Title: SECCHI FITS Header Keyword Definition

Interface Category: Ground Software

Applicable Subsystems: SECCHI Ground Data Systems, SECCHI Flight Software, SECCHI I&T Team

Purpose: This SICM defines the data type, range of values, and description for each of the keywords that will be included in the SECCHI FITS image header. The SECCHI science team, flight software team, and I&T lead will review this to make sure that keywords requiredfor instrument testing, instrument calibration, hardware-in-the-loop mission simulations, and science operations, are present. (Note: The content of this document is the same as the document titled “Definition of SECCHI Level 0.5 FITS Header” Or the appendix of the SECCHI Data Management Plan.)

Approved by:

Organization	Point of Contact / Position	Approval Date
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Revision History

Rev	Document Date	Author	Change Description
0 d1	11/9/01	Nathan Rich NRL / Interferometrics (202) 404-1408 *Nathan.rich@nrl.navy.mil*	Initial Release as SICM 06-0020.
0 d2	1/16/02	Nathan Rich	Released for comment
0 d3	9/30/02	Nathan Rich	Incorporate FITS definition with comments received into SICM. Renumbered/released as SICM 07-0007
0 d4	10/29/02	Nathan Rich	Make consistent with SECCHI Data Processing Plan appendix
0 d5	11/7/02	Nathan Rich	Modify filename; add CCD eval. Keywords; other changes
0 d6	12/19/03	Nathan Rich	Added or changed FILEORIG, DATE-OBS, GAINMODE, OFFSET, WGA_FILE, CLR_TBL, READ_TBL, LAMP, POLAR, EXPCMD, EXPCLRO, CLR_TIME, READTIME, JITRMAX, PCj_i
0 d7	7/30/04	Nathan Rich	Compare to FSW image header

DEFINITION OF SECCHI Level 0.5 FITS HEADER

OVERVIEW

MAIN HEADER

The items in the box are part of the pre-flight image header. Each group of keywords is to be added as they become applicable.

1. Minimum Header:
All images taken with SECCHI cameras should have this header information, from camera level testing onward.

2. Preflight Only:
Only images taken before launch will have these keywords.

3. Misc. Camera/CCD values:
Values specific to CCD and camera characteristics. Should be in all images from camera level testing onward.

4. Used from telescope level testing onward:
These keywords are applicable only if mechanisms apart from the camera are used in taking an exposure.

5. Housekeeping Parameters:
Ancillary information indirectly related to an image.

6. Software-Dependent Values:
These values are dependent on on-board image processing, nominally the SECCHI Flight Software.

7. Computed from information external to the image, on the ground:
These values have ancillary information about spacecraft position, attitude, etc. This includes coordinate system definition.

8. Computed from image values, on the ground:
Values computed from the image but not in the FSW are included here.

9. HISTORY:
Examples of history field values.

10. Simulation Images
Values used for images generated from simulations.

SECCHI FITS EXTENSION

Information about individual exposures used to compute a single image from a sequence is contained in an ASCII table extension to the FITS header.

11. Extension Table Column (Field) Definitions
These are the values that will be recorded for each exposure.

12. Keywords for FITS Extension
Each column in a FITS extension has its own set of keywords to define the type of value.

TABLE DESCRIPTION

The following tables have 4 columns: KEYWORD, TYPE, VALUES, and DESCRIPTION.

KEYWORD gives the name of the FITS keyword and may be up to 8 characters.

TYPE refers to the data type of the header value:

S String

I Integer

R Real

L Logical

The size of the data depends upon the data type. For example S*2 is a 2 character string, whereas I*2 is a 2 byte integer (16 bits).

VALUES shows the range of values that the KEYWORD can take.

DESCRIPTION gives a short description of the keyword. At the end of the description is a reference to a Flight Software (FSW) requirement, if any. (NOTE: FSW requirement numbers not up-to-date as of 9/10/02.)

References

1. "Coordinate Systems for Solar Image Data", http://orpheus.nascom.nasa.gov/~thompson/papers/coordinates.ps
2. "Definition of the Flexible Image Transport System (FITS)", http://archive.stsci.edu/fits/fits_standard/
3. "Definition of LASCO Level 1 FITS Header Keywords", http://lasco-www.nrl.navy.mil/level_1/level_1_keywords.html
4. "SSW Keyword/Tag Definitions", http://www.lmsal.com/solarsoft/ssw_standards.html
5. "A User's Guide for the Flexible Image Transport System (FITS)", http://fits.gsfc.nasa.gov/documents.html#Uguide
6. Detailed proposal for representing world coordinates in FITS (http://www.aoc.nrao.edu/~egreisen/inFITS.html):

6.1. *Representations of world coordinates in FITS* by Greisen and Calabretta, 31-December-2001.

6.2. *Representations of celestial coordinates in FITS* by Calabretta and Greisen, 12-December-2001.

6.3. *Representations of spectral coordinates in FITS* by Greisen and Valdes, 31-December-2001

7. SOHO object list http://Orpheus.nascom.nasa.gov/object.dat

MAIN HEADER

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
			Minimum Header	
SIMPLE	L	T	Conforms to FITS standard	FITS
BITPIX	I*2	16,32,-32,-64	Number of bits per pixel	FITS
NAXIS	I*2	0,2,3	Number of axes in the image (0 indicates header only)	FITS
NAXIS1	I*2	Positive	Length of the first axis (columns,x)	FITS
NAXIS2	I*2	Positive	Length of the second axis (rows,y)	FITS
DATE	S*23	Any	Date of file generation, in CCSDS standard format (UTC): "1996-05-21T17:28:48.208"	IDL
FILENAME	S*23	-->	Name of the FITS file: yyyymmdd_hhmmss_LTTS.fts Format as follows: S = Spacecraft (A,B,C)(c is for anything that is not associated with one or the other s/c); TT = a string representing telescope or camera: eu=EUVI, c1=COR1, c2=COR2, h1=HI1, h2=HI2, gt = GT, tk=Talktronics, ra=RAL development camera, …; L = a digit representing processing level(0,1,2,…), or 'r' for quick-look or 'p' for pre-flight The rest is year, month, day, hour, minute, second (equivalent to DATE-OBS)	SEB_hdr: derived from actualExpTime, platformID, telescopID
FILEORIG	S*12	Any	YMDDaaaa.MSD, where Y = LSD of year e.g. 2002 = '2'; M = Month (1 = Jan, 2 = Feb, … ,A=Oct, B= Nov, C = Dec); DD = Day of Month; aaaa = image counter & sequence number in base 36; SA = APID coding (actual ApID hex - 0x400); T = telescope (3=EUVI 2=COR1 1=COR2 5=HI1 4=HI2; for S/C B add 5)	SEB_hdr: filename
DATE-OBS	S*23	Any	Date and time of the start of the (first) opening of the shutter or CCD readout, whichever comes first (UTC): 2006-05-20t00:40:05.407 (accuracy level of time known from HISTORY or COMMENT)	SEB_hdr: derived from actualExpTime or ??? for dark

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
EXPTIME	R*4	Any	Time between open and close of shutter (seconds); if > 1 exposure, then the sum (individual exptimes in header extension) (FSW 410, 423)	SEB_hdr: (actualExpDuration + actualExpDuration_2) * 4e-6 or ??? for dark
OBSRVTRY	S*8	STEREO[AB]	Name of the satellite. (Replaces TELESCOP keyword.)	SEB_hdr: derived from platformID
DETECTOR	S*12	EUVI, COR1, COR2, HI1, HI2,…	Name of the telescope or devel. camera within SECCHI: Talktronics, RAL, EUVI, COR1, COR2, HI1, HI2, GT	SEB_hdr: derived from telescopID
SUMMED	I*2	1,2,4	Total Number of rows and columns being summed on the CCD or SEB or ground	SEB_hdr: depends on sumrow, sumcol, sebxsum, sebysum
CCDSUM	R*4	Any	(sumrow + sumcol)/2.0	SEB_hdr: derived from sumrow(col)
IPSUM	R*4	Any	(sebxsum + sebysum)/2.0	SEB_hdr: derived from sebx(y)sum
P1(2)COL	I*2	1..?	CCD column number of start(end) of image; 1-?? are underscan pixels, ??-???? are imaging pixels, ???? - ????? are overscan pixels (FSW 212,431) (NOTE: First column is 1, not 0.)	SEB_hdr: p1(2)col
P1(2)ROW	I*2	1..?	CCD row number of start(end) of image; 1-???? are imaging rows, ????-????? are overscan rows (FSW 212,431)	SEB_hdr: p1(2)row
INSTRUME	S*8	SECCHI	Name of the instrument	constant
VERSION	R*4	Any	Version number of FITS header (carry from camera testing through flight)	cvs and IDL procedure
ORIGIN	S*8	NRL GSFC UBHAM LMSAL APL ...	Institution where FITS file was created	
BUNIT	S*20	DN DN/s UNITLESS MSB etc.	Physical unit of array values (after BZERO and BSCALE, if present, are applied)	
BLANK	I*1	0	Value of missing or masked data.	constant
OBS_PROG	S*20?	List	Description of configuration or type of measurement (ie, 'Quantum E', 'Chrg Coll E', …) or name of proc.	STOL or planning tool?
COMMENT	S*7280	Any	*Comments. Can be repeated*	*varied*
COMMENT	S*7280	→	Describe method of deriving DATE-OBS	IDL pro
COMMENT	S*7280	→	'FITS coordinate for center of 1024x1024 image is (512.5,512.5).'	constant
HISTORY	S*7280	Any	*History. Can be repeated.*	*IDL pros*

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
END			Last keyword in the FITS header	na
			Pre-flight only	
OBSERVER	S*20	List	Character string identifying who acquired the data associated with the header	user input
OBJECT	S*20	?	Object observed; maintain constantly updated list of configurations which will be displayed in a menu?	user input
WGA_FILE	S*20	*.wga	Filename of list of waveforms and tables loaded	swire
COMMENT	S*80	Any	Observer will have ability to input comments into FITS header	user input
			Camera/CCD values (if applicable)	
CCD_ID	S*?	Any	Identification number of CCD	user input
CAMERA	S*?	List	Model of camera electronics used to acquire image (ie, 'Talktronics IDS-2100', 'RAL Prototype', 'RAL DM')	user input
DIODSTEP	I*2	Any	Step of instrument used to control diode wavelength, from which the actual diode wavelength is derived	user input
DIODWVLN	?	?	Wavelength of diode in Angstroms … or color?	user input
DIODFILE	S*?	Any	Name of file which contains diode counts	user input
CS	R*4	Any	Synchrotron current (units?)	user input
SR	I*4	Any	Grating number of …?	user input
FILTER	S*8	List	Filter between CCD and source	user input
DIODCOAT	I*2?	List?	Diode coating	user input
DIODDESC	S*?	List	Description of diode used (ie, 'AXUV-100AL')	user input
CONTAMIN	L	T(F)	CCD is considered contaminated	user input
DCS	R*4	Any	Synchrotron current at diode measurement	user input
VOLTAGE	R*4	Any	??	???
CCD_COAT	S*20	List	Description of coating on CCD (ie, 'None', 'AR', ..)	user input
OFFSET	I*2	-512 to 511	Offset setting of camera	SEB hdr: offset
GAIN	I*12	0-255	Video gain setting of camera (FSW 431?)	SEB hdr: gain
DITHER	L	T(F)	Dithering readout mode is on(off)	???
READPORT	S*1	A,B	CCD readout port (FSW 411,431)	na
GAINMODE	I*1	0, 1	CCD camera FPGA gain mode (0 high, 1 low) (FSW 434)?	SEB hdr: gainMode

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
TEMP_CCD	R*4	Any	Temperature of the CCD (degrees C)	HKP tlm
WAVEFILE	S*12	Any.img	Name of waveform table used by FSW.	???
READFILE	S*12	Any.img	Name of readout table file used by FSW.	???
CLR_TBL	I*1	0-7	Table used for clear (key in WGA file)	SEB hdr: clrTableID
READ_TBL	I*1	0-7	Table used for readout (key in WGA file)	SEB hdr: readoutTableID
			Used from telescope level testing onward	
FILTER	S*4	OPEN, S1, S2, DBL	Position of the EUVI filter (FSW 410,411,442)	SEB hdr: derived from actualFilterPosition
ENCODERF	I*2	0..179	Encoder reading from filter wheel	SEB hdr: actualFilterPosition
POLAR	R*4	0..357.5	Position of the polarizer, degrees from vertical WRT to CCD "North,"; if the image is computed from a sequence, then this is the sum of the positions during the sequence (FSW 410,411,442) (Polarizer steps in increments of 2.5 °, or 144 positions.)	SEB hdr: derived from actualPolarPosition
ENCODERP	I*2	0..143	Encoder reading from polarizer (0..143) or quadrant selector (0..23)	SEB hdr: actualPolarPosition
SECTOR	I*2	171 195 284 304	Sector (wavelength in Angstroms) of EUVI exposure (FSW 411,424?,442)	SEB hdr: derived from actualpolarposition
WAVELNTH	R*4	8 discrete values	Wavelength (in Angstroms) of peak of the bandpass	Ground table
SHUTTDIR	S*3	CW CCW	Direction of motion of the shutter from the CCD's POV (FSW 424?,442?)	SEB hdr: derived from actualshutterdirection and ground table
LED	S*1	N,R,P,B	Description of LED used (None, Red, Violet, Purple, Blue) (FSW 411,424?)	SEB hdr: derived from cmdLEDMode and ground table
LEDPULSE	I*4	any	Number of LED pulses commanded	SEB hdr: cmdLEDPulses
SCSTATUS	I*2	any	Spacecraft status message before exposure	SEB hdr: preExpSCStatus
DOORCLOS	L	T(F)	Telescope door was closed (open) (FSW 411?,424?,442)	SEB hdr: derived from actualDoorPosition
EXPCMD	R*4	Any	Commanded time between open and close of shutter (seconds) (FSW ???) or between end of clear and begin of readout?	SEB hdr: (cmdExpDuration + cmdExpDuration_2) * 1.024e-3 or ??? for dark
EXPCLRO	R*4	Any	Length of time between start of CCD clear operation and readout	???

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
			(seconds) (FSW ???)	
CLR_TIME	R*4	Any	Duration of clear operation	readout tables
READTIME	R*4	Any	Duration of CCD read-out operation	readout tables
EXPOUT	R*4	Any	Length of time, shutter close to camera readout (seconds) (FSW ???)	???
			Housekeeping parameters	
TEMPAFT1	R*4	Any	Temperature, Degrees C for COR1OPHTR1, EUVIAFTSHTR, or COR2OPHTR3	HKP Tlm
TEMPAFT2	R*4	Any	Temperature, Degrees C for COR1DOUB2, EUVIPRMMRR, or COR2RLYLNS	HKP Tlm
TEMPMID1	R*4	Any	Temperature, Degrees C for COR1PLRZR, EUVIAFTMNT, or COR2FLDLNS	HKP Tlm
TEMPTHRM	R*4	Any	Temperature, Degrees C for COR1THERM, EUVITHERM, or COR2THERM	S/C HKP Tlm
TEMPMID2	R*4	Any	Temperature, Degrees C for EUVISECMRR or COR2HRMRR	HKP Tlm
TEMPFWD1	R*4	Any	Temperature, Degrees C for COR1OCCLTR, EUVIENTR, or COR2OPHTR2	HKP Tlm
TEMPFWD2	R*4	Any	Temperature, Degrees C for COR1OPHTR1, EUVIFWDMNT, or COR2OPHTR1	HKP Tlm
			Software-dependent values: Use with FSW	
EXTEND	L	T	Indicates that there *may* be an extension. Does not necessarily mean an extension is present.	SEB hdr: derived from extHdrFlag ???
DATE_CMD	R*4	Any	uploaded time of exposure in seconds from 2000/01/01T11:58:56 UTC	SEB hdr: cmdExpTime
COMPRSSN	S*8	NONE RICE WAVELET ...	Code indicating the algorithm used in compressing the data (FSW 215,410) (Could include compression factor as part of the string.)	SEB hdr: derived from ipCmdLog
COMPFACT	R*4	Any	Commanded compression factor	SEB hdr: derived from ipCmdLog
DATE_MID	S*23	Any	Date of midpoint of the exposure(s) (UTC standard)	SEB hdr: derived from actualExpTime[_2…] and actualExpDuration[_2…]
OBT_TIME	R*4	Any	Value of the STEREO S/C On-Board Time (seconds) (FSW 043)	???
APID	I*2	List	Application ID for the telemetry from which this image is generated.	SEB hdr: derived from filename

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
OBS_ID	I*2	0..32767	Observing Sequence ID (number): A number that specifies an instrument setup/configuration or sequence of exposures (such as polarizer sequence); can be used to search the database for the same types of images. Corresponds with Observation ID in Planning Tool. (FSW 050)	SEB hdr: osNumber
OBSSETID	I*2	0..32767	Observing Set ID from Planning Tool	SEB hdr: campaignSet
SEB_PROG	S*8	Normal, Cal Lamp, Dark, LineScan, PolSeq ...	Description of the type of image (observing program ID). (Equivalent to LEB_PROG on LASCO) (FSW 217,410,411,416)	SEB hdr: derived from imageType
IP_PROG	S*8	B, PB, %P, Sum, Diff, Binning ...	Description of the onboard Image Processing routine which produced the image, usually from several exposures.	SEB hdr: derived from ipFunction and/or ipCmd and/or ipCmdLog ???
IMGCTR	I*2	Any	Sequential counter since: the last SEB reboot? or otherwise reset? Per telescope? Per CEB? (FSW 240?)	SEB hdr: imgctr
IMGSEQ	I*2	0..32767	Number of the image in the current sequence, starting at 0 (FSW 240?)	SEB hdr: imgseq
RECTIFY	L	T(F)	Status of rectification to put solar north to the top of the image	SEB hdr: derived from ipFunction and/or ipCmd and/or ipCmdLog ???
R1(2)COL	I*2	Any	The rectified begin(end) X-coordinate, as though rectification had been unnecessary. If RECTIFY is F, then this is equal to P1(2)COL.	SEB hdr: derived from ipFunction and/or ipCmd and/or ipCmdLog ??? and P1(2)COL
R1(2)ROW	I*2	Any	Rectified P1(2)ROW	"" and P1(2)ROW
SYNC	L	T(F)	The image is (not) commanded to be synchronous with the other spacecraft.	SEB hdr: derived from sync
JITTER	R*4	Any	Mean amplitude of jitter during exposure(s) (Arcseconds) (Computed onboard from GT values) (FSW 218,311,322)	SEB hdr: derived from GT/FPS image header values ???
JITRSDEV	R*4	Any	Standard deviation of JITTER, computed onboard.	SEB hdr: derived from GT/FPS image header values ???
JITRMAX	R*4	Any	Maximum amplitude of jitter during exposure	SEB hdr: derived from GT/FPS image header values ???
FPS_ON	L	T(F)	EUVI fine pointing system	SEB hdr: derived from

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
			(FPS) is (not) activated during exposure(s) (FSW 320,424?)	actualFPSmode
FPS_CMD	L	T(F)	FPS was (not) commanded on	SEB hdr: useFPS
SCFP_ON	L	T(F)	Fine pointing bit from spacecraft is (not) activated. (FSW 322)	SEB hdr: derived from actualSCFinePointMode
SCANT_ON	L	T(F)	The "move antenna" bit from the spacecraft is (not) set.	SEB hdr: derived from preExpSCStatus and postEXPSCStatus
CADENCE	R*4	Any	Number of seconds between exposures/sequences for the current observing program (not individual exposures in a sequence). Is zero if not part of a repeating observing sequence. (FSW 410?)	planning tool
FLARE	L	T(F)	A flare event has (not) been triggered by the flare detection algorithm prior to or during this observation sequence. (FSW 413,424?)	derived from critEvent???
FCOUNT	I*4	Any	Count level used by the flare detection algorithm to set FLARE on (FSW 413,424?)	???
FROW	I*2	Any	X-coordinate of FCOUNT (FSW ???)	???
FCOL	I*2	Any	Y-coordinate of FCOUNT (FSW ???)	???
S1(2)COL	I*2	Any	Start (end) X-coordinates of sub-image extracted by the FSW, equivalent to P1(2)COL (FSW 416)	SEB hdr: derived from ipFunction and/or ipCmd and/or ipCmdLog ??? and P1(2)COL
S1(2)ROW	I*2	Any	Start (end) Y-coordinates (FSW 416)	"" and P1(2)ROW
COSMICS	I*4	Any	Number of pixels removed from image by cosmic ray removal algorithm (if image is from a sequence, then the mean) (FSW 217,411,416)	???
N_IMAGES	I*2	0..1000+	Number of CCD readouts used to compute the image (Number of extension headers = N_IMAGES)	derived from ipCmdCnt ???
VCHANNEL	I*2	6 7	Virtual channel of telemetry downlink (7=Realtime or beacon, 6=Playback) (FSW 410)	CCSDS header
MASK	S*?	0..?	Space-delimited list of coordinates of pixel blocks masked by the flight software (FSW 417)	SEB hdr: derived from ipCmdLog and ground table
CME	L	T(F)	CME detection has (not) been triggered. (FSW 217,424?)	???
OFFSETUN	R*4	Any	Computed average of	???

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
			underscan pixels	
OFFSETOV	R*4	Any	Computed average of overscan pixels	???
OFF_UNSD	R*4	Any	Standard deviation of OFFSETUN	???
OFF_OVSD	R*4	Any	Standard deviation of OFFSETOV	???
			Computed from information external to the image, on the ground	
OFFSETCR	I*2	Any	Offset bias subtracted from image.	Computed from dark images on ground?
SOURCE	S*2	RT, SSR1, SSR2, SWX	How the image came down	derived from filename/APID and ground table
RSUN	R*4	Any	Radius of sun (Arcseconds)	SPICE/ephemeris
CROTA	R*4	Any	Rotation angle of image about axis perpendicular to the plane of the image. Specified in degrees CCW relative to the Y direction. (Obsolete) (Sign is opposite that of correction.)	SPICE
CRPIXi	R*4	Any	The pixel coordinates of disk center, even if that's outside the array.	SPICE, r1(2)col(row), GT tlm ?
PCj_i	R*4	Any	A coordinate transformation matrix; rotation information is included in these keywords (replaces CROTAi)	SPICE
CRVALj	R*4I*1	Any0	The reference data coordinates corresponding to CRPIX1(2). For example, if the pixel coordinates specify the origin, then set CRVAL1 and CRVAL2 to zero.	SPICE
CTYPE1	S*8	HPLN-TAN	A string value representing the type of each coordinate axis. TBD Helioprojective Gnomic (TAN) Projection (PROPOSED) CTYPE1 is for x (westward angle) axis (θ_x).	mostly constant
CTYPE2	S*8	HPLT-TAN	Helioprojective Gnomic Projection for y (northward angle) axis (θ_y). (PROPOSED)	mostly constant
CUNITj	S*8	Arcsec	The units of the coordinates along axis j.	constant
CDELTj	R*8	Any	The width and height of a pixel in data units, where units are specified by CUNITj (Same as PLATESCL)	ground table
X(Y)CEN	R*4	Any	East-West (North-South) FOV center of image relative to sun center in CDELT1(2)	derived

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
			units, positive West (North). X(Y)CEN is related to the above FITS keywords by: X(Y)CEN = CRVAL1(2) + CDELT1(2) * [(NAXIS1(2)+1)/2 - CRPIX1(2)] (units = arcseconds)	
SPICEFIL	S*?	Any	Name of SPICE file from which position parameters derived	MOC
---X_OBS	R*8	Any	Position of spacecraft in x direction (meters). Coordinate system TBD. (See paper by Thompson in references.)	SPICE
---Y_OBS	R*8	Any	" in y direction "	SPICE
---Z_OBS	R*8	Any	" in z direction "	SPICE
LONPOLE	I*1	180	Degrees (default for helioprojective coordinates)	constant

Coordinate System

Factors/requirements in selection of coordinate system:

- Easily correct for B angle
- Identify central meridian
- Easily correct for differences in solar radius from distance
- Ecliptic
- Ascertain position relative to planets

Possibilities suggested so far:

- EIT uses heliocentric ecliptic
- Helioprojective Cartesian with TAN projection
- RA and DEC with TAN projection

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
EAR_TIME	R*4	Any	Time(Sun to Earth) - Time(Sun to S/C) (Seconds)	SPICE/ephemeris
SUN_TIME	R*4	Negative	Time(Light-travel time from Sun to S/C.) (Seconds)	SPICE/ephemeris
CMDOFFSE	R*4	Any	Commanded offset from schedule (Seconds) (Exact definition TBD)	SEB hdr: lightTravelOffsetTime
ANTENNA	S*12	Any	Antenna which received (most) of the packets for this image	MOC hdr
OBJECT	S*20	comet, etc. ?	Type of object observed; maintain constantly updated list of features which will be displayed in a menu? See ref 7 above	planning tool ?

KEYWORD	TYPE	VALUES	DESCRIPTION	Source
OBJECTID	I*2	Any	Active region number (EUVI only)	planning tool ?
			Computed from image values, on the ground	
COMP_ACT	R*4	Any	Actual compression factor achieved	derived
DATAMIN	R*4	Any	Minimum value of the image, including the bias	derived
DATAMAX	R*4	Any	Maximum value of the image	derived
DATAZER	I*4	Any	Number of zero pixels in the image	derived
DATASAT	I*4	Any	Number of saturated values in the image	derived
DSATVAL	R*4	Any	Value used as saturated	constant
DATAAVG	R*4	Any	Average value of the image	derived
DATASIG	R*4	Any	Standard deviation in computing the average	derived
DATAP01	I*4	Any	Intensity of 1st percentile of image	derived
DATAP10	I*4	Any	Intensity of 10th percentile image	derived
DATAP25	I*4	Any	Intensity of 25th percentile of image	derived
DATAP75	I*4	Any	Intensity of 75th percentile of image	derived
DATAP90	I*4	Any	Intensity of 90th percentile of image	derived
DATAP95	I*4	Any	Intensity of 95th percentile of image	derived
DATAP98	I*4	Any	Intensity of 98th percentile of image	derived
DATAP99	I*4	Any	Intensity of 99th percentile of image	derived
MISSLIST	S*80	Any	Space-delimited list of missing blocks. The numbers are the 1D subscripts of a 32x32 array representing superpixels of the array.	derived
NMISSING	I*4	Any	Number of missing blocks (not including on-board masked regions)	derived
BSCALE	R*8	Any	If missing, then assumed to be 1: output data = FITS data * BSCALE + BZERO	derived
BZERO	R*8	Any	If missing, then assumed to be zero	derived
			HISTORY: (Examples from LASCO, just to give an idea....)	
HISTORY			'Vxx dd mmm yyyy reduce_level_1,'d2nnnnnn.fts','d5nnnnnn.fts''	IDL pros
HISTORY			'Vxx dd mmm yyyy get_exp_factor, old_exp_time, bias'	IDL pros
HISTORY			'Vxx dd mmm yyyy vigfilename.fts'	IDL pros
			SIMULATION Images	
RANDHEAT	L	T(F)	Each loop's heating function is (not) chosen randomly	user input
CONSHEAT	L	T(F)	All loops do (not) have same base heating rate	user input
SIMNOISE	L	T(F)	Photon noise is (not) included	user input
SIMBCKD	L	T(F)	Simulated background is (not) included	user input

SECCHI FITS EXTENSION

Information about individual exposures used to compute a single image from a sequence is contained in an ASCII table extension to the FITS header. With the exception of DELTTIME, the values in the columns (fields) have the same meaning as the corresponding keywords in the main header, if the main header is for a single image. If an image consists of a single exposure, this table is optional and would have a single row. There is one row for each exposure, including the first one in the sequence.

Extension Table Column (Field) Definitions

FIELD	HEADING	VALUES	DESCRIPTION
1	DELTTIME	Any	Time from DATE-OBS (seconds) of the beginning of the (first) exposure. First row is always zero.
2	EXPTIME	Any	Duration of the exposure (seconds)
3	CCDSUM	Any	(sumrow + sumcol)/2.0
4	IPSUM	Any	(sebxsum + sebysum)/2.0
5	POLAR	0..358	Position of the polarizer, degrees from vertical WRT to detector
6	SHUTTR	T(F)	Shutter was (not) commanded open during the exposure
8	SHUTTDIR	CW CCW	Direction of motion of the shutter from the CCD's POV (FSW ?)
9	LED	N,R,B,P	Color of LED commanded on (FSW 411)
10	DOOR	T(F)	Telescope door was open (closed)
11	IMGCTR	Any	Sequential counter since the last SEB reboot
12	IMGSEQ	Any	Number of the image in the current sequence, starting at 0
13	ASYNCH	T(F)	Flight software is (not) in asynchronous mode (FSW 020,419?)
14	FLARE	T(F)	A proton event has (not) been triggered by the flare detection algorithm prior to this exposure (FSW 413)
15	FCOUNT	Any	Count level used by the flare detection algorithm to detect proton event (FSW 413)
16	FROW	Any	X-coordinate of FLEVEL (FSW ???)
17	FCOL	Any	Y-coordinate of FLEVEL (FSW ???)
18	COSMICS	Any	Number of pixels removed from image by cosmic ray removal algorithm (FSW 217,411)

The following illustrates the layout of each row in the extension table:

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890

rrr.rrr rrr.rrr ii ii rrr.r l l sss l l iiii iiii l l iiiiii iiii iiii iiiiii
```

Keywords for FITS Extension

KEYWORD	TYPE	VALUES	DESCRIPTION
XTENSION	S*8	TABLE	Required
BITPIX	I*2	8	Indicates printable ASCII characters
NAXIS	I*2	2	Axes are the rows and columns of the table
NAXIS1	I*2	74	Number of characters in a table row

KEYWORD	TYPE	VALUES	DESCRIPTION
NAXIS2	I*2	Any	Number of exposures in the sequence (=NUM_EXP)
PCOUNT	I*2	0	Required
GCOUNT	I*2	1	Required
TFIELDS	I*2	18	Number of fields in each table row
TBCOL1	I*2	1	Column number of first character in first field
TFORM1	S*4	F7.3	FORTRAN format of field 1: single precision floating point
TTYPE1	S*8	DELTTIME	Heading for field 1.
TUNIT1	S*7	Seconds	Units of field 1.
TBCOL2	I*2	9	Column number of first character in field 2
TFORM2	S*4	F7.3	FORTRAN format of field 2: single precision floating point
TTYPE2	S*7	EXPTIME	Heading for field 2.
TUNIT2	S*7	Seconds	Units of field 2.
TBCOL3	I*2	17	Column number of first character in field 3
TFORM3	S*2	I2	FORTRAN format of field 3: integer
TTYPE3	S*6	SUMROW	Heading for field 3.
TUNIT3	S*2	NA	Units of field 3.
TBCOL4	I*2	20	Column number of first character in field 4
TFORM4	S*2	I2	FORTRAN format of field 4: integer
TTYPE4	S*6	SUMCOL	Heading for field 4.
TUNIT4	S*2	NA	Units of field 4.
TBCOL5	I*2	23	Column number of first character in field 5
TFORM5	S*2	F5.1	FORTRAN format of field 5: integer
TTYPE5	S*8	POLAR	Heading for field 5.
TUNIT5	S*7	Degrees	Units of field 5.
TBCOL6	I*2	29	Column number of first character in field 6
TFORM6	S*2	A1	FORTRAN format of field 6: character
TTYPE6	S*6	SHUTTR	Heading for field 6.
TUNIT6	S*7	Logical	Units of field 6.
TBCOL7	I*2	30	Column number of first character in field 7
TFORM7	S*2	A1	FORTRAN format of field 7: character
TTYPE7	S*8	APRT_SEL	Heading for field 7.
TUNIT7	S*7	Logical	Units of field 7.
TBCOL8	I*2	33	Column number of first character in field 8
TFORM8	S*2	A3	FORTRAN format of field 8: character
TTYPE8	S*8	SHUTTDIR	Heading for field 8.
TUNIT8	S*8	Dirction	Units of field 8.
TBCOL9	I*2	37	Column number of first character in field 9
TFORM9	S*2	A1	FORTRAN format of field 9: character
TTYPE9	S*4	LAMP	Heading for field 9.
TUNIT9	S*7	Logical	Units of field 9.
TBCOL10	I*2	39	Column number of first character in field 10
TFORM10	S*2	A1	FORTRAN format of field 10: character
TTYPE10	S*4	DOOR	Heading for field 10.
TUNIT10	S*7	Logical	Units of field 10.
TBCOL11	I*2	41	Column number of first character in field 11
TFORM11	S*2	I4	FORTRAN format of field 11: integer

KEYWORD	TYPE	VALUES	DESCRIPTION
TTYPE11	S*6	IMGCTR	Heading for field 11.
TUNIT11	S*4	None	Units of field 11.
TBCOL12	I*2	46	Column number of first character in field 12
TFORM12	S*2	I4	FORTRAN format of field 12: integer
TTYPE12	S*6	IMGSEQ	Heading for field 12.
TUNIT12	S*4	None	Units of field 12.
TBCOL13	I*2	51	Column number of first character in field 13
TFORM13	S*2	A1	FORTRAN format of field 13: character
TTYPE13	S*4	ASYNCH	Heading for field 13.
TUNIT13	S*7	Logical	Units of field 13.
TBCOL14	I*2	53	Column number of first character in field 14
TFORM14	S*2	A1	FORTRAN format of field 14: character
TTYPE14	S*4	FLARE	Heading for field 14.
TUNIT14	S*7	Logical	Units of field 14.
TBCOL15	I*2	55	Column number of first character in field 15
TFORM15	S*2	I6	FORTRAN format of field 15: integer
TTYPE15	S*6	FCOUNT	Heading for field 15.
TUNIT15	S*6	Counts	Units of field 15.
TBCOL16	I*2	62	Column number of first character in field 16
TFORM16	S*2	I4	FORTRAN format of field 16: integer
TTYPE16	S*4	FROW	Heading for field 16.
TUNIT16	S*3	Row	Units of field 16.
TBCOL17	I*2	67	Column number of first character in field 17
TFORM17	S*2	I4	FORTRAN format of field 17: integer
TTYPE17	S*6	FCOL	Heading for field 17.
TUNIT17	S*6	Column	Units of field 17.
TBCOL18	I*2	72	Column number of first character in field 18
TFORM18	S*2	I6	FORTRAN format of field 18: integer
TTYPE18	S*6	COSMICS	Heading for field 18.
TUNIT18	S*6	Pixels	Units of field 18.