BBR L1 PRODUCT DEFINITION DOCUMENT

VOLUME A: NOMINAL PRODUCTS

ECGP

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Approved by:

Authorized by:

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DOCUMENT STATUS SHEET

Version	Date	Pages	Changes
01.00	15/05/2015	30	Version for the TRR2 First issue of the document In the first draft of the document, information related to product definition has been extracted from the original ICD and included in this document.Following changes have been implemented: • L0 Product definition moved back to ICD • Support Files definition moved back to ICD • Intermediate Data Files definition moved back to ICD • Land/Water Mask is needed as input. • New BBR_SNG_1B product. • New fields in output products for the height and land water mask • Set of quality flags updated. • StateVector Quality added for all BBR L1 Products • Calibration products moved to Volume B No bar changes are included because more than 30% of the document has been changed.
01.01	22/07/2015	24	Version for the TRR2 Close-out Following RIDs have been implemented: • RID-TRR2-43: Clarified that the headers are also included in the netCDF4/HDF5 datablock (sections 5.8, 5.9 and 5.10) • RID-TRR2-42: Sections 4 a 6 of version 01.00 removed. Subsections 7.x of version 01.00 moved back to ECGP ICD. • RID-TRR2-47: Packaging of L0 and L1 products in a ZIP file. Additional changes: • Common subsets of fields not used in Nominal products removed from the document • Requested_Altitude removed from the product because it is a constant • CCDB_Redundancy field added for each acquisition time.
01.02	11/03/2016	24	Version for the AR2 Following changeshave been implemented: • Latitude and Longitude stored as independent varaibles (instead of as a couple latlon. o Requested_Barycentre -> BarycentreLatitude and BarycentreLongitude o • Requested_Altitude is constant (input from configuration file) so it is not written as output in the datablock) Dates of applicable documents
02.00	13/03/2017	21	Interface change for the BBR Nominal L1b and Single L1b product implementing EarthCARE metadata convention. Redline version generated by ESA

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1. INTRODUCTION

1.1. PURPOSE

This document has been produced in the frame of the “EarthCARE Ground Processor” project and its purpose is to describe the format and content of the L1 nominal products for the BBR processor.

1.2. SCOPE

This document has been derived from the original ICD where all interfaces (commanding, monitoring, input and output data) were described. In this document, the information related to BBR L1 Nominal Products has been extracted from the original ICD and has been included in this dedicated document.

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2. APPLICABLE AND REFERENCE DOCUMENTS

2.1. APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form part of this document to the extent specified herein. Applicable documents are those referenced in the Contract or approved by the Approval Authority. They are referenced in this document in the form [AD.X]:

Table 2.1: Applicable Documents

Ref.	Title	Code	Version	Date
[AD.1]	Earth Observation Mission CFI Software - General Software User Manual	EO-MA-DMS-GS-0002	4.1	07/05/2010
[AD.2]	ECSIM Interface Control Document	ECSIM-DMS-TEC-ICD01-R	1.7	18/11/2008
[AD.3]	Architecture of the ESSS and ECGP	EC.TN.ASD.SY.00017	7	19/12/2014
[AD.4]	Volume 0 Products Definitions - Introduction	EC.ICD.ASD.SY.00004	8	12/12/2014
[AD.5]	Volume 1 Products Definitions - Common Products Definitions	EC.ICD.ASD.SY.00005	8	20/08/2014
[AD.6]	ESSS and ECGP Common Interface Control Document	EC.ICD.ASD.SY.00009	8	09/12/2014
[AD.7]	Requirements for the ESSS & ECGP	EC.RS.ASD.SYS.00007	8	26/05/2010
[AD.8]	BBR ECGP Algorithm Theoretical Baseline Document	EC-TN-SEA-BBR-0005	9	03/2014
[AD.9]	EarthCARE PDGS Generic IPF Interface Specifications	EACA-GSEG-EOPG-TN-15-0001	1.1	13/11/2015
[AD.10]	Space Engineering - Software	ECSS-E-ST-40	C	06/03/2009
[AD.11]	Volume 3a Products Definitions – BBR L0 Products Definitions	EC.ICD.ASD.ATL.00019	6	11/12/2014
[AD.12]	Volume 6 Products Definitions – Auxiliary Data	EC.ICD.ASD.SY.00025	6	12/12/2014
[AD.13]	Earth Explorer Ground Segment File Format Standard	PE-TN-ESA-GS-0001	2.0	03/05/2012
[AD.14]	ECGP Interface Control Document (ICD)	EC.ICD.GMV.SY.00001	02.01	22/07/2015

2.2. REFERENCE DOCUMENTS

The following documents, although not part of this document, amplify or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.X]:

Table 2.2: Reference Documents

Ref.	Title	Code	Version	Date
[RD.1]	List of Acronyms and Abbreviations	EC.LI.ASD.SY.00001	4	10/01/2013
[RD.2]	Volume 3b Products Definitions – BBR L1 Products Definitions	EC.ICD.ASD.ATL.00022	5	09/03/2012
[RD.3]	BBR L1 Product Definition – Volume B: Calibration Products	EC.ICD.GMV.BBR.00002	01.02	11/03/2016

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3. TERMS, DEFINITIONS AND ABBREVIATED TERMS

3.1. DEFINITIONS

Concepts and terms used in this document and needing a definition are included in the following table:

Table 3.1: Definitions

Concept / Term	Definition

3.2. ACRONYMS

General EarthCARE abbreviations are in [RD.1]. Specific abbreviations used in this document are given below.

Acronyms used in this document and needing a definition are included in the following table:

Table 3.2: Acronyms

Acronym	Definition
ATLID	ATmospheric LIDar
BBR	EarthCARE Broadband Radiometer
CCDB	Characterisation/Calibration Database
ECGP	EarthCARE Level-1 Ground Processor
ESSS	EarthCARE Satellite System Simulator
FHN	Friedrichshafen – Germany
GERB	Geostationary Earth Radiation Budget
GUI	Graphical User Interface
HMI	Human-Machine Interface
H/W	Hardware
ICD	Interface Control Document
IMDD	Instrument Measurement Data Definition
ISP	Instrument Source Packet
LW	Long-Wave
MDS	Measurement Data Stream
MSI	MultiSpectral Imager
PCD	Product Confidence Data
PDD	Product Definition Document
PDGS	Payload Data Ground Segment
SCOE	Spacecraft Check-Out Equipment
SRDB	Spacecraft Reference Data Base
SW	Short-Wave
S/W	Software
TDS	Test Data Set
TOA	Top Of Atmosphere
TW	Total Wave
UV	Ultra-Violet
WGS	World Geodetic System

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4. BBR INSTRUMENT OVERVIEW

The Broad-Band Radiometer (BBR) is physically separated into two units: Optics Unit (OU), which is external to the spacecraft, and the Instrument Control Unit (ICU) which is internal to the spacecraft. An exploded general assembly view of the Optics Unit is shown in following figure.

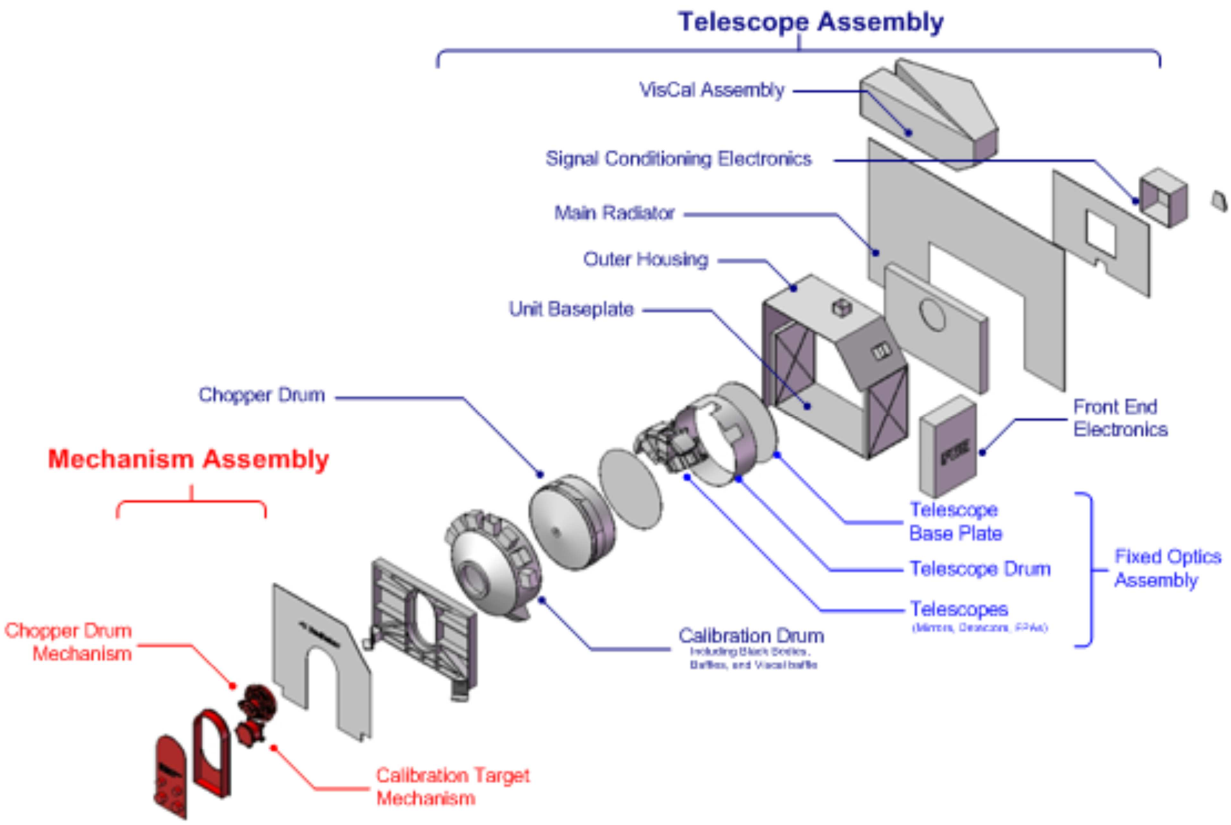

Figure 4.1: BBR Optics Unit Exploded View

4.1. DETECTOR

The detector is a 30 x 1 Vanadium Oxide micro-bolometer array, based on MEMS technology. It is a 100µm pixel pitch device with high fill factor and fast response (4ms time constant). Being thermistor-based, it has good linearity and noise performance characteristics.

Gold is vapour deposited in a low-pressure environment to produce a foam structure on the detector, which appears optically black. Trimming of the resultant black coating via laser ablation is required to physically define (reticulate) the pixels. The pixels are read out via a XenICs ROIC.

4.2. TELESCOPES

The detector array and ROIC, together with a mounting plate and PCB, form the focal plane assembly (FPA), which is mounted into each of the telescopes. Each telescope – shown in Figure 4.1 – consists of a 67 mm focal length f/2 off-axis paraboloid mirror, 30 mm square aperture, with appropriate straylight baffling.

Thermal stability control is provided at the telescope level. Owing to the response range required, the mirrors are fabricated from protectively coated Aluminium.

Each telescope also includes a triplet of ageing monitor photodiodes in the baffle walls. These are used during solar diffuser calibration to monitor the output of the SW calibration subsystem.

The three telescopes are mounted on a common baseplate, and housed in a thermal shield, with a fixed housing. This fixed telescope assembly is itself mounted – cantilevered – from one of the instruments main structural panels to provide good alignment.

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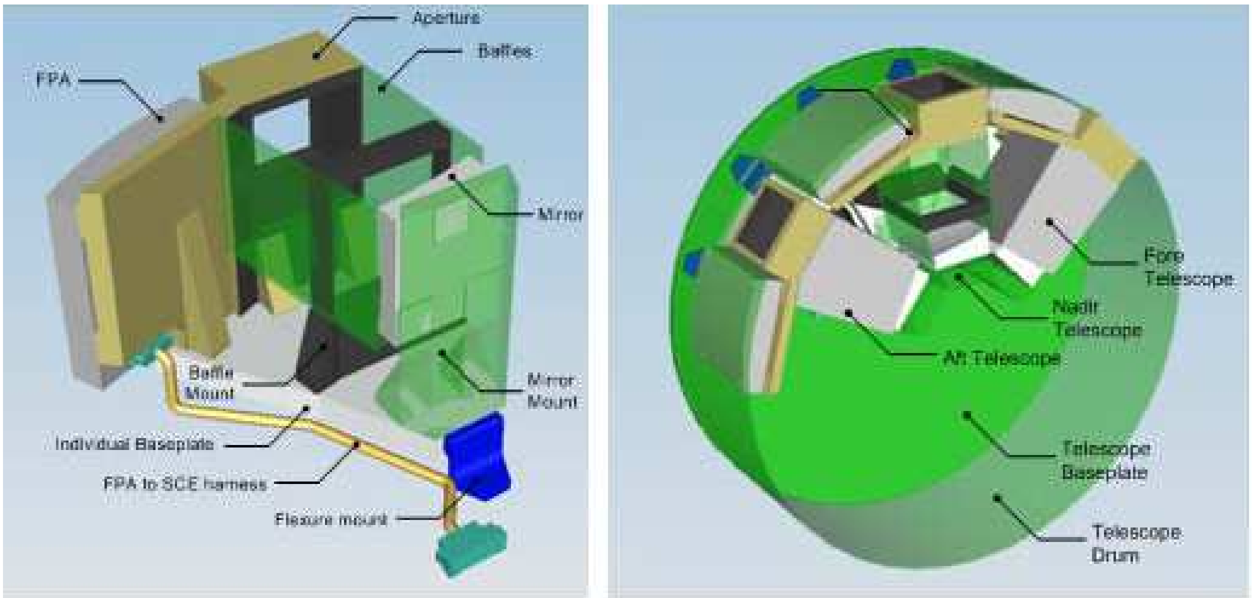

Figure 4.2: Telescope and Fixed Optics Assembly

4.3. CHOPPER

The chopper drum is a thin shell of aluminium containing four regularly spaced apertures, two of which include thin quartz/Suprasil filters. The chopper drum is rotated at 261rpm in order to achieve the required ground spacing distance. The chopper nearly completely encloses the fixed telescope assembly.

There are no electronic components on the chopper drum.

4.4. CALIBRATION DRUM AND CALIBRATION TARGETS

Around the outside of the chopper drum is the calibration drum - see Figure 4.7. On this drum are mounted four black bodies (a pair of warm black bodies and a pair of cold black bodies), as well as six earth viewing baffles.

In addition, a fold mirror is used to provide the telescopes with a view into the SW calibration subsystem (VisCal). Only one fold mirror is used; this mirror is patrolled between the three telescopes so that it is the same mirror in each view, thus maximising calibration commonality.

Lastly, another triad of monitor photodiodes is placed on the drum, looking into the SW calibration subsystem. These further characterise the SW ageing of the instrument, by allowing the measurement to differentiate between ageing in the VisCal optics and in the photo-diodes.

4.5. VISCAL

Once per orbit, the relative positions of spacecraft and sun, and the arrangement of baffles in the solar calibration subsystem, allow the Spectralon solar diffuser to be illuminated. At this time, the calibration drum is rotated so that the fold mirror is in front of one of the telescopes; the telescope then acquires data to allow the ageing monitoring to be performed. The assembly of fold mirrors, baffles, and solar diffuser is called the Visible Calibration system (VisCal).

The VisCal mirror position is cycled, so that over a period of three orbits, all telescopes will view the VisCal.

4.6. MECHANISM ASSEMBLY

The Mechanism Assembly (MA) consists of a pair of mechanisms.

The first drives the chopper drum. This comprises a direct drive DC brushless motor, with very low friction bearings, attached to the chopper drum. An optical encoder (relative, with reference pulse) is

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used to determine the chopper drum position and hence allow the instrument software to control the chopper speed.

The second mechanism is the calibration target mechanism. This is a stepper motor, driving the calibration drum through a gear head.

4.7. EXTERNAL CONFIGURATION

The external configuration of the Optics Unit – as shown in Figure 4.3 – is dominated by the requirement to passively cool the cold black body. The general instrument philosophy is to operate the bulk of the instrument at a temperature slightly below that required of the cold black body – this is done so that no active cooling methods (Peltier coolers etc.) are required. This means the instrument will operate at -10 °C.

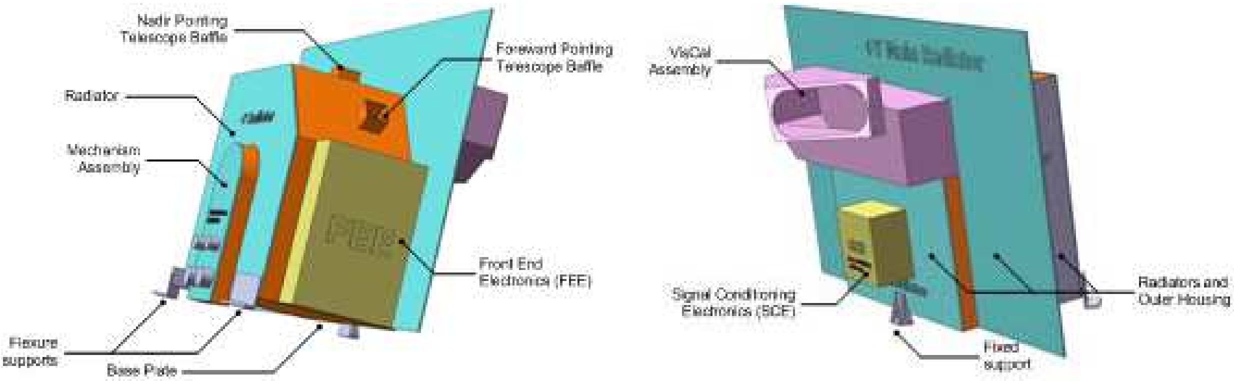

Figure 4.3: External Configuration of Optics Unit (two views)

Given the low altitude, and the location of the BBR on the earth facing side of the spacecraft, the thermal environment of the instrument is dominated by the Earthshine – the thermal emission of the earth. Hence the BBR instrument carries a large radiator to reject incoming Earthshine and radiate away internal heat to cool the instrument sufficiently.

4.8. MEASUREMENT OVERVIEW

4.8.1. VIEWING GEOMETRY

There are 3 telescopes, one for each view, fixed in the instrument box (no line-of-sight scanning).

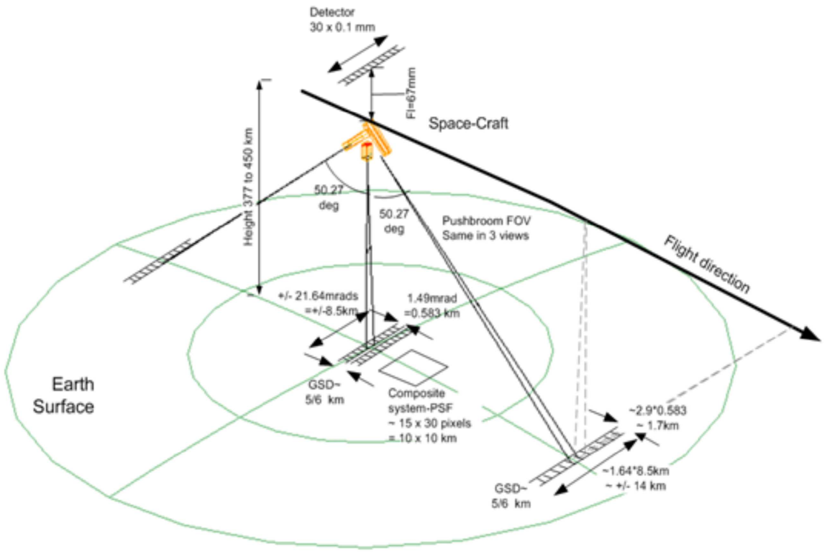

Figure 4.4: Viewing geometry

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As described previously, the view to the scene to be measured is chopped, by a cylindrical 'drum' shaped chopper, which rotates around the telescopes at constant speed. The detector chopping is to give alternating views of the scene to be measured (earth or calibration source), and some nearly constant background scene (the black surface of the instrument internals).

The channels implementation is by use of a quartz filter, to define the SW channel when the filter is present, and a TOTAL (TW) channel when it is absent. The LW channel is then obtained by subtraction (performed within the L0/L1 Instrument Processor). The BBR implements the filter as part of the chopper drum, such that two SW and two TW measurements are obtained on each cycle.

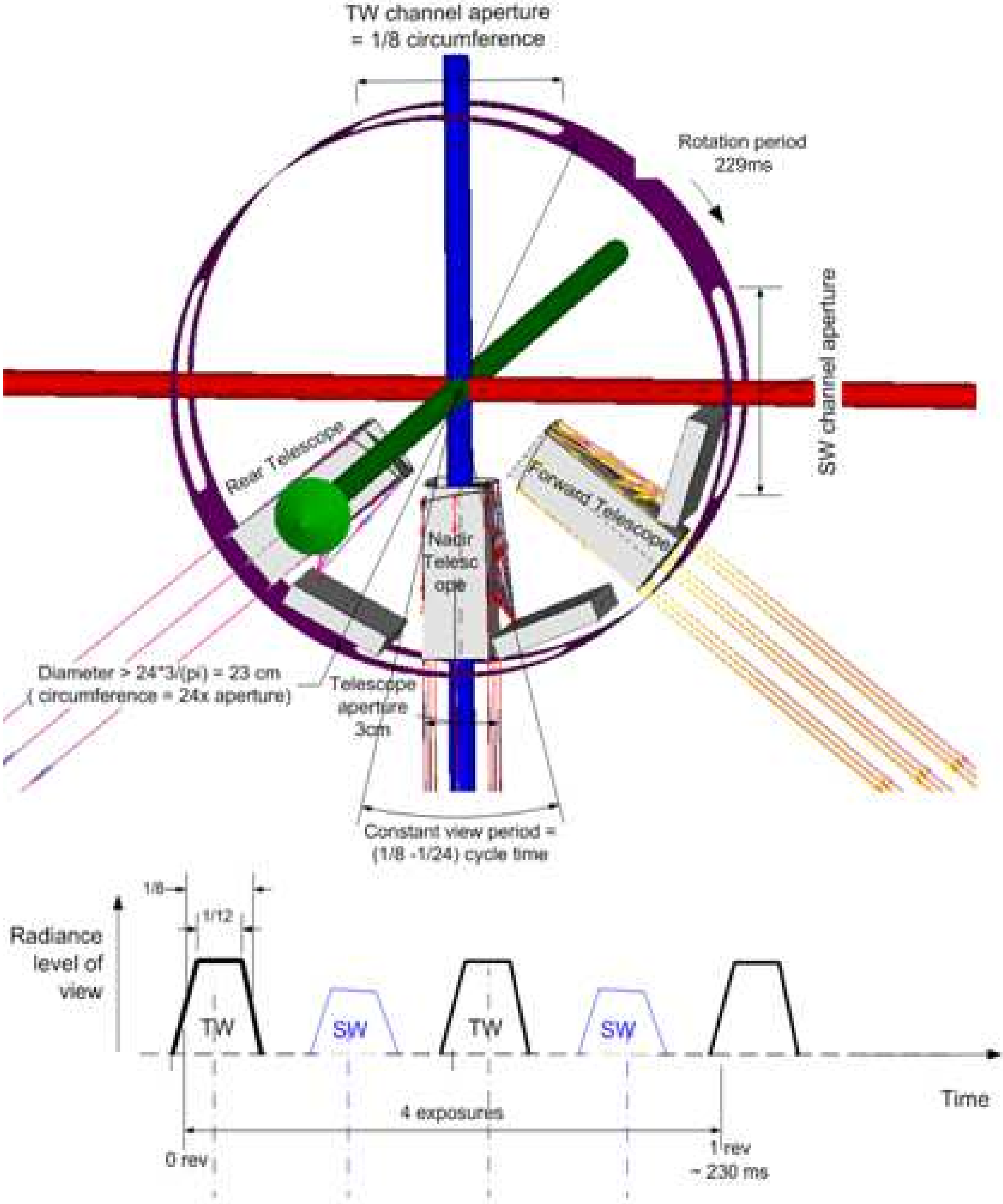

Figure 4.5: Chopper and chopper operation

The 10 km product (i.e. 10 km system PSF) is synthesised on ground from the individual pixel contributions.

Weighting is applied to permit sophisticated control of the view-view PSF matching and remove the residual yaw mismatch. This is all performed by the L0/L1 Instrument Processor.

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4.8.2. SIGNAL PROCESSING

The detectors themselves have low time constant, but the low exposure time of 19 ms means that the detectors do not reach their final value in the time available; some on-board signal processing is required. As in GERB, the detectors are sampled at a high rate (~200us) and an algorithm applied to determine the asymptote of the exponential rise. This is shown in following figure.

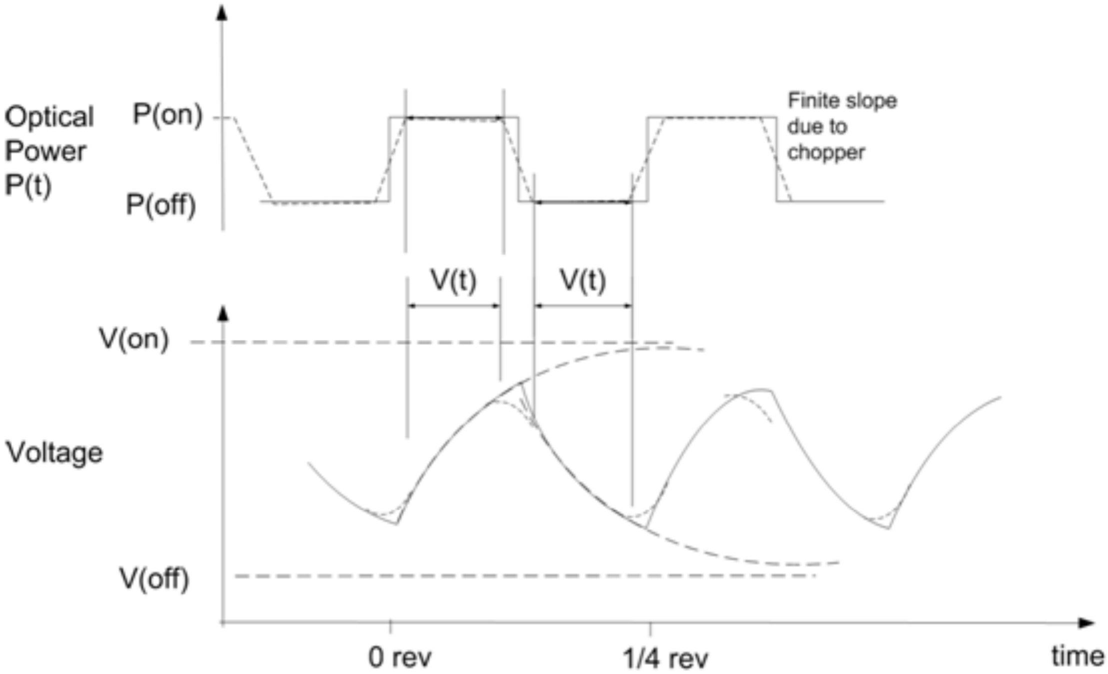

Figure 4.6: Signal processing concept (schematic only)

The design is based on detector technology used previously in ERB instruments, i.e. a thermal detector with black coated absorbing layer, required to give very broad-band response (~0.2m to 50m required), and sensing temperature of the absorbing layer by resistive change.

The baseline design uses a linear array detector in push-broom format, to build-up the 10km footprint from images at ground sampling distance (GSD) of approximately 5/6 km along track.

4.8.3. CALIBRATION

Via rotation of the calibration drum (see Figure 4.7), the telescopes periodically view:

(1) Black bodies, for TW (gain/offset) calibration. This is performed once per minute

(2) Fold mirror into the VisCal for SW ageing estimation. This is performed once per orbit

(3) Monitor photodiodes for additional ageing estimation. This is performed infrequently (e.g. once per month).

Note that all TW calibration is performed via the Level 0 to Level 1b data processing on ground in the L0/L1 Instrument Processor. The consideration of the effects of the SW ageing is not performed automatically within the L0/L1 Instrument Processor, but by analysis and L0/L1 processing algorithm modification.

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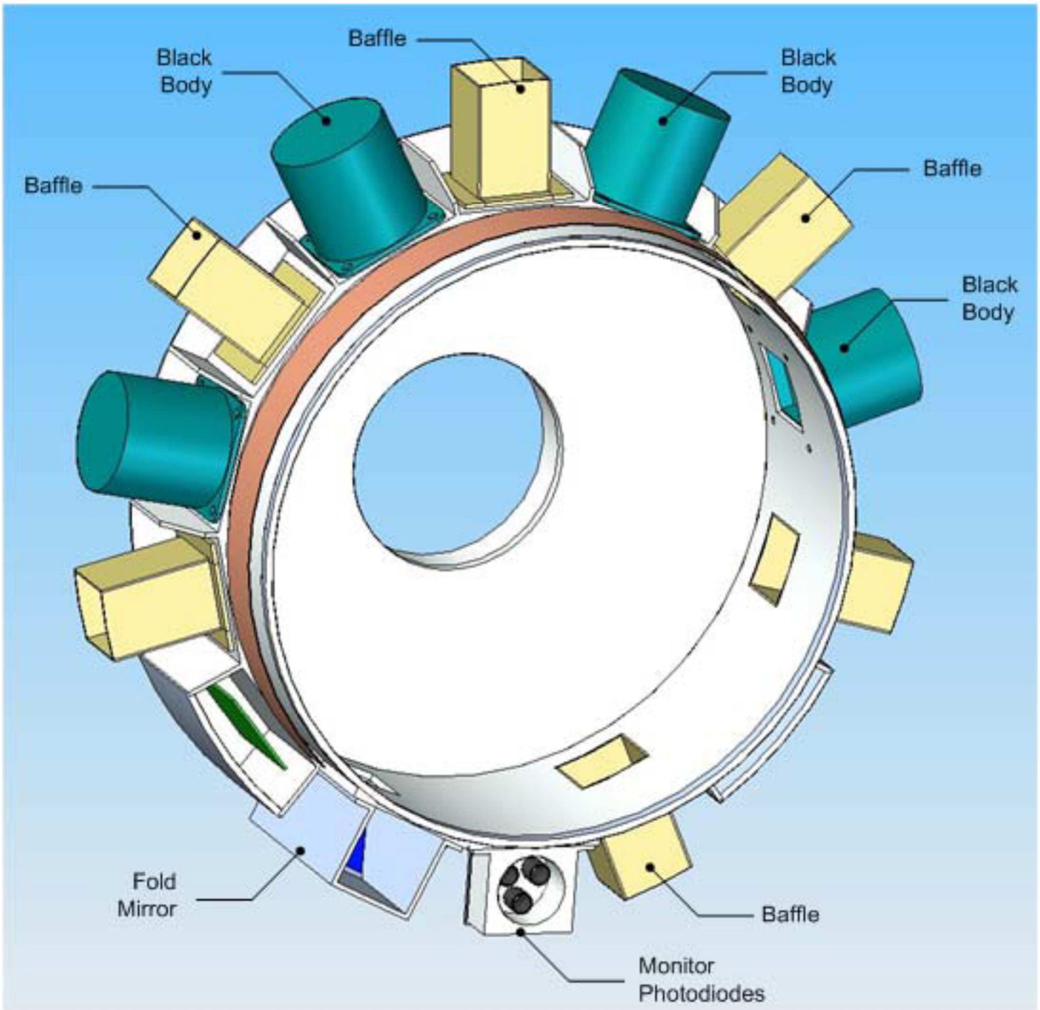

Figure 4.7: Calibration Drum Layout

4.8.4. SPECTRAL RESPONSE

The spectral response of the instrument is built up using the following elements.

Table 4.1: Elements participating in the instrument spectral response

Operation	TW	SW
Earth Scene Viewing	Earth Scene spectrum Focussing mirror Detector	Earth Scene spectrum Quartz Filter Focussing mirror Detector
Black body viewing	Black body spectrum Focusing mirror Detector	N/A
VisCal viewing	N/A	Solar spectrum Diffuser VisCal fold mirror Quartz Filter Focussing mirror Detector

Note: Content of current section (including text and figures) has been completely extracted from [RD.2].

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5. BBR L1 NOMINAL AND SINGLE PIXEL PRODUCTS

BBR L1 Nominal and Single Pixel Products are generated by the BBR L1 Processor.

5.1. TRANSFER MECHANISM

All EarthCARE Products are composed by two physical files:

- One XML for the headers (*filename*.HDR)
- One binary file for the records containing the data (*filename*.h5)

Both files are located into a ZIP package with the same name (i.e. *filename.ZIP)*.

5.2. FILE NAMING CONVENTION

The file naming convention for the EarthCARE Products is described in [AD.5].

5.3. DIMENSIONS

Following table contains all dimensions used in the definition of the BBR L1 Nominal products.
"Name" is used in the description of the product datablock below (for brevity).
"Dimension label" is the actual name of the dimension in the NetCDF product.

Table 5.1: BBR NetCDF Dimensions

Name	Description	N Elements	Dimension label
NOM 1B Nominal product			
size		3	pixelsize (standard/small/full)
view	Dimension used to define variables that are Telescope dependant.	3	view (aft/nadir/fore)
t	Position of the barycentre	Variable	along_track
edge	Edges	4	edge
band		2	band (SW/LW)
sourceISP	Dimension to store the S/C State Vector Quality fields for each source ISP contributing to the integrated ground pixel	30	source_packet
SNG 1B Single pixel product			
t	Dimension used to define variables depending on the number of samples recorded during the measurement time	Variable	along_track
view	Dimension used to define variables that are Telescope dependant.	3	view (aft/nadir/fore)
pixel	Dimension used to define variables that contain arrays of pixels	30	across_track
band		2	band (SW/TW)

5.4. QUALITY FIELDS

This section describes the quality fields in the BBR L1 products.

5.4.1. B-NOM QUALITY FIELDS (BBRNOMQUALITY)

BBRNOMQuality is composed by a set of quality flags. Currently there are 12 flags, each one being stored in a byte. This means that there are 12 bytes containing the 12 quality flags. In the B-NOM product, HDF group "Quality" contains this set.

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Following flags are stored in the BBRNOMQuality field.

Table 5.2: BBRNOMQuality fields

Field Name	#Dims	Dimensions	Type	Units	Description
invalid_flag	4	size, view, band, t	NC_BYTE		Whether the record is invalid i.e. broken by cal targets, caldrum slews etc. such that the product is missing along-track data
high_radiance_noise_flag	4	size, view, band, t	NC_BYTE		If true, the detector noise assessment from the previous black body readings exceeded some threshold, indicating that the error in this reading is too high.
blackbody_temperature_out_of_limits_flag	4	size, view, band, t	NC_BYTE		If true, at least one of the blackbody temperatures against which this telescope is calibrated is outside the range over which it has been calibrated.
gain_offset_frozen_flag	4	size, view, band, t	NC_BYTE	s	The integrated time (in s) from all the rows in the product since the last gain/offset calculation was valid
i1_vs_i2_mismatch_flag	4	size, view, band, t	NC_BYTE		The weighted sum of the differences between i1 and i2 from the detector exceeds some threshold, indicating high scene contrast within aperture measurements.
high_telescope_drift_flag	4	size, view, band, t	NC_BYTE		The temperature of the telescope foreoptics was drifting larger than some set threshold during this period
pixel_saturation_flag	4	size, view, band, t	NC_BYTE		Some of the constituent pixels are saturated within this product
telescope_temperature_out_of_limits_flag	4	size, view, band, t	NC_BYTE		The temperature of the telescopes was, during this period, out of accuracy limits (but within limits causing FDIR functions to start) indicating that the detector is operating in a regime for which it has not been calibrated
raw_mismatch_flag	4	size, view, band, t	NC_BYTE		If the telescope was in raw mode, and there was a mismatch between the ground computed values and the on-board computed values. True indicates that the on-board LUT has been corrupted, so the confidence in the radiance measurement is suspect.
chopper_nonadjacency_flag	4	size, view, band, t	NC_BYTE		If true, the subtraction of chopper background has not been performed on the adjacent chopper measurement, due to ISP loss. This indicates that the measurement may be polluted by uncorrected foreoptics temperature
nominal_calibrated_row_count	4	size, view, band, t	NC_SHORT		Number of rows used in the integration, which are calibrated using the nominal calibration processing.
nonnominal_calibrated_row_count	4	size, view, band, t	NC_SHORT		Number of rows used in the integration which are calibrated using the fall-back calibration processing due to missing LIN measurements for averaging.

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5.4.2. B-SNG QUALITY FIELDS (BBRSNGQUALITY)

BBRSNGQuality is composed by a set of quality flags. Currently there are 10 flags, each one being stored in a byte. This means that there are 10 bytes containing the 10 quality flags. In the B-SNG product, HDF group "Quality" contains this set. Following flags are stored in the BBRSNGQuality field.

Table 5.3: BBRSNGQuality fields

Field Name	#Dims	Dimensions	Type	Units	Description
invalid_flag	3	view, band, t	NC_BYTE		Whether the record is invalid i.e. broken by cal targets, caldrum slews etc. such that the product is missing along-track data
high_radiance_noise_flag	4	view, band, t, pixel	NC_BYTE		If true, the detector noise assessment from the previous black body readings exceeded some threshold, indicating that the error in this reading is too high.
blackbody_temperature_out_of_limits_flag	3	view, band, t	NC_BYTE		If true, at least one of the blackbody temperatures against which this telescope is calibrated is outside the range over which it has been calibrated.
gain_offset_frozen_flag	3	view, band, t	NC_BYTE	s	The integrated time (in s) from all the rows in the product since the last gain/offset calculation was valid
i1_vs_i2_mismatch_flag	4	view, band, t, pixel	NC_BYTE		The weighted sum of the differences between i1 and i2 from the detector exceeds some threshold, indicating high scene contrast within aperture measurements.
high_telescope_drift_flag	3	view, band, t	NC_BYTE		The temperature of the telescope foreoptics was drifting larger than some set threshold during this period
pixel_saturation_flag	4	view, band, t, pixel	NC_BYTE		Some of the constituent pixels are saturated within this product
telescope_temperature_out_of_limits_flag	3	view, band, t	NC_BYTE		The temperature of the telescopes was, during this period, out of accuracy limits (but within limits causing FDIR functions to start) indicating that the detector is operating in a regime for which it has not been calibrated
raw_mismatch_flag	3	view, band, t	NC_BYTE		If the telescope was in raw mode, and there was a mismatch between the ground computed values and the on-board computed values. True indicates that the on-board LUT has been corrupted, so the confidence in the radiance measurement is suspect.
chopper_nonadjacency_flag	3	view, band, t	NC_BYTE		If true, the subtraction of chopper background has not been performed on the adjacent chopper measurement, due to ISP loss. This indicates that the measurement may be polluted by uncorrected foreoptics temperature

5.5. B-NOM GEOLOCATION FIELDS (BBRNOMLOCATION)

The following table describes the geolocation information in the BBR nominal product (in HDF group "Location").

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Table 5.4: BBRNOMLocation fields

Field Name	#Dims	Dimensions	Type	Units	Description
barycentre_latitude	3	size, view, t	NC_DOUBLE	deg	Latitude of the target barycentre (Reference Frame: Geodetic). The reference height is the requested altitude.
barycentre_longitude	3	size, view, t	NC_DOUBLE	deg	Longitude of the target barycentre (Reference Frame: Geodetic). The reference height is the requested altitude.
solar_azimuth_angle	3	size, view, t	NC_FLOAT	deg	Solar azimuth at barycentre in the topocentric coordinate system
solar_elevation_angle	3	size, view, t	NC_FLOAT	deg	Solar elevation at barycentre in the topocentric coordinate system
sensor_azimuth_angle	3	size, view, t	NC_FLOAT	deg	Line of sight azimuth at barycentre in the topocentric coordinate system
sensor_elevation_angle	3	size, view, t	NC_FLOAT	deg	Line of sight elevation at barycentre in the topocentric coordinate system
platform_latitude	3	size, view, t	NC_DOUBLE	deg	Ground latitude of the spacecraft (Reference Frame: Geodetic)
platform_longitude	3	size, view, t	NC_DOUBLE	deg	Ground longitude of the spacecraft (Reference Frame: Geodetic)
platform_altitude	3	size, view, t	NC_FLOAT	m	Altitude of the spacecraft in m
zero_weight_edge_latitude	4	size, view, t, edge	NC_DOUBLE	deg	Latitudes of the edge of the trapezoid at which weight is zero. Four values: front-left, front-right, rear-right, rear-left (Reference Frame: Geodetic)
zero_weight_edge_longitude	4	size, view, t, edge	NC_DOUBLE	deg	Longitudes of the edge of the trapezoid at which weight is zero. Four values: front-left, front-right, rear-right, rear-left (Reference Frame: Geodetic)
one_weight_edge_latitude	4	size, view, t, edge	NC_DOUBLE	deg	Latitudes of the edge of the trapezoid at which weight is one. Four values: front-left, front-right, rear-right, rear-left (Reference Frame: Geodetic)
one_weight_edge_longitude	4	size, view, t, edge	NC_DOUBLE	deg	Longitudes of the edge of the trapezoid at which weight is one. Four values: front-left, front-right, rear-right, rear-left (Reference Frame: Geodetic)
size_across_track	3	size, view, t	NC_FLOAT	m	Size of the across track pixel (10km for standard, 5km for small, determined by ECGP for full)
size_along_track	3	size, view, t	NC_FLOAT	m	Size of the along track pixel (10km for standard, 10km for small, 10km for full)
low_quality_spacecraft_state_flag	3	size, view, t	NC_BYTE	unitless	The reported spacecraft state quality (From the spacecraft) is lower than the allowed threshold.
high_spacecraft_slew_flag	3	size, view, t	NC_BYTE	unitless	The spacecraft attitude was changing at unacceptably high rates
surface_elevation	3	size, view, t	NC_FLOAT	m	Average altitude of all pixels accumulated on current barycentre
land_fraction	3	size, view, t	NC_BYTE	percent	Percentage of Land pixels on current barycentre (100% means full land, 0% means full water, -1 means that there are no data).

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5.6. SIZE AND FREQUENCY OF TRANSFERS

Being 1/8 of orbit the nominal time frame for the EarthCARE L1 products, the size of the BBR L1 products is given for such time frame i.e. 1/8 of orbit. Following table summarises the sizes and frequency of generation of BBR L1 Nominal products. This information has been extracted from ECGP BBR L1 V2 implementation.

Table 5.5: BBR L1 nominal products size and frequency of transfers

MDS type	Size	Frequency of transfer	Comments
BBR_NOM_1B	110 MB	8 per orbit.	
BBR_SNG_1B	70 MB	8 per orbit.	

5.7. DATA DEFINITION

BBR L1 Products have different components, but there is a common structure for all of them. In this structure is included the Fixed Product Header and the Main Product Header which are identical for all products and so it is described below.

5.8. DATA STRUCTURE

BBR L1 Products have different components, but there is a common structure for all of them. This structure is presented in the table below.

Table 5.6: L1 Product logical structure

HeaderData
FixedProductHeader
VariableProductHeader
MainProductHeader
SpecificProductHeader
ScienceData

According to the above structure, the products are physically composed by:

- Headers (FixedProductHeader and VariableProductHeader) included in the XML file
- ScienceData included in the netCDF4/HDF5 binary file (which also contains the headers)

There are two different BBR L1b Products, sharing this structure. In this structure it is included the Fixed Product Header and the Main Product Header which are identical for all products and so it is described only once below.

5.9. BBR_SNG_1B

This is the Single Pixel BBR L1 product. The BBR_SNG_1B Level 1b data product corresponds to the SW or TW radiance from every telescope on every single pixel before being integrated. It is separated in the four components described below.

5.9.1. BBR_SNG_1B FIXED PRODUCT HEADER

The Fixed Product Header is common for all ECGP products and is defined in Products Definitions Volume 1 [AD.5].

5.9.2. BBR_SNG_1B MAIN PRODUCT HEADER

The Main Product Header for the BBR L1B Products is identical to the Main Product Header defined in Products Definitions Volume 1 [AD.5] but with following predefined values specific to BBR L1B SNG product:

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- fileCategory = "BBR_"
- productType = "SNG_"
- productLevel = "1B"

5.9.3. BBR_SNG_1B SPECIFIC PRODUCT HEADER

The Specific Product Header for the SNG BBR L1B Products is empty.

5.9.4. BBR_SNG_1B DATA BLOCK

Table 5.7: BBR single pixel product data block fields

Field Name	#Dims	Dimensions	Type	Units	Description
radiance	4	view, band, t, pixel	NC_FLOAT	W/(m2sr)	Filtered radiance W/m2/sr
radiance_error	4	view, band, t, pixel	NC_FLOAT	W/(m2sr)	Filtered radiance error (in which the detector noise is computed from the previous BB exposures) W/m2/sr
time	3	view, band, t	NC_DOUBLE	sec (seconds since 1 Jan 2000 00:00:00 UTC)	Time corresponding to the detector line capture (note that this will be different for different telescopes)
latitude	4	view, band, t, pixel	NC_DOUBLE	deg	Latitude of each single pixel (Reference Frame: Geodetic)
longitude	4	view, band, t, pixel	NC_DOUBLE	deg	Longitude of each single pixel (Reference Frame: Geodetic)
surface_elevation	4	view, band, t, pixel	NC_FLOAT	m	Altitude of each single pixel
land_flag	4	view, band, t, pixel	NC_BYTE	unitless	Flag which indicates if the point falls in the sea or inland
state_vector_quality_status	3	view, band, t	NC_INT	unitless	S/C State Vector Quality field copied from the ISP Private Science Data Header
CCDB_redundancy_flag	3	view, band, t	NC_BYTE	unitless	Flag to identify the redundancy configuration. 0=nominal 1=redundant
Quality (HDF group)			BBRSNGQuality		Quality information. See section 5.4.2 for details.

5.10. BBR_NOM_1B

This is the Nominal BBR L1 product. The BBR_NOM_1b Level 1b data product corresponds to the SW or LW radiance from a single telescope on a given pixel barycentre. It is separated in the four components described below.

5.10.1. BBR_NOM_1B FIXED PRODUCT HEADER

The Fixed Product Header is common for all ECGP products and is defined in Products Definitions Volume 1 [AD.5].

5.10.2. BBR_NOM_1B MAIN PRODUCT HEADER

The Main Product Header for the BBR L1B Products is identical to the Main Product Header defined in Products Definitions Volume 1 [AD.5] but with following predefined values specific to BBR L1B NOM product:

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- fileCategory = "BBR_"
- productType = "NOM_"
- productLevel = "1B"

5.10.3. BBR_NOM_1B SPECIFIC PRODUCT HEADER

This is the Specific Product Header for the NOM BBR L1B Products.

Table 5.8: BBR_NOM_1B Specific Product Header

#	Field Name	Type	Total size	Description/Value
1	sizeAcrossTrackSmall	NC_FLOAT	4	The across track size of the variable product, in [km]
2	sizeAlongTrackSmall	NC_FLOAT	4	The along track size of the variable product, in [km]
3	MDSCountLowQualityStandard	NC_SHORT	2	The number of MDS records with no poor quality flags
4	MDSCountLowQualityFull	NC_SHORT	2	The number of MDS records with no poor quality flags
5	MDSCountLowQualitySmall	NC_SHORT	2	The number of MDS records with no poor quality flags
6	unfilteredProduct	EC_BYTE	1	Flag to indicate if the unfiltering step was applied during processing (0=false, 1=true)

5.10.4. BBR_NOM_1B DATA BLOCK

Table 5.9: BBR nominal product data block fields

Field Name	#Dims	Dimensions	Type	Units	Description
radiance	4	size, view, band, t	NC_FLOAT	W/(m2sr)	Filtered radiance W/m2/sr
radiance_error	4	size, view, band, t	NC_FLOAT	W/(m2sr)	Filtered radiance error (in which the detector noise is computed from the previous BB exposures) W/m2/sr
time_barycentre	4	size, view, band, t	NC_DOUBLE	sec (seconds since 1 Jan 2000 00:00:00 UTC)	Time corresponding to the barycentre capture (note that this will be different for different telescopes)
time_start	4	size, view, band, t	NC_DOUBLE	sec (seconds since 1 Jan 2000 00:00:00 UTC)	Start time in the ISP stream (to assist backtracking into the Level 0 product).
time_end	4	size, view, band, t	NC_DOUBLE	sec (seconds since 1 Jan 2000 00:00:00 UTC)	End time in the ISP stream (to assist backtracking into the Level 0 product).
state_vector_quality_status	5	size, view, band, t, sourceISP	NC_INT	unitless	S/C State Vector Quality field copied from the ISP Private Science Data Header. This field stores the S/C State Vector Quality field for each ISP contributing to the integrated ground pixel
CCDB_redundancy	5	size, view,	NC_BYTE	unitless	Array of flags to identify the redundancy

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Field Name	#Dims	Dimensions	Type	Units	Description
		band, t, sourceISP			configuration. 0=nominal 1=redundant
valid_view_count	2	size, t	NC_BYTE		Number of valid views
matched_location_flag	2	size, t	NC_BYTE		Matched location flag
LW_SW_radiance_error_covariance	3	size, view, t	NC_FLOAT	$(W/(m2sr))^2$	Covariance between LW and SW radiance errors
Location (HDF group)			BBRNOMLocation		Location information. See section 5.5 for details
Quality (HDF group)			BBRNOMQuality		Quality information. See section 5.4.1 for details.

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