EPS-SG MWS Level 1B Product Format Specification (PFS)

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Document Change Record

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
V1Draft	28 August 2014	N/A	First Draft version
V1	12 December 2014	N/A	Version submitted for Preliminary Design Review
V1A	03 March 2015	N/A	Modified following comments from the Preliminary Design Review
V1B	09 March 2015	N/A	V1B – The cover page was not updated correctly in the earlier version.
V1C	15 September 2015	N/A	Major changes: 1. Added an additional dimension n_scans to measurement data and calibration data . 2. Included time and date variables to measurement data 3. Adapted to changes in GPFS.
V1D	15 December 2015	EUM-EPSSG-DCR-132	Version for Payload Acquisition and Data Processing ITT. Major changes: 1. Document Update following comments from Processing Specifications review. 2. Document Update following the updates in GPFS. 3. Update on Instrument status part according to the telemetry information from Industry documents. 4. Reorganised the data group structure. Added the new navigation group to include variables that are related to geolocation.
V2A	02 December 2016	EPSG_DCR_481	V2:Version for Payload Acquisition and Data Processing Kickoff Major changes: 1.Document Update following the updates in GPFS. 2.Removed XML dump 3. Recalculated the size of data.

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			4. Moved n_scans and n_channels from global dimensions to specific groups. 6. Moved orbit_angle from satellite status group to navigation_data 5. Some attributes variables were assigned dimensions. This is now corrected. These attributes are in some cases split to be scalar or assigned as variables in this version. mws_surface and mws_terrain_elevation dimensions are changed to account for different resolution for MWS pixels (channels 1 and 2 have lower resolution compared to other channels) Standard deviations of counts are provided for oversampled channels. The NcML file is updated and validated to be in line with the PFS document.
V3A	24 January 2018	EPSG_DCR_850	Updates following GPFS • Section 4.2: For all time variables in the product, the Valid_min is allowed to have negative values. • Section 4.2.3.1 Description of manoeuvre variables are according to GPFS. • Section 4.2.3.3 Updated processor_name Deleted processor_full_name from source in processing_status group • Section 4.2.5 Updated overall_quality_flag in quality group Deleted degraded_gaps and degraded_manouevre from quality group Updates following changes in PGS • Section 4.2 : Updated variable names so that they are the same as used in PGS. Also improved description of some variables. • Sections 4.2.3.2 and 4.2.4.3 Rearranged some variables across groups. • Sections 4.2.3.2 and 4.2.4.2

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
			Rearranged some variables across groups. • Section 4.2.3.2 Added new dimensions and variables according to PGS. • Sections 4.2.4.1 and 4.2.4.4 Moved mws_naviation_status from navigation group to quality information group. • Section 4.2.4.3 Updated variable list according to PGS. • Sections 4.2.4.4 and 4.2.4.5 Updated quality control variables in line with the PGS and rearranged variables across these groups. Other Changes • Section 4.2.5: The type of Valid_min and Valid_max for gap_start_time_utc and gap_end_time_utc are now correctly set to NC_DOUBLE. Also Missing_value attribute is assigned to these two variables. • Section Appendix A Recalculated size of data. • Section Appendix B Updated the section on BUFR data by inserting BUFR tables. • Section Appendix C Updated the NcML file including all changes in the PFS document. Corrected synctatical errors in the file.
V3B	26 September 2018		• Section 4.2: Number of FOVs, PRTs and HPRs given according to information from Instrument CDR. • Section 4.2.4.5: Two new variables added. • Appendix A: Recalculated the size of data according now available instrument dimensions.

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
			• Appendix B: Updated section on BUFR data. • Widespread minor changes.
V3C	21 February 2019	EPSG_DCR_1108	• Section 4.2.3.2: revamped Tm(3,25) variables. • Updates to the NcML description.
V3D	02 October 2019	EPSG_DCR_1422	• Section 4.2.3.2.1: Fixed missing value in Table 4-5. • Section 4.2.3.2.2: A new dimension defined in Table 4-6. • Section 4.2.3.2.3: slightly modified names to few variables, fixed data types, fixed values of 'valid_max' or' missing value' for few variables, fixed 'units' field of some variables in Table 4-7. • Section 4.2.3.3.1: changed source attribute values in Table 4-8. • Section 4.2.4.1: description of attributes changed in Table 4-11; a new dimension defined in the new Table 4-12. • Section 4.2.4.1.3: removed duplicated variables (mws_gain_control_status, mws_dc_offset_status), slightly modified names to few variables, fixed types, fixed values of 'valid_min', 'valid_max' or' missing value' for few variables, included 'add_offset', fixed 'units' field for some variables in Table 4-13. • Section 4.2.4.3.1: description of attribute changed in Table 4-15. • Section 4.2.4.3.3: slightly modified names to few variables, fixed types, fixed values of 'scale_factor', 'valid_min', 'valid_max' or' missing value' for few variables, included 'add_offset', fixed 'units' field for some variables in Table 4-16. • Section 4.2.4.5.3: introduced new variable mws_calibration_weights_quality_flag_warmview, slightly modified names to two variables in Table 4-18. • Section 4.2.5.3: Fixed count_missing_scanlines type, 'valid_min' and 'valid_max', fixed type of gap_start_time and gap_end_time in Table 4-21. • Throughout the document: names of groups are slightly changed (uppercase letters replace by lowercase), minor changes to the long names, removed the 'units' attribute from any dimensionless variable. Updated document signature table.

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
V4A	04 October 2021	EPSG_DCR_ 2085	• swap dimensions (transpose) of variables with rank greater than one, i.e. the ones with a 'scan' dimension (put 'scan'-dimension first) • Section 3.2: included statement on upper case/ lower case meaning of disposition indicator according to GPFS V4. • Sections 3.2 and 4.2.1: use of capital letters for part of location indicator within file name. • Section 4.2.1: updated **Table 4-1**. • Section 4.2.3.1.2: updated valid min/max of *semi_major_axis, eccentricity and inclination*. • Section 4.2.3.2.1: • Changed data type of *mws_onboard_software_version* to UINT and *mws_instrument model* to UBYTE. • Changed the abovementioned attributes to variables of the same group. • Section 4.2.3.2.2: added dimensions *n_thermometer_external, n_coef_therm_count_to_res* and *n_coef_therm_res_to_temp*. • Section 4.2.3.2.3: • Removed dimensions *n_motorcurrent_channels_selected, n_primary_power_switch, n_secondary_power_switch, n_local_oscillators, nbyte_motorpos_pcc_fix*. Added dimensions *n_instrument_current n_instrument_voltage.* Renamed dimension *n_motorcurrent_channels.* • Added variables *thermistor_counts_to_resistance_conv_coef, thermistor_resistance_to_temp_conv_coef, mean_reference_thermistor_log_resistance, stdev_reference_thermistor_log_resistance, mws_sce_register_status, mws_therm_ext_selgain, mws_therm_ext_count, mws_instrument_current, mws_dc_link_voltage, mws_dc_link_current, mws_acquis_sys_voltage, mws_instrument_voltage.*

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
			• Replaced variable *channel_bandcorrection_coefs* with the new *channel_central_wavenum, first_channel_band_correction, second_channel_band_correction*. • Corrected typo: instrument_reference_temperatuers_backup to 'temperatures'. • Added missing attribute 'add_offset=0.0' to variables *instrument_reference_temperatures* and *instrument_reference_temperatures_backup*. • Changed data type of *mws_gain_setting* to USHORT. • Changed name of *precision_resistor_counts* into *mws_hpr_count;* modified long name. • Changed units of *thermistor_counts_to_resistance_conv_coef* • Modified long_names of *channel_central_freq, mws_thermistor, mws_prt, mode_start_time_utc, mode_end_time_utc.* • Removed variable *mws_modeid*. • Revamped the name/type/dimension/longname of the MWS telemetry variables. • Section 4.2.4 (and Figure 4-1): renamed groups 'data/navigation_data', 'data/measurement_data', 'data/calibration_data' to data/navigation', 'data/measurement', data/calibration', respectively. • Section 4.2.3.3.3: Updated longname/units and added attributes valid min and valid max to variable *creation_time_utc.* • Section 4.2.4.1.1: attributes in table changed to variables of the same group. • Section 4.2.4.1.3: • Updated name and longname of variable *time_startscan_utc_earthview* • Changed type of variable *time_attitude*.

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
			• Corrected typo *mws_surface-type* to *mws_surface_type* (underscore instead of hyphen). • Removed attribute '*units*= - ' from variable *surface_type*. • Changed attribute '*units=meters*' to '*units=m*' for variable *mws_terrain_elevation.* • Set to 0 valid_min of variables *mws_antennapos_counts_earthview, mws_antennapos_counts_coldview, mws_antennapos_counts_warmview*. • Section 4.2.4.2.3: Fixed valid max of *mws_scan_number.* • Section 4.2.4.3.3: • Moved here from 'status/instrument' group variables *nonlinearity_correction* and *postdetection_amplifier_gain*. • Added new variable *moon_angle_threshold* and removed corresponding attribute in Section 4.2.4.3.1. • Removed variables *prt_resistance_slope*, *prt_resistance_offset*. • Added new variable *mws_calibration_gain* • Modified long_names of *mws_toa_radiance, mws_toa_brightness_temperature, counts_warmview_average_over_scans, counts_coldview_average_over_scans, mws_nedt_warm, mws_nedt_cold, striping_ratio_warm, striping_ratio_cold*. • Section 4.2.4.4 (and Figure 4-1): merged subgroups 'data/quality_information' and 'data/processing flag' into the new group 'data/processing_information'. • Section 4.2.4.4.3: • Added variables *mws_cof_quality_flag, mws_scantime_quality* and removed *mws_scanline_quality*. • For the variable *mws_navigation_status*: changed type and description. • Changed size to variable *mws_surface_flag*.

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
			• For the variables *mws_calibration_flag*, *mws_radiance_flag, mws_nedt_flag, mws_brightnesstemp_flag, mws_sr_flag*: modified long_name, changed data type to UBYTE, added range: 0 to 255, introduced attributes 'flag_values', 'flag_masks' and 'flag_meanings'. • Changed rank of variables *counts_coldview_processing_flag* and *counts_warmview_processing_flag,* • For the variables: *mws_position_flag_earthview, mws_position_flag_coldview, mws_position_flag_warmview, mws_surface_flag, mws_moon_contamination_flag, mws_channel_quality_flag, os_counts_earthview_averaging_flag, counts_coldview_processing_flag, counts_warmview_processing_flag, prt_processing_flag, mws_instrument_temperature_quality_flag, mws_rr_temperature_quality_flag, mws_calibration_weights_quality_flag_coldview, mws_calibration_weights_quality_flag_warmview, mws_prt_weights_quality_flag, mws_instrument_weights_quality_flag, mws_rr_weights_quality_flag:* modified long_name, changed data type to UBYTE, added range: 0 to 255, introduced attributes 'flag_mask' and 'flag_meaning'. • Data type of variable *moon_contamination_correction_flag* changed UBYTE. • For the variables *quality_proc_scan* and *quality_proc_chan*: changed name (*mws_l1b_processing_info_scan, mws_l1b_processing_info_chan*) and data type to USHORT and UBYTE, introduced attributes 'flag_mask' and 'flag_meaning'. • Section 4.2.5.1: updated meaning/value of the *overall_quality_flag* attribute. • Section 4.2.5.2: corrected typo in description of dimension *gap_items*. • Section 4.2.5.3:

Version	***Date of Version*** *as on profile*	***Document Change Request (DCR) Number*** *if applicable*	***Description of changes***
			• Added new variable *L1B_quality_flag* as variable version of the attribute *overall_quality_flag*. Corresponding attribute is kept for consistency with GPFS. • Changed type of variable *degraded_channels* into a new variable: a single UINT, added attributes 'long_name', 'flag_mask', 'flag_meaning'. • Section 4.3: Updated Product Version Control numbers. • Appendix A: updated product size according to changes above. • Appendix B (BUFR format definition) has been updated following MWS SAG comments. • Appendix D: updated list of TBC. • Throughout editorial changes.
V4B	22 November 2021	EPSG_DCR_2193	• Appendix B (BUFR format definition) has been updated in some of the references. The BUFR references marked with an asterisk (*) have to be considered as proposal, before to be assigned by WMO. • 0 07 194 or 0 25 084 (*) -> Orbit angle • 0 07 192 or 0 40 027 (*) -> Angle between Moon and space view • 0 12 192 (*) -> Rotating Reflector temperature • 0 33 208 (*) -> Scan line processing flags • 0 33 205 (*) -> MWS navigation status • 0 33 206 (*) -> MWS overall quality flag • 0 33 192 (*) -> Channel processing flags

Table of Contents

1. INTRODUCTION

1.1 Purpose and Scope

This document is the Format Specification for EPS-SG Microwave Sounder (MWS) Level 1B product generated centrally by the EPS-SG Ground Segment at the EUMETSAT. It specifies the detailed format of the MWS Level 1B product in agreement with the format and naming conventions set out in the Generic Product Format Specification [GPFS] applicable to all EPS-SG products. The instrument specific Product Format Specification contains all the instrument specific netCDF details, including specific metadata. The common groups and metadata are defined in [GPFS].

This document addresses the native format of the products generated in the EPS-SG Ground Segment, which is netCDF-4 as specified in [GPFS]. Other user formats will be specified elsewhere.

1.2 Relation to Other Documents

The EPS-SG MWS Level 1B Product Format Specification [MWS-L1B-PFS] is a System document in the System Specification tree. It is called up in [SRD], [OGSRD], MWS L1B Product Generation Specification [MWS-L1B-PGS], and EPS-SG System and Ground Segment documents including ICDs/IRDs wishing to convey information about the MWS L1B products format and content.

This document is derived from and compliant to [GPFS] for generic product format and naming conventions applicable to all EPS-SG products.

1.3 Applicable Documents

The documents listed in **Table 1-1** are applicable to this PFS.

Table 1-1: Applicable documents.

ID	Title	Reference and version
[GPFS]	EPS-SG Generic Product Format Specification (GPFS)	EUM/LEO-EPSSG/SPE/13/702108
[MCSD]	EPS-SG Mission Conventions and Standards Document	EUM/LEO-EPSSG/STD/14/745221
[DEV]	Development Logic for EPS-SG L0-L1-L2 Processing Specifications	EUM/LEO-EPSSG/TEN/14/763159
[HQ-BAS]	EPS-SG Data and Products Generation, Archiving and Dissemination Baseline at EUMETSAT HQ	EUM/LEO-EPSSG/SPE/15/819557
[CF]	netCDF Climate and Forecast (CF) Metadata Conventions: Version 1.6, 5 December 2010	http://cfconventions.org/Data/cf-conventions/cf-conventions-1.6/build/cf-conventions.pdf

1.4 Reference Documents

The documents listed in **Table 1-2** are reference to this PFS.

Table 1-2: Reference documents.

ID	Title	Reference
[SRD]	EPS-SG System Requirements Document	EUM/LEO-EPSSG/SPE/13/735903
[OGSRD]	EPS-SG Overall Ground Segment Requirements Document	EUM/LEO-EPSSG/REQ/13/725156
[MWS-L1B-PGS]	EPS-SG Microwave Sounder (MWS) Level 1B Product Generation Specification	EUM/LEO-EPSSG/SPE/14/777476

1.5 Acronyms

The definition of conventions, terms and abbreviations applicable to the EPS-SG programme can be found in [MCSD]. Abbreviations in this document are listed in the following *Table 1-3*.

Table 1-3: Acronyms.

Acronym	Meaning
AOI	Area of Interest
ATBD	Algorithm Theoretical Basis Document
BUFR	Binary Universal Form for the Representation of meteorological data
FDM	Flywheel Drive Mechanism
FOV	Field-Of-View
GADS	Generic Auxiliary Data Specification
GPFS	Generic Product Format Specification
GS	Ground Segment
GTS	Global Telecommunication System
HKTM	House Keeping Telemetry
L1B	Level 1B
MWS	Microwave Sounder
NAVATT	Navigation and Attitude packet, includes also time correlation and satellite status flag(s)
NeDT	Noise Equivalent Temperature
NRT	Near Real Time
NWP	Numerical Weather Prediction
OBCT	On Board Calibration Target
OGSRD	Overall Ground Segment Requirements Document
PFS	Product Format Specification
PGS	Product Generation Specification
PRT	Platinum Resistance Thermometer
RDM	Reflector Drive Motor
RF	Radio Frequency
TBC	To Be Confirmed
TBD	To Be Determined
TBW	To Be Written
UTC	Universal Time Coordinate
WMO	World Meteorological Organisation

1.6 Conventions and Terminology

Generic conventions and terminology used in this document for EPS-SG products are those described in the [GPFS]. Generic terms and definitions applicable to the EPS-SG Programme can be found in [MCSD].

1.6.1 Meaning of Table Headings

The meaning of the table headings of this PFS are listed in **Table 1-4**.

Table 1-4: Table heading meaning.

Element Name	Description
Filename	The name of the product (following naming convention described in **[GPFS]**).
Product ID	The Product identifier of the product (global attribute: Product identifier as described in the **[GPFS]**).
Product Description	A summary as defined in the relevant product format specification (global attribute: product description described in the **[GPFS]**).
Format	Native format of the product (i.e. netCDF-4).
Size	Estimated size of the product (MByte/Orbit).
Duration	Duration of product disseminated to the user (to be defined during Phase C).
Group Name	The name of the NetCDF group.
Variable Name	The name of NetCDF variable.
Attribute Name	The name of NetCDF attribute (see also http://www.unidata.ucar.edu/software/netcdf/docs/netcdf/Attribute-Conventions.html). Attributes may be global or related to a group instead of a variable; in this case they must appear before dimensions.
Dimension Name	The name of NetCDF dimension.
Description	Description of the element; for a variable the description must coincide with its “long_name” attribute.
Range or value	Range or value of variables, or value of dimensions or attributes, must match the “valid_min”, “valid_max”, or “valid_range” attributes.
Unit	Unit type of variables or attributes must coincide with “units” attribute.
Data Type or Type	Type of variables or attributes as defined in NetCDF Users Guide, not used for dimensions.
Dimension	Dimensions of the variables or attributes, in the same order than storage and with one dimension per line. Dimensions must be always defined before variables.
Usage	Usage of the product: - Internal: Product/Data is for use within the EPS-SG system. It is not made available to the end-users. - User: the product is disseminated to the end-users.

1.7 Document Structure

The structure of this PFS document is given in **Table 1-5**.

Table 1-5: Document structure.

Section Number	Title	Content
1	Introduction	The Scope and Purpose of the PFS document is described in this section, along with open issues, assumptions, applicable and reference documents.
2	Overview of MWS instrument	A description of the main features and characteristics of the MWS is provided in this section, along with its acquisition modes generating data to be processed in the Ground Segment.
3	EPS-SG MWS Level 1B Product Overview	A high-level overview on the MWS Level 1B Products structure is presented in this section. The Product Tree and the Product Naming convention are also specified here.
4	EPS-SG MWS Level 1B Product Detailed Format	The format of the MWS Level 1B Product (detailed description of the NetCDF data structure) is described in this section.
5	Product Format Version Control	This section is aimed to describe the product format version control number for each product described in this document.
APP A	Size of EPS-SG MWS Level 1B Product	In this section the size of each MWS Level 1B Product is provided.
APP B	BUFR Format for EPS-SG MWS Level 1B product	The BUFR dissemination format (Binary Universal Form for the Representation of meteorological data) of the MWS Level 1B Products is described in this section.
APP C	XML description of EPS-SG MWS L1 product	The .xml schemas for the MWS Level 1B Products are provided in this section.

2. OVERVIEW OF THE MICROWAVE SOUNDER INSTRUMENT

A description of the main features and characteristics of the MWS instrument can be found in [MWS-L1B-PGS].

3. EPS-SG MWS LEVEL 1B PRODUCT OVERVIEW

This section provides an overview of the Level 1B radiances generated centrally by the EPS-SG Ground Segment at the EUMETSAT Headquarters (also referred to as Mission Control Centre).

3.1 Product List

This section lists and describes the MWS Level 1B products generated at EUM Headquarters.

Table 3-1: EPS-SG MWS Level 1B Product.

Product ID	Product Description	Usage	Coverage
MWS-1B-RAD	MWS Level 1B Spectral Radiance	User	Global/Regional

3.2 Naming Convention

The naming convention of EPS-SG products complies with the naming convention specified in [GPFS] for all EPS-SG Ground Segment products generated in native format.

The product name of MWS L1B radiance product will be according to the following convention:

(pflag) '_' (productidentifier) '_' (oflag) '_' (originator) '_' (YYYYMMDDhhmmss) '_' (freeformat)

Where freeformat contains a number of product name fields separated by the underscore symbol "_". The contents of the fields are explained in Section 3.2 of [GPFS]. The disposition indicator (see [GPFS]) in the product filename is capitalized like the remainder of the filename. However, to indicate the last file before a gap, the disposition indicator will be in lower case. This is inherited from the input product.
An example product name (for illustrative purpose only) for MWS Level 1B radiance product:

W_XX-EUMETSAT-Darmstadt,SAT,SGA1-MWS-1B-RAD_C_EUMT_20220101121212_G_O_20220101103000_20220101104000_O_N___

This is a global L1B product, generated in the context of the EPS-SG Global mission, for the MWS instrument embarked on the Metop-SG/A1 satellite (SGA1).
The product was created on the 01 January 2022 at 12:12:12 hours, with a sensing start date of 01 January 2022 at 10:30:00 hours and a sensing end date of 01 January 2022 at 10:40:00 hours. The file was generated in the Ground Segment operational (O) environment during routine operations in NRT processing. The disposition mode indicates that it was produced during routine operations (O), in NRT processing (N).

The equivalent product file name using netCDF formatting would be:

W_XX-EUMETSAT-Darmstadt,SAT,SGA1-MWS-1B-RAD_C_EUMT_20220101121212_G_O_20220101103000_20220101104000_O_N___.nc

4 EPS-SG MWS LEVEL 1B PRODUCT DETAILED FORMAT

4.1 Overall Structure of EPS-SG Products

All EPS-SG product types generated by the EPS-SG Ground Segment are NetCDF-4 files complying with the generic structure and data model set out in the [GPFS]. Their high-level structure is presented in Figure 1 of the [GPFS], while the MWS L1B specific version is displayed below in Figure 4-1. The structure consists of a *Root* group, holding global attributes defined in the [GPFS] and the following sub-groups: *Status, Data* and *Quality*. No additional NetCDF-4 groups or sub-groups are foreseen for L1 products.

In the following sections, the physical composition of the MWS L1B radiance product is specified.

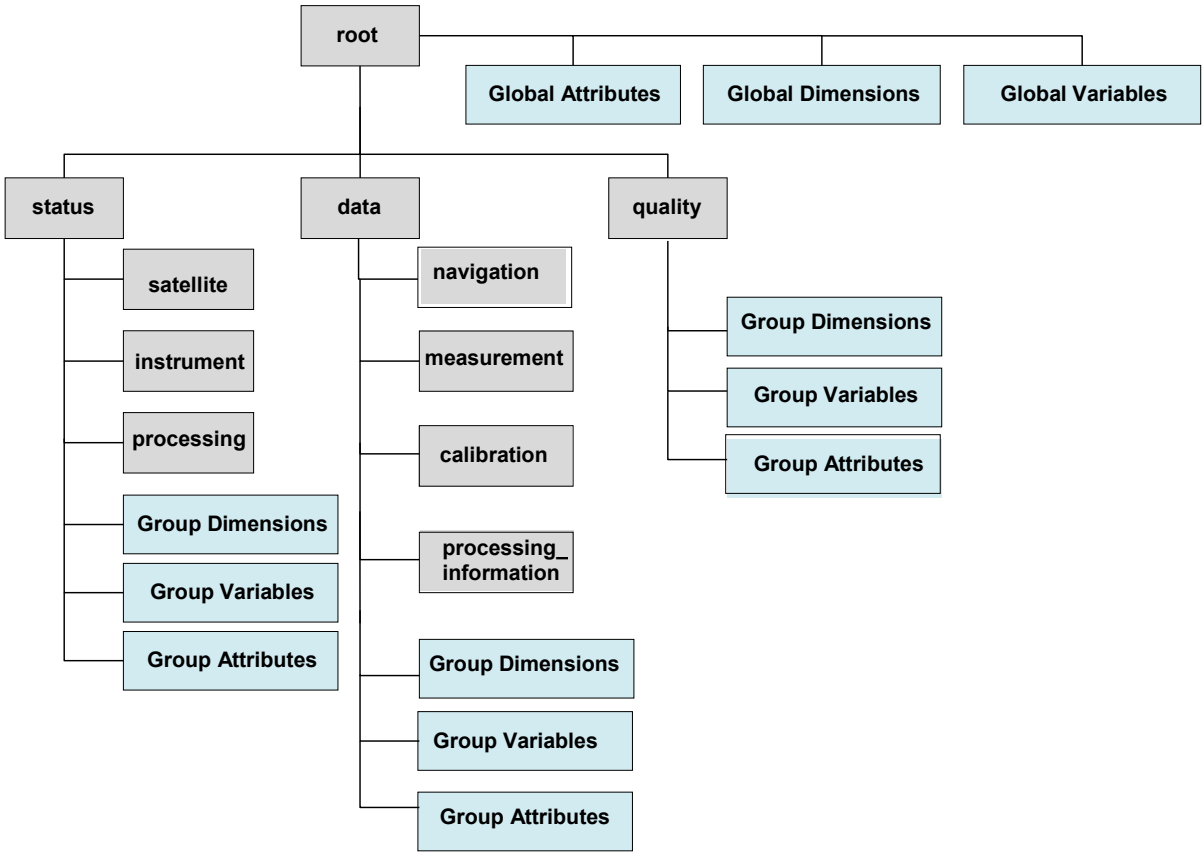

Figure 4-1: Overview of of EPS-SG MWS L1B radiance product.

4.2 MWS Level 1B Radiance

This section gives a detailed description of the NetCDF file content, including groups, attributes, variables and dimensions of the MWS Level 1B radiance product.

4.2.1 Product Summary Sheet

The following table gives a summary sheet of the MWS radiance product.

Table 4-1: MWS radiance product summary sheet.

Filename	**W_XX-EUMETSAT-Darmstadt,SAT,SGA1-MWS-1B-RAD_C_EUMT_20220101121212_G_O_20220101103000_20220101104000_O_N___.nc**
Product ID	MWS-1B-RAD
Product Description	TOA spectral radiances observed by the MWS
Format	netCDF-4
Size (MBytes/orbit**)**	86 MB
Duration	As defined in Phase C

4.2.2 root

This section describes the root composition for the MWS radiance product.

4.2.2.1 Global attributes

The table below describes the global attributes for the MWS L1B radiance product in accordance with the [GPFS].

Table 4-2: Global Attributes for MWS radiance product.

Attribute Name	Type	Meaning and/or value
Conventions	NC_STRING	e.g. “CF-1.6”
metadata_conventions	NC_STRING	e.g. “Unidata Dataset Discovery v1.0”
product_name	NC_STRING	Product name as set out in section 3.2 of MWS PFS
title	NC_STRING	MWS L1B Top of the Atmosphere Radiance
summary	NC_STRING	Product Summary (TBW)
doi	NC_STRING	Digital Object Identifier
keywords	NC_STRING	MWS L1B radiance
history	NC_STRING	(“original generated product”)
institution	NC_STRING	“EUMETSAT” *Note: This field may be extended with other values should products be generated in other locations.*
spacecraft	NC_STRING	Metop-SG A satellites: “SGA”[1-3]
instrument	NC_STRING	Instrument or product identifier ”MWS”
product_level	NC_STRING	Product processing level “1B” = Calibrated and geolocated science data

Attribute Name	Type	Meaning and/or value
type	NC_STRING	Character string providing an indication of the type of product: **type** | **Meaning** RAD | radiance
mission_type	NC_STRING	(“Global” | “Regional” | “Local”)
disposition_mode	NC_STRING	Identification of the type of processing (“Test” | “Commissioning” | “Operational” | “Validation”) Test = Test data Commissioning = Produced during commissioning Operational = expected quality as per requirements based on fully performed validation Validation = During validation of a new processor version during routine operations The ‘mode’ of disposition is related to the suitability of the data for various kinds of uses, and hence the use that should be made of it and the destination to which it should (or should not) be sent.
sensing_start_time_utc	NC_STRING	UTC time of start of sensing data formatted in CF date and time format with ms precision.
sensing_end_time_utc	NC_STRING	UTC time of end of sensing data formatted in CF date and time format with ms precision.
environment	NC_STRING	(“Operational” | “Validation” | “Development”|” Integration & Verification” | ”Engineering”)
references	NC_STRING	“www.eumetsat.int” *Note: It is intended that users of the product can access published, web-based references describing the data and the methods used to produce it at this address.*
orbit_start	NC_UINT	Absolute orbit number at sensing_start_time_utc
orbit_end	NC_UINT	Absolute orbit number at sensing_end_time_utc

4.2.2.2 Global dimensions

No common global dimensions are currently envisaged.

4.2.2.3 Global variables

No common global variables are currently envisaged.

4.2.3 Group name: status

This section describes the ‘status’ group for the MWS radiance product.

4.2.3.1 Group name: satellite

4.2.3.1.1 satellite: Dimensions

This section describes the dimensions in the status/satellite subgroup of the MWS L1B product.

Table 4-3: satellite: Dimensions for MWS L1B product.

Dimension name	Comment	Dimension length
manoeuvre_items	Number of manoeuvres occurring between product start and end	0 ≤ N

4.2.3.1.2 satellite: Variables

This section describes the variables for the status/satellite subgroup of the MWS L1B product with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 4-4: satellite: Variables for MWS radiance product.

Variables Name	Description	Type	Range or Value	Dimension
epoch_time_utc	Epoch time in UTC of the orbital elements.	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Epoch time in UTC of the orbital elements	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1.0e9	
valid_max	Valid maximum value	NC_DOUBLE	1.0e9	
missing_value	Missing value	NC_DOUBLE	-9.0e9	
semi_major_axis	Semi major axis of the orbit at epoch time [TOD]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Semi major axis of the orbit at epoch time [TOD]	
units	Physical units	NC_String	m	
valid_min	Valid minimum value	NC_DOUBLE	6.5e6	
valid_max	Valid maximum value	NC_DOUBLE	8.0e6	
missing_value	Missing value	NC_DOUBLE	-9.0e6	
eccentricity	Eccentricity of the orbit at epoch time [TOD]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Eccentricity of the orbit at epoch time [TOD]	

Variables Name	Description	Type	Range or Value	Dimension
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	0.01	
missing_value	Missing value	NC_DOUBLE	-9.0e2	
inclination	Inclination of the orbit at epoch time [TOD]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Inclination of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING	degrees	
valid_min	Valid minimum value	NC_DOUBLE	98.0	
valid_max	Valid maximum value	NC_DOUBLE	98.8	
missing_value	Missing value	NC_DOUBLE	-99.0	
perigee_argument	Argument of perigee of the orbit at epoch time [TOD]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Argument of perigee of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING	degrees	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	
right_ascension	Right ascension of the orbit at epoch time [TOD]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Right ascension of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING	degrees	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	
mean_anomaly	Mean anomaly of the orbit at epoch time [TOD]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Mean anomaly of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING	degrees	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	
earth_sun_distance_ratio	Ratio of current Earth-Sun distance to mean Earth-Sun distance	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Ratio of current Earth-Sun distance to mean Earth-Sun distance	

Variables Name	Description	Type	Range or Value	Dimension
valid_min	Valid minimum value	NC_DOUBLE	0.983	
valid_max	Valid maximum value	NC_DOUBLE	1.017	
missing_value	Missing value	NC_DOUBLE	-9999.0	
subsat_latitude_start	Latitude of sub-satellite point at start of the product	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Latitude of sub-satellite point at start of the product	
units	Physical units	NC_STRING	degrees_north	
valid_min	Valid minimum value	NC_DOUBLE	-90.0	
valid_max	Valid maximum value	NC_DOUBLE	90.0	
missing_value	Missing value	NC_DOUBLE	-99.0	
subsat_longitude_start	Longitude of sub-satellite point at start of the product	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Longitude of sub-satellite point at start of the product	
units	Physical units	NC_STRING	degrees_east	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	
subsat_latitude_end	Latitude of sub-satellite point at end of the product	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Latitude of sub-satellite point at end of the product	
units	Physical units	NC_STRING	degrees_north	
valid_min	Valid minimum value	NC_DOUBLE	-90.0	
valid_max	Valid maximum value	NC_DOUBLE	90.0	
missing_value	Missing value	NC_DOUBLE	-99.0	
subsat_longitude_end	Longitude of sub-satellite point at end of the product	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Longitude of sub-satellite point at end of the product	
units	Physical units	NC_STRING	degrees_east	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	
state_vector_time_utc	Time of the state vector and attitude items	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Time of the state vector and attitude items	

Variables Name	Description	Type	Range or Value	Dimension
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1.0e9	
valid_max	Valid maximum value	NC_DOUBLE	1.0e9	
missing_value	Missing value	NC_DOUBLE	-9.0e9	
x_position	X position of the orbital state vector [EARTH+FIXED]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	X position of the orbital state vector [EARTH+FIXED]	
units	Physical units	NC_STRING	m	
valid_min	Valid minimum value	NC_DOUBLE	-7.2e6	
valid_max	Valid maximum value	NC_DOUBLE	7.2e6	
missing_value	Missing value	NC_DOUBLE	-9.0e6	
y_position	Y position of the orbital state vector [EARTH+FIXED]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Y position of the orbital state vector [EARTH+FIXED]	
units	Physical units	NC_STRING	m	
valid_min	Valid minimum value	NC_DOUBLE	-7.2e6	
valid_max	Valid maximum value	NC_DOUBLE	7.2e6	
missing_value	Missing value	NC_DOUBLE	-9.0e6	
z_position	Z position of the orbital state vector [EARTH+FIXED]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Z position of the orbital state vector [EARTH+FIXED]	
units	Physical units	NC_STRING	m	
valid_min	Valid minimum value	NC_DOUBLE	-7.2e6	
valid_max	Valid maximum value	NC_DOUBLE	7.2e6	
missing_value	Missing value	NC_DOUBLE	-9.0e6	
x_velocity	X velocity of the orbital state vector [EARTH+FIXED]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	X velocity of the orbital state vector [EARTH+FIXED]	
units	Physical units	NC_STRING	$m\ s^{-1}$	
valid_min	Valid minimum value	NC_DOUBLE	-8.0e3	
valid_max	Valid maximum value	NC_DOUBLE	8.0e3	
missing_value	Missing value	NC_DOUBLE	-9.0e3	
y_velocity	Y velocity of the orbital state vector [EARTH+FIXED]	NC_DOUBLE	valid_min to valid_max	1

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	Y velocity of the orbital state vector [EARTH+FIXED]	
units	Physical units	NC_STRING	m s^{-1}	
valid_min	Valid minimum value	NC_DOUBLE	-8.0e3	
valid_max	Valid maximum value	NC_DOUBLE	8.0e3	
missing_value	Missing value	NC_DOUBLE	-9.0e3	
z_velocity	Z velocity of the orbital state vector [EARTH+FIXED]	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Z velocity of the orbital state vector [EARTH+FIXED]	
units	Physical units	NC_STRING	m s^{-1}	
valid_min	Valid minimum value	NC_DOUBLE	-8.0e3	
valid_max	Valid maximum value	NC_DOUBLE	8.0e3	
missing_value	Missing value	NC_DOUBLE	-9.0e3	
yaw_error	Yaw attitude error	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Yaw attitude error	
units	Physical units	NC_STRING	degrees	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	
roll_error	Roll attitude error	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Roll attitude error	
units	Physical units	NC_STRING	degrees	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	
pitch_error	Pitch attitude error	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Pitch attitude error	
units	Physical units	NC_STRING	degrees	
valid_min	Valid minimum value	NC_DOUBLE	0.0	
valid_max	Valid maximum value	NC_DOUBLE	360.0	
missing_value	Missing value	NC_DOUBLE	-999.0	

Variables Name	Description	Type	Range or Value	Dimension
leap_second_time_utc	UTC time of occurrence of a leap second in this product (if leap second occurred in the product time window); it represents the time after the leap second occurrence (i.e. midnight of day after the leap second; no leap second results in 0)"	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	UTC time of a leap second occurrence in the product	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00	
valid_min	Valid minimum value	NC_DOUBLE	-1.0e9	
valid_max	Valid maximum value	NC_DOUBLE	1.0e9	
missing_value	Missing value	NC_DOUBLE	-9.0e9	
leap_second_value	Value of leap second in product (1, 0, or −1) 1 = increment -1 = decrement	NC_SHORT	-1 to 1	1
long_name	Description of variable	NC_STRING	Value of leap second in product (1, 0, or −1)	
units	Physical units	NC_STRING	s	
valid_min	Valid minimum value	NC_SHORT	-1	
valid_max	Valid maximum value	NC_SHORT	1	
missing_value	Missing value	NC_SHORT	-999	
manoeuvre_occurrence	Occurrence of manoeuvres between start and end times of the product (1 or 2) 1 = in-plane manoeuvre occurred 2 = out-of-plane manoeuvre occurred	NC_BYTE	1 or 2 1 = in-plane manoeuvre occurred 2 = out-of-plane manoeuvre occurred	manoeuvre_items

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	Occurrence of manoeuvres between start and end times of the product (1 or 2) 1 = in-plane manoeuvre occurred 2 = out-of-plane manoeuvre occurred	Note: included only in case of manoeuvre
valid_min	Valid minimum value	NC_BYTE	1	
valid_max	Valid maximum value	NC_BYTE	2	
missing_value	Missing value	NC_BYTE	-9	
manoeuvre_start_time_utc	UTC time of start of manoeuvre	NC_DOUBLE	valid_min to valid_max	manoeuvre_items
long_name	Description of variable	NC_STRING	UTC time of start of manoeuvre	Note: included only in case of manoeuvre
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1.0e9	
valid_max	Valid maximum value	NC_DOUBLE	1.0e9	
missing_value	Missing value	NC_DOUBLE	-9.0e9	
manoeuvre_end_time_utc	UTC time of end of manoeuvre	NC_DOUBLE	valid_min to valid_max	manoeuvre_items
long_name	Description of variable	NC_STRING	UTC time of end of manoeuvre	Note: included only in case of manoeuvre
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1.0e9	
valid_max	Valid maximum value	NC_DOUBLE	1.0e9	
missing_value	Missing value	NC_DOUBLE	-9.0e9	

4.2.3.2 Group name: instrument

4.2.3.2.1 instrument: Attributes

No attributes are envisaged in the status/instrument subgroup of the MWS L1B product.

4.2.3.2.2 instrument: Dimensions

This section describes the dimensions in the status/instrument subgroup of the MWS L1B product.

Table 4-5: instrument: Dimensions for MWS L1B product

Dimension Name	Description	Range or Value
mode_items	Number of modes the instrument assumed during product duration	1≤ N
n_scans	Number of scan lines in the product	1 ≤ N
n_channels	Number of channels for the MWS instrument	24
n_thermistor	Number of thermistors	39
n_thermometer_external	Number of thermometers external to the instrument	4
n_coef_therm_count_to_res	Number of coefficients used in the conversion of thermistor counts to resistance	3
n_coef_therm_res_to_temp	Number of coefficients used in the conversion of thermistor resistance to temperature	7
n_current_motor	Number of motor currents	5
n_instrument_current	Number of instrument current	9
n_instrument_voltage	Number of instrument voltages	23
n_prts	Number of PRTs	6
n_precision_resistors	Number of precision resistors	6
n_temp_ref_inst	Number of reference instrument temperatures	5 to 20
n_band	Number (maximum) of channel bandwidths	4

4.2.3.2.3 instrument: Variables

This section describes the variables for the status/instrument subgroup of the MWS L1B product with their specific attributes. Essentially it contains all instrument Housekeeping Telemetry. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 4-6: instrument: Variables for L1B product

Variables Name	Description	Type	Range or Value	Dimension
channel_central_freq	Central frequency of MWS channels	NC_FLOAT	23 GHz to 230 GHz	n_channels
long_name	Description of variable	NC_STRING	Central frequency of MWS channels	
units	Physical units	NC_STRING	GHz	

Variables Name	Description	Type	Range or Value	Dimension
channel_bandwidths	Bandwidths of MWS channels	NC_INT	1 MHz to 5000 MHz	n_channels, n_band
long_name	Description of variable	NC_STRING	Bandwidths of MWS channels	
units	Physical units	NC_STRING	MHz	
channel_central_wavenum	Central wavenumber of MWS channels	NC_FLOAT		n_channels
long_name	Description of variable	NC_STRING	Central wavenumber of MWS channels	
units	Physical units	NC_STRING	cm^{-1}	
first_channel_band_correction	Channel first band correction coefficient	NC_FLOAT		n_channels
long_name	Description of variable	NC_STRING	Channel first band correction coefficient	
units	Physical units	NC_STRING	K	
second_channel_band_correction	Channel second band correction coefficient	NC_FLOAT		n_channels
long_name	Description of variable	NC_STRING	Channel second band correction coefficient	
thermistor_counts_to_resistance_conv_coef	Thermistor count to resistance conversion coefficients	NC_FLOAT		n_coef_therm_count_to_res
long_name	Description of variable	NC_STRING	Thermistor count to resistance conversion coefficients	
units	Physical units	NC_STRING	counts, counts, ohm	
thermistor_resistance_to_temp_conv_coef	Thermistor resistance to temperature conversion coefficients	NC_FLOAT		n_coef_therm_res_to_temp
long_name	Description of variable	NC_STRING	Thermistor resistance to temperature conversion coefficients	
units	Physical units	NC_STRING	K, K ohm^{-1}, K ohm^{-2}, K ohm^{-3}, K ohm^{-4}, K ohm^{-5}, K ohm^{-6}	
mean_reference_thermistor_log_resistance	Base-10 logarithm of the mean of pre-launch characterised thermistor resistance	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Base-10 logarithm of the mean of pre-launch characterised thermistor resistance	
units	Physical units	NC_STRING	ohm (log10)	

Variables Name	Description	Type	Range or Value	Dimension
stdev_reference_thermistor_log_resistance	Base-10 logarithm of the standard deviation of pre-launch characterised thermistor resistance	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Base-10 logarithm of the standard deviation of pre-launch characterised thermistor resistance	
units	Physical units	NC_STRING	ohm (log10)	
channel_freq_shift	Temperature-dependent channel central frequency shift	NC_SHORT	valid_min to valid_max	n_scans , n_channels
long_name	Description of variable	NC_STRING	Temperature-dependent channel central frequency shift	
units	Physical units	NC_STRING	MHz	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	2^{15} - 1	
missing_value	Missing value	NC_SHORT	-2^{15}	
precision_resistances_prime	Resistance of the high precision resistors: prime set	NC_FLOAT		n_precison_resistors
long_name	Description of variable	NC_STRING	Resistance of the high precision resistors: prime set	
units	Physical units	NC_STRING	ohm	
precision_resistances_redundant	Resistance of the high precision resistors: redundant set	NC_FLOAT		n_precison_resistors
long_name	Description of variable	NC_STRING	Resistance of the high precision resistors: redundant set	
units	Physical units	NC_STRING	ohm	
mirror_reflectivity_perpendicular	Rotating mirror reflectivity (perpendicular)	NC_FLOAT	0.5-1.0	n_channels
long_name	Description of variable	NC_STRING	Rotating mirror reflectivity (perpendicular)	
instrument_reference_temperatures	Instrument reference temperatures	NC_INT		n_temp_ref_inst
long_name	Description of variable	NC_STRING	Instrument reference temperatures	

Variables Name	Description	Type	Range or Value	Dimension
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
instrument_reference_temperatures_backup	Instrument backup reference temperatures	NC_INT		n_temp_ref_inst
long_name	Description of variable	NC_STRING	Instrument reference temperatures - backup	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
instrument_mode	Name of the instrument mode assumed	NC_STRING	"SCAN" | "POINTING"	mode_items
long_name	Description of variable	NC_STRING	Name of the instrument mode assumed	
missing_value	Missing value	NC_STRING	“UNDEFINED MODE“	
mode_start_time_utc	Start time of the mode	NC_DOUBLE	valid_min to valid_max	mode_items
long_name	Description of variable	NC_STRING	Start time of the mode	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1.e9	
valid_max	Valid maximum value	NC_DOUBLE	1.e9	
missing_value	Missing value	NC_DOUBLE	-9.e9	
mode_end_time_utc	End time of the mode	NC_DOUBLE	valid_min to valid_max	mode_items
long_name	Description of variable	NC_STRING	End time of the mode	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1.e9	
valid_max	Valid maximum value	NC_DOUBLE	1.e9	
missing_value	Missing value	NC_DOUBLE	-9.e9	

Variables Name	Description	Type	Range or Value	Dimension
mws_sce_register_status	MWS Scan Control Electronics (SCE) register status. Bitwise value: 0 = Not Active, 1 = Active	NC_UINT	Bits 24-31: Not Used (zero) Bits 22-23 : see MOS-ICD-JOP-SCE-12009 Bit 21: SCE current operating mode: Scan Profile Bit 20: SCE current operating mode: Constant Angular Speed Bit 19: SCE current operating mode: Fixed Position Bit 18: SCE current operating mode: Park Bit 17: SCE current operating mode: Motor Inactive Bit 16: SCE current operating mode: Init Bits 0-15: see MOS-ICD-JOP-SCE-12009	n_scans
long_name	Description of variable	NC_STRING	MWS Scan Control Electronics (SCE) register status. Bitwise value: 0 = Not Active, 1 = Active	
mws_onboard_software_version	Identifier of the version of the Service Software (SSW) component of the Boot and Service mode Software (BSSW)	NC_UINT	Version ID: $aa_{16}bb_{16}\_ii_{16}rr_{16}$ aa_{16} = 0 (Not Used) bb_{16} = 0 (Not Used) ii_{16} = 0 … 255 (Issue ID) rr_{16} = 0 … 255 (Revision ID) (all other values are invalid)	1
long_name	Description of variable	NC_STRING	Identifier of the version of the Service Software (SSW) component of the Boot and Service mode Software (BSSW)	
mws_startup_reason	Identifies the reason for the Instrument Control Unit (ICU) startup	NC_USHORT	00_{16} = Cold reset / Power on 01_{16} = Warm reset [non Tc] 02_{16} = Warm reset [Tc request] 03_{16} = Unhandled Exception 04_{16} = Error Detection and Correction (EDAC) Uncorrected code 05_{16} = EDAC Uncorrected data 06_{16} = Watchdog Timeout 07_{16} = Equipment Switch-Off Line (EQSOL) (all other values are invalid)	n_scans
long_name	Description of variable	NC_STRING	Identifies the reason for the Instrument Control Unit (ICU) startup	

Variables Name	Description	Type	Range or Value	Dimension
mws_icu_in_use	Identifier of the Instrument Control Unit (ICU) being used with respect to its redundancy	NC_UBYTE	A_{16} = ICU A (Ch 3-16 Receiver Side: QV, PRT set: Redundant), B_{16} = ICU B (Ch 3-16 Receiver Side: QH, PRT set: Prime), **(all other values are invalid)**	n_scans
long_name	Description of variable	NC_STRING	Identifier of the Instrument Control Unit (ICU) being used with respect to its redundancy	
mws_instrument_model	Identifier of the hardware instrument model in use with respect to its build	NC_UBYTE	00_{16} = Undefined 11_{16} = EFM $E0_{16}$ = EM $E1_{16}$ = EM1 $E2_{16}$ = EM2 $E8_{16}$ = EQM $F1_{16}$ = PFM $F2_{16}$ = FM2 $F3_{16}$ = FM3 (all other values are invalid)	1
long_name	Description of variable	NC_STRING	Identifier of the hardware instrument model in use with respect to its build	

Variables Name	Description	Type	Range or Value	Dimension
mws_function_status	Tm(3,25) Function Status: provides the status of the identified function	NC_UINT64	Bitwise value: 0 =Disabled, 1 = Enabled. Bit 63 EDAC SRAM Bit 62 Memory Scrubbing SRAM Bit 61: Memory Scrubbing SDRAM Bit 60: Watchdog Bit 59: Time Synchronisation Bit 58: Science Data Collection Bit 57: Dummy Science Data Reporting Bit 56: SMA Data Collection Bit 55: SMA Data Checking Bit 54: Not Used (zero) Bit 53: Not Used (zero) Bit 52: Not Used (zero) Bit 51: Not Used (zero) Bit 50: Monitoring [Service 12] Bit 49: Event Action [Service 19] Bit 48: Repeated Report Management Bit 47: Ch-1 Gain Control Bit 46: Ch-2 Gain Control Bit 45: Ch-3 Gain Control Bit 44: Ch-4 Gain Control Bit 43: Ch-5 Gain Control Bit 42: Ch-6 Gain Control Bit 41: Ch-7 Gain Control Bit 40: Ch-8 Gain Control Bit 39: Ch-9 Gain Control Bit 38: Ch-10 Gain Control Bit 37: Ch-11 Gain Control Bit 36: Ch-12 Gain Control Bit 35: Ch-13 Gain Control Bit 34: Ch-14 Gain Control Bit 33: Ch-15 Gain Control Bit 32: Ch-16 Gain Control Bit 31: Ch-17 Gain Control Bit 30: Ch-18 Gain Control Bit 29: Ch-19 Gain Control Bit 28: Ch-20 Gain Control Bit 27: Ch-21 Gain Control Bit 26: Ch-22 Gain Control Bit 25: Ch-23 Gain Control Bit 24: Ch-24 Gain Control Bit 23: Ch-1 DC-Offset Control Bit 22: Ch-2 DC-Offset Control Bit 21: Ch-3 DC-Offset Control Bit 20: Ch-4 DC-Offset Control Bit 19: Ch-5 DC-Offset Control Bit 18: Ch-6 DC-Offset Control Bit 17: Ch-7 DC-Offset Control Bit 16: Ch-8 DC-Offset Control Bit 15: Ch-9 DC-Offset Control Bit 14: Ch-10 DC-Offset Control Bit 13: Ch-11 DC-Offset Control Bit 12: Ch-12 DC-Offset Control Bit 11: Ch-13 DC-Offset Control Bit 10: Ch-14 DC-Offset Control Bit 9: Ch-15 DC-Offset Control Bit 8: Ch-16 DC-Offset Control Bit 7: Ch-17 DC-Offset Control Bit 6: Ch-18 DC-Offset Control Bit 5: Ch-19 DC-Offset Control Bit 4: Ch-20 DC-Offset Control Bit 3: Ch-21 DC-Offset Control Bit 2: Ch-22 DC-Offset Control Bit 1: Ch-23 DC-Offset Control **Bit 0: Ch-24 DC-Offset Control**	n_scans
long_name	Description of variable	NC_STRING	Tm(3,25) Function Status: provides the status of the identified function	
mws_discarded_tm_packets	Number of telemetry packets discarded due to SpaceWire interface output buffer anomalies	NC_USHORT		n_scans

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	Number of telemetry packets discarded due to SpaceWire interface output buffer anomalies	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	2^{16} - 1	
mws_edac_correction	Count of EDAC Corrections (COEC): number of Error Detection And Correction (EDAC) anomalies corrected within the code	NC_UINT		n_scans
long_name	Description of variable	NC_STRING	Count of EDAC Corrections (COEC): number of Error Detection And Correction (EDAC) anomalies corrected within the code	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32} - 1	
mws_cosi	Count of Spurious Interrupts (COSI) detected by the application software	NC_USHORT		n_scans
long_name	Description of variable	NC_STRING	Count of Spurious Interrupts (COSI) detected by the application software	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	2^{16} - 1	
mws_sdss	Sample Data Saturation Status (SDSS) of each of the 24 channels	NC_UINT	Bitwise value: 0 = Not Saturated, 1 = Saturated. Bit 0: Channel 1, …, Bit 23: Channel 24 Bits 24 – 31: Not Used (zero)	n_scans
long_name	Description of variable	NC_STRING	Sample Data Saturation Status (SDSS) of each of the 24 channels	

Variables Name	Description	Type	Range or Value	Dimension
mws_sdcs	Scan Mechanism Assembly (SMA) Data Check Status (SDCS): identifies the status of the check performed on the SMA motor position data for the current scan	NC_UBYTE	0 = Passed / Not applicable 1 = Failed (all other values are invalid)	n_scans
long_name	Description of variable	NC_STRING	Scan Mechanism Assembly (SMA) Data Check Status (SDCS): identifies the status of the check performed on the SMA motor position data for the current scan	
mws_thermistor	MWS instrument thermistor counts.	NC_USHORT		n_scans , n_thermistor

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	MWS instrument thermistor counts. Thermistor 1: Motor #1, Thermistor 2: Motor #2, Thermistor 3: Motor #3, Thermistor 4: SCE A, Thermistor 5: SCE B, Thermistor 6: spare #1, Thermistor 7: QON +X, Thermistor 8: QON -X, Thermistor 9: PSR, Thermistor 10: DD23, Thermistor 11: DD31, Thermistor 12: DD89, Thermistor 13: FE54, Thermistor 14: FE166, Thermistor 15: FE183, Thermistor 16: FE229, Thermistor 17: spare #2, Thermistor 18: BE54 (3..10) #1, Thermistor 19: BE54 (3..10) #2, Thermistor 20: BE54 (11..16) #1, Thermistor 21: BE54 (11..16) #2, Thermistor 22: BE166-229 (Unit C), Thermistor 23: BE183 (Unit D), Thermistor 24: MO A, Thermistor 25: MO B, Thermistor 26: spare #3, Thermistor 27: OBCT, Thermistor 28: Baseplate #1, Thermistor 29: Baseplate #2, Thermistor 30: Baseplate #3, Thermistor 31: Baseplate #4, Thermistor 32: SRx SECOIA, Thermistor 33: SRx Converters, Thermistor 34: PAM, Thermistor 35: SPE SECOIA and 54GHz switches, Thermistor 36: SPE non-54GHz switches, Thermistor 37: spare #4, Thermistor 38: PNRx SECOIA, Thermistor 39: PNRx non-54GHz switches.	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	4095	
missing_value	Missing value	NC_USHORT	2^{16} - 1	

Variables Name	Description	Type	Range or Value	Dimension
mws_prt_selectedgain	MWS Platinum Resistance Thermometer (PRT) selected gain. PRT 1: radius 137.5mm - 30deg, PRT 2: radius 67.5mm - 90deg, PRT 3: radius 137.5mm - 150deg, PRT 4: radius 67.5mm - 210deg, PRT 5: radius 137.5mm - 270deg, PRT 6: radius 67.5mm - 330deg.	NC_UBYTE	0 = Coarse 1 = Fine 1 2 = Fine 2 3 = Fine 3 (all other values are invalid)	n_scans, n_prts
long_name	Description of variable	NC_STRING	MWS Platinum Resistance Thermometer (PRT) selected gain. PRT 1: radius 137.5mm - 30deg, PRT 2: radius 67.5mm - 90deg, PRT 3: radius 137.5mm - 150deg, PRT 4: radius 67.5mm - 210deg, PRT 5: radius 137.5mm - 270deg, PRT 6: radius 67.5mm - 330deg.	
mws_prt_count	MWS Platinum Resistance Thermometer (PRT) counts. PRT 1: radius 137.5mm - 30deg, PRT 2: radius 67.5mm - 90deg, PRT 3: radius 137.5mm - 150deg, PRT 4: radius 67.5mm - 210deg, PRT 5: radius 137.5mm - 270deg, PRT 6: radius 67.5mm - 330deg.	NC_USHORT		n_scans, n_prts

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	MWS Platinum Resistance Thermometer (PRT) counts. PRT 1: radius 137.5mm - 30deg, PRT 2: radius 67.5mm - 90deg, PRT 3: radius 137.5mm - 150deg, PRT 4: radius 67.5mm - 210deg, PRT 5: radius 137.5mm - 270deg, PRT 6: radius 67.5mm - 330deg.	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	4095	
missing_value	Missing value	NC_USHORT	2^{16} - 1	
mws_hpr_selectedgain	MWS High Precision Resistor (HPR) selected gain	NC_UBYTE	0 = Coarse 1 = Fine 1 2 = Fine 2 3 = Fine 3 (all other values are invalid)	n_scans, n_precision_resistors
long_name	Description of variable	NC_STRING	MWS High Precision Resistor (HPR) selected gain	
mws_hpr_count	MWS High Precision Resistor (HPR) counts	NC_USHORT	valid_min to valid_max	n_scans, n_precision_resistors
long_name	Description of variable	NC_STRING	MWS High Precision Resistor (HPR) counts	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	4095	
missing_value	Missing value	NC_USHORT	2^{16} - 1	
mws_therm_ext_selectedgain	MWS external thermometers (EXT) selected gain. EXT 1: Receiver hood, EXT 2: Spacecraft position 1, EXT 3: Spacecraft position 2, EXT 4: Spacecraft position 3.	NC_UBYTE	0 = Coarse 1 = Fine 1 2 = Fine 2 3 = Fine 3 (all other values are invalid)	n_scans, n_thermometer_external

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	MWS external thermometers (EXT) selected gain. EXT 1: Receiver hood, EXT 2: Spacecraft position 1, EXT 3: Spacecraft position 2, EXT 4: Spacecraft position 3.	
mws_therm_ext_count	MWS external thermometers (EXT) counts. EXT 1: Receiver hood, EXT 2: Spacecraft position 1, EXT 3: Spacecraft position 2, EXT 4: Spacecraft position 3.	NC_USHORT	valid_min to valid_max	n_scans, n_thermometer_external
long_name	Description of variable	NC_STRING	MWS external thermometers (EXT) counts. EXT 1: Receiver hood, EXT 2: Spacecraft position 1, EXT 3: Spacecraft position 2, EXT 4: Spacecraft position 3.	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	4095	
missing_value	Missing value	NC_USHORT	$2^{16} - 1$	
mws_instrument_current	MWS instrument currents	NC_USHORT		n_scans, n_instrument_current
long_name	Description of variable	NC_STRING	MWS instrument currents. Current 1: Rx +8.5V, current 2: Rx -8.5V, current 3: Rx +5.7V, current 4: MO +12V, current 5: ICU +28V, current 6: ICU +15V, current 7: ICU -15V, current 8: ICU +5V, current 9: ICU +5.2V	
mws_dc_link_voltage	Voltage DC link	NC_USHORT		n_scans
long_name	Description of variable	NC_STRING	Voltage DC link	
mws_dc_link_current	Current DC link	NC_USHORT		n_scans

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	Current DC link	
mws_motor_current_sce	MWS scan control electronics (SCE) currents: SCE +12v current (CSEC_P12v), SCE -12v current (CSEC_M12v), SCE +5v current (CSEC_5v), SCE +3.3v current (CSEC_3v3), SCE +32v current (CSEC_32v)	NC_USHORT		n_scans, n_current_motor
long_name	Description of variable	NC_STRING	MWS scan control electronics (SCE) currents: SCE +12v current (CSEC_P12v), SCE -12v current (CSEC_M12v), SCE +5v current (CSEC_5v), SCE +3.3v current (CSEC_3v3), SCE +32v current (CSEC_32v)	
mws_acquis_sys_voltage	Acquisition system reference voltage	NC_USHORT		n_scans
long_name	Description of variable	NC_STRING	Acquisition system reference voltage	
mws_motor_current_selected	MWS motor current telemetry of the associated motor current select (MCS) parameter: MCS 1, …, MCS 5	NC_USHORT		n_scans, n_current_motor
long_name	Description of variable	NC_STRING	MWS motor current telemetry of the associated motor current select (MCS) parameter: MCS 1, …, MCS 5	
mws_instrument_voltage	MWS instrument voltages	NC_USHORT		n_scans, n_instrument_voltage

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	MWS instrument voltages. Voltage 1: P5v2F, voltage 2: P5v7, voltage 3: Vaux, voltage 4: P8v5, voltage 5: M8v5, voltage 6: 5vRef 1, voltage 7: 5vRef 2, voltage 8: P15v, voltage 9: M15v, voltage 10: P5v, voltage 11: P28v, voltage 12: P3v3, voltage 13: P1v8, voltage 14: P1v5, voltage 15: PAM P15v, voltage 16: PAM M15v, voltage 17: PLL P1v8, voltage 18: Gnd14 - AN2, voltage 19: Gnd26 - AN2, voltage 20: Gnd27 - AN2, voltage 21: Gnd28 - AN2, voltage 22: Gnd29 - AN2, voltage 23: Gnd30 - AN2	
mws_power_switch_status_primary	MWS power switch status - primary (PSSP)	NC_UBYTE	Bit 0: Rx DC/DC enable/disable, Bit 1: OBCT op heater on/off, Bit 2: Rx FE op heater on/off, Bit 3: Rx BE op heater on/off, Bit 4: Scan Mechanism Assembly (SMA) op heater on/off, Bit 5: SMA A primary bus on/off, Bit 6: SMA B primary bus on/off, Bit 7: SMA select A:A & B:B or A:B & B:A	n_scans
long_name	Description of variable	NC_STRING	MWS power switch status - primary (PSSP)	

mws_power_switch_status_secondary_a	MWS power switch status - secondary (PSSS) group A	NC_UINT64	Bit 63: not used (zero) Bit 62: Receiver (RX) over voltage protection (OVP) Bitwise value: 0 =Disabled, 1 = Enabled. Bit 61: RX over current protection (OCP) Bitwise value: 0 =Disabled, 1 = Enabled. Bit 60: PSSS 117 - Reserved 6 +8.5V Bit 59: PSSS 116 - Reserved 5 +8.5V Bit 58: PSSS 115 - Reserved 4 +8.5V Bit 57: PSSS 114 - Reserved 3 +8.5V Bit 56: PSSS 113 - Reserved 2 +8.5V Bit 55: PSSS 112 - Reserved 1 +8.5V Bit 54: PSSS 111 - Not used (zero) Bit 53: PSSS 110 - MO select direct/xstrap [A-A & B-B | A-B & B-A] Bit 52: PSSS 109 - MO side B +12V on/off Bit 51: PSSS 108 - MO side A +12V on/off Bit 50: PSSS 107 - BE229 (Ch-24) -8.5V on/off Bit 49: PSSS 106 - BE229 (Ch-24) +8.5V on/off Bit 48: PSSS 105 - BE229 (Ch-24) +5.7V on/off Bit 47: PSSS 104 - FE229 (Ch-24) DownConverter -8.5V on/off Bit 46: PSSS 103 - FE229 (Ch-24) DownConverter +8.5V on/off Bit 45: PSSS 102 - FE229 (Ch-24) Dielectric Resonator Oscillator DRO 3a/b select +5.7V on/off Bit 44: PSSS 101 - FE229 (Ch-24) Dielectric Resonator Oscillator DRO 3a/b supply +5.7V on/off Bit 43: PSSS 100 - FE229 (Ch-24) DownConverter +5.7V on/off Bit 42: PSSS 99 - BE183 (Ch-23) -8.5V on/off Bit 41: PSSS 98 - BE183 (Ch-22) -8.5V on/off Bit 40: PSSS 97 - BE183 (Ch-21) -8.5V on/off Bit 39: PSSS 96 - BE183 (Ch-20) -8.5V on/off Bit 38: PSSS 95 - BE183 (Ch-19) -8.5V on/off Bit 37: PSSS 94 - BE183 (Ch-23) +8.5V on/off Bit 36: PSSS 93 - BE183 (Ch-22) +8.5V on/off Bit 35: PSSS 92 - BE183 (Ch-21) +8.5V on/off Bit 34: PSSS 91 - BE183 (Ch-20) +8.5V on/off Bit 33: PSSS 90 - BE183 (Ch-19) +8.5V on/off Bit 32: PSSS 89 - BE183 (Ch-21...23) -8.5V on/off Bit 31: PSSS 88 - BE183 (Ch-19...20) -8.5V on/off Bit 30: PSSS 87 - BE183 (Ch-19...23) -8.5V on/off Bit 29: PSSS 86 - BE183 (Ch-23) +5.7V on/off Bit 28: PSSS 85 - BE183 (Ch-22) +5.7V on/off Bit 27: PSSS 84 - BE183 (Ch-21) +5.7V on/off Bit 26: PSSS 83 - BE183 (Ch-20) +5.7V on/off Bit 25: PSSS 82 - BE183 (Ch-19) +5.7V on/off Bit 24: PSSS 81 - BE183 (Ch-21...23) +5.7V on/off Bit 23: PSSS 80 - BE183 (Ch-19...20) +5.7V on/off Bit 22: PSSS 79 - BE183 (Ch-19...23) +5.7V on/off Bit 21: PSSS 78 - FE183 (Ch-19...23) DoCon -8.5V on/off Bit 20: PSSS 77 - FE183 (Ch-19...23) DoCon +8.5V on/off Bit 19: PSSS 76 - FE183 (Ch-19...23) DRO2a/b select +5.7V on/off Bit 18: PSSS 75 - FE183 (Ch-19...23) DRO2a/b supply +5.7V on/off	n_scans

Variables Name	Description	Type	Range or Value	Dimension
			Bit 17: PSSS 74 - FE183 (Ch-19..23) DoCon +5.7V on/off Bit 16: PSSS 73 - BE166 (Ch-18) -8.5V on/off Bit 15: PSSS 72 - BE166 (Ch-18) +8.5V on/off Bit 14: PSSS 71 - BE166 (Ch-18) +5.7V on/off Bit 13: PSSS 70 - FE166 (Ch-18) DoCon -8.5V on/off Bit 12: PSSS 69 - FE166 (Ch-18) DoCon +8.5V on/off Bit 11: PSSS 68 - FE166 (Ch-18) DRO1a/b +5.7V select on/off Bit 10: PSSS 67 - FE166 (Ch-18) DRO1a/b +5.7V supply on/off Bit 9: PSSS 66 - FE166 (Ch-18) DoCon +5.7V on/off Bit 8: PSSS 65 - DD89 (Ch-17) -8.5V on/off Bit 7: PSSS 64 - DD89 (Ch-17) +8.5V on/off Bit 6: PSSS 63 - DD89 (Ch-17) +5.7V on/off Bit 5: PSSS 62 - BE54 (Ch-15) -8.5V on/off Bit 4: PSSS 61 - BE54 (Ch-14) -8.5V on/off Bit 3: PSSS 60 - BE54 (Ch-13) -8.5V on/off Bit 2: PSSS 59 - BE54 (Ch-12) -8.5V on/off Bit 1: PSSS 58 - BE54 (Ch-11) -8.5V on/off Bit 0: PSSS 57 - BE54 (Ch-16) +8.5V on/off	
long_name	Description of variable	NC_STRING	MWS power switch status - secondary (PSSS) group A	

mws_power_switch_status_secondary_b	MWS power switch status - secondary (PSSS) group B	NC_UINT64	Bit 63: PSSS 56 - BE54 (Ch-16) +8.5V on/off Bit 62: PSSS 55 - BE54 (Ch-15) +8.5V on/off Bit 61: PSSS 54 - BE54 (Ch-14) +8.5V on/off Bit 60: PSSS 53 - BE54 (Ch-13) +8.5V on/off Bit 59: PSSS 52 - BE54 (Ch-12) +8.5V on/off Bit 58: PSSS 51 - BE54 (Ch-11) +8.5V on/off Bit 57: PSSS 50 - BE54 (Ch-11…16) LOB-7b -8.5V on/off Bit 56: PSSS 49 - BE54 (Ch-11…16) LOB-7a -8.5V on/off Bit 55: PSSS 48 - BE54 (Ch-11…16) LOB-6b -8.5V on/off Bit 54: PSSS 47 - BE54 (Ch-11…16) LOB-6a -8.5V on/off Bit 53: PSSS 46 - BE54 (Ch-11…16) LOB-7b +8.5V on/off Bit 52: PSSS 45 - BE54 (Ch-11…16) LOB-7a +8.5V on/off Bit 51: PSSS 44 - BE54 (Ch-11…16) LOB-6b +8.5V on/off Bit 50: PSSS 43 - BE54 (Ch-11…16) LOB-6a +8.5V on/off Bit 49: PSSS 42 - BE54 (Ch-13, 15, 16) +8.5V on/off (PSSS-42) Bit 48: PSSS 41 - BE54 (Ch-11…16) 1st/2nd amplifier, +8.5V on/off Bit 47: PSSS 40 - BE54 (Ch-10) -8.5V on/off Bit 46: PSSS 39 - BE54 (Ch-9) -8.5V on/off Bit 45: PSSS 38 - BE54 (Ch-8) -8.5V on/off Bit 44: PSSS 37 - BE54 (Ch-7) -8.5V on/off Bit 43: PSSS 36 - BE54 (Ch-6) -8.5V on/off Bit 42: PSSS 35 - BE54 (Ch-5) -8.5V on/off Bit 41: PSSS 34 - BE54 (Ch-4) -8.5V on/off Bit 40: PSSS 33 - BE54 (Ch-3) -8.5V on/off Bit 39: PSSS 32 - BE54 (Ch-10) +8.5V on/off Bit 38: PSSS 31 - BE54 (Ch-9) +8.5V on/off Bit 37: PSSS 30 - BE54 (Ch-8) +8.5V on/off Bit 36: PSSS 29 - BE54 (Ch-7) +8.5V on/off Bit 35: PSSS 28 - BE54 (Ch-5) +8.5V on/off Bit 34: PSSS 27 - BE54 (Ch-5) +8.5V on/off Bit 33: PSSS 26 - BE54 (Ch-4) +8.5V on/off Bit 32: PSSS 25 - BE54 (Ch-3) +8.5V on/off Bit 31: PSSS 24 - BE54 (Ch-8…9) +8.5V on/off Bit 30: PSSS 23 - BE54 (Ch-3…10) +8.5V on/off Bit 29: PSSS 22 - FE54 (Ch-3…16) LO 5 -8.5V on/off Bit 28: PSSS 21 - FE54 (Ch-3…16) LO 4 -8.5V on/off Bit 27: PSSS 20 - FE54 (Ch-3…16) LO 5 +5.7V on/off Bit 26: PSSS 19 - FE54 (Ch-3…16) LO 4 +5.7V on/off Bit 25: PSSS 18 - FE54 (Ch-3…16) +5.7V on/off Bit 24: PSSS 17 - DD31 (Ch-2) -8.5V on/off Bit 23: PSSS 16 - DD31 (Ch-2) +8.5V on/off Bit 22: PSSS 15 - DD31 (Ch-2) +5.7V on/off Bit 21: PSSS 14 - DD23 (Ch-1) -8.5V on/off	n_scans

Variables Name	Description	Type	Range or Value	Dimension
			Bit 20: PSSS 13 - DD23 (Ch-1) +8.5V on/off Bit 19: PSSS 12 - DD23 (Ch-1) +5.7V on/off Bit 18: PSSS 11 - SPE Ch-24 on/off Bit 17: PSSS 10 - SPE Ch-23 on/off Bit 16: PSSS 09 - SPE Ch-22 on/off Bit 15: PSSS 08 - SPE Ch-21 on/off Bit 14: PSSS 07 - SPE Ch-20 on/off Bit 13: PSSS 06 - SPE Ch-19 on/off Bit 12: PSSS 05 - SPE Ch-18 on/off Bit 11: PSSS 04 - SPE Ch-17 on/off Bit 10: PSSS 03 - SPE Ch-2 on/off Bit 9: PSSS 02 - SPE Ch-1 on/off Bit 8: PSSS 01 - SPE board on/off Bit 7 – 0 : not used.	
long_name	Description of variable	NC_STRING	MWS power switch status - secondary (PSSS) group B	
mws_local_oscillator_gain_control	Gain control (bit 0 and bit 1 pairs) of MWS local oscillators (LO)	NC_USHORT	Bit 15: Not Used (zero) Bit 14: Not Used (zero) Bit 13: Not Used (zero) Bit 12: Not Used (zero) Bit 11: Not Used (zero) Bit 10: Not Used (zero) Bit 9: LO 5 (54GHz) – bit 0 Bit 8: LO 5 (54GHz) – bit 1 Bit 7: LO 4 (54GHz) – bit 0 Bit 6: LO 4 (54GHz) –bit 1 Bit 5: LO 3 a&b (229GHz) – bit 0 Bit 4: LO 3 a&b (229GHz) – bit 1 Bit 3: LO 2 a&b (183GHz) –bit 0 Bit 2: LO 2 a&b (183GHz) – bit 1 Bit 1: LO 1 a&b (166GHz) –bit 0 Bit 0: LO 1 a&b (166GHz) – bit 1	n_scans
long_name	Description of variable	NC_STRING	Gain control (bit 0 and bit 1 pairs) of MWS local oscillators (LO)	
mws_SPE_FPGA_mode_parity_status	MWS Signal Processing Electronics (SPE) Field-Programmable Gate Array (FPGA) mode / parity status	NC_UBYTE		n_scans
long_name	Description of variable	NC_STRING	MWS Signal Processing Electronics (SPE) Field-Programmable Gate Array (FPGA) mode / parity status	
mws_channel_dc_offset	MWS Signal Processing Electronics (SPE) channel DC-offset	NC_UBYTE		n_scans, n_channels
long_name	Description of variable	NC_STRING	MWS Signal Processing Electronics (SPE) channel DC-offset	

Variables Name	Description	Type	Range or Value	Dimension
mws_channel_gain	MWS Signal Processing Electronics (SPE) channel gain	NC_USHORT		n_scans, n_channels
long_name	Description of variable	NC_STRING	MWS Signal Processing Electronics (SPE) channel gain	
mws_motor_position_pcc_fixed	MWS motor position telemetry acquired at known fixed Pixel Clock Count	NC_UINT		n_scans
long_name	Description of variable	NC_STRING	MWS motor position telemetry acquired at known fixed Pixel Clock Count	

4.2.3.3 Group name: processing

4.2.3.3.1 processing: Attributes

This section describes the attributes in the status/processing subgroup of the MWS L1B product.

Table 4-7: processing: Attributes for MWS L1B product.

Attribute name	Description	Type	Range or Value
processor_name	"Name of the product processor"	NC_STRING	MWS_L1B
processor_version	"Version number of the processor"	NC_STRING	"v[*n*]"
processing_mode	("NRT" | "Reprocessing") Processing mode in which the product was generated	NC_STRING	"NRT" or "Reprocessing"
format_version	Product format version control number.	NC_STRING	Refer to Table 4-19
pgs_reference_and_version	"Reference and version of the PGS"	NC_STRING	"EUM/LEO-EPSSG/SPE/14/777476 v[*n*] "
pfs_reference_and_version	"Reference and version of the PFS"	NC_STRING	"EUM/LEO-EPSSG/SPE/14/777550 v[*n*] "

Attribute name	Description	Type	Range or Value
atbd_reference_and_version	"Reference and version of the ATBD"	NC_STRING	EUM/LEO-EPSSG/SPE/14/737100 v[*n*]
baseline (optional)	"Climate data record collection version in reprocessed data – optional attribute"	NC_STRING	-
source	As particularised in the relevant product format specification, an array of strings of the form specified in as follows: (AUXILIARY_DATA_NAME)* (INPUT_PRODUCT_NAME)* where the asterisks indicate zero or more instances	NC_STRING	Input Data – MWS L0 File, NAVATT L0 File, Input Auxiliary Data – AUX_IBA, AUX_POFD, AUX_CCDB, AUX_CFI, AUX_COF, AUX_LSM, AUX_DEM

4.2.3.3.2 processing: Dimensions

No dimensions are envisaged.

4.2.3.3.3 processing: Variables

This section describes the variables for the status/processing subgroup of the MWS L1B product with their specific attributes.

Table 4-8: processing: Variables for MWS L1B product.

Variables Name	Description	Type	Range or Value	Dimension
creation_time_utc	Creation time information	NC_DOUBLE	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	UTC time of the start of the product creation	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00	
valid_min	Valid minimum value	NC_DOUBLE	-1.e9	
valid_max	Valid maximum value	NC_DOUBLE	1.e9	
missing_value	Missing value	NC_DOUBLE	-9.e9	

4.2.4 Group name: data

The dimensions that are common for the data groups are listed in this table.

Table 4-9: Dimensions for data group of MWS radiance product.

Dimension Name	Description	Range or Value
n_scans	Number of scan lines in the product	1 ≤ N
n_channels	Number of channels for the MWS instrument	24
n_fovs	Number of field of views per scan	95
n_fovs_cal	Number of cold and warm FOVs per scan	5
n_prts	Number of PRTs	6
n_channels_os	Number of channels with oversampling	2

4.2.4.1 Group name: navigation

4.2.4.1.1 navigation: Attributes

Attributes for this group are not envisaged.

4.2.4.1.2 navigation: Dimensions

Dimensions for this group are listed in the table below.

Table 4-10: Dimensions for navigation group of MWS radiance product.

Dimension Name	Description	Range or Value
n_resol	Number of resolutions for LSM and DEM association	2

4.2.4.1.3 navigation: Variables

This section describes the navigation group variables for the MWS L1B with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 4-11: navigation: Variables of MWS radiance product.

Variables Name	Description	Type	Range or Value	Dimension
antpos_convcoef_slope_earth view	Slope conversion factor from counts in telemetry to antenna position – Earth view	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Slope conversion factor from counts in telemetry to antenna position - Earth view	
units	Physical units	NC_STRING	degrees counts^{-1}	

Variables Name	Description	Type	Range or Value	Dimension
antpos_convcoef_intercept_earthview	Intercept conversion factor from counts in telemetry to antenna position – Earth view	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Intercept conversion factor from counts in telemetry to antenna position - Earth view	
units	Physical units	NC_STRING	degrees	
antpos_convcoef_slope_warmview	Slope conversion factor from counts in telemetry to antenna position – warm target view	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Slope conversion factor from counts in telemetry to antenna position - warm target view	
units	Physical units	NC_STRING	degrees $counts^{-1}$	
antpos_convcoef_intercept_warmview	Intercept conversion factor from counts in telemetry to antenna position – warm target view	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Intercept conversion factor from counts in telemetry to antenna position - warm target view	
units	Physical units	NC_STRING	degrees	
antpos_convcoef_slope_coldview	Slope conversion factor from counts in telemetry to antenna position – cold view	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Slope conversion factor from counts in telemetry to antenna position - cold view	
units	Physical units	NC_STRING	degrees $counts^{-1}$	
antpos_convcoef_intercept_coldview	Intercept conversion factor from counts in telemetry to antenna position – cold view	NC_FLOAT		1
long_name	Description of variable	NC_STRING	Intercept conversion factor from counts in telemetry to antenna position - cold view	
units	Physical units	NC_STRING	degrees	

Variables Name	Description	Type	Range or Value	Dimension
mws_scantime_utc	UTC time at scan start	NC_DOUBLE	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	UTC time at scan start	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	minimum time	NC_DOUBLE	-1e9	
valid_max	maximum time	NC_DOUBLE	1.e9	
missing_value	missing time value	NC_DOUBLE	-9.e9	
mws_lat	Latitude corresponding to each field of view	NC_INT	valid_min to valid_max	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Latitude corresponding to each field of view	
units	Physical units	NC_STRING	degrees_north	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-4}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	-900000	
valid_max	Valid maximum value	NC_INT	900000	
missing_value	Missing value	NC_INT	-2^{31}	
mws_lon	Longitude corresponding to each field of view	NC_INT	valid_min to valid_max	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Longitude corresponding to each field of view	
units	Physical units	NC_STRING	degrees_east	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-4}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	-1800000	
valid_max	Valid maximum value	NC_INT	1800000	
missing_value	Missing value	NC_INT	-2^{31}	
mws_solar_zenith_angle	Solar Zenith angle corresponding to each field of view	NC_USHORT	valid_min to valid_max	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Solar Zenith angle corresponding to each field of view	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-2}	

Variables Name	Description	Type	Range or Value	Dimension
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	18000	
missing_value	Missing value	NC_USHORT	2^{16} -1	
mws_solar_azimuth_angle	Solar Azimuth angle corresponding to each field of view	NC_SHORT	valid_min to valid_max	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Solar Azimuth angle corresponding to each field of view	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-2}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_SHORT	-18000	
valid_max	Valid maximum value	NC_SHORT	18000	
missing_value	Missing value	NC_SHORT	-2^{15}	
mws_satellite_zenith_angle	Satellite Zenith angle corresponding to each field of view	NC_SHORT	valid_min to valid_max	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Satellite Zenith angle corresponding to each field of view	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-2}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	9000	
missing_value	Missing value	NC_SHORT	-2^{15}	
mws_satellite_azimuth_angle	Satellite Azimuth angle corresponding to each field of view	NC_SHORT	valid_min to valid_max	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Satellite Azimuth angle corresponding to each field of view	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-2}	
add_offset	Offset applied	NC_DOUBLE	0.0	

Variables Name	Description	Type	Range or Value	Dimension
valid_min	Valid minimum value	NC_SHORT	-18000	
valid_max	Valid maximum value	NC_SHORT	18000	
missing_value	Missing value	NC_SHORT	-2^{15}	
orbit_angle	Angular position in the orbit, starting at zero when the satellite crosses the solar Ecliptic plane northbound.	NC_INT	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	Angular position in the orbit, starting at zero when the satellite crosses the solar Ecliptic plane northbound	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-4}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	3600000	
missing_value	Missing value	NC_INT	-2^{31}	
satellite_altitude	Spacecraft altitude above reference ellipsoid	NC_UINT	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	Spacecraft altitude above reference ellipsoid	
units	Physical units	NC_STRING	km	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-1}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_UINT	4000	
valid_max	Valid maximum value	NC_UINT	20000	
missing_value	Missing value	NC_UINT	$2^{32} - 1$	
time_attitude	UTC time associated with attitude angles	NC_DOUBLE	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	UTC time associated with attitude angles	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1.e9	
valid_max	Valid maximum value	NC_DOUBLE	1.e9	
missing_value	Missing value	NC_DOUBLE	-9.e9	
mws_rollang	Roll angle	NC_SHORT	valid_min to valid_max	n_scans

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	Roll angle	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_SHORT	$-2^{15}+1$	
valid_max	Valid maximum value	NC_SHORT	$2^{15}-1$	
missing_value	Missing value	NC_SHORT	-2^{15}	
mws_yawang	Yaw angle	NC_SHORT	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	Yaw angle	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_SHORT	$-2^{15}+1$	
valid_max	Valid maximum value	NC_SHORT	$2^{15}-1$	
missing_value	Missing value	NC_SHORT	-2^{15}	
mws_pitchang	Pitch angle	NC_SHORT	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	Pitch angle	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_SHORT	$-2^{15}+1$	
valid_max	Valid maximum value	NC_SHORT	$2^{15}-1$	
missing_value	Missing value	NC_SHORT	-2^{15}	
mws_moon_angles	Angle between Moon and individual space views	NC_USHORT	valid_min to valid_max	n_scans, n_fovs_cal
long_name	Description of variable	NC_STRING	Angle between Moon and individual space views	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-2}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	18000	
missing_value	Missing value	NC_USHORT	$2^{16}-1$	

Variables Name	Description	Type	Range or Value	Dimension
mws_surface_type	Fraction of pixel covered by land - Low res, High res	NC_SHORT	valid_min to valid_max	n_scans, n_fovs, n_resol
long_name	Description of variable	NC_STRING	Fraction of pixel covered by land - Low res, High res	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-4}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	10000	
missing_value	Missing value	NC_SHORT	-2^{15}	
mws_terrain_elevation	Terrain elevation	NC_SHORT	valid_min to valid_max	n_scans, n_fovs, n_resol
long_name	Description of variable	NC_STRING	Terrain elevation	
units	Physical units	NC_STRING	m	
valid_min	Valid minimum value	NC_SHORT	-500	
valid_max	Valid maximum value	NC_SHORT	10000	
missing_value	Missing value	NC_SHORT	-2^{15}	

4.2.4.2 Group name: measurement

4.2.4.2.1 measurement: Attributes

Attributes for this group are not currently envisaged.

4.2.4.2.2 measurement: Dimensions

Dimensions for this group are not currently envisaged.

4.2.4.2.3 measurement: Variables

This section describes the variables for the data/measurement subgroup for the MWS L1B product with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 4-12: measurement: Variables for MWS L1B product.

Variables Name	Description	Type	Range or Value	Dimension
mws_scan_number	Scan line number	NC_INT	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	MWS scan line number	

Variables Name	Description	Type	Range or Value	Dimension
valid_min	Valid minimum value	NC_INT	1	
valid_max	Valid maximum value	NC_INT	2^{31}-1	
missing_value	Missing value	NC_INT	-2^{31}	
mws_earth_view_counts	MWS Earth view counts (oversampled values of Channel 1 and 2 have been averaged)	NC_USHORT	valid_min to valid_max	n_scans, n_fovs, n_channels
long_name	Description of variable	NC_STRING	MWS Earth view counts (oversampled values of Channel 1 and 2 have been averaged)	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	2^{16} - 2	
missing_value	Missing value	NC_USHORT	2^{16} - 1	
mws_cold_view_counts	MWS cold view calibration counts (oversampled values of Channel 1 and 2 have been averaged)	NC_USHORT	valid_min to valid_max	n_scans, n_fovs_cal, n_channels
long_name	Description of variable	NC_STRING	MWS cold view calibration counts (oversampled values of Channel 1 and 2 have been averaged)	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	2^{16} - 2	
missing_value	Missing value	NC_USHORT	2^{16} - 1	
mws_warm_view_counts	MWS warm target view calibration counts(oversampled values of Channel 1 and 2 have been averaged)	NC_USHORT	valid_min to valid_max	n_scans, n_fovs_cal, n_channels

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	MWS warm target view calibration counts (oversampled values of Channel 1 and 2 have been averaged)	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	2^{16} - 2	
missing_value	Missing value	NC_USHORT	2^{16} - 1	
mws_earth_view_counts_os_stdev	Standard deviation of Channel 1 and 2 Earth view counts oversampled at every FOV	NC_USHORT	valid_min to valid_max	n_scans, n_fovs, n_channels_os
long_name	Description of variable	NC_STRING	Standard deviation of Channel 1 and 2 Earth view counts oversampled at every FOV	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	2^{16} - 2	
missing_value	Missing value	NC_USHORT	2^{16} - 1	
mws_antennapos_counts_earthview	Earth view antenna position counts	NC_UINT	valid_min to valid_max	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Earth view antenna position counts	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32}-2	
missing_value	Missing value	NC_UINT	2^{32}-1	
mws_antennapos_counts_coldview	Cold view antenna position counts	NC_UINT	valid_min to valid_max	n_scans, n_fovs_cal
long_name	Description of variable	NC_STRING	Cold view antenna position counts	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32}-2	
missing_value	Missing value	NC_UINT	2^{32}-1	

Variables Name	Description	Type	Range or Value	Dimension
mws_antennapos_counts_warmview	Warm target view antenna position counts	NC_UINT	valid_min to valid_max	n_scans, n_fovs_cal
long_name	Description of variable	NC_STRING	Warm target view antenna position counts	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32}-2	
missing_value	Missing value	NC_UINT	2^{32}-1	

4.2.4.3 Group name: calibration

4.2.4.3.1 calibration: Attributes

This section describes the attributes in the data/calibration subgroup of the MWS L1B product.

Table 4-13: Attributes for calibration group of MWS radiance product.

Attribute	Description	Type	Range or Value
antenna_correction_version	Version of the antenna pattern correction	NC_SHORT	1 - 1000

4.2.4.3.2 calibration: Dimensions

Dimensions for this group are not currently envisaged.

4.2.4.3.3 calibration: variables

This section describes the calibration group variables for the MWS L1B with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 4-14: calibration: Variables for MWS L1B product.

Variables Name	Description	Type	Range or Value	Dimension
mws_toa_radiance	Top of the atmosphere spectral radiance at Earth view FOVs	NC_INT	valid_min to valid_max	n_scans, n_fovs, n_channels
long_name	Description of variable	NC_STRING	Top of the atmosphere spectral radiance at Earth view FOVs	
units	Physical units	NC_STRING	mW m^{-2} sr^{-1} cm	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-8}	
add_offset	Offset applied	NC_DOUBLE	0.0	

Variables Name	Description	Type	Range or Value	Dimension
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	20000000	
missing_value	Missing value	NC_INT	-2^{31}	
mws_toa_brightness_temperature	Top of the atmosphere brightness temperature at Earth view FOVs	NC_INT	valid_min to valid_max	n_scans, n_fovs, n_channels
long_name	Description of variable	NC_STRING	Top of the atmosphere brightness temperature at Earth view FOVs	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	50000	
valid_max	Valid maximum value	NC_INT	350000	
missing_value	Missing value	NC_INT	-2^{31}	
counts_warmview_average_over_scans	Warm target view counts averaged (over scans) around current scan line	NC_USHORT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Warm target view counts averaged (over scans) around current scan line	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	65534	
missing_value	Missing value	NC_USHORT	$2^{16} - 1$	
counts_coldview_average_over_scans	Cold view counts averaged (over scans) around current scan line	NC_USHORT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Cold view counts averaged (over scans) around current scan line	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	65534	
missing_value	Missing value	NC_USHORT	$2^{16} - 1$	
warm_target_temperature	Warm target temperature	NC_INT	valid_min to valid_max	n_scans
long_name	Description of variable	NC_STRING	Warm target temperature	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	250000	
valid_max	Valid maximum value	NC_INT	400000	
missing_value	Missing value	NC_INT	-2^{31}	

Variables Name	Description	Type	Range or Value	Dimension
rr_temperature	Rotating reflector temperature	NC_INT		n_scans
long_name	Description of variable	NC_STRING	Rotating reflector temperature	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	250000	
valid_max	Valid maximum value	NC_INT	400000	
missing_value	Missing value	NC_INT	-2^{31}	
inst_temperature	Instrument temperature	NC_INT		n_scans
long_name	Description of variable	NC_STRING	Instrument temperature	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	250000	
valid_max	Valid maximum value	NC_INT	400000	
missing_value	Missing value	NC_INT	-2^{31}	
zero_radiance_count	Zero-radiance counts	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Zero-radiance counts	
units	Physical units	NC_STRING	counts	
valid_min	Valid minimum value	NC_INTT	-65536	
valid_max	Valid maximum value	NC_INT	65534	
missing_value	Missing value	NC_INT	$2^{31} - 1$	
mean_radiance_warmview	Warm view radiance	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Warm view radiance	
units	Physical units	NC_STRING	mW m^{-2} sr^{-1} cm	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-8}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	20000000	
missing_value	Missing value	NC_INT	-2^{31}	
mean_radiance_coldview	Cold view radiance	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Cold view radiance	
units	Physical units	NC_STRING	mW m^{-2} sr^{-1} cm	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-8}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	20000000	
missing_value	Missing value	NC_INT	-2^{31}	
rr_radiance	Rotating reflector emitted radiance	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Rotating reflector emitted radiance	

Variables Name	Description	Type	Range or Value	Dimension
units	Physical units	NC_STRING	mW m^{-2} sr^{-1} cm	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-8}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	20000000	
missing_value	Missing value	NC_INT	-2^{31}	
prt_resistance	Calculated PRT resistances	NC_INT	valid_min to valid_max	n_scans, n_prts
long_name	Description of variable	NC_STRING	Calculated PRT resistances	
units	Physical units	NC_STRING	ohm	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-2}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	$2^{31} - 1$	
missing_value	Missing value	NC_INT	-2^{31}	
mws_prt_temperature	PRT temperatures	NC_INT	valid_min to valid_max	n_scans, n_prts
long_name	Description of variable	NC_STRING	PRT temperatures	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	250000	
valid_max	Valid maximum value	NC_INT	400000	
missing_value	Missing value	NC_INT	-2^{31}	
primary_calibration_zero_order_term	a_0 calibration coefficients	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	a_0 calibration coefficients	
units	Physical units	NC_STRING	mW m^{-2} sr^{-1} cm	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-9}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31} + 1$	
valid_max	Valid maximum value	NC_INT	$2^{31} - 1$	
missing_value	Missing value	NC_INT	-2^{31}	
primary_calibration_first_term	a_1 calibration coefficients	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	a_1 calibration coefficients	
units	Physical units	NC_STRING	mW m^{-2} sr^{-1} cm counts^{-1}	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-13}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+ 1$	
valid_max	Valid maximum value	NC_INT	$2^{31} - 1$	
missing_value	Missing value	NC_INT	-2^{31}	

Variables Name	Description	Type	Range or Value	Dimension
primary_calibration_second_term	a_2 calibration coefficients	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	a_2 calibration coefficients	
units	Physical units	NC_STRING	mW m^{-2} sr^{-1} cm $counts^{-2}$	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-19}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
missing_value	Missing value	NC_INT	-2^{31}	
nonlinearity_correction	Nonlinear correction term	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Nonlinear correction term	
units	Physical units	NC_STRING	$counts^{-1}$	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-15}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
missing_value	Missing value	NC_INT	-2^{31}	
postdetection_amplifier_gain	Post detection amplifier gain	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Post detection amplifier gain	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-8}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	1	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
missing_value	Missing value	NC_INT	-2^{31}	
mws_calibration_gain	Calibration gain	NC_UINT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	Calibration gain	
units	Physical units	NC_STRING	counts K^{-1}	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-6}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	$2^{32}-2$	
missing_value	Missing value	NC_UINT	$2^{32}-1$	
moon_angle_threshold	Threshold for the difference between the Moon angle and the antenna space view position, for which the data are flagged as calibration contaminated	NC_USHORT		n_channels

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	Threshold for the difference between the Moon angle and the antenna space view position, for which the data are flagged as calibration contaminated	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-2}	
add_offset	Offset applied	NC_DOUBLE	0.0	
mws_nedt_warm	MWS radiometric sensitivity calculated using warm target view counts	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	MWS radiometric sensitivity calculated using warm target view counts	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	300000	
missing_value	Missing value	NC_INT	-2^{31}	
mws_nedt_cold	MWS radiometric sensitivity calculated using cold view counts	NC_INT	valid_min to valid_max	n_scans, n_channels
long_name	Description of variable	NC_STRING	MWS radiometric sensitivity calculated using cold view counts	
units	Physical units	NC_STRING	K	
scale_factor	Scale factor applied	NC_DOUBLE	10^{-3}	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	0	
valid_max	Valid maximum value	NC_INT	300000	
missing_value	Missing value	NC_INT	-2^{31}	
striping_ratio_warm	Striping ratio calculated using warm target view counts	NC_FLOAT	valid_min to valid_max	n_channels
long_name	Description of variable	NC_STRING	Striping ratio calculated using warm target view counts	
valid_min	Valid minimum value	NC_FLOAT	0.0	
valid_max	Valid maximum value	NC_FLOAT	10.0	
missing_value	Missing value	NC_FLOAT	-999.0	
striping_ratio_cold	Striping ratio calculated using cold view counts	NC_FLOAT	valid_min to valid_max	n_channels

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	Striping ratio calculated using cold view counts	
valid_min	Valid minimum value	NC_FLOAT	0.0	
valid_max	Valid maximum value	NC_FLOAT	10.0	
missing_value	Missing value	NC_FLOAT	-999.0	

4.2.4.4 Group name: processing_information

4.2.4.4.1 processing_information: Attributes

Attributes for this group are not currently envisaged.

4.2.4.4.2 processing_information: Dimensions

Dimensions for this group are not currently envisaged.

4.2.4.4.3 processing_information: Variables

This section describes the variables for the data/*processing*_information subgroup variables for the MWS L1B product with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 4-15: processing_information: Variables for MWS L1B product.

Variables Name	Description	Type	Range or Value	Dimension
mws_navigation_status	Bit field indicating the quality of the geolocation	NC_USHORT		n_scans
long_name	Description of Variable	NC_STRING	Bit field indicating the quality of the geolocation	
flag_masks	Value per bit	NC_USHORT	1,2,4,8,16,32,64,128,256,512,1024,2048,4096,8192,16384,32768	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition scan_not_processed geolocation_not_successful orbit_not_initialised_with_NAVATT attitude_not_initialised_with_NAVATT Predicted_Orbit_File_ingest_error manoeuvre IERS_Bulletin_A_ingest_error time_correlation_and_EOP_initialised_with_Predicted_Orbit_File full_accuracy_of_NAVATT_initialized_attitude_not_reached pointing_mode_not_YSM NAVATT_ingest_error N.A. N.A. N.A. N.A.	

Variables Name	Description	Type	Range or Value	Dimension
mws_cof_quality_flag	Bit field indicating the quality of the input context data	NC_UBYTE	0 to 255	n_channels
long_name	Description of Variable	NC_STRING	Bit field indicating the quality of the input context data	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition COF_missing_corrupted COF_time_read_error COF_coef_read_error COF_degraded_a0 COF_degraded_a1 COF_degraded_a2 COF_degraded_rad_rr	
mws_calibration_flag	Bit field indicating the quality of the calibration	NC_UBYTE	0 to 255	n_scans, n_channels
long_name	Description of Variable	NC_STRING	Bit field indicating the quality of the calibration	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition auxCCDB_CalibCoef_used auxCOF_CalibCoef_used latest_nominal_CalibCoef_used corrupted_warmview_radiance corrupted_warmview_or_cold view_counts moon_correction_applied RR_reflectivity_correction_not_applied	
mws_radiance_flag	Bit field indicating the quality of the antenna radiance	NC_UBYTE	0 to 255	n_scans, n_fovs, n_channels
long_name	Description of Variable	NC_STRING	Bit field indicating the quality of the antenna radiance	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition earthview_counts_missing calibration_is_non-nominal CH1_or_CH2_earthview_counts_missing earthview_counts_above_warm earthview_counts_outside_limits N.A. earthview_RR_reflectivity_set_to_one	
mws_nedt_flag	Bit field indicating the quality of radiometric sensitivity	NC_UBYTE	0 to 255	n_scans, n_channels

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of Variable	NC_STRING	Bit field indicating the quality of radiometric sensitivity	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition calibration_counts_missing calibration_is_non-nominal not_enough_scans_for_NEDT_evaluation NEDT_cold_above_requ NEDT_warm_above_requ N.A. N.A.	
mws_brightnes stemp_flag	Bit field indicating the quality of Earth view TOA radiances and brightness temperatures	NC_UBYTE	0 to 255	n_scans, n_fovs, n_channels
long_name	Description of Variable	NC_STRING	Bit field indicating the quality of Earth view TOA radiances and brightness temperatures	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition earthview_counts_missing earthview_antennaradiance_is_non-nominal CH1_or_CH2_earthview_counts_missing N.A. N.A. geolocation_is_non-nominal earthview_pointing_is_non-nominal	
mws_sr_flag	Bit field indicating the quality of the Striping Ratios	NC_UBYTE	0 to 255	n_channels
long_name	Description of Variable	NC_STRING	Bit field indicating the quality of the Striping Ratios	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition not_enough_scans_for_SR_cold_evaluation not_enough_scans_for_SR_warm_evaluation SR_cold_above_threshold SR_warm_above_threshold N.A. N.A. N.A.	
mws_scantime_ quality	Bit field indicating a time gap around this scan	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating a time gap around this scan	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	

Variables Name	Description	Type	Range or Value	Dimension
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition N.A. first_scan_after_time_gap last_scan_before_time_gap N.A. N.A. N.A. N.A.	
mws_position_flag_earthview	Bit field indicating the quality of the Earth view position	NC_UBYTE	0 to 255	n_scans, n_fovs
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the Earth view position	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition N.A. earthview_scan_angle_non-nominal N.A. N.A. N.A. N.A. N.A.	
mws_position_flag_coldview	Bit field indicating the quality of the cold view position	NC_UBYTE	0 to 255	n_scans, n_fovs_cal
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the cold view position	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition N.A. coldview_scan_angle_non-nominal N.A. N.A. N.A. N.A. N.A.	
mws_position_flag_warmview	Bit field indicating the quality of the warm view position	NC_UBYTE	0 to 255	n_scans, n_fovs_cal
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the warm view position	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition N.A. warmview_scan_angle_non-nominal N.A. N.A. N.A. N.A. N.A.	
mws_surface_flag	Bit field indicating the quality of the surface parameters	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the surface parameters	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition geolocation_is_non-nominal auxLSM_ingest_error auxDEM_ingest_error auxLSM_auxDEM_size_inconsistency auxLSM_auxDEM_assignment_error N.A. N.A.	

Variables Name	Description	Type	Range or Value	Dimension
mws_moon_contamination_flag	Bit field indicating the quality of the Moon intrusion screening	NC_UBYTE	0 to 255	n_scans, n_fovs_cal, n_channels
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the Moon intrusion screening	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition geolocation_is_non-nominal coldview_scan_angle_is_non-nominal moon_contamination N.A. N.A. N.A. N.A.	
mws_channel_quality_flag	Bit field indicating the quality of MWS channels	NC_UBYTE	0 to 255	n_scans, n_channels
long_name	Description of variable	NC_STRING	Bit field indicating the quality of MWS channels	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition channel_science_data_missing channel_is_off icu_redundant_side_used N.A. N.A. N.A. N.A.	
os_counts_earthview_averaging_flag	Bit field indicating the quality of the averaging over the oversampled Earth view counts	NC_UBYTE	0 to 255	n_scans, n_fovs, n_channels_os
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the averaging over the oversampled Earth view counts	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition channel_is_non-nominal gross_check_failure mad_test_failure mad_test_warning gross_check_warning N.A. N.A.	
counts_coldview_processing_flag	Bit field indicating the quality of the cold view count processing	NC_UBYTE	0 to 255	n_scans, n_channels
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the cold view count processing	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	

Variables Name	Description	Type	Range or Value	Dimension
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition channel_is_non-nominal too_few_samples_passed_checks gross_check_discarded_some_counts median_check_performed median_check_discarded_some_counts moon_in_all_coldviews along-track_check_failure	
counts_warmview_processing_flag	Bit field indicating the quality of the warm target view count processing	NC_UBYTE	0 to 255	n_scans, n_channels
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the warm target view count processing	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition channel_is_non-nominal too_few_samples_passed_checks gross_check_discarded_some_counts median_check_performed median_check_discarded_some_counts N.A. along-track_check_failure	
prt_processing_flag	Bit field indicating the quality of the PRTs	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating the quality of the PRTs	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition N.A. too_few_samples_passed_checks gross_check_discarded_some_temperatures PRT_proc_error median_check_discarded_some_temperatures N.A. along-track_adjustment	
mws_instrument_temperature_quality_flag	Bit field indicating the quality of instrument temperature	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating the quality of instrument temperature	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	

Variables Name	Description	Type	Range or Value	Dimension
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition N.A. too_few_samples_passed_checks gross_check_discarded_some_temperatures N.A. N.A. N.A. along-track_adjustment	
mws_rr_temperature_quality_flag	Bit field indicating the quality of RR temperature	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating the quality of RR temperature	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition N.A. too_few_samples_passed_checks gross_check_discarded_some_temperatures N.A. N.A. N.A. along-track_adjustment	
mws_calibration_weights_quality_flag_coldview	Bit field indicating the quality of cold view calibration weights	NC_UBYTE	0 to 255	n_scans, n_channels
long_name	Description of variable	NC_STRING	Bit field indicating the quality of cold view calibration weights	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition scan_counts_non-nominal no_scan_for_alongtrack_weighting some_discarded_scans N.A. N.A. no_averaging-moon_correction N.A.	
mws_calibration_weights_quality_flag_warmview	Bit field indicating the quality of warm view calibration weights	NC_UBYTE	0 to 255	n_scans, n_channels
long_name	Description of variable	NC_STRING	Bit field indicating the quality of warm view calibration weights	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition scan_counts_non-nominal no_scan_for_alongtrack_weighting some_discarded_scans N.A. N.A. N.A. N.A.	
mws_prt_weights_quality_flag	Bit field indicating the quality of weights of PRT temperatures	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating the quality of weights of PRT temperatures	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	

Variables Name	Description	Type	Range or Value	Dimension
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition scan_PRT_temperature_non-nominal no_scan_for_alongtrack_weighting some_discarded_scans_checks N.A. N.A. N.A. N.A.	
mws_instrument_weights_quality_flag	Bit field indicating the quality of weights of instrument temperatures	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating the quality of weights of instrument temperatures	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition scan_instr_temperature_non-nominal no_scan_for_alongtrack_weighting some_discarded_scans N.A. N.A. N.A. N.A.	
mws_rr_weights_quality_flag	Bit field indicating the quality of weights of RR temperatures	NC_UBYTE	0 to 255	n_scans
long_name	Description of variable	NC_STRING	Bit field indicating the quality of weights of RR temperatures	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	non-nominal_condition scan_RR_temperature_non-nominal no_scan_for_alongtrack_weighting some_discarded_scans N.A. N.A. N.A. N.A.	
moon_contamination_correction_flag	Moon contamination correction algorithm is applied	NC_UBYTE	0 or 1	1
long_name	Description of variable	NC_STRING	Moon contamination correction algorithm is applied	
mws_l1b_processing_info_scan	Summary of processing flags with scan dimension gathered for BUFR storing	NC_USHORT		n_scans
long_name	Description of variable	NC_STRING	Summary of processing flags with scan dimension gathered for BUFR storing	
flag_masks	Value per bit	NC_USHORT	1,2,4,8,16,32,64,128,256,512,1024,2048,4096,8192,16384,32768	

Variables Name	Description	Type	Range or Value	Dimension
flag_meanings	Meaning per bit	NC_STRING	non-nominal_scan_due_to_gap non-nominal_warm_target_temperature non-nominal_along-track_averaging_of_warm_target_temperatures non-nominal_instrument_temperature non-nominal_along-track_averaging_of_instrument_temperatures non-nominal_rotating_reflector_temperature non-nominal_along-track_averaging_of_rotating_reflector_temperatures non-nominal_antenna_scan_angle_Earth_view non-nominal_antenna_scan_angle_cold_view non-nominal_antenna_scan_angle_warm_view non-nominal_geolocation non-nominal_LSM_and_DEM_assignment ongoing_satellite_manoeuvre redundant_50GHz_rec_and_PRT_set_in_use N.A. N.A.	
mws_l1b_processing_info_chan	Summary of processing flags with chan and scan dimensions gathered for BUFR storing	NC_UBYTE		n_scans, n_channels
long_name	Description of variable	NC_STRING	Summary of processing flags with chan and scan dimensions gathered for BUFR storing	
flag_masks	Value per bit	NC_UBYTE	1,2,4,8,16,32,64,128	
flag_meanings	Meaning per bit	NC_STRING	channel_is_off non-nominal_mean_warm_view_count non-nominal_along-track_averaging_of_warm_view_counts non-nominal_mean_cold_view_count non-nominal_along-track_averaging_of_cold_view_counts non-nominal_calibration_coefficients Moon_intrusion_in_some_of_the_cold_view_FOVs non-nominal_processing_or_excessive_value_for_NEDT_(cold_or_warm)	

4.2.5 Group name: quality

4.2.5.1 quality: Attributes

This section describes the quality group attributes for the MWS L1B product.

Table 4-16: quality: Attributes for MWS L1B product.

Attribute name=	Data Type type=	Meaning /Value
overall_quality_flag	NC_USHORT	"0" if overall quality is OK. Individual bits of the flag are set to indicate degraded conditions: Bit 0: Missing_input_product(s) Bit 1: Data_gap(s) Bit 2: Corrupted_input_product(s) Bit 3: Instrument_anomaly Bit 4: Missing_or_degraded_auxiliary_data Bit 5: Degraded_due_to_manoeuvre Bits 6 to 15: Not_used

4.2.5.2 quality: Dimensions

This section describes the dimensions for the quality group of the MWS L1B product.

Table 4-17: quality: Dimensions for MWS L1B product.

Dimension name=	Comment	Dimension length=
gap_items	Number of gaps identified during product duration. *Note: it will not appear in the Product if overall_quality_flag bit 1 equals 0.*	„„ 1 ≤ N

4.2.5.3 quality: Variables

This section describes the variables for the quality group of the MWS L1B product with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 4-18: quality: Variables for MWS L1B product.

Variable Name	Description	Data Type	Range or Values	Dimension
L1B_quality_flag	Bit field indicating overall quality. Ok, if all bits off.	NC_USHORT	0 to 65535	1
long_name	Description of variable	NC_STRING	Bit field indicating overall quality. Ok, if all bits off.	

Variable Name	Description	Data Type	Range or Values	Dimension
flag_masks	Value per bit	NC_USHORT	1,2,4,8,16,32,64,128,256,512, 1024,2048,4096,8192,16384,32768	
flag_meanings	Meaning per bit	NC_STRING	missing_input_products data_gaps corrupted_input_products instrument_anomaly missing_or_degraded_aux_data degraded_due_to_manoeuvre degraded_due_to_moon_intrusion degraded_geolocation degraded_calibration degraded_toa_radiance N.A. N.A. N.A. N.A. N.A. N.A.	
degraded_channels	Bit field indicating degraded channels	NC_UINT	0 to 4294967295	1
long_name	Description of variable	NC_STRING	Bit field indicating degraded channels	
flag_masks	Value per bit	NC_UINT	1,2,4,8,16,32,64,128,256,512, 1024,2048,4096,8192,16384,32768, 65536,131072,262144,524288, 1048576,2097152,4194304, 8388608,16777216,33554432, 67108864,134217728,268435456,536870912,1073741824, 2147483648	
flag_meanings	Meaning per bit	NC_STRING	ch1 ch2 ch3 ch4 ch5 ch6 ch7 ch8 ch9 ch10 ch11 ch12 ch13 ch14 ch15 ch16 ch17 ch18 ch19 ch20 ch21 ch22 ch23 ch24 N.A. N.A. N.A. N.A. N.A. N.A. N.A.	
duration_of_product	Entire duration of the L1B product	NC_DOUBLE		1
long_name	Description of variable	NC_STRING	Entire duration of product	
units	Physical units	NC_STRING	s	
duration_of_data_present	Amount of data present in the product	NC_DOUBLE		1
long_name	Description of variable	NC_STRING	Amount of data present in product	
units	Physical units	NC_STRING	s	
duration_of_data_missing	Amount of missing data in the product	NC_DOUBLE		1
long_name	Description of variable	NC_STRING	Amount of missing data in product	
units	Physical units	NC_STRING	s	
duration_of_data_degraded	Amount of degraded data in the product	NC_DOUBLE		1
long_name	Description of variable	NC_STRING	Amount of degraded data in product	
units	Physical units	NC_STRING	s	

Variable Name	Description	Data Type	Range or Values	Dimension
count_missing_scanlines	Number of scan lines that are missing in product	NC_USHORT	valid_min to valid_max	1
long_name	Description of variable	NC_STRING	Number of scan lines that are missing in product	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	32767	
gap_start_time_utc	Gap start time in UTC	NC_DOUBLE		gap_items
long_name	Description of variable	NC_STRING	Gap start time in UTC	
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
valid_min	Valid minimum value	NC_DOUBLE	-1e9	
valid_max	Valid maximum value	NC_DOUBLE	1e9	
missing_value	Missing value	NC_DOUBLE	-9e9	
gap_end_time_utc	Gap end time in UTC	NC_DOUBLE		gap_items
units	Physical units	NC_STRING	seconds since 2020-01-01 00:00:00.000	
long_name	Description of variable	NC_STRING	Gap end time in UTC	
valid_min	Valid minimum value	NC_DOUBLE	-1e9	
valid_max	Valid maximum value	NC_DOUBLE	1e9	
missing_value	Missing value	NC_DOUBLE	-9e9	

5 PRODUCT FORMAT VERSION CONTROL

This section provides *Product Format Version Control Numbers* for each product defined within this document. This version is reflected in the following global attribute present in each EPSG mission product centrally generated as described in the [GPFS]:

- format_version

Table 4-1: Record Format Version Numbers.

Product ID	Product Format Version Control Number (format_version)	Product Format Specification Issue (pfs_ reference_and_version)	Generic Product Format Specification Issue (gpfs_ reference_and_version)
MWS L1B radiance	***0.0***	***1C***	***1E***
MWS L1B radiance	***1.0***	***1D***	***1H***
MWS L1B radiance	***2.0***	***2A***	***2A***
MWS L1B radiance	***3.0***	***3.0***	***3.0***
MWS L1B radiance	***3.0***	***3A***	***3B***
MWS L1B radiance	***4.0***	***3B***	***3B***
MWS L1B radiance	***5.0***	***3C***	***3C***
MWS L1B radiance	***5.0***	***3D***	***3C***
MWS L1B radiance	***6.0***	***4.0***	***3D***

As described in the [GPFS], the *Product Format Version Control Number* is updated whenever there is a change in the format or contents of a product that requires an update to software that has to read the product or has to check the product. This could be a change in the format itself (element is deleted, added, resized, re-typed,...), a change in the contents of an element (e.g. scale factor change) or a change in the way that element has to be interpreted. Any such element update requires the product format version number to be incremented.

A recommended way to use *major.minor* versions of the product format version control number both is to issue minor updates for a change resulting from a PFS update, and major updates for a change resulting from [GPFS] updates that affect all products. Then a [GPFS] update would reset all products back to a new major of (say) 12.0, and then 12.1, 12.2 etc. versions would indicate PFS-only updates.

APPENDIX A SIZE OF THE EPS-SG MWS LEVEL 1B PRODUCT

This appendix gives the estimated size of the EPS-SG MWS Level 1B product. Calculations are done assuming n_scans=2600 and n_temp_ref_inst=15. The global estimate is given in Table A-20, according to the sizes of the different groups detailed in the corresponding tables below.

Table A-2: Size of the MWS Level 1B Products.

Product ID	Product Description	Size (MB/orbit)
MWS L1B Radiance	MWS Level 1B Spectral Radiance	~86 MB

Size of the status group

The size of the satellite group is estimated to be of 94 bytes, while the instrument group size is estimated to be about 1100 kilobytes per orbit, as shown in the following table.

Status group: instrument	
Variable Name	**Size (bytes)**
channel_central_freq	96
channel_bandwidths	384
channel_central_wavenum	96
first_channel_band_correction	96
second_channel_band_correction	96
thermistor_counts_to_resistance_conv_coef	8
thermistor_resistance_to_temp_conv_coef	28
mean_reference_thermistor_log_resistance	4
stdev_reference_thermistor_log_resistance	4
channel_freq_shift	124800
precision_resistances_prime	24
precision_resistances_redundant	24
mirror_reflectivity_perpendicular	96
instrument_reference_temperatures	60
instrument_reference_temperatures_backup	60
instrument_mode	0
mode_start_time_utc	4
mode_end_time_utc	4
mws_onboard_software_version	4
mws_startup_reason	5200
mws_icu_in_use	2600
mws_instrument_model	1
mws_function_status	10400
mws_discarded_tm_packets	5200
mws_edac_correction	10400
mws_cosi	5200
mws_sdss	10400

mws_sdcs	2600
mws_thermistor	202800
mws_prt_selectedgain	15600
mws_prt_count	31200
mws_hpr_selectedgain	15600
mws_hpr_count	31200
mws_therm_ext_selectedgain	10400
mws_therm_ext_count	20800
mws_motor_current_sce	124800
mws_motor_current_selected	124800
mws_power_switch_status_primary	2600
mws_power_switch_status_secondary_a	10400
mws_power_switch_status_secondary_b	10400
mws_local_oscillator_gain_control	5200
mws_SPE_FPGA_mode_parity_status	2600
mws_channel_dc_offset	124800
mws_channel_gain	62400
mws_motor_position_pcc_fixed	10400
mws_sce_register_status	10400
mws_instrument_current	46800
mws_dc_link_voltage	5200
mws_dc_link_current	5200
mws_acquis_sys_voltage	5200
mws_instrument_voltage	119600
Total	**1176289**

Size of the data group

The size of the data group is calculated according to the following tables.

data group: navigation	
Variables Name	**Approximate Size (bytes)**
mws_scantime_utc	10400
mws_lat	988000
mws_lon	988000
mws_solar_zenith_angle	494000
mws_solar_azimuth_angle	494000
mws_satellite_zenith_angle	494000
mws_satellite_azimuth_angle	494000
orbit_angle	10400
satellite_altitude	10400
time_attitude	10400
mws_rollang	5200
mws_yawang	5200
mws_pitchang	5200
mws_moon_angles	26000

mws_surface_type	988000
mws_terrain_elevation	988000
Total	**6011200**

data group: measurement	
Variables Name	**Approximate Size (bytes)**
mws_scan_number	10400
mws_earth_view_counts	11856000
mws_cold_view_counts	624000
mws_warm_view_counts	624000
mws_earth_view_counts_os_stdev	988000
mws_antennapos_counts_earthview	988000
mws_antennapos_counts_coldview	52000
mws_antennapos_counts_warmview	52000
Total	**15194400**

data group: calibration	
Variables Name	**Approximate Size (bytes)**
mws_toa_radiance	23712000
mws_toa_brightness_temperature	23712000
counts_warmview_average_over_scans	124800
counts_coldview_average_over_scans	124800
warm_target_temperature	10400
rr_temperature	10400
inst_temperature	10400
zero_radiance_count	249600
mean_radiance_warmview	249600
mean_radiance_coldview	249600
rr_radiance	249600
prt_resistance	62400
mws_prt_temperature	62400
primary_calibration_zero_order_term	249600
primary_calibration_first_term	249600
primary_calibration_second_term	249600
nonlinearity_correction	249600
postdetection_amplifier_gain	249600
mws_calibration_gain	249600
moon_angle_threshold	48
mws_nedt_warm	249600
mws_nedt_cold	249600
striping_ratio_warm	96
striping_ratio_cold	96
Total	**50825040**

data group: processing_information	
Variables Name	**Size (bytes)**
mws_cof_quality_flag	24
mws_navigation_status	5200
mws_calibration_flag	62400
mws_radiance_flag	5928000
mws_nedt_flag	62400
mws_brightnesstemp_flag	5928000
mws_sr_flag	24
mws_scantime_quality	2600
mws_position_flag_earthview	247000
mws_position_flag_coldview	13000
mws_position_flag_warmview	13000
mws_surface_flag	2600
mws_moon_contamination_flag	312000
mws_channel_quality_flag	62400
os_counts_earthview_averaging_flag	494000
counts_coldview_processing_flag	62400
counts_warmview_processing_flag	62400
prt_processing_flag	2600
mws_instrument_temperature_quality_flag	2600
mws_rr_temperature_quality_flag	2600
mws_calibration_weights_quality_flag_coldview	62400
mws_calibration_weights_quality_flag_warmview	62400
mws_prt_weights_quality_flag	2600
mws_instrument_weights_quality_flag	2600
mws_rr_weights_quality_flag	2600
moon_contamination_correction_flag	1
mws_l1b_processing_info_scan	5200
mws_l1b_processing_info_chan	62400
Total	**13465449**

Size of the quality group

The size of this group is 50 bytes.

APPENDIX B BUFR FORMAT FOR THE EPS-SG MWS LEVEL 1B PRODUCT

The BUFR version of the MWS L1B product has a size of about 20 MB per orbit, when a basic compression is taken into account. The BUFR products will be distributed via EUMETCAST and via the Global Telecommunication System (GTS, WMO network). For the GTS network, the BUFR product shall be packaged as described in Section 6 of [GPFS]. This means that an additional product shall be generated, starting from the BUFR product, packaged as described in [GPFS].
Note: The BUFR references marked with an asterisk (*) have to be considered as proposal, before to be assigned by WMO.

References	Element	Variable(s) from NetCDF
0 08 070	TOVS/ATOVS product qualifier	2 (signifies L1B)
0 01 033	Identification of originating/generating centre	254
0 01 034	Identification of originating/generating sub-centre	0
0 01 007	Satellite identifier	/spacecraft
0 02 019 (*)	Satellite Instruments	/instrument
0 25 061	Software identification and version number	status/processor_version, /mission_type
0 05 040	Orbit number	/orbit_start
2 01 133	*Change data width*	
0 05 041	Scan line number	n_scans index
2 01 000	*Change data width*	
0 05 043	Field of view number	n_fovs index
301011	Year	/data/measurement/mws_scantime_utc
	Month	/data/measurement/mws_scantime_utc
	Day	/data/measurement/mws_scantime_utc
301012	Hour	/data/measurement/mws_scantime_utc
	Minute	/data/measurement/mws_scantime_utc
2 07 003	*Increase scale, reference value and data width*	

0 04 006	Second	/data/measurement/mws_scantime_utc
2 07 000	*Cancel increase in scale, reference value and data width*	
3 01 021	Latitude (high accuracy)	/data/navigation/mws_lat
	Longitude (high accuracy)	/data/navigation/mws_lon
102002	Repeat 2 descriptors 2x	
021166	landFraction	/data/navigation/mws_surface_type
010001	heightOfLandSurface	/data/navigation/mws_terrain_elevation
2 02 126	*Change scale*	
0 07 001	Height of station	/data/navigation/mws_space_craft_altitude
2 02 000	*Change scale*	
0 07 024	Satellite zenith angle	/data/navigation/mws_satellite_zenith_angle
0 05 021	Bearing or azimuth	/data/navigation/mws_satellite_azimuth_angle
0 07 025	Solar zenith angle	/data/navigation/mws_solar_zenith_angle
0 05 022	Solar azimuth	/data/navigation/mws_solar_azimuth_angle
0 07 194 or 0 25 084 (*)	Orbit angle	/data/navigation/orbit_angle
1 01 005	Repeat 1 descriptor 5 times	
0 07 192 or 0 40 027 (*)	Angle between Moon and space view	/data/navigation/mws_moon_angles
0 12 070	Warm load temperature	/data/calibration/warm_target_temperature
0 12 064	Instrument temperature	/data/calibration/inst_temperature
0 12 192 (*)	Rotating Reflector temperature	/data/calibration/rr_temperature
0 33 208 (*)	Scan line processing flags	/data/processing_information/mws_l1b_processing_info_scan

0 33 205 (*)	MWS navigation status	/data/processing_information/mws_navigation_status
0 33 206 (*)	MWS overall quality flag	/quality/overall_quality_flag
Brightness temperatures		
1 15 024	Repeat 15 descriptors 24 times	
0 05 042	Channel number	n_channels index
202130		Change scale to accommodate bandwidth range 3MHz to 4GHz. Default scale is -8 so that needs to be increased to -6.
0 02 154	Satellite channel bandwidths	/status/instrument_status/channel_bandwidths
202000		
0 02 104	Antenna polarization	/status/mws_icu_in_use
0 02 153	Central frequencies of MWS channels for ATOVS	/status/instrument_status/channel_central_freq
0 25 077	Bandwidth correction coefficient 1 for ATOVS	/status/instrument_status/first_channel_band_correction
0 25 078	Bandwidth correction coefficient 2 for ATOVS	/status/instrument_status/second_channel_band_correction
2 07 002	*Increase scale, reference value and data width*	
0 12 063	Brightness temperature	/data/calibration/mws_toa_brightness_temperature
2 07 000	*Cancel increase in scale, reference value and data width*	
2 07 001	*Increase scale, reference value and data width*	
0 33 089	Noise equivalent delta temperature (NEdT) quality indicators for warm target calibration	/data/calibration/mws_nedt_warm
0 33 090	NEdT quality indicators for cold target calibration	/data/calibration/mws_nedt_cold
2 07 000	*Cancel increase in scale, reference value and data width*	
0 33 192 (*)	Channel processing flags	/data/processing_information/mws_l1b_processing_info_chan

APPENDIX C XML DESCRIPTION OF THE EPS-SG MWS LEVEL 1B PRODUCT FORMAT

The XML representation of the EPS-SG MWS L1B radiance product can be found in the schema file here attached:

EPS-SG-MWS-L1B-RAD_60_00.xml

APPENDIX D OPEN ISSUES AND ASSUMPTIONS

D.1: TBDs

The following table presents the TBDs.

ID	Section	Title	Description
-	-	-	-

D.2: TBCs

The following table presents the TBCs.

ID	Section	Title	Description
~~**TBC-01**~~	~~4.2.4, 4.2.5~~	~~Empty Tables~~	~~Some attributes and dimensions tables are left empty currently. These might be filled in the future.~~
~~**TBC-02**~~	~~Appendix A~~	~~Data size~~	~~Data size is TBC as it is now based on the preliminary list of products.~~
~~**TBC-03**~~	~~4.2.4~~	~~Precision resistors~~	~~The number of precision resistors and their resistances are TBC.~~
~~**TBC-04**~~	~~4.2.3, 4.2.4~~	~~PRTs~~	~~The number of PRTs is TBC.~~
~~**TBC-05**~~	~~4.2.3, 4.2.4~~	~~Scan lines~~	~~The number of scan lines is TBC.~~
~~**TBC-06**~~	~~4.2.3, 4.2.4~~	~~Reference temperature~~	~~The number of reference temperature assumed for now is 15. This is to be confirmed.~~
TBC-07	Appendix B	BUFR table	BUFR format of the MWS L1B product is to be confirmed (pending WMO decisions).