D-64071

OCO (Orbiting Carbon Observatory) Project
OCO-2

Software Interface Specification
for the
SDOS Level 1A Instrument Product

Revision D
February 15, 2016

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
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Change Log

Revision	Date	Sections Changed	Author
Initial	6/16/2014		C. Avis
Rev B	11/18/2014	1, 3, 4.1, 4.2, 5	C. Avis
Rev C	3/15/2015	1, 5 (frame_qual_flag update and deletion of AutomaticQualityFlag), App. 1	C. Avis
Rev D	2/15/2016	1, 4.2 (updated naming convention), 5 & 6 (*instrument_time* and *spacecraft_time_gps* replaced by *spectrometer_instrument_time, hk_instrument_time, spectrometer_spacecraft_time_gps* and *hk_spacecraft_time_gps*), 5 (*i_cry_ccie_bcmd_cntr* type changed to Int16), 8 (deleted unused acronyms)	C. Avis

Table of Contents

1   Product Identification and Software Version

This document describes the specification of one of the data products generated by the OCO-2 Science Data Operations System (SDOS). This document applies to the following products and system version:

Product Name: Level 1A Instrument Product
Short Name: OCO2_L1aIn_Sample and OCO2_L1aIn_Pixel
System Version: B7.2.00 and later
GES DISC Version: Version 7, 7r and later
Product Description: Depacketized raw data formatted into a standard granularity with calibrated engineering data (for both science and calibration observations)

SDOS System B7.0.00 generates products either with predictive calibration parameters (Version 7) or with parameters derived via analysis of past instrument performance (Version 7r). Therefore, 7r is considered of higher quality. Analyses mixing the two sets should be undertaken with a degree of caution. The product specifications for 7 and 7r are identical and this document applies to both.

This document describes the OCO-2 Level 1A Instrument Product, both Sample mode (Section 5) and Single-Pixel mode (Section 6). The Version 7 collection has Level 1A products generated by system software B7.2.00 and B7.3.00. A few FrameHeader fields changed between B7.2.00 and B7.3.00. Therefore, Sections 5 and 6 each have both types of FrameHeaders described. Files created by B7.2.00 and B7.3.00 may be distinguished by their filename, which contains the ShortBuildID of either "B7200" or "B7300" (See Section 4.2).

This specification will apply to System Versions higher than 7 if no changes to these particular products were made.

2   Background information

The OCO-2 SDOS converts telemetry downloaded from the Observatory into data products that provide comprehensive mission results as well as material for further research and investigation. The SDOS generates products from Level 0 through Level 2, some of which are available for distribution to both the scientific community and the general public. All products are available to users of the SDOS computing cluster.

2.1   NASA Data Levels

The following table provides the definitions of the data levels used in this document. These definitions are standard within the NASA community

Level	Description
Packet data	Telemetry data stream as received at the ground station, with science and engineering data embedded
Level 0	Instrument science data (e.g., raw voltages, counts) at full resolution, time ordered, with duplicates and transmission errors removed
Level 1A	NASA Level 0 data that have been located in space and may have been transformed (e.g., calibrated, rearranged) in a reversible manner and packaged with needed ancillary and auxiliary data (e.g., radiances with the calibration equations applied)
Level 1B	Irreversibly transformed (e.g., resampled, remapped, calibrated) values of the instrument measurements (e.g., radiances, magnetic field strength)
Level 2	Geophysical parameters, generally derived from NASA Level 1 data, and located in space and time commensurate with instrument location, pointing, and sampling

2.2   Product Pedigree and Destination

This product is generated within the nominal SDOS pipeline by the L1aIn PGE using the following input data:
- Level 0 Instrument telemetry (science and housekeeping)

This product is expected to be an input to the following PGE's within the nominal SDOS pipeline:
- Geolocation
- CalApp
- L1aStat

The Level 1A product is slightly different for data acquired in Sample Mode vs. Single-pixel Mode.   Both product types are described in this document.

2.3   Suggested Tools to Read Product

The following set of tools can be used to open and examine this HDF-5 product on Linux systems. Other tools may be available.
- h5dump
- hdfview

3   Reference Documents

1. OCO-2 SDOS Software Design Document (JPL D-71459)
2. OCO-2 SDOS Data Bible
3. OCO-2 Science Data Management and Archive Plan (JPL D-64039)

4   Product Description

4.1   Format and Size

This product is in HDF-5 format. For most nominal orbits, the Sample and Single-pixel products will each use about 0.7 gigabytes (across multiple files).

4.2   Naming Convention

oco2_[*ProductId*][*Mode*]_[*Orbit*][*ModeCounter*]_[*AcquisitionDate*]_[*ShortBuildId*][*CalibType*]_[*ProductionDateTime*].h5

Field	Description	Format	Selection
ProductId	A mnemonic indicating a file type.	String	L1aIn — Level 1A Instrument product
Mode	The acquisition Mode associated with the data.	Two character string	GL – Sample Glint

Field	Description	Format	Selection
			ND – Sample Nadir
			TG – Sample Target
			DS – Sample Dark Calibration
			LS – Sample Lamp Calibration
			SS – Sample Solar Calibration
			BS – Sample Limb Calibration
			NP – Single-Pixel Nadir
			GP – Single-Pixel Glint
			TP – Single-Pixel Target
			DP – Single-Pixel Dark Calibration
			LP – Single-Pixel Lamp Calibration
			SP – Single-Pixel Solar Calibration
			BP – Single-Pixel Limb Calibration
			XS – Sample Transition
			XP – Single-Pixel Transition
			MS – Sample Lunar Calibration
			MP – Single-Pixel Lunar Calibration
			SB – Stand-by
Orbit	The Orbit on which the associated data were acquired. If the Orbit number is less than 10,000, zeros are prepended to the number to ensure that the field is five digits long.	nnnnn	Actual Orbit number for data acquired during operations
ModeCounter	This field indicates how many times an acquisition Mode occurs in an Orbit. If a mode occurs only once, ModeCounter is set to "a".	Single character	a, b, c, …
AcquisitionDate	The date (UTC) the data were acquired.	yymmdd	
ShortBuildId	The identification of the related software build	B*stuu*	s = ID of major build cycle t = ID of scheduled build within a major build cycle uu = ID of incremental or patch build

Field	Description	Format	Selection
4.3 CalibType	4.4 Indicates whether processing used predictive or retrospective calibration	4.5 Single character if retrospective; 4.6 Not present if predictive	4.7 r = retrospective calibration used
ProductionDateTime	The date and time (UTC) that the file was produced.	yymmddhhmmss	

5   Specification Table – Sample Mode

The HDF file structure consists of a large number of Data Elements with values. These Elements (a.k.a., 'fields') may be of various types (e.g., arrays, scalars) and are organized into Groups. Groups are utilized in various ways, such as to combine Elements/values generated by different PGE's.

Description of column headers in the following tables:

Data Element   The name of the Data Element
Shape   See Appendix 1
Type   The data type of the values
Units   The SI units of the values, if any
Minimum value   The lowest possible value. In some cases, this is the lowest safe value (i.e., a 'red' limit)
Maximum value   The highest possible value. In some cases, this is the highest safe value (i.e., a 'red' limit)
Comments   Descriptive information about the Element
(no value = n/a)

L1A_Instrument_Sample Product HDF specification

Group	Metadata					
Group description	Granule-level metadata					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
Standard Metadata	See OCO-2 Standard Metadata specification table below					
AcquisitionMode	Scalar	String				The instrument mode in which the data in the product were collected. Valid values are: 'Glint', 'Nadir', 'Target', 'Sample Dark Calibration', 'Sample Lamp Calibration', 'Sample Solar/limb Calibration', 'Single-Pixel Dark Calibration', 'Single-Pixel Lamp Calibration', 'Single-Pixel Solar/limb Calibration'
ActualFrames	Scalar	Int32		0	17798	Actual number of frames reported in this product
AllowedIHKGap	Scalar	Float32	Seconds			The maximum time allowed for finding valid IHK data to associate with each frame of science data
BadPixelMapChecksum	Spectrum_Array	UInt16				Checksum of corresponding Bad Pixel Map
BadPixelMapVersionNum	Spectrum_Array	UInt32		0	65535	Version number of corresponding Bad Pixel Map used to calibrate this data file

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
ExpectedFrames	Scalar	Int32		0	17798	Nominal number of frames in this product
FirstSoundingId	Scalar	Int64				The ID of the first sounding in this file
FPAScanOption	Spectrum_Array	BitField8				Bit field indicating the scan option used and the row separation, if used
L1AAlgorithmDescriptor	Scalar	String				Identification of the algorithm and version used to generate this product
LastSoundingId	Scalar	Int64				The ID of the last sounding in this file
ModeCounter	Scalar	String				The Nth occurrence of this particular mode for this orbit, indicated by letter ('a', 'b', 'c', 'd', etc.)
ModeFlagSpare	Scalar	UInt8				Not used - value 0
OperationMode	Scalar	String				The two-letter abbreviation of the AcquisitionMode: GL, ND, TG, DS, LS, SS, BS, NP, GP, TP, DP, LP, SP, BP, XS, XP, MS, MP, SB
ReportedSoundings	SoundingPosition_Array	Int8		0	1	Indicates the inclusion of each footprint in the data: 0 - not included, 1 - included
SpectralChannel	Spectrum_Array	String				A description of the spectral channels used for the measurements
TelemetryMode	Scalar	BitField16				Value of the Mode Flag with bits reflecting the commanded state of the instrument
Group	**FrameHeader (for files with ShortBuildID="B7300")**					
Group description	Miscellaneous information provided for every frame					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
clocking_offset_interval	Frame_Spectrum_Array	UInt16		0	256	The number of pixels between each successive pixel shift used to apply a clocking correction
clocking_offset_start	Frame_Spectrum_Array	Int8		-127	127	The first pixel where the flight software applies a focal plane clocking correction - negative value indicates the clocking shift operates downward, positive value indicates clocking shift is upward
cs_qual_flag	Frame_Array	UInt8				Bit flags indicating the quality of the color slice data: 0 - Good, non-zero - see documentation
diffuser_position	Frame_Array	UInt16				The position of the solar diffuser at the beginning of the mode: 0 - Lamp or Closed position, 75 - Open for science, 150 - Solar Calibration position
frame_id	Frame_Array	Int64				The mission-unique frame identifier
frame_qual_flag	Frame_Array	UInt64				Bit flags indicating the quality of the data in each frame: 0 - good, non-zero - see documentation
frame_time_string	Frame_Array	String				Time of telemetry frame (yyyy-mm-ddThh:mm:ss.mmmZ)

frame_time_tai93	Frame_Array	Float64	Seconds			Time of telemetry frame in seconds since Jan 1, 1993
full_checksum	Frame_Sounding_Spectrum_ Array	UInt8				Checksum for all science data in frame
hk_checksum	Frame_Array	UInt8				Checksum for all housekeeping data in frame
hk_frame_number	Frame_Array	UInt16				Frame number of the housekeeping frame reporting the engineering data
hk_saved_frame_number	Frame_Array	UInt16				Frame number saved at the last Operational command (STANDBY, SINGLE, RESIDUAL, SUMMED)
hk_time_checksum	Frame_Array	UInt8				Checksum of the time bytes in the IHK packet
spectrometer_instrument_time	5.1 Frame_Spectrum_ Array	5.2 UInt32	5.3 Mil liseconds			Time since digital processor (DP) power up as reported in each spectrometer's optical housekeeping telemetry
5.4 hk_instrument_time	5.5 Frame_Array	5.6 UInt32	5.7 Mil liseconds			Time since instrument controller (IC) power up
5.8 spectrometer_spacecraft_ time_gps	5.9 Frame_Spectrum_ Array	UInt32	5.10 Se conds			Last reported spacecraft time as reported in each spectrometer's optical housekeeping telemetry
5.11 hk_spacecraft_time_gps	5.12 Frame_Array	5.13 UInt32	5.14 Se conds			Last spacecraft time reported by instrument housekeeping
spare_ihk_byte20	Frame_Array	UInt8				Value from byte 20 in the IHK packet header
spare_ihk_byte21	Frame_Array	UInt8				Value from byte 21 in the IHK packet header
spectrometer_frame_number	Frame_Spectrum_Array	UInt16				Frame number for each spectrometer
spectrometer_saved_frame_number	Frame_Spectrum_Array	UInt16				Frame number saved at the last mode change
spectrometer_time_checksum	Frame_Sounding_Spectrum_ Array	UInt8				Checksum of the time bytes in the OHK packet
status_flags_ic	Frame_Array	UInt8				Instrument IC status bit flag
status_flags_ihk_byte36	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 36
status_flags_ihk_byte37	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 37

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
summed_multiplier	Frame_Spectrum_Array	Float32				The multiplicative term of the pixel summation formula - see documentation
summed_offset	Frame_Spectrum_Array	UInt8				The offset term of the pixel summation formula - see documentation
Group	**FrameHeader (for files with ShortBuildID="B7200")**					
Group description	Miscellaneous information provided for every frame					

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
clocking_offset_interval	Frame_Spectrum_Array	UInt16		0	256	The number of pixels between each successive pixel shift used to apply a clocking correction
clocking_offset_start	Frame_Spectrum_Array	Int8		-127	127	The first pixel where the flight software applies a focal plane clocking correction - negative value indicates the clocking shift operates downward, positive value indicates clocking shift is upward
cs_qual_flag	Frame_Array	UInt8				Bit flags indicating the quality of the color slice data: 0 - Good, non-zero - see documentation
diffuser_position	Frame_Array	UInt16				The position of the solar diffuser at the beginning of the mode: 0 - Lamp or Closed position, 75 - Open for science, 150 - Solar Calibration position
frame_id	Frame_Array	Int64				The mission-unique frame identifier
frame_qual_flag	Frame_Array	UInt64				Bit flags indicating the quality of the data in each frame: 0 - good, non-zero - see documentation
frame_time_string	Frame_Array	String				Time of telemetry frame (yyyy-mm-ddThh:mm:ss.mmmZ)
frame_time_tai93	Frame_Array	Float64	Seconds			Time of telemetry frame in seconds since Jan 1, 1993
full_checksum	Frame_Sounding_Spectrum_Array	UInt8				Checksum for all science data in frame
hk_checksum	Frame_Array	UInt8				Checksum for all housekeeping data in frame
hk_frame_number	Frame_Array	UInt16				Frame number of the housekeeping frame reporting the engineering data
hk_saved_frame_number	Frame_Array	UInt16				Frame number saved at the last Operational command (STANDBY, SINGLE, RESIDUAL, SUMMED)
hk_time_checksum	Frame_Array	UInt8				Checksum of the time bytes in the IHK packet

				Minimum value	Maximum value	
5.15 instrument_time	**5.16** Frame_Array	**5.17** U Int32	Milliseconds			Time in milliseconds since instrument power up
5.18 spacecraft_time_gps	**5.19** Frame_Array	**5.20** U Int32	**5.21** Se conds			Last reported spacecraft time in seconds
spare_ihk_byte20	Frame_Array	UInt8				Value from byte 20 in the IHK packet header
spare_ihk_byte21	Frame_Array	UInt8				Value from byte 21 in the IHK packet header
spectrometer_frame_number	Frame_Spectrum_Array	UInt16				Frame number for each spectrometer
spectrometer_saved_frame_number	Frame_Spectrum_Array	UInt16				Frame number saved at the last mode change
spectrometer_time_checksum	Frame_Sounding_Spectrum_ Array	UInt8				Checksum of the time bytes in the OHK packet
status_flags_ic	Frame_Array	UInt8				Instrument IC status bit flag
status_flags_ihk_byte36	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 36
status_flags_ihk_byte37	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 37
summed_multiplier	Frame_Spectrum_Array	Float32				The multiplicative term of the pixel summation formula - see documentation
summed_offset	Frame_Spectrum_Array	UInt8				The offset term of the pixel summation formula - see documentation
Group	**EngineeringData**					
Group description	Engineering data reported at rates other than every frame					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
adc_ref_volt	Frame_Spectrum_Array	Float32	Volts	0	50	ADC Reference Voltage monitor
adc_volt_5a	Frame_Spectrum_Array	Float32	Volts	0	50	ADC Analog 5VDC monitor
adc_volt_5d	Frame_Spectrum_Array	Float32	Volts	0	50	ADC Digital 5VDC monitor
afe1_power_state	Frame_Array	Int8				AFE #1 Power: 0 - Off, 1 = On
afe2_power_state	Frame_Array	Int8				AFE #2 Power: 0 - Off, 1 = On
afe3_power_state	Frame_Array	Int8				AFE #3 Power: 0 - Off, 1 = On
analog_supp_volt_n5	Frame_Array	Float32	Volts	0	50	Negative 5VDC analog voltage
analog_supp_volt_p5	Frame_Array	Float32	Volts	0	50	Positive 5VDC analog voltage
cal_door_pos_coarse	Frame_Array	Float32	Degrees	0	360	Position of calibration door in degrees from the Lamp/Closed position

cal_door_pos_n_steps	Frame_Array	UInt16		0	65535	Position of calibration door given in number of steps since last reset
cal_door_total_steps	Frame_Array	UInt16				Total number of steps that the cal door has been commanded to move since system boot (may wrap from 65535 to 0)
cal_motor_power_state	Frame_Array	Int8				CAL_MOTOR state: 0 - Off, 1 - On
control_flags_ic	Frame_Array	BitFlag8				Bit flag reporting IC control flags
cmd_id_history	Frame_Echo_Array	UInt8				Command IDs for commands reported in command history
cmd_msn_history	Frame_Echo_Array	UInt8				Message Sequence Numbers for commands reported in command history
cmd_flag_history	Frame_Echo_Array	UInt16				Second command words for commands reported in command history
current_winding	Frame_Array	UInt8		0	2	Current winding in use: 0=Primary, 1=Backup
digital_supp_volt_n12	Frame_Array	Float32	Volts	0	50	Negative 12VDC voltage monitor
dp_volt_p5	Frame_Array	Float32	Volts	0	50	Positive 5VDC digital processor voltage
dpp_power_state	Frame_Array	Int8				Digital Processor power state: 0 - Off, 1 - On
dsub_volt	Frame_Spectrum_Array	Float32	Volts	0	50	DSUB voltage monitor
engineering_time_string	Frame_Array	String				Time the IHK packet was generated (yyyy-mm-ddThh:mm:ss.mmmZ)
err_count	Frame_Array	UInt16				Accumulated error count
err_id_history	Frame_Echo_Array	UInt8				Error IDs for errors reported in error history
err_time_history	Frame_Echo_Array	UInt32				Error times (in seconds) for errors reported in error history
firmware_version_dp0	Frame_Array	Uint8				DP0 Firmware Version
firmware_version_dp1	Frame_Array	Uint8				DP1 Firmware Version
firmware_version_dp2	Frame_Array	Uint8				DP2 Firmware Version
firmware_version_ic	Frame_Array	Uint8				IC Firmware Version
gnd_volt	Frame_Spectrum_Array	Float32	Volts	0	50	GND voltage monitor
heater_state_history	Frame_Second_Array	UInt8		0	255	On/Off status for all 8 heaters between now and 15 seconds ago
heater_turn_off_set_point	Frame_Heater_Array	Float32	Degrees Celsius	-200	200	Temperature at which heaters are turned off (1 for each of 8 heaters)
heater_turn_on_set_point	Frame_Heater_Array	Float32	Degrees Celsius	-200	200	Temperature at which heaters are turned on (1 for each of 8 heaters)
hk_volt_offset	Frame_Array	Float32	Volts	0	50	Controller Expansion ADC zero (offset)
lamp1_monitor	Frame_Array	Float32	Volts	0	50	Lamp #1 voltage monitor

lamp1_power_state	Frame_Array	Int8				Lamp #1 power state: 0 - Off, 1 - On
lamp2_monitor	Frame_Array	Float32	Volts	0	50	Lamp #2 voltage monitor
lamp2_power_state	Frame_Array	Int8				Lamp #2 power state: 0 - Off, 1 - On
lamp3_monitor	Frame_Array	Float32	Volts	0	50	Lamp #3 voltage monitor
lamp3_power_state	Frame_Array	Int8				Lamp #3 power state: 0 - Off, 1 - On
logic_volt	Frame_Spectrum_Array	Float32	Volts	0	50	RS422 logic 5VDC monitor
logic_volt_p5	Frame_Array	Float32	Volts	0	50	Positive 5VDC logic voltage
memory_test_status	Frame_Array	BitFlag8				Memory Test status byte
mode_dp0	Frame_Array	UInt8				Instrument DP0 Mode
mode_dp1	Frame_Array	UInt8				Instrument DP1 Mode
mode_dp2	Frame_Array	UInt8				Instrument DP2 Mode
mode_ic	Frame_Array	UInt8				Instrument IC Mode
motor_winding_spare	Frame_Array	UInt8				Spare telemetry value
spare_ihk_byte186	Frame_Array	UInt8				Spare value from byte 186 in the IHK packet header
spare_ihk_byte187	Frame_Array	UInt8				Spare value from byte 187 in the IHK packet header
spare_ihk_byte890	Frame_Array	UInt16				Spare value from bytes 890-891 in the IHK packet header
spare_ihk_byte892	Frame_Array	UInt8				Spare value from byte 892 in the IHK packet header
temp_afe_cryocooler_tz2	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of AFE/Cryocooler, Thermal Zone 2
temp_afe_cryocooler_tz2b	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of AFE/Cryocooler, Thermal Zone 2B (Backup for TZ2)
temp_afe_electronics_enclosure	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of AFE Electronics Enclosure
temp_baffle_flange	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Baffle Flange
temp_cal_door_motor_tz4	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Calibration Door Motor, Thermal Zone 4
temp_cal_door_redundant	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of redundant sensor for the Calibration Door Motor, Thermal Zone 4B (Backup for TZ4)
temp_cal_resistor1_dn	Frame_Array	UInt16	DN			Data number value of reference resistor 1
temp_cal_resistor2_dn	Frame_Array	UInt16	DN			Data number value of reference resistor 2
temp_cal_resistor3_dn	Frame_Array	UInt16	DN			Data number value of reference resistor 3
temp_cal_resistor4_dn	Frame_Array	UInt16	DN			Data number value of reference resistor 4

temp_cal_resistor5_dn	Frame_Array	UInt16	DN			Data number value of reference resistor 5
temp_cal_resistor6_dn	Frame_Array	UInt16	DN			Data number value of reference resistor 6
temp_cryocooler_radiator	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Cryocooler radiator
temp_fpa_aband_tz5	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of FPA ABO2, Thermal Zone 5
temp_fpa_aband_tz5b	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of FPA ABO2, Thermal Zone 5B (Backup for TZ5)
temp_fpa_strong_co2	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of FPA SCO2
temp_fpa_weak_co2	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of FPA WCO2
temp_instrument_deck	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Instrument Deck (positive X-positive Y surface)
temp_optical_bench_grating_mz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Grating (minus Z)
temp_optical_bench_grating_pz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Grating (positive Z)
temp_optical_bench_mount_my	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Mount (minus Y)
temp_optical_bench_mount_my_tz3	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Mount (minus Y), Thermal Zone 3
temp_optical_bench_mount_px	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Mount (positive X)
temp_recollimator	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Recollimator
temp_relay_sco2_mz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Relay SCO2 (minus Z)
temp_relay_sco2_pz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Relay SCO2 (positive Z)
temp_rem_bottom	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of REM Bottom
temp_rem_top	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of REM Top
temp_shroud_mx_tz6	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (minus X), Thermal Zone 6
temp_shroud_my_pz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (minus Y-positve Z)
temp_shroud_py_mz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (positive Y-minus Z)
temp_shroud_py_tz1	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (positive Y), Thermal Zone 1
temp_shroud_py_tz1b	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (positive Y), Thermal Zone 1B (Backup for TZ1)
temp_shroud_radiator	Frame_Array	Float32	Degrees	-200	200	Temperature of Shroud Radiator

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
			Celsius			
temp_spare1	Frame_Array	UInt16	DN	-200	200	Temperature of spare temperature sensor
temp_telescope	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Telescope
temp_vchp_afecryo_radiator_mx	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, AFE/Cryocooler Radiator (minus X)
temp_vchp_afecryo_radiator_px	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, AFE/Cryocooler Radiator (positive X)
temp_vchp_shroud_radiator_mx	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, Shroud Radiator (positive X)
temp_vchp_shroud_radiator_px	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, Shroud Radiator (minus X)
timeout_error	Frame_Array	UInt8				Timeout error: 0 - OK, 1 - exceeded maximum allowable time to move to the commanded door position
vbias_gate_volt	Frame_Spectrum_Array	Float32	Volts	0	50	VBIASGATE voltage monitor
vbias_pwr_volt	Frame_Spectrum_Array	Float32	Volts	0	50	VBIASPOWER voltage monitor
vdd_volt	Frame_Spectrum_Array	Float32	Volts	0	50	VDD voltage monitor
volt_10v	Frame_Spectrum_Array	Float32	Volts	0	50	Positive 10V detector load bias voltage monitor
volt_n12	Frame_Array	Float32	Volts	0	50	Negative 12VDC converter output voltage
volt_p12	Frame_Array	Float32	Volts	0	50	Positive 12VDC converter output voltage
vpa_volt_n5	Frame_Spectrum_Array	Float32	Volts	0	50	Negative 5VDC monitor
vpa_volt_p5	Frame_Spectrum_Array	Float32	Volts	0	50	Positive 5VDC monitor
vreset_volt	Frame_Spectrum_Array	Float32	Volts	0	50	VRESET voltage monitor
Group	**FrameFPATemperatures**					
Group description	FPA temperatures provided for every frame					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
temp_fpa	Frame_Spectrum_Array	Float32	Degrees Celsius	-200	200	FPA temperatures extracted for this frame time from the temperature data history
Group	**SmoothedTemps**					
Group description	Temperatures smoothed to reduce the effect of temperature measurement noise on the spectra					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
temp_smooth_afe_cryocooler_tz2	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of AFE/Cryocooler, Thermal Zone 2 after noise-reduction processing

temp_smooth_afe_cryocooler_tz2b	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of AFE/Cryocooler, Thermal Zone 2B (Backup for TZ2) after noise-reduction processing
temp_smooth_afe_electronics_enclosure	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of AFE Electronics Enclosure after noise-reduction processing
temp_smooth_baffle_flange	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Baffle Flange after noise-reduction processing
temp_smooth_cal_door_motor_tz4	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Calibration Door Motor, Thermal Zone 4 after noise-reduction processing
temp_smooth_cal_door_redundant	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of redundant sensor for the Calibration Door Motor, Thermal Zone 4B (Backup for TZ4) after noise-reduction processing
temp_smooth_cryocooler_radiator	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Cryocooler radiator after noise-reduction processing
temp_smooth_fpa_aband_tz5	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of FPA ABO2, Thermal Zone 5 after noise-reduction processing
temp_smooth_fpa_aband_tz5b	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of FPA ABO2, Thermal Zone 5B (Backup for TZ5) after noise-reduction processing
temp_smooth_fpa_o2	Frame_Array	Float32	Degrees Celsius	-200	200	ABO2 FPA temperature after noise-reduction processing
temp_smooth_fpa_strong_co2	Frame_Array	Float32	Degrees Celsius	-200	200	SCO2 FPA temperature after noise-reduction processing
temp_smooth_fpa_weak_co2	Frame_Array	Float32	Degrees Celsius	-200	200	WCO2 FPA temperature after noise-reduction processing
temp_smooth_instrument_deck	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Instrument Deck (positive X-positive Y surface) after noise-reduction processing
temp_smooth_optical_bench_grating_mz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Grating (minus Z) after noise-reduction processing

temp_smooth_optical_bench_gratin g_pz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Grating (positive Z) after noise-reduction processing
temp_smooth_optical_bench_mount _my	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Mount (minus Y) after noise-reduction processing
temp_smooth_optical_bench_mount _my_tz3	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Mount (minus Y), Thermal Zone 3 after noise-reduction processing
temp_smooth_optical_bench_mount _px	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Optical Bench Mount (positive X) after noise-reduction processing
temp_smooth_recollimator	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Recollimator after noise-reduction processing
temp_smooth_relay_sco2_mz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Relay SCO2 (minus Z) after noise-reduction processing
temp_smooth_relay_sco2_pz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Relay SCO2 (positive Z) after noise-reduction processing
temp_smooth_rem_bottom	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of REM Bottom after noise-reduction processing
temp_smooth_rem_top	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of REM Top after noise-reduction processing
temp_smooth_shroud_mx_tz6	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (minus X), Thermal Zone 6 after noise-reduction processing
temp_smooth_shroud_my_pz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (minus Y-positive Z) after noise-reduction processing
temp_smooth_shroud_py_mz	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (positive Y-minus Z) after noise-reduction processing

				Minimum value	Maximum value	
temp_smooth_shroud_py_tz1	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (positive Y), Thermal Zone 1 after noise-reduction processing
temp_smooth_shroud_py_tz1b	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud (positive Y), Thermal Zone 1B (Backup for TZ1) after noise-reduction processing
temp_smooth_shroud_radiator	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Shroud Radiator after noise-reduction processing
temp_smooth_telescope	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of Telescope after noise-reduction processing
temp_smooth_vchp_afecryo_radiator_mx	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, AFE/Cryocooler Radiator (minus X) after noise-reduction processing
temp_smooth_vchp_afecryo_radiator_px	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, AFE/Cryocooler Radiator (positive X) after noise-reduction processing
temp_smooth_vchp_shroud_radiator_mx	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, Shroud Radiator (positive X) after noise-reduction processing
temp_smooth_vchp_shroud_radiator_px	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of VCHP Reservoir, Shroud Radiator (minus X) after noise-reduction processing
temp_smooth_afe_cryocooler_tz2	Frame_Array	Float32	Degrees Celsius	-200	200	Temperature of AFE/Cryocooler, Thermal Zone 2 after noise-reduction processing
Group	**FrameConfiguration**					
Group description	Configuration information provided for every frame					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
color_slice_position_o2	Frame_O2Slice_Array	Int16		1	1024	Absolute spectral position, in pixels, of each color slice in ABO2 band
color_slice_position_strong_co2	Frame_StrongCO2Slice_Array	Int16		1	1024	Absolute spectral position, in pixels, of each color slice in SCO2 band
color_slice_position_weak_co2	Frame_WeakCO2Slice_Array	Int16		1	1024	Absolute spectral position, in pixels, of each color slice in WCO2 band

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
footprint_spatial_end_position	Frame_SoundingPosition_Spectrum_Array	Uint8		1	220	Position of end of each footprint, in pixels, relative to initial_unused_pixels
footprint_spatial_start_position	Frame_SoundingPosition_Spectrum_Array	Uint8		1	220	Position of start of each footprint, in pixels, relative to initial_unused_pixels
initial_unused_pixels	Frame_Spectrum_Array	Int16		8	796	Distance in pixels of the start of first footprint from edge of FPA
Group	**CryocoolerData**					
Group description	Cryocooler status information					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
i_cry_acel_ovrld	Frame_Array	UInt8				Accelerometer Overload State: 0 - No Overload, 1 - Overload
i_cry_amp_tmp_trp_hi	Frame_Array	UInt8				CCE Amplifier Temperature Trip High: 0 - Not tripped, 1 - Tripped
i_cry_amp_tmp_trp_lo	Frame_Array	UInt8				CCE Amplifier Temperature Trip Low: 0 - Not tripped, 1 - Tripped
i_cry_ampctrl_enb	Frame_Array	UInt8				Amp Control Enabled: 0 - Disabled, 1 - Enabled
i_cry_auto_frz_enb	Frame_Array	UInt8				Automatic Freeze Enabled: 0 - Disabled, 1 - Enabled
i_cry_avg_cur1n	Frame_Array	Float32	Amperes			60V bus current, side 1
i_cry_avg_cur1p	Frame_Array	Float32	Amperes			60V bus current, side 1
i_cry_avg_cur2n	Frame_Array	Float32	Amperes			60V bus current, side 2
i_cry_avg_cur2p	Frame_Array	Float32	Amperes			60V bus current, side 2
i_cry_bad_cmd_val	Frame_Array	UInt8				Illegal command data value: 0 - Not illegal, 1 - Bad command value
i_cry_bad_frq_val	Frame_Array	UInt8				Illegal frequency value: 0 - No fault, 1 - Bad frequency value
i_cry_bus_60v_err	Frame_Array	UInt8				Bus 60V Dropout Error: 0 - No fault, 1 - Fault
i_cry_cage_cmd_event	Frame_Array	UInt8				Cage Command Default Case Statement
i_cry_cage_rly_st_0	Frame_Array	UInt8				Cage Relay State Bit 0 value
i_cry_cage_rly_st_1	Frame_Array	UInt8				Cage Relay State Bit 1 value
i_cry_cage_state	Frame_Array	UInt8				Cage State: 0 - Not caged, 1 - Caged
i_cry_cca_tmp_rate	Frame_Array	Float32	Degrees Celsius Minute^{-1}			CCA Temperature Rate
i_cry_cce_5v_mon	Frame_Array	Int8				5V Monitor Output from CCE

i_cry_cce_amp_temp	Frame_Array	Float32	Kelvins			Temperature at power amplifier
i_cry_cce_chksum	Frame_Array	UInt16				Cryocooler CCE Packet Checksum
i_cry_cce_cvtr_temp	Frame_Array	Float32	Kelvins			Temperature at DC converter
i_cry_cce_fault_out	Frame_Array	Int8				Fault Output from CCE: 0 - Fault, 1- No fault
i_cry_cce_pwr_enb	Frame_Array	Int8				Power Input to CCE: 0 - Disabled, 1 - Enabled
i_cry_cce_safehold_input	Frame_Array	Int8				Safe/Hold Input to CCE
i_cry_cce_tmp_rate	Frame_Array	Float32	Degrees Celsius Minute^{-1}			CCE Temperature Rate
i_cry_ccie_bcmd_cntr	Frame_Array	Int16				CCIE Bad Command Counter
i_cry_ccie_cmd_cntr	Frame_Array	UInt16				CCIE Command Counter
i_cry_ccie_cmd_hdr	Frame_CCIEHdr_Array	UInt16				CCIE Command Header
i_cry_ccie_msg_pntr	Frame_Array	UInt8				CCIE Message Buffer Pointer
i_cry_ccie_param	Frame_CCIEPrm_Array	UInt16				CCIE Parameter Header
i_cry_cdhd_tmp_hi	Frame_Array	UInt8				Cold Head Temperature Trip High: 0 - Not tripped, 1 - Cold Head temp tripped
i_cry_cdhd_tmp_lo	Frame_Array	UInt8				Cold Head Temperature Trip Low: 0 - Not tripped, 1 - Cold Head temp tripped
i_cry_cdhd_tmp_rate	Frame_Array	Float32	Degrees Celsius Minute^{-1}			Cold Head Temperature Rate
i_cry_ch_temp	Frame_Array	Float32	Kelvins			Cold Head Temperature
i_cry_chdh_tr_enb	Frame_Array	UInt8				Cold Head Trip Enabled: [0] - Disabled, [1] - Enabled
i_cry_cmd_cnt	Frame_Array	UInt16				Command and Error Counters
i_cry_cmd_def_case	Frame_Array	UInt8				Execute Command Default Case: 0 - No fault, 1 - Fault
i_cry_cmd_echo_enb	Frame_Array	UInt8				Auto Command Echo Enable Status: 0 - Disabled, 1 - Enabled
i_cry_cmd_state_event	Frame_Array	UInt8				Command State Default Case Event
i_cry_cmp_trp_hi	Frame_Array	UInt8				Compressor Trip High: 0 - Not tripped, 1 - Tripped
i_cry_cmp_trp_lo	Frame_Array	UInt8				Compressor Trip Low: 0 - Not tripped, 1 - Tripped
i_cry_conv_tmp_trp_hi	Frame_Array	UInt8				CCE Converter Temperature Trip High: 0 - Not tripped, 1 - Tripped
i_cry_conv_tmp_trp_lo	Frame_Array	UInt8				CCE Converter Temperature Trip Low: 0 - Not tripped, 1 - Tripped
i_cry_cp_temp	Frame_Array	Float32	Kelvins			Reject Temperature

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i_cry_csync_ctrl	Frame_Array	UInt8				CSYNC Control Enabled: 0 - Disabled, 1 - Enabled
i_cry_csync_ctrl_bit_0x00	Frame_Array	UInt8				CSYNC Control Bit 0x00 value: 0 - Disabled, 1 - Enabled
i_cry_csync_ctrl_bit_0x01	Frame_Array	UInt8				CSYNC Control Bit 0x01 value: 0 - Disabled, 1 - Enabled
i_cry_csync_ctrl_bit_0x02	Frame_Array	UInt8				CSYNC Control Bit 0x02 value: 0 - Disabled, 1 - Enabled
i_cry_csync_ctrl_bit_0x7e	Frame_Array	UInt8				CSYNC Control Bit 0x7E value: 0 - Disabled, 1 - Enabled
i_cry_csync_ctrl_bit_0x7f	Frame_Array	UInt8				CSYNC Control Bit 0x7F value: 0 - Disabled, 1 - Enabled
i_cry_csync_enb	Frame_Array	UInt8				CSYNC Enable Status: 0 - Disabled, 1 - Enabled
i_cry_dc_offseta	Frame_Array	Float32				Current DC control value for compressor side A
i_cry_dc_offsetb	Frame_Array	Float32				Current DC control value for compressor side B
i_cry_dcoffset_lp	Frame_Array	UInt8				DC Offset Loop State: 0 - Disabled, 1 - Enabled
i_cry_del_sig_over	Frame_Array	UInt8				Delta Sigma Input Overload: 0 - Not tripped, 1 - Tripped
i_cry_eeprom_wrt_err	Frame_Array	UInt8				EEPROM Write Error: 0 - No fault, 1 - Fault
i_cry_ext_trip	Frame_Array	UInt8				External Trip: 0 - Not tripped, 1 - Tripped
i_cry_extsafe_enb	Frame_Array	UInt8				External Safehold Enable Status: 0 - Disabled, 1 - Enabled
i_cry_fail_prm_cage_cmd	Frame_Array	UInt8				Primary Logic for Caging: 0 - OK, 1 - Failed
i_cry_fail_prm_ucage_cmd	Frame_Array	UInt8				Primary Logic for Uncaging: 0 - OK, 1 - Failed
i_cry_fail_red_cage_cmd	Frame_Array	UInt8				Redundant Logic for Caging: 0 - OK, 1 - Failed
i_cry_fail_red_ucage_cmd	Frame_Array	UInt8				Redundant Logic for Uncaging: 0 - OK, 1 - Failed
i_cry_frz_wave_st	Frame_Array	UInt8				Frozen Wave State: 0 - Vibration control not currently frozen, 1 - Vibration control frozen
i_cry_harm_trp	Frame_Array	UInt8				Individual Harmonic Trip State: 0 - Not tripped, 1 - Tripped
i_cry_hk_mgr_event	Frame_Array	UInt8				HK Manager Default Case Event
i_cry_hrm_vibe	Frame_Array	Float32	Microns Second^{-2}			Total Harmonic Vibration Output: RSS of all individual harmonics
i_cry_isr_time_err	Frame_Array	UInt8				ISR Timing Error: 0 - No fault, 1 - Fault
i_cry_isr_tlm_event	Frame_Array	UInt8				ISR Telemetry Default Case Event
i_cry_isr_vib_event	Frame_Array	UInt8				ISR Vibration Default Case Event
i_cry_m12v_supply	Frame_Array	Float32	Volts			-12V supply
i_cry_m12v_supply_d	Frame_Array	Float32	Volts			-12V supply
i_cry_max_drv_lmt	Frame_Array	UInt8				Maximum drive limit reached: 0 - Not over limit, 1 - Limit reached
i_cry_mode_state	Frame_Array	UInt8				Mode State: 0 - Standby Mode, 1 - Normal Mode

i_cry_motor_drive	Frame_Array	Float32				Current command operating drive
i_cry_mtr_pwra	Frame_Array	Float32	Watts			Side A Motor Power
i_cry_mtr_pwrb	Frame_Array	Float32	Watts			Side B Motor Power
i_cry_neg_cur_trp_a	Frame_Array	UInt8				Negative Overcurrent Trip Side A: 0 - Not tripped, 1 - Tripped
i_cry_neg_cur_trp_b	Frame_Array	UInt8				Negative Overcurrent Trip Side B: 0 - Not tripped, 1 - Tripped
i_cry_ovrcur_enb	Frame_Array	UInt8				Overcurrent Enable Status: 0 - Disabled, 1 - Enabled
i_cry_ovrcur_trip	Frame_Array	UInt8				Overcurrent Trip: 0 - Not tripped, 1 - Tripped
i_cry_p_chksum	Frame_Array	UInt16				Cryocooler (CCE and CCIE) Packet Checksum
i_cry_p12v_supply	Frame_Array	Float32	Volts			+12V supply
i_cry_p5v_supply	Frame_Array	Float32	Volts			+5V supply
i_cry_p60v_supply	Frame_Array	Float32	Volts			+60V supply
i_cry_pos_cur_trp_a	Frame_Array	UInt8				Positive Overcurrent Trip Side A: 0 - Not tripped, 1 - Tripped
i_cry_pos_cur_trp_	Frame_Array	UInt8				Positive Overcurrent Trip Side B: 0 - Not tripped, 1 - Tripped
i_cry_prt_fine_coarse	Frame_Array	UInt8				Degree of stability of the cold head temperature (I_CRY_CH_TEMP): 0 - cold head is well outside the cold head setpoint, 1 - cold head is maintaining good stability and control,
i_cry_prt_sel	Frame_Array	UInt8				PRT Sensor Selected: 0 - Primary, 1 - Redundant
i_cry_safehold_trip	Frame_Array	UInt8				Safehold Trip: 0 - Not tripped, 1 - Tripped
i_cry_spare_822	Frame_Array	UInt8				Spare bit value, IHK byte 822, bit 4
i_cry_spare_824_3	Frame_Array	UInt8				Spare bits value, IHK byte 824, bit 3
i_cry_spare_824_67	Frame_Array	UInt8				Spare bits value, IHK byte 824, bits 6-7
i_cry_spare_830	Frame_Array	UInt8				Spare bytes value, IHK byte 830, bits 1-7
i_cry_spare_838	Frame_Array	UInt16				Spare bytes value, IHK bytes 838-839
i_cry_spare_840	Frame_Array	UInt16				Spare bytes value, IHK bytes 840-841
i_cry_spare_842	Frame_Array	UInt16				Spare bytes value, IHK bytes 842-843
i_cry_spare_887	Frame_Array	UInt8				Spare bits value, IHK byte 887, bit 7
i_cry_spares	Frame_Spare_Array	UInt8				Cryocooler spare values, IHK bytes 712-801
i_cry_sw_cur_enb	Frame_Array	UInt8				Software Current Enable Status: 0 - Disabled, 1 - Enabled
i_cry_sw_trip	Frame_Array	UInt8				Software Trip: 0 - Not tripped, 1 - Tripped
i_cry_temp_trp_enb	Frame_Array	UInt8				Temperature Trip Enable Status: 0 - Disabled, 1 - Enabled
i_cry_timer_lsw	Frame_Array	UInt16				Value of least significant two bytes of timer
i_cry_timer_msw	Frame_Array	UInt16				Value of most significant two bytes of timer

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
i_cry_tlm_conv_err_hi	Frame_Array	UInt8				Telemetry Conversion Error High
i_cry_tlm_conv_err_lo	Frame_Array	UInt8				Telemetry Conversion Error Low
i_cry_tmp_loop_st	Frame_Array	UInt8				Temperature Loop State: 0 - Disabled, 1 - Enabled
i_cry_unk_cage_cmd	Frame_Array	UInt8				Unknown Cage Command
i_cry_vib_01	Frame_Array	Float32	Microns Second^{-2}			Vibration Magnitude for First Harmonic
i_cry_vib_auto	Frame_Array	UInt8				Vibration Input Auto Phase Control: 0 - Not Auto, 1 - Auto Phase
i_cry_vib_on_enb	Frame_Array	UInt8				Vibration Loop Enabled: 0 - Disabled, 1 - Enabled
i_cry_vib_trip	Frame_Array	UInt8				Vibration Trip: 0 - Not tripped, 1 - Tripped
i_cry_vib_trp_enb	Frame_Array	UInt8				Vibration Trip Enable Status: 0 - Disabled, 1 - Enabled
i_cry_wave_update_enb	Frame_Array	UInt8				Wave Update Enable Status: 0 - Disabled, 1 - Enabled
i_cry_wtchdog_enb	Frame_Array	UInt8				Watchdog Enable Status: 0 - Disabled, 1 - Enabled
i_cry_wtchdog_trip	Frame_Array	UInt8				Watchdog Trip: 0 - Not tripped, 1 - Tripped
Group	**FrameSampleMeasurement**					
Group description	Downsampled instrument measurements collected every frame					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
color_slice_data_o2	Frame_O2Slice_SpatialRow_Array	Uint16	DN	0	65535	Raw data numbers of the color slices used in the ABO2 band
color_slice_data_strong_co2	Frame_StrongCO2Slice_SpatialRow_Array	Uint16	DN	0	65535	Raw data numbers of the color slices used in the SCO2 band
color_slice_data_weak_co2	Frame_WeakCO2Slice_SpatialRow_Array	Uint16	DN	0	65535	Raw data numbers of the color slices used in the WCO2 band
footprint_o2_qual_flag	Frame_Sounding_Array	BitField16				Bit flags indicating the quality of the ABO2 data in footprint: 0 - Good, non-zero - see documentation
footprint_strong_co2_qual_flag	Frame_Sounding_Array	BitField16				Bit flags indicating the quality of the SCO2 data in footprint: 0 - Good, non-zero - see documentation
footprint_weak_co2_qual_flag	Frame_Sounding_Array	BitField16				Bit flags indicating the quality of the WCO2 data in footprint: 0 - Good, non-zero - see documentation
footprint_time_string	Frame_Sounding_Spectrum_Array	String				Data acquisition time for the center of footprint (yyyy-mm-ddThh:mm:ss.mmmZ)
footprint_time_tai93	Frame_Sounding_Spectrum_Array	Float64	Seconds			Data acquisition time for the center of footprint in seconds since Jan. 1, 1993
sample_measurements_o2	Frame_Sounding_FPAColor_Array	UInt16	DN	0	65535	Raw data numbers of the ABO2 spectrum
sample_measurements_strong_co2	Frame_Sounding_FPAColor_Array	UInt16	DN	0	65535	Raw data numbers of the SCO2 spectrum

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sample_measurements_weak_co2	Frame_Sounding_FPAColor_ Array	UInt16	DN	0	65535	Raw data numbers of the WCO2 spectrum
sounding_id	Frame_Sounding_Array	Int64				Unique identifier for each sounding

OCO-2 Standard Metadata

Group	Metadata					
Group description	This table describes the metadata contained in all OCO-2 HDF products					
	These metadata fields appear in the Metadata group in each of these products.					
	Each product may also contain product-specific fields in that group					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
AncillaryDataDescriptors	AncFile_Array	String				The file names of the ancillary data files that were used to generate this product (ancillary data sets include all input files except for the primary input files)
BuildId	Scalar	String				The ID of build in which included the software that created this product
CollectionLabel	Scalar	String				Label of the data collection containing this product
DataFormatType	Scalar	String				'NCSA HDF' - A character string that describes the internal format of the data product.
GapStartTime	Gap_Array	String				The timestamp after which a nonexistent, unnecessary, spurious, or erroneous data segment begins. Set to 1993-01-01T00:00:00.000Z if no bad segment exists.
GapStopTime	Gap_Array	String				The timestamp before which a nonexistent, unnecessary, spurious, or erroneous data segment ends. Set to 1993-01-01T00:00:00.000Z if no bad segment exists.
GranulePointer	Scalar	String				The filename of this product
HDFVersionId	Scalar	String				'5.x' - A character string that identifies the version of the HDF (Hierarchical Data Format) software that was used to generate this data file
InputPointer	InputPtr_Array	String				A pointer to one or more data granules that provide the major input that was used to generate this product.
InstrumentShortName	Scalar	String				'OCO-2' - The name of the instrument that collected the telemetry data
LongName	Scalar	String				A complete descriptive name for the data type of this product
PlatformLongName	Scalar	String				'Orbiting Carbon Observatory 2'
PlatformShortName	Scalar	String				'OCO-2'
PlatformType	Scalar	String				'spacecraft' - The type of platform associated with the instrument which acquires the accompanying data
ProcessingLevel	Scalar	String				Indicates data level (Level 0, Level 1A, Level 1B, Level 2) in this product
ProducerAgency	Scalar	String				'NASA' - Identification of the agency that provides the project funding
ProducerInstitution	Scalar	String				'JPL' - Identification of the institution that provides project management.
ProductionDateTime	Scalar	String				The date and time at which the product was created (yyyy-mm-ddThh:mm:ss.mmmZ)
ProductionLocation	Scalar	String				Facility in which this file was produced, typically: 'Operations Pipeline', 'Operations Pipeline 2', 'Science Computing Facility', 'Test Pipeline', Test Pipeline 2'
ProductionLocationCode	Scalar	String				One-letter code indicating the ProductionLocation, typically: ' ' - Operations Pipelines (1) or 2, 's' - Science Computing Facility, 't' - Test Pipelines (1) or 2

ProjectId	Scalar	String				'OCO-2' - The project identification string
QAGranulePointer	Scalar	String				A pointer to the quality assessment product that was generated with this product
RangeBeginningDate	Scalar	String				The date on which the earliest data contained in the product were acquired (yyyy-mm-dd)
RangeBeginningTime	Scalar	String				The time at which the earliest data contained in the product were acquired (hh:mm:ss.mmmZ)
RangeEndingDate	Scalar	String				The date on which the latest data contained in the product were acquired (yyyy-mm-dd)
RangeEndingTime	Scalar	String				The time at which the latest data contained in the product were acquired (hh:mm:ss.mmmZ)
ShortName	Scalar	String				The short name identifying the data type of this product
SISName	Scalar	String				The name of the document describing the contents of the product
SISVersion	Scalar	String				The version of the document describing the contents of the product
SizeMBECSDataGranule	Scalar	Float32	Megabytes			The size of this data granule in Megabytes
StartOrbitNumber	Scalar	Int32		1	99999	The first orbit on which data contained in the product were acquired
StartPathNumber	Scalar	Int32		1	233	The first WRS path on which data contained in the product was collected
StopOrbitNumber	Scalar	Int32		1	99999	The last orbit on which data contained in the product were acquired
StopPathNumber	Scalar	Int32		1	233	The last WRS path on which data contained in the product was collected

Product Quality Flags

frame_qual_flag	Bit	footprint_*_qual_flag	Bit	cs_qual_flag	
QAScienceCompleteO2 – 0=All O2 band science data (sample/hi-res pixels) present	0	CompleteSpectra 0=all spectral values present in footprint, 1=some spectral values missing from footprint	0	0=Frame contains color slice data	0
QAOHKCompleteO2 – 0=All O2 band OHK data is present	1	Spare	1	0=Frame contains all expected ABO2 color slice data	1
QAScienceCompleteWeakCO2 – 0=All Weak CO2 band science data (sample/hi-res pixels) present	2	CompleteFootprintInput 0=All input values used to calculate footprint descriptive information (footprint_time, footprint_spatial_start_position, and footprint_spatial_end_position) were present	2	0=Frame contains all expected WCO2 color slice data	2
QAOHKCompleteWeak CO2- 0=All WeakCO2 band OHK data is present	3	CompleteFootprintOutput 0=All footprint descriptive information (footprint_time, footprint_spatial_start_position, and footprint_spatial_end_position) could be calculated	3	0=Frame contains all expected SCO2 color slice data	3
QAScienceCompleteStrongCO2 – 0=All Strong CO2 band science data (sample/hi-res pixels) present	4	Spare	4-7	Spare	4
QAOHKCompleteStrongCO2 – 0=All Strong CO2 band OHK data is present	5	Reserved for higher-level products	8-15		
QAInstHKComplete – 0 = All instrument housekeeping data is present	6				
QAInstHKMostRecent – 0 = Most recent instrument housekeeping data was generated within an acceptable time period of the science data. The acceptable gap is reported in the AllowedIHKGap metadata field.	7				

CompleteFrame 0=All input data for this frame are available, 1=At least one data element is missing	8
CompleteHeader 0=All header data for this frame are available, 1=At least one data element in the header is missing.	9
AlgorithmicError 0=PGE successfully calculated all output elements in this frame, 1=Algorithmic errors detected in the frame	10
0 = Successfully calculated all ABO2 FPA temperatures	11
0 = Successfully calculated all WCO2 FPA temperatures	12
0 = Successfully calculated all SCO2 FPA temperatures	13
0 = Data from all bands acquired simultaneously. 1 = Data from one band offset in time from the other bands (Pixel-resolution data only). The offset is provided in the FrameTimeOffset Metadata field.	14
Calibration Door (Diffuser) position 1=Aperture blocked by Cal Door while in Science mode	15
Reserved for higher-level processing	16-63

6 Specification Table – Single-pixel Mode

L1A_Instrument_Pixel Product HDF specification

Group	Metadata					
Group description	Granule-level metadata					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
Standard Metadata	See OCO-2 Standard Metadata specification table below					
AcquisitionMode	Scalar	String				The instrument mode in which the data in the product were collected. Valid values are: 'Glint', 'Nadir', 'Target', 'Sample Dark Calibration', 'Sample Lamp Calibration', 'Sample Solar/limb Calibration', 'Single-Pixel Dark Calibration', 'Single-Pixel Lamp Calibration', 'Single-Pixel Solar/limb Calibration'
ActualFrames	Scalar	Int32		0	17798	Actual number of frames reported in this product
AllowedIHKGap	Scalar	Float32	Seconds			The maximum time allowed for finding valid IHK data to associate with each frame of science data
BadPixelMapChecksum	Spectrum_Array	UInt16				Checksum of corresponding Bad Pixel Map
BadPixelMapVersionNum	Spectrum_Array	UInt32				Version number of corresponding Bad Pixel Map used to calibrate this data file
ExpectedFrames	Scalar	Int32		0	17798	Nominal number of frames in this product
FPAScanOption	Spectrum_Array	BitField8				Bit field indicating the scan option used and the row separation, if used
FrameTimeOffset	Spectrum_Array	Float32	Seconds			Number of seconds that the data for each band is offset from the frame_time. Negative offsets indicate the data is earlier than the frame_time.
L1AAlgorithmDescriptor	Scalar	String				Identification of the algorithm and version used to generate this product
ModeCounter	Scalar	String				The Nth occurrence of this particular mode for this orbit, indicated by letter ('a', 'b', 'c', 'd', etc.)
ModeFlagSpare	Scalar	UInt8				Not used - value 0
OperationMode	Scalar	String				The two-letter abbreviation of the AcquisitionMode: GL, ND, TG, DS, LS, SS, BS, NP, GP, TP, DP, LP, SP, BP, XS, XP, MS, MP, SB

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
ReportedSoundings	SoundingPosition_Array	Int8		0	1	Indicates the inclusion of each footprint in the data (1 - included, 0 - not included)
SpectralChannel	Spectrum_Array	String				A description of the spectral channels used for the measurements
TelemetryMode	Scalar	BitField16				Value of the Mode Flag with bits reflecting the commanded state of the instrument
Group	**FrameHeader (for files with ShortBuildID="B7300")**					
Group description	Miscellaneous information provided for every frame					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
clocking_offset_interval	Frame_Spectrum_Array	UInt16		0	256	The number of pixels between each successive pixel shift used to apply a clocking correction
clocking_offset_start	Frame_Spectrum_Array	Int8		-127	127	The first pixel where the flight software applies a focal plane clocking correction - negative value indicates the clocking shift operates downward, positive value indicates clocking shift is upward
cs_qual_flag	Frame_Array	UInt8				Bit flags indicating the quality of the color slice data: 0 - Good, non-zero - see documentation
diffuser_position	Frame_Array	UInt16				The position of the solar diffuser at the beginning of the mode: 0 - Lamp or Closed position, 75 - Open for science, 150 - Solar Calibration position
frame_id	Frame_Array	Int64				The mission-unique frame identifier
frame_qual_flag	Frame_Array	UInt64				Bit flags indicating the quality of the data in each frame: 0 - good, non-zero - see documentation
frame_time_string	Frame_Array	String				Time of telemetry frame (yyyy-mm-ddThh:mm:ss.mmmZ)
frame_time_tai93	Frame_Array	Float64	Seconds			Time of telemetry frame in seconds since Jan 1, 1993
full_checksum	Frame_Sounding_Spectrum_Array	UInt8				Checksum for all science data in frame
hk_checksum	Frame_Array	UInt8				Checksum for all housekeeping data in frame
hk_frame_number	Frame_Array	UInt16				Frame number of the housekeeping frame reporting the engineering data
hk_saved_frame_number	Frame_Array	UInt16				Frame number saved at the last Operational command (STANDBY, SINGLE, RESIDUAL, SUMMED)
spectrometer_instrument_time	Frame_Spectrum_Array	UInt32	Milliseconds			Time since digital processor (DP) power up as reported in each spectrometer's optical housekeeping telemetry
hk_instrument_time	Frame_Array	UInt32	Milliseconds			Time since instrument controller (IC) power up
spectrometer_spacecraft_time_gps	Frame_Spectrum_Array	UInt32	Seconds			Last reported spacecraft time as reported in each

Data Element	Shape	Type	Units	Minimum value	Maximum value	Comments
						spectrometer's optical housekeeping telemetry
hk_spacecraft_time_gps	Frame_Array	UInt32	Seconds			Last spacecraft time reported by instrument housekeeping
spacecraft_time_gps	Frame_Array	UInt32	Seconds			Last reported spacecraft time in seconds
spare_ihk_byte20	Frame_Array	UInt8				Value from byte 20 in the IHK packet header
spare_ihk_byte21	Frame_Array	UInt8				Value from byte 21 in the IHK packet header
spectrometer_frame_number	Frame_Spectrum_Array	UInt16				Frame number for each spectrometer
spectrometer_saved_frame_number	Frame_Spectrum_Array	UInt16				Frame number saved at the last mode change
spectrometer_time_checksum	Frame_Sounding_Spectrum_Array	UInt8				Checksum of the time bytes in the OHK packet
status_flags_ic	Frame_Array	UInt8				Instrument IC status bit flag
status_flags_ihk_byte36	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 36
status_flags_ihk_byte37	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 37
summed_multiplier	Frame_Spectrum_Array	Float32				The multiplicative term of the pixel summation formula - see documentation
summed_offset	Frame_Spectrum_Array	UInt8				The offset term of the pixel summation formula - see documentation
Group	**FrameHeader (for files with ShortBuildID="B7200")**					
Group description	Miscellaneous information provided for every frame					
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**
clocking_offset_interval	Frame_Spectrum_Array	UInt16		0	256	The number of pixels between each successive pixel shift used to apply a clocking correction
clocking_offset_start	Frame_Spectrum_Array	Int8		-127	127	The first pixel where the flight software applies a focal plane clocking correction - negative value indicates the clocking shift operates downward, positive value indicates clocking shift is upward
cs_qual_flag	Frame_Array	UInt8				Bit flags indicating the quality of the color slice data: 0 - Good, non-zero - see documentation
diffuser_position	Frame_Array	UInt16				The position of the solar diffuser at the beginning of the mode: 0 - Lamp or Closed position, 75 - Open for science, 150 - Solar Calibration position
frame_id	Frame_Array	Int64				The mission-unique frame identifier
frame_qual_flag	Frame_Array	UInt64				Bit flags indicating the quality of the data in each frame: 0 - good, non-zero - see documentation

frame_time_string	Frame_Array	String				Time of telemetry frame (yyyy-mm-ddThh:mm:ss.mmmZ)
frame_time_tai93	Frame_Array	Float64	Seconds			Time of telemetry frame in seconds since Jan 1, 1993
full_checksum	Frame_Sounding_Spectrum_Array	UInt8				Checksum for all science data in frame
hk_checksum	Frame_Array	UInt8				Checksum for all housekeeping data in frame
hk_frame_number	Frame_Array	UInt16				Frame number of the housekeeping frame reporting the engineering data
hk_saved_frame_number	Frame_Array	UInt16				Frame number saved at the last Operational command (STANDBY, SINGLE, RESIDUAL, SUMMED)
hk_time_checksum	Frame_Array	UInt8				Checksum of the time bytes in the IHK packet
instrument_time	Frame_Array	UInt32	Milliseconds			Time in milliseconds since instrument power up
spacecraft_time_gps	Frame_Array	UInt32	Seconds			Last reported spacecraft time in seconds
spare_ihk_byte20	Frame_Array	UInt8				Value from byte 20 in the IHK packet header
spare_ihk_byte21	Frame_Array	UInt8				Value from byte 21 in the IHK packet header
spectrometer_frame_number	Frame_Spectrum_Array	UInt16				Frame number for each spectrometer
spectrometer_saved_frame_number	Frame_Spectrum_Array	UInt16				Frame number saved at the last mode change
spectrometer_time_checksum	Frame_Sounding_Spectrum_Array	UInt8				Checksum of the time bytes in the OHK packet
status_flags_ic	Frame_Array	UInt8				Instrument IC status bit flag
status_flags_ihk_byte36	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 36
status_flags_ihk_byte37	Frame_Array	UInt8				Instrument status bit flags from the IHK packet, byte 37
summed_multiplier	Frame_Spectrum_Array	Float32				The multiplicative term of the pixel summation formula - see documentation
summed_offset	Frame_Spectrum_Array	UInt8				The offset term of the pixel summation formula - see documentation
Group	**EngineeringData**					
Group description	Engineering data reported at rates other than every frame					
	Definition as for L1AIn - Sample					
Group	**FrameFPATemperatures**					

Group description	FPA temperatures provided for every frame						
	Definition as for L1AIn - Sample						
Group	**SmoothedTemps**						
Group description	Temperatures smoothed to reduce the effect of temperature measurement noise on the spectra						
	Definition as for L1AIn - Sample						
Group	**FrameConfiguration**						
Group description	Configuration information provided for every frame						
	Definition as for L1AIn - Sample						
Group	**CryocoolerData**						
Group description	Cryocooler status information						
	Definition as for L1AIn - Sample						
Group	**FrameSinglePixelMeasurements**						
Group description	Downsampled instrument measurements collected every frame						
Data Element	**Shape**	**Type**	**Units**	**Minimum value**	**Maximum value**	**Comments**	
color_slice_data_o2	Frame_O2Slice_SpatialRow_Array	Uint16	DN			Raw data numbers of the color slices used in the ABO2 band	
color_slice_data_strong_co2	Frame_StrongCO2Slice_SpatialRow_Array	Uint16	DN			Raw data numbers of the color slices used in the SCO2 band	
color_slice_data_weak_co2	Frame_WeakCO2Slice_SpatialRow_Array	Uint16	DN			Raw data numbers of the color slices used in the WCO2 band	
single_pixel_integrated_o2	Frame_SpatialRow_FPAColor_Array	Uint16	DN			Raw data numbers of the ABO2 band spectrum integrated pixels	
single_pixel_integrated_strong_co2	Frame_SpatialRow_FPAColor_Array	Uint16	DN			Raw data numbers of the SCO2 band spectrum integrated pixels	
single_pixel_integrated_weak_co2	Frame_SpatialRow_FPAColor_Array	Uint16	DN			Raw data numbers of the WCO2 band spectrum integrated pixels	
single_pixel_pedestal_o2	Frame_SpatialRow_FPAColor_Array	Uint16	DN			Raw data numbers of the SCO2 band spectrum pedestal pixels	
single_pixel_pedestal_strong_co2	Frame_SpatialRow_FPAColor_Array	Uint16	DN			Raw data numbers of the WCO2 band spectrum pedestal pixels	
single_pixel_pedestal_weak_co2	Frame_SpatialRow_FPAColor_Array	Uint16	DN			Bit flags indicating the quality of the ABO2 data in frame: 0 - Good, non-zero - see documentation	
single_pixel_o2_qual_flag	Frame_SpatialRow_Array	BitField16				Bit flags indicating the quality of the SCO2 data in frame: 0 - Good, non-zero - see documentation	

| single_pixel_strong_co2_qual_flag | Frame_SpatialRow_Array | BitField16 | | | | Bit flags indicating the quality of the WCO2 data in frame: 0 - Good, non-zero - see documentation |
| single_pixel_weak_co2_qual_flag | Frame_SpatialRow_Array | BitField16 | | | | Raw data numbers of the color slices used in the ABO2 band |

Product Quality Flags

frame_qual_flag	Bit	single_pixel_*_qual_flag	Bit
As for L1AIn - Sample		CompleteIntegratedSpectra 0=all integrated spectral values present in footprint, 1=some integrated spectral values missing from footprint	0
		CompletePedestalSpectra 0=all pedestal spectral values present in footprint, 1=some pedestal spectral values missing from footprint	1
		Spare	2-15

7   Appendix 1: Shape Descriptions

The shape name of a data element is a descriptive label that describes the rank and dimensions of that element.

Rules for creating shapes:
1. Shape names do not include any context information, such as what mode the instrument is in when it takes data with that shape. Any context information needed to distinguish between similarly named dimensions is appended as a label, just before the "_Array" suffix.
2. Any "temporal" dimension, e.g. Frame, is always outermost.
3. If Frame and Sounding are both present, they occur in direct sequence, i.e. Frame_Sounding_.
4. Shapes that include Frame, Sounding, and Spectrum cannot have any additional dimensions.
5. Spectrum precedes all other physical instrument dimensions, except when this rule contradicts any of the above rules.
6. If Spectrum and Sounding are present in the absence of Frame, they occur in direct sequence, i.e., Spectrum_Sounding.
7. Color comes after SinglePixel.
8. SinglePixel comes after Slice.

Shape	Rank	Max dimension sizes (Units)	Dimensions
AncFile_Array	1	20 (Number of ancillary input files)	AncFile
Frame_Array	1	10512 (Frames)	Frame
Frame_CCIEHdr_Array	2	10512 (Frames) x 8 (Bytes)	Frame, CCIEHdr
Frame_CCIEPrm_Array	2	10512 (Frames) x 8 (Bytes)	Frame, CCIEPrm
Frame_Echo_Array	2	10512 (Frames) x 5 (Command echoes)	Frame, Echo
Frame_Heater_Array	2	10512 (Frames) x 8 (Heaters)	Frame, Heater
Frame_O2Slice_Array	2	10512 (Frames) x 20 (Spectral Pixels)	Frame, O2Slice
Frame_O2Slice_SpatialRow_Array	3	10512 (Frames) x 20 (Spectral Pixels) x 220 (Spatial Rows)	Frame, O2Slice, SpatialRow
Frame_Second_Array	2	10512 (Frames) x 16 (Seconds)	Frame, Second
Frame_Sounding_FPAColor_Array	3	10512 (Frames) x 8 (Soundings) x 1024 (Spectral Pixels)	Frame, Sounding, FPAColor
Frame_Sounding_Spectrum_Array	3	10512 (Frames) x 8 (Soundings) x 3 (Spectrometers)	Frame, Sounding, Spectrum

Frame_SoundingPosition_Spectrum_Array	3	10512 (Frames) x 8 (Sounding Positions) x 3 (Spectrometers)	Frame, SoundingPosition, Spectrum
Frame_Spare_Array	2	10512 (Frames) x 90 (Bytes)	Frame, Spare
Frame_SpatialRow_Array	2	10512 (Frames) x 220 (Spatial Rows)	Frame, SpatialRow
Frame_SpatialRow_FPAColor_Array	3	10512 (Frames) x 220 (Spatial Rows) x 1024 (Spectral Pixels)	Frame, SpatialRow, FPAColor
Frame_Spectrum_Array	2	10512 (Frames) x 3 (Spectrometers)	Frame, Spectrum
Frame_Spectrum_Line_Array	3	10512 (Frames) x 3 (Spectrometers) x 440 (SpatialRows)	Frame, Spectrum, Line
Frame_StrongCO2Slice_Array	2	10512 (Frames) x 20 (Spectral Pixels)	Frame, StrongCO2Slice
Frame_StrongCO2Slice_SpatialRow_Array	3	10512 (Frames) x 20 (Spectral Pixels) x 220 (Spatial Rows)	Frame, StrongCO2Slice, SpatialRow
Frame_WeakCO2Slice_Array	2	10512 (Frames) x 20 (Spectral Pixels)	Frame, WeakCO2Slice
Frame_WeakCO2Slice_SpatialRow_Array	3	10512 (Frames) x 20 (Spectral Pixels) x 220 (Spatial Rows)	Frame, WeakCO2Slice, SpatialRow
Gap_Array	1	10 (Number of gaps)	Gap
InputPtr_Array	1	20 (Number of primary input files)	InputFile
SoundingPosition_Array	1	8 (Maximum number of footprints)	SoundingPosition
Spectrum_Array	1	3 (Spectrometers)	Spectrum

8   Appendix 2: Acronyms

CO_2	Carbon Dioxide
GES DISC	Goddard Earth Sciences Data and Information Services Center
HDF	Hierarchical Data Format
NASA	National Aeronautics and Space Administration
O_2	Oxygen
OCO	Orbiting Carbon Observatory
PGE	Product Generation Executive
SDOS	Science Data Operations System
SIS	Software Interface Specification
TBD	To Be Determined
UTC	Coordinated Universal Time