Mars Atmosphere and Volatile Evolution (MAVEN) Mission
Neutral Gas and Ion Mass Spectrometer (NGIMS)

NGIMS PDS Software Interface Specification

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Configuration Management Plan

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ACRONYMS

APP   Articulated Pointing Platform
ATM   Planetary Atmospheres Node
C&DH  Command and Data Handling
DAC   Digital to Analogue Converter
GSFC  Goddard Space Flight Center
ICD   Interface Control Document
I&T   Integration and Testing
INMS  Ion and Neutral Gas Mass Spectrometer
ITF   Instrument Team Facility
IUVS  Imaging Ultraviolet Spectrometer
LADEE Lunar Atmosphere and Dust Environment Explorer
LPW   Langmuir Probe and Waves
MAG   Magnetometer
MAVEN Mars Atmosphere and Volatile Evolution Mission
MSA   Mission Support Area
MLA   Sample Analysis at Mars
NMS   Neutral Mass Spectrometer
NGIMS Neutral Gas and Ion Mass Spectrometer
PDS   Planetary Data System
RF    Radio Frequency
SAM   Mars Science Laboratory
SEP   Solar Energetic Particles
SIS   Software Interface Specification
SOC   Science Operation Center
SQL   Structured Query Language
STATIC Supra-thermal and Thermal Ion Composition
SWEA  Solar Wind Electron Analyzer
SWIA  Solar Wind Ion Analyzer
TBD   To Be Determined
1. INTRODUCTION

1.1 Purpose and Scope

This document describes the format and the content of the Neutral Gas and Ion Mass Spectrometer (NGIMS) products as archived in the Planetary Atmospheres Discipline Node (ATM) of the Planetary Data System (PDS). The data products stored in PDS are a subset of the holdings of the NGIMS team database at NASA’s Goddard Space Flight Center (GSFC).

This SIS is intended to provide enough information to enable users to read and understand the NGIMS data products as stored in PDS. The users for whom this SIS is intended are software developers of the programs used in generating the NGIMS products and scientists who will analyze the data, including those associated with the MAVEN mission and those in the general planetary atmospheres science community.

1.2 Contents

NGIMS is an instrument on the MAVEN spacecraft designed to analyze the composition of the Martian upper atmosphere ( neutrals and ions) during the mission. This Data Product SIS describes how the NGIMS instrument acquires its data and how the data are processed.

1.3 Applicable Documents and Constraints

1. Planetary Data System Standards Reference, JPL D-7669 part 2, version 4.0.6, October 8, 2012.


1.4 Relationships with Other Interfaces

The NGIMS data products are stored on multiple data servers of GSFC. The master copy stored in an SQL (Structured Query Language) relational database for rapid instrument team access will be used by the NGIMS science team to retrieve and process data for delivery to PDS via the MAVEN Science Operation Center (SOC) as described by the MAVEN Science Data Management Plan.

2. MANAGEMENT AND OVERSIGHT

Data will be produced by the NGIMS science team for submission to PDS via the SOC. Data delivered to PDS will be managed and verified according to the MAVEN Science Operations Center to Instrument Facility Interface Control Document and the PDS Standards Reference.
3. DATA PRODUCT CHARACTERISTICS AND ENVIRONMENT

3.1 Instrument Overview

The MAVEN Neutral Gas and Ion Mass Spectrometer (NGIMS) is a high sensitivity quadrupole mass spectrometer with a mass range of 2 to 150 Dalton and unit mass resolution (Figure 1).

![Figure 1: The MAVEN NGIMS Instrument during Integration and Testing (I&T).](image)

The sensor of the NGIMS instrument has a high heritage from the Neutral Gas and Ion Mass Spectrometer (NGIMS) developed for the CONTOUR mission [1] and the Neutral Mass Spectrometer (NMS) developed for the LADEE Mission [2]. This mass spectrometer is similar to the CASSINI Ion and Neutral Mass Spectrometer (INMS) designed and developed at GSFC [3]. The MAVEN NGIMS instrument was modified from the heritage CONTOUR NGIMS instrument to increase the instrument sensitivity, field of view and overall operational flexibility.

3.2 Science Goals of the NGIMS Investigation

The NGIMS top level science goals are to:

- Establish the structure and composition of the upper neutral atmosphere by securing density profiles of He, N, O, CO, N₂, NO, O₂, Ar, and CO₂ along the spacecraft track.
- Measure isotope ratios such as \(^{13}\text{C}/^{12}\text{C},^{18}\text{O}/^{16}\text{O},^{15}\text{N}/^{14}\text{N},^{40}\text{Ar}/^{36}\text{Ar},^{38}\text{Ar}/^{36}\text{Ar}\).
- Secure profiles of thermal ions \(\text{O}^2+,\text{CO}^2+,\text{NO}^+,\text{O}^+,\text{CO}^+,\text{C}^+,\text{N}^2+,\text{OH}^+,\text{and N}^+\).

With more than five orbits each day over the course of the one year nominal mission the MAVEN NGIMS data set will greatly expand on the two detailed profiles of neutral and ion species data secured in this region of the atmosphere in 1976 by the Viking 1 and 2 entry probe aeroshell investigations. This will enable a detailed study of the response of the atmosphere to seasonal dust storms and variations in solar activity. The slow precession of the 75° inclination...
orbit will allow periapsis measurements at a range of latitudes and local times. Five one weeklong duration deep dip campaigns over the course of the nominal mission will enable NGIMS measurements over the ~125-500 km altitude range instead of the usual ~150-500 km region of the atmosphere. These deep dips in addition to sampling the well-mixed neutral atmosphere are expected to pass through the peak charged particle region of the ionosphere. NGIMS measurement requirements are to sample the neutral species listed above from the homopause to one scale height above the exobase with a vertical resolution of at least one half scale height for each species. This sampling resolution will enable neutral temperatures to be established from the scale heights.

<table>
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<th>NGIMS Instrument Parameters</th>
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| Neutral gas sampling systems | 1. Closed source (non-reactive species)  
2. Open source (wall reactive species) |
| Ion sampling system          | Thermal and supra-thermal positive ions |
| Source switching system      | Electrostatic quadrupole deflector |
| Field of view                | 1. Closed source: 2 \( \pi \) steradians  
2. Open source 10° cone half angle |
| Neutral mode ionization sources | Electron impact ionization with redundant filaments  
1. Closed source: 50 to 250 \( \mu \)A and 70eV  
2. Open source: 50 to 250 \( \mu \)A and 70eV |
| Mass analyzer                | Quadrupole mass filter; 0.508 cm field radius, 15 cm rod length;  
Radio frequencies: 1.4 and 3.0 MHz |
| Mass range                   | 2 – 150 Daltons and a unit mass resolution |
| Scan modes                   | 1. Survey: scan mass range in 0.1 Da steps  
2. Adaptive mode: select mass values |
| Crosstalk                    | \( 10^6 \) for adjacent masses |
| Detector system              | Two secondary electron multiplier detectors operating in pulse counting mode (detector noise <1 count per min)  
Dynamic range ~ \( 10^5 \) |
| Data rate                    | Integration period from 27 ms to 250 ms with a 3 ms setup time per period. |

### 3.3 Synergy with other MAVEN Investigations

The Remote-Sensing and Particles and Fields Packages complement the NGIMS capabilities. The Remote-Sensing Package consists of an Imaging Ultraviolet Spectrometer (IUVS). The Particles and Field Package consists of six individual instruments or instrument sensors designated; Suprathermal and Thermal Ion Composition (STATIC), Solar Wind Electron Analyzer (SWEA); Solar Wind Ion Analyzer (SWIA), Solar Energetic Particles (SEP), Langmuir Probe and Waves (LPW); and Magnetometer (MAG). While overlapping capabilities provide critical redundancies in certain cases, the set of measurements provided by the three packages is designed to secure a full range of energy input and atmospheric parameters to lead to a more precise determination of the rate
of atmospheric escape from the planet and its dependence on varying energy inputs from the sun. For example, the NGIMS team will utilize the LPW determinations of total electron density to establish the total ion density in those cases when ion drifts cause attenuation of the ion flow into the NGIMS. IUVS will secure limb scans near periapsis and disc maps at apoapsis and resolve certain species such as the D/H isotope ratio in the upper atmosphere for comparison with the D/H in the lower atmosphere measured by the MSL’s SAM instrument. The IUVS global maps will complement the NGIMS, LPW, and STATIC measurements taken along the spacecraft track. While the STATIC instrument will measure thermal ions in the same energy range as those sampled by the NGIMS instrument, the unit mass resolution of NGIMS allows it to secure isotope measurements. STATIC measurements that complement NGIMS are the supra-thermal ions in the energy range where these ions are escaping, and pick-up ions to energies 20 KeV.

3.4 Instrument Description

The NGIMS sensor consists of:
- two separate ion sources for sampling ambient neutrals and ions,
- four ion collimators
- four hot-filament electron guns,
- an electrostatic quadrupole switching lens that selects between the sources,
- various focusing lenses,
- a quadrupole mass analyzer, and
- two secondary electron multiplier (SEM) detectors.

The instrument control is provided by the Command and Data Handling (C&DH) unit, according to the instructions given to a user defined script. The C&DH and all the related electronics boards are packaged together. A sketch of the key NGIMS components is shown in Figure 2, and the primary instrument parameters are listed in Table – 1. Detailed information about the instrument is provided in [4].
Figure 2: Schematics illustrating the principal components of the NGIMS sensor.
Figure 3: Schematics of NGIMS electrostatic elements. Table 3 provides the related nomenclature.
3.4.1 Gas Sampling System

The NGIMS instrument uses two separate gas sampling systems (also referred to as ion sources), a closed source and an open source in order to optimize interpretation of the neutral species (Figure 3). In the closed source mode, the ram pressure of the inflowing gas creates a density enhancement in the source antechamber, allowing the sampled species to be measured with relatively high precision and sensitivity. This mode will be used to measure species, such as He, N₂, and Ar, which do not react with the antechamber surfaces.

The open source has the advantage that it can measure reactive neutral radicals, such as atomic oxygen, and ions. In this mode, the ambient neutral gas density is sampled directly with no stagnation enhancement and no collisions with the surfaces of the instrument. For open source ion measurements, the NGIMS angular response can be increased beyond the geometric view cone by adjusting the voltages on the ion collimator lenses. For neutral sampling in the open source mode, the ion collimator lenses and the repeller lens remove incoming ions and electrons, which could cause spurious ionization of neutral species, and allow only neutrals to pass into the ionization region.

3.4.2 Ion Optics

In both closed and open source modes, impacting electrons emitted from the hot-filament electron guns ionize the sampled neutrals. Electrostatic lenses are used to focus the ambient ions and those created from ambient neutrals by electron impact into the quadrupole switching lens (Mahaffy and Lai, 1990), an electrostatic device that steers ions from either the closed or open source through a system of focusing lenses into a dual radio frequency (RF) quadrupole mass analyzer.

3.4.3 Mass Analyzer

The mass analyzer selectively filters the ions according to their mass-to-charge ratio using a set of 4 hyperbolic rods excited with a RF wave form.

Two opposing potentials of the form $U_{DC} + U_{AC} \cos(2\pi ft)$ drive each pair of rods (Figure 4). Ions with the appropriate ratio of mass to charge achieve stable trajectories while the rest of the ions diverge and end up impacting the rods.

During a mass scan the absolute values of $U_{DC}$ and $U_{AC}$ are increased while the ratio $U_{DC}/U_{AC}$ is kept constant. The DC and AC potentials are calculated for the given target mass as:

$$U_{DC} = \frac{m r_0^2 \pi^2 f^2 a}{2e}$$

$$U_{AC} = \frac{m r_0^2 \pi^2 f^2 q}{e}$$
Where $m$ is the mass of the targeted ion, $r_0$ is the hyperbolic rods radius, $f$ the RF frequency, and $e$ the electron charge. $a \approx 0.23699$ and $q \approx 0.7060$ are constants that drive the mass resolution of the analyzer.

In order to cover the mass range of 2 to 150 Da while keeping the voltages relatively low, the RF frequency is switched from $f_1 = 1.4 \text{ MHz}$ to $f_2 = 3.0 \text{ MHz}$ at mass $m = 20.5 \text{ Da}$.

![Figure 4: Quadrupole mass filter and driving RF potentials.](image)

When the NGIMS is operating in the open source mode, a quadrupole bias voltage $U_{QB}$ is added to the DC voltage applied to the RF mass analyzer rods to slow down incoming ions and increase their residence time in the analyzer’s RF field.

### 3.4.4 Detectors

Ions exiting the quadrupole mass filter are directed toward one of the two redundant secondary electron multipliers for detection. During nominal operations only one detector is used at a given time. The multipliers are associated electrodes electronically biased such that most of the ions are deflected into one of the detectors. Charge pulses at the anode of the multiplier are amplified and counted. The detection threshold is determined by the background noise in the multiplier (approximately one count per minute). The upper count rate of each detector system is about 10 MHz, limited by the product of the multiplier pulse width and gain bandwidth of the pulse amplifier of the counting system. There is a non-linear response that occurs in the range of 1–10 MHz and needs to be accounted for.

### 3.4.5 Calibration Reservoir

In order to track possible long-term changes in sensitivity, NGIMS incorporates a calibration gas reservoir that will be used occasionally in flight to assess the instrument response. The calibration gases are equal parts of $\text{N}_2$, $\text{CO}_2$, Ar, Kr, and Xe to establish the response of the instrument over much of its mass range. Use of $\text{N}_2$ and $\text{CO}_2$ will serve another purpose to
establish calibration factors for two gases that were difficult to calibrate just prior to instrument pinch off because of the close proximity of the getter to the ionization region. The getter on NGIMS is incorporated in the break-off cap and will be removed from the instrument once this cap flies off into space. The calibration reservoir is sealed behind two micro-valves of SAM heritage to insure that no residual gas will enter the mass spectrometer during measurement times below 500 km. Calibration will be carried out at an interval of several weeks near apoapsis by opening both valves which establishes a restricted flow through a capillary leak into the open source of NGIMS.

3.4.6 Instrument Accommodation on the MAVEN Spacecraft

The NGIMS is mounted together with the STATIC and IUVS instruments on an Articulated Pointing Platform (APP) that is deployed after arrival at Mars (Figure 5). The APP enables instrument pointing independent of the solar array attitude. This implementation insures a high duty cycling for these three instruments. The optimal attitude for NGIMS is for the axis of the open source to be pointed along the velocity vector of the spacecraft (the RAM direction).
3.5 NGIMS Measurement Modes

NGIMS measurement modes are illustrated in Figure 6. The prime NGIMS science is realized below 500 km so above this altitude the instrument will generally be in a low power standby mode with filaments and detectors turned off. Science measurements will typically focus either on neutral gas or ambient ions although the flexible scripting command language will allow these modes to be interleaved if desired. The neutral mode will generally interleave open and closed source measurements (Figure 7) to allow corrections to be made in the open source measurements for signal variations due to upper atmosphere winds. The closed source with its $2\pi$ steradian field of view is quite insensitive to neutral winds. In the ion mode, the total ion signal measured by the NGIMS will be normalized to the LPW electron density.

![Figure 6: NGIMS Measurement Modes.](image)

3.6 Commanding and Operations

The NGIMS instrument-commanding schemes have a high heritage from the LADEE NMS instrument. However, instrument operations have been tailored to the science requirements of the MAVEN mission.

3.6.1 Commanding

The primary mode of commanding the instrument is through stored files of commands and code functions called scripts. There are two comprehensive scripts, one functional and one science, which define all operations desired for the instrument in a modular format. This allows loading
smaller configuration scripts to define how the operations will be executed (i.e., which modules to execute). The functional script is stored in EEPROM and configuration files are loaded to define checkout activities, from as simple as an aliveness check to a comprehensive performance test. As would be expected, the science configurations orchestrate the collection scenarios throughout the Martian orbits, by interacting much more intensively with the hardware in setting the various DACs, etc.

Individual instrument commands are also used to perform pre-defined functions, such as loading memory or controlling the execution of scripts. These database-defined commands use an upload execution code to define what priority the flight software needs to give to the execution (i.e., store for later or execute immediately).

![Diagram](image)

**Figure 7: Example of measurement sequences for neutral and ions**

3.6.2 Science Operation

During the science phase of the mission, the NGIMS instrument is scheduled to collect atmospheric measurements according to a pre-established and repeatable operational scenario. According to this scenario, upon reaching an altitude of ~5000 km along the inbound leg of the orbit, the MAVEN spacecraft will command NGIMS to exit its standby state and start science operations. The instrument FSW will then load the science script from EEPROM along with a configuration file handed by the spacecraft and will proceed into configuring the instrument for operation. During a first phase, the instrument will turn on a pair of filament/multiplier and collect background spectra to serve as an assessment of the level of chemical noise in the sensor. At the completion of these background scans, the science script will enter a hold for ~50 min to allow the instrument to reach its thermal equilibrium. The duration of the warm-up phase is timed to end when the spacecraft descends below 500 km altitude. Upon reaching the end of the warm-up period, the FSW resume the execution of the science script by setting up the proper voltages for the acquisition mode (neutral ions) and the ion source (open or closed) and
acquiring the required mass spectra according to mass tables embedded in the configuration file provided by the spacecraft. The configuration file provides the flexibility of defining customized scanning sequence that can be tailored to specific altitudes and expected signal levels and can alternate between measuring ions and neutrals.

The instrument will continue acquiring measurements for ~25 min during which the spacecraft would have reached periapsis and ascended above 500 km along its outbound leg before transitioning back to its standby state for the remainder of the orbit. During the mission, the instrument team is expected to generate and uplink to the spacecraft several NGIMS configuration files that are tailored to the atmospheric condition observed at Mars.

3.6.3 Telemetry

Telemetry is received by two different methods: real-time dataflow to the Instrument Team Facility (ITF) and post-event file retrieval. In both cases, this data is passed from the Mission Support Area (MSA), through the Science Operation Center (SOC), to the ITF in CCSDS frames. At the ITF, this raw data is unpacked and processed by various dedicated GSE software tools and databases. In addition to science relevant packets, the NGIMS telemetry contains housekeeping data. This data is used for assessment of the health of the instrument. The NGIMS files retrieved from the SOC system are used to create the comprehensive dataset for the science collection, known as the ‘GOLD’ dataset. This dataset is then submitted to the repository and fed to a database for use by the MAVEN science team.

3.7 Instrument Calibration

NGIMS was designed, built and tested at the Planetary Environment Laboratory (Code 699) of NASA’s Goddard Space Flight Center (GSFC). During integration and testing (I&T), the NGIMS instrument was mounted on a vacuum chamber in order to characterize its sensitivity in static pressure for a set of gases and gas mixtures. Ion field of view calibration was also conducted using an ion beam set up. However, no calibration data were obtained with a neutral beam.

The calibration of the mass spectrometer was carried out with the ion source cover replaced with a flanged transition joint that coupled the sensor to a static calibration chamber. Calibration continued after the tube was pinched-off and during instrument final integration, environmental testing, pre-launch operations and post launch checkouts. The calibration activities aimed to characterize instrument sensitivity over its mass range and to assess the stability of the instrument response in its flight environment.

During the initial calibration phases, He, Ne, Ar, Kr and Xe gases in pure forms or as mixtures were introduced into the NGIMS through a mixing manifold and the response of the instrument was established over a range of pressures. These gases were selected to provide signal over a wide mass range while avoiding interaction with the NGIMS getter (the getter does not pump noble gases). Since the instrument sensitivity varies slightly as a function of how the filaments and the multipliers are paired during operations, a set of calibration data were acquired for the trio CS filament #1/ OS filament #1\ CEM #1 as a group and for the trio CS filament #2/ OS filament #2/ CEM #2 as a group. The latter is chosen as a primary group for flight operations.
After this initial characterization, the sensor was sealed with an equal part mixture of He, Ne, Ar, Kr and Xe. This mixture was used to assess variations in the instrument response as it went through integration, environmental testing, and pre and post launch assessments.

3.7.1 Characterization of the Detector Chain

NGIMS relies on two identical and redundant detection chains. Each detection chain is comprised of a channel electron multiplier (CEM), a pulse amplifier, a pulse height discriminator and a counter. The linearity of each detector chain was established using He, Ne, Ar, and Kr for densities that range from $10^5$ to $10^{10}$ atoms/cc. This density range provided a signal on these species and their associated isotopes that ranges from $10^3$ c/s to $2 \times 10^7$ c/s. The data, presented in Figure 8 shows that both detector chains exhibit good linearity up to $2 \times 10^6$ c/s above which they display a non-linear behavior common to all paralyzable counting systems.

In such systems, as the counting rate goes up, a correction in the form of:

$$m = n \exp (-n \tau)$$

Figure 8: Detector linearity measured for the closed source at high and low filament emissions using Kr gas
where $n$ is the true event rate in counts/s, $m$ is the measured event rate in counts/s and $\tau$ is the per event dead time in seconds associated with the detection chain. The required dead time correction for each detection chain was derived using measurements of Kr isotopes signals at multiple sensor pressures. The three-isotope experimental method [5] was used to mitigate the effect of isotopic mass fractionations of Kr introduced in most vacuum systems. Figure 9 shows the variation of the dead time $\tau$ as a function of $^{84}$Kr abundance. The dead time for both detector chains can be fit by the analytical formula:

$$\tau = A \exp((m B)^C)$$

(2)

where $A$, $B$, $C$ are constants that characterize each detector chain. By applying this dead time correction, the linearity of both detection chains can be extended up to $10^7$ c/s after processing. Table – 2 provides the dead time correction parameters for the two detection chains.

| Table – 2: Parameters for Dead Time Correction |
|------------------|------------------|------------------|
|                  | CEM #1            | CEM #2            |
| A                | 1.38E-08          | 2.97E-08          |
| B                | 1.53E-07          | 2.44E-08          |
| C                | 1.5              | 1.5              |

3.7.2 Noise Level in the Detector Chain

The instrument was designed to minimize the noise level in the detector chain. This goal was achieved by a careful isolation of the multipliers from any stray electrons that originate in the ionization sources. Moreover, the detector electronics were placed at a very short distance from the multipliers to minimize noise pickup. Noise levels in the active detection chain were assessed by turning on the closed source while configuring the switching lenses to select the open source. In that configuration all recorded counts can be assumed to be noise. During instrument checkouts the noise level on both detection chains were found to be less than 10 counts/min.

3.7.3 Instrument Chemical Background

During integration the sensor underwent a multi-day high temperature bake out to insure the cleanliness of the internal surfaces and to minimize chemical background. After the ejection of the breakoff cap assembly, the instrument will be assessed for the level of residual instrument background induced by internal surface outgassing, filament outgassing, and spacecraft contamination. While this background tend to decay as the cumulative operational time of the instrument increases, the level and the nature of this background will set the detection limits of the instrument. During the science phase, regular background assessment activities will be conducted. These special engineering activities will provide the data necessary to account for the background level during data processing. Using the latest background values, the detector count rate $n$ can be corrected for background.
\[ n_B(m_s) = n(m_s) - b(m_s) - e(m_s) \] (3)

Where \( n \) is the measured count rate for the given mass channel \( m_s \), and \( b \) and \( e \) are, respectively, the chemical and electronic background levels for the same mass channel.

### 3.7.4 Instrument Sensitivity

The instrument sensitivity was measured in a static mode for Ar and Kr. In a static mode, the gas is leaked into the ionization source at a very low pressures and left to equilibrate before pressure readings are taken by an external stable ion gauge and the corresponding instrument response is recorded. The measurements from the instrument are processed for dead time correction and background subtraction. After the sensor was pinched off sensitivities was continuously tracked using the noble gas mixture that was sealed in the instrument. During the science phase, small amounts of the flight calibration gas will be leaked into the sensor and used to update the sensitivity values that were established during ground calibration for the multiplier voltage and discriminator setting chosen for flight.

1) **Closed source sensitivities**

The sensitivities in the closed source mode for Ar and Kr are provided in Table – 3. Closed source normalized sensitivity \( S_n \) for another species \( s \) of mass \( m_s \) and electron ionization cross-section (at 70 eV) \( \sigma_s \) can be derived through interpolation of the normalized sensitivities of Table – 3 according to mass. To derive an absolute sensitivity \( S_a \) for the species, the normalized sensitivity \( S_n \) need to be corrected for RF frequency and for ionization cross-section as:

\[ S_a = S_n * C_{RF}(m_s) * \sigma_s \] (4)

where \( C_{RF} \) is a sensitivity correction factor:

\[ C_{RF} = \begin{cases} 0.71 & \text{if } m_s \leq 20.5 \\ 1.00 & \text{if } m_s > 20.5 \end{cases} \] (5)

2) **Open Source Sensitivities**

The sensitivity in the open source cannot be derived using the encapsulated calibration gas and will be determined during the science phase by comparing the count rates for non-reactive atmospheric species (for example He, N\(_2\), Ar) that will collected during the science phase. This comparison will be accomplished by switching alternately between the open and the closed source. The absolute sensitivity of the open source \( O_a \) can then be given by:

\[ O_a = \frac{S_a(m_{ref}) * n_c(m_{ref})}{n_o(m_{ref})} * C_{EN}(m_s) \] (6)
where \( n_c \) is the dead time corrected count rate of a reference species \( m_{ref} \) as measured by the closed source, \( n_o \) is the dead time corrected count rate of the same reference species as measured by the open source. \( C_{EN} \) is the energy correction factor to be applied to account for the energy response of the open source. This correction factor will be derived in the early days of the science phase.

3) Ion Sensitivites

Precise sensitivity for ions can be derived using concurrent LPW electron density measurements. The absolute sensitivity for a given ion species is given by

\[
I_a = \frac{D_e}{n_f} \cdot C_{EN}(m_s)
\]

(7)

where \( n_f \) is the sum of all dead time corrected count rate for all mass channels. \( D_e \) is the time interpolated LPW electron density measurements. \( C_{EN} \) is the energy correction factor to be applied to account for the energy response of the instrument. This correction factor is identical to the one derived for the open source.

4) Attenuated Sensitivities

To mitigate the effect of detector saturation at high neutral and ion densities, degrading the tuning of key electrodes in the sensor ion-optics artificially reduces the sensitivity of the instrument. In each mode (closed source, open source, and ion modes) two “detuned” settings are available. The sensitivity of the two detuned settings \( (i = 1, 2) \) are related to the nominal sensitivities by:

\[
\begin{align*}
S_{a,i} &= S_a \cdot DS_{a,i} \\
O_{a,i} &= O_a \cdot DO_{a,i} \\
I_{a,i} &= I_a \cdot DI_{a,i}
\end{align*}
\]

(8)

where \( DS_{a,i}, DO_{a,i}, DI_{a,i} \) are the detuning factors for each mode. These factors are derived directly from the flight data. Detuned mass channels are recorded in the telemetry as \( m/z + 150 \) for the first detuned setting and \( m/z + 300 \) for the second detuned setting.

<table>
<thead>
<tr>
<th>Fil #</th>
<th>Emission (µA)</th>
<th>CEM #</th>
<th>Species</th>
<th>El cross section ({}^{(2)}) ( (\text{A}^2\text{s}) )</th>
<th>Absolute Sensitivity (counts/s)/(particle/cc)</th>
<th>Normalized Sensitivity (counts/s)/(particle/cc)/A(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>250</td>
<td>1</td>
<td>(^{40}\text{Ar})</td>
<td>2.52</td>
<td>2.84E-02</td>
<td>1.13E-02</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>1</td>
<td>$^{40}$Ar</td>
<td>2.52</td>
<td>1.83E-03</td>
<td>7.26E-04</td>
</tr>
<tr>
<td>---</td>
<td>----</td>
<td>---</td>
<td>--------</td>
<td>------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>1</td>
<td>250</td>
<td>1</td>
<td>$^{84}$Kr</td>
<td>3.45</td>
<td>2.03E-02</td>
<td>5.89E-03</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
<td>1</td>
<td>$^{84}$Kr</td>
<td>3.45</td>
<td>1.38E-03</td>
<td>4.00E-04</td>
</tr>
<tr>
<td>2</td>
<td>250</td>
<td>2</td>
<td>$^{40}$Ar</td>
<td>2.52</td>
<td>3.03E-02</td>
<td>1.20E-02</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>2</td>
<td>$^{40}$Ar</td>
<td>2.52</td>
<td>2.36E-03</td>
<td>9.36E-04</td>
</tr>
<tr>
<td>2</td>
<td>250</td>
<td>2</td>
<td>$^{84}$Kr</td>
<td>3.45</td>
<td>2.27E-02</td>
<td>6.57E-03</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>2</td>
<td>$^{84}$Kr</td>
<td>3.45</td>
<td>1.90E-03</td>
<td>5.51E-04</td>
</tr>
</tbody>
</table>

(1) This sensitivities will be updated following the first in-flight calibration activity.
(2) Electron impact ionization cross sections are from [6]

### 3.7.5 Closed Source Ram Enhancement Factor

The NGIMS closed source consists of a small aperture in a spherical antechamber. Gas flows into the source through this aperture and most of the gas eventually leaves through the same aperture after thermalization with the walls of the source. The density in a closed source of this geometry for species $i$ can be shown [7] from the relevant gas kinetic equations to be:

$$n_{s,i} = n_{a,i} \left[ \frac{T_{a,i}}{T_{s,i}} \right] \left[ \exp(-S_i^2) + \sqrt{\pi} S_i \left( 1 + \text{erf}(S_i) \right) \right]$$  \hspace{1cm} (9)

where

$$S_i = \frac{V \cos(\alpha)}{c_i}$$  \hspace{1cm} (10)

and

$$c_i = \sqrt{\frac{2K T_{a,i}}{m_i}}$$  \hspace{1cm} (11)

In these equations $n$ is the density and $T$ is the temperature with the subscripts $a$ and $s$ designating the ambient and source values respectively for species $i$. $V$ is the apparent bulk speed of the atmosphere in the spacecraft reference frame, $\alpha$ is the angle between the normal to the orifice and the spacecraft velocity vector, $c_i$ is the most probable speed of the ambient gas particles, and $K$ is the Boltzmann’s constant.
3.8 NGIMS Data Products

<table>
<thead>
<tr>
<th>Data Level</th>
<th>Brief Description</th>
<th>Relevant to NGIMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td>Raw telemetry data as received at the ground receiving station. May contain duplicate data and/or communication artifacts.</td>
<td>Yes</td>
</tr>
<tr>
<td>Level 0</td>
<td>Binary packets (as produced by the corresponding instrument).</td>
<td>Yes</td>
</tr>
<tr>
<td>Quicklook</td>
<td>Scientific data products that are generated using simplified science processing algorithms, e.g. with provisional calibrations. Available to MAVEN science team.</td>
<td>Yes</td>
</tr>
<tr>
<td>Level 1A</td>
<td>Extracted telemetry items/channels; no calibrations or corrections applied.</td>
<td>Yes</td>
</tr>
<tr>
<td>Level 1B</td>
<td>Extracted telemetry data to which instrument-level engineering and science calibrations have been applied.</td>
<td>Yes</td>
</tr>
<tr>
<td>Level 2</td>
<td>Research-grade instrument-level scientific data products in physical units.</td>
<td>Yes</td>
</tr>
<tr>
<td>Level 3</td>
<td>Mission Level Data Products. These are science products derived from the data of one or more instruments that have been resampled spatially and/or temporally to produce a merged data set.</td>
<td>Yes</td>
</tr>
<tr>
<td>Level 4+</td>
<td>Higher-level products for team use.</td>
<td>No</td>
</tr>
</tbody>
</table>

This document uses the MAVEN data definitions for all products as provided in the MAVEN Science Data Management Plan and delineated in Table – 4. These data have been reviewed and accepted by PDS to comply with PDS4 standards. The NGIMS team will deliver Level 0 to 3 to the SDC for the purpose of archiving. These data levels are defined in Table – 5. The NGIMS neutral products have no dependence on other instruments. However, NGIMS ion measurement products will use the LPW electron and STATIC ion density measurements as calibration data. The NGIMS processing will also require spacecraft altitude, velocity and APP pointing data in a form of SPICE kernels.

3.8.1 NGIMS Product Definitions

All NGIMS products delivered to the PDS are in “spreadsheet” format with comma-delimited columns or as ASCII text files. These products are described in Table – 6. Deliveries will be made to PDS in accordance with the schedule defined in the MAVEN Science Data Management Plan.

3.8.2 NGIMS Data Processing Pipeline

The NGIMS data products will be generated using a high heritage process that has been developed for the MSL SAM and the LADEE NMS instruments. Level 1A/B, 2 and 3 data will be
processed and will be made available to the SOC upon generation. All the data processing scripts and algorithms will be placed under version control and will be updated regularly during the mission.

<table>
<thead>
<tr>
<th>Data Level</th>
<th>Description</th>
<th>Archived</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Binary packets as produced by NGIMS</td>
<td>No</td>
</tr>
<tr>
<td>1A</td>
<td>Packets separated by telemetry channel (Housekeeping, Science and Instrument Log) and converted to ASCII format</td>
<td>Yes</td>
</tr>
<tr>
<td>1B</td>
<td>Calibrated Data Record: Time-stamped spectra (counts per unit mass and bands) separated by mode (ion or neutral) and source (closed or open) and corrected for instrument background. Product include relevant ephemeris including sensor boresight pointing, altitude, and spacecraft velocity.</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Derived Data Record: Single species abundance vs. time, and vs altitude, or single species energy distribution vs. time, and vs altitude. This product relies on LPW L2 products.</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Resampled Data Record: Altitude resampled abundances and energy distributions.</td>
<td>Yes</td>
</tr>
<tr>
<td>Quicklook</td>
<td>Mass-time spectrograms; 2-D plots, e.g. mass, counts, time, voltages</td>
<td>No</td>
</tr>
</tbody>
</table>

1) **Generation of Level 1A**

The binary packet data (L0) are separated by telemetry channel (housekeeping, science, Instrument log and markers) and converted to ASCII to generate the raw housekeeping, the raw science, raw message log, and raw marker list. These data are then time-stamped according to the spacecraft SCLK and checked for anomalies or gaps. The housekeeping and science values is expressed in engineering units (volts and digital numbers) when applicable.

2) **Generation of Level 1B**

The raw ASCII detector count rates (L1A) are corrected for detector response (dead time correction) using equations (1) and (2). The raw housekeeping values are converted to scientific units when applicable (physical unit corresponding to the measurement being made: for example deg C for temperature; A for current or emission; and V for voltage monitor circuits). The time tags in the science data, housekeeping, message log and marker list are realigned and corrected based on the reconstructed SCLK values. Instrument background for the processed mass channel
are subtracted using equation (3). Instrument background is estimated by linear extrapolation of the count rate at altitude > 500 km. Relevant ephemeris data are calculated in the IAU_MARS fixed body frame, and include altitude, spacecraft velocity, APP-Ram angle, local solar time, solar longitude, and solar latitude. The products generated at the end of this process are the calibrated housekeeping, and calibrated science (neutral and ion files), calibrated message log, and calibrated marker list.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Estimated Size (B = Bytes)</th>
<th>Type</th>
<th>Level</th>
<th>File label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration Housekeeping</td>
<td>Instrument housekeeping packets</td>
<td>6000 KB</td>
<td>Ground calibration</td>
<td>l1c</td>
<td>gnd-hk</td>
</tr>
<tr>
<td>Calibration Science</td>
<td>Instrument science packets</td>
<td>600 KB</td>
<td>Ground calibration</td>
<td>l1c</td>
<td>gnd-sci</td>
</tr>
<tr>
<td>Calibration Message Log</td>
<td>Instrument message log</td>
<td>10 KB</td>
<td>Ground calibration</td>
<td>l1c</td>
<td>gnd-msg</td>
</tr>
<tr>
<td>Calibration Markers</td>
<td>Instrument markers</td>
<td>10 KB</td>
<td>Ground calibration</td>
<td>l1c</td>
<td>gnd-mkr</td>
</tr>
<tr>
<td>Raw Housekeeping</td>
<td>Instrument housekeeping packets</td>
<td>6000 KB</td>
<td>flight</td>
<td>l1a</td>
<td>raw-hk</td>
</tr>
<tr>
<td>Raw Science</td>
<td>Instrument science packets</td>
<td>600 KB</td>
<td>flight</td>
<td>l1a</td>
<td>raw-sci</td>
</tr>
<tr>
<td>Raw Message Log</td>
<td>Instrument message log</td>
<td>10 KB</td>
<td>flight</td>
<td>l1a</td>
<td>raw-msg</td>
</tr>
<tr>
<td>Raw Markers</td>
<td>Instrument markers</td>
<td>10 KB</td>
<td>flight</td>
<td>l1a</td>
<td>raw-mkr</td>
</tr>
<tr>
<td>Calibrated Housekeeping</td>
<td>Instrument housekeeping packets</td>
<td>6000 KB</td>
<td>flight</td>
<td>l1b</td>
<td>cal-hk</td>
</tr>
<tr>
<td>Calibrated Science</td>
<td>Instrument science packets</td>
<td>600 KB</td>
<td>flight</td>
<td>l1b</td>
<td>osnb-osion</td>
</tr>
<tr>
<td>Calibrated Message Log</td>
<td>Instrument message log</td>
<td>10 KB</td>
<td>flight</td>
<td>l1b</td>
<td>cal-msg</td>
</tr>
<tr>
<td>Calibrated Markers</td>
<td>Instrument markers</td>
<td>10 KB</td>
<td>flight</td>
<td>l1b</td>
<td>cal-mkr</td>
</tr>
</tbody>
</table>
3) Generation of Level 2

The calibrated detector count rates (L1B) are separated by mass channel and acquisition mode (closed source, open source or ion). For closed source data, the count rates will be converted to source densities by interpolating the ionization cross-section for the processed species and applying equation (4) and (5). The source density will then be converted to atmospheric density by applying the ram enhancement correction given by equations (9), (10), and (11). In these equations $T_s$ is given by the housekeeping channel HK78 and captured in the L1B (see table A-3 and A-5). For the open source data, the count rates, will be converted to source density by applying the open source sensitivity derived using equation (6) and taking into account the proper fragmentation pattern. The reference mass will be $^4$He or $^{40}$Ar. In the open source, the source density is assumed to be equal to the atmospheric density. For ion data, each individual ion channel will be corrected for energy response by applying the same $C_{EN}$ correction factor used for the processing of the open source count rates. The density for each ion species will be derived using equation (7). Count rate measured in the detuned settings are used to derive densities when count rates in the un-detuned setting saturate. Note that this process will require the proper interpolation of the LPW electron density to match the SCLK time tags of the NGIMS ion measurements.

4) Generation of Level 3

The derived abundances from the open and closed source (L2) will be extrapolated to regular pressure altitude levels. Scale heights and scale height temperatures will be extracted assuming a barometric exosphere law for limited altitude ranges. These resampled abundances and scale heights will be repackaged as Level 3 products.

3.8.3 Data Validation

Data content validation will be performed by the NGIMS science team prior to delivery to the SOC. Data structure and format will be performed by the NGIMS science team and the PDS data review team as described in Section 4.3.
4. ARCHIVE VOLUMES

4.1 Generation

The NGIMS Instrument Team in cooperation with the Planetary Atmospheres Discipline Node (ATM) of PDS and the MAVEN SOC produces the NGIMS Data Product Archive Collection and its updates. The Archive Collection will include data acquired during calibration, commissioning, and science phases.

The Planetary Atmospheres Discipline Node and NGIMS will collaborate to design the PDS documentation files associated with the initial data delivery by the NGIMS team. All data formats are based on the Planetary Data System standards as documented in the PDS Standards Reference.

4.2 Data Transfer

The NGIMS team will submit data to the SOC as a tarred-gzipped bundle via ftp. Details will be worked out through further testing between NGIMS, SOC, and ATM.

4.3 Review and Revision

The Planetary Atmospheres Discipline Node and the SOC are responsible for organizing the Peer Review of the NGIMS data sets, according to PDS policy. The Peer Review Committee will include a small number of scientists, selected by ATM and the SOC and from outside the NGIMS Team, who have an interest in the anticipated data products. The Peer Review committee will also include NGIMS Team members and PDS and SOC representatives.

For NGIMS there will be a pre-launch review approximately 6 months from start of the science phase. This review will contain sample data and documentation in the format of the final archived data set. This sample data will be produced using datasets from the flight instrument checkout activities that differs from the final data set only in specific values and sizes. Data format and archive method will identical.

After the start of science operations, when generation of products has begun, each individual product will be validated to see that it conforms to the design specified in the SIS.

4.4 Data Volume Architecture

The complete set of NGIMS data will be archived in PDS in a single bundle in the PDS4 standard. In the outline below, each .csv, .txt, and .pdf file is assumed to have an .xml label file with the same filename base, which is not mentioned in the outline. Labels for other types of files are mentioned explicitly.

With the exception of the sample bundle provided by the NGIMS team to the PDS for the purpose of review and validation, all data files are named following the convention:

mvn-ngi_[level]_[file-label]-[tid]_[yyyy][mm][dd]T[hh][mm][ss]_v[xx]_r[ww].[ext]
The product’s [level] and [file-label] parameters reflect the processing level and type of data contained in the according to the nomenclature shown in Table – 6. The [tid] parameter is a 6-digit integer that uniquely identifies the executed script associated with the product. The time tag parameters [yyyy], [mm], [dd], [hh], [mm] and [ss] are respectively the numerical value of year, month, day, hours, minutes and seconds UTC when the data started to be collected by the instrument. The parameter [xx] reflects the data processing software version. The revision [ww] changes every time we reprocess the data. The file extension [ext] captures the file type (pdf, csv, txt, xml, etc.).

As an example the file mvn_ngi_L1b_cal-hk-14000_20141028T002112_v01_r01.csv is a csv file containing calibrated housekeeping data that were collected in orbit by the NGIMS instrument starting from 00:21:12 UTC on October 28th 2014 under the activity identifier 036467. The file was processed once with software version 01.

The data are organized in a bundle as follows:

**Root Level of NGIMS Bundle**

*Bundle label, including inventory for the bundle (bundle_maven_ngims.xml)*

*Bundle table of contents (readme.txt)*

**Context Collection** – contains mission, spacecraft, instrument, and other context objects. These context objects refer to the full descriptions in the document collection.

```
/context
  Inventory of context collection (collection_ngims_context_inventory.csv)
  Instrument context object (instrument_ngims.xml)
  Instrument host (spacecraft) context object (instrument_host_maven.xml)
  Investigation (MAVEN mission) context object (investigation_maven.xml)
```

**Ground Calibration Data Collection** – contains the raw data products and their labels that were acquired during NGIMS pre-launch integration and testing (Level 1c). This data is used to define the calibration constants for flight data.

```
/calibration
  Inventory of the data collection (collection_ngims_calibration_inventory.csv)
  Raw calibration housekeeping data tables (file_name.csv)
  Raw calibration science data tables (file_name.csv)
  Raw calibration message logs (file_name.txt)
  Raw calibration marker files (file_name.txt)
```
**Data Raw Collection** – contains the raw data products and their labels that were acquired during flight (Level 1A).

/data_l1a

- Inventory of the raw data collection (collection_ngims_data_raw_inventory.csv)
- Raw housekeeping data tables (file_name.csv)
- Raw science data tables (file_name.csv)
- Raw message logs (file_name.txt)
- Raw marker files (file_name.txt)

**Data Calibrated Collection** – contains the calibrated data products and their labels that were acquired during flight (Level 1B).

/data_l1b

- Inventory of the calibrated data collection (collection_ngims_data_calibrated_inventory.csv)
- Calibrated housekeeping data tables (file_name.csv)
- Calibrated science data tables (file_name.csv)
- Calibrated message logs (file_name.txt)
- Calibrated marker files (file_name.txt)

**Data Derived Collection** – contains the derived products of the data that was acquired during flight (Level 2).

/data_l2

- Inventory of the derived data collection (collection_ngims_data_derived_inventory.csv)
- Derived abundance tables (file_name.csv)

**Data Resampled Collection** – contains the resampled data that was acquired during flight (Level 3).

/data_l3

- Inventory of the derived data collection (collection_ngims_data_resampled_inventory.csv)
- Resampled abundance tables (file_name.csv)
- Resampled scale heights and scale height temperature tables (file_name.csv)
Document Collection – contains documents relevant to the bundle

_document

Inventory of the document collection (collection_ngims_document_inventory.csv)

MAVEN NGIMS SIS (ngims_pds_sis.pdf)

Schema Collection – contains the schemas used in the bundle

_xml_schema

Inventory of the schema collection (collection_ngims_xml_schema_inventory.csv)

5. ARCHIVE RELEASE SCHEDULE

Table – 7 shows the delivery schedule of NGIMS data to the SOC in reference to the mission timeline as provided in MAVEN Science Data Management Plan.

<table>
<thead>
<tr>
<th>Data Level</th>
<th>Audience</th>
<th>First Delivery</th>
<th>Delivery Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>MAVEN team</td>
<td>At the start of science operations</td>
<td>Within 24 hours of science telemetry receipt at SOC</td>
</tr>
<tr>
<td>Level 1A</td>
<td>MAVEN team</td>
<td>At the start of science operations</td>
<td>Within 24 hours of science telemetry receipt at SOC</td>
</tr>
<tr>
<td>Level 1B</td>
<td>MAVEN team</td>
<td>At the start of science operations</td>
<td>Within 3 business days of ITF receipt of Level 1A</td>
</tr>
<tr>
<td>Level 2</td>
<td>MAVEN team</td>
<td>No later than 2 months after the start of science operations</td>
<td>Within 1 week of ITF receipt of Level 1 and all ancillary data</td>
</tr>
<tr>
<td></td>
<td>Science community</td>
<td>No later than 6 months after the start of science operations</td>
<td>Every 3 months</td>
</tr>
<tr>
<td>Level 3</td>
<td>MAVEN team</td>
<td>No later than 3 months after the start of science operations, except where data product requires data from entire mission</td>
<td>No less frequently than every 4 weeks</td>
</tr>
</tbody>
</table>
Table – 7. Data processing timeline

<table>
<thead>
<tr>
<th>Data Level</th>
<th>Audience</th>
<th>First Delivery</th>
<th>Delivery Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Science community</td>
<td>No later than 6 months after the start of science operations, except where data product requires data from entire mission</td>
<td>Every 3 months</td>
</tr>
</tbody>
</table>

6. COGNIZANT PERSONS

Table – 8: Cognizant Persons for NGIMS PDS Data

<table>
<thead>
<tr>
<th>NGIMS Team</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Principal Investigator,</strong> Dr. Paul Mahaffy</td>
</tr>
<tr>
<td>NGIMS Scientist, Dr. Mehdi Benna</td>
</tr>
<tr>
<td>NGIMS Scientist, Dr. Meredith K Elrod</td>
</tr>
<tr>
<td>NGIMS calibration Engineer, Mr. Eric Raaen</td>
</tr>
<tr>
<td>NGIMS Archive Manager, Mr. Eric Lyness</td>
</tr>
<tr>
<td>NGIMS Ops Manager</td>
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7. REFERENCES


8. APPENDICES

8.1 NGIMS Electrodes Designation

Table A-1: NGIMS Electrode list and designation (see Figure 3)

<table>
<thead>
<tr>
<th>Lens #</th>
<th>Designation</th>
<th>Abbreviation</th>
<th>Min Potential (V)</th>
<th>Max Potential (V)</th>
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**Closed Source (CS) Sub Assembly**

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<td>CS Nozzle CS_NZ</td>
<td>-300</td>
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<td>CS Repeller CS_RP</td>
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<td>CS Repeller Shield CS_RS</td>
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**Switching Lens (SL) Sub Assembly**

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<td>SL_TF</td>
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<td>52</td>
<td>SL Quad Lens Top Back</td>
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<td>53</td>
<td>SL Quad Lens Bottom Back</td>
<td>SL_BB</td>
<td>-200</td>
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<td>54</td>
<td>SI Quad Lens Bottom Front</td>
<td>SL_BF</td>
<td>-900</td>
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<td>55</td>
<td>SL End Lens 1</td>
<td>SL_EL1</td>
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<td>56</td>
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**Ion Analyzer (IA) Sub Assembly**

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**Quadrupole (QD) Sub Assembly**

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<td>QD_R2</td>
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8.2 NGIMS DAC ID Designation:

This table provides the ID number of all digital to analog converters (DAC) that can be displayed in the science data tables under DAC_ID (Table A-4 and A-6).

Table A-2: NGIMS Electrode list and designation (see Figure 3)

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<td>OS_FS1_VCTL</td>
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<td>OS_FIL2_VCTL</td>
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<td>OS_FIL2_ECTL</td>
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<td>21</td>
<td>OS_FS2_VCTL</td>
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8.3 NGIMS Data Product Column Descriptions

The data user is highly encouraged to consult the most up-to-date version of the NGIMS SIS document (included in the NGIMS bundle) for the best use for the telemetry channels and the latest calibration parameters.

8.3.1 L1A Housekeeping Data Table

This table contains the raw housekeeping packets values generated while the instrument is on (during ground calibration or flight). The entries marked in green are the housekeeping channels of most relevance to the data calibration process. The rest of the housekeeping channels are most generally used to access the health of the instrument and the integrity of the NGIMS data.

Table A-3: Definition of the raw housekeeping data table

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<td>s</td>
<td>N/A</td>
<td>SCLK timestamp of any corresponding observed value.</td>
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<tr>
<td>2</td>
<td>MKID</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Marker ID of the current data point. Markers are tag numbers given to related set of measurements.</td>
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<tr>
<td>3</td>
<td>CDH:+5D_VMON</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of +5D_VMON at TIME.</td>
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<td>V</td>
<td>0−5</td>
<td>Engineering value of +13A_VMON at TIME.</td>
</tr>
<tr>
<td>5</td>
<td>CDH:-13A_MON</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of -13A_MON at TIME.</td>
</tr>
<tr>
<td>6</td>
<td>CDH:SPARE_4</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>7</td>
<td>CDH:SPARE_5</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>8</td>
<td>CDH:AGC_TMP</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of AGC_TMP at TIME. This value captures the temperature of the RF AGC board.</td>
</tr>
<tr>
<td>9</td>
<td>CDH:DET_TMP</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of DET_TMP at TIME. This value captures the temperature of the DET board.</td>
</tr>
<tr>
<td>10</td>
<td>CDH:RF_TMP</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of RF_TMP at TIME. This value captures the temperature of the RF board.</td>
</tr>
<tr>
<td>11</td>
<td>CDH:CDH_TMP</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of CDH_TMP at TIME. This value captures the temperature of the CDH board.</td>
</tr>
<tr>
<td>12</td>
<td>CDH:-5.7VREF</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of -5.7VREF at TIME.</td>
</tr>
<tr>
<td>13</td>
<td>CDH:PS_IMON_2</td>
<td>Real</td>
<td>V</td>
<td>0−5</td>
<td>Engineering value of PS_IMON_2</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Type</td>
<td>Min</td>
<td>Max</td>
<td>Value Description</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------</td>
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<td>-----</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>14</td>
<td>CDH:CDH_GND_REF</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CDH_GND_REF at TIME.</td>
</tr>
<tr>
<td>15</td>
<td>CDH:CTL_TMP</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_TMP at TIME. This value captures the temperature of the CTL board.</td>
</tr>
<tr>
<td>16</td>
<td>CDH:CTL_+5VMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_+5VMON at TIME.</td>
</tr>
<tr>
<td>17</td>
<td>CDH:CTL_+3.3VMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_+3.3VMON at TIME.</td>
</tr>
<tr>
<td>18</td>
<td>CDH:CTL_+2.5VMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_+2.5VMON at TIME.</td>
</tr>
<tr>
<td>19</td>
<td>CDH:CTL_+6VMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_+6VMON at TIME.</td>
</tr>
<tr>
<td>20</td>
<td>CDH:CTL_+4VMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_+4VMON at TIME.</td>
</tr>
<tr>
<td>21</td>
<td>CDH:CTL_+13VMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_+13VMON at TIME.</td>
</tr>
<tr>
<td>22</td>
<td>CDH:CTL_-13VMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_-13VMON at TIME.</td>
</tr>
<tr>
<td>23</td>
<td>CDH:PS_TMP</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of PS_TMP at TIME. This value captures the temperature of the PS board.</td>
</tr>
<tr>
<td>24</td>
<td>CDH:5V_IMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of 5V_IMON at TIME.</td>
</tr>
<tr>
<td>25</td>
<td>CDH:3.3V_IMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of 3.3V_IMON at TIME.</td>
</tr>
<tr>
<td>26</td>
<td>CDH:+13V_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of +13V_MON at TIME.</td>
</tr>
<tr>
<td>27</td>
<td>CDH:-13V_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of -13V_MON at TIME.</td>
</tr>
<tr>
<td>28</td>
<td>CDH:CTL_+5VREF</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_+5VREF at TIME.</td>
</tr>
<tr>
<td>29</td>
<td>CDH:CTL_-5VREF</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CTL_-5VREF at TIME.</td>
</tr>
<tr>
<td>30</td>
<td>CDH:CTL_SPARE</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>31</td>
<td>CDH:IA_L4A_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of IA_L4A_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L4A electrode.</td>
</tr>
<tr>
<td>32</td>
<td>CDH:IA_L4B_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of IA_L4B_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L4B electrode.</td>
</tr>
<tr>
<td>33</td>
<td>CDH:SL_TF_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of SL_TF_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_TF electrode.</td>
</tr>
<tr>
<td></td>
<td>CDH:SL_BB_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of SL_BB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_BB electrode.</td>
</tr>
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<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>35</td>
<td>CDH:MT_WD_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of MT_WD_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_WD electrode.</td>
</tr>
<tr>
<td>36</td>
<td>CDH:MT_EZ_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of MT_EZ_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_EZ electrode.</td>
</tr>
<tr>
<td>37</td>
<td>CDH:MT_MA1_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of MT_MA1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_MA1 electrode.</td>
</tr>
<tr>
<td>38</td>
<td>CDH:MT_MA2_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of MT_MA2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_MA2 electrode.</td>
</tr>
<tr>
<td>39</td>
<td>CDH:MT_FC_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of MT_FC_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_FC electrode.</td>
</tr>
<tr>
<td>40</td>
<td>CDH:QD_BS_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of QD_BS_MON at TIME. This value captures the drive circuit input needed to control the voltage on the QD_BS electrode.</td>
</tr>
<tr>
<td>41</td>
<td>CDH:BA_FIL_VMON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of BA_FIL_VMON at TIME.</td>
</tr>
<tr>
<td>42</td>
<td>CDH:BA_FIL_IMON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of BA_FIL_IMON at TIME.</td>
</tr>
<tr>
<td>43</td>
<td>CDH:BA_FIL_EMIS</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of BA_FIL_EMIS at TIME.</td>
</tr>
<tr>
<td>44</td>
<td>CDH:BA_GRID_IMON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of BA_GRID_IMON at TIME.</td>
</tr>
<tr>
<td>45</td>
<td>CDH:BA_PRES</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of BA_PRES at TIME.</td>
</tr>
<tr>
<td>46</td>
<td>CDH:THPRES</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Engineering value of THPRES at TIME.</td>
</tr>
<tr>
<td>47</td>
<td>CDH:OS_OLS_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_OLS_MON at TIME. This value captures the drive circuit input</td>
</tr>
<tr>
<td>No.</td>
<td>Parameter</td>
<td>Type</td>
<td>Value</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----</td>
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<td>----------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>CDH:OS_OL6_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of OS_OL6_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_OL5 electrode.</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>CDH:SL_TB_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of SL_TB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_TB electrode.</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>CDH:SL_BF_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of SL_BF_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_BF electrode.</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>CDH:SL_EL_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of SL_EL_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_EL electrode.</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>CDH:IA_L1_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IA_L1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L1 electrode.</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>CDH:IA_L2_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IA_L2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L2 electrode.</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>CDH:IA_L5_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IA_L5_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L5 electrode.</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>CDH:IA_L6_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IA_L6_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L6 electrode.</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>CDH:IF+_5REF_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IF+_5REF_MON at TIME.</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>CDH:IF-_5REF_MON</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IF-_5REF_MON at TIME.</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>CDH:IF_TMP</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IF_TMP at TIME. This value captures the temperature of the IF board.</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>CDH:IS_TMP</td>
<td>Real</td>
<td>V</td>
<td>Engineering value of IS_TMP at TIME. This value captures the temperature of the CS anti</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDH:EXT_THERM2</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of EXT_THERM2 at TIME.</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>60</td>
<td>CDH:BA_PRES_LO</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of BA_PRES_LO at TIME.</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>CDH:IF_GND_REF</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of IF_GND_REF at TIME.</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>CDH:SPARE_6</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>63</td>
<td>CDH:CDH_3.3VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of CDH_3.3VMON at TIME.</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>CDH:CDH_2.5VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of CDH_2.5VMON at TIME.</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>CDH:+160_VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of +160_VMON at TIME.</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>CDH:-160_VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of -160_VMON at TIME.</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>CDH:+80RF_VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of +80RF_VMON at TIME.</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>CDH:+15RF_VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of +15RF_VMON at TIME.</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>CDH:-15RF_VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of -15RF_VMON at TIME.</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>CDH:+5VREF</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of CDH:+5VREF at TIME.</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>CDH:-5VREF</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of CDH:-5VREF at TIME.</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>CDH:OS_FIL1_VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of OS_FIL1_VMON at TIME. This value captures OS_FIL1 voltage.</td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>CDH:OS_FIL2_VMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of OS_FIL2_VMON at TIME. This value captures OS_FIL2 voltage.</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>CDH:OS_FIL_EMON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of OS_FIL_EMON at TIME. This value captures the emission value on the active OS filament.</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>CDH:OS_FS1_MON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of OS_FS1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_FS1 electrode.</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>CDH:OS_EF1A_MON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of OS_EF1A_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1A electrode.</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>CDH:OS_EF1B_MON</td>
<td>Real</td>
<td>V 0–5</td>
<td>Engineering value of OS_EF1B_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1B electrode.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDH:OS_EF2A_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_EF2A_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2A electrode.</td>
</tr>
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</tr>
<tr>
<td>80</td>
<td>CDH:OS_EF2B_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_EF2B_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2B electrode.</td>
</tr>
<tr>
<td>81</td>
<td>CDH:OS_RES1_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_RES1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_RES1 electrode.</td>
</tr>
<tr>
<td>82</td>
<td>CDH:OS_RES2_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_RES2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_RES2 electrode.</td>
</tr>
<tr>
<td>83</td>
<td>CDH:OS_Ol1_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_Ol1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_Ol1 electrode.</td>
</tr>
<tr>
<td>84</td>
<td>CDH:OS_Ol2_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_Ol2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_Ol2 electrode.</td>
</tr>
<tr>
<td>85</td>
<td>CDH:OS_Ol3_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_Ol3_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_Ol3 electrode.</td>
</tr>
<tr>
<td>86</td>
<td>CDH:OS_Ol4_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_Ol4_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_Ol4 electrode.</td>
</tr>
<tr>
<td>87</td>
<td>CDH:OS_-5REF_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_-5REF_MON at TIME.</td>
</tr>
<tr>
<td>88</td>
<td>CDH:OS_GND_REF</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_GND_REF at TIME.</td>
</tr>
<tr>
<td>89</td>
<td>CDH:OS_FIl1_IMon</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_FIl1_IMon at TIME. This value captures OS_FIl1 current.</td>
</tr>
<tr>
<td>90</td>
<td>CDH:OS_FIl2_IMon</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_FIl2_IMon at TIME. This value captures OS_FIl2 current.</td>
</tr>
<tr>
<td>91</td>
<td>CDH:OS_TRAP_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of OS_TRAP_MON at TIME.</td>
</tr>
<tr>
<td>Line</td>
<td>CDH:OS_FS2_MON</td>
<td>Type</td>
<td>V</td>
<td>Range</td>
<td>Description</td>
</tr>
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<tr>
<td>92</td>
<td>Real V 0–5</td>
<td></td>
<td></td>
<td></td>
<td>Engineering value of OS_FS2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_FS2 electrode.</td>
</tr>
<tr>
<td>93</td>
<td>CDH:OS_EF1C_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_EF1C_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1C electrode.</td>
</tr>
<tr>
<td>94</td>
<td>CDH:OS_EF1D_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_EF1D_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1D electrode.</td>
</tr>
<tr>
<td>95</td>
<td>CDH:OS_EF2C_MON</td>
<td>Real</td>
<td>V</td>
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<td>Engineering value of OS_EF2C_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2C electrode.</td>
</tr>
<tr>
<td>96</td>
<td>CDH:OS_EF2D_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_EF2D_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2D electrode.</td>
</tr>
<tr>
<td>97</td>
<td>CDH:OS_EA1_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_EA1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EA1 electrode.</td>
</tr>
<tr>
<td>98</td>
<td>CDH:OS_EA2_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_EA2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EA2 electrode.</td>
</tr>
<tr>
<td>99</td>
<td>CDH:OS_COLA_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_COLA_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_COLA electrode.</td>
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<tr>
<td>100</td>
<td>CDH:OS_COLB_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_COLB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_COLB electrode.</td>
</tr>
<tr>
<td>101</td>
<td>CDH:OS_FIL_SEL_ST</td>
<td>Real</td>
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<td>N/A</td>
<td>Engineering value of OS_FIL_SEL_ST at TIME.</td>
</tr>
<tr>
<td>102</td>
<td>CDH:OS_+5REF_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_+5REF_MON at TIME.</td>
</tr>
<tr>
<td>103</td>
<td>CDH:OS_+13A_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of OS_+13A_MON at TIME.</td>
</tr>
<tr>
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<td>CDH:OS_TMP</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineered value of OS_TMP at TIME. This value captures the temperature of the OS board.</td>
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<tr>
<td>105</td>
<td>CDH:OS_SPARE</td>
<td>Real</td>
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<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>106</td>
<td>CDH:CS_FIL1_VMON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_FIL1_VMON at TIME. This value captures CS_FIL1 voltage.</td>
</tr>
<tr>
<td>107</td>
<td>CDH:CS_FIL2_VMON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_FIL2_VMON at TIME. This value captures CS_FIL2 voltage.</td>
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<tr>
<td>108</td>
<td>CDH:CS_FIL_EMON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_FIL_EMON at TIME. This value captures the emission value on the active CS filament.</td>
</tr>
<tr>
<td>109</td>
<td>CDH:CS_FS1_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_FS1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_FS1 electrode.</td>
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<tr>
<td>110</td>
<td>CDH:CS_EF1A_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_EF1A_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1A electrode.</td>
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<tr>
<td>111</td>
<td>CDH:CS_EF1B_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_EF1B_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1B electrode.</td>
</tr>
<tr>
<td>112</td>
<td>CDH:CS_EF2A_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_EF2A_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF2A electrode.</td>
</tr>
<tr>
<td>113</td>
<td>CDH:CS_EF2B_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_EF2B_MON at TIME. This value captures the drive circuit input to 0 – 5 control the voltage on the CS_EF2B electrode.</td>
</tr>
<tr>
<td>114</td>
<td>CDH:CS_AN1_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_AN1_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_AN1 electrode.</td>
</tr>
<tr>
<td>115</td>
<td>CDH:CS_AN2_MON</td>
<td>Real</td>
<td>V</td>
<td>0 – 5</td>
<td>Engineering value of CS_AN2_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_AN2 electrode.</td>
</tr>
</tbody>
</table>
| 116 | CDH:CS_IA_MON | Real | V  | 0 – 5 | Engineering value of CS_IA_MON at TIME. This value captures the drive circuit input needed to
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<tr>
<th></th>
<th>CDH:CS_IA_MON</th>
<th>Real</th>
<th>V</th>
<th>0–5</th>
<th>Engineering value of CS_IA_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_IA electrode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>117</td>
<td>CDH:CS_IFA_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_IFA_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_IFA electrode.</td>
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<tr>
<td>118</td>
<td>CDH:CS_IFB_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_IFB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_IFB electrode.</td>
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<tr>
<td>119</td>
<td>CDH:CS_NZ_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_NZ_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_NZ electrode.</td>
</tr>
<tr>
<td>120</td>
<td>CDH:CS-_5REF_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS-_5REF_MON at TIME.</td>
</tr>
<tr>
<td>121</td>
<td>CDH:CS_GND_REF</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_GND_REF at TIME.</td>
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<tr>
<td>122</td>
<td>CDH:CS_FIL1_IMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_FIL1_IMON at TIME. This value captures CS_FIL1 current.</td>
</tr>
<tr>
<td>123</td>
<td>CDH:CS_FIL2_IMON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_FIL2_IMON at TIME. This value captures CS_FIL2 current.</td>
</tr>
<tr>
<td>124</td>
<td>CDH:CS_TRAP_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_TRAP_MON at TIME.</td>
</tr>
<tr>
<td>125</td>
<td>CDH:CS_FS2_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_FS2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_FS2 electrode.</td>
</tr>
<tr>
<td>126</td>
<td>CDH:CS_EF1C_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_EF1C_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1C electrode.</td>
</tr>
<tr>
<td>127</td>
<td>CDH:CS_EF1D_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_EF1D_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1D electrode.</td>
</tr>
<tr>
<td>128</td>
<td>CDH:CS_EF2C_MON</td>
<td>Real</td>
<td>V</td>
<td>0–5</td>
<td>Engineering value of CS_EF2C_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_EF2C electrode.</td>
</tr>
</tbody>
</table>
| 129 | CDH:CS_EF2D_MON | Real | V | 0–5 | Engineering value of CS_EF2D_MON at TIME. This value captures the drive circuit input
<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Engineering value of CS_EA1_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EA1 electrode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>CDH:CS_EA1_MON</td>
<td>Real</td>
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<tr>
<td></td>
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<td>Engineering value of CS_EA2_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EA2 electrode.</td>
</tr>
<tr>
<td>131</td>
<td>CDH:CS_EA2_MON</td>
<td>Real</td>
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<tr>
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<td></td>
<td>Engineering value of CS_RP_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_RP electrode.</td>
</tr>
<tr>
<td>132</td>
<td>CDH:CS_RP_MON</td>
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<td>Engineering value of CS_RS_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_RS electrode.</td>
</tr>
<tr>
<td>133</td>
<td>CDH:CS_RS_MON</td>
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<td>Engineering value of CS_FIL_SEL_ST at TIME.</td>
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<tr>
<td>134</td>
<td>CDH:CS_FIL_SEL_ST</td>
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<tr>
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<td>Engineering value of CS_SPARE at TIME.</td>
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<tr>
<td>135</td>
<td>CDH:CS_+5REF_MON</td>
<td>Real</td>
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<td></td>
<td>Engineering value of CS_RF_AGC_MON at TIME.</td>
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<tr>
<td>136</td>
<td>CDH:CS_+13A_MON</td>
<td>Real</td>
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<td></td>
<td>Engineering value of CS_VCAP_MON at TIME.</td>
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<tr>
<td>137</td>
<td>CDH:CS_TMP</td>
<td>Real</td>
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<td>Engineering value of CS_VCAP_MON at TIME.</td>
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<tr>
<td>138</td>
<td>CDH:CS_SPARE</td>
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<td>Unused channel.</td>
</tr>
<tr>
<td>139</td>
<td>CDH:PS_IMON</td>
<td>Real</td>
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<tr>
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<td></td>
<td>Engineering value of EM1_IMON at TIME.</td>
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<tr>
<td>140</td>
<td>CDH:EM1_IMON</td>
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<td>Engineering value of EM2_IMON at TIME.</td>
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<td>CDH:EM2_IMON</td>
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<td>Engineering value of MULTANA1 at TIME.</td>
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<tr>
<td>142</td>
<td>CDH:MULTANA1</td>
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<td>Engineering value of MULTANA2 at TIME.</td>
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<td>143</td>
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<td>Engineering value of RF_AGC_MON at TIME.</td>
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<td>Engineering value of VCAP+_MON at TIME.</td>
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<td>CDH:SPARE_210</td>
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<td>CDH:SPARE_3</td>
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<td>CDH:+5VREF_DAC</td>
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<td>CDH:RF_Cntr</td>
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<td>FSW:BAD_CMD_ERR</td>
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<td>FSW:DWELL_MON_ADDR</td>
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<td>FSW:DWELL_MON_VAL</td>
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<td>FSW:LAST_FILE_ID</td>
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<td>FSW:MEM_ALLOC</td>
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<tr>
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</tr>
<tr>
<td>199</td>
<td>FSW:CTL_TMP</td>
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</tr>
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<td>QMS:COUNT2</td>
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<td>215</td>
<td>QMS:CTL_DIGITAL_STATUS</td>
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</tr>
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</tr>
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<td>QMS:ctl_packet_count</td>
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</tr>
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<td>QMS:DAC12BSPARE1</td>
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</tr>
<tr>
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<td>QMS:DAC12BSPARE2</td>
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</tr>
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<td>QMS:DAC12USPARE2</td>
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<td>QMS:DAC16BSPARE2</td>
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</tr>
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<tr>
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</tr>
<tr>
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<td>QMS:DAC8B_SPARE3</td>
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<td>QMS:DAC_SPARE</td>
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</tr>
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<td>QMS:os_fs1_vctl</td>
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<td>QMS:os_fil2_vctl</td>
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<td>QMS:OS_FIL2_EC</td>
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<td>QMS:CS_FIL1_VCTL</td>
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<tr>
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<td>QMS:CS_FS1_VCTL</td>
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<td>CS_NZ_VCTL</td>
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<td>MT_MU2_VCTL</td>
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<td>CS_AN1_VCTL</td>
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<td>279</td>
<td>QMS:OS_RES2_VCTL</td>
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<td>281</td>
<td>QMS:OS_OL2_VCTL</td>
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<tr>
<td>282</td>
<td>QMS:OS_COLA_VCTL</td>
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<tr>
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<td>QMS:OS_COLB_VCTL</td>
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<td>QMS:CS_RP_VCTL</td>
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<td>QMS:IA_L4B_VCTL</td>
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</tr>
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<td>QMS:IA_L6_VCTL</td>
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<td>293</td>
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</tr>
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<td>294</td>
<td>QMS:OS_EF1B_VCTL</td>
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<td>QMS:OS_EF2A_VCTL</td>
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<td>298</td>
<td>QMS:OS_EF2B_VCTL</td>
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<tr>
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<td>QMS:OS_EF2B_VCTL</td>
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<tr>
<td>300</td>
<td>QMS:OS_EF2D_VCTL</td>
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</tr>
<tr>
<td>301</td>
<td>QMS:CS_EF1A_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td>302</td>
<td>QMS:CS_EF1B_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td>303</td>
<td>QMS:CS_EF1C_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td>304</td>
<td>QMS:CS_EF1D_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td>305</td>
<td>QMS:CS_EF2A_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td>306</td>
<td>QMS:CS_EF2B_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td>307</td>
<td>QMS:CS_EF2C_VCTL</td>
<td>Real</td>
</tr>
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<td>308</td>
<td>QMS:CS_EF2D_VCTL</td>
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</tr>
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</tr>
<tr>
<td>311</td>
<td>QMS:CS_IFB_VCTL</td>
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<tr>
<td>---</td>
<td>---</td>
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<tr>
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<td></td>
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</tr>
<tr>
<td><strong>312</strong></td>
<td>QMS:SL_TB_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>313</strong></td>
<td>QMS:SL_BB_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>314</strong></td>
<td>QMS:SL_BF_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>315</strong></td>
<td>QMS:SL_EL_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>316</strong></td>
<td>QMS:OS OL3_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>317</strong></td>
<td>QMS:SL_TF_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>318</strong></td>
<td>QMS:OS OL5_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>319</strong></td>
<td>QMS:OS OL6_VCTL</td>
<td>Real</td>
</tr>
<tr>
<td><strong>320</strong></td>
<td>TM:TMSync</td>
<td>Real</td>
</tr>
<tr>
<td><strong>321</strong></td>
<td>TM:TMTick</td>
<td>Real</td>
</tr>
<tr>
<td><strong>322</strong></td>
<td>TM:TMSystemID</td>
<td>Real</td>
</tr>
<tr>
<td><strong>323</strong></td>
<td>TM:TMMarker</td>
<td>Real</td>
</tr>
<tr>
<td><strong>324</strong></td>
<td>TM:TMMarkerText</td>
<td>Text</td>
</tr>
</tbody>
</table>
8.3.2 L1A Science Data Table
This table contains the raw science packets values generated while the instrument is in a science telemetry mode (during ground calibration of flight).

Table A-4: Definition of the L1A science data table

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Format</th>
<th>Units</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TIME</td>
<td>Real</td>
<td>s</td>
<td>N/A</td>
<td>SCLK timestamp of any corresponding observed value.</td>
</tr>
<tr>
<td>2</td>
<td>MKID</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Marker ID of the current data point. Markers are tag numbers given to related set of measurements.</td>
</tr>
<tr>
<td>3</td>
<td>IP</td>
<td>Real</td>
<td>s</td>
<td>N/A</td>
<td>Engineering value of IP at TIME. This value captures the current integration period (IP) duration.</td>
</tr>
<tr>
<td>4</td>
<td>TUNING</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Engineering value of TUNING at TIME. This value captures the current focusing scheme of the sensor.</td>
</tr>
<tr>
<td>5</td>
<td>MASS</td>
<td>Real</td>
<td>M/Z</td>
<td>0 – 150</td>
<td>Engineering value of MASS at TIME. This value captures the current measured mass value.</td>
</tr>
<tr>
<td>6</td>
<td>COUNTS</td>
<td>Real</td>
<td>COUNTS</td>
<td>N/A</td>
<td>Engineering value of COUNTS at TIME. This value captures the number of counts detected with the active multiplier during the duration of the integration period.</td>
</tr>
<tr>
<td>7</td>
<td>DAC_ID</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Engineering value of DAC_ID at TIME. This value captures the ID of DAC used during electrode voltage scan (See Table A-2).</td>
</tr>
<tr>
<td>8</td>
<td>DAC_SETTING</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Engineering value of DAC_SETTING at TIME. This value captures the commanded setting of the DAC_ID electrode during its voltage scan.</td>
</tr>
</tbody>
</table>

8.3.3 L1A Message Log
The message log is an ASCII file that contains the messages generated by the C&DH as it executes the script. These messages are time tagged (in seconds) to allow the data user to correlate the data to the tasks executed by the instrument.

8.3.4 L1A Marker List
The marker file is an ASCII file that contains the markers generated by the C&DH as it executes the script. These markers are time tagged (in seconds) to allow the data user to correlate the data to the tasks executed by the instrument.

8.3.5 L1B Housekeeping Table
This table contains the calibrated housekeeping packets values generated while the instrument is on. The entries marked in green are the housekeeping channels of most relevance to the data
calibration process. The rest of the housekeeping channels are most generally used to access the health of the instrument and the integrity of the NGIMS data.

Table A-5: Definition of the L1B housekeeping table

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Format</th>
<th>Units</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TIME.</td>
<td>Real</td>
<td>s</td>
<td>N/A</td>
<td>SCLK timestamp of any corresponding observed value.</td>
</tr>
<tr>
<td>2</td>
<td>MKID</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Marker ID of the current data point. Markers are tag numbers given to related set of measurements.</td>
</tr>
<tr>
<td>3</td>
<td>CDH:+5D_VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of +5D_VMON at TIME.</td>
</tr>
<tr>
<td>4</td>
<td>CDH:+13A_VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of +13A_VMON at TIME.</td>
</tr>
<tr>
<td>5</td>
<td>CDH:-13A_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of -13A_MON at TIME.</td>
</tr>
<tr>
<td>6</td>
<td>CDH:SPARE_4</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>7</td>
<td>CDH:SPARE_5</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>8</td>
<td>CDH:AGC_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
<td>Scientific value of AGC_TMP at TIME. This value captures the temperature of the RF AGC board.</td>
</tr>
<tr>
<td>9</td>
<td>CDH:DET_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
<td>Scientific value of DET_TMP at TIME. This value captures the temperature of the DET board.</td>
</tr>
<tr>
<td>10</td>
<td>CDH:RF_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
<td>Scientific value of RF_TMP at TIME. This value captures the temperature of the RF board.</td>
</tr>
<tr>
<td>11</td>
<td>CDH:CDH_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
<td>Scientific value of CDH_TMP at TIME. This value captures the temperature of the CDH board.</td>
</tr>
<tr>
<td>12</td>
<td>CDH:-5.7VREF</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of -5.7VREF at TIME.</td>
</tr>
<tr>
<td>13</td>
<td>CDH:PS_IMON_2</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
<td>Scientific value of PS_IMON_2 at TIME.</td>
</tr>
<tr>
<td>14</td>
<td>CDH:CDH_GND_REF</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CDH_GND_REF at TIME.</td>
</tr>
<tr>
<td>15</td>
<td>CDH:CTL_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
<td>Scientific value of CTL_TMP at TIME. This value captures the temperature of the CTL board.</td>
</tr>
<tr>
<td>16</td>
<td>CDH:CTL_+5VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_+5VMON at TIME.</td>
</tr>
<tr>
<td>17</td>
<td>CDH:CTL_+3.3VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_+3.3VMON at TIME.</td>
</tr>
<tr>
<td>18</td>
<td>CDH:CTL_+2.5VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_+2.5VMON at TIME.</td>
</tr>
<tr>
<td>19</td>
<td>CDH:CTL_+6VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_+6VMON at TIME.</td>
</tr>
<tr>
<td>20</td>
<td>CDH:CTL_+4VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_+4VMON at TIME.</td>
</tr>
<tr>
<td>21</td>
<td>CDH:CTL_+13VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_+13VMON at TIME.</td>
</tr>
<tr>
<td>22</td>
<td>CDH:CTL_-13VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_-13VMON at TIME.</td>
</tr>
<tr>
<td>23</td>
<td>CDH:PS_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
<td>Scientific value of PS_TMP at TIME. This value captures the temperature of the PS board.</td>
</tr>
<tr>
<td>24</td>
<td>CDH:5V_IMON</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
<td>Scientific value of 5V_IMON at TIME.</td>
</tr>
<tr>
<td>25</td>
<td>CDH:3.3V_IMON</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
<td>Scientific value of 3.3V_IMON at TIME.</td>
</tr>
<tr>
<td>26</td>
<td>CDH:+13V_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of +13V_MON at TIME.</td>
</tr>
<tr>
<td>27</td>
<td>CDH:-13V_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of -13V_MON at TIME.</td>
</tr>
<tr>
<td>28</td>
<td>CDH:CTL_+5VREF</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_+5VREF at TIME.</td>
</tr>
<tr>
<td>29</td>
<td>CDH:CTL_-5VREF</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of CTL_-5VREF at TIME.</td>
</tr>
<tr>
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</tr>
<tr>
<td>30</td>
<td>CDH: CTL_SPARE</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>31</td>
<td>CDH: IA_L4A_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of IA_L4A_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L4A electrode.</td>
</tr>
<tr>
<td>32</td>
<td>CDH: IA_L4B_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of IA_L4B_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L4B electrode.</td>
</tr>
<tr>
<td>33</td>
<td>CDH: SL_TF_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of SL_TF_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_TF electrode.</td>
</tr>
<tr>
<td>34</td>
<td>CDH: SL_BB_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of SL_BB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_BB electrode.</td>
</tr>
<tr>
<td>35</td>
<td>CDH: MT_WD_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of MT_WD_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_WD electrode.</td>
</tr>
<tr>
<td>36</td>
<td>CDH: MT_EZ_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of MT_EZ_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_EZ electrode.</td>
</tr>
<tr>
<td>37</td>
<td>CDH: MT_MA1_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of MT_MA1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_MA1 electrode.</td>
</tr>
<tr>
<td>38</td>
<td>CDH: MT_MA2_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of MT_MA2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_MA2 electrode.</td>
</tr>
<tr>
<td>39</td>
<td>CDH: MT_FC_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of MT_FC_MON at TIME. This value captures the drive circuit input needed to control the voltage on the MT_FC electrode.</td>
</tr>
<tr>
<td>40</td>
<td>CDH: QD BS_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of QD BS_MON at TIME. This value captures the drive circuit input needed to control the voltage on the QD_BS electrode.</td>
</tr>
<tr>
<td>41</td>
<td>CDH: BA_FIL_VMON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of BA_FIL_VMON at TIME.</td>
</tr>
<tr>
<td>42</td>
<td>CDH: BA_FIL_IMON</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
<td>Scientific value of BA_FIL_IMON at TIME.</td>
</tr>
<tr>
<td>43</td>
<td>CDH: BA_FIL_EMIS</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
<td>Scientific value of BA_FIL_EMIS at TIME.</td>
</tr>
<tr>
<td>44</td>
<td>CDH: BA_GRID_IMON</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
<td>Scientific value of BA_GRID_IMON at TIME.</td>
</tr>
<tr>
<td>45</td>
<td>CDH: BA_PRES</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of BA_PRES at TIME.</td>
</tr>
<tr>
<td>46</td>
<td>CDH: THPRES</td>
<td>Real</td>
<td>N/A</td>
<td>N/A</td>
<td>Scientific value of THPRES at TIME.</td>
</tr>
<tr>
<td>47</td>
<td>CDH: OS OL5_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
<td>Scientific value of OS OL5_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS OL5 electrode.</td>
</tr>
</tbody>
</table>
| 48 | CDH: OS OL6_MON | Real | V | N/A | Scientific value of OS OL6_MON at TIME. This value captures the drive circuit input needed
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Type</th>
<th>Unit</th>
<th>Notes</th>
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<tr>
<td>49</td>
<td>CDH:SL_TB_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
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<td>CDH:SL_BF_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>51</td>
<td>CDH:SL_EL_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>52</td>
<td>CDH:IA_L1_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>53</td>
<td>CDH:IA_L2_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>54</td>
<td>CDH:IA_L5_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
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<td>V</td>
<td>N/A</td>
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<tr>
<td>56</td>
<td>CDH:IF+_5REF_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>57</td>
<td>CDH:IF-_5REF_MON</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>58</td>
<td>CDH:IF_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
</tr>
<tr>
<td>59</td>
<td>CDH:IS_TMP</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
</tr>
<tr>
<td>60</td>
<td>CDH:EXT_THERM2</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>61</td>
<td>CDH:BA_PRES_LO</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>62</td>
<td>CDH:IF_GND_REF</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>63</td>
<td>CDH:SPARE_6</td>
<td>Real</td>
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<td>N/A</td>
</tr>
<tr>
<td>64</td>
<td>CDH:CDH_3.3VMON</td>
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<td>N/A</td>
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<tr>
<td>65</td>
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<td>Real</td>
<td>V</td>
<td>N/A</td>
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<tr>
<td>66</td>
<td>CDH:+160_VMON</td>
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<td>CDH:-160_VMON</td>
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<td>68</td>
<td>CDH:+80RF_VMON</td>
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<tr>
<td>69</td>
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<td>CDH:+15RF_VMON</td>
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<tr>
<td>71</td>
<td>CDH:CDH+_5VREF</td>
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<tr>
<td>73</td>
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<tr>
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<td>CDH:OS_EF1A_MON</td>
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<td>CDH:OS_TRAP_MON</td>
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<td>Variable Name</td>
<td>Type</td>
<td>Value</td>
<td>Description</td>
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<tr>
<td>93</td>
<td>CDH:OS_EF1C_MON</td>
<td>Real V</td>
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<td>Scientific value of OS_EF1C_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1C electrode.</td>
</tr>
<tr>
<td>94</td>
<td>CDH:OS_EF1D_MON</td>
<td>Real V</td>
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<tr>
<td>95</td>
<td>CDH:OS_EF2C_MON</td>
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<td>Scientific value of OS_EF2C_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2C electrode.</td>
</tr>
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</tr>
<tr>
<td>97</td>
<td>CDH:OS_EA1_MON</td>
<td>Real V</td>
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<td>Scientific value of OS_EA1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EA1 electrode.</td>
</tr>
<tr>
<td>98</td>
<td>CDH:OS_EA2_MON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of OS_EA2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EA2 electrode.</td>
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<tr>
<td>99</td>
<td>CDH:OS_COLA_MON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of OS_COLA_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_COLA electrode.</td>
</tr>
<tr>
<td>100</td>
<td>CDH:OS_COLB_MON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of OS_COLB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_COLB electrode.</td>
</tr>
<tr>
<td>101</td>
<td>CDH:OS_FIL_SEL_ST</td>
<td>Real</td>
<td>N/A</td>
<td>Scientific value of OS_FIL_SEL_ST at TIME.</td>
</tr>
<tr>
<td>102</td>
<td>CDH:OS_+5REF_MON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of OS_+5REF_MON at TIME.</td>
</tr>
<tr>
<td>103</td>
<td>CDH:OS_+13A_MON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of OS_+13A_MON at TIME.</td>
</tr>
<tr>
<td>104</td>
<td>CDH:OS_TMP</td>
<td>Real °C</td>
<td>N/A</td>
<td>Scientific value of OS_TMP at TIME. This value captures the temperature of the OS board.</td>
</tr>
<tr>
<td>105</td>
<td>CDH:OS_SPARE</td>
<td>Real</td>
<td>N/A</td>
<td>Unused channel.</td>
</tr>
<tr>
<td>106</td>
<td>CDH:CS_FIL1_VMON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of CS_FIL1_VMON at TIME. This value captures CS_FIL1 voltage.</td>
</tr>
<tr>
<td>107</td>
<td>CDH:CS_FIL2_VMON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of CS_FIL2_VMON at TIME. This value captures CS_FIL2 voltage.</td>
</tr>
<tr>
<td>108</td>
<td>CDH:CS_FIL_EMON</td>
<td>Real A</td>
<td>N/A</td>
<td>Scientific value of CS_FIL_EMON at TIME. This value captures the emission value on the active CS filament.</td>
</tr>
<tr>
<td>109</td>
<td>CDH:CS_FS1_MON</td>
<td>Real V</td>
<td>N/A</td>
<td>Scientific value of CS_FS1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_FS1 electrode.</td>
</tr>
<tr>
<td></td>
<td>CDH:CS_EF1A_MON</td>
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<tr>
<td>110</td>
<td>CDH:CS_EF1B_MON</td>
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<tr>
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<td>132</td>
<td>CDH:CS_RS_MON</td>
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<td>CDH:VCAP+_MON</td>
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<td>141</td>
<td>CDH:PulseCounter</td>
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69
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<th>Scientific value of RF_Cntr at TIME. This value captures the current RF frequency.</th>
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<td>FSW:PKT_REV</td>
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<td>FSW:LAST_RESET</td>
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<td>FSW:LOAD_TYPE</td>
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<td>FSW:LAST_CMD</td>
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<td>FSW:N_CMDS</td>
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<td>FSW:N_CMD_ERRS</td>
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<td>164</td>
<td>FSW:BAD_CMD_ERR</td>
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<td>FSW:BAD_CMD_OP</td>
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<td>166</td>
<td>FSW:ZONE_ALERT</td>
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<td>167</td>
<td>FSW:INST_MODE</td>
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<td>168</td>
<td>FSW:SCRIPT_MODE</td>
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<td>169</td>
<td>FSW:TELEM_MODE</td>
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<td>FSW:LIB_VER</td>
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<td>FSW:LAST_MARKER</td>
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<td>174</td>
<td>FSW:CODE_CSUM</td>
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<td>175</td>
<td>FSW:SCRIPT_CSUM</td>
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<td>FSW:LIB_CSUM</td>
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<td>FSW:DWELL_MON.VAL</td>
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<td>FSW:SIDE_A</td>
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<td>FSW:POWER_STAT</td>
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<td>181</td>
<td>FSW:ALARM_STAT</td>
<td>Real</td>
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<td>182</td>
<td>FSW:ALARM_LEVEL</td>
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<td>183</td>
<td>FSW:N_ALARMS</td>
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<td>FSW:N_ALARM_ENAB</td>
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<td>185</td>
<td>FSW:N_ALARM_ACTIVE</td>
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<td>186</td>
<td>FSW:LAST_FILE_ID</td>
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<td>187</td>
<td>FSW:MEM_ALLOC</td>
<td>Real</td>
<td>N/A</td>
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<td>188</td>
<td>FSW:MEM_FREE</td>
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<td>N/A</td>
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<td>189</td>
<td>FSW:LARGEST_FREE_BLOCK</td>
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<td>190</td>
<td>FSW:N_ALLOCS</td>
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<td>191</td>
<td>FSW:N_FREES</td>
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<tr>
<td>192</td>
<td>FSW:PS_IMON</td>
<td>Real</td>
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<tr>
<td>193</td>
<td>FSW:EM1_IMON</td>
<td>Real</td>
<td>A</td>
</tr>
<tr>
<td>194</td>
<td>FSW:EM2_IMON</td>
<td>Real</td>
<td>°C</td>
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Scientific value captures the number of counts detected with active multiplier during the duration of the integration period.
<table>
<thead>
<tr>
<th>Sensor ID</th>
<th>Description</th>
<th>Type</th>
<th>Units</th>
<th>Value</th>
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<tr>
<td>195 FSW:AGC_TMP</td>
<td>Scientific value of AGC_TMP at TIME. This value captures the temperature of the RF AGC board.</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
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<tr>
<td>196 FSW:DET_TMP</td>
<td>Scientific value of DET_TMP at TIME. This value captures the temperature of the DET board.</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
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<tr>
<td>197 FSW:RF_TMP</td>
<td>Scientific value of RF_TMP at TIME. This value captures the temperature of the RF board.</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
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<tr>
<td>198 FSW:CDH_TMP</td>
<td>Scientific value of CDH_TMP at TIME. This value captures the temperature of the CDH board.</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
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<tr>
<td>199 FSW:CTL_TMP</td>
<td>Scientific value of CTL_TMP at TIME. This value captures the temperature of the CTL board.</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
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<tr>
<td>200 FSW:PS_TMP</td>
<td>Scientific value of PS_TMP at TIME. This value captures the temperature of the PS board.</td>
<td>Real</td>
<td>°C</td>
<td>N/A</td>
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<tr>
<td>201 FSW:OS_FIL_EMON</td>
<td>Scientific value of OS_FIL_EMON at TIME. This value captures the emission value on the active OS filament.</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
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<tr>
<td>202 FSW:CS_FIL_EMON</td>
<td>Scientific value of CS_FIL_EMON at TIME. This value captures the emission value on the active CS filament.</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
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<tr>
<td>203 FSW:THERM_PRESS</td>
<td>Scientific value of THERM_PRESS at TIME.</td>
<td>Real</td>
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<td>204 FSW:MISSED_TIME_CODES</td>
<td>Scientific value of MISSED_TIME_CODES at TIME.</td>
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<td>205 FSW:MISSED_ZONE_ALERTS</td>
<td>Scientific value of MISSED_ZONE_ALERTS at TIME.</td>
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<td>N/A</td>
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<tr>
<td>206 QMS:ADC_STATUS</td>
<td>Scientific value of ADC_STATUS at TIME.</td>
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<tr>
<td>207 QMS:AMUX1</td>
<td>Scientific value of AMUX1 at TIME.</td>
<td>Integer</td>
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<td>208 QMS:AMUX2</td>
<td>Scientific value of AMUX2 at TIME.</td>
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<td>Scientific value of AMUX_ADDR1 at TIME.</td>
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<td>Scientific value of AMUX_ADDR3 at TIME.</td>
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<td>Scientific value of AMUX_ADDR4 at TIME.</td>
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<tr>
<td>213 QMS:COUNT1</td>
<td>Scientific value of COUNT1 at TIME. This value captures the number of counts detected with multiplier 1 during the duration of the integration period.</td>
<td>Integer</td>
<td>COUNT</td>
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<tr>
<td>214 QMS:COUNT2</td>
<td>Scientific value of COUNT2 at TIME. This value captures the number of counts detected with multiplier 2 during the duration of the integration period.</td>
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<tr>
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<td>241</td>
<td>QMS:OS_FIL2_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>242</td>
<td>QMS:OS_FIL2_ECTL</td>
<td>Real</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>243</td>
<td>QMS:OS_FS1_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>244</td>
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<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>245</td>
<td>QMS:CS_FIL1_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>246</td>
<td>QMS:CS_FIL1_ECTL</td>
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<td>A</td>
<td>N/A</td>
</tr>
<tr>
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<td>QMS:Identifier</td>
<td>Type</td>
<td>Unit</td>
<td>Notes</td>
</tr>
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<td>----------------</td>
<td>-------</td>
<td>------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>248</td>
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<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>249</td>
<td>QMS:CS_FIL2_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>250</td>
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<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>251</td>
<td>QMS:CS_FS2_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
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<td>QMS:DT1_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
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<td>QMS:DT2_VCTL</td>
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<td>V</td>
<td>N/A</td>
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<td>254</td>
<td>QMS:QB_VCTL</td>
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<td>N/A</td>
</tr>
<tr>
<td>255</td>
<td>QMS:FIL_ON_CTRL</td>
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<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>256</td>
<td>QMS:RODAC_CTRL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>257</td>
<td>QMS:RODDC_CTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>258</td>
<td>QMS:RF_FREQ_SET</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>259</td>
<td>QMS:IP_COUNT</td>
<td>Real</td>
<td>ms</td>
<td>N/A</td>
</tr>
<tr>
<td>260</td>
<td>QMS:IP_SETUP</td>
<td>Real</td>
<td>ms</td>
<td>N/A</td>
</tr>
<tr>
<td>261</td>
<td>QMS:FIL_SELECT</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>262</td>
<td>QMS:BA_FIL_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>263</td>
<td>QMS:CS_NZ_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>264</td>
<td>QMS:MT_MU1_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>265</td>
<td>QMS:MT_MU2_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>266</td>
<td>QMS:CS_EA1_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>267</td>
<td>QMS:CS_AN1_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td></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>268</td>
<td>QMS:CS_EA2_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>269</td>
<td>QMS:CS_AN2_VCTL</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>270</td>
<td>QMS:QD_BS_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>271</td>
<td>QMS:MT_EZ_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>272</td>
<td>QMS:MT_MA1_VCTL</td>
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<td></td>
</tr>
<tr>
<td>273</td>
<td>QMS:MT_MA2_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>274</td>
<td>QMS:MT_WD_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>QMS:MT_FC_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>276</td>
<td>QMS:OS_EA1_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>277</td>
<td>QMS:OS_RES1_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>278</td>
<td>QMS:OS_EA2_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>279</td>
<td>QMS:OS_RES2_VCTL</td>
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</tr>
<tr>
<td>280</td>
<td>QMS:OS_OL1_VCTL</td>
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<td></td>
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<tr>
<td>281</td>
<td>QMS:OS_OL2_VCTL</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>282</td>
<td>QMS:OS_COLA_VCTL</td>
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<td></td>
</tr>
<tr>
<td>283</td>
<td>QMS:OS_COLB_VCTL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>284</td>
<td>QMS:CS_IA_VCTL</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Scientific value of CS_EA2_VCTL at TIME. This value captures the DAC setting for the CS_EA2 electrode.

Scientific value of CS_AN2_VCTL at TIME. This value captures the DAC setting for the CS_AN2 electrode.

Scientific value of QD_BS_VCTL at TIME. This value captures the DAC setting for the QD_BS electrode.

Scientific value of MT_EZ_VCTL at TIME. This value captures the DAC setting for the MT_EZ electrode.

Scientific value of MT_MA1_VCTL at TIME. This value captures the DAC setting for the MT_MA1 electrode.

Scientific value of MT_MA2_VCTL at TIME. This value captures the DAC setting for the MT_MA2 electrode.

Scientific value of MT_WD_VCTL at TIME. This value captures the DAC setting for the MT_WD electrode.

Scientific value of MT_FC_VCTL at TIME. This value captures the DAC setting for the MT_FC electrode.

Scientific value of OS_EA1_VCTL at TIME. This value captures the DAC setting for the OS_EA1 electrode.

Scientific value of OS_RES1_VCTL at TIME. This value captures the DAC setting for the OS_RES1 electrode.

Scientific value of OS_EA2_VCTL at TIME. This value captures the DAC setting for the OS_EA2 electrode.

Scientific value of OS_RES2_VCTL at TIME. This value captures the DAC setting for the OS_RES2 electrode.

Scientific value of OS_OL1_VCTL at TIME. This value captures the DAC setting for the OS_OL1 electrode.

Scientific value of OS_OL2_VCTL at TIME. This value captures the DAC setting for the OS_OL2 electrode.

Scientific value of OS_COLA_VCTL at TIME. This value captures the DAC setting for the OS_COLA electrode.

Scientific value of OS_COLB_VCTL at TIME. This value captures the DAC setting for the OS_COLB electrode.

Scientific value of CS_IA_VCTL at TIME. This value captures the DAC setting for the CS_IA electrode.
<table>
<thead>
<tr>
<th>Line</th>
<th>ID</th>
<th>Type</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>285</td>
<td>QMS:CS_RP_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>286</td>
<td>QMS:CS_RS_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>287</td>
<td>QMS:IA_L1_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>288</td>
<td>QMS:IA_L2_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>289</td>
<td>QMS:IA_L4A_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>290</td>
<td>QMS:IA_L4B_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>291</td>
<td>QMS:IA_L5_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>292</td>
<td>QMS:IA_L6_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>293</td>
<td>QMS:OS_EF1A_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>294</td>
<td>QMS:OS_EF1B_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>295</td>
<td>QMS:OS_EF1C_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>296</td>
<td>QMS:OS_EF1D_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>297</td>
<td>QMS:OS_EF2A_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>298</td>
<td>QMS:OS_EF2B_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>299</td>
<td>QMS:OS_EF2C_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>300</td>
<td>QMS:OS_EF2D_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td>301</td>
<td>QMS:CS_EF1A_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Property</td>
<td>Type</td>
<td>Value</td>
<td>Description</td>
</tr>
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<td>---------------------</td>
<td>-------</td>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>302</td>
<td>QMS:CS_EF1B_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_EF1B_VCTL at TIME. This value captures the DAC setting for the CS_EF1B electrode.</td>
</tr>
<tr>
<td>303</td>
<td>QMS:CS_EF1C_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_EF1C_VCTL at TIME. This value captures the DAC setting for the CS_EF1C electrode.</td>
</tr>
<tr>
<td>304</td>
<td>QMS:CS_EF1D_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_EF1D_VCTL at TIME. This value captures the DAC setting for the CS_EF1D electrode.</td>
</tr>
<tr>
<td>305</td>
<td>QMS:CS_EF2A_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_EF2A_VCTL at TIME. This value captures the DAC setting for the CS_EF2A electrode.</td>
</tr>
<tr>
<td>306</td>
<td>QMS:CS_EF2B_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_EF2B_VCTL at TIME. This value captures the DAC setting for the CS_EF2B electrode.</td>
</tr>
<tr>
<td>307</td>
<td>QMS:CS_EF2C_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_EF2C_VCTL at TIME. This value captures the DAC setting for the CS_EF2C electrode.</td>
</tr>
<tr>
<td>308</td>
<td>QMS:CS_EF2D_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_EF2D_VCTL at TIME. This value captures the DAC setting for the CS_EF2D electrode.</td>
</tr>
<tr>
<td>309</td>
<td>QMS:OS_OL4_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of OS_OL4_VCTL at TIME. This value captures the DAC setting for the OS_OL4 electrode.</td>
</tr>
<tr>
<td>310</td>
<td>QMS:CS_IFA_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_IFA_VCTL at TIME. This value captures the DAC setting for the CS_IFA electrode.</td>
</tr>
<tr>
<td>311</td>
<td>QMS:CS_IFB_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of CS_IFB_VCTL at TIME. This value captures the DAC setting for the CS_IFB electrode.</td>
</tr>
<tr>
<td>312</td>
<td>QMS:SL_TB_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of SL_TB_VCTL at TIME. This value captures the DAC setting for the SL_TB electrode.</td>
</tr>
<tr>
<td>313</td>
<td>QMS:SL_BB_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of SL_BB_VCTL at TIME. This value captures the DAC setting for the SL_BB electrode.</td>
</tr>
<tr>
<td>314</td>
<td>QMS:SL_BF_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of SL_BF_VCTL at TIME. This value captures the DAC setting for the SL_BF electrode.</td>
</tr>
<tr>
<td>315</td>
<td>QMS:SL_EL_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of SL_EL_VCTL at TIME. This value captures the DAC setting for the SL_EL electrode.</td>
</tr>
<tr>
<td>316</td>
<td>QMS:OS_OL3_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of OS_OL3_VCTL at TIME. This value captures the DAC setting for the OS_OL3 electrode.</td>
</tr>
<tr>
<td>317</td>
<td>QMS:SL_TF_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of SL_TF_VCTL at TIME. This value captures the DAC setting for the SL_TF electrode.</td>
</tr>
<tr>
<td>318</td>
<td>QMS:OS_OL5_VCTL</td>
<td>Real</td>
<td>V</td>
<td>N/A  Scientific value of OS_OL5_VCTL at TIME. This value captures the DAC setting for the OS_OL5 electrode.</td>
</tr>
</tbody>
</table>
### 8.3.6 L1B Science Data Table

This table contains the calibrated science packets values generated while the instrument is in a science telemetry mode.

**Table A-6: Definition of the L1B science data table**

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Format</th>
<th>Units</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>t_unix</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Unix time derived from sclk</td>
</tr>
<tr>
<td>2</td>
<td>t_sclk</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Sclk time direct from spacecraft</td>
</tr>
<tr>
<td>3</td>
<td>t_tid</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Time since beginning of run</td>
</tr>
<tr>
<td>4</td>
<td>tid</td>
<td>Integer</td>
<td></td>
<td>N/A</td>
<td>Identity marker per science experiment</td>
</tr>
<tr>
<td>5</td>
<td>umkid</td>
<td>Integer</td>
<td></td>
<td>N/A</td>
<td>Marker number indicating phase of ngims (e.g. warmup, phase mass scan etc)</td>
</tr>
<tr>
<td>6</td>
<td>orbit</td>
<td>Integer</td>
<td></td>
<td>N/A</td>
<td>Orbit number increasing before warmup to keep 1 orbit number for entire periapsis experiment</td>
</tr>
<tr>
<td>7</td>
<td>focus_mode</td>
<td>char</td>
<td></td>
<td>N/A</td>
<td>'csn', 'osnb', 'osion', or 'osnt' indicating which mode of operation</td>
</tr>
<tr>
<td>8</td>
<td>multiplier</td>
<td>Integer</td>
<td></td>
<td>0,1,2</td>
<td>Indicates which multiplier is on 0 indicates none</td>
</tr>
<tr>
<td>9</td>
<td>filament</td>
<td>Integer</td>
<td></td>
<td>0,1,2</td>
<td>Indicates which filament is on 0 indicates none</td>
</tr>
<tr>
<td>10</td>
<td>temperature_s</td>
<td>Integer</td>
<td>deg C</td>
<td>N/A</td>
<td>Temperature of the CS-antichamber transfer tube</td>
</tr>
<tr>
<td>11</td>
<td>mass</td>
<td>Integer</td>
<td>amu</td>
<td>1.5-450</td>
<td>Mass per charge. M/Z from 150-300 indicate first attenuation, 300-450 second attenuation</td>
</tr>
<tr>
<td>12</td>
<td>counts</td>
<td>Integer</td>
<td>counts</td>
<td>N/A</td>
<td>Raw counts from instrument uncalibrated</td>
</tr>
<tr>
<td>13</td>
<td>cps_raw</td>
<td>Real</td>
<td>cps</td>
<td>N/A</td>
<td>Raw counts converted to counts per second based on integration period</td>
</tr>
<tr>
<td>14</td>
<td>cps_raw_bkgd</td>
<td>Real</td>
<td>cps</td>
<td>N/A</td>
<td>Background subtracted off raw cps (for comparison only with low cps)</td>
</tr>
<tr>
<td>15</td>
<td>cps_dt</td>
<td>Real</td>
<td>cps</td>
<td>N/A</td>
<td>Deadtime corrected cps</td>
</tr>
<tr>
<td>#</td>
<td>Name</td>
<td>Format</td>
<td>Units</td>
<td>Range</td>
<td>Description</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>16</td>
<td>cps_dt_bkgd</td>
<td>Real</td>
<td>cps</td>
<td>N/A</td>
<td>Background subtracted deadtime corrected cps. recommend for use in all</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>science computations</td>
</tr>
<tr>
<td>17</td>
<td>bkgd</td>
<td>Real</td>
<td>cps</td>
<td>N/A</td>
<td>Computed background values from warmup scans</td>
</tr>
<tr>
<td>18</td>
<td>alt_iau</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Altitude geodetic iau coordinates</td>
</tr>
<tr>
<td>19</td>
<td>vsc_iau</td>
<td>Real</td>
<td>km/s</td>
<td>N/A</td>
<td>Space craft velocity geodetic iau coordinates</td>
</tr>
<tr>
<td>20</td>
<td>ram1</td>
<td>Real</td>
<td>deg</td>
<td>0-180</td>
<td>Ram pointing of the app in the direction of motion.</td>
</tr>
<tr>
<td>21</td>
<td>ram2rot-angle</td>
<td>Real</td>
<td>deg</td>
<td>0-180</td>
<td>Rotation angle of ngims boresight</td>
</tr>
<tr>
<td>22</td>
<td>sol-lon</td>
<td>Real</td>
<td>deg</td>
<td>0-180</td>
<td>Solar longitude</td>
</tr>
<tr>
<td>23</td>
<td>sol-lat</td>
<td>Real</td>
<td>deg</td>
<td>-90-90</td>
<td>Solar latitude</td>
</tr>
<tr>
<td>24</td>
<td>lst</td>
<td>char</td>
<td>hh:mm:ss</td>
<td>A.M/P.M.</td>
<td>Local solar time</td>
</tr>
<tr>
<td>25</td>
<td>x-iau</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Geodetic iau coordinates</td>
</tr>
<tr>
<td>26</td>
<td>y-iau</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Geodetic iau coordinates</td>
</tr>
<tr>
<td>27</td>
<td>z-iau</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Geodetic iau coordinates</td>
</tr>
<tr>
<td>28</td>
<td>vx-iau</td>
<td>Real</td>
<td>km/s</td>
<td>N/A</td>
<td>Geodetic iau coordinates</td>
</tr>
<tr>
<td>29</td>
<td>vy-iau</td>
<td>Real</td>
<td>km/s</td>
<td>N/A</td>
<td>Geodetic iau coordinates</td>
</tr>
<tr>
<td>30</td>
<td>vz-iau</td>
<td>Real</td>
<td>km/s</td>
<td>N/A</td>
<td>Geodetic iau coordinates</td>
</tr>
<tr>
<td>31</td>
<td>lat</td>
<td>Real</td>
<td>deg</td>
<td>0-180</td>
<td>Latitude</td>
</tr>
<tr>
<td>32</td>
<td>long</td>
<td>Real</td>
<td>deg</td>
<td>-90-90</td>
<td>Longitude</td>
</tr>
</tbody>
</table>

### 8.3.7 L1B Message Log
The calibrated message log is an ASCII file identical to the raw message log but with time-corrected stamps (in seconds).

### 8.3.8 L1B Marker List
The calibrated marker list is an ASCII file identical to the raw marker file but with time-corrected stamps (in seconds).

### 8.3.9 L2 Abundances
These table contains the abundances of for key neutral and ion species as measured by the instrument in the science telemetry mode.

**Table A-7: Definition of the L2 neutral abundance tables (csn-abund or cso-abund)**

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Format</th>
<th>Units</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>t_unix</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Unix time derived from slck</td>
</tr>
<tr>
<td>2</td>
<td>t_slck</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Slck time direct from spacecraft</td>
</tr>
<tr>
<td>3</td>
<td>t_tid</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Time since beginning of run</td>
</tr>
<tr>
<td>4</td>
<td>tid</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Identity marker per science experiment</td>
</tr>
<tr>
<td>5</td>
<td>orbit</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Orbit number increasing before warmup to keep 1 orbit number for entire</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>periapsis experiment</td>
</tr>
<tr>
<td>6</td>
<td>focusmode</td>
<td>char</td>
<td>N/A</td>
<td>N/A</td>
<td>‘csn’, ‘osnb’, ‘osion’, or ‘osnt’ indicating which mode of operation</td>
</tr>
<tr>
<td>7</td>
<td>alt</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Altitude geodetic iau coordinates</td>
</tr>
</tbody>
</table>
### 8.3.10 L3 Abundances and scale height temperatures

These tables contain the abundances and scale heights for key species as measured by the instrument in the science telemetry mode. These abundances are interpolated to equal pressure altitude.

#### Table A-9: Definition of the L3 resampled abundances table

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Format</th>
<th>Units</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>t_unix</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Unix time derived from sclk</td>
</tr>
<tr>
<td>2</td>
<td>t_sclk</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Sclk time direct from spacecraft</td>
</tr>
<tr>
<td>3</td>
<td>t_tid</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Time since beginning of run</td>
</tr>
<tr>
<td>4</td>
<td>tid</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Identity marker per science experiment</td>
</tr>
<tr>
<td>5</td>
<td>orbit</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Orbit number increasing before warmup to keep 1 orbit number for</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>entire periapsis experiment</td>
</tr>
<tr>
<td>6</td>
<td>focusmode</td>
<td>char</td>
<td>N/A</td>
<td>N/A</td>
<td>‘csn’, ‘osnb’, ‘osion’, or ‘osnt’ indicating which mode of operation</td>
</tr>
<tr>
<td>7</td>
<td>alt</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Altitude geodetic iau coordinates</td>
</tr>
<tr>
<td>8</td>
<td>ion_mass</td>
<td>Real</td>
<td>amu</td>
<td>2-150</td>
<td>Only specific m/z are included</td>
</tr>
<tr>
<td>9</td>
<td>cps_dt</td>
<td>Real</td>
<td>Count/s</td>
<td>N/A</td>
<td>Counts per second background subtracted, deadtime corrected, of key species</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>saturation of species accounted for.</td>
</tr>
<tr>
<td>10</td>
<td>abundance</td>
<td>Real</td>
<td>ion/cc</td>
<td>N/A</td>
<td>Density of ions</td>
</tr>
<tr>
<td>11</td>
<td>Sensitivity</td>
<td>Real</td>
<td>Counts/s/ion/cc</td>
<td>N/A</td>
<td>Reference instrument sensitivity to CO$_2$</td>
</tr>
<tr>
<td>12</td>
<td>precision</td>
<td>Real</td>
<td>N/A</td>
<td>0-1</td>
<td>Percent error (1 sigma) on density</td>
</tr>
<tr>
<td>13</td>
<td>quality</td>
<td>Char</td>
<td>N/A</td>
<td>P/D</td>
<td>Preliminary (P) or Definitive (D) error and density calculations</td>
</tr>
<tr>
<td>#</td>
<td>Name</td>
<td>Format</td>
<td>Units</td>
<td>Range</td>
<td>Description</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>focusmode</td>
<td>char</td>
<td>N/A</td>
<td>N/A</td>
<td>‘csn’, ‘osnb’, ‘osion’, or ‘osnt’ indicating which mode of operation</td>
</tr>
<tr>
<td>7</td>
<td>alt</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Altitude in geodetic iau coordinates</td>
</tr>
<tr>
<td>8</td>
<td>mass</td>
<td>Real</td>
<td>amu</td>
<td>2-150</td>
<td>Only specific m/z are included</td>
</tr>
<tr>
<td>9</td>
<td>species</td>
<td>char</td>
<td>N/A</td>
<td>N/A</td>
<td>Name of neutral mass density calculated</td>
</tr>
<tr>
<td>10</td>
<td>averaged_density</td>
<td>Real</td>
<td>Part/cc</td>
<td>N/A</td>
<td>Interpolated atmospheric density of the species being observed.</td>
</tr>
</tbody>
</table>

Table A-10: Definition of the resampled scale height table

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Format</th>
<th>Units</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>t_unix</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Unix time derived from sclk</td>
</tr>
<tr>
<td>2</td>
<td>t_sclk</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Sclk time direct from spacecraft</td>
</tr>
<tr>
<td>3</td>
<td>t_tid</td>
<td>Real</td>
<td>sec</td>
<td>N/A</td>
<td>Time since beginning of run</td>
</tr>
<tr>
<td>4</td>
<td>tid</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Identity marker per science experiment</td>
</tr>
<tr>
<td>5</td>
<td>orbit</td>
<td>Integer</td>
<td>N/A</td>
<td>N/A</td>
<td>Orbit number increasing before warmup to keep 1 orbit number for entire periapsis experiment</td>
</tr>
<tr>
<td>6</td>
<td>mid_alt</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Reference altitude for the scale height value</td>
</tr>
<tr>
<td>7</td>
<td>mass</td>
<td>Real</td>
<td>M/Z</td>
<td>0 – 150</td>
<td>Only specific m/z are included</td>
</tr>
<tr>
<td>8</td>
<td>species</td>
<td>Char</td>
<td>N/A</td>
<td>N/A</td>
<td>Species being measured.</td>
</tr>
<tr>
<td>9</td>
<td>scale_height</td>
<td>Real</td>
<td>km</td>
<td>N/A</td>
<td>Calculated scale height for the measured species</td>
</tr>
<tr>
<td>10</td>
<td>temperature</td>
<td>Real</td>
<td>deg K</td>
<td>N/A</td>
<td>Calculated scale height temperature for the measured species</td>
</tr>
</tbody>
</table>

8.4 List of NGIMS Calibration TIDs:

The list of TIDs that are relevant to instrument calibration and that provide trending of instrument performance are listed in the Table A-11. The data returned from these activities are archived in their raw form in the \calibration collection.

TIDs acquired after launch are archived in the \data_l1a and \data_l1b collections.

Table A-11: List of TID relevant to calibration that were collected prior to MAVEN launch

<table>
<thead>
<tr>
<th>Date</th>
<th>TID</th>
<th>Ops</th>
<th>Temperature</th>
<th>Script</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-Sep-12</td>
<td>10191</td>
<td>Argon Calibration</td>
<td>Ambient</td>
<td>cal_script.bas</td>
</tr>
<tr>
<td>23-Sep-12</td>
<td>10194</td>
<td>Krypton Calibration</td>
<td>Ambient</td>
<td>cal_script.bas</td>
</tr>
<tr>
<td>24-Sep-12</td>
<td>10197</td>
<td>Krypton Calibration</td>
<td>Ambient</td>
<td>cal_script.bas</td>
</tr>
<tr>
<td>24-Sep-12</td>
<td>10198</td>
<td>Krypton Calibration</td>
<td>Ambient</td>
<td>cal_script.bas</td>
</tr>
</tbody>
</table>
### 8.5 NGIMS Sample Label:

Below is a sample label for the data contained in:

```
mvn.ngi.lla.gnd.sci_011146_20130928T010754_v01_r01.csv
```

```
<?xml version="1.0" encoding="UTF-8"?>
<Product_Observational
  xmlns="http://pds.nasa.gov/pds4/pds/v1"
  xmlns:pds="http://pds.nasa.gov/pds4/pds/v1"
  xmlns:phxmd="http://pds.nasa.gov/pds4/mavenmd/v02"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://pds.nasa.gov/pds4/pds/v1
  http://pds.nasa.gov/pds4/schema/released/pds/v1/PDS4_PDS_1100.xsd
  http://pds.nasa.gov/pds4/mavenmd/v02
  http://atmos.ngimsu.edu/pub/PDS4/schema/MAVENMD_1100.xsd">
  <Identification_Area>
    <logical_identifier>urn:nasa:pds:maven_ngims:data:mvn.ngi.lla.gnd.sci_011146_20130928T010754_v01_r01</logical_identifier>
    <version_id>01</version_id>
    <title>Raw NGIMS Science Data</title>
    <information_model_version>1.1.0.0</information_model_version>
    <product_class>Product_Observational</product_class>
  </Identification_Area>
  <Observation_Area>
    <Time_Coordinates>
      <start_date_time>2013-09-28T01:07:54Z</start_date_time>
      <stop_date_time>2013-09-28T02:24:27Z</stop_date_time>
    </Time_Coordinates>
    <Primary_Result_Summary>
      <purpose>Science</purpose>
      <data_regime>Ions</data_regime>
      <processing_level_id>Raw</processing_level_id>
      <Science_Facets>
        <domain>Atmosphere</domain>
        <discipline_name>Atmospheres</discipline_name>
        <facet1>Structure</facet1>
      </Science_Facets>
    </Primary_Result_Summary>
    <Investigation_Area>
      <name>MAVEN with Neutral Gas and Ion Mass Spectrometer</name>
  </Observation_Area>
</Product_Observational>
```
<type>Mission</type>

<Internal_Reference>

</Internal_Reference>
</Investigation_Area>

<Observing_System>

<Observing_System_Component>

<name>Neutral Gas and Ion Mass Spectrometer</name>
<type>Instrument</type>
<description>
The MAVEN Neutral Gas and Ion Mass Spectrometer (NGIMS) instrument description is included in the MAVEN NGIMS Software Interface Specification (SIS) file 'ngims_pds_sis.docx' in the document collection of the MAVEN NGIMS bundle.
</description>
</Internal_Reference>
</Observing_System_Component>

<Observing_System_Component>

<name>MAVEN</name>
<type>Spacecraft</type>
<description>
The MAVEN spacecraft description document is included as a secondary member of the document collection of the MAVEN NGIMS bundle.
</description>
</Internal_Reference>
</Observing_System_Component>
</Observing_System>

<Target_Identification>

<name>Moon</name>
</Target_Identification>

<File_Area_Observational>

<File>

<file_name>mvn_ngi_l1a_gnd_sci_011146_20130928T010754_v01_r01.csv</file_name>

<local_identifier>mvn_ngi_l1a_gnd_sci_011146_20130928T010754_v01_r01</local_identifier>
<creation_date_time>2014-03-25T11:46:08</creation_date_time>
<file_size unit="byte">4374883</file_size>
<records>448</records>
</File>

<Header>

<name>Column headings for TABLE</name>
<local_identifier>HEADER</local_identifier>
<offset unit="byte">0</offset>
<object_length unit="byte">79</object_length>
<parsing_standard_id>PDS DSV 1</parsing_standard_id>
</Header>

<Table_Delimited>

<name>Raw NGIMS Housekeeping Values</name>
<local_identifier>TABLE</local_identifier>
A spreadsheet containing all NGIMS science data for the given period of time, with no corrections.

Records: 447

Record delimiter: carriage-return line-feed

Field delimiter: comma

### Field Delimited

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Number</th>
<th>Data Type</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME</td>
<td>1</td>
<td>ASCII_Real</td>
<td>SECONDS</td>
<td>SCLK Timestamp at the start of the integration period</td>
</tr>
<tr>
<td>MKID</td>
<td>2</td>
<td>ASCII_NonNegative_Integer</td>
<td>N/A</td>
<td>NGIMS numeric Marker ID of science observation</td>
</tr>
<tr>
<td>INTEGRATION_PERIOD</td>
<td>3</td>
<td>ASCII_Real</td>
<td>SECONDS</td>
<td>Duration of integration period starting at TIME</td>
</tr>
<tr>
<td>TUNING</td>
<td>4</td>
<td>ASCII_NonNegative_Integer</td>
<td>N/A</td>
<td>Numeric ID of the tuning in use by NGIMS during the integration period starting at TIME.</td>
</tr>
<tr>
<td>MASS</td>
<td>5</td>
<td>ASCII_Real</td>
<td>AMU_PER_ELEMENTARY_CHARGE</td>
<td>Mass-to-charge ratio of ions (u/e) scanned during</td>
</tr>
</tbody>
</table>
the integration period starting at TIME. This field is left blank during DAC scans.
  </description>
</Field_Delimited>
<Field_Delimited>
  <name>COUNTS_PER_SECOND</name>
  <field_number>6</field_number>
  <data_type>ASCII_Real</data_type>
  <unit>HERTZ</unit>
  <description>
    Frequency of ion counts detected throughout the integration period starting at TIME.
  </description>
</Field_Delimited>
<Field_Delimited>
  <name>DAC_ID</name>
  <field_number>7</field_number>
  <data_type>ASCII_NonNegative_Integer</data_type>
  <unit>N/A</unit>
  <description>
    Numeric ID of the DAC being scanned at TIME. A description of each DAC, along with a table assigning these numeric IDs, can be found in the SIS document accompanying this archive. This field is left blank during mass scans.
  </description>
</Field_Delimited>
<Field_Delimited>
  <name>DAC_VOLTAGE</name>
  <field_number>8</field_number>
  <data_type>ASCII_Real</data_type>
  <unit>Volts</unit>
  <description>
    Commanded voltage of the DAC with the numeric ID specified by the previous column throughout the integration period starting at TIME. This field is left blank during mass scans.
  </description>
</Field_Delimited>
</Record_Delimited>
</Table_Delimited>
</File_Area_Observational>
</Product_Observational>