

## Instrument Production Data Set (INSTR)

The Instrument Production Data Set (INSTR) is the Level 0 raw data from the CERES Scanner. It is structured into packets by the onboard software as programmed by the instrument developer, TRW. The packets are formatted according to Consultative Committee for Space Data Systems (CCSDS) standards. Although the CERES output is the same on each satellite, the packets contain ancillary information which are unique to a particular spacecraft. There are six basic pieces of information contained in a normal CERES data packet (e.g., science output format):

1. Packet Header - Same CCSDS format for all instruments.
2. Time (secondary header) - format specified by platform's selected CCSDS option
3. Radiometric Detector Outputs.
4. Instrument Elevation and Azimuth Position Data.
5. Instrument Analog Engineering Data (e.g., Temperatures and Voltages).
6. Instrument Digital Engineering Data.

There are five types of packets currently defined for the CERES instrument - Science, Diagnostic Memory, Diagnostic Processor, Diagnostic Gimbal, and Diagnostic Fixed Pattern. Each of these packet types corresponds to a particular operation of the CERES instrument.

For processing purposes, packets are grouped into Level 0 files which typically represent data collected from the CERES instrument over a 24-hour period. The TRMM Level 0 file format is illustrated in [Figure 1](#) and the Terra Level 0 file format is illustrated in [Figure 2](#). [Table 1](#) and [Table 2](#) lists the parameters and sizes for TRMM Level 0 files. [Table 3](#) and [Table 4](#) lists the parameters and sizes for Terra Level 0 files. [Table 5](#) and [Table 6](#) lists the parameters and sizes for Aqua and NPP Level 0 files.

**Level:** 0  
**Type:** Internal  
**Frequency:** 1/Day

**Portion of Globe Covered**  
**File:** Satellite Swath  
**Record:** N/A

**Time Interval Covered**  
**File:** 1 Day  
**Record:** Single 6.6-Second Scans

**Portion of Atmosphere Covered**  
**File:** N/A

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### Level 0 File Definitions

<b>File Header</b> (48 to 52 Bytes)
<b>Instrument Data Packets</b> (Number of Packets x 7132 Bytes)
<b>File Footer (QAC)</b> (Total = Length of QAC Footer (4) + [Number of Entries x 5] Bytes)
<b>File Footer (MDUL)</b> (Total = Length of MDUL Footer (4) + [Number of Entries x 5] Bytes)

QAC - List of packet IDs known to be corrupted or unusable  
(Minimum number of QAC entries is always = 1)

MDUL - List of packet IDs missing

Figure 1. TRMM Level 0 File Format

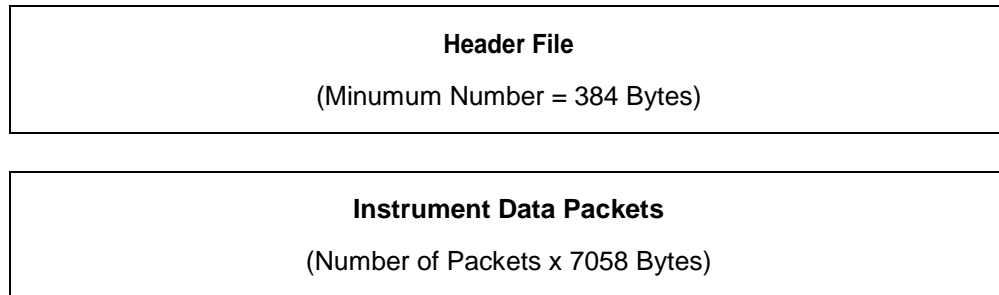


Figure 2. Terra Level 0 File Format

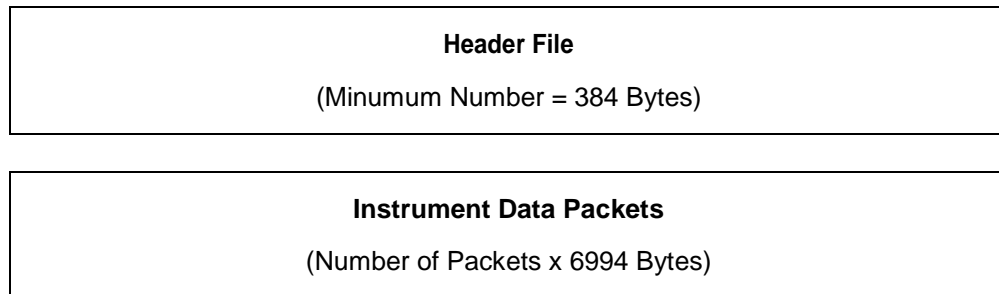


Figure 3. Aqua and NPP Level 0 File Format



Table 1. TRMM Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
<b>INSTR_PDS FILE HEADER</b>					
Spacecraft ID		N/A	N/A	1	16
Spacecraft Clock (first packet)		N/A	N/A	1	72
Spare		N/A	N/A	1	8
Spacecraft Clock (last packet)		N/A	N/A	1	72
Spare		N/A	N/A	1	8
Number of Packets in file		N/A	N/A	1	32
Processing Options		N/A	N/A	1	8
Data Type Flag		N/A	N/A	1	8
Time of Receipt at Originating Node		N/A	N/A	1	56
Spare		N/A	N/A	1	24
Select Options		N/A	N/A	1	8
Number of APIDs		N/A	N/A	1	8
APIDs		N/A	N/A	1 to 3	16
Spare		N/A	N/A	1	8
Number of QAC lists in file		N/A	N/A	1	8
Offset to QAC List		N/A	N/A	1	32
<b>INSTR_PDS_DATA_PACKET [1..13091]</b>					
<b>Primary Packet Header</b>					
Version Number	1	N/A	N/A	1	3
Type	2	N/A	N/A	1	1
Secondary Header Flag	3	N/A	N/A	1	1
APID	4	N/A	N/A	1	11
Sequence Flags	5	N/A	N/A	1	2
Packet Sequence Count	6	N/A	N/A	1	14
Packet Length	7	N/A	N/A	1	16
<b>Secondary Packet Header</b>					
Time Data	8	N/A	N/A	1	64
<b>Instrument Packet Status</b>					
Spare 1	9	N/A	N/A	1	16



Table 1. TRMM Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
Timecode ID	10	N/A	N/A	1	1
Quicklook Flag	11	N/A	N/A	1	1
Instrument ID	12	N/A	N/A	1	5
Data Version	13	N/A	N/A	1	5
Data Indicator	14	N/A	N/A	1	4
Packet Counter	15	N/A	0..65535	1	16
Spare 2	16	N/A	N/A	1	16
Spare 3	17	N/A	N/A	1	16
<b>Measurement_Data (1 of the 5 following record types):</b>					
<b>Science_Record [660]</b>					
Azimuth Position Count	18	count	0..65535	660	16
Elevation Position Count	19	count	0..65535	660	16
Total Detector Output	20	count	0..4095	660	12
WN Detector Output	21	count	0..4095	660	12
SW Detector Output	22	count	0..4095	660	12
Instrument Analog Data - ( <a href="#">Reference 3</a> )	23	-	-	660	12
<b>Memory_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
DAP Memory Dump Data	21	N/A	0..65535	660	16
ICP Memory Dump Data	22	N/A	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Gimbal_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
Elevation Error	21	count	0..65535	660	16
Azimuth Error	22	count	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Processor_Op_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
DAP Timing	21	N/A	0..65535	660	16
ICP Timing	22	N/A	0..65535	660	16

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Table 1. TRMM Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Fixed_Record [660]</b>					
Fixed Pattern in Elevation Field	19	N/A	0..65535	660	16
Fixed Pattern for Azimuth Field	20	N/A	0..65535	660	16
Fixed Pattern for Total Channel Field	21	N/A	0..4095	660	12
Fixed Pattern for WN Channel Field	22	N/A	0..4095	660	12
Fixed Pattern for SW Channel Field	23	N/A	0..4095	660	12
Fixed Pattern for Analog Field	24	N/A	0..4095	660	12
<b>Instrument Digital Status - (<a href="#">Reference 3</a>)</b>	25	-	-	1	2960
<b>Fill Data</b>	26	N/A	N/A	1	1104
<b>INSTR_PDS FILE FOOTER</b>					
QAC List	N/A	N/A	N/A	1	32
QAC Entries	N/A	N/A	N/A	variable	16
MDUL	N/A	N/A	N/A	1	32
MDU	N/A	N/A	N/A	variable	16

Table 2. TRMM Instrument Production Data Set Sizes

Description	Sizes
Total Header Bits/File:	416
Maximum Data Bits/ Packet Record:	57,056
Maximum Records/File:	13,091
Maximum Data Bits/File:	746,920,096
Minimum Footer Bits/File:	72
Total Bits/File:	746,920,584
Total Bytes/File:	93,365,073
<b>Total MBytes/file (1MB = 1024*1024 Bytes):</b>	<b>89.04</b>



Table 3. Terra Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
<b>INSTR_PDS Header File</b>					
See <a href="#">Reference 8</a> , Table 8.1.2.7-1. PDS/EDS Construction Record					
<b>INSTR_PDS_DATA_PACKET [1..13091]</b>					
<b>Primary Packet_Header</b>					
Version Number	1	N/A	N/A	1	3
Type	2	N/A	N/A	1	1
Secondary Header Flag	3	N/A	N/A	1	1
APID	4	N/A	N/A	1	11
Sequence Flags	5	N/A	N/A	1	2
Packet Sequence Count	6	N/A	N/A	1	14
Packet Length	7	N/A	N/A	1	16
<b>Secondary Packet_Header</b>					
Time Data	8	N/A	N/A	1	64
Quick Look Flag	9	N/A	N/A	1	8
<b>Instrument_Packet_Status</b>					
Spare 1	10	N/A	N/A	1	8
Timecode ID	11	N/A	N/A	1	1
Quicklook Flag	12	N/A	N/A	1	1
Instrument ID	13	N/A	N/A	1	5
Data Version	14	N/A	N/A	1	5
Data Indicator	15	N/A	N/A	1	4
Packet Counter	16	N/A	N/A	1	16
Spare 2	17	N/A	N/A	1	16
Spare 3	18	N/A	N/A	1	16
<b>Measurement_Data (1 of the 5 following record types):</b>					
<b>Science_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
Total Detector Output	21	count	0..4095	660	12
WN Detector Output	22	count	0..4095	660	12
SW Detector Output	23	count	0..4095	660	12
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Memory_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16

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Table 3. Terra Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
Elevation Position Count	20	count	0..65535	660	16
DAP Memory Dump Data	21	N/A	0..65535	660	16
ICP Memory Dump Data	22	N/A	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Gimbal_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
Elevation Error	21	count	0..65535	660	16
Azimuth Error	22	count	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Processor_Op_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
DAP Timing	21	N/A	0..65535	660	16
ICP Timing	22	N/A	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Fixed_Record [660]</b>					
Fixed Pattern in Elevation Field	19	N/A	0..65535	660	16
Fixed Pattern for Azimuth Field	20	N/A	0..65535	660	16
Fixed Pattern for Total Channel Field	21	N/A	0..4095	660	12
Fixed Pattern for WN Channel Field	22	N/A	0..4095	660	12
Fixed Pattern for SW Channel Field	23	N/A	0..4095	660	12
Fixed Pattern for Analog Field	24	N/A	0..4095	660	12
<b>Instrument Digital Status - (<a href="#">Reference 3</a>)</b>	25	-	-	1	2960
<b>Terra_Ancillary_Data</b>					
Ancillary Time Stamp	26	count	0..1.84x10 <sup>1</sup>	1	64
GPS/UTC Time Conversion	27	count	0..4.29x10 <sup>9</sup>	1	32
Solar Array Current	28	count	0..255	1	8
Mag Coil Current X	29	count	0..255	1	8
Mag Coil Current Y	30	count	0..255	1	8
Mag Coil Current Z	31	count	0..255	1	8
Satellite Position (X) Count	32	count	0..4.29x10 <sup>9</sup>	1	32



Table 3. Terra Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
Satellite Position (Y) Count	33	count	0..4.29x10 <sup>9</sup>	1	32
Satellite Position (Z) Count	34	count	0..4.29x10 <sup>9</sup>	1	32
Satellite Velocity (X) Count	35	count	0..4.29x10 <sup>9</sup>	1	32
Satellite Velocity (Y) Count	36	count	0..4.29x10 <sup>9</sup>	1	32
Satellite Velocity (Z) Count	37	count	0..4.29x10 <sup>9</sup>	1	32
Satellite Attitude (Roll) Count	38	count	0..65535	1	16
Satellite Attitude (Pitch) Count	39	count	0..65535	1	16
Satellite Attitude (Yaw) Count	40	count	0..65535	1	16
Satellite Attitude Rate (Roll) Count	41	count	0..65535	1	16
Satellite Attitude Rate (Pitch) Count	42	count	0..65535	1	16
Satellite Attitude Rate (Yaw) Count	43	count	0..65535	1	16
Solar X Position	44	count	0..255	1	8
Solar Y Position	45	count	0..255	1	8
Solar Z Position	46	count	0..255	1	8
Lunar X Position	47	count	0..255	1	8
Lunar Y Position	48	count	0..255	1	8
Lunar Z Position	49	count	0..255	1	8

Table 4. Terra Instrument Production Data Set Sizes

Description	Sizes
<b>Header File:</b>	
Total Header Bits/File (typical max):	5,760
Total Bytes/File:	720
<b>Total MBytes/file (1MB = 1024*1024 Bytes):</b>	<b>0.0007</b>
<b>Data File:</b>	
Maximum Data Bits/ Packet Record:	56,464
Maximum Records/File:	13,091
Maximum Data Bits/File:	739,170,224
Minimum Footer Bits/File:	0
Total Bits/File:	739,170,224
Total Bytes/File:	92,396,278
<b>Total MBytes/file (1MB = 1024*1024 Bytes):</b>	<b>88.12</b>





Table 5. Aqua and NPP Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
<b>INSTR_PDS File Header</b>					
See <a href="#">Reference 8</a> , Table 8.1.2.7-1. PDS/EDS Construction Record					
<b>INSTR_PDS_DATA_PACKET [1..13091]</b>					
<b>Primary Packet_Header</b>					
Version Number	1	N/A	N/A	1	3
Type	2	N/A	N/A	1	1
Secondary Header Flag	3	N/A	N/A	1	1
APID	4	N/A	N/A	1	11
Sequence Flags	5	N/A	N/A	1	2
Packet Sequence Count	6	N/A	N/A	1	14
Packet Length	7	N/A	N/A	1	16
<b>Secondary Packet_Header</b>					
Time Data	8	N/A	N/A	1	64
Quick Look Flag	9	N/A	N/A	1	8
<b>Instrument_Packet_Status</b>					
Spare 1	10	N/A	N/A	1	8
Timecode ID	11	N/A	N/A	1	1
Quicklook Flag	12	N/A	N/A	1	1
Instrument ID	13	N/A	N/A	1	5
Data Version	14	N/A	N/A	1	5
Data Indicator	15	N/A	N/A	1	4
Packet Counter	16	N/A	N/A	1	16
Spare 2	17	N/A	N/A	1	16
Spare 3	18	N/A	N/A	1	16
<b>Measurement_Data (1 of the 5 following record types):</b>					
<b>Science_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
Total Detector Output	21	count	0..4095	660	12
WN Detector Output	22	count	0..4095	660	12
SW Detector Output	23	count	0..4095	660	12
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12



Table 5. Aqua and NPP Instrument Production Data Set (INSTR)

Description	Element Number	Units	Range	Elements per Record	Bits per Element
<b>Memory_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
DAP Memory Dump Data	21	N/A	0..65535	660	16
ICP Memory Dump Data	22	N/A	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Gimbal_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
Elevation Error	21	count	0..65535	660	16
Azimuth Error	22	count	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Processor_Op_Record [660]</b>					
Azimuth Position Count	19	count	0..65535	660	16
Elevation Position Count	20	count	0..65535	660	16
DAP Timing	21	N/A	0..65535	660	16
ICP Timing	22	N/A	0..65535	660	16
Fill Data	23	N/A	0..15	660	4
Instrument Analog Data - ( <a href="#">Reference 3</a> )	24	-	-	660	12
<b>Fixed_Record [660]</b>					
Fixed Pattern in Elevation Field	19	N/A	0..65535	660	16
Fixed Pattern for Azimuth Field	20	N/A	0..65535	660	16
Fixed Pattern for Total Channel Field	21	N/A	0..4095	660	12
Fixed Pattern for WN Channel Field	22	N/A	0..4095	660	12
Fixed Pattern for SW Channel Field	23	N/A	0..4095	660	12
Fixed Pattern for Analog Field	24	N/A	0..4095	660	12
<b>Instrument Digital Status - (<a href="#">Reference 3</a>)</b>	25	-	-	1	2960



Table 6. Aqua and NPP Instrument Production Data Set Sizes

Description	Sizes
<b>Header File:</b>	
Total Header Bits/File (typical max):	5,760
Total Header Bytes/File:	720
<b>Total MBytes/file (1MB = 1024*1024 Bytes):</b>	<b>0.0007</b>
<b>Data File:</b>	
Maximum Data Bits/ Packet Record:	55,952
Maximum Records/File:	13,091
Maximum Data Bits/File:	732,467,632
Minimum Footer Bits/File:	0
Total Bits/File:	732,467,632
Total Bytes/File:	91,558,454
<b>Total MBytes/file (1MB = 1024*1024 Bytes):</b>	<b>87.32</b>



## INSTR 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.

INSTR Revision Record

SCCR Approval Date	Release/Version Number	SCCR Number	Description of Revision	Section(s) Affected
N/A	R3V1	N/A	<ul style="list-style-type: none"> <li>• Updated format to comply with standards.</li> </ul>	All
N/A	R3V2	N/A	<ul style="list-style-type: none"> <li>• Updated to add Aqua Level-0 File Format.</li> <li>• Updated format to comply with standards.</li> <li>• The EOSDIS Product Code line was removed from the document. (6/17/2008)</li> </ul>	3.1 All Sec. 3.1
N/A	R5V1	N/A	<ul style="list-style-type: none"> <li>• Added new satellite (NPP) format, which matches Aqua formats.</li> <li>• Some links were not working. They have now been modified. (12/09/2010)</li> <li>• The ASDC footer was added to the bottom of the document. (06/06/2013)</li> <li>• Eliminated section numbers from the Data Products Catalog. Specifically, in this document, section number 3.1 was removed. (12/17/2013)</li> <li>• Updated some links to refer to the .pdf file instead of the .doc file. (06/20/2014)</li> </ul>	Sec. 1.3, Fig. 3.1-3, Table 3.1-5, & Table 3.1-6 All All All All

