

MHS Level 1 Product Format Specification

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			<ul style="list-style-type: none"> • Clarified definition of bits for SWITCH_STATUS • Added definition of THERMISTOR_CHANNELS bits • Added clarification of bits for STATUS_WORD • Added Lunar Contamination flags to SCAN_LINE_QUALITY • Extended definitions of bits for CALIBRATION_QUALITY • Corrected FOV_DATA_QUALITY bit definition for MDR-1A and added definition for MDR-1B • Extended defiend bits for NAVIGATION_STATUS • Deleted description for INSTRUMENT_STATUS • Corrected channel names for CHANNEL_VALID and GAIN_CODE • Added EARTH_VIEW_POSITION_FLAG definitions • Added SPACE_VIEW_POISITION_FLAG definitions • Added OBCT_VIEW_POISITION_FLAG definitions • Added TELEMETRY_UPDATE definitions • Added GIADR-ADCONV to Occurrence Table • Updated Record Subclass Version Numbers
v7A	22/07/08		Migrated into Hummingbird. Body contents copied into standard template. Editorial updates – formatting, signature table updated.
v7B	09/09/08		<ul style="list-style-type: none"> • Added Appendix A with hyperlink referring to Annex. • Section 1.1: deleted reference to AD-3 (no longer present since relevant information now in AD-1). • Editorial edits – typos, standardisation, use of auto referencing for document and section references.

Issue / Revision	Date	DCN. No	Changed Pages / Paragraphs
v7C	11/12/08	EPS_AB_DCR_EUM_77	<ul style="list-style-type: none"> • MODE_SUBCOMM_CODE - typo in table. • TELEMETRY_UPDATE - references to bit '15' replaced by '31'. • Bit order in tables for TELECOMM_ACKN_FAULT, STATUS WORD, CHANNEL_VALID, GAIN_CODE reordered high to low.
v7D	07/07/11	ODT_DCR_155	<ul style="list-style-type: none"> • Added record subclass info.
		ODT_DCR_240	<ul style="list-style-type: none"> • Annex: Worksheets MDR-1A & MDR-1B, field ANGULAR_RELATION: Added Description note on azimuth angle range.
		OPS_ECPD_299 to be approved, then make DOCET	<ul style="list-style-type: none"> • Field CALIBRATION_QUALITY replaced by compound data type DATA_CALIBRATION. Annex: Updates to MDR-1A & MDR-1B, and new worksheet COMPOUNDS (see Annex for full details).
v7E	11/04/13	EPS_DOCET_228	<ul style="list-style-type: none"> • Changed the specifications for the 16-bit field 'CALIBRATION_QUALITY' (old section 3.5.1.13). Subdivided this into an 8-bit unsigned integer (u-byte) called 'NEDT_VALUE' and an 8-bit bit string (bitst(8)) called 'CALIBRATION_QUALITY'.
	20/06/13		<ul style="list-style-type: none"> • New version of document created to maintain version continuity with previous document. Previous document 211326 given invalid document reference by DM tool.

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1 INTRODUCTION

1.1 Purpose and Scope

This document is the Microwave Humidity Sounder (MHS) Level 1 Product Format Specification.

The generic product format specification used by this document is defined in the EPS Generic Product Format Specification [AD 1].

1.2 Structure of the Document

The document is organised in the following sections, including the introduction:

Section 1	Provides the scope of the document.
Section 2	Details the product formats for Level 1 products.
Sections 3-4	Describe the instrument and level-specific records for Level 1a and 1b products.
Section 5	details the occurrence rates of the various records within Level 1 products
Sections 6	Provides a history of version numbers for records defined within the document.
Appendix A	Provides links to detailed tables describing the record formats.

1.3 Applicable Documents

AD 1	EPS Generic Product Format Specification	EPS/GGS/SPE/96167
AD 2	EPS Ground Segment AVHRR/3 Level 1 Product Generation Specification	EPS/SYS/SPE/990007

1.4 Acronyms and Abbreviations Used in this Document

<i>Acronym</i>	<i>Meaning</i>
AMSU-A	Advanced Microwave Sounding Unit-A
GEADR	Global External Auxiliary Data Record
GIADR	Global Internal Auxiliary Data Record
MHS	Microwave Humidity Sounder
MDR	Measurement Data Record
NEdT	Noise Equivalent Delta Temperature
VEADR	Variable External Auxiliary Data Records
VIADR	Variable Internal Auxiliary Data Records

2 FORMAT OF MHS LEVEL 1 PRODUCTS

2.1 Overview

The product format for both MHS Level 1a and 1b products is based on the generic product format as described in [AD 1]. This document details the instrument-specific and level-specific additions required for MHS Level 1 products.

2.2 Generic Record Header Fields

All generic record header fields of the instrument/level specific records defined in this document shall have an INSTRUMENT_GROUP value of MHS [AD 2].

3 LEVEL 1A

3.1 Secondary Product Header Record

There is no SPHR defined for the MHS Level 1a product.

3.2 Global External Auxiliary Data Record

The global auxiliary datasets that are used by the Level 1a PGF (described in [AD 1]) but not written into the product are referenced by GEADRs as specified in [AD 2].

3.2.1 Record Subclasses

The following subclasses of GEADR are present for the MHS Level 1a product.

<i>Subclass</i>	<i>Description</i>	<i>Subclass ID</i>
MHSx_CAL	Calibration and configuration parameters	1
xxxx_BIT	Land/sea/coast database	2
xxxx_TOP	Topography database	3

Table 1: GEADR Level 1a subclasses

3.3 Global Internal Auxiliary Data Record

There are three subclasses of GIADR for the Level 1a Product. These are detailed in Appendix A of this document.

3.3.1 Record Subclasses

Record subclass determines the type of auxiliary data referenced.

<i>Subclass</i>	<i>Description</i>	<i>Subclass ID</i>
GIADR NAVIGATION	Earth View Telemetry	1
GIADR RADIANCES	Radiance Conversion Telemetry	2
GIADR ADCONV	Conversion Coefficients for the Digital Telemetry	3

Table 2: GIADR subclasses

3.3.2 GIADR Fields

3.3.2.1 RFI_BIAS_CORRECTION

<i>Value</i>	<i>Meaning</i>
1	H1, FOV 1, STX_1
2	H2, FOV 1, STX_1
3	H3, FOV 1, STX_1
4	H4, FOV 1, STX_1
5	H5, FOV 1, STX_1
6	H1, FOV 5, STX_1
...	
...	(channel values for FOVs 5, 10, 15, 20, ... 90)
...	
95	H5, FOV 90, STX_1
96	H1, space view, STX_1
...	
100	H5, space view, STX_1
101	H1, OBCT view, STX_1
...	
105	H5, OBCT view, STX_1
106	H1, FOV 1, STX_2
...	
210	H5, OBCT view, STX_2
211	H1, FOV 1, STX_3
...	
315	H5, OBCT view, STX_3
316	H1, FOV 1, SARR
...	
420	H5, OBCT view, SARR

Table 3: RFI_BIAS_CORRECTION word definitions

3.3.2.2 TRANSMITTER_POWER

Mean power at the time bias corrections were derived. Range is 0-255, representing analogue voltages from 0-5.1 V.

<i>Value</i>	<i>Meaning</i>
1	STX_1
2	STX_2
3	STX_3
4	SARR

Table 4: TRANSMITTER_POWER word definitions

3.3.2.3 NEW_BIAS_CORRECTION

<i>Value</i>	<i>Meaning</i>
1	H1, FOV 1, cycle 1
2	H2, FOV 1, cycle 1
3	H3, FOV 1, cycle 1
4	H4, FOV 1, cycle 1
5	H5, FOV 1, cycle 1
6	H1, FOV 3, cycle 1
...	
...	(channel values for FOVs 3, 6, 9, 12, ..., 90)
...	
155	H5, FOV 90, cycle 1
156	H1, space view, cycle 1
...	
160	H5, space view, cycle 1
161	H1, OBCT view, cycle 1
...	
165	H5, OBCT view, cycle 1
166	H1, FOV 1, cycle 2
...	
330	H5, OBCT view, cycle 2
331	H1, FOV 1, cycle 3
...	
495	H5, OBCT view, cycle 3

Table 5: NEW_BIAS_CORRECTION word definitions

3.4 Variable External and Internal Auxiliary Data Records

There are no VEADRs or VIADRs defined for the MHS Level 1a product.

3.5 Measurement Data Record

The MDR contains, per scan line, scene counts and calibration counts from cold space and warm target views. The MDR is detailed in the Annex (Appendix A) to this document.

3.5.1 Record Subclasses

There is one subclass of MDR for the Level 1a product.

<i>Subclass</i>	<i>Description</i>	<i>Subclass ID</i>
MDR-1A	Level 1A MDR	1

Table 6: MDR Level 1a subclasses

3.5.2 MDR Fields

3.5.2.1 HK TELEMETRY

3.5.2.1.1 *MODE_SUBCOMM_CODE*

<i>Bit</i>	<i>Meaning</i>	
Bits 7-4	SD3	1 mode cod
	Power-on	0000
	Warm-up	0001
	Standby	0010
	Scan	0011
	Fixed-view	0100
	Self-test	0101
	Safeing	0110
	Fault	0111
	Unused	1000 and 1110
Bit 3	Memory Data Packet ID	1111
	SD3: 2 PIE ID	
	0: PIE A 1: PIE B	
Bit 2-0	SD3:3 Sub-commutation code (indicates which set of thermistor telemetry data is included in this scan)	

Table 7: MODE_SUBCOMM_CODE bit string definitions

3.5.2.1.2 TELECOMM_ACKN_FAULT

<i>Word (bytes)</i>	<i>Bit</i>	<i>Meaning</i>
1 (bytes 0 and 1)	15	SD4:1 TC Clean (set to 1 if a parity or checksum is not found in the packet)
	14	SD4:2 TC Conforms (Set to 1 if the header of the received command conforms to CCSDS format)
	13	SD4:3 TC recognised flag (Set to 1 if received command is recognised MHS command)
	12	SD4:4 TC Legal flag (set if received command is legal for execution in the current MHS operation mode)
	11	SD5:9 FDM Motor current Trip Status
	10-0	SD4:5 TC Application ID
2 (bytes 2 and 3)	15-2	SD4:TC packet sequence count
	1-0	SD4:7 TC Received count
Byte 4	7	SD5:1 Current Monitor Fault
	6	SD5:2 Thermistor Monitor Fault
	5	SD5:3 Switch fault
	4	SD5:4 Processor Fault
	3	SD5:8 RDM Motor Current Trip Status
	2	SD5:5 DC Offset Error
	1	SD5:6 Scan Control Error
	0	SD5:7 REF ck Error

Table 8: TELECOMM_ACKN_FAULT word/bit string definitions

3.5.2.1.3 SWITCH_STATUS

<i>Word (bytes)</i>	<i>Bit</i>	<i>Meaning</i>
Byte 0	bit 7	Receiver channel H4 backend (0=off,1=on)
	bit 6	Receiver channel H3 backend (0=off,1=on)
	bit 5	Receiver channel H3/H4 local oscillator (0=A,1=B)
	bit 4	Receiver channel H3/H4 front-end (0=off,1=on)
	bit 3	Receiver channel H2 local oscillator (0=A,1=B)
	bit 2	Receiver channel H2 (0=off,1=on)
	bit 1	Receiver channel H1 local oscillator (0=A,1=B)
	bit 0	Receiver channel H1 (0=off,1=on)
Byte 1	bit 7	PROM (1=a PROM segment switch has failed ON)
	bit 6	Signal processing electronics/scan control electronics (0=off, 1=on)
	bit 5	Auxiliary operational heaters (0=off, 1=on)
	bit 4	Scan mechanism operational heaters(0=off, 1=on)
	bit 3	Receiver operational heaters (0=off, 1=on)
	bit 2	Rx CV (0=off, 1=on)
	bit 1	Receiver channel H5 local oscillator (0=A,1=B)
	bit 0	Receiver channel H5 (0=off,1=on)
Byte 2	bit 7	FDM motor current trip status(0=enabled,1=disabled)
	bit 6	RDM motor current trip status(0=enabled,1=disabled)
	bit 5	FDM motor supply (0=off, 1=on)
	bit 4	RDM motor supply (0=off, 1=on)
	bit 3	FDM motor sensors selected (0=A, 1=B)
	bit 2	RDM motor sensors selected (0=A, 1=B)
	bit 1	FDM zero position sensors (0=A, 1=B)
	bit 0	RDM zero position sensors (0=A, 1=B)

Table 9: SWITCH_STATUS word/bit definitions

3.5.2.1.4 THERMISTOR_TM_CHANNELS

<i>Value</i>	<i>Meaning</i>
1	LO H1 temperature (used as instrument temperature for LO-B)
2	LO H2 temperature
3	LO H3/H4 temperature
4	LO H5 temperature (used as instrument temperature for LO-A)
5	Mixer/LNA/Multiplexer H1 temperature
6	Mixer/LNA/Multiplexer H2 temperature
7	Mixer/LNA/Multiplexer H3/H4 temperature
8	Mixer/LNA/Multiplexer H5 temperature
9	Quasi-optics baseplate temperature #1 [dichroic D1(A) or polarisator (B)]
10	Quasi-optics baseplate temperature #2 [dichroic D2(A) or mirror (B)]
11	IF baseplate temperature #1
12	IF baseplate temperature #2
13	Scan mechanism core temperature
14	Scan mechanism housing temperature
15	RDM SSHM temperature
16	FDM SSHM temperature
17	Structure 1 temperature (-A edge, next to baseplate cutout)
18	Structure 2 temperature (-A edge, in-between Rx and SM)
19	Structure 3 temperature (-V edge, in-between EE and SM)
20	Processor module temperature
21	Main DC/DC converter module temperature
22	SCE RDM module temperature
23	SCE FDM module temperature
24	RF DC/DC converter temperature

Table 10: THERMISTOR_TM_CHANNELS word definitions

3.5.2.2 STATUS_WORD

<i>Bit</i>	<i>Meaning</i>
bit 7	DC Offset Valid (1 when all channels calibration targets are within acceptable limits)
bit 6	Scan Control Valid (1 if all mid pixel positions of the reflector during Earth, Space OBCT views are within the limits for the Scan Mode profile)
bit 5-4	Profile 00: Profile 0 (nominal scan mode profile with nominal space view position) 01: Profile 1 (alternate space view position 1) 10: Profile 2 (alternate space view position 2) 11: No Profile calculated (profile will be manually loaded and modified)
bits 3-0	0 (unused)

Table 11: STATUS_WORD bit string definitions

3.5.2.2.1 QUALITY_INDICATOR

<i>Bit</i>	<i>Meaning</i>
31	Do not use scan line for product generation
30	Time sequence error detected for this scan
29	Data gap precedes this scan
28	No calibration
27	No Earth location
26	First good time following a clock update
25	Instrument status changed within this scan
24 - 0	Not used

Table 12: QUALITY_INDICATOR bit definitions

3.5.2.2.2 SCAN_LINE_QUALITY

<i>Bit</i>	<i>Meaning</i>
	Time Problem Code (all bits off implies the scan time is as expected)
31-24	Not used
23	Time field is bad but can probably be inferred from the previous good time
22	Time field is bad and can't be inferred from the previous good time
21	This record starts a sequence that is inconsistent with previous times (i.e., there is a time discontinuity). This may or may not be associated with a spacecraft clock update (See bit 26 in QUALITY_INDICATOR Field)
20	Start of a sequence that apparently repeats scan times that have been previously accepted
	Lunar Contamination Problem Code
19-18	Not used
17	Scan line contains one or more space views that are lunar contaminated

<i>Bit</i>	<i>Meaning</i>
16	Lunar-contaminated scan line was able to be calibrated (only applicable if the previous flag [bit 17] is 1; otherwise, zero)
	Calibration Code Problem (Note these bits complement the channel indicators; all bits set to 0 indicates normal calibration.)
15	Scan line was not calibrated because of bad time
14	Scan line was calibrated using fewer than the preferred number of scan lines because of proximity to start or end of data set or to a data gap
13	Scan line was not calibrated because of bad or insufficient PRT data
12	Scan line was calibrated but with marginal PRT data
11	Some uncalibrated channels on this scan. (See channel indicators.)
10	Uncalibrated due to instrument mode.
9	Questionable calibration because of antenna position error of space view
8	Questionable calibration because of antenna position error of black body view
	Earth Location Problem Code (all bits off indicates the Earth location was normal)
7	Not earth located because of bad time; earth location fields zero filled
6	Earth location questionable because of questionable time code. (See time problem flags above.)
5	Earth location questionable – only marginal agreement with reasonableness check.
4	Earth location questionable – fails reasonableness check
3	Earth location questionable because of antenna position check
2 - 0	Not used

Table 13: SCAN_LINE_QUALITY bit definitions

3.5.2.2.3 DATA_CALIBRATION

This is a compound data type. For each channel, it contains information about the actual value of the NEdT and the calibration quality:

<i>Field</i>	<i>Description</i>	<i>SF</i>	<i>Dimension</i>	<i>Type</i>	<i>Type Size</i>	<i>Field Size</i>
NEDT_VALUE	Value of the noise-equivalent temperature	2	1, 1, 1	u-byte	1	1
CALIBRATION_QUALITY	Channel Quality Flags	0	1, 1, 1	bitst(8)	1	1

Table 14: Structure of compound data type DATA_CALIBRATION

The content of the individual fields is defined below:

3.5.2.2.3.1 *NEDT_VALUE*

Type: u-byte

There is one word for each channel, with H1 to H5 in order. Each word contains the actual channel-dependent value of NEdT with a scaling factor of 2; values corresponding to NEdTs larger than 2.55 K will be set to 255.

NEdT specifications:

Channel 1	1.0 K
Channel 2	1.0 K
Channel 3	1.0 K
Channel 4	1.0 K
Channel 5	1.0 K

3.5.2.2.4 *CALIBRATION_QUALITY*

Type: bitst(8): All bits off implies a good calibration.

There is one word for each channel, with H1 to H5 in order. The meaning for one channel is listed below.

<i>Bit</i>	<i>Meaning</i>
7	Actual NEdT value exceeds specification
6	This scan line is either the last one before or the first one after a sudden, anomalous jump (or drop) in calibration counts
5	No good black body counts for scan line
4	No good space view counts for scan line
3	No good PRTs for this line
2	Some bad black body view counts for this scan line
1	Some bad space view counts for this scan line
0	Some bad PRT temps on this scan line

Table 15: CALIBRATION_QUALITY bit definitions

3.5.2.2.5 FOV_DATA_QUALITY

<i>Bit</i>	<i>Meaning</i>
31	Not used
30	Set if secondary calibration used
29	Moon glint correction done
28-6	Not used
5-1	If bit n set to 1, then counts in channel n are physically unreasonable.
0	Set if all channels are missing

Table 16: FOV_DATA_QUALITY bit definitions

3.5.2.2.6 NAVIGATION_STATUS

<i>Bit</i>	<i>Meaning</i>
31 – 17	Not used
16	Earth location corrected for Euler angles
15 – 12	Earth location indicator 0 = earth location available 1 = user ephemeris files older than 24 hours 2 = no earth location available
11 – 8	Spacecraft attitude control 0 = operating in YGC or NOMINAL mode 1 = operating in another mode 2 = attitude exceeds nominal tolerance 3 = both 1 and 2
7 – 4	Attitude SMODE 0 = NOMINAL mode 1 = rate nulling mode 2 = YGC mode 3 = search mode 4 = coast mode
3 – 0	Attitude mode 0 = NOMINAL mode/no test 1 = yaw axis test in progress 2 = roll axis test in progress 3 = pitch axis test in progress

Table 17: NAVIGATION_STATUS bit string definitions

3.5.2.3 CHANNEL_VALID

<i>Bit</i>	<i>Meaning</i>
7	Channel H1 validity
6	Channel H2 validity
5	Channel H3 validity
4	Channel H4 validity
3	Channel H5 validity (set to 1 when all samples of the channel for this scan revolution lie within the ADC dynamic range)
2-0	SPE Mux Code:
	000 Channel H1 to SPE 6
	001 Channel H2 to SPE 6
	010 Channel H3 to SPE 6
	011 SPE 6 not used
	100 Channel H4 to SPE 6
	101 Channel H5 to SPE 6
	110 and 111: SPE 6 not used

Table 18: CHANNEL_VALID bit string definitions

3.5.2.4 GAIN_CODE

000: 0 dB
001: 1 dB
010: 2 dB
011: 3 dB
1xx: not used

<i>Bit</i>	<i>Meaning</i>
	WORD 1
7-5	Channel H1 Gain
4-2	Channel H2 Gain
1-0	Unused
	WORD 2
7-5	Channel H3 Gain
4-2	Channel H4 Gain
1-0	Unused
	WORD 3
7-5	Channel H5 Gain
4-0	Unused

Table 19: GAIN_CODE bit string definitions

3.5.2.5 POSITION VALIDITY FLAGS

3.5.2.5.1 EARTH_VIEW_POSITION_FLAG

<i>Value</i>	<i>Meaning</i>
1	Position flags for FOV's 1-8 (bits 0-7)
2	Position flags for FOV's 9-16 (bits 0-7)
3	Position flags for FOV's 17-24 (bits 0-7)
4	Position flags for FOV's 25-32 (bits 0-7)
5	Position flags for FOV's 33-40 (bits 0-7)
6	Position flags for FOV's 41-48 (bits 0-7)
7	Position flags for FOV's 49-56 (bits 0-7)
8	Position flags for FOV's 57-64 (bits 0-7)
9	Position flags for FOV's 65-72 (bits 0-7)
10	Position flags for FOV's 73-80 (bits 0-7)
11	Position flags for FOV's 81-88 (bits 0-7)
12	Position flags for FOV's 89-90 (bits 0-1), zero fill (bits 2-7)

Table 20: EARTH_VIEW_POSITION_FLAG word definitions

3.5.2.5.2 SPACE_VIEW_POSITION_FLAG

<i>Bit</i>	<i>Meaning</i>
7-4	Zero fill
3	Position flag for space view 4
2	Position flag for space view 3
1	Position flag for space view 2
0	Position flag for space view 1

Table 21: SPACE_VIEW_POSITION_FLAG bit definitions

3.5.2.5.3 OBCT_VIEW_POSITION_FLAG

<i>Bit</i>	<i>Meaning</i>
7-4	Zero fill
3	Position flag for OBCT view 4
2	Position flag for OBCT view 3
1	Position flag for OBCT view 2
0	Position flag for OBCT view 1

Table 22: OBCT_VIEW_POSITION_FLAG bit definitions

3.5.2.6 TELEMETRY_UPDATE

If bit=0, associated telemetry item is up-to-date. If bit =1, associated telemetry item was not updated during most recent telemetry cycle, possibly due to lost frame. The bits 31 to 4 are filled with zeroes for Metop.

<i>Bit</i>	<i>Meaning</i>
31-13	Zero fill
12	SARR-B power
11	SARR-A power
10	STX-3 power
9	STX-2 power
8	STX-1 power
7	STX-4 status
6	STX-3 status
5	STX-2 status
4	STX-1 status
3	Scan mechanism temperature
2	Electronics equipment temperature
1	Receiver temperature
0	Main bus select status

Table 23: TELEMETRY_UPDATE bit definitions

4 LEVEL 1B

4.1 Secondary Product Header Record

There is no SPHR defined for the MHS Level 1b product.

4.2 Global External Auxiliary Data Record

The global auxiliary datasets that are used by the Level 1b PGF [AD 2] but not written into the product are referenced by GEADRs as specified in [AD 1].

4.2.1 Record Subclasses

The following subclasses of GEADR are present for the MHS Level 1b product.

<i>Subclass</i>	<i>Description</i>	<i>Subclass ID</i>
MHSx_CAL	Calibration and configuration parameters	1

Table 24: GEADR Level 1b subclasses

4.3 Global Internal Auxiliary Data Data Record

There are three subclasses of GIADR for the Level 1b Product. These are detailed in the Annex (Appendix A) to this document. They are identical to the ones defined in Level 1a.

4.4 Variable External and Internal Auxiliary Data Records

There are no VEADRs or VIADRs defined for the MHS Level 1b product.

4.5 Measurement Data Record

The MDR contains, per scan line, scene radiance for channels 16-20 (MHS channels 1 – 5; H1 – H5). The MDR is detailed in the Annex to this document.

4.5.1 Record Subclasses

There is one subclass of MDR for the Level 1b product.

<i>Subclass</i>	<i>Description</i>	<i>Subclass ID</i>
MDR-1B	Level 1B MDR	2

Table 25: MDR Level 1b subclasses

4.5.2 MDR Fields

See Level 1a MDR, apart from the following:

4.5.2.1 FOV_DATA_QUALITY

<i>Bit</i>	<i>Meaning</i>
31	Not used
30	Set if secondary calibration used
29	Moon glint correction done
28-6	Not used
5-1	If bit n set to 1, then radiance in channel n is physically unreasonable or has not been calculated due to calibration problems
0	Set if all channels are missing

Table 26: FOV_DATA_QUALITY bit definitions

5 OCCURRENCE INFORMATION

5.1 Level 1a

<i>Record</i>	<i>Occurrence</i>
MPHR	Once per product
SPHR	No occurrence
GIADR-NAVIGATION	Once per product
GIADR-ADCONV	Once per product
GIADR-RADIANCES	Once per product
MDR-1A	Once per scan line

5.2 Level 1b

<i>Record</i>	<i>Occurrence</i>
MPHR	Once per product
SPHR	No occurrence
GIADR-NAVIGATION	Once per product
GIADR-ADCONV	Once per product
GIADR-RADIANCES	Once per product
MDR-1B	Once per scan line

6 RECORD FORMAT VERSION CONTROL

This section provides version numbers for the records defined within this document.

<i>Record Subclass</i>	<i>Format Version Number</i>	<i>Issue Defined</i>
SPHR	DELETED	6.4
	1	6.3
GIADR-NAVIGATION	3	6.5
	2	6.4
	1	6.3 (CDR)
GIADR-RADIANCE	3	6.5
	2	6.4
	1	6.3 (CDR)
GIADR-ADCONV	1	6.5 (NEW)
MDR-1A	4	7D
	3	6.5
	2	6.4
	1	6.3 (CDR)
MDR-1B	4	7D
	3	6.5
	2	6.4
	1	6.3 (CDR)

Table 27: Record Format Version Numbers

APPENDIX A MHS LEVEL 1 DATA RECORDS DETAILED SPECIFICATIONS

In the following Annex, detailed format specifications for all the Variable Internal and Measurement Data Records in MHS Level 1 products are included:

- GIADR-NAVIGATION
- GIADR-RADIANCE
- GIADR-ADCONV
- MDR-1A
- MDR-1B

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EPS.MIS.SPE.97229.ANX

This Document	
Title	MHS LEVEL 1 PRODUCT FORMAT SPECIFICATION TABLES
Reference Number	EPS/MIS/SPE/97229
Change Record	
Issue 4 Draft A	Removed orbit vector data from SPH
	Removed ADR 1B - identical to ADR-1A. Renamed ADR-1a to ADR.
Issue 5 Revision 0	Issue for CGS PDR
Issue 5 Revision 1	Revised Issue for CGS PDR
Issue 6 Revision 0	Moved fields of ADR into MDR-1A and MDR 1-B
	Deleted VIADR. Moved contents into MDR-1A and MDR-1B
Issue 6 Revision 1	Deleted old GIADRs and VIADRs
	Completely rewritten MDR-1A and MDR-1B
	Modified SPHR
	Added GIADR_NAVIGATION and GIADR_RADIANCE
Issue 6 Rev 2	Moved long field descriptions into Text-part
Issue 6 Rev 3	Changes to main text
Issue 6 Rev 4	EUM.EPS.SYS.DCR.02.168
	Moved INSTRUMENT_STATUS_FLAG field from SPHR to MDR-1A and MDR-1B
	SPHR has no content. Record deleted.
	EARTH_LOCATION field in MDR-1A and MDR-1B: Scale factor increased to 4. Field type changed to integer4 from integer2
	PRIMARY_CALIBRATION_SECOND_TERM data type changed from integer2 to integer4
	PRIMARY_CALIBRATION_FIRST_TERM data type changed from integer2 to integer4
	PRIMARY_CALIBRATION_ZEROTH_TERM data type changed from integer2 to integer4
	SPARE_CALIBRATION_SECOND_TERM data type changed from integer2 to integer4
	SPARE_CALIBRATION_FIRST_TERM data type changed from integer2 to integer4
	SPARE_CALIBRATION_ZEROTH_TERM data type changed from integer2 to integer4

	EULER_ANGLE scale factor changed to 3 and data type changed to integer2
	TIME_ATTITUDE changed to u-integer4 data type
	SPACECRAFT_ALTITUDE changed to u-integer4 data type
	CALIBRATION_QUALITY array size corrected from 5 x 15 to 5 x 1
	Corrected various field types names from integer*2 to integer2 and integer*4 to integer4
	Corrected various field arrays so that they are ordered correctly
	Updated offset/field size calculations
	ANGULAR_RELATION scale factor changed to 2
	MDR-1A:CHANNEL_QUALITY field renamed to CALIBRATION_QUALITY consistent with other ATOVS PFSS
	MDR-1B: PRT Temps changed to units values of Kelvins consistent with MDR-1A
	MDR: changed instrument types for fields with units of counts, ohms and Kelvins to unsigned
	MDR-1B: Scene radiances data type changed to integer4 and scale factor to 7
	Corrected GAIN_CODE and CHANNEL_VALID field types to bit strings and corrected units to NA. Moved details to main text.
	Corrected array ordering for a number of fields to group channels per FOV and not FOVs per channel
	EUM.EPS.SYS.DCR.02.229
	MDR-1A/1B: Following fields changed scale factor from 0 to 2
	<i>RESISTANCE_SLOPE</i>
	<i>RESISTANCE_OFFSET</i>
	<i>RESISTANCE_PRT_1</i>
	<i>RESISTANCE_PRT_2</i>
	<i>RESISTANCE_PRT_3</i>
	<i>RESISTANCE_PRT_4</i>
	<i>RESISTANCE_PRT_5</i>
	<i>TEMPERATURE_PRT_1</i>
	<i>TEMPERATURE_PRT_2</i>
	<i>TEMPERATURE_PRT_3</i>
	<i>TEMPERATURE_PRT_4</i>
	<i>TEMPERATURE_PRT_5</i>
	GIADR-RADIANCE: Following fields supplied with units:
	<i>NON_LINEAITY_COEFF_T1</i>

	<i>NON_LINEARITY_COEFF_T2</i>
	<i>NON_LINEARITY_COEFF_T3</i>
	MDR-1B: FOV_DATA_QUALITY changed from bitst(16) to bitst(32)
	MDR-1B: SURFACE_PROPERTIES made enumerated type, and description amended in line with MDR-1A
Issue 6 Rev 5	EUM.EPS.SYS.DCR.04.014
	GIADR-NAVIGATION
	MID_PIX_POSITION_ZERO SF changed to 2
	IDEAL_POINTING_ANGLE SF changed to 4
	IDEAL_NADIR_PIXEL SF changed to 2
	IDEAL_OBCT_POSITION SF changed to 2
	IDEAL_SPACE_TGT_POSITION SF changed to 2
	IDEAL_EARTH_PIXEL_POS SF changed to 2
	GIADR-ADCONV
	New Record
	GIADR_RADIANCE
	PRIMARY_REF_RESISTANCES data type changed to integer4
	SECONDARY_REF_RESISTANCES data type changed to integer4
	Field PRIMARY_RES_POL_COEFF_PRT_1 split into 4 fields PRIMARY_RES_POL_COEFF_PRT_1_F0 to PRIMARY_RES_POL_COEFF_PRT_1_F3 with separately specified SF and Units
	Change above also applied to fields PRIMARY_RES_POL_COEFF_PRT_2 to PRIMARY_RES_POL_COEFF_PRT_5 and fields SECONDARY_RES_POL_COEFF_PRT_1 to SECONDARY_RES_POL_COEFF_PRT_5
	Added field INST_TEMPERATURE_SENSOR_ID
	Added field PRIMARY_REF_TEMPERATURES
	Added field BACKUP_REF_TEMPERATURES
	COLD_SPACE_BIAS_CORRECTION array changed to 5 x 3
	COLD_SPACE_BIAS_CORRECTION data type changed to integer2 and SF changed to 3
	Added field WARM_LOAD_BIAS_CORRECTION

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MHS_Level_1_Product_Format_Specification_-_Annex[1].xls
Worksheet: MDR-1B

CHANNEL_H3_DC_OFFSET	Channel H3 DC offset word	0	counts	1	1	1	u-byte	1	1	76
CHANNEL_H4_DC_OFFSET	Channel H4 DC offset word	0	counts	1	1	1	u-byte	1	1	77
CHANNEL_H5_DC_OFFSET	Channel H5 DC offset word	0	counts	1	1	1	u-byte	1	1	78
CHANNEL_VALID	Channel Validity	0	N/A	1	1	1	bitst(8)	1	1	79
GAIN_CODE	Gain Settings of the Receiver	0	N/A	3	1	1	bitst(8)	1	3	80
MEASUREMENT DATA										
SCENE_RADIANCES	Scene Radiances (Channels H1-H5) - (Fields of View 1 - 90)	7	mW/m ² /sr/c m ⁻¹	5	90	1	integer4	4	1800	83
FOV_DATA_QUALITY	FOV data quality Flags	0	NA	90	1	1	bitst(32)	4	360	1883
POSITION VALIDITY FLAGS										
EARTH_VIEW_POSITION_FLAG	Earth view position validity flags (see MDR-1A)	0	N/A	12	1	1	u-byte	1	12	2243
SPACE_VIEW_POSITION_FLAG	Space view position validity flags (see MDR-1A)	0	N/A	1	1	1	u-byte	1	1	2255
OBCT_VIEW_POSITION_FLAG	Internal calibration target view position validity flag (see MDR-1A)	0	N/A	1	1	1	u-byte	1	1	2256
OBCT TEMPERATURE DATA										
PRT1_TEMPERATURE	bit 0-3 : 0 (unused) bit 4-15: On Board Target Temperature 1 (PRT1)	0	counts	1	1	1	u-integer2	2	2	2257
PRT2_TEMPERATURE	bit 0-3 : 0 (unused) bit 4-15: On Board Target Temperature 2 (PRT2)	0	counts	1	1	1	u-integer2	2	2	2259
PRT3_TEMPERATURE	bit 0-3 : 0 (unused) bit 4-15: On Board Target Temperature 3 (PRT3)	0	counts	1	1	1	u-integer2	2	2	2261
PRT4_TEMPERATURE	bit 0-3 : 0 (unused) bit 4-15: On Board Target Temperature 4 (PRT4)	0	counts	1	1	1	u-integer2	2	2	2263
PRT5_TEMPERATURE	bit 0-3 : 0 (unused) bit 4-15: On Board Target Temperature 5 (PRT5)	0	counts	1	1	1	u-integer2	2	2	2265

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MHS_Level_1_Product_Format_Specification_-_Annex[1].xls
Worksheet: MDR-1B

CAL_CHAN_1	bit 0-3: 0 (unused) bit 4-15: PRT Calibration 1: 118 Ohms	0	counts	1	1	1	u-integer2	2	2	2267
CAL_CHAN_2	bit 0-3: 0 (unused) bit 4-15: PRT Calibration 2: 95.3 Ohms	0	counts	1	1	1	u-integer2	2	2	2269
CAL_CHAN_3	bit 0-3: 0 (unused) bit 4-15: PRT Calibration 3: 80.6 Ohms	0	counts	1	1	1	u-integer2	2	2	2271
RESISTANCE PARAMETERS										
RESISTANCE_SLOPE	Slope m of the resistance equation	6	Ohm/counts	1	1	1	u-integer4	4	4	2273
RESISTANCE_OFFSET	Offset Roff of the resistance equation	2	Ohm	1	1	1	u-integer4	4	4	2277
RESISTANCE_PRT_1	Resistance value of PRT 1	2	Ohm	1	1	1	u-integer4	4	4	2281
RESISTANCE_PRT_2	Resistance value of PRT 2	2	Ohm	1	1	1	u-integer4	4	4	2285
RESISTANCE_PRT_3	Resistance value of PRT 3	2	Ohm	1	1	1	u-integer4	4	4	2289
RESISTANCE_PRT_4	Resistance value of PRT 4	2	Ohm	1	1	1	u-integer4	4	4	2293
RESISTANCE_PRT_5	Resistance value of PRT 5	2	Ohm	1	1	1	u-integer4	4	4	2297
TEMPERATURE_PRT_1	Temperature of PRT 1	3	K	1	1	1	u-integer4	4	4	2301
TEMPERATURE_PRT_2	Temperature of PRT 2	3	K	1	1	1	u-integer4	4	4	2305
TEMPERATURE_PRT_3	Temperature of PRT 3	3	K	1	1	1	u-integer4	4	4	2309
TEMPERATURE_PRT_4	Temperature of PRT 4	3	K	1	1	1	u-integer4	4	4	2313
TEMPERATURE_PRT_5	Temperature of PRT 5	3	K	1	1	1	u-integer4	4	4	2317
DISCRETE TELEMTRY										
MAIN_BUS	Main bus select (indicates which main bus is used by MHS); 1 (0V)=A bus (relay closed), 0 (5V)=B bus (relay opened)	0	N/A	1	1	1	u-byte	1	1	2321
MHS_SURVIVAL_HEATER	1= on, 0 = off	0	N/A	1	1	1	u-byte	1	1	2322
RF_CONVERTER_PROTECT_DISABLE	1 = no, 0 = yes	0	N/A	1	1	1	u-byte	1	1	2323
MHS_POWER_A	1= on, 0 = off	0	N/A	1	1	1	u-byte	1	1	2324
MHS_POWER_B	1= on, 0 = off	0	N/A	1	1	1	u-byte	1	1	2325
MAIN_CONVERTER_PROTECT_DISABLE	1 = no, 0 = yes	0	N/A	1	1	1	u-byte	1	1	2326

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MHS_Level_1_Product_Format_Specification_-_Annex[1].xls
Worksheet: MDR-1B

SURVIVAL_TEMPS	Survival temperatures; Word 1: Receiver temperature, Word 2: Electronics equipment temperature, Word 3: Scan mechanism temperature	0	counts	3	1	1	u-byte	1	3	2327
TRANSMITTER_TELEM	Transmitter telemetry (zero filled for Metop); Word 1: STX-1 status, Word 2: STX-2 status, Word 3: STX-3 status, Word 4: STX-4 status, Word 5: STX-1 power, Word 6: STX-2 power, Word 7: STX-3 power, Word 8: SARR-A power, Word 9: SARR-B power	0	counts	9	1	1	u-integer2	2	18	2330
TELEMETRY_UPDATE	Discrete telemetry update (see MDR-1A)	0	N/A	1	1	1	bitst(32)	4	4	2348
ASSOCIATED DATA										
QUALITY_INDICATOR	Quality Indicator Bit Field	0	N/A	1	1	1	bitst(32)	4	4	2352
SCAN_LINE_QUALITY	Scan Line Quality Flags	0	N/A	1	1	1	bitst(32)	4	4	2356
DATA_CALIBRATION	Noise-Equivalent Delta T and Channel Quality Flags	0	N/A	5	1	1	DATA_CALQUAL	2	10	2360
CALIBRATION COEFFICIENTS										
PRIMARY_CALIBRATION_SECOND_TERM	Primary Calibration Second Order Term a2 (H1-H5)	16	$mW/m^2/sr/c$ m^{-1}/cnt^2	5	1	1	integer4	4	20	2370
PRIMARY_CALIBRATION_FIRST_TERM	Primary Calibration First Order Term a1(H1-H5)	10	$mW/m^2/sr/c$ m^{-1}/cnt	5	1	1	integer4	4	20	2390
PRIMARY_CALIBRATION_ZEROTH_TERM	Primary Calibration Zeroth Order Term a0 (H1-H5)	6	$mW/m^2/sr/c$ m^{-1}	5	1	1	integer4	4	20	2410
SECONDARY_CALIBRATION_SECOND_TERM	Secondary Calibration Second Order Term a2 (H1-H5)	16	$mW/m^2/sr/c$ m^{-1}/cnt^2	5	1	1	integer4	4	20	2430
SECONDARY_CALIBRATION_FIRST_TERM	Secondary Calibration First Order Term a1 (H1-H5)	10	$mW/m^2/sr/c$ m^{-1}/cnt	5	1	1	integer4	4	20	2450
SECONDARY_CALIBRATION_ZEROTH_TERM	Secondary Calibration Zeroth Order Term a0 (H1-H5)	6	$mW/m^2/sr/c$ m^{-1}	5	1	1	integer4	4	20	2470
CALIBRATION PARAMETERS										
AVERAGE_WARM_TARGET_CNT	Average warm target count	0	counts	5	1	1	u-integer2	2	10	2490
AVERAGE_COLD_TARGET_CNT	Average cold target count	0	counts	5	1	1	u-integer2	2	10	2500
ZERO_RADIANCE_CNT	Zero Radiance Count	0	counts	5	1	1	u-integer2	2	10	2510
MEAN_WARM_TARGET_RAD	Mean warm target radiance	7	$mW/m^2/sr/c$ m^{-1}	5	1	1	u-integer4	4	20	2520

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MHS_Level_1_Product_Format_Specification_-_Annex[1].xls
Worksheet: MDR-1B

MEAN_COLD_TARGET_RAD	Mean cold target radiance	7	mW/m ² /sr/c m ⁻¹	5	1	1	u-integer4	4	20	2540
NONLINEARITY_PARAMETER	Non linearity parameter u	8	(mW/m ² /sr/c m ⁻¹) ^{u-1}	5	1	1	u-integer4	4	20	2560
NAVIGATION DATA AT SCAN LINE										
TIME_ATTITUDE	Time Associated with Attitude Angles	0	s	1	1	1	u-integer4	4	4	2580
EULER_ANGLE	Euler Angles: Roll, Pitch, Yaw	3	deg	3	1	1	integer2	2	6	2584
NAVIGATION_STATUS	Navigation Status Bit Field	0	N/A	1	1	1	bitst(32)	4	4	2590
SPACECRAFT_ALTITUDE	Spacecraft Altitude Above Reference Geoid (MSL)	1	km	1	1	1	u-integer4	4	4	2594
ANGULAR_RELATION	Angular relationships: solar zenith angle, satellite zenith angle, solar azimuth angle, satellite azimuth angle - (points 1 to 90). Note: azimuth angle range is -180 to +180, where minus is west and plus is east.	2	deg	4	90	1	integer2	2	720	2598
EARTH_LOCATION	Earth Location: latitude, longitude (point 1 to 90)	4	deg	2	90	1	integer4	4	720	3318
SURFACE_PROPERTIES	Surface property (0 = water, 1 = mixed/coast, 2 = land) (point 1 to 90)	0		90	1	1	enumerated	1	90	4038
TERRAIN_ELEVATION	Average terrain elevation (point 1 to 90)	0	m	90	1	1	integer2	2	180	4128
LUNAR_ANGLES	Angles between moon and individual space views (between 0 and 180 degrees, one word for each of the four space views)	2	deg	4	1	1	u-integer2	2	8	4308
SIZE OF THE RECORD										4316

Field Type	Size in Bytes
bitst(16)	2
bitst(24)	3
bitst(32)	4
bitst(40)	5
bitst(8)	1
boolean	1
byte	1
char(1)	1
char(2)	2
char(3)	3
char(4)	4
char(88)	88
DATA_CALQUAL	2
e-char(1)	1
e-char(2)	2
e-char(3)	3
enumerated	1
general time	15
integer2	2
integer4	4
integer8	8
long cds time	8
REC_HEAD	20
short cds time	6
u-byte	1
u-integer2	2
u-integer4	4
u-integer8	8

NOTE: Table must be sorted into ascending order