ENVISAT–1
GROUND SEGMENT

MIPAS
Michelson Interferometer for Passive Atmospheric Sounding

MIPAS Level 1B Processing Input/Output Data Definition

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DOCUMENT CHANGE RECORD

Issue	Revision	Date	Chapter/Paragraph Number, Change Description (and Reasons)
1		95/12/08	First formal issue of document
2 draft		96/03/01	Draft of second version based on comments in NW/2994/HNE
2		96/03/15	Second formal issue of document
3		96/06/28	Revision of document based on comments in NW/3195/HNE and NW/3304/HNE
3	A	96/08/30	Revision of document based on comments in NW/3420/HNE
3	B	96/09/23	Revision of document based on comments in NW/3477/HNE and NW/3488/HNE
3	C	97/01/29	Revision of document according to task 1 described in PO-SW-ESA-GS-0545
3	D	97/03/04	Minor corrections
3	E	97/07/16	Minor corrections to comply with TDS version 1.1 issue (minor revision) Modification according to changes in CCN PO-CN-BOM-GS-0006 and MN PO-MN-ESA-0806.
3	F	97/10/01	Minor corrections to comply with TDS version 1.3
4		97/10/06	Revision of Level 1B to comply with PO-RS-MDA-GS-2009 Implement changes consequently to a) E-mail J.-C. Debruyn (ESTEC) of 26/Nov/97, MIPAS L1B comparison IODD 4.0 vs PO-RS-MDA-GS-2009, Issue 3B, Envisat 1 Products Specification and NW/4395/ b) NW/4395/HNE, 13/Oct/97
4	A	99/03/11	Update issue (minor revision) Modification according to changes in CCN PO-CN-BOM-GS-0006 and MN PO-MN-ESA-0806.
4	B	99/10/12	Update issue (minor revision) New Structure ADS for variable information p. 23, 24, 31, 32, 33, 39 and 43
4	C	00/01/17	Update issue (minor revision) New fields added in Structure ADS p. 39 and 43

4	D	01/04/20	Update issue (minor revision), typo error, issues of documents and new field in LOS calibration
4	E	02/10/15	Update issue (minor revision), Prepared by Ginette Aubertin, Jean-Francois Leroux, Approved by Gaetan Perron Add MDS Validity band PCD value for ADC saturation Remove MDS Quality PCD value = -1 for no MDS Add Footnote to MDS instrument activity field (see all vertical bars in the left margin)
5		06/02/14	Update issue (major revision, change L1B product size), Prepared by Ginette Aubertin, Approved by Robert Poulin Add MDS azimuth/elevation angles in topocentric coordinates and spare fields Add Auxiliary L0 data packet in MDS Add Quadratic spectral correction factor in Scan ADS and CSI ADF Add ILS frequency shift in CS1 ADF Add flag for restituted attitude LOS correction option in PS1 ADF Update product size
5	A	07/01/30	Update issue (minor version) Prepared by Ginette Aubertin Approved by Gaetan Perron Note that the track of changes in version 5 were kept in version 5A Modify field 12.5 in Scan Information ADS Wrong page numbering (39a, 40)
5	B	09/09/24	Update issue (minor version) Prepared by Ginette Aubetin, approved by Gaetan Perron Modify field 26 in L1B Specific Product Header
6		09/10/30	Update issue (minor version) Prepared by Ginette Aubertin Approved by Gaean Perron Modify fields 7.3 and 7.6 in Summary Quality GADS Add one DSD reference for Restituted Attitude file in SPH Modify field 13 in Processing Parameters ADF Modify field 84 and 85 in Sweep structure Modify fiels 14 to 17 in Measure header structure Add fields in CA1 ADF for alignment matrix and mirror non-linearity Delete Note 15 in Structure ADS section Add Day/Night flag in sweep information, and in scan information Add Offset validation parameters to Offset Validation ADF

6	A	14/10/27	Update issue (minor version) Prepared by Ginette Aubertin and approved by Gaetan Perron Modify Section 3.1 IDENTIFIER, add Note 3: Modify Section 4.1.2 number of annotation data sets Modify Section 4.1.2.2, field 47 Modify Section 4.1.2.3.1, SPH size and Total size Modify Section appendix A.1.1, field 17

1. INTRODUCTION

1.1 Purpose of Document

The purpose of this document is to give a definition of all input and output files required for the ground processing of MIPAS data. This document determines the format and dimension of these files for nominal operation of the instrument. Finally, it indicates the frequency at which these files are generated or used. This provides precise guidelines for the team(s) involved in the initial development phases of processing software for the ENVISAT Payload Data Segment (PDS).

1.2 Scope

This document concerns the processing at the ground segment of the MIPAS instrument data. It covers only the processing up to level 1B data products and only the processing specific to the MIPAS instrument. The processing of data produced when the instrument is under test or characterization, e.g. during commissioning phase, is also excluded.

1.3 Reference / applicable documents

1.3.1 Applicable Documents

This section contains a list of applicable and reference documents for the IODD document. The reader must refer to the STD document [RD 9] to obtain the issue number of each document applicable to the current MISS software release when annotated with a asterisk.

No	Reference	Issue	Title
[AD 1]	PO-RP-BOM-GS-0003	*	Detailed Processing Model and Parameter Data List Document (DPM/PDL) for MIPAS Level 1B Processing
[AD 2]	PO-RS-MDA-GS-2009	*	Envisat-1 Products Specifications
[AD 3]	PO-RS-DOR-MP-0001	7	MIPAS Instrument Specification
[AD 4]	PO-IS-GMV-GS-0558	*	ENVISAT-1 Mission CFI Software PPF_ORBIT Software User Manual
[AD 5]	PO-IS-GMV-GS-0559	*	ENVISAT-1 Mission CFI Software PPF_POINTING Software User Manual
[AD 6]	PO-ID-DOR-SY-0032	*	Payload to Ground Segment Interface Control Document
[AD 7]	PO-IS-GMV-GS-0557	*	ENVISAT-1 Mission CFI Software PPF_LIB Software User Manual

1.3.2 Reference Documents

No	Reference	Issue	Title
[RD 1]	PO-PL-DAS-MP-0031	1.0	In-Flight Calibration Plan
[RD 2]	PO-RS-ESA-GS-0121	1.0	ENVISAT-1 Ground Segment Payload Data Segment, Technical Requirements
[RD 3]	PO-TN-ESA-GS-0242	5	ENVISAT-1 Product Format Guidelines
[RD 4]	PO-RS-ESA-GS-0252	1	Guidelines for the specification of ground processing algorithms

[RD 5]	PO-TN-BOM-GS-0007	1A	MIPAS Observational data validation
[RD 6]	PO-TN-BOM-GS-0006	*	MIPAS In-Flight Spectral Calibration and ILS Retrieval
[RD 7]	PO-TN-BOM-GS-0003	*	MIPAS Ground Segment I/O Files Definition
[RD 8]	PO-TN-ESA-GS-0361	1	ENVISAT-1 Reference Definitions Document for Mission Related Software
[RD 9]	PO-MA-BOM-GS-0002	1C	MIGSP S/W Transfer Document (STD)

1.4 Acronyms

ADC	Analog-to-Digital Converter
ADS	Annotation Data Set
API	Application Process Identifier
APS	Absolute Position measurement Sensor
ASU	Azimuth Scan Unit
BB	Blackbody
CBB	Calibration Blackbody
CBE	CBB Electronics
CFI	Customer Furnished Items
DS	Data Set
DSD	Data Set Descriptor
DSR	Data Set Records
DTU	Detector Unit
ESU	Elevation Scan Unit
FIR	Finite Impulse Response
FEO	Front End Optics
FEP	Front End Processor
FOS	Flight Operation Segment
FOV	Field Of View
GADS	Global Annotation Data Set
ID	Identification
IGM	Interferogram
ILS	Instrument Line Shape
ISP	Instrument Source Packet
LOS	Line Of Sight
LRAC	Low-rate Reference Archive Center
MDS	Measurement Data Set
MJD	Modified Julian Date
MPH	Main Product Header
NRT	Near Real Time
PAW	Preamplifier Warm Stage
PCD	Product Confidence Data
PDHS	Payload Data Handling Station
PDS	Payload Data Segment
PF	Processing Facility
PRT	Probe Resistive Temperature
S/C	Spacecraft
S/W	Software
SBT	Satellite Binary Time
SDP	Spectral Data Points
SPE	Signal Processing Electronics

SPH	Specific Product Header
TBC	To Be Confirmed
TBD	To Be Defined
UTC	Universal Time Coordinated
VCDU	Virtual Channel Data Unit

r.u.

kbytes	kilo-bytes [kB]:	2^{10} bytes = 1024 bytes = 8 192 bits
Mbytes	Mega-bytes [MB]:	2^{20} bytes = 1 024 kbytes = 1 048 576 bytes = 8 388 608 bits
kbps	kilobytes/s	8 192 bits per second

1.5 Definitions

Auxiliary data:

Auxiliary data is defined for the present document as all the additional data required by the ground segment for the generation and delivery of ground segment data products and coming neither from the space segment nor from the ground segment. These data are intended to be rarely changed. They include templates for data validation, look-up tables for data conversion, etc.

Also all additional data, apart from observational data (IGM or LOS signal), sent to the ground segment by the instrument to allow full interpretation of its observational data.

Input data:

In the present document, the term input refers to the origin with respect to the ground processor. It also implicitly mean data that is continuously produced. Thus, input data will contain either the primary data coming from the Space Segment or additional data coming from the FOS.

Calibration data:

Data calculated by the ground segment from specific periodical observational data (IGM) and used to calibrate subsequent scene spectra.

Decimation:

Operation consisting in taking one out of a predetermined number of points in a sampled signal. It is also called “undersampling”. When a signal has been properly filtered, the decimation permits to decrease the number of points required to represent the signal with the same resolution.

Scene:

Atmosphere observation; defined in contrast with blackbody and deep space observation.

Interferometer Sweep:

An interferometer sweep is the data recorded during a single measurement resulting in a complete interferogram. A sweep can be in either direction, reverse or forward.

Elevation Scan Sequence:

An elevation scan sequence comprises a sequence of interferometer sweeps within a fixed time interval at variable elevation and azimuth with respect to the MIPAS local normal reference frame.

The number of interferometer sweeps per elevation scan sequence is commandable in the range from 1 to 75. A typical elevation scan sequence consists of 16 interferometer sweeps for operation with high spectral resolution. For operation with lowest spectral resolution, the typical elevation scan sequence consists of 75 interferometer sweeps.

The instrument can perform these typical elevation scan sequences within less than 75 seconds, not including the time required for an offset calibration.

The azimuth angle shall be adjustable during an elevation scan sequence within a limited range, but not during an interferometer sweep.

2. GENERAL ASSUMPTIONS

2.1 Measurement scenario and assumptions

The MIPAS instrument will be in orbit around the earth on the ENVISAT satellite. It will acquire data on a sweep basis. Each sweep will generate 8 IGM and 1 set of auxiliary data. The IGM are amplified, filtered and converted to digital data with a 16-bit ADC. The IGM are then numerically filtered with complex coefficients and decimated. Two pairs out of the 8 IGM are equalized and combined. There are then 6 decimated IGM, with complex data points (18 bits for the real part and 18 bits for the imaginary part) that must be sent to the earth along with 1 set of auxiliary data for each sweep. The communication is done with packet data. In order to lower the bit rate, the IGM are separated into blocks and a bit truncation is performed on each block. The packets are formed from one or more blocks coming from one or more IGM and the auxiliary data is appended to two packets belonging to a sweep. *It is assumed that all data from a particular sweep (IGM and auxiliary) will be completely sent before sending data belonging to another sweep.*

According to ground segment definitions, MIPAS is a global coverage low rate (LR) instrument. The data is recorded on board and transmitted to ground via recorder playback, nominally once per orbit. The data can also be downlinked in real time, when the platform is in direct view of a receiving station. This option is also used for the transmission of instrument data in the raw mode. However, such data need not be processed to level 1B. Therefore, we only have to consider the first mode of transmission. In that mode, the on-board recording will nominally keep the last 3 minutes of a given orbit in addition to the new data from the subsequent orbit. Thus, there will normally be an overlap of 3 minutes in the data acquired. This is to ensure that the processing on an orbital data package is done only on complete elevation scans. It is assumed that instrument data produced in raw mode are only processed up to level 0 in the PDHS.

In actual ground segment architectural design, the MIPAS level 1B products can be generated in three different sites. The PDHS at ESRIN and Kiruna will acquire and process in near real time (NRT). They will generate the so-called un-consolidated level 1B products. In addition the LRAC, located at Kiruna, will process the MIPAS data off-line. This station will generate the consolidated level 1B products. The PDHS's receive their data directly from the platform while the LRAC receives its data from the PDHS's and possibly from other receiving stations. In all cases, it will be assumed that the de-multiplexing, cleaning and time-ordering of the data has been done, since these steps are not specific to the MIPAS instrument. Therefore, our input data corresponds to level 0 products, i.e. source packets are received in the same sequence as they are generated by the MIPAS instrument.

Because the instrument will also perform special calibration measurements that are needed for the processing of normal scene measurements, there will be constraints imposed on the ground segment depending on the availability of measurements and product delivery time. These constraints concern mainly the PDHS receiving stations. They are discussed thereafter.

Since there is more than one site to receive the packets, *it is assumed that all the packets from one sweep are received at the same site*. The site is responsible to reconstruct the 6 IGM from the blocks in the packets and to extract the auxiliary data for the same sweep.

If the received IGM are from deep space measurements for offset calibration, the ground segment calculates an offset calibration data file. This file is required to process subsequent scene measurement. In case data contained in an on-board recorder dump do not start with a complete offset calibration measurement, all scene data will be calibrated with the first valid offset calibration file produced with that recording sequence. Deep space measurements for offset calibration are produced every 300 seconds.

If the received IGM are for gain calibration, 300 deep space and 300 blackbody sweeps for each direction (total 1200 sweeps = 7200 IGM) are required to calculate the gain calibration data file. *It is assumed that the 7200 IGM for the calculation of the gain calibration are all received at the same site*. They are then processed and a new gain calibration data file becomes available. This new file is for the calibration of subsequent scene IGM. It is important that it is sent as soon as possible to all other sites that will receive scene data in order to ensure the best data accuracy. Gain calibration will occur once a week.

If the received IGM are scene data, the ground segment calculates 5 calibrated spectra, one for each band, and outputs the annotated data. To calculate those spectra, the ground segment needs the auxiliary data and calibration data.

According to the current baseline LOS calibration data will be processed external to the PDHS stations. It is assumed that auxiliary products containing LOS correction parameters are routinely disseminated to all level 1B processing sites.

2.2 Philosophy of level 1B product definition

According to its definition, the level 1B product shall be an engineering product obtained from observational data converted into relevant physical units after all suitable calibration.

For MIPAS, the level 1B product is defined as localized, radiometrically and spectrally calibrated spectra annotated with ILS information and with data quality information. The level 1B product shall contain only complete scans. It means that incomplete scans at the beginning and end of the level 0 product shall be rejected.

2.2.1 Definition of the calibrations and validations

The **localization** is the process of assigning the position of the tangent height point of a given scene measurement as well as the time of measurement. The tangent point is determined from the platform position and attitude together with the LOS pointing of the instrument. The LOS pointing information is also calibrated using special measurements acquired once a month by the instrument. The calculation for localization proceeds in three steps. First, the orbit parameters are initialized, once per orbit, using a predicted orbital state vector provided by the FOS. Second, a propagation along the orbit is computed for each scene measurement to generate the actual platform coordinates of that measurement. Third, the localization of the tangent point is calculated using the platform coordinates and the instrument pointing angles transformed to the platform reference frame. This latter calculation should take into account the refraction in the atmosphere.

The **radiometric calibration** is the process of assigning values in spectral radiance units [r.u.] (W / (cm^{-1} sr cm^2)) to the intensity axis (y axis) with a specified accuracy. The radiometric calibration relation can be broken down into an instrument offset and an instrument responsivity. The instrument offset is the response of the instrument to a zero spectral radiance input. It corresponds to the signal produced by the instrument itself. The instrument responsivity is the proportionality factor, referred to as the gain, between the input spectral radiance and the actual output units. The **offset calibration** is the result of a dedicated processing at the ground segment of special in-flight measurements, the deep space measurements for offset calibration. The offset calibration data produced are included in the Level 1B product. The strategy 'closest valid in time before' shall be used for offset subtraction from scene. The same offset calibration data shall be used for scenes of an entire elevation scan. The **gain calibration** is the result of a dedicated processing at the ground segment of special measurements, the blackbody measurements and deep space measurements for gain calibration. The gain calibration produced is not used immediately. It will become valid for use in Level 1B processing only when being given a validity start time external to the MIPAS PF.

The **spectral calibration** is the process of assigning values in (cm^{-1}) to the wavenumber axis (x axis) with a specified accuracy. Unlike the previous calibrations, the spectral calibration does not require special measurements. In fact, it is the result of a dedicated processing at the ground segment of normal scene measurements. The spectral calibration is performed as part of the routine level 1B processing. The strategy 'closest valid in time before' shall be used for spectral calibration of scene. The spectral calibration data is written to file simultaneously with ILS calibration data. The spectral calibration produced file is not used immediately. It will become valid for use in Level 1B processing only when being given a validity start time external to the MIPAS PF.

The **ILS calibration** is the process of assessing the instrument response (the ILS) to a single monochromatic spectral line. In principle, there is a different ILS shape associated with each observed wavenumber. However, the ILS is assessed only at a limited number of wavenumber values (one per band [AD 1]). The ILS assessment is intended to remove the instrument response from the observed spectra in order to generate the true physical spectra. However, such a procedure is not performed within level 1B processing and the ILS data is only annotated to the output product. As for the spectral calibration, the ILS calibration does not require special measurements. In fact, it is the result of a dedicated processing at the ground segment of normal scene measurements. The ILS calibration is performed as part of the routine level 1B processing.

The **data quality validation** is the process of assessing the overall quality of the scientific observations. It is composed of a validation of the instrument operational status (instrument validation or health monitoring) and a validation of the observational data, including the scene measurements and the calibration measurements. Some form of observational data validation is performed on all measurements. However, depending on the type of data, the kind of validation and the level of validation differ. The overall approach for observational validation is defined in [RD 5].

2.2.2 Definition of the product items

As it was already mentioned, in typical operation, the data from the instrument would be recorded on board over an orbit and transmitted to ground once per orbit. Thus, the ground processor would normally receive large data sets containing all measurements performed during an orbit. It is therefore “natural” to deliver the level 1B product in product items that contain all scene measurements of the orbit. This approach was adopted here. It should be mentioned however that the structure of the product was defined to allow easy access to individual measurements and even to individual bands within a given measurement.

The structure of the level 1B product is defined considering the following approach.

- The orbit initialization data is inserted in the product item.
- Offset calibration is used for the calculation and inserted in the product item.
- LOS calibration is used for the calculation and inserted in the product item.
- Radiometric calibration is used for the calculation and referred in the product item.
- Spectral calibration is used for the calculation and inserted in the product item.
- ILS calibration is not used for the calculation (to level 1B, it is intended to be used at higher processing levels) and it is inserted in the product item.
- Data quality indicators are inserted in the product item.
- All other auxiliary data files used for ground processing are referred in the product item.

2.2.3 Data storage conventions of the product items

Data storage representation, bit and byte numbering convention used for product item in the current document are the same as those in annex A of [AD 2].

Within product file, no alignment of data field is done, they are all contiguous. It means that there is no gap (filler bytes) between fields.

3 OVERVIEW OF I / O FILES

3.1 Approach for file definition

For each file described in this document, the information is provided following a standardized template. The file description is broken down into the following categories: identifier, name, type, description, format, notes, size, throughput, and remarks. In this section, each category is defined and the different descriptors used within the categories are presented.

IDENTIFIER:

An identifier has been defined for each kind of file used and generated at the ground segment. This identifier will be used for referring to specific kind of files and for referring to the associated file format. The identifiers are listed in the following table.

Type	Identifier	Name
Product	MIP_NL__0P	Nominal level 0 product
	MIP_LS__0P	Level 0 product for LOS calibration[1]
	MIP_RW__0P	Raw data mode and SPE self test mode data[1]
	MIP_NL__1P	Level 1B output product
Calibration	MIP_CG1_AX	Gain calibration
	MIP_CL1_AX	LOS calibration
	MIP_CS1_AX	ILS and spectral calibration
	MIP_CO1_AX	Offset validation
Auxiliary	MIP_CA1_AX	Instrument characterization data[3]
	MIP_PS1_AX	Processing parameters
	MIP_MW1_AX	Microwindow dictionary
	DOR_NAV_0P or AUX_FPO_AX	NRT DORIS navigator data[2] FOS predicted orbit state vectors[2]
Scratch	MIP_L1A_SC	Level 1A

1: These input level 0 products will be processed external to the PDHS stations and will not be described in the present document.

2: For the computation of LOS tangent point geolocation data platform position is needed. Data provided by DORIS or alternatively by the FOS will be used. Detailed formats of the former are not available at the current stage and those of the later are described in [AD 2] volume 16.

3: MIP_CA1 should be now defined as a Calibration type because it contains Non-Linearity coefficients related to MIP_CG1, MIP_CO1 and MIP_CS1. These files form a quadruplet that must be used together.

NAME:

This section contains a short descriptive name of the file.

TYPE:

The file type defines the general relation of the file with the ground processor. The following types are defined.

Product: The file is either the primary data coming from the Space Segment (Input-SS) or an *output* of the ground processor, to be delivered to the end users.

Calibration: The file is an intermediate *input/output* of the ground processor. It is the result of the processing of special measurements, the calibration measurements. The file is used by the ground processor for further processing towards the generation of the products. It may also accumulate results computed from incoming data and it is used for the validation of the input data.

Auxiliary: The file is an *input* to the ground processor containing data coming neither from the space segment nor from the ground segment. The file may originate from on-ground characterization or may be determined analytically.

Scratch: The file is an intermediate *output* of the ground processor not intended to be delivered to the end users but could be used for temporary storage, internal check or verification.

DESCRIPTION:

This section provides details about the contents and purpose of the file.

FORMAT:

The format of the product file has been defined according to the guidelines of [AD 2].

The format of all files has been defined according to the approach described in the following:

- A file is divided into four main parts: a general header (MPH), a specific header (SPH), data set descriptors (DSD) followed by the actual data (DS). Each of these parts has a specific structure defined in the following sections.
- Floating-point is used to store some data. The standard used for their format is “ANSI IEEE” 754-1985. Single precision floating-point data requires 32 bits of storage while double precision floating-point data requires 64 bits of storage.
- In the format tables, the size is given in bytes (except specific cases when the unit of storage is explicitly given in bits).

UNIT:

Physical units of the field. A “-” is given for a field corresponding to a flag, an cardinal number, an identification string, or any other unitless type of information.

SIZE:

The size unit is generally 1 byte (8 bits). See Section 1.4 for the definition of units.

NOTES:

This section contains notes about fields in the file.

THROUGHPUT:

This section gives the current baseline interval between file updates and the equivalent throughput.

REMARKS:

This section contains specific remarks about the file.

3.2 Summary of I / O files

The following table presents a summary of the main characteristics of the files described in the remaining sections of the document.

Identifier	Name	Size / Update period[2]
MIP_NL__0P	Nominal level 0 product	316.6 Mbytes / orbit[3]
MIP_NL__1P	Level 1B output product	299.4 Mbytes / orbit[3]
MIP_CG1_AX	Gain calibration	946.9 kbytes / week
MIP_CL1_AX	LOS calibration[1]	2.9 kbytes / month
MIP_CS1_AX	ILS and spectral calibration	3.6 kbytes / week
MIP_CO1_AX	Offset validation	129.9 kbytes / ΔT_t
MIP_CA1_AX	Instrument characterization data	14.7 kbytes / 3 months
MIP_PS1_AX	Processing parameters	67.9 kbytes / ΔT_t
MIP_MW1_AX	Microwindow dictionary	10.5 kbytes / ΔT_t
MIP_L1A_SC	Level 1A	887.2 Mbytes / orbit[3]

1: According to current baseline these calibration data will be produced external to the PDHS stations.
2: The update periods given correspond to typical values, according to [RD 1], and the calibration periods are programmable. ΔT_t is the time interval for in-flight testing (TBD). In principle, different files could be updated at different time intervals.
3: An orbit lasts 100.6 minutes.
4: A (elevation) scan lasts approximately 70.15 seconds.

The following table gives a cross-reference of the files required in the processing and calculation of the output file (MIP_NL__1P) and the calibration files (MIP_CG1_AX and MIP_CS1_AX). LOS calibration and offset validation files (MIP_CL1_AX and MIP_CO1_AX) are produced external to the PDHS stations and files required are not given in the table. ILS and spectral calibration (MIP_CS1_AX) is to be calculated from calibrated spectra (MIP_NL__1P). By looking in a column, the reader can determine the required files (the lines with a check mark) for the processing of the file identifying the column.

Identifier	**Name**	MIP_NL__1P	MIP_CG1_AX	MIP_CS1_AX
MIP_NL__0P	Nominal level 0 product	✓	✓	
MIP_NL__1P	Level 1B output product			✓
MIP_CG1_AX	Gain calibration	✓		
MIP_CL1_AX	LOS calibration	✓		
MIP_CS1_AX	ILS and spectral calibration	✓	✓	
MIP_CO1_AX	Offset validation	✓		
MIP_CA1_AX	Instrument characterization data	✓	✓	✓
MIP_PS1_AX	Processing parameters	✓	✓	✓
MIP_MW1_AX	Microwindow dictionary			✓
DOR_NAV_0P or AUX_FPO_AX	NRT DORIS navigator data FOS predicted orbit state vectors	✓		

4. DETAILED I / O DATA FORMATS

4.1 Products

4.1.1 Level 0

IDENTIFIER: MIP_NL__0P

NAME: Nominal level 0 product

TYPE: Product

DESCRIPTION:

The content of the DSR of Level 0 corresponds to source packets from the instrument. Each source packet corresponds to reconstructed unprocessed instrument data. Reconstructed means demultiplexed, cleaned and time-ordered. Since source packets from all instruments on ENVISAT-1 are multiplexed before being sent to earth, de-multiplexing is performed at the ground processing in order to recover the source packets for each instrument separately. The packets are then cleaned (removing duplicates) and time-ordered. It is assumed that only one Level 0 product per orbit will have to be processed.

FORMAT:

The Level 0 PDS product consists of the following parts [AD 2]:

- a Main Product Header (MPH)
- a Specific Product Header (SPH)
- a Measurement Data Set (MDS)

The general structure of the file is illustrated in Figure 4.1-1.

MPH: The MPH contains the identity of the product and its main characteristics. The MPH is one record. The MPH has the same fixed format and length as all other products.

SPH: The SPH contains 2 DSD that describe the DS on board. The format/ length of each DSD record is identical for all products.

MDS: The MDS is a collection of DSR. Each MDS DSR contains a start time, a source packet and a demultiplexer PCD.

Level 0 is a collection of source packets that are grouped in a series corresponding to approximately one orbit of measurements. A series of measurements is the input file to the ground processing.

All data received from the satellite are formed into source packets. The nominal data rate for MIPAS is 533 kbits/sec. Each measurement sweep produces many source packets. Nominally, the data consists of 6 scene IGM separated into blocks and individually bit-truncated.

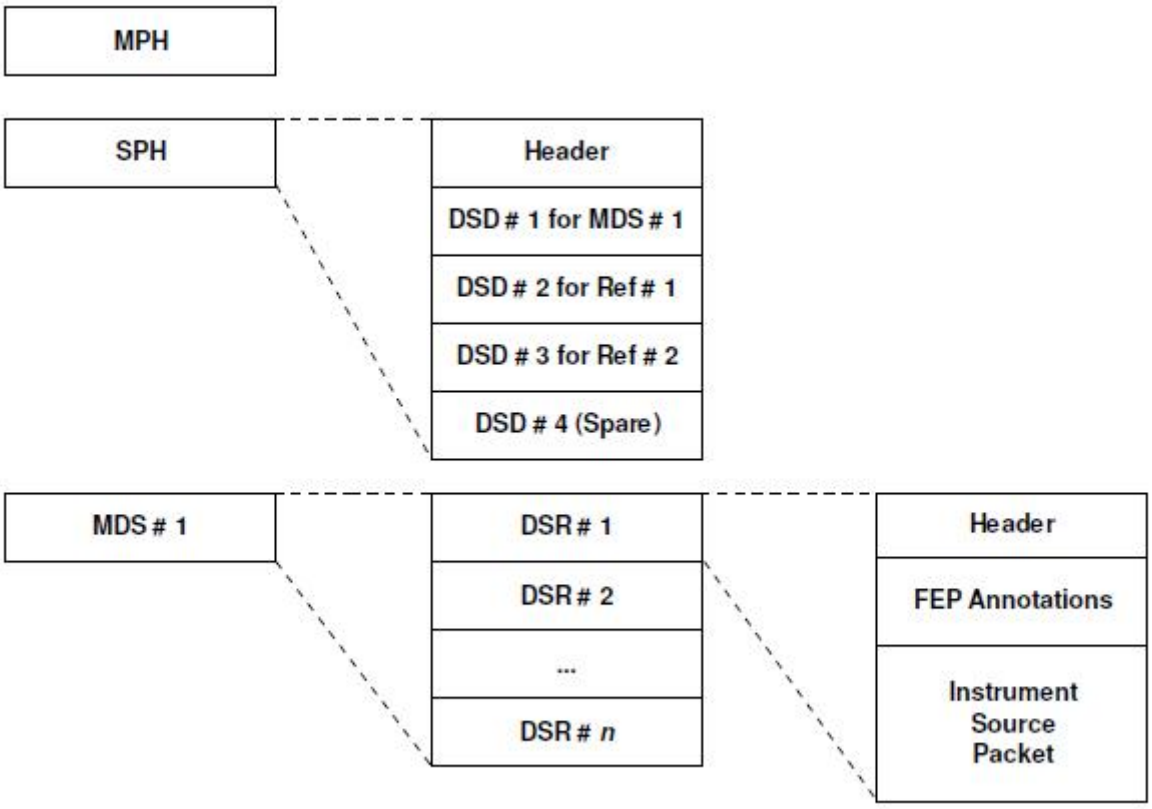

Figure 4.1-1 MIPAS Level 0 product file structure

4.1.1.1 Main Product Header structure

See section 4.1.2.1

4.1.1.2 Specific Product Header structure

The SPH contains four DSD: one describing a MDS that contains source packets, one referencing a level 0 processor configuration file, one for orbit state vector file used and one spare.

SECTION: ASCII SPH					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	SPH_DESCRIPTOR=	15*uc	keyword	15	
	quotation mark (“)	uc	-	1	
	SPH descriptor	28*uc	UTC	28	1
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
	Product location information				
2	START_LAT=	10*uc	keyword	10	
	WGS84 latitude of first satellite nadir point at the sensing start time of the MPH (positive north)	A1	10^{-6} degrees	11	
	<10-6degN>	10*uc	units	10	
	newline character	uc	terminator	1	
3	START_LONG=	11*uc	keyword	11	
	WGS84 longitude of first satellite nadir point at the sensing start time of the MPH (positive east, 0 = Greenwich)	A1	10^{-6} degrees	11	
	<10-6degE>	10*uc	units	10	
	newline character	uc	terminator	1	
4	STOP_LAT=	9*uc	keyword	9	
	WGS84 latitude of first satellite nadir point at the sensing stop time of the MPH (positive north)	A1	10^{-6} degrees	11	
	<10-6degN>	10*uc	units	10	
	newline character	uc	terminator	1	
5	STOP_LONG=	10*uc	keyword	10	
	WGS84 longitude of first satellite nadir point at the sensing stop time of the MPH (positive east, 0 = Greenwich)	A1	10^{-6} degrees	11	
	<10-6degE>	10*uc	units	10	
	newline character	uc	terminator	1	
6	SAT_TRACK=	10*uc	keyword	10	
	Sub-satellite track heading at the sensing start time in the MPH	Afl	degrees	15	
	<deg>	5*uc	units	5	
	newline character	uc	terminator	1	
7	Spare	50*uc	-	50	
	newline character	uc	terminator	1	

	Product confidence data information				
8	ISP_ERRORS_SIGNIFICANT=	23*uc	keyword	23	
	'1' if number of ISPs with CRC errors exceeds threshold, otherwise '0'	uc	-	1	
	newline character	uc	terminator	1	
9	MISSING_ISPS_SIGNIFICANT=	25*uc	keyword	25	
	'1' if number of missing ISPs exceeds threshold, otherwise '0'	uc	-	1	
	newline character	uc	terminator	1	
10	ISP_DISCARDED_SIGNIFICANT=	26*uc	keyword	26	
	'1' if number of ISPs discarded by PF-HS exceeds threshold, otherwise '0'	uc	-	1	
	newline character	uc	terminator	1	
11	RS_SIGNIFICANT=	15*uc	keyword	15	
	'1' if number of ISPs with Reed Solomon corrections exceeds threshold, otherwise '0'	uc	-	1	
	newline character	uc	terminator	1	
12	Spare	50*uc	-	50	
	newline character	uc	terminator	1	
	Other product quality information				
13	NUM_ERROR_ISPS=	15*uc	keyword	15	
	Number of ISPs containing CRC errors.	Al	ISPs	11	
	newline character	uc	terminator	1	
14	ERROR_ISPS_THRESH=	18*uc	keyword	18	
	Threshold at which number of ISPs containing CRC errors is considered significant.	Afl	percent	15	
	<%>	3*uc	units	3	
	newline character	uc	terminator	1	
15	NUM_MISSING_ISPS=	17*uc	keyword	17	
	Number of missing ISPs.	Al	ISPs	11	
	newline character	uc	terminator	1	
16	MISSING_ISPS_THRESH=	20*uc	keyword	20	
	Threshold at which number of ISPs missing is considered significant.	Afl	percent	15	
	<%>	3*uc	units	3	
	newline character	uc	terminator	1	
17	NUM_DISCARDED_ISPS=	19*uc	keyword	19	
	Number of ISPs discarded by PF-HS.	Al	ISPs	11	
	newline character	uc	terminator	1	
18	DISCARDED_ISPS_THRESH=	22*uc	keyword	22	
	Threshold at which number of ISPs discarded by PF-HS is considered significant.	Afl	percent	15	
	<%>	3*uc	units	3	
	newline character	uc	terminator	1	

19	NUM_RS_ISPS=	12*uc	keyword	12	
	Number of ISPs with Reed Solomon corrections.	Al	ISPs	11	
	newline character	uc	terminator	1	
20	RS_THRESH=	10*uc	keyword	10	
	Threshold at which number of ISPs with Reed Solomon corrections is considered significant.	Afl	percent	15	
	<%>	3*uc	units	3	
	newline character	uc	terminator	1	
21	Spare	100*uc	-	100	
	newline character	uc	terminator	1	
	ASAR specific information				
22	TX_RX_POLAR=	12*uc	keyword	12	
	quotation mark (“)	uc	-	1	
	Polarization	5*uc	ascii	5	2
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
23	SWATH=	6*uc	keyword	6	
	quotation mark (“)	uc	-	1	
	Swath number	3*uc	ascii	3	2
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
24	Spare	41*uc	-	41	
	newline character	uc	terminator	1	
	Data set descriptors				
25	DSD (M) for MDS	280*uc	dsd	280	3
26	DSD (R) pointing to configuration file	280*uc	dsd	280	3
27	DSD (R) pointing to the orbit state vector file used	280*uc	dsd	280	3
28	DSD – Spare (279 blank space characters followed by 1 newline character)	280*uc	dsd_sp	280	
TOTAL				1956	

NOTES:

1: e.g. "MIPAS_LEVEL_0_PRODUCT ".
2: Set to blank space.
3: "MIPAS_SOURCE_PACKETS " for MDS, "LEVEL_0_CONFIGURATION_FILE " and "ORBIT_STATE_VECTOR_FILE " for DSD referencing. For DSD ASCII format see section 4.1.2.2.

SIZE:

SPH size = 1956 bytes

4.1.1.3 Data Set structures

There is one DS for measurement data set (MDS). The MDS contains source packets and demultiplexer PCD.

SECTION: MDS #1					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	ISP sensing time (MJD)	s1, 2*ul	-	12	1
	FEP annotations				
2	Time stamp (MJD)	s1, 2*ul	-	12	1
3	Length of ISP (same as packet length in packet header)	us	bytes	2	
4	Number of VCDUs in the ISP which contain a CRC error	us	VCDUs	2	
5	Number of VCDUs in the ISP for which a Reed-Solomon error correction was performed	us	VCDUs	2	
6	Spare	2*uc	-	2	
	Instrument				
7	Source packet	*N**uc	-	*N*	2
TOTAL				32 + *N*	

NOTES:

1: MJD time format is described in [AD 2] annex A.
2: MIPAS source packet size is variable. See structure definition below.

For a complete description of the MIPAS source packet format and contents generated by the SPE, consult [AD 6] volume 4 and 8. The data field header size is of 1428 bytes at maximum. The source packets are organized as follows:

FIELD NAME	**SIZE** (in bits)
Packet Header	
Packet identification	
Packet version number	3
Packet type	1
Data field header flag	1
Application process ID	11
Packet sequence control	
Segmentation flags	2
Source sequence count	14
Packet Length	
Packet length	16
Packet Data Field	
Data field header	
Data Field header length	16
Instrument mode/ definition	16
ICU On-Board Time	32

Packet Type ID		4	
IGM-ID		16	
Number of blocks in packet		4	
Not used		8	
	Source ID Block #N	5	
Block info	Block Sequence Number Block #N	11	
(N=1..4)	No. of Samples Block #N	11	
	No. of Bits per Sample Block #N	5	
Auxiliary data		1 400	bytes
Source data field			
The source packet blocks		variable	

From the source packets, the "LOAD DATA" function of the ground segment is able to reconstruct the interferograms for each band and channels and to extract the auxiliary data. The format of the source packets is described in documents [AD 6], but is given here for completeness.

SIZE:

The size of the source packet is specified at the instrument level

minimum size: 1008 bytes
maximum size: 65542 bytes

Average size of source packets for a sweep in nominal measurement mode is 2850 bytes.

MDS #1 DSR average size = 32 + 2850 = 2882 bytes

In average, the number of source packets per sweep (nominal mode) is 90 and the number of sweeps per orbit is ~ 1280. Offset calibration sweeps are not taken into account for simplification, only scene sweeps.

DS = 90 × 1280 × 2882 = 332006400 bytes

Total size = 1247 bytes (MPH) + 1956 bytes (SPH) + 332006400 bytes (DS) ≈ 316.6 Mbytes

THROUGHPUT:

The throughput of the level 0 product in nominal measurement mode is

Throughput ~ 316.1 Mbytes / 100 min

4.1.2 Level 1B

IDENTIFIER: MIP_NL__1P

NAME: Level 1B product

TYPE: Product

DESCRIPTION:

The Level 1B product shall be an engineering product obtained from observational data converted into relevant physical units after all suitable calibration. The Level 1B product consists in a set of localized, radiometrically and spectrally calibrated spectra of the atmosphere with various annotated data calibrations, data assessments and data quality validation.

Each sweep generates 5 calibrated spectra (1 for each band) and 1 set of auxiliary data, all with the same time of measurement. The output data file contains the calibrated spectra with reference to calibration data and to the auxiliary data used during calculations. Each elevation scan header contains data specific for an individual elevation sequence belonging to the actual scene.

FORMAT:

The Level 1B PDS product consists of the following parts:

- a Main Product Header (MPH)
- a Specific Product Header (SPH)
- a Measurement Data Set (MDS)
- seven Annotation Data Sets (ADS)
- three Global Annotation Data Sets (GADS)

The general structure of the file is illustrated in Figure 4.1-2.

MPH: The MPH contains the identity of the product and its main characteristics. The MPH is one record. The Level 1B MPH is in ASCII format.

SPH: The SPH contains general information applicable to the whole product and 20 DSD that describes the DS on board and reference. The Level 1B SPH (including DSDs) is in ASCII format.

MDS: The MDS is a collection of DSR. Each MDS DSR contains a start time, sweep information and the spectra.

ADS: Each (of the seven) ADS is also a collection of DSR. Summary quality ADS contains quality information related to each scan. Geolocation ADS contains geolocation information related to each scan as the scan information ADS. A Structure ADS provides variable information in scan information ADS. Offset calibration ADS contains the offset data used for each scan. Finally, gain calibration ADS #1 and #2 contains gain data produced during processing (if any).

GADS: Each (of the three) GADS is also a collection of DSR. ILS and spectral calibration GADS contains the retrieved ILS data and the last spectral data if calculated during processing. LOS calibration GADS contains a copy of the LOS data used. Processing parameters GADS contains a copy of the processing parameter file used.

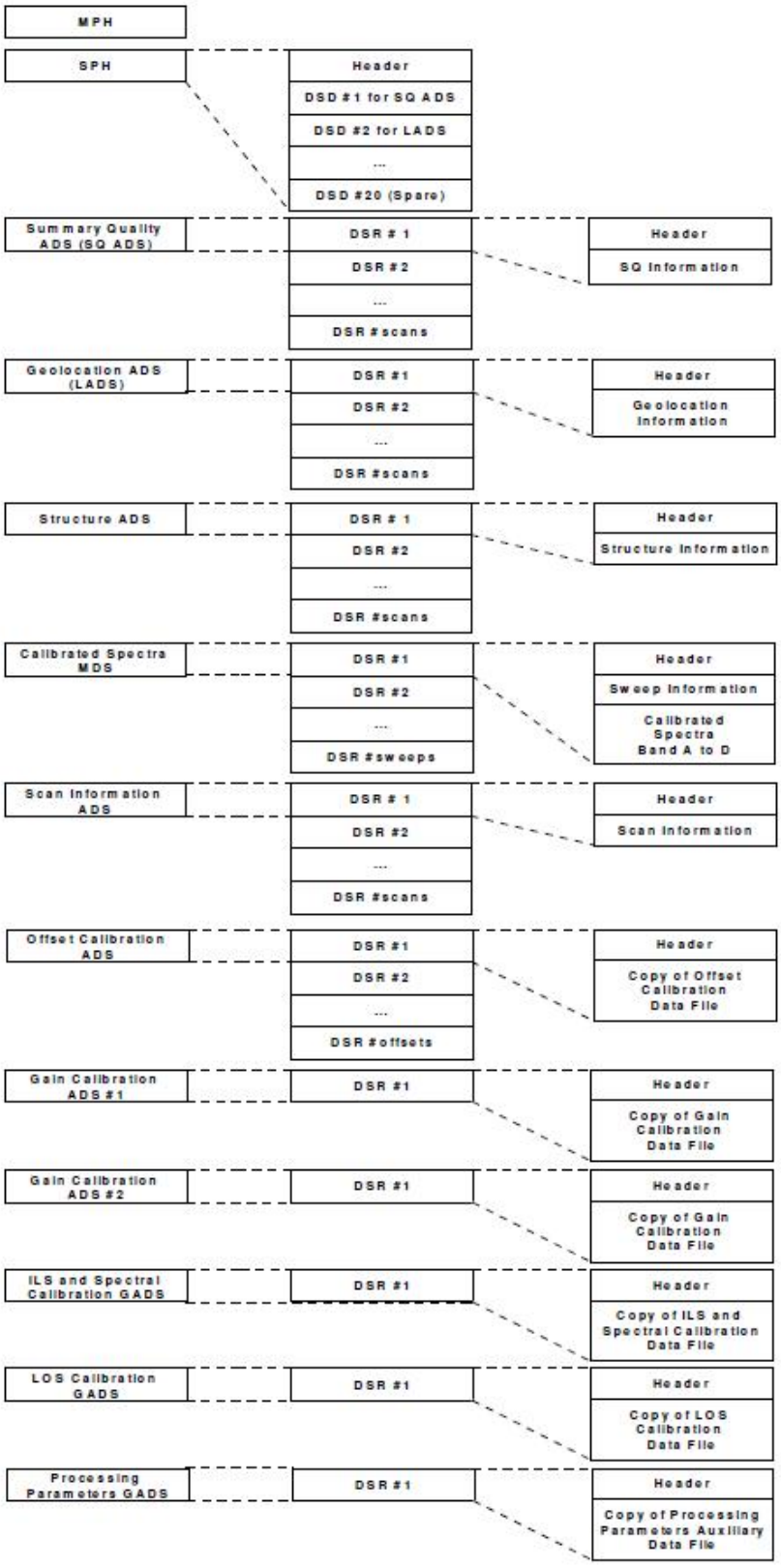

Figure 4.1-2 MIPAS level 1B product file structure

4.1.2.1 ASCII Main Product Header structure

SECTION: ASCII MPH					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	Product identification information				
1	PRODUCT=	8*uc	keyword	8	
	quotation mark (“)	uc	-	1	
	Product filename	62*uc	-	62	1
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
2	PROC_STAGE=	11*uc	keyword	11	
	Processing stage flag	uc	-	1	2, 8
	newline character	uc	terminator	1	
3	REF_DOC=	8*uc	keyword	8	
	quotation mark (“)	uc	-	1	
	Reference document describing product	23*uc	-	23	3
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
4	Spare	40*uc	-	40	
	newline character	uc	terminator	1	
	Information with regard to data acquisition and processing				
5	ACQUISITION_STATION=	20*uc	keyword	20	
	quotation mark (“)	uc	-	1	
	Acquisition station ID (up to 3 codes separated by commas)	20*uc	-	20	4
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
6	PROC_CENTER=	12*uc	keyword	12	
	quotation mark (“)	uc	-	1	
	Processing center ID which generated current product	6*uc	-	6	4
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
7	PROC_TIME=	10*uc	keyword	10	
	quotation mark (“)	uc	-	1	
	UTC time of processing	27*uc	UTC	27	5
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
8	SOFTWARE_VER=	13*uc	keyword	13	
	quotation mark (“)	uc	-	1	
	Software version number of processing software	14*uc	-	14	7
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
9	Spare	40*uc	-	40	
	newline character	uc	terminator	1	

	Information on time of data				
10	SENSING_START=	14*uc	keyword	14	
	quotation mark (“)	uc	-	1	
	UTC start time of data sensing	27*uc	UTC	27	5
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
11	SENSING_STOP=	13*uc	keyword	13	
	quotation mark (“)	uc	-	1	
	UTC stop time of data sensing	27*uc	UTC	27	5
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
12	Spare	40*uc	-	40	
	newline character	uc	terminator	1	
	Information on Envisat orbit and position				
13	PHASE=	6*uc	keyword	6	
	Phase	uc	-	1	8
	newline character	uc	terminator	1	
14	CYCLE=	6*uc	keyword	6	
	Cycle	Ac	-	4	6
	newline character	uc	terminator	1	
15	REL_ORBIT=	10*uc	keyword	10	
	Start relative orbit number	As	-	6	6
	newline character	uc	terminator	1	
16	ABS_ORBIT=	10*uc	keyword	10	
	Start absolute orbit number	As	-	6	6
	newline character	uc	terminator	1	
17	STATE_VECTOR_TIME=	18*uc	keyword	18	
	quotation mark (“)	uc	-	1	
	UTC of Envisat state vector	27*uc	UTC	27	5
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
18	DELTA_UT1=	10*uc	keyword	10	
	DUT1 = UT1 – UTC	Ado06	sec.	8	6
	<s>	3*uc	units	3	
	newline character	uc	terminator	1	
19	X_POSITION=	11*uc	keyword	11	
	X position in earth-fixed reference	Ado73	m	12	6
	<m>	3*uc	units	3	
	newline character	uc	terminator	1	
20	Y_POSITION=	11*uc	keyword	11	
	Y position in earth-fixed reference	Ado73	m	12	6
	<m>	3*uc	units	3	
	newline character	uc	terminator	1	
21	Z_POSITION=	11*uc	keyword	11	
	Z position in earth-fixed reference	Ado73	m	12	6
	<m>	3*uc	units	3	
	newline character	uc	terminator	1	

22	X_VELOCITY=	11*uc	keyword	11	
	X velocity in earth-fixed reference	Ado46	m/s	12	6
	<m/s>	5*uc	units	5	
	newline character	uc	terminator	1	
23	Y_VELOCITY=	11*uc	keyword	11	
	Y velocity in earth-fixed reference	Ado46	m/s	12	6
	<m/s>	5*uc	units	5	
	newline character	uc	terminator	1	
24	Z_VELOCITY=	11*uc	keyword	11	
	Z velocity in earth-fixed reference	Ado46	m/s	12	6
	<m/s>	5*uc	units	5	
	newline character	uc	terminator	1	
25	VECTOR_SOURCE=	14*uc	keyword	14	
	quotation mark (“)	uc	-	1	
	Source of orbit state vector	2*uc	-	2	9
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
26	Spare	40*uc	-	40	
	newline character	uc	terminator	1	
	SBT to UTC conversion information				
27	UTC_SBT_TIME=	13*uc	keyword	13	
	quotation mark (“)	uc	-	1	
	UTC time corresponding to SBT below	27*uc	UTC	27	5
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
28	SAT_BINARY_TIME=	16*uc	keyword	16	
	Satellite binary time (SBT)	Al	psec.	11	6
	newline character	uc	terminator	1	
29	CLOCK_STEP=	11*uc	keyword	11	
	Clock step size	Al	psec.	11	6
	<ps>	4*uc	units	4	
	newline character	uc	terminator	1	
30	Spare	32*uc	-	32	
	newline character	uc	terminator	1	
	Leap second information				
31	LEAP_UTC=	9*uc	keyword	9	
	quotation mark (“)	uc	-	1	
	UTC time of the occurrence of the leap second	27*uc	UTC	27	5
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
32	LEAP_SIGN=	10*uc	keyword	10	
	Leap second sign	Ac	s	4	6, 10
	newline character	uc	terminator	1	
33	LEAP_ERR=	9*uc	keyword	9	
	Leap second error	uc	-	1	11
	newline character	uc	terminator	1	
34	Spare	40*uc	-	40	
	newline character	uc	terminator	1	

	Product confidence data information				
35	PRODUCT_ERR=	12*uc	keyword	12	
	Product error	uc	-	1	12
	newline character	uc	terminator	1	
	Product size information				
36	TOT_SIZE=	9*uc	keyword	9	
	Total size of product	Ad	bytes	21	6
	<bytes>	7*uc	units	7	
	newline character	uc	terminator	1	
37	SPH_SIZE=	9*uc	keyword	9	
	Length of SPH	Al	bytes	11	6
	<bytes>	7*uc	units	7	
	newline character	uc	terminator	1	
38	NUM_DSD=	8*uc	keyword	8	
	Number of DSDs	Al	bytes	11	6
	newline character	uc	terminator	1	
39	DSD_SIZE=	9*uc	keyword	9	
	Length of each DSD	Al	bytes	11	6
	<bytes>	7*uc	units	7	
	newline character	uc	terminator	1	
40	NUM_DATA_SETS=	14*uc	keyword	14	
	Number of DSs attached	Al	bytes	11	6
	newline character	uc	terminator	1	
41	Spare	40*uc	-	40	
	newline character	uc	terminator	1	
TOTAL				1247	

NOTES:

1: Filename without extension, see [AD 2] volume A.
2: Set respectively to 'N' = Near Real Time, 'T' = Test Product, 'S' = Special Product and 'V' = Fully Validated.
3: ESA standard document no with version/issue, e.g., "AA-BB-CCC-DD-EEEE_V/I ".
4: For station center ID, see [AD 2] vol. 5. IDs are : PDHS-K, PDHS-E, LRAC, PDCC, FOS-ES, PDAS-F, UK-PAC, D-PAC, I-PAC, F-PAC, S-PAC, E-PAC and ECMWF.
5: UTC time format "DD-MMM-YYYY hh:mm:ss.tttttt", see [AD 2].
6: ASCII equivalent formats (S=sign + or -, X = a single number in ASCII format between 0 and 9) :

Ac	SXXX	4 bytes
As	SXXXXX	6 bytes
Al	SXXXXXXXXXX	11 bytes
Afl	SX.XXXXXXXXESXX	15 bytes
Ad	SXXXXXXXXXXXXXXXXXXXX	21 bytes
Ado	SX.XXXXXXXXXXXXXXXXXXESXXX	25 bytes
Ado*mn*	SXX⋯X.XX⋯X	2+*m*+*n* bytes

m is the number of digits before decimal points
n is the number of digits after decimal points

If not used, sign is set to + and numbers to 0, e.g., +.000000 for an Ado06 field.
7: Name of processor (up to 9 characters) / version number (up to 4 characters). E.g. "MIPAS/2.31 ".
8: If not used set to 'X'.

9: Sources are : FP = FOS predicted, DN = DORIS Level 0, FR = FOS restituted, DI = DORIS initial orbit and DP = DORIS precise orbit.
10: +000 if positive leap second, -001 if negative.
11: 1 if a leap second occurs within processing segment, 0 otherwise.
12: 1 if one (or more) error has been reported in the product, 0 otherwise.

SIZE:

ASCII MPH size = 1247 bytes

4.1.2.2 Specific Product Header structure

The first part of the SPH contains specific information related to the level 1B product. The last part contains DSD.

SECTION: ASCII SPH					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	SPH_DESCRIPTOR=	15*uc	keyword	15	
	quotation mark (“)	uc	-	1	
	SPH descriptor	28*uc	-	28	2
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
2	STRIPLINE_CONTINUITY_INDICATOR=	31*uc	keyword	31	
	Stripline counter	Ac	-	4	
	newline character	uc	terminator	1	
3	SLICE_POSITION=	15*uc	keyword	15	
	Slice position	Ac	-	4	3
	newline character	uc	terminator	1	
4	NUM_SLICES=	11*uc	keyword	11	
	Number of slices in this stripline	Ac	-	4	3
	newline character	uc	terminator	1	
	Product location information				
5	START_TIME=	11*uc	keyword	11	
	quotation mark (“)	uc	-	1	
	ZPD time of first MDSR of the first scan in the product	27*uc	UTC	27	
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
6	STOP_TIME=	10*uc	keyword	10	
	quotation mark (“)	uc	-	1	
	ZPD time of last MDSR of the last scan in the product	27*uc	UTC	27	
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	

7	FIRST_TANGENT_LAT=	18*uc	keyword	18	
	Latitude of LOS tangent point at center of scan (refraction corrected) of the first scan in the product. Positive north.	A1	10^{-6} degrees	11	
	<10-6degN>	10*uc	units	10	
	newline character	uc	terminator	1	
8	FIRST_TANGENT_LONG=	19*uc	keyword	19	
	Longitude of LOS tangent point at center of scan (refraction corrected) of the first scan in the product. Positive east.	A1	10^{-6} degrees	11	
	<10-6degE>	10*uc	units	10	
	newline character	uc	terminator	1	
9	LAST_TANGENT_LAT=	17*uc	keyword	17	
	Latitude of LOS tangent point at center of scan (refraction corrected) of the last scan in the product. Positive north.	A1	10^{-6} degrees	11	
	<10-6degN>	10*uc	units	10	
	newline character	uc	terminator	1	
10	LAST_TANGENT_LONG=	18*uc	keyword	18	
	Longitude of LOS tangent point at center of scan (refraction corrected) of the last scan in the product. Positive east.	A1	10^{-6} degrees	11	
	<10-6degE>	10*uc	units	10	
	newline character	uc	terminator	1	
11	Spare	50*uc	-	50	
	newline character	uc	terminator	1	
	General product information				
12	TOT_SWEEPS=	11*uc	keyword	11	
	Total number of sweeps in product	As	-	6	
	newline character	uc	terminator	1	
13	TOT_SCANS=	10*uc	keyword	10	
	Total number of scans in product (*N*)	As	-	6	
	newline character	uc	terminator	1	
14	TOT_NOM_SCANS=	14*uc	keyword	14	
	Number of nominal elevation scans in product	As	-	6	
	newline character	uc	terminator	1	
15	NUM_SWEEPS_PER_SCAN=	20*uc	keyword	20	
	Number of sweeps per nominal elevation scan	As	-	6	
	newline character	uc	terminator	1	
16	SCANS_PER_OFF_CAL=	18*uc	keyword	18	
	Number of nominal elevation scans per offset calibration	As	-	6	
	newline character	uc	terminator	1	
17	TOT_SP_SCANS=	13*uc	keyword	13	
	Number of special event scans in product	As	-	6	
	newline character	uc	terminator	1	

18	FRINGES_PER_SCENE=	18*uc	keyword	18	
	Number of fringe counts (samples at ADC) in scene (nominal mode)	Al	-	11	
	newline character	uc	terminator	1	
19	NUM_POINTS_PER_BAND=	20*uc	keyword	20	
	Number of points in bands	5*Al	-	55	1
	newline character	uc	terminator	1	
20	FIRST_WAVENUM=	14*uc	keyword	14	
	Wavenumber of first point in bands	5*Ado	cm^{-1}	125	1
	<cm-1>	6*uc	units	6	
	newline character	uc	terminator	1	
21	LAST_WAVENUM=	13*uc	keyword	13	
	Wavenumber of last point in bands	5*Ado	cm^{-1}	125	1
	<cm-1>	6*uc	units	6	
	newline character	uc	terminator	1	
22	NUM_NESR_PNTS=	14*uc	keyword	14	
	Number of points in NESR reported	Al	-	11	
	newline character	uc	terminator	1	
23	NESR_FIRST_WAVENUM=	19*uc	keyword	19	
	Wavenumber of first point in NESR reported	Ado	cm^{-1}	25	
	<cm-1>	6*uc	units	6	
	newline character	uc	terminator	1	
24	NESR_LAST_WAVENUM=	18*uc	keyword	18	
	Wavenumber of last point in NESR reported	Ado	cm^{-1}	25	
	<cm-1>	6*uc	units	6	
	newline character	uc	terminator	1	
25	SWEEP_ID=	9*uc	keyword	9	
	Sweep ID counter of first sweep in current product (as in source packet)	As	-	6	
	newline character	uc	terminator	1	
26	MAX_PATH_DIFF=	14*uc	keyword	14	4
	Maximum path difference in nominal scene measurements.	Afl	cm	15	
	<cm>	4*uc	units	4	
	newline character	uc	terminator	1	
27	Spare	47*uc	-	47	
	newline character	uc	terminator	1	
	Data set descriptors for attached data sets				
28	DSD for the SQ ADS	280*uc	dsd	280	
29	DSD for the Geolocation ADS (LADS)	280*uc	dsd	280	
29.5	DSD for ADS – Structure ADS	280*uc	dsd	280	
30	DSD for MDS	280*uc	dsd	280	
31	DSD for ADS – Scan Information ADS	280*uc	dsd	280	
32	DSD for ADS – Offset Calibration ADS	280*uc	dsd	280	
33	DSD for ADS – Gain Calibration ADS #1 (set to NOT USED if data not included in the product)	280*uc	dsd	280	

34	DSD for ADS – Gain Calibration ADS #2 (set to NOT USED if data not included in the product)	280*uc	dsd	280	
35	DSD for GADS – ILS and Spectral Calibration GADS (set to NOT USED if data not included in the product)	280*uc	dsd	280	
36	DSD for GADS – LOS Calibration Data	280*uc	dsd	280	
37	DSD for GADS – Processing Parameters Data	280*uc	dsd	280	
	Data set descriptors for referenced files				
38	DSD (R) for ILS and Spectral Calibration File used during processing	280*uc	dsd	280	
39	DSD (R) for Gain Calibration File used during processing	280*uc	dsd	280	
40	DSD (R) for Line of Sight Calibration File used during processing	280*uc	dsd	280	
41	DSD (R) for Instrument Characterization Data Calibration File used during processing	280*uc	dsd	280	
42	DSD (R) for Offset Validation Auxiliary Data File used during processing	280*uc	dsd	280	
43	DSD (R) for Microwindow Dictionary File used during processing	280*uc	dsd	280	
44	DSD (R) for Level 1B Processing Parameters File used during processing	280*uc	dsd	280	
45	DSD (R) for level 0 product file	280*uc	dsd	280	
46	DSD (R) for Orbit Data file used	280*uc	dsd	280	
47	DSD (R) for Restituted Attitude file used	280*uc	dsd	280	5
TOTAL				7040	

NOTES:

1: Field for common spectral axis definition (listed in order of band A, AB, B, C and D).
2: e.g. "MIPAS_LEVEL_1B_PRODUCT ".
3: Set to +001 if no stripline continuity.
4: Set to the same value as the field 51 of MIP_PS1_AX that was used to generate the L1B product.
5. Set to the name of restituted attitude file (AUX_FRA_AX) if used during the processing to correct the pointing, otherwise set this field to “MISSING”.

SIZE:

SPH size = 7040 bytes

The DSD has the following ASCII format.

SECTION: ASCII DSD					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	DS_NAME=	8*uc	keyword	8	
	quotation mark (“)	uc	-	1	
	Data set name	28*uc	-	28	1
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
2	DS_TYPE=	8*uc	keyword	8	
	DS type	uc	-	1	2
	newline character	uc	terminator	1	
3	FILENAME=	9*uc	keyword	9	
	quotation mark (“)	uc	-	1	
	External product reference	62*uc	-	62	
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
4	DS_OFFSET=	10*uc	keyword	10	
	DS offset in bytes	Ad	bytes	21	3
	<bytes>	7*uc	units	7	
	newline character	uc	terminator	1	
5	DS_SIZE=	8*uc	keyword	8	
	Total size of DS in bytes	Ad	bytes	21	4
	<bytes>	7*uc	units	7	
	newline character	uc	terminator	1	
6	NUM_DSR=	8*uc	keyword	8	
	Number of DSRs within the DS	Al	-	11	5
	newline character	uc	terminator	1	
7	DSR_SIZE=	9*uc	keyword	9	
	Length of the DSR in bytes	Al	bytes	11	6
	<bytes>	7*uc	units	7	
	newline character	uc	terminator	1	
8	Spare	32*uc	-	32	
	newline character	uc	terminator	1	
TOTAL				280	

NOTES:

1: Data set names:
"SUMMARY QUALITY ADS" for summary quality ADS,
"GEOLOCATION ADS" for geolocation ADS,
"STRUCTURE ADS" for structure information ADS,
"MIPAS LEVEL-1B MDS" for calibrated spectra MDS,
"SCAN INFORMATION ADS" for scan information ADS,
"OFFSET CALIBRATION ADS" for offset calibration ADS,
"GAIN CALIBRATION ADS#1" for gain calibration ADS #1,
"GAIN CALIBRATION ADS#2" for gain calibration ADS #2,
"ILS/SPECTRAL CAL GADS" for ILS and spectral calibration GADS,
"LOS CALIBRATION GADS" for LOS calibration GADS,

"PROCESS PARAMETERS GADS" for processing parameters GADS,
"ILS&SPECTRAL CAL FILE" for ILS and spectral calibration reference,
"GAIN CALIBRATION FILE" for gain calibration reference,
"LINE OF SIGHT FILE" for LOS calibration reference,
"INSTRUMENT CHAR FILE" for instrument characterization reference,
"OFFSET VALIDATION FILE" for offset validation reference,
"MICROWINDOWS FILE" for microwindow dictionary reference,
"PROCESS PARAMETERS FILE"" for processing parameters reference,
"ORBIT DATA FILE" for orbit data reference,
“RESTITUTED ATTITUDE FILE” for restituted attitude reference,
and "LEVEL-0 PRODUCT FILE" for level 0 reference.

2: =’M’ if a Measurement DS is attached
=’A’ if an Annotation DS is attached
=’G’ if a Global ADS is attached
=’R’ if no DS is attached (reference DSD only)

3: Position of the first byte of the corresponding DS wrt to the whole product.

4: Length in bytes of the corresponding DS.

5: e.g., number of sweeps for MDS.

6: 0 if no DS attached, -1 if size is variable.

4.1.2.3 Data Set structure

4.1.2.3.1 Measurement Data Set structure

The MDS contains sweep data, i.e., sweep information and calibrated spectra. The spectra are calibrated radiometrically, spectrally and localized.

SECTION: MDS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	ZPD crossing time (MJD)	s1, 2*ul	-	12	1
2	Quality indicator (PCD) Summary PCD information per band (field 24.6) : "0" = non-corrupted, "1" = one or more bands corrupted.	sc	-	1	
	Sweep header				
3	Sequential ID counter	us	-	2	2
4	S/C position vector in earth-fixed reference	3*do	km	24	10
5	LOS pointing angles (azimuth and elevation)	2*do	degrees	16	3
6	Tangent point geolocation (limb and error)	2*do	km	16	11
7	Tangent point geolocation (lat./long.)	2*sl	10^{-6} degrees	8	12
8	Radius of earth surface curvature in looking direction at nadir of LOS tangent point	do	km	8	13
9	Target to satellite range rate	do	km/sec	8	14
10	Target geodetic altitude rate	do	km/sec	8	15
11	Interferogram min/max at ADC for each detector. Min for all detectors followed by max for all detectors	16*ss	-	32	8, 16
12	Sweep ID counter (as in source packet)	us	-	2	8
13	Instrument mode/activity	us	-	2	8, 19
14	Last commanded number of sweeps	us	-	2	8
15	Relative position of current sweep in scan	us	-	2	9
16	Doppler correction factor calculated	do	-	8	9
17	Number of detected/corrected spikes	6*us	-	12	4, 17
18	Spike positions in the interferogram	6 × 10*ul	-	240	5, 17
19	Spike amplitudes	6 × 10 × 2*do	-	960	6, 17
20	Number of remaining detected/corrected spikes	6*us	-	12	9, 17
21	Average amplitudes of remaining detected/corrected absolute spike values	6 × 2*do	-	96	9, 17
22	Commanded left & right fringe count	2*ul	-	8	8
23	APS position at last scan gate start & stop	2*ul	-	8	8
24	Detected/corrected fringe count errors PCD	ss	-	2	9
24.5	Sweep direction, "F" forward and "R" reverse	uc	-	1	8

24.6	Band validity PCD (5 values, for band A, AB, B, C, D), "0" = non-corrupted, "2" = corrupted due to transmission errors, "4" = corrupted due to observational validation, "8" = corrupted due to ADC saturation.	5*uc	-	5	18
24.7	Detector non-linearity flux validity (4 values, for detectors A1, A2, AB and B), "0" = flux value is valid, "1" = flux > upper threshold or < lower threshold	4*uc	-	4	
24.8	Warning flag in ISP	us	-	2	
24.9	Error flag in ISP	us	-	2	
24.10	LOS elevation angle in topocentric coordinates	do	Degrees	8	
24.11	LOS azimuth angle in topocentric coordinates	do	Degrees	8	
25	Spare	2*uc	-	2	
25.1	Auxiliary L0 data packet	1400*uc	-	1400	20
25.2	Day/Night flag -1 Sun eclipsed by earth at tangent point +1 Sun direct sight at tangent point	ss	-	2	
25.3	Spare	510*uc	-	510	
	Processed data				
26	Spectral data points band A	N_A*fl	r.u.	$N_A \times 4$	7
27	Spectral data points band AB	N_{AB}*fl	r.u.	$N_{AB} \times 4$	7
28	Spectral data points band B	N_B*fl	r.u.	$N_B \times 4$	7
29	Spectral data points band C	N_C*fl	r.u.	$N_C \times 4$	7
30	Spectral data points band D	N_D*fl	r.u.	$N_D \times 4$	7
TOTAL				3433 + 4 $\times \sum N$	

NOTES:

1: MJD time format is described in [AD 2] annex A.
2: The sweep ID counter is a sequential counter that starts at 0 for each output file. It identifies each sweep contained within an output file (level 1B product).
3: Reference frame and definition as defined in [RD 8].
4: Result of spike detection/correction for the current sweep and for each of the 6 channels/bands. Are stored the number of spikes detected/corrected, the location of the bad pixel and the amplitude of the spikes (for the 10 highest) and the number and average of the remaining spikes. We also suppose that all detected spikes have been corrected.
5: Position of spike given in sampling number.
6: Amplitude (complex) of spike is given in arbitrary or normalized units as given at the output of the instrument.
7: Single precision floating point data is assumed for the calculated spectra. Amplitude of points is given in radiance units [W/(cm^2 sr cm^{-1})]. The given data points are real. The imaginary part (i.e.,

noise) is summarized and reported in the scan header information ADS #7. The number of points for each band is given in the SPH.

8: Extracted from ISP.
9: Calculated by the Level 1B processor.
10: Output POS of orbit propagator CFI S/W.
11: Output RES[6]/(7) of payload to target CFI S/W.
12: Output RES[3]/(4) and RES[5]/(6) of payload to target CFI S/W.
13: Output RES[15]/(16) of payload to target CFI S/W.
14: Output RES[37]/(38) of payload to target CFI S/W.
15: Output RES[23]/(24) of payload to target CFI S/W.
16: Channel sequence A1, A2, B1, B2, C1, C2, D1, D2.
17: Channel/band sequence A1, A2, B1, B2, C, D.
18: The band validity PCD is set to "2", if the auxiliary data was not found or not usable in the ISP, or the band AB had a missing ISP, or all bands are corrupted due to WARNING or ERROR flags set in the ISP. The band validity PCD is set to "8", if ADC saturation (<= -32768 or > 32767) occurred for this band.
19: This field holds the code for "instrument mode" and 'sub-activity' within that mode. The corresponding bit pattern is copied from the instrument source packets and converted into decimal. Refer to [AD6] for complete information.
Exemple: '39169' for nominal activity
'39172' for 'special events' activity (can be rearward or sideways)
20: This field is a copy of the ICU/SPE auxiliary packet contained in the the L0 Product for each measurement. Refer to [AD6] section 8.4.3 for complete description.

SIZE:

The following table computes the total number of points according to resolution.

Number of points in each band depending on resolution:

Band	Range	Bandwidth	Number of points depending on output requested resolution		
	[cm^{-1}]	[cm^{-1}]	0.025 cm^{-1}	0.05 cm^{-1}	0.25 cm^{-1}
A	685 – 970	285	11 401	5 701	1 141
AB	1020 – 1170	150	6 001	3 001	601
B	1215 – 1500	285	11 401	5 701	1 141
C	1570 – 1750	180	7 201	3 601	721
D	1820 – 2410	590	23 601	11 801	2 361
TOTAL		1 490	59 605	29 805	5 965

With 1280 (see section 4.1.1.3) sweeps in an orbit at maximal output requested resolution (59605 data points for the 5 bands), the size is:

MDS total size = $1280 \times (3433 + (59605 \times 4))$ bytes = 309571840 bytes

4.1.2.3.2 Annotation Data Set structure

The first ADS contains summary quality information. The second ADS contains geolocation information. The third ADS contains scan information. The fourth ADS contains offset calibration data. The fifth ADS contains gain calibration data. The sixth ADS contains gain validation data (statistics). The first GADS contains ILS and spectral calibration data. The second GADS contains LOS calibration data. The third GADS contains processing parameters data.

SECTION: SQ ADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	ZPD crossing time of first sweep in scan (MJD)	s1, 2*ul	mjd	12	1
2	Attachment flag	uc	-	1	11
	Scan quality information				
3	Number of corrupted sweeps	us	-	2	6
4	Number of corrupted sweeps with instrument errors	us	-	2	6
5	Spare (always set to 0)	us	-	2	
6	Number of corrupted sweeps with observational errors	us	-	2	6
7	Deleted. No field				
7.3	Number of sweeps for which the phase parameter exceeds 0.1 Sequence is: forward band B, forward band C, reverse band B, reverse band C.	4 x us	-	8	
7.6	Number of sweeps for which the OPD shift in band C differ from band B. Sequence is: forward direction, reverse direction	2 x us	-	4	
7.7	Number of sweeps for which the flux is out of range for one or all detectors (ref field 24.7 in MDS section)	us	-	2	
8	Spare	22*uc	-	22	
TOTAL				57	

SECTION: Geolocation ADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	ZPD time of the first sweep in the scan	s1, 2*ul	mjd	12	1
2	Attachment flag	uc	-	1	11
3	ZPD time of the sweep closest in time to the center of the scan	s1, 2*ul	mjd	12	1
4	ZPD time of the last sweep in the scan	s1, 2*ul	mjd	12	1
5	WGS84 latitude and longitude of first sweep in the scan	2*sl	10^{-6} degrees	8	
6	WGS84 latitude and longitude of the sweep closest in time to the center of the scan	2*sl	10^{-6} degrees	8	
7	WGS84 latitude and longitude of last sweep in the scan	2*sl	10^{-6} degrees	8	
8	Spare	8*uc	-	8	
TOTAL				69	

SECTION: Structure ADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Time of first scan info ADSR this record refers to	s1, 2*ul	mjd	12	1
2	Attachment flag (always set to 0)	uc	-	1	
3	Application process ID (= field 3 in scan information ADSR)	us	-	2	
4	DSR Length of scan information ADSR(s) to which this record refers (= field 1.5 in scan information ADSR)	ul	-	4	
5	Number of sweeps in current scan (*M*) (= field 7 in scan information ADSR)	us	-	2	
6	Number of points in NESR (*N*) (= field 22 in SPH)	ul	-	4	
7	Number of peaks fitted (*S*) (= field 12.6 in scan information ADSR)	us	-	2	
8	Size of blocks reporting of peaks fitted, field 12.8 to 12.14 (= $34 \times S + 2 \times \Sigma K(i)$, $i = 1 \ldots S$)	us	-	2	
8.1	Index of first Scan Info ADSR to which Structure ADSR pertains	ul	-	4	
8.2	Number of Scan Info ADSR to which Structure ADSR applies	ul	-	4	
8.3	Index of first MDSR to which Structure ADSR pertains	ul	-	4	
9	Spare	9*uc	-	9	
TOTAL				50	

SIZE:

ADSR size = 50 bytes

SECTION: Scan Information ADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Time of last start elevation scan sequence	s1, 2*ul	mjd	12	1
1.5	DSR Length	ul	-	4	
2	Attachment flag (always set to 0)	uc	-	1	
3	Application process ID	us	-	2	5
4	Filter set ID	us	-	2	5
5	Decimation factors	8*uc	-	8	5, 7
6	Band mapping configuration	6*uc	-	6	5
7	Number of sweeps in current scan (*M*)	us	sweeps	2	5
8	Number of fringe counts (samples at ADC)	ul	-	4	5
9	Commanded elevation and azimuth SAIT ID of current scan	2*uc	-	2	5
10	Commanded start elevation and azimuth angles of current scan	2*ul	-	8	5
11	Elevation scan counter	ul	-	4	2
12	Accumulated FCE corrected in gain calibration data, at end of current scan	sl	-	4	12
	CFI information				
12.01	True local solar time at target	sl	10^{-6} hours	4	14
12.02	Satellite to target azimuth	sl	10^{-6} degrees	4	14
12.03	Target to sun azimuth	sl	10^{-6} degrees	4	14
12.04	Target to sun elevation	sl	10^{-6} degrees	4	14
12.05	Day/Night flag -1 Sun eclipsed by earth for all tangent points in scan 0 Transition from day to night or vice versa in scan +1 Sun direct sight for all tangent points in scan	ss		2	

	Spare fields				
12.06	Spare	68*uc	-	68	
	Spectral calibration data				
12.1	MJD start time of first elevation scan (ZPD) from which scene data were extracted for actual spectral calibration	s1, 2*ul	mjd	12	1
12.2	Quality indicator (PCD) "0" = non-corrupted, "-1" = default values filled in	sc	-	1	
12.3	Linear spectral correction factor (K_{sc})	do	-	8	13
12.4	Standard deviation of correction factor	do	-	8	
12.5	Quadratic spectral correction factor (**Asc, Bsc Csc**)	3*do	-	24	
12.6	Number of peaks fitted (*S*)	us	-	2	
12.61	PAW gain scaling constant	8*fl	-	32	
12.7	Spare	14*uc	-	14	
	Peak #1				
12.8	Microwindow ID	8*uc	-	8	
12.9	Exact wavenumber of spectral line	do	cm^{-1}	8	
12.10	Detected frequency shift	do	cm^{-1}	8	
12.11	Correlation coefficient	do	-	8	
12.12	Number of coadded scene measurements (*K*(1))	us	-	2	
12.13	Sequential ID of scene measurements coadded	*K*(1)*us	-	*K*(1) × 2	
	Peak #2 to #S				
12.14	Each peak has same format as peak #1		-	(*S* – 1) × 34 + (2 × Σ*K*(*i*))	*i* = 2…*S*
	Spare fields				
13	Spare	0*uc	-	0	
	NESR data (total MIPAS bandwidth)				
14	The number of points (*N*) in NESR reported is given in the SPH. Data points first sweep of scan … Data points last sweep of scan	 *N**fl … *N**fl	 r.u. … r.u.	*M*×*N*×4 *N* × 4 … *N* × 4	
TOTAL				variable	

SIZE:

Assuming $K = 1$, $S = 5$, $M = 16$ and $N = 173$, then

ADSR size = $246 + S \times (34 + K \times 2) + M \times N \times 4 = 11474$ bytes

SECTION: Offset Calibration ADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Start time (MJD) of the elevation scan to which this data pertains. (ZPD crossing time of first sweep in scan for which offset cal. data are valid)	s1, 2*ul	mjd	12	1, 10
2	Attachment flag (always set to 0)	uc	-	1	
2.5	Band validity PCD for latest measurement (5 values for bands A, AB, B, C and D) "0" non-corrupted, "1" corrupted due to the instrument, "2" corrupted due to the transmission and "4" corrupted due to the observational validation.	5*uc	-	5	
4.5	Accumulated FCE correction in gain calibration data, at end of offset measurement sequence	5*ss	-	10	
5	Sweep direction, “F” forward and “R” reverse	uc	-	1	
5.1	Detector non-linearity flux validity (4 values, for detectors A1, A2, AB and B), “0” = flux value is valid, “1” = flux > upper threshold or < lower threshold for at least 1 offset	4*uc	-	4	
6	Spare	46*uc	-	46	
	Band A				
6.5	ZPD crossing time of first sweep in currently valid offset sequence for this band	sl, 2*ul	mjd	12	1
7	Decimation factor	us	-	2	5
8	Number of detected spikes	ul	-	4	6
9	Sweep IDs of IGM containing spike	10*us	-	20	6
10	Sample position of spikes in IGM	10*ul	-	40	6
11	Amplitude of spikes	10 × 2*do	-	160	6
12	Number of remaining detected spikes	us	-	2	6
13	Average amplitude of remaining detected spikes	2*do	-	16	6
14	Number of data points (N_A)	ul	-	4	8
15	Complex data points	N_A × 2*fl	-	N_A × 8	9
	Band AB				
16-25	Same as band A			260 + N_{AB} × 8	
	Band B				
26-35	Same as band A			260 + N_B × 8	
	Band C				
36-45	Same as band A			260 + N_C × 8	
	Band D				
46-55	Same as band A			260 + N_D × 8	

TOTAL	$1379 + 8 \times \sum N$	

SIZE:

A sweep generates the same number of points in each channel; this number of points varies with the resolution:

Resolution [cm^{-1}]	Number of points
0.025	304 520
0.05	152 388
0.25	30 682

These data points are then filtered with complex coefficients and decimated. It results in vectors with real and imaginary parts for each band. The decimation factor used in each band depends on its bandwidth. In the following table, we list the decimation factor that can be used in each channel (according to [AD 1]) and the resulting number of points assuming low resolution offset calibration.

Band	Decimation factor	Number of points
A	21	1 449
AB	36	846
B	22	1 384
C	30	1 015
D	11	2 767
TOTAL		7 461

Assuming the total number of points ΣN =7461, the ADSR length is

ADSR size = $1379 + \Sigma N \times 8$ = 61067 bytes

SECTION: Gain Calibration ADS #1					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Start time (MJD)	s1, 2*ul	mjd	12	1, 3
2	Attachment flag (always set to 0)	uc	-	1	
	Gain calibration data				
3	Copy of the MDSR #1 of the Gain Calibration file		-	variable	

SECTION: Gain Calibration ADS #2					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Start time (MJD)	s1, 2*ul	mjd	12	1, 3
2	Attachment flag (always set to 0)	uc	-	1	
	Gain calibration data				
3	Copy of the MDSR #2 of the Gain Calibration file		-	variable	

SECTION: ILS and Spectral Calibration GADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	ILS and spectral calibration data				
1	*Copy of the MDSR of the ILS and spectral calibration file*		-	variable	

SECTION: LOS Calibration GADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	LOS calibration data				
1	*Copy of the MDSR of the LOS calibration file*		-	175	

SECTION: Processing Parameters GADS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	Processing parameters data				
1	*Copy of the MDSR of the Processing parameters data file*		-	67982	

NOTES:

1: MJD time format is described in [AD 2] annex A.
2: Reset to zero after a new offset calibration.
3: This time corresponds to the ZPD crossing time of the first sweep of the scan for which the data is valid or used.
4: Include 1 record per complete elevation scan (start time equal to first sweep ZPD time of the scan for which the offset data were applied. Include also invalid offset as records (with an invalid flag), with start time equal to the actual MJD start time of the offset measurement. The number of records in ADS #8 will be equal or larger than the number of records in ADS #7.
5: Extracted from ISP.
6: Calculated by the Level 1B processor. The number of corrupted sweeps with instrument errors,
7: Channel sequence A1, A2, B1, B2, C1, C2, D1, D2.
8: Before decimation, low resolution sweep produces approximately 30769 data points while high resolution sweep produces approximately 307 692 data points. The decimation factor depends on the band and varies from 11 to 38.
9: IGM data points are complex data output from FIR filter at the SPE.
10: Only valid (non-corrupted) offsets are stored, and a new ADSR is written only if the selection of offset data for a given scan changes with respect to the previous scan. This selection may change due to the closest-in-time strategy, which is applied for each band separately. For an offset repeat cycle of

four scans the number of records per offset measurement will vary between four (worst case, selection of bands changes each scan) and one (case that all bands in previous and new offset measurement are valid).

11: Set to 1 if all MDSRs associated with this ADSR are blank or missing, 0 otherwise.
12: Sum of all MDS field 24 in scan.
13: Linear correction factor (same for all bands). Doppler effect is treated separately and remove from scene spectra before spectral calibration.
14: CFI information of sweep closest in time to center of scan.

SIZE:

Summary Quality ADS size = 80 × 57 bytes = 4560 bytes
Geolocation ADS size = 80 × 69 bytes = 5520 bytes
Structure ADS size = 80 × 50 bytes = 4000 bytes
Scan Information ADS size = 80 × 11474 bytes = 917920 bytes
Offset Calibration ADS size = (80 / 4) × 2 × 61067 bytes = 2442680 bytes
Gain Calibration ADS #1 size = 2 × (13 + 478322) bytes = 956670 bytes
Gain Calibration ADS #2 size = 2 × (13 + 4976) bytes = 9978 bytes
ILS and Spectral Calibration GADS size = 997 bytes
LOS Calibration GADS size = 175 bytes
Processing Parameters GADS size = 67982 bytes

TOTAL SIZE:

MPH size:	1247 bytes
SPH size:	7040 bytes
MDS size:	309571840 bytes
GADS and ADS size:	4410482 bytes
Total size =	306.6 **Mbytes** approximately

The previous evaluation of the size considers scene measurements acquired during one orbit in nominal mode and with an output resolution (user defined) to 0.025 cm^{-1}.

THROUGHPUT:

The throughput of the scene measurements in nominal measurement mode is

Throughput ~ 306.6 Mbytes / 100 min

REMARKS:

We assumed for the preceding calculations that one file is produced for each orbit (100 minutes).

4.1.2.4 PCD summary table

The following table provides a list of all PCD's contained in the Level 1B product and indicate their location.

PCD field	LOCATION
Product error	MPH (PCD information)
Quality indicator (PCD)	MDS (header)
Detected/corrected spikes in current sweep	MDS (sweep header)
Detected/corrected fringe count errors (FCE) in current sweep	MDS (sweep header)
Number of corrupted sweeps	Summary quality ADS (scan quality information)
Number of corrupted sweeps with instrument errors	Summary quality ADS (scan quality information)
Number of corrupted sweeps with data transmission errors	Summary quality ADS (scan quality information)
Number of corrupted sweeps with observational errors	Summary quality ADS (scan quality information)
Number of accumulated FCE since last offset calibration	Scan information ADS (header)

4.2 Processed calibration files

Gain calibration and offset validation data files have the same packaging format, outlined in the following figure:

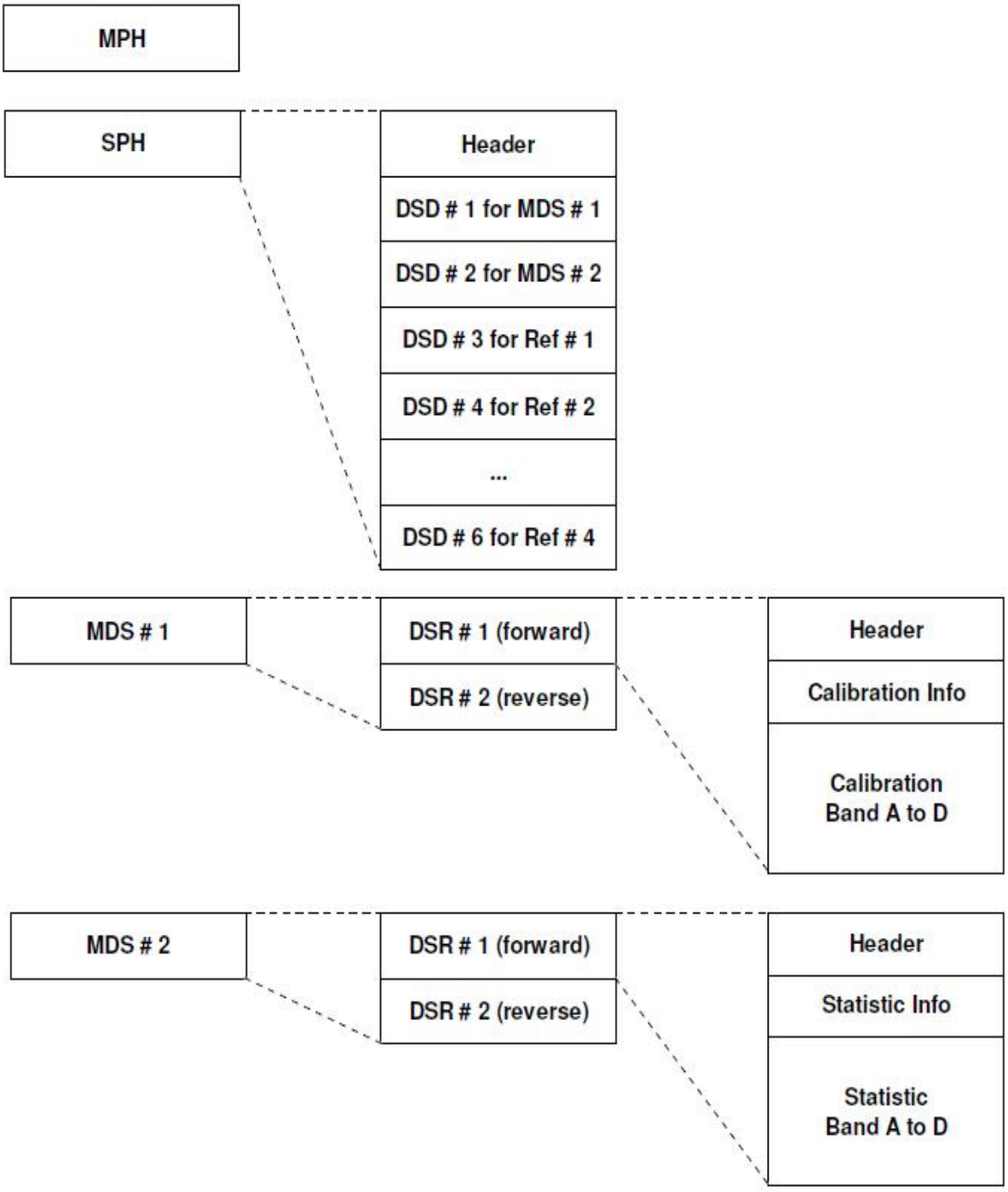

Figure 4.2-1 MIPAS gain calibration data file structure

The MPH has the same format as the one described for the Level 1B in Section 4.1.2.1. The SPH contains DSD records referring to the two MDSs and four external references. It has the following format:

SECTION: ASCII SPH					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	SPH_DESCRIPTOR=	15*uc	keyword	15	
	quotation mark (“)	uc	-	1	
	SPH descriptor	28*uc	UTC	28	1
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
2	Spare	51*uc	-	51	
	newline character	uc	terminator	1	
	Data set descriptors				
3	DSD (M) for MDS #1	280*uc	dsd	280	2
4	DSD (M) for MDS #2	280*uc	dsd	280	2
5	DSD (R) pointing to reference file #1	280*uc	dsd	280	2
6	DSD (R) pointing to reference file #2	280*uc	dsd	280	2
7	DSD (R) pointing to reference file #3	280*uc	dsd	280	2
8	DSD (R) pointing to reference file #4	280*uc	dsd	280	2
TOTAL				1778	

NOTES:

1: e.g. "MIPAS_GAIN_CALIBRATION " or "MIPAS_OFFSET_VALIDATION ".
2: DSD has the same format as the one described in Section 4.1.2.2. Data set names are:
"MIPAS_GAIN_VECTORS " or "MIPAS_OFFSET_VECTORS " for MDS #1,
"MIPAS_GAIN_STATISTICS " or "MIPAS_OFFSET_STATISTICS " for MDS #2,
"MIPAS_INST_CHARACTERIZATION " for reference #1,
"MIPAS_PROCESSING_PARAMETER " for reference #2,
Blank for reference #3,
"MIPAS_ILS_SPEC_CALIBRATION " for reference #4,

The MPH size is 1247 bytes. The SPH size is 1778 bytes.

Other calibration data files have the same packaging format, outlined in the following figure:

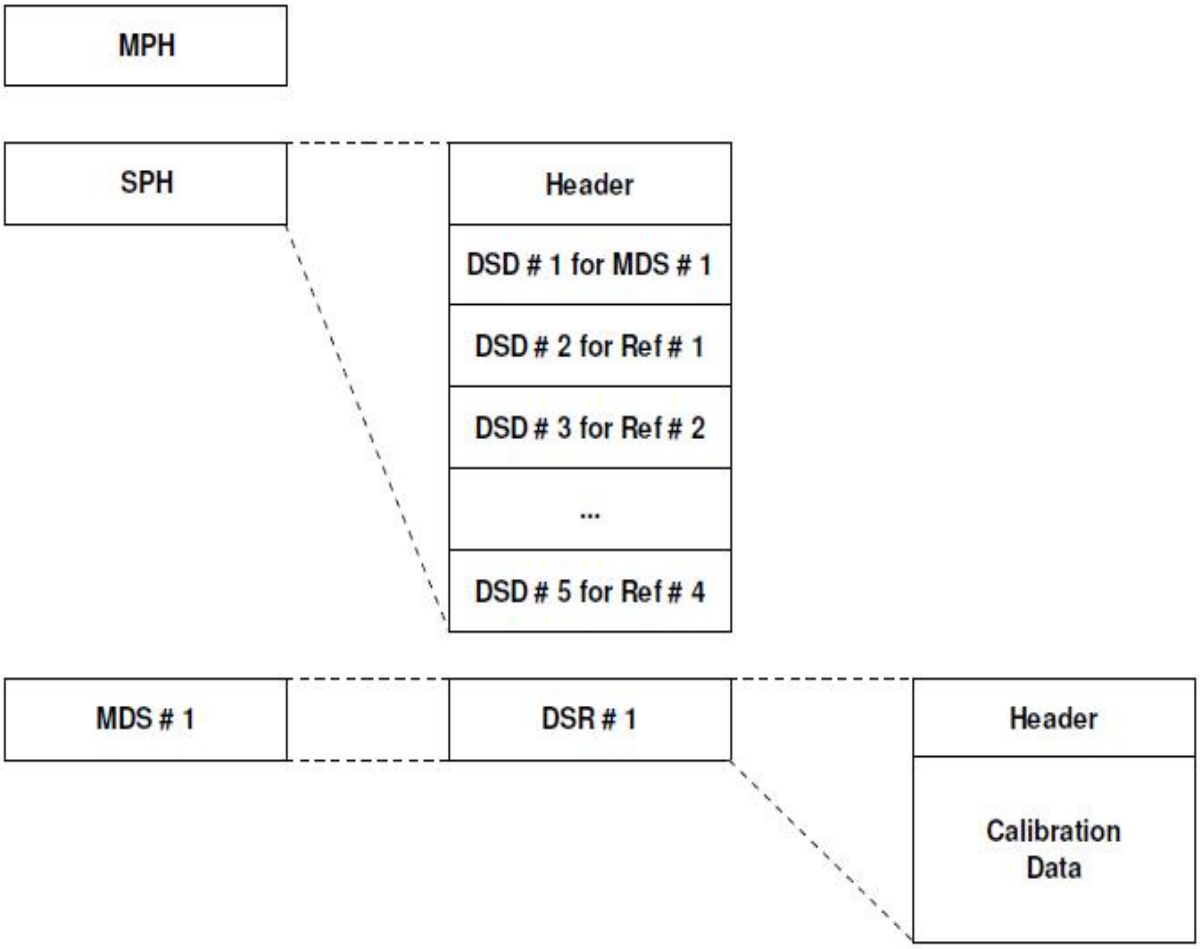

Figure 4.2-2 Other MIPAS calibration data file structure

The MPH has the same format as the one described for the Level 0 in Section 4.1.1.1. The SPH contains DSD records referring to the only one MDS and to the external references. It has the following format:

SECTION: ASCII SPH					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	SPH_DESCRIPTOR=	15*uc	keyword	15	
	quotation mark (“)	uc	-	1	
	SPH descriptor	28*uc	UTC	28	1
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
2	Spare	51*uc	-	51	
	newline character	uc	terminator	1	
	Data set descriptors				
3	DSD (M) for MDS #1	280*uc	dsd	280	2
4	DSD (R) pointing to reference file #1	280*uc	dsd	280	2
5	DSD (R) pointing to reference file #2	280*uc	dsd	280	2
6	DSD (R) pointing to reference file #3	280*uc	dsd	280	2
7	DSD (R) pointing to reference file #4	280*uc	dsd	280	2
TOTAL				1498	

NOTES:

1: e.g. "MIPAS_LOS_CALIBRATION " or "MIPAS_ILS_SPEC_CALIBRATION ".
2: DSD has the same format as the one described in Section 4.1.2.2. Data set names are:
"MIPAS_LOS_CALIBRATION " or "MIPAS_ILS_SPEC_CALIBRATION " for MDS #1,
"MIPAS_LOS_PROCESSING_PARAM " or "MIPAS_INST_CHARACTERIZATION " for reference #1,
"MIPAS_LOS_INPUTS " or "MIPAS_PROCESSING_PARAMETER " for reference #2,
Blank or "MIPAS_MICROWINDOW_DICTIONARY" for reference #3,
Blank for reference #4,

The MPH size is 1247 bytes. The SPH size is 1498 bytes.

4.2.1 Gain Calibration

IDENTIFIER: MIP_CG1_AX

NAME: Gain calibration

TYPE: Calibration

DESCRIPTION:

The gain calibration is a file used for the radiometric calibration of the scene interferograms. It allows to convert the scene (uncalibrated) spectra into physical units of spectral radiance. The gain calibration is the result of a dedicated processing at the ground segment of special measurements, the blackbody measurements and deep space measurements for gain calibration.

This file contains also a template for the validation of radiometric spectra generated using the gain measurements. The radiometric accuracy estimation is based on readings from the internal blackbody of the instrument and also on readings from the deep space [RD 5]. This estimation is done by a comparison of the computed magnitude against the accumulated mean and standard deviation kept in the present calibration file.

FORMAT:

In the SPH, there will be 6 DSD: 4 referencing to an external data file for each of the following files and 2 referencing to the MDS:

NO	FILE	ID
1	Instrument characterization data	MIP_CA1_AX
2	Processing parameters	MIP_PS1_AX
3	Spare	-
4	ILS and spectral calibration	MIP_CS1_AX

The following describes the format of the MDS #1 and #2.

SECTION: MDS #1					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Start time of cal. data acquisition (this time corresponds to the ZPD crossing time of the first sweep coadded in gain for the given direction)	s1, 2*ul	-	12	1
2	Quality indicator (PCD) summary PCD information per band (field 11.5) : "0" = non-corrupted, "4" = at least one band is invalid due to radiometric accuracy verification	Sc	-	1	
	Gain header				
3	IGM average min/max at ADC for each detector. Min for all detectors followed by max for all detectors	16*ss	-	32	2, 4
4	PRT average temperatures	5*do	Kelvin	40	3
5	Spare	8*uc	-	8	
6	Number of blackbody igms coadded	us	-	2	3
7	Number of blackbody igms corrupted and not coadded	us	-	2	3
8	Number of deep space igms coadded	us	-	2	3
9	Number of deep space igms corrupted and not coadded	us	-	2	3
10	FCE wrt previous gain	ss	-	2	3
10.5	FEO element temperatures	3*do	Kelvin	24	3
11	Sweep direction, "F" forward and "R" reverse	uc	-	1	3
11.5	Band validity PCD for latest gain measurement (5 values for bands A, AB, B, C and D) "0" non-corrupted, "4" invalid due to radiometric accuracy verification	5*uc	-	5	
11.6	Detector non-linearity flux validity (4 values, for detectors A1, A2, AB and B), “0” = flux value is valid, “1” = flux > upper threshold or < lower threshold for at least 1 DS	4*uc	-	4	
11.7	Detector non-linearity flux validity (4 values, for detectors A1, A2, AB and B), “0” = flux value is valid, “1” = flux > upper threshold or < lower threshold for at least 1 BB	4*uc	-	4	
12	Spare	11*uc	-	11	
	Band A				
12.5	Decimation factor	us	-	2	3
13	Number of detected/corrected spikes	ul	-	4	3
14	Sweep ID of igms containing spikes	10*us	-	20	3
15	Spike positions in the interferogram	10*ul	-	40	3
16	Spike amplitudes	10 × 2*do	-	160	3

17	Number of remaining detected/corrected spikes	ul	-	4	3
18	Average amplitudes of remaining detected/corrected spikes	2*do	-	16	3
19	Number of points in band (N_A)	ul	-	4	
20	Wavenumber of first point in band	do	cm^{-1}	8	
21	Wavenumber of last point in band	do	cm^{-1}	8	
22	Complex data points	$N_A \times$ 2*fl	-	$N_A \times 8$	
	Band AB				
23-33	Same as band A			266 + $N_{AB} \times 8$	
	Band B				
34-44	Same as band A			266 + $N_B \times 8$	
	Band C				
45-55	Same as band A			266 + $N_C \times 8$	
	Band D				
56-66	Same as band A			266 + $N_D \times 8$	
TOTAL				1482 + $8 \times \sum N$	

SECTION: MDS #2					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Time of creation	s1, 2*ul	-	12	
2	Quality indicator (PCD) "0" non-corrupted, "1" corrupted due to the instrument, "2" corrupted due to the transmission and "4" corrupted due to the observational validation, -1 blank MDSR	sc	-	1	
	Radiometric accuracy statistic information				
3	Number cumulated in statistics (one value per band)	5*ul	-	20	
4	Sweep direction, "F" forward and "R" reverse	uc	-	1	
5	Spare	34*uc	-	34	
	Band A				
6	Number of points in band (M_A)	ul	-	4	
7	Wavenumber of first point in band	do	cm^{-1}	8	
8	Wavenumber of last point in band	do	cm^{-1}	8	
9	Mean data points	$M_A \times$ fl	r.u.	$M_A \times 4$	
10	Standard deviation data points	$M_A \times$ fl	r.u.	$M_A \times 4$	
	Band AB				
11-15	Same as band A			20 + $M_{AB} \times 8$	
	Band B				
16-20	Same as band A			20 + $M_B \times 8$	

	Band C				
21-25	Same as band A			20 + $M_C \times 8$	
	Band D				
2630	Same as band A			20 + $M_D \times 8$	
TOTAL				168 + $8 \times \sum M$	

NOTES:

1: MJD time format is described in [AD 2] annex A.
2: Extracted from ISP.
3: Calculated by the Level 1B processor.
4: Channel sequence A1, A2, B1, B2, C1, C2, D1, D2.

SIZE:

The total number of points is provided in the table below.

Band	Range [cm^{-1}]	Bandwidth [cm^{-1}]	Requested resolution [cm^{-1}]	Number of points
A	685 – 970	285	0.025	11 401
AB	1020 – 1170	150	0.025	6 001
B	1215 – 1500	285	0.025	11 401
C	1570 – 1750	180	0.025	7 201
D	1820 – 2410	590	0.025	23 601
TOTAL		1 490		59 605

Assuming the total number of points $\Sigma N = 59605$, the MDS length is

MDS #1 DSR total = $1482 + \Sigma N \times 8 = 478322$ bytes

The total number of template points is provided in the table below.

Number of template points in each band

Band	Range [cm^{-1}]	Bandwidth [cm^{-1}]	100 × Requested resolution [cm^{-1}]	Number of points
A	685 – 970	285	2.5	115
AB	1020 – 1170	150	2.5	61
B	1215 – 1500	285	2.5	115
C	1570 – 1750	180	2.5	73
D	1820 – 2410	590	2.5	237
TOTAL		1 490		601

Assuming the total number of template points $\Sigma M = 601$, the MDS length is

MDS #2 DSR total = $168 + \Sigma M \times 8 = 4976$ bytes

Total size = 1247 bytes (MPH) + 1778 bytes (SPH) +
2×478322 bytes (MDS #1) + 2×4972 bytes (MDS #2) $\approx$ 946.9 kbytes

THROUGHPUT:

A gain calibration measurement sequence is expected to occur once a week.

Throughput ~ 946.0 kbytes / week

4.2.2 LOS Calibration

IDENTIFIER: MIP_CL1_AX

NAME: LOS calibration

TYPE: Calibration

DESCRIPTION:

The LOS calibration is a file used for the calibration of LOS pointing of the scene spectra. It allows to correct for instrument and platform pointing errors. The LOS calibration is the result of a dedicated processing at the ground segment of special measurements, the LOS measurements.

FORMAT:

In the SPH, there will be 5 DSD: 2 referencing to an external data file for each of the following files and 1 referencing to the MDS:

NO	FILE	ID
1	LOS inputs	-
2	LOS processing parameters	-
3	Blank	-
4	Blank	-

The following describes the format of the MDS. The exact content is TBD.

SECTION: MDS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Time of creation	s1, 2*ul	mjd	12	1
2	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
	LOS calibration data				
3	Angular frequency of first order harmonic pointing error related to x-axis (pitch)	do	degrees/ second	8	
4	Angular frequency of first order harmonic pointing error related to y-axis (roll)	do	degrees/ second	8	
5	Estimated bias of pointing related to x-axis (pitch)	do	degrees	8	
6	Estimated amplitude of first order harmonic pointing error related to x-axis (pitch)	do	degrees	8	
7	Estimated phase of first order harmonic pointing error related to x-axis (pitch)	do	degrees	8	
8	Estimated bias of pointing related to y-axis (roll)	do	degrees	8	
9	Estimated amplitude of first order harmonic pointing error related to y-axis (roll)	do	degrees	8	

10	Estimated phase of first order harmonic pointing error related to y-axis (roll)	do	degrees	8	
11	Variance of estimated bias of pointing related to x-axis (pitch)	do	$degrees^2$	8	
12	Variance of estimated amplitude of first order harmonic pointing error related to x-axis (pitch)	do	$degrees^2$	8	
13	Variance of estimated phase of first order harmonic pointing error related to x-axis (pitch)	do	$degrees^2$	8	
14	Variance of estimated bias of pointing related to y-axis (roll)	do	$degrees^2$	8	
15	Variance of estimated amplitude of first order harmonic pointing error related to y-axis (roll)	do	$degrees^2$	8	
16	Variance of estimated phase of first order harmonic pointing error related to y-axis (roll)	do	$degrees^2$	8	
17	Minimum function value of fit	do	-	8	
18	Number of orbits averaged	ul	-	4	
18.1	Search interval defined as a radius about expected position used for peak find algorithm	do	sec	8	
19	Spare	30*uc	-	30	
TOTAL				175	

NOTES:

1: MJD time format is described in [AD 2] annex A.

SIZE:

MDS # 1 total = 175 bytes

Total size = 1247 bytes (MPH) + 1498 bytes (SPH) + 175 bytes (MDS) ≈ 2.9 kbytes

THROUGHPUT:

A LOS calibration measurement sequence is expected to occur once a month.

Throughput ~ 2.9 kbytes / month

REMARKS:

1: The overall approach of LOS calibration processing still needs to be confirmed with instrument contractor.
2: It is anticipated that the LOS calibration measurements will allow only the calibration of elevation pointing angle and not for the azimuth pointing angle.

4.2.3 ILS and Spectral Calibration

IDENTIFIER: MIP_CS1_AX

NAME: ILS and spectral calibration

TYPE: Calibration

DESCRIPTION:

This file contains the ILS calibration representing the characteristic response of the instrument for different wavenumbers. It is not, as such, used within the processing of scene measurement up to level 1B. It is rather only annotated to the level 1B products. As for the spectral calibration, the ILS calibration does not require special measurements. In fact, it is the result of a dedicated processing at the ground segment of normal scene measurements.

This file also contains spectral calibration used for setting the wavenumber axis, i.e. the spectral calibration, of scene spectra. Unlike the previous calibrations, the spectral calibration does not require special measurements. In fact, it is also the result of a dedicated processing at the ground segment of normal scene measurements.

FORMAT:

In the SPH, there will be five DSD: three referencing to an external data file for each of the following files and one referencing to the MDS:

NO	FILE	ID
1	Instrument characterization data	MIP_CA1_AX
2	Processing parameters	MIP_PS1_AX
3	Microwindow dictionary	MIP_MW1_AX
4	Blank	-

The following describes the format of the MDS.

SECTION: MDS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Time of creation	s1, 2*ul	mjd	12	1
2	Overall quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
	ILS calibration data				
3.0	ILS time. ZPD time of first scene sweep used for ILS retrieval	s1, 2*ul	mjd	12	
3.1	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
3.2	Level 1B product filename containing the scene measurements used	62*uc	-	62	3
3.3	Number of ILS retrieved (*R*)	us	-	2	

3.4	Spare	50*uc	-	50	
	ILS #1				
3.5	Microwindow ID	8*uc	-	8	
3.6	Exact wavenumber of spectral line	do	cm^{-1}	8	4
3.7	Number of coadded scene measurements (*N*)	us	-	2	
3.8	Sequential ID of scene measurements coadded	*N**us	-	$N \times 2$	
3.9	ILS modeling parameter: linear shear variation along Z	fl	-	4	5
3.10	ILS modeling parameter: systematic IR misalignment along Y	fl	rad	4	5
3.10.1	ILS frequency shift	do	cm^{-1}	8	
3.10.2	Spare	50*uc		50	
	ILS #2 to #R				
3.11-	*same format as ILS #1*		-		
	Spectral calibration data				
4.0	Spectral time. ZPD time of first scene sweep used for spectral calibration	s1, 2*ul	mjd	12	
4.1	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
4.2	Level 1B product filename containing the scene measurements used	62*uc	-	62	3
4.3	Linear spectral correction factor	do	-	8	6
4.4	Standard deviation of correction factor	do	-	8	
4.5	Quadratic spectral correction factor (A**sc,** B**sc** C**sc**)	3*do	-	24	7
4.6	Number of peak fitted (*S*)	us	-	2	
4.7	Spare	50*uc	-	50	
	Peak #1				
4.8	Microwindow ID	8*uc	-	8	
4.9	Exact wavenumber of spectral line	do	cm^{-1}	8	4
4.10	Detected frequency shift	do	cm^{-1}	8	
4.11	Correlation coefficient	do	-	8	
4.12	Number of coadded scene measurements (*M*)	us	-	2	
4.13	Sequential ID of scene measurements coadded	*M**us	-	$M \times 2$	
	Peak #2 to #S				
4.14…	*same format as peak #1*		-		
TOTAL				307 + variable	

NOTES:

1: MJD time format is described in [AD 2] annex A.
2: Last modification time of file section using UTC time format, see [AD 2].

3: With the reference to the level 1B product file and sweep ID, it is possible to identify unambiguously the scene measurement that has been used for the actual spectral calibration. The reference to all underlying files can also be identified, including the offset calibration file, the gain calibration file, the LOS calibration file, the instrument characterization data file, the processing parameter file and the validation file.
4: The wavenumber at which the ILS or peak has been computed in a given microwindow is also given, corresponding to the reference line position used in auxiliary data.
5: The computed ILS itself is not stored, but instead are stored the two generating parameters that can be used to generate the corresponding ILS at a given wavenumber, as described in [RD 6] and [AD1 Appendix C].
6: Linear correction factor (same for all the bands). Doppler effect is treated separately and removed from scene spectra before spectral calibration.
7: In previous version this field was set to 0.0.

SIZE:

If we assume $M = 1$, i.e., no scene coadded for spectral calibration and $N = 5$ coadded scenes for ILS retrieval, R and $S = 5$, i.e., one ILS retrieval and one peak fitted per band then the size of the MDS is

MDS DSR total = $307 + (R \times (84 + N \times 2)) + (S \times (34 + M \times 2)) = 997$ bytes

Total size = 1247 bytes (MPH) + 1498 bytes (SPH) + 997 bytes (MDS) ≈ 3.6 kbytes

THROUGHPUT:

An ILS calibration is expected to be performed once per week, when the instrument is acquiring scene measurements. A spectral calibration is expected to be performed at least once every 2 scans, i.e., approximately 150 seconds, when the instrument is acquiring scene measurements. Calibration data will be written to file at the end of ILS calibration, i.e., once per week.

Throughput ~ 3.6 kbytes / week

However, during LOS and gain calibration (about 115 minutes), there is no spectral calibration performed, since no scene measurements are acquired. These calibrations occur only once a month and week respectively. Thus, the average throughput is slightly smaller, about 98.9% of the above mentioned value.

REMARKS:

1: The file format defined above allows for more than one ILS curve in each spectral band. Each ILS curve refers to a particular scene measurement by use of the level 1B product file name and sweep ID number. Thus, different ILS can refer to different scene measurements.
2: The ILS curves are assumed to be obtained from selected spectral lines taken in normal scene measurements (at full resolution). The selected spectral lines come from an appropriate choice (see [RD 6]) and are listed in auxiliary table.
3: The ILS calibration must be repeated at least every week because of the requirement on ILS stability.
4: The spectral calibration is repeated at least every 150 seconds because of the requirement on spectral stability. It may be possible to perform a spectral calibration for every scan measurement.

5: Even if the spectral calibration is done for every scene measurement, it will be necessary to generate a spectral calibration file because the spectral calibration is needed for the computation of the radiometric gain.

4.2.4 Offset validation

IDENTIFIER: MIP_CO1_AX

NAME: Offset validation

TYPE: Calibration

DESCRIPTION:

The offset validation is a file used for validation of calibrated offsets. It is used also for estimation of the NESR of the instrument. It consists of a valid offset, an accumulated mean and standard deviation of the calibrated difference of offset interferograms.

FORMAT:

In the SPH, there will be six DSD: four referencing to an external data file for each of the following files and two referencing to the MDS:

NO	FILE	ID
1	Instrument characterization data	MIP_CA1_AX
2	Processing parameters	MIP_PS1_AX
3	Spare	-
4	ILS and spectral calibration	MIP_CS1_AX

The following describes the format of the MDS #1 and #2.

SECTION: MDS #1					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	ZPD time of first deep space sweep used to generate average offset data over one orbit	s1, 2*ul	mjd	12	1
2	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
	Average offset				
3	Sweep direction, "F" forward and "R" reverse	uc	-	1	
3.1	Least square mean of uncalibrated power spectrum average offset for band A, AB, B, C and D	fl	-	5 x 4	
3.2	Least square standard deviation of uncalibrated power spectrum average offset for band A, AB, B, C and D	fl	-	5 x 4	
4	Spare	10*uc	-	10	
	Band A				
4.5	Decimation factor	us	-	2	
5	Number of points in band (N_A)	ul	-	4	
6	Wavenumber of first point in band	do	cm^{-1}	8	
7	Wavenumber of last point in band	do	cm^{-1}	8	
8	Complex data points	$N_A \times$ 2*fl	-	$N_A \times 8$	

	Band AB				
9-13	Same as band A			22 + $N_{AB} \times 8$	
	Band B				
14-18	Same as band A			22 + $N_B \times 8$	
	Band C				
19-23	Same as band A			22 + $N_C \times 8$	
	Band D				
24-28	Same as band A			22 + $N_D \times 8$	
TOTAL				174 + $8 \times \sum N$	

SECTION: MDS #2

FIELD	CONTENTS	TYPE	UNITS	SIZE	NOTES
1	ZPD time of first deep space sweep used to generate current validation data	s1, 2*ul	mjd	12	1
2	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
	NESR statistic information				
3	Number cumulated in statistics (one value per band)	5*ul	-	20	
4	Sweep direction, "F" forward and "R" reverse	uc	-	1	
5	Spare	34*uc	-	34	
	Band A				
6	Number of points in band (M_A)	ul	-	4	
7	Wavenumber of first point in band	do	cm^{-1}	8	
8	Wavenumber of last point in band	do	cm^{-1}	8	
9	Mean data points	$M_A \times$ fl	r.u.	$M_A \times 4$	
10	Standard deviation data points	$M_A \times$ fl	r.u.	$M_A \times 4$	
	Band AB				
11-15	Same as band A			20 + $M_{AB} \times 8$	
	Band B				
16-20	Same as band A			20 + $M_B \times 8$	
	Band C				
21-25	Same as band A			20 + $M_C \times 8$	
	Band D				
26-30	Same as band A			20 + $M_D \times 8$	
TOTAL				168 + $8 \times \sum M$	

NOTES:

1: MJD time format is described in [AD 2] annex A.

SIZE:

A sweep generates the same number of points in each channel; this number of points varies with the resolution:

Resolution [cm^{-1}]	Number of points
0.025	304 520
0.05	152 388
0.25	30 682

These data points are then filtered with complex coefficients and decimated. It results in vectors with real and imaginary parts for each band. The decimation factor used in each band depends on its bandwidth. In the following table, we list the decimation factor that can be used in each channel (according to [AD 1]) and the resulting number of points assuming low resolution offset calibration.

Band	Decimation factor	Number of points
A	21	1 449
AB	36	846
B	22	1 384
C	30	1 015
D	11	2 767
TOTAL		7 461

Assuming the total number of points $\Sigma N = 7461$, the MDS length is

MDS #1 DSR total = $174 + \Sigma N \times 8 = 59998$ bytes

The total number of template points is provided in the table below.

Number of template points in each band

Band	Range [cm^{-1}]	Bandwidth [cm^{-1}]	100 × Requested resolution [cm^{-1}]	Number of points
A	685 – 970	285	2.5	115
AB	1020 – 1170	150	2.5	61
B	1215 – 1500	285	2.5	115
C	1570 – 1750	180	2.5	73
D	1820 – 2410	590	2.5	237
TOTAL		1 490		601

Assuming the total number of template points $\Sigma M = 601$, the MDS length is

MDS #2 DSR total = $168 + \Sigma M \times 8 = 4976$ bytes

Total size = 1247 bytes (MPH) + 1778 bytes (SPH) +
2×59998 bytes (MDS #1) + 2×4976 bytes (MDS #2) $\approx$ 129.9 kbytes

THROUGHPUT:

The offset validation file will be computed externally to the MIPAS PF.

Throughput $\approx$ 129.9 kbytes / ΔT_t

4.3 Auxiliary data files

All auxiliary data files have the same packaging format, outlined in the following figure:

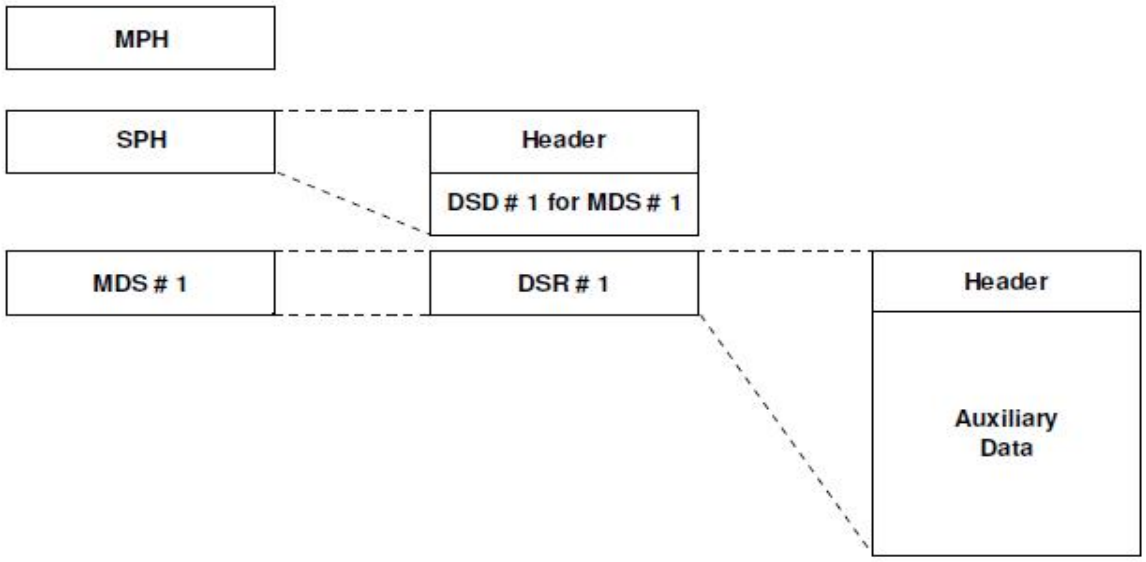

Figure 4.3-1 MIPAS auxiliary data file structure

The SPH contains only one DSD record referring to a MDS. It has the following format:

SECTION: ASCII SPH					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	SPH_DESCRIPTOR=	15*uc	keyword	15	
	quotation mark (“)	uc	-	1	
	SPH descriptor	28*uc	UTC	28	1
	quotation mark (”)	uc	-	1	
	newline character	uc	terminator	1	
2	Spare	51*uc	-	51	
	newline character	uc	terminator	1	
	Data set descriptors				
3	DSD (M) for MDS #1	280*uc	dsd	280	2
TOTAL				378	

NOTES:

1: e.g. "MIPAS_INST_CHARACTERIZATION ", "MIPAS_PROCESSING_PARAMETER ", "MIPAS_MICROWINDOW_DICTIONARY".

2: DSD has the same format as the one described in Section 4.1.2.2. Data set names are identical to SPH descriptor.

The MPH size is 1247 bytes. The SPH size is 378 bytes.

4.3.1 Instrument Characterization Data

IDENTIFIER: MIP_CA1_AX

NAME: Instrument characterization data

TYPE: Auxiliary

DESCRIPTION:

This file contains all instrument characterization data needed at ground by processing algorithms. It includes thermistor characterizations, non-linearity characterization, equalization characterization, blackbody characterization, DTU characterization, LOS characterization, SPE characterization, PAW characterization.

FORMAT:

The final format is TBD. It will follow the generic format of auxiliary data files.

SECTION: MDS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Creation time	s1, 2*ul	mjd	12	1
2	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
	Thermistors				
3	Thermistor time (UTC)	27*uc	UTC	27	3
4	FEO	6*do	-	48	2
5	Instrument	6*do	-	48	2
6	CBE	6*do	-	48	2
7	DPU/DTU range 1	6*do	-	48	2
8	DPU/DTU range 2	6*do	-	48	2
9	SPE	6*do	-	48	2
10	PAW	6*do	-	48	2
11	Spare	50*uc	-	50	
	Non-linearity				
12	Non-linearity r time (UTC)	27*uc	UTC	27	3
13	Detector responsivity coefficients characterized with ASCM approach	4 × 4 × 2*do	-	256	4
13.1	Photon flux min associated with the fit coefficients	4*do	-	32	
13.2	Photon flux max associated with the fit coefficients	4*do	-	32	
14	Spare	32*uc	-	32	
15	Spare	50*uc	-	50	
	Equalization				
16	Equalization time (UTC)	27*uc	UTC	27	3
17	Output port to equalize channel A	uc	-	1	6
18	Number of coefficients (*N*=32 TBD)	us	-	2	7

19	Complex coefficients	$N \times 2$*do	-	512	
20	Spare	50*uc	-	50	
	Blackbody				
21	Blackbody time (UTC)	27*uc	UTC	27	3
22	Correction factors	1(TBD)*do	-	8	
23	Base area element locations	8*do	m	64	
24	Base area PRT locations	3*do	m	24	
25	View factors	3*do	-	24	
26	Start wavenumber of grid on which surface emissivity data are represented	fl	cm^{-1}	4	
27	Wavenumber increment of grid on which surface emissivity data are represented	fl	cm^{-1}	4	
28	Number of data points in grid for surface emissivity *G*	us	-	2	
29	Surface emissivity vs wavenumber	*G*do	-	$G \times 8$	
29.2	Start wavenumber of grid on which effective emissivity data are represented	fl	cm^{-1}	4	
29.5	Wavenumber increment of grid on which effective emissivity data are represented	fl	cm^{-1}	4	
29.7	Number of data points in grid for effective emissivity *H*	us	-	2	
30	Effective emissivity vs wavenumber	*H*do	-	$H \times 8$	
31	PRT resistance values (high & low)	10*do	-	80	
32	Digital to PRT resistance	5×3*do	-	120	8
33	PRT resistance to temperature	5×3*do	-	120	9
34	Spare	30*uc	-	30	
	DTU				
35	DTU time (UTC)	27*uc	UTC	27	3
36	Detector responsivity vs temperature	8×4*do	-	256	10
37	Responsivity scaling factor (k_R)	do	-	8	
38	Spare	42*uc	-	42	
	SPE				
39	SPE time (UTC)	27*uc	UTC	27	3
40	Gain vs temperature and frequency	12(TBD) $\times$ 5(TBD) $\times$ 8*do	-	3840	
41	Phase vs temperature and frequency	12(TBD) $\times$ 5(TBD) $\times$ 8*do	-	3840	
42	Spare	50*uc	-	50	
	PAW				
43	PAW time (UTC)	27*uc	UTC	27	3
~~44~~	Field deleted	0	-	0	
45	Field deleted	0	-	0	

	Alignment Matrix				
44.1	Alignment matrix [3,3]	9 * do		72	
44.2	Spare	50*uc	-	50	
	Mispointing commanding				
44.5	Pitch, roll and yaw biases	3 * do		24	
44.6	Pitch, roll and yaw harmonics (sine, cosine, frequency)	3 * 3* 3 * do		216	
44.7	Derivative type	uc	-	1	
44.8	Number of harmonics	uc	-	1	
44.9	Spare	48*uc	-	48	
	Non-linearity scan mirror corrections				
45.1	Elevation angles	2 * do	Degrees	16	
45.2	Elevation angles corrections	2 * do	Degrees	16	
45.3	Spare	148 *uc		148	
	Azimuth				
46	Azimuth offset	do	degrees	8	
47	Spare	42*uc	-	42	
TOTAL				10211 + G × 8 + H × 8 +N ×16	

NOTES:

1: MJD time format is described in [AD 2] annex A.

2: A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ADC count, K/(ADC count)^2, K/(ADC count)^3, K/(ADC count)^4, K/(ADC count)^5.

3: Last modification time of file section using UTC time format, see [AD 2].

4: A fourth order polynomial relates detector (for A1, A2, B1 and B2) responsivity to a "digitized" incident flux which leads to a set of 4 coefficients. There is a different set of coefficients for the Forward and the Reverse direction for each detector A1, A2, B1 and B2.

6: '0' means no equalization, '1' means channel A1 and '2' means channel A2.

7: The number of coefficients is expected to be between 2 and 32.

8: A second order polynomial relates digital reading (from the 5 CBB PRT) to resistance values which leads to a set of 3 coefficients. The units of coefficients are ohm, ohm/ADC count, ohm/(ADC count)^2.

9: A second order polynomial relates PRT resistance values to actual temperature (Kelvin) which leads to a set of 3 coefficients. The units of coefficients are K, K/ohm, K/ohm^2.

10: A third order polynomial relates detector (for all 8) responsivity to DTU temperature which leads to a set of 4 coefficients. The units of coefficients are no units, K^{-1}, K^{-2}, K^{-3}.

Assuming N = 16 and G = H = 175, the MDS size is 10211 + (G + H) × 8 + N × 16 = 13267.

Total size ~ 1247 bytes (MPH) + 378 bytes (SPH) + 13267 bytes (MDS) ≈ 14.5 Kbytes

THROUGHPUT:

This file is expected to change at every re-calibration of digital to resistance coefficients. The maximal frequency of re-calibration is every 2 weeks but it is expected to be every 3 months. The expected throughput is therefore

Throughput ~ 14.5 Kbytes / 3 months

4.3.2 Processing Parameters

IDENTIFIER: MIP_PS1_AX

NAME: Processing parameters

TYPE: Auxiliary

DESCRIPTION:

This file contains all other parameters needed at ground by processing algorithms. It includes requested spectral axis definition, sinc interpolation table, standard deviation and rejection thresholds, conversion matrix between frame, etc.

FORMAT:

The final format is TBD. It will follow the generic format of auxiliary data files.

SECTION: MDS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Start time (MJD)	s1, 2*ul	-	12	1
2	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
	Sampling				
3	Sampling time (UTC)	27*uc	UTC	27	3
4	Nominal laser wavenumber	do	cm^{-1}	8	2
5	Spare	50*uc	-	50	
	Requested spectral axis				
6	Axis time (UTC)	27*uc	UTC	27	3
7	Number of points per band	5*ul	-	20	5
8	Wavenumber of first point in band	5*do	cm^{-1}	40	5
9	Wavenumber of last point in band	5*do	cm^{-1}	40	5
10	Spare	50*uc	-	50	
	Fringe counting error (FCE)				
11	FCE time (UTC)	27*uc	UTC	27	3
12	Spare	4*uc	-	4	
13	Number of points around ZPD band B and C	2*ul	-	8	
14	Spare	50*uc	-	50	
	NESR assessment				
15	NESR time (UTC)	27*uc	UTC	27	3
16	Standard deviation threshold	do	-	8	
17	Threshold of rejection	do	-	8	6
18	Template reduction factor	us	-	2	
19	Spare	50*uc	-	50	
	Radiometric validation				
20	Radiometric time (UTC)	27*uc	UTC	27	3
21	Standard deviation threshold	do	-	8	

22	Threshold of rejection	do	-	8	6
23	Template reduction factor	us	-	2	
24	Spare	50*uc	-	50	
	Scene measurement quality				
25	Quality time (UTC)	27*uc	UTC	27	3
26	Standard deviation threshold	do	-	8	
27	Threshold of rejection	do	-	8	6
28	Template reduction factor	us	-	2	
29	Spare	50*uc	-	50	
	Spike detection				
30	Spike time (UTC)	27*uc	UTC	27	3
31	Number of points per block	ul	-	4	
32	Standard deviation threshold	do	-	8	
33	Spare	50*uc	-	50	
	Sinc interpolation table				
34	Sinc time (UTC)	27*uc	UTC	27	3
35	Number of rows (N)	ul	-	4	
36	Number of columns (J)	ul	-	4	
37	Interpolation coefficients	$N \times J$*do	-	$N \times J \times 8$	
38	Spare	50*uc	-	50	
	Spectral calibration				
39	Spectral time (UTC)	27*uc	UTC	27	3
39.2	Time since ascending node crossing from which the search for the first valid scene data shall start, in seconds	do	s	8	
39.4	Update period	us	scans	2	9
39.6	Tangent height interval within which scene shall be extracted	2*fl	km	8	
39.8	Number of scenes to be co-added	us	scenes	2	
40	Simplex convergence tolerance	do	-	8	
41	Maximum number of iterations	ul	-	4	
42	Validity threshold for standard deviation	do	-	8	
43	Calibration method	uc	-	1	7
44	Spare	29*uc	-	29	
	ILS retrieval				
45	ILS time (UTC)	27*uc	UTC	27	3
45.2	Time since ascending node crossing from which the search for the first valid scene data shall start, in seconds	do	s	8	
45.4	Tangent height interval within which scene shall be extracted	2*fl	km	8	
45.6	Max. number of scenes to be co-added	us	scenes	2	
45.8	Max. number of subsequent scans from which scenes are to be extracted	us	scans	2	9
46	Simplex convergence tolerance	do	-	8	
47	Maximum number of iterations	ul	-	4	
47.5	Initial guesses for height and offset	2*fl	-	8	4

	Nominal set of modeling ILS parameters				
51	Maximum optical path difference	fl	cm	4	2, 11
52	Shear at ZPD along Y	fl	cm	4	2
53	Shear at ZPD along Z	fl	cm	4	2
54	Systematic IR misalignment angle along Y	fl	rad	4	4
55	Systematic IR misalignment angle along Z	fl	rad	4	2
56	Interferometer divergence (total angle) along Y	fl	rad	4	2
57	Interferometer divergence (total angle) along Z	fl	rad	4	2
58	Systematic laser misalignment angle along Y	fl	rad	4	2
59	Systematic laser misalignment angle along Z	fl	rad	4	2
60	Number of field of view subdivisions along Y	ul	-	4	2
61	Number of field of view subdivisions along Z	ul	-	4	2
62	Spare	4*uc	-	4	
63	Blur angular width along Y	fl	rad	4	2
64	Blur angular width along Z	fl	rad	4	2
65	Nominal optical speed	fl	cm/sec	4	2
66	Sampling perturbation of first sample	fl	cm	4	2
67	Time constant for attenuation of sampling perturbation	fl	sec	4	2
68	Relative speed fluctuation on the first sample	fl	-	4	2
69	Time constant for attenuation of speed fluctuation	fl	sec	4	2
70	Slope of relative gain versus relative frequency	fl	-	4	2
71	Delay mismatch between IR electrical response and ADC trigger signal	fl	sec	4	2
72	Relative drift rate of laser wavenumber per second	fl	sec^{-1}	4	2
73	Laser bandwidth due to white frequency noise	fl	Hz	4	2
73.1	Linear shear variation along Y	fl	-	4	2
73.2	Linear shear variation along Z	fl	-	4	4
74	Spare	42*uc	-	42	
	LOS				
75	LOS time (UTC)	27*uc	UTC	27	3
76.1	Minimum azimuth angle in side observation geometry	do	-	8	
76.2	Maximum azimuth angle in side observation geometry	do	-	8	
76.3	Spare	56*uc	-	56	
77	Minimum azimuth angle in rearward observation geometry	do	-	8	
78	Maximum azimuth angle in rearward observation geometry	do	-	8	
79	Spare	50*uc	-	50	

	CFI software parameters				
80	AOCS (Cx, Cy, Cz)	3*do	degrees	24	
81	ATT	3*do	degrees	24	
82	DATT	3*do	degrees/ second	24	
83	IDIR	ss	-	2	
84	IRAY	us	-	2	8
85	IERES	us	-	2	
85.1	Restituted attitude flag option	us	-	2	10
86	Spare	48*uc	-	48	
TOTAL				1422 + $N \times J \times 8$	

NOTES:

1: MJD time format is described in [AD 2] annex A.
2: Nominal set of modeling ILS parameters.
3: Last modification time of file section using UTC time format, see [AD 2].
4: Initial search value for ILS retrieval by simplex method.
5: Band sequence A, AB, B, C, D.
6: Given as a ratio, e.g., 0.05 means 5%.
7: 0 = peak find method, 1= cross correlation method.
8: Use internal LUT for refraction correction.
9: In nominal scans, i.e., ignore scans in special event mode.
10: 0 = use LOS CL1 ADF method, 1= use Restituted attitude AUX_FRA ADF (offline processing only)
11: In optimised resolution mode, the maximum optical path difference (MPD) is also used to truncate the nominal measurements when the MPD is set to 8.0 cm^{-1} instead of 8.2 cm^{-1}.

SIZE:

Assuming N = 65 and J = 128, the MDS size is 1422 + $N \times J \times 8$ = 67982.

Total size ~ 1247 bytes (MPH) + 378 bytes (SPH) + 67982 bytes (MDS) ≈ 70 kbytes

THROUGHPUT:

This file could be updated infrequently following in-flight instrument testing. Taking ΔT_t for the typical time interval between campaigns of in-flight instrument testing, the maximum throughput can be written as

Throughput ~ 70 kbytes / ΔT_t

4.3.3 Microwindow Dictionary

IDENTIFIER: MIP_MW1_AX

NAME: Microwindow dictionary

TYPE: Auxiliary

DESCRIPTION:

This file contains the reference microwindows that are used for spectral calibration and ILS retrieval. One or more reference spectral lines will be used for each channel/band. The technical note [RD 6] contains a section on the selection of suitable reference lines. Each spectral line is defined unambiguously by a set of selected parameters. The description includes the precise wavenumber value and its uncertainty, the limits of the microwindow in which the spectral line can be found, and also additional information on the peak shape and on the circumstances like the tangent height for which the line is expected to be used.

The maximum number of stored reference lines is not limited, but the number of active reference lines could be much less, with a minimum of about 5 (one per spectral band).

FORMAT:

SECTION: MDS					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
1	Time of creation	s1, 2*ul	mjd	12	1
2	Quality indicator (PCD) "0" non-corrupted, "-1" default values filled in	sc	-	1	
3	Total number in file (*N*)	ul	-	4	
	Microwindow #1				
4	ID	8*uc	-	8	2
5	Active	uc	-	1	3
6	Utility	uc	-	1	4
7	Peak position	do	cm^{-1}	8	
8	Microwindow left limit	do	cm^{-1}	8	5
9	Microwindow right limit	do	cm^{-1}	8	
10	Altitude	do	km	8	6
11	Peak height	do	r.u.	8	
12	Peak width (HWHM)	do	cm^{-1}	8	
13	Mathematical model	uc	-	1	7
14	Number of necessary coadditions	ul	-	4	8
15	Validity threshold	do	-	8	
	Microwindow #2 to #N				
	Same as microwindow #1	…	…		
TOTAL				$17 + N \times 71$	

NOTES:

1: MJD time format is described in [AD 2] annex A.
2: The spectral line is referenced by its id.
3: Set to 'A' if the microwindow is active or set to 'N' if it is not active.
4: Set to 'S' if the microwindow is used for spectral calibration or set to 'I' if it is used for ILS retrieval or set to 'B' if it is used for both.
5–8: See technical note [RD 6] for additional information about these parameters.

SIZE:

Assuming at total of $N = 128$ reference microwindows, this leads to:

MDS total = $17 + N \times 71$ bytes = 9105 bytes

Total size = 1247 bytes (MPH) + 378 bytes (SPH) + 9105 bytes (MDS) = 10.5 kbytes

THROUGHPUT:

This file is not expected to be changed, except maybe for the active reference microwindows, according to the requirements for the processing of real data

Throughput ~ 10.5 kbytes / ΔT_t

APPENDIX A SCRATCH FILE FORMAT

A.1 Level 1A

IDENTIFIER: MIP_L1A_SC

NAME: Level 1A

TYPE: Scratch

DESCRIPTION:

The level 1A scratch is composed of a set of reconstructed but uncalibrated measurements that can be either interferograms or LOS signals with calibrated source packet auxiliary data.

FORMAT:

The Level 1A is not a PDS product. It does not follow the format described in [RD 3].

The general structure of the file is illustrated in Figure A-1.

File header: Prototype file header.

Measure header: The measure header contains the information included in the MPH of level 0 product needed to generate level 1B product.

Measure table: The measure table contains several measure records, one for each signal extracted from source packets. A measure record contains the minimal subset of information needed for quickly find and retrieve a particular signal.

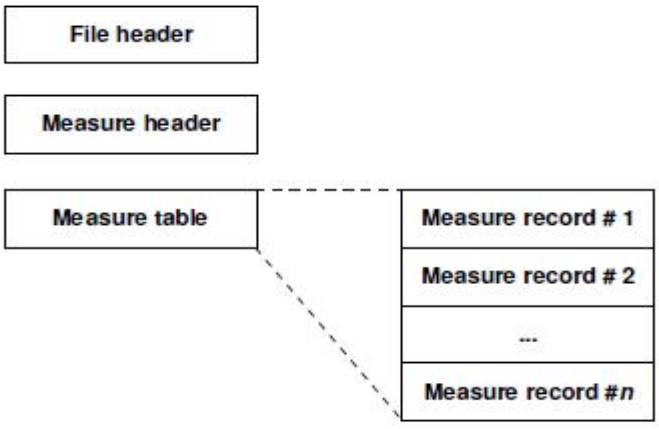

Figure A-1 MIPAS Level 1A scratch file structure

A.1.1 Measure header structure

SECTION: Measure header					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	Product identification information				
1	Reference document describing product	26*uc	-	26	
2	Spare	150*uc	-	150	
	Information on Envisat orbit and position				
3	Start absolute orbit number	ul	-	4	
4	Cycle	us	-	2	
5	Start relative orbit number	us	-	2	
6	Source of orbit vector	3*uc	-	3	
7	Phase	uc	-	1	
8	Spare	4*uc	-	4	
9	X position in earth-fixed reference	do	m	8	
10	Y position in earth-fixed reference	do	m	8	
11	Z position in earth-fixed reference	do	m	8	
12	X velocity in earth-fixed reference	do	m/sec	8	
13	Y velocity in earth-fixed reference	do	m/sec	8	
14	Z velocity in earth-fixed reference	do	m/sec	8	
14a	Spare	26*uc	-	26	
15	ΔUT1=UT1-UTC	9*uc	sec	9	
15a	Spare	5*uc	-	5	
16	UTC of Envisat state vector	28*uc	-	28	
17	Spare	36*uc	-	36	
	SBT to UTC conversion information				
18	Satellite binary time (SBT)	ul	-	4	
19	Clock step size	ul	psec	4	
20	UTC time corresponding to SBT	28*uc	-	28	
21	Leap error	sc	-	1	
22	Spare	uc	-	1	
23	Leap sign	ss	-	2	
	Product confidence data information				
24	PCD summary byte	uc	-	1	
25	Spare	121*uc	-	121	
	New of modified fields				
26	Acquisition station ID	21*uc	-	21	
27	Processing center ID which generated current product	7*uc	-	7	
28	UTC time of processing	28*uc	-	28	
29	Processing Software version number	15*uc	-	15	
30	UTC start time of the data sensing	28*uc	-	28	
31	UTC stop time of the data sensing	28*uc	-	28	
32	UTC time corresponding to SBT	28*uc	-	28	
33	Consolidated flag	sc	-	1	
34	Spare	114*uc	-	114	
TOTAL				776	

NOTES:

SIZE:

Measure header = 776 bytes

A.1.2 Measure table structure

SECTION: Measure record					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	Measure information				
1	Annotated value	do	-	8	
2	Measure ID	ul	-	4	
3	Sweep direction	ss	-	2	
4	Channel/Band	ss	-	2	
5	Source	ss	-	2	
6	Data mode	ss	-	2	
7	Quality flag	uc	-	1	
	Reference				
8	Filename of vector containing the measure	33*uc	-	33	
9	Spare	66*uc	-	66	
TOTAL				120	

SIZE:

Measure record = 120 bytes

The number of scene measurements in one orbit is approximately 1280 and the number of offset measurement in one orbit is approximately 120. The total entry in the table will be 1400 × 6 bands.

Total measure records = 1400 × 6 × 120 bytes = 1008000 bytes

A.1.3 Vector structure

SECTION: Vector					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	Header				
1	Tag	us	-	2	
2	Header length	us	-	2	
3	Number of points (*N*)	ul	-	4	
4	Resolution	do	-	8	
5	Origin	do	-	8	
6	Format	uc	-	1	
7	Label X axis	16*uc	-	16	
8	Label Y axis	16*uc	-	16	
9	Real/Complex flag	uc	-	1	1
	Annotated information				
10	Filename of sweep information	33*uc	-	33	
11	Spare	69*uc	-	69	
	Data points				
12	Complex points	$N \times 2$*fl	-	$N \times 8$	2
TOTAL				160 + $N \times 8$	

NOTES:

1: 'R' means real vector, 'C' means complex vector.
2: Complex data points are stored as follow: real part 1, imaginary part 1, real part 2, …

SIZE:

Number of points in interferograms depending on instrument resolution:

Channel or Band	Range [cm^{-1}]	Bandwidth [cm^{-1}]	Decimation factor	Number of points		
				0.025 cm^{-1}	0.05 cm^{-1}	0.25 cm^{-1}
A1	685 – 970	285	21	14 489	7 245	1 449
A2	685 – 970	285	21	14 489	7 245	1 449
AB	1020 – 1170	150	36	8 452	4 226	8 46
B	1215 – 1500	285	22	13 831	6 916	1 384
C	1570 – 1750	180	30	10 143	5 072	1 015
D	1820 – 2410	590	11	27 661	13 831	2 767
TOTAL		1 490		89 065	44 535	8 910

The number of high resolution (scene) measurements in one orbit is approximately 1280 with a total number of complex points of 89065 each and the number of low resolution (offset) measurement in one orbit is approximately 120 with a total number of complex points of 8910 each.

Total vectors = $1280 \times (123 + 160 + 89065 \times 8) + 120 \times (123 + 160 + 8910 \times 8) = 920975400$ bytes

A.1.4 Sweep structure

SECTION: Sweep					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	Uncalibrated source packet auxiliary data				
1	SBT	ul	-	4	
2	Decimation factors	8*sl	-	32	1
3	Source	ss	-	2	
4	Auxiliary data	1400*uc	-	1400	
5	Spare	2*uc	-	2	
5.1	True local solar time at target	do	-	8	
	Calibrated auxiliary data needed				
6	MJD time corresponding to SBT	2*do	-	16	
7	Azimuth angle in MIPAS frame	do	degrees	8	
8	Elevation angle in MIPAS frame	do	degrees	8	
9	PRT temperatures	5*do	Kelvin	40	
10	FEO temperatures	3*do	Kelvin	24	
	Calculated data				
11	MJD time corresponding to ZPD	2*do	-	16	
12	Azimuth angle corrected	do	degrees	8	
13	Elevation angle corrected	do	degrees	8	
14	S/C position in earth-fixed frame	3*do	km	24	
15	Tangent point geolocation, alt./lat./long.	3*do	km, degrees, degrees	24	
16	Earth radius at tangent point	do	km	8	
17	Target to S/C range rate	do	km/sec	8	
18	Target to S/C elevation rate	do	degrees/sec	8	
19	Doppler correction factor	do	-	8	
20	Number of blackbody interferograms coadded	ul	-	4	
21	Number of blackbody interferograms corrupted not coadded	ul	-	4	
22	Number of deep space interferograms coadded	ul	-	4	
23	Number of deep space interferograms corrupted not coadded	ul	-	4	
	Calibration references				
24	Filename of ILS and spectral calibration used	33*uc	-	33	
25	Filename of offset calibration used	33*uc	-	33	
26	Spare	6*uc	-	6	
	Spike information channel/band A1/A				
27	Spike amplitudes	20*do	-	160	
28	Average amplitude of remaining spikes	2*do	-	16	
29	Number of spikes detected/corrected	ul	-	4	
30	Spike positions	10*ul	-	40	
31	Spare	260*uc	-	260	
	Spike information channel A2				
32-36	Same as field 27-31	-	-	480	

	Spike information channel/band B1/AB				
37-41	Same as field 27-31	-	-	480	
	Spike information channel/band B2/B				
42-46	Same as field 27-31	-	-	480	
	Spike information channel/band C1/C				
47-51	Same as field 27-31	-	-	480	
	Spike information channel C2				
52-56	Same as field 27-31	-	-	480	
	Spike information channel/band D1/D				
57-61	Same as field 27-31	-	-	480	
	Spike information channel D2				
62-66	Same as field 27-31	-	-	480	
67	Scan time in MJD processing format	2*do	-	16	
68	Fringe count error detected	do	-	8	
69	Time offset since ascending node	do	sec	8	
70	Satellite to target azimuth	do	-	8	
71	Limb error	do	km	8	
72	ISP interferogram identification	us	-	2	
73	API	us	-	2	
74	Spectral calibration used	33*uc	-	33	
75	Offset calibration used	33*uc	-	33	
76	Spare	2*uc	-	2	
77	Responsivity scaling factor for all channels	8*do	-	64	1
78	Minimum ADC value for all channels	8*ss	-	16	1
79	Maximum ADC value for all channels	8*ss	-	16	1
80	Elevation scan counter	sl	-	4	
81	Non-linearity flux exceeded flag for detector A1, A2, B1 and B2	4*uc	-	4	
82	Target to sun azimuth	do	-	8	
83	Target to sun elevation	do	-	8	
84	Sweeps that exceed fringe count detection thresholds for band B and C	2*ss	-	4	
85	Sweeps that have a different fringe count error for band B and C	ss	-	2	
86	Spare	10*uc	-	10	
87	Elevation angle topocentric coordinates	do	degrees	8	
88	Azimuth angle topocentric coordinates	do	degrees	8	
89	Day/Night flag (-1 Sun eclipsed, +1 Sun direct sight)	ss	-	2	
90	Spare	254*uc	-	254	
TOTAL				6112	

NOTES:

1: Channel sequence A1, A2, B1, B2, C1, C2, D1, D2.

SIZE:

Total sweeps = 1400 × (123 + 6112) = 8729000 bytes

TOTAL SIZE:

Measure header size:	123 bytes
Measure header size:	776 bytes
Measure table total size:	1008000 bytes
Vector total size:	920975400 bytes
Sweep total size:	8729000 bytes
Total size ≈	907.9 **Mbytes** approximately

THROUGHPUT:

The previous evaluation of the size considers all measurements acquired during one orbit. The maximum throughput is 907.9 Mbytes / 100 min

A.1.5 File header structure

SECTION: File header					
FIELD	**CONTENTS**	**TYPE**	**UNITS**	**SIZE**	**NOTES**
	File information				
1	MIGSP tag	9*uc	-	9	
2	Comment	81*uc	-	81	
3	File type	33*uc	-	33	
TOTAL				123	

SIZE:

File header = 123 bytes

— End of document —