Mars Atmosphere and Volatile Evolution Mission
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Mars Atmosphere and Volatile Evolution (MAVEN) Mission

Neutral Gas and Ion Mass Spectrometer (NGIMS)

NGIMS PDS Software Interface Specification

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Prepared by:

Mehdi Benna
Meredith Elrod

Goddard Space Flight Center
Greenbelt, Maryland

National Aeronautics and Space Administration

Configuration Management Plan

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Questions or comments concerning this document should be addressed to:

MAVEN Configuration Management Office
MailStop 432
Goddard Space Flight Center
Greenbelt, Maryland 20771

REVIEW/APPROVAL PAGE

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Prepared by	Mehdi Benna; NGIMS Team (GSFC) Meredith Elrod; NGIMS Team (GSFC)
Approved (date)	Paul Mahaffy Principal Investigator, NGIMS (GSFC)
Approved (date)	Alex DeWolfe Science Data Center Lead (LASP)
Approved (date)	Reta Beebe PDS Atmospheres Node Manager (NMSU)
Approved (date)	Tom Morgan PDS Project Manager (GSFC)

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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
MSL	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.
2. Planetary Data System Archive Preparation Guide, JPL D-31224, version 1.4, April 1, 2010.
3. MAVEN Science Operations Center to Instrument Facility Interface Control Document (MAVEN-SOPS-ICD-0031), Revision F3, July 11, 2013.
4. MAVEN Science Data Management Plan (MAVEN-SOPS-PLAN-0068), Revision C, September 05, 2013.

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).

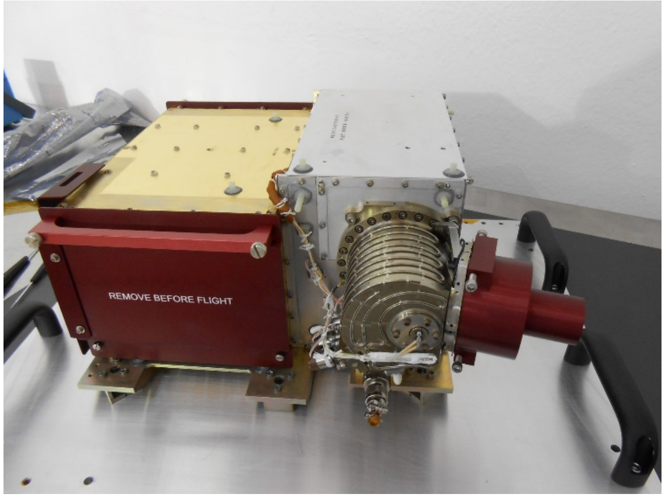


Figure 1: The MAVEN NGIMS Instrument during Integration and Testing (I&T).

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, N_2, NO, O_2, Ar, and CO_2 along the spacecraft track.
- Measure isotope ratios such as $^{13}C/^{12}C$, $^{18}O/^{16}O$, $^{15}N/^{14}N$, $^{40}Ar/^{36}Ar$, $^{38}Ar/^{36}Ar$.
- Secure profiles of thermal ions O^{2+}, CO^{2+}, NO^{+}, O^{+}, CO^{+}, C^{+}, N^{2+}, OH^{+}, 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 – 1: Key NGIMS parameters	
NGIMS Instrument Parameters	
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 π steradians 2. Open source 10° cone half angle
Neutral mode ionization sources	Electron impact ionization with redundant filaments 1. Closed source: 50 to 250 μA and 70eV 2. Open source: 50 to 250 μA 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^{8}
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; Supra-thermal 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].

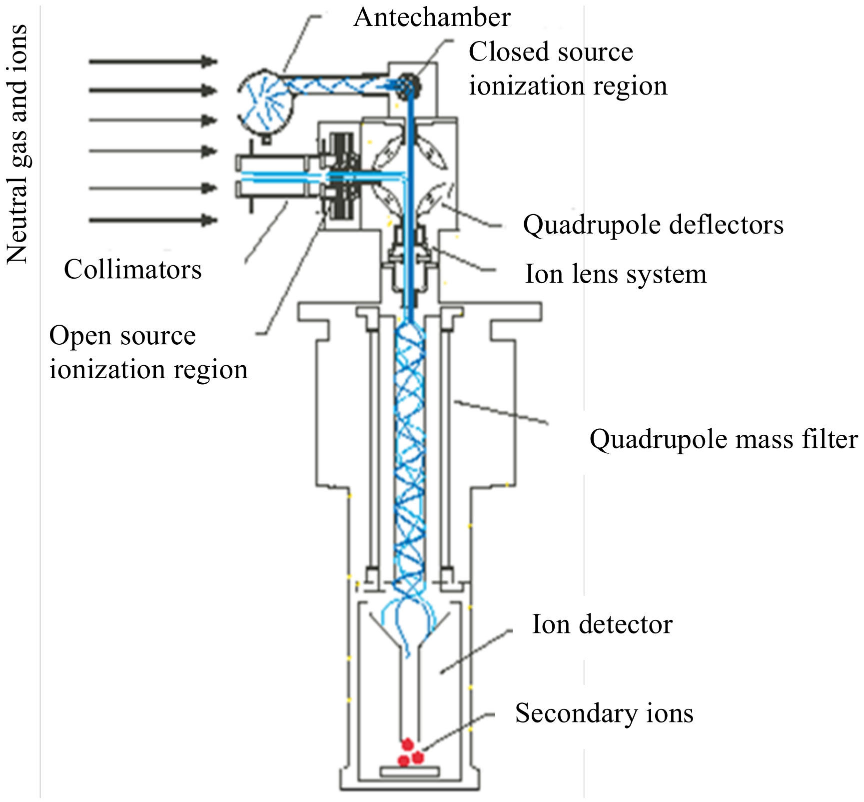


Figure 2: Schematics illustrating the principal components of the NGIMS sensor.

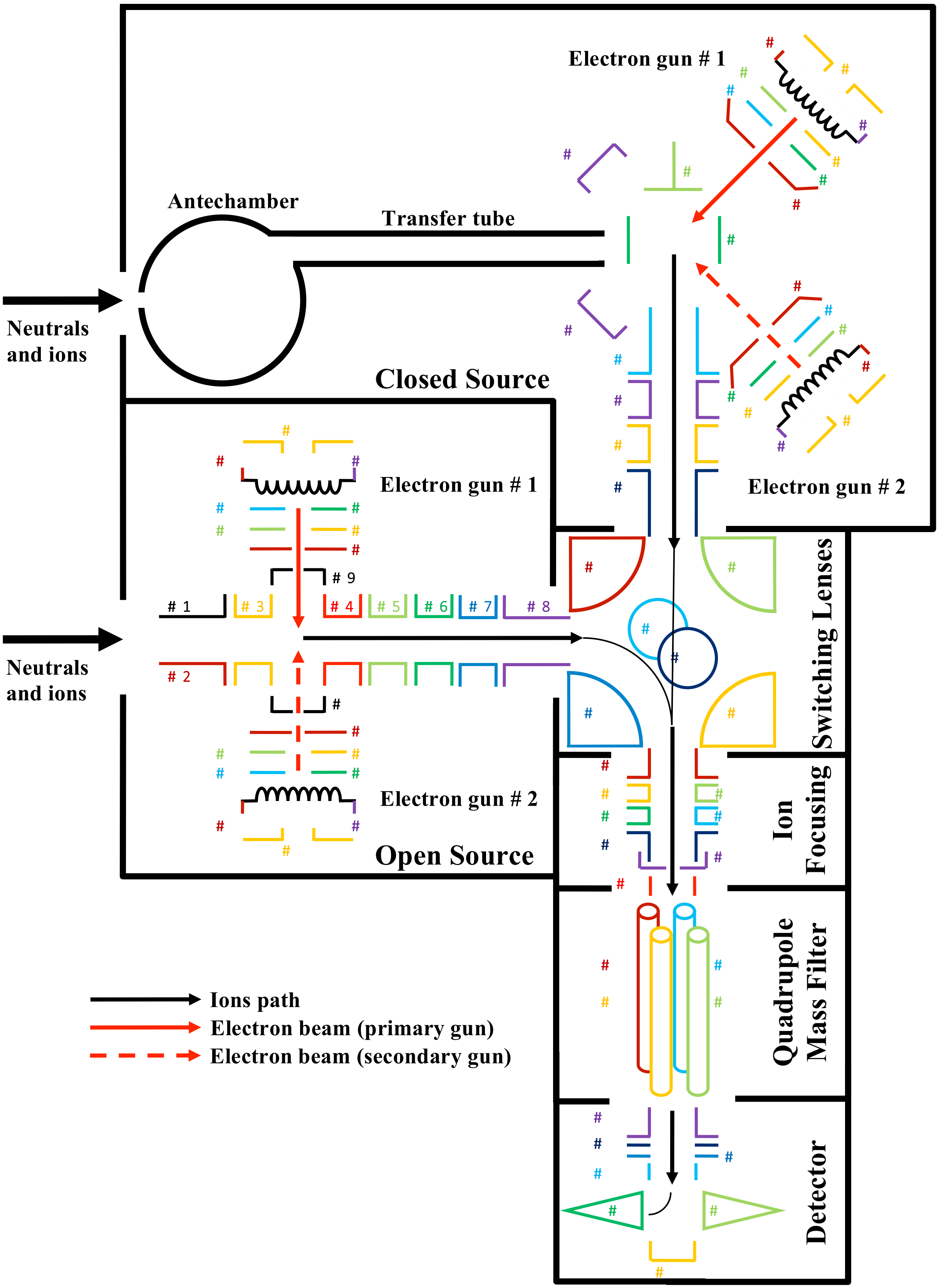


Figure 3: Schematics of NGIMS electrostatic elements. Table 3 provides the related nomenclature.

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, N_2, 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 $U_{DC} + U_{AC}\cos(2\pi f t)$ 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:

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

$$U_{AC} = \frac{m\, r_0^2\, \pi^2\, f^2\, q}{e}$$

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 $f_1 = 1.4\ MHz$ to $f_2 = 3.0\ MHz$ at mass $m = 20.5\ Da$.

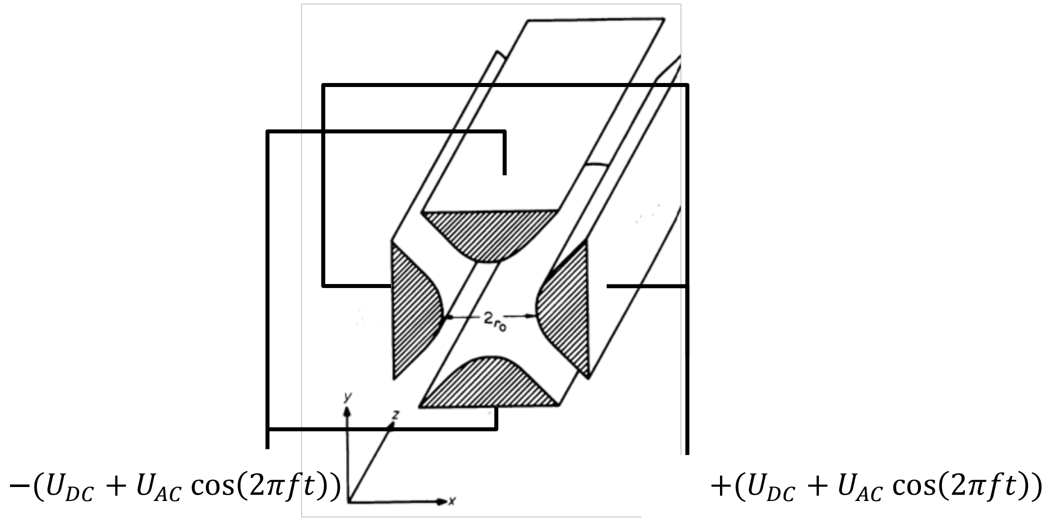


Figure 4: Quadrupole mass filter and driving RF potentials.

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

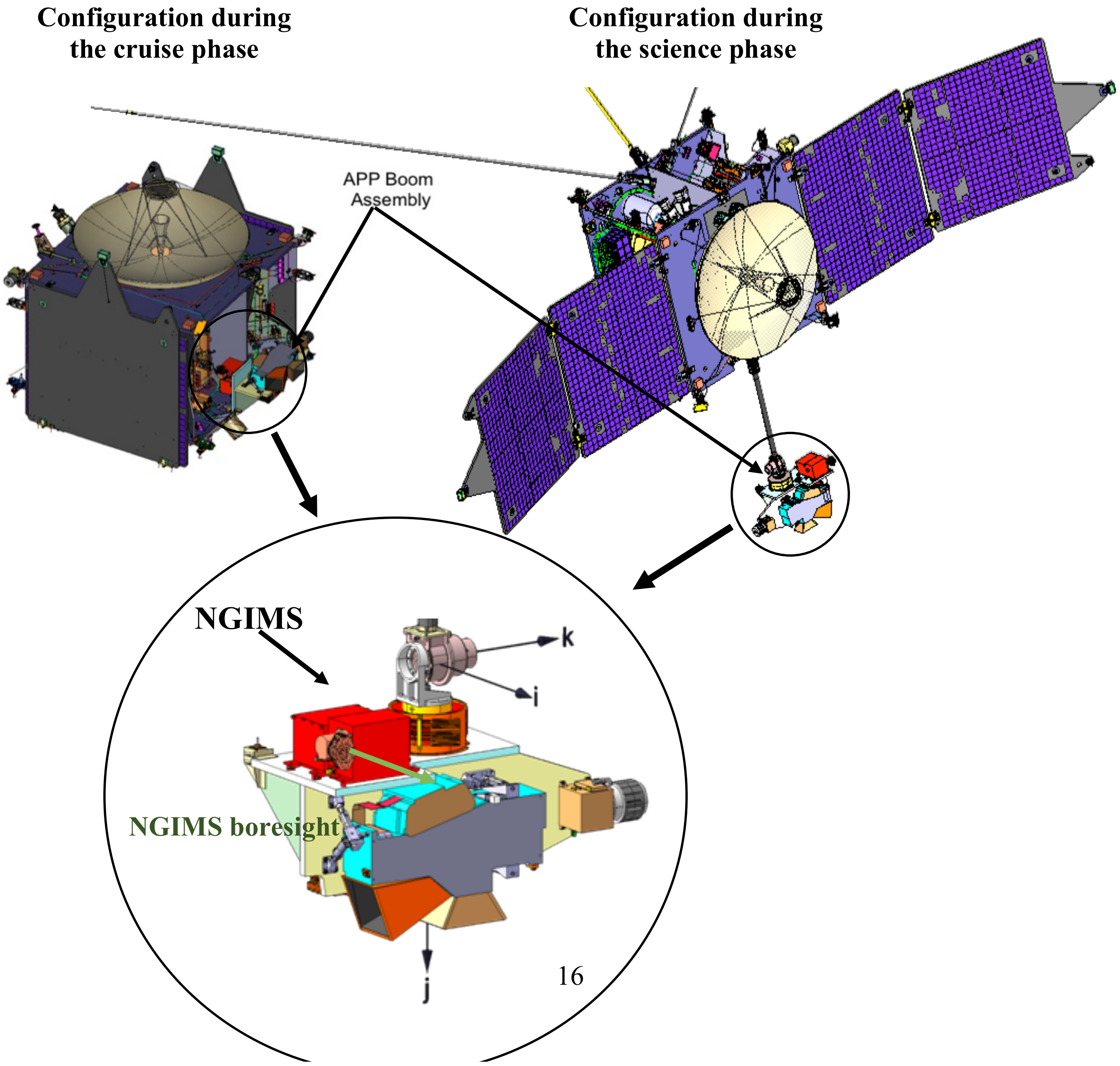
Ions exiting the quadrupole mass filter are directed toward one of the two redundant secondary electron multipliers for detection. During nominal operations only one detector is used at a given time. The multipliers are associated electrodes electronically biased such that most of the ions are deflected 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 N_2, CO_2, Ar, Kr, and Xe to establish the response of the instrument over much of its mass range. Use of N_2 and 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 π 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.

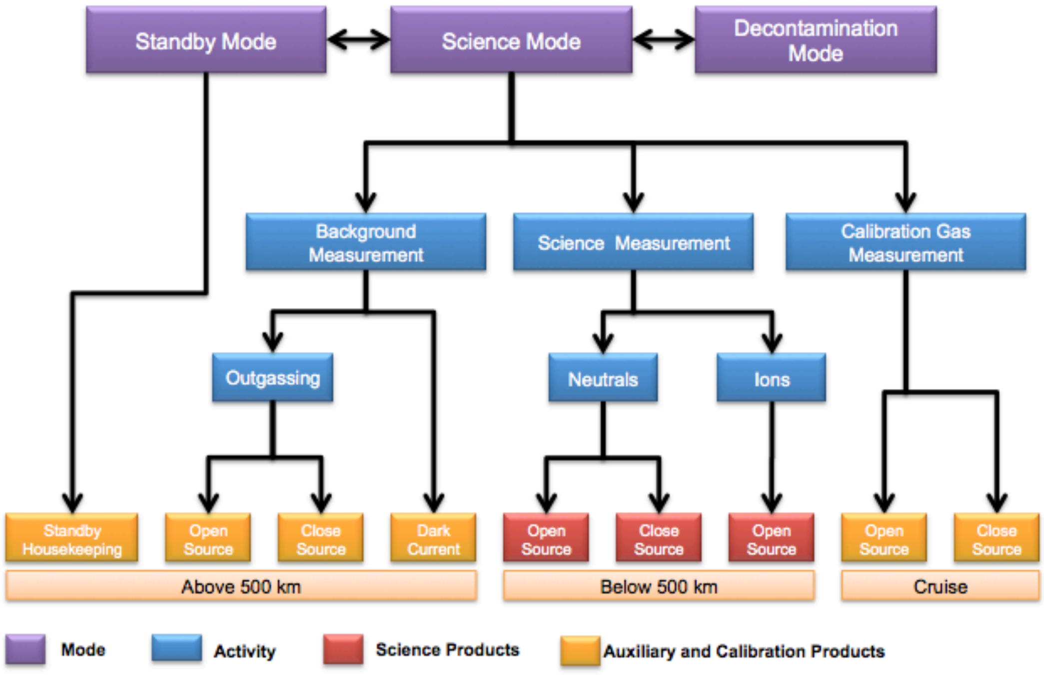


Figure 6: NGIMS Measurement Modes.

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 (ie, 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).

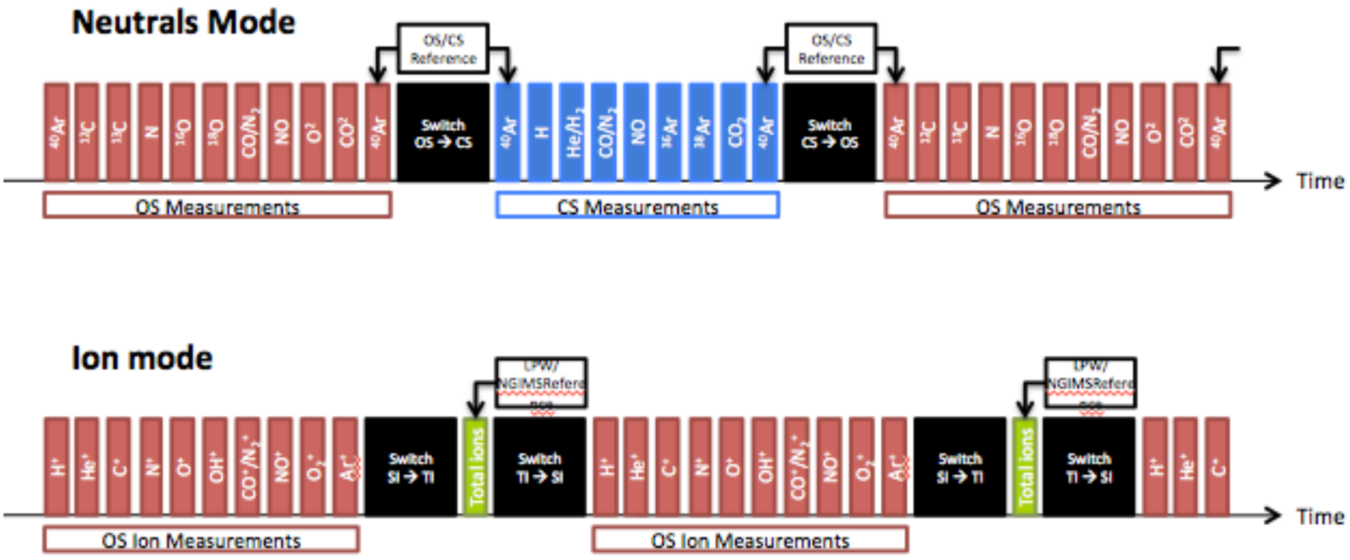


Figure 7: Example of measurement sequences for neutral and ions

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 2×10^7 c/s. The data, presented in Figure 8 shows that both detector chains exhibit good linearity up to 2×10^6 c/s above which they display a non-linear behavior common to all paralyzable counting systems.

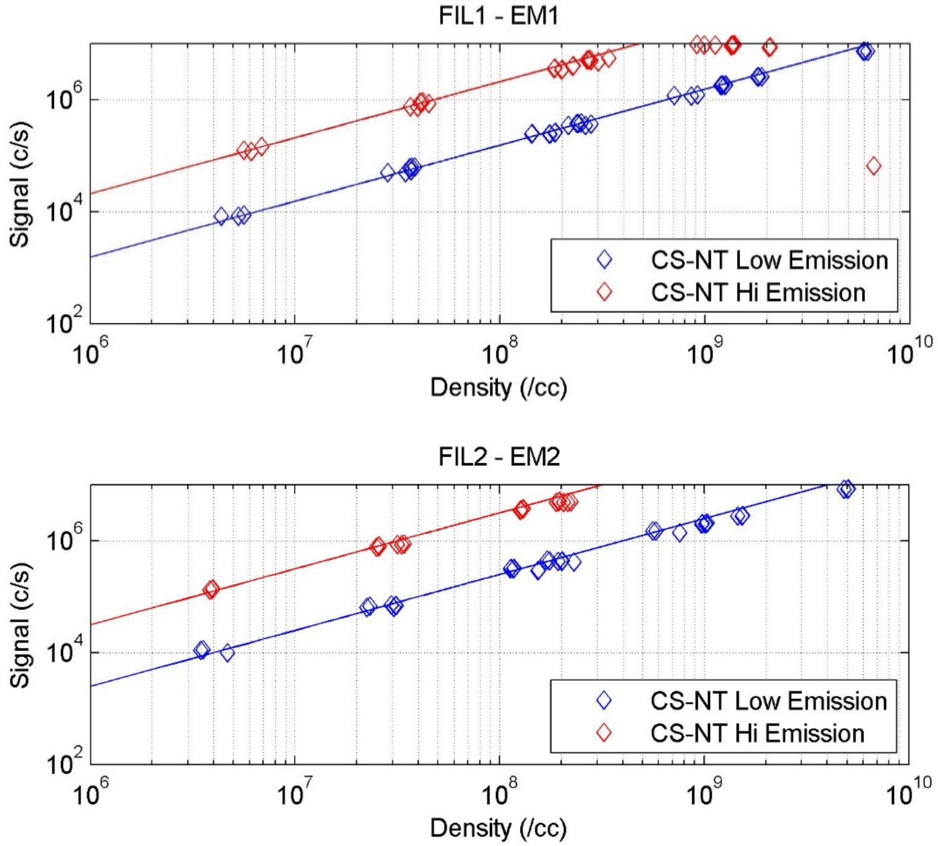


Figure 8: Detector linearity measured for the closed source at high and low filament

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

$$m = n \exp(-n\,\tau) \qquad (1)$$

where n is the true event rate in counts/s, m is the measured event rate in counts/s and τ 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 τ as a function of ^{84}Kr abundance. The dead time for both detector chains can be fit by the analytical formula:

$$\tau = A\exp((m\ B)^{C}) \tag{2}$$

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

$$n_B(m_s) = n(m_s) - b(m_s) - e(m_s) \quad (3)$$

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) σ_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:

$$S_a = S_n * C_{RF}(m_s) * \sigma_s \quad (4)$$

where C_{RF} is a sensitivity correction factor:

$$C_{RF} = \begin{cases} 0.71 \; if \; m_s \le 20.5 \\ 1.00 \; if \; m_s > 20.5 \end{cases} \quad (5)$$

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:

$$O_a = \frac{S_a(m_{ref}) * n_c(m_{ref})}{n_o(m_{ref})} * C_{EN}(m_s) \quad (6)$$

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 Sensitivities

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

$$I_a = \frac{D_e}{n_I} * C_{EN}(m_s) \tag{7}$$

where n_I 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:

$$\begin{aligned} S_{a,i} &= S_a * DS_{a,i} \\ O_{a,i} &= O_a * DO_{a,i} \\ I_{a,i} &= I_a * DI_{a,i} \end{aligned} \tag{8}$$

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 – 3. NGIMS Closed Source Sensitivities for He, Ar and Kr(1)

Fil #	Emission (μA)	CEM #	Species	EI cross section(2) (A°^{2})	Absolute Sensitivity (counts/s)/(particle/cc)	Normalized Sensitivity (counts/s)/(particle/cc)/A°^{2}
1	250	1	^{40}Ar	2.52	2.84E-02	1.13E-02

1	50	1	^{40}Ar	2.52	1.83E-03	7.26E-04
1	250	1	^{84}Kr	3.45	2.03E-02	5.89E-03
1	50	1	^{84}Kr	3.45	1.38E-03	4.00E-04
2	250	2	^{40}Ar	2.52	3.03E-02	1.20E-02
2	50	2	^{40}Ar	2.52	2.36E-03	9.36E-04
2	250	2	^{84}Kr	3.45	2.27E-02	6.57E-03
2	50	2	^{84}Kr	3.45	1.90E-03	5.51E-04

(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:

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

where

$$S_i = \frac{V\cos(\alpha)}{c_i} \tag{10}$$

and

$$c_i = \sqrt{\frac{2\,K\,T_{a,i}}{m_i}} \tag{11}$$

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, α 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 – 4. MAVEN Data Level Definitions

Data Level	Brief Description	Relevant to NGIMS
Raw	Raw telemetry data as received at the ground receiving station. May contain duplicate data and/or communication artifacts.	Yes
Level 0	Binary packets (as produced by the corresponding instrument).	Yes
Quicklook	Scientific data products that are generated using simplified science processing algorithms, e.g. with provisional calibrations. Available to MAVEN science team.	Yes
Level 1A	Extracted telemetry items/channels; no calibrations or corrections applied.	Yes
Level 1B	Extracted telemetry data to which instrument-level engineering and science calibrations have been applied.	Yes
Level 2	Research-grade instrument-level scientific data products in physical units.	Yes
Level 3	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.	Yes
Level 4+	Higher-level products for team use.	No

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 – 5. NGIMS Data processing levels

Data Level	Description	Archived
0	Binary packets as produced by NGIMS	No
1A	Packets separated by telemetry channel (Housekeeping, Science and Instrument Log) and converted to ASCII format	Yes
1B	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.	Yes
2	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.	Yes
3	Resampled Data Record: Altitude resampled abundances and energy distributions.	Yes
Quicklook	Mass-time spectrograms; 2-D plots, e.g. mass, counts, time, voltages	No

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 – 6. NGIMS Data Products

Product Name	**Description**	**Estimated Size (B = Bytes)**	**Type**	**Level**	**File label**
Calibration Housekeeping	Instrument housekeeping packets	6000 KB	Ground calibration	l1c	gnd-hk
Calibration Science	Instrument science packets	600 KB	Ground calibration	l1c	gnd-sci
Calibration Message Log	Instrument message log	10 KB	Ground calibration	l1c	gnd-msg
Calibration Markers	Instrument markers	10 KB	Ground calibration	l1c	gnd-mkr
Raw Housekeeping	Instrument housekeeping packets	6000 KB	flight	l1a	raw-hk
Raw Science	Instrument science packets	600 KB	flight	l1a	raw-sci
Raw Message Log	Instrument message log	10 KB	flight	l1a	raw-msg
Raw Markers	Instrument markers	10 KB	flight	l1a	raw-mkr
Calibrated Housekeeping	Instrument housekeeping packets	6000 KB	flight	l1b	cal-hk
Calibrated Science	Instrument science packets	600 KB	flight	l1b	osnb osion
Calibrated Message Log	Instrument message log	10 KB	flight	l1b	cal-msg
Calibrated Markers	Instrument markers	10 KB	flight	l1b	cal-mkr

Derived Abundances	Atmospheric abundances	100 KB	flight	l2	csn-abund cso-abund, ion-abund
Resampled Abundances	Altitude resampled abundances	250 KB	flight	l3	res-den
Resampled Scale Heights	Scale-heights and scale height temperatures binned by local time	100 KB	flight	l3	res-sht

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 – 7. Data processing timeline

Data Level	Audience	First Delivery	Delivery Schedule
Level 0	MAVEN team	At the start of science operations	Within 24 hours of science telemetry receipt at SOC
Level 1A	MAVEN team	At the start of science operations	Within 24 hours of science telemetry receipt at SOC
Level 1B	MAVEN team	At the start of science operations	Within 3 business days of ITF receipt of Level 1A
Level 2	MAVEN team	No later than 2 months after the start of science operations	Within 1 week of ITF receipt of Level 1 and all ancillary data
	Science community	No later than 6 months after the start of science operations	Every 3 months
Level 3	MAVEN team	No later than 3 months after the start of science operations, except where data product requires data from entire mission	No less frequently than every 4 weeks

Table – 7. Data processing timeline			
Data Level	**Audience**	**First Delivery**	**Delivery Schedule**
	Science community	No later than 6 months after the start of science operations, except where data product requires data from entire mission	Every 3 months

6. COGNIZANT PERSONS

Table – 8: Cognizant Persons for NGIMS PDS Data

NGIMS Team		
Principal Investigator, **Dr. Paul Mahaffy**	Planetary Environment Laboratory NASA Goddard Space Flight Center Code 699 8800 Greenbelt road Greenbelt, MD 20771	301 614-6379 Paul.mahaffy@nasa.gov
NGIMS Scientist **Dr. Mehdi Benna**	Planetary Environment Laboratory NASA Goddard Space Flight Center Code 699 8800 Greenbelt road Greenbelt, MD 20771	301 614-6392 mehdi.benna@nasa.gov
NGIMS Scientist **Dr. Meredith K Elrod**	Planetary Environment Laboratory NASA Goddard Space Flight Center Code 699 8800 Greenbelt road Greenbelt, MD 20771	301 614-5621 meredith.k.elrod@nasa.gov
NGIMS calibration Engineer **Mr. Eric Raaen**	Planetary Environment Laboratory NASA Goddard Space Flight Center Code 699 8800 Greenbelt road Greenbelt, MD 20771	301 614-6363 eric.raaen@nasa.gov
NGIMS Archive Manager **Mr. Eric Lyness**	Planetary Environment Laboratory NASA Goddard Space Flight Center Code 699 8800 Greenbelt road Greenbelt, MD 20771	301 614-6090 eric.lyness@nasa.gov
NGIMS Ops Manager	Planetary Environment Laboratory NASA Goddard Space Flight Center	301 614-6818

Mr. Edwin Weidner	Code 699 8800 Greenbelt road Greenbelt, MD 20771	edwin.r.weidner@nasa.gov
PDS Planetary Atmospheres Data Node		
PDS Atmospheres Node Manager **Dr. Reta Beebe**	Astronomy Department New Mexico State University P.O. Box 30001, MSC 4500 Las Cruces, NM 88003	575 646-1938 rbeebe@nmsu.edu
PDS Atmospheres Archive Manager **Mr. Lyle Huber**	Astronomy Department New Mexico State University P.O. Box 30001, MSC 4500 Las Cruces, NM 88003	575 646-1862 lhuber@nmsu.edu

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8. APPENDICES

8.1 NGIMS Electrodes Designation

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

Lens #	Designation	Abbreviation	Min Potential (V)	Max Potential (V)
Open Source (OS) Sub Assembly				
1	OS Collimator (a) (Split)	OS_COLa	-150	150
2	OS Collimator (b) (Split)	OS_COLb	-150	150
3	OS Lens 1	OS_OL1	-10	10
4	OS Lens 2	OS_OL2	-10	10
5	OS Lens 3	OS_OL3	-150	150
6	OS Lens 4	OS_OL4	-300	0
7	OS Lens 5	OS_OL5	-900	100
8	OS Nozzle	OS_OL6	-900	100
9	OS Electron Restrictor 1	OS_RES1	-150	150
10	OS Electron Deflector 1 (c)	OS_EF1c	-100	0
11	OS Electron Deflector 1 (d)	OS_EF1d	-100	0
12	OS Electron Focus 1 (a)	OS_EF1a	-100	0
13	OS Electron Focus 1 (b)	OS_EF1b	-100	0
14	OS Filament Shield 1	OS_FS1	-100	0
15	OS Filament 1-P	OS_FIL1-P	-70	-70
16	OS Filament 1-M	OS_FIL1-M	-70	-70
17	OS Electron Accelerator 1	OS_EA1	-100	200
18	OS Electron Restrictor 2	OS_RES2	-150	150
19	OS Electron Deflector 2 (c)	OS_EF2c	-100	0
20	OS Electron Deflector 2	OS_EF2d	-100	0

	(d)			
21	OS Electron Focus 2 (a)	OS_EF2a	-100	0
22	OS Electron Focus 2 (b)	OS_EF2b	-100	0
23	OS Filament Shield 2	OS_FS2	-100	0
24	OS Filament 2-P	OS_FIL2-P	-70	-70
25	OS Filament 2-M	OS_FIL2-M	-70	-70
26	OS Electron Accelerator 2	OS_EA2	-100	200
Closed Source (CS) Sub Assembly				
27	CS Ion Accelerator	CS_IA	-10	10
28	CS Ion Focus a	CS_IFa	-300	0
29	CS Ion Focus b	CS_IFb	-300	0
30	CS Nozzle	CS_NZ	-300	0
31	CS Repeller	CS_RP	-10	10
32	CS Repeller Shield	CS_RS	-10	10
33	CS Anode 1	CS_AN1	0	300
34	CS Electron Accelerator 1	CS_EA1	0	300
35	CS Electron Focus 1 (a)	CS_EF1a	-100	0
36	CS Electron Focus 1 (b)	CS_EF1b	-100	0
37	CS Electron Deflector 1 (c)	CS_EF1c	-100	0
38	CS Electron Deflector 1 (d)	CS_EF1d	-100	0
39	CS Filament 1-P	CS_FIL1-P	-70	-70
40	CS Filament 1-M	CS_FIL1-M	-70	-70
41	CS Filament Shield 1	CS_FS1	-100	0
42	CS Anode 2	CS_AN2	0	300
43	CS Electron Accelerator 2	CS_EA2	0	300

44	CS Electron Focus 2 (a)	CS_EF2a	-100	0
45	CS Electron Focus 2 (b)	CS_EF2b	-100	0
46	CS Electron Deflector 2 (c)	CS_EF2c	-100	0
47	CS Electron Deflector 2 (d)	CS_EF2d	-100	0
48	CS Filament 2-P	CS_FIL2-P	-70	-70
49	CS Filament 2-M	CS_FIL2-M	-70	-70
50	CS Filament Shield 2	CS_FS2	-100	0
Switching Lens (SL) Sub Assembly				
51	Sl Quad Lens Top Front	SL_TF	-200	100
52	SL Quad Lens Top Back	SL_TB	-900	100
53	SL Quad Lens Bottom Back	SL_BB	-200	100
54	Sl Quad Lens Bottom Front	SL_BF	-900	100
55	SL End Lens 1	SL_EL1	-100	900
56	SL End Lens 2	SL_EL2	-100	900
Ion Analyzer (IA) Sub Assembly				
57	IA Lens 1	IA_L1	-900	0
58	IA Lens 2	IA_L2	-900	0
59	IA Lens 4 (a) (Split)	IA_L4a	-300	0
60	IA Lens 4 (b) (Split)	IA_L4b	-300	0
61	IA Lens 5 (a) (Split)	IA_L5a	-900	0
62	IA Lens 5 (b) (Split)	IA_L5b	-900	0
63	IA Lens 6	IA_L6	-900	0
Quadrupole (QD) Sub Assembly				
64	Rod 1	QD_R1	RF	RF
65	Rod 2	QD_R2	RF	RF

66	Rod 3	QD_R3	RF	RF
67	Rod 4	QD_R4	RF	RF
68	Beam Shaping Lens	QD_BS	-150	150
Multiplier (MT) Sub Assembly				
69	Einzel Lens	MT_EZ	-200	100
70	Mask 1	MT_MA1	-200	100
71	Mask 2	MT_MA2	-200	100
72	Window	MT_WD	-200	100
73	Multiplier Neg 1	MT_MU1	-3500	0
74	Multiplier Neg 2	MT_MU2	-3500	0
75	Faraday Cup	MT_FC	-150	150

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)

DAC Designation	DAC ID
16	OS_FIL1_VCTL
17	OS_FIL1_ECTL
18	OS_FS1_VCTL
19	OS_FIL2_VCTL
20	OS_FIL2_ECTL
21	OS_FS2_VCTL
22	CS_FIL1_VCTL
23	CS_FIL1_ECTL
24	CS_FS1_VCTL
25	CS_FIL2_VCTL

26	CS_FIL2_ECTL
27	CS_FS2_VCTL
28	DT1_VCTL
29	DT2_VCTL
30	QB_VCTL
32	FIL_ON_CTRL
34	ROD_AC
36	ROD_DC
37	RF_FREQ
47	FIL_SEL
48	BA_FIL_VCTL
49	CS_NZ_VCTL
50	MT_MU1_VCTL
51	MT_MU2_VCTL
52	CS_EA1_VCTL
53	CS_AN1_VCTL
54	CS_EA2_VCTL
55	CS_AN2_VCTL
56	QD_BS_VCTL
57	MT_EZ_VCTL
58	MT_MA1_VCTL
59	MT_MA2_VCTL
60	MT_WD_VCTL
61	MT_FC_VCTL
62	OS_EA1_VCTL
63	OS_RES1_VCTL
64	OS_EA2_VCTL
65	OS_RES2_VCTL
66	OS_OL1_VCTL
67	OS_OL2_VCTL
68	OS_COLA_VCTL
69	OS_COLB_VCTL
70	CS_IA_VCTL

71	CS_RP_VCTL
72	CS_RS_VCTL
76	IA_L1_VCTL
77	IA_L2_VCTL
78	IA_L4A_VCTL
79	IA_L4B_VCTL
80	IA_L5_VCTL
81	IA_L6_VCTL
82	OS_EF1A_VCTL
83	OS_EF1B_VCTL
84	OS_EF1C_VCTL
85	OS_EF1D_VCTL
86	OS_EF2A_VCTL
87	OS_EF2B_VCTL
88	OS_EF2C_VCTL
89	OS_EF2D_VCTL
90	CS_EF1A_VCTL
91	CS_EF1B_VCTL
92	CS_EF1C_VCTL
93	CS_EF1D_VCTL
94	CS_EF2A_VCTL
95	CS_EF2B_VCTL
96	CS_EF2C_VCTL
97	CS_EF2D_VCTL
100	OS_OL4_VCTL
101	CS_IFA_VCTL
102	CS_IFB_VCTL
103	SL_TB_VCTL
104	SL_BB_VCTL
105	SL_BF_VCTL
106	SL_EL_VCTL
107	OS_OL3_VCTL
108	SL_TF_VCTL

109	OS_OL5_VCTL
110	OS_OL6_VCTL

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

#	**Name**	**Format**	**Units**	**Range**	**Description**
1	TIME.	Real	s	N/A	SCLK timestamp of any corresponding observed value.
2	MKID	Integer	N/A	N/A	Marker ID of the current data point. Markers are tag numbers given to related set of measurements.
3	CDH:+5D_VMON	Real	V	0 – 5	Engineering value of +5D_VMON at TIME.
4	CDH:+13A_VMON	Real	V	0 – 5	Engineering value of +13A_VMON at TIME.
5	CDH:-13A_MON	Real	V	0 – 5	Engineering value of -13A_MON at TIME.
6	CDH:SPARE_4	Real	N/A	N/A	Unused channel.
7	CDH:SPARE_5	Real	N/A	N/A	Unused channel.
8	CDH:AGC_TMP	Real	V	0 – 5	Engineering value of AGC_TMP at TIME. This value captures the temperature of the RF AGC board.
9	CDH:DET_TMP	Real	V	0 – 5	Engineering value of DET_TMP at TIME. This value captures the temperature of the DET board.
10	CDH:RF_TMP	Real	V	0 – 5	Engineering value of RF_TMP at TIME. This value captures the temperature of the RF board.
11	CDH:CDH_TMP	Real	V	0 – 5	Engineering value of CDH_TMP at TIME. This value captures the temperature of the CDH board.
12	CDH:-5.7VREF	Real	V	0 – 5	Engineering value of -5.7VREF at TIME.
13	CDH:PS_IMON_2	Real	V	0 – 5	Engineering value of PS_IMON_2

					at TIME.
14	CDH:CDH_GND_REF	Real	V	0 – 5	Engineering value of CDH_GND_REF at TIME.
15	CDH:CTL_TMP	Real	V	0 – 5	Engineering value of CTL_TMP at TIME. This value captures the temperature of the CTL board.
16	CDH:CTL_+5VMON	Real	V	0 – 5	Engineering value of CTL_+5VMON at TIME.
17	CDH:CTL_+3.3VMON	Real	V	0 – 5	Engineering value of CTL_+3.3VMON at TIME.
18	CDH:CTL_+2.5VMON	Real	V	0 – 5	Engineering value of CTL_+2.5VMON at TIME.
19	CDH:CTL_+6VMON	Real	V	0 – 5	Engineering value of CTL_+6VMON at TIME.
20	CDH:CTL_+4VMON	Real	V	0 – 5	Engineering value of CTL_+4VMON at TIME.
21	CDH:CTL_+13VMON	Real	V	0 – 5	Engineering value of CTL_+13VMON at TIME.
22	CDH:CTL_-13VMON	Real	V	0 – 5	Engineering value of CTL_-13VMON at TIME.
23	CDH:PS_TMP	Real	V	0 – 5	Engineering value of PS_TMP at TIME. This value captures the temperature of the PS board.
24	CDH:5V_IMON	Real	V	0 – 5	Engineering value of 5V_IMON at TIME.
25	CDH:3.3V_IMON	Real	V	0 – 5	Engineering value of 3.3V_IMON at TIME.
26	CDH:+13V_MON	Real	V	0 – 5	Engineering value of +13V_MON at TIME.
27	CDH:-13V_MON	Real	V	0 – 5	Engineering value of -13V_MON at TIME.
28	CDH:CTL_+5VREF	Real	V	0 – 5	Engineering value of CTL_+5VREF at TIME.
29	CDH:CTL_-5VREF	Real	V	0 – 5	Engineering value of CTL_-5VREF at TIME.
30	CDH:CTL_SPARE	Real	N/A	N/A	Unused channel.
31	CDH:IA_L4A_MON	Real	V	0 – 5	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.
32	CDH:IA_L4B_MON	Real	V	0 – 5	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.
33	CDH:SL_TF_MON	Real	V	0 – 5	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.

34	CDH:SL_BB_MON	Real	V	0 – 5	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.
35	CDH:MT_WD_MON	Real	V	0 – 5	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.
36	CDH:MT_EZ_MON	Real	V	0 – 5	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.
37	CDH:MT_MA1_MON	Real	V	0 – 5	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.
38	CDH:MT_MA2_MON	Real	V	0 – 5	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.
39	CDH:MT_FC_MON	Real	V	0 – 5	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.
40	CDH:QD_BS_MON	Real	V	0 – 5	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.
41	CDH:BA_FIL_VMON	Real	V	0 – 5	Engineering value of BA_FIL_VMON at TIME.
42	CDH:BA_FIL_IMON	Real	V	0 – 5	Engineering value of BA_FIL_IMON at TIME.
43	CDH:BA_FIL_EMIS	Real	V	0 – 5	Engineering value of BA_FIL_EMIS at TIME.
44	CDH:BA_GRID_IMON	Real	V	0 – 5	Engineering value of BA_GRID_IMON at TIME.
45	CDH:BA_PRES	Real	V	0 – 5	Engineering value of BA_PRES at TIME.
46	CDH:THPRES	Real	N/A	N/A	Engineering value of THPRES at TIME.
47	CDH:OS_OL5_MON	Real	V	0 – 5	Engineering value of OS_OL5_MON at TIME. This value captures the drive circuit input

					needed to control the voltage on the OS_OL5 electrode.
48	CDH:OS_OL6_MON	Real	V	0 – 5	Engineering value of OS_OL6_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_OL6 electrode.
49	CDH:SL_TB_MON	Real	V	0 – 5	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.
50	CDH:SL_BF_MON	Real	V	0 – 5	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.
51	CDH:SL_EL_MON	Real	V	0 – 5	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.
52	CDH:IA_L1_MON	Real	V	0 – 5	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.
53	CDH:IA_L2_MON	Real	V	0 – 5	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.
54	CDH:IA_L5_MON	Real	V	0 – 5	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.
55	CDH:IA_L6_MON	Real	V	0 – 5	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.
56	CDH:IF_+5REF_MON	Real	V	0 – 5	Engineering value of IF_+5REF_MON at TIME.
57	CDH:IF_-5REF_MON	Real	V	0 – 5	Engineering value of IF_-5REF_MON at TIME.
58	CDH:IF_TMP	Real	V	0 – 5	Engineering value of IF_TMP at TIME. This value captures the temperature of the IF board.
59	CDH:IS_TMP	Real	V	0 – 5	Engineering value of IS_TMP at TIME. This value captures the temperature of the CS anti

					chamber.
60	CDH:EXT_THERM2	Real	V	0 – 5	Engineering value of EXT_THERM2 at TIME.
61	CDH:BA_PRES_LO	Real	V	0 – 5	Engineering value of BA_PRES_LO at TIME.
62	CDH:IF_GND_REF	Real	V	0 – 5	Engineering value of IF_GND_REF at TIME.
63	CDH:SPARE_6	Real	N/A	N/A	Unused channel.
64	CDH:CDH_3.3VMON	Real	V	0 – 5	Engineering value of CDH_3.3VMON at TIME.
65	CDH:CDH_2.5VMON	Real	V	0 – 5	Engineering value of CDH_2.5VMON at TIME.
66	CDH:+160_VMON	Real	V	0 – 5	Engineering value of +160_VMON at TIME.
67	CDH:-160_VMON	Real	V	0 – 5	Engineering value of -160_VMON at TIME.
68	CDH:+80RF_VMON	Real	V	0 – 5	Engineering value of +80RF_VMON at TIME.
69	CDH:+15RF_VMON	Real	V	0 – 5	Engineering value of +15RF_VMON at TIME.
70	CDH:-15RF_VMON	Real	V	0 – 5	Engineering value of -15RF_VMON at TIME.
71	CDH:CDH_+5VREF	Real	V	0 – 5	Engineering value of CDH_+5VREF at TIME.
72	CDH:CDH_-5VREF	Real	V	0 – 5	Engineering value of CDH_-5VREF at TIME.
73	CDH:OS_FIL1_VMON	Real	V	0 – 5	Engineering value of OS_FIL1_VMON at TIME. This value captures OS_FIL1 voltage.
74	CDH:OS_FIL2_VMON	Real	V	0 – 5	Engineering value of OS_FIL2_VMON at TIME. This value captures OS_FIL2 voltage.
75	CDH:OS_FIL_EMON	Real	V	0 – 5	Engineering value of OS_FIL_EMON at TIME. This value captures the emission value on the active OS filament.
76	CDH:OS_FS1_MON	Real	V	0 – 5	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.
77	CDH:OS_EF1A_MON	Real	V	0 – 5	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.
78	CDH:OS_EF1B_MON	Real	V	0 – 5	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.

79	CDH:OS_EF2A_MON	Real	V	0 – 5	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.
80	CDH:OS_EF2B_MON	Real	V	0 – 5	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.
81	CDH:OS_RES1_MON	Real	V	0 – 5	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.
82	CDH:OS_RES2_MON	Real	V	0 – 5	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.
83	CDH:OS_OL1_MON	Real	V	0 – 5	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.
84	CDH:OS_OL2_MON	Real	V	0 – 5	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.
85	CDH:OS_OL3_MON	Real	V	0 – 5	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.
86	CDH:OS_OL4_MON	Real	V	0 – 5	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.
87	CDH:OS_-5REF_MON	Real	V	0 – 5	Engineering value of OS_-5REF_MON at TIME.
88	CDH:OS_GND_REF	Real	V	0 – 5	Engineering value of OS_GND_REF at TIME.
89	CDH:OS_FIL1_IMON	Real	V	0 – 5	Engineering value of OS_FIL1_IMON at TIME. This value captures OS_FIL1 current.
90	CDH:OS_FIL2_IMON	Real	V	0 – 5	Engineering value of OS_FIL2_IMON at TIME. This value captures OS_FIL2 current.
91	CDH:OS_TRAP_MON	Real	V	0 – 5	Engineering value of OS_TRAP_MON at TIME.

92	CDH:OS_FS2_MON	Real	V	0 – 5	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.
93	CDH:OS_EF1C_MON	Real	V	0 – 5	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.
94	CDH:OS_EF1D_MON	Real	V	0 – 5	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.
95	CDH:OS_EF2C_MON	Real	V	0 – 5	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.
96	CDH:OS_EF2D_MON	Real	V	0 – 5	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.
97	CDH:OS_EA1_MON	Real	V	0 – 5	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.
98	CDH:OS_EA2_MON	Real	V	0 – 5	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.
99	CDH:OS_COLA_MON	Real	V	0 – 5	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.
100	CDH:OS_COLB_MON	Real	V	0 – 5	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.
101	CDH:OS_FIL_SEL_ST	Real	N/A	N/A	Engineering value of OS_FIL_SEL_ST at TIME.
102	CDH:OS_+5REF_MON	Real	V	0 – 5	Engineering value of OS_+5REF_MON at TIME.
103	CDH:OS_+13A_MON	Real	V	0 – 5	Engineering value of OS_+13A_MON at TIME.

104	CDH:OS_TMP	Real	V	0 – 5	Engineering value of OS_TMP at TIME. This value captures the temperature of the OS board.
105	CDH:OS_SPARE	Real	N/A	N/A	Unused channel.
106	CDH:CS_FIL1_VMON	Real	V	0 – 5	Engineering value of CS_FIL1_VMON at TIME. This value captures CS_FIL1 voltage.
107	CDH:CS_FIL2_VMON	Real	V	0 – 5	Engineering value of CS_FIL2_VMON at TIME. This value captures CS_FIL2 voltage.
108	CDH:CS_FIL_EMON	Real	V	0 – 5	Engineering value of CS_FIL_EMON at TIME. This value captures the emission value on the active CS filament.
109	CDH:CS_FS1_MON	Real	V	0 – 5	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.
110	CDH:CS_EF1A_MON	Real	V	0 – 5	Engineering value of CS_EF1A_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1A electrode.
111	CDH:CS_EF1B_MON	Real	V	0 – 5	Engineering value of CS_EF1B_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1B electrode.
112	CDH:CS_EF2A_MON	Real	V	0 – 5	Engineering value of CS_EF2A_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF2A electrode.
113	CDH:CS_EF2B_MON	Real	V	0 – 5	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.
114	CDH:CS_AN1_MON	Real	V	0 – 5	Engineering value of CS_AN1_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_AN1 electrode.
115	CDH:CS_AN2_MON	Real	V	0 – 5	Engineering value of CS_AN2_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_AN2 electrode.
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

					control the voltage on the CS_IA electrode.
117	CDH:CS_IFA_MON	Real	V	0 – 5	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.
118	CDH:CS_IFB_MON	Real	V	0 – 5	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.
119	CDH:CS_NZ_MON	Real	V	0 – 5	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.
120	CDH:CS_-5REF_MON	Real	V	0 – 5	Engineering value of CS_-5REF_MON at TIME.
121	CDH:CS_GND_REF	Real	V	0 – 5	Engineering value of CS_GND_REF at TIME.
122	CDH:CS_FIL1_IMON	Real	V	0 – 5	Engineering value of CS_FIL1_IMON at TIME. This value captures CS_FIL1 current.
123	CDH:CS_FIL2_IMON	Real	V	0 – 5	Engineering value of CS_FIL2_IMON at TIME. This value captures CS_FIL2 current.
124	CDH:CS_TRAP_MON	Real	V	0 – 5	Engineering value of CS_TRAP_MON at TIME.
125	CDH:CS_FS2_MON	Real	V	0 – 5	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.
126	CDH:CS_EF1C_MON	Real	V	0 – 5	Engineering value of CS_EF1C_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1C electrode.
127	CDH:CS_EF1D_MON	Real	V	0 – 5	Engineering value of CS_EF1D_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1D electrode.
128	CDH:CS_EF2C_MON	Real	V	0 – 5	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.
129	CDH:CS_EF2D_MON	Real	V	0 – 5	Engineering value of CS_EF2D_MON at TIME. This value captures the drive circuit input

					needed to control the voltage on the CS_EF2D electrode.
130	CDH:CS_EA1_MON	Real	V	0 – 5	Engineering value of CS_EA1_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EA1 electrode.
131	CDH:CS_EA2_MON	Real	V	0 – 5	Engineering value of CS_EA2_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EA2 electrode.
132	CDH:CS_RP_MON	Real	V	0 – 5	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.
133	CDH:CS_RS_MON	Real	V	0 – 5	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.
134	CDH:CS_FIL_SEL_ST	Real	N/A	N/A	Engineering value of CS_FIL_SEL_ST at TIME.
135	CDH:CS_+5REF_MON	Real	V	0 – 5	Engineering value of CS_+5REF_MON at TIME.
136	CDH:CS_+13A_MON	Real	V	0 – 5	Engineering value of CS_+13A_MON at TIME.
137	CDH:CS_TMP	Real	V	0 – 5	Engineering value of CS_TMP at TIME. This value captures the temperature of the CS board.
138	CDH:CS_SPARE	Real	N/A	N/A	Unused channel.
139	CDH:PS_IMON	Real	V	0 – 5	Engineering value of PS_IMON at TIME.
140	CDH:EM1_IMON	Real	V	0 – 5	Engineering value of EM1_IMON at TIME. This value captures the current drawn by Multiplier 1.
141	CDH:EM2_IMON	Real	V	0 – 5	Engineering value of EM2_IMON at TIME. This value captures the current drawn by Multiplier 2.
142	CDH:MULTANA1	Real	V	0 – 5	Engineering value of MULTANA1 at TIME.
143	CDH:MULTANA2	Real	V	0 – 5	Engineering value of MULTANA2 at TIME.
144	CDH:RF_AGC_MON	Real	V	0 – 5	Engineering value of RF_AGC_MON at TIME.
145	CDH:VCAP+_MON	Real	V	0 – 5	Engineering value of VCAP+_MON at TIME.
146	CDH:VCAP-_MON	Real	V	0 – 5	Engineering value of VCAP-_MON at TIME.
147	CDH:SPARE_209	Real	N/A	N/A	Unused channel.

148	CDH:SPARE_210	Real	N/A	N/A	Unused channel.
149	CDH:SPARE_0	Real	N/A	N/A	Unused channel.
150	CDH:SPARE_1	Real	N/A	N/A	Unused channel.
151	CDH:SPARE_2	Real	N/A	N/A	Unused channel.
152	CDH:SPARE_3	Real	N/A	N/A	Unused channel.
153	CDH:+5VREF_DAC	Real	V	0 – 5	Engineering value of +5VREF_DAC at TIME.
154	CDH:-5VREF_DAC	Real	V	0 – 5	Engineering value of -5VREF_DAC at TIME.
155	CDH:PulseCounter	Real	CTS	N/A	Engineering value of PulseCounter at TIME. This value captures the number of counts detected with active multiplier during the duration of the integration period.
156	CDH:RF_Cntr	Real	N/A	N/A	Engineering value of RF_Cntr at TIME. This value captures the current RF frequency.
157	FSW:FSW_VER	Real	N/A	N/A	Engineering value of FSW_VER at TIME.
158	FSW:PKT_REV	Real	N/A	N/A	Engineering value of PKT_REV at TIME.
159	FSW:LAST_RESET	Real	N/A	N/A	Engineering value of LAST_RESET at TIME.
160	FSW:LOAD_TYPE	Real	N/A	N/A	Engineering value of LOAD_TYPE at TIME.
161	FSW:LAST_CMD	Real	N/A	N/A	Engineering value of LAST_CMD at TIME.
162	FSW:N_CMDS	Real	N/A	N/A	Engineering value of N_CMDS at TIME.
163	FSW:N_CMD_ERRS	Real	N/A	N/A	Engineering value of N_CMD_ERRS at TIME.
164	FSW:BAD_CMD_ERR	Real	N/A	N/A	Engineering value of BAD_CMD_ERR at TIME.
165	FSW:BAD_CMD_OP	Real	N/A	N/A	Engineering value of BAD_CMD_OP at TIME.
166	FSW:ZONE_ALERT	Real	N/A	N/A	Engineering value of ZONE_ALERT at TIME.
167	FSW:INST_MODE	Real	N/A	N/A	Engineering value of INST_MODE at TIME.
168	FSW:SCRIPT_MODE	Real	N/A	N/A	Engineering value of SCRIPT_MODE at TIME.
169	FSW:TELEM_MODE	Real	N/A	N/A	Engineering value of TELEM_MODE at TIME.
170	FSW:LIB_VER	Real	N/A	N/A	Engineering value of LIB_VER at TIME.
171	FSW:SCRIPT_ID	Real	N/A	N/A	Engineering value of SCRIPT_ID at TIME.
172	FSW:SCRIPT_VER	Real	N/A	N/A	Engineering value of SCRIPT_VER at TIME.
173	FSW:LAST_MARKER	Real	N/A	N/A	Engineering value of LAST_MARKER at TIME.

174	FSW:CODE_CSUM	Real	N/A	N/A	Engineering value of CODE_CSUM at TIME.
175	FSW:SCRIPT_CSUM	Real	N/A	N/A	Engineering value of SCRIPT_CSUM at TIME.
176	FSW:LIB_CSUM	Real	N/A	N/A	Engineering value of LIB_CSUM at TIME.
177	FSW:DWELL_MON_ADDR	Real	N/A	N/A	Engineering value of DWELL_MON_ADDR at TIME.
178	FSW:DWELL_MON_VAL	Real	N/A	N/A	Engineering value of DWELL_MON_VAL at TIME.
179	FSW:SIDE_A	Real	N/A	N/A	Engineering value of SIDE_A at TIME.
180	FSW:POWER_STAT	Real	N/A	N/A	Engineering value of POWER_STAT at TIME.
181	FSW:ALARM_STAT	Real	N/A	N/A	Engineering value of ALARM_STAT at TIME.
182	FSW:ALARM_LEVEL	Real	N/A	N/A	Engineering value of ALARM_LEVEL at TIME.
183	FSW:N_ALARMS	Real	N/A	N/A	Engineering value of N_ALARMS at TIME.
184	FSW:N_ALARM_ENAB	Real	N/A	N/A	Engineering value of N_ALARM_ENAB at TIME.
185	FSW:N_ALARM_ACTIVE	Real	N/A	N/A	Engineering value of N_ALARM_ACTIVE at TIME.
186	FSW:LAST_FILE_ID	Real	N/A	N/A	Engineering value of LAST_FILE_ID at TIME.
187	FSW:MEM_ALLOC	Real	N/A	N/A	Engineering value of MEM_ALLOC at TIME.
188	FSW:MEM_FREE	Real	N/A	N/A	Engineering value of MEM_FREE at TIME.
189	FSW:LARGEST_FREE_BLOCK	Real	N/A	N/A	Engineering value of LARGEST_FREE_BLOCK at TIME.
190	FSW:N_ALLOCS	Real	N/A	N/A	Engineering value of N_ALLOCS at TIME.
191	FSW:N_FREES	Real	N/A	N/A	Engineering value of N_FREES at TIME.
192	FSW:PS_IMON	Real	V	0 – 5	Engineering value of PS_IMON at TIME.
193	FSW:EM1_IMON	Real	V	0 – 5	Engineering value of EM1_IMON at TIME. This value captures the current drawn by Multiplier 1.
194	FSW:EM2_IMON	Real	V	0 – 5	Engineering value of EM2_IMON at TIME. This value captures the current drawn by Multiplier 2.
195	FSW:AGC_TMP	Real	V	0 – 5	Engineering value of AGC_TMP at TIME. This value captures the temperature of the RF AGC board.
196	FSW:DET_TMP	Real	V	0 – 5	Engineering value of DET_TMP at TIME. This value captures the temperature of the DET board.
197	FSW:RF_TMP	Real	V	0 – 5	Engineering value of RF_TMP at

					TIME. This value captures the temperature of the RF board.
198	FSW:CDH_TMP	Real	V	0 – 5	Engineering value of CDH_TMP at TIME. This value captures the temperature of the CDH board.
199	FSW:CTL_TMP	Real	V	0 – 5	Engineering value of CTL_TMP at TIME. This value captures the temperature of the CTL board.
200	FSW:PS_TMP	Real	V	0 – 5	Engineering value of PS_TMP at TIME. This value captures the temperature of the PS board.
201	FSW:OS_FIL_EMON	Real	V	0 – 5	Engineering value of OS_FIL_EMON at TIME. This value captures the emission value on the active OS filament.
202	FSW:CS_FIL_EMON	Real	V	0 – 5	Engineering value of CS_FIL_EMON at TIME. This value captures the emission value on the active CS filament.
203	FSW:THERM_PRESS	Real	N/A	N/A	Engineering value of THERM_PRESS at TIME.
204	FSW:MISSED_TIME_CODES	Real	N/A	N/A	Engineering value of MISSED_TIME_CODES at TIME.
205	FSW:MISSED_ZONE_ALERTS	Real	N/A	N/A	Engineering value of MISSED_ZONE_ALERTS at TIME.
206	QMS:ADC_STATUS	Integer	N/A	N/A	Engineering value of ADC_STATUS at TIME.
207	QMS:AMUX1	Integer	N/A	N/A	Engineering value of AMUX1 at TIME.
208	QMS:AMUX2	Integer	N/A	N/A	Engineering value of AMUX2 at TIME.
209	QMS:AMUX_ADDR1	Integer	N/A	N/A	Engineering value of AMUX_ADDR1 at TIME.
210	QMS:AMUX_ADDR2	Integer	N/A	N/A	Engineering value of AMUX_ADDR2 at TIME.
211	QMS:AMUX_ADDR3	Integer	N/A	N/A	Engineering value of AMUX_ADDR3 at TIME.
212	QMS:AMUX_ADDR4	Integer	N/A	N/A	Engineering value of AMUX_ADDR4 at TIME.
213	QMS:COUNT1	Integer	N/A	NA	Engineering value of COUNT1 at TIME. This value captures the number of counts detected with multiplier 1 during the duration of the integration period.
214	QMS:COUNT2	Integer	N/A	NA	Engineering value of COUNT2 at TIME. This value captures the number of counts detected with multiplier 2 during the duration of the integration period.
215	QMS:CTL_DIGITAL_STATUS	Integer	N/A	N/A	Engineering value of CTL_DIGITAL_STATUS at TIME.

216	QMS:CTL_ERROR_COUNT	Integer	N/A	N/A	Engineering value of CTL_ERROR_COUNT at TIME.
217	QMS:CTL_ERROR_STATUS	Integer	N/A	N/A	Engineering value of CTL_ERROR_STATUS at TIME.
218	QMS:CTL_IMM_CMD_COUNT	Integer	N/A	N/A	Engineering value of CTL_IMM_CMD_COUNT at TIME.
219	QMS:CTL_MSEQ_CMD_COUNT	Integer	N/A	N/A	Engineering value of CTL_MSEQ_CMD_COUNT at TIME.
220	QMS:CTL_PACKET_COUNT	Integer	N/A	N/A	Engineering value of CTL_PACKET_COUNT at TIME.
221	QMS:CTL_PARITY_ERR_COUNT	Integer	N/A	N/A	Engineering value of CTL_PARITY_ERR_COUNT at TIME.
222	QMS:CTL_SERIAL_NUM	Integer	N/A	N/A	Engineering value of CTL_SERIAL_NUM at TIME.
223	QMS:CTL_SYNC_CODE	Integer	N/A	N/A	Engineering value of CTL_SYNC_CODE at TIME.
224	QMS:DAC12BSPARE1	Real	N/A	N/A	Unused channel.
225	QMS:DAC12BSPARE2	Real	N/A	N/A	Unused channel.
226	QMS:DAC12BSPARE3	Real	N/A	N/A	Unused channel.
227	QMS:DAC12USPARE1	Real	N/A	N/A	Unused channel.
228	QMS:DAC12USPARE2	Real	N/A	N/A	Unused channel.
229	QMS:DAC16BSPARE1	Real	N/A	N/A	Unused channel.
230	QMS:DAC16BSPARE2	Real	N/A	N/A	Unused channel.
231	QMS:DAC8B_SPARE1	Real	N/A	N/A	Unused channel.
232	QMS:DAC8B_SPARE2	Real	N/A	N/A	Unused channel.
233	QMS:DAC8B_SPARE3	Real	N/A	N/A	Unused channel.
234	QMS:DAC_SPARE	Real	N/A	N/A	Unused channel.
235	QMS:RF_FREQ	Real	N/A	N/A	Engineering value of RF_FREQ at TIME.
236	QMS:SERIAL_NUM	Integer	N/A	N/A	Engineering value of SERIAL_NUM at TIME.
237	QMS:SERIAL_NUM_SET	Integer	N/A	N/A	Engineering value of SERIAL_NUM_SET at TIME.
238	QMS:SYNC_CODE	Integer	N/A	N/A	Engineering value of SYNC_CODE at TIME.
239	QMS:WAIT	Integer	N/A	N/A	Engineering value of WAIT at TIME.
240	QMS:OS_FIL1_VCTL	Real	N/A	0 – 256	Engineering value of OS_FIL1_VCTL at TIME. This value captures the DAC setting for the OS_FIL1 electrode.
241	QMS:OS_FIL1_ECTL	Real	N/A	0 – 256	Engineering value of OS_FIL1_ECTL at TIME. This value captures the DAC setting for the OS_FIL1 emission control.
242	QMS:OS_FS1_VCTL	Real	N/A	0 – 256	Engineering value of OS_FS1_VCTL at TIME. This value captures the DAC setting for the OS_FS1 electrode.
243	QMS:OS_FIL2_VCTL	Real	N/A	0 – 256	Engineering value of OS_FIL2_VCTL at TIME. This value

					captures the DAC setting for the OS_FIL2 electrode.
244	QMS:OS_FIL2_ECTL	Real	N/A	0 – 256	Engineering value of OS_FIL2_ECTL at TIME. This value captures the DAC setting for the OS_FIL2 emission control.
245	QMS:OS_FS2_VCTL	Real	N/A	0 – 256	Engineering value of OS_FS2_VCTL at TIME. This value captures the DAC setting for the OS_FS2 electrode.
246	QMS:CS_FIL1_VCTL	Real	N/A	0 – 256	Engineering value of CS_FIL1_VCTL at TIME. This value captures the DAC setting for the CS_FIL1 electrode.
247	QMS:CS_FIL1_ECTL	Real	N/A	0 – 256	Engineering value of CS_FIL1_ECTL at TIME. This value captures the DAC setting for the CS_FIL1 electrode.
248	QMS:CS_FS1_VCTL	Real	N/A	0 – 256	Engineering value of CS_FS1_VCTL at TIME. This value captures the DAC setting for the CS_FS1 electrode.
249	QMS:CS_FIL2_VCTL	Real	N/A	0 – 256	Engineering value of CS_FIL2_VCTL at TIME. This value captures the DAC setting for the CS_FIL2 electrode.
250	QMS:CS_FIL2_ECTL	Real	N/A	0 – 256	Engineering value of CS_FIL2_ECTL at TIME. This value captures the DAC setting for the CS_FIL2 electrode.
251	QMS:CS_FS2_VCTL	Real	N/A	0 – 256	Engineering value of CS_FS2_VCTL at TIME. This value captures the DAC setting for the CS_FS2 electrode.
252	QMS:DT1_VCTL	Real	N/A	0 – 256	Engineering value of DT1_VCTL at TIME. This value captures the DAC setting for the DET1 discriminator.
253	QMS:DT2_VCTL	Real	N/A	0 – 256	Engineering value of DT2_VCTL at TIME. This value captures the DAC setting for the DET1 discriminator.
254	QMS:QB_VCTL	Real	V	0 – 256	Engineering value of QB_VCTL at TIME.
255	QMS:FIL_ON_CTRL	Real	N/A	N/A	Engineering value of FIL_ON_CTRL at TIME.
256	QMS:RODAC_CTRL	Real	N/A	0 – 65536	Engineering value of RODAC_CTRL at TIME. This value captures the DAC setting for the RF AC amplitude.
257	QMS:RODDC_CTL	Real	N/A	0 – 65536	Engineering value of RODDC_CTL at TIME. This value captures the DAC setting for the RF DC

					amplitude.
258	QMS:RF_FREQ_SET	Integer	N/A	N/A	Engineering value of RF_FREQ_SET at TIME.
259	QMS:IP_COUNT	Real	ms	N/A	Engineering value of IP_COUNT at TIME. This value captures the current integration period (IP) duration.
260	QMS:IP_SETUP	Real	ms	N/A	Engineering value of IP_SETUP at TIME. This value captures the current settling period duration.
261	QMS:FIL_SELECT	Integer	N/A	N/A	Engineering value of FIL_SELECT at TIME.
262	QMS:BA_FIL_VCTL	Real	N/A	N/A	Engineering value of BA_FIL_VCTL at TIME.
263	QMS:CS_NZ_VCTL	Real	N/A	0 – 256	Engineering value of CS_NZ_VCTL at TIME. This value captures the DAC setting for the CS_NZ electrode.
264	QMS:MT_MU1_VCTL	Real	N/A	0 – 256	Engineering value of MT_MU1_VCTL at TIME. This value captures the DAC setting for the MT_MU1 electrode.
265	QMS:MT_MU2_VCTL	Real	N/A	0 – 256	Engineering value of MT_MU2_VCTL at TIME. This value captures the DAC setting for the MT_MU2 electrode.
266	QMS:CS_EA1_VCTL	Real	N/A	0 – 256	Engineering value of CS_EA1_VCTL at TIME. This value captures the DAC setting for the CS_EA1 electrode.
267	QMS:CS_AN1_VCTL	Real	N/A	0 – 256	Engineering value of CS_AN1_VCTL at TIME. This value captures the DAC setting for the CS_AN1 electrode.
268	QMS:CS_EA2_VCTL	Real	N/A	0 – 256	Engineering value of CS_EA2_VCTL at TIME. This value captures the DAC setting for the CS_EA2 electrode.
269	QMS:CS_AN2_VCTL	Real	N/A	0 – 256	Engineering value of CS_AN2_VCTL at TIME. This value captures the DAC setting for the CS_AN2 electrode.
270	QMS:QD_BS_VCTL	Real	N/A	0 – 256	Engineering value of QD_BS_VCTL at TIME. This value captures the DAC setting for the QD_BS electrode.
271	QMS:MT_EZ_VCTL	Real	N/A	0 – 256	Engineering value of MT_EZ_VCTL at TIME. This value captures the DAC setting for the MT_EZ electrode.
272	QMS:MT_MA1_VCTL	Real	N/A	0 – 256	Engineering value of

					MT_MA1_VCTL at TIME. This value captures the DAC setting for the MT_MA1 electrode.
273	QMS:MT_MA2_VCTL	Real	N/A	0 – 256	Engineering value of MT_MA2_VCTL at TIME. This value captures the DAC setting for the MT_MA2 electrode.
274	QMS:MT_WD_VCTL	Real	N/A	0 – 256	Engineering value of MT_WD_VCTL at TIME. This value captures the DAC setting for the MT_WD electrode.
275	QMS:MT_FC_VCTL	Real	N/A	0 – 256	Engineering value of MT_FC_VCTL at TIME. This value captures the DAC setting for the MT_FC electrode.
276	QMS:OS_EA1_VCTL	Real	N/A	0 – 256	Engineering value of OS_EA1_VCTL at TIME. This value captures the DAC setting for the OS_EA1 electrode.
277	QMS:OS_RES1_VCTL	Real	N/A	0 – 256	Engineering value of OS_RES1_VCTL at TIME. This value captures the DAC setting for the OS_RES1 electrode.
278	QMS:OS_EA2_VCTL	Real	N/A	0 – 256	Engineering value of OS_EA2_VCTL at TIME. This value captures the DAC setting for the OS_EA2 electrode.
279	QMS:OS_RES2_VCTL	Real	N/A	0 – 256	Engineering value of OS_RES2_VCTL at TIME. This value captures the DAC setting for the OS_RES2 electrode.
280	QMS:OS_OL1_VCTL	Real	N/A	0 – 256	Engineering value of OS_OL1_VCTL at TIME. This value captures the DAC setting for the OS_OL1 electrode.
281	QMS:OS_OL2_VCTL	Real	N/A	0 – 256	Engineering value of OS_OL2_VCTL at TIME. This value captures the DAC setting for the OS_OL2 electrode.
282	QMS:OS_COLA_VCTL	Real	N/A	0 – 256	Engineering value of OS_COLA_VCTL at TIME. This value captures the DAC setting for the OS_COLA electrode.
283	QMS:OS_COLB_VCTL	Real	N/A	0 – 256	Engineering value of OS_COLB_VCTL at TIME. This value captures the DAC setting for the OS_COLB electrode.
284	QMS:CS_IA_VCTL	Real	N/A	0 – 256	Engineering value of CS_IA_VCTL at TIME. This value captures the DAC setting for the CS_IA electrode.
285	QMS:CS_RP_VCTL	Real	N/A	0 – 256	Engineering value of CS_RP_VCTL

					at TIME. This value captures the DAC setting for the CS_RP electrode.
286	QMS:CS_RS_VCTL	Real	N/A	0 – 256	Engineering value of CS_RS_VCTL at TIME. This value captures the DAC setting for the CS_RS electrode.
287	QMS:IA_L1_VCTL	Real	N/A	0 – 4096	Engineering value of IA_L1_VCTL at TIME. This value captures the DAC setting for the IA_L1 electrode.
288	QMS:IA_L2_VCTL	Real	N/A	0 – 4096	Engineering value of IA_L2_VCTL at TIME. This value captures the DAC setting for the IA_L2 electrode.
289	QMS:IA_L4A_VCTL	Real	N/A	0 – 4096	Engineering value of IA_L4A_VCTL at TIME. This value captures the DAC setting for the IA_L4A electrode.
290	QMS:IA_L4B_VCTL	Real	N/A	0 – 4096	Engineering value of IA_L4B_VCTL at TIME. This value captures the DAC setting for the IA_L4B electrode.
291	QMS:IA_L5_VCTL	Real	N/A	0 – 4096	Engineering value of IA_L5_VCTL at TIME. This value captures the DAC setting for the IA_L5 electrode.
292	QMS:IA_L6_VCTL	Real	N/A	0 – 4096	Engineering value of IA_L6_VCTL at TIME. This value captures the DAC setting for the IA_L6 electrode.
293	QMS:OS_EF1A_VCTL	Real	N/A	0 – 4096	Engineering value of OS_EF1A_VCTL at TIME. This value captures the DAC setting for the OS_EF1A electrode.
294	QMS:OS_EF1B_VCTL	Real	N/A	0 – 4096	Engineering value of OS_EF1B_VCTL at TIME. This value captures the DAC setting for the OS_EF1B electrode.
295	QMS:OS_EF1C_VCTL	Real	N/A	0 – 4096	Engineering value of OS_EF1C_VCTL at TIME. This value captures the DAC setting for the OS_EF1C electrode.
296	QMS:OS_EF1D_VCTL	Real	N/A	0 – 4096	Engineering value of OS_EF1D_VCTL at TIME. This value captures the DAC setting for the OS_EF1D electrode.
297	QMS:OS_EF2A_VCTL	Real	N/A	0 – 4096	Engineering value of OS_EF2A_VCTL at TIME. This value captures the DAC setting for the OS_EF2A electrode.
298	QMS:OS_EF2B_VCTL	Real	N/A	0 – 4096	Engineering value of

					OS_EF2B_VCTL at TIME. This value captures the DAC setting for the OS_EF2B electrode.
299	QMS:OS_EF2C_VCTL	Real	N/A	0 – 4096	Engineering value of OS_EF2C_VCTL at TIME. This value captures the DAC setting for the OS_EF2C electrode.
300	QMS:OS_EF2D_VCTL	Real	N/A	0 – 4096	Engineering value of OS_EF2D_VCTL at TIME. This value captures the DAC setting for the OS_EF2D electrode.
301	QMS:CS_EF1A_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF1A_VCTL at TIME. This value captures the DAC setting for the CS_EF1A electrode.
302	QMS:CS_EF1B_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF1B_VCTL at TIME. This value captures the DAC setting for the CS_EF1B electrode.
303	QMS:CS_EF1C_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF1C_VCTL at TIME. This value captures the DAC setting for the CS_EF1C electrode.
304	QMS:CS_EF1D_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF1D_VCTL at TIME. This value captures the DAC setting for the CS_EF1D electrode.
305	QMS:CS_EF2A_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF2A_VCTL at TIME. This value captures the DAC setting for the CS_EF2A electrode.
306	QMS:CS_EF2B_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF2B_VCTL at TIME. This value captures the DAC setting for the CS_EF2B electrode.
307	QMS:CS_EF2C_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF2C_VCTL at TIME. This value captures the DAC setting for the CS_EF2C electrode.
308	QMS:CS_EF2D_VCTL	Real	N/A	0 – 4096	Engineering value of CS_EF2D_VCTL at TIME. This value captures the DAC setting for the CS_EF2D electrode.
309	QMS:OS_OL4_VCTL	Real	N/A	0 – 4096	Engineering value of OS_OL4_VCTL at TIME. This value captures the DAC setting for the OS_OL4 electrode.
310	QMS:CS_IFA_VCTL	Real	N/A	0 – 4096	Engineering value of CS_IFA_VCTL at TIME. This value captures the DAC setting for the CS_IFA electrode.
311	QMS:CS_IFB_VCTL	Real	N/A	0 – 4096	Engineering value of CS_IFB_VCTL

					at TIME. This value captures the DAC setting for the CS_IFB electrode.
312	QMS:SL_TB_VCTL	Real	N/A	0 – 4096	Engineering value of SL_TB_VCTL at TIME. This value captures the DAC setting for the SL_TB electrode.
313	QMS:SL_BB_VCTL	Real	N/A	0 – 4096	Engineering value of SL_BB_VCTL at TIME. This value captures the DAC setting for the SL_BB electrode.
314	QMS:SL_BF_VCTL	Real	N/A	0 – 4096	Engineering value of SL_BF_VCTL at TIME. This value captures the DAC setting for the SL_BF electrode.
315	QMS:SL_EL_VCTL	Real	N/A	0 – 4096	Engineering value of SL_EL_VCTL at TIME. This value captures the DAC setting for the SL_EL electrode.
316	QMS:OS_OL3_VCTL	Real	N/A	0 – 4096	Engineering value of OS_OL3_VCTL at TIME. This value captures the DAC setting for the OS_OL3 electrode.
317	QMS:SL_TF_VCTL	Real	N/A	0 – 4096	Engineering value of SL_TF_VCTL at TIME. This value captures the DAC setting for the SL_TF electrode.
318	QMS:OS_OL5_VCTL	Real	N/A	0 – 4096	Engineering value of OS_OL5_VCTL at TIME. This value captures the DAC setting for the OS_OL5 electrode.
319	QMS:OS_OL6_VCTL	Real	N/A	0 – 4096	Engineering value of OS_OL6_VCTL at TIME. This value captures the DAC setting for the OS_OL6 electrode.
320	TM:TMSync	Real	N/A	N/A	Engineering value of TMSync at TIME.
321	TM:TMTick	Real	N/A	N/A	Engineering value of TMTick at TIME.
322	TM:TMSystemID	Real	N/A	N/A	Engineering value of TMSystemID at TIME.
323	TM:TMMarker	Real	N/A	N/A	Engineering value of TMMarker at TIME. This value captures the Marker ID of the current data point. Markers are tag numbers given to related set of measurements.
324	TM:TMMarkerText	Text	N/A	N/A	Engineering value of TMMarkerText at TIME. This value captures the current Marker description.

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

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

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

#	Name	Format	Units	Range	Description
1	TIME.	Real	s	N/A	SCLK timestamp of any corresponding observed value.
2	MKID	Integer	N/A	N/A	Marker ID of the current data point. Markers are tag numbers given to related set of measurements.
3	CDH:+5D_VMON	Real	V	N/A	Scientific value of +5D_VMON at TIME.
4	CDH:+13A_VMON	Real	V	N/A	Scientific value of +13A_VMON at TIME.
5	CDH:-13A_MON	Real	V	N/A	Scientific value of -13A_MON at TIME.
6	CDH:SPARE_4	Real	N/A	N/A	Unused channel.
7	CDH:SPARE_5	Real	N/A	N/A	Unused channel.
8	CDH:AGC_TMP	Real	°C	N/A	Scientific value of AGC_TMP at TIME. This value captures the temperature of the RF AGC board.
9	CDH:DET_TMP	Real	°C	N/A	Scientific value of DET_TMP at TIME. This value captures the temperature of the DET board.
10	CDH:RF_TMP	Real	°C	N/A	Scientific value of RF_TMP at TIME. This value captures the temperature of the RF board.
11	CDH:CDH_TMP	Real	°C	N/A	Scientific value of CDH_TMP at TIME. This value captures the temperature of the CDH board.
12	CDH:-5.7VREF	Real	V	N/A	Scientific value of -5.7VREF at TIME.
13	CDH:PS_IMON_2	Real	A	N/A	Scientific value of PS_IMON_2 at TIME.
14	CDH:CDH_GND_REF	Real	V	N/A	Scientific value of CDH_GND_REF at TIME.
15	CDH:CTL_TMP	Real	°C	N/A	Scientific value of CTL_TMP at TIME. This value captures the temperature of the CTL board.
16	CDH:CTL_+5VMON	Real	V	N/A	Scientific value of CTL_+5VMON at TIME.
17	CDH:CTL_+3.3VMON	Real	V	N/A	Scientific value of CTL_+3.3VMON at TIME.
18	CDH:CTL_+2.5VMON	Real	V	N/A	Scientific value of CTL_+2.5VMON at TIME.
19	CDH:CTL_+6VMON	Real	V	N/A	Scientific value of CTL_+6VMON at TIME.
20	CDH:CTL_+4VMON	Real	V	N/A	Scientific value of CTL_+4VMON at TIME.
21	CDH:CTL_+13VMON	Real	V	N/A	Scientific value of CTL_+13VMON at TIME.
22	CDH:CTL_-13VMON	Real	V	N/A	Scientific value of CTL_-13VMON at TIME.
23	CDH:PS_TMP	Real	°C	N/A	Scientific value of PS_TMP at TIME. This value captures the temperature of the PS board.
24	CDH:5V_IMON	Real	A	N/A	Scientific value of 5V_IMON at TIME.
25	CDH:3.3V_IMON	Real	A	N/A	Scientific value of 3.3V_IMON at TIME.
26	CDH:+13V_MON	Real	V	N/A	Scientific value of +13V_MON at TIME.
27	CDH:-13V_MON	Real	V	N/A	Scientific value of -13V_MON at TIME.
28	CDH:CTL_+5VREF	Real	V	N/A	Scientific value of CTL_+5VREF at TIME.
29	CDH:CTL_-5VREF	Real	V	N/A	Scientific value of CTL_-5VREF at TIME.

30	CDH:CTL_SPARE	Real	N/A	N/A	Unused channel.
31	CDH:IA_L4A_MON	Real	V	N/A	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.
32	CDH:IA_L4B_MON	Real	V	N/A	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.
33	CDH:SL_TF_MON	Real	V	N/A	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.
34	CDH:SL_BB_MON	Real	V	N/A	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.
35	CDH:MT_WD_MON	Real	V	N/A	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.
36	CDH:MT_EZ_MON	Real	V	N/A	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.
37	CDH:MT_MA1_MON	Real	V	N/A	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.
38	CDH:MT_MA2_MON	Real	V	N/A	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.
39	CDH:MT_FC_MON	Real	V	N/A	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.
40	CDH:QD_BS_MON	Real	V	N/A	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.
41	CDH:BA_FIL_VMON	Real	V	N/A	Scientific value of BA_FIL_VMON at TIME.
42	CDH:BA_FIL_IMON	Real	A	N/A	Scientific value of BA_FIL_IMON at TIME.
43	CDH:BA_FIL_EMIS	Real	A	N/A	Scientific value of BA_FIL_EMIS at TIME.
44	CDH:BA_GRID_IMON	Real	A	N/A	Scientific value of BA_GRID_IMON at TIME.
45	CDH:BA_PRES	Real	V	N/A	Scientific value of BA_PRES at TIME.
46	CDH:THPRES	Real	N/A	N/A	Scientific value of THPRES at TIME.
47	CDH:OS_OL5_MON	Real	V	N/A	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.
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

					to control the voltage on the OS_OL6 electrode.
49	CDH:SL_TB_MON	Real	V	N/A	Scientific value of SL_TB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_TB electrode.
50	CDH:SL_BF_MON	Real	V	N/A	Scientific value of SL_BF_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_BF electrode.
51	CDH:SL_EL_MON	Real	V	N/A	Scientific value of SL_EL_MON at TIME. This value captures the drive circuit input needed to control the voltage on the SL_EL electrode.
52	CDH:IA_L1_MON	Real	V	N/A	Scientific value of IA_L1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L1 electrode.
53	CDH:IA_L2_MON	Real	V	N/A	Scientific value of IA_L2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L2 electrode.
54	CDH:IA_L5_MON	Real	V	N/A	Scientific value of IA_L5_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L5 electrode.
55	CDH:IA_L6_MON	Real	V	N/A	Scientific value of IA_L6_MON at TIME. This value captures the drive circuit input needed to control the voltage on the IA_L6 electrode.
56	CDH:IF_+5REF_MON	Real	V	N/A	Scientific value of IF_+5REF_MON at TIME.
57	CDH:IF_-5REF_MON	Real	V	N/A	Scientific value of IF_-5REF_MON at TIME.
58	CDH:IF_TMP	Real	°C	N/A	Scientific value of IF_TMP at TIME. This value captures the temperature of the IF board.
59	CDH:IS_TMP	Real	°C	N/A	Scientific value of IS_TMP at TIME. This value captures the temperature of the CS anti chamber.
60	CDH:EXT_THERM2	Real	V	N/A	Scientific value of EXT_THERM2 at TIME.
61	CDH:BA_PRES_LO	Real	V	N/A	Scientific value of BA_PRES_LO at TIME.
62	CDH:IF_GND_REF	Real	V	N/A	Scientific value of IF_GND_REF at TIME.
63	CDH:SPARE_6	Real	N/A	N/A	Unused channel.
64	CDH:CDH_3.3VMON	Real	V	N/A	Scientific value of CDH_3.3VMON at TIME.
65	CDH:CDH_2.5VMON	Real	V	N/A	Scientific value of CDH_2.5VMON at TIME.
66	CDH:+160_VMON	Real	V	N/A	Scientific value of +160_VMON at TIME.
67	CDH:-160_VMON	Real	V	N/A	Scientific value of -160_VMON at TIME.
68	CDH:+80RF_VMON	Real	V	N/A	Scientific value of +80RF_VMON at TIME.
69	CDH:+15RF_VMON	Real	V	N/A	Scientific value of +15RF_VMON at TIME.
70	CDH:-15RF_VMON	Real	V	N/A	Scientific value of -15RF_VMON at TIME.
71	CDH:CDH_+5VREF	Real	V	N/A	Scientific value of CDH_+5VREF at TIME.
72	CDH:CDH_-5VREF	Real	V	N/A	Scientific value of CDH_-5VREF at TIME.
73	CDH:OS_FIL1_VMON	Real	V	N/A	Scientific value of OS_FIL1_VMON at TIME. This value captures OS_FIL1 voltage.
74	CDH:OS_FIL2_VMON	Real	V	N/A	Scientific value of OS_FIL2_VMON at TIME. This value captures OS_FIL2 voltage.
75	CDH:OS_FIL_EMON	Real	A	N/A	Scientific value of OS_FIL_EMON at TIME. This value captures the emission value on the active OS filament.
76	CDH:OS_FS1_MON	Real	°C	N/A	Scientific value of OS_FS1_MON at TIME. This

					value captures the drive circuit input needed to control the voltage on the OS_FS1 electrode.
77	CDH:OS_EF1A_MON	Real	V	N/A	Scientific value of OS_EF1A_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1A electrode.
78	CDH:OS_EF1B_MON	Real	V	N/A	Scientific value of OS_EF1B_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1B electrode.
79	CDH:OS_EF2A_MON	Real	V	N/A	Scientific value of OS_EF2A_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2A electrode.
80	CDH:OS_EF2B_MON	Real	V	N/A	Scientific value of OS_EF2B_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2B electrode.
81	CDH:OS_RES1_MON	Real	V	N/A	Scientific value of OS_RES1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_RES1 electrode.
82	CDH:OS_RES2_MON	Real	V	N/A	Scientific value of OS_RES2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_RES2 electrode.
83	CDH:OS_OL1_MON	Real	V	N/A	Scientific value of OS_OL1_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_OL1 electrode.
84	CDH:OS_OL2_MON	Real	V	N/A	Scientific value of OS_OL2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_OL2 electrode.
85	CDH:OS_OL3_MON	Real	V	N/A	Scientific value of OS_OL3_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_OL3 electrode.
86	CDH:OS_OL4_MON	Real	V	N/A	Scientific value of OS_OL4_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_OL4 electrode.
87	CDH:OS_-5REF_MON	Real	V	N/A	Scientific value of OS_-5REF_MON at TIME.
88	CDH:OS_GND_REF	Real	V	N/A	Scientific value of OS_GND_REF at TIME.
89	CDH:OS_FIL1_IMON	Real	A	N/A	Scientific value of OS_FIL1_IMON at TIME. This value captures OS_FIL1 current.
90	CDH:OS_FIL2_IMON	Real	A	N/A	Scientific value of OS_FIL2_IMON at TIME. This value captures OS_FIL2 current.
91	CDH:OS_TRAP_MON	Real	V	N/A	Scientific value of OS_TRAP_MON at TIME.
92	CDH:OS_FS2_MON	Real	V	N/A	Scientific value of OS_FS2_MON at TIME. This

					value captures the drive circuit input needed to control the voltage on the OS_FS2 electrode.
93	CDH:OS_EF1C_MON	Real	V	N/A	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.
94	CDH:OS_EF1D_MON	Real	V	N/A	Scientific value of OS_EF1D_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF1D electrode.
95	CDH:OS_EF2C_MON	Real	V	N/A	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.
96	CDH:OS_EF2D_MON	Real	V	N/A	Scientific value of OS_EF2D_MON at TIME. This value captures the drive circuit input needed to control the voltage on the OS_EF2D electrode.
97	CDH:OS_EA1_MON	Real	V	N/A	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.
98	CDH:OS_EA2_MON	Real	V	N/A	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.
99	CDH:OS_COLA_MON	Real	V	N/A	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.
100	CDH:OS_COLB_MON	Real	V	N/A	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.
101	CDH:OS_FIL_SEL_ST	Real	N/A	N/A	Scientific value of OS_FIL_SEL_ST at TIME.
102	CDH:OS_+5REF_MON	Real	V	N/A	Scientific value of OS_+5REF_MON at TIME.
103	CDH:OS_+13A_MON	Real	V	N/A	Scientific value of OS_+13A_MON at TIME.
104	CDH:OS_TMP	Real	°C	N/A	Scientific value of OS_TMP at TIME. This value captures the temperature of the OS board.
105	CDH:OS_SPARE	Real	N/A	N/A	Unused channel.
106	CDH:CS_FIL1_VMON	Real	V	N/A	Scientific value of CS_FIL1_VMON at TIME. This value captures CS_FIL1 voltage.
107	CDH:CS_FIL2_VMON	Real	V	N/A	Scientific value of CS_FIL2_VMON at TIME. This value captures CS_FIL2 voltage.
108	CDH:CS_FIL_EMON	Real	A	N/A	Scientific value of CS_FIL_EMON at TIME. This value captures the emission value on the active CS filament.
109	CDH:CS_FS1_MON	Real	V	N/A	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.
110	CDH:CS_EF1A_MON	Real	V	N/A	Scientific value of CS_EF1A_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1A electrode.
111	CDH:CS_EF1B_MON	Real	V	N/A	Scientific value of CS_EF1B_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1B electrode.
112	CDH:CS_EF2A_MON	Real	V	N/A	Scientific value of CS_EF2A_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF2A electrode.
113	CDH:CS_EF2B_MON	Real	V	N/A	Scientific 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.
114	CDH:CS_AN1_MON	Real	V	N/A	Scientific value of CS_AN1_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_AN1 electrode.
115	CDH:CS_AN2_MON	Real	V	N/A	Scientific value of CS_AN2_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_AN2 electrode.
116	CDH:CS_IA_MON	Real	V	N/A	Scientific value of CS_IA_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_IA electrode.
117	CDH:CS_IFA_MON	Real	V	N/A	Scientific value of CS_IFA_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_IFA electrode.
118	CDH:CS_IFB_MON	Real	V	N/A	Scientific value of CS_IFB_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_IFB electrode.
119	CDH:CS_NZ_MON	Real	V	N/A	Scientific value of CS_NZ_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_NZ electrode.
120	CDH:CS_-5REF_MON	Real	V	N/A	Scientific value of CS_-5REF_MON at TIME.
121	CDH:CS_GND_REF	Real	V	N/A	Scientific value of CS_GND_REF at TIME.
122	CDH:CS_FIL1_IMON	Real	A	N/A	Scientific value of CS_FIL1_IMON at TIME. This value captures CS_FIL1 current.
123	CDH:CS_FIL2_IMON	Real	A	N/A	Scientific value of CS_FIL2_IMON at TIME. This value captures CS_FIL2 current.
124	CDH:CS_TRAP_MON	Real	V	N/A	Scientific value of CS_TRAP_MON at TIME.
125	CDH:CS_FS2_MON	Real	V	N/A	Scientific value of CS_FS2_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_FS2 electrode.
126	CDH:CS_EF1C_MON	Real	V	N/A	Scientific value of CS_EF1C_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EF1C electrode.
127	CDH:CS_EF1D_MON	Real	V	N/A	Scientific value of CS_EF1D_MON at TIME. This value captures the drive circuit input to

					control the voltage on the CS_EF1D electrode.
128	CDH:CS_EF2C_MON	Real	V	N/A	Scientific value of CS_EF2C_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_EF2C electrode.
129	CDH:CS_EF2D_MON	Real	V	N/A	Scientific value of CS_EF2D_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_EF2D electrode.
130	CDH:CS_EA1_MON	Real	V	N/A	Scientific value of CS_EA1_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EA1 electrode.
131	CDH:CS_EA2_MON	Real	V	N/A	Scientific value of CS_EA2_MON at TIME. This value captures the drive circuit input to control the voltage on the CS_EA2 electrode.
132	CDH:CS_RP_MON	Real	V	N/A	Scientific value of CS_RP_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_RP electrode.
133	CDH:CS_RS_MON	Real	V	N/A	Scientific value of CS_RS_MON at TIME. This value captures the drive circuit input needed to control the voltage on the CS_RS electrode.
134	CDH:CS_FIL_SEL_ST	Real	N/A	N/A	Scientific value of CS_FIL_SEL_ST at TIME.
135	CDH:CS_+5REF_MON	Real	V	N/A	Scientific value of CS_+5REF_MON at TIME.
136	CDH:CS_+13A_MON	Real	V	N/A	Scientific value of CS_+13A_MON at TIME.
137	CDH:CS_TMP	Real	°C	N/A	Scientific value of CS_TMP at TIME. This value captures the temperature of the CS board.
138	CDH:CS_SPARE	Real	N/A	N/A	Unused channel.
139	CDH:PS_IMON	Real	A	N/A	Scientific value of PS_IMON at TIME.
140	CDH:EM1_IMON	Real	A	N/A	Scientific value of EM1_IMON at TIME. This value captures the current drawn by Multiplier 1.
141	CDH:EM2_IMON	Real	A	N/A	Scientific value of EM2_IMON at TIME. This value captures the current drawn by Multiplier 2.
142	CDH:MULTANA1	Real	V	N/A	Scientific value of MULTANA1 at TIME.
143	CDH:MULTANA2	Real	V	N/A	Scientific value of MULTANA2 at TIME.
144	CDH:RF_AGC_MON	Real	V	N/A	Scientific value of RF_AGC_MON at TIME.
145	CDH:VCAP+_MON	Real	V	N/A	Scientific value of VCAP+_MON at TIME.
146	CDH:VCAP-_MON	Real	V	N/A	Scientific value of VCAP-_MON at TIME.
147	CDH:SPARE_209	Real	N/A	N/A	Unused channel.
148	CDH:SPARE_210	Real	N/A	N/A	Unused channel.
149	CDH:SPARE_0	Real	N/A	N/A	Unused channel.
150	CDH:SPARE_1	Real	N/A	N/A	Unused channel.
151	CDH:SPARE_2	Real	N/A	N/A	Unused channel.
152	CDH:SPARE_3	Real	N/A	N/A	Unused channel.
153	CDH:+5VREF_DAC	Real	V	N/A	Scientific value of +5VREF_DAC at TIME.
154	CDH:-5VREF_DAC	Real	V	N/A	Scientific value of -5VREF_DAC at TIME.
155	CDH:PulseCounter	Real	Hz	N/A	Scientific value of PulseCounter at TIME. This

					value captures the number of counts detected with active multiplier during the duration of the integration period.
156	CDH:RF_Cntr	Real	kHz	N/A	Scientific value of RF_Cntr at TIME. This value captures the current RF frequency.
157	FSW:FSW_VER	Real	N/A	N/A	Scientific value of FSW_VER at TIME.
158	FSW:PKT_REV	Real	N/A	N/A	Scientific value of PKT_REV at TIME.
159	FSW:LAST_RESET	Real	N/A	N/A	Scientific value of LAST_RESET at TIME.
160	FSW:LOAD_TYPE	Real	N/A	N/A	Scientific value of LOAD_TYPE at TIME.
161	FSW:LAST_CMD	Real	N/A	N/A	Scientific value of LAST_CMD at TIME.
162	FSW:N_CMDS	Real	N/A	N/A	Scientific value of N_CMDS at TIME.
163	FSW:N_CMD_ERRS	Real	N/A	N/A	Scientific value of N_CMD_ERRS at TIME.
164	FSW:BAD_CMD_ERR	Real	N/A	N/A	Scientific value of BAD_CMD_ERR at TIME.
165	FSW:BAD_CMD_OP	Real	N/A	N/A	Scientific value of BAD_CMD_OP at TIME.
166	FSW:ZONE_ALERT	Real	N/A	N/A	Scientific value of ZONE_ALERT at TIME.
167	FSW:INST_MODE	Real	N/A	N/A	Scientific value of INST_MODE at TIME.
168	FSW:SCRIPT_MODE	Real	N/A	N/A	Scientific value of SCRIPT_MODE at TIME.
169	FSW:TELEM_MODE	Real	N/A	N/A	Scientific value of TELEM_MODE at TIME.
170	FSW:LIB_VER	Real	N/A	N/A	Scientific value of LIB_VER at TIME.
171	FSW:SCRIPT_ID	Real	N/A	N/A	Scientific value of SCRIPT_ID at TIME.
172	FSW:SCRIPT_VER	Real	N/A	N/A	Scientific value of SCRIPT_VER at TIME.
173	FSW:LAST_MARKER	Real	N/A	N/A	Scientific value of LAST_MARKER at TIME.
174	FSW:CODE_CSUM	Real	N/A	N/A	Scientific value of CODE_CSUM at TIME.
175	FSW:SCRIPT_CSUM	Real	N/A	N/A	Scientific value of SCRIPT_CSUM at TIME.
176	FSW:LIB_CSUM	Real	N/A	N/A	Scientific value of LIB_CSUM at TIME.
177	FSW:DWELL_MON_ADDR	Real	N/A	N/A	Scientific value of DWELL_MON_ADDR at TIME.
178	FSW:DWELL_MON_VAL	Real	N/A	N/A	Scientific value of DWELL_MON_VAL at TIME.
179	FSW:SIDE_A	Real	N/A	N/A	Scientific value of SIDE_A at TIME.
180	FSW:POWER_STAT	Real	N/A	N/A	Scientific value of POWER_STAT at TIME.
181	FSW:ALARM_STAT	Real	N/A	N/A	Scientific value of ALARM_STAT at TIME.
182	FSW:ALARM_LEVEL	Real	N/A	N/A	Scientific value of ALARM_LEVEL at TIME.
183	FSW:N_ALARMS	Real	N/A	N/A	Scientific value of N_ALARMS at TIME.
184	FSW:N_ALARM_ENAB	Real	N/A	N/A	Scientific value of N_ALARM_ENAB at TIME.
185	FSW:N_ALARM_ACTIVE	Real	N/A	N/A	Scientific value of N_ALARM_ACTIVE at TIME.
186	FSW:LAST_FILE_ID	Real	N/A	N/A	Scientific value of LAST_FILE_ID at TIME.
187	FSW:MEM_ALLOC	Real	N/A	N/A	Scientific value of MEM_ALLOC at TIME.
188	FSW:MEM_FREE	Real	N/A	N/A	Scientific value of MEM_FREE at TIME.
189	FSW:LARGEST_FREE_BLOCK	Real	N/A	N/A	Scientific value of LARGEST_FREE_BLOCK at TIME.
190	FSW:N_ALLOCS	Real	N/A	N/A	Scientific value of N_ALLOCS at TIME.
191	FSW:N_FREES	Real	N/A	N/A	Scientific value of N_FREES at TIME.
192	FSW:PS_IMON	Real	A	N/A	Scientific value of PS_IMON at TIME.
193	FSW:EM1_IMON	Real	A	N/A	Scientific value of EM1_IMON at TIME. This value captures the current drawn by Multiplier 1.
194	FSW:EM2_IMON	Real	°C	N/A	Scientific value of EM2_IMON at TIME. This

					value captures the current drawn by Multiplier 2.
195	FSW:AGC_TMP	Real	°C	N/A	Scientific value of AGC_TMP at TIME. This value captures the temperature of the RF AGC board.
196	FSW:DET_TMP	Real	°C	N/A	Scientific value of DET_TMP at TIME. This value captures the temperature of the DET board.
197	FSW:RF_TMP	Real	°C	N/A	Scientific value of RF_TMP at TIME. This value captures the temperature of the RF board.
198	FSW:CDH_TMP	Real	°C	N/A	Scientific value of CDH_TMP at TIME. This value captures the temperature of the CDH board.
199	FSW:CTL_TMP	Real	°C	N/A	Scientific value of CTL_TMP at TIME. This value captures the temperature of the CTL board.
200	FSW:PS_TMP	Real	°C	N/A	Scientific value of PS_TMP at TIME. This value captures the temperature of the PS board.
201	FSW:OS_FIL_EMON	Real	A	N/A	Scientific value of OS_FIL_EMON at TIME. This value captures the emission value on the active OS filament.
202	FSW:CS_FIL_EMON	Real	A	N/A	Scientific value of CS_FIL_EMON at TIME. This value captures the emission value on the active CS filament.
203	FSW:THERM_PRESS	Real	V	N/A	Scientific value of THERM_PRESS at TIME.
204	FSW:MISSED_TIME_CODES	Real	N/A	N/A	Scientific value of MISSED_TIME_CODES at TIME.
205	FSW:MISSED_ZONE_ALERTS	Real	N/A	N/A	Scientific value of MISSED_ZONE_ALERTS at TIME.
206	QMS:ADC_STATUS	Integer	N/A	N/A	Scientific value of ADC_STATUS at TIME.
207	QMS:AMUX1	Integer	N/A	N/A	Scientific value of AMUX1 at TIME.
208	QMS:AMUX2	Integer	N/A	N/A	Scientific value of AMUX2 at TIME.
209	QMS:AMUX_ADDR1	Integer	N/A	N/A	Scientific value of AMUX_ADDR1 at TIME.
210	QMS:AMUX_ADDR2	Integer	N/A	N/A	Scientific value of AMUX_ADDR2 at TIME.
211	QMS:AMUX_ADDR3	Integer	N/A	N/A	Scientific value of AMUX_ADDR3 at TIME.
212	QMS:AMUX_ADDR4	Integer	N/A	N/A	Scientific value of AMUX_ADDR4 at TIME.
213	QMS:COUNT1	Integer	COUNT	N/A	Scientific value of COUNT1 at TIME. This value captures the number of counts detected with multiplier 1 during the duration of the integration period.
214	QMS:COUNT2	Integer	COUNT	N/A	Scientific value of COUNT2 at TIME. This value captures the number of counts detected with multiplier 2 during the duration of the integration period.
215	QMS:CTL_DIGITAL_STATUS	Integer	N/A	N/A	Scientific value of CTL_DIGITAL_STATUS at TIME.
216	QMS:CTL_ERROR_COUNT	Integer	N/A	N/A	Scientific value of CTL_ERROR_COUNT at TIME.
217	QMS:CTL_ERROR_STATUS	Integer	N/A	N/A	Scientific value of CTL_ERROR_STATUS at TIME.
218	QMS:CTL_IMM_CMD	Integer	N/A	N/A	Scientific value of

	_COUNT				CTL_IMM_CMD_COUNT at TIME.
219	QMS:CTL_MSEQ_CMD_COUNT	Integer	N/A	N/A	Scientific value of CTL_MSEQ_CMD_COUNT at TIME.
220	QMS:CTL_PACKET_COUNT	Integer	N/A	N/A	Scientific value of CTL_PACKET_COUNT at TIME.
221	QMS:CTL_PARITY_ERR_COUNT	Integer	N/A	N/A	Scientific value of CTL_PARITY_ERR_COUNT at TIME.
222	QMS:CTL_SERIAL_NUM	Integer	N/A	N/A	Scientific value of CTL_SERIAL_NUM at TIME.
223	QMS:CTL_SYNC_CODE	Integer	N/A	N/A	Scientific value of CTL_SYNC_CODE at TIME.
224	QMS:DAC12BSPARE1	Real	N/A	N/A	Unused channel.
225	QMS:DAC12BSPARE2	Real	N/A	N/A	Unused channel.
226	QMS:DAC12BSPARE3	Real	N/A	N/A	Unused channel.
227	QMS:DAC12USPARE1	Real	N/A	N/A	Unused channel.
228	QMS:DAC12USPARE2	Real	N/A	N/A	Unused channel.
229	QMS:DAC16BSPARE1	Real	N/A	N/A	Unused channel.
230	QMS:DAC16BSPARE2	Real	N/A	N/A	Unused channel.
231	QMS:DAC8B_SPARE1	Real	N/A	N/A	Unused channel.
232	QMS:DAC8B_SPARE2	Real	N/A	N/A	Unused channel.
233	QMS:DAC8B_SPARE3	Real	N/A	N/A	Unused channel.
234	QMS:DAC_SPARE	Real	N/A	N/A	Unused channel.
235	QMS:RF_FREQ	Real	N/A	N/A	Scientific value of RF_FREQ at TIME.
236	QMS:SERIAL_NUM	Integer	N/A	N/A	Scientific value of SERIAL_NUM at TIME.
237	QMS:SERIAL_NUM_SET	Integer	N/A	N/A	Scientific value of SERIAL_NUM_SET at TIME.
238	QMS:SYNC_CODE	Integer	N/A	N/A	Scientific value of SYNC_CODE at TIME.
239	QMS:WAIT	Integer	N/A	N/A	Scientific value of WAIT at TIME.
240	QMS:OS_FIL1_VCTL	Real	V	N/A	Scientific value of OS_FIL1_VCTL at TIME. This value captures the DAC setting for the OS_FIL1 electrode.
241	QMS:OS_FIL1_ECTL	Real	A	N/A	Scientific value of OS_FIL1_ECTL at TIME. This value captures the DAC setting for the OS_FIL1 emission control.
242	QMS:OS_FS1_VCTL	Real	V	N/A	Scientific value of OS_FS1_VCTL at TIME. This value captures the DAC setting for the OS_FS1 electrode.
243	QMS:OS_FIL2_VCTL	Real	V	N/A	Scientific value of OS_FIL2_VCTL at TIME. This value captures the DAC setting for the OS_FIL2 electrode.
244	QMS:OS_FIL2_ECTL	Real	A	N/A	Scientific value of OS_FIL2_ECTL at TIME. This value captures the DAC setting for the OS_FIL2 emission control.
245	QMS:OS_FS2_VCTL	Real	V	N/A	Scientific value of OS_FS2_VCTL at TIME. This value captures the DAC setting for the OS_FS2 electrode.
246	QMS:CS_FIL1_VCTL	Real	V	N/A	Scientific value of CS_FIL1_VCTL at TIME. This value captures the DAC setting for the CS_FIL1 electrode.
247	QMS:CS_FIL1_ECTL	Real	A	N/A	Scientific value of CS_FIL1_ECTL at TIME. This value captures the DAC setting for the

					CS_FIL1 electrode.
248	QMS:CS_FS1_VCTL	Real	V	N/A	Scientific value of CS_FS1_VCTL at TIME. This value captures the DAC setting for the CS_FS1 electrode.
249	QMS:CS_FIL2_VCTL	Real	V	N/A	Scientific value of CS_FIL2_VCTL at TIME. This value captures the DAC setting for the CS_FIL2 electrode.
250	QMS:CS_FIL2_ECTL	Real	A	N/A	Scientific value of CS_FIL2_ECTL at TIME. This value captures the DAC setting for the CS_FIL2 electrode.
251	QMS:CS_FS2_VCTL	Real	V	N/A	Scientific value of CS_FS2_VCTL at TIME. This value captures the DAC setting for the CS_FS2 electrode.
252	QMS:DT1_VCTL	Real	V	N/A	Scientific value of DT1_VCTL at TIME. This value captures the DAC setting for the DET1 discriminator.
253	QMS:DT2_VCTL	Real	V	N/A	Scientific value of DT2_VCTL at TIME. This value captures the DAC setting for the DET1 discriminator.
254	QMS:QB_VCTL	Real	V	N/A	Scientific value of QB_VCTL at TIME.
255	QMS:FIL_ON_CTRL	Real	N/A	N/A	Scientific value of FIL_ON_CTRL at TIME.
256	QMS:RODAC_CTRL	Real	V	N/A	Scientific value of RODAC_CTRL at TIME. This value captures the DAC setting for the RF AC amplitude.
257	QMS:RODDC_CTL	Real	V	N/A	Scientific value of RODDC_CTL at TIME. This value captures the DAC setting for the RF DC amplitude.
258	QMS:RF_FREQ_SET	Integer	N/A	N/A	Scientific value of RF_FREQ_SET at TIME.
259	QMS:IP_COUNT	Real	ms	N/A	Scientific value of IP_COUNT at TIME. This value captures the current integration period (IP) duration.
260	QMS:IP_SETUP	Real	ms	N/A	Scientific value of IP_SETUP at TIME. This value captures the current settling period duration.
261	QMS:FIL_SELECT	Integer	N/A	N/A	Scientific value of FIL_SELECT at TIME.
262	QMS:BA_FIL_VCTL	Real	V	N/A	Scientific value of BA_FIL_VCTL at TIME.
263	QMS:CS_NZ_VCTL	Real	V	N/A	Scientific value of CS_NZ_VCTL at TIME. This value captures the DAC setting for the CS_NZ electrode.
264	QMS:MT_MU1_VCTL	Real	V	N/A	Scientific value of MT_MU1_VCTL at TIME. This value captures the DAC setting for the MT_MU1 electrode.
265	QMS:MT_MU2_VCTL	Real	V	N/A	Scientific value of MT_MU2_VCTL at TIME. This value captures the DAC setting for the MT_MU2 electrode.
266	QMS:CS_EA1_VCTL	Real	V	N/A	Scientific value of CS_EA1_VCTL at TIME. This value captures the DAC setting for the CS_EA1 electrode.
267	QMS:CS_AN1_VCTL	Real	V	N/A	Scientific value of CS_AN1_VCTL at TIME. This value captures the DAC setting for the CS_AN1 electrode.

268	QMS:CS_EA2_VCTL	Real	V	N/A	Scientific value of CS_EA2_VCTL at TIME. This value captures the DAC setting for the CS_EA2 electrode.
269	QMS:CS_AN2_VCTL	Real	V	N/A	Scientific value of CS_AN2_VCTL at TIME. This value captures the DAC setting for the CS_AN2 electrode.
270	QMS:QD_BS_VCTL	Real	V	N/A	Scientific value of QD_BS_VCTL at TIME. This value captures the DAC setting for the QD_BS electrode.
271	QMS:MT_EZ_VCTL	Real	V	N/A	Scientific value of MT_EZ_VCTL at TIME. This value captures the DAC setting for the MT_EZ electrode.
272	QMS:MT_MA1_VCTL	Real	V	N/A	Scientific value of MT_MA1_VCTL at TIME. This value captures the DAC setting for the MT_MA1 electrode.
273	QMS:MT_MA2_VCTL	Real	V	N/A	Scientific value of MT_MA2_VCTL at TIME. This value captures the DAC setting for the MT_MA2 electrode.
274	QMS:MT_WD_VCTL	Real	V	N/A	Scientific value of MT_WD_VCTL at TIME. This value captures the DAC setting for the MT_WD electrode.
275	QMS:MT_FC_VCTL	Real	V	N/A	Scientific value of MT_FC_VCTL at TIME. This value captures the DAC setting for the MT_FC electrode.
276	QMS:OS_EA1_VCTL	Real	V	N/A	Scientific value of OS_EA1_VCTL at TIME. This value captures the DAC setting for the OS_EA1 electrode.
277	QMS:OS_RES1_VCTL	Real	V	N/A	Scientific value of OS_RES1_VCTL at TIME. This value captures the DAC setting for the OS_RES1 electrode.
278	QMS:OS_EA2_VCTL	Real	V	N/A	Scientific value of OS_EA2_VCTL at TIME. This value captures the DAC setting for the OS_EA2 electrode.
279	QMS:OS_RES2_VCTL	Real	V	N/A	Scientific value of OS_RES2_VCTL at TIME. This value captures the DAC setting for the OS_RES2 electrode.
280	QMS:OS_OL1_VCTL	Real	V	N/A	Scientific value of OS_OL1_VCTL at TIME. This value captures the DAC setting for the OS_OL1 electrode.
281	QMS:OS_OL2_VCTL	Real	V	N/A	Scientific value of OS_OL2_VCTL at TIME. This value captures the DAC setting for the OS_OL2 electrode.
282	QMS:OS_COLA_VCTL	Real	V	N/A	Scientific value of OS_COLA_VCTL at TIME. This value captures the DAC setting for the OS_COLA electrode.
283	QMS:OS_COLB_VCTL	Real	V	N/A	Scientific value of OS_COLB_VCTL at TIME. This value captures the DAC setting for the OS_COLB electrode.
284	QMS:CS_IA_VCTL	Real	V	N/A	Scientific value of CS_IA_VCTL at TIME. This value captures the DAC setting for the CS_IA electrode.

285	QMS:CS_RP_VCTL	Real	V	N/A	Scientific value of CS_RP_VCTL at TIME. This value captures the DAC setting for the CS_RP electrode.
286	QMS:CS_RS_VCTL	Real	V	N/A	Scientific value of CS_RS_VCTL at TIME. This value captures the DAC setting for the CS_RS electrode.
287	QMS:IA_L1_VCTL	Real	V	N/A	Scientific value of IA_L1_VCTL at TIME. This value captures the DAC setting for the IA_L1 electrode.
288	QMS:IA_L2_VCTL	Real	V	N/A	Scientific value of IA_L2_VCTL at TIME. This value captures the DAC setting for the IA_L2 electrode.
289	QMS:IA_L4A_VCTL	Real	V	N/A	Scientific value of IA_L4A_VCTL at TIME. This value captures the DAC setting for the IA_L4A electrode.
290	QMS:IA_L4B_VCTL	Real	V	N/A	Scientific value of IA_L4B_VCTL at TIME. This value captures the DAC setting for the IA_L4B electrode.
291	QMS:IA_L5_VCTL	Real	V	N/A	Scientific value of IA_L5_VCTL at TIME. This value captures the DAC setting for the IA_L5 electrode.
292	QMS:IA_L6_VCTL	Real	V	N/A	Scientific value of IA_L6_VCTL at TIME. This value captures the DAC setting for the IA_L6 electrode.
293	QMS:OS_EF1A_VCTL	Real	V	N/A	Scientific value of OS_EF1A_VCTL at TIME. This value captures the DAC setting for the OS_EF1A electrode.
294	QMS:OS_EF1B_VCTL	Real	V	N/A	Scientific value of OS_EF1B_VCTL at TIME. This value captures the DAC setting for the OS_EF1B electrode.
295	QMS:OS_EF1C_VCTL	Real	V	N/A	Scientific value of OS_EF1C_VCTL at TIME. This value captures the DAC setting for the OS_EF1C electrode.
296	QMS:OS_EF1D_VCTL	Real	V	N/A	Scientific value of OS_EF1D_VCTL at TIME. This value captures the DAC setting for the OS_EF1D electrode.
297	QMS:OS_EF2A_VCTL	Real	V	N/A	Scientific value of OS_EF2A_VCTL at TIME. This value captures the DAC setting for the OS_EF2A electrode.
298	QMS:OS_EF2B_VCTL	Real	V	N/A	Scientific value of OS_EF2B_VCTL at TIME. This value captures the DAC setting for the OS_EF2B electrode.
299	QMS:OS_EF2C_VCTL	Real	V	N/A	Scientific value of OS_EF2C_VCTL at TIME. This value captures the DAC setting for the OS_EF2C electrode.
300	QMS:OS_EF2D_VCTL	Real	V	N/A	Scientific value of OS_EF2D_VCTL at TIME. This value captures the DAC setting for the OS_EF2D electrode.
301	QMS:CS_EF1A_VCTL	Real	V	N/A	Scientific value of CS_EF1A_VCTL at TIME. This value captures the DAC setting for the CS_EF1A electrode.

302	QMS:CS_EF1B_VCTL	Real	V	N/A	Scientific value of CS_EF1B_VCTL at TIME. This value captures the DAC setting for the CS_EF1B electrode.
303	QMS:CS_EF1C_VCTL	Real	V	N/A	Scientific value of CS_EF1C_VCTL at TIME. This value captures the DAC setting for the CS_EF1C electrode.
304	QMS:CS_EF1D_VCTL	Real	V	N/A	Scientific value of CS_EF1D_VCTL at TIME. This value captures the DAC setting for the CS_EF1D electrode.
305	QMS:CS_EF2A_VCTL	Real	V	N/A	Scientific value of CS_EF2A_VCTL at TIME. This value captures the DAC setting for the CS_EF2A electrode.
306	QMS:CS_EF2B_VCTL	Real	V	N/A	Scientific value of CS_EF2B_VCTL at TIME. This value captures the DAC setting for the CS_EF2B electrode.
307	QMS:CS_EF2C_VCTL	Real	V	N/A	Scientific value of CS_EF2C_VCTL at TIME. This value captures the DAC setting for the CS_EF2C electrode.
308	QMS:CS_EF2D_VCTL	Real	V	N/A	Scientific value of CS_EF2D_VCTL at TIME. This value captures the DAC setting for the CS_EF2D electrode.
309	QMS:OS_OL4_VCTL	Real	V	N/A	Scientific value of OS_OL4_VCTL at TIME. This value captures the DAC setting for the OS_OL4 electrode.
310	QMS:CS_IFA_VCTL	Real	V	N/A	Scientific value of CS_IFA_VCTL at TIME. This value captures the DAC setting for the CS_IFA electrode.
311	QMS:CS_IFB_VCTL	Real	V	N/A	Scientific value of CS_IFB_VCTL at TIME. This value captures the DAC setting for the CS_IFB electrode.
312	QMS:SL_TB_VCTL	Real	V	N/A	Scientific value of SL_TB_VCTL at TIME. This value captures the DAC setting for the SL_TB electrode.
313	QMS:SL_BB_VCTL	Real	V	N/A	Scientific value of SL_BB_VCTL at TIME. This value captures the DAC setting for the SL_BB electrode.
314	QMS:SL_BF_VCTL	Real	V	N/A	Scientific value of SL_BF_VCTL at TIME. This value captures the DAC setting for the SL_BF electrode.
315	QMS:SL_EL_VCTL	Real	V	N/A	Scientific value of SL_EL_VCTL at TIME. This value captures the DAC setting for the SL_EL electrode.
316	QMS:OS_OL3_VCTL	Real	V	N/A	Scientific value of OS_OL3_VCTL at TIME. This value captures the DAC setting for the OS_OL3 electrode.
317	QMS:SL_TF_VCTL	Real	V	N/A	Scientific value of SL_TF_VCTL at TIME. This value captures the DAC setting for the SL_TF electrode.
318	QMS:OS_OL5_VCTL	Real	V	N/A	Scientific value of OS_OL5_VCTL at TIME. This value captures the DAC setting for the OS_OL5 electrode.

319	QMS:OS_OL6_VCTL	Real	V	N/A	Scientific value of OS_OL6_VCTL at TIME. This value captures the DAC setting for the OS_OL6 electrode.
320	TM:TMSync	Real	N/A	N/A	Scientific value of TMSync at TIME.
321	TM:TMTick	Real	N/A	N/A	Scientific value of TMTick at TIME.
322	TM:TMSystemID	Real	N/A	N/A	Scientific value of TMSystemID at TIME.
323	TM:TMMarker	Real	N/A	N/A	Scientific value of TMMarker at TIME. This value captures the Marker ID of the current data point. Markers are tag numbers given to related set of measurements.
324	TM:TMMarkerText	Text	N/A	N/A	Scientific value of TMMarkerText at TIME. This value captures the current Marker description.

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

#	Name	Format	Units	Range	Description
1	t_unix	Real	sec	N/A	Unix time derived from sclk
2	t_sclk	Real	sec	N/A	Sclk time direct from spacecraft
3	t_tid	Real	sec	N/A	Time since beginning of run
4	tid	Integer	N/A	N/A	Identity marker per science experiment
5	umkid	Integer	N/A	N/A	Marker number indicating phase of ngims (e.g. warmup, phase mass scan etc)
6	orbit	Integer	N/A	N/A	Orbit number increasing before warmup to keep 1 orbit number for entire periapsis experiment
7	focus_mode	char	N/A	N/A	‘csn’, ‘osnb’, ‘osion’, or ‘osnt’ indicating which mode of operation
8	multiplier	Integer	N/A	0,1,2	Indicates which multiplier is on 0 indicates none
9	filament	Integer	N/A	0,1,2	Indicates which filament is on 0 indicates none
10	temperature_s	Integer	deg C	N/A	Temperature of the CS-antichamber transfer tube
11	mass	Integer	amu	1.5-450	Mass per charge. M/Z from 150-300 indicate first attenuation, 300-450 second attenuation
12	counts	Integer	counts	N/A	Raw counts from instrument uncalibrated
13	cps_raw	Real	cps	N/A	Raw counts converted to counts per second based on integration period
14	cps_raw_bkgd	Real	cps	N/A	Background subtracted off raw cps (for comparison only with low cps)
15	cps_dt	Real	cps	N/A	Deadtime corrected cps

16	cps_dt_bkgd	Real	cps	N/A	Background subtracted deadtime corrected cps. recommend for use in all science computations
17	bkgd	Real	cps	N/A	Computed background values from warmup scans
18	alt_iau	Real	km	N/A	Altitude geodetic iau coordinates
19	vsc_iau	Real	km/s	N/A	Space craft velocity geodetic iau coordinates
20	ram1	Real	deg	0-180	Ram pointing of the app in the direction of motion.
21	ram2rot-angle	Real	deg	0-180	Rotation angle of ngims boresight
22	sol-lon	Real	deg	0-180	Solar longitude
23	sol-lat	Real	deg	-90-90	Solar latitude
24	lst	char	hh:mm:ss A.M/P.M.	N/A	Local solar time
25	x-iau	Real	km	N/A	Geodetic iau coordinates
26	y-iau	Real	km	N/A	Geodetic iau coordinates
27	z-iau	Real	km	N/A	Geodetic iau coordinates
28	vx-iau	Real	km/s	N/A	Geodetic iau coordinates
29	vy-iau	Real	km/s	N/A	Geodetic iau coordinates
30	vz-iau	Real	km/s	N/A	Geodetic iau coordinates
31	lat	Real	deg	0-180	Latitude
32	long	Real	deg	-90-90	Longitude

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)

#	Name	Format	Units	Range	Description
1	t_unix	Real	sec	N/A	Unix time derived from sclk
2	t_sclk	Real	sec	N/A	Sclk time direct from spacecraft
3	t_tid	Real	sec	N/A	Time since beginning of run
4	tid	Integer	N/A	N/A	Identity marker per science experiment
5	orbit	Integer	N/A	N/A	Orbit number increasing before warmup to keep 1 orbit number for entire periapsis experiment
6	focusmode	char	N/A	N/A	‘csn’, ‘osnb’, ‘osion’, or ‘osnt’ indicating which mode of operation
7	alt	Real	km	N/A	Altitude geodetic iau coordinates

8	mass	Real	amu	2-150	Only specific m/z are included
9	species	char	N/A	N/A	Name of neutral mass density calculated
10	cps_dt_bkgd	Real	Count/s	N/A	Counts per second background subtracted, deadtime corrected, of key species saturation of species accounted for.
11	abundance	Real	part/cc	N/A	Density of key neutrals
12	precision	Real	N/A	0-1	Percent error (1sigma) on density
13	quality	Char	N/A	P/D	Preliminary (P) or Definitive (D) error and density calculations

Table A-8: Definition of the L2 ion abundance table (ion-abund)

#	Name	Format	Units	Range	Description
1	t_unix	Real	sec	N/A	Unix time derived from sclk
2	t_sclk	Real	sec	N/A	Sclk time direct from spacecraft
3	t_tid	Real	sec	N/A	Time since beginning of run
4	tid	Integer	N/A	N/A	Identity marker per science experiment
5	orbit	Integer	N/A	N/A	Orbit number increasing before warmup to keep 1 orbit number for entire periapsis experiment
6	focusmode	char	N/A	N/A	‘csn’, ‘osnb’, ‘osion’, or ‘osnt’ indicating which mode of operation
7	alt	Real	km	N/A	Altitude geodetic iau coordinates
8	ion_mass	Real	amu	2-150	Only specific m/z are included
9	cps_dt	Real	Count/s	N/A	Counts per second deadtime corrected of key species. Background is negligible.
10	abundance	Real	ion/cc	N/A	Density of ions
11	Sensitivity	Real	Counts/s/ion/cc	N/A	Reference instrument sensitivity to CO_2^+
12	precision	Real	N/A	0-1	Percent error (1sigma) on density
13	quality	Char	N/A	P/D	Preliminary (P) or Definitive (D) error and density calculations

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

#	Name	Format	Units	Range	Description
1	t_unix	Real	sec	N/A	Unix time derived from sclk
2	t_sclk	Real	sec	N/A	Sclk time direct from spacecraft
3	t_tid	Real	sec	N/A	Time since beginning of run
4	tid	Integer	N/A	N/A	Identity marker per science experiment
5	orbit	Integer	N/A	N/A	Orbit number increasing before warmup to keep 1 orbit number for

					entire periapsis experiment
6	focusmode	char	N/A	N/A	‘csn’, ‘osnb’, ‘osion’, or ‘osnt’ indicating which mode of operation
7	alt	Real	km	N/A	Altitude in geodetic iau coordinates
8	mass	Real	amu	2-150	Only specific m/z are included
9	species	char	N/A	N/A	Name of neutral mass density calculated
10	averaged_density	Real	Part/cc	N/A	terpolated atmospheric density of the species being observed.

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

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

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

Date	TID	Ops	Temperature	Script
FM Calibration on Chamber				
23-Sep-12	10191	Argon Calibration	Ambient	cal_script.bas
23-Sep-12	10194	Krypton Calibration	Ambient	cal_script.bas
24-Sep-12	10197	Krypton Calibration	Ambient	cal_script.bas
24-Sep-12	10198	Krypton Calibration	Ambient	cal_script.bas

25-Sep-12	10199	Krypton Calibration	Ambient	cal_script.bas
25-Sep-12	10201	Xenon Calibration	Ambient	cal_script.bas
25-Sep-12	10202	Xenon Calibration	Ambient	cal_script.bas
26-Sep-12	10205	Helium Calibration	Ambient	cal_script.bas
26-Sep-12	10207	Helium Calibration	Ambient	cal_script.bas
28-Sep-12	10216	CS/OS switching Test	Ambient	OS_CS_test.bas
28-Sep-12	10217	CS/OS switching Test	Ambient	OS_CS_test.bas
10-Mar-12	10241	Pre Pinch-off	Ambient	cal_script.bas
10-Mar-12	10242	Post Pinch-off	Ambient	cal_script.bas

8.5 NGIMS Sample Label:

Below is a sample label for the data contained in:

`mvn_ngi_l1a_gnd_sci_011146_20130928T010754_v01_r01.csv`

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-model href="http://pds.nasa.gov/pds4/schema/released/pds/v1/PDS4_PDS_1100.sch" ?>
<?xml-model href="http://atmos.ngimsu.edu/pub/PDS4/schema/maven_schematron1.sch" ?>
<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_l1a_gnd_sci_011146_20130928T0
10754_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>
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                        Descriptions of different tuning modes, as well
                        as their assigned numeric IDs, can be found in
                        the SIS document accompanying this archive.
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```
                        the integration period starting at TIME. This
                        field is left blank during DAC scans.
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                        SIS document accompanying this archive. This
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