet starts with an 8 bit histogram cell (address) which is used as a first reference cell. This cell contains the absolute value (8 bit) of that histogram cell which address is written inside the data field header. The following cells contains the differences to the previous cell (if the value is in the range) or the absolute value marked by a flag (ref. 3.3.5.12)

A parameter in the last 12 bit of the data field indicates the number of the first unused data field in packet. Counting starts with 1. The maximum number of valid events could be 845. A complete filled TM has 846 as number of this parameter. Not used histogram cells are filled with the 2#1000 (refer also 3.3.5.13).

For the memory addressing scheme ref. RD 3.

6.6.6.3 Example

Data Field Header Format:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype [8 bit]								MSB Header time (24 bit)							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Header time (24 bit) LSB															
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
MSB Actual integration time LSB															
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
MSB Start Address (24 bit)															
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Start Address (24 bit) LSB								Histogram ID (8 bit)							

Compressed cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cell1				Cell2				Cell3				Cell4			

Compressed and not Compressed histogram cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cell1				Flag 16#8				Cell2							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Cell3				Cell4				Cell5				Flag 16#8			
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Cell6								Cell7				Cell8			

6.6.7 S6 TM packet (CsI polarimetric histograms)

6.6.7.1 Data field header

For S6 the header of each TM packet contains the type and sub type information, the start time of the histogram, the integration time, the histogram identification number and the start HEPI memory address of the first histogram cell.

6.6.7.2 Data field and compression

The memory cells are written in ascending order in the data field. The cells of the histogram contains the scattering angles (8) in different energy ranges (64) and positions (4096).

The data field of a TM packet starts with an 8 bit histogram cell (address) which is used as a first reference cell. This cell contains the absolute value (8 bit) of that histogram cell which address is written inside the data field header. The following cells contains the differences to the previous cell (if the value is in the range) or the absolute value marked by a flag (ref. 3.3.5.12)

A parameter in the last 12 bit of the data field indicates the number of the first unused data field in packet. Counting starts with 1. The maximum number of valid events could be 845. A complete filled TM has 846 as number of this parameter. Not used histogram cells are filled with the 2#1000 (refer also 3.3.5.13).

For the memory addressing scheme ref. RD 3.

6.6.7.3 Example

Data Field Header Format:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype [8 bit]								MSB Header time (24 bit)							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Header time (24 bit) LSB															
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
MSB Actual integration time LSB															
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
MSB Start Address (24 bit)															

64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Start Address (24 bit) LSB								Histogram ID (8 bit)							

Compressed cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cell1				Cell2				Cell3				Cell4			

Compressed and not Compressed histogram cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cell1				Flag 16#8				Cell2							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Cell3				Cell4				Cell5				Flag 16#8			
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Cell6								Cell7				Cell8			

6.6.8 S7 TM packet (CsI single and multiple histograms)

6.6.8.1 Data field header

For S7 the header of each TM packet contains the type and sub type information, the start time of the histogram, the integration time, the histogram identification number and the start HEPI memory address of the first histogram cell.

6.6.8.2 Data field and compression

The memory cells are written in ascending order in the data field. The cells contains the count rate during the integration time on different positions (4096) and in different energy ranges (256). Single and multiple histograms are using different sub types (7.0: single, 7.1 multiple).

The data field of a TM packet starts with an 8 bit histogram cell (address) which is used as a first reference cell. This cell contains the absolute value (8 bit) of that histogram cell which address is written inside the data field header.

The data field of a TM packet starts with an 8 bit histogram cell (address) which is used as a first reference cell. This cell contains the absolute value (8 bit) of that histogram cell which address is written inside the data field header. The following cells contains the differences to the previous cell (if the value is in the range) or the absolute value marked by a flag (ref. 3.3.5.12)

A parameter in the last 12 bit of the data field indicates the number of the first unused data field in packet. Counting starts with 1. The maximum number of valid events could be 845. A complete filled TM has 846 as number of this parameter. Not used histogram cells are filled with the 2#1000 (refer also 3.3.5.13).

For the memory addressing scheme ref. RD 3.

6.6.8.3 Example

Data Field Header Format:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype [8 bit]								MSB		Header time (24 bit)					
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
						Header time			(24 bit)					LSB	
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
MSB					Actual integration time										LSB
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
MSB					Start Address (24 bit)										
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Start Address (24 bit)						LSB		Histogram ID (8 bit)							

Compressed cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cell1				Cell2				Cell3				Cell4			

Compressed and not compressed histogram cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cell1				Flag 16#8				Cell2							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Cell3				Cell4				Cell5				Flag 16#8			
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Cell6								Cell7				Cell8			

6.6.9 S8 TM packet

6.6.9.1 Data field header

For S8 the header of each TM packet contains the type and sub type information, the flags of selected histogram bins and the 32 bit of the time of the first event in the packet.

6.6.9.2 Timing information and dummy structure

If the time difference between two succeeding events is larger then the integration time (empty histograms) a flag (16#F00) in the data structure indicated a dummy with the 32 time information of the next histogram.

A different flag (16#F01) in the data structure is used to indicate a restart of processing of the event type (ref. 6.2). This flag is either in combination with flag 16#F00 (time dummy) or on the beginning of a TM.

A third flag (16#F02) is used to identify the end of the used part of the data field in the TM packet. This is used if no more spectral timing histograms are available (leaving of science mode) or not fit into TM packet. Behind this flag all cells are filled with 16#F.

If less then 3 cells are available behind the last histogram the third flag (16#F02) is omitted. In this case any remaining (one or two) cells are filled with 16#F.

6.6.9.3 Data field and compression

The size of the event structure in the data field is not fixed. It contains selected and compressed histograms bins and the dummies.

6.6.9.4 Example

Data-Field-Header:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type – Subtype [8 bit]MSB								C7	C6	C5	C4	C3	C2	C1	C0
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MSB Time of First Event [32 bit]															
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Time of First Event [32 bit] LSB															

C0..7: Energy bins (cells) of HEPI histograms (0: not selected, 1: selected)

Compressed cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
cell m(histogram i)				cell n(histogram i)				cell m(histogram i+1)				cell n(histogram i+1)			
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
cell m(histogram i+2)				cell n(histogram i+2)				cell m(histogram i+3)				cell n(histogram i+3			

m,n: selected cells

Compressed cells and dummy with new time base:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
cell n(histogram i)				cell m(histogram i+1)				cell n(histogram i+1)				Flag 16#F			
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Flag 16#00								MSB Absolute time (32 bit total)							
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Absolute Time [32 bit]															
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Absolute time LSB								cell m(histogram i+2)				cell n(histogram i+2)			
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
cell m(histogram i+3)				cell n(histogram i+3				cell m(histogram i+4)				cell n(histogram i+4			

m,n: selected cells

Compressed cells and restart dummy :

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
cell n(histogram i)				cell m(histogram i+1)				cell n(histogram i+1)				Flag 16#F			
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Flag 16#01								cell m(histogram k)				cell n(histogram k)			
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
cell m(histogram k+1)				cell n(histogram k+1)				cell m(histogram k+2)				cell n(histogram k+2)			

m,n: selected cells

Compressed and not compressed Histogram Cells:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
cell m(histogram i)				Flag 16#F				cell n(histogram i)							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
cell m(histogram i+1)				cell n(histogram i+1)				cell m(histogram i+2)				Flag 16#F			
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
cell n(histogram i+2)								cell m(histogram i+3)				cell n(histogram i+3			

m,n: selected cells

Compressed cells and fill dummy :

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
cell n(histogram i)				cell m(histogram i+1)				cell n(histogram i+1)				Flag 16#F			
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Flag 16#0				Flag 16#2				Flag 16#F				Flag 16#F			
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Flag 16#F				Flag 16#F				Flag 16#F				Flag 16#F			

m,n: selected cells. Fill dummy used to fill TM packet until end when no more spectral timing histograms are available (leaving of science mode) or not fit into TM packet.

6.6.10 S13.1, S13.2 TM packet (CdTe raw, CsI raw and transparent)

6.6.10.1 Data field header

For S13.1 and S13.2 the header of each TM packet contains the type and sub type information and the 16 bit packet creation time of the packet.

6.6.10.2 Data field

The data field of S13.1 (CdTe raw) and S13.2 (CsI raw) are filled with the raw data from detectors without processing in HEPI nor in IASW. The HEPI format of 80 bit will be slightly compressed to 64 bit without loosing information.

6.6.10.3 Dummy

In case of restarting of one of processing the above event types (ref. 6.2) a dummy is written in the TM packet (all field filled with 16#FF).

6.6.10.4 Example

<u>CdTe raw data TM(13,1)</u>

Data-Field-Header 2 Word:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype = 16#D1								Spare [8bit]							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MSB	Packet Creation Time [16 bit]													LSB	

Data-Field 53 x 4 Word Record:

CdTe-Raw-data: Event-type 16#04# [8 bit] (single)
Event-type 16#14# [8 bit] (calibration)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Event-Type [8 bit]								MSB	Time [24 bit]						
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Time [24 bit]															LSB
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Amplitude [11 bit]											Rise time [7 bit]				
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
LSB		Y_Pos [7 bit]							Z_Pos [7 bit]						

CsI raw data TM(13,2)

Data-Field-Header 2 Word:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype =16#D2								Spare [8 bit]							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MSB	Packet creation time [16 bit]													LSB	

Data-Field 53 x 4 Word Record:

CsI-Raw-data: Event-type 16#40# (single)
Event-type 16#48# (double)
Event-type 16#4C# (triple)
Event-type 16#54# (calibration)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type [8 bit]								MSB	Time [24 bit]						
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Time [24 bit]															LSB
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Spare1 [6 bit]						Amplitude [10 bit]									
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63

Spare2 [4 bit]	Y_Pos [6 bit]	Z_Pos [6 bit]

Restart dummy:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16#FE								16#FE							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
16#FE								16#FE							

6.7 Diagnostic TM packet structure

All Diagnostic TM are generated in VC 1.
The generation could be enabled or disabled by TC from ground.

6.7.1 S13.1, S13.2 TM packet (CdTe raw, CsI raw and transparent)

These both TM types generated in Diagnostic mode have the same structure then the generated in Science mode.

6.7.2 S13.3

6.7.2.1 Data field header

For S13.3 the header of each TM packet contains the type and sub type information and the 16 bit packet creation time of the packet.

6.7.2.2 Data field

The data field of S13.3 (transparent) is filled independently of the origin of the data (PICSIT or ISGRI) and also independently of a disturbed data structure. This type could only used in diagnostic mode.

6.7.2.3 Dummy

In case of restarting of one of processing the above event types (ref. 6.2) a dummy is written in the TM packet. The dummy cells are filled with 16#FE

6.7.2.4 Example

Data Field Header Format:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type - Subtype =16#D3								Spare [8 bit]							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MSB Packet creation time [16 bit] LSB															

Data Field:

Word		

2	Output from HEPI HBR A 80 bit aligned. Could be all types and additional undefined types. Undefined types are 80 bit long.	
....		
211		

Restart dummy:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16#FE								16#FE							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
16#FE								16#FE							

7 Table handling

7.1 IASW tables

Tables are used in IASW to handle the large amount of internal and peripheral parameters. Each table in the IASW could changed by TC(5,3) commands according RD 2. Sending a TC(5,3) generates autonomously a TM (5,4) packet with same parameters.

One revision parameter is implemented for the internal tables and one for the external tables. These parameter could only be updated by memory patch command.

7.1.1 Internal tables

Following internal tables are used in IASW:

Table 30: IASW internal tables

Name	Size [Byte]	DPE start address
ISGRI GAIN_OFFSET_TABLE for Energy correction	32768	16#2A000
ISGRI_SHAPE_TABLE	4096	16#2E000
TM Threshold table	128	
IREM Threshold table	128 (6 byte used)	Not applicable
Amplitude correction parameter table	128 (79 byte used)	Not applicable
Science function table: Standard Mode	128 (40 byte)	Not applicable
Science function table: PPM Mode	128 (40 byte)	Not applicable
Science function table: Polarimetry Mode	128 (40 byte)	Not applicable

7.1.2 Peripheral tables

7.1.2.1 Overview

Each peripheral table stored in DPE could be verified by calculation of a checksum (CS).
A report task parameter TC starts the calculation of the CS of the specific table within the DPE. The CS is sent to ground by TM (5,4).

Each peripheral tables (context of the instrument) has its own image in IASW. Initiated by a TC from ground or by Broadcast information the IASW writes and reads the peripheral tables to/from the peripheral layers.

Also the periphery is able to calculate the CS of their tables and sends the CS on request by IASW or TC from ground.
After transmitting tables from IASW to periphery or back the checksums are compared by the IASW. If the result is not equal an on event message will be
generated by the IASW. The context saving/restore flags are set accordingly.
After context saving/restoring of all peripheral, an on event message will be generated with all context saving/restoring flags.

For context saving/restoring DPE must be in stand by mode (DPE reach it autonomously for eclipse).
The peripheral instruments has their own modes for save/restore context.. In case of eclipse DPE switch the sub instruments (except PICSIT) autonomously in stand by.
In case of failure during all processes DPE interrupt the context saving/restoring process for the current sub instrument and starts with the next one.

Following peripheral tables are stored within IASW:

Table 31: IASW peripheral tables

NAME	Size (external)	Size (internal)	DPE Start Address (pysical)
HEPI	10240	10240	16#20000
VETO	45	64	16#23000
PICIST	273	320	16#24000
ISGRI MCE 1 - 8	8 * 1344 = 10752	8 * 1344 = 10752	16#25000

After each Table a variable is attached (1 word) which indicates the length of the last block of the table.
In case of ISGRI these variables are attached as an array of 8x1 Word after the implementation of all context tables.
The variables are autonomously changed when the last block of a tables is updated by a TC(5,3) commands.
When patching the tables by memory patch command, these parameter remains unchanged if not also patched.

7.1.2.2 HEPI Context saving

HEPI context will **not** be saved during eclipse, because the DPE holds the master of HEPI tables.
The HEPI context includes the following LUT:

Table 32: HEPI context table structure

HEPI LUT RAM start address	Description	Size [byte]
16#2000	CsI Ampl. Correction: single/multiple events	8k
16#4000	CsI Ampl. Correction: calibration events	8k
16#6000	Histogram binning: CsI single	1k
16#6400	Histogram binning: CsI mult.	1k
16#6800	Histogram binning: CsI cal.	1k
16#6C00	Histogram binning: CsI polarimetry	1k

Nevertheless it is possible to start saving context by TC from ground.
Constraints:

DPE in stand by mode or diagnostic mode
Number of Blocks 160
Total size 10240 word
Last Block size 64 word
Start address of context in HEPI RAM: 16 # 2000
Context request command ID 16 # 0A

- DPE sends 160 times request command for table to HEPI
- DPE waits each time for context table data block
- If communication successful DPE saves context in RAM
- Checksum comparison is not applicable to HEPI
- DPE set context saving flag according the successful saving

7.1.2.3 VETO Context saving

Constraints:

DPE in stand by mode or diagnostic mode
VETO in stand by mode
Number of Blocks 1
Block size 45 word
Start address of context in VETO RAM: 16 # 0000
Context request command ID 16 # 09
Checksum request command ID 16# FB
Change to stand by mode command ID 16 # 01

- DPE sends request command for table to VETO
- DPE waits for context table data block
- If communication successful DPE saves context in RAM

- DPE calculate checksum
- DPE send request command for checksum to VETO
- DPE waits for checksum
- DPE compares the checksums
- DPE set context saving flag according the successful saving

7.1.2.4 PICSIT Context saving

Constraints:

DPE in stand by mode or diagnostic mode
PICSIT in maintenance mode (only for manually context saving). On eclipse the IASW sends an additional command to PICSIT to switch from nominal to maintenance mode)
Number of Blocks 5
Total size 273 word
Last Block size 17 word
Start address of context in PICSIT RAM: 16 # 0000
Context request command ID 16 # A0
Checksum request command ID 16# FB

Change to Maintenance Mode ID 16 # F3

- DPE sends 5 times request command for table to PICSIT
- DPE waits each time for context table data block
- If communication successful DPE saves context in RAM
- DPE calculate checksum
- DPE send request command for checksum to PICSIT
- DPE waits for checksum
- DPE compares the checksums
- DPE set context saving flag according the successful saving

7.1.2.5 ISGRI Context saving

The procedure is applicable each ISGRI MCE.
Constraints:

DPE in stand by mode or diagnostic mode.
For manual saving MCE_XX in stand by mode (XX is the number of the MCE). On eclipse the IASW sends an additional command to MCE_XX to switch from nominal to stand by mode).

Number of Blocks per MCE: 21
Total size 1316 word
Last Block size 128 word
Start address of context in MCE RAM: 16 # 7000
Context request command ID 16 # 1E

Checksum request command ID 16# 1D
Change to stand by mode command 16 # 15

- DPE sends 21 times request command for table to MCE_XX
- DPE waits each time for context table data block
- If communication successful DPE saves context in RAM
- DPE calculate checksum
- DPE send request command for checksum to MCE_XX
- DPE waits for checksum
- DPE compares the checksums
- DPE set context saving flag according the successful saving

7.1.2.6 HEPI Context restoring

Constraints:

Context save flag valid (only for autonomous restoring)
Context restore command ID 16 # 09

- DPE sends 160 times restore command with data block to HEPI
- If communication successful HEPI saves context in RAM
- Checksum comparison is not applicable to HEPI

7.1.2.7 VETO Context restoring

Constraints:

Context save flag valid (only for autonomous restoring)
VETO in stand by mode
Context restore command ID 16 # E0

- DPE sends restore command with data block to VETO
- If communication successful VETO saves context in RAM
- DPE calculate checksum
- DPE send request command for checksum to VETO
- DPE waits for checksum
- DPE compares the checksums
- DPE set context restoring flag according the successful saving
- VETO is still in stand by mode

7.1.2.8 PICSIT Context restoring

Constraints:

Context save flag valid (only for autonomous restoring)

PICSIT in stand by mode
Context restore command ID 16 # E0
Change to nominal mode command (warm start) ID 16 # F2
Apply context command ID 16 # E5

- DPE sends warm start command (only for autonomous restoring)
- DPE sends 5 times restore command with data block to PICSIT
- If communication successful PICSIT saves context in RAM
- DPE calculate checksum
- DPE send request command for checksum to PICSIT
- DPE waits for checksum
- DPE compares the checksums
- DPE send apply context command to PICSIT
- DPE set context restoring flag according the successful saving

7.1.2.9 ISGRI MCE Context restoring

The procedure is applicable each ISGRI MCE.

Constraints:

Context save flag valid (only for autonomous restoring)
MCE_XX in stand by mode (XX is the number of the MCE)
Context restore command ID 16 # 1A
Context apply command ID 16 # 16

- DPE sends 21 times restore command with data block to MCE_XX
- If communication successful MCE_XX saves context in RAM
- DPE calculate checksum
- DPE send request command for checksum to MCE_XX
- DPE waits for checksum
- DPE compares the checksums
- DPE send context apply command to MCE_XX
- DPE set context restoring flag according the successful saving

8 Memory Budget

Software-Part	Address state	Constants	Data	Instructions	
Runtime	AS 0	610	3945	3331	
CSSW	AS 0	1393	7190	18307	

IASW	AS 0	2457	29874	29928	
	AS 1	1428	2322	8601	
	AS 2	112	21390	3848	
	AS 3	0	18537	829	
Summary IASW		3997	72123	43206	
Total		6000	83258	64844	Word

These memory consumptions reflect both the RAM allocated within the DPE (DATA) and the memory for setting the initial program which is load from the PROM module (Constants and Instructions).

Remark: Astres is not included in this list.

9 Data Processing capabilities

The data processing capabilities were generated from IASW simulator measurements. Previous comparisons shows, that these measurements are reliable with respect to real time measurements.

9.1 Input data rate

Event type	Description	Events/sec	Selection in IASW
S1	CdTe photon by photon	980	1,0
S2	CdTe calibration	20	1,0
S3	Compton	260	0,25
S4	CsI photon by photon	2000	0,2

Event type	Description	Integration time [sec]	Compression
S5	CsI calibration histogram	10000	2
S6	CsI histogram polarimetry	1800	1,8
S7	CsI histogram single/multiple	1800	1,8
S8	CsI spectral timing histograms (2 channel)	0,001	2

9.2 CPU time and TM rate

Sub modes	Functions	Required time	Used part of available CPU time	Data rate [Packets / 8sec]
		[ms/cycle]	[%]	
Standard - pointing	H1,H3,H4,S1,S2,S3,S5,S7,S8	106	84	137
Standard - slew	H1,H3,H4,S1,S2,S3,S4,S5	108	86	136
Polarimetry - pointing	H1,H3,H4,S1,S2,S3,S5,S6,S8	106	84	140
Polarimetry - slew	H1,H3,H4,S1,S2,S3,S4,S5	108	86	136
Photon by Photon	H1,H3,H4,S1,S2,S3,S4,S5	108	86	136

Function	Required time [ms/125 msec cycle]	Used part of available CPU time [%]	Data rate [Packets/8sec]
S1	38	31	91
S2	0,3	0	1
S3	22	17	10
S4	36	29	30
S5	0,2	0	0,25
S6	8	7	15
S7	8	7	12
S8	26	21	19