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Herschel/SREM TM data

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Contents

Acronyms and Abbreviations

APID	Application Process ID
DDS	Data Disposition System
ESOC	European Space Operations Center
SREM	Standard Radiation Environment Monitor
SCET	Spacecraft Event Time

1 Introduction

The data from the SREM aboard Herschel is disseminated via the Data Disposition System (DDS). The TM format for SREM is summarized below.

2 DDS TM format

The experiment packets on-board the spacecraft are split into separate fixed length blocks and formatted into transfer frames for download to the ground and transfer to ESOC. These separate frames are then reconstituted back into complete experiment packets by the RMCS/MEMCS at ESOC and the complete experiment packets are delivered to the PIs. The experiment packets are timestamped with the Spacecraft Event Time (SCET). The SCET is the calibrated time of generation of the first bit in the associated packet. The contents of each reconstituted packet of experiment data is unprocessed, and a header is attached to the beginning of each packet (the DDS Packet Header) described below. For security reasons, each experiment packet is sent three times to ground.

2.1 DDS Packet Header

The DDS Packet Header for Telemetry Packets is an 18-octet header attached to the beginning of each packet. It includes the SCET time stamp, ground station received from, etc. This information is necessary to identify the source of the data packet. A bit and byte packed fixed format is used which is shown in table 1.

Table 1: DDS Packet Header items [reference ???]

Octet	Field	Type	Description
0 - 7	SCET	64 bit time	Time correlated OBT
8 - 11	Packet length	32 bit integer	Number of octets within the data packet excluding the DDS Packet Header
12 - 13	Ground Station ID	16 bit integer	00: unknown 73: Perth 74: New Norcia 75: Kouro 80: Villafranca
14 - 15	Virtual Channel ID	16 bit integer	2=VC-2, 3=VC-3
16	SLE Service		Identifies SLE service channel and the type of data
17	Time quality		0: good 1: inaccurate 2: bad

2.1.1 Spacecraft Event Time (SCET)

The time format used is the Sun MJT, as standard on Sun Solaris UNIX platforms. The format is two 32-bit integers. The first contains the number of seconds since 00:00, 1st January 1958 and the second integer contains the number of microseconds.

2.2 Data Records

Following the DDS Packet Header is the Telemetry Packet Data.

The telemetry source packets are of variable length and conform to the structure shown in figure 1.

SOURCE PACKET HEADER (48 bits)							PACKET DATA FIELD (VARIABLE)		
PACKET ID				PACKET SEQUENCE CONTROL		PACKET LENGTH	DATA FIELD HEADER	SOURCE DATA	PACKET ERROR CONTROL
Version Number	Type	Data Field Header Flag	Application Process ID	Segmentation Flags	Source Sequence Count				
3	1	1	11	2	14				
16 bits				16 bits		16 bits	112 bits	N x 16 bits	16 bits

Figure 1: Telemetry source packet fields

2.2.1 Source Packet Header

The fields of the Source Packet Header as shown in figure 1 are described in table 2.

Table 2: Source Packet Header Fields

Packet ID	
Version Number	The Version Number is set to $???_{BIN}$ for all telemetry issued on-board.
Type	For telemetry source packets, the type is set to zero.
Data Field Header Flag	This indicates the presence or absence of a Data Field Header and must be set to 1.
Application Process ID (APID)	The Application Process ID uniquely identifies the on board source of the packet. For SREM the APID is 16.
Packet Sequence Control	
Segmentation Flags	These two bits are set to 11_{BIN} indicating "no segmentation".
Source Sequence Count	Used to represent the actual Sequence Count. A separate source sequence count is maintained for each Application Process ID and is incremented by 1 whenever the source (APID) releases a packet. Therefore the counter corresponds to the order of release of packets by the source and enables the ground to detect missing packets.

2.2.2 Data Field Header

The data field header is preceded by the source packet header and followed by source data and error control in the telemetry packet (refer to figure 1). All data field headers have the same basic structure, as shown in figure 2. The SCET of the Data Field Header is in units of 2^{-16} seconds. The SREM data packets the Packet Type and Subtype are 8 and 7.

Spare	TM Source Packet PUS Version Number	Spare	Packet Type	Packet Subtype	Spare	Time	p1Val	p2Val
Bitstring (1 bit)	Enumerated (3 bits)	Bitsring (4 bits)	Enumerated (8 bits)	Enumerated (8 bits)	Bitsring (8 bits)	(48 bits)	(16 bits)	(16 bits)

Figure 2: Data field header fields

2.2.3 Source data

The packet source data constitutes the data element of the telemetry reports to the ground. For SREM aboard Herschel there are two different types of Source data, SREM Accumulation Data and SREM Total Dose Data.

In normal operation SREM will be put into the 'SREM Accumulation via OBCP' operation mode. The procedure takes four parameters (see table 3).

Table 3: Parameters of TC procedure [reference ???]

File ID	SREM accumulation file ID
Integration Time	Duration of accumulation interval in seconds
TD Frequency	Number of accumulations which are executed before an 'SREM Total Dose' is read out.
Stop_now	Is set to YES to stop SREM Accumulation via OBCP.

At the beginning of each accumulation the SCET (8 byte) is stored for later synchronization of the accumulation times. Then the data is accumulated. At the end of the accumulation period the HK data (14 byte) and the accumulation file (84 byte) are read out (SREM Accumulation Data). After 'TD Frequency' cycles the Total Dose (16 byte) is read out (SREM Total Dose Data).

The SREM Accumulation Data and SREM Total Dose Data consist of following items (table 4).

Table 4: SREM Data items [reference ???]

Accumulation Data		Total Dose Data	
item	bytes	item	bytes
SCET	6	Internal RadFET value	2
HK status word	2	Internal RadFET temperature	2
D1/D2 temperature	2	V_cal_ref_1_raw	2
D3 temperature	2	V_cal_ref_2_raw	2
Analog ground (-6V)	2	V_cal_ref_3_raw	2
6V voltage	2	V_cal_ref_4_raw	2
5V voltage	2	C_cal_ref_1_raw	2
High voltage	2	C_cal_ref_2_raw	2
Accumulation file ID	2		
ACC status word	2		
Start time (SREM time)	4		
Stopt time (SREM time)	4		
Counter TC1	4		
Counter S12	4		
Counter S13	4		
Counter S14	4		
Counter S15	4		
Counter TC2	4		
Counter S25	4		
Counter C1	4		
Counter C2	4		
Counter C3	4		
Counter C4	4		
Counter TC3	4		
Counter S32	4		
Counter S33	4		
Counter S34	4		
Counter PL1	4		
Counter PL2	4		
Counter PL3	4		
Total	104		16

3 Time synchronization

The SREM experiment packets contain five different time stamps (see table 5).

t1 is generated on reception of the packet on ground. It is UT corresponding to t2 (t1=t2). t2 is the SCET the packet is generated on the spacecraft. t3 is the SCET at stop of the data accumulation (t3≈t5). t4 and t5 are SREM times and correspond to the start and stop time of the accumulation.

Through relation t1=t2 the conversion between SCET and UT is defined. Through relation t3=t5 the conversion between SREM time and SCET is defined. These two rules finally allow to convert SREM time to UT.

Table 5: Time information contained in SREM experiment packets

t1	SCET (UT)	DDS Packet Header, time of data packet generation
t2	SCET	Data Field Header, time of data packet generation
t3	SCET	SREM Accumulation Data, stop of accumulation
t4	Start accumulation SREM time	SREM Accumulation Data
t5	Stop accumulation SREM time	SREM Accumulation Data

4 Simulated data

According to the described SREM/Herschel data formats a data decoding software was developed and tested with simulated data.

4.1 December 2007 simulated data

Binary-file SREM-16-8-7-131207.TLM together with XML-file SREM-AVM-RMS-131207.TLM.

4.1.1 APID, Type, and subtype

APID, Type, and Subtype (in Source Packet Header) of all experiment packets have the nominal values of 16/8/7.

4.1.2 DDS header, Time quality

The Time quality flag (see table 2) versus t1 is shown in the upper most panel of figure 3. The flag has the value 0 (good) except for 4 cases, where it is 2 (bad).

4.1.3 Source Packet Header, Source Sequence Counter

The Source Sequence Counter (ssc) as function of t1 is shown in the second panel of figure 3. The maximum value of the ssc is 16384 (14 bit).

4.1.4 Times

The first and last value of t1 found in the encoded binary-file are 2008-05-18T13:48:15.200288 and 2008-05-20T16:55:54.280965, respectively. These values agree with the information given in the XML-file SREM-AVM-RMS-131207.TLM.

The third panel of figure 3 shows the difference of t1 and t2 as function of t1. t1 is running slighty faster than t2. The difference after 2 days is however less than 0.1 seconds.

The last panel shows the time course of $t3$. $t3$ increases in steps of ≈ 120 *sec*. However all values occur several times in a row (some 2, some 4 times). Why?

4.1.5 SREM data

Neither the Accumulation Data nor the Total Dose Data seem to contain meaningfull values!

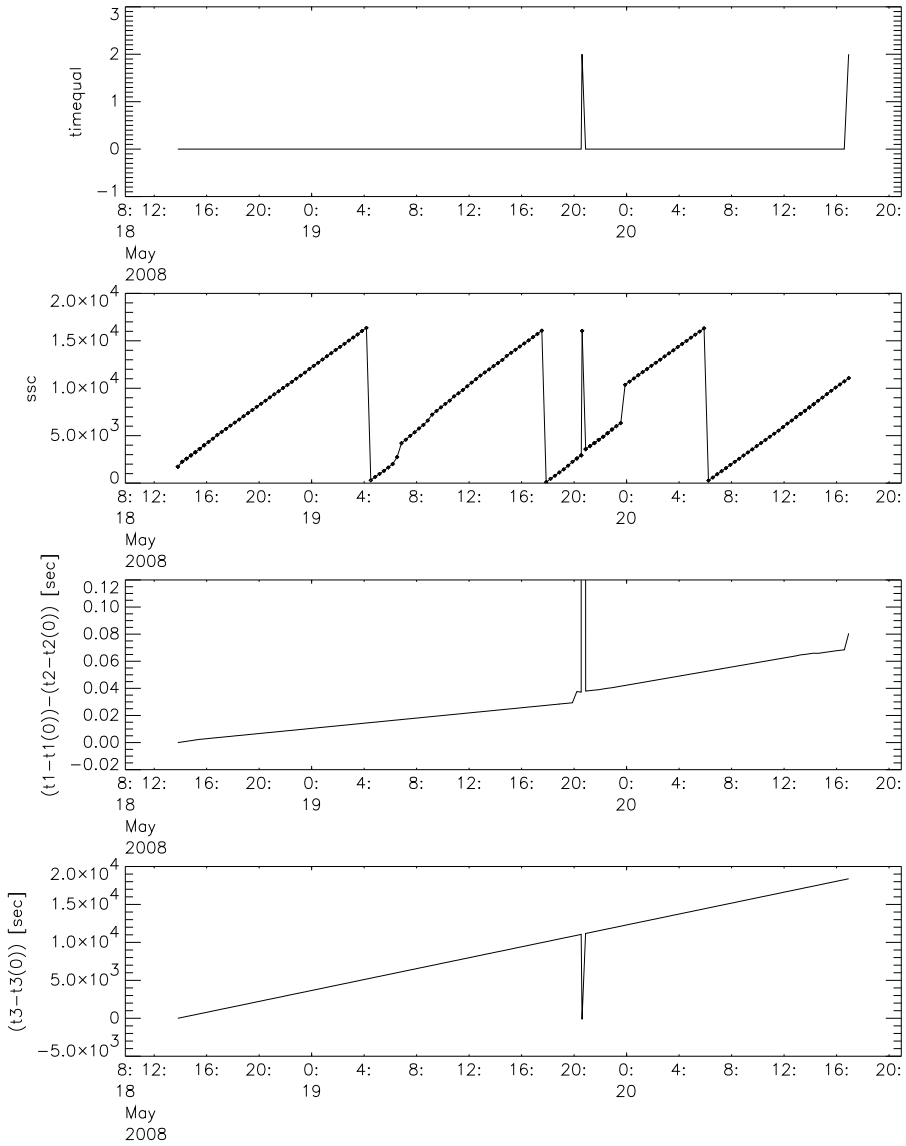

Figure 3: From top to bottom: Time quality (see table 1), Source Sequence Counter (see figure 1), $t1-t2$ (see table 5), and $t3-t3(0)$ as function of $t1$. Note the bad values around May 19, 20:36, which are associated with a bad time quality (Time quality = 2).