



HERSCHEL/PLANCK Orbit Events File ICD

DMS Document: PT-CMOC-FD-ICD-2103-OPS-GFI
Herschel Ground Segment Document: HGS-ICD-16
Planck Ground Segment Document: PGS-ICD-049

Version: Issue 1.4

09/09/2009

**Orbit Events are provided by Flight Dynamics to support mission operations and planning.
The interface is described in this document.**

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<u>Document Change Record</u>			DCR NO	1
			DATE	30/01/2004
			ORIGINATOR	M. Lauer
1. DOCUMENT TITLE: HERSCHEL/PLANCK Orbit Events File ICD				
2a. DMS DOCUMENT REFERENCE: PT-CMOC-FD-ICD-2103-OPS-GFI				
2b. HGS DOCUMENT REFERENCE : HGS-ICD-???				
2c. PGS DOCUMENT REFERENCE: PGS-ICD-049				
3. DOCUMENT ISSUE/REVISION NUMBER: Draft 0.0				
4. PAGE	5. PARAGRAPH	6. REASON FOR CHANGE		
All	All	Initial Draft		

<u>Document Change Record</u>			DCR NO	2
			DATE	05/07/2004
			ORIGINATOR	M. Lauer
1. DOCUMENT TITLE: HERSCHEL/PLANCK Orbit Events File ICD				
2a. DMS DOCUMENT REFERENCE: PT-CMOC-FD-ICD-2103-OPS-GFI				
2b. HGS DOCUMENT REFERENCE: N/A				
2c. PGS DOCUMENT REFERENCE: PGS-ICD-049				
3. DOCUMENT ISSUE/REVISION NUMBER: Issue 1.0				
4. PAGE	5. PARAGRAPH	6. REASON FOR CHANGE		
All	All	New document reference		
2	1.4	Reference to FTS ICD added		
3	1.5	Acronym list added		
7	3.3	Requirements added		
11	5.3	For FTS file naming convention reference to FTS ICD added		
15	7.3.1	Column for operational day number removed		
16, 17	7.3.2	AOS/LOS ten degree events replaced by five degree events		



<u>Document Change Record</u>		DCR NO	3
		DATE	19/11/2004
		ORIGINATOR	M. Lauer
1. DOCUMENT TITLE: HERSCHEL/PLANCK Orbit Events File ICD			
2a. DMS DOCUMENT REFERENCE:		PT-CMOC-FD-ICD-2103-OPS-GFI	
2b. HGS DOCUMENT REFERENCE:		N/A	
2c. PGS DOCUMENT REFERENCE:		PGS-ICD-049	
3. DOCUMENT ISSUE/REVISION NUMBER:		Issue 1.1	
4. PAGE	5. PARAGRAPH	6. REASON FOR CHANGE	
ii		Update of distribution list	
2	1.3, 1.4	Update of references	
7	3.1	Update of functional requirements R3.5.1.0-18 and R3.5.2.0-4 following issue 3 of [AD.2]	
16	7.3.2	Clarification on AOS/LOS five degree elevation events	

<u>Document Change Record</u>		DCR NO	4
		DATE	17/08/2006
		ORIGINATOR	F. Budnik
1. DOCUMENT TITLE: HERSCHEL/PLANCK Orbit Events File ICD			
2a. DMS DOCUMENT REFERENCE:		PT-CMOC-FD-ICD-2103-OPS-GFI	
2b. HGS DOCUMENT REFERENCE:		HGS-ICD-016	
2c. PGS DOCUMENT REFERENCE:		PGS-ICD-049	
3. DOCUMENT ISSUE/REVISION NUMBER:		Issue 1.2	
4. PAGE	5. PARAGRAPH	6. REASON FOR CHANGE	
i,ii	Signatures & Distribution List	Update of signature and distribution list	
1, 9, 11	1.1, 4.3, 5.1	Clarified who is recipient of the orbit events file	
11	5.3	File name convention changed	
2	1.3 - 1.4	Updated list of applicable and reference documents	
7	3.1	Adapted requirements to the latest version of [AD.2] and added requirements of [AD.5]	



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18	7.4	Added example file
16	7.3.2	Exchanged Villafranca by Cebreros

<u>Document Change Record</u>		DCR NO	5
		DATE	02/03/2009
		ORIGINATOR	F. Budnik
1. DOCUMENT TITLE: HERSCHEL/PLANCK Orbit Events File ICD			
2a. DMS DOCUMENT REFERENCE:		PT-CMOC-FD-ICD-2103-OPS-GFI	
2b. HGS DOCUMENT REFERENCE:		HGS-ICD-016	
2c. PGS DOCUMENT REFERENCE:		PGS-ICD-049	
3. DOCUMENT ISSUE/REVISION NUMBER:		Issue 1.3	
4. PAGE	5. PARAGRAPH	6. REASON FOR CHANGE	
16	7.3.2	Added Maspalomas to network of stations	
16	7.3.2	Clarified the scope of manouevre start/end events	

<u>Document Change Record</u>			DCR NO	6
			DATE	09/09/2009
			ORIGINATOR	F. Budnik
1. DOCUMENT TITLE: HERSCHEL/PLANCK Orbit Events File ICD				
2a. DMS DOCUMENT REFERENCE:			PT-CMOC-FD-ICD-2103-OPS-GFI	
2b. HGS DOCUMENT REFERENCE:			HGS-ICD-016	
2c. PGS DOCUMENT REFERENCE:			PGS-ICD-049	
3. DOCUMENT ISSUE/REVISION NUMBER: Issue 1.4				
4. PAGE	5. PARAGRAPH	6. REASON FOR CHANGE		



16	7.3.2	Removed the sentence in the fourth paragraph of 7.3.2: "A five degree event will not be reported in the event file if it does not occur between AxxH and LxxH."
18	7.4	Adjusted example file according to change above.



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Version: Issue 1.4
Date: 09/09/2009
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HERSCHEL/PLANCK
Flight Dynamics
ESOC/OPS-GFT

HERSCHEL/PLANCK Orbit Events File ICD



1. *Introduction*

The ICD describes the orbit events that are made available to the users by Flight Dynamics. The interface consists of a ASCII file containing one record per event.

1.1 *Purpose*

The ICD is written for all users that need to have access to event data for the missions HERSCHEL and PLANCK:

- Flight Dynamics
- Flight Control Team
- ESOC Scheduling Office
- Herschel Science Centre (HSC)
- Planck Science Office (PSO)

1.2 *Scope*

The ICD is applicable to both missions, HERSCHEL and PLANCK.



Introduction - Applicable Documents

1.3 Applicable Documents

	Document Project ID	Title		
	Author	Affiliation	Issue	Date
[AD.1]	QMS-EIMO-GSEG-DRD-1207-OPS	ESOC QMS Document Requirements Definition for Flight Dynamics Documentation		
	A. Schütz, R. E. Münch	OPS-GF	Issue 1.5	May 2006
[AD.2]	PT-CMOC-FD-RC-2001-OPS-GFT	HERSCHEL/PLANCK Flight Dynamics Requirements Compilation		
	G. Gienger	OPS-GFT	Issue 3.2	July 2006
[AD.3]	PT-CMOC-FD-IA-2002-OPS-GFT	HERSCHEL/PLANCK Flight Dynamics Implementation Analysis		
	G. Gienger	OPS-GFT	Issue 1.1	February 2005
[AD.4]	PLANCK/PSO/2002-003	PLANCK Ground Segment Interface Requirements Document		
	PGSSG	ESA/PSO	Issue 3.0	October 2004
[AD.5]	FIRST/HSC/DOC/0117	HERSCHEL Ground Segment Interface Requirements Document		
	HGSSE group	ESA	Issue 2.5	April 2006

1.4 Reference Documents

	Document Project ID	Title		
	Author	Affiliation	Issue	Date
[RD.1]	PT-MCS-ICD-1001-TOS-GDS	HP FTS ICD		
	G. Di Girolamo	OPS-GDS	Issue 1.3	April 2006
[RD.2]	PT-CMOC-SCHED-ICD-nnnn-OPS-ONF	Ground Station Schedule ICD		
	T. Beck	OPS-ONF		
[RD.3]	FIRST/HSC/DOC/0150	HERSCHEL Ground Segment List of ICDs		
	HGSSE Group		Issue 1.9	April 2006
[RD.4]	Planck/PSO/2004-008	PLANCK Ground Segment Low-Level ICD List and Requirements Compliance Matrix		
	M. McKinnell	SCI-SA	Issue 1.0	October 2004
[RD.4]	EMS Interface Control Document	EMS Interface Control Document		
	ESTRACK Management & Scheduling	OPS-GI	Issue 1.5	January 2006



1.5 Acronym List

AOS	Acquisition of Signal
DPC	Data Processing Centre
ESOC	European Space Operations Centre
ESTRACK	European Space Tracking (Network)
FCT	Flight Control Team
FDS	Flight Dynamics System
FTS	File Transfer System
G/S	Ground Station
HSC	Herschel Science Centre
ICD	Interface Control Document
LOS	Loss of Signal
MCS	Mission Control System
MOC	Mission Operations Centre
N/A	Not Applicable
PSO	Planck Science Office
S/C	Spacecraft
STDN	Spacecraft Trajectory Data Message
TBD	To Be Defined
UTC	Coordinated Universal Time
WIMPY	World-map with Station-predictions



Introduction - Acronym List



2. *Operational Assumptions and Constraints*

2.1 *Communications*

N/A

2.2 *Hardware*

N/A

2.3 *Software*

N/A

2.4 *User*

N/A

2.5 *Timing*

The orbit events files (long term and short term) are generated each time the orbit files (long term and short term) are updated.

Update frequency and data coverage fulfil the same requirements as for the orbit files, i.e.:

- the short term events file is updated every week, and covers the next 2 months
- the long term events file is generated at launch and on request, and covers the next 6 months



Operational Assumptions and Constraints - Timing



3. Requirements

3.1 Functional Requirements

The following requirements from [AD.2] shall be fulfilled:

R3.5.1.0-17 Orbit products and auxiliary data required for orbit and attitude control purposes, station scheduling and operations and spacecraft commanding shall be available once per week.

R3.5.1.0-18: The orbit determination and prediction subsystem shall be able to regularly generate the following products:

- Orbit reconstitution and prediction files
- STDN
- WIMPY
- Orbit events files, e.g. AOS/LOS times using the station horizon mask
- Orbit ephemeris messages for JPL/Horizons system.

R3.5.1.0-19 Orbit determination and prediction subsystem shall be able to predict Earth and Moon eclipses and Moon occultation.

R3.5.1.0-21 An automatically generated message shall be sent to ESOC scheduling office FCT, HSC, and PSO to indicate when updated orbit products are available.

The following requirements from [AD.5] shall be fulfilled:

FGS-IR-3.1-550 The MOC shall make available the orbit events corresponding to a given operational period.

FGS-IR-3.1-560 The HSC shall poll the MOC to know of the availability of new orbit event data for a given operational period.

FGS-IR-3.1-570 The HSC shall pull the orbit event data from the MOC.

3.2 On-Line Delivery Requirements

N/A

3.3 Off-Line Delivery Requirements

The following requirements from [AD.2] shall be fulfilled:

R4.2.0.0-1: The FDS shall support a file transfer system comparable in terms of function and interface with the XMM-NEWTON/ INTEGRAL file transfer system. Destination shall be either the Data Disposition System or the SCOS 2000 File Archive System, which shall perform the distribution to the recipients.

R4.2.0.0-2: The FDS shall support electronic notification, of the intended recipients of FDS



Requirements - Performance Requirements

products, of the availability of such products - the range of notification mechanisms to be defined in [RD.1]. Said mechanisms will also cover warnings (this does not exclude verbal notification during critical operations when FD staff are on-console).

3.4 *Performance Requirements*

R3.5.2.0-3: The orbit determination and prediction subsystem shall be able to predict orbit events times with an accuracy of 10 seconds over 6 months.

R3.5.2.0-4 With exception of the STDM files, all orbit products shall be updated following each regular orbit determination, i.e. weekly. STDM files shall be updated at a frequency deemed necessary for the antenna predictions.



4. *Interface Characteristics*

4.1 *Interface Location and Medium*

The HERSCHEL/FDS and PLANCK/FDS are parts of the Mission Operations Centres (MOC) at ESOC, Darmstadt.

4.2 *Hardware Characteristics and Limitations*

N/A

4.3 *Data Source, Destination and Transfer Mechanism*

Data Source is the FDS related to the mission, i.e. HERSCHEL/FDS or PLANCK/FDS.

Destinations are the MCS, the data archive, the ESOC scheduling office, the HERSCHEL Science Centre, and the PLANCK Science Office.

The transfer mechanism is the HERSCHEL/PLANCK File Transfer System (see [RD.1]).

4.4 *Node and Device Addressing*

N/A

4.5 *Relationship with other Interfaces*

The ESOC scheduling office will use the Herschel and Planck event files and the scheduling requests from the missions (Herschel, Planck, Mars Express, Rosetta, Venus Express) using New Norcia as prime ground station to produce a conflict-free ground station schedule [RD.2].





5. Access

5.1 Programs Using the Interface Data

The HERSCHEL/PLANCK orbit events file is used by

- the ESTRACK Management and Scheduling to generate station schedules;
- the HSC for information and diagnostic purposes;
- the PSO Science Pointing Planning Tool to extract eclipse and orbit manoeuvre times.

5.2 Failure Protection, Detection and Recovery Procedures

See [RD.1]

5.3 File Naming Conventions

The files have the following naming convention:

File	File Name	Extension
Short Term Orbit Events File	xyyyymmdd_vvvv	SEV
Long Term Orbit Events File	xyyyymmdd_vvvv	LEV

where

- - x is the spacecraft identifier: x = H for Herschel; x = P for Planck;
- - yyyymmdd is the creation date of the file;
- - vvvv is the version number of the file. Updates of the files on the same date will have different version numbers.

Each file is sent via the FTS wrapped up in a tar file. The naming convention of the wrapper files are provided in [RD.1].

5.4 Storage and File Deletion Requirements

For nominal operations, only the latest versions of the short and long term orbit events file are required.

5.5 Security Requirements

N/A



5.6 *Data Integrity Checks*

Flight Dynamics Test and Validation will check and authorise each orbit events file.

5.7 *Backup Requirements*

The HPMCS will provide a history of all data of operational relevance, in particular of the orbit events files.

5.8 *Input/Output Protocols, Calling Sequences*

N/A

5.9 *Synchronisation Requirements*

N/A

5.10 *Error Handling*

See [RD.1]



6. *Detailed Interface Specifications*

6.1 *Data Structure*

N/A

6.2 *Generation Method*

N/A

6.3 *Data Passed Across the Interface & Transfer Direction*

N/A

6.4 *Size and Frequency of Transfers*

The covered time span of each long term orbit events file extends from launch up to 6 months into the future.

The covered time span of each short term orbit events file extends from launch up to 2 months into the future.





7. Data Definition (Files)

7.1 File Characteristics

The orbit events file is an ASCII file, containing one record per event.

7.2 Header Records

N/A

7.3 Data Records

7.3.1 Record Format

The following table shows the format of the data records:

Name	Format	Contents
EVTID	A4	Event Type Identification
EVCNT	(X2,I10)	Event Count
PREREC	(X2,A1)	single character flag indicating whether event is predicted ('P') or reconstituted ('R')
EVTIM	(X2,A24)	Start Time of Event in the format 'YYYY-MM-DDThh:mm:ss.dddZ'
EVDUR	(X2,I8)	duration of event in seconds
EVTDES	(X2,A80)	description of event
LF	A1	single line feed character (ASCII 0Ahex)

The format definition refers to the ANSI FORTRAN notation for format statements.

EVTID is an alphanumeric string of length 4 which is unique for each event type.

EVCNT is a running number for each event type. It will always be in ascending consecutive order.

EVTIM is always given in UTC. The format is 'YYYY-MM-DDThh:mm:ss.dddZ' where YYYY is the year, MM the month, DD the day and hh, mm, ss and ddd are hours, minutes, seconds and milliseconds of the day. All other symbols are fixed character constants. The provided numerical accuracy of all events is 1 second, i.e. the milliseconds are always 0. EVDUR contains the duration of the event in seconds. Although the end of events can be derived from the start time of the event and its duration, the end of the event is additionally given for convenience. In this case EVTIM refers to the end of the event and EVDUR contains 0.



EVT DUR = -1 for an event indicates that the corresponding end event is not contained in the file (e.g. when the end event is later than the end time of the event file).

7.3.2 Event Types

The table at the end of this section shows all event types. The last column indicates whether a duration is related to the event or not.

In the following, additional comments are given.

The event types AxxH and LxxH refer to the event when the elevation of the line of sight from the G/S to the S/C rises above or falls below the horizon mask. The horizon mask defines, depending on the azimuth, the minimum required elevation of the antenna for reception of a signal. In the event description, the elevation of the horizon mask is given in degrees as 'nn'. The elevation for AxxH and LxxH may differ from each other.

The event types AxxF and LxxF refer to the event when the elevation of the line of sight from the GS to the S/C rises above or falls below five degrees (missions to the Lagrange points are not classified as deep space).

For the event types AxxH, AxxF, LxxH and LxxF the xx and XXX in EVTTID and EVTDES indicate the antenna and the ground station complex as follows:

G/S Antenna	xx (EVTTID)	XXX (EVTDES)
Perth	73	PER
New Norcia	74	NNO
Kourou	75	KOU
Maspalomas	82	MAS
Cebreros	83	CEB

Types LTCS and LTCE refer to the event, when the telecommand link between the G/S and the S/C is interrupted due an occultation by the Earth Moon. Types LTMS and LTME refer to the event, when the telemetry link is interrupted due an occultation by the Earth Moon. The G/S of the event is given as XXX in the event description with the same meaning as for the AOS/LOS events.

Types PENS and UMBS refer to the event, when the S/C enters the penumbra and umbra of the body indicated by xxx. The entry xxx can be either 'EAR' for Earth or 'MOO' for the Earth Moon. The events PENE and UMBE indicate the exit from penumbra and umbra. For the computation of the events, a spherical shape is assumed. For the Earth, the radius is equal to the equatorial radius of the ellipsoid.

Types OMAS and OMAE refer to orbit manoeuvre start time and end time. These times appear only as prediction (PREREC="P"), i.e. they will not be reconstructed after the manoeuvre. Moreover, these times are only given for orbit manoeuvres, i.e. for those manoeuvres that are made to maintain or change the orbit. Times for manoeuvres that are made to e.g. slew the spacecraft or to unload the momentum wheels are not included.



EVTID	Event Type	EVTDES	Duration until
AxxH	Acquisition of Signal at ground station with elevation angle nn	XXX_AOS_nn	XXX_LOS_nn
AxxF	Acquisition of Signal 5 degrees at ground station	XXX_AOS_05	XXX_LOS_5
LTCS	start of TC link interruption due to Earth Moon occultation	XXX_OCC_MOON_TC_START	XXX_OCC_MOON_TC_END
LTMS	start of TM link interruption due to Earth Moon occultation	XXX_OCC_MOON_TM_START	XXX_OCC_MOON_TM_END
PENS	penumbra start	xxx_PENUMBRA_START	xxx_PENUMBRA_END
UMBS	umbra start	xxx_UMBRA_START	xxx_UMBRA_END
OMAS	orbit manoeuvre start	ORB_MAN_START	ORB_MAN_END
LxxH	Loss of signal at ground station with elevation angle nn	XXX_LOS_nn	n/a
LxxF	Loss of signal 5 degrees at ground station	XXX_LOS_05	n/a
LTCE	end of TC link interruption due to Earth Moon occultation	XXX_OCC_MOON_TC_END	n/a
LTME	end of TM link interruption due to Earth Moon occultation	XXX_OCC_MOON_TM_END	n/a
UMBE	umbra end	xxx_UMBRA_END	n/a
PENE	penumbra end	xxx_PENUMBRA_END	n/a
OMAE	orbit manoeuvre end	ORB_MAN_END	n/a



Data Definition (Files) - File Example

7.4 File Example

A83F	3	P	2008-08-02T17:29:54.000Z	41120	CEB_AOS_05
A73H	1	P	2008-02-29T14:07:05.000Z	27161	PER_AOS_00
A74H	1	P	2008-02-29T14:08:20.000Z	25947	NNO_AOS_04
A73F	1	P	2008-02-29T14:08:40.000Z	25495	PER_AOS_05
A74F	1	P	2008-02-29T14:08:43.000Z	25431	NNO_AOS_05
A83H	1	P	2008-02-29T18:17:56.000Z	41473	CEB_AOS_03
A83F	1	P	2008-02-29T18:32:01.000Z	40800	CEB_AOS_05
L74F	1	P	2008-02-29T21:12:34.000Z	0	NNO_LOS_05
L73F	1	P	2008-02-29T21:13:35.000Z	0	PER_LOS_05
L74H	1	P	2008-02-29T21:20:47.000Z	0	NNO_LOS_03
A75H	1	P	2008-02-29T21:33:15.000Z	42959	KOU_AOS_02
L73H	1	P	2008-02-29T21:39:46.000Z	0	PER_LOS_00
A75F	1	P	2008-02-29T21:45:29.000Z	41358	KOU_AOS_05
L83H	1	P	2008-03-01T05:49:09.000Z	0	CEB_LOS_05
L83F	1	P	2008-03-01T05:52:01.000Z	0	CEB_LOS_05
L75F	1	P	2008-03-01T09:14:47.000Z	0	KOU_LOS_05
L75H	1	P	2008-03-01T09:29:14.000Z	0	KOU_LOS_02
A74H	2	P	2008-03-01T10:42:17.000Z	41221	NNO_AOS_00
A73H	2	P	2008-03-01T11:03:59.000Z	40920	PER_AOS_04
A74F	2	P	2008-03-01T11:05:12.000Z	39367	NNO_AOS_05
A73F	2	P	2008-03-01T11:06:53.000Z	39313	PER_AOS_05
A83H	2	P	2008-03-01T18:50:17.000Z	41725	CEB_AOS_03
A83F	2	P	2008-03-01T19:02:52.000Z	40831	CEB_AOS_05
L74F	2	P	2008-03-01T22:01:19.000Z	0	NNO_LOS_05
L73F	2	P	2008-03-01T22:02:06.000Z	0	PER_LOS_05
A75H	2	P	2008-03-01T22:08:07.000Z	42154	KOU_AOS_02
L74H	2	P	2008-03-01T22:09:18.000Z	0	NNO_LOS_03
A75F	2	P	2008-03-01T22:18:45.000Z	40666	KOU_AOS_05
L73H	2	P	2008-03-01T22:25:59.000Z	0	PER_LOS_00
L83F	1	P	2008-03-02T06:23:23.000Z	0	CEB_LOS_05
L83H	2	P	2008-03-02T06:25:42.000Z	0	CEB_LOS_05
L75F	2	P	2008-03-02T09:36:31.000Z	0	KOU_LOS_05
L75H	2	P	2008-03-02T09:50:41.000Z	0	KOU_LOS_01
A74H	3	P	2008-03-02T10:59:08.000Z	40736	NNO_AOS_00
A73H	3	P	2008-03-02T11:18:28.000Z	40611	PER_AOS_04
A74F	3	P	2008-03-02T11:21:23.000Z	38967	NNO_AOS_05
A73F	3	P	2008-03-02T11:23:07.000Z	38907	PER_AOS_05
OMAS	1	P	2008-03-02T13:56:23.000Z	460	ORB_MAN_START
OMAE	1	P	2008-03-02T14:04:03.000Z	0	ORB_MAN_END
A83H	3	P	2008-03-02T18:54:49.000Z	42191	CEB_AOS_02
A83F	3	P	2008-03-02T19:08:19.000Z	41149	CEB_AOS_05
L74F	3	P	2008-03-02T22:10:50.000Z	0	NNO_LOS_05
L73F	3	P	2008-03-02T22:11:34.000Z	0	PER_LOS_05



8. *Data Definition (Software Routines)*

8.1 *Routine Name and Description*

N/A

8.2 *Calling Sequence*

N/A

8.3 *Input Parameters*

N/A

8.4 *Output Parameters*

N/A

8.5 *Return Code*

N/A

8.6 *Restrictions on use*

N/A

8.7 *Running environment*

N/A

