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Minimum Operational Performance Standards (MOPS) for Aircraft VDL Mode 2 Physical Link and Network Layer

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FOREWORD

This document was originally prepared by RTCA Special Committee 214 (SC-214), and approved by the RTCA Program Management Committee (PMC) on March 21, 2012.

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EXECUTIVE SUMMARY

This document has been structured with guidelines according to the RTCA MOPS Drafting Guide dated September 21, 2001.

The material in this document highlights the minimum procedures for the physical link and network layer of the VDL Mode 2 subnetwork.

The test procedures used in this document have been coordinated with EUROCAE Working Group 92 during the preparation of EUROCAE Document ED92B.

This document includes four appendices. Appendix B should be considered a normative appendix.

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1. PURPOSE AND SCOPE

1.1 Introduction

This document contains the Minimum Operational Performance Standards (MOPS) and test procedures for aircraft Very High Frequency (VHF) Digital Link (VDL) Mode 2 physical, link and network layer protocol components which comprise an avionics transmitter/receiver (transceiver) function intended to be used for air-ground (A/G) data communications. This document is designed so that equipment certified to it will be compatible with the relevant Minimum Aviation System Performance Standards (MASPS) in RTCA DO-224C and with International Civil Aviation Organization (ICAO) Doc 9776, *Manual on VHF Digital Link (VDL) Mode 2*, which is also known as the VDL Mode 2 Technical Manual. Additional information on VDL Mode 2 is contained in ARINC Specification 631 and ARINC Characteristics 750 and 758.

Compliance with this MOPS is one means of assuring that the VDL Mode 2 equipment will function satisfactorily under all conditions normally encountered in air traffic services communications and that data formats will be compatible with the Aeronautical Telecommunication Network (ATN). These standards specify characteristics useful to designers, manufacturers, installers, and users of the VDL Mode 2 A/G communications system equipment. This document is organized with the following order and format:

- Section 1 describes the purpose and scope.
- Section 2 describes the minimum operational performance standards for:

  - general design requirements
  - standard conditions
  - environmental conditions
  - equipment test procedures
- Section 3 describes the installed equipment tests.
- Section 4 describes the operational tests.

Appendix A contains a list of acronyms used in this document.

Appendix B provides a correlation matrix between the test procedures of Section 2.4 and the VDL Mode 2 system level requirements given in RTCA DO-224C, and the equipment architecture classes defined in Section 1.3. This appendix is normative in the sense that it specifically identifies which requirements make up the minimum set for the standard classes of equipment.

Appendix C provides the analysis that establishes the equivalency between the Frame Error Rate and the bit error rate. This appendix provides the basis for the use of either bit error rate or frame error rate in the verification procedures of Section 2.4.

Appendix D defines the minimum functionality of the Data/Management Interface for Class Y and Class Z architectures. This functionality is described at a high level. No protocol details (i.e., bit definition, data rate, physical layer details, etc.) for the Data/Management Interface are given in this document. Such a standardized interface is the AVLC Simple Interface Protocol (ASIP) described in Attachment 10 to ARINC Characteristic 750.

1.2 System Overview

The VDL Mode 2 system provides interconnectivity for data communications between aircraft and ground-based users. The VDL Mode 2 A/G communications system architecture is defined to provide coverage similar to today's analog-based data communication system. VDL Mode 2 is a digital packet data system using phase-shift modulation. VDL Mode 2 provides a significant increase in capacity over the existing Aircraft Communications Addressing and Reporting System (ACARS) currently in use by many aircraft.

VDL Mode 2 is designed to be a subnetwork of the ATN and is organized according to the Open Systems Interconnection (OSI) reference model of the International Standards Organization (ISO). Point-to-point data communications between the aircraft router and the ground ATN router are provided through the VDL Mode 2 system via the ISO 8208 network interface. In addition to ISO 8208 communications, point-to-multi-point data communication is also provided as one-way data broadcast from the ground station to the aircraft stations.

The VDL Mode 2 system is related to the three lower layers of the OSI model (illustrated in Figure 1-1) providing services described as follows:

- Layer 1 (Physical layer): provides transceiver frequency control, bit exchanges over the radio media, and notification functions. These functions are more often known as "radio" and "modulation" functions.

  RTCA DO-224C defines the VDL Mode 2 modulation as being a differentially encoded eight phase shift keying (D8PSK) modulation scheme providing a 31.5 kb/s bit rate (at layer 1).

- Layer 2 (Link Layer) is split into two sublayers and a management entity:

  The Media Access Control (MAC) sublayer provides access to the Physical layer by a Carrier Sense Multiple Access (CSMA) algorithm.

  The Data Link Services (DLS) sublayer is composed of the Aviation VHF Link Control (AVLC) protocol derived from the High Level Data Link Control (HDLC) protocol (ISO 3309). The main functions of the AVLC protocol are frame exchanges, frame processing and error detection.

  The Link Management Entity (LME) manages link establishment between DLS peers.

- Layer 3: DO-224C defines only the Subnetwork Access Protocol (SNAcP) sublayer, the lowest network sublayer of OSI layer 3. It is compliant with the Subnetwork sublayer requirements defined in the ATN SARPs and conforms to ISO 8208. ISO 8208 is the network layer of the international X.25 standard published by International Telecommunication Union-Telecommunication Standardization Sector (ITU-T). It provides packet exchanges over a virtual circuit, error recovery, connection flow control, packet fragmentation and reassembly, and subnetwork connection management functions.

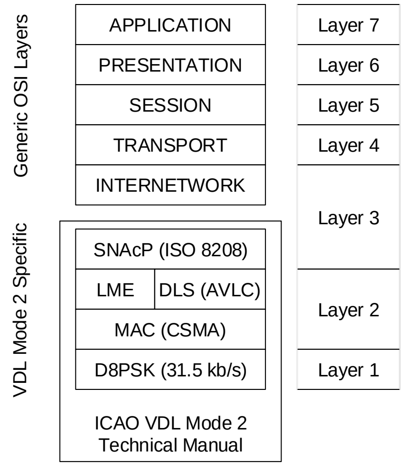


Figure 1-1: VDL Mode 2 Protocol Layers Using ATN/OSI Nomenclature

This document focuses on the use of VDL Mode 2 as an ATN-compliant subnetwork using ISO 8208 as the SNAcP. The specifics of the ISO 8208 protocol used for VDL Mode 2 are defined in DO-224C and the ICAO VDL Mode 2 Technical Manual. Some implementations may provide non-ATN communications using some or all of the ATN protocol stack illustrated in Figure 1-1. For example, the MAC sublayer can support either the ISO 8208 SNAcP defined in DO-224C or the commonly-used non-8208 protocol known as ACARS over AVLC (AOA). The specific SNAcP sublayer within this document does not exist in an AOA implementation. This document does not include standards used for AOA.

1.3 Possible Configuration of Aircraft Equipment

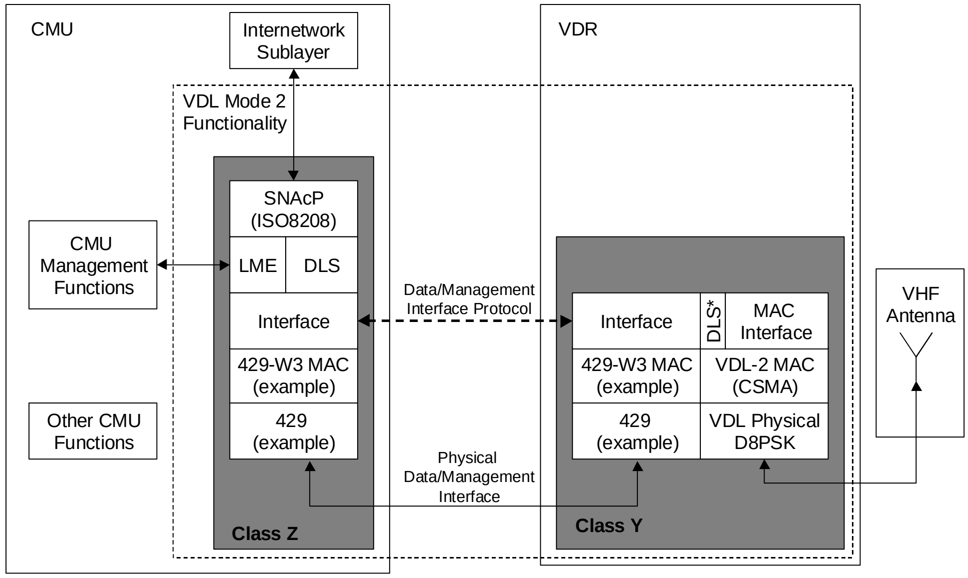
This section describes two possible architectures that can provide VDL Mode 2 functionality to user aircraft. Although not the only possible architectures, they are representative of the most common configurations expected in the marketplace.

1.3.1 Separated Equipment

This section describes the case of the VDL functionalities disseminated in separated equipment as shown in Figure 1-2. In this example, the VDL functionalities are distributed into the VHF Data Radio (VDR) and the Communication Management Unit (CMU). Requirements for equipment complying with either the VDR or CMU portions of the VDL Mode 2 functionality are specified within this document as being Class Y (VDR) and Class Z (CMU, ISO 8208), respectively. Alternative non-ISO 8208 implementations are identified as Class Y (VDR) and Class W (CMU, non-ISO 8208), respectively. Detailed requirements for non-ISO 8208 SNAcP sublayers are not included in this document. Throughout this document, Class Y and Class Z equipment are assumed to have the following configurations:

- Class Y equipment (VDR) includes the Physical layer, the MAC sublayer, and a function providing the data and management information transfer between the VDR and the CMU, including a small subset of the DLS functionality;
- Class Z equipment (CMU, ISO 8208) includes the SNAcP sublayer, the majority of the DLS sublayer, the LME entity and a function providing the data and management information transfer between the VDR and the CMU.

Other equipment required for operation of a Class Y/Class Z configuration includes a VHF antenna, as illustrated in Figure 1-2. A Class Y/Class Z architecture assumes that VDR control is performed through the CMU management functions.



** Note: This MOPS assumes that minor DLS functions formally included in the DLS sublayer, including bit stuffing and flag generation, are included in the Class Y equipment, but this is an assumption, not a minimum requirement.*

Figure 1-2: VDL Functions for Combination Class Y/Z Equipment

1.3.2 Integrated Equipment

In the case of integrated equipment (shown in Figure 1-3), all VDL functions are integrated into a common physical unit of equipment dedicated to VDL services. Throughout this document this integrated architecture is referred to as either Class X (ISO 8208) or Class V (non-ISO 8208) equipment.

Other equipment required for operation of a Class X configuration includes a VHF antenna, as illustrated in Figure 1-3. A Class X architecture assumes that VDR control is performed through a dedicated VDL Mode 2 control head and management function, but does not dictate how these functions are implemented.

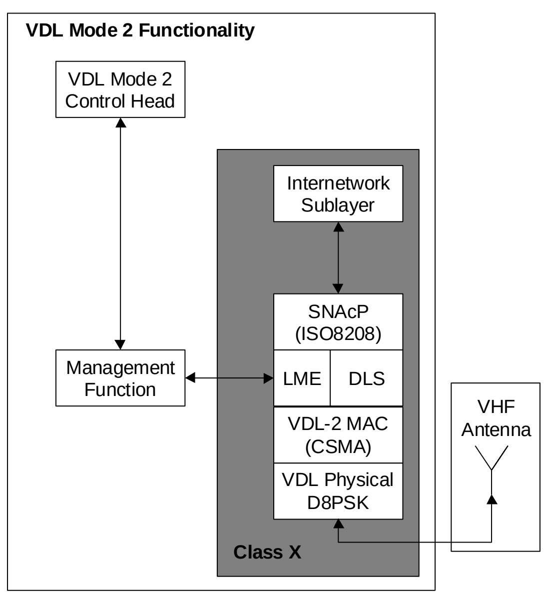


Figure 1-3: Integrated Class X VDL Mode 2 Architecture

1.4 Operational Applications

While operational applications will evolve with time, this document defines minimum standards to support implementation of anticipated applications. The specific applications to be served can be classified under the following general categories:

- Air Traffic Control (ATC) communications;
- Flight Information Services (FIS) communications;
- Aeronautical Operational Communications (AOC).

1.5 Operational Goals

The operational goal of the VDL Mode 2 system is to provide enhanced data capabilities, including greater throughput and more efficient use of the available spectrum resources.

1.6 Equipment Performance Verification

To test the equipment for compliance with the performance requirements, four types of tests are specified. These include:

- Bench Tests
- Environmental Tests
- Installed Equipment Tests
- Operational Tests

The performance requirements for each type of test and the corresponding test procedures are specified in this document. The order of tests suggests that the avionics transceiver be subjected to a succession of tests as it moves from design into design validation, equipment qualification, and operation. The objectives of these tests are described in the following subsections.

1.6.1 Bench Tests

The equipment will be subjected to bench tests to verify compliance with the performance requirements under controlled environment. The test results may be used as the basis for approval of equipment design, equipment qualification, and acceptance. The bench test procedures are specified in Section 2.4. Wherever possible, common procedures are used for Class X and Class Z or Class X and Class Y equipment. Where necessary, specific modifications of the tests are called out for each class of equipment. A cross-reference of tests to equipment classes is included in Appendix B.

1.6.2 Environmental Tests

Upon successful completion of bench tests the equipment will be subject to environmental tests to verify compliance to the performance requirements under extreme environmental conditions expected in actual operations and abnormal conditions. The test results may be applied to equipment qualification and acceptance. The environmental tests are specified in Section 2.3.

1.6.3 Installed Equipment Tests

After successful completion of the environmental tests, the equipment will be installed in the aircraft for further testing to verify compliance with the performance specifications of Section 3 in the aircraft environment. The installed equipment tests will be conducted primarily with the aircraft on the ground using simulated or operational system inputs and may be supplemented with flight tests. The test results may be used to isolate design faults that are traceable to the general aircraft environment, e.g., radio frequency interference (RFI) and the aircraft power supply system. As in the case of bench and environmental tests, installed equipment tests are critical to equipment qualification and acceptance. The installed equipment tests are specified in Section 3.

1.6.4 Operational Tests

After successful completion of the installed equipment tests, the equipment will be subject to operational tests conducted by operating personnel to ensure that the equipment, as a part of the overall A/G communications system, operates satisfactorily end-to-end in real operational environments. The operational tests are specified in Section 4.

1.7 Definitions of Terms

1.7.1 Adjacent Channel

In VDL Mode 2, an adjacent channel is a channel that has a bandwidth of 25 kHz and whose frequency assignment is adjacent to that of a desired reference channel. A first adjacent channel is a channel whose center frequency is 25 kHz above or below that of the desired VDL Mode 2 channel. The n^{th} adjacent channel is a channel whose center frequency is 25n kHz above or below that of the desired VDL Mode 2 channel.

1.7.2 Adjacent Channel Power

Adjacent channel power is the amount of radio frequency (RF) signal power that falls within a given adjacent channel. Contributors to adjacent channel power include discrete spurious signals, signal sidebands, and noise density (including phase noise) at the transmitter output.

1.7.3 Adjacent Channel Rejection (ACR)

ACR corresponds to the receiver's ability to demodulate the desired signal and meet the BER requirement in the presence of an adjacent channel interfering signal which has a power level higher than the desired signal power level.

The ACR ratio, expressed in decibels (dB), is the maximum power difference between the adjacent channel interfering signal and the desired signal that allows the specified BER performance to be met.

1.7.4 Bit Error Rate (BER)

BER is expressed as the ratio of the number of erroneous bits received to the total number of bits received. The uncorrected BER represents the BER without the benefit of Forward Error Correction (FEC).

1.7.5 Co-channel Interference (CCI)

CCI protection is the overall capability of a receiver to demodulate the desired signal and achieve the specified BER performance in the presence of an unwanted signal at the same assigned frequency.

The CCI ratio is the power ratio between the desired signal and the unwanted signal and is expressed in decibels.

1.7.6 Error Vector Magnitude (EVM)

Error Vector Magnitude (EVM) is defined as the root mean square (rms) error in the in phase-quadrature phase (I-Q) vector magnitude measured at the ideal sampling points, expressed as a percentage. Mathematically, this can be written as

$$EVM = 100 \cdot \sqrt{Expectation\left(\left(\Delta I^2 + \Delta Q^2\right)/\left(I^2 + Q^2\right)\right)}.$$

At the ideal sampling points, the I-Q values are on the unit circle so that $I^2 + Q^2 = 1$, and

$$EVM = 100 \cdot \sqrt{Expectation\left(\Delta I^2 + \Delta Q^2\right)}.$$

Methods that use more than one sample per symbol to determine EVM are acceptable, provided the measurements can be related to the definition above.

1.7.7 Reference Signal Level

The reference signal level is the desired signal level used in the receiver performance specifications unless otherwise stated.

1.7.8 Undesired VDL Mode 2 Test Signal

An undesired signal is a simulated VDL Mode 2 signal generated on a valid VDL Mode 2 frequency channel by means of a continuous wave signal frequency modulated by a 400 Hz tone at a peak frequency deviation of 5.25 kHz.

Note: *This test signal represents an idealized VDL Mode 2 signal, with adjacent channel spectral characteristics that are significantly better than those permitted for a VDL Mode 2 transmitter that marginally meets the requirements of Section 2.2.1.3.7 of this MOPS.*

1.7.9 Reference Bit Sequence

The maximum “transmit” period is determined by the maximum “burst” length permitted for VDL 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 will not exceed 15 cycles.

1.8 Reference Documents

This document uses shorthand references to other documents. The references and full identification of the applicable documents are as given below. The reference documents of the exact date and issue, including the indicated changes, apply unless otherwise noted.

Identifier	Date	Title
DO-160G	Dec 8, 2010	Environmental Conditions and Test Procedures for Airborne Equipment
DO-178B	Dec 1, 1992 including Errata, Mar 26, 1999	Software Considerations in Airborne Systems and Equipment Certification
DO-186B	Nov 8, 2005	Minimum Operational Performance Standards for Airborne Radio Communications Equipment Operating within the Radio Frequency Range 117.975 – 137.000 MHz
DO-224C	May, 2011	Signal-in-Space Minimum Aviation System Performance Standards (MASPS) for Advanced VHF Digital Data Communications Including Compatibility with Digital Voice Techniques
ICAO Doc 9776	Second Edition, 201x	Manual on VHF Digital Link (VDL) Mode 2
ISO 3309*	Dec, 1993	ISO Standard - Information Technology -- Telecommunications and information exchange between systems -- High-level data link control (HDLC) procedures -- Frame Structure
ISO/IEC 8208	Mar 15, 1990	Information Processing Systems – Data Communications – X.25 Packet Level Protocol for Data Terminal Equipment
ISO 8885*	Dec, 1993	HDLC Procedures – General Purpose XID Frame Information Field Content and Format

* *It should be noted that the HDLC standards referenced are obsolete by ISO and have been replaced by ISO13239. It should be noted that there are still sources for these obsolete standards and that ISO13239 is not fully interoperable with the referenced standards.*

1.9 Assumptions

This MOPS assumes an antenna that meets the requirements of DO-186B and DO-224C

2. MINIMUM PERFORMANCE STANDARDS

2.1 General Design Requirements

2.1.1 Airworthiness

The equipment shall not, under either normal or faulty conditions, impair the airworthiness of the aircraft in which it is installed.

2.1.2 Intended Function

The equipment shall perform its intended function, as defined by the manufacturer, and its proper use shall not create a hazard to users of the airspace.

2.1.3 ITU and FCC Rules and Regulations

The equipment should comply with the relevant International Telecommunications Union (ITU-R) Radio Regulations and Federal Communications Commission (FCC) Rules and Regulations and applicable electromagnetic interference (EMI) and electromagnetic compatibility (EMC) standards or such other requirements as are applicable.

2.1.4 Fire Protection

All materials used shall be self-extinguishing except for small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire. Furthermore, plenum cable shall be used, where appropriate, to prevent toxic fumes in case of a fire.

Note: *One means of showing compliance is contained in Federal Aviation Regulations (FAR), Part 25, Appendix F.*

2.1.5 Operation of Controls

The operation of controls intended for use during flight, in all possible positions, combinations and sequences, shall not result in a condition whose presence or continuation would be detrimental to the continued performance of the equipment. Controls shall be designed to maximize operational suitability and minimize pilot workload. Reliance on pilot memory for operational procedures shall be minimized.

2.1.6 Accessibility of Controls

Controls, which are not intended for adjustment by the flight crew, shall not be readily accessible. Controls that are normally adjusted in flight shall be readily accessible and properly labeled as to their intended function. The controls shall be operable with the use of only one hand.

2.1.7 Effects of Test

Unless otherwise provided, the design of the equipment shall be such that, subsequent to the application of the specified tests, no condition exists which would be detrimental to the continued performance of the equipment.

2.1.8 Equipment Classes

2.1.8.1 Receivers

One class of receiver is defined as follows:

Class F: Receivers which are to be used in a 25 kHz channel separation environment and intended for VDL Mode 2 operations.

2.1.8.2 Transmitters

Two classes of VDL Mode 2 transmitters, which are to be used in a 25 kHz channel separation environment, are defined as follows:

Class 7: Transmitters designed to operate with a range of 200 nautical miles, which are to be used in a 25 kHz channel separation environment and are intended for VDL Mode 2 operations.

Class 8: Transmitters designed to operate with a range of 100 nautical miles, which are to be used in a 25 kHz channel separation environment and are intended for VDL Mode 2 operations.

2.1.9 VDL Mode 2 Avionics Architecture Classes

This MOPS identifies five architecture classes, corresponding to various options of Figure 1-2 and Figure 1-3. These architecture classes are compliant with DO-224C.

Note: *The choice of architecture class is independent of the choice of transmitter and/or receiver class. Thus, for example, a Class Y VDL Mode 2 transceiver may have a Class F receiver and Class 8 transmitter. A combination nomenclature such as Class YF8 may be used.*

2.1.9.1 ISO 8208-compliant Equipment Classes

Note: *The following equipment architectures utilize the ATN-compliant and SARPs VDL Mode 2 compliant ISO 8208 interface. ISO 8208 compliance is required to assure proper communications with peer entities on the ground. This document recognizes that many implementations will choose to hide the ISO 8208 functionality within the complete protocol stack. Nevertheless, requirements and tests are identified at the ISO 8208 level as the minimum SARPs and MASPS requirement.*

2.1.9.1.1 Class X

Class X VDL Mode 2 equipment shall include the entire VDL Mode 2 protocol stack illustrated in Figure 1-3.

2.1.9.1.2 Class Y

Class Y VDL Mode 2 equipment shall include a partial VDL Mode 2 protocol stack including at least the physical layer and the MAC sublayer. When Class Y equipment is operated in conjunction with Class Z equipment, combination will include the entire VDL Mode 2 protocol stack. Class Y equipment shall contain portions of the DLS sublayer that are closely associated with the physical layer, e.g., bit-stuffing and CRC computation. Class Y equipment shall include a Data/Management Interface at the highest level of VDL Mode 2 capabilities that it provides. An example of an architecture using Class Y equipment is shown in Figure 1-2.

Note: *A widely accepted means for complying with the Data/Management interface requirements for Class Y equipment is ASIP, defined in Attachment 10 to ARINC Characteristic 750. This interface protocol assumes that the low level Data Link Services mentioned in the requirement are implemented in the Class Y equipment, as permitted by the requirement.*

2.1.9.1.3 Class Z

Class Z VDL Mode 2 equipment shall include a partial VDL Mode 2 protocol stack beginning above the MAC sublayer and extending through the subnetwork access protocol sublayer. When Class Z equipment is operated in conjunction with Class Y equipment, combination will include the entire VDL Mode 2 protocol stack. Class Z equipment shall include a Data/Management interface at the lowest level of VDL Mode 2 capabilities that it provides. An example of an architecture using Class Z equipment is shown in Figure 1-2.

Note: *A widely accepted means for complying with the Data/Management interface requirements for Class Z equipment is ASIP, defined in Attachment 10 to ARINC Characteristic 750. This interface protocol assumes that some low level Data Link Services mentioned in the requirement, including flag generation and bit-stuffing, are implemented in the Class Y equipment, as permitted by the requirement.*

2.1.9.2 Non-ISO 8208 Equipment Classes

2.1.9.2.1 Class V

Class V VDL Mode 2 equipment shall include the entire non-ISO-8208 protocol stack beginning with the VDL Mode 2 physical layer defined in Section 2.2.1, the Link Layer defined in Section 2.2.2, and the non-ISO 8208 subnetwork access protocol mentioned in Section 2.2.5.

2.1.9.2.2 Class W

Class W VDL Mode 2 equipment shall include the LME and DLS functions of VDL Mode 2, without including the ISO 8208 SNAcP sublayer. Class W equipment shall meet the VDL Mode 2 Link Layer requirements as specified in Section 2.2.2. Class W equipment shall include a Data/Management interface that permits access to the lowest level capabilities that it provides.

Notes:

1. *A widely accepted means for complying with the Data/Management interface requirements for Class W equipment is ASIP defined in Attachment 10 to ARINC Characteristic 750.*

2. *Class W equipment should be designed to interface with external Class Y equipment.*

2.1.10 Software Management

If the equipment design is implemented using digital computer techniques, the computer software package shall follow guidelines contained in RTCA document DO-178B "Software Considerations in Aircraft Systems and Equipment Certification." The equivalent or later editions of DO-178B may be used with the agreement of the authority.

2.2 Minimum Performance Requirements - Standard Conditions

2.2.1 VDL Mode 2 Physical Layer Requirements

All Class X, Class Y, and Class V VDL Mode 2 transceiver equipment shall meet the VDL Mode 2 physical layer requirements contained in the following subparagraphs.

2.2.1.1 Transceiver Requirements

Unless otherwise stated, all transceiver requirements shall be applicable under room temperature (25^{o} C) condition and with the transceiver tuned to any 25 kHz channel from 118.000 megahertz (MHz) to 136.975 MHz.

2.2.1.1.1 Tuning Range and Channel Increments

The transceiver shall be tunable to any 25 kilohertz (kHz) channel, from 118.000 MHz to 136.975 MHz (760 channels) as defined in RTCA DO-224C.

Note: *Manufacturers should note that in the future, part or all of the frequency band 108.000 to 117.975 MHz may become available for air-ground communications.*

2.2.1.1.2 Modulation

The VDL Mode 2 transceiver shall use D8PSK modulation as defined in RTCA DO-224C.

2.2.1.1.3 Tuning Time

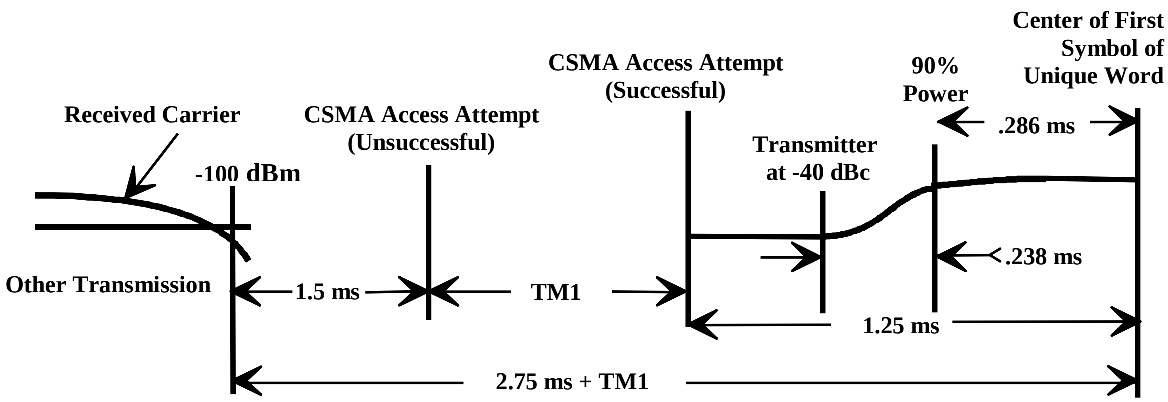
The transceiver shall be capable of tuning to and operating on any of the 25-kHz channels, from 118.000 to 136.975 MHz (760 channels), within 100 ms of the receipt of the "frequency change" command from the (remote) transceiver tuning control [when the transceiver is not transmitting].

2.2.1.1.4 Receive to Transmit Switching Time

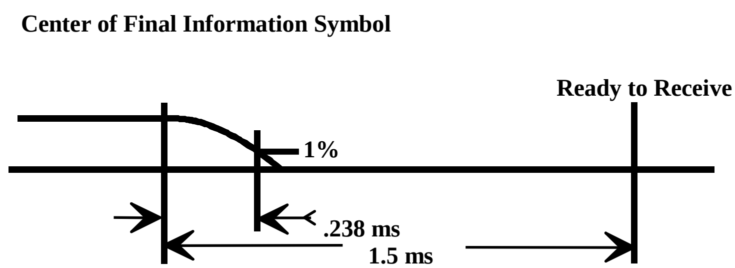
When the MAC persistence parameter is set to p=1, the midpoint of the first symbol of the synchronization sequence shall occur no more than 2.75 ms after the received signal falls below –100±2 dBm.

The receive-to-transmit switching or turn-around time is measured starting from the time the RF input signal level into the receiver drops below the channel busy-to-idle detection threshold (see paragraph 2.2.1.1.6) to the time the middle of the first D8PSK symbol of the 16-symbol Synchronization Sequence of the preamble is transmitted.

Figure 2-1 demonstrates a general receive to transmit turnaround time diagram.



Receive to Transmit Requirements



Transmit to Receive Requirements

Figure 2-1: Receive to Transmit Turnaround Time

2.2.1.1.5 Transmit to Receive Switching Time

The transceiver shall be capable of receiving and demodulating an incoming signal within 1.5 ms after the center of the final information symbol.

Note: *This requirement should include all decisions made at the MAC (CSMA) sublayer.*

2.2.1.1.6 Channel Sensing

The transceiver shall implement the physical layer channel sensing requirements of DO-224C, Section 3.2.1.7 and all subsections.

2.2.1.2 Receiver Requirements

Unless otherwise stated, all receiver requirements shall be applicable to Class F receivers under room temperature (25^{o} C) condition, at the stated nominal data rate, and with the receiver tuned to any 25 kHz channel over the entire frequency range of 118.000 to 136.975 MHz.

The receiver performance shall be based on an uncorrected BER of 0.001, or, equivalently, on a FER of 0.16, for a 240 octet VDL Mode 2 frame. In the detailed requirements that follow, the term "error rate" applies to either the BER or equivalent FER.

Note: The FER of 0.16 is equivalent to an uncorrected bit error rate of no more than 0.001, assuming that forward error correction is applied using the Reed-Solomon decoder specified in DO-224C.

For Class X equipment, the error rate shall be measured at the ISO 8208 interface.

For Class Y equipment, the error rate shall be measured at the Data/Management interface.

If a non-ISO 8208 interface is defined in accordance with Section 2.2.5, the error rate for Class V equipment shall be measured at the Data/Management Interface.

Unless stated otherwise, the reference signal level defined in Section 1.7.7 shall be minus 87 dBm.

2.2.1.2.1 Sensitivity

A signal level of minus 98 dBm at the input of the receiver from a VDL Mode 2 signal source shall produce an error rate that meets the requirements specified in Section 2.2.1.2.

2.2.1.2.2 Adjacent Channel Rejection

The receiver shall achieve the error rate requirement (Section 2.2.1.2) when a single undesired VDL Mode 2 signal (Section 1.7.8) operating on the upper or lower adjacent channel at a level 44 dB above the reference signal level (Section 2.2.1.2) is applied in addition to a desired signal at the reference signal level (Section 2.2.1.2).

2.2.1.2.3 Receiver Performance in the Presence of Strong Signals Within the VHF Aeronautical Band

The receiver shall achieve the error rate requirement (Section 2.2.1.2) when a continuous wave (CW) interfering signal is combined with the desired signal at the reference signal level (Section 2.2.1.2) at the receiver input, in the following conditions:

- Level of the interfering signal set at minus 33 dBm, at frequencies corresponding to second and third adjacent channels center.
- Level of the interfering signal set at minus 27 dBm, at frequencies corresponding to fourth and higher order adjacent channels center.

The frequency range of the interfering signal shall be 118.000 to 136.975 MHz, including the in-band frequencies of the second upper and second lower adjacent channels to which the receiver is tuned but excluding the frequency range between these two adjacent channels.

2.2.1.2.4 Receiver Performance in the Presence of Strong Signals Outside the VHF Aeronautical Band

The receiver shall achieve the error rate requirement (Section 2.2.1.2) when one of the specified unwanted signals is applied in addition to the desired signal at the reference signal level (Section 2.2.1.2).

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, except at the receiver IF frequencies, where the level shall be minus 33 dBm.
Modulation:	None
Frequency range:	50 kHz to 1215 MHz (excluding the range 87.5 to 156 MHz).

Unwanted signal C:

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

2.2.1.2.5 Desired Signal Dynamic Range

The receiver shall continue to achieve the BER or equivalent FER requirement (Section 2.2.1.2) when the desired signal level is increased from the sensitivity level (Section 2.2.1.2.1) to minus 7 dBm.

2.2.1.2.6 Symbol Rate Capture Range

The receiver shall achieve the error rate requirement (Section 2.2.1.2) when the desired signal at the reference signal level (Section 2.2.1.2) is subject to a symbol rate offset of ± 50 parts per million (ppm).

2.2.1.2.7 Frequency Capture Range

The receiver shall be capable of acquiring and maintaining a lock to the desired signal tuned to any selected channel at or above the sensitivity level (Section 2.2.1.2.1) with the maximum permitted signal frequency offset defined below.

The receiver shall achieve the required BER or equivalent FER (Section 2.2.1.2) when the desired signal at the sensitivity level (Section 2.2.1.2.1) is subject to a frequency offset of ± 967 Hz at the room temperature.

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

When tested over the range of environmental conditions specified in Section 2.3, frequency capture range performance shall be measured with a signal level 6 dB above the sensitivity level (Section 2.2.1.2.1)

2.2.1.2.8 Phase Acceleration

Receivers shall be able to demodulate signals exhibiting peak phase accelerations of 1000 Hz/s while the maximum frequency deviation falls within ± 685 Hz of the desired channel frequency, without degrading the specified BER or FER requirement of Section 2.2.1.2.

Note: *Phase Acceleration is related to frequency modulation processes, in both Doppler scenarios and VDL transmitter residual frequency modulation. The frequency modulation produced in Doppler scenarios is characterized by low modulation rates and low peak frequency deviations. DO-224C specifies maximum phase accelerations permissible in VDL transmitters that swamp those produced in Doppler scenarios. The rate in the test has been set to reflect both Doppler and VDL transmitter phase acceleration specifications to ensure VDL receivers will correctly demodulate signals modulated by Doppler and residual FM mechanisms.*

2.2.1.2.9 Co-channel Interference (CCI)

The receiver shall achieve the error rate requirement (Section 2.2.1.2) when an undesired VDL Mode 2 signal (Section 1.7.8) on the same VDL Mode 2 channel at a level 20 dB below the reference signal level (Section 2.2.1.2) is applied in addition to a desired signal at the reference signal level (Section 2.2.1.2).

2.2.1.2.10 Conducted Spurious Emission

When the receiver input is terminated in a resistive load that is equal to the nominal receiver input impedance, the level of any spurious emission appearing across the load shall not exceed minus 57 dBm over the frequency range of 50 kHz to 1215 MHz, with the exception of the range of 108 to 137 MHz, where it shall not exceed minus 64 dBm.

Note: *If other receiving systems are installed, receiver emissions that comply with this minimum standard may interfere with those systems. See the notes in Section 3.2.2 for additional information.*

2.2.1.2.11 FM Broadcast Intermodulation

The receiver shall achieve the error rate requirement (Section 2.2.1.2) in the presence of two unmodulated interfering signals within the frequency range of 87.5 to 107.9 MHz. Each interfering signal shall separately present a level of minus 5 dBm at the receiver input. The combined interfering signals shall be simultaneously applied to the receiver input in the presence of the desired signal at the reference signal level (Section 2.2.1.2).

2.2.1.2.12 In-band Intermodulation

The receiver shall achieve the error rate requirement (Section 2.2.1.2) in the presence of two undesired signals displaced in frequency from the desired signal as defined below:

Desired Signal:

Level:	Minus 75 dBm
Modulation:	VDL Mode 2
Frequency range:	test frequency.

Unwanted signal A:

Level:	minus 32 dBm

Modulation:	None
Frequency :	test frequency ±1 MHz.

Unwanted signal B:

Level:	minus 32 dBm
Modulation:	undesired VDL Mode 2 Test Signal (Section 1.7.8)
Frequency :	test frequency ±2 MHz

Note: *The objective of this requirement is to specify the receiver linearity in order to guarantee that the third order intercept point (IP3) is at least 0 dBm. This is the minimum acceptable value and manufacturers are encouraged to design their receiver to withstand an unwanted level of minus 29 dBm. (This corresponds to an IP3 value of plus 5 dBm)*

2.2.1.3 Transmitter Requirements

Unless otherwise stated, all transmitter requirements shall be applicable to both Class 7 and Class 8 transmitters under room temperature (25^{o} C) conditions and with the transmitter tuned to any 25 kHz channel over the frequency range of 118.000 to 136.975 MHz. Furthermore, unless otherwise stated all requirements shall be met with the transmitter output terminated in a resistive load matching the output impedance of the transmitter.

2.2.1.3.1 Channel Bit Rate

The channel bit rate shall be 31,500 bits per second ± 50 ppm.

2.2.1.3.2 RF Output Power

The RF output power of the transmitter shall be measured during signal transmission.

Class 7: The RF output power, measured at the transmitter antenna port, on all frequencies for which the transmitter is designed, shall not be less than 15 watts.

Class 8: The output power, measured at the transmitter antenna port, on all frequencies for which the transmitter is designed, shall not be less than 4 watts.

Note: *To achieve the requirements of Section 2.2.1.3.6 and Section 2.2.1.3.7, it is recommended that the maximum output power be limited to 25 watts.*

2.2.1.3.3 RF Power Rise Time

The transmitter ramp-up and power stabilization component of the training sequence shall be defined over time interval t = –5.5 to t = –0.5, where t = 0 is the middle of the first symbol of the synchronization sequence (refer to Figure 2-20). The RF power shall be less than minus 40 dB relative to carrier (dBc) prior to time t = –5.5 and equal to greater than 90% of manufacturer-stated nominal output power between t = –3.0 and –0.5. Time (t) is measured in symbol periods (approximately 95.24 µsec each.

Notes:

1. *It is recommended that the symbols transmitted during the ramp-up and power stabilization segment represent the information 000.*

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

3. *The relative timing associated with the RF rise time is shown in Figure 2-20 in Section 2.4.4.2.3.*

4. *Minus 40 dB relative to the carrier (dBc) is 40 dB below the manufacturer-stated output power.*

2.2.1.3.4 RF Power Release Time

The transmitter output power shall decay at least 20 dB below the rated RF output power level (Section 2.2.1.3.2) within 2.5 symbol periods (approximately 238.1 µsec) after the middle of the final information symbol. The transmitter power leakage when the transmitter is in the "off" state shall be less than –83 dBm.

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

2.2.1.3.5 Symbol Constellation Error

The EVM (Section 1.7.6), when measured over the first 100 symbols of the reference bit sequence (Section 1.7.9) shall be less than 6%.

2.2.1.3.6 Spurious Emissions

When the transmitter is "active" (i.e., transmitter is in transmit mode) 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:

(a) 0.25 microwatts (minus 36 dBm) within a bandwidth of 1 kHz, on any frequency in the range 9 kHz to 150 kHz.

(b) 0.25 microwatts (minus 36 dBm) within a bandwidth of 10 kHz, on any frequency in the range 150 kHz to 30 MHz.

(c) 0.25 microwatts (minus 36 dBm) within a bandwidth of 100 kHz, on any frequency in the range 30 MHz to 108 MHz.

(d) 0.25 microwatts (minus 36 dBm) within a bandwidth of 100 kHz, on any frequency in the range 108 MHz to 117.5 MHz.

(e) 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.

(f) 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.

(g) 0.25 microwatts (minus 36 dBm) within a bandwidth of 100 kHz, on any frequency in the range 137.475 MHz to 1.7 gigahertz (GHz).

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

(h) 47 to 68 MHz

(i) 88 to 108 MHz

(j) 162 to 244 MHz

(k) 328 to 336 MHz

(l) 470 to 862 MHz

Harmonic emission products shall be at least 60 dB below the rated RF output power, i.e., minus 60 dBc. Harmonic emission products in the ICAO Global Navigation Satellite System (GNSS) band extending from 1559 to 1610 MHz shall be no greater than minus 60 dBm. The level of the N-th harmonic emission product shall be measured in a bandwidth that is N times 25 kHz.

When the transmitter is “idle” (i.e., transceiver in receive mode) 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:

(m) 2 nW (minus 57 dBm) within a bandwidth of 1 kHz, on any frequency in the range 9 kHz to 150 kHz.

(n) 2 nW (minus 57 dBm) within a bandwidth of 10 kHz, on any frequency in the range 150 kHz to 30 MHz.

(o) 2 nW (minus 57 dBm) within a bandwidth of 100 kHz, on any frequency in the range 30 MHz to 1 GHz.

Notes:

1. *Spurious emissions are power emissions which are outside the desired 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.*

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

3. *If other receiving systems are installed, transmitter harmonics may interfere with those systems. See Section 3.2.2, Note 2.*

2.2.1.3.7 Adjacent Channel Power

<u>First adjacent channel power:</u>

The RF power measured over a 16 kHz channel bandwidth centered on the first adjacent channel shall not exceed minus 18 dBm under all operating conditions (including transmitter attack and decay).

The RF power measured over a 25 kHz channel bandwidth centered on the first adjacent channel shall not exceed plus 2 dBm under all operating conditions (including transmitter attack and decay).

<u>Second and third adjacent channel power:</u>

The RF power measured over a 25 kHz channel bandwidth when centered on either the second or the third adjacent channel shall not exceed minus 28 dBm under all operating conditions (including transmitter attack and decay).

Fourth adjacent channel power:

The RF power measured over a 25 kHz channel bandwidth centered on the fourth adjacent channel shall not exceed minus 38 dBm under all operating conditions (including transmitter attack and decay).

Beyond the fourth adjacent channel power:

Beyond the fourth adjacent channel, the RF power measured over a 25 kHz channel bandwidth shall decrease at a rate of no less than 5 dB per octave of channel offset (for example, minus 43 dBm at the eighth adjacent channel, minus 48 dBm at the sixteenth adjacent channel, and minus 53 dBm at the thirty-second adjacent channel) to minus 53 dBm or less under all operating conditions (including transmitter attack and delay).

Note: *The adjacent channel power requirements apply over the entire 117.8 MHz to 137.175 MHz band.*

2.2.1.3.8 (Reserved)

2.2.1.3.9 Load VSWR Capability

When a 2:1 mismatch is applied to the transmitter output terminal by a length of feeder cable, which is varied in electrical length by up to half a wave length, the requirements of Section 2.2.1.3.6 and Section 2.2.1.3.7 shall be met. In addition, the power output shall not be reduced by more than 3 dB from the rated RF output power (Section 2.2.1.3.2).

2.2.1.3.10 Frequency Tolerance

The frequency of the RF carrier shall be within ±5 ppm of the selected frequency.

2.2.2 VDL Mode 2 Link Layer Requirements

Class X and Class V equipment shall meet the Link layer requirements for VDL Mode 2, as specified in Section 3.2.2 of RTCA DO-224C including all applicable sub-sections, referenced tables, figures, appendices.

Class Y equipment shall meet the MAC sublayer requirements for VDL Mode 2, as specified in Section 3.2.2.3 of RTCA DO-224C including all applicable sub-sections, referenced tables, figures, appendices.

Class Z and Class W equipment shall meet the requirements of Section 3.2.2 of RTCA DO-224C including all applicable sub-sections, referenced tables, figures, appendices, except for the requirements of Section 3.2.2.3

The manufacturer shall declare if the equipment supports the output of information transferred by means of Unnumbered Information (UI) frames. If the equipment supports the output of UI information, the manufacturer shall declare the format and characteristics of the UI output.

Note: *It is strongly recommended that VDL Mode 2 avionics support the Ground Requested Broadcast Handoff capability of DO-224C, Section 3.2.2.5.4.10.*

2.2.3 VDL Mode 2 Network Layer 8208 Requirements

Class X and Class Z equipment shall meet the subnetwork layer requirements (ISO 8208) for VDL Mode 2 as specified in Section 3.2.3 of RTCA DO-224C, including all sub-sections, referenced tables, figures, and appendices.

2.2.4 VDL Mode 2 Network Layer Mobile SNDCF Requirements

Class X and Class Z avionics equipment shall meet the Network layer requirements (Mobile SNDCF) for VDL Mode 2 as specified in Section 3.2.4 of RTCA DO-224C, including all sub-sections, referenced tables, figures, and appendices.

2.2.5 Non-ISO 8208 Use of VDL Mode 2

For Class V and Class W architectures (Section 2.1.9.2), which support a non-ISO 8208 interface for ATN applications, the documentation of Network layer and Subnetwork Access Protocol requirements are outside the scope of this document and subject to verification outside of this MOPS.

Note: *As indicated in Section 1.1, this MOPS applies to VDL Mode 2 as an ATN subnetwork. Although much of this document may be applied to non-ATN capabilities using portions of the VDL Mode 2 protocol stack, such as AOA, this document does not intend to establish comprehensive standards for non-ATN, non-8208 use of VDL Mode 2. See ARINC Specification 631 implementation characteristics for information.*

2.2.6 Data/Management Interface

Class Y, Class Z, and Class W equipment provides a Data/Management interface for the purpose of exchanging data and control information between the lower VDL Mode 2 protocol stack and the upper VDL Mode 2 protocol stack. The Data/Management interface is described in Appendix D.

2.3 Minimum Performance Requirements - Environmental Conditions

2.3.1 Introduction

The environmental tests and performance requirements described in Table 2-1 and Table 2-2 provide a laboratory means of determining the overall performance characteristics of the equipment under conditions representative of those which may be encountered in actual operations.

Some of the environmental tests do not have to be performed unless the manufacturer wishes to qualify the equipment for that particular environmental condition. These tests are identified by the phrase "if required." If the manufacturer wishes to qualify the equipment to these additional environmental conditions, then these "If required" tests shall be performed.

It is the purview of the equipment manufacturer to determine the environment against which it is certifying the EUT. Unless otherwise specified, the test procedures applicable to a determination of equipment performance under environmental test conditions are contained in documents RTCA DO-160/EUROCAE ED-14 "Environmental Conditions and Test Procedures for Airborne Equipment". This document illustrates the pass/fail criteria for the environmental conditions associated with the latest version G, dated December 2010 for reference. The use of later editions of these documents must be agreed with the appropriate approval authority.

The tests in Table 2-1 and Table 2-2 shall, in general, be conducted only at the mid-band frequency, 127.500 MHz. However, tests conducted to ascertain equipment performance at extreme temperatures shall also be conducted at the lowest and highest channel assignments of the AM(R)S band.

2.3.2 Receiver

Note: *Some of the performance requirements in Section 2.2.1.2 are not required to be tested to all of the conditions contained in RTCA DO-160/ED-14. Judgment and experience have indicated that these particular performance parameters are not susceptible to certain environmental conditions and that the level of performance specified in Section 2.2.1.2 will not be measurably degraded by exposure to these conditions.*

2.3.3 Transmitter

Note: *Some of the performance requirements in Section 2.2.1.3 are not required to be tested to all of the conditions contained in RTCA DO-160/Eurocae ED-14. Judgment and experience have indicated that these particular performance parameters are not susceptible to certain environmental conditions and that the level of performance specified in Section 2.2.1.3 will not be measurably degraded by exposure to these conditions.*

Table 2-1: Receiver Environmental Test Conditions Matrix

Receiver Environmental Test Conditions Matrix											
Receiver Subsystem		**RTCA / DO-281B Compliance Sections**									
DO-160G Section	Function	2.2.1.1.5 Tx to Rx Switching time	2.2.1.2.1 Sensitivity	2.2.1.2.2 Adj. Channel Rej.	2.2.1.2.3 Rx Performance in Strong Signals within VHF band	2.2.1.2.4 Rx Performance in Strong Signals outside VHF band	2.2.1.2.5 Desired Signal Dynamic Range	2.2.1.2.6 Symbol Rate Capture Range	2.2.1.2.7 Frequency Capture Range	2.4.6.2.2 Packet Fragmentation and Reassembly	Notes
4.5.1	Low Temperature	X	X	X	X	X	X	X		X	(5)
4.5.2, 4.5.4	High Temperature	X	X							X	(5)
4.5.3	High Temperature	X	X	X	X	X		X		X	
4.6.1	Altitude		X	X						X	
4.6.2	Decompression (if required)		X	X						X	(5)
4.6.3	Overpressure (if required)		X	X						X	(5)
5.0	Temperature Variation		X	X					X	X	
6.0	Humidity		X	X						X	(5)
7.0	Shock		X	X						X	(1)
8.0	Vibration		X	X					X	X	
9.0	Explosion proof (if required)										(2) (3)
10.0	Waterproof (if required)		X	X						X	
11.0	Fluids Susceptibility (if required)		X	X						X	
12.0	Sand and Dust (if required)		X	X						X	
13.0	Fungus Resistance (if required)		X	X						X	
14.0	Salt Spray (if required)		X	X						X	
15.0	Magnetic Effect										(3)
16.5.1, 16.5.2	Power Input (Normal Operating Conditions)		X	X					X	X	
16.5.3, 16.5.4	Power Input (Abnormal Operating Conditions)		X							X	
17.0	Voltage Spike		X	X						X	
18.0	Audio Frequency Conducted Susceptibility – Power Inputs		X	X					X	X	

Receiver Environmental Test Conditions Matrix											
Receiver Subsystem		**RTCA / DO-281B Compliance Sections**									
DO-160G Section	Function	2.2.1.1.5 Tx to Rx Switching time	2.2.1.2.1 Sensitivity	2.2.1.2.2 Adj. Channel Rej.	2.2.1.2.3 Rx Performance in Strong Signals within VHF band	2.2.1.2.4 Rx Performance in Strong Signals outside VHF band	2.2.1.2.5 Desired Signal Dynamic Range	2.2.1.2.6 Symbol Rate Capture Range	2.2.1.2.7 Frequency Capture Range	2.4.6.2.2 Packet Fragmentation and Reassembly	Notes
19.0	Induced Signal Susceptibility		X							X	
20.0	Radio Frequency Susceptibility (Radiated and Conducted)		X	X					X	X	(4)
21.0	Emission of Radio Frequency Energy										(3)
22.0	Lightning Induced Transient Susceptibility (if required)		X	X					X	X	
23.0	Lightning Direct Effects (if required)		X	X					X	X	
24.0	Icing (if required)		X	X					X	X	
25.0	Electrostatic Discharge (ESD) (if required)		X	X					X	X	
26.0	Fire, Flammability	X	X	X	X	X		X		X	(6)

(1) The application of this test may result in damage to the equipment. It may, therefore, be conducted after the other tests. Furthermore, paragraph 2.1.7 of this document -" Effects of Tests" - does not apply following crash safety shocks.

(2) The application of this test may result in damage to the equipment. It may, therefore, be conducted after the other tests. Furthermore, paragraph 2.1.7 of this document -" Effects of Tests" - does not apply.

(3) Equipment performance requirements for this function of the EUT are defined within DO-160G.

(4) Tailor the conducted and radiated RF susceptibility tests in RTCA/DO-160G Section 20 as follows. From 112 MHz to 143 MHz excluding the tuned frequency plus and minus 200 kHz, perform the radiated RF susceptibility tests using a calibrated field strength of 25 millivolts per meter, and perform the conducted RF susceptibility using a calibrated cable bundle current of 40 microamperes. The frequency band of the tuned frequency plus and minus 200 kHz is excluded from this test. Use the calibration and test procedures in DO-160G Section 20.4, 20.5 and 20.6 that apply to Category T. For frequencies below 112 MHz and above 143 MHz use a category from RTCA/DO-160G Section 20 appropriate for the intended application of this radio. The tests should be performed with the antenna coaxial cable terminated in a matched load. This exclusion supersedes the exclusion frequencies specified in RTCA/DO-160G Section 20.3.d.

(5) All mechanical devices shall perform their intended functions.

(6) Equipment performance requirements are applicable only to equipment qualified to Category A or B.

Table 2-2: Transmitter Environmental Test Conditions Matrix

Transmitter Environmental Test Conditions Matrix											
Transmitter Subsystem		**RTCA / DO-281B Compliance Sections**									
DO-160G Section	Function	2.2.1.1.4 Rx to Tx Switching Time	2.2.1.3.1 Channel Bit Rate	2.2.1.3.2 RF Output Power	2.2.1.3.3 RF Power Rise Time	2.2.1.3.5 Symbol Constellation Error	2.2.1.3.6 Spurious Emissions	2.2.1.3.7 Adjacent Channel Power	2.2.1.3.10 Frequency Tolerance	2.4.6.2.2 Packet Fragmentation and Reassembly	Notes
4.5.1	Low Temperature	X	X	X	X	X	X	X	X	X	(10)
4.5.2, 4.5.4	High Temperature			X		X		X		X	(1) (10)
4.5.3	High Temperature	X	X	X	X	X	X	X	X	X	
4.6.1	Altitude			X		X		X		X	(2)
4.6.2	Decompression (if required)			X		X		X		X	(3) (10)
4.6.3	Overpressure (if required)			X		X		X		X	(10)
5.0	Temperature Variation		X	X		X		X	X	X	
6.0	Humidity			X		X		X		X	(10)
7.0	Shock			X		X		X		X	(4)
8.0	Vibration			X		X		X	X	X	(9)
9.0	Explosion proof (if required)										(5) (6)
10.0	Waterproof (if required)			X		X		X		X	
11.0	Fluids Susceptibility (if required)			X		X		X		X	
12.0	Sand and Dust (if required)			X		X		X		X	
13.0	Fungus Resistance (if required)			X		X		X		X	
14.0	Salt Spray (if required)			X		X		X		X	
15.0	Magnetic Effect										(6)
16.5.1, 16.5.2	Power Input (Normal Operating Conditions)			X		X		X	X	X	(7)
16.5.3, 16.5.4	Power Input (Abnormal Operating Conditions)			X		X				X	(8)
17.0	Voltage Spike			X		X		X		X	
18.0	Audio Frequency Conducted Susceptibility – Power Inputs			X		X		X	X	X	
19.0	Induced Signal Susceptibility			X		X		X	X	X	

Transmitter Environmental Test Conditions Matrix											
Transmitter Subsystem		**RTCA / DO-281B Compliance Sections**									
DO-160G Section	Function	2.2.1.1.4 Rx to Tx Switching Time	2.2.1.3.1 Channel Bit Rate	2.2.1.3.2 RF Output Power	2.2.1.3.3 RF Power Rise Time	2.2.1.3.5 Symbol Constellation Error	2.2.1.3.6 Spurious Emissions	2.2.1.3.7 Adjacent Channel Power	2.2.1.3.10 Frequency Tolerance	2.4.6.2.2 Packet Fragmentation and Reassembly	Notes
20.0	Radio Frequency Susceptibility (Radiated and Conducted)			X		X		X		X	
21.0	Emission of Radio Frequency Energy										(6)
22.0	Lightning Induced Transient Susceptibility (if required)			X		X		X	X	X	
23.0	Lightning Direct Effects (if required)			X		X		X	X	X	
24.0	Icing (if required)			X		X		X	X	X	
25.0	Electrostatic Discharge (if required)			X		X		X	X	X	
26.0	Fire, Flammability	X	X	X	X	X	X	X	X	X	(11)

(1) Under the conditions of these tests, the specified output power of 2.2.1.3.2 may be degraded by up to 6 dB. There shall be no evidence of materials exuding or dripping from the equipment components.

(2) Ensure that there is no evidence of corona or arcing without modulation and with modulation.

(3) Under the conditions of these tests, the specified output power of 2.2.1.3.2 may be degraded by up to 1.5 dB.

(4) The application of this test may result in damage to the equipment. It may therefore, be conducted after the other tests. Furthermore, Section 2.1.7 of this document, " Effects of Tests" - does not apply following crash safety shocks.

(5) The application of this test may result in damage to the equipment. It may, therefore, be conducted after the other tests. Furthermore, Section 2.1.7 - "Effects of Tests" - does not apply.

(6) Equipment performance requirements for this function of the EUT are defined within DO-160G.

(7) In respect to Sections 16.5.2.3 and 16.5.2.4 (Momentary power interruptions), the tests may be carried out following the power interruptions.

(8) Under the conditions of these tests, the specified output power of 2.2.1.3.2 may be degraded by up to 3 dB. For equipment operating on DC power, the gradual reduction to zero of the primary power voltage(s) should produce no detrimental effects (see Section 2.1.7- "Effects of Tests").

(9) EVM may degrade to 10%.

(10) All mechanical devices shall perform their intended functions.

(11) Equipment performance requirements are applicable only to equipment qualified to Category A or B.

2.4 Equipment Test Procedures

The following procedures provide guidelines for tests to ensure compliance with the VDL Mode 2 MOPS performance requirements. Alternative procedures or analyses providing equivalent performance documentation may be used, and if so they shall be accompanied with detailed documentation of the method used. Therefore, the procedures cited herein should be used as one criterion in evaluating acceptability of the alternate procedures.

2.4.1 Definition of Terms and Conditions of Tests

2.4.1.1 Warm-up and Stabilization of Test Equipment/Equipment Under Test

The equipment under test and the associated test equipment shall be powered up for a period of not less than one hour prior to the start of each test session to ensure that the unit under test and the test equipment are sufficiently stabilized under the test environment.

2.4.1.2 Alignment, Adjustment and Calibration for Equipment Under Test

All alignment, adjustment and calibration of the test equipment and equipment under test shall be performed prior to commencement of the test. Once the test starts, no further external alignment, adjustment and calibration of test equipment and the equipment under test shall be allowed, throughout the duration of the test. Automatic internal recalibration shall be permitted.

2.4.1.3 Equipment Termination

Unless otherwise specified, all tests shall be performed with the equipment RF terminal(s) terminated with a load matching the nominal characteristic impedance of the equipment.

2.4.1.4 Test Equipment Calibration and Replacement

All test equipment calibration shall use standards traceable to the National Institute of Standards and Technology (NIST) or equivalent. Furthermore, all test equipment calibration shall remain valid throughout the entire duration of the test. In the case that test equipment needs to be replaced due to equipment failure, the replacement equipment shall be of the same make and model as the equipment it replaces.

2.4.1.5 Failure of the Equipment Under Test

In the event that the equipment under test fails during the course of the test, a report shall be generated by the manufacturer of the failed equipment to detail the cause of the failure and the fixes proposed. Test shall not be continued if engineering judgment indicates that the changes made to correct the failure would impact the previously run tests.

2.4.1.6 Measurement Error Due to Test Equipment and Test Setup

Good engineering practices should be exercised to minimize measurement error contributed by the test equipment and test setup. Precautions shall be taken to minimize measurement errors due to contributions from noise sidebands of signal generators and impedance mismatches. In particular, special consideration should be given to the noise floor of the VHF signal generator used for adjacent channel and in-band interference tests to ensure that the minimum signal-to-noise ratio for the desired channel is maintained at the equipment under test. External filtering may be required to achieve this performance. Whenever practical, measurement error due to the test setup, including cable contributions, shall be compensated for.

2.4.1.7 Default RF Signal Level for Avionics High Level Protocol Testing

Unless otherwise stated, the desired RF signal level presented to the RF input of the avionics unit under test and the Ground System Emulator shall be adjusted to a level sufficient to ensure that noise-induced bit errors and frame errors do not affect the protocol test results.

Note: *A signal level of -50 dBm ±5 dB at the antenna port on a VDL Mode 2 receiver should be sufficient to satisfy this requirement.*

For Class Z and Class W equipment, which do not require an RF signal level from the LT, the default shall be an SQP value of 11 on the Data/Management Interface.

2.4.2 Special Test Mode and Test Equipment for Physical Layer Tests

Many of the tests of receiver performance require measurement of the VDL Mode 2 "error rate", which is defined to be either the bit error rate (BER) or the equivalent frame error rate (FER).

2.4.2.1 Frame Error Rate Testing

2.4.2.1.1 FER Test

When FER is used as the basis for performance verification it shall be measured by the following procedure:

For the purpose of the FER test, a series of up to 65,536 test frames shall be generated. Each FER test frame shall consist of a total of 240 octets. The first 238 octets shall contain the binary values corresponding to the integers 0 to 237, respectively, transmitted least significant bit first. The last two octets shall contain a binary representation of a FER test sequence number ranging from 0 to 65,535, transmitted least significant bit first. The FER test sequence number shall be incremented on each successive frame, with the count wrapping to zero on the frame following the maximum count.

Step 1 Set the appropriate transmitter signal level to the specified level required by the test.

Step 2 Using a Desired VDL Mode 2 Signal Source, as defined in Section 2.4.2.3, generate a series of FER test frames at the appropriate transmitter, beginning with a FER test sequence value of 0.

Step 3 Using an ATT, as defined in Section 2.4.3.1.1, or a UDMITT, as defined in Section 2.4.3.1.2, compare the received frames to the transmitted test frames. Any missing or duplicated FER sequence number shall be considered a frame error.

Step 4 Using the count of the successful frame transmissions, perform a sequential estimation test with a probability of missed detection $\beta \leq 0.01$ and verify compliance with the requirements of Section 2.2.1.2. No decision should be made for at least 115 frames.

Note: *A probability of missed detection $\beta \leq 0.01$ means that there is no more than a 1% chance that an implementation that fails the requirement will pass the test. Test designs based on a smaller value for β are acceptable. An example of the acceptance regions for such a test is shown in Figure 2-2. The test of Figure 2-2 has been designed for a false alarm rate, $\alpha \leq 0.05$.*

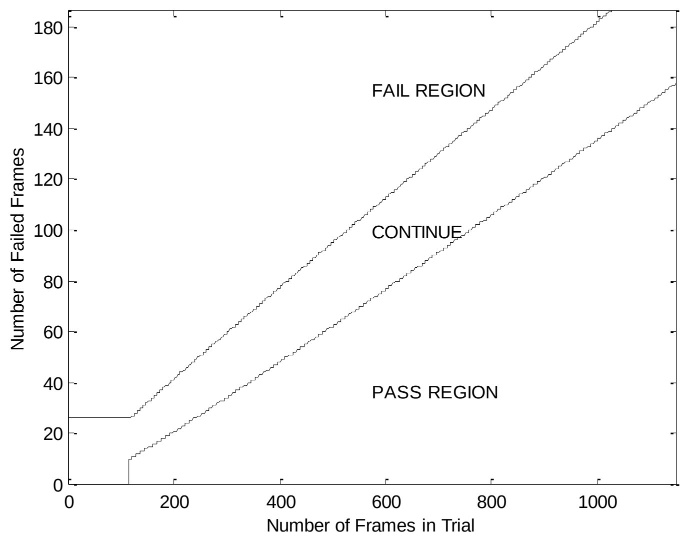


Figure 2-2: Accept/Reject/Continue Regions for Sequential FER Test

2.4.2.1.2 FER Test Setup

The test setup illustrated in Figure 2-3 shall be used when the physical layer test procedures require measurement of frame error rate.

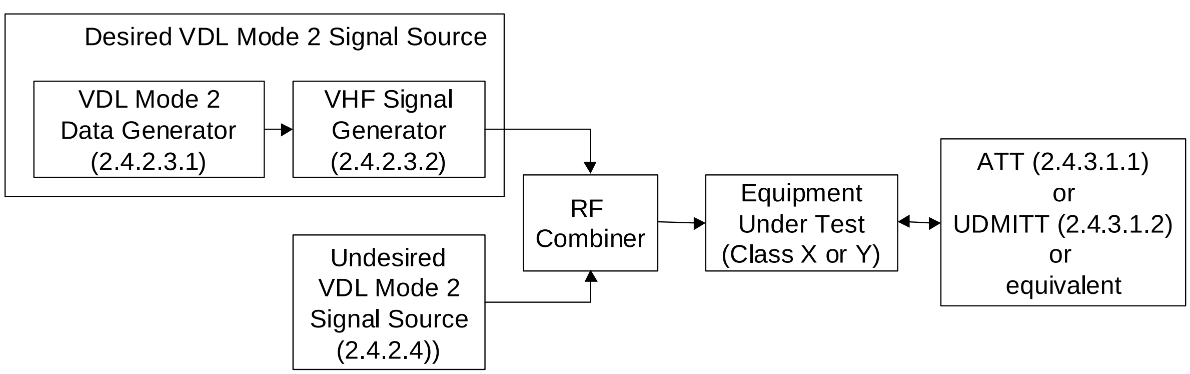


Figure 2-3: Frame Error Rate Test Set Up

2.4.2.2 Bit Error Rate Testing

When BER is used as the basis for performance verification, the VDL Mode 2 transceiver may include a BER mode, which is distinct from the operating mode, for measuring the uncorrected BER of the Physical layer using an external BER test fixture, as specified below. Such a BER mode provides means of isolating the Physical layer from the upper layers to allow performance measurement of the Physical layer alone. The test method used for verification shall be traceable back to the operational mode of the transceiver.

In the BER mode, the receiver shall forward each burst payload to the external BER test fixture prior to error detection or correction procedures.

2.4.2.2.1 External BER Test Fixture

The external BER Test Fixture shall include a message generator/processor to generate test payloads for the desired signal in both burst and non-burst (continuous) forms. An appropriate ramp up sequence shall be added to the test payload and mapped directly into the Mode 2 frame structure. The formatting shall include cyclic redundancy check (CRC), scrambling and header.

The external BER test fixture generating the transmitted burst payload and receiving and processing the received burst payload must be synchronized with the transceiver under test either explicitly (via some direct connection) or implicitly (via the known sequencing of the pseudorandom test payload).

Calculation of cumulative BER statistics shall begin once synchronization of the external BER test fixture between the transmitting and receiving burst payload has been accomplished. The external BER test fixture shall detect the loss of an entire burst implicitly by lack of a burst payload message in the given burst period. Each test shall also include a running count of synchronization failures in addition to the cumulative BER.

2.4.2.2.2 Test Payload

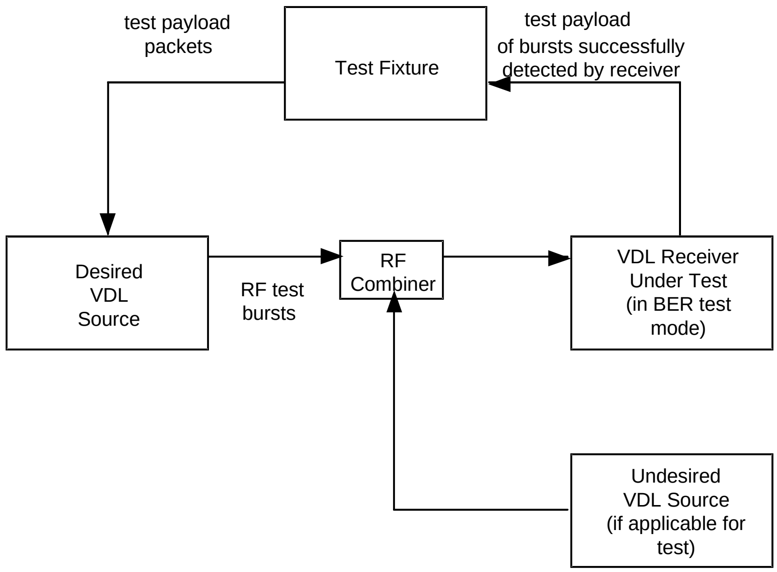
Test payload used in all BER tests shall be pseudorandom number (PN) sequences. For burst mode tests, the transmission shall consist of 20 bytes of pseudorandom data.

For BER tests the minimum length of the PN test sequence used shall be 100,000 bits in order to provide statistically meaningful BER measurement at an uncorrected BER of 0.001.

The PN test sequence used for the undesired signal shall be uncorrelated in content and burst timing with the PN test sequence used for the desired signal.

2.4.2.2.3 BER Test Setup

The test setup illustrated in Figure 2-4 shall be used when the physical layer test procedures require measurement of bit error rate.



<u>Figure 2-4:</u> Bit Error Rate Test Setup

2.4.2.3 Desired VDL Mode 2 Signal Source

2.4.2.3.1 VDL Mode 2 Data Generator

Physical and protocol layer tests require the use of a VDL Mode 2 Data Generator that can generate either deterministic or pseudorandom contents for payload, as well as all framing, formatting, coding, and bit-stuffing required for proper assembly of a valid VDL Mode 2 transmission burst, as specified in DO-224C.

2.4.2.3.2 VHF Signal Generator

Physical layer test procedures require the use of a high performance VHF signal generator, which shall be capable of generating the specified D8PSK modulation simultaneously with other phase and/or frequency modulation. If an external BER test fixture is used to measure error rate, the VHF signal generator shall support an appropriate interface for input and output of test payload data. The VHF Signal Generator should be capable of tuning 115.975 MHz to 137.000 MHz.

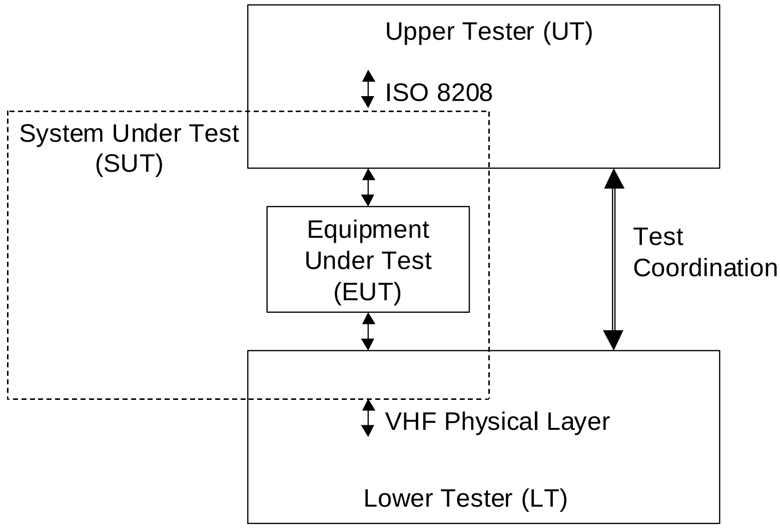
<u>Note:</u> *The recommendation to tune* below *the VDL Mode 2 band of operation is only for the purpose of the Phase Acceleration test of 2.4.4.1.8.*

2.4.2.4 Undesired VDL Mode 2 Signal Source

VHF signal generators are required to generate the undesired signals for verifying performance under various interference conditions. Tests for CCI and ACR require the generation of an undesired VDL Mode 2 signal, as defined in Section 1.7.8. A VHF signal generator capable of generating CW and externally modulating FM is also required.

2.4.3 VDL Mode 2 Test Set Definitions

In order to standardize testing of the various protocol layers above the Physical Layer across the range of VDL Mode 2 avionics architectures described in Section 1.3, this document adopts the nomenclature of ISO-9646, as illustrated in <u>Figure 2-5</u>. This section and its subsections give an overview of the major components involved in the test procedure descriptions.



<u>Figure 2-5</u>: ISO 9646 Test Configuration

The **Equipment Under Test** (EUT) is that part of the avionics equipment to be tested. For Class X equipment, the EUT includes SNAcP (ISO 8208), VME/LME, DLS (AVLC), MAC (CSMA) and Physical (D8PSK) protocol layers. For Class Y equipment, the implementation under test includes the MAC (CSMA) and Physical (D8PSK) protocol layers, and may include some functionality described under the DLS requirements. For Class Z equipment, the implementation under test includes SNAcP (ISO 8208), VME/LME, and most DLS (AVLC) functions.

The **Upper Tester** (UT) is the means of providing control and observation of the upper service boundary of the EUT and of any relevant abstract local primitive during test execution. For Class X and Class Z equipment, the upper service boundary is the ISO 8208 SNAcP interface. For Class Y equipment, the upper service boundary is the Data/Management Interface required by Section 2.2.6.

The **Lower Tester** (LT) is the means of providing control and observation at the appropriate Point of Control and Observation (PCO) either below the EUT or remote from the EUT, as defined by the chosen test method. For Class X and Class Y equipment, the lower service boundary between the EUT and the LT is the VHF Physical Layer. For Class Z equipment, the lower service boundary between the EUT and the LT is the Data/Management Interface required by Section 2.2.6.

2.4.3.1 Upper Tester (UT)

The UT is not necessarily a single definable piece of test instrumentation, but will likely be comprised of an assemblage of test equipment appropriate for a given test procedure capable of providing the functions necessary for that test. Based on the architecture class being tested, two UT configurations are anticipated. For Class X and Class Z equipment, the UT configuration will include the major functions illustrated in <u>Figure 2-6</u>. The Aircraft Test Tool is defined in Section 2.4.3.1.1.

Note: *Other points of access for UT to EUT than direct ISO 8208 I/O are acceptable providing that Link and subnetwork layers test procedures defined in this document can be implemented or acceptable alternate test procedures can be negotiated.*

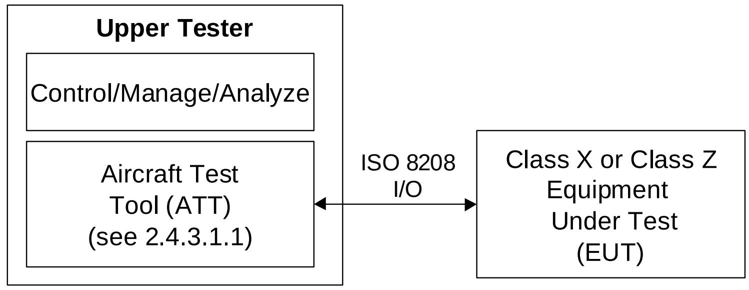


Figure 2-6: Upper Tester for Class X or Class Z Equipment

For Class Y equipment, the UT shall include additional functionality to emulate the upper layers of the VDL Mode 2 protocol stack between the ISO 8208 interface and the Data/Management Interface, as illustrated in Figure 2-7. The functionality of the Upper Data/Management Interface Test Tool (UDMITT) is described in Section 2.4.3.1.2.

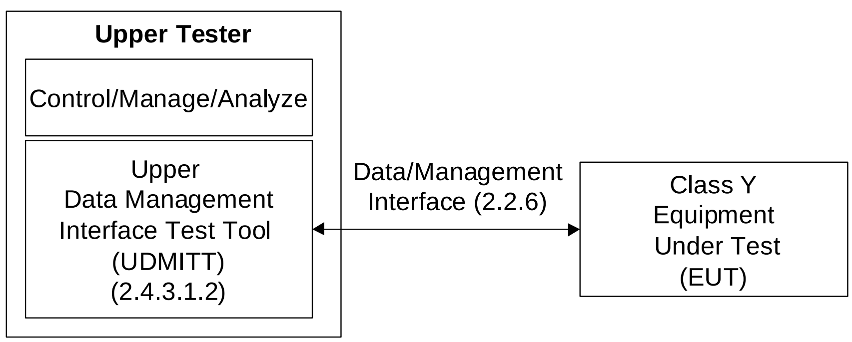


Figure 2-7: Upper Tester for Class Y Equipment

Note: *An acceptable implementation of a Data/Management Interface Test tool could be a combination of an ATT, as defined in Section 2.4.3.1.1, and certified Class Z equipment (e.g. a CMU implementing VDL Mode 2 functionality).*

The UT should have the following minimal capabilities:

- Ability to trace, save and translate information transfers at the appropriate interfaces
- Ability to load data fields within the constraints of the appropriate protocol, as required for the various test scenarios
- Ability to trigger events at the appropriate interface as required by the various test scenarios.

2.4.3.1.1 Aircraft Test Tool / Protocol Analyzer (ATT)

An Aircraft Test Tool (ATT) function includes a means of bi-directional communications with the VDL Mode 2 EUT by way of ISO 8208 packets. The ATT shall permit user control of data content and message timing for transmitted messages. The ATT shall permit user storage, retrieval and examination of incoming and outgoing messages on both octet and packet levels, in accordance with ISO 8208 and DO-224C. Data fields within packets will also be capable of being loaded with either live data scenarios or test data. The ATT will provide a means of validating and documenting the information content of any message transmitted or received from the EUT.

2.4.3.1.2 Upper Data/Management Interface Test Tool (UDMITT)

The Upper Data/Management Interface Test Tool (UDMITT) function includes a means of bi-directional communications with the VDL Mode 2 EUT by way of the Data/Management Interface required by Section 2.2.6. The UDMITT shall contain the functionality of the ATT with respect to storage, retrieval, examination, validation, documentation and analysis of transmitted and received data packets, plus the ability to interface with Class Y equipment over the defined Data/Management Interface. The UDMITT shall perform any timing-related tasks associated with VDL Mode 2 protocol layers above the Data/Management Interface within the default times specified in DO-224C.

Note: *An acceptable implementation of an UDMITT could be a combination of an ATT, as defined in Section 2.4.3.1.1, and certified Class Z equipment (e.g. a CMU implementing VDL Mode 2 functionality).*

2.4.3.2 Lower Tester (LT)

The LT is not necessarily a single definable piece of test instrumentation, but will likely be comprised of an assemblage of test equipment appropriate for a given test procedure capable of providing the functions necessary for that test. Based on the architecture class being tested, two LT configurations are anticipated. For Class X and Class Y equipment, the LT configuration will include the major functions illustrated in Figure 2-8. The Ground Station Emulator (GSE) is defined in Section 2.4.3.2.1.

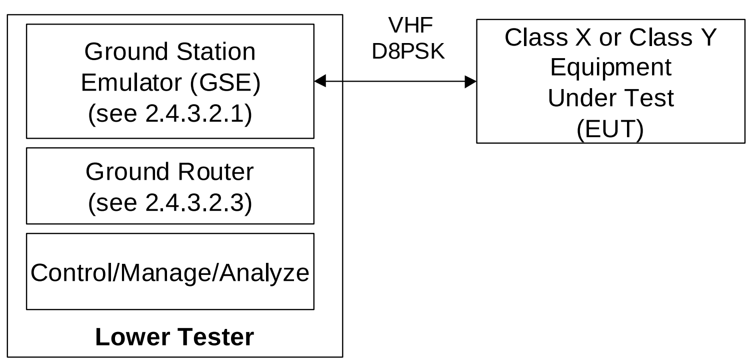


Figure 2-8: Lower Tester for Class X or Class Y Equipment

For Class Z equipment, the LT shall include additional functionality to emulate the lower layers (MAC, Physical) of the VDL Mode 2 protocol stack, as illustrated in Figure 2-9. The VDL Mode 2 Lower Layer Emulator is described in Section 2.4.3.1.2.

Figure 2-9 should be taken as illustrative only. There is no requirement to implement a GSE separately, but the GSE functionality specified in Section 2.4.3.1.1 should be present.

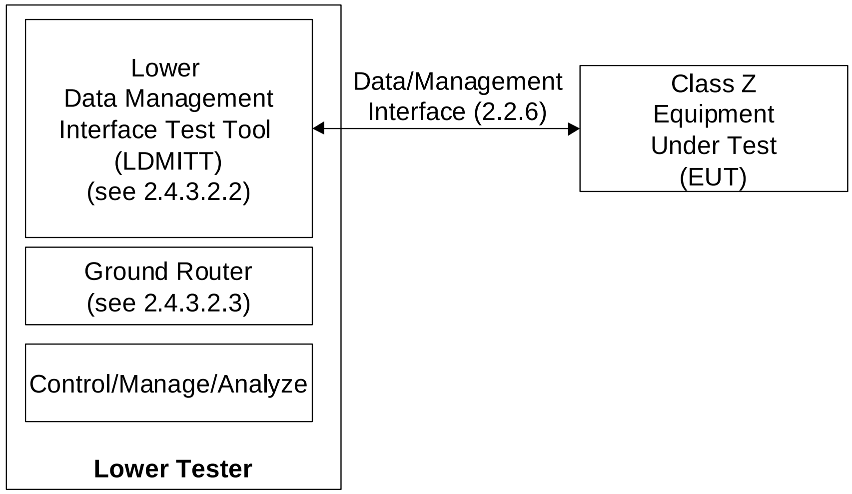


Figure 2-9: Lower Tester for Class Z Equipment

The LT should have the following capabilities:

- Ability to trace, save and translate information transfers at the appropriate ISO-8208 and AVLC levels
- Ability to load data fields within the constraints of the ISO-8208 and AVLC protocols, as required for the various test scenarios
- Ability to trigger events at the appropriate interface as required by the various test scenarios
- Means of validating and documenting the information content of any message transmitted to or received from the EUT
- Ability to emulate two VDL Mode 2 ground stations configured as one or two Ground Systems
- Ability to timestamp information transfers to and from the EUT.

2.4.3.2.1 Ground Station Emulator (GSE)

The GSE function emulates all the ground station functions in a typical VDL Mode 2 network. Some VDL Mode 2 functions and characteristics can be verified only when a VDL Mode 2 EUT is coupled through an RF link with its VDL Mode 2 Ground Station (GS) counterpart, each controlling or reacting to various states (or changes of state) of each other.

The GSE is not necessarily a single definable piece of test instrumentation, but will likely comprise an assemblage of test equipment appropriate for a given test procedure capable of providing the functions necessary for that test. The following is a minimal list that should be incorporated as part of the GS emulator tool:

The GSE must be compliant with the minimum requirements applying to ground stations established by RTCA DO-224C.

The GSE should be configurable to emulate the services that may be encountered in the field and the varied vendors that will provide these network services.

The GSE shall include a Desired VDL Mode 2 Signal Source, as defined in Section 2.4.2.3.

The GSE must be able to establish an ISO 8208 link with its peer entity in the ATT, and to emulate air-ground subnetwork operations via this link.

The GSE must have the ability to control the signaling and communications protocols embodied as part of the VDL Mode 2 and ATN technical manual standards, and to verify correct operation of those protocols.

The GSE must have the ability to operate in the configurations specified in Section 2.4.3.2.4.1 through Section 2.4.3.2.4.3

2.4.3.2.2 VDL Mode 2 Lower Data/Management Interface Test Tool (LDMITT)

The Lower Data/Management Interface Test Tool (LDMITT) function includes a means of bi-direction communications with the VDL Mode 2 EUT by means of the Data/Management Interface required by Section 2.2.6. The LDMITT shall contain the functionality of the ATT and the GSE with respect to storage, retrieval, examination, validation, documentation and analysis of transmitted and received data packets, plus the ability to interface with Class Z equipment over the defined Data/Management Interface. The LDMITT shall perform any timing-related tasks associated with VDL Mode 2 protocol layers below the Data/Management Interface within the default times specified in DO-224C.

Note: *An acceptable implementation of an LDMITT could be a combination of one or more GSEs, as specified in 2.4.3.2.1, and certified Class Y equipment (e.g. Class Y equipment complying with this MOPS).*

2.4.3.2.3 Air/Ground Router

The Lower Tester should have the ability to emulate one or more Aeronautical Telecommunications Network (ATN) Air/Ground router(s). The ATN ground router provides the peer communications services to the Upper Tester, allowing overall air/ground communications through the EUT.

2.4.3.2.4 Standard LT Configurations

The following five standard Lower Level Test configurations are defined to facilitate description of the testing to be performed on the advanced features in the VDL Mode 2 protocol (e.g., handoff between ground stations and routers). For simplicity, these configurations are shown as modifications of Figure 2-8. Equivalent configurations may be expressed as modifications of Figure 2-9 by replacing the VDL Mode 2 LDMITT with Class Y equipment having the interfaces shown as in the following figures. That is, for testing of Class Z equipment, the GSEs and all lower level VDL Mode 2 protocol layers are contained in the Lower Tester.

2.4.3.2.4.1 LT Configuration 1

In Configuration 1, the LT shall be configured as a single GSE, as shown in Figure 2-10.

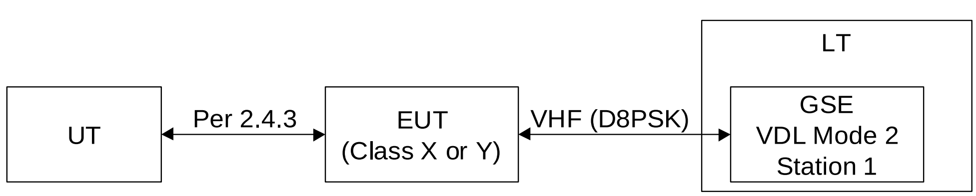


Figure 2-10: Lower Tester Configuration 1

2.4.3.2.4.2 LT Configuration 2

In Configuration 2, the LT shall be configured as a single GSE connected to a single router, as shown in Figure 2-11.

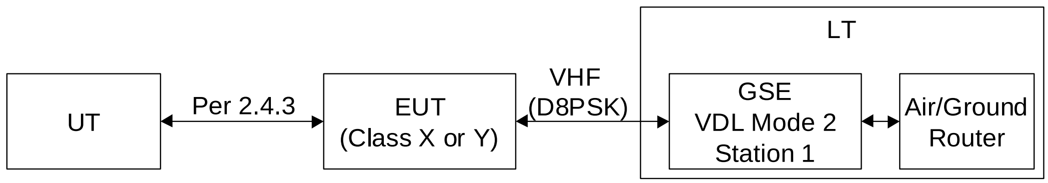


Figure 2-11: Lower Tester Configuration 2

2.4.3.2.4.3 LT Configuration 3

In Configuration 3, the LT shall be configured as two independent GSEs connected to a single router, as shown in Figure 2-12.

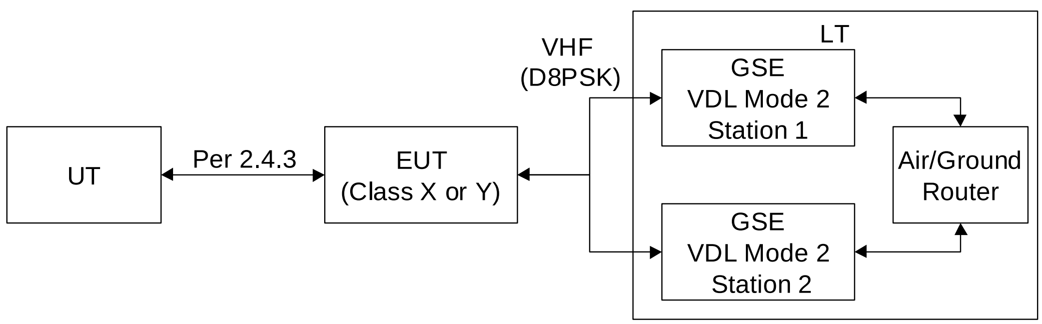


Figure 2-12: Lower Tester Configuration 3

2.4.3.2.4.4 LT Configuration 4

In Configuration 4, the LT shall be configured as three independent GSEs connected to a single router, as shown in Figure 2-13.

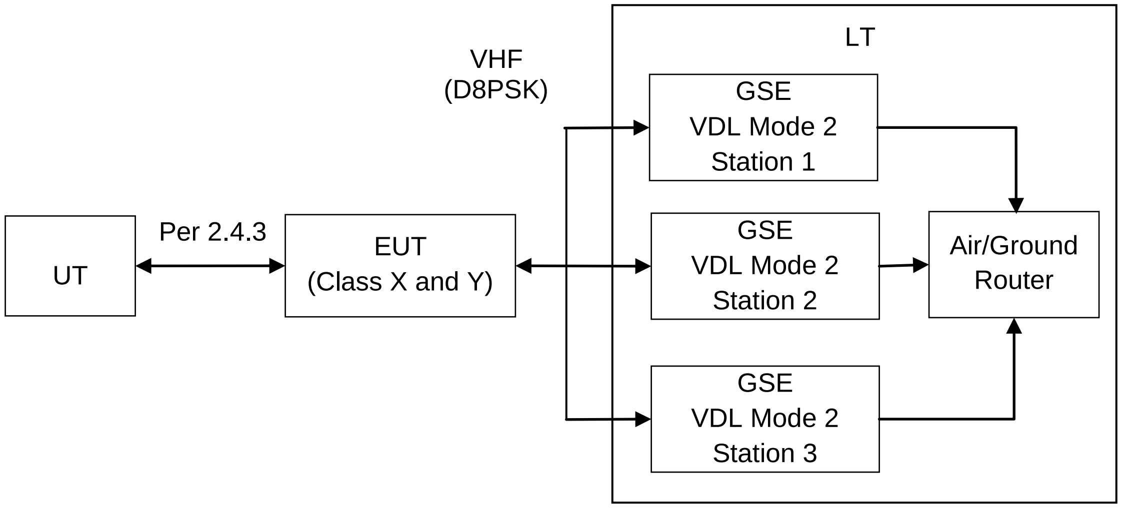


Figure 2-13: Lower Tester Configuration 4

2.4.3.2.4.5 LT Configuration 5

In Configuration 5, the LT shall be configured as four independent GSEs connected to a single router, as shown in Figure 2-14.

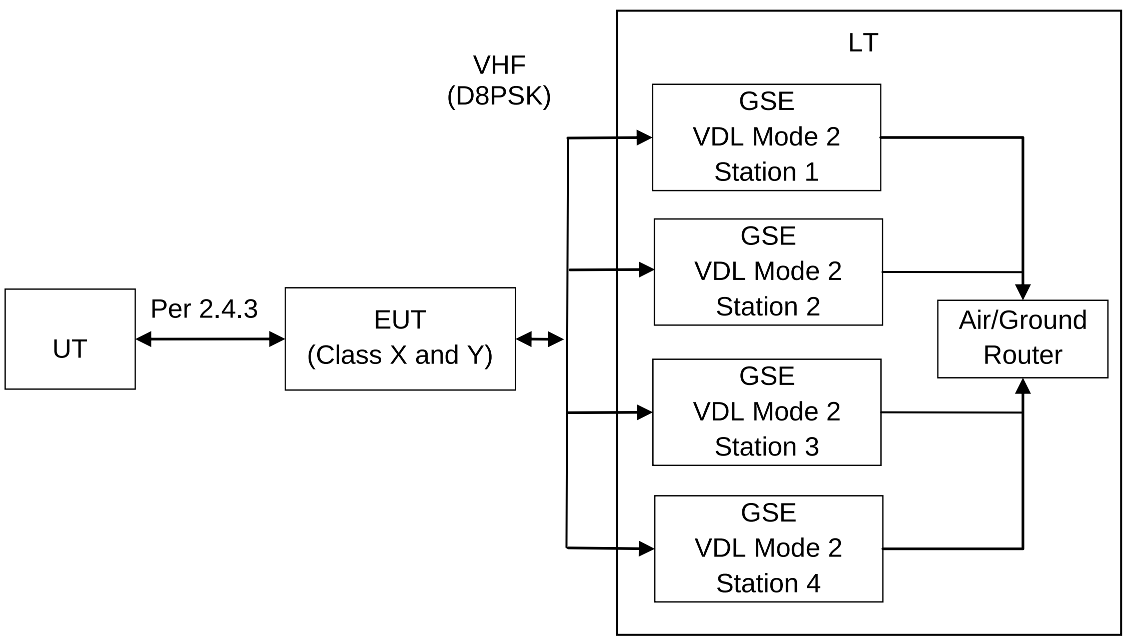


Figure 2-14: Lower Tester Configuration 5

2.4.4 Physical Layer Test Procedures

The following test procedures verify compliance with the physical layer requirements of Section 2.2.1 of this document. However, alternative procedures that provide equivalent information may be used. To reduce the number of test cases, the number of frequency channels at which the VDL transmitter and receiver are to be tested shall include a low channel (for example, 118.000 MHz), a mid channel (for example 128 MHz), and a high channel (for example 136.975 MHz).

These test procedures apply to Class X, Class V, and Class Y equipment. Class Z and Class W equipment are excluded from these procedures.

2.4.4.1 Receiver Test Procedures

For receiver error rate testing, the receiver will be placed in either of the equivalent error rate test modes. Figure 2-3 and Figure 2-4 show the basic test setups for measuring the appropriate error rate. In all of the detailed test procedure, it is acceptable to measure either the BER by means of the procedure given in Section **Error! Reference source not found.**, or the equivalent FER by means of the procedure given in Section 2.4.2.1.

2.4.4.1.1 Sensitivity

Reference: Section 2.2.1.2.1

Equipment Required

Desired VDL Mode 2 Signal Source

External BER test fixture (optional)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is not required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the desired VDL Mode 2 Signal Source (Section 2.4.2.3), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as appropriate. Adjust the level of the signal generator to produce the minimum signal level (Section 2.2.1.2.1) at the receiver input.

Step 4 Use the process of Section 2.4.2.1 or Section **Error! Reference source not found.**, as appropriate, to determine the error rate. Verify compliance with Section 2.2.2.1.2.

Step 5 Repeat Steps 2 to 4 at the other two remaining test frequencies (Section 2.4.4).

Step 6 Check that the sensitivity requirement (Section 2.2.1.2.1) is achieved at all three test frequencies (Section 2.4.4).

2.4.4.1.2 Adjacent Channel Rejection

Reference: Section 2.2.1.2.2

Equipment Required

Desired VDL Mode 2 Signal Source

Undesired VDL Mode 2 Signal Source

External BER Test Fixture (optional)

RF Combiner

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the VHF Signal Source (Section 2.4.2.3), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as appropriate. Adjust the level of the signal generator to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 4 Tune the Undesired VDL Mode 2 Signal Source (Section 2.4.2.4) to the first upper adjacent channel frequency and generate an undesired VDL Mode 2 test signal (Section 1.7.8). Set the signal level to produce, at the receiver input, a level 44 dB above the reference signal level established in Step 3.

Step 5 Apply the desired input signal and the adjacent interfering signal to the receiver input via the RF combiner.

Step 6 Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate, and verify compliance with the requirement of Section 2.2.1.2.2.

Step 7 Repeat Steps 4 through 6 for the lower adjacent channel.

Step 8 Repeat Steps 2 to 7 at the two remaining test frequencies (Section 2.4.4).

Note: *The noise sidebands of the interfering signal must not interfere with the desired signal in the receiver passband. The isolation offered by the RF combiner, must be sufficient to prevent intermodulation between the VHF generators. Additional filtering may be required.*

2.4.4.1.3 Rejection of Signals Within the VHF Aeronautical Band

Reference: Section 2.2.1.2.3

Equipment Required

Desired VDL Mode 2 Signal Source

Undesired VDL Mode 2 Signal Source

External BER Test Fixture (optional)

RF Combiner

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the desired VDL Mode 2 Signal Source (Section 2.4.2.3), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as

appropriate. Adjust the level of the desired VDL Mode 2 Signal Source to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 4 Use the Undesired VDL Mode 2 Signal Source (Section 2.4.2.4) to produce an unmodulated (CW) interfering signal.

Step 5 Tune the Undesired VDL Mode 2 Signal Source to the upper second adjacent channel frequency of the desired signal. Adjust the level of the Undesired VDL Mode 2 Signal Source to the unmodulated interfering signal power value (Section 2.2.1.2.3) at the receiver input.

Step 6 Apply the desired input signal and the undesired interfering signal to the receiver input via the RF combiner. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirement of Section 2.2.1.2.

Step 7 Repeat Steps 5 and 6 but tune the Undesired VDL Mode 2 Signal Source to the lower second adjacent channel of the desired signal.

Step 8 Repeat Steps 2 to 7 at the remaining test frequencies (Section 2.4.4).

Note: *The noise sidebands of the interfering signal must not interfere with the desired signal in the receiver passband. The isolation, offered by the RF combiner, must be sufficient to prevent intermodulation between the VHF generators.*

2.4.4.1.4 Rejection of Signals Outside the VHF Aeronautical Band

Reference: Section 2.2.1.2.4

Equipment Required

Desired VDL Mode 2 Signal Source

Undesired VDL Mode 2 Signal Source

External BER Test Fixture (optional)

RF Combiner

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the desired VDL Mode 2 Signal Source (Section 2.4.2.3), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as appropriate. Adjust the level of the signal generator to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 4 Use the Undesired VDL Mode 2 Signal Source (Section 2.4.2.4) to produce an unmodulated (CW) interfering signal.

Step 5 Tune the Undesired VDL Mode 2 Signal Source to a low-band frequency for one of the frequency bands defined for unwanted signal A in Section 2.2.1.2.4. Adjust the level of the Undesired VDL Mode 2 Signal Source to provide the interfering signal level defined in Section 2.2.1.2.4 at the receiver input.

Step 6 Apply the desired signal and the interfering signal to the receiver input via the RF combiner. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirement of Section 2.2.1.2.

Step 7 Repeat Steps 5 and 6 by tuning the Undesired VDL Mode 2 Signal Source frequency to a mid band test frequency for each of the bands defined for unwanted signal A in Section 2.2.1.2.4.

Step 8 Repeat Steps 5 and 6 by tuning the Undesired VDL Mode 2 Signal Source frequency to an upper band test frequency for each of the bands defined for unwanted signal A in Section 2.2.1.2.4.

Step 9 Repeat Steps 2 to 8 for the bands defined for unwanted signals B and C in Section 2.2.1.2.4.

Step 10 Repeat the Steps 2 to 9 for the desired signal on the remaining test frequencies.

Notes:

1. *The noise sidebands of the interfering signal must not interfere with the desired signal in the receiver passband. The isolation, offered by the RF combiner, must be sufficient to prevent intermodulation between the VHF generators.*

2. *Any interfering signal found to increase the BER above the reference BER should be investigated using a spectrum analyzer connected to the combiner output. This should determine whether the RF combiner/test setup is producing an on-channel signal into the receiver under test.*

3. *Alternative procedures or theoretical calculation may be used to reduce the number of discrete frequencies which need to be tested.*

2.4.4.1.5 Desired Signal Dynamic Range

Reference: Section 2.2.1.2.5

Equipment Required

Desired VDL Mode 2 Signal Source

External BER Test Fixture (optional)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is not required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the desired VDL Mode 2 Signal Source (Section 2.4.2.3), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as appropriate. Adjust the level of the signal generator to produce the maximum desired signal level (Section 2.2.1.2.5) at the receiver input.

Step 4 Apply the modulated signal to the receiver. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirements of Section 2.2.1.2.

Step 5 Repeat Steps 2 to 4 for the other two test frequencies (Section 2.4.4).

2.4.4.1.6 Symbol Rate Capture Range

Reference: Section 2.2.1.2.6

Equipment Required

Desired VDL Mode 2 Signal Source

External BER Test Fixture (optional)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is not required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the desired VDL Mode 2 Signal Source (Section 2.4.2.3), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as appropriate. Adjust the level of the signal generator to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 4 Adjust the transmitted data clock offset of the external BER test fixture to the maximum offset specified in Section 2.2.1.2.6. Alternatively, adjust the transmitted data clock of the VDL Mode 2 Data Generator to the maximum offset specified in Section 2.2.1.2.6

Step 5 Apply the modulated signal to the receiver. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirements of Section 2.2.1.2.

Step 6 Repeat Steps 4 and 5 after adjusting the transmitted data clock offset to the minimum offset specified in Section 2.2.1.2.6.

Step 7 Repeat Steps 2 to 6 for the other two test frequencies (Section 2.4.4).

2.4.4.1.7 Frequency Capture Range

Reference: Section 2.2.1.2.7

Equipment Required

Desired VDL Mode 2 Signal Source

External BER Test Fixture (optional)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is not required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the desired VDL Mode 2 Signal Source (Section 2.4.2.3), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4) plus the frequency offset (Section 2.2.1.2.7).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as

appropriate. Adjust the level of the signal generator to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 4 Apply the modulated signal to the receiver. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirements of Section 2.2.1.2.

Step 5 Repeat Steps 3 and 4 for the negative frequency offset (Section 2.2.1.2.7).

Step 6 Repeat Steps 3 to 5 for the other two test frequencies (Section 2.4.4).

2.4.4.1.8 Phase Acceleration

Reference: Section 2.2.1.2.8

Equipment Required

RF Signal Generator (HP8644A or equivalent)

Programmable Function Generator (HP3325A or equivalent)

Desired VDL Mode 2 Signal Source

Mixer (WJN9B or equivalent)

External BER Test Fixture (optional)

Measurement Procedure

Step 1 In the standard setup of Figure 2-3 or Figure 2-4, replace the Desired VDL Mode 2 Signal Source by a frequency modulated signal source, as shown in Figure 2-15. Set the Function Generator to create a sine wave at a rate of 0.8 Hz. Use the function generator output to frequency modulate the RF signal source at a peak frequency deviation of 200 Hz. Set the RF signal source to generate a carrier frequency of 2 MHz.

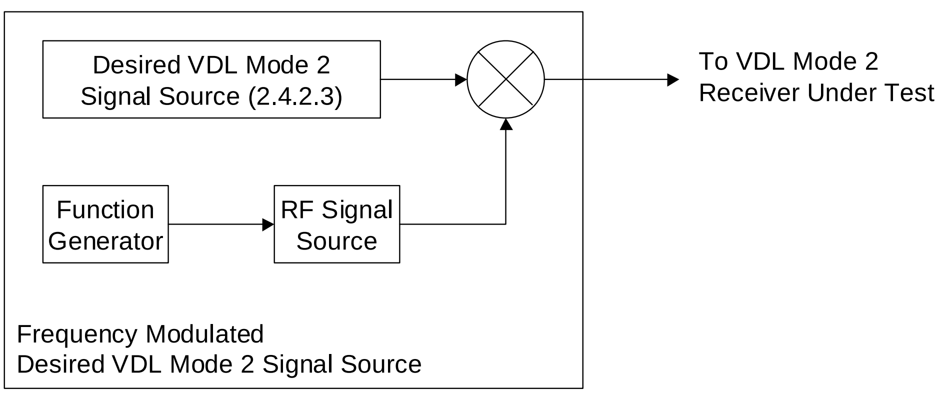


Figure 2-15: Frequency Modulated VDL Mode 2 Source

Step 2 Set the desired VDL Mode 2 Signal Source to generate an input signal to the receiver at 2 MHz below one of the test frequencies (Section 2.4.4) plus the frequency offset (Section 2.2.1.2.7). Set the receiver under test for the associated test frequency.

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as

appropriate. Adjust the level of the signal generator to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 4 Apply the data- and frequency modulated signal to the receiver under test. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirements of Section 2.2.1.2.

Step 5 Repeat Steps 2 to 4 for the other two test frequencies (Section 2.4.4).

2.4.4.1.9 Co-Channel Interference

Reference: Section 2.2.1.2.9

Equipment Required

Desired VDL Mode 2 Signal Source

Undesired VDL Mode 2 Signal Source

External BER Test Fixture (optional)

RF Combiner

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 or Figure 2-4, as appropriate. Notice that the RF combiner is required for this test. Set the receiver to BER mode, if appropriate.

Step 2 Set the desired VHF Signal Generator (Section 2.4.2.3.2), to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Modulate the desired signal with an appropriate test payload from either the VDL Mode 2 Data Generator (Section 2.4.2.3.1) or the BER Tester, as appropriate. Adjust the level of the signal generator to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 4 Tune Undesired VDL Mode 2 Signal Source to the receiver channel frequency and generate an Undesired VDL Mode 2 test signal. Adjust the level of the Undesired VDL Mode 2 Signal Source to provide an interfering signal level 20 dB below the reference signal level (Section 2.2.1.2) at the receiver input..

Step 6 Apply the desired signal and the undesired signal to the receiver input via the RF combiner. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirements of Section 2.2.1.2.

Step 7 Repeat Steps 3 to 6 for the other two test frequencies (Section 2.4.4).

2.4.4.1.10 Conducted Spurious Emission

Reference: Section 2.2.1.2.10

Equipment Required

Spectrum Analyzer

Measurement Procedure

Step 1 Connect the RF output of the equipment under test directly into the RF input of the spectrum analyzer. **Exercise caution:** do not allow the transmitter to radiate.

Step 2 Tune the transceiver to one of the test frequencies (Section 2.4.4).

Step 3 Using the spectrum analyzer, measure the power level of spurious emissions over the frequency range defined in Section 2.2.1.2.10.

Step 4 Record the frequency and power level of all spurious emissions, which are stronger than 20 dB below the limits specified in Section 2.2.1.2.10.

Step 5 Repeat Steps 2 to 4 for the other two test frequencies (Section 2.4.4).

Step 6 Check that the requirements of Section 2.2.1.2.10 are achieved for all three test frequencies (Section 2.4.4).

2.4.4.1.11 FM Broadcast Intermodulation

Reference: Section 2.2.1.2.11

Equipment Required

Desired VDL Mode 2 Signal Source

Undesired VDL Mode 2 Signal Source

VHF Signal Generator

External BER Test Fixture (optional)

RF Combiner

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-16 or Figure 2-17.

Step 2 Use the Desired VDL Mode 2 Signal Source as Signal Generator A. Tune Signal Generator A to one of the test frequencies (Section 2.4.4). Modulate the output of Signal Generator A with either an appropriate test payload in burst form provided by the external BER test fixture, or a test payload provided by the data generator, as appropriate. Adjust the level of Signal Generator A to produce the reference signal level (Section 2.2.1.2) at the receiver input.

Step 3 Use the Undesired VDL Mode 2 Signal Source as Signal Generator B and the VHF Signal Generator as Signal Generator C.

Step 4 Determine the appropriate third order intermodulation frequencies F_b and F_c in Note 2 below and tune signal generators B and C to the frequencies F_b and F_c to produce unmodulated signals. Adjust generators B and C to produce the levels specified in Section 2.2.1.2.11 at the receiver input.

Step 5 Apply the desired signal and the two interfering signals to the receiver input via the RF combiner. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirements of Section 2.2.1.2.

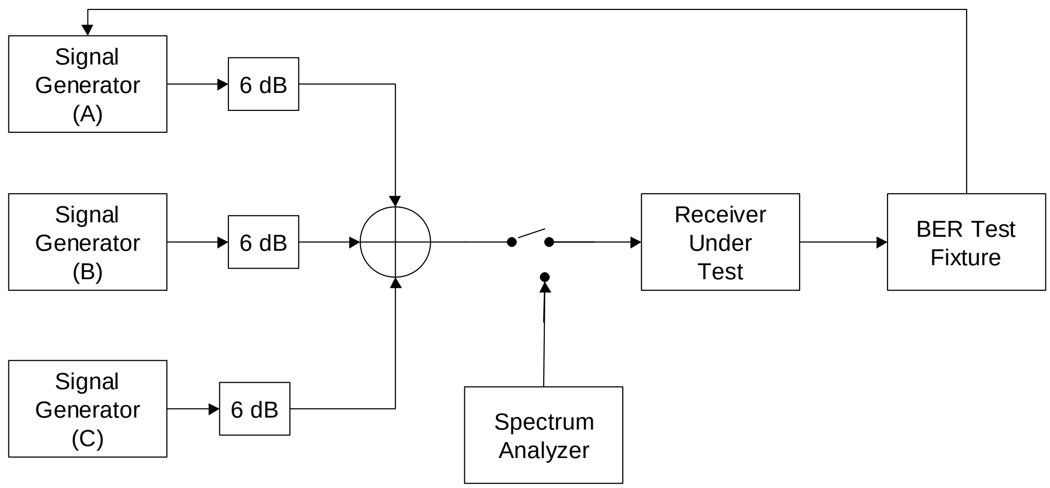
Step 6 Repeat Steps 3 to 5 for the other two test frequencies (Section 2.4.4).

Notes:

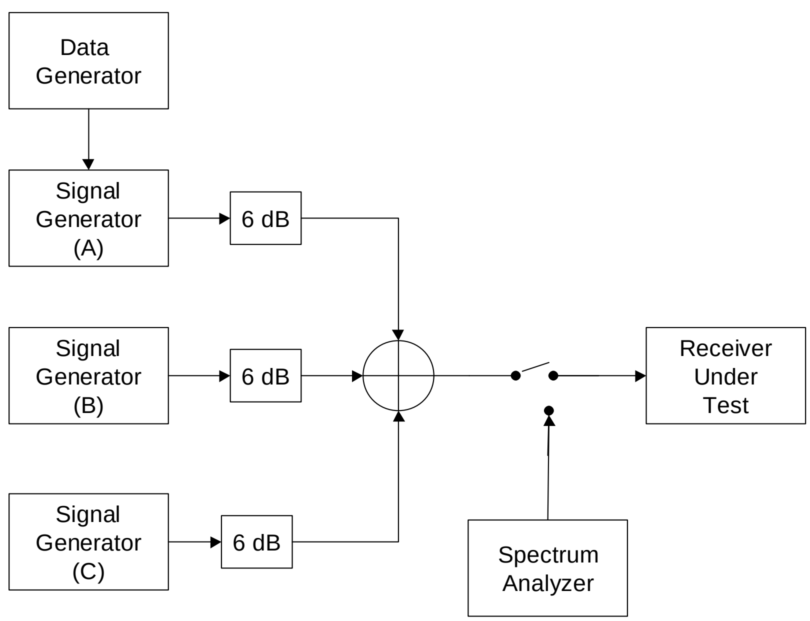
1. *The noise sidebands of the interfering FM modulated signals must not interfere with the desired signal in the receiver passband. The isolation, offered by the RF combiner, must be such that it prevents intermodulation between the generators.*

2. *Third order intermodulation frequencies are defined as:*

$$F_A = 2\ F_B - F_C \qquad or\, F_A = 2\ F_C - F_B$$



<u>Figure 2-16:</u> Intermodulation Measurement (BER)



<u>Figure 2-17:</u> Intermodulation Measurement (FER)

2.4.4.1.12 In-Band Intermodulation/Desensitization

Reference: Section 2.2.1.2.12

<u>Equipment Required</u>

Desired VDL Mode 2 Signal Source

Undesired VDL Mode 2 Signal Source

VHF Signal Generator

External BER Test Fixture (optional)

RF Combiner

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-16 or Figure 2-17.

Step 2 Use the Desired VDL Mode 2 Signal Source as Signal Generator A to generate the desired input signal to the receiver. Use the Desired VDL Mode 2 Signal Source as Signal Generator A. Tune Signal Generator A to one of the test frequencies (Section 2.4.4). Modulate the output of Signal Generator A with either an appropriate test payload in burst form provided by the external BER test fixture, or a test payload provided by the data generator, as appropriate. Adjust the level of Signal Generator A to produce a signal level of –75 at the receiver input.

Step 3 Use the VHF Source as interfering Signal Generator B. Tune Signal Generator B to a frequency 1 MHz above the selected channel frequency. Set Signal Generator B to produce an unmodulated carrier to the input of the receiver at minus 32 dBm.

Step 5 Use the Undesired VHF Source as interfering Signal Generator C. Tune Signal Generator C to a frequency 2 MHz above the selected test frequency. Create an Undesired VDL Mode 2 Signal with Generator C at a level of minus 32 dBm.

Step 6 Apply the desired signal and the two interfering signals to the receiver input via the RF combiner. Use the process of Section 2.4.2.1 or Section 2.4.2.2, as appropriate, to determine the error rate. Verify compliance with the error rate requirements of Section 2.2.1.2.

Step 7 Repeat Steps 3 to 6 for the other two test frequencies (Section 2.4.4).

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 & C, must be less than minus 105 dBm at the receiver input. Additional band-pass filters, inserted between each generator and the R.F combiner, may be necessary to reduce the intermodulation product.*

2.4.4.2 Transmitter Test Procedures

Vector Signal Analyzers integrate frequency-domain and time domain analyses to provide advanced measurements of complex signals. These analyzers offer complex signal analysis such as digital modulation (i.e. D8PSK for VDL Mode 2) plus AM/FM/PM demodulation, vector spectrum analysis and time-gated spectrum analysis.

2.4.4.2.1 Bit Rate

Reference: Section 2.2.1.3.1

This requirement may be satisfied by written evidence.

In this case, the manufacturer must declare crystal stability, aging and temperature coefficients.

Note: *The evidence must demonstrate that consideration has been given to the temperature variation to which the equipment will be subjected (See Chapter 4, "Environmental Test Conditions") and the frequency range for which the equipment is designed to operate.*

2.4.4.2.2 RF Output Power

Reference: Section 2.2.1.3.2

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

Power Meter (with pulse power measurement capability) or Vector Signal Analyzer.

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-18.

Step 2 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 3 Key the transmitter under test "on" and modulate the carrier with an appropriate test payload in burst form from the transmission generator.

Step 4 Set the power meter (or vector signal analyzer) to capture the VDL Mode 2 transmitted signal and determine the average transmitter output power during the message period.

Step 5 Repeat Steps 2 to 4 for the other two test frequencies (Section 2.4.4).

Step 6 Check that the measured output power is not less than the requirement for the appropriate class of transmitter under test (Section 2.2.1.3.2) for all three test frequencies (Section 2.4.4).

Note: *The output power must not be averaged over the time intervals between signal transmissions, i.e., output power delivered into 50 ohm load should be measured during signal transmission.*

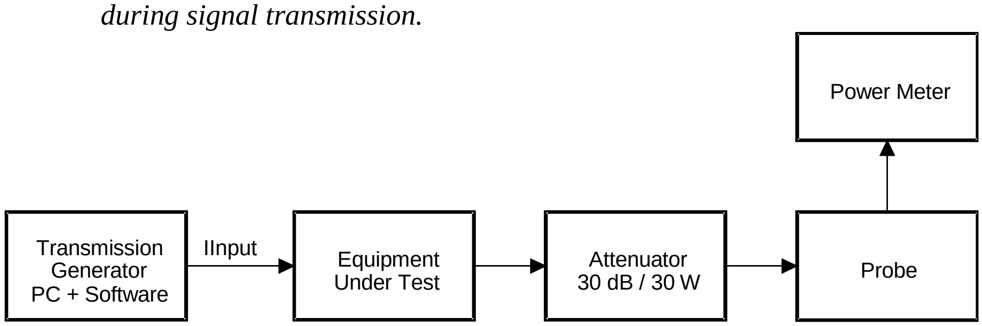


Figure 2-18: Output Power Measurement

2.4.4.2.3 RF Power Rise Time

Reference: Section 2.2.1.3.3

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

Vector Signal Analyzer

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-19.

Step 2 Configure the vector signal analyzer to display both constellation diagram and power versus time charts.

Step 3 Tune the transmitter and the vector signal analyzer to one of the test frequencies (Section 2.4.4).

Step 4 Use the transmission generator to generate a single test-burst.

Step 5 Capture the start of the test-burst using both constellation and power versus time display and identify the first symbol of the synchronization sequence.

Step 6 Check that the power level at 5.5 symbol periods before the middle of the first synchronization symbol is as defined in Section 2.2.1.3.3.

Step 7 Check that the RF power level for the 3 symbol periods before the middle of the first synchronization symbol is as defined in Section 2.2.1.3.3

Step 8 Check that the RF power rise time (defined in Section 2.2.1.3.3) is achieved.

Step 9 Repeat Steps 3 to 8 for the other two test frequencies (Section 2.4.4).

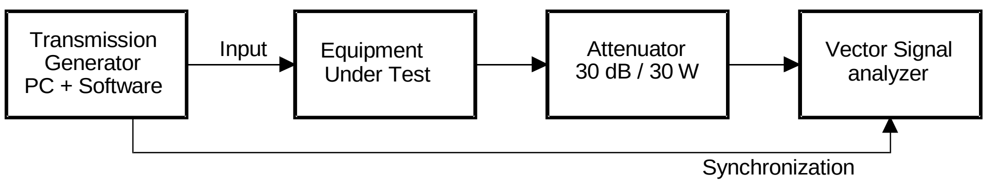
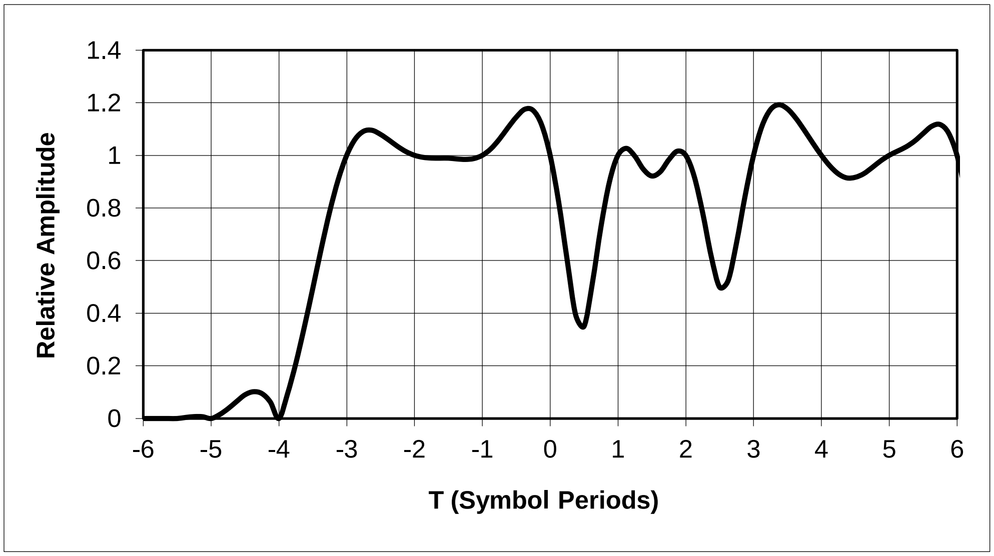


Figure 2-19: RF Power Rise and Release Time Measurement

Note: *The training sequence has a characteristic amplitude profile. For the synchronization sequence, the profile appears as shown in Figure 2-20. The point labeled T=0 is the middle (ideal sampling point) of the first symbol of the synchronization sequence. There is a pronounced notch in the profile at T=0.5, which provides a convenient marker. This makes it easy to check the power level at the appropriate time, which is 3.5 symbol periods prior to the notch, i.e., at T=-3. This could constitute an alternative method using a standard spectrum analyzer or fast storage oscilloscope.*



T=0 is the Middle of the First Symbol of the Synchronization Sequence.

Figure 2-20: Ramp Up and Beginning of VDL Mode 2 Synchronization Sequence

2.4.4.2.4 RF Power Release Time

Reference: Section 2.2.1.3.4

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

Vector Signal Analyzer

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-19.

Step 2 Configure the vector signal analyzer 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.

Step 3 Tune the transmitter and the vector signal analyzer to one of the test frequencies (Section 2.4.4).

Step 4 Use the transmission generator to produce a single burst message. Capture the end of this message on the vector signal analyzer.

Step 5 Use the power versus time display to determine the corresponding profile for each symbol of the "power down" ramp.

Step 6 Repeat Steps 3 to 5 for the other two test frequencies (Section 2.4.4)

Step 7 Check that the RF power release time (defined in Section 2.2.1.3.4) is achieved for all three test frequencies (Section 2.4.4).

2.4.4.2.5 Symbol Constellation Error

Reference: Section 2.2.1.3.5

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

Vector Signal Analyzer (with EVM capability)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-19.

Step 2 Tune the vector signal analyzer and the transmitter to one of the test frequencies (Section 2.4.4) and the correct modulation scheme, and select a suitable level range.

Step 3 Key the transmitter under test "on" and modulate it with an appropriate test payload in continuous form produced by the transmission generator.

Step 4 Record the EVM.

Step 5 Repeat Steps 2 to 4 for the other two test frequencies (Section 2.4.4).

Step 6 Check that the results are within the limits specified in Section 2.2.1.3.5 for all three test frequencies (Section 2.4.4).

2.4.4.2.6 Spurious Emissions

Reference: Section 2.2.1.3.6

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

Notch Filter or Bandpass Filter (capable of suppressing the on-channel signal by at least 60 dB)

Spectrum Analyzer (with power band marker function)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-21.

Step 2 Use the filter to reject the on-channel signal in order 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.

Step 3 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 4 Set the transmission generator to produce an appropriate test payload in burst form and key the transmitter under test "on".

Step 5 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.

Step 6 Measure the power level of each visible spurious signal using power band markers appropriate to the bandwidths specified in Section 2.2.1.3.6. Use the filter to reject the carrier in order to increase the dynamic range of the measurement without overloading the spectrum analyzer.

Step7 Measure the frequency response of the filter and take this into account when presenting spurious measurement results. If a bandpass filter is used, it will need to be tuned to several measurement frequencies, covering the overall measured frequency range.

Step 8 Repeat Steps 3 to 7 for the other two test frequencies (Section 2.4.4).

Step 9 Check that the results do not exceed the limits specified in Section 2.2.1.3.6 for all three test frequencies (Section 2.4.4).

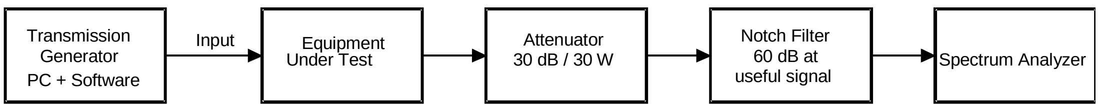


Figure 2-21: Spurious Emissions Measurement

2.4.4.2.7 Adjacent Channel Power

Reference: Section 2.2.1.3.7

Method of measurement for the first adjacent channel

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

Spectrum Analyzer (with power band marker function)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-22.

Step 2 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 3 Key the transmitter under test "on" and modulate it with the transmission generator to produce an appropriate test payload in burst form.

Step 4 Adjust the attenuator in the analyzer to the minimum value, which does not overload the input stage of the unit.

Step 5 Using 100 kHz span, display the Mode 2 signal envelope. Use the analyzer IF signal as the trigger source for the display and set averaging to 10.

Step 6 Using the power band marker function of the analyzer, measure the power in a 16 kHz bandwidth of the first upper adjacent channel.

Step 7 Repeat Step 6, except measure the power in a 25 kHz bandwidth of the first upper adjacent channel.

Step 8 Repeat Steps 3 to 7 for the first lower adjacent channel.

Step 9 Record the higher of the two measured values for the 16 kHz-bandwidth and 25 kHz-bandwidth measurements. Check that the first adjacent channel powers in the 16 kHz bandwidth and 25 kHz bandwidth are lower than the first adjacent channel power requirements for 16 kHz and 25 kHz bandwidths respectively (defined in Section 2.2.1.3.7).

Step 10 Repeat Steps 2 to 9 for the other two test frequencies (Section 2.4.4).

Step 11 Repeat Steps 2 through 10 with the spectrum analyzer set to peak hold and verify that the adjacent channel power measurements satisfy the requirements of Section 2.2.1.3.7 when compensating for the increased power measurement due to peak measurement versus average measurement.

Note 1: As an example, Agilent Application Note 1303, page 18, shows that the peak measurement can be 10 dB greater than the average value under some circumstances. Manufacturers are cautioned to verify the appropriate peak to average ratio for their test setup.

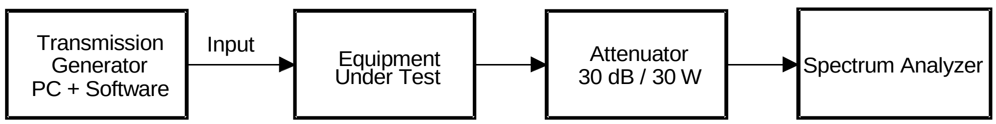


Figure 2-22: First Adjacent Channel Power Measurement

Method of measurement for the second and third adjacent channels

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

VF Bandpass Filters each with a 3 dB bandwidth of 25 kHz and attenuation in excess of 50 dB at ±50 kHz with center frequencies as follows:

Low-channel filter center frequency: Low channel test frequency (Section 2.4.4) plus 100 kHz

Mid-channel filter center frequency: Mid channel test frequency (Section 2.4.4)

High-channel filter center frequency: High channel test frequency (Section 2.4.4) minus 100 kHz

Note 2: The bandpass filter center frequency insertion loss and passband frequency response must be taken into account in all measurements.

Spectrum Analyzer (with power band marker function)

Measurement Procedure

CAUTION: *To protect the analyzer, ensure that the transmitter is not keyed "on" at the frequency of the bandpass filter used for this test.*

Step 1 Connect the equipment as shown in Figure 2-23.

Step 2 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 3 Offset the tuned frequency of the transmitter under test to 50 kHz above the VHF bandpass filter center frequency. Key the transmitter under test "on". Use the transmission generator to produce an appropriate test payload in burst form.

Step 4 Set the analyzer span to 50 kHz and tune the analyzer to the center frequency of the VHF bandpass 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 as the trigger source for the display and set averaging to 10.

Step 5 Set the analyzer’s power band marker function to 40 kHz. Notice that the measurement bandwidth (25 kHz) is defined by the VHF bandpass filter; setting the power band marker to the same bandwidth will give erroneous results.

Step 6 Determine the second lower adjacent channel power.

Step 7 Repeat Steps 3 to 6 with the transmitter under test tuned to 50 kHz below the center frequency of the bandpass filter. Determine the upper second adjacent channel power.

Step 8 Record the higher of the two measured values as the second adjacent channel power.

Step 9 Check that the second adjacent channel power is less than the second adjacent channel power requirement (defined in Section 2.2.1.3.7).

Step 10 Repeat Steps 2 to 9 for the other two test frequencies (Section 2.4.4).

Step 11 Repeat Steps 2 through 10 with the spectrum analyzer set to peak hold and verify that the adjacent channel power measurements satisfy the requirements of Section 2.2.1.3.7 when compensating for the increased power measurement due to peak measurement versus average measurement. See Note 1.

Step 12 Repeat Steps 2 through 11 with the selected VDL Mode 2 channels being 75 kHz above and 75 kHz below the test frequencies.

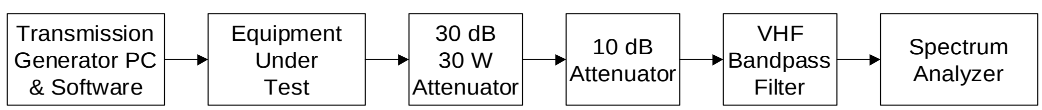


Figure 2-23: Second, Third and Fourth Adjacent Channel Power Measurement

Method of measurement for the fourth adjacent channel

Equipment Required

Transmission Generator (PC with suitable software)

Attenuator (30 dB/30 W)

VF Bandpass Filters each with a 3 dB bandwidth of 25 kHz and attenuation in excess of 50 dB at ±50 kHz with center frequencies as follows:

Low-channel filter center frequency: Low channel test frequency (Section 2.4.3.2.4.4) plus 100 kHz

Mid-channel filter center frequency: Mid channel test frequency (Section 2.4.3.2.4.4)

High-channel filter center frequency: High channel test frequency (Section 2.4.3.2.4.4) minus 100 kHz

Note 3: The bandpass filter center frequency insertion loss and passband frequency response must be taken into account in all measurements.

Spectrum Analyzer (with power band marker function)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-23.

Step 2 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 3 Offset the tuned frequency of the transmitter under test to 100 kHz above the VHF bandpass filter center frequency. Key the transmitter under test “on”. Use the transmission generator to produce a test payload in burst form.

Step 4 Set the analyzer span to 50 kHz and the center frequency to the center frequency of the VHF bandpass 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 as the trigger source for the display and set averaging to 10.

Step 5 Set the analyzer’s power band marker function to 40 kHz. Notice that the measurement bandwidth (25 kHz) is defined by the VHF bandpass filter; setting the power band marker to the same bandwidth will give erroneous results.

Step 6 Determine the fourth lower adjacent channel power.

Step 7 Repeat Steps 3 to 6 with the transmitter under test tuned to 100 kHz below the bandpass filter. Determine the fourth upper adjacent channel power.

Step 8 Record the higher of the two measured values as the fourth adjacent channel power.

Step 9 Check that the fourth adjacent channel power is less than the fourth adjacent channel power requirement (defined in Section 2.2.1.3.7).

Step 10 Repeat Steps 2 to 9 for the other two test frequencies (Section 2.4.4).

Step 11 Repeat Steps 2 through 10 with the spectrum analyzer set to peak hold and verify that the adjacent channel power measurements satisfy the requirements of Section 2.2.1.3.7 when compensating for the increased power measurement due to peak measurement versus average measurement. See Note 1.

Alternative Measurement Procedure for Adjacent Channel Power

Step 1 Connect the equipment as shown in Figure 2-24.

Step 2 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 3 Start the transmission generator that produces test payload in burst form.

Step 4 Use an attenuator to protect the measurement equipment and a notch filter centered on the carrier frequency, if the dynamic range of the spectrum analyzer is not sufficient. Set the spectrum analyzer resolution bandwidth (Br) much narrower than the channel bandwidth and the video bandwidth (Bv) equal to ten times Br in order to avoid errors due to video averaging of noise.

Step 5 Measure and store the RF signal spectrum centered on the carrier frequency with a frequency span wide enough to display the entire modulation spectrum between the -80 dB points, referred to the peak value.

Step 6 Convert the logarithmic trace values from the spectrum analyzer to linear spectral power densities by the relation:

$$P_i = \frac{10^{\frac{PidBm}{10}}}{B_n}$$

where P_{idBm} = Trace values (dBm)

B_n = Effective noise bandwidth of the spectrum analyzer (Hz)

P_i = Spectral power densities (mW/Hz)

*Note 4: B_n = k * Br, where k is a constant specified for each spectrum analyzer.*

Step 7 Perform integration of the linear spectral power densities. For computation of the linear spectral power values in the first, second and fourth adjacent channels, use the formula:

$$P_{ch} = B_{ch} \times \frac{1}{N} \times \sum_{i=1}^{N} P_i$$

where P_{ch} = power in the considered channel

B_{ch} = assigned bandwidth of the first, second or forth adjacent channel.

N = Number of power samples within the limits of the considered channel (assigned bandwidth B_{ch}).

Step 8 Perform the adjacent channel measurement for the first, second, third, and fourth adjacent channels on both sides of the carrier frequency (lower and upper adjacent channels).

Step 9 Check that the adjacent channel power on either side of the carrier for the first, second, third, and fourth adjacent channels are lower than the respective adjacent channel power requirements.

Step 10 Repeat Steps 2 to 9 for the other two test frequencies (Section 2.4.4).

Step 11 Repeat Steps 2 through 10 with the spectrum analyzer set to peak hold and verify that the adjacent channel power measurements satisfy the requirements of Section 2.2.1.3.7 when compensating for the increased power measurement due to peak measurement versus average measurement. See Note 1.

Measurement Procedure for Beyond Fourth Adjacent Channel

Step 1 Connect the equipment as shown in Figure 2-24.

Step 2 Use the notch filter to attenuate the carrier in order 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.

Step 3 Use the transmission generator and key the transmitter under test with repetitive test payload in burst form.

Step 4 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 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.

Step 6 Record the transmitter noise level measured in each 25 kHz channel bandwidth in the 5^{th} adjacent channel through the 32^{nd} adjacent channel using the power band marker function of the analyzer.

Step 7 Plot each measured adjacent channel power in dBm versus its adjacent channel number in linear/linear scale. Also plot the maximum level spectrum mask on the same graph by interconnecting the points (4, -38 dBm) and (32, -53 dBm) with a straight line.

Note 5: The two points (4, -38) and (32, -53) in Step 7 define the 5 dB per octave slope that limits the wideband noise between the 4^{th} and 32^{nd} adjacent channels as defined in Section 2.2.1.3.7.

Step 8 Verify that the measured adjacent channel powers between the 4^{th} and 32^{nd} adjacent channel are below the maximum level spectrum mask plotted in Step 7.

Step 9 Mark on the spectrum analyzer the spectrum level at the 32^{nd} adjacent channel corresponding to a power level of –53 dBm in a 25 kHz band.

Step 10 Observe the power spectrum on the scope to verify that the RF spectrum beyond the 32^{nd} adjacent channel is no more than the level established in Step 9 above.

Step 11 Repeat Steps 4 to 10 for the other test frequencies (Section 2.4.4). See Note 1.

Step 12 Verify that the wide-band noise does not exceed the limit specified in Section 2.2.1.3.7 for all three test frequencies (Section 2.4.4).

Step 13 Repeat Steps 2 through 12 with the spectrum analyzer set to peak hold and verify that the adjacent channel power measurements satisfy the requirements of Section 2.2.1.3.7 when compensating for the increased power measurement due to peak measurement versus average measurement.

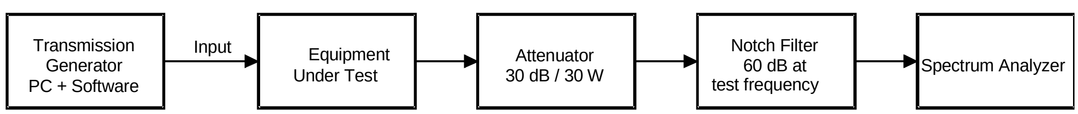


Figure 2-24: Measurement beyond 4^{th} Adjacent Channel

2.4.4.2.8 (Reserved)

2.4.4.2.9 Load VSWR Capability

Reference: Section 2.2.1.3.9

Equipment Required

Transmission Generator (PC with suitable software)

30 dB Directional Coupler

Adjustable Delay Line

2:1 VSWR Resistive Load

Vector Signal Analyzer (with power band marker function)

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-25.

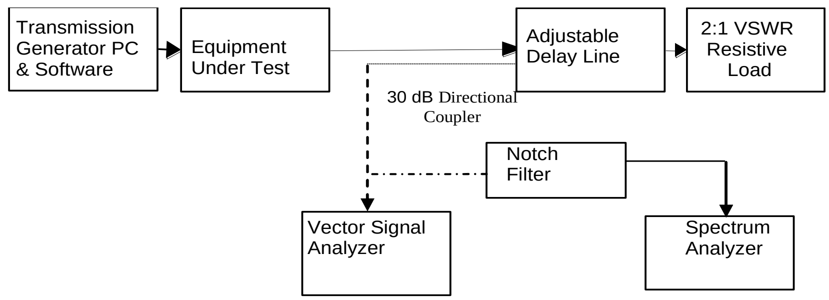
Step 2 Tune the transmitter to one of the test frequencies (Section 2.4.4).

Step 3 Key the transmitter under test with the transmission generator with repetitive test payload in continuous form.

Step 4 Vary the VSWR phase angle of the load with the delay line and measure the minimum average forward RF output power from the Transmitter using the power band marker function of the vector signal analyzer.

Step 5 Repeat Steps 2 to 4 for the other two test frequencies (Section 2.4.4).

Step 6 Check that the minimum average forward RF output power is greater than the limit defined in Section 2.2.1.3.9 for all three test frequencies (Section 2.4.4).



<u>Figure 2-25</u>: Load VSWR Capability

Step 7 Perform the tests defined in step 2 through 11 of Section 2.4.4.2.7

<u>Note:</u> *Adjust the delay line for worst adjacent power for whatever channel is being measured. Repeat for low, mid and high frequency carrier frequencies.*

Step 8 Perform the tests defined in step 2 through 9 of Section 2.4.4.2.6

2.4.4.2.10 Frequency Tolerance

Reference: Section 2.2.1.3.10

This requirement may be satisfied by written evidence.

In this case, the manufacturer shall declare crystal stability, aging and temperature coefficients, and provide evidence that the design supports the requirements. The evidence shall demonstrate that consideration has been given to the temperature variation to which the equipment will be subjected (See Section 2.3) and the frequency range for which the equipment is designed to operate.

2.4.4.3 Physical Layer System Level Test Procedures

2.4.4.3.1 Receive to Transmit Switching Time

Reference: Section 2.2.1.1.4

<u>Equipment Required</u>

Transmission Generator, or PC with suitable software

50 dB attenuator

30 dB attenuator

2 20 dB directional couplers

PIN diode attenuator

VHF signal generator

RF combiner

Vector Signal Analyser (VSA) with power band marker function

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-26.

Step 2 Configure the VSA to display Power versus Time, external trigger enabled.

Step 3 Set the VHF signal generator to produce an on-channel CW signal of minus 80 dBm at the input to the equipment under test. Set the PIN diode attenuator to 0 dB.

Step 4 Use the transmission generator to set the MAC parameters for the equipment under test:

TM2 (Channel busy) = 120 seconds.

P (Persistance) = 1

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

Step 5 Use the transmission generator to load the equipment under test with a minimum length VDL Mode 2 message and request transmission of the message by the equipment under test.

Step 6 Use the computer control to set the PIN attenuator to 20 dB and trigger the VSA.

Step 7 Use the VSA to confirm that the 20 dB signal attenuation "step" occurred in an insignificant time. Measure the time interval until between the step and commencement of transmission, determined by the transmitter output achieving 90 % of rated RF. power.

Step 8 After accounting for the minimum inter-access time (TM1), calculate the receive to transmit "turn-around" time. Check that the maximum allowable receive to transmit turn-around time has not been exceeded.

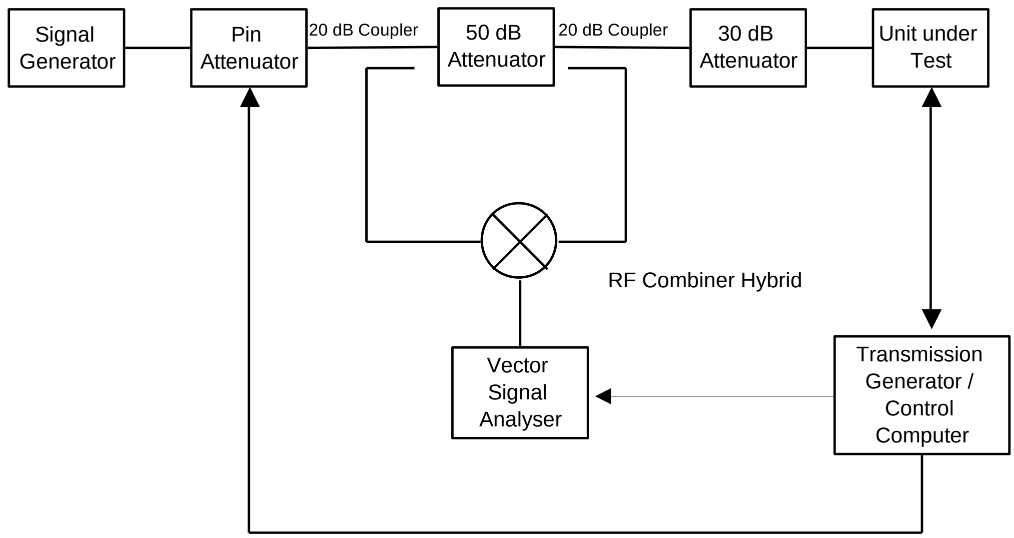


Figure 2-26: Receive to Transmit Turn-Around Time Measurement

2.4.4.3.2 Transmit to Receive Switching Time

Reference: Section 2.2.1.1.5

Equipment Required

Transmission Generator, or PC with suitable software

Arbitrary Waveform Generator (AWG)

Vector Signal Generator

2 30 dB attenuators

2 20 dB directional couplers

VHF signal generator

RF combiner

Vector Signal Analyzer with power band marker function

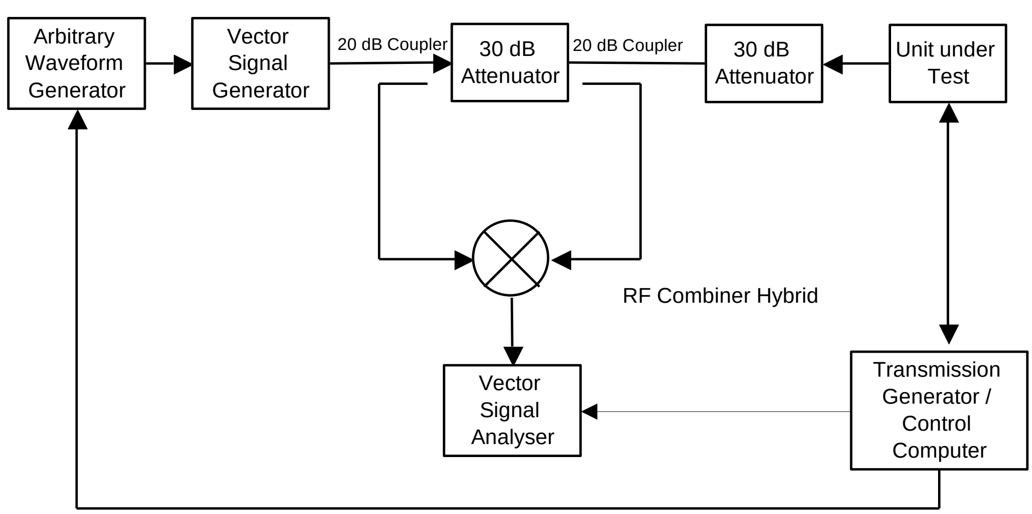


Figure 2-27: Transmit to Receive Turn-Around Time Measurement

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-27.

Step 2 Configure the VSA to display Power versus Time, external trigger enabled.

Step 3 Set the VSA to provide a signal of minus 60 dBm at the input of the equipment under test.

Step 4 Load the Arbitrary Waveform Generator (AWG) with a valid VDL Mode 2 message.

Step 5 Use the transmission generator to set the MAC parameters for the equipment under test:

TM2 (Channel busy) = 120 seconds.

P (Persistance) = 1

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

Step 6 Load a minimum length VDL Mode 2 message into the equipment under test. Request transmission of this message and trigger the VSA.

Step 7 Record the time interval between the trigger event and the cessation of transmission from the equipment under test. Use the result to calculate the minimum time between the transmit request and the trigger event for the AWG.

Step 8 Load the equipment under test with a minimum length VDL Mode 2 message and request transmission.

Step 9 Check whether the equipment under test had successfully received the transmission from the AWG.

Step 10 If the AWG transmission was not correctly received, increase the AWG time delay and repeat Step 8 until the equipment under test has successfully received the minimum length messages from the AWG.

Step 11 Check that the maximum transmit to receive turn-around time has not been exceeded.

2.4.4.3.3 Channel Sensing

Reference: Section 2.2.1.1.6
Equipment Required
Desired VDL Mode 2 Source
PIN diode attenuator, with 0, 5, >10 dB settings
Attenuator, 30 dB/30 W
Attenuator, 20 dB
2 VHF circulators
Storage scope
50 ohm load
Control unit or PC.

Measurement Procedure

Notes:

1: This procedure should be performed after successful completion of the MAC tests described in Section 2.4.5.3 and its subsections.

2: For Class Y equipment, a modified test procedure that measures the Channel Congestion output at the Data/Management Interface may be used.

Busy-to-Idle (carrier)

Step 1 Connect the equipment as shown in Figure 2-28.
Step 2 Set the PIN attenuator to the minimum attenuation and the LT to produce a signal of -95 +/- 2 dBm at the EUT.
Step 3 Configure the Programmable Pulse Generator to generate the waveform shown in Figure 2-29a when commanded by the Controller.
Step 4 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to: TM1 = 10ms, TM2 = 30 sec, *p* = 256/256, M1 = 1.
Step 5 Configure the PIN Attenuator to provide 5 dB of attenuation during the low period of the pulse waveform and switch the LT to CW mode.
Step 6 Configure the storage scope to trigger on the falling edge of the pulse waveform.
Step 7 Using the UT command the EUT to transmit data of any form.
Step 8 Using the Controller, trigger the Programmable Pulse Generator.
Step 9 After recording whether a transmission occurred, and at least 10 ms after the rising edge of the pulse waveform purge the EUT of any pending data and reset the scope.

Note: The pending data can be purged either using a command from the UT or by momentarily making the channel idle prior to the beginning of another trial.

Step 10 Repeat Steps 7 through 9 an additional 999 times.
Step 11 Verify that the EUT transmitted a message for fewer than 10% of the trials.
Step 12 Configure the Programmable Pulse Generator to generate the waveform shown in Figure 2-29b when commanded by the Controller.
Step 13 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to: TM1 = 10ms, TM2 = 30 sec, *p* = 256/256, M1 = 1.
Step 14 Configure the PIN Attenuator to provide 5 dB of attenuation during the low period of the pulse waveform and switch the LT to CW mode.
Step 15 Using the UT command the EUT to transmit data of any form.
Step 16 Using the Controller, trigger the Programmable Pulse Generator.
Step 17 After recording whether a transmission occurred, and at least 10 ms after the rising edge of the pulse waveform purge the EUT of any pending data and reset the scope.

Note: The pending data can be purged either using a command from the UT or by momentarily making the channel idle prior to the beginning of another trial.

Step 18 Repeat Steps 15 through 17 an additional 999 times.
Step 19 Verify that the EUT transmitted the message for at least 90% of the trials.

Busy-to-Idle (Mode 2 message)

Step 20 With the PIN attenuator configured to provide minimum attenuation, set the LT to produce a signal level of -95 +/- 2 dBm at the receiver input.
Step 21 Configure the PIN attenuator to provide at least 10 dB of attenuation.
Step 22 Configure the UT to send a data message to the EUT for transmission upon command by the Controller. Configure the Programmable Pulse Generator to produce a single step between high power and low power.
Step 23 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to: TM1 = 10ms, TM2 = 30 sec, p = 256/256, M1 = 1.
Step 24 From the LT send a maximum length VDL Mode 2 frame. At the conclusion of the transmission of the message header from the LT, and using the Controller, trigger the attenuator to produce at least 10 dB of attenuation and trigger the UT to send the data message to the EUT for transmission.
Step 25 Trigger the scope on the edge of the PIN diode control line. Verify that no transmitter action occurs until the conclusion of the transmission of the VDL frame from the LT.

Idle-to-Busy

Step 26 Set the PIN attenuator to the minimum attenuation and the LT to produce a signal of -98 +/- 2 dBm at the EUT.
Step 27 Configure the Programmable Pulse Generator to generate the waveform shown in Figure 2-29c when commanded by the Controller.
Step 28 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to: TM1 = 10ms, TM2 = 30 sec, p = 1/256, M1 = 2.
Step 29 Configure the PIN Attenuator to provide 5 dB of attenuation during the low period of the pulse waveform and switch the LT to CW mode.
Step 30 Configure the storage scope to trigger on the falling edge of the pulse waveform.
Step 31 Using the UT command the EUT to transmit data of any form.
Step 32 Using the Controller, trigger the Programmable Pulse Generator.
Step 33 After recording whether a transmission occurred, and at least 10 ms after the rising edge of the pulse waveform purge the EUT of any pending data and reset the scope.

Note: *The pending data can be purged either using a command from the UT or by momentarily making the channel idle prior to the beginning of another trial*.

Step 34 Repeat Steps 31 through 33 an additional 999 times.
Step 35 Verify that the EUT transmitted a message for fewer than 10% of the trials.

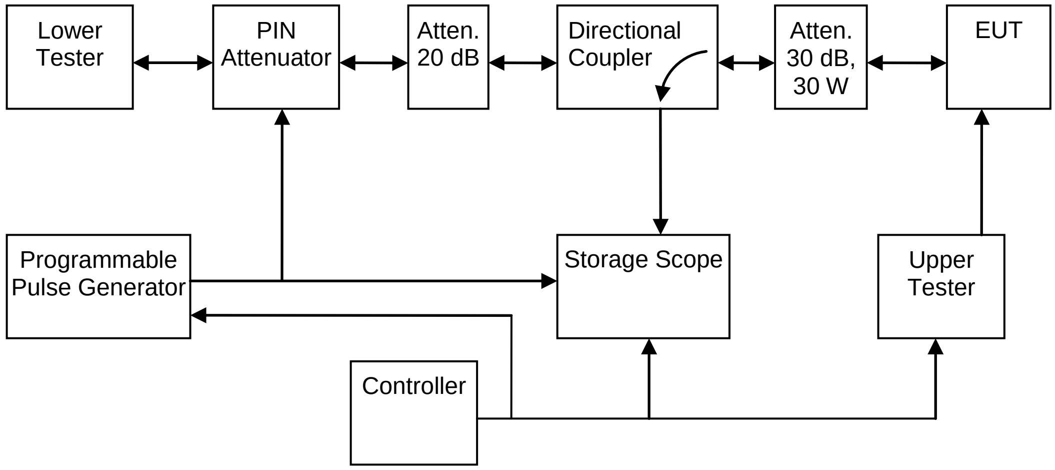


Figure 2-28: Channel Sensing Test Configuration

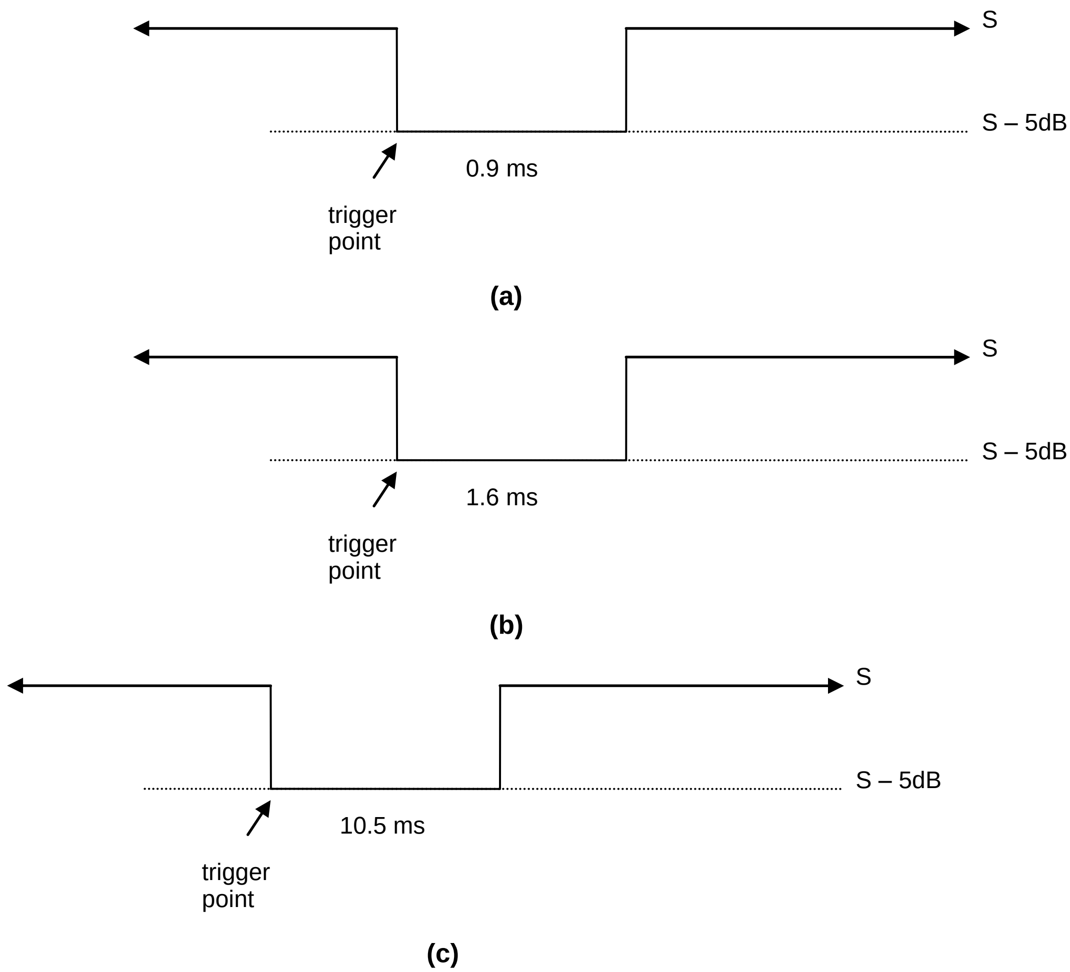


Figure 2-29: PIN Attenuator Control Signals for Channel Sense Test

2.4.4.3.4 Tuning Time

Reference: Section 2.2.1.1.3

The manufacturer shall submit written evidence to demonstrate compliance with this requirement.

2.4.5 VDL Mode 2 Link Layer Test Procedures

The following test procedures are considered to be a satisfactory means of establishing compliance with the Link layer requirements of Section 2.2.2 of this document.

2.4.5.1 Test Procedure Structure

ISO 9646 "Information Technology – Open Systems Interconnection – Conformance Testing Methodology and Framework" has been consulted for guidance in constructing the test procedures for verification of protocol layers above the Physical (D8PSK) level of the VDL Mode 2 protocol stack.

2.4.5.1.1 Overview of Test Cases

These tests are based on the Upper Tester and Lower Tester functionality described in Sections 2.4.3.1 and Section 2.4.3.2. The concepts of ISO 9646 were applied to provide additional structure in the test description. The following sections provide an overview of key elements of the ISO 9646 methodology.

The tests have been designed to maximize the interaction and observation within the Lower Tester.

2.4.5.1.2 Declarations Part

The Declaration Part outlines the test environment. Here the test equipment is defined. It also introduces the Points of Control and Observation (PCOs). These points are defined in the test setup where stimuli are injected and where the test results are observed. Wherever possible, the tests are arranged so that the PCO falls within the Lower Tester, thereby eliminating any dependence on the avionics architecture.

2.4.5.1.3 Constraints Part

The Constraints Part contains the definitions of the (AVLC) frames and (ISO 8208) packets, together with parameters which are used in the test Steps; the individual fields are all defined there.

2.4.5.1.4 Detailed Test Cases

Each test case is designed for the verification of a distinct function of the EUT. In order to allow the performance of individual test cases in any sequence, the test cases are designed to be independent from the previous tests; i.e., they contain all necessary Steps required to reach the test objective. Each test case therefore starts at a well-defined idle state of the EUT. In order to avoid effects on successive test cases execution, each test case must leave the EUT in the defined idle state after execution.

Unless otherwise noted, the test procedures assume that both link and network assumptions use default parameters as identified in DO-224C or as identified for the equipment under test.

2.4.5.1.5 Test Case Description

2.4.5.1.5.1 Procedure description

Each test case is related to a specific requirement established in Section 2.2. Each test will be described in tables similar to Table 2-3.

2.4.5.1.5.2 Message Sequence Charts

A message sequence chart stating the events (in terms of message exchange) that shall occur between the UT and LT will be added to the procedure description in most test cases.

One message is represented by a directed arrow between source and destination. Each arrow is named with the AVLC frame and further described using parameters of that AVLC frame, whenever specific parameter values are necessary for control of test operation.

2.4.5.1.6 Test Cases Macros

The following named macros are defined to facilitate the test descriptions. These macros consist of specific test actions that are done many times. They are always referred to by name.

<u>Table 2-3</u>: *Pro Forma* Test Description Table

Name	*Description*	
Test Case Name	The name of the test case used as a reference in the overall test suite	
Purpose	Describes the intention of the test case	
Reference	Provides a reference to the paragraphs of the requirements which are addressed by the test case	
Configuration	Describes which of several possible LT configuration is used to perform the test.	
Context	Indicates which part of the test case is executed. The following entries are defined:	
	Preamble	In this part of the test case the IUT is brought into the appropriate state to begin the test
	Test Body	In this part of the test case the actual test steps required for the verification are defined
	Postamble	In this part of the test case the IUT is brought into the defined idle state
Step	Numbers the individual test steps	
Action	Holds the action to be performed during the test. Following actions are defined:	
	DO	
	INHIBIT	
	RECEIVE	
	REPEAT	
	SEND	
	SET	
	VERIFY	
	WAIT	
PCO	Point of Control and Observation, which indicates where in the test set-up the action shall be performed. The following entries are used:	
	EUT	Equipment Under Test
	UT	Upper Tester
	LT	Lower Tester
	GSE *n*	The *n*-th Ground Station Emulator (for LT Configurations 2 and 3)
Action Qualifier	This is the main description of the test step; it defines or further qualifies the precise actions for the test step. In addition, it either holds one or more of the entries shown below:	
	A **time** to wait	
	A **macro name** with parameters value as appropriate	
Comment	A comment which adds information for understanding of the actual step	
Comments	An overall comment on the test case, if necessary	

2.4.5.1.6.1 Establish a link layer connection (SET_{AVLC})

Macro Name: SET_{AVLC}					
Purpose: Establish a link layer connection					
Parameters: No macro level parameters are required. However, parameter can be specified in the Action Qualifier field in the test procedure step that invokes this macro. For example, parameters of the GSIF sent in this macro can be further specified or changed in the Action Qualifier field of the test step.					
Reference:					
Context	Step	Action	PCO	Action Qualifier	Comment
Macro	1	SEND	LT	GSIF (v=0)	
	2	RECEIVE	LT	XID_CMD_LE (P=1)	
	3	SEND	LT	XID_RSP_LE (F=1)	
Comments:					

2.4.5.1.6.2 Establish (explicit) a network layer connection (SET_{8208})

Macro Name: SET_{8208}					
Purpose: Establish a network layer connection					
Parameters: no macro level parameters are required					
Reference:					
Context	Step	Action	PCO	Action Qualifier	Comment
Macro	1	SET_{AVLC}			
	2	SEND	UT	CALL REQUEST Packet	
	3	RECEIVE	LT	INFO Frame with CALL REQUEST Packet	
	4	SEND	LT	INFO Frame with CALL ACCEPTED Packet	
	5	RECEIVE	UT	CALL ACCEPTED packet	
Comments:					

2.4.5.1.6.3 Establish (expedited) a network layer connection

Macro Name: SET_{8208X}					
Purpose: Establish (expedited) a network layer connection					
Parameters: no macro level parameters are required					
Reference:					
Context	Step	Action	PCO	Action Qualifier	Comment
Macro	1	SEND	LT	GSIF with v =1	v=1 indicates support for expedited connection
	2	SEND	UT	CALL REQUEST Packet	
	3	RECEIVE	LT	XID_CMD_LE (P=1) with v = 1 and CALL REQUEST packet in the Expedited Subnetwork Connection parameter	
	4	SEND	LT	XID_RSP_LE (F=1) with v = 1 and CALL ACCEPTED Packet in the Expedited Subnetwork Connection parameter	
	5	RECEIVE	UT	CALL ACCEPTED packet	
Comments:					

2.4.5.1.6.4 Check link is established

Macro Name: $CHECK_{link}$					
Purpose: Check that a link is established between EUT and LT					
Parameters: no macro level parameters are required					
Reference :					
Context	Step	Action	PCO	Action Qualifier	Comment
Macro	1	SEND	LT	RR (P=1)	
	2a	VERIFY	LT	RR (F=1)	If link is established
	2b	VERIFY	LT	DM(F=0)	If link is not established and LT and EUT are on the same frequency
	2c	VERIFY	LT	No response from EUT after N2 times RR transmissions	If link is not established and LT and EUT are on different frequencies
Comments: Use Step 2a, 2b or 2c depending on which state of the link is to be verified.					

2.4.5.1.6.5 Check network link is established

Macro Name: CHECK$_{Network}$					
Purpose: Check that a link is established between EUT and LT					
Parameters: no macro level parameters are required					
Reference :					
Context	Step	Action	PCO	Action Qualifier	Comment
Macro	1	SEND	LT	DATA packet	
	2	VERIFY	LT	RR with correct flow control information	
Comments:					

2.4.5.1.6.6 Close a link layer connection

Macro Name: RESET$_{AVLC}$					
Purpose: End or relinquish a network layer connection					
Parameters: no macro level parameters are required					
Reference:					
Context	Step	Action	PCO	Action Qualifier	Comment
Macro	1	SEND	LT	DISC (P=0)	
Comments:					

2.4.5.1.6.7 Close network layer connection

Macro Name: RESET$_{8208}$					
Purpose: End or relinquish a network layer connection					
Parameters: no macro level parameters are required					
Reference:					
Context	Step	Action	PCO	Action Qualifier	Comment
Macro	1	SEND	LT	CLEAR REQUEST	ISO 8208 message
	2	RECEIVE	LT	CLEAR CONFIRM	ISO 8208 message
	3	SEND	LT	DISC (P=0)	AVLC frame
Comments:					

2.4.5.2 (Reserved)

2.4.5.3 MAC Sublayer

The proper overall functioning of the MAC sublayer is confirmed by the tests within this section.

2.4.5.3.1 MAC services

2.4.5.3.1.1 Multiple Access

The proper operation of a non-adaptive p-persistant CSMA protocol is verified by means of the tests in Section 2.4.5.3.2.2.

2.4.5.3.1.2 Channel Occupancy

Test Case Name: Channel Occupancy					
Purpose: Verify that the EUT maintains control of the channel for a period of k-1 maximum length packets.					
Configuration: 1					
Reference: DO-224C, 3.2.2.3.1.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}		Use GSIF with N1=16,504 (maximum value) and k= the maximum supported by the EUT	The maximum value of k is 4.
Test body	1	VERIFY	LT	XID_CMD_LE has N1=16,504 and k=maximum supported by EUT	
	2	DO	UT	Create k-1 INFO frames with 2048 octets of data.	
	3	SEND	UT	k-1 INFO frames prepared in Step 2	
	4	VERIFY	LT	k-1 INFO frames received, and that the EUT transmitter power does not drop below –98 dBm for more than 1 ms during the transmission.	
Postamble		$RESET_{AVLC}$			
Comment The UT may use any higher level commands necessary to create the desired INFO frames.					

2.4.5.3.1.3 Channel Congestion

The channel congestion detection and notification to MAC sublayer is verified by the test of Section 2.4.5.3.2.2.

2.4.5.3.2 MAC System Parameters

The MAC system parameters are verified by the following subsections.

2.4.5.3.2.1 Timer TM1 (inter-access delay timer)

Purpose:

Verify that the MAC sub-layer waits TM1 between consecutive access attempts

Test procedure:

Equipment Required

- Desired VDL Mode 2 Source
- PIN diode attenuator, with 0, 5, >10 dB settings
- Attenuator, 30 dB/30 W
- Attenuator, 20 dB
- 2 VHF circulators
- Storage scope
- 50 ohm load
- Control unit or PC.

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-28.

Step 2 Configure the PIN Attenuator to provide at least 10 dB of attenuation during the low period of the pulse waveform. Configure the storage scope to trigger on the falling edge of the pulse waveform.

Step 3 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to:

TM1 (Inter-access delay) = 50 ms.

TM2 (Channel busy) = 60 seconds.

p (Persistence) = 1

M1 (Maximum no. of attempts) = 1

Step 4 Set the PIN attenuator to the minimum attenuation and the LT to produce a CW signal of -95 +/- 2 dBm at the EUT (Channel busy).

Step 5 Use the UT to load the EUT with a minimum length Mode-2 message and request transmission of the message.

Step 6 Use the Controller to trigger the attenuator to produce at least 10 dB of attenuation (Channel idle).

Step 7 Use the oscilloscope to measure the delay, tt_i, between the trigger reference and the beginning of transmission of the message

Step 8 Repeat steps 4-7 50 times and calculate the system delay

$$T_{sys} = \frac{1}{50}\sum_{i=1}^{50} tt_i$$

Step 9 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to:

TM1 (Inter-access delay) = 50 ms.

TM2 (Channel busy) = 60 seconds.

p (Persistence) = 1/256

M1 (Maximum no. of attempts) = 10

Step 10 Set the PIN attenuator to the minimum attenuation and the LT to produce a CW signal of -95 +/- 2 dBm at the EUT (Channel busy).

Step 11 Use the UT to load the EUT with a minimum length Mode-2 message and request transmission of the message.

Step 12 Use the Controller to trigger the attenuator to produce at least 10 dB of attenuation (Channel idle).

Step 13 Use the oscilloscope to measure the delay, tt_i, between the trigger reference and the beginning of transmission of the message and calculate the message delay $t_i = tt_i - T_{sys}$

Step 14 Repeat steps 10-13 100 times

Step 15 Verify that the maximal message delay is less than (M1-0.5)*TM1 and more than 95% message delays are between (M1-1.5)*TM1 and (M1-0.5)*TM1 (Note 1)

<u>*Note:*</u> *For p=1/256 and M1=10, the probability that the messages are transmitted at the last, i.e., the 10-th, attempt is* $\left(1-\frac{1}{256}\right)^9 = 96.5\%$.

Step 16 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to:

TM1 (Inter-access delay) = 100 ms.

Step 17 Repeat step 10 to 15

Timer TM2 (channel busy timer)

Purpose:

Verify that the link layer is notified after the expiration of the Timer TM2 (channel busy timer).

Test procedure:

Equipment Required

- Desired VDL Mode 2 Source
- PIN diode attenuator, with 0, 5, >10 dB settings
- Attenuator, 30 dB/30 W
- Attenuator, 20 dB
- 2 VHF circulators
- Storage scope
- 50 ohm load
- Control unit or PC.

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-28.

Step 2 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to:

TM1 (Inter-access delay) = 50 ms.

TM2 (Channel busy) = 6 seconds.

p (Persistence) = 1/256

M1 (Maximum no. of attempts) = 20

Step 3 Set the PIN attenuator to the minimum attenuation and the LT to produce a CW signal of -95 +/- 2 dBm at the EUT (Channel busy).

Step 4 Use the upper tester to load the equipment under test with a minimum length Mode-2 message and request transmission of the message

Step 5 Use the oscilloscope to verify that no message is transmitted, and that the VME is notified of channel congestion after TM2.

Step 6 Repeat the test with no RF signal on the channel. Use the oscilloscope to verify that the message has been transmitted and that no channel congestion occurs.

2.4.5.3.2.2 Parameter p (persistence)

Test Case Name: MAC layer Parameter p (persistence)					
Configuration: 1					
Purpose: Verify the p parameter of the MAC layer					
Reference : MASPS 3.2.2.3.2.3 (and 3.2.2.3.2.1)					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble					
Test body	1	SET_{AVLC}			
	2	SEND	LT	GSIF with TM2=60 sec, p=256/256, M1=65535 (0xFFFF)	The TM1 value is a constant for the EUT, declared before test.
	3	SEND	UT	CALL REQUEST	
	4	DO	LT	Measure and record the time from insertion of CALL_REQUEST to receipt of CALL_REQUEST at LT, t_i .	
	5	$RESET_{8208}$			clear the resulting connection
	6	REPEAT		Steps 1-5 20 times	
	7	DO	LT	Compute the average measured time, $\bar{t}$ by the following $\bar{t} = \frac{1}{20}\sum t_i$ $T_{256} = \bar{t} - t_{CALL\_REQUEST}$	$t_{CALL\_REQUEST}$ is the duration of the CALL_REQUEST transmission. T_{255} is the minimum delay time, which is assumed to be the protocol delay.
	8	VERIFY		$\bar{t} < 0.1 \times TM1$	
	9	SET_{AVLC}			
	10	SEND	LT	GSIF with TM2=60 sec, p=25/256 M1=65535 (0xFFFF)	This test assumes that TM1 has the default value of 4.5 msec
	11	SEND	UT	CALL REQUEST	
	12	DO	LT	Measure and record the time from insertion of CALL_REQUEST to receipt of CALL_REQUEST at LT, t_i .	
	13	$RESET_{8208}$			clear the resulting connection
	14	REPEAT		Steps 9-12 200 times (N=200)	
	15	DO	LT	Compute the average measured time, $\bar{t}$ $\bar{t} = \frac{1}{200}\sum t_i$ $T = \bar{t} - t_{CALL\_REQUEST} - T_{256}$	
	16	VERIFY	LT	$\left[\frac{1-p}{p} - 3\sqrt{\frac{1-p}{Np^2}}\right] \leq \frac{T}{TM1} \leq \left[\frac{1-p}{p} + 3\sqrt{\frac{1-p}{Np^2}}\right]$	See comment 1
	17	REPEAT	LT	Steps 9-16 with p=13/256 and p=40/256	

Test Case Name: MAC layer Parameter p (persistence)					
Configuration: 1					
Purpose: Verify the p parameter of the MAC layer					
Reference : MASPS 3.2.2.3.2.3 (and 3.2.2.3.2.1)					
Context	Step	Action	PCO	Action Qualifier	Comment
Postamble		$RESET_{8208}$			return EUT to initial state
Comments: 1. This test requires that the LT have direct access to the AVLC protocol. 2. The verification limits of step 16 are based on the fact that the actual delay time of a p-persistance algorithm is a random variable with a geometric distribution and parameter p. The mean value of this random variable is (1-p)/p times the TM1 timer, and the variance is $(1-p)/p^2$ times the square of the TM1 timer value. Summing and scaling 200 such samples, as in step 15, results in a Gaussian distribution with mean (1-p)/p times TM1 and variance $(1-p)/(Np^2)$ times $TM1^2$. The acceptance criteria in step 16 assures that 99% of the tests will be successful.					

2.4.5.3.2.3 Counter M1 (maximum access attempts)

The maximum access attempts counter M1 is verified in Section 2.4.5.3.2.1.

2.4.5.3.3 Description of MAC Layer Procedures

The media access control procedures are verified by the following subsections.

2.4.5.3.3.1 Channel Sensing

Channel sensing is verified by the tests of section 2.4.4.3.3.

2.4.5.3.3.2 Access Attempt

Purpose:

Verify that an access attempt is made when the channel transitions from busy to idle.

Test procedure:

Equipment Required

- Desired VDL Mode 2 Source
- PIN diode attenuator, with 0, 5, >10 dB settings
- Attenuator, 30 dB/30 W
- Attenuator, 20 dB
- 2 VHF circulators
- Storage scope
- 50 ohm load
- Control unit or PC.

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-28.

Step 2 Using the LT generating GSIF frames or by other means, configure the EUT such that the MAC layer parameters are set to:

TM1 (Inter-access delay) = 50 ms.

TM2 (Channel busy) = 6 seconds.

p (Persistence) = 256/256

M1 (Maximum no. of attempts) = 65535

Step 3 Set the PIN attenuator to the minimum attenuation and the LT to produce a CW signal of -95 +/- 2 dBm at the EUT (Channel busy).

Step 4 Use the UT to load the equipment under test with a minimum length Mode-2 message and request transmission of the message.

Step 5 Use the oscilloscope to verify that no message is transmitted.

Step 6 Prior to the expiration of the Timer TM2, release the RF channel.

Step 7 Use the oscilloscope to verify that the message is being transmitted.

2.4.5.3.3.3 Signal Quality Parameter

2.4.5.3.3.3.1 Original SQP

Requirement:

The original SQP value shall be determined from the signal strength, *PdBm*, using the following formula:

If (PdBm <= -98), then SQP = 0.

If (-98 < PdBm < -27), then SQP = INT(((100+PdBm)/5)+0.5)

If (Pdm>=-27), then SQP = 15

The signal strength measurement shall be accurate to ± 7 dB and be monotonic.

Test Procedure:

Equipment Required

- VHF Signal Generator
- External BER test fixture

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 but notice that the RF combiner is not required for this test. Set the receiver under test into the operational mode.

Step 2 Set the Desired VDL Source, (a VHF signal generator) to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Adjust the level of the signal generator to –98 dBm at the receiver input terminals.

Step 4 Modulate the Desired signal with the test payload (maximum burst length of symbols) provided by the external BER test fixture.

Step 5 Verify that the original SQP value is in the limits defined.

Step 6 Repeat steps 3, 4 & 5 for signal power at -80dBm, -70dBm, -60dBm, -50dBm, -40dBm, -30dBm, and -27dBm, respectively.

Step 7 Repeat Steps 2 to 6 at the two remaining test frequencies (Section 2.4.4).

2.4.5.3.3.3.2 Supplement 4 SQP (Optional)

Requirement:

When the VDR supports ARINC Characteristic 750 VHF Data Radio supplement 4, in addition to the original SQP, a second SQP value, i.e., supplement 4 SQP, shall be calculated using the following table:

Supplement 4 SQP Value	Power Range (dBm)
0	*<-98*
1	*-98≤PdBm<-97*
2	*-97≤PdBm<-96*
3	*-96≤PdBm<-95*

4	*-95≤PdBm<-94*
5	*-94≤PdBm<-93*
6	*-93≤PdBm<-92*
7	*-92≤PdBm<-90*
8	*-90≤PdBm<-88*
9	*-88≤PdBm<-86*
10	*-86≤PdBm<-84*
11	*-84≤PdBm<-82*
12	*-82≤PdBm<-80*
13	*-80≤PdBm<-74*
14	*-74≤PdBm≤-68*
15	*>-68*

The signal strength measurement shall be accurate to ± 7 dB and be monotonic.

Test procedure:
Equipment Required

- VHF Signal Generator
- External BER test fixture

Measurement Procedure

Step 1 Connect the equipment as shown in Figure 2-3 but notice that the RF combiner is not required for this test. Set the receiver under test into the operational mode.

Step 2 Set the Desired VDL Source, (a VHF signal generator) to generate an input signal to the receiver at one of the test frequencies (Section 2.4.4).

Step 3 Adjust the level of the signal generator to –99 dBm at the receiver input terminals.

Step 4 Modulate the Desired signal with the test payload (maximum burst length of symbols) provided by the external BER test fixture.

Step 5 Verify that the supplement 4 SQP value is in the limits defined.

Step 6 Repeat steps 3, 4 & 5 for signal power at -97.5dBm, -96.5dBm, -95.5dBm, -94.5dBm, -93.5dBm, -92.5dBm, -91dBm, -89dBm, -87dBm, -85dBm, -83dBm, -81dBm, -77dBm, -71dBm, and -67dBm, respectively.

Step 7 Repeat Steps 2 to 6 at the two remaining test frequencies (Section 2.4.4).

2.4.5.4 Data Link Service Sublayer

The DLS sublayer requirements of DO-224B consist of a series of data structures and a series of processing actions or services. The data structures are not, in general, observable in a "black box" test of Class X equipment. For Class Y and Class Z equipment, the structures *are* observable via a Data/Management interface satisfying the functional requirements of Appendix D.

For Class X equipment, the service capabilities of the DLS sublayer are indirectly demonstrated during the Network Layer testing of Section 2.4.6. For Class Y and Class Z equipment, the following test procedures are stated in terms of the AVLC data frames and contents to facilitate verification via the Data/Management Interface.

For all classes of equipment, specific AVLC frame formats are assumed to be developed and maintained as part of the embedded software. Results from Software Verification activities in accordance with DO-178B demonstrating the proper implementation of these structures provide sufficient verification that some requirements have been satisfied, as detailed below. If the AVLC structures are implemented and maintained in hardware, the equivalent information from verification in accordance with DO-254 is acceptable.

This document assumes that most DLS sublayer functionality exists in Class X or Class Z equipment.

Unless otherwise stated, all DLS Sublayer tests are to be performed with the LT providing the default test signal level defined in Section 2.4.1.7.

2.4.5.4.1 Services

2.4.5.4.1.1 Frame Sequencing

Procedure

Test Case Name: Frame Sequencing					
Purpose: Verify the receiving DLS sub-layer ensures that duplicated frames are discarded and all frames are delivered exactly once over a point-to-point connection.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.10					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}			
Test body	1	SEND	LT	INFO (P=0), NS=n containing one DATA packet	
	2	SEND	LT	A duplicate (NS=n) INFO (P=0) containing CLEAR REQUEST PACKET	Duplicate frame (NS=n in both INFO frames) containing CLEAR REQUEST PACKET
	3	$CHECK_{Network}$	LT	Verify the network connection is active	If the duplicate INFO was delivered, the network connection would be cleared
	4	VERIFY	UT	DATA packet is delivered	
Postamble		$RESET_{8208}$	LT		
Comment:					

2.4.5.4.1.2 Error Detection

Procedure

Test Case Name: Error detection					
Purpose: Verify the receiving DLS sub-layer detects and discards frames corrupted during transmission.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.1.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	CREATE	LT	10 AVLC frames with valid FCS not equal to 00_H. Replace the 2-octets of FCS with 00_H.	
	2	SET_{AVLC}			
Test body	1	SEND	LT	Alternating valid data frames (content does not matter) and corrupted frames generated in Preamble.	
	2	VERIFY	UT	Valid data frames are passed to user, corrupted frames are discarded.	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Y equipment, this verification may be at the Data/Management Interface. For Class X and Z equipment, the verification may be at the 8208 interface.					

Message Sequence Chart

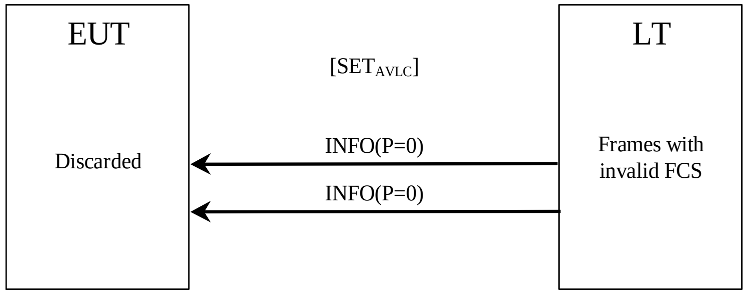


Figure 2-30: Error Detection

2.4.5.4.1.3 Station Identification

Procedure

Test Case Name: Station identification					
Purpose: Verify the receiving DLS sub-layer accepts (over a point-to-point connection) only frames that are addressed to it.					
Configuration 1					
Reference: DO-224C, 3.2.2.4.1.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	CREATE	LT	10 AVLC frames with address field set to the binary complement of the address assigned to the system under test.	
	2	SET$_{AVLC}$			
Test body	1	SEND	LT	Alternating data frames with a valid address and invalid address frames generated in Preamble.	
	2	VERIFY	UT	Only frames with the valid address are passed to the user	See comment 2
Postamble		RESET$_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Y equipment, this verification may be at the Data/Management Interface. For Class X and Class Z equipment, this may be observed at the ISO 8208 interface.					

Message Sequence Chart

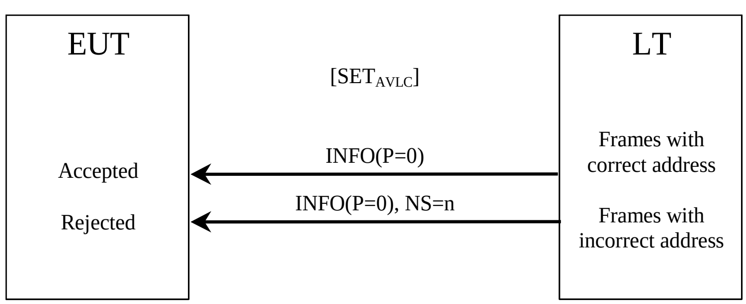


Figure 2-31: Station Identification

2.4.5.4.1.4 Broadcast Addressing

Procedure

Test Case Name: Broadcast Addressing
Purpose: Verify the DLS supports the use of Broadcast Service addresses recognized by appropriate receivers.
Configuration: 1
Reference: DO-224C 3.2.2.4.1.4
Comment: The requirements in this section are verified within all test procedures in this document that include a broadcast GSIF, for example, Sections 2.4.5.4.1.5(b) and 2.4.5.4.2.4.

2.4.5.4.1.5 Data Transfer

Procedure (a)

Test Case Name: Data Transfer (a)
Purpose: Verify data is transferred in the information fields of VDL INFO, UI and XID frames, per ISO 7809
Configuration: 1
Reference: DO-224C, 3.2.2.4.1.5
Comments: 1. This requirement is verified by means of Section 2.4.5.4.5.2 (INFO), Section 2.4.5.4.9.5 (UI), and Section 2.4.5.4.7 (XID) and other test sections within this document.

Procedure (b)

Test Case Name: Data Transfer (b)					
Purpose: Verify that the link layer processes a data size of 2048 octets without segmenting.(see DO-224C, Table 3-49)					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.1.5 and DO-224C, Table 3-49					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}		Use GSIF with N1=16,504 (maximum value)	
Test body	1	SEND	UT	INFO frame with 2048 octets of data	
	2	VERIFY	LT	single INFO frame with 2048 octets of data	
Postamble		$RESET_{AVLC}$			
Comment					

Procedure (c)

Test Case Name: Data Transfer (c)					
Purpose: Verify that one and only one data link user packet is contained in INFO frame.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.1.5.					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}			
Test body	1	SEND	UT	DATA packet #1	
	2	SEND	UT	DATA packet #2	
	3	VERIFY	LT	Receive two INFO frames with continuous sequence numbers, the first containing DATA packet #1, the second containing DATA packet #2	
Postamble		$RESET_{8208}$			
Comments:					

2.4.5.4.2 AVLC Data Link Protocol

2.4.5.4.2.1 Frame Format

Procedure

Test Case Name: AVLC Frame Format
Purpose: Verify that all AVLC frames format conform to the ISO 3309 frame structure and Figure 3-4 of DO-224C.
Configuration: 1
Reference: DO-224C, 3.2.2.4.2.1 and DO-224C Figure 3-4.
Comments: 1. Detailed frame formats should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Proper functioning of AVLC frame formats are implicitly tested by all tests of Section 2.4.5.4 and its subsections.

2.4.5.4.2.2 Address Structure

Procedure

Test Case Name: AVLC Address Structure
Purpose: Verify that all AVLC frames to the address structure specified in ISO 3309 and Table 3-4 of DO-224C.
Configuration: 1
Reference: DO-224C, 3.2.2.4.2.2 and DO-224C Figure 3-4.
Comments: 1. Detailed address formats should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Proper functioning of AVLC addressing are implicitly tested by Sections 2.4.5.4.1.4 and all tests of Section 2.4.5.5.

2.4.5.4.2.3 Address Fields

Procedure (a)

Test Case Name: AVLC Address Fields
Purpose: Verify that AVLC address field contains both destination address and source address.
Configuration: 1
Reference: DO-224C, 3.2.2.4.2.3 and all sub-paragraphs and DO-224C Figure 3-4 and Table 3-4.
Comments: 1. Detailed address formats should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Proper functioning of AVLC addressing are implicitly tested by Sections 2.4.5.4.1.4 and all tests of Section 2.4.5.5.

Procedure (b)

Test Case Name: AVLC Air / Ground bit setting at startup					
Purpose: Verify that the Air / Ground bit in AVLC header reflects correctly the fact that the aircraft is in the air or on the ground at startup					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.2.3.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		DO	UT	Configure the EUT in the air, and startup the EUT	See comment 1
Test body	1	SET_{AVLC}	LT		
	2	VERIFY	LT	The A/G bit conveyed by the XID_CMD_LE sent by the aircraft at the previous step is set to 0.	
	3	DO		Repeat step 1 and 2 with EUT on ground and check the A/G bit is set to 1.	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the access to the corresponding interface of the EUT.					

Procedure (c)

Test Case Name: AVLC Air / Ground bit setting transition					
Purpose: Verify that the Air / Ground bit in AVLC header is updated upon aircraft takeoff and landing					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.2.3.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		DO	UT	Configure the EUT in the air, and startup the EUT	See comment 1
Test body	1	SET_{AVLC}	LT		See comment 2
	2	VERIFY	LT	The A/G bit conveyed by the XID_CMD_LE sent by the aircraft at the previous step is set to 0.	
	3	DO	UT	Place the EUT on the ground to simulate landing	
	4	$CHECK_{link}$	LT		
	5	VERIFY	LT	The link is still established The A/G bit conveyed by the RR(F=1) sent by the aircraft in the previous step is set to 1.	
	6	DO	UT	Place the EUT on the air to simulate takeoff	
	7	$CHECK_{link}$	LT	The link is still established The A/G bit conveyed by the RR(F=1) sent by the aircraft in the previous step is set to 0.	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the access to the corresponding interface of the EUT. 2. No FSL are present in the GSIF used in this step.					

2.4.5.4.2.4 Broadcast Address

Procedure (a)

Test Case Name: Broadcast Address Fields (a)
Purpose: Verify address encoding for the Broadcast service.
Configuration: 1
Reference: DO-224C, 3.2.2.4.2.4 and all sub-paragraphs and DO-224C Table 3-4 and Table 3-5.
Comments: 1. Detailed address formats should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Proper functioning of AVLC addressing are implicitly tested by all tests that utilize UI or XID frames.

Procedure (b)

Test Case Name: Broadcast Address Fields (b)					
Purpose: Verify the aircraft DLS prevents the transmission block of a Frame with all-1s link address.					
Configuration: 1					
Reference: DO-224C 3.2.2.4.2.4.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	When possible, configure aircraft with 0xFFFFFF aircraft station address	If the aircraft cannot be configured with 0xFFFFFF aircraft station address, then the test is passed.
	2	SET	LT	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
Test body	1	WAIT	LT GS1	GSIF on f1	Operating frequency f1 = CSC
	2	VERIFY	LT	EUT does not transmit any frames	
Postamble					
Comment: 1. Detailed broadcast address field formatting should be verified as part of the DO-178B software verification process (see Section 2.4.5.4)					

2.4.5.4.2.5 Link Control Field

Procedure

Test Case Name: Link Control Fields
Purpose: Verify address proper command/response action of the link control field.
Configuration: 1
Reference: DO-224C, 3.2.2.4.2.5 and Table 3-6
Comments: 1. Proper functioning of AVLC link control field command and response mechanisms are implicitly tested by all tests of Section 2.4.5.4 and Section 2.4.5.5.

2.4.5.4.2.6 Information Field

Procedure

Test Case Name: Information Field
Purpose: Verify the information field of an SREJ and XIDs is set according to VDL Mode 2 procedures, and all other frames are set according to ISO 4335 procedure.
Configuration: 1
Reference: DO-224C, 3.2.2.4.2.6
Comments: 2. Detailed information field formatting should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 3. The SREJ and XID frames are tested in Section 2.4.5.5.2 and its subsections.

2.4.5.4.3 Data Link Service System Parameters

Procedure

Test Case Name: DLS System Parameters
Purpose: Verify the setting of DLS system parameters.
Configuration: 1
Reference: DO-224C, 3.2.2.4.3
Comments: 1. Detailed datalink service parameters should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Setting of the DLS system parameters is tested by the XID processing of Section 2.4.5.5.2.

2.4.5.4.3.1 Timer T1 (delay before retransmission)

Procedure

Note 1: For the purpose of this T1 Timer test, the type of frame used (for queuing) to trigger the start of the T1 Timer will be an INFO frame. Other frames which can be used to trigger this event are RR (P=1), SREJ (P=1) or FRMR.

Test Case Name: DLS Timer T1 (delay before retransmission)					
Purpose: Verify the setting and usage of the T1 timer within the DLS.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.3.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble				Unload channel (no transmission on the frequency)	
Test body	1	SET_{AVLC}			
	2	INHIBIT	LT	Inhibit generation of any type of acknowledgement for the first N2-1 INFO frames	See comment 3
	3	SEND	UT	INFO	See comment 4 The EUT starts a T1 timer
	4	RECEIVE	LT	INFO received and time stamped	
	5	REPEAT		Repeat step 4 (N2-1 times)	Receive (N2-1) re-transmissions of the same INFO from the UT
	6	SEND	LT	RR (F=1)	
	7	VERIFY	LT	EUT stops re-transmitting INFO to the LT	
	8	VERIFY	LT	1) Same INFO was received all the time at the LT 2) Calculation of T1 values lies within the values indicated in Table 2-5.	
Postamble		$RESET_{AVLC}$			
Comments: 1. The Timer T1 formula should be verified during the DO-178B design review process. 2. This test requires the UT and LT to directly access the AVLC protocol. 3. For Class Y equipment, UT control and observation point may be at the Data/Management Interface. 4. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Note 2: Channel Utilization due to GSIFs and INFO frames is supposed to be very low. Minimum values are calculated with a utilization of 0%, maximum value with a utilization of 10%. Default values for T1 min, T1 max, T1 mult, T1 exp, M1 and TM1 have been used for the determination of the values in the Table 2-4.

Table 2-4: Default Values for GSIF Parameters

Parameter	Value per SARPS
T1 min	1
T1 max	15
T1 mult	1.45
T1 exp	1.7
M1	135
TM1	4.5

Note 3: Nevertheless because the transmission delay between MAC layer and the AVLC (e.g. over the link between ATSU/CMU and VDR) has not been taken into

account, one second should be added to the values in the Table 2-5 below based on the estimation provided in ARINC Specification 631.

Table 2-5: Minimum and Maximum Values of T1 for Testing

Delta between retransmission in sec	1	2	3	4	5
T1 min	2.2	2.2	2.2	2.2	2.2
T1 max	3.3	4.0	5.2	7.2	10.5
Comment: These values are computed with *p*=1.					

Message Sequence Chart

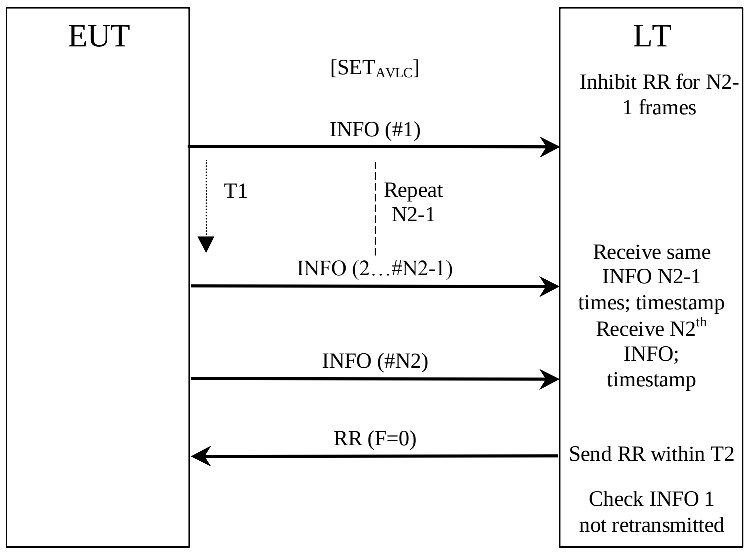


Figure 2-32: Timer T1 (delay before retransmission)

2.4.5.4.3.2 Timer T2 (delay before acknowledgement)

Procedure

Test Case Name: Timer T2 (delay before acknowledgement)					
Purpose: Verify the setting and usage of Timer T2.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.3.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			No INFO frame in the queue!
Test body	1	SEND	LT	INFO (data content not important to this test)	
	2	VERIFY	LT	RR (F=0) is received at the expiration of T2 Timer	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol.					

Message Sequence Chart

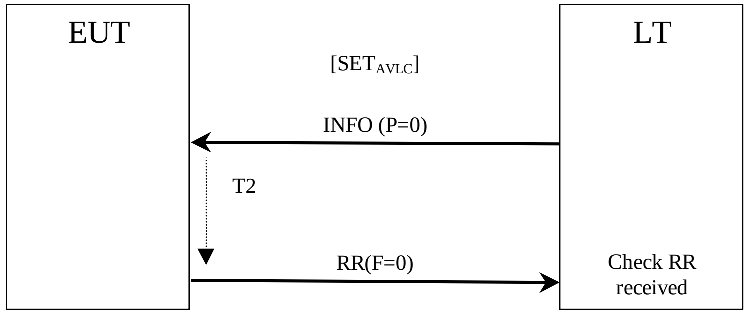


Figure 2-33: Timer T2 (delay before acknowledgement)

2.4.5.4.3.3 Timer T3 (link initialization time)

Procedure

Test Case Name: Timer T3 (link initialization time)					
Purpose: Verify the setting and usage of Timer T3.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.3.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		INHIBIT	LT	Inhibit response (XID_RSP_LE) of the first XID_CMD_LE	
Test body	1	SEND	LT	GSIF	
	2	RECEIVE	LT	XID_CMD_LE (P=1) and mark with timestamp	
	3	REPEAT		Repeat step 2 N2-1 times	
	4	SEND	LT	After the N2-th transmission of the XID_CMD_LE, allow the LT to respond with an XID_RSP_LE prior to Timer T3 expiration since last XID_CMD_LE	
	5	WAIT	LT	Check that the EUT is not re-transmitting XID_CMD_LE anymore	
	6	CHECK$_{link}$			
	7	VERIFY	LT	Check that all received XID_CMD_LE are retransmission of the first one by verifying that the XID sequencing parameter is incremented correctly according to DO-224C, 3.2.2.5.2.4.4 and all other parts are equal	
	8	VERIFY	LT	Verify T3 values based on timestamps is within table values as specified in DO-224C, 3.2.2.5.2.4.4	
Postamble		RESET$_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol.					

Note: *Channel Utilization due to GSIFs and INFO frames is supposed to be very low. Minimum values are calculated with a utilization of 0%, maximum value with a utilization of 10%.*

Table 2-6: Minimum and Maximum Values of T3 for Testing

Delta between retransmission in sec	1	2	3	4	5
T3 min	7.2	7.2	7.2	7.2	7.2
T3 max	8.3	9.0	10.2	12.2	15.5

Message Sequence Chart

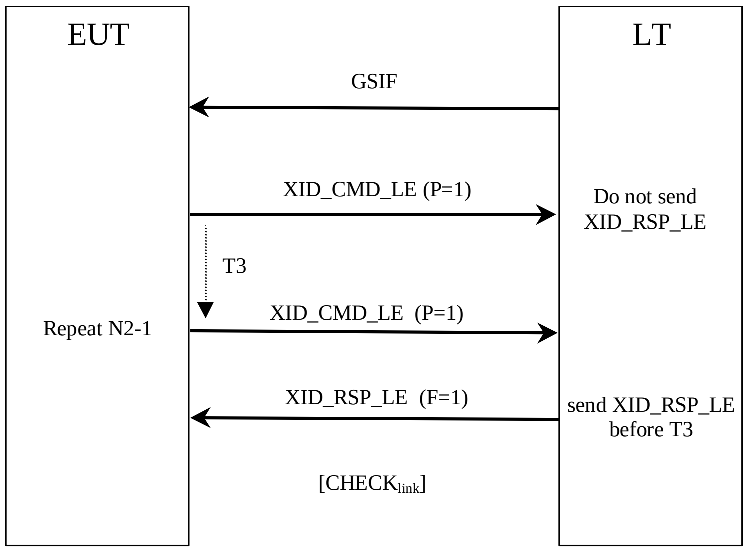


Figure 2-34: Timer T3 (link initialization time)

2.4.5.4.3.4 Timer T4 (maximum delay between transmissions)

Procedures (a) ABM Mode

Test Case Name: Timer T4 (maximum delay between transmissions) – ABM					
Purpose: Verify the setting and usage of Timer T4 in ABM.					
Configuration: 3					
Reference: DO-224C 3.2.2.4.3.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		ABM
		SEND	LT GS2	GSIFs periodically	
Test body	1	SEND	LT GS1	INFO	
	2	INHIBIT	LT GS1	Any additional frames except GSIF for a period to exceed EUT T4	
	3	RECEIVE	LT GS1	RR (F=0) and timestamp (TS1)	
	4	WAIT	LT GS1	EUT T4	
	5	RECEIVE	LT GS1	RR(P=1) and time stamp it (TS2)	
	6	REPEAT	LT GS1	Repeat step 5 N2-1 times without time stamping	
	7	WAIT	LT GS1	T1	
	8	VERIFY	LT GS1	Verify that the EUT stops retransmissions of the RR (P=1)	
	9	VERIFY	LT GS1	Check that TS2-TS1=T4	
	10	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
Postamble		$RESET_{AVLC}$			

Procedure (b) SRM Mode

Test Case Name: Timer T4 (maximum delay between transmissions) – SRM

Purpose: Verify the setting and usage of Timer T4 in SRM					
Configuration: 3					
Reference: DO-224C 3.2.2.4.3.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1	Since the LT is still sending GSIF frames with sufficient signal quality from the same GS address, verify that the EUT Attempts link establishment with this same GS address	SRM
Test body	1	SEND	LT GS2	GSIFs periodically	
		SEND	LT GS1	An out-of-sequence	
	2	INHIBIT	LT GS1	Any additional frames except GSIF for a period to exceed EUT T4	
	3	RECEIVE	LT GS1	SREJ (NR=0, F=0, ACK N(S)=1) and timestamp (TS1)	
	4	WAIT	LT GS1	EUT T4	
	5	RECEIVE	LT GS1	SREJ (NR=0, P=1, ACK N(S)=1) and timestamp (TS2)	
	6	REPEAT	LT GS1	Repeat step 5 N2-1 times without time stamping	
	7	WAIT	LT GS1	EUT T1	
	8	VERIFY	LT GS1	Verify that the EUT stops retransmissions of the SREJ	
		VERIFY	LT GS1	Check that TS2-TS1=T4	
	9	RECEIVE	LT GS2	XID_CMD_HO(P=1)	
Postamble		$RESET_{AVLC}$			

Procedure (c) FRM Mode

Test Case Name: Timer T4 (maximum delay between transmissions) – FRM					
Purpose: Verify the setting and usage of Timer T4 in FRM					
Configuration: 1					
Reference: DO-224C 3.2.2.4.3.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}		GSIF shall contain a value of 100 ms for TM1, 4000 for M1 and 10 mn for T4	These values will raise T1 value above T4.
Test body	1	SEND	LT	Place the EUT in Frame Reject Mode by sending an invalid frame from the LT, for example a frame having a size that exceeds N1.	
	2	INHIBIT	LT	Any additional frames except GSIF for a period to exceed EUT T4	
	3	RECEIVE	LT	Verify that the EUT sends a FRMR Frame (P=1) upon receipt of the invalid frame from the LT and time stamp (TS1).	
	4	WAIT	LT	T4	
	5	RECEIVE	LT	FRMR (P=1) and timestamp (TS2)	
	6	RECEIVE	LT	FRMR (P=1) * N2-1 times	
	7	VERIFY	LT	Verify that the EUT retransmits the FRMR (P=1) on every T1 expiration for a total of N2-1 retransmissions (i.e., a total of N2 transmissions.	
	8	VERIFY	LT	Verify that the EUT stops retransmissions of FRMR (P=1) after a total of N2 transmissions.	
	9	VERIFY	LT	Check that TS2-TS1=T4	
Postamble		$RESET_{AVLC}$			

2.4.5.4.3.5 Parameter N1 (maximum number of bits in frame)

Procedure

Test Case Name: Parameter N1 (maximum number of bits in frame)					
Purpose: Verify the setting and usage of parameter N1.					
Reference: DO-224C, 3.2.2.4.3.5					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	LT	INFO (P=0,length = N1)	
	2	RECEIVE	LT	RR (F=0)	
	3	SEND	LT	INFO (P=0,length > N1)	
	4	VERIFY	LT	FRMR (P=1)	We do not check that the INFO is not send to the UL but only reception of FRMR
	5	SEND	LT	UA (F=1)	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class X and Z equipment, the specific SET_{AVLC} and $RESET_{AVLC}$ may be replaced by any control action that has the desired affect at the AVLC layer.					

Message Sequence Chart

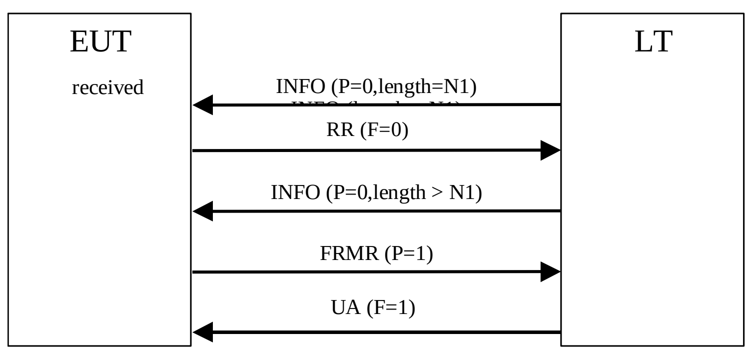


Figure 2-35: Parameter N1 (maximum number of bits in frame)

2.4.5.4.3.6 Counter N2 (maximum number of transmissions)

Procedure

Test Case Name: Counter N2 (maximum number of transmissions)					
Purpose: Verify the setting and usage of counter N2.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.3.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	INHIBIT	LT	LT from responding to any INFO frames from the EUT.	
	2	SEND	UT	INFO (P=0) (#1) Upon T1 for INFO # 1, EUT will retransmit the INFO frame up to N2-1 (for frame # 1).	
	3	SEND	UT	Before N2-1 repetitions of INFO #1 have been received at the LT, send another INFO (P=0) frame (#2) to the LT.	This frame will have a new N2 counter associated with it and will retransmit upon T1 expiration
	4	SEND	LT	RR (F=0) for INFO#1	
	5	VERIFY	LT	INFO#2 is received exactly N2 times	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. This test may require setting of specific values to Tmin, Tmax, Tmult, and Texp to induce large values of T1 in order to ease the generation of several INFO frames from the UT within N2*T1.					

Message Sequence Chart

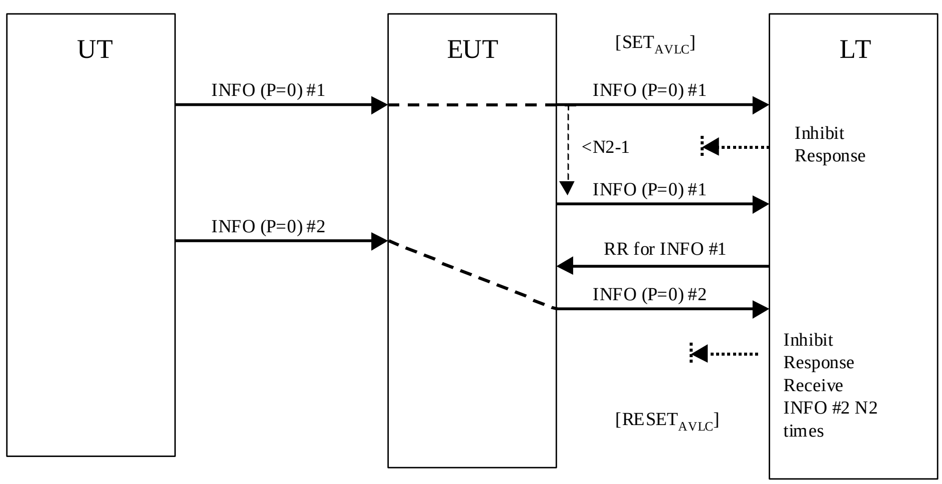


Figure 2-36: Counter N2 (maximum number of transmissions)

2.4.5.4.3.7 Parameter k (window size)

Procedure

Test Case Name: Parameter k (window size)					
Purpose: Verify the setting and usage of parameter k.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.3.7					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	INHIBIT	LT	Inhibit the LT from responding to k INFO frames	
	2	SEND	UT	k+1 INFO (within EUT T1)	
	3	VERIFY	LT	k-1 INFO (P=0) are received. One INFO (P=1) is received.	k+1 INFO is blocked at EUT waiting for RR from LT
	4	SEND	LT	RR (F=1)	
	5	VERIFY	LT	(k+1)-st INFO (P=0)	
Postamble		$RESET_{AVLC}$			

Comments:
1. This test requires the LT to directly access its AVLC protocol.
2. This test may require setting of specific values to Tmin, Tmax, Tmult, and Texp to induce large values of T1 in order to ease the generation of several INFO frames from the UT within N2*T1.
3. The maximum value of k is 4.

Message Sequence Chart

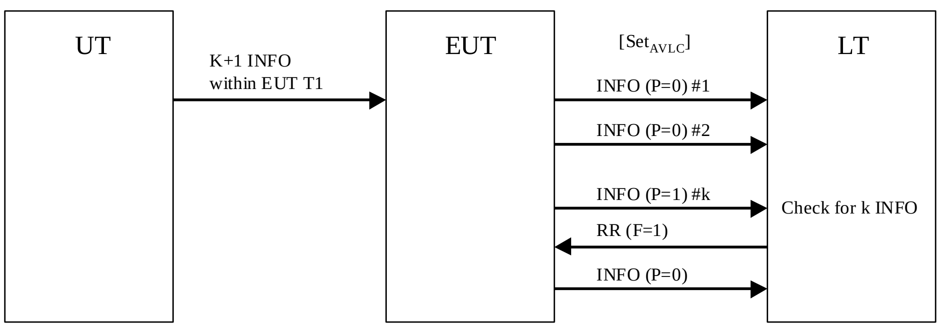


Figure 2-37: Parameter k (window size)

2.4.5.4.4 Modes of Operation

2.4.5.4.4.1 Operational Mode

Procedure

Test Case Name: Operational Mode					
Purpose: Verify the operational mode of the DLS to be Asynchronous Balanced Mode (ABM).					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.5.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			The state machine should now be in data transfer mode (ABM)
Test body	1	SEND	LT	INFO	
	2	VERIFY	LT	RR	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface. 3. It may be desirable to perform this test as the first test of MAC and DLS functionality.					

Message Sequence Chart

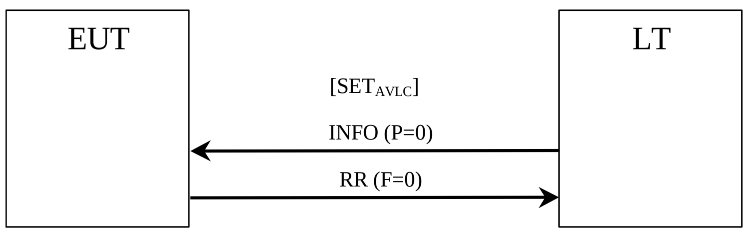


Figure 2-38: Operational Mode

2.4.5.4.4.2 Non-Operational Mode

Procedure

Test Case Name: Non-Operational Mode					
Purpose: Verify the non-operational mode of the DLS to be Asynchronous Disconnect Mode (ADM).					
Configuration: 1					
Reference: 3.2.2.4.5.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		$RESET_{AVLC}$	LT		Force Disconnect
Test body	1	SEND	LT	INFO (p=0)	
	2	VERIFY	LT	DM (F=0)	
Postamble					
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Message Sequence Chart

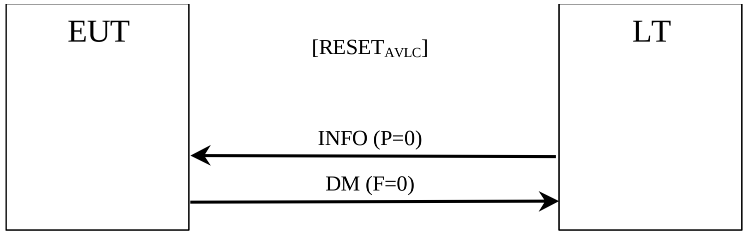


Figure 2-39: Non-Operational Mode

2.4.5.4.4.2.1 DISC Frame

Procedure

Test Case Name: DISC Frame					
Purpose: Verify transmission and operation of DISC frames.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.5.2.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET$_{AVLC}$			
Test body	1	SEND	LT	DISC (P=0)	Maintain EUT on the same channel by whatever means
	2	SEND	LT	RR (P=1)	
	3	VERIFY	LT	DM (F=0)	
	4	SET$_{AVLC}$			
	5	SEND	LT	DISC (P=1)	Maintain EUT on the same channel by whatever means
	6	SEND	LT	RR(P=1)	
	7	VERIFY	LT	DM(F=0)	
Postamble		RESET$_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol.					

2.4.5.4.4.2.2 DM Frame

Procedure (a)

Test Case Name: DM Frame (a)					
Purpose: Verify transmission and operation of DM frames (DM generated by the EUT)					
Configuration: 3					
Reference: DO-224C, 3.2.2.4.5.2.2.					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 to f1	f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 to f1	
	3	SET	UT	EUT scanning on f1	
Test body	1	SEND	LT GS1	INFO (P=0)	The emulated GS source address must belong to a service provider that is listed in the local preference table in the EUT
	2	RECEIVE	LT GS1	DM (F=0)	
	3	SEND	LT GS1	GSIF	
	4	RECEIVE	LT GS1	XID_CMD_LE (P=1)	
	5	SEND	LT GS1	XID_RSP_LE (F=1)	
	6	SEND	LT GS2	INFO (P=0)	
	7	RECEIVE	LT GS2	DM (F=0)	
	8	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
Postamble		$\text{RESET}_{\text{AVLC}}$	LT GS1		
Comments: 1. This test requires the LT to directly access its AVLC protocol.					

Procedure (b)

Test Case Name: DM Frame (b)					
Purpose: Verify transmission and operation of DM frames (DM generated by the LT)					
Reference: DO-224B, 3.2.2.4.5.2.2.					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	UT	INFO (P=0)	
	2	SEND	LT	DM (F=0)	LT is emulating that the link is lost
	3	VERIFY	LT	XID_CMD_LE (P=1)	EUT re-establish the (existing) link
	4	SEND	LT	XID_RSP_LE (F=1)	
	5	$CHECK_{LINK}$	LT	Verify the link is active	
	6	REPEAT		Step 1-5 with DM (F=1) in Step 2	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol.					

Procedure (c)

Test Case Name: DM Frame (c)
Purpose: Verify transmission and operation of DM frames during Aircraft Initiated Handoff
Reference: DO-224C, 3.2.2.4.5.2.2.
Comment: Covered in 2.4.5.5.4.6 procedure (b)

2.4.5.4.4.2.3 Frame Reject Mode

Procedure

Test Case Name: Frame Reject Mode					
Purpose: Verify state transition in the Frame Reject Mode.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.5.2.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT		
Test body	1	SEND	LT	INFO (Nr > 0)	
	2	VERIFY	LT	FRMR	
	3	SEND	LT	UA (F=1)	
	4	$CHECK_{LINK}$	LT	Verify the link is still active	
	5	SEND	LT	INFO (Ns=1)	Out of sequence
	6	VERIFY	LT	SREJ(Nr=0) ACK=1	
	7	SEND	LT	INFO(Nr>0)	
	8	VERIFY	LT	FRMR	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol.. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Message Sequence Chart

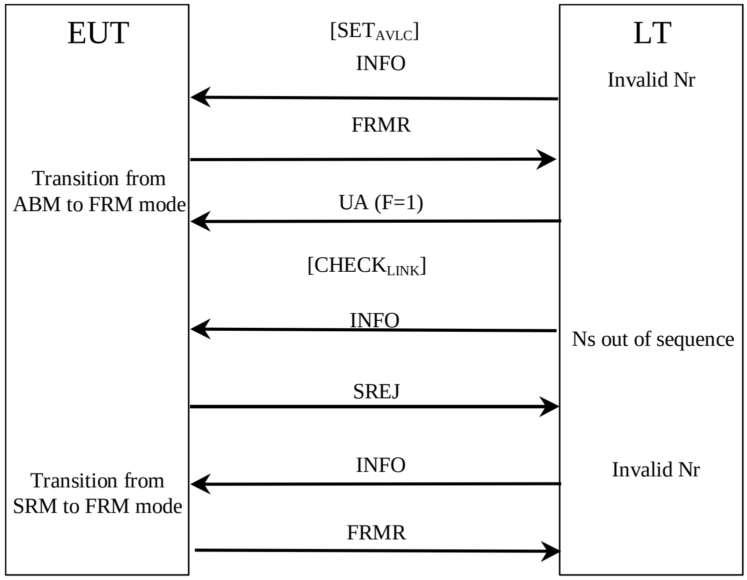


Figure 2-40: Frame Reject Mode

2.4.5.4.4.2.4 Selective Reject Mode

Procedure

Test Case Name: Selective Reject Mode
Purpose: Verify the state transition in the Selective Reject Mode
Configuration: 1
Reference: DO-224C, 3.2.2.4.5.2.4
Comment: Requirement is verified by the tests of Sections 2.4.5.4.3.4 (b) and 2.4.5.4.9.2.

2.4.5.4.5 Use of the P/F bit

2.4.5.4.5.1 General

Procedure

Test Case Name: General
Purpose: Verify usage of the P/F bit within AVLC frames.
Configuration: 1
Reference:DO-224C, 3.2.2.4.6
Comment: This requirement is verified by all tests in Section 2.4.5.4 that set or read the P/F bits.

2.4.5.4.5.2 INFO frames

Procedure

Test Case Name: INFO frames					
Purpose: Verify processing of INFO frames.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.6.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	LT	INFO (P=0, N(s)=n_0) and timestamp	
	2	VERIFY	LT	RR (F=0) within EUT T2 from the INFO transmission	
	3	SEND	LT	INFO (P=0, N(s)=n_0+2) and timestamp	Incorrect N_s
	4	VERIFY	LT	SREJ (F=0) within EUT T2 from the INFO transmission	
	5	SEND	LT	INFO (P=1, N(s)=n_0+1 and timestamp	
	6	VERIFY	LT	RR (F=1) within EUT T2	
	7	SEND	LT	INFO (P=1) frame with an incorrect N(s)	
	8	VERIFY	LT	SREJ (F=1) within EUT T2	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol.. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Message Sequence Chart

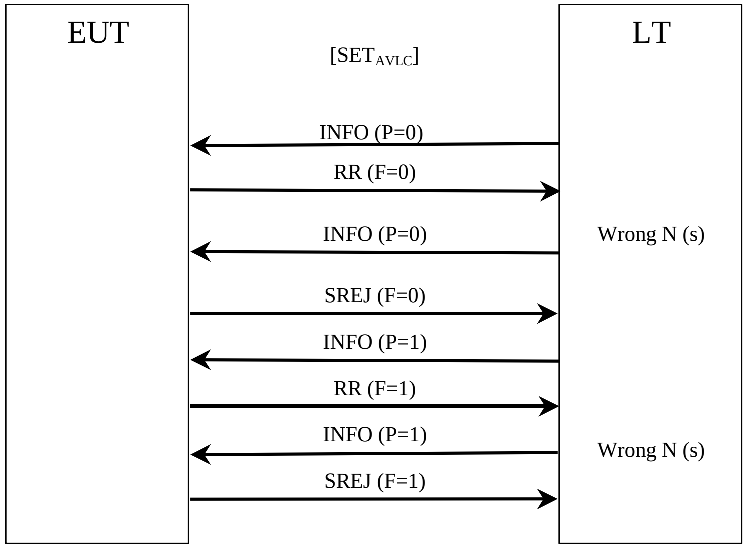


Figure 2-41: INFO frames

2.4.5.4.5.3 Unnumbered Frames

Procedure (a) DM frame

See 2.4.5.4.4.2.2

Procedure (b) UI frame

See 2.4.5.4.9.5

Procedure (c) DISC frame

Test Case Name: Unnumbered Frames					
Purpose: Verify the usage and processing of unnumbered type frames.					
Configuration: 1					
Reference: DO-224C 3.2.2.4.6.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET$_{AVLC}$		The XID_RSP_LE frame shall contain one parameter with an unacceptable value	This will lead to a DISC
Test body	1	VERIFY	LT	DISC with P=0	
Postamble		RESET$_{AVLC}$	LT		

Procedure (d) UA frame

See 2.4.5.4.9.4

2.4.5.4.6 Unnumbered Command Frames Collisions

The requirements of DO-224C 3.2.2.4.7 are verified by the following subparagraphs.

2.4.5.4.6.1 DLE Procedures

Procedure

Test Case Name: DLE Procedures					
Purpose: Verify DLE procedures based on addressing precedence.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.7.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	LT	INFO exceeding N1in length	
	2	VERIFY	LT	FRMR (P=1)	
	3	SEND	LT	FRMR(P=1)	
	4	VERIFY	LT	FRMR (P=1) after EUT T1 timer elapses since the last transmission of the FRMR frame	
	5	SEND	LT	UA (F=1)	
	6	$CHECK_{link}$	LT	Verify the link is active	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. The GS address must be greater than the EUT address by the design of the VDL Mode 2 Address Field.					

Message Sequence Chart

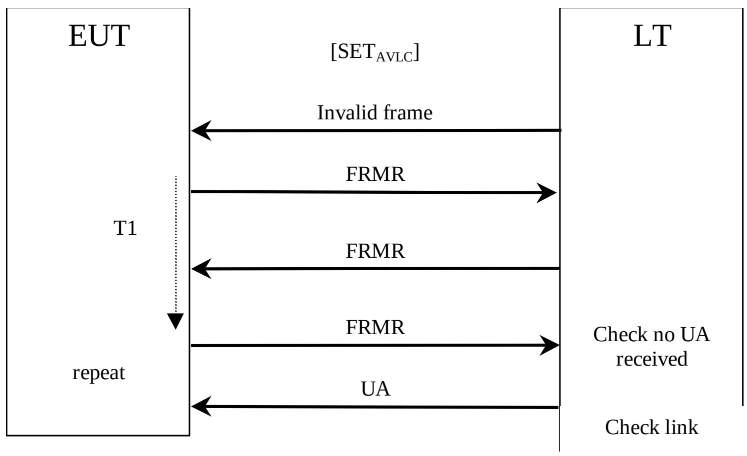


Figure 2-42: DLE Procedures

2.4.5.4.6.2 LME Procedures

Procedure (a) Broadcast Handoff vs. Air Initiated Handoff

This procedure is applicable to equipment that supports both Broadcast Handoff and Air initiated handoff.

Test Case Name: Broadcast Handoff vs. Air Initiated Handoff					
Purpose: Verify LME procedure that shall give precedence to Broadcast Handoff during an Air Initiated Handoff					
Configuration: 4					
Reference:DO-224C, 3.2.2.4.7.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	
	2	INHIBIT	LT GS2	GS2 will not respond to next XID_CMD_HO(P=1)	
	3	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	4	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	5	SEND	LT GS3	Broadcast XID_CMD_HO (P=0) containing aircraft and GS1 DLS addresses.	
	6	$CHECK_{LINK}$	LT GS3	Link with GS3 is established	
	7	VERIFY	LT GS2	EUT stops transmitting XID_CMD_HO(F=1)	
	8	WAIT	LT	EUT TG5 for initiation	
	9	SEND	LT GS1	INFO(P=0)	
	10	RECEIVE	LT GS1	DM(F=0)	
	11	$CHECK_{LINK}$	LT GS2	Link with GS2 is not established	
Postamble		$RESET_{AVLC}$	LT GS2		
Comment:					

Procedure (b) Air Initiated Handoff vs. Ground Requested Broadcast Handoff

This procedure is applicable to equipment that supports both Broadcast Handoff and Air initiated handoff.

Test Case Name: Air Initiated Handoff vs. Ground Requested Broadcast Handoff					
Purpose: Verify LME procedure that shall give precedence to Air Initiated Handoff when receiving a Ground Requested Broadcast Handoff					
Reference: DO-224C, 3.2.2.4.7.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	
	2	INHIBIT	LT GS2	GS2 will not respond to next XID_CMD_HO(P=1)	
	3	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	4	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	5	SEND	LT GS1	Broadcast XID_CMD_HO (P=0) with address filter parameter containing DLS addresses other than GS2.	
	6	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	7	SEND	LT GS2	XID_RSP_HO (F=1)	
	8	WAIT	LT	EUT TG5 for initiation	
	9	SEND	LT GS1	INFO(P=0)	
	10	RECEIVE	LT GS1	DM(F=0)	
	11	$CHECK_{LINK}$	LT GS2	Link with GS2 is established	
Postamble		$RESET_{AVLC}$	LT GS2		
Comment:					

Procedure (c) Air Initiated Handoff shall have precedence over Ground Initiated Handoff

This procedure is applicable to equipment that supports Air Initiated Handoff.

Test Case Name: Aircraft Initiated Handoff vs. Ground Initiated Handoff					
Purpose: Verify LME procedure that shall give precedence to Air Initiated Handoff during when receiving a Ground Initiated Handoff					
Configuration: 3					
Reference: DO-224C, 3.2.2.4.7.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	
	2	INHIBIT	LT GS2	GS2 will not respond to next XID_CMD_HO(P=1)	
	3	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	4	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	5	SEND	LT GS2	XID_CMD_HO (P=1)	
	6	RECEIVE	LT GS2	XID_CMD_HO (P=1)	EUT retransmit as it is still waiting for a response
	7	SEND	LT GS2	XID_RSP_HO (F=1)	
	8	$CHECK_{LINK}$	LT GS2	Link with GS2 is established	
	9	WAIT	LT	EUT TG5 for initiation	
	10	SEND	LT GS1	INFO(P=0)	
	11	RECEIVE	LT GS1	DM(F=0)	
	12	$CHECK_{LINK}$	LT GS2	Link with GS2 is still active	
Postamble		$RESET_{AVLC}$	LT GS2		
Comment:					

2.4.5.4.7 XID Frame

<u>Procedure</u>

Test Case Name: XID Frame					
Purpose: Verify the usage and processing of XID type frames. The procedures for testing the use of XID Frames to establish and maintain links are given later in this document. The following procedure tests XID frame retransmissions based on Timer T3 and the use of the XID Sequence Parameter.					
Configuration: 1					
Reference: DO-224C,3.2.2.4.8					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	INHIBIT	LT	All automatic responses to EUT commands	
	2	SEND	LT	Repeated GSIF with default parameters	
	3	$RESET_{AVLC}$			
Test body	1	VERIFY	LT	N2 repeated XID_CMD_LE transmissions from the EUT, spaced T3 apart. Verify that the sequence number in the XID Sequencing Parameter in all of the XID_CMD_LE frames is identical and that the retransmission number in the XID Sequencing Parameter increments by one in each successive retransmission of the XID_CMD_LE.	
	2	$RESET_{AVLC}$			
	3	DO	LT	Enable automatic responses.	
	4	SEND	LT	Repeated GSIF	
	5	SET_{AVLC}			
	6	SEND	LT	XID_CMD_LPM (P=1) with acceptable parameters to the EUT, sequence number 1, retransmission number 0	
	7	RECEIVE	LT	XID_RSP_LPM (F=1) having the sequence number 1	
	8	SEND	LT	Same XID_CMD_LPM (P=1) with the same acceptable parameters, sequence number 1, retransmission number 1.	
	9	VERIFY	LT	XID_RSP_LPM(F=1) with sequence number 1	
	10	SEND	LT	XID_CMD_LPM (P=1) with acceptable parameters, sequence number 6, retransmission number 2.	Retransmission number 2 value should be ignored
	11	VERIFY	LT	XID_RSP_LPM (F=1) with sequence number 6.	
Postamble		$RESET_{AVLC}$			
Comments This test requires the LT to directly access the AVLC protocol.					

Message Sequence Chart

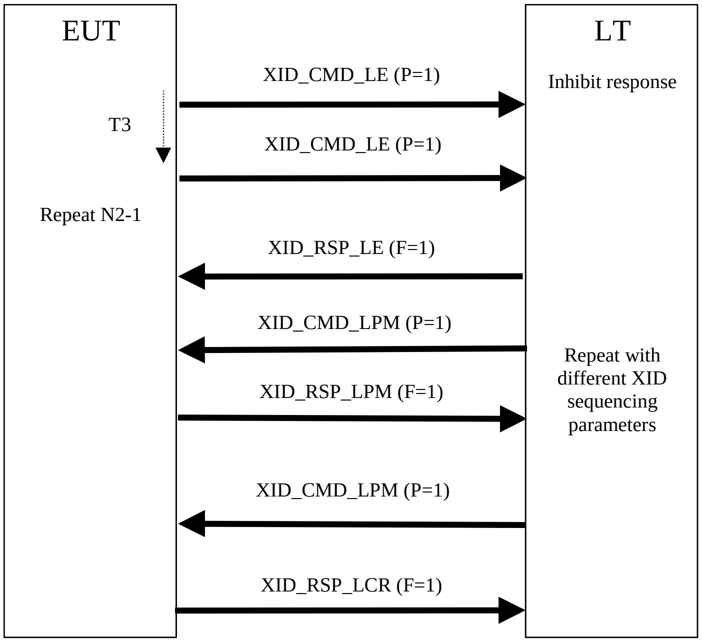


Figure 2-43: XID Frame

2.4.5.4.8 Broadcast

Note: *VDL Mode 2 avionics do not generate broadcast messages. The Broadcast requirement of DO-224C, Section 3.2.2.4.9 specifies limitations on the valid types of broadcast messages that are allowable in the VDL Mode 2 system.*

2.4.5.4.9 Information Transfer

Procedure

Test Case Name: Information Transfer
Purpose: Verify that the avionics implements the procedures for information transfer specified by ISO 4335 and ISO 7809
Configuration: 1
Reference: DO-224C, 3.2.2.4.10
Comments: 1. This requirement is verified by means of the totality of the tests specified in Section 2.4.5. 2. Test verification of specific exceptions to ISO 4335 and ISO 7809 are contained in Section 2.4.5.4.9.1 through 2.4.5.4.9.6.

2.4.5.4.9.1 Transmit Queue Management

2.4.5.4.9.1.1 Eliminate Redundant Frames

Procedure

Test Case Name: Eliminate Redundant Frames
Purpose: Verify that at most one RR, SREJ, DM, or retransmitted INFO frame is queued.
Reference: DO-224C, 3.2.2.4.10.1.1
Comments: This requirement deals with internal queue management, which is difficult to directly observe from external PCO. Therefore, this requirement may be verified as part of DO-178B software verification process.

2.4.5.4.9.1.2 Procedures for Transmission

Procedure

Note: *The structure of this test is as follows. A large amount of data is created at both the ground and air interfaces. At the ground interface, an erroneous frame is inserted in the data stream. Neither ground nor airborne data can be sent, because the channel is occupied by CW. When the channel is released, data exchange begins. When the EUT detects the erroneous frame, it responds with a FRMR, which is a supervisory frame. This supervisory frame is given priority, and inserted in the stream of downlink INFO frames.*

Test Case Name: Procedures for Transmission					
Purpose: Verify supervisory frames have higher priority than the information frames.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.10.1.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET_{AVLC}		Set the AVLC parameter W to 2	
	2	DO	LT	Occupy the RF channel 100% of the time	Transmitting CW at the channel frequency is an acceptable means of occupying the channel
Test body	1	DO	LT	Create 20 INFO frames with information content consisting of 20 octets. In the *n*-th INFO frame, the octets should all be set to the binary representation of *n*. In the fifth INFO frame, set N(s)=4, N(r)=10.	
	2	DO	UT	Create 50 INFO frames with information content of 20 octets. In the *n*-th INFO frame, the octets should all be set to the binary representation of *n+128*.	
	3a	DO	LT	Unblock the RF channel	steps 3a , 3b and 3c should be initiated in the specified order within the time required to transmit one of the INFO frames
	3b	SEND	LT	INFO (frames #1 to #20 in sequential order	
	3c	SEND	UT	All 50 UT frames created in Step 2	
	4	VERIFY	LT	FRMR (P=1) is received in the midst of the downlink INFO frames.	
	5	$RESET_{AVLC}$			
	6	SET_{AVLC}			
	7	DO	LT	Occupy the channel 100% of the time	
	8	REPEAT		Steps 1-3 with 10 LT INFO frames, all of which are valid	
	9	SEND	LT	XID_CMD_LPM(P=1) to change W size to 4	send XID frame immediately after INFO #10 from LT
	10	DO	LT	Occupy the channel 100% of the time for a period sufficient for the EUT to process the XID-CMD_LPM frame.	
	11	VERIFY	LT	XID_RSP_LPM followed by UT INFO frames.	
	12	$RESET_{AVLC}$			
	13	SET_{AVLC}			
	14	REPEAT		Steps 1-3 with 10 LT INFO frames, all of which are valid	
	15	SEND	LT	DISC(P=0)	send DISC frame immediately after INFO #10 from LT
	16	VERIFY	LT	DM, followed by no additional INFO frames.	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol.. 2. For Class X and Class Z equipment, the SEND actions may be performed by any external command that causes the desired AVLC action. 3. This requirement deals with internal queue management, which are difficult to directly observe from external PCOs. Therefore, this requirement may be verified as part of ED12B/DO-178B software verification process					

Message Sequence Chart

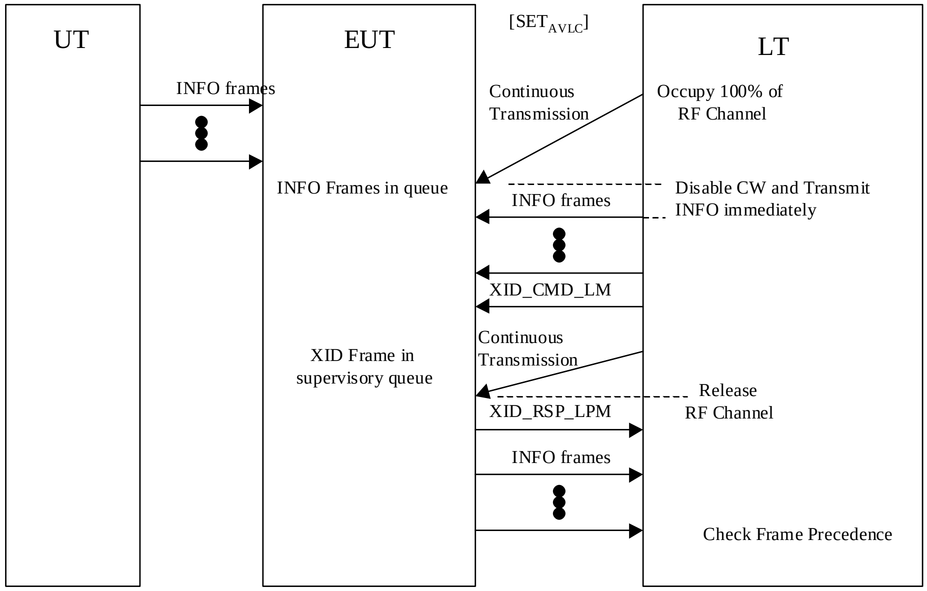


Figure 2-44: Procedures for Transmission

2.4.5.4.9.2 SREJ Frame

Procedure

Test Case Name: SREJ Frame					
Purpose: Verify the usage and processing of the SREJ(F=1) frame. The SREJ (P=1) case has already been tested in Section 2.4.5.4.3.4.					
Configuration: 1					
Reference: DO-224C 3.2.2.4.10.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	LT	Two consecutive INFO (P=0) frames with N(s) = 0 and N(s) = 2 (1 missing frame, N(s) = 1).	(frame # 0, 2)
	2	VERIFY	LT	Confirm that the EUT enters the SRM state by receiving an SREJ (F=0, NR=1) after frame 2	
	3	SEND	LT	INFO (P=1,Ns=3)	(frame # 3).
	4	VERIFY	LT	The EUT sends an SREJ (NR=1, F=1) frame	
	5	SEND	LT	The missing INFO (P=0) N(s)=1.	
	6	VERIFY	LT	Receipt of RR (F=0)	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol.. 2. For Class Y equipment, UT control and observation point may be at the Data/Management Interface.					

Message Sequence Chart

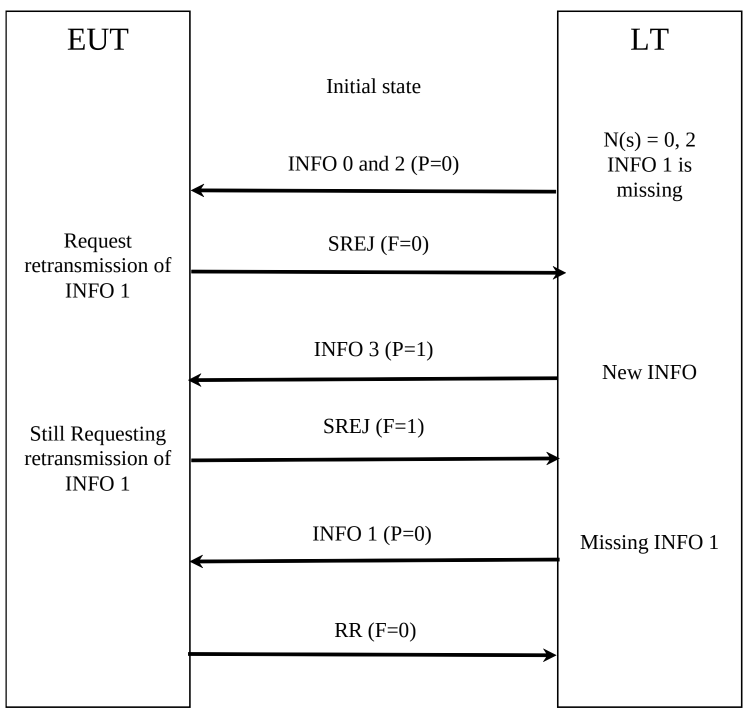


Figure 2-45: SREJ Frame

2.4.5.4.9.3 FRMR Frame

Procedure

Test Case Name: FRMR Frame					
Purpose: Verify the usage and processing of the FRMR frame.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.10.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	UT	INFO (P=0) frame. Data content does not matter	Comment 2
	2	INHIBIT	LT	After acknowledging first INFO frame, inhibit LT from acknowledging future INFO frames	
	3	SEND	LT	2 INFO (P=0) frames. Data content does not matter.	Vr and Vs will be non-zero.
	4	SEND	UT	INFO frame	As this frame is not acknowledged, it will stay in the retransmission queue
	5	SEND	LT	Invalid INFO frame.	
	6	RECEIVE	LT	FRMR (P=1)	
	7	WAIT	LT	T3 value for EUT	
	8	SEND	LT	UA (F=1)	
	9	VERIFY	LT	EUT does not retransmit the last INFO frame as the retransmission queue has been reset.	
	10	$CHECK_{link}$		Verify RR frames contain Nr=0	
	11	REPEAT		Steps 1 to 4	
	12	SEND	LT	FRMR (P=1)	
	13	RECEIVE	LT	UA (F=1)	
	14	VERIFY	LT	EUT does not retransmit the last INFO frame as the retransmission queue has been reset.	
	15	$CHECK_{link}$		Verify RR frames contain Nr=0	
	16	SEND	LT	Invalid frame	
	17	RECEIVE	LT	FRMR(P=1)	
	18	SEND	LT	RR (P=0) NR=0	Any other frame other than a UA may be used in this step.
	19	RECEIVE	LT	FRMR(P=1).	Confirms that the EUT retransmits the FRMR when the UA (F=1) does not arrive as expected
	20	SEND	LT	UA(F=1)	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol.. 2. For Class X or Class W equipment, any higher level command that results in the generation of INFO frames may be used where appropriate (for example, in Step 1).					

2.4.5.4.9.4 UA Frame

Procedure (a)

Test Case Name: UA Frame (a)					
Purpose: Verify the EUT does not respond to a UA frame that is not in response to a FRMR and maintains normal operation.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.10.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	LT	UA (F=1)	Unexpected
	2	$CHECK_{LINK}$	LT		Confirm that the link functions as normal
Postamble		$RESET_{AVLC}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol..					

Procedure (b)

Test Case Name: UA Frame (b)
Purpose: Verify that the avionics does not generate UA frames in response to commands other than FRMR.
Configuration: 1
Reference: DO-224C, 3.2.2.4.10.4
Comments: 1. This requirement is verified by means of the totality of the tests specified in Section 2.4.5.

Procedure (c)

Test Case Name: UA Frame (c)
Purpose: Verify that the avionics does generate a UA in response to a FRMR command
Configuration: 1
Reference: DO-224C, 3.2.2.4.10.4
Comments: 1. This requirement is verified by test case FRMR Frame (b) in Section 2.4.5.4.9.3.

2.4.5.4.9.5 UI Frame

Procedure (a)

Test Case Name: UI Frame (a)					
Purpose: Verify that reception of a UI frame does not upset normal link operation.					
Configuration: 1					
Reference: DO-224C, 3.2.2.4.10.5					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET $_{8208}$			
Test body	1	DO	LT	Prepare UI frame with 2048 octets of data. The octets should be numbered sequentially 0-255 with the pattern repeated 8 times.	
	2	CHECK$_{NETWORK}$	LT		
	3	SEND	LT	UI	
	4	CHECK$_{NETWORK}$	LT		
Postamble		RESET $_{8208}$			
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Y equipment, UT control and observation point may be at the Data/Management Interface, and the INFO frames may be generated directly. In this case, SET$_{AVLC}$ and RESET$_{AVLC}$ may be substituted for the preamble and postamble, and CHECK$_{AVLC}$ may be substituted for CHECK$_{NETWORK}$.					

Procedure (b)

Test Case Name: UI Frame (b)					
Purpose: Verify that information in UI frame is passed to designated output.					
Reference: DO-224C, 3.2.2.4.10.5					
Preamble		SET$_{AVLC}$	LT		
Test body	1	DO	LT	Prepare UI frame with 2048 octets of data. The octets should be numbered sequentially 0-255 with the pattern repeated 8 times.	
	2	SEND	LT	UI	
	3	VERIFY	UT	Data content is presented in output format as declared in response to Section 2.2.2.	
Postamble		RESET$_{AVLC}$	LT		
Comments: This test need only be performed if the manufacturer has declared the capability to output UI data in accordance with Section 2.2.2.					

2.4.5.4.9.6 TEST Frame

Procedure

Test Case Name: TEST Frame					
Purpose: Verify the usage and processing of the TEST frame exchange.					
Reference: DO-224C, 3.2.2.4.10.6, 3.2.2.4.2.5 and Table 3-6.					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET$_{AVLC}$		Include support for TEST frame (bit 12 of HDLC options = 1)	
Test body	1	SEND	LT	TEST	
	2	VERIFY	LT	Receive the TEST frame in response.	Optional step to be performed only if EUT supports TEST frames
	3	CHECK$_{LINK}$	LT	Verify that link is still active.	
Postamble		RESET$_{AVLC}$			

Message Sequence Chart

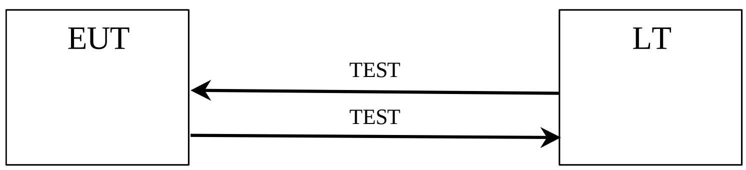


Figure 2-46: TEST Frame

2.4.5.5 Link Management Entity

This document assumes that VDL Mode 2 LME functionality is contained in Class X and Class Z equipment.

Unless otherwise stated, all tests are to be performed with the LT providing the default test signal level defined in Section 2.4.1.7.

If capabilities identified in DO-224C as optional are not included in the equipment under test, those test sections identified as optional in the following paragraphs need not be performed. If optional capabilities are included in the equipment, such capabilities should be tested with the indicated procedure.

2.4.5.5.1 Services

2.4.5.5.1.1 Link Provision

Procedure (a)

Test Case Name: Link Provision (a)
Purpose: Verify that the avionics establishes a link with a peer DLE entity.
Configuration: 1
Reference: DO-224C, 3.2.2.5.1.1
Comments: This requirement is verified by test case in Section 2.4.5.5.4.4.

Procedure (b)

Test Case Name: Link Provision (b)
Purpose: Verify that the avionics determines a ground station/peer LME relation by the DLS address mask.
Configuration: 1
Reference: DO-224C, 3.2.2.5.1.1
Comments: This requirement is verified by test case of Section 2.4.5.5.4.6.

Procedure (c)

Test Case Name: Link Provision (c)
Purpose: Verify that the avionics establishes monitors all transmissions to maintain a reliable link.
Configuration: 1
Reference: DO-224C, 3.2.2.5.1.1
Comments: This requirement is verified by tests of Section 2.4.5.5.4.6 and Section 2.4.5.5.3.2

2.4.5.5.1.2 Link Change Notification

Procedure

Test Case Name: Link Change Notification					
Purpose: Verify the VME notifies the intermediate-system system management entity (IS-SME) of changes in link connectivity supplying information contained in the XID frames received.					
Configuration: 1					
Reference: DO-224C, 3.2.2.5.1.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT		
Test body	1	SEND	LT	DISC	
	2	VERIFY	UT	At the UT, verify an event occurs informing the IS-SME of a link disconnect, including addressing information for the disconnected peer.	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. The form and format of the event may be manufacturer-specific. 3. The IS-SME is assumed to be the airborne ATN router associated with the avionics equipment under test. 4. The manufacturer may propose alternate methods for this test, in accordance with Section 2.4 and 2.4.1.					

2.4.5.5.2 Exchange Identity (XID) Formats

2.4.5.5.2.1 Encoding

Procedure

Test Case Name: Encoding
Purpose: Verify that the XID information field is encoded per ISO 8885, and DO-224C.
Reference: DO-224C, 3.2.2.5.2., 3.2.2.5.2.1, and Table 3-48a through Table 3-48c.
Comments: 1. Detailed XID information field encoding may be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Proper functioning of a subset of XID parameters (e.g. AVLC Specific Options, ATN Router NET) are verified within Section 2.4.6. 3. Overall proper formatting of XID information is implicitly tested by all procedures that transmit or receive XID frames.

2.4.5.5.2.2 Public Parameters

Procedure

Test Case Name: Public Parameters
Purpose: Verify that the XID public parameters are encoded per ISO 8885 and DO-224C.
Reference: DO-224C, 3.2.2.5.2.2, 3.2.2.5.2.2.1, 3.2.2.5.2.2.2, and Table 3-8, Table 3-9.
Comments: Encoding of XID Public Parameters with the addition of the private parameter data link layer subfield, should be verified as part of the DO-178B software verification process (see Section 2.4.5.4)

2.4.5.5.2.3 Private Parameters

Procedure

Test Case Name: Private Parameters
Purpose: Verify that the XID Private Parameters are encoded per ISO 8885 and DO-224C.
Reference: DO-224C, 3.2.2.5.2.3 and 3.2.2.5.2.4 and subparagraphs
Comments: Encoding of XID Private Parameters should be verified as part of the DO-178B software verification process (see Section 2.4.5.4)

2.4.5.5.2.4 General Purpose Private Parameters

Procedure

Test Case Name: General Purpose Private Parameters
Purpose: Verify that the XID General Purpose Private parameters are encoded per ISO 8885 and DO-224C. This includes the following parameters • VDL Private Parameter Set Identifier • Connection Management Parameter • Signal Quality Parameter • XID Sequencing Parameter • AVLC Specific Options Parameter • Expedited Subnetwork Connection Parameter • LCR Cause Parameter
Reference: DO-224C, 3.2.2.5.4., 3.2.2.5.2.4.1 through 3.2.2.5.2.4.7, Tables 3-11 through 3-21
Comments: Encoding of XID General Purpose Private Parameters should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) Note that the AVLC Specific Options and LCR Cause Parameters were updated in DO-224C.

2.4.5.5.2.5 Aircraft Initiated Private Parameters

Procedure

Test Case Name: Aircraft Initiated Information Private Parameters
Purpose: Verify that the Aircraft Initiated Information Private parameters are encoded per ISO 8885 and DO-224C. This includes the following parameters • Modulation Support Parameter • Acceptable Alternate Ground Station Parameter • Destination Airport Parameter • Aircraft Location Parameter
Reference: DO-224C, 3.2.2.5.2.5, 3.2.2.5.2.5.1 through 3.2.2.5.2.5.4 Tables 3-22 through 3-27
Comments: Encoding of Aircraft Initiated Information Parameters should be verified as part of the DO-178B software verification process (see Section 2.4.5.4)

2.4.5.5.2.6 Ground Initiated Modification Private Parameters

Procedure

Test Case Name: Ground Initiated Modification Private Parameters
Purpose: Verify that the Ground Initiated Modification parameters are encoded per ISO 8885 and DO-224C. This includes the following parameters • Autotune Frequency Parameter • Replacement Ground Station • Timer T4 Parameter. • MAC Persistence Parameter. • Counter M1 Parameter. • Timer TM2 Parameter. • Timer TG5 Parameter. • T3min Parameter. • Ground Station Address Filter Parameter. • Broadcast Connection Parameter.
Reference: DO-224C, 3.2.2.5.2.6, 3.2.2.5.2.6.1 through 3.2.2.5.2.6.10, Tables 3-28 through 3-38
Comments: 1. Encoding of Ground Initiated Modification Parameter should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Proper operation of several of these parameters (e.g. MAC Persistence, M1, TM2) is demonstrated by the tests in Section 2.4.5.3 of this document. 3. Avionics do not transmit these parameters, but must utilize them to control link operation.

2.4.5.5.2.7 Ground Initiated Private Parameters

Procedure

Test Case Name: Ground Initiated Private Parameters
Purpose: Verify that the Ground Initiated Private Parameters are encoded per ISO 8885 and DO-224C. This includes the following parameters • Frequency Support List Parameter • Airport Coverage Indication Parameter • Nearest Airport Parameter • ATN Router NETs Parameter • Ground Based System Mask Parameter • Timer TG3 Parameter • Timer TG4 Parameter • Ground Station Location Parameter
Reference: DO-224C, 3.2.2.5.2.7, 3.2.2.5.2.7.1 through 3.2.2.5.2.7.8, Tables 3-39 through 3-48
Comments: 1. Encoding of Ground Initiated Private Parameters should be verified as part of the DO-178B software verification process (see Section 2.4.5.4) 2. Avionics do not transmit these parameters, but use them to control link operation. 3. Tests establishing ATN and AOA communications should verify the avionics properly handles the ATN Router Net parameter and how it is used for ATN and non-ATN communications initiation, as applicable to the equipment under test.

2.4.5.5.3 LME Service System Parameters

2.4.5.5.3.1 Timer TG1 (frequency dwell time)

Procedure

Test Case Name: Timer TG1					
Purpose: Verify proper operation of the LME frequency dwell time timer, TG1					
Configuration: 1					
Reference: DO-224C, 3.2.2.5.3.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT	Set operating frequency of the GS to f1.	f1 is the Common Signaling Channel (CSC).
Test body	1	SET	UT	Set TG1 to minimum available for the equipment under test, consistent with DO-224C 3.2.2.5.3.1 constraints.	This is an equipment-specific process. Setting TG1 to minimum minimizes the time for this test.
	2	SET	UT	Tune the EUT to f2	By whatever means. f2 can be any valid VHF frequency that is not the CSC.
	3	VERIFY	UT	Upon expiration of TG1, the EUT tunes to f1 (CSC)	
	4	SEND	LT	Repeated GSIF frames on f1	
	5	VERIFY	LT	XID_CMD_LE received prior to expiration of TG1	
	6	REPEAT		Steps 1-5 with TG1 set to max	
Postamble		$RESET_{AVLC}$			
Comments: 1. For Class Z equipment, the operating frequency and GSIF frames may be generated on the Data/Management Interface. 2. An alternate way of testing this feature could be to monitor the time separation between two consecutive configurations of the VDR, first one with frequency f1, second one with frequency f2.					

2.4.5.5.3.2 Timer TG2 (maximum idle activity time)

Procedure

Test Case Name: Timer TG2 (maximum idle activity time)					
Purpose: Verify setting and usage of Timer TG2.					
Configuration: 1					
Reference: DO-224C, 3.2.2.5.3.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of the GS1 to f1	F1 = CSC
	2	SET	LT GS2	Operating frequency of the GS2 to f1	
	3	SET	UT	Set TG2 to minimum available for the equipment under test, consistent with DO-224C Section 3.2.2.5.3.2 constraints.	
	4	SEND	LT GS1	GSIFs	(No FSL or RGSL)
	5	SET_{AVLC}	LT GS1		
	6	SEND	LT GS2	GSIFs	(No FSL or RGSL)
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active.	
	2	DO	LT GS1	Disable Transmissions	
	3	WAIT	LT GS2	GSIF	
	4	DO	LT GS2	Configure for no more GSIFs	
	5	WAIT	LT	100% of EUT TG2 value since step 1 completed with no GS1 activity	
	6	VERIFY	LT GS2	XID_CMD_HO(P=1)	
	7	SEND	LT GS2	XID_RSP_HO(F=1)	
	8	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active.	
	9	WAIT	UT	50% of EUT TG2 value with no activity	
	10	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active.	
	11	WAIT	LT	50% of EUT TG2 value with no activity	This is 100% of EUT since step 8 completed.
	12	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active.	
	13	DO	LT GS1	Enable transmission so GSIFs can be received again.	
	14	WAIT	LT	100% of EUT TG2 value with no GS2 activity from Step 12.	GS1 GSIF must be received while waiting
	15	VERIFY	LT GS1	XID_CMD_HO(P=1)	
	16	SEND	LT GS1	XID_RSP_HO(F=1)	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the operating frequency and GSIF frames may be generated at the Data/Management Interface.					

Message Sequence Chart

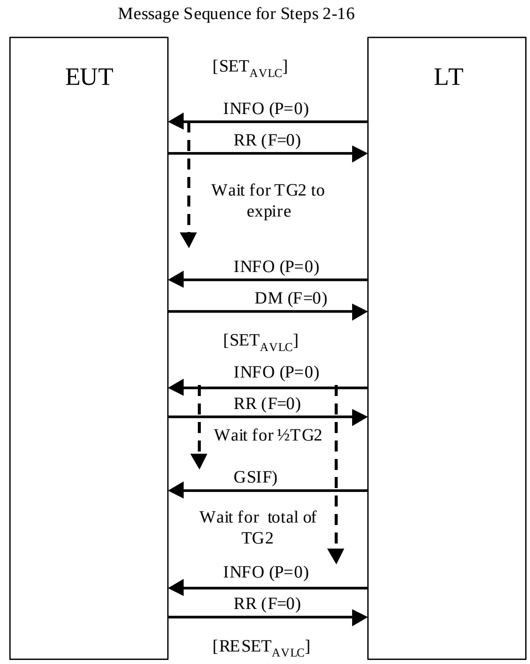


Figure 2-47: Timer TG2

2.4.5.5.3.3 Timer TG3 (maximum time between transmissions)

There is no avionics requirement in DO-224C, Section 3.2.2.5.3.3. This is a ground station requirement only.

2.4.5.5.3.4 Timer TG4 (maximum time between GSIFs)

There is no avionics requirement in DO-224C, Section 3.2.2.5.3.3. This is a ground station requirement only.

2.4.5.5.3.5 Timer TG5 (maximum link overlap time)

Procedure

Test Case Name: Timer TG5 (maximum link overlap time)					
Purpose: Verify setting and usage of Timer TG5.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.3.5					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	
	2	DO	LT GS1	Slowly reduce signal level or SQP from GS1 until a handoff occurs.	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1)	
	4	SEND	LT GS2	XID_RSP_HO (F=1)	EUT should start TG5 timer on receipt of XID_RSP_HO
	5	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	WAIT	LT	For expiration of TG5 timer in EUT	The TG5 timer referred to here is the TG5 timer for initiating action.
	8	SEND	LT GS1	INFO (P=0)	
	9	VERIFY	LT GS1	DM(F=0)	
	10	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble		$RESET_{AVLC}$	LT GS2		
Comments: 1. EUT TG5 for response is tested in section 2.4.5.5.4.9.					

2.4.5.5.4 Description of LME Procedures

Compliance with the requirements is verified by the following subsections.

2.4.5.5.4.1 Frequency Management

Procedure (a)

Test Case Name: Frequency Management
Purpose: Verify that the Frequency Search Procedure complies with DO-224C.
Reference: DO-224C, 3.2.2.5.4.1.1
Comments: 1. This requirement is verified by the test procedure of Section 2.4.5.5.3.1 and 2.4.5.5.4.1 (d) of this document.

Procedure (b)

Test Case Name: Frequency Recovery – Air FSL (b)					
Purpose: Verify that the Frequency Recovery Procedure complies with DO-224C. Verify when EUT is airborne, the air FSL is used for frequency recovery on loss of CSC, and non-CSC frequencies.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.1.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	DO	UT	Set aircraft air/ground state to 'airborne'.	
	2	SET	LT GS2	Operating frequency of the GS2 to f1	f1 = CSC
	3	SET	LT GS1	Operating frequency of the GS1 to f2	
	4	SET	LT GS3	Operating frequency of the GS3 to f3	
	5	SET_{AVLC}	LT GS2	GSIFs on f1 including an FSL parameter (gnd-bit = 0) containing GS1 on f2 frequency.	
	6	VERIFY	LT GS2	EUT establishes link on f1	
Test body	1	SET	LT GS2	Prevent GS2 from TX and wait to allow TG2 to expire.	At this point, there is no further uplink traffic on the established f1 link
	2	VERIFY	LT GS1	XID_CMD_HO(P=1) received on f2 after expiration of TG2 timer in EUT	the EUT moves to the next frequency in the list
	3	SEND	LT GS1	XID_RSP_HO(F=1)	
	4	$CHECK_{LINK}$	LT GS1	Verify link is established on f2.	
	5	SEND	LT GS1	GSIFs on f2 including an FSL parameter (gnd-bit = 0) containing GS3 on f3 frequency.	
	6	SET		CW on frequency f2 for time > TM2	Create congested situation, f2 is now unusable
	7	SEND	UT	INFO frame	The INFO frame is sent to start TM2
	8	VERIFY	LT GS3	XID_CMD_HO(P=1) on f3	EUT tunes to f3
	9	SEND	LT GS3	XID_RSP_HO(F=1) on f3	
	10	$CHECK_{LINK}$	LT GS3	Verify link is established on f3.	
	11	SEND	LT GS3	DISC(P=0)	Forces disconnect on f3
	12	SEND	LT GS2	GSIFs on f1 including an FSL parameter (gnd-bit = 0) containing GS1 on f2 frequency.	
	13	VERIFY	LT GS2	XID_CMD_LE(P=1) on f1	EUT tunes to f1 (CSC)
	14	SEND	LT GS2	XID_RSP_LE(F=1) on f1	
Postamble	1	$RESET_{AVLC}$	LT GS1, LTGS2, & LT GS3		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the operating frequency and GSIF frames may be generated on the Data/Management Interface.					

Procedure (c)

Test Case Name: Frequency Recovery Frequency Support List (c)					
Purpose: Verify Aircraft in the air ignores Ground-Based FSL with matching airport coverage parameter while in Frequency Recovery.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.1.2, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	Configure EUT in air	
	2	SET	UT	Configure EUT destination airport as "KBWI"	
	3	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	4	SET	LT GS2	Operating frequency of GS2 as f2	
	5	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address), Airport Coverage Parameter: "KBWI"	
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: "KBWI"	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: "KBWI"	
	2	$CHECK_{LINK}$	LT GS1	verify link with GS1 is active	EUT does NOT tune to f2: EUT in air and gnd = 1
	3	DO	LT GS1	Disable transmission from GS1	
	4	VERIFY	UT	Upon TG2 expiration, EUT does NOT tune to f2	EUT does not use Ground-based FSL for freq. recovery.
	5	VERIFY	UT	EUT loses VDL Service	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (d)

Test Case Name: Frequency Recovery Frequency Support List (d)					
Purpose: Verify Aircraft in air ignores Ground-Based FSL while in Frequency Recovery with non-matching airport coverage parameter.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.1.2, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	Configure EUT in air	
	2	SET	UT	Configure EUT destination airport as "KORD"	Mismatch in airport coverage between EUT and GSIF
	3	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	4	SET	LT GS2	Operating frequency of GS2 as f2	
	5	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address), Airport Coverage Parameter: "KBWI"	
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: "KBWI"	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: "KBWI"	
	2	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	EUT does NOT tune to f2: EUT in air and gnd = 1
	3	DO	LT GS1	Disable transmission from GS1	
	4	VERIFY	UT	Upon TG2 expiration, EUT does not tune to f2.	EUT does not use Ground-based FSL for freq. recovery.
	5	VERIFY	UT	EUT loses VDL Service	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (e)

Test Case Name: Frequency Recovery Frequency Support List (e)					
Purpose: Verify Aircraft in air uses Frequency Recovery FSL in air with matching airport coverage parameter.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.1.2, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	Configure EUT in air	
	2	SET	UT	Configure EUT destination airport as “KBWI”	Matching airport coverage.
	3	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	4	SET	LT GS2	Operating frequency of GS2 as f2	
	5	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 0), FSL (Freq: f2, GS2 address) , Airport Coverage: “KBWI”	
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 0), FSL (Freq: f2, GS2 address) , Airport Coverage: “KBWI”	
	2	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
	3	DO	LT GS1	Disable transmission from GS1 and wait for TG2 to expire.	
	4	VERIFY	UT	EUT tunes to f2	
	5	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Freq. Recovery
	6	SEND	LT GS2	XID_RSP_HO (F=1)	
	7	$\text{CHECK}_{\text{LINK}}$	LT GS2	verify link with GS2 is active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (f)

Test Case Name: Frequency Recovery Frequency Support List (f)					
Purpose: Verify Aircraft in air uses Frequency Recovery FSL in air with non-matching airport coverage parameter.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	Configure EUT in air	
	2	SET	UT	Configure EUT destination airport as “KORD”	Non-matching airport coverage.
	3	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	4	SET	LT GS2	Operating frequency of GS2 as f2	
	5	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 0), FSL (Freq: f2, GS2 address), Airport Coverage: “KBWI”	
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 0), FSL (Freq: f2, GS2 address) , Airport Coverage: “KBWI”	
	2	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	3	DO	LT GS1	Disable transmission from GS1 and wait for TG2 to expire.	
	4	VERIFY	UT	EUT tunes to f2	
	5	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Freq. Recovery
	6	SEND	LT GS2	XID_RSP_HO (F=1)	
	7	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (g)

Test Case Name: Frequency Recovery Frequency Support List (g)					
Purpose: Verify that the Frequency Recovery Procedure complies with DO-224C. Verify when aircraft is airborne, it does not use ground FSL with matching airport coverage parameter for frequency recovery.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.1.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	Set aircraft air/ground state to 'airborne'.	
	2	SET	UT	Configure EUT destination airport as "KCID"	
	3	SET	LT GS1	Operating frequency of the GS1 to f1	f1 = CSC
	4	SET	LT GS2	Operating frequency of the GS2 to f2	
	5	SET	UT	EUT scanning on f2	By whatever means
	6	SET_{AVLC}	LT GS2	GSIF on f2 including an FSL parameter (gnd-bit = 1) containing GS3 on f3 frequency, Airport Coverage Parameter: "KCID".	Advertise ground FSL with matching coverage parameter.
	7	VERIFY	LT GS2	EUT establishes link on f2	
Test body	1	SEND	LT GS2	DISC(P=0)	At this point, there is no further established f2 link
	2	VERIFY	UT	EUT tunes to f1.	A ground FSL received on non-CSC frequency is not used for frequency recovery.
	3	SEND	LT GS1	GSIF	
	4	VERIFY	LT GS1	XID_CMD_LE(P=1) received on f1 after expiration of TG2 timer in EUT	
	5	SEND	LT GS1	XID_RSP_LE(F=1)	
	6	$CHECK_{LINK}$	LT GS1	Verify link is established on f1	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LTGS2		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the operating frequency and GSIF frames may be generated on the Data/Management Interface.					

Procedure (h)

Test Case Name: Frequency Recovery – Air FSL (h)					
Purpose: Verify that the Frequency Recovery Procedure complies with DO-224C. Air FSL is used for frequency recovery on CSC. Subsequent Link Failure with no additional FSL choice results in default fallback to CSC.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.1.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1		UT	Set aircraft air/ground state to 'airborne'.	
	2	SET	LT GS1	Operating frequency of the GS1 to f1	F1 = CSC
	3	SET	LT GS2	Operating frequency of the GS2 to f3	
	4	SET_{AVLC}	LT GS1	GSIFs on f1 including an FSL parameter (gnd-bit = 0) containing GS2 on f2 frequency.	FSL identifies GS2 on a frequency (f2) where GS2 does not exist.
	5	VERIFY	LT GS1	EUT establishes link on f1	
Test body	1	SEND	LT GS1	DISC (P=0).	At this point, there is no further uplink traffic on the established f1 link
	2	VERIFY	UT	EUT tunes to f2 and transmits XID_CMD_HO(P=1) to GS2.	the EUT moves to the next frequency in the list
	3	WAIT	UT	EUT reaches N2 due to no response to XID_CMD_HO (P=1)	
	4	VERIFY	UT	EUT tunes to f1	Fallback to CSC
	5	SEND	LT GS1	Restore GS1 and send GSIF (no FSL)	
	6	VERIFY	LT GS1	XID_CMD_LE(P=1) on f1	
	7	SEND	LT GS1	XID_RSP_LE(F=1) on f1	
	8	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link is established on f1.	
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the operating frequency and GSIF frames may be generated on the Data/Management Interface.					

Procedure (i)

Test Case Name: Frequency Recovery Frequency Support List (i)					
Purpose: Verify Aircraft LME uses Frequency Recovery FSL followed by a GRAIHO.					
Configuration: 4					
Reference: DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 ≠ CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	F2 = CSC
	3	SET	LT GS3	Operating frequency of GS3 as f3	
	4	SET	UT	Configure EUT in air, scanning on f1	
	5	SET	UT	Configure EUT destination airport as “KBWI”	
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 0), FSL (Freq: f2, GS2 address) , Airport Coverage: “KBWI”	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f2	
	9	SEND	LT GS3	GSIFs on f3	
Test body	1	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 0), FSL (Freq: f2, GS2 address) , Airport Coverage: “KBWI”	
	2	DO	LT GS1	Disable the transmission of GS1	At this point, there is no further established link on f1
	3	VERIFY	UT	EUT tunes to f2	Freq Recovery
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for a GSIF
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	WAIT		For expiration of EUT TG5 timer	
	8	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	No response from UT as RR is not received since GS1 is on a different frequency.
	9	SEND	LT GS2	XID_CMD_HO (P=0, replacement ground station list includes: GS3 address, autotune frequency: f3)	GRAIHO from f2 to f3
	10	VERIFY	UT	EUT tunes to f3	
	11	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	Verify Immediate HO to GS3 w/o waiting for a GSIF
	12	SEND	LT GS3	XID_RSP_HO (F=1)	
	13	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

2.4.5.5.4.2 Link Connectivity

Procedure

Test Case Name: Link Connectivity Procedures
Purpose: Verify link connectivity procedures between air and ground-based systems.
Reference: DO-224C, 3.2.2.5.4.2
Comments: 1. This requirement is verified by the test procedure of Section 2.4.5.5.4.4. through Section 2.4.5.5.4.12 of this document.

2.4.5.5.4.3 Ground Station Identification

Procedure (a)

Test Case Name: GSIF Processing GS Functionality
Purpose: Verify that the aircraft LME processes GSIF content to identify GS functionality and operational parameters.
Reference: DO-224C, 3.2.2.5.4.3
Comments: 1. This requirement is verified by all test procedures that utilize GSIF frames for ground-to-air communications.

Procedure (b)

Test Case Name: GSIF Processing GS Functionality with Connection
Purpose: Verify that the aircraft LME processes only information and parameters for XID_CMD_LPM
Reference: DO-224C, 3.2.2.5.4.3, Table 3-48.
Comments: 1. The mandatory functionality of Table 3-48 is verified by all test procedures that utilize GSIF frames for ground-to-air communications. 2. Additional optional functionality should be verified as part of as part of the DO-178B software verification process (see Section 2.4.5.4).

2.4.5.5.4.4 Link Establishment

Figure 2-48 demonstrates link establishment procedure, where the first two parts have been verified in test procedures 2.4.5.4.5.3 (c) and 2.4.5.4.4.2.2 (b). The following test procedure (a) verifies the last part in Figure 2-48.

Message Sequence Chart

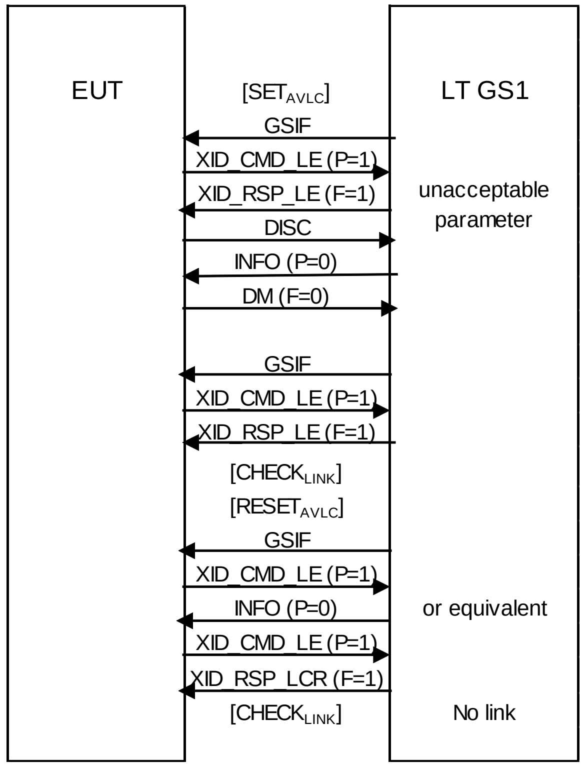


Figure 2-48: Link Establishment

Procedure (a)

Test Case Name: Link Establishment (a)					
Purpose: Verify retransmission of XID_CMD_LE.					
Configuration: 2					
Reference: DO-224C, 3.2.2.5.4.4, 3.2.2.5.4.4.1, 3.2.2.5.4.4.2, 3.2.2.5.4.4.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET	LT	Channel frequency, f1=CSC	If possible, configure the EUT not to leave VDL
Test body	1	SEND	LT	GSIF to establish the link	
	2	VERIFY	LT	XID_CMD_LE (P=1)	
	3	VERIFY	LT	Verify that XID_CMD_LE has all of the mandatory parameters.	
	4	SEND	LT	Unicast frame other than TEST or XID within T3	
	5	VERIFY	LT	XID_CMD_LE (P=1) retransmitted	
	6	SEND	LT	XID_RSP_LCR(F=1)	
	7	$CHECK_{LINK}$	LT	Verify no link exists	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the AVLC frames and content may be generated at the Data/Management Interface.					

Procedure (b)

Test Case Name: Link Establishment (b)					
Purpose: Verify the Aircraft LME link establishment procedures, with autotune but without any answer from the autotuned GS					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.4, 3.2.2.5.4.4.1, 3.2.2.5.4.4.2, 3.2.2.5.4.4.3, 3.2.2.5.4.6.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	Operating frequency f2 ≠ CSC
	3	SET	EUT	Aircraft is airborne	
	4	SET	EUT	Aircraft is scanning the CSC	
	5	INHIBIT	LT GS2	Disable transmission from GS2	
Test body	1	SEND	LT GS1	GSIF to establish the link	
	2	VERIFY	LT GS1	XID_CMD_LE (P=1)	
	3	SEND	LT GS1	XID_RSP_LE (F=1) with an autotune to f2 on (RGSL) GS2.	
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) sent N2 times	N2 counter
	5	SEND	LT GS1	GSIF to establish the link	
	6	VERIFY	LT GS1	XID_CMD_LE (P=1) on f1	
	7	SEND	LT GS1	XID_RSP_LE (F=1)	
	8	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
Postamble		$\text{RESET}_{\text{AVLC}}$	LT GS1		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the AVLC frames and content may be generated at the Data/Management Interface.					

Equipment under test shall comply with either procedure (c) or (d).

Procedure (c)

Test Case Name: Link establishment on Ground-Based Frequency Support List (c)					
Purpose: Verify Aircraft LME evaluates ground-based Frequency Support List before establishment on CSC at startup.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	Operating frequency f2 = alternate frequency
	3	SET	UT	Start-up EUT on ground	
	4	SET	UT	Configure EUT destination or departure airport as “KORD”	The selection of destination or departure airport depends on the flight phase, i.e., landing or departure.
	5	SET	EUT	Aircraft is scanning the CSC	
Test body	1	SEND	LT GS1	GSIF to establish the link with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	2	VERIFY	LT GS2	XID_CMD_LE (P=1)	EUT has tuned to f2
	3	SEND	LT GS2	XID_RSP_LE (F=1)	
	4	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is active, EUT remains on f2.	
Postamble					
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (d)

Test Case Name: Link establishment on Ground-Based Frequency Support List (d)					
Purpose: Verify Aircraft LME evaluates ground-based Frequency Support List when while connecting on CSC at startup.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	Operating frequency f2 = alternate frequency
	3	SET	UT	Start-up EUT on ground	
	4	SET	UT	Configure EUT destination or departure airport as “KORD”	The selection of destination or departure airport depends on the flight phase, i.e., landing or departure.
	5	SET	EUT	Aircraft is scanning the CSC	
Test body	1	SEND	LT GS1	GSIF to establish the link with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	2	VERIFY	LT GS1	XID_CMD_LE (P=1)	
	3	SEND	LT GS1	XID_RSP_LE (F=1)	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1)	EUT has tuned to f2
	3	SEND	LT GS2	XID_RSP_HO (F=1)	
	4	CHECK$_{LINK}$	LT GS2	Verify link with GS2 is active, EUT remains on f2.	
Postamble					
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Equipment under test shall comply with either procedure (e) or (f).

Procedure (e)

Test Case Name: Link establishment on Ground-Based Frequency Support List (e)					
Purpose: Verify Aircraft LME falls back on CSC when ground-FSL fails at startup.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	Operating frequency f2 = alternate frequency
	3	SET	UT	Start-up EUT on ground	
	4	SET	UT	Configure EUT destination or departure airport as “KORD”	The selection of destination or departure airport depends on the flight phase, i.e., landing or departure.
	5	SET	EUT	Aircraft is scanning the CSC	
Test body	1	SEND	LT GS1	GSIF to establish the link with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	2	VERIFY	LT GS2	XID_CMD_LE (P=1)	EUT has tuned to f2
	3	INHIBIT	LT GS2	No XID_RSP_LE sent	
	4	VERIFY	UT	EUT tunes to f1 after N2 retransmissions, and optionally TG1 (on f2), has expired	EUT has tuned to f1 after N2 expires
	5	SEND	LT GS1	GSIF to establish the link with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	6	VERIFY	LT GS1	XID_CMD_LE (P=1)	EUT ignores the FSL
	7	SEND	LT GS1	XID_RSP_LE (F=1)	
	8	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active, EUT remains on f1.	
Postamble					
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (f)

Test Case Name: Link establishment on Ground-Based Frequency Support List (f)					
Purpose: Verify Aircraft LME falls back on CSC when ground-FSL fails at startup (previously connected to CSC).					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	Operating frequency f2 = alternate frequency
	3	SET	UT	Start-up EUT on ground	
	4	SET	UT	Configure EUT destination or departure airport as “KORD”	The selection of destination or departure airport depends on the flight phase, i.e., landing or departure.
	5	SET	EUT	Aircraft is scanning the CSC	
Test body	1	SEND	LT GS1	GSIF to establish the link with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	2	VERIFY	LT GS1	XID_CMD_LE (P=1)	
	3	SEND	LT GS1	XID_RSP_LE (F=1)	
	4	VERIFY	LT GS2	XID_CMD_HO (P=1)	EUT has tuned to f2
	5	INHIBIT	LT GS2	No XID_RSP_HO sent	
	6	VERIFY	UT	EUT tunes to f1	EUT has tuned to f1 after N2 expires
	7	SEND	LT GS1	GSIF to establish the link with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	8	VERIFY	LT GS1	XID_CMD_LE (P=1)	EUT ignores the FSL
	9	SEND	LT GS1	XID_RSP_LE (F=1)	
	10	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active, EUT remains on f1.	
Postamble					
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

2.4.5.5.4.5 Link Parameter Modification

Procedure

Test Case Name: Link Parameter Modification					
Purpose: Verify setting of parameters via XID frame					
Configuration: 1					
Reference: DO-224C, 3.2.2.5.4.5					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}		With default parameters	
Test body	1	SEND	LT	XID_CMD_LPM (C/R=0, P=1) with the following parameters T4 = 1 min, p=0, M1= 1, TM2=6 sec, TG5=0 sec	
	2	VERIFY	LT	XID_RSP_LPM (C/R=1,P=1) confirming these parameters	
	3	DO		The tests of Section 2.4.5.4.3 and associated subsections to verify parameters are properly set	
	4	SEND	LT	XID_CMD_LPM (C/R=0, P=1) with the following parameters T4=1440 min, p=1, M1=65,535 TM2=120 sec TG5=255 sec	
	5	VERIFY	LT	XID_RSP_LPM (C/R=1,P=1) confirming these parameters	
Postamble		$RESET_{AVLC}$			
Comments: 1. This test assumes that the LT has direct access to the AVLC protocol. 2. This test should be performed after the tests of Section 2.4.5.4.3. The combination of 2.4.5.4.3 and Steps 1 and 2 show that the EUT can support modification of the link parameters. 3. If the EUT supports only a limited range of values for any parameter, Steps 1 and 4 may be modified with the appropriate lower and upper limits of that range.					

2.4.5.5.4.6 Aircraft Initiated Handoff

Procedure (a)

Test Case Name: Aircraft Initiated Handoff – Multiple Provider					
Purpose: Verify LME air initiated handoff procedures					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET_{AVLC}	LT GS1		GS1 and GS2 are on the same frequency and do not belong to the same ground system.
	2	SEND	LT GS2	GSIF	
Test body	1		UT	Cause the EUT to change GS (and provider)	The means to trigger the GS change should not inherently disconnect the link
	2	RECEIVE	LT GS2	XID_CMD_LE (P=1)	
	3	SEND	LT GS2	XID_RSP_LE (F=1)	
	4	VERIFY	LT GS1	DISC(P=0)	The exact timing of the DISC reception is not specified in the standards
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble		$RESET_{AVLC}$	LT GS2		
Comments:					

Procedure (b)

Test Case Name: Aircraft Initiated Hand-off because of poor signal quality on connected ground station					
Purpose: Verify LME air initiated handoff procedures					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	GS1 and GS2 are on the same frequency and belong to the same ground system.
	2	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	3	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	4	SEND	LT GS2	XID_RSP_HO (F=1).	The EUT will automatically start its TG5 timer upon receipt of the XID_RSP_HO (F=1).
	5	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	WAIT		EUT TG5 for initiation	
	8	SEND	LT GS1	INFO(P=0)	
	9	RECEIVE	LT GS1	DM(F=0)	
	10	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble		$RESET_{AVLC}$	LT GS2		
Comment:					

Procedure (c)

Test Case Name: Aircraft Initiated Hand-off					
Purpose: Verify LME air initiated handoff procedures					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	GS1 and GS2 are on the same frequency and belong to the same ground system.
	2	INHIBIT	LT GS2	Set GS2 to reject the next XID_CMD_HO from the a/c	
	3	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	4	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	5	SEND	LT GS2	DM(F=0) frame	
	6	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	7	SEND	LT GS2	XID_RSP_LCR (F=1)	
	8	$CHECK_{LINK}$	LT GS1	GS1 is active	
	9	$CHECK_{LINK}$	LT GS2	GS2 is not active	
Postamble		$RESET_{AVLC}$	LT GS1		
Comments:					

Procedure (d)

Test Case Name: Aircraft Initiated Hand-off – N2 exceeded on connected ground station					
Purpose: Verify LME air initiated handoff procedures					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	GS1 and GS2 are on the same frequency and belong to the same ground system
	2	INHIBIT	LT GS1	Set GS1not to answer any downlink frame	
	3	SEND	UT	Send INFO frame	
	4	RECEIVE	LT GS1	INFO frame sent N2 times	
	5	VERIFY	LT GS1	No frame sent to EUT	
	6	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	7	SEND	LT GS2	XID_RSP_HO (F=1)	
	8	$CHECK_{LINK}$	LT GS1	Verify GS1 is not active	
	9	$CHECK_{LINK}$	LT GS2	Verify GS2 is active	
Postamble		$RESET_{AVLC}$	LT GS1		
Comments:					

Procedure (e)

Test Case Name: Aircraft Initiated Hand-off – TG2 expired on connected ground station					
Purpose: Verify LME air initiated handoff procedures					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT GS1		
Test body	1	SEND	LT GS2	GSIF	GS1 and GS2 on same frequency and belong to the same ground system
	2	INHIBIT	LT GS1	Set GS1 not to send any uplink (XID, INFO…)	
	3	VERIFY	LT GS1	No frame sent to EUT	
	4	WAIT	LT GS1	EUT TG2 for expiration	
	5	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	6	SEND	LT GS2	XID_RSP_HO (F=1)	
	7	$CHECK_{LINK}$	LT GS1	GS1 is not active	
	8	$CHECK_{LINK}$	LT GS2	GS2 is active	
Postamble		$RESET_{AVLC}$	LT GS1		
Comments:					

Procedure (f)

Test Case Name: Air Initiated Handoff (f) – N2 counter expiration on XID_CMD_HO					
Purpose: Verify the Aircraft LME air initiated handoff procedures, without autotune and without any answer to the XID_CMD_HO from the destination GS					
Configuration: 2					
Reference : DO-224C, 3.2.2.5.4.6.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	EUT	Aircraft is scanning the CSC	
	4	SET$_{AVLC}$	LT GS1		
	5	SEND	LT GS2	GSIFs on f1	
	6	WAIT	UT	Wait until a GS2 GSIF is received by EUT.	
	7	SET	LT GS2	Disable transmission on GS2	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1 to trigger aircraft handoff.	
	2	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	3	VERIFY	LT GS2	Do not send any uplink to aircraft.	
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) sent 6 times	N2 counter
	5	CHECK$_{LINK}$	LT GS1	Verify link with GS1 is active	
	6	DO	LT GS2	Restore ability to transmit from GS2	
	7	CHECK$_{LINK}$	LT GS2	Verify link with GS2 is NOT active	
Postamble	1	RESET$_{AVLC}$	LT GS1		
	2	RESET$_{AVLC}$	LT GS2		
Comments: 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the AVLC frames and content may be generated at the Data/Management Interface.					

Procedure (g)

Test Case Name: Aircraft Initiated Hand-off Procedure (g)					
Purpose: Verify correct system behavior under normal conditions when an autotune command is included in the XID_RSP_HO following an Air-Initiated Handoff.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	Make sure GS2 configuration is for same provider
	3	SET	LT GS3	Operating frequency of GS3 as f2	Make sure GS3 configuration is for same provider
	4	SET	UT	EUT in air scanning on CSC	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f1	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT GS2	Verify immediate HO attempt to GS2
	3	SEND	LT GS2	XID_RSP_HO (F=1, replacement ground station list including GS3 address, autotune frequency set as f2) .	
	4	VERIFY	UT	EUT tunes to f2	
	5	VERIFY	LT GS3	XID_CMD_HO (P=1) to LT GS3	
	6	SEND	LT GS3	XID_RSP_HO (F=1)	
	7	WAIT	UT	For expiration of EUT TG5 timer	
	8	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
	9	$CHECK_{LINK}$	LT GS2	Verify link with GS1 is inactive	
	10	$CHECK_{LINK}$	LT GS3	Verify link with GS2 is inactive	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comment: 1. This test requires the UT and LT to directly access the AVLC protocol.					

Procedure (h)

Test Case Name: Aircraft Initiated Hand-off Procedure (h)					
Purpose: Verify that when the aircraft LME receives an Autotune parameter on the CSC, and all subsequent downlink XID_CMD_HO frames on the autotuned frequency are lost, the aircraft LME continues to attempt to send the XID_CMD_HO frames using normal re-transmission procedures, and eventually reverts to the CSC and performs a successful link establishment.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	Make sure GS2 configuration is for same provider.
	3	SET	LT GS3	Operating frequency of GS3 as f2 and transmit path in GS3 is disabled.	Keep downlink enabled to allow GS3 to receive XID frames from aircraft LME, but not respond to them. Make sure GS3 configuration is for same provider.
	4	SET	UT	EUT in air, scanning on CSC	
	5	SEND	LT GS1	GSIFs on f1	
	6	SET_{AVLC}	LT GS1		
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS3	GSIFs on f2	
	9	SEND	LT GS2	GSIFs on f1	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT GS2	Verify immediate HO attempt to GS2
	3	SEND	LT GS2	XID_RSP_HO (F=1, replacement ground station list including GS3 address, autotune frequency set as f2) .	
	4	VERIFY	UT	EUT tunes to f2	
	5	VERIFY	LT GS3	XID_CMD_HO (P=1) to LT GS3 N2 times	GS3 does not respond to XID_CMD_HO frames.
	6	VERIFY	UT	EUT tunes to f1	
	7	WAIT	LT GS1	GSIF on f1	Be sure GSIF was available to aircraft before proceeding with next VERIFY step.
	8	VERIFY	LT GS1	XID_CMD_LE (P=1) to LT GS1.	
	9	SEND	LT GS1	XID_RSP_LE (F=1)	
	10	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	11	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is inactive	
	12	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is inactive	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comment: 1. This test requires the UT and LT to directly access the AVLC protocol.					

Procedure (i)

Test Case Name: Aircraft Initiated Hand-off Procedure (i)					
Purpose: Verify that following loss of communications on the current frequency while the aircraft is airborne, and no FSL is present, the aircraft reverts to the CSC and selects a station to which to perform a link establishment.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.6					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	Make sure GS2 configuration is for same provider
	3	SET	LT GS3	Operating frequency of GS3 as f2	Make sure GS3 configuration is for same provider
	4	SET	UT	EUT in air scanning on CSC	
	5	SEND	LT GS1	GSIFs on f1	No FSL included.
	6	SET_{AVLC}	LT GS1		
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f1	No FSL included.
	9	SEND	LT GS3	GSIFs on f2	No FSL included.
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT GS2	Verify immediate HO attempt to GS2
	3	SEND	LT GS2	XID_RSP_HO (F=1, replacement ground station list including GS3 address, autotune frequency set as f2) .	
	4	VERIFY	UT	EUT tunes to f2	
	5	VERIFY	LT GS3	XID_CMD_HO (P=1) to LT GS3	
	6	SEND	LT GS3	XID_RSP_HO (F=1)	
	7	WAIT	UT	For expiration of EUT TG5 timer	
	8	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is inactive	
	9	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is inactive	
	10	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
	11	DO	LT GS3	Prevent GS3 from transmission and wait for TG2 expiration	
	12	VERIFY	UT	EUT tunes to f1	
	13	SET_{AVLC}	LT GS2		
	14	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	15	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is inactive	
	16	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is inactive	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comment: 1. This test requires the UT and LT to directly access the AVLC protocol.					

2.4.5.5.4.7 (Reserved)

2.4.5.5.4.8 Ground Initiated Handoff

Procedure (a)

Test Case Name: Ground Initiated Handoff (a)					
Purpose: Verify Aircraft LME handling GIHO on CSC.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	UT	EUT scanning on f1	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1)	GIHO from GS2
	3	VERIFY	LT GS2	XID_RSP_HO (F=1) to GS2	
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	5	WAIT		For expiration of EUT TG5 timer	
	6	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (b)

Test Case Name: Ground Initiated Handoff (b)					
Purpose: Verify Aircraft LME handling GIHO on non-CSC frequency.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 ≠ CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	UT	EUT scanning on f1	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1)	GIHO from GS2
	3	VERIFY	LT GS2	XID_RSP_HO (F=1) to GS2	
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	5	WAIT		For expiration of EUT TG5 timer	
	6	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (c)

Test Case Name: Ground Initiated Handoff (c)					
Purpose: Verify Aircraft LME handling of GIHO with all optional parameters.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1=CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	UT	EUT in air scanning on f1	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f1	
Test body	1	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1, parameter set id, procedure class, HDLC options, N1-downlink, N1-uplink, k-downlink, k-uplink, Timer T1-downlink, Counter N2, Timer T2, AVLC specific options(gbit=1), Timer T4, MAC persistence, Counter M1, Timer TM2, Timer TG5, Timer T3min, ATN router NETs, System Mask, TG3, TG4, Ground Station Location, FSL (GS3/f3))	Unless otherwise noted, use default values for all parameters.
	3	VERIFY	LT GS2	XID_RSP_HO (F=1) to GS2	
	4	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is active	
	5	WAIT		For expiration of EUT TG5 timer	
	6	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is not active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (d)

Test Case Name: Ground Initiated Handoff (d)					
Purpose: Verify Aircraft LME handling 2 consecutive GIHOs.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1=CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	LT GS3	Operating frequency of GS3 as f1	
	4	SET	UT	EUT scanning on f1	
	5	SEND	LT GS1	GSIFs on f1	
	6	SET_{AVLC}	LT GS1		
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f1	
	9	SEND	LT GS3	GSIFs on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1)	GIHO from GS2
	3	VERIFY	LT GS2	XID_RSP_HO (F=1) to GS2	
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	5	WAIT		For expiration of EUT TG5 timer	
	6	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
	7	SEND	LT GS3	XID_CMD_HO (P=1)	GIHO from GS3
	8	VERIFY	EUT	XID_RSP_HO (F=1) to GS3	
	9	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
	10	WAIT		For expiration of EUT TG5 timer	
	11	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (e)

Test Case Name: Ground Initiated Handoff (e)					
Purpose: Verify Aircraft LME handling GIHO followed by loss of link.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	LT GS3	Operating frequency of GS3 as f2	Operating frequency f2 = CSC
	4	SET	UT	EUT scanning on f1	
	5	SEND	LT GS1	GSIFs on f1	
	6	SET_{AVLC}	LT GS1		
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f1	
	9	SEND	LT GS3	GSIFs on f2	
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1)	GIHO from GS2
	3	VERIFY	UT	XID_RSP_HO (F=1) to GS2	
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	5	WAIT		For expiration of EUT TG5 timer	
	6	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
	7	DO	LT GS1	Disable transmission from GS1	
	8	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	9	DO	LT GS2	Disable transmission from GS2 and wait for TG2 expiration	
	10	VERIFY	UT	EUT Tunes to f2	Fallback to CSC
	11	SET_{AVLC}	LT GS3		
	12	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (f)

Test Case Name: Ground Initiated Handoff (f)					
Purpose: Verify Aircraft LME handling GIHO followed by an Air-Initiated Handoff.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1=CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	LT GS3	Operating frequency of GS3 as f1	
	4	SET	UT	EUT scanning on f1	
	5	SEND	LT GS1	GSIFs on f1	
	6	SET_{AVLC}	LT GS1		
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f1	
	9	SEND	LT GS3	GSIFs on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1)	GIHO from GS2
	3	VERIFY	UT	XID_RSP_HO (F=1) to GS2	
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	5	WAIT		For expiration of EUT TG5 timer	
	6	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
	7	DO	LT GS1	Disable transmission from GS1	
	8	WAIT		For expiration of EUT TG2 timer and until a GS3 GSIF has been received.	To erase GS1 from PECT (no transmissions from GS1)
	9	SEND	LT GS2	DISC(P=0)	
	10	VERIFY	UT	XID_CMD_HO (P=1)	XID_CMD_LE is also acceptable
	11	SEND	LT GS3	XID_RSP_HO (F=1)	XID_RSP_LE is also acceptable
	12	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (g)

Test Case Name: Ground Initiated Handoff (g)					
Purpose: Verify Aircraft LME handling GIHO retransmission procedures.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1=CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	UT	EUT scanning on f1	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1)	GIHO from GS2
	3	VERIFY	LT GS2	XID_RSP_HO (F=1) to GS2	
	4	SEND	LT GS2	XID_CMD_HO (P=1)	Retransmitted GIHO from GS2 with same XID Seq# as previous GIHO
	5	VERIFY	EUT	XID_RSP_HO (F=1) to GS2	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (h)

Test Case Name: Ground Initiated Handoff (h)					
Purpose: Verify Aircraft LME handles an invalid GIHO by rejecting the handoff and continuing to use its current link					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1=CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	UT	EUT scanning on f1	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1 with an invalid parameter)	Invalid GIHO from GS2
	3	VERIFY	UT	XID_RSP_LCR (F=1) to GS2	
	4	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is not active	
	6	WAIT	UT	At least TG5 Response duration from time the invalid GIHO was received.	
	7	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (i)

Test Case Name: Ground Initiated Handoff (i)					
Purpose: Verify Aircraft LME handling a DISC from ground due to a RSP with unacceptable parameters.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1=CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	UT	EUT scanning on f1	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1)	GIHO from GS2
	3	VERIFY	LT GS2	XID_RSP_HO (F=1) to GS2	
	4	SEND	LT GS2	DISC(P=0)	Simulating a ground response to an XID_RSP_HO with unacceptable parameters. -DISC must be sent within TG5
	5	SEND	LT GS1	XID_CMD_HO (P=1)	OPTIONAL (EUT may or may not perform)
	6	VERIFY	LT GS1	XID_RSP_HO (F=1) to GS1	Required if EUT performed step 5. Otherwise Not allowed (skip step).
	7	$CHECK_{LINK}$	LT GS1	verify link with GS1 is active	
	8	WAIT	UT	At least TG5 duration since step 4	
	9	$CHECK_{LINK}$	LT GS1	verify link with GS1 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (j)

Test Case Name: Ground Initiated Handoff (j)					
Purpose: Verify Aircraft LME handling GIHO with RGSL.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.8 through 3.2.2.5.4.8.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1=CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	LT GS3	Operating frequency of GS3 as f1	
	4	SET	UT	EUT scanning on f1	
	5	SEND	LT GS1	GSIFs on f1	
	6	SET_{AVLC}	LT GS1		
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f1	
	9	SEND	LT GS3	GSIFs on f1	
Test body	1	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	2	SEND	LT GS2	XID_CMD_HO (P=1, Replacement Ground Station List includes: GS3 address)	GIHO from GS2
	3	DO	LT GS1	Disable transmission from GS1	
	4	DO	LT GS2	Disable transmission from GS2	
	5	VERIFY	LT GS2	XID_RSP_HO (F=1) to GS2	
	6	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	Upon TG2 expiration, EUT uses RGSL provided in GIHO.
	7	SEND	LT GS3	XID_RSP_HO (F=1)	
	8	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

2.4.5.5.4.9 Ground Requested Aircraft Initiated Handoff

Procedure (a)

Test Case Name: Ground Requested Aircraft Initiated Handoff (a)					
Purpose: Verify Aircraft LME tunes between various frequencies based on ground requested aircraft initiated handoff.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	6	SEND	LT GS2	GSIFs on f2	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including GS2 address, autotune frequency set as f2)	GRAIHO from f1 to f2
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for a GSIF
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	6	SEND	LT GS2	XID_CMD_HO (P=0, replacement ground station list including GS1 address, autotune frequency set as f1)	GRAIHO from f2 to f1
	7	VERIFY	UT	EUT tunes to f1	
	8	VERIFY	LT GS1	XID_CMD_HO (P=1) to GS1	Verify Immediate HO to GS1 w/o waiting for a GSIF
	9	SEND	LT GS1	XID_RSP_HO (F=1)	
	10	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (b)

Test Case Name: Ground Requested Aircraft Initiated Handoff (b)					
Purpose: Verify Aircraft LME tunes between multiple frequencies and then fallback to the CSC					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f3	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f2	
	8	SEND	LT GS3	GSIFs on f3	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including GS2 address, autotune frequency set as f2)	GRAIHO from f1 to f2
	2	VERIFY	EUT	EUT tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for a GSIF
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	6	SEND	LT GS2	XID_CMD_HO (P=0, replacement ground station list including GS3 address, autotune frequency set as f3)	GRAIHO from f2 to f3
	7	VERIFY	UT	EUT tunes to f3	
	8	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	Verify Immediate HO to GS3 w/o waiting for a GSIF
	9	SEND	LT GS3	XID_RSP_HO (F=1)	
	10	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
	11	DO	LT GS3	Disable transmission from GS3 and wait for TG2 expiration.	
	12	VERIFY	UT	EUT tunes to f1	EUT falls back to CSC
	13	SET_{AVLC}	LT GS1		
	14	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	15	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (c)

Test Case Name: Ground Requested Aircraft Initiated Handoff (c)					
Purpose: Verify Aircraft LME procedures based on ground requested aircraft initiated handoff with more than one GS addresses in the Replacement Ground Station List parameter. The ground stations are attempted in the order listed in the RGSL.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3, 3.2.2.5.2.6.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	6	SEND	LT GS2	GSIFs on f2	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list consisting of the following addresses: {GS2 address, non-existent address 1, non-existent address 2}, autotune frequency set as f2)	GRAIHO from f1 to f2. Non-existent address could be a legal address with a recognized provider prefix that is not implemented in the test environment.
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify immediate HO to GS2 w/o waiting for GSIF
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	6	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (d)

Test Case Name: Ground Requested Aircraft Initiated Handoff (d)					
Purpose: Verify Aircraft LME procedures based on ground requested aircraft initiated handoff with more than one GS addresses in the Replacement Ground Station List parameter. The ground stations are attempted in the order listed in the RGSL.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3, 3.2.2.5.2.6.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	
	2	SET	LT GS2	Operating frequency of GS2 as f2	No GSIFs are transmitted from GS2
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list consisting of the following addresses: {GS3 (non-existent address 1), GS4 (non-existent address 2), GS2 address}, autotune frequency set as f2)	GRAIHO from f1 to f2
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS3	XID_CMD_HO (P=1) to LT non-existent address 1 N2 times	Verify Immediate HO to non-existent address 1 w/o waiting for GSIF
	4	VERIFY	LT GS4	XID_CMD_HO (P=1) to LT non-existent address 2 N2 times	
	5	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT GS2	
	6	SEND	LT GS2	XID_RSP_HO (F=1)	
	7	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (e)

Test Case Name: Ground Requested Aircraft Initiated Handoff (e)					
Purpose: Verify Aircraft LME procedures based on receiving a ground requested aircraft initiated handoff with all optional parameters.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SEND	LT GS1	GSIFs on f1	
	4	SET$_{AVLC}$	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	6	SEND	LT GS2	GSIFs on f2	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including: GS2 address, autotune frequency set as f2, parameter set id, procedure class, HDLC options, N1-downlink, N1-uplink, k-downlink, k-uplink, Timer T1-downlink, Counter N2, Timer T2, AVLC specific options, Timer T4, MAC persistence, Counter M1, Timer TM2, Timer TG5, Timer T3min, Frequency support, ATN router NETs, System Mask, TG3, TG4, Ground Station Location)	Use default values for all parameters. GRAIHO f1 to f2
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for GSIF
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	CHECK$_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble	1	RESET$_{AVLC}$	LT GS1		
	2	RESET$_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (f)

Test Case Name: Ground Requested Aircraft Initiated Handoff (f)					
Purpose: Verify Aircraft LME procedures based on receiving a ground requested aircraft initiated handoff followed by Air-Initiated Handoff.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f2	
	4	SEND	LT GS1	GSIFs on f1	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f2	
	8	SEND	LT GS3	GSIFs on f2	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including: GS2 address, autotune frequency set as f2)	GRAIHO f1 to f2
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for GSIF
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is active	
	6	DO	LT GS2	Disable transmission from GS2	
	7	SEND	LT GS3	GSIF	Must occur before TG2 expiration
	8	VERIFY	LT GS3	Upon GS2's TG2 expiration, XID_CMD_HO (P=1) to GS3	Air-Initiated Handoff
	9	SEND	LT GS3	XID_RSP_HO (F=1)	
	10	$\text{CHECK}_{\text{LINK}}$	LT GS3	Verify link with GS3 is active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
	3	$\text{RESET}_{\text{AVLC}}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (g)

Test Case Name: Ground Requested Aircraft Initiated Handoff (g)					
Purpose: Verify Aircraft LME procedures when GRAIHO fails due to single non-existent address. GRAIHO is delivered on the CSC.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	No GSIFs are transmitted from GS2
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including non-existent address (GS3), autotune frequency set as f2)	GRAIHO f1 to f2
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS3	XID_CMD_HO (P=1) to non-existent address N2 times	Verify Immediate HO to non-existent address w/o waiting for GSIF
	4	VERIFY	UT	EUT tunes to f1	Fallback to CSC
	5	SET_{AVLC}	LT GS1		
	6	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (h)

Test Case Name: Ground Requested Aircraft Initiated Handoff (h)					
Purpose: Verify Aircraft LME procedures when GRAIHO fails due to multiple non-existent addresses					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	No GSIFs are transmitted from GS2
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test Body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list consisting of (non-existent address1 (GS3), non-existent address2 (GS4), non-existent address3 (GS5)) , autotune frequency set as f2)	GRAIHO f1 to f2
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS3	XID_CMD_HO (P=1) to non-existent address1 N2 times	
	4	VERIFY	LT GS4	XID_CMD_HO (P=1) to non-existent address2 N2 times	
	5	VERIFY	LT GS5	XID_CMD_HO (P=1) to non-existent address3 N2 times	
	6	VERIFY	UT	EUT tunes to f1	Fallback to CSC
	7	SET_{AVLC}	LT GS1		
	8	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (i) (Optional)

Test Case Name: Ground Requested Aircraft Initiated Handoff (i)					
Purpose: Verify Aircraft LME procedures when initial GRAIHO fails but handoff succeeds after hearing GSIF on a new frequency.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	6	SEND	LT GS2	GSIFs on f2	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including non-existent address 1 (GS3), autotune frequency set as f2)	GRAIHO f1 to f2
	2	VERIFY	EUT	EUT tunes to f2	
	3	VERIFY	LT GS3	XID_CMD_HO (P=1) to non-existent address with no response	
	4	SEND	LT GS2	GSIF	Must be received prior to N2 being reached on attempt to handoff to GS3.
	5	VERIFY	LT GS3	XID_CMD_HO (P=1) to non-existent address 1 is sent a total of N2 times since the retune	
	6	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT GS2	
	7	SEND	LT GS2	XID_RSP_HO (F=1)	
	8	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (j) (Optional)

Test Case Name: Ground Requested Aircraft Initiated Handoff (j)					
Purpose: Verify Aircraft LME procedures when GRAIHO includes both FSL and RGSL, and RGSL has non-existent addresses.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	No GSIFs are transmitted from GS2
	3	SET	LT GS3	Operating frequency of GS3 as f3	No GSIFs are transmitted from GS3
	4	SET	UT	EUT in air, scanning on f1	
	5	SEND	LT GS1	GSIFs on f1	
	6	SET_{AVLC}	LT GS1		
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list consisting of {non-existent address1 (GS4), non-existent address2 (GS5)} , autotune frequency set as f2, air (gbit=0), frequency support list consisting of (GS3 address and f3))	GRAIHO f1 to f2 with FSL:f3
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS4	XID_CMD_HO (P=1) to non-existent address1 N2 times	Verify Immediate HO to non-existent address w/o waiting for GSIF
	4	VERIFY	LT GS5	XID_CMD_HO (P=1) to non-existent address2 N2 times	
	5	VERIFY	UT	EUT tunes to f3	Freq. Recovery
	6	VERIFY	LT GS3	XID_CMD_HO (P=1) to LT GS3	Verify Immediate HO to GS3 w/o waiting for GSIF
	7	SEND	LT GS3	XID_RSP_HO (F=1)	
	8	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
	9	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (k)

Test Case Name: Ground Requested Aircraft Initiated Handoff (k)					
Purpose: Verify aircraft LME hands off to a new ground station through AIHO and then autotunes from CSC to a non-CSC frequency through GRAIHO					
Configuration: 4					
Reference: DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	Operating frequency f1 = CSC
	3	SET	LT GS3	Operating frequency of GS3 as f2	Operating frequency f2 = alternate frequency (not CSC)
	4	SEND	LT GS1	GSIFs on f1	
	5	SET$_{AVLC}$	LT GS1		
	6	SEND	LT GS2	GSIFs on f1	
	7	CHECK$_{LINK}$	LT GS1	Verify EUT establishes link with GS1 on f1	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	
	3	SEND	LT GS2	XID_RSP_HO (F=1)	
	4	CHECK$_{LINK}$	LT GS2	Verify link with GS2 is active	Need N(r)=0 in uplinked RR.
	5	WAIT		Wait for TG5 expiration	
	6	SEND	LT GS2	XID_CMD_HO (P=0, replacement ground station list including GS3 address, autotune frequency set as f2)	GRAIHO from f1 to f2
	7	VERIFY	UT	EUT tunes to f2	
	8	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	
	9	SEND	LT GS3	XID_RSP_HO (F=1)	
	10	CHECK$_{LINK}$	LT GS3	Verify link with GS3 is active	Need N(r)=0 in uplinked RR.
	11	CHECK$_{LINK}$	LT GS2	Verify link with GS2 is not active	No Response from UT as RR is not received since GS2 is on a different (f1) frequency.
	12	CHECK$_{LINK}$	LT GS1	Verify link with GS1 is not active	No Response from UT as RR is not received since GS2 is on a different (f1) frequency.
Postamble	1	RESET$_{AVLC}$	LT GS1		
	2	RESET$_{AVLC}$	LT GS2		
	3	RESET$_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (l)

Test Case Name: Ground Requested Aircraft Initiated Handoff (l)					
Purpose: Verify aircraft LME autotunes from CSC to a non-CSC frequency through GRAIHO, and then hands off to a new ground station through AIHO					
Configuration: 4					
Reference: DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	Operating frequency f2 = alternate frequency (not CSC)
	3	SET	LT GS3	Operating frequency of GS3 as f2	Operating frequency f2 = alternate frequency (not CSC)
	4	SEND	LT GS1	GSIFs on f1	
	5	SEND	LT GS2	GSIFs on f2	
	6	SEND	LT GS3	GSIFs on f2	
	7	SET_{AVLC}	LT GS1		
	8	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including GS2 address, autotune frequency set as f2)	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for a GSIF.
	3	SEND	LT GS2	XID_RSP_HO (F=1)	
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	Need N(r)=0 in uplinked RR.
	5	WAIT	UT	Wait until a GS3 GSIF is received.	
	6	DO	LT GS2	Slowly reduce the RF signal level from LT GS2	
	7	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	
	8	SEND	LT GS3	XID_RSP_HO (F=1)	
	9	WAIT	UT	Aircraft TG5 to expire	
	10	DO	LT GS2	Restore the RF signal level from LT GS2	
	11	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is not active	
	12	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	Need N(r)=0 in uplinked RR.
Postamble	1	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (m)

Test Case Name: Ground Requested Aircraft Initiated Handoff (m)					
Purpose: Verify Aircraft LME keeps the current link available if invalid frequency is received in ground requested aircraft initiated handoff.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.11					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	Operating frequency f1 = CSC
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	6	SEND	LT GS2	GSIFs on f1	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	
	3	SEND	LT GS2	XID_RSP_HO (F=1)	
	4	SEND	LT GS2	XID_CMD_HO (P=0, replacement ground station list including GS3 address, autotune frequency set as an invalid frequency)	GRAIHO from f1 to f2
	5	VERIFY	LT GS2	XID_CMD_LCR (P=0) to GS2	The aircraft rejects the GRAIHO
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	Need N(r)=0 in uplinked RR.
Postamble	1	$RESET_{AVLC}$	LT GS1		
	1	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (n)

Test Case Name: Ground Requested Aircraft Initiated Handoff (n)					
Purpose: Verify Aircraft LME accepts a retransmitted Ground Requested Aircraft Initiated Handoff					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3, 3.2.2.5.2.4.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	6	SEND	LT GS2	GSIFs on f2	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including GS2 address, autotune frequency set as f2, XID Sequence# (s: 0, r: 1)	A retransmitted GRAIHO with ‘r’ bits in XID Sequence# set to 1
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for a GSIF
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (o)

Test Case Name: Ground Requested Aircraft Initiated Handoff (o)					
Purpose: Verify that when the aircraft receives an Autotune parameter on a non CSC frequency, and all the subsequent XID_CMD_HO are lost, the aircrafts reverts back to the CSC using link establishment procedure.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.11.2.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	Operating frequency f2 = alternate frequency (not CSC)
	3	SEND	LT GS1	GSIFs on f1	
	4	SEND	LT GS2	GSIFs on f2	
	5	SET_{AVLC}	LT GS1		
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including GS2 address, autotune frequency set as f2)	
	2	VERIFY	EUT	Tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 w/o waiting for a GSIF.
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	Need N(r)=0 in uplinked RR.
	6	SEND	LT GS2	XID_CMD_HO (P=0, replacement ground station list including a non-existent GS3 address, autotune frequency set as f3)	Operating frequency f3 = alternate frequency (not CSC)
	7	VERIFY	EUT	Tunes to f3	
	8	VERIFY	EUT	Sends XID_CMD_HO (P=1) to GS3 N2 times.	N2 default value is 6
	9	VERIFY	EUT	Tunes back to CSC(f1)	
	10	WAIT	UT	Wait until EUT receives a GSIF from GS1	
	11	VERIFY	LT GS1	XID_CMD_LE(P=1)	
	12	SEND	LT GS1	XID_RSP_LE(F=1)	
	13	$CHECK_{LINK}$	LT GS1	Verify link with GS1is active	
Postamble		$RESET_{AVLC}$	LT GS1		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (p)

Test Case Name: Ground Requested Aircraft Initiated Handoff (p)					
Purpose: Verify Aircraft LME procedures when GRAIHO followed by DISC. Aircraft LME is expected to fall back to CSC.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.9 through 3.2.2.5.4.9.3, 3.2.2.5.4.11 through 3.2.2.5.4.11.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
Test body	1	SEND	LT GS1	XID_CMD_HO (P=0, replacement ground station list including GS2 address, autotune frequency set as f2)	GRAIHO f1 to f2
	2	VERIFY	UT	EUT tunes to f2	
	3	VERIFY	LT GS2	XID_CMD_HO (P=1)	
	4	SEND	LT GS2	XID_RSP_HO (F=1)	
	5	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is active	
	6	SEND	LT GS2	DISC (P=0) prior to expiration of the aircraft's TG5 timer.	
	7	VERIFY	UT	EUT tunes to f1	Fallback to CSC
	8	WAIT	LT GS1	GSIF on f1	
	9	SET_{AVLC}	LT GS1		
	10	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
Comments 3. This test requires the UT and LT to directly access the AVLC protocol. 4. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

2.4.5.5.4.10 Ground Requested Broadcast Handoff (optional)

Procedure (a) for avionics that supports Ground Requested Broadcast Handoff

Test Case Name: Ground Requested Broadcast Handoff (a)					
Purpose: Verify Aircraft LME procedures based on ground requested broadcast handoff for EUT that supports Ground Broadcast Handoff.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.10 and subparagraphs					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET	LT GS1 LT GS2	Set indication that GS supports Broadcast Subnetwork Connection by setting ‘b1’ to 1 and ‘bs’ to 1 in the AVLC Specific Options parameter. Set GS1 and GS2 operating frequency to f1.	
Test body	1	SET	LT GS1	Signal level to 20 dB above the minimum specified in Section 2.2.1.2.1. For Class Z equipment, use an SQP of 10. Transmit GSIFs until Step 4.	See comments
	2	SET	LT GS2	Signal level to 15 dB above the minimum specified in Section 2.2.1.2.1. For Class Z equipment, use an SQP of 8. Continuously transmit GSIFs throughout the test.	See comments
	3	SET_{8208}	LT GS1		
	4	INHIBIT	LT GS1	All transmissions from GS1. This simulates a ground system failure	
	5	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Include the M/I and LCI subfields that the GS1 LME maintained for the existing connection in the Broadcast Connection Parameter .	
	6	SEND	LT GS2	XID_CMD_HO frame prepared in Step 5.	
	7	$\text{CHECK}_{\text{NETWORK}}$	LT GS2	Verify that information flows via GS2 and not via GS1	
	8	RESET_{8208}	LT GS2	Drop network connection with GS2.	
	9	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	10	REPEAT		Steps 1-4	
	11	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Do not include the LCI subfield in the Broadcast Connection Parameter .	
	12	SEND	LT GS2	XID_CMD_HO frame prepared in Step 11.	
	13	VERIFY	LT GS2	CALL REQUEST from EUT	
	14	SEND	LT GS2	CALL ACCEPTED	
	15	$\text{CHECK}_{\text{NETWORK}}$	LT GS1	Verify that information flows via GS2 and not via GS1	
	16	REPEAT		Steps 8-10 (this includes repeat of Steps 1-4)	
	17	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Include the LCI subfield in the Broadcast Connection Parameter, as well as LCI information from an address different from GS1 and GS2.	
	18	SEND	LT GS2	XID_CMD_HO frame prepared in Step 17	
	19	VERIFY	LT GS2	CLEAR REQUEST from EUT to different address	
	20	$\text{CHECK}_{\text{NETWORK}}$	LT GS2	Verify that information flows via GS2 and not via GS1	
	21	REPEAT		Steps 8-10 (this includes repeat of Steps 1-4)	

Test Case Name: Ground Requested Broadcast Handoff (a)					
Purpose: Verify Aircraft LME procedures based on ground requested broadcast handoff for EUT that supports Ground Broadcast Handoff.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.10 and subparagraphs					
Context	Step	Action	PCO	Action Qualifier	Comment
	22	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Set the DLS Address in Ground Station Address Filter parameter to address other than GS1.	
	23	SEND	LT GS2	XID_CMD_HO frame prepared in Step 22	
	24	$\text{CHECK}_{\text{AVLC}}$	LT GS2	Verify that no link exists	
	25	REPEAT		Steps 8-10 (this includes repeat of Steps 1-4)	
	26	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Do not use the EUT address in the aircraft identifier subfield of the Broadcast Connection Parameter	
	27	SEND	LT GS2	XID_CMD_HO frame prepared in Step 22	
	28	$\text{CHECK}_{\text{AVLC}}$	LT GS2	Verify that no link exists	
Postamble		RESET_{8208}	LT GS2	Drop network connection with GS2.	
		$\text{RESET}_{\text{AVLC}}$	LT GS1		
Comments 1. This test requires the LT to directly access its AVLC protocol.. 2. For Class Z equipment, the AVLC frames and content may be generated at the Data/Management Interface. 3. This test does not imply any relationship between an SQP of 10 and a signal level 20 dB above sensitivity or an SQP of 8 and a signal level of 15 dB above sensitivity. The only intent is to have representative signal levels throughout the test.					

Partial Message Sequence Chart

Ground Requested Broadcast Handoff Procedure (a) Steps 1-21

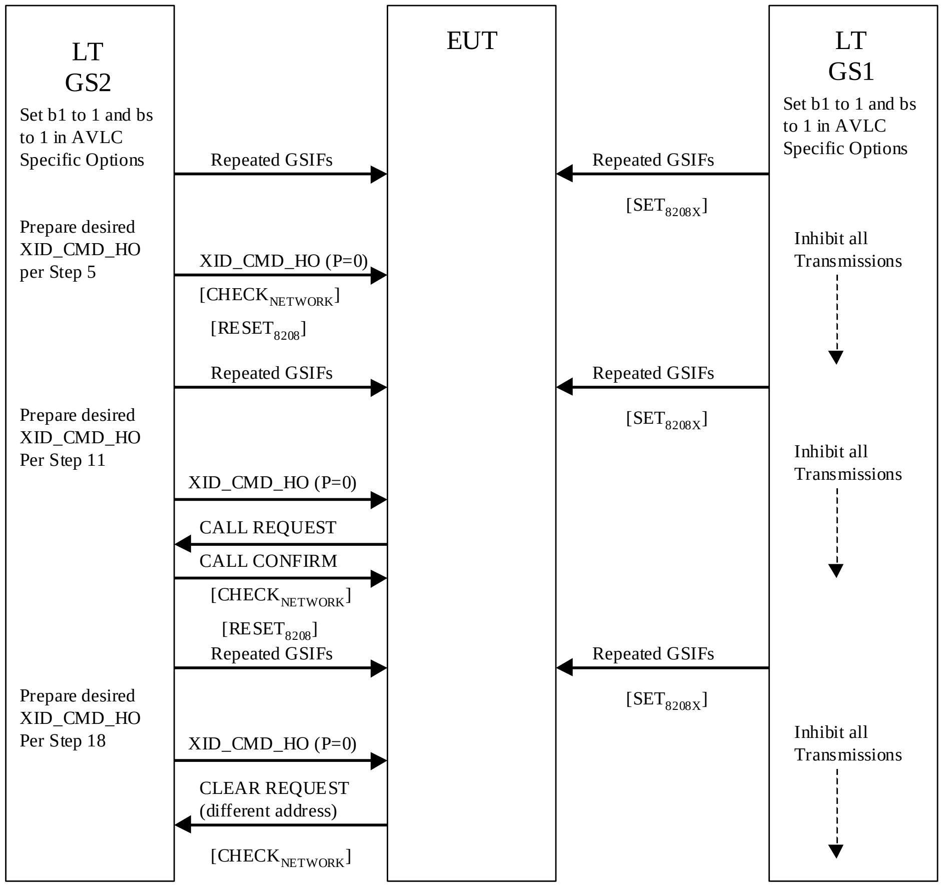


Figure 2-49: Ground Requested Broadcast Handoff (a) (partial)

<u>Procedure (b) for avionics that supports Air Initiated Handoff, but not Ground Requested Broadcast Handoff.</u>

Note: This combination of capabilities is less desirable than support for Ground Requested Broadcast Handoff because it requires additional channel loading to explicitly support the handoff.

Test Case Name: Ground Requested Broadcast Handoff (b)					
Purpose: Test EUT that Does Not Support Broadcast Link Handoffs but does support Aircraft Initiated Handoffs					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.10					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET	LT GS1 LT GS2	Set indication that GS supports Broadcast Subnetwork Connection by setting ‘b1’ to 1 and ‘bs’ to 1 in the AVLC Specific Options parameter. Set GS1 and GS2 operating frequency to f1.	
Test body	1	SEND	LT GS1	GSIFs	
	2	SET_{8208}	LT GS1		
	3	SEND	LT GS2	GSIFS	
	4	INHIBIT	LT GS1	All transmissions from GS1. This simulates a ground system failure	
	5	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Include the M/I and LCI subfields that the GS1 LME maintained for the existing connection in the Broadcast Connection Parameter.	
	6	SEND	LT GS2	XID_CMD_HO frame prepared in Step 5.	
	7	VERIFY	LT GS2	XID_CMD_HO(P=1) from EUT	This is an air-initiated handoff
	8	SEND	LT GS2	XID_RSP_HO(F=1)	
	9	$CHECK_{AVLC}$	LT GS2	Confirm link is active	
	10	$RESET_{AVLC}$	LT GS2		
	11	REPEAT		Steps 1-4	
	12	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Set the DLS Address in Ground Station Address Filter parameter to address other than GS1.	
	13	SEND	LT GS2	XID_CMD_HO frame prepared in Step 12	
	14	$CHECK_{AVLC}$	LT GS2	Verify that no link exists	
	15	REPEAT		Steps 8-11 (this includes repeat of Steps 1-4)	
	16	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Do not use the EUT address in the aircraft identifier subfield of the Broadcast Connection Parameter	
	17	SEND	LT GS2	XID_CMD_HO frame prepared in Step 16	
	18	$CHECK_{AVLC}$	LT GS2	Verify that no link exists	
Postamble		$RESET_{8208}$	LT GS1		
Comments 1. This test requires the LT to directly access its AVLC protocol. 2. For Class Z equipment, the AVLC frames and content may be generated at the Data/Management Interface.					

<u>Procedure (c) for avionics that supports neither Air Initiated Handoff nor Ground Requested Broadcast Handoff.</u>

Note: Some minimal equipment may not support either type of handoff. In this case, it is assumed that the Ground Router knows the aircraft capabilities (or lack thereof) and initiates a Ground Requested handoff.

Test Case Name: Ground Requested Broadcast Handoff (c)					
Purpose: Test EUT that Does Not Support Broadcast Link Handoffs or Aircraft Initiated Handoffs					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.10					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble			LT GS1 LT GS2	Set indication that GS supports Broadcast Subnetwork Connection by setting ‘b1’ to 1 and ‘bs’ to 1 in the AVLC Specific Options parameter. Set GS1 and GS2 operating frequency to f1.	
Test body	1	SET	LT GS1	Signal level to 20 dB above the minimum specified in Section 2.2.1.2.1. For Class Z equipment, use an SQP of 10.	See comments
	2	SET	LT GS2	Signal level to 15 dB above the minimum specified in Section 2.2.1.2.1. For Class Z equipment, use an SQP of 8. Continuously transmit GSIFs throughout the test.	See comments
	3	SET_{8208}	LT GS1		
	4	INHIBIT	LT GS1	All transmissions from GS1. This simulates a ground system failure	
	5	SET	LT GS2	Prepare XID_CMD_HO(P=0) with GS2 address in the Replacement Ground Station List Parameter. Include the M/I and LCI subfields that the GS1 LME maintained for the existing connection in the Broadcast Connection Parameter .	This is all the valid information needed for a broadcast handoff
	6	SEND	LT GS2	XID_CMD_HO frame prepared in Step 5.	
	7	$CHECK_{AVLC}$	LT GS2	Confirm link is inactive	
	8	SEND	LT GS2	XID_CMD_HO (P=1)	Ground initiated starts here.
	9	RECEIVE	LT GS2	XID_RSP_HO (F=1)	
	10	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
Postamble		$RESET_{8208}$	LT GS1		
		$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the LT to directly access its AVLC protocol.. 2. For Class Z equipment, the AVLC frames and content may be generated at the Data/Management Interface. 3. This test does not imply any relationship between an SQP of 10 and a signal level 20 dB above sensitivity or an SQP of 8 and a signal level of 15 dB above sensitivity. The only intent is to have representative signal levels throughout the test.					

2.4.5.5.4.11 Ground Requested Autotune

Procedure (a)

Test Case Name: Ground Commanded Autotune					
Purpose: Verify Aircraft LME procedures based on ground requested autotune parameter.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.11					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	GS1	Operating frequency of GS1 to f1	f1 = CSC
	2	SET	GS2	Operating frequency of GS2 to f2	
Test body	1	SEND	LT GS2	Send GSIFs periodically	
	2	SEND	LT GS1	Send GSIFs periodically	
	3	VERIFY	LT GS1	XID_CMD_LE (P=1) addressed to LT GS1	
	4	SEND	LT GS1	XID_RSP_LE (F=1), with the Autotune (f2) and Replacement Ground Station List parameters (GS2)	
	5	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2 on frequency f2.	
	6	SEND	LT GS2	XID_RSP_HO (F=1)	
	7	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	8	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
Postamble		$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the LT to directly access its AVLC protocol.					

Procedure (b) Reserved

Procedure (c)

Test Case Name: Ground Requested Autotune (c)					
Purpose: Verify Aircraft LME procedures based on an invalid ground requested autotune parameter (bad frequency) in XID_RSP_LE.					
Configuration: 2					
Reference: DO-224C, 3.2.2.5.4.11					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SEND	LT GS1	GSIFs on f1	
Test body	1	DO	EUT	Start-up the avionics and wait for GSIF from GS1	
	2	VERIFY	LT GS1	XID_CMD_LE (P=1) to GS1	
	3	SEND	LT GS1	XID_RSP_LE (F=1), replacement ground station list including GS2 address, but autotune frequency set as an invalid frequency.	The autotune frequency value is out of acceptable range.
	4	VERIFY	LT GS1	XID_CMD_LCR (P=0) to GS1	The aircraft rejects the autotune
	5	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	Need N(r)=0 in uplinked RR.
Postamble		$\text{RESET}_{\text{AVLC}}$	LT GS1		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (d)

Test Case Name: Ground Requested Autotune (d)					
Purpose: Verify Aircraft LME keeps the current link available if invalid frequency is received in autotune (in XID_RSP_HO).					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.11					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	Operating frequency f1 = CSC
	3	SEND	LT GS1	GSIFs on f1	
	4	SET_{AVLC}	LT GS1		
	5	$CHECK_{LINK}$	LT GS1	Verify that EUT establishes link with GS1 on f1	
	6	SEND	LT GS2	GSIFs on f1	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	
	3	SEND	LT GS2	XID_RSP_HO (F=1), replacement ground station list including GS3 address, autotune frequency set as an invalid frequency.	The autotune frequency value is out of acceptable range.
	4	VERIFY	LT GS2	XID_CMD_LCR (P=0) to GS2	The aircraft rejects the autotune
	5	$CHECK_{LINK}$	LT GS2	Verify link with GS2is active	Need N(r)=0 in uplinked RR.
Postamble		$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

2.4.5.5.4.12 Expedited Subnetwork Connection Management (optional)

Procedure

Test Case Name: Expedited Subnetwork Connection Management					
Purpose: Verify the procedures for expedited subnetwork connection management.					
Configuration: 1					
Reference: DO-224C, 3.2.2.5.4.13 through 3.2.2.5.4.13.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble					
Test body	1	SEND	LT	GSIF frames with v-bit of AVLC specific options set to 1, including the Ground System address and ground DTE address.	
	2	VERIFY	UT	EUT provides Ground System address and ground DTE address to system management entity	System management entity is assumed external to VDL Mode 2 EUT.
	3	SEND	UT	CALL REQUEST packet, including an ISH PDU, the ground DTE address and SNDCF header.	Comment 2
	4	VERIFY	LT	XID_CMD_LE(P=1) containing the Expedited Subnetwork Connection Parameter, which, in turn, includes ISH PDU, 8208 CALL REQUEST, and SNDCF header	
	5	SEND	LT	XID_RSP_LE (F=1) including an Expedited Subnetwork Connection Parameter, which in turn, includes ISH PDU, 8208 CALL ACCEPTED, and SNDCF header.	This establishes both the AVLC and 8208 level connections.
	6	VERIFY	UT	Receipt of XID_RSP_LE by observing ISO 8208 CALL ACCEPTED packet with user data being SNDCF header and ISH PDU.	
Postamble		$RESET_{8208}$			
Comments 1. This test requires the LT to directly access its AVLC protocol, and the UT to access the ISO 8208 protocol. 2. It is permissible to substitute any higher level UT control/output that establishes receipt of the required ISO 8208 protocol units. 3. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

2.4.5.5.4.13 Frequency Support List

Procedure (a)

Test Case Name: Ground-Based Frequency Support List (a)					
Purpose: Verify Aircraft LME evaluates Airport Coverage parameter when using ground-based Frequency Support List.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	EUT in air	
	2	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	3	SET	LT GS2	Operating frequency of GS2 as f2	
	4	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	5	SET_{AVLC}	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address), Airport Coverage Parameter: “KBWI”	
	8	SET	UT	Configure EUT destination airport as “KBWI”	
Test body	1	SET	UT	Configure EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	Airport Coverage Parameter does not match EUT destination airport
	3	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	EUT did not retune due to mismatched airport coverage.
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (b)

Test Case Name: Ground-Based Frequency Support List (b)					
Purpose: Verify Aircraft LME tunes to a frequency provided in ground-based Frequency Support List (FSL) on ground, tunes to a frequency provided in air based FSL upon takeoff, and reverts to CSC following an uplink DISC.					
Configuration: 4					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f3	
	4	SET	UT	Configure EUT in air	
	5	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	matching Airport Coverage
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS3 address), Airport Coverage Parameter: “KBWI”	
Test body	1	$\text{CHECK}_{\text{LINK}}$	LT GS1	verify link with GS1 is active	
	2	SET	UT	Configure EUT destination airport as “KBWI”	
	3	SET	UT	Configure EUT on ground	
	4	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	This step is optional
	5	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in FSL
	6	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2
	7	SEND	LT GS2	XID_RSP_HO (F=1)	
	8	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is active	
	9	WAIT	UT	For expiration of EUT TG5 timer	
	10	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is not active	
	11	WAIT	LT GS2	GSIF on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS3 address), Airport Coverage Parameter: “KBWI”	
	12	SET	UT	EUT in air	
	13	VERIFY	UT	EUT tunes to f3	EUT tunes to f3 provided in FSL
	14	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	Verify Immediate HO to GS3
	15	SEND	LT GS3	XID_RSP_HO (F=1)	
	16	$\text{CHECK}_{\text{LINK}}$	LT GS3	Verify link with GS3 is active	
	17	SEND	LT GS3	DISC (before TG5 expires)	
	18	VERIFY	UT	EUT tunes to f1 (CSC)	After the air FSL is exhausted, the EUT reverts to CSC.
	19	SEND	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	20	VERIFY	LT GS1	XID_CMD_LE (P=1) to GS1	
	21	SEND	LT GS1	XID_RSP_LE (F=1)	
	22	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (c)

Test Case Name: Ground-Based Frequency Support List (c)					
Purpose: Verify Aircraft LME tunes to a frequency provided in Frequency Support List with mismatched Airport Coverage parameter during takeoff.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f2	
	4	SET	LT GS4	Operating frequency of GS4 as f3	
	5	SET	UT	EUT in air	
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS3	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS4 address), Airport Coverage Parameter: “KORD”	
	9	SET	UT	Configure EUT destination airport as “KBWI”	
Test body	1	SET	UT	Configure EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	This step is optional
	3	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in FSL
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	WAIT	UT	For expiration of EUT TG5 timer	
	8	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
	9	WAIT	LT GS3	GSIF on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS4 address), Airport Coverage Parameter: “KORD”	
	10	SET	UT	EUT in air	
	11	VERIFY	UT	EUT tunes to f3	EUT tunes to f3 provided in FSL with mismatched airport coverage parameter
	12	VERIFY	LT GS4	XID_CMD_HO (P=1) to GS4	Verify Immediate HO to GS4
	13	SEND	LT GS4	XID_RSP_HO (F=1)	
	14	$CHECK_{LINK}$	LT GS4	Verify link with GS4 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS4		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (d)

Test Case Name: Ground-Based Frequency Support List (d)					
Purpose: Verify Aircraft LME evaluates its status (air vs. ground) when using ground-based Frequency Support List.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	Configure EUT in air	
	2	SET	UT	Configure EUT destination airport as “KBWI”	
	3	SET	UT	EUT scanning on f1	Tune to f1 by whatever means.
	4	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 ≠ CSC.
	5	SET	LT GS2	Operating frequency of GS2 as f1	
	6	SET	LT GS3	Operating frequency of GS3 as f2	
	7	SET	LT GS4	Operating frequency of GS4 as f2	
	8	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS3 address), Airport Coverage Parameter: “KBWI”	
	9	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	10	SEND	LT GS2	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS4 address), Airport Coverage Parameter: “KORD”	
Test body	1	$\text{CHECK}_{\text{LINK}}$	UT	Verify link with GS1 is active	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS3 address), Airport Coverage Parameter: “KBWI”	GSIF with matching airport coverage parameter.
	3	VERIFY	EUT	EUT does NOT tune to f2	EUT in Air while AVLC Specific Options gnd=1
	4	WAIT	LT GS2	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS4 address), Airport Coverage Parameter: “KORD”	GSIF with non-matching airport coverage parameter.
	5	VERIFY	UT	EUT does NOT tune to f2	EUT in Air while AVLC Specific Options gnd=1
	6	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
	7	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is not active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (e)

Test Case Name: Ground-Based Frequency Support List (e)					
Purpose: Verify Aircraft LME tunes between various frequencies provided in Frequency Support List. FSL contains multiple entries.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	EUT in air	
	2	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	3	SET	LT GS2	Operating frequency of GS2 as f2	
	4	SET	LT GS3	Operating frequency of GS3 as f3	
	5	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), (Freq: f3, GS3), Airport Coverage Parameter: “KBWI”	Multiple entries in the FSL parameter
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), (Freq: f3, GS3), Airport Coverage Parameter: “KBWI”	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address) , Airport Coverage Parameter: “KBWI”	
	9	SEND	LT GS3	GSIFs on f3 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address) , Airport Coverage Parameter: “KBWI”	
	10	SET	UT	EUT destination airport as “KBWI”	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), (Freq: f3, GS3), Airport Coverage Parameter: “KBWI”	
	3	VERIFY	UT	EUT tunes to a randomly selected FSL parameter *fx*	See comment 3
	4	VERIFY	LT GSx	XID_CMD_HO (P=1) to GSx	Verify Immediate HO to GSx from FSL
	5	SEND	LT GSx	XID_RSP_HO (F=1)	
	6	$\text{CHECK}_{\text{LINK}}$	LT GSx	Verify link with GSx is active	
	7	$\text{CHECK}_{\text{LINK}}$	LT GS1	verify link with GS1 is not active	
	8	WAIT	UT	For expiration of EUT TG5 timer	
	9	WAIT	LT GSx	GSIF on fx with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address), Airport Coverage Parameter: “KBWI”	
	10	SET	UT	EUT in air	
	11	VERIFY	UT	EUT tunes to f1	EUT tunes to f1 provided in FSL
	12	VERIFY	LT GS1	XID_CMD_HO (P=1) to GS1	Verify Immediate HO to GS1
	13	SEND	LT GS1	XID_RSP_HO (F=1)	
	14	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
	15	$\text{CHECK}_{\text{LINK}}$	LT GSx	Verify link with GSx is not active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
	3	$\text{RESET}_{\text{AVLC}}$	LT GS3		

Test Case Name: Ground-Based Frequency Support List (e)					
Purpose: Verify Aircraft LME tunes between various frequencies provided in Frequency Support List. FSL contains multiple entries.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface. 3. x can be either 2 or 3 in the test case. After repeating this test for 20 times, the frequencies in FSL should be selected with approximately equal number of times. The detailed randomness of frequency selection should be verified as part of the DO-178(B) software verification process.					

Procedure (f)

Test Case Name: Ground-Based Frequency Support List (f)					
Purpose: Verify Aircraft LME tunes to frequency provided in Frequency Support List followed by an air-initiated handoff.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	EUT in air	
	2	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	3	SET	LT GS2	Operating frequency of GS2 as f2	
	4	SET	LT GS3	Operating frequency of GS3 as f2	
	5	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address),, Airport Coverage Parameter: "KBWI"	
	6	SET_{AVLC}	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address),, Airport Coverage Parameter: "KBWI"	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address) , Airport Coverage Parameter: "KBWI"	
	9	SEND	LT GS3	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address) , Airport Coverage Parameter: "KBWI"	
	10	SET	UT	EUT destination airport as "KBWI"	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: "KBWI"	
	3	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in FSL
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
	8	WAIT	UT	For expiration of EUT TG5 timer	
	9	WAIT	LT GS3	GSIF	
	10	DO	LT GS2	Disable the transmission of GS2	
	11	VERIFY	LT GS3	XID_CMD_HO(P=1) to GS3	Air-Initiated Handoff
	12	SEND	LT GS3	XID_RSP_HO(F=1)	
	13	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
	14	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (g)

Test Case Name: Ground-Based Frequency Support List (g)					
Purpose: Verify Aircraft LME tunes to a frequency provided in Frequency Support List and fails to establish a link on ground.					
Configuration: 2					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	UT	EUT in air	
	3	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 (non-existent address)), Airport Coverage Parameter: "KBWI"	
	4	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 (non-existent address)), Airport Coverage Parameter: "KBWI"	
	5	$CHECK_{LINK}$	LT GS1	EUT establishes link with GS1 on f1	
	6	SET	UT	EUT destination airport as "KBWI"	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, non-existent address), Airport Coverage Parameter: "KBWI"	
	3	VERIFY	UT	EUT tunes to f2	
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT non-existent address 1 N2 times	
	5	VERIFY	UT	EUT tunes to f1	Fallback to CSC
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, non-existent address), Airport Coverage Parameter: "KBWI"	
	7	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	8	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, non-existent address), Airport Coverage Parameter: "KBWI"	
	9	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	EUT not thrashing by using FSL again.
	10	SET	UT	EUT in air	
	11	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	EUT continues to use f1 after taking off.
Postamble	1	$RESET_{AVLC}$	LT GS1		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface. 3. "non-existent address" is a validly formatted address that is not in use by any of the GSs.					

Procedure (h)

Test Case Name: Ground-Based Frequency Support List (h)					
Purpose: Verify Aircraft LME tunes to a frequency provided in Frequency Support List, then loses its link, and will not use the same FSL again.					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	UT	EUT in air	
	3	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	4	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2address), Airport Coverage Parameter: “KBWI”	
	5	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	6	SET	LT GS2	Operating frequency of GS2 as f2	
	7	SET	LT GS2	No GSIFs on f2	
	8	SET	UT	EUT destination airport as “KBWI”	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2address), Airport Coverage Parameter: “KBWI”	
	3	VERIFY	UT	EUT tunes to f2	
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	WAIT	UT	For expiration of EUT TG5 timer	
	8	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
	9	DO	LT GS2	Disable transmission from GS2	
	10	VERIFY	UT	EUT tunes to f1	Fallback to CSC
	11	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2address), Airport Coverage Parameter: “KBWI”	
	12	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	13	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2address), Airport Coverage Parameter: “KBWI”	
	14	VERIFY	UT	EUT does not tunes to f2 and keep link active with GS1	FSL is not taken into account a second time
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (i)

Test Case Name: Ground-Based Frequency Support List (i)					
Purpose: Verify Aircraft LME tunes to frequencies provided in Frequency Support List and fails to establish a link on takeoff.					
Configuration: 3					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	UT	EUT in air	
	2	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	3	SET	LT GS2	Operating frequency of GS2 as f2	
	4	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	5	$\mathrm{SET}_{\mathrm{AVLC}}$	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	6	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	7	SET	UT	EUT destination airport as “KBWI”	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	3	VERIFY	UT	EUT tunes to f2	
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	$\mathrm{CHECK}_{\mathrm{LINK}}$	LT GS2	Verify link with GS2 is active	
	7	$\mathrm{CHECK}_{\mathrm{LINK}}$	LT GS1	Verify link with GS1 is not active	
	8	WAIT	UT	For expiration of EUT TG5 timer	
	9	WAIT	LT GS2	GSIF on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS3 non-existent address), Airport Coverage Parameter: “KBWI”	
	10	SET	UT	Configure EUT in air	
	11	VERIFY	UT	EUT tunes to f1	EUT tunes to f1 provided in FSL
	12	VERIFY	LT GS3	XID_CMD_HO (P=1) to non-existent GS N2 times	Verify Immediate HO to non-existent GS
	13	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	14	VERIFY	EUT	XID_CMD_HO (P=1) to GS1	
	15	SEND	LT GS1	XID_RSP_HO (F=1)	
	16	$\mathrm{CHECK}_{\mathrm{LINK}}$	LT GS1	Verify link with GS1 is active	
Postamble	1	$\mathrm{RESET}_{\mathrm{AVLC}}$	LT GS1		
	2	$\mathrm{RESET}_{\mathrm{AVLC}}$	LT GS2		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface. 3. “non-existent address” is a validly formatted address that is not in use by any of the GSs.					

Procedure (j)

Test Case Name: Ground-Based Frequency Support List (j)					
Purpose: Verify Aircraft LME evaluates Airport Coverage parameter when using ground-based Frequency Support List (FSL received in XID_RSP_LE).					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	UT	Configure EUT on ground	
	4	SET	UT	Configure EUT destination or departure airport as “KCID”	The selection of destination or departure airport depends on the flight phase, i.e., landing or departure.
	5	SET	EUT	Aircraft is scanning the CSC	
Test body	1	SEND	LT GS1	GSIF to establish the link	
	2	VERIFY	LT GS1	XID_CMD_LE (P=1)	
	3	SEND	LT GS1	XID_RSP_LE (F=1) with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KORD”	Airport Coverage Parameter does not match EUT destination or departure airport
	4	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	5	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active, EUT remains on f1.	Need N(r)=0 in uplinked RR.
Comments 3. This test requires the UT and LT to directly access the AVLC protocol. 4. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (k)

Test Case Name: Ground-Based Frequency Support List (k)					
Purpose: Verify Aircraft LME evaluates Frequency Support List received in XID_RSP_LE, and XID_RSP_HO frames.					
Configuration: 4					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET	LT GS3	Operating frequency of GS3 as f2	
	4	SET	UT	Configure EUT on ground	
	5	SET	UT	Configure EUT destination or departure airport as “KCID”	The selection of destination or departure airport depends on the flight phase, i.e., landing or departure.
	6	SET	EUT	Aircraft is scanning the CSC	
Test body	1	SEND	LT GS1	GSIF to establish the link	
	2	VERIFY	LT GS1	XID_CMD_LE (P=1)	
	3	SEND	LT GS1	XID_RSP_LE (F=1) with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS3 address), Airport Coverage Parameter: “KCID”	Airport Coverage Parameter matches EUT destination or departure airport
	4	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	5	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in FSL
	6	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	Verify Immediate HO to GS3 without a GSIF.
	7	SEND	LT GS3	XID_RSP_HO (F=1) with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS2 address), with Airport Coverage Parameter: “KCID”	
	8	$\text{CHECK}_{\text{LINK}}$	LT GS3	Verify link with GS3 is active	Need N(r)=0 in uplinked RR.
	9	WAIT	UT	Wait for TG5 to expire	
	10	SET	UT	Configure EUT in air	
	11	VERIFY	UT	EUT tunes to f1	EUT tunes to f1 provided in FSL.
	12	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2 without a GSIF.
	13	SEND	LT GS2	XID_RSP_HO (F=1)	
	14	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is active	Need N(r)=0 in uplinked RR.
Postamble					
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (l)

Test Case Name: Ground-Based Frequency Support List (l)					
Purpose: Verify Aircraft LME keeps the current link available if only an invalid ground Frequency Support List parameter (bad frequency) is received (FSL received in XID_RSP_LE).					
Configuration: 3					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	UT	Configure EUT on ground	
	4	SET	UT	Configure EUT destination or departure airport as “KCID”	The selection of destination or departure airport depends on the flight phase, i.e., landing or departure.
	5	SET	EUT	Aircraft is scanning the CSC	
Test body	1	SEND	LT GS1	GSIF to establish the link	
	2	VERIFY	LT GS1	XID_CMD_LE (P=1)	
	3	SEND	LT GS1	XID_RSP_LE (F=1) with AVLC Specific Options (gnd = 1), FSL (Freq: set as invalid frequency, GS2 address), Airport Coverage Parameter: “KCID”	Airport Coverage Parameter matches EUT destination or departure airport
	4	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	5	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active and EUT remains on f1.	Need N(r)=0 in uplinked RR.
Postamble					
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (m)

Test Case Name: Ground-Based Frequency Support List (m)					
Purpose: Verify Aircraft LME tunes to another ground station when there is no more signal then apply a frequency provided in ground-based Frequency Support List on ground and a Frequency Support List during takeoff.					
Configuration: 5					
Reference: DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	Operating frequency f1 = CSC
	3	SET	LT GS3	Operating frequency of GS3 as f2	Operating frequency f2≠ CSC
	4	SET	LT GS4	Operating frequency of GS4 as f3	Operating frequency f3≠ CSC
	5	SET	UT	Configure EUT in air	
	6	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS3 address), Airport Coverage Parameter: "KBWI"	
	7	SET_{AVLC}	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS3 address), Airport Coverage Parameter: "KBWI"	
	8	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	9	SEND	LT GS2	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS3 address), Airport Coverage Parameter: "KBWI"	
	10	SEND	LT GS3	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS4 address)	
	11	SET	UT	Configure EUT destination airport as "KBWI"	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	VERIFY	LT GS2	XID_CMD_HO (P=1)	Verify HO to GS2
	3	SEND	LT GS2	XID_RSP_HO (F=1)	
	4	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	5	WAIT	UT	Wait for TG5 to expire	
	6	SET	UT	Configure EUT on ground	
	7	SEND	LT GS2	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS3 address), Airport Coverage Parameter: "KBWI"	
	8	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in FSL
	9	VERIFY	LT GS3	XID_CMD_HO (P=1) to GS3	Verify Immediate HO to GS3
	10	SEND	LT GS3	XID_RSP_HO (F=1)	
	11	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is active	
	12	SEND	LT GS3	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS4 address)	
	13	SET	UT	EUT in air	
	14	VERIFY	UT	EUT tunes to f3	EUT tunes to f3 provided in FSL
	15	VERIFY	LT GS4	XID_CMD_HO (P=1) to GS4	Verify Immediate HO to GS4
	16	SEND	LT GS4	XID_RSP_HO (F=1)	
	17	$CHECK_{LINK}$	LT GS4	Verify link with GS4 is active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
	4	$RESET_{AVLC}$	LT GS4		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (n)

Test Case Name: Ground-Based Frequency Support List (n)					
Purpose: Verify Aircraft LME tunes to a frequency provided in Frequency Support List and fails to establish a link with first entry in FSL.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f3	
	4	SET	UT	Configure EUT in air	
	5	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2) (Freq: f3, GS3), Airport Coverage Parameter: “KBWI”	
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2) (Freq: f3, GS3), Airport Coverage Parameter: “KBWI”	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	9	SET	UT	EUT destination airport as “KBWI”	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2) (Freq: f3, GS3), Airport Coverage Parameter: “KBWI”	This step is optional
	3	VERIFY	UT	EUT tunes to a randomly selected FSL parameter *fx*	See comment 3
	4	VERIFY	LT GSx	XID_CMD_HO (P=1)	Verify Immediate HO to GSx
	5	SEND	LT GSx	XID_RSP_HO (F=1)	
	6	$CHECK_{LINK}$	LT GSx	Verify link with GSx is active	
	7	DO	LT GSx	Disable the transmission of GSx	
	8	VERIFY	UT	EUT tunes to selected FSL parameter *fy*	If *x* = 2 in step 2 above then y = 3. If *x* = 3 in step 2 above then y = 2.
	9	VERIFY	LT GSy	XID_CMD_HO (P=1)	Verify Immediate HO to GSy
	10	SEND	LT GSy	XID_RSP_HO (F=1)	
	11	$CHECK_{LINK}$	LT GSy	Verify link with GSy is active	
	12	$CHECK_{LINK}$	LT GSx	Verify link with GSx is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		

Comments

1. This test requires the UT and LT to directly access the AVLC protocol.
2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.
3. x can be either 2 or 3 in the test case. After repeating this test for 20 times, the frequencies in FSL should be selected with approximately equal number of times. The detailed randomness of frequency selection should be verified as part of the DO-178(B) software verification process.

Procedure (o)

Test Case Name: Ground-Based Frequency Support List (o)					
Purpose: Verify Aircraft LME tunes to a frequency provided in ground-based Frequency Support List (FSL) on ground and randomly tunes to frequency provided in air based FSL upon takeoff.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS4	Operating frequency of GS4 as f4	Operating frequency f4 = CSC
	2	SET	LT GS1	Operating frequency of GS1 as f1	
	3	SET	LT GS2	Operating frequency of GS2 as f2	
	4	SET	LT GS3	Operating frequency of GS3 as f3	
	5	SET	UT	EUT in air	
	6	SET_{AVLC}	LT GS4	GSIF with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: "KCID"	
	7	VERIFY	LT GS4	EUT establishes link with GS4 on f4	
	8	SET	UT	Configure EUT destination airport as "KCID"	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS4	GSIF on f4 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: "KCID"	This step is optional
	3	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in FSL
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to GS2	Verify Immediate HO to GS2
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	WAIT	UT	For expiration of EUT TG5 timer	
	8	$CHECK_{LINK}$	LT GS4	Verify link with GS4 is not active	
	9	SEND	LT GS2	GSIF on f2 with AVLC Specific Options (gnd = 0), FSL ((Freq: f3, GS3 address), (Freq: f1, GS1 address)), Airport Coverage Parameter: "KKCI"	Air FSL with non-matching airport coverage parameter.
	10	SET	UT	EUT in air	
	11	VERIFY	UT	EUT tunes to a randomly selected FSL parameter *fx*	See comment 3
	12	VERIFY	LT GSx	XID_CMD_HO (P=1) to GSx	Verify Immediate HO to GSx
	13	SEND	LT GSx	XID_RSP_HO (F=1)	
	14	$CHECK_{LINK}$	LT GSx	Verify link with GSx is active	
	15	SEND	LT GSx	DISC(P=0) (before expiration of EUT TG5 timer)	
	16	VERIFY	UT	EUT tunes to selected FSL parameter *fy*	If *fx* = 1 in step 11 above then y = 3. If *fx* = 3 in step 11 above then y = 1.
	17	VERIFY	LT GSy	XID_CMD_HO (P=1) to GSy	XID_CMD_LE is also acceptable
	18	SEND	LT GSy	XID_RSP_HO (F=1)	XID_RSP_LE is also acceptable
	19	$CHECK_{LINK}$	LT GSy	Verify link with GSy is active	
	20	$CHECK_{LINK}$	LT GSx	Verify link with GSx is not active	No Response from UT as RR is not received since GSx is on a different (*fx*) frequency.
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		

Test Case Name: Ground-Based Frequency Support List (o)					
Purpose: Verify Aircraft LME tunes to a frequency provided in ground-based Frequency Support List (FSL) on ground and randomly tunes to frequency provided in air based FSL upon takeoff.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
	3	$RESET_{AVLC}$	LT GS4		

Comments

1. This test requires the UT and LT to directly access the AVLC protocol.
2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.
3. x can be either 1 or 3 in the test case. After repeating this test for 20 times, the frequencies in FSL should be selected with approximately equal number of times. The detailed randomness of frequency selection should be verified as part of the DO-178(B) software verification process.

Procedure (p)

Test Case Name: Ground-Based Frequency Support List (p)					
Purpose: Verify that when the aircraft LME fails to handoff to a Frequency/GS pair randomly selected from a Ground FSL, the aircraft LME will select another Frequency/GS pair from the FSL and perform a successful handoff to the selected GS.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f2 and RF signal is attenuated to prevent communications.	
	3	SET	LT GS3	Operating frequency of GS3 as f3 and RF signal is attenuated to prevent communications.	
	4	SET	UT	EUT in air	
	5	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), (Freq: f3, GS3 address), Airport Coverage Parameter: "KBWI"	Multiple entries in the Ground-FSL parameter
	6	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), (Freq: f3, GS3 address), Airport Coverage Parameter: "KBWI"	
	7	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	8	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address) , Airport Coverage Parameter: "KBWI"	One entry in the Air-FSL parameter
	9	SEND	LT GS3	GSIFs on f3 with AVLC Specific Options (gnd = 0), FSL (Freq: f1, GS1 address) , Airport Coverage Parameter: "KBWI"	One entry in the Air-FSL parameter
	10	SET	UT	EUT destination airport as "KBWI"	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), (Freq: f3, GS3 address), Airport Coverage Parameter: "KBWI"	Be sure GSIF was available to aircraft before proceeding with next VERIFY step.
	3	VERIFY	UT	EUT tunes to a randomly selected Ground-FSL parameter *fx*	See comment 3
	4	SET	LT GSy	RF signal is increased to nominal level to allow communications.	GSy is the other GS from the Ground-FSL not selected by the aircraft.
	5	VERIFY	LT GSx	XID_CMD_HO (P=1) to LT GSx N2 times	Verify immediate HO attempt to GSx from Ground-FSL
	6	VERIFY	UT	EUT tunes to other Ground-FSL parameter *fy* in the Ground-FSL.	
	7	VERIFY	LT GSy	XID_CMD_HO (P=1) to LT GSy.	
	8	SEND	LT GSy	XID_RSP_HO (F=1)	
	9	$CHECK_{LINK}$	LT GSy	Verify link with GSy is active	
	10	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is not active	
	11	$CHECK_{LINK}$	LT GSx	Verify link with GSx is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		

Test Case Name: Ground-Based Frequency Support List (p)					
Purpose: Verify that when the aircraft LME fails to handoff to a Frequency/GS pair randomly selected from a Ground FSL, the aircraft LME will select another Frequency/GS pair from the FSL and perform a successful handoff to the selected GS.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
	3	$RESET_{AVLC}$	LT GS3		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface. 3. x can be either 2 or 3 in the test case. After repeating this test for 20 times, the frequencies in FSL should be selected with approximately equal number of times. The detailed randomness of frequency selection should be verified as part of the DO-178(B) software verification process.					

Procedure (q)

Test Case Name: Ground-Based Frequency Support List (q)					
Purpose: Verify that following a transition from air to ground, after performing a handoff to a Frequency/GS from a Ground FSL parameter, which is received in a GSIF from a non-CSC frequency, and then receiving an uplink DISC frame while TG5 is still running, if no further Frequency/GS pair is available in the Ground FSL, the aircraft LME reverts to the CSC and performs a successful link establishment.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC.
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f3	
	4	SET	UT	EUT in air	
	5	SET	UT	Tune the EUT to f2.	Tune to f2 by whatever means
	6	SEND	LT GS1	GSIFs on f1	
	7	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 1), FSL (Freq: f3, GS3 address), Airport Coverage Parameter: “KBWI”	One and only one entry in the Ground-FSL parameter
	8	SET_{AVLC}	LT GS2	GSIF on f2 with AVLC Specific Options (gnd = 1), FSL (Freq: f3, GS3 address), Airport Coverage Parameter: “KBWI”	
	9	VERIFY	LT GS2	EUT establishes link with GS2 on f2	
	10	SEND	LT GS3	GSIFs on f3	GSIF does not contain an Air-FSL.
	11	SET	UT	EUT destination airport as “KBWI”	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS2	GSIF on f2 with AVLC Specific Options (gnd = 1), FSL (Freq: f3, GS3 address), Airport Coverage Parameter: “KBWI”	Be sure GSIF was available to aircraft before proceeding with next VERIFY step.
	3	VERIFY	UT	EUT tunes to f3	EUT tunes to f3 provided in the Ground-FSL
	4	VERIFY	LT GS3	XID_CMD_HO (P=1) to LT GS3	Verify immediate HO to GS3 from Ground-FSL
	5	SEND	LT GS3	XID_RSP_HO (F=1)	
	6	$\text{CHECK}_{\text{LINK}}$	LT GS3	Verify link with GS3 is active	
	7	SEND	LT GS3	DISC (P=0) prior to expiration of the aircraft’s TG5 timer.	
	8	VERIFY	UT	EUT tunes to f1	
	9	WAIT	LT GS1	GSIF on f1	Be sure GSIF was available to aircraft before proceeding with next VERIFY step.
	10	VERIFY	LT GS1	XID_CMD_LE (P=1) to GS1	
	11	SEND	LT GS1	XID_RSP_LE (F=1)	
	12	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is active	
	13	$\text{CHECK}_{\text{LINK}}$	LT GS3	Verify link with GS3 is not active	
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
	3	$\text{RESET}_{\text{AVLC}}$	LT GS3		

Test Case Name: Ground-Based Frequency Support List (q)					
Purpose: Verify that following a transition from air to ground, after performing a handoff to a Frequency/GS from a Ground FSL parameter, which is received in a GSIF from a non-CSC frequency, and then receiving an uplink DISC frame while TG5 is still running, if no further Frequency/GS pair is available in the Ground FSL, the aircraft LME reverts to the CSC and performs a successful link establishment.					
Configuration: 4					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.					

Procedure (r)

Test Case Name: Ground-Based Frequency Support List (r)					
Purpose: Verify that following a transition from ground to air, after performing a handoff to a Frequency/GS from an Air-FSL, and then receiving an uplink DISC frame while TG5 is still running, if no further Frequency/GS pair is available in the Air-FSL, the aircraft LME reverts to the CSC and performs a successful link establishment.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC.
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f3	
	4	SET	LT GS4	Operating frequency of GS4 as f3	
	5	SET		EUT in air	
	6	SET		Tune the EUT to f1.	
	7	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	8	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS3 address), (Freq: f3, GS4 address)	Two entries in the Air-FSL parameter
	9	SEND	LT GS3	GSIFs on f3	GSIF does not contain an FSL.
	10	SEND	LT GS4	GSIFs on f3	GSIF does not contain an FSL.
	11	SET_{AVLC}	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	12	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	13	SET	UT	EUT destination airport as “KBWI”	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	Be sure GSIF was available to aircraft before proceeding with next VERIFY step. This step is optional.
	3	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in the Ground-FSL
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT GS2	Verify immediate HO to GS2 from Ground-FSL
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is inactive	
	8	WAIT	LT GS2	GSIF on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS3 address), (Freq: f3, GS4 address) and TG5 expiration	Be sure GSIF was available to aircraft before proceeding with next SET step. Two entries in the Air-FSL parameter.
	9	SET	UT	EUT in air	
	10	VERIFY	UT	EUT tunes f3.	

Test Case Name: Ground-Based Frequency Support List (r)					
Purpose: Verify that following a transition from ground to air, after performing a handoff to a Frequency/GS from an Air-FSL, and then receiving an uplink DISC frame while TG5 is still running, if no further Frequency/GS pair is available in the Air-FSL, the aircraft LME reverts to the CSC and performs a successful link establishment.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
	11	VERIFY	LT GSx	XID_CMD_HO (P=1) to LT GSx	GSx is randomly selected from Air-FSL parameter. See comment 3.
	12	SEND	LT GSx	XID_RSP_HO (F=1)	
	13	$CHECK_{LINK}$	LT GSx	Verify link with GSx is active	
	14	SEND	LT GSx	DISC (P=0) prior to expiration of the aircraft's TG5 timer.	
	15	VERIFY	LT GSy	XID_CMD_HO (P=1) to LT GSy.	Verify immediate HO to GSy, the other GS from the Air-FSL. Both GS's are on same frequency.
	16	SEND	LT GSy	XID_RSP_HO (F=1)	
	17	$CHECK_{LINK}$	LT GSy	Verify link with GSy is active	
	18	DO	GSx	Disable TX Path	
	19	SEND	LT GSy	DISC (P=0) prior to expiration of the aircraft's TG5 timer.	
	20	VERIFY	UT	EUT tunes to f1.	f1 = CSC *NOTE:* Optionally, EUT may attempt XID_CMD_HO(P=1) back to GSx and fallback to CSC only after failing (N2) to reconnect.
	21	WAIT	LT GS1	GSIF on f1	Be sure GSIF was available to aircraft before proceeding with next VERIFY step.
	22	VERIFY	LT GS1	XID_CMD_LE (P=1) to LT GS1.	
	23	SEND	LT GS1	XID_RSP_LE (F=1)	
	24	$CHECK_{LINK}$	LT GS1	Verify link with GS1 is active	
	25	$CHECK_{LINK}$	LT GS2	Verify link with GS2 is not active	
	26	$CHECK_{LINK}$	LT GS3	Verify link with GS3 is not active	
	27	$CHECK_{LINK}$	LT GS4	Verify link with GS4 is not active	
Postamble	1	$RESET_{AVLC}$	LT GS1		
	2	$RESET_{AVLC}$	LT GS2		
	3	$RESET_{AVLC}$	LT GS3		
	4	$RESET_{AVLC}$	LT GS4		
Comments 1. This test requires the UT and LT to directly access the AVLC protocol. 2. For Class Z equipment, LT control and observation point may be at the Data/Management Interface. 3. x can be either 3 or 4 in the test case. After repeating this test for 20 times, the ground stations in FSL should be selected with approximately equal number of times. The detailed randomness of frequency selection should be verified as part of the DO-178(B) software verification process.					

Procedure (s)

Test Case Name: Ground-Based Frequency Support List (s)					
Purpose: : Verify that when the aircraft LME fails to handoff to a Frequency/GS pair selected from an Air-FSL, it will select another Frequency/GS pair from the FSL and perform a successful handoff to the selected GS.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	Operating frequency f1 = CSC.
	2	SET	LT GS2	Operating frequency of GS2 as f2	
	3	SET	LT GS3	Operating frequency of GS3 as f3 and RF signal is attenuated to prevent communications.	
	4	SET	LT GS4	Operating frequency of GS4 as f3 and RF signal is attenuated to prevent communications.	
	5	SET		EUT in air	
	6	SET		Tune the EUT to f1.	
	7	SEND	LT GS1	GSIFs on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	8	SEND	LT GS2	GSIFs on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS3 address), (Freq: f3, GS4 address)	Two entries in the Air-FSL parameter
	9	SEND	LT GS3	GSIFs on f3	GSIF does not contain an FSL.
	10	SEND	LT GS4	GSIFs on f3	GSIF does not contain an FSL.
	11	SET$_{AVLC}$	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	
	12	VERIFY	LT GS1	EUT establishes link with GS1 on f1	
	13	SET	UT	EUT destination airport as “KBWI”	
Test body	1	SET	UT	EUT on ground	
	2	WAIT	LT GS1	GSIF on f1 with AVLC Specific Options (gnd = 1), FSL (Freq: f2, GS2 address), Airport Coverage Parameter: “KBWI”	Be sure GSIF was available to aircraft before proceeding with next VERIFY step. This step is optional.
	3	VERIFY	UT	EUT tunes to f2	EUT tunes to f2 provided in the Ground-FSL
	4	VERIFY	LT GS2	XID_CMD_HO (P=1) to LT GS2	Verify immediate HO to GS2 from Ground-FSL
	5	SEND	LT GS2	XID_RSP_HO (F=1)	
	6	CHECK$_{LINK}$	LT GS2	Verify link with GS2 is active	
	7	CHECK$_{LINK}$	LT GS1	Verify link with GS1 is inactive	
	8	WAIT	LT GS2	GSIF on f2 with AVLC Specific Options (gnd = 0), FSL (Freq: f3, GS3 address), (Freq: f3, GS4 address) and TG5 expiration.	Be sure GSIF was available to aircraft before proceeding with next SET step. Two entries in the Air-FSL parameter.
	9	SET	UT	EUT in air	
	10	VERIFY	UT	EUT tunes f3.	

Test Case Name: Ground-Based Frequency Support List (s)					
Purpose: : Verify that when the aircraft LME fails to handoff to a Frequency/GS pair selected from an Air-FSL, it will select another Frequency/GS pair from the FSL and perform a successful handoff to the selected GS.					
Configuration: 5					
Reference : DO-224C, 3.2.2.5.4.12 through 3.2.2.5.4.12.2					
Context	Step	Action	PCO	Action Qualifier	Comment
	11	VERIFY	LT GSx	XID_CMD_HO (P=1) to LT GSx	GSx is randomly selected from Air-FSL parameter. See comment 3.
	12	SET	LT GSy	RF signal is increased to nominal level to allow communications.	GSy is the other GS from the Air-FSL not selected by the aircraft. Both GS’s are on the same frequency.
	13	VERIFY	LT GSx	XID_CMD_HO (P=1) to LT GSx N2 times	Verify immediate HO attempt to GSx from Air-FSL
	14	VERIFY	LT GSy	XID_CMD_HO (P=1) to LT GSy.	GSy is the other GS from the Air-FSL not selected by the aircraft. Both GS’s are on the same frequency.
	15	SEND	LT GSy	XID_RSP_HO (F=1)	
	16	$\text{CHECK}_{\text{LINK}}$	LT GSy	Verify link with GSy is active	
	17	WAIT	UT	For expiration of EUT TG5 timer	
	18	SET	LT GSx	RF signal is increased to nominal level to allow communications.	GSx is the first GS from the Air-FSL selected by the aircraft. The HO attempt to GSx failed.
	19	$\text{CHECK}_{\text{LINK}}$	LT GS1	Verify link with GS1 is not active	
	20	$\text{CHECK}_{\text{LINK}}$	LT GS2	Verify link with GS2 is not active	
	21	$\text{CHECK}_{\text{LINK}}$	LT GSx	Verify link with GSx is not active	GSx is the first GS from the Air-FSL selected by the aircraft. The HO attempt to GSx failed.
	22	$\text{CHECK}_{\text{LINK}}$	LT GSy	Verify link with GSy is active	GSy is the second GS from the Air-FSL selected by the aircraft. The HO attempt to GSy succeeded.
Postamble	1	$\text{RESET}_{\text{AVLC}}$	LT GS1		
	2	$\text{RESET}_{\text{AVLC}}$	LT GS2		
	3	$\text{RESET}_{\text{AVLC}}$	LT GS3		
	4	$\text{RESET}_{\text{AVLC}}$	LT GS4		

Comments

4. This test requires the UT and LT to directly access the AVLC protocol.
5. For Class Z equipment, LT control and observation point may be at the Data/Management Interface.
6. x can be either 3 or 4 in the test case. After repeating this test for 20 times, the ground stations in FSL should be selected with approximately equal number of times. The detailed randomness of frequency selection should be verified as part of the DO-178(B) software verification process.

2.4.6 VDL Mode 2 Network Layer Test Procedures

The following test procedures are considered to be satisfactory means of establishing compliance with the requirements of Section 2.2.3 of this document. These test procedures apply to Class X and Class Z equipment. For all test procedures, the UT and LT point of control and observation shall be the ISO 8208 interface.

2.4.6.1 Architecture

2.4.6.1.1 Access Points

Procedure

Test Case Name: Access Points					
Purpose: Verify the subnetwork service access point (SNSAP) is uniquely identified by the subnetwork data terminal equipment (DTE) address.					
Reference: DO-224C, 3.2.3.1.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble					
Test Body	1	SET_{8208}			
	2	VERIFY	UT	The ISO 8208 CALL ACCEPTED packet. The SNSAP is defined within the aircraft 24-bit address field.	
Postamble		$RESET_{8208}$			

2.4.6.2 Services

Compliance with the requirements of DO-224C, 3.2.3.2.1 is verified by the following subsections.

2.4.6.2.1 Subnetwork Connection Management

Equipment under test shall comply with either procedure (a) or (b).

Procedure (a) Explicit Subnetwork Connection Establishment

Test Case Name: Explicit Subnetwork Connection Establishment					
Purpose: Verify Explicit Subnetwork Connection Process					
Configuration: 3					
Reference: DO-224C, 3.2.3.6.3.2.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}	LT		
Test body	1	SEND	UT	CALL REQUEST Packet	
	2	RECEIVE	LT	INFO (P=0) with the CALL REQUEST Packet	
	3	VERIFY	LT	CALL REQUEST Packet from the INFO Frame	
	4	SEND	LT	INFO (P=0) with the CALL ACCEPTED Packet	
	5	RECEIVE	UT	CALL ACCEPTED Packet from the INFO Frame	
Postamble		$RESET_{AVLC}$	LT		
Comments: 1) If X.121 addressing is used in the air ground router configuration, at the UT, verify that the Called Line Address Notification Facility was used to inform the aircraft of X.121 ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets). 2) If VSDA addressing is used in the air ground router configuration, at the UT, verify that the Called Address Extention Facility was used to inform the aircraft of the VSDA ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets).					

Procedure (b) Expedited Subnetwork Connection Establishment (Optional)

Test Case Name: Expedited Subnetwork Connection Establishment					
Purpose: Verify Expedited Subnetwork Connection Process					
Configuration: 3					
Reference: DO-224C, 3.2.3.6.3.2.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SEND	LT	GSIF with v = 1	v=1 indicates Expedited Subnetwork Connection is supported
Test body	1	SEND	UT	CALL REQUEST Packet	
	2	RECEIVE	LT	XID_CMD_LE (P=1) with v = 1 and CALL REQUEST packet in the Expedited Subnetwork Connection parameter	
	3	VERIFY	LT	CALL REQUEST packet from the XID_CMD_LE (P=1)	
	4	SEND	LT	XID_RSP_LE (F=1) with v = 1 and CALL ACCEPTED Packet in the Expedited Subnetwork Connection parameter	
	5	RECEIVE	UT	CALL ACCEPTED Packet from the XID_RSP_LE (F=1)	
	6	VERIFY	UT	CALL ACCEPTED packet from the XID_RSP_LE (F=1)	
Postamble		$\text{RESET}_{\text{AVLC}}$	LT		

Comments:

1) If the XID_RSP_LE does not contain the CALL ACCEPTED or CLEAR REQUEST packets in response to the CALL REQUEST packet sent in the XID_CMD_LE, then verify that the UT send the CALL REQUEST packet directly to the LT as opposed to via the XID_CMD_LE.
2) If X.121 addressing is used in the air ground router configuration, at the UT, verify that the Called Line Address Notification Facility was used to inform the aircraft of X.121 ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets).
3) If VSDA addressing is used in the air ground router configuration, at the UT, verify that the Called Address Extention Facility was used to inform the aircraft of the VSDA ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets).

Equipment under test shall comply with either procedure (c) or (d).

<u>Note:</u> *Subnetwork connection maintenance should also be verified after a handoff across frequencies, as depicted in test procedures in Sections 2.4.5.5.4.1, 2.4.5.5.4.9, 2.4.5.5.4.11, and 2.4.5.5.4.13.*

Procedure (c) Explicit Subnetwork Connection Maintenance

Test Case Name: Explicit Subnetwork Connection Maintenance					
Purpose: Verify Explicit Subnetwork Maintenance Process					
Configuration: 3					
Reference: DO-224C, 3.2.3.6.3.3.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET $_{8208}$	LT GS1		
	2	SEND	LT GS2	GSIFs (v=0)	
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	RECEIVE	LT GS2	XID_CMD_HO (P=1)	
	3	SEND	LT GS2	XID_RSP_HO (F=1).	
	4	SEND	UT	CALL REQUEST Packet	Set Fast Select Facility in CALL REQUEST
	5	RECEIVE	LT	INFO (P=0) containing CALL REQUEST Packet	
	6	VERIFY		CALL REQUEST Packet from the INFO Frame	
	7	SEND	LT	INFO (P=0) with the CALL ACCEPTED Packet	Set Fast Select Facility in CALL ACCEPTED
	8	RECEIVE	UT	CALL ACCEPTED packet from the INFO Frame	
	9	VERIFY	LT & UT	SNDCF context by the exchange LREF compression technique in Call Setup user data fields.	
Postamble	1	RESET$_{8208}$	LT		
Comments: 1) The Fast Select facility allows the CALL REQUEST and CALL ACCEPTED user data fields to be expanded to 128 octets as opposed to their respective default values of 16 octets. 2) If X.121 addressing is used in the air ground router configuration, at the UT, verify that the Called Line Address Notification Facility was used to inform the aircraft of X.121 ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets). 3) If VSDA addressing is used in the air ground router configuration, at the UT, verify that the Called Address Extention Facility was used to inform the aircraft of the VSDA ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets).					

Procedure (d) Expedited Subnetwork Connection Maintenance (Optional)

Test Case Name: Expedited Subnetwork Connection Maintenance					
Purpose: Verify Expedited Subnetwork Maintenance Process					
Configuration: 3					
Reference: DO-224C, 3.2.3.6.3.3.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET $_{8208X}$	LT GS1		
	2	SEND	LT GS2	GSIFs (v=1)	v=1 indicates Expedited Subnetwork Connection is supported
Test body	1	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	2	SEND	UT	CALL REQUEST Packet	
	3	RECEIVE	LT GS2	XID_CMD_HO (P=1) with v = 1 and CALL REQUEST packet in the Expedited Subnetwork Connection parameter	
	4	SEND	LT GS2	XID_RSP_HO (F=1) with v = 1 and CALL ACCEPTED packet in the Expedited Subnetwork Connection parameter	
	5	RECEIVE	UT	CALL ACCEPTED Packet from the XID_RSP_HO (F=1)	
	6	VERIFY	UT	CALL ACCEPTED packet from the XID_RSP_HO (F=1)	
	7	RESET$_{8208}$	UT		Clear the SVC and disconnect the data link with GS2
	8	DO	LT GS1	Restore RF signal level from LT GS1	
	9	SET $_{8208X}$	LT GS1		
	10	DO	LT GS1	Slowly reduce the RF signal level from LT GS1	
	11	SEND	UT	CALL REQUEST Packet	
	14	RECEIVE	LT GS2	XID_CMD_HO (P=1) with v = 1 and CALL REQUEST packet in the Expedited Subnetwork Connection parameter	
	12	SEND	LT GS2	XID_RSP_HO (F=1) with v = 1 and CLEAR REQUEST packet in the Expedited Subnetwork Connection parameter	
	13	RECEIVE	UT	CLEAR REQUEST Packet from the XID_RSP_HO (F=1)	
	14	VERIFY	UT	CLEAR REQUEST packet from the XID_RSP_HO (F=1)	
Postamble	1	RESET$_{AVLC}$	LT		

Comments:

1) If a CALL ACCEPTED or a CLEAR REQUEST packet is not received by the UT, then the UT should send a CALL REQUEST packet to the LT directly (bypassing the XID encapsulation of the CALL REQUEST).
2) If X.121 addressing is used in the air ground router configuration, at the UT, verify that the Called Line Address Notification Facility was used to inform the aircraft of X.121 ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets).
3) If VSDA addressing is used in the air ground router configuration, at the UT, verify that the Called Address Extention Facility was used to inform the aircraft of the VSDA ground DTE address (this is in the exchange of the CALL REQUEST and CALL ACCEPTED packets).

Figure 2-50: (RESERVED)

2.4.6.2.2 Packet Fragmentation and Reassembly

Procedure

Test Case Name: Packet Fragmentation and Reassembly					
Purpose: Verify packet fragmentation and reassembly procedures for large data units passed through the subnetwork.					
Configuration: 1					
Reference: DO-224C, 3.2.3.2.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}		negotiate Maximum Packet Size to 128 octets during call setup	
Test Body	1	SEND	LT	Three DATA packets with the following settings: - DATA packet 1: D-bit = 0, Q-bit = 0, M-bit = 1, User Data = 128 octets with the value of 0xAA. - DATA packet 2: D-bit = 0, Q-bit = 0, M-bit = 1, User Data = 128 octets with the value of 0x55. - DATA packet 3: D-bit = 0, Q-bit = 0, M-bit = 0, User Data = 44 octets with the value of 0xBB.	
	2	VERIFY	UT	All three ISO 8208 DATA packets are received and that the actual data delivery for the higher layer entity (SNDCF, CLNP, etc), is a combination of all three linked ISO 8208 DATA packets with a total length of 300 octets. Verify that the data content is correct and in order.	
	3	SEND	UT	Three DATA packets with the following settings: - DATA packet 1: D-bit = 0, Q-bit = 0, M-bit = 1, User Data = 128 octets with the value of 0xAA. - DATA packet 2: D-bit = 0, Q-bit = 0, M-bit = 1, User Data = 128 octets with the value of 0x55. - DATA packet 3: D-bit = 0, Q-bit = 0, M-bit = 0, User Data = 44 octets with the value of 0xBB.	
	4	VERIFY	LT	All three ISO 8208 DATA packets are received and that the actual data delivery for the higher layer entity (SNDCF, CLNP, etc), is a combination of all three linked ISO 8208 DATA packets with a total length of 300 octets. Verify that the data content is correct and in order.	
Postamble		$RESET_{8208}$			
Comment: The data content is provided for the purpose of test definition and is not mandatory. Manufacturers may substitute other valid data, provided that the packets are distinguishable at the LT.					

Message Sequence Chart

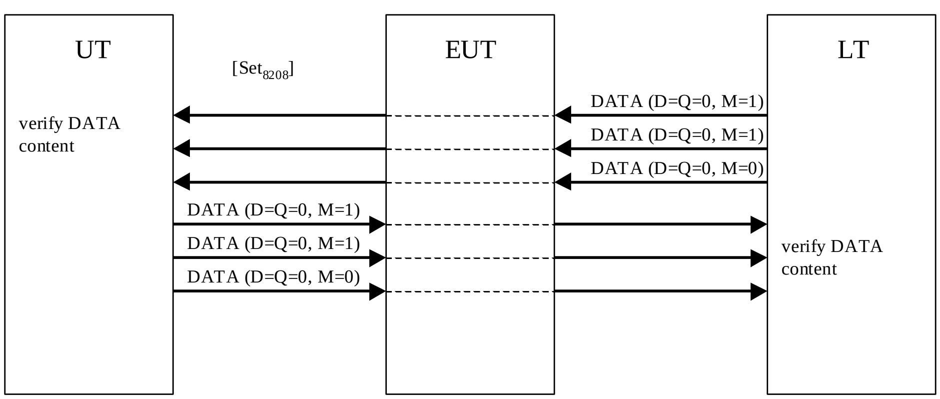


Figure 2-51: Packet Fragmentation and Reassembly

2.4.6.2.3 Error Recovery

Procedure

Test Case Name: Error Recovery					
Purpose: Verify the error recovery procedures based on the use of ISO 8208 REJECT packets.					
Configuration: 1					
Reference: DO-224C, 3.2.3.2.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}			
Test Body	1	$CHECK_{8208}$			
	2	SEND	LT	DATA packet, with the P(S) count set to be incorrect, e.g., for a packet with P(S) =2, set the P(R) value to 0. Set the user data field with 20 octets of data (data content can be any).	counter value is incorrect
	3	VERIFY	LT	REJECT with P(R) field set to current P(S) value	
	4	SEND	LT	DATA packet with correct P(S)	
	5	VERIFY	UT	DATA packet is received	
Postamble		$RESET_{8208}$			
Comment: The value of 20 octets is provided of test definition and is not mandatory. Manufacturers may substitute other valid numbers of octets.					

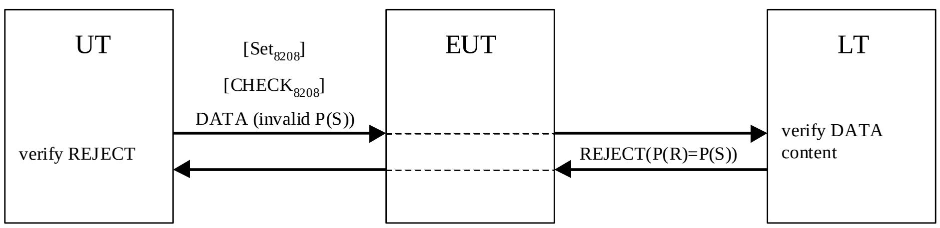


Figure 2-52: Error Recovery

2.4.6.2.4 Connection Flow Control

Procedure

Test Case Name: Connection Flow Control					
Purpose: Verify the connection flow control procedures using ISO 8208 DATA packets sequence numbering.					
Configuration: 1					
Reference: DO-224C, 3.2.3.2.4 and 3.2.3.2.4.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble	1	SET	LT GS1	Operating frequency of GS1 as f1	f1 = CSC
	2	SET	LT GS2	Operating frequency of GS2 as f1	
	3	SET_{8208}	LT GS1		
	4	SEND	LT GS2	GSIF	
Test Body	1	INHIBIT	LT GS1	Sending of RR packet	
	2	SEND	UT	W+4 DATA packets of 20 octets, content is arbitrary	
	3	VERIFY	LT GS1	W DATA packets received at LT	
	4	WAIT	LT GS1	59 seconds	59 seconds is one second less than the window closure time.

Test Case Name: Connection Flow Control					
Purpose: Verify the connection flow control procedures using ISO 8208 DATA packets sequence numbering.					
Configuration: 1					
Reference: DO-224C, 3.2.3.2.4 and 3.2.3.2.4.1					
Context	Step	Action	PCO	Action Qualifier	Comment
	5	SEND	LT GS1	RR packet with appropriate parameters	This step needs to be completed before window closure.
	6	VERIFY	LT GS1	4 DATA packets received	
	7	SEND	LT GS1	RR packet with appropriate parameters	
	8	SEND	UT	W+4 DATA packets of 20 octets, content is arbitrary	
	9	VERIFY	LT GS1	W DATA packets received at LT	
	10	WAIT	LT GS1	> 1 minute	
	11	VERIFY	LT GS2	EUT commences AIHO to GS2	
Postamble		$RESET_{8208}$			
Comment: 1. This test explicitly tests UT-to-LT direction and flow control. The LT-to-UT direction is explicitly tested by $CHECK_{8208}$ macro. 2. The value of 20 octets is provided of test definition and is not mandatory. Manufacturers may substitute other valid numbers of octets. 3. W (Window size) and A (Ack Window) are negotiated at call setup time					

Message Sequence Chart

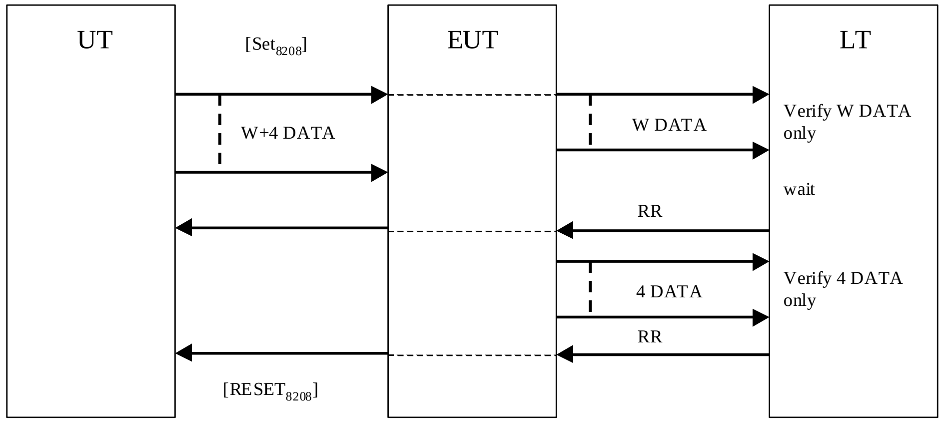


Figure 2-53: Connection Flow Control

2.4.6.3 Packet Format

Procedure

Test Case Name: Packet Format					
Purpose: Verify ISO 8208 packet formats and Fast Select facility for call setup.					
Configuration: 1					
Reference: DO-224C, 3.2.3.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}			
Test Body	1	VERIFY	LT	Receive CALL REQUEST with the Fast Select facility set with the extended data format option.	This extension allows the SNDCF negotiation data and ISH PDU to be carried in the ISO 8208 CALL REQUEST user data field up to 128 octets.
	2	VERIFY	LT	Verify that the Calling and Called DTE addresses within the ISO CALL REQUEST packet are correct; length fields are consistent with the size of the addresses; The address length and actual address order should be as shown: - Calling DTE address length, Called DTE address length - Called DTE address, Calling DTE address	
	3	VERIFY		Verify that the DTE addresses are encoded in BCD format.	
	4	VERIFY	LT	Verify that the ISO 8208 CALL REQUEST packet's user data field contains the SNDCF negotiation data and the ISH PDU.	
Postamble		$RESET_{8208}$			
Comment: The value of 20 octets is provided of test definition and is not mandatory. Manufacturers may substitute other valid numbers of octets,					

2.4.6.3.1 General Format Identifier

Procedure

Test Case Name: General Format Identifier					
Purpose: Verify that the qualifier bit (Q-bit) in DATA packets is set to 0 and that modulo 8 sequencing is used in VDL Mode 2.					
Reference: DO-224C, 3.2.3.3.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}			
Test body	1	SEND	UT	DATA	
	2	VERIFY	LT	Receive DATA packet and verify that the Q-bit is set to 0, and that bits 5 and 6 are coded as follows in the General Format Identifier (bit 5 = 1, bit 6 = 0). Verify that P(S) and P(R) are coded on 3 bits.	
Postamble		$RESET_{8208}$			

2.4.6.3.2 Calling and Called DTE Addresses

Compliance with the requirement of DO-224C, Section 3.2.3.3.2 is verified by the following subsections.

2.4.6.3.2.1 Encoding

Procedure

Test Case Name: Encoding
Purpose: Verify Calling and called DTE address fields identification and encoding.
Reference: DO-224C, 3.2.3.3.2.1
Comments: This requirement is verified by the test procedure of Section 2.4.6.3.

2.4.6.3.2.2 Aircraft DTE Address

Procedure

Test Case Name: Aircraft DTE Address
Purpose: Verify that the Aircraft DTE Address is encoded as BCD
Reference: DO-224C, 3.2.3.3.2.2.1
Comments: This requirement is verified by the test procedure of Section 2.4.6.3.

2.4.6.3.2.3 Ground DTE Address

Procedure (a) Reserved

Procedure (b)

Test Case Name: Ground DTE Address (VSDA Address)					
Purpose: Verify VDL Specific DTE Address					
Configuration: 3					
Reference: DO-224C, 3.2.3.3.2.2.2.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SEND	LT	GSIF	Include ATN Net Parameter for VSDA address in GSIF
Test body	1	SEND	UT	XID_CMD_LE (P=1)	
	2	RECEIVE	LT	XID_CMD_LE (P=1)	
	3	SEND	LT	XID_RSP_LE (F=1)	Include ATN Net Parameter for VSDA address in XID_RSP_LE
	4	SEND	UT	CALL REQUEST	With Called Address field using the VSDA address
	5	RECEIVE	LT	CALL REQUEST	
	6	VERIFY	LT	CALL REQUEST with VSDA address in called address field	
Postamble		$\mathrm{RESET}_{\mathrm{AVLC}}$	LT		
Comments:					

2.4.6.3.2.4 Ground Network DTE Address

Procedure

Test Case Name: Ground Network DTE Address					
Purpose: Verify detection and processing of the ground Network DTE (X.121) address.					
Configuration: 1					
Reference: DO-224C, 3.2.3.3.2.2.2.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}		Set the x-bit of the AVLC specific options to 1.	This will enable support for the Ground Network DTE addresses (X.121 addresses).
Test Body	1	SEND	UT	CALL REQUEST	
	2	SEND	LT	CALL ACCEPTED containing the Ground Network Address (X.121 address) in the Called address	
	3	SEND	LT	CLEAR REQUEST	
	4	RECEIVE	LT	CLEAR CONFIRMATION	
	5	SEND	UT	CALL REQUEST	
	6	VERIFY	LT	Called address contains the Ground Network Address (X.121 address) provided in the previous CALL ACCEPTED	
Postamble		$RESET_{8208}$			

2.4.6.3.3 Call User Data Field

Procedure

Test Case Name: Call User Data Field
Purpose: Verify usage of the fast select facility to enable VDL mobile SNDCF Call User Data, including intermediate system hello (ISH) PDU
Reference: DO-224C, 3.2.3.3
Comments: This requirement is verified by the test procedure of Section 2.4.6.3.

2.4.6.3.4 Packet Types

Procedure

Test Case Name: Packet Types					
Purpose: Verify the usage of ISO 8208 packet types. Packet encoding will be as specified in ISO 8208.					
Reference: DO-224C, 3.2.3.3.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}			
Test body	1	SEND	UT	DATA packet containing 20 octets of user data (data content can be any)	Keep sending DATA packets until k-window is reached (in X.25 packet layer) to observe the receipt of RR from the LT.
	2	VERIFY	LT	Receipt of DATA packets with user data unchanged, and verify the sending of RR to the UT.	
	3	SEND	LT	DATA packets containing 20 octets of user data (data content can be any)	Keep sending DATA packets until k-window is reached (in X.25 packet layer) to observe the receipt of RR from the UT.
	4	VERIFY	UT	DATA packets with user data unchanged, and verify the sending of RR to the LT.	
	5	SEND	UT	RESET REQUEST	
	6	VERIFY	LT	RESET REQUEST	
	7	SEND	LT	RESET CONFIRMATION	
	8	VERIFY	UT	RESET CONFIRMATION	
	9	SEND	LT	RESET REQUEST	
	10	VERIFY	UT	RESET REQUEST	
	11	SEND	UT	RESET CONFIRMATION	
	12	VERIFY	LT	RESET CONFIRMATION	
	13	SEND	UT	CLEAR REQUEST	
	14	VERIFY	LT	CLEAR REQUEST	
	15	SEND	LT	CLEAR CONFIRMATION	
	16	VERIFY	UT	CLEAR CONFIRMATION	
	17	SEND	LT	DATA packet with an invalid PS subfield.	No verify follows, this is to force UT ISO-8208 peer to a certain state
	18	SEND	UT	REJECT	The PS subfield was incorrect in the DATA packet received. The REJECT will indicate (to the ground peer) the next expected sequenced DATA packet.
	19	VERIFY	LT	REJECT	
	20	SEND	LT	CLEAR REQUEST	these steps merely allow LT/UT peers to complete the REJECT process
	21	SEND	UT	CLEAR CONFIRMATION	
	22	SEND	UT	RESTART REQUEST	
	23	VERIFY	LT	RESTART REQUEST	
	24	SEND	LT	RESTART CONFIRMATION	
	25	VERIFY	UT	RESTART CONFIRMATION	
Postamble		$RESET_{8208}$	LT		

Comment

1. This procedure is *not* a test of the UT/LT ability to execute the ISO-8208 peer-to-peer protocol, but only of the ability of the VDL Mode 2 EUT to pass the protocol commands without modification.
2. The value of 20 octets is provided of test definition and is not mandatory. Manufacturers may substitute other valid numbers of octets.
3. CALL REQUEST and CALL ACCEPTED are verified by the test procedures of Section 2.4.6.3.2.4 and 2.4.6.3.2.3 (b).

2.4.6.4 Subnetwork Layer System Parameters

The system parameters of the Subnetwork layer are utilized as part of the network layer (ISO 8208) test procedures within Section 2.4.6.4 of this document. These parameters are as described in RTCA DO-224C, Table 3-49.

2.4.6.4.1 Packet Size

Procedure

Test Case Name: Packet Size					
Purpose: Verify the negotiation of packet size via the flow control parameter negotiation.					
Configuration: 1					
Reference: DO-224C, 3.2.3.4.1					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}		N1=[11 (link layer header) + 4 (packet layer header) + Packet Size]*8	We want to impose a packet size of 512 octets maximum, N1 =(11+4+512)*8 = 4216
Test Body	1	SEND	UT	CALL REQUEST	
	2	VERIFY	LT	Verify in the CALL REQUEST that the flow control parameter negotiation or non-standard default packet size facility is set and that the packet size lower than 1024 (default value)	
	3	SEND	LT	CALL ACCEPTED with packet size lower than the one in the CALL REQUEST	
	4	SEND	LT	DATA	Length > negotiated packet size
	5	VERIFY	LT	CLEAR REQUEST is received, and a CLEAR CONFIRMATION is sent to the UT	
Postamble		$RESET_{AVLC}$	LT		Channel is cleared

2.4.6.4.2 Parameter W (transmit window size)

Procedure

Test Case Name: Parameter W (transmit window size)					
Purpose: Verify the setting and usage of parameter W.					
Configuration: 1					
Reference: DO-224C, 3.2.3.4.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test Body	1	SEND	UT	CALL REQUEST	
	2	SEND	LT	CALL ACCEPTED with W set to 2	
	3	SEND	UT	3xDATA	
	4	VERIFY	LT	2xDATA	
	5	WAIT	LT	3 minutes	
	6	SEND	LT	RR	
	7	VERIFY	LT	1xDATA	
Postamble		$RESET_{8208}$			

2.4.6.4.3 Parameter A (acknowledgement window size)

Procedure

Test Case Name: Parameter A (acknowledgement window size)					
Purpose: Verify the setting and usage of parameter A					
Reference: DO-224C, 3.2.3.4.3					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test Body	1	SEND	UT	CALL REQUEST	
	2	SEND	LT	CALL ACCEPTED with A set to 2	
	3	SEND	LT	DATA	
	4	VERIFY	LT	No RR received	
	5	SEND	LT	DATA	
	6	VERIFY	LT	RR	
Postamble		$RESET_{8208}$			

2.4.6.5 Description of Procedures

Procedure

Test Case Name: Description of Procedures
Purpose: Verify usage of ISO 8208.
Reference: DO-224C, 3.2.3.3
Comments: This requirement is verified by all test procedures that exchange ISO-8208 packets.

Other requirements of DO-224C, Section 3.2.3.6 apply only to ground station operation.

2.4.6.5.1 Supported Facilities

All ISO 8208 facilities specified in DO-224C Section 3.2.3.6.1 except for Packet Retransmission are tested in other procedures in this MOPS. The test procedure of Packet Retransmission is given below. References to the test procedures that cover the other facilities are also given below.

Test Case Name: Packet Retransmission Test Procedure					
Purpose: Verify the VDL Mode 2 supported options and facilities of ISO 8208.					
Reference: DO-224C, 3.2.3.6.1, Table 3-50					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{8208}			
Test body	1	SEND	LT	A packet with P(S) = 1	
	2	RECEIVE	LT	Reject packet upon expiration of timer T27, setting P(R) = 0.	
	3	SEND	LT	DATA Packet until ack window size is full (flow control parameter “A”), with P(S) packet send counts starting with 0, and incrementing accordingly.	
	4	VERIFY	LT	RR packet acknowledging receipt of packets sent by the LT.	
Postamble		$RESET_{8208}$			

2.4.6.5.1.1 Nonstandard Default Packet Sizes

Procedure

Test Case Name: Nonstandard Default Packet Sizes
Purpose: Verify use of nonstandard default packet sizes.
Reference: DO-224C, 3.2.3.6.1, Table 3-50
Comments: This requirement is verified by the test procedure of Section 2.4.6.4.1.

2.4.6.5.1.2 Nonstandard Default Window Sizes

Procedure

Test Case Name: Nonstandard Default Window Sizes
Purpose: Verify use of nonstandard default window sizes.
Reference: DO-224C, 3.2.3.6.1, Table 3-50
Comments: This requirement is verified by the test procedure of Section 2.4.6.4.2 and Section 2.4.6.4.3.

2.4.6.5.1.3 Flow Control Parameter Negotiation

Procedure

Test Case Name: Flow Control Parameter Negotiation.
Purpose: Verify use Flow Control Parameter negotiation on ISO 8208 link.
Reference: DO-224C, 3.2.3.6.1, Table 3-50
Comments: This requirement is verified by the test procedure of Section 2.4.6.4.1 and Section 2.4.6.4.2.

2.4.6.5.1.4 Fast Select

Procedure

Test Case Name: Fast Select
Purpose: Verify use ISO 8208 Fast Select capability
Reference: DO-224C, 3.2.3.6.1, Table 3-50
Comments: This requirement is verified by the test procedures of Section 2.4.6.3, Section 2.4.6.3.3, 2.4.6.5.3.2.2 and Section 2.4.7.2.1.

2.4.6.5.1.5 Fast Select Acceptance

Procedure

Test Case Name: Fast Select Acceptance
Purpose: Verify that the transmitter is able to accept use of ISO 8208 Fast Select.
Reference: DO-224C, 3.2.3.6.1, Table 3-50
Comments: This requirement is verified by the test procedures of Section 2.4.6.5.3.2.2, and Section 2.4.7.2.1.

2.4.6.5.1.6 Called Line Address Modified Notification

Procedure

Test Case Name: Called Line Address Modified Notification
Purpose: Verify use ISO 8208 Called Address Modified.
Reference: DO-224C, 3.2.3.6.1, Table 3-50
Comments: This requirement is verified by the test procedures of Section 2.4.6.5.4.4.

2.4.6.5.1.7 Called Address Extension

Procedure

Test Case Name: Called Address Extension
Purpose: Verify use ISO 8208 Called Address Extension capability
Reference: DO-224C, 3.2.3.6.1, Table 3-50
Comments: This requirement is verified by the test procedures of Section 2.4.6.3.2.3 and Section 2.4.6.3.2.4.

2.4.6.5.2 Unsupported Facilities

Procedure

Test Case Name: Unsupported Facilities
Purpose: Verify the non-use of unsupported options and facilities of ISO 8208.
Reference: DO-224C, 3.2.3.6.2
Comment: Checking for unsupported facilities is primarily a ground-system responsibility. Assurance that the avionics does not request unsupported facilities is verified by all of the protocol test procedures. A request by the avionics for an unsupported facility would result in an unexpected response from the LT, thus failing the test in question.

2.4.6.5.3 Subnetwork Establishment and Connection Management

Procedure

Test Case Name: Subnetwork Establishment and Connection Management
Purpose: Verify the subnetwork establishment and connection management options.
Reference: DO-224C, 3.2.3.6.3
Comment: This requirement is verified within the link layer and network layer connection establishment and management procedures within this document.

2.4.6.5.3.1 Subnetwork Entity Initialization

Procedure

Test Case Name: Subnetwork Establishment and Connection Management
Purpose: Verify subnetwork initialization procedures based on XID_CMD_LE and XID_RSP_LE.
Reference: DO-224C, 3.2.3.6.3
Comment: This requirement is verified within the link layer and network layer connection establishment and management procedures within this document.

2.4.6.5.3.2 Subnetwork Connection Establishment

Note: DO-224C 3.2.3.6.3.2 is a Ground Station requirement, and is not within the scope of this MOPS.

2.4.6.5.3.2.1 Explicit Subnetwork Connection Establishment

Procedure

Test Case Name: Explicit Subnetwork Connection Establishment
Purpose: Verify the procedures for explicit subnetwork connection establishment.
Reference: DO-224C, 3.2.3.6.3.2.1
Comment: This requirement is verified by the SET_{8208} macro.

2.4.6.5.3.2.2 Expedited Subnetwork Connection Establishment (optional)

Procedure

Test Case Name: Expedited Subnetwork Connection Establishment
Purpose: Verify the procedures for expedited subnetwork connection establishment
Reference: DO-224C, 3.2.3.6.3.2.2
Comment: This requirement is verified by the procedures in Section 2.4.6.2.1.

2.4.6.5.4 Subnetwork Connection Maintenance

Procedure

Test Case Name: Subnetwork Connection Maintenance
Purpose: Verify the procedures for subnetwork connection maintenance.
Reference: DO-224C, 3.2.3.6.3.3
Comment: This requirement is verified by the procedures of Section 2.4.6.5.3.

2.4.6.5.4.1 Explicit Subnetwork Connection Maintenance

Procedure

Test Case Name: Explicit Subnetwork Connection Maintenance
Purpose: Verify the procedures for explicit subnetwork connection maintenance.
Reference: DO-224C, 3.2.3.6.3.3.1
Comment: This requirement is verified by the procedures of Section 2.4.6.2.1.

2.4.6.5.4.2 Expedited Subnetwork Connection Maintenance (optional)

Procedure

Test Case Name: Expedited Subnetwork Connection Maintenance
Purpose: Verify the procedures for subnetwork connection maintenance.
Reference: DO-224C, 3.2.3.6.3.3.2
Comment: This requirement is verified by the procedures of Section 2.4.6.2.1.

2.4.6.5.4.3 Broadcast Subnetwork Connection Maintenance

Test Case Name: Broadcast Subnetwork Connection Maintenance
Purpose: Verify the procedures for subnetwork connection maintenance.
Reference: DO-224C, 3.2.3.6.3.3.3
Comment: This requirement is verified by the procedures of Section 2.4.5.5.4.10.

2.4.6.5.4.4 Call Redirection for X.121-based Networks

Procedure

Test Case Name: Call Redirection for X.121-based Networks					
Purpose: Verify the procedures for subnetwork connection maintenance.					
Configuration: 2					
Reference: DO-224C, 3.2.3.6.3.4					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble		SET_{AVLC}			
Test body	1	SEND	UT	CALL REQUEST packet including VSDA for non-existent router	
	2	RECEIVE	UT	CALL ACCEPTED using CLAMN to indicate call redirection	
	3	SEND	UT	DATA Packet until ack window size is full (flow control parameter “A”), with P(S) packet send counts starting with 0, and incrementing accordingly.	Verifying SVC established
	4	VERIFY	UT	RR packet acknowledging receipt of packets sent by the LT.	
Postamble		$RESET_{8208}$			

2.4.6.5.5 Error Handling

Procedure

Test Case Name: Error handling.
Purpose: Verify the procedures for error handling during subnetwork connection maintenance.
Reference: DO-224C, 3.2.3.6.4
Comment: This requirement is verified within the link layer and network layer connection establishment and management procedures within this document.

2.4.6.5.6 Acknowledgements

Procedure

Test Case Name: Acknowledgements
Purpose: Verify the procedures for acknowledgement processing during subnetwork connection maintenance.
Reference: DO-224C, 3.2.3.6.5
Comment: This requirement is verified within the link layer and network layer connection establishment and management procedures within this document.

2.4.7 VDL Mode 2 Mobile SNDCF Test Procedures

The VDL Mode 2 Mobile SNDCF requirement in DO-224C, Section 3.2.4.1 is a description on how the higher layer SNDCF entity will operate.

2.4.7.1 (Reserved)

2.4.7.2 Call User Data Encoding

The Call User Data Exchange Requirement in DO-224C, Section 3.2.4.3 is a description on how the higher layer SNDCF entity will operate.

2.4.7.2.1 ISH PDU

Procedure

Test Case Name: ISH PDU
Purpose: Verify the ISH PDU is included in both the ISO 8208 CALL REQUEST and CALL ACCEPTED packets user data field.
Reference: DO-224C, 3.2.4.3.1
Comment: The capability to transfer the ISH within the CALL REQUEST and CALL ACCEPTED has been demonstrated in Section 2.4.5.5.4.1. Generation of the ISH is a function of the higher level entity responsible for the SNDCF.

2.4.7.2.2 Maintained/Initialized Status Bit

Procedure

Test Case Name: Maintained/Initialized Status Bit					
Purpose: Verify the usage and setting of the maintained/initialized status bit. The fifth bit of the compression technique octet (i.e. the sixth octet of the Call User Data field) is the maintained/initialized (M/I) status bit which is used to indicate whether the SNDCF context (e.g. the compression state) was maintained from an old SVC to a new SVC.					
Reference: DO-224C, 3.2.4.3.2					
Context	Step	Action	PCO	Action Qualifier	Comment
Preamble					
Test body	1	SEND	UT	CALL REQUEST packet to the LT with the Fast Select facility and Extended Data Format to set.	This extension allows for SNDCF negotiation data and ISH PDU data to be carried in the ISO 8208 CALL REQUEST user data field up to 128 octets.
	2	VERIFY	LT	CALL REQUEST packet as sent from UT.	
	3	SEND	LT	CALL ACCEPTED with the Fast Select facility and Extended Data Format to set. Include the SNDCF negotiation data response and ISH PDU in the ISO 8208 CALL ACCEPTED user data field..	At this point, a network connection is established between air and ground simulated peers
	4	VERIFY	UT	CALL ACCEPTED packet as send from LT.	
	5	SEND	UT	CLEAR REQUEST	
	6	VERIFY	LT	CLEAR REQUEST as sent from UT.	
	7	SEND	LT	CLEAR CONFIRMATION	
	8	SEND	UT	Re-establish a network connection as in Step 1 with the following exceptions: - In the SNDCF negotiation data (ISO 8208 CALL REQUEST packet user data field), set the M/I status bit (5^{th} bit of the compression technique octet) to 1. - In the SNDCF negotiation data (ISO 8208 CALL ACCEPTED packet user data field), set the M/I status bit (5^{th} bit of the compression technique octet) to 1.	
	9	VERIFY	LT	The M/I status bit (in the ISO 8208 CALL REQUEST packet user data field of the compression technique octet) is set to 1,	
	10	VERIFY	UT	Verify the M/I status bit (in the ISO 8208 CALL ACCEPTED packet user data field of the compression technique octet) is also set to 1.	
Postamble		$RESET_{8208}$			

2.4.7.2.3 CALL REQUEST

Procedure

Test Case Name: CALL REQUEST
Purpose: Verify the support for the CALL REQUEST functionality.
Reference: DO-224C, 3.2.4.3.3
Comment: This capability has been demonstrated in Section 2.4.7.2.2. Generation of the CALL REQUEST is a function of the higher level entity responsible for the SNDCF

2.4.7.2.4 CALL ACCEPTED

Procedure

Test Case Name: CALL ACCEPTED
Purpose: Verify the support for the CALL ACCEPTED functionality
Reference: DO-224C, 3.2.4.3.4
Comment: This capability has been demonstrated in Section 2.4.7.2.2. Generation of the CALL ACCEPTED is a function of the higher level entity responsible for the SNDCF

2.4.8 Non-ISO 8208 Use of VDL Mode 2

The VDL Mode 2 performance of Class V equipment shall be verified by means of the MAC sublayer (Section 2.4.5.3), the Data Link layer (Section 2.4.5.4) and the Link Management Entity (Section 2.4.5.5) given in this document. In all cases, appropriate substitution of equivalent higher-level link procedures or message type may be made in lieu of any ISO-8208 procedure or message type.

Note: *As indicated in Section 1.1, this MOPS applies to VDL Mode 2 as an ATN subnetwork. Although much of this document may be applied to non-ATN capabilities using portions of the VDL Mode 2 protocol stack, such as AOA, this document does not intend to establish comprehensive standards for non-ATN, non-8208 use of VDL Mode 2.*

For Class V and Class W equipment, the non-8208 Subnetwork Layer and Subnetwork Access protocol shall be verified using procedures equivalent to those in Sections 2.4.6 and 2.4.7 of this document.

2.4.9 Data/Management Interface

For Class Y, Class Z, and Class W equipment, the functionality of the Data/Management interface is demonstrated by means of the Data Link layer (Section 2.4.5.4) and the Link Management Entity (Section 2.4.5.5) tests defined in this document.

3. INSTALLED EQUIPMENT TESTS

3.1 Equipment Installation

The equipment shall be installed in accordance with the manufacturer's installation instructions.

3.1.1 Accessibility

Equipment controls and displays installed for in-flight use shall be readily accessible from the pilot's normal seated position. The appropriate operator/crew member(s) shall have an unobstructed view of displayed data when in the normal seated position.

3.1.2 Aircraft Environment

The equipment performance shall be compatible with the environmental conditions present in the specific location in the aircraft where the equipment is installed.

3.1.3 Display Visibility

Display intensity shall be adjustable to levels suitable for data interpretation under all cockpit ambient light conditions ranging from total darkness to reflected sunlight.

Note: *Visors, glare shields or filters may be used to achieve an acceptable level of display visibility.*

3.1.4 Dynamic response

Operation of the equipment shall not be adversely affected by aircraft maneuvering or changes in attitude encountered in normal flight operations.

3.1.5 Failure Protection

Any probable failure of the equipment shall not degrade the normal operation of equipment or systems connected to it. Likewise, the failure of interfaced equipment or systems shall not degrade normal operation of the equipment.

3.1.6 Inadvertent Turnoff

Appropriate controls shall be provided to prevent the inadvertent turnoff of the equipment.

3.1.7 Aircraft Power Source

The voltage and voltage tolerance characteristics of the equipment shall be compatible with the aircraft power source.

3.2 Installed Equipment Performance Requirements

The installed equipment shall meet the requirements stated in Sections 2 and 3 in addition to, or as modified by, the requirements stated below.

3.2.1 Dynamic Response

Operation of the equipment shall not be adversely affected by aircraft ground operations, maneuvering, or changes in attitude encountered in normal flight operations.

3.2.2 Interference Effects

The equipment shall not be the source of harmful conducted or radiated interference and shall not be adversely affected by conducted or radiated interference from other equipment or systems installed in the aircraft.

Notes:

1. *Electromagnetic compatibility (EMC) problems noted after installation of this equipment may result from such factors as design characteristics of previously installed systems or equipment and the physical installation itself. It is not intended that the equipment manufacturer necessarily design for all installation environments. The installing facility will be responsible for resolving any incompatibility between this equipment and previously installed equipment in the aircraft. The various factors contributing to the incompatibility must be considered.*

2. *The FCC requirement in CFR 47, of –40 dBc for aircraft spurious emissions, may not protect GNSS (including GPS) navigation receivers nor Aeronautical Mobile Satellite Service (AMSS) communication receivers from harmful interference because additional attenuation is required. Of particular concern to GNSS are VHF 12^{th} and 13^{th} harmonics (especially at 121.150, 121.175, 121.2, 131.2, 131.25, and 131.3 MHz). Of particular concern to AMS(R)S are the VHF 12^{th} and 13^{th} harmonics (for AMS(R)S systems operating in the band 1525 - 1559 MHz, especially at 118.0 - 119.9 MHz and at 127.1 - 129.9 MHz; and for AMS(R)S systems operating in the band 1610 - 1626.5 MHz, especially at 121.1 - 123.85 MHz and 134.15 - 135.55 MHz).*

3. *Spurious emissions from the VHF antenna or a VHF box can be a problem. Additional filtering and shielding may be required to protect navigation receivers on an aircraft. Intersystem EMC issues are beyond the scope of this document. However, if simultaneous operation is required, the methodology stated in the following equation, if applicable, may be used to determine the harmonic levels that would be acceptable for a given set of conditions. The conditions that correlate with a particular manufacturer's transmitter design should be specified in the installation information for the transmitter if the manufacturer intends for the transmitter to be used on aircraft that would include such receiving systems.*

Transmitter Harmonic Level = Sensitivity of Receiving System
+ Receiver Interference to Desired Signal Level
- Safety Margin
- Aggregate Effect Margin
+ Antenna Isolation
+ Harmonic Filter Attenuation (if used)

Examples for GNSS and AMSS: *The levels listed in Table 3-1 are not specifications but are simply the result of the listed receiver and installation parameters, which vary with specific receivers and installations.*

3.3 Conditions of Test

Conditions stated in the following subparagraphs are applicable to the equipment tests specified in paragraph 3.4.

3.3.1 Power Input

Unless otherwise specified, tests shall be conducted with the equipment powered by the aircraft's electrical power generating system.

3.3.2 Associated Equipment or Systems

Unless otherwise specified, all electrically operated equipment and systems on the aircraft shall be operational before conducting interference tests.

3.3.3 Environment

During the tests, the equipment shall not be subject to environmental conditions that exceed those specified by the manufacturer.

Table 3-1: Example of Interference Protection for GNSS and AMSS

Item		GNSS		AMSS	
1	Victim operating frequency.	1575.4	MHz	1530.0	MHz
2	Receiver Susceptibility Mask	-120.5	dBm	-163.2	dBm
3	Aeronautical Safety Margin	6.0	dB	0.0	dB
4	Total Allowed RFI at receiver input	-126.5	dBm	-163.2	dBm
5	Worst VDL noise equivalent factor	0.0	dB	0.0	dB
6	Multiple System Allotment	6.0	dB	0.0	dB
7	Single Emitter Allotment	0.0	dB	0.0	dB
8	Allowable VDL-induced RFI at Victim	-132.5	dBm	-163.2	dBm
9	Antenna Gain toward RFI source	0.0	dBi	0.0	dBi
10	VDL-Antenna-Port-to-Victim-Antenna-Port Isolation	36.4	dB	36.1	dB
11	RFI Emission Limit	-96.1	dBm	-127.1	dBm
12	Max VDL Transmit Power	41.8	dBm	41.8	dBm
13	Maximum Permissible VDR Harmonic Power Level	-60.0	dBm	-60.0	dBm
14	Example Required External Filter Rejection	36.1	dB	67.1	dB
15	Example Total Harmonic Control (VDR design + external filter)	-137.9	dBc	-168.9	dBc

Item Notes: Items 2, 6, 9, 10, 14 and 15 are installation dependent.

1. GNSS (1559-1610 MHz); AMSS (1525-1559 MHz).
2. Susceptibility = Sensitivity (dBm) + Interference to Signal ratio (I/S) (dB). As of 2001, most GA GPS receivers permit I/S of +20 dB. GPS Sensitivity from RTCA DO-208, Section 2.2.3.1; GPS I/S from RTCA DO-208, Section 2.2.3.2, Continuous Wave. SATCOM susceptibility from RTCA DO-210D, Change 1, Section 2.1.9.
3. Safety Margin per RTCA DO-235.
4. Calculated as Item 2 (dBm) - Item 3 (dB).
5. Item maintained for compatibility with other analyses, no effect on VDL.
6. Assume that there are multiple systems contributing to GPS interference. This value may be 0 or 3 to 10 dB depending on installation and is computed as 10 * Log(Number of Interferers).
7. Item maintained for compatibility with other analyses, assume only single VDR transmitting on the same aircraft.
8. Calculated as Item 4 (dBm) + Item 5 (dB) – Item 6 (dB) + Item 7 (dB)
9. Item maintained for compatibility with other analyses. For this analysis, the antenna gain is assumed to be included in Item 10.
10. Isolation from TX antenna port to RX antenna port, taken as free-space loss at a distance of 1 meter, with no consideration of antenna gain, antenna pattern or cable loss.
11. Calculated as Item 8 (dBm) + Item 10 (dB).
12. Assume 15 W (41.8 dBm) VDL transmitter with no cable loss.
13. VDL harmonic output level per Section 2.2.1.3.6. For AMSS, it is assumed that the steps taken to reduce 12^{th} and 13^{th} order harmonic levels for GNSS result in the same reduction for adjacent AMSS frequencies.
14. Better VDL Harmonic performance will result in lower necessary filter rejection. Calculated as Item 13 (dBm) – Item 11 (dBm).
15. Total Harmonic Level allowed at input to transmit antenna, relative to carrier power. Calculated as Item 11 (dBm) – Item 12 (dBm).

Other References: RTCA DO-229B, GPS/WAAS Airborne Equipment
RTCA DO-262 MOPS for Next-Generation AMS(R)S Airborne Equipment

3.4 Test Procedures for Installed Equipment Performance

The following test procedures are considered satisfactory for determining required equipment performance when the equipment is installed in an aircraft. Although specific test procedures are cited, it is recognized that other methods may be preferred by the installing activity. These alternate procedures may be used if the installing activity can show that they provide at least equivalent information. In such cases, the procedures cited herein should be used as one criterion in evaluating the acceptability of the alternate procedures. The equipment shall be tested to demonstrate compliance with the minimum requirements stated in Section 2.2.. In order to meet this requirement, test results provided by the equipment manufacturer as proof of conformity may be accepted in lieu of bench tests performed by the installing activity.

3.4.1 Conformity Inspection

Visually inspect the installed equipment to determine the use of acceptable workmanship and engineering practices. Verify that all mechanical and electrical connections have been made properly and the equipment has been located and installed in accordance with the manufacturer's recommendations.

3.4.2 Equipment Function

Vary all controls of the equipment through each function to determine that the equipment is operating according to the manufacturer's instructions and that each control performs its intended function.

3.4.3 Equipment Accessibility

Determine that all equipment controls are readily accessible and that displayed data is easily interpreted.

3.4.4 Interference Effects

With the equipment energized, individually operate each other electrically operated equipment and systems on the aircraft to determine that no significant conducted or radiated interference exists. Evaluate all reasonable combinations of control settings and operating modes. Operate communications and navigation equipment on at least the low, high, and one mid-band frequencies. Make note of systems or modes of operation that should also be evaluated during flight. If appropriate, repeat tests using emergency power with the aircraft's batteries alone and the inverters operating.

Note: *The procedure may be adequate in consideration of the note in Paragraph 3.2.2.*

3.4.5 Power Supply Fluctuations

Under normal aircraft conditions, cycle the aircraft engine(s) through all normal power settings and verify proper operation of the equipment as specified by the equipment manufacturer.

3.4.6 Reception

The reception of VHF communications signals shall be confirmed by monitoring a local communication frequency.

3.4.7 Transmission

The transmission of VHF communications signals shall be verified by establishing contact with another VHF communication station and receiving a report of reliable communications.

4. EQUIPMENT OPERATIONAL PERFORMANCE CHARACTERISTICS

4.1 Required Operational Performance Requirements

To ensure the operator that operations can be conducted safely and reliably in the expected operational environment, there are specific minimum acceptable VHF Data Link, Mode 2, equipment performance requirements that shall be met. The following paragraphs identify these requirements.

4.1.1 Power Inputs

Prior to flight, verify that the equipment is receiving primary input power necessary for proper conditions.

4.1.2 Displays

With the equipment operating, verify that the displays required for the selection and annunciation of various communication modes/functions of operation are operating and readable.

4.1.3 Communications Controls

Cockpit control(s) required for proper operation of the equipment shall be available for use.

4.1.4 Equipment Operating Functions

The equipment shall operate in each of its installed operating modes, data and voice, as appropriate to the installed equipment.

4.1.5 System Operational Indication

Communication failure of degradation below minimum acceptable performance shall be readily discernible.

4.1.6 Equipment Operating Limitations

Equipment operating limitations of the aircraft station should be contained in the aircraft flight manual.

4.2 Test Procedures for Operational Performance Requirements

Operation equipment tests may be conducted as part of normal pre-flight tests. For those tests that can be run only in flight, procedures should be developed to perform these tests as early during the flight as possible to verify that the equipment is performing its intended function(s).

4.2.1 Power Input

With the aircraft's electrical power generating system operating, energize the equipment and verify that electrical power is available to the equipment.

4.2.2 Communications Displays

With the equipment operating, verify that the required display(s) are operational.

4.2.3 Communications Controls

The communications control(s) shall be operated, as required, to verify satisfactory equipment response.

4.2.4 Functional Operating Tests

Verify that the equipment performs its intended function(s) for each of the operating modes available to the operator and from available ground facilities.

Using the associated data link message entry and retrieval equipment, send a test message that will elicit a response. Check for the timeliness of the reply message, that the reply message is appropriate to the transmitted test message, and that the reply message has no apparent errors.

4.2.5 System Operational Indication

System operational readiness shall be monitored either by means of Built-In-Test-Equipment (BITE) and/or by suitable preflight tests contained in a check list or flight manual. All equipment failure annunciators shall be tested during preflight tests to verify proper operation.

4.2.6 Equipment Operating Limitations

Verify that any equipment operating limitations of the aircraft station are contained in the aircraft flight manual.

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Standards for Air Traffic Data Communication Services

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APPENDIX A: ACRONYMS AND GLOSSARY

A/G	Air-Ground
AAC	Aeronautical Administrative Communications
ABM	Asynchronous Balanced Mode
ACARS	Aircraft Communications Addressing and Reporting System
ACK	Acknowledgment
ADM	Asynchronous Disconnect Mode
AMCP	Aeronautical Mobile Communications Panel
AMSS	Aeronautical Mobile Satellite Service
AOA	ACARS over AVLC
AOC	Aeronautical Operational Control
ARS	Administration Region Selector
ASIP	AVLC Simple Interface Protocol
ATA	Air Transport Association
ATC	Air Traffic Control
ATN	Aeronautical Telecommunications Network
ATS	Air Traffic Services
AVLC	Aviation VHF Link Control
BCD	Binary Coded Decimal
BER	Bit Error Rate
BIS	Boundary Information System
CAA	Civil Aviation Authority
CLNP	Connectionless Network Protocol
CMD	Command
CMU	Communication Management Unit
CRC	Cyclic Redundancy Check
CSMA	Carrier Sense Multiple Access
D8PSK	Differential Eight Phase Shift Keying
dB	Decibel
dBm	Decibels referenced to one milliwatt
DCE	Data Circuit Equipment
DISC	Disconnect
DLE	Data Link Entity
DLS	Data Link Services

DM	Disconnect Mode
DSB-AM	Double Sideband-Amplitude Modulation
DTE	Data Terminating Equipment
EMC	Electromagnetic Compatibility
ES	End System
ESIS	End System Intermediate System
EUT	Equipment Under Test
FAR	Federal Aviation Regulations
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FER	Frame Error Rate
FIS	Flight Information Services
FMS	Flight Management System
FRM	Frame Reject Mode
FRMR	Frame Reject
GA	General Aviation
GFI	General Format Identifier
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GS	Ground Station (emulator)
GSE	Ground Station Emulator
GSIF	Ground Station Information Frame
HDLC	High-level Data Link Control
HO	Handoff
Hz	Hertz
I/Q, I-Q, I & Q	In-phase and Quadrature-phase
I/S	Interference power to Signal power ratio
ICAO	International Civil Aeronautical Organization
ID	Identification
INFO	Information Frame
IPI	Initial Protocol Identifier
IS	Intermediate System
ISH	Intermediate System Hello
ISO	International Standards Organization
ITU	International Telecommunications Union
kHz	Kilohertz

LCI	Logical Channel Identifier
LCR	Link Connection Reject
LDMITT	Lower Data/Management Interface Test Tool
LME	Link Management Entity
LREF	Local Reference
LT	Lower Tester
M/I	Maintained / Initialized
MAC	Media Access Control
MHz	Megahertz
MOPS	Minimum Operational Performance Standards
ms	millisecond
NAK	Negative Acknowledgement
NAS	National Airspace System
NET	Network Entity Title
NIST	National Institute of Standards and Technology
NSAP	Network Service Access Point
OSI	Open Systems Interconnection
PCO	Point of Control and Observation
PDU	Protocol Data Unit
PLP	Packet Level Protocol
QOS	Quality Of Service
RF	Radio Frequency
RSP	Response
SARPs	Standards and Recommended Practices
SME	System Management Entity
SNAcP	Subnetwork Access Control Protocol
SNDCF	Subnetwork Dependent Convergence Function
SNPA	Subnetwork Point of Attachment
SNSAP	Subnetwork Service Access Point
SNSME	Subnetwork System Management Entity
SQP	Signal Quality Parameter
SRM	Selective Reject Mode
SVC	Switched Virtual Circuit
UA	Unnumbered Acknowledgement
UDMITT	Upper Data/Management Interface Test Tool
UI	Unnumbered Information

UT	Upper Tester
VDL	VHF Digital Link
VDR	VHF Digital Radio
VHF	Very High Frequency
VME	VDL Management Entity
XID	Exchange Identifier

APPENDIX B: REQUIREMENTS CROSS REFERENCE MATRICES – VERIFICATION TESTING AND EQUIPMENT ARCHITECTURE CLASS (NORMATIVE)

Table B-1 contains the MOPS environmental condition requirements cross reference to verification testing and equipment architecture classes.

Table B-2 contains the MOPS standard condition requirements cross reference to verification testing and equipment architecture classes. For the purpose of this partitioning, this table assumes that the division of requirements between Class Y, Class W and Class Z equipment is as defined in this document. In the Tables, **X** indicates that this paragraph should be considered or the specified test(s) should be performed to qualify the indicated class of equipment as MOPS-compliant. An **O** indicates that the requirement and test case is Optional. A blank entry indicates that, for the assumed division of requirements, the tests of the indicated paragraph need not be performed to qualify the indicated class of equipment as MOPS-compliant. A **C**, used for Class V and Class W, indicates that a manufacturer desiring to qualify equipment as MOPS-compliant must customize the tests for the non-ISO-8208 subnetwork protocols specified in Section 2.2.5. Class V and Class W equipment does not include the ISO 8208 SNAcP sublayer requirements defined in section 2.2.3 and 2.2.4. Hence, a manufacturer of Class V and Class W equipment that desires to qualify equipment as MOPS compliant must provide equivalent documentation of SNAcP sublayer requirements and verification tests to that of RTCA DO-224C and this MOPS.

Manufacturers desiring to implement a division of requirements different than that assumed in this Appendix will adjust a small number of requirements in the DLS functionality between Class Y and Class Z (or W) equipment.

This appendix is deemed to be a normative appendix as it identifies the partitioning of requirements among the basic equipment classes. The details of such requirements are contained in Section 2.2, 2.3, and 2.4 of the MOPS.

Note: RTCA DO-224C specifications take precedence over Table B-2 regarding applicability and optional implementation of requirements.

Table B-1: **Traceability Matrix For Environmental Conditions**

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Physical Layer									
Physical Layer System Level Attributes									
Magnetic Effect - XCVR in Receive Mode	2.3.1	n/a	n/a	15.0	X	X	X		
Magnetic Effect - XCVR in Transmit Mode	2.3.1	n/a	n/a	15.0	X	X	X		
Emission of Radio Frequency - XCVR in Receive Mode	2.3.1	n/a	n/a	21.0	X	X	X		
Emission of Radio Frequency - XCVR in Transmit Mode	2.3.1	n/a	n/a	21.0	X	X	X		
Receive to Transmit Switching Time during:									
• Low and High Temperature	2.2.1.1.4 and 2.3.1	3.2.1.9.2	2.4.4.3.1	4.5.1 and 4.5.3	X	X	X		
• Fire, Flammability	2.2.1.1.4 and 2.3.1	3.2.1.9.2	2.4.4.3.1	26.0	(3)	(3)	(3)		
Transmit to Receive Switching Time during:									
• Low and High Temperature	2.2.1.1.5 and 2.3.1	3.2.1.9.2	2.4.4.3.2	4.5.1 through 4.5.4	X	X	X		
• Fire, Flammability	2.2.1.1.5 and 2.3.1	3.2.1.9.2	2.4.4.3.2	26.0	(3)	(3)	(3)		
Receiver Attributes									
Sensitivity during:									
• Low and High Temperature	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	4.5.1 through 4.5.4	X	X	X		
• Altitude	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	4.6.1	X	X	X		
• Decompression (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	4.6.2	X	X	X		
• Overpressure (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	4.6.3	X	X	X		
• Temperature Variation	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	5.0	X	X	X		
• Humidity	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	6.0	X	X	X		
• Shock	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	7.0	X	X	X		
• Vibration	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	8.0	X	X	X		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
• Waterproof (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	10.0	X	X	X		
• Fluids Susceptibility (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	11.0	X	X	X		
• Sand and Dust (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	12.0	X	X	X		
• Fungus Resistance (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	13.0	X	X	X		
• Salt Spray (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	14.0	X	X	X		
• Power Input (Normal and Abnormal)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	16.5.1 through 16.5.4	X	X	X		
• Voltage Spike	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	17.0	X	X	X		
• Audio Frequency Conducted Susceptibility - Power Inputs	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	18.0	X	X	X		
• Induced Signal Susceptibility	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	19.0	X	X	X		
• Radio Frequency Susceptibility (Radiated and Conducted)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	20.0	X	X	X		
• Lightning Induced Transient Susceptibility (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	22.0	X	X	X		
• Lightning Direct Effects (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	23.0	X	X	X		
• Icing (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	24.0	X	X	X		
• Electrostatic Discharge (ESD) (if required)	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	25.0	X	X	X		
• Fire, Flammability	2.2.1.2.1 and 2.3.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	26.0	(3)	(3)	(3)		
Adjacent Channel Rejection during:									
• Low and High Temperature	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	4.5.1 and 4.5.3	X	X	X		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
• Altitude	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	4.6.1	X	X	X		
• Decompression (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	4.6.2	X	X	X		
• Overpressure (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	4.6.3	X	X	X		
• Temperature Variation	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	5.0	X	X	X		
• Humidity	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	6.0	X	X	X		
• Shock	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	7.0	X	X	X		
• Vibration	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	8.0	X	X	X		
• Waterproof (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	10.0	X	X	X		
• Fluids Susceptibility (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	11.0	X	X	X		
• Sand and Dust (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	12.0	X	X	X		
• Fungus Resistance (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	13.0	X	X	X		
• Salt Spray (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	14.0	X	X	X		
• Power Input (Normal)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	16.5.1 and 16.5.2	X	X	X		
• Voltage Spike	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	17.0	X	X	X		
• Audio Frequency Conducted Susceptibility - Power Inputs	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	18.0	X	X	X		
• Radio Frequency Susceptibility (Radiated and Conducted)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	20.0	X	X	X		
• Lightning Induced Transient Susceptibility (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	22.0	X	X	X		
• Lightning Direct Effects (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	23.0	X	X	X		
• Icing (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	24.0	X	X	X		
• Electrostatic Discharge (ESD) (if required)	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	25.0	X	X	X		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
• Fire, Flammability	2.2.1.2.2 and 2.3.1	n/a	2.4.4.1.2	26.0	**(3)**	**(3)**	**(3)**		
Receiver Performance in the Presence of Strong Signals Within the VHF Aeronautical Band during:									
• Low and High Temperature	2.2.1.2.3 and 2.3.1	n/a	2.4.4.1.3	4.5.1 and 4.5.3	**X**	**X**	**X**		
• Fire, Flammability	2.2.1.2.3 and 2.3.1	n/a	2.4.4.1.3	26.0	**(3)**	**(3)**	**(3)**		
Receiver Performance in the Presence of Strong Signals Outside the VHF Aeronautical Band during:									
• Low and High Temperature	2.2.1.2.4 and 2.3.1	n/a	2.4.4.1.4	4.5.1 and 4.5.3	**X**	**X**	**X**		
• Fire, Flammability	2.2.1.2.4 and 2.3.1	n/a	2.4.4.1.4	26.0	**(3)**	**(3)**	**(3)**		
Desired Signal Dynamic Range during:									
• Low Temperature	2.2.1.2.5 and 2.3.1	n/a	2.4.4.1.5	4.5.1	**X**	**X**	**X**		
Symbol Rate Capture Range during:									
• Low and High Temperature	2.2.1.2.6 and 2.3.1	3.2.1.2.3	2.4.4.1.6	4.5.1 and 4.5.3	**X**	**X**	**X**		
• Fire, Flammability	2.2.1.2.6 and 2.3.1	3.2.1.2.3	2.4.4.1.6	26.0	**(3)**	**(3)**	**(3)**		
Frequency Capture Range during:									
• Temperature Variation	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	5.0	**X**	**X**	**X**		
• Vibration	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	8.0	**X**	**X**	**X**		
• Power Input (Normal)	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	16.5.1 and 16.5.2	**X**	**X**	**X**		
• Audio Frequency Conducted Susceptibility – Power Inputs	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	18.0	**X**	**X**	**X**		
• Radio Frequency Susceptibility (Radiated and Conducted)	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	20.0	**X**	**X**	**X**		
• Lightning Induced Transient Susceptibility (if required)	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	22.0	**X**	**X**	**X**		
• Lightning Direct Effects (if required)	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	23.0	**X**	**X**	**X**		
• Icing (if required)	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	24.0	**X**	**X**	**X**		
• Electrostatic Discharge	2.2.1.2.7 and 2.3.1	3.7.1	2.4.4.1.7	25.0	**X**	**X**	**X**		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
(ESD) (if required)									
Transmitter Attributes									
Bit Rate during:									
• Low and High Temperature	2.2.1.3.1 and 2.3.1	3.2.1.2.3	2.4.4.2.1	4.5.1 and 4.5.3	X	X	X		
• Temperature Variation	2.2.1.3.1 and 2.3.1	3.2.1.2.3	2.4.4.2.1	5.0	X	X	X		
• Fire, Flammability	2.2.1.3.1 and 2.3.1	3.2.1.2.3	2.4.4.2.1	26.0	(3)	(3)	(3)		
RF Output Power during:									
• Low and High Temperature	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	4.5.1 through 4.5.4	X	X	X		
• Altitude	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	4.6.1	X	X	X		
• Decompression (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	4.6.2	X	X	X		
• Overpressure (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	4.6.3	X	X	X		
• Temperature Variation	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	5.0	X	X	X		
• Humidity	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	6.0	X	X	X		
• Shock	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	7.0	X	X	X		
• Vibration	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	8.0	X	X	X		
• Waterproof (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	10.0	X	X	X		
• Fluids Susceptibility (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	11.0	X	X	X		
• Sand and Dust (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	12.0	X	X	X		
• Fungus Resistance (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	13.0	X	X	X		
• Salt Spray (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	14.0	X	X	X		
• Power Input (Normal and Abnormal)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	16.5.1 through 16.5.4	X	X	X		
• Voltage Spike	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	17.0	X	X	X		
• Audio Frequency Conducted Susceptibility – Power Inputs	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	18.0	X	X	X		
• Induced Signal	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	19.0	X	X	X		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Susceptibility									
• Radio Frequency Susceptibility (Radiated and Conducted)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	20.0	X	X	X		
• Lightning Induced Transient Susceptibility (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	22.0	X	X	X		
• Lightning Direct Effects (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	23.0	X	X	X		
• Icing (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	24.0	X	X	X		
• Electrostatic Discharge (ESD) (if required)	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	25.0	X	X	X		
• Fire, Flammability	2.2.1.3.2 and 2.3.1	3.4.1, 3.8.1	2.4.4.2.2	26.0	(3)	(3)	(3)		
RF Power Rise Time during:									
• Low and High Temperature	2.2.1.3.3 and 2.3.1	3.2.1.3.1	2.4.4.2.3	4.5.1 and 4.5.3	X	X	X		
• Fire, Flammability	2.2.1.3.3 and 2.3.1	3.2.1.3.1	2.4.4.2.3	26.0	(3)	(3)	(3)		
Symbol Constellation Error during:									
• Low and High Temperature	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	4.5.1 through 4.5.4	X	X	X		
• Altitude	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	4.6.1	X	X	X		
• Decompression (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	4.6.2	X	X	X		
• Overpressure (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	4.6.3	X	X	X		
• Temperature Variation	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	5.0	X	X	X		
• Humidity	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	6.0	X	X	X		
• Shock	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	7.0	X	X	X		
• Vibration	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	8.0	X	X	X		
• Waterproof (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	10.0	X	X	X		
• Fluids Susceptibility (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	11.0	X	X	X		
• Sand and Dust (if	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	12.0	X	X	X		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
required)									
• Fungus Resistance (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	13.0	X	X	X		
• Salt Spray (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	14.0	X	X	X		
• Power Input (Normal and Abnormal)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	16.5.1 through 16.5.4	X	X	X		
• Voltage Spike	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	17.0	X	X	X		
• Audio Frequency Conducted Susceptibility – Power Inputs	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	18.0	X	X	X		
• Induced Signal Susceptibility	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	19.0	X	X	X		
• Radio Frequency Susceptibility (Radiated and Conducted)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	20.0	X	X	X		
• Lightning Induced Transient Susceptibility (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	22.0	X	X	X		
• Lightning Direct Effects (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	23.0	X	X	X		
• Icing (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	24.0	X	X	X		
• Electrostatic Discharge (ESD) (if required)	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	25.0	X	X	X		
• Fire, Flammability	2.2.1.3.5 and 2.3.1	3.2.1.2.2	2.4.4.2.5	26.0	(3)	(3)	(3)		
Spurious Emissions during:									
• Low and High Temperature	2.2.1.3.6 and 2.3.1	3.2.1.10.2	2.4.4.2.6	4.5.1 and 4.5.3	X	X	X		
• Fire, Flammability	2.2.1.3.6 and 2.3.1	3.2.1.10.2	2.4.4.2.6	26.0	(3)	(3)	(3)		
Adjacent Channel Power during:									
• Low and High Temperature	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	4.5.1 through 4.5.4	X	X	X		
• Altitude	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	4.6.1	X	X	X		
• Decompression (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	4.6.2	X	X	X		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
• Overpressure (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	4.6.3	X	X	X		
• Temperature Variation	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	5.0	X	X	X		
• Humidity	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	6.0	X	X	X		
• Shock	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	7.0	X	X	X		
• Vibration	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	8.0	X	X	X		
• Waterproof (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	10.0	X	X	X		
• Fluids Susceptibility (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	11.0	X	X	X		
• Sand and Dust (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	12.0	X	X	X		
• Fungus Resistance (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	13.0	X	X	X		
• Salt Spray (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	14.0	X	X	X		
• Power Input (Normal)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	16.5.1 and 16.5.2	X	X	X		
• Voltage Spike	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	17.0	X	X	X		
• Audio Frequency Conducted Susceptibility – Power Inputs	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	18.0	X	X	X		
• Induced Signal Susceptibility	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	19.0	X	X	X		
• Radio Frequency Susceptibility (Radiated and Conducted)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	20.0	X	X	X		
• Lightning Induced Transient Susceptibility (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	22.0	X	X	X		
• Lightning Direct Effects (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	23.0	X	X	X		
• Icing (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	24.0	X	X	X		
• Electrostatic Discharge (ESD) (if required)	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	25.0	X	X	X		
• Fire, Flammability	2.2.1.3.7 and 2.3.1	3.2.1.10.3	2.4.4.2.7	26.0	(3)	(3)	(3)		

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Frequency Tolerance during:									
• Low and High Temperature	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	4.5.1 and 4.5.3	X	X	X		
• Humidity	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	6.0	X	X	X		
• Vibration	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	8.0	X	X	X		
• Power Input (Normal)	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	16.5.1 and 16.5.2	X	X	X		
• Audio Frequency Conducted Susceptibility – Power Inputs	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	18.0	X	X	X		
• Induced Signal Susceptibility	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	19.0	X	X	X		
• Lightning Induced Transient Susceptibility (if required)	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	22.0	X	X	X		
• Lightning Direct Effects (if required)	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	23.0	X	X	X		
• Icing (if required)	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	24.0	X	X	X		
• Electrostatic Discharge (ESD) (if required)	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	25.0	X	X	X		
• Fire, Flammability	2.2.1.3.10 and 2.3.1	3.7.1	2.4.4.2.10	26.0	(3)	(3)	(3)		
MAC, DLS, LME and SNAcP Layers									
Magnetic Effect	2.3.1	n/a	n/a	15.0				X	X
Emission of Radio Frequency	2.3.1	n/a	n/a	21.0				X	X
Protocol Performance (Link, Network, Mobile SNDCF)									
• Low and High Temperature	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7 (Note 1)	4.5.1 through 4.5.4	C	X	(2)	C	X
• Altitude	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	4.6.1	C	X	(2)	C	X
• Decompression (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	4.6.2	C	X	(2)	C	X
• Overpressure (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	4.6.3	C	X	(2)	C	X
• Temperature Variation	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	5.0	C	X	(2)	C	X

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
• Humidity	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	6.0	**C**	**X**	**(2)**	**C**	**X**
• Shock	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	7.0	**C**	**X**	**(2)**	**C**	**X**
• Vibration	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	8.0	**C**	**X**	**(2)**	**C**	**X**
• Waterproof (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	10.0	**C**	**X**	**(2)**	**C**	**X**
• Fluids Susceptibility (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	11.0	**C**	**X**	**(2)**	**C**	**X**
• Sand and Dust (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	12.0	**C**	**X**	**(2)**	**C**	**X**
• Fungus Resistance (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	13.0	**C**	**X**	**(2)**	**C**	**X**
• Salt Spray (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	14.0	**C**	**X**	**(2)**	**C**	**X**
• Power Input (Normal and Abnormal)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	16.5.1 through 16.5.4	**C**	**X**	**(2)**	**C**	**X**
• Voltage Spike	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	17.0	**C**	**X**	**(2)**	**C**	**X**
• Audio Frequency Conducted Susceptibility – Power Inputs	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	18.0	**C**	**X**	**(2)**	**C**	**X**
• Induced Signal Susceptibility	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	19.0	**C**	**X**	**(2)**	**C**	**X**
• Radio Frequency Susceptibility (Radiated and Conducted)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	20.0	**C**	**X**	**(2)**	**C**	**X**
• Lightning Induced Transient Susceptibility (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	22.0	**C**	**X**	**(2)**	**C**	**X**
• Lightning Direct Effects (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	23.0	**C**	**X**	**(2)**	**C**	**X**
• Icing (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	24.0	**C**	**X**	**(2)**	**C**	**X**
• Electrostatic Discharge (ESD) (if required)	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	25.0	**C**	**X**	**(2)**	**C**	**X**

TRACEABILITY MATRIX FOR ENVIRONMENTAL CONDITIONS									
Description	**Requirement**		**Verification Test**		**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**	**VDL Mode 2 MOPS**	**Enviro Cond (DO-160G)**	**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
• Fire, Flammability	2.2.2, 2.2.3, 2.2.4	3.2.2, 3.2.3, 3.2.4	2.4.5, 2.4.6, 2.4.7	26.0	**(3)**	**(3)**	**(3)**	**(3)**	**(3)**

Note 1: Successful completion of the test procedure of Section 2.4.6.2.2 indicates, in a global sense, that all levels of the protocol stack operate as desired. Detailed compliance to the individual requirements is demonstrated by means of the Standard Operating Condition tests.

Note 2: This test only applies for Class Y equipment if the equipment includes subnetwork functionality.

Note 3: Equipment performance requirements are applicable only to equipment qualified to Category A or B.

TABLE B-2: TRACEABILITY MATRIX FOR STANDARD CONDITIONS

TRACEABILITY MATRIX FOR STANDARD CONDITIONS								
Description	**Requirement**		**Verification Test**	**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**		**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Physical Layer								
Physical Layer System Level Attributes								
Tuning Range and Channel Increments	2.2.1.1.1	3.7.2	2.4.4	X	X	X		
Modulation	2.2.1.1.2	3.2.1.2	2.4.4.1.1	X	X	X		
Tuning Time	2.2.1.1.3	3.7.2	2.4.4.3.3	X	X	X		
Receive to Transmit Switching Time	2.2.1.1.4	3.2.1.9.1.	2.4.4.3.1	X	X	X		
Transmit to Receive Switching Time	2.2.1.1.5	3.2.1.9.2	2.4.4.3.2	X	X	X		
Receiver Attributes								
Sensitivity	2.2.1.2.1	3.5.2, 3.6.1, 3.9.2, 3.10.1	2.4.4.1.1	X	X	X		
Adjacent Channel Rejection	2.2.1.2.2	n/a	2.4.4.1.2	X	X	X		
Receiver Performance in the Presence of Strong Signals Within the VHF Aeronautical Band	2.2.1.2.3	n/a	2.4.4.1.3	X	X	X		
Receiver Performance in the Presence of Strong Signals Outside the VHF Aeronautical Band	2.2.1.2.4	n/a	2.4.4.1.4	X	X	X		
Desired Signal Dynamic Range	2.2.1.2.5	n/a	2.4.4.1.5	X	X	X		
Symbol Rate Capture Range	2.2.1.2.6	3.2.1.2.3	2.4.4.1.6	X	X	X		
Frequency Capture Range	2.2.1.2.7	3.7.1	2.4.4.1.7	X	X	X		
Doppler Rate	2.2.1.2.8	3.5.1.1, 3.5.1.2, 3.5.1.3	2.4.4.1.8	X	X	X		
Co-Channel Interference	2.2.1.2.9	3.5.1.4.1	2.4.4.1.9	X	X	X		
Conducted Spurious Emission	2.2.1.2.10	n/a	2.4.4.1.10	X	X	X		
FM Broadcast Intermodulation	2.2.1.2.11	n/a	2.4.4.1.11	X	X	X		
In-Band Intermodulation	2.2.1.2.12	n/a	2.4.4.1.12	X	X	X		
Transmitter Attributes								
Bit Rate	2.2.1.3.1	3.2.1.2.3	2.4.4.2.1	X	X	X		
RF Output Power	2.2.1.3.2	3.4.1, 3.8.1	2.4.4.2.2	X	X	X		
RF Power Rise Time	2.2.1.3.3	3.2.1.3.1	2.4.4.2.3	X	X	X		
RF Power Release Time	2.2.1.3.4	3.2.1.3.2	2.4.4.2.4	X	X	X		
Symbol Constellation Error	2.2.1.3.5	3.2.1.2.2	2.4.4.2.5	X	X	X		

TRACEABILITY MATRIX FOR STANDARD CONDITIONS								
Description	**Requirement**		**Verification Test**	**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**		**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Spurious Emissions	2.2.1.3.6	3.2.1.10.2	2.4.4.2.6	X	X	X		
Adjacent Channel Power	2.2.1.3.7	3.2.1.10.3	2.4.4.2.7	X	X	X		
Load VSWR Capability	2.2.1.3.9	n/a	2.4.4.2.9	X	X	X		
Frequency Tolerance	2.2.1.3.10	3.7.1	2.4.4.2.10	X	X	X		
MAC Layer								
Multiple Access – p-persistent CSMA	2.2.2	3.2.2.3.1.1	2.4.5.3.1.1, 2.4.5.3.1.2, 2.4.5.3.2.1 through 2.4.5.3.2.4	X	X	X		
Channel Occupancy	2.2.2	3.2.2.3.1.2	2.4.5.3.1.2	X	X	X		
Channel Congestion	2.2.2	3.2.2.3.1.3	2.4.5.3.2.2, 2.4.5.3.1.3	X	X	X		
Timer TM1 (Inter-access Delay Timer)	2.2.2	3.2.2.3.2 and 3.2.2.3.2.1	2.4.5.3.2.1, 2.4.5.3.2.3	X	X	X		
Timer TM2 (Channel Busy Timer)	2.2.2.	3.2.2.3.2 and 3.2.2.3.2.2	2.4.5.3.2.2	X	X	X		
Parameter p (Persistence)	2.2.2	3.2.2.3.2 and 3.2.2.3.2.3	2.4.5.3.2.3	X	X	X		
Counter M1 (Maximum Number of Access Attempts)	2.2.2	3.2.2.3.2 and 3.2.2.3.2.4	2.4.5.3.2.4	X	X	X		
Channel Sensing	2.2.1.1.6, 2.2.2	3.2.1.7, and 3.2.2.3.3.1	2.4.4.3.3, 2.4.5.3.3.1	X	X	X		
Access Attempt	2.2.2	3.2.2.3.3.2	2.4.5.3.3.2	X	X	X		
Data Link Service (DLS) Sublayer .								
Frame Sequencing	2.2.2	3.2.2.4.1.1	2.4.5.4.1.1	X	X		X	X
Error Detection	2.2.2	3.2.2.4.1.2	2.4.5.4.1.2	X	X	X		
Station Identification	2.2.2	3.2.2.4.1.3	2.4.5.4.1.3	X	X		X	X
Broadcast Addressing	2.2.2	3.2.2.4.1.4	2.4.5.4.1.4	X	X		X	X
Data Transfer	2.2.2	3.2.2.4.1.5	2.4.5.4.1.5	X	X		X	X
Frame Format	2.2.2	3.2.2.4.2.1	2.4.5.4.2.1	X	X		X	X
Address Structure	2.2.2	3.2.2.4.2.2	2.4.5.4.2.2 and 2.4.5.4.1.4	X	X		X	X
Address Fields	2.2.2	3.2.2.4.2.3 through 3.2.2.4.2.3.7	2.4.5.4.2.3	X	X		X	X
Broadcast Address	2.2.2	3.2.2.4.2.4 and 3.2.2.4.2.4.1	2.4.5.4.2.4	X	X		X	X
Link Control Field	2.2.2	3.2.2.4.2.5	2.4.5.4.2.5	X	X		X	X

TRACEABILITY MATRIX FOR STANDARD CONDITIONS								
Description	**Requirement**		**Verification Test**	**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**		**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Information Field	2.2.2	3.2.2.4.2.6	2.4.5.4.2.6	X	X		X	X
Data Link Service System Parameters	2.2.2	3.2.2.4.3	2.4.5.4.3	X	X		X	X
Timer T1 (delay before retransmission)	2.2.2	3.2.2.4.3.1	2.4.5.4.3.1	X	X		X	X
Timer T2 (delay before acknowledgement)	2.2.2	3.2.2.4.3.2	2.4.5.4.3.2	X	X		X	X
Timer T3 (link initialization time)	2.2.2	3.2.2.4.3.3	2.4.5.4.3.3	X	X		X	X
Timer T4 (maximum delay between transmissions)	2.2.2	3.2.2.4.3.4	2.4.5.4.3.4	X	X		X	X
Parameter N1 (maximum number of bits in frame)	2.2.2	3.2.2.4.3.5	2.4.5.4.3.5	X	X		X	X
Counter N2 (maximum number of transmissions)	2.2.2	3.2.2.4.3.6	2.4.5.4.3.6	X	X		X	X
Parameter k (window size)	2.2.2	3.2.2.4.3.7	2.4.5.4.3.7	X	X		X	X
Description of Procedures	2.2.2	3.2.2.4.4	all DLS tests	X	X		X	X
Modes of Operation	2.2.2	3.2.2.4.5	2.4.5.4.4	X	X		X	X
Operational Mode	2.2.2	3.2.2.4.5.1	2.4.5.4.4.1	X	X		X	X
Non-Operational Mode	2.2.2	3.2.2.4.5.2	2.4.5.4.4.2	X	X		X	X
DISC Frame	2.2.2	3.2.2.4.5.2.1	2.4.5.4.4.2.1	X	X		X	X
DM Frame	2.2.2	3.2.2.4.5.2.2	2.4.5.4.4.2.2	X	X		X	X
Frame Reject Mode	2.2.2	3.2.2.4.5.2.3	2.4.5.4.4.2.3	X	X		X	X
Sent Selective Reject Mode	2.2.2	3.2.2.4.5.2.4	2.4.5.4.9.2, 2.4.5.4.4.2.4	X	X		X	X
Use of the P/F bit	2.2.2	3.2.2.4.6	all DLS tests, 2.4.5.4.5	X	X		X	X
General	2.2.2	3.2.2.4.6.1	2.4.5.4.5.1	X	X		X	X
INFO frames	2.2.2	3.2.2.4.6.2	2.4.5.4.5.2	X	X		X	X
Unnumbered Frames	2.2.2	3.2.2.4.6.3	2.4.5.4.5.3	X	X		X	X
Unnumbered Command Frames Collisions	2.2.2	3.2.2.4.7	2.4.5.4.6	X	X		X	X
DLE Procedures	2.2.2	3.2.2.4.7.1	2.4.5.4.6.1	X	X		X	X
LME Procedures	2.2.2	3.2.2.4.7.2	2.4.5.4.6.2	X	X		X	X
XID Frame	2.2.2	3.2.2.4.8	2.4.5.4.7	X	X		X	X
Broadcast (not applicable to airborne equipment)	2.2.2	3.2.2.4.9	2.4.5.4.8					
Information Transfer	2.2.2	3.2.2.4.10	2.4.5.4.9	X	X		X	X
Transmit Queue Management	2.2.2	3.2.2.4.10.1	2.4.5.4.9.1.1 and 2.4.5.4.9.1.2	X	X		X	X

TRACEABILITY MATRIX FOR STANDARD CONDITIONS								
Description	**Requirement**		**Verification Test**	**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**		**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Eliminate Redundant Frames	2.2.2	3.2.2.4.10.1.1	2.4.5.4.9.1.1	X	X		X	X
Procedures for Transmission	2.2.2	3.2.2.4.10.1.2	2.4.5.4.9.1.2	X	X		X	X
SREJ Frame	2.2.2	3.2.2.4.10.2	2.4.5.4.9.2	X	X		X	X
FRMR Frame	2.2.2	3.2.2.4.10.3	2.4.5.4.9.3	X	X		X	X
UA Frame	2.2.2	3.2.2.4.10.4	2.4.5.4.9.4	X	X		X	X
UI Frame	2.2.2	3.2.2.4.10.5	2.4.5.4.9.5	X	X		X	X
TEST Frame	2.2.2	3.2.2.4.10.6	2.4.5.4.9.6	X	X		X	X
Link Management Entity (LME)								
Services	2.2.2	3.2.2.5.1	2.4.5.5.1	X	X		X	X
Link Provision	2.2.2	3.2.2.5.1.1	2.4.5.5.1.1, 2.4.5.5.4.4, 2.4.5.5.4.6 and 2.4.5.5.3.2	X	X		X	X
Link Change Notification	2.2.2	3.2.2.5.1.2	2.4.5.5.1.2	X	X		X	X
Exchange Identity (XID) Formats	2.2.2	3.2.2.5.2	2.4.5.5.2	X	X		X	X
Encoding	2.2.2	3.2.2.5.2.1	2.4.5.5.2.1	X	X		X	X
Public Parameters	2.2.2	3.2.2.5.2.2 through 3.2.2.5.2.2.2	2.4.5.5.2.2	X	X		X	X
Private Parameters	2.2.2	3.2.2.5.2.3	2.4.5.5.2.3	X	X		X	X
General Purpose Private Parameters	2.2.2	3.2.2.5.2.4 through 3.2.2.5.2.4.7	2.4.5.5.2.4	X	X		X	X
Aircraft Initiated Private Parameters	2.2.2	3.2.2.5.2.5 through 3.2.2.5.2.5.4	2.4.5.5.2.5	X	X		X	X
Ground Initiated Modification Private Parameters	2.2.2	3.2.2.5.2.6 through 3.2.2.5.2.6.10	2.4.5.5.2.6	X	X		X	X
Ground Initiated Private Parameters	2.2.2	3.2.2.5.2.7 through 3.2.2.5.2.7.8	2.4.5.5.2.7.	X	X		X	X
LME Service System Parameters	2.2.2	3.2.2.5.3	2.4.5.5.3	X	X		X	X
Timer TG1 (minimum frequency dwell time)	2.2.2	3.2.2.5.3.1	2.4.5.5.3.1	X	X		X	X
Timer TG2 (maximum idle activity time)	2.2.2	3.2.2.5.3.2	2.4.5.5.3.2	X	X		X	X
Timer TG3 (maximum time between transmissions)	2.2.2	3.2.2.5.3.3	2.4.5.5.3.3	X	X		X	X
Timer TG4 (maximum time between GSIFs)	2.2.2	3.2.2.5.3.4	2.4.5.5.3.4	X	X		X	X

TRACEABILITY MATRIX FOR STANDARD CONDITIONS								
Description	Requirement		Verification Test	Equipment Architecture Class				
	VDL Mode 2 MOPS	MASPS (DO-224C)		Class V	Class X	Class Y	Class W	Class Z
Timer TG5 (maximum link overlap time)	2.2.2	3.2.2.5.3.5	2.4.5.5.3.5	X	X		X	X
Description of LME Procedures	2.2.2	3.2.2.5.4	2.4.5.5.4 through 2.4.5.5.4.12	X	X		X	X
Frequency Management	2.2.2	3.2.2.5.4.1 through 3.2.2.5.4.1.2	2.4.5.5.4.1	X	X		X	X
Link Connectivity	2.2.2	3.2.2.5.4.2	2.4.5.5.4.2	X	X		X	X
Ground Station Identification	2.2.2	3.2.2.5.4.3	2.4.5.5.4.3	X	X		X	X
Link Establishment	2.2.2	3.2.2.5.4.4 through 3.2.2.5.4.4.3	2.4.5.5.4.4	X	X		X	X
Link Parameter Modification	2.2.2	3.2.2.5.4.5 through 3.2.2.5.4.5.2	2.4.5.5.4.5	X	X		X	X
Aircraft Initiated Handoff	2.2.2	3.2.2.5.4.6 through 3.2.2.5.4.6.6	2.4.5.5.4.6	X	X		X	X
Aircraft Requested Ground Initiated Handoff (Not applicable any more.)	2.2.2	3.2.2.5.4.7	2.4.5.5.4.7					
Ground Initiated Handoff	2.2.2	3.2.2.5.4.8 through 3.2.2.5.4.8.4	2.4.5.5.4.8	X	X		X	X
Ground Requested Aircraft Initiated Handoff	2.2.2	3.2.2.5.4.9 through 3.2.2.5.4.9.3	2.4.5.5.4.9	X	X		X	X
Ground Requested Broadcast Handoff	2.2.2	3.2.2.5.4.10	2.4.5.5.4.10	O	O		O	O
Ground Requested Autotune	2.2.2	3.2.2.5.4.11	2.4.5.5.4.11	X	X		X	X
Expedited Subnetwork Connection Management	2.2.2	3.2.2.5.4.13 through 3.2.2.5.4.13.3	2.4.5.5.4.12	O	O		O	O
Frequency Support List	2.2.2	3.2.2.5.4.12 through 3.2.2.5.4.12.2	2.4.5.5.4.13	X	X		X	X
Subnetwork Access Protocol (SNAcP) Sublayer								
Architecture	2.2.3	3.2.3.1	2.4.6.1	C	X		C	X
Access Points	2.2.3	3.2.3.1.1	2.4.6.1.1	C	X		C	X
Services	2.2.3	3.2.3.2	All subsection of 2.4.6.2	C	X		C	X
Subnetwork Connection Management	2.2.3	3.2.3.2.1	2.4.6.2.1	C	X		C	X
Packet Fragmentation and Reassembly	2.2.3	3.2.3.2.2	2.4.6.2.2	C	X		C	X
Error Recovery	2.2.3	3.2.3.2.3	2.4.6.2.3	C	X		C	X
Connection Flow Control	2.2.3	3.2.3.2.4	2.4.6.2.4	C	X		C	X
Packet Format	2.2.3	3.2.3.3	2.4.6.3	C	X		C	X
General Format Identifier	2.2.3	3.2.3.3.1	2.4.6.3.1	C	X		C	X

TRACEABILITY MATRIX FOR STANDARD CONDITIONS								
Description	**Requirement**		**Verification Test**	**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**		**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Calling and Called DTE Addresses	2.2.3	3.2.3.3.2	2.4.6.3.2	C	X		C	X
Encoding	2.2.3	3.2.3.3.2.1	2.4.6.3.2.1 and 2.4.6.3	C	X		C	X
Address Field	2.2.3	3.2.3.3.2.2	All tests involving the exchange of ISO-8208.packets.	C	X		C	X
Aircraft DTE Address	2.2.3	3.2.3.3.2.2.1	2.4.6.3.2.2 and 2.4.6.3	C	X		C	X
Ground VDL Specific DTE Addressing (VSDA)	2.2.3	3.2.3.3.2.2.2	2.4.6.3.2.3	C	X		C	X
Ground DTE Address	2.2.3	3.2.3.3.2.2.2.1	2.4.6.3.2.3	C	X		C	X
Ground Network DTE Address	2.2.3	3.2.3.3.2.2.2.2	2.4.6.3.2.4	C	X		C	X
Call User Data Field	2.2.3	3.2.3.3.3	2.4.6.3.3 and 2.4.6.3	C	X		C	X
Packet Types	2.2.3	3.2.3.3.4	2.4.6.3.4	C	X		C	X
Subnetwork Layer Service System Parameters	2.2.3	3.2.3.4	2.4.6.4 through 2.4.6.4.3	C	X		C	X
Packet Size	2.2.3	3.2.3.4.1	2.4.6.4.1	C	X		C	X
Parameter W (transmit window size)	2.2.3	3.2.3.4.2	2.4.6.4.2	C	X		C	X
Parameter A (acknowledgement window size)	2.2.3	3.2.3.4.3	2.4.6.4.3	C	X		C	X
Effects of Layers 1 and 2 on the Subnetwork Layer	2.2.3	3.2.3.5	2.4.6.4 through 2.4.6.4.3	C	X		C	X
Description of Procedures	2.2.3	3.2.3.6	2.4.6.5	C	X		C	X
Supported Facilities	2.2.3	3.2.3.6.1	2.4.6.5.1 through 2.4.6.5.1.7.	C	X		C	X
Unsupported Facilities	2.2.3	3.2.3.6.2	2.4.6.5.2.	C	X		C	X
Subnetwork Establishment and Connection Management	2.2.3	3.2.3.6.3	2.4.6.5.3	C	X		C	X
Subnetwork Entity Initialization	2.2.3	3.2.3.6.3.1	2.4.6.5.3.1.	C	X		C	X
Explicit Subnetwork Connection Establishment	2.2.3	3.2.3.6.3.2.1	2.4.6.5.3.2.1	C	X		C	X
Expedited Subnetwork Connection Establishment	2.2.3	3.2.3.6.3.2.2	2.4.6.5.3.2.2 and 2.4.5.5.4.12	O	O		O	O
Subnetwork Connection Maintenance	2.2.3	3.2.3.6.3.3	2.4.6.5.4 and 2.4.6.5.3 through 2.4.6.5.3.2.2	C	X		C	X
Explicit Subnetwork Connection Maintenance	2.2.3	3.2.3.6.3.3.1	2.4.6.5.4.1 and 2.4.6.5.3 through 2.4.6.5.3.2.2	C	X		C	X
Expedited Subnetwork Connection	2.2.3	3.2.3.6.3.3.2	2.4.6.5.4.2 and 2.4.6.5.3	O	O		O	O

TRACEABILITY MATRIX FOR STANDARD CONDITIONS								
Description	**Requirement**		**Verification Test**	**Equipment Architecture Class**				
	VDL Mode 2 MOPS	**MASPS (DO-224C)**		**Class V**	**Class X**	**Class Y**	**Class W**	**Class Z**
Maintenance			through 2.4.6.5.3.2.2					
Broadcast Subnetwork Connection Maintenance	2.2.3	3.2.3.6.3.3.3	2.4.6.5.4.3.	C	X		C	X
Call Redirection for X.121-based Networks	2.2.3	3.2.3.6.3.4	2.4.6.5.4.4	C	X		C	X
Error Handling	2.2.3	3.2.3.6.4	2.4.6.5.5 and 2.4.6.3.4	C	X		C	X
Acknowledgements	2.2.3	3.2.3.6.5	2.4.6.5.6 and 2.4.6.3.4	C	X		C	X
VDL Mobile SNDCF								
Call User Data Encoding	2.2.4	3.2.4.3	2.4.7.2	C	X		C	X
ISH PDU	2.2.4	3.2.4.3.1	2.4.7.2.1 and 2.4.5.5.4.12	C	X		C	X
Maintained/Initialized Status Bit	2.2.4	3.2.4.3.2	2.4.7.2.2	C	X		C	X
CALL REQUEST	2.2.4	3.2.4.3.3	2.4.7.2.3 and 2.4.7.2.2	C	X		C	X
CALL ACCEPTED	2.2.4	3.2.4.3.4	2.4.7.2.4 and 2.4.7.2.2	C	X		C	X

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APPENDIX C: ANALYSIS OF BER VS. BLOCK FAILURE RATE

C.1 Overview

The VDL Mode 2 compliant transceivers are required to perform VDL Mode 2 data modulation and demodulation as described in the VDL MASPS DO-224C [1]. The VDL MASPS shows the message encoding process. As shown in that document, a transmission consists of from one to several concatenated AVLC frames, each with its own CRC. Zero-bit insertion is performed on the concatenated frames. Reed-Solomon encoding is performed on the data and it is interleaved and bit scrambled prior to I/Q modulation and transmission.

When the data is received the reverse of this process is performed. The demodulated data is unscrambled and de-interleaved. Reed-Solomon error correction is performed and zero-bit removal is performed on the resultant data. The data is then searched for flag characters indicating the AVLC frame boundaries. An ARINC 750 [2] compliant radio will then perform CRC validation on each frame prior to sending that frame to the attached Communications Management Unit (CMU) through which air-ground communications take place.

There are several locations in the above demodulation and decoding process at which errors can prevent the eventual transfer of the frame to the CMU. If the CRC fails, then a frame will be prevented from being sent to the CMU. If the Reed-Solomon error correction fails then it may introduce uncorrected errors and the CRC will fail. If the length is determined incorrectly (during demodulation), then errors may be introduced and the CRC will fail. If bit errors result in flag characters being erroneously inserted in the data then the frame search for one or more frames will occur incorrectly and the CRC(s) will fail.

The MOPS offers the equipment manufacturer the option of testing the receiver performance by means of BER or Frame Error Rate (FER). The BER is tested by means of a BER test mode. Since the BER test mode is not an operational mode, there may be residual questions concerning software verification activity based on this mode and its applicability to the operational Mode 2 software.

The following section will show how an upper bound on the uncorrected BER can be determined by measuring the AVLC message transfer failure rate. An AVLC message transfer will fail whenever one of the above failures causes a CRC failure or otherwise prevents a message containing one AVLC frame from being delivered to the CMU. The message will consist of exactly one Reed-Solomon block. An upper bound on the uncorrected BER can be determined without enabling a special mode in the transceiver that disables error correction or detection.

Reference [3] shows the performance of the RS(255,249) code as it relates to BER in VDL Mode 2. This is summarized below.

C.2 Analysis

C.2.1 Bit Error Rate

An approximate relationship between uncorrected BER and E_b/N_0 for D8PSK is expressed as follows:

$$BER = \operatorname{erfc}\left(\sin\left(\frac{\pi}{8}\right)\times\sqrt{\frac{3E_b}{2N_0}}\right),$$

where *BER* is the uncorrected bit error rate, $\operatorname{erfc}(x)=\frac{2}{\sqrt{\pi}}\int_x^\infty e^{-t^2}dt$, $\frac{\pi}{8}$ is one half of the constellation spacing, in radians, and $\frac{E_b}{N_0}$ is the ratio of the received energy in one information bit to the noise power spectral density.

C.2.2 Frame Error Rate

Given an uncorrected BER, the probability of decoding and correcting a RS(255,249) block can be determined. Let p_b equal the probability of a single bit error. The probability that a bit is received correctly then is $1 - p_b$ and the probability that a RS code word is received correctly is the probability that all eight bits in the code word are received without error,

$$p_{correct\_word} = (1 - p_b)^8$$

and the probability that a RS code word is received in error is 1 minus the probability it was received correctly:

$$p_{error\_word} = 1 - p_{correct\_word} = 1 - (1 - p_b)^8$$

The Block Failure Rate (BFR) can be defined in terms of the block success rate. Success is defined as receiving a block with three or fewer code word errors (since the RS(255,249) code can correct three code words). The probability of receiving a block successfully then is the summation of the probabilities of receiving a block with 0, 1, 2, or 3, code word errors. With n = 255 and m = 0, 1, 2, or 3 errors and a three error correction capability, the probability of a block success then is

$$p_{success\_block} = \sum_{m=0}^{3}\binom{n}{m}\left(p_{error\_word}\right)^m\left(p_{correct\_word}\right)^{n-m}$$

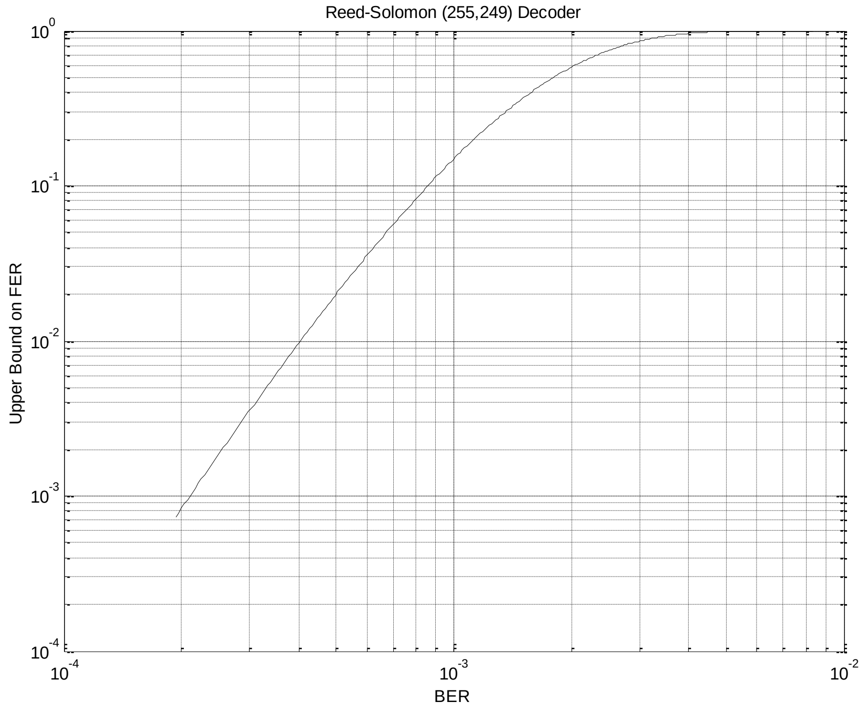
and the probability of a block failure is 1 minus the probability of success:

$$BFR = 1 - p_{success\_block}.$$

In computing the BFR, that is, the probability that an accepted block of VDL Mode 2 data will contain undetected errors, this analysis ignores the effects of acquiring and decoding the block header. That is, this analysis assumes that there the decoding of the header information is error-free. But in real operation, some number of header errors will occur, thereby causing the block processing to terminate. This will have the effect of eliminating some percentage of the block errors that would otherwise be accepted. Because the frame includes both the header and the payload block, the Frame Error Rate (FER), therefore, is upper bounded by the BFR. That is, $\text{FER} \le \text{BFR}$ in all cases.

C.2.3 BER vs FER

A plot and tabulated listing of BFR versus FER are shown in Figure C-1 and Table C-1. This evidence indicates, it is possible to indirectly determine the BER performance by determining the FER performance.



<u>Figure C-54:</u> Upper Bound on FER vs. BER for VDL Mode 2 Reed-Solomon Decoding

C.2.4 Testing FER in an ARINC 750 Compliant VDR

An ARINC 750 compliant VDR will pass demodulated and decoded Mode 2 AVLC frames to the CMU only if the CRC calculation for that frame indicates that the frame was received without error. Each frame is then sent over an ARINC 429 high-speed communication interface to the CMU in a single UNITDATA.request message as part of the CMU to VDR ASIP (ARINC 750 Attachment 10). Since a single received transmission can contain multiple frames, one received transmission can result in many AVLC frames (in UNITDATA.request messages) being sent to the CMU by the VDR. There are several causes that will prevent an AVLC frame from being sent to the CMU.

<u>Table C-1</u>: Tabulation of E_b/N_0, BER, BFR for VDL Mode 2

E_b/N_0	BER	BFR
12.0	8.30E-03	1.0000
12.1	7.60E-03	0.9999
12.2	6.90E-03	0.9996
12.3	6.30E-03	0.9988
12.4	5.70E-03	0.9971
12.5	5.20E-03	0.9933
12.6	4.70E-03	0.9859
12.7	4.20E-03	0.9726
12.8	3.80E-03	0.9507
12.9	3.40E-03	0.9174
13.0	3.10E-03	0.8704
13.1	2.70E-03	0.8088
13.2	2.40E-03	0.7336
13.3	2.20E-03	0.6474
13.4	1.90E-03	0.5548
13.5	1.70E-03	0.4608
13.6	1.50E-03	0.3706
13.7	1.30E-03	0.2885
13.8	1.20E-03	0.2173
13.9	1.00E-03	0.1585
14.0	9.00E-04	0.1120
14.1	8.00E-04	0.0767
14.2	7.00E-04	0.0510
14.3	6.00E-04	0.0329
14.4	5.00E-04	0.0207
14.5	4.00E-04	0.0126
14.6	4.00E-04	0.0075
14.7	3.00E-04	0.0044
14.8	3.00E-04	0.0025
14.9	2.00E-04	0.0014
15.0	2.00E-04	0.0007

The demodulator fails to achieve synchronization with the unique word portion of the incoming reception. This will cause all AVLC frames contained in that message to not be sent to the CMU.

The demodulator detects an error in the header portion of the incoming reception, indicating an incorrectly decoded message length component. This will result in all AVLC frames contained in that message to not be sent to the CMU.

The demodulator *fails* to detect an error in the header portion of the incoming reception. Depending on the decoded length, this may result in none, some, or all of the AVLC frames contained in that message to not be sent to the CMU.

The Reed-Solomon error correction fails because the number of code words in error in a block exceeds the correction capability of the code. This will result in one or more AVLC frames contained in that message to not be sent to the CMU due to CRC failure.

Due to the multiple reasons that some or all of the AVLC frames may not be sent to the CMU as the result of bit errors, FER can not be determined generally by comparing the number of AVLC frames sent by the VDR to the CMU with the number uplinked in the transmission received by the VDR. It is possible however to measure the FER by restricting the data sent in a transmission to a particular format:

The transmission must contain one AVLC frame.

The transmission length must be such that in fills one Reed-Solomon block, that is 255 bytes including check symbols.

If the transmitted data meets these restrictions then AVLC frames that fail the CRC check will fail due to either Reed-Solomon block failure, header failure, or unique word failure. All of these errors will combine to prevent the AVLC frame from being sent to the CMU. However, the combined error rate so determined will be an upper bound on the FER. An upper bound on the BER can then be determined by comparing the FER to the data in Figure C-1 and Table C-1 shown above.

C.3 Testing Considerations

C.3.1 Example Block Failure Message

The primary constraint for a message used for FER testing is that its length as encoded in the header be exactly 1992 bits in length. This value indicates the total number of data bits following the header FEC and excludes bits included for addition of Reed-Solomon check symbols.

In order that this message will be passed to the CMU it must also conform to a standard AVLC frame format shown in DO-224C [1]. A partial representation of this format is shown below.

Table C-2: AVLC Frame Format

Octet Number	Content
1	Flag
2	Destination address octet 1
3	Destination address octet 2
4	Destination address octet 3
5	Destination address octet 4
6	Source address octet 1
7	Source address octet 2
8	Source address octet 3
9	Source address octet 4
10	Link control field
11	Information field octet 1
12	Information field octet 2
.	.
.	.
N-3	Information field octet N-13
N-2	CRC MSB
N-1	CRC LSB
N	Flag

Prior to transmission, the message formatted as above will have zero-bit insertion performed on the data located between the flags (octets 2 through N-1). Depending on the data, this *may* make the file larger and cause the data length to be an non-integer number of octets. Reed-Solomon check symbols are added after zero-bit insertion which will increase the size of the message by 48 bits (for a full row of 249 octets of data).

The CRC value is calculated on the data in the Table C-2 that extends from octets 2 through N-3 and is appended in octets N-2 and N-1. Zero-bit insertion is performed on octets 2 through N-1 and the resultant data is bounded by flag characters (0x7E) prior to Reed-Solomon encoding. Even though the data prior to CRC calculation contains no consecutive strings of "ones" that would cause zero-bit insertion to increase the data length, the CRC itself may have such a string of ones. Therefore the creation of the message is an iterative process:

1. Create the address, link control and information data to be 245 octets in length.
2. Calculate and append the CRC (adds 2 octets).
3. Zero-bit insert and bound the data with flag characters (adds 2 octets).
4. If length is greater than 249 then modify data and go to step 2.
5. Append Reed-Solomon Check symbols (adds 6 octets).

The following data is an example of a message created using the above process. The address and link control fields consist of nine consecutive 0x55 characters (ASCII 'U" character).

```
- HEX format -
00000000: 7e55 5555 5555 5555 5555 3031 3233 3435  ~UUUUUUUUU012345
00000010: 3637 3839 3031 3233 3435 3637 3839 3031  6789012345678901
00000020: 3233 3435 3637 3839 3031 3233 3435 3637  2345678901234567
00000030: 3839 0d0a 3031 3233 3435 3637 3839 3031  89..012345678901
00000040: 3233 3435 3637 3839 3031 3233 3435 3637  2345678901234567
00000050: 3839 3031 3233 3435 3637 3839 0d0a 3031  890123456789..01
00000060: 3233 3435 3637 3839 3031 3233 3435 3637  2345678901234567
00000070: 3839 3031 3233 3435 3637 3839 3031 3233  8901234567890123
00000080: 3435 3637 3839 0d0a 3031 3233 3435 3637  456789..01234567
00000090: 3839 3031 3233 3435 3637 3839 3031 3233  8901234567890123
000000a0: 3435 3637 3839 3031 3233 3435 3637 3839  4567890123456789
000000b0: 0d0a 3031 3233 3435 3637 3839 3031 3233  ..01234567890123
000000c0: 3435 3637 3839 3031 3233 3435 3637 3839  4567890123456789
000000d0: 3031 3233 3435 3637 3839 0d0a 3031 3233  0123456789..0123
000000e0: 3435 3637 3839 3031 3233 3435 3637 3839  4567890123456789
000000f0: 3031 3233 0d0a 4373 7e1f 29a4 7a34 db    0123..Cs~.).z4.
```

The message starts with the flag character (0x7E), is followed by the address and link control fields (9 octets, ASCII "UUUUUUUUU"). These are followed by the information field, the ASCII sequence:

```
0123456789012345678901234567890123456789<CR><LF>
0123456789012345678901234567890123456789<CR><LF>
0123456789012345678901234567890123456789<CR><LF>
0123456789012345678901234567890123456789<CR><LF>
0123456789012345678901234567890123456789<CR><LF>
012345678901234567890123<CR><LF>
```

This is followed by the two CRC bytes (0x43, 0x73) the flag character (0x7E), and the six Reed-Solomon check symbols (0x1F, 0x29, 0xA4, 0x7A, 0x34, 0xDB). This message will be scrambled and will have the sync and header sequences prepended prior to transmission.

C.3.2 CRC Failure Probability

The method shown here for evaluating the FER relies upon a CRC calculation upon the content of each AVLC frame to successfully determine whether a block failure has occurred. Consequently, the probability of successfully determining a block failure is dependent upon the probability of success inherent in the16-bit CRC. The 16-bit polynomial specified for the AVLC frame check sequence can detect [4]:

- all single and double errors,
- all errors with an odd number of bits,
- all burst errors of length 16 or less,
- 99.997% of 17-bit error bursts,
- and 99.998% of 18-bit and longer bursts.

Out of all the above listed, the worse case probability of success for the CRC is 0.99997. The CRC then will successfully reject 0.99997 of all frames whose errors could not be corrected by the Reed-Solomon error correction. That is, the FER determined by allowing the CRC to detect bad blocks will be 0.99997 of the actual FER. For example, if the actual FER is 0.157 then the FER determined by using the CRC to detect bad frames will be $0.99997 \bullet 0.157 = 0.156699$. It makes the radio appear to be marginally better than it actually is.

There are reasons this can be considered an inconsequential error: The CRC success rate used was a pathological case and the CRC probability of success on random data is better than this. The difference between the actual and the CRC determined FER, at a FER corresponding to the system BER, is small enough to be considered within the margin of measurement error.

In any event, If this is considered too large a value then frames passed by the CRC routine can be compared to a priori known frame content to determine the true FER.

References

[1] "Signal-in-Space Minimum Aviation System Performance Standards (MASPS) for Advanced VHF Digital Data Communications Including Compatibility with Digital Voice Techniques", RTCA Document No. DO-224C, July 18, 2005.

[2] ARINC 750-3 "VHF Data Transceiver", November 30, 2000.

[3] "BER Performance of the RS(255,249) Code in VDL Mode 2", Milan Yagodich, RTCA Special Committee 172, Working Group 2 Meeting, Washington, D.C., August 10-14, 1999.

[4] "Computer Networks", A.S. Tannenbaum, 1981 Prentice Hall.

APPENDIX D: ASSUMED FUNCTIONAL CAPABILITIES OF THE DATA/MANAGEMENT INTERFACE

D.1 Data/Management Interface

Class Y and Class Z equipment provides a Data/Management interface for the purpose of exchanging data and control information between the lower VDL Mode 2 protocol stack and the upper VDL Mode 2 protocol stack. The Data/Management interface has the functionality specified in the following subsections. When a non-ISO-8208 interface is defined in accordance with Section 2.2.5, Class W VDL Mode 2 transceiver equipment includes a Data/Management interface meeting the same functional requirements as Class Z equipment.

For the purpose of establishing requirements, the Data/Management interface is viewed as supporting either Class Y functions or Class Z functions. For non-ATN implementations, the Class W is equivalent to Class Z.

Note: *A widely accepted means for complying with the Data/Management interface requirements for Class Y, Class Z, and Class W equipment is ASIP, defined in Attachment 10 to ARINC Characteristic 750.*

Compliance with these requirements is established by the applicable Class Y or Class Z/W protocol tests in Section 2.4 of the MOPS.

D.2 Class Y Data/Management Functions

D.2.1 VDL Frame Transmission

Class Y equipment accepts formatted VDL Mode 2 frames from the Data/Management interface for transmission over the VHF channel. Class Y equipment confirms transmission of each frame over the VHF frequency. Confirmation information is provided to the Data/Management interface.

Note: *It is permissible to perform certain low-level functions defined by DO-224C, such as bit-stuffing, flag generation, and frame check sequence generation, in the Class Y equipment.*

D.2.2 VDL Frame Reception

Class Y equipment outputs formatted VDL Mode 2 frames to the Data/Management interface when they are received from the VHF channel. Only data received in frames that satisfy the FCS is provided over the interface. FCS information need not be supplied over the interface.

Note: *It is permissible to perform certain low-level functions defined by DO-224C, such as deletion of extra "stuffing" bits, and flag checking, in the Class Y equipment.*

D.2.3 Addressing

Class Y equipment maintains a list of at least three valid destination addresses. Class Y equipment outputs the received data only if the frame destination address matches one of the three stored addresses.

D.2.4 Signal Quality

Class Y equipment outputs to the Data/Management interface signal quality parameter information for every received transmission that contains a valid FCS. The signal quality information should be available within one second of the completion of the FCS verification process.

D.2.5 Channel Utilization

Class Y equipment outputs to the Data/Management interface a data element that indicates the percentage of time that the channel is occupied by its own or other VHF transmitters. This data element should be provided to the interface at one second intervals.

D.2.6 Channel Congestion

Class Y equipment outputs to the Data/Management interface a data element that indicates if the channel is congested. This data element indicates a congested channel whenever the TM2 timer of the MAC sublayer expires.

D.2.7 Operating Parameters

Class Y equipment accepts the following operating parameter information from the Data/Management interface.

Operating Frequency	118 to 136.975 MHz in steps of 0.025 MHz
Persistence	1/256 to 1 in steps of 1/256
M1 contents	1 through 65535
TM1 timer value	0 to 125 ms in 0.5 ms steps
TM2 timer value	6 to 120 seconds in 1 second steps
Destination Address	at least three independently controllable addresses

The Class Y reports the values of these parameters to the Data/Management interface upon request.

Note: *These values are consistent with the values stated in ARINC 750, Attachment 10.*

D.2.8 Frequency Change

If commanded to tune to a different frequency, Class Y equipment deletes all untransmitted frames, and reports each frame deleted in this manner over the Data/Management interface.

D.2.9 Commanded Data Purge

Class Y equipment accepts and executes a command to purge all untransmitted frames, and reports each frame deleted in this manner over the Data/Management interface.

D.3 Class Z and Class W Data/Management Functions

D.3.1 VDL Frame Transmission

Class Z and Class W equipment provides formatted VDL Mode 2 frames from the Data/Management interface for transmission over the VHF channel. Class Z and Class W equipment accepts confirmation that each frame has been transmitted over the VHF frequency. Confirmation information is accepted from the Data/Management interface.

Note: *It is permissible to perform certain low-level functions defined by DO-224C, such as bit-stuffing, flag generation, and frame check sequence generation, in the Class Y equipment.*

D.3.2 VDL Frame Reception

Class Z and Class W equipment accepts formatted VDL Mode 2 frames from the Data/Management interface. Depending on the implementation of the Frame Check Sequence processing, it is permissible for Class Z and Class W equipment to assume that all such frames have satisfied the VDL Mode 2 Frame Check Sequence.

Note: *It is permissible to perform certain low-level functions defined by DO-224C, such as deletion of extra "stuffing" bits, and flag checking, in the Class Y equipment.*

D.3.3 Addressing

Class Z and Class W equipment assumes that received data available on the Data/Management interface is correctly addressed.

D.3.4 Signal Quality

Class Z and Class W equipment accepts signal quality parameter information from the Data/Management interface for every received frame.

D.3.5 Channel Utilization

Class Z and Class W equipment accepts from the Data/Management interface a data element that indicates the percentage of time that the channel is occupied by its own or other VHF transmitters.

D.3.6 Channel Congestion

Class Z and Class W equipment accepts from the Data/Management interface a data element that indicates if the channel is congested.

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