AIA/SDO FITS Keywords for Scientific Usage and Data Processing at Levels 0, 1.0, and 1.5

(A document in progress; This Version for Level 0 & 1 at SDO Launch)

Keyword Nomenclature:

(Telemetry keywords are ***bold italic***; derived keywords are **bold**; potential keywords are *italic*)

{# = Integer (~ 0-999); @ = Optional single character A-Z; & = Alpha-numeric}

LL@#	Lower Left corner pixel for row (X) / column (Y) for Region of Interest (ROI) # on CCD
NAXIS@#	Dimension (in pixels) along row (X) / column (Y) for ROI # on CCD
A@&&&&&&	Originating from telemetry data (@: H = HDR, F = FDB, I = ISP)

(Note: The definitions of the output data levels included below have been extracted in part from the current Stanford SDO DRMS and SUMS computer database. Phil Scherrer's "JSOC Keywords used for metadata" document [current update 5/25/10] will be used to define and explain the keyword usage.)

1. Level-0 Keywords

1.1 Basic Image Configuration Keywords and Information for Level-0 (Some are Level-1 as noted)

Definition of Level-0 Metadata for the Image Header (Note: The only intended external use of this level is for JSOC-OPS quick-look viewing in near-real time.)

Metadata for Level-0, when the image comes down, consists of keywords derived directly from the image camera header data and those stored in a ground database containing the image characteristics, such as image size, date of observation, telescope, instrument, etc., plus that generated from the associated image status packet (ISP), including the status of mechanisms, the camera itself, the image stabilization system (ISS), and the guide telescope (GT). (See image status packet list in Section 1.2 below.)

Metadata for Level-0 may be updated further in the next 24 hours as the final versions of SDO roll information and Flight Dynamics System data are received.

Data Image for Level-0

Decompressed raw data recompressed using non-lossy compression, such as rice.

The following keywords come from science data packet image header (HDR) information (definition in Doc. AIA02019):

AHAPID = Packet APID (11b; from HDR)
AHTCS = Packet Time Code Seconds (32b; from HDR)
AHTCSS = Packet Time Code Sub Seconds (32b; from HDR)
AHTLFSN = Camera/Frame Serial Number (32b; from HDR)
AHTAPC = TAP Code (4b; from HDR)
AHBITID = Bit Select ID (4b; from HDR)
AHCPIDN = Compression parameter *n* (4b; from HDR)
AHCPIDK = Compression parameter *k* (4b; from HDR)
AHLUTID = Lookup Table ID (8b; from HDR)

The 9 keywords above will be useful in identifying and reconstructing the acquired image, as indicated below.

NAXIS = the number of axes of the overall image, int, (nominally = 2) {Level-1 also}
NAXIS1 = the total number of pixels along axis 1 of overall image, int, (nominally = 4096 for X axis) {Level-1 also}
NAXIS2 = the total number of pixels along axis 2 of overall image, int, (nominally = 4096 for Y axis) {Level-1 also}
CAMERA = the most significant 2b of ***AHTLFSN*** +1 = [1, 2, 3, 4] and the AIA camera (telescope) number associated with the image (int) {Level-1 also}
FSN = the least significant 30b of ***AHTLFSN*** and is the Frame Serial Number (int) {Level-1 also}
FID = the Frame Definition Block (FDB) ID (int) found in the crop/de-crop tables for this image {Level-1 also}
TLMDSNAM = Telemetry data series name (string) with first packet of image
IMGFPT = the first packet time in "ISO" units constructed from ***AHTCS*** and ***AHTCSS***.
IMGAPID = ***AHAPID***, Image Application ID (int)
TAPCODE = ***AHTAPC***, "Take a Picture code" (int)
BITSELID = ***AHBITID***, Bit select id, r (int)
COMPID = the compression id; n, k; constructed from ***AHCPIDN*** and ***AHCPIDK***. (int)
CROPID = Crop Table ID
LUTID = ***AHLUTID***, Lookup table id (int)
NPACKETS int, Number of packets in image
NERRORS int, Number of decompression errors
EOIERROR short, Last pixel error; End Of Image Error
HEADRERR short, Header error in image
OVERFLOW short, Data overflow error in image

QUALITY int, Level-0 and -1 quality word (QUALITY = 0 means OK; see Appendix 2) {Level-1 also}
INSTRUME = "AIA_i" string, name of instrument (within telescope package) where i = camera number = 1, 2, 3, or 4

The following lower case keywords appear only in the JSOC Level-0 Lookdata keywords:

cparms_sg000	DRMS segment 0
image_bzero	multiplier for data values
image_bscale	offset for data values
cparms_sg001	DRMS segment 1
image_sm_bzero	multiplier for data values in small image
image_sm_bscale	offset for data values in small image

(Note: Compressed files may have extra and/or different key words.)

1.2 FITS, JSOC, and Image Statistics Keywords for Level-0 and Level-1

SIMPLE = "T" Boolean, always T for True, if conforming FITS file
BITPIX = "16" integer, Bits/pixel: 16, 32, -32, or -64 (negative for floating point) (HMI uses as 16 in L0)

EXTEND FITS file may contain extensions
BLD_VERS string, JSOC build version
ORIGIN string, location where file was made, e.g., "SDO/JSOC-SDP"
DATE string, date and time of file creation in format: yyyy-mm-ddThh:mm:ss[.sss] in UTC (FITS- and iso-standard)

DATE_OBS = T_OBS – (EXPTIME/2.0) string, UTC, date when image observation started
= DATE_D$OBS = DATE__OBS other forms of this keyword in the database or in printouts
T_OBS time**,** UTC**,** middle of the exposure time (shutter open start time + exposure time / 2.

EXPTIME floating point, calculated in double precision, exposure time in seconds

EXPSDEV float, calculated in double precision, standard deviation of the exposure time (see Appendix 1: AIA Camera Exposure Time Calculation for details on the 4 keywords above.)

IMG_TYPE string, shutter image type: 'LIGHT' or 'DARK'

TELESCOP = "SDO/AIA"	string, name of source telescope package
INSTRUME = "AIA" (TBD)	string, name of instrument {Level-1 only}
INT_TIME = ***AICFGDL4*** **-** ***AICFGDL3*** (+ rollover)	double, interval time between readout delay and shutter operation delay plus rollover (i.e., CCD integration duration)
WAVELNTH = ***AIAWVLEN*** = AIA_IMG_WAVELENGTH	integer, wavelength of this observation in angstroms, with 2 each for camera (telescope) 1, 2, 4, and 4 each for camera 3 with mapping reference number of each wavelength
= 335 (0), 131 (1)	for camera 1
= 211 (2), 193 (3)	for camera 2
= 1600 (4), 1700 (5), 4500 (6), 171 (7)	for camera 3
= 304 (8), 94 (9)	for camera 4
WAVEUNIT = "angstrom"	wavelength unit: angstrom
WAVE_STR = string(**WAVELNTH+'_'+*AIFILTYP***)	wavelength Filter Position
TOTVALS	int, Expected number of data values (pixels)
DATAVALS	int, Actual number of data values in image
MISSVALS	int, Missing values: **TOTVALS – DATAVALS**
PERCENTD	int, Actual number of data values in image as percent of the total: (**DATAVALS/TOTVALS**) *100.0
DATAMIN	short, minimum value from all pixels (pixel units are in "DN")
DATAMAX	short, maximum value from all pixels
DATAMEDN	short, median value from all pixels
DATAMEAN	float, mean value for all pixels
DATARMS	float, RMS deviation from the mean value of all pixels
DATASKEW	float, Skewness from the mean value of all pixels
DATAKURT	float, Kurtosis of all pixels
DATACENT	float, median value of center column of the image {Level-1 only}
COMMENT	Comment
HISTORY	ASCII history record, one or more, usually by SSW
BLANK = "-32768"	value signaling undefined integer data
CHECKSUM (e.g., = 'nhkHqek9nekGnek9')	HDU checksum updated date/time for FITS file
DATASUM (e.g., = '4246760921')	data unit checksum updated date/time for FITS file
END	{FITS required; not at end of current Level-0 files (TBD)}

1.3 Image Status Packet (ISP) Keywords [from APID 027, as of May 2008] to be included in Level-0 and Level-1

ISPSNAME		ISP Series Name
ISPPKTIM		Packet time from the following two ISP keywords, Prime key value for the ISP record
ATCS027	= APID027_TIMECODE_SECONDS,	APID027 timecode in seconds
ATCSS027	= APID027_TIMECODE_SUBSECS,	APID027 timecode in subseconds, [Quality/Sanity Check time]
ISPPKTVN		Packet version number
AIVNMST	= AIA_VER_NUM_IMAGE_STATUS,	ISP version number
AIMGOTS	= AIA_IMG_OBT_TIME_SH_SEC,	seconds time tag read from OBC shutter time tag register for the shutter operation making this image
ASQHDR	= AIA_SEQ_HEADER,	a combination of the camera number and the frame serial number, both of which have their own keywords, as follows
ASQTNUM	= AIA_SEQ_TEL_NUM,	from which the camera (telescope) number that took this image, **CAMERA** (= ***ASQTNUM*** + 1), can be sanity checked
ASQFSN	= AIA_SEQ_FRAME_SN	from which the frame serial number of this image, ***AHFSN***, can be sanity checked (independent of the camera number)
AIAHFSN	= AIA_IMG_HIST_FSN,	the FSN of the image from which the histogram data was obtained
AECDELAY	= AIA_IMG_AEC_DELAY,	time since image used for AEC
AIAECTI	= AIA_IMG_AEC_TABLE_ID,	Automatic Exposure Control (AEC) table used with image
AIASEN	= AIA_IMG_AS_ENCODER	aperture selection encoder reading
AIFDBID	= AIA_IMG_FDB_ID,	frame definition block id, [Quality/Sanity Check ***AFDBID*?**]
AIMGOTSS	= AIA_IMG_OBT_TIME_SH_SS,	subseconds time tag read from OBC shutter time tag register for the shutter operation making this image
AIFCPS	= AIA_IMG_FC_POSITION	currently loaded target value for the focus position mechanism
AIFTSWTH	= AIA_IMG_FLT_TYPE_SW_TH,	filter switch threshold for 131A wavelength (exposure)
AIFRMLID	= AIA_IMG_FRMLIST_ID,	framelist id for this image
AIFTSID	= AIA_IMG_FTS_ID,	framelist timeline schedule (FTS) id for this image
AIHISMXB	= AIA_IMG_HIST_MAX_BIN,	bin number of maximum of standard histogram for previous image in this wavelength used for the current AEC
AIHIS192	= AIA_IMG_HISTC_BN_192,	cumulative histogram value at bin #192
AIHIS348	= AIA_IMG_HISTC_BN_348,	cumulative histogram value at bin #348
AIHIS604	= AIA_IMG_HISTC_BN_604,	cumulative histogram value at bin #604

AIHIS860	= AIA_IMG_HISTC_BN_860,	cumulative histogram value at bin #860
AIFWEN	= AIA_IMG_FW_ENCODER	filter wheel selector encoder reading (0-255) for this image
AIMGSHCE	= AIA_IMG_SH_CMDED_EXPOSURE	commanded exposure for image
AECTYPE	= AIA_IMG_AEC_TYPE,	AEC table for current wavelength (4 tables per wavelength)
AECMODE	= AIA_IMG_AEC_MODE,	mode of AEC (on/off)
AISTATE	= AIA_IMG_ISS_LOOP,	ISS on/off
AIAECENF	= AIA_IMG_AEC_ENA_FLAG,	AEC enable flag for this image
AIFILTYP	= AIA_IMG_FILTER_TYPE	filter type, “thick”, “thin” (used for 131 A only), or “open”
AIMSHOBC	= AIA_IMG_SH_OPEN_BOT_CENTR,	shutter timer register value for this position of this image
AIMSHOBE	= AIA_IMG_SH_OPEN_BOT_EDGE,	(same as above)
AIMSHOTC	= AIA_IMG_SH_OPEN_TOP_CENTR,	(same as above)
AIMSHOTE	= AIA_IMG_SH_OPEN_TOP_EDGE,	(same as above)
AIMSHCBC	= AIA_IMG_SH_CLOSE_BOT_CENTR,	(same as above)
AIMSHCBE	= AIA_IMG_SH_CLOSE_BOT_EDGE,	(same as above)
AIMSHCTC	= AIA_IMG_SH_CLOSE_TOP_CENTR ,	(same as above)
AIMSHCTE	= AIA_IMG_SH_CLOSE_TOP_EDGE,	(same as above)
AICFGDL1	= AIA_IMG_CFG_DELAY_1,	mechanism delay 1 for this image
AICFGDL2	= AIA_IMG_CFG_DELAY_2,	clear table delay for this image
AICFGDL3	= AIA_IMG_CFG_DELAY_3,	shutter operation delay for this image
AICFGDL4	= AIA_IMG_CFG_DELAY_4 ,	readout delay for this image
AIFOENFL	= AIA_IMG_FOCUS_ENA_FLAG,	flag to indicate if focus table used or not
AIMGFSN	= AIA_IMG_FRLIST_POS,	position within framelist of this frame
AIMGTYP	= AIA_IMG_IMAGE_TYPE	software logic shows “dark” (0) only, {replaced by **IMG_TYP**}
AIAWVLEN	= AIA_IMG_WAVELENGTH	
AIAGP1	= AIA_IMG_GP1,	general purpose register word 1
AIAGP2	= AIA_IMG_GP2,	general purpose register word 2
AIAGP3	= AIA_IMG_GP3,	general purpose register word 3
AIAGP4	= AIA_IMG_GP4,	general purpose register word 4
AIAGP5	= AIA_IMG_GP5,	general purpose register word 5
AIAGP6	= AIA_IMG_GP6,	general purpose register word 6 (Onboard image quality flag; if not zero, set a bit in the Level-1 quality word)
AIAGP7	= AIA_IMG_GP7,	general purpose register word 7 (***AICFGDL1*** delay value in full precision)
AIAGP8	= AIA_IMG_GP8,	general purpose register word 8 (***AICFGDL2*** delay value in full precision)

AIAGP9	= AIA_IMG_GP9,	general purpose register word 9 (***AICFGDL3*** delay value in full precision)
AIAGP10	= AIA_IMG_GP10,	general purpose register word 10 (***AICFGDL4*** delay value in full precision)
AGT1SVY	= AIA_IMG_GT1_SUNVECTOR_Y,	Guide Telescope (GT) 1 Sun vector in y direction
AGT1SVZ	= AIA_IMG_GT1_ SUNVECTOR _Z,	Guide Telescope (GT) 1 Sun vector in z direction
AGT2SVY	= AIA_IMG_GT2_SUNVECTOR_Y,	Guide Telescope (GT) 2 Sun vector in y direction
AGT2SVZ	= AIA_IMG_GT2_ SUNVECTOR _Z,	Guide Telescope (GT) 2 Sun vector in z direction
AGT3SVY	= AIA_IMG_GT3_SUNVECTOR_Y,	Guide Telescope (GT) 3 Sun vector in y direction
AGT3SVZ	= AIA_IMG_GT3_ SUNVECTOR _Z,	Guide Telescope (GT) 3 Sun vector in z direction
AGT4SVY	= AIA_IMG_GT4_SUNVECTOR_Y	Guide Telescope (GT) 4 Sun vector in y direction
AGT4SVZ	= AIA_IMG_GT4_ SUNVECTOR _Z,	Guide Telescope (GT) 4 Sun vector in z direction
AIMGSHEN	= AIA_IMG_SH_ENCODER,	shutter selector encoder reading (0-255) for this image

2. Additional Level-1 Keywords

More level definitions

Definition of Level-1.0 (Note: This temporary level is generated on demand from Level-0 and is held for up to 60 days.)

1. Header
   Metadata for Level-0 reduced to those scientific FITS keywords needed for analysis at Level-1, updating the image coordinate mapping keywords to meaningful and nearly correct values, plus other keywords needed for Level -1 and above.
2. Data
   Decompressed raw data (level 0) with overscan pixels removed, dark pedestal and current, as well as flat field, corrections applied, bad pixel and cosmic-ray spike maps created and used to fix bad pixels and despike the cosmic-rays, image flipped to align with Solar North, and, finally, image rescaled to integer.

Definition of Level-1.5 (Note: The output from this level will be used to generate the permanently stored data.)

1. Header
   Metadata for Level-1.0 updated for the applied calibrations below (that will irreversibly modify the data).
2. Data

Floating-Point Level-1.0 data images that are adjusted for plate scale, rotation, and sub-pixel registration; roll corrected; and finally rescaled to integer.

Note: Level-1 keywords include those identified as such above plus those following.

2.1 Level-1 Image, Scale, and Processing Keywords

The following lower case keywords appear only in the JSOC Level-1 Lookdata keywords:

cparms_sg000	DRMS segment 0
image_lev1_bzero	multiplier for data values
image_lev1_bscale	offset for data values
cparms_sg001	DRMS segment 1
bad_pixel_bzero	multiplier for data values in bad pixel list
bad_pixel_bscale	offset for data values in bad pixel list
cparms_sg002	DRMS segment 2
spikes_bzero	multiplier for data values in spikes list
spikes_bscale	offset for data values in spikes list

The following lower case keywords appear only in the JSOC Level-1.5 Lookdata keywords:

cparms_sg000	DRMS segment 0
image_lev1p5_bzero	multiplier for data values
image_lev1p5_bscale	offset for data values

T_REC	slotted form of **T_OBS** (Currently being implemented)
T_REC_step	**T_REC** step (seconds)
T_REC_epoch	epoch date
T_REC_round	center of slot {Level-1.0 only}
T_REC_index	Index keyword associated with T_OBS
QUALLEV0	int, Level-0 quality word in Level-0 (see Appendix 2)
QUALITY	int, Level-1 quality word (see Appendix 3)

ROI_NWIN	= Number of Windows (4b; from FDB) for number of Region Of Interest(s) (ROI) (int) (= 0, 1, 2)
ROI_SUM	= SummingMode (4b; from FDB) for summing (int): 1x1, 2x2, 4x4 (= 0, 1, 2)
ROI_NAX1	= Number of CCD Columns (from FDB and de-crop table) for width of ROI 1 in pixels (int)
ROI_NAY1	= Number of CCD Rows (from FDB and de-crop table) for height of ROI 1 in pixels (int)

ROI_LLX1	= CCD X-variable location of lower left corner pixel of ROI 1 (int)	
ROI_LLY1	= CCD Y-variable location of lower left corner pixel of ROI 1 (int)	
ROI_NAX2	= Number of CCD Columns (from FDB and de-crop table) for width of ROI 2 in pixels (int)	
ROI_NAY2	= Number of CCD Rows (from FDB and de-crop table) for height of ROI 2 in pixels (int)	
ROI_LLX2	= CCD X-variable location of lower left corner pixel of ROI 2 (int)	
ROI_LLY2	= CCD Y-variable location of lower left corner pixel of ROI 2 (int)	
PIXLUNIT		string, to denote pixel value units in "DN"
KEYWDDOC		string, web pointer in FITS header for keyword doc: "www.lmsal.com/sdodocs/…AIA02840" full document title: "www.lmsal.com/sdodocs/AIA_FITS_Keywords_AIA02840"
FLAT_REC		is a pointer to the calibration file containing information on the dark processed image and processed flat field image used to correct the current image.
NSPIKE		number of spikes in image
BLD_VERSN		gives the JSOC build version by pointing to jsoc_version.h
LVL_NUM		Level number of image
		In a histogram of image values:
DATAP01		pixel value corresponding to lowest 1 percentile
DATAP10		pixel value corresponding to lowest 10 percentile
DATAP25		pixel value corresponding to lowest 25 percentile
DATAP75		pixel value corresponding to lowest 75 percentile
DATAP90		pixel value corresponding to lowest 90 percentile
DATAP95		pixel value corresponding to lowest 95 percentile
DATAP98		pixel value corresponding to lowest 98 percentile
DATAP99		pixel value corresponding to lowest 99 percentile
TEMPCCD	(being defined)	Temperature at CCD
TEMPCEB	(being defined)	Temperature at common electronics box
TEMPSMIR	(being defined)	Temperature at secondary mirror
TEMPPMIR	(being defined)	Temperature at primary mirror
DN_GAIN	(being defined)	DN/electron gain value in Intensity Through-Put Series
DN_GN_V	(being defined)	version # for **DN_GAIN** value in Intensity Through-Put Series
EFF_AREA	(being defined)	effective area value in Intensity Through-Put Series
EFF_AR_V	(being defined)	version # for **EFF_AREA** value in Intensity Through-Put Series

OSCNMEAN	;not used at present by AIA - to be removed	mean value of overscan rows
OSCNRMS	;not used at present by AIA - to be removed	rms deviation from the mean value of overscan rows

Temperatures measurements at CCD, common electronics box, primary mirror, and secondary mirror will be found here when all of the data are in the JSOC and time-averaged from the time-averaged series (mean, maximum, and variation smoothed over 300 sec). Camera attitude pointing information can be found in **MPO_REC**. DN per electron gain factor and effective area in cm^2 pointer will later be found here pointing to the Intensity Through-Put Series for these values.

Currently the following keywords are not in Level-1:

CUT_OUT	(to be defined)	int, Is this a cut out?, 0 = no, 1=yes
BADPIXEL	(to be defined)	segment pointer to the list of bad pixels corrected in image and stored with image in JSOC
SPIKELST	(to be defined)	segment pointer to the list of spikes, as well as old and new values corrected in image and stored with image in JSOC

2.2 Level-1 Coordinate Mapping Keywords

These keywords are to be populated separately for each instrument in Level-1.0, and above, when information becomes available following the definitions, assumptions, and guidelines in Phil Scherrer's "JSOC Keywords used for metadata" document [current update 5/25/10 or later], which can be found on the web at http://jsoc.stanford.edu/doc/keywords/JSOC_Keywords_for_metadata . Please consider Phil's document as another appendix to the present document, because it presents a full description of the following image coordinate mapping keywords, discussing the FITS standards, including instrument and spacecraft pointing. Below the keywords and a brief description are presented. For AIA it is assumed: 1) there is a fixed value for each telescope plate scale, **IMSCL_MP**: 2) the center of the solar disk is the origin. The spacecraft pointing keywords are now included below. Note in the following that the lower case, Italicized, letters specify mapping from array axes (j) to image axes (i).

CTYPE*i*	Text, type of image coordinate axis ***i*** for other Cxxxx keywords, where **CTYPE1 = HPLN-TAN (SOLARX),** **CTYPE2 = HPLT-TAN (SOLARY),** for

		longitude and latitude, respectively. (see Phil's document for coordinate mapping descriptions).
CUNIT*i*		Physical units for position on image axis ***I***, where **CUNIT1 = CUNIT2 =** "arcsec"
CRVAL*i*		Physical value along image axis ***i*** at the center of the pixel, where **CRVAL1 = CRVAL2 = 0.0**
CDELT*i*		Pixel spacing per index value along image axis ***I***, equal to **IM_SCALE** except at higher levels when the image has been rescaled (**CDELT1, CDELT2** in x, y directions, respectively)
CRPIX*j*		Reference pixel along array axis ***j***, with the center of the lower left pixel numbered 1 (not 0), i.e., location of disk center in x and y directions on image, where **CRPIX1 = X0_MP + 1, CRPIX2 = Y0_MP + 1** (see **X0_MP**, **Y0_MP** below).
CROTA*j*		Rotation needed for array axes to get to image axes (in degrees), where **CROTA2 = SAT_ROT** + **INST_ROT** (see below) Note: No **CROTA1**
CRDER*i*	(TBD, to appear in **MPO_REC**)	Estimate of random error in coordinate ***i*** expressed in **CUNIT*i***.
CSYSER*i*	(TBD, to appear in **MPO_REC**)	Estimate of systematic error in coordinate ***i*** expressed in **CUNIT*i***.
R_SUN		Radius of the Sun's image in pixels on the CCD detector, for the visible light (float)
MPO_REC		is the Master Pointing series record pointer to the Science reference bore sight information (See Appendix 4) and replaces **SCIRFBSV**, the science reference bore sight version number
INST_ROT		Master pointing CCD rotation wrt SDO Z (float, degrees)
IMSCL_MP		Master pointing image scale in arc-sec per CCD pixel (float), replacing **IM_SCALE**; This value will be used for the estimate of CDELT for AIA
X0_MP		Master pointing X0 sun center in CCD frame in pixels, start 0.0 (float) for raw image
Y0_MP		Master pointing Y0 sun center in CCD frame in pixels, start 0.0 (float) for raw image
RSUN_LF		Limb fit Solar radius in pixels (float)
X0_LF		Limb fit X0 sun center in CCD frame in pixels (float)
Y0_LF		Limb fit Y0 sun center in CCD frame in pixels (float)

ASD_REC	Ancillary Science Data series record pointer (string)
SAT_Y0	Position of solar center wrt the SDO -Y axis in arcsec (float)
SAT_Z0	Position of solar center wrt the SDO Z axis in arcsec (float)
SAT_ROT	Position angle of solar pole wrt the SDO X axis (float, degrees)
ACS_MODE	ACS pointing mode (ACS are strings)- ACS_AN_ACS_MODE
ACS_ECLP	ACS eclipse flag - ACS_AN_FLAG_CSS_ECLIPSE
ACS_SUNP	ACS sun presense flag - ACS_AN_FLAG_DSS_SUNPRES
ACS_SAFE	ACS safe hold flag - ACS_AN_FLAG_ACE_INSAFEHOLD
ACS_CGT	ACS ID of Controlling Guide Telescope - ACS_AN_NUM_CGT
ORB_REC	Orbit vector series record pointer (string)
DSUN_REF	Reference distance to Sun: 149,597,870,691.0 m (double)
DSUN_OBS	Distance from Sun center to SDO in m (double)
RSUN_REF	Reference radius of the Sun: 696,000,000.0 m (double)
RSUN_OBS	Apparent radius of the Sun seen by SDO (arcsec, double)
GCIEC_X	Geocentric Inertial X position in m (double)
GCIEC_Y	Geocentric Inertial Y position in m (double)
GCIEC_Z	Geocentric Inertial Z position in m (double)
HCIEC_X	Heliocentric Inertial X position in m (double)
HCIEC_Y	Heliocentric Inertial Y position in m (double)
HCIEC_Z	Heliocentric Inertial Z position in m (double)
OBS_VR	Speed of observer in radial direction in m/s (double)
OBS_VW	Speed of observer in solar-west direction in m/s (double)
OBS_VN	Speed of observer in solar-north direction in m/s (double)
CRLN_OBS	Carrington longitude of the observer in degrees (float)
CRLT_OBS	Carrington latitude of the observer in degrees (float)
CAR_ROT	Carrington rotation number of CRLN_OBS(integer)
HGLN_OBS	Stoneyhurst heliographic longitude of the observer (very small value) in degrees (float)
HGLT_OBS	Stoneyhurst heliographic latitude of the observer in degrees (float) (=**CRLT_OBS**)

The following non-keyword quantities can be calculated from the Level-1 keywords above:

FOVX1 = **CDELT1 * ROI_NAX1**	ROI 1 X-Axis Field of View in arcsec

FOVY1 = **CDELT2 * ROI_NAY1** ROI 1 Y-Axis Field of View in arcsec
FOVX2 = **CDELT1 * ROI_NAX2** ROI 2 X-Axis Field of View in arcsec
FOVY2 = **CDELT2 * ROI_NAY2** ROI 2 Y-Axis Field of View in arcsec

3. Approximate Lists of Keywords for Level 0 and 1 Metadata (Data File Headers)

Level 0	Level 1	Brief Description	Sample Values of Keyword	Section
SIMPLE =	**SIMPLE**		T	1.2
BITPIX =	**BITPIX**		8	1.2
NAXIS =	**NAXIS**		2	1.1
NAXIS1 =	**NAXIS1**		4096	1.1
NAXIS2 =	**NAXIS2**		4096	1.1
EXTEND =	**EXTEND**		T	1.2
ORIGIN =	**ORIGIN**		‘SDO/JSOC-SDP’	1.2
DATE =	**DATE**		‘2008-01-08T23:57:38’	1.2
TELESCOP =	**TELESCOP**		‘SDO/AIA’	1.2
INSTRUME =	**INSTRUME**		‘AIA’	1.2
DATE__OBS =	**DATE__OBS**		‘2008-01-08T18:56:00.005’	1.2, App. 1
T_OBS =	**T_OBS**		**‘**2008-01-08T18:56:03.005’	1.2, App. 1
CAMERA =	**CAMERA**		3	1.1 (Header)
IMG_TYPE =	**IMG_TYPE**		‘LIGHT or DARK’	1.2
EXPTIME =	**EXPTIME**		5.039	1.2, App. 1
EXPSDEV =	**EXPSDEV**		0.019	1.2, App. 1
INT_TIME =	**INT_TIME**	[= ***AICFGDL4*** **-** ***AICFGDL3*** (+ rollover), interval time between readout delay and shutter operation delay plus rollover]		1.2
WAVELNTH =	**WAVELNTH**		171	1.2
WAVEUNIT =	**WAVEUNIT**		‘angstrom’	1.2
WAVE_STR =	**WAVE_STR**		‘171_01’	1.2
FSN =	**FSN**	Frame Serial Number	75000	1.1 (Header)
FID =	**FID**	Frame Definition Block ID		1.1 (Crop table)
TLMDSNAM		Telemety data series name with first packet of image		1.1 (Header)
IMGFPT		First packet time		1.1 (Header)

IMGAPID		Packet APID, "Image Application ID"		1.1 (Header)
TAPCODE		"Take a Picture code"		1.1 (Header)
BITSELID		Bit Select ID, r		1.1 (Header)
COMPID		Compression ID; n, *k*		1.1 (Header)
CROPID		Crop table ID		1.1 (Crop table)
LUTID		Lookup table id		1.1 (Header)
NPACKETS		Number of packets in image		1.1
NERRORS		Number of decompression errors		1.1
EOIERROR		Last pixel error; End Of Image Error		1.1
HEADRERR		Header error in image		1.1
OVERFLOW		Data overflow error in image		1.1
QUALITY =	**QUALLEV0**	Level-0 Quality word		1.1, 2.1
	QUALITY	Level-1 Quality word		1.1, 2.1
TOTVALS =	**TOTVALS**	Expected number of data values (pixels)		1.2
DATAVALS =	**DATAVALS**	Actual number of data values in image		1.2
MISSVALS =	**MISSVALS**	Missing values: TOTVALS – DATAVALS		1.2
PERCENTD =	**PERCENTD**	Percentage of good data	100.0	1.2
DATAMIN =	**DATAMIN**		81.0	1.2
DATAMAX =	**DATAMAX**		4100.0	1.2
DATAMEDN =	**DATAMEDN**		218.345670	1.2
DATAMEAN =	**DATAMEAN**		218.345670	1.2
DATARMS =	**DATARMS**		22.687300	1.2
DATASKEW =	**DATASKEW**		218.345670	1.2
DATAKURT =	**DATAKURT**		218.345670	1.2
DATACENT =	**DATACENT**		(TBD)	1.2
	PIXLUNIT		**‘**DN’	2.1
	KEYWDDOC	‘www.lmsal.com/sdodocs/…Keywords-AIA02840’		2.1
	FLAT_REC			2.1
	CTYPE1		‘HPLN-TAN’	2.2
	CUNIT1		‘arcsec’	2.2
	CRVAL1		0.0	2.2
	CDELT1		0.6	2.2
	CRPIX1		2047.5	2.2
	CTYPE2		‘HPLT-TAN’	2.2

CUNIT2		‘arcsec’	2.2
CRVAL2		0.0	2.2
CDELT2		0.6	2.2
CRPIX2		2050.5	2.2
CROTA2		0.0	2.2
R_SUN	Radius of the Sun’s image in pixels, for the visible light		2.2
MPO_REC	Master Pointing series record pointer		2.2
INST_ROT	Rotation of the camera from the SDO Z axis		2.2
IMSCL_MP	Master pointing image scale		2.2
X0_MP			2.2
Y0_MP			2.2
RSUN_LF			2.2
X0_LF			2.2
Y0_LF			2.2
ASD_REC			2.2
SAT_Y0			2.2
SAT_Z0			2.2
SAT_ROT	Position angle of solar pole wrt the SDO Z axis		2.2
ACS_MODE			2.2
ACS_ECLP			2.2
ACS_SUNP			2.2
ACS_SAFE			2.2
ACS_CGT			2.2
ORB_REC			2.2
DSUN_REF	Reference distance to Sun	149597870691.0	2.2
DSUN_OBS	Distance from Sun’s center to SDO		2.2
RSUN_REF	Radius of the Sun in	696000000.0	2.2
RSUN_OBS	Apparent radius of the Sun seen by SDO		2.2
GCIEC_X			2.2
GCIEC_Y			2.2
GCIEC_Z			2.2
HCIEC_X			2.2
HCIEC_Y			2.2
HCIEC_Z			2.2

		OBS_VR			2.2
		OBS_VW			2.2
		OBS_VN			2.2
		CRLN_OBS			2.2
		CRLT_OBS			2.2
		CAR_ROT			2.2
		HGLN_OBS			2.2
		HGLT_OBS			2.2
ROI_NWIN	=	**ROI_NWIN**	Number of windows or ROIs	0	2.1
		ROI_SUM		0	2.1
		ROI_NAX1		4096	2.1
		ROI_NAY1		4096	2.1
		ROI_NAX2		0	2.1
		ROI_NAY2		0	2.1
		ROI_LLX1		0	2.1
		ROI_LLY1		0	2.1
		ROI_LLX2		0	2.1
		ROI_LLY2		0	2.1
		DN_GAIN		(TBD)	2.1
		DN_GN_V		(TBD)	2.1
		EFF_AREA		(TBD)	2.1
		EFF_AR_V		(TBD)	2.1
		TEMPCCD		(TBD)	2.1
		TEMPCEB		(TBD)	2.1
		TEMPSMIR		(TBD)	2.1
		TEMPPMIR		(TBD)	2.1

Currently all of the ISP keywords are in both Level-0 and Level-1:

ISPSNAME	=	**ISPSNAME**	ISP Series Name	aia.lev0_isp_0011	1.3 (ISP)
ISPPKTIM	=	**ISPPKTIM**	Packet time	'2008-01-08T18:56:01.000'	1.3 (ISP)
ISPPKTVN	=	**ISPPKTVN**	Packet version number	'001.1'	1.3 (ISP)
AIVNMST	=	***AIVNMST***	ISP version number		1.3 (ISP)
AIMGOTS	=	***AIMGOTS***	seconds time tag		1.3 (ISP)
ASQHDR	=	***ASQHDR***	**[=** ***ASQTNUM*** (2b) {=Camera} + ***ASQFSN*** (30b) {=FSN}]		1.3 (ISP)

ASQTNUM	=	***ASQTNUM***	[= Camera – 1]	1.3 (ISP)
ASQFSN	=	***ASQFSN***	[another FSN]	1.3 (ISP)
AIAHFSN	=	***AIAHFSN***	the FSN of the image from which the histogram data was obtained	1.3 (ISP)
AECDELAY	=	***AECDELAY***	time since image used for AEC	1.3 (ISP)
AIAECTI	=	***AIAECTI***	Automatic Exposure Control (AEC) tables used with this image	1.3 (ISP)
AIASEN	=	***AIASEN***	aperture selection encoder reading	1.3 (ISP)
AIFDBID	=	***AIFDBID***	[another FDB ID]	1.3 (ISP)
AIMGOTSS	=	***AIMGOTSS***	subseconds time tag	1.3 (ISP)
AIFCPS	=	***AIFCPS***	currently loaded target value	1.3 (ISP)
AIFTSWTH	=	***AIFTSWTH***	filter switch threshold for 131A wavelength (exposure)	1.3 (ISP)
AIFRMLID	=	***AIFRMLID***	framelist id for this image	1.3 (ISP)
AIFTSID	=	***AIFTSID***	framelist timeline schedule (FTS) id	1.3 (ISP)
AIHISMXB	=	***AIHISMXB***	bin number of maximum of standard histogram for previous image in this wavelength used for the current AEC	1.3 (ISP)
AIHIS192	=	***AIHIS192***	cumulative histogram value at bin #192	1.3 (ISP)
AIHIS348	=	***AIHIS348***	cumulative histogram value at bin #348	1.3 (ISP)
AIHIS604	=	***AIHIS604***	cumulative histogram value at bin #604	1.3 (ISP)
AIHIS860	=	***AIHIS860***	cumulative histogram value at bin #860	1.3 (ISP)
AIFWEN	=	***AIFWEN***	filter wheel selector encoder reading	1.3 (ISP)
AIMGSHCE	=	***AIMGSHCE***	5.0	1.3 (ISP)
AECTYPE	=	***AECTYPE***	AEC table for current wavelength	1.3 (ISP)
AECMODE	=	***AECMODE***	mode of AEC (‘OPEN’ ro ‘CLOSED’)	1.3 (ISP)
AISTATE	=	***AISTATE***	ISS (‘OPEN’ ro ‘CLOSED’)	1.3 (ISP)
AIAECENF	=	***AIAECENF***	AEC enable flag for this image	1.3 (ISP)
AIFILTYP	=	***AIFILTYP***	01	1.3 (ISP)
AIMSHOBC	=	***AIMSHOBC***	shutter timer register value	1.3 (ISP)
AIMSHOBE	=	***AIMSHOBE***	shutter timer register value	1.3 (ISP)
AIMSHOTC	=	***AIMSHOTC***	shutter timer register value	1.3 (ISP)
AIMSHOTE	=	***AIMSHOTE***	shutter timer register value	1.3 (ISP)
AIMSHCBC	=	***AIMSHCBC***	shutter timer register value	1.3 (ISP)
AIMSHCBE	=	***AIMSHCBE***	shutter timer register value	1.3 (ISP)
AIMSHCTC	=	***AIMSHCTC***	shutter timer register value	1.3 (ISP)
AIMSHCTE	=	***AIMSHCTE***	shutter timer register value	1.3 (ISP)
AICFGDL1	=	***AICFGDL1***	mechanism delay 1	1.3 (ISP)

AICFGDL2 =	***AICFGDL2***	clear table delay	1.3 (ISP)
AICFGDL3 =	***AICFGDL3***	shutter operation delay	1.3 (ISP)
AICDGDL4 =	***AICDGDL4***	readout delay	1.3 (ISP)
AIFOENFL =	***AIFOENFL***	flag to indicate if focus table used or not	1.3 (ISP)
AIMGFSN =	***AIMGFSN***	position within framelist of this frame	1.3 (ISP)
AIMGTYP =	***AIMGTYP***	'dark'	1.3 (ISP)
AIAWVLEN =	***AIAWVLEN***	(coded wavelength for this observation)	1.3 (ISP)
AIAGP1 =	***AIAGP1***	general purpose register word 1	1.3 (ISP)
AIAGP2 =	***AIAGP2***	general purpose register word 2	1.3 (ISP)
AIAGP3 =	***AIAGP3***	general purpose register word 3	1.3 (ISP)
AIAGP4 =	***AIAGP4***	general purpose register word 4	1.3 (ISP)
AIAGP5 =	***AIAGP5***	general purpose register word 5	1.3 (ISP)
AIAGP6 =	***AIAGP6***	gpr word 6 (Onboard Level-1 image quality flag)	1.3 (ISP)
AIAGP7 =	***AIAGP7***	gpr word 7 (***AICFGDL1*** delay value in full precision)	1.3 (ISP)
AIAGP8 =	***AIAGP8***	gpr word 8 (***AICFGDL2*** delay value in full precision)	1.3 (ISP)
AIAGP9 =	***AIAGP9***	gpr word 9 (***AICFGDL3*** delay value in full precision)	1.3 (ISP)
AIAGP10 =	***AIAGP10***	gpr word 10 (***AICFGDL4*** delay value in full precision)	1.3 (ISP)
AGT1SVY =	***AGT1SVY***	GT 1 Sun vector in y direction	1.3 (ISP)
AGT1SVZ =	***AGT1SVZ***	GT 1 Sun vector in z direction	1.3 (ISP)
AGT2SVY =	***AGT2SVY***	GT 2 Sun vector in y direction	1.3 (ISP)
AGT2SVZ =	***AGT2SVZ***	GT 2 Sun vector in z direction	1.3 (ISP)
AGT3SVY =	***AGT3SVY***	GT 3 Sun vector in y direction	1.3 (ISP)
AGT3SVZ =	***AGT3SVZ***	GT 3 Sun vector in z direction	1.3 (ISP)
AGT4SVY =	***AGT4SVY***	GT 4 Sun vector in y direction	1.3 (ISP)
AGT4SVZ =	***AGT4SVZ***	GT 4 Sun vector in z direction	1.3 (ISP)
AIMGSHEN =	***AIMGSHEN***	shutter selector encoder reading	1.3 (ISP)
COMMENT =	**COMMENT**	Comment	1.2
HISTORY =	**HISTORY**	ASCII history record, one or more	1.2
BLANK =	**BLANK**	-32768	1.2 (definition)
CHECKSUM =	**CHECKSUM**	(e.g., = 'nhkHqek9nekGnek9')	1.2
DATASUM =	**DATASUM**	(e.g., = '4246760921')	1.2
END =	**END**	End of file	1.2

Appendix 1: AIA Camera Exposure Time Calculation

Telemetry parameters required from AIA Image Status Packet:

AIMGOTS = AIA_IMG_OBT_TIME_SH_SEC
AIMGOTSS = AIA_IMG_OBT_TIME_SH_SS
cmdexp = double(***AIMGSHCE***) = AIA_IMG_SH_CMDED_EXPOSURE
shopbc = double(***AIMSHOBC***) = AIA_IMG_SH_OPEN_BOT_CENTR
shopbe = double(***AIMSHOBE***) = AIA_IMG_SH_OPEN_BOT_EDGE
shoptc = double(***AIMSHOTC***) = AIA_IMG_SH_OPEN_TOP_CENTR
shopte = double(***AIMSHOTE***) = AIA_IMG_SH_OPEN_TOP_EDGE
shclbc = double(***AIMSHCBC***) = AIA_IMG_SH_CLOSE_BOT_CENTR
shclbe = double(***AIMSHCBE***) = AIA_IMG_SH_CLOSE_BOT_EDGE
shcltc = double(***AIMSHCTC***) = AIA_IMG_SH_CLOSE_TOP_CENTR
shclte = double(***AIMSHCTE***) = AIA_IMG_SH_CLOSE_TOP_EDGE

AIMGSHCE is the commanded exposure (19 bits) starting from ~0.005 s (due to size of narrow shutter slit) in 0.001 s steps to 524.28 s [$(2^{19}-1)*10^{-3} = 524287*10^{-3}$] (timings are from document AIA01259 rev H). The maximum exposure of the AIA shutter mechanism is ~268.4 s. The 24 bit shutter open and close time measurements have a resolution of 0.000004 s, starting at 0.000004 s up to ~67 s [$(2^{24} - 1) * 4*10^{-6} = 67108860*10^{-6}$]. The commanded exposure value can be used to determine the rollover value. The expected value of the commanded exposure to the nearest 0.1 sec just before each of the three possible rollover steps is 67.1 s, 134.2 s, and 201.3 s, respectively. When ***AIMGSHCE*** is above any of these values it has rolled over 1, 2, or 3 times, respectively, and the number of rollovers multiplied by 67.108864 s needs to be added to the respective shutter close minus open time before averaging. Please note that the programmer needs to take care near the rollover steps because the hardware and/or software may not work quite the same as in the ideal case presented here.

The actual exposure is the average of the difference of the closing time minus the opening time for each of the four measurements positions, except when ***AIMGSHCE*** is less than 0.072 s, in which case the shutter mechanism is in its narrow slit mode. In the latter mode the narrow slit opening (smaller by 0.35) is utilized for one or more passes. The current operational planning calls for the shutter exposure to be about 5 s per image for each camera.

Using the above, together with Rock Bush's email of 28-Feb-08 on HMI T_OBS and EXPTIME and John Serafin's email of 20-May-08 on a rollover algorithm in C, the following algorithm has been written in IDL for calculating the AIA camera shutter exposure time

for each camera, **EXPTIME;** standard deviation, **EXPSDEV;** the shutter open start time plus the middle of the exposure time, **T_OBS;** and the date when the observation started, **DATE_OBS.**

; Computer quantities (note: all variables should be double precision and time is in seconds):

AIA_Shutter_Open_Start_Time = ***AIMGOTS*** + ***AIMGOTSS*** ;combine these in TAI

;Intermediate calculation variables:

```
   cshclbc = shclbc + 67.108864d0 * nrollct(cmdexp, shclbc)      ;correct for rollovers
   cshclbe = shclbe + 67.108864d0 * nrollct(cmdexp, shclbe)
   cshcltc = shcltc + 67.108864d0 * nrollct(cmdexp, shcltc)
   cshclte = shclte + 67.108864d0 * nrollct(cmdexp, shclte)

   shebc = cshclbc – shopbc                                      ;close time – open time
   shebe = cshclbe - shopbe
   shetc = cshcltc - shoptc
   shete = cshclte - shopte

   mean = (shebc + shebe + shetc + shete)/4.0d0                  ;mean and standard deviation
   exp_sd = sqrt(1/3 * ( (shebc-mean) * (shebc-mean) + (shebe-mean) * (shebe-mean) + $
(shetc-mean) * (shetc-mean) + (shete-mean) * (shete-mean) ))     ;continued from previous line

   if (cmdexp lt 0.072d0) then begin                             ;in narrow slit mode
         mean = mean * 0.35
         exp_sd = expsd * 0.35
   endif
```

EXPTIME = mean ;AIA_Shutter_Exposure_Time
EXPSDEV = exp_sd ;AIA_Shutter_Exposure_SD

```
EXPTIME_Offset = (cshclbc + shopbc + cshclbe + shopbe + cshcltc + shoptc + cshclte + $ shopte)/8.0d0
                                 ;continued from previous line
```

T_OBS = AIA_Shutter_Open_Start_Time + EXPTIME_Offset ;(add in seconds, calculate DATA_OBS, then convert T_OBS to UTC)

DATE_OBS = **T_OBS -** (**EXPTIME**/2.0) ;(add in seconds then convert to UTC time)

Note: the T_OBS time is the shutter open start time plus the middle of the exposure time. As such a shutter exposure offset is the mean of all the open and close times. The EXPTIME is the shutter open time duration. DATE_OBS is the date when observation started.

```
;Rollover procedure nrollct
;for rollovers at 67.1, 134.2 and 201.3 with integers used below that are about one quarter of the
;interval away from the rollover values and thus not critical

   Pro nrollct, cmdexp, clostim

   If (cmdexp < 51.0) then  return 0
   If (cmdexp < 84.0) then  if (clostim > 33.0)  then return 0  else return 1
   If (cmdexp < 117.0)  then return 1
   If (cmdexp < 151.0) then  if (clostim > 33.0)  then return 1  else return 2
   If (cmdexp < 184.0) then  return 2
   If (cmdexp < 217.0) then  if (clostim > 33.0)  then return 2  else return 3
   If (cmdexp < 251.0) then  return 3
   return  if (clostim > 33.0)  then return 3  else return 4
   end
```

Appendix 2: AIA Level-0 Quality Definition

(updated by Rock Bush, 6/09/10)

QUALITY = 0 means OK.

Bit 0 is the low bit (0x01).
The first 4 bits are determined from the Img struct passed back by imgdecode
The parameter MISSVALS is from Img struct TOTVALS - DATAVALS

Bit	Meaning
0	Overflow Flag Set
1	Header Error Flag Set
2	Compression Error in Image
3	Last Pixel Error
4	Missing Image Status Packet: (FSN != HSQFGSN) or HSQFGSN missing
5	Missing Image: (MISSVALS = TOTVALS) or NPACKETS = 0
6	Corrupt Image: (FSN = 469769216)
7	Invalid Time: (AIMGSHCE != 0) and (AIMGOTS = 0)
8	MISSVALS > 0
9	MISSVALS > 0.01*TOTVALS
10	MISSVALS > 0.05*TOTVALS
11	MISSVALS > 0.25*TOTVALS
12	
13	
14	
15	

AIA specific

16	Dark Image;	IMG_TYPE == 'DARK'
17	ISS Loop Open;	AISTATE == "OPEN"; (AISTATE != 0)

```
18      9.4nm Mech Error;  AIAWVLEN == 9 &&
                              {(AIFILTYP == 0 && AIFWEN != 269 && AIFWEN != 270
                                && AIFWEN !=  74 && AIFWEN !=  75)}
                             || (AIFILTYP == 1 && AIFWEN !=  11 && AIFWEN !=  12)
19      13.1nm Mech Error; AIAWVLEN == 1 &&
                              {(AIFILTYP == 0 && AIFWEN != 269 && AIFWEN != 270
                                && AIFWEN !=  74 && AIFWEN !=  75)}
                             || (AIFILTYP == 1 && AIFWEN !=  11 && AIFWEN !=  12)
20      17.1nm Mech Error; AIAWVLEN == 7 &&
                              {(AIFILTYP == 0 && AIFWEN != 203 && AIFWEN != 204)
                             || (AIFILTYP == 1 && AIFWEN !=  11 && AIFWEN !=  12)}
21      19.3nm Mech Error; AIAWVLEN == 3 && {AIASEN != 6
                             || (AIFILTYP == 0 && AIFWEN != 269 && AIFWEN != 270
                                && AIFWEN !=  74 && AIFWEN !=  75)}
                             || (AIFILTYP == 1 && AIFWEN !=  11 && AIFWEN !=  12)
22      21.1nm Mech Error; AIAWVLEN == 2 && {AIASEN != 24
                             || (AIFILTYP == 0 && AIFWEN != 203 && AIFWEN != 204
                                && AIFWEN !=  74 && AIFWEN !=  75)}
                             || (AIFILTYP == 1 && AIFWEN != 137 && AIFWEN != 138)
23      30.4nm Mech Error; AIAWVLEN == 8 &&
                              {(AIFILTYP == 0 && AIFWEN != 203 && AIFWEN != 204
                                && AIFWEN !=  74 && AIFWEN !=  75)}
                             || (AIFILTYP == 1 && AIFWEN != 137 && AIFWEN != 138)
24      33.5nm Mech Error; AIAWVLEN == 0 &&
                              {(AIFILTYP == 0 && AIFWEN != 203 && AIFWEN != 204
                                && AIFWEN !=  74 && AIFWEN !=  75)}
                             || (AIFILTYP == 1 && AIFWEN != 137 && AIFWEN != 138)
25      160nm Mech Error;  AIAWVLEN == 4 && AIFWEN != 269 && AIFWEN != 270
26      170nm Mech Error;  AIAWVLEN == 5 && AIFWEN != 137 && AIFWEN != 138
27      450nm Mech Error;  AIAWVLEN == 6 && AIFWEN !=  74  && AIFWEN !=   75
28      Invalid Wavelength; WAVE_STR == "UNKNOWN"
29
30
31
```

****

AIA Mechanism position definitions from Paul Boerner

WAVELEN	FILTER_TYPE	FW_ENCODER	AS_ENCODER"
1600	"Don't check"	"269 or 270"	"Don't check"
	"Don't check"	"269 or 270"	"Don't check"
	"Don't check"	"269 or 270"	"Don't check"
1700	"Don't check"	"137 or 138"	"Don't check"
	"Don't check"	"137 or 138"	"Don't check"
	"Don't check"	"137 or 138"	"Don't check"
4500	"Don't check"	"74 or 75"	"Don't check"
	"Don't check"	"74 or 75"	"Don't check"
	"Don't check"	"74 or 75"	"Don't check"

WAVELEN	FILTER_TYPE	FW_ENCODER	AS_ENCODER"
94	0	"269 or 270"	"Don't check"
	1	"11 or 12"	"Don't check"
	2 (0)	"74 or 75"	"Don't check"
131	0	"269 or 270"	"Don't check"
	1	"11 or 12"	"Don't check"
	2 (0)	"74 or 75"	"Don't check"
171	0	"203 or 204"	"Don't check"
	1	"11 or 12"	"Don't check"
304	0	"203 or 204"	"Don't check"
	1	"137 or 138"	"Don't check"

	2 (0)	"74 or 75"	"Don't check"
335	0	"203 or 204"	"Don't check"
	1	"137 or 138"	"Don't check"
	2 (0)	"74 or 75"	"Don't check"

WAVELEN	FILTER_TYPE	FW_ENCODER	AS_ENCODER"
193	0	"269 or 270"	6
	1	"11 or 12"	6
	2 (0)	"74 or 75"	6
211	0	"203 or 204"	24
	1	"137 or 138"	24
	2 (0)	"74 or 75"	24

Note: FILTER_TYPE "2" is not set correctly in the AIA flight software and is always reported as "0". The quality checks for FILTER_TYPE = 0 include both the FILTER_TYPE "0" and "2" mechanism positions.

****

Fits keyword and Image Status Packet (ISP) keyword translation:

ASQFSN	AIA_SEQ_FRAME_SN	int
AISTATE	AIA_IMG_ISS_LOOP	string
AIAWVLEN	AIA_IMG_WAVELENGTH	int
AIASEN	AIA_IMG_AS_ENCODER	int
AIFILTYP	AIA_IMG_FILTER_TYPE	short
AIFWEN	AIA_IMG_FW_ENCODE	int

****

AIAWVLEN lookup values:

Index: { 0, 1, 2, 3, 4, 5, 6, 7, 8 9 }
Wavelength: { 335, 131, 211, 193, 1600, 1700, 4500, 171, 304, 94 }

Appendix 3: HMI and AIA Level 1 Quality Definition

(updated by Rock Bush, October 19, 2010)

Bit0 is the low bit (0x01)
The parameter MISSVALS is from Img struct TOTVALS - DATAVALS

Bit	Meaning
0	FLAT_REC == MISSING; Flatfield data not available
1	ORB_REC == MISSING; Orbit data not available
2	ASD_REC == MISSING; Ancillary Science Data not available
3	MPO_REC == MISSING; Master pointing data not available
4	RSUN_LF == MISSING or X0_LF == MISSING or Y0_LF == MISSING; HMI Limb fit not acceptable
5	
6	
7	
8	MISSVALS > 0
9	MISSVALS > 0.01*TOTVALS
10	MISSVALS > 0.05*TOTVALS
11	MISSVALS > 0.25*TOTVALS
12	ACS_MODE != 'SCIENCE'; Spacecraft not in science pointing mode
13	ACS_ECLP == 'YES'; Spacecraft eclipse flag set
14	ACS_SUNP == 'NO'; Spacecraft sun presence flag not set
15	ACS_SAFE == 'YES'; Spacecraft safemode flag set
16	IMG_TYPE == 'DARK'; Dark image
17	HWLTNSET == 'OPEN' HMI ISS loop open or AISTATE == 'OPEN'; AIA ISS loop Open
18	(FID >= 1 and FID <= 9999) HMI Calibration Image or (AIFTSID >= 0xC000) AIA Calibration Image

19 HCFTID == 17; HMI CAL mode image;
20 (AIFCPS <= -20 or
AIFCPS >= 100); AIA focus out of range
21 AIAGP6 != 0; AIA register flag
22
23
24
25
26
27
28
29
30 Quicklook image
31 Image not available

IMG_TYPE; "Image type: LIGHT or DARK"

HMI ISS loop open; HWLTNSET == 'OPEN'; (HWLTNSET != 0)
HWLTNSET = HMI_IMG_ISS_LOOP

AIA ISS loop open; AISTATE == 'OPEN'; (AISTATE != 0)
AISTATE = AIA_IMG_ISS_LOOP

HMI calibration image (FID >= 1 and FID <= 9999)
FID = Filtergram ID identical to
HSQFGID = HMI_SEQ_FILTERGRAM_ID FID

AIA calibration image (AIFTSID >= 0xC000)
AIFTSID = AIA_IMG_FTS_ID; active FTS ID number

AIA focus out of range (AIFCPS <= -20 or AIFCPS >= 100)
AIFCPS = AIA_IMG_FC_POSITION; focus mechanism position

AIAGP6= AIA_IMG_GP6; AIA General Purpose Register #6

Appendix 4: SDO Master Pointing Parameter Definition File

(this jsd from Rock Bush on May 4, 2010)

```
#=====General Series Information=====
Seriesname:          sdo.master_pointing
Author:              "production"
Owner:               production
Unitsize:            0
Archive:             0
Retention:           0
Tapegroup:           0
PrimeKeys:           T_START
DBIndex:             T_START
Description:         "Master Pointing Parameters"

#=====Keywords=====
#===== (0) Keywords from document: JSOC keywords used for metadata

Keyword:ORIGIN,       string, constant, record,     "SDO/JSOC-SDP", "%s",   "none", "ORIGIN Location where file made"
Keyword:TELESCOP,  string, constant, record,            "SDO", "%s",   "none", "SDO spacecraft"
Keyword:DATE,            time, variable, record, DRMS_MISSING_VALUE,  "0",    "ISO", "Date_time of processing; ISO 8601"
Keyword:T_START,      time, variable, record, DRMS_MISSING_VALUE,  "0",    "ISO", "Interval start Date_time; ISO 8601"
Keyword:T_STOP,        time, variable, record, DRMS_MISSING_VALUE,  "0",    "ISO", "Interval stop Date_time; ISO 8601"
Keyword:T_HKVALS,   time, variable, record, DRMS_MISSING_VALUE,  "0",    "ISO", "Housekeeping data select Date_time; ISO
8601"
Keyword:VERSION,       int, variable, record, DRMS_MISSING_VALUE, "%d",   "none", "Version"

#===== (0.1) SDO Spacecraft Inertial Reference Pointing Offset

Keyword:SC_Y_INRT_BIAS, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "SDO Y Axis offset between
inertial and science sun center"
Keyword:SC_Z_INRT_BIAS, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "SDO Z Axis offset between
inertial and science sun center"
```

#===== (1) HMI Image Locations

Keyword:H_CAM1_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:H_CAM1_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:H_CAM1_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:H_CAM1_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:H_CAM2_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:H_CAM2_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:H_CAM2_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:H_CAM2_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

#===== (2) AIA Image Locations

Keyword:A_094_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_094_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_094_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_094_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_131_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_131_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_131_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_131_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_171_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_171_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_171_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_171_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_193_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel”
Keyword:A_193_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_193_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"

Keyword:A_193_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_211_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_211_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_211_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_211_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_304_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_304_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_304_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_304_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_335_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_335_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_335_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_335_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_1600_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_1600_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_1600_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_1600_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_1700_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_1700_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_1700_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_1700_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

Keyword:A_4500_IMSCALE, float, variable, record, DRMS_MISSING_VALUE, "%f", "arcsec", "Image scale in arcsec/pixel"
Keyword:A_4500_X0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD x direction"
Keyword:A_4500_Y0, float, variable, record, DRMS_MISSING_VALUE, "%f", "pixel", "Image center in CCD y direction"
Keyword:A_4500_INSTROT, float, variable, record, DRMS_MISSING_VALUE, "%f", "deg", "Rotation of CCD from SDO Z axis"

#===== (3) HMI Alignment Parameters

Keyword:HMI_FSW_AL1_POSITION, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HAL1POS]"
Keyword:HMI_FSW_AL2_POSITION, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HAL2POS]"
Keyword:HMI_AL1_STATUS, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HAL1STAT]"
Keyword:HMI_AL2_STATUS, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HAL2STAT]"

Keyword:HMI_ISS_ERRGAINY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIERRGNY]"
Keyword:HMI_ISS_ERRGAINZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIERRGNZ]"
Keyword:HMI_ISS_ERROFFY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIERROFY]"
Keyword:HMI_ISS_ERROFFZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIERROFZ]"

Keyword:HMI_ISS_PZTOFFA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIPZTOFA]"
Keyword:HMI_ISS_PZTOFFB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIPZTOFB]"
Keyword:HMI_ISS_PZTOFFC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIPZTOFC]"

Keyword:HMI_ISS_PKT_YCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIYCOEFA]"
Keyword:HMI_ISS_PKT_YCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIYCOEFB]"
Keyword:HMI_ISS_PKT_YCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIYCOEFC]"
Keyword:HMI_ISS_PKT_ZCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIZCOEFA]"
Keyword:HMI_ISS_PKT_ZCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIZCOEFB]"
Keyword:HMI_ISS_PKT_ZCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[HIZCOEFC]"

#===== (4) AIA Alignment Parameters

Keyword:AIA_IS1_ERRGAINY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1ERRGNY]"
Keyword:AIA_IS1_ERRGAINZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1ERRGNZ]"
Keyword:AIA_IS1_ERROFFY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1ERROFY]"
Keyword:AIA_IS1_ERROFFZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1ERROFZ]"

Keyword:AIA_IS1_PZTGAINA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1PZTGNA]"
Keyword:AIA_IS1_PZTGAINB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1PZTGNB]"
Keyword:AIA_IS1_PZTGAINC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1PZTGNC]"

Keyword:AIA_IS1_PZTOFFA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1PZTOFA]"
Keyword:AIA_IS1_PZTOFFB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1PZTOFB]"
Keyword:AIA_IS1_PZTOFFC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A1PZTOFC]"

Keyword:AIA_GT1_PKT_YCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT1_YCA]"
Keyword:AIA_GT1_PKT_YCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT1_YCB]"
Keyword:AIA_GT1_PKT_YCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT1_YCC]"
Keyword:AIA_GT1_PKT_ZCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT1_ZCA]"
Keyword:AIA_GT1_PKT_ZCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT1_ZCB]"
Keyword:AIA_GT1_PKT_ZCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT1_ZCC]"

Keyword:AIA_IS2_ERRGAINY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2ERRGNY]"
Keyword:AIA_IS2_ERRGAINZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2ERRGNZ]"
Keyword:AIA_IS2_ERROFFY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2ERROFY]"
Keyword:AIA_IS2_ERROFFZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2ERROFZ]"

Keyword:AIA_IS2_PZTGAINA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2PZTGNA]"
Keyword:AIA_IS2_PZTGAINB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2PZTGNB]"
Keyword:AIA_IS2_PZTGAINC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2PZTGNC]"
Keyword:AIA_IS2_PZTOFFA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2PZTOFA]"
Keyword:AIA_IS2_PZTOFFB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2PZTOFB]"
Keyword:AIA_IS2_PZTOFFC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A2PZTOFC]"

Keyword:AIA_GT2_PKT_YCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT2_YCA]"
Keyword:AIA_GT2_PKT_YCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT2_YCB]"
Keyword:AIA_GT2_PKT_YCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT2_YCC]"
Keyword:AIA_GT2_PKT_ZCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT2_ZCA]"
Keyword:AIA_GT2_PKT_ZCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT2_ZCB]"
Keyword:AIA_GT2_PKT_ZCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT2_ZCC]"

Keyword:AIA_IS3_ERRGAINY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3ERRGNY]"
Keyword:AIA_IS3_ERRGAINZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3ERRGNZ]"
Keyword:AIA_IS3_ERROFFY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3ERROFY]"
Keyword:AIA_IS3_ERROFFZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3ERROFZ]"

Keyword:AIA_IS3_PZTGAINA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3PZTGNA]"
Keyword:AIA_IS3_PZTGAINB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3PZTGNB]"
Keyword:AIA_IS3_PZTGAINC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3PZTGNC]"
Keyword:AIA_IS3_PZTOFFA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3PZTOFA]"
Keyword:AIA_IS3_PZTOFFB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3PZTOFB]"
Keyword:AIA_IS3_PZTOFFC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A3PZTOFC]"

Keyword:AIA_GT3_PKT_YCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT3_YCA]"
Keyword:AIA_GT3_PKT_YCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT3_YCB]"
Keyword:AIA_GT3_PKT_YCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT3_YCC]"
Keyword:AIA_GT3_PKT_ZCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT3_ZCA]"
Keyword:AIA_GT3_PKT_ZCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT3_ZCB]"
Keyword:AIA_GT3_PKT_ZCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT3_ZCC]"

Keyword:AIA_IS4_ERRGAINY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4ERRGNY]"
Keyword:AIA_IS4_ERRGAINZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4ERRGNZ]"
Keyword:AIA_IS4_ERROFFY, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4ERROFY]"
Keyword:AIA_IS4_ERROFFZ, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4ERROFZ]"

Keyword:AIA_IS4_PZTGAINA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4PZTGNA]"
Keyword:AIA_IS4_PZTGAINB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4PZTGNB]"
Keyword:AIA_IS4_PZTGAINC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4PZTGNC]"
Keyword:AIA_IS4_PZTOFFA, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4PZTOFA]"
Keyword:AIA_IS4_PZTOFFB, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4PZTOFB]"
Keyword:AIA_IS4_PZTOFFC, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[A4PZTOFC]"

Keyword:AIA_GT4_PKT_YCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT4_YCA]"
Keyword:AIA_GT4_PKT_YCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT4_YCB]"
Keyword:AIA_GT4_PKT_YCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT4_YCC]"
Keyword:AIA_GT4_PKT_ZCOEF_A, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT4_ZCA]"
Keyword:AIA_GT4_PKT_ZCOEF_B, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT4_ZCB]"
Keyword:AIA_GT4_PKT_ZCOEF_C, float, variable, record, DRMS_MISSING_VALUE, "%f", "none", "[AGT4_ZCC]"