RTCA, Inc.
1828 L Street, NW, Suite 805
Washington, DC 20036-5133 USA

Minimum Operational Performance Standards for Aircraft VDL Mode 2 Physical, Link and Network Layer

RTCA DO-281A
Supersedes DO-281
November 8, 2005

Prepared by: SC-172

Copies of this document may be obtained from

RTCA, Inc.

Telephone: 202-833-9339
Facsimile: 202-833-9434
Internet: www.rtca.org

Please visit the RTCA Online Store for document pricing and ordering information.

Foreword

This document has been prepared by RTCA Special Committee 172 (SC-172), and approved by the RTCA Program Management Committee (PMC) on November 8, 2005.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- Coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- Analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- Developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- Assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

The organization's recommendations are often used as a basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

As RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U. S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

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

The physical layer material of this document is based on the Physical Layer MOPS for Aircraft VDL Mode 2 (EUROCAE WG-47 document ED-92, dated March 2000). The link and network layer requirements are defined in RTCA DO-224B Section 3.2.2 through 3.2.4 and the ICAO VDL Mode 2 Technical Manual.

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

The test procedures used in this document have been coordinated with EUROCAE Working Group 47 during the preparation of Change 1 to Eurocae Document ED92 Part I and the draft of Eurocae Document ED92 Part II.

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

This page intentionally left blank

Table of Contents

1. PURPOSE AND SCOPE 1

1.1 Introduction 1

1.2 System Overview 2

1.3 Possible Configuration of Aircraft Equipment 3
1.3.1 Separated Equipment 3
1.3.2 Integrated Equipment 4

1.4 Operational Applications 5

1.5 Operational Goals 5

1.6 Equipment Performance Verification 5
1.6.1 Bench Tests 6
1.6.2 Environmental Tests 6
1.6.3 Installed Equipment Tests 6
1.6.4 Operational Tests 6

1.7 Definitions of Terms 7
1.7.1 Adjacent Channel 7
1.7.2 Adjacent Channel Power 7
1.7.3 Adjacent Channel Rejection (ACR) 7
1.7.4 Bit Error Rate (BER) 7
1.7.5 Co-channel Interference (CCI) 7
1.7.6 Error Vector Magnitude (EVM) 7
1.7.7 Reference Signal Level 8
1.7.8 Undesired VDL Mode 2 Test Signal 8
1.7.9 Reference Bit Sequence 8

1.8 Reference Documents 8

1.9 Assumptions 9

2. MINIMUM PERFORMANCE STANDARDS 11

2.1 General Design Requirements 11
2.1.1 Airworthiness 11
2.1.2 Intended Function 11
2.1.3 ITU and FCC Rules and Regulations 11
2.1.4 Fire Protection 11
2.1.5 Operation of Controls 11
2.1.6 Accessibility of Controls 11
2.1.7 Effects of Test 12

2.1.8 Equipment Classes 12
2.1.8.1 Receivers 12
2.1.8.2 Transmitters 12
2.1.9 VDL Mode 2 Avionics Architecture Classes 12
2.1.9.1 ISO 8208-compliant Equipment Classes 12
2.1.9.1.1 Class X 13
2.1.9.1.2 Class Y 13
2.1.9.1.3 Class Z 13
2.1.9.2 Non-ISO 8208 Equipment Classes 13
2.1.9.2.1 Class V 13
2.1.9.2.2 Class W 14
2.1.10 Software Management 14

2.2 Minimum Performance Requirements - Standard Conditions 14
2.2.1 VDL Mode 2 Physical Layer Requirements 14
2.2.1.1 Transceiver Requirements 14
2.2.1.1.1 Tuning Range and Channel Increments 14
2.2.1.1.2 Modulation 14
2.2.1.1.3 Tuning Time 15
2.2.1.1.4 Receive to Transmit Switching Time 15
2.2.1.1.5 Transmit to Receive Switching Time 15
2.2.1.1.6 Channel Sensing 15
2.2.1.2 Receiver Requirements 15
2.2.1.2.1 Sensitivity 16
2.2.1.2.2 Adjacent Channel Rejection 16
2.2.1.2.3 Receiver Performance in the Presence of Strong Signals Within the VHF Aeronautical Band 16
2.2.1.2.4 Receiver Performance in the Presence of Strong Signals Outside the VHF Aeronautical Band 16
2.2.1.2.5 Desired Signal Dynamic Range 16
2.2.1.2.6 Symbol Rate Capture Range 17
2.2.1.2.7 Frequency Capture Range 17
2.2.1.2.8 Phase Acceleration 17
2.2.1.2.9 Co-channel Interference (CCI) 17
2.2.1.2.10 Conducted Spurious Emission 18
2.2.1.2.11 FM Broadcast Intermodulation 18
2.2.1.2.12 In-band Intermodulation 18
2.2.1.3 Transmitter Requirements 18
2.2.1.3.1 Channel Bit Rate 19
2.2.1.3.2 RF Output Power 19
2.2.1.3.3 RF Power Rise Time 19
2.2.1.3.4 RF Power Release Time 19
2.2.1.3.5 Symbol Constellation Error 20
2.2.1.3.6 Spurious Emissions 20
2.2.1.3.7 Adjacent Channel Power 21
2.2.1.3.8 (Reserved) 22
2.2.1.3.9 Load VSWR Capability 22
2.2.1.3.10 Frequency Tolerance 22

2.2.2 VDL Mode 2 Link Layer Requirements 22
2.2.3 VDL Mode 2 Network Layer 8208 Requirements 22
2.2.4 VDL Mode 2 Network Layer Mobile SNDCF Requirements 23
2.2.5 Non-ISO 8208 Use of VDL Mode 2 23
2.2.6 Data/Management Interface 23

2.3 Minimum Performance Requirements - Environmental Conditions 23
2.3.1 Introduction 23
2.3.2 Receiver 24
2.3.3 Transmitter 24

2.4 Equipment Test Procedures 31
2.4.1 Definition of Terms and Conditions of Tests 31
2.4.1.1 Warm-up and Stabilization of Test Equipment/Equipment Under Test 31
2.4.1.2 Alignment, Adjustment and Calibration for Equipment Under Test 31
2.4.1.3 Equipment Termination 31
2.4.1.4 Test Equipment Calibration and Replacement 31
2.4.1.5 Failure of the Equipment Under Test 31
2.4.1.6 Measurement Error Due to Test Equipment and Test Setup 32
2.4.1.7 Default RF Signal Level for Avionics High Level Protocol Testing 32
2.4.2 Special Test Mode and Test Equipment for Physical Layer Tests 32
2.4.2.1 Frame Error Rate Testing 32
2.4.2.1.1 FER Test 32
2.4.2.1.2 FER Test Setup 33
2.4.2.2 Bit Error Rate Testing 33
2.4.2.2.1 External BER Test Fixture 34
2.4.2.2.2 Test Payload 34
2.4.2.2.3 BER Test Setup 35
2.4.2.3 Desired VDL Mode 2 Signal Source 35
2.4.2.3.1 VDL Mode 2 Data Generator 35
2.4.2.3.2 VHF Signal Generator 35
2.4.2.4 Undesired VDL Mode 2 Signal Source 35
2.4.3 VDL Mode 2 Test Set Definitions 36
2.4.3.1 Upper Tester (UT) 37
2.4.3.1.1 Aircraft Test Tool / Protocol Analyzer (ATT) 38
2.4.3.1.2 Upper Data/Management Interface Test Tool (UDMITT) 38
2.4.3.2 Lower Tester (LT) 38
2.4.3.2.1 Ground Station Emulator (GSE) 39
2.4.3.2.2 VDL Mode 2 Lower Data/Management Interface Test Tool (LDMITT) 40
2.4.3.2.3 Air/Ground Router 40
2.4.3.2.4 Standard LT Configurations 40
2.4.3.2.4.1 LT Configuration 1 40
2.4.3.2.4.2 LT Configuration 2 41
2.4.3.2.4.3 LT Configuration 3 41
2.4.4 Physical Layer Test Procedures 41
2.4.4.1 Receiver Test Procedures 42
2.4.4.1.1 Sensitivity 42
2.4.4.1.2 Adjacent Channel Rejection 42

2.4.4.1.3 Rejection of Signals Within the VHF Aeronautical Band 43
2.4.4.1.4 Rejection of Signals Outside the VHF Aeronautical Band 44
2.4.4.1.5 Desired Signal Dynamic Range 45
2.4.4.1.6 Symbol Rate Capture Range 46
2.4.4.1.7 Frequency Capture Range 46
2.4.4.1.8 Phase Acceleration 47
2.4.4.1.9 Co-Channel Interference 48
2.4.4.1.10 Conducted Spurious Emission 48
2.4.4.1.11 FM Broadcast Intermodulation 49
2.4.4.1.12 In-Band Intermodulation/Desensitization 50
2.4.4.2 Transmitter Test Procedures 51
2.4.4.2.1 Bit Rate 51
2.4.4.2.2 RF Output Power 52
2.4.4.2.3 RF Power Rise Time 52
2.4.4.2.4 RF Power Release Time 54
2.4.4.2.5 Symbol Constellation Error 55
2.4.4.2.6 Spurious Emissions 55
2.4.4.2.7 Adjacent Channel Power 56
2.4.4.2.8 (Reserved) 61
2.4.4.2.9 Load VSWR Capability 61
2.4.4.2.10 Frequency Tolerance 62
2.4.4.3 Physical Layer System Level Test Procedures 62
2.4.4.3.1 Receive to Transmit Switching Time 62
2.4.4.3.2 Transmit to Receive Switching Time 64
2.4.4.3.3 Channel Sensing 66
2.4.4.3.4 Tuning Time 69
2.4.5 VDL Mode 2 Link Layer Test Procedures 69
2.4.5.1 Test Procedure Structure 69
2.4.5.1.1 Overview of Test Cases 69
2.4.5.1.2 Declarations Part 69
2.4.5.1.3 Constraints Part 70
2.4.5.1.4 Detailed Test Cases 70
2.4.5.1.5 Test Case Description 70
2.4.5.1.5.1 Procedure description 70
2.4.5.1.5.2 Message Sequence Charts 70
2.4.5.1.6 Test Case Macros 70
2.4.5.1.6.1 Establish a link layer connection (SET_{AVLC}) 71
2.4.5.1.6.2 Establish (explicit) a network layer connection (SET_{8208}) 72
2.4.5.1.6.3 Establish (expedited) a network layer connection 72
2.4.5.1.6.4 Check link is established 72
2.4.5.1.6.5 Check network link is established 72
2.4.5.1.6.6 Close a link layer connection 73
2.4.5.1.6.7 Close network layer connection 73
2.4.5.2 (Reserved) 73
2.4.5.3 MAC Sublayer 73
2.4.5.3.1 MAC services 73
2.4.5.3.1.1 Multiple Access 73
2.4.5.3.1.2 Channel Occupancy 74
2.4.5.3.1.3 Channel Congestion 74

2.4.5.3.2 MAC System Parameters 74
2.4.5.3.2.1 Timer TM1 (inter-access delay timer) 74
2.4.5.3.2.2 Timer TM2 (channel busy timer) 75
2.4.5.3.2.3 Parameter p (persistence) 75
2.4.5.3.2.4 Counter M1 (maximum access attempts) 77
2.4.5.3.3 Description of MAC Layer Procedures 77
2.4.5.3.3.1 Channel Sensing 78
2.4.5.3.3.2 Access Attempt 78
2.4.5.4 Data Link Service Sublayer 78
2.4.5.4.1 Services 79
2.4.5.4.1.1 Frame Sequencing 79
2.4.5.4.1.2 Error Detection 79
2.4.5.4.1.3 Station Identification 80
2.4.5.4.1.4 Broadcast Addressing 80
2.4.5.4.1.5 Data Transfer 81
2.4.5.4.2 AVLC Data Link Protocol 81
2.4.5.4.2.1 Frame Format 81
2.4.5.4.2.2 Address Structure 82
2.4.5.4.2.3 Address Fields 82
2.4.5.4.2.4 Broadcast Address 82
2.4.5.4.2.5 Link Control Field 82
2.4.5.4.2.6 Information Field 83
2.4.5.4.3 Data Link Service System Parameters 83
2.4.5.4.3.1 Timer T1 (delay before retransmission) 84
2.4.5.4.3.2 Timer T2 (delay before acknowledgment) 85
2.4.5.4.3.3 Timer T3 (link initialization time) 86
2.4.5.4.3.4 Timer T4 (maximum delay between transmissions) 87
2.4.5.4.3.5 Parameter N1 (maximum number of bits in frame) 89
2.4.5.4.3.6 Counter N2 (maximum number of transmissions) 90
2.4.5.4.3.7 Parameter k (window size) 91
2.4.5.4.4 Modes of Operation 92
2.4.5.4.4.1 Operational Mode 92
2.4.5.4.4.2 Non-Operational Mode 92
2.4.5.4.4.2.1 DISC Frame 93
2.4.5.4.4.2.2 DM Frame 94
2.4.5.4.4.2.3 Frame Reject Mode 95
2.4.5.4.4.2.4 Selective Reject Mode 96
2.4.5.4.5 Use of the P/F bit 96
2.4.5.4.5.1 General 96
2.4.5.4.5.2 INFO frames 96
2.4.5.4.5.3 Unnumbered Frames 97
2.4.5.4.6 Unnumbered Command Frames Collisions 97
2.4.5.4.6.1 DLE Procedures 97
2.4.5.4.6.2 LME Procedures 98
2.4.5.4.7 XID Frame 100
2.4.5.4.8 Broadcast 101
2.4.5.4.9 Information Transfer 101
2.4.5.4.9.1 Transmit Queue Management 102
2.4.5.4.9.1.1 Eliminate Redundant Frames 102
2.4.5.4.9.1.2 Procedures for Transmission 102

2.4.5.4.9.2 SREJ Frame 104
2.4.5.4.9.3 FRMR Frame 105
2.4.5.4.9.4 UA Frame 106
2.4.5.4.9.5 UI Frame 107
2.4.5.4.9.6 TEST Frame 107
2.4.5.5 Link Management Entity 108
2.4.5.5.1 Services 108
2.4.5.5.1.1 Link Provision 108
2.4.5.5.1.2 Link Change Notification 109
2.4.5.5.2 Exchange Identity (XID) Formats 109
2.4.5.5.2.1 Encoding 109
2.4.5.5.2.2 Public Parameters 109
2.4.5.5.2.3 Private Parameters 110
2.4.5.5.2.4 General Purpose Private Parameters 110
2.4.5.5.2.5 Aircraft Initiated Private Parameters 110
2.4.5.5.2.6 Ground Initiated Modification Private Parameters 111
2.4.5.5.2.7 Ground Initiated Private Parameters 111
2.4.5.5.3 LME Service System Parameters 112
2.4.5.5.3.1 Timer TG1 (frequency dwell time) 112
2.4.5.5.3.2 Timer TG2 (maximum idle activity time) 113
2.4.5.5.3.3 Timer TG3 (maximum time between transmissions) 114
2.4.5.5.3.4 Timer TG4 (maximum time between GULS) 114
2.4.5.5.3.5 Timer TG5 (maximum link overlap time) 114
2.4.5.5.4 Description of LME Procedures 115
2.4.5.5.4.1 Frequency Management 115
2.4.5.5.4.2 Link Connectivity 116
2.4.5.5.4.3 Ground Station Identification 117
2.4.5.5.4.4 Link Establishment 117
2.4.5.5.4.5 Link Parameter Modification 119
2.4.5.5.4.6 Aircraft Initiated Handoff 119
2.4.5.5.4.7 Aircraft Requested Ground Initiated Handoff (optional) 121
2.4.5.5.4.8 Ground Initiated Handoff 122
2.4.5.5.4.9 Ground Requested Aircraft Initiated Handoff 122
2.4.5.5.4.10 Ground Requested Broadcast Handoff (optional) 123
2.4.5.5.4.11 Ground Commanded Autotune (optional) 128
2.4.5.5.4.12 Expedited Subnetwork Connection Management (optional) 129
2.4.6 VDL Mode 2 Network Layer Test Procedures 130
2.4.6.1 Architecture 130
2.4.6.1.1 Access Points 130
2.4.6.2 Services 130
2.4.6.2.1 Subnetwork Connection Management 130
2.4.6.2.2 Packet Fragmentation and Reassembly 134
2.4.6.2.3 Error Recovery 135
2.4.6.2.4 Connection Flow Control 135
2.4.6.3 Packet Format 136
2.4.6.3.1 General Format Identifier 137
2.4.6.3.2 Calling and Called DTE Addresses 137
2.4.6.3.2.1 Encoding 137
2.4.6.3.2.2 Aircraft DTE Address 137

2.4.6.3.2.3 Ground DTE Address 138
2.4.6.3.2.4 Ground Network DTE Address 139
2.4.6.3.3 Call User Data Field 139
2.4.6.3.4 Packet Types 139
2.4.6.4 Subnetwork Layer System Parameters 140
2.4.6.4.1 Packet Size 141
2.4.6.4.2 Parameter W (transmit window size) 141
2.4.6.4.3 Parameter A (acknowledgement window size) 142
2.4.6.5 Description of Procedures 142
2.4.6.5.1 Supported Facilities 142
2.4.6.5.1.1 Nonstandard Default Packet Sizes 143
2.4.6.5.1.2 Nonstandard Default Window Sizes 143
2.4.6.5.1.3 Flow Control Parameter Negotiation 143
2.4.6.5.1.4 Fast Select 143
2.4.6.5.1.5 Fast Select Acceptance 143
2.4.6.5.1.6 Called Line Address Modified Notification 143
2.4.6.5.1.7 Called Address Extension 144
2.4.6.5.2 Unsupported Facilities 144
2.4.6.5.3 Subnetwork Establishment and Connection Management 144
2.4.6.5.3.1 Subnetwork Entity Initialization 144
2.4.6.5.3.2 Subnetwork Connection Establishment 144
2.4.6.5.3.2.1 Explicit Subnetwork Connection Establishment 144
2.4.6.5.3.2.2 Expedited Subnetwork Connection Establishment (optional) 145
2.4.6.5.4 Subnetwork Connection Maintenance 145
2.4.6.5.4.1 Explicit Subnetwork Connection Maintenance 145
2.4.6.5.4.2 Expedited Subnetwork Connection Maintenance (optional) 145
2.4.6.5.4.3 Broadcast Subnetwork Connection Maintenance 145
2.4.6.5.5 Error Handling 145
2.4.6.5.6 Acknowledgements 146
2.4.7 VDL Mode 2 Mobile SNDCF Test Procedures 146
2.4.7.1 (Reserved) 146
2.4.7.2 Call User Data Encoding 146
2.4.7.2.1 ISH PDU 146
2.4.7.2.2 Maintained/Initialized Status Bit 147
2.4.7.2.3 CALL REQUEST 148
2.4.7.2.4 CALL CONFIRMATION 148
2.4.8 Non-ISO 8208 Use of VDL Mode 2 148
2.4.9 Data/Management Interface 148

3. INSTALLED EQUIPMENT TESTS 149

3.1 Equipment Installation 149
3.1.1 Accessibility 149
3.1.2 Aircraft Environment 149
3.1.3 Display Visibility 149
3.1.4 Dynamic response 149
3.1.5 Failure Protection 149
3.1.6 Inadvertent Turnoff 149
3.1.7 Aircraft Power Source 149

3.2 Installed Equipment Performance Requirements 150
3.2.1 Dynamic Response 150
3.2.2 Interference Effects 150

3.3 Conditions of Test 151
3.3.1 Power Input 151
3.3.2 Associated Equipment or Systems 151
3.3.3 Environment 151

3.4 Test Procedures for Installed Equipment Performance 153
3.4.1 Conformity Inspection 153
3.4.2 Equipment Function 153
3.4.3 Equipment Accessibility 153
3.4.4 Interference Effects 153
3.4.5 Power Supply Fluctuations 153
3.4.6 Reception 153
3.4.7 Transmission 154

4. EQUIPMENT OPERATIONAL PERFORMANCE CHARACTERISTICS 155

4.1 Required Operational Performance Requirements 155
4.1.1 Power Inputs 155
4.1.2 Displays 155
4.1.3 Communications Controls 155
4.1.4 Equipment Operating Functions 155
4.1.5 System Operational Indication 155
4.1.6 Equipment Operating Limitations 155

4.2 Test Procedures for Operational Performance Requirements 155
4.2.1 Power Input 156
4.2.2 Communications Displays 156
4.2.3 Communications Controls 156
4.2.4 Functional Operating Tests 156
4.2.5 System Operational Indication 156
4.2.6 Equipment Operating Limitations 156

MEMBERSHIP 157

APPENDIX A: ACRONYMS AND GLOSSARY 1

APPENDIX B: REQUIREMENTS CROSS REFERENCE MATRICES – VERIFICATION TESTING AND EQUIPMENT ARCHITECTURE CLASS (NORMATIVE) 1

APPENDIX C: ANALYSIS OF BER VS. BLOCK FAILURE RATE 1

APPENDIX D: ASSUMED FUNCTIONAL CAPABILITIES OF THE DATA/MANAGEMENT INTERFACE 1

TABLE OF TABLES

Table 2-1: Receiver Environmental Test Conditions Matrix 25
Table 2-2: Transmitter Environmental Test Conditions Matrix 28
Table 2-3: *Pro Forma* Test Description Table 71
Table 2-4: Default Values for GSIF Parameters 84
Table 2-5: Minimum and Maximum Values of T1 for Testing 85
Table 2-6: Minimum and Maximum Values of T3 for Testing 87
Table 3-1: Example of Interference Protection for GNSS and AMSS 152

TABLE OF FIGURES

Figure 1-1: VDL Mode 2 Protocol Layers Using ATN/OSI Nomenclature 3
Figure 1-2: VDL Functions for Combination Class Y/Z Equipment 4
Figure 1-3: Integrated Class X VDL Mode 2 Architecture 5
Figure 2-1:Accept/Reject/Continue Regions for Sequential FER Test 33
Figure 2-2: Frame Error Rate Test Set Up 34
Figure 2-3: Bit Error Rate Test Setup 35
Figure 2-4: ISO 9646 Test Configuration 36
Figure 2-5: Upper Tester for Class X or Class Z Equipment 37
Figure 2-6: Upper Tester for Class Y Equipment 37
Figure 2-7: Lower Tester for Class X or Class Y Equipment 38
Figure 2-8: Lower Tester for Class Z Equipment 39
Figure 2-9: Lower Tester Configuration 1 41
Figure 2-10: Lower Tester Configuration 2 41
Figure 2-11: Lower Tester Configuration 3 41
Figure 2-12: Frequency Modulated VDL Mode 2 Source 47
Figure 2-13: Intermodulation Measurement (BER) 50
Figure 2-14: Intermodulation Measurement (FER) 50
Figure 2-15: Output Power Measurement 52
Figure 2-16: RF Power Rise and Release Time Measurement 53
Figure 2-17: Ramp Up and Beginning of VDL Mode 2 Synchronization Sequence 54
Figure 2-18: Spurious Emissions Measurement 56
Figure 2-19: First Adjacent Channel Power Measurement 57
Figure 2-20: Second, Third and Fourth Adjacent Channel Power Measurement 58
Figure 2-21: Measurement beyond 4th Adjacent Channel 61
Figure 2-22: Load VSWR Capability 62
Figure 2-23: Receive to Transmit Turn-Around Time Measurement 64
Figure 2-24: Receive to Transmit Turn-Around Time Measurement 65
Figure 2-25: Channel Sensing Test Configuration 68
Figure 2-26: PIN Attenuator Control Signals for Channel Sense Test 69
Figure 2-27: Error Detection 80
Figure 2-28: Station Identification 80
Figure 2-29: Timer T1 (delay before retransmission) 85
Figure 2-30: Timer T2 (delay before acknowledgement) 86
Figure 2-31: Timer T3 (link initialization time) 87
Figure 2-32: Parameter N1 (maximum number of bits in frame) 89

Figure 2-33: Counter N2 (maximum number of transmissions) 90
Figure 2-34: Parameter k (window size) 91
Figure 2-35: Operational Mode 92
Figure 2-36: Non-Operational Mode 93
Figure 2-37: Frame Reject Mode 95
Figure 2-38: INFO frames 97
Figure 2-39: DLE Procedures 98
Figure 2-40: XID Frame 101
Figure 2-41: Procedures for Transmission 103
Figure 2-42: SREJ Frame 104
Figure 2-43: TEST Frame 108
Figure 2-44: Timer TG2 114
Figure 2-45: Link Establishment 118
Figure 2-46: Ground Requested Broadcast Handoff (a) (partial) 125
Figure 2-47: (RESERVED) 133
Figure 2-48: Packet Fragmentation and Reassembly 134
Figure 2-49: Error Recovery 135
Figure 2-50: Connection Flow Control 136

This page intentionally left blank.

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-224B and with the International Civil Aviation Organization (ICAO) VDL Mode 2 Technical Manual. Additional information on VDL Mode 2 is contained in ARINC Characteristics 631, 637, 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 the air traffic control A/G operations 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 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 is provides a correlation matrix between the test procedures of Section 2.4 and the VDL Mode 2 system level requirements given in RTCA DO-224B, 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