

**INTERFACE DESIGN DESCRIPTION  
FOR THE  
MULTI-MODE MAGNETIC DETECTION SYSTEM**

**CONTRACT NO. N00014-03-C-0388**

**DOCUMENT NUMBER: 0BSB2-03-C-0388-01**

**REVISION: I**

**21 November 2008**

Prepared for:  
Office of Naval Research,  
ONR 321  
Ballston Tower ONE  
800 North Quincy Street,  
Arlington, VA 22217-5660

Prepared by:  
Polatomic Incorporated  
1810 N. Glenville Dr., Ste. 116  
Richardson, TX 75081

CAGE 0BSB2  
3MDS Project  
Polatomic Incorporated

Release Approval (Signatures on file):

| <b>Name</b>  | <b>Title</b>         | <b>Date</b>      |
|--------------|----------------------|------------------|
| Rich Tobaben | Software Manager     | 21 November 2008 |
| Don King     | Engineering Director | 21 November 2008 |
| Jim Manning  | Program Manager      | 21 November 2008 |

COTR: Office of Naval Research, ONR 321  
Contracting Agency: Office of Naval Research, ONR 321

DISTRIBUTION STATEMENT: Approved for public release; distribution is unlimited.

| Report Documentation Page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                                     |                                          | Form Approved<br>OMB No. 0704-0188       |                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------|------------------------------------------|------------------------------------------|---------------------------------|
| Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. |                                    |                                     |                                          |                                          |                                 |
| 1. REPORT DATE<br><b>21 NOV 2008</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                    | 2. REPORT TYPE<br><b>N/A</b>        |                                          | 3. DATES COVERED<br><b>-</b>             |                                 |
| 4. TITLE AND SUBTITLE<br><b>Interface Design Description For The Multi-Mode Magnetic Detection System</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                                     |                                          | 5a. CONTRACT NUMBER                      |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                          | 5b. GRANT NUMBER                         |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                          | 5c. PROGRAM ELEMENT NUMBER               |                                 |
| 6. AUTHOR(S)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                    |                                     |                                          | 5d. PROJECT NUMBER                       |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                          | 5e. TASK NUMBER                          |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                          | 5f. WORK UNIT NUMBER                     |                                 |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br><b>Polatomic Incorporated 1810 N. Glenville Dr., Ste. 116 Richardson, TX 75081</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |                                     |                                          | 8. PERFORMING ORGANIZATION REPORT NUMBER |                                 |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                    |                                     |                                          | 10. SPONSOR/MONITOR'S ACRONYM(S)         |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                          | 11. SPONSOR/MONITOR'S REPORT NUMBER(S)   |                                 |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT<br><b>Approved for public release, distribution unlimited</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                    |                                     |                                          |                                          |                                 |
| 13. SUPPLEMENTARY NOTES<br><b>See also ADM202599. The Multi-Mode Magnetic Detection System (3MDS)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                    |                                     |                                          |                                          |                                 |
| 14. ABSTRACT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                    |                                     |                                          |                                          |                                 |
| 15. SUBJECT TERMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                    |                                     |                                          |                                          |                                 |
| 16. SECURITY CLASSIFICATION OF:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     | 17. LIMITATION OF ABSTRACT<br><b>SAR</b> | 18. NUMBER OF PAGES<br><b>68</b>         | 19a. NAME OF RESPONSIBLE PERSON |
| a. REPORT<br><b>unclassified</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | b. ABSTRACT<br><b>unclassified</b> | c. THIS PAGE<br><b>unclassified</b> |                                          |                                          |                                 |

**3MDS IDD**  
**0BSB2-03-C-0388-01**

RECORD OF REVIEW AND HISTORY FOR

Document No. 0BSB2-03-C-0388-01

Contract No N00014-03-C-0388

| Action                   | Revision Identification | Release Date     |
|--------------------------|-------------------------|------------------|
| Initial Release          | -                       | 1 December 2005  |
| 1 <sup>st</sup> Revision | A                       | 10 January 2006  |
| 2 <sup>nd</sup> Revision | B                       | 13 January 2006  |
| 3 <sup>rd</sup> Revision | C                       | 6 July 2006      |
| 4 <sup>th</sup> Revision | D                       | 2 October 2006   |
| 5 <sup>th</sup> Revision | E                       | 26 February 2007 |
| 6 <sup>th</sup> Revision | F                       | 26 June 2007     |
| 7 <sup>th</sup> Revision | G                       | 21 January 2008  |
| 8 <sup>th</sup> Revision | H                       | 21 April 2008    |
| 9 <sup>th</sup> Revision | I                       | 21 November 2008 |

TABLE OF CONTENTS

| <u>Paragraph</u> |                                                                  | <u>Page</u> |
|------------------|------------------------------------------------------------------|-------------|
| <b>1.</b>        | <b>SCOPE .....</b>                                               | <b>1</b>    |
| 1.1              | Identification. ....                                             | 1           |
| 1.2              | System Overview. ....                                            | 1           |
| 1.3              | Document Overview. ....                                          | 1           |
| 1.3.1            | Revision Information.....                                        | 1           |
| <b>2.</b>        | <b>REFERENCED DOCUMENTS .....</b>                                | <b>2</b>    |
| 2.1              | Government Documents. ....                                       | 2           |
| 2.1.1            | Specifications. ....                                             | 2           |
| 2.1.2            | Standards. ....                                                  | 2           |
| 2.1.3            | Drawings.....                                                    | 2           |
| 2.1.4            | Other publications. ....                                         | 2           |
| 2.2              | Non-Government Documents. ....                                   | 2           |
| 2.2.1            | Specifications. ....                                             | 2           |
| 2.2.2            | Standards. ....                                                  | 2           |
| 2.2.3            | Other publications. ....                                         | 2           |
| <b>3.</b>        | <b>INTERFACE DESIGN .....</b>                                    | <b>3</b>    |
| 3.1.1            | System Variants .....                                            | 3           |
| 3.2              | Message Data Interfaces. ....                                    | 6           |
| 3.3              | Formats and Interfaces. ....                                     | 6           |
| 3.3.1            | GPS Data .....                                                   | 7           |
| 3.3.2            | Format 1 – Sensor Data and Control Response.....                 | 10          |
| 3.3.3            | Format 2 – Sensor Control Data .....                             | 23          |
| 3.3.4            | Format 3 – Sensor Compensation Control Data.....                 | 27          |
| 3.3.5            | Format 4 – System Control .....                                  | 29          |
| 3.3.6            | Format 5 – Pre-Mapped Target Data (Future Growth) .....          | 38          |
| 3.3.7            | Format 6 – False Target Data Output (Future Growth).....         | 39          |
| 3.3.8            | Format 7 – Track Data .....                                      | 40          |
| 3.3.9            | Format 8 – Detection Data .....                                  | 42          |
| 3.3.10           | Format 9 – Time Domain Detection Data.....                       | 44          |
| 3.3.11           | Format 11 – High Speed Debug Data.....                           | 48          |
| 3.3.12           | Format 12 – Start/End Playback/Retrieve .....                    | 48          |
| 3.3.13           | Format 13 – Recorded File Directory Listing .....                | 49          |
| 3.3.14           | Format 14 – Message Recording Wrapper.....                       | 50          |
| 3.3.15           | Format-15 Noise Reduction/Detection Processing Control .....     | 51          |
| 3.3.16           | Format-16 System Diagnostic Status.....                          | 56          |
| 3.3.17           | Format 17 - Noise Reduction/Detection Initialization Status..... | 57          |
| 3.3.18           | Format 18 – Command Track Generation .....                       | 58          |
| 3.3.19           | Format 19 Tracker Input Data .....                               | 60          |
| <b>4.</b>        | <b>REQUIREMENTS TRACEABILITY .....</b>                           | <b>64</b>   |
| <b>5.</b>        | <b>NOTES .....</b>                                               | <b>64</b>   |
| 5.1              | Abbreviations and Acronyms. ....                                 | 64          |
| 5.2              | Other.....                                                       | 65          |

## **1. SCOPE**

### **1.1 Identification.**

This Interface Design Description (IDD) specifies the design for all internal and external software configuration item interfaces on the Multi-Mode Magnetic Detection System (3MDS), and documents the partition of related software development tasks between Polatomic, Inc. (PI) and Applied Signal Technology, Inc. (AST).

### **1.2 System Overview.**

The goal of the 3MDS project is to develop and demonstrate a real-time airborne magnetic detection system that is Unmanned Aerial Vehicle (UAV)-based. The magnetic detection system consists of: a magnetometer, auxiliary sensors for noise reduction, and noise reduction/detection software. The system will be able to perform target search, target detection and, after cueing, perform target re-detection, localization, verification, classification, and tracking in deep water and in the littoral. This system will also support playback of collected data to support training and future algorithm development.

Three proposed variants to the system are planned. A fixed-wing aircraft and manned helicopter variant, a single unmanned aerial vehicle variant, and a dual unmanned aerial vehicle variant. These variants are described in more detail in section 3.

### **1.3 Document Overview.**

This IDD describes the interface characteristics between subsystems of the 3MDS project. The IDD is divided into the following sections:

- Section 1 contains identification and system overview.
- Section 2 lists documents applicable to this program.
- Section 3 contains the interface design descriptions necessary to ensure proper performance of the 3MDS system. This section contains message data layouts of all formats passed through interfaces.
- Section 4 defines requirements traceability.
- Section 5 contains notes and acronyms.
- Section 6 contains appendixes.

#### **1.3.1 Revision Information**

This revision is the final revision planned for the 3MDS program and serves to incorporate all Exception Notices published after release of Revision H (21 April 2008). The cumulative changes reflected in this document are indicated by red color text.

## **2. REFERENCED DOCUMENTS**

### **2.1 Government Documents.**

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting officer.

#### **2.1.1 Specifications.**

Multi-Mode Magnetic Detection System, Contract Number N68335-01-D-0237, MMMDS Preliminary Specification, dated 3/5/2003

#### **2.1.2 Standards.**

MIL\_STD 498 IDD Data Item Description used as guidance

##### **2.1.2.1 Federal.**

None.

##### **2.1.2.2 Military.**

None.

##### **2.1.2.3 Other Government Agency.**

None.

#### **2.1.3 Drawings.**

None.

#### **2.1.4 Other publications.**

Multi-Mode Magnetic Detection System, Contract Number: N00014-03-C-0388, Attachment Number 1, Statement of Work, dated 8/1/2003

### **2.2 Non-Government Documents.**

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

#### **2.2.1 Specifications.**

None.

#### **2.2.2 Standards.**

None.

#### **2.2.3 Other publications.**

Davis, J. "A UAV-Based Multi-Mode Magnetic Detection System (3MDS)", FY05 LASW FNC Execution Plan, June 2004

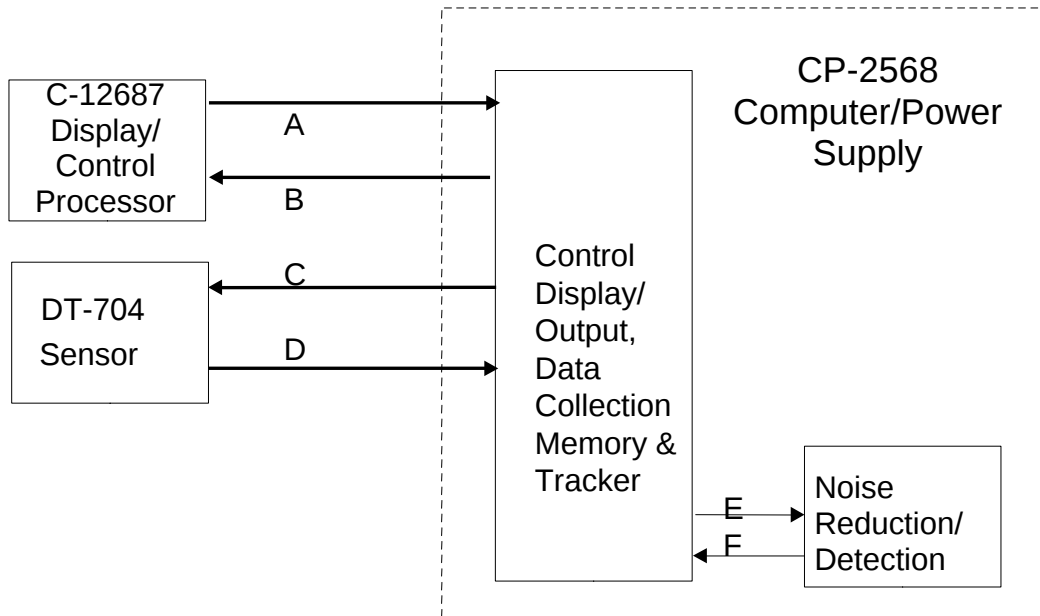
Novatel Users' Guide, OEM4 Family of Receivers Command and Log Reference Revision 8 Firmware Version 1.400 dated 5/2/2002

### 3. INTERFACE DESIGN

This section describes the system, interfaces, and primary data applicable to the 3MDS system.

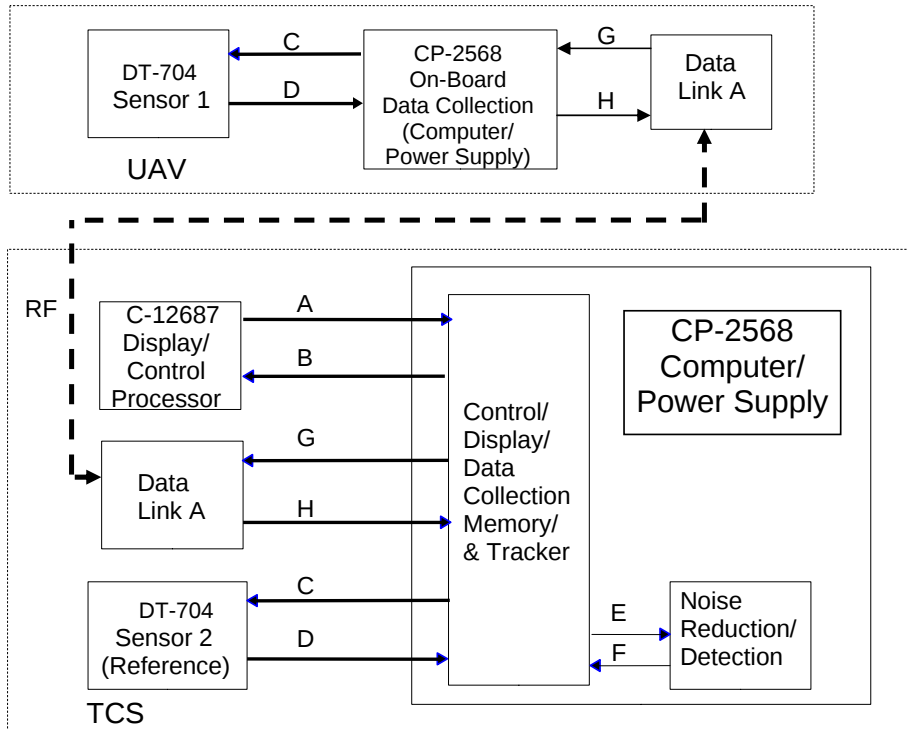
#### 3.1.1 System Variants

Three known system variants are proposed for the current program. These variants are described in the following subsections.



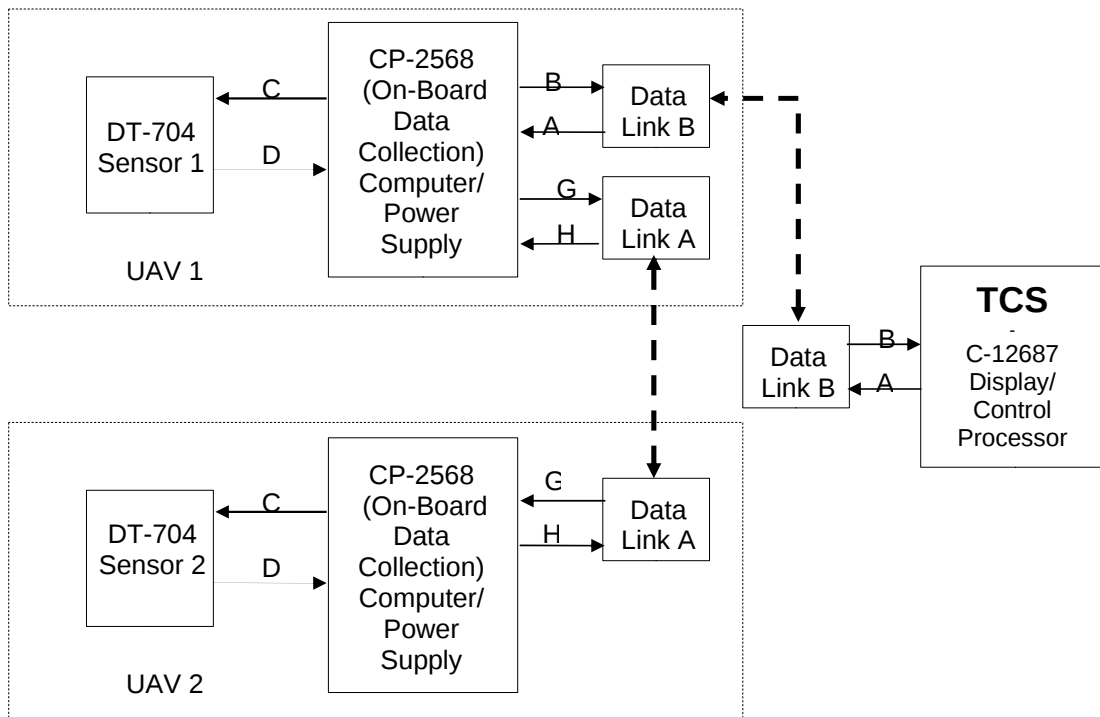
**Figure 1 - System Variant I: Fixed Wing Aircraft & Manned Helicopter Platform**

Figure 1 depicts the interface connections for an AN/ASQ-233 system operated in a single sensor environment for fixed wing and helicopter installations. The interfaces marked; A, B, C, D, E & F include message Formats listed in Table 2 and fully defined in this document.



**Figure 2 - System Variant II: Single Unmanned Aerial Vehicle Platform**

Figure 2 depicts the interface connections for an AN/ASQ-233 system operated in a UAV in conjunction with the Tactical Control Station (TCS) ground unit. The interfaces marked; A, B, C, D, E, F, G, & H F include message Formats listed in Table 2 and fully defined in this document.



**Figure 3 - System Variant III: Dual Unmanned Aerial Vehicle Platform**

Figure 3 depicts the interface connections for a dual AN/ASQ-233 system operated in UAV's. The interfaces marked; A, B, C, D, E, F, G, & H F include message Formats listed in Table 2 and fully defined in this document.

### 3.2 Message Data Interfaces.

The 3MDS system collects data from the AN/ASQ-233 sensor head and places it into message data interfaces for archival and access by the Noise Reduction and Detection module. Input to the Computer/Power Supply is accomplished either directly through Ethernet from the AN/ASQ-233 (System Variant I) or via a radio frequency (RF) data link (Variants II and III).

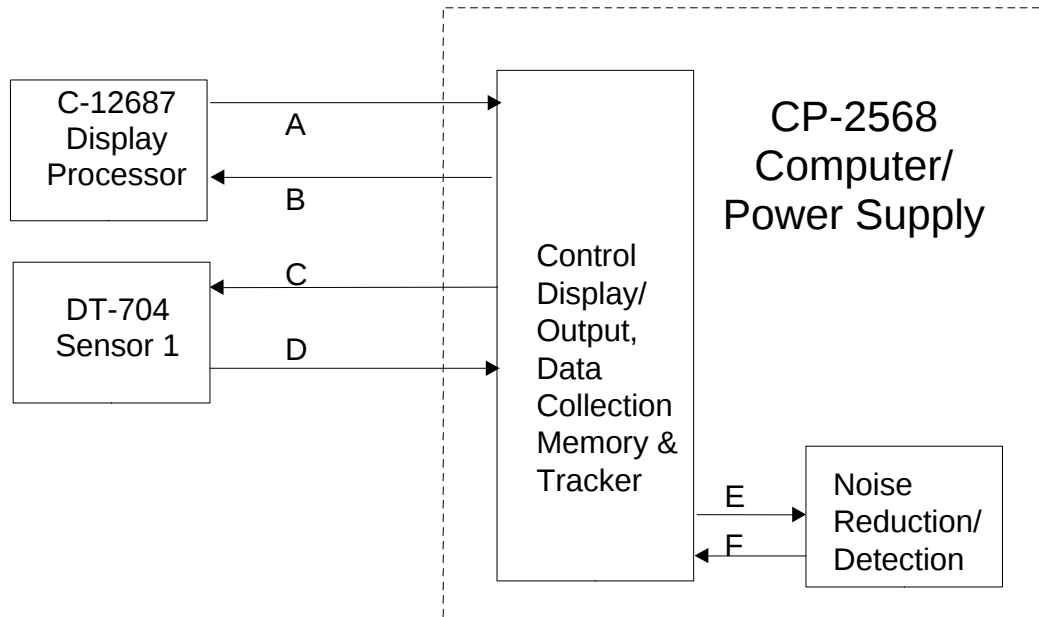


Figure 4 – Message data interfaces for data archival & noise reduction/detection processing

### 3.3 Formats and Interfaces.

Data is transferred using common message formats through interfaces between subsystems. Formats are logical and functional groupings of data. The message format tables and their sub-field definition tables are listed in Table 1. GPS data, described in paragraph 3.3.2.5, is maintained throughout in Little Endian format. All other data in all Formats is defined in Big Endian format with the most significant byte of a multi-byte item assigned to the byte with the smallest valued address with decreasingly significant bytes assigned subsequently larger valued byte addresses. Likewise, bit assignments are Big Endian with the most significant bit in a bit defined field assigned to the lowest bit position of 0 and adjacent bits assigned to succeeding larger or higher bit positions. An example of the Big Endian address assignment is provided in Figure 5. Interfaces convey a variety of Message Formats. The letters A, B, C, D, E, F, G, and H in Figure 1 through Figure 4 represent data interfaces between subsystems. The relationship between interfaces and formats is specified in Table 2.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**Figure 5– Big Endian Byte and Bit Order**

|                |                 |                 |                 |
|----------------|-----------------|-----------------|-----------------|
| Bit order      | 0 1 2 3 4 5 6 7 | 0 1 2 3 4 5 6 7 | 0 1 2 3 4 5 6 7 |
| Byte Order     | 0               | 1               | 2               |
| Register Value | 01001101        | 10010100        | 11011001        |
| Memory Value   | 01001101        | 10010100        | 11011001        |

### 3.3.1 GPS Data

All GPS data in Format 1 messages is in Little Endian format as provided by the Novatel GPS board.

**Table 1 - List of Message Formats**

| Message Format Name                                                      |
|--------------------------------------------------------------------------|
| Table 3 - <b>Format 1</b> Sensor Data and Control Response               |
| Table 4 - Format 1 Control Status – Search/Reference Designation         |
| Table 5 - Format 1 Control Status Decode                                 |
| Table 6 - Sensor Search/Reference Designation Decode                     |
| Table 7 - Manufacturer Serial Number                                     |
| Table 8 - Component Type Decode                                          |
| Table 9 Sensor Status Field Decode                                       |
| Table 10 - Format 1 Sensor BIT Status Decode                             |
| Table 11 - GPS Data Buffer Format Definition for 10 Hz Logs              |
| Table 12 - Binary Message Header Structure                               |
| Table 13 - <i>MARKPOS, MARK2POS Position at Time of Mark Input Event</i> |
| Table 14 - <i>BESTPOS Best Position</i>                                  |
| Table 15 - Position or Velocity Type                                     |
| Table 16 - Solution Status                                               |
| Table 17 - <i>BESTVEL Best Available Velocity Data</i>                   |
| Table 18 - <b>Format 2</b> Sensor Internal Control Data                  |
| Table 19 FPGA Write/Read Block Definition                                |
| Table 20 FPGA Read Block Definition                                      |
| Table 21 - <b>Format 3</b> Sensor Compensation Control Data              |
| Table 22 - <b>Format 4</b> System Control                                |
| Table 23 - Format 4 Mode/Command Decode                                  |
| Table 24 - Format 4 BIT Status Decode                                    |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| <b>Message Format Name</b>                                                          |
|-------------------------------------------------------------------------------------|
| Table 25 - Format 4 System Status                                                   |
| Table 26 ENRAD Processing Channel Selection Table                                   |
| Table 27 Fast Adaptive Pendulum Noise Reduction Reference Channel Selection Options |
| Table 28 Fast Adaptive Pendulum Noise Reduction Main Channel Selection              |
| Table 29 - <b>Format 5</b> Pre-Mapped Target Data                                   |
| Table 30 - <b>Format 6</b> False Target Data Output                                 |
| Table 31 - <b>Format 7</b> Track Data                                               |
| Table 32 Format 7 Tracker Status Decode                                             |
| Table <b>33</b> - Format 8 – Detection Data                                         |
| Table 34 Format 8 Detection Status Decode                                           |
| Table 35 - <b>Format 9</b> Time Domain Noise Reduced Data                           |
| Table 36 Format 9 Status Decode                                                     |
| Table 37 - <b>Format 10</b> Frequency Domain Real-Time Noise Data                   |
| Table 39 - <b>Format 11</b> High Speed Debug Data                                   |
| Table 40 - <b>Format 12</b> Start/End Playback/Retrieve                             |
| Table 41 - <b>Format 13</b> Recorded File Directory Readout                         |
| Table 42 - <b>Format 14</b> Message Recording Wrapper                               |
| Table 43 - <b>Format-15</b> Noise Reduction/Detection Processing Control            |
| Table 44 -- Format 15 Mode/Command Decode Option 1 - Test Mode                      |
| Table 45 -- Format 15 Mode/Command Decode Option 2 - Normal Mode                    |
| Table 46 -- Format 15 Mode/Command Decode Option 3 - Playback Mode                  |
| Table 47 - Noise Box Control Decode                                                 |
| Table 48 - ENRAD Processing Channel Selection Table                                 |
| Table 49 - <b>Format-16</b> System Diagnostic Status Information                    |
| Table 50 - <b>Format-17</b> Noise Reduction/Detection Initialization Status         |
| Table 51 – <b>Format 18</b> Command Track Generation                                |
| Table 52 - <b>Format 19</b> Tracker Input Data                                      |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**Table 2 - Interface/Format Relationship**

| <b>Interface</b> | <b>Originator</b>               | <b>Transfers Message<br/>Formats</b>             | <b>Netcentric<br/>Data</b> |
|------------------|---------------------------------|--------------------------------------------------|----------------------------|
| A                | Display Processor               | 3, 4, 18                                         | 5                          |
| B                | Computer/Power Supply           | 1, 2, 3, 4, 6, 7, 8, 9, 10, 11,<br>12, 13,14, 16 | 6                          |
| C                | Computer/Power Supply           | 1, 3, 12                                         |                            |
| D                | Sensor                          | 1, 2, 3, 11,12                                   |                            |
| E                | Control/Display/Output/Tracker  | 1,12, 15                                         | 5                          |
| F                | Noise Reduction/Detection       | 8, 9, 10                                         | 6                          |
| G                | Computer/ Power Supply          | 1, 3, 4                                          |                            |
| H                | Airborne Computer/ Power Supply | 1, 2, 3, 4,11, 12, 13,14                         |                            |

The formats are described in detail in the following paragraphs.

### 3.3.2 Format 1 – Sensor Data and Control Response

Table 3 - Format 1 Sensor Data and Control Response summarizes the message data layout for Format 1 which contains Sensor Data and Control Response to and from the Computer/Power Supply, Display processor, and the DT-704 sensor. Other than the total field magnetometer signal, each data block contains output from a vector magnetometer, a three-axis accelerometer, and a Novatel Global Positioning System (GPS) unit contained within the AN/ASQ-233 sensor head. Built-In Test (BIT) and control status words are recorded as well. Detailed formats for the Control Status-Search/Reference Designation, Manufacturer Serial Number, BIT Status Decode, and the GPS data are described in following paragraphs.

**Table 3 - Format 1 Sensor Data and Control Response**

| Relative Base Address (bytes) | Item                                                          | Size (bits) | Definition Units/LSB Value/Other        |
|-------------------------------|---------------------------------------------------------------|-------------|-----------------------------------------|
| 0                             | ID                                                            | 8           | 00000001B                               |
| 1                             | Reserved                                                      | 24          | TBD                                     |
| 4                             | Message Length                                                | 32          | 93                                      |
| 8                             | Source MSN                                                    | 16          | See Manufacturer Serial Number Decode   |
| 10                            | Destination MSN                                               | 16          | See Manufacturer Serial Number Decode   |
| 12                            | Sample Count                                                  | 32          | 1                                       |
| 16                            | Control Status-Search/Reference Designation                   | 16          | 1                                       |
| 18                            | Compensated Total Field                                       | 64          | nT (DPFP)                               |
| 26                            | DT-704 Uncompensated Total Field Cluster A, or Magnetometer A | 40          | $6.4906 \times 10^{-7}$ nT (See Note 1) |
| 31                            | DT-704 Uncompensated Total Field Cluster B, or Magnetometer B | 40          | $6.4906 \times 10^{-7}$ nT (See Note 1) |
| 36                            | Vector Magnetometer—T Component (See Note 2)                  | 24          | 0.0077486 nT                            |
| 39                            | Vector Magnetometer—L Component (See Note 2)                  | 24          | 0.0077486 nT                            |
| 42                            | Vector Magnetometer—D Component (See Note 2)                  | 24          | 0.0077486 nT                            |
| 45                            | Vector Magnetometer Corrected—T Component (See Note 2)        | 64          | nT (DPFP)                               |
| 53                            | Vector Magnetometer Corrected—L Component (See Note 2)        | 64          | nT (DPFP)                               |
| 61                            | Vector Magnetometer Corrected—D Component (See Note 2)        | 64          | nT (DPFP)                               |
| 69                            | 3-Axis Accelerometer—T Component (See Note 2)                 | 16          | 0.120 mG                                |
| 71                            | 3-Axis Accelerometer—L Component (See Note 2)                 | 16          | 0.120 mG                                |
| 73                            | 3-Axis Accelerometer—D Component (See Note 2)                 | 16          | 0.120 mG                                |
| 75                            | Sensor Status                                                 | 32          | See Sensor Status Decode                |
| 79                            | Closest Match Sample Count                                    | 32          | 1 (See Note 3)                          |

<sup>1</sup>  $20 \times 10^6 / (28.025 \times 2^{40})$  represents the expression from which the  $6.4906 \times 10^{-7}$  LSB value is derived, where 28.025 is the conversion scale factor from Frequency (Hz) to magnetic field (nT).  $2^{40}$  accounts for the field size in bits.  $20 \times 10^6$  represents the idealized clock speed in MHz. This LSB value will remain constant regardless of the actual clock speed.

<sup>2</sup> T is Transverse with Positive North on West heading, L is Longitudinal with Positive South on North heading, D is Positive Down.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | Item              | Size (bits) | Definition Units/LSB Value/Other    |
|-------------------------------|-------------------|-------------|-------------------------------------|
| 83                            | Sensor BIT Status | 16          | See Sensor <u>BIT Status Decode</u> |
| 85                            | GPS Buffer Offset | 8           |                                     |
| 86                            | GPS Data Buffer   | 56          |                                     |

### 3.3.2.1 Control Status-Search/Reference Designation

The following table defines the elements of Control Status – Search/Reference Designation provided in Format 1 by the DT-704 sensor. These codes are written once every system cycle (430.44 Hz) as a 16-bit field to the message data block starting at byte address 16, and can be used to identify both control status (commanded and acknowledged) as well as reference and search sensor designation.

**Table 4 - Format 1 Control Status – Search/Reference Designation**

| Control Status – Search/Reference Designation  |                              |                     |                                                          |
|------------------------------------------------|------------------------------|---------------------|----------------------------------------------------------|
| Subfield Alignment (Left to Right)<br>0-----15 | Item                         | Field Length (Bits) | Definition                                               |
| 0-----11                                       | Control Status               | 12                  | See Control Status Decode                                |
| 12-----15                                      | Search/Reference Designation | 4                   | See Table 6 - Sensor Search/Reference Designation Decode |

#### 3.3.2.1.1 Control Status Decode for Format 1

Table 5 provides the control status decode for control of the DT-704 total field magnetometer. One of these codes is output every system cycle (430.44 Hz) as a 12-bit field to the message data block at the starting byte address 16 in response to commanded operation, and can be used by other system functions to monitor the status of the total field magnetometer operation.

**Table 5 - Format 1 Control Status Decode**

| Control Status Value |              | Definition                                           |
|----------------------|--------------|------------------------------------------------------|
| Command/Response     | (Binary)     |                                                      |
| (1/0)                | 000 00000000 | No Change                                            |
| (1/0)                | 000 00000001 | Send format 00000001B (toggles format 00001011B OFF) |
| (1/0)                | 000 00000010 | Send format 00000010B once                           |
| (1/0)                | 000 00000011 | Send format 00000011B once                           |
| (1/0)                | 000 00000100 | Send format 00001011B (toggles format 00000001B OFF) |
| (1/0)                | 000 00000101 | Do not transmit any formats                          |

<sup>3</sup> Closest Match Sample Count is added to Format 1 by Sensor-to-Sensor Data Alignment to indicate best time matched samples in two sensor data streams. If no second sensor data stream exists or if no sample count matches this sample within limits, the value is zero, and "Closest Match Sample Count Valid" in Sensor Status Field is set to "False".

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Control Status Value |              | Definition                                       |
|----------------------|--------------|--------------------------------------------------|
| Command/<br>Response | (Binary)     |                                                  |
| (1/0)                | 000 00000110 | Synchronize/Reset Sampling at Next GPS PPS Pulse |
| (1/0)                | 000 00000111 | Reset (Reboot)                                   |
| (1/0)                | 000 00001000 | Auto BIT                                         |
| (1/0)                | 000 00001001 | BIT Stop                                         |
| (1/0)                | 000 00001010 | Test Processor                                   |
| (1/0)                | 000 00001011 | Test Sensor                                      |
| (1/0)                | 000 00001100 | Test GPS                                         |
| (1/0)                | 000 00001101 | Test Vector                                      |
| (1/0)                | 000 00001110 | Test Laser/Driver                                |
| (1/0)                | 000 00001111 | Test Resonance PWB                               |
| (1/0)                | 000 00010000 | Send Sensor Optimization Coefficients            |
| (1/0)                | 000 00010001 | Apply Received Sensor Optimization Coefficients  |
| (1/0)                | 000 00010010 | Compensation Coefficient Application Begun       |
| (1/0)                | 000 00010011 | Optimize                                         |
| (1/0)                | 000 00010100 | Compensator coefficients applied                 |
| (1/0)                | 000 00010101 | Not assigned                                     |
| (1/0)                | 000 00010110 | Open laser loop                                  |
| (1/0)                | 000 00010111 | Close laser loop                                 |
| (1/0)                | 000 00011000 | Open resonance A loop                            |
| (1/0)                | 000 00011001 | Close resonance A loop                           |
| (1/0)                | 000 00011010 | Connect RO sweep D/A 1                           |
| (1/0)                | 000 00011011 | Connect RO sweep D/A 2                           |
| (1/0)                | 000 00011100 | Connect laser sweep D/A 1                        |
| (1/0)                | 000 00011101 | Connect laser sweep D/A 2                        |
| (1/0)                | 000 00011110 | Connect AX error signal D/A 1                    |
| (1/0)                | 000 00011111 | Connect AX error signal D/A 2                    |
| (1/0)                | 000 00100000 | Connect AY error signal D/A 1                    |
| (1/0)                | 000 00100001 | Connect AY error signal D/A 2                    |
| (1/0)                | 000 00100010 | Connect AZ error signal D/A 1                    |
| (1/0)                | 000 00100011 | Connect AZ error signal D/A 2                    |
| (1/0)                | 000 00100100 | Connect BX error signal D/A 1                    |
| (1/0)                | 000 00100101 | Connect BX error signal D/A 2                    |
| (1/0)                | 000 00100110 | Connect BY error signal D/A 1                    |
| (1/0)                | 000 00100111 | Connect BY error signal D/A 2                    |
| (1/0)                | 000 00101000 | Connect BZ error signal D/A 1                    |
| (1/0)                | 000 00101001 | Connect BZ error signal D/A 2                    |
| (1/0)                | 000 00101010 | Connect summed error signal D/A 1                |
| (1/0)                | 000 00101011 | Connect summed error signal D/A 2                |
| (1/0)                | 000 00101100 | Connect summed chopper D/A 1                     |
| (1/0)                | 000 00101101 | Connect summed chopper D/A 2                     |
| (1/0)                | 000 00101110 | AX sum ON                                        |
| (1/0)                | 000 00101111 | AX sum OFF                                       |
| (1/0)                | 000 00110000 | AY sum ON                                        |
| (1/0)                | 000 00110001 | AY sum OFF                                       |
| (1/0)                | 000 00110010 | AZ sum ON                                        |
| (1/0)                | 000 00110011 | AZ sum OFF                                       |
| (1/0)                | 000 00110100 | BX sum ON                                        |
| (1/0)                | 000 00110101 | BX sum OFF                                       |
| (1/0)                | 000 00110110 | BY sum ON                                        |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Control Status Value |               | Definition                  |
|----------------------|---------------|-----------------------------|
| Command/<br>Response | (Binary)      |                             |
| (1/0)                | 000 00110111  | BY sum OFF                  |
| (1/0)                | 000 00111000  | BZ sum ON                   |
| (1/0)                | 000 00111001  | BZ sum OFF                  |
| (1/0)                | 000 00111010  | Connect RO AGC D/A 1        |
| (1/0)                | 000 00111011  | Connect RO AGC D/A 2        |
| (1/0)                | 000 00111100  | Connect laser AGC D/A 1     |
| (1/0)                | 000 00111101  | Connect laser AGC D/A 2     |
| (1/0)                | 000 00111110  | Open resonance B loop       |
| (1/0)                | 000 00111111  | Close resonance B loop      |
| (1/0)                | 000 01000000  | Open resonance C loop       |
| (1/0)                | 000 01000001  | Close resonance C loop      |
| (1/0)                | 000 01000010  | Open resonance D loop       |
| (1/0)                | 000 01000011  | Close resonance D loop      |
| (1/0)                | 000 01000100  | Playback ON                 |
| (1/0)                | 000 01000101  | Playback OFF                |
| (1/0)                | 000 01000110  | Lock laser to AX            |
| (1/0)                | 000 01000111  | Lock laser to AY            |
| (1/0)                | 000 01001000  | Lock laser to AZ            |
| (1/0)                | 000 01001001  | Lock laser to BX            |
| (1/0)                | 000 01001010  | Lock laser to BY            |
| (1/0)                | 000 01001011  | Lock laser to BZ            |
| (1/0)                | .000 01001100 | [not assigned] (see Note 4) |
| (1/0)                | .             | .                           |
| (1/0)                | .             | .                           |
| (1/0)                | 000 10000000  | [not assigned] (see Note 4) |

Commands are sent from the CP-2568, Computer/Power Supply, to the DT-704, sensor, with Command/Response set to 1. The DT-704 acknowledges and responds with the indicated Command Value and the Command/Response set to 0 in a subsequent Format 1 output when, either the command has been acted upon, or the commanded activity has been initiated, depending upon the nature of the commanded action. For commands that cause interruption in Format 1 Message transmission, such as "Send format 00001011B" and "Do not transmit any formats", one Format 1 will be sent to acknowledge the command. Normal Format 1 output by the DT-704 will include a Control Status of 0000 00000000 reporting no change from last command.

<sup>4</sup> No Control Status definition assigned

### 3.3.2.1.2 Sensor Search/Reference Designation Decode for Format 1

Table 6 defines the valid settings for the Sensor Search/Reference Designation Field of the Control Status – Search/Reference Designation item found at byte offset 16 of the Format 1 message. This field is used to indicate which of two streams of DT-704 sensor data is to be used as reference data and which is to be treated as search data for noise reduction purposes. Prior to designation in any system operation, all sensors will report “No Designation”, 0000B.

**Table 6 - Sensor Search/Reference Designation Decode**

| <b>Sensor Search/Reference Designation (Binary)</b> | <b>Definition</b>     |
|-----------------------------------------------------|-----------------------|
| 0000                                                | No Designation (Test) |
| 0001                                                | Search                |
| 0010                                                | Reference             |
| 0011                                                | Not Defined           |
| :                                                   | Not Defined           |
| :                                                   | Not Defined           |
| 1111                                                | Not Defined           |

### 3.3.2.2 Manufacturer Serial Number

The Manufacturer Serial Number (MSN) field, described in Table 7 consists of a Component Type sub-field and a Component Serial Number sub-field which, together, define a unique identifying number. Table 8 defines the valid settings of the Component Type sub-field.

**Table 7 - Manufacturer Serial Number**

| <b>Manufacturer Serial Number</b>         |                         |                            |                           |
|-------------------------------------------|-------------------------|----------------------------|---------------------------|
| <b>Subfield Alignment (Left to Right)</b> | <b>Item</b>             | <b>Field Length (Bits)</b> | <b>Definition</b>         |
| <b>0-----15</b>                           |                         |                            |                           |
| <b>0---3</b>                              | Component Type          | 4                          | See Component Type Decode |
| <b>4-----15</b>                           | Component Serial Number | 12                         | Assigned Serial Number    |

**Table 8 - Component Type Decode**

| <b>Type Code (Binary)</b> | <b>Definition</b>                                     |
|---------------------------|-------------------------------------------------------|
| 0000                      | P2000 (test)                                          |
| 0001                      | DT-704 Sensor                                         |
| 0010                      | Computer Power Supply (Detection Capable) CPS Control |
| 0011                      | Computer Power Supply (Record & Relay) CPS Control    |
| 0100                      | Display/Control Processor                             |
| 0101                      | Display Processor                                     |
| 0110                      | Test Controller                                       |
| 0111                      | CPS Noise Reduction Detection                         |
| 1000                      | Maintenance Console                                   |
| :                         | Not Defined                                           |
| :                         | Not Defined                                           |
| 1111                      | Not Defined                                           |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**3.3.2.3 Sensor Status Decode for Format 1**

Table 9 provides the definition of the Sensor Status field from the DT-704 sensor. These codes are written once every system cycle (430.44 Hz) as a 4-byte field to the message data block starting at byte address 75, for use by control and processing components of the system to monitor sensor status.

**Table 9 Sensor Status Field Decode**

| <b>Sensor Status Field</b>                    |                                                          |                                  |
|-----------------------------------------------|----------------------------------------------------------|----------------------------------|
| <b>Sub-Field<br/>Bit Position<br/>0-----7</b> | <b>Field Name</b>                                        | <b>Definition</b>                |
| 0                                             | Sample Count Reset on this Sample                        | 0 = False, 1 = True              |
| 1                                             | Sample Count Rejected by Alignment Function <sup>5</sup> | 0 = False, 1 = True              |
| 2                                             | Laser Locked                                             | 0 = False, 1 = True              |
| 3                                             | Sensor Locked                                            | 0 = False, 1 = True <sup>6</sup> |
| 4                                             | Closest Match Sample Count Valid                         | 0 = False, 1 = True <sup>7</sup> |
| 5                                             | Noise Box Sample                                         | 0 = False, 1 = True <sup>8</sup> |
| 6                                             | Not Assigned                                             | 0                                |
| *                                             | *                                                        | 0                                |
| *                                             | *                                                        | 0                                |
| *                                             | *                                                        | 0                                |
| *                                             | *                                                        | 0                                |
| *                                             | *                                                        | 0                                |
| *                                             | *                                                        | 0                                |
| *                                             | *                                                        | 0                                |
| *                                             | *                                                        | 0                                |
| 15                                            | Not Assigned                                             | 0                                |
| 16                                            | Laser Locked                                             | 0 = False, 1 = True              |
| 17                                            | Mag Locked                                               | 0 = False, 1 = True              |
| 18                                            | Cell A sustain                                           | 0 = False, 1 = True              |
| 19                                            | Cell B sustain                                           | 0 = False, 1 = True              |
| 20                                            | Cell C sustain                                           | 0 = False, 1 = True              |
| 21                                            | Cell D sustain                                           | 0 = False, 1 = True              |
| 22                                            | Cell E sustain                                           | 0 = False, 1 = True              |
| 23                                            | Cell F sustain                                           | 0 = False, 1 = True              |
| 24                                            | Laser Sweeping                                           | 0 = False, 1 = True              |
| 25                                            | Mag Sweeping                                             | 0 = False, 1 = True              |
| 26                                            | Sensor Balanced                                          | 0 = False, 1 = True              |
| 27                                            | Temp Above 55°C                                          | 0 = False, 1 = True              |
| 28                                            | Temp Above 65°C                                          | 0 = False, 1 = True              |
| 29                                            | Spare                                                    |                                  |
| 30                                            | Spare                                                    |                                  |
| 31                                            | Spare                                                    |                                  |

<sup>5</sup> Assigned at Detection CPS indicating a sample not supplied to Noise Reduction/Detection.

<sup>6</sup> Sensor Locked = False indicates the sample is not to be supplied to Noise Reduction/Detection because sensor data fields have not stabilized.

<sup>7</sup> Assigned at Detection CPS indicating the sample contains a valid Closest Match Sample Count value

<sup>8</sup> Assigned at Detection CPS Control indicating the sample has been saved for Noise Box reprocessing by Noise Reduction/Detection Processor.

### 3.3.2.4 Sensor BIT Status Decode for Format 1

The following table provides the sensor BIT status decode provided by the DT-704 sensor. These codes are written once every system cycle (430.44 Hz) as a 2-byte field to the message data block starting at byte address 83, and can be used by the noise reduction and detection processor to monitor system status.

**Table 10 - Format 1 Sensor BIT Status Decode**

| BIT Test Value<br>(Binary) | Definition                                |
|----------------------------|-------------------------------------------|
| 00000000 00000000          | No detected failures; operation normal    |
| 00000000 00000001          | Processor Board Time-Out Failure          |
| 00000000 00000010          | Processor Board Real-Time BIT Failure     |
| 00000000 00000011          | Processor Board Dedicated BIT Failure     |
| 00000000 00000100          | Loop Board Time-Out Failure               |
| 00000000 00000101          | Loop Board Real-Time BIT Failure          |
| 00000000 00000110          | Loop Board Dedicated BIT Failure          |
| 00000000 00000111          | Sensor Time-Out Failure                   |
| 00000000 00001000          | Sensor Real-Time BIT Failure              |
| 00000000 00001001          | Sensor Dedicated BIT Failure              |
| 00000000 00001010          | GPS Time-Out Failure                      |
| 00000000 00001011          | GPS Real-Time Failure                     |
| 00000000 00001100          | GPS Dedicated BIT Failure                 |
| 00000000 00001101          | Vector Magnetometer Time-Out Failure      |
| 00000000 00001110          | Vector Magnetometer Real-Time BIT Failure |
| 00000000 00001111          | Vector Magnetometer Dedicated BIT Failure |
| 00000000 00010000          | [not assigned] (see Note 9)               |
| .                          | .                                         |
| .                          | .                                         |
| 11111111 11111111          | [not assigned] (see Note 9)               |

### 3.3.2.5 GPS Data for Format 1

The following table provides the format of the GPS position and time data recorded to the message data block<sup>10</sup>. For complete GPS details refer to the Novatel Users' Guide OEM4 Family of Receivers Command and Log Reference Revision 8 Firmware Version 1.400.

**Table 11 - GPS Data Buffer Format Definition for 10 Hz Logs**

| Relative<br>Base<br>Address<br>(bytes) | Item                  | Size (bits) | Definition                                                                           |
|----------------------------------------|-----------------------|-------------|--------------------------------------------------------------------------------------|
| 0                                      | Markposb (binary) log | 832         | ONNEW (Event Mark) Asynch trigger for every 44 <sup>th</sup> 430 Hz sample = 9.77 Hz |
| 104                                    | Bestposb (binary) log | 832         | ONTIME 0.10 synch trigger (100 msec = 10 Hz, synchronous with GPS sec)               |
| 208                                    | bestvelb (binary) log | 608         | ONTIME 0.10 synch trigger (100 msec = 10 Hz, synchronous with GPS sec)               |

<sup>9</sup> No sensor BIT status definition assigned.

<sup>10</sup> GPS data will not actually be available if the GPS antenna is not installed or is unable to locate a satellite constellation.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

|     |               |     |  |
|-----|---------------|-----|--|
| 284 | filler(spare) | 192 |  |
|-----|---------------|-----|--|

GPS Log Notes:

1. The Novatel OEM4 GPS Receiver User's Guide (Vol. 1 & 2) in PDF form is available at [www.novatel.ca](http://www.novatel.ca). The Tables below, Table 12 through Table 17, describing GPS log formats are excerpted from the Novatel OEM4 GPS Receiver User's Guide (Vol. 1 & 2) and are copyrighted by Novatel, Inc.
2. Each log has a header that contains header length, message ID, message length, Idle Time, Time Status, Time (type of time depends on log), Receiver Status.

**Table 12 - Binary Message Header Structure**

| Field # | Field Name           | Field Type | Description                                                                                                                                                                                                                                  | Binary Bytes | Binary Offset | Ignored on Input |
|---------|----------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|------------------|
| 1       | Sync                 | Char       | Hexadecimal 0xAA.                                                                                                                                                                                                                            | 1            | 0             | N                |
| 2       | Sync                 | Char       | Hexadecimal 0x44.                                                                                                                                                                                                                            | 1            | 1             | N                |
| 3       | Sync                 | Char       | Hexadecimal 0x12.                                                                                                                                                                                                                            | 1            | 2             | N                |
| 4       | Header Length        | Uchar      | Length of the header.                                                                                                                                                                                                                        | 1            | 3             | N                |
| 5       | Message ID           | Ushort     | This is the Message ID number of the.                                                                                                                                                                                                        | 2            | 4             | N                |
| 6       | Message Type         | Char       | Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit 0 = Original Message 1 = Response Message                                                                       | 1            | 6             | N                |
| 7       | Port Address         | Char       | (decimal values greater than 16 may be used) (lower 8 bits only) a                                                                                                                                                                           | 1            | 7             | N b              |
| 8       | Message Length       | Ushort     | The length in bytes of the body of the message. This does not include the header nor the CRC.                                                                                                                                                | 2            | 8             | N                |
| 9       | Sequence             | Ushort     | This is used for multiple related logs. It is a number that counts down from N-1 to 0 where N is the number of related logs and 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0. | 2            | 10            | N                |
| 10      | Idle Time            | Char       | The percentage of time that the processor is idle in the last second. Take the time (0 - 200) and divide by two to give the percentage of time (0 - 100%).                                                                                   | 1            | 12            | Y                |
| 11      | Time Status          | Enum       | Indicates the quality of the GPS                                                                                                                                                                                                             | 1 c          | 13            | N d              |
| 12      | Week                 | Ushort     | GPS week number.                                                                                                                                                                                                                             | 2            | 14            | N d              |
| 13      | Milliseconds         | GPSec      | Milliseconds from the beginning of the GPS week.                                                                                                                                                                                             | 4            | 16            | N d              |
| 14      | Receiver Status      | Ulong      | 32 bits representing the status of various hardware and software components of the receiver                                                                                                                                                  | 4            | 20            | Y                |
| 15      | Reserved             | Ushort     | Reserved for internal use.                                                                                                                                                                                                                   | 2            | 24            | Y                |
| 16      | Receiver S/W Version | Ushort     | This is a value (0 - 65535) that represents the receiver software build number.                                                                                                                                                              | 2            | 26            | Y                |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

3. The 430 Hz sample Mark Event time of the markposb log is associated with the 1<sup>st</sup> of 44 (430 Hz) samples (identified by the GPS Buffer Offset Count = 0).

**Table 13 - MARKPOS, MARK2POS Position at Time of Mark Input Event**

| Field # | Field type   | Data Description                                                            | Format  | Binary Bytes | Binary Offset |
|---------|--------------|-----------------------------------------------------------------------------|---------|--------------|---------------|
| 1       | header       | Log header                                                                  |         | H            | 0             |
| 2       | sol status   | Solution status (see Table 12, <i>Solution Status</i> , )                   | Enum    | 4            | H             |
| 3       | pos type     | Position type (see Table 11, )                                              | Enum    | 4            | H+4           |
| 4       | lat          | Latitude                                                                    | Double  | 8            | H+8           |
| 5       | lon          | Longitude                                                                   | Double  | 8            | H+16          |
| 6       | hgt          | Height above mean sea level                                                 | Double  | 8            | H+24          |
| 7       | undulation   | Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) | Float   | 4            | H+32          |
| 8       | datum id#    | Datum ID number                                                             | Enum    | 4            | H+36          |
| 9       | lat $\sigma$ | Latitude standard deviation                                                 | Float   | 4            | H+40          |
| 10      | lon $\sigma$ | Longitude standard deviation                                                | Float   | 4            | H+44          |
| 11      | hgt $\sigma$ | Height standard deviation                                                   | Float   | 4            | H+48          |
| 12      | stn id       | Base station ID                                                             | Char[4] | 4            | H+52          |
| 13      | diff_age     | Differential age in seconds                                                 | Float   | 4            | H+56          |
| 14      | sol_age      | Solution age in seconds                                                     | Float   | 4            | H+60          |
| 15      | #obs         | Number of observations tracked                                              | Uchar   | 1            | H+64          |
| 16      | #GPSL1       | Number of GPS L1 ranges used in computation                                 | Uchar   | 1            | H+65          |
| 17      | #L1          | Number of GPS L1 ranges above the RTK mask angle                            | Uchar   | 1            | H+66          |
| 18      | #L2          | Number of GPS L2 ranges above the RTK mask angle                            | Uchar   | 1            | H+67          |
| 19      | Reserved     |                                                                             | Uchar   | 1            | H+68          |
| 20      |              |                                                                             | Uchar   | 1            | H+69          |
| 21      |              |                                                                             | Uchar   | 1            | H+70          |
| 22      |              |                                                                             | Uchar   | 1            | H+71          |
| 23      | xxxx         | 32-bit CRC (ASCII and Binary only)                                          | Hex     | 4            | H+72          |
| 24      | [CR][LF]     | Sentence terminator (ASCII only)                                            | -       | -            | -             |

*This log contains the estimated position of the antenna when a pulse is detected at a mark input. MARKPOS is a result of a pulse on the MK1I input and MARK2POS is generated when a pulse occurs on a MK2I input.*

*The position at the mark input pulse is extrapolated using the last valid position and velocities. The latched time of mark impulse is in GPS weeks and seconds into the week. The resolution of the latched time is 49 ns.*

4. The GPS Week (2 bytes) and GPS milli-Seconds (4 Bytes) in the Header of the markposb log are located with byte offsets of 14 and 16 into the GPS Data Buffer. These also equate to byte offsets of 0 and 2 of the 3MDS Format 1 data sample whose GPS Buffer Offset Count = 2. (GPS Buffer Offset Count has a byte offset of 85 in every 3MDS Format 1 data (430 Hz) sample).
5. The Lat (8 bytes) and Lon (8 bytes) of the markposb log are located with byte offsets of H(Hdr len)+8 = 28+8=36 and H+16=28+16=44 into the GPS Data Buffer. For the Lat, this equates to a byte offset of 1 of the 3MDS Format 1 data sample whose GPS Buffer Offset Count = 5. For the

### 3MDS IDD

0BSB2-03-C-0388-01 Rev I

Lon, this equates to a byte offset of 2 of the 3MDS Format 1 data sample whose GPS Buffer Offset Count = 6. (GPS Buffer Offset Count has a byte offset of 85 in every 3MDS Format 1 data (430 Hz) sample).

6. The Altitude (8 bytes) in meters of the markposb log is located with a byte offset of  $H(\text{Hdr len})+24 = 28+24=52$  into the GPS Data Buffer. This equates to a byte offset of 3 of the 3MDS Format 1 data sample whose GPS Buffer Offset is 7.
7. The GPS milli-Seconds (4 bytes) in the Header of the bestposb log is located with a byte offset of 120 into the GPS Data Buffer. This also equates to a byte offset of 1 of the 3MDS Format 1 data sample whose GPS Buffer Offset Count = 17. (GPS Buffer Offset Count has a byte offset of 85 in every 3MDS Format 1 data (430 Hz) sample).
8. The GPS milli-Seconds (4 bytes) in the Header of the bestvelb log is located with a byte offset of 224 into the GPS Data Buffer. This also equates to a byte offset of 0 of the 3MDS Format 1 data sample whose GPS Buffer Offset Count = 32.

**Table 14 - BESTPOS Best Position**

| Field # | Field type   | Data Description                                                            | Format  | Binary Bytes | Binary Offset |
|---------|--------------|-----------------------------------------------------------------------------|---------|--------------|---------------|
| 1       | header       | Log header                                                                  |         | H            | 0             |
| 2       | sol status   | Solution status, see Table 12)                                              | Enum    | 4            | H             |
| 3       | pos type     | Position type, see Table 11                                                 | Enum    | 4            | H+4           |
| 4       | lat          | Latitude                                                                    | Double  | 8            | H+8           |
| 5       | lon          | Longitude                                                                   | Double  | 8            | H+16          |
| 6       | hgt          | Height above mean sea level                                                 | Double  | 8            | H+24          |
| 7       | undulation   | Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) | Float   | 4            | H+32          |
| 8       | datum id#    | Datum ID                                                                    | Enum    | 4            | H+36          |
| 9       | lat $\sigma$ | Latitude standard deviation                                                 | Float   | 4            | H+40          |
| 10      | lon $\sigma$ | Longitude standard deviation                                                | Float   | 4            | H+44          |
| 11      | hgt $\sigma$ | Height standard deviation                                                   | Float   | 4            | H+48          |
| 12      | stn id       | Base station ID                                                             | Char[4] | 4            | H+52          |
| 13      | diff_age     | Differential age in seconds                                                 | Float   | 4            | H+56          |
| 14      | sol_age      | Solution age in seconds                                                     | Float   | 4            | H+60          |
| 15      | #obs         | Number of observations tracked                                              | Uchar   | 1            | H+64          |
| 16      | #GPSL1       | Number of GPS L1 ranges used in computation                                 | Uchar   | 1            | H+65          |
| 17      | #L1          | Number of GPS L1 ranges above the RTK mask angle                            | Uchar   | 1            | H+66          |
| 18      | #L2          | Number of GPS L2 ranges above the RTK mask angle                            | Uchar   | 1            | H+67          |
| 19      | Reserved     |                                                                             | Uchar   | 1            | H+68          |
| 20      |              |                                                                             | Uchar   | 1            | H+69          |
| 21      |              |                                                                             | Uchar   | 1            | H+70          |
| 22      |              |                                                                             | Uchar   | 1            | H+71          |
| 23      | xxxx         | 32-bit CRC (ASCII and Binary only)                                          | Hex     | 4            | H+72          |
| 24      | [CR][LF]     | Sentence terminator (ASCII only)                                            | -       | -            | -             |

*This log contains the best available combined GPS and inertial navigation system (INS - if available) position computed by the receiver. In addition, it reports several status indicators, including differential*

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

age, which is useful in predicting anomalous behavior brought about by outages in differential corrections. A differential age of 0 indicates that no differential correction was used.

With the system operating in an RTK mode, this log will reflect the latest low-latency solution for up to 60 seconds after reception of the last base station observations. After this 60 second period, the position reverts to the best solution available; the degradation in accuracy is reflected in the standard deviation fields. If the system is not operating in an RTK mode, pseudorange differential solutions continue for the time specified in the DGPSTIMEOUT command.

**Table 15 - Position or Velocity Type**

| Position Type(binary) | Position Type (ASCII)           | Description                                                                   |
|-----------------------|---------------------------------|-------------------------------------------------------------------------------|
| 0                     | NONE                            | No solution                                                                   |
| 1                     | FIXEDPOS                        | Position has been fixed by the FIX POSITION command                           |
| 2                     | FIXEDHEIGHT                     | Position has been fixed by the FIX HEIGHT/AUTO command                        |
| 3                     | Reserved                        |                                                                               |
| 4                     | FLOATCONV                       | Solution from floating point carrier phase ambiguities                        |
| 5                     | WIDELANE                        | Solution from widelane ambiguities                                            |
| 6                     | NARROWLANE                      | Solution from narrowlane ambiguities                                          |
| 7                     | Reserved                        |                                                                               |
| 8                     | DOPPLER_VELOCITY                | Velocity computed using instantaneous Doppler                                 |
| 9-15                  | Reserved                        |                                                                               |
| 16                    | SINGLE                          | Single point position                                                         |
| 17                    | PSRDIFF                         | Pseudorange differential solution                                             |
| 18                    | WAAS                            | Solution calculated using corrections from an SBAS                            |
| 19                    | PROPAGATED                      | Propagated by a Kalman filter without new observations                        |
| 20                    | OMNISTAR                        | OmniSTAR VBS position (L1 sub-meter) a                                        |
| 21-31                 | Reserved                        |                                                                               |
| 32                    | L1_FLOAT                        | Floating L1 ambiguity solution                                                |
| 33                    | IONOFREE_FLOAT                  | Floating ionospheric-free ambiguity solution                                  |
| 34                    | NARROW_FLOAT                    | Floating narrow-lane ambiguity solution                                       |
| 48                    | L1_INT                          | Integer L1 ambiguity solution                                                 |
| 49                    | WIDE_INT                        | Integer wide-lane ambiguity solution                                          |
| 50                    | NARROW_INT                      | Integer narrow-lane ambiguity solution                                        |
| 51                    | RTK_DIRECT_INS                  | RTK status where the RTK filter is directly initialized from the INS filter b |
| 52-56                 | INS calculated position types b |                                                                               |
| 64                    | OMNISTAR_HP                     | OmniSTAR HP position (L1/L2 decimeter) a                                      |
| 65                    | Reserved                        |                                                                               |

- a. In addition to a NovAtel OEM4 family receiver, a NovAtel OmniSTAR L-Band receiver and a subscription to the OmniSTAR service are required. Contact NovAtel for details.
- b. Output only by the BESTPOS and BESTVEL logs when using an inertial navigation system such as NovAtel's SPAN products.
- c. Output only when using an inertial navigation system..
- d. PENDING implies there are not enough satellites being tracked to verify if the FIX POSITION entered into the receiver is valid. The receiver needs to be tracking two or more GPS satellites to perform this check. Under normal conditions you should only see PENDING for a few seconds on power up before the GPS receiver has locked onto its first few satellites. If

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

*your antenna is obstructed (or not plugged in) and you have entered a FIX POSITION command, then you may see PENDING indefinitely.*

**Table 16 - Solution Status**

| <b>Solution Status</b> |                                         | <b>Description</b>                                                                                                                        |
|------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>(Binary)</b>        |                                         |                                                                                                                                           |
| 0                      | SOL_COMPUTED                            | Solution computed                                                                                                                         |
| 1                      | INSUFFICIENT_OBS                        | Insufficient observations                                                                                                                 |
| 2                      | NO_CONVERGENCE                          | No convergence                                                                                                                            |
| 3                      | SINGULARITY                             | Singularity at parameters matrix                                                                                                          |
| 4                      | COV_TRACE                               | Covariance trace exceeds maximum (trace > 1000 m)                                                                                         |
| 5                      | TEST_DIST                               | Test distance exceeded (maximum of 3 rejections if distance > 10 km)                                                                      |
| 6                      | COLD_START                              | Not yet converged from cold start                                                                                                         |
| 7                      | V_H_LIMIT                               | Height or velocity limits exceeded (in accordance with COCOM export licensing restrictions)                                               |
| 8                      | VARIANCE                                | Variance exceeds limits                                                                                                                   |
| 9                      | RESIDUALS                               | Residuals are too large                                                                                                                   |
| 10                     | DELTA_POS                               | Delta position is too large                                                                                                               |
| 11                     | NEGATIVE_VAR                            | Negative variance                                                                                                                         |
| 12                     | Reserved                                |                                                                                                                                           |
| 13                     | INTEGRITY_WARNING                       | Large residuals make position unreliable                                                                                                  |
| 14-17                  | INS solution status values <sup>a</sup> |                                                                                                                                           |
| 18                     | PENDING                                 | When a FIX POSITION command is entered, the receiver computes its own position and determines if the fixed position is valid <sup>b</sup> |
| 19                     | INVALID_FIX                             | The fixed position, entered using the FIX POSITION command, is not valid                                                                  |

**Table 17 - BESTVEL Best Available Velocity Data**

| <b>Field #</b> | <b>Field type</b> | <b>Data Description</b>                                                                                                       | <b>Format</b> | <b>Binary Bytes</b> | <b>Binary Offset</b> |
|----------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------|----------------------|
| 1              | header            | Log header                                                                                                                    |               | H                   | 0                    |
| 2              | sol status        | Solution status                                                                                                               | Enum          | 4                   | H                    |
| 3              | vel type          | Velocity type                                                                                                                 | Enum          | 4                   | H+4                  |
| 4              | latency           | A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results. | Float         | 4                   | H+8                  |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Field # | Field type | Data Description                                                                                                                                      | Format | Binary Bytes | Binary Offset |
|---------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------|---------------|
| 5       | age        | Differential age in seconds                                                                                                                           | Float  | 4            | H+12          |
| 6       | hor spd    | Horizontal speed over ground, in meters per second                                                                                                    | Double | 8            | H+16          |
| 7       | trk gnd    | Actual direction of motion over ground (track over ground) with respect to True North, in degrees                                                     | Double | 8            | H+24          |
| 8       | vert spd   | Vertical speed, in meters per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down) | Double | 8            | H+32          |
| 9       | Reserved   |                                                                                                                                                       | Float  | 4            | H+40          |
| 10      | xxxx       | 32-bit CRC (ASCII and Binary only)                                                                                                                    | Hex    | 4            | H+44          |
| 11      | [CR][LF]   | Sentence terminator (ASCII only)                                                                                                                      | -      | -            | -             |

*This log contains the best available velocity information computed by the receiver. In addition, it reports a velocity status indicator, which is useful in indicating whether or not the corresponding data is valid. The velocity measurements sometimes have a latency associated with them. The time of validity is the time tag in the log minus the latency value.*

*The velocity is typically computed from the average change in pseudorange over the time interval or the RTK Low Latency filter. As such, it is an average velocity based on the time difference between successive position computations and not an instantaneous velocity at the BESTVEL time tag. The velocity latency to be subtracted from the time tag will normally be 1/2 the time between filter updates. Under default operation, the positioning filters are updated at a rate of 2 Hz. This translates into a velocity latency of 0.25 second. The latency can be reduced by increasing the update rate of the positioning filter being used by requesting the BESTVEL or BESTPOS messages at a rate higher than 2 Hz. For example, a logging rate of 10 Hz would reduce the velocity latency to 0.005 seconds. For integration purposes, the velocity latency should be applied to the record time tag.*

*While you are standing still, your velocity may jump several centimetres per second. Once you start moving, your velocity will become less noisy. The latency of the instantaneous doppler velocity is always 0.15 seconds. You will know that you have an instantaneous doppler velocity solution when you see DOPPLER\_VELOCITY in field #3 (vel type) below. BESTVEL uses an instantaneous doppler velocity that has low latency and is not delta position dependent. If you change your velocity quickly, you can see this in the DOPPLER\_VELOCITY solution.*

*A valid solution with a latency of 0.0 indicates that the instantaneous Doppler measurement was used to calculate velocity.*

### 3.3.3 Format 2 – Sensor Control Data

Table 18 summarizes the message data layout for Format 2 which contains Sensor Control Data sent between the Maintenance Console laptop, the Display/Computer/Power Supply, and the DT-704 sensor.

**Table 18 - Format 2 Sensor Internal Control Data**

| Relative Base Address (bytes) | Item                        | Size (bits) | Definition Units/LSB Value/Other      |
|-------------------------------|-----------------------------|-------------|---------------------------------------|
| 0                             | ID                          | 8           | 00000010B                             |
| 1                             | Reserved                    | 24          | TBD                                   |
| 4                             | Message Length              | 32          | 272                                   |
| 8                             | Source MSN                  | 16          | See Manufacturer Serial Number Decode |
| 10                            | Destination MSN             | 16          | See Manufacturer Serial Number Decode |
| 12                            | Sample Count                | 32          | 1                                     |
| 16                            | FPGA Write Block Definition |             | See Table 19                          |
| 144                           | FPGA Read Block Definition  |             | See Table 20                          |

**Table 19 FPGA Write/Read Block Definition**

| Relative Base Address (bytes) | FPGA Address | Item                         | Size (bits) | Definition Units/LSB Value/Other |
|-------------------------------|--------------|------------------------------|-------------|----------------------------------|
| 16                            | 4000000      | Serial DAC Spare             | 16          | 0000                             |
| 18                            | 4000002      | Serial DAC Spare             | 16          | 0000                             |
| 20                            | 4000004      | Serial DAC Spare             | 16          | 0000                             |
| 22                            | 4000006      | Serial DAC Spare             | 16          | 0000                             |
| 24                            | 4000008      | clk adjust                   | 16          | 0000                             |
| 26                            | 400000A      | Serial DAC Spare             | 16          | 0000                             |
| 28                            | 400000C      | Serial DAC for Laser Temp    | 16          | 4000                             |
| 30                            | 400000E      | Serial DAC for Laser Current | 16          | 8E80                             |
| 32                            | 4000010      | RF Gain A                    | 16          | 8000                             |
| 34                            | 4000012      | RF Gain B                    | 16          | 8000                             |
| 36                            | 4000014      | RF Gain C                    | 16          | 8000                             |
| 38                            | 4000016      | RF Gain D                    | 16          | 8000                             |
| 40                            | 4000018      | RF Gain E                    | 16          | 8000                             |
| 42                            | 400001A      | RF Gain F                    | 16          | 8000                             |
| 44                            | 400001C      | D/A Spare G                  | 16          | 0000                             |
| 46                            | 400001E      | D/A Spare H                  | 16          | 0000                             |
| 48                            | 4000020      | PWM Piezo A                  | 16          | 6230                             |

Formatted Table

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | FPGA Address | Item                                  | Size (bits) | Definition Units/LSB Value/Other        |
|-------------------------------|--------------|---------------------------------------|-------------|-----------------------------------------|
| 50                            | 4000022      | PWM Piezo B                           | 16          | 6230                                    |
| 52                            | 4000024      | PWM Piezo C                           | 16          | 6230                                    |
| 54                            | 4000026      | PWM Piezo D                           | 16          | 6230                                    |
| 56                            | 4000028      | PWM Piezo E                           | 16          | 6230                                    |
| 58                            | 400002A      | PWM Piezo F                           | 16          | 6230                                    |
| 60                            | 400002C      | Set the starting place for temp sweep | 16          | 4000                                    |
| 62                            | 400002E      | Threshold for Laser Auto Lock         | 16          | FFE0, LSB                               |
| 64                            | 4000030      | Threshold for Laser Auto Lock         | 16          | FFFF, MSB                               |
| 66                            | 4000032      | Set the starting place for mag sweep  | 16          | 3000                                    |
| 68                            | 4000034      | 19kdelayload                          | 16          | 005C                                    |
| 70                            | 4000036      | lasercurrentdcld                      | 16          | 4800, not in use                        |
| 72                            | 4000038      | sweepdevload                          | 16          | 0005                                    |
| 74                            | 400003A      | 9p5kdelayload                         | 16          | 0108                                    |
| 76                            | 400003C      | 9p5kdetlevelset[15..0]                | 16          | 0000, used to make modulation off of D0 |
| 78                            | 400003E      | testpointcontrol                      | 16          | A213                                    |
| 80                            | 4000040      | controlword                           | 16          | 0B98                                    |
| 82                            | 4000042      | magfiltersgain[15..0]                 | 16          | 502F                                    |
| 84                            | 4000044      | magerrorgain[15..0]                   | 16          | 4F44                                    |
| 86                            | 4000046      | magcenterfreq[15..0]                  | 16          | 0000                                    |
| 88                            | 4000048      | magcenterfreq[31..16]                 | 16          | 2407                                    |
| 90                            | 400004A      | 432sweepdelay                         | 16          | 3800                                    |
| 92                            | 400004C      | magsweepdevwrite                      | 16          | 005D, Mag Sweep Amplitude               |
| 94                            | 400004E      | 864sweepdelay                         | 16          | 1800                                    |
| 96                            | 4000050      | 19kdetlevelset[15..0]                 | 16          |                                         |
| 98                            | 4000052      | 19kdetlevelset[31..16]                | 16          |                                         |
| 100                           | 4000054      | agcsetpointA[15..0]                   | 16          |                                         |
| 102                           | 4000056      | agcsetpointA[31..16]                  | 16          |                                         |
| 104                           | 4000058      | Dig Resistor Value A,B                | 16          | 3A/135                                  |
| 106                           | 400005A      | Dig Resistor Value C                  | 16          | 14E                                     |
| 108                           | 400005C      | Dig Resistor Value D,E                | 16          | 3A/135                                  |
| 110                           | 400005E      | Dig Resistor Value F                  | 16          | 153                                     |
| 112                           | 4000060      | Sends Dig Resistor Value              | 16          |                                         |
| 114                           | 4000062      | Startup                               | 16          |                                         |
| 116                           | 4000064      | Resets DPC and Re-sync 430 to PPS     | 16          | 0000, Aligns data to GPS                |
| 118                           | 4000066      | lasersyncdetgain[15..0]               | 16          | 000C                                    |
| 120                           | 4000068      | lasererrorgain[15..0]                 | 16          | 2FC1                                    |
| 122                           | 400006A      | NEWERcontrol                          | 16          | 0000                                    |
| 124                           | 400006C      | NEWcontrol                            | 16          | 3008                                    |
| 126                           | 400006E      | debugcontrol                          | 16          | 0000                                    |
| 128                           | 4000070      | morecontrol                           | 16          | 0042                                    |
| 130                           | 4000072      | Threshold for Mag Auto Lock           | 16          | 0000, LSB                               |
| 132                           | 4000074      | Threshold for Mag Auto Lock           | 16          | 0500, MSB                               |
| 134                           | 4000076      | agcsetpointC[15..0]                   | 16          |                                         |
| 136                           | 4000078      | agcsetpointC[31..16]                  | 16          |                                         |
| 138                           | 400007A      | Accel Adjust X                        | 16          |                                         |
| 140                           | 400007C      | Accel Adjust Y                        | 16          |                                         |

Formatted Table

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | FPGA Address | Item           | Size (bits) | Definition Units/LSB Value/Other |
|-------------------------------|--------------|----------------|-------------|----------------------------------|
| 142                           | 400007E      | Accel Adjust Z | 16          |                                  |

Formatted Table

**Table 20 FPGA Read Block Definition**

| Relative Base Address (bytes) | FPGA Address | Item                          | Size (bits) | Definition Units/LSB Value/Other |
|-------------------------------|--------------|-------------------------------|-------------|----------------------------------|
| 144                           | 4000080      | Vector Z LSB                  | 16          | T                                |
| 146                           | 4000082      | Vector Z MSB                  | 16          | T                                |
| 148                           | 4000084      | Vector Y LSB                  | 16          | L, (-1) done in processor        |
| 150                           | 4000086      | Vector Y MSB                  | 16          | L, (-1) done in processor        |
| 152                           | 4000088      | Vector X LSB                  | 16          | D, (-1) done in processor        |
| 154                           | 400008A      | Vector X MSB                  | 16          | D, (-1) done in processor        |
| 156                           | 400008C      | Vector S LSB                  | 16          |                                  |
| 158                           | 400008E      | Vector S MSB                  | 16          |                                  |
| 160                           | 4000090      | Photo Det DC A                | 16          |                                  |
| 162                           | 4000092      | Photo Det DC B                | 16          |                                  |
| 164                           | 4000094      | Photo Det DC C                | 16          |                                  |
| 166                           | 4000096      | Photo Det DC D                | 16          |                                  |
| 168                           | 4000098      | Photo Det DC E                | 16          |                                  |
| 170                           | 400009A      | Photo Det DC F                | 16          |                                  |
| 172                           | 400009C      | Monitor Laser Current -       | 16          |                                  |
| 174                           | 400009E      | Temp set after lock on        | 16          |                                  |
| 176                           | 40000A0      | BPF out 430 MSB               | 16          |                                  |
| 178                           | 40000A2      | BPF out 430 LSB               | 16          |                                  |
| 180                           | 40000A4      | Boxcar out 430/860 MSB        | 16          |                                  |
| 182                           | 40000A6      | Boxcar out 430/860 LSB        | 16          |                                  |
| 184                           | 40000A8      | Integrator out 430/860 MSB    | 16          |                                  |
| 186                           | 40000AA      | Integrator out 430/860 LSB    | 16          |                                  |
| 188                           | 40000AC      | Acluster [15..0]              | 16          |                                  |
| 190                           | 40000AE      | Bcluster [15..0]              | 16          |                                  |
| 192                           | 40000B0      | Monitor Laser Current +       | 16          |                                  |
| 194                           | 40000B2      | Monitor Laser Temp -          | 16          |                                  |
| 196                           | 40000B4      | Monitor Laser Temp +          | 16          |                                  |
| 198                           | 40000B6      | Open A/D Channel              | 16          |                                  |
| 200                           | 40000B8      | Board Temperature             | 16          |                                  |
| 202                           | 40000BA      | LaserBoxOut19k LSB            | 16          |                                  |
| 204                           | 40000BC      | Tempclosedloop[31..16]        | 16          |                                  |
| 206                           | 40000BE      | cnt[15..0]                    | 16          |                                  |
| 208                           | 40000C0      | he4dataA[0],GND[14..0]        | 16          |                                  |
| 210                           | 40000C2      | he4dataA[16..1]               | 16          |                                  |
| 212                           | 40000C4      | he4dataA[31],he4dataA[31..17] | 16          |                                  |
| 214                           | 40000C6      | he4dataB[0],GND[14..0]        | 16          |                                  |
| 216                           | 40000C8      | he4dataB[16..1]               | 16          |                                  |
| 218                           | 40000CA      | he4dataB[31],he4dataB[31..17] | 16          |                                  |
| 220                           | 40000CC      | system status bits            | 16          |                                  |
| 222                           | 40000CE      | y-accel                       | 16          | T                                |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | FPGA Address | Item                    | Size (bits) | Definition Units/LSB Value/Other |
|-------------------------------|--------------|-------------------------|-------------|----------------------------------|
| 224                           | 40000D0      | 19kerrorgained MSB      | 16          |                                  |
| 226                           | 40000D2      | x-accel                 | 16          | L, (-1)                          |
| 228                           | 40000D4      | 9.5kerrorgained LSB     | 16          |                                  |
| 230                           | 40000D6      | 19kIntegOut MSB         | 16          |                                  |
| 232                           | 40000D8      | LaserBoxOut19k MSB      | 16          |                                  |
| 234                           | 40000DA      | 9.5kIntegOut MSB        | 16          |                                  |
| 236                           | 40000DC      | 9.5kIntegOut LSB        | 16          |                                  |
| 238                           | 40000DE      | lasercurrentdac[13..0]  | 16          |                                  |
| 240                           | 40000E0      | photoagcd [26..11]      | 16          |                                  |
| 242                           | 40000E2      | agccontrola LSB         | 16          |                                  |
| 244                           | 40000E4      | agccontrola MSB         | 16          |                                  |
| 246                           | 40000E6      | High Speed Data MSB     | 16          |                                  |
| 248                           | 40000E8      | High Speed Data LSB     | 16          |                                  |
| 250                           | 40000EA      | ToSubA LSB              | 16          |                                  |
| 252                           | 40000EC      | ToSubA MSB              | 16          |                                  |
| 254                           | 40000EE      | ToSubC LSB              | 16          |                                  |
| 256                           | 40000F0      | 19kIntegOut LSB         | 16          |                                  |
| 258                           | 40000F2      | 19kerrorgained LSB      | 16          |                                  |
| 260                           | 40000F4      |                         | 16          |                                  |
| 262                           | 40000F6      | ToSubC MSB              | 16          |                                  |
| 264                           | 40000F8      |                         | 16          |                                  |
| 266                           | 40000FA      | z-accel (not connected) | 16          |                                  |
| 268                           | 40000FC      | z-accel (digitized)     | 16          | D                                |
| 270                           | 40000FE      | Tempclosedloop[15..0]   | 16          |                                  |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**3.3.4 Format 3 – Sensor Compensation Control Data**

Table 21 summarizes the message data layout for Format 3 which contains Sensor Compensation Control Data. The DT-704 Sensor holds an initial set of compensation parameters in non-volatile memory for use at power-on. A copy of the initial set is sent via a Format 3 message to the CP-2568 Computer/Power Supply (CPS) for recording. Revised Sensor Compensation Control Data Sets are sent from the CPS as they are developed in the CPS. Each Format 3 message from the CPS to the sensor is acknowledged by the sensor to the CPS via another Format 3 message.

**Table 21 - Format 3 Sensor Compensation Control Data**

| Relative Base Address (bytes) | Item            | Size (bits) | Definition Units/LSB Value/Other         |
|-------------------------------|-----------------|-------------|------------------------------------------|
| 0                             | ID              | 8           | 00000011B                                |
| 1                             | Reserved        | 24          | TBD                                      |
| 4                             | Message Length  | 32          | 256                                      |
| 8                             | Source MSN      | 16          | See Table 7 - Manufacturer Serial Number |
| 10                            | Destination MSN | 16          | See Table 7 - Manufacturer Serial Number |
| 12                            | Sample Count    | 32          | 1                                        |
| 16                            | T Perm Term     | 64          | nT (DPFP)                                |
| 24                            | L Perm Term     | 64          | nT (DPFP)                                |
| 32                            | D Perm Term     | 64          | nT (DPFP)                                |
| 40                            | TT Induced      | 64          | (DPFP)                                   |
| 48                            | LL Induced N    | 64          | (DPFP)                                   |
| 56                            | DD Induced E    | 64          | (DPFP)                                   |
| 64                            | LT + TL Induced | 64          | (DPFP)                                   |
| 72                            | TD + DT Induced | 64          | (DPFP)                                   |
| 80                            | LD + DL Induced | 64          | (DPFP)                                   |
| 88                            | tt Eddy         | 64          | (DPFP)                                   |
| 96                            | ll Eddy         | 64          | (DPFP)                                   |
| 104                           | dd Eddy         | 64          | (DPFP)                                   |
| 112                           | tl Eddy         | 64          | (DPFP)                                   |
| 120                           | td Eddy         | 64          | (DPFP)                                   |
| 128                           | lt Eddy         | 64          | (DPFP)                                   |
| 136                           | ld Eddy         | 64          | (DPFP)                                   |
| 144                           | dt Eddy         | 64          | (DPFP)                                   |
| 152                           | dl Eddy         | 64          | (DPFP)                                   |
| 160                           | Ave. He         | 64          | nT (DPFP)                                |
| 168                           | TBD             | 64          |                                          |
| 176                           | TBD             | 64          |                                          |
| 184                           | T Vector gain   | 64          | (DPFP)                                   |
| 192                           | L Vector gain   | 64          | (DPFP)                                   |
| 200                           | D Vector gain   | 64          | (DPFP)                                   |
| 208                           | T Offset        | 64          | nT (DPFP)                                |
| 216                           | L Offset        | 64          | nT (DPFP)                                |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| <b>Relative<br/>Base<br/>Address<br/>(bytes)</b> | <b>Item</b> | <b>Size<br/>(bits)</b> | <b>Definition<br/>Units/LSB Value/Other</b> |
|--------------------------------------------------|-------------|------------------------|---------------------------------------------|
| 224                                              | D Offset    | 64                     | nT (DPFP)                                   |
| 232                                              | X Angle     | 64                     | degrees(DPFP)                               |
| 240                                              | Y Angle     | 64                     | degrees(DPFP)                               |
| 248                                              | Z Angle     | 64                     | degrees(DPFP)                               |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

### 3.3.5 Format 4 – System Control

Table 22 summarizes the message data layout for Format 4 which contains System Control Data.

**Table 22 - Format 4 System Control**

| Relative Base Address (bytes) | Item                                     | Size (bits) | Definition Units/LSB Value/Other                                                                       |
|-------------------------------|------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------|
| 0                             | ID                                       | 8           | 00000100B                                                                                              |
| 1                             | Reserved                                 | 24          | TBD                                                                                                    |
| 4                             | Message Length                           | 32          | 240                                                                                                    |
| 8                             | Source MSN                               | 16          | See Manufacturer Serial Number Decode                                                                  |
| 10                            | Destination MSN                          | 16          | See Manufacturer Serial Number Decode                                                                  |
| 12                            | Sample Count                             | 32          | 1                                                                                                      |
| 16                            | Modes/Command                            | 32          | See <u>Mode/Command Decode</u>                                                                         |
| 20                            | Bit Status                               | 32          | See <u>Bit Status Decode</u>                                                                           |
| 24                            | Aircraft Standard Turn Rate              | 64          | Degrees/Sec (DPFP)                                                                                     |
| 32                            | Search MSN                               | 16          | See 3.3.2.2                                                                                            |
| 34                            | Reference MSN                            | 16          | See 3.3.2.2                                                                                            |
| 36                            | Detection MSN                            | 16          | See 3.3.2.2                                                                                            |
| 38                            | Relay MSN                                | 16          | See 3.3.2.2                                                                                            |
| 40                            | System Status                            | 32          | See System Status Decode                                                                               |
| 44                            | Record/Playback Filename                 | 512         | Filename (See Note 11)                                                                                 |
| 108                           | Retrieve Destination Filename            | 512         | Filename (See Note 9)                                                                                  |
| 172                           | Retrieve/Playback start Format           | 8           | Designated Format ID                                                                                   |
| 173                           | Retrieve/Playback start data point count | 24          | 1 (Starting Data point count of Designated Format ID)                                                  |
| 176                           | Noise Box Control                        | 8           | See 3.3.15.2 Noise Box Control Decode                                                                  |
| 177                           | Geology Processing Control               | 8           | Start/Continue = 1, Stop = 0                                                                           |
| 178                           | Use Data File Valid                      | 8           | Flag saying if we should use the following data (1) or if we should use default parameters (0)         |
| 179                           | FFT power of 2                           | 8           | FFT size as a power of 2 ex: =9 then FFT size = $2^9 = 512$                                            |
| 180                           | ANC L History Size                       | 8           | Tells how big the L history will be in terms of FFT size = integer multiple of the FFT size            |
| 181                           | (ANC L History)/(Coeff update rate)      | 8           | Tells how often the L history will be updated in terms of FFT size = integer fractions of the FFT size |
| 182                           | Ref Channels To Use                      | 64          | On/off flags for selecting which channels to use (See ENRAD Processing Channel Selection Table)        |
| 190                           | Gap Delay                                | 8           | 1                                                                                                      |
| 191                           | FAR Type                                 | 8           | CFAR or Fixed Threshold (2=fixed,1= cfar, 0 = default)                                                 |
| 192                           | FAR Value                                | 32          | # of FAR per hour or the fixed level as a float                                                        |

<sup>11</sup> Filename is from 1 to 63 ASCII characters long and is terminated by a null byte.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | Item                           | Size (bits) | Definition Units/LSB Value/Other                                                                                     |
|-------------------------------|--------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------|
| 196                           | S1 Turn Indicator Threshold    | 32          | For in turn out of turn threshold                                                                                    |
| 200                           | S2 Turn Indicator Threshold    | 32          | For in turn out of turn threshold                                                                                    |
| 204                           | S3 Turn Indicator Threshold    | 32          | For in turn out of turn threshold                                                                                    |
| 208                           | Fixed Joint T thresh.          | 32          | Fixed Threshold Joint Max T stat level for detector                                                                  |
| 212                           | Fixed MAD T thresh.            | 32          | Fixed Threshold MAD Max T stat level for detector                                                                    |
| 216                           | Fixed ELF T thresh.            | 32          | Fixed Threshold ELF Max T stat level for detector                                                                    |
| 220                           | Detector ELF start freq        | 32          | single precision value for starting ELF frequency                                                                    |
| 224                           | Detector ELF end freq          | 32          | single precision value for ending ELF frequency                                                                      |
| 228                           | Detector Update Rate           | 8           | Detector update rate as a factor of how many calls per FFT block ( $\leq NFFT$ & a power of 2)                       |
| 229                           | PNR Enabled                    | 8           | Pendulum Noise Reduction Control enabled =1, or disabled = 2, default = 2                                            |
| 230                           | PNR_refs                       | 16          | On/off flags for selection of reference channels for Fast Adaptive Pendulum Noise Reduction use. Defined in Table 27 |
| 232                           | PNR_Main                       | 8           | On/off flags for selection of Main channels for Fast Adaptive Pendulum Noise Reduction use. Defined in Table 28      |
| 233                           | PNR_ntaps                      | 8           | # of taps to use in the Fast Adaptive Pendulum Noise Reduction Algorithm (Default = 1)                               |
| 234                           | PNR_taplength                  | 16          | # of data points per tap (min = 1 = default)                                                                         |
| 236                           | PNR_LHistorySize               | 16          | # of data points in Fast Adaptive Pendulum Noise Reduction History (Default = 500)                                   |
| 238                           | No. of ELF Harmonics           | 8           | Unsigned, Range $1 \leq x \leq 255$ , Default=1                                                                      |
| 239                           | No. of ELF Search Fundamentals | 8           | Unsigned, Range $2 \leq x \leq 255$ , Default=2                                                                      |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**3.3.5.1 Mode/Command Decode for Format 4**

Two options exist for the mode/command decode – Test Mode = 00(Binary) and Normal Mode = 01(Binary). Commands for both options are described in Table 23:

**Table 23 - Format 4 Mode/Command Decode**

| Mode Bits 0,1 | Command Code Value Bits 2-29 | Command                              |
|---------------|------------------------------|--------------------------------------|
| 00            | 1                            | No Test                              |
| 00            | 2                            | Full System BIT                      |
| 00            | 3                            | Test Processor Power Supply          |
| 00            | 4                            | Test Processor Board No. 1           |
| 00            | 5                            | Test Processor Board No. 2           |
| 00            | 6                            | Test Processor Board No. 3           |
| 00            | 7                            | Test Processor Board No. 4           |
| 00            | 8                            | Test All Processors                  |
| 00            | 9                            | Test Processor to Sensor I/O         |
| 00            | 10                           | Test Processor Analog PWB            |
| 00            | 11                           | Test Sensor Processor                |
| 00            | 12                           | Test Sensor RLLC                     |
| 00            | 13                           | Test Sensor Ignition                 |
| 00            | 14                           | Test Sensor RF                       |
| 00            | 15                           | Test Sensor Laser                    |
| 00            | 16                           | Sensor BIT                           |
| 00            | 17                           | Control BIT                          |
| 00            | 18                           | Test Control Processor               |
| 00            | 19                           | Test Control Display                 |
| *             | *                            | Undefined                            |
| 01            | 50015                        | Undefined                            |
| 01            | 50016                        | Normal Mode/All On                   |
| 01            | 50017                        | Record On (See 3.3.5.2.1 Recording)  |
| 01            | 50018                        | Normal Mode/All Off                  |
| 01            | 50019                        | Record Off (See 3.3.5.2.2 Retrieval) |
| 01            | 50020                        | Format 1 Transmit On                 |
| 01            | 50021                        | Format 2 Transmit On                 |
| 01            | 50022                        | Format 3 Transmit On                 |
| 01            | 50023                        | Format 4 Transmit On                 |
| 01            | 50024                        | Format 5 Transmit On                 |
| 01            | 50025                        | Format 6 Transmit On                 |
| 01            | 50026                        | Format 7 Transmit On                 |
| 01            | 50027                        | Format 8 Transmit On                 |
| 01            | 50028                        | Format 9 Transmit On                 |
| 01            | 50029                        | Format 10 Transmit On                |
| 01            | 50030                        | Format 11 Transmit On                |
| 01            | 50031                        | Format 12 Transmit On                |
| 01            | 50032                        | Format 13 Transmit On                |
| 01            | 50033                        | Format 14 Transmit On                |
| 01            | 50034                        | Format 15 Transmit On                |
| 01            | 50035                        | Format 16 Transmit Once              |
| 01            | 50075                        | Format 1 Transmit Off                |
| 01            | 50076                        | Format 2 Transmit Off                |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| <b>Mode Bits 0,1</b> | <b>Command Code Value Bits 2-29</b> | <b>Command</b>                                    |
|----------------------|-------------------------------------|---------------------------------------------------|
| 01                   | 50077                               | Format 3 Transmit Off                             |
| 01                   | 50078                               | Format 4 Transmit Off                             |
| 01                   | 50079                               | Format 5 Transmit Off                             |
| 01                   | 50080                               | Format 6 Transmit Off                             |
| 01                   | 50081                               | Format 7 Transmit Off                             |
| 01                   | 50082                               | Format 8 Transmit Off                             |
| 01                   | 50083                               | Format 9 Transmit Off                             |
| 01                   | 50084                               | Format 10 Transmit Off                            |
| 01                   | 50085                               | Format 11 Transmit Off                            |
| 01                   | 50086                               | Format 12 Transmit Off                            |
| 01                   | 50087                               | Format 13 Transmit Off                            |
| 01                   | 50088                               | Format 14 Transmit Off                            |
| 01                   | 50089                               | Format 15 Transmit Off                            |
| 01                   | 50090                               | Undefined                                         |
| 01                   | *                                   | *                                                 |
| 01                   | 50100                               | Learn Tolles and Lawson Coefficient set           |
| 01                   | 50101                               | Apply Learned Tolles and Lawson Coefficient set   |
| 01                   | 50102                               | Restore Default Tolles and Lawson Coefficient set |
| 01                   | 50103                               | Apply Geomagnetic Coefficients                    |
| 01                   | 50104                               | Apply Geology Coefficients                        |
| 01                   | 50105                               | Apply Buffeting Coefficients                      |
| 01                   | 50106                               | Processor Analog Outputs On                       |
| 01                   | 50107                               | Learn Adaptive Coefficients                       |
| 01                   | 50108                               | Synchronize Sensor Sampling (Reset)               |
| 01                   | 50109                               | Auto Optimize Sensor                              |
| 01                   | 50110                               | Update Search/ Reference/ Detection Designation   |
| 01                   | 50111                               | Playback Mode Operator Control                    |
| 01                   | 50112                               | Playback Mode Data Control                        |
| 01                   | 50113                               | Retrieve Data to Display Processor                |
| 01                   | 50114                               | Delete File "Filename"                            |
| 01                   | 50115                               | Retrieve Directory Listing                        |
| 01                   | 50116                               | Dual Sensor Tracker Input                         |
| 01                   | 50117                               | Single Sensor Tracker Input                       |
| *                    | 50118                               | Undefined                                         |
| *                    | *                                   | *                                                 |
| *                    | *                                   | Undefined                                         |

### 3.3.5.2 Recording and Retrieving

#### 3.3.5.2.1 Recording

Upon power-up, the CPS connects with the attached sensor, the associated Display Control Processor (DCP), and the associated CPS. Once connected, the CPS will begin receiving Format 1 messages from the sensor. All message traffic will be recorded under filename "Startup1" or, alternatively, "Startup2" in the PBOD flash memory. When the sensor's GPS unit has achieved "fine steering" mode, the CPS will acquire the current data/time from the first MarkPosb log in a Format 1 message reporting the fine steering mode. The CPS will use the date/time obtained as the seed value for its internal clock. Upon establishment of the internal clock, the CPS will define a session recording filename to be the value of the

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

initial clock setting of the form (YearMonthDayHourMinuteSecond –yyyyMMddhhmmss). The file is to be established under a directory name of "Data" within the PBOD and all data stored in the Startup(1/2) file is to be transferred into the front of the newly created file with all subsequent messages stored in the file after the Startup(1/2) records. A Format 4 message with the path/filename in the "Record/Playback Filename" field is to be sent to the DCP with the command mode value of "50017 – Record On." All subsequent message traffic to or from CPS Control is to be recorded in the named file until command is received from the DCP to "50019 - Record Off," whereupon the CPS will close the file, stop recording, and acknowledge the Format 4 command to the DCP. Any subsequent command from the DCP to "Set Record ON" will cause the creation of a new file under a name drawn from the, then, current date/time of the CPS clock and placed in the PBOD directory name of "Data".

### 3.3.5.2.2 Retrieval

The DCP is to maintain, on a general status window, the name of the file to which data is currently being recorded. (The DCP should maintain a restart file of the currently active commands and other pertinent system execution parameters that are for resumption of execution should the DCP be stopped unintentionally. The DCP should have a shutdown mode that clears the file. Upon startup, the DCP should check the file and, if the file is still valid, use it to resume operation. If the file is not valid, proceed with initial setup.) When the operator enters a retrieve command to the DCP, the DCP is to request an updated Format 13 Recorded File Directory Readout, format it for display in windows organized by directory folder for the operator to select the files to be retrieved. The DCP will, then, issue retrieve commands for that/those files to the operator designated root folder of the DCP and notify the operator of the progress and completion of the retrieval.

### 3.3.5.3 BIT Status Decode for Format 4

**Table 24 - Format 4 BIT Status Decode**

| <b>Bit Test Value<br/>(Binary)</b> | <b>Definition<br/>Units/LSB Value/Other</b>   |
|------------------------------------|-----------------------------------------------|
| 00000000000000000000000000000000   | No Fail                                       |
| 00000000000000000000000000000001   | System Fail                                   |
| 00000000000000000000000000000010   | Computer/Power Supply Fail                    |
| 00000000000000000000000000000100   | Processor Board No. 1 Fail                    |
| 00000000000000000000000000001000   | Processor Board No. 2 Fail                    |
| 00000000000000000000000000010000   | Processor Board No. 3 Fail                    |
| 00000000000000000000000000100000   | Processor Board No. 4 Fail                    |
| 00000000000000000000000001000000   | Processor to Sensor I/O Fail                  |
| 00000000000000000000000010000000   | Processor Analog PWB Fail                     |
| 00000000000000000000000100000000   | Sensor Processor Fail                         |
| 00000000000000000000001000000000   | Sensor RLLC Fail                              |
| 00000000000000000000010000000000   | Sensor Ignition Fail                          |
| 00000000000000000000100000000000   | Sensor RF Fail                                |
| 00000000000000000010000000000000   | Sensor Laser Fail                             |
| 00000000000000000100000000000000   | Sensor LRU Fail                               |
| 00000000000000001000000000000000   | Control LRU Fail                              |
| 00000000000000100000000000000000   | Control Processor Fail                        |
| 00000000000010000000000000000000   | Control Display Fail                          |
| 00000000000100000000000000000000   | Noise Reduction/Detection Initialization Fail |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**3.3.5.4 System Status-**

Table 25 defines the elements of System Status Information output to the Display/Control Processor by the Detection Computer Power Supply (CPS) provided in Format 4. This Status Summary is output every time one of the indicated Status Parameters changes or whenever the Operator commands a change in activity by sending a Format 4 message to a CPS.

**Table 25 - Format 4 System Status**

| <b>System Status</b>                   |                                                          |                               |                                                                                                                                               |
|----------------------------------------|----------------------------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sub-Field Alignment</b><br>0-----31 | <b>Item</b>                                              | <b>Size<br/>(in<br/>bits)</b> | <b>Definition<br/>Units/LSB Value/Other</b>                                                                                                   |
| 0                                      | Reset Status                                             | 2                             | Reset Status Code<br>0 = No Reset Active<br>1 = Reset in Progress<br>2 = Reset Complete<br>3 = Reset Fail                                     |
| 2                                      | Search Sensor/<br>Reference Sensor<br>Time Drift         | 2                             | Sensor Time Drift Range<br>0 = <= Threshold 0 (Green)<br>1 = <= Threshold 1 (Blue)<br>2 = <= Threshold 2 (Yellow)<br>3 = <= Threshold 3 (Red) |
| 4                                      | System Configuration<br>Defined                          | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 5                                      | Recording On                                             | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 6                                      | Recording to Named<br>File                               | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 7                                      | Format 4 Message<br>Count Reset                          | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 8                                      | Search Sensor Sample<br>Count Error                      | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 9                                      | Reference Sensor<br>Sample Count Error                   | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 10                                     | Search Sensor Data<br>Stopped                            | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 11                                     | Reference Sensor Data<br>Stopped                         | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 12                                     | Error – Designated<br>Record File Name<br>Already Exists | 1                             | 0 = False<br>1 = True                                                                                                                         |
| 13                                     | Noise Box in Process                                     | 1                             | 0 = False<br>1 = True                                                                                                                         |
| *                                      | Not Yet Defined                                          | 1                             |                                                                                                                                               |
| *                                      | Not Yet Defined                                          | 1                             |                                                                                                                                               |
| 31                                     | Not Yet Defined                                          | 1                             |                                                                                                                                               |

### 3.3.5.5 Processing Channel Selection Table

Table 26 provides description of the table for specifying selection of Noise Reduction and Detection processing channels for execution within the CP-2569 Computer Power Supply. This definition is placed in a Format 4 System Control message and transmitted to the Computer Power Supply where it is translated to a Format 15 Noise Reduction/Detection Processing Control message and sent to be delivered to the Environmental Noise Reduction and Detection (ENRAD module).

**Table 26 ENRAD Processing Channel Selection Table**

| Ref Channel Selection Decode    |                                |                                         |
|---------------------------------|--------------------------------|-----------------------------------------|
| Sub-Field Alignment<br>0-----63 | Channel                        | Definition<br>Units/LSB Value/<br>Other |
| 0                               | Search VMT                     | 0=off,1=on                              |
| 1                               | Search VML                     | 0=off,1=on                              |
| 2                               | Search VMD                     | 0=off,1=on                              |
| 3                               | Search ACT                     | 0=off,1=on                              |
| 4                               | Search ACL                     | 0=off,1=on                              |
| 5                               | Search ACD                     | 0=off,1=on                              |
| 6                               | Search Vertical Velocity       | 0=off,1=on                              |
| 7                               | Search S1                      | 0=off,1=on                              |
| 8                               | Search S2                      | 0=off,1=on                              |
| 9                               | Search S3                      | 0=off,1=on                              |
| 10                              | Search S4                      | 0=off,1=on                              |
| 11                              | Search S5                      | 0=off,1=on                              |
| 12                              | Search S6                      | 0=off,1=on                              |
| 13                              | Search S7                      | 0=off,1=on                              |
| 14                              | Search S8                      | 0=off,1=on                              |
| 15                              | Search S9                      | 0=off,1=on                              |
| 16                              | Search S10                     | 0=off,1=on                              |
| 17                              | Search S11                     | 0=off,1=on                              |
| 18                              | Search S12                     | 0=off,1=on                              |
| 19                              | Search S13                     | 0=off,1=on                              |
| 20                              | Search S14                     | 0=off,1=on                              |
| 21                              | Search S15                     | 0=off,1=on                              |
| 22                              | Search S16                     | 0=off,1=on                              |
| 23                              | Search <i>Bestpos</i> Altitude | 0=off,1=on                              |
| 24                              | Search Horizontal Speed        | 0=off,1=on                              |
| 25                              | Search Heading                 | 0=off,1=on                              |
| 26                              | undefined                      | 0=off,1=on                              |
| 27                              | undefined                      | 0=off,1=on                              |
| 28                              | undefined                      | 0=off,1=on                              |
| 29                              | undefined                      | 0=off,1=on                              |
| 30                              | undefined                      | 0=off,1=on                              |
| 31                              | undefined                      | 0=off,1=on                              |
| 32                              | Reference UTF                  | 0=off,1=on                              |
| 33                              | Reference VMT                  | 0=off,1=on                              |
| 34                              | Reference VML                  | 0=off,1=on                              |
| 35                              | Reference VMD                  | 0=off,1=on                              |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| <b>Ref Channel Selection Decode</b>    |                                   |                                                              |
|----------------------------------------|-----------------------------------|--------------------------------------------------------------|
| <b>Sub-Field Alignment</b><br>0-----63 | <b>Channel</b>                    | <b>Definition</b><br><b>Units/LSB Value/</b><br><b>Other</b> |
| 36                                     | Reference ACT                     | 0=off,1=on                                                   |
| 37                                     | Reference ACL                     | 0=off,1=on                                                   |
| 38                                     | Reference ACD                     | 0=off,1=on                                                   |
| 39                                     | Reference Vertical Velocity       | 0=off,1=on                                                   |
| 40                                     | Reference S1                      | 0=off,1=on                                                   |
| 41                                     | Reference S2                      | 0=off,1=on                                                   |
| 42                                     | Reference S3                      | 0=off,1=on                                                   |
| 43                                     | Reference S4                      | 0=off,1=on                                                   |
| 44                                     | Reference S5                      | 0=off,1=on                                                   |
| 45                                     | Reference S6                      | 0=off,1=on                                                   |
| 46                                     | Reference S7                      | 0=off,1=on                                                   |
| 47                                     | Reference S8                      | 0=off,1=on                                                   |
| 48                                     | Reference S9                      | 0=off,1=on                                                   |
| 49                                     | Reference S10                     | 0=off,1=on                                                   |
| 50                                     | Reference S11                     | 0=off,1=on                                                   |
| 51                                     | Reference S12                     | 0=off,1=on                                                   |
| 52                                     | Reference S13                     | 0=off,1=on                                                   |
| 53                                     | Reference S14                     | 0=off,1=on                                                   |
| 54                                     | Reference S15                     | 0=off,1=on                                                   |
| 55                                     | Reference S16                     | 0=off,1=on                                                   |
| 56                                     | Reference <i>Bestpos</i> Altitude | 0=off,1=on                                                   |
| 57                                     | Reference Horizontal Speed        | 0=off,1=on                                                   |
| 58                                     | Reference Heading                 | 0=off,1=on                                                   |
| 59                                     | undefined                         | 0=off,1=on                                                   |
| 60                                     | undefined                         | 0=off,1=on                                                   |
| 61                                     | undefined                         | 0=off,1=on                                                   |
| 62                                     | undefined                         | 0=off,1=on                                                   |
| 63                                     | undefined                         | 0=off,1=on                                                   |

### 3.3.5.6 Fast Adaptive Pendulum Noise Reduction Reference Channel Selection Table

Table 27 provides description of the table for specifying selection of Main processing channels for use by the Fast Adaptive Pendulum Noise Reduction Algorithm within the CP-2569 Computer Power Supply. These selections are placed in a Format 4 System Control message and transmitted to the Computer Power Supply where it is translated to a Format 15 Noise Reduction/Detection Processing Control message and sent to be delivered to the Environmental Noise Reduction and Detection (ENRAD module).

**Table 27 Fast Adaptive Pendulum Noise Reduction Reference Channel Selection Options**

| <b>Fast Adaptive Pendulum Noise Reduction Reference Channel Selection</b> |                     |                                                    |
|---------------------------------------------------------------------------|---------------------|----------------------------------------------------|
| <b>Sub-Field Bit Alignment</b><br>0-----15                                | <b>Channel</b>      | <b>Definition</b><br><b>Units/LSB Value/ Other</b> |
| 0                                                                         | Undefined           | 0=off,1=on                                         |
| 1                                                                         | Reference Sensor S3 | 0=off,1=on                                         |
| 2                                                                         | Reference Sensor S2 | 0=off,1=on                                         |
| 3                                                                         | Reference Sensor S1 | 0=off,1=on                                         |

| Fast Adaptive Pendulum Noise Reduction <b>Reference Channel Selection</b> |                                      |                                      |
|---------------------------------------------------------------------------|--------------------------------------|--------------------------------------|
| Sub-Field Bit Alignment<br>0-----15                                       | Channel                              | Definition<br>Units/LSB Value/ Other |
| 4                                                                         | Reference Sensor Heading             | 0=off,1=on                           |
| 5                                                                         | Reference Sensor Horizontal Velocity | 0=off,1=on                           |
| 6                                                                         | Reference Sensor Vertical Velocity   | 0=off,1=on                           |
| 7                                                                         | Reference Sensor UTF                 | 0=off,1=on                           |
| 8                                                                         | Undefined                            | 0=off,1=on                           |
| 9                                                                         | Undefined                            | 0=off,1=on                           |
| 10                                                                        | Search Sensor S3                     | 0=off,1=on                           |
| 11                                                                        | Search Sensor S2                     | 0=off,1=on                           |
| 12                                                                        | Search Sensor S1                     | 0=off,1=on                           |
| 13                                                                        | Search Sensor Heading                | 0=off,1=on                           |
| 14                                                                        | Search Sensor Horizontal Velocity    | 0=off,1=on                           |
| 15                                                                        | Search Sensor Vertical Velocity      | 0=off,1=on                           |

### 3.3.5.7 Fast Adaptive Pendulum Noise Reduction Algorithm Main Channel Selection Table

Table 28 provides description of the table for specifying selection of Main processing channels for use by the Fast Adaptive Pendulum Noise Reduction Algorithm within the CP-2569 Computer Power Supply. These selections are placed in a Format 4 System Control message and transmitted to the Computer Power Supply where it is translated to a Format 15 Noise Reduction/Detection Processing Control message and sent to be delivered to the Environmental Noise Reduction and Detection (ENRAD module).

**Table 28 Fast Adaptive Pendulum Noise Reduction Main Channel Selection**

| Fast Adaptive Pendulum Noise Reduction <b>Main Channel Selection</b> |                              |                                      |
|----------------------------------------------------------------------|------------------------------|--------------------------------------|
| Sub-Field Bit Alignment<br>0-----7                                   | Channel                      | Definition<br>Units/LSB Value/ Other |
| 0                                                                    | Undefined                    | 0=off,1=on                           |
| 1                                                                    | Undefined                    | 0=off,1=on                           |
| 2                                                                    | Undefined                    | 0=off,1=on                           |
| 3                                                                    | Undefined                    | 0=off,1=on                           |
| 4                                                                    | Undefined                    | 0=off,1=on                           |
| 5                                                                    | ENRAD Noise Reduced UTF      | 0=off,1=on                           |
| 6                                                                    | Search Sensor Filtered UTF   | 0=off,1=on                           |
| 7                                                                    | Search Sensor Unfiltered UTF | 0=off,1=on, Default = 1              |

### 3.3.6 Format 5 – Pre-Mapped Target Data (Future Growth)

The following table summarizes the message data layout for Format 5 which contains Pre-Mapped Target Data. This format is not planned to be incorporated into the 3MDS Execution Phase, but is defined here for future implementation.

**Table 29 - Format 5 Pre-Mapped Target Data**

| Relative Base Address (bytes) | Item              | Size (bits) | Definition Units/LSB Value/Other      |
|-------------------------------|-------------------|-------------|---------------------------------------|
| 0                             | ID                | 8           | 00000101B                             |
| 1                             | Reserved          | 24          | TBD                                   |
| 4                             | Message Length    | 32          | 72                                    |
| 8                             | Source MSN        | 16          | See Manufacturer Serial Number Decode |
| 10                            | Destination MSN   | 16          | See Manufacturer Serial Number Decode |
| 12                            | Sample Count      | 32          | 1                                     |
| 16                            | Number of Targets | 32          | 1                                     |
| 20                            | Target Number 1   | 32          | 00000001H                             |
| 24                            | Target Latitude   | 64          | degrees(DPFP)                         |
| 32                            | Target Longitude  | 64          | degrees(DPFP)                         |
| 40                            | Target Depth      | 64          | degrees (DPFP)                        |
| 48                            | North Moment      | 64          | degrees (DPFP)                        |
| 56                            | East Moment       | 64          | degrees (DPFP)                        |
| 64                            | Vertical Moment   | 64          | degrees (DPFP)                        |
|                               | See Note 12       |             |                                       |

<sup>12</sup> The Pre-Mapped Target Data message contains the "Number of Targets" sets of target definitions each containing [Target Number, Target Latitude, Target Longitude, Target Depth, North Moment, East Moment, and Vertical Moment] as defined here. A single Pre-Mapped Target Data message may be succeeded by additional Pre-Mapped Target Data messages with more target definitions to be added to the Pre-Mapped Target Data Table.

### 3.3.7 Format 6 – False Target Data Output (Future Growth)

The following table summarizes the message data layout for Format 6 which contains World Magnetic Model Data. This format is not planned to be incorporated into the 3MDS Execution Phase, but is defined here for future implementation.

**Table 30 - Format 6 False Target Data Output**

| Relative Base Address (bytes) | Item              | Size (bits) | Definition Units/LSB Value/Other      |
|-------------------------------|-------------------|-------------|---------------------------------------|
| 0                             | ID                | 8           | 00000110B                             |
| 1                             | Reserved          | 24          | TBD                                   |
| 4                             | Message Length    | 32          | 72                                    |
| 8                             | Source MSN        | 16          | See Manufacturer Serial Number Decode |
| 10                            | Destination MSN   | 16          | See Manufacturer Serial Number Decode |
| 12                            | Sample Count      | 32          | 1                                     |
| 16                            | Number of Dipoles | 32          | 1                                     |
| 20                            | Dipole Number 1   | 32          | 00000001H                             |
| 24                            | Dipole Latitude   | 64          | degrees (DPFP)                        |
| 32                            | Dipole Longitude  | 64          | degrees (DPFP)                        |
| 40                            | Dipole Depth      | 64          | degrees (DPFP)                        |
| 48                            | North Moment      | 64          | degrees (DPFP)                        |
| 56                            | East Moment       | 64          | degrees (DPFP)                        |
| 64                            | Vertical Moment   | 64          | degrees (DPFP)                        |
|                               | See Note 13       |             |                                       |

<sup>13</sup> The False Target Data Output message contains the "Number of Dipole" sets of false target definitions each containing [Dipole Number, Dipole Latitude, Dipole Longitude, Dipole Depth, North Moment, East Moment, and Vertical Moment] as defined here. A single False Target Data Output message may be succeeded by additional False Target Data Output messages with more target definitions to be added to the False Target Data Table.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**3.3.8 Format 7 – Track Data**

The following table summarizes the message data layout for Format 7 which contains Track Data output by the MAD Tracker function generated from operator selected detection information.

**Table 31 - Format 7 Track Data**

| Relative Base Address (bytes) | Item                           | Size (bits) | Definition Units/LSB Value/Other                                                   |
|-------------------------------|--------------------------------|-------------|------------------------------------------------------------------------------------|
| 0                             | ID                             | 8           | 00000111B                                                                          |
| 1                             | Reserved                       | 24          | TBD                                                                                |
| 4                             | Message Length                 | 32          | 212                                                                                |
| 8                             | Source MSN                     | 16          | See Manufacturer Serial Number Decode                                              |
| 10                            | Destination MSN                | 16          | See Manufacturer Serial Number Decode                                              |
| 12                            | Sample Count                   | 32          | 1                                                                                  |
| 16                            | CPA Time 1                     | 64          | Earliest selected CPA Time; Seconds since midnight start of mission day GMT (DPFP) |
| 24                            | CPA Time 2                     | 64          | Latest selected CPA Time; Seconds since midnight start of mission day GMT (DPFP)   |
| 32                            | Latitude                       | 64          | degrees(DPFP)                                                                      |
| 40                            | Longitude                      | 64          | degrees(DPFP)                                                                      |
| 48                            | Depth                          | 64          | feet(DPFP)                                                                         |
| 56                            | Velocity                       | 64          | Knots (DPFP)                                                                       |
| 64                            | Heading                        | 64          | degrees (DPFP)                                                                     |
| 72                            | North Dipole Moment            | 64          | nT –ft <sup>3</sup> (DPFP)                                                         |
| 80                            | East Dipole Moment             | 64          | nT –ft <sup>3</sup> (DPFP)                                                         |
| 88                            | Vertical (down) Dipole Moment  | 64          | nT –ft <sup>3</sup> (DPFP)                                                         |
| 96                            | HED Moment                     | 64          | Amp-Meter (DPFP)                                                                   |
| 104                           | ELF Moment                     | 64          | Amp-Meter (DPFP)                                                                   |
| 112                           | ELF Frequency                  | 64          | Hertz (DPFP)                                                                       |
| 120                           | Reserved for Future Capability | 64          |                                                                                    |
| 128                           | Reserved for Future Capability | 64          |                                                                                    |
| 136                           | Reserved for Future Capability | 64          |                                                                                    |
| 144                           | Reserved for Future Capability | 64          |                                                                                    |
| 152                           | Reserved for Future Capability | 64          |                                                                                    |
| 160                           | Reserved for Future Capability | 64          |                                                                                    |
| 168                           | Reserved for Future Capability | 64          |                                                                                    |
| 176                           | Reserved for Future Capability | 64          |                                                                                    |
| 184                           | Reserved for Future Capability | 64          |                                                                                    |
| 192                           | Reserved for Future Capability | 64          |                                                                                    |
| 200                           | Reserved for Future Capability | 64          |                                                                                    |
| 208                           | Tracker Status                 | 32          | See Table 32 Format 7 Tracker Status Decode                                        |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**Table 32 Format 7 Tracker Status Decode**

| System Status                   |                                           |                   |                                                                                                                                        |
|---------------------------------|-------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Sub-Field Alignment<br>0-----31 | Item                                      | Size<br>(in bits) | Definition<br>Units/LSB Value/Other                                                                                                    |
| 0                               | Tracker Result<br>Confidence Status       | 2                 | Tracker Result Status<br>Code <sup>14</sup><br>0 = No Confidence<br>1 = Low Confidence<br>2 = Medium Confidence<br>3 = High Confidence |
| 2                               | Full Column Rank                          | 1                 | 0 = False<br>1 = True                                                                                                                  |
| 3                               | Convergence                               | 1                 | 0 = False<br>1 = True                                                                                                                  |
| 4                               | Depth Test                                | 1                 | 0 = Fail<br>1 = Pass                                                                                                                   |
| 5                               | Speed Test                                | 1                 | 0 = Fail<br>1 = Pass                                                                                                                   |
| 6                               | Dipole Moment Test                        | 1                 | 0 = Fail<br>1 = Pass                                                                                                                   |
| 7                               | First Estimated CPA<br>Range Test         | 1                 | 0 = Fail<br>1 = Pass                                                                                                                   |
| 8                               | Second Estimated CPA<br>Range Test        | 1                 | 0 = Fail<br>1 = Pass                                                                                                                   |
| 9                               | HED total moment Test                     | 1                 | 0 = Fail<br>1 = Pass                                                                                                                   |
| 10                              | NRTD or CTF Used for<br>Track Calculation | 1                 | 0 = NRTD (Noise Reduced<br>Time Domain)<br>1 = CTF (Compensated<br>Total Field)                                                        |
| 11                              | CPA1 Invalid                              | 1                 | 0 = False,<br>1 = True <sup>15</sup>                                                                                                   |
| 12                              | CPA2 Invalid                              | 1                 | 0 = False,<br>1 = True <sup>15</sup>                                                                                                   |
| 13                              | Not Yet Defined                           |                   |                                                                                                                                        |
| *                               |                                           |                   |                                                                                                                                        |
| *                               |                                           |                   |                                                                                                                                        |
| 31                              | Not Yet Defined                           | 1                 |                                                                                                                                        |

<sup>14</sup> 0 = No Confidence (Full Column Rank=False)  
1 = Low Confidence (Full Column Rank=True, but does not meet High or Medium Confidence Criteria)  
2 = Medium Confidence (Full Column Rank=True, Four other tests=Pass) or (Full Rank  
Convergence=False, All Tests Pass)  
3 = High Confidence (Full Rank=True, Convergence=True, All tests=Pass)

<sup>15</sup> Either CPA found to be invalid precludes generation of a Track solution, and, therefore, none of the track output fields will contain valid data.

### 3.3.9 Format 8 – Detection Data

The following table summarizes the message data layout for Format 8 which contains Detection Data.

**Table 33 - Format 8 – Detection Data**

| Relative Base Address (bytes) | Item                                               | Size (bits) | Definition Units/LSB Value/Other                                                                       |
|-------------------------------|----------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------|
| 0                             | ID                                                 | 8           | 00001000B                                                                                              |
| 1                             | Reserved                                           | 24          | TBD                                                                                                    |
| 4                             | Message Length                                     | 32          | 96                                                                                                     |
| 8                             | Source MSN                                         | 16          | See Manufacturer Serial Number Decode                                                                  |
| 10                            | Destination MSN                                    | 16          | See Manufacturer Serial Number Decode                                                                  |
| 12                            | Message Count                                      | 32          | 1                                                                                                      |
| 16                            | Detection Flag                                     | 8           | >3 = Not Assigned<br>3 = Joint Detection<br>2 = MAD Detection<br>1 = ELF Detection<br>0 = No Detection |
| 17                            | Format 8 Detection Data Status                     | 24          | See Format 8 Detection Status Decode                                                                   |
| 20                            | Reserved                                           | 32          | TBD                                                                                                    |
| 24                            | GPS Time for detection data                        | 64          | Seconds since midnight start of mission day GMT (DPFP)                                                 |
| 32                            | GPS Latitude for Detection Data                    | 64          | Degrees (DPFP)                                                                                         |
| 40                            | GPS Longitude for Detection Data                   | 64          | Degrees (DPFP)                                                                                         |
| 48                            | GPS Height above mean sea level for Detection Data | 64          | Meters (DPFP)                                                                                          |
| 56                            | Joint Detection Level (See Note 16)                | 64          | Range (-1,1x10 <sup>6</sup> ) (DPFP)                                                                   |
| 64                            | MAD Detection Level (See Note 12)                  | 64          | Range (-1,1x10 <sup>6</sup> ) (DPFP)                                                                   |
| 72                            | ELF Detection Level (See Note 12)                  | 64          | Range (-1,1x10 <sup>6</sup> ) (DPFP)                                                                   |
| 80                            | Slant Range                                        | 64          | Ft. (DPFP)                                                                                             |
| 88                            | ELF Frequency Estimate                             | 64          | Hertz (DPFP)                                                                                           |

<sup>16</sup> Detection levels are representations of T-statistic values for declaring detection strength.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**Table 34 Format 8 Detection Status Decode**

| Subfield<br>Alignment | Field Name                   | Definition<br>Units/LSB Value/Other |
|-----------------------|------------------------------|-------------------------------------|
| 0-----23              |                              |                                     |
| 0                     | Data Valid                   | 0 = Not Valid<br>1 = Valid          |
| 1                     | Format 8 Message Count Reset | 0 = Not Reset<br>1 = Reset          |
| 2                     | Not Assigned                 | N/A                                 |
| 22                    | Not Assigned                 | N/A                                 |
| 23                    | Turn in Progress Detected    | 0 = Not Detected<br>1 = Detected    |

### 3.3.10 Format 9 – Time Domain Detection Data

The following table summarizes the message data layout for Format 9 which contains Time Domain Detection Data.

**Table 35 - Format 9 Time Domain Noise Reduced Data**

| Relative Base Address (bytes) | Item                               | Size (bits) | Definition Units/LSB Value/Other                       |
|-------------------------------|------------------------------------|-------------|--------------------------------------------------------|
| 0                             | ID                                 | 8           | 00001001B                                              |
| 1                             | Reserved                           | 24          | TBD                                                    |
| 4                             | Message Length                     | 32          | 48                                                     |
| 8                             | Source MSN                         | 16          | See Manufacturer Serial Number Decode                  |
| 10                            | Destination MSN                    | 16          | See Manufacturer Serial Number Decode                  |
| 12                            | Message Count                      | 32          | 1                                                      |
| 16                            | Format 9 Status                    | 32          | See Format 9 Status Decode                             |
| 20                            | Sample Count for time domain point | 32          | 1                                                      |
| 24                            | GPS Time for time domain pt        | 64          | Seconds since midnight start of mission day GMT (DPFP) |
| 32                            | Noise Reduced Time Domain Value    | 64          | nT (DPFP)                                              |
| 40                            | Compensated Total Field Value      | 64          | nT (DPFP) <sup>17</sup>                                |

<sup>17</sup> The Compensated Total Field Values from the Search Sensor Format 1 messages decimated to 10 Hz and filtered.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**Table 36 Format 9 Status Decode**

| Subfield Alignment | Field Name                              | Definition<br>Units/LSB Value/Other            |
|--------------------|-----------------------------------------|------------------------------------------------|
| 0-----32           |                                         |                                                |
| 0                  | Format 9 Data Valid                     | 0 = Not Valid<br>1 = Valid                     |
| 1                  | Format 9 Message Count Reset            | 0 = Not Reset<br>1 = Reset                     |
| 2                  | Single Sensor/Dual Sensor Selection     | 0 = Single Sensor<br>1 = Dual Sensor           |
| 3                  | Sample Value Interpolated <sup>18</sup> | 0 = No interpolation<br>1 = Value interpolated |
|                    | Not Assigned                            | N/A                                            |
| 15                 | Noise Box/Detection Result              | 0 = Detection Result<br>1 = Noise Box Result   |
| *                  | "                                       | "                                              |
| 32                 | Not Assigned                            | N/A                                            |

<sup>18</sup> When in Dual Sensor Mode (Status Bit 2 = 1) and data from the Reference Sensor is not available for less than 1 (one) second, the missing values are estimated through interpolation to minimize impact from short data dropout.

**Format 10 – Frequency Domain Noise Reduced Data**

The following table summarizes the message data layout for Format 10 which contains real-valued Power Spectral Density data in arrays for frequency bins from dc to the Nyquist frequency. The size of each array, in number of points, is defined by the message parameter Number of Frequency Domain Points. The maximum number of points for each array that will be delivered in a Format 10 message is 1025 and, therefore, the largest value that will be assigned to the Number of Frequency Domain Points parameter is 2048.

**Table 37 - Format 10 Frequency Domain Real-Time Noise Data**

| Relative Base Address (bytes) | Item                                                                                             | Size (bits) | Definition Units/LSB Value/Other                       |
|-------------------------------|--------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------|
| 0                             | ID                                                                                               | 8           | 00001010B                                              |
| 1                             | Reserved                                                                                         | 24          | TBD                                                    |
| 4                             | Message Length                                                                                   | 32          | See Note <sup>19</sup>                                 |
| 8                             | Source MSN                                                                                       | 16          | See Manufacturer Serial Number Decode                  |
| 10                            | Destination MSN                                                                                  | 16          | See Manufacturer Serial Number Decode                  |
| 12                            | Message Count                                                                                    | 32          | 1                                                      |
| 16                            | Data Valid                                                                                       | 8           | See Table 38 Format 10 Data Valid Decode               |
| 17                            | Alignment Spare                                                                                  | 56          | 0                                                      |
| 24                            | Number of Frequency Domain Points (NFFT)                                                         | 32          | 1                                                      |
| 28                            | Sample Count for newest time in FFT array                                                        | 32          | 1                                                      |
| 32                            | GPS Time for newest time in FFT array                                                            | 64          | Seconds since midnight start of mission day GMT (DPFP) |
| 40                            | Decimated Sampling Frequency (sampling frequency of FFT data)                                    | 64          | Hz (DPFP)                                              |
| 48                            | Noise Reduced Frequency Domain Value (1) (See Note 20)                                           | 64          | $nT^2/\text{Hz}$ (DPFP)                                |
|                               | .                                                                                                |             |                                                        |
| 48 + (((NFFT/2)+1)-1)*8       | Noise Reduced Frequency Domain Value (NFFT/2+1)                                                  | 64          | $nT^2/\text{Hz}$ (DPFP)                                |
| 48 + ((NFFT/2)+1)*8           | Motion Noise Reduced Frequency Domain Value (1) from the Sensor (After decimation) (See Note 21) | 64          | $nT^2/\text{Hz}$ (DPFP)                                |

<sup>19</sup> Format 10 Message length is variable relative to the value of NFFT, the number of points used in FFT computation. For any given Format 10 message, the length is determined by the equation

Len = 48 + ((NFFT/2)+1)\*8 + ((NFFT/2)+1)\*8

<sup>20</sup> Noise Reduced Frequency Domain data = ENRAD Frequency Domain Total Field Output (noise reduced data)

<sup>21</sup> Motion Noise Reduced Frequency Domain Data = ENRAD Frequency Domain Input Total Field (derived from either the CTF or UTFa field from format 1 - after LPF, decimation, and HPF).

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes)                     | Item                                                                                        | Size (bits) | Definition Units/LSB Value/Other |
|---------------------------------------------------|---------------------------------------------------------------------------------------------|-------------|----------------------------------|
|                                                   | .                                                                                           |             |                                  |
| 48 +<br>((NFFT/2)+1)*8<br>+<br>(((NFFT/2)+1)-1)*8 | Motion Noise Reduced Frequency Domain Value ((NFFT/2)+1) from the Sensor (After decimation) | 64          | nT <sup>2</sup> /Hz (DPFP)       |

**Table 38 Format 10 Data Valid Decode**

| Subfield Alignment<br>0-----7 | Field Name                 | Definition<br>Units/LSB Value/Other          |
|-------------------------------|----------------------------|----------------------------------------------|
| 0                             | Noise Box/Detection Result | 0 = Detection Result<br>1 = Noise Box Result |
| 1                             | Not Assigned               | N/A                                          |
| 2                             | Not Assigned               | N/A                                          |
| 3                             | Not Assigned               | N/A                                          |
| 4                             | Not Assigned               | N/A                                          |
| 5                             | Not Assigned               | N/A                                          |
| 6                             | Not Assigned               | N/A                                          |
| 7                             | Format 10 Data Valid       | 0 = Not Valid<br>1 = Valid                   |

### 3.3.11 Format 11 – High Speed Debug Data

The following table summarizes the message data layout for Format 11 which contains High Speed Debug Data transmitted at 37878.7988 Hz. High Speed Debug Data is reserved for sensor test and diagnosis and is not used in normal operation.

**Table 39 - Format 11 High Speed Debug Data**

| Relative Base Address (bytes) | Item                       | Size (bits) | Definition Units/LSB Value/Other |
|-------------------------------|----------------------------|-------------|----------------------------------|
| 0                             | ID                         | 8           | 00001011B                        |
| 1                             | Data Point Count           | 24          | 8                                |
| 4                             | Selectable by FPGA program | 32          | TBD                              |

### 3.3.12 Format 12 – Start/End Playback/Retrieve

Table 40 defines the format and content of the system message that bounds recorded data that is being reprocessed through Playback, or Retrieved to the Display/Control Processor for archive or external processing. After a Format 4 message containing a command to enter Playback Mode is received by a Computer/Power Supply, execution of the command begins with a Format 12 message set to Start, and completes with a Format 12 message set to End. Format 12 messages may be sent to any system components involved in the Playback/Retrieve operation, but are definitely sent to the commanding Display/Control Processor.

**Table 40 - Format 12 Start/End Playback/Retrieve**

| Start-End Playback/Retrieve |                   |             |                                       |
|-----------------------------|-------------------|-------------|---------------------------------------|
| Byte Offset                 | Item              | Size (bits) | Definition Units/LSB Value/Other      |
| 0                           | ID                | 8           | 00001100B                             |
| 1                           | Reserved          | 24          | TBD                                   |
| 4                           | Message Length    | 32          | 18                                    |
| 8                           | Source MSN        | 16          | See Manufacturer Serial Number Decode |
| 10                          | Destination MSN   | 16          | See Manufacturer Serial Number Decode |
| 12                          | Message Count     | 32          | 1                                     |
| 16                          | Playback/Retrieve | 8           | 00H/01H                               |
| 17                          | Start/End         | 8           | 00H/01H                               |

### 3.3.13 Format 13 – Recorded File Directory Listing

Table 41 defines the format and content of the system control message that is sent in response to the Format 4 command to retrieve stored filenames and sizes to the Display/Control Processor. The filenames are sent in “blocks” of 10 filenames in a Format 13 message with the “Block Number of Filename Block” incremented by 1 with each message.

**Table 41 - Format 13 Recorded File Directory Readout**

| Recorded File Directory Readout |                                |             |                                          |
|---------------------------------|--------------------------------|-------------|------------------------------------------|
| Byte Offset                     | Item                           | Size (bits) | Definition<br>Units/LSB Value/Other      |
| 0                               | ID                             | 8           | 00001101B                                |
| 1                               | Reserved                       | 24          | TBD                                      |
| 4                               | Message Length                 | 32          | Variable :<br>$20+(N-1)*72 +8$           |
| 8                               | Source MSN                     | 16          | See Manufacturer Serial<br>Number Decode |
| 10                              | Destination MSN                | 16          | See Manufacturer Serial<br>Number Decode |
| 12                              | Message Count                  | 32          | 1                                        |
| 16                              | Number of Filenames (n)        | 16          | 1                                        |
| 18                              | Block Number of Filename Block | 16          | 1                                        |
| 20                              | Filename 1                     | 512         | Filename Note                            |
| 84                              | File Size in Bytes             | 64          | 1                                        |
| :                               | :                              | :           | :                                        |
| $20+(N-1)*72$                   | Filename N                     | 512         | Filename Note                            |
| $20+(N-1)*72 +8$                | File Size in Bytes             | 64          | 1                                        |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

**3.3.14 Format 14 – Message Recording Wrapper**

Table 41 defines the format and content of the message wrapper that is used to encapsulate each message recorded by the Record/Playback/Retrieve function in response to the Format 4 command to begin storing message data.

**Table 42 - Format 14 Message Recording Wrapper**

| <b>Message Recording Wrapper</b> |                                  |                    |                                             |
|----------------------------------|----------------------------------|--------------------|---------------------------------------------|
| <b>Byte Offset</b>               | <b>Item</b>                      | <b>Size (bits)</b> | <b>Definition<br/>Units/LSB Value/Other</b> |
| 0                                | ID                               | 8                  | 00001110B                                   |
| 1                                | Reserved                         | 24                 | TBD                                         |
| 4                                | Message Length                   | 32                 | Variable :<br>20+Content Message Length-1   |
| 8                                | Source MSN                       | 16                 | See Manufacturer Serial Number Decode       |
| 10                               | Destination MSN                  | 16                 | See Manufacturer Serial Number Decode       |
| 12                               | Message Count                    | 32                 | 1                                           |
| 16                               | Content Message ID               | 8                  | MSG ID                                      |
| 17                               | Content Message Length N (bytes) | 24                 | 1                                           |
| 20                               | MSG Byte 1                       | 8                  | First byte of Message                       |
| :                                | :                                | :                  | :                                           |
| 20+Content Message Length-1      | MSG Byte N                       | 8                  | Last Byte of Message                        |

### 3.3.15 Format-15 Noise Reduction/Detection Processing Control

Table 49 defines the format and content of the message that conveys control direction to the Noise Reduction and Detection Processing functions. This message is derived from the Format 4 message sent from the Display/Control Processor to the Computer/Power Supply. Format 15 messages are sent to the function calling the Noise Reduction and Detection processes where the message is delivered in the call with the Data Valid item set to "Valid."

**Table 43 - Format-15 Noise Reduction/Detection Processing Control**

| Relative Base Address (bytes) | Item                                | Size (bits) | Definition Units/LSB Value/Other                                                                                                    |
|-------------------------------|-------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 0                             | ID                                  | 8           | 00001111B                                                                                                                           |
| 1                             | Reserved                            | 24          | TBD                                                                                                                                 |
| 4                             | Message Length                      | 32          | 96                                                                                                                                  |
| 8                             | Source MSN                          | 16          | See Manufacturer Serial Number Decode                                                                                               |
| 10                            | Destination MSN                     | 16          | See Manufacturer Serial Number Decode                                                                                               |
| 12                            | Message Count                       | 32          | 1                                                                                                                                   |
| 16                            | Data Valid                          | 16          | 1 = Valid,<br>0 = Invalid                                                                                                           |
| 18                            | Mode/Command                        | 16          | See Mode/Command Decode                                                                                                             |
| 20                            | Bit Status                          | 32          | See Bit Status Decode                                                                                                               |
| 24                            | Aircraft Standard Turn Rate         | 64          | Degrees/Sec (DPFP)                                                                                                                  |
| 32                            | Noise Box Control                   | 8           | Start/Continue = 1, Stop = 0                                                                                                        |
| 33                            | Geology Processing Control          | 8           | Start/Continue = 1, Stop = 0                                                                                                        |
| 34                            | Use Data File Valid                 | 8           | Flag saying if we should use the following data (1) or if we should use default parameters (0)                                      |
| 35                            | FFT power of 2                      | 8           | FFT size as a power of 2 ex: =9 then FFT size = $2^9 = 512$                                                                         |
| 36                            | ANC L History Size                  | 8           | Tells how big the L history will be in terms of FFT size = integer multiple of the FFT size                                         |
| 37                            | (ANC L History)/(Coeff update rate) | 8           | Tells how often the L history will be updated in terms of FFT size = integer fractions of the FFT size                              |
| 38                            | Ref Channels To Use                 | 64          | On/off flags for selecting which channels to use - see decode for more info (See Table 26 ENRAD Processing Channel Selection Table) |
| 46                            | Gap Delay                           | 8           | 1                                                                                                                                   |
| 47                            | FAR Type                            | 8           | CFAR or Fixed Threshold (2=fixed,1= cfar, 0 = default)                                                                              |
| 48                            | FAR Value                           | 32          | # of FAR per hour or the fixed level as a float                                                                                     |
| 52                            | S1 Turn Indicator Threshold         | 32          | For in turn out of turn threshold                                                                                                   |
| 56                            | S2 Turn Indicator Threshold         | 32          | For in turn out of turn threshold                                                                                                   |
| 60                            | S3 Turn Indicator Threshold         | 32          | For in turn out of turn threshold                                                                                                   |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | Item                           | Size (bits) | Definition Units/LSB Value/Other                                                                                     |
|-------------------------------|--------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------|
| 64                            | Fixed Joint T thresh.          | 32          | Fixed Threshold Joint Max T stat level for detector                                                                  |
| 68                            | Fixed MAD T thresh.            | 32          | Fixed Threshold MAD Max T stat level for detector                                                                    |
| 72                            | Fixed ELF T thresh.            | 32          | Fixed Threshold ELF Max T stat level for detector                                                                    |
| 76                            | Detector ELF start freq        | 32          | single precision value for starting ELF frequency                                                                    |
| 80                            | Detector ELF end freq          | 32          | single precision value for ending ELF frequency                                                                      |
| 84                            | Detector Update Rate           | 8           | Detector update rate as a factor of how many calls per FFT block ( $\leq \text{NFFT}$ & a power of 2)                |
| 85                            | PNR_Enabled                    | 8           | Pendulum Noise Reduction Control<br>enabled = 1 or<br>disabled = 2<br>default = 2                                    |
| 86                            | PNR_refs                       | 16          | On/off flags for selection of reference channels for Fast Adaptive Pendulum Noise Reduction use. Defined in Table 27 |
| 88                            | PNR_Main                       | 8           | On/off flags for selection of Main channels for Fast Adaptive Pendulum Noise Reduction use. Defined in Table 28      |
| 89                            | PNR_ntaps                      | 8           | # of taps to use in the Fast Adaptive Pendulum Noise Reduction Algorithm (Default = 1)                               |
| 90                            | PNR_taplength                  | 16          | # of data points per tap (min = 1 = default)                                                                         |
| 92                            | PNR_LHistorySize               | 16          | # of data points in Fast Adaptive Pendulum Noise Reduction History (Default = 500)                                   |
| 94                            | No. of ELF Harmonics           | 8           | Unsigned, Range $1 \leq x \leq 255$ , Default=1                                                                      |
| 95                            | No. of ELF Search Fundamentals | 8           | Unsigned, Range $2 \leq x \leq 255$ , Default=2                                                                      |

### 3.3.15.1 Mode/Command Decode for Format 15

Three options exist for the mode/command decode – Test Mode, Normal Mode, and Playback Mode. All three options are described in the following subparagraphs:

#### 3.3.15.1.1 Option 1 – Test Mode

**Table 44 -- Format 15 Mode/Command Decode Option 1 - Test Mode**

| Mode/Command Value<br>(Binary) | Definition<br>Units/LSB Value/Other |
|--------------------------------|-------------------------------------|
| 00xxxxxxxxxxxxxx               | <b>Test Mode</b>                    |
| 0000000000000000               | No Test                             |
| 0000000000000001               | Test in Progress                    |

#### 3.3.15.1.2 Option 2 – Normal Mode

**Table 45 -- Format 15 Mode/Command Decode Option 2 - Normal Mode**

| Mode/Command Value<br>(Binary) | Definition<br>Units/LSB Value/Other |
|--------------------------------|-------------------------------------|
| 01xxxxxxxxxxxxxx               | <b>Normal Mode</b>                  |
| 0100000000000000               | Normal Mode/All Off                 |
| 0100000000000001               | Normal Mode On                      |
| 0100000000001000               | Synchronize Sensor Sampling (Reset) |
| 0100000001000000               | Clear/Restart Processing History    |

#### 3.3.15.1.3 Option 3 – Playback Mode

**Table 46 -- Format 15 Mode/Command Decode Option 3 - Playback Mode**

| Mode/Command Value<br>(Binary) | Definition<br>Units/LSB Value/Other |
|--------------------------------|-------------------------------------|
| 11xxxxxxxxxxxxxx               | <b>Playback Mode</b>                |
| 1100000000000000               | Playback Mode Operator Control      |
| 1100000000000001               | Playback Mode Data Control          |
| 1100000000001000               | Synchronize Sensor Sampling (Reset) |
| 1100000001000000               | Clear/Restart Processing History    |

### 3.3.15.2 Noise Reduction and Detection Processing Control

In order to provide operator control over Noise Reduction and Detection (NRD) Processing during operational testing, a number of parameters and switch fields are included in the Display Control Processor Operator Window Tabs and to Format 4 for transmission to the processing elements. These fields are defined starting with Relative Base Address 176 - Noise Box Control of Table 22 and continuing through Relative Base Address 237 – Reserved for Future Use.

There are three distinct control functions provided by these parameters:

- a. Provide initialization values for processing array sizes and computational terms,
- b. Direct the acquisition of new or previously collected “Noise Box Data” to facilitate the Noise Reduction process,

- c. Adjust threshold and other control parameters during test execution.

In order to accomplish these three control functions, an initial set of the parameters is to be provided to the NRD processing program's initialization function prior to any noise reduction or detection processing can begin. Noise Box data source selection has additional activation control to separate Noise Box data processing from normal NRD processing, and the full set of NRD parameters are provided and updated to NRD after the initialization operation designation.

Thus, NRD is not initialized for processing until the operator actively changes the Use Data File Valid control to either "Use Default" (0) or "Use Following" (1) from its default setting of "Not set by operator" (3). No Format 1 sensor data is provided to NRD until both a) NRD has been initialized, and b) the operator designates "Noise Box Control Active" (1) along with "Noise Box Selection" set to either "Start" (1), or "Previous" (2).

If Noise Box Collect is set to "Start" (1). Noise Box Control Active is set to "Yes" (1), and initialization has been completed, Format 1 data will be provided to NRD for Noise Box Data processing and the same Format 1 data will be recorded for use on later tests under operator direction. This Format 1 data will also be recorded with all other messages in the full data recording file. The Noise Box collection period continues until the operator changes Noise Box Collect to Stop = 0, whereupon the recording of the Noise Box data will be closed, NRD will be commanded to Stop Noise Box Collection, and current Format 1 sensor data will be sent to NRD for processing.

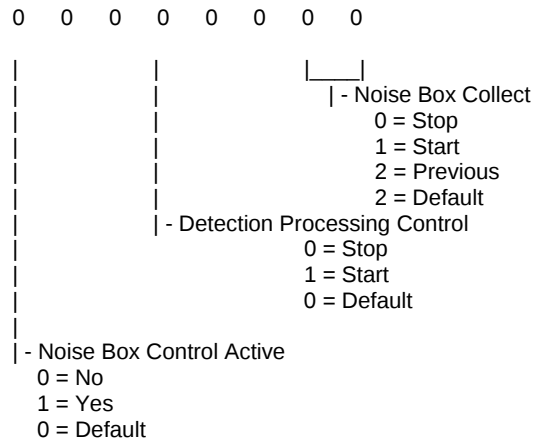
If Noise Box Collect is set to "Previous" (2), NRD has been initialized, and Noise Box Control Active is set to "Yes" (1), a Noise Box Collect set to "Start" (1) will be sent to NRD in a Format 15 message by Computer Power Supply (CPS) Control. CPS Control will, then, read the stored Format 1 Noise Box data from the previously recorded file and provide it to NRD as quickly as NRD can accept it. This Format 1 data will also be recorded with all other messages in the full data recording file. When the last pre-recorded Format 1 Noise Box Data message has been provided to NRD, a Format 15 message commanding Noise Box Collect to "Stop" (0) will be provided to NRD. CPS Control will, the, direct the current Format 1 sensor data being received from the sensor(s) to be provided to NRD for processing.

Other NRD control parameters may be updated by the operator at any time on the display tab and directed to be sent to NRD during processing.

### 3.3.15.3 Noise Box Control Decode

The Noise Box Control consists of two sub-fields in an eight bit field.

**Table 47 - Noise Box Control Decode**



### 3.3.15.4 Processing Channel Selection Table

Table 26 provides a description of the table for specifying selection of Noise Reduction and Detection processing channels for execution within the CP-2569 Computer Power Supply. This definition is placed in a Format 4 System Control message and transmitted to the Computer Power Supply where it is translated to a Format 15 Noise Reduction/Detection Processing Control message and sent to be delivered to the Environmental Noise Reduction and Detection (ENRAD) module.

**Table 48 - ENRAD Processing Channel Selection Table**

| Ref Channel Selection Decode |                                |            |
|------------------------------|--------------------------------|------------|
| Sub-Field Alignment          | Channel                        |            |
| 0-----63                     |                                | 0=off,1=on |
| 0                            | Search VMT                     | 0=off,1=on |
| 1                            | Search VML                     | 0=off,1=on |
| 2                            | Search VMD                     | 0=off,1=on |
| 3                            | Search ACT                     | 0=off,1=on |
| 4                            | Search ACL                     | 0=off,1=on |
| 5                            | Search ACD                     | 0=off,1=on |
| 6                            | Search Vertical Velocity       | 0=off,1=on |
| 7                            | Search S1                      | 0=off,1=on |
| 8                            | Search S2                      | 0=off,1=on |
| 9                            | Search S3                      | 0=off,1=on |
| 10                           | Search S4                      | 0=off,1=on |
| 11                           | Search S5                      | 0=off,1=on |
| 12                           | Search S6                      | 0=off,1=on |
| 13                           | Search S7                      | 0=off,1=on |
| 14                           | Search S8                      | 0=off,1=on |
| 15                           | Search S9                      | 0=off,1=on |
| 16                           | Search S10                     | 0=off,1=on |
| 17                           | Search S11                     | 0=off,1=on |
| 18                           | Search S12                     | 0=off,1=on |
| 19                           | Search S13                     | 0=off,1=on |
| 20                           | Search S14                     | 0=off,1=on |
| 21                           | Search S15                     | 0=off,1=on |
| 22                           | Search S16                     | 0=off,1=on |
| 23                           | Search <i>Bestpos</i> Altitude | 0=off,1=on |
| 24                           | Search Horizontal Speed        | 0=off,1=on |
| 25                           | Search Heading                 | 0=off,1=on |
| 26                           | undefined                      | 0=off,1=on |
| 27                           | undefined                      | 0=off,1=on |
| 28                           | undefined                      | 0=off,1=on |
| 29                           | undefined                      | 0=off,1=on |
| 30                           | undefined                      | 0=off,1=on |
| 31                           | undefined                      | 0=off,1=on |
| 32                           | Reference UTF                  | 0=off,1=on |
| 33                           | Reference VMT                  | 0=off,1=on |
| 34                           | Reference VML                  | 0=off,1=on |
| 35                           | Reference VMD                  | 0=off,1=on |
| 36                           | Reference ACT                  | 0=off,1=on |
| 37                           | Reference ACL                  | 0=off,1=on |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

|    |                                   |            |
|----|-----------------------------------|------------|
| 38 | Reference ACD                     | 0=off,1=on |
| 39 | Reference Vertical Velocity       | 0=off,1=on |
| 40 | Reference S1                      | 0=off,1=on |
| 41 | Reference S2                      | 0=off,1=on |
| 42 | Reference S3                      | 0=off,1=on |
| 43 | Reference S4                      | 0=off,1=on |
| 44 | Reference S5                      | 0=off,1=on |
| 45 | Reference S6                      | 0=off,1=on |
| 46 | Reference S7                      | 0=off,1=on |
| 47 | Reference S8                      | 0=off,1=on |
| 48 | Reference S9                      | 0=off,1=on |
| 49 | Reference S10                     | 0=off,1=on |
| 50 | Reference S11                     | 0=off,1=on |
| 51 | Reference S12                     | 0=off,1=on |
| 52 | Reference S13                     | 0=off,1=on |
| 53 | Reference S14                     | 0=off,1=on |
| 54 | Reference S15                     | 0=off,1=on |
| 55 | Reference S16                     | 0=off,1=on |
| 56 | Reference <i>Bestpos</i> Altitude | 0=off,1=on |
| 57 | Reference Horizontal Speed        | 0=off,1=on |
| 58 | Reference Heading                 | 0=off,1=on |
| 59 | undefined                         | 0=off,1=on |
| 60 | undefined                         | 0=off,1=on |
| 61 | undefined                         | 0=off,1=on |
| 62 | undefined                         | 0=off,1=on |
| 63 | undefined                         | 0=off,1=on |

### 3.3.16 Format-16 System Diagnostic Status

Table 41 defines the format and content of the message that provides collected System Diagnostic Status Information. Format 16 is sent from the Detection CPS to the Display Control Processor in response to a Format 4 command to provide the information.

**Table 49 - Format-16 System Diagnostic Status Information**

| Relative Base Address (bytes) | Item                            | Size (bits) | Definition Units/LSB Value/Other      |
|-------------------------------|---------------------------------|-------------|---------------------------------------|
| 0                             | ID                              | 8           | 00010000B                             |
| 1                             | Reserved                        | 24          | TBD                                   |
| 4                             | Message Length                  | 32          | 204                                   |
| 8                             | Source MSN                      | 16          | See Manufacturer Serial Number Decode |
| 10                            | Destination MSN                 | 16          | See Manufacturer Serial Number Decode |
| 12                            | Message Count                   | 32          | 1                                     |
| 16                            | Search Sensor Format 1 Count    | 32          | 1                                     |
| 20                            | Reference Sensor Format 1 Count | 32          | 1                                     |
| 24                            | Count of Format 2 Messages      | 32          | 1                                     |
| 28                            | Count of Format 3 Messages      | 32          | 1                                     |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | Item                                       | Size (bits) | Definition Units/LSB Value/Other |
|-------------------------------|--------------------------------------------|-------------|----------------------------------|
| 32                            | Count of Format 4 Messages                 | 32          | 1                                |
| 36                            | Count of Format 5 Messages                 | 32          | 1                                |
| 40                            | Count of Format 6 Messages                 | 32          | 1                                |
| 44                            | Count of Format 7 Messages                 | 32          | 1                                |
| 48                            | Count of Format 8 Messages                 | 32          | 1                                |
| 52                            | Count of Format 9 Messages                 | 32          | 1                                |
| 56                            | Count of Format 10 Messages                | 32          | 1                                |
| 60                            | Count of Format 12 Messages                | 32          | 1                                |
| 64                            | Count of Format 13 Messages                | 32          | 1                                |
| 68                            | Count of Format 14 Messages                | 32          | 1                                |
| 72                            | Count of Format 15 Messages                | 32          | 1                                |
| 76                            | Search Sensor GPS Time Status              | 32          | 1                                |
| 80                            | Reference Sensor GPS Time Status           | 32          | 1                                |
| 84                            | Number Reset Attempts in this Reset Cycle. | 32          | 1                                |
| 88                            | Aligner Case 0 count                       | 32          | 1                                |
| 92                            | Aligner Case 1 count                       | 32          | 1                                |
| 96                            | Aligner Case 2 count                       | 32          | 1                                |
| 100                           | Aligner Case 3 count                       | 32          |                                  |
| 104                           | Aligner Buffer Low Threshold               | 32          |                                  |
| 108                           | Aligner Buffer High Threshold              | 32          |                                  |
| 112                           | Reset Attempt Limit                        | 32          |                                  |
| 116                           | Rest Millisec Slack                        | 32          |                                  |
| 120                           | Reserved for future use                    | 32          |                                  |
| 134                           | Reserved for future use                    | 32          |                                  |
| 138                           | Reserved for future use                    | 32          |                                  |
| 142                           | Reserved for future use                    | 32          |                                  |
| 146                           | Reserved for future use                    | 32          |                                  |
| 150                           | Reserved for future use                    | 32          |                                  |
| 154                           | Reserved for future use                    | 32          |                                  |
| 158                           | Reserved for future use                    | 32          |                                  |
| 162                           | Reserved for future use                    | 32          |                                  |
| 166                           | Reserved for future use                    | 32          |                                  |
| *                             | *                                          | *           | *                                |
| 200                           | Reserved for future use                    | 32          | *                                |

### 3.3.17 Format 17 - Noise Reduction/Detection Initialization Status

Table 50 defines the format and content of the message which contains the notification to CPS Control that the NRD function has completed its initialization. Initialization completion status of 1 indicates successful initialization. A completion status of 0 indicates unsuccessful completion. Unsuccessful initialization will result in a System Fail Bit Status Code being sent to the Display Control Processor from the CPS in a Format 4 message.

**Table 50 - Format-17 Noise Reduction/Detection Initialization Status**

| Relative Base Address (bytes) | Item                                | Size (bits) | LSB/Definition/Code                     |
|-------------------------------|-------------------------------------|-------------|-----------------------------------------|
| 0                             | ID                                  | 8           | 00010001B                               |
| 1                             | Reserved                            | 24          | TBD                                     |
| 4                             | Message Length                      | 32          | 20                                      |
| 8                             | Source MSN                          | 16          | See Manufacturer Serial Number Decode   |
| 10                            | Destination MSN                     | 16          | See Manufacturer Serial Number Decode   |
| 12                            | Message Count                       | 32          | 1                                       |
| 16                            | NRD Processor Initialization Status | 32          | 1 = Initialized,<br>0 = Not Initialized |

### 3.3.18 Format 18 – Command Track Generation

Table 51 defines the format and content of the Command Track Generation message sent from the Display Control Processor to the Detection Capable Computer Power Supply directing the generation of a track from two Operator selected detections for prediction of the path of a possible target and to provide the pertinent information from the two Format 8 Detection Data messages reporting the selected detections.

**Table 51 – Format 18 Command Track Generation**

| Relative Base Address (bytes) | Item                                      | Size (bits) | Definition Units/LSB Value/Other                                                                              |
|-------------------------------|-------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------|
| 0                             | ID                                        | 8           | 00010010B                                                                                                     |
| 1                             | Reserved                                  | 24          | TBD                                                                                                           |
| 4                             | Message Length                            | 32          | 168                                                                                                           |
| 8                             | Source MSN                                | 16          | See Manufacturer Serial Number Decode                                                                         |
| 10                            | Destination MSN                           | 16          | See Manufacturer Serial Number Decode                                                                         |
| 12                            | Message Count                             | 32          | 1                                                                                                             |
| 16                            | Detection 1 Message Count                 | 32          | Message Count value from the earliest Format 8 Detection selected by the Operator for use in Track Generation |
| 20                            | Detection 2 Message Count                 | 32          | Message Count value from the latest Format 8 Detection selected by the Operator for use in Track Generation   |
| 24                            | GPS Time for detection data <sup>22</sup> | 64          | Seconds since midnight start of mission day GMT (DPFP)                                                        |

<sup>22</sup> Related to Detection 1 identified by Detection 1 Message Count.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

|     |                                                                     |    |                                                              |
|-----|---------------------------------------------------------------------|----|--------------------------------------------------------------|
| 32  | GPS Latitude for Detection Data <sup>22</sup>                       | 64 | Degrees (DPFP)                                               |
| 40  | GPS Longitude for Detection Data <sup>22</sup>                      | 64 | Degrees (DPFP)                                               |
| 48  | GPS Height above mean sea level<br>for Detection Data <sup>22</sup> | 64 | Meters (DPFP)                                                |
| 56  | Joint Detection Level <sup>22</sup>                                 | 64 | Range (-1,1x10 <sup>6</sup> ) (DPFP)                         |
| 64  | MAD Detection Level <sup>22</sup>                                   | 64 | Range (-1,1x10 <sup>6</sup> ) (DPFP)                         |
| 72  | ELF Detection Level <sup>22</sup>                                   | 64 | Range (-1,1x10 <sup>6</sup> ) (DPFP)                         |
| 80  | Slant Range <sup>22</sup>                                           | 64 | Ft. (DPFP)                                                   |
| 88  | ELF Frequency Estimate <sup>22</sup>                                | 64 | Hertz (DPFP)                                                 |
| 96  | GPS Time for detection data <sup>23</sup>                           | 64 | Seconds since midnight<br>start of mission day GMT<br>(DPFP) |
| 104 | GPS Latitude for Detection Data <sup>23</sup>                       | 64 | Degrees (DPFP)                                               |
| 112 | GPS Longitude for Detection Data <sup>23</sup>                      | 64 | Degrees (DPFP)                                               |
| 120 | GPS Height above mean sea level<br>for Detection Data <sup>23</sup> | 64 | Meters (DPFP)                                                |
| 128 | Joint Detection Level <sup>23</sup>                                 | 64 | Range (-1,1x10 <sup>6</sup> ) (DPFP)                         |
| 136 | MAD Detection Level <sup>23</sup>                                   | 64 | Range (-1,1x10 <sup>6</sup> ) (DPFP)                         |
| 144 | ELF Detection Level <sup>23</sup>                                   | 64 | Range (-1,1x10 <sup>6</sup> ) (DPFP)                         |
| 152 | Slant Range <sup>23</sup>                                           | 64 | Ft. (DPFP)                                                   |
| 160 | ELF Frequency Estimate <sup>23</sup>                                | 64 | Hertz (DPFP)                                                 |

<sup>23</sup> Related to Detection 2 identified by Detection 2 Message Count

### 3.3.19 Format 19 Tracker Input Data

Table 52 defines the format and content of the Tracker Input Data message sent from the System Control Processor of the Detection Capable Computer Power Supply to the Track Generator for generation of a track from two Operator selected detections identified as CPA1 and CPA2 for prediction of the path of a possible target.

**Table 52 - Format 19 Tracker Input Data**

| Relative Base Address (bytes) | Item                                          | Size (bits) | Definition Units/LSB Value/Other                                                |
|-------------------------------|-----------------------------------------------|-------------|---------------------------------------------------------------------------------|
| 0                             | ID                                            | 8           | 00010011B                                                                       |
| 1                             | Reserved                                      | 24          | TBD                                                                             |
| 4                             | Message Length                                | 32          | Variable dependent on WW (window width):<br>$72 + ((WW*12)) * 8 + ((WW*2)) * 4$ |
| 8                             | Source MSN                                    | 16          | See Manufacturer Serial Number Decode                                           |
| 10                            | Destination MSN                               | 16          | See Manufacturer Serial Number Decode                                           |
| 12                            | Message Count                                 | 32          | 1                                                                               |
| 16                            | Reserved                                      | 32          | TBD                                                                             |
| 20                            | Window Width (WW)                             | 32          | LSB=1 See Note 24 , nominal value=301                                           |
| 24                            | Reference Position Latitude                   | 64          | Format 8 Latitude from selected detection CPA2 in Degrees (DPFP)                |
| 32                            | Reference Position Longitude                  | 64          | Format 8 Longitude from selected detection CPA2 in Degrees (DPFP)               |
| 40                            | Time of CPA1                                  | 64          | Seconds since midnight start of mission day GMT (DPFP), From Format 8           |
| 48                            | Time of CPA2                                  | 64          | Seconds since midnight start of mission day GMT (DPFP), From Format 8           |
| 56                            | Slant Range CPA1                              | 64          | Feet, From Format 8 (DPFP)                                                      |
| 64                            | Slant Range CPA2                              | 64          | Feet, From Format 8 (DPFP)                                                      |
| 72                            | AC Latitude Position (CPA1) window element 1  | 64          | Format 1 GPS Data in Degrees (DPFP)                                             |
|                               | ⋮                                             |             |                                                                                 |
| $72 + (WW-1)*8$               | AC Latitude Position (CPA1) window element WW | 64          | Format 1 GPS Data in Degrees (DPFP)                                             |

<sup>24</sup> The window width is required to be an odd number of 10 Hz data points (430 Hz points decimated to 10 Hz). This value is maintained in the CPS.

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | Item                                           | Size (bits) | Definition Units/LSB Value/Other            |
|-------------------------------|------------------------------------------------|-------------|---------------------------------------------|
| 72 + (WW)*8                   | AC Latitude Position (CPA2) window element 1   | 64          | Format 1 GPS Data in Degrees (DPFP)         |
|                               | .                                              |             |                                             |
| 72 + ((WW*2) -1)*8            | AC Latitude Position (CPA2) window element WW  | 64          | Format 1 GPS Data in Degrees (DPFP)         |
| 72 + (WW*2)*8                 | AC Longitude Position (CPA1) window element 1  | 64          | Format 1 GPS Data in Degrees (DPFP)         |
|                               | .                                              |             |                                             |
| 72 + ((WW*3) -1)*8            | AC Longitude Position (CPA1) window element WW | 64          | Format 1 GPS Data in Degrees (DPFP)         |
| 72 + (WW*3)*8                 | AC Longitude Position (CPA2) window element 1  | 64          | Format 1 GPS Data in Degrees (DPFP)         |
|                               | .                                              |             |                                             |
| 72 + ((WW*4) -1)*8            | AC Longitude Position (CPA2) window element WW | 64          | Format 1 GPS Data in Degrees (DPFP)         |
| 72 + (WW*4)*8                 | AC Altitude Position (CPA1) window element 1   | 64          | Format 1 GPS Data in Meters (DPFP)          |
|                               | .                                              |             |                                             |
| 72 + ((WW*5) -1)*8            | AC Altitude Position (CPA1) window element WW  | 64          | Format 1 GPS Data in Meters (DPFP)          |
| 72 + (WW*5)*8                 | AC Altitude Position (CPA2) window element 1   | 64          | Format 1 GPS Data in Meters (DPFP)          |
|                               | .                                              |             |                                             |
| 72 + ((WW*6) -1)*8            | AC Altitude Position (CPA2) window element WW  | 64          | Format 1 GPS Data in Meters (DPFP)          |
| 72 + (WW*6)*8                 | AC Velocity (CPA1) window element 1            | 64          | Meters/Second from Format 1 GPS Data (DPFP) |
|                               | .                                              |             |                                             |
| 72 + ((WW*7) -1)*8            | AC Velocity (CPA1) window element WW           | 64          | Meters/Second from Format 1 GPS Data (DPFP) |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative Base Address (bytes) | Item                                                      | Size (bits) | Definition Units/LSB Value/Other                                             |
|-------------------------------|-----------------------------------------------------------|-------------|------------------------------------------------------------------------------|
| 72 + (WW*7)*8                 | AC Velocity (CPA2) window element 1                       | 64          | Meters/Second from Format 1 GPS Data (DPFP)                                  |
|                               | .                                                         |             |                                                                              |
| 72 + ((WW*8)-1)*8             | AC Velocity (CPA2) window element WW                      | 64          | Meters/Second from Format 1 GPS Data (DPFP)                                  |
| 72 + (WW*8)*8                 | AC Heading (CPA1) window element 1                        | 64          | Format 1 GPS Data Degrees (DPFP)                                             |
|                               | .                                                         |             |                                                                              |
| 72 + ((WW*9)-1)*8             | AC Heading (CPA1) window element WW                       | 64          | Format 1 GPS Data in Degrees (DPFP)                                          |
| 72 + (WW*9)*8                 | AC Heading (CPA2) window element 1                        | 64          | Format 1 GPS Data in Degrees (DPFP)                                          |
|                               | .                                                         |             |                                                                              |
| 72 + ((WW*10)-1)*8            | AC Heading (CPA2) window element WW                       | 64          | Format 1 GPS Data in Degrees (DPFP)                                          |
| 72 + (WW*10)*8                | Noise Reduced Time Domain Values (CPA1) window element 1  | 64          | Format 9 nT (DPFP)                                                           |
|                               | .                                                         |             |                                                                              |
| 72 + ((WW*11)-1)*8            | Noise Reduced Time Domain Values (CPA1) window element WW | 64          | Format 9 nT (DPFP)                                                           |
| 72 + (WW*11)*8                | Noise Reduced Time Domain Values (CPA2) window element 1  | 64          | Format 9 nT (DPFP)                                                           |
|                               | .                                                         |             |                                                                              |
| 72 + ((WW*12)-1)*8            | Noise Reduced Time Domain Values (CPA2) window element WW | 64          | Format 9 nT (DPFP)                                                           |
| 72 + (WW*12)*8                | GPS Time CPA1 window data element 1                       | 32          | Milliseconds since Beginning of week from Format 1 GPS Data (Integer, LSB=1) |
|                               | .                                                         |             |                                                                              |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

| Relative<br>Base<br>Address<br>(bytes)       | Item                                 | Size<br>(bits) | Definition<br>Units/LSB Value/Other                                                   |
|----------------------------------------------|--------------------------------------|----------------|---------------------------------------------------------------------------------------|
| 72 +<br>((WW*12)<br>*8+<br>((WW*1)-<br>1)*4  | GPS Time CPA1 window data element WW | 32             | Milliseconds since<br>Beginning of week from<br>Format 1 GPS Data<br>(Integer, LSB=1) |
| 72 +<br>((WW*12))<br>*8+<br>((WW*1))*4       | GPS Time CPA2 window data element 1  | 32             | Milliseconds since<br>Beginning of week from<br>Format 1 GPS Data<br>(Integer, LSB=1) |
|                                              | .                                    |                |                                                                                       |
| 72 +<br>((WW*12))<br>*8+<br>((WW*2)-<br>1)*4 | GPS Time CPA2 window data element WW | 32             | Milliseconds from<br>Beginning of week from<br>Format 1 GPS Data<br>(Integer, LSB=1)  |

#### **4. REQUIREMENTS TRACEABILITY**

TBD

#### **5. NOTES**

##### **5.1 Abbreviations and Acronyms.**

|                     |                                                                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3MDS                | Multi-Mode Magnetic Detection System                                                                                                                                    |
| AGC                 | Automatic Gain Control                                                                                                                                                  |
| ANC                 | Adaptive Noise Cancellation                                                                                                                                             |
| AST                 | Applied Signal Technology, Inc.                                                                                                                                         |
| B                   | Binary                                                                                                                                                                  |
| BIT                 | Built-In Test                                                                                                                                                           |
| CFAR                | Constant False Alarm Rate                                                                                                                                               |
| CPA                 | Closest Point of Approach                                                                                                                                               |
| CPS                 | Computer/Power Supply                                                                                                                                                   |
| D/A                 | Digital to Analog                                                                                                                                                       |
| DCP                 | Display/Control Processor                                                                                                                                               |
| DPFP                | Double Precision Floating Point                                                                                                                                         |
| ELF                 | Extremely Low Frequency                                                                                                                                                 |
| FAR                 | False Alarm Rate                                                                                                                                                        |
| FFT                 | Fast Fourier Transform                                                                                                                                                  |
| GMT                 | Greenwich Mean Time                                                                                                                                                     |
| GPS                 | Global Positioning System                                                                                                                                               |
| H                   | Hexadecimal                                                                                                                                                             |
| IDD                 | Interface Design Document                                                                                                                                               |
| LSB                 | Least Significant Bit                                                                                                                                                   |
| MAD                 | Magnetic Anomaly Detection                                                                                                                                              |
| mG                  | milli-Gs (Gravity)                                                                                                                                                      |
| mV                  | milli-Volts                                                                                                                                                             |
| nT                  | nano-Tesla                                                                                                                                                              |
| nT /ft <sup>3</sup> | Magnetic Moment Unit of Measurement                                                                                                                                     |
| P2K                 | Polatomic P2000 Magnetometer                                                                                                                                            |
| PPS                 | Pulse Per Second                                                                                                                                                        |
| pT                  | pico-Tesla                                                                                                                                                              |
| PWB                 | Printed Wiring Board                                                                                                                                                    |
| Q                   | Indicator for dividing point between fractional and integer binary portions of a fixed point number in a memory or register location (also known as Q point arithmetic. |

**3MDS IDD**  
**0BSB2-03-C-0388-01 Rev I**

|      |                              |
|------|------------------------------|
| RF   | Radio Frequency              |
| RLLC | Resonance Laser Loop Control |
| TBD  | To Be Determined             |
| TCS  | Tactical Control System      |
| TEC  | Thermal Electric Cooler      |
| UAV  | Unmanned Aerial Vehicle      |

**5.2 Other**

TLD

- T - Transverse (aligned with the wings – positive right)
- L - Longitudinal (aligned with direction of plane – positive forward)
- D - Down (positive down – sometimes called Vertical with positive up)