

# **VHF Digital Link Mode 2 Avionics Qualification Policy Test Description**

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# **ARINC**

2551 Riva Road  
Annapolis, MD 21401  
U.S.A



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| <b>Change Log</b> |             |                         |
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# 1 SCOPE

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## 1.1 Identification

This VHF Digital Link Mode 2 (VDLM2) Avionics Qualification Policy (AQP) Test Description document provides the tests required for Phase 3 avionics qualification and describes the test procedures and expected results for each test case. These procedures implement the plan outlined in the *VHF Digital Link Mode 2 Avionics Qualification Policy Test Plan*.

VDLM2 is being developed and implemented under ARINC project number 612346.

## 1.2 System Overview

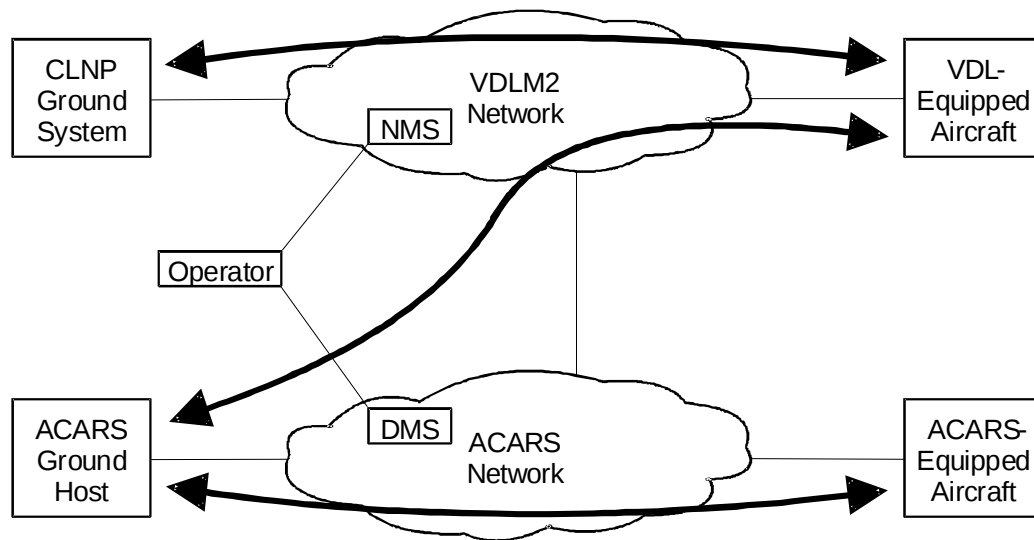
### 1.2.1 VDLM2 Overview

The Operational System is a data communications network that supports end-to-end digital communications between airborne systems and ground systems for Airline Operational Control (AOC), Airline Administrative Control (AAC), and Air Traffic Services (ATS) communication. The system is the successor to ARINC's Very High Frequency (VHF) Aircraft Communications Addressing and Reporting System (ACARS) that has been in use for more than 20 years. Although the earlier system worked well for many years, it does not have the required capacity to support the predicted growth in the next century. The requirements placed on the system are intended to address both the short-term and long-term needs for aeronautical air/ground communication, including both character-oriented and bit-oriented data delivery. Consequently, the system must coexist and interface with the ACARS network for the foreseeable future. Figure 1-1 depicts a high-level view of ARINC's current and planned air/ground networks. In addition, the VDLM2 system uses digital modulation techniques that permit 31.5 kps versus 2.4 kps of the earlier VHF ACARS system. This increase in speed will result in a much greater overall capacity.

### 1.2.2 AQP System Overview

The experience gained from the VHF, Satellite Communications (SATCOM), and High Frequency Data Link (HFDL) services demonstrates that the AQP program provides value to the data link services by improving system efficiency and end-to-end performance. It also indicates that the AQP program can be most effective if implemented in parallel with the development and fielding of a new communications

media. For these reasons, extension of the AQP program to include VDLM2 is considered appropriate.



*Figure 1-1. ARINC Air/Ground Networks*

The AQP consists of four distinct test phases that are briefly described in the following paragraphs. The objective of the four AQP Phases is to protect the ARINC VHF Digital Link (VDL) and ACARS networks from the risks associated with untested avionics and to provide a test process that will insure the early identification of avionics problems. Significant changes in VDL software and hardware require the requalification of that avionics configuration as follows:

**Phase 1:** The avionics manufacturer develops its VHF Data Link systems using simple communications emulators instead of the operational networks.

**Phase 2:** An avionics vendor may contract with a Data Link Service Provider for access to identical, but isolated, VHF ground network equipment (ground stations and processors) for the purposes of development and final test and evaluation of the VDLM2 avionics. While actual, field-ready, ground station equipment is used, all ground equipment and avionics operate in an environment that is totally isolated from the operational system; thereby providing maximum protection for airline messages. The avionics vendor is free to perform whatever tests are considered necessary to ensure that the avionics will operate well with the ARINC networks and are likely to pass both the Phase 3 and Phase 4 AQP tests on the first evaluation. ARINC provides technical support for the Phase 2 tests when requested by the vendor.

**Phase 3:** This test is conducted by ARINC Avionics Test and Evaluation (ATE) staff and within the ARINC Avionics Qualification Facilities (AQFs). The test

focuses on system performance and efficiency as well as verification of compliance with the applicable Airlines Electronic Engineering Committee (AEEC) specifications for both VDL and ACARS. The test would normally include the Communications Management Unit (CMU), Control and Display Unit (CDU), VHF Data Radio (VDR), and cockpit printer to create the system configuration. Other peripheral devices, such as the Aircraft Condition Monitoring System (ACMS), Flight Management Computer (FMC), and Centralized Fault Display Interface Unit (CFDIU) are emulated using a 429-bus emulator.

**Phase 4:** Following the acceptable outcome of the Phase 3 lab tests, the avionics are subjected to an operational flight test. The test is conducted during the first normally scheduled flight when the avionics are initially installed or updated. The first test of an entirely new configuration usually includes a ground observer and an airborne observer that each collect data. The flight test results are evaluated to consider key parameters such as uplink performance, stuck carrier, and other features. These tests will be used in the AQP process during the establishment of the GLOBALink VDL2 service. After gaining experience, ARINC may relax the flight test requirement and instead use a process of continual trend monitoring of all aircraft and fleets. An individual flight test would be appropriate when a downward performance trend was identified with a specific avionics product or aircraft.

After the avionics have demonstrated satisfactory behavior in AQP Phases 3 and 4, ARINC will permit full unrestricted use of the system on the operational network.

## 1.3 Document Overview

### 1.3.1 Document Outline

This document contains the following sections:

#### **Section 1, Scope**

Identifies the project, system, and document overview and provides a list of acronyms and terms used in this document.

#### **Section 2, Applicable Documents**

Lists applicable ARINC and non-ARINC documents and references for this effort and for the project.

#### **Section 3, Test Preparation**

Describes the hardware, software, test instrument, and test tool pretest configurations and procedures.

#### **Section 4, Test Procedures**

Describes the test procedures and expected results for each test case or group of cases.

#### **Appendix A, Data Sheet**

Data sheet for tests covered in this document.

#### **Appendix B, Test Equipment Setup**

Describes the configuration of major test equipment.

#### **Appendix C, AGTS Setup**

Describes the configuration of the Air/Ground Test Station (AGTS).

#### **Appendix D, VDR Test Requirements**

Provides a listing of VDR specifications.

#### **Appendix E, Phase 3 AQP Test Results/Data**

Data Sheet for ACARS tests.

### **1.3.2 Document Tailoring**

Table 1-1 is a cross-reference matrix between this document and the *ARINC Engineering Practices* (AEP) Test Description.

*Table 1-1. AEP Test Description/VDLM2 AQP Test Description Cross References*

| <b><i>AEP</i></b>                          | <b><i>VDLM2 AQP Test Description</i></b>                                                                                                                                                |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0 Scope                                  | 1.0 Scope                                                                                                                                                                               |
| 1.1 Identification                         | 1.1 Identification                                                                                                                                                                      |
| 1.2 System Overview                        | 1.2 System Overview                                                                                                                                                                     |
| 1.3 Document Overview                      | 1.3 Document Overview                                                                                                                                                                   |
| 1.4 Term and Acronyms                      | 1.4 Term and acronyms                                                                                                                                                                   |
| 2.0 Applicable Documents                   | 2.0 Applicable Documents                                                                                                                                                                |
| 2.1 ARINC Documents                        | 2.1 ARINC Documents                                                                                                                                                                     |
| 2.2 Non-ARINC Documents                    | 2.2 Non-ARINC Documents                                                                                                                                                                 |
| 3. Formal Qualification Test Specification | 4.0 Test Procedures                                                                                                                                                                     |
| 3.1 Test Case Name and Project ID          | 4.1.x Individual VDR Receiver Test Descriptions<br>4.2.x Individual VDR Transmitter Test Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation |
| 3.2 Requirements Traceability              | Appendix D: VDR Test Requirements                                                                                                                                                       |
| 3.3 Initialization                         | 4.1.x Individual VDR Receiver Test Pretest                                                                                                                                              |

| <b><i>AEP</i></b>                          | <b><i>VDLM2 AQP Test Description</i></b>                                                                                                                                                                                   |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | Descriptions<br>4.2.x Individual VDR Transmitter Test Pretest Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation<br>Appendix B: Test Equipment Setup<br>Appendix C: AGTS Setup |
| 3.4 Test Input                             | 4.1.x Individual VDR Receiver Test Descriptions<br>4.2.x Individual VDR Transmitter Test Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation                                    |
| 3.5 Expected Test Results                  | 4.1.x Individual VDR Receiver Test Descriptions<br>4.2.x Individual VDR Transmitter Test Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation<br>Appendix A: Data Sheet          |
| 3.6 Criteria for Evaluating Results        | Appendix A: Data Sheet                                                                                                                                                                                                     |
| 3.7 Assumptions and Constraints            | 4.1.x Individual VDR Receiver Test Descriptions<br>4.2.x Individual VDR Transmitter Test Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation                                    |
| 4.0 Formal Qualification Test Preparations | 3.0 Test Preparation                                                                                                                                                                                                       |
| 4.1 Hardware Preparation                   | 3.1 Hardware Preparation                                                                                                                                                                                                   |
| 4.2 Software Preparation                   | 3.2 Software Preparation                                                                                                                                                                                                   |
| 4.3 Other Pretest Preparation              | 3.3 Test Instrument Preparations / Procedures<br>3.4 Test Tool Preparations / Procedures<br>Appendix B: Test Equipment Setup<br>Appendix C: AGTS Setup                                                                     |
| 5.0 Formal Qualification Test Procedures   | 4.0 Test Procedures                                                                                                                                                                                                        |
| 5.1 Test Name and Project ID               | 4.1.x Individual VDR Receiver Test Descriptions<br>4.2.x Individual VDR Transmitter Test Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation                                    |
| 5.2 Pretest Procedures                     | 4.1.x Individual VDR Receiver Test Pretest Descriptions<br>4.2.x Individual VDR Transmitter Test Pretest Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation                    |

| <i><b>AEP</b></i>   | <i><b>VDLM2 AQP Test Description</b></i>                                                                                                                                                                          |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | Appendix B: Test Equipment Setup<br>Appendix C: AGTS Setup                                                                                                                                                        |
| 5.3 Test Procedures | 4.1.x Individual VDR Receiver Test Descriptions<br>4.2.x Individual VDR Transmitter Test Descriptions<br>4.3.x Individual Physical Layer System Parameters<br>4.4.x AOA Test Evaluation<br>Appendix A: Data Sheet |
| 5.4 Test Schedules  | N/A                                                                                                                                                                                                               |

## 1.4 Terms and Acronyms

The following abbreviations, acronyms, and mnemonics are used in this document.

| <i>Item</i> | <i>Meaning</i>                                          |
|-------------|---------------------------------------------------------|
| AAC         | Airline Administrative Control                          |
| ABE         | Avionics Bus Emulator                                   |
| ACARS       | Aircraft Communications Addressing and Reporting System |
| ACMS        | Aircraft Condition Monitoring System                    |
| ACR         | Adjacent Channel Rejection                              |
| AEEC        | Airlines Electronics Engineering Committee              |
| AEP         | <i>ARINC Engineering Practices</i>                      |
| AGTS        | Air/Ground Test Station                                 |
| AOA         | ACARS Over AVLK                                         |
| AOC         | Airline Operational Control                             |
| AQF         | Avionics Qualification Facility                         |
| AQP         | Avionics Qualification Policy                           |
| ARB         | Arbitrary Waveform Generator                            |
| ASIP        | AVLC Simple Interface Protocol                          |
| ATE         | Avionics Test and Evaluation                            |
| ATN         | Aeronautical Telecommunications Network                 |
| ATS         | Air Traffic Services                                    |
| AVLC        | Aviation VHF Link Control                               |
| AWG         | Arbitrary Waveform Generator                            |
| BER         | Bit Error Rate                                          |
| CBD         | Channel Busy Detection                                  |

|       |                                               |
|-------|-----------------------------------------------|
| CDU   | Control and Display Unit                      |
| CFDIU | Centralized Fault Display Interface Unit      |
| CLNP  | Connectionless Mode Network Protocol          |
| CMU   | Communications Management Unit                |
| CRC   | Cyclic Redundancy Check                       |
| CSC   | Common Signal Channel                         |
| CSMA  | Carrier Sense Multiple Access                 |
| CW    | Continuous Wave (carrier only)                |
| D8PSK | Differential 8-Phase Shift Keying             |
| dB    | Decibel                                       |
| DBI   | Downlink Block Identifier                     |
| dBm   | Decibels Below 1 Milliwatt                    |
| DMS   | Data Management System                        |
| EVM   | Error Vector Magnitude                        |
| FM    | Frequency Modulation                          |
| FMC   | Flight Management Computer                    |
| GPS   | Global Positioning System                     |
| GSIF  | Ground Station Identification Frame           |
| HDLC  | High Level Data Link Control                  |
| HF    | High Frequency                                |
| HFDL  | High Frequency Data Link                      |
| I/Q   | Inphase & Quadrature (signal components)      |
| ICAO  | International Civil Aviation Organization     |
| IDU   | Interactive Display Unit                      |
| IST   | Intramedia Switch Timer                       |
| LDR   | Data Loader                                   |
| LED   | Light-Emitting Diode                          |
| MAC   | Media Access Control                          |
| MIDU  | Multiple Interactive Display Unit             |
| MOPS  | Minimum Operational Performance Specification |
| MSK   | Minimum Shift Keying                          |
| MSN   | Message Sequence Number                       |

|        |                                     |
|--------|-------------------------------------|
| NMS    | Network Management System           |
| NOCOMM | No Communication                    |
| PC     | Personal Computer                   |
| PECT   | Peer Entity Contact Table           |
| POA    | Plain Old ACARS                     |
| QM     | Quality Management                  |
| RF     | Radio Frequency                     |
| RR     | Receive Ready                       |
| Rx     | Receiver                            |
| SA     | Media Advisory                      |
| SARPs  | Standards and Recommended Practices |
| SATCOM | Satellite Communications            |
| SQP    | Signal Quality Parameter            |
| Tx     | Transmitter                         |
| UBI    | Uplink Block Identifier             |
| VDL    | VHF Digital Link                    |
| VDLM2  | VHF Digital Link Mode 2             |
| VDR    | VHF Data Radio                      |
| VHF    | Very High Frequency (30-300 MHz)    |
| VSA    | Vector Signal Analyzer              |

# 2 APPLICABLE DOCUMENTS

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## 2.1 ARINC Documents

- [1] *ARINC Engineering Practices*, ARINC Document Number 15849 Rev. L
- [2] *ARINC GLOBALink Avionics Qualification Policy*, ARINC Number Central File: 07-1-3
- [3] *Data Link Ground System Standard and Interface Specification (DGSS/IS)*, ARINC Specification 620-4, November 1999
- [4] *Air-Ground Character-Oriented Protocol Specification*, ARINC Specification 618-4, August 1999
- [5] *Mark 2 Aircraft Communications Addressing and Reporting System*, ARINC Characteristic 724-9, July 1998
- [6] *Aircraft Communications Addressing and Reporting System (ACARS)*, ARINC Characteristic 724B-3, December 1995
- [7] *Multi-Purpose Control and Display Unit*, ARINC Characteristic 739-1, June 1990
- [8] *Multiple-Input Cockpit Printer*, ARINC Characteristic 740-1, June 1988
- [9] *Full-Format Cockpit Printer*, ARINC Characteristic 744, December 1990
- [10] *Communications Management Unit (CMU) Mark 2*, ARINC Characteristic 758-1, March 2000
- [11] *VHF Data Radio (VDR)*, ARINC Characteristic 750-3
- [12] *VHF Digital Link Implementation Description*, ARINC Specification 631-3
- [13] *Internetworking Specification*, ARINC Specification 637
- [14] *Communications Applications*, ARINC Specification 638A
- [15] *MARK 33 Digital Information Transfer System*, ARINC Specification 429
- [16] *ACARS Protocols for Avionics End Systems*, ARINC Specification 619-1, January 1997
- [17] *ACARS Avionics Qualification Policy Phase 3 Test Plan and Procedures*, ARINC Document Number 13136
- [18] *ATS Data Link Applications Over ACARS Air-Ground Network*, ARINC Specification 622-3, September 1998
- [19] *ACARS Avionics Qualification Policy Phase 4 Test Plan and Procedures*, ARINC Document Number 11584

- [20] *VHF Digital Link Mode 2 Air/Ground Test Station (AGTS) Software Users Manual*
- [21] *VHF Digital Link Mode 2 Avionics Qualification Policy Test Plan*, ARINC Document Number 19861

## 2.2 Non-ARINC Documents

- [22] *VHF Digital Link Standards and Recommended Practices (SARPs)*, ICAO Document Annex 10, Volume III, Part I, No. 72, November 6, 1997, ARINC Document Reference 18802
- [23] *RTCA MASPS, DO-224, SC172-224*, April 1, 1998, ARINC Document Reference 18971
- [24] *RTCA MOPS, SC-172*, January 1998, ARINC Document Reference 18513

# 3 TEST PREPARATIONS

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## 3.1 Hardware Preparation

Figure 3-1 and Table 3-1 illustrate the hardware configuration and identification for each hardware element being used for these tests. Figure 3-1 shows the basic connectivity between the Avionics Test Set and the Test Ground Station. The instruments are shown with text indicating uses. Figures detailing connection of these instruments in specific tests are referenced in the test steps within Section 4 (Test Procedures) of this document.

## 3.2 Software Preparation

The manufacturers provide software revisions for the avionics. The software is loaded into the avionics with an industry standard data loader. No additional software configuration is needed for the avionics.

## 3.3 Test Instrument Preparations/Procedures

The test equipment consists of an Avionics Test Set and commercial instruments. Preset configurations and scripts are used for some instruments. Details of the instrument configurations and Avionics Test Set basic configuration are contained in Appendix B.

## 3.4 Test Tool Preparations/Procedures

The AGTS is configured with scripts to facilitate testing avionics suites to ensure compatibility with the ground stations and network (reference Appendix C).

## 3.5 Other Pretest Preparations

No additional configuration is needed for the avionics tests.

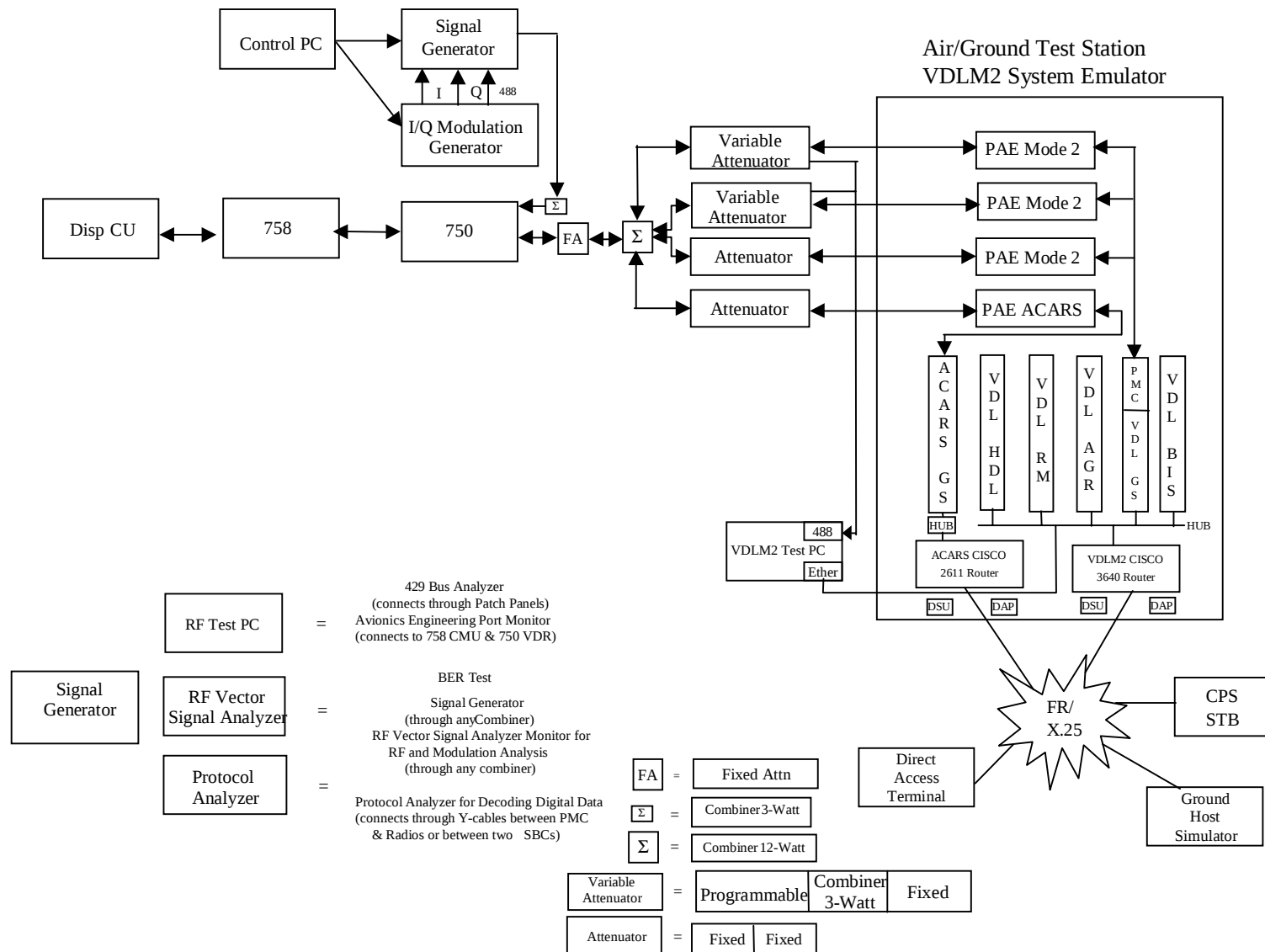


Figure 3-1. AQP Test Environment

*Table 3-1. Commercial Test Instruments/Hardware*

| <b><i>Equipment</i></b>                          | <b><i>Identification</i></b>                                                                                                     |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Vector Signal Generator                          | Rhode & Schwarz SMIQ03B                                                                                                          |
| I/Q Modulation Generator                         | Rhode & Schwarz AMIQ. Use WinQAIM software for Calculating Inphase & Quadrature (I/Q) Signals for I/Q Modulation Generator AMIQ. |
| Vector Signal Analyzer (VSA)                     | Hewlett-Packard 89440A Series with Digital Demodulation Option.                                                                  |
| Digital and Vector Signal Generator              | Marconi 2050 Series.                                                                                                             |
| Protocol Analyzer                                | Digitech-LeCroy PCI-900/PCI/5 with WAN 900 Option                                                                                |
| Radio Frequency (RF) Test Personal Computer (PC) | PC with ARINC 429 I/O & Data Bus Analysis Software/ASIP Software for VDR testing.                                                |
| Control PC                                       | PC with IEEE-488 I/O to control SMIQ & AMIQ                                                                                      |
| Air/Ground Test Station                          | ARINC AGTS and/or bilingual ground station                                                                                       |
| Fixed Attenuator                                 | 30 dB attenuation with 25 watt (minimum) power rating                                                                            |
| Combiner / Splitter 3 way                        | Mini Circuits ZA3CS-440-3W-N                                                                                                     |
| Combiner 4 way                                   | Mini Circuits ZB4CS-440-12W-N                                                                                                    |
| Attenuator Driver                                | HP-11713A                                                                                                                        |
| Variable Attenuators                             | HP-84946-001 / 84966-001 combination 0-121 dB                                                                                    |

👉 **Note:** Other comparable equipment may be substituted as required.



# 4 TEST PROCEDURES

## 4.1 VDR Receiver Tests

This section of testing consists of tests listed in Table 4-1.

*Table 4-1. Receiver Test Identification*

| <i>Test Name</i>                                       | <i>Applicable Sections</i> |
|--------------------------------------------------------|----------------------------|
| Sensitivity                                            | 4.1.1                      |
| Adjacent Channel Rejection                             | 4.1.2                      |
| Rejection of signals in the VHF Aeronautical Band      | 4.1.3                      |
| Rejection of Signals Outside the VHF Aeronautical Band | 4.1.4                      |
| Desired Signal Dynamic Range                           | 4.1.5                      |
| Minimum Message Length                                 | 4.1.6                      |
| Frequency Capture Range                                | 4.1.7                      |
| In-band Intermodulation                                | 4.1.8                      |
| Cochannel Interference                                 | 4.1.9                      |
| Signal Quality Analysis                                | 4.1.10                     |
| Channel Utilization                                    | 4.1.11                     |
| Channel Congestion                                     | 4.1.12                     |

VHF Vector Signal Generator, VHF Signal Generator Frequency Modulation (FM) capable, Modulation Generator, Bit Error Rate (BER) test fixture, RF combiner, 429 data bus analyzer with AVLIC Simple Interface Protocol (ASIP), and transmission generator PC with ASIP software are required equipment.

### 4.1.1 Sensitivity Test

This test verifies that the receiver sensitivity is in compliance with specifications. The test consists of running an uncorrected BER test at a specified signal level and recording the result (reference Appendix D [D.1.2.1.1] and MOPS [5.2.1.1]).

#### 4.1.1.1 Sensitivity Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

#### 4.1.1.2 Sensitivity Test Procedures

1. Connect the equipment as shown in Figure 4-1, but notice that the RF combiner is not required for this test. Set the receiver under test into the uncorrected BER mode and select a frequency.

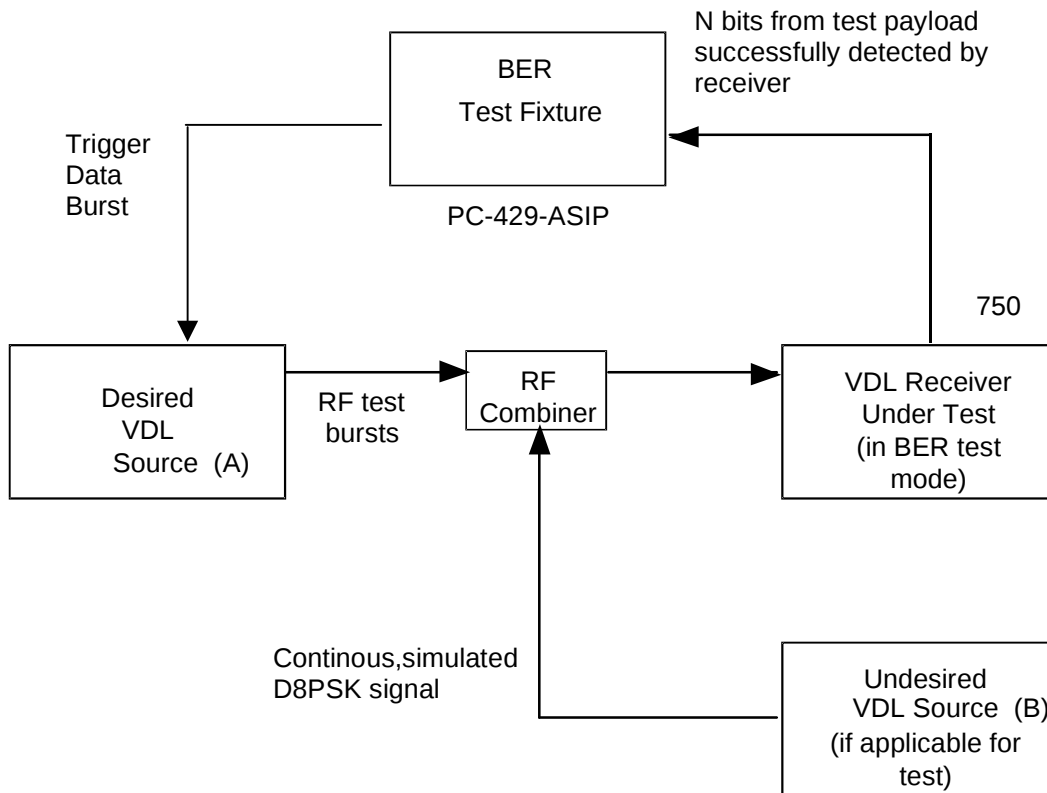


Figure 4-1. Receiver BER Measurement

2. Set the desired VDL source (VHF vector signal generator) to generate an input signal to the receiver on the test frequency.
3. Modulate the desired signal with the test payload (maximum burst length of symbols) provided by the external BER test fixture. Adjust the level of the signal generator to the maximum signal level of  $-98$  dBm at the receiver input terminals.
4. Using the external BER test fixture, determine the uncorrected BER of the demodulated data at the receiver output. Check the sensitivity requirement. The uncorrected BER should be equal to, or better than,  $10^{-3}$ . Record the test result on the Data Sheet in Appendix A.

### 4.1.2 Adjacent Channel Rejection

This test verifies that the receiver Adjacent Channel Rejection (ACR) ratio is in compliance with specifications. The test consists of running an uncorrected BER test in the presence of a reference signal and recording the result (reference Appendix D [D.1.2.1.2] and MOPS [5.2.1.2]).

#### 4.1.2.1 Adjacent Channel Rejection Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

#### 4.1.2.2 Adjacent Channel Rejection Test Procedures

1. Connect the equipment as shown in Figure 4-1 and set the receiver to the uncorrected BER mode and select a frequency.
2. Adjust the desired VDL source (generator A) to produce an input signal to the receiver at the test frequency.
3. Modulate generator A with the test payload (maximum burst length of symbols) provided by the external BER test fixture. Adjust signal generator A to produce the reference signal level of  $-87$  dBm at the receiver input terminals.
4. Use the second VHF signal generator (named B) to generate an adjacent channel interfering input signal to the receiver.
5. Tune generator B to the first upper adjacent channel frequency. Set generator B to produce a narrow-band FM signal (to simulate a second VDL Mode 2 source). Set generator B to FM mode, internal 400 Hz modulation, and deviation of 5.25 kHz. Apply the desired input signal and the adjacent interfering signal to the receiver input via the RF combiner.
6. Adjust the level of signal generator B until the uncorrected BER is reduced to the minimum requirement of equal to, or better than,  $10^{-3}$ . Record the interfering signal level at the receiver input terminals.
7. Determine the ratio between the desired and interfering signal levels.
8. Repeat Steps 3 through 8 for the second and fourth upper adjacent channels.
9. Check that the ACR requirement of 44 dB, 50 dB, and 60 dB is achieved and record the test results on the Data Sheet in Appendix A.

### 4.1.3 Rejection of Signals in the VHF Aeronautical Band

This test verifies that the receiver channel rejection to interference within the aeronautical band is in compliance with specifications. The test excludes the frequency range between first adjacent higher and lower frequencies to the test frequency. The test consists of running an uncorrected BER test in the presence of a reference signal and recording the result (reference Appendix D [D.1.2.1.3] and MOPS [5.2.1.3]).

#### **4.1.3.1 Rejection of Signals in the VHF Aeronautical Band Test Pretest Procedures**

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

#### **4.1.3.2 Rejection of Signals in the VHF Aeronautical Band Test Procedures**

1. Connect the equipment as shown in Figure 4-1 and set the receiver to the uncorrected BER mode and select a frequency.
2. Adjust the desired VDL source (generator A) to produce an input signal to the receiver at the test frequency. Choose three frequencies to check.
3. Modulate generator A with the test payload (maximum burst length of symbols) provided by the external BER test fixture. Adjust signal generator A to produce the reference signal level of  $-87$  dBm at the receiver input terminals.
4. Set the second VHF signal generator (named B) to produce an unmodulated (Continuous Wave [CW]) interfering signal to the receiver input.
5. Tune generator B to a channel frequency in the aeronautical band other than channels immediately adjacent to the frequency of generator A. Adjust the level of the signal generator B to the unmodulated interfering signal power value of  $-33$  dBm at the receiver terminals.
6. Apply the wanted input signal and the unmodulated interfering signal to the receiver input via the RF combiner and determine the uncorrected BER of the demodulated data with the external BER test fixture.
7. Check that the uncorrected BER is equal to, or better than,  $10^{-3}$  and record the test result on the Data Sheet in Appendix A.
8. Repeat Steps 1 through 7 for each frequency selected in Step 2.

#### **4.1.4 Rejection of Signals Outside the VHF Aeronautical Band**

This test verifies that the receiver channel rejection to interference outside of the aeronautical band is in compliance with specifications. The test consists of running an uncorrected BER test in the presence of a reference signal and recording the result (reference Appendix D [D.1.2.1.4] and MOPS [5.2.1.4]).

#### **4.1.4.1 Rejection of Signals Outside the VHF Aeronautical Band Test Pretest Procedures**

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

#### 4.1.4.2 Rejection of Signals Outside the VHF Aeronautical Band Test Procedures

9. Connect the equipment as shown in Figure 4-1 and set the receiver to the uncorrected BER mode.
10. Use the desired VDL source (generator A) to produce an input signal to the receiver at the test frequency. Choose three frequencies to check.
11. Modulate generator A with the test payload (maximum burst length of symbols) using the external BER test fixture. Adjust signal generator A to provide the reference signal level of  $-87$  dBm at the receiver input terminals.
12. Use the second signal generator (named B) to generate one of the specified interfering signals at the receiver input.
13. Tune generator B to any frequency defined in Appendix D (D.1.2.1.4). Adjust the level of generator B to provide the interfering signal level also defined in Appendix D (D.1.2.1.4) at the receiver input terminals.
14. Apply the desired input signal and the interfering signal to the receiver input via the RF combiner and determine the uncorrected BER with the external BER test fixture.
15. Repeat Steps 5 and 6 for all other frequencies selected in Step 2.
16. Check that the uncorrected BER is equal to, or better than,  $10^{-3}$  in all cases and record the test result on the Data Sheet in Appendix A.

#### 4.1.5 Desired Signal Dynamic Range

This test verifies that the receiver dynamic range is in compliance with specifications. The test consists of running an uncorrected BER test at the top end of the specified dynamic range (reference Appendix D [D.1.2.1.5] and MOPS [5.2.1.5]).

##### 4.1.5.1 Desired Signal Dynamic Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

##### 4.1.5.2 Desired Signal Dynamic Test Procedures

1. Connect the equipment as shown in Figure 4-1 but notice that the RF combiner is not needed for this test. Set the receiver to the uncorrected BER mode.
2. Adjust the desired VDL source (generator A) to generate an input signal to the receiver at the test frequency.
3. Modulate generator A with the test payload (maximum burst length of symbols) using the external BER test fixture. Adjust generator A to provide the maximum reference signal level of  $-7$  dBm at the receiver input terminals.
4. Apply the modulated signal to the receiver and determine the uncorrected BER of the demodulated data at the receiver output with the external BER test fixture.

5. Check that the uncorrected BER is equal to, or better than,  $10^{-3}$  and record the test result on the Data Sheet in Appendix A.

#### 4.1.6 Minimum Message Length

This test verifies that the receiver can demodulate a minimum length message without degradation of BER. The test consists of running an uncorrected BER test using a message of specified length (reference Appendix D [D.1.2.1.6] and SARPs [6.4.4.1.1]).

##### 4.1.6.1 Minimum Message Length Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

##### 4.1.6.2 Minimum Message Length Test Procedures

1. Connect the equipment as shown in Figure 4-1 but notice that the RF combiner is not needed for this test. Set the receiver to the uncorrected BER mode.
2. Tune the desired VDL source (generator A) to generate an input signal to the receiver at the test frequency. Adjust generator A to provide the reference signal level of  $-87$  dBm at the receiver input terminals.
3. Tune the VHF signal generator to the receiver channel frequency and modulate it with a test payload of 131071 bits (16383 octets) in length per the SARPs P1 definition using the external BER test fixture.
4. Check that the uncorrected BER is equal to, or better than,  $10^{-3}$  and that the entire message can be decoded without degradation of BER. Record the test result on the Data Sheet in Appendix A.

#### 4.1.7 Frequency Capture Range

This test verifies that the receiver can acquire and lock to any selected channel with a specified frequency offset. The test consists of running an uncorrected BER test with the signal offset a specified amount (reference Appendix D [D.1.2.1.7] and MOPS [5.2.1.7]).

##### 4.1.7.1 Frequency Capture Range Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

##### 4.1.7.2 Frequency Capture Range Test Procedures

1. Connect the equipment as shown in Figure 4-1 but notice that the RF combiner is not needed for this test. Set the receiver to the uncorrected BER mode.
2. Set the desired VDL source (generator A) and the external BER test fixture to generate a receiver input signal.

3. Tune generator A to the test frequency plus the frequency offset of 967 Hz and modulate it with the test payload (use several different message lengths) provided by the external BER test fixture. Adjust generator A to provide the reference signal level  $-87$  dBm at the receiver input terminals.
4. Apply the modulated signal to the receiver and determine the uncorrected BER of the demodulated data at the receiver output with the external BER test fixture.
5. Repeat Steps 3 to 5 for the negative frequency offset of  $-967$  Hz.
6. Check that the uncorrected BER is equal to, or better than,  $10^{-3}$  and record the test result on the Data Sheet in Appendix A.

**Note:** This value is composed of the maximum transmitter frequency error at 136.975 MHz ( $\pm 685$  Hz) and the maximum Doppler shift ( $\pm 282$  Hz).

### 4.1.8 In-Band Intermodulation

This test verifies that the receiver can operate successfully in the presence of strong interference on nearby channels. The test consists of running an uncorrected BER test in the presence of two other interfering signals. The objective is to confirm that the receiver provides a third order intercept point (IP3) of at least 0 dBm (reference Appendix D [D.1.2.1.8] and MOPS [5.2.1.12]).

#### 4.1.8.1 In-Band Intermodulation Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-2).

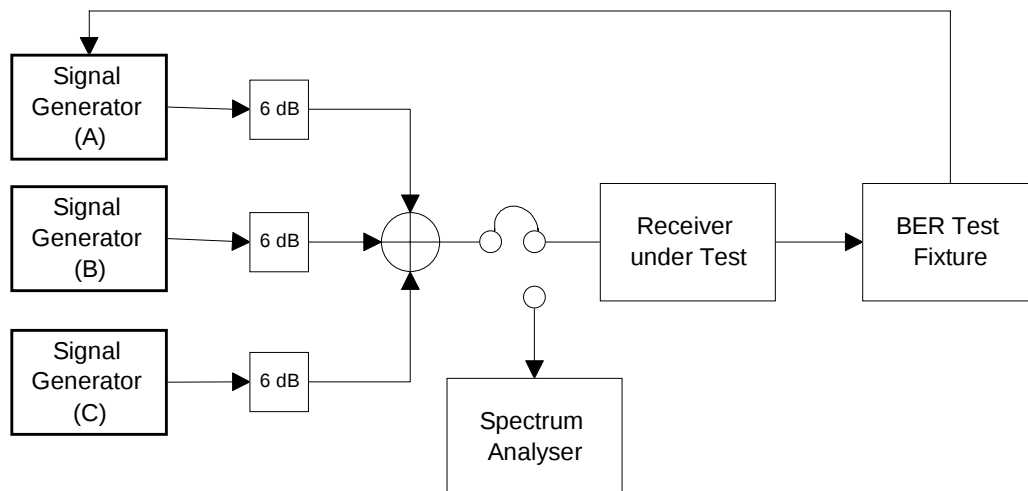


Figure 4-2. Intermodulation Measurement

#### 4.1.8.2 In-Band Intermodulation Test Procedures

1. Connect the equipment as shown in Figure 4-2.
2. Use a signal generator (named A) to generate the desired input signal to the receiver.
3. Tune generator A to the test frequency and modulate the carrier with the test payload (maximum burst length of symbols) provided by the external BER test fixture. Adjust generator A to provide a level of  $-75$  dBm at the receiver input terminals.
4. Tune interfering signal generator B to a frequency 1 MHz above the selected test frequency. Set signal generator B to produce an unmodulated carrier at a level of  $-32$  dBm to the receiver input terminals.
5. Tune interfering signal generator C to a frequency 2 MHz above the selected test frequency. Set signal generator C to produce a simulated Mode 2 signal input to the receiver input terminals at a level of  $-32$  dBm. To produce simulated Mode 2 signal, set generator C to produce a narrow-band FM signal with internal 400 Hz modulation and deviation of 5.25 kHz.
6. Apply the desired signal and the two interfering signals to the receiver input via the RF combiner and determine the uncorrected BER of the demodulated data at the receiver output with the external BER test fixture.
7. Repeat Steps 3 to 6 for the remaining frequency combinations by retuning generators B and C.
8. Check that the uncorrected BER is equal to, or better than,  $10^{-3}$  and record the test result on the Data Sheet in Appendix A.

 **Note:** In the absence of the desired signal (i.e., generator A switched “off”), the intermodulation products produced by any interaction between the interfering signal generators B and C, must be less than  $-105$  dBm at the receiver input. Additional band-pass filters, inserted between each generator and the RF combiner, may be necessary to reduce the intermodulation product.

#### 4.1.9 Cochannel Interference

This test verifies that the receiver can function in the presence of cochannel interference. The test consists of running an uncorrected BER test with a specified amount of cochannel interference (reference Appendix D [D.1.2.1.9] and MOPS [5.2.1.9]).

##### 4.1.9.1 Cochannel Interference Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures for the BER Test Set listed in Section 3 (reference Figure 4-1).

#### 4.1.9.2 Cochannel Interference Test Procedures

1. Connect the equipment as shown in Figure 4-1 and set the receiver to the uncorrected BER mode.
2. Use the desired VDL source (named A) to generate a desired input signal to the receiver.
3. Tune generator A to the test frequency and modulate the carrier with the test payload (maximum burst length of symbols) provided by the external BER test fixture. Adjust generator A to provide the reference signal level of  $-87$  dBm at the receiver input terminals.
4. Use the second signal generator (named B) to generate a cochannel interfering input signal to the receiver.
5. Tune the signal generator B to the receiver channel frequency and configure it to produce a narrow band FM signal with a maximum deviation of  $\pm 5.25$  kHz. Modulate generator B with a 400 Hz sine wave. Adjust generator B to produce an interfering signal level 20 dB below the reference signal level at the receiver input terminals.
6. Apply the desired signal and the cochannel interfering FM modulated signal to the receiver input via the RF combiner and measure the uncorrected BER of the demodulated data at the receiver output with the external BER test fixture.
7. Check that the uncorrected BER is equal to, or better than,  $10^{-3}$  and record the test result on the Data Sheet in Appendix A.

#### 4.1.10 Signal Quality Analysis

This test verifies that the receiver can correctly report signal quality analysis information to the CMU. The test consists of introducing several specified signal levels to the receiver and confirming that they are correctly forwarded to the CMU (reference Appendix D [D.1.2.1.10] and ARINC Characteristic 750 [4.3.5 and A10.4.7]).

##### 4.1.10.1 Signal Quality Analysis Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-1).

##### 4.1.10.2 Signal Quality Analysis Test Procedures

1. Connect the equipment as shown in Figure 4-1 and set the receiver to normal operation. The RF combiner is not required for this test.
2. Use the desired VDL source (named A) to generate a desired input signal to the receiver.
3. Tune generator A to the test frequency and modulate the carrier with the test payload (maximum burst length of symbols) provided by the external BER test fixture.

Adjust generator A to provide the reference signal level of –100 dBm at the receiver input terminals.

4. Use the 429 Data Bus Analyzer with ASIP software to read the `SQP.indication` primitive words sent by the VDR. Read the SQP value from the `SQP.indication` primitive per A10.5.10 of ARINC Characteristic 750.
5. The decoded signal level should be 0 based upon the –100 dBm input. The mapping between reported SQP numbers and input signal level is defined in A10.4.7 of ARINC Characteristic 750.
6. Repeat Steps 3 through 5 for other levels defined on the Data Sheet in Appendix A.
7. Check for proper results of tests and record the test on the Data Sheet in Appendix A.

### 4.1.11 Channel Utilization

This test verifies that the receiver can correctly report channel utilization information gathered in one-second reporting intervals to the CMU. The test consists of introducing traffic on the signal channel of the receiver and confirming that channel utilization is correctly reported to the CMU (reference Appendix D [D.1.2.1.11] and ARINC 750 Characteristic [A10.4.10]).

#### 4.1.11.1 Channel Utilization Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-1).

#### 4.1.11.2 Channel Utilization Test Procedures

1. Connect the equipment as shown in Figure 4-1 and set the receiver to normal operation.
2. Use the desired VDL source (named A) to generate a desired input signal to the receiver.
3. Tune generator A to the test frequency and set modulation for D8PSK. Adjust generator A to provide the reference signal level of –75 dBm at the receiver input terminals.
4. Use the 429 Data Bus Analyzer with ASIP software to read the `CU.indication` primitive words sent by the VDR. Read the `CU.indication` value from the `CU.indication` primitive per A10.5.11 of ARINC Characteristic 750.
5. Manually send a short message at different rates.
6. Note changes in utilization percentage reported in the 429 word with varying transmission rates.

 **Note:** Because it is not possible to synchronize test signals with internal VDR sampling, only average measurements can be made.

7. Check for proper results of tests and record the test results on the Data Sheet in Appendix A.

## 4.1.12 Channel Congestion

This test verifies that the receiver can correctly report channel congestion to the CMU when the channel busy timer (TM2) expires. The test consists of introducing traffic on the signal channel of the receiver and confirming that channel congestion is correctly reported to the CMU (reference Appendix D [D.1.2.1.12] and ARINC Characteristic 750 [A10.4.10]).

### 4.1.12.1 Channel Congestion Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-1).

### 4.1.12.2 Channel Congestion Test Procedures

1. Connect the equipment as shown in Figure 4-1 and set the receiver to normal operation.
2. Use the undesired VDL source (named B) to generate an undesired input signal to the receiver.
3. Tune generator B to the test frequency and set modulation for D8PSK. Adjust generator B to provide the reference signal level of  $-75$  dBm at the receiver input terminals.
4. Send a message using the transmission generator to the VDR for transmission.
5. After 60 seconds have elapsed, use the 429 Data Bus Analyzer with ASIP software to read the `CHAN_COG.indication` primitive words sent by the VDR. Read the `CHAN_COG.indication` value from the `CHAN_COG.indication` primitive per A10.5.13 of ARINC Characteristic 750.
6. The decoded data should be 000 based upon the channel blocking D8PSK input and expiration of 60 second timer (TM2).
7. Check for the correct output and record the results on the Data Sheet in Appendix A.

 **Note:** TM2 is specified for 60 seconds in a system environment. However, a VDR test interface may use a different default value. The default value may need to be reset to 60 seconds.

## 4.2 VDR Transmitter Tests

This section of testing consists of tests listed in the Table 4-2.

*Table 4-2. Transmitter Test Identification*

| <b><i>Test Name</i></b>          | <b><i>Applicable Sections</i></b> |
|----------------------------------|-----------------------------------|
| Output Power                     | 4.2.1                             |
| RF Power Rise time               | 4.2.2                             |
| RF Power Release time            | 4.2.3                             |
| Symbol Constellation Error (EVM) | 4.2.4                             |
| Spurious Emissions               | 4.2.5                             |
| Adjacent Channel Power           | 4.2.6                             |
| Wide Band Noise                  | 4.2.7                             |
| Frequency Tolerance              | 4.2.8                             |
| Ramp-up Transients               | 4.2.9                             |
| CBD/CSMA                         | 4.2.10                            |

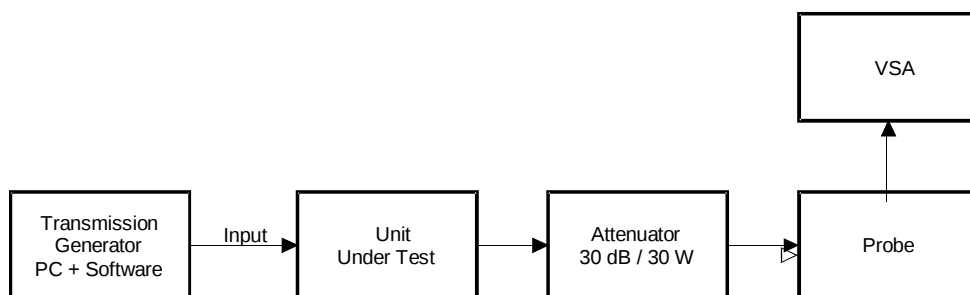
VSA, transmission generator PC with software, attenuators, notch filters, and bandpass filters are required equipment.

### 4.2.1 Output Power

This test verifies that the transmitter delivers the specified output power. The test consists of introducing a data stream for transmission to the transmitter and measuring the RF output power (reference Appendix D [D.1.2.2.1] and MOPS [5.2.2.2]).

#### 4.2.1.1 Output Power Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-3).



*Figure 4-3. Output Power Measurement*

#### 4.2.1.2 Output Power Test Procedures

1. Connect the equipment as shown in Figure 4-3.
2. Tune the transmitter to a test frequency.
3. Key the transmitter under test “on” and modulate the carrier with continuous maximum length Mode 2 messages from the transmission generator.
4. Set the power meter (or VSA) to capture the Mode 2 transmitted signal and determine the average transmitter output power during the message period.
5. Check that the manufacturers declared output power is not less than 15 watts and record the result on the Data Sheet in Appendix A.

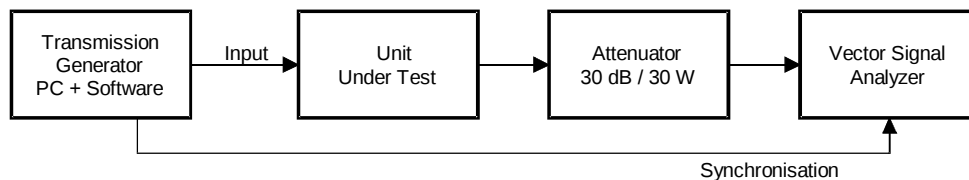
 **Note:** Output power delivered into a 50-ohms load shall be measured during signal transmission (steady state power level) and shall not be averaged.

#### 4.2.2 RF Power Rise Time

This test verifies that the transmitter achieves full output power within a specified period of time. The test consists of introducing a data stream for transmission to the transmitter and measuring the time required to reach 90% of declared output power (reference Appendix D [D.1.2.2.2] and MOPS [5.2.2.3]).

##### 4.2.2.1 RF Power Rise Time Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-4).



*Figure 4-4. RF Power Rise and Release Time Measurement Also Suitable for Symbol Constellation Error*

##### 4.2.2.2 RF Power Rise Time Test Procedures

1. Connect the equipment as shown in Figure 4-4.
2. Configure the VSA to display both constellation diagram and power versus time charts.
3. Use the transmission generator to produce a minimum length Mode 2 message and capture the start of this message.
4. Using both constellation and power versus time display, identify the first symbol of the synchronization sequence.

5. Check RF power level 3 (purposed change to prekey length from 4 to 3) symbol periods before the first synchronization symbol (defined in Appendix D Section D.1.2.2.2) occurs.
6. Check that the RF power rises to 90% of full power in less than 190 microseconds (two symbols). Reference Figure 4-5 or 4-6 for representation of results on test equipment. Record the results on the Data Sheet in Appendix A.

**Note:** There is a characteristic notch in the synchronization sequence, which is located 2.5 symbol periods after the first synchronization symbol. Therefore, it is easy to check the RF power level 5.5 symbol periods (524  $\mu$ s) before this “marker.” This could constitute an alternative method using a standard spectrum analyzer or fast storage oscilloscope (see Figures 4-4 through 4-6).

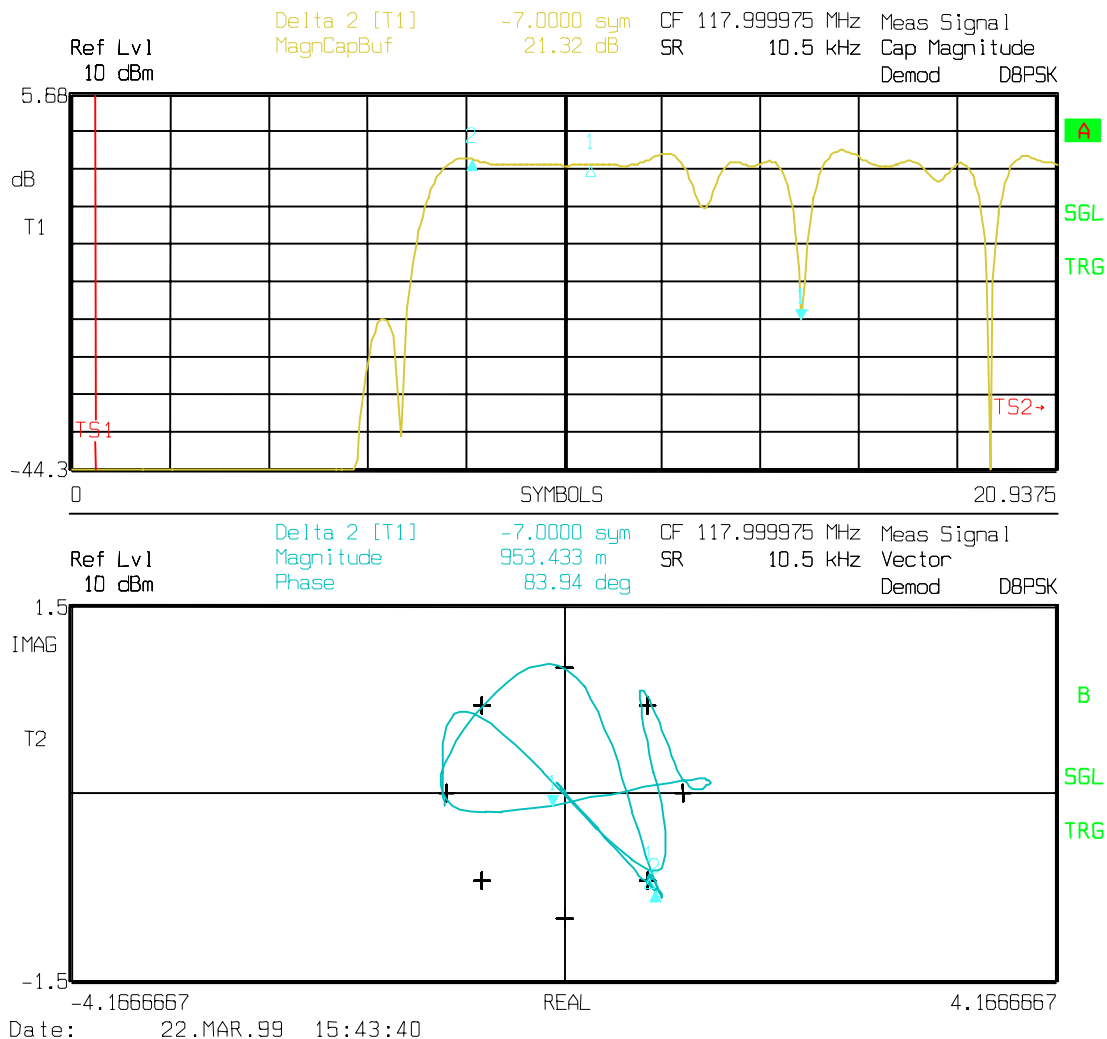


Figure 4-5. VSA Displays Illustrating RF Rise-Time

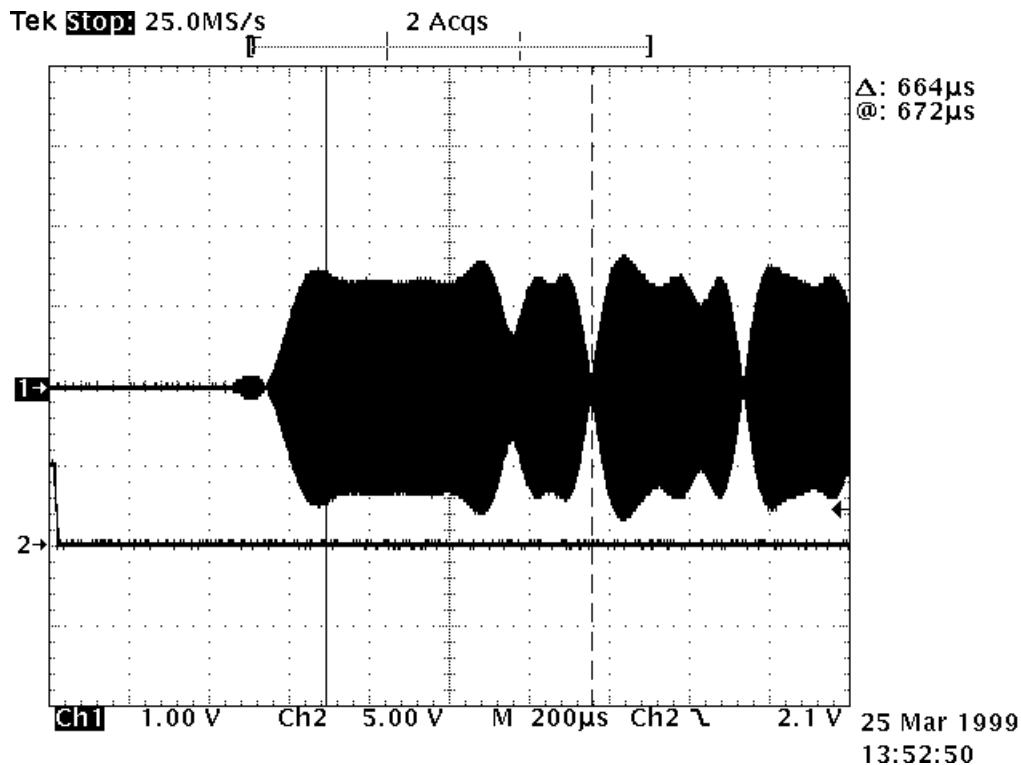


Figure 4-6. Oscilloscope Display Illustrating RF Rise-Time

### 4.2.3 RF Power Release Time

This test verifies that the transmitter output decays 20 dB below full output power within a specified period of time. The test consists of introducing a data stream for transmission to the transmitter and measuring the time required for the power to decay by 20 dB after the message is sent (reference Appendix D [D.1.2.2.3] and MOPS [5.2.2.4]).

#### 4.2.3.1 RF Power Release Time Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-4).

#### 4.2.3.2 RF Power Release Time Test Procedures

1. Connect the equipment as shown in Figure 4-4.
2. Configure the VSA in digital demodulation mode, to display log magnitude of I/Q vectors, with normalization disabled. Set the Y axis to read “dBm.” The symbol times are displayed on the resultant profile of power versus time. Use of the trigger hold off function will aid signal acquisition.

3. Use the transmission generator to produce a minimum length Mode 2 message. Capture the end of this message on the VSA.
4. Use the power versus time display to determine the corresponding profile for each symbol of the “power down” ramp.
5. Check that the RF power release time is within 190 microseconds (two symbols) after transmitting the final information symbol. Record the result on the Data Sheet in Appendix A.

#### **4.2.4 Symbol Constellation Error**

This test verifies that the transmitter Error Vector Magnitude (EVM) is within specification. The EVM is a measure of overall modulation accuracy. The test consists of introducing a data stream for transmission to the transmitter and measuring the EVM of the emitted waveform (reference Appendix D [D.1.2.2.4] and MOPS [5.2.2.5]).

##### **4.2.4.1 Symbol Constellation Test Pretest Procedures**

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-4).

##### **4.2.4.2 Symbol Constellation Test Procedures**

1. Connect the equipment as shown in Figure 4-4.
2. Tune the VSA to the test frequency and modulation scheme, select a suitable level range.
3. Key the transmitter under test “on” and modulate it with continuous maximum length Mode 2 messages produced by the transmission generator.
4. Measure the EVM of the signal.
5. Check that the EVM is less than 6% and record the result on the Data Sheet in Appendix A.

#### **4.2.5 Spurious Emissions**

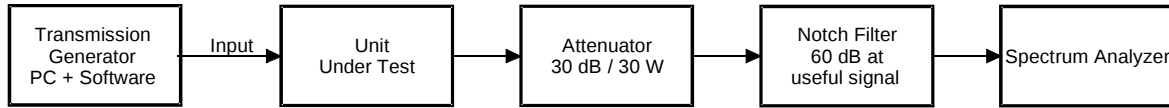
This test verifies that no transmitter spurious emissions exceed specified values. The test consists of looking for spurious emissions in different portions of the spectrum. Any such emissions should not exceed specified values in a given frequency range (reference Appendix D [D.1.2.2.5] and MOPS [5.2.2.6]).

##### **4.2.5.1 Spurious Emissions Test Pretest Procedures**

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-7).

#### 4.2.5.2 Spurious Emissions Test Procedures

1. Connect the equipment as shown in Figure 4-7. If avionics can be tuned, use crystal filter in place of notch filter.



*Figure 4-7. Spurious Emissions Measurement*

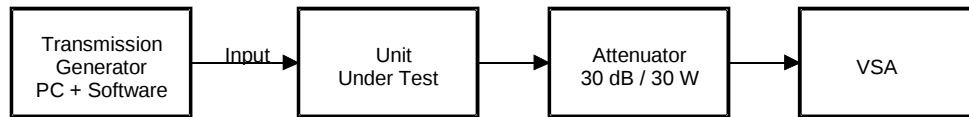
2. Use a notch filter to reject the on-channel signal to increase the dynamic range of the measurement without overloading the spectrum analyzer. Measure the frequency response of the filter and take this into account when calculating spurious measurement results.
3. Set the transmission generator to produce continuous maximum length Mode 2 messages and key the transmitter under test “on.”
4. Adjust the spectrum analyzer reference level to provide the maximum dynamic range for display and set the input attenuator to the minimum required to ensure that no signal at the analyzer input exceeds the maximum allowable level.
5. Measure the power level at each visible spurious signal using power band markers appropriate to the bandwidths specified in Appendix D (D.1.2.2.5). Use the filter to reject the carrier to increase the dynamic range of the measurement without overloading the spectrum analyzer.
6. Measure the frequency response of the filter and take this into account when presenting spurious measurement results. If a bandpass filter is used, it must be tuned to several measurement frequencies, covering the overall measured frequency range.
7. Check that the results do not exceed the limits specified in Appendix D (D.1.2.2.5) for any spurious emission on frequencies between 30 MHz and 1 GHz. Check that harmonic emission products are 60 dB lower than output power. Choose a small group of frequency ranges to check. Record the results on the Data Sheet in Appendix A.

#### 4.2.6 Adjacent Channel Power

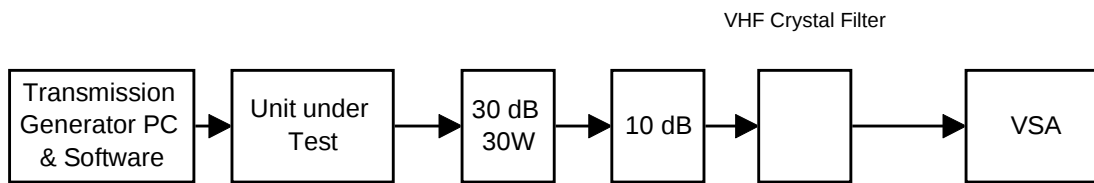
This test verifies that the adjacent channel power produced by the transmitter does not exceed specified values. The test consists of introducing a data stream for transmission to the transmitter and measuring emissions in adjacent channels. Any such emissions should not exceed specified values (reference Appendix D [D.1.2.2.6] and MOPS [5.2.2.7]).

#### 4.2.6.1 Adjacent Channel Power Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figures 4-8 and 4-9).



*Figure 4-8. First Adjacent Channel Power Measurement*



*Figure 4-9. Second and Fourth Adjacent Channel Power Measurement*

#### 4.2.6.2 Adjacent Channel Power Test Procedures

##### 4.2.6.2.1 Adjacent Channel Power Test Procedures—First Channel

1. Connect the equipment as shown in Figure 4-8.
2. Adjust the attenuator in the analyzer to the minimum value that does not overload the input stage of the unit.
3. Key the transmitter under test “on” and modulate it with the transmission generator to produce continuous maximum length Mode 2 messages.
4. Using 100 kHz span, display the Mode 2 signal envelope. Use the analyzer IF signal power as the trigger source for the display and set averaging to 10.
5. Using the power band marker function of the analyzer, measure the power in a 16 kHz bandwidth of the first upper adjacent channel.
6. Check that the first adjacent channel power does not exceed  $-18$  dBm. Record the result on the Data Sheet in Appendix A.

##### 4.2.6.2.2 Adjacent Channel Power Test Procedures—Second Channel

*Important:* To protect the analyzer, ensure that the transmitter cannot be keyed “on,” at the frequency of the crystal filter used for this test.

1. Connect the equipment as shown in Figure 4-9.

2. Offset the tuned frequency of the transmitter under test to 50 kHz above the VHF crystal filter center frequency. Key the transmitter under test “on.” Use the transmission generator to produce continuous maximum length Mode 2 messages.
3. Set the analyzer span to 50 kHz and center frequency to the center frequency of the VHF crystal filter. Decrease the analyzer input attenuator to the minimum level at which the attenuated RF signal from the transmitter under test does not overload the analyzer. Use the analyzer IF signal power as the trigger source for the display and set averaging to 10.
4. Set the analyzer’s power band marker function to 40 kHz. Notice that the measurement bandwidth is defined by the VHF crystal filter and setting the power band marker to the same bandwidth will give an erroneous result.
5. Check that the second adjacent channel power does not exceed –28 dBm. Record the results on the Data Sheet in Appendix A.

#### **4.2.6.2.3 Adjacent Channel Power Test Procedures—Fourth Channel**

1. Connect the equipment as shown in Figure 4-9.
2. Offset the tuned frequency of the transmitter under test to 100 kHz above the VHF crystal filter center frequency. Key the transmitter under test “on.” Use the transmission generator to produce continuous maximum length Mode 2 messages.
3. Set the analyzer span to 50 kHz and center frequency to the center frequency of the VHF crystal filter. Decrease the analyzer input attenuator to the minimum level at which the attenuated RF signal from the transmitter under test does not overload the analyzer. Use the analyzer IF signal power as the trigger source for the display and set averaging to 10.
4. Set the analyzer’s power band marker function to 40 kHz. Notice that the measurement bandwidth is defined by the VHF crystal filter and setting the power band marker to the same bandwidth will give an erroneous result.
5. Determine the fourth lower adjacent channel power.
6. Check that the fourth adjacent channel power does not exceed –38 dBm. Record the results on the Data Sheet in Appendix A.

### **4.2.7 Wideband Noise**

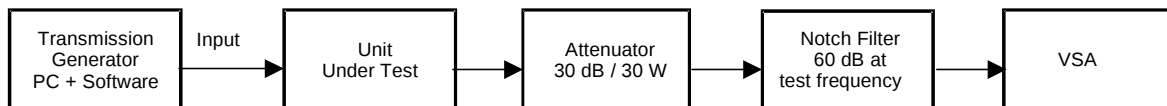
This test verifies that wideband emissions produced by the transmitter do not exceed specified values. The test consists of introducing a data stream for transmission to the transmitter and measuring emissions in adjacent channels. Any such emissions beyond the fourth adjacent channel should reduce at a specified rate (reference Appendix D [D.1.2.2.7] and MOPS [5.2.2.8]).

#### 4.2.7.1 Wideband Noise Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-10).

#### 4.2.7.2 Wideband Noise Test Procedures

1. Connect the equipment as shown in Figure 4-10. If avionics can be tuned, use a crystal filter in place of a notch filter.



*Figure 4-10. Wideband Noise Measurement*

2. Set analyzer span to 50 kHz and band power marker function to 25 kHz.
3. Use the filter to attenuate the carrier to increase the dynamic range of the measurement without overloading the spectrum analyzer. Measure the frequency response of the filter and take this into account when presenting noise measurement results.
4. Key the transmitter under test using the transmission generator with repetitive maximum length Mode 2 messages.
5. Adjust the spectrum analyzer reference level to provide the maximum dynamic range for display and set the input attenuator to minimum. Ensure that no signal at the analyzer input exceeds the maximum allowable level.
6. Record the transmitter noise level versus the frequency displacement using the power band marker function of the analyzer.
7. Check that the wide-band noise reduces at a minimum rate of 5 dB per octave from the fourth adjacent channel to a maximum value of -53 dBm. Record the result on the Data Sheet in Appendix A.

### 4.2.8 Frequency Tolerance

This test verifies that emissions produced by the transmitter are within a specified frequency tolerance. The test consists of introducing a data stream for transmission to the transmitter and measuring the frequency of the emissions (reference Appendix D [D.1.2.2.8] and MOPS [5.2.2.10]).

#### 4.2.8.1 Frequency Tolerance Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-8).

#### 4.2.8.2 Frequency Tolerance Test Procedures

1. Connect the equipment as shown in Figure 4-8.
2. Set the spectrum analyzer to capture the Mode 2 transmitted signal and ensure that no signal at the analyzer input exceeds the maximum allowable level.
3. Set the transmitter to a test frequency.
4. Key the transmitter under test using the transmission generator with repetitive maximum length Mode 2 messages.
5. Use the center function on the analyzer to ensure that the analyzer is correctly tuned to the captured signal. Turn on the frequency counter function and measure the frequency of the captured signal.
6. Check that the measured frequency is within  $\pm 5$  PPM of the transmitted frequency. For example, the tolerance for 136.925 MHz signal would be  $\pm 685$  Hz. Record the results on the Data Sheet in Appendix A.

#### 4.2.9 Ramp-Up Transients

This test provides a simple method to evaluate emissions for abrupt transitions at the time of ramp-up. Such transitions are undesirable and may cause interference to adjacent channels. The test consists of using a separate receiver to monitor the channel in use during data transmissions.

##### 4.2.9.1 Ramp-Up Transients Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-8).

##### 4.2.9.2 Ramp-up Transients Test Procedures

1. Connect the equipment as shown in Figure 4-8. In addition, set up a designated receiver with an audio output to monitor the transmissions.
2. Set the spectrum analyzer to capture the Mode 2 transmitted signal and ensure that no signal at the analyzer input exceeds the maximum allowable level.
3. Set the transmitter to a test frequency. Loosely couple the monitor receiver to the system.
4. Key the transmitter under test using the transmission generator with repetitive maximum length Mode 2 messages.
5. Listen to the monitor receiver for any signs of clicking type sounds at the beginning of the data transmissions by the avionics. If a discernable click is detected, investigate the ramp-up area of transmit waveform with the VSA.
6. Verify that no click is detected from the avionics transmit ramp-up. Record the results on the Data Sheet in Appendix A.

## 4.2.10 Channel Busy Detection/CSMA

The avionics should consider a channel busy when a signal greater than  $-87$  dBm is detected. The channel is clear with a signal of  $-92$  dBm or less. If the channel is sensed busy, then the CMU should not transmit. The test must be completed before TM2 expires (reference SARPs 6.4.3.2.1) and message is purged from radio. TM2 default is 60 seconds at system level.

### 4.2.10.1 Channel Busy Detection/CSMA Pretest Procedures

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Using a directional coupler, enable the signal generator to input into the avionics. Hook a waveform generator to the signal generator for the bursting tests.

#### 4.2.10.1.1 Channel Busy Detection Test Procedures

1. Put avionics into AOA communication (see Section 4.4.2).
2. Using the signal generator input, a constant Differential 8-Phase Shift Keying (D8PSK) signal into the avionics with a signal strength of  $-86$  dBm.
3. Manually initiate a user downlink message from the avionics.
4. Verify that the message is not transmitted.
5. Change the signal generator output to  $-95$  dBm.
6. Verify that the avionics now transmits the message.
7. Record the result on the Data Sheet in Appendix A.

#### 4.2.10.1.2 CSMA Test Procedures

1. Put avionics into AOA communication (see Section 4.4.2).
2. Using a signal generator and waveform generator, input D8PSK bursts to the avionics with a duty cycle of 50%.
3. Manually initiate a user downlink message from the avionics.
4. Verify that avionics should not transmit during a burst.
5. Using different burst duty cycles (10, 20, 30...90%) and repetition rates, check that the avionics do not transmit during a burst.
6. Record the result on the Data Sheet in Appendix A.

## 4.3 Physical Layer System Parameters

This section of testing consists of the tests listed in Table 4-3.

*Table 4-3. Physical Layer System Test Identification*

| <i>Test Name</i>                        | <i>Applicable Sections</i> |
|-----------------------------------------|----------------------------|
| Receiver to Transmitter Turnaround Time | 4.3.1                      |
| Transmitter to Receiver Turnaround Time | 4.3.2                      |

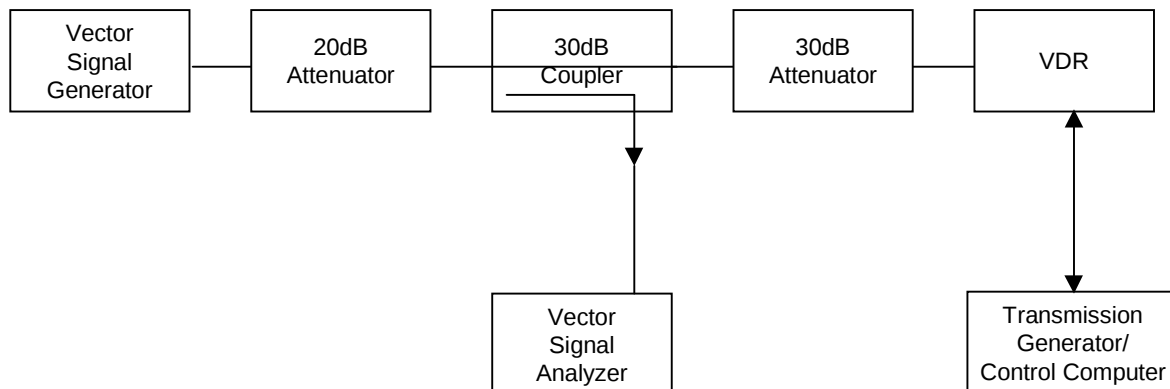
VSA, transmission generator PC with software, attenuators, and directional couplers are required equipment.

### 4.3.1 Receiver to Transmitter Turnaround Time

This test verifies that the VDR can begin the transmission of a message within a specified time after terminating the receive function. The test consists of introducing a data stream for transmission to the transmitter and terminating a signal impinging upon the receiver. The time required for the VDR to make the transition from receive to transmit is measured (reference Appendix D [D.1.2.3.1] and MOPS [5.2.3.1]).

#### 4.3.1.1 Receiver to Transmitter Turnaround Time Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-11).



*Figure 4-11. Receiver to Transmitter Turnaround Measurement*

#### 4.3.1.2 Receiver to Transmitter Turnaround Time Test Procedures

1. Connect the equipment as shown in Figure 4-11.
2. Configure the VSA to display power versus time.
3. Set the VHF signal generator to produce an on-channel CW signal of  $-50$  dBm at the input to the equipment under test.
4. Use the transmission generator to set the Media Access Control (MAC) parameters for the equipment under test:

TM1 (Inter-access delay) = 0.5 ms

TM2 (Channel busy) = 60 seconds

P (Persistence) = 1

M1 (Maximum no. of attempts) = 65,535

5. Use the transmission generator to load the equipment under test with a minimum length Mode 2 message and request transmission of the message by the equipment under test.
6. Turn off RF at signal generator.
7. Use the VSA capture buffer to confirm that the –20 dB signal attenuation “step” occurred in an insignificant time. Measure the time interval between the step and commencement of transmission, determined by the transmitter output achieving 90% of rated RF power.
8. After accounting for the minimum interaccess time (TM1) calculate the “turnaround” time. Check that the maximum receive-to-transmit turnaround time has not been exceeded. The transmission of the unique word portion of the training sequence should occur within 2.5 ms after termination of the receive function. Record the results on the Data Sheet in Appendix A.

### 4.3.2 Transmitter to Receiver Turnaround Time

This test verifies that the VDR can begin receiving and demodulating an incoming message within a specified time after transmitting the final information symbol. The test consists of introducing a data stream for transmission to the VDR transmitter and starting a delayed transmission from another source to be received by the VDR. The time required for the VDR to make the transition from transmit to receive is measured (reference Appendix D [D.1.2.3.2] and MOPS [5.2.3.2]).

#### 4.3.2.1 Transmitter to Receiver Turnaround Time Test Pretest Procedures

There are no special pretest procedures other than performing outlined pretest setup procedures listed in Section 3 (reference Figure 4-12).

#### 4.3.2.2 Transmitter to Receiver Turnaround Time Test Procedures

1. Connect the equipment as shown in Figure 4-12.

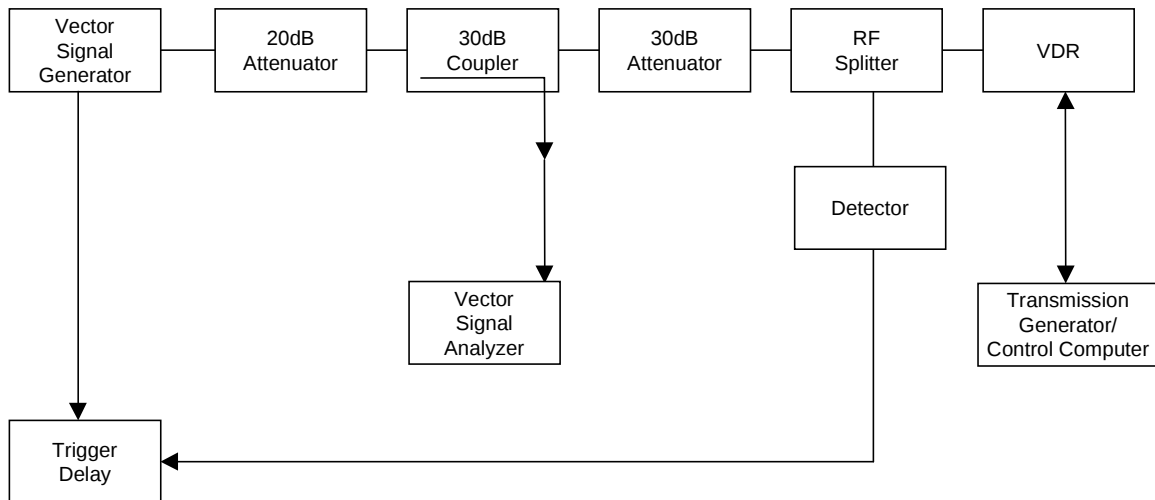


Figure 4-12. Transmitter to Receiver Turnaround Time Measurement

2. Configure the VSA to display power versus time, external trigger enabled.
3. Set the signal generator to provide a signal of  $-60$  dBm at the input of the equipment under test.
4. Load the Arbitrary Waveform Generator (AWG) with a valid Mode 2 message.
5. Use the transmission generator to set the MAC parameters for the equipment under test:

TM1 (Inter-access delay) = 0.5 ms  
 TM2 (Channel busy) = 60 seconds  
 P (Persistence) = 1  
 M1 (Maximum no. of attempts) = 65,535

6. Load a minimum length Mode 2 message into the equipment under test. Request transmission of this message and trigger the VSA.
7. Record the time interval between the trigger event and the cessation of transmission from the unit under test. Use the result to calculate the minimum time between the transmit request and the trigger event for the AWG.
8. Load the equipment under test with a minimum length Mode 2 message and request transmission.

9. Check whether the equipment under test had successfully received the transmission from the AWG.
10. If the AWG transmission was not correctly received, increase the AWG time delay and repeat Step 7 until the equipment under test has successfully received the minimum length messages from the AWG.
11. Check that the maximum transmit-to-receive turnaround time has not been exceeded. The receipt of the unique message should occur within 1.5 ms after transmitting the final information symbol. Record the results on the Data Sheet in Appendix A.

## 4.4 ACARS Over AVLIC Test

This section of testing consists of the tests listed in Table 4-4.

*Table 4-4. AOA Test Identification*

| <b>Test Name</b>                                            | <b>Applicable Sections</b> |
|-------------------------------------------------------------|----------------------------|
| Plain Old ACARS Phase 3                                     | 4.4.1                      |
| Basic Link Establishment                                    | 4.4.2                      |
| Intramedia Switch and Debounce Timer                        | 4.4.3                      |
| Voice/Data Mode                                             | 4.4.4                      |
| Handoff Sequence                                            | 4.4.5                      |
| Multimedia                                                  | 4.4.6                      |
| T4 Maximum Delay Between Transmissions Timer                | 4.4.7                      |
| VAT4 Message Assembly Timer                                 | 4.4.8                      |
| VAT8 UBI Reset Timer                                        | 4.4.9                      |
| VAC1 Counter and VAT7 Timer                                 | 4.4.10                     |
| Autotune                                                    | 4.4.11                     |
| NOCOMM Timer VAT6                                           | 4.4.12                     |
| Criss-Cross Uplink Acknowledgment                           | 4.4.13                     |
| Message Success                                             | 4.4.14                     |
| 622/623 ATS Messages                                        | 4.4.15                     |
| International Civil Aviation Organization (ICAO) Addressing | 4.4.16                     |
| AVLC Link Management                                        | 4.4.17                     |
| AVLC Frame Management                                       | 4.4.18                     |

### Equipment Required

AGTS

See Figure 3-1.

#### 4.4.1 Plain Old ACARS Phase 3

Before testing the ACARS Over AVLC (AOA) portion of the avionics configuration a Plain Old ACARS Phase 3 test must be completed. Reference: *ACARS Avionics Qualification Policy, Phase III Test Plan and Procedures*, ARINC Document Number 13136 and Appendix E. Record the results on the Data Sheet in Appendix A.

Plain Old ACARS Phase 3 test will verify proper protocol, autotune, channel busy detection, prekey, message formats, and sensitivity needed for Minimum Shift Keying (MSK) modulated ACARS.

#### 4.4.2 Basic Link Establishment

This test verifies that the avionics implements AOA basic link establishment correctly. This test consists of observing uplink and downlink messages (reference ARINC Specification 618, 11.5.1). This state is the baseline for many other tests.

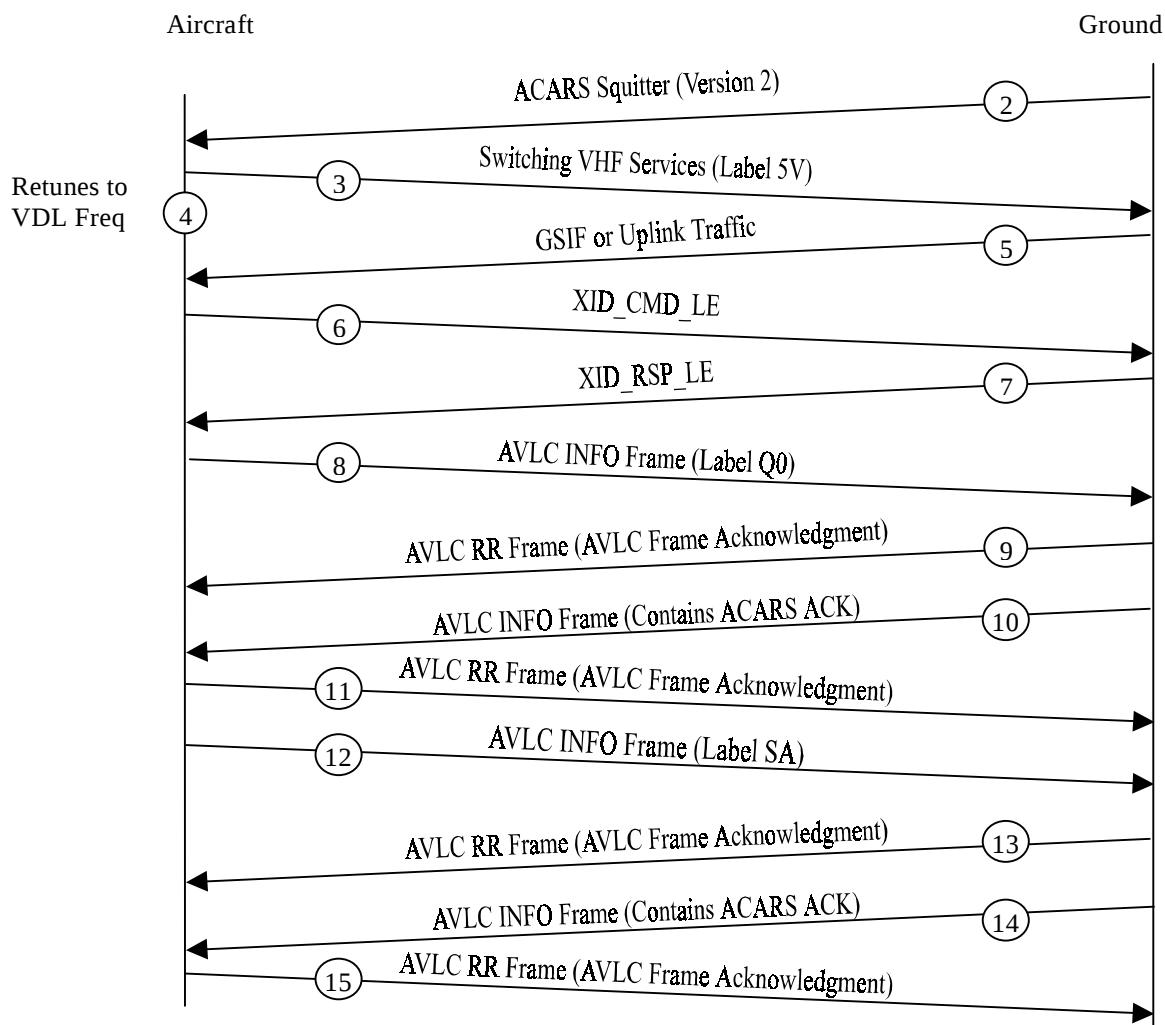


Figure 4-13. Basic Link Establishment

#### 4.4.2.1 Basic Link Establishment Pretest Procedures

Connect the avionics in a standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities are enabled.

#### 4.4.2.2 Basic Link Establishment Test Procedures

1. Put avionics in communication on ACARS.
2. Generate and uplink a version 2 squitter to avionics containing the Common Signaling Channel (CSC) frequency.
3. Verify that the avionics transmits a VDL Switch Advisory label 5V ACARS downlink.
4. Verify that avionics tune to the CSC frequency.

5. Generate a Ground Station Identification Frame (GSIF).
6. Verify that avionics receive the GSIF and transmits an XID\_CMD\_LE.
7. Verify that ground transmits an XID\_RSP\_LE.
8. Verify that avionics transmits an Aviation VHF Link Control (AVLC) frame containing an ACARS block (Q0 label link test or any other pending ACARS downlink except media advisory).
9. Verify that ground transmits an AVLC acknowledgment frame to avionics (Receive Ready [RR] or other types, see Specification 631).
10. Verify that ground transmits an AVLC INFO frame containing the ACARS message block acknowledgment.
11. Verify that avionics transmits an AVLC acknowledgment frame to avionics (RR or other types, see Specification 631).
12. Verify that avionics transmits an AVLC INFO frame containing an ACARS label SA media advisory block.
13. Verify that ground transmits an AVLC acknowledgment frame to avionics (RR or other types, see Specification 631).
14. Verify that ground transmits an AVLC INFO frame containing the ACARS message block acknowledgment.
15. Verify that avionics transmits an AVLC acknowledgment frame to avionics (RR or other types, see Specification 631).
16. Record correct link establishment test results on the Data Sheet in Appendix A.

### 4.4.3 Intramedia Switch and Debounce Timers Test

This test verifies the implementation of media switching between ACARS and AOA (reference ARINC Specification 618, 11.4).

#### 4.4.3.1 Intramedia Switch and Debounce Timers Pretest Procedures

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities are enabled.

##### 4.4.3.1.1 Intramedia Switch and Debounce Timers Procedures Scenario 1

1. Put avionics in communication on ACARS.
2. Put avionics into AOA communication (see Section 4.4.1) (Intramedia Switch Timer [IST] starts).
3. Break transmitter of ground station (functional equivalent).

4. Initiate a user downlink such that the avionics become NOCOMM on AOA before the IST expires (VAT12 = 600s).
5. Verify that avionics falls back to previous ACARS base frequency and establishes communication (avionics should send a Q0 automatically, debounce timer starts).
6. Continue sending squitters indicating AOA to avionics on regular ACARS.
7. Avionics should not try to establish AOA communication until debounce timer expires (VAT13 = 300s).
8. Record the result on the Data Sheet in Appendix A.

#### **4.4.3.1.2 Intramedia Switch and Debounce Timers Procedures Scenario 2**

1. Put avionics in communication on ACARS.
2. Put avionics into AOA communication (see Section 4.4.1) (IST starts).
3. Break transmitter of ground station (functional equivalent).
4. Initiate a user downlink such that the avionics become NOCOMM on AOA after the IST expires (VAT12 = 600s).
5. Verify that avionics falls back to previous base ACARS frequency and establishes communication (avionics should wait and listen for traffic before assuming permission to send).
6. Restore transmitter of AOA ground station.
7. Continue sending squitters indicating AOA to avionics on regular ACARS.
8. Avionics should not try to establish AOA communication until debounce timer expires (VAT13 = 300s).
9. Record the result on the Data Sheet in Appendix A.

#### **4.4.3.1.3 Intramedia Switch and Debounce Timers Procedures Scenario 3**

1. Put avionics in communication on ACARS.
2. Autotune avionics to an alternate ACARS frequency.
3. Put avionics into AOA communication (see Section 4.4.1) (Intramedia Switch Timer [IST] starts).
4. Break transmitter of ground station (functional equivalent).
5. Initiate a user downlink such that the avionics becomes NOCOMM on AOA before the IST expires (VAT12 = 600s).

6. Verify that avionics falls back to previous ACARS frequency (autotune/alternate frequency) and establishes communication (avionics should send a Q0 automatically, debounce timer starts).
7. Continue sending squitters indicating AOA to avionics on regular ACARS.
8. Avionics should not try to establish AOA communication until debounce timer expires (VAT13 = 300s).
9. Record the result on the Data Sheet in Appendix A.

#### **4.4.3.1.4 Intramedia Switch and Debounce Timers Test Procedure Scenario 4**

1. Put avionics in communication on ACARS.
2. Autotune avionics to an alternate ACARS frequency.
3. Put avionics into AOA communication (see Section 4.4.1) (IST starts).
4. Break transmitter of ground station (functional equivalent).
5. Initiate a user downlink such that the avionics becomes NOCOMM on AOA after the IST expires (VAT12 = 600s).
6. Verify that avionics falls back to base ACARS frequency and establishes communication (avionics should wait and listen for traffic before assuming permission to send).
7. Restore transmitter of AOA ground station.
8. Continue sending squitters indicating AOA to avionics on regular ACARS.
9. Avionics should not try to establish AOA communication until debounce timer expires (VAT13 = 300s).
10. Record the result on the Data Sheet in Appendix A.

### **4.4.4 Voice/Data Mode Test**

This test verifies the correct transition from data mode to voice mode and also voice mode back to data mode (reference ARINC Specification 618, 11.6.4, VAT9 Voice Mode Timer 600 s).

#### **4.4.4.1 Voice/Data Mode Pretest Procedures**

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities are enabled.

##### **4.4.4.1.1 Voice/Data Mode Procedures Scenario 1**

1. Put avionics in communication on ACARS.
2. Put avionics into AOA communication (see Section 4.4.2).
3. Put avionics into voice mode (5P).

4. After three minutes, put avionics back into data mode (Q6).
5. Initiate a user downlink message.
6. Verify that the avionics sends the downlink user message on the previous data frequency.
7. Record the result on the Data Sheet in Appendix A.

#### **4.4.4.1.2 Voice/Data Mode Procedures Scenario 2**

1. Put avionics in communication on ACARS.
2. Put avionics into AOA communication (see Section 4.4.2).
3. Put avionics into voice mode (5P).
4. After 15 minutes, put avionics back into data mode.
5. Initiate a user downlink message.
6. Continue sending GSIFs.
7. Verify that the avionics sends the downlink user message on the previous data frequency only after sending an XID\_CMD\_LE and receiving an XID\_RSP\_LE (the avionics has to listen for uplink traffic first).
8. Record the results on the Data Sheet in Appendix A.

### **4.4.5 Handoff Sequence**

This test verifies that the avionics implements AOA handoff sequences correctly (reference ARINC Specification 631, 4.3). The avionics initiates a handoff for the following four main reasons:

1. The VHF SQP on the current link is poor and the SQP of another station is significantly better.
2. Counter N2 (max # of transmissions) is exceeded on any frame sent to the current ground station.
3. Timer TM2 (channel busy) expires for the current link.
4. TG2 expires (max idle time).

#### **4.4.5.1 Handoff Sequence Pretest Procedures**

Avionics have an RF link to both Plain Old ACARS and two AOA radios. Ground station controller and complete message monitoring capabilities are enabled.

**4.4.5.1.1 Handoff Sequence Procedures Scenario 1**

↓ XID\_CMD\_HO

↑ XID\_RSP\_HO

↓ Start downlinking to new ground station

1. Put avionics in AOA communication state with Radio # 1 (see Section 4.4.2).
2. Using attenuators, ramp Radio #1 down and Radio #2 up until Radio #2 is 60 dB greater signal strength than Radio #1. Send uplink messages from both radios to other addresses over time to show signal changes.
3. Send identical GSIFs except for the source address from each radio.
4. Verify that avionics initiates/completes a handoff to Radio # 2.
5. Initiate a user downlink to verify connection to Radio # 2.
6. Record the result on the Data Sheet in Appendix A.

**Variations**

- A. GSIF for Radio # 2 has a different system mask—avionics will not handoff (if system mask is acceptable, the aircraft may disconnect from #1 and reestablish link on #2).
- B. When avionics attempts a handoff to Radio #2, it is rejected with an XID\_RSP\_LCR (or not answered)—the current link should not be affected.
- C. GSIF for Radio # 2 has a different system mask, avionics attempts to reestablish link to Radio # 2 and is not answered—the current link should not be affected.
- D. After handoff, test TG5 by sending an uplink from Radio # 1. The ACK from the avionics should go to Radio # 1 (two links exist during handoff and if an uplink from the old station is received, it should ACK on the old station).

**4.4.5.1.2 Handoff Sequence Procedures Scenario 2**

1. Put avionics in AOA communication state with Radio # 1 (see Section 4.4.2).
2. Send good GSIFs from Radio # 2 with a good source address with the same signal strength.
3. Disable the transmitter on ground station Radio # 1.
4. Initiate a user downlink message to Radio #1 from the avionics.
5. Verify that avionics retransmits a message at an interval of the T1 (2-28s) counter N2 times.
6. Counter N2 reached limit (6).

7. Avionics should attempt handoff to Radio #2. (After avionics hands off the CMU, the VDR will use VAC1 and VAT7 to retransmit the message).
8. Record the result on the Data Sheet in Appendix A.

#### Variations

- A. GSIF for Radio # 2 has a different system mask—avionics will not handoff (if the system mask is acceptable, the aircraft may disconnect from #1 and reestablish link on #2).

#### 4.4.5.1.3 Handoff Sequence Procedures Scenario 3

1. Put avionics in AOA communication state with Radio # 1 (see Section 4.4.2).
2. Use a signal generator to input constant traffic into the avionics until TM2 expires.
3. Avionics should tune to the alternate frequency provided in the frequency support list, if already on CSC stay. (ARINC Specification 618, AOA does not provide alternate frequency in GSIF.)
4. Record the result on the Data Sheet in Appendix A.

#### 4.4.5.1.4 Handoff Sequence Procedures Scenario 4

If the CMU has knowledge of frequencies broadcast by the ground via uplink XIDs, and if the CMU goes NOCOMM, the CMU *may* try the CSC and these frequencies. TG1—the maximum frequency dwell time of 240s—may cause significant delays. (ARINC Specification 618, AOA does not provide alternate frequencies.)

#### 4.4.5.1.5 Handoff Sequence Procedures Scenario 5

The current ground link becomes NOCOMM; avionics refers to PECT for handoff.

1. Put avionics in AOA communication state with Radio # 1 (see Section 4.4.2).
2. Send identical GSIFs from four different source addresses. Radio # 1 is the highest signal strength at –30 dBm with the three other GSIFs lower in power in 20 dB increments (#2 –50 dBm, #3 –70 dBm, #4 –90 dBm).
3. Radio # 1 ground station disconnects.
4. Verify that avionics attempts a handoff to the next ground station with the highest signal strength—#2. Observe the retransmission interval of XID\_CMD\_HO (T3 = 6-15s). Stop sending GSIFs from each station after avionics attempts a handoff to it.
5. Verify that avionics attempts a handoff to the next ground station with the highest signal strength—#3.
6. Verify that avionics attempts a handoff to the next ground station with the highest signal strength—#4.
7. Record the result on the Data Sheet in Appendix A.

#### **4.4.5.1.6 Handoff Sequence Procedures Scenario 6**

TG2 expires (max idle).

1. Put avionics in AOA communication state with Radio # 1 (see Section 4.4.2).
2. Send good GSIFs from Radio # 2 with a good source address with the same signal strength.
3. Disable the transmitter on the ground station Radio # 1. Continue sending GSIFs from Radio #2.
4. TG2 expires for Radio #1. Verify that avionics handoffs to Radio #2.
5. Record the result on the Data Sheet in Appendix A.

### **4.4.6 Multimedia**

This test verifies that the avionics will handle communication simultaneously on AOA/ACARS, SATCOM, and HF.

#### **4.4.6.1 Multimedia Pretest Procedures**

Avionics have an RF link to both Plain Old ACARS and two AOA radios. Ground station controller and complete message monitoring capabilities are enabled.

##### **4.4.6.1.1 Multimedia Test Procedures Scenario 1**

1. Put avionics in AOA communication state (see Section 4.4.2).
2. Execute ARINC multimedia emulation software for HF and SATCOM.
3. Establish communication on SATCOM and HF.
4. Send several uplink messages on each medium (AOA, SATCOM, and HF).
5. Verify that the CMU responds to each unsolicited uplink with a downlink response via the medium over which the uplink was received.
6. Initiate a downlink user message from the avionics.
7. Verify that the downlink message is routed over the preferred media even if all the media are in communication.
8. Validate maintenance of separate Uplink Block Identifier (UBI)/Downlink Block Identifier (DBI) counts for each medium.
9. Record the result on the Data Sheet in Appendix A.

##### **4.4.6.1.2 Multimedia Test Procedures Scenario 2—Multiblock Downlink Handling**

Validate the avionics ability to handle interrupted multiblock downlink messages. Verify that the avionics will restart a multiblock downlink message when changing communications media.

1. Establish communication on all three media (AOA, SATCOM, and HF).
2. Initiate a multiblock downlink. Verify that downlink is routed via AOA link.
3. ACK only the first block of the downlink. Allow the avionics to go NOCOMM.
4. Verify that the avionics resumes communications via an alternate media and restarts the downlink message from the beginning (AOA may drop to ACARS and try before sending on HF/SATCOM).
5. Verify that the CMU maintains the original Message Sequence Number (MSN) for the multiblock that was retransmitted.
6. Record the result on the Data Sheet in Appendix A.

#### **4.4.6.1.3 Multimedia Test Procedures Scenario 3—Transitions Between Media**

Validate that the avionics transitions properly between media.

1. Establish communication on all three media.
2. For each medium, force avionics to lose communication and reestablish communication. Force an establish and lose Media Advisory (SA) label message for each medium.

#### **4.4.7 T4 Maximum Delay Between Transmissions Timer**

This test verifies the T4 delay between transmissions timer. Timer T4 is used to verify the continued existence of the link (reference SARPs 6.5.3.4.4).

##### **4.4.7.1 T4 Maximum Delay Between Transmissions Timer Pretest Procedures**

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities and the ground station controller are enabled.

#### 4.4.7.2 T4 Maximum Delay Between Transmissions Timer Test Procedures

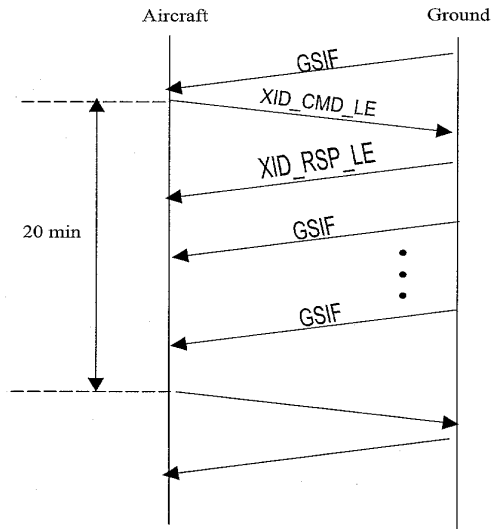


Figure 4-14. T4 Maximum Delay Between Transmissions Timer

1. Put avionics into AOA communication (see Section 4.4.2).
2. Timer T4 is restarted when last downlink is sent.
3. Continue sending GSIFs from the ground station.
4. Verify that after 20 minutes the avionics send a downlink requiring an acknowledgment (RR w/poll = 1).
5. Record the results on the Data Sheet in Appendix A.

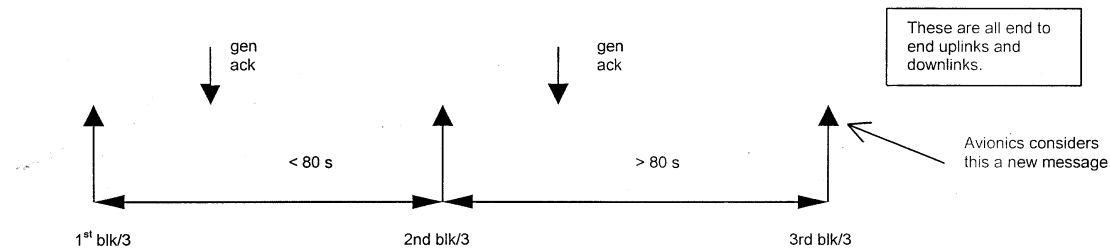
#### 4.4.8 VAT4 Message Assembly Timer

This test verifies the VAT4 message assembly timer. Timer VAT4 is used to detect when a multiblock uplink is incomplete, regardless of whether one uplink or two uplink messages are outstanding (reference ARINC Specification 618, 3.6.4.1 and 5.4.2.4).

##### 4.4.8.1 VAT4 Message Assembly Timer Pretest Procedures

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities and the ground station controller are enabled.

#### 4.4.8.1.1 VAT4 Message Assembly Timer Test Procedures Scenario 1



*Figure 4-15. VAT4 Message Assembly Timer Test—Scenario 1*

1. Put avionics into AOA communication (see Section 4.4.2).
2. Set the monitor to display only end-to-end messages.
3. Uplink first block of message to the avionics.
4. Verify avionics ACKs message.
5. Before the 80 s timer expires, uplink second block of message to the avionics.
6. Verify avionics ACKs message.
7. After the 80 s timer expires, uplink third block of message to the avionics.
8. Verify that avionics considers block 1 and 2 an incomplete message and block 3 a new message.
9. Record the result on the Data Sheet in Appendix A.

#### 4.4.8.1.2 VAT4 Message Assembly Timer Test Procedures Scenario 2

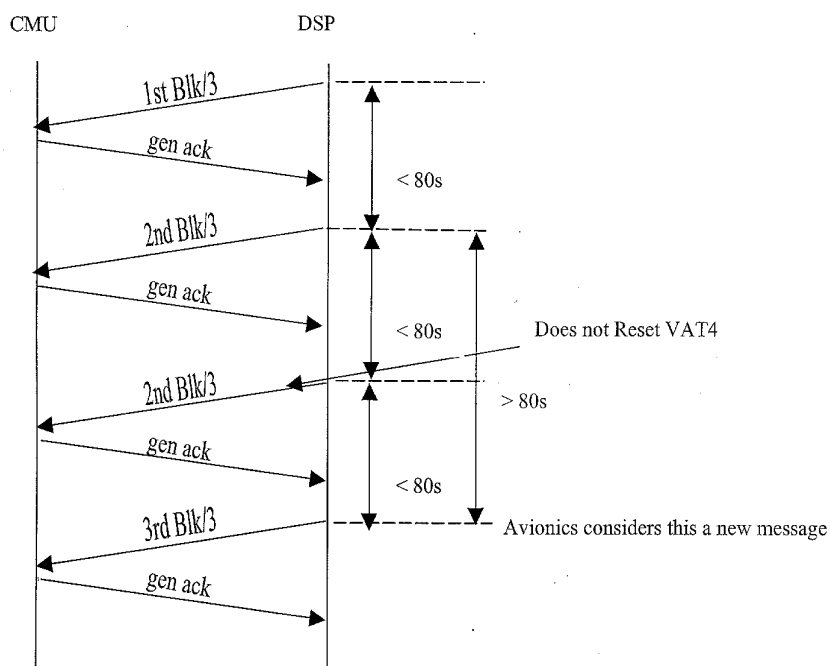


Figure 4-16. VAT4 Message Assembly Timer Test—Scenario 2

1. Put avionics into AOA communication (see Section 4.4.2).
2. Set the monitor to display only end-to-end messages.
3. Uplink first block of message to the avionics.
4. Verify avionics ACKs message.
5. Before the 80 s timer expires, uplink second block of message to the avionics.
6. Verify avionics ACKs message.
7. Before the 80 s timer expires, retransmit the second block of message to the avionics (this should not reset the VAT4 timer).
8. Verify avionics ACKs message.
9. After the 80 s timer expires, uplink third block of message to the avionics.
10. Verify that avionics considers block 1 and 2 an incomplete message and block 3 a new message.
11. Record the result on the Data Sheet in Appendix A.

#### 4.4.8.1.3 VAT4 Message Assembly Timer Test Procedures Scenario 3

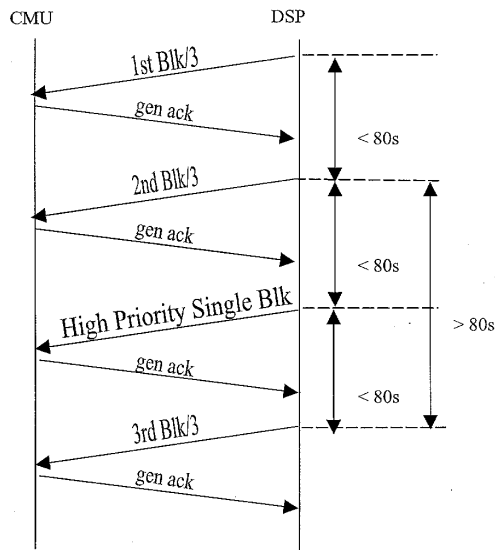


Figure 4-17. VAT4 Message Assembly Timer Test—Scenario 3

1. Put avionics into AOA communication (see Section 4.4.2).
2. Set the monitor to display only end-to-end messages.
3. Uplink first block of message to the avionics.
4. Verify avionics ACKs message.
5. Before the 80 s timer expires, uplink second block of message to the avionics.
6. Verify avionics ACKs message.
7. Before the 80 s timer expires, uplink a higher priority single block message to the avionics (this should reset the VAT4 timer).
8. Verify avionics ACKs message.
9. Wait 80 s after uplinking the second block of the multiblock, then uplink third block of message to the avionics.
10. Verify that avionics considers blocks 1 ,2, and 3 a complete message.
11. Record the result on the Data Sheet in Appendix A.

### 4.4.9 VAT8 UBI Reset Timer

This test verifies the VAT8 UBI reset timer. Timer VAT8 is used to detect duplicate uplink messages (reference ARINC Specification 618, 3.5.1 and 5.4.2.8).

#### 4.4.9.1 VAT8 UBI Reset Timer Pretest Procedures

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities and the ground station controller are enabled.

#### 4.4.9.2 VAT8 UBI Reset Timer Test Procedures

1. Put avionics into AOA communication (see Section 4.4.2).
2. Set the monitor to display only end-to-end messages.
3. Uplink user message to the avionics.
4. Verify that avionics ACKs message and that avionics properly receives message as new.
5. Before the 600 s timer expires, retransmit message several times to avionics.
6. Verify avionics ACKs messages. Avionics treats messages as duplicates (does not display or act on them).
7. After the 600 s timer expires, retransmit message to avionics.
8. Verify avionics ACKs messages. Avionics considers last uplink a new message and displays as new.
9. Record the result on the Data Sheet in Appendix A.

### 4.4.10 VAC1 Counter and VAT7 Timer

This test verifies VAC1 transmission counter (2) and the VAT7 (45 s) no ACK timer (reference ARINC Specification 618, 5.4.4 and 5.4.2.7).

#### 4.4.10.1 VAC1 Counter and VAT7 Timer Pretest Procedures

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities and the ground station controller are enabled.

#### **4.4.10.2 VAC1 Counter and VAT7 Timer Test Procedures**

1. Put avionics into AOA communication (see Section 4.4.2).
2. Initiate an avionics audit on the cockpit printer.
3. Disable the end-to-end ACK capability. Break the ACKs coming from the host computer.
4. Initiate a user downlink message.
5. Verify that on the printer audit avionics sends message VAC1 (2) times at an interval of VAT7 (45 s).
6. Record the result on the Data Sheet in Appendix A.

#### **4.4.11 Autotune**

When the VAT6 timer expires, any multiblock message in progress should be retransmitted beginning with the first block (reference ARINC Specification 618, 11.5 and 620 4.2.6, 4.2.8).

##### **4.4.11.1 Autotune Pretest Procedures**

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities and the ground station controller are enabled.

##### **4.4.11.1.1 POA to AOA Autotune Test Procedures**

1. Put avionics into POA communication.
2. Uplink an autotune message label ;; to the avionics.
3. Verify that the avionics ACKs the autotune on the original frequency.
4. Verify that the avionics initiated a link on the proper frequency without a Media Advisory.
5. Record the result on the Data Sheet in Appendix A.

##### **Variations**

- A. When avionics is autotuned the debounce timer VAT13 is ignored.
- B. Nested autotunes work properly.
- C. Test ICAO address field in autotune.

**4.4.11.1.2 AOA to POA Autotune Test Procedures**

1. Put avionics into AOA communication (see Section 4.4.2).
2. Uplink an autotune message label ;; to the avionics.
3. Verify that the avionics ACKs the autotune on the original frequency.
4. Verify that the avionics initiated a link on the proper frequency without a Media Advisory.
5. Record the result on the Data Sheet in Appendix A.

**Variations**

- A. Nested autotunes work properly.

**4.4.12 NOCOMM Timer VAT6**

When the VAT6 timer expires any multiblock message in progress should be retransmitted beginning with the first block (reference ARINC Specification 618, 3.6.3 and 5.4.2.6).

**4.4.12.1 NOCOMM Timer VAT6 Pretest Procedures**

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities and the ground station controller are enabled.

**4.4.12.1.1 NOCOMM Timer VAT6 Test Procedures Scenario 1**

1. Put avionics into AOA communication (see Section 4.4.2).
2. Initiate a multiblock downlink user message from the avionics.
3. End-to-end ACK the first block of the downlink.
4. By putting avionics into voice mode, force the avionics to delay complete delivery of the downlink message.
5. Return avionics to AOA COMM state such that VAT6 does not expire ( $< 600$  s). AOA link will be preserved if NOCOMM is less than 240 s (TG2).
6. Avionics should continue sending multiblock downlink.
7. Record the result on the Data Sheet in Appendix A.

#### 4.4.12.1.2 NOCOMM Timer VAT6 Test Procedures Scenario 2

1. Put avionics into AOA communication (see Section 4.4.2).
2. Initiate a multiblock downlink user message from the avionics.
3. End-to-end ACK the first block of the downlink.
4. By putting avionics into voice mode, force the avionics to delay complete delivery of the downlink message.
5. Return avionics to AOA COMM state such that VAT6 expires ( $> 600$  s).
6. Avionics should restart sending the multiblock downlink.
7. Record the result on the Data Sheet in Appendix A.

#### 4.4.13 Criss-Cross Uplink Acknowledgment

This test verifies that the CMU minimizes its use of the RF spectrum and queuing delays of messages by acknowledging uplinks properly (reference ARINC Specification 618, 11.3.3).

##### 4.4.13.1 Criss-Cross Uplink Acknowledgment Pretest Procedures

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA. Complete message monitoring capabilities and the ground station controller are enabled.

##### 4.4.13.1.1 Criss-Cross Uplink Acknowledgment Test Procedures Scenario 1

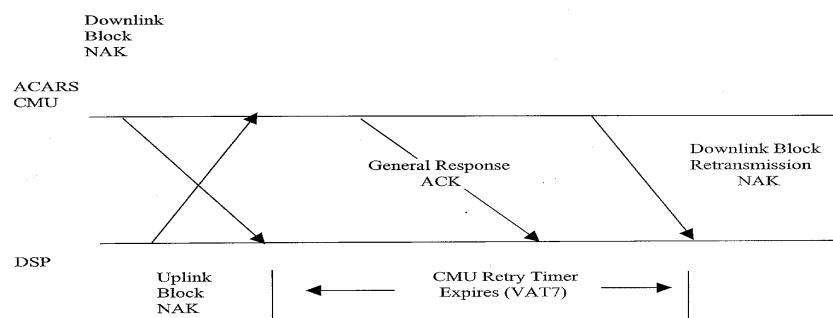


Figure 4-18. Criss-Cross Uplink Acknowledgment Test Procedures Scenario 1

1. Put avionics into AOA communication (see Section 4.4.2).
2. Send a user downlink message from the avionics.
3. Immediately after the downlink is transmitted, send an uninitiated user uplink message with the ground station controller.
4. Block the end-to-end uplink ACK from the host computer emulator.
5. Verify that avionics ACKs the uplink.
6. Verify that the downlink is retransmitted when VAT7 (45s) expires.
7. Record the result on the Data Sheet in Appendix A.

#### 4.4.13.1.2 Criss-Cross Uplink Acknowledgment Test Procedures Scenario 2

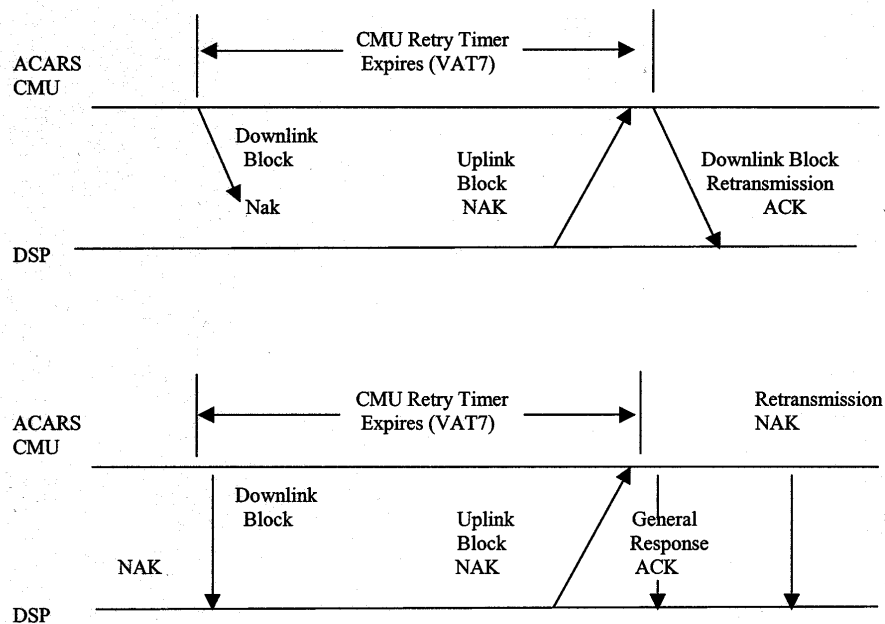


Figure 4-19. Criss-Cross Uplink Acknowledgment Test Procedures Scenario 2

1. Put avionics into AOA communication (see Section 4.4.2).
2. Send a user downlink message from the avionics.
3. Block the end-to-end uplink ACK from the host computer emulator.
4. Uplink a user message immediately prior to the expiration of VAT7.
5. Verify that the CMU uses the retransmitted block or a general response downlink to deliver the ACK.

6. Record the result on the Data Sheet in Appendix A.

#### **4.4.14 Message Success**

Uplink success test measures the ability of a paired CMU and VDR to perform these functions: successfully receive, process, and respond to addressed uplink messages, over the full operation range of received signal levels. This is both a BER and burn-in test for the entire avionics configuration.

The test is conducted by sending an uplink message from the ground station through a calibrated bank of RF attenuators to the avionics transceiver.

##### **4.4.14.1 Message Success Pretest Procedures**

Place programmable attenuators in line with the RF path for message success. Ground station controller will also operate the programmable attenuators.

##### **4.4.14.2 Message Success Test Procedures**

1. Put avionics into AOA communication (see Section 4.4.2).
2. A different user uplink message is generated every two seconds and sent to the avionics.
3. If the message is successfully received by the avionics, it sends acknowledgments. The message is successful only if the ground station receives both the data link and end-to-end acknowledgments.
4. Send 100 uplinks at each power level from -20 dBm to -120 dBm at 5 dB increments while keeping the avionics in communication.
5. The ground station program keeps a record of the number of uplinks sent and acknowledgments received.
6. Record the result on the Data Sheet in Appendix A.

#### **4.4.15 622/623 ATS Messages**

This test verifies that the CMU properly implements ATS messages (reference ARINC Specification 622 and ARINC Specification 623).

##### **4.4.15.1 622/623 Pretest Procedures**

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA.

#### 4.4.15.2 622/623 Test Procedures

1. Verify the following:
  - Avionics check uplink CRC
  - Four spaces for CRC (DOS)
  - Multiblock
  - No CR/LF in uplink (DOS)
  - Downlink CRC (remember readbacks)
  - Multiblock
2. Check supplemental address; when typing in information, you can corrupt the address by typing in too few characters, wrong number of characters, no init data, etc.
3. Is the readback supplemental address the same as the uplink or is it hardcoded?
4. Check all IMIs using Specification 622 (remember to check readbacks too).
5. Check message forms very thoroughly using Specification 623; look at notes for fields in specifications (print out large batch of messages and then check).
6. Try to mess up downlink form by typing in bad data as follows:
 

|    |     |      |       |          |
|----|-----|------|-------|----------|
| B1 | CRC | FORM | SUPP  | 4-7 SUPP |
| B2 | CRC | FORM | SUPP  | CRCMB    |
| B3 | CRC | FORM | SUPP  | 4-7 SUPP |
| B4 | CRC | FORM | SUPP  | CRCMB    |
| B5 | CRC | FORM | SUPP  | 4-7 SUPP |
| B9 | CRC | FORM | SUPP  | 4-7 SUPP |
| BB | CRC | FORM | SUPP  | 4-7 SUPP |
|    |     |      |       |          |
| A1 | CRC | FORM | CRCMB |          |
| A3 | CRC | FORM | CRCMB |          |
| A4 | CRC | FORM | CRCMB |          |
| A9 | CRC | FORM | CRCMB |          |
| AB | CRC | FORM | CRCMB |          |
7. Record the result on the Data Sheet in Appendix A.

## **4.4.16 ICAO Addressing**

### **4.4.16.1 ICAO Addressing Pretest Procedures**

Connect the avionics in standard configuration. Avionics have an RF link to both Plain Old ACARS and AOA.

### **4.4.16.2 ICAO Addressing Test Procedures**

1. Put avionics into AOA communication (see Section 4.4.2).
2. Manually initiate a user downlink message from the avionics.
3. Verify that the ICAO number of the avionics matches the ICAO number at the BEP terminal.
4. Record the result on the Data Sheet in Appendix A.

## **4.4.17 AVLC Link Management**

Deferred

## **4.4.18 AVLC Frame Management**

Deferred

# A DATA SHEET

| <i>Description</i>                           | <i>Requirement</i>                                                                                                                                                                                                                                                                   | <i>Pass</i> | <i>Fail</i> |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| <b>Receiver Tests – Section 4.1</b>          |                                                                                                                                                                                                                                                                                      |             |             |
| Avionics Frequency _____                     |                                                                                                                                                                                                                                                                                      |             |             |
| Sensitivity<br>Section 4.1.1                 | Uncorrected BER of the demodulated data at receiver outputs should be equal to, or better than, $10^{-3}$ . Result _____.                                                                                                                                                            |             |             |
| Adjacent Channel Rejection<br>Section 4.1.2  | The difference between the desired signal and interfering signal should be at least 44 dB, 50 dB, and 60dB. Result A_____, B_____, C_____.                                                                                                                                           |             |             |
| Rejection in Aero band<br>Section 4.1.3      | The uncorrected BER with the desired and the interfering in band signals applied should be equal to, or better than, $10^{-3}$ .<br>Interference Frequency A _____ Result _____.<br>Interference Frequency B _____ Result _____.<br>Interference Frequency C _____ Result _____.     |             |             |
| Rejection outside Aero Band<br>Section 4.1.4 | The uncorrected BER with the desired and the interfering out of band signals applied should be equal to, or better than, $10^{-3}$ .<br>Interference Frequency A _____ Result _____.<br>Interference Frequency B _____ Result _____.<br>Interference Frequency C _____ Result _____. |             |             |
| Dynamic Range<br>Section 4.1.5               | The uncorrected BER should be equal to, or better than, $10^{-3}$ when the reference signal level is increased to $-7$ dBm. Result _____.                                                                                                                                            |             |             |
| Minimum Message Length<br>Section 4.1.6      | The uncorrected BER should be equal to, or better than, $10^{-3}$ over the entire message length. Result _____.                                                                                                                                                                      |             |             |
| Frequency Capture Range<br>Section 4.1.7     | The uncorrected BER should be equal to, or better than, $10^{-3}$ when the frequency of the reference signal is offset by $\pm 967$ Hz. Result A_____, B_____.                                                                                                                       |             |             |
| In-band Intermodulation<br>Section 4.1.8     | The BER of $10^{-3}$ is achieved for all cases. Correct results are obtained when the IP3 is at least 0 dBm. Result _____.                                                                                                                                                           |             |             |

| <i>Description</i>                       | <i>Requirement</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <i>Pass</i> | <i>Fail</i> |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| Co-channel Interference<br>Section 4.1.9 | The uncorrected BER should be equal to, or better than, $10^{-3}$ when the co-channel interference is introduced at a level 20 dB below the reference signal. Result _____.                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |             |
| SQA Notification<br>Section 4.1.10       | The VDR correctly reports SQP information to the CMU.<br>Results :<br>Input of -100 dBm produces SQP of 0. Result _____.<br>Input of -90 dBm produces SQP of 2. Result _____.<br>Input of -80 dBm produces SQP of 4. Result _____.<br>Input of -70 dBm produces SQP of 6. Result _____.<br>Input of -60 dBm produces SQP of 8. Result _____.<br>Input of -50 dBm produces SQP of 10. Result _____.<br>Input of -40 dBm produces SQP of 12. Result _____.<br>Input of -30 dBm produces SQP of 14. Result _____.<br>Input of -25 dBm produces SQP of 15. Result _____.<br><br>Note: No specification available on tolerance. |             |             |
| Channel Utilization<br>Section 4.1.11    | The VDR correctly reports channel utilization changes to the CMU. Results: (pass/fail) _____.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |             |
| Channel Congestion<br>Section 4.1.12     | When attempting to send a message in the presence of an occupied channel, the VDR correctly reports channel congestion to the CMU after 60 seconds<br>Result (pass/fail) _____.                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |

| <i>Description</i>                                                           | <i>Requirement</i>                                                                                                                                                                                                                                                          | <i>Pass</i> | <i>Fail</i> |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| <b>Transmitter Tests – Section 4.2</b>                                       |                                                                                                                                                                                                                                                                             |             |             |
| Avionics Frequency _____                                                     |                                                                                                                                                                                                                                                                             |             |             |
| Output Power<br>Section 4.2.1                                                | The transmitter delivers not less than 15 watts output power.<br>Result _____.                                                                                                                                                                                              |             |             |
| RF Power Rise Time<br>Section 4.2.2                                          | The transmitter achieves 90% of full output within 190 microseconds (two symbols). Result _____.                                                                                                                                                                            |             |             |
| RF Power Release Time<br>Section 4.2.3                                       | The transmitter output will drop by at least 20 dB below the declared output level within 190 microseconds (two symbols) after the final information symbol. Result _____.                                                                                                  |             |             |
| Symbol constellation Error<br>Section 4.2.4                                  | The transmitter EVM shall be less than 6%.<br>Result _____.                                                                                                                                                                                                                 |             |             |
| Spurious Emissions<br>Section 4.2.5                                          | The transmitter does not produce any spurious emissions above the levels specified in Appendix D Section D.1.2.2.5.<br>Results Group A (Spec –36dBm) _____.<br>Results Group B (Spec –54 dBm) _____.<br>Results Harmonics (Spec – 60 dBc) _____.                            |             |             |
| Adjacent Channel Power<br>Section 4.2.6                                      | The transmitter does not produce adjacent channel power beyond levels specified in Appendix D Section D.1.2.2.6.<br>Results First Adj. Channel (Spec -18dBm) _____.<br>Results Second Adj. Channel (Spec –28dBm) _____.<br>Results Fourth Adj. Channel (Spec –38dBm) _____. |             |             |
| Wide Band Noise<br>Section 4.2.7                                             | The wide band noise produced by the transmitter reduces at a minimum rate of 5 dB per octave from the fourth adjacent channel to a maximum value of –53 dBm. Result _____.                                                                                                  |             |             |
| Frequency Tolerance<br>Section 4.2.8                                         | The frequency of the transmitter carrier should be within + / - 5 ppm. (136.975 MHz is +/- 685 Hz)<br>Result _____.                                                                                                                                                         |             |             |
| Ramp-up Transients<br>Section 4.2.9                                          | No click is detected from the avionics transmit ramp-up in the monitor receiver. Result _____.                                                                                                                                                                              |             |             |
| Channel Busy<br>Detection/Carrier Sense<br>Multiple Access<br>Section 4.2.10 | Scenario 1 Result _____.<br>Scenario 2 Result _____.                                                                                                                                                                                                                        |             |             |

| <i>Description</i>                                    | <i>Requirement</i>                                                                                                                                            | <i>Pass</i> | <i>Fail</i> |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| <b>Physical Layer System Parameters - Section 4.3</b> |                                                                                                                                                               |             |             |
| Test Frequency _____                                  |                                                                                                                                                               |             |             |
| Rx to Tx turn-around time<br>Section 4.3.1            | The VDR shall begin the transmission of the unique word portion of the training sequence within 2.46 ms after terminating the receive function. Result _____. |             |             |
| Tx to Rx turn-around time<br>Section 4.3.2            | The VDR shall be capable of receiving and demodulating an incoming signal within 1.5 ms after transmitting the final information symbol. Result _____.        |             |             |
|                                                       |                                                                                                                                                               |             |             |

| Description                                               | Requirement                                                                                                                                                                                                                                                                                                                |                          |                      | Pass | Fail |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------|------|------|
| AOA Tests – Section 4.4                                   |                                                                                                                                                                                                                                                                                                                            |                          |                      |      |      |
| Plain Old ACARS Phase 3<br>Section 4.4.1                  | Pass                                                                                                                                                                                                                                                                                                                       | Non-network<br>impacting | Network<br>Impacting | Fail |      |
| Basic Link Establishment<br>Section 4.4.2                 | Avionics correctly implements the basic link establishment                                                                                                                                                                                                                                                                 |                          |                      |      |      |
| Intramedia Switch and<br>Debounce Timers<br>Section 4.4.3 | Scenario 1 Result _____.<br>Scenario 2 Result _____.<br>Scenario 3 Result _____.<br>Scenario 4 Result _____.                                                                                                                                                                                                               |                          |                      |      |      |
| Voice/Data mode<br>Section 4.4.4                          | Scenario 1 Result _____.<br>Scenario 2 Result _____.                                                                                                                                                                                                                                                                       |                          |                      |      |      |
| Handoff Sequence<br>Section 4.4.5                         | Scenario 1 Result _____.<br>Scenario 1 A Result _____.<br>Scenario 1 B Result _____.<br>Scenario 1 C Result _____.<br>Scenario 1 D Result _____.<br>Scenario 2 Result _____.<br>Scenario 2 A Result _____.<br>Scenario 3 Result _____.<br>Scenario 4 Result _____.<br>Scenario 5 Result _____.<br>Scenario 6 Result _____. |                          |                      |      |      |
| Multimedia<br>Section 4.4.6                               | Scenario 1 Result _____.<br>Scenario 2 Result _____.<br>Scenario 3 Result _____.                                                                                                                                                                                                                                           |                          |                      |      |      |
| Maximum Delay Between<br>Retransmissions<br>Section 4.4.7 | Result _____.                                                                                                                                                                                                                                                                                                              |                          |                      |      |      |
| Message Assembly Timer<br>Section 4.4.8                   | Scenario 1 Result _____.<br>Scenario 2 Result _____.<br>Scenario 3 Result _____.                                                                                                                                                                                                                                           |                          |                      |      |      |
| UBI Reset Timer<br>Section 4.4.9                          | Result _____.                                                                                                                                                                                                                                                                                                              |                          |                      |      |      |
| VAC1 Counter and VAT7<br>Timer<br>Section 4.4.10          | Result _____.                                                                                                                                                                                                                                                                                                              |                          |                      |      |      |

| Description                       |                            | Requirement              |                   | Pass | Fail |
|-----------------------------------|----------------------------|--------------------------|-------------------|------|------|
| Autotune                          | POA to AOA Result _____.   |                          |                   |      |      |
| Section 4.4.11                    | POA to AOA A Result _____. |                          |                   |      |      |
|                                   | POA to AOA B Result _____. |                          |                   |      |      |
|                                   | POA to AOA C Result _____. |                          |                   |      |      |
|                                   | AOA to POA Result _____.   |                          |                   |      |      |
|                                   | AOA to POA A Result _____. |                          |                   |      |      |
|                                   |                            |                          |                   |      |      |
| NOCOMM Timer                      | Scenario 1 Result _____.   |                          |                   |      |      |
| Section 4.4.12                    | Scenario 2 Result _____.   |                          |                   |      |      |
|                                   |                            |                          |                   |      |      |
| Criss-Cross Uplink Acknowledgment | Scenario 1 Result _____.   |                          |                   |      |      |
| Section 4.4.13                    | Scenario 2 Result _____.   |                          |                   |      |      |
|                                   |                            |                          |                   |      |      |
| Message Success                   | Signal Strength (dBm)      | Message Success/Attempts | % Message Success |      |      |
| Section 4.4.14                    | -20                        |                          |                   |      |      |
|                                   | -25                        |                          |                   |      |      |
|                                   | -30                        |                          |                   |      |      |
|                                   | -35                        |                          |                   |      |      |
|                                   | -40                        |                          |                   |      |      |
|                                   | -45                        |                          |                   |      |      |
|                                   | -50                        |                          |                   |      |      |
|                                   | -55                        |                          |                   |      |      |
|                                   | -60                        |                          |                   |      |      |
|                                   | -65                        |                          |                   |      |      |
|                                   | -70                        |                          |                   |      |      |
|                                   | -75                        |                          |                   |      |      |
|                                   | -80                        |                          |                   |      |      |
|                                   | -85                        |                          |                   |      |      |
|                                   | -90                        |                          |                   |      |      |
|                                   | -95                        |                          |                   |      |      |
|                                   | -100                       |                          |                   |      |      |
|                                   | -105                       |                          |                   |      |      |
|                                   | -110                       |                          |                   |      |      |
| -115                              |                            |                          |                   |      |      |
| -120                              |                            |                          |                   |      |      |
|                                   |                            |                          |                   |      |      |
| 622/623 ATS Messages              | Result _____.              |                          |                   |      |      |
| Section 4.4.15                    |                            |                          |                   |      |      |
|                                   |                            |                          |                   |      |      |
| ICAO Addressing                   | Result _____.              |                          |                   |      |      |
| Section 4.4.16                    |                            |                          |                   |      |      |
| AVLC Link Management              |                            |                          |                   |      |      |

| <i>Description</i>                      | <i>Requirement</i> | <i>Pass</i> | <i>Fail</i> |
|-----------------------------------------|--------------------|-------------|-------------|
| Section 4.4.17                          |                    |             |             |
|                                         |                    |             |             |
| AVLC Frame Management<br>Section 4.4.18 |                    |             |             |



# B TEST EQUIPMENT SETUP

## B.1 Test Instrument Setup

Use the manuals supplied with the test equipment as a reference for general configuration questions. Information furnished in this section is intended to assist with any special setup information or the use of instrument setup scripts for the tests outlined in this document.

### B.1.1 HP-89440A Series VSA

A group of Instrument State files have been prepared for the VSA. The files are resident on disk # 22676 (VDL VSA States). These files map to the Transmitter Tests in Section 4.2 per the following list:

|                            |                 |          |
|----------------------------|-----------------|----------|
| Output Power               | (Section 4.2.1) | Pwr_1    |
| RF Power Rise Time         | (Section 4.2.2) | Rise_1   |
| RF Power Release Time      | (Section 4.2.3) | Release1 |
| Symbol Constellation Error | (Section 4.2.4) | VDL_Dig1 |
| Spurious Emissions         | (Section 4.2.5) | VDL_VEC1 |
| Adjacent Channel Power     | (Section 4.2.6) | VDL_VEC1 |
| Wide Band Noise            | (Section 4.2.7) | VDL_VEC1 |
| Frequency Tolerance        | (Section 4.2.8) | VDL_VEC1 |

Files map to Physical Layer System Parameters in Section 4.3 per the following list:

|                                         |                 |      |
|-----------------------------------------|-----------------|------|
| Receiver to transmitter turnaround time | (Section 4.3.1) | Rt_1 |
| Transmitter to receiver turnaround time | (Section 4.3.2) | Tr_1 |

### B.1.2 Rhode & Schwarz I/Q Modulation Generator

The I/Q Modulation functionality is provided by the combined use of the Rhode & Schwarz SMIQ Vector Signal Generator and the AMIQ Modulation Generator. The waveform is created by the playback of a data file using the AMIQ, which vector modulates the SMIQ Signal Generator.

#### B.1.2.1 SMIQ Signal Generator

The SMIQ/AMIQ combination is operated manually from the front panel of the SMIQ signal generator by use of an interconnecting IEEE 488 interface. The following keystrokes are used to load an appropriate waveform file to the Modulation Generator and produce an output from the signal generator.

1. PRESET
2. FREQUENCY—Enter 136.975 MHz, RETURN
3. LEVEL—Enter -30 dBm, RETURN
4. VECTOR Mod, SELECT, STATE ON, RETURN, RETURN
5. AMIQ CLT, SELECT
6. MODE AUTO/SINGLE/or EXT-SINGLE, SELECT, RETURN
7. LEVEL I 0.5V/50 Ohm, SELECT
8. LEVEL Q 0.5V/50 Ohm, SELECT
9. SELECT WAVEFORM
10. DRIVE C HARD DISC, SELECT
11. DIRECTORY AQP\_VDL, SELECT
12. WAVEFORM (waveform per test requirement), SELECT
13. For external triggering, place in VECTOR mode

#### **B.1.2.2 AMIQ Modulation Generator**

Use procedures outlined in previous step (B.1.2.1).

#### **B.1.3 BER Test Fixture**

The BER test fixture consists of a PC with an ARINC 429 I/O card using Williamsburg Version 3 protocol to support ASIP avionics messages. The BER test fixture will compare the recovered data from the VDR receiver with a known standard message. The standard message will be in Mode 2 format, including Cyclic Redundancy Check (CRC), interleaving, scrambling and header.

The tests are conducted with maximum length Mode 2 messages (131,071 bits) unless otherwise stated. Calculation of cumulative BER statistics begins once synchronization between the test signal generator and the VDR has been accomplished. The test fixture detects the loss of an entire burst implicitly by lack of a burst payload message in the given burst period. Each test includes a running count of synchronization failures in addition to the cumulative BER.

Reference vendor specific information for operation of radio interfaces and test modes.

#### **B.1.4 Transmission Generator**

The Transmission Generator PC consists of a PC with an ARINC 429 I/O card using Williamsburg Version 3 protocol to support ASIP avionics messages. Most tests are conducted with maximum length Mode 2 messages (131,071 bits), unless otherwise

stated. The standard message will be in Mode 2 format, including CRC, interleaving, scrambling, and header.

The maximum transmit period is determined by the maximum burst length permitted for Mode 2 operation. The maximum burst length is 4.16 seconds at the nominal symbol rate of 10,500 symbols/second. Some tests will use messages that are less than maximum length. The minimum off period is determined by the transmitter power down time plus the channel idle detection time. The ICAO Standards and Recommended Practices (SARPs) specifies a minimum off period is 3.1 ms. The maximum duty cycle is therefore 4.16 seconds in the transmit mode followed by 3.1 ms off.

Reference vendor specific information for operation of radio interfaces and test modes.

### **B.1.5 Transmitter/Receiver Cavity Filter**

Set up as lowpass series-notch cavity filter per manual. Use Conversion Loop part number 76-38-05. Place supplied cover on second port. Reference Tx Rx Systems manual part number 7-9146-1.

## **B.2 Avionics Test Set Setup**

The following sections provide the general power up procedures for the VDL Test Set. The following settings are provided for general reference and should not be considered absolute.

### **B.2.1 Prepower Settings**

1. Install either a Control and Display Unit (CDU), Multiple Interactive Display Unit (MIDU), or Interactive Display Unit (IDU) in the panel display cutout. Note that one connector is used for the MIDU or IDU and another for the CDU. Set the front panel MIDU/IDU selector switch accordingly. Use the MIDU position for the CDU. Place switch in the up position to select the CDU.
2. Set Voice/Data switch in the down position to select Data.
3. Set the CW Key switch in the down position to select not keyed (716 Mode only).
4. Set Break Transmitter (Tx) switch in the up position to select connected (716 Mode only).
5. Set Break Receiver (Rx) switch in the up position to select connected (716 Mode only).
6. Connect the cable from J4 (Patch Panel) on rear of test set to the PC-429 interface. This will allow access to the Data Bus Analyzer from the patch panel on the front of the test set.
7. Connect the cable(s) from J1 (HF ABE), J2 (SDU-1), or J3 (SDU-2) on rear of test set to the PC-429 interface of PCs designated to host the Avionics Bus Emulator

(ABE) for HF and SATCOM. Make these connections, as required, based upon the configuration of avionics under test.

### B.2.2 Power Up

1. Power up the 28 Vdc and 115 Vac 400 Hz power supplies located in the bottom of the rack.
2. Set the Data Loader switch in the OFF position. The Data Loader switch is used only for directing input from an ARINC 615 Data Loader. Leave the switch in the OFF position when not using the data loader to avoid enabling load status in avionics.
3. Place the following circuit breakers in the ON position: fans, CDU or MIDU, CMU, printer, and VDR. Place the LDR (Data Loader) and VDR fan in the ON position, as required.

 **Note:** The fans switch controls 115 Vac fans located in the top of the cabinet and a 5-volt power supply used to illuminate panel Light-Emitting Diodes (LEDs). The VDR fans switch controls 115 Vac 400 Hz applied to the VDR pallet fan only.

4. Set VDR TEST MODE switch in the up position to select test mode (750 Mode only).

# C AIR/GROUND TEST SET SETUP

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Refer to the *VHF Digital Link Mode 2 Air/Ground Test Station (AGTS) Software User Manual* for setup and use of the AGTS.



# D TEST REQUIREMENTS

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## D.1 VDR Test Requirement

### D.1.1 VDL MODE 2 Transceiver Requirements

Unless otherwise stated all specifications shall be met under room conditions, at the nominal data rate, with the transceiver tuned to any 25 kHz channel within the range, 118.000 to 136.975 MHz.

### D.1.2 VDL MODE 2 Equipment Requirements

#### D.1.2.1 Receiver Requirements

The uncorrected BER requirement shall be equal to, or better than  $10^{-3}$ .

The reference signal level applied at the receiver input for all receiver requirements unless otherwise stated, is  $-87$  dBm.

##### D.1.2.1.1 Sensitivity

A maximum signal level of  $-98$  dBm from a modulated VDL Mode 2 signal source shall produce the uncorrected BER requirement specified in Appendix D (D.1.2.1) (above).

##### D.1.2.1.2 Adjacent Channel Rejection

The minimum adjacent channel rejection ratio (ACR) shall be determined in the presence of the reference signal level specified in Appendix D (D.1.2.1).

The ACR required to achieve the uncorrected BER in Appendix D (D.1.2.1) shall be equal to, or greater than,  $44$  dB.

##### D.1.2.1.3 Receiver Performance in the Presence of Strong Signals in the VHF Aeronautical Band

The uncorrected BER requirement in Appendix D (D.1.2.1) shall be achieved when an unmodulated interfering signal of  $-33$  dBm is combined with the reference signal level. The frequency range of the interfering signal shall be 118.000 to 136.975 MHz, including the frequency equivalent to the second higher channel to which the receiver is tuned.

##### D.1.2.1.4 Receiver Performance in the Presence of Strong Signals Outside the VHF Aeronautical Band

The uncorrected BER requirement in Appendix D (D.1.2.1) shall be achieved when one of the specified unwanted signals is applied in addition to the reference signal level.

Unwanted signal A:

Level: minus 33 dBm  
Modulation: None  
Frequency range: 108 to 156 MHz (excluding 117.950 to 137.025 MHz).

Unwanted signal B:

Level: minus 7 dBm  
Modulation: None  
Frequency range: 50 kHz to 1215 MHz (excluding the range 87.5 to 156 MHz).

👉 **Note:** A maximum interfering level of –33 dBm is permitted at the receiver IF frequencies.

Unwanted signal C:

Level: minus 5 dBm  
Modulation: None  
Frequency range: 87.5 to 107.9 MHz.

#### **D.1.2.1.5 Desired Signal Dynamic Range**

The receiver shall continue to achieve the uncorrected BER requirement in Appendix D (D.1.2.1) when the reference signal level is increased to a level of –7 dBm.

#### **D.1.2.1.6 Minimum Message Length**

The uncorrected BER requirement in Appendix D (D.1.2.1) shall be achieved over the entire length of the minimum transmission P1 as specified in the SARPs (6.4.4.1.1). P1 is specified at 131071 bits.

#### **D.1.2.1.7 Frequency Capture Range**

The receiver shall be capable of acquiring and maintaining a lock to any selected channel with the maximum permitted signal frequency offset.

The uncorrected BER requirement in Appendix D (D.1.2.1) shall be achieved when the reference signal level is subject to a frequency offset of plus/minus 967 Hz.

👉 **Note:** This value is composed of the maximum transmitter frequency error at *136.975 MHz ( $\pm 685$  Hz) and the maximum Doppler shift ( $\pm 282$  Hz).*

#### **D.1.2.1.8 In-Band Intermodulation**

The aim of the following requirement is to specify the receiver linearity in order to guarantee the third order interception point (IP3) is at least 0 dBm.

👉 **Note:** 0 dBm is the minimum acceptable value and manufacturers are encouraged to design their receiver to withstand an unwanted level of –29 dBm. (This corresponds to an IP3 value of plus 5 dBm.)

The uncorrected BER requirement of  $10^{-3}$  shall be achieved in the presence of two interfering signals, displaced in frequency, from the desired signal.

Desired signal:

Level: minus 75 dBm  
 Modulation: VDL Mode-2

Unwanted signal A:

Level: minus 32 dBm  
 Modulation: none  
 Frequency: test frequency +/- 1 MHz.

Unwanted signal B:

Level: minus 32 dBm  
 Modulation: VDL Mode-2 (or simulated Mode-2, see Appendix A.3)  
 Frequency: test frequency +/- 2 MHz.

**D.1.2.1.9 Co-Channel interference**

The uncorrected BER requirement of  $10^{-3}$  shall be achieved when a VDL Mode-2 interfering signal (or simulated Mode-2 signal) is applied in addition to the reference signal level.

The co-channel interference ratio shall be less than 20 dB.

**D.1.2.1.10 SQA Notification**

The VDR shall report a Signal Quality Analysis number to the CMU per ARINC 750 (4.3.5 & A10.4.7) and SARPs Annex 10, Part 1 (6.4.1.1.4). A value on a scale between 0 and 15 is used where 0 to 3 is poor, 4 to 12 is adequate, and 13 to 15 is excellent.

**D.1.2.1.11 Channel Utilization Parameter**

The VDR shall provide a channel utilization parameter to upper layers per ARINC 750 (A10.4.10). The VDR should send the CMU an indication of the percentage of the time that the channel is busy. The CU parameter should be sent to the CMU in a CU.indication message at 1-second intervals.

**D.1.2.1.12 Channel Congested Indication**

The VDR maintains a timer (TM2) whose expiration will indicate that the channel is occupied. When the TM2 timer expires the VDR will send a channel congested message to the CMU per ARINC 750 (A10.3.1).

**D.1.2.2 Transmitter requirements**

Unless otherwise stated, these requirements are applicable to transmitter classes, 7 & 8 and over the entire frequency range of 118.000 to 136.975 MHz.

Unless otherwise stated, the reference bit sequence is specified as follows:

The maximum “transmit” period is determined by the maximum “burst” length permitted for Mode-2 operation. The maximum burst length is 4.16 seconds at the nominal symbol rate of 10,500 symbols/s.

The minimum “off” period is determined by the transmitter “power down” time plus the “channel idle” detection time. According to ICAO SARPs, the minimum “off” period is 3.1 ms.

The maximum duty cycle is therefore 4.16 seconds in “transmit” mode followed by 3.1 ms “off”. The reference bit sequence shall not exceed 15 cycles.

#### **D.1.2.2.1 Manufacturers’ Declared Output Power**

Class 7:

The RF output power, measured at the transmitter antenna port, on all frequencies for which the transmitter is designed, shall be not less than 15 watts (average).

Class 8:

The RF output power, measured at the transmitter antenna port, on all frequencies for which the transmitter is designed, shall be not less than 4 watts (average).

 **Note 1:** To achieve the requirements of Appendix D (sections D.1.2.2.6 and D.1.2.2.7), it is recommended that the maximum radiated power be limited to 25 watts (average).

 **Note 2:** To minimize interference to other VHF services operated at a typical airport, the radiated power from a Class 7 transmitter should be restricted to 4 watts while the aircraft is on the ground

 **Note 3:** To facilitate Note 2 (above), air transport category aircraft may provide a “weight-on-wheels” signal to the transceiver.

#### **D.1.2.2.2 RF Power Rise Time**

The transmitter output power shall achieve at least 90% of the manufacturer declared output power level per Appendix D (D.1.2.2.1) in a time less than 190  $\mu$ s (two symbols).

 **Note 1:** The transmitter power stabilization segment shall consist of 5 symbols each representing 000 (2 symbols for the RF power rise time and 3 symbols for the receiver AGC stabilization).

 **Note 2:** In order to minimize the transient effect of power rising in an adjacent channel, careful attention must be paid to the profile of the RF signal during the ramp-up period.

#### **D.1.2.2.3 RF Power Release Time**

The transmitter output power shall decay at least 20 dB below the manufacturer declared output power level per Appendix D (D.1.2.2.1) within 190  $\mu$ s (two symbols) after transmitting the final information symbol.

 **Note :** In order to minimize the transient effect of power decreasing in an adjacent channel, careful attention must be paid to the profile of the RF signal during the ramp-down period.

#### **D.1.2.2.4 Symbol constellation error**

The rms Error Vector Magnitude (EVM), when measured over the first 100 symbols of the reference bit sequence, shall be less than 6%.

#### **D.1.2.2.5 Spurious emissions**

When the transmitter is “active” and terminated in a resistive load equal to the nominal output impedance, the power of any spurious emission at the output of the transmitter shall not exceed:

Group A:

- 0.25 microwatts (minus 36 dBm) within a bandwidth of 100 kHz, on any frequency in the range 30 MHz to 108 MHz.
- 0.25 microwatts (minus 36 dBm) within a bandwidth of 100 kHz, on any frequency in the range 108 MHz to 117.5 MHz.
- 0.25 microwatts (minus 36 dBm) within a bandwidth of 10 kHz, on any frequency in the range 117.5 MHz to 117.8 MHz.
- 0.25 microwatts (minus 36 dBm) within a bandwidth of 10 kHz, on any frequency in the range 137.175 MHz to 137.475 MHz.
- 0.25 microwatts (minus 36 dBm) within a bandwidth of 100 kHz, on any frequency in the range 137.475 MHz to 1 GHz.

Additionally, the level of spurious emissions at discrete frequencies (excluding harmonics) in the following bands shall not exceed 4 nW (minus 54 dBm).

Group B:

- 47 to 68 MHz
- 88 to 108 MHz
- 162 to 244 MHz
- 328 to 336 MHz
- 470 to 862 MHz

Harmonics:

Harmonic emission products shall be at least 60 dB lower than manufacturer declared output power. (ie –60 dBc)

 **Note 1:** Spurious emissions are conducted RF emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include parasitic emissions, intermodulation products and frequency conversion products.

 **Note 2:** Within the frequency range 117.8 MHz to 137.175 MHz, the VDL transmitter shall meet the requirements of Appendix D [D.1.2.2.6 and D.1.2.2.7].

 **Note 3:** In order to ensure adequate protection of a GNSS receiver when a VDL transceiver is operated on the same aircraft, the manufacturer should ensure that the transmitter harmonic filter remains effective at frequencies in the band, 1559 - 1610 MHz.

#### **D.1.2.2.6 Adjacent Channel Power**

First adjacent channel power:

The RF power measured over a 16 kHz channel bandwidth centered on the first adjacent channel shall not exceed –18 dBm.

Second adjacent channel power:

The RF power measured over a 25 kHz channel bandwidth centered on the second adjacent channel shall not exceed –28 dBm.

Fourth adjacent channel power:

The RF power measured over a 25 kHz channel bandwidth centered on the fourth adjacent channel shall not exceed –38 dBm.

 **Note:** Regarding transceiver equipment manufactured to comply with Amendment 72 of the VDL SARPs (ICAO Annex 10, Volume III), manufacturers are reminded that the Aeronautical Mobile Communications Panel (AMCP) of ICAO has proposed that these equipment may not be installed after 1/1/2002 and may not be operated, in any aircraft after 1/1/2005.

#### **D.1.2.2.7 Wide-Band Noise**

The RF power measured in a 25 kHz channel bandwidth shall reduce at a minimum rate of 5 dB per octave from the fourth adjacent channel to a maximum value of –53 dBm.

 **Note:** Regarding transceiver equipment manufactured to comply with Amendment 72 of the VDL SARPs (ICAO Annex 10, Volume III), manufacturers are reminded that the Aeronautical Mobile Communications Panel (AMCP) of

ICAO has proposed that these equipment may not be installed after 1/1/2002 and may not be operated, in any aircraft after 1/1/2005.

#### **D.1.2.2.8 Frequency Tolerance**

The frequency of the RF carrier shall be within plus/minus 5 ppm of the selected frequency. (For 136.925 MHz the maximum offset is + / - 685 Hz.)

#### **D.1.2.3 Transceiver Timing Requirements**

##### **D.1.2.3.1 Receiver to Transmitter Turn-Around Time**

An airborne station shall begin the transmission of the unique word portion of the training sequence within 1.5 ms after terminating the receive function.

##### **D.1.2.3.2 Transmitter to Receiver Turn-Around Time**

An airborne station shall be capable of receiving and demodulating an incoming signal within 1.5 ms after transmitting the final information symbol.

 **Note:** This requirement shall include all decisions made at the CSMA layer.



# E PLAIN OLD ACARS TESTS

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA                                                         |                                            |                                            |                                            | Test ID:                                 |                          |
|------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|------------------------------------------|--------------------------|
| VHF? <input type="checkbox"/> HFDLK? <input type="checkbox"/> SATCOM? <input type="checkbox"/> |                                            |                                            |                                            |                                          |                          |
| Airline:                                                                                       | <input style="width: 95%;" type="text"/>   |                                            |                                            |                                          |                          |
| Initial/Retest:                                                                                | <input type="checkbox"/>                   | Srn Number:                                |                                            | <input style="width: 80%;" type="text"/> |                          |
| Test Engineers' Initials:                                                                      | <input style="width: 90%;" type="text"/>   |                                            |                                            |                                          |                          |
| Test Dates:                                                                                    | From:                                      | <input style="width: 60%;" type="text"/>   | To:                                        | <input style="width: 60%;" type="text"/> |                          |
| <b>Tested Configuration:</b>                                                                   |                                            |                                            |                                            |                                          |                          |
| Unit                                                                                           | Manufacturer                               | Part #                                     | Serial #                                   |                                          |                          |
| MU:                                                                                            | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> |                                          |                          |
| CU:                                                                                            | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> |                                          |                          |
| RADIO:                                                                                         | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> |                                          |                          |
| PRINTER:                                                                                       | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> | <input style="width: 150px;" type="text"/> |                                          |                          |
| <b>MU SOFTWARE PART NUMBERS:</b>                                                               |                                            |                                            |                                            |                                          |                          |
| <input style="width: 70px;" type="text"/>                                                      | <input style="width: 150px;" type="text"/> | <input style="width: 70px;" type="text"/>  | <input style="width: 150px;" type="text"/> |                                          |                          |
| <input style="width: 70px;" type="text"/>                                                      | <input style="width: 150px;" type="text"/> | <input style="width: 70px;" type="text"/>  | <input style="width: 150px;" type="text"/> |                                          |                          |
| <input style="width: 70px;" type="text"/>                                                      | <input style="width: 150px;" type="text"/> | <input style="width: 70px;" type="text"/>  | <input style="width: 150px;" type="text"/> |                                          |                          |
| <input style="width: 70px;" type="text"/>                                                      | <input style="width: 150px;" type="text"/> | <input style="width: 70px;" type="text"/>  | <input style="width: 150px;" type="text"/> |                                          |                          |
| <input style="width: 70px;" type="text"/>                                                      | <input style="width: 150px;" type="text"/> | <input style="width: 70px;" type="text"/>  | <input style="width: 150px;" type="text"/> |                                          |                          |
| <b>Applicable Aircraft:</b> <input style="width: 250px;" type="text"/>                         |                                            |                                            |                                            |                                          |                          |
| <b>Peripheral Devices:</b>                                                                     |                                            |                                            |                                            |                                          |                          |
| OAT:                                                                                           | <input type="checkbox"/>                   | FMC:                                       | <input type="checkbox"/>                   | DFDAU:                                   | <input type="checkbox"/> |
| Other:                                                                                         | <input style="width: 230px;" type="text"/> |                                            |                                            |                                          |                          |
| Notes:                                                                                         | <input style="width: 570px;" type="text"/> |                                            |                                            |                                          |                          |
| <input style="width: 550px;" type="text"/>                                                     |                                            |                                            |                                            |                                          |                          |
| <input style="width: 550px;" type="text"/>                                                     |                                            |                                            |                                            |                                          |                          |
| <input style="width: 550px;" type="text"/>                                                     |                                            |                                            |                                            |                                          |                          |
| <input style="width: 550px;" type="text"/>                                                     |                                            |                                            |                                            |                                          |                          |
| <input style="width: 550px;" type="text"/>                                                     |                                            |                                            |                                            |                                          |                          |
| <input style="width: 550px;" type="text"/>                                                     |                                            |                                            |                                            |                                          |                          |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA               |                                                                                                                       | Test ID:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----|-----|-----|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <b>OOOI EVENTS</b>                                   |                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| <b>DESCRIPTION</b>                                   | <b>REQUIREMENT</b>                                                                                                    | <b>Y/N</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Message Sequencing                                   | Messages are downlinked in a logical order according to airline documentation                                         | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Message Buffering                                    | Messages are buffered when not acknowledged and retransmitted when radio contact resumes                              | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Timers                                               | OFF/ON events are delayed approximately 10 seconds                                                                    | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Filters                                              | IN/OUT events are delayed approximately 2 seconds                                                                     | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Source                                               | Source of OOOI events                                                                                                 | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
|                                                      | If Digital 429, list peripheral (s):                                                                                  | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| OOOI Labels                                          | MU Uses Standard QA-QV OOOI Labels or unique ON/OFF with Dept. & Dest.                                                | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| COMMENTS: <input style="width: 500px;" type="text"/> |                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| <b>RETRANSMISSION INTERVAL</b>                       |                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| <b>DESCRIPTION</b>                                   | <b>REQUIREMENTS</b>                                                                                                   | <b>DATA: Time Between Transmissions (Seconds)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Retransmissions                                      | Downlinks are retransmitted 3 - 5 times at randomly spaced intervals from 10 to 25 seconds before NOCOMM is displayed | <table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th>Test#\Xmission</th> <th>1&amp;2</th> <th>2&amp;3</th> <th>3&amp;4</th> <th>4&amp;5</th> <th>5&amp;6</th> <th>P/F</th> </tr> </thead> <tbody> <tr> <td>1</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>2</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>3</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>4</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> </tbody> </table> | Test#\Xmission           | 1&2                      | 2&3                      | 3&4                      | 4&5 | 5&6 | P/F | 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 3 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Test#\Xmission                                       | 1&2                                                                                                                   | 2&3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3&4                      | 4&5                      | 5&6                      | P/F                      |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| 1                                                    | <input type="checkbox"/>                                                                                              | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| 2                                                    | <input type="checkbox"/>                                                                                              | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| 3                                                    | <input type="checkbox"/>                                                                                              | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| 4                                                    | <input type="checkbox"/>                                                                                              | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| <b>PREKEY TIME</b>                                   |                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| <b>DESCRIPTION</b>                                   | <b>REQUIREMENTS</b>                                                                                                   | <b>DATA</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Unmodulated Carrier Transmission Time                | 1 millisecond max.                                                                                                    | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Prekey                                               | 85 milliseconds max.                                                                                                  | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| Programmable Prekey                                  | Is prekey programmable?                                                                                               | <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |
| COMMENTS: <input style="width: 500px;" type="text"/> |                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                          |                          |                          |     |     |     |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |   |                          |                          |                          |                          |                          |                          |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA               |                                                                                                                                                     | Test ID:                                  |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| <b>MISCELLANEOUS</b>                                 |                                                                                                                                                     |                                           |
| <b>DESCRIPTION</b>                                   | <b>REQUIREMENT</b>                                                                                                                                  | <b>DATA (P/F)</b>                         |
| <b>Protocol and Embedded ACKs</b>                    | Avionics utilizes UBI/DBI protocol                                                                                                                  | <input type="checkbox"/>                  |
|                                                      | If yes, protocol works correctly                                                                                                                    | <input type="checkbox"/>                  |
|                                                      | Downlink retransmissions contain the same MSN before and after a NOCOMM condition.                                                                  | <input type="checkbox"/>                  |
|                                                      | Avionics processes uplink with the same UBI within 10 minutes as a duplicate uplink                                                                 | <input type="checkbox"/>                  |
|                                                      | An embedded ACK to an uplink is changed to an embedded NAK in subsequent downlink retransmissions.                                                  | <input type="checkbox"/>                  |
|                                                      | Avionics properly handles embedded ACKs in uplink messages.                                                                                         | <input type="checkbox"/>                  |
|                                                      | Avionics provides embedded ACKs in downlink messages.                                                                                               | <input type="checkbox"/>                  |
| COMMENTS: <input style="width: 500px;" type="text"/> |                                                                                                                                                     |                                           |
| <b>U/L &amp; D/L Multiblock Processing</b>           | Avionics accepts and prints multiblock messages.                                                                                                    | <input type="checkbox"/>                  |
|                                                      | Avionics accepts and displays multiblock messages.                                                                                                  | <input type="checkbox"/>                  |
|                                                      | "INCOMPLETE MESSAGE" advisory given when subsequent blocks not received in 1.5 minutes.                                                             | <input type="checkbox"/>                  |
|                                                      | If part of a multiblock downlink has been acknowledged, and the avionics goes NOCOMM, the entire multiblock message is resent when COM is regained. | <input type="checkbox"/>                  |
| COMMENTS: <input style="width: 500px;" type="text"/> |                                                                                                                                                     |                                           |
| <b>Tracker Message</b>                               | Tracker Message interval (minutes).                                                                                                                 | <input style="width: 50px;" type="text"/> |
|                                                      | Intervals are at 10 minutes and only in the absence of other downlinks.                                                                             | <input type="checkbox"/>                  |
|                                                      | NOT sent while the aircraft is on the ground.                                                                                                       | <input type="checkbox"/>                  |
|                                                      | Tracker Messages are not queued while the avionics is in voice mode.                                                                                | <input type="checkbox"/>                  |
|                                                      | Tracker Timer reset by uplink ACK to a downlink.                                                                                                    | <input type="checkbox"/>                  |
| COMMENTS: <input style="width: 500px;" type="text"/> |                                                                                                                                                     |                                           |
| <b>Contact Message</b>                               | Contact Message interval.                                                                                                                           | <input style="width: 50px;" type="text"/> |
|                                                      | Sent only if no uplink traffic is heard for a defined period of time.                                                                               | <input type="checkbox"/>                  |
|                                                      | NOT sent while the aircraft is on the ground.                                                                                                       | <input type="checkbox"/>                  |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA                     |                                                                              | Test ID:                                   |
|------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------|
| <b>CHANNEL ACCESS</b>                                      |                                                                              |                                            |
| DESCRIPTION                                                | REQUIREMENT                                                                  | DATA (P/F)                                 |
| Channel Access Algorithm                                   | Will not transmit while receiving a 1200 Hz MSK modulated signal.            | <input type="checkbox"/>                   |
|                                                            | Will not transmit while receiving a 2400 Hz MSK modulated signal.            | <input type="checkbox"/>                   |
|                                                            | Will not transmit while receiving a random (1200/2400) MSK modulated signal. | <input type="checkbox"/>                   |
|                                                            | Will not transmit while receiving actual traffic with 75 ms prekey.          | <input type="checkbox"/>                   |
|                                                            | Must check for channel occupancy before transmitting an ACK to an uplink.    | <input type="checkbox"/>                   |
| Carrier Sense Multiple Access                              | The avionics implements a non-persistent CSMA algorithm.                     | <input type="checkbox"/>                   |
| COMMENTS:                                                  |                                                                              | <input style="width: 500px;" type="text"/> |
| <b>AGENCY CODE, REGISTRATION NUMBER, AND FLIGHT NUMBER</b> |                                                                              |                                            |
| DESCRIPTION                                                | REQUIREMENT                                                                  | DATA                                       |
| Default Agency                                             | Enter the default agency code source and list the agency code.               | <input style="width: 100px;" type="text"/> |
|                                                            |                                                                              | <input type="checkbox"/>                   |
| Agency Code Chars.                                         | Will the avionics accept numeric characters for the agency code?             | <input type="checkbox"/>                   |
| Default Reg#                                               | Enter the default registration source and list the registration number.      | <input style="width: 100px;" type="text"/> |
|                                                            |                                                                              | <input style="width: 100px;" type="text"/> |
| Flight Number                                              | Flight numbers less than four characters are padded with leading zeros.      | <input type="checkbox"/>                   |
|                                                            | Will the avionics accept alpha characters for the flight number.             | <input type="checkbox"/>                   |
| AN/FI Address                                              | Avionics supports both AN and FI addressing                                  | <input type="checkbox"/>                   |
| COMMENTS:                                                  |                                                                              | <input style="width: 500px;" type="text"/> |
| <b>Page 4</b>                                              |                                                                              |                                            |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA  |                                                                                                                                                                                                              | Test ID:                 |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>MULTI-MEDIA FUNCTIONS</b>            |                                                                                                                                                                                                              |                          |
| DESCRIPTION                             | REQUIREMENT                                                                                                                                                                                                  | DATA                     |
| Preferred Media & Simultaneous Media    | MU uses VHF as preferred media and only communicates via SATCOM/HFDL when VHF is unavailable or when responding to an unsolicited SATCOM/HFDL U/L. MU always attempts to complete on media where originated. | <input type="checkbox"/> |
| Multiblock D/L Handling                 | The MU correctly handles Multiblock retransmission when changing media. Entire message is retransmitted. Original MSN is retained.                                                                           | <input type="checkbox"/> |
| VHF to SATCOM/HF                        | The avionics completes failed VHF transmissions on SATCOM/HF Media and alerts the crew of the VHF NOCOMM conditions. Avionics sends downlinks via SATCOM/HF when in Voice Mode (if available).               | <input type="checkbox"/> |
| SATCOM/HF to VHF Transitions            | The avionics monitors the available VHF frequencies and attempts to re-establish the VHF media (label QO, SA, etc.)                                                                                          | <input type="checkbox"/> |
| Automatic Link Establishment            | MU automatically sends a QO downlink (followed by SA) via SATCOM whenever the SDU logs on. Same as VHF & HF.                                                                                                 | <input type="checkbox"/> |
| UBI/DBI Handling                        | The MU correctly maintains separate and independent UBI/DBI's for the VHF, SATCOM, and HF links.                                                                                                             | <input type="checkbox"/> |
| <b>622/623 PROTOCOL &amp; FUNCTIONS</b> |                                                                                                                                                                                                              |                          |
| D/L Message Format                      | ATS messages are downlinked in proper format.                                                                                                                                                                | <input type="checkbox"/> |
| U/L Message Format                      | Uplinks are checked for ATS format compliance.                                                                                                                                                               | <input type="checkbox"/> |
| CRC                                     | Downlinks contain proper CRC values.                                                                                                                                                                         | <input type="checkbox"/> |
|                                         | Uplinks are tested for proper CRC values.                                                                                                                                                                    | <input type="checkbox"/> |
|                                         | U/L messages w/o CRC or improper CRC are rejected.                                                                                                                                                           | <input type="checkbox"/> |
|                                         | Avionics accepts U/L's with or without ending CR/LF chars.                                                                                                                                                   | <input type="checkbox"/> |
| ATS U/L Response                        | MU provides readback responses where appropriate (i.e., PDC Accept/Reject)                                                                                                                                   | <input type="checkbox"/> |
| Multiblock ATS Messages                 | MU properly handles multiblock ATS messages                                                                                                                                                                  | <input type="checkbox"/> |
| Multiblock Prioritization               | Avionics supports nesting of higher priority single block uplinks.                                                                                                                                           | <input type="checkbox"/> |
|                                         | Avionics supports nesting of higher priority multiblock uplinks.                                                                                                                                             | <input type="checkbox"/> |
| COMMENTS:                               |                                                                                                                                                                                                              | <input type="text"/>     |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |                          | Test ID:                 |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------|------|--|----------|--|----------|--|-----|------|-----|------|-----|------|--|--|--|--|--|--|--|
| <b>STUCK CARRIER</b>                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |                          |                          |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Stuck Transmitter                                  | Avionics does not exhibit any stuck transmitter as a result of power cycling or related testing.                                                                                                                                                                                                                                                                                                                                                                      |                          |                          |                          | <input type="checkbox"/> |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| COMMENTS: <input style="width: 90%;" type="text"/> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |                          |                          |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| <b>AUTOTUNE FUNCTIONS</b>                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |                          |                          |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| DESCRIPTION                                        | REQUIREMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Label                    | DATA #                   | P/F                      |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| ACK to Command                                     | Avionics provides ACK to autotune command before changing frequency.                                                                                                                                                                                                                                                                                                                                                                                                  |                          |                          | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Channel Changeover                                 | Avionics changes to frequency specified by Autotune command.                                                                                                                                                                                                                                                                                                                                                                                                          |                          |                          | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Link Tests on New Frequency                        | Avionics immediately conducts at least 3 Link Tests on the new frequency                                                                                                                                                                                                                                                                                                                                                                                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Return to Base Frequency and Conduct Link Test     | Avionics returns to the base freq. and immediately conducts at least 3 Tests to re-establish communication                                                                                                                                                                                                                                                                                                                                                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Autotune to an Autotune                            | If the avionics was autotuned and a subsequent autotune is received, the avionics will correctly retune and return to the base frequency if unable to establish or maintain communication.                                                                                                                                                                                                                                                                            |                          |                          | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Power Interruption                                 | Avionics recalls last autotuned freq. if 115VAC power is interrupted (> 1 min) and 28VDC is retained                                                                                                                                                                                                                                                                                                                                                                  |                          |                          | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
|                                                    | For how long will MU recall last autofreq with both 115VAC and 28 VDC removed?                                                                                                                                                                                                                                                                                                                                                                                        |                          | <input type="text"/>     | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| COMMENTS: <input style="width: 90%;" type="text"/> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |                          |                          |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Frequency Tuning                                   | Will the avionics tune between 118.000 MHz and 136.975 MHz.                                                                                                                                                                                                                                                                                                                                                                                                           |                          |                          | <input type="checkbox"/> |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
| Frequency Table                                    | <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Frequency</th> <th colspan="2">Scan</th> <th colspan="2">Trackers</th> <th colspan="2">Contacts</th> </tr> <tr> <th>Y/N</th> <th>Time</th> <th>Y/N</th> <th>Time</th> <th>Y/N</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td style="height: 100px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> |                          |                          |                          |                          | Frequency | Scan |  | Trackers |  | Contacts |  | Y/N | Time | Y/N | Time | Y/N | Time |  |  |  |  |  |  |  |
| Frequency                                          | Scan                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                          | Trackers                 |                          | Contacts                 |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
|                                                    | Y/N                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Time                     | Y/N                      | Time                     | Y/N                      | Time      |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |
|                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |                          |                          |                          |           |      |  |          |  |          |  |     |      |     |      |     |      |  |  |  |  |  |  |  |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA             |                                                                                             |                           |                 | Test ID:                 |
|----------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------|-----------------|--------------------------|
| <b>MU TO TRANSMITTER/RECEIVER AUDIO LEVELS</b>     |                                                                                             |                           |                 |                          |
| <b>DESCRIPTION</b>                                 | <b>REQUIREMENT</b>                                                                          |                           |                 |                          |
| Audio Output Level                                 | <input type="text"/> Vpk                                                                    | <input type="text"/> Vrms | 1.0 Vrms +/- 2% | <input type="checkbox"/> |
| Audio Rx Level to MU                               | <input type="text"/> Vpk                                                                    | <input type="text"/> Vrms | 1.0 Vrms +/- 2% | <input type="checkbox"/> |
| AM Modulation                                      | Verify when using newly updated transceiver or when audio levels above are out of tolerance |                           |                 | <input type="checkbox"/> |
| % Output Modulation                                | <input type="text"/> %                                                                      |                           | > 85 %          | <input type="checkbox"/> |
| COMMENTS: <input style="width: 90%;" type="text"/> |                                                                                             |                           |                 |                          |
| <b>SUMMARY OF TEST RESULTS</b>                     |                                                                                             |                           |                 |                          |
|                                                    |                                                                                             |                           |                 |                          |
| Page 7                                             |                                                                                             |                           |                 |                          |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA                                                  |                                |                      |                             | Test ID:                             |
|-----------------------------------------------------------------------------------------|--------------------------------|----------------------|-----------------------------|--------------------------------------|
| <b>DOWNLINK SUCCESS RATIO TESTS</b>                                                     |                                |                      |                             |                                      |
| Calibration (loss) factor: <input type="text"/> dB                                      |                                |                      |                             |                                      |
| Attenuation offset required to cause a -20dBm RF Level @ ground station receiver input  |                                |                      |                             |                                      |
| Downlink prekey used: <input type="text"/> mS (typically 75-85 mS)                      |                                |                      |                             |                                      |
| <b>Downlink success ratio data</b>                                                      |                                |                      |                             |                                      |
| Attenuator<br>Setting<br>(dB)                                                           | RF Level<br>at GSC RX<br>(dBm) | # Downlinks<br>Sent  | # Downlinks<br>Acknowledged | Resultant<br>Downlink<br>Success (%) |
| <input type="text"/>                                                                    | -20                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -30                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -40                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -50                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -60                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -70                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -80                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -90                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -95                            | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -100                           | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -105                           | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -110                           | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| <input type="text"/>                                                                    | -115                           | <input type="text"/> | <input type="text"/>        | <input type="text"/>                 |
| Downlink success requirement: 98% or better<br>at reception levels from -20 to -100dBm. |                                |                      |                             | <input type="checkbox"/>             |
| COMMENTS: <input style="width: 500px;" type="text"/>                                    |                                |                      |                             |                                      |
|                                                                                         |                                |                      |                             |                                      |
| Page 8                                                                                  |                                |                      |                             |                                      |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA                                                                                                                                                                           |                                |                      |                           | Test ID:                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------------------|---------------------------|------------------------------------|
| <b>UPLINK SUCCESS RATIO TESTS</b>                                                                                                                                                                                |                                |                      |                           |                                    |
| Calibration (loss) factor: <input type="text"/> dB<br>Attenuation offset required to cause a -20dBm RF Level @ ground station receiver input<br>Uplink prekey used: <input type="text"/> mS (typically 75-85 mS) |                                |                      |                           |                                    |
| <b>Uplink success ratio data</b>                                                                                                                                                                                 |                                |                      |                           |                                    |
| Attenuator<br>Setting<br>(dB)                                                                                                                                                                                    | RF Level<br>at GSC RX<br>(dBm) | # Uplinks<br>Sent    | # Uplinks<br>Acknowledged | Resultant<br>Uplink<br>Success (%) |
| <input type="text"/>                                                                                                                                                                                             | -20                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -30                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -40                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -50                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -60                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -70                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -80                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -90                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -95                            | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -100                           | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -105                           | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -110                           | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| <input type="text"/>                                                                                                                                                                                             | -115                           | <input type="text"/> | <input type="text"/>      | <input type="text"/>               |
| Uplink success requirement: 98% or better<br>(with 75mS of prekey) at reception levels from -20 to -100 dBm.                                                                                                     |                                |                      |                           | <input type="checkbox"/>           |
| COMMENTS: <input style="width: 90%;" type="text"/>                                                                                                                                                               |                                |                      |                           |                                    |
| Page 9                                                                                                                                                                                                           |                                |                      |                           |                                    |

| ARINC PHASE 3 AQP<br>TEST RESULTS/DATA                                  |          |             | Test ID:                 |
|-------------------------------------------------------------------------|----------|-------------|--------------------------|
| <b>DOWNLINK LABELS</b>                                                  |          |             |                          |
| LABEL                                                                   | SUBLABEL | DESCRIPTION | P/F                      |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
| <b>UPLINK LABELS</b>                                                    |          |             |                          |
| LABEL                                                                   | SUBLABEL | DESCRIPTION | P/F                      |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
|                                                                         |          |             | <input type="checkbox"/> |
| <b>COMMENTS</b>                                                         |          |             |                          |
| <div style="border: 1px solid black; height: 40px; width: 100%;"></div> |          |             |                          |

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