National Aeronautics and Space Administration

IXPE-SOC-DOC-018
Version H1.11
EFFECTIVE DATE: 2026-06-10

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

ST-12

IMAGING X-RAY POLARIMETRY EXPLORER (IXPE)
SCIENCE OPERATIONS CENTER (SOC)

Software Release Notes

For CALDB version 20260610

IXPE Science Operations Center

Signatures

PREPARED BY

Kurt Dietz/ES52 Date
Software Engineer

APPROVED BY

Allyn Tennant/ST12 Date

Stephen L. O'Dell/ST12 Date

Revision Log

Date	Rev	Notes
2022-10-30	1.6	Release notes for version 1.6.
2023-06-13	H1.7	Release notes for HEASOFT 6.32, IXPE heasoftpy tools version 1.7
2024-08-23	H1.9	Release notes for HEASOFT 6.34, IXPE heasoftpy tools version 1.9
2025-03-07	H1.10	Release notes for HEASOFT 6.35, IXPE heasoftpy tools version 1.10
2025-09-07	H1.11	Release notes for HEASOFT 6.36 IXPE heasoftopy fools version 1.11
2026-04-24	H1.12	Release notes for CALDB version 20260424
2026-06-10	H1.13	Release notes for CALDB version 20260610

Table of Contents

1 Introduction

The Imaging X-ray Polarimetry Explorer (IXPE) is a NASA mission in partnership with the Italian space agency (Agenzia Spaziale Italiana, ASI). IXPE provides the capability to measure the (linear) polarization of x rays from astrophysical sources. In addition, IXPE introduces the capability for x-ray polarimetric imaging, uniquely enabling measurement of x-ray polarization with scientifically meaningful spatial, spectral, and temporal resolution.

1.1 Purpose

This document describes the major changes (features and bug fixes) to the software for the version 1.11 release.

The IXPE Science Operations Center (SOC), at NASA Marshall Space Flight Center (MSFC), provides ground support for science operations of this space-based observatory. The primary functions of the SOC are these:

1. Develop software and operations to transform an IXPE long-term (1 year at a time) target list into an annual observing schedule, based upon orbital and pointing constraints, and to generate weekly Instrument Activity Plans (IAPs) that will guide the commanding of the Observatory by the Mission Operations Center (MOC) at the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP). This function is identified as "Mission Planning" or MP.
2. Develop software, calibration data, and operations to translate, correct, calibrate, and transform raw science telemetry into science data products for use by the IXPE Science Team and by the greater scientific community. This function is identified as "Science Processing" or SP.

Hence, the two major components of the IXPE SOC software are Mission Planning (MP) software and Science Processing (SP) software. The purpose of this document is to detail the operational use of the IXPE SOC Science Processing software modules and associated tasks involved with maintaining the processing environment.

1.2 Scope

This document is intended to describe the changes to the publicly released and the internal pipeline software released in version 1.6 from the Imaging X-ray Polarimetry Explorer (IXPE) Science Operations Center (SOC).

1.3 Audience

This document is intended for users of publicly released IXPE software and data.

2 References and Documents

1. "The JSON Data Interchange Syntax", ECMA-404, European Computer Manufacturers Association. https://www.ecma-international.org/publications-and-standards/standards/ecma-404/
2. "ISO 8601 Date and Time Format", International Organization for Standardization. https://www.iso.org/iso-8601-date-and-time-format.html

3. "Overview of the FITS Data Format", https://heasarc.gsfc.nasa.gov/docs/heasarc/fits_overview.html
4. "The Calibration Requirements for Spectral Analysis", https://heasarc.gsfc.nasa.gov/docs/heasarc/caldb/docs/memos/cal_gen_92_002/cal_gen_92_002.html

3 Organization and Responsibilities

The IXPE SOC is responsible for maintenance of this document and delivery of software and data products to NASA. Much of the Instrument-related software and calibration database (CALDB) were produced by the ASI Space Science Data Center (SSDC) with substantial contributions by the IXPE Instrument Team at Istituto Nazionale di Astrofisica (INAF) and at Istituto Nazionale di Fisica Nucleare (INFN).

4 Software change description.

4.1 CALDB Data

1. Bgdparam files:
    a. Data/ixpe/gpd/bcf/bgdparam/ixpe_d2_20250414_bgdparam_01.fits:
        i. Background rejection parameters for DU2 immediately post-anomaly as provided by Alessandro Di Marco
    b. Data/ixpe/gpd/bcf/bgdparam/ixpe_d2_20250414_bgdparam_02.fits:
        i. Update to version 01 with a revised value of TBORDMAX to 5, as provided by Alessandro Di Marco.
    c. Data/ixpe/gpd/bcf/bgdparam/ixpe_d2_20250615_bgdparam_02.fits:
        i. Update to version 01 with a revised value of TBORDMAX to 5, as provided by Alessandro Di Marco.
2. Badpix files:
    a. data/ixpe/xrt/bcf/badpix/ixpe_d2_20250414_badpix_01.fits:
        i. Updated bad pixel map for DU2 for immediately after the anomaly. Masks out new bad rows as well as a larger spot where a spurious burst occurred.
    b. data/ixpe/xrt/bcf/badpix/ixpe_d2_20250414_badpix_02.fits:
        i. Updated bad pixel map for DU2 starting roughly 1.3 hours after the anomaly. Only the new bad rows are masked, and not the "burst" spot pixels.
3. Phascale files:
    a. data/ixpe/xrt/bcf/phascale/ixpe_d1_20190101_phascale_01.fits, data/ixpe/xrt/bcf/phascale/ixpe_d2_20190101_phascale_01.fits, data/ixpe/xrt/bcf/phascale/ixpe_d3_20190101_phascale_01.fits:
        i. Initial PHASCALE for all detectors. Scale is set to 1.
    b. data/ixpe/xrt/bcf/phascale/ixpe_d2_20250414_phascale_01.fits:

i. PHASCALE for DU2 immediately after DU2 post-anomaly. Scale is set to 0 so that no spurious "burst" events are used in the charge map calculations.

c. data/ixpe/xrt/bcf/phascale/ixpe_d2_20250414_phascale_02.fits:

i. PHASCALE for DU2 starting roughly 1.3 hours after the anomaly. Scale set to 0.688 to account for anomalous change in ASIC gain.

4. CALDB index files.
   a. Both the xrt and gpd caldb index files were updated to include the above files.

4.2 IXPE SOC Pipeline Tool

No Changes were made to the IXPE pipeline tools for this update.

4.3 Mission Planning tools:

No Changes were made to the IXPE mission planning tools for this update.

Appendix A: Acronyms and Definitions

A.1 Acronyms

ADC	Analog-to-Digital Converter
ADCS	Attitude Determination and Control Subsystem
APID	Application ID
ARF	Ancillary Response Function
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
BCF	Basic Calibration File
CALDB	(HEASARC) Calibration DataBase
CCSDS	Consultative Committee for Space Data Systems
CDH	Command and Data Handling
CPF	Calibration Product File
DSU	(IXPE) Detectors Service Unit
DU	(IXPE) Detector Unit
ECEF	Earth-Centered, Earth-Fixed (coordinates)
FCW	(DU) Filter and Calibration Wheel
FITS	Flexible Image Transport System
FSW	Flight Software
GPD	Gas Pixel Detector
GPS	Global Positioning System
GTI	Good Time Interval
HDU	Header Data Unit (FITS file extension)
HEASARC	High-Energy Astrophysics Science Archive Research Center
INAF	Instituto Nazionale di Astrofisica

INFN	Instituto Nazionale di Fisica Nucleare
ISO	International Organization for Standards
ISOT	ISO 8601 Time standard
IXPE	Imaging X-ray Polarimetry Explorer
MMA	IXPE Mirror Module Assembly
MOC	Mission Operations Center
MP	(SOC) Mission Planning
MSFC	Marshall Space Flight Center
OGIP	(HEASARC) Office of Guest Investigator Programs
RMF	Response Matrix File
SC	Spacecraft
SOC	Science Operations Center
SP	(SOC) Science Processing
SSDC	(ASI) Space Science Data Center
TT	Terrestrial Time
UTC	Universal Time Coordinated

Appendix B: Definition of FITS format codes

The table below defines the data type codes used in the description of the FITS file formats in the main sections of this document.

Table B-1: FITS keyword format codes

FITS format code	Description	# 8-bit bytes
L	logical (Boolean)	1
X	bit	*
B	Unsigned byte	1
I	16-bit integer	2
J	32-bit integer	4
K	64-bit integer	8
A	character	1
E	single precision floating point	4
D	double precision floating point	8
C	single precision complex	8
M	double precision complex	16
P	array descriptor	8
Q	array descriptor	16

(from https://docs.astropy.org/en/stable/io/fits/usage/table.html)