



ROSETTA

Technical Note

Doc. No: RO-DSS-TN-1081

Issue : 6d

Date: 17.09.2003

Sheet: 1 of 76

Title:

COORDINATE SYSTEMS FOR ROSETTA

CI-No. :

DRL-No. :

Model :

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DOCUMENT UPDATES

1	25.05.2000	all	First issue
2	26.10.2000	§1 §2 §7 §8 §10.7 §109 §11 §11.2 §11.3 §11.4 §11.5	Document completely revised Update of Scope Reference Documents added Definitions extended New HGA data added SAS chapter new defined, SAS-1,2 swapped! NAVCAM Unit A and B swapped! SSP new implemented MGA-S new MGA-X new LGA-1 new LGA-2 new
3	29.11.2000	§11.1.1 §11.1.2 §11.2.4 §11.2.5 §11.4 §12.1 §12.4 §12.5	Yu-axes are in the Xsc Zsc plane Figure IMU-A completed. Directions of IMU-A reference axis corrected. Figure SAS-3 unit system: Panel definition adjusted. Position and Direction parameter names adjusted. Figure SAS-4 unit system: Panel definition adjusted. Position and Direction parameter names adjusted. Figure NAVCAM overview: Names of unit axes adjusted. Figure Lander unit system: Direction of Xsc swapped. Position and direction of SSP adjusted. Direction of LGA-1 boresight axes adjusted. Direction of LGA-2 boresight axes adjusted.
4	28.02.2001	all all all §8.4	Transformations from the unit mirror frames to the S/C frame added. Transformations from unit functional frames to the mirror frames added. Measured unit frames (misalignments) removed. Xsc of HGAROT1 attachment point adjusted.
5	20.12.2001	§ 8.2.1	Table T_ and Query Q_ renamed.
6	18.01.2002	20 28 32 46 64 79	Direction cosines corrected. HGAROT2 attachment point corrected. RW direction cosines corrected. AST-SAS axis set definition taken out; they use same definition. missing direction cosine added. bookmark error removed.
6a	19.04.2002	7 19 30 34 - 78	Description of the relation between the "Q_unit_ALIGN" tables and the data source tables "T_". Q_UL_SA replaced by Q_UL_SA_PERF. Old query name corrected by Q_SAT_RW_ALIGN. Alignment queries renamed by Q_SAT_unit_ALIGN.
6b	16.05.2002	All	Removal of many typographical and "cut and paste" errors. The significant changes are highlighted in yellow.
6c	21.10.2002	See change bars	References to the Rosetta Flight Dynamics Database updated;
6d	17.09.2003	61, 64-65	Modification of STR-B Orientation

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1. SCOPE

The purpose of this technical note is twofold:

- To define the various co-ordinate systems which are relevant for the definition of alignment data.
- To serve as a reference document for generation of the Flight Dynamics Database.

In this document the reference to the satellite data tables (T_SAT or T_UL_) and to the satellite data queries (Q_SAT or Q_UL) are given in the tables of "General Description" in lines "RFDDDB-table / query". For alignment queries the returned data are extracted from the T_SAT_Unit_FNC_SC_MEAS.

2. APPLICABLE DOCUMENTS

Reference	Document Identifier	Description
AD1	RO-DSS-IS-1001	System Interface Requirements Specification. This document specifies the basic alignment requirements.
AD2	RO-DSS-TN-1020	ROSETTA Pointing and Alignment Definition. This document describes the requirements in more detail and defines some of the measurement frames.
AD3	RO-DSS-IF-1201 issue 2	Spacecraft Mechanical / Thermal Interface Control Document PFM Build Status

3. REFERENCE DOCUMENTS

Reference	Document Identifier	Description
RF1	RO-DSS-TN-1087	RFDDDB Parameter Definition
RF2	RO-MMT-1164/99	
RF3	RO-DSS-CR-1026	
RF4	RO-MMT-0473/00	SAS Numbering

4. ACRONYMS

AOCMS	Attitude and Orbit Control and Measurement System
APM	Antenna Pointing Mechanism
HGA	High Gain Antenna
IMU	Inertial Measurement Unit
LGA	Low Gain Antenna
MGA	Medium Gain Antenna
NAVCAM	Navigation Camera
RCS	Reaction Control System
RFDDDB	Rosetta Flight Dynamics Database
RSDB	Rosetta System Database
RUM	Rosetta User's Manual
RW	Reaction Wheel
SAS	Sun Acquisition Sensor
SSP	Surface Science Package
STR	Star tracker

5. ABBREVIATIONS

N/A	not applicable
§	paragraph
ref.	reference
tbc	to be confirmed
X_U, Y_U, Z_U	(local or currently concerned) unit reference axes

6. PARAMETER NAME DEFINITION IN THE RFDDB

All parameters found in this document shall be stored in the RFDDB. The link between the parameters defined in this document and their placeholders in the RFDDB is the RFDDB Parameter Definition Document (RF1).

7. DEFINITIONS

7.1 TRANSFORMATION MATRIX

Transformation Matrix M_{AtoB} from reference frame A to reference frame B:

$$V_B = M_{AtoB} * V_A$$

The vector V in reference frame B (V_B) is given by the product of the matrix M_{AtoB} and the vector V in reference frame A (V_A).

7.2 SPACECRAFT MECHANICAL AXES (X_{SC} , Y_{SC} , Z_{SC})

The spacecraft mechanical build axes are fixed relative to the spacecraft geometry and shall be used during spacecraft design and integration for the positioning of spacecraft items.

The spacecraft axes are named X_{SC} , Y_{SC} , Z_{SC} and form a right-hand orthogonal coordinate system, with the origin at the centre of the spacecraft / launcher separation plane.

Z_{SC} is perpendicular to this interface plane, with positive sense towards the upper (payload) plane, and is nominally coincident with the payload line of sight.

X_{SC} is defined by a mechanical reference on the spacecraft structure, and is nominally orientated with its positive sense towards the High Gain Antenna (HGA) mounting plane.

Y_{SC} is right-hand perpendicular to the plane spanned by the X_{SC} / Z_{SC} axes, mainly parallel to the direction of the Solar Arrays.

When the spacecraft is integrated with the launch vehicle, the $+Z_{SC}$ axis is aligned with the launch vehicle longitudinal (+X) axis. The X_{SC} axis will be positioned relative to the launch vehicle by the adapter and umbilical link / pyro connectors key ways.

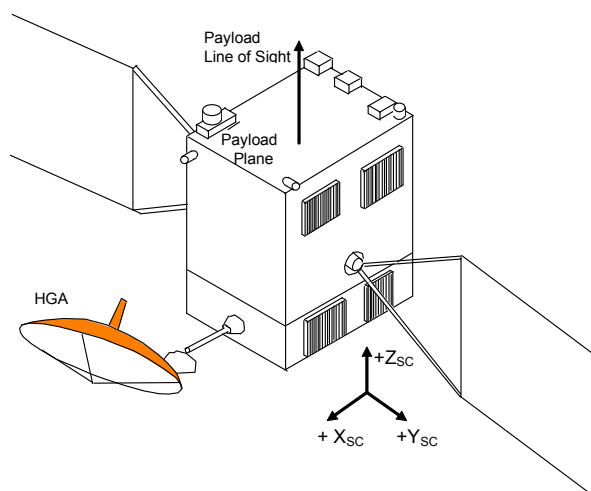


Figure 1: Spacecraft assembly

7.3 UNIT MECHANICAL AXES (X_U, Y_U, Z_U)

This unit-fixed right hand orthogonal set of axes represents the reference system for each spacecraft item. The origin is located at the centre of the reference hole in the item mounting plane. The $+Z_U$ axis is normal to the mounting plane and in the direction from the mounting plane to the item. The other two axes lie in the mounting plane.

The unit reference axes shall be identified on the item by mechanical or optical (mirror) references for measurement or adjustment.

7.4 DIRECTION COSINE MATRIX

For all units, direction cosine data are provided in the following form:

Direction cosines	X_{SC}	Y_{SC}	Z_{SC}
X_U	a_{11}	a_{12}	a_{13}
Y_U	a_{21}	a_{22}	a_{23}
Z_U	a_{31}	a_{32}	a_{33}

This is to be interpreted as follows:

$$\begin{bmatrix} X_U \\ Y_U \\ Z_U \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} X_{SC} \\ Y_{SC} \\ Z_{SC} \end{bmatrix}$$

7.5 UNITS AND FRAMES

7.5.1 General

In order to describe, systematically, the geometrical properties of ROSETTA, the spacecraft is broken down into units. The position and orientation of each unit (with the exception of the central body) is given in relation to its "parent unit". For instance, for a sun sensor located on a solar array, this solar array is the parent unit. In the same way, the parent unit of the solar array is the central body. The central body is at the root of the tree and thus has no parent unit.

For each unit, a "local frame" is defined. Firstly, this local frame is defined by its relation to the geometry of the unit. The unit mass and inertia properties and the unit geometry or shape (e.g. corner points of a box) are defined with respect to its local frame. The definition of these parameters is not within the scope of this document. The measurement directions of each instrument are also defined with respect to its local frame.

Secondly, the relation between the local frame and its parent frame is defined, i.e. a transformation matrix between local frame and parent frame is given and the origin of the local frame is given in the parent frame.

The definition of the relation between local frame and parent frame depends on whether the unit is "fixed" or "articulated". Fixed units are all units which have a rigid connection with their parent unit, e.g. the array-mounted SASs with the solar array. Here, the orientation of the local frame and the position of its origin are fixed within the parent frame.



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The articulated units of Rosetta are the solar array wings and the high gain antenna. The articulated units of Rosetta are specifically "rotating", i.e. the solar arrays rotate with respect to the central body, the HGA arm rotates with respect to the central body and the HGA dish rotates with respect to the HGA arm. (The HGA arm is later denoted "HGAROT1" and the HGA dish "HGAROT2").

For a rotating unit, the rotation axis is defined in the parent frame by its direction (expressed as a unit vector given in the parent frame) and by specifying the position of a point on the rotation axis within the parent frame. Commonly, the position of the "attachment point" is provided. While the "attachment point" must be on the rotation axis, there is no firm a priori definition of its location along the axis. To comply with intuition, the location along the axis is selected within the bearing or hinge.

In addition to the rotation axis direction and attachment point, in the case of rotating units the orientation of the local frame and the location of its origin with respect to the parent frame are provided for zero rotation angle, corresponding to the reference orientation of the rotating unit. The limiting angles of rotation in positive and negative direction of rotation are also provided.

7.5.2 Units overview

Units overview				
Group	Unit	Parent unit	Type	Remark
Relevant geometrical units	Central body	N/A	Fixed	Without parent unit
	SA+Y	Central body	Rotating	
	SA-Y	Central body	Rotating	
	HGAROT1	Central body	Rotating	
	HGAROT2	HGAROT1	Rotating	
Actuators	Reaction wheels	Central body	Fixed	
	RCS	Central body	Fixed	
Sensors	IMU-A	Central body	Fixed	
	IMU-B	Central body	Fixed	
	IMU-C	Central body	Fixed	
	SAS-1	Central body	Fixed	
	SAS-2	Central body	Fixed	
	SAS-3	SA+Y	Fixed	
	SAS-4	SA-Y	Fixed	
	STR-A	Central body	Fixed	
	STR-B	Central body	Fixed	
	NAVCAM-A	Central body	Fixed	
	NAVCAM-B	Central body	Fixed	
Payload instruments	ALICE	Central body	Fixed	
	MIRO	Central body	Fixed	
	OSIRIS-NAC	Central body	Fixed	
	OSIRIS-WAC	Central body	Fixed	
	VIRTIS	Central body	Fixed	
Other units	SSP	Central body	Fixed	
	MGA	Central body	Fixed	
	LGA	Central body	Fixed	

8. RELEVANT GEOMETRICAL UNITS

8.1 CENTRAL BODY

8.1.1 General description

Central Body	
Identification	Central body
Type of unit	Fixed
Parent unit	-
Coordinate systems	Spacecraft mechanical reference frame (central body unit system)

8.1.2 Coordinate systems

Central Body Coordinate Systems		
Spacecraft reference mechanical frame (central body reference system)	Origin	Centre of the spacecraft / launcher interface.
	Z-axis	Perpendicular to the spacecraft / launcher interface plane, pointing towards the upper (payload) panel. Nominally along the payload line of sight.
	X-axis	Normal to the HGA mounting plane pointing outward from the spacecraft body.
	Y-axis	Completing a right handed orthogonal system. Nominally parallel to the solar array longitudinal axis.

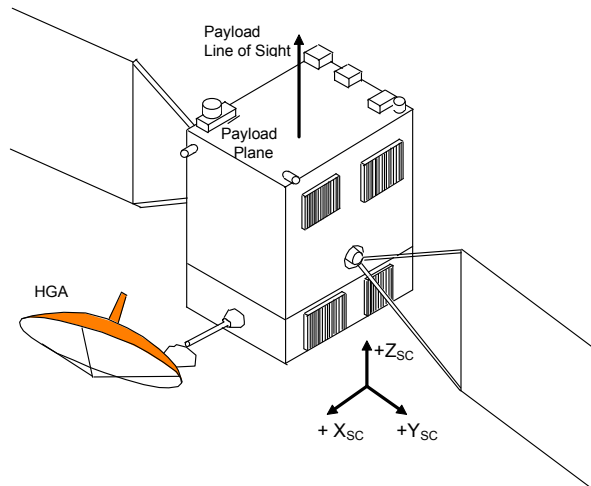


Figure 2: Spacecraft mechanical reference system

The faces of the box-shaped central body can be identified by the direction of the normal unit vector (e.g. +Y side, -Y side)

8.2 SOLAR ARRAY +Y

8.2.1 General description

SA+Y	
Identification	Solar array at the +Y side of the central body
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_UL_SA / Q_SAT_SA_ALIGN
Product tree	B18C
CONFIG_Id (from RFDDDB)	USAYP000
Type of unit	Rotating
Parent unit	Central body system
Coordinate systems	Central body system. Solar array +Y unit system.
Parameters	Position of SA+Y attachment point. Direction of SA+Y rotation axis. Orientation of SA+Y unit system to the spacecraft reference frame.
Variables	Solar array rotation angle

8.2.2 Coordinate systems

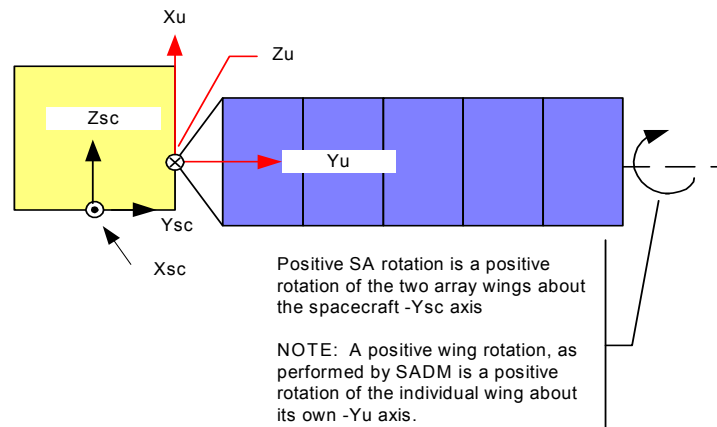


Figure 3: SA+Y overview and unit frame



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SA+Y coordinate systems		
SA+Y Parent frame: Central body reference system	See § 8.1 Central Body	
SA+Y unit reference system	Origin	Attachment point.
	X_U	Completing a right handed orthogonal system.
	Y_U	In solar array plane, along longitudinal symmetry axis of array, pointing away from spacecraft.
	Z_U	Perpendicular to solar array. The normal to the active cell face is in the $-Z_U$ direction.

8.2.3 Parameters

Position of SA+Y attachment point				
RFDDB-table / query	T SAT UNIT MECH SC NOM / Q SAT UNIT MECH SC NOM			
Parameter description	Position of the attachment point of the SA+Y to the central body			
Provided in (reference coordinate system)	Central body system			
Provided as	Three vector components			
Physical units	m			
Nominal values	RFDDB-ref.:	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	Figure-ref.:	X_{sc}	Y_{sc}	Z_{sc}
		0	1.0645	1.3211

Direction of SA+Y rotation axis				
RFDDB-table / query	T UL SA / Q SAT SA ALIGN			
Parameter description	Direction of the SA+Y or rotation axis unit vector			
Provided in (reference coordinate system)	Central body system			
Provided as	Three vector components			
Physical units	Dimensionless			
Nominal values	RFDDB-ref.:	A_SA_ROT_x	A_SA_ROT_y	A_SA_ROT_z
	Figure-ref.:	X_{sc}	Y_{sc}	Z_{sc}
		0	1	0

Orientation of SA+Y frame to the spacecraft reference frame				
RFDDB-table / query	T SAT UNIT MECH SC NOM / Q SAT UNIT MECH SC NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the SA+Y unit reference system at zero rotation angle			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
RFDDB-identification :	X_U	0	0	1
A_MECH_SC_1x to	Y_U	0	1	0
A_MECH_SC_3z	Z_U	-1	0	0



8.2.4 Variables

SA+Y rotation angle		
RFDDB-table / query	T_UL_SA / Q_UL_SA_PERF	
Variable description	Rotation angle around the SA+Y rotation axis.	
Provided in (reference coordinate system)	Central body system	
Provided as	Angle with sign in mathematical sense (positive about the direction of the rotation axis unit vector)	
Physical units	deg	
Reference position	Implicitly defined by the transformation matrix from central body to SA+Y unit frame, which provides the transformation at zero rotation angle. Nominally, at zero rotation angle, the $-Z_0$ axis of SA+Y is aligned with the spacecraft +X axis.	
Physical range:	RFDDB-ref.:	P_SA_ROT_MIN_HW
		Min
		-180°
		P_SA_ROT_MAX_HW
		Max
		+180°

8.3 SOLAR ARRAY -Y

8.3.1 General description

SA-Y	
Identification	Solar array at the -Y side of the central body
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_UL_SA / Q_UL_SA_PERF / Q_SAT_SA_ALIGN
Product tree	B18C
CONFIG_Id (from RFDDDB)	USAYM000
Type of unit	Rotating
Parent unit	Central body system
Coordinate systems	Central body system. SA-Y unit system.
Parameters	Position of SA-Y attachment point. Direction of SA-Y rotation axis. Orientation of SA-Y unit system to the spacecraft reference frame.
Variables	Solar array rotation angle

8.3.2 Coordinate systems

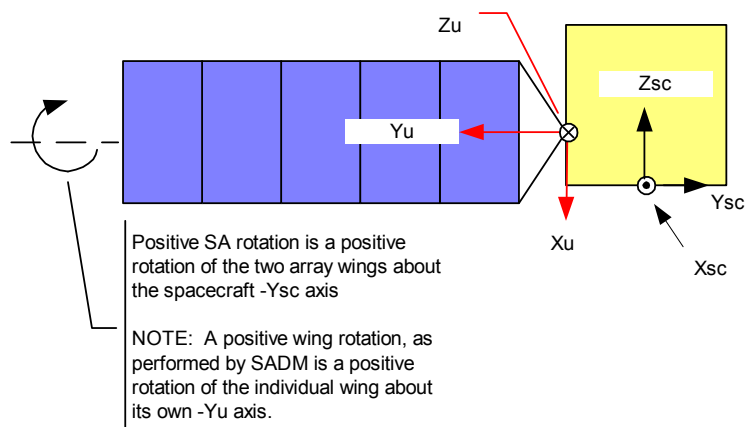


Figure 4: SA-Y overview and unit frame



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SA-Y coordinate systems		
SA-Y Parent frame: Central body reference system	See § 8.1 Central Body	
SA-Y unit reference system	Origin	Attachment point.
	X_U	Completing a right handed orthogonal system.
	Y_U	In solar array plane, along longitudinal symmetry axis of array, pointing away from spacecraft.
	Z_U	Perpendicular to solar array. The normal to the active cell face is in the $-Z_U$ direction.

8.3.3 Parameters

Position of SA-Y attachment point				
RFDDDB-table / query	T SAT UNIT MECH SC NOM / Q SAT UNIT MECH SC NOM			
Parameter description	Position of the attachment point of the SA-Y to the central body			
Provided in (reference coordinate system)	Central body system			
Provided as	Three vector components			
Physical units	m			
Nominal values	RFDDDB-ref.:	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	Figure-ref.:	X_{sc}	Y_{sc}	Z_{sc}
		0	-1.0645	1.3211

Direction of SA-Y rotation axis				
RFDDDB-table / query	T UL SA / Q SAT SA ALIGN			
Parameter description	Direction of the SA-Y or rotation axis unit vector			
Provided in (reference coordinate system)	Central body system			
Provided as	Three vector components			
Physical units	Dimensionless			
Nominal values	RFDDDB-ref.:	A_SA_ROT_x	A_SA_ROT_y	A_SA_ROT_z
	Figure-ref.:	X_{sc}	Y_{sc}	Z_{sc}
		0	-1	0

Orientation of SA-Y frame to the spacecraft reference frame				
RFDDDB-table / query	T SAT UNIT MECH SC NOM / Q SAT UNIT MECH SC NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the SA-Y unit reference system at zero rotation angle			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
RFDDDB-identification :	X_U	0	0	-1
A_MECH_SC_1x to	Y_U	0	-1	0
A_MECH_SC_3z	Z_U	-1	0	0

8.3.4 Variables

SA-Y rotation angle		
RFDDDB-table / query	T_UL_SA / Q_UL_SA_PERF	
Variable description	Rotation angle around the SA-Y rotation axis.	
Provided in (reference coordinate system)	Central body system	
Provided as	Angle with sign in mathematical sense (positive about the direction of the rotation axis unit vector)	
Physical units	deg	
Reference position	Implicitly defined by the transformation matrix from central body to SA-Y unit frame, which provides the transformation at zero rotation angle. Nominally, at zero rotation angle, the $-Z_0$ axis of SA-Y is aligned with the spacecraft +X axis.	
Physical range:	RFDDDB-ref.:	P_SA_ROT_MIN_HW
		Min
		-180°
		P_SA_ROT_MAX_HW
		Max
		+180°

8.4 HGAROT1

8.4.1 Introduction

The HGA system is split into two units. The first unit "HGAROT1", (the HGA arm), is attached to the central body through a rotation axis. The degree of freedom around this axis is the HGA elevation (see Figure 5: Overview and rotation axes). It comprises all the elements that can rotate directly about this axis, i.e. the part of the antenna pointing mechanism that is neither fixed to the central body nor rotates about the HGA azimuth rotation (see Figure 6: APM and rotation axes).

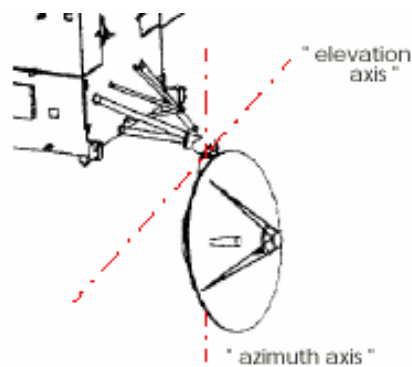


Figure 5: Overview and rotation axes

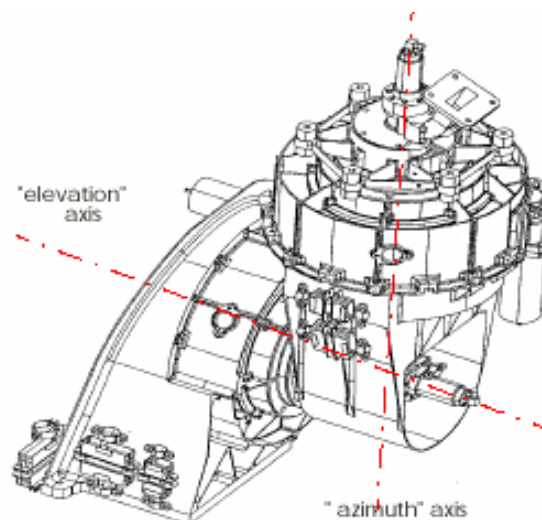


Figure 6: APM and rotation axes

Note that the APM tripod support structure and the fixed part of the APM are considered part of the central body.



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8.4.2 General description

HGAROT1	
Identification	Part of the HGA pointing mechanism that rotates around the HGA elevation axis i.e. the part neither fixed to the central body nor fixed to the HGA dish.
RFDDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN, Q_UL_HGA_PERF
Product tree	B19C
CONFIG_Id (from RFDDDB)	UHG HGAROT1 (tbc)
Type of unit	Rotating
Parent unit	Central body system
Coordinate systems	Central body system. HGAROT1 nominal unit system.
Parameters	Position of HGAROT1 attachment point. Direction of HGAROT1 rotation axis. Orientation of HGAROT1 nominal unit frame to spacecraft reference frame.
Variables	HGAROT1 rotation angle

8.4.3 Coordinate systems

HGAROT1 coordinate systems		
HGAROT1 Parent frame: Central body reference system	See § 8.1 Central Body	
HGAROT1 reference system	Origin	Attachment point.
	X _U	Completing a right handed orthogonal system.
	Y _U	Along the elevation axis of the APM, in the same direction as the spacecraft Y-axis.
	Z _U	Along the projection of the "azimuth" axis onto the plane perpendicular to the "elevation" axis, pointing away from the HGA dish to the spacecraft center body.

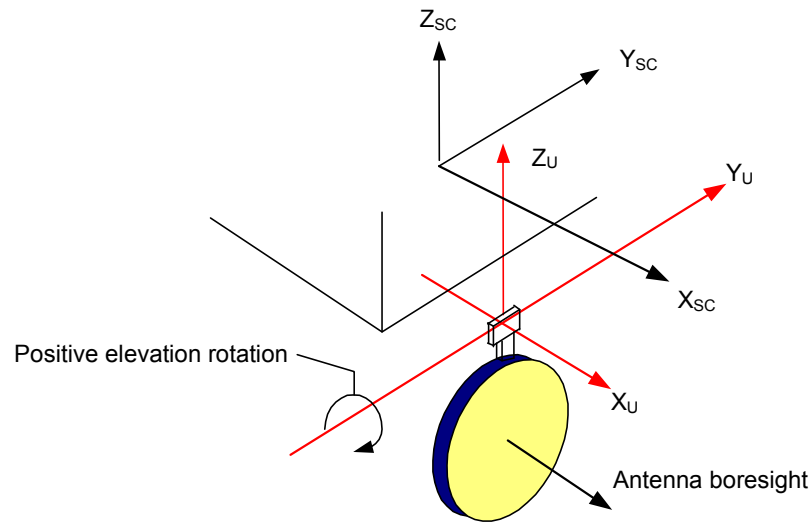


Figure 7: HGAROT1 unit system

Positive elevation rotation is a positive rotation about Y_u.

8.4.4 Parameters

Position of HGAROT1 attachment point				
RFDDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN			
Parameter description	Position of the attachment point of the HGAROT1 to the central body, at the intersection of the rotation axis with the interface plane between the fixed and rotary parts of the APM.			
Provided in (reference coordinate system)	Central body system			
Provided as	Three vector components			
Physical units	m			
Nominal values	RFDDDB-ref.:	HGA_POS_x	HGA_POS_y	HGA_POS_z
	Figure-ref.:	X _{sc}	Y _{sc}	Z _{sc}
		2.1515	0	0.0800

Direction of HGAROT1 rotation axis				
RFDDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN			
Parameter description	Direction of the HGAROT1 rotation axis unit vector.			
Provided in (reference coordinate system)	Central body system			
Provided as	Three vector components			
Physical units	Dimensionless			
Nominal values	RFDDDB-ref.:	A_HGA_ROT_x	A_HGA_ROT_y	A_HGA_ROT_z
	Figure-ref.:	X _{sc}	Y _{sc}	Z _{sc}
		0	1	0



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Orientation of HGAROT1 nominal unit frame to the spacecraft reference frame

RFDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the HGAROT1 nominal unit reference system, at zero rotation angle.			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values	Direction cosines	X _{SC}	Y _{SC}	Z _{SC}
RFDDB-identification:	X _U	1	0	0
A_HGA_ALI_1x to	Y _U	0	1	0
A_HGA_ALI_3z	Z _U	0	0	1

8.4.5 Variables

HGAROT1 rotation angle

RFDDB-table / query	T_UL_HGA / Q_UL_HGA_PERF	
Variable description	Rotation angle about the HGAROT1 rotation axis.	
Provided in (reference coordinate system)	Central body system	
Provided as	Angle with sign in mathematical sense (positive around the direction of the rotation axis unit vector)	
Physical units	deg	
Reference position	Implicitly defined by the transformation matrix from central body to HGAROT1 unit frame, which provides the transformation at zero rotation angle. Nominally, at zero rotation angle, the HGAROT1 X-axis is aligned with the spacecraft X-axis and the HGAROT1 Z-axis is aligned with the spacecraft Z-axis.	
Operational range:	RFDDB-ref.: P_HGA_ROT_MIN_HW	P_HGA_ROT_MAX_HW
	Min	Max
	-165°	+30°

8.5 HGAROT2

8.5.1 Introduction

HGAROT2 comprises the HGA dish with all rigid attachments. It is attached to the HGAROT1 through a rotation axis (corresponding to the so called HGA azimuth rotation).

8.5.2 General description

HGAROT2	
Identification	Group of elements that can rotate about the HGA "azimuth" axis.
RFDDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN, Q_UL_HGA_PERF
Product tree	B19C
CONFIG_Id (from RFDDDB)	UHGHHGAROT2 (tbc)
Type of unit	Rotating
Parent unit	HGAROT1
Coordinate systems	HGAROT1 nominal unit system. HGAROT2 nominal unit system.
Parameters	Position of HGAROT2 attachment point. Direction of HGAROT2 rotation axis. Orientation of HGAROT2 nominal unit frame to the HGAROT1 frame.
Variables	HGAROT2 rotation angle

8.5.3 Coordinate systems

HGAROT2 coordinate systems		
HGAROT2 Parent frame: HGAROT1 unit reference system	See 8.4 HGAROT1	
HGAROT2 unit reference system	Origin	Attachment point.
	X_U	Parallel to the direction of the antenna boresight.
	Y_U	Completing a right handed orthogonal system.
	Z_U	Along the so called azimuth axis of the APM, pointing away from the HGA dish towards the spacecraft center body.

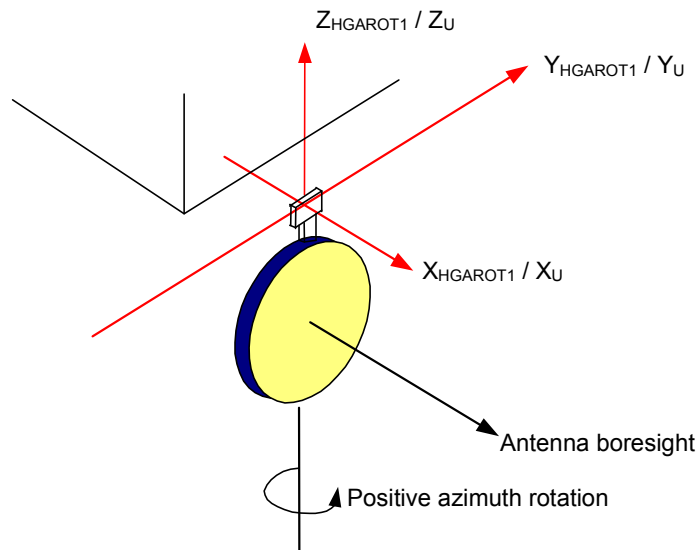


Figure 8: HGAROT2 unit system

Positive azimuth rotation is a positive rotation about Z_U .

8.5.4 Parameters

Position of HGAROT2 attachment point				
RFDDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN			
Parameter description	Position of the attachment point of the HGAROT2 to the HGAROT1.			
Provided in (reference coordinate system)	HGAROT1 system			
Provided as	Three vector components			
Physical units	m			
Nominal values	RFDDDB-ref.:	HGA_POS_x	HGA_POS_y	HGA_POS_z
	Figure-ref.:	$X_{HGAROT1}$	$Y_{HGAROT1}$	$Z_{HGAROT1}$
		0	0	0

Direction of HGAROT2 rotation axis				
RFDDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN			
Parameter description	Direction of the HGAROT2 rotation axis unit vector.			
Provided in (reference coordinate system)	HGAROT1 system			
Provided as	Three vector components			
Physical units	Dimensionless			
Nominal values	RFDDDB-ref.:	A_HGA_ROT_x	A_HGA_ROT_y	A_HGA_ROT_z
	Figure-ref.:	$X_{HGAROT1}$	$Y_{HGAROT1}$	$Z_{HGAROT1}$
		0	0	1



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Orientation of HGAROT2 nominal unit frame to the HGAROT1 reference frame

RFDDDB-table / query	T_UL_HGA / Q_SAT_HGA_ALIGN			
Parameter description	Transformation matrix (§ 7.1) from the HGAROT1 nominal unit reference system to the HGAROT2 nominal unit reference system at zero rotation angle.			
Provided in (reference coordinate system)	HGAROT1 system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values	Direction cosines	$X_{HGAROT1}$	$Y_{HGAROT1}$	$Z_{HGAROT1}$
RFDDDB-identification:	X_U	1	0	0
A_HGA_ALI_1x to	Y_U	0	1	0
A_HGA_ALI_3z	Z_U	0	0	1

8.5.5 Variables

HGAROT2 rotation angle

RFDDDB-table / query	T_UL_HGA / Q_UL_HGA_PERF	
Variable description	Rotation angle about the HGAROT2 rotation axis.	
Provided in (reference coordinate system)	HGAROT1 system	
Provided as	Angle with sign in mathematical sense (positive around the direction of the rotation axis unit vector)	
Physical units	deg	
Reference position	Implicitly defined by the transformation matrix from HGAROT1 unit frame to HGAROT2 unit frame, which provides the transformation at zero rotation angle. Nominally, at zero rotation angle, the HGAROT2 X-axis is aligned with the HGAROT1 X-axis, and the HGAROT2 Z-axis is aligned with the HGAROT1 Z-axis.	
Operational range:	RFDDDB-ref.:	
	P_HGA_ROT_MIN_HW	P_HGA_ROT_MAX_HW
	Min	Max
	-260°	+80°

8.6 CORNER POINT POSITIONS

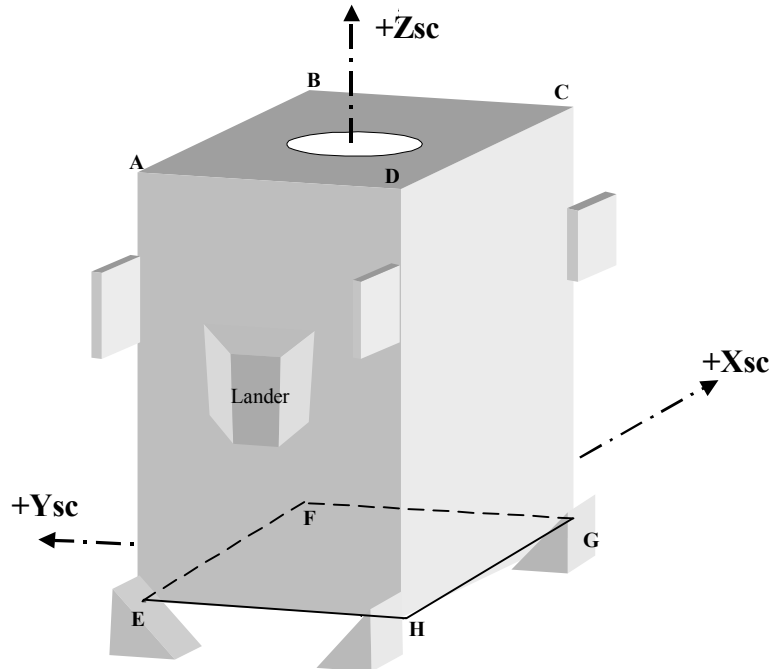


Figure 9: Corner point positions

Corner point positions			
Corner point	Reference point coordinates [m]		
	X_{sc}	Y_{sc}	Z_{sc}
A	-1.0500	1.0000	2.6550
B	1.0500	1.0000	2.6550
C	1.0500	-1.0000	2.6550
D	-1.0500	-1.0000	2.6550
E	-1.0500	1.0000	0.0800
F	1.0500	1.0000	0.0800
G	1.0500	-1.0000	0.0800
H	-1.0500	-1.0000	0.0800

9. ACTUATORS

9.1 REACTION WHEELS

9.1.1 Introduction

Four wheels are defined and located symmetrically on the internal deck and +X shear wall. The nomenclature is according to the Avionics and Spacecraft Mechanical / Thermal ICD:

W1, W2, W3, W4

The direction of the spin axis (Z_U) of each wheel is defined by the unit vectors in the spacecraft coordinate frame - see Section 9.1.3. Rotary orientation on the bracket is given by the unit X-axis.

9.1.2 General description

Reaction Wheel	
Identification	RW
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM
Product tree	B22BA
CONFIG_Id (from RFDDDB)	UACRWA01, UACRWA02, UACRWA03, UACRWA04
Parent unit	Central body
Coordinate systems	Central body system. RW mirror system (one mirror per wheel along boresight direction).
Parameters	Nominal direction of RW rotation axes to spacecraft frame. Direction of RW mirrors to spacecraft frame. Functional direction of RW rotation axes to RW mirrors.

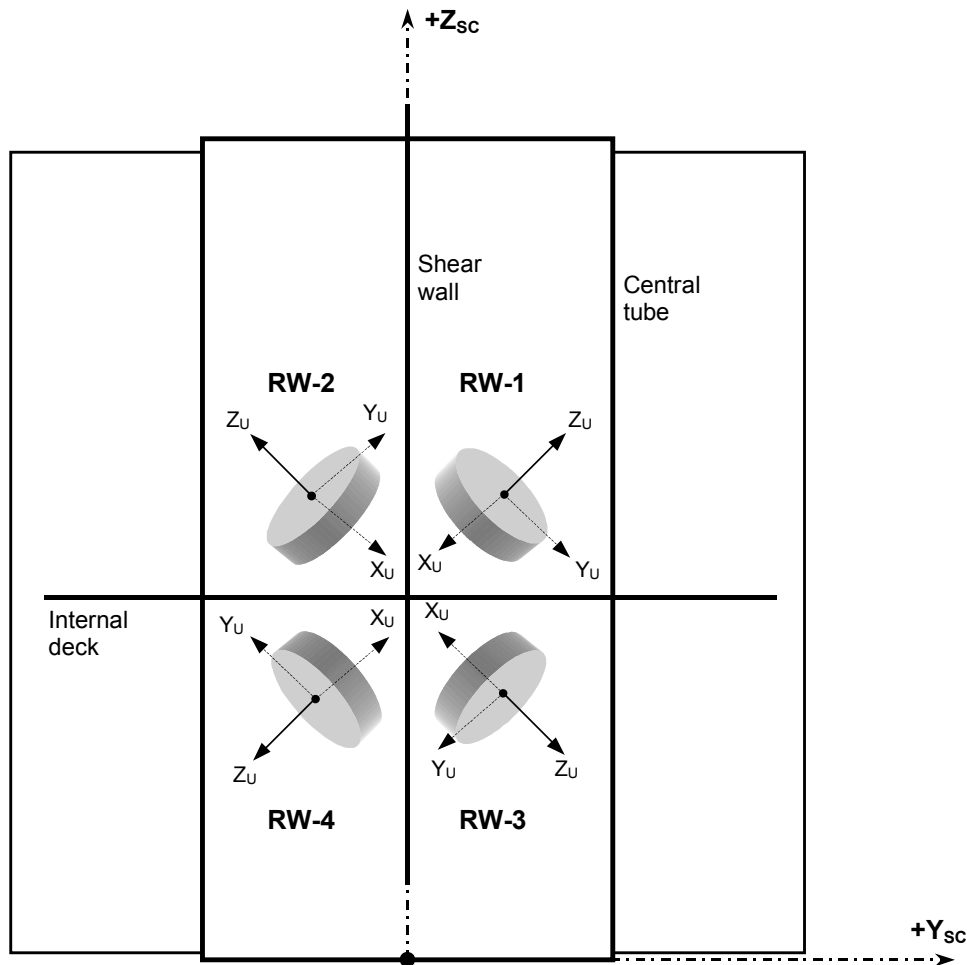


Figure 10: Reaction wheels overview

The reference point for each wheel is the origin of the unit coordinate system on the mounting bracket – see scheme below:

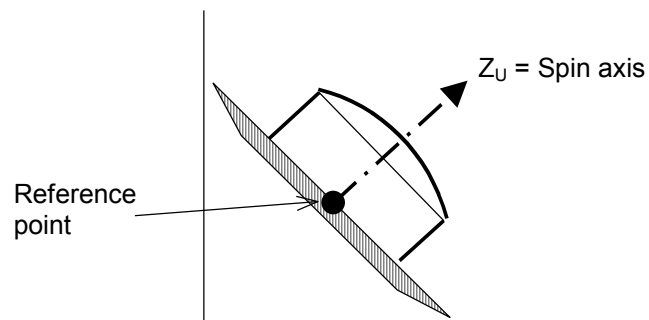


Figure 11: Reaction wheel spin axis



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9.1.3 Parameters

Position of Reaction Wheel attachment point					
RFDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM				
Parameter description	Position of the attachment point of the Reaction Wheel to the central body				
Provided in (reference coordinate system)	Central body system				
Provided as	Three vector components				
Physical units	m				
Nominal values	RFDDB-ref.: Figure-ref.:	Reaction Wheel	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
			X _{sc}	Y _{sc}	Z _{sc}
		RW-1	0.72	0.18	1.265
		RW-2	0.72	-0.18	1.265
		RW-3	0.72	0.18	0.935
RW-4	0.72	-0.18	0.935		

Direction of Reaction Wheel rotation axes to spacecraft reference frame					
RFDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM				
Product tree					
Parameter description	Nominal direction of RW rotation axes to spacecraft reference frame				
Provided in	Central body system				
Provided as	Direction cosine vector				
Nominal values	RFDDB-ref.: Figure-ref.:	Direction cosines	BSIGHT_SC_x	BSIGHT_SC_y	BSIGHT_SC_z
			X _{sc}	Y _{sc}	Z _{sc}
		W1 (Z _U)	0.612372	0.5	0.612372
		W2 (Z _U)	0.612372	-0.5	0.612372
		W3 (Z _U)	0.612372	0.5	-0.612372
W4 (Z _U)	0.612372	-0.5	-0.612372		

9.2 REACTION CONTROL SYSTEM (THRUSTERS)

9.2.1 Introduction

Twelve thrusters are necessary for attitude and orbit control. Two sets of twelve thrusters are provided for redundancy purposes. They are spread over the spacecraft structure for highest effectivity.

The nomenclature for the main units is URCTR01A, URCTR02A, ...URCTR12A. The nomenclature for the redundant units is URCTR01B, URCTR02B, ... URCTR12B.

9.2.2 General description

The following two sketches show the locations. The A units have the larger lever arm.

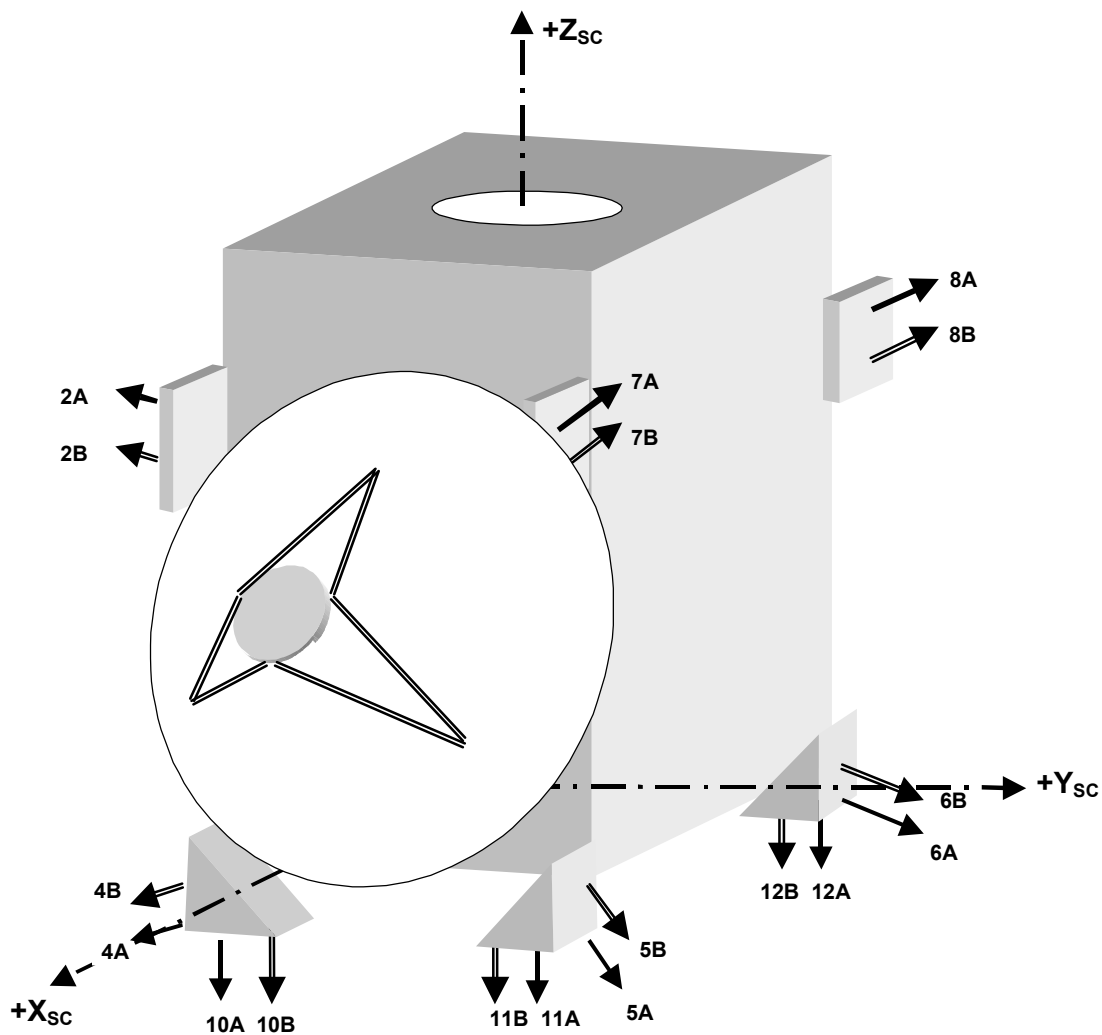


Figure 12: Thruster locations and orientations, view 1

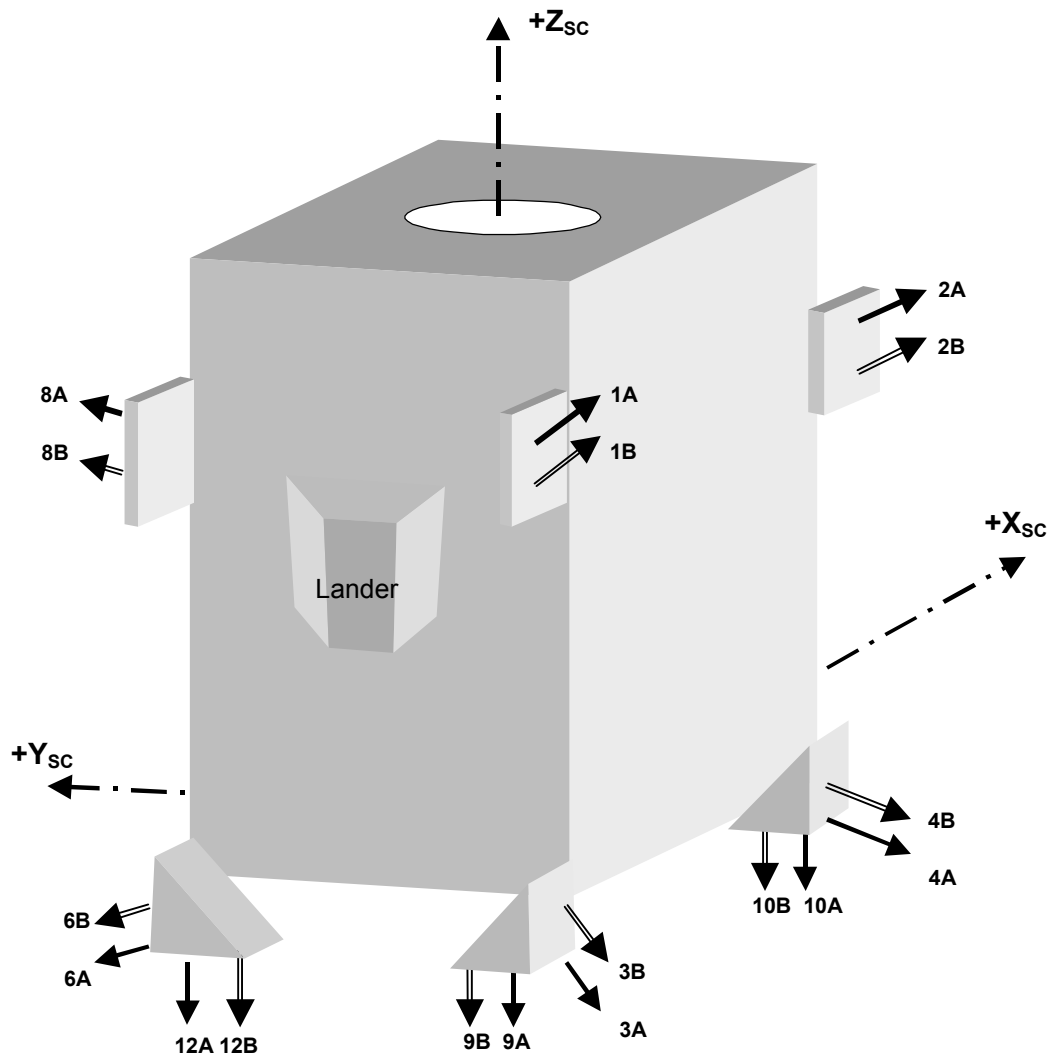


Figure 13: Thruster locations and orientations, view 2

Thrusters	
Identification	24 reaction control thrusters
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM
Product tree	B14A
CONFIG_Id (from RFDDDB)	URCTR1A to URCTR12B
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system
Parameters	Direction of thruster boresight axis

9.2.3 Parameters

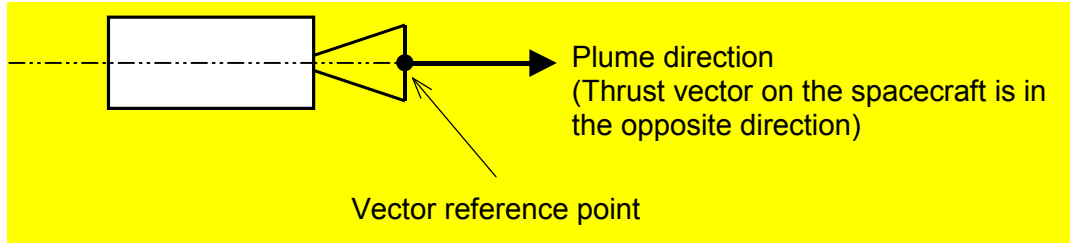


Figure 14: Definition of thruster plume direction and resulting thrust vector

Location and direction cosines						
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM					
Location of vector reference point (end of nozzle) Physical units: m				Direction cosines of plume direction		
RFDDDB-ref.:	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z	A_MECH_SC_1x	A_MECH_SC_1y	A_MECH_SC_1z
Figure-ref.:	X _{SC}	Y _{SC}	Z _{SC}	X _{SC}	Y _{SC}	Z _{SC}
URCTR01A	-1.2319	-1.1395	+2.1768	-0.469846	-0.866025	+0.171010
URCTR01B	-1.2381	-1.1509	+2.1019	-0.469846	-0.866025	+0.171010
URCTR02A	+1.2319	-1.1395	+2.1768	+0.469846	-0.866025	+0.171010
URCTR02B	+1.2381	-1.1509	+2.1019	+0.469846	-0.866025	+0.171010
URCTR03A	-1.2319	-1.1395	-0.0843	-0.469846	-0.866025	-0.171010
URCTR03B	-1.2381	-1.1509	-0.0094	-0.469846	-0.866025	-0.171010
URCTR04A	+1.2319	-1.1395	-0.0843	+0.469846	-0.866025	-0.171010
URCTR04B	+1.2381	-1.1509	-0.0094	+0.469846	-0.866025	-0.171010
URCTR05A	+1.2319	+1.1395	-0.0843	+0.469846	+0.866025	-0.171010
URCTR05B	+1.2381	+1.1509	-0.0094	+0.469846	+0.866025	-0.171010
URCTR06A	-1.2319	+1.1395	-0.0843	-0.469846	+0.866025	-0.171010
URCTR06B	-1.2381	+1.1509	-0.0094	-0.469846	+0.866025	-0.171010
URCTR07A	+1.2319	+1.1395	+2.1768	+0.469846	+0.866025	+0.171010
URCTR07B	+1.2381	+1.1509	+2.1019	+0.469846	+0.866025	+0.171010
URCTR08A	-1.2319	+1.1395	+2.1768	-0.469846	+0.866025	+0.171010
URCTR08B	-1.2381	+1.1509	+2.1019	-0.469846	+0.866025	+0.171010
URCTR09A	-1.1600	-0.9030	-0.1992	0.0	0.0	-1.0
URCTR09B	-1.1600	-0.8270	-0.1992	0.0	0.0	-1.0
URCTR10A	+1.1600	-0.9030	-0.1992	0.0	0.0	-1.0
URCTR10B	+1.1600	-0.8270	-0.1992	0.0	0.0	-1.0
URCTR11A	+1.1600	+0.9030	-0.1992	0.0	0.0	-1.0
URCTR11B	+1.1600	+0.8270	-0.1992	0.0	0.0	-1.0
URCTR12A	-1.1600	+0.9030	-0.1992	0.0	0.0	-1.0
URCTR12B	-1.1600	+0.8270	-0.1992	0.0	0.0	-1.0

10. PAYLOAD UNIT REFERENCE FRAMES

10.1 ALICE

10.1.1 General description

ALICE	
Identification	ALICE
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	A11A
CONFIG_Id (from RFDDDB)	UALALICE
Coordinate systems	Central body system. ALICE nominal unit system. ALICE mirror system. ALICE functional unit system.
Parameters	Position of ALICE unit reference hole. Orientation of ALICE nominal unit frame to the spacecraft reference frame. Orientation of ALICE mirror frame to the spacecraft reference frame. Orientation of ALICE functional frame to the ALICE mirror frame.

10.1.2 Coordinate systems

The reference point is taken as the origin and the direction cosines as the axes of the local frame.

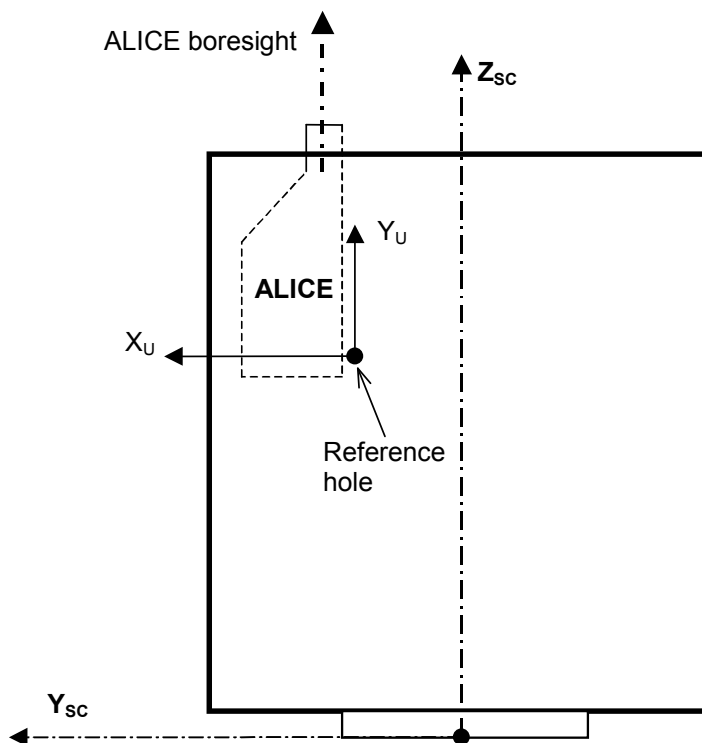


Figure 15: ALICE unit system



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10.1.3 Parameters

Position of ALICE reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the ALICE to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values (RFDDDB-identification: UNIT_POS_X to UNIT_POS_Z)	X _{SC} -1.0244	Y _{SC} 0.6900	Z _{SC} 2.3000

Orientation of ALICE nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the ALICE nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{SC}	Y _{SC}	Z _{SC}
	X _U	0	1	0
	Y _U	0	0	1
	Z _U	1	0	0

Orientation of ALICE mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the ALICE mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X _{SC}	Y _{SC}	Z _{SC}
	X _{mirror}	0	1	0
	Y _{mirror}	0	0	1
	Z _{mirror}	1	0	0

Orientation of ALICE functional frame to the ALICE mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from ALICE mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X _{mirror}	Y _{mirror}	Z _{mirror}
	X _{fu}	1	0	0
	Y _{fu}	0	1	0
	Z _{fu}	0	0	1

10.2 MIRO

10.2.1 General description

MIRO	
Identification	MIRO
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	A11B
CONFIG_Id (from RFDDDB)	UMRMIRO0
Coordinate systems	Central body system. MIRO nominal unit system. MIRO mirror system. MIRO functional unit system.
Parameters	Position of MIRO unit reference hole. Orientation of MIRO nominal unit frame to the spacecraft reference frame. Orientation of MIRO mirror frame to the spacecraft reference frame. Orientation of MIRO functional frame to the MIRO mirror frame.

10.2.2 Coordinate systems

The reference point is taken as the origin and the direction cosines as the axes of the local frame.

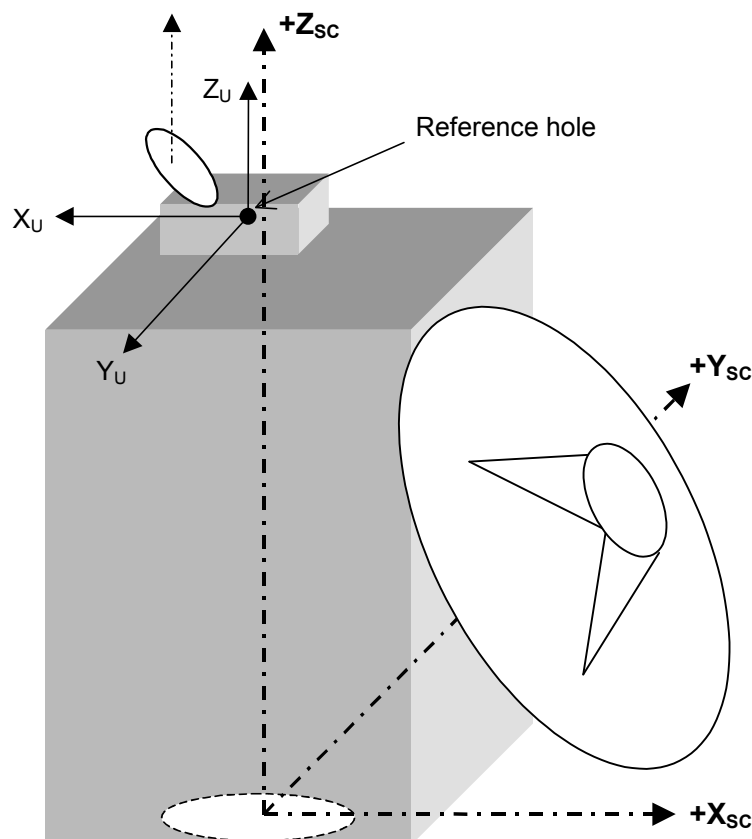


Figure 16: MIRO unit system



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10.2.3 Parameters

Position of MIRO reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the MIRO to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values (RFDDDB-identification: UNIT_POS_X to UNIT_POS_Z)	X _{sc} -0.1100	Y _{sc} 0.9236	Z _{sc} 2.6550

Orientation of MIRO nominal reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the MIRO unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _u	-1	0	0
	Y _u	0	-1	0
	Z _u	0	0	1

Orientation of MIRO mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the MIRO mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _{mirror}	-1	0	0
	Y _{mirror}	0	-1	0
	Z _{mirror}	0	0	1

Orientation of MIRO functional frame to MIRO mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from the MIRO mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X _{mirror}	Y _{mirror}	Z _{mirror}
	X _{fu}	1	0	0
	Y _{fu}	0	1	0
	Z _{fu}	0	0	1

10.3 OSIRIS-NAC

10.3.1 General description

OSIRIS-NAC	
Identification	OSIRIS-NAC
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	A11DB
CONFIG_Id (from RFDDDB)	USRNAC00
Coordinate systems	Central body system. OSIRIS-NAC nominal unit system. OSIRIS-NAC mirror system. OSIRIS-NAC functional unit system.
Parameters	Position of OSIRIS-NAC unit reference hole. Orientation of OSIRIS-NAC nominal unit frame to the spacecraft reference frame. Orientation of OSIRIS-NAC mirror frame to the spacecraft reference frame. Orientation of OSIRIS-NAC functional frame to the OSIRIS-NAC mirror frame.

10.3.2 Coordinate systems

The reference point is taken as the origin and the direction cosines as the axes of the local frame.

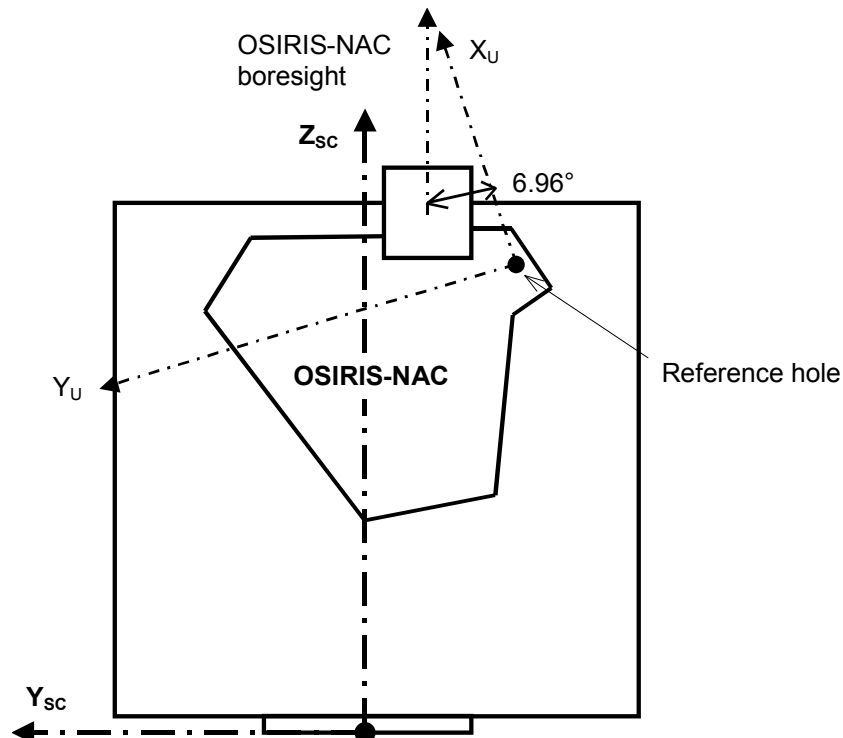


Figure 17: OSIRIS-NAC unit system



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10.3.3 Parameters

Position of OSIRIS-NAC reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the OSIRIS-NAC to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values (RFDDDB-identification: UNIT_POS_X to UNIT_POS_Z)	X _{SC} -1.0520	Y _{SC} -0.3250	Z _{SC} 2.4291

Orientation of OSIRIS-NAC nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the OSIRIS-NAC unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{SC}	Y _{SC}	Z _{SC}
	X _U	0	0.1211764	0.9926310
	Y _U	0	0.9926310	-0.1211764
	Z _U	-1	0	0

Orientation of OSIRIS-NAC mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the OSIRIS-NAC mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X _{SC}	Y _{SC}	Z _{SC}
	X _{mirror}	0	0	1
	Y _{mirror}	0	1	0
	Z _{mirror}	-1	0	0

Orientation of OSIRIS-NAC functional frame to OSIRIS-NAC mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from OSIRIS-NAC mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X _{mirror}	Y _{mirror}	Z _{mirror}
	X _{fu}	1	0	0
	Y _{fu}	0	1	0
	Z _{fu}	0	0	1

10.4 OSIRIS-WAC

10.4.1 General description

OSIRIS-WAC	
Identification	OSIRIS-WAC
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	A11DA
CONFIG_Id (from RFDDDB)	USRWAC00
Coordinate systems	Central body system. OSIRIS-WAC nominal unit system. OSIRIS-WAC mirror system. OSIRIS-WAC functional unit system.
Parameters	Position of OSIRIS-WAC unit reference hole. Orientation of OSIRIS-WAC nominal unit frame to the spacecraft reference frame. Orientation of OSIRIS-WAC mirror frame to the spacecraft reference frame. Orientation of OSIRIS-WAC functional unit frame to the OSIRIS-WAC mirror frame.

10.4.2 Coordinate systems

The reference point is taken as the origin and the direction cosines as the axes of the local frame.

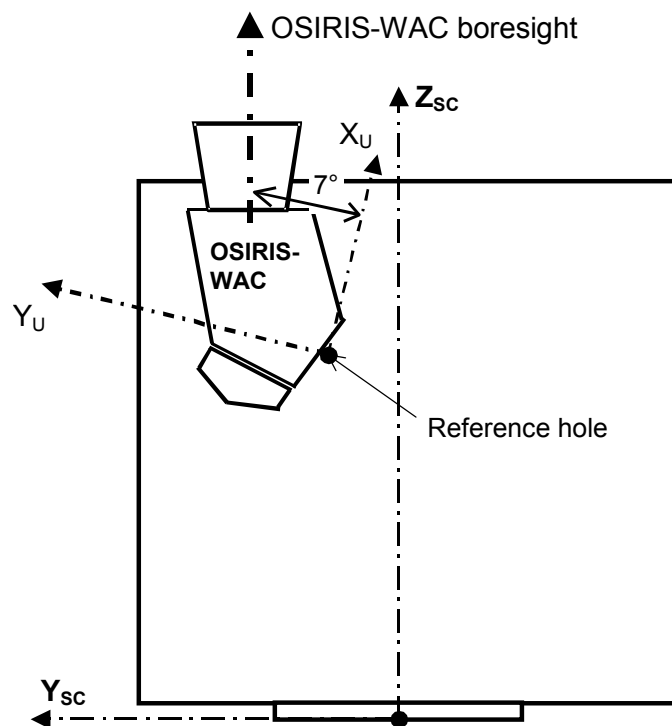


Figure 18: OSIRIS-WAC unit system



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10.4.3 Parameters

Position of OSIRIS-WAC reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the OSIRIS-WAC to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values (RFDDDB-identification: UNIT_POS_X to UNIT_POS_Z)	X_{SC} -1.0500	Y_{SC} 0.2325	Z_{SC} 2.1139

Orientation of OSIRIS-WAC reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the OSIRIS-WAC unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X_{SC}	Y_{SC}	Z_{SC}
	X_U	0	-0.1218693	0.9925462
	Y_U	0	0.9925462	0.1218693
	Z_U	-1	0	0

Orientation of OSIRIS-WAC mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the OSIRIS-WAC mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X_{SC}	Y_{SC}	Z_{SC}
	X_{mirror}	0	0	1
	Y_{mirror}	0	1	0
	Z_{mirror}	-1	0	0

Orientation of OSIRIS-WAC functional frame to OSIRIS-WAC mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from OSIRIS-WAC mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X_{mirror}	Y_{mirror}	Z_{mirror}
	X_{fu}	1	0	0
	Y_{fu}	0	1	0
	Z_{fu}	0	0	1

10.5 VIRTIS

10.5.1 General description

VIRTIS	
Identification	VIRTIS
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	A11C
CONFIG_Id (from RFDDDB)	UVRVIRTIS000
Coordinate systems	Central body system. VIRTIS nominal unit system. VIRTIS mirror system. VIRTIS functional unit system.
Parameters	Position of VIRTIS unit reference hole. Orientation of VIRTIS unit reference axes to the spacecraft reference frame. Orientation of VIRTIS mirror frame to the spacecraft reference frame. Orientation of VIRTIS functional frame to the VIRTIS mirror frame.

10.5.2 Coordinate systems

The reference point is taken as the origin and the direction cosines as the axes of the local frame.

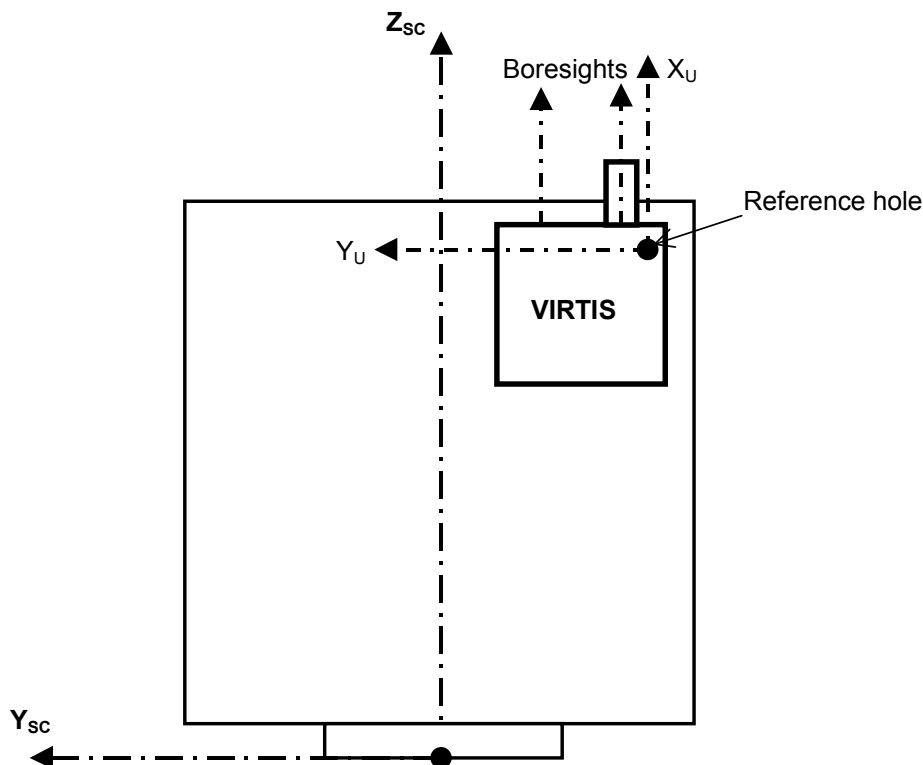


Figure 19: VIRTIS unit system



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10.5.3 Parameters

Position of VIRTIS reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the VIRTIS to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values (RFDDDB-identification: UNIT_POS_X to UNIT_POS_Z)	X_{sc} -1.050	Y_{sc} -0.8400	Z_{sc} 2.5462

Orientation of VIRTIS nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the VIRTIS nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
	X_U	0	0	1
	Y_U	0	1	0
	Z_U	-1	0	0

Orientation of VIRTIS mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the VIRTIS mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
	Xmirror	0	0	1
	Ymirror	0	1	0
	Zmirror	-1	0	0

Orientation of VIRTIS functional frame to VIRTIS mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from the VIRTIS mirror system to functional unit reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	Xmirror	Ymirror	Zmirror
	Xfu	1	0	0
	Yfu	0	1	0
	Zfu	0	0	1

11. SENSOR UNIT REFERENCE FRAMES

11.1 IMU ASSEMBLY

11.1.1 Introduction

Three units are mounted on a common bracket on the -Y BSM panel. The nomenclature for unit identification is IMU-A, IMU-B, IMU-C.

Two connectors on each unit define the relative orientation on the bracket. The reference point is the center of the datum plane on the bracket.

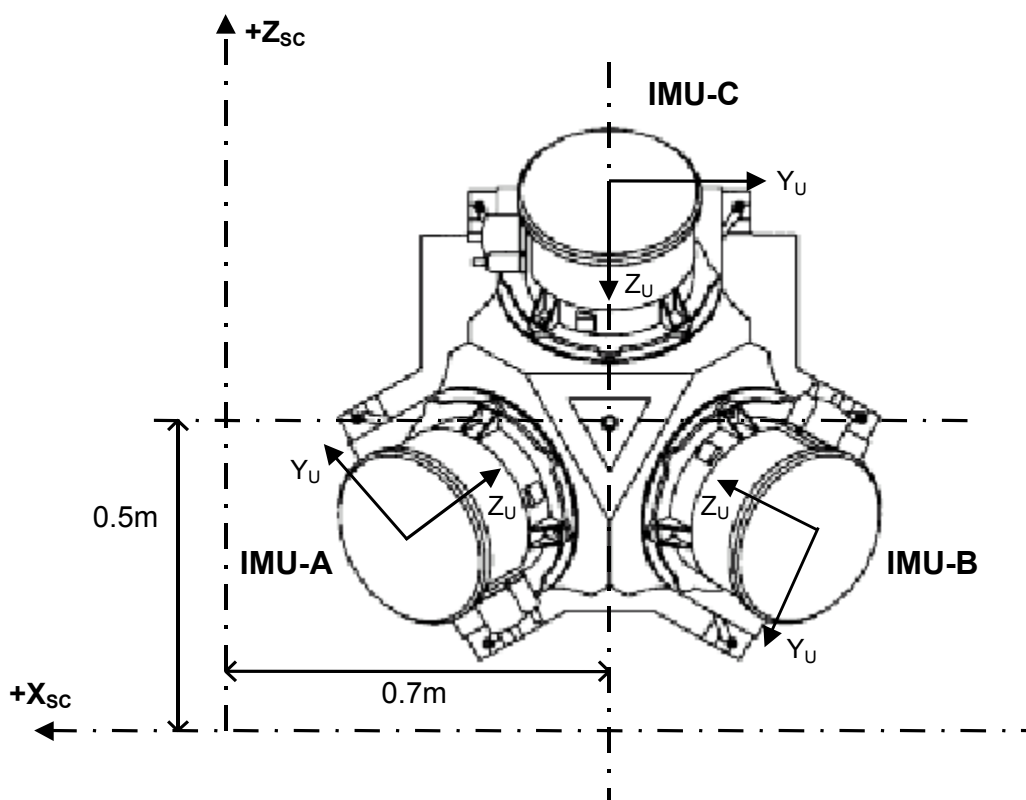


Figure 20: IMU overview

Remarks:

- X_U axes are directed along the cylindrical axis, at 45° to the $+Y_{SC}$ axis.
- Y_U axes are in the $X_{SC} Z_{SC}$ plane.

11.1.2 IMU-A

11.1.2.1 General description

IMU-A	
Identification	IMU-A
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	B22C
CONFIG_Id	UACIMP01
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. IMU-A nominal unit system. IMU-A mirror system. IMU-A functional unit system.
Parameters	Position of IMU-A unit reference hole. Orientation of IMU-A nominal unit frame to the spacecraft reference frame. Orientation of IMU-A mirror frame to the spacecraft reference frame. Orientation of IMU-A functional frame to the IMU-A mirror frame.

11.1.2.2 Coordinate systems

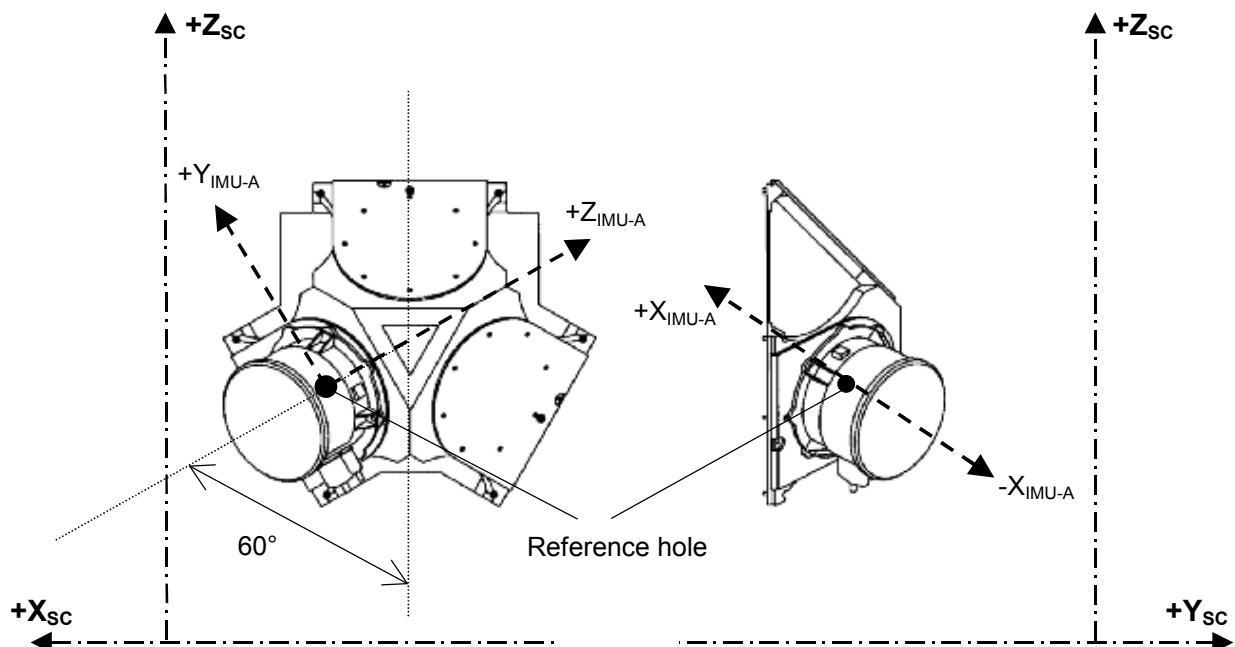


Figure 21: IMU-A unit system



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11.1.2.3 Parameters

Position of IMU-A reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the IMU-A to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values	RFDDDB-ref.: UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	Figure-ref.: X _{sc}	Y _{sc}	Z _{sc}
	-0.5699	-0.8568	0.4249

Orientation of IMU-A nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the IMU-A nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units values	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _u	-0.612372	-0.707107	0.353553
	Y _u	0.5	0	0.866025
	Z _u	-0.612372	0.707107	0.353553

Orientation of IMU-A mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the IMU-A mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _{mirror}	-0.612372	-0.707107	0.353553
	Y _{mirror}	0.5	0	0.866025
	Z _{mirror}	-0.612372	0.707107	0.353553

Orientation of IMU-A functional frame to IMU-A mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from IMU-A mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X _{mirror}	Y _{mirror}	Z _{mirror}
	X _{fu}	1	0	0
	Y _{fu}	0	1	0
	Z _{fu}	0	0	1

11.1.3 IMU-B

11.1.3.1 General description

IMU-B	
Identification	IMU-B
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	B22C
CONFIG_Id (from RFDDDB)	UACIMP02
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. IMU-B nominal unit system. IMU-B mirror system. IMU-B functional unit system.
Parameters	Position of IMU-B unit reference hole . Orientation of IMU-B nominal unit frame to the spacecraft reference frame. Orientation of IMU-B mirror frame to the spacecraft reference frame. Orientation of IMU-B functional frame to the IMU-B mirror frame.

11.1.3.2 Coordinate systems

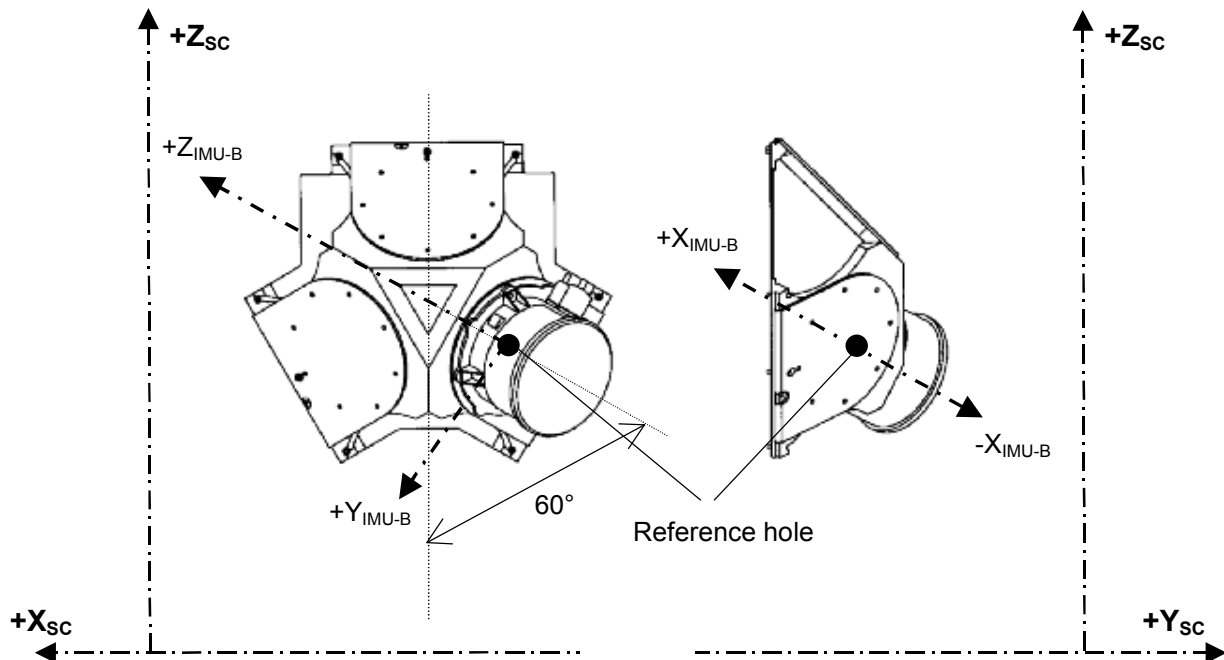


Figure 22: IMU-B unit system



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11.1.3.3 Parameters

Position of IMU-B reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the IMU-B to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values RFDDDB-ref.: Figure-ref.:	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	X _{sc}	Y _{sc}	Z _{sc}
	-0.8301	-0.8568	0.4249

Orientation of IMU-B nominal unit reference axes to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the IMU-B nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _U	0.612372	-0.707107	0.353553
	Y _U	0.5	0	-0.866025
	Z _U	0.612372	0.707107	0.353553

Orientation of IMU-B mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the IMU-B mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _{mirror}	0.612372	-0.707107	0.353553
	Y _{mirror}	0.5	0	-0.866025
	Z _{mirror}	0.612372	0.707107	0.353553

Orientation of IMU-B functional frame to IMU-B mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from IMU-B mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X _{mirror}	Y _{mirror}	Z _{mirror}
	X _{fu}	1	0	0
	Y _{fu}	0	1	0
	Z _{fu}	0	0	1

11.1.4 IMU-C

11.1.4.1 General description

IMU-C	
Identification	IMU-C
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	B22C
CONFIG_Id (from RFDDDB)	UACIMP03
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. IMU-C nominal unit system. IMU-C mirror system. IMU-C functional unit system.
Parameters	Position of IMU-C unit reference hole. Orientation of IMU-C nominal unit reference axes to the spacecraft reference frame. Orientation of IMU-C mirror frame to the spacecraft reference frame. Orientation of IMU-C functional frame to the IMU-C mirror frame.

11.1.4.2 Coordinate systems

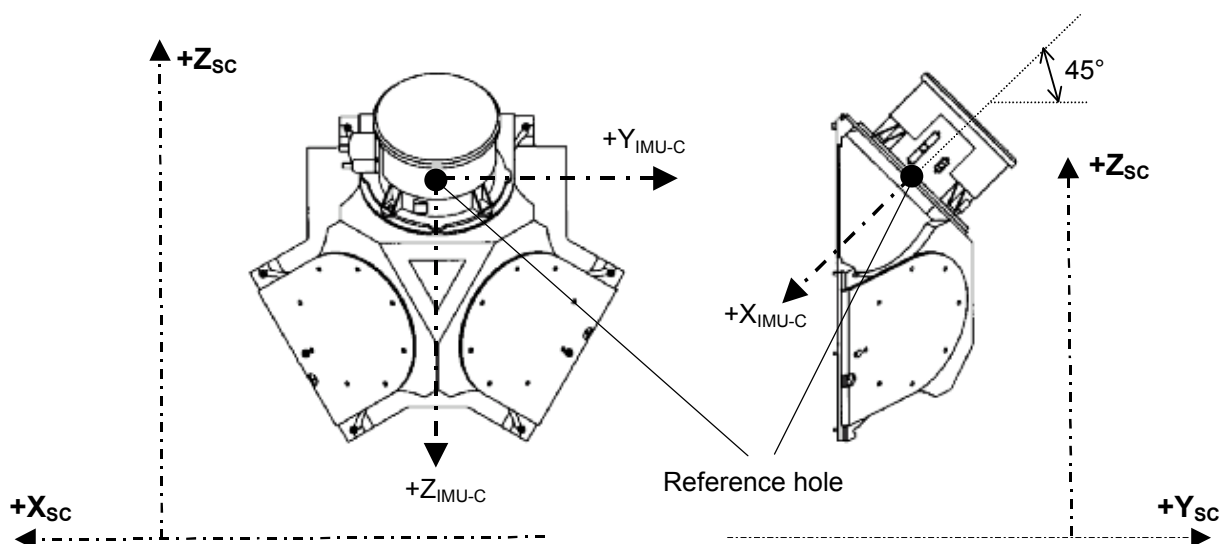


Figure 23: IMU-C unit system



11.1.4.3 Parameters

Position of IMU-C reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the IMU-C to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values RFDDDB-ref.: Figure-ref.:	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	X _{sc}	Y _{sc}	Z _{sc}
	-0.7000	-0.8568	0.6503

Orientation of IMU C nominal reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the IMU-C nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _U	0	-0.707107	-0.707107
	Y _U	-1	0	0
	Z _U	0	0.707107	-0.707107

Orientation of IMU-C mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the IMU-C mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _{mirror}	0	-0.707107	-0.707107
	Y _{mirror}	-1	0	0
	Z _{mirror}	0	0.707107	-0.707107

Orientation of IMU-C functional frame to IMU-C mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from IMU-C mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X _{mirror}	Y _{mirror}	Z _{mirror}
	X _{fu}	1	0	0
	Y _{fu}	0	1	0
	Z _{fu}	0	0	1

11.2 SAS

11.2.1 Introduction

Four sensors are required to provide sun direction information during any phase of the mission. Their locations, orientations and nomenclature are as follows:

- SAS-1 boresight towards $+X_{SC}$
- SAS-2 boresight towards $-X_{SC}/+Z_{SC}$, tilted at 45°
- SAS-3 on SA+Y wing
- SAS-4 on SA-Y wing

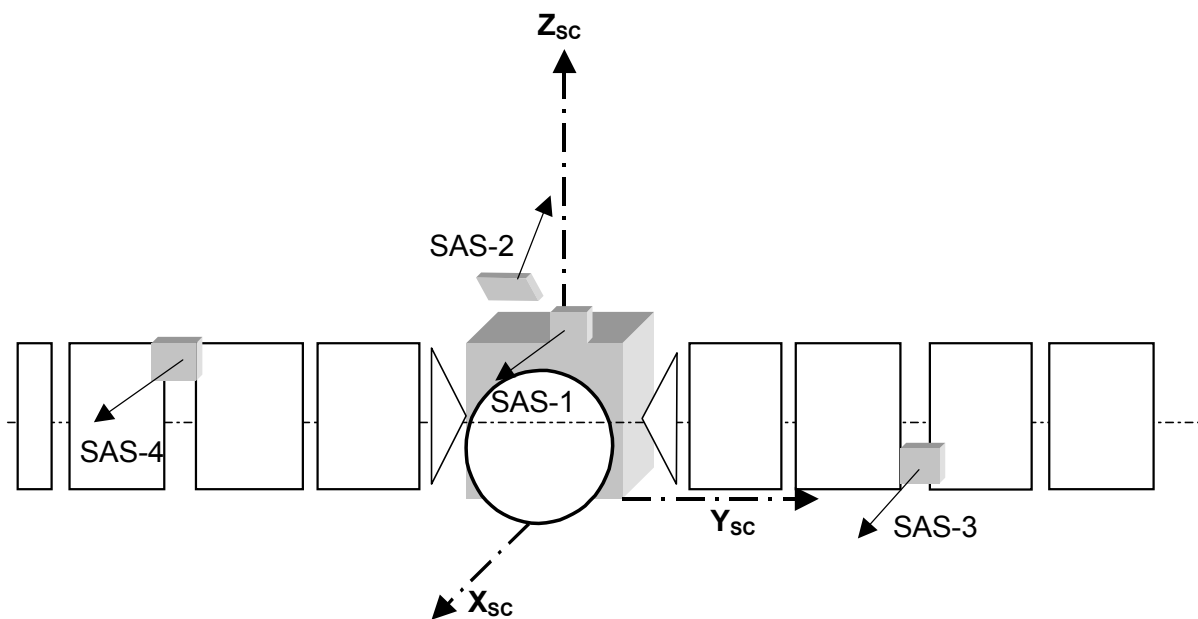


Figure 24: SAS overview

11.2.2 SAS-1

11.2.2.1 General description

SAS-1	
Identification	SAS-1
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM
Product tree	B22E
CONFIG_Id (from RFDDDB)	UACSAS01
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. SAS-1 nominal unit system.
Parameters	Position of SAS-1 unit reference hole. Orientation of SAS-1 nominal unit reference axes to the spacecraft reference frame.

11.2.2.2 Coordinate systems

The unit is mounted on a bracket pointing towards $+X_{SC}$.

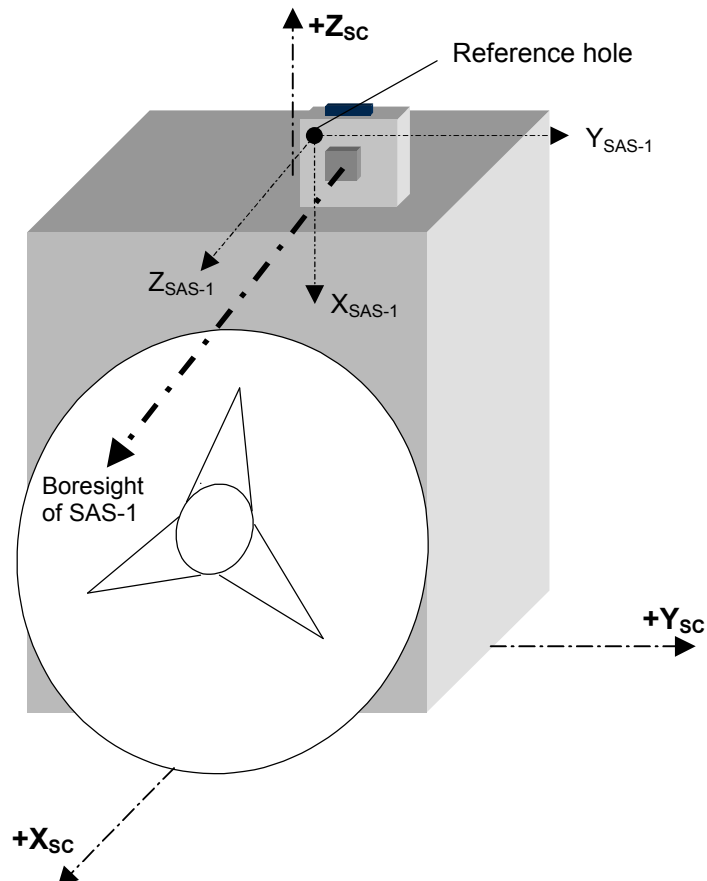


Figure 25: SAS-1 unit system



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11.2.2.3 Parameters

Position of SAS-1 reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the SAS-1 to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values	RFDDDB-ref.: UNIT_POS-x	UNIT_POS-y	UNIT_POS-z
	Figure-ref.: X_{sc}	Y_{sc}	Z_{sc}
	0.9400	0.4500	3.0600

Orientation of SAS-1 nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the SAS-1 nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
	X_U	0	0	-1
	Y_U	0	1	0
	Z_U	1	0	0

11.2.3 SAS-2

11.2.3.1 General description

SAS-2	
Identification	SAS-2
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM
Product tree	B22E
CONFIG_Id (from RFDDDB)	UACSAS02
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. SAS-2 nominal unit system.
Parameters	Position of SAS-2 unit reference hole. Orientation of SAS-2 unit reference axes to the spacecraft reference frame.

11.2.3.2 Coordinate systems

The sensor is mounted on a 45° tilted bracket pointing $-X_{sc} / +Z_{sc}$.

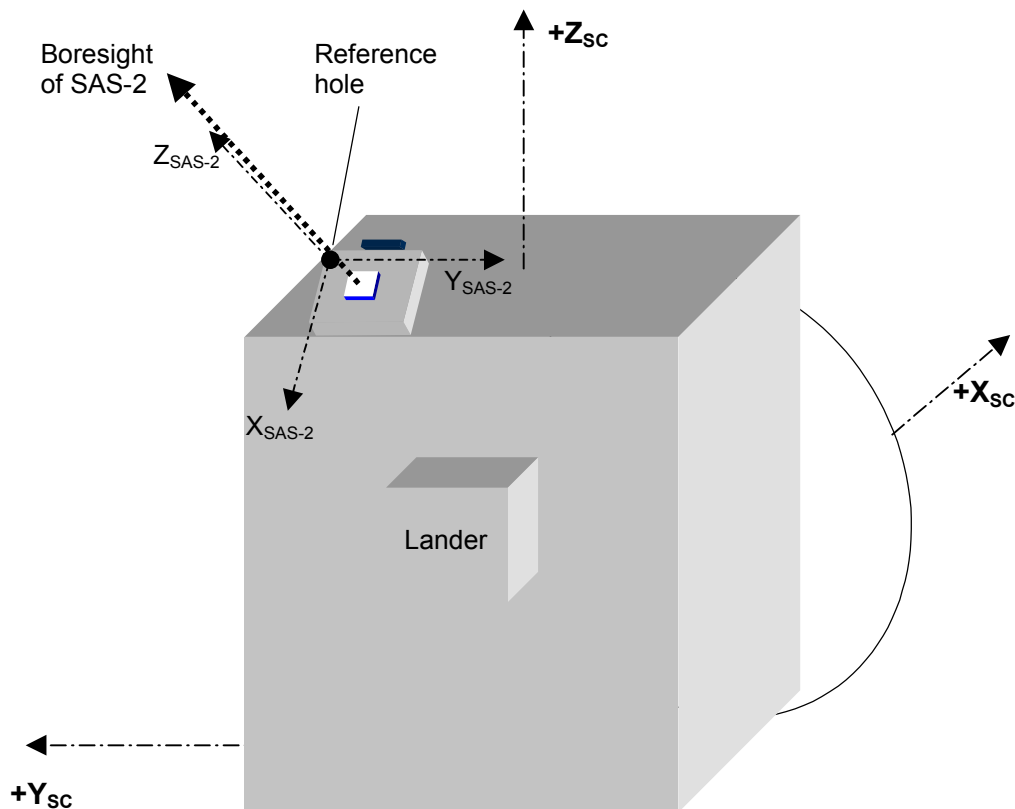


Figure 26: SAS-2 unit system



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11.2.3.3 Parameters

Position of SAS-2 reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the SAS-2 to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values	RFDDDB-ref.: UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	Figure-ref.: X _{sc}	Y _{sc}	Z _{sc}
	-1.2478	0.1760	2.7593

Orientation of SAS-2 nominal unit reference axes to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the SAS-2 nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _u	-0.707107	0	-0.707107
	Y _u	0	-1	0
	Z _u	-0.707107	0	0.707107

11.2.4 SAS-3

11.2.4.1 General description

SAS-3	
Identification	SAS-3
RFDDDB-table / query	T_UL_MNT_SAS_SA_NOM / Q_UL_MNT_SAS_SA_NOM
Product tree	B22E
CONFIG_Id (from RFDDDB)	UACSAS03
Type of unit	Fixed
Parent unit	SA+Y
Coordinate systems	SA+Y nominal system. SAS-3 nominal unit system.
Parameters	Position of SAS-3 unit reference hole. Orientation of SAS-3 nominal unit frame to the SA+Y nominal frame.

11.2.4.2 Coordinate systems

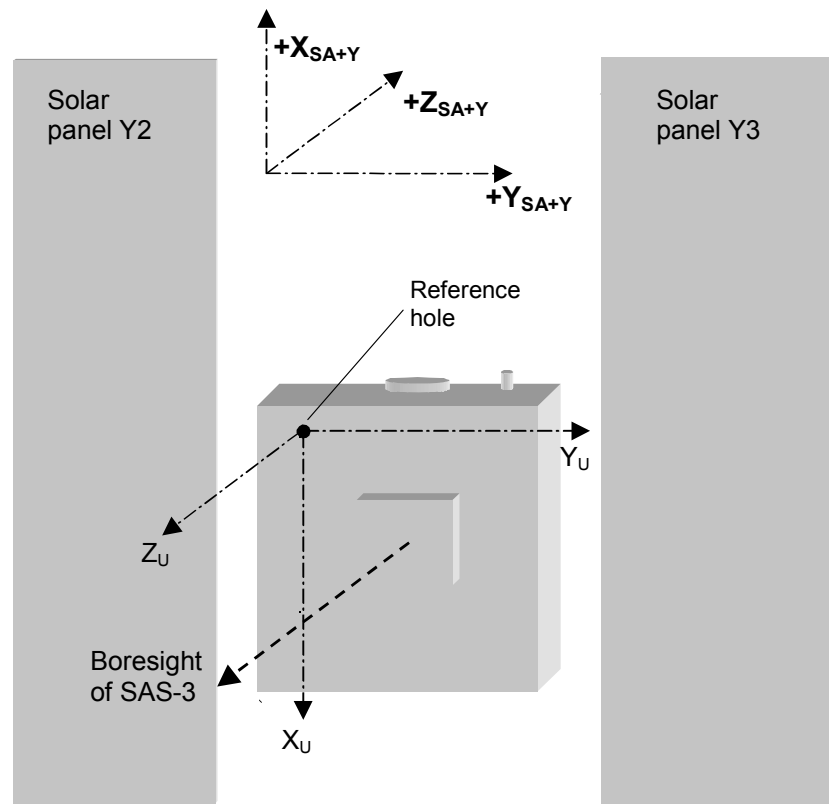


Figure 27: SAS-3 unit system



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11.2.4.3 Parameters

Position of SAS-3 reference hole				
RFDDDB-table / query	T_UL_MNT_SAS_SA_NOM / Q_UL_MNT_SAS_SA_NOM			
Parameter description	Position of the reference hole of the SAS-3 to the SA+Y attachment point			
Provided in (reference coordinate system)	SA+Y			
Provided as	Coordinates in SA+Y unit frame			
Physical units	m			
Nominal values	RFDDDB-ref.:	SAS_POS_x	SAS_POS_y	SAS_POS_z
	Figure-ref.:	X_{SA+Y}	Y_{SA+Y}	Z_{SA+Y}
		-0.337	6.909	-0.009

Orientation of SAS-3 nominal unit frame to the SA+Y frame				
RFDDDB-table / query	T_UL_MNT_SAS_SA_NOM / Q_UL_MNT_SAS_SA_NOM			
Parameter description	Direction cosine of SAS-3 nominal unit reference frame to the SA+Y nominal frame			
Provided in (reference coordinate system)	SA+Y			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MNT_SAS_SA_1x to A_MNT_SAS_SA_3z)	Direction cosines	X_{SA+Y}	Y_{SA+Y}	Z_{SA+Y}
	X_U	-1	0	0
	Y_U	0	1	0
	Z_U	0	0	-1

11.2.5 SAS-4

11.2.5.1 General description

SAS-4	
Identification	SAS-4
RFDDDB-table / query	T_UL_MNT_SAS_SA_NOM / Q_UL_MNT_SAS_SA_NOM
Product tree	B22E
CONFIG_Id (from RFDDDB)	UACSAS04
Type of unit	Fixed
Parent unit	SA-Y
Coordinate systems	SA-Y system. SAS-4 unit system.
Parameters	Position of SAS-4 nominal unit reference hole. Orientation of SAS-4 nominal unit frame to the SA-Y nominal frame.

11.2.5.2 Coordinate systems

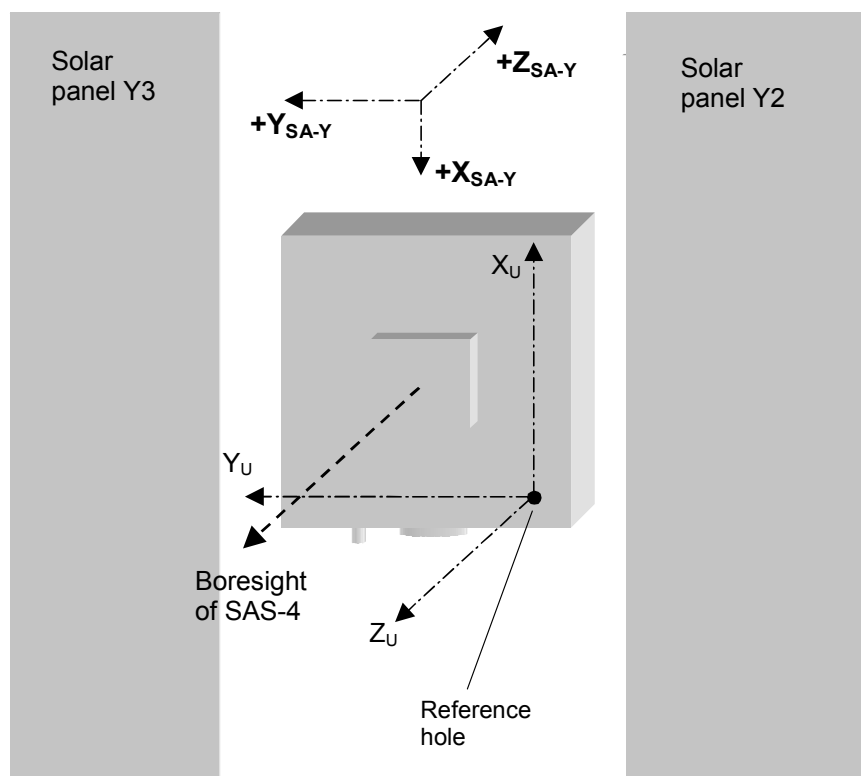


Figure 28: SAS-4 unit system



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11.2.5.3 Parameters

Position of SAS-4 reference hole				
RFDDDB-table / query	T_UL_MNT_SAS_SA_NOM / Q_UL_MNT_SAS_SA_NOM			
Parameter description	Position of the reference hole of the SAS-4 to the SA-Y attachment point			
Provided in (reference coordinate system)	SA-Y			
Provided as	Coordinates in SA-Y unit frame			
Physical units	m			
Nominal values	RFDDDB-ref.:	SAS_POS_x	SAS_POS_y	SAS_POS_z
	Figure-ref.:	X _{SA-Y}	Y _{SA-Y}	Z _{SA-Y}
		-0.337	6.909	-0.009

Orientation of SAS-4 nominal unit frame to the SA-Y frame				
RFDDDB-table / query	T_UL_MNT_SAS_SA_NOM / Q_UL_MNT_SAS_SA_NOM			
Parameter description	Direction cosine of SAS-4 nominal unit frame to the SA-Y nominal frame			
Provided in (reference coordinate system)	SA-Y			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MNT_SAS_SA_1x to A_MNT_SAS_SA_3z)	Direction cosines	X _{SA-Y}	Y _{SA-Y}	Z _{SA-Y}
	X _U	-1	0	0
	Y _U	0	1	0
	Z _U	0	0	-1

11.3 STAR TRACKER

11.3.1 Introduction

Two units are attached on tilted brackets onto the $-X_{SC}$ shear walls. The boresights are located as follows:

STR-A: Oriented in the $X_{SC} Y_{SC}$ plane, at 15° from the $-X_{SC}$ axis towards the $+Y_{SC}$ axis.

STR-B: First, consider a vector in the $X_{SC} Y_{SC}$ plane, at 15° from the $-X_{SC}$ axis towards the $-Y_{SC}$ axis. The STR boresight is at an angle of -10° to this vector, the 10° being measured out of the $X_{SC} Y_{SC}$ plane towards the $-Z_{SC}$ direction.

Unit identification is STR-A and STR-B.

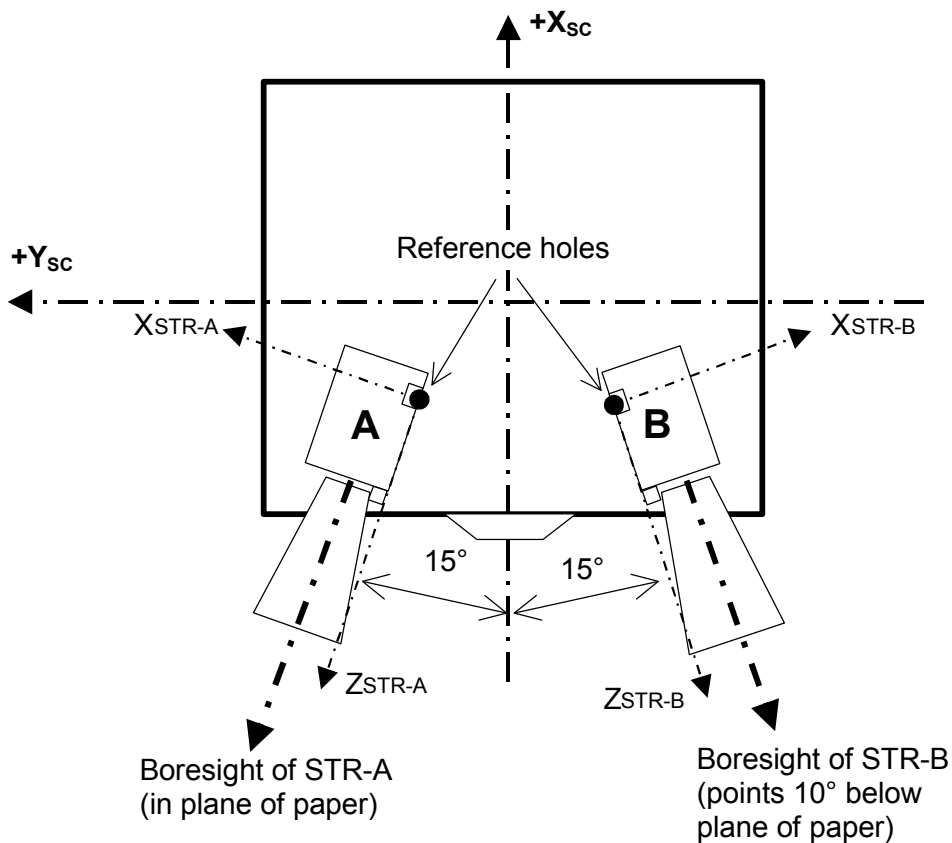


Figure 29: STR overview

11.3.2 STR-A

11.3.2.1 General description

STR-A	
Identification	STR-A
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	B22DA
CONFIG_Id (from RFDDDB)	UACSTR1OHB00
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. STR-A nominal unit system. STR-A mirror system. STR-A functional unit system.
Parameters	Position of STR-A unit reference hole. Orientation of STR-A nominal unit reference axes to the spacecraft reference frame. Orientation of STR-A mirror frame to the spacecraft reference frame. Orientation of STR-A functional frame to the STR-A mirror frame.

11.3.2.2 Coordinate systems

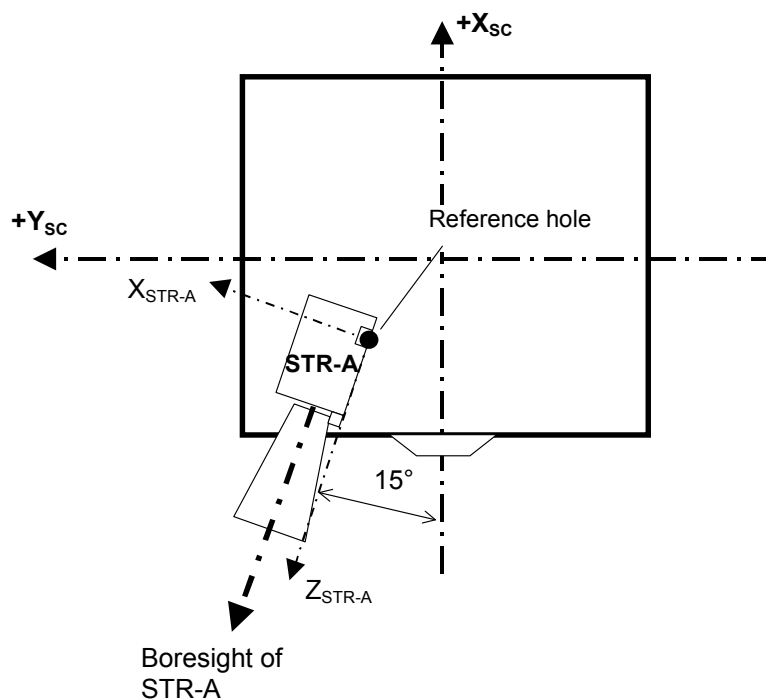


Figure 30: STR-A unit system



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11.3.2.3 Parameters

Position of STR-A reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the STR-A to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values RFDDDB-ref.:	X_{sc}	Y_{sc}	Z_{sc}
	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	-0.8539	0.4509	1.8200

Orientation of STR-A nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the STR-A nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
	X_U	0.258819	0.965926	0
	Y_U	0	0	-1
	Z_U	-0.965926	0.258819	0

Orientation of STR-A mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the STR-A mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
	Xmirror	0.258819	0.965926	0
	Ymirror	0	0	-1
	Zmirror	-0.965926	0.258819	0

Orientation of STR-A functional frame to STR-A mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from STR-A mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	Xmirror	Ymirror	Zmirror
	Xfu	1	0	0
	Yfu	0	1	0
	Zfu	0	0	1

11.3.3 STR-B

11.3.3.1 General description

STR-B	
Identification	STR-B
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	B22DA
CONFIG_Id (from RFDDDB)	UACSTR2OHB00
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. STR-B unit system. STR-B mirror system. STR-B functional unit system.
Parameters	Position of STR-B unit reference hole. Orientation of STR-B nominal unit frame to the spacecraft reference frame. Orientation of STR-B mirror frame to the spacecraft reference frame. Orientation of STR-B functional unit frame to the STR-B mirror frame.

11.3.3.2 Coordinate systems

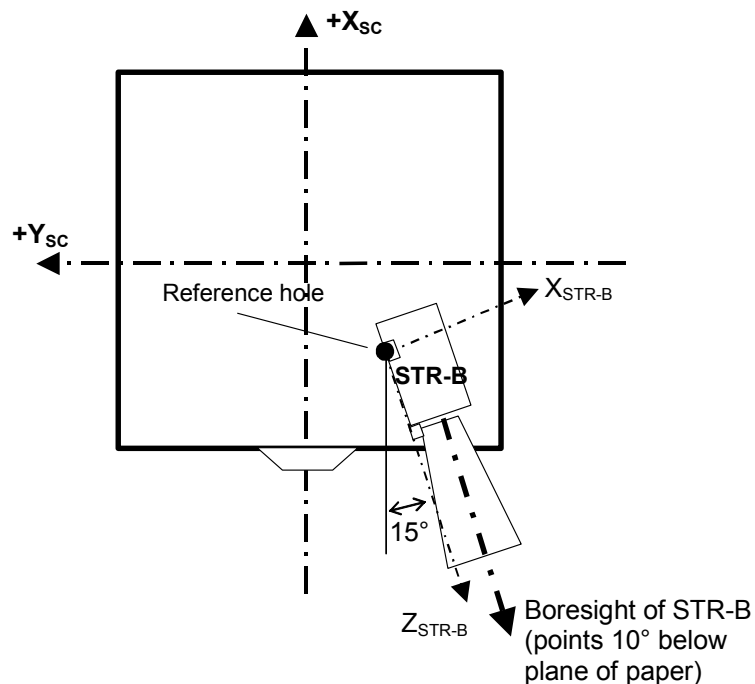


Figure 31: STR-B unit system



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11.3.3.3 Parameters

Position of STR-B reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the STR-B to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values RFDDDB-ref.:	X_{SC}	Y_{SC}	Z_{SC}
	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	-0,85388	-0,46019	2,03092

Orientation of STR-B nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the STR-B nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X_{SC}	Y_{SC}	Z_{SC}
	X_U	0,258819	-0,9659258	0
	Y_U	-0,1677313	-0,0449435	0,9848078
	Z_U	-0,9512512	-0,254887	-0,1736482

Orientation of STR-B mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the STR-B mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X_{SC}	Y_{SC}	Z_{SC}
	Xmirror	0,258819	-0,9659258	0
	Ymirror	-0,1677313	-0,0449435	0,9848078
	Zmirror	-0,9512512	-0,254887	-0,1736482

Orientation of STR-B functional frame to STR-B mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from STR-B mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	Xmirror	Ymirror	Zmirror
	Xfu	1	0	0
	Yfu	0	1	0
	Zfu	0	0	1

11.4 NAVCAM

11.4.1 Introduction

Two units are attached to the $-X_{SC}$ PSM. The boresights are aligned with the $+Z_{SC}$ axis.

Unit identification is NAVCAM-A and NAVCAM-B.

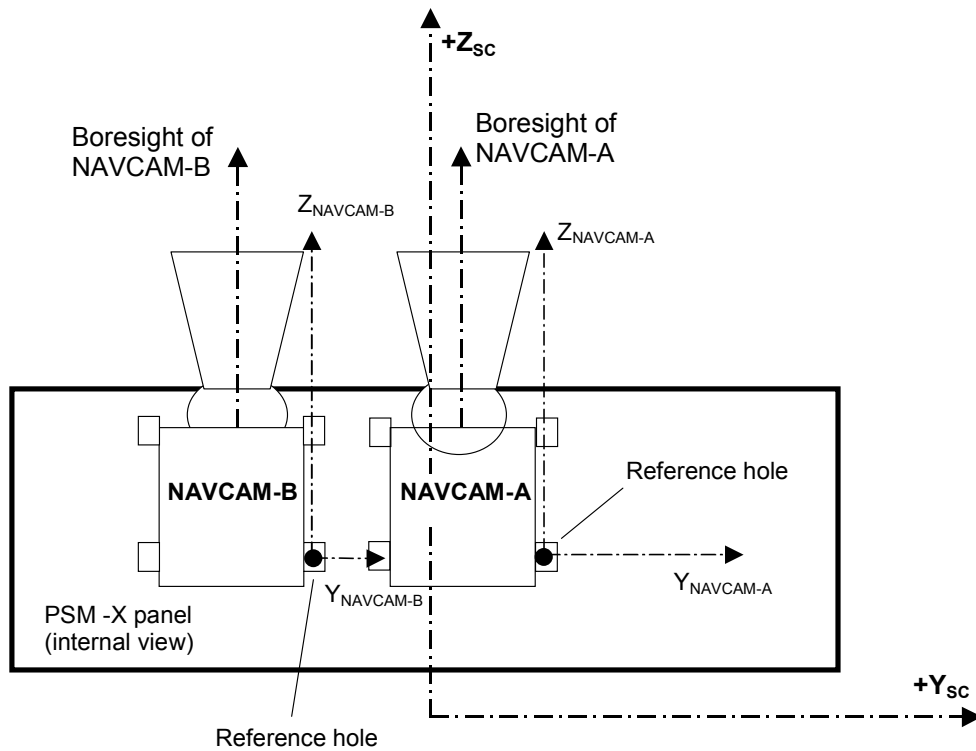


Figure 32: NAVCAM overview

11.4.2 NAVCAM-A

11.4.2.1 General description

NAVCAM-A	
Identification	NAVCAM-A
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	B22BD
CONFIG_Id (from RFDDDB)	UACCAM10H000
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. NAVCAM-A nominal unit system. NAVCAM-A mirror system. NAVCAM-A functional unit system.
Parameters	Position of NAVCAM-A unit reference hole. Orientation of NAVCAM-A nominal unit frame to the spacecraft reference frame. Orientation of NAVCAM-A mirror frame to the spacecraft reference frame. Orientation of NAVCAM-A functional unit frame to the NAVCAM-A mirror frame.

11.4.2.2 Coordinate systems

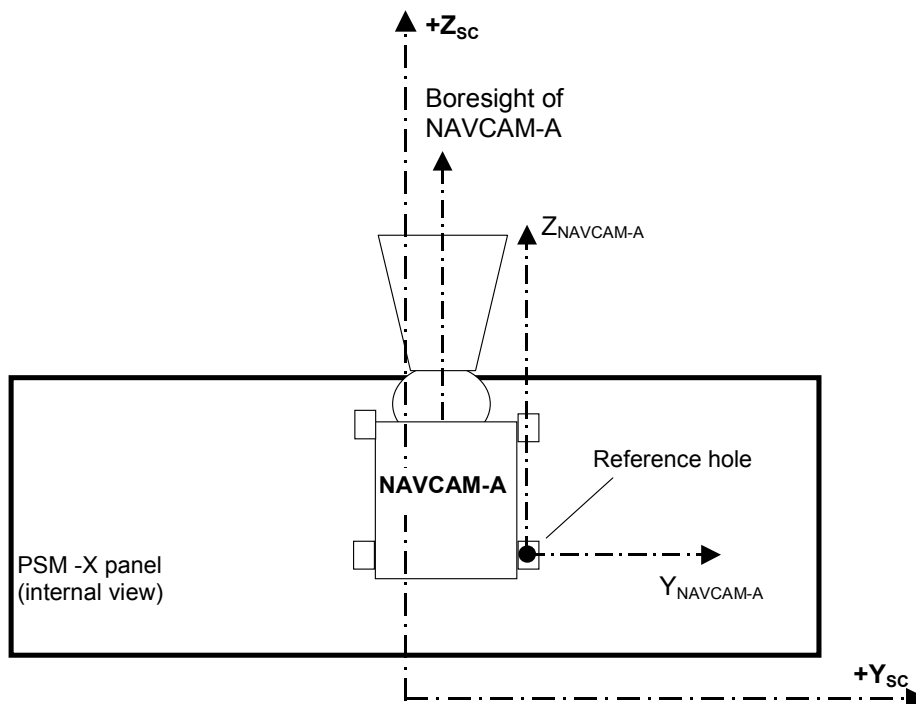


Figure 33: NAVCAM-A unit system



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11.4.2.3 Parameters

Position of NAVCAM-A reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the NAVCAM-A to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values RFDDDB-Ref.:	X _{sc}	Y _{sc}	Z _{sc}
	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	-0.9734	0.174	1.971

Orientation of NAVCAM-A nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the NAVCAM-A nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _u	1	0	0
	Y _u	0	1	0
	Z _u	0	0	1

Orientation of NAVCAM-A mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the NAVCAM-A mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X _{sc}	Y _{sc}	Z _{sc}
	X _{mirror}	-0.70711	0.70711	0
	Y _{mirror}	-0.70711	-0.70711	0
	Z _{mirror}	0	0	1

Orientation of NAVCAM-A functional frame to NAVCAM-A mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from NAVCAM-A mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X _{mirror}	Y _{mirror}	Z _{mirror}
	X _{fu}	-0.70711	-0.70711	0
	Y _{fu}	0.70711	-0.70711	0
	Z _{fu}	0	0	1

11.4.3 NAVCAM-B

11.4.3.1 General description

NAVCAM-B	
Identification	NAVCAM-B
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	B22DB
CONFIG_Id (from RFDDDB)	UACCAM20H000
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. NAVCAM-B nominal unit system. NAVCAM-B mirror system. NAVCAM-B functional unit system.
Parameters	Position of NAVCAM-B unit reference hole. Orientation of NAVCAM-B nominal unit frame to the spacecraft reference frame. Orientation of NAVCAM-B mirror frame to the spacecraft reference frame. Orientation of NAVCAM-B functional unit frame to the NAVCAM-B mirror frame.

11.4.3.2 Coordinate systems

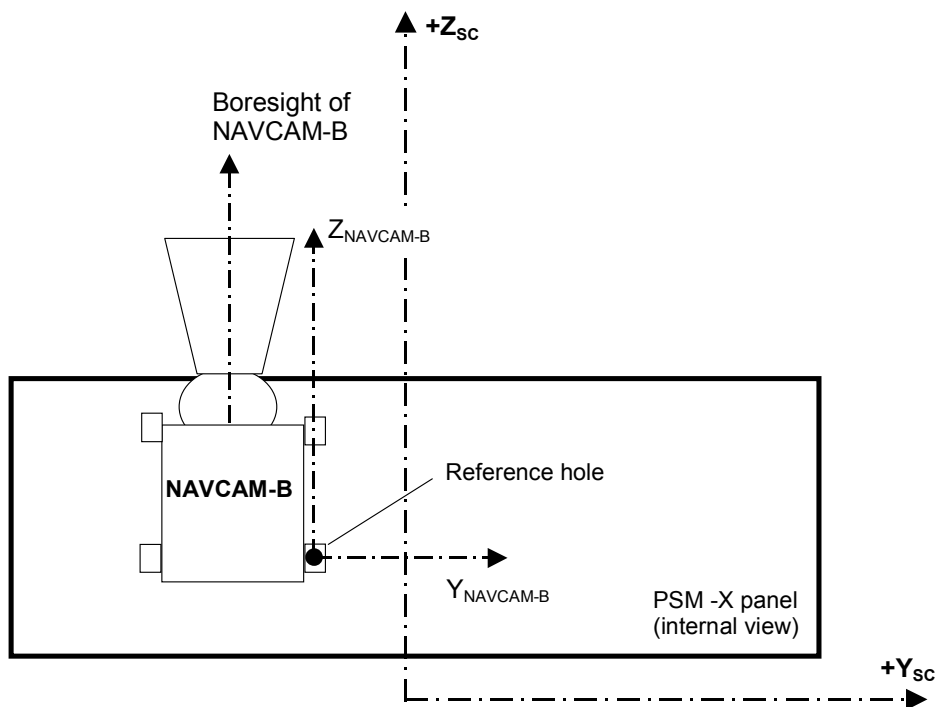


Figure 34: NAVCAM-B unit system



11.4.3.3 Parameters

Position of NAVCAM-B reference hole			
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the NAVCAM-B to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values RFDDDB-ref.:	X_{SC}	Y_{SC}	Z_{SC}
	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	-0.9734	-0.1460	1.9710

Orientation of NAVCAM-B nominal unit reference frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the NAVCAM-B nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4.			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X_{SC}	Y_{SC}	Z_{SC}
	X_U	1	0	0
	Y_U	0	1	0
	Z_U	0	0	1

Orientation of NAVCAM-B mirror frame to the spacecraft reference frame				
RFDDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the NAVCAM-B mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X_{SC}	Y_{SC}	Z_{SC}
	Xmirror	-0.70711	0.70711	0
	Ymirror	-0.70711	-0.70711	0
	Zmirror	0	0	1

Orientation of NAVCAM-B functional frame to NAVCAM-B mirror frame				
RFDDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from NAVCAM-B mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	Xmirror	Ymirror	Zmirror
	Xfu	-0.70711	-0.70711	0
	Yfu	0.70711	-0.70711	0
	Zfu	0	0	1

12. OTHER UNITS

12.1 SSP

12.1.1 General description

SSP	
Identification	SSP
RFDDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM
Product tree	A21
CONFIG_Id (from RFDDDB)	USBLANDER000
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. SSP nominal unit system. SSP mirror system. SSP functional unit system.
Parameters	Position of SSP unit reference hole. Orientation of SSP nominal unit frame to the spacecraft reference frame. Orientation of SSP mirror frame to the spacecraft reference frame. Orientation of SSP functional unit frame to the SSP mirror frame.

12.1.2 Coordinate systems

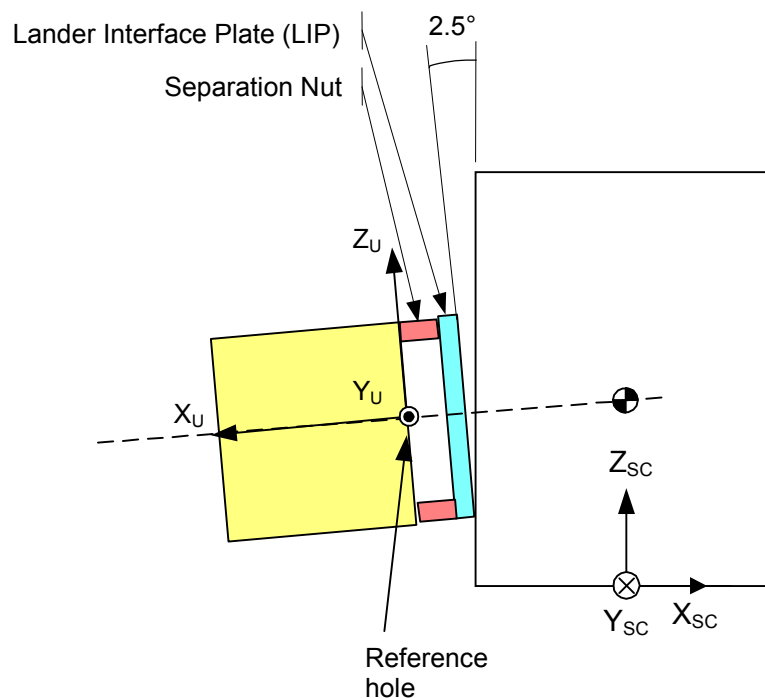


Figure 35: Lander unit system



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12.1.3 Parameters

Position of SSP reference hole			
RFDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM		
Parameter description	Position of the reference hole of the SSP to the central body		
Provided in (reference coordinate system)	Central body system		
Provided as	Coordinates in spacecraft reference frame		
Physical units	m		
Nominal values RFDDB-ref.:	X_{sc}	Y_{sc}	Z_{sc}
	UNIT_POS_x	UNIT_POS_y	UNIT_POS_z
	-0.8690	0	1.3260

Orientation of SSP nominal unit reference frame to the spacecraft reference frame				
RFDDB-table / query	T_SAT_UNIT_MECH_SC_NOM / Q_SAT_UNIT_MECH_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the SSP nominal unit reference system			
Provided in (reference coordinate system)	Central body system			
Provided as	Direction cosine matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDB-identification: A_MECH_SC_1x to A_MECH_SC_3z)	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
	X_u	-0.999048	0	-0.043619
	Y_u	0	-1	0
	Z_u	-0.043619	0	0.999048

Orientation of SSP mirror frame to the spacecraft reference frame				
RFDDB-table / query	T_SAT_UNIT_MIRR_SC_NOM / Q_SAT_UNIT_MIRR_SC_NOM			
Parameter description	Transformation matrix (§ 7.1) from the central body system to the SSP mirror frame			
Provided in (reference coordinate system)	Central body system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDB-identification: A_UNIT_MIRR_SC_1x to A_UNIT_MIRR_SC_3z)	Direction cosines	X_{sc}	Y_{sc}	Z_{sc}
	Xmirror	-0.999048	0	-0.043619
	Ymirror	0	-1	0
	Zmirror	-0.043619	0	0.999048

Orientation of SSP functional frame to SSP mirror frame				
RFDDB-table / query	T_SAT_UNIT_FNC_MIRR_NOM / Q_SAT_UNIT_FNC_MIRR_NOM			
Parameter description	Transformation matrix (§ 7.1) from SSP mirror system to unit functional reference system			
Provided in (reference coordinate system)	Unit mirror system			
Provided as	3 * 3 matrix according to § 7.4			
Physical units	Dimensionless			
Nominal values (RFDDB-identification: A_UNIT_FNC_MIRR_1x to A_UNIT_FNC_MIRR_3z)	Direction cosines	X_{mirror}	Y_{mirror}	Z_{mirror}
	X_{fu}	1	0	0
	Y_{fu}	0	1	0
	Z_{fu}	0	0	1

12.2 MGA-S

12.2.1 General description

MGA-S	
Identification	MGA-S
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM
Product tree	B17DA
CONFIG_Id (from RFDDDB)	UTTMGAS0
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. MGA-S nominal unit system.
Parameters	Direction of MGA-S boresight axis

12.2.2 Coordinate systems

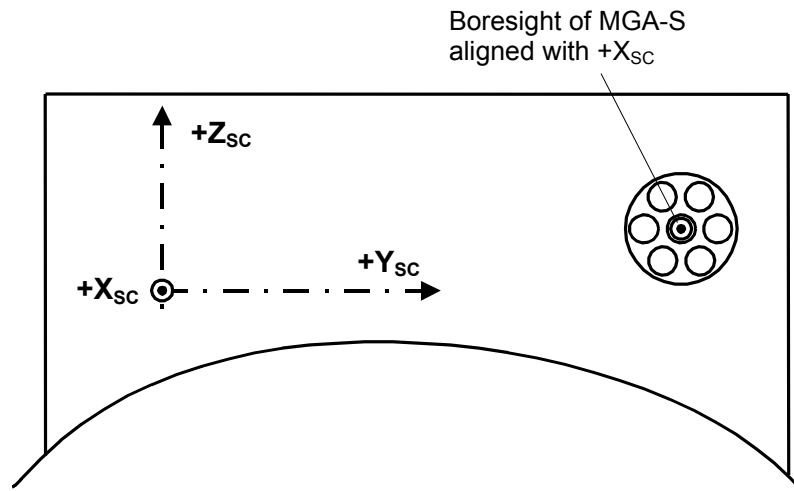


Figure 36: MGA-S overview

12.2.3 Parameters

Direction of MGA-S boresight axis			
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM		
Parameter description	Direction of the MGA-S boresight axis		
Provided in (reference coordinate system)	Central body system		
Provided as	Three vector components		
Physical units	Dimensionless		
Nominal values	X_{sc}	Y_{sc}	Z_{sc}
	RFDDDB-ref.: BSIGHT_SC_x	BSIGHT_SC_y	BSIGHT_SC_z
	1	0	0

12.3 MGA-X

12.3.1 General description

MGA-X	
Identification	MGA-X
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM
Product tree	B17DB
CONFIG_Id (from RFDDDB)	UTTMGAX0
Type of unit	Fixed
Parent unit	Central body
Coordinate systems	Central body system. MGA-X nominal unit system.
Parameters	Direction of MGA-X boresight axis

12.3.2 Coordinate systems

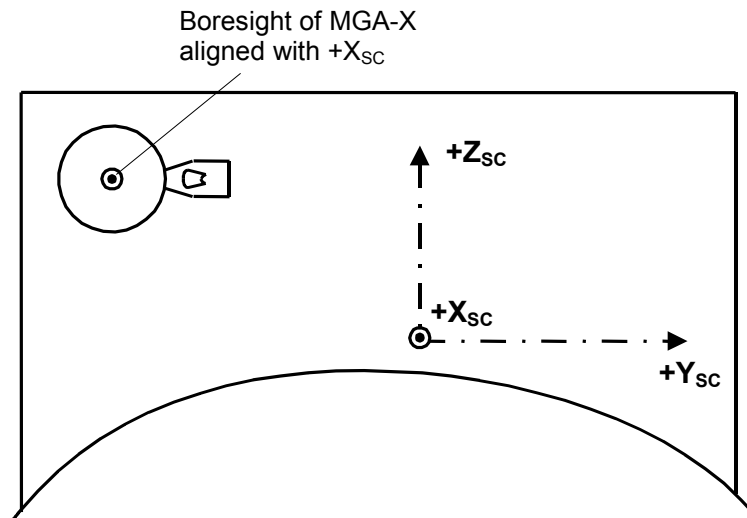


Figure 37: MGA-X overview

12.3.3 Parameters

Direction of MGA-X boresight axis			
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM		
Parameter description	Direction of the MGA-X boresight axis		
Provided in (reference coordinate system)	Central body system		
Provided as	Three vector components		
Physical units	Dimensionless		
Nominal values	X_{SC}	Y_{SC}	Z_{SC}
	RFDDDB-ref.: BSIGHT_SC_x	BSIGHT_SC_y	BSIGHT_SC_z
	1	0	0

12.4 LGA-1

12.4.1 General description

LGA-1	
Identification	LGA-1
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM
Product tree	B17E
CONFIG_Id (from RFDDDB)	UTTLGA01
Type of unit	Fixed - front
Parent unit	Central body
Coordinate systems	Central body system. LGA-1 unit system.
Parameters	Direction of LGA-1 boresight axis

12.4.2 Coordinate systems

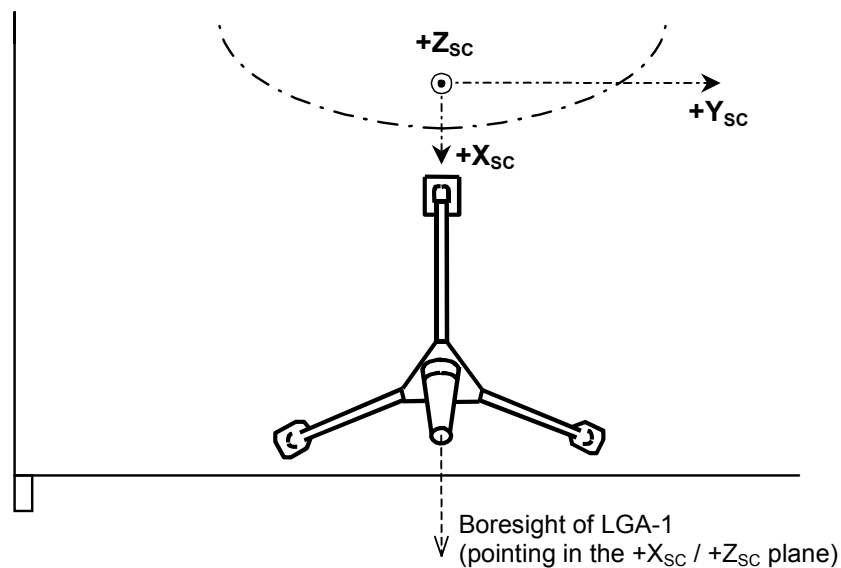


Figure 38: LGA-1 boresight axis

12.4.3 Parameters

Direction of LGA-1 boresight axis			
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM		
Parameter description	Direction of the LGA-1 boresight axis		
Provided in (reference coordinate system)	Central body system		
Provided as	Three vector components		
Physical units	Dimensionless		
Nominal values	X_{sc}	Y_{sc}	Z_{sc}
	RFDDDB-ref.: BSIGHT_SC_x	BSIGHT_SC_y	BSIGHT_SC_z
	0.5	0	0.866025

12.5 LGA-2

12.5.1 General description

LGA-2	
Identification	LGA-2
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM
Product tree	B17E
CONFIG_Id (from RFDDDB)	UTTLGA02
Type of unit	Fixed - rear
Parent unit	Central body
Coordinate systems	Central body system. LGA-2 unit system.
Parameters	Direction of LGA-2 boresight axis

12.5.2 Coordinate systems

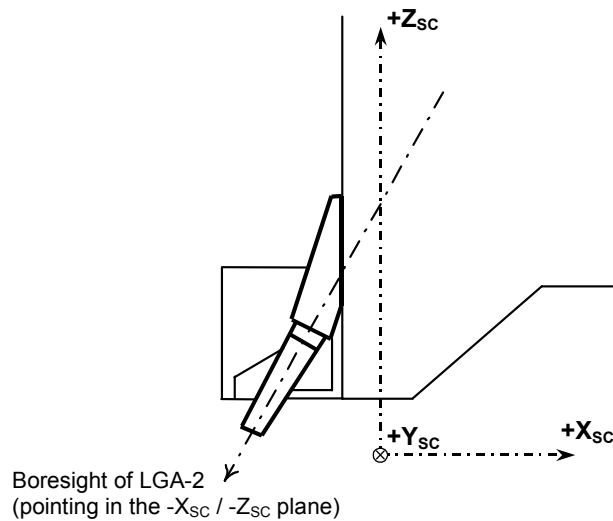


Figure 39: LGA-2 boresight axis

12.5.3 Parameters

Direction of LGA-2 boresight axis				
RFDDDB-table / query	T_SAT_UNIT_BSIGHT_SC_NOM / Q_SAT_UNIT_BSIGHT_SC_NOM			
Parameter description	Direction of the LGA-2 boresight axis			
Provided in (reference coordinate system)	Central body system			
Provided as	Three vector components			
Physical units	Dimensionless			
Nominal values		X_{sc}	Y_{sc}	Z_{sc}
	RFDDDB-ref.:	BSIGHT_SC_x	BSIGHT_SC_y	BSIGHT_SC_z
		-0.5	0	-0.866025