



GOES R SERIES PRODUCT DEFINITION AND USERS' GUIDE

(PUG)

VOLUME 1: MAIN

VOLUME 2: L0 PRODUCTS

VOLUME 3: LEVEL 1B PRODUCTS

VOLUME 4: GOES-R REBROADCAST (GRB)

VOLUME 5: LEVEL 2+ PRODUCTS

APPENDIX X: ISO SERIES METADATA

27 October 2017

REVISION 1.1



**U.S. Department of Commerce (DOC)
National Oceanic and Atmospheric Administration (NOAA)
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National Aeronautics and Space Administration (NASA)**

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APPENDIX X: ISO SERIES METADATA

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11/20/2017

Date

CHANGE RECORD

ISSUE	CCR #	DATE	PAGES AFFECTED	DESCRIPTION
Rev. 1.0	03240	03/02/2017	All	CDRL SE-16 under Government Control. Harris DCN 7035538 PUG L0 Vol 2 Rev E has been placed under Gov. GS control as GS Series 416-R-PUG-L0-0346 Vol 2 Rev 1.0.
Rev. 1.1	03332	10/27/2017	All	CDRL SE-16 under Government Control. Harris DCN 7035538 PUG L0 Vol 2 Rev F has been placed under Gov. GS control as GS Series 416-R-PUG-L0-0346 Vol 2 Rev 1.1.



**PRODUCT DEFINITION AND USER'S GUIDE
(PUG)**

VOLUME 2: L0 PRODUCTS

FOR

**GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE
R SERIES (GOES-R) CORE GROUND SEGMENT**

CONTRACT NO: DG133E-09-CN-0094

DOCUMENT CONTROL NUMBER: 7035538

CDRL SE-16

REVISION F

16 JUNE 2017

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THESE ITEM(S) / DATA HAVE BEEN REVIEWED IN ACCORDANCE WITH THE INTERNATIONAL TRAFFIC IN ARMS REGULATIONS (ITAR), 22 CFR PART 120.11, AND THE EXPORT ADMINISTRATION REGULATIONS (EAR), 15 CFR 734(3)(b)(3), AND MAY BE RELEASED WITHOUT EXPORT RESTRICTIONS.

PRODUCT DEFINITION AND USER'S GUIDE (PUG) VOLUME 2: L0 PRODUCTS

FOR GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE R SERIES (GOES-R) CORE GROUND SEGMENT

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RECORD OF CHANGE

REVISION	DATE	DESCRIPTION
-	08 February 2011	Initial Release Pre-ECP5
-.1	25 August 2011	Interim Release includes ECP5 PTR-2871 Incorporate GSP comments & organize document structure into volumes PTR-2872 Update content for TBDs/Action Items PTR-2874 Incorporate monthly work-in-progress comments
A	06 February 2012	Pre-CDR Release PTR 3226 Update per BCN_046 ATP for BCR 049 Metadata Delivery PTR-3525 Incorporate GSP Comments (from Interim Release) PTR-3525 Incorporate GSP Comments (CDR Release) PTR-3526 Update Content for TBDs/Action Items (CDR Release)
B	26 July 2012	CDR+90 Release PTR-3239 SE-16 PUG – Update External File Naming Convention for New Static Metadata Files from Metadata BCR PTR-4138 Remove ITAR from Volume 4, GRB PTR-3576 Remove Reference to AWG Ancillary Data PTR-3409 Update Content for TBD-11, TBD-17 and TBD-20 PTR-4039 Update Content for TBDs/Action Items PTR-4203 PUG Update for SUVI Image Refresh and Snow Ice Metadata PTR-4298 GSP Comments Rev A PTR-4204 SE-16 PUG Feedback on PUG for L1b Volume 3 PTR-4845 SE-16 PUG Incorporate Peer Review Comments Deferred from Rev A (Note: Updated NcML files are from 6/12 for CMI and 6/11 for all others)

16 June 2017

REVISION	DATE	DESCRIPTION
B.1	17 December 2012	Post-CDR Interim Release PTR-4841 SE-16 PUG - Deferred Comments from Release A PTR-4946 SE-16 PUG - Deferred Comments from PostCDR+90 Peer Review PTR-5318 SE-16 PUG: BCN_067 ATP for ECP007 RFP Amend 4 PTR-5373 SE-16 PUG - Update PUG Vol 5 Product Algorithm Output Tables PTR-5403 Incorporate customer comments against Rev. B
B.2	20 May 2013	Post-CDR Interim Release PTR-6419 SE-16_Product Definition and User's Guide (PUG) Release Update Rev B.2 Update due to BCR75 PTR-6158 UMB_Delivery_SE-16_Product Definition and User's Guide (PUG) Release Update Rev B.2 PTR-6159 SE-16 PUG - Deferred Comments from Rev. B.1 Peer Review PTR-6837 SE-16 PUG Incorporate Customer Comments Against Rev B.1 PTR-6877 SE-16 Product Definition and User's Guide (PUG) - BCN_085 ATP for MAG SEISS L1b Changes
C	06 December 2013	Post-CDR Interim Release PTR-9218 Delivery_SE-16_Product Definition and User's Guide (PUG) Release Update Rev C 1) ITAR content and markings removed from this volume. 2) No other changes made for this version.
C.1	05 December 2014	Post-CDR Interim Release Vol 1, Main: <ul style="list-style-type: none"> • Added FITS format section (SUVI) Vol 2, L0: <ul style="list-style-type: none"> • Minor editorial changes Vol 3, L1b: <ul style="list-style-type: none"> • Revised Space Weather and Solar instrument sections • Co-located Instrument Calibration Data with instrument section

REVISION	DATE	DESCRIPTION
		<p>Vol 4, GRB:</p> <ul style="list-style-type: none"> • Revised Space Weather and Solar instrument sections • Corrected APID list <p>Vol 5, L2+:</p> <ul style="list-style-type: none"> • Combined Volumes 5A and 5B • Added section for Latitude/Longitude grid (Radiation products) • Added Appendix for dynamic source data • Miscellaneous changes to CMI product <p>Appendix X, ISO Series Metadata:</p> <ul style="list-style-type: none"> • Revised L1b, L2+, Instrument Calibration Data sections <p>PTR-12388 UMB_Delivery_SE-16_ Product Definition and User's Guide (PUG) Release Update Rev C.1</p> <ul style="list-style-type: none"> • Incorporates PTR-7028, PTR-7556, PTR-7557, PTR-7553, PTR-8055, PTR-8742, PTR-9027, PTR-9518, PTR-11701 • Combined Vol 5A and Vol 5B into a single volume • Rearranged major sections of the document (consolidated File Naming conventions, consolidated APID lists, etc.), for usability <p>PTR-7028 Update Cumulative ERB/PCRB Changes in Next Rev of Document</p> <ul style="list-style-type: none"> • ERB: delete the Rainfall Rate Coefficient Algorithm • PCRB: change GLM Lightning Event Peak L1b/GRB update • PCRB: change Radiation Grid from ABI Grid to Latitude/Longitude <p>PTR-7556 Deferred Comments from Rev. B.2 Peer Review</p> <ul style="list-style-type: none"> • Incorporate comments deferred from Revision B.2 Peer Review <p>PTR-7753 SE-16: Updates to PUG Rev C for next Release</p> <ul style="list-style-type: none"> • Fixed MAG L1b OMAS/GRB/PD periodicity <p>PTR-8055 SE-16 PUG BCR # 127 + BCR #129 + BCR 124 + BCN_120 ATP for NcML/Product Definition for non-ABI Sensors + BCN_149, BCR 115 Update GLM L2 NcML + BCR 119 + BCR #127 and 129 (IPS and Product Set 1 NcML Corrections)</p> <ul style="list-style-type: none"> • BCR#127: incorporated IPS Product NcML corrections

16 June 2017

REVISION	DATE	DESCRIPTION
		<ul style="list-style-type: none"> • BCR#129: incorporated IPS and Product Set 1 NcML corrections • BCR#124: changed SUVI, SEISS, MAG NcML • BCN_120: NcML/product definition for non-ABI instruments • BCN_149 / BCR#115: updated GLM L2+ NcML definition • BCR#119: changed SUVI GLM INR report design • ECP-9a: added aggregation criteria for Geomagnetic Field, Solar Flux: X-Ray products • BCR#212: incorporated Product Set 2 NcML corrections <p>PTR-8742 SE-16 PUG - Scheduled Science Instrument Products definitions</p> <ul style="list-style-type: none"> • Updated SUVI, EXIS, SEISS, MAG, GLM product definitions <p>PTR-9027 SE-16 PUG - Evaluate Customer Comments Against Rev B.2</p> <ul style="list-style-type: none"> • Incorporated customer comments not previously addressed in PUG Rev C <p>PTR-9518 SE-16 PUG, Evaluate Customer Comments from Rev C</p> <ul style="list-style-type: none"> • Incorporated customer comments against PUG Rev C <p>PTR-11701 SE-16 PUG - Update for BCR # 227, Non-ABI product Corrections Incorporated non-ABI Product NcML corrections</p>
D	13 May 2015	<p>PTR-7557 UMB_Delivery_SE-16_Product Definition and User's Guide (PUG) Release Update Rev D</p> <ul style="list-style-type: none"> • Incorporate customer comments against PUG Rev C.1 <p>PTR-13600</p> <ul style="list-style-type: none"> • SE-16 PUG - Miscellaneous Corrections <p>Appendix X</p> <ul style="list-style-type: none"> • New content – L0 and GRB Info ISO Series Metadata <p>Vol 2, L0</p> <ul style="list-style-type: none"> • Restructured to be consistent with other volumes <p>Vol 3, L1b</p> <ul style="list-style-type: none"> • New content – dynamic and semi-static processing parameters <p>Vol 4, GRB</p> <ul style="list-style-type: none"> • New content – GRB Information <p>Vol 5, L2+</p>

REVISION	DATE	DESCRIPTION
		<ul style="list-style-type: none"> New content – dynamic and semi-static processing parameters
D.1	11 August 2015	PTR-14093 <ul style="list-style-type: none"> Change 132.8 Angstroms wavelength to 131.2 Angstroms in SUVI documentation PTR-14107 <ul style="list-style-type: none"> Update various L2 product lineage issues PTR-13638 <ul style="list-style-type: none"> Update document for ECP-023 new CONUS center points PTR-14388 <ul style="list-style-type: none"> WR 757: SE-16: CMI - Update PUG to change scaling of band 7 to a max brightness temp of 400K
D.2	24 March 2016	PUG release aligned with PC DO.03.00.00 software baseline. PTR-14663 <ul style="list-style-type: none"> SE-16 PUG, Evaluate Customer Comments from Rev D PTR-15294 <ul style="list-style-type: none"> SE-16 PUG, Add GRB-INFO-STATIC description PTR-15324 <ul style="list-style-type: none"> SE-16 PUG - Misc. Updates to Sync with GS File Naming Conventions
E	15 June 2016	PUG release aligned with PC DO.04.00.00 software baseline. PTR-16585 <ul style="list-style-type: none"> SE-16 PUG - Miscellaneous Corrections PTR-16442 <ul style="list-style-type: none"> WR 1949: GLM appears to have Timing Artifacts (PUG Update) PTR-15605 <ul style="list-style-type: none"> WR 813: Space Weather products' enhancements requested by NCEI (SE-16 PUG) <ul style="list-style-type: none"> Add SEISS MPS-LO energy bounds/levels to differential_flux_energy_band_label variable value PTR-15580 <ul style="list-style-type: none"> WR 1697: SE-16 PUG - Rainfall Rate Product DQF Valid Range is Incorrect

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		PTR-15194 • WR 1177: SE-16 Modify Product Definition User's Guide for expanded ABI L1b Radiance Limits
E.1	4 November 2016	PUG release aligned with PC DO.04.02.00 software baseline, except where otherwise noted. PTRDOC-15878 DO.05.00.00 • WR 1552: SE-16 PUG - ABI L1b Instrument Calibration Data - Number of detector rows discrepancy PTRDOC-16363 • WR 2261: SE-16 PUG - Provide documentation for CAL INR data file structures PTRDOC-16387 DO.05.00.00 • WR 2218: SE-16 PUG - There are no ABI CCR results in the PM Generated ABI INR Report PTRDOC-16397 DO.05.00.00 • WR 1937: SE-16 PUG - GLM L2+ product metadata errors PTRDOC-16639 DO.05.00.00 • WR 1698: SE-16 PUG - Sea Surface Temperature Fill Value incorrect PTRDOC-16911 DO.05.00.00 • WR 2961: SE-16 PUG - Update to clarify Rainfall Rate metadata PTRDOC-16936 • WR 2566: SE-16 PUG - Add Derived Motion Winds PQI and Diagnostic Intermediate Products to the PUG PTRDOC-17008 • WR 2749: SE-16 PUG - Update to reflect 2 minute EXIS L0 LZSS file aggregation time PTRDOC-17088 • WR 2874: SE-16 PUG - Correct File Names of Instrument Calibration Files Produced PTRDOC-17123 • WR 1739: SE-16 PUG - SUVI Instrument Calibration File Names PTRDOC-17254 • WR 2962: SE-16 PUG - CMI Coefficients update-ADR 143

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REVISION	DATE	DESCRIPTION
		<p>PTRDOC-17416</p> <ul style="list-style-type: none"> WR 3058: SE-16 PUG - SUVI scale factors in products do not match scale factors in the PUG <p>PTRDOC-17661</p> <ul style="list-style-type: none"> WR 3274: SE-16 PUG - Update to Align with XTCE Database v6.3.005A <p>PTRDOC-17818 DO.06.00.00</p> <ul style="list-style-type: none"> WR 2260: SE-16 PUG - Derived Motion Winds (DMW) Wind Direction: Incorrect Direction
E.2	30 March 2017	<p>PUG release aligned with GOES-R Ground Segment Product Capabilities (PG, PD, PM) software baselines, as follows: DO.04.04.00: April 2017 DO.05.00.00: July 2017 DO.06.00.00: September 2017 (TBR)</p> <p>PTRDOC-17880 DO.05.00.00 Vol 5, Table 5.1.6.4-1.</p> <ul style="list-style-type: none"> WR 3383: SE-16 PUG - Changes for Expansion of CMI range to match DO.04 Rad-ADR 154 <p>PTRDOC-17887 DO.04.04.00 Vol 3, Section 5.0.1; Vol 4, Section 7.0.1; Vol 5, Section 5.0.1</p> <ul style="list-style-type: none"> WR 3483: SE-16 PUG - add explanation/instructions for converting 'seconds since epoch' to standard date/time <p>PTRDOC-17995 DO.06.00.00 Vol 3, Table 5.3.2.5.1-11; Vol 4, Table 7.4.2.5.1-11.</p> <ul style="list-style-type: none"> WR 3438: SE-16 PUG - Fix Incorrect Flag Definition in EXIS Files - ADR 159 <p>PTRDOC-18023 DO.06.00.00 Vol 5, Table 4.3.7-2.</p> <ul style="list-style-type: none"> WR 2291: SE-16 PUG - GRIP is not showing full SRB image on GOES WEST <p>PTRDOC-18057 DO.05.00.00 Vol 3, Sections D.7, D.8 and D.9.</p> <ul style="list-style-type: none"> WR 3554: SE-16 PUG - Provide documentation for [CAL] INR data file structures (ABI, GLM, SUVI) <p>PTRDOC-18090 DO.06.00.00 Vol 3, Section 5.1.4.1.</p> <ul style="list-style-type: none"> WR 3433: SE-16 PUG - Include pixels with under-saturated sample contributors in ABI Sample Outlier files <p>PTRDOC-18144 DO.06.00.00 Vol 5, Table 5.1.7.6-2.</p> <ul style="list-style-type: none"> WR 3076: SE-16 PUG: DMW Output File is not CF Compliant-ADR 139 (PUG Changes)

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REVISION	DATE	DESCRIPTION
		<p>PTRDOC-18158 DO.06.00.00 Vol 3, Table 5.3.1.5-2; Vol 4, Table 7.4.1.5.2.</p> <ul style="list-style-type: none"> WR 3078: SE-16 PUG: EXIS - Add total number of valid SPS measurements used - ADR 148 <p>PTRDOC-18191 DO.05.00.00 Vol 3, Table 5.3.1.5-2; Vol 4, Tables 7.4.1.5.1 and 7.4.1.5.2.</p> <ul style="list-style-type: none"> WR 3568: SE-16 PUG: Revise EXIS EUVS-C Cadence - ADR 183 (PUG Updates) <p>PTRDOC-18225 DO.05.00.00 Vol 3, Sections D.4 and D.5.</p> <ul style="list-style-type: none"> WR 3324, 2989: SE-16 PUG - Update Documentation for MAG, SEISS CAL INR data file structures <p>PTRDOC-18228 DO.06.00.00 Vol 3, Table 5.3.2.5-2; Vol 4, Table 7.4.2.5.2.</p> <ul style="list-style-type: none"> WR 3571: SE-16 PUG: Add SUVI roll angle to EXIS XRS - ADR 147 (PUG Changes) <p>PTRDOC-18259 DO.06.00.00 Vol 5, Table 5.21.6-2.</p> <ul style="list-style-type: none"> WR 3222: SE-16 PUG - Land L2: FSC Metadata Issues-ADR 167 <p>PTRDOC-18406 DO.06.00.00 Vol 3, Table 5.5.1.5-2; Vol 4, Tables 7.6.1.5.1 and 7.6.1.5.2.</p> <ul style="list-style-type: none"> WR 3429: SE-16 PUG - MAG Add IB and OB measurements in 4 coord frames-ADR 145 <p>PTRDOC-18441 DO.04.04.00 Vol 3, Table 5.1.3.6.3-2; Vol 4, Table 7.1.3.6.1.1-2.</p> <ul style="list-style-type: none"> WR 3804: SE-16 PUG: Bad Radiance-to-Brightness-Temp Conversion Coeffs <p>PTRDOC-18608 DO.04.04.00 Vol 5, Table A.2-1, Section E.1.</p> <ul style="list-style-type: none"> WR 1264: SE-16 PUG: Change DMW Intermediate Product Filename (Data Short Name) <p>PTRDOC-18646 DO.05.00.00 Vol 3, Tables 5.3.1.5-2, 5.4.4.5-1, 5.4.4.5-2, 5.4.4.5.2-4 and 5.4.6.2-1; Vol 4, Tables 7.4.1.5.1, 7.4.1.5.2, 7.5.4.5.1, 7.5.4.5.1.2-4 and 7.5.4.5.2.</p> <ul style="list-style-type: none"> WR 3918: SE-16 PUG: Removing Hyphens in EXIS and SEIS Vars and Attrs-ADR 207
F	16 June 2017	<p>PTRDOC-18154 DO.06.00.00 Vol 3, section 5.0.2; Vol 4, section 7.0.2; Vol 5, section 5.0.2</p>

16 June 2017

REVISION	DATE	DESCRIPTION
		<ul style="list-style-type: none"> WR 3725: SE-16 PUG - Add description of unsigned integer processing <p>PTRDOC-18519 DO.06.00.00 Vol 3, Table 5.3.1.5-2, Table 5.4.4.5-2; Vol 5, Table 5.10.6-2</p> <ul style="list-style-type: none"> WR 3897: SE-16 PUG: Variable missing from XRS and SGPS files- ADR 211 <p>PTRDOC-18813 DO.06.00.00 Vol 3, Table 5.2.1.5.1-2, section 5.2.1.5.2, Table 5.2.1.5.4-5, Table 5.3.1.5-2, Table 5.3.1.5.2-7, Table 5.3.2.5-2, Table 5.3.2.5.1-15, Table 5.4.1.5-2, Table 5.4.1.5.2-9, Table 5.4.2.5-2, Table 5.4.2.5.2-5, Table 5.4.3.5-2, Table 5.4.3.5.2-6, Table 5.4.4.5-2, Table 5.4.4.5.2-6, Table 5.5.1.5-2, Table 5.5.1.5.2-3; Vol 4, Table 7.3.1.5.1.2-8, Table 7.3.1.5.2, Table 7.4.1.5.1.2-7, Table 7.4.1.5.2, Table 7.4.2.5.1.1-15, Table 7.4.2.5.2, Table 7.5.1.5.1.2-9, Table 7.5.1.5.2, Table 7.5.2.5.1.2-5, Table 7.5.2.5.2, Table 7.5.3.5.1.2-6, Table 7.5.3.5.2, Table 7.5.4.5.1.2-6, Table 7.5.4.5.2, Table 7.6.1.5.1.2-3, Table 7.6.1.5.2</p> <ul style="list-style-type: none"> WR 4164: SE-16 PUG: Space weather eclipse_flag flags do not capture all possible states <p>PTRDOC-18819 DO.06.00.00 Vol 4, section 4.1, section 4.3</p> <ul style="list-style-type: none"> WR 4139: SE-16 PUG: GRB Default Modem Configuration - QPSK <p>PTRDOC-18879 DO.06.00.00 Vol 4, section 2.0, section 5.0, section 6.0, section 6.2.6.3, section 7.1.3.6, section 7.3.1.5</p> <ul style="list-style-type: none"> WR 4179: SE-16 PUG: ABI L1b metadata sent prior to end of scene in GRB <p>PTRDOC-18890 DO.06.00.00 Vol 4, Table A</p> <ul style="list-style-type: none"> WR 3511: SE-16 PUG: Add statement on CCSDS reserved APIDs to the PUG <p>PTRDOC-18907 DO.06.00.00 Vol 3, section 5.3.1.1; Vol 4, section 7.4.1.1</p> <ul style="list-style-type: none"> WR 3257: SE-16 PUG: Resolve Time Stamp Error in EXIS Files-ADR 158 <p>PTRDOC-18910 DO.06.00.00 Vol 3, Table 5.3.1.5-2; Vol 4, Table 7.4.1.5.1, Table 7.4.1.5.2</p> <ul style="list-style-type: none"> WR 4205: SE-16 PUG: EXIS EUVS long name corrections-ADR278 <p>PTRDOC-18951 DO.06.00.00 Vol 3, Table 5.6.2.2-1</p>

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REVISION	DATE	DESCRIPTION
		<ul style="list-style-type: none"> • WR 3407: SE-16 PUG: GLM Background Image Metadata Differences from PUG <p>PTRDOC-18955 DO.06.00.00 Vol 1 – 5, Appendix X, several sections and tables</p> <ul style="list-style-type: none"> • WR 4263: BCR_591 ATP for ECP-029, SE-16: ECP-029 - Update Product Users Guide (PUG) for Mode 6 functionality <p>PTRDOC-19131 DO.07.00.00 Vol 3, Table 5.2.1.1-1, Table 5.2.1.5.3-1, Table 5.2.1.5.4-2, Table A.1; Vol 4, Table 7.3.1.1-1, Table 7.3.1.5.1.1-1, Table 7.3.1.5.1.2-2</p> <ul style="list-style-type: none"> • WR 4023: SE-16 PUG: SUVI short exposure time - Long term fix - ADR 199 <p>PTRDOC-19350 DO.06.00.00 Vol 3, Table 5.3.1.5.2-3, Table 5.3.2.5.1-3; Vol 4, Table 7.4.1.5.1.2-3, Table 7.4.2.5.1.1-3</p> <ul style="list-style-type: none"> • WR 4540: SE-16 PUG: EUVS and EXIS Processing and Data Quality Flag Meanings

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1.0 SCOPE

The Product Definition and User's Guide (PUG) document provides product descriptions and formats for all data and products produced and made available to users by the Geostationary Operational Environmental Satellite R Series (GOES-R) Core Ground Segment (GS), developed under contract DG133E-09-CN-0094. This includes the GOES-R Rebroadcast (GRB), Level 0 data, Level 1b products and all Level 2+ end-products. This also includes ISO series metadata, instrument calibration data, and semi-static source data and algorithm packages.

The PUG is divided into five volumes. This volume, Volume 2: Level 0 Products, contains Level 0 product descriptions, and format information. Detailed Level 0 product field-level content information provided by the GOES-R instruments is located in the GOES-R instrument command and telemetry handbooks. Note that there is a separate standalone Appendix X containing detailed descriptions of the ISO series metadata associated with Level 0 products.

2.0 GOES-R INSTRUMENT OVERVIEW

The six instruments on the Geostationary Operational Environmental Satellite-R series (GOES-R) offer unique observations of the environment and consist of the Advanced Baseline Imager (ABI), Extreme Ultra-Violet and X-Ray Irradiance Sensors (EXIS), Geostationary Lightning Mapper (GLM), Magnetometer (MAG), Solar Ultraviolet Imager (SUVI) and Space Environment In-Situ Suite (SEISS).

The ABI instrument is a multi-spectral channel, two-axis scanning radiometer designed to provide variable area imagery and radiometric information of the Earth's surface and atmosphere as well as the capability for star sensing. The ABI measures emitted and solar reflected radiance simultaneously in all spectral channels, but channels 1-6 sense primarily solar reflected radiance, and channels 7-16 sense primarily emitted radiance. Data availability, radiometric quality, simultaneous data collection, coverage rates, scan flexibility, and minimizing data loss due to the sun, are prime capability requirements of the ABI system. The ABI scans the Earth with three different geographic coverage areas: Full Disk, Continental United States (CONUS), and Mesoscale. The ABI utilizes the concepts of scenes and timelines in defining its scanner operations. For ABI timeline details, reference Volume 2, Section 2.2 Level 0 ABI. Correspondingly, the L1b algorithm generates L1b data product from L0 product for the three coverages. Consequently, Level 2+ (L2+) output products are generated for these same coverage areas.

The Full Disk is defined as a circle, with a 17.4 degree angular diameter from the perspective of the ABI centered at the instrument's nadir that reaches the Earth's limb. Overscan is required to deal with the non-ideal orbit and image motion compensation. CONUS is defined as a nadir-viewed rectangle 8.0215 x 4.8129 degrees, approximately 5000 E/W x 3000 North/South kilometers, in the geographic area of 10N-60N latitude and 60W-125W longitude; Mesoscale is defined as the equivalent of a 1.6043 x 1.6043 degree, approximately 1000 x 1000 kilometer region. Full Disk images are generated in ABI scanning Mode 3, Mode 6 and Mode 4, while Mesoscale and CONUS images are only generated in ABI scanning Mode 3 and 6. Note that CONUS images are extracted from Full Disk images in Mode 4 for distribution to PDA.

The X-ray Sensor (XRS) and the Extreme Ultraviolet Sensor (EUVS) are packaged together in one instrument called the EXIS. EXIS is designed to be pointed at the sun to acquire space weather data at all times except for brief calibration and maintenance activities.

EUVS consists of three spherical grating spectrometer channels. The three channels, denoted A, B and C, give coverage in the bands of 16-37nm (1.4nm resolution), 115-135nm (1.3nm resolution) and 275-285nm (0.2nm resolution). From these, a reconstruction of the full spectrum between 5nm and 127 nm will be possible.

XRS: X-ray Sensor consists of three photodiode-based photometer channels, two active (A and B) and one inactive. Channel A covers 0.05-0.4nm and channel B covers 0.1-0.8nm. The "dark" diode channel allows background subtraction. All active channels view the sun through two Beryllium (Be) filters. Each XRS

channel consists of a low-sensitivity and a high-sensitivity detector whose responses overlap in order to span the required total dynamic range. The low-sensitivity detectors are quadrant photodiodes which view the sun through a small aperture, allowing X and Y position information to be extracted for bright, localized events such as solar flares.

The GLM instrument is a single-channel, near-infrared optical detector, used to detect, locate and measure the optical pulses associated with lightning over the Full Disk Earth. The instrument has sufficient spatial and temporal resolution to allow tracking of each lightning flash within a specific storm cell and calculation of the cell's optical center over time.

The Magnetometer instrument provides three orthogonal measurements of the geomagnetic field in space at a refresh rate of at least 0.5 seconds, a dynamic range of ± 512 nT in each of the three orthogonal axes and field measurements with a resolution of at least 0.016 nT per axis. The sampling rate of the product data is 10 Hz. This measurement data is used to map the space environment that controls charged particle dynamics in the outer region of the magnetosphere and provide information on the general level of geomagnetic activity, monitor current systems in space, and permit detection of magnetopause crossings, sudden storm commencements, and sub storms.

The SEISS instrument consists of a suite of sensors that monitors the proton, electron, and heavy ion fluxes at geosynchronous orbit. The information provided by the SEISS is critical for assessing the radiation hazard to astronauts and satellites. In addition to hazard assessment, the information from the SEISS can be used to warn of high flux events, mitigating any damage to radio communication. The SEISS instrument suite consists of the Energetic Heavy Ion Sensor (EHIS), the Magnetospheric Particle Sensor -High and Low (MPS-HI and MPS-LO), and the Solar and Galactic Proton Sensor (SGPS). There are two SGPSs in each suite, one looking east and one looking west.

The SUVI instrument is designed to provide a view of the solar corona, taking the Full Disk solar images at high cadence around the clock, except for brief periods during an eclipse, in the soft XUV to EUV wavelength range. Available combinations of exposures and filters allows the coverage of the entire dynamic range of solar XUV features, from coronal holes to X-class flares, as well as the estimate of temperature and solar emissions.

3.0 LEVEL 0 PRODUCTS OVERVIEW AND CHARACTERISTICS

GOES-R Level 0 (L0) products are composed of Consultative Committee for Space Data Systems (CCSDS) packets containing all science, housekeeping, engineering, and diagnostic telemetry data downlinked by the ABI, GLM, SUVI, EXIS, SEISS, and Magnetometer (MAG) instruments.. The content and form of the CCSDS space packets in the Level 0 product files are exactly as generated by the instruments. There are separate Level 0 product files for each of these instrument or instrument suites. The Level 0 product files also contain orbit and attitude/angular rate packets generated by the spacecraft. Each packet contains a unique Application Process Identifier (APID).

A diagram of a CCSDS packet is presented in Figure 3.0-1.

PRIMARY HEADER							SECONDARY HEADER	DATA VARIABLE
PACKET IDENTIFICATION				PACKET SEQUENCE CONTROL				
VERSION NUMBER	TYPE	SEC. HDR FLAG	APPLICATION PROCESS ID	SEQUENCE FLAGS	PACKET SEQUENCE COUNT	PACKET LENGTH	TIME CODE AND ANCILLARY DATA	
3 bits	1 bit	1 bit	11 bits	2 bits	14 bits	16 bits	104 bits	
							13 – 8K octets	

Figure 3.0-1 Telemetry CCSDS Header

The 11-bit Application Process IDs (APIDs) are provided in the applicable tables in the Level 0 product descriptions in this document.

The GOES-R Spacecraft Telemetry and Command Handbook as well as the GOES-R instrument telemetry and command handbooks are controlled under the International Traffic in Arms Regulations (ITAR) by the U.S. Department of State. Information from those documents is needed to fully exploit GOES-R L0 data. To include all the necessary information from the command and telemetry handbooks in the PUG is prohibitive. The information provided in this non-ITAR-controlled Product Definition and User Guide for L0 products is intentionally insufficient to make full use of data from the L0 archive products.

The Level 0 products conform to Unidata's Attribute Conventions for Data Discovery (ACDD). Unidata's ACDD are identified and described in the main volume of the PUG. Conforming to this set of conventions facilitates cataloging product files based on information contained in the product files.

The ACDD recommended global attributes, `time_coverage_start` and `time_coverage_end`, contain the start and end time, respectively, associated with each instance of a Level 0 product file. These times do not correlate precisely to the time frame associated with the data in a Level 0 product file's packets. There are two reasons for this. CCSDS space packets containing telemetry data from the instruments are written to the instrument-specific Level 0 product files as they are received by the ground system. It is possible for packets in the Level 0 product files to not be in time order because they are not transmitted by the satellite in the order they were generated or time-stamped. As a result, it is possible for the time frames of temporally adjacent Level 0 product files from the same instrument to have packets that overlap (i.e., by seconds) in time. In addition, the approach to populating time fields in CCSDS packets varies across the instruments. In the case of ABI, several approaches are used when populating the standard time fields in the CCSDS secondary header.

It is also important to note that the Level 0 product files contain all telemetry received from the instruments, not just observation data, which complicates the time-stamping semantics.

Rather than incorporate sophisticated rules for populating the `time_coverage_start` and `time_coverage_end` global attributes in the Level 0 product files, the standard time fields from the first and last packets' CCSDS secondary headers in a Level 0 product file are used. Typically, these fields contain the spacecraft time of when the packet is generated. Tenth-second resolution is provided for these global attributes because it is satisfactory from a cataloging standpoint, and is consistent with the use of these same global attributes in Level 1b and Level 2+ products. When the time interval associated with a user's retrieval request of Level 0 product file is within a few seconds of the `time_coverage_start` and `time_coverage_end` global attributes, the temporally adjacent Level 0 product files should also be accessed.

The size of these Level 0 archive files is configurable for each instrument and is based on timing and the data rate for each instrument. Level 0 processing is currently configured to generate Level 0 archive files as shown in Table 3.0. The L0 Archive Interval values in Table 3.0, Level 0 Product File Generation Cadence, reflect current cadence values for generating L0 product files; the archive interval values are configurable.

Table 3.0 Level 0 Product File Generation Cadence

Instrument	L0 Archive Interval
ABI	2 minutes
EXIS	2 minutes
GLM	5 minutes
Magnetometer	1 minute
SEISS	5 minutes
SUVI	2 minutes

The Level 0 products use the netCDF-4 file format. The telemetry data in the constituent CCSDS space packets is stored in a byte array, making the data opaque from a netCDF-4 format standpoint. In addition to the byte array used for storing the CCSDS space packets, there are two other arrays that capture the offset into the byte array where each packet starts and the packet's size. Refer to Figure 3.0-2, netCDF-4 Level 0 Product File Design.

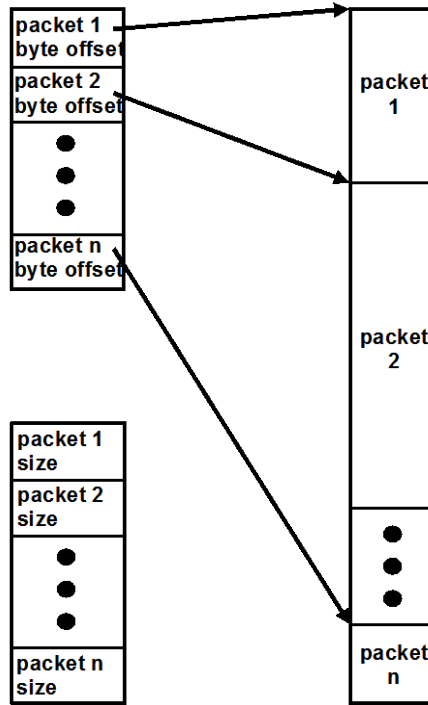


Figure 3.0-2 netCDF-4 Level 0 Product File Design

In the primary header of the CCSDS space packet is the eleven bit Application Process Identifier (APID) field. The APID field identifies the specific type of packet, and is used to support interpretation of its contents. Dedicated APID value ranges are associated with each instrument, except for the Magnetometer whose telemetry packets use spacecraft APIDs.

Due to spacecraft and instrument anomalies, and uncorrectable communication errors associated with the downlink of CCSDS space packets from the satellite, it is possible for Level 0 product files to be missing packets.

4.0 LEVEL 0 PRODUCT DESCRIPTIONS

This section describes the content of the GOES-R Level 0 product files, and defines their format. In addition, this section defines the netCDF global attributes contained in the Level 0 product files.

The Level 0 products include a metadata field identifying the percentage of product data lost due to uncorrectable Level 0 data errors. This metadata field is not specifically discussed in the product description paragraphs.

Tables are used to communicate the detailed definition of the global attributes, and the netCDF variables used to store and provide access to the CCSDS space packets containing instrument or spacecraft orbit and attitude/angular rate telemetry data. Refer to Table 4.0, Level 0 Product Files – Instrument Types.

Table 4.0 Level 0 Product Files – Instrument Types

Advanced Baseline Imager (ABI)

Extreme Ultraviolet and X-ray Irradiance Sensor (EXIS)
Geostationary Lightning Mapper (GLM)
Magnetometer (MAG)
Space Environment In-Situ Suite (SEISS)
Solar Ultraviolet Imager (SUVI)

For each type of Level 0 product file, one table defines their global attributes. Another table defines their variables and their variables' attributes. By default, in the product tables included in this volume, the values of the variables are dynamic and the values of the attributes are static. However, there are situations when an attribute value is selected from a list of valid values, has a fixed format, or is a dynamic value. Furthermore, there are situations where a variable or attribute value contains spatial coordinates, dimensioning information related to coverage areas and resolution, band dependent values, or flag values. For all these cases, ***bold italic text*** is used to convey how to properly interpret what the value of the variable or attribute should be.

4.1 ABI Level 0 Product

4.1.1 Description

The ABI Level 0 product contains CCSDS science, housekeeping, engineering, and diagnostic telemetry data packets received from the ABI, and repackaged orbit and attitude, and attitude angular rate telemetry data packets from the spacecraft. The range of CCSDS Application Identifiers (APIDs) used in the ABI telemetry packets is defined in Table 4.1.1, ABI L0 Product APIDs.

Table 4.1.1 ABI L0 Product APIDs

Packet Name (description)	APID (decimal)
ABI Housekeeping and Engineering Telemetry	
Housekeeping Telemetry 0 (Instrument status @ 1Hz)	288
Housekeeping Telemetry 1 (Current & voltage telemetry @ 0.05 Hz & Primary CCE)	289
Housekeeping Telemetry 2 (Voltage, current and temperature telemetry @ 0.1 Hz)	290
Housekeeping Telemetry 3 (Current & voltage telemetry @ 0.05 Hz & Secondary CCE)	291
Normal Scan Telemetry (Scanner shaft angle telemetry @ 100Hz)	320
Global Configuration Status Telemetry (Scene ID list and rate @ start of timeline)	321
EU Engineering Telemetry (Electronics Unit voltage, current, temperature, and bi-level telemetry @ 1 Hz)	322

Packet Name (description)	APID (decimal)
SU Engineering Telemetry (Sensor Unit voltage, current, temperature, and bi-level telemetry @ 1 Hz)	323
PIFT Telemetry (Predicted X,Y,Z force and torque data on spacecraft @ 20 Hz)	325
Command Status Telemetry (Status of received command - valid, fail, CRC failure, etc.)	327
Software Load Status Telemetry (Status of software command - successful, fail, CRC failure, storage failure, timeout, etc.)	328
Event Log Telemetry (Reports on the type and number of events logged.)	329
Store Table Status Telemetry (Indicates the status of the Store Table Command.)	330
ABI Diagnostic Telemetry	
Scan Diagnostics Telemetry (Scan angle commands, motor currents, LOS comp, SMC Comp, etc. @ 100Hz when enabled)	353
Software Version Telemetry (Software / firmware version of all modules.)	354
Power On Self-Test (POST) Telemetry (Reports the results of power on tests.)	355
Scan CAL Telemetry (Scanner shaft angle telemetry @ 100Hz when Enabled)	356
Scan CAL Diagnostics Telemetry (Scan angle commands, motor currents, LOS comp, SMC Comp, etc. @ 100Hz when enabled)	357
High Speed IO Statistics Telemetry (Provides the status of the High Speed IO, Instrument Controller and Data Processor serial ports.)	358
P&TC Configuration Telemetry (Contains a dump of the current settings of the P&TC.)	363
VNIR VP Configuration Telemetry (Dump of the configuration of the VNIR VP)	367
IR VP Configuration Telemetry (Dump of the configuration of the IR VP)	368
Target Star List Telemetry (Current or next Target Star List telemetry)	372
LOS Compensation Data Telemetry (Current or next LOS Table telemetry)	374
Spacecraft Attitude and Orbit Telemetry (Retransmitted copy of Spacecraft Attitude and orbit data @ 1Hz)	384
Spacecraft Angular Rate Telemetry (Retransmitted copy of Spacecraft Angular Rate @ 100Hz)	385
Memory Dump Telemetry (Memory dump from specified address.)	416
Software Statistic Telemetry (Provides statistics on the software.)	417

Packet Name (description)	APID (decimal)
ABI Primary Cryocooler Telemetry	
Normal Telemetry (standard telemetry needed for monitoring the cooler and control electronics under normal operating conditions @ 0.5Hz)	448
Control Telemetry (standard control telemetry needed for monitoring the cooler and control electronics under normal operations)	449
Wave_a Coefficients (32 waveform coefficients for the compressor motor side A)	450
Wave_b Coefficients (32 waveform coefficients for the compressor motor side B)	451
Perturbation Coefficients (32 perturbation coefficients for the compressor motor side A)	452
Vibration Errors (32 vibration error coefficients)	453
Current Transfer Gains (32 active (current loop) transfer gain coefficients for the system)	454
Average Transfer Gains (32 averaged transfer gain coefficients for the system)	455
Low Temp PRT Coefficients (primary and redundant PRT low temperature coefficients)	456
Mid Temp PRT Coefficients (primary and redundant PRT mid temperature coefficients)	457
High Temp PRT Coefficients (primary and redundant PRT high temperature coefficients)	458
Thermistor Coefficients	459
Diagnostic Coefficients (interleaved A/D conversions in the most recent cooler period)	460
Trip Telemetry (normal telemetry at a trip event)	461
Debug Telemetry User Defined (user defined values via an upload)	462
Automatic Restart Trip Telemetry Packet (frozen copy of the NORMAL telemetry packet at a cooler trip event following an automatic restart)	478
Spacecraft Telemetry (Packet Name)	APID (decimal)
Attitude and Orbit Telemetry	384
Angular Rate Telemetry	385
Eclipse Flag	173
SUVI Roll Angle Error	173
Yaw Flip Flag	164

Packet Name (description)	APID (decimal)
Solar Array Current 1 – 4	151
Solar Array Current 5 – 8	151
Solar Array Current 9 – 12	151
Solar Array Current 13 – 16	151

The format, approach to populating time fields used for cataloguing, and uncorrectable downlink errors metadata are identical for each of the instrument-specific Level 0 product files. These characteristics are defined above in Paragraph 3.0, Level 0 Products Overview and Characteristics.

The detailed description of the ISO series metadata for the ABI Level 0 product is located in Appendix X, ISO Series Metadata.

4.1.2 Data Fields

The ABI Level 0 product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow.

The filename conventions for the ABI Level 0 product are located in Appendix A. In cases where a metadata processing anomaly occurs a default value will be used. These are noted in the “Value” column of the Level 0 Product tables. In cases where a processing error occurs or data is not available the fill value will be used, except as noted.

Table 4.1.2-1 ABI Level 0 Product: Global Attributes

Global Attribute Name	Value	Type
id	<i>universally unique identifier (UUID) for the instance of the product.</i>	string
dataset_name	<i>refer to filename conventions for L0 products in Appendix A. Default values are noted in Appendix A.</i>	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	405cba30-aba1-11e3-a5e2-0800200c9a66	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
title	ABI L0 Raw Packet Data	string
summary	CCSDS science, housekeeping, engineering, and diagnostic telemetry data packets received from the ABI, and repackaged orbit and attitude telemetry data packets from the spacecraft.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	SPECTRAL/ENGINEERING > VISIBLE WAVELENGTHS > SENSOR COUNTS, SPECTRAL/ENGINEERING > INFRARED WAVELENGTHS > SENSOR COUNTS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > THERMAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > ELECTRICAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > PHASE AND AMPLITUDE, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > VIEWING GEOMETRY, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ORBITAL CHARACTERISTICS, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ATTITUDE CHARACTERISTICS	string
orbital_slot	<i>possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.</i>	string
platform_ID	<i>possible valid values are G16 and G17.</i>	string
instrument_type	GOES-R Series Advanced Baseline Imager	string

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Global Attribute Name	Value	Type
instrument_ID	<i>serial number of the instrument.</i>	string
processing_level	National Aeronautics and Space Administration (NASA) L0	
date_created	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.OZ</i>	string
production_site	<i>possible values are WCDAS and RBU.</i>	string
production_environment	<i>possible values are OE, ITE, and DE. Default value is n/a</i>	string
production_data_source	<i>possible values are Realtime, Simulated, Playback, and Test. Default value is n/a</i>	string
time_coverage_start	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.OZ</i>	string
time_coverage_end	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.OZ</i>	string

Table 4.1.2-2 ABI Level 0 Product: Variables

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
offset_to_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte offset for each downlinked ABI CCSDS packet	string
			_FillValue	-1	int
			valid_range	0 2147483628	int
			units	1	string
size_of_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte count for each downlinked ABI CCSDS packet	string
			_FillValue	-1	int
			valid_range	20 8198	int
			units	count	string
abi_space_packet_data	byte	<i>number_of_data_bytes = unlimited</i>	long_name	ABI CCSDS level 0 packet data	string
			_Unsigned	TRUE	string
			units	1	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float

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Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	percent	string
			long_name	container for product version	string
product_version_container	int	n/a	product_version	<i>format is vVVrRR where VV is major release # and RR is minor revision #.</i>	string

4.2 EXIS Level 0 Product

4.2.1 Description

Table 4.2.1 lists all of the L0 packets (APIDS) that may be present in the L0 EXIS data. Data listed as housekeeping means that the telemetry packet is flight software status information and flight hardware analog and status information. Engineering is a subset of housekeeping required to successfully process science data into data products. Science Data is data produced by the detector channels.

Table 4.2.1 EXIS L0 Product APIDs

Telemetry Packet Name	APID (Decimal)
BFAST (Boot Fast – housekeeping data)	898
BMED (Boot Medium – housekeeping data)	900
BSLOW (Boot Slow – housekeeping data)	902
BSYSTEM (Boot System Diagnostic – housekeeping data)	904
DET (Detector Diagnostic – housekeeping/diagnostic data)	912
DUMP (Dump Diagnostic – housekeeping/diagnostic data)	906
DWELL (Dwell Diagnostic – housekeeping/diagnostic data)	907
EUVSA (EUVS-A Science – science and engineering data)	930
EUVSB (EUVS-B Science – science and engineering data)	931
EUVSC_P0 (EUVS-C Science Packet #0 – science and engineering data)	944
EUVSC_P1 (EUVS-C Science Packet #1 – science and engineering data)	945
EUVSC_P2 (EUVS-C Science Packet #2 – science and engineering data)	946
EUVSC_P3 (EUVS-C Science Packet #3 – science and engineering data)	947
EUVSC_P4 (EUVS-C Science Packet #4 – science and engineering data)	948
EUVSC_P5 (EUVS-C Science Packet #5 – science and engineering data)	949
EUVSC_P6 (EUVS-C Science Packet #6 – science and engineering data)	950
EUVSC_P7 (EUVS-C Science Packet #7 – science and engineering data)	951
EVTMSG (Event Message – housekeeping/diagnostic data)	896
IDAC (IDAC Diagnostic – housekeeping/diagnostic)	913
MEMORY (Memory Diagnostic – housekeeping/diagnostic)	909
RFAST (RAM Fast – housekeeping data)	899
RMED (RAM Medium – housekeeping data)	901
RSLOW (RAM Slow – housekeeping data)	903
RSYSTEM (RAM System Diagnostic – housekeeping data)	905
SPS (Solar Positioning Sensor – science and engineering data)	928
TABLE (Table Diagnostic – housekeeping/diagnostic data)	910
TM_DRFT (Time Drift Diagnostic – housekeeping/diagnostic data)	908

XRS (XRS – science and engineering data)	929
Spacecraft Telemetry (Packet Name)	APID (decimal)
Attitude and Orbit Telemetry	384
Angular Rate Telemetry	385
Eclipse Flag	173
SUVI Roll Angle Error	173
Yaw Flip Flag	164
Solar Array Current 1 – 4	151
Solar Array Current 5 – 8	151
Solar Array Current 9 – 12	151
Solar Array Current 13 – 16	151

The format, approach to populating time fields used for cataloguing, and uncorrectable downlink errors metadata are identical for each of the instrument-specific Level 0 product files. These characteristics are defined above in Paragraph 3.0, Level 0 Products Overview and Characteristics.

The detailed description of the ISO series metadata for the EXIS Level 0 product is located in Appendix X, ISO Series Metadata.

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4.2.2 Data Fields

The EXIS Level 0 product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow.

The filename conventions for the EXIS Level 0 product are located in Appendix A.

Table 4.2.2-1 EXIS Level 0 Product: Global Attributes

Global Attribute Name	Value	Type
id	<i>universally unique identifier (UUID) for the instance of the product.</i>	string
dataset_name	<i>refer to filename conventions for L0 products in Appendix A. Default values are noted in Appendix A.</i>	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	542948c0-a561-11e4-bcd8-0800200c9a66	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
title	EXIS L0 Raw Packet Data	string
summary	CCSDS science, housekeeping, and diagnostic telemetry data packets received from the EXIS, including the EUVS, XRS, and SPS, and orbit and attitude telemetry data packets received from the spacecraft.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	SPECTRAL/ENGINEERING > ULTRAVIOLET WAVELENGTHS > SENSOR COUNTS, SPECTRAL/ENGINEERING > X-RAY > SENSOR COUNTS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > THERMAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > ELECTRICAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > VIEWING GEOMETRY, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ORBITAL CHARACTERISTICS, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ATTITUDE CHARACTERISTICS	string
orbital_slot	<i>possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.</i>	string
platform_ID	<i>possible values are G16 and G17.</i>	string
instrument_type	GOES-R Series Extreme Ultraviolet and X-ray Irradiance Sensor	string
EUVS_instrument_ID	<i>serial number of the EXIS EUVS instrument (sensor).</i>	string
XRS_instrument_ID	<i>serial number of the EXIS XRS instrument (sensor).</i>	string

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Global Attribute Name	Value	Type
processing_level	National Aeronautics and Space Administration (NASA) L0	string
date_created	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.OZ</i>	string
production_site	<i>possible values are WCDAS and RBU.</i>	string
production_environment	<i>possible values are OE, ITE, and DE. Default value is n/a</i>	string
production_data_source	<i>possible values are Realtime, Simulated, Playback, and Test. Default value is n/a</i>	string
time_coverage_start	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.OZ</i>	string
time_coverage_end	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.OZ</i>	string

Table 4.2.2-2 EXIS Level 0 Product: Variables

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
offset_to_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte offset for each downlinked EXIS or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	0 2147483628	int
			units	1	string
size_of_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte count for each downlinked EXIS or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	20 256	int
			units	count	string
exis_space_packet_data	byte	<i>number_of_data_bytes = unlimited</i>	long_name	EXIS or spacecraft orbit and attitude CCSDS level 0 packet data	string
			_Unsigned	TRUE	string
			units	1	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float

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Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	percent	string
product_version_containe r	int	n/a	long_name	container for product version	string
			product_ver sion	<i>format is vVVrRR where VV is major release # and RR is minor revision #.</i>	string

4.3 GLM Level 0 Product

4.3.1 Description

The GLM Level 0 product contains CCSDS science, including lightning event, housekeeping, engineering, and diagnostic telemetry data packets received from the GLM, and orbit and attitude, and attitude angular rate telemetry data packets received from the spacecraft. The range of CCSDS Application Identifiers (APIDs) used in the GLM telemetry packets is defined in Table 4.3.1, GLM L0 Product APIDs.

Table 4.2.1 lists all of the L0 packets (APIDS) that may be present in the L0 EXIS data. Data listed as housekeeping means that the telemetry packet is flight software status information and flight hardware analog and status information. Engineering is a subset of housekeeping required to successfully process science data into data products. Science Data is data produced by the detector channels.

Table 4.3.1 GLM L0 Product APIDs

Telemetry Packet Name	APID (Decimal)	Category
Memory Dump	520	Diagnostic
Software Profiler	521	Diagnostic
Spare	522	Diagnostic
Spare	523	Diagnostic
Filesystem Listing	524	Diagnostic
File Echo	525	Diagnostic
Real-Time Event Processor (RTEP) Event Packet	600	Science
Background Packet	601	Science
Time code Packet	602	Science
SpaceWire ASIC Read-Only Memory (SWAROM) Housekeeping	700	Housekeeping & Engineering
GLM Custom Housekeeping	701	Housekeeping & Engineering
SWAROM Software Status	710	Housekeeping & Engineering
Spare	711	Housekeeping & Engineering
Spare	712	Housekeeping & Engineering
GLM Custom Monitors	713	Housekeeping & Engineering
GLM Custom Software Status		
Real-Time Event Messages	760	Event Message
Spacecraft Telemetry (Packet Name)	APID (decimal)	
Attitude and Orbit Telemetry	384	
Angular Rate Telemetry	385	
Eclipse Flag	173	
SUVI Roll Angle Error	173	
Yaw Flip Flag	164	

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Solar Array Current 1 – 4	151	
Solar Array Current 5 – 8	151	
Solar Array Current 9 – 12	151	
Solar Array Current 13 – 16	151	

The format, approach to populating time fields used for cataloguing, and uncorrectable downlink errors metadata are identical for each of the instrument-specific Level 0 product files. These characteristics are defined above in Paragraph 3.0, Level 0 Products Overview and Characteristics.

The detailed description of the ISO series metadata for the GLM Level 0 product is located in Appendix X, ISO Series Metadata.

4.3.2 Data Fields

The GLM Level 0 product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. The filename conventions for the GLM Level 0 product are located in Appendix A.

Table 4.3.2-1 GLM Level 0 Product: Global Attributes

Global Attribute Name	Value	Type
id	<i>universally unique identifier (UUID) for the instance of the product.</i>	string
dataset_name	<i>refer to filename conventions for L0 products in Appendix A. Default values are noted in Appendix A.</i>	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	f82fc080-a560-11e4-bcd8-0800200c9a66	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
title	GLM L0 Raw Packet Data	string
summary	CCSDS science, including lightning event, housekeeping, engineering, and diagnostic telemetry data packets received from the GLM, and orbit and attitude telemetry data packets received from the spacecraft.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	SPECTRAL/ENGINEERING > VISIBLE WAVELENGTHS > SENSOR COUNTS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > THERMAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > ELECTRICAL PROPERTIES, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ORBITAL CHARACTERISTICS, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ATTITUDE CHARACTERISTICS	string
orbital_slot	<i>possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.</i>	string
platform_ID	<i>possible values are G16 and G17.</i>	string
instrument_type	GOES-R Series Geostationary Lightning Mapper	string
instrument_ID	<i>serial number of the instrument.</i>	string
processing_level	National Aeronautics and Space Administration (NASA) L0	string

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Global Attribute Name	Value	Type
date_created	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string
production_site	<i>possible values are WCDAS and RBU.</i>	string
production_environment	<i>possible values are OE, ITE, and DE. Default value is n/a</i>	string
production_data_source	<i>possible values are Realtime, Simulated, Playback, and Test. Default value is n/a</i>	string
time_coverage_start	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string
time_coverage_end	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string

Table 4.3.2-2 GLM Level 0 Product: Variables

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
offset_to_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte offset for each downlinked GLM or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	0 2147483628	int
			units	1	string
size_of_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte count for each downlinked GLM or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	20 8198	int
			units	count	string
glm_space_packet_data	byte	<i>number_of_data_bytes = unlimited</i>	long_name	GLM or spacecraft orbit and attitude CCSDS level 0 packet data	string
			_Unsigned	TRUE	string
			units	1	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string

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Variable			Attribute		
Name	Type	Shape	Name	Value	Type
product_version_container	int	n/a	long_name	container for product version	string
			product_version	<i>format is vVVrRR where VV is major release # and RR is minor revision #.</i>	string

4.4 Magnetometer Level 0 Product

4.4.1 Description

The Magnetometer Level 0 product contains CCSDS science, engineering, and diagnostic telemetry data packets received from the Magnetometer, and orbit and attitude, and eclipse of the sun related and yaw flip state telemetry data packets received from the spacecraft. The range of CCSDS Application Identifiers (APIDs) used in the Magnetometer telemetry packets is defined in Table 4.4.1, Magnetometer L0 Product APIDs.

Table 4.4.1 Magnetometer L0 Product APIDs

Packet Name (Magnetometer sub-allocation in spacecraft allocation)	APID (decimal)
MAG 1 & 2 science data	200
MAG Maintenance Mode Data	201
Spare APIDs (MAG data is in certain bit locations)	202
Spacecraft Telemetry (Packet Name)	APID (decimal)
Attitude and Orbit Telemetry	384
Angular Rate Telemetry	385
Eclipse Flag	173
SUVI Roll Angle Error	173
Yaw Flip Flag	164
Solar Array Current 1 – 4	151
Solar Array Current 5 – 8	151
Solar Array Current 9 – 12	151
Solar Array Current 13 – 16	151

The format, approach to populating time fields used for cataloguing, and uncorrectable downlink errors metadata are identical for each of the instrument-specific Level 0 product files. These characteristics are defined above in Paragraph 3.0, Level 0 Products Overview and Characteristics.

The detailed description of the ISO series metadata for the Magnetometer Level 0 product is located in Appendix X, ISO Series Metadata.

4.4.2 Data Fields

The Magnetometer Level 0 product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow.

The filename conventions for the Magnetometer Level 0 product are located in Appendix A.

Table 4.4.2-1 Magnetometer Level 0 Product: Global Attributes

Global Attribute Name	Value	Type
id	<i>universally unique identifier (UUID) for the instance of the product.</i>	string
dataset_name	<i>refer to filename conventions for L0 products in Appendix A. Default values are noted in Appendix A.</i>	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	389e80c0-a561-11e4-bcd8-0800200c9a66	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0	string
title	Magnetometer L0 Raw Packet Data	string
summary	CCSDS science, engineering, and diagnostic telemetry data packets received from the inboard and outboard Magnetometer, and orbit and attitude telemetry data packets received from the spacecraft.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	SUN-EARTH INTERACTIONS > IONOSPHERE/MAGNETOSPHERE DYNAMICS > SENSOR COUNTS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > THERMAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > ELECTRICAL PROPERTIES, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ORBITAL CHARACTERISTICS, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ATTITUDE CHARACTERISTICS	string
orbital_slot	<i>possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.</i>	string
platform_ID	<i>possible values are G16 and G17.</i>	string
instrument_type	GOES-R Series Magnetometer	string

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Global Attribute Name	Value	Type
inboard_MAG_instrument_ID	<i>serial number of the inboard magnetometer.</i>	string
outboard_MAG_instrument_ID	<i>serial number of the inboard magnetometer.</i>	string
processing_level	National Aeronautics and Space Administration (NASA) L0	string
date_created	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string
production_site	<i>possible values are WCDAS and RBU.</i>	string
production_environment	<i>possible values are OE, ITE, and DE. Default value is n/a</i>	string
production_data_source	<i>possible values are Realtime, Simulated, Playback, and Test. Default value is n/a</i>	string
time_coverage_start	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string
time_coverage_end	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string

Table 4.4.2-2 Magnetometer Level 0 Product: Variables

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
offset_to_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte offset for each downlinked Magnetometer or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	0 2147483628	int
			units	1	string
size_of_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte count for each downlinked Magnetometer or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	20 256	int
			units	count	string
mag_space_packet_data	byte	<i>number_of_data_bytes = unlimited</i>	long_name	Magnetometer or spacecraft orbit and attitude CCSDS level 0 packet data	string
			_Unsigned	TRUE	string

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Variable			Attribute		
Name	Type	Shape	Name	Value	Type
			units	1	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
product_version_container	int	n/a	long_name	container for product version	string
			product_version	<i>format is vVvRR where VV is major release # and RR is minor revision #.</i>	string

4.5 SEISS Level 0 Product

4.5.1 Description

The SEISS Level 0 product contains CCSDS science, housekeeping, engineering, error log, log (non-error) and memory dump telemetry data packets received from the SEISS, as well as orbit and attitude, and eclipse of the sun related and yaw flip state telemetry data packets received from the spacecraft. The values of CCSDS Application Identifiers (APIDs) used in the SEISS telemetry packets is defined in Table 4.5.1, SEISS L0 Product APIDs.

Table 4.5.1 SEISS L0 Product APIDs

Packet Name (category)	APID (decimal)
DPU Engineering (Engineering)	1025
DPU Memory Dump (Memory Dump)	1026
DPU Logger (Log)	1027
DPU Test Report (Engineering)	1028
DPU Error (Error Log)	1029
DPU Housekeeping (Housekeeping)	1030
DPU Memory CRC (Engineering)	1031
DPU Autonomous Function Low Limit (Engineering)	1032
DPU Autonomous Function High Limit (Engineering)	1052
SGPS+X Engineering (Engineering)	1033
SGPS+X Science (Science)	1034
SGPS-X Engineering (Engineering)	1035
SGPS-X Science (Science)	1036
MPS-LO Engineering (Engineering)	1037
MPS-LO Science-1 (Science)	1038
MPS-LO Science-2 (Science)	1039
MPS-LO Science-3 (Science)	1040
MPS-LO Science-4 (Science)	1041
MPS-LO Science-5 (Science)	1042
MPS-HI Engineering (Engineering)	1043

Packet Name (category)	APID (decimal)
MPS-HI Science-1 (Science)	1044
MPS-HI Science-2 (Science)	1045
MPS-HI Science-3 (Science)	1046
MPS-HI Science-4 (Science)	1047
MPS-HI Science-5 (Science)	1048
EHIS Engineering (Engineering)	1049
EHIS Science (Science)	1050
EHIS Memory Dump (Memory Dump)	1051
Spacecraft Telemetry (Packet Name)	APID (decimal)
Attitude and Orbit Telemetry	384
Angular Rate Telemetry	385
Eclipse Flag	173
SUVI Roll Angle Error	173
Yaw Flip Flag	164
Solar Array Current 1 – 4	151
Solar Array Current 5 – 8	151
Solar Array Current 9 – 12	151
Solar Array Current 13 – 16	151

The format, approach to populating time fields used for cataloguing, and uncorrectable downlink errors metadata are identical for each of the instrument-specific Level 0 product files. These characteristics are defined above in Paragraph 3.0, Level 0 Products Overview and Characteristics.

The detailed description of the ISO series metadata for the SEISS Level 0 product is located in Appendix X, ISO Series Metadata.

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4.5.2 Data Fields

The SEISS Level 0 product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow. The filename conventions for the SEISS Level 0 product are located in Appendix A.

Table 4.5.2-1 SEISS Level 0 Product: Global Attributes

Global Attribute Name	Value	Type
id	<i>universally unique identifier (UUID) for the instance of the product.</i>	string
dataset_name	<i>refer to filename conventions for L0 products in Appendix A. Default values are noted in Appendix A.</i>	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	85e0f200-a561-11e4-bcd8-0800200c9a66	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
title	SEISS L0 Raw Packet Data	string
summary	CCSDS science, housekeeping, engineering, and diagnostic telemetry data packets received from the SEISS, including the EHIS, MPS-HI, MPS-LO and SGPS, and orbit and attitude telemetry data packets received from the spacecraft.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	SUN-EARTH INTERACTIONS > IONOSPHERE/MAGNETOSPHERE DYNAMICS > SENSOR COUNTS, SUN-EARTH INTERACTIONS > SOLAR ENERGETIC PARTICLE FLUX > SENSOR COUNTS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > THERMAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > ELECTRICAL PROPERTIES, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ORBITAL CHARACTERISTICS, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ATTITUDE CHARACTERISTICS	string
orbital_slot	<i>possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.</i>	string
platform_ID	<i>possible values are G16 and G17.</i>	string
instrument_type	GOES-R Series Space Environment In-Situ Suite	string
EHIS_instrument_ID	<i>serial number of the SEISS EHIS instrument (sensor).</i>	string
MPS-HI_instrument_ID	<i>serial number of the SEISS MPS-HI instrument (sensor).</i>	string

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Global Attribute Name	Value	Type
MPS-LO_instrument_ID	<i>serial number of the SEISS MPS-LO instrument (sensor).</i>	string
SGPS-X_instrument_ID	<i>serial number of the SEISS SGPS-X instrument (sensor).</i>	string
SGPS+X_instrument_ID	<i>serial number of the SEISS SGPS+X instrument (sensor).</i>	string
processing_level	National Aeronautics and Space Administration (NASA) L0	string
date_created	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string
production_site	<i>possible values are WCDAS and RBU.</i>	string
production_environment	<i>possible values are OE, ITE, and DE. Default value is n/a</i>	string
production_data_source	<i>possible values are Realtime, Simulated, Playback, and Test. Default value is n/a</i>	string
time_coverage_start	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string
time_coverage_end	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string

Table 4.5.2-2 SEISS Level 0 Product: Variables

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
offset_to_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte offset for each downlinked SEISS or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	0 2147483628	int
			units	1	string
size_of_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte count for each downlinked SEISS or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	20 475	int
			units	count	string
seiss_space_packet_data	byte	<i>number_of_data_bytes = unlimited</i>	long_name	SEISS or spacecraft orbit and attitude CCSDS level 0 packet data	string
			_Unsigned	TRUE	string
			units	1	string

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Variable			Attribute		
Name	Type	Shape	Name	Value	Type
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
product_version_container	int	n/a	long_name	container for product version	string
			product_version	<i>format is vVVrRR where VV is major release # and RR is minor revision #.</i>	string

4.6 SUVI Level 0 Product

4.6.1 Description

The SUVI Level 0 product contains science, housekeeping and engineering, guide telescope, diagnostic data, event message, and memory dump telemetry data packets received from the SUVI, as well as orbit, and eclipse of the sun related and yaw flip state telemetry data packets received from the spacecraft. The range of CCSDS Application Identifiers (APIDs) used in the SUVI telemetry packets is defined in Table 4.6.1, SUVI L0 Product APIDs.

Table 4.6.1 SUVI L0 Product APID

Packet Name	APID (decimal)
Kernel Housekeeping Data	782
FSA Housekeeping Data	783
Kernel Engineering Data	784
FSA Engineering Data	785
Kernel Engineering Data-2	786
FSA Engineering Data-2	787
Kernel Test Packet	791
Thermal Data (Heater configuration and status)	793
Limit Monitor Data	794
Mechanism Data	795
Guide Telescope Sample Data	796
Sequencer Data	799
Image Summary Packet	800
Image Data (Science/Test)	801
Image Data (Dark Images)	802
Image Data (Front filter light leak – Trending)	803
Image Data (Analysis filter light leak – Trending)	804
Image Data (Flat field)	808
Test (Flat field images – not for L1b processing)	809
Image Data	810

Packet Name	APID (decimal)
Image Data (GT/ET Cross calibration / Post eclipse)	811
Image Data (light Transfer curve (LTC) images)	812
Image Data (Yaw flip)	813
Image Data (Bakeout)	814
Image Data (Focus)	815
SWAROM Housekeeping Data	816
File Dump Data	820
Diagnostic Data	822
Run Time Reports	823
Memory Dump Data	825
Event Messages	826
Guide Telescope Data	827
SUROM Dump Data	828
SUROM Status Telemetry (Housekeeping)	829
SWAROM Dump Data	830
SWAROM Status Telemetry (Engineering)	831
Reserved for Housekeeping APIDS	832 – 839
Image Data (Dark Image)	848
Reserved (Calibration)	849
Image Data (LED Image)	850
Reserved Calibration APIDs	851 – 857
Image Data (Off-point image)	858
Image Data (Flat Field image)	859
Reserved (Calibration)	860 – 863
Reserved (Calibration)	864 – 867
Reserved Science APIDs	868 – 879

Packet Name	APID (decimal)
Reserved Engineering APIDs	880 - 895
Spacecraft Telemetry (Packet Name)	APID (decimal)
Attitude and Orbit Telemetry	384
Angular Rate Telemetry	385
Eclipse Flag	173
SUVI Roll Angle Error	173
Yaw Flip Flag	164
Solar Array Current 1 – 4	151
Solar Array Current 5 – 8	151
Solar Array Current 9 – 12	151
Solar Array Current 13 – 16	151

The format, approach to populating time fields used for cataloguing, and uncorrectable downlink errors metadata are identical for each of the instrument-specific Level 0 product files. These characteristics are defined above in Paragraph 3.0, Level 0 Products Overview and Characteristics.

The detailed description of the ISO series metadata for the SUVI Level 0 product is located in Appendix X, ISO Series Metadata.

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4.6.2 Data Fields

The SUVI Level 0 product is delivered using the netCDF-4 file format. Its global attributes and the variables are defined in the tables that follow.

The filename conventions for the SUVI Level 0 product are located in Appendix A.

Table 4.6.2-1 SUVI Level 0 Product: Global Attributes

Global Attribute Name	Value	Type
id	<i>universally unique identifier (UUID) for the instance of the product.</i>	string
dataset_name	<i>refer to filename conventions for L0 products in Appendix A. Default values are noted in Appendix A.</i>	string
naming_authority	gov.nesdis.noaa	string
institution	DOC/NOAA/NESDIS> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Services	string
project	GOES	string
iso_series_metadata_id	1a47ee90-a561-11e4-bcd8-0800200c9a66	string
Metadata_Conventions	Unidata Dataset Discovery v1.0	string
keywords_vocabulary	NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 7.0.0.0.0	string
title	SUVI L0 Raw Packet Data	string
summary	CCSDS science, including processed guide telescope, housekeeping, including event message, engineering, and diagnostic telemetry data packets received from the SUVI, and orbit and attitude telemetry data packets received from the spacecraft.	string
license	Unclassified data. Access is restricted to approved users only.	string
keywords	SPECTRAL/ENGINEERING > ULTRAVIOLET WAVELENGTHS > SENSOR COUNTS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > THERMAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > ELECTRICAL PROPERTIES, SPECTRAL/ENGINEERING > SENSOR CHARACTERISTICS > VIEWING GEOMETRY, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ORBITAL CHARACTERISTICS, SPECTRAL/ENGINEERING > PLATFORM CHARACTERISTICS > ATTITUDE CHARACTERISTICS	string
orbital_slot	<i>possible values are GOES-East, GOES-West, GOES-Test, and GOES-Storage.</i>	string
platform_ID	<i>possible values are G16 and G17.</i>	string
instrument_type	GOES-R Series Solar Ultraviolet Imager	string
instrument_ID	<i>serial number of the instrument.</i>	string
processing_level	National Aeronautics and Space Administration (NASA) L0	string
date_created	<i>format is YYYY-MM-DD" T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string

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Global Attribute Name	Value	Type
production_site	<i>possible values are WCDAS and RBU.</i>	string
production_environment	<i>possible values are OE, ITE, and DE. Default value is n/a</i>	string
production_data_source	<i>possible values are Realtime, Simulated, Playback, and Test. Default value is n/a</i>	string
time_coverage_start	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string
time_coverage_end	<i>format is YYYY-MM-DD"T"HH:MM:SS.s"Z". Default value is 2000-01-00T00:00:00.0Z</i>	string

Table 4.6.2-2 SUVI Level 0 Product: Variables

Variable			Attribute		
Name	Type	Shape	Name	Value	Type
offset_to_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte offset for each downlinked SUVI or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	0 2147483628	int
			units	1	string
size_of_packet	int	<i>number_of_packets = unlimited</i>	long_name	byte count for each downlinked SUVI or spacecraft orbit and attitude CCSDS packet	string
			_FillValue	-1	int
			valid_range	20 8198	int
			units	count	string
suvi_space_packet_data	byte	<i>number_of_data_bytes = unlimited</i>	long_name	SUVI or spacecraft orbit and attitude CCSDS level 0 packet data	string
			_Unsigned	TRUE	string
			units	1	string
percent_uncorrectable_L0_errors	float	n/a	long_name	percent data lost due to uncorrectable L0 errors	string
			_FillValue	-999	float
			valid_range	0.0 1.0	float
			units	percent	string
	int	n/a	long_name	container for product version	string

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Variable			Attribute		
Name	Type	Shape	Name	Value	Type
product_version_containe r			product_ver sion	<i>format is vVVrRR where VV is major release # and RR is minor revision #.</i>	string

APPENDIX A L0 PRODUCT FILENAME CONVENTIONS

The main volume of the PUG contains a summary level description of the filename conventions used for all GOES-R product and data files. This appendix contains the detailed filename conventions for Level 0 products defined in this volume of the PUG.

As discussed in the main volume of the PUG, filenames consist of a set of string fields delimited by an underscore or a period that are concatenated together. The content and format of several of the filename string fields are common across more than one of the Level 0 product filenames. Refer to Table A-1, Common Filename String Fields.

Table A-1 Common Filename String Fields

Common String Field	Description	Values and Meanings
System Environment	Defines whether the file is created by the operational system or a test system. Also defines whether the data in the file is real-time, test, playback, or simulated data.	<p>“OR” = operational system real-time data “OT” = operational system test data “IR” = test system real-time data “IT” = test system test data “IP” = test system playback data “IS” = test system simulated data</p> <p>Note: Real-time data created by the operational system (i.e., “OR”) support the operational mission. Default value is “OR”.</p>
Data Short Name	Product identifier	(See Table A.1)
Platform Identifier	Identifies the applicable GOES-R series satellite.	<p>“G16” = GOES-16 (R) “G17” = GOES-17 (S) Default value is “Gnn”</p>
Level 0 Data File Date & Time	Time stamps from the first and last CCSDS packets contained in the file.	<p>“sYYYYDDDDHHMMSSs” = start date & time “eYYYYDDDDHHMMSSs” = end date & time</p> <p>Notes:</p> <ul style="list-style-type: none"> ➤ YYYY = year: e.g., 2015 ➤ DDD = day of year: 001-366 ➤ HH = UTC hour of day: 00-23 ➤ SSs = second of minute: 00-60 (60 indicates leap second and third “s” is tenth of second)
Level 0 Data File Creation Date & Time	Date & time the file is created.	<p>“cYYYYDDDDHHMMSSs”</p> <p>Notes:</p> <ul style="list-style-type: none"> ➤ YYYY = year: e.g., 2015 ➤ DDD = day of year: 001-366 ➤ HH = UTC hour of day: 00-23 ➤ MM = minute of hour: 00-59 ➤ SSs = second of minute: 00-59 (60 indicates leap second and third “s” is tenth of second) <p>Default value for all three time stamps (start-, end-, and create-date) is “20000011200000”.</p>

A.1 Level 0 Product Filenames

Level 0 product filenames are assembled using filename string fields as follows:

*<System Environment>_<DSN>_<Platform ID>_<Observation Period Start Date & Time>
 <Observation Period End Date & Time><Creation Date & Time>.<File Extension>*

The string fields other than Data Short Name (DSN) and file extension are defined above in Table A-1, Common Filename String Fields. The Data Short Names for Level 0 products are defined in Table A.1.

Table A.1 Level 0 Product File Data Short Names

Level 0 Product File Type	Data Short Name
Advanced Baseline Imager (ABI)	ABI-L0-xxx, Where xxx = “-T03” for Timeline ID 3 (ABI Mode 3) “-T04” for Timeline ID 4 (ABI Mode 4) “-T05” for Timeline ID 5 (ABI Mode 6) “-T01” through “-T63” for non-operational Timelines
Geostationary Lightning Mapper (GLM)	GLM-L0
Solar Ultraviolet Imager (SUVI)	SUVI-L0
Extreme Ultraviolet and X-ray Irradiance Sensor (EXIS)	EXIS-L0
Space Environment In-Situ Suite (SEISS)	SEIS-L0
Magnetometer (MAG)	MAG-L0

The file extension for a Level 0 product file is “.nc” (netCDF-4 file).

The filename for a GOES R satellite operational GLM Level 0 product on February 4, 2016 with an observation start and end time of midnight UTC, and 12 minutes past midnight, respectively, with a file creation time of 15 minutes past midnight is:

“OR_GLM-L0_G16_s20160350000000_e20160350012000_c20160350015000.nc”.

Example file name containing all possible default values (in italics):

“*OR_GLM-L0_Gnn_s20000011200000_e20000011200000_c20000011200000.nc*”

A.2 Level 0 ISO Series Metadata File Naming Convention

Table A-2 L0 ISO Series Naming Convention

Field Name	Description	Values and Meanings
System Environment	Defines whether the file is created by the operational system or a test system. Also	“OR” = operational system real-time data “OT” = operational system test data “IR” = test system real-time data “IT” = test system test data

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	defines whether the data in the file is real-time or test.	Default value is "OR".
Data Short Name	Product identifier	"_ABI" = Advanced Baseline Imager "_GLM" = Geostationary Lightning Mapper "_EXIS" = Extreme Ultra-Violet/X-Ray Irradiance Sensors "_SEIS" = Space Environment In-Situ Suite "_MAG" = Magnetometer "_SUVI" = Solar Ultraviolet Imager
		This sub-field is always preceded by a dash, "-". Valid value is: "-L0"
		This sub-field is always preceded by a dash, "-". ISO Series identifier that is: "-ISO-SERIES"
Creation Date & Time	Identifies the Date and Time when the product level metadata was produced. Starts with an underscore "_" followed by a letter "c" followed by a subfield for the UTC Date and Time (to tenth of second).	"_c"<YYYYDDDhhmmsst> The subfield format for the date includes: YYYY = Year (4 characters: 0001-9999) DDD = Day of the year (3 characters: 001-366) hh = Hours (2 characters: 00-23) mm = Minutes (2 characters: 00-59) ss = Seconds (2 characters: 00-59) t = tenths of seconds (1 character: 0 – 9)
Extension	Identifies the file extension.	".xml" = XML

Example file name: OR_ABI-L0-ISO-SERIES_c20162881413000.xml