

SBFITSEXT Version 1.0
A Set of FITS Standard Extensions for Amateur
Astronomical Processing Software Packages
March 19, 2003

This document describes a set of Extensions to the FITS standard for use with Amateur Astronomical Image Processing (AIP) Software Packages. The current state of uniformity between the major AIP Software Packages is dismal at best. The hope is that in publishing this Standard all the Major Packages (CCDOPS, MaximDl and CCDSoft, etc.) will commit to adhere to this Standard and that will then give the other Packages sufficient reason to adhere.

Mandatory Keywords

The following Keywords are all **mandatory** in the FITS Standard and thus must be included in this Standard:

SIMPLE
BITPIX
NAXIS
NAXIS1
NAXIS2

As these keywords are defined in the FITS standard we won't repeat the keyword types (String, Float, etc.) or default/typical values but instead refer you to the actual FITS standard.

Mandatory Standard Reserved Keywords

These keywords are defined in the FITS Standard and per this Standard are **mandatory**:

OBJECT *String* - The name of Object Imaged, ie M57
TELESCOP *String* - The model Telescope, ie LX200
INSTRUME *String* - The model Camera used, ie ST-7
OBSERVER *String* - The name of the Observer, ie John Doe
DATE-OBS *String* - The **UTC** date and time at the **start of the exposure** in the ISO standard 8601 format: '2002-09-07T15:42:17.123' (CCYY-MM-DDTHH:MM:SS.SSS). Note that we have dropped the non-standard but common **TIME-OBS** keyword by including the time in **DATE-OBS**.
BSCALE *Floating Point* - The last two are for 16 bit images. Typically BSCALE = 1.0
BZERO *Floating Point* - Typically 32768.0
HISTORY *String* - Include multiple copies of this keyword for every modification made to the image in the order made. The table below lists the common modifications and should be included as stated below. Modifications not included in the list should use language that reasonably describes the modification:

Dark Subtraction
Bias Subtraction
Flat Field
Image Co-Addition
LR Deconvolve Image
DDP Image

Crop Image
 Flip Horizontally
 Flip Vertically
 Rotate Image
 Resample Pixel Size
 Enlarge Image
 Reduce Image

 Scale ADU Values
 Remove Cool Pixels
 Smooth Pixels
 Sharpen Pixels
 Quantize ADU Values
 Remove Warm Pixels
 Log Scale ADU Values
 Invert ADU Values

Mandatory Extension Keywords

The following Keywords are not defined in the FITS Standard but are defined in this Standard. **All must be included.**

EXPTIME	Floating Point - The total exposure time in seconds. For Track and Accumulate Images this is the sum of all the exposure times.
CCD-TEMP	Floating Point - Temperature of CCD when exposure taken
XPIXSZ	Floating Point - Pixel width in microns (after binning)
YPIXSZ	Floating Point - Pixel height in microns (after binning)
XBINNING	Integer - Binning factor in width
YBINNING	Integer - Binning factor in height
XORGSUBF	Integer - Sub frame X position of upper-left pixel relative to whole frame in binned pixel units
YORGSUBF	" " Y "
EGAIN	Floating Point - Electronic gain in e-/ADU
FOCALLEN	Floating Point - Focal Length of the Telescope used in millimeters
APTDIA	Floating Point - Aperture Diameter of the Telescope used in millimeters.
APTAREA	Floating Point - Aperture Area of the Telescope used in square-millimeters. Note that we are specifying the area as well as the diameter because we want to be able to correct for any central obstruction.
CBLACK	Integer - Upon initial display of this image use this ADU level for the Black level.
CWHITE	Integer - Upon initial display of this image use this ADU level as the White level. For the SBIG method of displaying images using Background and Range the following conversions would be used: Background = CBLACK Range = CWHITE - CBLACK
PEDESTAL	Integer - Add this ADU count to each pixel value to get to a zero-based ADU. For example in SBIG images we add 100 ADU to each pixel to stop underflow at Zero ADU from noise. We would set PEDESTAL to -100 in this case.
DATAMAX	Integer - Pixels at or above DATAMAX are considered to be saturated and thus unusable for Photometric calculations
SWCREATE	String - This indicates the name and version of the Software that initially created this file ie 'SBIGs CCDOps Version 5.10'
SWMODIFY	String - This indicates the name and version of the Software that modified this file ie 'SBIGs CCDOps Version 5.10' and there can be multiple copies of this keyword. Only add this keyword if you

actually modified the image and we suggest placing this above the **HISTORY** keywords corresponding to the modifications made to the image.

SBSTDVER *String* - This string indicates the version of this standard that the image was created to ie 'SBFITSEXT Version 1.0'

Optional Keywords

The following Keywords are not defined in the FITS Standard but are defined in this Standard. They may or may not be included by AIP Software Packages adhering to this Standard. Any of these keywords read by an AIP Package must be preserved in files written.

FILTER *String* - Optical Filter used to take image, ie H-Alpha. If this keyword is not included there was no filter used to take the image.

TRAKTIME *Floating Point* - If the image was auto-guided this is the exposure time in seconds of the tracker used to acquire this image. If this keyword is not present then the image was unguided or hand guided.

SNAPSHOT *Integer* - Number of images combined to make this image as in Track and Accumulate or Co-Added images.

SET-TEMP *Floating Point* - This is the setpoint of the cooling in degrees C. If it is not specified the setpoint is assumed to be the **CCD-TEMP** specified above.

IMAGETYP *String* - This indicates the type of image and should be one of the following:
Light Frame
Dark Frame
Bias Frame
Flat Field

OBJCTRA *String* - This is the Right Ascension of the center of the image in hours, minutes and seconds. The format for this is '12 24 23.123' (HH MM SS.SSS) using a space as the separator.

OBJCTDEC *String* - This is the Declination of the center of the image in degrees. The format for this is '+25 12 34.111' (SDD MM SS.SSS) using a space as the separator. For the sign, North is + and South is -.

CENTAZ *String* - Azimuth in degrees of the center of the image in degrees. Format is the same as the **OBJCTDEC** keyword.

CENTALT *String* - Altitude in degrees of the center of the image in degrees. Format is the same as the **OBJCTDEC** keyword.

SITELAT *String* - Latitude of the imaging location in degrees. Format is the same as the **OBJCTDEC** keyword.

SITELONG *String* - Longitude of the imaging location in degrees. Format is the same as the **OBJCTDEC** keyword.

Evolution of the Standard

Over time it is anticipated that this standard will want to evolve. The mechanism for that will be mostly informal. If you have proposed changes or additions to this standard please forward them to:

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Periodically I'll revise the Standard.