2.1 Bidirectional Scans (BDS)

The BiDirectional Scans (BDS) product contains 24 hours of instantaneous Level-1b CERES data for a single scanner instrument. The BDS contains instantaneous radiance measurements recorded every 0.01-second for views of space, internal calibration, solar calibration and Earth. It contains all elevation scan modes which include the normal Earth scan and the short Earth scan modes and both the fixed and rotating azimuth plane scan modes.

The BDS product includes:

- Filtered broadband radiances for the total, shortwave, and window channels for each 0.01 second measurement
- Geolocation and viewing geometry for every Earth-viewing measurement
- Instrument status, engineering temperatures and voltages for each 6.6 second scan
- Sun geometry, satellite position and velocity for each scan
- All raw engineering and status data from the instrument

A more detailed listing of the data parameters for this product can be found in the BDS Collection Guide: http://ceres.larc.nasa.gov/collect_guide.php (Reference 3).

Level: 1B
Frequency: 1/Day
Portion of Atmosphere Covered: Satellite Altitude

Time Interval Covered:
File: 24 Hours
Record: Single 6.6-Second Scans

Portion of Globe Covered:
File: Satellite Altitude
Record: N/A

Product Version:
TRMM: Edition1-CV, Edition3 ++ see NOTE
Terra: Edition1, Edition1-CV, Edition2, Edition3 ++ see NOTE
Aqua: Edition1, Edition1-CV, Edition2, Edition3 ++ see NOTE

NOTE: The Slow Mode and Drift Corrected Counts SDSs are only available on Edition1 BDS products with a configuration code of 027025 or greater and Edition2 BDS products with a configuration code of 028028 or greater. Solar and Lunar Azimuth and Elevation Angle SDSs are only available on Edition1-CV BDS products and Edition2 BDS products with a configuration code of 031033 or higher and Edition3. In addition, the Satellite-Celestial Vdata parameters for Solar and Lunar Beta and Eta Angles along with Earth-Moon Distance, Moon Colatitude at start of record and Moon Longitude at start of record are only available for Edition1-CV BDS products, Edition2 BDS products with a configuration code of 031033 or higher and Edition3 BDS products.

Bidirection Scans (BDS) Definition

Table 2.1-1 summarizes the contents and estimated product size of each data structure type contained within an BDS file. Each BDS product contains three metadata structures, 35 SDS structures, and eight VData structures.

Table 2.1-1. BDS HDF Structure Summary

Name	Description Table	Records	Number of Fields	Nominal Size (Bytes)
CERES Baseline Header Metadata	Table B-1	1	36	~25907
CERES_metadata Vdata	Table B-2	1	14	~1024
BDS Product-specific Metadata	Table 2.1-2	1	11	~66
BDS SDS Summary	Table 2.1-3	1 .. 13091	47	1,249,567,630
BDS Vdata Summary	Table 2.1-4	1 .. 13091	185	32,230,162
Total Size (Bytes):				**1,281,824,789**
Total Size (MBytes, including ~0.2% HDF overhead; 1MByte = 1024^2Bytes):				**1,224.89**

BDS Metadata

The BDS product includes three data structures. These include the CERES Baseline Header Metadata and the CERES_metadata Vdata parameters, which are listed in Appendix B. The BDS-specific metadata parameters are listed in Table 2.1-2.

Table 2.1-2. BDS Product-Specific Metadata

Item	Parameter Name	Units	Range	Data Type
1	ScanMode	N/A	XtrkOnly, RapsOnly, FapsOnly, Raps/Faps, Xtrk/Raps, Xtrk/Faps, Xtrk/Raps/Faps	s(14)
2	Second Time Constant Mode	N/A	Off, On	s(3)
3	Ephemeris Data Used	N/A	Real, Pred, Sim	s(4)
4	Attitude Data Used	N/A	Real, Sim	s(4)
5	Percent Total Channel Bad	N/A	0.0 .. 100.0	F11.6
6	Percent Window Channel Bad	N/A	0.0 .. 100.0	F11.6
7	Percent Short Wave Channel Bad	N/A	0.0 .. 100.0	F11.6
8	Percent FAPS	N/A	0.0 .. 100.0	F11.6
9	Percent RAPS	N/A	0.0 .. 100.0	F11.6
10	Percent Transitional	N/A	0.0 .. 100.0	F11.6
11	Percent Crosstrack	N/A	0.0 .. 100.0	F11.6
12	TOA_Model_Used	N/A	CERES-TOA or WGS 84	s(9)
13	Number Input Files	N/A	1 .. n	uint32

BDS Scientific Data Sets

Every Scientific Data Set (SDS) in the BDS file represents a time ordered collection of data where each row in the SDS corresponds to a packet of data, and each column corresponds to a single sample within a packet. Most of the SDSs have 660 samples per packet of a single parameter arranged as shown in Figure 2.1-1.

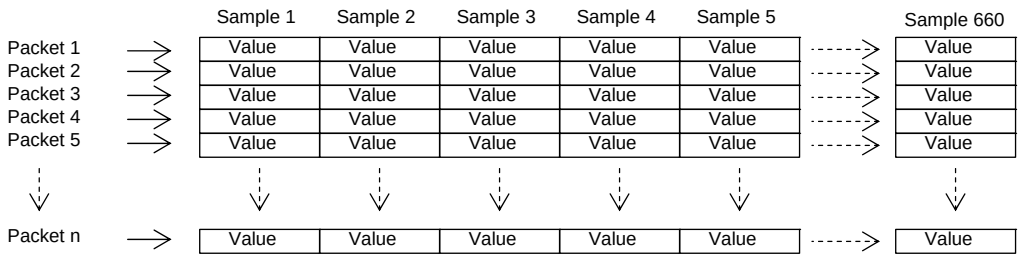

Figure 2.1-1. BDS SDS Schematic

Table 2.1-3 summarizes the contents of each SDS structure contained within the BDS file (listed in alphabetical order by their SDS structure name). All SDS parameters have an HDF Rank = 2 and the maximum number of SDS elements corresponds to the number of rows by the number of columns. Data types are referenced by their HDF classification (e.g. Char8, Float32, Float64, Int8, UInt8, Int16, UInt16, Int32, UInt32, Int64, UInt64).

Table 2.1-3. BDS SDS Summary

SDS Name	Maximum SDS Elements	Data Type	Range	Units	Maximum Size (Bytes)
Raw Instrument Status Data	13091x185	uint16	Reference 3	N/A	4,843,670
Julian Date and Time	13091x2	float64	2449353.0 .. 2458500.0	day	209,456
Azimuth Position Count	13091x660	uint16	0 .. 4095	count	17,280,120
Elevation Position Count	13091x660	uint16	0 .. 4095	count	17,280,120
Radiance and Mode Flags	13091x660	uint32	Table 3.2-1	N/A	34,560,240
Secondary Sample Level QA Flags	13091x660	uint32	Reference 3	N/A	34,560,240
Primary Scan Level QA Flags	13091x660	uint32	Reference 3	N/A	34,560,240
Secondary Scan Level QA Flags	13091x660	uint32	Reference 3	N/A	34,560,240
Converted Azimuth Angles	13091x660	float32	0.0 .. 360.0	deg	34,560,240
Converted Elevation Angles	13091x660	float32	0.0 .. 260.0	deg	34,560,240
CERES Viewing Zenith at Surface	13091x660	float32	0.0 .. 90.0	deg	34,560,240
CERES Solar Zenith at Surface	13091x660	float32	0.0 .. 180.0	deg	34,560,240
CERES Relative Azimuth at Surface	13091x660	float32	0.0 .. 360.0	deg	34,560,240
Colatitude of CERES FOV at Surface	13091x660	float32	0.0 .. 180.0	deg	34,560,240
Longitude of CERES FOV at Surface	13091x660	float32	0.0 .. 360.0	deg	34,560,240

Table 2.1-3. BDS SDS Summary

SDS Name	Maximum SDS Elements	Data Type	Range	Units	Maximum Size (Bytes)
Cone Angles	13091x660	float32	0.0 .. 90.0	deg	34,560,240
Clock Angles	13091x660	float32	0.0 .. 360.0	deg	34,560,240
Cone Angle Rates	13091x660	float32	-100.0 .. 100.0	deg sec^{-1}	34,560,240
Clock Angle Rates	13091x660	float32	-10.0 .. 10.0	deg sec^{-1}	34,560,240
Colatitude of CERES FOV at TOA	13091x660	float32	0.0 .. 180.0	deg	34,560,240
Longitude of CERES FOV at TOA	13091x660	float32	0.0 .. 360.0	deg	34,560,240
CERES Viewing Zenith at TOA - Geocentric	13091x660	float32	0.0 .. 90.0	deg	34,560,240
CERES Solar Zenith at TOA - Geocentric	13091x660	float32	0.0 .. 180.0	deg	34,560,240
CERES Relative Azimuth at TOA - Geocentric	13091x660	float32	0.0 .. 360.0	deg	34,560,240
Sample Aligned Analog Data	13091x660	uint16	0 ..4095	count	17,280,120
Drift Corrected SW Counts	13091x660	float32	0.0 .. 4095.0	count	34,560,240
Drift Corrected WN Counts	13091x660	float32	0.0 .. 4095.0	count	34,560,240
Drift Corrected TOT Counts	13091x660	float32	0.0 .. 4095.0	count	34,560,240
Shortwave Detector Output	13091x660	uint16	0 .. 4095	count	17,280,120
Window Detector Output	13091x660	uint16	0 .. 4095	count	17,280,120
Total Detector Output	13091x660	uint16	0 .. 4095	count	17,280,120
CERES SW Filtered Radiance Upwards	13091x660	float32	-10.0 .. 510.0	W m-2sr^{-1}	34,560,240
CERES WN Filtered Radiance Upwards	13091x660	float32	0.0 .. 50.0	W m-2sr^{-1}	34,560,240
CERES TOT Filtered Radiance Upwards	13091x660	float32	0.0 .. 700.0	W m-2sr^{-1}	34,560,240
Count Conversion SW Sample Offsets	4x660	float32	N/A	count	10,560
Count Conversion WN Sample Offsets	4x660	float32	N/A	count	10,560
Count Conversion TOT Sample Offsets	4x660	float32	N/A	count	10,560
SW Spaceclamp Values	13091x2	float32	N/A	count	104,728
WN Spaceclamp Values	13091x2	float32	N/A	count	104,728
TOT Spaceclamp Values	13091x2	float32	N/A	count	104,728
Solar Elevation Angles[2]	13091x660	float32	0.0 .. 360.0	deg	34,560,240
Solar Azimuth Angles[2]	13091x660	float32	0.0 .. 360.0	deg	34,560,240
Lunar Elevation Angles[2]	13091x660	float32	0.0 .. 360.0	deg	34,560,240
Lunar Azimuth Angles[2]	13091x660	float32	0.0 .. 360.0	deg	34,560,240
SW Slow Mode and Drift Corrected Counts[1]	13091x660	float32	0.0 .. 4095.0	count	34,560,240

Table 2.1-3. BDS SDS Summary

SDS Name	Maximum SDS Elements	Data Type	Range	Units	Maximum Size (Bytes)
WN Slow Mode and Drift Corrected Counts[1]	13091x660	float32	0.0 .. 4095.0	count	34,560,240
TOT Slow Mode and Drift Corrected Counts[1]	13091x660	float32	0.0 .. 4095.0	count	34,560,240
SDS Total Size (Bytes)					1,249,567,630
SDS Total Size (MBytes, plus a small HDF overhead percentage)					1194.06

[1] These SDSs are available on Aqua and Terra Edition1 BDSs beginning with CC-Code 027025 and Aqua and Terra Edition2 BDSs beginning with CC-Code 028028. These SDSs are also available on TRMM, Terra and Aqua Edition1-CV and Terra and Aqua Edition2 BDSs beginning with CC-Code 031033 and TRMM, Aqua and Terra Edition3 BDSs.

[2] These SDSs are available on TRMM, Aqua and Terra Edition1-CV BDSs and Terra and Aqua Edition2 BDSs beginning with CC-Code 031033 and TRMM, Aqua and Terra Edition3 BDSs.

BDS Vdata

The BDS contains eight Vdatas which are collections of records containing one or more fields. Each of the eight Vdatas contains *n* (1..10391) records of packet level data, and there is a one-to-one correspondence of the Vdatas record numbers to the BDS SDSs row numbers. Table 2.1-4 summarizes each of the BDS Vdatas. Reference 3 provides detailed descriptions of the parameters.

Table 2.1-4. BDS Vdata Summary

Vdata Name	Number of Fields	Maximum Records	Number Bytes per Record	Maximum Size (Bytes)
Satellite-Celestial Data	18	13091	160	2,094,560
Converted Instrument Status Data	25	13091	88	1,152,008
Position Counts	12	13091	528	6,912,048
Temperature Counts	39	13091	450	5,890,950
Voltage and Torque Counts	24	13091	180	2,356,380
Converted Temperatures	35	13091	708	9,268,428
Converted Voltages and Torques	23	13091	348	4,555,668
Count Conversion Constants	9	1	120	120
Vdata Total Size (Bytes)				32,230,162
Vdata Total Size (MBytes, plus a small HDF overhead percentage)				30.80

BDS Revision Record

The product Revision Record contains information pertaining to approved section changes. The table lists the date the Software Configuration Change Request (SCCR) was approved, the Release and Version Number, the SCCR number, a short description of the revision, and the revised sections. The authors are listed on the document cover.

BDS Revision Record

SCCR Approval Date	Release/ Version Number	SCCR Number	Description of Revision	Section(s) Affected
N/A	R3V1	N/A	• Updated format to comply with standards.	All
1/16/04	R4V1	497	• Updated to add newly added SDSs. Also reordered the tables to match the order on the BDS. • Updated format to comply with standards.	All All
11/18/05	R4V2	599	• Updated to add newly added SDSs containing Solar and Lunar Azimuth and Elevation Angles along with updated Satellite-Celestial Vdata to add Solar and Lunar Beta and Eta Angles, Earth-Moon Distance, Colatitude of Moon at start of record and Longitude of Moon at start of record, per Reqt.# 1-5. • Updated format to comply with standards. • The EOSDIS Product Code line was removed from the document. (6/17/2008) • Some links were not working. They have now been modified. (12/09/2010)	All All Sec. 2.1 All