Document 118-16 (Volume V)

Range Commanders Council

Telemetry Group

TEST METHODS FOR TELEMETRY SYSTEMS AND SUBSYSTEMS
VOLUME V
TEST METHODS FOR DIGITAL RECORDER/REPRODUCER SYSTEMS AND RECORDER MEMORY MODULES

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DUGWAY PROVING GROUND
REAGAN TEST SITE
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NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
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TEST METHODS FOR TELEMETRY SYSTEMS AND SUBSYSTEMS
VOLUME V

TEST METHODS FOR DIGITAL RECORDER/REPRODUCER SYSTEMS AND RECORDER MEMORY MODULES

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New Mexico 88002-5110

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Table of Contents

List of Figures

List of Tables

Preface

This document presents the results of efforts by the Range Commanders Council Telemetry Group under RCC Task TG-123. This document (Volume V of the RCC Document 118 series) describes procedures used for verifying the performance parameters of digital recorder systems and recorder memory modules, to test compatibility and standard compliance, and to increase interoperability. Additionally, procedures are included for acceptance and operational readiness tests of digital recorder/reproducer systems.

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Acronyms

ARINC	Aeronautical Radio, Incorporated
AVC	Advanced Video Coding
BCS	basic character set
CAN	controller area network
COTS	commercial off-the-shelf
CSDW	channel-specific data word
DCRsi	Digital Cartridge Recording System
FFT	fast Fourier transform
GPS	Global Positioning System
HEX	hexadecimal
Hz	hertz
IAW	in accordance with
IEEE	Institute of Electrical and Electronics Engineers
IRIG	Inter-range Instrumentation Group
kBd	kilobaud
Kbps	kilobits per second
kHz	kilohertz
LED	light-emitting diode
MATLAB®	Matrix Laboratory
Mb	megabits
Mbps	megabits per second
METS	Metadata Encoding and Transmission Standard
MHz	megahertz
MIL-STD	Military Standard
MPEG	Moving Picture Experts Group
PC	personal computer
PCM	pulse code modulation
RMM	recorder memory module
SCSI	Small Computer Systems Interface
SFID	subframe identifier
STANAG	Standardization Agreement
SUT	system under test
TMATS	Telemetry Attributes Transfer Standard
UART	Universal Asynchronous Receiver/Transmitter

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CHAPTER 1

Introduction

This document describes procedures used in verifying the performance parameters of digital recorder systems and recorder memory modules (RMMs) to test compatibility and standard compliance and increase interoperability. Definitions of terms applicable to these procedures are found in the Inter-range Instrumentation Group (IRIG) Standard 106-13 Telemetry Standards, Chapter 10[1], referred to as Chapter 10 in the rest of this document.

Procedures are included for acceptance and operational readiness tests of digital recorder/reproducer systems. Not all tests are required for any one system, and tests other than those indicated may be required for a given system, depending on system configuration and application. Actual reproduction test methods will be covered in a subsequent release.

	In this document, the following notations are used. a. Those tests recommended during acceptance testing or after replacement of major components are indicated by a (1). b. Those tests recommended during operational readiness tests are indicated by a (2).

There are some requirements from the specification that will be verified in the course of validating specific packet data types, including the commit-to-stream time and time precision accuracy.

It is understood that some amount of errors is to be expected due to the nature of recording a simulated signal. The errors occur because the recorder and simulation boxes are not synchronized, causing some signal/framing errors at the beginning and ending of a recording. The errors can be excluded only by evaluating errors occurring after some fixed amount of time after the start of data and before the end of data.

[1] Range Commanders Council. "Digital Recording Standard" in *Telemetry Standards*. RCC 106-13. June 2013. Superseded by *Telemetry Standards*. RCC 106-15. July 2015. Retrieved 24 March 2016. Available at http://www.wsmr.army.mil/RCCsite/Documents/106_Previous_Versions/106-13_Telemetry_Standards/chapter10.pdf.

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CHAPTER 2

Approach and Methodology

2.1 General

This document describes procedures used in measuring performance parameters of recorder/ reproducer systems and RMMs to insure compatibility and uniformity.

2.2 Acceptance Testing (1)

Acceptance testing will consist of the methods and analysis to determine compliance with Chapter 10.

2.3 Operational Testing (2)

Operational testing will consist of a subset of acceptance testing with some additional steps and/or methods to verify operational suitability.

2.4 Methodology

Commercially available test equipment and validation software[2] will test the digital recorder against all the applicable data types described in Chapter 10, paragraph 10.6 with the exception of Analog (10.6.5), Message (10.6.9), and Image (10.6.11). Analog signal verification will be accomplished with a signal generator and Matrix Laboratory (MATLAB®) software from Mathworks, Inc.

In general, the Metadata Encoding and Transmission Standard (METS-231) box will be connected to the system under test (SUT) using an appropriate wiring harness. The METS-231 will be configured to output data for every data type that it is capable of producing. A sample recording will be made and then verified using the METS validation software.

A baseline configuration consisting of time (Military Standard [MIL-STD]-1553), video (Aeronautical Radio, Incorporated [ARINC]-429), and pulse code modulation (PCM) (packed, unpacked, and throughput modes) will be used to verify these five packet types plus the computer-generated packets. Ethernet, Universal Asynchronous Receiver/Transmitter (UART), discrete, and analog packet types will be tested individually.

For MIL-STD-1553 and PCM testing, there will be tests with the METS-231 configured to produce data with no errors, and additional tests with errors. For MIL-STD-1553, testing includes single and multi-message settings at bus loading of 30, 40, and 50 percent along with no response and protocol errors. For PCM data, the configuration includes various data rates from 100 kilobits per second (kbps) up to 5 megabits per second (Mbps). Standard METS formats 1, 2, 3, and 4 shall be used along with at least one channel of Chapter 8[3] data.

---

[2] METS-231 Multi-Channel Test Data Generator P/N 21023x001 and METS Validation Software or equivalent. Available from Scientific Data Systems, 2137 North Main Street, Las Cruces, NM 88001.

[3] Range Commanders Council. "Digital Data Bus Acquisition Formatting Standard" in *Telemetry Standards*. RCC 106-13. June 2013. Superseded by *Telemetry Standards*. RCC 106-15. July 2015. Retrieved 15 August 2016. Available at http://www.wsmr.army.mil/RCCsite/Documents/106_Previous_Versions/106-13_Telemetry_Standards/chapter8.pdf.

Each section will discuss the specific methodology used to validate a specific data type. A description of the actual settings used to configure the METS-231 along with the rationale behind the settings will be given. The section on data reduction will describe the expected outputs from the METS validation software and how to interpret any potential errors.

Other software tools identified in this document include a packet viewer (as a part of the EMC Corporation Chapter 10 Toolset available at http://irig106.org/) and a HEX file editor (WinHex or equivalent, http://www.x-ways.net/winhex).

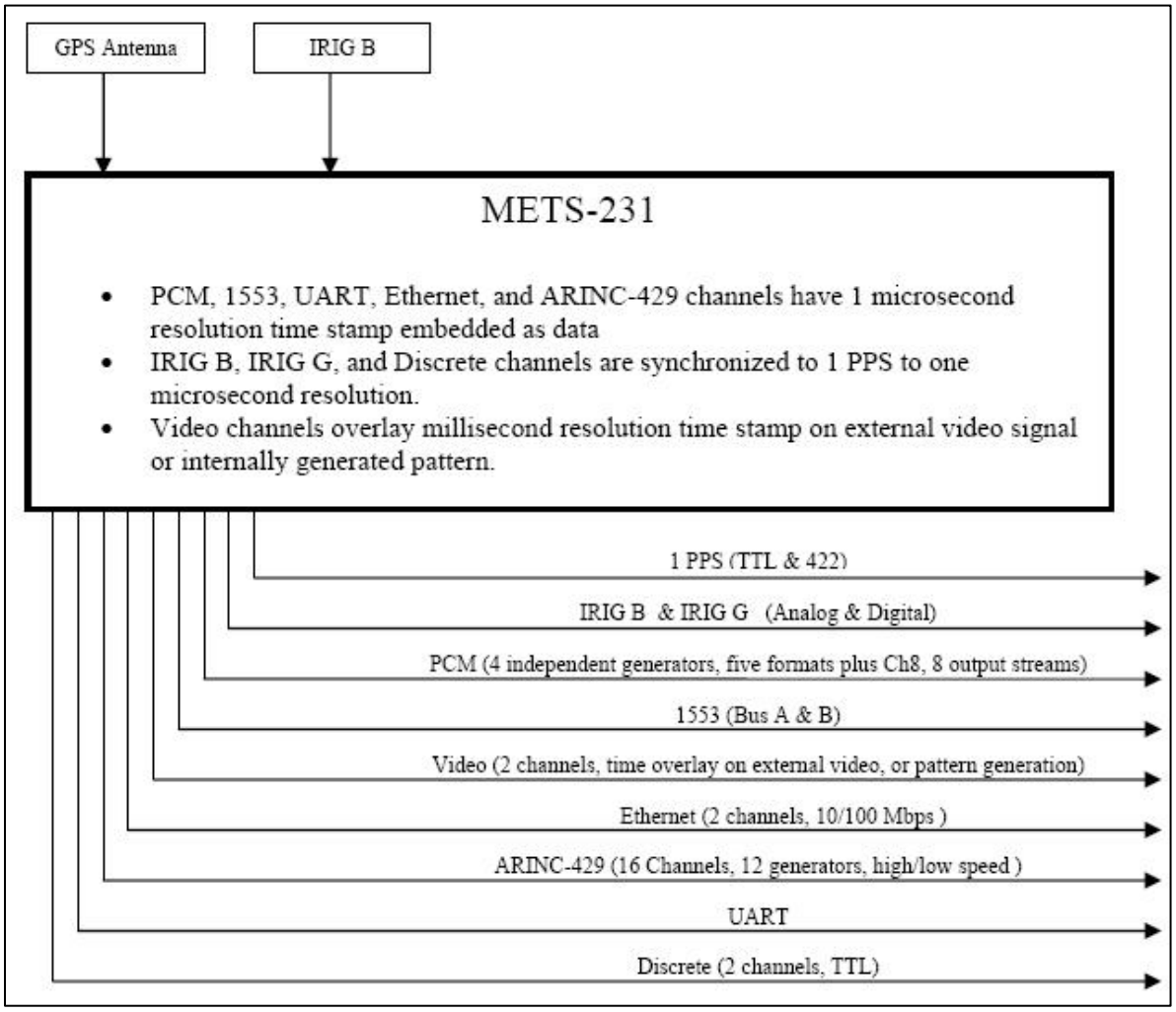

Figure 2-1. METS-231 Block Diagram

2.5 PCM Configuration Parameters

Appendix A contains the actual PCM configuration parameters for tests M_01-01 through M_03-03.

2.6 METS Validation Software

Appendix B provides a cross-reference table of METS validation software functionality to the appropriate section in Chapter 10.

2.7 Python Program to Parse Packet HEX Data

Appendix C provides a script that can be used to parse IRIG 106 analog packets saved from the EMC packet viewer program.

Table 2-1. METS Configuration Matrix

		Test Configuration	M01-01	M01-02	M01-03	M02-01	M02-02	M03-01	M03-02	M03-03	M04-01	M04-02	M04-03	M04-04	M05-01	M05-02	M05-03	M05-04	M05-05	M05-06	M06-01	M06-02	M06-03	M06-04
PCM	Data Rates	5000000	■	■	■	■	■	■	■	■														
		2000000	■	■				■	■	■														
		1000000	■																					
		500000		■	■			■	■	■														
		160000			■	■	■	■	■	■														
		100000			■																			
	CH10 Packet	Packed	■	■	■	■	■	■	■	■														
		Unpacked	■	■	■	■	■	■	■	■														
		Throughput	■	■	■	■	■																	
	METS Formats	Format 1	■		■			■	■	■														
		Format 2	■		■	■		■	■	■														
		Format 3		■	■			■	■	■														
		Format 4		■	■		■	■	■	■														
		Chapter 8	■	■	■																			
	Errors	Trunc Frames				■																		
1553	Message types	Single Msg	■	■	■																			
		Multi-Msg#1				■				■														
		Multi-Msg#2					■																	
	Bus loading	30%	■	■	■																			
		40%						■	■															
		50%				■	■			■														
		Dyn Loading								■														
	Message errors	Protocol Errs						■																
		No Responses							■															
ARINC	Speed	Low	■	■	■	■	■	■	■	■														
		High	■	■	■	■	■	■	■	■														
	Bus loading	25%	■	■	■	■	■	■	■	■														
		50%		■	■																			
	METS Format	Format 0	■	■	■	■	■	■	■	■														
		Errors						■	■	■														
Video	Format		■	■	■	■	■	■	■	■														
Ethernet	Speed	10 Mb									■	■	■											
		100 Mb										■		■										
	Frames	Single Frame									■	■												
		Multi Frame											■											
		Error Frame												■										
UART	BAUD rates	9600 bps													■	■	■							
		115200 bps																■	■	■				
	Parity	No													■			■						
		Even														■			■					
		Odd															■			■				

Table 2-1. METS Configuration Matrix

Test Configuration			M01-01	M01-02	M01-03	M02-01	M02-02	M03-01	M03-02	M03-03	M04-01	M04-02	M04-03	M04-04	M05-01	M05-02	M05-03	M05-04	M05-05	M05-06	M06-01	M06-02	M06-03	M06-04
Analog	Frequency	1 kHz																					■	
		2 kHz																						■
		5 kHz																					■	
		20 kHz																						■
Discrete	Pulses Cnts	2																			■			
		4																			■			
		25																				■		
		50																				■		
	Period	2																			■	■		
		4																			■	■		
	Burst period	2																			■	■		
		4																			■	■		

CHAPTER 3

Operational Requirements

3.1 General

Subsection 10.3.1 of Chapter 10 contains a list of requirements that must be met for a recorder to be 100 percent compliant with the standard.

3.2 Operational Test (1) and (2)

3.2.1 General

This test determines the compliance of an on-board or ground recorder with the list of mandatory compliancy requirements in Chapter 10 Subsection 10.3.1.1 and Subsection 10.3.1.2, respectively. These tests can be done by inspection and do not involve any recording of data or analysis.

3.2.2 Test Equipment

No equipment is required for this test.

3.2.3 Procedure

Verify that the recorder has the physical functionality or capability shown in Table 3-1 and Table 3-2. As part of an operational check it would be prudent to actually verify the operation of the various physical components.

Table 3-1. On-Board Recorder Mandatory Compliancy Requirements

Applicable Compliancy Section (1)	Function/Capability
Recorder Electrical Interfaces	
10.3, 10.4	Fibre Channel and or IEEE-1394B Data Download Port
10.3, 10.7	Discrete Lines and or RS-232 and 422 Full Duplex Communication
10.3	External Power Port
Recorder Download Interface Protocols	
10.4, 10.9	Fibre Channel SCSI or IEEE-1394B SCSI/SBP-2
Recorder Control/Status Interface Protocols	
10.7	Discrete Control/Status and or RS-232 and 422 Control/Status
RMM Electrical Interface & Power	
10.3, 10.9	IEEE-1394B Bilingual Socket
Commercial Off-the-Shelf (COTS) Media Electrical Interfaces	
10.3	COTS Media Interface
RMM Interface Protocols	
10.9	IEEE-1394B SCSI/SBP-2
COTS Media Interface Protocols	
10.3	COTS Media Interface

Table 3-1. On-Board Recorder Mandatory Compliancy Requirements

Applicable Compliancy Section (1)	Function/Capability
Recorder Media/RMM/COTS Media Interface File Structure	
10.5	Directory, File Structures & Data Organization
10.3.6	Directory & File Table Entries
Packetization and Data Format	
10.6	Packet Structures, Generation, Media Commitment & Time Stamping
10.6	Data Type Formats
Data Interoperability	
10.11	Original Recording Files

(1) References to sections within the 2013 version of Chapter 10.

Table 3-2. Ground-Based Recorder Mandatory Compliancy Requirements

Applicable Compliancy Section [1]	Function/Capability
Recorder Electrical Interfaces	
10.10	Ethernet
Recorder Remote Interface Protocols	
10.10, 10.4	iSCSI
COTS Media Electrical Interfaces	
10.4, 10.9	Fibre Channel SCSI or IEEE-1394B SCSI/SBP-2
COTS Media Interface Protocols	
10.3	COTS Media Interface
Remote Data Access Interface File Structure	
10.5	Directory, File Structures, and Data Organization
10.3.7	Directory and File Table Entries
Packetization and Data Format	
10.6	Packet Structures, Generation, Media Commitment, and Time Stamping
10.6	Data Type Formats
Data Interoperability	
10.11	Original Recording Files

[1] References to sections within the 2013 version of Chapter 10.

CHAPTER 4

Data Download and Electrical Interface

4.1 General

Chapter 10 requires that every recorder have either a Fibre Channel or IEEE 1394B interface for data download purposes. An Ethernet interface is optional and is defined in Subsection 10.4.3. This chapter will outline the steps to verify that the recorder meets the requirements of Section 10.4.

4.2 Data Download Test (1) and (2)

4.2.1 General

This test will verify the ability to download data from an RMM.

4.2.2 Test Equipment

a. METS-231 test set to simulate data to be recorded.

b. METS validation software to perform actual data download.

4.2.3 Procedure

a. Connect the METS-231 test set output to the input of the SUT.

b. Record several minutes of data.

c. Use the METS validation software to verify the ability to download the data by selecting the checkbox beside “Process From RMM” as shown in Figure 4-1.

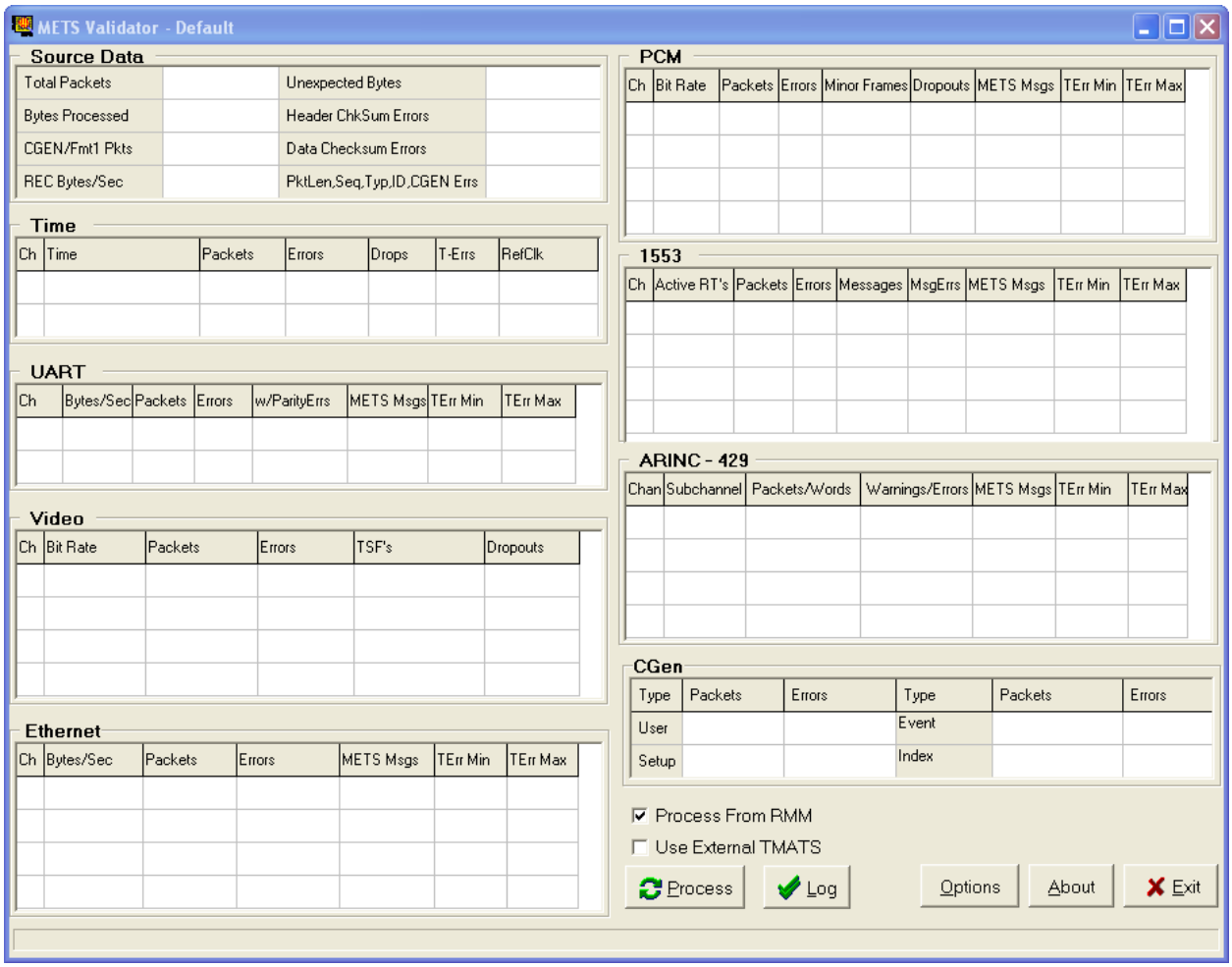

Figure 4-1. METS Validation Software Screen Configured to Process from RMM

The METS validation software will perform a number of tests to determine compliance of the data on the RMM prior to beginning actual validation of the data. The applicable tests as they pertain to the format of the RMM and the ability to download that data are outlined in Appendix B. If the RMM passes these tests the METS validation software proceeds with the actual validation of the data.

Clicking on the Process button at this point will present a dialog box as shown in Figure 4-2.

Figure 4-2. METS Validation Software RMM Selection Dialog

If the METS validation software determines there is an error within the Standardization Agreement (STANAG) directory, it will not process the data from the RMM. The error will be indicated by an error dialog box such as seen in Figure 4-3.

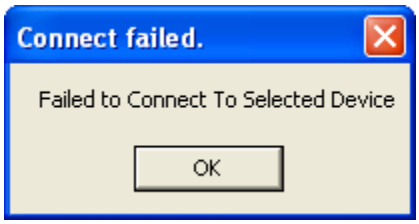

Figure 4-3. METS Validation RMM Process Error

The METS validation software keeps a log of all processing in the Logs subdirectory beneath the directory where the program is installed. To determine the actual error you must examine the latest error log file (*.iolog) such as Figure 4-4.

```
(I)Processing Group Initialized
(I)Connecting: 4:2 [] 4194304
(I)STANAG Directory Block Size is 512 bytes.
(I)STANAG Directory Format : Little Endian
(E)DirBlk[1] has undefined data after file entries.  30
(I)Processing Group Shutdown
```

Figure 4-4. Example of an Error Log File

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CHAPTER 5

Interface File Structure

5.1 General

Chapter 10 Section 10.5 defines the data structure of compliant files. This structure was adapted from AEDP-6,[4] Subsection 2.3, File Structure Definition. The primary rationale behind this choice was to ensure that data recorded in the Chapter 10 format could be read independent of any computer operating system.

5.2 File Structure Verification (1)

5.2.1 General

This test determines compliance of a Chapter 10 file with the published format as outlined in Chapter 10, Subsection 10.5.1 and following. The information in the accompanying tables is for example purposes only and does not specify exactly what will appear in the actual data.

5.2.2 Test Equipment

For this test the METS-231 test set will be used to generate simulated data.

5.2.3 Automated Procedure

Connect the METS-231 output to the input of the Chapter 10 SUT. Use the personal computer (PC) with the METS validation software to process the data on the RMM. This process is described in Subsection 4.2.3.

5.2.4 Manual Procedure

The file structure on the RMM device can be verified by connecting the RMM to a PC and using a HEX editor capable of displaying the data on any attached device. The STANAG-4575 file structure can then be examined and compared to Figure 5-1.

[4] North Atlantic Treaty Organization. *NATO Advanced Data Storage Interface Requirements and Implementation Guide*. AEDB-6 Ed. B V. 1. December 2014. May be superseded by update. Retrieved 11 August 2016. Available at https://nso.nato.int/nso/zPublic/ap/AEDP-6edBv1.pdf.

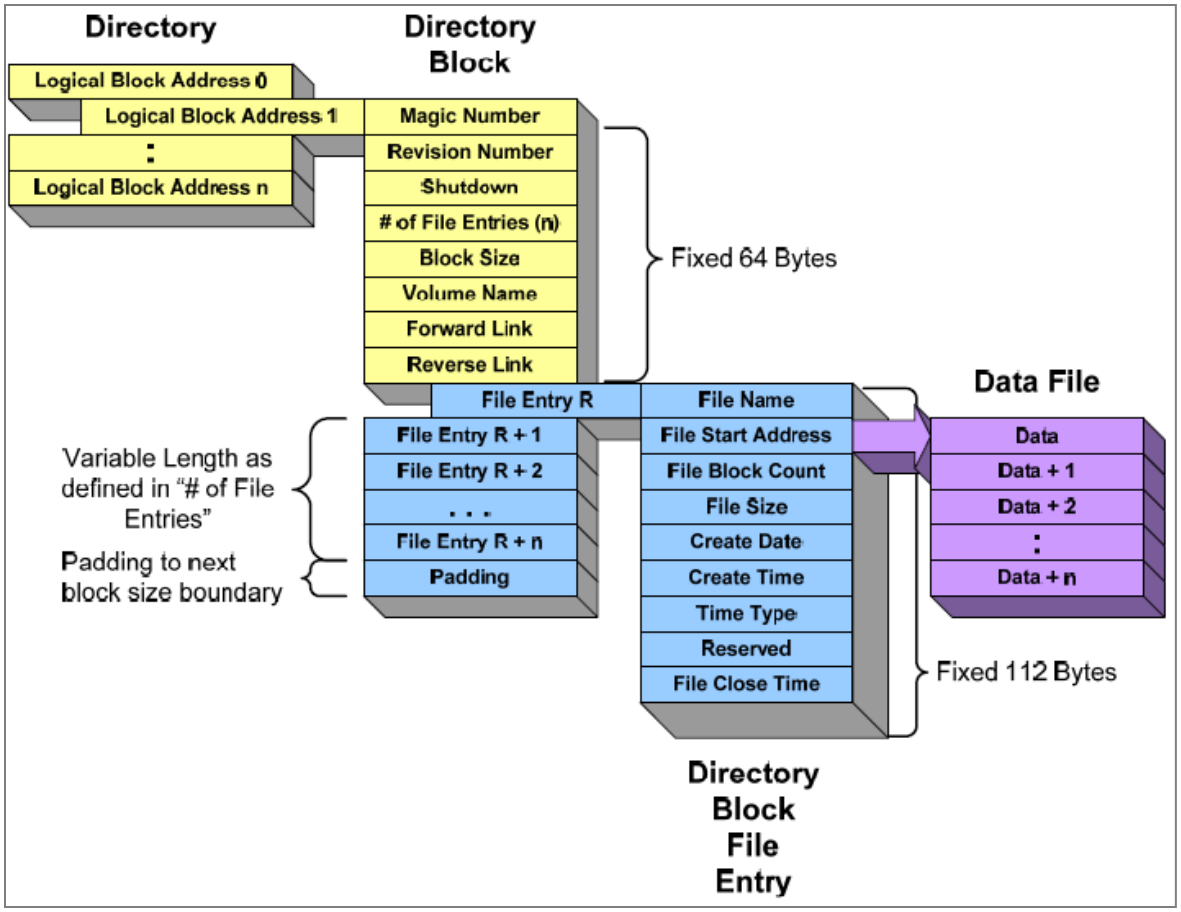

Figure 5-1. Chapter 10 Directory Structure

Using the search tool in the HEX editor, locate the string "FORTYtwo" to determine the beginning of the directory block. This can be seen in Figure 5-2 appearing at HEX address 200. From Chapter 10 Subsection 10.5.2, this would then be interpreted as shown in Table 5-1.

```
00000190  C7 95 93 7C 6A 0B 7C 3B 0B 9B 3B 5A 98 DC 52 CB    Ç•"|j.|;.›;Z˜ÜRË
000001A0  EF BB 61 98 47 51 90 E7 61 51 44 E7 99 53 54 E9    ï»a˜GQ□çaQDç™STé
000001B0  F9 77 16 30 77 A0 30 C1 A3 86 CA 17 BD 70 8E 23    ùw.0w 0Á£†Ê.½p□#
000001C0  26 C9 D7 B6 F1 B6 25 B6 DD B4 CD BA AD 9E EF 47    &É×¶ñ¶%¶Ý´Í°-□ïG
000001D0  61 90 47 61 93 47 69 91 77 67 33 53 A8 EA F1 7F    a□Ga"Gi'wg3S¨êñ□
000001E0  26 00 D4 00 F8 02 10 0E 60 24 42 D9 8E D7 26 F1    &.Ô.ø...`$BÙ□×&ñ
000001F0  D4 26 FA D6 1E F6 44 34 9B B9 59 95 D7 7F F2 00    Ô&úÖ.öD4›¹Y•×□ò.
00000200  46 4F 52 54 59 74 77 6F 0F FF 00 01 00 00 02 00    FORTYtwo.ÿ......
00000210  52 4D 4D 5F 31 35 35 37 00 74 65 63 20 49 52 49    RMM_1557.tec IRI
00000220  47 20 31 30 36 20 54 6F 6F 6C 73 00 00 00 00 00    G 106 Tools.....
00000230  00 00 00 00 00 00 00 01 00 00 00 00 00 00 00 01    ................
00000240  66 69 6C 65 31 00 00 00 00 00 00 00 00 00 00 00    file1...........
00000250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
00000260  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
00000270  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 80    ...............□
00000280  00 00 00 00 00 04 81 AF 00 00 00 00 09 03 5C 90    ......□¯......\□
00000290  32 35 30 38 32 30 30 38 31 33 30 31 30 37 30 30    25082008130107 00
000002A0  FF FF FF FF FF FF FF FF 31 33 30 36 30 37 30 30    ÿÿÿÿÿÿÿÿ13060700
000002B0  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF    ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
```

Figure 5-2. HEX Dump of RMM Directory Block

Table 5-1. STANAG-4575 Directory Block

Bytes	Description	Value
8	Magic Number	FORTYtwo
1	Revision Number	0x0f
1	Shutdown	0xff
2	# of File Entries	1
4	Block Size	0x00000200
32	Volume Name	RMM_1557
8	Forward Link	1
8	Reverse Link	1

Figure 5-2 also shows the single file entry and can be interpreted as shown in Table 5-2. Note that the fields File Name, Create Date, Create Time, and File Close Time are basic character set (BCS) encoded and can be read similar to ASCII characters in the HEX dump. The format for the Create Date field is DDMMYYYY. The BCS time fields have a format of HHMMSSss.

Table 5-2. STANAG File Entry Format

Bytes	Description	Value
56	File Name	file1
8	Start Address	0x80
8	Block Count	0x481af
8	Size	0x09035c90
8	Create Date	25082008
8	Create Time	13010700
1	Time Type	0xff
7	Reserved	
8	File Close Time	13060700

From Table 5-2, we see a create date of 25 August 2008 and a create time of 13:01:07.000. The time type value of 0xff indicates that the time comes from a time data packet. It should be noted that the address field is the block number of the first data word of the file; hence the 0x80 value translates to the physical address 0x10000 as the block size as this example allocates 0x200 bytes for each block. The beginning of the actual file data indicated by the HEX pattern 0x25eb (Chapter 10 packet sync word) is shown in Figure 5-3.

```
0000FFE0  DB B6 D9 B6 D5 B6 FD B6 0D B6 2D B4 ED B8 6D 92    Û¶Ù¶Õ¶ý¶.¶-´í¸m'
0000FFF0  6F 6D 63 6F 4B 63 BB 4B 99 B9 55 95 FF 7F 02 00    omcoKc»K™¹U•ÿ□..
00010000  25 EB 00 00 00 0C 00 00 62 0B 00 00 03 00 00 01    %ë.......b.......
00010010  00 00 00 00 00 00 8A 03 07 00 00 00 47 5C 50 4E    ......Š.....G\PN
00010020  3A 32 20 54 65 73 74 20 50 72 6F 6A 65 63 74 3B    :2 Test Project;
00010030  0D 0A 47 5C 54 41 3A 32 20 54 65 73 74 20 54 61    ..G\TA:2 Test Ta
00010040  69 6C 3B 0D 0A 47 5C 31 30 36 3A 37 3B 0D 0A 47    il;..G\106:7;..G
00010050  5C 44 53 49 5C 4E 3A 31 3B 0D 0A 47 5C 44 53 49    \DSI\N:1;..G\DSI
00010060  2D 31 3A 52 45 43 4F 52 44 45 52 5F 49 4E 50 55    -1:RECORDER_INPU
00010070  54 5F 43 48 41 4E 4E 45 4C 53 3B 0D 0A 47 5C 44    T_CHANNELS;..G\D
00010080  53 54 2D 31 3A 53 54 4F 3B 0D 0A 52 2D 31 5C 49    ST-1:STO;..R-1\I
```

Figure 5-3. Hex Dump of Actual File Data

CHAPTER 6

Data Format Definitions

6.1 Common Packet Elements

This chapter defines the test procedures to verify that packet structure common elements adhere to the Chapter 10 standard. Every Chapter 10 recorder must produce data files that contain certain common elements. The basic structure of every Chapter 10 recording is shown in Figure 6-1. Data files are made up of individual packets of data that conform to one of the standard packet types defined in Section 10.6. Every packet is made up of a packet header, body and a trailer. An optional secondary header may also be present.

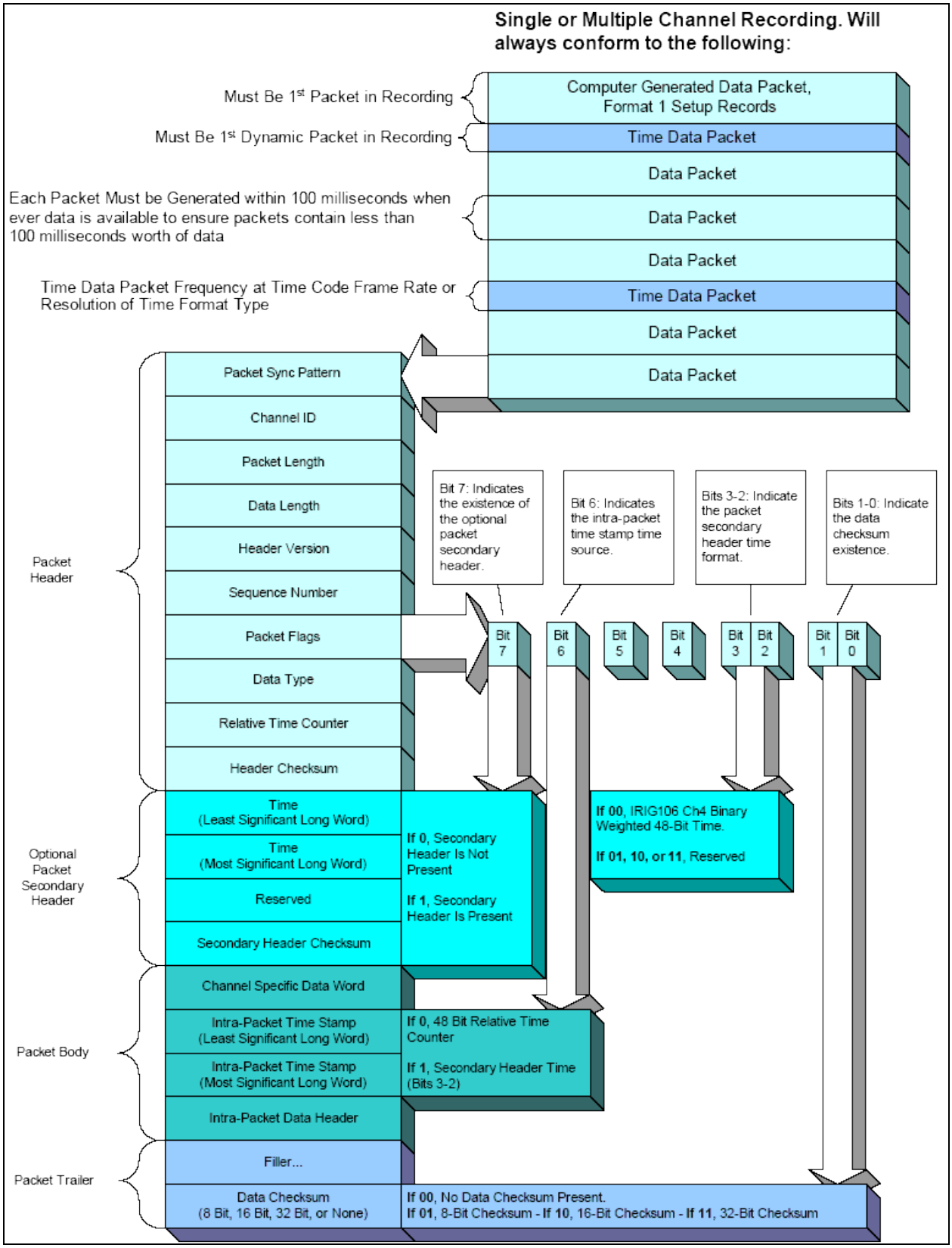

Figure 6-1. Chapter 10 Data Recording Structure

In the course of verifying the format of each data type these common packet elements will also be verified as a byproduct of the test. The METS validation software identifies any anomalies associated with the physical structure of the packets and will in turn provide validation or an exception should one be detected.

Inspection of the binary data is an acceptable alternative to the METS validation software but is discouraged due to the huge amount of data involved. Several Chapter 10 packet dumper utilities are available to help in this manual task. Current freely available versions can be found on the IRIG106.org website.

The first packet in every Chapter 10 file must contain a setup record (Channel 0, Computer-Generated Data, Format 1). This packet contains the IRIG 106-13 Chapter 9[5] Telemetry Attributes Transfer Standard (TMATS) information defining the configuration of the recorder. For the remainder of the packet validation sections the TMATS must reflect the setup of the METS-231 test set. The actual validation of the setup record can be accomplished manually using either a HEX editor utility or one of the packet viewer utilities previously mentioned.

6.2 PCM Data Packets (1) and (2)

6.2.1 General

This test will verify the ability of the SUT to properly record PCM data in a variety of formats. The IRIG 106-13 standard defines three different modes of recording PCM data including packed, unpacked, and throughput.

The METS-231 test set will generate up to eight channels of PCM data from four independent generators. Figure 6-2 shows this in diagrammatic form.

[5] Range Commanders Council. "Telemetry Attributes Transfer Standard" in *Telemetry Standards*. RCC 106-13. June 2013. Superseded by *Telemetry Standards*. RCC 106-15. July 2015. Retrieved 12 April 2016. Available at http://www.wsmr.army.mil/RCCsite/Documents/106_Previous_Versions/106-13_Telemetry_Standards/Chapter%209.pdf.

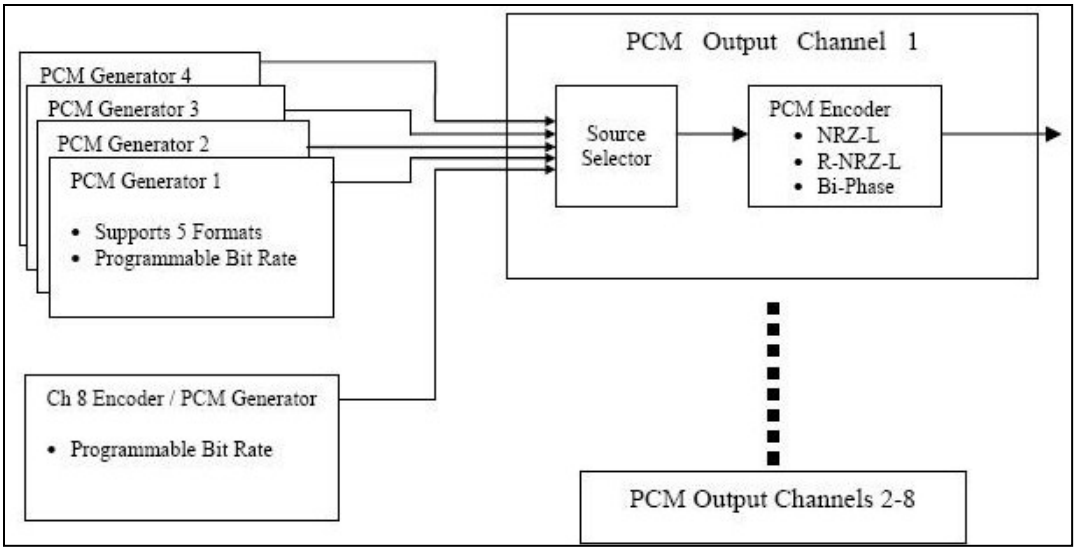

Figure 6-2. METS PCM output

For the PCM packet type the METS-231 shall be configured in a number of different modes to both verify the ability of the SUT to record the data and to test the response to known errors. Figure 6-3 shows the METS-231 configuration to be used for the first series of tests.

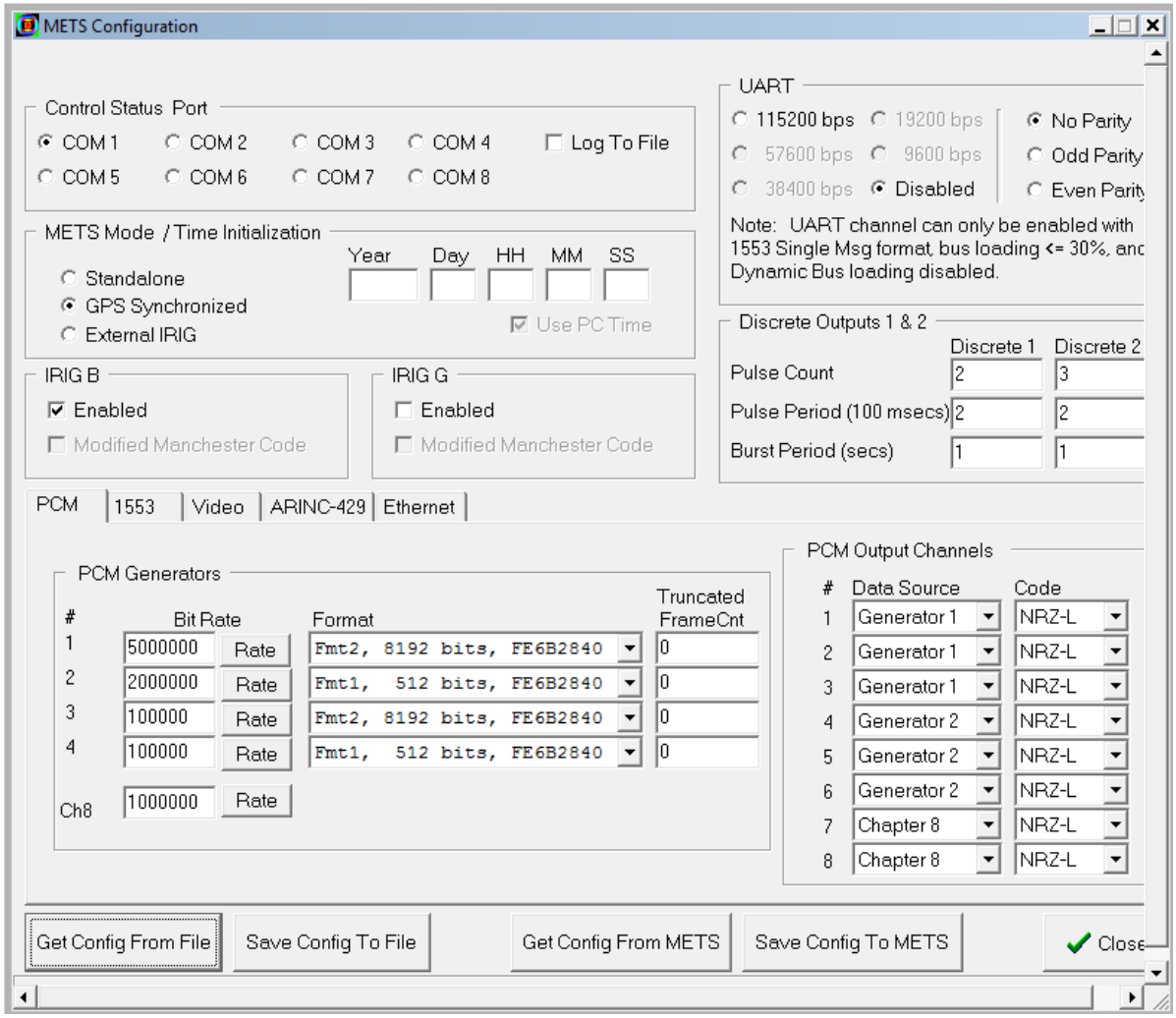

Figure 6-3. METS-231 Configuration Screen for Test M_01-01

Using an external time synchronization source such as the Global Positioning System (GPS) allows for easy correlation between recorded data and specific test events. The configuration shown in Figure 6-3 depicts an external GPS time source but could just as easily be IRIG-B.

Table 6-1. PCM Setup Details for Configuration M_01-01

Recorder PCM Configuration								
CH #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Rate	5Mb	5Mb	5Mb	1Mb	2Mb	1Mb	1Mb	1Mb
Sync	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840	faf320	faf320
Mode	Packed	Unpack	Throughput	Packed	Unpack	Throughput	Packed	Unpack
Word/Frame	511	511	511	31	31	31	256	256
Min/Maj	32	32	32	1	1	1	1	1
Bits/Word	16	16	16	16	16	16	24	24
Subframe ID (SFID) Start	1	1	1	0	0	0	0	0
Word Time	.0000032	.0000032	.0000032	.000008	.000008	.000008	.000024	.000024

Configure the SUT using TMATS to reflect the setup shown in Table 6-2.

Table 6-2. Recorder Configuration for Test M_01-01

Chan Num	Data Type	Bit Rate	Word Length	Frame Count	Words in Frame	Bits in Frame	Data Mode
1	IRIG						
2	1553						
10	VIDEO						
11	VIDEO						
14	ARINC429						
15	ARINC429						
17	PCM	5000000	16	32	511	8192	Packed
18	PCM	5000000	16	32	511	8192	Unpacked
19	PCM	5000000	16	32	511	8192	Throughput
20	PCM	2000000	16	1	31	512	Packed
21	PCM	2000000	16	1	31	512	Unpacked
22	PCM	2000000	16	1	31	512	Throughput
23	PCM	1000000	24	1	256	6144	Packed
24	PCM	1000000	24	1	256	6144	Unpacked

6.2.2 Test Equipment

a. METS-231 test set.

b. METS validation software.

Figure 6-4 shows a typical configuration for testing ARINC-429, Ethernet, MIL-STD-1553, PCM, UART, and video data packets. This configuration will also be used for the data download, command, status, and discrete control.

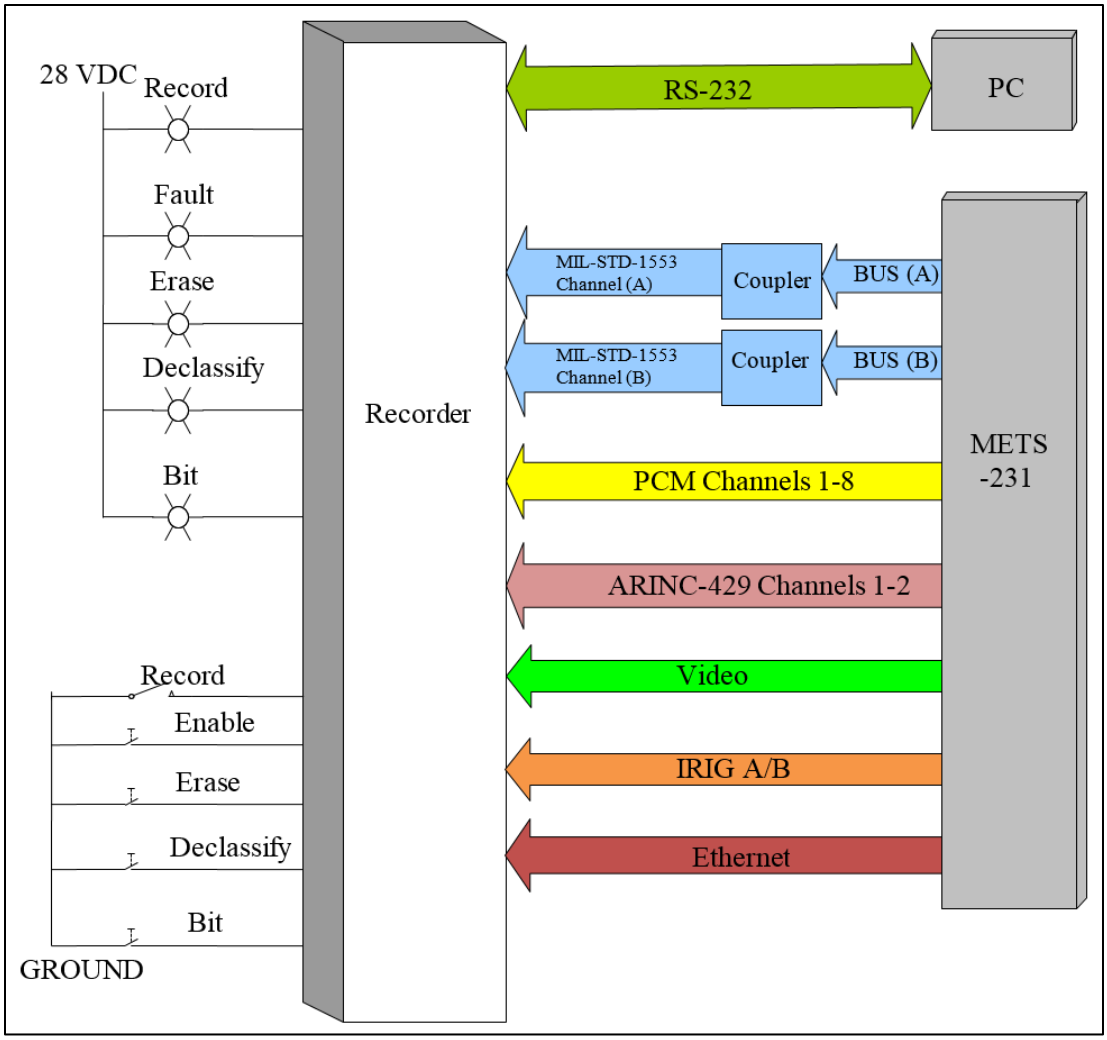

Figure 6-4. Typical Test Setup for METS-231 and System Under Test

6.2.3 **Procedure**

c. Connect the test set output to the input of the SUT.

d. Set the test set to configuration M_01_01 and record data for a minimum of two minutes.

e. Run the METS validation software against the SUT.

f. Repeat this process for configurations M_01-02 and M_01-03.

6.2.4 **Data Reduction**

The primary method for data reduction will be to use the METS validation software tool to evaluate the results of the recording directly from the RMM. This will produce a number of log files that will need to be visually inspected. All errors between one second after startup and within one second of stopping should be evaluated.

The METS validation software must be configured to mirror the configuration of the METS-231 simulator in order to properly match up the channels. This is accomplished using the options tab as shown in Figure 6-5 below.

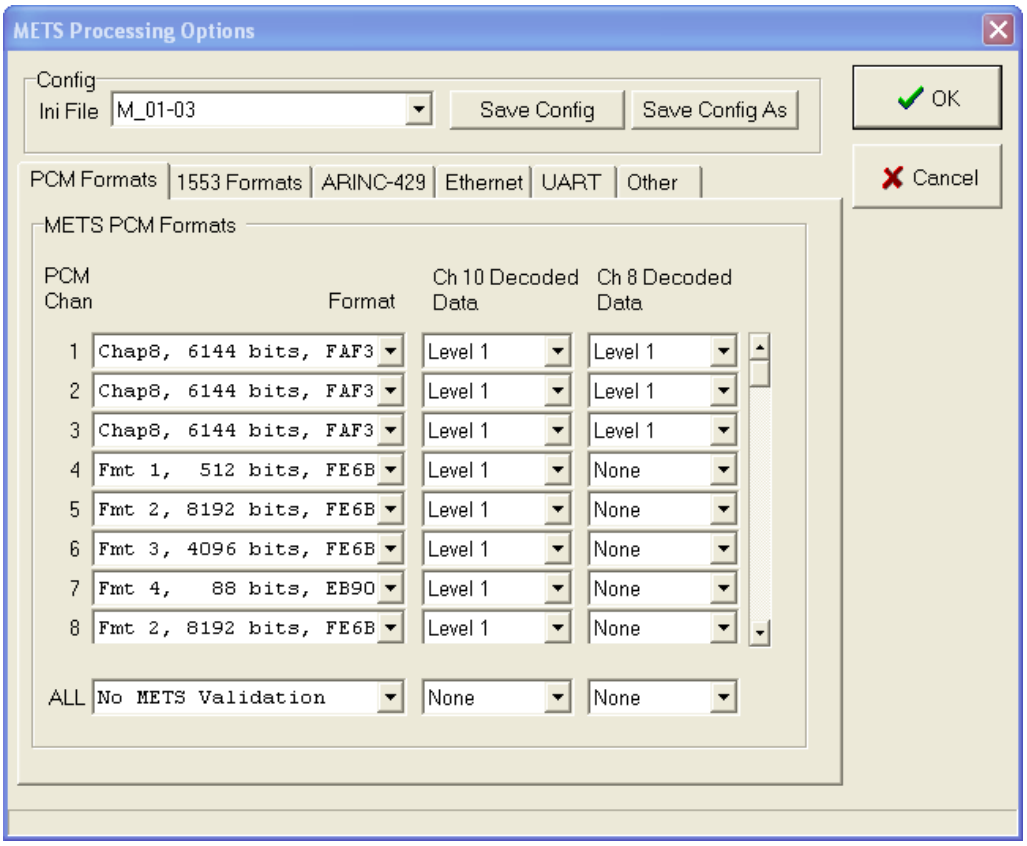

Figure 6-5. METS Validation Software Configuration Options

For test conditions M_01-01 through M_01-03 the METS configuration should have no errors. Having no errors should result in a log file from the METS validation software with only informational (I) messages as shown in Table 6-3.

Table 6-3. Expected Results from METS Validation Software for Packets with no Errors

(I)[00003074] TCR01,084: IRIG-B Time 054 21:56:44.000 RT 790040000000 (Locked)
(I)[0005fff8] TCR01,085: IRIG-B Time 054 21:56:45.000 RT 790050000000 (Locked)[10000000 Hz]
(I)[00452dcc] TCR01,086: IRIG-B Time 054 21:56:46.000 RT 790060000000 (Locked)[10000000 Hz]
(I)[0083d94c] TCR01,087: IRIG-B Time 054 21:56:47.000 RT 790070000000 (Locked)[10000000 Hz]
(I)[00c254e4] TCR01,088: IRIG-B Time 054 21:56:48.000 RT 790080000000 (Locked)[10000000 Hz]
(I)[0101cc68] TCR01,089: IRIG-B Time 054 21:56:49.000 RT 790089999998 (Locked)[9999998 Hz]
(I)[0140b268] TCR01,090: IRIG-B Time 054 21:56:50.000 RT 790100000002 (Locked)[10000004 Hz]
(I)[017f0c84] TCR01,091: IRIG-B Time 054 21:56:51.000 RT 790109999998 (Locked)[9999996 Hz]
(I)[01bda4e4] TCR01,092: IRIG-B Time 054 21:56:52.000 RT 790120000001 (Locked)[10000003 Hz]
(I)[01fccf0c] TCR01,093: IRIG-B Time 054 21:56:53.000 RT 790130000000 (Locked)[9999999 Hz]
(I)[023b4c20] TCR01,094: IRIG-B Time 054 21:56:54.000 RT 790139999999 (Locked)[9999999 Hz]
(I)[027a2e40] TCR01,095: IRIG-B Time 054 21:56:55.000 RT 790150000000 (Locked)[10000001 Hz]

For test condition M_02-01 the METS configuration has truncated PCM frames enabled. This truncation will result in error messages from the METS validation software similar to those shown in Table 6-4.

Table 6-4. Expected Results from METS Validation Software for Truncated PCM Frames
(E)[0008dbb0] PCM15,077,00,00004: METS: Unexpected SFID Counter value. Expected 16 Found 25
(E)[0008dbb0] PCM15,077,00,00004: METS: Unexpected Ramp Word value. Expected 3100 Found 4000
(E)[000a0c44] PCM11,027,00,00004: METS: Unexpected Message Number. Expected 0xbced Found 0xbd05
(E)[000a0c44] PCM11,027,00,00004: METS: Unexpected SFID Counter value. Expected 14 Found 6
(E)[000a0c44] PCM11,027,00,00004: METS: Unexpected Ramp Word value. Expected 2900 Found 5300
(I)[000bcb0c] TCR01,064: IRIG-B Time 054 23:31:27.000 RT 846870000000 (Locked)[10000000 Hz]
(E)[000da308] PCM17,145,00,00000: METS: Inconsistent frame numbers within minor frame. Word=511 Data Expected=0xbd3f Found=0xfe6b
(E)[000da308] PCM17,145,01,006c6: METS: Unexpected Message Number. Expected 0xbd40 Found 0xbd41
(E)[000da308] PCM17,145,01,006c6: METS: Unexpected SFID Counter value. Expected 1 Found 2
(E)[000da308] PCM17,145,01,006c6: METS: Unexpected Ramp Word value. Expected 11200 Found 11300
(E)[00102ca8] PCM11,030,00,00004: METS: Unexpected Message Number. Expected 0xbd32 Found 0xbd65
(E)[00102ca8] PCM11,030,00,00004: METS: Unexpected SFID Counter value. Expected 19 Found 6

6.3 Time Data Packets (1)

6.3.1 General

This test determines the compliance of the Chapter 10 recorder with regard to the recording of time data packets. This test is not typically part of an operational check-out, as it is primarily concerned with validating the ability of the recorder to synchronize with an external time source and to accurately time-tag individual data packets.

6.3.2 Test Equipment

METS-231 test equipment.

NOTE	The resolution of the embedded time or the counters determines the time resolution of this technique. The embedded time can be either absolute time (for example, GPS time) or relative time. If relative time is used the signal source and signal detector must be synchronized to each other. The number of sets of equipment is determined by the number of channels that must be tested simultaneously.

6.3.3 Test Method

a. Connect test equipment as shown in Figure 6-4.

b. Record 60 minutes of data on the SUT and then validate with the METS validation software.

c. Examine the METS validation software logs to evaluate the timing analysis.

6.4 MIL-STD-1553 Data Packets (1) and (2)

6.4.1 General

This test determines the compliance of the SUT when recording MIL-STD-1553 data. Data will be collected for this packet type with no errors, with protocol errors, and with no

response errors. The METS-231 will be configured for single and multiple 1553 messages. Bus loadings will include 30, 40, and 50 percent. Dynamic loading will also be used for at least one test condition.

6.4.2 Test Equipment

a. METS-231.

b. METS validation software.

6.4.3 Procedure

a. Connect test equipment as shown in Figure 6-4.

b. Configure the recorder using M_03-01.

c. Record data for a minimum of two minutes.

d. Run the METS validation software against the SUT.

e. Repeat this process for configurations M_03-02 and M_03-03.

6.4.4 Data Reduction

Examine the METS logs and verify that no errors occurred with the exception of initial startup of the recorder. A log file from a test with no errors should look something similar to Table 6-3. Configurations M_01-01 through M_02-02 should have error-free 1553 data. Table 6-5 shows a log file from configuration M_03-01 with the results of protocol errors.

Table 6-5. Expected Results from METS Validation Software for 1553 Packets with Errors

```
(I)[03f9d250] TCR01,112: IRIG-B Time 048 19:26:00.000 RT 699600000000 (Locked)[10000000 Hz]
(I)[042c7f4c] TCR01,113: IRIG-B Time 048 19:26:01.000 RT 699610000000 (Locked)[10000000 Hz]
(I)[045f3368] TCR01,114: IRIG-B Time 048 19:26:02.000 RT 699619999999 (Locked)[ 9999999 Hz]
(I)[04918b14] TCR01,115: IRIG-B Time 048 19:26:03.000 RT 699630000001 (Locked)[10000002 Hz]
(E)[049472bc] MIL02,089,62,00b2e: METS: Unexpected Cmd Word.  Expected 3ff2 Found 7811
(E)[049472bc] MIL02,089,63,00b42: METS(097f): Unexpected Message Number.  Expected 0xd530 Found 0xd531
(E)[0496eba8] MIL02,090,02,0002a: METS: Unexpected Cmd Word.  Expected 3ff2 Found 7811
(E)[0496eba8] MIL02,090,03,0003e: METS(097f): Unexpected Message Number.  Expected 0xd536 Found 0xd537
(E)[0496eba8] MIL02,090,08,00144: METS: Unexpected Cmd Word.  Expected 3ff2 Found 7811
(E)[0496eba8] MIL02,090,09,00158: METS(097f): Unexpected Message Number.  Expected 0xd53c Found 0xd53d
(E)[0496eba8] MIL02,090,14,0025e: METS: Unexpected Cmd Word.  Expected 3ff2 Found 7811
(E)[0496eba8] MIL02,090,15,00272: METS(097f): Unexpected Message Number.  Expected 0xd542 Found 0xd543
(E)[0496eba8] MIL02,090,20,00378: METS: Unexpected Cmd Word.  Expected 3ff2 Found 7811
(E)[0496eba8] MIL02,090,21,0038c: METS(097f): Unexpected Message Number.  Expected 0xd548 Found 0xd549
(E)[0496eba8] MIL02,090,26,00492: METS: Unexpected Cmd Word.  Expected 3ff2 Found 7811
(E)[0496eba8] MIL02,090,27,004a6: METS(097f): Unexpected Message Number.  Expected 0xd54e Found 0xd54f
```

6.5 Analog Data Packets (1) and (2)

6.5.1 General

This test determines the compliance of the SUT when recording analog data.

6.5.2 Test Equipment

a. METS validation software for format verification.

b. A signal generator and appropriate data extraction tools to transfer the analog data to a PC.

c. MATLAB® or equivalent software to perform a fast Fourier transform (FFT) function to verify the frequency of the recorded data.

6.5.3 Procedure

a. Connect the signal generator output to the input of the SUT.

b. Record data for a minimum of two minutes.

c. Run the METS validation software against the SUT.

6.5.4 Data Reduction

Examine the METS logs and verify that no errors occurred with the exception of initial startup of the recorder. Transfer the data to a PC and utilize MATLAB® to perform an FFT on the analog signal in order to verify the ability to adequately record the frequency of the signal. This can be done using one of the freely available Packet Viewer applications and transferring the HEX values from individual analog packets into Excel® or directly into MATLAB®.

Appendix C contains a script written in the Python language that will convert the output from a Chapter 10 packet viewer program into tabular data suitable for processing in Excel® or MATLAB®. Further processing will then be required to convert the HEX values into an equivalent decimal value. Other commercially available applications can also be used to create a comma-separated value file of values from the analog data.

6.6 Discrete Data Packets (1) and (2)

6.6.1 General

This test determines the compliance of the SUT when recording discrete data.

6.6.2 Test Equipment

a. METS-231.

b. METS validation software.

6.6.3 Procedure

a. Connect the METS output to the input of the SUT.

b. Record data for a minimum of two minutes.

c. Run the METS validation software against the SUT.

6.6.4 Data Reduction

Examine the METS logs and verify that no errors occurred with the exception of initial startup of the recorder.

Configuration M_06-01 and M_06-02 contain discrete data. Log file output is shown in Table 6-6.

Table 6-6. Discrete Data

(I)[00003074] TCR01,084: IRIG-B Time 054 21:56:44.000 RT 790040000000 (Locked)
(I)[0005fff8] TCR01,085: IRIG-B Time 054 21:56:45.000 RT 790050000000 (Locked)[10000000 Hz]
(I)[00452dcc] TCR01,086: IRIG-B Time 054 21:56:46.000 RT 790060000000 (Locked)[10000000 Hz]
(I)[0083d94c] TCR01,087: IRIG-B Time 054 21:56:47.000 RT 790070000000 (Locked)[10000000 Hz]
(I)[00c254e4] TCR01,088: IRIG-B Time 054 21:56:48.000 RT 790080000000 (Locked)[10000000 Hz]
(I)[0101cc68] TCR01,089: IRIG-B Time 054 21:56:49.000 RT 790089999998 (Locked)[9999998 Hz]
(I)[0140b268] TCR01,090: IRIG-B Time 054 21:56:50.000 RT 790100000002 (Locked)[10000004 Hz]
(I)[017f0c84] TCR01,091: IRIG-B Time 054 21:56:51.000 RT 790109999998 (Locked)[9999996 Hz]
(I)[01bda4e4] TCR01,092: IRIG-B Time 054 21:56:52.000 RT 790120000001 (Locked)[10000003 Hz]
(I)[01fccf0c] TCR01,093: IRIG-B Time 054 21:56:53.000 RT 790130000000 (Locked)[9999999 Hz]
(I)[023b4c20] TCR01,094: IRIG-B Time 054 21:56:54.000 RT 790139999999 (Locked)[9999999 Hz]
(I)[027a2e40] TCR01,095: IRIG-B Time 054 21:56:55.000 RT 790150000000 (Locked)[10000001 Hz]

6.7 Computer-Generated Data Packets (1)

6.7.1 General

This test determines the compliance of the SUT when recording computer-generated data packets. This consists of primarily index and event packets.

6.7.2 Test Equipment

a. METS-231.

b. METS validation software.

6.7.3 Procedure

a. Connect the METS output to the input of the SUT. Ensure that indexing and events are enabled (if supported by the recorder).

b. Record data for a minimum of 10 minutes. Generate event records either through hardware or by issuing the .Event command through a terminal emulation or recorder control program.

c. Run the METS validation software against the SUT.

6.7.4 Data Reduction

Examine the METS logs and verify that no errors occurred.

6.8 ARINC-429 Data Packets (1) and (2)

6.8.1 General

This test determines the compliance of the SUT when recording ARINC-429 data.

6.8.2 Test Equipment

a. METS-231.

b. METS validation software.

6.8.3 Procedure

a. Connect the METS output to the input of the SUT.

b. Record data for a minimum of two minutes.

c. Run the METS validation software against the SUT.

6.8.4 Data Reduction

Examine the METS logs and verify that no errors occurred with the exception of initial startup of the recorder. Configuration M_03-02 has ARINC-429 data with parity errors. Log file output is shown in Table 6-7.

Table 6-7. ARINC-429 Data with Errors

(I)[00003058] TCR01,248: IRIG-B Time 057 17:11:54.000 RT 619139999999 (Locked)
(E)[000132ac] A429-0e,101,145,00488: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[000132ac] A429-0e,101,279,008b8: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[0006f134] A429-0e,102,131,00418: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[0006f134] A429-0e,102,263,00838: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[000c97d4] A429-0e,103,131,00418: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[000c97d4] A429-0e,103,263,00838: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(I)[000fd774] TCR01,249: IRIG-B Time 057 17:11:55.000 RT 619150000001 (Locked)[10000002 Hz]
(E)[0010fad8] A429-0e,104,131,00418: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[0010fad8] A429-0e,104,263,00838: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[00166384] A429-0e,105,151,004b8: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000
(E)[00166384] A429-0e,105,347,00ad8: METS: Bus 7 incorrectly reported parity error in word 12. Expected 00000000 Found 07600000

6.9 Message Data Packets (1) and (2)

This test determines the compliance of the SUT when recording message data. The METS-231 does not have the capability to generate message data packets. The METS validation software will verify the contents of a message data packet type if present. This packet type was originally conceived to provide a way to record message-oriented data not covered by some other standard, such as Ethernet. In an operational use this data would have to be validated using a packet viewer application.

6.10 Video Data Packets (1) and (2)

6.10.1 General

This test determines the compliance of the SUT when recording video data. It should be noted that this test only determines the validity of the video packets and not the video content. Actual verification of MPEG transport streams can be accomplished with commercially available software from Manzanita Systems, Inc.

6.10.2 Test Equipment

a. METS-231 and METS validation software.

b. Optional MPEG-2 Transport Stream Analyzer software from Manzanita Systems.

6.10.3 Procedure

a. Connect the METS output to the input of the SUT.

b. Record data for a minimum of two minutes.

c. Run the METS validation software against the SUT.

6.10.4 Data Reduction

Examine the METS logs and verify that no errors occurred with the exception of initial startup of the recorder. Use a data extraction or Chapter 10 video viewer tool as a visual verification of the video content.

Configurations M_01-01 through M_03-03 contain video data. Expected log file output is shown in Table 6-8.

Table 6-8. Video Data

Chan #	# MPEG-2 Packets	Format Errors	CSDW Errors	Packet Drops	IPH Errors	Calculated Bitrate
1	169901	0	0	0	0	4000004.8
2	169901	0	0	0	0	4000004.8
3	0	0	0	0	0	1000000.0
4	0	0	0	0	0	1000000.0

6.11 Image Data Packets

This release of this test method does not cover image data packets.

6.12 UART Data Packets (1) and (2)

6.12.1 General

This test determines the compliance of the SUT when recording UART data.

6.12.2 Test Equipment

a. METS-231.

b. METS validation software.

6.12.3 Procedure

a. Connect the test set output to the input of the SUT.

b. Set the test set to configuration M_05_01 and record data for a minimum of two minutes. Configurations are shown in Table 6-9.

c. Run the METS validation software against the SUT.

d. Repeat this process for configurations M_05-02 through M_05-06.

Table 6-9. UART Configuration Matrix

Test Configuration	Baud Rate	Parity
M_05-01	9600	No
M_05-02	9600	Even
M_05-03	9600	Odd
M_05-04	115200	No
M_05-05	115200	Even
M_05-06	115200	Odd

6.12.4 Data Reduction

Use the METS validation software tool to evaluate the results of the recording directly from the RMM. This will produce a number of log files that will need to be visually inspected. All errors between one second after startup and within one second of stopping should be evaluated. Log file summary output should show no errors as depicted in Table 6-10.

Table 6-10. UART Expected Results Summary Log File

UART Packet Summary								
Chan #	Total Packets	Seq No. Errors	Ref Time Errors	Ref Time SyncErrs	DataTime StampErr	Ref Time Lat Errs	Total Errors	Total Warnings
1	393	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0

UART Data Summary								
Chan #	Total Bytes	Channel-Specific Errors	IPH Time Errors	SubChan Channel Errors	Data Length Errors	Packets w/Parity Errors	METS Total Packets	METS Packet Errors
1	7860	0	0	0	0	0	393	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0

UART Timing Summary								
Chan #	UART Messages	Minimum Delta	Maximum Delta	MinDelta@ FileOffset	MinDelta@ PktRefTime	MaxDelta@ FileOffset	MaxDelta@ PktRefTime	
1	389	-0.000008	-0.000008	ef0	782708999910	ef0	782708999910	
2	0							
3	0							

6.13 IEEE-1394 Data Packets (1) and (2)

The METS-231 does not currently support this packet type; however, commercially available test equipment from Dap Technology (Model FS800) does provide a way to simulate IEEE-1394 packet data. Analysis would consist of using a packet viewer application to verify the contents of the packets.

6.14 Parallel Data Packets (1) and (2)

6.14.1 General

This test determines the compliance of the SUT when recording parallel data.

6.14.2 Test Equipment

a. METS-231.

b. METS validation software.

6.14.3 Procedure

a. Connect the METS output to the input of the SUT.

b. Record data for a minimum of two minutes.

c. Run the METS validation software against the SUT.

6.14.4 Data Reduction

Examine the METS logs and verify that no errors occurred with the exception of initial startup of the recorder. This test reuses the discrete test method (Section 6.6) and assumes the METS-231 has been connected in the same manner to the recorder.

6.15 Ethernet Data Packets (1) and (2)

6.15.1 General

This test determines the compliance of the SUT when recording Ethernet data.

6.15.2 Test Equipment

a. METS-231.

b. METS validation software.

6.15.3 Procedure

a. Set the test set to configuration M_04-01 and record data for a minimum of two minutes.

b. Run the METS validation software against the SUT.

c. Repeat this process for configurations M_04-02, M_04-03, and M_04-04.

6.15.4 **Data Reduction**

Examine the METS logs and verify that no errors occurred with the exception of initial startup of the recorder.

Configurations M_04-01 through M_04-03 should have error-free Ethernet data. Table 6-11 shows a log file from configuration M_04-01 with the result errors caused by the use of invalid filler data. The IRIG 106-13 requires that filler data be either 00 or 0xff, which is not the case in the data.

Table 6-11. Results from METS Validation Software for Ethernet Packets with no Format Errors

```
(E)[0000522c] ETH02,182,00,00000: METS: Unexpected Frame Number.  Expected 0x2991 Found
0x29c0. [Single]
(E)[0000522c] ETH02,182,00,00000: Packet contains filler byte with invalid data (0x48)
(E)[00005a28] ETH02,183,00,00000: METS: Unexpected Frame Number.  Expected 0x5ed7 Found
0x5eee. [Single]
(E)[00005a28] ETH02,183,00,00000: Packet contains filler byte with invalid data (0x19)
(I)[00006224] TCR01,076: IRIG-B Time 041 23:31:21.000 RT 846810000003 (Locked)[ 9999998 Hz]
(E)[00008000] ETH02,184,00,00000: METS: Unexpected Frame Number.  Expected 0x5eef Found
0x5efa. [Single]
(E)[00008000] ETH02,184,00,00000: Packet contains filler byte with invalid data (0x62)
(E)[000087fc] ETH02,185,00,00000: METS: Unexpected Frame Number.  Expected 0x5efb Found
0x5f06. [Single]
(E)[000087fc] ETH02,185,00,00000: Packet contains filler byte with invalid data (0xd7)
(E)[000090a0] ETH02,186,00,00000: METS: Unexpected Frame Number.  Expected 0x5f07 Found
0x5f13. [Single]
(E)[000090a0] ETH02,186,00,00000: Packet contains filler byte with invalid data (0x21)
```

Configuration M_04-04 contains Ethernet data with frame errors. Table 6-12 shows a log file from configuration M_04-04 with frame errors. These should be the only errors in the METS validation software log file.

Table 6-12. Results from METS Validation Software for Ethernet Packets with Format Errors

(I)[000005c8] TCR01,024: IRIG-B Time 040 19:38:42.000 RT 707220000001 (Locked)
(E)[00000744] ETH02,124,00,00000: Packet contains filler byte with invalid data (0x2e)
(E)[00002df4] ETH02,125,00,00000: METS: Unexpected Frame Number. Expected 0x52bf Found 0x52ca. [Errors-Frame1]
(E)[00002df4] ETH02,125,00,00000: Packet contains filler byte with invalid data (0xdf)
(E)[000067f0] ETH02,126,00,00000: METS: Unexpected Frame Number. Expected 0x52cb Found 0x52dc. [Errors-Frame1]
(E)[000067f0] ETH02,126,00,00000: Packet contains filler byte with invalid data (0x9f)
(E)[00008ea0] ETH02,127,00,00000: METS: Unexpected Frame Number. Expected 0x52dd Found 0x52e8. [Errors-Frame1]
(E)[00008ea0] ETH02,127,00,00000: Packet contains filler byte with invalid data (0x2e)
(E)[0000c89c] ETH02,128,00,00000: METS: Unexpected Frame Number. Expected 0x52e9 Found 0x52fa. [Errors-Frame1]
(E)[0000c89c] ETH02,128,00,00000: Packet contains filler byte with invalid data (0x82)

```
(E)[0000ef4c] ETH02,129,00,00000: METS: Unexpected Frame Number.  Expected 0x52fb Found 0x5306.
[Errors-Frame1]
(E)[0000ef4c] ETH02,129,00,00000: Packet contains filler byte with invalid data (0xd7)
(E)[00012948] ETH02,130,00,00000: METS: Unexpected Frame Number.  Expected 0x5307 Found 0x5318.
[Errors-Frame1]
(E)[00012948] ETH02,130,00,00000: Packet contains filler byte with invalid data (0xea)
(E)[00014ff8] ETH02,131,00,00000: METS: Unexpected Frame Number.  Expected 0x5319 Found 0x5324.
[Errors-Frame1]
(E)[00014ff8] ETH02,131,00,00000: Packet contains filler byte with invalid data (0x3f)
(E)[000189f4] ETH02,132,00,00000: METS: Unexpected Frame Number.  Expected 0x5325 Found 0x5336.
[Errors-Frame1]
(E)[000189f4] ETH02,132,00,00000: Packet contains filler byte with invalid data (0x3e)
(E)[0001b0a4] ETH02,133,00,00000: METS: Unexpected Frame Number.  Expected 0x5337 Found 0x5342.
[Errors-Frame1]
(E)[0001b0a4] ETH02,133,00,00000: Packet contains filler byte with invalid data (0xfa)
(I)[0001eaa0] TCR01,025: IRIG-B Time 040 19:38:43.000 RT 707229999999 (Locked)[ 9999998 Hz]
(E)[0001ec34] ETH02,134,00,00000: METS: Unexpected Frame Number.  Expected 0x5343 Found 0x5354.
[Errors-Frame1]
(E)[0001ec34] ETH02,134,00,00000: Packet contains filler byte with invalid data (0x10)
(E)[000212e4] ETH02,135,00,00000: METS: Unexpected Frame Number.  Expected 0x5355 Found 0x5360.
[Errors-Frame1]
```

6.16 NMEA-RTCM Packets

This release of this test method does not cover NMEA-RTCM packets.

6.17 EAG ACMI Packets

This release of this test method does not cover EAG ACMI packets.

6.18 ACCTS Packets

This release of this test method does not cover ACCTS packets.

6.19 Controller Area Network (CAN) Bus Packets

The METS-231 does not currently support this packet type; however, commercially available test equipment from VECTOR (Model VN7600) does provide a way to simulate CAN bus packet data. Analysis would consist of using a packet viewer application to verify the contents of the packets.

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CHAPTER 7

Recorder Control and Status

7.1 General

Chapter 10 requires that every recorder have an RS-232/422 port to accept commands and provide status. Optionally, the recorder may be controlled by using a Fibre Channel, an IEEE 1394B interface, or an Ethernet connection. Recorders must provide electrical inputs for discrete control in accordance with (IAW) Chapter 10 Subsection 10.7.10. This chapter will outline the steps to verify that the recorder meets the requirements of Section 10.7.

7.2 Test Equipment

a. METS-231 and PC with hyperterminal software or equivalent.

b. PC with Wireshark for Ethernet data streaming capture.

7.3 Procedure

a. Chapter 10 Command Verification. See Table 7-1.

b. Discrete Control and Status. See Figure 7-1.

c. Recorder Light-Emitting Diode (LED) States. See Table 7-2.

Table 7-1. Chapter 10 Command Verification

Step	Activity	Comments	Pass	Fail
1	Verify Power Supply is Off			
2	Verify Bench power switch is OFF			
3	Launch Host PC serial communications program (Hyper terminal) Configure METS for PCM 1 Mbps and MIL-STD-1553 10-Hz rate			
4	**Configure** the host software to: **Enter**: Baud rate: **38.4 kBd** **Enter**: Parity: **No Parity** **Enter**: Data Bits: **8 Data Bits** **Enter**: Stop Bits: **1 Stop Bit** **Enter:** Flow Control**: None** **Enter**: Local Echo: **ON** **Enter**: Send CR/LF: **ON**			
5	Power Supply = **ON**			
6	Bench Power Switch = **ON**			
7	**Wait for ready prompt * test by issuing carriage return line feed.**			
8	Issue **.BIT** command ***.STATUS** S 02 XX% ***.STATUS** S 00 **Wait until bit is complete S 00**			
9	Issue **.ERASE** Command			

10	Issue **.STATUS** verify recorder replies with percentage erased			
11	Issue **.FILES.** Verify no files are present Should return '*'			
12	Issue **.HEALTH.** Verify recorder channels are displayed. Verify documentation as to bit allocation matrix. Verify channels available.			
13	Issue **.CRITICAL**, Specify and view masks that determine which of the .HEALTH status bits are critical warnings			
14	Issue **.DECLASSIFY,** Verify Secure Erase documentation is provided.			
15	Issue **.DISMOUNT**. Verify power is removed from RMM. Verify with .MEDIA, verify no media present			
16	Issue **.MOUNT**. Verify power is re applied to RMM, Verify Media present			
17	Issue .TMATS WRITE			
18	Send test configuration Ch 1 Video S-Video @4 Mb Ch 2 Video @ 4 Mb Ch 3 Video @ 4 Mb Ch 4 Video @ 4 Mb Ch1-Ch8 MIL-STD-1553 Enabled Time External IRIG-B PCM channels for 1 Mb/sec, 512 bits per word			
19	Issue .**TMATS SAVE 1**			
20	Issue **.SETUP** (Verify existing configuration)			
21	**Issue .SETUP 1**			
22	Verify MIL-STD-1553 channels from METS are "ON" 10 % bus loading			
23	Verify IRIG time is synchronized w/time code generator			
24	Verify METS GPS Sync Light is ON			
25	Verify Video signal and time overlay is present in all videos			
26	Issue **.FILES**.			
27	Issue **.ERASE** Verify erase indicator is "ON"			
28	Issue .**MEDIA** Verify memory available			
29	Issue **.STATUS** Verify in Idle state			
30	Issue **.PUBLISH** command to start live data streaming over Ethernet interface. Verify with external capture tool.			
31	Issue **.RECORD**			
32	Issue **.TIME** write down time verify time matches IRIG display			
33	Issue **.DATE** and verify date matches IRIG display			
34	Issue **.STATUS** Verify unit is in record			
35	Issue **.MEDIA** Verify memory usage			
36	Wait 10 minutes			
37	Issue .**TIME**			
38	Issue **.STOP**			
39	Issue **.FILES**			
40	Issue .MEDIA, verify usage			
41	Issue .RESET verify unit resets			

42	Issue **.EVENT** [*text string*]. Display event table or add event to event table			
43	Issue **.STOP**, Verify recorder stopped			
44	Issue **.LOOP**. Verify recorder goes into record and play in read after write mode			
45	Issue **.STOP**, Verify recorder stopped			
46	Issue **.FIND** to select new play point			
47	Issue **.PLAY** , verify operation from documentation provided			
48	Issue **.PAUSE** , verify operation from documentation provided			
49	Issue **.RESUME** , verify operation from documentation provided			
50	Issue **.STOP**, Verify recorder stopped			
51	Issue **.REPLAY** , verify operation from documentation provided			
52	Issue **.STOP**, Verify recorder stopped			
53	Issue **.SHUTTLE** , verify operation from documentation provided			
54	Issue **.STOP**, Verify recorder stopped			
55	Issue **.HELP** verify Table of commands available			
56	Issue **.IRIG-106** and verify version number			
57	Power Supply = **OFF**			
58	Bench Power Switch = **OFF**			
59	Remove RMM			

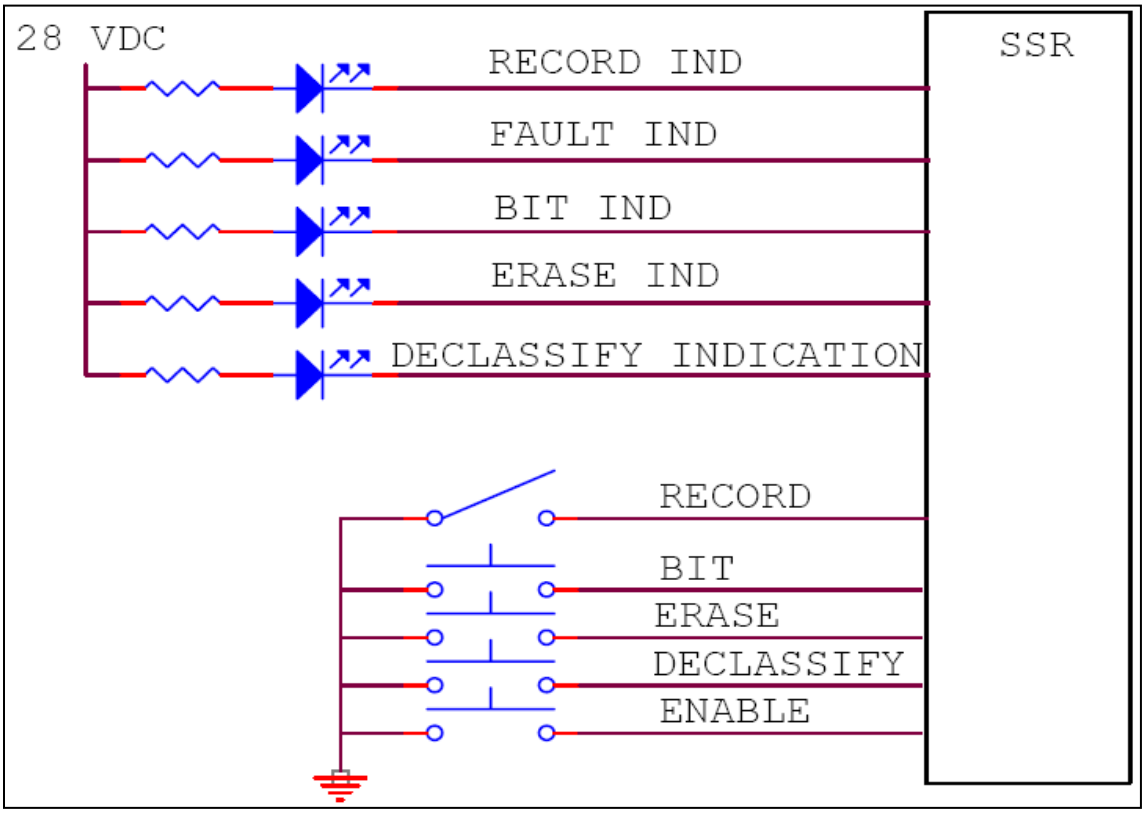

Figure 7-1. Discrete Control and Status

Table 7-2. Recorder LED States

LED	On	Flashing *	Off
ERASE	Media erased	Media erasing is in progress.	Not erased media
RECORD	In recording		Not in recording
FAULT	Recorder is not ready, or any of the critical warning exists.		Recording is running properly. No critical warning.
BIT	Built-in test running		Built-in test is not running
DECLASSIFY	Media declassified	Media declassification is in progress.	Not declassified media
* Flashing is defined as On: 500 ms, and Off: 500 ms.			

CHAPTER 8

Declassification

IRIG 106-13 includes both an approach and algorithm description to accomplish the declassification of an RMM IAW multiple regulations quoted in the document. It is recognized that this approach will not necessarily meet with the approval of all security organizations charged with protecting program data. These procedures were provided as a potential solution for dealing with the declassification of solid-state media inside an RMM.

It is outside the purview of this document to identify any procedures that would satisfy the requirements to certify that a solid-state memory has been declassified according to the above mentioned procedures.

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APPENDIX A

METS-231 Recorder PCM Configuration Tables

Table A-1. M_01-01

CH #	1	2	3	4	5	6	7	8
Rate	5Mb	5Mb	5Mb	2Mb	2Mb	2Mb	1Mb	1Mb
Sync	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840	faf320	faf320
Mode	Packed	Unpack	Throughput	Packed	Unpack	Throughput	Packed	Unpack
Word/Frame	511	511	511	31	31	31	256	256
Min/Maj	32	32	32	1	1	1	1	1
Bits/Word	16	16	16	16	16	16	24	24
SFID Start	1	1	1	0	0	0	0	0
Word Time	.0000032	.0000032	.0000032	.000008	.000008	.000008	.000024	.000024

Table A-2. M_01-02

CH #	1	2	3	4	5	6	7	8
Rate	2Mb	2Mb	2Mb	5Mb	5Mb	5Mb	500Kb	500Kb
Sync	fe6b2840	fe6b2840	fe6b2840	eb90	eb90	eb90	faf320	faf320
Mode	Packed	Unpack	Throughput	Packed	Unpack	Throughput	Packed	Unpack
Word/Frame	255	255	255	10	10	10	256	256
Min/Maj	16	16	16	1	1	1	1	1
Bits/Word	16	16	16	8	8	8	24	24
SFID Start	0	0	0	0	0	0	0	0
Word Time	.000008	.000008	.000008	.0000016	.0000016	.0000016	.000048	.000048

Table A-3. M_01-03

CH #	1	2	3	4	5	6	7	8
Rate	5Mb	5Mb	5Mb	160Kb	500Kb	160Kb	100Kb	500Kb
Sync	faf320	faf320	faf320	fe6b2840	fe6b2840	fe6b2840	Eb90	fe6b2840
Mode	Packed	Unpack	Throughput	Unpack	Unpack	Unpack	Unpack	Packed
Word/Frame	256	256	256	31	511	255	10	511
Min/Maj	1	1	1	1	32	16	1	32
Bits/Word	24	24	24	16	16	16	8	16
SFID Start	0	0	0	0	1	0	0	1
Word Time	.0000048	.0000048	.0000048	.0001	.000032	.0001	.00008	.000032

Table A-4. M_02-01

CH #	1	2	3	4	5	6	7	8
Rate	5Mb	5Mb	160Kb	160Kb	5Mb	160Kb	5Mb	160Kb
Sync	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840	fe6b2840
Mode	Unpack	Unpack	Unpack	Unpack	Packed	Packed	Throughput	Throughput
Word/Frame	511	511	511	511	511	511	511	511
Min/Maj	32	32	32	32	32	32	32	32
Bits/Word	16	16	16	16	16	16	16	16
SFID Start	1	1	1	1	1	1	1	1

Word Time	.0000032	.0000032	.0001	.0001	.0000032	.0001	.0000032	.0001

Table A-5. M_02-02

CH #	1	2	3	4	5	6	7	8
Rate	5Mb	5Mb	160Kb	160Kb	5Mb	160Kb	5Mb	160Kb
Sync	eb90	eb90	eb90	eb90	eb90	eb90	eb90	eb90
Mode	Unpack	Unpack	Unpack	Unpack	Packed	Packed	Throughput	Throughput
Word/Frame	10	10	10	10	10	10	10	10
Min/Maj	1	1	1	1	1	1	1	1
Bits/Word	8	8	8	8	8	8	8	8
SFID Start	0	0	0	0	0	0	0	0
Word Time	.0000016	.0000016	.00005	.00005	.0000016	.00005	.0000016	.0005

Table A-6. M_03-01

CH #	1	2	3	4	5	6	7	8
Rate	5Mb	2Mb	500Kb	160Kb	5Mb	2Mb	500Kb	160Kb
Sync	fe6b2840	fe6b2840	fe6b2840	eb90	fe6b2840	fe6b2840	fe6b2840	eb90
Mode	Unpack	Unpack	Unpack	Unpack	Packed	Packed	Packed	Packed
Word/Frame	31	511	255	10	31	511	255	10
Min/Maj	1	32	16	1	1	32	16	1
Bits/Word	16	16	16	8	16	16	16	8
SFID Start	0	1	0	0	0	1	0	0
Word Time	.0000032	.000008	.0000032	.00005	.0000032	.000008	.000032	.00005

Table A-7. M_03-02

CH #	1	2	3	4	5	6	7	8
Rate	5Mb	2Mb	500Kb	160Kb	5Mb	2Mb	500Kb	160Kb
Sync	fe6b2840	fe6b2840	fe6b2840	eb90	fe6b2840	fe6b2840	fe6b2840	eb90
Mode	Unpack	Unpack	Unpack	Unpack	Packed	Packed	Packed	Packed
Word/Frame	31	511	255	10	31	511	255	10
Min/Maj	1	32	16	1	1	32	16	1
Bits/Word	16	16	16	8	16	16	16	8
SFID Start	0	1	0	0	0	1	0	0
Word Time	.0000032	.000008	.0000032	.00005	.0000032	.000008	.000032	.00005

Table A-8. M_03-03

CH #	1	2	3	4	5	6	7	8
Rate	5Mb	2Mb	500Kb	160Kb	5Mb	2Mb	500Kb	160Kb
Sync	fe6b2840	fe6b2840	fe6b2840	eb90	fe6b2840	fe6b2840	fe6b2840	eb90
Mode	Unpack	Unpack	Unpack	Unpack	Packed	Packed	Packed	Packed
Word/Frame	31	511	255	10	31	511	255	10
Min/Maj	1	32	16	1	1	32	16	1
Bits/Word	16	16	16	8	16	16	16	8
SFID Start	0	1	0	0	0	1	0	0
Word Time	.0000032	.000008	.000032	.00005	.0000032	.000008	.000032	.00005

APPENDIX B

METS Validation Coverage by Chapter 10 Paragraphs

Table B-1 identifies the individual Chapter 10 paragraphs validated by the METS validation. In this table, the value "NR" indicates that the corresponding Chapter 10 paragraph does not require any validation.

Table B-1. Chapter 10 Paragraphs Validated by the METS Validation Software

Chapter 10 Paragraph	Title	
10.1	General	NR
10.1.1	Interface Levels	NR
10.2	Definitions/Acronyms	NR
10.3	Operational Requirements	NR
10.3.1	Recorder Compliancy Requirements	NR
10.3.2	Required Configuration	NR
10.3.3	Exclusions to Standard.	NR
10.3.4	Internal System Management	Y
10.3.5	Data Download	Y
10.3.6	IEEE-1394b Interface to Recorder Media	Y
10.3.7	Required File Tables Entries	Y
10.3.7.1	File Table Entry Conditions.	Y
10.3.8	Recorder Configuration File	N
10.3.9	Recorder Data Streaming Transport.	N
10.3.10	COTS Media.	NR
10.4	Data Download and Electrical Interface	N
10.4.1	Fibre Channel (FC) Recorder Download Interface	N
10.4.2	IEEE-1394B Recorder Interface	N
10.4.3	Ethernet Recorder Interface	N
10.5	Interface File Structure Definitions	Y
10.5.1	Data Organization	Y
10.5.1.1	Data Hierarchy	Y
10.5.2	Directory Definition	Y
10.5.3	Data Definitions	Y
10.5.3.1	Directory Byte Order	Y
10.5.3.2	Data Format Byte Order	Y
10.5.3.3	Character Set	Y
10.5.3.4	Naming Restrictions	Y
10.6	Data Format Definition	Y
10.6.1	Common Packet Elements	Y
10.6.1.A	Basic Structure	Y
10.6.1.B	Checksum	Y
10.6.1.C	Packet Size	Y
10.6.1.D	Packet Generation Time (100 ms)	Y
10.6.1.E	Filler/Idle packets Disallowed	Y

Table B-1. Chapter 10 Paragraphs Validated by the METS Validation Software		
Chapter 10 Paragraph	**Title**	
10.6.1.F	All reserved bits set to 0	Y
10.6.1.G	Commit to Stream Time (1 second)	Y
10.6.1.H	Version bits and packet structure bits static for file	Y
10.6.1.1	Packet Header	Y
10.6.1.1.A	Packet Sync Pattern	Y
10.6.1.1.B	Channel ID	Y
10.6.1.1.C	Packet Length	Y
10.6.1.1.D	Data Length	Y
10.6.1.1.E	Data Type Version	Y
10.6.1.1.F	Sequence Number	Y
10.6.1.1.G	Packet Flags	Y
10.6.1.1.H	Data Type	Y
10.6.1.1.I	Relative Time Counter	Y
10.6.1.1.J	Header Checksum	Y
10.6.1.2	Packet Secondary Header (Optional).	N
10.6.1.3	Packet Body	Y
10.6.1.3.A	Channel Specific Data	Y
10.6.1.3.B	Intra-Packet Time Stamp	Y
10.6.1.3.C	Intra-Packet Data Header	Y
10.6.1.3.D	Data	Y
10.6.1.4	Packet Trailer	Y
10.6.1.4.A	Filler	Y
10.6.1.4.B	8-Bit Data Checksum	Y
10.6.1.4.C	16-Bit Data Checksum	Y
10.6.1.4.D	32-Bit Data Checksum	Y
10.6.2	PCM Data Packets	NR
10.6.2.1	PCM Data Packets Format 0. Reserved.	NR
10.6.2.2	PCM Data Packets Format 1 (IRIG 106 Chapter 4 and 8).	Y
10.6.2.2.A	PCM Packet Channel-Specific Data	Y
	R	Y
	IPH	Y
	MA	Y
	MI	Y
	LOCKST	Y
	MODE	Y
	SYNCOFFSET	N
10.6.2.2.B	PCM Packet Body	Y
10.6.2.2.C	PCM Data In Unpacked Mode	Y
10.6.2.2.D	PCM Data In Packed Mode	Y
10.6.2.2.E	PCM Data In Throughput Mode	Y
10.6.2.2.F	PCM Data Word Order in 32-Bit Alignment Mode	Y
10.6.2.2.G	PCM Intra-Packet Header	Y
10.6.3	Time Data Packets	NR

Table B-1. Chapter 10 Paragraphs Validated by the METS Validation Software		
Chapter 10 Paragraph	**Title**	
10.6.3.1	Time Data Packets, Format 0.	NR
10.6.3.2	Time Data Packets, Format 1 (IRIG/GPS/RTC).	Y
10.6.3.2.A	Time Packet Channel Specific Data	Y
10.6.3.2.B	Time Packet Body	Y
10.6.4	MIL-STD-1553	NR
10.6.4.1	MIL-STD-1553 Bus Data Packets, Format 0. Reserved	NR
10.6.4.2	MIL-STD-1553 Bus Data Packets, Format 1 (MIL-STD-1553B Bus Data	Y
10.6.4.2.A	MIL-STD-1553 Packet Channel Specific Data	Y
10.6.4.2.B	MIL-STD-1553 Packet Body	Y
10.6.4.2.C	MIL-STD-1553 Intra-Packet Header	Y
10.6.4.2.D	Packet Format	Y
10.6.4.3	MIL-STD-1553 Bus Data Packets, Format 2 (Bus 16PP194 Weapons Bus Data).	N
10.6.5	Analog Data Packets	NR
10.6.5.1	Analog Data Packets, Format 0. Reserved.	NR
10.6.5.2	Analog Data Packets, Format 1.	Y
10.6.5.2.A	Analog Packet Channel Specific Data	Y
10.6.5.2.B	Analog Samples	Y
10.6.5.2.B1	Unpacked Mode	Y
10.6.5.2.B2	Packed Mode	Y
10.6.6	Discrete Data Packets	NR
10.6.6.1	Discrete Data Packets, Format 0.	NR
10.6.6.2	Discrete Data Packets, Format 1.	N
10.6.7	Computer Generated Data Packets	NR
10.6.7.1	Computer Generated Data Packets Format 0, User Defined	Y
10.6.7.2	Computer Generated Data Packets Format 1, Setup Records.	Y
10.6.7.2.A	Format 1 – Channel-Specific Data Word	Y
10.6.7.3	Computer Generated Data Packets Format 2, Recording Event	Y
10.6.7.3.A	Event Packet Location	Y
10.6.7.3.B	Channel Specific Data Word	Y
10.6.7.3.C	Event Period Of Capture	Y
10.6.7.3.D	Event Condition Of Capture	Y
10.6.7.3.E	Event Initial Capture	Y
10.6.7.3.F	Event Trigger Measurement Description	Y
10.6.7.3.G	Recording Event Intra-Packet Time Stamp	Y
10.6.7.3.H	Recording Event Intra-Packet Data Header	Y
10.6.7.4	Computer Generated Data Packets Format 3, Recording Index	Y
10.6.7.4.A	Recording Index Packet Location	Y
10.6.7.4.B	Channel Specific Data Word	Y
10.6.7.4.C	Recording Index Intra-Packet Time Stamp	Y
10.6.7.4.D	Recording Index Intra-Packet Data Header	Y
10.6.7.4.E	Root Index Packet Entry Format	Y
10.6.7.4.F	Node Index Packet Entry Format	Y
10.6.8	ARINC-429 Data Packets	NR

Table B-1. Chapter 10 Paragraphs Validated by the METS Validation Software		
Chapter 10 Paragraph	**Title**	
10.6.8.1	ARINC-429 Data Packets, Format 0.	Y
10.6.8.1.A	ARINC-429 Packet Channel Specific Word	Y
10.6.8.1.B	Intra-Packet Data Header	Y
10.6.8.1.C	ARINC-429 Packet Data Words	Y
10.6.9	Message Data Packets	NR
10.6.9.1	Message Data Packets, Format 0.	Y
10.6.9.1.A	Message Packet Channel Specific Data Word	Y
10.6.9.1.B	Complete Message Channel Specific Data Word	Y
10.6.9.1.C	Segmented Message Channel Specific Data Word	Y
10.6.9.1.D	Message Data Intra-Packet Header	Y
10.6.10	Video Packets	NR
10.6.10.1	Video Packets, Format 0 (MPEG-2/H.264).	Y
10.6.10.1.A	Video Packet Audio	NR
10.6.10.1.B	Video Packet Channel Specific Data Word	Y
10.6.10.1.C	Intra Packet Header	Y
10.6.10.1.D	Video Packet Data	Y
10.6.10.2	Video Packets, Format 1 (ISO 13818-1 MPEG-2 Bit Stream).	NR
10.6.10.2.A	MPEG-2 Stream Packet Body	NR
10.6.10.2.B	Video Packet Audio	NR
10.6.10.2.C	MPEG-2 Channel Specific Data Word	Y
10.6.10.2.D	Intra Packet Header	Y
10.6.10.3	Video Packets, Format 2 (ISO 14496 MPEG-4 Part 10 AVC/H.264). Format 2	N
10.6.10.3.A	AVC/H.264 Stream Packet Body	N
10.6.10.3.B	Video Packet Audio	N
10.6.10.3.C	AVC/H.264 Channel Specific Data Word	N
10.6.10.3.D	Intra Packet Header	N
10.6.11	Image Packets	NR
10.6.11.1	Image Packets, Format 0 (Image Data).	N
10.6.11.1.A	Image Packet Channel Specific Data Word	N
10.6.11.1.B	Image Intra Packet Header	N
10.6.11.2	Image Packets, Format 1 (Still Imagery).	N
10.6.11.2.A	Still Image Packet Channel Specific Data Word	N
10.6.11.2.B	Still Image Intra-Packet Header	N
10.6.12	UART Data Packets	NR
10.6.12.1	UART Data Packets, Format 0.	Y
10.6.12.1.A	UART Packet Channel Specific Data Word	Y
10.6.12.1.B	UART Intra-Packet Header	Y
10.6.13	IEEE-1394 Data Packets	NR
10.6.13.1	IEEE-1394 Data Packets, Format 0 (IEEE-1394 Transaction	N
10.6.13.1.A	IEEE-1394 Channel Specific Data Word	N
10.6.13.1.B	IEEE-1394 Intra-Packet Header	N
10.6.13.1.C	IEEE-1394 Data Packet Body Types	N
10.6.13.2	IEEE-1394 Data Packets, Format 1 (IEEE-1394 Physical Layer).	NR

Table B-1. Chapter 10 Paragraphs Validated by the METS Validation Software		
Chapter 10 Paragraph	**Title**	
10.6.13.2.A	IEEE-1394 Channel Specific Data Word	N
10.6.13.2.B	IEEE-1394 Format 1 Intra-Packet Header	N
10.6.13.2.C	IEEE-1394 Format 1 Packet Body Types	N
10.6.14	Parallel Data Packets	NR
10.6.14.1	Parallel Data Packet, Format 0.	N
10.6.14.1.A	Parallel Packet Channel Specific Data Word	N
10.6.14.1.B	General Purpose Parallel Data	N
10.6.14.1.C	DCRsi Parallel Data Packets	N
10.6.15	Ethernet Data Packets	NR
10.6.15.1	Ethernet Data Packets, Format 0.	Y
10.6.15.1.A	Ethernet Data Packet Format 0, Channel Specific Data Word	Y
10.6.15.1.B	Ethernet Data Packet Format 0 Intra-Packet Header	Y
10.7	Recorder Control and Status	N
10.7.1	Recorder Control	N
10.7.2	Communication Ports	N
10.7.3	RS-232/422 Port	N
10.7.4	Commands	N
10.7.5	Status Requests	N
10.7.6	Serial Status	N
10.7.7	Default Interface	N
10.7.8	Serial Commands	N
10.7.9	Serial Commands	N
10.7.10	Required Discrete Control Functions	N
10.7.11	Voltage	N
10.7.12	Status Query	N
10.7.13	Erase Command	N
10.7.14	Declassify Command	N
10.7.15	Command Enable	N
10.8	Declassification	N
10.8.1	Approach	N
10.8.2	Algorithm	N
10.9	IEEE 1394B Interface to Recorder Media	N
10.9.1	Media Time Synchronization	N
10.9.2	Physical and Signaling	N
10.9.3	Removable Media Communication	N
10.9.4	Transport of Serial Commands	N
10.9.5	Mandated IEEE-1394b Interface Connector	N
10.9.6	Real Time Clock	N
10.9.7	Mandatory Commands for Processor Devices	N
10.9.8	Time Setting Requirements	N
10.9.9	Set Time	N
10.9.10	Date Setting Requirements	N
10.9.11	Checking Battery Status	N

Table B-1. Chapter 10 Paragraphs Validated by the METS Validation Software		
Chapter 10 Paragraph	**Title**	
10.9.12	Declassification Supporting Commands	N
10.9.13	Vendor Specific Devices	N
10.9.14	Mandatory ORB Formats for the Processor Device	N
10.10	Ground Based Recorders	N
10.10.1	Interface.	N
10.10.2	Data Format	N
10.10.3	Recording Media	N
10.10.4	Remote Command and Control	N
10.10.5	Data Replay and Reproduction	N
10.11	Data Interoperability	N
10.11.1	Original Recording Files	N
10.11.2	Modified Recording Files	N
10.11.3	Original Recording and Modified Recording File Extension	N
10.11.4	File Naming	N
10.11.5	Data Transfer File	N
10.11.5.1	Data Transfer File Structure Definition	N
10.11.5.1.A	Tape Devices.	N
10.11.5.1.B	Random Access Devices	N
10.11.5.2	Data Transfer File Extension.	N
10.11.6	Recording Directory File	N
10.11.6.1	Recording Directory File Extension.	N

APPENDIX C
Python Program to Parse Packet HEX Data

```
#!/usr/bin/env python
# This script will parse IRIG 106 Chapter 10 Analog packets saved from the
# EMC packet viewer program. Select the number of packets to view and then
# click the save button.
#
# This version was written to parse Analog packet data with two sub-channels.
#

in_file = 'M_06-04.txt'
out_file = 'output.txt'

def main():
    # Reduce the file to one huge string.
    f = open(in_file, 'r')
    s = f.read()
    f.close()

    # The data words to be written out.
    out_words = []

    for packet in s.split('=' * 98):
        # Jump ahead to the data
        packet = packet[packet.find('PACKET DATA:')+12:].strip()

        # Strip the 8 char address from each line.
        lines = packet.splitlines()
        for i, line in enumerate(lines):
            lines[i] = ' '.join(line.split()[1:])
        packet = '\n'.join(lines)

        # Split the packet into words
        words = [word.strip() for word in packet.split()]

        # Skip the two sync words.
        out_words += words[2:]

    f = open(out_file, 'w')
    for i in range(len(out_words) / 2):
        f.write('%s %s\n' % tuple(out_words[:2]))
        del out_words[0]
        del out_words[0]
    f.close()

if __name__ == '__main__':
    main()
```

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APPENDIX D

Index of Tests

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APPENDIX E

Citations

North Atlantic Treaty Organization. *NATO Advanced Data Storage Interface Requirements and Implementation Guide*. AEDB-6 Ed. B V. 1. December 2014. May be superseded by update. Retrieved 11 August 2016. Available at https://nso.nato.int/nso/zPublic/ap/AEDP-6edBv1.pdf.

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———. "Digital Recording Standard" in *Telemetry Standards*. RCC 106-13. June 2013. Superseded by *Telemetry Standards*. RCC 106-15. July 2015. Retrieved 24 March 2016. Available at http://www.wsmr.army.mil/RCCsite/Documents/106_Previous_Versions/106-13_Telemetry_Standards/chapter10.pdf.

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********** **NOTHING FOLLOWS** **********