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

(A document in progress)

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 5/8/09] 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

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.

IMGAPID = ***AHAPID***, Image Application ID (int) {Level-1 also}
IMGFPT = the first packet time in "ISO" units constructed from ***AHTCS*** and ***AHTCSS***.
TLMDSNAM = Telemetry data series name (string) with first packet of image
TAPCODE = ***AHTAPC***, "Take a Picture code" (int)
BITSELID = ***AHBITID***, Bit select id, r (int)
LUTID = ***AHLUTID***, Lookup table id (int)
COMPID = the compression id; n, k; constructed from ***AHCPIDN*** and ***AHCPIDK***. (int)
FSN = the least significant 30b of ***AHTLFSN*** and is the Frame Serial Number (int) {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}
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) {Level-1 also}

CROPID is the id associated in the crop table with each image frame to generated onboard and will contain **FID**, the Frame Definition Block ID (int) found in the crop table {Level-1 also} to be extracted from the de-crop table during the jsoc processing. The Frame Definition Block ID identifies the Frame Definition Block (FDB) (generated and stored in the FDB database on the ground), from which the following can be obtained:

1.2 Region of Interest Keywords for *Level-0*

AFDBID = Frame Definition Block ID (8b; from FDB) (int)
ROI_SUM = SummingMode (4b; from FDB) for summing (int): 1x1, 2x2, 4x4 (= 0, 1, 2) {Level-1 also}
ROI_NWIN = Number of Windows (4b; from FDB) for number of Region Of Interest(s) (ROI) (int) (= 0, 1, 2)
ROI_NAX1 = Number of CCD Columns (16b; from FDB and de-crop table) for width of ROI 1 in pixels (int) {Level-1 also}
ROI_NAY1 = Number of CCD Rows (16b; from FDB and de-crop table) for height of ROI 1 in pixels (int) {Level-1 also}
ROI_NAX2 = Number of CCD Columns (16b; from FDB and de-crop table) for width of ROI 2 in pixels (int) {Level-1 also}
ROI_NAY2 = Number of CCD Rows (16b; from FDB and de-crop table) for height of ROI 2 in pixels (int) {Level-1 also}
ROI_LLX1 = CCD X-variable location of lower left corner pixel of ROI 1 (int) {Level-1 also}
ROI_LLY1 = CCD Y-variable location of lower left corner pixel of ROI 1 (int) {Level-1 also}
ROI_LLX2 = CCD X-variable location of lower left corner pixel of ROI 2 (int) {Level-1 also}
ROI_LLY2 = CCD Y-variable location of lower left corner pixel of ROI 2 (int) {Level-1 also}

Using the basic keywords above for the lower-left pixel of the 2 target regions of interest (ROI) and for the widths and heights of the regions, together with the lower-left corner pixel (LLC) information for the origin of the ROI with columns designated along the horizontal axis and rows along the vertical axis, the derived keywords below can be determined for each of the Region(s) of Interest (ROIs), 1 and 2. If more than one ROI is indicated, they most likely will be strips across the CCD. The summing mode keyword, **ROI_SUM**, will also be useful in reconstructing the image.

For **ROI_NWIN** [number of window ROIs (int):
= 0 for full (4kx4k) CCD;
= 1 for 1 ROI;
= 2 for 2 ROIs]

Derived Keywords (int):
NAXIS = 2, 2, 1 [corresponds to number of axes of images for **ROI_NWIN** = 0, 1, 2, respectively] {Level-1 also}

NAXIS1 = 4096, **ROI_NAX1,** total number of pixels in area {Level-1 also}
NAXIS2 = 4096, **ROI_NAY1,** 0 {Level-1 also}
[the first 2 values of **NAXIS#** correspond, respectively, to the axis length for **ROI_NWIN** = 0, 1 and the last value corresponds to the total number of pixels in ROIs for **NAXIS1** and to zero by definition for **NAXIS2** to not confuse simple FITS file readers for **ROI_NWIN** = 2.]

1.3 FITS, JSOC, and Image Statistics Keywords for *Level-0*

SIMPLE = "T" Boolean, always T for True, if conforming FITS file{Level-1 also}
BITPIX = "16" integer, Bits/pixel: 16, 32, -32, or -64 (negative for floating point) (HMI uses as 16 in L0) {Level-1 also}

BLANK = "-32768" value signaling undefined integer data {Level-1 also}
EXTEND FITS file may contain extensions {Level-1 also}
ORIGIN string, location where file was made, e.g., "SDO/JSOC-SDP" {Level-1 also}

DATE string, date and time of file creation in format: yyyy.mm.ddThh:mm:ss[.sss] in UTC {Level-1 also}

DATE-OBS = T_OBS – (EXPTIME/2.0) string, UTC, date when image observation started {Level-1 also}
T_OBS time**,** UTC**,** middle of the exposure time (shutter open start time + exposure time / 2. {Level-1 also}

EXPTIME floating point, calculated in double precision, exposure time in seconds {Level-1 also}

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.) {Level-1 also}

TELESCOP = "SDO/AIA" string, name of source telescope package {Level-1 also}
INSTRUME = "AIA_ATAi" string, name of instrument (within telescope package) where i = camera number = 1, 2, 3, or 4 {Level-1 also}

INT_TIM = ***AICFGDL4*** **-** ***AICFGDL3*** (+ rollover) double, interval time between readout delay and shutter operation delay plus rollover (i.e., CCD integration duration) {Level-1 also}

WAVELNTH = ***AIAWVLEN*** = AIA_IMG_WAVELENGTH wavelength of this observation, {Level-1 also}, with 2 each for camera (telescope) 1, 2, 4, and 4 each for camera 3 (as a float in nm (Phil)), and with mapping reference number of each wavelength in ( ):

= 33.5 (0), 13.1 (1) for camera 1
= 21.1 (2), 19.3 (3) for camera 2
= 160.0 (4), 170.0 (5), 450.0 (6), 17.1 (7) for camera 3
= 30.4 (8), 9.4 (9) for camera 4

WAVEUNIT = "nm" Wavelength unit: nm {Level-1 also}
WAVE_STR = string(**WAVELNTH**+***AIFILTYP***) Wavelength Filter Position (with no decimal in **WAVELNTH**)

{Level-1 also}

DATAVALS int, Actual number of data values in image {Level-1 also}
MISSVALS int, Missing values: **TOTVALS – DATAVALS** {Level-1 also}
TOTVALS int, Expected number of data values (pixels) {Level-1 also}
PERCENTD int, Actual number of data values in image as percent of the total: (**DATAVALS/TOTVALS**) *100.0 {Level-1 also}
DATAMIN short, minimum value from all pixels {Level-1 also}
DATAMAX short, maximum value from all pixels {Level-1 also}
DATAMEDN short, median value from all pixels {Level-1 also}
DATAMEAN float, mean value for all pixels {Level-1 also}
DATARMS float, RMS deviation from the mean value of all pixels {Level-1 also}
DATASKEW float, Skewness from the mean value of all pixels {Level-1 also}
DATAKURT float, Kurtosis of all pixels {Level-1 also}
COMMENT Comment {Level-1 also}
HISTORY ASCII history record, one or more, usually by SSW {Level-1 also}
END {FITS required} {Level-1 also}

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

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) {Level-1 also}
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 {Level-1 also as **APER_SEL**}
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 {Level-1 also as **FOCUSPOS**}
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 {Level-1 also as **FILWLSEL**}
AIMGSHCE = AIA_IMG_SH_CMDED_EXPOSURE	commanded exposure for image {Level-1 also as **CMDEXPT**}
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” {Level-1 also as **FILT_TYP**}
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	"dark" (0) or "light" (1) shutter type {Level-1 also as **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
AIAGP7	= AIA_IMG_GP7,	general purpose register word 7
AIAGP8	= AIA_IMG_GP8,	general purpose register word 8
AIAGP9	= AIA_IMG_GP9,	general purpose register word 9
AIAGP10	= AIA_IMG_GP10,	general purpose register word 10
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
ACSUM027	= APID027_CHECKSUM,	ISP checksum (last of ISP telemetry words)

2. 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 map created, 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 de-spiked, or replaced, using the bad pixel map; 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

BSCALE		Multiplier for data values
BZERO		Offset for data values
QUALLEV0		int, Level-0 quality word in Level-0
QUALITY		int, Level-1 quality word
SUM_MODE	= **AFDBSM**	int, Summing Mode
APER_SEL	= ***AIASEN***	long int, Aperture selection encoder reading
FILWLSEL	= ***AIWEN***	int, Filter wheel selector encoder reading (0-255)
FILT_TYP	= ***AIFILTYP***	string, filter type of ‘thick’, ‘thin’, or ‘open’
IMG_TYP	= ***AIMGTYP***	string, image type of ‘light’ or ‘dark’
CMDEXPT	= ***AIMGSHCE***	float, Commanded exposure

FOCUSPOS	= ***AIFCPS***	long int, Focus position, i.e., currently loaded focus target value
CUT_OUT		int, Is this a cut out?, 0 = no, 1=yes
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		Temperature at CCD
TEMPCEB		Temperature at common electronics box
TEMPSMIR		Temperature at secondary mirror
TEMPPMIR		Temperature at primary mirror
PZTOFFS1		PZT offset
PZTOFFS2		PZT offset
PZTOFFS3		PZT offset
DARK		string, Name of dark processed image
DARK_VER		float, Version number of dark image
FLAT		string, Name of processed flat field image
FLAT_VER		float, Version number of flat field image
FLAT_FIELD		Set when applied to image
LEAP_SEC		Current number of leap seconds to add to TAI
DN_GAIN		float, Value of DN per electron gain factor
DN_GN_V		float, Version number of DN gain value
EFF_AREA		float, Value of effective area in cm^2
EFF_AR_V		float, Version number of effective area value
ATT_PT_V		float, Version number of S/C camera attitude pointing
FILENAME		Name of data file
LVL_NUM		Level number of image
REL_VER		Relative version number of reformatter, data, and/or metadata
PIPELNVR		Pipeline version”
SCIRFBSV		Science reference bore sight version number

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 guidelines in Phil Scherrer's "JSOC Keywords used for metadata" document [current update 5/8/09]. Please refer to this document, which gives 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. 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
CRPIX*j*	Reference pixel along array axis ***j***, with the first pixel numbered 1 (not 0).
CRVAL*i*	Physical value along image axis ***i*** at the center of the pixel.
CDELT*i*	Pixel spacing per index value along image axis ***i***
CUNIT*i*	Physical units for position on image axis ***i***
CROTA*j*	Rotation needed for array axes to get to image axes (in degrees).
CRDER*i*	Estimate of random error in coordinate ***i*** expressed in **CUNIT*i***.
CSYSER*i*	Estimate of systematic error in coordinate ***i*** expressed in **CUNIT*i***.
R_SUN	Radius of the Sun's image in pixels, for the visible light (float)
DSUN_OBS	Distance from Sun's center to SDO in m (float)
RSUN_REF	Radius of the Sun in m, (float)
SAT_ROT	Position angle of solar pole wrt the SDO Z axis (float, degrees)
INST_ROT	Rotation of the camera from the SDO Z axis (float, degrees) (**CROTA*j*** will be the sum **SAT_ROT** + **INST_ROT**)
IM_SCALE	Arc-sec per CCD pixel default value for the particular instrument (float). This value will be used for the estimate of CDELT for AIA.
X0	X-axis location of solar disk center in pixels, start 0.0 (float)
Y0	Y-axis location of solar disk center in pixels, start 0.0 (float)
XCEN1	X co-ordinate of ROI 1 array center (float)
YCEN1	Y co-ordinate of ROI 2 array center (float)
XCEN2	X co-ordinate of ROI 1 array center (float)
YCEN2	Y co-ordinate of ROI 2 array center (float)

where **a** = **CROTA2** for ROI 1,

XCEN1 = CRVAL1 + CDELT1*cos(a)*((ROI_NAX1+1)/2 – CRPIX1)
– CDELT2*sin(a)*((ROI_NAY1+1)/2 – CRPIX2)
YCEN1 = CRVAL2 + CDELT1*sin(a)*((ROI_NAX1+1)/2 – CRPIX1)
+ CDELT2*cos(a)*((ROI_NAY1+1)/2 – CRPIX2)

and for ROI 2,

XCEN2 = CRVAL1 + CDELT1*cos(a)*((ROI_NAX2+1)/2 – CRPIX1)
– CDELT2*sin(a)*((ROI_NAY2+1)/2 – CRPIX2)
YCEN2 = CRVAL2 + CDELT1*sin(a)*((ROI_NAX2+1)/2 – CRPIX1)
+ CDELT2*cos(a)*((ROI_NAY2+1)/2 – CRPIX2)

FOVX1 = CDELT1 * ROI_NAX1	ROI 1 X-Axis Field of View in CUNITi
FOVY1 = CDELT2 * ROI_NAY1	ROI 1 Y-Axis Field of View in CUNITi
FOVX2 = CDELT1 * ROI_NAX2	ROI 2 X-Axis Field of View in CUNITi
FOVY2 = CDELT2 * ROI_NAY2	ROI 2 Y-Axis Field of View in CUNITi
HELIOCN1	Heliocentric coordinates (6) - Rock (TBD)
HELIOCN2	
HELIOCN3	
HELIOCN4	
HELIOCN5	
HELIOCN6	
GEOCEN1	Geocentric coordinates (6) - Rock (TBD)
GEOCEN2	
GEOCEN3	
GEOCEN4	
GEOCEN5	
GEOCEN6	
CARRINGT	Carrington keyword - Rock (TBD)

3. Draft of Level 0 and 1 Headers with Sample Keywords

Level 0		Level 1	Brief Description	Sample Keyword	Section
SIMPLE	=	**SIMPLE**		T	1.3
BITPIX	=	**BITPIX**		16	1.3

BLANK	=	**BLANK**	-32768	1.3 (definition)
NAXIS	=	**NAXIS**	2	1.2
NAXIS1	=	**NAXIS1**	4096	1.2
NAXIS2	=	**NAXIS2**	4096	1.2
EXTEND	=	**EXTEND**	T	1.3
DATE-OBS	=	**DATE-OBS**	‘2008-01-08T18:56:00.005’	1.3, App. 1
ORIGIN	=	**ORIGIN**	‘SDO/JSOC-SDP’	1.3
DATE	=	**DATE**	‘2008-01-08T23:57:38’	1.3
TELESCOP	=	**TELESCOP**	‘SDO/AIA’	1.3
INSTRUME	=	**INSTRUME**	‘AIA_ATA3’	1.3
T_OBS	=	**T_OBS**	**‘**2008-01-08T18:56:03.005’	1.3, App. 1
CAMERA	=	**CAMERA**	3	1.1 (Header)
EXPTIME	=	**EXPTIME**	5.039	1.3, App. 1
EXPSDEV	=	**EXPSDEV**	0.019	1.3, App. 1
INT_TIME	=	**INT_TIME**	[= ***AICFGDL4*** **-** ***AICFGDL3*** (+ rollover), interval time between readout delay and shutter operation delay plus rollover]	1.3
WAVELNTH	=	**WAVELNTH**	17.1	1.2, 1.3
WAVEUNIT	=	**WAVEUNIT**	‘nm’	1.3
WAVE_STR	=	**WAVE_STR**	‘17101’	1.3
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	=	**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	=	**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)		1.3
DATAVALS =	**DATAVALS**	Actual number of data values in image		1.3
MISSVALS =	**MISSVALS**	Missing values: TOTVALS – DATAVALS		1.3
PERCENTD =	**PERCENTD**	Percentage of good data	100.0	1.3
DATAMIN =	**DATAMIN**		81.0	1.3
DATAMAX =	**DATAMAX**		4100.0	1.3
DATAMEDN =	**DATAMEDN**		218.345670	1.3
DATAMEAN =	**DATAMEAN**		218.345670	1.3
DATARMS =	**DATARMS**		22.687300	1.3
DATASKEW =	**DATASKEW**		218.345670	1.3
DATAKURT =	**DATAKURT**		218.345670	1.3
ROI_SUM =	**ROI_SUM**			1.2
ROI_NWIN		Number of windows or ROIs	0	1.2
ROI_NAX1 =	**ROI_NAX1**		4096	1.2
ROI_NAX1 =	**ROI_NAX1**		4096	1.2
ROI_NAX2 =	**ROI_NAX2**		0	1.2
ROI_NAX2 =	**ROI_NAX2**		0	1.2
ROI_LLX1 =	**ROI_LLX1**		0	1.2
ROI_LLY1 =	**ROI_LLY1**		0	1.2
ROI_LLX2 =	**ROI_LLX2**		0	1.2
ROI_LLY2 =	**ROI_LLY2**		0	1.2
ISPSNAME		ISP Series Name	aia.lev0_isp_0011	1.4
ISPPKTIM		Packet time	‘2008-01-08T18:56:01.000’	1.4
ISPPKTVN		Packet version number	‘001.1’	1.4
AIVNMST		ISP version number		1.4 (ISP)
AIMGOTS		seconds time tag		1.4 (ISP)
ASQHDR		**[=** ***ASQTNUM*** (2b) {=Camera} + ***ASQFSN*** (30b) {=FSN}]		1.4 (ISP)
ASQTNUM		[= Camera – 1]		1.4 (ISP)
ASQFSN		[another FSN]		1.4 (ISP)
AIAHFSN		the FSN of the image from which the histogram data was obtained		1.4 (ISP)
AECDELAY		time since image used for AEC		1.4 (ISP)
AIAECTI		Automatic Exposure Control (AEC) tables used with this image		1.4 (ISP)

AIASEN	=	**APERT_SEL**	aperture selection encoder reading	1.4 (ISP)
AIFDBID			[another FDB ID]	
AIMGOTSS			subseconds time tag	1.4 (ISP)
AIFCPS	=	**FOCUSPOS**	currently loaded target value	1.4 (ISP)
AIFTSWTH			filter switch threshold for 131A wavelength (exposure)	1.4 (ISP)
AIFRMLID			framelist id for this image	1.4 (ISP)
AIFTSID			framelist timeline schedule (FTS) id	1.4 (ISP)
AIHISMXB			bin number of maximum of standard histogram for previous image in this wavelength used for the current AEC	1.4 (ISP)
AIHIS192			cumulative histogram value at bin #192	1.4 (ISP)
AIHIS348			cumulative histogram value at bin #348	1.4 (ISP)
AIHIS604			cumulative histogram value at bin #604	1.4 (ISP)
AIHIS860			cumulative histogram value at bin #860	1.4 (ISP)
AIFWEN	=	**FILWLSEL**	filter wheel selector encoder reading	1.4 (ISP)
AIMGSHCE	=	**COMDEXPT**	5.0	1.4 (ISP)
AECTYPE			AEC table for current wavelength	1.4 (ISP)
AECMODE			mode of AEC	1.4 (ISP)
AISTATE			ISS on/off	1.4 (ISP)
AIAECENF			AEC enable flag for this image	1.4 (ISP)
AIFILTYP	=	**FILT_TYP**	01	1.4 (ISP)
AIMSHOBC			shutter timer register value	1.4 (ISP)
AIMSHOBE			shutter timer register value	1.4 (ISP)
AIMSHOTC			shutter timer register value	1.4 (ISP)
AIMSHOTE			shutter timer register value	1.4 (ISP)
AIMSHCBC			shutter timer register value	1.4 (ISP)
AIMSHCBE			shutter timer register value	1.4 (ISP)
AIMSHCTC			shutter timer register value	1.4 (ISP)
AIMSHCTE			shutter timer register value	1.4 (ISP)
AICFGDL1			mechanism delay 1	1.4 (ISP)
AICFGDL2			clear table delay	1.4 (ISP)
AICFGDL3			shutter operation delay	1.4 (ISP)
AICDGDL4			readout delay	1.4 (ISP)
AIFOENFL			flag to indicate if focus table used or not	1.4 (ISP)
AIMGFSN			position within framelist of this frame	1.4 (ISP)

AIMGTYP =	**IMG_TYPE**		‘LIGHT’	1.4 (ISP)
AIAWVLEN		(coded wavelength for this observation)		1.4 (ISP)
AIAGP1		general purpose register word 1		1.4 (ISP)
AIAGP2		general purpose register word 2		1.4 (ISP)
AIAGP3		general purpose register word 3		1.4 (ISP)
AIAGP4		general purpose register word 4		1.4 (ISP)
AIAGP5		general purpose register word 5		1.4 (ISP)
AIAGP6		general purpose register word 6		1.4 (ISP)
AIAGP7		general purpose register word 7		1.4 (ISP)
AIAGP8		general purpose register word 8		1.4 (ISP)
AIAGP9		general purpose register word 9		1.4 (ISP)
AIAGP10		general purpose register word 10		1.4 (ISP)
AGT1SVY		GT 1 Sun vector in y direction		1.4 (ISP)
AGT1SVZ		GT 1 Sun vector in z direction		1.4 (ISP)
AGT2SVY		GT 2 Sun vector in y direction		1.4 (ISP)
AGT2SVZ		GT 2 Sun vector in z direction		1.4 (ISP)
AGT3SVY		GT 3 Sun vector in y direction		1.4 (ISP)
AGT3SVZ		GT 3 Sun vector in z direction		1.4 (ISP)
AGT4SVY		GT 4 Sun vector in y direction		1.4 (ISP)
AGT4SVZ		GT 4 Sun vector in z direction		1.4 (ISP)
AIMGSHEN		shutter selector encoder reading		1.4 (ISP)
	BSCALE	multiplier for data values		2.1
	BZERO	offset for data values		2.1
	CUT_OUT	Is this a cut out?, 0 = no, 1=yes		2.1
	DATAP01		722.00000	2.1
	DATAP10		726.00000	2.1
	DATAP25		730.00000	2.1
	DATAP75		1094.0000	2.1
	DATAP90		1368.0000	2.1
	DATAP95		1662.0000	2.1
	DATAP98		2282.0000	2.1
	DATAP99		2826.0000	2 .1
	TEMPCCD	Temp. at CCD	-60.5	2.1
	TEMPCEB	Temp. at common electronics box	-30.3	2.1

TEMPSMIR	Temp. at secondary mirror	17.9	2.1
TEMPPMIR	Temp. at primary mirror	25.2	2.1
PZTOFFS1	PZT offset		2.1
PZTOFFS2	PZT offset		2.1
PZTOFFS3	PZT offset		2.1
DARK	Name of dark processed image		2.1
DARK_VER	Version number of dark image		2.1
FLAT	Name of processed flat field image		2.1
FLAT_VER	Version number of flat field image		2.1
FLAT_FLD	Set when applied to image		2.1
LEAP_SEC	Current number of leap seconds to add to TAI		2.1
DN_GAIN	Value of DN per electron gain factor		2.1
DN_GN_V	float, Version number of DN gain value		2.1
EFF_AREA	Value of effective area in cm^2		2.1
EFF_AR_V	Version number of effective area value		2.1
ATT_PT_V	Version number of S/C camera attitude pointing		2.1
FILENAME	Name of data file		2.1
LVL_NUM	Level number of image		2.1
REL_VER	Relative version number of reformatter, data, and/or metadata		2.1
PIPELNVR	Pipeline version”		2.1
SCIRFBSV	Science reference bore sight version number		2.1
FOVX1	Field of View in CUNITi	1020	2.2
FOVY1	Field of View in CUNITi	1020	2.2
FOVX2	Field of View in CUNITi	0	2.2
FOVY2	Field of View in CUNITi	0	2.2
CTYPE2		‘SOLARY’	2.2
CROTA2		0.0	2.2
CDELT1		0.5	2.2
CDELT2		0.5	2.2
CRPIX1		-357.291	2.2
CRPIX2		850.624	2.2
CRVAL1		0.0	2.2
CRVAL2		0.0	2.2
CUNIT1		‘arcsec’	2.2

	CUNIT2		‘arcsec’	2.2
	CRDER1	Estimate of random error in 1 as CUNITi		2.2
	CRDER2	Estimate of random error in 2 as CUNITi		2.2
	CSYSER1	Estimate of systematic error in 1 as CUNITi		2.2
	CSYSER2	Estimate of systematic error in 2 as CUNITi		2.2
	R_SUN	Radius of the Sun’s image in pixels, for the visible light		2.2
	DSUN_OBS	Distance from Sun’s center to SDO in m		2.2
	RSUN_REF	Radius of the Sun in m,	960.0	2.2
	SAT_ROT	Position angle of solar pole wrt the SDO Z axis		2.2
	INST_ROT	Rotation of the camera from the SDO Z axis		2.2
	IM_SCALE		0.5	2.2
	X0	X-axis of solar disk center,	2047.0	2.2
	Y0	Y-axis of solar disk center,	2047.0	2.2
	XCEN1	X of ROI 1 array center,	434.895	2.2
	YCEN1	Y of ROI 1 array center,	369.062	2.2
	XCEN2	X of ROI 2 array center,	-434.895	2.2
	YCEN2	Y of ROI 2 array center,	-369.062	2.2
	HELIOCN1	Heliocentric coordinates (6) - Rock (TBD)		2.2
	HELIOCN2			2.2
	HELIOCN3			2.2
	HELIOCN4			2.2
	HELIOCN5			2.2
	HELIOCN6			2.2
	GEOCEN1	Geocentric coordinates (6) - Rock (TBD)		2.2
	GEOCEN2			2.2
	GEOCEN3			2.2
	GEOCEN4			2.2
	GEOCEN5			2.2
	GEOCEN6			2.2
	CARRINGT	Carrington keyword - Rock (TBD)		2.2
COMMENT =	**COMMENT**		Comment	1.3
HISTORY =	**HISTORY**		ASCII history record, one or more	1.3
END =	**END**		End of file	1.3

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

(from Rock Bush, 6/02/09)

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	Image Status Packet Missing; (FSN != ASQFSN) or ASQFSN missing
5	
6	
7	
8	MISSVALS > 0
9	MISSVALS > 0.01*TOTVALS
10	MISSVALS > 0.05*TOTVALS
11	MISSVALS > 0.25*TOTVALS
or	
8	bits 8 to 11; 4 bit integer quantity
9	if MISSVALS == 0; == 0
10	if MISSVALS != 0; == 0.84*LOG(MISSVALS/TOTVALS) + 15
11	
12	
13	
14	
15	

```
AIA specific
16
17          ISS Loop Open;      AISTATE != 0; AISTATE == "OPEN"
18          9.4nm Mech Error;  AIAWVLEN == 9 &&
                                {(AIFILTYP == 0 && AIFWEN != 269 && AIFWEN != 270)
                                || (AIFILTYP == 1 && AIFWEN !=  11 && AIFWEN !=  12)
                                || (AIFILTYP == 2 && AIFWEN !=  74 && AIFWEN !=  75)}
19          13.1nm Mech Error; AIAWVLEN == 1 &&
                                {(AIFILTYP == 0 && AIFWEN != 269 && AIFWEN != 270)
                                || (AIFILTYP == 1 && AIFWEN !=  11 && AIFWEN !=  12)
                                || (AIFILTYP == 2 && AIFWEN !=  74 && AIFWEN !=  75)}
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)
                                || (AIFILTYP == 1 && AIFWEN !=  11 && AIFWEN !=  12)
                                || (AIFILTYP == 2 && AIFWEN !=  74 && AIFWEN !=  75)}
22          21.1nm Mech Error; AIAWVLEN == 2 && {AIASEN !=  24
                                || (AIFILTYP == 0 && AIFWEN != 203 && AIFWEN != 204)
                                || (AIFILTYP == 1 && AIFWEN != 137 && AIFWEN != 138)
                                | (AIFILTYP == 2 && AIFWEN !=  74 && AIFWEN !=  75)}
23          30.4nm Mech Error; AIAWVLEN == 8 &&
                                {(AIFILTYP == 0 && AIFWEN != 203 && AIFWEN != 204)
                                || (AIFILTYP == 1 && AIFWEN != 137 && AIFWEN != 138)
                                || (AIFILTYP == 2 && AIFWEN !=  74 && AIFWEN !=  75)}
24          33.5nm Mech Error; AIAWVLEN == 0 &&
                                {(AIFILTYP == 0 && AIFWEN != 203 && AIFWEN != 204)
                                || (AIFILTYP == 1 && AIFWEN != 137 && AIFWEN != 138)
                                || (AIFILTYP == 2 && AIFWEN !=  74 && AIFWEN !=  75)}
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
```

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	"74 or 75"	"Don't check"
131	0	"269 or 270"	"Don't check"
	1	"11 or 12"	"Don't check"
	2	"74 or 75"	"Don't check"
171	0	"203 or 204"	"Don't check"
	1	"11 or 12"	"Don't check"
	2	"Don't Check"	"Don't check"

304	0	"203 or 204"	"Don't check"
	1	"137 or 138"	"Don't check"
	2	"74 or 75"	"Don't check"
335	0	"203 or 204"	"Don't check"
	1	"137 or 138"	"Don't check"
	2	"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	"74 or 75"	6
211	0	"203 or 204"	24
	1	"137 or 138"	24
	2	"74 or 75"	24

****

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

ASQFSN	AIA_SEQ_FRAME_SN	longlong
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
AIFOENFL	AIA_IMG_FOCUS_ENA_FLAG	short

****

AIAWVLEN lookup values:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

{ 33.5, 13.1, 21.1, 19.3, 160.0, 170.0, 450.0, 17.1, 30.4, 9.4 }