



DESCRIPTION OF THE SWIFT COMMON CALIBRATION FILES

Version 1.1

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1 Introduction

This document describes the format of Swift calibration files valid for all instruments or related to other Swift component and their organization in the Calibration Database.

The files are not specific to any of the instruments but some can be applicable to all.

The files are stored in CALDB in FITS format with the layout described in this document. Whenever possible standard OGIP layouts were used.

1.1 Applicable Documents

[1] - BCF & CPF Calibration File Guidelines - OGIP Calibration Memo CAL/GEN/92-003

[2] - HFWG Recommendation R8 -1994 February 02

[3] - Required and Recommended FITS keywords for Calibration Files -OGIP Calibration Memo CAL/GEN/92-011

[4] - A Panchromatic Gamma Ray Burst MIDEX Mission - Phase A Study Report in response to AO-98-0SS-03

2 Common Swift CALDB

The Common Swift calibration files are stored in a directory named *mis* in the CALDB dedicated to Swift. These files are either generated at the SSC or delivered to the SSC.

The Common Swift Calibration files are finally delivered by SSC to HEASARC. The delivery occurs each time the files are updated.

2.1 Scope

During the course of the Swift mission the Calibration data in the Common area shall provide:

- a way to store and archive Common calibration data;
- naming convention and header structure for Common calibration files;
- indexing for software access to Common calibration data based on FITS header keywords;
- a traceable history of Common calibration data in the database by maintaining the history of versions

3 Common Calibration File Set

The Swift Common Calibration Files stored in the CALDB database. They are used in the data reduction software and in the data analysis.

3.1 File Naming Convention

The files in the Swift common CALDB are named as follows:

sw<datatype>[<date>]v<version>.ext

where:

datatype is the calibration data type identifier (at most eight characters long);

date is an integer giving the date when the file should first be used, with the format: YYYYMMDD;

version is a three digit integer giving the file issue number;

ext is set to 'fits' for all files . If there are exception these are

3.2 Datatypes

Table 1 lists the files included into the BCFS with a short description.

<i>datatype</i>	<i>Cal directory</i>	<i>Used in pipeline</i>	<i>description</i>
Align	bfc	yes	Alignment definition file.
Clock	bcf	Use by barycor	Clock correction file

Table 1 -Datatypes and short description of the common Swift files

4 Files General Description

All the Swift common files are FITS files. Keywords required by FITS OGIP standards and listed in this paragraph are described in documents [1], [2] and [3] (section 1.1). See chapter 5 for a detailed description of format for these FITS files.

4.1 Mandatory keywords

Table 2 lists the mandatory keywords to be added to the primary header and to the headers of all extensions of the Fits files. See documents [1] [2] (section 1.1) for keyword description.

<i>keyword name</i>	<i>keyword value</i>	<i>comment</i>
TELESCOP	'SWIFT'	/ Telescope (mission) name
INSTRUME	'<spec>'	/ Instrument Name
DATE	YYYY-MM-DDThh:mm:ss	/ Creation Date This keyword is omitted for empty Primary Headers.
CHECKSUM	<up to date checksum>	/ HDU checksum updated <date>
DATASUM	<up to date datasum>	/ Data unit checksum updated <date>

Table 2 –Mandatory header keywords

The keyword INSTRUME is set to the component to which the calibration file is refer to. Table 3 lists the additional mandatory keywords common to all table headers. Each CALDB keywords has different values for different Calibration Files. The CALDB keywords and the EXTNAME keyword are specified for each datatype in the related paragraph in section 5.

<i>keyword name</i>	<i>keyword value</i>	<i>comment</i>
EXTNAME	<extension name>	/ Name of the binary table extension or /Name of the image extension This is omitted if data are stored in the Primary Header
ORIGIN	<organization name>	/ Source of FITS file
CREATOR	< task name and version number>	/ Creator
CONTENT	<short description of the content>	/File content
FILENAME	<file name>	/ File name
VERSION	<version number>	/ Extension version number
CALDB keywords:		
CCLSxxxx	OGIP-class of calibration file	/Dataset is a Calibration Product File /Dataset is a Basic Calibration File
CDTPxxxx	<datatype code>	/Calibration file contains data
CCNMxxxx	<extension codename>	/Type of Calibration data
CDESxxxx	<descriptive string>	/ Description

CVSD:xxxx	<start valid data>	/UTC date when file should first be used
CVST:xxxx	<start valid time>	/UTC time when file should first be used

Table 3 - Table Headers mandatory keywords

Table 4 lists header keywords required under certain circumstances. These keywords are specified, when necessary, for each *datatype* in the related paragraph in section 5.

Keyword name	Keyword value	Comment
CBDnxxxx	array describing parameter limitations of the dataset	/ Parameter boundary
CSYSNAME	spatial coordinate system in use	/spacial coord system used in this dataset
TDIMnnn	Number of elements & Ordering of n-d array	/ Array dimensions
HDUCLASS	'OGIP '	/ format conforms to OGIP standards
HDUDOC	<document number>	/ Document describing the format
HDUCLASn	<character string to classify the extension	/ (Specific to the type)
HDUVERS _n	<string giving the format version>	/ Version of file format
TIMESYS	TT	/ Time system
MJDREFI	51910	/ Reference MJD, Interger part
MJDREFF	7.4287037e-4	/Reference MJD, fractional part
CLOCKAPP	F	/ If clock corrections are applied (F/T)

Table 4 - Table Headers keywords required under certain circumstance

The order in which the header keywords are layout in the calibration files is the following :

- Required FITS keywords
- Descriptive column keywords for binary table
- EXTNAME, TELESCOP, INSTRUME, FILTER, ORIGIN, CREATOR, VERSION, FILENAME, CONTENT
- TIMESYS, MJDREFI, MJDREFF, CLOCKAPP
- CALDB keywords
- Comment keywords
- Additional Local keywords
- DATA, DATASUM, CHECKSUM

The description of the calibration file within this document includes the file structure, the setting of CALDB keywords and specific keywords related to the file

5 Files format

5.1 Alignment Definition File

5.1.1 File Name

swalignYYYYMMDDvNNN.fits

5.1.2 Description

The software that calculates the attitude and the coordinates assumes a specific orientation of the XYZ coordinates system for the spacecraft. This is different from what Swift uses where the +X direction is the pointing direction and the positive roll angle is in the opposite direction of what the software assumes. The alignment file contains the coefficient of the alignment matrix between the two coordinate systems and the definition of the roll angle convention.

The file format consist of an empty primary header that contains the alignment matrix, ALIGNMij and roll angle convention, ROLLSIGN and ROLLOFF.

5.1.3 File Format

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>
0	PRIMARY	

Table 5 - Telescope Description Calibration File Format

5.1.4 Primary Header Keywords

All keywords listed in Table 2 and Table 3 are included in the header for this HDU. Below are listed specific setting of some of the CALDB keywords and others relevant to this file.

<i>keyword name</i>	<i>keyword value</i>	<i>comment</i>
INSTRUME	'SC'	Instrument name
Table 2 & 3 - mandatory header keywords		
CALDB Keywords		
CCLS0001	'BCF'	/ Dataset is Basic Calibration File
CCNM0001	'ALIGNMENT'	/ Type of calibration data
CDTP0001	'DATA'	/ Calibration file contains data
CVSD0001	'2004-10-12'	/ UTC date when calibration should first be used
CVST0001	'00:00:00'	/ UTC time when calibration should first be used
CDES0001	'SPACECRAFT-LEVEL ALIGNMENT FILE	/Description

Table 6 – Alignment Description File Primary Header Keywords

The following is a listing of the alignment header.

```

COMMENT
COMMENT -----
COMMENT The spacecraft boresight is +X, but the software boresight is +Z.
COMMENT The orientation of the spacecraft axes with respect to the software
COMMENT boresight axes is specified by the following rotation matrix.
COMMENT -----
ALIGNM11=          0 / SAT -> BOR coords alignment matrix element Aij
ALIGNM12=          1 / where (i,j) indicates (row,column)
ALIGNM13=          0
ALIGNM21=          0 / [3x3 rotation matrix, common to all sensors]
ALIGNM22=          0
ALIGNM23=          1 / BORX = M11 * SATX + M12 * SATY + M13 * SATZ
ALIGNM31=          1 / BORY = M21 * SATX + M22 * SATY + M23 * SATZ
ALIGNM32=          0 / BORZ = M31 * SATX + M32 * SATY + M33 * SATZ
ALIGNM33=          0
COMMENT -----
COMMENT The roll convention keywords specify the direction in which positive
COMMENT roll increases.
COMMENT -----
ROLLSIGN=          -1 / Sign of roll angle positive direction
ROLLOFF =          0. / [deg] Offset of roll angle
COMMENT -----
RA_NOM =           0.
DEC_NOM =           0.
COMMENT

```

5.2 Clock correction Calibration File

5.2.1 File Name

swlockcorYYYYMMDDvNNN.fits

5.2.2 Description

The file contains the coefficients of the function to calculate the Swift time corrections. The coefficients are derived from the spacecraft clock data provided from the MOC and applied to the Swift times by specific tools. The FITS file structure consists of an empty primary header and a bin table containing the following columns:

- TSTART and TSTOP: give the mission elapse time of the time interval validity for the polynomial coefficients derived;
- TOFFSET: gives the time offset used in the formula to correct the times;
- C0, C1, C2: are coefficient of the polynomial;
- MAXGAP: is the largest gap with no data (set to -1 for unknown);
- TYPE: is a flag set to 0 (YES) or 1 (NO) and indicates the segment clock continuity;
- CHI_N and DOF; are the reduced chi-squared (set to -1 for unknown) and the degree of freedom while performing the fits.

The MAXGAP, TYPE CHI_N and DOF are not used in the correction calculation. To correct a time 't' the quantity in the files are used as follows:

$TCORR = TOFFSET + (C0 + C1 * T1 + C2 * T1 * T1) * 1e-6$ (second)
where $T1 = t - TSTART / 86400$

5.2.3 File Format

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>		
0	PRIMARY			
1	BINTABLE	CLOCK_CORRECT		
		Column Names	Format	Units
		TSTART	D	s
		TSTOP	D	s
		TOFFSET	D	s
		C0	D	-
		C1	D	-
		C2	D	-
		MAXGAP	D	d
		TYPE	J	-
		CHI_N	D	-
		DOF	J	-

Table 7 – Format Clock correction Calibration File Format

5.2.4 Primary Header Keywords

All keywords of Table 2 are mandatory header keywords.

5.2.5 Extension 1 - Header Keywords

All keywords listed in Table 2 and Table 3 are included in the header for this HDU. Below are listed specific settings of some of the CALDB keywords and others relevant to this file.

<i>keyword name</i>	<i>keyword value</i>	<i>Comment</i>
Table 2 & 3 mandatory header keywords		
CALDB Keywords		
CCLS0001	'BCF'	/ Dataset is Basic Calibration File
CCNM0001	'CLOCK'	/ Type of calibration data
CDES0001	'SPACECRAFT CLOCK OFFSET FILE'	/ Description
CDTP0001	'DATA'	/ Calibration file contains data

CVSD0001	'2004-11-20'	/ UTC date when calibration should first be used
CVST0001	'19:30:15'	/ UTC time when calibration should first be used
Transmission keywords extension		
EXTNAME	'CLOCK_CORRECT'	/ Name of the binary table extension
TIMESYS	TT	/ Time system
MJDREFI	51910	/ Reference MJD, Interger part
MJDREFF	7.4287037e-4	/Reference MJD, fractional part
TSTART	<value>	/Start time
TSTOP	<value>	/Stop time
DATE-OBS	<string>	/Start date
DATE-END	<string>	/Stop date
CLOCKAPP	F	/ If clock corrections are applied (F/T)

Table 8 – Clock Correction Calibration File Extension 1 Keywords