

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

Integrated Modular Avionics (IMA) Development Guidance and Certification Considerations

RTCA DO-297
November 8, 2005

Prepared by: SC-200
© 2005, RTCA, Inc.

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 was prepared jointly by RTCA Special Committee (SC-200) and EUROCAE Working Group 60 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 Telecommunications Union and other appropriate international organizations can be based.

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

Since 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 Page Intentionally Left Blank

Currently in preview, click buy full version

TABLE OF CONTENTS

CHAPTER 1	INTRODUCTION.....	1
1.1	Purpose.....	1
1.2	Scope	2
1.3	Background.....	2
1.4	Relationship to Other Documents.....	3
1.5	References	3
1.6	How to Use This Document.....	3
CHAPTER 2	INTEGRATED MODULAR AVIONICS OVERVIEW.....	7
2.1	IMA Design and Certification Terminology.....	7
2.1.1	IMA Design Terminology	7
2.1.2	Certification Terminology.....	9
2.2	Architectural Considerations.....	11
2.3	Key Characteristics.....	11
2.3.1	Platforms and Hosted Applications	11
2.3.2	Shared Resources	13
2.3.3	Robust Partitioning.....	14
2.3.4	Application Programming Interface (API).....	14
2.3.5	Health Monitoring and Fault Management.....	15
2.4	Stakeholders.....	15
2.4.1	Certification Authority.....	15
2.4.2	Certification Applicant.....	16
2.4.3	IMA System Integrator	16
2.4.4	Platform and Module Suppliers.....	16
2.4.5	Application Supplier.....	16
2.4.6	Maintenance Organization.....	17
CHAPTER 3	GENERAL DEVELOPMENT CONSIDERATIONS.....	19
3.1	IMA System Development Process	20
3.1.1	IMA Platform Development Process	20
3.1.2	Hosted Application Development Process	22
3.1.3	IMA System Development Process	22
3.2	IMA System Resource Allocation Activities.....	24
3.3	Aircraft Safety and Security.....	24
3.4	Development Assurance and Tool Assurance.....	25
3.5	Partitioning and Resource Management Activities.....	25
3.5.1	Design for Robust Partitioning.....	27
3.5.2	Partitioning Analysis.....	28
3.6	Health Monitoring and Fault Management.....	30
3.6.1	Components and Aspects to be Monitored.....	30
3.6.2	Health Determination of Each Application.....	31
3.6.3	Health Determination of the IMA System as a Whole.....	31
3.6.4	Response to Each Type of Failure.....	31
3.6.5	Flight Crew Annunciation and Messaging	32
3.6.6	Control of Maintenance Actions and Reporting.....	32
3.6.7	Redundancy Management	33
3.6.8	Single Event Upset (SEU) Faults	33
3.7	IMA System Configuration Management.....	33
3.7.1	Configuration Data	34
3.8	Guidance on Use of Shared Databases.....	35
3.9	Master Minimum Equipment List (MMEL)	35
3.9.1	Design Considerations for MMEL.....	35
3.9.2	Approval Considerations for an MMEL.....	36
3.10	Human Factors Considerations	36
CHAPTER 4	CERTIFICATION TASKS	39
4.1	Overview of the Certification Process.....	39
4.2	Task 1 – Module Acceptance.....	41

4.2.1	Module Acceptance Objectives.....	41
4.2.2	Module Acceptance Data	42
4.2.3	Module Acceptance Plan (MAP)	43
4.2.4	Module Requirements Specification (MRS).....	44
4.2.5	Module Validation and Verification (V&V) Data	45
4.2.6	Module Quality Assurance (QA) Records.....	46
4.2.7	Module Configuration Index (MCI)	46
4.2.8	Module Acceptance Configuration Management (CM) Records	46
4.2.9	Module Acceptance Accomplishment Summary (MAAS).....	47
4.2.10	Module Acceptance Data Sheet (MADS).....	47
4.2.11	Module Problem Reports	48
4.2.12	Additional Module Acceptance Life Cycle Data.....	48
4.3	Task 2 – Application Acceptance	48
4.3.1	Application Acceptance Objectives.....	49
4.3.2	Application Acceptance Data	49
4.4	Task 3 – IMA System Acceptance.....	50
4.4.1	IMA System Acceptance Objectives	50
4.4.2	IMA System Acceptance Data.....	51
4.4.3	IMA System Certification Plan (IMASCP).....	51
4.4.4	IMA System Validation and Verification Plan (IMASVVP).....	52
4.4.5	IMA System Configuration Index (IMASCI)	52
4.4.6	IMA System Accomplishment Summary (IMASAS).....	53
4.4.7	Other IMA System Life Cycle Data	53
4.5	Task 4 – Aircraft Integration of IMA System (Including V&V)	53
4.5.1	Aircraft Integration Objectives	54
4.5.2	Aircraft-level IMA System Compliance Data.....	54
4.5.3	Aircraft-level IMA System Certification Plan (IMASCP).....	55
4.5.4	Aircraft-level IMA Validation & Verification Plan.....	55
4.5.5	Aircraft-level IMA System Configuration Index (IMASCI).....	55
4.5.6	Aircraft-level IMA System Accomplishment Summary (IMASAS)	56
4.5.7	Other Aircraft-level Data	56
4.6	Task 5 – Change.....	56
4.6.1	Changes to IMA System Modules, Resources and Applications	56
4.6.2	Change Objectives.....	56
4.6.3	Change Management Process	57
4.6.4	Change Impact Analysis (CIA).....	58
4.6.5	Change Data	59
4.7	Task 6 – Reuse of Modules or Applications	59
4.7.1	Objectives of the Reuse Process.....	59
4.7.2	Reuse of a Software Module or Application.....	60
4.7.3	Reuse of a Complex Electronic Hardware Module or Application	60
4.7.4	Reuse of Environmental Qualification Test Data.....	61
4.7.5	Reuse of a Module that Contains Software and Hardware	61
4.7.6	Reuse Compliance Data	61
CHAPTER 5	INTEGRAL PROCESSES	63
5.1	Safety Assessment	63
5.1.1	Responsibilities of the Certification Applicant	63
5.1.2	Responsibilities of the IMA System Integrator	64
5.1.3	Responsibilities of the IMA Platform Supplier	64
5.1.4	Responsibilities of the Application Supplier	64
5.1.5	Safety Assessment Activities.....	65
5.2	System Development Assurance	69
5.2.1	Software Guidance	69
5.2.2	Electronic Hardware Guidance	69
5.2.3	Integration Tool Qualification	70
5.2.4	Shared Design Assurance.....	70
5.2.5	IMA System Configuration Management	70
5.2.6	Environmental Qualification Testing (EQT)	70
5.3	Validation	72

5.4	Verification	73
5.5	Configuration Management (CM)	75
5.5.1	IMA System Configuration Management Plan	75
5.5.2	Configuration Control.....	76
5.6	Quality Assurance (QA).....	77
5.7	Certification Liaison	78
5.7.1	Certification Liaison Process	78
5.7.2	Means of Compliance and Planning Data	78
5.7.3	Development Life Cycle Data.....	79
5.7.4	Compliance Substantiation	80
5.7.5	Life Cycle Data Submittals.....	81
5.7.6	Certification Liaison Process When Changes Are Made.....	82
5.7.7	Certification Liaison Process For Reuse of Modules.....	83
CHAPTER 6 CONSIDERATIONS FOR CONTINUED AIRWORTHINESS OF IMA SYSTEMS.....		85
6.1	Training.....	85
6.2	Maintenance.....	86
6.3	Post-certification Modifications	86

ANNEXES

ANNEX A	OBJECTIVE TABLES	93
ANNEX B	GLOSSARY OF TERMS	105
ANNEX C	LIST OF ABBREVIATIONS AND ACRONYMS.....	117
ANNEX D	IMA SYSTEM DESIGN EXAMPLES.....	119

LIST OF FIGURES

<u>Figure 1</u>	Chapters and their relationships.....	4
<u>Figure 2</u>	Relationship of IMA design terms	9
<u>Figure 3</u>	Example of a typical design highlighting potential shared resources	19
<u>Figure 4</u>	IMA system certification tasks illustration.....	40
<u>Figure 5</u>	Planning data for IMA system.....	79
<u>Figure 6</u>	Life cycle data for IMA system	80
<u>Figure 7</u>	Compliance summaries for IMA.....	81
<u>Figure D-1</u>	Configured single LRU platform	120
<u>Figure D-2</u>	Distributed modular platform	121
<u>Figure D-3</u>	Common module structure	122
<u>Figure D-4</u>	Distributed complex IMA system	124
<u>Figure D-5</u>	Fault reporting hierarchy.....	125
<u>Figure D-6</u>	SDX IMA platform architecture.....	126

LIST OF TABLES

<u>Table 1</u>	Key IMA platform characteristics	12
<u>Table 2</u>	Key application characteristics	13
<u>Table 3</u>	Relationship among integration activities and acceptance tasks	23
<u>Table 4</u>	Overview of IMA certification tasks	40
<u>Table 5</u>	Overview of typical validation activities.....	72

<u>Table 6: Overview of typical verification activities</u>	<u>73</u>
<u>Table 7: CC1/CC2 definition.....</u>	<u>76</u>
<u>Table 8: Life cycle data to be submitted to certification authority</u>	<u>81</u>
<u>Table A-1: IMA module/platform development process (Task 1) objectives.....</u>	<u>93</u>
<u>Table A-2: Hosted application development and acceptance (Task 2) objectives.....</u>	<u>95</u>
<u>Table A-3: IMA system-level development and acceptance (Task 3) objectives.....</u>	<u>97</u>
<u>Table A-4: Aircraft-level integration (Task 4) objectives</u>	<u>99</u>
<u>Table A-5: Change (Task 5) objectives</u>	<u>102</u>
<u>Table A-6: Module or application reuse (Task 6) objectives.....</u>	<u>103</u>

Currently in preview, click buy full version

EXECUTIVE SUMMARY

The use of Integrated Modular Avionics (IMA) is rapidly expanding and is found in all classes of aircraft. In recognition of this rapid growth RTCA established Special Committee 200 (SC-200) and EUROCAE established Working Group 60 (WG-60) to jointly develop a document that could be used as guidance in the design, development, and application of IMA. Participants in the development of the document included government, industry, and academic personnel.

IMA is a shared set of flexible, reusable, and interoperable hardware and software resources that, when integrated, form a platform that provides services, designed and verified to a defined set of safety and performance requirements, to host applications performing aircraft functions.

This document provides guidance for IMA developers, integrators, applicants, and those involved in the approval and continued airworthiness of IMA systems. It provides specific guidance for the assurance of IMA systems as differentiated from traditional federated avionics.

The development of this document is based on earlier RTCA/EUROCAE documents, for example RTCA DO-178/EUROCAE ED-12, Software Considerations in Airborne Systems and Equipment Certification and RTCA DO-254/EUROCAE ED-80, Design Assurance Guidance for Airborne Electronic Hardware. Concepts from other RTCA and EUROCAE documents as well as SAE and ARINC documents, also guided the document preparation.

Currently in preview, click buy full version

This Page Intentionally Left Blank

CHAPTER 1 INTRODUCTION

1.1 PURPOSE

This document contains guidance for Integrated Modular Avionics (IMA) developers, application developers, integrators, certification applicants, and those involved in the approval and continued airworthiness of IMA systems in civil certification projects. The guidance describes the objectives, processes, and activities for those involved in the development and integration of IMA modules, applications, and systems to incrementally accumulate design assurance toward the installation and approval of an IMA system on an approved aviation product as differentiated from traditional federated aviation system architectures.

IMA system concepts are presented, including the platform and modules, and their relationships to the hosted applications and avionics functions used in an aircraft installation. This includes the description of how the developers and integrators can accumulate incremental acceptance of the modules, platform, and application integration which will provide a means for applicants to achieve design assurance of an IMA system on an approved aviation product.

During the IMA system development the certification applicant for a Type Certificate (TC) or Supplemental Type Certificate (STC) program should develop an effective system of communication among the module and platform developers and system integrators. This is especially important when these suppliers are from different companies. Otherwise, there may be a misunderstanding of the implementation during final integration and approval of the IMA system installation.

Six tasks define the incremental acceptance of IMA systems in the certification process:

- Task 1: Module acceptance.
- Task 2: Application software or hardware acceptance.
- Task 3: IMA system acceptance.
- Task 4: Aircraft integration of IMA system - including Validation and Verification (V&V).
- Task 5: Change of modules or applications.
- Task 6: Reuse of modules or applications.

Approval of an IMA system installation may be based on the accumulation of incremental acceptance, culminating in the complete design assurance needed to demonstrate that the installed system and functions comply with the applicable regulations and guidance.

The incremental acceptance, if appropriate, may be granted in the form of an acceptance letter, stamped type design data, or other means for the specific project.