

MESSENGER EPPS EPS EDR-to-CDR Processing

Version 1D

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1 Purpose

This document provides a description of the conversion of MESSENGER Energetic Particle and Plasma Spectrometer (EPS) Experimental Data Records (EDRs) to Calibrated Data Records (CDRs). The processing steps described in this document represent the state of knowledge at the date of this document.

2 Introduction

The Science EDRs are the raw data records used to derive data used for scientific analysis. The processing steps from the EDR to the CDR level are described in this document.

3 Calibration Implementation

See the EPPS CDR SIS for a detailed description of instrument design issues relevant to calibration. We present below the specific calibration algorithm used in the production of EPS CDRs, including the Geometry/Efficiency factors used. Note that by reporting “differential” flux, we are implicitly “pretending” that the flux is constant across the energy band.

In practice, the CDR files are generated using the same Mission Independent Data Layer (MIDL) codebase which also underlies the EPS Instrument Team’s science analysis software. The rates are read in from the EDR files as number of counts in an accumulation interval. The rates in the CDR are then just derived by the simple formula:

$$\textit{Rate} = \textit{Counts}/\Delta T$$

$$\Delta T = \textit{Accumulation Time}$$

For channels with a double-bounded pass-band, the flux is calculated by:

$$\textit{Flux} = \textit{Counts}/(\Delta T * \Delta E * G)$$

$$\Delta E = \textit{Upper Energy Bound} - \textit{Lower Energy Bound}$$

$$G = \textit{Geometry Factor} = 0.0007 \text{ cm}^2\text{-sr (large pixel)}$$

$$0.000035 \text{ cm}^2\text{-sr (small pixel)}$$

Whether the instrument is operating in large or small pixel mode is determined by the following: Before 2007:249 - small pixel mode except for 2005:214:13:16:1 -2005:214:15:42:59. After 2007:249 pixel mode is read from the EPS_ION_PIX_SIZE or EPS_ELEC_PIX_SIZE field in the Long Status EDR.

4 Calibration Procedure

What follows is a summary of the procedure for applying the algorithm from the previous section to produce CDR rates from EDR rates.

DT = Integration time (column 2 in the EDR)

C = The “Rate” value from the EDR. This is in raw counts accumulated over DT.

U = Upper energy bound in KeV. Get this from the table in the CDR SIS for the Rate you’re calibrating.

L = Lower energy bound in KeV. Also from the CDR SIS table.

G = Geometry factor (assumed energy independent for now). See previous section for how to find.

Flux (in *Counts/keV-cm²-sr-sec*) = $C/(DT*(U-L)*G)$.

5 Revision History

Rev	Date	Author(s)	Description	Sections
1A	15Jul2009	Lillian Nguyen Lawrence Brown	Initial version.	All
1B	03Dec2009	Lillian Nguyen Lawrence Brown	Overhaul after initial PDS review. Add section on calibration procedure.	4
1C	14Jan2010	Lillian Nguyen Lawrence Brown	Added revision history and fixed versioning.	5, title page
1D	09Dec2015	Susan Ensor	Final edits reflecting end of mission	All