MESSENGER Software Interface Specification for the Neutron Spectrometer Experiment Data Records
Version 4.4

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Document Review

This document and the archive it describes have been through PDS Peer Review and have been accepted into the PDS archive.

David Lawrence, MESSENGER NS Instrument Scientist, has reviewed and approved this document.

Susan Slavney, PDS Geosciences Node Representative, has reviewed and approved this document.

Susan Enson, MESSENGER Science Operations Center Lead, has reviewed and approved this document.
## Revision History

<table>
<thead>
<tr>
<th>Version Number</th>
<th>Date</th>
<th>Section</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>12/22/2008</td>
<td>N/A</td>
<td>• Start of revision history: version included in MESSENGER PDS Release 4.</td>
</tr>
<tr>
<td>4.1</td>
<td>11/9/2009</td>
<td>5.3.4.9</td>
<td>• Changed ROW_BYTES from 79 to 80 for NS Calibration/Diagnostic EDR. The extra byte comes from the line-feed character that was missing previously.</td>
</tr>
</tbody>
</table>
| 4.2            | 6/15/11    | Document Review, Revision History | • Replaced signature page with document review information  
• Changed “periherm” to “apoherm” in description of orbit start times for orbit numbering.  
• Add section column to revision history table.                                                                                                                                                                      |
| 4.3            | 5/25/12    | 2, 7                             | • Change document name *Data Management and Science Analysis Plan* to *Data Management and Archiving Plan*. Update references.  
• Reference *MESSENGER Data Management and Archiving Plan* for release schedule and remove delivery schedule table from this document.                                                                                                                   |
| 4.4            | 7/7/15     | Title and various sections, 5.4.3 | • Change “Experimental Data Record” to “Experiment Data Record” in document name and text.  
• Note use of clock partitions in time tags in product labels following January 8, 2013 S/C clock reset.                                                                                                             |
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1. Purpose and Scope of Document

1.1. Purpose
This document will serve to provide users of the MESSENGER Neutron Spectrometer (NS) data products with a basic description of the Neutron Spectrometer instrument and Experiment Data Records (EDRs). The NS EDR data products are deliverables to the Planetary Data System (PDS) and the scientific community that it supports. Note that the Gamma Ray Spectrometer (GRS) and Neutron Spectrometer instruments are generally referred to together as the Gamma-Ray and Neutron Spectrometer (GRNS) instrument. However they are two separate instruments, each with its own Event Processing Unit (EPU) and the data products are described within the specific SIS of each instrument. This document is both an EDR data product SIS and an EDR archive volume SIS.

1.2. Scope
This Software Interface Specification (SIS) document is of a very limited scope due to the EDRs being of a very low-level. It does not provide a description or understanding of the NS instrument or its EDRs at a detailed level. It is not intended for general use by data analysts outside of the MESSENGER project and it is not intended for the typical science user to access the EDRs routinely. Rather, the EDRs are mainly useful as an input to producing the Calibrated Data Record (CDR) and Reduced Data Record (RDR) products. There will be a separate PDS data archive for the CDR and RDR products and these products will be described by a separate RDR SIS.

Data are converted to engineering and science units from raw EDR units (such as conversion of bins to energies and binary numbers to temperatures) in the CDRs, which will be accompanied by calibration reports describing the calibration process. CDR and RDR products planned to be produced are identified in the MESSENGER Data Management and Archiving Plan which also contains the schedule for their delivery to PDS.

2. Applicable Documents
The MESSENGER NS SIS is responsive to the following Documents:

- MESSENGER Data Management and Archiving Plan, The Johns Hopkins University, APL. Document ID number 7384-9019
3. Relationships with other Interfaces
The NS data products are stored on Hard Disk and in an SQL (Structured Query Language) relational database for rapid mission access during mission operations. The data products will be electronically transferred to the PDS Geosciences Node according to the delivery schedule in the MESSENGER Data Management and Archiving Plan. The data in the EDR files themselves will be stored in a PDS binary table object with the exception of the NS Status and NS Calibration/Diagnostic EDRs. These two EDRs will consist of data stored in PDS ASCII table objects.

4. Roles and Responsibilities
The roles and responsibilities of the instrument teams, Applied Physics Lab (APL), Applied Coherent Technology (ACT), and the Planetary Data System (PDS) are defined in the MESSENGER Data Management and Archiving Plan.

5. Data Product Characteristics and Environment

5.1. Instrument Overview
The Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) mission is designed to orbit Mercury following two flybys each of Venus and Mercury. It launched in August 2004 and will use several flybys of Venus and Mercury to achieve an orbit insertion around Mercury on March 2011. Initial data collection will begin during the first two flybys of Mercury, and will primarily consist of global mapping and measurements of the surface, atmosphere and magnetosphere composition.

MESSENGER will then remain in orbit for the rest of the nominal mission, which is scheduled to end in March 2012 [see MESSENGER Data Management and Archiving Plan for extended mission updates]. Once in orbit around Mercury it will begin a series of observations using multiple instruments. These observations will provide data to answer questions about the nature and composition of Mercury’s crust, tectonic history, the structure of the atmosphere and magnetosphere, and the nature of the polar caps.

The Neutron Spectrometer (NS) is one of the instruments onboard the MESSENGER spacecraft. It is designed to observe the neutrons emitted from Mercury’s surface in the thermal, epithermal, and fast energy ranges, from ~ 0.01 eV to 7 MeV, that are produced by nuclear reactions by the cosmic ray background (CRB). Elements that can be most readily identified by the NS include those that strongly moderate and absorb neutrons (hydrogen and rare earths). The approximate average element atomic mass can also be
estimated. It may be feasible for the NS to measure the water content at Mercury’s north pole.

The MESSENGER NS consists of a sandwich of three scintillators that are optically decoupled from each other. The first and third scintillators are lithium ($^6$Li)-glass scintillators (LiG) which respond to a combination of thermal and epithermal neutrons that span the range between 0 eV and about 1 keV. (Thermal neutrons correspond to 0 to ~ 0.025 eV and epithermal neutrons correspond to ~ 0.025 eV up to ~ several keV.) The middle scintillator is a borated plastic (BP) scintillator that responds only to epithermal and fast neutrons, since it is surrounded by thermal neutron absorbers (LiG on each end and wrapped with a sheet of gadolinium). Each of these scintillators generates a neutron spectrum (or histogram) When a neutron interacts with one of these scintillators, a charge is generated in its electronics. The charge is converted into one of 64 LiG channels (32 for the old NS spectra in Sec. 5.2) or 64 (BP) channels, which are correlated to the energy deposited in the scintillators. Over a commanded integration time period the distribution of events (neutron interactions) as a function of equivalent-electron energy (channel number) is recorded. The result is a histogram of the number of events in each channel accumulated over the integration period, which is designated as a singles prompt neutron spectrum. Three such spectra are produced, one by each lithium-glass (LiG) scintillator and one by the borated plastic (BP) scintillator. (Some of the neutrons detected in the BP scintillator will be downscattered to thermal energies and be detected in the LiG scintillators.)

Time-correlated events in the BP scintillator provide a measure of the neutron energies of the flux of fast neutrons $0.7 \text{ MeV} < E < 7 \text{ MeV}$). These events are defined by a time-correlated pair of interactions in the BP scintillator. The first pulse corresponds to a neutron that loses all of its energy (above detection threshold and thermal neutron energies) in the BP scintillator, since the second pulse corresponds to the energy released by the $^{10}\text{B}(n,\alpha)^{7}\text{Li}$ reaction after the neutron has slowed down to thermal energies and has been absorbed in the scintillator. The signature of the time-correlated events includes the pulse height (measure of energy) of the first event (called the prompt energy, $E_p$), the pulse height of the second event that corresponds to the Q-value of the $^{10}\text{B}(n,\alpha)^{7}\text{Li}$ reaction (called the capture energy, $E_c$), and the time between first and second events (or Time To Second Pulse, TTSP). When a fast neutron interacts with the BP scintillator, a charge is generated corresponding to $E_p$. The charge is converted into channels, which are correlated to neutron energy. Over a commanded integration time period the distribution of $E_p$ events as a function of energy (channel number) is recorded. The result is a histogram of the number of $E_p$ events in each channel accumulated over the integration period for TTSP values between 0.3 and 5.4 $\mu$s, which is designated as the time-correlated early spectrum corresponding to $E_c$. A time-correlated late spectrum histogram is also accumulated, for events whose second pulse occurs substantially later than expected, for TTSP values between 20 and 25 $\mu$s, as a measure of spectrum background. The two TTSP spectra each have 256 channels (8 quasilog channels for the old NS spectra in Sec. 5.2).
In addition to the five spectra described above, the NS EDRs include a precommanded set of up to the first 256 events of BP event-mode data at higher precision \( E_p \), \( E_c \), and TTSP values (16 bits, 16 bits, and 8 bits respectively). \( E_p \) has a precision of only 8 bits for the old NS events in Sec. 5.2. The event-mode data \( (E_p, E_c, \text{and TTSP}) \) are event-by-event time-series data of fast-neutron events, rather than energy histograms. Over the integration time period, a set of event classification flags is polled to determine whether valid BP sensor events have occurred. An additional event mode produces the Calibration/Diagnostics data in higher precision along with data quality and event classification flags, up to the first 96 events, as generated in any of the LG or BP sensors. (Normally only the instrument engineer would activate the Calibration/Diagnostics mode and examine the subsequent data.)

Neutron and gamma-ray burst modes are also available. The gamma-ray and neutron burst data packets are of astrophysical interest and are present when the corresponding mode is activated. Gamma-rays are detected by the NS sensors, as well as neutrons, and the BP sensor detects gamma-rays of the widest energy range with the highest efficiency, of the three sensors. Gamma-ray bursts are detected as BP counts that exceed a settable threshold over background as determined by a running average of a counter. The gamma-ray burst packet contains a time series of 1-s counts starting and ending at settable pre- and post-trigger times, along with the trigger time and other parameters. Neutron burst packets are not really detected bursts against some threshold but rather a subset of the normal neutron science packets called Short Science packets (fast neutrons only) that allows determination of neutron bursts as a reduced data set, enabling neutron burst mode to operate on much shorter time scales with little increase in data rate. These modes are useful for examining solar events, particularly solar neutrons.

Another data mode, available only after the software upload described in Sec. 5.2, is the GCR (Galactic Cosmic Ray) mode, in which GCRs are identified by coincidence between each LiG sensor and the BP sensor (double coincidences) and/or by coincidences between all three sensors (triple coincidences). The two 64-channel spectra from the LiG sensors associated with these coincidences have a broad central peak that facilitates setting gains and discriminators for these sensors. The non-coincident LiG sensor spectra have no identifiable peak, making such settings difficult.

The NS data rate is driven by the integration time for the spectra, since these EDRs constitute the largest amount of data. Since the orbital neutron flux is significantly higher than the gamma-ray flux, the NS integration times can be smaller than those for the GRS while still retaining statistical significance. Assumption of a reasonable 20-second integration time at low and moderate altitudes and correspondingly larger integration times at higher altitudes yields an estimated data rate of 4 Mbits per earth day. Further information on the NS instrument can be found in the MESSENGER instrument paper (not yet published).

### 5.2. Data Product Overview

There are ten different types of NS data products. The data products are identified via the value for the STANDARD_DATA_PRODUCT_ID within each PDS label. The data
products were modified by a software upload that occurred on 6/1/2006 (DOY 152). The upload occurred just after the NS was booted up on this date, so this upload applies to all data products generated on or after 6/1/2006. The NS Spectra was replaced by the NS Full Science Spectra in this upload, the NS GCR Spectra was created, and minor updates were made to some other data products. The NS Full Science Spectra and GCR Spectra have new ApIDs. The EDR format is designed to accommodate all data products before and after the software upload transparently. The data products are described as follows:

<table>
<thead>
<tr>
<th>Data Product</th>
<th>Product Description</th>
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<tbody>
<tr>
<td>NS Full Science Spectra</td>
<td>• Detached PDS label file&lt;br&gt;• Data file – contains 5 spectra histogram arrays, status and software counters from all three sensors in a binary table&lt;br&gt;• Created as a result of 6/1/2006 flight software update. Replaces NS Spectra EDRs till end of mission</td>
</tr>
<tr>
<td>NS Spectra</td>
<td>• Detached PDS label file&lt;br&gt;• Data file - Contains 5 spectra histogram arrays, status, and software counters from all three sensors in a binary table&lt;br&gt;• Replaced by NS Full Science spectra as a result of 6/1/2006 flight software update</td>
</tr>
<tr>
<td>NS Events</td>
<td>• Detached PDS label file&lt;br&gt;• Data file - contains BP events time series in a binary table</td>
</tr>
<tr>
<td>NS Galactic Cosmic Ray (GCR)</td>
<td>• Detached PDS label file&lt;br&gt;• Data file – Galactic Cosmic Ray spectra and counters from LiG sensors in a binary table&lt;br&gt;• Created by 6/1/2006 flight software update</td>
</tr>
<tr>
<td>NS Gamma Burst</td>
<td>• Detached PDS label file&lt;br&gt;• Data file - Gamma Burst BP time series in a binary table</td>
</tr>
<tr>
<td>NS Short Science</td>
<td>• Detached PDS label file&lt;br&gt;• Data file – Contains 3 BP spectra histogram arrays in a binary table (“neutron burst mode”)</td>
</tr>
<tr>
<td>NS TC Counts</td>
<td>• Detached PDS label file&lt;br&gt;• Data file – Time-correlated “neutron burst mode” counts in binary table</td>
</tr>
<tr>
<td>NS Status</td>
<td>• Detached PDS label file&lt;br&gt;• Data file – critical state information in an ASCII table</td>
</tr>
<tr>
<td>NS Calibration / Diagnostic</td>
<td>• Detached PDS label file.&lt;br&gt;• Data file – events time series for all three sensors in an ASCII table</td>
</tr>
<tr>
<td>Command Echo</td>
<td>• Detached PDS label file.&lt;br&gt;• Data file – command echo information stored in an ASCII table.</td>
</tr>
</tbody>
</table>

**NS Full Science Spectra EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_FULLSPECTRA”. Contains the five spectra histogram arrays, LiG1, LiG2, BPS, BPET, and BPLT (LiG sensors 1 and 2, BP
singles, BP early time correlated, and BP late time correlated, respectively), and associated counters, data collected by the NS in “Full Science” mode. Data is stored in a PDS binary table. This EDR replaces the NS Spectra EDR as a result of a flight software update in which the previous “Science Mode” packet is retired and replaced by the “Full Science Mode” packet. The Full Science Spectra data will be organized such that one EDR file will contain all the data with timestamps that correspond to a given Earth day.

The LiG1, LiG2, and BPS spectra each have 64 bins, while the BPET and BPLT spectra each have 256 bins. Each spectrum has the following scaling capability: bin counts premultiplied by 2, and commandable divide by N (separate N for each spectrum). New BPET and BPLT software counters were added in the update, and the LG1/BPS and LG2/BPS software counters were removed; also sensor and LVPS temperatures were added.

**NS Spectra EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_SPECTRA”. Contains the five spectra histogram arrays, LiG1, LiG2, BPS, BPET, and BPLT, data collected by the NS in “Science Data” mode. Data is stored in a PDS binary table. This EDR is longer created past February 2006 as a result of a flight software update. The NS Spectra data will be organized such that one EDR file will contain all the data with timestamps that correspond to a given Earth day.

The LiG1 and LiG2 spectra each have 32 bins, the BPS spectrum has 64 bins, and the BPET and BPLT spectra each have 8 quasi-log bins. Each spectrum has the following scaling capability: bin counts premultiplied by 2 and fixed power-of-2 divide.

**NS Events EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_EVENTS”. Contains event data time series collected by the NS in “Full Science” mode. Data is stored in a binary table. The data file is organized such that one EDR file will contain all the events data with timestamps that correspond to a given Earth day. The events data are transmitted in the same science telemetry packet that contains the NS spectra data. An individual science telemetry packet will contain from 0-255 events. Events are not individually timetagged. Instead, the Mission Elapsed Time (MET) recorded by the science telemetry packet will be assigned to all N events. Thus 1-255 events will share the same MET time tag within a given EDR. The MET records the start of the reporting/accumulation period.

As stated above in Sec. 5.1, E_p, E_c, and TTSP values have precision 16 bits, 16 bits, and 8 bits respectively. (E_p has a precision of only 8 bits for the old NS events prior to the software update.)

**NS Galactic Cosmic Ray EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_GALACTIC_COSMICRAY”. Contains LiG1 and LiG2 Galactic Cosmic Ray spectra and associated counters. Data is stored in a binary table. Each Galactic Cosmic Ray EDR file will contain all the data with
timestamps that correspond to a given Earth day. This data product is not available before the software update.

The two GCR spectra each have 64 bins and have the same scaling capability as mentioned for the Full Science Spectra above. Double or triple coincidence mode is commandable.

**NS Gamma burst EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_GAMMA_BURST”. Contains Gamma Ray burst data time series collected by the NS in “Gamma Burst” mode. Data is stored in a binary table. Each Gamma Burst EDR file will contain all the Gamma Bursts data with timestamps that correspond to one Earth day.

**NS Short Science EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_SHORTSCIENCE”. Contains data collected by the NS in “Short Science” mode, otherwise called “neutron burst” mode. In short science mode the data telemetered from the spacecraft is a subset of the data in “Full Science” mode. It may be generated as a result of telemetry constrained situations. The data includes 3 spectra histogram arrays - BPS, BPET and BPLT stored in a binary table. Each Short Science EDR file will contain all the data with timestamps that correspond to a given Earth day.

This EDR essentially renames the “so-called” NS Neutron Burst Spectra EDR as a result of the flight software update. Also the BPS spectrum is added in the update. And the changes made in the relevant spectra and scaling by the update apply (mentioned above for the Full Science Spectra).

**NS Time-Correlated Counts EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_TIME_CORRELATED_COUNTS”. Contains data collected by the NS in “TC Counters” mode, otherwise called “neutron burst” counter mode. Contains the BP TC Early Counter, whose value equals the summation of every channel in the early time-correlated spectra, and the BP TC late counter, whose value equals the summation of every channel in the late time-correlated spectra. Data is stored in a binary table. Each Time-Correlated counters EDR file will contain all the Neutron burst counters with timestamps that correspond to one Earth day. This EDR essentially renames the NS Neutron Burst Counter EDR.

**NS Status EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_STATUS”. Contains critical state information recorded in the NS Status Telemetry packet. Data is stored in an ASCII table. Each Status EDR file will contain all the status data with timestamps that correspond to one Earth day. This EDR had some fields omitted, added, or modified by the software update.

**NS Calibration/Diagnostic EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_CALIBRATION_DIAGNOSTIC”. Contains the calibration event series data recorded in the NS Calibration/Diagnostic telemetry packet for all three sensors. Each Calibration/Diagnostic EDR file will contain all the diagnostic event data with a time stamp that corresponds to one Earth day. A calibration/diagnostic telemetry packet contains data for the first 96 events that are recorded in a given accumulation period. If less than 96 events are collected then the packet only contains data on the events that did occur. The event data collected by the calibration/diagnostic telemetry packet are not individually time tagged. Instead, the MET recorded by the packet, which corresponds to the start of the accumulation period, will be assigned to all 96 events (or the actual events that were recorded, if less than 96). Thus, 1-96 events will share the same MET time tag in a given Calibration/Diagnostic EDR. This mode is expected to be used only by the instrument engineer, for event diagnostics.

**NS Command Echo EDR**
The STANDARD_DATA_PRODUCT_ID is “NS_COMMAND_ECHO”. Contains the commands executed by the spacecraft as well as information on command arguments, command success, and time tags of the command. Each EDR file will contain all the command echo data with timestamps that correspond to one Earth day.

### 5.3. Data Processing

#### 5.3.1. Data Processing Level

There is one EDR Data Archive Volume for the NS instrument. The data volume will contain level 2 CODMAC data products or EDRs. Each product will have a unique file name and conform to the file naming convention in section 6.4. All EDR products will be stored at the Applied Physics Laboratory/Science Operations Center (APL/SOC) during mission operations. The data volume will be electronically transferred to the PDS Geosciences Node following the procedure in section 5.3.3.

#### 5.3.2. Data Product Generation

The Neutron Spectrometer EDR files will be produced by the MESSENGER Science Operations Center (SOC) operated jointly by APL and ACT. Data downlink is telemetered through NASA’s Deep Space Network (DSN) managed by the Jet Propulsion Laboratory in Pasadena, CA, and then forwarded to APL. Inputs to the SOC will consist of telemetry in the form of CCSDS packets. Level-1 NS raw spectral and engineering data is then broken out of the data stream and stored online at the SOC. The ‘PIPE-NS2EDR’ software packages the Level 1 CODMAC data to the PDS formats defined in this SIS (section 5.3.4 and Appendices). The resulting files are designated as Level 2 CODMAC data or EDRs. The EDR data products are made available to the MESSENGER Science Team for initial evaluation and validation. At the end of the evaluation and validation period, the data are organized and stored in the directory.
structure described in section 6.5 for transmittal to the Geosciences Node. The transmittal process is described in section 5.3.3.

5.3.3. Data Flow
The MESSENGER SOC operates under the auspices of the MESSENGER Project Scientist to plan data acquisition and generate and validate data archives. The SOC supports and works with the Mission Operations Center (MOC), the Science Team, instrument scientists, and the PDS. The SOC will produce early versions of products that can be used by the science and instrument teams. The following chart shows the data flow from the different groups. The MOC handles raw data flow to and from the MESSENGER spacecraft and the SOC converts the telemetry into EDRs. The science team validates the EDRs and notifies the SOC if corrections are needed. Documentation and EDRs are delivered to the PDS Geosciences node. SPICE kernels are delivered to the PDS Navigation and Ancillary Information (NAIF) node.

The MESSENGER SOC will deliver data for the NS EDR data volume to the PDS Geosciences Node in standard product packages. Each package will comprise data and files organized into directory structures consistent with the volume design described in section 6.5.
Figure 1. MESSENGER data flow
The following describes the electronic transfer process of releasing data to PDS. This transfer process will be used for the first PDS delivery. Future data deliveries will be assumed to follow the same process unless otherwise noted in an update of this document. Given the long duration of the mission the project is reserving the option of exploring alternate data delivery methods for subsequent deliveries. As such, the method of electronic transfer may change and will be revised accordingly in the SIS. Any changes to the delivery process will be noted in an update to the SIS document and will include the specific dates which will use the new delivery process. The delivery of products to the data volume will follow the schedule in the MESSENGER Data Management and Archiving Plan.

In the week prior to the delivery date the directory structure will be compressed into a single “zip archive” file for transmittal to the PDS node. The zip archive preserves the directory structure internally so that it can be recreated after electronic delivery to the PDS node. The zip archive file is transmitted to the PDS node via FTP to an account set up by the receiving node. Also transmitted will be a checksum file created using the MD5 algorithm. This provides an independent method of verifying the integrity of the zip file after it has been sent. Within days of transmittal the PDS node will acknowledge receipt of the archive and checksum file. If acknowledgement is not received, or if problems are reported, the MESSENGER SOC will immediately take corrective action to effect successful transmittal.

After transmittal the PDS node will uncompress the zip archive file and check for data integrity using the checksum file. The node will then perform any additional verification and validation of the data provided and will report any discrepancies or problems to the MESSENGER SOC. It is expected that the node will perform these checks in about two weeks. After inspection has been completed to the satisfaction of the PDS node, the node will issue to the MESSENGER SOC acknowledgement of successful receipt of the data. Following receipt of a data delivery the PDS node will organize the data into a PDS volume archive structure within its online data system. Newly delivered data will be made available publicly from PDS once accompanying labels and other documentation have been validated.
5.3.4. Labeling and Identification

For every EDR data file there exists a detached PDS label file. Detached means that the label file is separate from the data file, as opposed to being in the header portion of the data file. The following are examples of PDS labels for each of the NS EDRs. Details about the label format are specified later in Section 6.3.

Each PDS label file will contain a pointer to an external format file. This format file describes the table structure of the EDR data file. Details for each format file are found in the Appendices.

5.3.4.1. NS Full Science Spectra PDS Label

PDS_VERSION_ID = "PDS3"

/*** FILE FORMAT ***/
FILE_RECORDS = 1439
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 1514

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "NS_FSP2006172ZZZ_DAT"
PRODUCT_VERSION_ID = "V1"
PRODUCT_CREATION_TIME = 2007-01-22T16:51:04
PRODUCT_TYPE = "DATA"
STANDARDS_PRODUCT_ID = "NS_FULLSPECTRA"
SOFTWARE_NAME = "PIPE-NS2EDR"
SOFTWARE_VERSION_ID = "1.0"
INSTRUMENT_HOST_NAME = "MESSENGER"
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
INSTRUMENT_ID = "NS"
DATA_SET_ID = "MSS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"
MISSION_PHASE_NAME = "VENUS 1 CRUISE"
TARGET_NAME = "CALIBRATION"
START_TIME = 2006-06-21T12:00:38.000
STOP_TIME = 2006-06-21T23:59:37.000
SPACECRAFT_CLOCK_START_COUNT = 59378381
SPACECRAFT_CLOCK_STOP_COUNT = 59421521
^TABLE = "NS_FSP2006172ZZZ.DAT"
OBJECT = TABLE
COLUMNS = 38
INTERCHANGE_FORMAT = BINARY
ROWS = 1439
ROW_BYTES = 1514
DESCRIPTION = "This table contains one set of spectra data, status, and software event counters collected from the MESSENGER Neutron Spectrometer (NS) and telemetered via the NS Full Science Data packet. A set is defined as all data with time stamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."
^STRUCTURE = "NS_FULLSPE.FMT"
END_OBJECT = TABLE
END

5.3.4.2. NS Spectra PDS Label

PDS_VERSION_ID = "PDS3"
5.3.4.3. NS Events PDS Label

FILE_RECORDS = 1140
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 378

PRODUCT_ID = "NS_EVT2005108ZZZ_DAT"
PRODUCT_VERSION_ID = "V1"
PRODUCT_CREATION_TIME = 2006-07-14T18:00:46
PRODUCT_TYPE = "DATA"
STANDARD_DATA_PRODUCT_ID = "NS_EVENTS"
SOFTWARE_NAME = "PIPE-NS2EDR"
SOFTWARE_VERSION_ID = "1.0"
INSTRUMENT_HOST_NAME = "MESSENGER"
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
INSTRUMENT_ID = "NS"
DATA_SET_ID = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"
MISSION_PHASE_NAME = "EARTH CRUISE"
TARGET_NAME = "CALIBRATION"
START_TIME = 2005-04-18T14:00:17.000
STOP_TIME = 2005-04-18T23:59:46.000
SPACECRAFT_CLOCK_START_COUNT = 22319954
SPACECRAFT_CLOCK_STOP_COUNT = 22355923

TABLE = "NS_EVT2005108ZZZ.DAT"
OBJECT = TABLE
COLUMNS = 30
INTERCHANGE_FORMAT = BINARY
ROWS = 1140
ROW_BYTES = 378

DESCRIPTION = "This table contains one set of spectra data, status, and software event counters collected from the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with time stamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."

"STRUCTURE = "NS_EVT.FMT"
END_OBJECT = TABLE
END
5.3.4.4.  Galactic Cosmic Ray PDS Label

PDS_VERSION_ID = "PDS3"

/*** FILE FORMAT ***/
FILE_RECORDS = 379
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 288

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "NS_GCR2006172ZZZ_DAT"
PRODUCT_VERSION_ID = "V1"
PRODUCT_CREATION_TIME = 2007-01-16T21:38:53
PRODUCT_TYPE = "DATA"
STANDARD_DATA_PRODUCT_ID = "NS_GALACTIC_COSMICRAY"
SOFTWARE_NAME = "PIPE-NS2EDR"
SOFTWARE_VERSION_ID = "1.0"
INSTRUMENT_HOST_NAME = "MESSENGER"
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
INSTRUMENT_ID = "NS"
DATA_SET_ID = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"
MISSION_PHASE_NAME = "VENUS 1 CRUISE"
START_TIME = 2006-06-21T12:00:37.000
STOP_TIME = 2006-06-21T15:09:37.000
SPACECRAFT_CLOCK_START_COUNT = 59378381
SPACECRAFT_CLOCK_STOP_COUNT = 59389721
^TABLE = "NS_GCR2006172ZZZ.DAT"

DESCRIPTION = "This table contains one set of galactic cosmic ray spectra data collected from the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with time stamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."
^STRUCTURE = "NS_GCR.FMT"
END_OBJECT = TABLE
END

5.3.4.5.  Gamma Burst PDS Label

PDS_VERSION_ID = "PDS3"

/*** FILE FORMAT ***/
FILE_RECORDS = 379
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 288

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "NS_GCR2006172ZZZ_DAT"
PRODUCT_VERSION_ID = "V1"
PRODUCT_CREATION_TIME = 2007-01-16T21:38:53
PRODUCT_TYPE = "DATA"
STANDARD_DATA_PRODUCT_ID = "NS_GALACTIC_COSMICRAY"
SOFTWARE_NAME = "PIPE-NS2EDR"
SOFTWARE_VERSION_ID = "1.0"
INSTRUMENT_HOST_NAME = "MESSENGER"
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
INSTRUMENT_ID = "NS"
DATA_SET_ID = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"
MISSION_PHASE_NAME = "VENUS 1 CRUISE"
START_TIME = 2006-06-21T12:00:37.000
STOP_TIME = 2006-06-21T15:09:37.000
SPACECRAFT_CLOCK_START_COUNT = 59378381
SPACECRAFT_CLOCK_STOP_COUNT = 59389721
^TABLE = "NS_GCR2006172ZZZ.DAT"

DESCRIPTION = "This table contains one set of galactic cosmic ray spectra data collected from the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with time stamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."
^STRUCTURE = "NS_GCR.FMT"
END_OBJECT = TABLE
END
**NS SIS revision date:** July 7, 2015

```plaintext
/*** FILE FORMAT ***/
FILE_RECORDS = 62
RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES  = 346

/*** GENERAL DATA DESCRIPTION PARAMETERS /***/
PRODUCT_ID = "NS_GAB2005133ZZZ_DAT"
PRODUCT_VERSION_ID = "V1"
PRODUCT_CREATION_TIME = 2006-03-10T15:42:19
PRODUCT_TYPE = "DATA"
STANDARD_DATA_PRODUCT_ID = "NS_GAMMA_BURST"
SOFTWARE_NAME = "PIPE-NS2EDR"
SOFTWARE_VERSION_ID = "1.0"
INSTRUMENT_HOST_NAME = "MESSENGER"
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
INSTRUMENT_ID = "NS"
DATA_SET_ID = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"
MISSION_PHASE_NAME = "EARTH CRUISE"
TARGET_NAME = "CALIBRATION"
START_TIME = 2005-05-13T19:36:06.000
SPACECRAFT_CLOCK_START_COUNT = 24500110
SPACECRAFT_CLOCK_STOP_COUNT = 24515648
^TABLE = "NS_GAB2005133ZZZ.DAT"
OBJECT = TABLE
COLUMNS = 8
INTERCHANGE_FORMAT = BINARY
ROWS = 62
ROW_BYTES = 346
DESCRIPTION = "This table contains one set of Gamma burst data collected from the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with time stamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."
^STRUCTURE = "NS_GAB.FMT"
END_OBJECT = TABLE
END

5.3.4.6. **Short Science PDS Label**

```plaintext
PDS_VERSION_ID = "PDS3"
/*** FILE FORMAT ***/
FILE_RECORDS = 6
RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES  = 1184

/*** GENERAL DATA DESCRIPTION PARAMETERS /***/
PRODUCT_ID = "NS_SSP2006167ZZZ_DAT"
PRODUCT_VERSION_ID = "V1"
PRODUCT_CREATION_TIME = 2006-01-12T22:04:20
PRODUCT_TYPE = "DATA"
STANDARD_DATA_PRODUCT_ID = "NS_SHORTSPECTRA"
SOFTWARE_NAME = "PIPE-NS2EDR"
SOFTWARE_VERSION_ID = "1.0"
INSTRUMENT_HOST_NAME = "MESSENGER"
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
INSTRUMENT_ID = "NS"
DATA_SET_ID = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"
MISSION_PHASE_NAME = "VENUS 1 CRUISE"
TARGET_NAME = "CALIBRATION"
START_TIME = 2006-06-16T13:08:39.000
```
STOP_TIME = 2006-06-16T13:11:09.000
SPACECRAFT_CLOCK_START_COUNT = 58950463
SPACECRAFT_CLOCK_STOP_COUNT = 58950613
^TABLE = "NS_SSP2006167ZZZ.DAT"

OBJECT = TABLE
COLUMNS = 17
INTERCHANGE_FORMAT = BINARY
ROWS = 6
ROW_BYTES = 1184
DESCRIPTION =
This table contains one set of spectra data collected from the MESSENGER Neutron Spectrometer (NS) and telemetered via the NS Short Science Data packet. A set is defined as all data with time stamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document.

^STRUCTURE = "NS_SHORTSCI.FMT"
END_OBJECT = TABLE
END

5.3.4.7. Time-Correlated Counts PDS Label

PDS_VERSION_ID = "PDS3"

/*** FILE FORMAT ***/
FILE_RECORDS = 57
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 14

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "NS_TCC2006068ZZZ_DAT"
PRODUCT_VERSION_ID = "V1"
PRODUCT_CREATION_TIME = 2007-01-18T17:01:12
PRODUCT_TYPE = "DATA"
STANDARD_DATA_PRODUCT_ID = "NS_TIME_CORRELATED_COUNTS"
SOFTWARE_NAME = "PIPE-NS2EDR"
SOFTWARE_VERSION_ID = "1.0"
INSTRUMENT_HOST_NAME = "MESSENGER"
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
INSTRUMENT_ID = "NS"
DATA_SET_ID = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"
MISSION_PHASE_NAME = "VENUS 1 CRUISE"
TARGET_NAME = "CALIBRATION"
START_TIME = 2006-03-09T14:49:32.000
STOP_TIME = 2006-03-09T14:58:52.000
SPACECRAFT_CLOCK_START_COUNT = 50402916
SPACECRAFT_CLOCK_STOP_COUNT = 50403476
^TABLE = "NS_TCC2006068ZZZ.DAT"

OBJECT = TABLE
COLUMNS = 4
INTERCHANGE_FORMAT = BINARY
ROWS = 57
ROW_BYTES = 14
DESCRIPTION =
This table contains one set of time-correlated spectra counters collected from the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with timestamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document.

^STRUCTURE = "NS_TCC.FMT"
END_OBJECT = TABLE
END
5.3.4.8. Status PDS Label

PDS_VERSION_ID = "PDS3"

/*** FILE FORMAT ***/  
FILE_RECORDS = 1680  
RECORD_TYPE = FIXED_LENGTH  
RECORD_BYTES = 622

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/  
PRODUCT_ID = "NS_STA2005108ZZZ_TAB"  
PRODUCT_VERSION_ID = "V1"  
PRODUCT_CREATION_TIME = 2006-07-14T21:24:46  
PRODUCT_TYPE = "ANCILLARY"  
STANDARD_DATA_PRODUCT_ID = "NS_STATUS"  
SOFTWARE_NAME = "PIPE-NS2EDR"  
SOFTWARE_VERSION_ID = "1.0"  
INSTRUMENT_HOST_NAME = "MESSENGER"  
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"  
INSTRUMENT_ID = "NS"  
DATA_SET_ID = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"  
MISSION_PHASE_NAME = "EARTH_CRUISE"  
TARGET_NAME = "CALIBRATION"  
START_TIME = 2005-04-18T13:53:23.000  
STOP_TIME = 2005-04-18T23:59:48.000  
SPACECRAFT_CLOCK_START_COUNT = 22319540  
SPACECRAFT_CLOCK_STOP_COUNT = 22355925  
TABLE = "NS_STA2005108ZZZ.TAB"  
OBJECT = TABLE  
COLUMNS = 103  
INTERCHANGE_FORMAT = ASCII  
ROWS = 1680  
ROW_BYTES = 622  
DESCRIPTION = "This table contains one set of status telemetry information gathered by the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with timestamps corresponding to a given Earth day. The complete column definitions are contained in an external file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."

STRUCTURE = "NS_STATUS.FMT"  
END_OBJECT = TABLE  
END

5.3.4.9. Calibration/Diagnostic PDS Label

PDS_VERSION_ID = "PDS3"

/*** FILE FORMAT ***/  
FILE_RECORDS = 58841  
RECORD_TYPE = FIXED_LENGTH  
RECORD_BYTES = 80

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/  
PRODUCT_ID = "NS_CAD2004225ZZZ_TAB"  
PRODUCT_VERSION_ID = "V1"  
PRODUCT_CREATION_TIME = 2006-03-13T15:45:27  
PRODUCT_TYPE = "ANCILLARY"  
STANDARD_DATA_PRODUCT_ID = "NS_CALIBRATION_DIAGNOSTIC"  
SOFTWARE_NAME = "PIPE-NS2EDR"  
SOFTWARE_VERSION_ID = "1.0"  
INSTRUMENT_HOST_NAME = "MESSENGER"  
INSTRUMENT_NAME = "NEUTRON SPECTROMETER"
### Instrument ID

**INSTRUMENT_ID**  = "NS"

**DATA_SET_ID**  = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"

**MISSION_PHASE_NAME**  = "LAUNCH"

**TARGET_NAME**  = "CALIBRATION"

**START_TIME**  = 2004-08-12T20:44:41.000

**STOP_TIME**  = 2004-08-12T21:22:01.000

**SPACECRAFT_CLOCK_START_COUNT**  = 830719

**SPACECRAFT_CLOCK_STOP_COUNT**  = 832959

**TABLE**  = "NS_CAD2004225ZZZ.TAB"

**OBJECT**  = TABLE

**COLUMNS**  = 11

**INTERCHANGE_FORMAT**  = ASCII

**ROWS**  = 58841

**ROW_BYTES**  = 80

**DESCRIPTION**  = "This table contains one set of calibration and diagnostic data collected from the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with timestamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."

**STRUCTURE**  = "NS_CAL_DIAG.FMT"

**END_OBJECT**  = TABLE

**END**

---

#### 5.3.4.10. Command Echo PDS Label

**PDS_VERSION_ID**  = "PDS3"

/*** FILE FORMAT /***

**FILE_RECORDS**  = 59

**RECORD_TYPE**  = FIXED_LENGTH

**RECORD_BYTES**  = 125

/*** GENERAL DATA DESCRIPTION PARAMETERS /***

**PRODUCT_ID**  = "NS_CMD2008214ZZZ_TAB"

**PRODUCT_VERSION_ID**  = "V1"

**PRODUCT_CREATION_TIME**  = 2008-12-05T20:04:15

**PRODUCT_TYPE**  = "ANCILLARY"

**STANDARD_DATA_PRODUCT_ID**  = "NS_COMMAND_ECHO"

**SOFTWARE_NAME**  = "PIPE-NS2EDR"

**SOFTWARE_VERSION_ID**  = "1.0"

**INSTRUMENT_HOST_NAME**  = "MESSENGER"

**INSTRUMENT_NAME**  = "NEUTRON SPECTROMETER"

**INSTRUMENT_ID**  = "NS"

**DATA_SET_ID**  = "MESS-E/V/H-GRNS-2-NS-RAWDATA-V1.0"

**MISSION_PHASE_NAME**  = "MERCURY 2 CRUISE"

**TARGET_NAME**  = "CALIBRATION"

**START_TIME**  = 2008-08-01T14:46:19

**STOP_TIME**  = 2008-08-01T15:22:28

**SPACECRAFT_CLOCK_START_COUNT**  = 126089415

**SPACECRAFT_CLOCK_STOP_COUNT**  = 126091584

**TABLE**  = "NS_CAD2004225ZZZ.TAB"

**OBJECT**  = TABLE

**COLUMNS**  = 11

**INTERCHANGE_FORMAT**  = ASCII

**ROWS**  = 59

**ROW_BYTES**  = 125

**DESCRIPTION**  = "This table contains one set of commands executed by the MESSENGER Neutron Spectrometer (NS). A set is defined as all data with timestamps corresponding to a given Earth day. The complete column definitions are contained in an external structure file found in the LABEL directory of the archive volume. Additional details are contained in the EDR SIS document."

**STRUCTURE**  = "NS_CMDECHO.FMT"
5.4. Standards Used in Generating Data Products

5.4.1. PDS Standards
The NS EDR data products are constructed according to the data object concepts developed by the PDS. By adopting the PDS format, the data products are consistent in content and organization with other planetary data collections. In the PDS standard, the EDR data file is grouped into objects with PDS labels describing the objects. Each EDR data product consists of the following:

- A data file containing an ASCII or binary table object, in fixed field format. ASCII table objects are additionally in comma separated value (CSV) format. This makes the ASCII data extremely easy to read by many commercial off-the-shelf programs. See section 5.2 for a listing of the data products and whether the data is contained in an ASCII or binary table object.
- A label file which serves as a high-level description of the parameters which correspond to the data file. The label file contains a pointer to an external format file which details the structure of the table object in the data file.

5.4.2. Coordinate Systems
SPICE kernels will be archived at the PDS NAIF node. Coordinate systems will be included in the appropriate RDR SIS documents.

5.4.3. Time Standards
The MET field in the NS EDR tables matches the spacecraft time in integer seconds that is transmitted to MESSENGER subsystems by the Integrated Electronics Module (IEM). This is referred to by the MESSENGER project as Mission Elapsed Time (MET). MET = 0 is August 3, 2004, at 05:59:16 UTC, which is 1000 seconds prior to the MESSENGER launch. Relativistic effects and circumstances occurring during the mission would result in MET not being a true account of seconds since launch. Following a planned spacecraft clock reset\(^1\) on January 8, 2013, partition numbers (1/, or 2/) were added to product labels to disambiguate MET seconds after the spacecraft clock reset (if partition number is not present, SPICE defaults to partition 1/). For this reason the MESSENGER spacecraft clock coefficients file is archived at the PDS Navigation and Ancillary Information Facility (NAIF) Node. This file is used in conjunction with the leapseconds kernel file in order to calculate the conversion between MET and UTC.

\(^1\) See instrument host catalog file in NS EDR volume catalog directory for more information on MESSENGER spacecraft clock reset.
The conversion is easily done through the use of SPICE kernels and the CHRONOS Utility. CHRONOS is a utility included with the SPICE package that is distributed by the PDS NAIF node. The SPICE kernels are files that contain the information needed to perform the conversion. Two SPICE kernels are required. One is the Leapseconds Kernel (LSK) and the other is the MESSENGER Spacecraft Clock Kernel (SCLK). The SCLK file is used by CHRONOS to convert between spacecraft clock time and ephemeris time, while the LSK file is used to convert from ephemeris time to UTC time. The CHRONOS utility is self-documenting and the SPICE package itself contains full documentation on each of the utilities (including CHRONOS) and how they are used.

5.4.4. Data Storage Conventions

The data are organized following PDS standards and stored on hard disk and an SQL (Structured Query Language) relational database for rapid access during mission operations. The MESSENGER SOC will transfer data to PDS via electronic transfer and delivery methods as detailed in section 5.3.3. After verification of the data transfer PDS will provide public access to MESSENGER science data products through its online data distribution system.

5.5. Data Validation

The NS EDR data products will be validated by the NS Instrument scientist for science content and for compliance with PDS archive standards [MESSENGER Data Management and Archiving Plan].

6. Detailed Data Product Specification

6.1. Data Product Structure and Organization

The MESSENGER NS data set will be archived at the PDS Geosciences node as a data archive volume. The NS EDR products in the data archive volume are intended to store the data in a form closest to the raw telemetry data received from the spacecraft. The automated production and release of EDRs will follow the release schedule in the MESSENGER Data Management and Archiving Plan. There is only one NS EDR data archive volume which will be created at the first delivery to PDS. Subsequent deliveries to PDS will update this data volume. If errors are discovered the data will be replaced with corrected EDRs on the next scheduled delivery date.

The EDRs are organized in the data archive volume according to the structure defined in section 6.5. First there is the top level <DATA> directory. Then subsequent directories are organized into folders by year. In each year folder there are directories organized by month. The PDS START_TIME keyword in the EDR is used to determine the year and month directory in which the EDR will be placed.
6.2. Data Format Description
Data is stored in ASCII table format or in binary table format. A detached PDS label file will provide a detailed description of the structure of each table. See section 5.2 for details on which EDR contains a binary table or an ASCII table.

6.3. Label and Header Descriptions

6.3.1. PDS Label File Format
The following are the keyword definitions for the detached PDS label file. The detached PDS label file has the same name as the data file it describes, except for the extension .LBL to distinguish it as a label file.

**PDS_VERSION_ID**
Represents the version number of the PDS standards documents that is valid when a data product label is created. PDS3 is used for the MESSENGER Data products.

**RECORD_TYPE**
The record_type element indicates the record format of a file. The FIXED_LENGTH value is appropriate for the BINARY table object used for the MESSENGER NS EDR data products.

**FILE_RECORDS**
The file_records element indicates the number of physical file records, including both label records and data records.

**RECORD_BYTES**
The number of bytes in a physical file record, including record terminators and separators.

**PRODUCT_ID**
The product_id data element represents a permanent, unique identifier assigned to a data product by its producer.

**PRODUCT_CREATION_TIME**
Defines the UTC system format time when the product was created.

**PRODUCT_VERSION_ID**
Identifies the version of an individual product within a data set.
Example: V1, V2, V3
Product_version_id will be incremented if a given EDR has to be regenerated and sent to PDS to replace a previously submitted EDR.

**PRODUCT_TYPE**
Identifies the type or category of a product within a data set.

**STANDARD_DATA_PRODUCT_ID**
Used to link a NS EDR file to one of the 7 types of NS data products defined within the NS EDR SIS.

**SOFTWARE_NAME**
Identifies the data processing software used to generate the EDR products.

**SOFTWARE_VERSION_ID**
Indicates the version of the data processing software used to generate the EDR products from the spacecraft telemetry.

**INSTRUMENT_HOST_NAME**
The full name of the host on which an instrument is based. In this case it is the MESSENGER spacecraft.

**INSTRUMENT_NAME**
The full, unabbreviated name of the instrument.

**INSTRUMENT_ID**
Unique id associated with the Neutron Spectrometer instrument.

**DATA_SET_ID**
The data_set_id element is a unique alphanumeric identifier for a data set or a data product. The data_set_id value for a given data set or product is constructed according to flight project naming conventions. There is only one data_set_id for the NS EDRs.

**MISSION_PHASE_NAME**
Provides the commonly used identifier of a mission phase.

**TARGET_NAME**
The target of the observation.

**START_TIME**
Provides the date and time of the beginning of an event or observation (whether it be a spacecraft, ground-based, or system event) in UTC system format.

**STOP_TIME**
Provides the date and time of the end of an observation or event (whether it be a spacecraft, ground-based, or system event) in UTC system format.

**SPACECRAFT_CLOCK_START_COUNT**
Mission Elapsed Time (MET) corresponding to the first record in the data table.

**SPACECRAFT_CLOCK_STOP_COUNT**
Mission Elapsed Time (MET) corresponding to the last record in the data table.

**^TABLE**
Pointer to the external data file which contains the table object.

**OBJECT**
Specifies that the PDS object containing the data. In the case of the NS EDRs the object is a binary or ASCII table. This object contains its own elements. NOTE: the end of the object definition is always marked with an END_OBJECT line.

**COLUMNS**
Identifies the number of columns (fields) in the table.

**INTERCHANGE_FORMAT**
Specifies the format of the table.

**ROWS**
The number of rows in the binary table.

**ROW_BYTES**
Specifies the number of bytes for each row in the table.

^STRUCTURE
This is a pointer to the external file which provides the structure definition for the table object.

6.3.2. Table Object Keyword Definitions
The following describes the keywords used to define the PDS table object:

OBJECT = COLUMN
Identifies this as a column in the table object.

COLUMN_NUMBER
Identifies the location of the column within the larger data object (such as a table). For tables consisting of rows (I= 1, N) and columns (j = 1, M) the column_number is the j-th index of any row.

NAME
Indicates a literal value representing the common term used to identify the column object.

BYTES
Specifies the number of bytes allocated for this particular column element.

DATA_TYPE
Specifies the internal representation and/or mathematical properties of the value being stored in this column.

START_BYTE
Identifies the location of the first byte of the particular column, counting from 1.

ITEMS
Defines the number of multiple, identical occurrences of a single object. Ex. For the NS Spectra EDR it indicates that column 8 is a 32-bin histogram.

ITEM_BYTES
Represents the size in bytes of an individual item.

6.4. File Naming Conventions
The general form of the NS EDR file name is "NS_ZZZYYYYDDDDWWW.XXX", where:

NS instrument identifier: represents the NS instrument
ZZZ EDR product identifier:
     FSP – Full Science Spectra EDR
     SPE – Spectra EDR
     EVT – Events EDR
     GCR – Galactic Cosmic Ray EDR
     GAB – Gamma Burst EDR
     SSP – Short Science EDR
     TCC – Time-Correlated Counts EDR
     STA – Status EDR
     CAD – Calibration/Diagnostic EDR
     CMD – Command Echo EDR
YYYY The four digit year corresponding to the start time of the first record in the data table.

DDD The three digit day of year corresponding to the start time of the first record in the data table.

WWW Reserved 3 character string to use during the course of the mission as necessary to identify “special” data products. Nominal data products will be identified with ‘ZZZ’.

XXX The file extension: detached PDS label files will be ‘LBL’, the binary data files will be ‘DAT’, ASCII data files are ‘TAB’.

6.5. Directory Structure and Contents for Static Volumes

The following illustration shows the directory structure overview for the NS EDR Data Archive Volume. This volume contains the NS EDR data products, supporting documentation, and any additional files required for the volume to be compliant with PDS standards. The content of the volume is expected to be updated with periodic releases according to the schedule in the MESSENGER Data Management and Archiving Plan. Revised EDRs (if needed) will also be delivered according to the same schedule. Revised EDRs will have an incremented version number in the PDS label.

Directory Structure Overview

```
<ROOT>
  |
  |
  <LABEL>
  |
  | <INDEX> <CATALOG> <DOCUMENT> |
  |
  <DATA>
  |
  |<2004> <2005> <2006> <2007> |
  |
  |<JANUARY> <FEBRUARY> |
```
6.5.1. Directory Contents

<ROOT> Directory
This is the top-level directory of a volume. The following are files contained in the root directory.

**AAREADME.TXT** - General information file. Provides users with an overview of the contents and organization of the associated volume, general instructions for its use, and contact information.

**VOLDESC.CAT** - PDS file containing the VOLUME object. This gives a high-level description of the contents of the volume. Information includes: production date, producer name and institution, volume ID, etc.

**ERRATA.TXT** - Text file for identifying and describing errors and/or anomalies found in the current volume, and possibly previous volumes of a set. Any known errors for the associated volume will be documented in this file.

<DOCUMENT> Directory
This subdirectory contains the documentation that will be needed in order to understand and analyze the EDR data products. Multiple copies of each document will be stored, each one in a different format. Files will be stored in PDF and ASCII format.

**DOCINFO.TXT** – Identifies and describes the function of each file in the DOCUMENT directory.

<CATALOG> Directory
This subdirectory contains the catalog object files for the entire volume. The following files are included in the catalog subdirectory.

**CATINFO.TXT**: Identifies and describes the function of each file in the catalog directory.

**DATASET.CAT**: Describes the general content of the dataset and includes information about the duration of the mission and the person or group responsible for producing the data.

**INSTRUMENT.CAT**: Describes physical attributes of the NS instrument and provides relevant references to published literature.

**INSTRUMENT_HOST.CAT**: Describes the MESSENGER spacecraft.

**MISSION.CAT**: Describes the scientific goals and objectives of the MESSENGER program. It also identifies key people and institutions.

**REF.CAT**: Contains the reference objects. These reference additional documents that may be useful to the person using the MLA EDR.

<INDEX> Directory
This subdirectory contains the indices for all data products on the volume. The following files are contained in the index subdirectory.

**INDEXINFO.TXT** – Identifies and describes the function of each file in the index subdirectory. This includes a description of the structure and contents of each index table in the subdirectory AND usage notes.
INDEX.TAB - The EDR index file is organized as a table: there is a row for each observation on the volume; the columns contain parameters that describe the observation and instrument and spacecraft parameters.

INDEX.LBL - Detached PDS label for INDEX.TAB. It contains the INDEX_TABLE object which identifies and describes the columns of the NS index table.

< LABEL > Directory

This subdirectory contains the format files for each of the different EDR product types. The format file describes the structure of the PDS Binary (or ASCII) table object in the EDR data file.

<Data> - Data Directory

This is the top level of the directory in which the EDRs are contained. The data directories are organized by year (YYYY) followed by month. The EDRs reside in the month folders. The START_TIME of the EDR is used to determine the year and month in which the EDR will be placed.

6.6. Archive Volume and File Size

The final NS EDR archive volume has a size of approximately 40 GB.

7. Archive Release Schedule to PDS

The MESSENGER NS EDR archive will be transferred from the SOC to the PDS Geosciences Node using the electronic transfer process detailed in section 5.3.3. The transfer will follow the schedule documented in the MESSENGER Data Management and Archiving Plan.
8. Appendices

8.1. **NS_FULLSPE.FMT Table Fields**

Below is a table that shows the structure of the binary table containing the NS Full Science Spectra data. Following this is the content of the format file itself.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>MET</td>
<td>Time tag in seconds of the start of the associated reporting/accumulation period.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>ACTUAL_ACCUM</td>
<td>Actual accumulation period for software counters and energy histograms.</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>GCR_MODE</td>
<td>Galactic Cosmic Ray (GCR) Coincidence mode.</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>SENSOR_CFG_CHANGED</td>
<td>Sensor configuration changed flag.</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG_SAFING</td>
<td>Maximum Lithium Glass (LG) safing level reached.</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_SAFING</td>
<td>Maximum Borated Plastic (BP) safing level reached.</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LOG_COMPRENSION</td>
<td>Identifies when the log compression data mode has been enabled.</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>SENSOR_TEMP</td>
<td>Sensor Temperature</td>
</tr>
<tr>
<td>23</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>TEMP_MONITOR</td>
<td>LVPS Temperature Monitor</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG1_SCALE</td>
<td>LG1 Singles spectrum scale</td>
</tr>
<tr>
<td>27</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG2_SCALE</td>
<td>LG2 Singles spectrum scale</td>
</tr>
<tr>
<td>29</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_SCALE</td>
<td>BP Singles spectrum scale</td>
</tr>
<tr>
<td>31</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>TC_SCALE</td>
<td>Time-correlated spectrum scale</td>
</tr>
<tr>
<td>33</td>
<td>2 X 64</td>
<td>MSB Unsigned Integer</td>
<td>Singles_LG1</td>
<td>64 channel histogram of event energies that arrived as a single event. Lithium Glass 1 sensor.</td>
</tr>
<tr>
<td>161</td>
<td>2 X 64</td>
<td>MSB Unsigned Integer</td>
<td>Singles_LG2</td>
<td>64 channel histogram of event energies that arrived as a single event. Lithium Glass 2 sensor.</td>
</tr>
<tr>
<td>289</td>
<td>2 X 64</td>
<td>MSB Unsigned Integer</td>
<td>Singles_BP_Spectra</td>
<td>64 channel histogram of event energies that arrived as a solo event. Borated Plastic sensor.</td>
</tr>
<tr>
<td>417</td>
<td>2 X 256</td>
<td>MSB Unsigned Integer</td>
<td>TC_EARLY</td>
<td>A histogram of prompt BP events that had a delayed BP event occurring during the early capture window.</td>
</tr>
<tr>
<td>929</td>
<td>2 X 256</td>
<td>MSB Unsigned Integer</td>
<td>TC_LATE</td>
<td>A histogram of prompt BP events that had a delayed BP event occurring during the late capture window.</td>
</tr>
<tr>
<td>1441</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_RAW_EVENTS</td>
<td>LG1 raw event software counter.</td>
</tr>
<tr>
<td>1445</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG2_RAW_EVENTS</td>
<td>LG2 raw event software counter.</td>
</tr>
<tr>
<td>1449</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>BP_RAW_EVENTS</td>
<td>BP raw event software counter.</td>
</tr>
<tr>
<td>1453</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>SW_TOTAL_EVENTS</td>
<td>Total events processed by software in the current accumulation period.</td>
</tr>
<tr>
<td>1457</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>DEAD_TIME</td>
<td>Dead time software counter.</td>
</tr>
<tr>
<td>1461</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_RESET</td>
<td>LG1 charge reset software counter.</td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>NAME</td>
<td>COLUMN_NUMBER</td>
<td>BYTES</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>---------------</td>
<td>-------</td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>NAME</td>
<td>COLUMN_NUMBER</td>
<td>BYTES</td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>NAME</td>
<td>COLUMN_NUMBER</td>
<td>BYTES</td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>NAME</td>
<td>COLUMN_NUMBER</td>
<td>BYTES</td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>NAME</td>
<td>COLUMN_NUMBER</td>
<td>BYTES</td>
</tr>
</tbody>
</table>

| 1465 | 4 | MSB Unsigned Integer | LG2_RESET | LG2 charge reset software counter. |
| 1469 | 4 | MSB Unsigned Integer | BP_RESET | BP charge reset software counter. |
| 1473 | 4 | MSB Unsigned Integer | BPP_LGXS | Software counter for prompt pulse in BP detector with delayed secondary pulse in LG1 or LG2 detector. |
| 1477 | 4 | MSB Unsigned Integer | LG1_OVER_RANGE | LG1 prompt over range software counter. |
| 1481 | 4 | MSB Unsigned Integer | LG2_OVER_RANGE | LG2 prompt over range software counter. |
| 1485 | 4 | MSB Unsigned Integer | BP_OVER_RANGE | BP prompt over range software counter. |
| 1489 | 4 | MSB Unsigned Integer | VALID_TC_EVENT | Valid time-correlated software counter. |
| 1493 | 4 | MSB Unsigned Integer | LG1_BPP_COIN | LG1/BPP coincidence event software counter. |
| 1497 | 4 | MSB Unsigned Integer | LG2_BPP_COIN | LG2/BPP coincidence event software counter. |
| 1501 | 4 | MSB Unsigned Integer | LG1_BPP_LG2_COIN | LG1/BPP/LG2 coincidence event software counter. |
| 1505 | 4 | MSB Unsigned Integer | TC_EARLY_COUNTER | Summation of all channels of early time-correlated spectra |
| 1509 | 4 | MSB Unsigned Integer | TC_LATE_COUNTER | Summation of all channels of late time-correlated spectra |
| 1513 | 2 | MSB Unsigned Integer | EVENT_MODE_DATA_LEN | Event mode data length. |
OBJECT  = COLUMN
  NAME   = SENSOR_CFG_CHANGED
  COLUMN_NUMBER = 5
  BYTES   = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 13
  DESCRIPTION = "Sensor Configuration Changed Flag.
  -0 config unchanged, =1 config changed."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME   = LG_SAFING
  COLUMN_NUMBER = 6
  BYTES   = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 15
  DESCRIPTION = "Maximum Lithium Glass (LG) safing level reached during
current reporting period.
  =0 nominal, =1 seeking, =2 level1_rampdown,
  =3 level1_waiting, =4 level1_seeking, =5 level2_safing."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME   = BP_SAFING
  COLUMN_NUMBER = 7
  BYTES   = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 17
  DESCRIPTION = "Maximum safing level reached during current reporting
period for the Borrated Plastic (BP) sensor.
  =0 nominal, =1 seeking, =2 level1_rampdown,
  =3 level1_waiting, =4 level1_seeking, =5 level2_safing."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME   = LOG_COMPRESSION
  COLUMN_NUMBER = 8
  BYTES   = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 19
  DESCRIPTION = "Identifies when the log compression data mode has
been enabled. The NS flight software uses 32-bit to 16-bit log compression
on software counters when the log compression data mode is enabled.
See the NS Flight Software document for details on the log compression
algorithm.
  =0 no log compression. =1 log compression enabled."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME   = SENSOR_TEMP
  COLUMN_NUMBER = 9
  BYTES   = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 21
  DESCRIPTION = "Sensor Temperature, External Channel 4 (LVPS)."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME   = TEMP_MONITOR
  COLUMN_NUMBER = 10
  BYTES   = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 23
  DESCRIPTION = "LVPS Temperature monitor."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME   = LG1_SCALE
COLUMN_NUMBER = 11
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 25
DESCRIPTION = "LG1 singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_SCALE
COLUMN_NUMBER = 12
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 27
DESCRIPTION = "LG2 singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_SCALE
COLUMN_NUMBER = 13
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 29
DESCRIPTION = "BP singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TC_SCALE
COLUMN_NUMBER = 14
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 31
DESCRIPTION = "Time-correlated spectra scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SINGLES_LG1
COLUMN_NUMBER = 15
BYTES = 128
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 33
ITEMS = 64
ITEM_BYTES = 2
DESCRIPTION = "Spectrum is a 64 channel histogram of event energies that arrived as a single event with no time correlation to the other sensors. LG1 is the Lithium Glass 1 sensor."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SINGLES_LG2
COLUMN_NUMBER = 16
BYTES = 128
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 161
ITEMS = 64
ITEM_BYTES = 2
DESCRIPTION = "Spectrum is a 64 channel histogram of event energies that arrived as a single event with no time correlation to the other sensors. LG2 is the Lithium Glass 2 sensor."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SINGLES_BP_SPECTRA
COLUMN_NUMBER = 17
BYTES = 128
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 289
ITEMS = 64
ITEM_BYTES = 2
DESCRIPTION = "BP is the Borated Plastic sensor. Spectrum is a 64 channel histogram of event energies that arrived as a solo event with respect to the other sensors."
The time-correlated early spectrum is a histogram of prompt BP events that had a delayed BP event occurring during the early capture window, as defined by commandable software parameters provided in columns 83 and 84 of the NS Status EDR, and no additional events in the event set.

The time-correlated late spectrum is a histogram of prompt BP events that had a delayed BP event occurring during the late capture window, as defined by commandable software parameters provided in columns 85 and 86 of the NS Status EDR, and no additional events in the event set.

LG1 raw event software counter.

LG2 raw event software counter.

BP raw event software counter.

Total events processed by software in the current accumulation period.
OBJECT        = COLUMN
NAME           = DEAD_TIME
COLUMNNUMBER   = 24
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 1457
DESCRIPTION    = "Dead time software counter. Units are in microseconds/16. Multiply by 16 to get back to microseconds."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LG1_RESET
COLUMNNUMBER   = 25
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 1461
DESCRIPTION    = "LG1 charge reset software counter."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LG2_RESET
COLUMNNUMBER   = 26
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 1465
DESCRIPTION    = "LG2 charge reset software counter."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = BP_RESET
COLUMNNUMBER   = 27
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 1469
DESCRIPTION    = "BP charge reset software counter."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = BPP_LGXS
COLUMNNUMBER   = 28
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 1473
DESCRIPTION    = "Software counter for prompt pulse in BP detector with delayed secondary pulse in LGx detector (x=1 or 2)."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LG1_OVER_RANGE
COLUMNNUMBER   = 29
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 1477
DESCRIPTION    = "LG1 prompt over range software counter (pulse height larger than maximum specified)."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LG2_OVER_RANGE
COLUMNNUMBER   = 30
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 1481
DESCRIPTION    = "LG2 prompt over range software counter (pulse height larger than maximum specified)."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = BP_OVER_RANGE
COLUMNNUMBER   = 31
BYTES          = 4
<table>
<thead>
<tr>
<th>NAME</th>
<th>DATA_TYPE</th>
<th>START_BYTE</th>
<th>COLUMN_NUMBER</th>
<th>BYTES</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALID_TC_EVENT</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1485</td>
<td>32</td>
<td>4</td>
<td>&quot;BP prompt over range software counter (pulse height larger than maximum specified).&quot;</td>
</tr>
<tr>
<td>COLUMN</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1489</td>
<td>33</td>
<td>4</td>
<td>&quot;Time-correlated software counter: non-coincidence and not over range events.&quot;</td>
</tr>
<tr>
<td>COLUMN</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1493</td>
<td>34</td>
<td>4</td>
<td>&quot;LG1/BFP coincidence event software counter.&quot;</td>
</tr>
<tr>
<td>COLUMN</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1501</td>
<td>35</td>
<td>4</td>
<td>&quot;LG1/BFP/LG2 coincidence event software counter.&quot;</td>
</tr>
<tr>
<td>COLUMN</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1505</td>
<td>36</td>
<td>4</td>
<td>&quot;Summation of all channels of early time-correlated spectra.&quot;</td>
</tr>
<tr>
<td>COLUMN</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1509</td>
<td>37</td>
<td>4</td>
<td>&quot;Summation of all channels of late time-correlated spectra.&quot;</td>
</tr>
<tr>
<td>COLUMN</td>
<td>MSB UNSIGNED_INTEGER</td>
<td>1513</td>
<td>38</td>
<td>2</td>
<td>&quot;Event mode data length. A value greater than zero indicates that events were observed by the instrument. A corresponding NS Full Science Events EDR will archive the event data.&quot;</td>
</tr>
</tbody>
</table>
## 8.2. **NS_SPE.FMT Table Fields**

Below is a table that shows the structure of the binary table containing the NS Spectra data. Following this is the content of the format file itself.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>MET</td>
<td>Time tag in seconds of the start of the associated reporting/accumulation period.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury.</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>ACTUAL_ACCUM</td>
<td>Actual accumulation period for software counters and energy histograms.</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>SENSOR_CFG_CHANGED</td>
<td>Sensor configuration changed flag.</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG_SAFING</td>
<td>Maximum Lithium Glass (LG) safing level reached.</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_SAFING</td>
<td>Maximum Borated Plastic (BP) safing level reached.</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LOG_COMPRRESSION</td>
<td>Identifies when the log compression data mode has been enabled.</td>
</tr>
<tr>
<td>19</td>
<td>2 X 32</td>
<td>MSB Unsigned Integer</td>
<td>SINGLES_LG1</td>
<td>32 channel histogram of event energies that arrived as a single event. Lithium Glass 1 sensor.</td>
</tr>
<tr>
<td>83</td>
<td>2 X 32</td>
<td>MSB Unsigned Integer</td>
<td>SINGLES_LG2</td>
<td>32 channel histogram of event energies that arrived as a single event. Lithium Glass 2 sensor.</td>
</tr>
<tr>
<td>147</td>
<td>2 X 64</td>
<td>MSB Unsigned Integer</td>
<td>SINGLES_BP_SPECTRA</td>
<td>64 channel histogram of event energies that arrived as a solo event. Borated Plastic sensor.</td>
</tr>
<tr>
<td>275</td>
<td>2 X 8</td>
<td>MSB Unsigned Integer</td>
<td>TC_EARLY</td>
<td>A histogram of prompt BP events that had a delayed BP event occurring during the early capture window.</td>
</tr>
<tr>
<td>291</td>
<td>2 X 8</td>
<td>MSB Unsigned Integer</td>
<td>TC_LATE</td>
<td>A histogram of prompt BP events that had a delayed BP event occurring during the late capture window.</td>
</tr>
<tr>
<td>307</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_RAW_EVENTS</td>
<td>LG1 raw event software counter.</td>
</tr>
<tr>
<td>311</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG2_RAW_EVENTS</td>
<td>LG2 raw event software counter.</td>
</tr>
<tr>
<td>315</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>BP_RAW_EVENTS</td>
<td>BP raw event software counter.</td>
</tr>
<tr>
<td>319</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>SW_TOTAL_EVENTS</td>
<td>Total events processed by software in the current accumulation period.</td>
</tr>
<tr>
<td>323</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>DEAD_TIME</td>
<td>Dead time software counter.</td>
</tr>
<tr>
<td>327</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_RESET</td>
<td>LG1 charge reset software counter.</td>
</tr>
<tr>
<td>331</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG2_RESET</td>
<td>LG2 charge reset software counter.</td>
</tr>
<tr>
<td>335</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>BP_RESET</td>
<td>BP charge reset software counter.</td>
</tr>
<tr>
<td>339</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>BPP_LGX5</td>
<td>Software counter for prompt pulse in BP detector with delayed secondary pulse in LG1 or LG2 detector.</td>
</tr>
<tr>
<td>343</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_OVER_RANGE</td>
<td>LG1 prompt over range software counter.</td>
</tr>
<tr>
<td>347</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG2_OVER_RANGE</td>
<td>LG2 prompt over range software counter.</td>
</tr>
<tr>
<td>351</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>BP_OVER_RANGE</td>
<td>BP prompt over range software counter.</td>
</tr>
<tr>
<td>355</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>VALID_TC_EVENT</td>
<td>Time-correlated software counter.</td>
</tr>
<tr>
<td>359</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_BPP_COIN</td>
<td>LG1/BPP coincidence event software.</td>
</tr>
<tr>
<td>363</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG2_BPP_COIN</td>
<td>LG2/BPP coincidence event software counter.</td>
</tr>
<tr>
<td>-----</td>
<td>---</td>
<td>----------------------</td>
<td>--------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>367</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_BPP_LG2_COIN</td>
<td>LGI/BPP/LG2 coincidence event software counter.</td>
</tr>
<tr>
<td>371</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG1_BPS_COIN</td>
<td>LGI/BPS coincidence event software counter.</td>
</tr>
<tr>
<td>375</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>LG2_BPS_COIN</td>
<td>LG2/BPS coincidence event software counter.</td>
</tr>
</tbody>
</table>

OBJECT = COLUMN
NAME = MET
COLUMN_NUMBER = 1
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 1
DESCRIPTION = "Time tag in seconds of the start of the associated Reporting/Accumulation period."

END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = ORBIT_NUMBER
COLUMN_NUMBER = 2
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 5
DESCRIPTION = "Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at aphelion and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0."

END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = ACTUAL_ACCUM
COLUMN_NUMBER = 3
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 7
DESCRIPTION = "Actual accumulation period for software counters and energy histograms."

END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SENSOR_CFG_CHANGED
COLUMN_NUMBER = 4
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 11
DESCRIPTION = "Sensor Configuration Changed Flag. =0 config unchanged, =1 config changed."

END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG_SAFING
COLUMN_NUMBER = 5
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 13
DESCRIPTION = "Maximum Lithium Glass (LG) safing level reached during current reporting period. =0 nominal, =1 seeking, =2 level1_rampdown, =3 level1_waiting, =4 level1_seeking, =5 level2_safing."

END_OBJECT = COLUMN
OBJECT = COLUMN
  NAME = BP_SAFING
  COLUMN_NUMBER = 6
  BYTES = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 15
  DESCRIPTION = "Maximum safing level reached during current reporting
  period for the Borated Plastic (BP) sensor.
  =0 nominal, =1 seeking, =2 level1_rampdown,
  =3 level1_waiting, =4 level1_seeking, =5 level2_safing"
END_OBJECT = COLUMN

OBJECT = COLUMN
  NAME = LOG_COMPRESSION
  COLUMN_NUMBER = 7
  BYTES = 2
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 17
  DESCRIPTION = "The Log Compression flag identifies when the log compression data
  mode has
  been enabled. The NS flight software uses 32-bit to 16-bit log compression on software
  counters when the log compression data mode is enabled. See the NS Flight Software
  document
  for details on the log compression algorithm.
  =0 no log compression. =1 log compression enabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
  NAME = SINGLES_LG1
  COLUMN_NUMBER = 8
  BYTES = 64
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 19
  ITEMS = 32
  ITEM_BYTES = 2
  DESCRIPTION = "Spectrum is a 32 channel histogram of event energies
  that arrived as a single event with no time correlation to the other
  sensors. LG1 is the Lithium Glass 1 sensor."
END_OBJECT = COLUMN

OBJECT = COLUMN
  NAME = SINGLES_LG2
  COLUMN_NUMBER = 9
  BYTES = 64
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 83
  ITEMS = 32
  ITEM_BYTES = 2
  DESCRIPTION = "Spectrum is a 32 channel histogram of event energies
  that arrived as a single event with no time correlation to the other
  sensors. LG2 is the Lithium Glass 2 sensor."
END_OBJECT = COLUMN

OBJECT = COLUMN
  NAME = SINGLES_BP_SPECTRA
  COLUMN_NUMBER = 10
  BYTES = 128
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  START_BYTE = 147
  ITEMS = 64
  ITEM_BYTES = 2
  DESCRIPTION = "BP is the Borated Plastic sensor. Spectrum is a 64
  channel histogram of event energies that arrived as a solo event with
  respect to the other sensors."
END_OBJECT = COLUMN

OBJECT = COLUMN
  NAME = TC_EARLY
  COLUMN_NUMBER = 11
BYTES          = 16
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 275
ITEMS          = 8
ITEM_BYTES     = 2
DESCRIPTION    = "The time-correlated early spectrum is a histogram of prompt BP events that had a delayed BP event occurring during the early capture window, as defined by commandable software parameters provided in columns 83 and 84 of the NS Status EDR, and no additional events in the event set."
END_OBJECT    = COLUMN
OBJECT        = COLUMN
NAME           = TC_LATE
COLUMN_NUMBER  = 12
BYTES          = 16
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 291
ITEMS          = 8
ITEM_BYTES     = 2
DESCRIPTION    = "The time-correlated late spectrum is a histogram of prompt BP events that had a delayed BP event occurring during the late capture window, as defined by commandable software parameters provided in columns 85 and 86 of the NS Status EDR, and no additional events in the event set."
END_OBJECT    = COLUMN
OBJECT        = COLUMN
NAME           = LG1_RAW_EVENTS
COLUMN_NUMBER  = 13
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 307
DESCRIPTION    = "LG1 Raw event software counter."
END_OBJECT    = COLUMN
OBJECT        = COLUMN
NAME           = LG2_RAW_EVENTS
COLUMN_NUMBER  = 14
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 311
DESCRIPTION    = "LG2 Raw event software counter."
END_OBJECT    = COLUMN
OBJECT        = COLUMN
NAME           = BP_RAW_EVENTS
COLUMN_NUMBER  = 15
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 315
DESCRIPTION    = "BP Raw event software counter."
END_OBJECT    = COLUMN
OBJECT        = COLUMN
NAME           = SW_TOTAL_EVENTS
COLUMN_NUMBER  = 16
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 319
DESCRIPTION    = "Total events processed by software in the current accumulation period."
END_OBJECT    = COLUMN
OBJECT        = COLUMN
NAME           = DEAD_TIME
COLUMN_NUMBER  = 17
BYTES          = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE = 323
DESCRIPTION = "Dead time software counter. Units are in microseconds/16. Multiply by 16 to get back to microseconds."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_RESET
COLUMN_NUMBER = 18
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 327
DESCRIPTION = "LG1 charge reset software counter."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_RESET
COLUMN_NUMBER = 19
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 331
DESCRIPTION = "LG2 charge reset software counter."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_RESET
COLUMN_NUMBER = 20
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 335
DESCRIPTION = "BP charge reset software counter."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BPP_LGXS
COLUMN_NUMBER = 21
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 339
DESCRIPTION = "Software counter for prompt pulse in BP detector with delayed secondary pulse in LGx detector (x=1 or 2)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_OVER_RANGE
COLUMN_NUMBER = 22
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 343
DESCRIPTION = "LG1 prompt over range software counter (pulse height larger than maximum specified)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_OVER_RANGE
COLUMN_NUMBER = 23
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 347
DESCRIPTION = "LG2 prompt over range software counter (pulse height larger than maximum specified)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_OVER_RANGE
COLUMN_NUMBER = 24
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 351
DESCRIPTION = "BP prompt over range software counter (pulse height larger than maximum specified)."
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = VALID_TC_EVENT
COLUMN_NUMBER = 25
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 355
DESCRIPTION = "Time-correlated software counter: non-coincidence and not over range events."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_BPP_COIN
COLUMN_NUMBER = 26
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 359
DESCRIPTION = "LG1/BPP coincidence event software counter."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_BPP_COIN
COLUMN_NUMBER = 27
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 363
DESCRIPTION = "LG2/BPP coincidence event software counter."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_BPP_LG2_COIN
COLUMN_NUMBER = 28
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 367
DESCRIPTION = "LG1/BPP/LG2 coincidence event software counter."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_BPS_COIN
COLUMN_NUMBER = 29
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 371
DESCRIPTION = "LG1/BPS coincidence event software counter."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_BPS_COIN
COLUMN_NUMBER = 30
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 375
DESCRIPTION = "LG2/BPS coincidence event software counter."
END_OBJECT = COLUMN

8.3. NS_EVT.FMT Table Fields
Below is a table that shows the structure of the binary table containing the NS Events EDR data. Following this is the content of the format file.
<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>MET</td>
<td>Time tag in seconds of the start of the associated reporting/accumulation period.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury.</td>
</tr>
<tr>
<td>7</td>
<td>2 X 255</td>
<td>MSB Unsigned Integer</td>
<td>EVT_MODE_LEN</td>
<td>Event mode data length.</td>
</tr>
<tr>
<td>9</td>
<td>2 X 255</td>
<td>MSB Unsigned Integer</td>
<td>EVT_MODE_TTSP</td>
<td>Event mode data for Time-to-Second-Pulse (TTSP) values.</td>
</tr>
<tr>
<td>519</td>
<td>2 X 255</td>
<td>MSB Unsigned Integer</td>
<td>EVT_MODE_BPP</td>
<td>Event mode data containing the BPP event energies.</td>
</tr>
<tr>
<td>1029</td>
<td>2 X 255</td>
<td>MSB Unsigned Integer</td>
<td>EVT_MODE_BPS</td>
<td>Event mode data containing the BPS event energies.</td>
</tr>
</tbody>
</table>

**OBJECT** - COLUMN

**NAME** - MET
COLUMN_NUMBER = 1
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 1
DESCRIPTION = "Time tag in seconds of the start of the associated reporting/accumulation period."

END_OBJECT - COLUMN

**OBJECT** - COLUMN

**NAME** - ORBIT_NUMBER
COLUMN_NUMBER = 2
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 5
DESCRIPTION = "Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at aphelion and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0."

END_OBJECT - COLUMN

**OBJECT** - COLUMN

**NAME** - EVT_MODE_LEN
COLUMN_NUMBER = 3
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 7
DESCRIPTION = "Event mode data length. This specifies the N number of items containing data in the following event mode data fields. Event mode data length is commandable and can vary from 0-255."

END_OBJECT - COLUMN

**OBJECT** - COLUMN

**NAME** - EVT_MODE_TTSP
COLUMN_NUMBER = 4
BYTES = 510
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 9
ITEMS = 255
ITEM_BYTES = 2
DESCRIPTION = "Event mode data for Time-To-Second-Pulse (TTSP) values. The Ith item in the TTSP field is the TTSP for the Ith correlated time event. If EVT_MODE_LEN is less than 255 then the item columns greater than N do not contain valid data and will default to 0."

END_OBJECT - COLUMN

**OBJECT** - COLUMN

**NAME** - EVT_MODE_BPP
COLUMN_NUMBER = 5
8.4. NS_GCR.FMT Table Fields
Below is a table that shows the structure of the binary table containing the NS Gamma-Ray Burst EDR data. Following this is the content of the format file.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>MET</td>
<td>Time tag in seconds of the gamma-ray burst trigger.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury.</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>ACTUAL_ACCUM</td>
<td>Actual accumulation period.</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>GCR_MODE</td>
<td>Galactic Cosmic Ray Coincidence Mode</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>SENSOR_CFG_CHANGED</td>
<td>Sensor configuration changed flag.</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG_SAFING</td>
<td>Maximum Lithium Glass (LG) safing level reached.</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_SAFING</td>
<td>Maximum Borated Plastic (BP) safing level reached.</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LOG_COMPRESSION</td>
<td>Identifies when the log compression data mode has been enabled.</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>SENSOR_TEMP</td>
<td>Sensor temperature.</td>
</tr>
<tr>
<td>23</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>TEMP_MONITOR</td>
<td>LVPS temperature monitor.</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG1_SCALE</td>
<td>LG1 Singles spectrum scale.</td>
</tr>
<tr>
<td>27</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG2_SCALE</td>
<td>LG2 Singles spectrum scale.</td>
</tr>
<tr>
<td>29</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_SCALE</td>
<td>BP Singles spectrum scale.</td>
</tr>
<tr>
<td>31</td>
<td>2 X 64</td>
<td>MSB Unsigned Integer</td>
<td>LG1_GCR_SPECTRUM</td>
<td>LG1 Galactic Cosmic Ray spectrum.</td>
</tr>
<tr>
<td>33</td>
<td>2 X 64</td>
<td>MSB Unsigned Integer</td>
<td>LG2_GCR_SPECTRUM</td>
<td>LG2 Galactic Cosmic Ray spectrum.</td>
</tr>
</tbody>
</table>

Object = Column
NAME = MET
COLUMN_NUMBER = 1
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 1
DESCRIPTION = "Time tag in seconds of the start of the associated..."
Reporting/Accumulation period.

DESCRIPTION = "Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at apoherm and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0."

DESCRIPTION = "Actual accumulation period."

DESCRIPTION = "Galactic Cosmic Ray (GCR) Coincidence mode. =1 Doubles, =2 Triples, =3 Either."

DESCRIPTION = "Sensor Configuration Changed Flag. =0 config unchanged, =1 config changed."

DESCRIPTION = "Maximum Lithium Glass (LG) safing level reached during current reporting period. =0 nominal, =1 seeking, =2 level1_rampdown, =3 level1_waiting, =4 level1_seeking, =5 level2_safing."

DESCRIPTION = "Maximum safing level reached during current reporting period for the Borated Plastic (BP) sensor. =0 nominal, =1 seeking, =2 level1_rampdown, =3 level1_waiting, =4 level1_seeking, =5 level2_safing."

OBJECT = COLUMN
NAME = LOG_COMPRESSION
COLUMN_NUMBER = 8
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 19
DESCRIPTION = "Identifies when the log compression data mode has been enabled. The NS flight software uses 32-bit to 16-bit log compression on software counters when the log compression data mode is enabled. See the NS Flight Software document for details on the log compression algorithm.
-0 no log compression. =1 log compression enabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SENSOR_TEMP
COLUMN_NUMBER = 9
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 21
DESCRIPTION = "Sensor Temperature, External Channel 4 (LVPS)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TEMP_MONITOR
COLUMN_NUMBER = 10
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 23
DESCRIPTION = "LVPS Temperature monitor."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_SCALE
COLUMN_NUMBER = 11
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 25
DESCRIPTION = "LG1 singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_SCALE
COLUMN_NUMBER = 12
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 27
DESCRIPTION = "LG2 singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_SCALE
COLUMN_NUMBER = 13
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 29
DESCRIPTION = "BP singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TC_SCALE
COLUMN_NUMBER = 14
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 31
DESCRIPTION = "Time-correlated spectra scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_GCR_SPECTRUM
COLUMN_NUMBER = 15
BYTES = 128
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 33
ITEMS = 64
ITEM_BYTES = 2
DESCRIPTION = "LG1 Galactic Cosmic Ray spectrum."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_GCR_SPECTRUM
COLUMN_NUMBER = 16
BYTES = 128
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 161
ITEMS = 64
ITEM_BYTES = 2
DESCRIPTION = "LG2 Galactic Cosmic Ray spectrum."
END_OBJECT = COLUMN

8.5. NS_GAB.FMT Table Fields
Below is a table that shows the structure of the binary table containing the NS Gamma-Ray Burst EDR data. Following this is the content of the format file.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>MET</td>
<td>Time tag in seconds of the gamma-ray burst trigger.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>GAMMA_RAY_MODE</td>
<td>Gamma ray mode.</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_CH_UPPER_LIMIT</td>
<td>The highest BP channel that will be used as part of the source of the Gamma-Ray burst BP counts.</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>TRIG_BOXCAR_ACCUM</td>
<td>Number of counts in the running box car accumulator at the time of the trigger.</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BURST_THRESHOLD</td>
<td>Burst lower pulse threshold for trigger.</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>POST_TRIGGER_COUNTS</td>
<td>Number of post trigger counts.</td>
</tr>
<tr>
<td>19</td>
<td>2 X 164</td>
<td>MSB Unsigned Integer</td>
<td>GAMMA_RAY_BURST</td>
<td>Collection of 164 (1-sec) BP counts.</td>
</tr>
</tbody>
</table>

OBJECT = COLUMN
NAME = MET
COLUMN_NUMBER = 1
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 1
DESCRIPTION = "Time tag in seconds of the gamma-ray burst trigger."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = ORBIT_NUMBER
COLUMN_NUMBER = 2
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 1
DESCRIPTION = "Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at apoherm and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0."
END_OBJECT = COLUMN
8.6.NS_SHORTSCI.FMT Table Fields
Below is a table that shows the structure of the binary table containing the NS Short Science EDR data. Following this is the content of the format file.
<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>MET</td>
<td>Time tag in seconds of the start of the associated reporting/accumulation period.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury.</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>ACTUAL_ACCUM</td>
<td>Actual accumulation period for software counters and energy histograms.</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>GCR_MODE</td>
<td>Galactic Cosmic Ray (GCR) Coincidence mode.</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>SENSOR_CFG_CHANGED</td>
<td>Sensor configuration changed flag.</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG_SAFING</td>
<td>Maximum Lithium Glass (LG) safing level reached.</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_SAFING</td>
<td>Maximum Borated Plastic (BP) safing level reached.</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LOG_COMPRPRESSION</td>
<td>Identifies when the log compression data mode has been enabled.</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>SENSOR_TEMP</td>
<td>Sensor Temperature</td>
</tr>
<tr>
<td>23</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>TEMP_MONITOR</td>
<td>LVPS temperature monitor.</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG1_SCALE</td>
<td>LG1 singles spectrum scale.</td>
</tr>
<tr>
<td>27</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>LG2_SCALE</td>
<td>LG2 singles spectrum scale.</td>
</tr>
<tr>
<td>29</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>BP_SCA L E</td>
<td>BP singles spectrum scale.</td>
</tr>
<tr>
<td>31</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>TC_SCALE</td>
<td>Time-correlated spectrum scale.</td>
</tr>
<tr>
<td>33</td>
<td>2 X 64</td>
<td>MSB Unsigned Integer</td>
<td>SINGLES_BP_SPECTRA</td>
<td>64 channel histogram of event energies that arrived as a solo event. Borated Plastic sensor.</td>
</tr>
<tr>
<td>161</td>
<td>2 X 256</td>
<td>MSB Unsigned Integer</td>
<td>TC_EARLY</td>
<td>A histogram of prompt BP events that had a delayed BP event occurring during the early capture window.</td>
</tr>
<tr>
<td>673</td>
<td>2 X 256</td>
<td>MSB Unsigned Integer</td>
<td>TC_LATE</td>
<td>A histogram of prompt BP events that had a delayed BP event occurring during the late capture window.</td>
</tr>
</tbody>
</table>

**OBJECT** - COLUMN
**NAME** = MET
**COLUMN_NUMBER** = 1
**BYTES** = 4
**DATA_TYPE** = MSB_UNSIGNED_INTEGER
**START_BYTE** = 1
**DESCRIPTION** = "Time tag in seconds of the start of the associated Reporting/Accumulation period."

**END_OBJECT** - COLUMN

**OBJECT** - COLUMN
**NAME** = ORBIT_NUMBER
**COLUMN_NUMBER** = 2
**BYTES** = 2
**DATA_TYPE** = MSB_UNSIGNED_INTEGER
**START_BYTE** = 5
**DESCRIPTION** = "Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at apoherm and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0."

**END_OBJECT** - COLUMN

**OBJECT** - COLUMN
**NAME** = ACTUAL_ACCUM
**COLUMN_NUMBER** = 3
**BYTES** = 4
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 7
DESCRIPTION    = "Actual accumulation period for software counters and
energy histograms."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = GCR_MODE
COLUMN_NUMBER  = 4
BYTES          = 2
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 11
DESCRIPTION    = "Galactic Cosmic Ray (GCR) Coincidence mode.
-1 Doubles, -2 Triples, -3 Either."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = SENSOR_CFG_CHANGED
COLUMN_NUMBER  = 5
BYTES          = 2
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 13
DESCRIPTION    = "Sensor Configuration Changed Flag.
=0 config unchanged, =1 config changed."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LG_SAFING
COLUMN_NUMBER  = 6
BYTES          = 2
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 15
DESCRIPTION    = "Maximum Lithium Glass (LG) safing level reached during
current reporting period.
=0 nominal, =1 seeking, =2 level1_rampdown, =3 level1_waiting, =4 level1_seeking, =5 level2_safing."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = BP_SAFING
COLUMN_NUMBER  = 7
BYTES          = 2
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 17
DESCRIPTION    = "Maximum safing level reached during current reporting
period for the Borrate Plastic (BP) sensor.
=0 nominal, =1 seeking, =2 level1_rampdown, =3 level1_waiting, =4 level1_seeking, =5 level2_safing"
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LOG_COMPRESSION
COLUMN_NUMBER  = 8
BYTES          = 2
DATA_TYPE      = MSB_UNSIGNED_INTEGER
START_BYTE     = 19
DESCRIPTION    = "Identifies when the log compression data mode has
been enabled. The NS flight software uses 32-bit to 16-bit log compression
on software counters when the log compression data mode is enabled.
See the NS Flight Software document for details on the log compression
algorithm.
=0 no log compression, =1 log compression enabled."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = SENSOR_TEMP
COLUMN_NUMBER  = 9
BYTES          = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 21
DESCRIPTION = "Sensor Temperature, External Channel 4 (LVPS)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TEMP_MONITOR
COLUMN_NUMBER = 10
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 23
DESCRIPTION = "LVPS Temperature monitor."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_SCALE
COLUMN_NUMBER = 11
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 25
DESCRIPTION = "LG1 singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_SCALE
COLUMN_NUMBER = 12
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 27
DESCRIPTION = "LG2 singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_SCALE
COLUMN_NUMBER = 13
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 29
DESCRIPTION = "BP singles spectrum scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TC_SCALE
COLUMN_NUMBER = 14
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 31
DESCRIPTION = "Time-correlated spectra scale."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SINGLES_BP_SPECTRA
COLUMN_NUMBER = 15
BYTES = 128
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 33
ITEMS = 64
ITEM_BYTES = 2
DESCRIPTION = "Spectrum is a 64 channel histogram of event energies that arrived as a single event with no time correlation to the other sensors. LG1 is the Lithium Glass 1 sensor."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TC_EARLY
COLUMN_NUMBER = 16
BYTES = 512
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 161
ITEMS = 256
ITEM_BYTES = 2
DESCRIPTION = "The time-correlated early spectrum is a histogram of prompt BP events that had a delayed BP event occurring during the early capture window, as defined by commandable software parameters provided in columns 83 and 84 of the NS Status EDR, and no additional events in the event set."

DESCRIPTION = "The time-correlated late spectrum is a histogram of prompt BP events that had a delayed BP event occurring during the late capture window, as defined by commandable software parameters provided in columns 85 and 86 of the NS Status EDR, and no additional events in the event set."

8.7. NS_TCC.FMT Table Fields

Below is a table that shows the structure of the binary table containing the NS Time-Correlated Counts EDR data. Following this is the content of the format file.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>MET</td>
<td>Time tag in seconds of the first sample in the neutron burst counters packet.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>MSB Unsigned Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>TC_EARLY_COUNTER</td>
<td>Summation of all channels of early time-correlated spectra.</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>MSB Unsigned Integer</td>
<td>TC_LATE_COUNTER</td>
<td>Summation of all channels of late time-correlated spectra.</td>
</tr>
</tbody>
</table>

OBJECT = COLUMN
NAME = MET
COLUMN_NUMBER = 1
BYTES = 4
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 1
DESCRIPTION = "Time tag in seconds of the first sample in the neutron burst counters packet."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = ORBIT_NUMBER
COLUMN_NUMBER = 2
BYTES = 2
DATA_TYPE = MSB_UNSIGNED_INTEGER
START_BYTE = 1
DESCRIPTION = "Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at apoherm and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0."
END_OBJECT = COLUMN
8.8. **NS_STATUS.FMT Table Fields**

Below is a table that shows the structure of the ASCII table containing the NS Status EDR data. The ASCII table is both fixed-width and comma delimited. Note that in PDS ASCII table format, the Start Byte has to take into account the comma delimiter and empty spaces. Following this is the content of the format file.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>ASCII Integer</td>
<td>MET</td>
<td>Time tag in seconds of the start of the associated reporting/accumulation period.</td>
</tr>
<tr>
<td>15</td>
<td>6</td>
<td>ASCII Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury.</td>
</tr>
<tr>
<td>23</td>
<td>5</td>
<td>ASCII Integer</td>
<td>STATUS_INTERVAL</td>
<td>Defines the interval at which status is reported.</td>
</tr>
<tr>
<td>30</td>
<td>5</td>
<td>ASCII Integer</td>
<td>MACRO_BLOCKS</td>
<td>Number of macro blocks free.</td>
</tr>
<tr>
<td>37</td>
<td>5</td>
<td>ASCII Integer</td>
<td>TLM_VOLUME</td>
<td>Telemetry volume (KB) produced by NS.</td>
</tr>
<tr>
<td>44</td>
<td>5</td>
<td>ASCII Integer</td>
<td>WATCH_ADDR</td>
<td>Address loaded for peaking into memory for diagnostic purposes.</td>
</tr>
<tr>
<td>51</td>
<td>3</td>
<td>ASCII Integer</td>
<td>WATCH_MEM</td>
<td>Memory watch address id loaded to complete 20-bit address.</td>
</tr>
<tr>
<td>56</td>
<td>5</td>
<td>ASCII Integer</td>
<td>WATCH_DATA1</td>
<td>Watched memory, byte 1 value.</td>
</tr>
<tr>
<td>63</td>
<td>5</td>
<td>ASCII Integer</td>
<td>WATCH_DATA2</td>
<td>Watched memory, byte 2 value.</td>
</tr>
<tr>
<td>70</td>
<td>3</td>
<td>ASCII Integer</td>
<td>SW_VERSION</td>
<td>Software version number.</td>
</tr>
<tr>
<td>75</td>
<td>3</td>
<td>ASCII Integer</td>
<td>ALARM_ID</td>
<td>Latest alarm id.</td>
</tr>
<tr>
<td>80</td>
<td>1</td>
<td>ASCII Integer</td>
<td>ALARM_TYPE</td>
<td>Latest alarm type.</td>
</tr>
<tr>
<td>83</td>
<td>3</td>
<td>ASCII Integer</td>
<td>ALARM_COUNT</td>
<td>Count of alarms.</td>
</tr>
<tr>
<td>88</td>
<td>3</td>
<td>ASCII Integer</td>
<td>CMD_EXEC</td>
<td>Number of commands executed.</td>
</tr>
<tr>
<td>93</td>
<td>3</td>
<td>ASCII Integer</td>
<td>CMD_REJECT</td>
<td>Number of commands rejected.</td>
</tr>
<tr>
<td>98</td>
<td>3</td>
<td>ASCII Integer</td>
<td>MAC_EXEC</td>
<td>Number of macro commands executed.</td>
</tr>
<tr>
<td>103</td>
<td>3</td>
<td>ASCII Integer</td>
<td>MAC_REJECT</td>
<td>Number of macro commands rejected.</td>
</tr>
<tr>
<td>108</td>
<td>3</td>
<td>ASCII Integer</td>
<td>MACRO_ID</td>
<td>ID of most recent macro executed.</td>
</tr>
<tr>
<td>113</td>
<td>1</td>
<td>ASCII Integer</td>
<td>MACRO_LEARN</td>
<td>Macro learn mode.</td>
</tr>
<tr>
<td>116</td>
<td>1</td>
<td>ASCII Integer</td>
<td>MONITOR_RESP</td>
<td>Monitor response.</td>
</tr>
<tr>
<td>119</td>
<td>1</td>
<td>ASCII Integer</td>
<td>WRITE_ENABLE</td>
<td>Memory write enable.</td>
</tr>
<tr>
<td>122</td>
<td>3</td>
<td>ASCII Integer</td>
<td>SPARE</td>
<td>Spare column.</td>
</tr>
<tr>
<td>127</td>
<td>6</td>
<td>ASCII Integer</td>
<td>PLUS_5V</td>
<td>+5 volt monitor (LVPS).</td>
</tr>
<tr>
<td>135</td>
<td>6</td>
<td>ASCII Integer</td>
<td>NEG_5V</td>
<td>-5 volt monitor (LVPS).</td>
</tr>
<tr>
<td>143</td>
<td>6</td>
<td>ASCII Integer</td>
<td>PLUS_12V</td>
<td>+12 volt monitor (LVPS).</td>
</tr>
<tr>
<td>ASCII Integer</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>NEG_12V -12 volt monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>159</td>
<td>EXTERNAL_CH1 External channel 1 (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>EXTERNAL_CH2 External channel 2 (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>EXTERNAL_CH3 External channel 3 (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>EXTERNAL_CH4 External channel 4 (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191</td>
<td>EXTERNAL_CH5 External channel 5 (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>199</td>
<td>PLUS5V_I +5V current monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>207</td>
<td>NEG5V_I -5V current monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>215</td>
<td>PLUS12V_I +12V current monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>223</td>
<td>NEG12V_I -12V current monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>231</td>
<td>TEMP_MON Temperature monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>239</td>
<td>PRIMARY_I Primary current monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>247</td>
<td>SWITCHED_PRI_I Switched primary current monitor (LVPS).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>255</td>
<td>VOLT_LG_HVPS Voltage of LG HVPS(1).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>262</td>
<td>VOLT_BP_HVPS Voltage of BP HVPS(2).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>269</td>
<td>TEMP_LG Temperature of LG.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>276</td>
<td>TEMP_BP Temperature of BP.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>283</td>
<td>HVPS_SPARSE1 Spare column.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>290</td>
<td>HVPS_SPARSE2 Spare column.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>297</td>
<td>CAPTURE_E_LIMIT Capture energy limit.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>304</td>
<td>EVENT_MODE_LEN Event mode length.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>314</td>
<td>POWER_MANAGEMENT Power management bit register.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>322</td>
<td>TRIG_SAMPLE_TAP Trigger sample tap.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>330</td>
<td>GAIN_DAC Controls BP channel gain by changing ADC reference voltage.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>338</td>
<td>BP_CHARGE_RESET BP charge reset.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>346</td>
<td>BP_PRMPT_THRESH Channel 0 (BP) prompt trigger threshold.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>354</td>
<td>BP_SEC_THRESH Channel 0 (BP) secondary trigger threshold.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>362</td>
<td>LG1_TRIG_THRESH Channel 1 (LG) trigger threshold.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>370</td>
<td>LG2_TRIG_THRESH Channel 2 (LG) trigger threshold.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>378</td>
<td>BP_RAW_EVENT Channel 0 (BP) raw event hardware counter (1-sec accumulation).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>386</td>
<td>LG1_RAW_EVENT Channel 1 (LG1) raw event hardware counter (1-sec accumulation).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>394</td>
<td>LG2_RAW_EVENT Channel 2 (LG2) raw event hardware counter (1-sec accumulation).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>402</td>
<td>LG_SAFING_STATE LG current sensor state.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>405</td>
<td>BP_SAFING_STATE BP current sensor state.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>408</td>
<td>SPARE Spare column.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>411</td>
<td>SCREEN_ON_DQ Set calibration/diagnostic mode to screen out data with DQ bit set.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>414</td>
<td>NON_COMP_SCI_DATA Science data mode enabled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>417</td>
<td>FAST_COMP_SCI_DATA Fast compression of science data enabled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>420</td>
<td>LOG_COMP_SCI_DATA Log compression of spectra enabled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>423</td>
<td>DIAG_DATA_PACKET Diagnostic packet enabled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>426</td>
<td>SPARE_DATA_PACKET Spare data packet enabled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>429</td>
<td>HV1_ENABLED HV1 (BP) enabled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>432</td>
<td>HV2_ENABLED HV2 (LG1 or LG2) enabled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>435</td>
<td>ACCUM_FLAG Flag for instrument accumulation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>438</td>
<td>ACCUM_PERIOD Currently commanded accumulation period.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>445</td>
<td>REPORT_PERIOD Currently commanded reporting period.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>452</td>
<td>LG1_ULD LG1 Upper-Level Discriminator.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>459</td>
<td>LG2_ULD LG2 Upper-Level Discriminator.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>466</td>
<td>BP_ULD BPP Upper-Level Discriminator.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Column</td>
<td>Type</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------------------</td>
<td>--------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>473</td>
<td>ASCII Integer</td>
<td>HI_VOLT_SETP_BP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>480</td>
<td>ASCII Integer</td>
<td>HI_VOLT_SEPT_LG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>487</td>
<td>ASCII Integer</td>
<td>HVPS_1_MAX_VAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>494</td>
<td>ASCII Integer</td>
<td>HVPS_2_MAX_VAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>501</td>
<td>ASCII Integer</td>
<td>SAFING_RETRY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>508</td>
<td>ASCII Integer</td>
<td>SAFING_INTERVAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>515</td>
<td>ASCII Integer</td>
<td>SAFING_THRESHOLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>522</td>
<td>ASCII Integer</td>
<td>EARLY_CAPTURE_START</td>
<td></td>
<td></td>
</tr>
<tr>
<td>527</td>
<td>ASCII Integer</td>
<td>EARLY_CAPTURE_END</td>
<td></td>
<td></td>
</tr>
<tr>
<td>532</td>
<td>ASCII Integer</td>
<td>LATE_CAPTURE_START</td>
<td></td>
<td></td>
</tr>
<tr>
<td>537</td>
<td>ASCII Integer</td>
<td>LATE_CAPTURE_END</td>
<td></td>
<td></td>
</tr>
<tr>
<td>542</td>
<td>ASCII Integer</td>
<td>CH0_LATCH_UPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>547</td>
<td>ASCII Integer</td>
<td>CH1_2_LATCH_UPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>552</td>
<td>ASCII Integer</td>
<td>GAMMA_BURST_CNT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>557</td>
<td>ASCII Integer</td>
<td>TELEMETRY_PRIORITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>560</td>
<td>ASCII Integer</td>
<td>SPARE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>563</td>
<td>ASCII Integer</td>
<td>GCR_COINCIDENCE_MODE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>566</td>
<td>ASCII Integer</td>
<td>GCR_PACKET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>569</td>
<td>ASCII Integer</td>
<td>GAMMARAY_BURST_RESPONSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>572</td>
<td>ASCII Integer</td>
<td>GAMMA_BURST_THRESH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>579</td>
<td>ASCII Integer</td>
<td>GAMMA_CH_LIMIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>584</td>
<td>ASCII Integer</td>
<td>GAMMA_MODE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>587</td>
<td>ASCII Integer</td>
<td>TC_COUNTERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>590</td>
<td>ASCII Integer</td>
<td>SPARE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>595</td>
<td>ASCII Integer</td>
<td>GAMMA_POST_TRIG_LEN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>602</td>
<td>ASCII Integer</td>
<td>SPARE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>609</td>
<td>ASCII Integer</td>
<td>SPARE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>616</td>
<td>ASCII Integer</td>
<td>SPARE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OBJECT** - COLUMN

**NAME** - MET
**COLUMN_NUMBER** = 1
**BYTES** = 12
**DATA_TYPE** = ASCII_INTEGER
**START_BYTE** = 1
**DESCRIPTION** = "Time tag in seconds associated with the field values in the same row."

**END_OBJECT** - COLUMN

**OBJECT** - COLUMN

**NAME** - ORBIT_NUMBER
**COLUMN_NUMBER** = 2
**BYTES** = 6
**DATA_TYPE** = ASCII_INTEGER
**START_BYTE** = 15
**DESCRIPTION** = "Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at aphelion and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0."

**END_OBJECT** - COLUMN

**OBJECT** - COLUMN

**NAME** - STATUS_INTERVAL
**COLUMN_NUMBER** = 3
**BYTES** = 5
**DATA_TYPE** = ASCII_INTEGER
**START_BYTE** = 23

57
DESCRIPTION = "Status interval (in seconds). Valid values: 1-65535 (0=off). Defines the interval at which status is reported. Not an accumulation interval. All status fields are either stationary values of registers or 1-second accumulations (such as for hardware counters)."

OBJECT = COLUMN

NAME = MACRO_BLOCKS
COLUMN_NUMBER = 4
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 30
DESCRIPTION = "Number of macro blocks free."

OBJECT = COLUMN

NAME = TLM_VOLUME
COLUMN_NUMBER = 5
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 37
DESCRIPTION = "Telemetry volume produced (KB) by NS (compressed data with telemetry headers, etc.). For telemetry control purposes."

OBJECT = COLUMN

NAME = WATCH_ADDR
COLUMN_NUMBER = 6
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 44
DESCRIPTION = "Memory watch address. Address loaded for peaking into memory for diagnostic purposes."

OBJECT = COLUMN

NAME = WATCH_MEM
COLUMN_NUMBER = 7
BYTES = 3
DATA_TYPE = ASCII_INTEGER
START_BYTE = 51
DESCRIPTION = "Memory watch address id (page number) loaded to complete 20-bit address."

OBJECT = COLUMN

NAME = WATCH_DATA1
COLUMN_NUMBER = 8
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 56
DESCRIPTION = "Watched memory, byte 1 value of the stack-errors word maintained by the common code."

OBJECT = COLUMN

NAME = WATCH_DATA2
COLUMN_NUMBER = 9
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 63
DESCRIPTION = "Watched memory, byte 2 value of the stack-errors word maintained by the common code."

OBJECT = COLUMN

NAME = SW_VERSION
COLUMN_NUMBER = 10
BYTES = 3
DATA_TYPE = ASCII_INTEGER
START_BYTE = 70
DESCRIPTION    = "Software version number."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = ALARM_ID
COLUMN_NUMBER  = 11
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 75
DESCRIPTION    = "Latest alarm id. See NS Flight Software document,
Table 2.12 Alarm ID and compiled in Monitor limits."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = ALARM_TYPE
COLUMN_NUMBER  = 12
BYTES          = 1
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 80
DESCRIPTION    = "Latest alarm type. =0 Persistent. =1 Transient."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = ALARM_COUNT
COLUMN_NUMBER  = 13
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 83
DESCRIPTION    = "Count of alarms."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = CMD_EXEC
COLUMN_NUMBER  = 14
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 88
DESCRIPTION    = "Number of commands executed."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = CMD_REJECT
COLUMN_NUMBER  = 15
BYTES          = 3
DATA_TYPE      = ASCIIINTEGER
START_BYTE     = 93
DESCRIPTION    = "Number of commands rejected."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = MAC_EXEC
COLUMN_NUMBER  = 16
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 98
DESCRIPTION    = "Number of macro commands executed."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = MAC_REJECT
COLUMN_NUMBER  = 17
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 103
DESCRIPTION    = "Number of macro commands rejected."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = MACRO_ID
COLUMN_NUMBER  = 18
BYTES          = 3
DATA_TYPE     = ASCII_INTEGER
START_BYTE    = 108
DESCRIPTION   = "ID of most recent macro executed."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = MACRO_LEARN
COLUMN_NUMBER  = 19
BYTES          = 1
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 113
DESCRIPTION    = "Macro learn mode. =0 not learning, =1 learning."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = MONITOR_RESP
COLUMN_NUMBER  = 20
BYTES          = 1
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 116
DESCRIPTION    = "Monitor response. =0 disabled, =1 enabled."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = WRITE_ENABLE
COLUMN_NUMBER  = 21
BYTES          = 1
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 119
DESCRIPTION    = "Memory write enable. =0 disabled, =1 enabled."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = SPARE
COLUMN_NUMBER  = 22
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 122
DESCRIPTION    = "Spare column."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = PLUS_5V
COLUMN_NUMBER  = 23
BYTES          = 6
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 127
DESCRIPTION    = "+5 volt monitor. (LVPS)"
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = NEG_5V
COLUMN_NUMBER  = 24
BYTES          = 6
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 135
DESCRIPTION    = "-5 volt monitor (LVPS)."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = PLUS_12V
COLUMN_NUMBER  = 25
BYTES          = 6
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 143
DESCRIPTION    = "+12 volt monitor (LVPS)."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = NEG_12V
COLUMN_NUMBER  = 26
BYTE       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  151
DESCRIPTION = "-12 volt monitor (LVPS)."
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = EXTERNAL_CH1
COLUMN_NUMBER =  27
BYTES       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  159
DESCRIPTION = "External channel 1 (LVPS).
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = EXTERNAL_CH2
COLUMN_NUMBER =  28
BYTES       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  167
DESCRIPTION = "External channel 2 (LVPS).
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = EXTERNAL_CH3
COLUMN_NUMBER =  29
BYTES       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  175
DESCRIPTION = "External channel 3 (LVPS).
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = EXTERNAL_CH4
COLUMN_NUMBER =  30
BYTES       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  183
DESCRIPTION = "External channel 4 (LVPS).
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = EXTERNAL_CH5
COLUMN_NUMBER =  31
BYTES       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  191
DESCRIPTION = "External channel 5 (LVPS).
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = PLUS5V_I
COLUMN_NUMBER =  32
BYTES       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  199
DESCRIPTION = "+5V current monitor (LVPS)."
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = NEG5V_I
COLUMN_NUMBER =  33
BYTES       =  6
DATA_TYPE   = ASCII_INTEGER
START_BYTE  =  207
DESCRIPTION = "-5V current monitor (LVPS)."
END_OBJECT  = COLUMN

OBJECT      = COLUMN
NAME        = PLUS12V_I
COLUMN_NUMBER = 34
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 215
DESCRIPTION = "+12V current monitor (LVPS)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = NEG12V_I
COLUMN_NUMBER = 35
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 223
DESCRIPTION = "-12V current monitor (LVPS)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TEMP_MON
COLUMN_NUMBER = 36
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 231
DESCRIPTION = "Temperature Monitor (LVPS)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = PRIMARY_I
COLUMN_NUMBER = 37
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 239
DESCRIPTION = "Primary current Monitor (LVPS)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SWITCHED_PRI_I
COLUMN_NUMBER = 38
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 247
DESCRIPTION = "Switched Primary current Monitor (LVPS)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = VOLT_LG_HVPS
COLUMN_NUMBER = 39
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 255
DESCRIPTION = "Voltage of LG HVPS(1)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = VOLT_BP_HVPS
COLUMN_NUMBER = 40
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 262
DESCRIPTION = "Voltage of BP HVPS(2)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TEMP_LG
COLUMN_NUMBER = 41
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 269
DESCRIPTION = "Temperature of LG."
END_OBJECT = COLUMN

OBJECT = COLUMN
<table>
<thead>
<tr>
<th>NAME</th>
<th>COLUMN_NUMBER</th>
<th>BYTES</th>
<th>DATA_TYPE</th>
<th>START_BYTE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMP_BP</td>
<td>42</td>
<td>5</td>
<td>ASCII_INTEGER</td>
<td>276</td>
<td>&quot;Temperature of BP.&quot;</td>
</tr>
<tr>
<td>HVPS_SPARE1</td>
<td>43</td>
<td>5</td>
<td>ASCII_INTEGER</td>
<td>283</td>
<td>&quot;Spare column.&quot;</td>
</tr>
<tr>
<td>HVPS_SPARE2</td>
<td>44</td>
<td>5</td>
<td>ASCII_INTEGER</td>
<td>290</td>
<td>&quot;Spare column.&quot;</td>
</tr>
<tr>
<td>CAPTURE_E_LIMIT</td>
<td>45</td>
<td>5</td>
<td>ASCII_INTEGER</td>
<td>297</td>
<td>&quot;Capture energy limit.&quot;</td>
</tr>
<tr>
<td>EVENT_MODE_LEN</td>
<td>46</td>
<td>3</td>
<td>ASCII_INTEGER</td>
<td>304</td>
<td>&quot;Event mode length.&quot;</td>
</tr>
<tr>
<td>FAILED_PACKETS</td>
<td>47</td>
<td>3</td>
<td>ASCII_INTEGER</td>
<td>309</td>
<td>&quot;Failed packets.&quot;</td>
</tr>
<tr>
<td>POWER_MANAGEMENT</td>
<td>48</td>
<td>6</td>
<td>ASCII_INTEGER</td>
<td>314</td>
<td>&quot;Power Management bit register. Defines various circuit parameters, including normal and sleep modes.&quot;</td>
</tr>
<tr>
<td>TRIG_SAMPLE_TAP</td>
<td>49</td>
<td>6</td>
<td>ASCII_INTEGER</td>
<td>322</td>
<td>&quot;Trigger sample tap.&quot;</td>
</tr>
</tbody>
</table>
OBJECT = COLUMN
NAME = GAIN_DAC
COLUMN_NUMBER = 50
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 330
DESCRIPTION = "Controls BP channel Gain by changing ADC reference voltage."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_CHARGE_RESET
COLUMN_NUMBER = 51
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 338
DESCRIPTION = "BP Charge reset."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_PRMPT_THRESH
COLUMN_NUMBER = 52
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 346
DESCRIPTION = "Channel 0 (BP) Prompt Trigger Threshold."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_SEC_THRESH
COLUMN_NUMBER = 53
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 354
DESCRIPTION = "Channel 0 (BP) Secondary Trigger Threshold."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_TRIG_THRES
COLUMN_NUMBER = 54
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 362
DESCRIPTION = "Channel 1 (LG) Trigger Threshold."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG2_TRIG_THRESH
COLUMN_NUMBER = 55
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 370
DESCRIPTION = "Channel 2 (LG) Trigger Threshold."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = BP_RAW_EVENT
COLUMN_NUMBER = 56
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE = 378
DESCRIPTION = "Channel 0 (BP) Raw Event Hardware Counter (1-second accumulation)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LG1_RAW_EVENT
COLUMN_NUMBER = 57
BYTES = 6
DATA_TYPE = ASCII_INTEGER
START_BYTE  = 386
DESCRIPTION  = "Channel 1 (LG1) Raw Event Hardware Counter
(1-second accumulation)."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME      = LG2_RAW_EVENT
  COLUMN_NUMBER  = 58
  BYTES     = 6
  DATA_TYPE = ASCII_INTEGER
  START_BYTE = 394
  DESCRIPTION  = "Channel 2 (LG2) Raw Event Hardware Counter
(1-second accumulation)."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME      = LG_SAFING_STATE
  COLUMN_NUMBER  = 59
  BYTES     = 1
  DATA_TYPE = ASCII_INTEGER
  START_BYTE = 402
  DESCRIPTION = "LG current sensor state. 
=0 Nominal, =1 Seeking, =2 Level 1 Rampdown, =3 Level 1 Waiting,
=4 Level 1 Seeking, =5 Level 2 Safing."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME      = BP_SAFING_STATE
  COLUMN_NUMBER  = 60
  BYTES     = 1
  DATA_TYPE = ASCII_INTEGER
  START_BYTE = 405
  DESCRIPTION = "BP current sensor state. 
=0 Nominal, =1 Seeking, =2 Level 1 Rampdown, =3 Level 1 Waiting,
=4 Level 1 Seeking, =5 Level 2 Safing."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME      = Spare
  COLUMN_NUMBER  = 61
  BYTES     = 1
  DATA_TYPE = ASCII_INTEGER
  START_BYTE = 408
  DESCRIPTION = "Spare column."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME      = SCREEN_ON_DQ
  COLUMN_NUMBER  = 62
  BYTES     = 1
  DATA_TYPE = ASCII_INTEGER
  START_BYTE = 411
  DESCRIPTION = "Set Calibration/Diagnostic mode to screen out data with
DQ bit set. =0 No Screen, =1 Screen."
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME      = NON_COMP_SCI_DATA
  COLUMN_NUMBER  = 63
  BYTES     = 1
  DATA_TYPE = ASCII_INTEGER
  START_BYTE = 414
  DESCRIPTION = "Science data mode enabled. =1 Enabled, =0 Disabled"
END_OBJECT  = COLUMN

OBJECT  = COLUMN
  NAME      = FAST_COMP_SCI_DATA
  COLUMN_NUMBER  = 64
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 417
DESCRIPTION = "Fast compression of science data enabled. =1 Enabled, =0 Disabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = LOG_COMP_SCI_DATA
COLUMN_NUMBER = 66
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 420
DESCRIPTION = "Log Compression of Spectra enabled. =1 Enabled, =0 Disabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = DIAG_DATA_PACKET
COLUMN_NUMBER = 67
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 423
DESCRIPTION = "Diagnostic Packet enabled. =1 Enabled, =0 Disabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SPARE_DATA_PACKET
COLUMN_NUMBER = 68
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 426
DESCRIPTION = "Spare data packet enabled. =1 Enabled, =0 Disabled.
Used to enable Gamma Burst mode packets."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = HV1_ENABLED
COLUMN_NUMBER = 69
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 429
DESCRIPTION = "HV1 (BP) Enabled. =1 Enabled, =0 Disabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = HV2_ENABLED
COLUMN_NUMBER = 70
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 432
DESCRIPTION = "HV2 (LG1 and LG2) Enabled. =1 Enabled, =0 Disabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = ACCUM_FLAG
COLUMN_NUMBER = 71
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 435
DESCRIPTION = "Flag for instrument accumulation. =0 Not accumulating, =1 Accumulating."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = ACCUM_PERIOD
COLUMN_NUMBER = 72
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 438
DESCRIPTION = "Currently commanded accumulation period."
NAME = REPORT_PERIOD
COLUMN_NUMBER = 72
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 445
DESCRIPTION = "Currently commanded reporting period."

NAME = LG1_ULD
COLUMN_NUMBER = 73
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 452
DESCRIPTION = "LG1 Upper-Level Discriminator. Raw ADC units."

NAME = LG2_ULD
COLUMN_NUMBER = 74
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 459
DESCRIPTION = "LG2 Upper-Level Discriminator. Raw ADC units."

NAME = BP_ULD
COLUMN_NUMBER = 75
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 466
DESCRIPTION = "BPP Upper-Level Discriminator. Raw ADC units."

NAME = HI_VOLT_SETP_BP
COLUMN_NUMBER = 76
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 473
DESCRIPTION = "Currently commanded High Voltage set point for BP HVPS."

NAME = HI_VOLT_SETP_LG
COLUMN_NUMBER = 77
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 480
DESCRIPTION = "Currently commanded High Voltage set point for LG HVPS."

NAME = HVPS_1_MAX_VAL
COLUMN_NUMBER = 78
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 487
DESCRIPTION = "Maximum commandable HVPS 1 value."

NAME = HVPS_2_MAX_VAL
COLUMN_NUMBER = 79
BYTES = 5
DATA_TYPE = ASCII_INTEGER
START_BYTE = 494
DESCRIPTION    = "Maximum commandable HVPS 2 value."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = SAFING_RETRY
COLUMN_NUMBER  = 80
BYTES          = 5
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 501
DESCRIPTION    = "Sensor safing Retry value."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = SAFING_INTERVAL
COLUMN_NUMBER  = 81
BYTES          = 5
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 508
DESCRIPTION    = "Sensor Safing Interval value."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = SAFING_THRESHOLD
COLUMN_NUMBER  = 82
BYTES          = 5
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 515
DESCRIPTION    = "LG1, LG2, BP Safing Threshold."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = EARLY_CAPTURE_START
COLUMN_NUMBER  = 83
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 522
DESCRIPTION    = "Early Capture Window Start Time."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = EARLY_CAPTURE_END
COLUMN_NUMBER  = 84
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 527
DESCRIPTION    = "Early Capture Window End Time."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LATE_CAPTURE_START
COLUMN_NUMBER  = 85
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 532
DESCRIPTION    = "Late Capture Window Start Time."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LATE_CAPTURE_END
COLUMN_NUMBER  = 86
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 537
DESCRIPTION    = "Late Capture Window End Time."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = CH0_LATCH_UPS
COLUMN_NUMBER  = 87
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE = 542
DESCRIPTION = "Total number of Latch-ups on Channel 0 since last boot."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = CH1_2_LATCH_UPS
COLUMN_NUMBER = 88
BYTES = 3
DATA_TYPE = ASCII_INTEGER
START_BYTE = 547
DESCRIPTION = "Total number of Latch-ups on Channels 1 and 2 since last boot."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = GAMMA_BURST_CNT
COLUMN_NUMBER = 89
BYTES = 3
DATA_TYPE = ASCII_INTEGER
START_BYTE = 552
DESCRIPTION = "Cumulative number of gamma ray bursts (mod 256)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = TELEMETRY_PRIORITY
COLUMN_NUMBER = 90
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 557
DESCRIPTION = "Priority level for science telemetry."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = SPARE
COLUMN_NUMBER = 91
BYTES = 3
DATA_TYPE = ASCII_INTEGER
START_BYTE = 560
DESCRIPTION = "Spare column."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = GCR_COINCIDENCE_MODE
COLUMN_NUMBER = 92
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 563
DESCRIPTION = "Gamma Cosmic ray coincidence mode.
Value is set to 0 when SW_VERSION is less than 5 due to non-existence of this telemetry point in prior software versions. Otherwise values are
-1 Doubles, -2 Triples, -3 Either."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = GCR_PACKET
COLUMN_NUMBER = 93
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 566
DESCRIPTION = "Gamma Cosmic ray packet enabled. Value is set to 0 when SW_VERSION is less than 5 due to non-existence of this telemetry point in prior software versions. -0 Disabled, -1 Enabled."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = GAMMARAY_BURST_RESPONSE
COLUMN_NUMBER = 94
BYTES = 1
DATA_TYPE = ASCII_INTEGER
START_BYTE = 569
NS SIS revision date: July 7, 2015

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>GAMMA_BURST_THRESH</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>96</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>572</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Gamma Ray Burst Response Macro enabled. Value is set to 0 when SW_VERSION is less than 5 due to non-existence of this telemetry point in prior software versions. -0 Disabled, -1 Enabled.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>GAMMA_CH_LIMIT</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>96</td>
</tr>
<tr>
<td>BYTES</td>
<td>3</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>579</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Gamma Ray (processed count) Channel Limit.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>GAMMA_MODE</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>97</td>
</tr>
<tr>
<td>BYTES</td>
<td>1</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>584</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Gamma Ray mode. -0 raw count, -1 processed count.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>TC_COUNTERS</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>98</td>
</tr>
<tr>
<td>BYTES</td>
<td>1</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>587</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Time-correlated (TC) counters mode enabled. Value is set to 0 when SW_VERSION is less than 5 due to the non-existence of this telemetry point in prior software versions.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>SPARE</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>99</td>
</tr>
<tr>
<td>BYTES</td>
<td>1</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>590</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Spare column.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>GAMMA_POST_TRIG_LEN</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>100</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>595</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Gamma Ray Post Trigger Length.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>SPARE</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>101</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>602</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Spare column.&quot;</td>
</tr>
</tbody>
</table>
8.9. **NS_CAL_DIAG.FMT Table Fields**

Below is a table that shows the structure of the ASCII table containing the NS Calibration/Diagnostic EDR data. The ASCII table is both fixed-width and comma delimited. Note that in PDS ASCII table format, the Start Byte has to take into account the comma delimiter and empty spaces. Following this is the content of the format file.

Events can be filtered using the Data Quality flag (bit 12 in the Status Register column), but even then events may or may not have valid values for the BP or LG fields, depending on the type of event. The instrument engineer must determine the event type using the Status Register bit flags. This mode is expected to be used only by the instrument engineer, for event diagnostics.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>ASCII Integer</td>
<td>MET</td>
<td>Time tag of each event recorded in the calibration/diagnostic data packet.</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>ASCII Integer</td>
<td>ORBIT_NUMBER</td>
<td>Unique consecutive integer identifying a given orbit of MESSENGER around Mercury</td>
</tr>
<tr>
<td>22</td>
<td>5</td>
<td>ASCII Integer</td>
<td>SEQUENCE_CT</td>
<td>Continuous sequence count for each AppID.</td>
</tr>
<tr>
<td>29</td>
<td>5</td>
<td>ASCII Integer</td>
<td>LENGTH</td>
<td>Number of bytes in the calibration/diagnostic packet.</td>
</tr>
<tr>
<td>36</td>
<td>5</td>
<td>ASCII Integer</td>
<td>BPP_ENERGY</td>
<td>Borated Plastic (BP) detector prompt pulse energy.</td>
</tr>
<tr>
<td>43</td>
<td>5</td>
<td>ASCII Integer</td>
<td>BPS_ENERGY</td>
<td>BP detector delayed secondary pulse energy.</td>
</tr>
<tr>
<td>50</td>
<td>3</td>
<td>ASCII Integer</td>
<td>TTSP</td>
<td>Time from first to second pulse for valid BP events.</td>
</tr>
<tr>
<td>55</td>
<td>3</td>
<td>ASCII Integer</td>
<td>DATA_QUALITY</td>
<td>Data quality indicator flags (16 bits, one flag/bit).</td>
</tr>
<tr>
<td>60</td>
<td>5</td>
<td>ASCII Integer</td>
<td>LG1_ENERGY</td>
<td>LG1 energy.</td>
</tr>
<tr>
<td>67</td>
<td>5</td>
<td>ASCII Integer</td>
<td>LG2_ENERGY</td>
<td>LG2 energy.</td>
</tr>
<tr>
<td>74</td>
<td>5</td>
<td>ASCII Integer</td>
<td>STATUS_REGISTER</td>
<td>Status register.</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BYTES</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>START_BYTE</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Time tag of each event recorded in the Calibration/Diagnostic data packet. All events recorded in a given packet will have the same MET time tag value.&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>ORBIT_NUMBER</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>2</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>15</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Orbit number is a unique identifier for a given orbit of the MESSENGER spacecraft around Mercury. Orbit number is defined as starting at apoherm and is calculated using the MET value and the appropriate SPICE kernels. Orbit numbering does not start until MESSENGER performs the Mercury orbit insertion. Until that time the value for orbit number is 0.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>SEQUENCE_CT</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>3</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>22</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Continuous sequence count for each AppID.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>LENGTH</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>4</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>29</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Number of bytes [packet secondary header + packet data field] - 1. The number of events (N) collected at a given MET is determined by N = (Length-3)/12.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>BPP_ENERGY</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>5</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>36</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Borated Plastic (BP) detector prompt pulse energy.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>BPS_ENERGY</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>6</td>
</tr>
<tr>
<td>BYTES</td>
<td>5</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>43</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;BP detector delayed secondary pulse energy.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>TTSP</td>
</tr>
<tr>
<td>COLUMN_NUMBER</td>
<td>7</td>
</tr>
<tr>
<td>BYTES</td>
<td>3</td>
</tr>
<tr>
<td>DATA_TYPE</td>
<td>ASCII_INTEGER</td>
</tr>
<tr>
<td>START_BYTE</td>
<td>50</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Time from first to second pulse for valid BP events.&quot;</td>
</tr>
</tbody>
</table>
OBJECT        = COLUMN
NAME           = DATA_QUALITY
COLUMN_NUMBER  = 8
BYTES          = 3
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 55
DESCRIPTION    = "Data quality indicator flags (16 bits, one flag/bit).
Indicate whether event is in energy range, if pileup is detected, etc."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LG1_ENERGY
COLUMN_NUMBER  = 9
BYTES          = 5
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 60
DESCRIPTION    = "LG1 energy."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = LG2_ENERGY
COLUMN_NUMBER  = 10
BYTES          = 5
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 67
DESCRIPTION    = "LG2 energy."
END_OBJECT    = COLUMN

OBJECT        = COLUMN
NAME           = STATUS_REGISTER
COLUMN_NUMBER  = 11
BYTES          = 5
DATA_TYPE      = ASCII_INTEGER
START_BYTE     = 74
DESCRIPTION    = "Status register. Contains flags allowing determination
of event type (16 bits, one flag/bit)."
END_OBJECT    = COLUMN

8.10. NS_CMDECHO.FMT Table Fields

Below is a table that shows the structure of the ASCII table containing the NS Command Echo EDR data. The ASCII table is both fixed-width and comma delimited. Note that in PDS ASCII table format, the Start Byte has to take into account the comma delimiter and empty spaces. Following this is the content of the format file.

<table>
<thead>
<tr>
<th>Start Byte</th>
<th>Length (bytes)</th>
<th>Data Type</th>
<th>Column Name</th>
<th>Summary (see format file text for full description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>ASCII Integer</td>
<td>MET</td>
<td>Mission Elapsed time in seconds.</td>
</tr>
<tr>
<td>15</td>
<td>19</td>
<td>ASCII Integer</td>
<td>CMD_UTC_TIME</td>
<td>UTC time in YYYY-MM-DDTHH:MM:SS format derived from the MET using SPICE kernels.</td>
</tr>
<tr>
<td>37</td>
<td>3</td>
<td>ASCII Integer</td>
<td>MACRO_FLAG</td>
<td>Identifies as single command or part of a macro.</td>
</tr>
<tr>
<td>43</td>
<td>3</td>
<td>ASCII Integer</td>
<td>CMD_OPCODE</td>
<td>Indicates level of success for the command.</td>
</tr>
<tr>
<td>49</td>
<td>4</td>
<td>ASCII Integer</td>
<td>CMD_OPCODE_STRING</td>
<td>Command opcode expressed as hexadecimal.</td>
</tr>
<tr>
<td>57</td>
<td>40</td>
<td>ASCII Integer</td>
<td>CMD_OPCODE_STRING</td>
<td>Hex command translated into string mnemonic.</td>
</tr>
<tr>
<td>101</td>
<td>22</td>
<td>ASCII Integer</td>
<td>CMD_ARG_PARAMETERS</td>
<td>Up to the first 10 command arguments.</td>
</tr>
</tbody>
</table>

OBJECT        = COLUMN
NAME           = MET
COLUMN_NUMBER  = 1
BYTES          = 12
DATA_TYPE      = ASCII_INTEGER
START_BYTE = 1
DESCRIPTION = "Mission Elapsed Time in seconds."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = CMD_UTC_TIME
COLUMN_NUMBER = 2
BYTES = 19
DATA_TYPE = CHARACTER
START_BYTE = 15
DESCRIPTION = "UTC time in YYYY-MM-DDTHH:MM:SS format derived from the MET using SPICE kernels."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = MACRO_FLAG
COLUMN_NUMBER = 3
BYTES = 3
DATA_TYPE = CHARACTER
START_BYTE = 37
DESCRIPTION = "Identifies the command echo as a single command (CMD) or part of a command macro (MAC)."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = CMD_RESULT
COLUMN_NUMBER = 4
BYTES = 3
DATA_TYPE = ASCII_INTEGER
START_BYTE = 43
DESCRIPTION = "Indicates the level of success for the command. The success level is command dependent and is described for each separate command in the NS Flight Software Document."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = CMD_OPCODE
COLUMN_NUMBER = 5
BYTES = 4
DATA_TYPE = CHARACTER
START_BYTE = 49
DESCRIPTION = "The command opcode expressed as a hexadecimal string."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = CMD_OPCODE_STRING
COLUMN_NUMBER = 6
BYTES = 40
DATA_TYPE = CHARACTER
START_BYTE = 57
DESCRIPTION = "The hex command translated into a string mnemonic. A hex command without an associated string map is set to UNDEFINED_CMD_STRING."
END_OBJECT = COLUMN

OBJECT = COLUMN
NAME = CMD_ARG_PARAMETERS
COLUMN_NUMBER = 7
BYTES = 22
DATA_TYPE = CHARACTER
START_BYTE = 101
DESCRIPTION = "The command echo packet returns up to the first 10 command arguments. Most commands contain less than 10. The arguments are represented by a single hex string. The decoding of the hex string is command dependent and described for each separate command in the NS Flight Software Document."
END_OBJECT = COLUMN
8.11. **SPICE Kernel Files used in MESSENGER Data Products**

The following SPICE kernel files will be used to compute the UTC time and any geometric quantities found in the PDS labels. Kernel files will be generated throughout the mission with a filenaming convention specified by the MESSENGER project. SPICE kernel files will be archived with the PDS NAIF node.

* .bsp:
MESSENGER spacecraft ephemeris file. Also known as the Planetary Spacecraft Ephemeris Kernel (SPK) file.

* .bc:
Messenger spacecraft orientation file. Also known as the Attitude C-Kernel (CK) file.

* .tf:
MESSENGER reference frame file. Also known as the Frames Kernel. Contains the MESSENGER spacecraft, science instrument, and communications antennae frame definitions.

* .ti:
MESSENGER instrument kernel (I-kernel). Contains references to mounting alignment, operation modes, and timing as well as internal and field of view geometry for the NS instrument.

* .tsc:
Messenger spacecraft clock coefficients file. Also known as the Spacecraft Clock Kernel (SCLK) file.

* .tpc:
Planetary constants file. Also known as the Planetary Constants Kernel (PcK) file.

* .tls:
NAIF leapseconds kernel file. Used in conjunction with the SCLK kernel to convert between Universal Time Coordinated (UTC) and MESSENGER Mission Elapsed Time (MET). Also called the Leap Seconds Kernel (LSK) file.

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**8.12. CODMAC/NASA Definition of Processing Levels**

<table>
<thead>
<tr>
<th>CODMAC/NASA Definition of processing levels for science data sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODMAC/NASA Definition of processing levels for science data sets</td>
</tr>
<tr>
<td><strong>CODMAC Level</strong></td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

---
<table>
<thead>
<tr>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>calibrated, rearranged) in a reversible manner and packaged with needed ancillary and auxiliary data (e.g. radiances with calibration equations applied). Referred to in the MESSENGER Program as Calibrated Data Records (CDRs). In some cases these also qualify as derived data products (DDPs). Corresponds to NASA Level 1A.</td>
</tr>
<tr>
<td>4</td>
<td>Resampled data</td>
</tr>
<tr>
<td>5</td>
<td>Derived Data</td>
</tr>
<tr>
<td>6</td>
<td>Ancillary Data</td>
</tr>
<tr>
<td>7</td>
<td>Corrective Data</td>
</tr>
<tr>
<td>8</td>
<td>User Description</td>
</tr>
</tbody>
</table>

The above is based on the national research council committee on data management and computation (CODMAC) data levels.

### 8.13. MESSENGER Glossary and Acronym List

- **ACT**: Applied Coherent Technology Corporation
- **ADC**: Analog-to-Digital Converter
- **AM**: Atmosphere and Magnetosphere Group
- **APL**: The Johns Hopkins university Applied Physics Laboratory
- **ApID**: Application Identifier code for telemetry packet type
- **ASCII**: American Standard Code for Information Interchange
- **BP**: Borated Plastic detector
- **CCD**: Charged-Coupled Device
- **CCSDS**: Consultative Committee for Space Data Systems
- **CDR**: Calibrated Data Record
- **CK**: C-Kernel (SPICE)
- **CODMAC**: Committee on Data Management and Computation
- **CO-I**: Co-Investigator
- **DAC**: Digital-to-Analog converter
- **DPU**: Data Processing Unit
- **DSMS**: Deep Space Mission Services
- **EDR**: Experiment Data Records
- **EK**: Event Kernel
- **EPPS**: Energetic Particle and Plasma Spectrometer
- **EPU**: Event Processing Unit
- **ET**: Ephemeris Time
- **FIPS**: Fast Imaging Plasma Spectrometer
- **FITS**: Flexible Image Transport System
- **FOV**: Field-of-View
- **FPA**: Focal Plane Assembly
- **FTP**: File Transfer protocol
- **GC**: Geochemistry Group
- **GCR**: Galactic Cosmic Ray
- **GP**: Geophysics Group
- **GRNS**: Gamma-ray and Neutron Spectrometer
- **GSFC**: Goddard Space Flight Center
- **HVPS**: High Voltage Power Supply
- **I&T**: Integration and Test
- **I2C**: Inter-Integrated Circuit
- **IEM**: Integrated Electronic Module
- **IK**: Instrument Measurement Kernel (SPICE)
- **LG**: Lithium Glass detector
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSK</td>
<td>Leapseconds Kernel (SPICE)</td>
</tr>
<tr>
<td>LVPS</td>
<td>Low Voltage Power Supply</td>
</tr>
<tr>
<td>MAG</td>
<td>Magnetometer</td>
</tr>
<tr>
<td>MASCOS</td>
<td>Mercury Atmospheric and Surface Composition Spectrometer</td>
</tr>
<tr>
<td>MDIS</td>
<td>Mercury Dual Imaging System</td>
</tr>
<tr>
<td>MESSENGER</td>
<td>MERCURY, SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING</td>
</tr>
<tr>
<td>MET</td>
<td>Mission Elapsed Time</td>
</tr>
<tr>
<td>MOC</td>
<td>Mission Operations Center</td>
</tr>
<tr>
<td>NAIF</td>
<td>Navigation and Ancillary Information Facility</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>PCK</td>
<td>Planetary Constant Kernel (SPICE)</td>
</tr>
<tr>
<td>PDS</td>
<td>Planetary Data System</td>
</tr>
<tr>
<td>SCLK</td>
<td>Space Clock Kernel (SPICE)</td>
</tr>
<tr>
<td>SIS</td>
<td>Software Interface Specification</td>
</tr>
<tr>
<td>SOC</td>
<td>MESSENGER Science Operations Center</td>
</tr>
<tr>
<td>SPICE</td>
<td>Spacecraft, Planet, Instrument, C-matrix Events</td>
</tr>
<tr>
<td>SPK</td>
<td>Spacecraft and Planets Kernel (SPICE)</td>
</tr>
<tr>
<td>SQL</td>
<td>Structured Query Language</td>
</tr>
<tr>
<td>UTC</td>
<td>Coordinated Universal Time</td>
</tr>
<tr>
<td>XRS</td>
<td>X-Ray Spectrometer</td>
</tr>
</tbody>
</table>