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LANDSAT 8 (L8) CALIBRATION PARAMETER FILE (CPF) DATA FORMAT CONTROL BOOK (DFCB)

Version 9.0

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Executive Summary

This document describes the contents of the Calibration Parameter File (CPF) generated by the Image Assessment System (IAS) for the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). The IAS periodically updates the CPF. This file is stamped with applicability dates and is published, allowing systems or individuals who require the file to access it. The CPF is also available to International Ground Stations (IGSs) and customers via the Landsat Mission Web Site (LMWS). The CPF supplies the radiometric and geometric correction parameters and other pertinent parameters required during Level 0 (L0) and Level 1 (L1) processing to create products of uniform consistency.

This document also describes the Response Linearization Look Up Table (RLUT). The values contained in the table are a product of the Non-Linear Response Characterization used to correct the non-linear relationship between the input signal and the Digital Number (DN) value at the output of the OLI and TIRS instruments.

Document History

Document Number	Document Version	Publication Date	Change Number
LDCM-DFCB-005	Version 1.0	February 2010	CCR# 113
LDCM-DFCB-005	Version 2.0	May 2011	CCR# 229
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LDCM-DFCB-005	Version 4.0	August 2012	DCR# 1017
LDCM-DFCB-005	Version 5.0	April 2013	DCR# 1268
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LSDS-810	Version 8.0	November 2015	CR# 12552
LSDS-810	Version 9.0	February 2017	CR# 13206

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Section 1 Introduction

This document describes the contents of the Calibration Parameter File (CPF) and the Response Linearization Look Up Table (RLUT) generated by the Image Assessment System (IAS). The IAS assesses image quality to ensure compliance with the radiometric and geometric requirements of the Landsat 8 spacecraft and the Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) sensors throughout the life of the mission. The RLUT is an extension of the CPF that contains coefficients used to linearize the output of the OLI and TIRS detectors.

The IAS periodically performs radiometric and geometric calibration to provide updates to the CPF file. This file is stamped with applicability dates and is archived at the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center. The Project makes the CPF available to the Level 0 (L0) and Level 1 (L1) production systems, International Ground Stations (IGSs), and customers through an Online Cache system.

1.1 Document Organization

This document contains the following sections:

- Section 1 provides an introduction.
- Section 2 describes the CPF file structure, updates, and file-naming conventions, and contains a table that lists and describes the actual CPF parameters.
- Section 3 describes the RLUT file structure, updates, and file-naming conventions, and contains a table that lists and describes the RLUT file contents.
- The References section contains a list of reference documents.

Section 2 Calibration Parameter File (CPF) File

2.1 Description

All parameters are stored as American Standard Code for Information Interchange (ASCII) text using the Object Description Language (ODL) syntax developed by Jet Propulsion Laboratory (JPL). ODL is a tagged keyword language developed to provide a human-readable data structure to encode data for simplified interchange. In certain cases, the ODL interpreter developed by JPL may provide for the handling of lexical elements (for example, building blocks) included in the Consultative Committee for Space Data Systems (CCSDS) specification of the Parameter Value Language (PVL).

The body of the file contains two statement types:

- Group statements – aid in file organization and enhances parsing granularity of parameter sets
- Attribute assignment statements – assign values to parameters

The ODL structure allows nesting of parameter groups; however, for simplicity, the nesting of parameter groups in the CPF is prohibited.

2.1.1 ODL Syntax

The ODL syntax employs the following conventions:

- The parameter definition is in the form of “parameter = value.”
- The value can be either a scalar or an array. Array values are enclosed in parentheses and are separated by commas.
- Parameter arrays can exist on multiple lines.
- Line feeds <LF> are at the end of each line in the file.
- Blank spaces and lines are ignored.
- Each line of comments must begin with /* and end with */, including comments embedded on the same line as a parameter definition.
- Quotation marks are required for values that are text strings, including single characters. The exceptions to this rule are the GROUP and END_GROUP identifiers or values, which do not use quotation marks. The use of double quotation marks is optional for parameters with date / time values. ODL recognizes dates if they follow prescribed formats.
- In general, for ODL, case is not significant. However, for the CPF, case is significant for parameter and group names. All group names are in upper-case letters and parameters are in mixed case.
- Indentation is not significant but is used for readability.
- The reserved word END concludes the file.
- Most parameter values were derived during prelaunch instrument and spacecraft testing and analysis.
- Formats for CPF numerical parameters are accurate; however, negative signs are not explicitly stated.

- Parameter groups are not nested.

2.2 Effective Dates

The CPF is time-stamped with an effective date range. The parameters in the file—Effective_Date_Begin and Effective_Date_End—designate the range of valid acquisition dates and are in YYYY-MM-DDThh:mm:ss format (ISO 8601). The parameter file used in processing an image requires an effective date range that includes the acquisition date of the ordered image.

2.3 File-Naming Convention

Through the course of the mission, a serial collection of CPFs is generated and made available for distribution. The probability exists that a CPF will be replaced due to improved calibration parameters for a given period, or perhaps due to file error. The collection number is used to determine the collection version. Unique file version numbers are needed as file contents change. The unique 00 version number is for the original CPF, which was created before launch. Version numbers for all effective date ranges after the launch begin with 01.

The IAS uses the file-naming example depicted in Table 2-1.

LC08CPF_yyyy^{1}mm^{1}dd^1_yyyy^{2}mm^2 dd^2_cc.nn	
L	Constant for Landsat
C	Sensor (C = combined OLI and TIRS)
08	Satellite numerical representation
CPF	Three-letter CPF designator
_	CPF designator / starting date separator
yyyy^1	Four-digit effective starting year
mm^1	Two-digit effective starting month
dd^1	Two-digit effective starting day
_	Effective starting / ending date separator
yyyy^2	Four-digit effective ending year
mm^2	Two-digit effective ending month
dd^2	Two-digit effective ending day
_	Ending date / collection number separator
cc	Collection number (starts with 01)
.	Collection number / version number separator
nn	Version number for this file (starts with 00)

Table 2-1. CPF Naming Convention

For example, if the IAS created four CPFs at three-month intervals, and updated the first file twice and the second and third files once in 2012, the assigned file names would be as follows:

File 1 LC08CPF_20120101_20120331_01.01
LC08CPF_20120101_20120331_01.02
LC08CPF_20120101_20120331_01.03
File 2 LC08CPF_20120401_20120630_01.01

LC08CPF_20120401_20120630_01.02
File 3 LC08CPF_20120701_20120930_01.01
LC08CPF_20120701_20120930_01.02
File 4 LC08CPF_20121001_20121231_01.01

This example assumes that the effective date ranges do not change. The effective date range for a file can change if a specific problem (e.g., detector outage) is discovered within the nominal effective range. Assuming this scenario, two CPFs with new names and effective date ranges are created for the period under consideration. The Effective_Date_End for a new pre-problem CPF would change to the day before the problem occurred, while the Effective_Date_Begin remains unchanged.

A post-problem CPF with a new file name would be created with the Effective_Date_Begin corresponding to the imaging date when the problem occurred and the Effective_Date_End corresponding to the original Effective_Date_End for the period under consideration. New versions of all other CPFs affected by the updated parameters also would be created.

For example, assume a detector stopped responding on July 25, 2012. Two new CPFs need to be created that supersede the period represented by file number three, version two, and a new version of file number four. The new file names and version numbers become the following:

File 3 LC08CPF_20120701_20120930_01.01
LC08CPF_20120701_20120930_01.02
LC08CPF_20120701_20120724_01.03
LC08CPF_20120725_20120930_01.03
File 4 LC08CPF_20121001_20121231_01.01
LC08CPF_20121001_20121231_01.01

2.4 CPF File Updates

Only the most recent CPF should be used in OLI and TIRS data processing. At launch, the CPF contains values derived from prelaunch test data. The CPF is updated on a predetermined schedule and as circumstances or events require.

2.5 Parameters

Table 2-3 lists the parameters that make up the CPF file. The group / parameters are listed in alphabetical order to present a sorted list to assist in parameter location. The actual file is not sorted in any particular order, but the FILE_ATTRIBUTES group is at the top. Table 2-3 is a list of the group contents and the parameters that make up the groups, data type, and a brief description.

2.6 File Content Description

Each parameter entry described in Table 2-3 has the following attributes:

- Parameter Group – identifies a related set of parameters.

- Parameter Name – uniquely identifies and describes each parameter's contents. Many parameters are band / Sensor Chip Assembly (SCA) level parameters; therefore, the parameter expands to the number of band / SCA combinations. In those cases, the description attribute signifies the total expansion. Table 2-2 describes the band designators.

Band #	Band	Minimum Lower Band Edge (nm)	Maximum Upper Band Edge (nm)
1	Coastal Aerosol	433	453
2	Blue	450	515
3	Green	525	600
4	Red	630	680
5	Near-Infrared (NIR)	845	885
6	Short Wavelength Infrared (SWIR) 1	1560	1660
7	SWIR 2	2100	2300
8	Panchromatic	500	680
9	Cirrus	1360	1390
10	TIRS Thermal 1	10300	11300
11	TIRS Thermal 2	11500	12500
12	OLI Blind SWIR1	0	0
13	OLI Blind SWIR2	0	0
14	OLI Blind Cirrus	0	0
15	TIRS Blind	0	0
16	TIRS Secondary Thermal 1	0	0
17	TIRS Secondary Thermal 2	0	0
18	TIRS Secondary Blind	0	0
19	Video Reference Pixel (VRP) Coastal Aerosol	433	453
20	VRP Blue	450	515
21	VRP Green	525	600
22	VRP Red	630	680
23	VRP NIR	845	885
24	VRP SWIR1	1560	1660
25	VRP SWIR2	2100	2300
26	VRP Panchromatic	500	680
27	VRP Cirrus	1360	1390
28	OLI VRP Blind SWIR1	0	0
29	OLI VRP Blind SWIR2	0	0
30	OLI VRP Blind Cirrus	0	0

Table 2-2. Band Designator Description

- Datatype – the data type of the parameter and (if an array) the size required.
- Description – briefly describes the parameter, its format, and its nominal, expected, or sample value(s). The valid parameter format for numeric data uses the letters S, N, and E. S stands for the sign and can assume values "+" or "-." If

no sign is specified, the "+" sign is assumed. N stands for any digit between 0 and 9. E stands for scientific (exponential) notation that represents the 'multiplication by 10 raised to the power' specified by the value following the letter E. For example, the valid format "SN.NNNNESNN" can assume any positive or negative value with a significant digit ranging from 0.0 to 9999.99 multiplied by 10 raised to the power of any whole number between -99 and +99 and written as such, +9.9999E-99. The precision of all double values is to six significant digits, unless otherwise specified.

- The groups / parameters listed in Table 2-3 are in alphabetical order for clarity and do not necessarily depict the group / parameter order in the actual file.
- The OLI, TIRS, and TIRS Blind Band groups have been kept separate to make it easier to update sensor-specific parameters, with the following exceptions:
  - Impulse Noise
  - Image-to-Image (I2I) Assessment Trend Threshold Line and Sample
  - Band-to-Band (B2B) Assessment Trend Threshold Line and Sample

Parameter Group	Parameter Name	Datatype	Units	Description
ANCILLARY_ENG_CONV	Gyro_Conv_Angle	Double	Arc-Seconds	The Scalable Inertial Reference Unit (SIRU) integrated angle counts scale factor. Format: N.NN
ANCILLARY_ENG_CONV	Gyro_Conv_Time	Double	Seconds	The SIRU time stamp scale factor. Format: N.NESNN
ANCILLARY_ENG_CONV	Quaternion_Conv_Scalar	Double	Unitless	Quaternion least significant digit. Format: NESNN Default: 1.0E-09
ANCILLARY_ENG_CONV	Quaternion_Conv_Vector	Double	Unitless	Quaternion least significant digit. Format: NESNN Default: 1.0E-09
ANCILLARY_ENG_CONV	Quaternion_Eng_Conv	Double	Unitless	Least significant digit in attitude quaternion fields. Format: NESNN Default: 1.0E-09
ANCILLARY_ENG_CONV	Star_Conv_Intensity	Double	Apparent magnitude	Star tracker star intensity, Low Surface Brightness (LSB). Format: N.NNN
ANCILLARY_ENG_CONV	Star_Conv_Position	Double	Arc-seconds	Star tracker star centroid position, LSB. Format: N.N
ANCILLARY_ENG_CONV	Star_Conv_Time	Double	Seconds	Star tracker time code least significant bit. Format: N.NNN
ANCILLARY_ENG_CONV	TIRS_Integration_Time_Scale	Double	microseconds per count	Scaling factor to convert the TIRS integration time from counts to microseconds
ANCILLARY_ENG_CONV	OLI_Integration_Time_Scale	Double	microseconds per count	Scaling factor to convert the OLI integration time from counts to microseconds
ANCILLARY_ENG_CONV	OLI_Integration_Time_MS_Offset_Nominal	Integer	Counts	Integration time offset nominal for OLI Multispectral (MS) bands
ANCILLARY_ENG_CONV	OLI_Integration_Time_PAN_Offset_Nominal	Integer	Counts	Integration time offset nominal for the OLI Panchromatic (PAN) band
ANCILLARY_ENG_CONV	OLI_Integration_Time_MS_Offset_8x	Integer	Counts	Integration time offset 8x for OLI MS bands
ANCILLARY_ENG_CONV	OLI_Integration_Time_PAN_Offset_8x	Integer	Counts	Integration time offset 8x for the OLI PAN band
ANCILLARY_QA_THRESHOLDS	Angular_Momentum_Tolerance	Double	$Meters^2$ per second	Deviation from nominal orbital angular momentum to be an outlier. Format: NNNNESNN
ANCILLARY_QA_THRESHOLDS	IRU_Outlier_Threshold	Double array	Arc-seconds	The values to flag invalid SIRU points of the redundant inertial reference unit's four axes. Contains four values. Format: N.NN
ANCILLARY_QA_THRESHOLDS	Orbit_Radius_Tolerance	Double	Kilometers	Deviation (meters) from nominal orbital radius to be an outlier. Format: NNNESNN
ANCILLARY_QA_THRESHOLDS	Quaternion_Normalization_Outlier_Threshold	Double	Unitless	Deviation from one for a quaternion's magnitude for it to be an outlier. Format: NNESNN

Parameter Group	Parameter Name	Datatype	Units	Description
ANCILLARY_QA_THRESHOLDS	Spacecraft_Clock_TAI_Epoch	Double	Seconds	The spacecraft time code in Temps Atomique International format. Format: NNNNNN
ATTITUDE	ACS_to_OLI_Rotation_Matrix	Double array	Unitless	OLI to Attitude Control System (ACS) Rotation Matrix (3x3). Format: SN.NNNNNNNNNESNN
ATTITUDE	ACS_to_TIRS_Rotation_Matrix	Double array	Unitless	Array (3x3) Format: SN.NNNNNNNNN
ATTITUDE	CM_to_OLI_Offsets	Double array	Meters	Spacecraft center of mass to OLI offset in ACS reference frame (3x1) array. Format: N.NNN
ATTITUDE	CM_to_TIRS_Offsets	Double array	Meters	Array (3x1) Format: SN.NNN
ATTITUDE	IRU_to_ACS_Align_Matrix	Double array	Unitless	Inertial Reference Unit (IRU) to ACS Alignment Matrix describing the relationship of the gyro axes to the attitude control reference axes, (3x3) matrix. Format: SN.NNNNNNNNNESNN
ATTITUDE	SIRU_AXIS_A	Double array	Unitless	Measurement of inertial rates associated with spacecraft motion. Array size 3. Format: N.NNNNNNNN
ATTITUDE	SIRU_AXIS_B	Double array	Unitless	Measurement of inertial rates associated with spacecraft motion. Array size 3. Format: N.NNNNNNNN
ATTITUDE	SIRU_AXIS_C	Double array	Unitless	Measurement of inertial rates associated with spacecraft motion. Array size 3. Format: N.NNNNNNNN
ATTITUDE	SIRU_AXIS_D	Double array	Unitless	Measurement of inertial rates associated with spacecraft motion. Array size 3. Format: N.NNNNNNNN
AVERAGE_BIAS	Bias_Even_B##_SCA##	Double array	DN	Average bias PAN band ## = 08; SCAs ## = 1 – 14; Even lines. Format: NNNN.NN
AVERAGE_BIAS	Bias_Odd_B##_SCA##	Double array	DN	Average bias PAN band ## = 08; SCAs ## = 1 – 14; Odd lines. Format: NNNN.NN
AVERAGE_BIAS	Bias_SWIR_B##_SCA##	Double array	DN	Average bias SWIR bands ## = 06 - 07, 09; SCAs ## = 1 – 14; one value per detector. Format: NNNN.NN
AVERAGE_BIAS	Bias_VNIR_B##_SCA##	Double array	DN	Average bias Visible Near-Infrared (VNIR) bands ## = 01 – 05; SCAs ## 1- 14; one value per detector. Format: NNNNNN

Parameter Group	Parameter Name	Datatype	Units	Description
B2B_ASSESSMENT	Corr_Fit_Method	Integer	Unitless	OLI and TIRS, Correlate Fit Method. Format: N Values: 1 – Elliptical Paraboloid, 2 – Elliptical Gaussian, 3 - Reciprocal Paraboloid
B2B_ASSESSMENT	Corr_Pix_Max	Double	DN	Correlation window maximum valid pixel values. Format: NNNNN
B2B_ASSESSMENT	Corr_Pix_Min	Double	DN	Correlation window minimum valid pixel values. Format: NNNNN
B2B_ASSESSMENT	Corr_Window_Size	Integer array	Lines/samples	OLI and TIRS, correlation window size. (2x1) array, lines / samples. Format: NN, NN.
B2B_ASSESSMENT	Fill_Threshold	Double	Unitless	Minimum percent of valid pixels present within the correlation window or correlation is not performed. Format: N.NN
B2B_ASSESSMENT	Max_Displacement_Offset	Double	Magnitude of lines/samples	Maximum diagonal displacement allowed. Format: NNNN.N
B2B_ASSESSMENT	Min_Corr_Strength	Double	Unitless	OLI and TIRS, minimum correlation strength. Format: N.N
B2B_ASSESSMENT	Trend_Threshold_Line_B##	Double array	microRadians	Trending occurs only if Root Mean Square Error (RMSE) values are below threshold values. B ## = 1-11. SCA level OLI 14 values per band, TIRS 3 values per band. Format: N.N
B2B_ASSESSMENT	Trend_Threshold_Sample_B##	Double array	microRadians	Trending occurs only if RMSE values are below threshold values. B ## = 1-11. SCA level OLI 14 values per band, TIRS 3 values per band. Format: N.N
CLOUD_COVER_ASSESSMENT	Cirrus_Threshold	Double array	Unitless	Cirrus threshold for the cloud cover assessment. This array is either four or one in size. If it is four in size, the per-pixel threshold is calculated using the equation: Threshold = A * exp(B + elevation(x,y)/C) + D Where A, B, C, and D are the values from the array and elevation(x,y) is the elevation at the current pixel's location. If a single value is in the array, it is a constant for the entire image.
CLOUD_COVER_ASSESSMENT	Minimum_Sun_Elevation	Double	Degrees	Minimum sun elevation angle threshold for performing cloud cover assessment. If the sun elevation angle is less than this threshold, cloud cover assessment is not performed.

Parameter Group	Parameter Name	Datatype	Units	Description
DIFFUSER_RADIANCE	Diff_Bidir_Refl_Prim_B##_SCA##	Double array	Unitless	Primary Diffuser Bidirectional Reflectance Factor. One value per detector. PAN 988, MS 494. Band ## = 01-09, SCA ## = 1-14, Format: N.NNNNNN
DIFFUSER_RADIANCE	Diff_Bidir_Refl_Pris_B##_SCA##	Double array	Unitless	Pristine Diffuser Bidirectional Reflectance Factor. One value per detector. PAN 988, MS 494. Band ## = 01-09, SCA ## = 1-14. Format: N.NNNNNN
DIFFUSER_RADIANCE	Diff_Rad_Primary_B##_SCA##	Double array	W/m^2 sr um	Primary Diffuser Radiance, Band ## = 01-09, SCA ## = 1-14, One value per detector. PAN 988, MS 494. Format: N.NNNNNN
DIFFUSER_RADIANCE	Diff_Rad_Pristine_B##_SCA##	Double array	W/m^2 sr um	Pristine Diffuser Radiance, Band ## = 01-09, SCA ## = 1-14, One value per detector. PAN 988, MS 494, Format: N.NNNNNN
EARTH_CONSTANTS	Datum	Character array	Unitless	Datum applied during processing. Char array size 30. Default value: WGS84.
EARTH_CONSTANTS	Earth_Angular_Velocity	Double	Radians/second	Earth Angular Velocity. Rotation rate in radians / second. Format: N.NNNNNNNNNNESNN Default value: 7.2921158553E-05
EARTH_CONSTANTS	Eccentricity	Double	Unitless	Number describing the Earth ellipsoid eccentricity squared (World Geodetic Standard 1984 (WGS84) standard). Format: N.NNNNNNNNNNNNNN Default value: 0.00669437999013
EARTH_CONSTANTS	Ellipsoid_Name	Character Array	Unitless	Name of the ellipsoid used to represent the semi-major and semi-minor axes of the Earth. Char array size 6. Default value: WGS84
EARTH_CONSTANTS	Ellipticity	Double	W/m^2	Ratio describing polar flattening or Earth's deviation from an exact sphere (WGS84) standard). Format: N.NNNNNNNNNNNNNN Default value: 0.00335281066474
EARTH_CONSTANTS	Gravity_Constant	Double	(m/kg)^2	Universal gravitational constant times the mass of the Earth. Format: N.NNNNNNENN Default value: 3.986005E14
EARTH_CONSTANTS	J2_Earth_Model	Double	Unitless	Term that describes Earth’s dynamic oblateness. Format: NNNN.NNESNN Default value: 1.08263E-03
EARTH_CONSTANTS	Leap_Days	Integer	Days	Leap seconds day of occurrence. Format: NN
EARTH_CONSTANTS	Leap_Months	Character array	Months	Leap seconds month of occurrence. Array size: 3

Parameter Group	Parameter Name	Datatype	Units	Description
EARTH_CONSTANTS	Leap_Seconds	Integer array	Seconds	Leap seconds of day. Format: N
EARTH_CONSTANTS	Leap_Years	Integer array	Years	Leap seconds year of occurrence. Format: NNNN
EARTH_CONSTANTS	Number_of_Leap_Seconds	Integer array	Unitless	Number of leap second occurrences. Format: N
EARTH_CONSTANTS	Semi_Major_Axis	Double	Meters	Earth semi-major axis; distance in meters from the center of the Earth to the equator. Format: NNNNNNN Default value: 6378137.0
EARTH_CONSTANTS	Semi_Minor_Axis	Double	Meters	Earth semi-minor axis; distance in meters from the center of the Earth to the poles. Format: NNNNNNN.NNNN Default value: 6356752.3142
EARTH_CONSTANTS	Speed_of_Light	Double	Meters/second	Speed of light in meters per second. Format: N.NNNNNNNNEN Default value: 2.99792458E8
EARTH_CONSTANTS	Spheroid_Code	Integer	Unitless	Numerical code representing the approximate shape of the Earth in format and size. Format: NN Default value:12
FILE_ATTRIBUTES	Baseline_Date	Character array	Date/time	The date the CPF was entered into the baseline production. Char array size 20. Format: yyyy-MM-ddThh:mm:ss, where YYYY = 2011-2050, MM = 01-12, DD = 01-31, T = time separator, hh = 01-24, mm = 00-59, ss = 00-60.
FILE_ATTRIBUTES	Description	Character array	Unitless	Text field intended to describe the rationale for the updated CPF or other comments related to the CPF. Maximum string is 4000 characters.
FILE_ATTRIBUTES	Effective_Date_Begin	Character array	Date/time	Effective start date for this file. Char array size 20. Format: YYYY-MM-ddThh:mm:ss, where YYYY = 2011-2050, MM = 01-12, DD = 01-31, T = time separator, hh = 01-24, mm = 00-59, ss = 00-60.
FILE_ATTRIBUTES	Effective_Date_End	Character array	Date/time	Effective end date for this file. Char array size 20. Format: YYYY-MM-ddThh:mm:ss, where YYYY = 2011-2050, MM = 01-12, DD = 01-31, T = time separator, hh = 01-24, mm = 00-59, ss = 00-60.

Parameter Group	Parameter Name	Datatype	Units	Description
FILE_ATTRIBUTES	File_Name	Character array	Unitless	CPF file name. Char array size 200. Format: LX08CPF_YYYYMMDD_YYYYMMDD_cc.nn where YYYYMMDD = effective start date and effective end date respectively, cc = collection number (01-99) and nn = incrementing version for within a quarter (00-99)
FILE_ATTRIBUTES	File_Source	Character array	Unitless	Baseline CPF used as a source to create this CPF. Char array size 200. Format: LX08CPF_YYYYMMDD_YYYYMMDD_cc.nn where X = sensor applicability (O = OLI, T = TIRS, or C = Both), YYYYMMDD = effective start date and effective end date respectively, cc = collection number (01-99) and nn = incrementing version for within a quarter (01-99)
FILE_ATTRIBUTES	Sensor_Name	Character array	Unitless	Name of sensor. Character array size 100. Valid values: Operational Land Imager or Thermal Infrared Sensor
FILE_ATTRIBUTES	Spacecraft_Name	Character array	Unitless	Descriptor used to identify the spacecraft for which the calibration parameters are applicable. Char array size 100. Default value: Landsat_8.
FILE_ATTRIBUTES	Version	Integer	Unitless	Version number of the effective date range overlap. Format: NN where N = 00-99.
FILE_ATTRIBUTES	Collection_Number	Integer	Unitless	Collection number for each collection version. Format: NN where N = 1-99
FOCAL_PLANE_CAL	Across_Postfit_RMSE_Threshold	Double	Microradians	Post-fit residual Root Mean Square (RMS) threshold to determine if trending values saved for the Focal Plane Alignment. Format: NN.N
FOCAL_PLANE_CAL	Along_Postfit_RMSE_Threshold	Double	Microradians	Post-fit residual RMS threshold to determine if trending values are saved for the Focal Plane Alignment. Format: NN.N
FOCAL_PLANE_CAL	Corr_Fit_Method	Integer	Unitless	Correlation fit method. Format: N Values: 1 – elliptical paraboloid, 2 – elliptical gaussian, 3 - reciprocal paraboloid.
FOCAL_PLANE_CAL	Corr_Window_Size	Integer array	Lines/samples	Correlation window size, 2x1 lines / samples. Format: NN, NN.
FOCAL_PLANE_CAL	Fill_Threshold	Double	Unitless	Minimum percent of valid pixels present within the correlation window or correlation is not performed. Format: N.NN

Parameter Group	Parameter Name	Datatype	Units	Description
FOCAL_PLANE_CAL	Fit_Order	Integer	Unitless	Order of polynomial to fit. Range: 0..2. Format: N
FOCAL_PLANE_CAL	Max_Displacement_Offset	Double	Magnitude of lines/samples	Maximum diagonal displacement allowed. Format: NNNN.N
FOCAL_PLANE_CAL	Min_Corr_Strength	Double	Unitless	Minimum correlation strength. Format: N.N
FOCAL_PLANE_CAL	Tie_Point_Weight	Double	Microrad^2	Weight associated with each correlation point for use during the Legendre polynomial fit. Format: N.NN
GCP_CORRELATION	Corr_Fill_Value	Integer	DN	Ground Control Point (GCP) Fill Value to Ignore. Format: N
GCP_CORRELATION	Corr_Fit_Method	Integer	Unitless	Correlation fit method. Format: N Values: 1 – elliptical paraboloid, 2 – elliptical gaussian, 3 - reciprocal paraboloid.
GCP_CORRELATION	Corr_Window_Size	Integer array	Lines/samples	GCP search window size, 2x1 lines / samples. Format: NN, NN.
GCP_CORRELATION	Fill_Threshold	Double	Unitless	Minimum percent of valid pixels present within the correlation window or correlation is not performed. Format: N.NN.
GCP_CORRELATION	Max_Displacement_Offset	Double	Magnitude of lines/samples	Maximum diagonal displacement allowed. Format: NNNN.N
GCP_CORRELATION	Min_Corr_Strength	Double	Unitless	GCP minimum correlation strength. Format: N.N
GEO_SYSTEM	Y_Postfit_GCP_RMS	Double	Meters	Line of Sight (LOS) model correction projection space ground distance post-fit GCP RMS threshold in the Y direction. Format: N.NNNNNN
GEO_SYSTEM	Y_Prefit_GCP_RMS	Double	Meters	LOS model correction projection space ground distance pre-fit GCP RMS threshold in the Y direction. Format: N.NNNNNN
GEO_SYSTEM	X_Postfit_GCP_RMS	Double	Meters	LOS model correction projection space ground distance post-fit GCP RMS threshold in the X direction. Format: N.NNNNNN
GEO_SYSTEM	X_Prefit_GCP_RMS	Double	Meters	LOS model correction projection space ground distance pre-fit GCP RMS threshold in the X direction. Format: N.NNNNNN
GEO_SYSTEM	Low_Pass_Cutoff	Double	Hz	Cut off frequency used to develop the filter kernel for separating the high-frequency component out of the attitude data sequence. Format: N.N

Parameter Group	Parameter Name	Datatype	Units	Description
GEO_SYSTEM	Max_Percent_GCP_Outliers	Double	Unitless	The maximum percentage of GCPs that can be considered outliers for an acceptable precision LOS model solution. Format: N.NN
GEO_SYSTEM	Minimum_Number_Correlated_Validation_GCPs	Integer	Unitless	Minimum number of correlated validation GCPs to successfully perform geometric characterization.
GEO_SYSTEM	Minimum_Number_Nonoutlier_Control_GCPs	Integer	Unitless	Minimum number of non-outlier GCPs required to consider the precision model solution valid.
GEO_SYSTEM	MS_Grid_Density_Elev	Integer	Meters	LOS projection grid elevation density for the MS bands. Format: N
GEO_SYSTEM	MS_Grid_Density_Lines	Integer	Pixels	LOS projection grid line density for the MS bands. Format: N
GEO_SYSTEM	MS_Grid_Density_Samples	Integer	Pixels	LOS projection grid sample density for the MS bands. Format: N
GEO_SYSTEM	Optimal_Band_Order	Integer array	Unitless	Unique band order to improve processing efficiency. Valid values 1-11, Array size 11, Format: NN.
GEO_SYSTEM	PAN_Grid_Density_Elev	Integer	Meters	LOS projection grid elevation density for the PAN band. Format: N
GEO_SYSTEM	PAN_Grid_Density_Lines	Integer	Pixels	LOS projection grid line density for the PAN band. Format: N
GEO_SYSTEM	PAN_Grid_Density_Samples	Integer	Pixels	LOS projection grid sample density for the PAN band. Format: N
GEO_SYSTEM	Percent_Outlier_Threshold	Double	Unitless	The outlier threshold used by LOS model correction.
GEO_SYSTEM	Time_Code_Outlier_Threshold	Double	Milliseconds	LOS model creation OLI time code outlier threshold. Format: N.NNNNNN
GEO_SYSTEM	TIRS_Grid_Density_Elev	Integer	Meters	LOS projection grid elevation density for the TIRS bands. Format: N
GEO_SYSTEM	TIRS_Grid_Density_Lines	Integer	Pixels	LOS projection grid line density for the TIRS bands. Format: N
GEO_SYSTEM	TIRS_Grid_Density_Samples	Integer	Pixels	LOS projection grid sample density for the TIRS bands. Format: N
HISTOGRAM_CHARACTERIZATION	Frames_To_Skip_Bottom	Integer	Frames	Frames to skip at the bottom of the image. For use in the histogram statistics characterization algorithm. Format: N
HISTOGRAM_CHARACTERIZATION	Frames_To_Skip_Top	Integer	Frames	Frames to skip at the top of the image. For use in the histogram statistics characterization algorithm. Format: N

Parameter Group	Parameter Name	Datatype	Units	Description
I2I_ASSESSMENT	Corr_Fit_Method	Integer	Unitless	Correlation fit method. Format: N Values: 1 – elliptical paraboloid, 2 – elliptical gaussian, 3 - reciprocal paraboloid.
I2I_ASSESSMENT	Corr_Pix_Max	Integer	DN	Correlation window maximum valid pixel values. Format: NNNNN
I2I_ASSESSMENT	Corr_Pix_Min	Integer	DN	Correlation window minimum valid pixel values. Format: NNNNN
I2I_ASSESSMENT	Corr_Window_Size	Integer array	Lines/samples	Correlation window size, array 2x1, lines / samples Format: NN, NN
I2I_ASSESSMENT	Fill_Threshold	Double	Unitless	Minimum percent of valid pixels present within the correlation window or correlation is not performed. Format: N.NN
I2I_ASSESSMENT	Max_Displacement_Offset	Double	Magnitude of lines/samples	Maximum diagonal displacement allowed. Format: NNNN.N
I2I_ASSESSMENT	Min_Corr_Strength	Double	Unitless	I2I minimum correlation strength. Format: N.NN
I2I_ASSESSMENT	Trend_Threshold_Line	Double array	Unitless	Trending occurs only if RMSE values are below the threshold values. One value per band, 11 values. Format: N.NNN
I2I_ASSESSMENT	Trend_Threshold_Sample	Double array	Unitless	Trending occurs only if RMSE values are below the threshold values. One value per band, 11 values. Format: N.NNN
IMPULSE_NOISE	IN_Limit	Integer array	DN	Impulse noise limit includes all bands for the OLI and TIRS sensors (see Table 2-2 for the band list), one value per band, 30 values. Format: NN
IMPULSE_NOISE	Median_Filter_Width	Integer array	Pixels	Width of impulse noise median filter, includes all bands for the OLI and TIRS sensors (see Table 2-2 for the band list), must be an odd number, one value per band, 30 values. Format: N Default: 3.
LAMP_RADIANCE	Effective_Rad_Backup_B##_SCA##	Double array	W/m^2/sr/um	Effective lamp radiance backup lamp; one value per detector. PAN 988, MS 494. Band ## = 01 - 09, SCA ## = 1-14. Format: N.NNN
LAMP_RADIANCE	Effective_Rad_Pristine_B##_SCA##	Double array	W/m^2/sr/um	Effective lamp radiance pristine lamp; one value per detector. PAN 988, MS 494. Band ## = 01 - 09, SCA ## = 1-14. Format: N.NNN
LAMP_RADIANCE	Effective_Rad_Working_B##_SCA##	Double array	W/m^2/sr/um	Effective lamp radiance working lamp; one value per detector. PAN 988, MS 494. Band ## = 01 - 09, SCA ## = 1-14. Format: N.NNN

Parameter Group	Parameter Name	Datatype	Units	Description
LOS_MODEL_CORRECTION	Attitude_Apri	Double array	Micro-radians & Micro-radians/Second	List of a priori mean and sigma attitude values for the LOS model correction solution. It is an array of 12 values with indices 0-5 representing the means in micro-radians and indices 6-11 representing the sigma in micro-radians / second. Format NNN.N
LOS_MODEL_CORRECTION	Ephemeris_Apri	Double array	Meters & Meters/Second	List of a priori mean and sigma ephemeris values for the LOS model correction solution. It is an array of 12 values with indices 0-5 representing the means in meters and indices 6-11 representing the sigma in meters / second. Format NNN.N
LOS_MODEL_CORRECTION	DOQ_Observation_Apri	Double array	Micro-radians	Observation precision weights for Digital Orthophoto Quadrangle (DOQ) chip_source, two values, 0 = across-track, 1 = along-track. Format N.N
LOS_MODEL_CORRECTION	GLS_Observation_Apri	Double array	Micro-radians	Observation precision weights for Global Land Survey (GLS) chip_source, two values, 0 = across-track, 1 = along-track. Format N.N
LUNAR_IRRADIANCE	Median_Filter_Size	Integer	Unitless	Width of the median filter. Format: N
LUNAR_IRRADIANCE	Irradiance_Conversion	Double array	Unitless	Factors to convert to irradiance. One value per band, nine values. Format: N.NNNNNE-NN
LUNAR_IRRADIANCE	Integration_Threshold_Factor	Double array	W/m^2/um	Radiance Integration Thresholds Factor. One value per band, nine values. Format: N.NN
OLI_ABSOLUTE_GAINS	Gain_B##	Double array	DN/(W/m^2-sr-um)	The calculated absolute gain. Parameter expands to the number of bands, 14 values per band. Band ## = 01-09. Format: NN.NNNN
OLI_DETECTOR_NOISE	Detector_Noise_B##_SCA##	Double array	DN	Detector noise. Band ## = 01-09 (Normal bands, PAN 988, MS 494 detectors), 12-14 (Blind Bands, 12 & 13 104 detectors, 14 103 detectors) SCA ## = 01-14. One value per detector. Format: N.NN
OLI_DETECTOR_NOISE	VRP_Detector_Noise_B##_SCA ##	Double array	DN	Video Reference Pixel Detector noise. Band ## = 01-09. One value per detector. PAN 24, MS 12 values. Band ## = 12-14. One value per detector. 65 values. SCA ## = 01-14; Format: N.NNN
OLI_DETECTOR_OFFSETS	Across_Detector_Offsets_B##_SCA##	Double array	Pixels	Across-track detector offsets, Band ## = 01 – 09, SCA ## = 1 – 14. One value per detector. PAN 988, MS 494. Format: N.NNN
OLI_DETECTOR_OFFSETS	Along_Detector_Offsets_B##_SCA##	Double array	Pixels	Along-track detector offsets, Band ## = 01 – 09, SCA ## = 01 – 14. One value per detector. PAN 988, MS 494. Format: N.NNN

Parameter Group	Parameter Name	Datatype	Units	Description
OLI_DETECTOR_STATUS	Detector_Select_Table	Integer	Unitless	Indicates which detector map the CPF applies to. Valid values: 1-5, with 5 indicating a custom map is loaded. Format: N
OLI_DETECTOR_STATUS	Detector_Select_Table_Id	Integer	Unitless	Identifies the number of the currently loaded custom Detector_Select_Table. Only has meaning if the Detector_Select_Table setting is 5.
OLI_DETECTOR_STATUS	Inoperable_B##_SCA##	Integer array	Unitless	Identifier indicating whether this detector is inoperable. Array size is dependent on the number of inoperable detectors. Parameter repeats for each band within each SCA. Band ## = 1-9 and 12-14. SCA ## = 1-14. Format: NNN
OLI_DETECTOR_STATUS	Inoperable_Count_B##	Integer array	Unitless	Number of inoperable detectors per band, 14 values per band. Band ## = 1-9 and 12-14. Format: NNN
OLI_DETECTOR_STATUS	Out_Of_Spec_B##_SCA##	Integer array	Unitless	Identifier indicating whether a detector is outside the parameters of specifications. Parameter repeats for each band within each SCA. Band ## = 1-9 and 12-14. SCA ## = 1-14. Format: NNN
OLI_DETECTOR_STATUS	Out_Of_Spec_Count_B##	Integer array	Unitless	Number of out-of-specification detectors per band, 14 values per band. Band ## = 1-9 and 12-14. Format: NNN
OLI_DETECTOR_STATUS	VRP_Inoperable_B##_SCA##	Integer array	Unitless	Identifier indicating whether this detector is inoperable. Array size is dependent on the number of inoperable detectors. Parameter repeats for each band within each SCA. Band ## = 1-9 and 12-14. SCA ## = 1-14. Format: NNN
OLI_DETECTOR_STATUS	VRP_Inoperable_Count_B##	Integer array	Unitless	Number of inoperable detectors per band, 14 values per band. Band ## = 1-9 and 12-14. Format: NNN
OLI_DETECTOR_STATUS	VRP_Out_Of_Spec_B##_SCA##	Integer array	Unitless	Identifier indicating whether a detector is outside the parameters of specifications. Parameter repeats for each band within each SCA. Band ## = 1-9 and 12-14. SCA ## = 1-14. Format: NNN
OLI_DETECTOR_STATUS	VRP_Out_Of_Spec_Count_B##	Integer array	Unitless	Number of out-of-specification detectors per band, 14 values per band. Band ## = 1-9 and 12-14. Format: NNN

Parameter Group	Parameter Name	Datatype	Units	Description
OLI_FOCAL_PLANE	Across_LOS_Legendre_B## _SCA##	Double array	Radians	Angular across-track LOS for a band within an SCA. Array size 4. (Legendre Coeffs), four values per band / SCA. Band ## = 01-09, SCA ## = 1-14. Fourth value defaults to 0.0. Format: SN.NNNNNNNNESNN
OLI_FOCAL_PLANE	Along_LOS_Legendre_B## _SCA##	Double array	Radians	Angular along-track LOS for a band within an SCA. Array size 4. (Legendre Coeffs), four values per band / SCA. Band ## = 01-09, SCA ## = 1-14. Fourth value defaults to 0.0. Format: SN.NNNNNNNNESNN
OLI_FOCAL_PLANE	Band_Names	Char array	Unitless	Name of bands. Array size 9x30
OLI_FOCAL_PLANE	Band_Offset	Integer array	Pixels	Band offset. Offset from the top of the frame. Array of nine values. Format: N
OLI_FOCAL_PLANE	Band_Order	Integer array	Unitless	Band number for each band in order of nearest to most distant from the center of the focal plane, nine values, Format: N
OLI_FOCAL_PLANE	Detectors_Per_Band	Integer array	Unitless	Number of detectors per band, nine values, Format: NNN
OLI_FOCAL_PLANE	Nominal_Fill_Offset_B##	Integer array	IFOV	Nominal fill offset. B ## = 01-09. Array of 14 values per band. Format: N
OLI_FOCAL_PLANE	SCA_Offset_B##	Integer array	Pixels	SCA offset. Offset from top of frame, B## = 01-09. Array of 14 values. Format: NNN
OLI_FOCAL_PLANE	SCA_Overlap	Integer array	Pixels	SCA overlap width. Overlap between SCAs. Array of nine values. Format: NNN
OLI_FRAMING_PARAMETERS	Frames_Per_Scene	Integer	Frames	Number of image frames included in a full OLI Level 0 Reformatted (L0R) scene. Format: N
OLI_FRAMING_PARAMETERS	Min_Scene_Overlap_Frames	Integer	Frames	The minimum number of OLI frames present between two scenes to maintain scene overlap and enough data to align the SCAs. Format: N
OLI_NONUNIFORMITY	Solar_Diffuser_Scale_Primary_B ##_SCA##	Double array	Unitless	Correction factors applied to remove response variations due to changes in ‘primary’ (working) solar diffuser panel characteristics. Array of 494 values (988 values for PAN band), one for each detector. B## = 01-09, SCA## = 01-14. Format: N.NNNNNN

Parameter Group	Parameter Name	Datatype	Units	Description
OLI_NONUNIFORMITY	Solar_Diffuser_Scale_Pristine_B##_SCA##	Double array	Unitless	Correction factors applied to remove response variations due to changes in 'pristine' (backup) solar diffuser panel characteristics. Array of 494 values (988 values for PAN band), one for each detector. B## = 01-09, SCA## = 01-14. Format: N.NNNNNN
OLI_PARAMETERS	Across_IFOV_MS	Double	Radians	Multispectral across-track angle in radians subtended by detector. Instantaneous Field of View (IFOV) in the across-track direction. Solid angle through which a detector is sensitive to radiation. Format: N.NNE-NN
OLI_PARAMETERS	Across_IFOV_PAN	Double	Radians	PAN across-track angle in radians subtended by detector. IFOV in the across-track direction. Solid angle through which a detector is sensitive to radiation. Format: N.NNE-NN
OLI_PARAMETERS	Along_IFOV_MS	Double	Radians	Multispectral along-track angle in radians subtended by detector. IFOV in the along-track direction. Solid angle through which a detector is sensitive to radiation. Format: N.NNE-NN
OLI_PARAMETERS	Along_IFOV_PAN	Double	Radians	PAN along-track angle in radians subtended by detector. IFOV in the along-track direction. Solid angle through which a detector is sensitive to radiation. Format: N.NNE-NN
OLI_PARAMETERS	Band_Count	Integer	Unitless	Number of imaging bands of the OLI instrument. Format: N
OLI_PARAMETERS	Detector_Settling_Time_MS	Double	msec	Time between successive measurements, MS band. Format: N.NNN
OLI_PARAMETERS	Detector_Settling_Time_PAN	Double	msec	Time between successive measurements, PAN band. Format: N.NNN
OLI_PARAMETERS	Frame_Time_Fill_Offset_Tolerance	Double	Seconds	Absolute frame time difference allowed from the nominal sampling time between two frame times. Format: N.NE-NN
OLI_PARAMETERS	Frame_Time_Clock_Drift_Tolerance	Double	Seconds	Absolute frame time difference allowed from the nominal sampling time between two frame times due to systematic drift in the time codes. Format: N.NE-NN
OLI_PARAMETERS	Integration_Time_Tolerance	Double	msec	Integration Time Tolerance, deviation from the norm. Format: N.NNN
OLI_PARAMETERS	Integration_Time_Scale	Double	unitless	Scaling factor to convert the OLI integration duration in the L0R file to seconds. Format: N.NESN
OLI_PARAMETERS	Nominal_Frame_Time	Double	msec	OLI nominal frame time. Format: N.NNN

Parameter Group	Parameter Name	Datatype	Units	Description
OLI_PARAMETERS	Nominal_Integration_Time_MS	Double	msec	Length of time that detectors collect a charge. MS band. Format: N.NNN
OLI_PARAMETERS	Nominal_Integration_Time_PAN	Double	msec	Length of time that detectors collect a charge. PAN band. Format: N.NNN
OLI_PARAMETERS	Rollover_Error_Tolerance	Double	Seconds	The Rollover_Error_Tolerance is the threshold difference between consecutive OLI time codes that detect the presence of the OLI time code rollover error. This error occurs when the microseconds or milliseconds field of the time code is sampled between the time when it reaches its rollover value (1000 for microseconds, 86400000 for milliseconds) and increments to the next time code field (milliseconds or days) and the time when the rolled over field returns to zero. Format: N.NE-NN
OLI_PARAMETERS	SCA_Count	Integer	Unitless	Number of SCAs used in the OLI instrument. Format: NN, Default: 14.
OLI_PARAMETERS	VRP_Count	Integer array	Unitless	Number of VRPs, Size 9 Format: NN, MS Default: 12, PAN Default: 24
OLI_POST_RELATIVE_GAINS	Post_Rel_Gain_B##_SCA##	Double array	Unitless	Scaling of post-launch relative gain for the detector, eliminates striping. Parameter repeats for each band within each SCA. Band N = 01-09, SCA ## = 01-14. Format: N.NNNNNN
OLI_PRE_RELATIVE_GAINS	Pre_Rel_Gain_B##_SCA##	Double array	Unitless	Scaling of prelaunch relative gain for the detector, eliminates striping. Parameter repeats for each band within each SCA. Band ## = 01-09, SCA ## = 01-14. Format: N.NNNNNN
OLI_RADIANCE_RESCALE	Reflectance_Multiplicative_Facto r	Double array	W/m^2-sr-um	Reflectance multiplicative factor (gain), one value per band, nine values. Format: N.NNNNNN
OLI_RADIANCE_RESCALE	Reflectance_Additive_Factor	Double array	(W/m-sr-um)/DN	Reflectance additive factor (bias), one value per band, nine values. Format: N.NNNNNN
OLI_RELATIVE_GAINS	Relative_Gains_B##_SCA##	Double array	Unitless	Scaling of relative gains for the detector, eliminates striping. Parameter repeats for each band within each SCA. Band N = 01-09, SCA ## = 01-14. Format: N.NNNNNN

Parameter Group	Parameter Name	Datatype	Units	Description
OLI_SATURATION_LEVEL	Analog_High_Saturation_Level_B##_SCA##	Integer array	DN	Analog high saturation level, one value per detector. PAN 988, MS 494. Normal Bands ## = 01-09 and Blind Bands ## = 12 – 14, 12 & 13 have 104 detectors and 14 has 103 detectors, SCA ## = 01-14. Format: NNNN.
OLI_SATURATION_LEVEL	Analog_Low_Saturation_Level_B##_SCA##	Integer array	DN	Analog low saturation level, one value per detector. PAN 988, MS 494. Normal Bands ## = 01-09 and Blind Bands ## = 12 – 14, 12 & 13 have 104 detectors and 14 has 103 detectors, SCA ## = 01-14, Format: NNNN.
OLI_SATURATION_LEVEL	Digital_High_Saturation_Level_B##_SCA##	Integer array	DN	Digital high saturation level, one value per detector. PAN 988, MS 494. Normal Bands ## = 01-09 and Blind Bands ## = 12 – 14, 12 & 13 have 104 detectors and 14 has 103 detectors, SCA ## = 01-14. Format: NNNN.
OLI_SATURATION_LEVEL	Digital_Low_Saturation_Level_B##_SCA##	Integer array	DN	Digital low saturation level, one value per detector. PAN 988, MS 494. Normal Bands ## = 01-09 and Blind Bands ## = 12 – 14, 12 & 13 have 104 detectors and 14 has 103 detectors, SCA ## = 01-14. Format: NNNN
OLI_SATURATION_LEVEL	High_Radiance_Saturation	Double array	W/m^2-sr-um	High radiance saturation, band level, normal imaging bands only, Bands 1-9. Format: NNNN.NNNN
OLI_SATURATION_LEVEL	Low_Radiance_Saturation	Double array	W/m^2-sr-um	Low radiance saturation, band level, normal imaging bands only, Bands 1-9. Format NN.NNNN
OLI_SATURATION_LEVEL	VRP_Analog_High_Saturation_Level_B##_SCA##	Integer array	DN	VRP analog high saturation level, one value per detector. PAN 24, MS 12. Bands ## = 01-09 and Blind Bands ## = 12 – 14 have 65 detectors, SCA ## = 01-14. Format: NNNN.
OLI_SATURATION_LEVEL	VRP_Analog_Low_Saturation_Level_B##_SCA##	Integer array	DN	VRP analog low saturation level, one value per detector. PAN 24, MS 12. Bands ## = 01-09 and Blind Bands ## = 12 – 14 have 65 detectors, SCA ## = 01-14, Format: NNNN.
OLI_SATURATION_LEVEL	VRP_Digital_High_Saturation_Level_B##_SCA##	Integer array	DN	VRP digital high saturation level, one value per detector. PAN 24, MS 12. Bands ## = 01-09 and Blind Bands ## = 12 – 14 have 65 detectors, SCA ## = 01-14. Format: NNNN.

Parameter Group	Parameter Name	Datatype	Units	Description
OLI_SATURATION_LEVEL	VRP_Digital_Low_Saturation_Level_B##_SCA##	Integer array	DN	VRP digital low saturation level, one value per detector. PAN 24, MS 12. Bands ## = 01-09 and Blind Bands ## = 12 – 14 have 65 detectors, SCA ## = 01-14. Format: NNNN
OLI_SCA_PARAMETERS	Discontinuity_Ratio_B##	Double array	Unitless	SCA discontinuity ratios model, 13 values. Contains 13 values because the left-most SCA is the reference. Format: N.N
OLI_SCA_PARAMETERS	Max_Valid_Correlation_Shift	Integer array	Unitless	Valid correlation maximum, one value per band, nine values. Format: N
OLI_SCA_PARAMETERS	Min_Valid_Neighbor_Segments	Integer array	Unitless	Minimum valid neighboring segments, one value per band, nine values. Format: N.
OLI_SCA_PARAMETERS	SCA_Overlap_Threshold	Double array	Unitless	The SCA Overlap Threshold is added and subtracted from the default discontinuity ratio to define the acceptable range of discontinuity ratios calculated by the SCA overlap characterization algorithm, one value per band, nine values. Format: N.N
OLI_SCA_PARAMETERS	Stripe_Cutoff	Double array	DN	Stripe Matrix DN cutoffs, one value per band, nine values. Format: N.NN
OLI_TEMP_SENSITIVITY	OLI_Reference_Temp	Double	Kelvin	OLI reference temperature.
OLI_TEMP_SENSITIVITY	OLI_Thermistor_Flag	Integer	Unitless	OLI thermistor flag. Format: N. N = 0 or 1.
OLI_TEMP_SENSITIVITY	Temp_Sensitivity_Coeff_B##_SCA##	Double Array	Unitless	Temperature sensitivity coefficients, one value per detector. PAN 988, MS 494. Band ## = 01-09, SCA ## = 1-14. Format: N.NNNNNN
ORBIT_PARAMETERS	Argument_Of_Perigee	Double	Degrees	Nominal angle of the point nearest Earth in orbit as measured from the ascending node in the direction of satellite motion. Format: NN.N. Default: 90.0
ORBIT_PARAMETERS	Descending_Node_Row	Integer	Unitless	Row corresponding to the Earth's equator. Format: NN Default: 60.
ORBIT_PARAMETERS	Descending_Node_Time_Max	Character array	Units of Time	Maximum local solar time of the descending node in a.m. hours and minutes. Char array size 5. Format: hh:mm, where hh = 01-24, and mm = 00 – 59
ORBIT_PARAMETERS	Descending_Node_Time_Min	Character array	Units of Time	Minimum local solar time of descending node in a.m. hours and minutes. Char array size 5. Format: hh:mm, where hh = 01-24, and mm = 00 – 59.
ORBIT_PARAMETERS	Eccentricity	Double	Unitless	Nominal eccentricity of the satellite's orbit. Format: N.NNNNNNNN Default: 0.00117604.

Parameter Group	Parameter Name	Datatype	Units	Description
ORBIT_PARAMETERS	Inclination_Angle	Double	Degrees	Angle formed by Earth's equatorial and satellite plane. Format: NN.NNNN Default: 98.2096.
ORBIT_PARAMETERS	Launch_Date	Character array	Date/time	Launch date and time. Char array size 20. Format: YYYY-MM-ddthh:mm:ss, where 2011-2050, MM = 01-12, DD = 01-31, T = T, hh = 00-24, mm = 00 – 60, ss = 00 - 60. (Example, 2011-12-20T20:15:25).
ORBIT_PARAMETERS	Long_Path1_Row60	Double	Degrees	Longitude in degrees west of the point at which path 1 crossed the equator (row 60). Format: SNN.N Default: -64.6.
ORBIT_PARAMETERS	Nodal_Regression_Rate	Double	Degrees/Day	Rate in degrees per day that the orbital plane rotates with respect to the Earth. Format: N.NNNNNNNNN Default: 0.985647366
ORBIT_PARAMETERS	Nominal_Angular_Momentum	Double	Meters^2/seconds	Ephemeris angular momentum nominal in orbit. Format: N.NNNNNNNENN Default: 5.3136250E10.
ORBIT_PARAMETERS	Nominal_Orbit_Radius	Double	Kilometers	Nominal distance from the Earth's center to the spacecraft track. Format: NNNN.NNNNNN Default: 7063.046473
ORBIT_PARAMETERS	Orbital_Period	Double	Seconds	Time required to complete one orbit. Format: NNNN.NNNNNN Default: 5907.437694
ORBIT_PARAMETERS	Scenes_Per_Orbit	Integer	Unitless	Number of scenes or row locations per orbit. Format: NNN Default: 248.
ORBIT_PARAMETERS	Semi_Major_Axis	Double	Kilometers	Nominal semi-major axis of the satellite's orbit. Format: NNNN.NNNNNN Default: 7063.050267.
ORBIT_PARAMETERS	Semi_Minor_Axis	Double	Kilometers	Nominal semi-minor axis of the satellite's orbit. Format: NNNN.NNNNN Default: 7063.04268.
ORBIT_PARAMETERS	WRS_Cycle_Days	Integer	Days	Time, in days, required for the satellite to view Earth once. Format: NN Default: 16.
ORBIT_PARAMETERS	WRS_Cycle_Orbits	Integer	Unitless	Number of orbits or paths in a complete World Reference System (WRS) cycle. Format: NNN Default: 233.
REFLECTANCE_CONVERSION	Reflect_Conv_Coeff	Double array	sr/w/m^2um	Radiance to reflectance conversion coefficient for one value per band, nine values, Format: N.NNN
TIRS_ABSOLUTE_GAINS	Gain_B##	Double array	DN/(W/m^2-sr-um)	The calculated absolute gain. Parameter expands to the number of bands, three values per band. Band ## = 10-11. Format: NNN.N

Parameter Group	Parameter Name	Datatype	Units	Description
TIRS_ABSOLUTE_GAINS_BLIND	Gain_B##	Double array	Unitless	The calculated absolute gain. Parameter expands to the number of bands, three values per band. Band ## = 15. Format: N.N
TIRS_ALIGN_CAL	Across_Postfit_RMSE_Threshold	Double	Microradians	Post-fit residual RMS threshold to determine if trending values are saved for TIRS Alignment Cal. Format: NN.N
TIRS_ALIGN_CAL	Align_Constraint_Weight	Double	1/microradians	Alignment constraint weight. Format: N.NNNNN
TIRS_ALIGN_CAL	Along_Postfit_RMSE_Threshold	Double	Microradians	Post-fit residual RMS threshold to determine if trending values are saved for TIRS Alignment Cal. Format: NN.N
TIRS_ALIGN_CAL	Corr_Fit_Method	Integer	Unitless	Peak fit method. Integer. Format N Values: 1 – elliptical paraboloid, 2 – elliptical gaussian, 3 - reciprocal paraboloid.
TIRS_ALIGN_CAL	Corr_Window_Size	Integer	Lines/samples	Correlation window size. 2x1 array, lines / samples. Format: NN, NN.
TIRS_ALIGN_CAL	Fill_Threshold	Double	Unitless	Minimum percent of valid pixels present within the correlation window or correlation is not performed. Format: N.NN
TIRS_ALIGN_CAL	Fit_Order	Integer	Unitless	Order of polynomial to fit. Range: 0..2. Format: N
TIRS_ALIGN_CAL	Max_Displacement_Offset	Double	Magnitude of lines/samples	Maximum diagonal displacement allowed. Format: NNNN.N
TIRS_ALIGN_CAL	Min_Corr_Strength	Double	Unitless	Minimum correlation strength. Format: N.NN
TIRS_ALIGN_CAL	Tie_Point_Weight	Double	1/microradians	Weight associated with each correlation point for use during the Legendre polynomial fit. Format: N.NN
TIRS_DETECTOR_NOISE	Detector_Noise_B##_SCA##	Double array	DN	Detector noise. Band ## = 10-11, Blind Band 15, and 16-18, SCA ## = 01 - 03. One value per detector, 640 detectors. Format: N.NNNN
TIRS_DETECTOR_OFFSETS	Across_Detector_Offsets_B##_SCA##	Double array	Pixels	Across-track detector offsets, Band ## = 10 - 11, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: N.NNN
TIRS_DETECTOR_OFFSETS	Along_Detector_Offsets_B##_SCA##	Double array	Pixels	Along-track detector offsets, Band ## = 10 - 11, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: N.NNN
TIRS_DETECTOR_RESPONSE	Background_Response_B##_SCA##	Double array	DN	Background response, Band ## = 10 - 11, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: NNN.NNNNNN

Parameter Group	Parameter Name	Datatype	Units	Description
TIRS_DETECTOR_RESPONSE	Gain_Offsets_B##_SCA##	Double array	DN	Radiometric offset to account for the heat the detectors see from the instrument optics when viewing deep space, Band ## = 10 - 11, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: SN.NNNNNNESNN
TIRS_DETECTOR_RESPONSE	Baseline_Dark_Response_B##_SCA##	Double array	DN	Baseline dark response, Band ## = 10 - 11, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: NNN.NNNNNN
TIRS_DETECTOR_RESPONSE	Blackbody_Thermistor_Weights	Double array	Unitless	Weights for TIRS blackbody thermistors. Array of four values for four blackbody thermistors (one value for each thermistor). Date Range: 0.0 – 1.0, Format: N.NN
TIRS_DETECTOR_RESPONSE_BLIND	Background_Response_B##_SCA##	Double array	DN	Background response, Band ## = 15, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: N.NNNNNN
TIRS_DETECTOR_RESPONSE_BLIND	Gain_Offsets_B##_SCA##	Double Array	DN	Radiometric offset to account for the heat the detectors see from the instrument optics when viewing deep space, Band ## = 15, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: N.NNNNNN
TIRS_DETECTOR_RESPONSE_BLIND	Baseline_Dark_Response_B##_SCA##	Double array	DN	Baseline dark response, Band ## = 15, SCA ## = 01 – 03. One value per detector. Detector Count: 640. Format: NNN.NNNN
TIRS_DETECTOR_STATUS	Inoperable_B##_SCA##	Integer array	Unitless	Identifier indicating whether this detector is operable. Array size is dependent on the number of inoperable detectors. Parameter repeats for each band within each SCA. Band ## = 10-11, 15-18. SCA ## = 01-03. Format: NNN
TIRS_DETECTOR_STATUS	Inoperable_Count_B##	Integer array	Unitless	Number of inoperable detectors per band. Three values per band. Band ## = 10-11, 15-18. Format: NNN
TIRS_DETECTOR_STATUS	Out_Of_Spec_B##_SCA##	Integer array	Unitless	Identifier indicating whether a detector is outside the parameters of the specifications. Parameter repeats for each band within each SCA. Band ## = 10-11, 15-18. SCA ## = 01-03 Format: NNN
TIRS_DETECTOR_STATUS	Out_Of_Spec_Count_B##	Integer array	Unitless	Number of out-of-specification detectors per band. Three values per band. Band ## = 10-11, 15-18. Format: NNN

Parameter Group	Parameter Name	Datatype	Units	Description
TIRS_DETECTOR_STATUS	Detector_Map_Id	Integer	Unitless	Identifies the TIRS detector map version number. The value is incremented each time the detector offsets change to use a different set of detectors from the secondary TIRS bands. This action replaces detectors in the primary TIRS bands.
TIRS_FOCAL_PLANE	Across_LOS_Legendre_B## _SCA##	Double array	Radians	Angular across-track LOS for a band within an SCA. Array size 4. (Legendre Coeffs), four values per band / SCA. Band ## = 10-11, SCA ## = 01-03. Format: SN.NNNNNNNESNN
TIRS_FOCAL_PLANE	Along_LOS_Legendre_B## _SCA##	Double array	Radians	Angular along-track LOS for a band within an SCA. Array size 4. (Legendre Coeffs), four values per band / SCA. Band ## = 10-11, SCA ## = 01-03. Format: SN.NNNNNNNNESNN
TIRS_FOCAL_PLANE	Alternate_Row_Offset_B##	Integer array	Pixels	Alternate Row Offset. B ## = 10-11. Array of three values per band. Format: N.
TIRS_FOCAL_PLANE	Band_Names	Char array	Unitless	Name of bands. Array size 2x30
TIRS_FOCAL_PLANE	Band_Offset	Integer array	Pixels	Band offset. Offset from top of frame. Array of two values. Format: N
TIRS_FOCAL_PLANE	Nominal_Fill_Offset_B##	Integer array	IFOV	Nominal fill offset. B ## = 10-11. Array of three values per band. Format: N.
TIRS_FOCAL_PLANE	Primary_Row_Offset_B##	Integer array	Pixels	Primary row offset. B ## = 10-11. Array of three values per band. Format: N.
TIRS_FOCAL_PLANE	SCA_Offset_B##	Integer array	Pixels	SCA offset. Offset from the top of the frame, B## = 10-11. Array of three values. Format: N
TIRS_FOCAL_PLANE	SCA_Overlap	Integer array	Pixels	SCA overlap width. Overlap between SCAs. Array of two values. Format: N
TIRS_FRAMING_PARAMETERS	Frames_Per_Scene	Integer	Frames	Number of image frames included in a full TIRS L0R scene. Format: N
TIRS_FRAMING_PARAMETERS	Min_Scene_Overlap_Frames	Integer	Frames	The minimum number of TIRS frames present between two scenes to maintain scene overlap and enough data to align the SCAs. Format: N
TIRS_NONUNIFORMITY	Blackbody_Scale_B##_SCA##	Double array	Unitless	Correction factors applied to remove response variations due to changes in blackbody source characteristics. Array of 640 values, one for each detector. B## = 10-11, SCA## = 01-03. Format: N.NNNNNN

Parameter Group	Parameter Name	Datatype	Units	Description
TIRS_PARAMETERS	Across_IFOV_Thermal	Double array	Radians	Across-track angle in radians subtended by the detector. IFOV in the across-track direction. Solid angle through which a detector is sensitive to radiation. Format: N.NNE-NN
TIRS_PARAMETERS	Along_IFOV_Thermal	Double	Radians	Along-track angle in radians subtended by the detector. IFOV in the along-track direction. Solid angle through which a detector is sensitive to radiation. Format: SN.NNNNESNN
TIRS_PARAMETERS	Band_Count	Integer	Unitless	Number of imaging bands of the TIRS instrument. Format: N, Default: 2.
TIRS_PARAMETERS	Frame_Time_Fill_Offset_Tolerance	Double	Seconds	Absolute frame time difference allowed from the nominal sampling time between two frame times. Format: N.NE-NN
TIRS_PARAMETERS	Frame_Time_Clock_Drift_Tolerance	Double	Seconds	Absolute frame time difference allowed from the nominal sampling time between two frame times due to systematic drift in the time codes. Format: N.NE-NN
TIRS_PARAMETERS	Integration_Time_Scale	Double	seconds per microsecond	Scaling factor to convert the TIRS integration duration in the L0R file to seconds. Format: N.NESN
TIRS_PARAMETERS	Integration_Time_Tolerance	Double	msec	Integration time tolerance, deviation from the norm. Format: N.NNN
TIRS_PARAMETERS	Nominal_Integration_Time	Double	msec	Length of time detectors collect a charge. Format: N.N
TIRS_PARAMETERS	Nominal_Frame_Time	Double	msec	Nominal frame time. Format: NN.NNN
TIRS_PARAMETERS	SCA_Count	Integer	Unitless	Number of SCAs used in the TIRS instrument. Format: N Default: 3.
TIRS_PARAMETERS	SSM_Encoder_Origin_SideA	Double	Seconds	Scene select mirror encoder origin for side A electronics. Format: N.NNNNNNNNN
TIRS_PARAMETERS	SSM_Encoder_Origin_SideB	Double	Seconds	Scene select mirror encoder origin for side B electronics. Format: N.NNNNNNNNN
TIRS_PARAMETERS	SSM_Encoder_Time_Offset	Double	Seconds	Scene select mirror encoder time offset. Format: N.N
TIRS_PARAMETERS	SSM_Mirror_Angle	Double	Radians	Scene select mirror angle. Format: N.NNNNNNNNNNNNNN
TIRS_PARAMETERS	SSM_Mirror_Angle_Deviation	Double	Radians	Scene select mirror angle deviation. Format: N.N
TIRS_PARAMETERS	SSM_Telescope_Pitch_Offset	Double	Radians	Scene select mirror telescope pitch offset. Format: N.N
TIRS_PARAMETERS	SSM_Telescope_Roll_Offset	Double	Radians	Scene select mirror telescope roll offset. Format: N.N

Parameter Group	Parameter Name	Datatype	Units	Description
TIRS_PARAMETERS	SSM_Telescope_Yaw_Offset	Double	Radians	Scene select mirror telescope yaw offset. Format: N.N
TIRS_PARAMETERS	SSM_Tolerance	Double	Radians	Scene select mirror tolerance. Format: N.NNNNE-NN
TIRS_POST_REL_GAINS	Post_Rel_Gains_B##_SCA##	Double array	Unitless	Scaling of post-launch relative gain for the detector; eliminates striping. Parameter repeats for each band within each SCA. Band N = 10-11, SCA ## = 01-03. Format: N.NN
TIRS_POST_REL_GAINS_BLIND	Post_Rel_Gains_Blind_B##_SCA##	Double array	Unitless	Scaling of post-launch relative gain for the detector; eliminates striping. Parameter repeats for each band within each SCA. Band N = 15, SCA ## = 01-03. Format: N.NN
TIRS_PRE_REL_GAINS	Pre_Rel_Gains_B##_SCA##	Double array	Unitless	Scaling of prelaunch relative gain for the detector; eliminates striping. Parameter repeats for each band within each SCA. Band ## = 10-13, SCA ## = 01-03. Format: N.NN
TIRS_PRE_REL_GAINS_BLIND	Pre_Rel_Gains_Blind_B##_SCA##	Double array	Unitless	Scaling of prelaunch relative gain for the detector; eliminates striping. Parameter repeats for each band within each SCA. Band ## = 15, SCA ## = 01-03. Format: N.NN
TIRS_RADIANCE_RESCALE	Radiance_Additive_Factor	Double array	W/m^2-sr-um	Radiance Additive Factor (Bias). An array size of two for Bands 10 and 11. Format: N.NNNNNN
TIRS_RADIANCE_RESCALE	Radiance_Multiplicative_Factor	Double array	(W/m-sr-um)/DN	Radiance Multiplicative Factor (Gain). An array size of two for Bands 10 and 11. Format: N.NNNNNNE-NN
TIRS_THERMAL_CONSTANTS	K1_Constant	Double array	W/m^2-ster-um	Coefficient to convert TIRS radiance to temperature. Parameter repeats for each band. Band N = 10 – 11.
TIRS_THERMAL_CONSTANTS	K2_Constant	Double array	Kelvin	Coefficient to convert TIRS radiance to temperature. Parameter repeats for each band. Band N = 10 – 11.
TIRS_RELATIVE_GAINS	Rel_Gains_B##_SCA##	Double array	Unitless	Scaling of relative gains for the detector; eliminates striping. Parameter repeats for each band within each SCA. Band N = 10-11, SCA ## = 01-03. Format: N.NNNNNN
TIRS_RELATIVE_GAINS_BLIND	Rel_Gains_Blind_B##_SCA##	Double array	Unitless	Scaling of relative gains for the detector; eliminates striping. Parameter repeats for each band within each SCA. Band N = 15, SCA ## = 01-03. Format: N.NNNNNN
TIRS_SATURATION_LEVEL	Analog_High_Saturation_Level_B##_SCA##	Integer array	DN	Analog high saturation radiance level, one value per detector. 640 detectors. Bands ## = 10-11 & 15, SCA ## = 01-03. Format: NNN.

Parameter Group	Parameter Name	Datatype	Units	Description
TIRS_SATURATION_LEVEL	Analog_Low_Saturation_Level_B##_SCA##	Integer array	DN	Analog low saturation radiance level, one value per detector. 640 detectors. Bands ## = 10-11 & 15, SCA ## = 01-03, Format: NNN
TIRS_SATURATION_LEVEL	Digital_High_Saturation_Level_B##_SCA##	Integer array	DN	Digital high saturation level, one value per detector. 640 detectors. Bands ## = 10-11 & 15, SCA ## = 01-03, Format: NNNN
TIRS_SATURATION_LEVEL	Digital_Low_Saturation_Level_B##_SCA##	Integer array	DN	Digital low saturation level, one value per detector. 640 detectors. Bands ## = 10-11 & 15, SCA ## = 01-03, Format: NNNN
TIRS_SATURATION_LEVEL	High_Radiance_Saturation	Double array	W/m^2-sr-um	High radiance saturation, band level, normal imaging bands only, Bands 10-11. Format: NNNN.NNNN
TIRS_SATURATION_LEVEL	Low_Radiance_Saturation	Double array	W/m^2-sr-um	Low radiance saturation, band level, normal imaging bands only, Bands 10-11. Format NN.NNNN
TIRS_SCA_PARAMETERS	Discontinuity_Ratio_B##	Double array	Unitless	SCA discontinuity ratios model, band level, two values per band. Contains two values because the left-most SCA is the reference. Bands ## = 10-11. Format: N.N
TIRS_SCA_PARAMETERS	Max_Valid_Correlation_Shift	Integer array	Unitless	Valid correlation maximum, one value per band, two values. Format: N
TIRS_SCA_PARAMETERS	Min_Valid_Neighbor_Segments	Integer array	Unitless	Minimum valid neighboring segments, one value per band, two values. Format: N.
TIRS_SCA_PARAMETERS	SCA_Overlap_Threshold	Double array	Unitless	The SCA Overlap Threshold is added and subtracted from the default discontinuity ratio to define the acceptable range of discontinuity ratios calculated by the SCA overlap characterization algorithm, one value per band, two values. Format: N.NN
TIRS_SCA_PARAMETERS	Stripe_Cutoff	Double array	DN	Stripe Matrix DN cutoffs, one value per band, two values. Format: N.NN
TIRS_TEMP_SENSITIVITY	TIRS_Reference_Temp	Double	Kelvin	TIRS reference temperature.
TIRS_TEMP_SENSITIVITY	TIRS_Thermistor_Flag	Integer	Unitless	TIRS thermistor flag. Format: N. N = 0 or 1.
TIRS_TEMP_SENSITIVITY	Temp_Sensitivity_Coeff_B##_SCA##	Double array	Unitless	Temperature sensitivity coefficients, one value per detector. Detector numbers: 640. Band ## = 10-11, SCA ## = 01-03. Format: N.NNNNNN
UT1_TIME_PARAMETERS	UT1_Day	Integer array	Days	Day of Universal Time Code (UTC) Corrected (UT1) time correction prediction; values represent from the effective begin date 180 days forward; Format: NN, where NN = 1-31

Parameter Group	Parameter Name	Datatype	Units	Description
UT1_TIME_PARAMETERS	UT1_Modified_Julian	Integer array	Unitless	Modified Julian day; values represent from effective begin date 180 days forward; MJD = Julian day - 2 400 000.5; Julian date is a running day count starting 1 January 4713 B.C. Format: NNNNN, where NNNNN = e.g., 50234 (for May 31, 1996).
UT1_TIME_PARAMETERS	UT1_Month	Char array	Unitless	Month of UT1 time correction prediction; values represent from the effective begin date 180 days forward; Format: MMM, where MMM = Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, or Dec
UT1_TIME_PARAMETERS	UT1_UTC	Double array	seconds	UT1 - UTC time difference. Values span 180 days Format: N.NNNNN where N.NNNNN = e.g., 0.44321.
UT1_TIME_PARAMETERS	UT1_X	Double array	Arc seconds	X shift pole wander, values span 180 days. Format: N.NNNNN where N.NNNNN = e.g., 0.45431.
UT1_TIME_PARAMETERS	UT1_Y	Double array	Arc seconds	Y shift pole wander, values span 180 days Format: N.NNNNN where N.NNNNN = e.g., 0.13454.
UT1_TIME_PARAMETERS	UT1_Year	Integer array	Years	UT1 / UTC Year of UT1 time correction prediction; values represent from effective begin date 180 days forward; Format: YYYY where YYYY = 2011-2050.

Table 2-3. CPF Parameter Groups

2.6.1 Sample OLI CPF ODL File

The following is an example of the CPF format. It is not a complete list of the parameters the production CPF contains. The sample CPF contains examples of the included TIRS SCAs, bands, and detectors. The OLI and TIRS data are organized into separate groups, except the Impulse Noise, B2B, and I2I Assessment groups. The OLI groups with band / SCA / detector level parameters are organized by band (1–9 and 12–14) and SCAs (1–14); TIRS reflects the actual band / SCA numbers for bands (10–11 and 15–18) and SCAs (1–3).

```
GROUP = FILE_ATTRIBUTES
 Spacecraft_Name = "Landsat_8"
 Sensor_Name = "Operational Land Imager"
 Effective_Date_Begin = "2009-01-01T00:00:00"
 Effective_Date_End = "2009-03-31T23:59:59"
 Baseline_Date = "2009-01-01T00:00:01"
 File_Name = "LCO8CPF_20090101_20090331_01.02"
 File_Source = "LCO8CPF_20090101_20090331_01.01"
 Description = "Initial development"
 Version = 2
 Collection_Number = 1
END_GROUP = FILE_ATTRIBUTES
GROUP = OLI_PARAMETERS
 Band_Count = 9
 SCA_Count = 14
 Detector_Settling_Time_MS = 0.010
 Detector_Settling_Time_PAN = 0.010
 Nominal_Frame_Time = 4.236
 Nominal_Integration_Time_MS = 3.600
 Nominal_Integration_Time_PAN = 0.660
 Integration_Time_Tolerance = 0.010
Along_IFOV_MS = 4.26E-05
 Along_IFOV_PAN = 2.125E-05
 Across_IFOV_MS = 4.26E-05
 Across_IFOV_PAN = 2.125E-05
 VRP_Count = (12,12,12,12,12,12,12,24,12)
END_GROUP = OLI_PARAMETERS
GROUP = IMPULSE_NOISE
  IN_Limit = (1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)
  Median_Filter_Width = (3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3)
END_GROUP = IMPULSE_NOISE
GROUP = OLI_FOCAL_PLANE
  Detector_Count = (494, 494, 494, 494, 494, 494, 494, 988, 494)
  Band_Names = ("OLI_Coastal_Aerosol", "OLI_Blue", "OLI_Green",
     "OLI_Red",  "OLI_NIR", "OLI_SWIR1", "OLI_SWIR2", "OLI_PAN",
     "OLI_CIRRUS")
  Band_Offset = (1,0,0,0,0,0,0,0,1)
```

```
  Band_Order = (8,2,1,5,4,3,7,6,9)
  SCA_Overlap = (2,0,0,0,0,0,0,0,2)
  SCA_Offset_B01 =
(369,142,369,142,369,142,369,142,369,142,369,142,369,142)
  SCA_Offset_B02 =
(349,162,349,162,349,162,349,162,349,162,349,162,349,162)
  SCA_Offset_B03 =
(429,82,429,82,429,82,429,82,429,82,429,82,429,82)
  SCA_Offset_B04 =
(409,102,409,102,409,102,409,102,409,102,409,102,409,102)
  SCA_Offset_B05 =
(389,122,389,122,389,122,389,122,389,122,389,122,389,122)
  SCA_Offset_B06 =
(467,40,467,40,467,40,467,40,467,40,467,40,467,40)
  SCA_Offset_B07 =
(449,62,449,62,449,62,449,62,449,62,449,62,449,62)
  SCA_Offset_B08 =
(443,68,443,68,443,68,443,68,443,68,443,68,443,68)
  SCA_Offset_B09 =
(487,20,487,20,487,20,487,20,487,20,487,20,487,20)
  Along_LOS_Legendre_B01_SCA01 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B02_SCA01 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B03_SCA01 = (0.0, 0.0, 0.0, 0.0)
     .
     .
     .
  Along_LOS_Legendre_B09_SCA01 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B10_SCA01 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B11_SCA01 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B01_SCA02 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B02_SCA02 = (0.0, 0.0, 0.0, 0.0)
     .
     .
     .
  Along_LOS_Legendre_B08_SCA04 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B09_SCA04 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B01_SCA05 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B02_SCA05 = (0.0, 0.0, 0.0, 0.0)
     .
     .
     .
  Along_LOS_Legendre_B08_SCA14 = (0.0, 0.0, 0.0, 0.0)
  Along_LOS_Legendre_B09_SCA14 = (1.1, 2.2, 3.3, 0.0)
  Across_LOS_Legendre_B01_SCA01 = (0.1, 0.2, 0.3, 0.0)
  Across_LOS_Legendre_B02_SCA01 = (0.0, 0.0, 0.0, 0.0)
  Across_LOS_Legendre_B03_SCA01 = (0.0, 0.0, 0.0, 0.0)
     .
```

```
      .
      .
   Across_LOS_Legendre_B07_SCA14 = (0.0, 0.0, 0.0, 0.0)
   Across_LOS_Legendre_B08_SCA14 = (0.0, 0.0, 0.0, 0.0)
   Across_LOS_Legendre_B09_SCA14 = (0.0, 0.0, 0.0, 0.0)
   Nominal_Fill_Offset_B01 = (2,2,2,2,2,2,2,2,2,2,2,2,2,2)
   Nominal_Fill_Offset_B02 = (2,2,2,2,2,2,2,2,2,2,2,2,2,2)
   Nominal_Fill_Offset_B03 = (2,2,2,2,2,2,2,2,2,2,2,2,2,2)
   Nominal_Fill_Offset_B04 = (2,2,2,2,2,2,2,2,2,2,2,2,2,2)
   Nominal_Fill_Offset_B05 = (2,2,2,2,2,2,2,2,2,2,2,2,2,2)
   Nominal_Fill_Offset_B06 = (4,4,4,4,4,4,4,4,4,4,4,4,4,4)
   Nominal_Fill_Offset_B07 = (4,4,4,4,4,4,4,4,4,4,4,4,4,4)
   Nominal_Fill_Offset_B08 = (2,2,2,2,2,2,2,2,2,2,2,2,2,2)
   Nominal_Fill_Offset_B09 = (4,4,4,4,4,4,4,4,4,4,4,4,4,4)
END_GROUP = OLI_FOCAL_PLANE
GROUP = EARTH_CONSTANTS
 Ellipsoid_Name = "WGS84"
 Semi_Major_Axis = 6378137
 Semi_Minor_Axis = 6356752.3142
 Ellipticity = 0.00335281066474
 Eccentricity = 0.00669437999013
 Gravity_Constant = 3.986005E+14
 J2_Earth_Model = 0.00108263
 Earth_Angular_Velocity = 7.2921158553E-05
 Datum = "WGS84"
 Speed_of_Light = 2.99792458E8
 Spheroid_Code = 12
 Number_of_Leap_Seconds = 24
 Leap_Years =
(1972,1973,1974,1975,1976,1977,1978,1979,1980,1981,

1982,1983,1985,1988,1990,1991,1992,1993,1994,1996,1997,1999,2006
,2009)
 Leap_Months =
("Jul","Jan","Jan","Jan","Jan","Jan","Jan","Jan","Jan",

"Jul","Jul","Jul","Jul","Jan","Jan","Jan","Jul","Jul","Jul","Jan
",
      "Jul","Jan","Jan","Jan")
 Leap_Days = (1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1)
 Leap_Seconds =
(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1)
END_GROUP = EARTH_CONSTANTS
      .
      .
      .
GROUP = OLI_SCA_PARAMETERS
```

```
  Discontinuity_Ratio_B01 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B02 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B03 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B04 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B05 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B06 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B07 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B08 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Discontinuity_Ratio_B09 = (1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0,
    1.0, 1.0, 1.0)
  Stripe_Cutoff = (4.27, 4.27, 4.27, 4.27, 4.27, 4.27, 4.27,
4.27, 4.27)
  Max_Valid_Correlation_Shift = (0, 0, 0, 0, 0, 0, 0, 0, 0)
  Min_Valid_Neighbor_Segments = (0, 0, 0, 0, 0, 0, 0, 0, 0)
END_GROUP = OLI_SCA_PARAMETERS
     .
     .
     .
GROUP = OLI_DETECTOR_STATUS
 Detector_Select_Table = 1
 Detector_Select_Table_Id = 1
 Inoperable_Count_B01 = (2,0,0,0,0,0,0,0,0,0,0,0,0,1)
 Inoperable_Count_B02 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
 Inoperable_Count_B03 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
 Inoperable_Count_B04 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
 Inoperable_Count_B05 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
 Inoperable_Count_B06 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
 Inoperable_Count_B07 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
 Inoperable_Count_B08 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
 Inoperable_Count_B09 = (0,0,0,0,0,0,0,0,0,0,0,0,0,2)
```

```
Inoperable_Count_B12 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Inoperable_Count_B13 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Inoperable_Count_B14 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Inoperable_B01_SCA01 = (5, 494)
Inoperable_B02_SCA01 = (0)
Inoperable_B03_SCA01 = (0)
Inoperable_B04_SCA01 = (0)
    .
    .
    .
Inoperable_B04_SCA14 = (0)
Inoperable_B05_SCA14 = (0)
Inoperable_B06_SCA14 = (0)
Inoperable_B07_SCA14 = (0)
Inoperable_B08_SCA14 = (0)
Inoperable_B09_SCA14 = (1, 300)
Inoperable_B12_SCA14 = (0)
Inoperable_B13_SCA14 = (0)
Inoperable_B14_SCA14 = (0)
Out_Of_Spec_Count_B01 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B02 = (0,2,0,0,0,0,0,0,0,0,0,0,3,0)
Out_Of_Spec_Count_B03 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B04 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B05 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B06 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B07 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B08 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B09 = (0,0,2,0,0,0,0,0,0,0,0,0,1,0)
Out_Of_Spec_Count_B12 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B13 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_Count_B14 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
Out_Of_Spec_B01_SCA01 = (0)
Out_Of_Spec_B02_SCA01 = (0)
Out_Of_Spec_B03_SCA01 = (0)
Out_Of_Spec_B04_SCA01 = (0)
    .
    .
    .
Out_Of_Spec_B06_SCA14 = (0)
Out_Of_Spec_B07_SCA14 = (0)
Out_Of_Spec_B08_SCA14 = (0)
Out_Of_Spec_B09_SCA14 = (0)
Out_Of_Spec_B12_SCA14 = (0)
Out_Of_Spec_B13_SCA14 = (0)
Out_Of_Spec_B14_SCA14 = (0)
VRP_Inoperable_Count_B01 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_Count_B02 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
```

```
VRP_Inoperable_Count_B03 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_Count_B04 = (2,0,0,0,0,0,0,0,0,0,0,0,0,2)
VRP_Inoperable_Count_B05 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_Count_B06 = (0,3,0,0,0,0,0,0,0,0,0,0,1,0)
VRP_Inoperable_Count_B07 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_Count_B08 = (1,0,0,0,0,0,0,0,0,0,0,0,0,3)
VRP_Inoperable_Count_B09 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_Count_B12 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_Count_B13 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_Count_B14 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Inoperable_B01_SCA01 = (0)
VRP_Inoperable_B02_SCA01 = (0)
VRP_Inoperable_B03_SCA01 = (0)
VRP_Inoperable_B04_SCA01 = (1, 494)
VRP_Inoperable_B05_SCA01 = (0)
    .
    .
    .
VRP_Inoperable_B07_SCA14 = (0)
VRP_Inoperable_B08_SCA14 = (1, 202, 988)
VRP_Inoperable_B09_SCA14 = (0)
VRP_Inoperable_B12_SCA14 = (0)
VRP_Inoperable_B13_SCA14 = (0)
VRP_Inoperable_B14_SCA14 = (0)
VRP_Out_Of_Spec_Count_B01 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B02 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B03 = (0,0,0,0,0,0,2,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B04 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B05 = (0,1,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B06 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B07 = (0,0,0,0,0,0,0,0,0,0,0,2,0,0)
VRP_Out_Of_Spec_Count_B08 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B09 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B12 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B13 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_Count_B14 = (0,0,0,0,0,0,0,0,0,0,0,0,0,0)
VRP_Out_Of_Spec_B01_SCA01 = (0)
VRP_Out_Of_Spec_B02_SCA01 = (0)
    .
    .
    .
VRP_Out_Of_Spec_B06_SCA14 = (0)
VRP_Out_Of_Spec_B07_SCA14 = (0)
VRP_Out_Of_Spec_B08_SCA14 = (0)
VRP_Out_Of_Spec_B09_SCA14 = (0)
VRP_Out_Of_Spec_B12_SCA14 = (0)
VRP_Out_Of_Spec_B13_SCA14 = (0)
```

```
 VRP_Out_Of_Spec_B14_SCA14 = (0)
END_GROUP = OLI_DETECTOR_STATUS
GROUP = OLI_DETECTOR_NOISE
  Det_Noise_B01_SCA01 = (0.826453, 0.85202, 0.862148,
    0.817986, 0.86884, 0.793304, 0.810627, 0.795681, 0.82387,
     .
     .
     .
    0.847327, 0.817922, 0.790234, 0.809606, 0.833036, 0.815992)
  Det_Noise_B02_SCA01 = (2.541882, 2.502805, 2.300733, 1.903023,
    1.833412, 1.960781, 1.982815, 1.769923, 1.531295, 1.742089,
     .
     .
     .
    1.963567, 1.446604, 1.366729, 1.328951, 1.370862, 1.360887)
     .
     .
     .
  Det_Noise_B09_SCA14 = (0.826453, 0.85202, 0.862148,
    0.817986, 0.86884, 0.793304, 0.810627, 0.795681, 0.82387,
     .
     .
     .
    0.847327, 0.817922, 0.790234, 0.809606, 0.833036, 0.815992)
  Det_Noise_B14_SCA14 = (2.541882, 2.502805, 2.300733, 1.903023,
    1.833412, 1.960781, 1.982815, 1.769923, 1.531295, 1.742089,
     .
     .
     .
    1.963567, 1.446604, 1.366729, 1.328951, 1.370862, 1.360887)
END_GROUP = OLI_DETECTOR_NOISE
     .
     .
     .
GROUP = UT1_TIME_PARAMETERS
  UT1_Year = (2000, 2000, 2000, 2000, 2000, 2000, 2000, 2000,
2000, 2000, 2000, 2000,  2000, 2000, 2000, 2000, 2000, 2000,
     2000, 2000, 2000,
     .
     .
     .
     2000, 2000, 2000, 2000, 2000)
  UT1_Month = ("May", "May", "May", "May", "May", "May", "May",
"May", "May", "May",     "May", "May", "May", "May", "May",
"Jun", "Jun", "Jun", "Jun", "Jun", "Jun", "Jun",  "Jun", "Jun",
"Jun", "Jun", "Jun", "Jun", "Jun",
     .
```

```
      .
      .
    "Nov", "Nov", "Nov", "Nov", "Nov", "Nov", "Nov", "Nov",
"Nov", "Nov", "Nov")
  UT1_Day = (17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,
30, 31, 1, 2, 3, 4, 5,   6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,
17, 18, 19, 20, 21,
      .
      .
      .
    17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31,
     1, 2, 3, 4, 5, 6, 7, 8,  9, 10, 11, 12)
  UT1_Modified_Julian = (51681, 51682, 51683, 51684, 51685,
51686, 51687, 51688, 51689,   51690, 51691, 51692, 51693, 51694,
51695, 51696, 51697,
      .
      .
      .
     51848, 51849, 51850, 51851, 51852, 51853, 51854, 51855,
51856, 51857, 51858, 51859,   51860)
  UT1_X = (0.09085, 0.09139, 0.09221, 0.09319, 0.09399, 0.09448,
0.09463, 0.09477,   0.0953, 0.09611, 0.09731, 0.09892, 0.10069,
0.10233,
      .
      .
      .
    -0.04982, -0.05081, -0.05179, -0.05276, -0.05372, -0.05467,
-0.05561, -0.05653,
    -0.05744, -0.05835, -0.05924)
  UT1_Y = (0.32848, 0.32775, 0.32715, 0.32663, 0.32619, 0.32566,
0.32475, 0.32351,   0.3224, 0.32157, 0.32083, 0.32009, 0.31935,
0.31868,
      .
      .
      .
    0.26994, 0.27101, 0.27209, 0.27318, 0.27429, 0.27542,
0.27656, 0.27772, 0.2789,     0.28008, 0.28129)
  UT1_UTC = (0.22588, 0.22489, 0.22402, 0.22328, 0.22267,
0.22213, 0.22163, 0.22112,    0.22057, 0.21997, 0.21929,
0.21852, 0.21766, 0.21673,
      .
      .
      .
     0.13942, 0.13863, 0.1378, 0.13686, 0.1358, 0.13459,
0.13323, 0.13176, 0.13021,    0.12867, 0.12721)
END_GROUP = UT1_TIME_PARAMETERS
END
```

Section 3 Response Linearization Lookup Table (RLUT) File

3.1 Description

The RLUT file provides the parameters used to linearize the detector response for the OLI and TIRS instruments. Multiple methods of linearizing the response are supported. The parameters are organized into groups of detectors for each band / SCA. The file is very large and is stored in Hierarchical Data Format (HDF). This document provides a high-level overview of how the RLUT is applied to linearize the detector response, but for the full details see LSDS-649 Landsat 8 (L8) Calibration and Validation (Cal/Val) Algorithm Description Document (ADD).

3.2 Effective Dates

Each RLUT file covers an effective date range. The parameters in the file, "Effective Begin Date" and "Effective End Date," designate the range of valid acquisition dates and are in YYYY-MM-DDThh:mm:ss format (ISO 8601). The parameter file used in processing an image should have an effective date range that includes the acquisition date of the ordered image. The detector linearity is not expected to change often; therefore, the effective date range is typically very large.

3.3 File-Naming Convention

Throughout the mission, the file change history is maintained by means of effective begin and end dates, collection number, plus the assignment of a version number to deal with changes that occur during the effective date period.

The file name contains the file identifier, sensor identifier, effective date range, and version number. Table 3-1 presents a valid example.

LC08RLUT_yyyy^{1}mm^{1}dd^1_yyyy^{2}mm^{2}dd^{2}cc_nn.h5	
L	Constant representing Landsat
C	Sensor (C = Combined OLI and TIRS)
08	Satellite numerical representation
RLUT	Response Linearization Look Up Table
_	RLUT / starting date separator
yyyy^1	Four-digit effective starting year
mm^1	Two-digit effective starting month
dd^1	Two-digit effective starting day
_	Effective starting / ending date separator
yyyy^2	Four-digit effective ending year
mm^2	Two-digit effective ending month
dd^2	Two-digit effective ending day
_	Date / collection number separator
cc	Collection number (starts with 01)
_	Collection / version number separator
nn	Version number for this file (starts with 01)
.	File name / extension separator
h5	HDF file extension

Table 3-1. File-Naming Convention

For example, if the IAS created four RLUTs at three-month intervals, and updated the first file twice and the second and third files once, the assigned file names would be as follows:

File 1 LC08RLUT_20130101_20130331_01_01.h5
LC08RLUT_20130101_20130331_01_02.h5
LC08RLUT_20130101_20130331_01_03.h5
File 2 LC08RLUT_20130401_20130630_01_01.h5
LC08RLUT_20130401_20130630_01_02.h5
File 3 LC08RLUT_20130701_20130930_01_01.h5
LC08RLUT_20130701_20130930_01_02.h5
File 4 LC08RLUT_20131001_20131231_01_01.h5

This example assumes that the effective date ranges do not change. The effective date range for a file can change if a specific problem (e.g., detector outage) is discovered somewhere within the effective date range. In this scenario, two RLUTs with new names and effective date ranges are created for the period under consideration. The "Effective End Date" for a new pre-problem RLUT would change to the day before the problem occurred and the "Effective Begin Date" remains unchanged. A post-problem RLUT with a new file name would be created with the "Effective Begin Date" corresponding to the imaging date when the problem occurred and the "Effective End Date" corresponding to the original "Effective End Date" for the period under consideration. New versions of all other RLUTs affected by the updated parameters also would be created.

For example, assume a detector stopped responding on July 25, 2012. Two new RLUTs need to be created that supersede the period represented by file number three, version two, and a new version of file number four. The new file names and version numbers become the following:

File 3 LC08RLUT_20130701_20130930_01_01.h5
LC08RLUT_20130701_20130930_01_02.h5
LC08RLUT_20130701_20130724_01_03.h5
LC08RLUT_20130725_20130930_01_03.h5
File 4 LC08RLUT_20131001_20131231_01_01.h5
LC08RLUT_20131001_20131231_01_02.h5

3.4 RLUT File Updates

The RLUT file is created during radiometric calibration by the Non-Linear Response Characterization algorithm. The linearization coefficients generated are used to correct the non-linear relationship between the input signal and the DN value.

3.5 RLUT File Groups

The RLUT file can contain up to four groups. The following subsections describe these groups.

3.5.1 File Attributes

The FILE_ATTRIBUTES group contains a single Hierarchical Data Format Version 5 (HDF5) compound data type, which includes metadata about the file. Table 3-2 lists the parameters present. The data type field includes the size of the field in parentheses.

Parameter Name	Data Type	Description
File Source	String(201)	Baseline RLUT used as a source to create this RLUT, conforming to the file-naming standard for RLUT files.
Effective Begin Date	String(27)	Effective beginning date this file covers. Format: YYYY-MM-DDThh:mm:ss, where YYYY = Year, MM = Two-digit month number (01-12), DD = Two-digit day of month (01-31), T = Time separator, hh = Two-digit hour (01-24), mm = Minutes (00-59), ss = Seconds (00-60).
Effective End Date	String(27)	Effective ending date this file covers. Same format as the Effective Begin Date field.
Effective Status	String(13)	Describes the status of the RLUT. The RLUT is either "ACTIVE" = Currently used in production, "UNTESTED" = Created for test purposes but has not been tested, "TESTED" = Created for test purposes and has not been analyzed, "VALIDATED" = Analyzed the test results and accepted the results but not used in production, "DENIED" = Failed validation.
Baseline Date	String(27)	The date the RLUT was entered into the baseline production. Same format as the Effective Begin Date field.
Description	String(4001)	Text field intended to describe the rationale for the updated RLUT or other comments related to the RLUT.
File Version	Integer (32 bit)	Version number of the effective date range overlap. Format: NN, where N = 01-99.
Collection	Integer(32 bit)	Collection number. Format: NN, where N = 1-99.

Table 3-2. File Attributes Group

3.5.2 Linearization Parameters

The LINEARIZATION_PARAMETERS group contains the parameters to linearize image pixel values using a quadric equation with three coefficients. The parameters are used in the equation:

$$output = C0 + C1 * input + C2 * (input)^2$$

where:

input is the original input pixel value
C0, C1, and C2 are the coefficients from the RLUT
output is the linearized output value

Three sets of coefficients are provided. Each set covers a different range of input values, with the ranges indicated by the cutoff threshold parameters. An input value less than the Low Cutoff Threshold indicates the low coefficients should be used. An input value greater than or equal to the High Cutoff Threshold indicates the high coefficients should be used. An input value greater than or equal to the Low Cutoff

Threshold and less than the High Cutoff Threshold indicates the "Mid" coefficients should be used. The quadratic equation coefficients are chosen to make the output values continuous across the thresholds.

The linearization parameters group contains a tree of sub-groups for each band and SCA of the L0R image. The group hierarchy is:

/LINEARIZATION_PARAMETERS/Band##/SCA##

where the "##" is a two-digit number. Only the subset of bands that use this linearization method are present in the file.

An "Attribute Values" dataset for each band / SCA contains a per-detector record with the 11 parameters. Table 3-3 shows the parameters contained in each record.

Parameter Name	Data Type	Description
Low Cutoff Threshold	Double	Low cutoff threshold input value for using the Remap Low Coefficients. Input values less than this value have the Low coefficients applied.
High Cutoff Threshold	Double	High cutoff threshold input value for using the Remap High Coefficients. Input values greater than or equal to this value have the High coefficients applied.
Remap Coefficient 0 Low	Double	Remap Coefficient 0 (C0) for input values less than the Low Cutoff Threshold
Remap Coefficient 1 Low	Double	Low Remap Coefficient 1 (C1) for input values less than the Low Cutoff Threshold
Remap Coefficient 2 Low	Double	Low Remap Coefficient 2 (C2) for input values less than the Low Cutoff Threshold
Remap Coefficient 0 Mid	Double	Mid Remap Coefficient 0 (C0) for input values greater than or equal to the Low Cutoff Threshold and less than the High Cutoff Threshold
Remap Coefficient 1 Mid	Double	Mid Remap Coefficient 1 (C1) for input values greater than or equal to the Low Cutoff Threshold and less than the High Cutoff Threshold
Remap Coefficient 2 Mid	Double	Mid Remap Coefficient 2 (C2) for input values greater than or equal to the Low Cutoff Threshold and less than the High Cutoff Threshold
Remap Coefficient 0 High	Double	High Remap Coefficient 0 (C0) for input values greater than or equal to the High Cutoff Threshold
Remap Coefficient 1 High	Double	High Remap Coefficient 1 (C1) for input values greater than or equal to the High Cutoff Threshold
Remap Coefficient 2 High	Double	High Remap Coefficient 2 (C2) for input values greater than or equal to the High Cutoff Threshold

Table 3-3. Linearization Parameters Group

3.5.3 Linearity Lookup

The LINEARITY_LOOKUP group contains parameters to linearize image pixel values using a pair of lookup tables for each detector. The first table is the "DN Lookup Table

(DN_LUT)" that holds input image pixel values. The second table (named "Correction") holds the corrections to apply to the matching input value from the DN_LUT to linearize it. These tables are only defined for a subset of the possible input values. Input values that fall between two entries in the DN_LUT table are linearized using linear interpolation between the two table entries.

The linearity lookup group contains a tree of sub-groups for each band and SCA of the L0R image. The group hierarchy is:

/LINEARITY_LOOKUP/Band##/SCA##

where the "##" is a two-digit number. Only the subset of bands that use this linearization method are present in the file. Each of the band / SCA sub-groups contains the Correction and DN_LUT datasets. Those datasets are two-dimensional, with the first dimension being the detector in the SCA. The second dimension is the indices mentioned above.

3.5.4 TIRS Secondary Lookup

The TIRS_SECONDARY_LOOKUP group is in the same format as the Linearity Lookup group. This group is used to perform a second linearization on the TIRS bands. See LSDS-649 Landsat 8 (L8) Calibration and Validation (Cal/Val) Algorithm Description Document (ADD) for details.

3.6 Example RLUT File Contents

The following is an example of the contents of an RLUT file. An RLUT is too large to include in this document; therefore, a representative subset is shown. HDF files are binary and cannot be shown directly. The output shown is generated from the HDF tool "h5dump."

3.6.1 File Contents

The following shows a subset of the groups and datasets present in the RLUT file. Some of the groups and datasets were eliminated.

```
FILE_CONTENTS {
 group      /
 group      /FILE_ATTRIBUTES
 dataset    /FILE_ATTRIBUTES/Attribute Values
 group      /LINEARITY_LOOKUP
 group      /LINEARITY_LOOKUP/Band01
 group      /LINEARITY_LOOKUP/Band01/SCA01
 dataset    /LINEARITY_LOOKUP/Band01/SCA01/Correction
 dataset    /LINEARITY_LOOKUP/Band01/SCA01/DN_LUT
     .
     .
 group      /LINEARITY_LOOKUP/Band09/SCA14
 dataset    /LINEARITY_LOOKUP/Band09/SCA14/Correction
 dataset    /LINEARITY_LOOKUP/Band09/SCA14/DN_LUT
 group      /LINEARIZATION_PARAMETERS
 group      /LINEARIZATION_PARAMETERS/Band01
```

```
group     /LINEARIZATION_PARAMETERS/Band01/SCA01
dataset    /LINEARIZATION_PARAMETERS/Band01/SCA01/Parameter Values
     .
     .
group     /LINEARIZATION_PARAMETERS/Band11/SCA03
dataset    /LINEARIZATION_PARAMETERS/Band11/SCA03/Parameter Values
group     /TIRS_SECONDARY_LOOKUP
group     /TIRS_SECONDARY_LOOKUP/Band10
group     /TIRS_SECONDARY_LOOKUP/Band10/SCA01
dataset    /TIRS_SECONDARY_LOOKUP/Band10/SCA01/Correction
dataset    /TIRS_SECONDARY_LOOKUP/Band10/SCA01/DN_LUT
     .
     .
group     /TIRS_SECONDARY_LOOKUP/Band11/SCA03
dataset    /TIRS_SECONDARY_LOOKUP/Band11/SCA03/Correction
dataset    /TIRS_SECONDARY_LOOKUP/Band11/SCA03/DN_LUT
}
```

3.6.2 File Attributes

The following shows an example file attributes group for an RLUT file named LC08RLUT_20130211_20431231_01_01:

```
GROUP "/FILE_ATTRIBUTES" {
  DATASET "Attribute Values" {
    DATATYPE  H5T_COMPOUND {
      H5T_STRING {
        STRSIZE 201;
        STRPAD H5T_STR_NULLTERM;
        CSET H5T_CSET_ASCII;
        CTYPE H5T_C_S1;
      } "File Source";
      H5T_STRING {
        STRSIZE 27;
        STRPAD H5T_STR_NULLTERM;
        CSET H5T_CSET_ASCII;
        CTYPE H5T_C_S1;
      } "Effective Begin Date";
      H5T_STRING {
        STRSIZE 27;
        STRPAD H5T_STR_NULLTERM;
        CSET H5T_CSET_ASCII;
        CTYPE H5T_C_S1;
      } "Effective End Date";
      H5T_STRING {
        STRSIZE 13;
        STRPAD H5T_STR_NULLTERM;
        CSET H5T_CSET_ASCII;
        CTYPE H5T_C_S1;
      } "Effective Status";
      H5T_STRING {
        STRSIZE 27;
        STRPAD H5T_STR_NULLTERM;
        CSET H5T_CSET_ASCII;
        CTYPE H5T_C_S1;
      } "Baseline Date";
```

```
      H5T_STRING {
        STRSIZE 4001;
        STRPAD H5T_STR_NULLTERM;
        CSET H5T_CSET_ASCII;
        CTYPE H5T_C_S1;
      } "Description";
      H5T_STD_I32LE "File Version";
      H5T_STD_I32LE "Collection";
    }
    DATASPACE  SIMPLE { ( 1 ) / ( H5S_UNLIMITED ) }
    DATA {
    (0): {
        "LC08RLUT_20130211_20431231_01_01",
        "2013-02-11T00:00:00",
        "2043-12-31T23:59:59",
        "ACTIVE",
        "2013-02-11T14:22:00",
        "Example RLUT file",
        1
      }
    }
  }
}
```

3.6.3 Linearization Parameters

The following shows a subset of the linearization parameters group for Band 1, SCA 1. Detector indices 0 and 493 are shown.

```
GROUP "/LINEARIZATION_PARAMETERS/Band01/SCA01" {
  DATASET "Parameter Values" {
    DATATYPE  H5T_COMPOUND {
      H5T_IEEE_F64LE "Low Cutoff Threshold";
      H5T_IEEE_F64LE "High Cutoff Threshold";
      H5T_IEEE_F64LE "Remap Coefficient 0 Low";
      H5T_IEEE_F64LE "Remap Coefficient 1 Low";
      H5T_IEEE_F64LE "Remap Coefficient 2 Low";
      H5T_IEEE_F64LE "Remap Coefficient 0 Mid";
      H5T_IEEE_F64LE "Remap Coefficient 1 Mid";
      H5T_IEEE_F64LE "Remap Coefficient 2 Mid";
      H5T_IEEE_F64LE "Remap Coefficient 0 High";
      H5T_IEEE_F64LE "Remap Coefficient 1 High";
      H5T_IEEE_F64LE "Remap Coefficient 2 High";
    }
    DATASPACE  SIMPLE { ( 494 ) / ( H5S_UNLIMITED ) }
    DATA {
    (0): {
        2272.76,
        4002.9,
        -5.32695,
        1.02555,
        -1.99743e-06,
        -35.7473,
        1.04732,
        -5.65025e-06,
        145.074,
```

```
        0.975671,
        9.25166e-07
      },
    .
    .
    (493): {
        2283.09,
        4112.52,
        -5.30746,
        1.02563,
        -2.03276e-06,
        -34.035,
        1.04596,
        -5.37592e-06,
        158.022,
        0.971898,
        1.18779e-06
      }
    }
  }
}
```

3.6.4 Linearity Lookup

The following shows a subset of the linearity lookup group for Band 1, SCA 1. Detector indices 0, 1, and 493 are shown.

```
GROUP "/LINEARITY_LOOKUP/Band01/SCA01" {
  DATASET "Correction" {
    DATATYPE  H5T_IEEE_F32LE
    DATASPACE  SIMPLE { ( 494, 30 ) / ( 494, 30 ) }
    DATA {
    (0,0): 0, 3.77412, 9.31998, 19.5086, 28.5411, 36.4608, 43.0774,
    (0,7): 44.8134, 52.691, 57.5239, 58.8895, 64.4882, 64.595, 64.8059,
    (0,14): 56.2792, 48.283, 40.6644, 36.518, 35.2887, 30.2817, 23.1921,
    (0,21): 17.5155, 13.6248, 8.40348, 3.89021, 0, 0, 0, 0, 0,
    (1,0): 0, 3.8924, 9.5495, 19.2418, 28.5375, 36.5742, 41.9221, 44.8616,
    (1,8): 52.1491, 58.988, 64.483, 64.91, 56.3117, 48.2654, 41.0084,
    (1,15): 35.5532, 30.3734, 22.5006, 18.2008, 13.2989, 9.32666, 5.57695,
    (1,22): 0, 0, 0, 0, 0, 0, 0, 0,
      .
      .
    (493,0): 0, 3.70134, 9.61079, 19.4106, 28.7769, 36.6645, 45.1082,
    (493,7): 53.0993, 59.4599, 64.607, 65.2626, 65.7533, 57.6989, 49.0001,
    (493,14): 40.7364, 34.7344, 29.8251, 21.8335, 16.2751, 11.9934,
    (493,20): 7.96127, 4.0712, 0, 0, 0, 0, 0, 0, 0, 0
    }
  }
  DATASET "DN_LUT" {
    DATATYPE  H5T_IEEE_F32LE
    DATASPACE  SIMPLE { ( 494, 30 ) / ( 494, 30 ) }
    DATA {
    (0,0): 0, 224, 447, 892, 1338, 1786, 2140, 2233, 2679, 3029, 3128,
```

```
    (0,11): 3577, 3723, 4032, 4496, 4959, 5421, 5778, 5884, 6342, 6804,
    (0,21): 7265, 7724, 8185, 8644, 9103, 16383, 16383, 16383, 16383,
    (1,0): 0, 225, 447, 894, 1340, 1788, 2077, 2236, 2684, 3134, 3583,
    (1,11): 4039, 4505, 4968, 5431, 5896, 6353, 6817, 7278, 7738, 8201,
    (1,21): 8658, 9119, 16383, 16383, 16383, 16383, 16383, 16383, 16383,
      .
      .
    (493,0): 0, 225, 448, 896, 1344, 1794, 2253, 2691, 3142, 3593, 3853,
    (493,11): 4049, 4516, 4982, 5446, 5909, 6371, 6836, 7299, 7776, 8223,
    (493,21): 8685, 9144, 16383, 16383, 16383, 16383, 16383, 16383, 16383
    }
  }
}
```

3.6.5 TIRS Secondary Lookup

The following shows a subset of the TIRS secondary lookup group for Band 10, SCA 1. Detector indices 0, 1, and 639 are shown.

```
GROUP "/TIRS_SECONDARY_LOOKUP/Band10/SCA01" {
  DATASET "Correction" {
    DATATYPE  H5T_IEEE_F32LE
    DATASPACE  SIMPLE { ( 640, 15 ) / ( 640, 15 ) }
    DATA {
    (0,0): 175.81, 68.0814, 61.3403, 47.5361, 24.9845, 14.8277, 5.63286,
    (0,7): -7.28101, -5.84053, 7.48868, 26.1619, 63.7182, 137.577, 254.891,
    (0,14): 0,
    (1,0): 177.265, 70.7234, 63.64, 49.552, 26.2521, 15.7871, 5.30871,
    (1,7): -6.66447, -5.88362, 7.23938, 26.6269, 65.9243, 141.864, 266.463,
    (1,14): 0,
      .
      .
    (639,0): 163.989, 84.5163, 74.6663, 57.5964, 32.8338, 21.1577, 7.73121,
    (639,7): -8.26329, -11.3373, 11.8694, 35.5326, 76.4884, 144.394,
    (639,13): 246.482, 0
    }
  }
  DATASET "DN_LUT" {
    DATATYPE  H5T_IEEE_F32LE
    DATASPACE  SIMPLE { ( 640, 15 ) / ( 640, 15 ) }
    DATA {
    (0,0): -2.97605, 265.478, 446.18, 735.661, 1155.7, 1415.13, 2030.65,
    (0,7): 2798.95, 3232.08, 3691.3, 4182.96, 4693.15, 5510, 6364.38,
    (0,14): 16384,
    (1,0): -3.04696, 260.675, 437.884, 721.568, 1133.59, 1387.83, 1991.26,
    (1,7): 2741.96, 3166.17, 3615.17, 4094.85, 4591.23, 5386.35, 6212.01,
    (1,14): 16384,
    (2,0): -2.98628, 267.985, 450.476, 745.672, 1175.52, 1440.71, 2070.84,
    (2,7): 2855.81, 3297.42, 3768.25, 4268.99, 4787.32, 5614.31, 6471.65,
    (2,14): 16384,
      .
```

```
    .
  (639,0): 1.59151, 241.829, 425.683, 718.498, 1140.84, 1401.85, 2021.76,
  (639,7): 2793.32, 3231.07, 3680.53, 4167.32, 4674.25, 5497.27, 6367.11,
  (639,14): 16384
  }
 }
}
```

References

Please see http://landsat.usgs.gov/tools_acronyms_ALL.php for a list of acronyms.

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